

Groundwater and Streamflow Information Program

Next Generation Water Observing System — the Illinois River Basin

Emergency managers and water resource managers rely on the USGS's water monitoring system and its associated water data delivery and instrument testing infrastructure to provide monitoring data to address complex water challenges involving too much, too little, or poor-quality water. Each year, floods, droughts, and water quality issues remind us of the vulnerability of our physical and socioeconomic well-being and the importance of monitoring our Nation's water. This monitoring system is currently functioning, but it was designed many decades ago to address 20th century challenges and needs major upgrades to meet the increasingly complex water challenges facing communities across the Nation. In fiscal year 2021, the USGS selected the Illinois River Basin as the third basin for implementing the Nation's next-generation integrated water observing system (NGWOS) to provide high-fidelity, real-time data on water quantity and quality necessary to support modern water prediction and decision support systems for water emergencies and daily water operations.

Substantial advances in water science, together with breakthroughs in technological and computational resources, have resulted in sophisticated new capabilities that can provide managers and decision support systems with the information, insights, and data needed to address today's water challenges. Modern models require high-density data describing the major hydrologic characteristics that the models represent, such as streamflow, evapotranspiration, water storage in snowpack, soil moisture, groundwater, and many others. However, these models and tools require more extensive observational data than the current hydrologic monitoring networks can provide.

When fully implemented, the USGS NGWOS will intensively monitor at least 10 medium-sized watersheds (10,000-20,000 square miles) and underlying aquifers that represent larger regions across the Nation. Data from this suite of watersheds will be used, alongside data from existing monitoring networks, to address data gaps that limit integrated water availability assessments and water prediction. This advanced observing system will provide quantitative information on streamflow, evapotranspiration, snowpack, soil moisture, a broad suite of water quality constituents (nutrients, salinity, turbidity, and wastewater indicators), connections between groundwater and surface water, and water use. It will be directly coupled with the National Water Model and other advanced modeling tools to provide state-of-the-art flood and drought forecasts, drive emergency and water-management decision support systems, and to provide data necessary to address difficult questions such as:

- What are the near-term and long-term risks of floods and droughts, and what scenarios change these risks?
- What factors affect water availability in basins that possess a complex mixture of urban and agricultural land use?
- How do nutrient loads influence harmful algal blooms (HABs)?
- What are the best ways to monitor for water supply contaminants such as perfluoroalkyl and polyfluoroalkyl substances (PFAS)?
- What are the best practices to inform federal state and local agencies about sediment loads in watersheds to facilitate planning of dredging operations that maintain navigable waters?

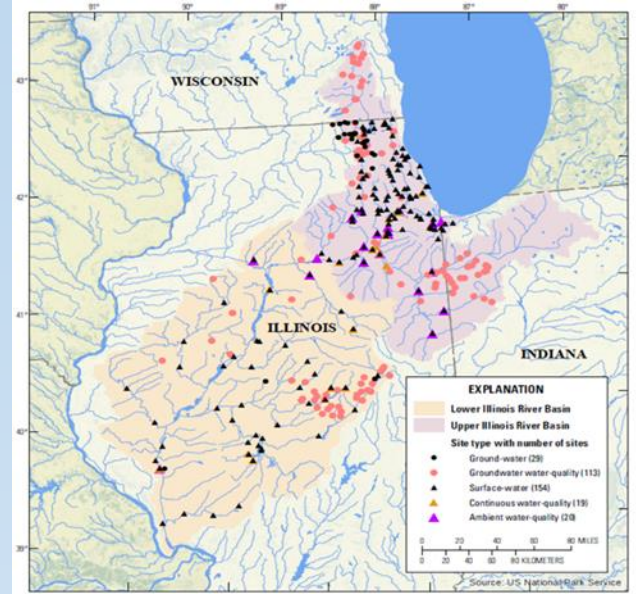


Next Generation Water Observing System in the Illinois River Basin

The USGS has selected the Illinois River Basin as its third NGWOS basin. This decision was based on rigorous quantitative ranking of US basins, input from USGS Regions and Science Centers, and feedback from targeted external stakeholders. Covering ~29,000 square miles that includes ~44% of Illinois and smaller parts of Wisconsin and Indiana, the Illinois River Basin ranked high among US basins because of its socioeconomic importance, ecological significance, and unique combination of mixed urban/rural land use. Principal economic drivers in the upper Illinois Basin are manufacturing/industry and a \$7 billion sport fishing industry in the Great Lakes. The driver in the lower basin is agriculture (corn/soybean), with Illinois' agricultural commodities generating more than \$19 billion annually. The Illinois River Basin likewise plays an important ecological role as the primary connection between the Great Lakes and the Mississippi River.

Long-term issues in the Illinois River Basin that could be informed by NGWOS include:

- **Nutrients** – The Illinois River Basin is one of the largest contributors of nitrogen and phosphorus loading to the Gulf of Mexico. While agricultural runoff from farms in the Illinois River Basin and other parts of the Mississippi River Basin is the main driver of the Gulf dead zone, urban wastewater discharges, such as those in the Illinois River Basin, are also a source of nitrogen and phosphorus delivered to the Gulf of Mexico.
- **Sediment** – Since the enactment of environmental regulations in the 1970s, water quality in the Illinois Waterway has steadily improved. However, erosion and sedimentation continue to degrade water quality in the basin and remain major issues. The US Army Corps of Engineers removes approximately 250,000 cubic yards of sediment from the Illinois Waterway each year for the operation and maintenance of the inland waterway navigation system which is essential to the economy of the Midwest and the Nation.
- **Harmful algal blooms (HABS)** – In Illinois, algal blooms typically occur during the warm-weather months of June through September. Blue-green algae are often present in Illinois lakes in small or moderate amounts, but can grow and proliferate quickly in warm, fresh water that is rich with nutrients. In recent years, extended periods of warm summer weather and a supply of nutrient-laden runoff have combined to produce an increasing number of reports of harmful algal blooms.
- **Water availability** – Water availability is an increasingly important issue within the Illinois River Basin. Population growth in northeastern Illinois and declining regional aquifer (Cambrian-Ordovician aquifer) levels and water quality (radium issues) have municipalities carefully planning water supplies for the future.
- **Urban flooding** – Development of improved water observing systems are needed to protect life and property during major flood events. Urban flooding causes a disproportionate amount of the total monetary damages related to flooding in the Illinois River Basin. New monitoring technology and deployments of relatively low cost and spatially dense arrays of sensors in urban watersheds are needed to further understand the causes and underpinnings of urban flooding as well as prepare for and respond to urban flooding.
- **Emerging contaminants** – The term “emerging contaminants” refers to many kinds of chemicals, including medicines, personal care or household cleaning products, lawn care, and agricultural products, among others. These chemicals enter our Nation's lakes and rivers and have a detrimental effect on fish and other aquatic species. The risk they pose to human health and the environment is not yet fully understood. Several cities within the Illinois River basin have reported perfluoroalkyl and polyfluoroalkyl substances (PFAS) detections within their municipal drinking water systems.



An integrated data-to-modeling approach in the Illinois River Basin will help improve regional water-availability assessments and water prediction in mixed urban/agricultural landscapes in the midwestern US and beyond. Planning and stakeholder engagement for the NGWOS in the Illinois River Basin will begin in fiscal year 2021.

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Next Generation Water Observing System <https://www.usgs.gov/NextGenWOS>