Stream Length Impaired by pH, Acidity, or Caustic Conditions

This EnviroAtlas national map displays the length in kilometers of streams, coasts, and canals in each 12-digit hydrological unit (HUC) in the U.S. that are impaired by pH, acidity, or caustic conditions. Stream pH may be too low (acidic) or too high (basic).

Why are impaired streams important?

Stream impairments can be due to a variety of causes, including chemical pollutants, physical conditions such as siltation, or biological contaminants such as bacteria. This map shows streams that are impaired by pH, acidity, or caustic conditions. Stream pH is a measure of the concentration of hydrogen ions in the water. The pH scale ranges from 0 to 14; 7 is neutral, pH<7 is acidic, and pH>7 is basic. Most aquatic plants, animals, and insects prefer water with a pH that is close to neutral.[1]

Natural factors and human activities both influence pH. Acids and bases can be introduced to streams in storm water runoff, by leaching into groundwater, through direct discharges of wastewater, or as atmospheric deposition. The chemical composition of rocks and soils in and around a stream can affect pH, as can plants decaying in the water.[2,3]

Human activities that influence pH usually make streams more acidic. Coal-fired power plants and emissions from vehicles lead to acidic deposition. Gases and particles produced by burning fossil fuels enter the atmosphere, where they can travel long distances before being deposited in streams. Controls on these emissions have reduced acidic deposition in the United States in recent decades, but streams can take years to recover.[2,4] Nitrogen in fertilizer and manure can also enter the atmosphere, settle in streams, and cause acidic deposition. Drainage from abandoned mines can deposit sulfuric acid and heavy metals into streams.[1,4] Other pollutants can make water more basic. These include lime-containing fertilizers, asphalt from roads, wastewater from certain industries, and some mine wastes.[1,5]

When a stream's pH is too low or too high, it can kill fish, zooplankton, and macroinvertebrates, change their behavior, or make it harder for them to grow normally and reproduce. Acidic streams have lower species richness, since only acid-tolerant species can survive.[2] Changes to pH can cause metals or other toxic chemicals to be released from soils to expose living organisms. For example, aluminum is not soluble at a

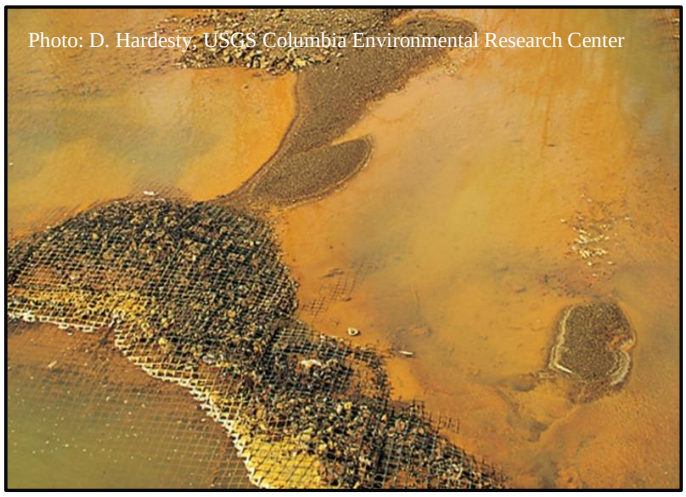
Photo: D. Hardesty, USGS Columbia Environmental Research Center

neutral pH, but it can be toxic to fish at a low pH.[1,2] Many sport fish—like lake trout and walleye—as well as some crayfish species cannot tolerate a low pH.[1] High pH can also harm aquatic life; it can increase the concentration of a toxic form of ammonia, NH_3.[1,5]

Section 303(d) of the Clean Water Act requires states to identify impaired waters—waters that do not support state-designated uses, such as fishing, irrigation, industrial uses, or drinking water supply, due to pollution or other impairments. States must establish a Total Maximum Daily Load (TMDL), which caps the amount of each pollutant allowed in the water body based on its use. The TMDL sets a load limit in order for the water body to meet water quality standards and then divides the load into allowable contributions from point and nonpoint sources.

How can I use this information?

The map, Stream Length Impaired by pH, Acidity, or Caustic Conditions, provides information about the length of streams or other waters with these impairments in each 12-digit HUC. Information about the extent and causes of impairments could guide projects for improving water quality or inform decisions about how best to protect water resources.

Users can view this information along with other EnviroAtlas layers, such as land cover and riparian buffers, to identify possible sources of impairments and potential remediation strategies. The map can be combined with layers on recreation or domestic water consumption to show how impairments relate to the uses of streams. This layer can be compared with

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the stream length layer to find out what percent of stream length in a HUC is impaired by pH, acidity, or caustic conditions.

How were the data for this map created?

The May 1, 2015 303(d) Listed Impaired Waters National Hydrography Dataset (NHD) Indexed Dataset was obtained from the EPA's WATERS Geospatial Data Downloads web page. This dataset includes features based on the NHDPlus flowlines and a table listing impaired waters. The impairment causes were then summarized into broad categories. For this layer, the causes included were pH, Acidity, or Caustic Conditions. The flowline features were split where they cross 12-digit HUC boundaries, and the lengths of all waters impaired by nuisance species were summed for each 12-digit HUC. For detailed information on how the data were generated, see the metadata.

What are the limitations of these data?

All national data layers, such as the 303(d) Listed Impaired Waters NHD Indexed Dataset, are inherently imperfect; they are an estimation of the truth based on the best available science. Calculations based on these data are therefore also estimations, and the mapped should be used to inform further investigation. Periodic updates to EnviroAtlas will reflect improvements to nationally available data.

This layer only represents waters on a state's approved 303(d) list. It does not include waters that have an approved TMDL in place, are expected to attain water quality standards, or have not yet been added to the 303(d) Listed Impaired Waters NHDPlus Indexed Dataset. The extent of monitoring and the methods used vary from state to state. Because the total lengths of waters in a 12-digit HUC may vary, this information should be considered in conjunction with data on stream density and total lengths of streams and coastlines to better understand the extent of impairment in a HUC. Accuracy information for the source data sets can be found on their respective web sites.

How can I access these data?

EnviroAtlas data can be viewed in the interactive map, accessed through web services, or downloaded. The dataset used to calculate the impairment counts, which provides greater detail on specific water bodies and the causes and sources of impairment, can be found on EPA's WATERS Geospatial Data Downloads website.

Where can I get more information?

There are numerous resources on water quality and impairment; a selection of these resources is listed below. The EPA Office of Water provides information on Section 303(d) of the Clean Water Act. For additional information on how the data were created, see the metadata. To ask specific questions about this data layer, please contact the EnviroAtlas Team.

Acknowledgements

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Selected Publications

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