Water Priorities for the Nation—
USGS Integrated Water Science Basins

The United States faces growing challenges to its water supply, infrastructure, and aquatic ecosystems because of population growth, climate change, floods, and droughts (National Academies of Sciences, Engineering, and Medicine, 2018). To help address these challenges, the U.S. Geological Survey (USGS) Water Resources Mission Area (WMA) is integrating recent advances in monitoring, research, and modeling to improve assessments of water availability throughout the United States. A key part of this effort is the intensive study of 10 Integrated Water Science (IWS) basins across the Nation between 2019 and 2028.

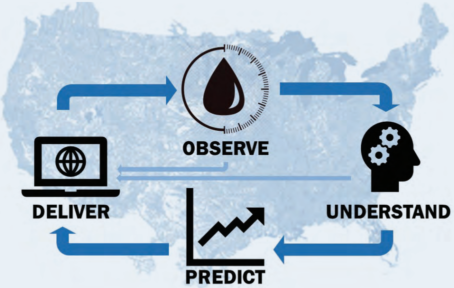
The Integrated Water Science Basin Plan—Intensive Study of Representative Basins in the United States

The goal is to study 10 IWS basins that are representative of large geographic regions across the United States (see candidates on fig. 1) and that encompass a variety of potential threats to the amount and quality of water across the Nation. Lessons learned from these smaller IWS basins (10,000–20,000 square miles in size) about the interactions among climate, human effects, surface water, groundwater, water quality, and water supply and demand will be used to help quantify and forecast water availability in the larger regions and ultimately the Nation.

Strategies for individual IWS basins will be informed by the following:

1. stakeholder input on the most pressing regional water availability issues and information needs;
2. a catalog of existing data, observation networks, and models that could be used to help assess basin and regional water availability; and
3. data and research gaps that may limit the accuracy of basin models and their broader regional application.

Once key gaps have been identified, targeted new observations and research will fill those gaps and lead to better understanding of factors that limit water availability. The new data and understanding will promote development of the most accurate basin and regional models possible. In turn, these models will be used to improve delivery of information and predictions about the Nation's water supplies, now and into the future.



Observe, understand, predict, and deliver: Each of these processes are necessary for acquiring reliable and actionable information about water availability. For example, if observing systems are not advanced, understanding is limited, as is the ability to build better models for prediction. This interdependence is why science integration is critical and why it is a priority at the USGS.

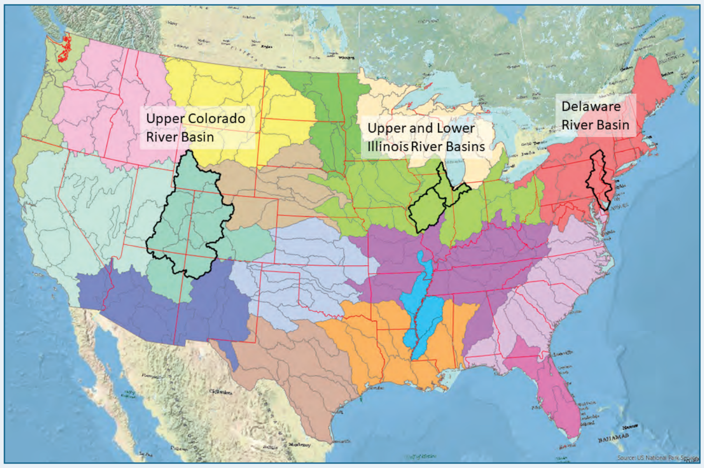


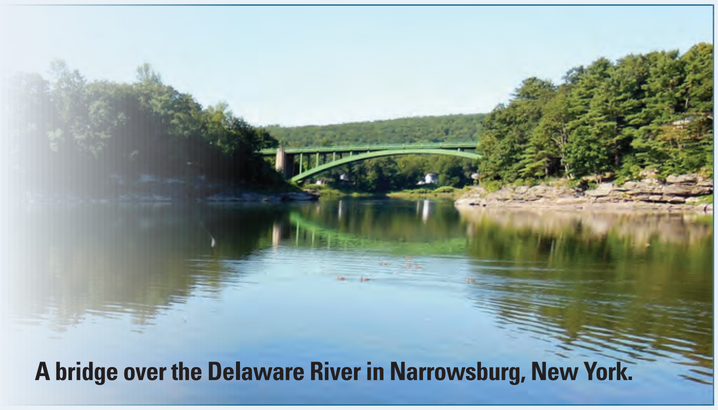
Figure 1. Candidate hydrologic regions for the Integrated Water Science (IWS) basin plan. The Delaware River Basin, the Upper Colorado River Basin, and the Upper and Lower Illinois River Basins were selected in 2019, 2020, and 2021, respectively, as IWS basins. Additional basins are planned for addition each year through 2028.

Implementing the USGS Integrated Water Science Basin Plan

IWS activities are in progress within the Delaware River, Upper Colorado River, and Upper and Lower Illinois River Basins (fig. 1), where planning began in 2019, 2020, and 2021, respectively. New basins will be added each year, as funding is available, until activities in 10 IWS basins are underway.

Basins have been or will be selected by combining stakeholder input with objective quantitative rankings that account for environmental, engineered, and social settings; ecological resources; water demand; water quality and water quantity; and changes to water resources in different regions (Van Metre and others, 2020). The end result will be the intensive study of a representative suite of basins in the United States that have diverse water availability and use attributes.

Water managers in the Delaware River Basin have a long history of developing innovative, regional solutions to ensure the long-term sustainability of this treasured resource that supplies drinking water to more than 17 million people (Hutson and others, 2016). Integrating USGS water science in the Delaware River Basin provides insights that support innovative modern water prediction and decision-support systems in a nationally important, complex interstate river system. As an example, the USGS deployed autonomous underwater vehicles in the lower Delaware River during 2019–20 to improve understanding of processes that affect current velocity, salinity, water temperature, and water quality in the Delaware Estuary. These valuable data will be used to inform models of the effects of flow management and sea-level rise on salinity intrusion.



A bridge over the Delaware River in Narrowsburg, New York.

A section of the Colorado River near Grand Junction, Colorado.

In the Upper Colorado River Basin, integrated data and models of streamflow, groundwater, evapotranspiration, snowpack, soil moisture, water quality, and water use are being developed to inform water availability assessments for the region. An integrated data-to-modeling approach in the Upper Colorado River Basin will help improve regional water prediction in other snowmelt-dominated systems in the Rocky Mountains and beyond. The approach is useful for addressing issues of water availability and water quality and for evaluating the effects of short-term climate perturbation (for example, fire and drought) and long-term climate change. As an example, the USGS is developing advanced methods for estimating the spatial variability of snow water equivalent that will be incorporated into models to improve prediction of the volume, timing, and duration of streamflow resulting from snowmelt.

The Upper and Lower Illinois River Basins provide an opportunity to conduct integrated water science in a system challenged by an overabundance of nutrients—primarily nitrogen and phosphorus—and associated harmful algal blooms that excessive nutrient loads can produce (Leland and Porter, 2000; Panno and others, 2008). These basins consist of extensive urban and agricultural land uses, which makes them an ideal setting to help improve understanding of how nutrient sources, in combination with climate and land-use change, may limit water availability.

A barge navigating the Illinois River in the Illinois River Basin.

References Cited

Hutson, S.S., Linsey, K.S., and Ludlow, R.A., Reyes, B., and Shourds, J.L., 2016, Estimated use of water in the Delaware River Basin in Delaware, New Jersey, New York, and Pennsylvania, 2010: U.S. Geological Survey Scientific Investigations Report 2015–5142, 76 p., accessed June 2021 at https://doi.org/10.3133/sir20155142.

Leland, H.V., and Porter, S.D., 2000, Distribution of benthic algae in the upper Illinois River basin in relation to geology and land use: Freshwater Biology, v. 44, p. 279–301, accessed June 2021 at https://doi.org/10.1046/j.1365-2427.2000.00536.x.

Panno, S.V., Kelly, W.R., Hackley, K.C., Hwang, H.-H., and Martinsek, A.T., 2008, Sources and fate of nitrate in the Illinois River Basin, Illinois: Journal of Hydrology, v. 359, p. 174–188, accessed June 2021 at https://doi.org/10.1016/j.jhydrol.2008.06.027.

National Academies of Sciences, Engineering, and Medicine, 2018, Future water priorities for the Nation—Directions for the U.S. Geological Survey Water Mission Area: Washington, D.C., The National Academies Press, 110 p., accessed June 2021 at https://doi.org/10.17226/25134.

Van Metre, P.C., Qi, S., Deacon, J., Dieter, C., Driscoll, J.M., Fienen, M., Kenney, T., Lambert, P., Lesmes, D., Mason, C.A., Mueller-Solger, A., Musgrove, M., Painter, J., Rosenberry, D., Sprague, L., Tesoriero, A.J., Windham-Myers, L., and Wolock, D., 2020, Prioritizing river basins for intensive monitoring and assessment by the US Geological Survey: Environmental Monitoring and Assessment, v. 192, art. 458, 17 p., accessed June 2021 at https://doi.org/10.1007/s10661-020-08403-1.

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