4-Year Soils Contest Rules/Guidelines

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INTRODUCTION

Soil judging provides an opportunity for students to study soils through direct experience in the field. Students learn to describe soil properties, identify different kinds of soils and associated landscape features, and interpret soil information for agriculture and other land uses. These skills are developed by studying a variety of soils formed from a wide range of parent materials and vegetation in different topographic settings. Students gain an appreciation for soil as a natural resource by learning about soils and their formation. We all depend on soil for growing plants, crops, and range for livestock; building materials; replenishing water supplies; and waste disposal. If we do not care for our soils, loss of productivity and environmental degradation will follow. By understanding more about soils and their management through activities like soil judging, we stand a better chance of conserving soil and other natural resources for future generations.

This handbook is organized into sections that describe the format and content of the contest. The contest involves soil description and interpretation at sites by students, who record their observations on a scorecard. The handbook content sections follow the organization of soil and related information given on the scorecard.

CONTEST RULES, SCORING, AND PROCEDURES

Official Team and Individual Competitor Composition and Scoring

Each school's official team will consist of up to four members judging four sites. Only the official team from each school will be considered for team awards. Up to four alternates from each school may compete for individual awards only. The top three individual scores for each official team at each site will be added together and totaled for all four sites. This will be used as the official team score for the team competition. The individual awards will be based on contestants' total score for all four sites. Other contestants from each school may be entered into the contest but may not be considered for individual awards.

Below is an example of the computation of official team and individual scores:

STUDENT	SITE 1	SITE 2	SITE 3	SITE 4	TOTAL INDIVIDUAL
Jones	232	241	254	183	910
Smith	261	262	313	186	1022
Brown	**208**	277	**251**	171	907
Green	275	**234**	289	**167**	965
TEAM	768	780	856	540	

TEAM SCORE = 2944

** Note: The team score is <u>not</u> the sum of the individual scores. Scores in **bold** were the lowest individual scores for each pit and were not used to compute the team score.

Breaking a Tie

In the case of a tied score, for individual awards, the tiebreaker will be the contestants' estimate of the percent clay for the surface horizon of Site 1. The individual closest (+ or -) to the official clay percentage on the official key will be the winner of the tie. If that should fail to break the tie, the next lower horizon will be used and so forth, until a winner of the tie is determined. The tiebreaker for team awards will be the summation of all individual scores for all four pits. The team with the highest cumulative score will be declared the winner. If this method results in a tie, the percent clay estimates for the surface horizon of Site 1 of all four team members will be added together and averaged. The team with an average estimate closest to the official key (+ or -) will be the winner of the tie. If this fails to break the tie, the next lower horizon will be used and so forth until the tie is broken.

Timing of Contest

Fifty minutes will be allowed for judging each site. This will be divided between time in the pit, time out of the pit and time open for all. For half of the group, timing will be: ten minutes in the pit; ten minutes out; ten minutes in; ten minutes out; ten minutes open for all. For the other half of the group timing will be: ten minutes out of the pit; ten minutes in; ten minutes out; ten minutes in; ten minutes open for all. Contestants will alternate starting in and out of the pit at each site. For large numbers of contestants, it may be necessary to provide more than one control section at each site. The contest host may alter the timing schedule and/or rotation to accommodate large numbers of contestants with the approval of a majority of the coaches present at the coaches' meeting. Changes in contest timing and/or rotation should be finalized and announced at the coaches' meeting.

Permitted Equipment

Contestants may use a clean clipboard, hand level, containers for samples, sieve (#10, 2mm), pencils (no ink pens), knife, water and acid bottles, Munsell color book (Hue 10R to Hue 5Y), non-programmable calculator and tape (metric preferred - all depths will be in cm.). A textural triangle, Attachment 1 (Abbreviations) and Attachments 2 and 3 (Rating Charts) will be supplied at the contest. It is not necessary to memorize Attachments 1, 2, or 3. If possible, contest hosts should provide extra hand levels, pencils, water and acid bottles, and copies of attachments and site cards at each pit.

Contest Site Set-up

Each site will require contestants to describe from four to six mineral horizons. In each pit, a control zone will be clearly marked with bright tape or paint and used for the determination of horizon depths and boundary distinctions. This area will be the officially scored profile and must not be disturbed by contestants. It is recommended that one or two official tapes or meter sticks be affixed on either side of the official judging zone. The profile depth and number of horizons to be judged and any chemical or other relevant data (i.e. pH, base saturation (%), organic carbon (%), calcium carbonate (%), and/or dry color) will be provided at each site on a Site Card. In the case of multiple control zones at a site, site cards must be provided for each control zone. A blue marker will be placed somewhere in the third horizon to assist contestants in determination of the third horizon's lower depth. The depth in centimeters from the surface to the blue marker will be given on the Site Card. A sample Site Card is provided in Attachment 4.

Contest Judges and Pit Monitors

The official judges for the contest should be Natural Resource Conservation Service, university or other professional soil scientists. If possible, a team composed of two or more soil scientists should be the official judges. If possible, the same judges should provide official descriptions for all practice and contest pits. On contest day, site monitors are required at each pit to enforce rules, keep time, clean the site and rewet the pit face between rotations (if needed), and collect scorecards between rotations.

Score Cards

Each contestant must give his or her scorecard to the pit monitor before rotating to the next site. Each contestant must ensure that their scorecard has his or her name, contestant number, university and site number on it prior to submitting it to the site monitor. In the case where colored score cards are used, it is the contestant's responsibility to use the appropriately colored score card for each pit.

Slope

Stakes will be installed near each site for slope measurement and clearly marked. The official slope will be measured between the stakes. Contest organizers should install the stakes at approximately the same height, although this is not required. Contestants must be prepared to measure the actual slope of the soil surface between the stakes, regardless of stake height.

SCORE CARD INSTRUCTIONS

The scorecard consists of five parts: I. Soil Morphology; II. Soil Profile Characteristics; III. Site Characteristics, IV. Soil Classification, and V. Interpretations. *The Soil Survey Manual*, United States Department of Agriculture Handbook No. 18, 2017; *Soil Taxonomy*, Second Edition, 1999; and *Keys to Soil Taxonomy*, current edition, will be used as guides. Any significant deviations from these references for a contest must be noted in separate correspondence.

I. SOIL MORPHOLOGY

For a complete list of acceptable abbreviations, for use in parts A through E of this section, see Attachment 1. These abbreviations must be used by contestants during the contest. Any other abbreviations will be marked incorrect. If no entry is required for any box on the front of the scorecard, it must be marked with a dash "-". Blank boxes or any other symbol will be marked incorrect.

A. Horizonation

The official list for standard horizon designations and conventions is found in Chapter 3 of the *Soil Survey Manual*. It is also listed in the latest edition of *Keys to Soil Taxonomy*.

a. Prefix Column - Arabic numerals (e.g. 2,3, etc.) indicating lithologic discontinuities and the prime, used for horizons having otherwise identical designations, should be placed in the first column. For contest purposes, discontinuity symbols will be used for different geologic materials, as well as materials of strongly contrasting particle size classes, as described in *Soil*

Taxonomy. The "l" for first parent material is understood. Therefore, contestants should not enter a “1” in the first column, but rather a dash “-“.

b. Master Column - Enter the appropriate master horizon designation, i.e., A, E, B, C or R, or combinations of these letters indicating transitional or combination horizons (e.g. AB, BA, E/B, etc).

c. Subordinate Distinction Column - Enter the appropriate lower case letter or letters, according to the definitions given in Chapter 18 of *Keys to Soil Taxonomy*. For this contest the following horizon subordinate distinctions may include, but are not limited to: b, c, d, g, k, p, r, ss, t, and w. The conventions for ordering multiple subordinate distinctions will be waived for the contest, i.e. Btk = Bkt. If a subordinate distinction (subscript) is not applicable, enter a dash “-“ in the box.

d. Number Column - Enter Arabic numerals whenever a horizon identified by a single combination of master and subordinate distinction letters needs to be subdivided. All master and subscript letters must be the same. (i.e. Btkl - Btk2 is correct; Btkl - Btky2 is incorrect; Btkl - 2Btk2 is correct).

B. Boundary

a. Lower Depth Column – For each site, four to six horizons will be described within a specified depth. The contestant should determine the depth in centimeters from the soil surface to the lower boundary of each horizon. Thus, for a Btl that occurs between 23 and 37 cm below the surface, the contestant should enter 37 in the Lower Depth Column.

Contest officials will place a blue marker somewhere in the third horizon. Unless otherwise noted on the Site Card, no horizon less than eight cm thick (no matter how contrasting) will be described. If the Site Card does not indicate a horizon thinner than eight cm is present and one occurs in the profile, contestants should combine it with the adjoining horizon that is most similar. When two horizons combine to a total thickness of eight cm or more, always describe the properties of the thicker horizon.

Depth measurements should be made in the control zone. The allowed range for answers will depend on the boundary distinctness and to a lesser degree, the topography of the boundary, as determined by the judges.

If a lithic or paralithic contact occurs anywhere in the exposed control zone (within 150 cm of the soil surface), it must be considered in answering topics in the remaining sections of the score card including: Effective Soil Depth, Permeability and Water Retention Difference and any rating charts. This is true even if the contact is at or below the specified description depth and is not an actual horizon in the contest profile description. If such a situation arises, contestants should assume the last horizon's properties extend to the contact. Contestants sure to note the contact depth while in the pit, even if it is below the description depth.

If the contact is within the specified description depth, it should be described as one of the scored horizons and the appropriate nomenclature applied (i.e. Cr or R). Morphological features need not be recorded for Cr or R horizons. If they are, graders will ignore the entries and no points will be deducted.

b. Distinctness of Boundary Column - No boundary distinctness designator should be given for the last horizon, unless a lithic or paralithic contact exists at the lower boundary. A dash "-"should be recorded for distinctness of the last horizon to be described when a lithic or paralithic contact is not present.

The topography or shape of the boundaries will not be directly considered, but may influence contest officials.

As a guide, the following system will relate a horizon's lower depth and boundary distinctness. When scoring answers for the lower depth, graders will adjust for the distinctness of the boundary. For full credit, the lower depth of each horizon must be within the specified range for the distinctness of boundary class from the officially described depth. For example, if the official horizon description depth and distinction were 24 cm and a clear boundary, graders would accept depths between 21 and 27 cm (24 ± 3 cm) for full credit.

Distinctness	Abbreviation	Lower Depth Adjustment
Abrupt	**A**	± 1 cm
Clear	**C**	± 3 cm
Gradual	**G**	± 8 cm
Diffuse	**D**	± 15 cm

Contest officials may modify this method of determining full credit on a given site.

C. Texture

a. Rock Fragment Modifier Column - Modification of textural classes is made in the Rock Fragment Modifier Column when the soil contains more than 15 percent, by volume, rock fragments. For the purposes of this contest, the following modifiers will be used when the volume of rock fragments is between 15 and 35 percent.

If the volume of rock fragments is between 35 and 60 percent, contestants should prefix the appropriate modifier with the word "very." If the volume is greater than 60 percent, the prefix "extremely" is used. Contestants should enter the correct abbreviation from Attachment 1 for the rock fragment modifier. Percent values for rock fragments should not be used. If rock fragment modifiers are not needed, a dash "-" should be entered on the scorecard.

Coarse Fragment	Abbreviation	Size
Spherical or equiaxial		
Gravelly	**GR**	0.2 – 7.5 cm
Cobbly (includes stones and boulders)	**CB**	> 7.6 cm
Flat		
Channery	**CH**	0.2 – 15 cm
Flaggy (includes stones and boulders)	**FL**	> 15 cm

b. Class Column - Soil texture classes are those defined in the *Soil Survey Manual* (1993). The textural class for the less than 2 mm fraction of each horizon should be entered in the Class Column. Acceptable abbreviations are given in Attachment 1. For sand, loamy sand, and sandy loam textures, modifiers must be used if needed (i.e., very fine, fine, or coarse).

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

c. Sand and Clay Columns - Estimates of percent sand and percent clay should be made for each horizon and entered as Arabic numbers in the appropriate columns. Answers within plus or minus five of the actual values will be given full credit. Partial credit may be given at the discretion of the contest officials. Actual sand and clay contents will be determined by laboratory analysis on selected horizons. These estimates will also be used as "tie breakers" in scoring.

D. Color

Munsell soil color charts are used to determine the <u>moist</u> soil matrix color for each horizon described. Color must be designated by hue, value, and chroma. Space is provided to enter the hue, value, and chroma for each horizon separately on the scorecard. At the discretion of the official judges, more than one color may be given full credit. The color of the surface horizon will be determined on a moist, rubbed (mixed) sample. For lower horizons (in some soils this will also include the lower portion of the epipedon) peds should be collected from near the central part of the horizon and broken to expose the matrix. For Bt horizons with continuous clay films, care should be taken to ensure that the color of a ped interior rather than a clay film is described for the matrix color. The color recorded for any other horizon, including a mottled horizon, should be the dominant color.

E. Structure

Soil structure refers to the aggregation of primary soil particles into secondary compound groups or clusters of particles. These units are separated by natural planes, zones, or surfaces of weakness. Dominant type (formerly called shape) and grade of structure for each horizon are to be judged. If the horizon lacks definite structural arrangements or if there is no observable aggregation, "structureless" should be recorded in the grade column and either "massive" or "single grain" (whichever is appropriate) should be recorded in the type column.

If various types of structure exist within the horizon, contestants should record the type and grade of structure that is most common. Compound structure (e.g., prismatic parting to angular or subangular blocky structure) is common in many soils. In this case, structure having the stronger grade should be described. If the structures are of equal grade, the structure type with the largest peds should be described.

a. Grade

The grade of structure is determined by the distinctness of the aggregates and their durability. Expression of structure grade is often moisture dependent and so may change with drying of the soil.

Grade	Abbreviation	Description
Structureless	**0**	That condition in which there is no observable aggregation or no definite, orderly arrangement of natural lines of weakness.
Weak	**1**	Soil breaks into a very few poorly formed, indistinct peds, most of which are destroyed in the process of removal. Type of structure is barely observable in place. Clay coatings, if present, are thin and ped interiors look nearly identical to outer surfaces.
Moderate	**2**	Soil contains well-formed, distinct peds in the disturbed soil when removed by hand. They are moderately durable with little unaggregated material. The type of structure observed in the undisturbed pit face may be indistinct.
Strong	**3**	Durable peds are very evident in undisturbed soil of the pit face with very little or no unaggregated material when peds are removed from the soil. The peds adhere weakly to one another, are rigid upon displacement, and become separated when the soil is disturbed.

b. Type

Soil structure types are described below, in Chapter 3 of the Soil Survey Manual (2017) and the *Field Book for Describing and Sampling Soils*.

Type	Symbol	Description
Granular	**GR**	Spheroids or polyhedrons bounded by curved planes or very irregular surfaces, which have slight or no accommodation to the faces of surrounding peds. For the purposes of this contest crumb structure is included with granular structure.
Subangular blocky	**SBK**	Polyhedron-like structural units that are approximately the same size in all dimensions. Peds have mixed rounded and flattened faces with many rounded vertices.
Angular blocky	**ABK**	Similar to subangular blocky but block-like units have flattened faces and many sharply angular vertices.
Platy	**PL**	Plate-like with the horizontal dimensions significantly greater than the vertical dimension. Plates are approximately parallel to the soil surface**.** Note: this does not apply to geogenic platy structure including plate-shaped structural units formed by recent alluvial deposition or by rock weathering.
Wedge	**WEG**	Elliptical, interlocking lenses that terminate in acute angles, bounded by slickensides. Wedges are not limited to vertic materials.
Prismatic	**PR**	Prism-like with the two horizontal dimensions considerably less than the vertical. Vertical faces are well defined and arranged around a vertical line with angular vertices. The structural units have angular tops.
Columnar	**COL**	Same as prismatic but with rounded tops or caps.
Massive	**MA**	No structure is apparent and the material is coherent. The individual units that break out of a profile have no natural planes of weakness.
Single grain	**SGR**	No structure is apparent. Soil fragments and single mineral grains do not cohere (e.g., loose sand). 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.

F. Consistency

Soil consistence refers to the resistance of the soil to deformation or rupture at a specified moisture level and is a measure of internal soil strength. Consistence is largely a function of soil moisture, texture, structure, organic matter content, and type of clay, as well as adsorbed cations. As field moisture will affect consistence, a contestants should use their personal judgement to correct for either wet or dry conditions on the day of the contest. These corrections also will be made by the official judges. Contestants should judge the consistence of moist soil (midway between air-dry and field-capacity) for a ped or soil fragment from each horizon as outlined in in Chapter 3 of the Soil Survey Manual (2017) and the *Field Book for Sampling and Describing Soils* and below.

Consistence	Symbol	Description
Loose	L	Soil is non-coherent (e.g., loose sand).
Very friable	VFR	Soil crushes very easily under very slight force (gentle pressure) between thumb and finger but is coherent when pressed.
Friable	FR	Soil crushes easily under slight force (gentle to moderate pressure) between thumb and forefinger and is coherent when pressed.
Firm	FI	Soil crushes under moderate force (moderate pressure) between thumb and forefinger, but resistance to crushing is distinctly noticeable.
Very firm	VFI	Soil crushes or breaks only when strong force is applied between thumb and all fingers on one hand.
Extremely firm	EF	Soil cannot be crushed or broken by strong force between thumb and all fingers but can be by applying moderate force between hands.
Slightly rigid	SR	Soil cannot be crushed by applying moderate force between hands but can be by standing (entire body weight on one foot) on the structural unit.
Rigid	R	Soil cannot be crushed by standing on it with one body weight but can be if moderately hit with hammer.
Very rigid	VR	Soil requires heavy, strong blow(s) with hammer to crush.

G. Soil Features (Redox Concentrations and Redox Depletions)

Redoximorphic (redox, RMF) features are caused by the reduction and oxidation of iron and manganese associated with soil wetness/dryness and not rock color. Characteristic color patterns are created by these processes. Redox features are colors in soils resulting from the concentration (gain) or depletion (loss) of pigment when compared to the soil matrix color. Reduced iron (Fe^{2+}) and manganese (Mn^{2+}) ions may be removed from a soil if vertical or lateral fluxes of water occur. Wherever iron and manganese is oxidized and precipitated, they form either soft masses or hard concretions and nodules. Redox features are used for identifying aquic conditions and determining soil wetness class. For this contest only the presence or absence of redoximorphic features (Y or N/-) in terms of redox concentrations, redox depletions, and reduced matrix will be evaluated. Movement of iron and manganese as a result of redox processes in a soil may result in redoximorphic features that are defined as follows:

a. Redox concentrations – These are zones of apparent pedogenic accumulation of Fe-Mn oxides, and include: nodules and concretions (firm, irregular shaped bodies with diffuse to sharp boundaries; masses (soft bodies of variable shapes in the soil matrix; zones of high chroma color ("red" for Fe and "black" for Mn); and pore linings (zones of accumulation along pores). Dominant processes involved are chemical dissolution and precipitation; oxidation and reduction; and physical and/or biological removal, transport and accrual.

Presence: **Yes (Y)** **RMF concentrations are present**
No (N/-) **RMF concentrations not present**

b. Redox depletions – These are zones of low chroma (2 or less) and normally high value (4 or more) where either Fe-Mn oxides alone or Fe-Mn oxides and clays have been removed by illuviation.

Presence: **Yes (Y)** **RMF depletions are present**
No (N/-) **RMF depletions not present**

The color of the redox feature must differ from that of the soil matrix by at least one color chip in order to be described. For determination of a seasonal high water table, depletions of chroma 2 or less and value of 4 or more must be present. If this color requirement is not met, the depletions should be described, but the depletions do not affect the soil wetness class or site interpretations. Low chroma (≤ 2) in the soil may be due to drainage, parent material, or other features. However, parent material variations and other such features should not be considered in evaluating soil wetness or soil drainage characteristics. Colors associated with the following features will not be considered as redox features: carbonates, concretions, nodules, krotovina, rock colors, roots, or mechanical mixtures of horizons such as B horizon materials in an Ap horizon. Redox features can be retained as relic features in soils (now called "mottles") from prior soil moisture regimes. A soil must have current hydrologic conditions (e.g., water table, landscape position, etc) needed for redox features to be marked with a "Y" in this contest. If no redox features are present, enter a dash "-" or an "N". Specific definitions may be found in *Soil Taxonomy* (1999) in the "Aquic Conditions" section of "Other Diagnostic Soil Characteristics."

II. SOIL PROFILE CHARACTERISTICS

A. Hydraulic Conductivity

In this contest, we will estimate the hydraulic conductivity of the surface horizon, as well as the most limiting horizon. A lithic or paralithic contact, regardless of whether or not it is within the specified judging depth, should be considered when determining the hydraulic conductivity. In this contest, such a contact will be considered to have very low permeability. We will consider primarily texture, as it is the soil characteristic that exerts the greatest control on permeability.

The general permeability classes will relate to texture:

Class	Textures
Low	SC, SIC, and C Also includes: R, Cr, Cd, fragipan or natric horizons
Moderate	All other textural classes excluded from the "Low" or "High" classes.
High	All sands and loamy sands, COSL

B. Effective Soil Depth

For this contest, effective soil depth is considered to be the depth of soil to a root limiting layer, as defined in *Soil Taxonomy* (i.e. duripan, fragipan, petrocalcic, lithic, or paralithic contact). If a lithic or paralithic contact exists below the judging depth, it should be considered when evaluating effective soil depth

Class	Depth to root limiting layer (cm)
Very deep	> 150
Deep	100 – 150
Moderately deep	50 – 99
Shallow	25 – 49
Very shallow	< 25

C. Water Retention Difference

Water retention difference refers to the amount of water (in cm), a soil is capable of holding within the upper 150 cm, or above a lithic or paralithic contact, whichever is shallower. We will use the following four classes as listed on the scorecard.

Class	Water Retention (cm of water)
Very low	< 7.5
Low	7.5 – 14.9
Moderate	15.0 – 22.5
High	> 22.5

Texture is an important factor influencing moisture retention, and the following estimated relationships will be used:

Textures	Water Retention (cm water/cm soil)
VFS, FS, S, COS, LCOS, LS	0.05
LFS, LVFS, COSL	0.10
SL, FSL, SCL, SC, C, SIC	0.15
VFSL, L, SIL, SI, SICL, CL	0.20

For the lithic or paralithic contact, you are to assume that no water retention occurs below the contact. If the contact is below the specified judging depth, but above 150 cm, assume that the properties of the lowest horizon extend to the contact for water retention calculations. If a profile is not exposed to 150 cm. and no lithic or paralithic contact is visible, assume the properties of the lowest horizon extend to 150 cm.

Coarse fragments are considered to have negligible (assume zero) moisture retention; as a consequence it is necessary to adjust the moisture estimates accordingly. An adjustment, however, is made only for coarse fragment content of 15 percent or greater.

For fragipans and dense glacial till the moisture storage is considered one-half of the normal for the fragipan or dense till and any lower horizons.
Below is an example of a moisture calculation using these rules. Soil profile description is for illustration.

Soil Profile Description

Horizon	Lower Depth (cm)	Texture	Coarse Fragments
Ap	0 – 18	L	2% gravel
A	18 – 27	GRCL	15% gravel
Bt1	27 – 40	GRCL	20% gravel
Bt2	40 – 75	C	10% gravel
Btx	75 – 99	CL	5% gravel
BC	99 – 140	VGRCL	55% gravel
Cr	150 +	Weathered limestone	

Water Retention Calculations

Horizon	Depth x Moisture x Adj Factors	Water Retention
Ap	18 cm x 0.20 cm/cm	3.60 cm
A	9 cm x 0.20 cm/cm x 0.85*	1.53 cm
Bt1	13 cm x 0.20 cm/cm x 0.80*	2.08 cm
Bt2	35 cm x 0.15 cm/cm	5.25 cm
Btx	24 cm x 0.20 cm/cm x 0.50**	2.40 cm
BC	41 cm x 0.20 cm/cm x 0.45* x 0.50**	1.84 cm
Cr	10 cm x 0.00 cm/cm***	0.00 cm

** correction for the volume of coarse fragments above 15%* 16.7 cm = moderate

*** correction for Fragipan*

**** correction for bedrock*

D. Soil Wetness Class

Soil wetness classes as defined in the Soil Survey Manual will be used. Soil wetness is a reflection of the rate at which water is removed from the soil by both runoff and percolation. Landscape position, slope gradient, infiltration rate, surface runoff, and permeability, are significant factors influencing the soil wetness class. Redoximorphic features, including concentrations, depletions and depleted matrix, are the common indicators of soil wetness (prolonged soil saturation and reduction) and are used to assess soil wetness class. The following determines the depth to soil wetness:

(1) The top of an A horizon with: (a)
Matrix chroma ≤ 2, and
(b) Redoximorphic depletions or redoximorphic concentrations as soft masses or pore linings, and
(c) Redoximorphic depletions or a depleted matrix due to prolonged saturation and reduction in the horizon directly below the A horizon, or

(2) The shallowest observed depth of value ≥ 4 with chroma ≤ 2 redoximorphic depletions or depleted matrix due to prolonged saturation and reduction.

The wetness classes utilized in this contest are:

Class	Description
1	Not wet above 150 cm
2	Wet in some part between 101 and 150 cm
3	Wet in some part between 51 and 100 cm
4	Wet in some part between 26 and 50 cm
5	Wet at 25 cm or shallower

If no evidence of wetness is present above a lithic or paralithic contact that is shallower than 150 cm, assume Class 1: not wet above 150 cm. If no evidence of wetness exists within the specified depth for judging and that depth is less than 150 cm, then assume Class 1: not wet above 150 cm.

III. SITE CHARACTERISTICS

A. Parent Materials

Mark the appropriate parent material(s) found in the soil on the scorecard. At least 25 cm. of a parent material must be present to be recognized as a separate parent material. If more than one parent material is present record all of them with an Arabic number on the front of the scorecard and mark the type of parent material(s) found on the parent material section on the back of the scorecard. Parent materials, like soils, do not always lend themselves to easy classification, so the contest officials may need to take the complexity of the situation into account in scoring alternative interpretations. The following are definitions of parent materials.

Eolian sand - Primarily fine and medium sand that has accumulated through wind action, normally on a dune topography.

Loess – Fine-grained, wind deposited materials that are dominantly silt size. Where loess mantles are thin (<75 cm) there may be some larger particles toward the base of the loess deposit. A small amount of larger particles can be incorporated through plant or animal activity.

Glacial till – Relatively unsorted, unstratified glacial age material, ranging in particle size from boulders to clay, deposited directly by ice without significant reworking by melt water. Glacial till can be almost any texture.

Glacial outwash – A type of glacial age fluvial deposit characteristic of heavily loaded streams with highly variable discharge that were fed by glacial melt waters. Glacial outwash is stratified and may be variable in texture. Glacial outwash has been in place long enough for development of a soil profile. Strata containing medium or coarser sand and/or gravel are present. It is this coarser material that distinguishes glacial outwash from lacustrine sediments. Glacial outwash may occur on outwash plains, stream terraces, kames, eskers or relatively coarse material separating loess from glacial till. In some areas, abrupt changes in texture in outwash are considered a change in parent material.

Residuum – the unconsolidated and partially weathered mineral materials accumulated by disintegration of bedrock including depressions and sinkholes in karst areas. This material has been thought to be weathered in place, but some interpretations would call for significant movement prior to the onset of soil formation.

Colluvium - A mixed deposit of rock fragments and soil material accumulated on, and especially, at the base of hill slopes. Colluvium results from the combined forces of gravity and water, in the local movement and deposition of materials. Colluvium is generally poorly sorted. Material deposited locally in the form of alluvial fans will also be considered colluvium.

Volcanic deposit – Materials derived from volcanic ash or cinder deposits. Volcanic deposits can vary greatly in composition, chemistry and particle size.

Alluvium - Unconsolidated sediments that have been deposited by streams in floodplains. Stratification in alluvium may, or may not be evident. Deposits can be of any age. Soil formation in recent alluvium is typically limited to no more than some development of soil structure, and this is not always present.

Beach deposit – Sandy material deposited near the shore of a lake primarily by wave action.

Lacustrine / marine deposit - Relatively fine-textured, well-sorted, stratified materials deposited in lake or slack water environments (lacustrine) or sediments derived from a variety of sources and deposited by ocean waters (marine)

Unconsolidated Coastal Plain Sediments - Unconsolidated Coastal Plain sediments include Tertiary-aged or younger materials deposited by wind and water in both marine and non-marine environments that have not undergone compaction to the extent that they would be classified as a rock. The sediments are usually stratified and may be any size. Some soils contain secondary precipitated minerals that cement horizons or layers such as ironstone, plinthite, or ortstein. Diagnostic evidence is needed to distinguish the unconsolidated Coastal Plain sediments from more recent alluvium found on floodplains and stream terraces and would be provided by judges if applicable.

B. Landform

Select the local landform of the site from the choices on the scorecard. In a situation where two parent materials are present, the landform will be selected on the basis of the process that controls the shape of the landscape. In most cases, this will be the lower parent material. For example, if loess covers glacial till and the depth for judging extends into the till, the correct landform would be till plain. Or, if loess is underlain by residuum, which is exposed in the pit, then an upland landform should be used. Only one landform is to be identified at each site. Select the one that best describes the situation. Dual or partial credit may be awarded.

Depression – A depression refers to the nearly level bottom of a closed basin landform which has no visible external surface drainage. Ponding of water may occur following periods of heavy rainfall. If the soil pit occurs in the bottom of a closed basin that is within an upland or floodplain site, the students should check only the “depression” position on the scorecard. Depressions may include such features as limestone sinks and sink holes, or low closed basins on floodplains or coastal plains. A depression should be a natural feature, and may be altered by but not be formed as the result of some man-made structure. For example, if an embankment crosses a drainage way and creates a closed basin, or if humans excavate a pond, they are not considered natural features. Parent material is variable.

Coastal & Lacustrine – formed from constructional processes. Coastal or lacustrine landforms are used when parent materials were deposited through oceanic or lake processes.

Beach - A more or less continuous ridge of sandy material along the present or former shoreline of a lake or ocean. The parent material is beach deposit.

Lakebed / playa – A level landform located on the bed of a former lake or pond and underlain by stratified lacustrine sediments. The deepest parent material is lacustrine deposit. May have alluvial, glaciofluvial and/or eolian sediments above the lacustrine sediments. Includes ice-walled lake plains.

Eolian – formed from constructional processes where sediments were deposited locally or regionally by wind.

Dune - A hill or ridge, of wind-blown sand. The parent material is eolian sand.

Loess bluff / hill / plain - A landform consisting of windblown silt deposits that are thick enough that the entire solum is developed in the loess. The parent material is loess.

Erosional - formed by erosional processes. Erosional landforms are used when residuum is the deepest parent material, or when bedrock is observed or denoted at any depth on the site card.

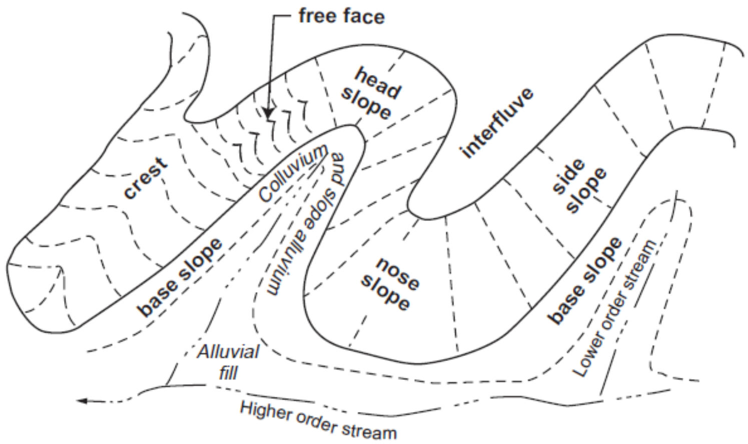
Upland headslope - The concave portion of a slope at the head of a drainageway on which slope lengths converge downward.

Upland sideslope - The generally linear portion of slope along the side of a drainageway.

Upland noseslope - The convex portion of a slope at the open end of a drainageway on which slope lengths diverge downward.

Interfluve/Crest - The high area (including divides) between adjacent drainage ways.

Base Slope - A base slope is a linear or concave landform downhill from an inflection point where the slope angle decreases and upslope eroding sediment collects. Older or highly dissected base slopes may be found in steep or in mountainous terrain on uplands. Weak to strong subsoil development is usually evident, depending on the upslope stability and age of the deposit.



(adapted from Wysocki, et al., 2000)

Fluvial – constructional process resulting in landforms constructed through the processes of rivers or streams.

Alluvial fan - A low, cone-shaped deposit formed by material deposited from a tributary stream of steep gradient flowing into an area with less gradient. This includes colluvial and alluvial foot slopes. The parent material is colluvium.

Back swamp – The section of a floodplain where deposits of fine silts and clays settle after a flood. Backswamps usually lie behind a stream's natural levees. The parent material is alluvium.

Floodplain - Land bordering on an active stream, builds up sediment from overflow of a stream. Although flooding may or may not occur frequently, this landform is subject to inundation, when the stream is at flood stage. The parent material is alluvium.

Natural levee - Elongated ridges of sediment that form on the floodplain immediately adjacent to the cut banks. The parent material is alluvium.

Stream terrace - A landform in a stream or river valley, below the upland and above the current floodplain, consisting of a nearly level surface, and hill slope leading downward from the surface.

Glacial – constructional landform created through the deposition of ice derived sediments.

Drumlin / moraine / plain - A landform that is underlain by glacial till. The topography can vary from relatively flat to undulating and for our purposes consists of ground, recessional or end moraines and includes drumlins. This landform is selected even if the landscape is covered by loess as long as soil development extends into the till. The parent material is glacial till.

Esker / kame / crevasse filling - a conical shaped hill (kame) or a sinuous ridge (esker) composed of stratified sand and gravel deposited by melt waters in contact with glacial ice. The parent material is glacial outwash.

Outwash plain / terrace - A landform of low relief, when considered regionally, composed of glacio-fluvial debris spread away from the margins of the glacier by melt waters that were not confined to a river valley. The parent material is glacial outwash.

Mass Movement

Landslide / debris flow - Thick, debris deposits on valley floors. Deposited as geologic and soil materials become saturated and move downhill due to gravity. Parent material is colluvial.

Solution

Sinkhole – Circular, often funnel shaped topographic depression created by subsidence of soil, sediment, or rock as underlying strata are dissolved by groundwater.

Tectonic / Volcanic

Lava flow / plain – A broad area of level or nearly level land that is underlain by a relatively thin succession of basaltic lava flows resulting from eruptions at fissures, cinder cones and/or shield volcanoes.

Volcanic feature – An opening in the surface that issued hot magma, ash and gasses and accumulated nearby, forming a stratovolcano, shield volcano, cinder cone, caldera, fissure, dome or other landform or group of landforms.

C. Slope

Stakes will be located at each site, indicating where slope is to be determined. The slope ranges and classes are listed on the scorecard. Each contestant should have an instrument to measure slope. The tops of the stakes should be at the same height but this is not a requirement. Contestants must measure the actual slope between the stakes, regardless of height.

D. Hillslope Profile Position

Hillslope position represents the geomorphic segment of the topography in which the soil is located. These slope components have characteristic geometries and greatly influence soils through differences in slope stability, water movement, and other slope processes. Not all profile elements may be present on a given hillslope. The landscape unit considered when evaluating hillslope profile position should be relatively large and include the soil pit and/or the area between the slope stakes. Minor topographic irregularities are not considered for this contest.

Hillslope Position	Description
Summit	Highest level of an upland landform with a relatively gentle, planar slope. The summit is often the most stable part of a landscape. If the site is on a summit and has a slope < 2%, the summit position on the scorecard should be selected. Not every hillslope has a summit, as some hillslopes have shoulders at the crest of the hill.
Shoulder	Rounded (convex-up) hillslope component below the summit. The shoulder is the transitional zone from the summit to the backslope and is erosional in origin.
Backslope	Steepest slope position that forms the principal segment of many hillslopes. The backslope is commonly linear along the slope, is erosional in origin, and is located between the shoulder and the footslope positions.
Footslope	Slope position at the base of a hillslope that is commonly rounded, concave. The footslope is transitional between the erosional backslope and depositional toeslope. Accumulation of sediments often occurs within this position.
Toeslope	Lowest landform component that extends away from the base of the hillslope. If the site is a toeslope and has a slope of < 2%, toeslope should be selected on the scorecard.
None	This designation should only be used when the slope at the site is < 2% and the site is not in a well-defined example of one of the slope positions given above (e.g., within a nearly level upland plain, terrace, or floodplain).

E. Surface Runoff

Runoff is the water that flows over the surface of the soil, without infiltrating. Soil characteristics, management practices, climatic factors, vegetative cover, and topography determine the rate and amount of runoff. In this contest, six runoff classes will be used. Correct answers will consider the combined effects of hydraulic conductivity of the surface and slope on runoff rate. For contest purposes, vegetation is not considered. Treat each site as if it were a plowed field. The following guidelines will be used:

	Hydraulic Conductivity of the Surface Horizon		
Slope	**High**	**Moderate**	**Low**
Concave	negligible	negligible	negligible
< 1%	negligible	low	medium
1 – 4.9%	very low	medium	high
5 – 20%	low	high	very high
> 20%	medium	very high	very high

IV. SOIL CLASSIFICATION

Soil Taxonomy, USDA-NRCS Agricultural Handbook 436, 2nd Edition (1999) and the most current edition of *Keys to Soil Taxonomy* should be referred to for all details on soil classification.

Contestants should mark only the diagnostic horizons of the soil to be classified. In the case of buried soils, only the diagnostic horizons (or lack thereof) present above the buried soil should be selected on the scorecard and used to determine taxonomic classification. For example, if a soil contains a horizon sequence of A(ochric)-C1-C2-Ab-Btb(argillic) and the Ab and Btb horizons meet the definition of a buried soil, the correct answers would be "ochric" under epipedon and "none" under subsurface diagnostic feature. If argillic was selected under diagnostic horizons, it would be incorrect. Laboratory data will be provided, if necessary, for each soil. This information will be used to determine the correct epipedon, subsurface horizon or feature, and order for each soil.

Dry colors of surface horizons may be provided at some or all sites for help in making taxonomic decisions. If dry colors are not provided, taxonomic decisions should be based solely on moist color.

V. SOIL INTERPRETATIONS

A. Interpretations for Roadfill, Septic Tank Absorption Fields, and Houses with Basements

Guidelines for the suitability of soils for roadfill, septic tank absorption fields, and houses with basements were adapted from the *National Soils Handbook* of the Natural Resources Conservation Service and are contained in Appendix Two. Contestants will be supplied with these rating tables the day of the contest.

Critical depths for each guideline are taken from the control zone. The soil properties and their restrictive features are listed in descending order of importance in the tables in Attachment Two. On the scorecard, contestants should check the most severe limitation / worst suitability and list the number of the first restrictive feature associated with that rating. For example, when two or more properties give a soil the same rating (i.e., moderate-flooding and moderate-wetness), identify the restrictive feature as the one listed closest to the top of the table. A severe (or poor) rating always takes precedence over a moderate (or fair) one.

When soil has a slight or good rating for an interpretation, a contestant should write "none" or enter a dash “-“for the restrictive feature.

B. Wastewater Loading Rate at 75 cm

Loading rate defines the rate wastewater enters the soil. The differences in wastewater loading rates are related to soil characteristics defining pore sizes and pore size distribution. Geology, texture, structure and consistence each contribute to soil porosity and effluent movement. Individual states and some counties have developed loading rate tables based on soil morphologic features. In this contest a modified and simplified loading rate table will be used.

To simplify the determination of loading rate, contestants should evaluate the loading rate for the soil material located at a depth of 75 cm (including a Cr or R if present at 75 cm.). To further simplify the determination, coarse fragments less than 35% will be ignored.

Appendix Three will be given to each contestant during the contest. It contains the soil loading rates in gallons per day per square foot (gpd/ft^2). For example, for a sandy loam having moderate (2), subangular blocky structure and friable consistence, a loading rate of 0.84 gpd/ft^2 should be entered on the scorecard.

Permanent Revision Proposed For Future Contests and Passed by the Coaches, 2014
Dr. Chris Baxter, University of Wisconsin – Platteville
Dr. Gary C. Steinhardt, Purdue University
Dr. Jamie Patton, University of Wisconsin Extension

Minor Revisions Reviewed by Rules Committee, 2019
Dr. Chris Baxter, University of Wisconsin – Platteville

APPENDIX 1 – Abbreviations for Soil Morphology

Distinctness of Boundary:

Abrupt = A   Clear = C   Gradual = G   Diffuse =D

Textural Classes:

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

Coarse Fragments:

Gravelly	= GR	Channery	= CH
Very gravelly	= VGR	Very channery	= VCH
Extremely gravelly	= EGR	Extremely channery	= ECH
Cobbly	= CB	Flaggy	= FL
Very cobbly	= VCB	Very flaggy	= VFL
Extremely cobbly	= ECB	Extremely flaggy	= EFL

Structure, Grade:

Structureless = 0   Weak = 1   Moderate = 2   Strong = 3

Structure, Shape:

Granular	= GR	Angular blocky	= ABK
Platy	= PL	Subangular blocky	= SBK
Prismatic	= PR	Single grain	= SGR
Columnar	= COL	Massive	= MA
Wedge	= WEG		

Consistence:

Loose	= L	Firm	= FI
Very Friable	= VFR	Very Firm	= VFI
Friable	= FR	Extremely Firm	= EFI

APPENDIX 2 - Rating Guide for Soil Interpretations

Suitability as a Roadfill Material

Reason #	Property	Good	Fair	Poor
1	Depth to bedrock or cemented pan	> 150 cm	100 to150 cm	< 100 cm
2	Shrink swell	< 8 cm clay	8 to 16 cm clay	> 16 cm clay
3	Strength (avg. 25 to 100 cm)	S, LS, SL	L, SCL	all others
4	Ponding	no	------	yes
5	Depth to high water table	> 90 cm	30 to 90 cm	< 30 cm
6	Slope	< 15%	15 to 25%	> 25%
7	Flooding (floodplain landform)	none	------	any
8	Frost action	S, LS	all others	SI, SIL, SICL
9	% > 8 cm stones, 0 to 40 cm	< 25%	25 to 50%	> 50%

Onsite Wastewater Treatment

Reason #	Property	Slight	Moderate	Severe
1	Flooding (floodplain landform)	none	------	any
2	Depth to bedrock or cemented pan	> 150 cm	100 to 150 cm	< 100 cm
3	Ponding	no	-------	yes
4	Depth to high water table	> 150 cm	120 to 150 cm	< 120 cm
5	Onsite wastewater loading rate at 75 cm (Appendix 3)	0.52-0.84	-------	< 0.52 or > 0.84, or NR
6	Slope	< 8%	8 to 15%	> 15%
7	% > 8 cm stones, 0 to 40 cm	< 25%	25 to 50%	> 50%

Houses with Basements

Reason #	Property	Slight	Moderate	Severe
1	Flooding (floodplain landform)	none	------	any
2	Ponding (closed depression)	no	-------	yes
3	Depth to high water table	> 150 cm	75 to 150 cm	< 75 cm
4	Depth to bedrock or cemented pan	>150 cm	100 to 150 cm	< 100 cm
5	Slope	< 8%	8 to 15%	> 15%
6	Shrink swell	< 8 cm clay	8 to 16 cm clay	> 16 cm clay
7	% > 8 cm stones, 0 to 100 cm	< 25%	25 to 50%	> 50%

APPENDIX 3 –Key for Determining Onsite Wastewater Subsurface Loading Rates

Structure Shape/Grade	SGR, PL, RCF	GR, ABK, SBK, PR				MA		
		Weak (1)		Mod (2), Strong (3)				
Moist Consistence	**Any**	**VFR, FR**	**FI, VFI, EFI**	**VFR, FR**	**FI, VFI, EFI**	**VFR**	**FR**	**FI, VFI, EFI**
Texture								
Dense till Fragipan Cr or R horizon > 35% CF	NR	NR	NR	NR	NR	NR	NR	NR
S, COS, VCOS, LCOS, LS	1	1	NR	NR	NR	1	NR	NR
FS, LFS, COSL	0.84	0.91	NR	NR	NR	0.91	0.84	NR
SL,FSL	0.75	0.75	NR	0.84	NR	0.84	0.75	0.69
L, SIL, VFSL, SCL, SI, VFS, LVFS	0.62	0.69	0.62	0.75	0.52	0.62	0.52	0.45
SICL (≤ 35% clay) CL (≤ 35% clay)	0.52	0.52	0.45	0.62	0.52	0.62	0.52	0.45
SICL (> 35% clay CL (> 35% clay)	NR	NR	0.4	0.45	0.4	NR	0.2	NR
SC, SIC, C	NR	NR	NR	NR	0.2	NR	NR	NR

*NR = not recommended or not applicable

NACTA SOILS CONTEST
4-Year Division
SITE CARD

SITE NO. __________

Describe _____________ horizons to a depth of ____________ cm.

Blue marker is in the third horizon at ___________ cm.

Horizon	pH	% Base Sat.	% Organic C	% $CaCO_3$
1.				
2.				
3.				
4.				
5.				
6.				