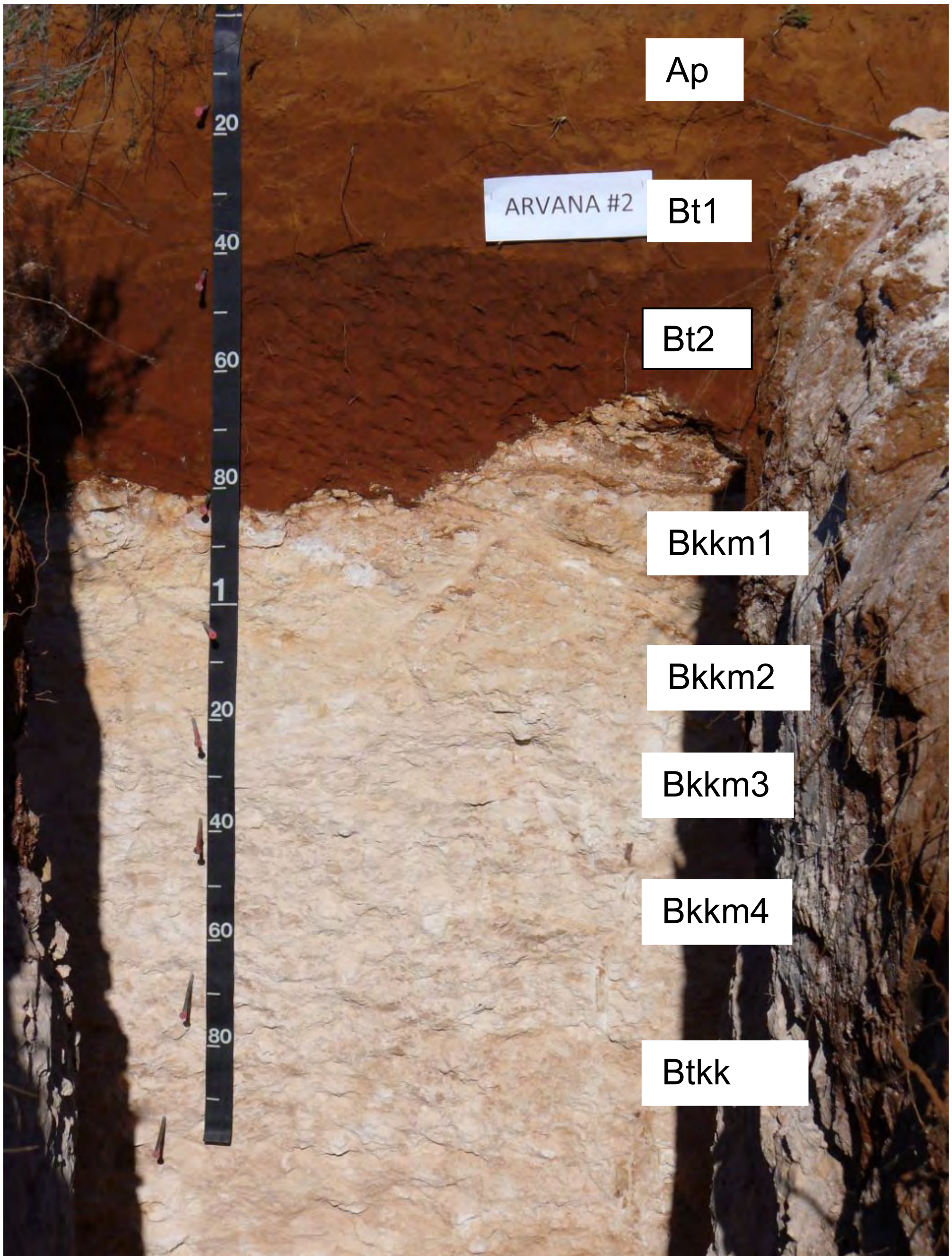
Region IV Soils Contest
Oct. 19 - 23, 2009
Texas Tech University
Lubbock, Texas



NRCS Natural Resources Conservation Service

Wayne H. Hudnall
Texas Tech University
MS 42122
Lubbock, TX 79409
wayne.hudnall@ttu.edu
806-742-4490 office
806-577-7990 cell

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 team total in the individually judged pits. 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 Thursday, Oct. 22, 2008.

Contest format

This contest will be an "open book" contest, in that the contest handbook will be allowed at the contest. Prohibited items include Soil Taxonomy, Keys to Soil Taxonomy & Field Book for Describing & Sampling Soils. Cell phones are prohibited. Each site will have its own scorecard indicated by a unique color. Each individual contestant will be given color scorecards corresponding to each site. Students must correctly enter the pit 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 combine the scores of two, team-judged pits and the team score from four, individually-judged pits. 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 14 scorecards will determine the overall scoring per team. Students from institutions having less than three team members are allowed to compete, but they are only eligible for individual awards.

The clay content of a predetermined third horizon at one of the individually-judged sites will be used to break ties in team and individual scores. In order to break a tie in team scores, the mean clay content 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 lowest horizon will be used in the same manner. The clay content of the tie breaker horizon will be compared to that estimated by the individual in order to break a tie between individuals. If this does not break the tie, the next lowest horizon will be used in the same manner. In order to break a tie in the ranking of teams for group judging, the team estimate of the clay content of a predetermined third horizon at one of the group-judged sites 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 lowest horizon will be used in the same manner.

Results will be announced Friday afternoon and will be final. Trophies will be awarded to the top three teams and plaques to the top five high individuals. Trophies will also be awarded to the top three teams from the team completion.

At each site a pit will be excavated and an area will be designated on one of the pit walls for the measurement of horizon depth and boundary distinctness. A restricted area of the pit wall will be outlined with flagging and a nail will be placed „somewhere in the third horizon‟. A tape measure will also be attached to the restricted area. THE FLAGGED AREA IS TO BE UNDISTURBED! Picking, taking samples or other disturbances is 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 critique between four and six horizons per pit. Slope stakes will be placed along the grade for determination of % slope and Site Position designation (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 36 cm from the surface.
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	Pits 1 and 3		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 designates authorization to be inside the pit trench.
[**]Free time designates authorization for any competitor to enter the pit trench.

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. 1). 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 1. 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 (-) **must** be recorded for credit.

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 may use their discretion if 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 (Table 2). This method maximizes the opportunity for all four team members to contribute to the final team score.

Table 2. Score tabulation example.

Contestant	Team Pits	Site 1	Site 2	Site 3	Site 4	Total
A		132	130	110	144	416
B		146	116	141	138	541
C		130	112	160	158	560
D		125	114	129	145	513
Total score:1955	310	408	360	430	447	

The scores from the two team-judged pits will be added to the individual scores for the overall team total.

Scorecard

The scorecard consists of four parts: I. Soil Morphology; II. Site Characteristics; III. Soil Taxonomy; and IV. 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 (10^{th} e., 2006) will be used as guides. These publications are available on the Internet for downloading at the USDA-NRCS website:

http://soils.usda.gov/technical/.

Part I. Soil Morphology

A. Horizon Designations (Chpt. 18, pp. 311-316, Keys to Soil Taxonomy, 2006).

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 must place a dash in that position to receive credit.

B. 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 flagged 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 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 a lithic or paralithic contact occurs at or above 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 lithic or 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. R, Cr, Cd, Byym or Bkkm). However, morphological features need not be provided except for effervescence and **dashes** should be used on the scorecard. If the contestant gives morphological information, it will be ignored by the graders and it will not count against their total score. If in doubt concerning the nature of the horizon, the contestant would be advised to provide all of the normal data. Petrocalcic, petrogypsic and R horizons will be considered lithic contact horizons. A contestant may be asked to name two to three petrocalcic and petrogypsic horizons. If a petrocalcic horizon is underlain by a calcic horizon, the calcic horizon must be fully described. The stage of the carbonate for petrocalcic and calci horizons should be determined in the pit from the restricted area. The restricted area should also be used to determine if the petrocalcic meets the continuity criteria required for a petrocalcic horizon. If the restricted area has stage V, for example, but the area outside does not, stage V should be marked. Cr and Cd horizons will be considered as paralithic horizons.

C. Boundary Distinctness (Chpt. 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 lowest horizon will not be determined and will not be graded, therefore a dash (-) should be recorded.

Distinctness classes are:

- Very Abrupt (V); <0.5 cm
- Abrupt (A): 0.5 - 2.0 cm
- Clear (C): 2.1 - 5.0 cm
- Gradual (G): 5.1-15.0 cm
- Diffuse (D): > 15 cm

D. Clay Percentage and Texture (Chpt. 3, pp. 136-143, Soil Survey Manual).

Estimates of the clay percent should be placed in the space provided. A scaled range for correct answers compared to the lab-determined values 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 from laboratory data. Soil texture classes as defined in Chapter 3 and their official abbreviations (supplied to contestants as Attachment 2, page 17) will be used. Deviation from standard nomenclature will be incorrect (i.e., silty loam, clayey sand). 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 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 gravel and cobbles occur in the same horizon, the dominant condition should be described (Attachment 1, page 17).

Coarse fragment modifiers are required as follows:

Coarse fragment (vol/vol)	Modifier
0-15%	none needed
16-35%	gravelly or cobbly
36-60%	very gravelly or cobbly
>60%	extremely gravelly or 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).

E. Color (Chpt. 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 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. The 2000 revised edition of Munsell color charts will be used for the contest.

F. Redoximorphic Features (RMF) (Keys to Soil Taxonomy, 10th ed., pp. 23-24).

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 a major determinate of color patterns within or across entire 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, and clay have been removed through reduction and transport processes. They may be identified as:

1. Iron depletions. Zones that contain lesser amounts of Fe and Mn oxides but have clay content similar to that of the adjacent matrix.
2. Clay depletions. Zones that contain lesser amounts of Fe, Mn, and clay compared to the adjacent matrix.

An important RMF is the "reduced matrix" where soil is saturated and/or reduced at the time of observation. A reduced matrix may occur in soils with no other visible RMF"s. A reduced matrix will **not** be on this contest due to the required identification time of the need for alpha, alpha, dipyridyl solution to determine the presence of reduced Fe.

Report the moist abundance as few, common, many (<2%, 2-20%, and >20%, respectively) of the *most dominant* RMF. Indicate if it is a concentration or depletion (Con/Dep). If no RMF features are present, mark both "Abundance" and "Con/Dep" with a dash (-).

G. 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, prismatic, and columnar. If either two structure types or compound structures are present, describe the one with the larger peds. If there is no structure, indicate "structureless" (SL) in the grade column and "massive" (MA) or "single grain" (SG) in the shape column. If the contestant cannot determine the larger unite, they should write both in the blank.

Part II. Site Characteristics

A. Site position.

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

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. If present, it comprises the transition zone from summit to backslope.

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

4. Footslope. The hillslope profile position that forms the concave surface at the base of a hillslope. It is a transition zone between upslope sites of erosion and transport (shoulder, backslope) and downslope sites of deposition (toeslope).

5. Toeslope. The hillslope position that forms the gently inclined surface at the base of a hillslope. Toeslopes in profile are commonly gentle and linear, and are constructional surface forming the lower part of a hillslope continuum.

6. Floodplain. The lowest geomorphic surface which is adjacent to the stream bed 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. For this contest, draws will be considered streams.

7. 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 more 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 (draw) is reasonably apparent.

8. Depression. Inter-dune area.

9. Dune. A ridge of sand created by the wind.

10. Playa. Shallow wetland that occurs primarily in semi-arid and arid environments. The correct parent material is lacustrine.

Most playas on the Southern High Plains have formed as a result of dissolution and deflation. The wind-blown material is deposited on the eastern to southeastern side of the playa. This geomorphic surface represents the major surface. For this landscape, the site position will be determined by its position on the landscape, such as Summit, Shoulder, Backslope, Footslope or Toeslope. Eolian should be marked as the parent material.

11. Playa annulus. A bench surrounding a playa. The correct site position would be either Footslope or Toeslope depending upon its relationship to the surrounding landscape. Colluvium should be marked as the parent material.

12. Plain. Site position that is level to nearly level (0 to 5 % slope) that does not meet any other geomorphic position.

B. Parent Material.

Parent material kind is a term describing the general physical, chemical and mineralogical composition of the material, mineral or organic, from which the soil develops. Mode of deposition and/or weathering may be implied or implicit. The following parent materials will be used in this contest:

1. Alluvium. Unconsolidated, clastic material subaerilly deposited by running water, including gravel, sand, silt, clay, and various mixtures of these.

2. Claystone. Non-cemented Permian material. (To be used with Permian materials that are not cemented such Cd.)

3. Colluvium. Unconsolidated, unsorted sediments detached from the hillslopes and deposited at a toeslope or within a stream bottom by gravity and water.

4. Eolian. Wind deposited sediments.

5. Lacustrine deposit. Clastic sediments and chemical precipitates deposited in lakes.

6. Marine deposit. Sediments (predominantly sands, silts, and clays) of marine origin; laid down in the salty waters of an ocean. (To be used with Permian materials that may have Cr, R, or C horizons. If the soil has developed from Permian-age sediments, is not alluvium, but one cannot see the parent material, Marine deposits should be marked.)

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

Sometimes two parent materials will be evident in a profile, for example eolian over marine. If evident, indicate the transition with an Arabic numeral in the Master horizon 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.

C. Slope classes.

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 the two stakes at each site. The student is responsible for checking the heights of the stakes.

D. Erosion classes.

The degree to which accelerated erosion has modified the soil may be estimated during soil examinations. The conditions of eroded soil are based on a comparison of the suitability for use and the management needs of the eroded soil with those of the uneroded soil. The eroded soil is identified and classified on the basis of the properties of the soil that remains. The original thickness of the A and E horizons (if present) will be supplied at each pit. The following classes will be used based upon the thickness of the original surface.

Deposition. The soil is in a position that could receive additional sediments and there is evidence that the soil regularly receives additional sediments. The thickness of the A and E horizon (if present) currently at the site is greater than the original thickness of the A and E horizons.

Class 1. The class consists of soils that have lost some, but on the average less than 25 percent, of the original A and/or E horizons or of the uppermost 20 cm if the original A and/or E horizons were less than 20 cm thick.

Class 2. This class consists of soil that have lost, on the average, 25 to 75 percent of the original A and/or E horizons or of the uppermost 20 cm if the original A and/or E horizons were less than 20 cm thick.

Class 3. This class consists of soils that have lost, on the average, 76 percent or more of the original A and/or E horizons or of the uppermost 20 cm if the original A and/or E horizons were less than 20 cm thick.

Class 4. This class consists of soils that have lost all of the original A and/or E horizons or the uppermost 20 cm if the original A and/or E horizons were less than 20 cm thick.

Part III. Soil Taxonomy

Keys to Soil Taxonomy, 10th Edition (2006) 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. For this contest, all soils, except Vertisols, that have Low water retention will be classified as Aridisols.

Stages of Carbonate Accumulation
Pedogenic carbonate is closely linked to soil age based on the observation that soils of progressively older geomorphic surfaces contain soils with progressively greater amounts of carbonate. The sequential increase of carbonate is ordered into four stages based on gravel content (see attached figures, pages 15 and 16). Soils formed in gravelly parent materials progress from stage I pebble coatings to stage II interpebble fillings; a stage III plugged horizon, and eventually a stage IV laminar horizon atop the plugged horizon. Soils formed in nongravelly material progress from stage I filaments to stage II nodules, a stage III plugged horizon, and eventually a stage IV laminar horizon atop the plugged horizon. For older more developed carbonate accumulations two additional stages are added[i]. Stage V is characterized by laminae > 1cm thick and may contain pisoliths as well as vertical faces and fractures coated with laminated carbonate. Stage VI contains multiple generations of recemented laminae, breccia, and pisoliths. Stages V and VI petrocalcic horizons will be considered buried, but a lithlogical discontinuity **will not** be assigned.

Part IV. Interpretations

A and B. 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 or paralithic contact occur at 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. 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 sand clay horizons. Massive, silt and silt loam E horizons, natric horizons. All root-limiting horizons have Low hydraulic conductivity.

C. Water retention difference (Chpt. 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 retentions 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 para-lithic 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 by a horizon. Contestants are to assume that lithic and paralithic contacts, and duripans, petrocalcic and petrogypsic horizons have no water retention and that water retention is not to be calculated for any horizon below these contacts. 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). NOTE: Duripans, petrocalcic, petrogypsic, and R horizons are considered to be root limiting and are NOT to be considered for water retention. Table 4. Is a sample calculation of water retention diference.

Five classes recognized are:

Very High	>30 cm
High	22.50-29.99 cm
Medium	15.00-22.49 cm
Low	7.50-14.99 cm
Very Low	<7.50 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, loamy very fine sand, very fine sand, fine sand, fine sandy loam, sandy clay loam, sandy clay, clay, silty clay	0.15
coarse sandy loam, loamy 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	texture	coarse fragments	water retention	
Ap	0-12	sil	0	(12cm)(0.20 cm/cm) =	2.4
Bt1	12-28	sil	0	(16cm)(0.20cm/cm) =	3.2
Bt2	28-54	sicl	0	(26cm)(0.20cm/cm) =	5.2
Btk1	54-105	sicl	5	(51cm)(0.20cm/cm)(0.95) =	9.69
Btk2	105-132	cl	15	(27cm)(0.20cm/cm)(0.85) =	4.59
Bkkm	132+	-	-	0	0.00

total water retention difference = 25.08 cm
= HIGH

D. Internal free water occurrence. (Chpt. 3, pp. 101, Soil Survey Manual).

Free-water classes are determined by the depth to specific redoximorphic features (RMF) in soil, those with chroma 2 or less and value of 4 or more, i.e., gray depletions of *any* abundance as defined by the NRCS. The soil free-water classes for this contest are:

Very Shallow: <25 cm
Shallow: 25-49.9 cm
Moderately Deep: 50-99.9 cm
Deep: 100-150 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.

E. 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". „Ponded" class shall be used to describe surface runoff in depression and playa site positions.

Table 5. Surface runoff classes.

	Hydraulic Conductivity of the Surface Horizon		
% slope	High	Moderate	Low
	------------	surface runoff class	----------------
0-1	very slow	very slow	very slow
1.1-3	very slow	slow	slow
3.1-5	slow	medium	medium
5.1-8	medium	medium	rapid
8.1-12	medium	rapid	very rapid
12.1-20	rapid	very rapid	very rapid
>20	very rapid	very rapid	very rapid

Proposed Stages of Carbonate Accumulation for the Revised Soil Survey Manual

(May 12, 2005)

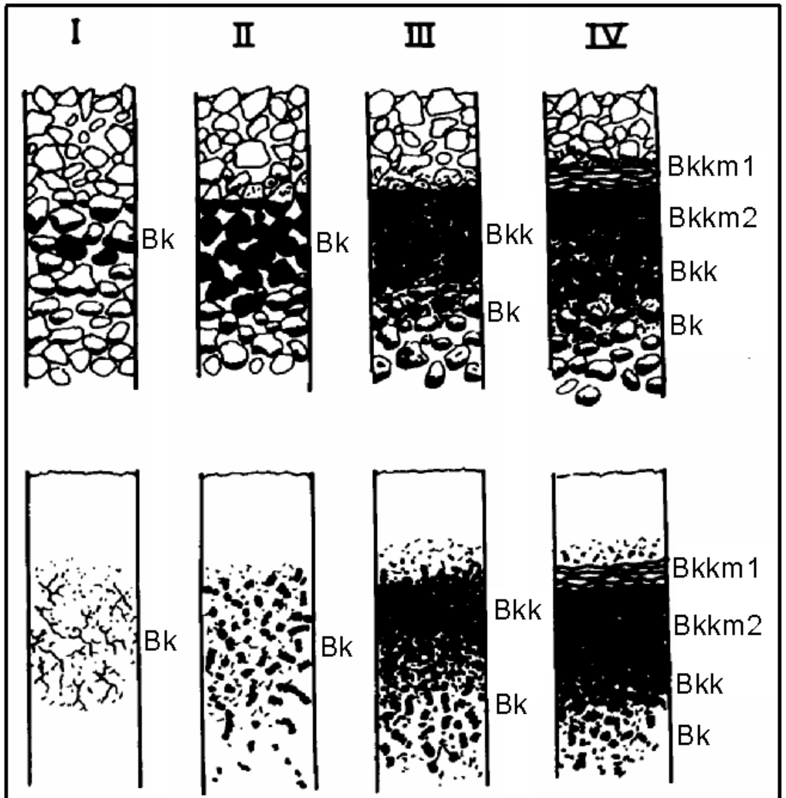
Stages of Carbonate Accumulation

Pedogenic carbonate is closely linked to soil age based on the observation that soils of progressively older geomorphic surfaces contain soils with progressively greater amounts of carbonate. The sequential increase of carbonate is ordered into four stages based on gravel content[1] (see attached figure). Soils formed in gravelly parent materials progress from stage I pebble coatings to stage II interpebble fillings, a stage III plugged horizon, and eventually a stage IV laminar horizon atop the plugged horizon. Soils formed in nongravelly material progress from stage I filaments to stage II nodules, a stage III plugged horizon, and eventually a stage IV laminar horizon atop the plugged horizon. For older more developed carbonate accumulations two additional stages are added[2]. Stage V is characterized by laminae > 1cm thick and may contain pisoliths as well as vertical faces and fractures coated with laminated carbonate. Stage VI contains multiple generations of recemented laminae, breccia, and pisoliths. The time required to reach a certain morphogenetic stage depends on particle size of the soil. Gravelly soils pass through the stages more quickly than nongravelly soils since gravelly soils have lower surface area and less pore space.

[1] Gile, L.H., F.F. Peterson, and R.B. Grossman. 1966. Morphological and genetic sequences of carbonate accumulation in desert soil. Soil Science 101:347-360.
[2] Bachman, G.O. and M.N. Machettte. 1977. Calcic soils and calcretes in the southwestern United States. U.S. Geol. Surv. Open-File Rep. 77-794. U.S. Gov. Print. Office, Washington, DC.
Machette, M.N. 1985. Calcic soils of the southwestern United States. p. 1-21. Soils and Quaternary geology of the southwestern United States. Spec. Pap. Geol Soc. Am. 203.

Schematic diagram of diagnostic carbonate morphology for the stages of carbonate accumulation in the two morphologentic sequences (left below). Stages are described (right below), including stages V and VI not shown in diagram.

Carbonate Morphogenetic Stages



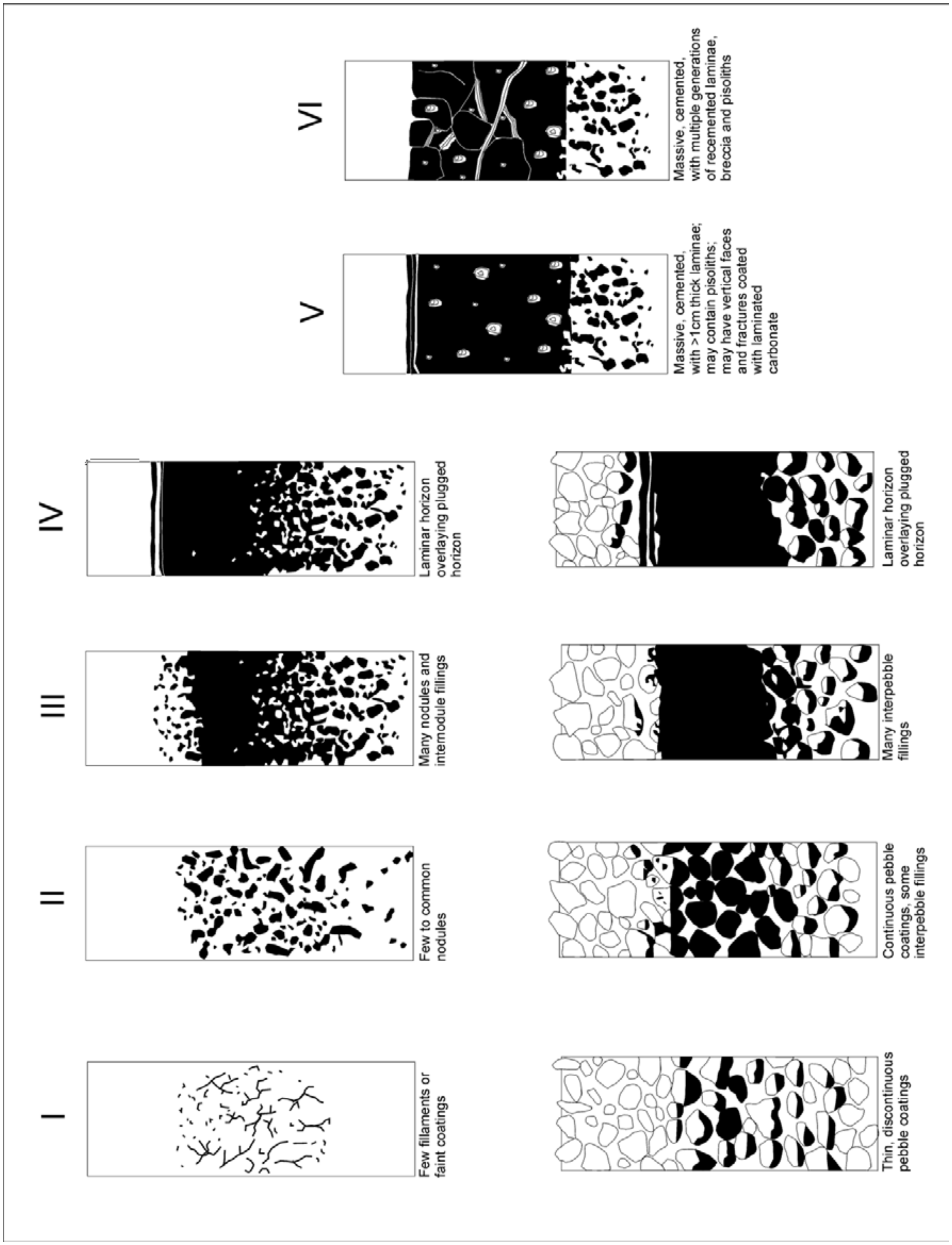
Definitions of Carbonate Morphogenetic Stages

	Diagnostic carbonate morphology	
Stage	Gravelly sequence[1]	Nongravelly sequence
I	Thin pebble coatings, continuous in last part of stage.	Few[2] filaments, masses, or faint coatings.
II	Continuous pebble coatings, some interpebble masses.	Few to common nodules or masses.
III	Many interpebble masses; plugged horizon[3] develops in last part of stage.	Many nodules and internodular masses; plugged horizon develops in last part of stage.
IV	Laminar horizon overlying plugged horizon.	Laminar horizon overlying plugged horizon.
V	Very strongly cemented to indurated with > 1 cm thick laminae; may contain pisoliths and have vertical faces and fractures coated with laminated carbonate.	
VI	Indurated with multiple generations of recemented laminae, breccia, and pisoliths.	

[1] Morphologies are best expressed where “nongravelly” materials contain less than about 20 % by volume of rock fragments (fragments 2 mm or larger in diameter), and “gravelly” materials contain more than about 60 % by volume of rock fragments. Materials that have between 20 % and 60 % by volume of rock fragments have intermediate morphologies.

[2]Few < 2, common 2 to < 20, many = 20 or greater percent of area covered.

[3]Plugged horizon contains 50 percent or more pedogenic carbonate (by vol).



I
Few fillaments or faint coatings
Thin, discontinuous pebble coatings
II
Few to common nodules
Continuous pebble coatings, some interpebble fillings
III
Many nodules and internodule fillings
Many interpebble fillings
IV
Laminar horizon overlaying plugged horizon
Laminar horizon overlaying plugged horizon
V
Massive, cemented, with >1cm thick laminae; may contain pisoliths; may have vertical faces and fractures coated with laminated carbonate
VI
Massive, cemented, with multiple generations of recemented laminae, breccia and pisoliths

Attachment 1

Official Abbreviations
(note: contestants will be provided with this at the contest site)

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

Concentration: 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	-CPR	Massive	-M

Attachment 2

Texture Triangle

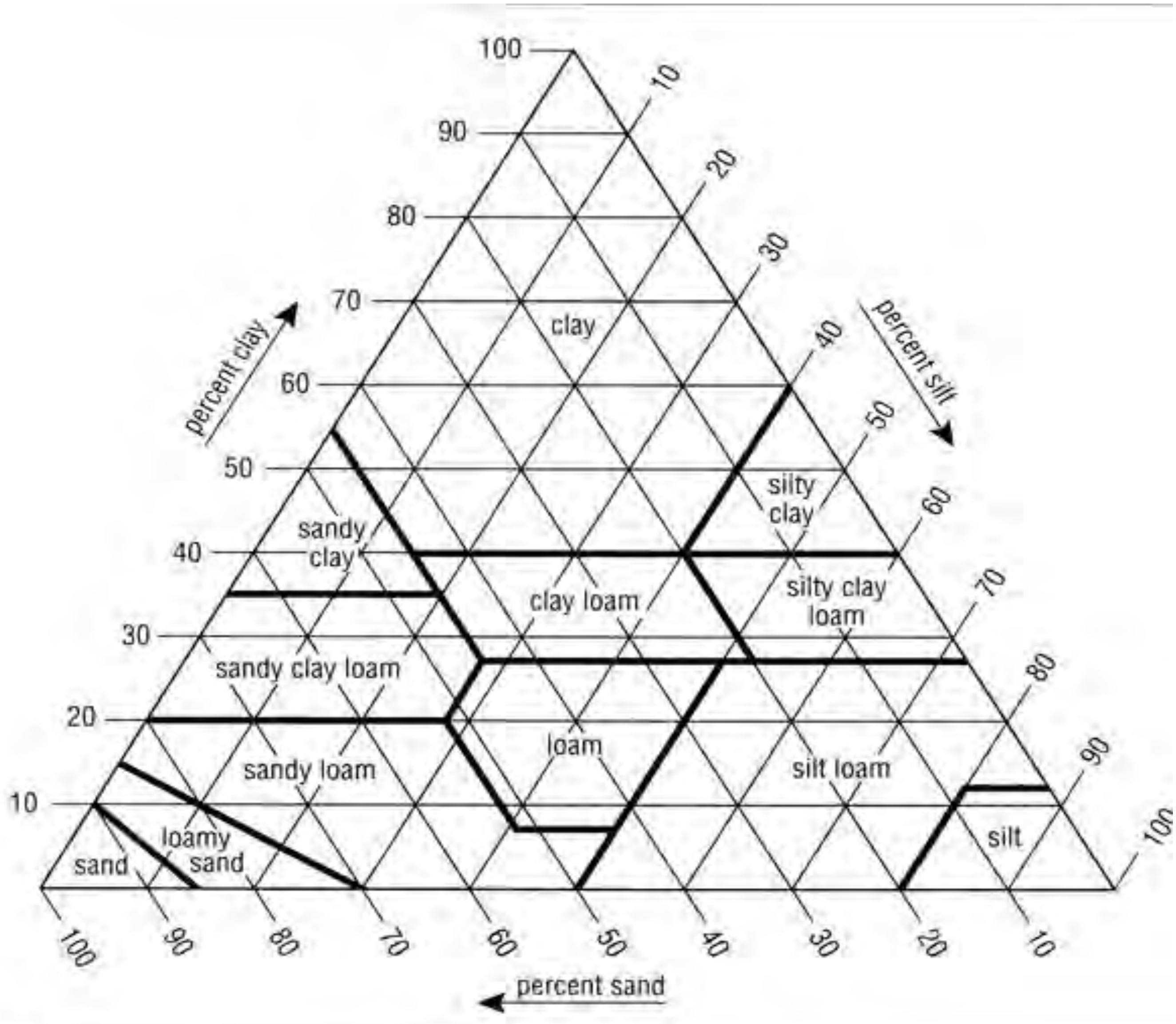


Chart showing the percentages of clay, silt, and sand in the basic textural classes.

Source: Soil Survey Manual

SCORE CARD
REGION IV COLLEGIATE SOIL JUDGING
TEXAS TECH UNIVERSITY
Oct. 19-23, 2009

Score. Part I	
Part II	
Part III	
Part IV	
TOTAL	

SITE NUMBER___________ CONTESTANT ID ________________

Part I. SOIL MORPHOLOGY. Describe ________ mineral horizons within a depth of _________ cm.

Horizon			Lower Depth (cm) (2)	Bound Distinct. (2)	Clay % (2)	Texture (4)	Color			Redoximorphic Features		Structure		Effervescence
Mas. (2)	Sub. (2)	No. (2)					Hue (2)	Val. (2)	Chr. (2)	Abund. (2)	Con/Dep (2)	Grade (2)	Type (2)	(2)

PART I. SCORE ________

PART II. SITE CHARACTERISTICS.

A. Site Position (5)				B. Parent Material (5) (Mark all that apply)				C. Slope (5) %				D. Erosion Class (5)	
	Summit		Stream terrace		Alluvium				0-1		8-12		Deposition
	Shoulder		Depression		Claystone		Marine deposit		1-3		12-20		Class 1
	Backslope		Dune		Colluvium		Residium		3-5		20-45		Class 2
	Footslope		Playa		Eolian				5-8		>45		Class 3
	Toeslope		Playa annulus		Lacustrine								Class 4
	Floodplain		Plain										

PART II. SCORE ________

Part III. Soil Taxonomy.

A. Diagnostic Surface Horizons (10)		B. Subsurface Horizons and Features Mark all that apply (10 each)				C. Carbonate Stage Mark all that apply (10 each)		D. Order (10)	
	Mollic Epipedon		Argillic		Fe/Mn concretions		Stage I		Alfisols
	Ochric Epipedon		Buried		Lithic contact		Stage II		Aridisols
	Umbric Epipedon		Calcic		Natric		Stage III		Entisols
	None		Cambic		Paralithic contact		Stage IV		Inceptisols
			Duripan		Petrocalcic		Stage V		Mollisols
			Fragipan		Slickensides		Stage VI		Ultisols
			Gypsic		Gilgai				Vertisols
			Krotovina		None				

PART III. Score _________

Part IV. Interpretations.

A. Hydraulic conductivity Surface (5)		B. Hydraulic conductivity Soil (5)		C. Water retention difference (5)			
	High		High		Very High (>30 cm)		Low (7.50-14.99 cm)
	Moderate		Moderate		High (22.50-29.99 cm)		Very Low (<7.50 cm)
	Low		Low		Medium (15.00-22.49 cm)		

D. Internal free-water occurrence (5)		E. Surface Runoff (5)	
	Class 1…>150 cm		Ponded
	Class 2…100-149 cm		Very Slow
	Class 3…50-100 cm		Slow
	Class 4…25-50 cm		Medium
	Class 5…<25 cm		Rapid
			Very Rapid

Part IV. Score ___________

SCORE CARD
REGION IV COLLEGIATE SOIL JUDGING Example of a completed scorecard.
TEXAS TECH UNIVERSITY
Oct. 19-23, 2009

Score.	
Part I.	160
Part II.	20
Part III.	90
Part IV	25
Total	295

SITE NUMBER____Example________ CONTESTANT ID ___6D______________

Part I. SOIL MORPHOLOGY. Describe __5______ mineral horizons within a depth of ___150_______ cm.

Horizon			Lower Depth	Bound Distinct.	Clay	Texture	Color			Redoximorphic Features		Structure		Effervescence
Mas. (2)	Sub. (2)	No. (2)	(cm) (2)	(2)	% (2)	(4)	Hue (2)	Val. (2)	Chr. (2)	Abund. (2)	Con/Dep (2)	Grade (2)	Type (2)	(2)
A	p	-	18	A	15	FSL	7.5YR	4	3	-	-	1	SBK	-
B	t	1	33	C	28	SCL	5YR	3	4	-	-	3/3	PR/SBK	-
B	t	2	72	V	32	SCL	5YR	4	6	-	-	3/3	PR/SBK	-
B	kkmb	-	126	C	-	-	-	-	-	-	-	-	-	VE
B	tkkb	-	150	-	36	SC	7.5YR	7	4	-	-	2	SBK	VE

PART I. SCORE __160______

PART II. SITE CHARACTERISTICS.

A. Site Position (5)				B. Parent Material (5) (Mark all that apply)				C. Slope (5) %				D. Erosion Class (5)	
	Summit		Stream terrace		Alluvium				0-1		8-12		Deposition
	Shoulder		Depression		Claystone		Marine deposit	X	1-3		12-20	X	Class 1
	Backslope		Dune		Colluvium		Residium		3-5		20-45		Class 2
	Footslope		Playa	X	Eolian				5-8		>45		Class 3
	Toeslope		Playa annulus		Lacustrine								Class 4
	Floodplain	X	Plain										

PART II. SCORE ___20_____

Example of a completed scorecard.

Part III. Soil Taxonomy.

A. Diagnostic Surface Horizons (10)		B. Subsurface Horizons and Features Mark all that apply (10 each)				C. Carbonate Stage Mark all that apply (10 each)		D. Order (10)	
	Mollic Epipedon	x	Argillic		Fe/Mn concretions		Stage I	x	Alfisols
x	Ochric Epipedon	x	Buried	x	Lithic contact		Stage II		Aridisols
	Umbric Epipedon	x	Calcic		Natric	x	Stage III		Entisols
	None		Cambic		Paralithic contact		Stage IV		Inceptisols
			Duripan	x	Petrocalcic	x	Stage V		Mollisols
			Fragipan		Slickensides		Stage VI		Ultisols
			Gypsic		Gilgai				Vertisols
			Krotovina		None				

PART III. Score ___90______

Part IV. Interpretations.

A. Hydraulic conductivity Surface (5)		B. Hydraulic conductivity Soil (5)		C. Water retention difference (5) 72 cm*0.15 = 10.8			
	High		High		Very High (>30 cm)	x	Low (7.50-14.99 cm)
x	Moderate		Moderate		High (22.50-29.99 cm)		Very Low (<7.50 cm)
	Low	x	Low (root-limiting layer)		Medium (15.00-22.49 cm)		

D. Internal free-water occurrence (5)		E. Surface Runoff (5)	
x	Class 1…>150 cm		Ponded
	Class 2…100-149 cm		Very Slow
	Class 3…50-100 cm	x	Slow
	Class 4…25-50 cm		Medium
	Class 5…<25 cm		Rapid
			Very Rapid

Part IV. Score ___25________