Streamflow

This indicator describes trends in the volume of water carried by streams across the United States, as well as the timing of peak flow.

Background

Streamflow is a measure of the amount of water carried by rivers and streams, and it represents a critical resource for people and the environment. Changes in streamflow can directly influence the supply of drinking water and the amount of water available for irrigating crops, generating electricity, and other needs. In addition, many plants and animals depend on streamflow for habitat and survival.

Streamflow naturally varies over the course of a year. For example, rivers and streams in many parts of the country have their highest sustained flow when snow melts in the spring. The amount of streamflow is important because very high flows can cause erosion and damaging floods, while very low flows can diminish water quality, harm fish, and reduce the amount of water available for people to use. The timing of peak flow is important because it affects the ability of reservoir managers to store water to meet people's needs later in the year. In addition, some plants and animals (such as fish that migrate) depend on a particular pattern of streamflow as part of their life cycles.

Climate change can affect streamflow in several ways. Changes in the amount of snowpack and earlier spring melting (see the Snowpack indicator on p. 58) can alter the size and timing of peak streamflows. More precipitation is expected to cause higher average streamflow in some places, while heavier storms (see the Heavy Precipitation indicator on p. 30) could lead to larger peak flows. More frequent or severe droughts will reduce streamflow in certain areas.

About the Indicator

The U.S. Geological Survey measures streamflow in rivers and streams across the United States using continuous monitoring devices called stream gauges. This indicator is based on 211 stream gauges located in areas where trends will not be artificially influenced by dams, reservoir management, wastewater treatment facilities, or other activities.

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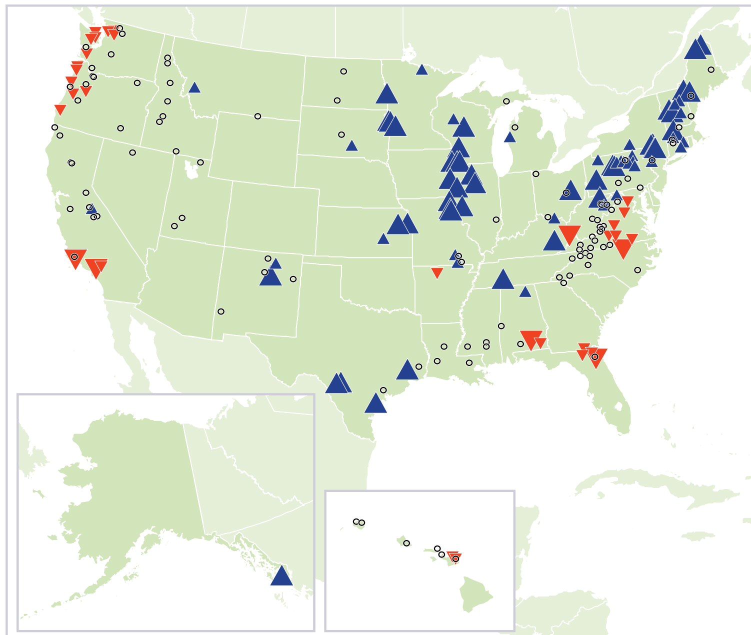
Figure 1. Volume of Seven-Day Low Streamflows in the United States, 1940–2009

This map shows percentage changes in the minimum amount of water carried by rivers and streams across the country, based on the long-term rate of change from 1940 to 2009. Minimum streamflow is based on the seven-day period with the lowest average flow during a given year.

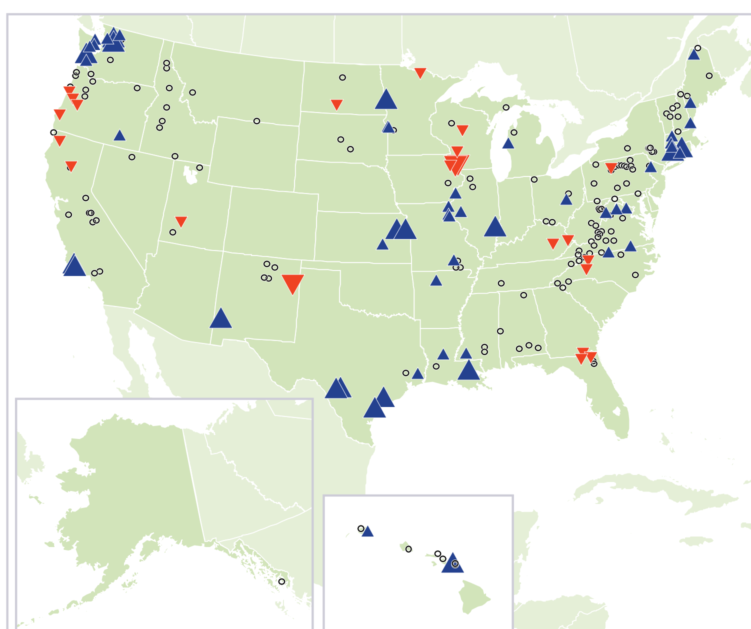


Data source: USGS, 2012[1]

More than 50% decrease | 20% to 50% decrease | 20% decrease to 20% increase | 20% to 50% increase | More than 50% increase

Figure 2. Volume of Three-Day High Streamflows in the United States, 1940–2009

This map shows percentage changes in the maximum amount of water carried by rivers and streams across the country, based on the long-term rate of change from 1940 to 2009. Maximum streamflow is based on the three-day period with the highest average flow during a given year.



Data source: USGS, 2012[2]

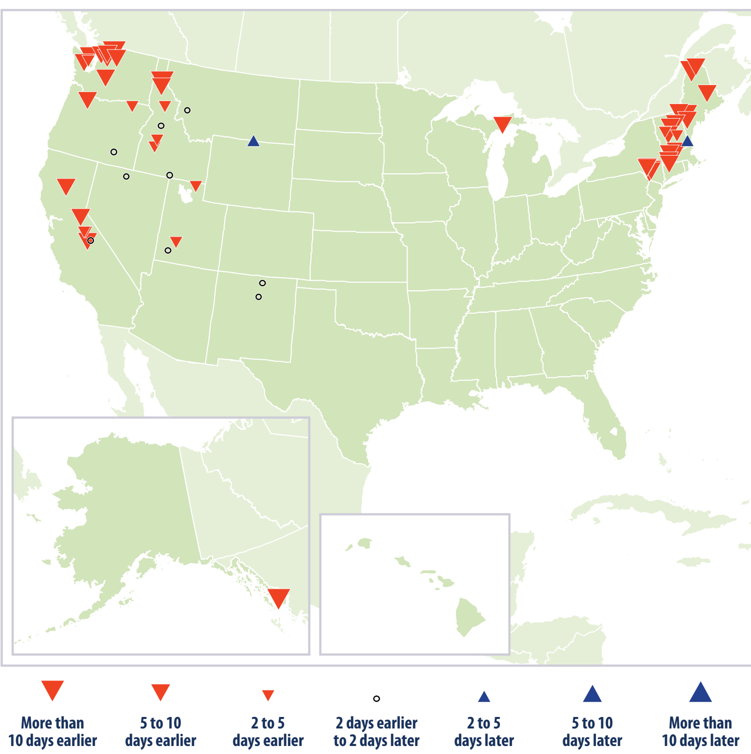
More than 50% decrease | 20% to 50% decrease | 20% decrease to 20% increase | 20% to 50% increase | More than 50% increase

Key Points

- Over the past 70 years, seven-day low flows have generally increased in the Northeast and Midwest (in other words, on the driest days, streams are carrying more water than before). Low flows have generally decreased (that is, streams are carrying less water than before) in parts of the Southeast and the Pacific Northwest. Overall, more sites have seen increases than decreases (see Figure 1).
- Three-day high-flow trends vary from region to region across the country. For example, streams in the Northeast have generally seen an increase or little change in high flows since 1940, while some West Coast streams have seen a decrease and others have seen an increase (see Figure 2). Overall, more sites have seen increases than decreases.
- Sixty percent of the streams measured show winter-spring runoff happening more than five days earlier than it did in the past. The most dramatic change has occurred in the Northeast (see Figure 3).

Figure 3. Timing of Winter-Spring Runoff in the United States, 1940–2009

This map shows changes in the timing of peak spring flow carried by rivers and streams, based on the long-term rate of change from 1940 to 2009. This analysis focuses on parts of the country where streamflow is strongly influenced by snowmelt. It is based on the winter-spring center of volume, which is the date when half of the streamflow between January 1 and May 31 of each year has passed.



Data source: USGS, 2012[3]

This indicator examines three important measures of streamflow conditions that occur over the course of a year. Figure 1 looks at the driest conditions each year, which are commonly calculated by averaging the lowest seven consecutive days of streamflow over the year. This method captures the year's most severe, sustained dry spell. Figure 2 examines high flow conditions, which are commonly calculated as the highest average flow over three consecutive days. Based on typical weather patterns, three days is an optimal length of time to capture runoff associated with large storms and peak snowmelt.

Figure 3 shows changes in the timing of spring runoff over time. This measure is limited to 55 stream gauges in areas where at least 30 percent of annual precipitation falls as snow. Scientists look at the total volume of water that passes by a gauge between January 1 and May 31 and then determine the date when exactly half of the water has gone by. This date is called the winter-spring center of volume. A long-term trend toward an earlier date suggests that spring snowmelt is happening earlier.

Indicator Notes

Measurements were taken in areas where streamflow is not highly affected by human influences, including changes in land cover. However, changes in land cover and land use over time could still influence streamflow trends at some streams. The gauges used for this indicator are not evenly distributed across the country.

Data Sources

Streamflow data were collected by the U.S. Geological Survey. These data came from a set of watersheds with minimal human impacts, which have been classified as reference gauges.[4] Daily average streamflow data are stored in the National Water Information System and are publicly available at: http://waterdata.usgs.gov/nwis.