# Region IV Soils Contest
# November 8-9, 2012
# Oklahoma State University
# Stillwater, OK

## CONTEST RULES

## Team Composition

A team is composed of three or four undergraduate students who are enrolled in a full-time, four-year curriculum in the institution they are representing. Each institution may enter only one team in the contest. Additionally, up to four alternate competitors from each team are allowed to compete in the contest activities, but their scores will not count towards the sweepstakes (overall) total. However, alternate competitors are eligible for individual awards. All students must be eligible to represent their institution according to the rules and regulations governing eligibility at their institution. Team and alternate students should be designated by Wednesday night, November 7, 2011.

## Contest Format

This contest will be a "open book" contest; the contest handbook may be used during the contest. Cell phones are prohibited. Each site will have its own scorecard indicated by a unique color. Each individual contestant will be given colored scorecards corresponding to each site. Students must correctly enter their contestant ID number on their scorecard. Scorecard entries must be made according to the instructions for each specific feature to be judged (see following sections of the handbook). Only one response should be entered in each blank, unless told otherwise.

The contest will consist of three parts: a) four individually judged pits (Thursday), b) one team-judged pit (Friday) and c) the sweepstakes (overall) score, a combination of both team and individual results. The sweepstakes placings will be used to select which teams advance to the National ASA Soil Contest in the spring. The team scores from the individually-judged pits will be the sum of the top three individual scores for each pit. Therefore, the sum of 13 scorecards (3 individuals x 4 individual pits + 1 team judged pit) will determine the sweepstakes score per team. Students from institutions having less than three team members may compete, but they are only eligible for individual awards.

The clay content of the third horizon will be used to break ties in both the individual and team competitions. In order to break a tie in the sweepstakes scores, the mean clay content for site 1 will be calculated from the estimates provided by all members of a given team. The team with the mean estimate closest to the actual value will receive the higher placing. If this does not break the tie, the next site will be used in the same manner. For individual ties, the clay content of the third horizon at sites 1, 2, and so on will be compared to that estimated by the individual in order to break a tie between individuals. For the team judged pit, the team estimate of the clay content of the third horizon will be compared to the actual value. The team with the estimate closest to the actual value will receive the higher placing. If this does not break the tie, the next deepest horizon will be used.

Results will be announced Friday afternoon and will be final. Awards will be given to the top three sweepstakes teams, top three in team-judging, and top five in individual-judging.

At each site a pit will be excavated and a restricted area will be designated on one of the pit walls for the measurement of horizon depth and determination of boundary distinctness. The restricted area will be clearly outlined and a nail will be placed 'somewhere in the third horizon'. A tape measure will also be attached to the restricted area. THE RESTRICTED AREA IS TO BE UNDISTURBED! Picking, taking samples, or other disturbances within the restricted area are not permitted. The pit ID, depth to be considered, the number of horizons to describe, pertinent chemical data, and other relevant information will be displayed on a sign at each pit (Fig. 1). Contestants should expect to evaluate between four and six horizons per pit. Slope stakes will be placed along the grade for determination of slope and site position (Part II.A. of scorecard).

PIT 1

Describe five mineral horizons between the surface and a depth of 112 cm.

| Horizon | B.S. | ESP | O.C. |
|---|---|---|---|
| | ----------------- | % | ----------------- |
| 1 | 100 | 2 | 0.9 |
| 2 | 100 | 5 | 0.7 |
| 3 | 100 | 12 | 0.3 |
| 4 | 100 | 28 | 0.1 |
| 5 | 100 | 12 | 0.1 |

The nail is in the third horizon and at a depth of 36 cm.
Original thickness of topsoil was 18 cm.

Figure 1. Example of information provided at each pit.

Fifty minutes will be allowed for the judging of each site. During registration, each contestant will be assigned a number-letter combination corresponding to team-group designations. This will uniquely identify each contestant and be used to facilitate rotations at the pit (Table 1):

Table 1. Contestant rotations.

| Time | Individual Pits 1 and 3 | | Individual Pits 2 and 4 | |
|---|---|---|---|---|
| | Odd team no. | Even team no. | Odd team no. | Even team no. |
| First 5 min. | In[*] | Out | Out | In |
| Next 5 min. | Out | In | In | Out |
| Next 10 min. | In | Out | In | Out |
| Next 10 min. | Out | In | In | Out |
| Next 20 min. | Free[**] | Free | Free | Free |

[*]In and out refer to contestants allowed in the pit or outside of the pit, respectively.
[**]During free time, contestants may remain in or out of the pit.

The restricted area on the pit wall will be outlined with flagging and a tape measure mounted that is NOT to be disturbed, and a nail will be inserted somewhere in the third horizon of each pedon (Fig. 2). Contestants should provide the following for their personal use: tape measure, clinometers (or Abney level), water bottle or sprayer, acid bottle, knife, pencils, Munsell color charts (10R to 5Y), hand towel, hand lens, and containers for soil samples. Calculators, 2 mm diameter sieves, and clipboards may also be used. No other materials other than those supplied by the host will be permitted during the contest. Cell phones, pagers, or other communication devices are prohibited during the contest. Talking is NOT permitted between contestants during the 50 minutes of pit judging. Pit monitors will be instructed to collect scorecard from contestants and they will receive a zero for that pit if any of the above rules are broken, especially talking to other contestants. Contestants should show respect for each other and avoid creating distractions during the competition.

Figure 2. Example of restricted area of pit wall.

## Scoring and Abbreviations

Grading will be done by individuals competent in soil morphology and classification. Each grader will grade only one pit and scores will be re-counted by another grader for accuracy. Variable credit may be given at the discretion of the judges. For horizons, two points will be given for the correct master horizon designation even if other components are in error. Where an answer is not needed or is inappropriate, a dash (-) may be used. In such cases, students will also be given credit for blanks.

Contestants may use the official abbreviations (preferred, see Attachment 1) or write out answers. Use of abbreviations other than official abbreviations is strongly discouraged, but graders shall give credit if, in their opinion, the meaning of an unofficial abbreviation is obvious.

A team is composed of three or four undergraduate students. The team score will be the sum of the top three individual scores at each pit (see Table 2). This method maximizes the opportunity for all four team members to contribute to the final team score.

Table 2. Score tabulation example for the Individual Contest.

| Contestant | Site 1 | Site 2 | Site 3 | Site 4 | Total |
|---|---|---|---|---|---|
| A | 132 | 130 | 110 | 144 | 516 |
| B | 146 | 116 | 141 | 138 | 541 |
| C | 130 | 112 | 160 | 158 | 560 |
| D | 125 | 114 | 129 | 145 | 513 |
| Total score: 1645 | 408 | 360 | 430 | 447 | |

The score from the team-judged pit will be added to the individual scores for the sweepstakes team total.

## Scorecard

The scorecard consists of five parts: A. Soil Morphology; B. Soil Profile Characteristics; C. Site Characteristics; D. Soil Classification; and E. Site Interpretations (refer to the attached example). The Soil Survey Manual (Chpt. 3, 1993), and Field Book for Describing and Sampling Soils, Ver. 2.0 (Schoeneberger, P. J. et al., 2002) and Keys to Soil Taxonomy (11th e., 2010) should be used as guides during practice. These publications are available at: http://soils.usda.gov/technical/.

## Part A. Soil Morphology

### **1**. Horizon Designations (Chapter 18, pp. 315-321, Keys to Soil Taxonomy, 2010).

Horizon designation will follow standard procedures, including a master, transitional or combination horizon symbol in the "Master" column, and when needed, a lower case symbol in the suffix column, and an Arabic numeral in the "No." column. All B horizons **must** have a suffix. Arabic numerals indicating lithologic discontinuities and prime symbols to distinguish otherwise identical designations should be placed in the "Master" column. If no designation is necessary, contestants may leave a space blank or record a "-" (dash) to indicate no designation. Only mineral horizons will be described for the contest, and students should be familiar with A, E, B, C and R horizon designations, plus transitional and combination horizons. Suffix symbols that could be used in the contest area are: b, c, d, g, k, n, r, ss, t, u, w, and y.

### **2.** Depth.

The depth of the lower boundary as measured from the soil surface should be recorded (cm). Alternately, the depth of both the upper and lower boundary may be given, but only the depth to the lower boundary will be graded. For example, a Bt1 horizon occurring from 30-45 cm may be recorded as "45 cm" (preferred) or "30-45 cm". The last horizon boundary should be the specified judging depth with a "+" added. Thus, if the pit sign states "Describe 5 horizons from the surface to a depth of 140 cm", the fifth depth designation should be "140+". However, when the specified depth is at a lithic or paralithic contact, the "+" is dropped from the depth.

Depth measurements should be made between the tapes in the restricted area on the pit wall. A range for the depth considered correct will be based on the distinctness and topography of the boundary. No horizon less than 8 cm thick will be described. If a horizon less than 8 cm thick occurs, it should be combined with the adjacent horizon that is most similar for the depth measurement purposes. When two horizons combine to a total thickness of 8 cm or more, the properties of the thicker horizon should be described. If lamellae are encountered that are thinner than 8 cm, then the convention is to describe the eluvial and illuvial horizons as a unit, ie., E&Bt, and the thickest horizon would be described.

If a lithic contact occurs at the specified depth on the site card, the contact should be considered in evaluating the water retention difference, effective soil depth, and hydraulic conductivity. Otherwise, the last horizon should be assumed to extend to 150 cm for making all relevant evaluations. If a paralithic contact occurs within the specified depth, the contact should be considered as one of the horizons to be included in the description, and the appropriate horizon nomenclature should be applied (i.e. Cr

## **3.** Boundary Distinctness (Chapter 3, pp. 133-134, Soil Survey Manual).

Distinctness refers to the thickness of the zone within which the boundary can be located. The distinctness of a boundary depends partly on the degree of contrast between the adjacent layers and partly on the thickness of the transitional zone between them. The topography of the boundary will not be required for this contest. The boundary distinctness of the deepest horizon will not be determined so it can be left blank or dashed.

Distinctness classes are:

Abrupt (A): 0.1 - 2.0 cm
Clear (C): 2.1 - 5.0 cm
Gradual (G): 5.1-15.0 cm
Diffuse (D): > 15 cm

Note: For the purpose of this contest, the class "very abrupt" ie., < 0.5 cm, will not be used.

## **4.** Clay Percentage and Texture (Chapter 3, pp. 136-143, Soil Survey Manual)

Estimates of the clay content as a weight percentage of the soil fines should be placed in the space provided. A scaled range for correct answers compared to values estimated by the judges will be used according to:

| Actual % | Allowed deviation |
|---|---|
| <20 | +/- 2 |
| 20-40 | +/- 3 |
| >40 | +/- 4 |

The textural class and % clay for each horizon will be determined by the judges and supported by laboratory data. Soil texture classes as defined in Chapter 3 and their official abbreviations (supplied to contestants as Attachment 2) will be used. Deviation from standard nomenclature will be incorrect (i.e., sandy silt, silty loam). Credit for sand, loamy sand, and sandy loam textures will NOT be given if sand modifiers are needed (i.e. very fine, fine, or coarse).

Modification of the textural class will be required if the horizon contains more than 15% by volume coarse fragments (>2mm), which includes carbonate and ironstone nodules. Sieves will be allowed during the contest. For the purpose of this contest, only the following terms will be used to describe coarse fragments:

Gravelly – fragments 2-75 mm diameter of any lithology and shape.
Cobbly – fragments of any shape and lithology that are > 75 mm diameter by their long axis.

If gravels and cobbles occur in the same horizon, the dominant condition should be described

Coarse fragment modifiers are required as follows:

| Coarse fragment (vol/vol) | Modifier |
|---|---|
| <15% | none needed |
| 15-34% | gravelly or cobbly |
| 35-60% | very gravelly or very cobbly |
| >60% | extremely gravelly or extremely cobbly |

For example, if the horizon has a texture of clay loam with 40% by volume gravel-size fragments, the correct texture designation should be VGR CL (very gravelly clay loam).

## **5.** Color (Chapter 3, pp. 146-157, Soil Survey Manual)

The Munsell color notation to include hue, value, and chroma will be used to describe the moist soil color of each horizon. For surface horizons, the moist color will be determined on briefly rubbed samples as directed in the discussions of mollic epipedon in Soil Taxonomy. For all other horizons, the color recorded should be the dominant moist color of the matrix (the color that occupies the greatest volume of the horizon). Often the most noticeable color may be that of the ped surface, *but* the ped surface color may not constitute sufficient volume to be designated as the dominant color.

## **6.** Structure.

Both grade (structureless, weak, moderate, or strong) and type (shape) of structure should be recorded. Acceptable types of structure are restricted to the following: granular, platy, subangular blocky, angular blocky, wedge, prismatic, and columnar. If two structure types are present in a given horizon, describe the structure with the stronger grade. If the two structures are of equal grade, describe the one with the larger physical size. If there is no structure, indicate "structureless" (SL) in the grade column and "massive" (MA) or "single grain" (SG) in the shape column.

## **7.** Redoximorphic Features (RMF) (Keys to Soil Taxonomy, 11th ed., pp. 24-25).

Redoximorphic features are soil morphological features caused by alternating reduction/oxidation processes. The reduction/oxidation of iron (Fe) and, to a lesser extent, manganese (Mn), minerals result in most RMF features. Iron is a major pigment that influences soil color. The loss, accrual, and valence/mineral state of Fe are major determinates of color patterns within or across soil horizons. Iron or Mn reduction occurs when free oxygen is limited or excluded from a soil volume or horizon by water saturation for extended time. Reduced iron ($Fe^{2+}$) is comparatively much more soluble and mobile than oxidized iron ($Fe^{3+}$), and moves with water flow and by diffusion gradients. When soil is reduced, Fe and Mn in local zones can be removed, leaving uncoated mineral grains (depletions) of lighter color. Reduced Fe is oxidized and precipitates when water drains from soil (reentry of free oxygen), or where oxygen is present in, or along, soil pores, including root channels, or along roots. The re-oxidized Fe or Mn may form crystals, soft masses, or hard concretions or nodules (concentrations). Oxidized Fe will generally have a redder or yellower color than adjacent soil particles, while Mn often will have a darker color than adjacent soil particles.

Therefore, redox concentrations are defined as zones of Fe-Mn accumulation from:

1. Nodules and concentrations.  Concentrations have internal rings and nodules do not.
2. Masses.  Masses are non-cemented concentrations.
3. Pore linings.  Pore linings may be either coatings on pore surfaces or impregnations from the matrix adjacent to pores.

Redox *depletions* are defined as zones with chromas less than, or values higher than those in the matrix where either Fe, or Mn, or both Fe, and Mn, have been removed through reduction and transport processes.  They may be identified as iron depletions.  Zones that contain lesser amounts of Fe and Mn oxides compared to the adjacent matrix.
Report the abundance as few, common, many (<2%, 2-20%, and >20%, respectively) of the *most abundant* RMF.  Indicate if it is a concentration or depletion (Con/Dep).  If RMF features are absent, mark both "Abundance" and "Con/Dep" with a dash or leave blank

## **8.** Effervescence (Chapter  3, pp. 192-193, Soil Survey Manual).

Cold, diluted (usually about 1 M) HCl is used to test for carbonates in the field.  The amount, particle size and mineralogy (calcite vs dolomite) of the carbonate affect the reaction of carbonates with acid.  The following classes will be used to describe the effervescence of carbonate phases in soils:

Non-effervescent (NE) - no reaction; apparently carbonates are absent

Very slightly effervescent (VS) - few bubbles seen

Slightly effervescent (SL) - bubbles readily seen

Strongly effervescent (ST) - bubbles form low foam

Violently effervescent (VE)- thick foam forms quickly

## **Part B.  Soil Profile Characteristics**

## **1.** Infiltration Rate

Infiltration rate is defined as the maximum rate at which water enters the surface mineral soil horizon. It depends upon particle-size distribution, organic carbon content, and structure of the surface horizon as well as soil management and kind of crops (although management is not included as a factor for this contest). The properties of the subsoil, particularly the amount of cracking, influence the infiltration rate to a much lesser degree and are considered for hydraulic conductivity class below. Relationships given below may be used in estimating the infiltration rate.

Rapid. Water enters the soil at a rate greater than 7.5 cm per hour. Normally this class includes horizons with one of the following:

(1) Sand or loamy sand textures, or

(2) Sandy loam textures with greater than 1.2% organic carbon.

Medium. Water enters the soil at a rate of 0.5 to 7.5 cm per hour. This class includes texture and structure combinations not included in the other two classes.

Slow. Water enters the soil at a rate of less than 0.5 cm per hour. This class includes horizons that meet both of the following:

(1) Have either clay, silty clay, or sandy clay textures, and

(2) Is either massive or has weak grade of structure.

**2.** Hydraulic conductivity (Classes simplified from p. 2-70, Field Book, V. 2.0, 2002).

Saturated hydraulic conductivity of the surface horizon and the *most limiting* horizon (Hydraulic Conductivity/Soil) within the depth specified for judging will be estimated. Should a lithic, paralithic, or densic contact occur at or above the specified judging depth, it should be considered in evaluating hydraulic conductivity.

High**.** Greater than 3.6 cm/hr. This class includes sands and loamy sands and some highly structured sandy loams. Horizons containing large quantities of coarse fragments with insufficient fines to fill many voids between the fragments are also included in this class.

Moderate. Between 0.036 and 3.6 cm/hr. This class includes materials excluded from the "Low" and "High" classes.

Low. Less than 0.036 cm/hr. Normally, low hydraulic conductivity is associated with clay, silty clay, and sandy clay horizons. Horizons with low hydraulic conductivity exhibit clayey textures (clays, silty clays, and sandy clays), lithic contact, or paralithic contact.

**3.** Soil Wetness Class. (Chpt. 3, pp. 101, Soil Survey Manual).

Free-water (wetness) classes are determined by the depth to specific redoximorphic features (RMF) in the soil, specifically depletions with a chroma of 2 or less and a value of 4 or more, i.e., gray depletions of *at least common* abundance as defined by the NRCS. Redox concentrations alone shall not be sufficient evidence for a state of wetness, The wetness classes for this contest are:

Very Shallow: <25 cm
Shallow: 25 to <50 cm
Moderately Deep: 50 to <100 cm
Deep: 100 to <150 cm
Very Deep: ≥150 cm

If no evidence of wetness exists within the specified depth for characterization and that depth is less than 150 cm, assume "Very Deep". These classes indicate free-water and reduction occurs, but do not indicate the duration of occurrence of free-water.

**4.** Water retention difference (Chapter 5, pp. 292-293, Soil Survey Manual).

The amount of water that a soil can hold between 33 kPa (1/3 bar) and 1500 kPa (15 bars) soil-water tension within the zone accessible to roots is the water retention difference of the soil. The water retention difference of the whole soil is calculated by estimating the amount of water each horizon can hold, determining which horizons are sufficiently accessible to plant roots to be significant sources of water, and summing the water retention differences of the accessible layers. Water retention difference is commonly expressed in cm water/cm soil. Classes are based on the amount of water retention difference in the upper 1.5 m of soil, or above a root-limiting layer, such as a lithic or paralithic contact. A number of factors are used to determine the water retention difference of individual horizons. These include texture, clay mineralogy, soil structure, volume of coarse fragments, organic matter content, and bulk density. For the contest, only texture and volume of coarse fragments will be used to estimate the water retention differences of individual horizons above 1.5 m. Estimated water retention in relation to texture is given in Table 3. If the instructions for a pit require judging a profile that is less than 1.5 m deep, then assume the last horizon extends to a depth of 1.5 m unless it is directly underlain or contains a lithic or paralithic contact. Contestants are to assume that plant roots are sufficiently restricted by these contacts that no water is available below the contact. Coarse fragments are considered to have negligible (assume zero) moisture retention so estimates must reflect the coarse fragment content (subtract the percentage of coarse fragment volume, see example below). Table 4. Is a sample calculation of water retention difference. The five classes recognized are:

Very Low (<7.50 cm)

Low (7.50-14.99 cm)

Medium (15.00-22.49 cm)

High (22.50-29.99 cm)

Very High (>30 cm)

Table 3. Estimated relationships of water retention difference to texture.

| Texture Class of Soil Horizon | cm $H_2O$/cm soil |
|---|---|
| silt, silt loam, silty clay loam, loam, clay loam, very fine sandy loam | 0.20 |
| sandy loam, fine sandy loam, sandy clay loam sandy clay, clay, silty clay | 0.15 |
| coarse sandy loam, loamy fine sand, loamy very fine sand, loamy sand | 0.10 |
| loamy coarse sand, all sands | 0.05 |

Table 4. The following is a sample calculation of water retention difference.

| Horizon | Depth | Text. | Crs. Frag. | Water Ret. | |
|---|---|---|---|---|---|
| Ap | 0-12 | ls | 0 | (12cm)(0.10) = | 1.2 |
| Bt1 | 12-28 | sc | 0 | (16cm)(0.15) = | 2.4 |
| Bt2 | 28-54 | scl | 0 | (26cm)(0.15) = | 3.9 |
| 2Bt3 | 54-105 | l | 5 | (51cm)(0.20)(0.95) = | 9.69 |
| 2Bt4 | 105-132 | grl | 20 | (27cm)(0.20)(0.80) = | 4.32 |
| 2R | 132+ | - | - | 0 | 0.00 |
| | | | Total water retention difference = | | 21.51 cm |
| | | | | = | HIGH |

## **5.** Effective Soil Depth

Soil depth classes as defined as the depth from the soil surface to the upper boundary of a root restricting layer. Root restricting layers include lithic and paralithic contacts, 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 less than 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 soil depth classes are:

Very Shallow......................................... root restricting layer within 25 cm of soil surface

Shallow...............................................................root restricting layer from 25 to <50 cm

Moderately deep..............................................root restricting layer from 50 to <100 cm

Deep ...............................................................root restricting layer from 100 to <150 cm

Very deep .........................................................root restricting layer at 150 cm or deeper

## **Part C. Site Characteristics**

### **1.** Landform.

Identify the landform on which the soil pit is located. If the pit is in an ambiguous position or the position obscured by the spoil pile, the slope stakes should be placed to reinforce the identity of the position represented by the pit. A topographic map with the pit location marked may also be provided to guide the students in the evaluation of the position of site.

1. Depression. Positions on the landscape where water and/or sediment accumulate. They have no free surface water drainage outlet.

2. Floodplain. The lowest geomorphic surface which is adjacent to the stream channel and which floods *first* when the stream goes into flood stage. It is formed by the deposition of alluvium. Each stream has only one floodplain.

3. Stream terrace. These are geomorphic surfaces formed by the deposition of alluvium and are higher in elevation than the flood plain. A stream may have one or more terraces. For the purpose of this contest, a landform will NOT be designated as a stream terrace unless its association with a present-day stream is reasonably apparent.

4. Uplands. Areas dominated by residual and colluvial parent materials and usually occur above floodplains and stream terraces. The bulk of soil material in uplands is produced by physical and chemical weathering of parent material in place and mass wasting such as soil creep, debris and mud flows, slump, landslides, etc.

5. Dune. Generally concave upward shape dominated by sand. Processes of formation are dominated by saltation. A dune may be active or stabilized (fully vegetated).

## **2.** Site Position.

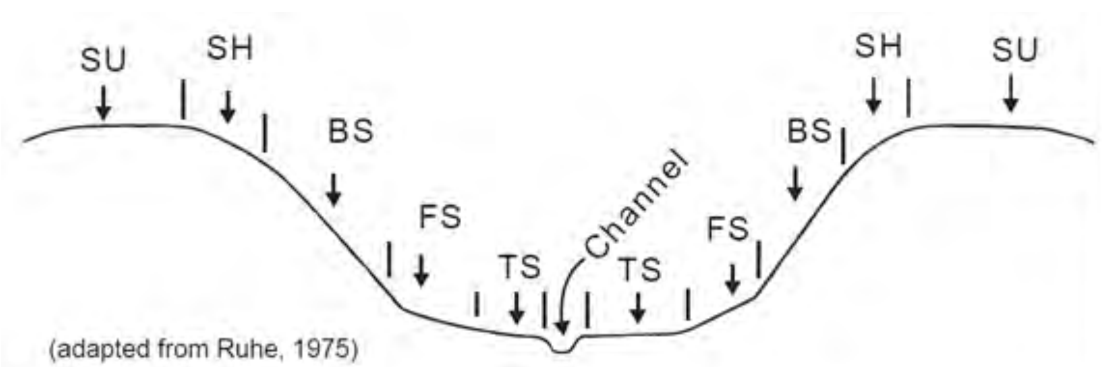
The following are the designations for site positions that will be used in this contest with a brief description. All landforms will have a site position.

1. Summit. The topographically highest position of a hillslope profile with a nearly level (planar or only slightly convex) surface. Ridge tops are included under summit since they are topographic highs and are usually planar in one direction.

2. Shoulder. The hillslope profile position that forms the convex, erosional surface near the top of a hillslope. It comprises the transition zone from summit to backslope.

3. Backslope. This position includes all landscape positions between the shoulder and footslope.

4. Footslope. The position that forms the concave surface at the base of a hillslope. In some landscapes, the footslope may gradually transition into a toeslope, where the toeslope gently transitions to a floodplain or depression. For this contest, footslope and toeslope will not be separated.



**3.** Parent Material.

Parent material refers to unconsolidated organic and mineral material in which soils form. As parent material cannot be observed in its original state, inference from the properties of the soil and from other evidence must be used. Mode of deposition and/or weathering may be implied or implicit. The following parent materials will be used in this contest:

1. Alluvium. Unconsolidated sediments deposited by running water of streams and rivers, including cobbles, gravels, sand, silt, clay, and various mixtures of these. Alluvium may occur on terraces well above present streams, or present flood plains or deltas, or as a fan at the base of a slope.

2. Colluvium. Unconsolidated, unsorted sediments detached from the hillslopes and deposited at a footslope by gravity and water.

3. Aeolian. Wind deposited sediments.

4. Residuum. Unconsolidated, weathered, or partly weathered mineral material that accumulates by disintegration of bedrock in place.

Sometimes two parent materials may be evident in a pedon, for example alluvium over residuum. If evident, indicate the transition with an Arabic numeral in the prefix column beginning with the number 2 for the first transition. It is implied that the overlying parent material is number 1. For example, the following sequence may be found in a profile with two parent materials: A – E – Bt1 – 2Bt1 – 2Bt2 etc.

**4.** Slope Gradient.

Slope classes to be used in the contest are listed on the scorecard. If a site falls on the boundary of two slope classes, mark the steeper class. The slope is to be determined between two stakes at each site designated for this purpose. The student is responsible for checking the heights of the stakes.

**5.** Surface runoff.

Surface runoff refers to water that flows away from the soil over the land surface. Surface runoff is controlled by a number of factors including soil properties, climate, and plant cover. Runoff can be significantly altered by management (i.e., natural cover, cultivation, minimum tillage operations, etc.). For the purpose of this contest, only the runoff classes in Table 5 will be used. If the surface has a dense vegetative or debris cover, the surface runoff class should be assigned *one lower class rate* to a minimum of 'Very Slow'. Sites in depressional positions will be considered to have very slow runoff.

Table 5. Surface runoff classes.

| % slope | Hydraulic Conductivity of the Surface Horizon<br>High | Moderate | Low |
|---|---|---|---|
| | ------------ surface runoff class ---------------- | | |
| 0-1 | very slow | very slow | very slow |
| 1-3 | very slow | slow | slow |
| 3-5 | slow | medium | medium |
| 5-8 | medium | medium | rapid |
| 8-12 | medium | rapid | very rapid |
| 12-20 | rapid | very rapid | very rapid |
| 20 + | very rapid | very rapid | very rapid |

If a slope fall exactly on a slope break, select the higher slope category. Should a site be forested or in pasture, the surface runoff may be significantly decreased due to vegetative or residue cover. When cover is dense (less than 10% bare soil), the surface runoff class should be assigned one lower rate class to a minimum of very slow. "Pounded" shall be used to describe surface runoff in depressional areas only.

## **6.** Soil Erosion Potential

Soil erosion potential refers to the likelihood of soil erosion by water. The potential for future erosion losses is influenced mainly by the texture of the surface soil and the amount of surface runoff at a site. Soil erosion potential is estimated using the following table.

*Soil Erosion Potential Classes*

The following erosion table assumes granular structure or structureless - single grained in the surface horizon and that the soil is bare, although in this contest there is no adjustment if that is not the case.

| | Surface Horizon Texture | | | |
|---|---|---|---|---|
| Surface Runoff | S, LS | SCL, SC | SL, CL, C, SiC | L, Si, SiL, SiCL |
| Ponded | Very Low | Very Low | Very Low | Very Low |
| Very slow | Very Low | Very Low | Low | Medium |
| Slow | Very Low | Low | Medium | Medium |
| Medium | Very Low | Low | Medium | High |
| Rapid | Low | Medium | High | Very High |
| Very Rapid | Medium | High | Very High | Very High |

## Part D. Soil Classification

Keys to Soil Taxonomy, 11th Edition (2010) should be used for details on soil classification. Only the diagnostic horizons, features, and orders possible for mineral soils in the area, along with pertinent data displayed on the pit sign, are listed on the scorecard.

**Particle-Size Control Section**
The upper and lower limits of the family control section should be identified as defined in the latest Keys to Soil Taxonomy and Soil Taxonomy.

**Family Particle Size Class**
Based on the determination of family control section, calculate the weighted percentage sand, silt, clay (and if needed, coarse fragment content in the control section), and determine the family particle size class. Students will need to know when to use the three broad particle size classes and when to use the seven more specific particle size classes. If two or more strongly contrasting particle size classes are present within the control section, both family particle-size classes should be identified. For example, check both coarse-silty and clayey if the family is coarse-silty over clayey.

## Part E. Site Interpretations

Soil interpretations involve the determination of the degree of limitation within each soil for a specified use. The most restrictive soil property determines the limitation rating. In cases where the base of the pit does not extend to the depth indicated in the following tables (e.g., 150 cm), one should assume that the lowest horizon in the pit extends to the depth of interest. These soil use interpretation tables are partially extracted and modified from the National Soil Survey Handbook (NSSH). Only those characteristics which commonly pose restrictions on the use of soils of this area are listed for your use in evaluation. Depth to seasonally high water table is based on the shallowest observed depth of redoximorphic depletions of value ≥4 with chroma ≤2 or depleted matrix. The hydraulic conductivity criteria for the septic tank absorption field interpretation exclude the upper 50 cm of the soil profile—only the soil between the depths of 50 and 150 cm should be considered.

## Soil Use Interpretations Tables

**Dwellings with Basement**

| | Degree of Limitation | | |
|---|---|---|---|
| Factors Affecting Use | Slight | Moderate | Severe |
| 1. Flooding or ponding frequency | None | Not a choice | Rare to Frequent |
| 2. Slope (pct) | <6 | 6 - 15 | >15 |
| 3. Depth to seasonally high water table (cm) | >100 | 50 - 100 | <50 |
| 4. Depth to soft rock (Cr) (cm) | >100 | 50 - 100 | <50 |
| 5. Depth to hard rock (R) (cm) | >150 | 100 - 150 | <100 |

**Septic Tank Absorption Fields**

| | Degree of Limitation | | |
|---|---|---|---|
| Factors Affecting Use | Slight | Moderate | Severe |
| 1. Flooding or ponding frequency | None | Not a choice | Rare to Frequent |
| 2. Slope (pct) | <6 | 6 - 15 | >15 |
| 3. Depth to seasonally high water table (cm) | >150 | 100 - 150 | <100 |
| 4. Depth to High or Low hydraulic conductivity* | >150 | 100- 150 | <100 |
| 5. Depth to rock (R or Cr) (cm) | >150 | 100 - 150 | <100 |

* Excluding the upper 50 cm of the soil profile. Only evaluate soil horizons between 50 and 150 cm.

**Local Roads and Streets**

| | Degree of Limitation | | |
|---|---|---|---|
| Factors Affecting Use | Slight | Moderate | Severe |
| 1. Flooding or ponding frequency | None | Not a choice | Rare to Frequent |
| 2. Slope (pct) | <6 | 6 - 15 | >15 |
| 3. Depth to seasonally high water table (cm) | >50 | 25 - 50 | <25 |
| 4. Depth to soft rock (Cr) (cm) | >100 | 50 - 100 | <50 |
| 5. Depth to hard rock (R) (cm) | >150 | 100 - 150 | <100 |

Attachment 1
Official Abbreviations

Boundary Distinctness: Abrupt - A    Clear – C    Gradual – G    Diffuse – D

Coarse Fragments:

| | | | |
|---|---|---|---|
| Gravelly | -GR | Cobbly | -CB |
| Very Gravelly | -VGR | Very Cobbly | -VCB |
| Extremely Gravelly | -XGR | Extremely Cobbly | -XCB |

Texture

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

RMF, Abundance/Concentration

Abundance: Few – F    Common – C    Many – M

Redoximorphic Features: Concentration – CON    Depletion – DEP

Structure Grade: Weak – 1    Moderate – 2    Strong – 3    Structureless – 0

Structure Type:

| | | | |
|---|---|---|---|
| Granular | -GR | Angular Blocky | -ABK |
| Platy | -PL | Subangular Blocky | -SBK |
| Prismatic | -PR | Single grain | -SG |
| Columnar | -CO | Massive | -M |
| Wedge | -W | | |

Effervescence: Non-effervescent – NE    Very slightly effervescent – VS
Slightly effervescent – SL    Strongly effervescent – ST
Violently effervescent - VE

Attachment 2

Texture Triangle

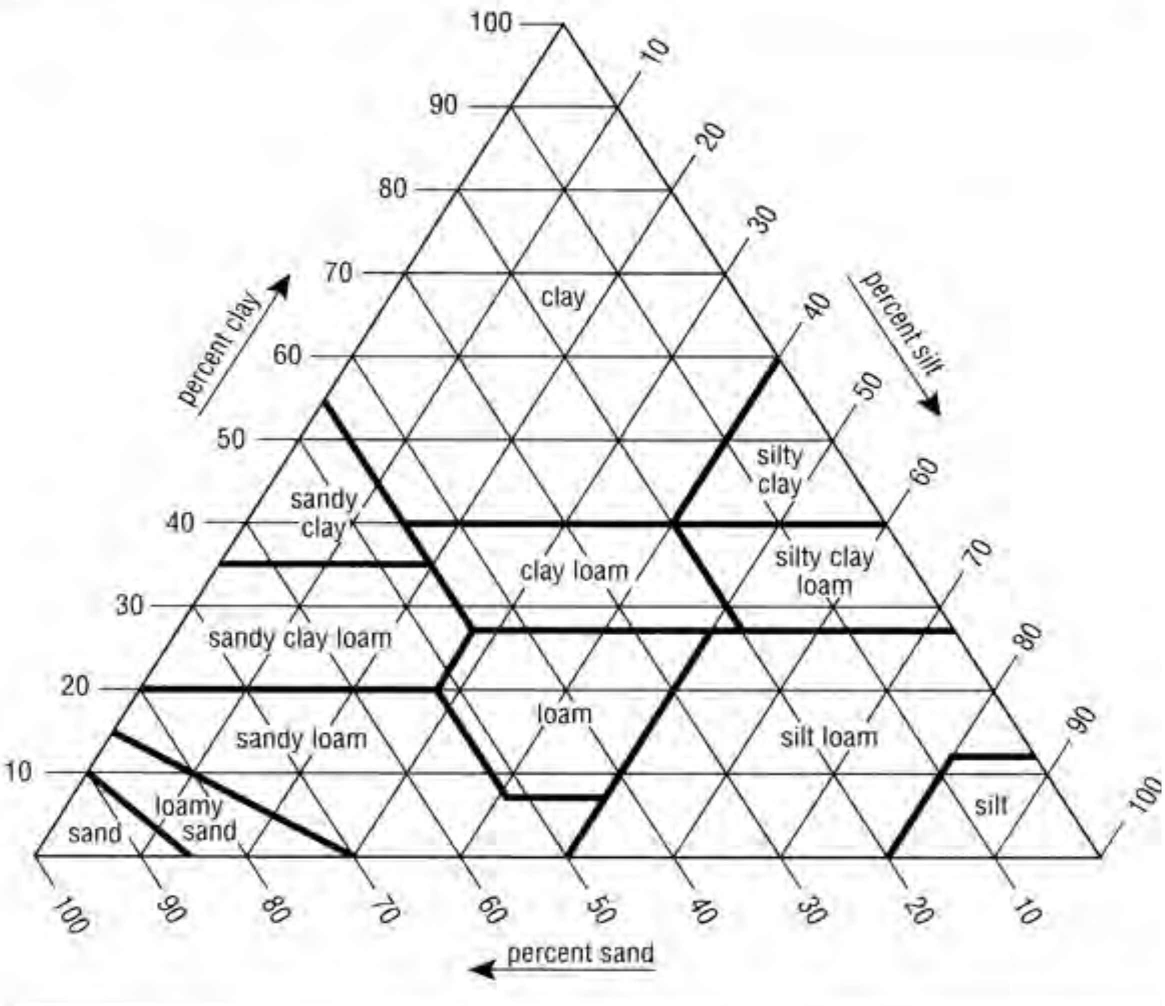



Chart showing the percentages of clay, silt, and sand in the basic textural classes.

Source: Soil Survey Manual