

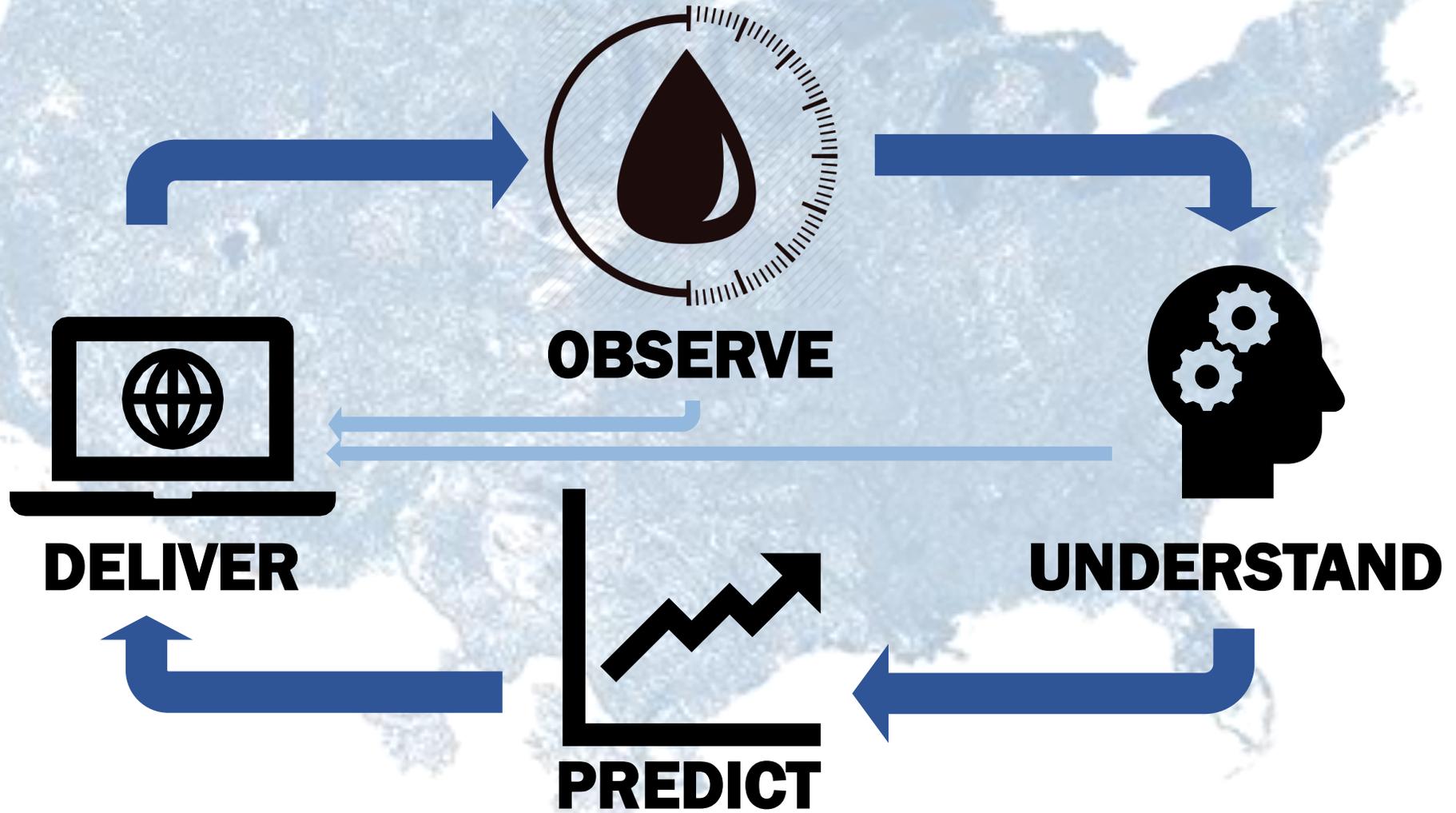
Update on USGS Integrated Water Monitoring Initiatives

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Integrated Water Science Process



Integrated Water Science Initiative



Next Generation Water Observing System (NGWOS)

NGWOS collects real-time data on water quantity and quality in more affordable, rapid, and intensive ways than has previously been possible. The flexible monitoring approach enables USGS networks to evolve with new technology and emerging threats.



Integrated Water Availability Assessments (IWAA)

IWAAs examine the supply, use, and availability of the nation's water. These regional and national assessments evaluate water quantity and quality in both surface and groundwater, as related to human and ecosystem needs and as affected by human and natural influences.



Integrated Water Prediction (IWP)

IWP builds a powerful set of modeling tools to predict the amount and quality of surface and groundwater, now and into the future. These models use the best available science to provide information for more rivers and aquifers than can be directly monitored.



National Water Information System (NWIS) Modernization; National Water Dashboard

NWIS data systems that house USGS water information are being modernized to maximize data integrity, simplify data delivery to the general public, automate early warning to enable faster response times during water emergencies, and support the new National Water Dashboard.



Integrated Water Science Basins

10 Intensive Reference Basins to Drive the Future of Integrated Water Science:

- Regional focus areas for intensive observation, assessments, modeling, and prediction
- 10 river basins (10,000-20,000 mi²) representative of larger water-resource regions
- Goal: Establish 10 basins in 10 years
- Develop a deep, integrated understanding that can be extended to the broader region
- Basin selection process includes quantitative metrics and extensive stakeholder engagement



Components of the Integrated Water Science Basins



Catalog existing observational networks, models, and data repositories and identify monitoring and knowledge gaps.



Establish integrated set of fixed and mobile monitoring assets in the water, ground, and air to fill data gaps.



Conduct targeted hydrologic research to fill knowledge gaps.



Use new data and knowledge to develop improved basin models.



Use models to assess past, current, and future water availability – including water quantity, quality, and use.

National Target Integrated Water Science Basin Issues



Water quantity – Precipitation, snow accumulation/melt, soil moisture, evapotranspiration, infiltration, recharge, and runoff, and their influence on surface-water and groundwater storage.

Water quality – Nutrients, salinity, sediment, and temperature in surface water and groundwater. Additional topics may include PFAS, metals, pesticides, and other organics.

Water use – Public supply, irrigation, thermoelectric power, and water diversions/inter-basin transfers. Additional topics may include domestic supply, self-supplied industrial, mining, livestock, and aquaculture uses.

Ecological communities – Algae, bacteria, fish, macroinvertebrates.

Climatic and socioeconomic factors – Climatic effects on precipitation, temperature, drought, and atmospheric circulation; socioeconomic drivers of supply, demand, and use; and land cover effects on hydrologic processes.

Steps for Selecting Integrated Water Science Basins



1. USGS Leadership establishes target Hydrologic Regions for next IWS Basin
2. Prioritize targeted Hydrologic Region(s) based on quantitative rankings of candidate HUC04 basins (*VanMetre et al, 2020*)
3. Solicit/review input on basin nominations/priorities from Regions, local USGS Science Centers
4. Engage national and regional stakeholders in each potential Region to understand science and monitoring gaps/priorities, and upcoming initiatives
5. Recommend potential basins to WMA Leadership for final selection
6. Select next IWS Basin



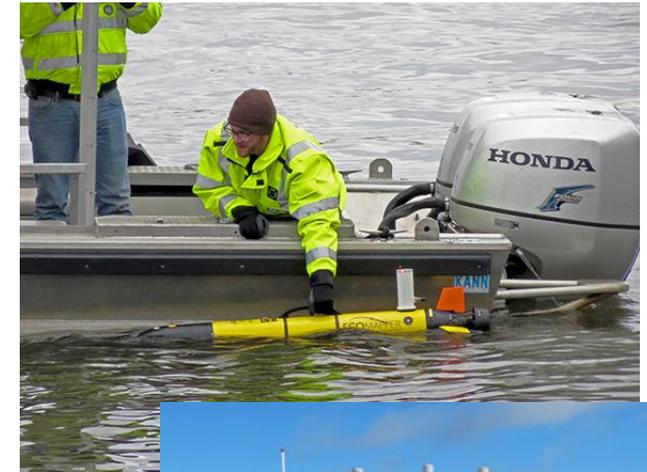
Integrated Water Science OBSERVE / DELIVER



The USGS Next Generation Water Observing System (NGWOS) will provide high-resolution, real-time data on water quantity, quality, and use in Integrated Water Science Basins to support National modern water-availability prediction and decision support systems

- Approach

- Increases spatial and temporal coverage of critical data
- Dense array of sensors at selected sites
- Use state-of-the-art data collection methods
- Test and mature new technologies
- Improved USGS operational efficiency
- Modernized and timely data storage and delivery



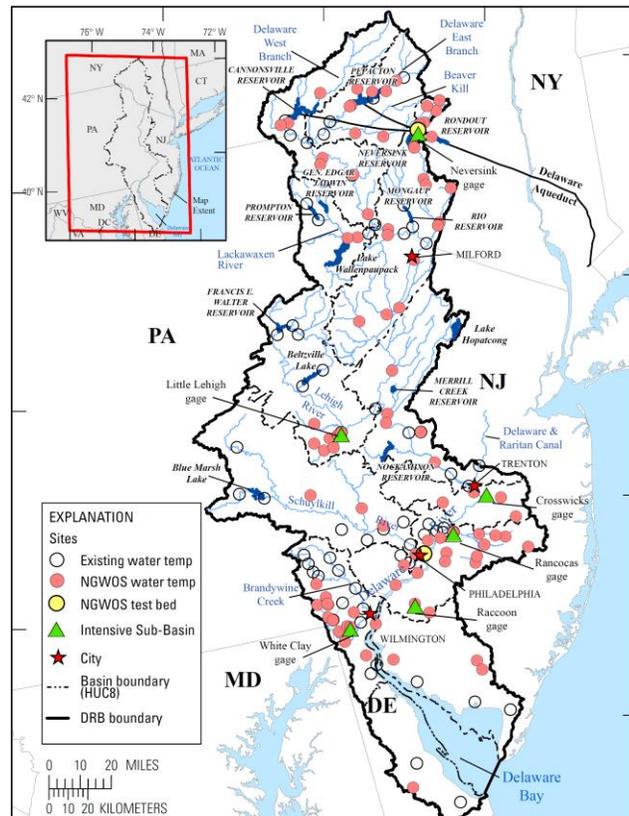
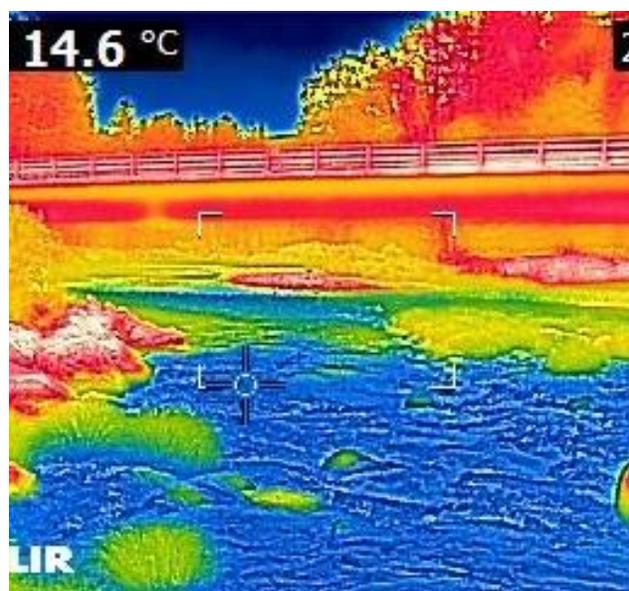
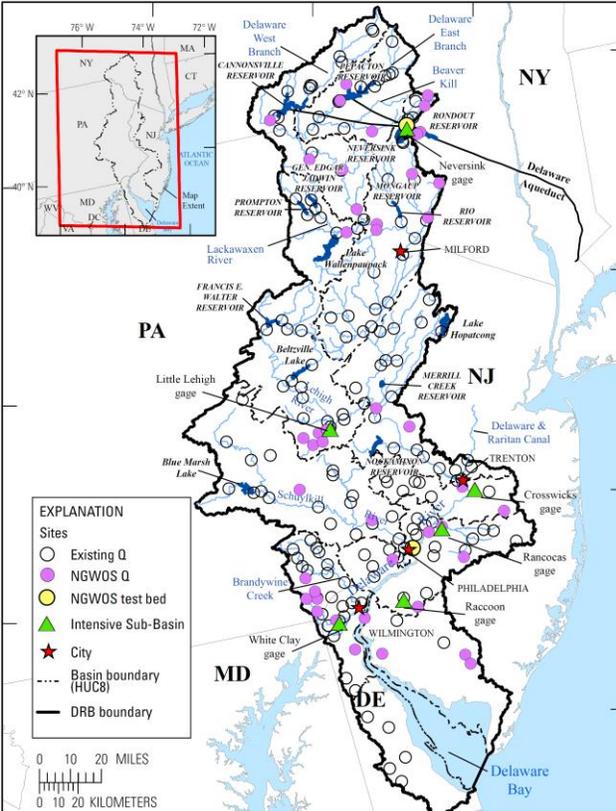
Increasing Network Density

Delaware River Basin

- 50 new or re-activated streamgages
- 99 new or re-activated temperature sites
- 64 new or re-activated salinity / specific conductance sites
- Guided by gap analysis / network design studies
- Enhancements to communications
- Evaluation of new technologies (non-contact sensors, UAS-based discharge/temp measurements)

Upper Colorado

- Adding new snow monitoring, test beds, ASO research
- New streamflow stations
- Monitoring groundwater to streams
- Adding and upgrading real-time/discrete water-quality stations downstream of recently burned areas in the UCOL for evaluation of post-fire impacts on water-quality.



Synoptic Surveys

Delaware River Basin Examples

High spatial intensity, short duration monitoring that extends understanding from high temporal intensity sites

Salinity front mapping in the lower Delaware River

- Two AUV (ecomappers) deployed
- Cross sectional mapping at key locations
- Summer 2020 mainstem dissolved oxygen survey delayed to 2021

Salinity front mapping in aquifer

- Electromagnetic mapping using a towed time domain EM unit to map the fresh to saline groundwater transition



Innovation Test Beds

Sites for testing / methods development

Independent Seaport Museum, PA

- Core measurements will include discharge, water quality (including nitrate), camera
- Temp/salinity string, lower cost nitrate sensor, e. coli sensor, UAS testing
- Significant opportunity for outreach / engagement with museum

Neversink Basin, NY

- measuring ET, soil moisture, snowpack, GW-SW interaction and water quantity / quality
- FY20 planned tests – thermal imaging, UAS, soil moisture sensors, snowpack sensors, sediment sensors
- Protocols and methods development

Upper Colorado

- Stations equipped with multiple new sensors for measuring snow-water equivalent, snow density, liquid water content, snow depth, soil moisture, and meteorological parameters.
- NextGen SWE sensors and non-contact streamgages to allow for model evaluation of natural streamflow from the test-bed basins



Highlights of 2021 Planned DRB NGWOS Activities

- SALINITY: Aquifer saltwater intrusion monitoring; Tidal discharge monitoring in upper DRB estuary; Road salt monitoring in DE; Continuous SC monitoring ~50 sites; SC-Cl surrogates; Synoptic survey in the estuary
- STREAMFLOW: ~50 new gages; Water budget monitoring; Enhanced reservoir monitoring; Isotope hydrology; Flow permanence database/monitoring; Expansion of Precip/ET network; Gradient self-potential mapping of gaining and losing zones of Delaware River
- TEMP: Air-water combo sensing; Thermal cameras at additional selected gages; 100 continuous sensors at gages; Synoptic sensors for gw-sw interactions; remote sensing of historic temperature;
- R&D: testing / methods development includes ongoing evaluations of cameras for stage and velocity estimation, ice detection; in situ e. coli sensor testing; long-range, low-power communications testing; autonomous surface / underwater vehicles for water quality and bathymetry.

Highlights of 2021 Planned UCOL NGWOS Activities

- **SNOW to STREAMFLOW MONITORING:**
 - Snow test-bed sites with two snow-observation locations (one above tree line and one below tree line) equipped with multiple sensors for measuring snow-water equivalent, snow density, liquid water content, snow depth, soil moisture, and meteorological parameters; also includes a non-contact stream gages.
 - ASO flights in Fraser River watershed with ground-truth measurements.
 - Operationalize drone-mounted ground-penetrating radar to measure snow depth, volume, and stratigraphy
 - More than 20 additional streamgages, including non-contact technology, in ungagged areas to support snow monitoring
- **GROUNDWATER to STREAMS:**
 - Application of ground-based geophysical techniques and potentially a forward-looking infrared camera to identify groundwater-recharge and -discharge zones in French Gulch.
 - IWS basin-wide monitoring of water isotopes in surface water and precipitation to evaluate relative contribution of groundwater.
- **WATER QUALITY and SEDIMENT MONITORING:**
 - Network of real-time water-quality sondes at key locations
 - Piloting eDNA collection at streamgages in the basin
 - Novel bedload and suspended sediment monitoring

Highlights of 2021 Planned ILRB NGWOS Activities

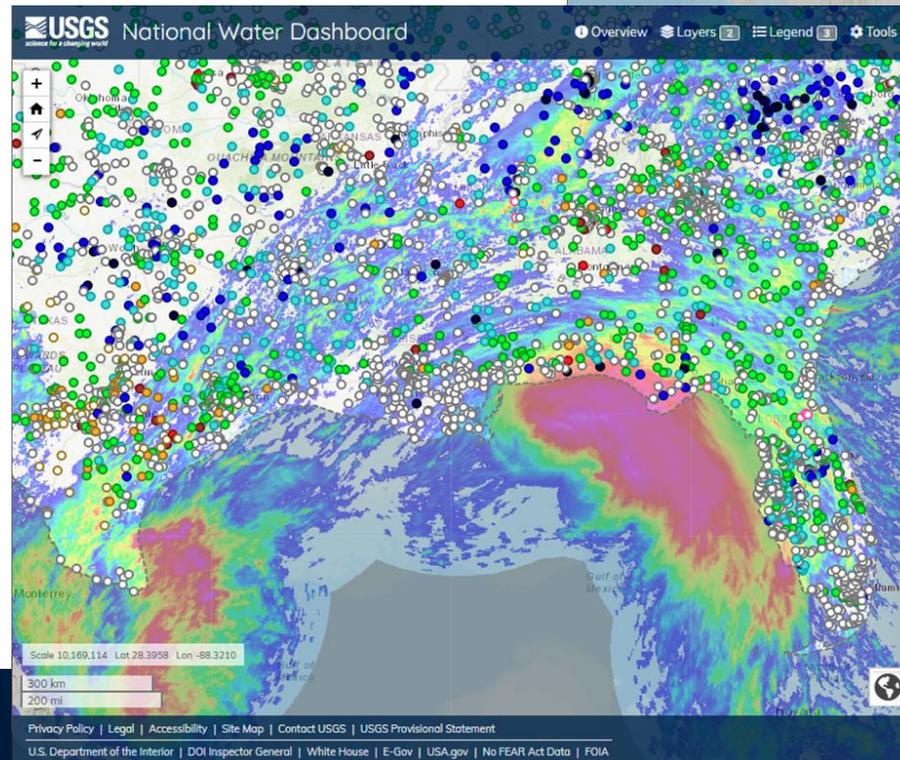
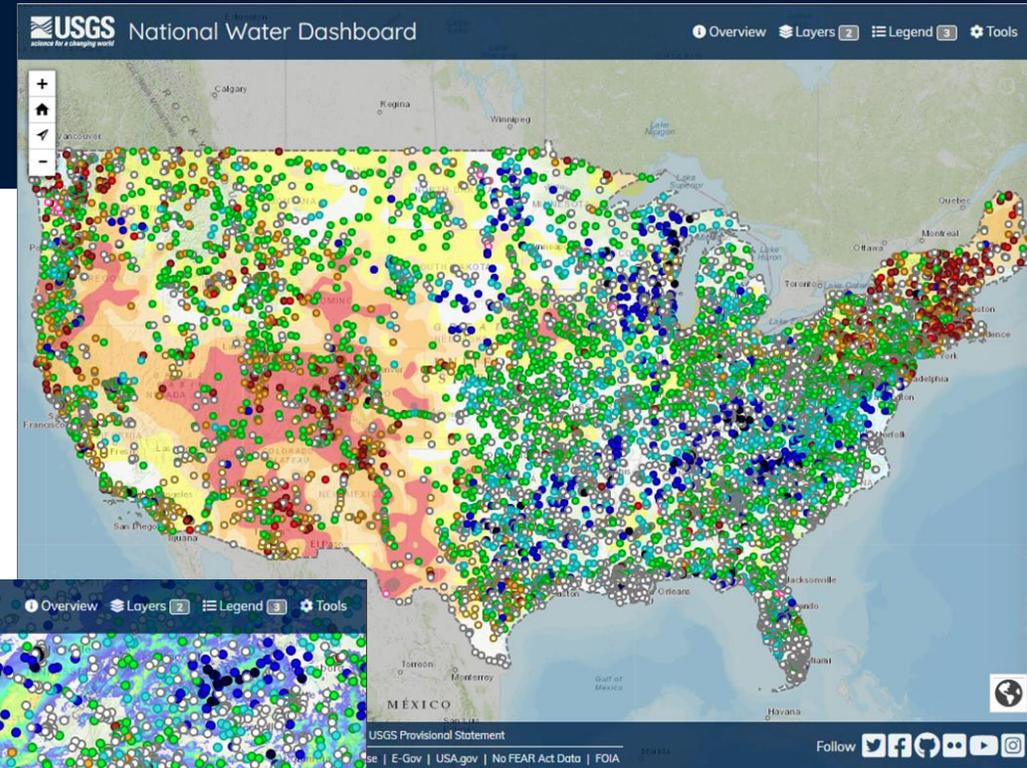
- **NUTRIENTS:**
 - New nutrient monitoring at 6 sites that fill data gaps.
- **HABs:**
 - Collect baseline algal community data.
 - Install multispectral cameras at 2 existing supergage sites.
 - Install real-time video camera and multi-spectral camera at selected locations
 - Synoptic survey w/ HABs instruments at 15 sites.
 - Co-locate multisensory fluorometers for a Proxies study.
 - Passive samplers for algal toxins (SPATT samplers).
 - Support/expand USGS multispectral library.
 - Mobile HABs platform-vessel-mounted.
- **URBAN HYDROLOGY:**
 - Installation of high-density monitoring of a selected sewershed in under-served area of Chicago
- **WATER CHEMISTRY:**
 - Establish baseline sampling for emerging contaminants at selected sites
 - Deploy next-gen fluorometers at selected supergage sites to look for proxy relations targeting PFAS, HABs and metals

National Water Dashboard

NATIONAL WATER DASHBOARD

(Experimental Release - October 2020):

- The NWD presents real-time stream, lake and reservoir, precipitation and groundwater data for more than 13,500 USGS real-time observation stations across the country.
- Monitoring data shown along with weather data such as radar, watches and warnings, past precipitation totals, precipitation forecasts and drought conditions from other sources.
- The NWD will also link to the USGS WaterAlert system, which sends out instant, customized updates about water conditions



Select Highlights of New 2021 National Observing Activities

- INSTRUMENTATION R&D:
 - Test and, as appropriate, transition new and innovative hydrologic monitoring related techniques, methods, and instrumentation. (AUVs, Real-time P, algal classification, and e coli sensors)
 - Camera innovations (storage/processing, stage estimation, ice detection)
 - Implementation and testing of new telemetry systems
- DISCRETE SAMPLING R&D:
 - Develop, test, identify, and document procedures that allow for collection of a representative water samples for the analysis of PFAS, that is reproducible within defined limits of variability.
- REMOTE SENSING R&D:
 - Evaluate technologically ready approaches for remotely sensing water quality and to develop an IT framework for data processing, display, and delivery.
- NATIONAL TEMPERATURE DATA:
 - Promote expanded delivery of historic and future water temperature observations across the Nation.

Questions?

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Threatened Federal Priority Streamgages

- The FPS program has been flat funded since 2016.
- FPS Network costs have continued to increase by 1%-3% every year due to increases in salary, travel, equipment, and communication costs.
- Cost increases have been covered by 1) USGS partners, where gages are jointly funded, or 2) delaying planned network enhancements where possible.
- Network enhancements can no longer be delayed, and operational costs are estimated to increase another 1%-3%.
- As a result, gages will begin to be discontinued in FY2021, if additional funds are not provided.

Number of Threatened Federal Priority Streamgages FY2021

