Study finds urbanization means different things to different watersheds

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Civil and Environmental Engineering Assistant Professor Aditi Bhaskar's recent study uncovered profound differences in streamflow changes in various urban watersheds. Credit: Andy Miller

Prior to urbanization, the natural landscape and climate determined how much water flowed into streams and rivers. Urban development now dramatically affects how much and where water flows, but Civil and

Environmental Engineering Assistant Professor Aditi Bhaskar has found changes to streamflow vary significantly from city to city.

With urban development rapidly increasing, it is important to understand how this development will impact water supply and flooding. In a paper published recently in *Water Resources Research*, Bhaskar and her colleagues analyzed streamflow change in 53 watersheds over 20-year periods of peak urbanization.

"Urbanization is sometimes treated as a universal transformer of streamflow," Bhaskar said. "We saw it can change streamflow in different ways."

Past studies have examined the effect of urbanization on streamflow in individual watersheds, and a few have compared metropolitan areas to suburban and rural areas to gage urbanization impacts. Bhaskar's study is the first broad comparison of urbanizing watersheds across the United States that looks at low to high flow conditions. She and her colleagues used U.S. Geological Survey stream measurements and recently released national housing density data that dates back to the 1930s.

The study found urbanization does not change streamflow consistently. Low flows went up in about half the streams and went down in the other half. High flows generally increased with urbanization, with the largest increases in semi-arid and arid areas.

A sign on this urban structure warns of flash flooding. Bhaskar and her colleagues found flood control infrastructure drastically alters the amount of streamflow in urban watersheds. Credit: Aditi Bhaskar

Bhaskar observed the biggest streamflow differences in places where wastewater, water supply and flood control infrastructure had transformed the way water would naturally flow.

"Streamflow change with urbanization is not easily predictable with any common metrics that we tested—for example, impervious surface cover or housing density change," she said.

Each urbanizing watershed was evaluated in the context of climate data for the period in which it was studied. By distinguishing flow changes

brought on by climate change from those resulting from urbanization, Bhaskar expects we will better be able to predict future changes from further urbanization, helping us manage flooding and water availability.

With this broad overview informing their future work, Bhaskar's research group now will turn their attention to how specific urban drivers change streamflow in different cities.

More information: A. S. Bhaskar et al. Hydrologic signals and surprises in U.S. streamflow records during urbanization, *Water Resources Research* (2020). DOI: 10.1029/2019WR027039

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