# 2011 National Collegiate Soil Judging Contest

## OFFICIAL MANUAL

## Oregon State University

## Bend Area, Oregon

## April 25 - 30, 2011

For information regarding the contest contact Dr. Ron Reuter (ron.reuter@oregonstate.edu)

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## OFFICIAL MANUAL

This booklet is the **Official Manual for the 2011 National Collegiate Soil Judging Contest** (2011 NCSJC). This booklet is produced for the exclusive purpose of supporting the 2011 NCSJC and its operations in the Bend area, central Oregon. This manual is based on manuals from prior contests, including 1) the 2005 Northwest Regional Collegiate Soil Judging Contest, 2) the 2007 NW Cooperative Regional Soil Judging Contest, 3) the 2007 National Collegiate Soil Judging Contest hosted by Utah State, and 4) various other collegiate soil judging materials. Soil classification and horizon designations are based on *Keys to Soil Taxonomy, eleventh edition, 2010*, available at http://soils.usda.gov/technical/classification/tax_keys/. Unless otherwise noted in this manual, soil morphology is based on *Field Book for Describing and Sampling Soils v. 2.0, 2002 (Field Book)*, available at http://soils.usda.gov/technical/fieldbook/.

Accompanying this manual is the **2011 NCSJC Official Scorecard**. This scorecard is based on the 2007 Northwest Regional Soil Judging Contest, hosted by Oregon State University and the 2007 National Soil Judging Contest, hosted by Utah State University.

## CONTEST INFORMATION

The 2011 National Collegiate Soils Contest consists of an individual and a group competition. Three to four eligible students may represent the participating team in the individual competition. All eligible students traveling with a team may participate in all other contest activities, including practice-site judging and the group judging.

### INDIVIDUAL CONTEST

The individual contest will be Friday, April 29, 2011. Three contest sites will be judged by each individual. The top three individual scores for each of the three sites will be totaled for the individual team score.

At each contest site, the number of horizons to be described to a specific depth will be posted and stated by the site monitor. A maximum of six horizons will be described. There will be a nail in the third horizon to be described and the depth of the nail will be specified. A control section will be delineated with engineer's tape and a measuring tape secured in the center of the control section. Participants must **NOT** pick in the control sections **nor** may they block access to the control section (violators risk disqualification).

Sixty minutes (1 hour) is the most time allowed for the judging of each individual contest site. At each site, each (individual) contestant will be assigned to a *cluster*. Clusters will have designated times and locations in the site to judge. Clusters will rotate through the pit on times allocated as follows: 5 minutes read site narrative, 5 minutes in/out of the pit, 5 minutes out/in of the pit, 10 minutes in/out of the pit, 10 minutes out/in of the pit, and a final 25 minutes available for any contestant to be in or out of the pit. Clusters allowed "in" first at one site, will be "out" first at the next site, and so on.

## GROUP CONTEST

Group judging will occur on Saturday, April 30th. Two sites will be group judged by each team. The score for each of the two sites will be summed for the group judging component of the team score. Forty-five minutes (0.75 hr) are allowed for each of the group judging sites. Rotations and times for each team will be distributed to the coaches by or on Thursday, April 28th.

## TEAM AND INDIVIDUAL SCORING AND RESULTS

Students should describe the sites on the appropriate scorecards provided. Write legibly on the scorecards, minimizing stray marks. A dash (–) should be placed in the soil morphology boxes that do not require an answer. Contestants should use the abbreviations provided with this manual. Credit for non-standard abbreviations or ambiguous answers will not be guaranteed. Partial credit may be given at the discretion of the judges.

Ties will be broken by comparing the estimate of clay percentage for a previously designated horizon of each contest soil. In the event of a tie, clay percent estimates at Site 1 will be considered, then at Site 2, if necessary, and so on. Individuals with the clay percent estimate and teams with the average clay percent estimates closest to that of the judges will break the tie.

Scoring and tabulation of results will occur during the contest days. The total score for each participating team will be the total of the individual and group scores. The top-ten-scoring individuals, top-five groups, and the top-five teams will be recognized at the awards ceremony on Saturday, April 30th.

## CONTEST SUPPLIES AND MATERIALS

The spirit of the contest is for the students to experience the soilscapes of the recently volcanically active Pacific Northwest. Some of the soils in this area have only been developing for 7000 years (when Mt. Mazama exploded). Some areas escaped influence of the recent volcanism or had evidence removed by landscape processes. Elevation, aspect, and topography strongly influence local climate which in-turn influences vegetation. In short, its complicated.

Soil Taxonomy can be a burdensome thing to deal with, and regional interpretations may direct how Soil Taxonomy is applied. We recognize that students will be challenged here. Because of this, we are open to students doing any combination of the following:

1) Carry a marked-up copy of Keys to Soil Taxonomy

2) Carry extracted sheets of the Keys along with notes in the margins

3) Carry a team-developed simplified Key

We will not review or provide comments on simplified keys that teams develop. We will not provide a suite of Great Groups to choose from.

Contestants may each have a 'soil kit' consisting of the following items as contest supplies and materials:

- ☐ Acid bottle with dilute HCl
- ☐ Carrying case, bag or bucket
- ☐ Clinometer, Abney level or Brunton-type compass
- ☐ Clipboard
- ☐ Containers for soil samples
- ☐ Color book, with Munsell color designation
- ☐ Pencils/pens
- ☐ Soil knife and/or rock hammer
- ☐ Water bottles

Optional allowed contest items:

- ☐ #10 sieve
- ☐ Brush
- ☐ Dust mask
- ☐ Hand lenses
- ☐ Hand towel
- ☐ Scratch plates, ceramic and glass
- ☐ Tape measure
- ☐ Container for storage of items

At the contest, contestants will be supplied with:

- ☑ Abbreviation sheet
- ☑ Interpretations sheets
- ☑ Scorecards
- ☑ Texture triangle
- ☑ Chemicals (e.g., dilute HCl)
- ☑ Relevant site soil data
- ☑ Site narrative

The following are considered forbidden items at the contest sites:

- Electronic media devices
- Soil science-related text
- Soil texture examples

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## SCORECARD

The scorecard consists of five sections: A. Site Characteristics; B. Soil Morphology; C. Whole Pedon Characteristics; D. Soil Classification; and E. Soil Interpretations. The points for each item are indicated on the card. The scorecard is based on the *Field Book* and NASIS codes, and contest judges intend to use it as reference.

### A. SOIL MORPHOLOGY

Each correct answer will be worth points indicated (2 or 3); points indicated (2 or 3) will also be subtracted for each incorrect answer that is marked, to a minimum score of zero.

**A.1. Horizonation**

The number of horizons to be judged, and the total depth of soil to judge, will be given at each site. Narrow transitional horizons less than 8 cm should be regarded as a gradual boundary and the center used as the measuring point. Horizons that may be thinner than 8 cm and still should be described are an A, E, Bh, Bs or Bhs. These horizons must be at least 2.5 cm thick to be described. O horizons are not described.

***Prefix:*** Lithologic discontinuities will be indicated by the appropriate Arabic numeral(s). If there are no discontinuities in the profile, place a dash in the space.

***Master:*** Enter the appropriate master horizon (A, E, B, C, L[1], O, R), transitional horizon, or combination horizon.

***Suffix:*** Enter the appropriate lower case letter or letters (subscripts or subdistinctions). For this contest, you should be familiar with the following subscripts: a, b, c, d, di[1], e, f, g[2], i, k, m, n, p, q, r, ss, t, w, x, and y. In this contest, the subscript (subdistinction) 'g' is used to indicate significant redoximorphic features and is not limited to gleying *sensu stricto*; professional soils work in the Pacific Northwest typically follows this convention. Subordinate distinctions written in combination must be written in the correct sequence and abide by conventions expressed in the *Field Book* in order to receive full credit. In this contest, subscripts will be used with transitional and combination horizons. If a subscript is not applicable, enter a dash in the box.

***Number (No):*** Arabic numerals are used to indicate vertical subdivisions within a horizon or layer. Sequential horizons having the same master horizon and suffix designations should be numbered to indicate vertical sequence: for example, Bw1-Bw2-Bw3. The numbering of vertical subdivisions within a horizon should continue through a lithologic discontinuity if the same master horizon and suffix is used in both materials: for example, Bw1-Bw2-2Bw3-3Bw4. If vertical subdivisions are not called for, enter a dash in the box.

***Primes:*** It may be appropriate to give the same designation to two or more horizons in a pedon if the horizons are separated by a horizon of a different kind. The prime is used on the lower of the two horizons having identical letter designations and should be entered with the capital letter for the Master

1 Limnic materials, particularly diatomaceous earth, are common in and near the contest area. At the time of this writing it is not known whether these will or will not be present in the contest pits.

2 *In this contest, the subscript (subdistinction) 'g' is used to indicate significant redoximorphic features and is not limited to gleying *sensu stricto*; professional soils work in the Pacific Northwest typically follows this convention.

horizon in the blank designated for that purpose. If three horizons have identical designations, a double prime is used on the lower. The following horizon sequence illustrates the use of the prime: A, E, Bs, E', Bhs1, Bhs2, BC, C.

**A.2. Boundary**

***Depth:*** Determine the depth in centimeters (cm) from the soil surface to the middle of the lower boundary of each horizon. The depth from the surface to the nail in the third horizon will be given for each site. Total depth to be described will be given and if that depth corresponds to the lower boundary of the last horizon, that horizon boundary should be described. Otherwise, this box should be dashed. Note that the depths should be judged at the tape within the control section. Credit will be given based on the distinctness of the boundary: abrupt ±1, clear ±2, gradual ±5, diffuse ±10 cm

***Distinctness*** **(Dist.):** Enter the abbreviation (A, C, G, or D) for each boundary whose lower depth is determined. If the lower boundary of the last horizon to be judged is not visible within the depth of judging, enter a dash. The classes of distinctness of boundaries are designated in the *Field Book* as follows:

**Table Dist. Distinctness classes and abbreviations**

| Class | Abbreviation | Description |
|---|---|---|
| Very abrupt | (V) | <0.5 cm |
| Abrupt | (A) | 0.5 to < 2 cm |
| Clear | (C) | 2 to <5 cm |
| Gradual | (G) | 5 to <15 cm |
| Diffuse | (D) | ≥ 15 cm |

**A.3. Color**

Describe the dominant matrix color of the soil in the MOIST state only. Write the correct Munsell notations for Hue, Value, and Chroma in the appropriate boxes on the scorecard. The color of any A horizon should be evaluated on a gently crushed specimen. Color for all other horizons should be evaluated on the interiors of broken peds. Record the dominant matrix color. Judges may give credit for two colors if the colors are present in equal amounts. However only write one color answer in the scorecard box.

**A.4. Texture**

***Volume Percentage of Coarse Fragment*** **(%CF):** Enter an estimate of the volume percentage of coarse fragments in the appropriate box on the scorecard. Coarse fragment volume percentage will be needed when calculating the Water Retention Difference. If no coarse fragments modifiers are needed, enter a dash on the scorecard. Answers within plus/minus 10% of the official judges' answers will be given credit.

***Coarse Fragment Modifier*** **(CF Mod.):** Modifications of textural classes are required whenever coarse fragments ≥ 2 mm occupy more than ≥ 15% of the soil volume. Enter the appropriate abbreviation for each modifier.

<15% of the volume occupied by rock fragments: No modifer is used. Enter a dash (-).
15 to <35% of the volume occupied by rock fragments: The adjective form of the dominant kind of rock fragment is used ( e.g., *gravelly* loam; GR L).

35 to <60% of the volume occupied by rock fragments: The adjective form of the dominant kind of rock fragment is used with the word "very" ( *very gravelly* loam; GRV L).

60 to <90% of the volume occupied by rock fragments: The adjective form of the dominant kind of rock fragment is used with the word "extremely" (e.g., *extremely gravelly* loam; GRX L).

≥ 90% of the volume occupied by rock fragments: Use the name of the dominant rock fragment only, with no fine earth soil textural class (e.g., *gravel)*. Place dash in texture class box.

**Table CF Mod1. Coarse fragment modifier terms and abbreviations**

| Shape | Size | Rock Fragments (abbreviation) | Adjective (abbreviation) |
|---|---|---|---|
| Rounded, subrounded, angular, or irregular | 0.2 to 7.6 cm diameter | Gravel (GR) | Gravelly (GR) |
| | 7.6 to 25 cm diameter | Cobbles (CO) | Cobbly (CB) |
| | 25 to 60 cm diameter | Stones (ST) | Stony (ST) |
| | >60 cm diameter | Boulders (BO) | Bouldery (BY) |
| Flat | 0.2 to 15 cm long | Channers (CN) | Channery (CN) |
| | 15 cm to 38 cm long | Flagstones (FL) | Flaggy (FL) |
| | 38 cm to 60 cm long | Stones (ST) | Stony (ST) |
| | >60 cm long | Boulders (BO) | Bouldery (BY) |

**Table CF Mod2. Coarse fragment abbreviations**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Gravelly | GR | | Very Gravelly | GRV | | Extremely Gravelly | GRX |
| Cobbly | CO | | Very Cobbly | CBV | | Extremely Cobbly | CBX |
| Stony | ST | | Very Stony | STV | | Extremely Stony | STX |
| Bouldery | BO | | Very Bouldery | BYV | | Extremely Bouldery | BYX |
| Channery | CN | | Very Channery | CNV | | Extremely Channery | CNX |
| Flaggy | FL | | Very Flaggy | FLV | | Extremely Flaggy | FLX |

***Coarse Fragment Roundness*** **(CF Rnd.):** Estimate the relative degree of abrasion of the predominant size coarse fragment in each horizon as shown by the sharpness of its edges and corners. Refer to *Field Book* for illustrations of roundness. Enter the appropriate abbreviation for each class modifier.

**Table CF Rnd. Coarse fragment roundness class and abbreviations**

| Roundness class | Abbreviation |
|---|---|
| Very Angular | VA |
| Angular | AN |
| Subangular | SA |
| Subrounded | SR |
| Rounded | RO |
| Well Rounded | WR |

***Class:*** Enter the name of the USDA textural class of the fine earth fraction, with the appropriate modifiers for sand size, if necessary.

**Table Class. Texture class names and abbreviations**

| | | | | |
|---|---|---|---|---|
| Coarse Sand | COS | | Sand | S |
| Fine Sand | FS | | Very Fine Sand | VFS |
| Loamy Coarse Sand | LCOS | | Loamy Sand | LS |
| Loamy Fine Sand | LFS | | Loamy Very Fine Sand | LVFS |
| Coarse Sandy Loam | COSL | | Sandy Loam | SL |
| Fine Sandy Loam | FSL | | Very Fine Sandy Loam | VFSL |
| Loam | L | | Silt Loam | SIL |
| Silt | SI | | Sandy Clay Loam | SCL |
| Clay Loam | CL | | Silty Clay Loam | SICL |
| Sandy Clay | SC | | Silty Clay | SIC |
| Clay | C | | | |

***Clay*** **(% Clay):**

Enter the estimate for weight % of clay in the fine earth fraction. Answers within plus/minus 3% of the official judges' answers will be given credit.

**A.5. Structure**

Soil structure is the arrangement of primary particles into aggregates. The aggregates are separated by natural planes or zones of weakness. Soil structure is evaluated by the grade and type of structural units, if present.

***Grade:*** Enter the appropriate number for the strength of the structural units, if present (0 for structureless, 1 for weak, 2 for moderate, 3 for strong). Grade describes the distinctness of structural units. Criteria are the ease of separation into discrete units and the proportion of units that hold together when the soil is handled. Four classes are used:

Structureless (0): Soil material either clings together in large uniform masses without planes of weaknesses (massive), or separates as individual primary particles (sand) and do not form aggregates (single grain).

Weak (1): The units are barely observable in place. When gently disturbed, the soil material parts into a mixture of whole and broken units and much of the materials exhibit no planes of weakness. Faces that indicate persistence through wet-dry-wet cycles are evident if the soil is handled carefully. Distinguishing a soil that is structureless from that has weak structure is sometimes difficult. Weakly expressed structural units most soils have surface that differ from in some way from the interiors.

Moderate (2): The units are well formed and evident in undisturbed soil. When disturbed, the soil material parts into a mixture of mostly whole units, some broken units, and material that is not in units. Peds part from adjoining peds to reveal nearly entire faces that have properties distinct from those of fractured surfaces.

Strong (3): The units are distinct in undisturbed soil. They separate cleanly when the soil is disturbed. When removed, the soil material separates mainly into whole units. Peds have distinctive surface properties.

***Type:*** Enter the abbreviation for the type (shape) of the aggregates. If the soil is structureless, the condition is described by either massive or single grain. Use the following criteria and abbreviations for structure type:

Granular (GR) Aggregates are approximately spherical or polyhedral and are bounded by curved or irregular faces that are not casts of adjacent aggregates. They are somewhat rounded and smaller then most other structures.

Platy (PL) Aggregates are flat, plate-like, oriented horizontally.

Wedge (WEG) Elliptical, interlocking lenses with slickensides and acute-angle terminations; not limited to vertic materials.

Blocky (SBK, ABK) Aggregates are block-like or polyhedral, nearly equidimensional, and bounded by flat or slightly rounded surfaces that are casts of the faces of adjacent aggregates. Blocks are typically subangular blocky (SBK; i.e. with rounded corners and edges), or angular (ABK; i.e. with faces intersecting at relatively sharp angles).

Prismatic (PR) Aggregates are taller than broad or deep, bounded by flat to rounded vertical faces that are casts of adjacent aggregates. Corners and edges may be angular or subrounded; tops are usually indistinct and flat to irregular.

Columnar (COL) The units are similar to prisms and are bounded by flat or slightly rounded vertical faces. The tops of the columns, in contrast to those of prisms, are very distinct and normally rounded.

Massive (MA) The individual units that break out of a profile have no natural planes of weakness. A coherent mass showing no evidence of any distinct arrangement of the soil particles.

Single grain (SGR) The soil material is non-coherent when removed from the profile. (In some cases where weak cohesive/adhesive forces with water exist some seemingly cohesive units can be removed but under very slight force they fall apart into individual particles.)

### A.6. Consistence

Soil consistence refers to the resistance of the soil to deformation or rupture at various moisture levels. Consistence is largely a function of texture, structure and organic matter, although the type of clay and absorbed cations are also involved.

**Moist Consistence (Moist Consist.):** Judge the consistence of moist soil (approximately midway between air-dry and field-capacity). To determine moist consistence, the specimen fails under the conditions described.

**Table Moist Consist. Moist consistence classes and abbreviations**

| Moist Consistence | Abbreviation | Description |
|---|---|---|
| Loose | LO | Intact specimen not obtainable. |
| Very friable | VFR | Very slight force between fingers. |
| Friable | FR | Slight force between fingers. |
| Firm | FI | Moderate force between fingers. |
| Very firm | VFI | Strong force between fingers. |
| Extremely firm | EFI | Moderate force between hands. |

### A.7. Redoximorphic Features

Redoximorphic features are those that result from cycles of reduction and oxidation of Fe and Mn compounds. Redox feature are manifest as loss (depletion) or gain (concentration) of pigment compared to the matrix color. For the purposes of this contest, redox features will be defined as described below.

**Concentrations (Conc.):** These are zones of apparent accumulation and/ or concentration of Fe/Mn oxide masses and concretion/nodules due to periodic saturation, reduction, movement, and oxidation.

**Depletions (Deplet.):** These are zones of low chroma (2 or less) that have been depleted in Fe/Mn and, in some cases clay. Fro this contest, only those zones having a chroma of 2 or less resulting from redoximorphic processes will be considered redox depletions.

**Quantity (qty).** Enter the abbreviation (F, C, or M) for each abundance class of redoximorphic features in the appropriate box on the scorecard. If no redoximorphic features are present enter a dash in the appropriate box on the scorecard.

**Table qty. Abundance class of redoximorphic features**

| Abundance(qty) | Abbreviation | Description |
|---|---|---|
| None | - | No redoximorphic features are present |
| Few | F | Occupies < 2 % of the horizon |
| Common | C | Occupies 2 to 20 % of the horizon |
| Many | M | Occupies > 20 % of the horizon |

Note: If there are multiple depletions or concentrations describe the ones in greatest abundance. If they are of equal abundance and contrast, describe the one that has the largest feature.

### A.8. Carbonates($CO_3$)

Carbonates occur in some locations in the contest area. Typically the carbonates are found in the lower horizons. Accumulations of pedogenic carbonates can occur as concentrations (disseminated masses and nodules) and/or as ped or void features (coating on peds, in seams, or coating on gravels).

***Effervesence (Efferv.)*:** Cold 1 m HCl will be used in this contest to test for the presence of carbonates in the soil matrix. (We will provide 1 M HCl, bring your own empty bottles.) The following five classes of effervescence and abbreviations will be used:

**Table Efferv. Classes of effervescence and abbreviations**

| Effervesence (Efferv.) | Abbreviation | Description |
|---|---|---|
| Noneffervescent | NE | No bubbles form |
| Very Slightly effervescent | VS | Few bubbles form |
| Slightly effervescent | SL | Numerous bubbles form |
| Strongly effervescent | ST | Bubbles form a low foam |
| Violently effervescent | VE | Bubbles form a thick foam |

## B. WHOLE PEDON CHARACTERISTICS

Each correct answer will be worth 10 points as indicated; 10 points will also be subtracted for each incorrect answer that is marked, to a minimum score of zero.

**B.1. Soil Water**

***Saturated Hydraulic Conductivity (Ksat)***: In this contest, we are concerned with the saturated hydraulic conductivity (Ksat); approximately the rate that water flows through soil under saturated conditions. Saturated hydraulic conductivity should be evaluated for both the ***surface*** horizon of the soil, and the layer that is the ***most limiting***, or limiting layer. The limiting layer is the soil horizon that has the lowest saturated hydraulic conductivity.

Saturated hydraulic conductivity classes are defined below:

**Table Ksat. Classes of saturated hydraulic conductivity and abbreviations**

| Ksat Abbreviation | Description |
|---|---|

High - This class includes sands, loamy sands, and sandy loams. Loams with strong granular structure also have high hydraulic conductivity. Horizons containing large quantities of rock fragments (>60%) and with insufficient fines to fill many voids between the fragments are also in this class.

Moderate - This class includes texture and structure combinations not included in the other two classes.

Low -. This class includes sandy clays, silty clays, and clays with moderate, weak, or no structure. Fragipans, duripans, lithic or paralithic contacts are also in this class. Cemented horizons and densic layers within the specified observation depth have low saturated hydraulic conductivity.

***Soil Wetness Class:*** The depth to the shallowest occurrence of common or more ( ≥ 2% by volume) redoximorphic concentrations or depletions will determine the soil wetness class. If no evidence of such features is observed within the depth of judging, wetness call is assumed to be > 150 cm. There are exceptions where the redoximorphic features are relict. Examine the current landscape position carefully to determine whether observed redox features are plausible.

Water Retention Difference (wrd): Water retention difference represents the amount of plant-available water that can be retained from the mineral soil surface to the top of a restrictive layer (see Effective Rooting Depth) or a depth of 150 cm, which ever is shallower. We will use the following general relationships between texture and water retention difference (Table wrd-1)

**Table wrd-1. Classes of texture and water retention difference values**

| Textural Class Abbreviation | Value (cm water/cm soil) |
|---|---|
| S, LS, LCOS, COS, FS, VFS | 0.05 |
| LVFS, LFS, COSL | 0.10 |
| VFSL, FSL, SL, SCL, SC, L, CL, SIC, C | 0.15 |
| SI, SIL, SICL | 0.20 |

Coarse fragments are assumed to hold no water that is available for plant use. For horizons that contain coarse fragments, first determine the water retention difference for the fine earth, then reduce this amount by the value proportionate to the volume of coarse fragments. We will use four classes of water retention difference. These are:

**Table wrd-2. Classes of water retention difference and values**

| Class | Abbreviation | Values |
|---|---|---|
| Very low | VL | wrd < 7.5 cm |
| Low | L | 7.5 $\leq$ wrd < 15.0 cm |
| Moderate | M | 15.0 $\leq$ wrd <22.5 cm |
| High | H | wrd $\geq$ 22.5 cm |

**B.2. Soil Depth**

***Effective Rooting Depth(erd):*** The depth from the soil surface to the upper boundary of a root-restricting layer. Root restricting layers include lithic and Paralithic contacts, silica and/or $CaCO_3$ cemented layers, fragipans and dense horizons. A sand and/or gravel layer with insufficient fines to fill the voids is also restrictive. If the lower depth of judging is <150 cm, and there is no restricting layer within or at the judging depth, the horizon encountered at the bottom of the judged profile may be assumed to continue to at least 150 cm. Effective rooting depth classes are:

**Table B.2. Effective rooting depth classes and abbreviations**

| Class | Abbreviation | Definition |
|---|---|---|
| Very Deep | VD | ≥ 150 cm |
| Deep | D | 100 to <150 cm |
| Moderate | M | 50 to <100 cm |
| Shallow | S | 25 to <50 cm |
| Very Shallow | VS | <25 cm |

## C. SITE CHARACTERISTICS

Oregon is a geologically active region, with many contemporary and intersecting Earth processes acting below and above the surface. Each correct answer will be worth points indicated (5 or 10); points indicated (5 or 10) will also be subtracted for each incorrect answer that is marked, to a minimum score of zero. ***At any one site,*** one must consider the arrangement of site landforms and materials, on and within which soils develop, to have been generated by a succession of surficial processes. The complexity of all contest sites provides an opportunity to learn about the interactions of these processes on parent materials and on soil genesis itself. Hence, *site context* (i.e., geomorphology) is critical to understand before 'jumping in the pit.' Much of this section is not scored, although contestants are expected to be familiar with terminology and read each brief site narrative (materials provided and time allotted at each contest pit) so as to provide the basis from which the rest of the score card is completed. Contestants are expected to check one or more boxes in each of the categories of Surficial Processes, Lithology and Composition; failure to provide a correct answer *will not* count against them (even though they are provided the information!).

### C.1. Landforms

***Basin / Lake Basin:*** (Basin) A depressed area without an outlet in which sediments have accumulated. (Lake Basin) A depressed area with or without an outlet that currently or historically accumulated lacustrine sediments.

***Canyonside:*** The side of a long, deep, narrow, very steep sided river valley with high relief (>100 m). Slopes range from 15 to more than 100 percent. Landform parallels a watercourse (e.g., stream), but *does not* parallel or have relation to the shoreline of a water body (e.g., lake)[see Escarpment].

***Escarpment:*** A mixed-origin landform with high relief (>100 m). A long, more or less continuous cliff or relatively steep slope facing in one general direction, breaking the continuity of the land by separating two level or gently sloping surfaces, and produced by erosion of a fault scarp or by differential erosion of bedrock. *May* parallel shoreline of a water body (e.g., lake)[see Canyonside], but *does not* parallel or have relation to a watercourse (e.g., stream).

***Fluvial Terrace / Floodplain:*** Level landscape features at an elevation above the floodplain. They consist of well-sorted materials deposited by an adjacent stream or river. The floodplain refers to a nearly level plain that borders a stream or river. Floodplains are currently subject to periodic overflow unless artificially protected.

***Lava Flow / Plain:*** A broad area of level or nearly level land, from one to thousands of square kilometers in extent, that is underlain by a relatively thin succession of basaltic lava flows resulting from eruptions at fissures, cinder cones and/or shield volcanoes.

***Moraine****:* A landform built at the edge of the stagnant ice. Usually appears as a series of ridges and valleys composed of glaciofluvial materials, ice-contract deposits, and till. Slopes range from 0% to 50%.

***Plateau / Butte:*** (Plateau) A mixed-origin landform. A flat, upland region underlain by horizontal strata or characterized by horizontal structure, which may be highly dissected. (Butte) A conspicuous, usually isolated, generally flat-topped hill or small mountain with relatively steep slopes pr precipitous cliffs, often capped with a resistant layer of rock and bordered by talus, and representing an erosion remnant carved from flat-lying rocks; regionally synonymous with *mesa*.

***Volcano:*** An opening or rupture in the surface that issued hot magma, ash and gases and accumulated nearby, forming a stratovolcano, shield volcano, cinder cone, caldera, fissure, dome or other landform or group of landforms. All of these types are present in the contest area and are simply grouped as *volcano*.

**C.2. Site Position**

In general most site positions will be readily distinguishable. However some landforms will be complex. In some cases the landscape unit considered will be relatively large and include the soil pit. If a site position cannot be clearly distinguished, select "None".

**Summit:** Site position where land slopes down in all directions

**Shoulder:** An area of the landscape adjacent to the summit that has a convex land-surface shape and that slopes downward towards the lower landscape.

**Backslope:** A mostly linear surface that extends downward from a summit or shoulder position.

**Footslope:** A *concave* slope segment at the base of a hill.

**Toeslope:** A *linear* slope segment at the base of a hill, beyond a recognizable footslope.

**Depression:** A low-lying area completely surrounded by higher ground and having no outlet for surface drainage.

**None:** slopes less than 2% and where none of the above slope elements can be distinguished. This includes broad flat outwash plains, as well as broad flat terraces, and lava plains.

**C.3. Surface Processes** (not scored)

The original surficial processes that acted on materials at this site in the geological past. Refer to site narrative to determine which apply. More than one surficial process may be checked.

**Table C.3. Surficial (geomorphic) processes and related materials and landforms.**

| **Process** | **Types** | **Subdivisions** (examples) |
|---|---|---|
| Eolian | Landform | Dune |
| | Material | Sand sediment |
| Fluvial | Landform | Floodplain |
| | Material | Sandy gravel sediment |
| Glacial | Landform | Moraine |
| | Material | Till |
| Lacustrine | Landform | Lake basin |
| | Material | Silt sediment |
| Mass-wasting | Landform | Hillslope |
| | Material | Bouldery sediment |
| Residual | Landform | Hillslope |
| | Material | Weathered rock: Soil |
| Volcanic | Landform | Cinder cone |
| | Material | Tephra |

**C.4. Lithology** (not scored)

**Agglomerate:** Consolidated (lithified) rounded volcanic fragments.

**Ash:** Unconsolidated tephra under 2 mm.

**Breccia:** Consolidated (lithified) angular rock fragments.**Pumice :** Highly vesicular unconsolidated tehpra**,** usually greater than 2 mm in size. ( S.G. < 1.0)

**Loess:** wind blown deposits composed of silt and silt loam materials.

**Outwash:** Stratified sands and gravel deposited by glacial meltwater.

**Scoria:** Moderately vesicular tehpra**,** usually greater than 2 mm in size, usually heavy and darker than pumice. (S. G. > 2.0)

**Sediment:** fragments of rock materials transported by sediment, and differentiated by grain size, arrangement (bedding, sorting, fabric, etc.), and surficial process [see A.3].

**Till:** Unsorted, unstratified glacial debris consisting clay, silt, sand, and coarse fragments that was transported and deposited by glacial ice.

**Tuff:** Consolidated (lithified) volcanic ash.

**Other:** Undifferentiable bedrock or other Earth materials.

**C.5. Composition** (not scored)

Parent material lithologies (rock types) in the contest area are indirectly or indirectly derived from volcanoes. Lithology in the sense used by the contest relates to the amount of silicon contained in the primary volcanic rock, which can then be related to characteristics of the soil parent material.

**Basalt**: Black to dark grey extrusive, mafic igneous rock.

**Andesite**: Dark Greyish extrusive, moderately mafic igneous rock.

**Dacite**: Light greyish extrusive, moderately silicic igneous rock.

**Rhyolite**: White to light grey extrusive, silicic igneous rock. Black, glassy variety known as obsidian.

**Other**: Undifferentiated composition.

**C.6. Slope**

Use a clinometer or Abney level to measure slope between flags at contest sites. If measurement falls on class break, the convention is to go with the higher class. Slope classes used in this contest are:

**Table C.6. Slope classes**

**Depression**

0 - <3%; 3 - <7%; 7 - <12%; 12 - < 20%; and 20% or more

**C.7. Surface Runoff**

Runoff, as related to soil science, refers to the relative rate water is removed by flow over the surface of the soil. The rate is determined to a great extent by slope, however, properties of the site and soil that affect infiltration and percolation rates also affect runoff. The following table provides the surface runoff classes that will be used in this contest:

**Table sr. Surface Runoff Class**

| | Surface Hydraulic Conductivity | | |
|---|---|---|---|
| **Slope Class** | **High** | **Moderate** | **Low** |
| Depression | Ponded | Ponded | Ponded |
| Nearly level (0- < 3%) | Very Slow | See note below | Slow |
| Gently sloping (3- < 7%) | Slow | See note below | Medium |
| Moderately sloping (7- <12%) | Medium | See note below | Rapid |
| Strongly sloping (12- < 20%) | Rapid | See note below | Very Rapid |
| Steep (> 20%) | Very Rapid | See note below | Very Rapid |

***Note:*** In the case of **moderate** surface hydraulic conductivity: where there is good vegetative cover use the slower class; if the soil surface is bare or there is poor vegetative cover use the more rapid class.

## D. SOIL CLASSIFICATION

*Keys to Soil Taxonomy, 11th Edition* (2010) is the basic reference for this section. Note that some soils may have more than one subsurface diagnostic horizon or feature. In this case, check all those that may apply. Each correct answer will be worth points indicated (5 or 10); points indicated (5 or 10) will also be subtracted for each incorrect answer that is marked, to a minimum score of zero. Laboratory data necessary to accurately classify each soil will be posted on a card at each pit. Unless otherwise indicated, soil moisture regimes will be assumed to be xeric.

***Epipedons:*** The kind of epipedon should be determined. All mineral soils for contest purposes should be considered to have mollic epipedons if no other kind of epipedon is present. For distinguishing between mollic, umbric, and melanic epipedons data will be supplied.

***Diagnostic Subsurface Horizons and Features:*** Indicate all diagnostic subsurface horizons and features that are present. More than one may be present. If none is present, mark "none" for full credit. Remember that negative credit may be given for incorrect answers to prevent guessing (although a total score for one answer will never be less than zero).

***Order:*** Classify the soil to the appropriate order.

***Suborder:*** Classify the soil to the proper suborder.

***Great Group:*** Classify the soil to the proper great group.

***Other Important Soil Characteristics:***

**Andic Soil Properties**

In the field, during the 2011 NCSJC, a soil layer is considered to have ***andic soil properties***, if it meets ***all*** of the following criteria:

1. **Glass count** – has greater than or equal to 5% volcanic glass;
2. **% Sand** – has greater than or equal to 30% sand in fine earth (<2mm) fraction;
3. **Smeariness –** is weakly to strongly smeary;
4. **Effervescence** – is non-effervescent in dilute HCl;
5. **NaF pH** – >8.4 pH in 1N NaF

**FURTHER**, if 60% of the upper 60 cm of the soil profile (aka *60-60* rule) has andic soil properties, then we consider the soil a member of the ***Andisols order***. Contestants must refer to the ***soil***, ***site narrative*** and ***pit card*** to further classify the Andisols.

CONTEST OPERATION FOR ANDISOLS

During the 2011 NCSJC, the following information is available or must be determined by contestants (in order relevant to criteria above):

1. **Glass count** – noted in percent value on data card posted at the pit;
2. **% Sand** – contestant must determine;
3. **Smeariness** – contestant must determine (manner of failure-smeariness table below);

**MANNER OF FAILURE** - The rate of change and the physical condition soil attains when subjected to compression. Samples are moist or wetter.

| Failure Class | Code | | Criteria: Related Field Operation |
|---|---|---|---|
| | PDP | NASIS | |
| ***SMEARINESS*** | | | **Use a 3 cm block. (Press between thumb & forefinger.)** |
| Non-Smeary [1] | NS | NS | At failure, the sample does not change abruptly to fluid, fingers do not skid, no smearing occurs. |
| Weakly Smeary [1] | WS | WS | At failure, the sample changes abruptly to fluid, fingers skid, soil smears, little or no water remains on fingers. |
| Moderately Smeary [1] | MS | MS | At failure, the sample changes abruptly to fluid, fingers skid, soil smears, some water remains on fingers. |
| Strongly Smeary [1] | SM | SM | At failure, the sample abruptly changes to fluid, fingers skid, soil smears and is slippery, water easily seen on fingers. |

[1] *Smeariness* failure classes are used dominantly with Andic materials, but may also be used with some spodic materials.

*from p. 2-50, Field Book, ver. 2.0*

4. **Effervescence** – contestant must determine (test for free carbonates) – dilute HCl will be supplied by the contest;
5. **NaF pH** – noted in pH units *for each soil profile layer* on data card posted at the pit.

**Aquic Conditions**

Refer to section of this title in the Keys to Soil Taxonomy.

**Biological Soil Crust**

*Operational Contest Requirements*

An approximately 2 x 2 m area adjacent to each contest pit will be taped off from entry and disturbance. Contestants are to use their "out-of-pit" time to observe and record this site soil characteristic. Like areas will be taped off near practice pits.

**Record a checkmark** on Scorecard to indicate the *presence* of surface **biological soil crust**. No entry (checkmark) implies that surface **biological soil crust** is *absent*.

*Intent for use of Biological Soil Crust in the 2011 NCSJS*

It is recognized that Biological Soil Crust currently is *not* a property associated with Soil Taxonomy, 11 Edition, as a differentiating characteristic. However, the ubiquitous nature of Biological Soil Crust, particularly in the arid to semi-arid wildlands of western North America and like environments overseas, and its important role as management indicator of range condition, wildlife habitat, soil carbon and nutrient cycling status, surface age, etc., make it a prime candidate for future status as a differentiating

characteristic in Soil Taxonomy. It is anticipated that our Soil Judgers will encounter these features during their career and this is an opportune time to introduce them to it.

*Definition of the Important Soil Characteristic*

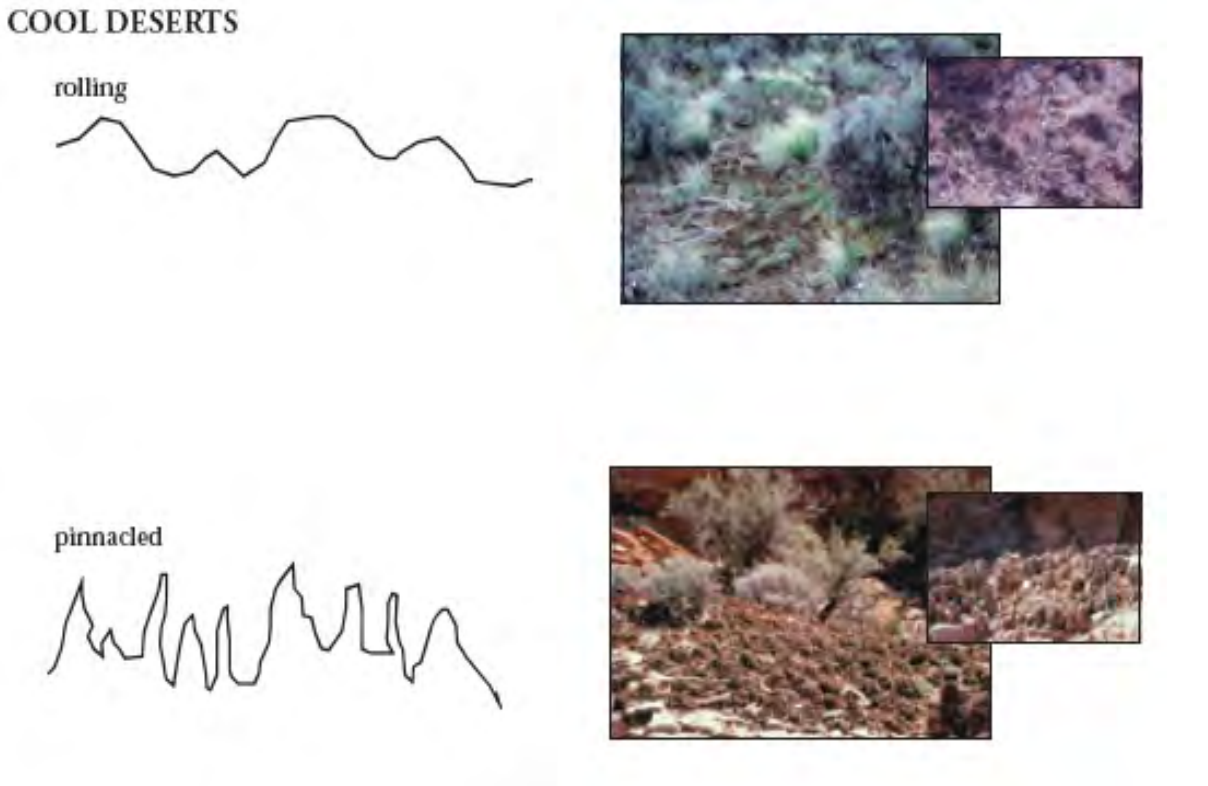
Biological Soil Crust meeting any of the criteria (see below) are recorded with a checkmark in the blank for Biological Soil Crust under the heading "Other Important Soil Characteristics," in "Section D. Soil Classification" of the Scorecard.

**BIOLOGICAL SOIL CRUST**

| **Kind** | **Criteria:** |
|---|---|
| **BIOLOGICAL CRUST** | Visibly biotically dominated surface "mat" of algae, lichens, mosses, and or cyanobacteria, conforming to an irregular patchy, hummocky surface microrelief (see examples next page and BLM Technical Reference 1730-2). Minerals and biota are integral, together forming a platy crust. Not necessary to pull surface crust apart to determine for contest.<br><br>Colors of biota range from greenish, greenish blue, greenish gray, grayish green; to brown, reddish brown, dark brown; to black. |

*Modified from the Field Book, vers. 2.0*

*Cool Desert Biological Crusts – Analogs to Contest Area*




*from Belknap (2001)*

An example of a site with biological soil crust.

(Above) Microphytic (dry moss) soil crust on a Vitrixerands. Approximate Contest view while standing. Boot for scale.

(above) Site with dominant Ponderosa Pine, basalt stones and boulders on surface, and brown microphytic soil crust.

(below) Microphytic (dry moss and other herbaceous microflora) soil crust on a Vitrixerands (close-up view).

*Photos by Jay Noller*

*Soil Crusts*

(From the *Field Book*) by C. Franks, R. Grossman, and P. Schoeneberger, NRCS, Lincoln, NE

A soil crust is a thin (e.g. <1 cm up to 10 cm thick) surface layer of soil particles bound together by living organisms and / or by minerals into a horizontal "mat" or small polygonal plates. Soil crusts form at the soil surface and have different physical and /or chemical characteristics than the underlying soil material. Typically soil crusts change the infiltration rate of the mineral soil and stabilize loose soil particles and aggregates. There are two general categories of Soil Crusts: I) Biological Crusts, and II) Mineral Crusts.

I) Biological Crusts (also called biotic, cryptogamic, microbiotic, or microphytic crusts)**:** a thin, biotically

dominated surface layer or mat formed most commonly by cyanobacteria (blue green algae), green and brown algae, mosses, and/or lichens (NRCS, 1997: NRCS, 2001a) that forms in or on the soil surface. Various types of microbiotic crusts have been recognized based on the biological communities of which they are composed (no prevailing consensus on types of biological crusts, at present).

II) Mineral Crusts (see the *Field Book*)

**Brittleness**

Refer to section of this title in the Keys to Soil Taxonomy.

**Densic materials**

Refer to section of this title in the Keys to Soil Taxonomy.

**Identifiable secondary carbonates**

Refer to section of this title in the Keys to Soil Taxonomy.

**Slickensides**

Refer to section of this title in the Keys to Soil Taxonomy.

**None**

None of the above “Other important Soil Characterisitics” are present.

## E. SOIL INTERPRETATIONS

Land-use limitations will be assessed for dwellings with basements, septic tank absorption fields, and local roads and streets, using guidelines from the National Soil Survey Handbook. These guidelines will be made available to the contestants at the contest sites.

**E.1. Dwellings with Basement:** Adapted from NSSH Table 620.3 but modified to fit northwest region soils.

**Table dwb. Table Degree of Limitation**

| Factors Affecting Use | Slight | Moderate | Severe |
|---|---|---|---|
| 1. Flooding or Ponding Frequency | None | Not a choice | Rare to Frequent |
| 2. Slope | < 6 % | 6 – 15 % | >15 % |
| 3. Depth, seasonally high water table | >100 cm | 50- 100 cm | <50 cm |
| 4. Depth to soft rock or dense sediments (Cr) | >100 cm | 50 – 150 cm | <50 cm |
| 5. Depth to hard rock (R) | >150 cm | 100 – 150 cm | <100 cm |

**E.2. Septic Tank Absorption Fields:** Adapted from NSSH Table 620.17 but modified to fit NW region soils.

**Table staf. Degree of Limitation**

| Factors Affecting Use | Slight | Moderate | Severe |
|---|---|---|---|
| 1. Flooding or ponding frequency | None | Not a choice | Rare to Frequent |
| 2. Slope (%) | <6 | 6 – 15 | >15 |
| 3. Depth to seasonal high water table | >150 cm | 100 – 150 cm | <100 cm |
| 4. Limiting Hydraulic conductivity | Moderate | Not a choice | Low or High Ksat |
| 5. Depth to rock (cm) | >150 cm | 100 – 150 cm | <100 cm |

**E.3. Local Roads and Streets**: Adapted from NSSH Table 620.5 but modified to fit NW region soils.

**Table lrs. Degree of Limitation**

| Factors Affecting Use | Slight | Moderate | Severe |
|---|---|---|---|
| 1. Flooding or Ponding Frequency | None | Not a choice | Rare to Frequent |
| 2. Slope (%) | <6 | 6 - 15 | >15 |
| 3. Depth to seasonal high water table | >50 cm | 50 – 25 cm | <25 cm |
| 4. Depth to soft rock or dense sediments (Cr) | >100 cm | 50 -100 cm | <50 cm |
| 5 Depth to hard rock (R) | >150 cm | 100 – 150 cm | <100 cm |

# ABBREVIATIONS

**Boundary Distinctness**

| | | | | |
|---|---|---|---|---|
| Very abrupt | V | | Abrupt | A |
| Clear | C | | Gradual | G |
| Diffuse | D | | | |

**Coarse Fragment Modifiers**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Gravelly | GR | | Very Gravelly | GRV | | Extremely Gravelly | GRX |
| Cobbly | CO | | Very Cobbly | CBV | | Extremely Cobbly | CBX |
| Stony | ST | | Very Stony | STV | | Extremely Stony | STX |
| Bouldery | BO | | Very Bouldery | BYV | | Extremely Bouldery | BYX |
| Channery | CN | | Very Channery | CNV | | Extremely Channery | CNX |
| Flaggy | FL | | Very Flaggy | FLV | | Extremely Flaggy | FLX |

**Coarse Fragment Roundness**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Very Angular | VA | | Angular | AN | | Subangular | SA |
| Subrounded | SR | | Rounded | RO | | Well Rounded | WR |

**Texture Class**

| | | | | |
|---|---|---|---|---|
| Coarse Sand | COS | | Sand | S |
| Fine Sand | FS | | Very Fine Sand | VFS |
| Loamy Coarse Sand | LCOS | | Loamy Sand | LS |
| Loamy Fine Sand | LFS | | Loamy Very Fine Sand | LVFS |
| Coarse Sandy Loam | COSL | | Sandy Loam | SL |
| Fine Sandy Loam | FSL | | Very Fine Sandy Loam | VFSL |
| Loam | L | | Silt Loam | SIL |
| Silt | SI | | Sandy Clay Loam | SCL |
| Clay Loam | CL | | Silty Clay Loam | SICL |
| Sandy Clay | SC | | Silty Clay | SIC |
| Clay | C | | | |

**Structure**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Grade:*** | Structureless | 0 | | Weak | 1 | | Moderate | 2 | | Strong | 3 |
| ***Type:*** | Granular | GR | | Platy | PL | | Wedge | WEG | | | |
| | Blocky | SBK or ABK | | Prismatic | PR | | Columnar | COL | | | |
| | Massive | MA | | Single Grain | SGR | | | | | | |

**Moist Consistence**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Loose | LO | | Very Friable | VFR | | Friable | FR |
| | | | | | | | |
| Firm | FI | | Very Firm | VFI | | Extremely Firm | EFI |

**Redoximorphic Features Abundance**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| None | - | | Few | F | | Common | C | | Many | M |

**Effervescence**

| | |
|---|---|
| Non-effervescent | NE |
| Very slightly Effervescent | VS |
| Slightly Effervescent | SL |
| Strongly Effervescent | ST |
| Violently Effervescent | VE |

**Smeariness**

| | |
|---|---|
| Non-Smeary | NS |
| Weakly Smeary | WS |
| Moderately Smeary | MS |
| Strongly Smeary | SM |