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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 that we will know the uses for which they are best suited. Thus we can plan soil management practices that will 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 is prepared to aid in studying, interpreting and understanding the Minnesota Land Judging Score Card (Form S-31). A copy of the score card is on pages 18, 19, and 20 of this publication.

By following the score card closely in studying the soil we learn how to use the land and manage it. Part I guides us in taking an inventory of the soil. From it we can determine the principal faults of the field area which are recorded in Part II. The completion of Part III of the card will indicate the land capability class to which we think the land belongs. In Part IV, the appropriate land use system or rotation is selected. From the information gained and recorded the land judge selects the proper supporting practices in Part V of the card.

Within each field area to be judged, a pit will be dug to expose the soil profile. A soil profile is a vertical (up-and-down) cross section of the soil down to the unweathered underlying material. In addition, a placard will be displayed indicating the soil tests, original depth of the surface soil, availability of barnyard manure, etc.

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Part I. *Physical Features of the Soil*

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

Color of Surface Soil

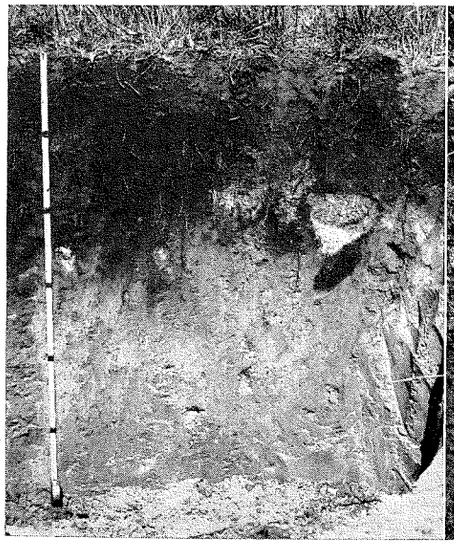
The darkness of the surface soil color is a good measure of how much organic matter it contains. Organic matter content tells you two things about the soil: its tilth and its ability to supply nitrogen to growing crops.

Soils high in organic matter usually have good tilth. That is, they work easily; do not become cloddy and do not crust after rains; take in water readily; store water for crop use; and resist erosion. Soils high in organic matter are capable of furnishing considerable nitrogen to crops, if weather conditions are favorable for the decay of the organic matter. Through this decay essential elements such as nitrogen, phosphorus, potassium, sulfur, calcium, and magnesium are made available.

Soil should be moist when determining color because the color variations are then easier to see. For example, a dark soil high in lime may be decidedly grayish when dry, due to the lime, but darker when moist. In judging the color of the surface soil, we study the layer (horizon) from the top down to the first real change in color. This change is usually easy to recognize in **prairie** soils.

In some cases, however, the organic matter has leached downward, blending the dark color into the subsoil. This makes it more difficult to detect the exact line between the surface soil and the subsoil.

In soils of **forest** origin that have not been disturbed, the top few inches are dark, but just below this there may be a gray-colored layer. Both of these lay-



Prairie Soil

Forest Soil

ers are part of the surface soil. Below the light-colored layer the soil usually is somewhat darker in color. This pattern in forest soils is due to the leaching of organic matter from the lower surface soil into the subsoil.

On your score card, "Color of Surface Soil" is divided into three groups.

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

MEDIUM DARK mineral soils are dark brown to grayish brown in color. They have only a fair to low supply of organic matter and, even though they work easily and are reasonably fertile, will probably need careful attention in order to keep organic matter up. The crop rotation should contain more legume and grass than in the case of 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 a definite shortage of organic matter and nitrogen. If the soil texture is fine, tilth is generally poor. Take special care to use plenty of legumes green manure crops, crop residues, and barnyard manure, since these soils need organic matter. Corn planted in such soils will usually need nitrogen, unless the previous crop was a legume and the field has been manured.

Texture of Surface Soil

Soil texture refers to the size of the soil particles. It varies according to the proportion of sand, silt, and clay in the soil. Texture probably exerts more influence on productivity and on type of management, especially organic matter and fertilizer needs, than any other physical property of soils. 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 the subsoil must be considered.

Surface texture is an important factor in good tilth. It influences drainage, maintenance of organic matter, lime and fertilizer needs, and resistance to erosion. 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 quite difficult to increase the organic matter content in coarse soils. They benefit from additions of fresh organic matter in the form of legumes, green manure crops, or barnyard manure every year. Coarse soils need less lime than fine soils to correct acidity but must have more frequent applications. They leach easily and are limited in production because they lack the capacity to hold plant nutrients and water. Therefore, fertilizers should be supplied more on a year-to-year or crop basis on coarse than on fine soils.

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

To determine texture, rub a small amount of moist soil between your thumb and finger. Sand particles feel distinctly 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. Since most soils have a mixture of all sizes of particles it is necessary to determine which will be the most important.

Soils are given texture names which indicate the relative importance of the various sizes of particles. For example,

sand is placed last in the term "loamy sand" because it is the most important particle in that soil.

FINE soils include clays and silty clay loams—that is, soils that are made up of at least 27 percent clay. Fine soils usually feel smooth and are always sticky when moist. When the moist soil is rubbed or squeezed between your thumb and finger, it ribbons out like toothpaste. However, when they are dry, the small clods are very difficult to break. The finer-textured soils in this group, the clays, require very 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. Ordinarily they feel velvety between the fingers when moist but are not very sticky. Some have a slight grittiness because of the sand grains present. These medium-textured surface soils are the easiest to till.

MODERATELY COARSE surface soils include the sandy loams. They have 43 percent or more of 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 have enough clay or silt to prevent a handful of the moist soil from falling apart readily after being gripped tightly in the hand. These soils may be subject to drought and are easily affected by temperature changes. Tilth is usually a minor problem.

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

ORGANIC is listed as a soil texture, although truly it is not. When judging peat or muck soil list the texture as "organic." Well-decomposed peat or muck may feel fine in texture but as it is not sticky—no clay content—it is not a "fine"-textured soil.

Depth Favorable for Root Growth

The combined depth of the surface soil and the subsoil easily penetrated by roots is of great importance. The greater this favorable depth, the greater the food and water storage zone. The corn plant, for example, will feed 42 inches deep, grain less, and alfalfa more. Some of the characteristics of a soil which may curtail root penetration and retard growth are clay pans, gravel layers, bedrock, or a high water table. Sand does not necessarily limit depth. It does cause excessive internal drainage and droughtiness.

Deep soil favorable to root growth should have a thickness of at least 36 inches. Many good soils are deeper. A **medium soil** (20 to 36 inches thick) is classed as moderately good. A **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 be able to move easily in both the surface soil and subsoil for proper plant growth. In addition, the soil must be able to adsorb (collect on the surface of the soil grains) and store sufficient water for plant growth. At the same time some water should drain out to furnish room for the air needed for root growth and to let bacteria work.

Soils with excellent internal drainage are made up of about 25 percent air space and 25 percent water storage. Soils with slow water movement warm up rather slowly in the spring, organic matter decomposes slowly, and the 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 soils that are very sandy or gravelly.

Internal drainage in soils is judged by (1) color of subsoil and (2) texture and structure of subsoil. When air is present in the subsoil at all times, the soil will be a brightly colored tan or yellow due to the rusting of the iron. If there is no air in the soil for a long time, the soil color becomes a dull gray. If air is missing for only a 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 an otherwise bright tan or yellow subsoil with mottling.

It is evident then that as the color changes from dull gray to a mottled color to bright tan or 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 supply of organic matter, and still they have poor internal drainage. Such poor drainage may be caused by a high water table—a problem that may occur in either fine or coarse-textured soils and very often in organic soils.

Internal drainage has been divided in four groups on your score card: Poor, Moderate, Good, and Excessive.

POOR drainage makes the entire subsoil dull gray or mottled. Occasionally soils must be classified as having poor drainage even though they are somewhat bright colored because the 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 very important. Poor internal drainage caused by a high water table may be remedied by tiling or ditching, or both. In case the soil texture is extremely fine you may have to reduce the distance between the tile lines.

MODERATE internal drainage is evidenced by a bright-colored (tan or yellow) upper subsoil with lower levels gray or, at best, only mottled. In some cases tiling or ditching may be needed, but usually the use of deep-rooted legumes provides enough drainage.

GOOD internal drainage is usually evidenced by a bright (tan or yellow or red) subsoil and is uniform in color throughout its entire depth. Crops produce to their utmost in this soil. It may be necessary to keep an eye on the organic matter content, but deep-rooted legumes are not required to help the drainage.

EXCESSIVE internal drainage occurs in subsoils which 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 droughty, often to the extent that roots cannot penetrate very deeply. Use of these soils for cropland is hazardous and is only possible if heavy and frequent applications of organic matter are made. This lack of organic matter is due to leaching and to the low clay content.

Slope

Slope is an important factor in judging soils because of its influence on the amount of surface soil formed, on water runoff, and on soil erosion. Three characteristics of slope must be kept in mind in judging its effects. These are percentage of slope (steepness), length of slope, and uniformity of the 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 the surplus water runs off slowly. However, steep slopes make handling of machinery rather difficult or in some cases impossible.

The **length** of slope governs the amount of water that can run off and thus the amount of erosion taking place. The lower part of the slope is usually the hardest hit by erosion. Practices such as contouring and terracing that will break long slopes into shorter sections are important in water erosion control. Irregular slopes, those with knobs and low spots, tend to hold water in certain spots and then form gullies. On this kind of slope it is often impossible to contour or terrace for water erosion control. Thus, grasses and legumes must form a major portion of the crop rotation on steep slopes.

It will be of value for you to practice estimating slope percentages since no device may be used during a land judging contest in Minnesota. A simple device for checking your estimates is one made from a stout string 100 inches long, a stone mason's line level, and a yardstick. One person holds the string at the ground level and 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 may 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 usually not a problem but surface drainage generally is with fine-textured soils. The use of a legume promotes surface drainage. However, the amount and type of legume used in the crop rotation will be governed by the tilth of the soil, as well as by surface and internal drainage needs. Such practices as ditching, bedding, and diversions to handle surface water are often necessary.

Some land with a 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 is not generally serious unless the slope is long. Usually about one-third sod in the crop rotation will control erosion. If the slopes are long and uniform (no knobs), it is often possible to break up the slope 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 the 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 without additional mechanical practices such as contouring or terracing. When practicable, field strips, contour strips, terraces, and diversions will reduce the amount of sod needed to offer protection from erosion. Be careful to control gullies on such slopes. Grassed waterways are ordinarily used along with the other practices, but the use of terraces may be somewhat limited on the steeper of these slopes.

STRONGLY SLOPING—over 12 to 18 percent. Here 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 land 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 is important in order to prevent the loss of surface soil with its organic matter, plant nutrients, and good tilth. In considering this physical feature of the land we are speaking of man-made erosion. Both wind and water erosion

are included. Water erosion occurs when beating raindrops disperse soil particles, especially on bare soil. The runoff water can then carry these soil particles away. The first principle in controlling soil erosion, then, is to keep the surface of slopes protected by vegetation as much of the time as possible.

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

The seriousness of soil erosion on any field depends on the depth of the surface soil, the kind of subsoil, and the presence of gullies. In areas where the surface soil has 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 the forest soil areas, where the dark-colored surface was very shallow before erosion became a serious problem.

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 much easier after losing their surface soil than soils with shallow or very fine-textured subsoils.

Since it is difficult to evaluate properly some of the effects of erosion on productivity, you are to judge erosion in terms of how much surface soil remains. At most judging areas, undisturbed soil will rarely be available for determining how much erosion has taken place from a cultivated field. For this reason the approximate original depth of the surface soil will be given on the field placard.

The following terms are used to describe the amount of soil lost by erosion:

DEPOSITS represent that condition where surface soil from another area has been washed or blown onto the field being judged. The thickness of these deposits may vary from less than an inch to several inches. It must be apparent that the deposit is different from the original underlying surface soil.

NONE-TO-SLIGHT erosion occurs when at least two-thirds of the original surface soil remains. Sheet erosion is usually the cause of this situation. Gullies are not always present.

MODERATE erosion has taken place if one-third to two-thirds of the surface soil still remains. Sheet erosion predominates. Rills (little gullies an inch or so deep) occur before cultivation erases them. Some small gullies may be present in this type of erosion but they are not too deep to be crossed by farm implements.

SEVERE erosion has taken place if less than one-third of the original surface soil is left. Gullies are usually present and often cannot be crossed with farm machinery. On a field of this sort, erosion develops at a faster rate if no control methods are used. The subsoil, having much less organic matter, erodes easily, and a field in this condition generally has many areas where the subsoil is exposed. In an area where wind erosion is severe, small dunes or drifts of soil will be seen in the fence rows or road ditches.

SEVERE, WITH GULLYING OR BLOWOUTS is the term used to describe erosion which has practically taken over the field. Gullies of this type are definitely not crossable with farm machinery and need drastic measures for control. The presence of blowouts (irregular basins dug by the wind) indicates that wind erosion has become so

severe that the field can no longer be rated as cropland.

Surface Runoff

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

POOR surface drainage usually occurs in a low area where the soil is fine textured. 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 the soil texture is somewhat fine.

FAIR surface drainage may prevail on a nearly level field where water stands only occasionally for a sufficient length of time to destroy crops. Percolation is generally good. On bottomlands, overflow from streams rarely occurs. Tillage operations may be hampered at times when drainage is only fair.

GOOD surface drainage presents no serious problems. Slope may remove the water or, if the field is nearly level, the coarser texture of the soil allows for ample percolation.

EXCESSIVE drainage usually indicates that the slope is pronounced or that the soil texture is loose sand or gravel. These soils are droughty.

Part II. *Major Faults*

In this section we are concerned with deciding which of six physical features of the land and the soil have faults that will place the land in a class poorer than class one. Color is the one feature which 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, check the item "no serious faults" only.

Part III. *Land Capability Classes*

Land Suited for Cultivation

Land Capability Class I includes land which rated average or better on all the physical features except color. The darkness of the color indicates the organic matter content and natural nitrogen level. We can therefore, expect Class I land to be of medium or fine texture; deep; having good or moderate internal drainage; nearly level; having none to slight erosion; and be rated good as to surface run-off.

Land Capability Class II includes land which may be rated good from every standpoint but which has 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 may be such as to create a wind-erosion hazard.

Land Capability Class III includes areas which are moderately good for

cultivation. This land is more limited in use than 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, or a shallow root zone. These less desirable physical features call for use of intensive soil-conserving practices.

Land Capability Class IV includes land good enough for occasional cultivation but not suited for regular production of cultivated crops. To a large extent it is too steep or too shallow for regular cultivation. Generally speaking it can be cultivated safely, perhaps one year in six; in other years its best use is for sod crops. If it is nearly level, it is usually too sandy and therefore very droughty.

Land Best Suited for Permanent Vegetation

Land 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 for forestry use. Good management is of course needed for satisfactory production of either grass or trees.

Land Capability Class VI land is not suitable for any cutlivation and is limited somewhat for grazing or forestry by such features as shallow soil or steep slopes. Wherever the rainfall is adequate for crop production, the limitations of Class VI land are most likely to be steep slopes or shallow soil. This is good land for forestry or for grazing, although not so good as parts of the cultivatable land classes.

Land Capability Class VII is not only unsuited to cultivation but is severely limited in use for grazing or for forestry. It requires extreme care to control or prevent erosion. In rough, timbered areas its use for either grazing or forestry requires special care.

Land 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.

Part. IV. *Basic Practice*

Now that we have studied the physical features of the soil and the land, have determined the limiting factors of the land classification, and have decided on the land capability group, we are now ready to lay out a proper soil management program for the area.

First, it is necessary to select **one** basic practice such as a rotation system suitable for this field. There may be one or more land use systems adaptable to the field, depending on desirable supporting practices. Keep in mind that you are always to consider the most **intensive** use for which the field is adapted. Also, do not take into consieration the possible needs of the farm operator for livestock feed. Even if you think that more than one basic practice would fit the situation, select only the one that you consider the best.

Proportion of Soil-Conserving Crops in the Rotation

Generally, but not always, at least one-fourth or less of the 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). In many instances the amount of sod necessary for erosion control can be reduced 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 the rotation to the needs of the soil. For example, when the land has been 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 six years, using an order such as corn, corn, grain with green manure, corn, grain with a legume seeding, 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 one year out of six.

Keep in mind that land classified poorer than Class I because of an 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 the first year.

Pasture Renovation

An area adaptable only to pasture might require a complete renovation job, such as is the case with Class V or Class VI land. Renovation involves the killing of the old sod, preparation of a new seedbed, proper liming, fertilization, and reseeding. This situation prevails when the present sod is not satisfactory.

Pasture Maintenance

If the area is too steep, too stony, or too wet to work, perhaps it is best to fertilize the present sod in order to keep it as productive as possible and then have it grazed. The use of a fertilizing program only might apply if that sod is primarily bluegrass.

Forest Planting

If Class VI or Class VII land appears best adapted to forest planting, limit your plans to that use only.

Wildlife or Recreation

Under ordinary circumstances, Class VIII land is adapted only to wildlife uses or recreational purposes. Only the wildlife will need any attention in the land management program. Land used for recreation needs no attention. No productive vegetation is expected on this class land.

Part V. *Supporting Practices*

All the supporting practices appropriate to the basic practice you have selected for the field being judged should be indicated by a check mark. One or more might properly be marked. Indicate only those which you think are needed according to the soil features and land capability which you previously determined. Irrespective of the crop now on the land, all supporting practices needed now or in the future within the rotation cycle or land use plan should be checked.

Fertilizers and Amendments

LIME is needed if the *p*H reading on a mineral soil is below 6.3. On peat soils, lime should be used when the *p*H reading is below 5.4. It should be noted that the *p*H reading on peat soils cannot be interpreted in the same manner as the reading on mineral soils.

NITROGEN fertilizer needs must be determined by the organic matter content (color and deth of surface soil), soil texture, percent of erosion, and the

previous crop grown. If the surface soil is **dark** in color and deep, if a legume has not been the preceding crop, and if manure has not been used, apply nitrogen for corn, potatoes, sugar beets, and small grains without a legume seeding.

We may expect that most fertilizer mixtures will contain some "starter" nitrogen. Therefore, for all crops and soils, check **nitrogen** on the score card when you desire its further use, such as broadcasting or sidedressing.

On **medium dark** soil some nitrogen will be needed for corn even though legumes have just been on the land, unless an adequate application of manure is planned. This is especially true if the surface soil depth has been reduced by erosion. Small grains will not need extra nitrogen on medium dark soils if they follow legumes or if barnyard manure is used. Small grains seeded with legumes on medium dark soils may need a light application of nitrogen. If manure is not used, nitrogen should be indicated for permanent grass pastures, bromegrass, and other grasses.

On **light** soils, especially if the surface soil is shallow due to erosion or is coarse textured, some nitrogen will be needed for a starter on corn or potatoes. This nitrogen will be necessary even though both legumes and an application of barnyard manure 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, an application of nitrogen may be helpful—unless manure is applied or the next crop is to be a legume. If this soil has been cropped for many years (and some decomposition has taken place), some nitrogen will likely be beneficial unless a legume was the preceding crop or manure is used.

PHOSPHORUS should be checked as needed when the soil test shows medium or low, even if barnyard manure is to be added.

POTASSIUM is needed for corn, legumes, potatoes, and sugar beets when the soil test shows medium—unless a fairly heavy application of barnyard manure is planned. If the test is low, apply potassium to 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.

You have been considering the need of the soil for individual plant nutrients: nitrogen (N), phosphorus (P), and potassium (K). It is well to remember that in the many cases where two or all three of the nutrients are required they will be applied in a single fertilizer which contains them. There are fertilizers which contain only N, only P, or only K and there are also those which contain various combinations.

On organic soils the first requirement is usually for both phosphorus and potassium. Most peats being farmed are well supplied with lime, but occasionally there are peats which will 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.

Grass Pastures

Rotational or ration-a-day grazing must accompany the use of intensive fertilizer on permanent grass pastures. Phosphorus or potassium should be applied according to soil test. A nitrogen application of 30 to 50 pounds per acre should be made 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, an annual application of 30 to 50 pounds of nitrogen per acre should be used for pasture.

Manures

Green manure is grass, or a mixture of grass and legume, planted with the small grain and used only for plowing under. It may be plowed under in the fall of the seeding year or the following spring. The principal use of a green manure is to add nitrogen and organic matter to the soil. A light-colored surface soil that is medium or coarse textured often requires this treatment. The use of green manure helps reduce the number of sod years in a long rotation.

Barnyard manure is usually used for a cultivated or row crop but can be used on grain, hay, or pasture if the supply is plentiful. Refer back to the discussion of manure on page 12. If the field placard states that barnyard manure is available, this means that it is in plentiful supply for this field for the next crop year, should you think it proper to use it.

Miscellaneous Measures

Brush or weed removal, either by mechanical or chemical means, is of importance either in the renovation of permanent pastures or in the improvement of native sod pastures. This practice will not only allow more space, light, moisture, and plant food for the pasture plants but will also encourage more efficient grazing.

Woodlot protection is vital in an area dedicated to woodlot or forestry use. Seedling trees should be protected from forest fires and also from grazing by farm animals.

Game cover planting may be used on barren land areas in Capability Classes VII and VIII or in field shelterbelts within the 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 of berry shrubs to provide food for all species of birds and wild animals.

Wind Erosion Control

Field strip cropping is an arrangement whereby at least one strip in three is either hay, pasture, or winter grain. This strip, if possible, should separate the spring small grain and the cultivated crop strips. In Minnesota the strips are usually run crosswise to the prevailing winds. On sandy soils strips cannot exceed 10 to 13 rods in width; on silt and silt loam, 16 rods wide; and on fine-textured soils subject to blowing, not more than 20 rods wide.

Field shelterbelts are ordinarily made up of three to five rows of trees with a row of dense shrubs on either side. Wind protection offered by this belt 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 onto the roadway.

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 while stubble or trash protection is more easily maintained on coarse sandy soils. These two methods are grouped together only for score card purposes.

Cover crops are especially adaptable for controlling wind erosion in areas where a large percentage of intertilled crops are used in the rotation. Winter rye is the most common crop used for this purpose. Sweetclover left over winter would serve the same purpose. Sod crops are not considered cover crops because as hay crops they fit into the strip cropping method of control

or they may form permanent protection when used in pasture areas.

Water Erosion Control

Contouring only consists of working the land along the slope when carrying out field operations. This practice is effective on gentle slopes of 2 to 5 percent which are not over 300 feet long. (See discussion of terraces in relation to long slopes on page 7.) Contouring only is never recommended on slopes steeper than 5 or 6 percent.

Contour strip cropping is an arrangement whereby strips of sod alternate with strips of small grain or cultivated crops. This is an effective method of water erosion control on slopes from 3 to 18 percent. The steepness of the slope and the type of soil should govern the width of the strips, which may vary from 60 to 125 feet. Steeper slopes and erosive soils require narrow strips.

Field strip cropping (also listed under wind erosion) may sometimes be used for controlling water erosion if slopes are too irregular for contour strip cropping. Width of strips should be about the same as for contour strip cropping. This practice should not be used, however, unless approximately 75 percent of the row crop strips follow along the slope and do not go up and down the slope. Likewise steeper slopes—over 12 percent—should not be field strip cropped. For steeper slopes refer to the discussion of contour strip cropping in the preceding paragraph.

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

Terraces must be laid out to an exact and very gradual grade so that the channels on the upper sides will slowly lead the 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 the farm operations must be parallel to the terrace. Terraces should be recommended only on uniform slopes of less than 10 or 12 percent. They are especially effective on long slopes, those of 300 feet or over, because they divide the slope.

Terracing combined with strip cropping may be used to an 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 will also allow the use of more intertilled crops than the use of either method by itself.

"Contour only" does not need to be checked with contour strip cropping, terracing or a combination of the two. In steeper areas, contour strip cropping might well be combined with terraces for added protection.

Sod waterways located in the natural flowage areas of a sloping field will 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 and hence the cutting action of the running water is reduced. As indicated before, sod waterways may be used in conjunction with all the other methods of water erosion control.

Drainage

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 not only in draining areas where water stands a considerable part of the growing season, but also in removing excess water held in the soil where it is a detriment 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 runoff of water has to be disposed of quickly. Ditches are also adapted for areas which require removal of a considerable amount of water throughout the year. They are appropriate for the drainage of the large portholes, marshes, or bogs. Open ditches are used under the assumption that drainage is possible and necessary.

On nearly level fields with highly impenetrable soils, a type of open ditch called "bedding" may be used. 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.

Rotational Grazing

This item has been included as a supporting practice because it is the proper method to make use of pastures efficiently, especially those where fertility only is used on a well-established sod.

How to Use the Minnesota Score Card

A score card, Form 31 (revised), is to be filled out for each field or land area to be judged. The following instructions are important to both the contestant and to the person grading the card.

Front page: As you enter the event you will be given a number as a part of the registration data on the tabulating sheet, S-32. Insert this number on each of your cards as the Participant Number.

List the field number on each card either as 1, 2, 3, or 4. Take this number from the field data placard which will be posted in each area being judged.

Fill in your name and other information called for in the middle of the page. Check the group which you represent—such as adult, 4-H, or FFA.

Leave the scoring record for the judges to fill in after the card has been graded.

Part I. Physical Features

Check one item, and **only one,** under each of the seven physical features in Part I of the card. When you decide which description most properly fits the soil and the land being studied, place a small, but distinct "x" in the space preceding the item. If you change your mind, carefully erase the mistake or write the word "error" through it. Then put in another "x" as your final decision.

Be sure to refer to the field placard to find out the "original depth of surface soil" before you mark the erosion feature.

Part II. Major Faults

To effectively and easily arrive at the proper Land Capability Class it is necessary first to determine the faults of the physical features of a given parcel of land. In this section of the score card (Part II), there are listed the six features, **one or more** of which affect the selection of the proper capability class. The item, "no serious faults," is also listed to be checked for land that has no major faults (No. I land).

A check mark should be placed opposite each feature which is faulty by being of **only average quality or below,** in the rating given in Part I of the scorecard. These check marks point out the features or feature which you feel is of importance in placing the land in some lower capability class than No. I.

Should you feel that there is **no** fault which would place the land in other than class No. I, check the item "no serious fault" only.

Part III. Land Capability Class

Circle one, and **only one,** capability class number of the eight listed in this section. Be guided in your selection by your decisions in Part II, along with the brief class definitions in this section.

Part IV. Basic Practice

Place an x before only **one** of the Basic Practices. There may be situations where either of two selections might be proper, but mark only one, as the judges will take into consideration the various possibilities.

Keep in mind that the most intensive use of the land is to be your guide. For instance, No. I land may make excellent pasture but that is not the most intensive use for it.

Part V. Supporting Practices

Before starting to mark your selections of the Supporting Practices, do four things:

1. Observe the field placard to get the pH reading, needed for determining the lime need.
2. Notice the available phosphorus and potassium levels in the soil, to be used as aids in deciding on the use of these fertilizing elements.
3. Notice whether or not barnyard manure is available.

Now place an "x" before **each** supporting practice that should be used with the basic practice which you selected for this field. Commonly there are several items that should be marked. Be sure that the practices you select are suitable for this field and will apply to the basic practice.

The field placard will carry the following information:

4. Observe the length of slope given on the field placard.
5. Observe the crop listed for last year and for next year, as the crop history and plans will influence your fertilizer use for next year.
6. If the number of supporting practices are given check only that number in Part V of the score card.

FIELD NO._____

Original depth of surface soil _____
pH _____
Nitrogen _____
Phosphorus _____
Potassium _____
Length of slope (feet) _____
Crop last year _____
Crop next year _____
Manure available _____

Check (__) Supporting Practices

How to Grade the Score Card

Prior to the judging event the committee will look over the field, examine the soil profile and note the data on the field placard. Then a score card will be marked with correct answers; this card will serve as the guide for grading the cards of the contestants taking part in the event.

No section of the score card will ever have a **negative score**—nothing lower than zero.

If the judging committee decides on alternative selections, the scorers will be advised.

The details of the grading is given under the scorecard sections following:

Part I. Physical Features

Five points are to be allowed for the correct selection in each section. If the committee indicates a second choice in any instance, three points will be credited if that choice is marked. All other selections will receive no credit. No "minus scores" are to be listed.

Total the section's score and insert it at the bottom of the page.

Part II. Major Faults

The total score of eight points for this section will be divided among the faults that should be indicated, or allotted to the "no serious faults" item.

Two points will be deducted from the earned score for each incorrectly marked feature. (No "minus" scores.)

The total score (never below zero) will be inserted after "Your Score."

Part III. Land Capability Class

Seven points are to be allowed if the correct land capability class is checked. If the selection is incorrect by one place, only four points are given. No score for all other selections.

Insert the score for this section at the bottom of the page.

Part IV. Basic Practice

Fifteen points are to be given if the contestant marks the correct basic practice. No credit will be given, nor deduction made, for an incorrect choice. The committee may recognize that there might be more than one correct selection. Full credit will be allowed if one, and only one, of the accepted possible selections is made.

Put the score in the appropriate place.

Part V. Supporting Practices

The possible score for this section is 35. If the committee permits alternate selection of basic practice systems, it should give a set of supporting practices for each system to be allowed.

The committee should set the value for each item so that the total equals 35 points for each alternate set of practices selected. If, for example, there were four selected as correct, one would get 8 points and the rest 9 points each.

In certain instances the participants may be advised of the proper number of supporting practices.

For guessing on the supporting practices, a penalty is imposed. Five points are deducted for each incorrect practice checked. Make no deductions for any practices not checked and **never record a minus score.**

Record the score at the bottom of the page for the Supporting Practices section.

Final Tabulation

After transferring the five scores from each of the five sections to the spaces on the front of the card, total them.

Then transfer the scores for each field judged by the contestant to the tabulation sheet and total them. This will result in a combined contest score for each participant.

Ties in total scores may be broken by using the score of part I of the cards from field number one. If the tie remains unbroken, use parts II, II, IV, and V until it is broken.

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Contour Strip Cropping. Extension Folder 108. 1953

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Wind Erosion Control. Extension Bulletin 235. 1948

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PART I. PHYSICAL FEATURES

(Possible Score—35)
Check one item in each section

Color of Surface Soil When Moist

_____ **DARK**—Black, very dark brown or dark gray; high organic content
_____ **MEDIUM DARK**—Brown or grayish brown; medium organic matter
_____ **LIGHT**—Light brown or light gray; low organic matter

Texture of Surface Soil

_____ **FINE**—Clays and clay loams; sticky when wet
_____ **MEDIUM**—Silt loam to loam; smooth; may have some grittiness
_____ **MODERATELY COARSE**—Sandy loams; gritty; cohesive when moist
_____ **COARSE**—Sands and gravels; gritty; never cohesive
_____ **ORGANIC**—Peats and mucks

Depth Favorable to Root Growth (down to a limiting layer)

_____ **DEEP**—36 inches or over
_____ **MEDIUM**—20 to 36 inches
_____ **SHALLOW**—20 inches or less

Internal Drainage (ease of air and water movement in the subsoil)

_____ **POOR**—Dull gray, olive, mottled or dark
_____ **MODERATE**—Bright upper with the lower gray, or mottled
_____ **GOOD**—Uniform color, usually bright
_____ **EXCESSIVE**—Uniform color, usually bright but open and porous

Slope

_____ **NEARLY LEVEL**—0 to 2%
_____ **GENTLY SLOPING**—over 2 to 6%
_____ **MODERATELY SLOPING**—over 6 to 12%
_____ **STRONGLY SLOPING**—over 12 to 18%
_____ **STEEP**—over 18%

Erosion (depth of surface soil)

_____ **DEPOSITS**—Washed-in or blown-in material
_____ **NONE TO SLIGHT**—At least ⅔ remaining
_____ **MODERATE**—⅓ to ⅔ remaining; rills may show
_____ **SEVERE**—Less than ⅓ remaining; slight gullying
_____ **SEVERE WITH GULLYING OR BLOWOUTS**

Surface Run-off

_____ **POOR**—Depression; wet most of the time
_____ **FAIR**—Nearly level; surface water an occasional problem
_____ **GOOD**—No serious problem
_____ **EXCESSIVE**—Run-off may cause an erosion problem

Your Score_____

PART II. MAJOR FAULTS OF THIS FIELD

(Possible Score—8)

(Check only the feature or features that affect the capability rating of this field)

_____ Texture of surface soil
_____ Depth favorable to roots
_____ Internal drainage
_____ Slope
_____ Erosion
_____ Surface run-off
_____ No serious faults

Your Score_____

PART III. LAND CAPABILITY CLASSES

(Possible Score—7)
(Circle only **one** class number)

Land Suited for Cultivation

I—No special hazards
II—Some hazards, easily overcome
III—Severe hazards, require much treatment
IV—Very severe hazards, best overcome with hay or pasture

Land Best Suited for Permanent Vegetation

V—Few limitations for permanent vegetation
VI—Moderate limitations for permanent vegetation
VII—Severe limitations for permanent vegetation
VIII—No productive vegetation

Your Score_____

PART IV. BASIC PRACTICE

(Possible Score—15)

Select, by checking, **only one** of the basic practices below, which you think to be the best for good soil management of this land. Always consider the most intensive use of the land.

_____ Less than ¼ of the rotation time in sod
_____ ¼ to, and including, ⅓ of the rotation time in sod
_____ ⅓ to, and including, ½ of the rotation time in sod
_____ Over ½ of the rotation time in sod
_____ Pasture—Use complete renovation
_____ Pasture—Fertilize and manage present sod only
_____ Forest planting
_____ Wildlife or recreational use

Your Score_____

PART V. SUPPORTING PRACTICES

(Possible Score—35)

_____ Lime
_____ Nitrogen
_____ Phosphorus
_____ Potassium
_____ Barnyard manure
_____ Green manure
_____ Contouring only
_____ Contour strip cropping
_____ Terracing
_____ Sod waterways
_____ Brush or weed removal
_____ Woodlot protection
_____ Game-cover or food planting
_____ Field strip cropping
_____ Field shelter belt
_____ Rough or trash cover tillage
_____ Cover crops
_____ Tile drainage
_____ Open ditch drainage
_____ Rotational grazing

Your Score_____

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