Percent Developed Land on Wet Areas

This EnviroAtlas national map estimates the percent of land within each subwatershed (12-digit HUC) that is frequently or periodically wet and has been developed or urbanized. A wetness index of 550 was used to determine if the area was considered to be wet. In this map, development includes open spaces, parks, golf courses, residential areas, commercial areas, industrial areas, and associated infrastructure.

Why is developed land on wet areas important?

A wetness index or Composite Topographic Index (CTI), based on watershed contributing area, slope, and overland flow, was used to generate a series of EnviroAtlas data layers for land cover on wet areas. This data layer depicts developed land on wet areas that have been converted to other uses, including open spaces, parks, golf courses, single family homes, multifamily housing, retail, commercial, industrial sites, and associated roads and infrastructure. Wet areas are typically created by runoff from natural land cover when rain falls on saturated soil. Surface and rill (or small channel) runoff carries excess water to lowland depressions or wet areas. Runoff collects in wet areas until they fill and overflow downstream. In this way, stream networks can be extended into areas that would not be hydrologically connected during drier times.[1] Vegetation is a major influence on hydrological connectivity; it increases infiltration to limit runoff, and it directs and slows water flow during floods. Riparian vegetation also connects existing stream channels, either surficially or underground, with former channels (e.g., backwaters and oxbow lakes).[2]

The wet areas data layers cover potential runoff contributing areas that may or may not be defined as wetlands. The three main components used to define wetlands are the presence of wetland hydrology, hydric soils, and hydrophytic (water-adapted) vegetation. A depression that carries water during wet periods may be temporary and may not possess one or more of the required wetland components. Conversely, wet areas with high wetness index values may be true wetlands.

Wet areas provide important ecosystem services, including wildlife habitat, biological diversity, sediment capture, groundwater recharge, nutrient and toxics filtration, carbon

sequestration, and flood water storage. The expansion of development into wet areas increases the coverage of impervious surfaces (e.g., rooftops and roadways) and reduces the residence time of water on the landscape, sending precipitation and polluted overland flow from nonpoint sources directly through drains to streams and rivers.[3] As impervious surfaces increase, stormwater runoff increases in quantity, speed, temperature, and pollutant load. Stormwater runoff can degrade aquatic habitat, increase flood potential, and raise the temperature of receiving water bodies. Research has shown that stream degradation occurs at relatively low watershed imperviousness levels of 10–20%.[4] By slowing the passage of water, wet areas can help prevent sediment, nutrients, harmful bacteria, pesticides, and metals from entering waterways and degrading water quality.

Impervious surfaces affect the quantity, as well as the quality, of water resources. Normally, rainwater entering the soil recharges groundwater aquifers. Water percolates slowly through the soil to enter streams and rivers, contributing to base flows and regulating stream flow after precipitation events. Impervious surfaces greatly reduce rainwater percolation and groundwater recharge, thus contributing to potential shortages in water supply.[4]

Using wet area map layers and evidence of hydrological connectivity, planners and other interested users can identify the areas with high proportions of impervious surfaces where additional conservation or restoration of remaining wet areas (as in image above) might improve

CONTINUED ON BACK ▶

the retention and filtration of runoff following heavy precipitation. Multiple functions may be ranked by local needs for water quality improvement, wildlife habitat, or flood protection.

How can I use this information?

This national map uses a wetness index to estimate the percent land area of 12-digit HUCs covered by development on former wet areas. It is one of a series of national-scale maps displaying land cover on wet areas using a CTI wetness index. For conservation efforts, this map may be overlaid with Supplemental Data such as National Wetland Inventory (NWI) and Protected Areas (PADUS) or other national EnviroAtlas data layers such as Potentially Restorable Wetlands. The developed land on wet areas map may be overlaid with data on cropland or impervious cover to show possible contributing sources. Wet areas maps may be compared with EPA impaired waters data to optimize filtration planning when implementing Total Maximum Daily Loads in streams. Wet areas alongside or upstream of impaired stream segments may help reduce pollutant loads to streams.

How were the data for this map created?

This dataset of developed land on wet areas for each 12-digit Hydrological Unit (HUC-12) is based on the 2006 National Land Cover Database (NLCD) and the USDA's 2010 Crop Data Layer (CDL). These combined sources provide NLCD land coverages and agricultural land uses. A wetness index or Composite Topographic Index (CTI) was developed to identify areas that collect water. The wetness index grid, calculated from National Elevation Data (NED), relates upstream contributing area and slope to overland flow. Results from previous studies suggested that CTI values > 550 captured the majority of wet areas. Percentages of developed land coverage on wet areas (NLCD classes 121 Developed Open Space and 122–124 Low, Medium, and High Intensity Development) within 12-digit HUCs were calculated by raster cell counts with a cell size of 30m x 30m and an area of 900 m^2 per raster cell. A list of metric creation steps is included in the metadata processing steps; access the metadata for the data layer from the drop down menu on the interactive map table of contents and click again on metadata at the bottom of the metadata summary page for more details.

What are the limitations of these data?

EnviroAtlas uses the best data available, but there are still limitations associated with these data. The landcover classes found in NLCD and CDL are created through the classification of satellite imagery. Human classification of different landcover types that have a similar spectral signature can result in classification errors.

The wetness index, CTI, tends to overestimate wet areas, in part because it does not consider precipitation and evaporation water balances. It will also overestimate wetness in areas with highly permeable soils that do not retain water. Finally, CTI indicates wet areas based entirely on topography and surface water flow and will miss wet areas created by other factors such as heavy precipitation or irrigation outflow.[5]

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. Land cover, crop, and elevation data are available on their respective websites.

Where can I get more information?

A selection of references relating to wet areas, hydrological connectivity, and development is listed below. Information about the base data layers can be found at the websites linked throughout the text. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

Acknowledgements

Peter Cada, Hillary Nicholas, Michael Paul, Tetra Tech, Inc., produced the wetness index data analyses for this map. The fact sheet was created by Sandra Bryce, Innovate!, Inc.

Selected Publications

1. Bracken, L.J., and J. Croke. 2007. The concept of hydrological connectivity and its contribution to understanding runoff-dominated geomorphic systems. *Hydrological Processes* 21:1749–1763.

2. Tabacchi, E., L. Lambs, H. Guilloy, A-M. Planty-Tabacchi, E. Muller, and H. Decamps. 2000. Impacts of riparian vegetation on hydrological processes. *Hydrological Processes* 14:2959–2976.

3. Ambrosio, J.D., T. Lawrence, and L.C. Brown. 2012. A basic primer on nonpoint source pollution and impervious surface. Fact Sheet AEX-444-04. Ohio State University Extension, Food, Agricultural and Biological Engineering, Columbus, Ohio.

4. Arnold, C.L., and C.J. Gibbons. 1996. Impervious surface coverage: The emergence of a key environmental indicator. *Journal of the American Planning Association* 62:243–258.

5. Van Rees, C.B., and J.M. Reed. 2014. Wetland loss in Hawai'i since human settlement. *Wetlands* 34:335–350.