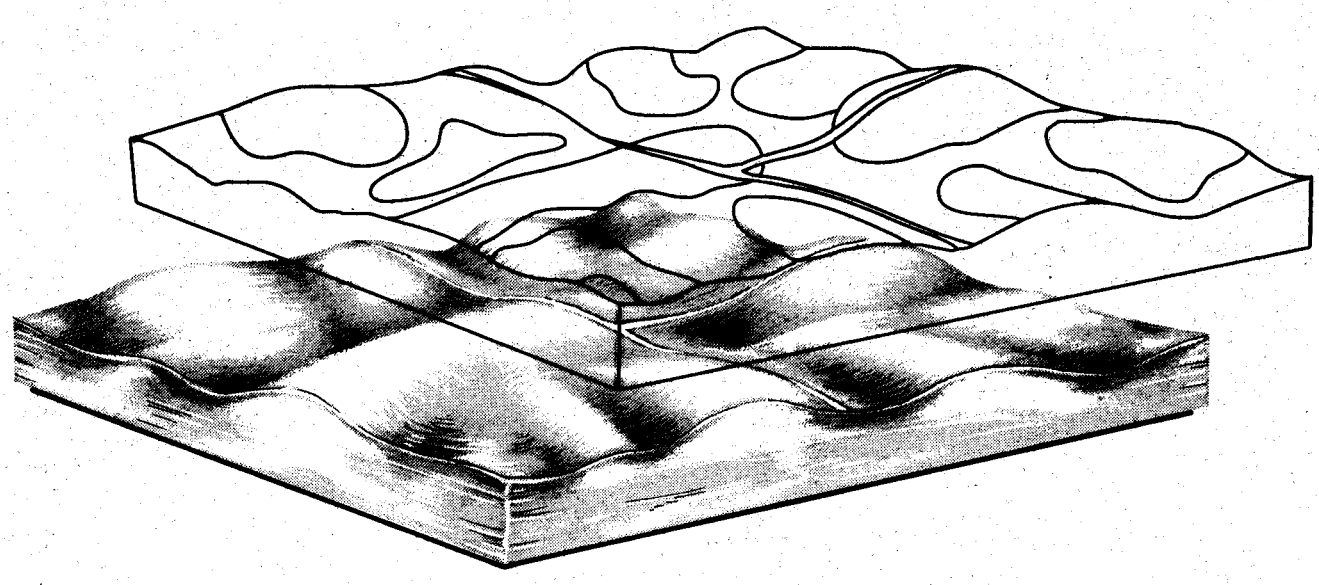
MINNESOTA EXTENSION SERVICE
UNIVERSITY OF MINNESOTA
AGRICULTURE

Productivity Factors and Crop Equivalent Ratings for Soils of Minnesota



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Productivity Factors and Crop Equivalent Ratings for Soils of Minnesota

Introduction

Minnesota soils are the foundation for large, diversified agricultural and forest industries. The agricultural industry presently generates about 6.4 billion dollars annually from the productivity of some 23 million acres of cropland (*Minnesota Agricultural Statistics*, 1989). Forest use dominates the soils and climate of another 17 million acres and generates about 4.4 billion dollars.

Soils do not uniformly produce crops or trees. The native productive capacity of soils is dependent on basic chemical and physical properties including texture, pH, and available water holding capacity. In Minnesota, soils vary from acid peat bogs in the north to gently rolling, deep loamy soils in the south. The southern mineral soils are high in organic matter and are capable of yielding 200 bushels of corn per acre under favorable conditions. To achieve a specific yield requires adapting management to soil properties and climate. Absolute yields are not as important as the economically optimum yields that can be obtained with intensive management.

Information has been compiled on the basic soil physical and chemical properties, and the productivity for crops, pasture, and timber. This report is designed to summarize soil, land use, and economic information that can be used with detailed soil maps, to answer practical questions about the relative productivity of specific land parcels. Since the first *Crop Equivalent Rating Guide* was published in 1975 an accelerated soil survey program has been in progress. Additional information about soil properties, suitability, yield potential, and management problems on some 600 soils has been collected and incorporated in this publication. The Crop Equivalent Rating (CER) reflects relative differences in productivity between soils. The differences are based on the net economic return obtained using a specific "level" of management. "Level" means a measure of inputs of tillage, fertilizer, weed and insect control, and harvesting procedures that result in a crop yield. The rating can be used to help determine how a specific tract of land should be managed, what a fair rental or purchase price is, and to assist in determining a fair market value for land or in defining prime agricultural land. Use of a productivity rating which is based on net economic return is superior to one based only on crop yields because: **1)** no one set of management factors can be applied with uniform success over all soils or even a wide range of soils; and **2)** ever changing technology results in changing yield levels which need to be periodically re-evaluated.

It is difficult to assess effects of varying management on yields. Reliable estimates of sustained (or attainable) yield must be acquired by **(1)** observing the same soil over time within a definable range of management or by **(2)** observing a well-defined set of management factors over time on different but related soils. Option **(1)** is preferable, but usually more costly to accomplish. Both options have been used to develop this report (and earlier reports).

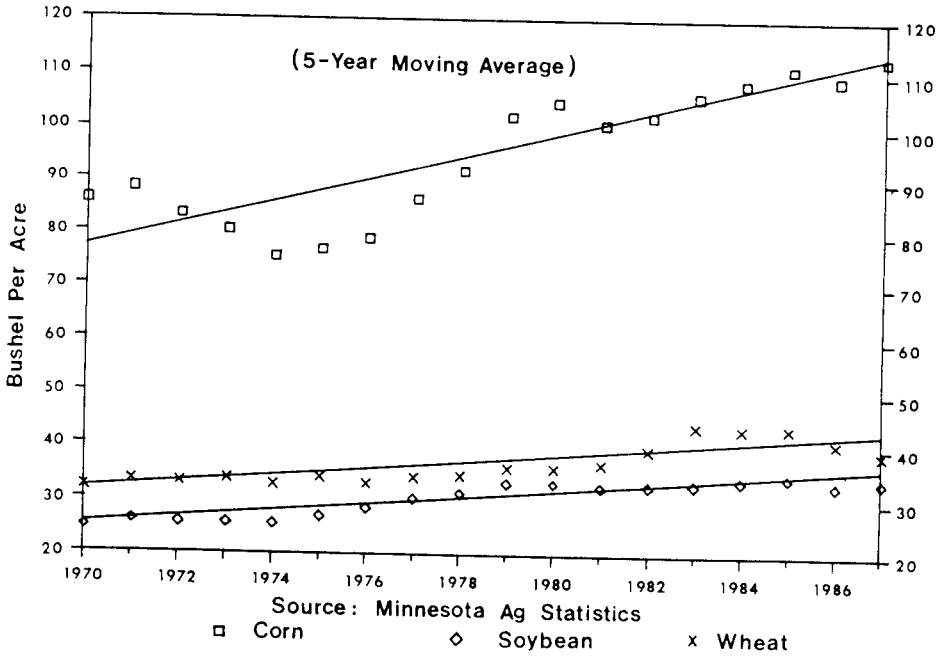


Figure 1. *Long-term average trends in yields of corn, soybeans, and spring wheat, in Minnesota.*

Technology changes that can result in new yield estimates include: new varieties, new fertilizer and herbicide formulations, new tillage methods (also seeding and harvesting), and new knowledge of soil properties affecting plant growth. Also the prevalence of new plant disease vectors must continually be monitored. The use of irrigation, especially sprinkler irrigation, in a mostly rain-fed agriculture generally reduces the variability in soil moisture supply. Crop yields in Minnesota have increased over a long period of time with the application of improved soil and crop management (**Figure 1**). There is reason to believe that yield trends

will continue upward with the development of better crop varieties and the application of improved soil and crop management practices. The increases in the last decade can likely be attributed to better insect and weed control, more timely and precise application of fertilizers, as well as improved varieties.

In summary, crop yield is the result of the interaction between the natural environment and management factors. The two environmental factors soil and climate are fixed in time and space and can be represented on maps. Management and technology are generally independent of location so yield estimates developed in this report are in terms of specified levels of management and technology.

This report discusses the factors resulting in the establishment of the crop equivalent rating, how these factors were determined and used to arrive at the ratings, and how the ratings can be used. The tables developed provide representative data on basic soil properties important in determining crop yields, the distribution of crops on individual soils, and representative ratings (**Tables 7, 8,** and **9**).

Productivity Ratings

Productivity ratings have become widely used. In most instances they are used to reflect physical and chemical properties of soils and the effect of those properties on productivity for the most commonly grown crop or crops. Productivity is usually estimated for one or two levels of management (NCR, 1965). Ratings provide potential of soil mapping units.

Productivity ratings in general are numbers that reflect the relative value of a soil for agricultural or forestry use. The ratings are frequently developed on the basis of soil physical and chemical properties. The Crop Equivalent Rating (CER) goes a step beyond relating soil properties to gross yield. Recognizing the importance of management in obtaining economic yields, the CER reflects inputs necessary to obtain a given yield; and therefore, provides net economic returns (i.e., returns over selected costs) which can be indexed. Because CER's are indexed on a scale of 0 to 100, a relative ranking can be assigned to any soil of significant extent in Minnesota.

CER's are intended to be used in conjunction with detailed soil surveys as a tool for evaluating the productivity of the soil resource. A specific practical use of these ratings is to provide an objective means for identifying the location and extent of the most economically productive soils. This information can be used to determine a fair purchase or rental price, planning the protection of agricultural land, indicating to farmers what can be gained by increasing management inputs, and formulating equalized assessments. The applications are discussed in greater detail beginning on page 10.

Obtaining the CER requires knowledge of the inherent productive capacity of soils, an estimate of the gross yield that can be obtained with a set of management conditions, and costs of inputs required to achieve those conditions.

Soil properties

Data on soil properties considered to have the most influence on crop yields are provided in **Table 7**. This information is provided to help interpret the yields and CER's provided in **Table 9**. If questions arise about why one soil is more productive than another, the basic soil properties can be compared. As an example, fertilizer and lime applications over a period of years can alter levels of pH and nutrients of the cultivated surface. They often do not markedly affect soil test values in the subsoil.

Important subsoil fertility characteristics are recorded for each soil in **Table 7**. Differences in subsoil fertility levels may be considered in recommendations made by soil testing laboratories. Two soils with the same soil-test in the topsoil may receive different recommendations due to the variation in subsoil fertility.

Crop yield estimates

The yield estimates provided in **Table 9** were developed from a number of sources. Information was obtained on the yields attained at each of the (presently) seven Agricultural Experiment Station field locations. A second and major source of crop yield data is that developed during the conduct of progressive soil surveys. In the process of completing the detailed soil survey, crop yield data were gathered from cooperating farmers on soils of major extent in each of the soil survey areas. Yield data in previously published soil surveys were adjusted to the current date using linear trends for the principal crop. Additionally, the yield estimates were compared with county values provided by the Minnesota Agricultural Statistics Service and were reviewed by soil scientists of the Minnesota Cooperative Soil Survey.

Factors in Moderately High Level of Management

In **Table 9**, yield estimates are based on a moderately high level of management. The factors listed below and involved in this management level are briefly discussed in the subsequent paragraphs.

1. Drainage on soils where necessary, protection from flooding, or application of irrigation.
2. Erosion control practices on soils where needed, including proper use of residues.
3. Use of limestone, sulfur, and fertilizer as indicated by soil tests.
4. Use of herbicides for weed control and insecticides as may be needed.
5. Use of adapted varieties in populations related to soil moisture and fertility supply.
6. Timeliness of all operations related to seeding, cultivation, weed and insect control, and harvesting.
7. Harvest procedures that minimize losses.

Drainage

Effective control of the moisture regime in the rooting zone is a major contribution to optimum plant production. In many soils of Minnesota (more than 20 million acres) a tile or open ditch system has been installed to lower the water table so the rooting zone is not saturated for damaging lengths of time during the growing season. Where soils occur along major

streams some form of water diversion may be necessary to reduce flooding. In the calculation of drainage cost, all soils requiring drainage have been grouped according to the intensity of tile or ditch system needed with proportionate costs assigned to each group. Tile systems are assumed to be effective for 25 years, or longer if properly maintained.

Protection from flooding

This management consideration is mostly confined to cultivation along major streams, but is also of consideration in a number of the broad flat glacial lake plains of Minnesota. All flooding cannot be prevented but can be minimized or the frequency reduced. There is an annual cost consideration in the maintenance of some dike or diversion structure. This is a rather difficult cost to establish, except locally, since it is a function of field size and proximity to water course.

Irrigation

Presently about 500,000 acres of cropland in Minnesota have some form of supplemental water management, mostly in the form of sprinkler systems. Two types of systems dominate use, the center pivot and the traveling gun. About 90 percent of presently irrigated acres in Minnesota have these systems. Center pivot systems commonly operate on a quarter section of land.

The largest concentrations of irrigated land are found in the west central, north central, and east central parts of the state.

Most irrigation is done on the coarser textured soils—sandy loams and loamy sands—and where there is an adequate source of groundwater. In a few places, surface water from streams or rivers is used as a supply.

Irrigated yields, mostly of corn, average two to three times the yield from comparable non-irrigated soil. Concurrently production costs are significantly increased by development of the water supply, cost of delivery, and the delivery system.

Erosion control

Water and wind erosion, the latter particularly in the Red River Valley, are management problems. In a moderately high level of management soil losses are held to allowable amounts and long term productivity is not diminished. Soils formed in silty materials are especially subject to water erosion, particularly in southeastern Minnesota, where cultivated fields are often located on slopes of 4 to 12 percent. The cost of erosion control increases with increasing length and steepness of land slope. More terraces are needed or more contour strip-cropping than on less sloping areas. Grassed waterways occupy a significant part of the field thus reducing the amount of row crop acreage and yields are reduced due to increased water runoff.

Use of residues

A primary purpose of incorporating residues has been to return organic matter and nutrients to the soil. Proper residue management is regarded as a necessary part of soil conservation resulting in a reduction of soil loss due to water and wind erosion.

Soil amendments

As illustrated in **Figure 2** the use of lime and fertilizers in Minnesota has been relatively constant during the 9 year period (1980-89) (*Fertilizer Summary Data*, 1988). A moderately high level of management includes application of major nutrients as indicated by soil tests and of certain minor nutrients where indicated by soil and plant tissue analysis. Fertility level and the pH of the soil should be optimum for the crops grown.

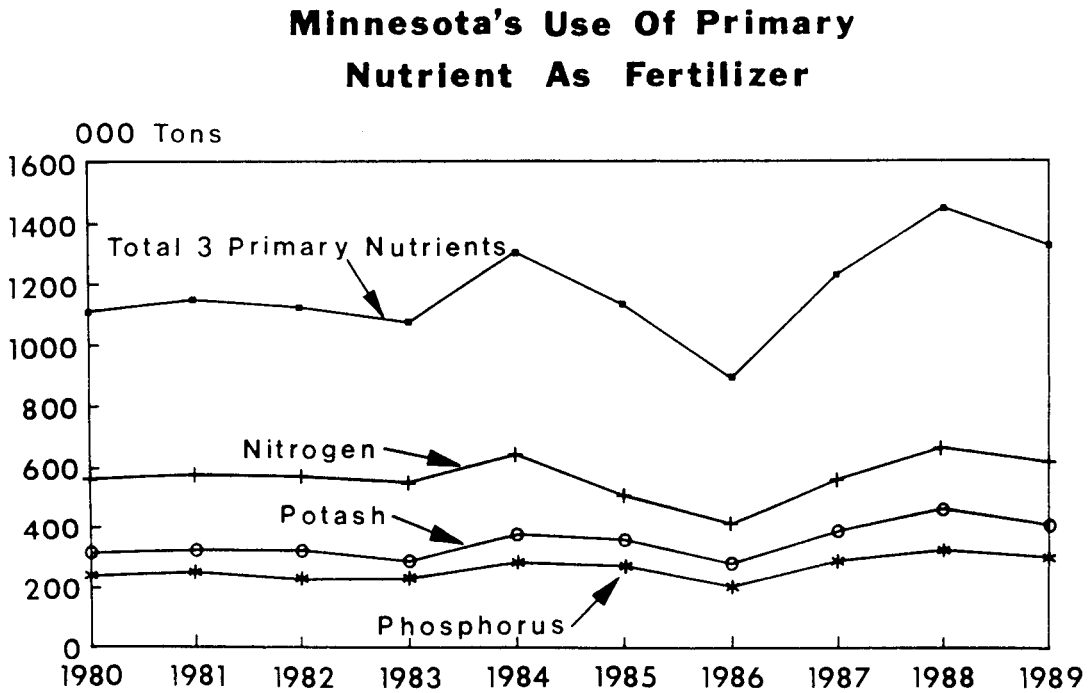


Figure 2. *Use of primary nutrients and fertilizers in Minnesota (1980-88).*

In 1988 the estimated average per acre use of N, P, and K, was as follows:

Corn	—	110 pounds N, 50 pounds P, 60 pounds K
Wheat	—	60 pounds N, 40 pounds P, 25 pounds K
Oats	—	20 pounds N, 20 pounds P, 15 pounds K
Soybeans	—	4 pounds N, 40 pounds P, 10 pounds K

In a moderately high level of management these average use levels are commonly exceeded in accord with soil test levels and proposed yield goals. As has been pointed out the use of N on lower lying and finer textured soils (clay loams to clay) is especially important (Rehm et al., 1986).

The heightened concern over excessive use of nutrients, particularly N and P, mandates that application rates do not exceed the plant and soils capability to use or retain these materials against leaching losses.

Weed and insect control

Probably no factor in recent years has done more to increase the amount of harvested, quality grain, and hay than adequate control of pests. It is now reported that more than 95 percent of corn acreage is treated with pesticides (herbicides or insecticides or both). Likewise, more than 95 percent of the soybeans and nearly 90 percent of the wheat and sunflowers are treated (*Minnesota Agricultural Statistics*, 1987-1989). This treatment is also a major cost factor in production, commonly exceeding $25 per acre (1989 prices).

Varietal selection

In a moderately high level of management the use of currently adapted varieties is considered to be the prevailing practice. But, adapted varieties are always subject to change due to the onset of new diseases and expanded insect populations. Also, cultivars with more yield potential, due to more desirable rooting habits or lodging resistance are developed. For example, small grain varieties popular 5-10 years ago have largely been replaced by higher yielding selections.

Seeding rates

Present day technology offers considerable control over this management practice. With a moderately high level of management seeding rates are adjusted in consideration of the moisture holding capacity of the soil. Where the rooting zone water capacity is high, e.g. 12 inches of plant-available water for a 5 foot rooting zone, plant population can be raised to higher density, e.g., 24,000-26,000 plants per acre (corn).

Timely tillage and harvesting

Timeliness of operations is often the difference between average and above-average production. The average planting date for corn for the years 1985-89 was about May 8. Research in southwestern Minnesota has indicated that corn planted one week earlier (May 1) compared to one week later than average (May 15) would have a yield increase of about 15 bushels. Timeliness is also a critical factor in application of weed and insect control measures. Harvesting losses are frequently minimized by the earliest possible harvest following grain maturity.

Control of harvesting losses

Farm estimates of harvesting losses range from a very few percent to as much as one-third of a crop. While higher losses may be attributed to some kind of natural disaster, losses from poorly operating equipment or poor timing of the harvest are frequently estimated in the range of 5 to 15 percent. It is assumed that with a moderately high level of management, losses are less than 5 percent of the crop.

Climate

Even with a well defined management system on well-characterized soils, there is a third major variable (or set of variables) that needs to be considered. Climate, both during the growing season and in the post-growing season months, exerts considerable influence on what the actual crop yield will be. Many aspects need to be considered including total precipitation, soil temperature, rainfall distribution, wind velocities, solar radiation, frost occurrence, seasonal progression of soil water and temperature, and atmospheric humidity—all operating individually, collectively, and with interaction. Observations made over a period of approximately 10 years are necessary to assess the relationship between climate and yield.

Weather, particularly during the growing season, is a major contributor to yield variability. It was concluded (Gross and Rust, 1972) that nearly two-thirds of the yield variability in Minnesota rain-fed corn could be associated with monthly temperature and soil moisture variations, the latter being rather directly related to over-winter recharge, length of growing season, rainfall, its distribution, and evaporation.

From the Red River Valley in the northwest to the Mississippi Valley of southeastern Minnesota, growing season precipitation is about two-thirds of the annual total (**Figure 3**). Additionally, there are air temperature fluctuations affecting above ground growth rates as well as germination, nitrogen metabolism, and other root environmental conditions. Growing degree days (**Figure 4**) is a kind of climatic measurement that outlines the limits of mature growth for the commonly grown crops.

A kind of climatic measurement combining county indexed values of annual precipitation (**Figure 3**) and of growing degree days (**Figure 4**) is presented in **Figure 5** as climate product index values for each county.These values, also indexed, range downward from southern to northern counties reflecting reduced growing degree days and annual precipitation.

Development of Crop Equivalent Ratings

As previously noted, crop equivalent ratings are intended to reflect the relative net economic return per acre of soil when managed for cultivated crop, or permanent pasture. An effort is made to express dollar equivalence in net return for the most commonly grown crops. To derive a net income figure for all soils of interest and then to rank them, using 100 as equivalent

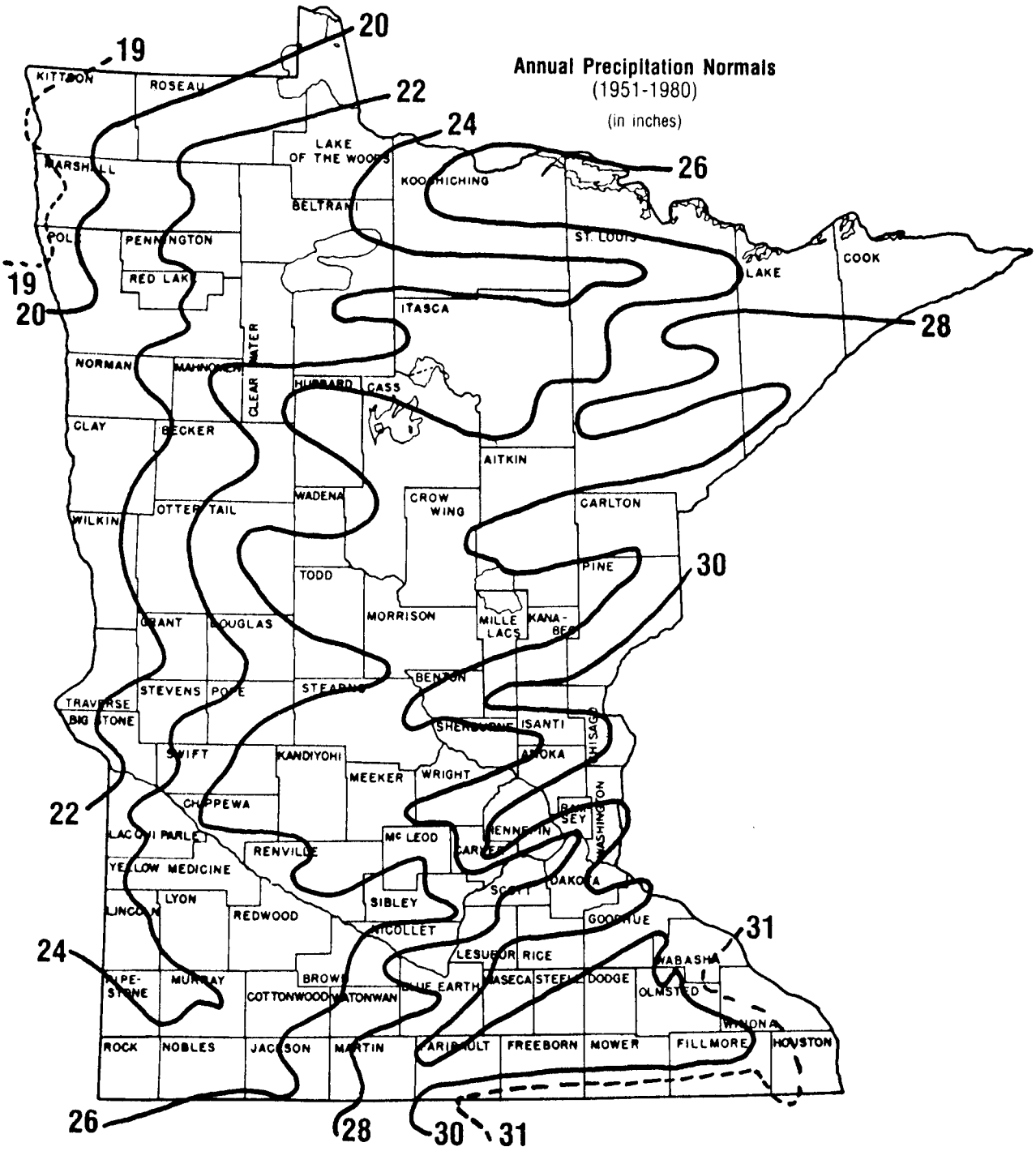


Figure 3. Annual precipitation normals (1951-80).
Source: Adapted from *Climate of Minnesota. Precipitation normals* (1941-70). Donald G. Baker and Earl L. Keuhnast. Tech. Bul. 314 (1978). Minnesota Agricultural Experiment Station.

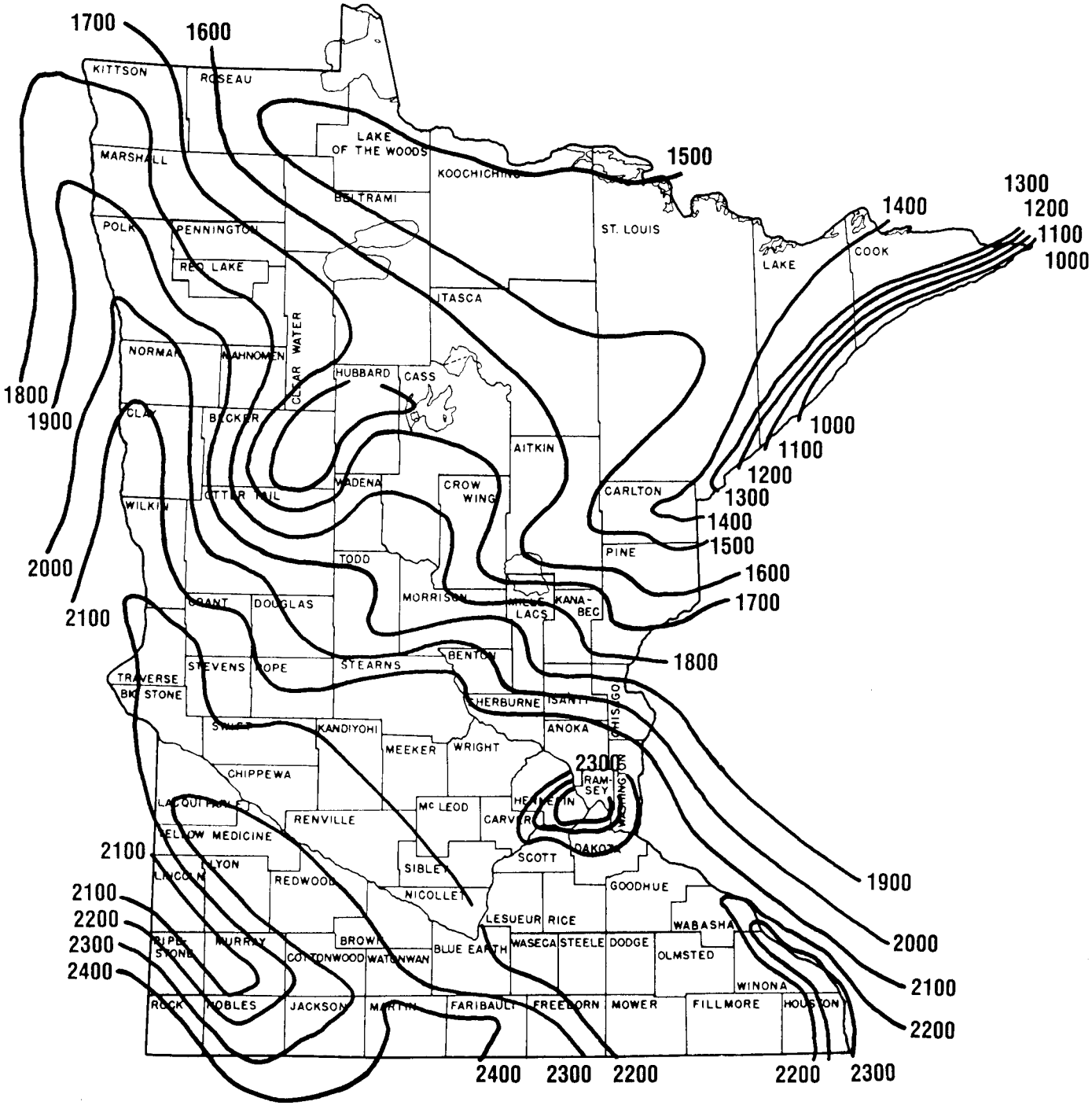


Figure 4. *Normal growing degree days (base 50° days between May 10 and September 20, average planting and maturing dates for corn in Minnesota.*

Source: State Climatology Office, Division of Waters, Minnesota Department of Natural Resources.

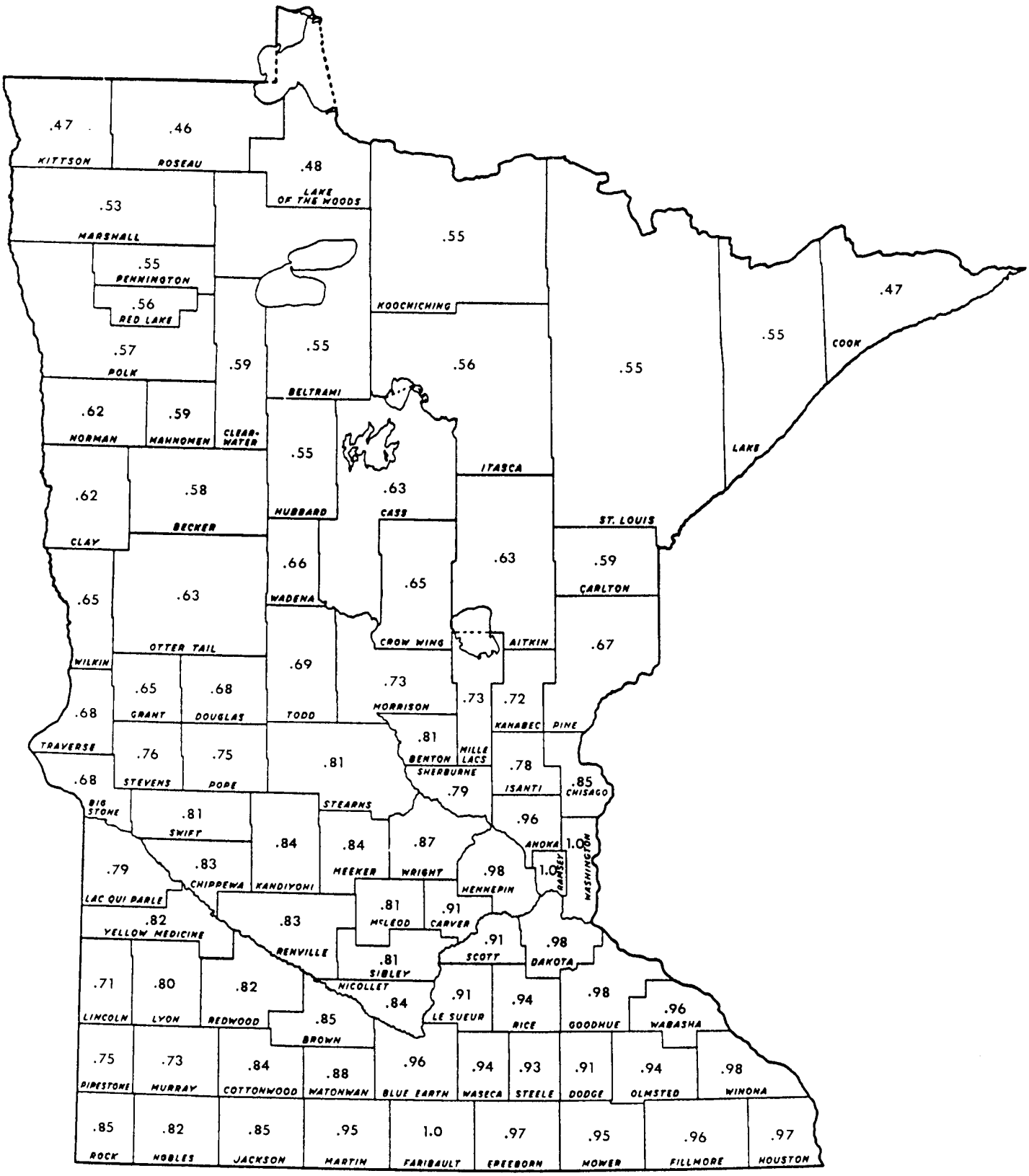


***Figure 5** . Climate Product Indices calculated for each county from indexed annual precipitation (**Figure 3**) and growing degree days (**Figure 4**).*

to the highest rating, requires consideration of several items.

First, the gross productivity of the soil unit is evaluated at the moderately high level of management discussed. The particular combination of crops that is presently grown on a given soil needs to be determined. These data are derived from observations made during the course of the soil survey and other observations. They are summarized in **Table 8**. The information is not specific in regard to kind of row crop or grain crop, but this can be reasonably estimated by considering local cropping practices. Where one crop, such as corn or spring wheat dominates, that crop largely determines gross productivity. For most soils, several crops are considered in calculating the gross income estimates.

Thus, taking the production estimates for the specific cropping sequence times the market price provides a gross value for the given soil. Prices used in **Table 1** represent a three-year average (1987-1989).

Costs of production are subtracted from the gross production figure. These costs can be considered as fixed and variable. Fixed (or allocated) costs considered are investment interest charge, taxes, permanent improvements such as drainage systems, terraces, or other structures. Variable (or direct) costs include seed, fertilizer, pesticides, tillage, and harvesting. Production costs have been largely assembled from record-keeping projects of the Department of Agricultural and Applied Economics (**Table 2**). In lieu of specific production cost figures, it is possible to review the physical and chemical limitations to production on related soils and to compare these limitations with soils of known productivity to "dollar equate costs."

To illustrate the method of calculating net returns per acre, examples are given in **Appendix B**. An index value of 100 was assigned to soils where the calculated average net return for dominant cropland use was $169 for the period of 1987-1989. Thus, the Nicollet soil is assigned an index value (CER) of 100; the Bearden soil an index of 64 (net $107.18); the Pierz soil, an index of 30 (net for cropland $51.80). These CER values are considered appropriate for the geographic center (reference county) of the soil.

The entries in **Table 9** include about 700 soil series and slope or erosion combinations. That is, some soil series occur frequently on more than one range of slope or with more than one erosion condition. The list is about a third of the total mapping units presently in use in Minnesota, but is considered representative. Within county mapping legends (now published for some 50 counties, **Appendix A**) there are additional slope and erosion units.

Adjustments for Slope and Erosion

As slope increases, production costs reflect increasing need for conservation practices to control runoff and erosion. Concurrently yields generally decrease due to less retention of rainfall. If erosion has occurred, yields are somewhat further reduced due to a less desirable seedbed, physically and chemically. In **Table 9**, CER values are mostly given for the lowest slope on which the soil occurs. Adjustments of the CER values on the basis of increasing slope and/or increasing erosion are suggested in **Table 3**.

Adjustments for Lands in Pasture and Timber

Since row crop production is not generally recommended on slopes over about 15 percent, because of soil erosion and water loss, soils which occur on these and steeper slopes should largely be evaluated for permanent pasture or timber production. Less reliable data are available on gross production of either permanent pasture or timber species than for annual crops. In **Table 9**, woodland production potentials have been included on soils where woodland land use is considered significant. Where soils are used for woodland production exclusively or for permanent pasture, the Crop Equivalent Rating (CER) may be adjusted, generally downward. A CER about one-third the value in **Table 9** is suggested. Pasture ratings are included for a number of soils.

Table 6 provides some estimates of relative productivity for woodland production of some common species as related to site index.

Adjustments for Climate

A climatic adjustment of the CER value may be desirable on some soils in some counties. The **Table 8** values should be considered appropriate for the presently defined Minnesota "geographic center" of the series.

A suggested adjustment, where deemed advisable, follows:

If the climate product index (CPI) of the county (**Figure 5**) in question differs by more than 0.05 from the CPI of the geographic reference county for the soil then the CER may be adjusted by the ratio of the respective CPI's. For example:

Clarion loam, 1-6 percent, occurs in several counties. The reference county is Martin and the assigned CER is 90. The CPI for Martin Co. is 0.95.

Clarion loam also occurs in Watonwan county where CPI is 0.88.

Suggested CER for Clarion in Watonwan would be: 90 x .88/.95 = 84.

Climatic adjustments within a county on a given soil which occurs throughout the county may be considered if the east-west or north-south distance is more than 50 miles across the county. Up to a 5 percent difference in CER may be appropriate.

Adjustments for Drainage

Since the CER values listed assume adequate drainage as needed on certain soils under cultivation, adjustments may be necessary if drainage or other water management is incomplete. A suggested adjustment follows:

If the soil requires surface or tile drainage for a moderately high level of production, and if a given acreage lacks this input, the CER used should be about 20 percent of the **Table 9** figure. This adjustment may apply only to a portion of the soil acreage on a given tract, if drainage exists on other portions.

Soils which occur along streamways are often subject to flooding. In the soil survey, flooding is characterized as occasional (about 1 year in 5) or frequent (more than 50 percent of the time).

If the percentage of time that some flooding occurs is commonly known and if it can be established that flooding is detrimental to crop or pasture production then a proportionate decrease in the CER value for such soil may be determined.

For example, Arenzville silt loam, 0-2 percent is assigned a CER of 75 for the non-flooded condition. If it can be ascertained that detrimental flooding occurs 40 percent of the time, a reduced CER of 45 (75 - (.40x75)) is suggested.

Adjustments for Special Soil Conditions (Symbols)

On the soil map of a given tract there may be special symbols which indicate a condition which usually lowers the production potential. These symbols represent areas, perhaps an acre or so in size, that are too small to delineate at the published map scale. Nevertheless they are shown to indicate to the land operator a soil condition which may merit special treatment. In recent surveys the discussion about the map unit will include mention of these special conditions as applicable.

The use of special symbols has varied somewhat over time, or from one county survey to another. Hence it is difficult to make a general rule for any modification of the CER that may be appropriate.

It is suggested that each county consult with the technical soil scientist assigned to the area as to adjustments for these conditions. As a very general rule, a reduction in the CER of about 5 percent for each symbol shown in a given map unit may be appropriate. For example, if the CER is 65 for the unit and one symbol appears in the delineation, a revised value of 62 may be used. Such an adjustment may not significantly change the weighted average CER for the given tract.

Adjustments for Irrigation

Some increase in CER values can be assigned to irrigated soils as 'returns over costs' are somewhat higher (see **Appendix B** example). The response to irrigation is somewhat more on those soils with lower water holding capacity and less on soils with moderate water holding properties. A sliding scale of CER adjustments is recommended as shown in **Table 4**, (MAOO, 1989).

Extensive soils, presently being irrigated, are included in **Table 9** with recommended CER for irrigated land use.

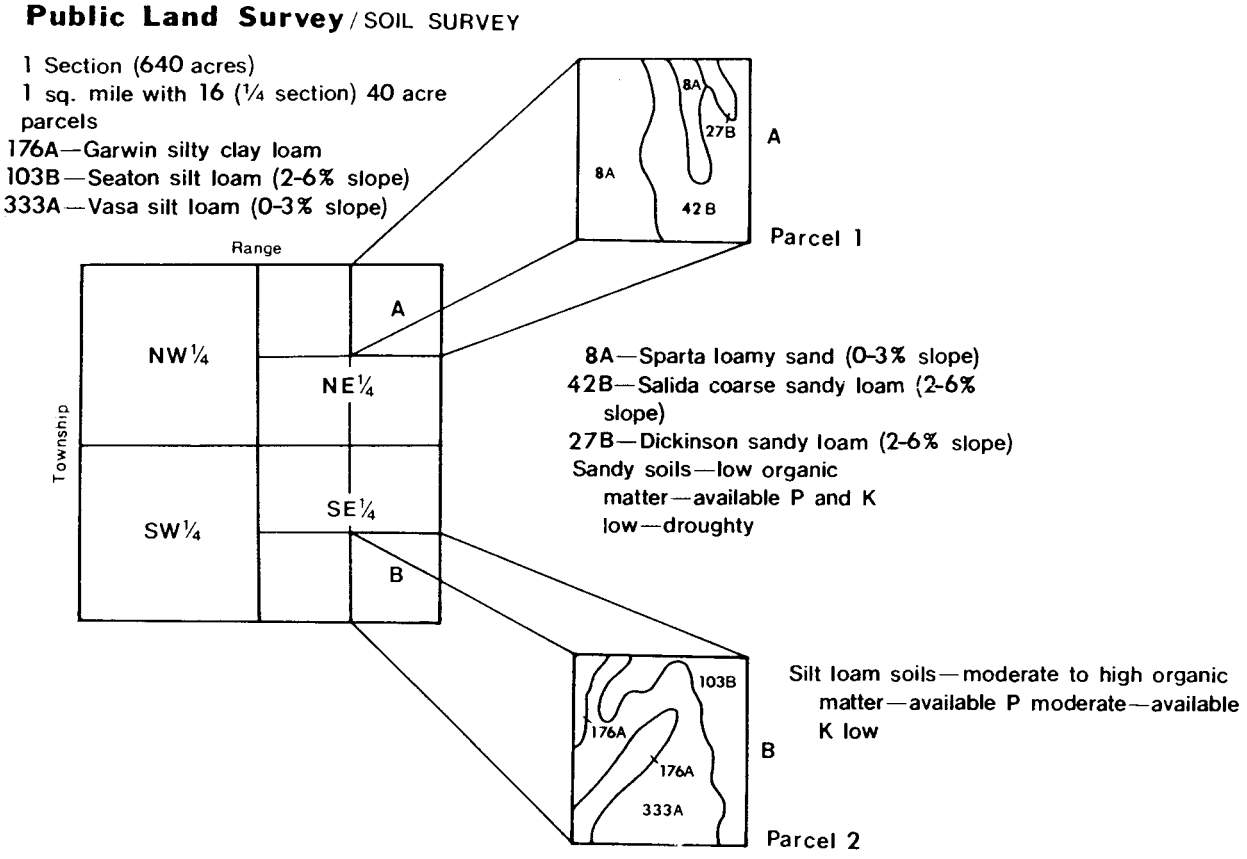


Figure 6. Soil survey illustrated by 40-acre parcels within a public land survey section.

Applications of Crop Equivalent Ratings

CER's can be used to evaluate productivity of different land parcels. This information can aid decisions about what land should be kept in agricultural uses, what the intensity of soil management should be, what the cash rent or purchase value should be, and what might be considered as a basis for equalizing assessed valuation.

When CER's are used with detailed soil survey maps the area and distribution of each soil can be measured and an evaluation of productivity can be made for an individual soil or as a weighted average for a parcel. Four areas of applications are discussed in the following paragraphs. Additional applications may become apparent when CER's are used more extensively.

Management

One use of CER's is to provide a general assessment of the quality of the soil resource being managed. Although most farmers can tell from experience which of their soils are productive, using CER's provides an independent, objective, and quantitative method to evaluate productivity.

For example, suppose there are two 40 acre parcels to be evaluated for agricultural use in a given section (**Figure 6**). The two parcels are located according to their legal description from the public land survey. The relative productivity index of the two land parcels can be determined following these four steps:

1. **Obtain soil map and legend.**

   Soil maps prepared by a soil scientist provide an inventory of the soil resources of an area. The mapping units outlined on the map provide a basis for soil-use suggestions and for crop-yield and/or crop equivalency estimates (**Figures 7 and 8**). Soil maps are prepared by the Minnesota Cooperative Soil Survey* (see **Appendix A** for current availability).

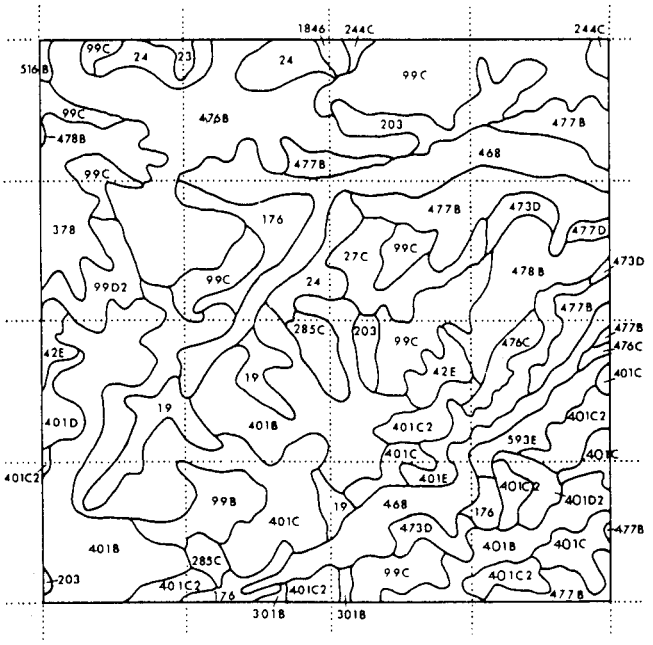
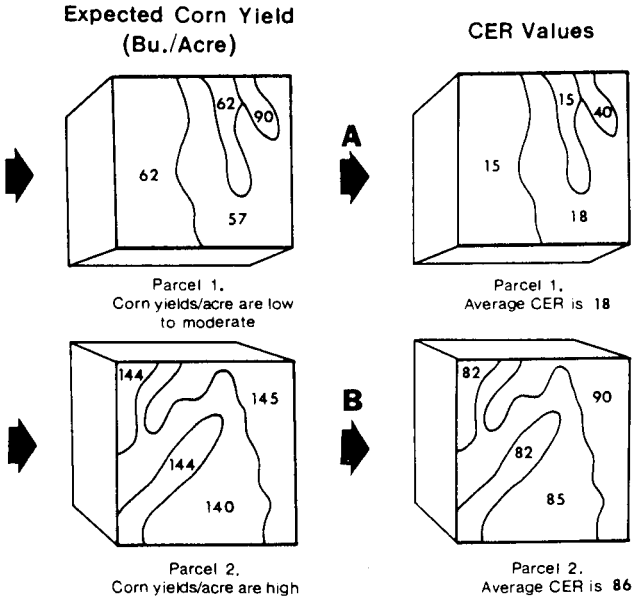


Figure 7. Computer digitized display of soil map of section 11, Kalmar Township, Olmsted County with 40-acre parcel line boundaries.

*Figure 8. Comparison of expected corn yields and crop equivalent ratings on individual soils for a land parcel (see **Figure 6**).*



2. **Obtain crop equivalent rating for each soil mapping unit.**

   Using **Table 9**, the CER's for each of the mapping units can be determined. For soils or map units not provided, soil scientists familiar with soils and crop production can provide an estimated CER.

3. **Measure and record acreage of each mapping-unit category in each tract of agricultural land in the county.**

   Measurements may be made with a planimeter, grid, or electronic area calculator using a microcomputer. In those counties with installed Soil Survey Information Systems (SSIS) the measurements are greatly facilitated (see PRODEX discussion). Assistance may be available at the office of the District Conservationist or the County Extension Director.

4. **Calculate a weighted average crop equivalent rating for each tract of agriculture land.**

   The acreage of each soil is multiplied by the CER. The totals for all mapping units are added together, and divided

* *The Minnesota Cooperative Soil Survey includes the following agencies—USDA Soil Conservation Service, USDA Forest Service, Minnesota Agricultural Experiment Station, Minnesota Department of Natural Resources, Minnesota Extension Service and the Board of Soil and Water Resources.*

by the number of acres in the tract. The result is a tract-productivity index. It is a weighted average index of the soil productivity of the tract.

From the weighted average CER for the two 40-acre parcels it is evident that parcel B in the SE1/4 section is the more productive (**Figure 8**).

CER's by themselves should not be used as the only basis for making management decisions, but they can be a useful tool to indicate what changes might be expected as a result of making a decision to improve drainage, irrigate, or terrace. Management decisions can be made that reflect the most limiting factors to productivity whether it be drainage, droughtiness, or slope.

PRODEX: Field (or parcel) CER Calculation

A primary use of soil survey information is as a tool for land evaluation. In those counties having recently completed soil surveys and where the county has requested and received a digitized computer-retrievable soil survey the determination of the Crop Equivalent Rating for individual tracts of land—up to one sectio—is readily attainable through the local service facilities of the USDA Soil Conservation Service and/or the Minnesota Extension Service This computer software (PRODEX, 1987) allows rapid use of the detailed soil survey information to evaluate and spatially display relative productivity of various tracts. Weighted average ratings for land parcels can be used for land management, land rent or purchase, equalized assessment and preservation of agricultural land. Results of calculations and displays can be saved in printed or electronic format.

Land rent or purchase

CER's can provide an indication of the relative quality of the soil resource when land is being considered for rent or purchase. In general, the typical net economic returns that can be expected from farming a given parcel of land correlate quiet closely with its CER. The CER rating is thus a useful gauge of the comparative productive values of different properties.

Because CER's are based on a moderately high level of management and crop enterprises and historical costs and returns, they are not an absolute predictor of the level of future returns once a parcel is purchased or leased and put into production. That depends on variables that are "outside" of the CER formula: individual management decisions, future changes in market prices, or production of "nontraditional" crops. However, CER's can prove very helpful in making initial comparisons of the potential economic productivity of alternative parcels with varying soils, and thus help buyers make better-informed decisions in the marketplace.

Preservation of agricultural land

Weighted average CER's provide an objective indicator of the overall quality of the soils for a parcel or land area. High CER values would indicate that the parcel is high quality agricultural land and that it should possibly be dedicated to agriculture.

Specific CER values to use in determining preservation policy cannot be provided. Those values need to be determined on a local basis taking into account other factors such as size and location of the parcel and whether the surrounding land use is compatible with agricultural use.

EQUALIZED ASSESSMENT*

CER's are being used increasingly by Minnesota assessors to achieve better equalization of property valuations on agricultural land. Because CER's are objectively calculated on the basis of the quality of soil resources in each property, they provide a basis for consistent and uniform valuation of agricultural properties. Within a local jurisdiction, CER-based assessments on agricultural land vary only by the relative quality of the soils—not on how well or poorly they are used by the current operator.

In order to use CER's in the valuation process, a relationship must be determined between current market values of agricultural land in the assessment district and their CER's. This relationship is typically identified by analyzing the prices paid for agricultural land in recent "arms-length" sales and the CER of each property sold. Once this general relationship between CER and market value is established, a schedule relating average CER to market value can be established and then applied to all agricultural properties in the jurisdiction.

Here is an example of how CER's can be used in the agricultural land evaluation process:

1. Determine the indicated amount paid for tillable land.

For each arms'-length farmland sale occurring during the assessment sale study period, calculate the price paid for the tillable cropland involved in the sale. This is accomplished by first taking the total sale price and making any necessary adjustments for financing terms and/or time trends to arrive at the total indicated sale price as of the assessment date—January 2 in Minnesota. From this adjusted sale price any contributory value for buildings, building sites, personal property, woods, permanent pasture, meadow, waste, and any other non-tillable land is subtracted. The remaining portion of the sale price is attributable to the tillable land portion of the property sale. Unimproved land sales that are all or nearly all tillable are preferable to improved land sales as indicators of market prices for tillable land, because they require fewer assumptions about the contributory values of buildings and other lands.

2. Calculate the average price paid per tillable acre.

Divide the sale price attributable to the tillable land in each sale by the number of tillable acres. The result is the average price paid per tillable acre.

3. Calculate the average CER per tillable acre.

Obtain, either from existing assessment records or by measurement, the total adjusted CER of the tillable land included in the sale parcel. Total adjusted CER is calculated by taking the total

** This discussion prepared by Matt Smith, Local Government Services, Minnesota Department of Revenue.*

CER's of the tillable acreage and making any necessary adjustments for drainage, irrigation, special soil map symbols, or any other factors that affect the productivity of the particular parcel. Average CER per tillable acre is then computed by dividing the total adjusted CER of tillable land by the number of tillable acres.

4. Calculate the tillable CER multiplier.

Compute the tillable CER multiplier in each sale by dividing the average price per tillable acre by the average CER per tillable acre. This is called a "CER multiplier", and expresses the sale price/CER relationship in each sale in terms of dollars paid per CER per tillable acre.

5. Prepare graphs of CER's vs. market prices.

Prepare a graph showing average sale price per tillable acre on one axis and average CER per tillable acre on the other. Plot the combination of CER and sale price calculated in each sale. When the data are plotted, they will show the actual pattern of CER versus market price evident in the sales data. (As an alternative, tillable CER multipliers may be graphed versus tillable CER's—the same relationship will appear using either approach). Separate graphs can be made for subregions within the assessment district to examine whether different relationships between sale price and CER exist in different parts of the jurisdiction.

From the data plotted on the graph, derive a general relationship between CER and market value from the sales data for use in valuing agricultural properties. This may be done using a variety of methods, from choosing the median CER multiplier calculated from the sales data, to hand drawing a line on the graph that best fits the sales data, to estimating a linear (straight-line) or nonlinear (curved line) regression line between CER and market value. **Figure 9** shows three possible ways of relating CER to market value, using actual farm sales data from one Minnesota county. Note that for this sample of sales, a nonlinear relationship appears to give the best "fit" in terms of a low coefficient of dispersion (COD). The coefficient of dispersion is a measure of the consistency and uniformity of assessors' evaluations. For other sets of sales data, different relationships may work best. The most important consideration should be to derive the most accurate relationship possible between market value and CER as indicated by the sales data. Where the sales sample size is sufficient and the data clearly warrant it, this may also include calculating different CER/market value relationships for different parts of the assessment jurisdiction. In all aspects, deriving the "best" relationship between CER and market value depends heavily on the individual assessor's professional judgment.

6. Valuation of agricultural properties.

Using the general relationship between CER and the market value of tillable land derived in step 5, a schedule or table for estimating the market values of individual agricultural properties can be developed. The "shape" of the schedule will depend on the particular relationship that has been identified between market value and CER as illustrated in **Figure 9**.

Figure 9. *Possible relationships between crop equivalent ratings (CER) and market price of agricultural land.*

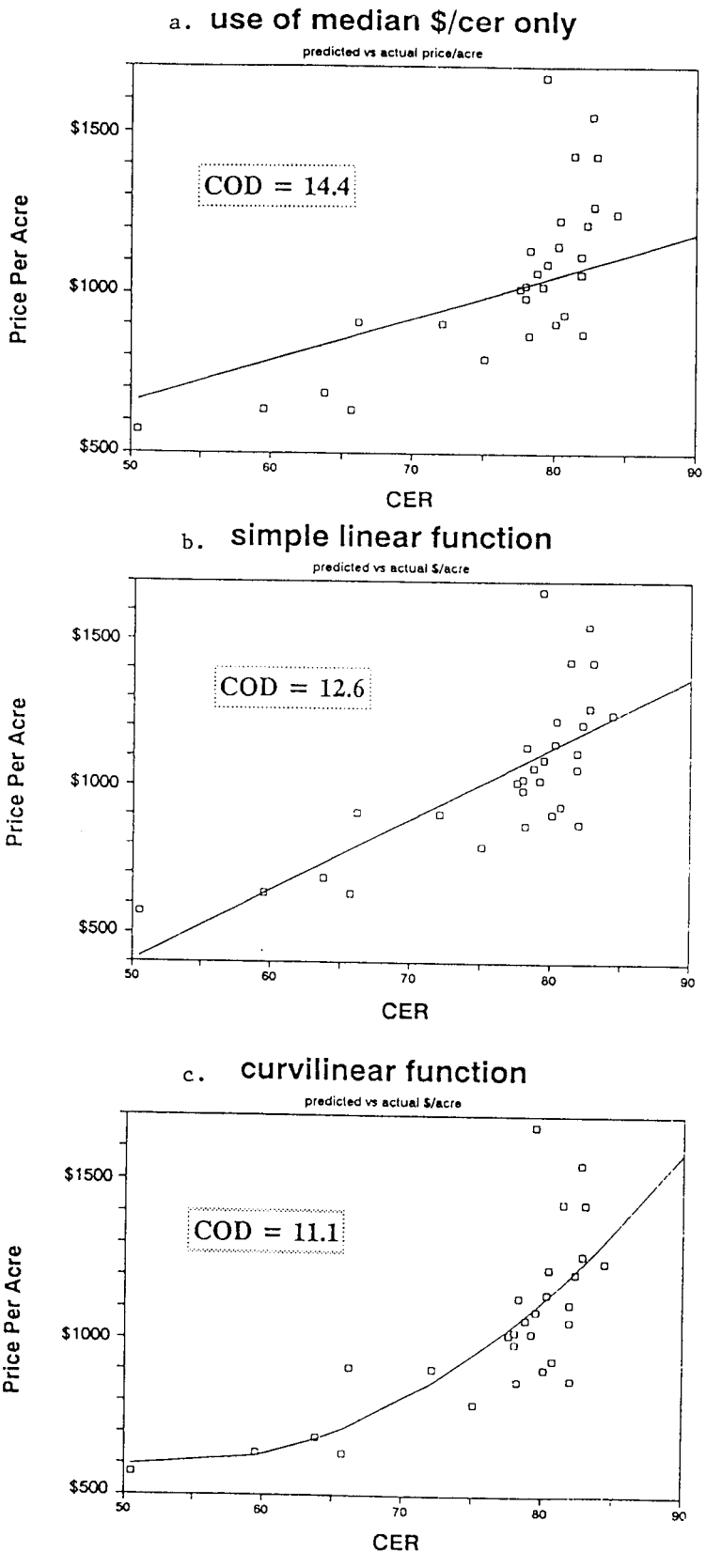


Table 1. Average prices received for some principal crops by Minnesota farmers, 1987-89.

Crop	Unit	1987	1988	1989	AVERAGE
Corn	bu	$1.48	$2.14	$2.30	$1.97
Corn Silage	ton	10.91	12.58	8.00	13.83
Soybeans	bu	4.97	7.01	6.45	6.14
Sugar Beets	ton	39.00	41.30	37.50	39.27
Sunflowers	cwt	7.35	11.88	12.05	10.43
Potatoes	cwt	4.46	4.48	8.28	5.58
Wheat	bu	2.4	3.22	3.80	3.16
Oats	bu	1.49	1.2.27	1.96	1.91
Barley	bu	1.53	2.29	2.64	2.15
Alfalfa	ton	63.67	87.00	104.17	84.94
Mixed Hay	ton	59.50	80.50	93.83	77.94
Pature	AUM	11.90	16.10	18.77	15.59

Source: Minnesota Agricultural Statistics Service

Table 2a. Average production costs per acre of principal crops by production areas of Minnesota (1987-89).

Area	Corn	Corn Silage	Soy-beans	Sugar beets	Sun-flowers	Wheat	Oats	Barley	Alfalfa	Mixed Hay	Pasture
1	168.54	124.23	83.87	---	---	68.29	59.16	68.09	91.15	70.26	28.25
2	172.63	138.29	86.88	---	---	67.99	63.38	67.80	92.06	71.70	30.75
3	162.88	122.20	87.50	---	92.68	64.05	62.55	63.84	95.72	74.97	33.23
4	173.05	130.64	82.86	223.04	---	59.65	58.17	59.48	82.97	64.54	27.46
5	149.25	117.29	85.55	208.73	80.08	56.74	55.66	55.63	71.63	55.27	22.37
6	143.06	129.22	78.79	---	---	55.04	57.36	54.88	89.83	69.04	27.25
7	133.62	108.31	85.06	---	---	54.78	53.16	54.61	65.18	50.19	20.03
8	135.23	111.93	72.41	204.94	80.77	60.87	55.37	65.17	65.48	50.41	20.10
9	136.49	126.29	76.08	208.13	78.71	75.17	59.04	72.58	54.56	42.55	18.36
10	132.26	96.27	83.70	---	---	55.88	56.13	57.24	51.94	39.93	15.74
11	140.64	102.39	71.23	190.35	78.22	72.40	57.86	69.62	58.26	44.72	17.47
12	142.57	110.78	72.24	191.06	78.51	75.34	60.16	73.05	58.97	45.43	18.18

AREA COUNTIES

1. Fillmore, Goodhue, Houston, Olmsted, Wabasha, and Winona
2. Dakota, Dodge, Freeborn, Mower, Rice, Steele, and Waseca
3. Carver, Hennepin, Kandiyohi, Le Sueur, Scott, and Wright
4. Blue Earth, Brown, Cottonwood, Faribault, Jackson, Martin, Murray, Nicollet, Nobles, Redwood, Renville, Sibley, and Watonwan
5. Big Stone, Chippewa, Grant, Lincoln, Lyon, Pipestone, Rock, Stevens, Swift, and Yellow Medicine
6. Anoka, Douglas, Isanti, Pope, Ramsey, Sherburne, Stearns, and Todd
7. Aitkin, Benton, Carlton, Chisago, Crow Wing, Morrison, Wadena, and Washington
8. Becker and Otter Tail
9. Clay, Traverse, and Wilkin
10. Beltrami, Cass, and Itasca
11. Clearwater, Lake of the Woods, Mahnomen, Marshall, and Pennington
12. Kittson, Norman, and Polk

Table 2b. Examples of production cost items per acre for principal crops in 4 of the 12 production areas of Minnesota (1987-89).

Area: 4
COUNTIES: Blue Earth, Brown, Cottonwood, Faribault, Jackson, Martin, Murray, Nicollet, Nobles, Redwood, Renville, Sibley, and Watonwan

Cost	Corn	Corn Silage	Soy-beans	Sugar beets	Wheat	Oats	Barley	Alfalfa	Mixed Hay	Pasture
Fertilizer	$ 24.66	28.86	10.37	34.09	11.37	12.36	11.31	22.60	16.95	5.60
Chemicals	23.60	28.69	22.84	60.78	4.40	2.29	4.38	1.41	1.06	0.35
Seed	22.75	22.75	11.33	28.00	9.97	10.69	9.96	13.62	10.21	3.37
Cultivation	49.95	24.18	19.26	38.32	18.01	16.96	17.93	16.65	12.49	4.12
Taxes	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19	9.19
Misc.	34.25	8.40	6.08	41.67	4.12	4.17	4.13	14.39	10.79	3.56
Interest	8.64	8.56	3.78	10.99	2.59	2.51	2.57	5.13	3.85	1.27
TOTAL	**$173.05**	**130.64**	**82.86**	**223.04**	**59.65**	**58.17**	**59.48**	**82.97**	**64.54**	**27.46**

Area: 6
COUNTIES: Anoka, Douglas, Isanti, Pope, Ramsey, Sherburne, Stearns, and Todd

Cost	Corn	Corn Silage	Soy-beans	Wheat	Oats	Barley	Alfalfa	Mixed Hay	Pasture
Fertilizer	$ 20.64	41.23	10.47	11.07	14.52	11.01	35.97	26.98	8.90
Chemicals	19.73	25.23	22.84	4.07	1.67	4.06	1.40	1.05	0.35
Seed	19.50	19.50	11.33	9.00	10.92	8.96	13.15	9.86	3.25
Cultivation	46.41	22.36	19.62	18.53	17.82	18.47	15.71	11.78	3.89
Taxes	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67
Misc.	22.84	6.10	4.05	3.19	3.10	3.19	12.51	9.38	3.10
Interest	7.28	8.14	3.81	2.52	2.66	2.51	4.42	3.31	1.09
TOTAL	**$143.06**	**129.22**	**78.79**	**55.04**	**57.36**	**54.88**	**89.83**	**69.04**	**27.25**

Area: 7
COUNTIES: Aitkin, Benton, Carlton, Chisago, Crow Wing, Morrison, Wadena, and Washington

Cost	Corn	Corn Silage	Soy-beans	Wheat	Oats	Barley	Alfalfa	Mixed Hay	Pasture
Fertilizer	$ 16.44	24.18	14.53	11.07	11.63	11.01	18.42	13.82	4.56
Chemicals	19.73	25.23	22.84	4.07	3.13	4.06	1.40	1.05	0.35
Seed	19.50	19.50	11.33	10.00	10.45	9.96	11.93	8.95	2.95
Cultivation	45.49	21.91	22.91	18.35	16.93	18.29	13.99	10.49	3.46
Taxes	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18
Misc.	20.41	5.41	4.02	3.56	3.33	3.56	11.09	8.32	2.75
Interest	6.86	6.91	4.24	2.56	2.50	2.55	3.17	2.38	0.78
TOTAL	**$133.62**	**108.31**	**85.06**	**54.78**	**53.16**	**54.61**	**65.18**	**50.19**	**20.03**

Area: 12
COUNTIES: Kittson, Norman, and Polk

Cost	Corn	Corn Silage	Soy-beans	Sugar beets	Sun-flowers	Wheat	Oats	Barley	Alfalfa	Mixed Hay	Pasture
Fertilizer	$ 19.26	22.63	6.10	22.49	13.00	16.45	16.45	18.48	13.96	10.47	3.46
Chemicals	22.53	27.23	23.17	45.10	20.37	17.10	2.53	14.13	1.05	0.79	0.26
Seed	19.50	19.50	11.33	25.50	11.87	9.67	10.92	8.90	11.93	8.95	2.95
Cultivation	46.41	23.42	19.30	50.28	21.69	19.78	19.40	19.78	13.32	9.99	3.30
Taxes	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76	4.76
Misc.	22.76	6.03	4.02	33.28	2.87	3.96	3.17	3.37	11.12	8.34	2.75
Interest	7.36	7.22	3.55	9.65	3.95	3.63	2.92	3.62	2.83	2.12	0.70
TOTAL	**$142.57**	**110.78**	**72.24**	**191.06**	**78.51**	**75.34**	**60.16**	**73.05**	**58.97**	**45.43**	**18.18**

Sources: *What to Grow* Series (1987-89), Minnesota Extension Service, Department of Agricultural and Applied Economic. Minnesota Department of Education, vocational division.

Table 3. Percent changes in crop equivalent rating (CER).

Suggested for slope and erosion units not listed for soils in **Table 9.**
Given: CER for A slope, 1 erosion

Erosion condition	Slope (percent) B(2-6)	C(6-12)	D(12-18)	E(18-35)
0 or 1 (none)	- 5%	- 20%	- 30%	- 40%
2 (moderate)	- 10	- 25	- 35	- 45
3 (severe)	- 15	- 35	- 45	- 55

If soils are shallow to rock or have relatively impermeable subsoils, percentage changes should be greater by at least 5 additional percent in any category. It should be noted that on D slopes, or steeper, land use may change significantly.

Table 4: Numeric or percent changes in crop equivalent ratings (CER) for irrigated soils.

Non-irrigated (CER)	Increase for irrigation (CER)
18-33	+9 or 30%
34-47	+8 or 20%
48-55	+7 or 15%
56-60	+6 or 10%

Source: Agricultural sub-committee, Minnesota Association of Assessing Officers-1989.

*Table 5. Example of acreage measurement and calculation of crop equivalent ratings (CER) for a portion of section 11, Kalmar township, Olmsted County, Minnesota (see **Figure 7**).*

Township: Kalmar Section 11 Parcel: 1

Mapping Unit	CER	Area	CER * Acres
244C	20	1.6	32
99C	65	13.4	869
203	90	5.7	512
477B	85	9.9	844
468	40	10.2	408
Average CER: 65		**Total acreage: 40.8**	

Township: Kalmar Section 11 Parcel: 2

Mapping Unit	CER	Area	CER * Acres
99C	65	19.2	1245
244C	20	1.0	20
1946	70	1.2	84
203	90	6.6	598
468	40	7.0	279
477B	85	1.9	158
476B	70	4.2	292
Average CER: 65		**Total acreage: 41.0**	

Township: Kalmer Section 11 Parcel: 3

Mapping Unit	CER	Area	CER * Acres
99C	65	.7	45
468	40	4.7	188
477B	85	2.5	213
1846	70	.4	27
24	85	8.2	700
476B	70	23.8	1663
23	75	.7	54
Average CER: 70		**Total acreage: 41.0**	

Table 6. Examples of relative productivity classes (H,M,L) expressed in ranges of site indexes for common species of woodland groups listed in Table 9.

Woodland Group	Species	Class-Site Index Range
Upland Hardwood (UH)	Aspen	H - > 75 M - 60-75 L - < 60
	Red Oak	H - > 70 M - 55-70 L - < 55
Upland Conifer (UC)	Jack Pine	H - > 60 M - 45-60 L - < 45
	Red Pine	H - > 55 M - 45-55 L - < 45
Lowland Hardwood (LH)	Cottonwood	H - > 90 M - 70-90 L - < 70
Lowland Conifer (LC)	Black Spruce	H - > 40 M - 25-40 L - < 25

Table 7. Physical and chemical properties of representative Minnesota soils.*

Map No.	Soil Series	Surface properties[1] O.M.	pH	P	K	Texture	Subsoil properties[2] pH	P	K	Perm.	Rooting zone Drainage	Available Water[3] Capacity
6	Aastad	5.5	6.9	7	250	clay loam	7.6	3	200	.2-.6	Moderately well	9.8
26	Aazdahl	5.0	7.0	5	250	clay loam	7.6	5	200	.2-.6	Moderately well	9.5
13	Adolph	6.0	5.8	18	125	silt loam	6.8	18	100	.6-2	Very poor	9.2
21	Ahmeek	2.5	5.0	20	100	loam	5.5	20	100	.2-6	Well and moderately well	8.6(r)
1821	Algansee	1.5	5.8	20	75	loamy sand	6.5	15	50	6-20	Somewhat poor	4.0
22	Allendale	2.0	5.8	15	75	loamy fine sand	6.0	15	75	6-20	Somewhat poor	5.7
292	Alstad	3.0	6.0	15	100	sandy loam	5.5	15	125	.6-2	Somewhat poor	9.2
29	Alvin	2.5	6.0	10	125	fine sandy loam	5.5	15	125	.6-6	Well	9.4
496	Andrusia	1.6	5.8	20	75	loamy sand	6.5	10	60	2-6	Well	4.0
159	Anoka	1.7	5.8	30	70	loamy fine sand	5.5	30	70	.6-2	Well	7.8
49	Antigo	4.5	5.8	20	175	silt loam	5.2	20	175	.6-2	Well	8.2
16	Arenzville	4.5	7.0	40	95	silt loam	6.5	36	95	.6-2	Moderately well or well	11.3
341	Arvilla	4.3	7.0	5	75	sandy loam	7.5	3	50	>6	Somewhat excessive	3.8
410	Athelwold	4.0	6.0	10	250	silty clay loam	7.0	5	250	.6-2	Moderately well	8.3
489	Atkinson	2.8	7.0	24	135	loam	6.3	28	180	.6-2	Well	7.8
189	Auburndale	6.0	5.5	20	125	silt loam	5.0	10	125	.2-.6	Poor	9.0
52	Augsburg	5.0	8.0	5	275	silt loam	8.2	5	275	2-6	Poor and very poor	10.3
43	Automba	4.0	5.1	15	75	fine sandy loam	5.6	15	75	.2-2	Well and moderately well	8.9
503	Balmlake	3.0	5.5	15	100	fine sandy loam	5.8	10	100	.6-2	Well	4.5
319	Barbert	4.5	5.8	10	250	silt loam	5.9	10	275	.06-.2	Very poor	12.6
33	Barnes	4.7	7.2	5	280	loam	7.8	3	185	.2-.6	Well	10.1
316	Baroda	7.9	6.0	10	250	silty clay loam	5.5	20	225	<.06	Poor	9.7
62	Barrington	4.5	6.3	15	150	silt loam	5.8	20	150	.6-2	Well and moderately well	11.1
456	Barronett	5.0	6.5	15	150	silt loam	5.8	20	150	.2-.6	Poor	12.0
555	Barto	6.6	5.5	40	125	coarse sdy loam	5.3	40	70	2-6	Well	1.8(r)
167	Baudette	4.0	6.5	10	125	fine sandy loam	7.5	5	125	.6-2	Moderately well	12.0
460	Baytown	3.5	5.3	20	125	silt loam	5.0	20	125	.6-2	Well	7.2
93	Bearden	4.7	7.9	15	290	silty clay loam	8.1	3	185	.2-2	Somewhat poor	11.5
655	Bearville	2.0	5.3	20	75	loamy sand	6.0	5	200	.2-.6	Poor	6.9
310	Beauford	4.8	7.1	8	180	clay	7.4	5	230	.06-2	Poor	7.6
25	Becker	4.5	6.3	10	150	loam	5.8	15	125	2-6	Well and moderately well	4.9
73	Bellechester	2.4	7.4	5	75	sand	7.6	5	75	6-20	Excessive	2.8(r)
125	Beltrami	5.2	6.4	25	150	fine sandy loam	6.3	25	330	.6-2	Mod. well & somewhat poor	10.6
74	Beotia	5.0	7.0	10	275	silt loam	7.2	5	200	.2-2	Well	11.5
305	Bergland	5.5	6.0	10	200	clay	7.0	5	200	<.06	Poor	6.4
76	Bertrand	3.0	7.0	15	150	silt loam	6.0	20	150	.6-2	Well	14.0
531	Beseman	>20	4.5	<10	<50	muck	4.5	<10	<50	.2-6	Very poor	>25
79	Billett	2.5	5.8	15	125	sandy loam	6.0	15	125	2-6	Well or moderately well	10.6
392	Biscay	5.7	7.0	6	165	loam	7.0	6	120	.6-2	Poor and very poor	7.5
405	Bixby	2.2	6.0	85	200	loam	5.0	46	175	.6-2	Well	6.6
170	Blomford	2.1	7.0	5	125	loamy fine sand	5.5	15	150	6-20	Poor	8.2
382	Blooming	3.6	6.3	10	150	silt loam	5.8	15	175	6-2	Well	11.5
720	Blowers	3.0	6.0	15	125	sandy loam	5.6	15	125	.2-.6	Moderately well	7.0(r)
35	Blue Earth	10.7	7.6	16	330	mucky silt loam	7.5	11	400	.6-2	Very poor	14.1
75	Bluffton	6.0	6.1	34	180	loam	6.1	63	175	.6-6	Poor and very poor	10.6
644	Boash	7.0	7.6	5	300	clay loam	8.0	5	250	.06-.2	poor	9.5
81	Boone	1.5	6.3	5	50	loamy fine sand	6.3	5	50	6-20	Excessive	2.7
522	Boots	>20	6.5	<10	<50	muck	6.5	<10	<50	2-6	Very poor	>25
46	Borup	4.8	7.6	4	75	loam	7.8	3	95	2-6	Very poor and poor	11.0
169	Braham	1.6	7.0	5	125	loamy fine sand	7.0	10	150	6-20	Well and moderately well	8.4
163	Brainerd	2.5	5.8	22	105	sandy loam	6.0	14	75	.2-.6	Moderately well	6.8(r)
124	Brickton	4.0	6.0	10	200	silt loam	7.5	5	250	.2-.6	Somewhat poor	10.0
120	Brill	2.5	5.5	20	175	silt loam	5.5	20	175	.6-2	Moderately well	8.2
416	Brookings	5.4	6.6	14	235	silty clay loam	8.0	3	145	.6-2	Moderately well or well	11.5
1905	Brownsdale	4.5	6.0	15	200	silt loam	5.0	30	200	.2-.6	Poor	9.8
84	Brownton	6.2	7.5	5	300	silty clay loam	7.5	5	275	.06-2	Poor	10.0
561	Bullwinkle	>20	5.8	<10	<50	muck	6.5	10	200	.6-2	Very poor	>18
151	Burkhardt	4.0	6.0	20	75	sandy loam	5.8	20	60	2-20	Somewhat excessive	3.6
78	Burnsville	2.2	5.8	20	125	sandy loam	7.0	15	2	-20	Well	3.8
437	Buse	1.6	7.9	4	175	loam	8.1	4	130	.2-2	Well	10.1
85	Calco	5.5	8.0	5	175	silty clay loam	8.0	5	175	.6-2	Poor or very poor	11.9
367	Campia	2.5	7.0	15	150	silt loam	5.8	20	150	.6-2	Well	14.4

*Soil selected for inclusion in Tables 7, 8, and 9 are those which occur in two or more counties and/or have an extent greater than 3000 acres.

Table 7. (Continued) Physical and chemical properties of representative Minnesota soils.*

Map No.	Soil Series	Surface properties[1] O.M.	pH	P	K	Texture	Subsoil properties[2] pH	P	K	Perm.	Rooting zone Drainage	Available Water[3] Capacity
86	Canisteo	6.9	7.7	7	170	clay loam	7.8	5	165	.6-6	Poor and very poor	9.9
1895	Carmi	4.0	6.3	15	175	loam	5.6	20	175	2-6	Well	6.5
524	Caron	>20	>6.3	<10	<50	muck	6.3	<10	<50	2-20	Very poor	>30
50	Cashel	4.5	7.5	5	300	silty clay	7.5	5	300	.06-6	Somewhat poor	9.1
544	Cathro	>20	6.8	<10	<50	muck	6.8	<10	<50	.2-6	Very poor	16.2
472	Channahon	2.5	7.5	15	200	loam	7.5	15	250	.6-2	Well and moderately well	3.4
19	Chaseburg	1.7	7.0	35	100	silt loam	6.5	35	100	.6-2	Well and moderately well	12.8
329	Chaska	3.5	8.0	5	275	silt loam	8.0	5	275	.6-2	Poor and somewhat poor	9.6
155	Chetek	2.1	5.8	20	75	sandy loam	5.8	20	60	2-20	Somewhat excessive	5.1
404	Chilgren	2.5	6.3	15	150	loam	7.5	5	200	.6-2	Poor	9.8
102	Clarion	4.1	6.5	10	155	loam	7.1	5	160	.6-2	Well	11.3
641	Clearwater	7.0	7.5	5	300	clay	8.0	5	300	.06-.2	Poor	10.0
371	Clontarf	4.0	6.3	5	100	sandy loam	7.0	5	75	2-6	Moderately well	6.5
355	Cloquet	4.1	5.6	44	140	fine sandy loam	5.5	40	100	>20	Somewhat excessive	3.8
88	Clyde	7.0	6.5	15	175	silty clay loam	6.5	10	150	.6-2	Poor and very poor	10.0
478	Coggon	3.0	5.8	30	200	silt loam	5.3	30	200	.6-2	Moderately well	14.6
1833	Coland	8.3	6.3	20	225	clay loam	6.3	20	225	.6-2	Poor	11.4
96	Collinwood	5.7	6.1	23	325	silty clay loam	7.5	5	220	.06-.6	Moderately well	8.5
98	Colo	8.0	6.0	15	200	silty clay loam	6.5	20	225	.6-2	Poor	11.8
47	Colvin	4.8	7.9	3	290	silty clay loam	8.0	3	260	.2-.6	Poor and very poor	11.0
18	Comfrey	5.6	7.2	18	150	silty clay loam	7.7	5	115	.6-2	Poor and very poor	10.7
452	Comstock	2.5	5.8	15	150	silt loam	5.5	20	150	.6-2	Somewhat poor	12.7
557	Conic	3.5	5.3	10	100	gravelly sdy loam	5.8	10	100	.06-2	Well	3.0(r)
100	Copaston	4.3	7.0	5	150	loam	6.3	10	125	.6-2	Well	3.0(r)
109	Cordova	5.3	6.3	21	265	clay loam	6.0	13	215	.2-.6	Poor	10.1
571	Coriff	5.0	7.6	5	100	loam	7.6	5	100	.6-2	Poor	10.5
117	Cormant	6.0	7.0	15	25	loamy fine sand	7.0	15	25	6-20	Poor and very poor	4.9
459	Corunna	4.5	7.0	10	150	loam	7.0	10	150	.2-.6	Poor	9.0
601	Council	2.5	5.3	20	100	sandy loam	5.0	20	100	.6-2	Well	10.5
615	Cowhorn	3.0	5.3	20	100	loamy vry fine sand	5.5	20	100	2-6	Somewhat poor	6.0
118	Crippin	4.5	7.5	5	150	loam	7.5	5	125	.6-2	Somewhat poor	11.5
1918	Croke	6.0	6.5	10	250	loam	7.0	5	275	.06-.2	Moderately well	10.5
268	Cromwell	3.0	5.3	40	140	sandy loam	5.3	40	100	6-20	Excessive	5.3
449	Crystal Lk	2.5	6.3	15	150	silt loam	5.3	20	150	.6-2	Moderately well	14.0
204	Cushing	3.0	7.0	10	100	sandy loam	7.0	10	150	.2-.6	Well and moderately well	8.5
620	Cutaway	1.5	5.6	15	75	loamy fine sand	5.3	15	125	.2-.6	Well and moderately well	5.0
129	Cylinder	6.7	6.3	10	165	loam	7.0	5	120	.6-2	Somewhat poor	6.4
5	Dakota	2.7	5.5	10	80	loam	5.5	10	80	.6-2	Well	6.8
133	Dalbo	3.5	5.8	10	200	silt loam	7.3	5	250	.6-2	Moderately well	10.7
281	Darfur	6.0	7.0	5	115	loam	7.0	5	115	.6-6	Poor	8.5
494	Darnen	5.5	7.0	5	200	loam	7.0	5	200	.6-2	Moderately well and well	11.3
183	Dassel	4.5	6.3	20	140	loam	6.3	20	140	2-6	Poor and very poor	8.0
536	Dawson	>20	3.5	<10	<50	muck	3.5	<10	<50	.2-6	Very poor	>18
453	DeMonville	2.5	6.3	15	50	loamy sand	5.8	15	75	.2-20	Well and moderately well	7.3
505	Debs	5.5	6.6	25	150	silt loam	7.0	5	250	.6-2	Well	11.0
547	Deerwood	>20	7.5	<10	<50	muck	7.5	<10	<50	6-20	Very poor	6.4
336	Delft	6.0	7.6	20	175	clay loam	7.6	10	160	.2-.6	Poor	13.5
27	Dickinson	2.6	6.0	10	120	fine sandy loam	6.0	6	90	2-6	Well & somewhat excessive	6.2
327	Dickman	3.8	6.3	5	110	sandy loam	5.8	15	75	2-20	Well	4.3
9	Dodgeville	3.5	6.3	10	175	silt loam	5.8	15	150	.2-2	Well	6.3(r)
591	Doland	4.1	7.5	20	200	silt loam	8.1	14	150	.6-2	Well	11.1
425	Donaldson	4.0	7.0	10	150	fine sandy loam	7.5	5	225	.06-6	Mod. well& somewhat poor	8.5
550	Dora	>20	5.8	<10	<50	mucky peat	6.3	10	250	<.06	Very poor	>18
698	Doran	5.0	6.5	15	350	clay loam	7.5	5	350	.06-.2	Somewhat poor	10.0
473	Doreton	4.0	5.8	35	200	loam	6.3	35	175	.6-2	Well	6.8
406	Dorset	5.5	6.3	20	150	sandy loam	7.0	10	50	6-20	Well	3.7
137	Dovray	7.6	7.5	5	250	clay	7.0	5	250	.06-6	Poor and very poor	8.4
516	Dowagiac	4.0	6.3	15	200	loam	5.8	15	200	.6-2	Well	6.3
574	Du Page	4.0	8.0	5	225	loam	8.0	5	225	.6-2	Well or moderately well	11.2
260	Duelm	2.8	7.0	10	50	loamy coarse sand	6.3	15	40	6-20	Poor and moderately well	4.2
504	Duluth	3.1	5.3	20	150	very fine sandy loam	5.5	20	125	.06-.2	Well and moderately well	12.2
123	Dundas	3.3	6.0	16	135	loam	5.6	16	180	.2-.6	Somewhat poor and poor	11.0
502	Dusler	3.5	5.3	20	150	silt loam	5.5	20	135	.06-.2	Somewhat poor and poor	12.2

Table 7. (Continued) *Physical and chemical properties of representative* Minnesota soils.*

Map No.	Soil Series	Surface properties[1] O.M.	pH	P	K	Texture	Subsoil properties[2] pH	P	K	Perm.	Rooting zone Drainage	Available Water[3] Capacity
565	Eckvoll	4.0	6.3	15	150	loamy fine sand	6.3	10	200	.6-2	Moderately well	8.5
616	Effie	4.0	5.5	20	175	silt loam	7.5	5	200	.06-.2	Poor	9.5
141	Egeland	2.8	7.0	10	100	loam	7.0	10	100	2-6	Well	6.9
1830	Eitzen	3.0	7.0	20	150	silt loam	6.5	30	150	.6-2	Well and moderately well	15.1
593	Elbaville	5.9	7.0	25	150	silt loam	7.0	25	150	.2-2	Well	8.3
143	Eleva	2.5	5.8	10	100	sandy loam	5.8	5	50	.6-6	Well & somewhat excessive	5.1(r)
510	Elmville	4.0	7.5	5	75	fine sandy loam	8.2	5	150	2-6	Somewhat poor	8.4
12	Emmert	2.2	6.3	10	50	loamy coarse sand	7.0	10	40	>20	Excessive	2.1
145	Enstrom	3.3	7.0	5	40	loamy fine sand	7.5	5	40	6-20	Moderately well	7.6
191	Epoufette	2.0	6.5	10	75	sandy loam	7.0	5	100	2-6	Poor and very poor	3.5
237	Erin	3.8	5.7	31	300	silt loam	5.0	49	260	.2-.6	Well and moderately well	11.3
645	Espelie	3.0	7.0	10	150	fine sandy loam	7.4	5	225	.06-2	Poor	6.8
192	Estelline	3.9	6.7	8	245	silt loam	6.8	5	195	.6-2	Well	8.2
41	Estherville	3.0	6.7	12	90	sandy loam	7.3	6	75	>20	Well or somewhat excessive	4.5
409	Etter	3.5	6.3	20	150	fine sandy loam	5.0	20	150	.6-2	Well	7.2
149	Everly	5.0	6.0	10	225	clay loam	6.5	5	225	.6-2	Well or moderately well	10.6
484	Eyota	2.0	6.5	10	75	sandy loam	6.5	10	150	.6-2	Well	8.0
156	Fairhaven	2.2	5.8	16	115	silt loam	6.5	20	95	.6-2	Well	6.4
57	Fargo	4.3	7.2	12	475	silty clay	7.6	6	400	.06-.2	Poor	9.8
69	Fedji	2.0	6.0	5	125	loamy fine sand	6.0	5	150	.6-20	Well	9.0
455	Festina	2.4	6.4	56	105	silt loam	5.7	72	145	.6-2	Well	14.5
160	Fieldon	6.0	7.8	2	110	loam	7.8	2	100	.6-6	Poor	7.9
144	Flak	1.8	5.8	48	60	sandy loam	6.1	18	60	.2-.6	Well	6.4(r)
66	Flaming	2.4	5.8	15	75	fine sand	5.8	15	75	6-20	Moderately well	4.8
92	Flandreau	3.5	6.3	15	225	silt loam	6.3	15	200	.6-2	Well	8.8
36	Flom	4.8	7.3	7	235	clay loam	7.5	4	200	.2-.6	Poor	10.6
479	Floyd	4.5	6.7	12	170	silt loam	7.2	4	130	.6-2	Somewhat poor	10.8
426	Foldahl	2.9	7.0	5	75	loamy fine sand	7.0	5	90	6-20	Moderately well	8.2
375	Forada	4.0	7.0	5	75	sandy loam	6.5	5	50	2-6	Poor and very poor	5.1
339	Fordville	5.6	6.9	10	105	loam	6.8	4	115	.6-6	Well	6.0
168	Forman	4.1	7.0	5	275	clay loam	7.5	3	175	.06-.6	Well	10.1
171	Formdale	4.0	7.0	5	275	clay loam	8.0	3	175	.2-.6	Well	10.0
71	Fossum	4.0	8.0	3	75	sandy loam	8.0	3	50	6-20	Poor and very poor	5.4
1877	Fostoria	4.5	7.0	10	175	loam	7.0	10	175	.6-2	Somewhat poor	12.5
65	Foxhome	4.5	7.0	5	75	sandy loam	7.5	3	50	6-20	Moderately well	3.2
296	Fram	7.0	7.5	15	250	loam	8.0	5	300	.6-2	Mod. well & somewhat poor	10.5
476	Frankville	3.5	5.5	16	135	silt loam	5.3	35	160	.06-.2	Well	5.2
264	Freeon	2.3	5.2	18	95	silt loam	5.5	19	80	.2-2	Moderately well	9.5
266	Freer	2.4	5.3	18	175	silt loam	5.5	17	115	.6-2	Somewhat poor	10.2
173	Frontenac	3.5	7.0	20	200	loam	7.0	20	180	.6-2	Well	8.3
210	Fulda	5.9	7.0	10	275	silty clay	7.5	10	275	.06-.6	Poor	9.8
174	Gale	3.0	6.3	35	150	silt loam	5.8	40	175	.6-2	Well	6.7(r)
175	Galva	4.0	6.3	15	225	silty clay loam	7.0	10	200	.6-2	Well	10.4
77	Garnes	3.0	7.0	10	150	fine sandy loam	8.0	5	150	.6-2	Moderately well	10.0
176	Garwin	6.0	5.8	15	200	silty clay loam	6.3	15	175	.6-2	Poor	15.5
1835	Germantown	4.5	5.8	15	170	clay loam	8.0	3	170	.2-.6	Well	4.8(r)
114	Glencoe	6.0	7.2	16	205	clay loam	7.3	13	250	.2-2	Very poor	11.3
60	Glyndon	3.9	8.0	3	130	loam	8.3	2	70	.6-6	Mod. well & somewhat poor	11.1
180	Gonvick	5.7	7.0	12	130	loam	7.3	14	175	.6-2	Moderately well	10.5
617	Goodland	2.0	5.8	20	200	silt loam	5.8	15	150	.6-2	Well	5.0
177	Gotham	2.0	6.3	10	60	fine sand	6.3	10	60	6-20	Well & somewhat excessive	5.4
659	Graceville	5.0	6.3	15	225	silt loam	6.3	15	200	.6-2	Well and moderately well	11.5
178	Granby	5.0	7.0	5	75	fine sandy loam	7.0	5	50	6-20	Poor and very poor	5.5
259	Grays	3.5	6.3	10	150	silt loam	5.8	10	125	.6-2	Moderately well and well	11.5
549	Greenwood	>20	4.5	<10	<50	peat	4.5	<10	<50	.6-6	Very poor	>30
59	Grimstad	2.8	7.9	5	40	fine sandy loam	7.8	5	90	6-20	Somewhat poor & mod. well	8.3
128	Grogan	3.8	5.8	15	175	silt loam	7.0	10	160	2-6	Well and moderately well	11.5
613	Grovecity	4.0	7.0	10	160	loam	7.0	10	150	2-6	Somewhat poor & mod. well	9.5
233	Growton	2.1	7.0	10	150	sandy loam	5.8	20	125	.6-2	Moderately well	7.9
482	Grygla	4.3	7.0	5	40	fine sand	8.0	12	45	6-20	Poor and very poor	8.3
230	Guckeen	6.4	6.5	13	340	silty clay loam	6.0	5	325	.06-.6	Mod. well & somewhat poor	9.7
372	Hamar	6.6	7.5	5	80	loamy fine sand	7.5	5	75	2-20	Poor or somewhat poor	4.9
414	Hamel	6.0	6.0	25	200	loam	6.3	20	175	.2-2	Poor	11.2

Table 7. (Continued) Physical and chemical properties of representative Minnesota soils.*

Map No.	Soil Series	Surface properties[1] O.M.	pH	P	K	Texture	Subsoil properties[2] pH	P	K	Perm.	Rooting zone Drainage	Available Water[3] Capacity
184	Hamerly	5.0	7.8	10	200	clay loam	8.0	4	150	.2-2	Somewhat poor & mod. well	10.2
1878	Hamre	>20	5.8	<10	<50	muck	7.6	5	250	.2-.6	Very poor	15.0
111	Hangaard	6.0	7.5	5	80	sandy loam	7.5	5	60	6-20	Poor and somewhat poor	2.9
282	Hanska	5.9	7.0	5	100	sandy loam	7.0	5	75	2-6	Poor	6.8
112	Harps	6.0	8.0	5	170	clay loam	8.0	5	170	.6-2	Poor	11.1
185	Hattie	5.0	7.5	5	250	silty clay	8.0	5	250	.06-.2	Well & moderately well	8.8
187	Haug	>20	7.5	<10	<50	muck	8.0	5	250	.6-2	Very poor	12.0
380	Havana	3.5	6.3	10	150	silt loam	5.8	15	175	.2-.6	Poor	11.3
611	Hawick	2.5	6.3	10	90	loamy sand	7.0	5	75	2-6	Excessive	3.5
104	Hayden	1.8	6.4	30	180	loam	5.8	25	160	.6-2	Well	10.5
190	Hayfield	3.5	6.3	50	200	silt loam	5.8	40	175	.6-2	Mod. poor or somewhat well	7.5
366	Hecla	4.0	7.0	5	70	loamy sand	7.0	5	60	2-20	Moderately well	6.5
8027	Hegne	5.0	7.5	5	375	silty clay loam	7.5	5	400	.06-.2	Poor and very poor	10.0
232	Heyder	3.8	6.3	10	150	sandy loam	5.8	20	150	.6-2	Well	9.1
254	Hibbing	2.5	5.3	30	150	silt loam	6.5	15	200	.06-2	Well and moderately well	8.1
436	Hidewood	5.0	7.5	10	225	silty clay loam	7.5	5	165	.2-2	Somewhat poor	11.0
647	Hilaire	3.0	7.0	5	200	loamy fine sand	7.5	5	250	.06-.2	Mod. well&somewhat poor	5.5
48	Hiwood	1.0	5.3	15	75	loamy fine sand	5.5	5	75	6-20	Moderately well	4.0
200	Holdingford	3.5	5.8	30	80	sandy loam	5.8	20	70	.6-2	Well	8.0(r)
487	Hoopeston	2.5	6.0	10	125	fine sdy loam	6.5	5	75	2-6	Somewhat poor	6.5
523	Houghton	>20	6.0	<10	<50	muck	6.0	<10	<50	.2-6	Very poor	>25
7	Hubbard	1.9	6.2	26	75	loamy sand	6.4	21	65	6-20	Excessive	3.7
194	Huntersville	2.0	6.0	10	100	loamy fine sand	6.0	10	125	.2-.6	Moderately well	4.0
194	Huntsville	4.6	7.3	40	120	silt loam	7.3	32	130	.6-2	Moderately well and well	13.4
54	Ihlen	5.2	6.5	5	195	silty clay loam	6.8	3	190	.6-2	Well	5.9(r)
172	Indus	2.1	6.0	5	295	clay loam	7.8	3	230	.06-.2	Poor and somewhat poor	7.7
556	Insula	2.0	6.0	10	100	gravelly sandy loam	6.0	10	60	2-6	Well	1.7(r)
261	Isan	4.0	5.8	10	50	sandy loam	5.8	20	40	6-20	Poor and very poor	4.1
161	Isanti	5.0	5.6	8	49	loamy fine sand	5.6	20	36	6-20	Poor and very poor	4.3
618	Itasca	1.5	5.8	20	200	silt loam	6.3	10	150	.6-2	Well	11.0
594	Jeffers	7.0	7.5	10	250	clay loam	7.5	10	225	.6-2	Poor	10.2
1902	Jewett	2.5	6.5	15	100	silt loam	5.3	20	100	.6-2	Well	10.2
203	Joy	4.7	6.3	15	190	silt loam	5.3	20	175	.6-2	Somewhat poor	15.9
15	Judson	5.0	6.3	40	125	silt loam	6.3	30	130	.6-2	Well or moderately well	13.2
518	Kalmarville	5.5	7.5	15	200	silty clay loam	7.5	15	200	2-6	Poor and very poor	8.6
105	Kamrar	5.0	7.0	5	180	silty clay	6.3	10	200	.2-.6	Moderately well	11.5
415	Kanaranzi	4.0	6.3	10	150	loam	7.5	5	70	.6-20	Well	5.2
53	Kandota	3.0	6.0	10	100	sandy loam	6.5	10	100	.2-2	Well	6.6
205	Karlstad	3.5	5.0	15	90	sandy loam	7.4	5	60	2-6	Moderately well	5.0
206	Kasota	3.1	6.6	22	215	loam	5.8	20	185	.06-.6	Well	6.7
24	Kasson	3.0	6.0	18	200	silt loam	5.3	30	200	.2-2	Moderately well	12.8
208	Kato	5.5	6.6	6	85	silty clay loam	6.3	9	70	.6-2	Poor and very poor	8.1
619	Keewatin	2.5	5.5	15	100	silt loam	6.0	10	150	.06-.2	Somewhat poor	9.0
209	Kegonsa	3.8	6.5	10	150	silt loam	5.5	20	150	.6-2	Well	7.7
250	Kennebec	5.0	6.3	40	130	silt loam	6.3	30	130	.6-2	Moderately well	13.4
30	Kenyon	4.1	6.0	10	135	silt loam	5.5	13	150	.6-2	Moderately well and well	14.1
238	Kilkenny	4.7	6.3	15	300	clay loam	5.3	15	300	.2-.6	Well and moderately well	10.1
342	Kingsley	2.6	6.3	10	70	sandy loam	5.8	10	60	.2-.6	Well	8.1
197	Kingston	5.2	6.3	24	200	silty clay loam	6.5	5	150	.6-2	Mod. poor or somewhat well	11.3
58	Kittson	5.2	7.5	8	80	loam	8.2	4	160	.2-2	Mod. well & somewhat poor	10.5
213	Klinger	5.5	5.8	10	135	silty clay loam	6.3	10	150	.6-2	Somewhat poor	12.6
539	Klossner	>20	6.5	<10	<50	muck	6.0	<10	<50	.2-6	Very poor	>18
562	Knoke	9.0	8.0	5	180	silty clay loam	8.0	5	200	.2-.6	Very poor	12.3
461	Koronis	3.0	6.3	15	150	loam	7.0	10	150	2-6	Well	9.0
91	Kranzburg	4.3	6.6	12	230	silty clay loam	7.4	4	165	.2-2	Well	11.3
481	Kratka	4.8	7.5	5	75	fine sandy loam	7.5	3	50	.2-20	Poor and very poor	8.2
51	La Prairie	5.5	7.5	5	200	loam	8.0	5	200	.6-2	Moderately well	11.4
1907	Lakefield	6.0	8.0	5	175	sil loam	8.0	5	190	.6-2	Mod. well & somewhat poor	12.0
216	Lamont	2.0	5.5	5	100	fine sandy loam	5.8	5	75	2-6	Well	8.6
418	Lamoure	5.9	7.7	10	175	silty clay loam	7.6	8	140	.6-2	Poor	10.8
220	Langhel	1.4	8.0	3	200	loam	8.0	3	200	.6-2	Well	10.4
179	Langola	2.5	6.0	57	100	loamy fine sand	6.1	48	85	6-20	Well and moderately well	6.9
222	Lasa	1.9	7.0	30	120	fine sand	6.6	15	80	2-6	Somewhat excessive	4.8

Table 7. (Continued) Physical and chemical properties of representative Minnesota soils.*

Map No.	Soil Series	Surface properties[1] O.M.	pH	P	K	Texture	Subsoil properties[2] pH	P	K	Perm.	Rooting zone Drainage	Available Water[3] Capacity
485	Lawler	4.5	5.8	10	100	silt loam	6.0	5	90	.6-2	Somewhat poor	7.2
226	Lawson	4.5	7.0	40	120	silt loam	7.0	30	130	.6-2	Somewhat poor	12.6
239	Le Sueur	3.8	6.4	21	180	clay loam	5.8	12	175	.6-2	Mod. well to somewhat poor	10.4
1984	Leafriver	>20	6.0	<10	<50	muck	6.2	15	40	2-20	Very poor	6.5
227	Lemond	8.1	7.5	5	100	loam	7.5	5	75	2-6	Poor	6.9
559	Lena	>20	8.0	<10	<50	muck	8.0	<10	<50	.2-6	Very poor	>20
709	Lengby	1.5	6.5	20	75	sandy loam	7.4	5	60	.6-2	Well	7.0
138	Lerdal	3.4	5.8	16	345	clay loam	5.5	14	300	.06-.2	Somewhat poor to mod.well	10.1
106	Lester	2.7	5.8	28	205	loam	5.8	14	165	.6-2	Well	10.1
241	Letri	7.0	7.0	10	225	clay loam	7.5	5	225	.6-2	Poor	11.1
244	Lilah	1.7	5.1	6	85	sandy loam	5.6	29	75	>20	Excessive	3.1
1916	Lindaas	8.0	7.0	15	250	silty clay loam	7.8	10	300	.06-.2	Poor	12.0
247	Linder	2.8	7.0	5	100	sandy loam	7.8	3	100	2-6	Somewhat poor	5.5
301	Lindstrom	5.0	6.3	25	135	silt loam	5.8	30	170	.6-2	Well	15.2
162	Lino	1.2	5.8	14	40	loamy fine sand	5.6	16	50	6-20	Somewhat poor	4.3
713	Linveldt	5.0	7.0	5	100	fine sandy loam	7.6	5	75	.6-2	Moderately well	9.0
470	Lismore	4.9	6.5	9	160	silty clay loam	7.6	3	125	.2-.6	Moderately well	11.0
181	Litchfield	2.3	6.3	34	135	loamy fine sand	6.6	15	80	2-6	Mod. well & somewhat poor	6.3
477	Littleton	4.0	7.0	15	175	silt loam	7.0	25	250	.6-2	Somewhat poor	11.0
537	Lobo	>20	3.6	<10	<50	peat	3.4	<10	<50	>6	Very poor	>30
245	Lohnes	3.6	7.0	3	25	loamy coarse sand	7.8	3	20	6-20	Moderately well and well	4.5
248	Lomax	5.5	6.3	15	150	loam	5.8	15	175	2-6	Well	9.4
572	Lowlein	4.5	6.3	10	125	sandy loam	7.0	5	150	.6-2	Moderately well	9.0
533	Loxley	>20	3.5	<10	<50	muck	3.5	<10	<50	.2-6	Very poor	>20
546	Lupton	>20	7.5	<10	<50	muck	7.5	<10	<50	.2-.6	Very poor	>20
211	Lura	7.0	7.0	6	250	silty clay	7.5	5	275	.06-.2	Very poor and poor	11.1
45	Maddock	2.1	7.0	5	60	loamy fine sand	7.0	5	50	6-20	Well	5.5
136	Madelia	5.1	7.0	5	190	silty clay loam	7.4	3	170	.6-2	Poor	13.6
454	Mahtomedi	3.3	5.8	20	75	loamy coarse sand	5.3	20	60	6-20	Excessive	4.2
347	Malachy	4.0	7.5	3	100	sandy loam	7.5	3	80	.6-6	Mod. well & somewhat poor	6.0
511	Marcellon	4.5	6.3	10	125	loam	7.0	5	125	.6-2	Moderately well	9.5
249	Marcus	5.0	6.3	15	225	silty clay loam	7.0	10	200	.6-2	Poor	12.0
543	Markey	>20	7.5	<10	<50	muck	7.5	<10	<50	.2-6	Very poor	14.3
251	Marlean	5.5	7.0	5	125	silty clay loam	7.5	5	125	2-6	Well	7.8
110	Mama	6.0	6.3	15	300	silty clay loam	6.6	10	300	.06-.2	Poor	10.0
242	Marquette	2.0	6.8	5	80	loamy sand	8.0	5	60	2-6	Excessive	3.0
252	Marshan	5.3	6.7	4	80	silty clay loam	6.5	7	100	.6-2	Very poor and poor	6.9
246	Marysland	5.0	6.0	5	100	loam	8.0	5	110	.6-2	Poor and very poor	6.4
131	Massbach	3.0	6.5	15	150	silt loam	5.8	20	170	.6-2	Well and moderately well	8.9
412	Mavie	7.0	8.0	2	155	fine sandy loam	8.2	2	120	6-20	Poor	7.4
253	Maxcreek	5.5	7.0	10	150	silty clay loam	7.0	5	175	.6-2	Poor and very poor	12.0
378	Maxfield	6.0	7.0	10	140	silty clay loam	7.0	10	150	.6-2	Poor	12.7
255	Mayer	7.9	7.7	4	100	loam	7.8	8	80	.6-2	Very poor and poor	3.4
256	Mazaska	5.5	6.3	15	300	silty clay loam	5.3	15	300	.06-.6	Poor	9.4
108	McIntosh	6.2	8.0	3	155	silt loam	8.3	10	140	.2-2	Mod. well & somewhat poor	11.1
257	McPaul	3.0	7.0	25	130	silt loam	7.5	20	130	.6-2	Well and moderately well	13.2
202	Meehan	1.5	6.3	10	50	loamy sand	6.3	15	50	6-20	Somewhat poor	4.0
458	Menahga	2.5	6.0	90	70	loomy sand	5.8	95	45	6-20	Excessive	2.6
377	Merton	5.0	6.3	10	150	silt loam	6.3	10	175	.6-2	Mod. well & somewhat poor	11.8
535	Merwin	>20	4.5	<10	<50	mucky peat	4.8	<10	<50	.06-.6	Very poor	>20
558	Mesaba	3.0	6.3	10	100	gravelly sandy loam	5.8	10	80	2-6	Well	3.5(r)
152	Milaca	1.8	6.0	29	85	fine sandy loam	6.2	11	75	.2-2	Well	7.9(r)
551	Millerville	>20	6.5	<10	<50	mucky peat	6.1	<10	<50	.2-6	Very poor	>20
269	Millington	7.1	8.0	5	150	silty clay loam	8.0	5	150	.6-2	Poor	11.0
463	Minneiska	3.0	7.5	10	150	fine sandy loam	7.5	10	130	2-6	Moderately well	10.1
363	Minneopa	4.0	6.3	15	150	loamy fine sand	7.0	10	100	2-20	Moderately well	5.5
287	Minnetonka	6.9	6.3	10	150	silty clay loam	6.0	10	250	.06-.2	Poor	10.8
376	Moland	5.0	6.3	10	150	silt loam	6.3	10	175	.6-2	Well	11.7
90	Moody	4.4	6.6	13	240	silty clay loam	7.1	9	200	.6-2	Well	11.2
534	Mooselake	>20	5.3	<10	<50	mucky peat	5.8	<10	<50	2-6	Very poor	>20
164	Mora	3.0	5.9	13	50	fine sandy loam	6.2	8	75	.2-6	Mod. well & somewhat poor	9.2(r)
621	Morph	2.5	6.0	15	150	vry fine sdy loam	6.5	10	150	.6-2	Poor	9.5
1888	Moundprairie	2.5	7.5	15	125	silty clay loam	7.5	15	140	.6-2	Poor and very poor	11.8

Table 7. (Continued) Physical and chemical properties of representative Minnesota soils.*

Map No.	Soil Series	Surface properties[1] O.M.	pH	P	K	Texture	Subsoil properties[2] pH	P	K	Perm.	Rooting zone Drainage	Available Water[3] Capacity
401	Mt. Carroll	4.5	6.1	24	135	silt loam	6.0	30	180	.6-2	Well	17.1
525	Muskego	>20	7.0	<10	<50	muck	6.6	<10	<50	.2-6	Very poor	18.3
1959	Nary	2.0	5.8	15	125	fine sdy loam	5.5	15	150	.2-.6	Moderately well	9.3
622	Nashwauk	1.5	5.5	15	125	fine sandy loam	6.3	10	150	.06-.2	Well	6.0
492	Nasset	3.3	5.8	25	135	silt loam	5.8	25	150	.6-2	Well	8.2
40	Nebish	3.4	6.3	27	220	loam	7.3	10	200	.6-2	Well	9.9
186	Nemadji	1.5	5.3	15	60	fine sand	5.0	15	50	6-20	Somewhat poor	3.8
583	Nereson	4.0	7.5	5	100	fine sandy loam	8.3	5	160	.6-6	Moderately well	10.6
235	Nessel	4.5	6.3	65	185	loam	5.3	60	335	.6-2	Moderately well	11.1
576	Newalbin	2.0	6.5	30	100	silt loam	6.5	35	100	.6-2	Poor	12.0
515	Newfound	2.8	4.8	15	125	gravelly sandy loam	5.3	15	100	.06-.2	Well	5.0(r)
501	Newglarus	2.0	6.5	25	135	silt loam	6.0	30	150	.06-.2	Well	5.9(r)
381	Newry	3.0	6.3	10	150	silt loam	6.0	15	175	.6-2	Moderately well	12.8
274	Newson	1.5	4.6	8	20	mucky loamy sand	4.6	26	45	6-20	Poor and very poor	4.9
130	Nicollet	3.7	6.5	9	180	clay loam	7.0	6	180	.6-2	Mod. well & somewhat poor	10.5
575	Nishna	6.0	7.0	5	175	silty clay	8.0	3	175	.06-.2	Poor	7.6
217	Nokasippi	8.0	5.3	10	50	mucky loamy fine sand	5.8	15	70	.6-20	Very poor	6.3
142	Nokay	5.0	5.3	15	70	sandy loam	5.8	15	70	.6-6	Somewhat poor and poor	7.7(r)
661	Nora	3.0	6.8	10	300	silt loam	7.5	10	250	.6-2	Well	12.0
446	Normania	5.2	7.0	5	225	loam	7.0	5	200	.6-2	Moderately well	11.4
429	Northcote	6.7	7.0	10	450	clay	7.5	5	400	.06-.2	Poor and very poor	7.4
563	Northwood	>20	7.0	<10	<50	muck	7.4	5	225	.6-2	Very poor	10.2
224	Nowen	2.1	6.3	15	150	sandy loam	6.3	15	125	.6-2	Poor and somewhat poor	9.1
430	Noyes	4.3	7.5	5	400	sandy clay loam	8.0	3	400	.06-.2	Poor and somewhat poor	8.7
207	Nymore	2.3	6.2	50	70	loamy sand	6.4	39	55	6-20	Excessive	2.5
275	Ocheyedan	3.5	6.3	10	225	loam	7.3	5	225	.6-2	Well	11.0
466	Ogilvie	3.0	5.6	20	75	silt loam	5.0	25	75	.6-2	Somewhat poor and poor	7.8
134	Okoboji	8.8	7.5	5	175	silty clay loam	7.5	5	175	.2-.6	Very poor	11.7
276	Oldham	7.5	7.0	15	250	silty clay loam	8.0	15	300	.06-.6	Poor and very poor	10.1
188	Omega	1.0	5.3	15	50	loamy sand	6.5	15	50	6-20	Somewhat excessive	4.1
277	Onamia	2.5	5.8	15	75	sandy loam	5.3	20	70	.6-2	Well	7.2
303	Ontonagon	2.5	5.8	25	125	silty clay	6.5	5	120	<.06	Well or moderately well	7.3
631	Oran	2.5	6.3	20	250	silt loam	6.0	15	225	.6-2	Somewhat poor	10.5
493	Oronoco	2.4	7.0	25	135	loam	5.8	25	135	.6-2	Well	13.2
413	Osakis	5.7	6.3	10	125	loam	7.5	3	60	6-20	Moderately well	3.8
317	Oshawa	5.9	8.0	5	125	silt loam	8.0	5	125	.6-2	Very poor	11.7
2	Ostrander	3.3	5.9	10	140	loam	5.5	18	125	.6-2	Well	11.3
279	Otterholt	2.5	5.8	15	100	silt loam	5.0	20	125	.6-2	Well	11.0
506	Overly	4.7	7.0	15	275	silty clay loam	6.0	3	200	.2-.6	Well or moderately well	11.3
1975	Oylen	3.0	6.3	10	75	sandy loam	7.3	5	50	2-6	Moderately well	4.5
703	Paddock	4.5	6.8	10	125	sandy loam	6.5	15	125	.2-.6	Somewhat poor	7.0
587	Palsgrove	1.5	6.3	25	135	silt loam	6.0	30	175	.06-.2	Well	7.8(r)
165	Parent	6.0	6.5	35	75	loam	7.0	19	75	.2-2	Poor and very poor	8.5
34	Parnell	7.5	7.2	15	255	silty clay loam	6.5	14	300	.06-.6	Very poor	10.4
280	Pelan	2.0	7.0	10	75	sandy loam	8.0	5	75	.6-2	Moderately well	7.7
607	Pengilly	3.0	6.3	10	150	very fine sandy loam	6.3	10	150	.6-2	Poor	9.7
581	Percy	6.0	7.5	5	100	sandy clay loam	8.0	3	160	.6-6	Poor	9.2
434	Perella	6.5	7.0	15	275	silty clay loam	7.5	10	190	.2-.6	Poor	11.6
623	Pierz	2.5	6.3	15	75	sandy loam	5.5	20	60	2-6	Well	5.6
283	Plainfield	1.6	5.6	60	60	sand	6.0	70	30	6-20	Excessive	3.7
284	Poinsett	5.9	7.0	5	275	silty clay loam	8.0	3	200	.6-2	Well	11.3
119	Pomroy	1.4	5.8	10	50	loamy fine sand	5.8	15	70	6-20	Well and moderately well	5.8(r)
148	Poppleton	1.2	7.0	5	80	fine sand	7.0	5	60	6-20	Mod. well & somewhat poor	5.0
285	Port Byron	4.0	6.5	12	160	silt loam	5.8	30	275	.6-2	Well and moderately well	13.0
507	Poskin	3.0	6.0	20	150	silt loam	5.5	20	125	.6-2	Somewhat poor	6.8
325	Prebish	7.1	7.0	30	75	loam	7.0	20	75	.2-.6	Very poor	8.9
397	Primghar	4.5	6.1	8	335	silty clay loam	7.0	4	145	.6-2	Somewhat poor	14.0
344	Quam	9.3	7.0	5	200	silty clay loam	7.0	5	200	.2-.6	Very poor	11.5
99	Racine	3.5	6.8	32	195	silt loam	5.5	20	190	.6-2	Well and moderately well	12.1
289	Radford	4.1	7.0	20	125	silt loam	7.5	20	125	.6-2	Somewhat poor	12.5
291	Ransom	7.2	7.0	10	225	silty clay loam	7.0	10	225	.6-2	Mod. well & somewhat poor	9.0
294	Rasset	3.0	5.8	35	135	sandy loam	6.3	15	100	2-6	Somewhat excessive	5.3
450	Rauville	6.5	8.0	5	250	silty clay loam	8.0	5	275	.2-2	Very poor	10.6

Table 7. (Continued) *Physical and chemical properties of representative* Minnesota soils.*

Map No.	Soil Series	Surface properties[1] O.M.	pH	P	K	Texture	Subsoil properties[2] pH	P	K	Perm.	Rooting zone Drainage	Available Water[3] Capacity
608	Rawles	3.0	7.5	35	125	silt loam	7.5	35	125	.6-2	Moderately well	12.6
295	Readlyn	5.7	5.5	30	250	silt loam	6.2	10	210	.6-2	Somewhat poor	11.3
116	Redby	2.0	5.7	66	25	loamy fine sand	6.6	15	10	6-20	Somewhat poor	8.2
82	Redeye	2.0	5.8	10	100	loamy sand	6.8	10	125	.2-.6	Well	5.0(r)
566	Regal	5.0	7.6	10	100	loam	7.6	5	60	.6-2	Poor	5.0
650	Reiner	4.0	6.5	10	100	fine sandy loam	8.0	5	200	.6-2	Moderately well	9.8
4	Renova	3.0	6.5	30	200	silt loam	5.5	25	180	.6-2	Well	11.6
373	Renshaw	5.5	7.0	10	100	loam	7.5	5	80	>6	Somewhat excessive	4.5
654	Revere	6.0	8.0	5	180	clay loam	8.0	5	180	.6-2	Poor	10.5
298	Richwood	4.0	7.0	10	160	silt loam	5.8	25	250	.6-2	Well	11.1
639	Ridgeport	3.5	7.0	20	100	sandy loam	7.0	20	90	2-6	Somewhat excessive	6.0
541	Rifle	>20	7.0	<10	<50	mucky peat	7.0	<10	<50	.6-6	Very poor	>20
529	Ripon	4.0	7.0	10	175	silt loam	5.8	15	150	.6-2	Well	7.1
299	Rockton	3.0	5.4	24	50	loam	5.8	29	115	.6-2	Well	5.7(r)
439	Rockwell	6.0	7.6	25	130	fine sandy loam	8.3	4	120	.2-20	Poor or very poor	4.3
374	Rockwood	3.0	5.8	15	125	sandy loam	6.3	10	125	.2-6	Well	6.5(r)
219	Rolfe	5.8	5.5	69	360	silt loam	6.3	43	350	.06-2	Very poor	6.7
582	Roliss	6.7	7.5	8	100	loam	7.5	5	150	.2-2	Poor and very poor	10.6
198	Rollingstone	2.0	6.3	25	135	silt loam	5.0	20	175	.06-.2	Well	7.0
545	Rondeau	>20	7.0	<10	<50	muck	6.3	<10	<50	.2-6	Very poor	>18
166	Ronneby	3.5	6.0	10	50	loam	5.8	10	75	.6-6	Somewhat poor	8.9(r)
471	Root	4.5	7.5	15	200	silt loam	7.5	15	200	.6-2	Poor and very poor	7.8
1943	Roscommon	5.0	7.0	15	25	loamy sand	7.4	10	25	6-20	Poor and very poor	4.0
712	Rosewood	5.0	7.6	5	75	fine sandy loam	7.0	5	60	2-6	Poor and very poor	5.2
302	Rosholt	2.5	5.5	20	75	sandy loam	5.8	20	60	2-20	Well	4.1
624	Rosy	1.5	5.3	15	150	sandy loam	5.8	15	150	.6-2	Moderately well	8.5
290	Rothsay	3.3	7.5	5	210	silt loam	7.8	3	145	.6-6	Well	12.7
1932	Runeberg	6.0	6.5	10	125	sandy loam	7.3	5	125	.2-.6	Poor and very poor	7.4
304	Rushmore	6.0	7.0	10	225	silty clay loam	7.0	10	225	.2-2	Poor	10.2
306	Sac	4.0	5.8	15	225	silty clay loam	6.3	15	225	.6-2	Well	10.3
42	Salida	2.5	7.0	5	90	sandy loam	7.5	5	75	>20	Excessive	2.3
625	Sandwick	1.5	5.8	15	75	loamy fine sand	6.5	10	100	.2-.6	Somewhat poor	5.0
153	Santiago	2.5	5.8	15	125	silt loam	5.5	20	100	.2-2	Well	10.0
307	Sargeant	2.0	5.3	15	200	silt loam	5.8	15	150	.06-.2	Somewhat poor	8.5
328	Sartell	.5	5.8	15	40	fine sand	5.3	15	50	6-20	Excessive	5.3
467	Sawmill	4.5	6.3	30	125	silty clay loam	7.0	20	175	.6-2	Poor	13.0
309	Schapville	4.0	7.0	15	200	silty clay loam	7.0	10	250	.06-2	Moderately well and well	6.2(r)
637	Schley	2.5	5.5	15	175	silt loam	5.5	15	150	.6-2	Somewhat poor	10.0
423	Seaforth	3.3	7.5	5	200	loam	8.0	3	200	.6-2	Moderately well	11.3
103	Seaton	3.0	6.3	25	135	silt loam	5.3	30	175	.6-2	Well and moderately well	17.0
540	Seelyeville	>20	5.3	<10	<50	muck	5.3	<10	<50	.2-6	Very poor	>20
517	Shandep	6.0	6.3	5	75	loam	6.3	5	75	.6-2	Very poor	10.2
323	Shields	3.5	5.8	15	275	silt loam	5.3	15	275	.06-.2	Somewhat poor	8.8
72	Shooker	2.2	6.5	25	150	loam	7.0	20	300	.6-2	Poor	9.8
286	Shorewood	7.6	6.5	10	150	silty clay loam	6.3	10	250	.06-.6	Mod. well & somewhat poor	9.4
312	Shullsburg	3.8	5.9	10	215	silt loam	6.3	4	265	.06-2	Somewhat poor	7.1(r)
212	Sinai	5.5	7.0	5	250	silty clay	7.5	5	250	<.2	Moderately well and well	8.9
402	Sioux	4.0	7.4	6	130	sandy loam	7.7	5	100	>6	Excessive	3.4
23	Skyberg	3.5	5.2	15	180	silt loam	5.5	19	170	.06-2	Somewhat poor	11.9
765	Smiley	5.0	7.6	5	150	sandy clay loam	8.0	5	200	.6-2	Poor	9.5
267	Snellman	2.0	5.8	10	100	fine sandy loam	6.0	10	150	.6-2	Well	8.5
265	Soderville	1.6	5.3	10	50	loamy fine sand	5.8	15	35	6-20	Somewhat poor	5.7
11	Sogn	3.5	8.0	5	150	silt loam	8.0	5	150	.6-2	Somewhat excessive	1.8(r)
199	Sol	2.0	5.8	10	100	sandy loam	6.3	10	150	.2-.6	Well	9.5
215	Southridge	2.5	6.0	25	125	silt loam	5.5	15	175	.06-.2	Well	9.5
8	Sparta	1.6	5.8	5	100	loamy sand	5.8	5	75	6-20	Excessive	4.5
140	Spicer	6.5	7.5	20	200	silt loam	7.5	5	200	.6-2	Poor and very poor	11.7
663	Spillco	5.5	7.0	10	150	silt loam	7.5	5	200	.6-2	Mod. well or somewhat poor	12.0
313	Spillville	6.0	7.0	15	200	loam	6.5	15	225	.6-2	Mod. well or somewhat poor	11.8
147	Spooner	4.8	6.7	4	100	silt loam	6.8	6	110	.6-2	Poor	11.7
31	Storden	2.4	7.7	4	150	loam	7.5	5	150	.6-2	Well	11.0
432	Strandquist	5.7	8.0	5	75	loam	8.0	5	250	.6-20	Poor	8.4
243	Stuntz	2.0	5.8	15	150	vry fine sdy loam	6.6	10	150	.2-.6	Somewhat poor	10.5

Table 7. (Continued) Physical and chemical properties of representative Minnesota soils.*

Map No.	Soil Series	Surface properties[1] O.M.	pH	P	K	Texture	Subsoil properties[2] pH	P	K	Perm.	Rooting zone Drainage	Available Water[3] Capacity
462	Sunburg	3.0	8.0	5	150	fine sandy loam	7.8	5	150	.6-2	Well	9.0
70	Svea	5.3	7.0	10	250	loam	8.0	5	225	.2-2	Well or moderately well	10.8
127	Sverdrup	3.1	7.0	3	100	fine sandy loam	8.0	3	80	2-20	Well	5.9
595	Swanlake	4.0	7.5	5	150	loam	7.5	5	150	.6-2	Well	11.0
293	Swenoda	4.3	7.0	5	70	sandy loam	7.5	5	70	2-6	Moderately well or well	9.8
435	Syrene	4.5	7.5	5	125	sandy loam	8.0	5	50	6-20	Poor and very poor	4.1
514	Tacoosh	>20	6.8	<10	<50	mucky peat	6.6	15	125	.2-2	Very poor	>20
214	Talcot	7.0	7.5	5	170	silty clay loam	7.5	5	125	.6-6	Very poor	6.8
320	Tallula	3.5	7.0	5	150	silt loam	7.3	5	150	.6-2	Well	12.0
628	Talmoon	6.0	6.0	20	200	silt loam	6.6	10	200	.2-.6	Very poor	10.5
597	Tara	6.2	8.0	10	160	silt loam	8.2	7	150	.6-2	Moderately well	11.5
627	Tawas	>20	6.8	<10	<50	muck	6.8	10	25	.2-6	Very poor	12.0
94	Terril	6.0	6.6	6	130	loam	6.4	5	130	.6-2	Moderately well	11.4
651	Thiefriver	5.0	7.6	5	100	fine sandy loam	8.0	5	50	2-6	Poor	7.0
656	Thistledew	1.5	6.0	20	75	loamy sand	6.5	10	200	.2-.6	Moderately well	5.9
322	Timula	2.2	7.5	10	135	silt loam	7.5	10	135	.6-2	Well or moderately well	13.0
234	Tonka	4.8	6.3	15	250	loam	5.8	15	250	.06-.2	Poor	10.7
330	Towner	3.5	7.0	5	100	fine sandy loam	7.5	5	100	6-20	Well and moderately well	8.4
97	Trent	6.1	6.3	10	400	silty clay loam	7.1	9	200	.6-2	Moderately well	11.6
331	Tripoli	6.5	6.8	15	175	silty clay loam	7.5	5	150	.6-2	Poor	11.0
386	Trosky	5.2	7.5	10	250	silty clay loam	8.0	5	250	.2-2	Poor	7.8
101	Truman	4.1	6.7	8	200	silt loam	6.8	4	150	.6-2	Well	10.8
393	Udolpho	4.5	6.3	15	150	silt loam	5.5	20	175	.6-2	Somewhat poor and poor	8.1
64	Ulen	2.9	8.0	5	75	fine sandy loam	8.2	6	60	6-20	Somewhat poor & mod. well	6.4
335	Urness	15.3	8.0	5	200	mucky silt loam	8.0	5	200	.2-2	Very poor	12.2
236	Vallers	5.2	7.9	4	215	clay loam	8.1	3	200	.2-.6	Poor	11.3
333	Vasa	2.8	7.0	20	140	silt loam	5.8	30	150	.6-2	Mod. well & somewhat poor	13.7
567	Verndale	3.0	6.3	20	150	sandy loam	7.0	10	50	.6-2	Well	5.5
421	Ves	4.0	7.0	5	225	loam	8.0	5	200	.6-2	Well	11.1
297	Vienna	4.5	7.1	7	285	silty clay loam	7.7	4	160	.2-.6	Well	11.1
403	Viking	5.5	7.5	10	450	clay loam	7.5	5	400	<.06	Poor	7.3
334	Vlasaty	2.0	5.8	15	180	silt loam	5.8	15	170	.2-.6	Moderately well	8.7
39	Wadena	3.3	6.8	24	100	loam	6.3	22	85	.6-2	Well	6.1
157	Wahpeton	7.0	7.5	10	350	silty clay	7.5	5	400	.2-2	Moderately well	9.2
229	Waldorf	7.4	6.5	15	150	silty clay loam	7.6	5	200	.2-2	Poor	11.1
240	Warba	2.0	5.6	15	150	fine sandy loam	5.8	15	150	.2-.6	Well and moderately well	10.5
337	Warman	10.0	5.8	20	75	loam	6.3	15	50	.6>20	Very poor	5.6
538	Waskish	>20	4.0	<10	<50	peat	4.0	<10	<50	6	Very poor	>30
218	Watab	5.0	5.3	15	70	loamy fine sand	5.3	15	70	2-20	Somewhat poor	6.5(r)
338	Waubay	5.7	7.0	5	275	silty clay loam	8.0	3	225	.6-2	Moderately well	11.3
369	Waubeek	3.5	6.6	20	140	silt loam	5.8	30	175	.6-2	Well and moderately well	12.7
491	Waucoma	3.0	6.0	20	100	loam	5.8	25	125	.6-2	Well	7.6
483	Waukee	3.8	6.0	10	100	loam	5.8	15	90	.6-2	Well	7.8
411	Waukegan	3.5	6.5	14	105	silt loam	5.9	22	85	.6-2	Well	8.0
38	Waukon	3.5	6.6	19	235	loam	7.3	5	165	.6-2	Well	9.6
629	Wawina	1.5	5.8	15	100	lmy vry fine sand	6.3	15	100	2-6	Well	8.0
113	Webster	6.4	6.7	9	180	clay loam	7.3	5	170	.6-2	Poor	12.3
340	Whalan	3.5	6.6	35	170	silt loam	5.5	61	175	.06-2	Well	8.8(r)
343	Wheatville	3.8	7.5	5	275	loam	8.0	5	275	2-6	Somewhat poor	9.2
490	Whitewood	6.0	6.5	15	225	silty clay loam	7.5	5	175	.2-2	Somewhat poor	11.6
630	Wildwood	>20	5.3	<10	<50	muck	6.6	5	225	.06-.2	Very poor	10.0
345	Wilmonton	7.1	7.0	10	225	clay loam	7.5	5	225	.2-2	Mod. well & somewhat poor	11.1
107	Winger	6.7	7.8	6	180	silty clay loam	8.2	6	145	.6-2	Somewhat poor to poor	11.9
652	Wyandotte	5.5	8.0	5	175	clay loam	8.0	5	50	.6-2	Poor	7.5
121	Wykeham	4.0	5.3	15	125	fine sandy loam	7.0	5	125	.2-.6	Moderately well	6.0
508	Wyndmere	5.0	8.0	5	125	fine sandy loam	8.0	5	125	2-6	Somewhat poor	7.6
158	Zimmerman	1.1	5.9	46	70	loamy fine sand	6.0	28	50	6-20	Excessive	4.8
664	Zook	7.0	5.8	15	200	silty clay loam	6.3	20	225	.06-.2	Poor	9.5
495	Zumbro	1.9	7.0	5	100	loamy sand	7.5	5	75	6-20	Moderately well and well	6.2

[1] Properties of a mixed plow layer, 0 to 6 inches depth

[2] Properties of the subsoil at a depth of 20-30 inches, unless shallow to consolidated material

[3] Calculated plant available water (inches) to a depth of 5 feet, or to a root-restricting zone (r)

Values for percent organic matter (O.M.), available P and K (pounds per acre), pH are determined by procedures used in the University of Minnesota Soil Testing Laboratory. Permeability (Perm.) is expressed in inches per hour of the least permeable horizon (layer) in the soil.

Table 8. Percentage distribution of cultivated, permanent pasture, and forest land use on representative soils of Minnesota and the acreage mapped to date.

Map Symbol	Slope & Erosion	Mapping Unit	Reference County	Rows Crops	Small Grains	Rotation Hay	Permanent Pasture	Forest	Other	Total Acreage
6	A1	Aastad	Lyon	45	40	5	5	0	5	32029
26	A1	Aazdahl	Traverse	45	40	5	5	0	5	73166
13	A1	Adolph	Benton	5	10	20	40	15	10	2299
21	B1	Ahmeek	Carlton	0	5	5	10	75	57	576218
21	A1	Algansee	Washington	5	5	5	30	30	25	3031
22	A1	Allendale	Carlton	0	5	5	15	70	5	2748
292	B1	Alstad	Stearns	30	15	25	10	15	5	15558
29	A1	Alvin	Goodhue	15	30	30	15	5	5	1080
496	B1	Andrusia	Beltrami	5	5	5	5	75	5	22500
159	A1	Anoka	Isanti	40	20	20	10	5	5	26768
49	A1	Antigo	Washington	45	10	15	10	10	10	35973
16	A1	Arenzville	Houston	40	5	5	30	10	10	16152
341	A1	Arvilla	Douglas	35	30	20	5	0	10	66469
410	A1	Athelwold	Pipestone	60	25	5	5	0	5	7400
489	A1	Atkinson	Olmsted	50	10	20	15	0	5	7820
189	A1	Auburndale	Dakota	5	5	10	30	20	30	1598
52	A1	Augsburg	Clay	30	50	10	5	0	5	25803
43	A1	Automba	Carlton	0	10	5	10	70	5	20958
503	B1	Balmlake	Beltrami	0	5	5	5	85	0	10325
319	A1	Barbert	Blue Earth	85	5	5	5	0	0	7377
33	B1	Barnes	Murray	80	10	5	5	0	0	282848
316	A1	Baroda	Blue Earth	80	5	5	5	0	5	4404
62	A1	Barrington	Blue Earth	50	10	10	10	10	10	2638
456	A1	Barronett	Washington	20	15	15	25	20	5	1535
555	C1	Barto	Kawishwi	0	0	0	0	95	5	62844
167	B1	Baudette	Lake of the Woods	0	5	10	5	80	0	26735
460	B1	Baytown	Washington	40	30	20	5	0	5	2600
93	A1	Bearden	Norman	35	55	5	0	0	5	189252
655	A1	Bearville	Itasca	0	5	5	5	85	0	10830
310	A1	Beauford	Blue Earth	85	5	5	5	0	0	32069
25	A1	Becker	Olmsted	70	5	5	10	5	5	9929
73	F1	Bellechester	Goodhue	0	0	10	70	10	10	4274
125	A1	Beltrami	Beltrami	15	15	10	10	45	5	32940
74	A1	Beotia	Lincoln	65	20	5	5	0	5	2954
305	A1	Bergland	Carlton	0	5	5	15	75	0	4157
76	A1	Bertrand	Houston	30	20	20	20	5	5	720
531	A1	Beseman	Carlton	0	5	5	65	20	5	21765
79	B1	Billet	Goodhue	50	10	15	15	5	5	5881
392	A1	Biscay	Le Sueur	70	10	5	5	0	10	42061
405	B1	Bixby	Steele	50	15	10	10	5	10	4307
170	A1	Blomford	Anoka	15	20	35	20	5	5	5129
382	B1	Blooming	Freeborn	80	10	5	5	0	0	20397
720	B1	Blowers	Todd	30	15	25	20	5	5	89545
35	A1	Blue Earth	Blue Earth	70	10	5	5	0	10	54344
75	A1	Bluffton	Stearns	15	10	30	30	5	10	16226
644	A1	Boash	Pennington	20	60	5	10	0	5	6912
81	B1	Boone	Dakota	20	30	20	15	5	10	5275
522	A1	Boots	Hennepin	5	0	5	5	0	85	14169
46	A1	Borup	Clay	40	45	5	5	0	5	24327
169	B1	Braham	Sherburne	30	15	25	20	10	0	14085
163	B1	Brainerd	Morrison	30	15	25	15	10	5	166221
124	A1	Brickton	Isanti	20	15	15	10	35	5	2541
120	A1	Brill	Washington	30	15	20	10	20	5	4035
416	A1	Brookings	Pipestone	45	30	10	10	0	5	55379
1905	A1	Brownsdale	Mower	85	5	5	5	0	0	7450
84	A1	Brownton	Faribault	85	5	5	5	0	0	11015
561	A1	Bullwinkle	Beltrami	0	0	0	0	95	5	117500
151	C1	Burkhardt	Dakota	65	10	10	10	0	5	12020
78	A1	Burnsville	Wright	30	10	30	5	15	10	18253
437	D1	Buse	Lyon	0	5	5	60	0	30	30307
85	A1	Calco	Rock	75	10	5	5	0	5	28822
367	B1	Campia	Carlton	15	25	25	10	20	5	8396
86	A1	Canisteo	Brown	85	5	5	5	0	0	523669
1895	B1	Carmi	Dakota	80	10	5	5	0	0	3354
524	A1	Caron	Freeborn	45	5	0	25	0	25	40758
50	A1	Cashel	Norman	10	25	5	35	15	10	4580

Table 8. (Continued) Percentage distribution of cultivated, permanent pasture, and forest land use on representative soils of Minnesota and the acreage mapped to date.

Map Symbol	Slope & Erosion	Mapping Unit	Reference County	Rows Crops	Small Grains	Rotation Hay	Permanent Pasture	Forest	Other	Total Acreage
544	A1	Cathro	Beltrami	0	5	5	25	5	60	279953
472	B1	Channahon	Olmsted	15	10	30	20	5	20	16060
19	A1	Chaseburg	Olmsted	55	5	5	30	5	0	36821
329	A1	Chaska	Washington	60	10	10	10	10	0	10071
155	B1	Chetek	Washington	15	10	10	15	20	30	49834
404	A1	Chilgren	Beltrami	10	20	10	10	45	5	59199
102	B1	Clarion	Martin	85	5	5	5	0	0	497777
641	A1	Clearwater	Pennington	15	65	5	10	0	5	34883
371	A1	Clontarf	Swift	50	40	5	5	0	0	11050
355	A1	Cloquet	Carlton	5	5	5	10	70	5	28913
88	A1	Clyde	Mower	85	5	5	5	0	0	61104
478	B1	Coggon	Olmsted	50	10	10	10	10	10	3290
1833	A1	Coland	Cottonwood	80	5	5	10	0	0	59869
96	A1	Collinwood	Jackson	85	5	5	5	0	0	97717
98	A1	Colo	Rice	75	5	5	5	5	5	23286
47	A1	Colvin	Clay	40	40	5	10	0	5	124002
18	A1	Comfrey	Nobles	60	5	5	30	0	0	24328
452	A1	Comstock	Washington	15	25	25	10	20	5	2525
557	C1	Conic	Kawishiwi	0	0	0	0	90	10	27765
100	A1	Copaston	Dakota	10	25	30	30	0	5	12249
109	A1	Cordova	LeSueur	75	5	10	5	5	0	120143
571	A1	Coriff	Stearns	60	10	20	5	5	0	5025
117	A1	Cormant	Beltrami	5	5	5	5	75	5	103895
459	A1	Corunna	Stearns	55	10	25	5	0	5	4445
601	E1	Council	Houston	10	10	30	30	15	5	1280
615	A1	Cowhorn	Itasca	0	5	15	10	70	0	35700
118	A1	Crippin	Martin	85	5	5	5	0	0	36291
1918	A1	Croke	Traverse	40	50	5	0	0	5	13250
268	A1	Cromwell	Carlton	0	5	5	10	80	0	22254
449	A1	Crystal Lake	Washington	15	15	15	20	30	5	1440
204	B1	Cushing	Stearns	30	15	25	10	15	5	76819
620	B1	Cutaway	Beltrami	0	5	5	10	80	0	90160
129	A1	Cylinder	Freeborn	75	10	5	5	0	5	17166
5	A1	Dakota	Freeborn	65	10	20	5	0	0	17598
133	A1	Dalbo	Isanti	50	15	15	10	5	5	7642
281	A1	Darfur	Blue Earth	85	5	5	5	0	0	20687
494	A1	Darnen	Big Stone	45	45	5	5	0	0	21298
183	A1	Dassel	Blue Earth	20	10	20	45	0	5	14087
536	A1	Dawson	Carlton	0	5	5	5	85	0	10240
453	B1	DeMontreville	Stearns	20	15	25	15	20	5	20795
505	B1	Debs	Beltrami	5	10	5	5	70	5	9410
547	A1	Deerwood	Pennington	5	10	5	55	5	20	52048
336	A1	Delft	Jackson	85	10	5	0	0	0	101972
27	A1	Dickinson	Freeborn	60	30	5	5	0	0	49647
327	A1	Dickman	Stearns	50	30	10	5	0	5	82329
9	C1	Dodgeville	Goodhue	20	20	20	20	10	10	2253
591	B1	Doland	Chippewa	65	20	10	5	0	0	61520
425	A1	Donaldson	Wilkin	55	40	5	0	0	0	17635
550	A1	Dora	Itasca	0	0	0	0	100	0	11680
698	A1	Doran	Wilkin	50	40	5	5	0	0	99160
473	D1	Dorerton	Olmsted	0	0	25	45	20	10	6715
406	B1	Dorset	Todd	35	20	30	10	5	0	33910
137	A1	Dovray	Stevens	45	30	10	10	0	5	11146
516	A1	Dowagiac	Mower	60	15	15	5	5	0	18345
574	A1	DuPage	Yellow Medicine	75	10	5	5	0	5	8981
10	C1	Dubuque	Goodhue	15	5	10	40	30	0	21584
260	A1	Duelm	Morrison	45	15	20	10	5	5	36383
504	A1	Duluth	Carlton	5	5	10	10	65	5	63845
123	A1	Dundas	LeSueur	70	5	10	5	10	0	24680
502	A1	Dusler	Carlton	0	5	5	10	80	0	10057
565	A1	Eckvoll	Beltrami	10	20	20	15	30	5	41254
616	A1	Effie	Beltrami	0	5	5	5	85	0	46900
141	A1	Egeland	Yellow Medicine	55	35	5	5	0	0	18555

Table 8. (Continued) Percentage distribution of cultivated, permanent pasture, and forest land use on representative soils of Minnesota and the acreage mapped to date.

Map Symbol	Slope & Erosion	Mapping Unit	Reference County	Rows Crops	Small Grains	Rotation Hay	Permanent Pasture	Forest	Other	Total Acreage
1830	A1	Eitzen	Houston	80	5	5	10	0	0	4070
593	D1	Elbaville	Houston	0	0	0	45	50	5	14890
143	B1	Eleva	Olmsted	5	5	20	15	10	45	5753
510	A1	Elmville	Wilkin	40	50	5	5	0	0	36840
12	C1	Emmert	Washington	0	5	10	30	40	15	14713
145	A1	Enstrom	Kittson	5	25	20	35	10	5	23410
191	A1	Epoufette	Beltrami	0	0	5	10	85	0	14150
237	B1	Erin	Rice	15	20	30	20	10	5	25447
645	A1	Espelie	Pennington	30	50	10	5	0	5	3755
192	A1	Estelline	Pipestone	60	30	5	5	0	0	28766
41	A1	Estherville	Kandiyohi	50	30	10	5	0	5	223962
409	B1	Etter	Dakota	55	20	10	5	5	5	7777
149	B1	Everly	Nobles	85	5	5	5	0	0	121711
484	C1	Eyota	Olmsted	15	5	25	40	5	10	4420
156	A1	Fairhaven	Rice	60	20	10	5	0	5	41358
57	A1	Fargo	Clay	45	45	5	5	0	0	136455
69	B1	Fedji	Blue Earth	40	25	20	5	5	5	4963
455	A1	Festina	Houston	70	10	15	5	0	0	10040
160	A1	Fieldon	Watonwan	75	10	5	5	0	5	16719
144	B1	Flak	Morrison	30	15	30	15	10	0	46639
66	A1	Flaming	Clay	15	55	10	15	0	5	25697
92	A1	Flandreau	Rock	75	15	5	5	0	0	16023
36	A1	Flom	Lyon	55	20	10	10	0	5	189665
479	A1	Floyd	Mower	70	5	10	10	0	5	35457
426	A1	Foldahl	Clay	20	60	10	5	0	5	15478
375	A1	Forada	Todd	35	15	20	20	0	10	23325
339	A1	Fordville	Yellow Medicine	60	25	10	5	0	0	26939
168	B1	Forman	Lyon	40	40	10	5	0	5	103241
171	B1	Formdale	Grant	50	40	5	5	0	0	33409
71	A1	Fossum	Swift	25	30	5	35	0	5	6140
1877	A1	Fostoria	Faribault	90	5	5	0	0	0	10301
65	A1	Foxhome	Norman	30	50	10	10	0	0	6509
296	B1	Fram	Big Stone	40	40	5	10	0	5	9340
476	B1	Frankville	Olmsted	35	10	30	20	5	0	12130
264	B1	Freeon	Morrison	10	10	20	40	15	5	8556
266	A1	Freer	Morrison	10	15	20	30	20	5	13076
173	F1	Frontenac	Olmsted	0	0	0	35	50	15	3676
210	A1	Fulda	Big Stone	65	15	5	10	0	5	20545
174	D1	Gale	Winona	15	15	40	25	5	0	3025
175	A1	Galva	Nobles	60	20	10	5	0	5	2277
77	A1	Garnes	Pennington	10	25	10	10	40	5	17387
176	A1	Garwin	Olmsted	85	5	5	5	0	0	20417
1835	B1	Germantown	Cottonwood	65	20	5	5	0	5	3500
114	A1	Glencoe	Martin	80	5	5	5	0	5	296707
60	A1	Glyndon	Clay	50	40	5	5	0	0	90318
180	A1	Gonvick	Stearns	60	15	20	5	0	0	62225
617	B1	Goodland	Itasca	0	5	10	5	80	0	11585
177	B1	Gotham	Goodhue	70	15	5	5	0	5	7961
659	A1	Graceville	Rock	80	10	5	5	0	0	13730
178	A1	Granby	Blue Earth	55	35	5	5	0	0	1675
259	B1	Grays	Blue Earth	80	5	5	5	0	5	3304
549	A1	Greenwood	Itasca	0	0	0	0	45	55	260721
59	A1	Grimstad	Norman	35	50	5	5	0	5	52733
128	B1	Grogan	Faribault	85	5	5	5	0	0	13915
613	A1	Grovecity	Kandiyohi	70	20	5	0	0	5	3025
233	B1	Growton	Morrison	40	15	25	10	5	5	37250
482	A1	Grygla	Beltrami	5	10	5	5	70	5	76550
230	A1	Guckeen	Faribault	85	5	5	5	0	0	53464
372	A1	Hamar	Norman	20	35	20	15	0	10	8903
414	A1	Hamel	LeSueur	65	5	20	5	0	5	68139
184	A1	Hamerly	Stevens	50	35	5	5	0	5	300416
1878	A1	Hamre	Beltrami	5	15	10	10	10	50	59489
111	A1	Hangaard	Todd	15	20	30	30	0	5	6040
282	A1	Hanska	Brown	85	5	5	5	0	0	8938
497	A1	Hantho	Swift	60	30	5	5	0	0	7230

Table 8. (Continued) Percentage distribution of cultivated, permanent pasture, and forest land use on representative soils of Minnesota and the acreage mapped to date.

Map Symbol	Slope & Erosion	Mapping Unit	Reference County	Rows Crops	Small Grains	Rotation Hay	Permanent Pasture	Forest	Other	Total Acreage
112	A1	Harps	Martin	80	10	5	5	0	0	20174
185	B1	Hattie	Big Stone	55	20	10	10	0	5	24234
187	A1	Haug	Kittson	0	10	5	40	0	45	42565
380	A1	Havana	Freeborn	85	5	5	5	0	0	10055
611	C1	Hawick	Stearns	30	25	20	10	10	5	50090
104	B1	Hayden	Wright	40	10	15	10	10	15	250460
190	A1	Hayfield	Mower	75	10	10	5	0	0	8540
366	A1	Hecla	Swift	25	15	20	25	5	10	9355
8027	A1	Hegne	Clay	50	45	5	0	0	0	6862
232	B1	Heyder	Hennepin	50	10	15	10	10	5	24732
254	A1	Hibbing	Carlton	5	5	15	10	55	10	1595
436	A1	Hidewood	Pipestone	55	15	15	10	0	5	31827
647	A1	Hilaire	Wilkin	30	55	5	5	0	5	3876
48	A1	Hiwood	Beltrami	0	5	5	10	80	0	34470
200	B1	Holdingford	Stearns	30	20	30	10	10	0	28280
487	A1	Hoopeston	Watonwan	70	20	5	5	0	0	2660
523	A1	Houghton	Kandiyohi	10	0	5	20	0	65	4910
7	A1	Hubbard	Sherburne	50	15	25	5	0	5	191561
139	B1	Huntersville	Wadena	35	15	20	5	20	5	6515
194	A1	Huntsville	Winona	75	5	5	5	5	5	6300
54	A1	Ihlen	Rock	30	20	20	20	10	0	8965
172	A1	Indus	Lake of the Woods	0	0	5	5	80	10	11716
556	C1	Insula	Kawishwi	0	0	0	0	95	5	15924
261	A1	Isan	Morrison	20	15	25	30	5	5	29003
161	A1	Isanti	Sherburne	25	15	15	30	5	10	62597
618	B1	Itasca	Itasca	0	5	5	5	85	0	22690
594	A1	Jeffers	Cottonwood	70	10	10	5	0	5	8495
1902	B1	Jewett	Stearns	30	15	30	10	10	5	2512
203	A1	Joy	Olmsted	80	5	5	5	0	5	15301
15	B1	Judson	Rice	35	10	20	25	5	5	6612
518	A1	Kalmarville	Houston	25	10	15	25	20	5	18305
105	B1	Kamrar	Blue Earth	65	10	10	5	5	5	3504
415	A1	Kanaranzi	Nobles	75	10	10	5	0	0	13298
53	B1	Kandota	Todd	30	10	45	10	5	0	39700
205	A1	Karlstad	Beltrami	5	5	5	10	70	5	22902
206	A1	Kasota	LeSueur	60	15	15	5	0	5	2842
24	A1	Kasson	Dodge	75	5	10	5	0	5	62625
208	A1	Kato	Rice	65	10	10	10	0	5	12335
619	A1	Keewatin	Itasca	0	5	5	5	85	0	18170
209	A1	Kegonsa	Olmsted	40	20	25	5	5	5	4826
250	A1	Kennebec	Dakota	80	5	10	5	0	0	4595
30	B1	Kenyon	Dodge	75	5	10	5	0	5	44399
238	B1	Kilkenny	LeSueur	50	10	15	10	15	0	87257
342	B1	Kingsley	Dakota	15	10	10	15	25	25	44793
197	A1	Kingston	Blue Earth	90	5	5	0	0	0	30664
58	A1	Kittson	Clay	35	50	5	5	0	5	23509
213	A1	Klinger	Goodhue	80	10	5	5	0	0	33535
539	A1	Klossner (Palms)	Faribault	75	5	5	5	0	10	70977
562	A1	Knoke	Redwood	80	10	5	5	0	0	7219
461	B1	Koronis	Stearns	50	15	25	5	5	0	26965
91	A1	Kranzburg	Pipestone	45	30	15	5	0	5	77045
481	A1	Kratka	Pennington	15	30	10	30	10	5	89762
51	A1	LaPrairie	Lyon	50	25	10	10	0	5	15806
1907	A1	Lakefield	Martin	90	5	5	0	0	0	3569
216	B1	Lamont	Freeborn	50	15	15	10	5	5	3580
418	A1	Lamoure	Lyon	50	30	10	5	0	5	82833
220	E1	Langhei	Douglas	0	0	10	80	0	10	17250
179	A1	Langola	Benton	35	15	20	10	15	5	4028
222	B1	Lasa	Watonwan	55	30	5	5	0	5	5508
485	A1	Lawler	Mower	65	10	10	10	0	5	5805
226	A1	Lawson	Goodhue	30	5	5	5	5	50	2783
239	A1	LeSueur	LeSueur	75	5	10	5	5	0	134220
984	A1	Leafriver	Wadena	0	0	0	55	0	45	36980
227	A1	Lemond	Watonwan	80	10	5	5	0	0	17528
559	A1	Lena	Kandiyohi	10	10	20	20	0	40	6100

Table 8. (Continued) Percentage distribution of cultivated, permanent pasture, and forest land use on representative soils of Minnesota and the acreage mapped to date.

Map Symbol	Slope & Erosion	Mapping Unit	Reference County	Rows Crops	Small Grains	Rotation Hay	Permanent Pasture	Forest	Other	Total Acreage
709	B1	Lengby	Beltrami	5	5	5	10	70	5	14190
138	B1	Lerdal	LeSueur	60	10	15	5	10	0	24154
106	B1	Lester	LeSueur	65	10	10	5	10	0	362283
241	A1	Letri	Cottonwood	80	5	10	5	0	0	55896
244	B1	Lilah	Olmsted	65	15	15	5	0	0	5396
1916	A1	Lindaas	Wilkin	45	45	5	5	0	0	28937
247	A1	Linder	Watonwan	70	20	5	5	0	0	15313
301	B1	Lindstrom	Winona	70	5	15	10	0	0	34794
162	A1	Lino	Anoka	40	15	5	20	10	10	52805
713	A1	Linveldt	Pennington	15	45	15	5	10	10	7516
470	A1	Lismore	Murray	70	10	10	5	0	5	7709
181	A1	Litchfield	Blue Earth	60	15	15	5	0	5	16960
477	A1	Littleton	Olmsted	50	5	10	15	10	10	11560
537	A1	Lobo	Carlton	0	0	0	0	95	5	1622
245	B1	Lohnes	Pennington	25	45	5	15	0	10	53770
248	A1	Lomax	Blue Earth	70	10	10	0	0	10	4268
572	A1	Lowlein	Stearns	55	15	25	5	0	0	8790
533	A1	Loxley	Carlton	0	5	5	10	80	0	36059
546	A1	Lupton	Beltrami	0	0	0	5	90	5	48065
211	A1	Lura	Jackson	85	5	5	5	0	0	49483
45	A1	Maddock	Douglas	45	35	15	5	0	0	25828
136	A1	Madelia	Blue Earth	85	5	5	5	0	0	33688
454	B1	Mahtomedi	Stearns	10	15	35	20	20	0	74398
347	A1	Malachy	Swift	50	35	5	5	0	5	6710
511	A1	Marcellon	Stearns	45	15	30	5	5	0	6480
249	A1	Marcus	Rock	90	5	5	0	0	0	19360
543	A1	Markey	Beltrami	0	15	15	25	0	45	202445
251	E1	Marlean	Olmsted	0	0	0	30	30	40	10618
110	A1	Marna	Blue Earth	80	10	5	5	0	0	80801
242	B1	Marquette	Beltrami	0	5	5	10	80	0	11650
252	A1	Marshan	Mower	70	5	5	10	0	10	25113
246	A1	Marysland	Swift	55	15	5	25	0	0	52031
131	B1	Massbach	Olmsted	30	10	15	30	5	10	3640
412	A1	Mavie	Pennington	25	40	10	15	5	5	13217
253	A1	Maxcreek	Freeborn	85	5	5	5	0	0	33025
378	A1	Maxfield	Goodhue	70	10	5	10	0	5	48545
255	A1	Mayer	Redwood	85	5	5	5	0	0	45976
256	A1	Mazaska	LeSueur	60	10	10	10	10	0	14027
108	A1	McIntosh	Stevens	40	50	5	5	0	0	47906
257	A1	McPaul	Goodhue	20	5	10	40	15	10	5895
202	A1	Meehan	Itasca	0	5	5	5	85	0	48660
458	A1	Menahga	Wadena	5	5	5	10	70	5	155109
377	A1	Merton	Freeborn	90	5	5	0	0	0	15993
535	A1	Merwin	Carlton	0	10	15	5	70	0	3308
558	C1	Mesaba	Kawishiwi	0	0	0	0	95	5	82831
152	B1	Milaca	Benton	20	20	20	15	15	10	14325
551	A1	Millerville	Anoka	0	5	5	90	0	0	1460
269	A1	Millington	Redwood	85	5	5	5	0	0	41913
463	A1	Minneiska	LeSueur	60	5	5	15	10	5	18299
363	A1	Minneopa	Blue Earth	65	15	10	5	0	5	5778
287	A1	Minnetonka	Blue Earth	60	10	10	10	5	5	24539
376	B1	Moland	Rice	90	5	5	0	0	0	9464
90	A1	Moody	Rock	90	5	5	0	0	0	52640
534	A1	Mooselake	Carlton	0	5	0	5	90	0	47538
164	A1	Mora	Benton	5	5	15	15	50	10	44410
621	A1	Morph	Itasca	0	5	10	5	80	0	17440
1888	A1	Moundprairie	Houston	60	10	5	10	10	5	2280
401	B1	Mt. Carroll	Olmsted	50	5	25	10	5	5	159518
525	A1	Muskego	Blue Earth	65	5	5	15	0	10	27714
1959	A1	Nary	Beltrami	10	10	10	10	60	0	6560
622	B1	Nashwauk	Itasca	0	5	5	5	85	0	133450
492	B1	Nasset	Houston	50	10	25	10	5	0	3900
40	B1	Nebish	Becker	15	15	10	10	45	5	168730
186	A1	Nemadji	Carlton	5	5	10	5	70	5	10667
583	A1	Nereson	Kittson	0	40	35	10	15	0	3185
235	B1	Nessel	Hennepin	35	20	20	10	5	10	19262

Table 8. (Continued) Percentage distribution of cultivated, permanent pasture, and forest land use on representative soils of Minnesota and the acreage mapped to date.

Map Symbol	Slope & Erosion	Mapping Unit	Reference County	Rows Crops	Small Grains	Rotation Hay	Permanent Pasture	Forest	Other	Total Acreage
576	A1	Newalbin	Winona	55	5	5	35	0	0	4130
515	C1	Newfound	Kawishiwi	0	0	0	0	95	5	3957
501	B1	Newglarus	Winona	45	15	30	5	5	0	9900
381	A1	Newry	Freeborn	85	5	5	5	0	0	10859
274	A1	Newson	Carlton	5	5	10	5	70	5	9822
130	A1	Nicollet	Martin	90	5	5	0	0	0	340344
575	A1	Nishna	Redwood	85	5	5	5	0	0	8545
217	A1	Nokasippi	Morrison	5	5	5	65	10	10	6499
142	A1	Nokay	Morrison	30	15	25	15	15	0	88418
661	C1	Nora	Rock	80	5	5	10	0	0	7950
446	A1	Normania	Redwood	85	5	5	5	0	0	177492
429	A1	Northcote	Kittson	30	50	10	5	0	5	200420
563	A1	Northwood	Beltrami	0	5	5	5	0	85	44900
224	A1	Nowen	Anoka	20	20	20	15	15	10	1345
430	A1	Noyes	Kittson	30	50	5	10	0	5	4900
207	A1	Nymore	Wadena	35	15	30	15	5	0	67769
275	B1	Ocheyedan	Faribault	90	5	5	0	0	0	16044
466	A1	Ogilvie	Benton	5	10	15	35	30	5	4110
134	A1	Okoboji	Brown	85	5	5	5	0	0	105997
276	A1	Oldham	Swift	70	10	5	10	0	5	28902
188	A1	Omega	Carlton	5	5	15	10	60	5	32465
277	A1	Onamia	Crow Wing	15	20	20	10	30	5	6147
303	A1	Ontonagon	Carlton	0	5	5	15	75	0	31267
631	A1	Oran	Mower	85	5	5	5	0	0	48715
493	B1	Oronoco	Olmsted	50	5	25	10	5	5	3570
413	A1	Osakis	Douglas	45	25	20	10	0	0	29320
317	A1	Oshawa	LeSueur	0	0	0	5	5	90	5862
2	B1	Ostrander	Rice	75	10	10	5	0	0	78922
279	B1	Otterholt	Dakota	15	15	10	10	20	30	2289
506	A1	Overly	Clay	40	50	5	5	0	0	5930
1975	A1	Oylen	Wadena	55	20	15	5	5	0	7385
703	A1	Paddock	Todd	25	20	30	20	5	0	39400
587	B1	Palsgrove	Winona	50	10	30	5	5	0	7205
165	A1	Parent	Morrison	20	10	10	30	20	10	48173
34	A1	Parnell	Stevens	60	30	5	5	0	0	66155
280	A1	Pelan	Pennington	5	10	10	10	65	0	8528
607	A1	Pengilly	Beltrami	0	0	0	0	80	20	9000
581	A1	Percy	Kittson	0	35	15	35	10	5	36565
434	A1	Perella	Chippewa	70	20	5	5	0	0	11775
623	B1	Pierz	Morrison	60	10	10	10	10	0	12360
283	B1	Plainfield	Winona	10	10	10	10	40	20	25116
284	B1	Poinsett	Lyon	80	10	5	5	0	0	12265
119	B1	Pomroy	Morrison	40	10	20	10	20	0	39347
148	A1	Poppleton	Kittson	0	40	25	25	5	5	31001
285	A1	Port Byron	Olmsted	85	5	5	5	0	0	88290
507	A1	Poskin	Washington	25	15	25	10	20	5	2100
325	A1	Prebish	Morrison	5	5	25	30	25	10	47813
397	A1	Primghar	Nobles	70	10	10	5	0	5	2880
344	A1	Quam	Grant	65	25	5	5	0	0	42591
99	B1	Racine	Olmsted	70	10	15	5	0	0	98278
289	A1	Radford	Goodhue	55	5	5	20	10	5	9951
291	A1	Ransom	Nobles	80	10	5	5	0	0	23771
294	A1	Rasset	Carver	40	10	25	20	0	5	1398
450	A1	Rauville	Lyon	0	0	0	10	0	90	13778
608	A1	Rawles	Houston	65	10	5	5	10	5	2240
295	A1	Readlyn	Mower	70	10	10	5	0	5	34130
116	A1	Redby	Kittson	0	20	5	5	70	0	74210
82	B1	Redeye	Todd	30	15	15	5	35	0	6655
566	A1	Regal	Stearns	50	15	15	15	0	5	23763
650	A1	Reiner	Pennington	15	50	10	10	10	5	50557
4	B1	Renova	Rice	30	15	25	20	5	5	37001
373	A1	Renshaw	Swift	25	45	10	15	5	0	42525
654	A1	Revere	Redwood	80	10	5	5	0	0	5657
298	A1	Richwood	Olmsted	60	15	15	5	0	5	5885
639	A1	Ridgeport	Stearns	60	20	10	5	5	0	4935
541	A1	Rifle	Todd	5	5	5	30	15	40	293165

Table 8. (Continued) Percentage distribution of cultivated, permanent pasture, and forest land use on representative soils of Minnesota and the acreage mapped to date.

Map Symbol	Slope & Erosion	Mapping Unit	Reference County	Rows Crops	Small Grains	Rotation Hay	Permanent Pasture	Forest	Other	Total Acreage
529	A1	Ripon	Washington	40	30	20	5	0	5	5400
299	A1	Rockton	Olmsted	60	20	10	10	0	0	23736
439	A1	Rockwell	Pennington	25	30	10	25	0	10	76175
374	B1	Rockwood	Todd	30	20	30	15	5	0	72160
219	A1	Rolfe	Blue Earth	60	10	10	15	0	5	3655
582	A1	Roliss	Grant	40	45	10	5	0	0	92998
198	C1	Rollingstone	Winona	35	15	40	5	5	0	7700
545	A1	Rondeau	Beltrami	0	5	5	20	10	60	8578
166	A1	Ronneby	Benton	5	5	10	15	60	5	29813
471	A1	Root	Olmsted	0	0	0	50	45	5	2740
1943	A1	Roscommon	Wadena	5	5	15	30	45	0	29735
712	A1	Rosewood	Pennington	15	45	10	15	10	5	14279
302	B1	Rosholt	Washington	25	15	25	10	20	5	5020
624	A1	Rosy	Beltrami	5	5	10	5	75	0	28170
290	B1	Rothsay	Chippewa	60	30	5	5	0	0	16970
1932	A1	Runeberg	Todd	20	15	25	30	5	5	12305
304	A1	Rushmore	Nobles	80	10	5	5	0	0	24458
306	B1	Sac	Rock	85	5	5	5	0	0	77425
42	B1	Salida	Pope	10	15	20	40	0	15	31624
625	A1	Sandwick	Itasca	0	5	5	5	85	0	37060
153	B1	Santiago	Washington	15	25	30	15	10	5	22375
307	A1	Sargeant	Mower	80	5	5	5	5	0	15455
328	A1	Sartell	Benton	10	5	15	10	60	0	97705
467	A1	Sawmill	Olmsted	60	5	5	15	10	5	5125
309	C1	Schapville	Olmsted	5	5	20	50	10	10	7160
637	A1	Schley	Mower	85	5	5	5	0	0	14700
423	A1	Seaforth	Redwood	80	10	5	5	0	0	76834
103	B1	Seaton	Winona	55	10	30	5	0	0	234537
540	A1	Seelyeville	Morrison	0	5	5	30	0	60	210460
517	A1	Shandep	Freeborn	80	10	5	5	0	0	5890
323	A1	Shields	Rice	60	10	10	5	10	5	12037
72	A1	Shooker	Beltrami	5	5	10	5	75	0	70070
286	B1	Shorewood	Blue Earth	75	5	5	5	5	5	29264
312	B1	Shullsburg	Olmsted	5	5	25	45	10	10	4938
212	A1	Sinai	Lyon	65	20	10	5	0	0	20052
402	B1	Sioux	Swift	10	10	25	35	0	20	73655
23	A1	Skyberg	Mower	80	5	5	5	0	5	47909
765	A1	Smiley	Pennington	10	40	15	20	10	5	160762
267	B1	Snellman	Beltrami	5	5	5	5	80	0	29380
265	A1	Soderville	Anoka	65	5	5	10	10	5	5958
11	B1	Sogn	Houston	10	10	35	35	5	5	4038
199	B1	Sol	Beltrami	5	5	10	10	70	0	13300
215	B1	Southridge	Winona	35	15	45	5	0	0	7370
8	A1	Sparta	Washington	60	20	5	10	0	5	27471
140	A1	Spicer	Faribault	80	10	5	5	0	0	57600
663	A1	Spillco	Rock	85	5	5	5	0	0	8850
313	A1	Spillville	Faribault	75	5	5	5	5	5	15323
147	A1	Spooner	Itasca	0	5	10	10	75	0	29229
31	D1	Storden	Cottonwood	0	10	10	75	0	5	31005
432	A1	Strandquist	Beltrami	5	40	10	30	10	5	20691
243	A1	Stuntz	Itasca	0	5	5	5	85	0	16465
462	E1	Sunburg	Kandiyohi	0	0	5	50	0	45	1625
70	A1	Svea	Swift	60	30	5	5	0	0	82265
127	A1	Sverdrup	Chippewa	60	20	10	10	0	0	51183
595	C1	Swanlake	Cottonwood	55	15	15	15	0	0	530025
293	B1	Swenoda	Clay	40	40	10	10	0	0	20440
435	A1	Syrene	Norman	10	35	5	50	0	0	11070
514	A1	Tacoosh	Todd	5	0	0	50	0	45	38345
214	A1	Talcot	Cottonwood	50	10	10	20	0	10	9017
320	B1	Tallula	Dakota	60	15	15	10	0	0	4836
628	A1	Talmoon	Itasca	0	0	0	5	90	5	13360
597	A1	Tara	Chippewa	65	20	10	5	0	0	70370
627	A1	Tawas	Beltrami	0	0	0	0	95	5	67740
94	B1	Terril	Blue Earth	75	10	10	5	0	0	51601
651	A1	Thiefriver	Pennington	20	45	10	20	0	5	3107
656	B1	Thistledew	Itasca	0	5	5	5	85	0	6740

Table 8. (Continued) Percentage distribution of cultivated, permanent pasture, and forest land use on representative soils of Minnesota and the acreage mapped to date.

Map Symbol	Slope & Erosion	Mapping Unit	Reference County	Rows Crops	Small Grains	Rotation Hay	Permanent Pasture	Forest	Other	Total Acreage
322	C1	Timula	Goodhue	15	10	35	30	5	5	51044
234	A1	Tonka	Stevens	70	20	5	5	0	0	5019
330	A1	Towner	Grant	15	20	30	30	0	5	11160
97	A1	Trent	Rock	90	5	5	0	0	0	49600
331	A1	Tripoli	Mower	80	5	5	10	0	0	76100
368	A1	Trosky	Pipestone	55	10	25	5	0	5	8600
101	B1	Truman	Faribault	90	5	5	0	0	0	35474
393	A1	Udolpho	Mower	80	10	5	5	0	0	8827
64	A1	Ulen	Norman	35	50	5	5	0	5	68353
335	A1	Urness	Douglas	15	10	10	65	0	0	17940
236	A1	Vallers	Stevens	50	35	5	5	0	5	153930
333	A1	Vasa	Goodhue	70	10	15	5	0	0	5390
567	A1	Verndale	Wadena	50	10	25	10	0	5	27395
421	B1	Ves	Yellow Medicine	75	15	5	5	0	0	238154
297	B1	Vienna	Pipestone	70	10	10	10	0	0	40002
403	A1	Viking	Clay	45	45	5	5	0	0	13770
334	B1	Vlasaty	Mower	90	5	5	0	0	0	4520
39	A1	Wadena	Dakota	80	10	5	5	0	0	66012
157	A1	Wahpeton	Clay	45	35	5	10	5	0	17920
229	A1	Waldorf	Jackson	85	5	5	5	0	0	108372
240	B1	Warba	Itasca	0	5	10	5	80	0	114860
337	A1	Warman	Morrison	5	5	10	25	50	5	10145
538	A1	Waskish	Beltrami	0	0	0	0	100	0	7345
218	A1	Watab	Morrison	25	15	25	15	15	5	17340
338	A1	Waubay	Chippewa	70	20	5	5	0	0	20158
369	B1	Waubeek	Olmsted	60	15	15	5	0	5	7355
491	B1	Waucoma	Olmsted	35	5	20	20	20	0	2175
483	A1	Waukee	Olmsted	80	5	10	5	0	0	16880
411	A1	Waukegan	Dakota	85	5	5	5	0	0	80375
38	B1	Waukon	Mahnomen	45	15	25	10	5	0	122010
629	B1	Wawina	Itasca	0	5	15	10	70	0	7480
113	A1	Webster	Freeborn	90	5	5	0	0	0	614848
340	B1	Whalan	Olmsted	5	5	55	20	10	5	11596
343	A1	Wheatville	Norman	40	50	5	5	0	0	89322
490	A1	Whitewood	Rock	85	5	5	5	0	0	42510
630	A1	Wildwood	Itasca	0	0	0	5	95	0	30990
345	A1	Wilmonton	Cottonwood	85	5	5	5	0	0	56928
107	A1	Winger	Stevens	25	55	10	5	0	5	14084
652	A1	Wyandotte	Pennington	20	45	15	10	0	10	5825
121	A1	Wykeham	Beltrami	20	10	25	10	35	0	22625
508	A1	Wyndmere	Clay	30	45	10	5	5	5	28500
158	A1	Zimmerman	Anoka	5	20	25	10	40	0	225851
664	A1	Zook	Martin	10	5	5	80	0	0	2000
495	A1	Zumbro	Wabasha	50	10	15	10	10	5	5088

Table 9. Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	← Yield estimates → Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
6	Aastad	Lyon	1	0-2	102	48	84	4.7	4.0			65
26	Aazdahl	Traverse	1	1-3	100	50	90	4.6	3.8			70
13	Adolph	Benton	dr	0-2	95	--	70	3.5	3.8			45 (25P)
21	Ahmeek	Carlton	1	2-12	--	--	80	4.7	3.5	UC	M	35
1821	Algansee	Washington	oc	0-2	86	--	62	3.4	3.5			15
22	Allendale	Carlton	1	0-2	--	--	70	3.2	3.5	UH, UC	M, L	14
292	Alstad	Stearns	1	1-4	1—5	--	77	5.0	3.8			70
29	Alvin	Goodhue	1	0-3	110	--	80	4.0	4.0			65
496	Andrusia	Beltrami	1	1-6	--	20	60	3.0	2.8	UC	M	25
			1	6-12	--	15	50	2.5	0.0	UC	L	20
159	Anoka	Isanti	1	0-2	77	--	60	3.9	3.5			50 (55I)
			1	2-6	74	--	50	3.4	3.3			45
49	Antigo	Washington	1	0-2	88	--	60	3.6	3.8			45
			1	2-6	85	--	55	3.3	3.6			40
16	Arenzville	Houston	1	0-2	144	--	78	5.5	4.0			70 (35P)
341	Arvilla	Douglas	1	0-2	65	30	54	3.3	2.6			34 (43I)
			1	2-6	60	26	50	2.8	2.5			30
			1	6-12	55	22	45	2.4	2.1			25
410	Athelwold	Pipestone	1	0-2	90	--	75	4.0	3.6			57
489	Atkinson	Olmsted	1	0-1	134	--	82	5.0	4.3			80
189	Auburndale	Dakota	1	0-2	100	--	70	3.8	4.0			30 (20P)
52	Augsburg	Clay	1	0-2	--	52	86	4.2	3.9			64
43	Automba	Carlton	1	0-2	--	--	82	4.9	3.5	UC, UH	H, H	50
			1	2-6	--	--	80	4.8	3.5	UC, UH	M, M	48
503	Balmlake	Beltrami	1	1-6	--	25	70	3.5	3.0	UC	M	42
			1	6-12	--	20	65	3.4	--	UC	L	36
319	Barbert	Blue Earth	1	0-2	120	--	70	3.6	5.1*			67
33	Barnes	Murray	1	1-3	93	--	78	4.3	4.2			64
			2	3-6	83	--	71	3.8	4.0			60
316	Baroda	Blue Earth	1	0-2	120	--	80	5.4	4.6			70
62	Barrington	Blue Earth	1	1-3	135	--	82	5.5	4.2			80
456	Barronett	Washington	1	0-2	106	--	74	4.0	4.0			50 (30P)
555	Barto	Kawishiwi	1	2-18	--	--	--	--	--	UC	L	NR
167	Baudette	Lake of the Woods	1	0-5	--	--	90	4.8	4.3	UH, UC	H, H	60
460	Baytown	Washington	1	1-6	85	--	60	3.3	3.8			40
			1	6-12	75	--	52	2.9	3.0			35
93	Bearden	Norman	1	0-2	--	56	87	4.8	--			64
			1	2-6	--	53	84	4.6	--			60
655	Bearville	Itasca	1	0-2	--	--	55	3.5	5.0*	LH, LC	H,H	20P
310	Beauford	Blue Earth	1	0-2	140	--	85	5.6	5.1			75
25	Becker	Olmsted	1	0-2	96	--	64	4.5	4.0			50
73	Bellechester	Goodhue	1	25-45	--	--	--	2.0	1.7			10P
125	Beltrami	Beltrami	1	0-2	--	40	85	5.0	4.6	UH	H	50
74	Beotia	Lincoln	1	0-2	100	40	78	4.0	3.5			55
			1	2-4	90	36	68	3.8	3.3			52
305	Bergland	Carlton	1	0-2	--	--	70	4.2*	6.2*	LC	M	1
76	Bertrand	Houston	1	0-2	150	--	88	6.3	3.5			82
			1	2-6	145	--	86	6.1	3.3			80
531	Beseman	Carlton	1	0-2	--	--	62	4.7	6.2*	LC	M	5P
79	Billet	Goodhue	1	2-6	86	--	59	3.7	4.2			35
			1	6-12	82	--	55	3.4	3.7			30
392	Biscay	Le Sueur	1	0-2	115	--	65	3.7	3.7			60
405	Bixby	Steele	1	0-2	92	--	65	3.4	4.2			48
			2	2-6	87	--	60	3.1	4.0			45
170	Blomford	Anoka	1	0-2	79	--	56	3.2	3.7			36
382	Blooming	Freeborn	1	2-6	132	--	88	4.8	5.0			82
			1	6-12	120	--	82	4.4	4.6			70
720	Blowers	Todd	1	1-5	100	--	80	4.2	4.0			48
35	Blue Earth	Blue Earth	1	0-2	108	--	62	3.6	6.6*			55
75	Bluffton	Stearns	1	0-2	91	--	64	3.7	4.0			45
644	Boash	Pennington	1	0-2	--	46	85	3.8	4.0			56

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
81	Boone	Dakota	1	2- 6	52	--	48	2.4	3.4			15
			1	6-12	42	--	40	2.2	3.2			12
522	Boots	Hennepin	1	0- 2	95	--	0	3.9	5.6*			5P
46	Borup	Clay	1	0- 2	--	48	85	3.7	3.8			57
169	Braham	Sherburne	1	2- 6	82	--	60	4.0	3.8			45
			2	2- 6	72	--	50	3.8	--			42
			1	6-12	67	--	44	3.6	--			37
			2	6-12	62	--	40	3.2	--			35
163	Brainerd	Morrison	1	0- 2	92	--	70	4.4	3.7			55
			1	2- 7	87	--	66	4.2	3.6			52
			1	7-13	82	--	60	3.8	3.2			45
124	Brickton	Isanti	1	0- 2	90	--	75	4.0	3.6			45
120	Brill	Washington	1	0- 2	94	--	68	3.7	3.5			46
416	Brookings	Pipestone	1	0- 3	102	42	78	4.3	3.7			67
1905	Brownsdale	Mower	1	0- 2	116	--	70	3.5	3.2			65
84	Brownton	Faribault	1	0- 2	140	--	85	4.4	3.6			70
561	Bullwinkle	Beltrami	1	0- 2	--	--	--	--	--	LC	M	N
151	Burkhardt	Dakota	1	0- 2	77	--	48	3.3	3.4			30 (39I)
			1	2- 6	71	--	44	3.1	2.7			28
			2	6-12	65	--	40	2.6	2.2			24
78	Burnsville	Wright	1	0- 6	77	--	57	3.2	3.7			40
			1	6-12	63	--	52	2.5	3.0			34
			2	6-12	57	--	48	2.3	2.6			32
			2	12-18	--	--	40	2.1	2.2			30
			1	18-35	--	--	--	--	2.0			27
437	Buse	Lyon	1	18-25	--	--	45	2.0	2.5			8P
			1	25-40	--	--	--	--	2.0			6P
85	Calco	Rock	oc	0- 2	100	46	86	4.2	4.4			55
367	Campia	Carlton	1	0- 2	--	--	80	4.7	3.5			45
			1	2-12	--	--	75	4.5	3.4			40
			1	12-25	--	--	--	4.0	3.0			200 (5P)
86	Canisteo	Brown	1	0- 2	140	--	85	4.2	4.0			65
1895	Carmi	Dakota	1	2- 8	107	--	76	4.0	5.6			48
524	Caron	Freeborn	dr	0- 2	100	--	75	--	6.7*			60
50	Cashel	Norman	1	0- 2	--	50	82	4.2	4.0			52
			1	2- 8	--	46	76	4.0	3.8			47
544	Cathro	Beltrami	dr	0- 2	--	--	60	3.4	6.7*			20P
472	Channahon	Olmsted	1	1- 6	77	--	49	3.3	3.9			36
			1	6-12	72	--	41	3.0	3.5			30
19	Chaseburg	Olmsted	1	0- 2	127	--	56	4.5	4.0			60 (30P)
329	Chaska	Washington	1	0- 2	125	--	65	3.5	3.5			53
155	Chetek	Washington	1	0- 6	77	--	55	3.5	3.5			28
			1	6-12	72	--	50	3.0	3.0			24
			1	12-25	--	--	--	2.6	2.7			15P
404	Chilgren	Beltrami	1	0- 2	--	50	78	4.3	3.3	UH	H	50
102	Clarion	Martin	1	1- 6	148	--	88	4.9	3.9			85
641	Clearwater	Pennington	1	0- 2	--	48	85	3.9	5.5			55
371	Clontarf	Swift	1	0- 2	78	40	60	3.4	3.0			39 (47I)
355	Cloquet	Carlton	1	0- 2	--	--	74	3.7	3.2	UC	M	30
			1	2-12	--	--	70	3.5	3.0	UC	M	25
			1	12-25	--	--	62	3.2	2.7	UC	L	15P
88	Clyde	Mower	1	0- 2	145	--	82	4.0	3.7			75
478	Coggon	Olmsted	1	2- 6	115	--	84	5.2	4.0			65
1833	Coland	Cottonwood	oc	0- 2	125	--	79	4.9	3.9			60
96	Collinwood	Jackson	1	0- 2	140	--	85	4.5	4.1			75
98	Colo	Rice	1	0- 2	120	--	70	4.2	4.8			65 (30P)
47	Colvin	Clay	1	0- 2	95	45	85	3.7	4.6			60
18	Comfrey	Nobles	1	0- 2	119	--	80	4.8	4.7			55
452	Comstock	Washington	1	0- 2	101	--	72	3.9	4.0			56
557	Conic	Kawishiwi	1	2-18	--	--	--	--	--	UC	L	NR
100	Copaston	Dakota	1	0- 2	72	--	50	3.1	3.4			34
			1	2-6	67	--	46	2.9	3.2			30
			1	6-12	62	--	40	2.7	2.9			25

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
109	Cordova	Le Sueur	1	0-2	135	--	84	4.8	4.0			70
571	Coriff	Stearns	1	0-2	110	--	86	4.2	3.8			56
117	Cormant	Beltrami	1	0-2	--	30	55	2.6	6.7*	LH, LC	M, H	24
459	Corunna	Stearns	1	0-2	108	--	85	4.4	3.8			50
601	Council	Houston	2	12-20	110	--	73	4.8	3.7	UH	M	15P
			1	20-30	--	--	--	4.6	3.0	UH	L	12P
615	Cowhorn	Itasca	1	0-2	--	--	73	4.3	3.8	UH, UC	M, M	23
118	Crippin	Martin	1	0-2	150	--	88	4.8	4.1			83
1918	Croke	Traverse	1	0-2	94	51	91	3.9	--			65
268	Cromwell	Carlton	1	0-2	--	--	80	3.5	3.0	UC	M	25P
			1	2-6	--	--	75	3.4	2.9	UC	M	20P
9	Crystal Lake	Washington	1	1-3	106	--	76	4.1	4.0			55
204	Cushing	Stearns	1	2-8	100	--	80	5.0	3.8			50
			1	8-15	90	--	75	4.5	3.6			42
			1	15-25	--	--	60	3.5	3.0			20P
620	Cutaway	Beltrami	1	0-8	--	--	75	3.5	2.8	UH		35 (12P)
129	Cylinder	Freeborn	1	0-2	115	--	74	4.0	3.8			60
5	Dakota	Freeborn	1	0-2	94	--	70	4.2	3.6			54
			1	2-6	90	--	65	4.0	3.5			50
			1	6-14	84	--	62	3.6	3.1			44
133	Dalbo	Isanti	1	2-7	100	--	75	4.5	4.5			53
			1	7-12	95	--	70	4.0	4.0			45
281	Darfur	Blue Earth	1	0-2	125	--	75	4.1	4.0			60
494	Darnen	Big Stone	1	0-4	105	49	90	4.1	4.1			65
183	Dassel	Blue Earth	1	0-2	110	--	75	3.9	3.6			50 (15P)
536	Dawson	Carlton	dr	0-2	--	--	65	5.0*	6.2*	LC	L	20P
453	DeMontreville	Stearns	1	2-6	70	--	60	3.4	2.7	UC	M	40
			1	6-12	55	--	50	3.0	2.5	UC	M	30
			1	12-25	--	--	--	2.7	2.2	UC	L	12P
505	Debs	Beltrami	1	1-6	--	40	80	4.0	3.5	UH	H	50
			1	6-12	--	35	75	3.8	3.0	UH	M	45
547	Deerwood	Pennington	1	0-2	--	35	63	2.9	5.7*			20P
336	Delft	Jackson	1	0-2	152	--	90	4.7	--			80
27	Dickinson	Freeborn	1	0-2	95	--	65	3.5	3.2			45
			1	2-6	90	--	60	3.2	3.1			40
			1	6-12	84	--	55	3.0	2.5			34
327	Dickman	Stearns	1	0-2	74	--	62	3.4	3.3			35 (43I)
			1	2-6	69	--	60	3.1	3.2			32
			1	6-12	65	--	57	2.9	3.0			28
9	Dodgeville	Goodue	1	1-6	98	--	63	3.7	4.0			38
			2	6-12	92	--	58	3.2	3.5			32
591	Doland	Chippewa	1	1-6	110	46	83	4.4	3.9			60
425	Donaldson	Wilkin	1	0-2	90	50	90	3.8	--			65
550	Dora	Itasca	1	0-2	--	--	--	--	--	LC	M	NR
698	Doran	Wilkin	1	0-2	92	47	90	3.8	4.0			68
473	Dorerton	Olmsted	1	12-25	--	--	--	3.0	3.0			20P
			1	25-40	--	--	--	--	2.5			15P
406	Dorset	Todd	1	0-2	63	--	58	3.4	3.2			36 (44I)
			1	2-6	58	--	54	3.2	3.1			33
			1	6-12	53	--	50	2.9	2.9			28
137	Dovray	Stevens	1	0-2	90	50	74	4.4	4.1			55
516	Dowagiac	Mower	1	0-2	93	--	75	3.3	3.7			45
			1	2-6	78	--	65	3.0	3.0			40
574	Du Page	Yellow Medicine	oc	0-2	120	46	82	4.0	4.0			63
10	Dubuque	Goodhue	1	6-12	102	--	63	4.4	4.5	UH	M	32 (20P)
			2	6-12	92	--	55	4.2	4.2	UH	M	30 (18P)
			1	12-18	--	--	50	4.2	4.0	UH	L	15P
			2	12-18	--	--	45	3.8	3.8	UH	L	15P
			1	18-25	--	--	--	3.6	3.5	UH	L	13P
260	Duelm	Morrison	1	0-2	69	--	56	3.0	3.0			40
504	Duluth	Carlton	1	0-2	--	--	82	5.0	4.0	UC	H	35
			1	2-12	--	--	74	4.6	3.7	UC	M	30
			1	12-25	--	--	--	4.0	3.1	UC	M	20P

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
123	Dundas	Le Sueur	1	0- 2	110	--	70	4.5	4.5			60
502	Dusler	Carlton	1	0- 2	--	--	82	4.8	4.0	UH, LH	H, M	15P
565	Eckvoll	Beltrami	1	0- 2	--	37	66	3.0	3.4			35
616	Effie	Beltrami	1	0- 2	--	--	75	4.0	3.7	LH, LC	H, H	45
141	Egeland	Yellow	1	0- 2	68	38	59	3.4	3.2			40
		Medicine	1	2- 6	60	33	49	2.9	3.0			36
1830	Eitzen	Houston	oc	0- 2	157	--	75	6.0	3.8			85 (40P)
593	Elbaville	Houston	1	30-45	--	--	--	--	2.8	UH	M	15P
143	Eleva	Olmsted	1	2- 6	91	--	57	3.5	2.5			45
			1	6-12	81	--	53	3.1	2.0			38
510	Elmville	Wilkin	1	0- 2	96	48	90	3.7	4.8			65
12	Emmert	Washington	1	3- 15	--	--	30	2.5	2.8	UC	L	15P
			1	15-25	--	--	--	2.0	2.5	UC	L	12P
145	Enstrom	Kittson	1	0- 2	--	36	66	3.0	3.5			35
191	Epoufette	Beltrami	1	0- 2	--	--	--	2.5	3.0	LH, LC	M, M	20P
237	Erin	Rice	1	2- 6	105	--	80	4.6	4.5			66
			1	6-12	95	--	70	4.4	4.3			56
			1	12-18	85	--	65	3.9	3.7			50
			1	18-30	--	--	--	3.5	3.5			20P
645	Espelie	Pennington	1	0- 2	--	42	70	3.4	4.8			50
192	Estelline	Pipestone	1	0- 2	85	--	77	3.8	3.1			50
			1	2- 6	80	--	72	3.6	3.0			47
			2	2- 6	75	--	68	3.4	2.8			44
41	Estherville	Kandiyohi	1	0- 2	67	--	47	3.0	2.8			35 (42I)
			1	2- 6	62	--	42	2.6	2.5			32
409	Etter	Dakota	1	2- 6	75	--	58	3.4	4.8			35
			1	6-12	65	--	51	3.2	4.6			30
149	Everly	Nobles	1	2- 6	109	--	82	4.4	3.8			75
			2	2- 6	104	--	77	4.2	3.7			72
			1	6-12	99	--	72	4.2	3.5			65
			2	6-12	95	--	68	3.9	3.2			62
484	Eyota	Olmsted	1	6- 12	120	--	78	4.5	3.0			55 (15P)
			1	12-20	--	--	73	4.2	2.4			14P
156	Fairhaven	Rice	1	0- 2	107	--	76	4.0	3.7			70
			1	2- 6	102	--	74	3.8	3.5			65
57	Fargo	Clay	1	0- 2	--	50	90	4.0	3.6			65
69	Fedji	Blue Earth	1	1- 3	90	--	60	3.7	3.2			44
455	Festina	Houston	1	0- 2	162	--	88	6.8	3.8			100
			1	2- 6	157	--	86	6.3	3.6			95
			2	6-12	150	--	83	6.1	3.0			85
160	Fieldon	Watonwan	1	0- 2	123	38	76	4.5	3.6			60
144	Flak	Morrison	1	2- 6	87	--	75	4.2	3.2			50
			2	2- 6	83	--	65	3.7	3.0			48
			1	6-12	77	--	65	3.8	3.0			43
			2	6-12	72	--	60	3.3	2.9			40
66	Flaming	Clay	1	0- 2	50	30	62	2.8	3.5			27
92	Flandreau	Rock	1	0- 2	95	--	77	3.8	3.5			53
			1	2- 6	90	--	69	3.4	3.2			50
36	Flom	Lyon	1	0- 2	102	46	85	4.5	4.0			55
479	Floyd	Mower	1	1- 4	124	--	85	4.5	4.5			75
426	Foldahl	Clay	1	0- 2	80	39	80	3.3	4.5			54
375	Forada	Todd	1	0- 2	82	32	60	3.8	3.5			42
339	Fordville	Yellow	1	0- 2	82	38	70	3.5	3.3			50 (55I)
		Medicine	1	2- 6	77	34	65	3.1	3.2			47
168	Forman	Lyon	1	1- 3	97	46	85	4.5	4.0			65
			2	3- 6	87	40	80	4.3	3.8			62
171	Formdale	Grant	1	2- 5	96	49	85	4.6	3.6			64
71	Fossum	Swift	1	0- 2	73	32	58	3.3	3.0			30
1877	Fostoria	Faribault	1	0- 2	155	--	87	4.7	--			96
65	Foxhome	Norman	1	0- 2	--	42	77	3.5	3.5			50
296	Fram	Big Stone	1	1- 4	88	39	75	4.0	3.0			50
476	Frankville	Olmsted	1	1- 6	110	--	72	4.0	3.5			62
			1	6-12	100	--	67	3.8	3.0			56
264	Freeon	Morrison	1	1- 4	96	--	80	4.5	4.0			55 (15P)

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
266	Freer	Morrison	1	0-2	92	--	72	3.7	3.7			50
173	Frontenac	Olmsted	1	15-35	--	--	--	--	1.9	UH	M	15P
210	Fulda	Big Stone	1	0-2	95	41	76	4.2	4.6			48
174	Gale	Winona	1	6-15	81	--	60	3.6	3.5			44
175	Galva	Nobles	1	1-3	105	--	82	5.0	4.2			65
77	Garnes	Pennington	1	0-2	--	52	83	4.7	4.1	UH, UC	H, H	58
176	Garwin	Olmsted	1	0-2	144	--	90	5.4	4.9			82
1835	Germantown	Cottonwood	1	1-6	84	--	74	3.8	3.4			55
114	Glencoe	Martin	1	0-2	130	--	72	4.1	4.2			65
60	Glyndon	Clay	1	0-2	--	51	89	3.9	3.8			68
			1	2-6	--	47	83	3.7	3.6			64
180	Gonvick	Stearns	1	1-2	120	45	91	4.8	4.3			75
			1	2-4	115	43	86	4.6	4.1			72
617	Goodland	Itasca	1	1-10	--	--	68	4.1	3.8	UH, UC	H,H	25
177	Gotham	Goodhue	1	2-12	73	--	44	3.0	3.1			25
			1	12-35	--	--	35	2.5	2.8			15P
659	Graceville	Rock	1	0-2	123	--	79	4.2	3.9			67
			1	2-6	118	--	76	4.0	3.8			63
8	Granby	Blue Earth	1	0-2	97	--	65	3.9	3.6			55
259	Grays	Blue Earth	1	2-8	128	--	80	5.1	4.8			80
549	Greenwood	Itasca	1	0-2	--	--	--	--	--	LC	M	NR
59	Grimstad	Norman	1	0-2	--	48	82	4.2	3.9			55
128	Grogan	Faribault	1	1-6	135	--	80	5.1	3.8			67
613	Grovecity	Kandiyohi	1	0-2	130	49	92	4.7	--			80
233	Growton	Morrison	1	0-2	102	--	80	5.0	3.6			62
			1	2-4	97	--	75	4.8	3.0			60
482	Grygla	Beltrami	1	0-2	--	37	60	3.2	6.7*	LH, LC	M, M	35
230	Guckeen	Faribault	1	1-3	150	--	85	4.8	5.3			79
			1	3-6	145	--	80	4.6	4.8			75
372	Hamar	Norman	1	0-2	--	36	60	3.2	3.5			28
414	Hamel	Le Sueur	1	0-2	135	--	85	4.7	5.0			65
184	Hamerly	Stevens	1	0-3	96	50	85	4.5	3.9			60
1878	Hamre	Beltrami	1	0-2	--	36	65	2.9	5.4*			30 (20P)
111	Hangaard	Todd	1	0-2	60	34	50	3.1	3.0			30
282	Hanska	Brown	1	0-2	125	--	72	4.2	3.7			54 (59I)
497	Hantho	Swift	1	0-2	100	50	85	4.2	4.5			60
112	Harps	Martin	1	0-2	135	--	80	4.5	3.9			55
185	Hattie	Big Stone	1	1-4	88	40	75	3.5	3.2			38
			1	4-10	84	37	70	3.3	3.0			32
187	Haug	Kittson	dr	0-2	--	30	56	3.5	6.7*			25 (18P)
380	Havana	Freeborn	1	0-2	122	--	75	4.8	4.3			68
611	Hawick	Stearns	1	6-12	50	--	35	2.2	2.0			10 (8P)
			1	12-40	--	--	--	2.0	1.2			5P
104	Hayden	Wright	1	2-6	120	--	80	5.1	4.9			65
			2	2-6	115	--	75	4.8	4.8			62
			1	6-12	110	--	75	4.6	4.4			5
			2	6-12	105	--	70	4.1	4.3			52
			1	12-18	95	--	65	3.8	3.8			50
			2	12-18	90	--	60	3.6	3.3			46
			1	18-25	--	--	--	--	3.1			20P
			1	25-35	--	--	--	--	2.9			15P
190	Hayfield	Mower	1	1-3	100	--	65	4.0	3.7			63
366	Hecla	Swift	1	0-3	65	33	48	3.0	2.6			30
8027	Hegne	Clay	1	0-2	90	48	80	4.0	--			59
232	Heyder	Hennepin	1	2-6	95	--	75	4.5	4.5			50
			1	6-12	87	--	70	4.2	4.2			45
254	Hibbing	Carlton	1	0-2	--	--	80	4.9	4.7	UC	H	43
			1	2-12	--	--	75	4.7	4.2	UC	M	38
436	Hidewood	Pipestone	1	0-2	100	--	86	4.5	3.8			60
647	Hilaire	Wilkin	1	0-2	83	40	80	3.8	4.4			50
48	Hiwood	Beltrami	1	0-2	--	--	40	2.5	2.5	UC		25 (10P)
200	Holdingford	Stearns	1	4-8	100	--	78	4.7	3.4			57
			1	8-15	85	--	70	4.2	3.2			48

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
487	Hoopeston	Watonwan	1	0-2	103	--	74	3.9	3.5			45
523	Houghton	Kandiyohi	dr	0-2	100	--	--	3.2	6.2*			45 (10P)
7	Hubbard	Sherburne	1	0-2	72	--	50	3.2	3.1			36 (43I)
			2	0-2	68	--	45	3.0	3.0			34
			1	2-6	68	--	42	3.0	3.0			33
			2	2-6	65	--	36	2.8	2.7			30
			1	6-12	60	--	30	2.6	2.7			26
			2	6-12	55	--	--	2.4	2.4			24
139	Huntersville	Wadena	1	1-6	80	--	62	4.0	3.0	UH, UC	M, M	40
194	Huntsville	Winona	oc	0-2	130	--	65	4.4	4.0			70
54	Ihlen	Rock	1	0-2	120	--	70	3.6	3.1			57
			1	2-6	110	--	65	3.2	2.8			53
172	Indus	Lake of the Woods	1	0-2	--	--	--	4.2	6.0	LH, LC	H,H	45 (30P)
556	Insula	Kawishiwi	1	2-18	--	---	--	--	--	UC	L	NR
			1	18-35	--	--	--	--	--	UC	L	NR
261	Isan	Morrison	1	0-2	73	--	55	3.0	3.2			35
161	Isanti	Sherburne	1	0-2	71	--	46	3.0	3.0			25 (33I)
618	Itasca	Itasca	1	1-10	--	--	78	4.3	4.1	UH, UC	H, H	40
594	Jeffers	Cottonwood	1	0-2	96	--	80	3.8	3.5			60
1902	Jewett	Stearns	1	2-8	107	--	85	4.2	3.6			58
203	Joy	Olmsted	1	1-4	150	--	90	5.4	4.9			95
15	Judson	Rice	1	2-6	127	--	70	4.0	4.0			75 (35P)
518	Kalmarville	Houston	oc	0-2	94	--	50	3.3	9.0*			45 (20P)
105	Kamrar	Blue Earth	1	2-6	112	--	82	4.6	4.3			75
			1	6-12	106	--	78	4.4	4.0			65
415	Kanaranzi	Nobles	1	0-2	84	--	65	3.4	4.4			45
			1	2-6	80	--	60	3.2	4.2			42
53	Kandota	Todd	1	2-6	112	--	77	5.2	3.2			60
			1	6-12	107	--	72	4.7	3.0			52
			1	12-25	--	--	62	3.7	2.6			25
205	Karlstad	Beltrami	1	0-2	--	32	56	3.2	2.9	UC	M	30
206	Kasota	Le Sueur	1	0-2	105	--	65	4.0	4.2			60
24	Kasson	Dodge	1	0-2	120	--	72	4.2	4.2			66
			1	2-6	115	--	67	4.0	4.0			62
208	Kato	Rice	1	0-2	122	--	75	4.4	5.1			65
619	Keewatin	Itasca	1	0-2	--	--	63	3.2	3.5	LH, LC	M,H	25P
209	Kegonsa	Olmsted	1	0-2	104	--	68	4.1	4.2			60
			1	2-6	100	--	66	3.8	4.0			57
250	Kennebec	Dakota	oc	0-2	137	--	78	4.7	5.8			78
30	Kenyon	Dodge	1	0-2	135	--	85	5.0	5.4			80
			1	2-6	130	--	80	4.8	5.0			76
			2	2-6	125	--	75	4.4	4.4			72
238	Kilkenny	Le Sueur	1	2-6	115	--	75	4.8	5.3			68
			2	6-12	95	--	60	4.4	5.0			58
			2	12-18	80	--	50	3.8	4.4			52
			1	18-25	--	--	--	3.2	4.1			20P
342	Kingsley	Dakota	1	3-8	95	--	70	3.6	3.8			35
			1	8-15	85	--	60	3.4	3.6			30
			1	15-25	--	--	--	2.9	3.3			18
197	Kingston	Blue Earth	1	1-3	160	--	85	5.1	--			95
58	Kittson	Clay	1	1-5	60	52	90	4.0	5.0			65
213	Klinger	Goodhue	1	1-3	138	--	86	5.0	6.0			85
539	Klossner (Palms)	Faribault	dr	0-2	125	--	70	3.9	6.2*			55
562	Knoke	Redwood	1	0-2	110	--	73	3.8	3.6			55
461	Koronis	Stearns	1	2-6	115	--	82	5.0	4.6			72
			1	6-12	100	--	72	4.2	4.4			62
91	Kranzburg	Pipestone	1	0-2	105	52	80	4.4	3.7			65
			2	2-6	95	44	75	4.2	3.3			60
481	Kratka	Pennington	1	0-2	--	38	70	3.5	4.0			38
51	LaPrairie	Lyon	oc	0-2	95	44	85	4.5	4.4			65
1907	Lakefield	Martin	1	0-2	155	--	90	4.8	--			90

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
216	Lamont	Freeborn	1	2- 6	84	--	55	3.2	3.9			45
			1	6-12	74	--	45	2.9	3.6			39
418	Lamoure	Lyon	1	0- 2	97	42	80	4.0	4.2			50
220	Langhei	Douglas	1	18-40	--	--	--	2.6	3.5			17P
179	Langola	Benton	1	0- 2	80	--	60	3.2	3.4			32 (41I)
			1	2- 6	75	--	55	2.9	3.2			29
222	Lasa	Watonwan	1	2- 8	70	--	45	3.0	3.2			25
485	Lawler	Mower	1	0- 2	116	--	68	3.6	3.9			65
226	Lawson	Goodhue	1	0- 2	147	--	90	5.2	6.2			80
239	LeSueur	Le Sueur	1	0- 2	140	--	88	5.1	5.4			85
			1	2- 6	132	--	84	4.7	5.1			80
1984	Leafriver	Wadena	1	0- 2	--	--	--	--	3.1			10P
227	Lemond	Watonwan	1	0- 2	120	--	75	4.3	4.3			50
559	Lena	Kandiyohi	dr	0- 2	77	--	60	3.2	6.2*			23
709	Lengby	Beltrami	1	1- 6	--	--	70	3.0	2.8	UH	H	45 (20P)
			1	6-12	--	--	65	2.8	2.6	UH	M	40 (15P)
138	Lerdal	Le Sueur	1	2- 6	6	100	--	65	4.8	4.3		50
			1	6-12	87	--	56	4.4	.1			43
106	Lester	Le Sueur	1	2- 6	140	--	81	5.1	4.9			77
			2	2- 6	130	--	75	4.8	4.7			74
			1	6-12	125	--	71	4.5	4.5			66
			2	6-12	120	--	69	4.3	4.2			62
			1	12-18	--	--	60	4.0	3.9			54
			1	18-25	--	--	55	--	3.1			20P
241	Letri	Cottonwood	1	0- 2	122	--	84	5.0	4.0			80
244	Lilah	Olmsted	1	6-12	68	--	38	2.5	2.2			15
1916	Lindaas	Wilkin	1	0- 2	80	40	77	3.5	3.8			55
247	Linder	Watonwan	1	0- 3	100	--	55	3.0	2.8			31
301	Lindstrom	Winona	1	2- 6	150	--	84	5.2	4.2			90
			1	6-15	140	--	74	5.0	4.0			76
162	Lino	Anoka	1	0- 2	82	--	60	2.9	3.0			30 (39I)
713	Linveldt	Pennington	1	0- 2	--	50	78	3.9	3.3			45
470	Lismore	Murray	1	0- 3	100	--	86	4.2	3.8			75
181	Litchfield	Blue Earth	1	1- 3	92	--	58	3.4	3.2			42
477	Littleton	Olmsted	1	0- 1	160	--	89	5.4	4.6			97
			1	1- 4	155	--	86	5.2	4.4			92
537	Lobo	Carlton	dr	0- 2	--	--	--	--	--	LC	M	NR
245	Lohnes	Pennington	1	0- 6	--	24	44	1.8	2.9			15
248	Lomax	Blue Earth	1	1- 3	130	--	70	4.7	0.0			74
572	Lowlein	Stearns	1	0- 2	95	--	72	4.2	3.5			58
533	Loxley	Carlton	dr	0- 2	--	--	62	3.8	6.0*	LC	M	20P
546	Lupton	Beltrami	1	0- 2	--	--	--	--	4.0	LC	L	NR
211	Lura	Jackson	1	0- 2	125	--	70	3.9	4.5			55
45	Maddock	Douglas	1	0- 2	65	30	42	2.7	2.0			25
			1	2- 6	62	27	38	2.2	1.9			22
			1	6-12	55	22	33	1.7	1.7			18
136	Madelia	Blue Earth	1	0- 2	150	--	88	4.8	5.0			85
454	Mahtomedi	Stearns	1	2- 8	45	--	46	2.2	1.8	UC	M	23
			1	8-15	35	--	41	1.8	1.7	UC	M	20
			1	15-25	--	--	--	1.5	1.2	UC	L	10P
			1	25-40	--	--	--	1.4	1.0	C	L	8P
347	Malachy	Swift	1	0- 2	80	37	60	3.8	3.4			40 (48I)
511	Marcellon	Stearns	1	0- 2	117	--	92	5.5	4.1			72
249	Marcus	Rock	1	0- 2	128	--	86	4.0	--			77
543	Markey	Beltrami	dr	0- 2	--	--	55	2.6	6.2*			20P
251	Marlean	Olmsted	1	25-40	--	--	--	--	1.5	UH	L	10P
110	Marna	Blue Earth	1	0- 2	145	--	85	4.6	4.0			80
242	Marquette	Beltrami	1	1- 6	--	20	40	2.3	2.0	UC	M	20
252	Marshan	Mower	1	0- 2	121	--	70	4.6	4.4			75
246	Marysland	Swift	1	0- 2	77	44	74	3.5	3.4			48
131	Massbach	Olmsted	1	2- 6	122	--	66	4.0	3.9			70
			1	6-12	107	--	62	3.4	3.2			60
412	Mavie	Pennington	1	0- 2	--	42	70	3.4	5.7*			40

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....	bu	.....	T/A	AUM			
253	Maxcreek	Freeborn	1	0-2	138	--	86	5.0	4.2			80
378	Maxfield	Goodhue	1	0-2	139	--	88	5.2	4.2			83
255	Mayer	Redwood	1	0-2	115	--	67	4.0	3.5			55
256	Mazaska	Le Sueur	dr	0-2	110	--	72	4.2	4.3			70
108	McIntosh	Stevens	1	0-3	97	50	80	4.4	4.6			65
257	McPaul	Goodhue	1	0-2	130	--	86	5.7	5.7			65 (25P)
202	Meehan	Itasca	1	0-2	--	--	53	2.5	1.6	UC	M	20 (10P)
458	Menahga	Wadena	1	0-2	42	--	40	2.0	1.6	UC	M	15
			1	2-6	35	--	36	1.6	1.4	UC	M	13
377	Merton	Freeborn	1	1-3	150	--	90	5.5	--			97
535	Merwin	Carlton	dr	0-2	--	--	65	5.1*	6.2*	LC	L	20P
558	Mesaba	Kawishiwi	1	2-18	--	--	--	--	--	UC	L	NR
			1	18-35	--	--	--	--	--	UC	L	NR
152	Milaca	Benton	1	2-6	92	--	71	4.0	3.5			45
			1	6-12	83	--	66	3.8	3.3			38
			1	12-18	--	--	53	2.8	3.2			34
551	Millerville	Anoka	dr	0-2	--	--	56	3.0	6.7*			35P
269	Millington	Redwood	oc	0-2	130	--	78	4.5	4.9			45
463	Minneiska	Le Sueur	oc	0-2	115	--	68	4.4	3.1			55 (25P)
363	Minneopa	Blue Earth	oc	0-3	95	--	65	3.6	3.0			60
287	Minnetonka	Blue Earth	1	0-2	140	--	85	4.6	6.1*			58
376	Moland	Rice	1	0-2	140	--	90	5.4	--			82
			1	2-6	132	--	85	5.2	--			78
			1	6-12	125	--	80	4.9	--			68
90	Moody	Rock	1	0-2	130	--	79	4.0	--			70
			1	2-4	125	--	75	3.8	--			67
534	Mooselake	Carlton	dr	0-2	--	--	65	--	6.2*	LC	M	20P
164	Mora	Benton	1	1-3	105	--	75	5.2	3.2	UH, UC	M, M	50
			1	3-5	100	--	70	5.0	3.0	UH, UC	M, M	46
			1	2-4	125	--	75	3.8	--			67
534	Mooselake	Carlton	dr	0-2	--	--	65	--	6.2*	LC	M	20P
164	Mora	Benton	1	1-3	105	--	75	5.2	3.2	UH, UC	M, M	50
			1	3-5	100	--	70	5.0	3.0	UH, UC	M, M	46
621	Morph	Itasca	1	0-2	--	--	75	4.3	4.1	LH, LC	H, H	40
1888	Moundprairie	Houston	oc	0-2	120	--	68	4.2	10.0			55
401	Mt. Carroll	Olmsted	1	2-6	145	--	86	5.2	4.9			86
			1	6-12	135	--	80	4.7	4.7			75
			2	6-12	130	--	75	4.5	4.5			70
			1	12-18	110	--	67	4.2	4.2			63
			2	12-18	105	--	63	4.0	4.0			58
525	Muskego	Blue Earth	dr	0-2	110	--	70	3.8	6.6*			55
1959	Nary	Beltrami	1	0-2	--	--	50	3.0	2.5	UH	H	15
622	Nashwauk	Itasca	1	1-10	--	--	63	3.0	3.3	UH, UC	M, M	20P
492	Nasset	Houston	1	3-6	140	--	87	4.6	3.7			75
			1	6-12	130	--	82	4.2	3.0			64
40	Nebish	Becker	1	2-6	89	40	72	4.2	4.4	UH	H	55
			1	6-12	79	--	67	3.8	3.9	UH	M	48
			1	12-18	--	--	57	3.2	3.5	UH	M	44
186	Nemadji	Carlton	1	0-2	--	--	65	3.6	3.5	UC	M	22P
583	Nereson	Kittson	1	0-2	--	52	80	4.7	4.7			57
235	Nessel	Hennepin	1	1-4	110	--	82	4.9	4.7			67
576	Newalbin	Winona	1	0-2	136	--	72	5.2	3.5			60 (25P)
515	Newfound	Kawishiwi	1	2-18	--	--	--	--	--	UC	M	NR
501	Newglarus	Winona	1	3-6	114	--	76	4.4	2.9			60
			1	6-12	104	--	71	4.0	2.7			52
			1	12-20	--	--	66	3.8	2.5			45
381	Newry	Freeborn	1	1-3	125	--	85	4.7	4.1			75
274	Newson	Carlton	1	0-2	--	--	58	3.6	5.2*	LC	M	20P
130	Nicollet	Martin	1	0-2	155	--	92	6.0	--			100
575	Nishna	Redwood	1	0-2	120	44	76	3.6	4.1			55
217	Nokasippi	Morrison	1	0-2	72	--	50	3.2	3.3			20P
142	Nokay	Morrison	1	0-2	97	--	75	4.2	3.5			45
			1	2-7	92	--	70	4.0	3.0			42
661	Nora	Rock	1	4-10	128	--	63	3.7	3.7			58

Table 9. (Continued) *Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).*

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....	bu	.....	T/A	AUM			
446	Normania	Redwood	1	1- 3	140	48	89	5.1	3.8			75
429	Northcote	Kittson	1	0- 2	--	48	80	4.0	3.8			57
563	Northwood	Beltrami	1	0- 2	--	--	55	5.0*	--			15
224	Nowen	Anoka	1	0- 2	102	--	76	4.7	4.0			46
30	Noyes	Kittson	1	0- 2	--	50	86	4.2	3.9			50
207	Nymore	Wadena	1	0- 2	54	--	41	2.7	2.9			25 (34I)
			1	2- 6	49	--	36	2.5	2.7			23
			1	6-12	39	--	31	2.1	2.4			20
275	Ocheyedan	Faribault	1	2- 6	145	--	75	4.2	--			85
466	Ogilvie	Benton	1	0- 2	100	--	76	4.5	4.0			42
134	Okoboji	Brown	1	0- 2	135	--	80	4.3	3.7			60
276	Oldham	Swift	1	0- 2	92	42	72	3.9	4.0			50
188	Omega	Carlton	1	0- 2	--	--	60	3.2	2.9	UC	M	18P
			1	2-12	--	--	55	3.0	2.7	UC	L	16P
277	Onamia	Crow Wing	1	0- 2	90	--	75	4.0	2.6			44 (52I)
			1	2- 7	85	--	70	3.8	2.4			42
303	Ontonagon	Carlton	1	0- 2	--	--	62	4.2	3.9	LC	H	25P
			1	2-12	--	--	56	3.8	3.7	UC	M	22P
631	Oran	Mower	1	1- 4	125	--	75	4.5	4.0			70
493	Oronoco	Olmsted	1	6-12	126	--	79	5.0	3.5			60
413	Osakis	Douglas	1	0- 3	80	38	65	3.0	2.6			35
317	Oshawa	Le Sueur	ff	0- 2	--	--	--	--0	5.9*			5P
2	Ostrander	Rice	1	1-6	132	--	80	5.0	3.8			75
			1	6-12	122	--	72	4.6	3.6			65
279	Otterholt	Dakota	1	1- 6	120	--	88	4.3	4.3			60
506	Overly	Clay	1	0- 2	--	52	90	4.0	4.0			70
1975	Oylen	Wadena	1	0- 2	74	--	51	3.6	4.1			28 (38I)
703	Paddock	Todd	1	0- 2	87	--	72	3.2	3.2			40
587	Palsgrove	Winona	1	2- 6	139	--	86	5.5	2.9			90
			1	6-12	134	--	81	5.3	2.7			86
165	Parent	Morrison	1	0- 2	8	--	55	5.0	4.0			40 (20P)
34	Parnell	Stevens	1	0- 2	80	45	70	4.7	5.4			50
280	Pelan	Pennington	1	0- 2	--	40	65	3.3	4.7	UH	M	42
607	Pengilly	Beltrami	1	0- 2	--	--	--	--	--	LH, LC	M, M	NR
581	Percy	Kittson	1	0- 2	--	50	76	4.0	6.7*			50
434	Perella	Chippewa	1	0- 2	92	44	82	4.2	3.7			65
623	Pierz	Morrison	1	0- 2	80	--	75	3.5	3.0			30
			1	2- 6	75	--	70	3.0	2.8			28
283	Plainfield	Winona	1	0- 6	59	--	46	2.8	3.0	UC	M	20
			1	6-12	55	--	40	2.4	2.0	UC	M	17
284	Poinsett	Lyon	1	2- 6	97	43	80	4.5	3.7			58
			2	2- 6	87	39	75	4.0	3.5			55
119	Pomroy	Morrison	1	0- 2	75	--	58	3.1	2.7	UH	M	35
			1	2- 7	70	--	52	2.9	2.5	UH	M	32
148	Poppleton	Kittson	1	0- 2	--	30	53	2.6	3.0			26
285	Port Byron	Olmsted	1	0- 2	155	--	90	6.1	4.6			95
			1	2- 6	150	--	87	6.0	4.5			90
			1	6-12	130	--	76	5.8	4.2			80
507	Poskin	Washington	1	0- 2	94	--	74	4.0	4.0			56
325	Prebish	Morrison	1	0- 2	85	--	62	3.3	4.0			40
397	Primghar	Nobles	1	0- 2	119	44	87	5.0	4.4			75
344	Quam	Grant	1	0- 2	110	44	76	4.2	4.3			50
99	Racine	Olmsted	1	1- 6	127	--	80	5.0	3.8			77
			1	6-12	117	--	75	4.5	3.5			70
289	Radford	Goodhue	1	0- 2	144	--	90	5.7	5.6			75
291	Ransom	Nobles	1	0- 2	120	--	85	4.4	4.2			75
294	Rasset	Carver	1	0- 6	75	--	55	3.0	2.7			30
450	Rauville	Lyon	ff	0- 2	--	--	--	--	2.7			10P
608	Rawles	Houston	oc	0- 2	142	--	78	5.2	6.7*			75
295	Readlyn	Mower	1	0- 2	127	--	90	4.7	4.4			77
116	Redby	Kittson	1	0- 2	--	30	55	3.0	2.5	UC, UH	M,H	25
82	Redeye	Todd	1	2- 6	78	--	55	3.2	3.0			40
			1	6-12	68	--	50	3.0	2.7			35

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
566	Regal	Stearns	1	0-2	90	--	76	3.2	3.0			40
650	Reiner	Pennington	1	0-2	--	50	83	3.8	3.7			60
4	Renova	Rice	1	2-6	130	--	65	4.8	5.0			67
			1	6-12	120	--	60	4.6	4.8			58
			2	12-18	95	--	45	4.2	4.6			49
373	Renshaw	Swift	1	0-2	80	40	53	3.5	2.8			37 (45I)
			1	2-6	75	36	48	3.3	2.6			34
654	Revere	Redwood	1	0-2	105	--	75	4.2	3.3			45
298	Richwood	Olmsted	1	0-2	150	--	90	5.2	4.0			90
639	Ridgeport	Stearns	1	0-2	72	--	57	3.2	1.9			20 (26I)
541	Rifle	Todd	dr	0-2	70	--	52	3.0	6.2*			15P
529	Ripon	Washington	1	1-2	90	--	64	3.6	3.9			50
			1	2-6	84	--	60	3.4	3.4			47
299	Rockton	Olmsted	1	1-6	104	--	75	3.8	4.1			60
			1	6-12	90	--	70	3.4	3.9			52
439	Rockwell	Pennington	1	0-2	--	46	80	3.7	3.9			50
374	Rockwood	Todd	1	2-6	95	--	80	4.1	4.0			50
			1	6-12	90	--	75	3.8	3.8			43
			1	12-18	--	--	60	3.6	3.0			20P
219	Rolfe	Blue Earth	1	0-2	115	--	70	3.6	3.9			60
582	Roliss	Grant	1	0-2	90	50	82	3.8	4.4			50
198	Rollingstone	Winona	1	3-12	104	--	66	3.8	2.4			56
545	Rondeau	Beltrami	dr	0-2	--	--	40	3.0	5.0			5P
166	Ronneby	Benton	1	0-2	97	--	70	4.2	3.9	UH	M	40
471	Root	Olmsted	ff	0-2	--	--	--	--	6.8*	LH	H	40P
1943	Roscommon	Wadena	1	0-2	40	--	50	2.4	2.4	UH	M	15
712	Rosewood	Pennington	1	0-2	--	40	70	2.9	2.9			30
302	Rosholt	Washington	1	1-6	81	--	60	3.1	3.8			43
			1	6-15	76	--	55	2.9	3.5			36
624	Rosy	Beltrami	1	0-6	--	--	85	4.9	4.3	UH	H	45
290	Rothsay	Chippewa	1	2-6	97	48	82	4.0	3.8			57
1932	Runeberg	Todd	1	0-2	87	--	77	4.7	7.0*			35 (20P)
304	Rushmore	Nobles	1	0-2	120	--	85	5.0	4.4			72
306	Sac	Rock	1	1-3	133	--	87	4.6	4.4			76
42	Salida	Pope	1	0-6	57	20	40	2.6	2.4			18 (8P)
			1	6-12	47	--	35	2.2	2.0			15 95P)
625	Sandwick	Itasca	1	0-2	--	--	55	3.3	3.0	UH	M	20P
153	Santiago	Washington	1	2-6	100	--	72	3.6	3.9			58
			1	6-15	95	--	68	3.4	3.8			50
307	Sargeant	Mower	1	0-2	93	--	75	3.5	3.5			50
328	Sartell	Benton	1	0-2	62	--	45	3.0	3.1	UH	L	25 (33I)
			1	2-6	57	--	40	2.7	3.0	UH	L	23
			1	6-12	52	--	35	2.4	2.8	UH	L	20
467	Sawmill	Olmsted	dr	0-2	135	--	80	5.5	4.4			75
309	Schapville	Olmsted	1	6-12	90	--	60	3.6	2.4			27 (10P)
			1	12-25	--	--	--	3.0	2.2			8P
637	Schley	Mower	1	0-2	125	--	80	4.2	4.2			60
423	Seaforth	Redwood	1	1-3	135	46	80	4.4	3.8			65
103	Seaton	Winona	1	1-3	150	--	88	5.7	4.2			95
			1	3-6	145	--	84	5.2	4.0			90
			1	2-6	150	--	87	6.0	4.5			90
			1	6-12	130	--	76	5.8	4.2			80
			2	6-12	140	--	80	5.0	3.7			80
			2	12-20	--	--	75	4.4	3.4			65 (30P)
540	Seelyeville	Morrison	dr	0-2	--	--	50	3.0	6.2*			20
517	Shandep	Freeborn	1	0-2	110	--	70	3.8	3.5			48
323	Shields	Rice	1	0-2	102	--	60	3.7	3.7			55
72	Shooker	Beltrami	1	0-2	--	--	75	4.6	4.2	LH	H	40
286	Shorewood	Blue Earth	1	0-6	140	--	80	4.4	4.1			66
312	Shullsburg	Olmsted	1	1-6	110	--	65	4.0	3.8			55 (25P)
			1	6-12	--	--	60	3.8	3.6			48 (20P)
212	Sinai	Lyon	1	1-3	95	46	85	4.4	4.0			65
402	Sioux	Swift	1	0-2	57	30	50	2.8	2.2			27 (36I)
			1	2-6	51	26	45	2.3	1.8			24

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
23	Skyberg	Mower	1	0-2	120	--	70	4.0	4.0			60
765	Smiley	Pennington	1	0-2	--	50	85	4.4	4.0			55
267	Snellman	Beltrami	1	1-6	--	--	70	3.5	3.0	UH	H	50 (25P)
265	Soderville	Anoka	1	0-4	75	--	60	3.2	3.7			30 (39I)
11	Sogn	Houston	1	2-12	70	--	45	2.8	2.8			20P
199	Sol	Beltrami	1	1-6	--	25	45	3.0	2.5	UH	H	25
215	Southridge	Winona	1	2-6	130	--	86	5.3	2.9			80
8	Sparta	Washington	1	0-2	62	--	45	2.6	2.8			15
			1	2-6	57	--	40	2.4	2.6			13
140	Spicer	Faribault	1	0-2	146	--	85	4.4	4.8			70
663	Spillco	Rock	oc	0-2	132	--	74	3.7	3.7			70
313	Spillville	Faribault	oc	0-2	125	--	94	6.0	5.4			65
147	Spooner	Itasca	1	0-2	--	--	82	4.8	4.0	UH	H	40
31	Storden	Cottonwood	1	12-18	--	--	40	2.4	2.5			12P
			1	18-35	--	--	--	2.1	2.3			8P
432	Strandquist	Beltrami	1	0-2	--	39	60	3.2	5.7*			30
243	Stuntz	Itasca	1	0-2	--	--	73	4.0	4.0	UH	H	25P
462	Sunburg	Kandiyohi	1	18-25	--	--	--	2.4	2.6			20P
70	Svea	Swift	1	0-2	107	50	86	4.4	4.2			70
			1	2-4	97	46	82	4.2	4.0			65
127	Sverdrup	Chippewa	1	0-2	60	34	55	3.0	2.6			30 (39I)
			1	2-6	54	29	45	2.8	2.3			28
			1	6-12	48	25	40	1.6	2.0			24
595	Swanlake	Cottonwood	1	2-6	96	--	69	4.0	3.5			50 (20P)
			1	6-12	86	--	64	3.5	3.3			44 (15P)
293	Swenoda	Clay	1	2-8	88	40	80	3.4	3.2			58
435	Syrene	Norman	1	0-2	--	40	60	3.4	3.4			25 (10P)
514	Tacoosh	Todd	dr	0-2	67	--	--	--	3.2			10P
214	Talcot	Cottonwood	1	0-2	91	--	70	4.0	3.8			60
320	Tallula	Dakota	1	2-6	140	--	89	5.0	5.0			85
628	Talmoon	Itasca	1	0-2	--	--	--	--	4.0*	LH	M	10P
597	Tara	Chippewa	1	0-2	120	54	80	4.5	4.3			73
627	Tawas	Beltrami	dr	0-2	--	--	--	--	--	LC	M	NR
94	Terril	Blue Earth	1	0-2	142	--	98	5.6	4.8			93
			1	2-6	140	--	94	5.4	4.6			90
			1	6-15	135	--	88	5.0	4.2			80
651	Thief river	Pennington	1	0-2	--	42	73	3.9	6.2*			50
656	Thistledew	Itasca	1	0-6	--	--	53	3.3	3.2	UH	M	15P
322	Timula	Goodhue	1	2-6	132	--	83	4.8	4.5			70
			1	6-12	122	--	76	4.6	4.5			60
234	Tonka	Stevens	1	0-2	95	45	75	4.2	4.0			48
330	Towner	Grant	1	0-2	80	40	65	3.5	3.6			53
97	Trent	Rock	1	0-3	140	45	85	4.3	0.0			80
331	Tripoli	Mower	1	0-2	127	--	89	4.5	4.3			80
368	Trosky	Pipestone	1	0-2	100	44	82	4.3	3.8			67
101	Truman	Faribault	1	2-6	150	--	80	4.8	--			90
393	Udolpho	Mower	1	0-2	105	--	70	3.5	4.0			60
64	Ulen	Norman	1	0-2	--	45	78	3.3	3.5			45
335	Urness	Douglas	1	0-2	85	28	68	3.4	3.6			20P
236	Vallers	Stevens	1	0-2	85	40	78	4.2	4.0			58
333	Vasa	Goodhue	1	0-3	140	--	92	5.4	5.2			85
567	Verndale	Wadena	1	0-2	74	--	51	3.6	3.3			36 (43I)
			1	2-6	69	--	46	3.1	3.1			34
421	Ves	Yellow Medicine	1	1-4	105	45	82	4.4	3.4			65
297	Vienna	Pipestone	1	2-4	93	--	77	4.2	3.2			54
			1	4-6	90	--	74	4.0	3.0			52
403	Viking	Clay	1	0-2	--	50	82	3.9	4.0			53
334	Vlasaty	Mower	1	1-4	100	--	67	5.0	--			60
39	Wadena	Dakota	1	0-2	100	--	70	4.2	4.0			50 (55I)
			1	2-6	95	--	65	4.0	3.8			47

Table 9. (Continued) Representative soils, slope and erosion or drainage condition, estimated yields of principal crops and permanent pasture, woodland groups, and crop equivalent ratings (CER).

Map Symbol	Mapping Unit	Reference County	Erosion[1] Condition	Slope Percent	Corn	Wheat	Oats	Mixed Hay	Permanent[2,3] Pasture	Woodland[6] Group	Rating	CER[4,5]
					.....bu.....			T/A	AUM			
157	Wahpeton	Clay	1	0-2	--	52	87	4.7	4.0			66
			1	2-6	--	49	81	4.2	3.8			63
229	Waldorf	Jackson	1	0-2	140	--	90	4.8	5.0			70
240	Warba	Itasca	1	1-8	--	--	85	4.2	4.0	UH	H	30P
337	Warman	Morrison	dr	0-2	--	---	65	3.0	6.2*	LC	M	36
538	Waskish	Beltrami	dr	0-2	--	--	--	--	--	LC	L	NR
218	Watab	Morrison	1	0-2	80	--	55	3.3	3.2			35(42I)
338	Waubay	Chippewa	1	0-2	94	50	83	4.2	3.8			67
369	Waubeek	Olmsted	1	1-6	142	--	85	5.0	3.8			85
			1	6-12	134	--	76	4.6	3.5			73
491	Waucoma	Olmsted	1	2-6	130	--	82	5.0	4.0			75
483	Waukee	Olmsted	1	0-2	105	--	75	4.1	3.8			70
			1	2-6	100	--	70	3.9	3.6			67
411	Waukegan	Dakota	1	0-2	120	--	80	4.0	4.2			65
			1	2-6	110	--	75	3.8	4.0			62
38	Waukon	Mahnomen	1	2-6	110	42	85	4.0	4.1			68
			2	2-6	100	40	80	3.8	3.9			65
			1	6-12	95	38	75	3.8	3.8			58
			2	6-12	90	36	70	3.6	3.6			55
			1	12-18	--	34	65	3.4	3.4			52
629	Wawina	Itasca	1	0-10	--	--	63	3.8	3.5	UH	M	25P
113	Webster	Freeborn	1	0-2	150	--	90	4.9	--			85
340	Whalan	Olmsted	1	1-6	99	--	64	3.8	3.7			60
			1	6-12	92	--	58	3.6	3.4			50
343	Wheatville	Norman	1	0-2	--	50	85	4.0	4.5			70
490	Whitewood	Rock	1	0-2	128	--	86	4.0	3.7			65
630	Wildwood	Itasca	1	0-2	--	--	--	--	5.0*	LH	M	NR
345	Wilmonton	Cottonwood	1	0-2	116	--	85	4.8	4.0			70
107	Winger	Stevens	1	0-2	100	47	75	4.0	4.0			55
652	Wyandotte	Pennington	1	0-2	--	42	73	3.4	3.0			38
121	Wykeham	Beltrami	1	0-2	--	--	80	4.5	3.7			56
508	Wyndmere	Clay	1	0-2	--	47	86	3.5	4.5			60
158	Zimmerman	Anoka	1	0-2	76	--	52	2.8	3.3	UC	M	30(39I)
			1	2-6	72	--	46	2.6	3.0	UC	M	28
			1	6-12	64	--	40	2.3	2.7	UC	L	2
664	Zook	Martin	oc	0-2	118	--	74	3.5	4.0			38(20P)
495	Zumbro	Wabasha	1	0-2	77	--	46	3.2	3.0			45

Map number listed is the state-wide number assigned to the soil and which appears on all recently published soil survey maps. (Before 1979 an alphabetic legend was used.)

The reference is the presently considered 'geographic' center of the soil as it occurs in Minnesota. Future detailed surveys may result in the change of the geographic center.

[1] The erosion/condition noted is the estimated degree of erosion (—none or slight; 2—moderate) or condition of drainage assumed (dr—water table lowered for cultivated crop production) or degree of flooding (oc—occasional flooding occurs once or less in 2 years.)

[2] AUM-animal unit months.

[3] Permanent pasture yields are considered to be dominantly bluegrass except where asterisks (**) occur to indicate reed canary grass.

[4] Crop equivalent ratings are mostly derived for dominant cropland use of the soil. On some soils where dominant use is presently permanent pasture alternate rating for pasture (P) is given. On those soils on which irrigation is used an alternate rating (I) is given.

[5] NR—Not rated for cropland or pastureuse.

[6] For explanation of woodland groups and ratings. See Table 6.

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Appendix A

Status of Soil Surveys and Available Reports in Minnesota - 1991
Soil Survey publications are available for the following counties in Minnesota. Those out of print may be found in libraries. Copies of those county reports available may be obtained in the following ways:
1. Request from the local county office of the Soil Conservation Service
2. Request from the local county office of the Minnesota Extension Service

County	Availability	Date published or estimated publication year
Aitkin	Survey in progress	1993
Anoka	Available	1977
Becker	Survey in progress	1993
Beltrami	Field mapping completed—to be published	1992
Benton	Available	1977
Big Stone	To be published	1992
Blue Earth	Available	1979
Brown	Field mapping completed—to be published	1988
Carlton	Available	1978
Carver	Available	1968
Cass	Field mapping completed—to be published	1993
Chippewa	Available	1982
Chisago	Field work completed—to be published	1993
Clay	Available	1982
Clearwater	Survey in progress	1994
Cook	No survey scheduled	—
Cottonwood	Available	1979
Crow Wing	Available	1965
Dakota	Available	1983
Dodge	Available	1961
Douglas	Available	1974
Faribault	Field mapping completed—to be published	1992
Fillmore	Available	1958
Freeborn	Available	1980
Goodhue	Available	1976
Grant	Available	1978
Hennepin	Available	1974
Houston	Available	1984
Hubbard	Survey in progress	1996
Isanti	Available	1958
Itasca	Available	1987
Jackson	Available	1988
Kanabec	Out of print. No survey scheduled	—
Kandiyohi	Available	1987
Kawishiwi Area	Available	1978
Kittson	Available	1979
Koochiching	Survey in progress	—
Lac Qui Parle	Survey in progress	1995
Lake	No survey scheduled	—
Lake of the Woods	Field mapping completed—to be published	1992
LeSueur	Available	1989
Lincoln	Available	1970
Lyon	Available	1979
Mahnomen	Field work completed—to be published	1994
Martin	Available	1989
Marshall	Survey in progress	1993
McLeod	Survey in progress	1995
Mecker	Survey in progress	1994
Mille Lacs	Out of print . No survey scheduled	—
Morrison	Field work completed—to be published	1992
Mower	Available	1990
Murray	Available	1990
Nicollet	Field mapping completed—to be published	1992
Nobles	Available	1976

County	Availability	Date published or estimated publication year
Norman	Available	1974
Olmsted	Available	1980
Ottertail	Survey in proress	1996
Pennington	Available	1984
Pine	Out of print. No survey scheduled	—
Pipestone	Available	1976
Polk	Survey in progress	1995
Pope	Available	1972
Ramsey	Available	1980
Red Lake	No survey scheduled	—
Redwood	Available	1985
Renville	Survey in progress	1995
Rice	Available	1975
Rock	Available	1988
Roseau	Survey in progress	1995
Scott	Available	1951
Sherburne	Available	1968
Sibley	Field mapping completed—to be published	1994
St. Louis	Survey in progress	1996
Stearns	Available	1985
Steele	Available	1973
Stevens	Available	1971
Swift	Available	1973
Todd	Available	1990
Traverse	Available	1990
Wabasha	Available	1965
Wadena	Available	1991
Waseca	Available	1965
Washington	Available	1980
Watonwan	Field mapping completed—to be published	1992
Wilkin	Available	1989
Winona	Field mapping completed—to be published	1992
Wright	Available	1968
Yellow Medicine	Available	1981

APPENDIX B

Calculation of net return per acre on representative soils

CER CALCULATIONS **130 - Nicollet**

STATE-WIDE

1. REFERENCE DATA

Reference County	Slope Erosion	Slope Percent	Soil Texture	Acreage	Cost Area
Martin	1	0-2	clay loam	340,344	4

2. CROP YIELDS

Corn	Soybeans	Oats	Mixed Hay
(bu/ac)	(bu/ac)	(bu/ac)	(ton/ac)
155	52	92	6.0

3. CROP/LAND USE- PERCENT

Corn	Soybeans	Oats	Mixed Hay
44	46	5	5

4. GROSS RETURN PER CROP ([2] x [3] x PRICE) ($)

Corn	Soybeans	Oats	Mixed Hay
134.35	146.87	8.79	23.38

5. TOTAL GROSS RETURN

$313.39

6. CROP COSTS ($)

Corn	Soybeans	Oats	Mixed Hay
173.05	82.86	58.17	64.54

7. YIELD x STORAGE COST[1] ($)

Corn	Soybeans	Oats	Mixed Hay
23.25	23.92	11.96	24.42

8. TOTAL COSTS ([6] + [7]) ($)

Corn	Soybeans	Oats	Mixed Hay
196.30	106.78	70.13	88.96

No drainage cost calculated

9. CROP/LAND USE x TOTAL COST ([8] x [3]) ($)

Corn	Soybeans	Oats	Mixed Hay
86.37	49.12	3.51	4.45

10. NET RETURN PER CROP ([4] - [9]) ($)

Corn	Soybeans	Oats	Mixed Hay
47.98	97.75	5.28	18.93

11. TOTAL NET RETURN
$169.94

[1] *Storage costs as listed in appendix C*

CER CALCULATIONS 93 - Bearden

STATE-WIDE

1. REFERENCE DATA

Reference County	Erosion	Slope Percent	Soil Texture	State Acreage	Cost Area
Norman	1	0-2	silty clay loam	189,252	12

2. CROP YIELDS

Soybeans	Wheat	Oats	Barley	Mixed Hay
(bu/ac)	(bu/ac)	(bu/ac)	(ton/ac)	(ton/acre)
36	56	87	62	4.8

3. CROP/LAND USE - PERCENT

Soybeans	Wheat	Oats	Barley	Mixed Hay
35	34	10	11	5

4. GROSS RETURN PER CROP ([2] x [3] x PRICE) ($)

Soybeans	Wheat	Oats	Barley	Mixed Hay
77.36	60.17	16.62	14.66	18.71

5. TOTAL GROSS RETURN
$187.52

6. CROP COSTS ($)

Soybeans	Wheat	Oats	Barley	Mixed Hay
(bu)	(bu)	(bu)	(bu)	(ton)
72.24	75.34	60.16	73.05	45.43

7. YIELD x STORAGE COST[1] ($)

Soybeans	Wheat	Oats	Barley	Mixed Hay
16.56	12.32	11.31	9.30	19.54

8. TOTAL COSTS ([6] + [7]) ($)

Soybeans	Wheat	Oats	Barley	Mixed Hay
88.80	87.66	71.47	82.35	64.97

No drainage cost calculated

9. CROP/LAND USE x TOTAL COST ([8] x [3]) ($)

Soybeans	**Wheat**	**Oats**	**Barley**	**Mixed Hay**
31.08	29.80	7.15	9.06	3.25

10. NET RETURN PER CROP ([4] - [9]) ($)

Soybeans	**Wheat**	**Oats**	**Barley**	**Mixed Hay**
46.28	30.37	9.47	5.60	15.46

11. TOTAL NET RETURN
$107.18

[1] Storage costs as listed in appendix C.

CER CALCULATIONS 623 - Pierz

STATE-WIDE

1. REFERENCE DATA

Reference County	Erosion	Slope Percent	Soil Texture	State Acreage	Cost Area
Morrison	1	0-2	sandy loam	12,360	7

2. CROP YIELDS

Corn	Corn Silage	Oats	Mixed Hay	Pasture
(bu/ac)	(ton/ac)	(bu/ac)	(ton/ac)	(AUM)
80	12	75	3.5	3.0

3. CROP/LAND USE - PERCENT

Corn	Corn Silage	Oats	Mixed Hay	Pasture
41	19	10	10	10

4. GROSS RETURN PER CROP ([2] x [3] x PRICE) ($)

Corn	Corn Silage	Oats	Mixed Hay	Pasture
64.62	31.53	14.33	27.28	4.68

5. TOTAL GROSS RETURN
$142.44

6. CROP COSTS

Corn	Corn Silage	Oats	Mixed Hay	Pasture
126.94	102.89	50.50	47.68	19.03

7. YIELD x STORAGE COST[1] ($)

Corn	Corn Silage	Oats	Mixed Hay	Pasture
12.00		9.75	14.25	

8. TOTAL COSTS ([6] + [7]) ($)

Corn	Corn Silage	Oats	Mixed Hay	Pasture
138.94	102.89	60.25	61.93	19.03

No drainage cost calculated

9. CROP/LAND USE x TOTAL COST ([8] x [3]) ($)

Corn	Corn Silage	Oats	Mixed Hay	Pasture
56.97	19.55	6.03	1.93	19.03

10. NET RETURN PER CROP ([4] - [9]) ($)

Corn	Corn Silage	Oats	Mixed Hay	Pasture
7.65	11.98	8.30	21.09	2.78

11. TOTAL NET RETURN
$51.80

[1] Storage costs as listed in appendix C.

STATE-WIDE

1. REFERENCE DATA

Reference County	Erosion	Slope Percent	Soil Texture	State Acreage	Cost Area
Douglas	1	0-2	sandy loam	66,469	6

2. CROP YIELDS

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
(bu/ac)	(bu/ac)	(bu/ac)	(bu/ac)	(ton/ac)	(AUM/ac)
65	29	30	54	3.3	2.6

3. CROP/LAND USE - PERCENT

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
22	13	10	20	20	5

4. GROSS RETURN PER CROP ([2] x [3] x PRICE) ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
28.17	23.15	9.48	20.63	51.44	2.03

5. TOTAL GROSS RETURN
$134.90

6. CROP COSTS ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
135.91	74.85	52.29	54.49	65.59	25.89

7. YIELD x STORAGE COST[1] ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
9.75	13.34	6.60	7.02	13.43	

8. TOTAL COSTS ([6] + [7]) ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
145.66	88.19	58.89	61.51	79.02	25.89

No drainage cost calculated

9. CROP/LAND USE x TOTAL COST ([8] x [3]) ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
32.05	11.46	5.89	12.30	15.80	1.29

10. NET RETURN PER CROP ([4] - [9]) ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
-3.88	11.69	3.59	8.33	35.64	0.74

11. TOTAL NET RETURN
$56.11

[1] Storage costs as listed in appendix C.

STATE-WIDE

1. REFERENCE DATA

Reference County	Erosion	Slope Percent	Soil Texture	State Acreage	Cost Area
Douglas	1	0-2	sandy loam	66,469	6

2. CROP YIELDS

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
(bu/ac)	(bu/ac)	(bu/ac)	(bu/ac)	(ton/ac)	(AUM/ac)
135 {I}	33 {I}	30	54	4.6 {I}	2.6

3. CROP/LAND USE - PERCENT

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
65	5	5	5	5	5

4. GROSS RETURN PER CROP ([2] x [3] x PRICE) ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
172.87	10.13	4.74	5.16	17.93	2.03

5. TOTAL GROSS RETURN
$212.86

6. CROP COSTS ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
167.16 {I}	98.06 {I}	52.29	54.49	102.98 {I}	v25.89

7. YIELD x STORAGE COST[1] ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
20.25	15.18	6.60	7.02	18.72	

8. TOTAL COSTS ([6] + [7]) ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
187.41 {I}	113.24 {I}	58.89	61.51	121.70 {I}	25.89

No drainage cost calculated

9. CROP/LAND USE x TOTAL COST ([8] x [3]) ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
121.82	5.66	2.94	3.08	6.09	1.29

10. NET RETURN PER CROP ([4] - [9]) ($)

Corn	Soybeans	Wheat	Oats	Mixed Hay	Pasture
51.05 {I}	4.47 {I}	1.80	2.08	11.84 {I}	0.74

11. TOTAL NET RETURN
$71.98

[1] Storage costs as listed in appendix C.

Appendix C

Crop storage costs used in calculations of net returns based on estimated 6 months storage (1987-89)

Crop	Unit	1987	1988	1989	AVERAGE
Corn	bu	$ 0.12	$ 0.17	$ 0.10	$ 0.15
Soybeans	bu	0.37	0.53	0.48	0.46
Wheat	bu	0.17	0.22	0.27	0.22
Oats	bu	0.10	0.16	0.14	0.13
Barley	bu	0.11	0.16	0.19	0.15
Alfalfa	ton	3.84	5.22	6.25	5.11
Mixed Hay	ton	3.60	3.92	4.69	4.07

Source: *Ag. Outlook 1988.* Cooperative Extension Service (Minnesota, North Dakota, South Dakota). In *The Farmer/ The Dakota Farmer.*

Appendix D

Numerical listing of soils included in **Tables 7, 8**, and **9**. The numbers correspond to the current statewide assignment for soil survey mapping units. A complete soil survey legend of Minnesota may be obtained from the State Conservationist, Soil Conservation Service.

2 Ostrander
4 Renova
5 Dakota
6 Aastad
7 Hubbard
8 Sparta
9 Dodgeville
10 Dubuque
11 Sogn
12 Emmert
13 Adolph
15 Judson
16 Arenzville
18 Comfrey
19 Chaseburg
21 Ahmeek
22 Allendale
23 Skyberg
24 Kasson
25 Becker
26 Aazdahl
27 Dickinson
29 Alvin
30 Kenyon
31 Storden
33 Barnes
34 Parnell
35 Blue Earth
36 Flom
38 Waukon
39 Wadena
40 Nebish
41 Estherville
42 Salida
43 Automba
45 Maddock
46 Borup
47 Colvin
48 Hiwood
49 Antigo
50 Cashel
51 LaPrairie
52 Augsburg
53 Kandota
54 Ihlen
57 Fargo
58 Kittson
59 Grimstad
60 Glyndon
62 Barrington
64 Ulen
65 Foxhome
66 Flaming
69 Fedji
70 Svea
71 Fossum
72 Shooker
73 Bellechester
74 Beotia
75 Bluffton
76 Bertrand
77 Garnes
78 Burnsville
79 Billet
81 Boone
82 Redeye
84 Brownton
85 Calco
86 Canisteo
88 Clyde
90 Moody
91 Kranzburg
92 Flandreau
93 Bearden
94 Terril
96 Collinwood
97 Trent
98 Colo
99 Racine
100 Copaston
101 Truman
102 Clarion
103 Seaton
104 Hayden
105 Kamrar
106 Lester
107 Winger
108 McIntosh
109 Cordova
110 Marna
111 Hangaard
112 Harps
113 Webster
114 Glencoe
116 Redby
117 Cormant
118 Crippin
119 Pomroy
121 Wykeham
123 Dundas
124 Brickton
125 Beltrami
127 Sverdrup
128 Grogan
129 Cylinder
130 Nicollet
131 Massbach
133 Dalbo
134 Okoboji
136 Madelia
137 Dovray
138 Lerdal
139 Huntersville
140 Spicer
141 Egeland
142 Nokay
143 Eleva
144 Flak
145 Enstrom
147 Spooner
148 Poppleton
149 Everly
151 Burkhardt
152 Milaca
153 Santiago
155 Chetek
156 Fairhaven
157 Wahpeton
158 Zimmerman
159 Anoka
160 Fieldon
161 Isanti
162 Lino
163 Brainerd
164 Mora
165 Parent
166 Ronneby
167 Baudette
168 Forman
169 Braham
170 Blomford
171 Formdale
172 Indus
173 Frontenac
174 Gale
175 Galva
176 Garwin
177 Gotham
178 Granby
179 Langola
180 Gonvick
181 Litchfield
183 Dassel
184 Hamerly
185 Hattie
186 Nemadji
187 Haug
188 Omega
189 Auburndale
190 Hayfield
191 Epoufette
192 Estelline
194 Huntsville
197 Kingston
198 Rollingstone
199 Sol
200 Holdingford
202 Meehan
203 Joy
204 Cushing
205 Karlstad
206 Kasota
207 Nymore
208 Kato
209 Kegonsa
210 Fulda
211 Lura
212 Sinai
213 Klinger
214 Talcot
215 Southridge
216 Lamont
217 Nokasippi
218 Watab
219 Rolfe
220 Langhei
222 Lasa
224 Nowen
226 Lawson
227 Lemond
229 Waldorf
230 Guckeen
232 Heyder
233 Growton
234 Tonka
235 Nessel
236 Vallers
237 Erin
238 Kilkenny
239 LeSueur
240 Warba
241 Letri
242 Marquette
243 Stuntz
244 Lilah
245 Lohnes
246 Marysland
247 Linder
248 Lomax
249 Marcus
250 Kennebec
251 Marlean
252 Marshan
253 Maxcreek
254 Hibbing
255 Mayer
256 Mazaska
257 McPaul
259 Grays
260 Duelm
261 Isan
264 Freeon
265 Soderville
266 Freer
267 Snellman
268 Cromwell
269 Millington
274 Newson
275 Ocheyedan
276 Oldham
277 Onamia
279 Otterholt
280 Pelan
281 Darfur
282 Hanska
283 Plainfield
284 Poinsett
285 Port Byron
286 Shorewood
287 Minnetonka
289 Radford
290 Rothsay
291 Ransom
292 Alstad
293 Swenoda
294 Rasset
295 Readlyn
296 Fram
297 Vienna
298 Richwood
299 Rockton
301 Lindstrom

Appendix D *(Continued)*

302	Rosholt
303	Ontonagon
304	Rushmore
305	Bergland
306	Sac
307	Sargeant
309	Schapville
310	Beauford
312	Shullsburg
313	Spillville
316	Baroda
317	Oshawa
319	Barbert
320	Tallula
322	Timula
323	Shields
325	Prebish
327	Dickman
328	Sartell
329	Chaska
330	Towner
331	Tripoli
333	Vasa
334	Vlasaty
335	Urness
336	Delft
337	Warman
338	Waubay
339	Fordville
340	Whalan
341	Arvilla
342	Kingsley
343	Wheatville
344	Quam
345	Wilmonton
347	Malachy
355	Cloquet
363	Minneopa
366	Hecla
367	Campia
368	Trosky
369	Waubeek
371	Clontarf
372	Hamar
373	Renshaw
374	Rockwood
375	Forada
376	Moland
377	Merton
378	Maxfield
380	Havana
381	Newry
382	Blooming
392	Biscay
393	Udolpho
397	Primghar
401	Mt. Carroll
402	Sioux
403	Viking
404	Chilgren
405	Bixby
406	Dorset
409	Etter
410	Athelwold
411	Waukegan
412	Mavie
413	Osakis
414	Hamel
415	Kanaranzi
416	Brookings
418	Lamoure
421	Ves
423	Seaforth
425	Donaldson
426	Foldahl
429	Northcote
430	Noyes
432	Strandquist
434	Perella
435	Syrene
436	Hidewood
437	Buse
439	Rockwell
446	Normania
449	Crystal Lake
450	Rauville
452	Comstock
453	DeMontreville
454	Mahtomedi
455	Festina
456	Barronett
458	Menahga
459	Corunna
460	Baytown
461	Koronis
462	Sunburg
463	Minneiska
466	Ogilvie
467	Sawmill
470	Lismore
471	Root
472	Channahon
473	Dorerton
476	Frankville
477	Littleton
478	Coggon
479	Floyd
481	Kratka
482	Grygla
483	Waukee
484	Eyota
485	Lawler
487	Hoopeston
489	Atkinson
490	Whitewood
491	Waucoma
492	Nasset
493	Oronoco
494	Darnen
495	Zumbro
496	Andrusia
497	Hantho
501	Newglarus
502	Dusler
503	Balmlake
504	Duluth
505	Debs
506	Overly
507	Poskin
508	Wyndmere
510	Elmville
511	Marcellon
514	Tacoosh
515	Newfound
516	Dowagiac
517	Shandep
518	Kalmarville
522	Boots
523	Houghton
524	Caron
525	Muskego
529	Ripon
531	Beseman
533	Loxley
534	Mooselake
535	Merwin
536	Dawson
537	Lobo
538	Waskish
539	Klossner (Palms)
540	Seelyeville
541	Rifle
543	Markey
544	Cathro
545	Rondeau
546	Lupton
547	Deerwood
549	Greenwood
550	Dora
551	Millerville
555	Barto
556	Insula
557	Conic
558	Mesaba
559	Lena
561	Bullwinkle
562	Knoke
563	Northwood
565	Eckvoll
566	Regal
567	Verndale
571	Coriff
572	Lowlein
574	Du Page
575	Nishna
576	Newalbin
581	Percy
582	Roliss
583	Nereson
587	Palsgrove
591	Doland
593	Elbaville
594	Jeffers
595	Swanlake
597	Tara
601	Council
607	Pengilly
608	Rawles
611	Hawick
613	Grovecity
615	Cowhorn
616	Effie
617	Goodland
618	Itasca
619	Keewatin
620	Cutaway
621	Morph
622	Nashwauk
623	Pierz
624	Rosy
625	Sandwick
627	Tawas
628	Talmoon
629	Wawina
630	Wildwood
631	Oran
637	Schley
639	Ridgeport
641	Clearwater
644	Boash
645	Espelie
647	Hilaire
650	Reiner
651	Thiefriver
652	Wyandotte
654	Revere
655	Bearville
656	Thistledew
659	Graceville
661	Nora
663	Spillco
664	Zook
698	Doran
703	Paddock
709	Lengby
712	Rosewood
713	Linveldt
720	Blowers
765	Smiley
1821	Algansee
1830	Eitzen
1833	Coland
1835	Germantown
1877	Fostoria
1878	Hamre
1888	Moundprairie
1895	Carmi
1902	Jewett
1905	Brownsdale
1907	Lakefield
1916	Lindaas
1918	Croke
1932	Runeberg
1943	Roscommon
1959	Nary
1975	Oylen
1984	Leafriver
8027	Hegne

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