

HYDROLOGIC SOIL GROUPS FOR IOWA SOILS

Many variables influence the volume and rate of runoff from the ground surface. Soil properties are included in these variables. Physical properties of each soil series have been utilized to determine a factor called the hydrologic soil group (HSG). All soils fall into one of four HSGs.

Persons familiar with NRCS hydrology may notice that the HSG for many soil series have changed from what has been published in previous technical documents. Originally, some soils were assigned a HSG based on measured rainfall, runoff, and infiltrometer data. Other soils were then assigned a HSG based on a comparison of the soil profile without taking into account actual soil properties. In recent years, a scientific approach has been developed to determine the HSG based on the physical properties of the soil. Using this procedure, the HSG is determined by the soil layer with the lowest saturated hydraulic conductivity and the depth to any impermeable or nearly impermeable layer or the depth to the water table (if present). The least transmissive layer can be any soil horizon that transmits water at a slower rate relative to those horizons above or below it.

The four hydrologic soil groups are described as follows:

- A Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. Some soils having loamy sand, sandy loam, loam or silt loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
- B Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures. Some soils having loam, silt loam, silt, or sandy clay loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
- C Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

- D Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential. All soils with a depth to a water impermeable layer less than 20 inches and all soils with a water table within 24 inches of the surface are in this group, although some may have a dual classification, as described in the next paragraph, if they can be adequately drained.

Certain wet soils are placed in group D based solely on the presence of a water table within 24 inches of the surface even though the saturated hydraulic conductivity may be favorable for water transmission. If these soils can be adequately drained, then they are assigned to dual hydrologic soil groups (A/D, B/D, and C/D) based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition. For the purpose of hydrologic soil group, adequately drained means that the seasonal high water table is kept at least 24 inches below the surface in a soil where it would be higher in a natural state.

For a more detailed description of the procedure to assign a HSG to a specific soil series or for more detailed definitions of the various HSGs, refer to the NEH, Part 630, Chapter 7, Hydrologic Soil Groups.

In the past, Iowa has published a list of Hydrologic Soil Groups for each soil series found in the state. Due to the improvement in the technology, it is now possible to determine the HSG more accurately by map unit and on a county by county basis. Instead of publishing a list, the method to use to determine the HSG for a given soil is to go to the Field Office Technical Guide. **As of the date of this amendment, select the link “Field Office Technical Guide” under “Helpful Links” on the Iowa NRCS home page and navigate to the HSGs using the path outlined below:**

FOTG → Section II → Soils Information → Soil Survey Area → County Listing (pick your county of interest) → Soils Tables → Erosion Factors → Hyd Grp (column 7)

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HYDROLOGIC SOIL-COVER COMPLEXES

A combination of the effects of hydrologic soil group (soil) and the land use and treatment class (cover) is used to determine the runoff curve number (CN). The CN indicates the runoff potential of a soil-cover complex during periods when the soil is not frozen. The higher the CN, the higher the potential for runoff.

Land Use

Fallow is the land use with the highest potential for runoff because the land is kept as bare as possible to conserve moisture for use by a succeeding crop.

A row crop is any field crop planted in rows far enough apart that most of the soil surface is exposed to rainfall impact during the early growing season (i.e.: corn, soybeans, sorghum).

Small grain is planted in rows close enough together that the soil surface is not exposed except during planting and shortly thereafter.

Close-seeded legumes or rotation meadow 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.

Pasture is a long term stand of forage plants which gives year-round protection to the soil.

Meadow is a field in which grass is continually grown, protected from grazing, and generally mowed for hay.

Woods are forested areas that have at least 30 percent canopy coverage as viewed by aerial photography.

Farmsteads include the area surrounding the farm headquarters including buildings, lots, driveways, etc.

Roads are improved travelways (not farm lanes). Hard surface roads include any type of asphalt or concrete paving. Road right-of-way is included in the total road area used to determine CN.

Treatment or Practice

Straight row fields are those farmed in straight rows either up and down hill or across the slope.

Contoured fields are those farmed as nearly as possible on the contour. The hydrologic effect of contouring is due to the surface storage provided by the furrows because the storage prolongs the time during which infiltration can take place. The magnitude of the storage depends not only on the dimensions of the furrows but also on the land slope, crop, and manner of planting and cultivation. See Contour Farming (330) in the Field Office Technical Guide for additional guidance.

The contoured and terraced condition is to be used for systems containing open-end level or graded terraces with grassed waterway outlets where all tillage is done on the contour between the terraces. The area above closed-end level terraces and terraces with tile outlets is to be included with the contoured area for runoff curve number computations.

EFFECTS OF TERRACES AND WATER & SEDIMENT CONTROL BASINS ON RUNOFF

Runoff may be adjusted for the effect of terraces in the design of many conservation practices. Terraces may have a shorter design life than some other practices so a partial credit is used. For areas that have or definitely will have closed-end terraces, the runoff may be reduced by 1.0 inch. The same considerations apply to water & sediment control basins. The adjusted runoff is computed by the use of the formula:

$$Q_a = Q - \left(\frac{\text{Area_Terraced}}{\text{Total_Drainage_Area}} \right) (1.0_inch)$$

Where :

Q = Runoff Depth, inches

Q_a = Adjusted Runoff Depth, inches

On level terraced areas, the water stored by the terrace will infiltrate into the soil and will not be considered as part of the runoff. For terraces using underground outlets that drain into the practice being designed, a base flow of 0.05 cfs per acre needs to be added to the inflow.

Peak flow rates may be reduced by the same percentage as the reduction in runoff volume.

Many software packages are not able to directly give credit for the runoff reduction. For those situations a revised rainfall value can be calculated from the adjusted runoff depth and the runoff curve number.

A spreadsheet has been developed to perform the calculations. The spreadsheet can be found on the Iowa Engineering web page using the following path from the Iowa NRCS home page:

Iowa NRCS home page → Topics → Technical Resources → Engineering → Engineering Spreadsheets → IaTerraceCredit.xls

The first tab on the spreadsheet, labeled "IA EFH2-91(35-36)", gives two examples that show how the Peak Flow Adjustment Factor is calculated. These examples refer to a rainfall-runoff nomograph located in EFH Chapter 2. An alternative to using the nomograph is to use tables giving rainfall-runoff relationships by curve number. These tables are located in the National Engineering Handbook Part 630, Hydrology; Chapter 10, Estimation of Direct Runoff from Storm Rainfall; Appendix 10A, Rainfall - Runoff Tables for Selected Runoff Curve Numbers. These tables have rainfall-runoff values for curve numbers 50 - 98.