LAND JUDGING IN UTAH

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Adapted From "Land Judging In Oklahoma"
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"Exercise 3 Land Judging In Utah"
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I. Introduction

Land as a natural resource is one of the most important resources used by humans to meet one or more of their basic needs. It provides the raw materials for the production of feed and fiber, and acts as a storage place for water and nutrients for future use. Land provides space for agriculture, for our cities, highways, recreation areas, and many other uses. Nothing surrounds us more completely or interacts with our daily lives more than our land. However, like so many things important to life, our land resources go unnoticed until we learn to more completely appreciate it.

The land resource is limited in quantity and its quality varies from place to place. This is particularly true in Utah where we are so limited to the amount of land that we can inhabit and develop to provide all of us with our individual needs. Soils are a result of the interactions of climate and vegetation on certain geological materials as conditioned by topography over a given period of time. It is no wonder that so many kinds of soils exist with different features and properties. Soils vary in the kind, number, and degree of development of major horizons and sub-horizons that may form. As we go from our valley floors to the tops of our mountains, the soil properties vary.

II. Judging Land

Land judging is a recent judging event in the field of agriculture and has only recently been made available to the FFA High School classes. Land can be judged in a manner similar to judging animals, farm or horticultural crops, or even agricultural mechanization. In judging crops or horticultural plants, we look at the size, shape, and quality to determine which is best. Similarly, when judging land, we look for clues that tell us how well the land can produce crops or be used for other purposes. Soil characteristics, climate, and topography are good clues to the soils capabilities, but close examination of the soil texture, structure, depth, infiltration, permeability, soil reaction, degree of erosion, slope, drainage and flooding are necessary to classify land into capability classes. As we understand these capability classes more completely, we will better realize how we can most effectively utilize the land resource that we have available. In land judging, the major factors affecting how the land can be used must be determined. These factors are used to correctly recommend conservation practices, fertilizers and also soil management practices for conserving the soil.

Land judging can help to:

- Understand basic soil differences,
- Know how soil properties affect crop growth,
- Know why soils respond differently to management practices,
- Realize the influence of land features on production and land protection,
- Select suitable soil and water conservation practices,
- Determine land capability class, and finally,
- Determine proper use and treatment of the land resource.

III. Soil Profile

Soils are composed of a series of horizontal layers of varying degrees of development and thickness. The layers are commonly parallel to the soil surface. These layers are called horizons and the horizons make up the soil. A sideview or vertical cross-section of the soil often can be seen in an exposed ditch bank or a recent excavation. This allows the topsoil and subsoil to be examined easily and for these soil horizons to be described. These horizons differ in color, as well as in physical, chemical, and biological characteristics. The soil usually has three major parts or horizons: (1) the topsoil or "A" horizon, (2) the subsoil or "B" horizon, (3) the parent material or "C" horizon. There are, of course, other horizons but no soil has all

horizons. The **"A" horizon** is the mineral horizon of maximum biological activity and is subject to all the direct influences of the environment. Consequently, it usually has the maximum organic matter content (unless on organic layer exists) but may be low in clay, calcium, iron and aluminum depending upon the interaction of climate, especially precipitation.

Because of leaching, the A horizon frequently has a loss of a large percentage of nutrients necessary for plant nutrition. The "A" horizon in Utah soils will vary greatly in organic matter accumulation and there may be a much lower loss of clays and nutrients than in soils from a more humid region. In humid areas (over 20 inches rain per year) much of the lower A is leached to a light-colored E horizon.

The **"B" horizon** is the horizon in which silica clay minerals, organic colloids, calcium carbonate, and calcium sulfate may accumulate. While some of the clay may be transported downward from the "A" and "E" horizons, there are also clays present that have originated from the weathering of the minerals in the "B" horizons.

The **"C" horizon** is composed of geologic materials that have not been changed appreciably by the weathering processes. It may have softened and accumulated lime. It is common that the geologic material is similar in chemical, physical, and mineralogical composition to that from which the overlying soil has developed. However, their depositions may make the "C" horizon to form from different parent material than the "A", "E" and "B." Figure 1 describes a hypothetical soil which shows the letter designation used in describing the major kinds of horizons usually present.

We can use soil information to help us manage our farms or other soil management responsibilities. For example, soil applied fertilizers are intended to enter the crop plant through its root systems. Therefore, information regarding the soil in terms of the horizon depths and their textures, structures, nutrient reserves, salt content and distribution, pH, organic matter, densities and moisture holding capacities can be of prime importance in making crop management decisions. The more agriculture becomes a high yield, precision oriented science, the greater will be the need to utilize proven technology in order to manage each cropping season with maximum efficiency for maximum economic returns.

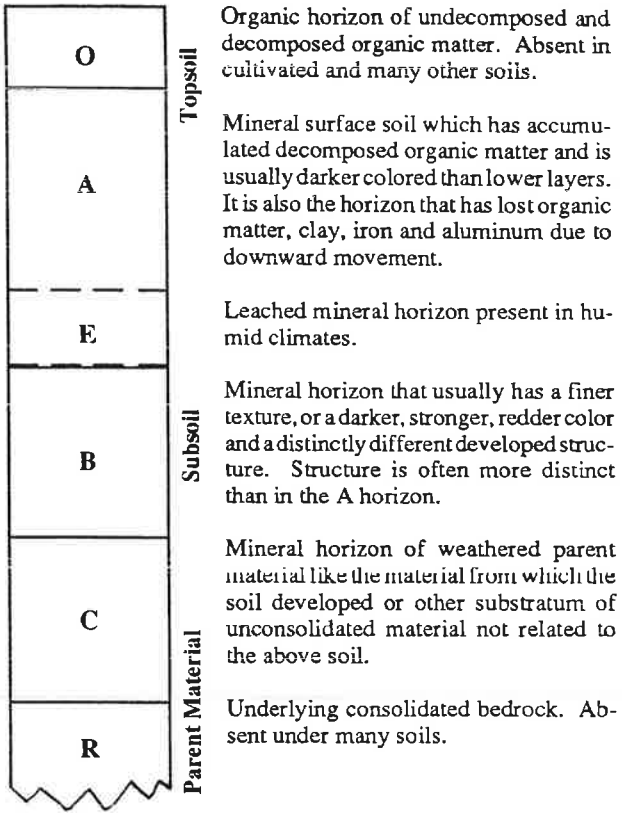

Fig. 1. Hypothetical soil showing the letter description used in describing the major kinds of horizons usually present.

IV. Soil Factors

Soil Texture

Soil Texture refers to the relative proportion of sand, silt and clay particles that are in a specific soil mass. Texture is best determined when the soil is wet or near "field capacity." When sand is rubbed between the fingers and thumb it feels gritty; silt feels smooth and floury when dry; clays are slick, sticky, and plastic when wet. The United States Department of Agriculture (USDA) has recognized 14 texture groups but for land judging purposes they have been grouped into five broad groups for ease of judging capabilities.

Table 1 – Texture Groups

SANDY SOILS	
Coarse	Sands
	Loamy Sands
LOAMY SOILS	
Moderately Coarse	Sandy Loam
Medium	Fine Sandy Loam
	Very Fine Sandy Loam
	Loam
	Silt Loam
	Silt
Moderately Fine	Clay Loam
	Sandy Clay Loam
	Silty Clay Loam
CLAYEY SOILS	
Fine	Sandy Clay
	Silty Clay
	Clay

- **Coarse Textured** soils are loose, very friable and the individual grains can be readily seen or felt. When squeezed between thumb and forefinger, it is very gritty. Squeezed when dry, it will fall apart as pressure is released. When moist, a mold may be formed which is unstable and crumbles as the soil is handled.

- **Moderately Coarse-Textured** soils are gritty but contain enough silt and clay to make a moist soil hold together. The individual sand particles can be seen and felt. When the soil is dry it can be molded into a ball which break apart readily when handled.

- **Medium Textured** soils are slightly gritty but are smooth and soft when the soil is moist. When the soil is dry it will form a ball that will bear careful handling without breaking. When the soil is moist it will squeeze out between the thumb and forefinger but will form only a small ribbon.

- **Moderately Fine Textured** soils usually break into clods when dry. When moist soil is squeezed out between the thumb and forefinger, it will form a short ribbon which will tend to break or the ribbon will bend downward. The soil may also have a slightly gritty or velvety feel when moist.

- **Fine Textured** soils form a very hard clod when dry but are quite sticky or plastic when moist. When moist soil is squeezed out between the thumb and forefinger it forms a long ribbon which will support itself.

The surface texture is usually determined from the plow depth or about 0 to 7 inches. However, in some areas the surface layer has been eroded away or is only 1 or 2 inches thick. For contests, a box sample will be provided for the contestant to judge texture. These boxes will contain three texture groups.

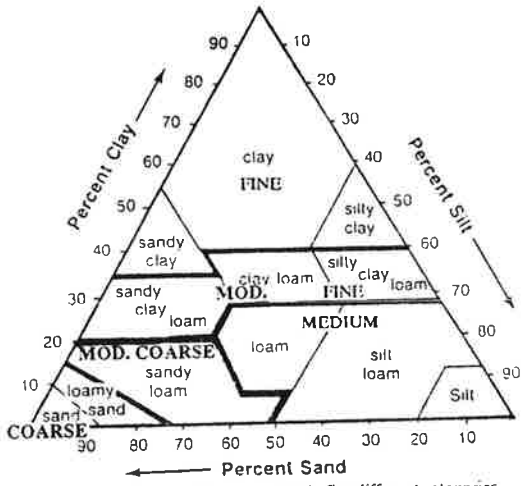

Fig. 2. Soil textural classes shown in five different categories.

Table 2 – Box Sample

Texture Group	Surface Texture	Maximum Capability Class for Soil Texture
Gravelly and Sandy soils	(sands and loamy sands)	**III**
Loamy soils	(loam, sandy loam, fine sandy loam, very fine sandy loam, silt loam, silt, clay loam, sandy clay loam and silty clay loam.)	**I**
Clayey soils	(sandy clay, silty clay and clay.)	**III**

Soil Depth

Depth refers to the total thickness of the surface and subsoil plus any parent material that is favorable for root development. Dense hardpan, bedrock or a seasonally high water table may restrict the growth of commonly grown crops. Soil Depth will be rated as follows:

Table 3 – Soil Depth Rating	
	Maximum Capability Class for Soil Depth
Deep Soils are those soils that have a rooting depth which is more than 40 inches thick.	**I**
Moderately Deep Soils are those that have a rooting depth of 20 to 40 inches.	**III**
Shallow Soils are those soils that have a rooting depth of less than 20 inches.	**IV**

Drainage

In many irrigated areas water tables are common. You can tell where the water table is by digging or drilling a hole in the soil. Then, measure the depth from the soil surface to the water standing in the hole. High water tables can often be lowered or eliminated by installing a suitable drainage system. Proper irrigation management helps alleviate many water table problems.

Where there is no water table within 40 inches of the soil surface, the land is classed as "well drained." See Table 4 to determine the drainage class and maximum capability for drainage class.

Where drainage is a problem, high Salinity may occur and reduce land capability class.

Table 4 – Soil Drainage Capability	
Soil Drainage Class	**Capability Class**
Well Drained: Water table more than 40 inches below soil surface.	**I**
Moderately Well Drained: Water table 31 to 40 inches below soil surface.	**II**
Somewhat Poorly Drained: Water table 20 to 30 inches below soil surface.	**III**
Poorly Drained: Water table less than 20 inches below soil surface.	**IV**

Soil Slope

Soil slope is a very important factor in determining water runoff, erosion and the use of farm equipment. Slope is expressed as a percent, and is defined as the number of feet of vertical rise or fall of the land in a horizontal distance of 100 feet. For example, a slope between two points which are 100 feet apart with a difference in elevation of 3 feet would have a 3% slope. Slope groups are defined as follows:

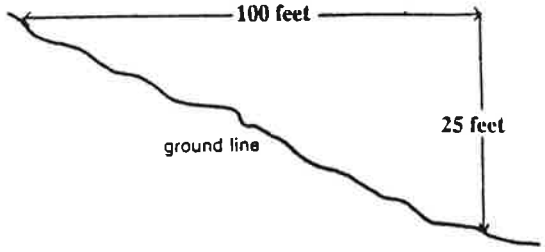

Fig. 3. Diagram showing a 25 percent slope.

Table 5 – Slope Groups

		Maximum Capability Class
Nearly Level	less then 2 percent	**I**
Gently Sloping	2.1 to 5 percent	**II**
Moderately Sloping	5.1 to 8 percent	**III**
Strongly Sloping	8.1 to 15 percent	**IV**
Steep	15.1 percent or more	**VI**

EROSION

	Maximum Capability Class
None to Slight: No evidence of gullies; no soil accumulations on uphill side of plants. Land is usually nearly level or gently sloping.	**I**
Moderate: Some evidence of soil movement is evident. Soil accumulates in low spots or behind vegetation. Soil may also accumulate at the lower ends of the fields. Some small crossable gullies may be present.	**II**
Severe: Considerable evidence of soil movement is observable. Frequent crossable gullies or occasional uncrossable are present. Deep accumulations of soil are present in low areas and at ends of fields.	**VI**

Note: A crossable gully is one that can be crossed with a standard two-wheel drive tractor pulling standard farm implements.

Structure

Soil structure is not judged, however, it is very important in its effect upon permeability and soil use. It also relates to how well crops can grow. It is necessary to know about this soil property. Structure means the shape and arrangement of soil particles into clusters or aggregates. Each aggregate has a particular shape that determines the type of soil structure. It is best to observe this property in the soil rather than in the sample box because digging disturbs the structure. The various types are shown in Figure 4.

- **Single Grained** - Each soil particle functions as an individual unit due to the lack of binding material. This structureless condition is usually found in coarse-textured or sandy soils and is usually erodible. (Not shown in diagram)
- **Granular and/or Subangular Blocky** - Granular is sphere-like or rounded aggregates with no flat surfaces due to contact pressure from the faces of surrounding aggregates. Subangular blocky is block-like or tending toward six-faced aggregates having mixed, rounded and flat surfaces with many rounded vertices or corners. (F and D in diagram)
- **Blocky** - Block-like or tending toward six-faced aggregates having flat surfaces with mostly sharp, angular vertices or edges that are mold casts formed by surrounding aggregates. (C in diagram)
- **Prismatic** - Prism-like or vertically-oriented aggregates with the vertical axis much greater in length than the horizontal axis. Flat surfaces or faces are well defined. (A in diagram)
- **Columnar** - The same as prismatic only with rounded tops. Often an indication of sodium problems in semi arid climates. (B in diagram)
- **Platy** - Plate-like or relatively thin horizontal plates or leaflets. (E in diagram)
- **Massive** - Medium to fine-textured soils with indistinct aggregates or no apparent aggregation. This type is characteristic of clayey, very slowly permeable soils. (Not shown in diagram)

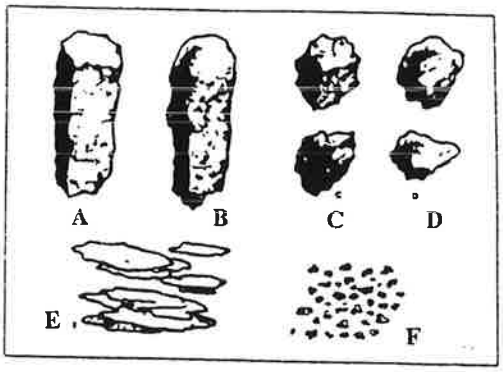

Fig. 4. Drawings illustrate some of the types of soil structure: A, prismatic; B, columnar; C, angular blocky; D, subangular blocky; E, platy; and F, granular

V. Interpretation of Soil Factors

Permeability

Movement of water in the soil is extremely complex. It requires knowledge of many interacting factors to come to any degree of understanding of the rate, amount and direction of movement under any set of circumstances. Water movement toward plant roots is extremely important but the growth of plant roots into and throughout the soil may be equally important!

Permeability is a physical soil characteristic that alters water flow. Permeability is the quality of a soil that allows water and air to move through it. Permeability will alter the rate and amount of water flow to rates thereby regulating (1) plant nutrient transport and (2) water availability to plant roots. Permeability is directly affected by all soil characteristics. It is extremely important because it affects the supply of air, water and soil nutrients in the root zone that will be available to the plant. We predict the permeability of the soil by soil texture, structure and consistence. Permeability may be increased or decreased and still remain within the range of each permeability rating. Soils, of course, are not uniform even though they may appear to be so on the surface. Many micro environments exist within each cubic foot of soil. Mineral soils are really about 50% pore space, filled with varying percentages of water and air depending on the soil water content.

Each soil layer has a permeability rating controlled by the relative rate of moisture and air movement through the most restricting layer.

For judging contests, the subsoil sample in the box will be used to determine the permeability. Subsoil texture and structure are of primary importance in estimating the permeability. The following four classifications will serve to judge soil permeability:

- **Rapidly permeable** - Soils with coarse-textured (sandy) subsoils that are granular or single-grained are rapidly permeable. Subsoils tend to be very friable or loose when moist, and exhibit little restriction of water or air.

- **Moderately permeable** - Soils with moderately fine-textured (silt loams, loams, etc.) subsoils that are prismatic, subangular blocky or granular are moderately permeable. Also, most medium and moderately coarse-textured subsoils are moderately permeable regardless of structure. These subsoils tend to be friable to very friable with visible large pores.

- **Slowly permeable** - Soils that have fine and moderately fine-textured (clay loams, sandy clay loams) subsoils with subangular blocky and granular structures are slowly permeable. These subsoils tend to be friable to firm when moist. Length differences of vertical and horizontal cracks is not noticeable. Soil units tend to break more easily along the vertical axis than occurs in the very slow, permeable soils. Slowly permeable soils frequently have thick surface and thick transitional horizons from the surface to the most clayey horizon.

- **Very slowly permeable** - Soils with claypans, or clay subsoil layers are usually very slowly permeable. The structure is massive or angular blocky and generally free from visible pores. These subsoils tend to be very firm when moist. Horizontal "cracks" are longer than vertical ones. Root growth is generally restricted to ped faces and cracks.

Soil texture and structure have an important effect upon water movement in soils. Soil management should be carried out to maintain or improve structure of soils. By so doing water movement characteristics of the soil will also be improved.

Surface Runoff

Surface runoff is water removed by flowing over the soil surface. This includes rainfall, as well as water from adjacent slopes. It would also include water moving over the soil surface from melting snow. It is a combination of soil slope, position in the landscape, permeability, infiltration rate, and is directly related to ground cover.

- **Rapid** - Water is removed from the surface at a rapid rate. A large amount of rainfall runs off and only a small portion moves into the soil; the runoff increases the erosion hazard. Rapid runoff is a result of compaction, clayey textures and/or slopes greater than 3%. Runoff is lessened by rapidly permeable soils on these slopes.

- **Moderate** - Water runs off readily but yet is slow enough that a large amount of the water enters the soil. This condition causes less erosion hazard than does rapid runoff and is desirable; this flow is considered normal runoff. This condition occurs on slopes of 1-3% with the exception of soils which are rapidly permeable.

- **Slow** - Water flows off so slowly that free water covers the soil for moderate periods. This increases the moisture supply but may interfere with farming operations. This condition occurs on slopes of 0-1% and includes nearly level, loamy and clayey soils with moderately permeable subsoils as well as nearly level, sandy soils with slowly permeable subsoils.

- **Very Slow** - Water is removed so slowly or stands so long that the soil remains wet for long periods. Most of the water either passes through the soil or evaporates. Generally this condition occurs on level to slightly concave landscapes. However, deep sandy soils with rapidly permeable subsoils on slopes also may have very slow runoff because the infiltration is so high that most rainfalls produce no runoff.

VI. Soil Amendments

Fertilizers and other soil amendments are essential to the production of crops. No single set of fertilizer requirements or soil amendments will fit all areas of the country and all crops. The intent of this section is to familiarize Utah contestants with soil fertility requirements and terminology and to identify deficiencies from given soil test values.

pH

Generally pH values in Utah soils range between 7.2 and 8.5. When the pH values are above 8.5, it is usually an indication of excess sodium and reclamation procedures may be needed. Very few soils that we commonly work with have pH values below 7.0. Those soils that do are usually located on water benchlands or in the higher elevations that have increased precipitation. Soils in areas of high precipitation (about 20 inches) have soil pII usually less that 7.0. When soil pH exceeds 8.5, reclamation procedures such as drainage; soil amendments of gypsum, sulfuric acid, calcium chloride; or planting of adapted crops along with an organic amendment might be recommended. High pH soils not only have a sodium problem generally but they may have an associated salinity problem. Therefore, *when any pH value given for a field is above 8.5, a reclamation procedure should be indicated and that generally means drainage of some kind.*

Soil Salinity

Salt-affected soils are frequently encountered in Utah. One category of salt-affected soils, referred to as saline soil, is soil that contains excess soluble salts. Too much soluble salts limits the ability of crop plants to absorb water. The other major category of salt-affected soil, referred to as sodic soils, has excess exchangeable sodium on the cation exchange complex. Water percolates very slowly into and through sodic soils. A third category of saline + sodic is sometimes included. Table 6 gives the guidelines for classification of saline and sodic soils.

Table 6 – Guidelines for the Classification of Salt-Affected Soils.

Measurement	Normal	Saline	Sodic	Saline + Sodic
EC*	<4	>4	<4	>4
ESP**	<15	<15	>15	>15
SAR†	<13	<13	>13	>13

* Electrical Conductivity of the saturated soils sample extract.

** Exchangeable sodium content by the cation exchange capacity.

† Sodium absorption ratio (replaces ESP because it is related but is quicker and easier to measure).

Reclamation of saline soils requires (1) good internal drainage and (2) sufficient excess irrigation water to dissolve and leach out the salts. Reclamation of sodic soils also requires good drainage and excess irrigation and, in addition, a \soil amendment (usually gypsum) to replace the excess exchangeable sodium and allow it to be flushed it through the soil profile.

For purposes of the Land Judging Contest a saline soil will be indicated by EC > 4 (electrical conductivity greater than 4). Mark the Score Card box C-21 Amendment if drainage and leaching are required.

Phosphorus

Low levels of phosphorus in Utah soils are 10 ppm or less. When any value is given *less than 10 ppm*, you should *check the appropriate box* on the scorecard.

Potassium

Soils with potassium soil test levels of 120 ppm or less are considered deficient and require the addition of potassium. If potatoes are being grown, potassium is recommended with test values as much as 150 ppm; above that level, no potassium is needed. When any value is given that is *less than 120 ppm*, you *check the appropriate box* on the scorecard.

Nitrogen

No established level of nitrogen in the soil adequately indicates sufficiency or deficiency for all crops. Any value that would be

deficient for corn, small grains, or potatoes may be adequate for alfalfa, green beans, or other legumes. On the other hand, an adequate level of nitrogen for small grains or corn may be a deficient amount for maximum production of potatoes or some grass varieties. The adequate level of nitrogen in the soil also is dependent on the yield goals.

Nitrogen will be given as adequate or deficient without a numerical value. The *scorecard is checked when the deficiency is indicated.* The following is an example of soil test information:

pH	7.8	**Phosphorus**	15 ppm
Potassium	160 ppm	**Nitrogen**	Deficient

On the scorecard, Phosphorus, Potassium and Nitrogen should be checked.

VII. Climate

Climate influences the kinds of crops that can be grown and the yields. The length of growing season is expressed in days; however, a more descriptive expression of the influence of climate on crop growth is the heat unit or plant development unit (Du). Heat units are calculated from daily temperature data. Table 2 shows the land class based on plant development units.

Table 7 – Land Capability Class Related to Climate

Climate (Heat Units - Du)	Maximum Capability for Climate Limitation
5,000 or more*	I
3,500 - 4,999	II
2,500 - 3,499	III
1,500 - 2,499	IV

* In contests this information is normally provided.

VIII. General Guide For Selecting Land Capability Classes

Land Capability Classes

Land is classified by USDA on the basis of permanent limitations or hazards in its use from the standpoint of keeping the soil permanently productive. The soil features of a particular area are all considered when determining the land capability class. There are eight recognized capability classes of land. They are divided into cultivatable and non-cultivatable.

Cultivatable

- **Class I** - Soils in Class I have few limitations that restrict their use.
- **Class II** - Soils in Class II have some limitations that reduce the choice of plants or require moderate conservation practices.
- **Class III** - Soils in Class III have severe limitations that reduce the choice of plants or require special conservation practices or both.
- **Class IV** - Soils in Class IV have very severe limitations that restrict the choice of plants, require very careful management, special conservation or both.

Non-Cultivatable

- **Class V** - Soils in Class V have little or no erosion hazards, but have other limitations that are impractical to remove that limits their use largely to pasture, range, woodland or wildlife food and cover. These may include areas of very poor drainage or frequently flood areas. (Frequent flooding will be shown with "other factors" when it occurs.) They

Table 8 – Soil Features for Determing Land Capability Classes

	Soil Feature	Best Land Class
Texture:	Coarse textured	III
	Moderately coarse, medium	I
	Moderately Fine	I
	Fine	III
Depth:	Deep	I
	Moderately deep	III
	Shallow	VI
Slope:	Nearly level 0-2%	I
	Gently sloping 2.1-5%	II
	Moderately sloping 5.1-8%	III
	Strongly sloping 8.1-15%	IV
	Steep and Very Steep > 15%	VI
Erosion:	None to slight erosion	I
	Moderate	II
	Severe or very severe	VI
Permeability:	Rapid	III
	Moderate	I
	Slow	II
	Very Slow	III
Surface Runoff:	Rapid	III
	Moderate and Slow	I
	Very Slow	II

also include areas where large boulders, trees, termites mounds, etc., limit the land's capability.

- **Class VI** - Soils in Class VI have severe limitations that make them generally unsuited for cultivation and limits their use largely to pasture or range, woodland, or wildlife food and cover.

- **Class VII** - Soils in Class VII have many severe limitations that make them unsuited for cultivation and that restrict their use largely to grazing, woodland, or wildlife.

- **Class VIII** - Soils and land forms in Class VIII have limitations that preclude their use for commercial plant production and restrict their use to wildlife, recreation, water supply or aesthetic purposes.

IX. Interpretations of Land Treatments

General Instructions and Interpretations

Disregard practices and/or cover on the land at the time of the contest. If terraces and controlled irrigation systems are needed and are already on the field you would use practice 8 or 12, which ever one applies, under possible mechanical treatments. If there are other factors that are not observable by the contestant but affect the possible treatments, these will be shown and the contestant must prescribe the proper treatment. An example of this would be "flooding" under the homesite evaluation.

X. Guide To Treatment Practices

In order to facilitate teaching, Tables 9 to 11 have been developed to assist students in learning treatment alternatives. These are designed to show various combinations of soil, texture, slope, erosion, permeability and depth and the associated treatment practices both vegetative and mechanical. The various treatment definitions are separated into vegetative and mechanical and are defined as follows:

Vegetative

1. No special practices required.

2. Crop rotation with frequent soil conserving crop or special water control in furrows.

3. Row crops not more than 2 in 4 years.

4. Row crops not more than 1 in 5 years.

5. Return crop residue to soil.

6. Practice Conservation Tillage - provide for a protective cover by leaving crop residue of any previous crop as a mulch on or mixed in the surface of the soil. At least 30% residue should remain on the soil surface after planting.

7. Suitable only for permanent pasture or hay, or orchard with cover crop, with controlled irrigation system.

Mechanical

8. Terrace and farm on contour, or controlled irrigation system. Terrace is an embankment or ridge of earth constructed across the slope to control runoff and minimize erosion. Conduct farming operations on the contour or at right angles to slope direction. For contest purposes ***all soils, except sandy textured soils, with slopes over 2 percent will be considered as needing terraces or irrigation with a controlled irrigation system.****

9. Maintain terraces, or controlled irrigation systems. Practices that keep terraces and irrigation systems working effective.

10. Install drainage system. To remove excess surface or ground water from land by means of surface or subsurface drains. ***Used when drainage is poorer than well drained.***

11. Control erosion. One or more conservation practices that will adequately control runoff and erosion. ***Used any time active erosion is taking place within the field area.***

12. Controlled irrigation system only.

13. No mechanical treatment needed - use when erosion and drainage is not a problem, and supplemental irrigation is not needed (dry cropland) or on slopes that are too steep to irrigate and erosion is not a problem).

* A controlled irrigation system refers to sprinklers, gated pipe, drip irrigation, or other types of mechanical control of water.

Table 9 – Coarse Textured Soils - Deep and Moderately Deep

Slope[1]	Erosion	Permeability	Vegetative Treatment	Mechanical Treatment
N.L.	None	Mod to Rapid	3,5,6	13
N.L.	Moderate	Mod to Rapid	3,5,6	11
N.L.	Severe	Mod to Rapid	4,5,6	11
G.S.	None	Mod to Rapid	4,5,6	12,13
G.S.	Moderate	Mod to Rapid	4,5,6	11,12
G.S.	Severe	Mod to Rapid	7	11,12
M.S.	None	Mod to Rapid	4,5,6	12,13
M.S.	Moderate	Mod to Rapid	7	11,12
M.S.	Severe	Mod to Rapid	7	11,12
Str.	None	Mod to Rapid	4,5,6	12,13
Str.	Mod-Sev.	Mod to Rapid	7	11
Steep	None	Mod to Rapid	7	13
Steep	Moderate	Mod to Rapid	7	11
Steep	Severe	Mod to Rapid	7	11

[1] See footnote at end of Table 11.

Table 10 – Loamy and Clayey Soils - Deep and Moderately Deep

Slope[1]	Erosion	Permeability	Vegetative Treatment	Mechanical Treatment
N.L.	None	Very Slow	2,5,6	13
N.L.	Moderate	Very Slow	2,5,6	11
G.S.	None	Very Slow	3,5,6	8,9
G.S.	Moderate	Very Slow	3,5,6	8,9,11
G.S.	Severe	Very Slow	7	8,9,11
M.S.	None	Very Slow	4,5,6	8,9
M.S.	Moderate	Very Slow	4,5,6	8,9,11
M.S.	Severe	Very Slow	7	8,9,11
Str.	None	Very Slow	4,5,6	8,9
Str.	Mod-Sev	Very Slow	7	8,9,11
Steep	None	Very Slow	7	8,9
Steep	Mod-Sev	Very Slow	7	8,9,11
N.L.	None	Slow-Mod	1,5,6	13
N.L.	Moderate	Slow-Mod	2,5,6	11
N.L.	Severe	Slow-Mod	2,5,6	11
G.S.	None	Slow-Mod	4,5,6	8,9
G.S.	Moderate	Slow-Mod	4,5,6	8,9,11
G.S.	Severe	Slow-Mod	7	8,9,11
M.S.	None	Slow-Mod	4,5,6	8,9
M.S.	Mod-Sev	Slow-Mod	7	8,9,11
Str.	None	Slow-Mod	4,5,6	8,9
Str.	Mod-Sev	Slow-Mod	7	8,9,11
Steep	Mod-Sev	Slow-Mod	7	8,9
Steep	Mod-Sev	Slow-Mod	7	8,9,11

[1] See footnote at end of Table 11.

Table 11 – Moderately Coarse, Medium, Moderately Fine and Fine Textured Soil - Shallow

Slope[1]	Erosion	Permeability	Vegetative Treatment	Mechanical Treatment
N.L.	None	All Conditions	3,5,6	13
N.L.	Mod-Sev		4,5,6	11
G.S.	None		4,5,6	8,9
G.S.	Mod-Sev		4,5,6	8,9,11
M.S.	None		4,5,6	8,9
M.S.	Mod-Sev		7	8,9,11
Str.	None		4,5,6	8,9
Str	Mod-Sev		7	8,9,11
Steep	All		7	8,9,11

For soils that have a drainage wetter than "well drained" add item #10 "Install Drainage System" to possible mechanical treatments.

[1] **Note:**
N.L. = Nearly Level Slope
G.S. = Gently Sloping
M.S. = Moderately Sloping
Str. = Strongly Sloping
Steep = Steep Slope

Slow-Mod. = Slow to Moderate Permeability
Mod-Sev = Moderate to Severe Erosion

All explanations given in this brochure are for teaching and understanding. Because of the possibility of over-looking a difference between the narratives and the tables, the tables will be the final word in contest situations.

XI. Homesite Evaluation

A home is one of the largest and most important investments that a person will make in a lifetime. Families and communities can avoid many construction and maintenance problems if a soil study is made on the construction site before construction begins. Soil information can be used to predict potential problems before home or other construction begins.

Before building or buying a home a person should consider if:

- There is a flooding hazard. Avoid homes in a flood plain unless there is adequate protection.
- Surface runoff is a problem.
- Internal drainage is a problem. Can a basement be dug?
- The soils have high shrink-swell properties.
- Slope or soil movement (erosion) make the site unsuitable.
- Soils exhibit conditions of high corristivity that might corrode water and sewer pipes.
- Grading and soil removal was extensive. Was the surface soil removed.
- The soil properties are favorable for lawn grasses, trees, shrubs, flowers and garden vegetables and fruits.

This contest is designed to emphasize the importance of soils and their limitations for urban uses. Many of the soil properties that are important for agricultural uses are also important for urban uses. Even though some of the properties are the same a different set of criteria is used to evaluate the soil for urban uses.

Texture Factors (Homesite Selection)

This refers to the texture of the surface soil. Surface texture is not a factor for sewage lagoons and septic systems because lagoons are dug below the surface and most of the surface soil is used in making the berm around the lagoon.

- **Coarse: Moderate Limitations** – may require stabilization with organic material and/or loamy topsoil to improve moisture and nutrient holding and supplying capacity for desired plant growth. Washing and blowing may be a problem during construction.
- **Moderately Coarse, Medium, Moderately Fine: None to Slight Limitations** – Care should be exercised during construction to be sure the surface soil is not covered by less desirable material.
- **Fine: Severe Limitations** – for uses other than sewage lagoons. Soil is sticky when wet, hard when dry, difficult to work when used for flower beds and gardens. The soils crack when dry, swell when wet, requiring frequent and low rate of watering for plant growth.

Permeability (Homesite Selection)

This normally refers to the rate of water or air movement through the most restrictive layer in the soil and for water flow, is measured in "inches per hour." Some people refer to this as internal drainage. Onsite investigation is important in determining the permeability of soils. In some soils septic tank laterals may be placed below the most restrictive layer. For this reason it is important to test the proposed site before construction starts so that a proper system can be designed. Generally soils that are unsuited for septic tank systems are better suited for sewage lagoons. Septic tank systems work on the principle of the liquid seeping into the soils, therefore a soil with a slow or very slow permeability does not work well for this type of system. A sewage lagoon works on the principle of the liquid standing in a pool and evaporating, therefore a soil that does not allow the liquid to enter into the soil works best for this type of system.

- **Very Slow**: ***Very severe limitations for septic systems absorption field.*** Water movement is usually less than 0.06 inches per hour. This would require a prohibitively large field of lateral lines or costly modifications would be necessary. Because of this, septic tank systems are not recommended. ***Limitations for sewage lagoons would be none to slight.*** This type of soil would have a severe limitation for lawns and landscaping.

- **Slow**: ***Severe limitations for septic systems absorption field.*** Soils generally would be moderately fine textured with a blocky type soil structure. Problems are generally the same as those soils with very slow permeabilities but the modifications required for use are usually less intense. Water movement ranges from ***0.06 to 0.2 inches per hour.*** Onsite percolation tests should be done before design of systems is started. Should the soil be in the .06" per hour range (percolation rate of 1 1/2 inches per day) the cost would generally be prohibitive. ***Limitations would be none to slight for sewage lagoons and moderate for lawns and landscaping.***

- **Moderate**: ***Moderate limitations for septic system absorption field and sewage lagoon.*** The soils are generally moderately coarse and medium textured. Permeability ranges from ***0.6 to 2 inches per hour. None to slight limitations for lawns and landscaping.***

- **Rapid**: ***Slight limitations for septic system absorption field,*** however if the permeability is too rapid, then the septic systems may not adequately filter effluent. This situation would require an onsite investigation, but ***for contest purposes*** a soil with rapid permeability will be considered to have a ***slight limitation*** for septic tank absorption fields. ***Moderate limitation for lawns and landscaping. Severe limitation for sewage lagoons.*** The soils are usually coarse (sandy) or moderately coarse textured. Permeability is greater than 2 inches per hour. If the permeability approaches 6 inches per hour then it would be difficult to maintain adequate water depth in a sewage lagoon and a ground water pollution problem could be created.

Table 12 – Effect of Soil Depth On Land Use Adaption

	Depth in Inches	Foundations for Buildings	Lawns and Landscaping	Septic System Absorption Field	Sewage Lagoon
Shallow	< 20"	Severe	Severe	V. Severe	V. Severe
Mod. Deep	21-40"	Moderate	Moderate	Severe	Severe
Deep	> 41"	None to Slight	None to Slight	Slight	Slight

Table 13 – Effect of Slope On Land Use Adaptation

	Slope in Percent	Foundations for Buildings	Lawns and Landscaping	Septic System Absorption Field	Sewage Lagoon
Nearly Level to Gently Sloping	0-3	None to Slight	None to Slight	None to Slight	None to Slight
Mod. Sloping	3.1-5	None to Slight	None to Slight	None to Slight	Moderate to Slight
Strongly Sloping	5.1-8	None to Slight	None to Slight	None to Slight	Moderate to Slight
Steep	8.1-15	Moderate	Moderate	Moderate	Severe
V. Steep	15.1+	Severe	Severe	Severe	Severe

Soil Depth

This refers to the vertical depth of a soil to bedrock or other root restrictive layers such as hardpans that severely restrict or prohibit excavation or root penetration. Table 12 is used as a guide to determine the limitation for the different land uses.

Slope (Homesite Selection)

This refers to the steepness of the land surface as measured in feet of vertical fall or rise in a horizontal distance of 100 feet and is expressed as a percent. The slope ranges for urban uses are broader and different than for that of agricultural uses. Table 13 will aid in the interpretation of the slope for the various land uses.

Erosion

Slope erosion can greatly increase the cost of construction and landscaping of a homesite. Severe gully erosion can also cause problems in the operation of a septic tank absorption field.

- **None to Slight or Moderate**: None to slight limitations for any use.
- **Severe**: Moderate limitation for any use.

Surface Runoff (Homesite Selection)

This is generally a factor of importance in connection with surface drainage, permeability and erosion. Special attention needs to be given to adjacent areas. Runoff from surrounding property may cause ponding and water accumulations around the home. Surface runoff is not a factor for sewage lagoons because they will be protected from outside water.

- **Rapid**: Usually occurs on slopes of more than 5 percent except sands where the runoff would be slow. Severe limitations requiring care to maintain and to prevent erosion on lawns and gardens. None to slight limitations for foundations for buildings, and septic systems absorption field.
- **Moderate**: None to slight limitations for any use. Occurs on slopes of 3 to 5 percent.
- **Slow**: Occurs on slopes of 0 to 3 percent and on deep sands. Severe limitations may require costly modification for foundations for buildings and special design of septic systems absorption fields. On deep sands, slow runoff would not present any limitations. None to slight limitations for other uses.

Shrink-Swell Potential (Homesite Selection)

This factor is implied in the permeability and texture of a soil. Because it is important in foundations for buildings, the design should have special consideration. The finest texured layer in the profile is generally considered in shrink-swell limitations. Shrink-swell is not generally a factor for lawns and landscaping.

- **Low**: Coarse (sandy) and moderately coarse textured soils have none to slight limitations for all uses.
- **Moderate**: Medium and moderately fine textured soils have moderate limitations for all uses.
- **High**: Fine (clayey) textured soils have severe limitations for all uses.

Water Table (Homesite Selection)

The internal wetness of a soil is influenced by most of the factors previously discussed. Generally, internal drainage is a reflection of permeability. However, the presence and depth to a water table is more a reflection of climate, season, kind and amount of irrigation in the area and landscape position. Water table must be evaluated on the basis and the depth to the water table and the persistence of the water table. This requires extensive study throughout the year under all climatic and irrigation conditions. For contest purposes only depth to the water at the time of the contest will be considered. Table 13 gives the limitations for a soil with a water table for the various land uses.

Flooding

Flooding is a problem that is often overlooked in the purchase of a home. An area may have been free of floods for several years and then serious flooding could occur. Urban development can increase the runoff from a small watershed by as much as 75 percent, thus greatly increasing the flooding hazard. Historic records must be studied as well as position on the landscape, and proximity to streams must be used as a guide to determine flooding potential. This information is usually given for contest purposes.

- **None**: Limitations none to slight for all uses.
- **Occasional**: Flooding less frequent than one year in two. Severe limitations for foundations for buildings. Moderate limitations for septic system absorption field. None to slight limitations for sewage lagoons and lawns and landscaping.
- **Frequent**: Flooding more frequent than one year in two. Severe limitation for all uses.

XII. Conducting Homesite Evaluation

Homesite evaluations will be conducted in conjunction with the regular land judging contest. The same pits and conditions that are used for the land judging portion will be used in the homesite evaluation. The judging criteria that will apply to both the land judging and the

Table 14 – Depth to Water Table

Degree of Limitation	Foundations for Buildings	Lawns and Landscaping	Septic System Absorption Field	Sewage Lagoon
Slight	More than 3 ft.	More than 2 ft.	More than 6 ft.	More than 5 ft.
Moderate	2-3 ft.	1-2 ft.	4-6 ft.	3-5 ft.
Severe	Less than 2 ft.	Less than 1 ft.	Less than 4 ft.	Less than 3 ft.

homesite evaluation will be duplicated. In other words the same texture for both the surface and subsoil that were determined for the land judging will be used to judge the homesite. The homesite questions will be in addition to the regular land judging items. An extra 5 minutes will be allowed at each pit location. This should be adequate because much of the judging will be done as part of the land judging evaluation. Items from the land judging portion that are duplicated in the homesite evaluation will be awarded points in the land judging portion of the contest only.

XIII. Setting Up and Holding a Land Judging Contest

Plan

A coordinator or chairman must set up a meeting of interested leaders and agencies, determine who can help and make assignments, set a date, select judges, guides and graders. In planning consider the number of teams, divisions and number of individuals that will participate. A team consists of four contestants with the three high scores tabulated as the official team score.

Site Selection

Locate an area where different conditions can be found to study and judge. Make sure that permission is secured from the owner to use the area. Select four sites, dig pits and prepare an official key for each site well before the contest. This will insure that graders can score the contest in the shortest possible time.

Preparing Field Site

Each site should have flags or stakes to indicate field boundaries of the area to be judged. The fields should be a minimum of 100 feet x 100 feet in size, but do not necessarily have to be square. Two well marked stakes should be placed 100 feet apart for judges to use to estimate slopes. These should be the same distance above the ground and with the normal slope of the land as much as possible. A hole must be dug to expose the soil. Representative samples of topsoil and subsoil should be available and marked. If the soil is very dry a supply of water should be on hand to moisten soil samples.

Site Cards

This card provides the contestant with all necessary information. It should be prepared in advance and placed at the site before the contest. Include site number, estimated thickness of original topsoil, soil test data and any other factors that may be useful in judging the land capabilities.

Conducting the Contest

Register teams by using consecutive numbers and team members by using letters A, B, C, and D. Have sets of land judging cards and tabulation cards prepared ahead of time if a large number of contestants are expected. When the contest begins, contestants registered with Letter A will go to site 1; those with B to site 2, C to site 3, and D to site 4. Allow 15 minutes to judge each site unless homesite evaluation is also being judged. This will require some additional time. Use a signal to start and stop the judging at each site. Each group moves to the next site. Cards are collected before leaving a site and someone is designated to pick up the cards and take them to the graders. Group A then goes to site 2; B to site 3; C to site 4; and D to site 1. However, sites are not arranged to fit this sequence and can be changed. This procedure allows groups of 20-40 people to move with little confusion.

General Contest Rules

1. No talking or comparing of cards.
2. No clipboards, bubble viles, tape measures, or other measuring devices allowed.
3. Contestants can have the following pieces of equipment: a. writing instrument (pencils are better than pens especially in wet weather). b. Knife or nail. c. Contest cards.
4. The land judging handbook shall be used to resolve contest differences and should be used in setting up and conducting all contests.

Scoring and Grading

Categories on the scorecard carry varying values depending on the judges evaluation of its relative importance. The total points possible on each site is 75 with 45 points from Part I and 30 points from Part II. In Part I, items A thru F and H have only one correct answer. No partial credit is awarded. Item C must have all appropriate blocks checked to get credit for the answer. In part, the applicable vegetative, mechanical and fertilizer practices are checked according to the judgment of the contestants and other factors shown.

Use a master or tally sheet to simplify the entry of individual scores by listing team members vertically and sites horizontally on the sheet. Circle the low total score for elimination and team scores can be added quickly.

In the case of a tie in the team score, use the scores of the 4th individual. If one team has only three members, the team with the 4th member is the winner. If a tie still exists, use the scores from Site 1, then use Site 2, Site 3 and Site 4 and the team with the first largest score can be declared the winner. If this does not break the tie, the score from Part I, then Part II of Site 1, Site 2, and Site 3, Site 4 can be used or all team names with tied scores can be placed in a hat and drawn for placings. This same procedure can be used to break individual tied scores.

Land Judging Score Card
Cooperative Extension Service
Utah State University

Contestant No. _____ Field No. _____

Name _____

Address _____

County/School _____ Organization _____

Score	Part I: Soil Factors (Check Appropriate Square)
	A. Texture *Sur. Sub.* ☐ ☐ 1. Coarse ☐ ☐ 2. Moderately coarse ☐ ☐ 3. Medium ☐ ☐ 4. Moderately fine ☐ ☐ 5. Fine
	B. Depth of Soil ☐ 1. Deep ☐ 2. Moderately deep ☐ 3. Shallow
	C. Slope ☐ 1. Nearly level ☐ 2. Gently sloping ☐ 3. Moderately sloping ☐ 4. Strongly sloping ☐ 5. Steep
	D. Erosion, Wind & Water ☐ 1. None to slight ☐ 2. Moderate ☐ 3. Severe
	Interpretations of Soil Factors
	E. Permeability ☐ 1. Rapid ☐ 2. Moderate ☐ 3. Slow ☐ 4. Very slow
	F. Surface Runoff ☐ 1. Rapid ☐ 2. Moderate ☐ 3. Slow ☐ 4. Very slow
	G. Major Factors that Keep an Area Out of Class I ☐ 1. Texture ☐ 6. Permeability ☐ 2. Depth ☐ 7. Runoff ☐ 3. Slope ☐ 8. Wetness ☐ 4. Erosion ☐ 9. Flooding ☐ 5. Climate ☐ 10. None
	H. Land Capability Class ☐ 1. Class I ☐ 5. Class V ☐ 2. Class II ☐ 6. Class VI ☐ 3. Class III ☐ 7. Class VII ☐ 4. Class IV ☐ 8. Class VIII
	I. Climate (Heat Units) ☐ 1. 5,000 or more ☐ 2. 3,500 - 4,999 ☐ 3. 2,500 - 3,499 ☐ 4. 1,500 - 2,499

Score	Part II: Recommended Land Treatments
	A. Vegetative ☐ 1. Row crop/occasional soil conserving crop ☐ 2. Row crop/frequent soil conserving crop ☐ 3. Row crops not more than 2 out of 4 years ☐ 4. Row crops not more than 1 out of 5 years ☐ 5. Return crop residue to the soil ☐ 6. Practice conservation tillage ☐ 7. Permanent pasture and range
	B. Mechanical ☐ 8. Terrace and farm on contour ☐ 9. Maintain terraces ☐ 10. Install drainage system ☐ 11. Control gullies and erosion ☐ 12. Controlled irrigation system ☐ 13. No mechanical treatment needed
	C. Fertilizer & Soil Amendments ☐ 14. Soil amendments ☐ 15. Phosphorus (P_2O_5) ☐ 16. Potassium (K_2O) ☐ 17. Nitrogen (N) ☐ 18. Fertilizer or soil amendments not needed
	- NOTES -

Score Part I _____ (Possible 45 points) Score Part II _____ (Possible 30 points) Total Score _____ (Possible 75 points)

Homesite Evaluation Card
Utah State University

Contestant No. _____ Field No. _____

Name _____

Address _____

County/School _____ Organization _____

Part I: Land Factors

Score	Features of the Site Being Considered (3 points each)
	A. Texture - Surface ☐ Coarse ☐ Mod. Coarse, Medium, Mod. Fine ☐ Fine
	B. Permeability ☐ Very Slow < 0.06"/hour ☐ Slow 0.06-0.6"/hour ☐ Moderate 0.6-2.0"/hour ☐ Rapid 2.0"/hour +
	C. Depth of Soil ☐ Shallow 10-20" ☐ Mod. Deep 20-40" ☐ Deep 40-72"
	D. Slope ☐ N.L to Gentle 0-3 % ☐ Moderate 3-5 % ☐ Strong 5-8 % ☐ Steep 8-15 % ☐ Very Steep 15 % +
	E. Erosion ☐ None-Slight-Moderate ☐ Severe
	F. Surface Runoff ☐ Slow ☐ Moderate ☐ Rapid
	G. Shrink-Swell (heaviest layer) ☐ Low ☐ Moderate ☐ High
	H. Water Table (permanent or temporary) ☐ Shallow < 40" ☐ Mod. Deep 40-60" ☐ Deep > 60"
	I. Flooding ☐ None ☐ Occasional < 1 in 2 yrs. ☐ Frequent > 1 in 2 years
	Final Evaluation All factors none to slight One or more factors mod. None severe One or more factors severe None very severe Very severe

Part II: Planned Use - Family Dwelling Site Without Basement Interpretations of Limitations (2 points each)

Degree of Limitation	Foundations for Buildings	Lawns and Landscaping	Septic System	Sewage Lagoon
Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐		
Slight Moderate Severe Very Severe		☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
Slight Moderate	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	
Slight Moderate Severe	☐ ☐ ☐		☐ ☐ ☐	☐ ☐ ☐
Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
Slight Moderate Severe	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐	☐ ☐ ☐
Slight Moderate Severe Very Severe	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐	☐ ☐ ☐ ☐
	18	18	18	16

Score Part 1 _____ (possible 27 points) **Score Part 2** _____

Total Score Part I and Part 2 _____ (possible 97 points)