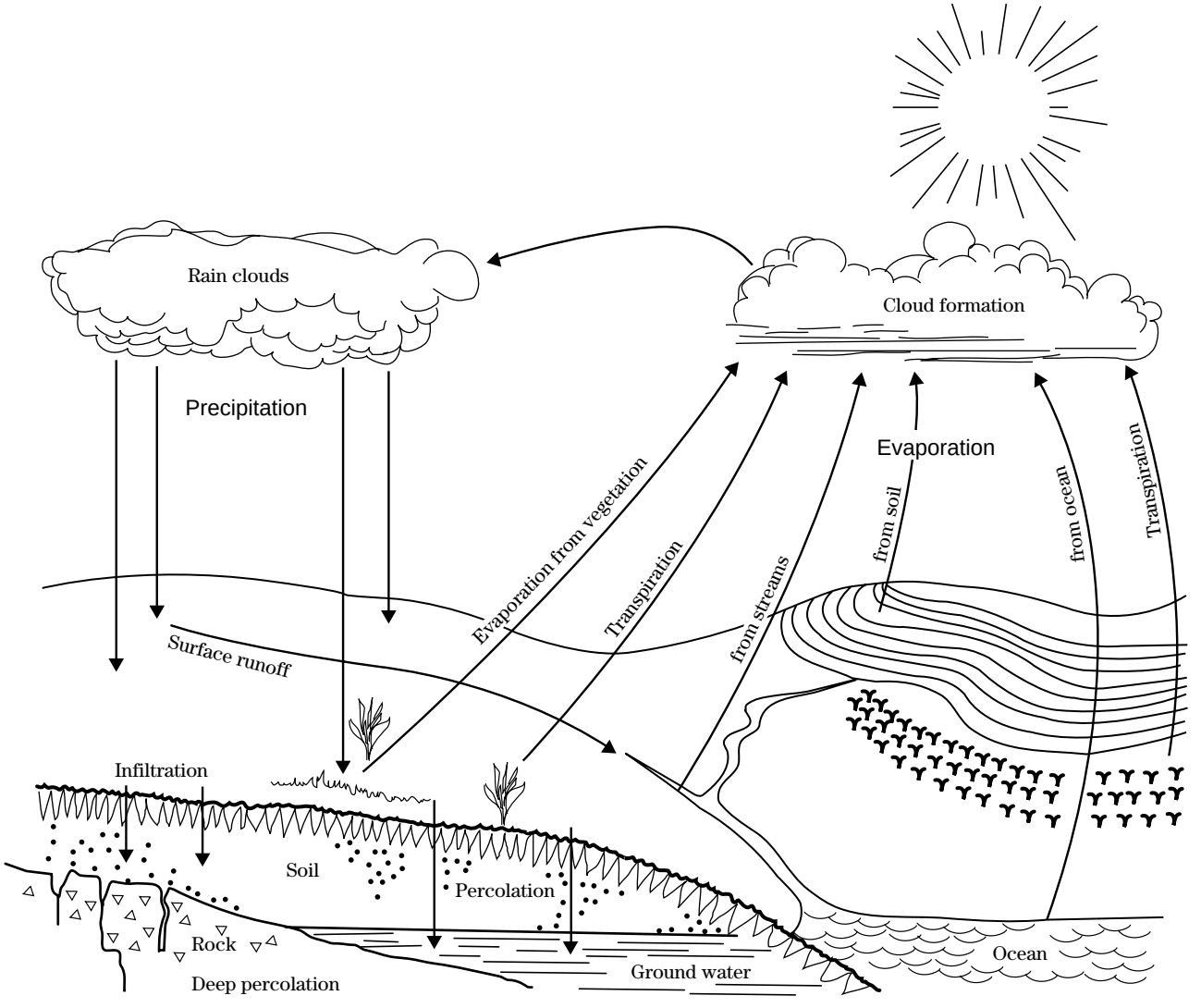
United States
Department of
Agriculture

**Natural
Resources
Conservation
Service**

Part 630 Hydrology
National Engineering Handbook

Chapter 8 Land Use and Treatment Classes



Issued June 2002

Acknowledgments

Chapter 8 was originally prepared by **Victor Mockus**, retired hydraulic engineer, USDA Soil Conservation Service, and was published in 1964. It was reprinted with minor revisions in 1969. This version was prepared by the Natural Resources Conservation Service (NRCS)/Agricultural Research Service (ARS) Curve Number Work Group. Members of this group are:

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630.0800 General

The land use and treatment classes ordinarily evaluated in watershed studies are briefly described. These classes are used in determining hydrologic soil-cover complexes which are used in a method for estimating runoff from rainfall. See National Engineering Handbook, section 630 (NEH 630), chapter 9 for more information on hydrologic soil-cover complexes and chapter 10 for methods for estimating runoff from rainfall.

630.0801 Classification of land use and treatment

In the Natural Resources Conservation Service (NRCS) method of runoff estimation, the effects of the surface conditions of a watershed are evaluated by means of land use and treatment classes. *Land use* is the watershed cover and includes every kind of vegetation, litter and mulch, fallow, and bare soil as well as nonagricultural uses, such as water surface (lakes, swamps) and impervious surfaces (roads, roofs). *Land treatment* applies mainly to agricultural land uses and includes mechanical practices, such as contouring or terracing, and management practices, such as grazing control or rotation of crops. The *classes* consist of use and treatment combinations that actually occur on watersheds.

Land use and treatment classes are readily obtained either by observation or by measurement of plant and litter density and extent on sample areas.

630.0802 Classes

The land uses and treatments described here are listed in NEH 630, chapter 9, table 9–1. This table also shows the runoff curve numbers (CN) for hydrologic soil-cover complexes for which the hydrologic conditions are listed.

(a) Cultivated land

Fallow listed in table 9–1 is the agricultural land use and treatment with the highest potential for runoff because the land is kept as bare as possible to conserve moisture for use by a succeeding crop. The loss by runoff is offset by the gain because of reduced transpiration. Other kinds of fallow, such as stubble mulch, are not listed, but they can be evaluated by comparing their field condition with those for classes that are listed.

Row crop is any field crop (maize, sorghum, soybeans, sugarbeets, tomatoes, tulips) planted in rows far enough apart that most of the soil surface is exposed to rainfall impact throughout the growing season. At planting time the crop is equivalent to fallow and may be so again after harvest. In most evaluations the average condition when runoff occurs is assumed. Row crops are planted either in straight rows or on the contour, and they are in either a poor or a good rotation. These land treatments are described later in this chapter.

Small grain (wheat, oats, barley, flax) is planted in rows close enough that the soil surface is not exposed except during planting and shortly thereafter. Land treatments are those used with row crops.

Close-seeded or broadcast legumes or rotation meadows (alfalfa, sweetclover, timothy, and combinations of these) are either planted in close rows or broadcast. This cover may be allowed to remain for more than a year so that year-round protection is given to the soil.

Straight-row fields are those farmed in straight rows either up and down the hill or across the slope. Where land slopes are less than about 2 percent, farming across the slope in straight rows is equivalent to contouring and should be so considered when using table 9–1.

Rotations are planned sequences of crops, and their purpose is to maintain soil fertility or reduce erosion or provide an annual supply of a particular crop. Hydrologically, rotations range from poor to good in proportion to the amount of dense vegetation in the rotation, and they are evaluated in terms of hydrologic effects. *Poor rotations* are generally one-crop land uses, such as continuous corn (maize) or continuous wheat or combinations of row crops, small grains, and fallow. *Good rotations* generally include alfalfa or another close-seeded legume or grass to improve tilth and increase infiltration. Their hydrologic effects may carry over into succeeding years after the crop is removed though normally the effects are minor after the second year. The carryover effect is not considered in table 9–1.

Contoured fields are those farmed as nearly as possible on the contour. The hydrologic effect of contouring results from the surface storage provided by the furrows because the storage prolongs the time during which infiltration can take place. The magnitude of storage depends not only on the dimensions of the furrows, but also on the land slope, crop, and manner of planting and cultivation. Planting small grains or legumes on the contour makes small furrows that disappear because of climatic action during the growing season. The contour furrows used with row crops are either large when the crop is planted and made smaller by cultivation or small after planting and made larger by cultivation, depending on the type of farming. Average conditions for the growing season are used in table 9–1. The relative effects of contouring for all croplands shown in the table are based on data from experimental watersheds having slopes from 3 to 8 percent. Stripcropping is a land use and treatment not specifically shown in table 9–1 because it is a composite of uses and treatments. It is evaluated by the method of example 10–4 in chapter 10. The terraced entries in table 9–1 refer to systems that have open-end level or graded terraces, grassed waterway outlets, and contour furrows between the terraces. The hydrologic effects are due to the replacement of a low-infiltration land use by grassed waterways and to the increased opportunity for infiltration in the furrows and terraces. Closed-end level terraces, not shown in table 9–1, are evaluated by the methods in NEH 630, chapter 12.

Conservation tillage is an umbrella term used to represent specific residue management practices, such as no-till/strip-till, mulch-till, or ridge-till. These practices leave all or a portion of the previous crop's residue on the soil surface to:

- reduce soil erosion caused by the forces of wind and water,
- reduce surface runoff,
- increase infiltration, and
- reduce evaporation.

No-till is defined as managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round while growing crops in narrow slots or tilled or residue-free strips in soil previously untilled by full-width inversion implements.

Mulch-till is defined as managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round while growing crops where the entire field surface is tilled prior to planting.

Ridge-till is defined as managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round while growing crops on preformed ridges alternated with furrows protected by crop residue (NRCS 1999).

(b) Grassland

Grassland in watersheds can be evaluated by means of the three hydrologic conditions of native pasture or range shown in table 8–1, which are based on cover effectiveness, not forage production. The percent of area covered (or density) and the intensity of grazing are visually estimated. In making the estimates, consider that grazing on any but dry soils results in lowering of infiltration rates because of compaction of the soil by hooves, an effect that may carry over for a year or more even without further grazing.

An alternative system of evaluation is shown in table 8–2. In this system, density and air-dry weights of grasses and litter are used. The air-dry weights are determined by sampling. The field work can be kept to a minimum by sampling a small number of representative sites rather than a large number of random sites. In the table the classes with plus signs are midway between adjacent classes so that the CN for these classes must be obtained by interpolation in table 9–1.

Contour furrows on native pasture or range are longer lasting than those on cultivated land, their length of life being dependent on the soil, intensity of grazing, and on the density of cover. The dimensions and spacings of furrows vary with climate and topography. The CN in table 9–1 are based on data from contoured grassland watersheds in the central and southern Great Plains. Terraces are seldom used on grassland. When they are, the construction methods expose bare soils, and for 2 or 3 years the terraced grassland is more like terraced cropland in its effect on surface runoff.

Table 8–1 Classification of native pasture or range

Vegetative condition	Hydrologic condition
Heavily grazed—No mulch or has plant cover on < 0.5 of area	Poor
Not heavily grazed—Plant cover on 0.5 to 0.75 of the area	Fair
Lightly grazed—Plant cover on > 0.75 of the area	Good

Table 8–2 Air-dry weight classification of native pasture or range

Cover density (%)	Plant and litter air-dry weight (tons/ac) 1/		
	< 0.5	0.5 to 1.5	> 1.5
< 50	Poor	Poor +	Fair
50 to 75	Poor +	Fair	Fair +
> 75	Fair	Fair +	Good

1/ Classes with plus signs are midway between adjacent classes so CN must be obtained by interpolation in table 9–1.

Meadow is a field on which grass is continuously grown, protected from grazing, and generally mowed for hay. Drained meadows (those having a low water table) have little or no surface runoff except during storms that have a high rainfall intensity. Undrained meadows (those having a high water table) may be so wet that they are the equivalent of water surfaces in the runoff computations of chapter 10. If a wet meadow is drained, its soil-group classification as well as its land use and treatment class may change (see chapter 7 regarding the change in soil classification and/or dual hydrologic soil groups).

(c) Woods and forest

Woods are usually small isolated groves of trees being raised for farm or ranch use. The woods can be evaluated as shown in table 8–3, which is based on cover effectiveness, not on timber production. The hydrologic condition is visually estimated. In areas where national or commercial forest covers a large part of a watershed, the NRCS hydrologist is guided by the letter between the Forest Service and the Soil Conservation Service dated November 8, 1954 (USDA 1954).

Table 8–3 Classification of woods

Vegetative condition	Hydrologic condition
Heavily grazed or regularly burned. Litter, small trees, and brush are destroyed.	Poor
Grazed, but not burned. Some litter, but woods are not protected.	Fair
Protected from grazing. Litter and shrubs cover the soil.	Good

630.0803 Determinations of classes

The land use and treatment classes on a watershed can be determined at the same time the soils are classified (NEH 630, ch. 7). As with soils, the classes are determined for hydrologic unit (NEH 630, ch. 6). Locations of the classes within the units are ignored. A worksheet with classes shown in the order given in table 9–1 is convenient for tabulating percentages or acreages and is useful later in computing weighted CN. Classifying the cover on a 400 square mile watershed should take less than a day. The data may be available as digital overlays in a Geographic Information System (GIS) format.

For an analytical study of the effects of cover location in a watershed on the shapes of outflow hydrographs, see the chapter by Merrill Bernard in *Headwaters Control and Use* (USDA 1937). Bernard's study shows that the percentage of area in high runoff producing crops has more influence on the hydrographs than does the location of these crops within the watershed. The effect of location is significant, however, when corn and grass are concentrated in equal-sized areas.

630.0804 References

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