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3 Part 630 Hydrology

4 National Engineering Handbook

5 **Chapter 8: Land Use and Land Treatment Classes**

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47 **630.0800 General**

48 The land use and treatment classes ordinarily evaluated in watershed studies are briefly described.
49 These classes define hydrologic soil-cover complexes which are used in a method for estimating
50 runoff from rainfall, [See National Engineering Handbook, section 630, (NEH 630), Chapter 9 for
51 more information on hydrologic soil-cover complexes and Chapter 10 for methods for estimating
52 runoff from rainfall (NRCS, 1999a).]

53

54 **630.0801 Classification of land use and land treatment**

55 In the Natural Resources Conservation Service (NRCS) method of runoff estimation, the effects of
56 the surface conditions of a watershed are evaluated by means of land use and treatment classes.
57 *Land use* is watershed cover and includes all vegetation, litter and mulch, fallow, and bare soil as
58 well as nonagricultural uses, such as water surface (lakes and swamps) and impervious surfaces
59 (e.g., roads and impermeable roofs). *Land treatment* primarily applies to agricultural land uses.
60 Land treatments include mechanical practices, grazing control, and rotation of crops. Low impact
61 developments (LIDs) are also considered as land treatments. The combinations of land use and of
62 land treatment *classifications* that occur on watersheds are used to determine the potential for runoff
63 from rainfall

64 Land use and land treatment classifications can be obtained by casual observation or by detailed
65 measurement of plant and litter density and coverage on representative sample areas with the later
66 approach having the higher potential for accuracy.

67 **630.0802 Classes**

68 The different land uses and land treatments are described in this chapter and their use in estimating
69 runoff Curve Numbers (CNs) for hydrologic soil-cover complexes and the hydrologic conditions is
70 described in Chapter 9. Chapter 9 contains tables listing CNs for different land use and land
71 treatment combinations.

72

73 **(a) Cultivated land**

74 **Fallow** is the agricultural land use and treatment with the highest potential for runoff because the
75 land is kept as bare as possible to conserve moisture (reduce evapotranspiration) for use by a
76 succeeding crop. However, bare soils can become very dry through evaporation only. Other types
77 of fallow, such as stubble mulch, are not listed, but they can be evaluated by comparing their field
78 condition with those for classes that are listed and should be defined as experience-based CNs.

79 **Row crop** is any field crop (e.g., maize, sorghum, soybeans, tomatoes, tulips, or grapes) planted in
80 rows far enough apart that most of the soil surface is exposed to rainfall impact throughout the
81 growing season. At planting time, the crop is equivalent to fallow and may again be in fallow after
82 harvest. Row crops are planted either in straight rows or along contours. They are in either a poor
83 or a good rotation as described under the following section on rotations.

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

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

90 **Straight-row** fields are those farmed in straight rows either up and down the hill or across the
91 hillslope. Where land slopes are less than about 2 percent, farming across the slope in straight rows
92 is equivalent to contouring and should be considered when estimating the CN.

93 **Rotations** are planned sequences of crops. Their purpose is to maintain soil fertility, reduce erosion
94 or provide an annual supply of a particular crop. Hydrologically, rotations range from poor to good
95 in proportion to the amount of dense vegetation in the rotation, and are evaluated in terms of
96 hydrologic effects. *Poor rotations or no rotations* are generally one-crop land uses, such as
97 continuous corn (maize) or continuous wheat or combinations of row crops, small grains, and fallow.

98 *Good rotations* generally include alfalfa or another close-seeded legume or grass to improve tilth
99 and increase infiltration. These hydrologic effects may carry over into succeeding years after the
100 crop is removed, although normally the effects are minor after the second year. The carryover
101 effect is not considered when estimating the CN.

102 **Contoured fields** are those farmed as nearly as possible on the contour. The hydrologic effect of
103 contouring results from the surface storage provided by the furrows because the storage prolongs
104 the time during which infiltration can take place. The magnitude of storage depends not only on the
105 dimensions of the furrows but also on the land slope, crop, and manner of planting and cultivation.
106 Planting small grains or legumes on the contour creates small furrows that disappear because of
107 climatic action during the growing season. The contour furrows used with row crops are either
108 large when the crop is planted and made smaller by cultivation or small after planting and made
109 larger by cultivation, depending on the type of farming. Average conditions for the growing season
110 are listed in Chapter 9. The relative effects of contouring for all croplands are based on data from
111 experimental watersheds with slopes ranging from 3 to 8 percent. *Strip cropping* is a land use and
112 treatment not specifically used in estimating CN because it is a composite of uses and treatments. It
113 is evaluated by the method of example 10-4 in Chapter 10. Terraced entries refer to systems that
114 have open-end level or graded terraces, grassed waterway outlets, and contour furrows between the
115 terraces. The hydrologic effects due to the replacement of a low-infiltration land use by grassed
116 waterways and to the increased opportunity for infiltration are evaluated by the methods in NEH
117 630, Chapter 12.

118 **Conservation tillage** is a broad term representing specific residue management practices, such as
119 no-till/strip-till, mulch-till, or ridge-till. These practices leave all or a portion of the previous crop's
120 residue on the soil surface to: reduce soil erosion caused by the forces of wind and water,

- 121 • reduce surface runoff,
- 122 • increase infiltration, and
- 123 • reduce soil evaporation.

124 *No-till* is defined as managing the amount, orientation, and distribution of crop and other plant
125 residue on the soil surface year-round. This is accomplished by growing crops in narrow slots or

126 tilled or residue-free strips in soil previously untilled by full-width inversion implements (NRCS,
127 1999b).

128 *Mulch-till* is defined as managing the amount, orientation, and distribution of crop and other plant
129 residue on the soil surface year-round. This is accomplished by growing crops where the entire
130 field surface is tilled prior to planting (NRCS, 1999b).

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

134

135 **(b) Grassland**

136 **Grassland** in watersheds can be classified by means of the three hydrologic conditions for native
137 pasture or range shown in Table 8-1, which are based on cover condition, not forage production.
138 The percent of area covered (or density) and the intensity of grazing are visually estimated. In
139 making the estimates, one should consider that grazing on anything other than dry soils results in
140 lowering of infiltration rates because of compaction of the soil by hooves, an effect that may carry
141 over for a year or more even without further grazing.

142 **Table 1.** Classification of native pasture or range

Vegetative condition	Hydrologic condition
Heavily grazed – No mulch or has plant cover on < 50% of area	Poor
Not heavily grazed – Plant cover on 50% to 75% of the area	Fair
Lightly grazed – Plant cover on > 75% of the area	Good

143

144 An alternative system of evaluation is shown in Table 8-2. In this system, density and air-dry
145 weights of grasses and litter are used. The air-dry weights are determined from filed samples. The
146 field work can be kept to a minimum by sampling a small number of representative sites rather than
147 a large number of random sites. In Table 8-2, the classes with plus signs are midway between
148 adjacent classes so that the CNs for these classes should be estimated by interpolation in Chapter 9.

149
 150 Contour furrows on native pasture or range are longer lasting than those on cultivated land, with the
 151 length of life being dependent on the soil, intensity of grazing, and cover density. The dimensions
 152 and spacing of furrows vary with the climate and topography. The CNs in Chapter 9 are based on
 153 data from contoured grassland watersheds in the central and southern Great Plains. Terraces are

154 **Table 2.** Air-dry weight classification of native pasture or range

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

155 *Classes with plus signs are midway between adjacent classes so CN should be estimated by interpolation in Chapter 9
 156 tables.

157
 158 seldom used on grassland; however, when used, the construction methods expose bare soils. Thus,
 159 the terraced grassland is more like terraced cropland in its effect on surface runoff for 2 or 3 years.

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

168 **(c) Woods and forests**

169 **Woods** are usually small isolated groves of trees being raised for farm or ranch use. Woods can be
170 evaluated as shown in Table 8-3, which is based on cover effectiveness, not on timber production.
171 The hydrologic condition is visually estimated.

172 **Forests:** As contrasted to woods, forests are characterized by extensive or continuous vegetative
173 cover, abundant organic material, and extensive ground cover. Forests may have several layers of
174 over-story and under-story canopy cover, are often found on steep slopes, are often located in
175 inaccessible locations, and infrequently disturbed. A humid climate, which is needed to generate
176 the vegetation, is also a characteristic of forests. Grazing is usually minimal and timber production
177 may be a management goal. While forest soils may be classified as HSG A or HSG B, forested
178 watersheds are not always compatible with the CN method, as described in Chapter 9.

179 Common hydrologic processes include: canopy and litter interception and stem-flow, an impeding
180 soil layer causing delayed drainage, secondary (subsurface) flow contributions, non-Darcy soil-
181 water flow processes, base-flow from local upland groundwater sources, and direct channel
182 interception. There is, however, very little overland flow and no direct or unimpeded rain contact
183 with the soil surface. Infiltration capacities far exceed the expected effective rainfall intensities;
184 Hortonian overland flow is non-existent or very rare.

185 Where areas of national or commercial **forests** covered a large part of a watershed, the NRCS
186 hydrologist was guided by the letter between the USDA Forest Service and the Soil Conservation
187 Service dated November 8, 1954 (USDA, 1954), when determining CNs for National Forest lands.
188 The USDA Forest Service will make the determination of CNs for National Forests in consultations
189 with the NRCS.

190

191

192 **Table 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

193

194 **630.0803 Determination of classes**

195 The land use and treatment classes on a watershed can be determined at the same time the soils are
 196 classified (NEH 630, Ch. 7). As with soils, the classes are determined for a hydrologic unit (NEH
 197 630, Ch. 6). Distributions of the classes within the units is not required, just the percentage of each.
 198 A worksheet with classes shown in the order given in Chapter 9 can be convenient for tabulating
 199 percentages or acreages and is useful later in computing composite runoff volume (depth) or Q and
 200 then determining the total Q for the subwatershed. By using Geographic Information Systems
 201 (GIS) remote sensing procedures in conjunction with the National Land Cover Database (NLCD)
 202 database, classifying the cover on a 400 square mile watershed may take less than a day.

203

204 **630.0804 References**

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