Soil Runoff Potential

Indicator Names

- *% Low Runoff Potential Soils in Watershed (WS)*
- *% Moderately Low Runoff Potential Soils in Watershed (WS)*
- *% Moderately High Runoff Potential Soils in Watershed (WS)*
- *% High Runoff Potential Soils in Watershed (WS)*

Indicator Category | **Ecological** and **Stressor**

Subcategory | *Soil Attributes*

Available in RPS Tool files for all lower 48 states

Indicator Description

Background

Soil runoff potential describes the likelihood for surface runoff to occur during rainfall or snowmelt. Surface runoff is generated when the movement of water into the soil is slow enough to result in water flow along the land surface and into waterbodies.

Soil scientists have defined and mapped four categories of soil runoff potential, termed *Hydrologic Soil Groups*.[1] The classification of soils into Hydrologic Soil Groups is based on characteristics such as soil texture and degree of compaction, or by measured rates of downward water movement in the soil.[1] The water table depth and the depth to an impermeable layer are also considered.[1]

What the Indicators Measure

These indicators measure the area of each Hydrologic Soil Group in a HUC12 subwatershed:*

- ***% Low Runoff Potential Soils in Watershed (WS)*** – area of soils in Hydrologic Soil Group A (low runoff potential) in the HUC12 (Figure 1). Expressed as a percentage of the total HUC12 area.
- ***% Moderately Low Runoff Potential Soils in WS*** – area of soils in Hydrologic Soil Group B (moderately low runoff potential) in the HUC12. Expressed as a percentage of the total HUC12 area
- ***% Moderately High Runoff Potential Soils in WS*** – area of soils in Hydrologic Soil Group C (moderately high runoff potential) in the HUC12. Expressed as a percentage of the total HUC12 area.
- ***% High Runoff Potential Soils in WS*** – area of soils in Hydrologic Soil Group D (high runoff potential) in the HUC12. Expressed as a percentage of the total HUC12 area.

The indicators of low and moderately low runoff potential are classified as **Ecological** indicators. The indicators of high and moderately high runoff potential are classified as **Stressor** Indicators.

Relevance to Water Quality Restoration and Protection

Soil runoff potential plays a fundamental role in the hydrology of a watershed and its water quality.[2] Soil runoff potential, along with topography and land use, largely determine the relative amount of precipitation that drains across the surface versus percolates into groundwater.[2,3] Understanding a watershed's hydrology is key to diagnosing potential sources of pollution.[4,5]

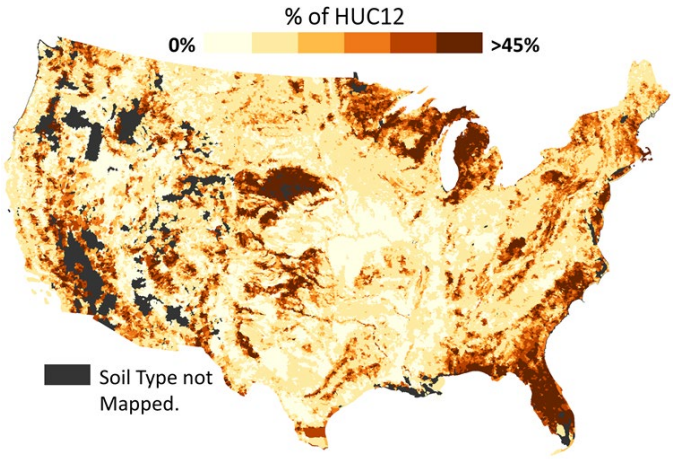

*Figure 1. Map of **% Low Runoff Potential Soils in Watershed** for HUC12s across the contiguous US.*

Soils with high runoff potential, such as soils with high clay content, can amplify issues related to nonpoint source pollution because runoff may flush sediment, nutrients, pathogens, and other pollutants from the landscape and into nearby waters.[2,4] In contrast, soils with low runoff potential, like sandy soils, can better allow precipitation to filter through the soil and recharge groundwater supplies.[2,4] Note, however, that certain pollutants which readily dissolve in water, such as nitrate, can still pose issues in areas with low runoff potential because the pollutants can leach into groundwater and become a long-term pollutant source to surface waters.[5]

Soil runoff potential has been used by the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) to estimate the vulnerability of soils to sediment, phosphorus, and nitrogen loss and to quantify the benefits of land conservation practices.[7] The US Forest Service has also included soil runoff potential as an indicator of the vulnerability of watersheds to climate change.[8] In this vulnerability assessment, soil runoff potential was factored in an evaluation of future changes

* HUC12s are subwatershed delineations in the National Watershed Boundary Dataset. HUC12s are referenced by their 12-digit Hydrologic Unit Code.

in erosion and groundwater recharge that may occur on forested lands.[8]

These indicators can be used to identify HUC12s that are dominated by soils with high runoff potential and to assess the vulnerability of HUC12s to future degradation due to more frequent and intense rainfall or other types of climate change. Additional indicators, such as land use trends, can also be included in an evaluation of watershed vulnerability to gain a more complete picture of potential climate change impacts on watersheds.

Processing Method

These indicators are measured from soil data in the Natural Resources Conservation Service (NRCS) Gridded Soil Survey Geographic Database (gSSURGO). The gSSURGO database maps the location of soil types across the nation at a resolution of 10 meters or approximately 33 feet. The July 2020 version of gSSURGO was used for analysis of the soil runoff potential indicators.

The gSSURGO database reports numeric and descriptive attributes of each soil type in the database, including the Hydrologic Soil Group assigned to soil types based on field surveys completed by soil scientists.

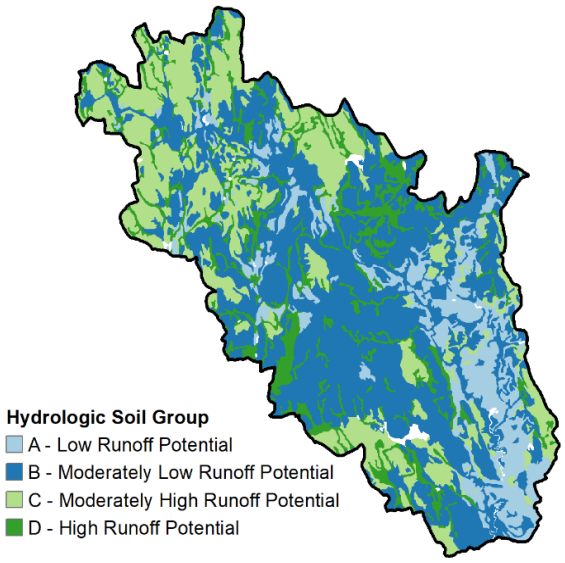

Figure 2. Example map of Hydrologic Soil Group classifications in a HUC12 subwatershed.

To calculate the percentage of a HUC12 covered by each Hydrologic Soil Group, a map layer of the dominant Hydrologic Soil Group per soil type was created from the gSSURGO database and was overlaid with HUC12 boundaries (Figure 2). The area of each Hydrologic Soil Group was then calculated per HUC12 and converted to a percentage of total HUC12 area.

Limitations

- Hydrologic Soil Group is not reported for every soil type in the gSSURGO database. A missing area threshold of 50% was used for reporting values of the soil runoff potential indicators. Blank values are reported for HUC12s that are missing Hydrologic Soil Group in 50% or more of the HUC12 area.
- The slope of the soil surface and land cover are not considered when assigning Hydrologic Soil Groups.[1]
- The classification of soils into Hydrologic Soil Groups is based on the judgment of soil scientists, primarily relying on their interpretation of criteria found in either the NRCS National Engineering Handbook or National Soil Survey Handbook. As a result, large-scale mapping of hydrologic soil groups can be susceptible to inconsistencies and inaccuracies.[6] Efforts that require a detailed analysis of soil conditions should consult soil survey reports for the area of interest.

Links to Access Data and Additional Information

HUC12 indicator data can be accessed within the EPA Restoration and Protection Screening (RPS) Tool, in downloadable data files, or as a web service. Visit the EPA RPS website for links to access the RPS Tool, HUC12 indicator database, and web service.

The gSSURGO dataset used to calculate these indicators is accessible from the NRCS gSSURGO website.

References

[1]Mockus, V., et al. 2009. Part 630 Hydrology National Engineering Handbook, Chapter 7: Hydrologic soil groups. *Natural Resources Conservation Service*.

[2]Allan, J., et al. 2020. Stream ecology: structure and function of running waters. *Springer Nature*.

[3]O'Geen, A., 2013. Soil Water Dynamics. *Nature Education Knowledge*. 4(5): 9.

[4]Winter, T., et al. 1998. Ground water and surface water: a single resource. *US Geological Survey*. Vol. 1139.

[5]Mueller, D., et al. 1995. Nutrients in ground water and surface water of the United States: An analysis of data through 1992. *US Geological Survey*. 95: 4031.

[6]Abraham, S., et al. 2020. Classification of soils into hydrologic groups using machine learning. *Data*. 5(1): 2.

[7]USDA NRCS. 2012. Assessment of the Effects of Conservation Practices on Cultivated Cropland in the Upper Mississippi River Basin.

[8]US Forest Service. 2013. Assessing the Vulnerability of Watersheds to Climate Change. General Technical Report PNW-GTR-884.