

# LAND-CAPABILITY CLASSIFICATION

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The standard soil-survey map shows the different kinds of soil that are significant and their location in relation to other features of the landscape. These maps are intended to meet the needs of users with widely different problems and, therefore, contain considerable detail to show important basic soil differences.

The information on the soil map must be explained in a way that has meaning to the user. These explanations are called interpretations. Soil maps can be interpreted by (1) the individual kinds of soil on the map, and (2) the grouping of soils that behave similarly in responses to management and treatment. Because there are many kinds of soil, there are many individual soil interpretations. Such interpretations, however, provide the user with all the information that can be obtained from a soil map. Many users of soil maps want more general information than that of the individual soil-mapping unit. Soils are grouped in different ways according to the specific needs of the map user. The kinds of soil grouped and the variation permitted within each group differ according to the use to be made of the grouping.

The capability classification is one of a number of interpretive groupings made primarily for agricultural purposes. As with all interpretive groupings the capability classification begins with the individual soil-mapping units, which are building stones of the system (table 1). In this classification the arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops that do not require specialized site conditioning or site treatment. Nonarable soils (soils unsuitable for longtime sustained use for cultivated crops) are grouped according to their potentialities and limitations for the production of permanent vegetation and according to their risks of soil damage if mismanaged.

The individual mapping units on soil maps show the location and extent of the different kinds of soil. One can make the greatest number of precise statements and predictions about the use and management of the individual mapping units shown on the soil map. The capability grouping of soils is designed (1) to help landowners and others use and interpret the soil maps, (2) to introduce users to the detail of the soil map itself, and (3) to make possible broad generalizations based on soil potentialities, limitations in use, and management problems.

The capability classification provides three major categories of soil groupings: (1) Capability unit, (2) capability subclass, and (3) capability class.

TABLE 1.—Relationship of soil-mapping unit to capability classification

Soil-mapping unit	Capability unit	Capability subclass	Capability class
<p>A soil mapping unit is a portion of the landscape that has similar characteristics and qualities and whose limits are fixed by precise definitions. Within the cartographic limitations and considering the purpose for which the map is made, the soil mapping unit is the unit about which the greatest number of precise statements and predictions can be made.</p> <p>The soil mapping units provide the most detailed soils information. The basic mapping units are the basis for all interpretive groupings of soils. They furnish the information needed for developing capability units, forest site groupings, crop suitability groupings, range site groupings, engineering groupings, and other interpretive groupings. The most specific management practices and estimated yields are related to the individual mapping unit.</p>	<p>A capability unit is a grouping of one or more individual soil mapping units having similar potentials and continuing limitations or hazards. The soils in a capability unit are sufficiently uniform to (a) produce similar kinds of cultivated crops and pasture plants with similar management practices, (b) require similar conservation treatment and management under the same kind and condition of vegetative cover, (c) have comparable potential productivity.</p> <p>The capability unit condenses and simplifies soils information for planning individual tracts of land, field by field. Capability units with the class and subclass furnish information about the degree of limitation, kind of conservation problems and the management practices needed.</p>	<p>Subclasses are groups of capability units which have the same major conservation problem, such as—</p> <ul style="list-style-type: none"> <li>e—Erosion and runoff.</li> <li>w—Excess water.</li> <li>s—Root-zone limitations.</li> <li>c—Climatic limitations.</li> </ul> <p>The capability subclass provides information as to the kind of conservation problem or limitations involved. The class and subclass together provide the map user information about both the degree of limitation and kind of problem involved for broad program planning, conservation need studies, and similar purposes.</p>	<p>Capability classes are groups of capability subclasses or capability units that have the same relative degree of hazard or limitation. The risks of soil damage or limitation in use become progressively greater from class I to class VIII.</p> <p>The capability classes are useful as a means of introducing the map user to the more detailed information on the soil map. The classes show the location, amount, and general suitability of the soils for agricultural use. Only information concerning general agricultural limitations in soil use are obtained at the capability class level.</p>

The first category, capability unit, is a grouping of soils that have about the same responses to systems of management of common cultivated crops and pasture plants. Soils in any one capability unit are adapted to the same kinds of common cultivated and pasture plants and require similar alternative systems of management for these crops. Longtime estimated yields of adapted crops for individual soils within the unit under comparable management do not vary more than about 25 percent.<sup>1</sup>

The second category, the subclass, is a grouping of capability units having similar kinds of limitations and hazards. Four general kinds of limitations or hazards are recognized: (1) Erosion hazard, (2) wetness, (3) rooting-zone limitations, and (4) climate.

The third and broadest category in the capability classification places all the soils in eight capability classes. The risks of soil damage or limitations in use become progressively greater from class I to class VIII. Soils in the first four classes under good management are capable of producing adapted plants, such as forest trees or range plants, and the common cultivated field crops<sup>2</sup> and pasture plants. Soils in classes V, VI, and VII are suited to the use of adapted native plants. Some soils in classes V and VI are also capable of producing specialized crops, such as certain fruits and ornamentals, and even field and vegetable crops under highly intensive management involving elaborate practices for soil and water conservation.<sup>3</sup> Soils in class VIII do not return on-site benefits for inputs of management for crops, grasses, or trees without major reclamation.

The grouping of soils into capability units, subclasses, and classes is done primarily on the basis of their capability to produce common cultivated crops and pasture plants without deterioration over a long period of time. To express suitability of the soils for range and woodland use, the soil-mapping units are grouped into range sites and woodland-suitability groups.

## ASSUMPTIONS

In assigning soils to the various capability groupings a number of assumptions are made. Some understanding of these assumptions is necessary if

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<sup>1</sup> Yields are significant at the capability-unit level and are one of the criteria used in establishing capability units within a capability class. Normally, yields are estimated under the common management that maintains the soil resource. The main periods for such yield estimates are 10 or more years in humid areas or under irrigation and 20 or more years in subhumid or semiarid areas. The 25 percent allowable range is for economically feasible yields of adapted cultivated and pasture crops.

<sup>2</sup> As used here the common crops include: Corn, cotton, tobacco, wheat, tame hay and pasture, oats, barley, grain sorghum, sugarcane, sugar beets, peanuts, soybeans, field-grown vegetables, potatoes, sweet potatoes, field peas and beans, flax, and most clean-cultivated fruit, nut, and ornamental plants. They do not include: Rice, cranberries, blueberries, and those fruit, nut, and ornamental plants that require little or no cultivation.

<sup>3</sup> Soil and water conservation practices is a general expression for all practices including but not limited to those for erosion control.

the soils are to be grouped consistently in the capability classification and if the groupings are to be used properly. They are:

1. A taxonomic (or natural) soil classification is based directly on soil characteristics. The capability classification (unit, subclass, and class) is an interpretive classification based on the effects of combinations of climate and permanent soil characteristics on risks of soil damage, limitations in use, productive capacity, and soil management requirements. Slope, soil texture, soil depth, effects of past erosion, permeability, water-holding capacity, type of clay minerals, and the many other similar features are considered permanent soil qualities and characteristics. Shrubs, trees, or stumps are not considered permanent characteristics.
2. The soils within a capability class are similar only with respect to degree of limitations in soil use for agricultural purposes or hazard to the soil when it is so used. Each class includes many different kinds of soil, and many of the soils within any one class require unlike management and treatment. Valid generalizations about suitable kinds of crops or other management needs cannot be made at the class level.
3. A favorable ratio of output to input <sup>4</sup> is one of several criteria used for placing any soil in a class suitable for cultivated crop, grazing, or woodland use, but no further relation is assumed or implied between classes and output-input ratios. The capability classification is not a productivity rating for specific crops. Yield estimates are developed for specific kinds of soils and are included in soil handbooks and soil-survey reports.
4. A moderately high level of management is assumed—one that is practical and within the ability of a majority of the farmers and ranchers. The level of management is that commonly used by the “reasonable” men of the community. The capability classification is not, however, a grouping of soils according to the most profitable use to be made of the land. For example, many soils in class III or IV, defined as suitable for several uses including cultivation, may be more profitably used for grasses or trees than for cultivated crops.
5. Capability classes I through IV are distinguished from each other by a summation of the degree of limitations or risks of soil damage that affect their management requirements for longtime sustained use for cultivated crops. Nevertheless, differences in kinds of management or yields of perennial vegetation may be greater between some pairs of soils within one class than between some pairs of soils from different classes. The capability class is not determined by the kind of practices recommended. For example, class II, III, or IV may or may not require the same kind of practices when used for cultivated crops, and classes I through VII may or may not require the same kind of pasture, range, or woodland practices.

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<sup>4</sup> Based on longtime economic trends for average farms and farmers using moderately high level management. May not apply to specific farms and farmers but will apply to broad areas.

6. Presence of water on the surface or excess water in the soil; lack of water for adequate crop production; presence of stones; presence of soluble salts or exchangeable sodium, or both; or hazard of overflow are not considered permanent limitations to use where the removal of these limitations is feasible.<sup>5</sup>
7. Soils considered feasible for improvement by draining, by irrigating, by removing stones, by removing salts or exchangeable sodium, or by protecting from overflow are classified according to their continuing limitations in use, or the risks of soil damage, or both, after the improvements have been installed. Differences in initial costs of the systems installed on individual tracts of land do not influence the classification. The fact that certain wet soils are in classes II, III, and IV does not imply that they should be drained. But it does indicate the degree of their continuing limitation in use or risk of soil damage, or both, if adequately drained. Where it is considered not feasible to improve soils by drainage, irrigation, stone removal, removal of excess salts or exchangeable sodium, or both, or to protect them from overflow, they are classified according to present limitations in use.
8. Soils already drained or irrigated are grouped according to the continuing soil and climatic limitations and risks that affect their use under the present systems or feasible improvements in them.
9. The capability classification of the soils in an area may be changed when major reclamation projects are installed that permanently change the limitations in use or reduce the hazards or risks of soil or crop damage for long periods of time. Examples include establishing major drainage facilities, building levees or flood-retarding structures, providing water for irrigation, removing stones, or large-scale grading of gullied land. (Minor dams, terraces, or field conservation measures subject to change in their effectiveness in a short time are not included.)
10. Capability groupings are subject to change as new information about the behavior and responses of the soils becomes available.
11. Distance to market, kinds of roads, size and shape of the soil areas, locations within fields, skill or resources of individual operators, and other characteristics of land-ownership patterns are not criteria for capability groupings.
12. Soils with such physical limitations that common field crops can be cultivated and harvested only by hand are not placed in classes I, II, III, and IV. Some of these soils need drainage or stone removal, or both, before some kinds of machinery can be used. This does not imply that mechanical equipment cannot be used on some soils in capability classes V, VI, and VII.
13. Soils suited to cultivation are also suited to other uses such as pasture, range, forest, and wildlife. Some not suited to cultivation are suited to pasture, range, forest, or wildlife; others are suited only to pasture or

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<sup>5</sup> Feasible as used in this context means (1) that the characteristics and qualities of the soil are such that it is possible to remove the limitation, and (2) that over broad areas it is within the realm of present-day economic possibility to remove the limitation.

- range and wildlife; others only to forest and wildlife; and a few suited only to wildlife, recreation, and water-yielding uses. Groupings of soils for pasture, range, wildlife, or woodland may include soils from more than one capability class. Thus, to interpret soils for these uses, a grouping different from the capability classification is often necessary.
14. Research data, recorded observations, and experience are used as the bases for placing soils in capability units, subclasses, and classes. In areas where data on response of soils to management are lacking, soils are placed in capability groups by interpretation of soil characteristics and qualities in accord with the general principles about use and management developed for similar soils elsewhere.

## CAPABILITY CLASSES

### Land Suited to Cultivation and Other Uses

#### **Class I—Soils in class I have few limitations that restrict their use.**

Soils in this class are suited to a wide range of plants and may be used safely for cultivated crops, pasture, range, woodland, and wildlife. The soils are nearly level<sup>6</sup> and erosion hazard (wind or water) is low. They are deep, generally well drained, and easily worked. They hold water well and are either fairly well supplied with plant nutrients or highly responsive to inputs of fertilizer.

The soils in class I are not subject to damaging overflow. They are productive and suited to intensive cropping. The local climate must be favorable for growing many of the common field crops.

In irrigated areas, soils may be placed in class I if the limitation of the arid climate has been removed by relatively permanent irrigation works. Such irrigated soils (or soils potentially useful under irrigation) are nearly level, have deep rooting zones, have favorable permeability and water-holding capacity, and are easily maintained in good tilth. Some of the soils may require initial conditioning including leveling to the desired grade, leaching of a slight accumulation of soluble salts, or lowering of the seasonal water table. Where limitations due to salts, water table, overflow, or erosion are likely to recur, the soils are regarded as subject to permanent natural limitations and are not included in class I.

Soils that are wet and have slowly permeable subsoils are not placed in class I. Some kinds of soil in class I may be drained as an improvement measure for increased production and ease of operation.

Soils in class I that are used for crops need ordinary management practices to maintain productivity—both soil fertility and soil structure. Such practices may include the use of one or more of the following: Fertilizers and lime, cover and green-manure crops, conservation of crop residues and animal manures, and sequences of adapted crops.

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<sup>6</sup> Some rapidly permeable soils in class I may have gentle slopes.

**Class II—Soils in class II have some limitations that reduce the choice of plants or require moderate conservation practices.**

Soils in class II require careful soil management, including conservation practices, to prevent deterioration or to improve air and water relations when the soils are cultivated. The limitations are few and the practices are easy to apply. The soils may be used for cultivated crops, pasture, range, woodland, or wildlife food and cover.

Limitations of soils in class II may include singly or in combination the effects of (1) gentle slopes, (2) moderate susceptibility to wind or water erosion or moderate adverse effects of past erosion, (3) less than ideal soil depth, (4) somewhat unfavorable soil structure and workability, (5) slight to moderate salinity or sodium easily corrected but likely to recur, (6) occasional damaging overflow, (7) wetness correctable by drainage but existing permanently as a moderate limitation, and (8) slight climatic limitations on soil use and management.

The soils in this class provide the farm operator less latitude in the choice of either crops or management practices than soils in class I. They may also require special soil-conserving cropping systems, soil conservation practices, water-control devices, or tillage methods when used for cultivated crops. For example, deep soils of this class with gentle slopes subject to moderate erosion when cultivated may need one of the following practices or some combination of two or more: Terracing, stripcropping, contour tillage, crop rotations that include grasses and legumes, vegetated water-disposal areas, cover or green-manure crops, stubble mulching, fertilizers, manure, and lime. The exact combinations of practices vary from place to place, depending on the characteristics of the soil, the local climate, and the farming system.

**Class III—Soils in class III have severe limitations that reduce the choice of plants or require special conservation practices, or both.**

Soils in class III have more restrictions than those in class II and when used for cultivated crops the conservation practices are usually more difficult to apply and to maintain. They may be used for cultivated crops, pasture, woodland, range, or wildlife food and cover.

Limitations of soils in class III restrict the amount of clean cultivation; timing of planting, tillage, and harvesting; choice of crops; or some combination of these limitations. The limitations may result from the effects of one or more of the following: (1) Moderately steep slopes; (2) high susceptibility to water or wind erosion or severe adverse effects of past erosion; (3) frequent overflow accompanied by some crop damage; (4) very slow permeability of the subsoil; (5) wetness or some continuing waterlogging after drainage; (6) shallow depths to bedrock, hardpan, fragipan, or claypan that limit the rooting zone and the water storage; (7) low moisture-holding capacity; (8) low fertility not easily corrected; (9) moderate salinity or sodium; or (10) moderate climatic limitations.

When cultivated, many of the wet, slowly permeable but nearly level

soils in class III require drainage and a cropping system that maintains or improves the structure and tilth of the soil. To prevent puddling and to improve permeability it is commonly necessary to supply organic material to such soils and to avoid working them when they are wet. In some irrigated areas, part of the soils in class III have limited use because of high water table, slow permeability, and the hazard of salt or sodic accumulation. Each distinctive kind of soil in class III has one or more alternative combinations of use and practices required for safe use, but the number of practical alternatives for average farmers is less than that for soils in class II.

**Class IV—Soils in class IV have very severe limitations that restrict the choice of plants, require very careful management, or both.**

The restrictions in use for soils in class IV are greater than those in class III and the choice of plants is more limited. When these soils are cultivated, more careful management is required and conservation practices are more difficult to apply and maintain. Soils in class IV may be used for crops, pasture, woodland, range, or wildlife food and cover.

Soils in class IV may be well suited to only two or three of the common crops or the harvest produced may be low in relation to inputs over a long period of time. Use for cultivated crops is limited as a result of the effects of one or more permanent features such as (1) steep slopes, (2) severe susceptibility to water or wind erosion, (3) severe effects of past erosion, (4) shallow soils, (5) low moisture-holding capacity, (6) frequent overflows accompanied by severe crop damage, (7) excessive wetness with continuing hazard of waterlogging after drainage, (8) severe salinity or sodium, or (9) moderately adverse climate.

Many sloping soils in class IV in humid areas are suited to occasional but not regular cultivation. Some of the poorly drained, nearly level soils placed in class IV are not subject to erosion but are poorly suited to inter-tilled crops because of the time required for the soil to dry out in the spring and because of low productivity for cultivated crops. Some soils in class IV are well suited to one or more of the special crops, such as fruits and ornamental trees and shrubs, but this suitability itself is not sufficient to place a soil in class IV.

In subhumid and semiarid areas, soils in class IV may produce good yields of adapted cultivated crops during years of above average rainfall; low yields during years of average rainfall; and failures during years of below average rainfall. During the low rainfall years the soil must be protected even though there can be little or no expectancy of a marketable crop. Special treatments and practices to prevent soil blowing, conserve moisture, and maintain soil productivity are required. Sometimes crops must be planted or emergency tillage used for the primary purpose of maintaining the soil during years of low rainfall. These treatments must be applied more frequently or more intensively than on soils in class III.

## Land Limited in Use—Generally Not Suited to Cultivation <sup>7</sup>

**Class V—Soils in class V have little or no erosion hazard but have other limitations impractical to remove that limit their use largely to pasture, range, woodland, or wildlife food and cover.**

Soils in class V have limitations that restrict the kind of plants that can be grown and that prevent normal tillage of cultivated crops. They are nearly level but some are wet, are frequently overflowed by streams, are stony, have climatic limitations, or have some combination of these limitations. Examples of class V are (1) soils of the bottom lands subject to frequent overflow that prevents the normal production of cultivated crops, (2) nearly level soils with a growing season that prevents the normal production of cultivated crops, (3) level or nearly level stony or rocky soils, and (4) ponded areas where drainage for cultivated crops is not feasible but where soils are suitable for grasses or trees. Because of these limitations cultivation of the common crops is not feasible but pastures can be improved and benefits from proper management can be expected.

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

Physical conditions of soils placed in class VI are such that it is practical to apply range or pasture improvements, if needed, such as seeding, liming, fertilizing, and water control with contour furrows, drainage ditches, diversions, or water spreaders. Soils in class VI have continuing limitations that cannot be corrected, such as (1) steep slope, (2) severe erosion hazard, (3) effects of past erosion, (4) stoniness, (5) shallow rooting zone, (6) excessive wetness or overflow, (7) low-moisture capacity, (8) salinity or sodium, or (9) severe climate. Because of one or more of these limitations these soils are not generally suited to cultivated crops. But they may be used for pasture, range, woodland, or wildlife cover or for some combination of these.

Some soils in class VI can be safely used for the common crops provided unusually intensive management is used. Some of the soils in this class are also adapted to special crops such as sodded orchards, blueberries, or the like, requiring soil conditions unlike those demanded by the common crops. Depending upon soil features and local climate the soils may be well or poorly suited to woodlands.

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<sup>7</sup> Certain soils grouped into classes V, VI, VII, and VIII may be made fit for use for crops with major earthmoving or other costly reclamation.

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

Physical conditions of soils in class VII are such that it is impractical to apply such pasture or range improvements as seeding, liming, fertilizing, and water control with contour furrows, ditches, diversions, or water spreaders. Soil restrictions are more severe than those in class VI because of one or more continuing limitations that cannot be corrected, such as (1) very steep slopes, (2) erosion, (3) shallow soil, (4) stones, (5) wet soil, (6) salts or sodium, (7) unfavorable climate, or (8) other limitations that make them unsuited to common cultivated crops. They can be used safely for grazing or woodland or wildlife food and cover or for some combination of these under proper management.

Depending upon the soil characteristics and local climate, soils in this class may be well or poorly suited to woodland. They are not suited to any of the common cultivated crops; in unusual instances, some soils in this class may be used for special crops under unusual management practices. Some areas of class VII may need seeding or planting to protect the soil and to prevent damage to adjoining areas.

**Class VIII—Soils and landforms in class VIII have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply or to esthetic purposes.**

Soils and landforms in class VIII cannot be expected to return significant on-site benefits from management for crops, grasses, or trees, although benefits from wildlife use, watershed protection, or recreation may be possible.

Limitations that cannot be corrected may result from the effects of one or more of the following: (1) Erosion or erosion hazard, (2) severe climate, (3) wet soil, (4) stones, (5) low-moisture capacity, and (6) salinity or sodium.

Badlands, rock outcrop, sandy beaches, river wash, mine tailings, and other nearly barren lands are included in class VIII. It may be necessary to give protection and management for plant growth to soils and landforms in class VIII in order to protect other more valuable soils, to control water, or for wildlife or esthetic reasons.

## **CAPABILITY SUBCLASSES**

Subclasses are groups of capability units within classes that have the same kinds of dominant limitations for agricultural use as a result of soil and climate. Some soils are subject to erosion if they are not protected, while others are naturally wet and must be drained if crops are to be grown. Some soils are shallow or droughty or have other soil deficiencies. Still

other soils occur in areas where climate limits their use. The four kinds of limitations recognized at the subclass level are: Risks of erosion, designated by the symbol (e); wetness, drainage, or overflow (w); rooting-zone limitations (s); and climatic limitations (c). The subclass provides the map user information about both the degree and kind of limitation. Capability class I has no subclasses.

Subclass **(e) erosion** is made up of soils where the susceptibility to erosion is the dominant problem or hazard in their use. Erosion susceptibility and past erosion damage are the major soil factors for placing soils in this subclass.

Subclass **(w) excess water** is made up of soils where excess water is the dominant hazard or limitation in their use. Poor soil drainage, wetness, high water table, and overflow are the criteria for determining which soils belong in this subclass.

Subclass **(s) soil limitations within the rooting zone** includes, as the name implies, soils that have such limitations as shallowness of rooting zones, stones, low moisture-holding capacity, low fertility difficult to correct, and salinity or sodium.

Subclass **(c) climatic limitation** is made up of soils where the climate (temperature or lack of moisture) is the only major hazard or limitation in their use.<sup>8</sup>

Limitations imposed by erosion, excess water, shallow soils, stones, low moisture-holding capacity, salinity, or sodium can be modified or partially overcome and take precedence over climate in determining subclasses. The dominant kind of limitation or hazard to the use of the land determines the assignment of capability units to the (e), (w), and (s) subclasses. Capability units that have no limitation other than climate are assigned to the (c) subclass.

Where two kinds of limitations that can be modified or corrected are essentially equal, the subclasses have the following priority: e, w, s. For example, we need to group a few soils of humid areas that have both an erosion hazard and an excess water hazard; with them the e takes precedence over the w. In grouping soils having both an excess water limitation and a rooting-zone limitation the w takes precedence over the s. In grouping soils of subhumid and semiarid areas that have both an erosion hazard and a climatic limitation the e takes precedence over the c, and in grouping soils with both rooting-zone limitations and climatic limitations the s takes precedence over the c.

Where soils have two kinds of limitations, both can be indicated if needed for local use; the dominant one is shown first. Where two kinds of problems are shown for a soil group, the dominant one is used for summarizing data by subclasses.

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<sup>8</sup> Especially among young soils such as alluvial soils, although not limited to them, climatic phases of soil series must be established for proper grouping into capability units and into other interpretive groupings. Since the effects result from interactions between soil and climate, such climatic phases are not defined the same in terms of precipitation, temperature, and so on, for contrasting kinds of soil.