



## Stream Length Impaired by Pathogens

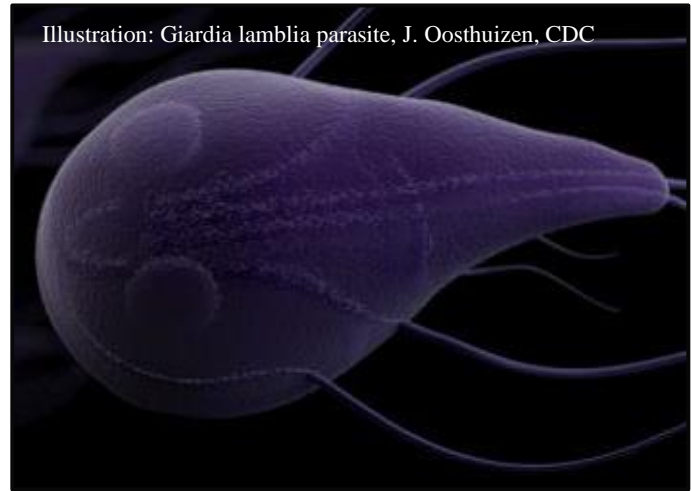
This EnviroAtlas national map displays the length in kilometers of streams, coasts, and canals from the 303(d) list of impaired waters in each 12-digit hydrological unit (HUC) that are impaired by pathogens (microbes that can spread disease). Microorganisms such as bacteria, viruses, and protozoa play important roles in aquatic ecosystems. However, some of them can cause serious illnesses.

### Why are streams impaired by pathogens 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 pathogens. Pathogens are the most commonly reported form of water pollution in the United States. Waterborne pathogens can cause illnesses in humans or pets that drink or swim in contaminated water. They mainly cause gastrointestinal illnesses, but they can also cause upper respiratory illnesses, rashes, eye infections, ear aches, or infected wounds.

Pathogen impairments can impact people's health, hurt the economy, and reduce opportunities for recreation. In coastal areas, they can cause beach closures. They can contaminate shellfish, which concentrate pathogens that infect humans when eaten. Water impaired by pathogens is harder to treat for drinking. In particular, the parasite cryptosporidium cannot be killed by chlorine alone; it requires more expensive water treatment methods like filtration or ozonation. In 1993, cryptosporidium in Milwaukee's water supply sickened an estimated 400,000 people.<sup>1</sup>

Most pathogens in waterways come from human or animal waste. The National Pollutant Discharge Elimination System places limits on the levels of pathogens that can be present in discharges from wastewater plants. However, wet weather can sometimes cause sewer overflows. Sewage can also come from boats, or from failing sewer lines and septic systems. Other pathogen sources include pet waste, garbage, farm animals, manure used as fertilizer, meat or seafood processing facilities, and textile or paper plants. They can also come from wildlife like beaver, deer, and waterfowl. Pathogen impairments are generally higher in urbanized watersheds than in forested areas.<sup>2</sup> Riparian buffers (vegetated areas along streams) can help intercept pathogens before they reach streams. The dangers from fecal contamination depend partly



on the source. Some pathogens in animal waste do not infect humans, but some diseases do spread to humans from animals; these are called zoonotic diseases. Giardia, salmonella, cryptosporidium, and dangerous strains of *Escherichia coli* (*E. coli*) can come from animals or humans.

Pathogen impairments are usually identified by measuring levels of two bacteria, *Escherichia coli* and those from the genus *Enterococci*. Both groups of bacteria are found in human and animal digestive tracts. Most strains do not cause illnesses, but they are useful as indicators because they are easy to measure and because it is not practical to test for all possible pathogens. High levels of these two bacteria can indicate human or animal waste in the water. Many of the pathogens that are found alongside *E. coli* and *Enterococci* can cause illnesses in swimmers.

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 because of pollution or other impairments. States must establish a [Total Maximum Daily Load](#) (TMDL) that caps the amount of each pollutant allowed in the water body based on its use.

### How can I use this information?

The map, Stream Length Impaired by Pathogens, provides information about the length of streams or other waters with impairments in 12-digit HUC across the U.S. 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 impervious surfaces 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 water use. It can be compared with the stream length layer to find out what percent of stream length in a HUC is impaired by pathogens.

### 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 [NHDPlusV2](#) flowlines and a table of impaired waters. The impairment causes were then summarized into broad categories. For this layer, the category is pathogens. The flowline features were split where they cross 12-digit HUC boundaries, and the lengths of all waters impaired by pathogens were summed for each 12-digit HUC.

### 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 data 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

### Selected Publications

1. Mac Kenzie, W.R., N.J. Hoxie, M.E. Proctor, S. Gradus, K.A. Blair, D.E. Peterson, J.J. Kazmierczak, D.G. Addiss, K.R. Fox, J.B. Rose, and J.P. Davis. 1994. [A massive outbreak in Milwaukee of cryptosporidium infection transmitted through the public water supply](#). *New England Journal of Medicine* 331:161–167.
  2. Walters, S.P., A.L. Thebo, and A.B. Boehm. 2011. [Impact of urbanization and agriculture on the occurrence of bacterial pathogens and \*stx\* genes in coastal waterbodies of central California](#). *Water Research* 45:1752–1762.
- Postel, S.L., and B.H. Thompson. 2005. [Watershed protection: Capturing the benefits of nature's water supply services](#). *Natural Resources Forum* 29:98–108.
- U.S. Environmental Protection Agency. 2001. [Protocol for developing pathogen TMDLs, first edition](#). United States Environmental Protection Agency, Office of Water. 134 p.
- U.S. Environmental Protection Agency. 2012. [Recreational Water Quality Criteria](#). United States Environmental Protection Agency, Office of Science and Technology, Health and Ecological Criteria Division. 63 p.
- U.S. Environmental Protection Agency. 2012. [Summaries of Water Pollution Reporting Categories](#). United States Environmental Protection Agency, Office of Water, Watershed Branch. Accessed April 2021.
- U.S. Environmental Protection Agency. 2017. [Introduction to the Clean Water Act](#). U.S. Environmental Protection Agency - Watershed Academy Web. 90 p.

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, access the [metadata](#) for the data layer from the layer list drop down menu on the interactive map. To ask specific questions about this data layer, please contact the [EnviroAtlas Team](#).

### Acknowledgments

The data for this map were generated by Megan Culler, EPA Student Services Contractor. This fact sheet was created by Megan Culler.