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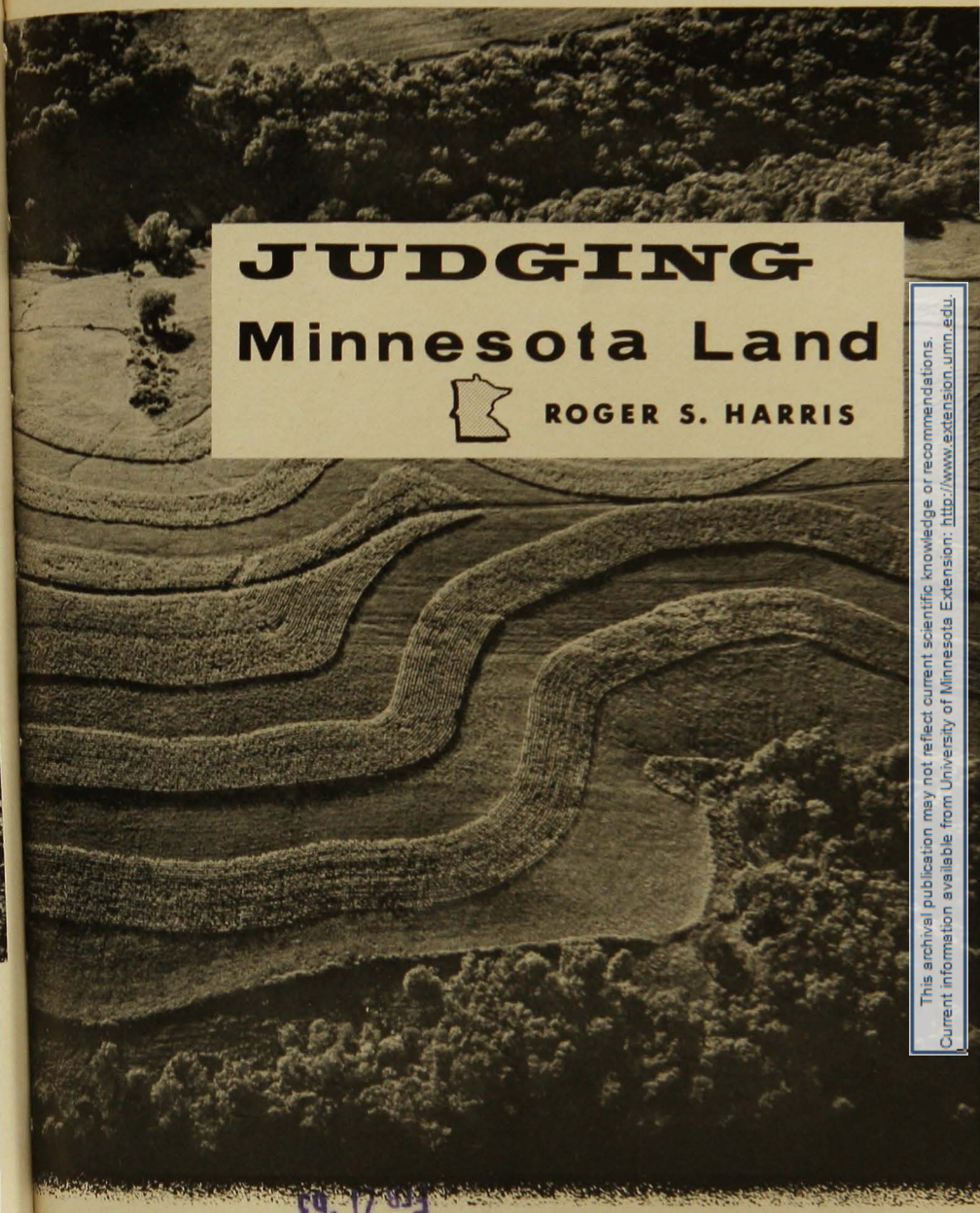

JUDGING Minnesota Land

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Judging Minnesota Land

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TO UNDERSTAND IS TO KNOW. Land judging helps us understand the properties of soils so we can know the uses for which they are best suited. Thus we can plan soil management practices that improve fertility, maintain tilth, control erosion, and increase yields.

Soil and land study helps us to:

- Learn the basic properties of soils.
- Evaluate their effects on crop growth.
- Assign proper uses to the land.
- Recognize adaptable soil and water conservation practices.
- Notice possible changes in land features.

This publication was prepared to aid in studying, interpreting, and understanding the Minnesota Land Judging Scorecard (Form S-31, Revised April 1962). A copy of the scorecard is on page 19.

By following the scorecard closely when studying the soil, we learn how to use and manage the land. Part I guides us in taking a soil inventory. From it we can determine the principal faults of the field area. These are recorded in Part II. The completion of Part III of the card indicates the land capability class. In Part IV the recommended land treatments are divided into four categories: land use, special practices, fertilizer and soil amendments, and mechanical.

Within each field area judged, a pit is dug to expose the soil profile. A soil profile is a vertical cross section of the soil down to the unweathered, underlying material. A placard is also displayed indicating data to assist the judge in making decisions. A copy of this field placard is on page 18.

Physical Soil Features

In Part I of the scorecard, the first four of the seven physical soil features are observed by studying the soil profile. The last three consider principally the topography or lay of the land and degree of erosion.

Color of Plow Layer

The darkness of the surface soil color is a good measure of organic matter content. Organic matter content tells you two things about the soil: its tilth and its

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ability to supply nitrogen to growing crops.

Soils high in organic matter usually have good tilth. That is, they: (1) work easily, (2) do not become cloddy, (3) do not crust after rains, (4) take in water readily, (5) store water for crop use, and (6) resist erosion. Soils high in organic matter can furnish considerable nitrogen to crops if weather conditions are favorable for decay of organic matter. Through this decay essential elements are made available.

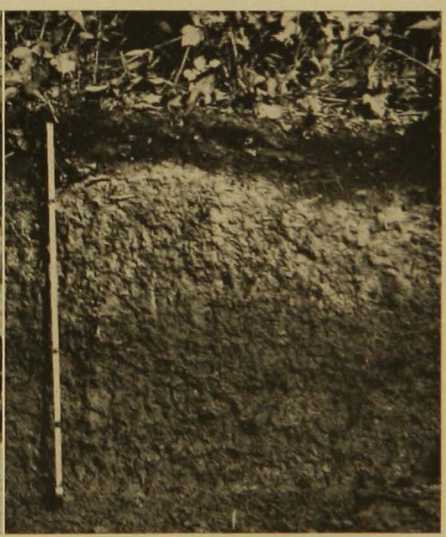
Soil should be moist when determining color because color variations are then easier to see. For example, a dark soil high in lime may be grayish when dry due to lime but darker when moist. In judging surface soil color, we study the layer (horizon) from the top down to the first real color change. This change is usually easy to recognize in **most soils**. In some cases, however, organic matter has leached downward, blending the dark color into the subsoil. This makes it more difficult to detect the exact line between surface soil and subsoil.

In soils of forest origin that have not been disturbed, the top few inches are dark. Just below this there may be a gray-colored layer. Both layers are part of the surface soil. Below the light-colored layer the soil usually is somewhat darker. This pattern in **forest soils** is due to leaching of organic matter from the lower surface soil into the subsoil.

On your scorecard, "Color of Plow Layer" is divided into three groups:

Dark surface color in mineral soils range from dark gray to black. Dark soils are high in organic matter. We expect them to be in good tilth, unless unusually fine in texture, and capable of supplying considerable nitrogen to crops. However, in selecting the proper crop rotation and nitrogen application, you must also consider thickness of the dark layer. If thin—for example, less than plow depth—the soil cannot supply as much nitrogen as it would if thick.

Prairie soil.



Forest soil.

Medium mineral soils are dark brown to dark-grayish brown. They have only a fair to low supply of organic matter. Moreover, although they work easily and are reasonably fertile, they usually need careful attention in order to keep organic matter content up. The crop rotation should contain more legume and grass than for dark-colored soils. In addition, most of these soils can use some nitrogen fertilizer, unless manured.

Light color in mineral soils, light brown or gray, usually indicates shortage of organic matter and nitrogen. If soil texture is fine, tilth is generally poor. Use plenty of legumes, green manure crops, crop residues, and barnyard manure because these soils need organic matter. Corn planted in such soils usually needs nitrogen, unless the previous crop was a legume and the field manured.

Texture of Plow Layer

Soil texture refers to size of soil particles. It varies according to the proportion of sand, silt, and clay in the soil. Texture probably influences productivity and type of management, especially organic matter and fertilizer needs, more than any other physical property. Keep in mind that your judging for this section refers to the surface soil only. In evaluating such factors as drainage and droughtiness, depth as well as texture of subsoil must be considered.

Surface texture is important to good tilth. It influences drainage, organic matter maintenance, lime and fertilizer needs, and erosion resistance. Coarse soils warm up earlier in the spring and are less likely to bake or crust than fine soils. However, they may be droughty and susceptible to wind erosion.

It is difficult to increase organic matter content in coarse soils. They benefit from yearly additions of fresh organic matter in the form of legumes, green manure crops, or barnyard manure. Coarse soils need less lime than fine soils to correct acidity but must have more frequent applications. They leach easily. They are also limited in production because they lack capacity to hold plant nutrients and water. Therefore, supply fertilizers more on a year-to-year or crop basis on coarse soils.

Fine soils require less frequent but heavier applications of lime, fertilizer, and organic matter. However, they often need careful handling to control erosion on slopes or, if level, to improve drainage and infiltration. (Infiltration is the ability of soil to take in water.)

To determine texture, rub a little moist soil between your thumb and finger. Sand particles feel gritty; silt feels velvety; clay feels sticky. It takes relatively small amounts of clay in proportion to sand or silt to make a soil sticky. Because most soils have a mixture of all sizes of particles, you must determine which are the most important.

Soils are given texture names that indicate the relative importance of various sizes of particles. For example, sand is placed last in the term "loamy sand" because it is the most prevalent particle in that soil.

Fine soils include clays and silty clay loams—that is, soils consisting of at least 27 percent clay. Fine soils usually feel smooth and are always sticky when moist. When you rub or squeeze the moist soil between your thumb and finger, it ribbons out like toothpaste. However, when dry, the small clods are very difficult to break. The finer-textured soils in this group—the clays—require careful handling to prevent puddling when wet. If the land is level, surface water drains away very slowly.

Medium soils such as loam and silt loam contain less than 27 percent clay and not more than 52 percent sand. Ordi-

narily they feel velvety between fingers when moist but are not very sticky. Some have a slight grittiness because of sand grains present. These medium-textured surface soils are the easiest to till.

Moderately coarse surface soils include sandy loams. They have 43 percent or more sand, according to the amount of clay and silt present. Clay content is limited to 20 percent and silt to 50 percent. These soils feel predominantly gritty due to the sand. But, they have enough clay or silt to prevent a handful of moist soil from falling apart readily after being gripped tightly. These soils may be subject to drought and are easily affected by temperature changes as they warm up earlier in the spring than those of finer texture. Tilth is usually a minor problem.

Coarse soils include loamy sands and fine gravels. Because of high sand and gravel content, they feel very gritty and do not hold together even when moist. They are droughty, retain plant food poorly, and are of low value for crop production.

Depth Favorable to Roots

The combined depth of the surface soil and subsoil that is easily penetrated by roots is a very important factor. The greater this favorable depth, the greater the food and water storage zone. The corn plant, for example, feeds 42 inches deep; grain less, alfalfa more. Some characteristics of a soil that may curtail root penetration and retard growth are: clay pans, gravel layers, bedrock, or a high water table. Sand does not necessarily limit depth. However, it causes excessive internal drainage and droughtiness.

Deep soil favorable to root growth is at least 36 inches thick. Many good soils are deeper.

Medium soil (20 to 36 inches thick) is classed as moderately good.

Shallow soil (20 inches thick or less) greatly restricts the root zone because of the limited soil zone for plant food and moisture storage.

Internal Drainage

Air and water must move easily in both the surface soil and subsoil for proper plant growth. In addition, the soil must adsorb (collect on the surface of soil grains) and store sufficient water for plant growth. At the same time, some water should drain out to furnish room

Study the soil profile.

for air needed for root growth and to let bacteria work.

Soils with excellent internal drainage consist of about 25 percent air space and 25 percent water storage space. Soils with slow water movement warm up rather slowly in the spring. Furthermore, organic matter decomposes slowly and release of plant nutrients is also slowed. This condition is generally due to a high water table. Internal drainage may be excessive, causing droughtiness in very sandy or gravelly soils.

Internal drainage in soils is judged by: (1) color of subsoil, and (2) texture and structure of subsoil. When air is always present in the subsoil, the soil is a brightly colored tan or yellow due to rusting of the iron content. If no air is in the soil for a long time, the soil color becomes dull gray. If air is missing for only part of each season, the subsoil becomes mottled. That is, it has splotches of tan or yellow mixed with dull gray. Be careful not to confuse lime deposits in bright tan or yellow subsoil with mottling.

It is evident then that as color changes from dull gray to mottled to bright tan, yellow, or red, internal drainage is increasingly better. Sometimes very fine-textured depressional soils are dark colored to a considerable depth due to a large organic matter supply. But, these soils still have poor internal drainage. Such poor drainage may be caused by a high water table. This problem may occur in fine- or coarse-textured soils and often in organic soils.

Internal drainage is divided into five groups on your scorecard: good, moderate, somewhat poor, poor or very poor, and excessive.

Good internal drainage is usually evidenced by a bright tan, yellow, or red subsoil. The subsoil is uniform in color throughout its entire depth. Crops produce best in this soil. It may be necessary to watch organic matter content, but deep-rooted legumes are not required to help drainage.

Moderate internal drainage is evidenced by a bright tan or yellow upper subsoil with lower levels gray or, at best, mottled. In some cases tiling or ditching may be needed. Usually the use of deep-rooted legumes provides enough drainage. There is really little difference between good and moderate.

Somewhat poor internal drainage is indicated by a mottled upper subsoil while the lower part is gray or mottled. Tiling or ditching is usually needed. The use of deep-rooted legumes will help improve drainage.

Poor or very poor internal drainage makes the entire subsoil dull gray or mottled. Occasionally, bright colored soils have poor drainage because their texture is extremely fine and in poor tilth. Some of these subsoils may be olive colored. Soils can be dark in color and still be poorly drained. With such soils the frequent use of deep-rooted legumes is important. You may correct poor internal drainage caused by a high water table by tiling and/or ditching. If soil texture is extremely fine you may have to reduce the distance between the tile lines.

Excessive internal drainage occurs in subsoils that are usually bright and uniform in color but are so coarse in texture that much water drains away. These very sandy or gravelly subsoils are so droughty that roots often can't penetrate deeply. Use of these soils for cropland is hazardous and possible only if you make heavy and frequent applications of organic matter. This lack of organic matter is due to leaching and to the low clay content of the soil.

Slope

Slope is an important factor in judging soils. It influences the amount of surface soil formed, water runoff, and water erosion. Keep in mind three characteristics of slope when judging its effects. These are percentage of slope (steepness), length of slope, and uniformity of slope.

The **percentage** of slope influences the speed of water runoff. If the percentage of a slope (number of feet of drop per 100 feet of slope) is doubled, the speed of water running off is increased four times. This increases erosion 64 times. Some slope may be of value on soils with poor internal drainage if surplus water runs off slowly. However, steep slopes make handling of machinery difficult or even impossible.

The **length** of slope governs the amount of water runoff and, thus, the amount of erosion. The lower part of the slope is usually the hardest hit by erosion. Practices such as contouring and terracing break long slopes into shorter sections. These are important in water erosion control.

Irregular slopes, those with knobs and low spots, tend to gather water in certain spots and then form gullies. It is often impossible to contour or terrace these slopes for water erosion control. Thus, grasses and legumes must form a major portion of the crop rotation on steeper slopes.

It will be of value for you to practice estimating slope percentages. You cannot use a device during a land-judging contest in Minnesota. A simple device for checking your estimates is made from a stout string 100 inches long, a stonemason's line-level, and a yardstick. One person holds the string at ground level. After placing the line-level in the middle of the string, another person stretches the string downhill. The cord is raised or lowered until it is level. The distance from the end of the string to the ground is measured in inches. Each inch represents 1 percent of slope. Or, you can request a Slope Finder Kit from your county extension agent and make your own device.

The slope groups used in Minnesota are as follows:

Nearly level—0 to 2 percent. On this slope, water erosion is not usually a problem. However, surface drainage generally is a problem with fine-textured soils. The use of a legume promotes internal drainage. The amount and type of legume used in crop rotation are governed by tilth, as well as surface and internal drainage needs. Such practices as ditching, bedding, and making diversions to handle surface water are often necessary on poorly drained soils.

Some land with 2 percent slope may not need better drainage. In fact, it may be droughty.

Gently sloping—over 2 to 6 percent. Erosion is a problem but not generally serious unless slope is long. Usually about one-third sod in the crop rotation controls erosion. If slopes are long and uniform (no knobs), it is often possible to break them up with contour strips or terraces. These practices may reduce the sod necessary for erosion control to less than one-third of the crop rotation. If slopes are not too long, simple contouring is effective if used with caution.

Moderately sloping—over 6 to 12 percent. Here erosion is a definite problem. Generally, it takes one-half sod to control erosion plus mechanical practices such as contouring or terracing. When practicable, field strips, contour strips, terraces, and diversions reduce the sod needed. Be careful to control gullies on such slopes. Grassed waterways are ordinarily used along with the other practices. How-

ever, the use of terraces may be limited on the steeper slopes.

Strongly sloping—over 18 percent. Erosion is a serious problem and gullies form easily. These soils may be droughty if shallow or coarse textured. Generally, the crop rotation needs to have at least two-thirds sod for erosion control. Terracing is not advisable.

Steep—over 18 percent. This is usually too sloping for crops in Minnesota. It is best suited for pasture or woodland or, in the case of steep, rocky land, for wildlife.

Erosion

Prevention or control of erosion stops the loss of surface soil with its organic matter, plant nutrients, and good tilth. We are speaking of manmade erosion and both wind and water erosion are included.

Water erosion occurs when beating raindrops scatter soil particles, especially on bare soil. The runoff water then carries these soil particles away. Therefore, the first principle in controlling soil erosion is to protect slope surfaces with vegetation as much as possible.

On uniform slopes, soil loss usually occurs as sheet or rill erosion. Sheet erosion is a gradual but fairly uniform loss of surface soil from all parts of the slope. Rills are little gullies that are easily hidden with the next tillage operation. If not controlled, rills may develop into large gullies. Because sheet or rill erosion is not as obvious as gully erosion, the problem is often far advanced when recognized. On irregular slopes where water concentrates, gully erosion may start soon after fields are first plowed. Grassed waterways in most cases prevent soil loss by gullying.

The seriousness of soil erosion on any field depends on surface soil depth, kind of subsoil, and presence of gullies. Where surface soil formed for centuries under grass (prairies), there usually are several inches of dark surface soil high in organic matter. More surface soil may be lost in these areas than in forest soil areas where the dark-colored surface is very shallow before erosion becomes serious.

Some soils, particularly those formed from wind-deposited materials (called loess), have deep silty subsoils. If not gullied, these soils can be built up to good production more easily after losing their surface soil than soils with coarse or very fine-textured subsoils.

It is difficult to evaluate some erosion effects on productivity. You must judge erosion in terms of how much surface soil remains. At most judging areas, undisturbed soil is rarely available for determining how much erosion occurred from a cultivated field. Therefore, the approximate original depth of the surface soil is given on the field placard.

In certain areas we find a condition opposite of erosion—deposits of soil brought by wind or water from other areas. We do not upgrade a soil because of a deposition, no matter how good the material.

None-to-slight erosion occurred when at least two-thirds of the original surface soil remains. Sheet erosion is usually the cause. Gullies are seldom present.

Moderate erosion took place if one- to two-thirds of the surface soil remains. Sheet erosion predominates. Rills (little gullies about 1 inch deep) occur before cultivation erases them. Some small gullies may be present but they are not too deep to be crossed by your farm implements.

Severe erosion occurred if less than one-third of the original surface soil remains. Gullies are usually present and often cannot be crossed with farm ma-

chinery. On such a field erosion develops faster if no control methods are used. The subsoil, having much less organic matter, erodes easily. A field in this condition generally has subsoil exposed in many areas. Where wind erosion is severe, small dunes or drifts of soil are seen in the fence rows or in road ditches.

Surface Water Runoff

This section deals with the length of time water remains on the land surface. The water may be from rains, overflow from streams, or seepage from springs. It is influenced by the rate of runoff and percolation (rate of water movement down into the soil). Drowning of crops, slow soil warmup in spring, tillage operation hazards, and droughtiness (with excessive drainage) are problems caused by surface drainage conditions.

Good surface runoff presents no serious problems. Slope may remove water. Or, if the field is nearly level, coarser soil texture allows ample percolation.

Fair surface runoff may prevail on a nearly level field where water only occasionally stands long enough to destroy crops. Percolation is generally good. On bottomlands, overflow from streams rarely occurs. Tillage operations may be hampered when drainage is only fair.

Poor surface runoff usually occurs in a low area on fine-textured soil. Both runoff and percolation are slow. Bottomlands with poor surface drainage frequently permit flood waters to remain long enough to destroy crops. On slight slopes below seepage areas, surface drainage may be poor if texture is somewhat fine.

Excessive runoff usually indicates that slope is pronounced or soil texture is loose sand or gravel. Soils are droughty.

Major Factors

We are concerned here with deciding which of four features of land and soil have faults that place the land below Class I. Color does not affect the inherent capability of land. There may be more than one major fault.

If you think that the area being judged is Class I land, only check the item "no serious faults" on your scorecard.

EROSION is a serious fault if the soil is susceptible to erosion (wind or water) or if damage already occurred.

WATER is a dominant hazard if in excess. This includes poor drainage wetness, high water table, or overflow.

SOIL with limitations in the root zone area such as shallowness, coarse texture, stoniness, or drought is a hazard.

CLIMATE is a hazard when: (1) temperature during the growing season may be excessively high or low or (2) the growing season is too short for economical crop production. This condition might prevail in the northern third of Minnesota and in some other isolated areas.

NO SERIOUS FAULT—If this situation prevails, the land is classed as No. I. It would be No. I if:

- It has any of the three plow layer colors.

- Plow layer is medium or fine textured.
- Depth is deep.
  Or, if medium, all other features are good.
- Internal drainage is good.
- Slope is nearly level.
- Erosion is none to slight.
- Surface runoff is good.

Land Capability Classes

Classify land for its most intensive use. The land class cannot be better than that reflected in the lowest rating of any physical feature except color. Color of surface soil usually has no bearing on land class designations.

One physical feature does not necessarily set the capability class. You must consider all six, except color. Deficiencies of physical features will guide you in determining the major factors. These will in turn guide you in selecting the proper land capability class.

Capability Class I includes land rated average or better on all physical features except color. Color darkness indicates the organic matter content and natural nitrogen level. We therefore expect Class I land to be of medium or fine texture, deep, of good or moderate internal drainage, nearly level, none to slight in erosion, and rated good as to the surface runoff.

Capability Class II includes land rated good from every standpoint but with certain physical conditions that make it less desirable than Class I. The surface soil color and texture as well as the subsoil depth might be satisfactory. The internal drainage of the land may be a little too slow or too rapid for Class I. There may be enough slope to create a water erosion hazard. Or, the climate or texture may create a wind erosion hazard.

Capability Class III includes areas that are moderately good for cultivation. This land is more limited in use than

General guides for selecting cultivable land classes

Physical feature	Best land class possible*
Texture:	
Fine or medium	I or II
Moderately coarse	III or II
Coarse	IV
Depth:	
Deep	I
Medium	II
Shallow	IV or III
Internal drainage:	
Good or moderate	I
Somewhat poor	II
Poor or very poor	III or II
Excessive	IV
Slope:	
Nearly level	I
Gently sloping	II
Moderately sloping	III
Strongly sloping	IV
Steep	VI
Erosion:	
None to slight	I
Moderate	II
Severe	Moderate slope, III; steep, VI
Runoff:	
Good	I
Fair	III or II
Poor	III or IV
Excessive	III

* The class listed first usually is the proper selection. But, judgment must be used as to the hazard involved. This table is not an absolute yardstick.

Class II land because of one or more detrimental physical features. Some of these features are moderate slope, coarse-textured surface, moderate or severe erosion, poor drainage, and a shallow root zone. These less desirable physical features call for intensive soil-conserving practices.

Capability Class IV includes land good enough for occasional but not regular cultivation. Generally speaking it can be cultivated safely perhaps 1 year in 6. In other years its best use is for sod crops. If nearly level, it is usually too sandy and, therefore, very droughty.

Capability Class V land is nearly level and not subject to erosion. Because of excessive wetness due to overflow or some permanent obstruction like excessive stoniness or rock outcrops, it is not suited for cultivation. The land has few limitations for grazing or forestry use. Good management is needed for satisfactory production of either grass or trees.

Capability Class VI land is not suitable for any cultivation. It also is somewhat limited for grazing or forestry by such features as shallow soil or steep slopes. Wherever rainfall is adequate for crop production, the limitations of Class VI land are usually steep slopes or shallow soil. This is good land for forestry or for grazing although not so good as parts of the cultivable land classes.

Capability Class VII is not only unsuited for cultivation but is severely limit-

DEFINITIONS OF LAND CAPABILITIES CLASSES

Suited for cultivation as most intensive use, but may be used in other ways.	Class I	**Few** limitations restrict use.
	Class II	**Some** limitations reduce choice of plants and/or require moderate conservation practices.
	Class III	**Severe** limitations reduce choice of plants and/or require special conservation practices.
	Class IV	**Very severe** limitations restrict choice of plants and/or require very careful management.
Land limited in use and not suited for cultivation; suited for grazing, forestry, or wildlife food and cover.	Class V	**Few** limitations for permanent vegetation; no erosion problem, but often subject to overflow; usually wet or stony.
	Class VI	**Some** limitations for permanent vegetation; suited to woodland; often highly eroded or steep.
	Class VII	**Severe** limitations; use restricted to grazing, woodland, or wildlife.
Not suited to any productive vegetation.	Class VIII	Land only suited to wildlife, recreation, or water supply.

ed for grazing or forestry. It requires extreme care to control or prevent erosion. In rough, timbered areas its use for either grazing or forestry, of course, requires special care.

Capability Class VIII is only suited for wildlife or recreational purposes. Such land is usually marshy or rocky; therefore, few or none of the physical features are classed as satisfactory.

Recommended Treatments

Land Use

This is the first practice to consider. Your decision on land capability class is your guide for selecting one, and one only, land use. Always select the most intensive use appropriate to proper soil and water conservation and adaptable to other recommended treatments.

Generally, **one-fourth or less** of crops grown on Class I land should be soil conserving (sod); on Class II, **one-fourth to one-third** (inclusive); and on Class III, **one-third to one-half** (inclusive). You can often reduce the amount of sod necessary for erosion control by using appropriate supporting practices (such as terracing or contouring), and by maintaining organic matter with green manure crops or barnyard manure.

Sometimes a green manure crop may be used along with sod in the rotation to adjust to soil needs. For example, when land is placed in Class II because of poor internal drainage, deep-rooted legumes may not be needed every third year. The rotation may be lengthened to 6 years, using an order such as corn, corn, grain with green manure, corn, grain with a legume seeding, and hay. This provides more row crop (one-half instead of one-third) and the same amount of grain (one-third) and of legume for maintenance of tilth (one-third). But, it allows legumes to stay long enough for their roots to penetrate deeply only 1 year out of 6.

Keep in mind that land classified poorer than Class I because of occasional overflow hazard may still need no more than one-fourth soil-conserving crops to maintain tilth and production.

Ordinarily we think of Class IV land as needing **over one-half** of its rotation in conserving crops. Such land might easily need sod continuously, being plowed or renovated only to prepare a seedbed for seeding down again to a sod crop. When the land is reseeded, a small-grain nurse crop might be harvested.

Permanent grassland applies often to land Classes IV, V, or VI.

Woodland might be the most adaptable use for Classes V, VI, or VII. Woodlot protection is vital in an area dedicated to woodlot or forestry use. Protect seedling trees from forest fires and grazing by farm animals.

Wildlife or recreation could be the only most intensive use for land Class VIII and sometimes for Class VII. Ordinarily, only the wildlife need any attention in the land management program. Land used for recreation needs no attention except for fire control. No productive vegetation is expected on this land.

Special Practices

Rough or trash cover tillage may be proper for land Classes I, II, or III. This

is primarily a wind erosion treatment but improves infiltration rate of moisture into soil. It also aids in holding snow cover on land. The plow-plant or minimum tillage systems are part of rough tillage. Likewise, stubble mulching falls within this practice.

Rough or trash tillage leaves a rough, cloddy surface or crop residue in the form of a stubble mulch on the field after working. A clod mulch is better adapted to finer soils. Stubble or trash protection is more easily maintained on coarse, sandy soils. These two methods are grouped together only for scorecard purposes.

Green manure is grass or a mixture of grass and legume planted with small grain. It is used only for plowing under in the fall of the seeding year or the following spring. It adds nitrogen and organic matter to the soil. A light-colored surface soil, medium or coarse textured, often requires this treatment. Green manure helps reduce the number of sod years in a long rotation. Recent study of green manure indicates that it may be left for one hay crop and also as a cover crop.

Tree planting and protection is of considerable value for noncrop land. Included in this grouping would be Christmas tree plantations and reforestation. Farmstead and field shelterbelts are not included here. The protection phase of this practice involves fire control and prevention of grazing, insect, and disease damage.

Under "land use," woodland concerns a land use. In this section, tree planting and protection considers the forest improvement method. Both might be marked in actual land judging.

Proper pasture management principally concerns nonrotation pasture. However, grazing methods such as ration-a-day or other grazing controls are involved. In addition, this type of pasture management includes pasture establishment or renovation; both include seeding, fertilization, and liming when needed. (See special pasture fertility suggestion in fertilizer and soil amendment sections.)

Game cover planting may be used on barren land areas in capability Classes VII and VIII or in field shelterbelts within cropland areas. These plantings usually consist of native shrubs for permanent cover or of sweetclover which acts as a perennial because of its self-seeding habit after the first seeding.

Game food planting often goes hand-in-hand with game cover planting. It involves the planting of grain crops and berry shrubs to provide food for birds and wild animals.

Fertilizer and Soil Amendments

Barnyard manure is usually used for a cultivated or row crop. It also can be used on grain, hay, or pasture if supply is plentiful. (See the discussion of manure under nitrogen, phosphorus, and potassium.) If the field placard states that barnyard manure is available, it is in plentiful supply for this field for the next crop year if you think it proper to use.

Nitrogen (N) fertilizer needs must be determined by organic matter content (color and depth of surface soil), soil texture, percent of erosion, and the previous crop grown. If surface soil is dark and deep, if a legume was not the preceding crop, and if manure was not used, apply nitrogen for corn, potatoes, sugar beets, and small grains without a legume seeding.

Most corn fertilizer mixtures contain some starter nitrogen. Therefore, for all crops and soils, check nitrogen on the

scorecard when you desire its further use such as for sidedressing.

On medium dark soil some nitrogen is needed for corn even though legumes were just grown, unless adequate manure application is planned. This is especially true if surface soil depth was reduced by erosion. Small grains do not need extra nitrogen on medium dark soils if they follow legumes or if you use barnyard manure. Small grains seeded with legumes on medium dark soils may need a light application of nitrogen. If manure is not used, indicate nitrogen for permanent grass pastures, bromegrass, and other grasses.

On light colored soils, especially if surface soil is shallow due to erosion or is coarse textured, some nitrogen is needed for a starter on corn or potatoes. This nitrogen is necessary even though both legumes and a barnyard manure application are included in the management program. Nitrogen is needed on small grains—both with and without legume and grass seedings—unless the preceding crop was a legume or if manure is used. Unless heavily manured, permanent grass pastures need nitrogen.

If the soil is a raw, undecomposed (brown) peat, application of nitrogen may be helpful—unless manure is applied or the next crop is to be a legume. If this soil was cropped for many years (and some decomposition took place), some nitrogen is probably beneficial unless a legume was the preceding crop or manure is used.

Phosphorus (P) should be checked if the soil tests medium or low, even if manure is to be added. For corn, check phosphorus even if the soil tests high.

Potassium (K) is needed for corn, legumes, potatoes, and sugar beets when the soil test shows medium—unless you plan a fairly heavy application of barnyard manure. If the test is low, apply potassium for all of these crops even though you plan to manure. Also use potassium on a low-testing soil for such grains as oats, barley, wheat, and flax, and for permanent pasture grass if no manure is to be used. For flax apply phosphorus and potassium only on a low test unless it is being seeded down.

You have been considering the need of the soil for individual plant nutrients: nitrogen, phosphorus, and potassium. Remember that in many cases where two or three nutrients are required, they will all be applied in a single fertilizer. There are fertilizers that contain only nitrogen, only phosphorus, or only potassium. There are also those that contain combinations of these nutrients.

On organic soils the first requirement is usually for both phosphorus and potassium. Most peats being farmed are well supplied with lime. Occasionally there are peats that require lime in addition to phosphorus and potassium.

In all the above recommendations where a legume is involved do not count the preceding crop as a legume unless the sod is at least 50 percent legume and 50 percent or less grass.

Special Pasture Fertilizer Treatments

Grass pastures—Rotational or ration-a-day grazing must be accompanied by intensive fertilization on permanent grass pasture. Apply phosphorus or potassium according to soil test. Make a nitrogen application of 30 to 50 pounds per acre after each harvest or grazing period.

Legume-grass pastures — Established stands of legume-grass mixtures should receive annual applications of phosphorus and potassium according to soil test. In addition to the phosphorus and potassium, use an annual application of 30 to 50 pounds nitrogen per acre for pasture.

The land-judging procedure determines which soil additives are necessary but not how much of each is needed.

Lime is needed if the pH reading on a mineral soil is below 6.3. On peat soils, use lime when the pH reading is below 5.4. The pH reading on peat soils cannot be interpreted in the same manner as the reading on mineral soils. Often lime may not be needed for the next crop. But, if the pH is below 5.3 for peat or 6.3 for mineral soil, check lime as it will be needed for the succeeding crops.

Gypsum (sulphur) should be applied if the field placard indicates a low or medium level.

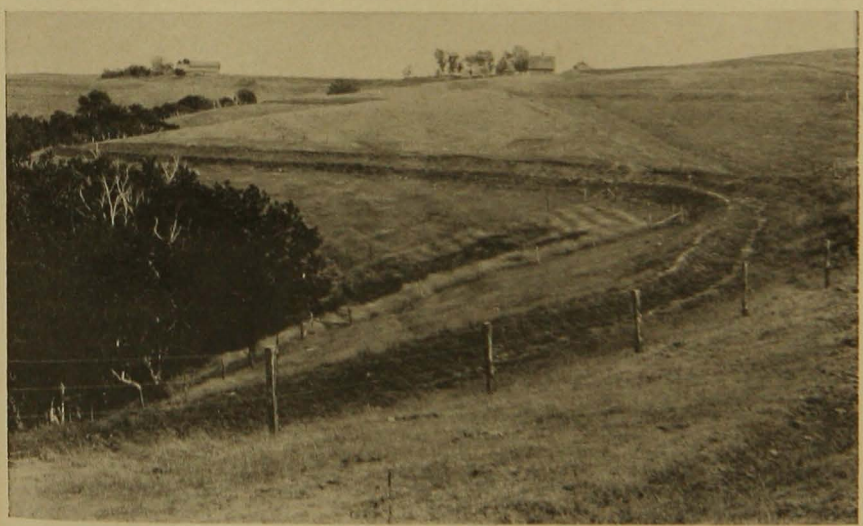
Mechanical Practices

Mechanical practices are concerned mostly with wind and water erosion and drainage and water control for land Classes I through IV. Some practices such as gully control, drainage and water control, and water storage or detention are effective on lower class land.

In case of a drainage need, check that item without regard to the system to be used. In actual operation it is presumed that you will use the proper type of drainage—tile, open ditch, or bedding. These practices may be effective in conserving moisture or removing excess water from cropland.

Contouring only is proper on gentler slopes or more drastic slopes if you plan only to prepare a seedbed on old sod for reseeding to a new sod crop. It consists of working the land along the slope. This practice is effective on gentle slopes of 2 to 5 percent, not over 300 feet long. Other practices are recommended for slopes steeper than 5 or 6 percent, unless it is Class IV land and in sod at least half the time.

Contour strip cropping is when strips of sod alternate with strips of small grain or cultivated crops. This is an effective method of water erosion con-



A diversion terrace with field terraces above.

trol on slopes from 3 to 18 percent. Slope steepness and soil type should govern the width of the strips. These may vary from 60 to 125 feet. Steeper slopes and erosive soils require narrower strips.

Check contour strips if the slope is not too uniform. Grassed waterways make up for control of uneven or non-uniform slopes. Contour strips and terraces (see below) may be parallel or adhere exactly to the contour.

A good sod waterway.

Terraces are ridges of soil, approximately on the contour. They act as barriers to retard water on its downhill run. They often can be used to reduce the sod necessary for erosion control.

Terraces must be laid out to an exact and very gradual grade. Thus channels on the upper sides can slowly lead excess water off the field to a sodded outlet area. This outlet might be one or more sod waterways. When the terrace method is used, the whole field may be put into one crop. But, all farm operations must be parallel to the terraces. Terraces are recommended only on uniform slopes of less than 10 or 12 percent. They are especially effective on long slopes, 300 feet or over, because they divide the slope.

Terracing combined with strip cropping may be used to advantage on fields with slopes ranging from 7 to 12 percent. This system combines two effective water erosion control methods, thus resulting in greater safety. It also allows more use of intertilled crops than does either method by itself.

Contour only does not need to be checked with contour strip cropping, terracing, or a combination of the two practices.

Diversion terraces, leading excess water off the field, should be considered as part of most terracing programs.

Parallel terraces are often installed but usually require some cutting and filling to compensate for high and low spots in the channel.

A designation of terracing is expected to include maintaining the terrace and a system for proper functioning.

Sod waterways located in the natural flowage areas of a sloping field allow runoff water to move slowly down the drainageway without making gullies. The velocity of the running water is reduced by the grass in the sod. Hence, cutting action of the running water is reduced. As indicated before, sod waterways may be used together with all other water erosion control methods. This practice is recommended if there is evidence of gullying or possible gullying in natural runoff concentration points. It is assumed that there is usually extra runoff water originating in areas above the field being judged.

Gully control may be used where extensive gullies are in existence and beyond repair by simple sod waterways. Diversion terraces are often combined with this practice.

Drainage, in our land judging, is indicated as such if needed. However, we must consider the various types and requirements. It is expected that in actual operation the proper drainage system is used.

Drain tile may be installed in fields of poorly drained soils. A suitable outlet must be found before tiling can be recommended. Drain tiles are effective in draining areas where water stands much of the growing season. Moreover, they effectively remove excess water held in the soil where it is detrimental to crop growth. Tile systems are often used to keep seepage areas on slopes dry enough to be worked.

Open ditches are frequently used where a heavy water runoff must be disposed of quickly. Ditches are also adapted for areas requiring removal of considerable water throughout the year. They are appropriate for drainage of large potholes, marshes, or bogs. Open ditches are used under the assumption that drainage is possible and necessary.

Bedding, a type of open ditch, may be used on nearly level fields with highly impenetrable soils. The bedding method provides flat areas with a series of shallow, dead-furrowlike ditches at regular intervals. They lead the surface water into a larger open ditch. Small bedding ditches may be crossed with farm implements but should be kept open to work properly. This practice may be combined with land leveling.

Tile drainage is impractical in the northern half of Minnesota due to the tile cost in relation to land values and potential income.

Wind strips, known usually as field strip cropping, are effective and recommended for wind erosion control. These strips are of alternate sod or stubble crops (or row crops). Check this practice where wind erosion is present or where it is a potential problem.

Field shelterbelts are used for wind-erosion control. In addition they act as snow catches for additional field moisture conservation and winter ground cover. They also protect crops from hot, dry winds. They may be made of one or more rows of shrubs or trees planted at a right angle to prevailing winds. In the past they were usually made up of three to five rows of trees with a row of dense shrubs on either side. With such a belt, wind protection is effective for a distance 20 times the height of the trees. Strips should not be closer than 150 feet to a highway in order to prevent snow from drifting on to the highway.

Recent studies prove that a one-row shelterbelt is very effective and economi-

A two-row shelterbelt in June and January.

cal as to planting cost and acreage usage. Experts found that a filter belt is more advantageous than a belt that attempts to be a complete wind block.

Water storage or detention devices have their usage determined by the terrain or topography of land, erodibility of soil, and size of drainage area.

Water storage areas may be simple dug ponds on flatter land. They are used mainly for stock watering. They usually are not involved in water-erosion control. In some instances the ponds may be stocked with fish or used for other recreational purposes. You can construct them by using an earth dam rather than simple excavation if the terrain allows it.

Detention devices hold excess water and let it down gradually to minimize flood damage from flash runoff of heavy rains or fast snow melt. These structures are built to hold a large volume of water but may be nearly dry during times of little precipitation.

In practically all instances, these devices ought to be aided by control practices on the land above such as terraces and contour strip cropping to prevent excess silting in reservoirs.

Fence any water holding or storage area for safety and to prevent damage by trampling shore lines or pond banks.

These structures are often a part of a gully control program.

Field Placard and Scorecard

These data should be determined before a judging event and posted at each profile pit and field being judged. They guide both leaders and participants.

Fertility items are listed high, medium, or low. The pH is given in actual figures. "Crop next year" refers to crop next to be harvested.

Field No._____

N_____ Slope length_____feet

P_____ Depth original top soil_____inches

K_____ Field size_____acres

S_____ Crop last year_____

pH_____ Crop next year_____

Recommended Practices

	Number
Land use	Check_____
Special practices	Check_____
Fertilizer and amendments	Check_____
Mechanical	Check_____

Land Judging Scorecard, Agricultural Extension Service
University of Minnesota

Participant No.____ Name_____

Field No.____ Address_____ County or School_____

Score	PART I PHYSICAL FEATURES 42 points (check only one in each section)
	Color of Plow Layer ☐ Dark ☐ Medium ☐ Light
	Texture of Plow Layer ☐ Fine ☐ Medium ☐ Moderately coarse ☐ Coarse
	Depth Favorable to Roots ☐ Deep ☐ Medium ☐ Shallow
	Internal Drainage ☐ Good or moderate ☐ Somewhat poor ☐ Poor or very poor ☐ Excessive
	Slope ☐ Nearly level ☐ Gently sloping ☐ Moderately sloping ☐ Strongly sloping ☐ Steep
	Erosion ☐ None to slight ☐ Moderate ☐ Severe
	Surface Water Runoff ☐ Good ☐ Fair ☐ Poor ☐ Excessive
X	PART II MAJOR FACTORS 5 points
	☐ *Erosion*—past damage; future hazard ☐ *Water*—hazard of wetness ☐ *Soil*—limitations in the root zone ☐ *Climate*—temperature; very short growing season ☐ *No serious fault*

Score	PART III LAND CAPABILITY CLASS 5 points
	I II III IV V VI VII VIII Circle *one* of the above
X	PART IV RECOMMENDED TREATMENTS 48 points
	Land Use—check only one ☐ Sod—less than ¼ of time ☐ Sod—¼ to ⅓ of time ☐ Sod—⅓ to ½ of time ☐ Sod—over ½ of time ☐ Permanent grassland ☐ Woodland ☐ Wildlife or recreation
	Special Practices ☐ Rough or trash cover tillage ☐ Green manure ☐ Tree planting and protection ☐ Proper pasture management ☐ Game cover or food planting
	Fertilizer and Soil Amendments ☐ Barnyard manure ☐ Nitrogen ☐ Phosphorus ☐ Potassium ☐ Lime ☐ Gypsum (sulphur)
	Mechanical ☐ Contouring only ☐ Contour strips ☐ Terrace and maintain ☐ Sod waterway ☐ Gully control ☐ Drainage ☐ Windstrips ☐ Field shelterbelt ☐ Water storage or detention device

SCORE

_____ Part I _____ Part III

_____ Part II _____ Part IV

_____ TOTAL

Grading the Scorecard

(Never record a minus score in any section.)

Part I. Physical Features

Allow 6 points for each of the seven features. Place score for each in the column to the left.

If the wrong box is checked or if a feature is not marked, the score for that feature is zero.

In certain instances, judges may allow an alternative choice if the decision is close. The master scorecard or "key" indicates what is acceptable.

Add points and place the total in Part I in score box at lower right of card.

Part II. Major Factors

Allow 5 points for marking correctly.

Deduct 1 point for each factor marked incorrectly or correct factor not marked.

Place score in score column to the left and transfer it to Part II in the score box.

Part III. Land Capability Class

Allow 5 points if correct class number is circled. If more than one number is circled, the score is zero.

If the circle is one class off of correct, allow 3 points credit. This rule does not apply between Class IV and V land.

Place score in score column and transfer it to lower right score box, Part III.

Part IV. Recommended Treatments

Allow 12 points for each of the four sections. Notice the number of treatments listed on the field placard for each. The judges assign point values when more than one treatment is recommended.

No score in any section will be lower than zero.

Land use. Only *one* item is allowed. If more than one or if none are marked, the score is zero. The judges may allow alternative selections. Insert score in left column.

Special practices. If only one correct practice is recommended and marked, allow 12 points. If more than one is recommended, the judges assign credits for each to total 12 points. Insert score in left column. Take 2 points off for each marked incorrectly. Give no credit for recommended treatments not marked.

Fertilizer and Soil Amendments. Judges assign point values to each item to be checked according to field placard. Insert score in left column. Take 2 points off each marked incorrectly. Give no credit for recommended treatments not marked.

Mechanical. The judges assign point value if more than one practice is recommended. If only one is required, 12 points is the value. Alternative practices may be allowed by the judges and will be noted on "key" card. Take 2 points off for each marked incorrectly. Give no credit for recommended treatments not marked. Insert score in left column.

Add the scores for each of the four sections of Part IV and insert in the lower right score box, Part IV.

Add the scores for the four parts of the card and insert in "total" space.

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