Percent Natural Land Cover in Stream Buffer

This EnviroAtlas national map portrays the percent of natural land cover within 30 meters of streams, rivers, and other hydrologically-connected waterbodies (e.g., lakes and ponds) within each 12-digit hydrologic unit (HUC). The map uses the 2006 National Land Cover Database (NLCD) to define natural land cover (forest, shrub, grass, and wetland), and it excludes agriculture, developed, and barren land.


Photo: Iowa stream, L. Betts, NRCS

Why are stream buffers important?

Natural land cover adjacent to streams and rivers, sometimes called the riparian area (or riparian buffer), helps protect terrestrial wildlife habitat, aquatic habitat, and water quality. Riparian areas store stormwater and runoff, filter pollutants from the air and soil, and moderate air and water temperatures. Maintaining natural vegetation in stream buffers benefits water quality at the site as well as downstream. Land management in upstream areas directly affects the water quality in downstream rivers, bays, and estuaries. Natural stream buffers can provide air quality, carbon storage, and climate stabilization benefits while adding recreation, cultural, and aesthetic value to an area. The quantity and quality of benefits provided by riparian buffers in any particular area depend on local conditions such as climate, slope, soil permeability, buffer width, pollutant load, and depth to water table.[1, 2]

Riparian areas intercept and filter stormwater and runoff. By trapping and processing pollutants, riparian vegetation can prevent sediment, nutrients, harmful bacteria, pesticides, and other pollutants from entering waterbodies. Riparian vegetation can help regulate the flow of flood water into a waterbody by slowing runoff, allowing it to soak into the ground to recharge ground water, and transpiring moisture back into the atmosphere through leaves and stems. Forested riparian buffers provide as much as 40 times the flood water storage of a cropped agricultural field and 15 times that of grass turf because of the ability of tree canopy to capture rainfall on the surface area of the leaves, stems, and branches and to take up water through deep roots.[2] By storing water and securing the stream bank with roots, riparian vegetation can reduce flood potential, help prevent erosion, and minimize downstream property damage.

Riparian vegetation, particularly tree cover, can regulate the temperature of the water and protect habitat for fish and other aquatic life. Elevated temperatures increase the impacts of nonpoint source pollution and deplete oxygen from the system.[2] Small fish, some amphibians, and most aquatic insects also rely on leaf litter from overhanging vegetation as their primary food source.

Narrow buffer widths of 5–15 meters (16–49 feet) maintain bank stability and provide some temperature moderation, but they are inadequate for sediment and nutrient reduction.[2] Narrow buffer strips are also subject to flood and wind damage. Streams with adjacent disturbances require wider buffers.[2] A published review of 66 studies covering nutrient removal by buffer vegetation (grass, grass and trees, forest) found that 75% and 90% excess nitrogen was removed from mean buffer widths of 28 and 112 meters (92 and 367 feet), respectively.[3] Though trees return a significant portion of the nitrogen they remove back to the soil as leaf litter, trees also enable denitrification, a process where bacteria in saturated soil transform dissolved nitrates into gaseous nitrogen compounds that escape to the atmosphere.[1]

Natural vegetation in stream buffers provides critical wildlife habitat for resident and migratory species that depend on riparian areas for cover, food, and water. Vegetated buffers create critical corridors for wildlife to safely move under cover from one area to another. Maintaining breeding habitat for songbirds and wildlife corridors for the movement of large mammals requires wider buffer widths of 30.5–91.4 meters (100-300 feet).[2,4] The benefits of aquatic and riparian habitat extend beyond the stream by maintaining biodiversity downstream, throughout the watershed, and in the surrounding region.

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How can I use this information?

This map layer indicates which 12-digit HUCs may benefit from riparian buffer restoration projects to improve water quality. An area can be more thoroughly investigated by increasing the transparency on this map and adding data for streams and water bodies from the supplemental map data (NHD) to an aerial imagery base map. Examination of these layers in more detail shows land cover along streams and reveals where upstream areas may be contributing to problems in downstream communities. Many states have developed guidelines for riparian buffer best management practices (BMPs) and recommended buffer widths.

How were these data created?

These data were generated by using the 2006 National Land Cover Dataset (NLCD) and high resolution (1:24,000 or higher) National Hydrography Data (NHD) depicting stream lines and water bodies in the landscape assessment tool, Analytical Tools Interface for Landscape Assessments (ATtILA). ATtILA is an Esri ArcView extension created by EPA that calculates many commonly-used landscape metrics, including land cover adjacent to streams. The 30-meter stream buffers for this group of EnviroAtlas metrics were generated by delineating a polygon one-pixel wide (30 meters) on either side of a stream network and around the perimeter of hydrologically-connected lakes or ponds. The percent natural land cover for the area (NLCD classified forest, shrubland, grassland, and wetland) contained within the buffer polygon was recorded for each 12-digit HUC. Waterbodies not hydrologically connected were not included in the analysis. For more information on this calculation, see the ATtILA User's Manual.

What are the limitations of these data?

Though EnviroAtlas uses the best data available, there are limitations associated with the data. The landcover classes found in NLCD are created through the classification of satellite imagery. Human classification of landcover types that have a similar spectral signature can result in classification errors. As a result, NLCD is a best estimate of actual landcover. Also, because of its 30m pixel size, NLCD may miss riparian buffers that are <30m wide.

A national-scale metric such as this gives an overview of the extent of natural land cover within a fixed-distance buffer summarized by 12-digit HUCs. However, at any point along a stream network, natural land cover may be narrower or wider than the fixed-distance buffer. Fixed-distance buffers cannot account for differences among buffer areas caused by gaps in riparian vegetation, upslope sources of pollutants, or upslope forested areas.[5] They do not reflect upstream-downstream patterns of watershed land cover, differences between forested and unforested stream banks, or flowpaths for runoff, influenced by local topography.[5] A full research effort, one that considered variable buffer widths, would be required to get an accurate local estimate of riparian vegetation filtering capabilities within or among watersheds.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. The NLCD and NHD data are accessible through their respective websites.

Where can I get more information?

A selection of resources related to riparian buffers is listed below. For additional information on how the data were created, 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. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

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Selected Publications

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2. Palone, R.S., and A.H. Todd (eds.). 1997. Chesapeake Bay riparian handbook: A guide for establishing and maintaining riparian forest buffers. NA-TP-02-97, U.S. Forest Service, Radnor, Pennsylvania.

3. Mayer, P.M., S.K. Reynolds, M.D. McCutchen, and T.J. Canfield. 2006. Riparian buffer width, vegetative cover, and nitrogen removal effectiveness: A review of current science and regulations. EPA/600/R-05/118. U.S. Environmental Protection Agency, Cincinnati, Ohio.

4. Bentrup, G. 2008. Conservation buffers: Design guidelines for buffers, corridors, and greenways. General Technical Report SRS-109. U.S. Forest Service, Southern Research Station, Asheville, North Carolina. 110 p.

5. Baker, M.E., Weller, D.E., Jordan, T.E. 2006. Improved methods for quantifying potential nutrient interception by riparian buffers. *Landscape Ecology*, 21 (8): 1327–1345.