Restructuring USGS Water Programs and New Directions for Water Quality

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Overview

To meet 21st century water resource challenges USGS Water Mission Area is planning

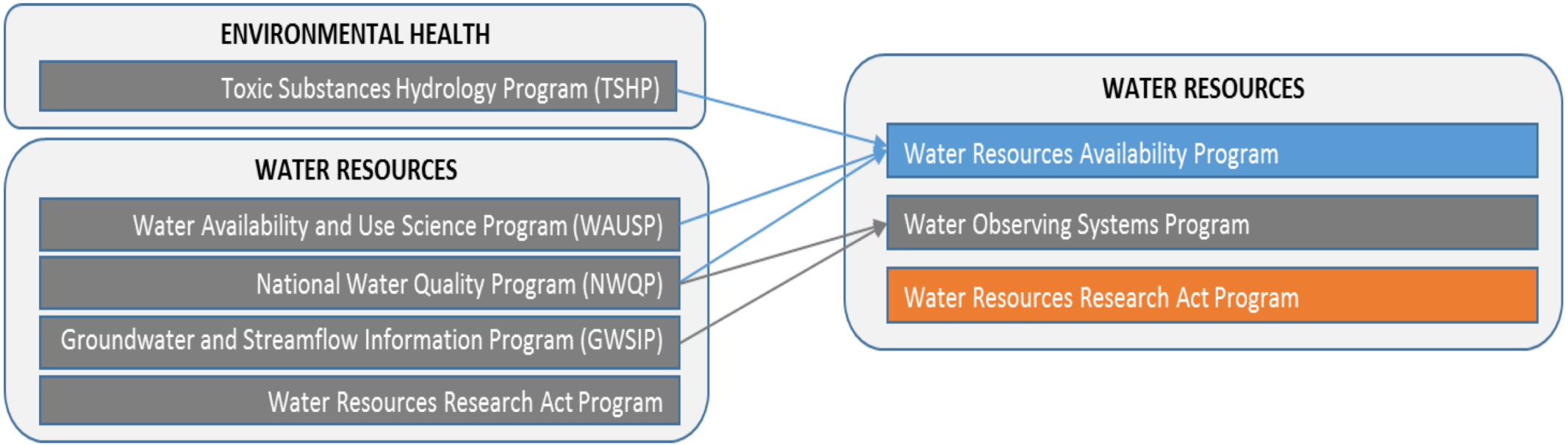
- targeted enhancements to USGS water observing systems, and
- strategic investments in research, modeling, and assessments that will advance water prediction capabilities and yield integrated water availability assessments

To support these goals the Water Mission Area is restructuring our budget programs and establishing new science priorities

What's happening: Program Restructuring

Technical adjustments being proposed as part of the FY20 budget to improve integration of programs and align resources more effectively include:

- Consolidates 4 current Water Mission Area programs into 3 programs
- Realigns the Toxic Substances Hydrology Program, previously part of the Environmental Health Mission Area, into the Water Mission Area.



Water Observing Systems Program (WOSP)

- Encompasses WMA objectives to collect, manage, and disseminate high-quality water data in real time and over long term
- Provides information for managing Nation's water resources and responding to water hazards that can result in loss of life and property
- Will be responsible for implementing WMA priorities for next generation observing systems for water quantity and quality
- Operates real-time and long-term monitoring networks for:
  - ✓ Streamflow (National Streamflow Information Program)
  - ✓ Groundwater (National Groundwater Monitoring Network, other water level networks)
  - ✓ Water quality including SW, GW, and atmospheric deposition (NAWQA, NADP)

Water Resources Availability Program (WRAP)

- Fulfills goals established in SECURE Water Act and National Water Census to improve understanding of Nation's water availability
- WRAP will:
  - ✓ Conduct regional/national water availability assessments, inclusive of water quantity and quality, for human and ecological uses
  - ✓ Evaluate long-term trends in water availability (quantity, quality and use)
  - ✓ Provide seasonal to decadal forecasts of water availability
  - ✓ Support socioeconomic and water resource management through science, data delivery, and decision support tools
- Water-quality related research, assessment, and modeling activities conducted by NAWQA and Toxics will funded by WRAP

What's Happening: NAWQA will end in FY21

To support new WMA Science priorities the National Water Quality Assessment (NAWQA) Project will complete all Cycle 3 assessment activities by FY21

- **Reports:** By the end of FY21, all NAWQA products identified in a Cycle 3 transition plan will be completed
- **Monitoring:** During FY19-FY21, long-term discrete water-quality monitoring networks will continue to operate
  - Changes in long-term WQ monitoring networks may start in FY22
  - However, some changes will take place at the start of FY20:
    - Planned biological sampling for fish, macroinvertebrates, and algal communities at NWQN sites will end starting in FY20.
    - Sampling of NAWQA groundwater enhanced trends networks (ETNs) and vertical flow path studies (VFPS) will end starting in FY20
    - Implement modified pesticide analytical schedule with fewer compounds in long-term stream and river monitoring network in FY20 (Consult with OPP on compounds to retain)

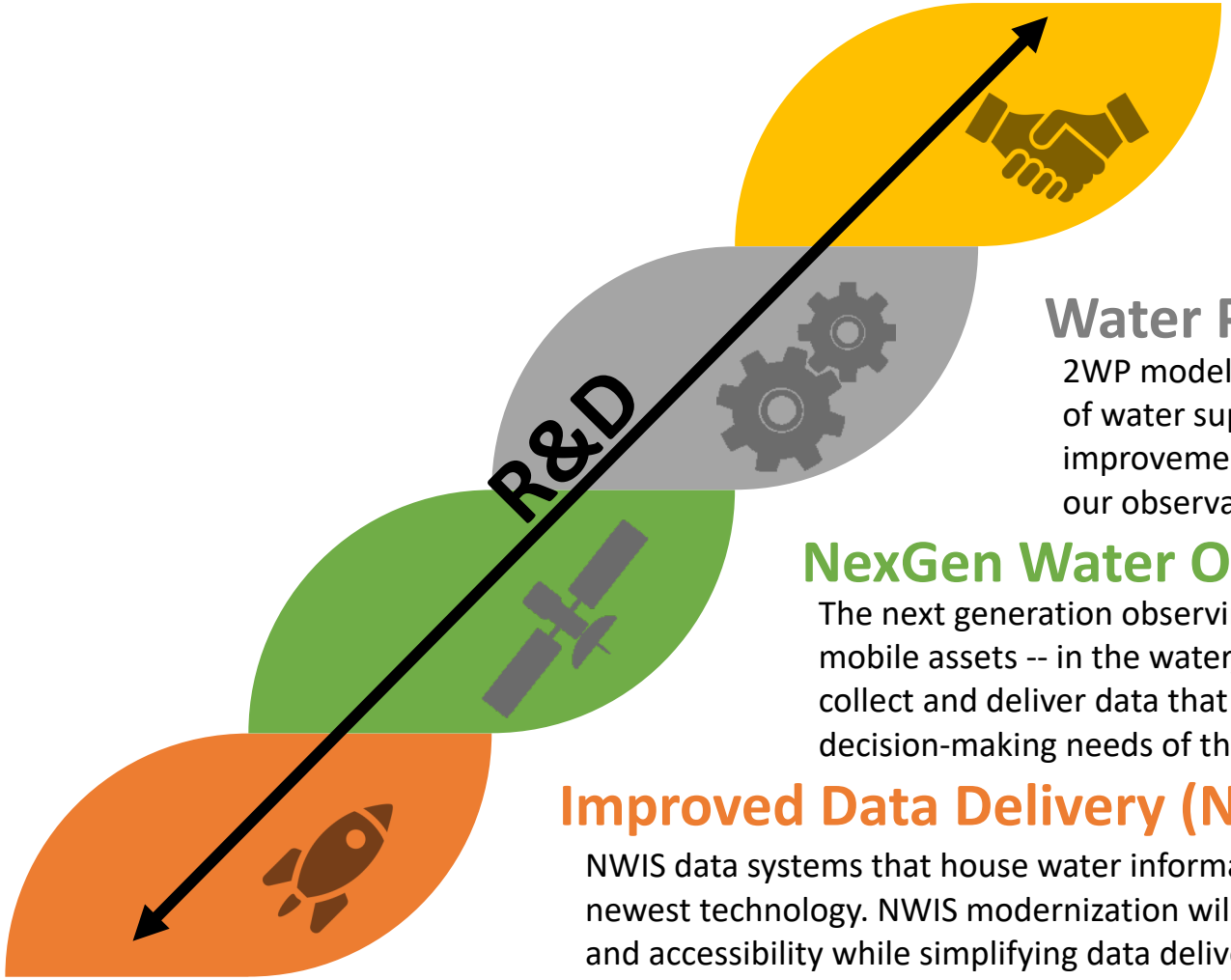
Why is this Happening?

- To align future water activities so they support the 4 new WMA priorities, which are driven by:
  - USGS Water Science Strategy
  - Recommendations in National Academy of Science report: "*Future Water Priorities for the Nation: Directions for the U.S. Geological Survey Water Mission Area*"
  - Input from Water Sub-Cabinet (USGS tasked with advancing water prediction via enhanced data collection and integrated models)
  - Input from USGS Water Science Centers and WMA stakeholders
- WMA has had flat funding for many years
  - New priorities have seen strong support from Congress (FY19 increase of $7M for Next Generation Water Observing System)

When is this Happening?

- If approved by Congress, new funding program structure would take effect on October 1, 2019
- NAWQA transition period is FY20-21
- Planning for new WMA work programs (NGWOS, 2WP, IWAAs, and NWIS Modernization) that support new science priorities: FY19-20
- Pilot NGWOS and IWAAs studies in Delaware River Basin and TBD basin in western U.S. FY19-21
- Implementation of new WMA work programs: FY21 and beyond

What's Happening: New WMA Priorities



Integrated Water Availability Assessments

IWAAs evaluate water availability in terms of the spatial and temporal distribution of water quantity and quality in both surface and groundwater, as related to human and ecosystem needs and as affected by human and natural influences.

Water Prediction Work Program (2WP)

2WP model predictions will support daily to decadal forecast-based management of water supplies and infrastructure at a regional and National extent through improvement of existing tools and development of new capacity supported by our observational data and data collected by other monitoring organizations.

NexGen Water Observing System (NGWOS)

The next generation observing systems (NGWOS) is an integrated set of fixed and mobile assets -- in the water, on the ground and in the air-- that will measure, collect and deliver data that can help address water resource challenges and decision-making needs of the future.

Improved Data Delivery (NWIS Modernization)

NWIS data systems that house water information will be modernized to the newest technology. NWIS modernization will maximize data integrity, reliability, and accessibility while simplifying data delivery to the general public.

What are potential impacts wrt to USGS water-quality work?

- Some monitoring and assessment work done by NAWQA and Toxics Program will be reduced or eliminated over FY20-21
- As part of NGWOS, increased use of in-situ sensors and remote sensing methods to monitor water-quality
- Under flat funding scenario this could result in less discrete water-quality and ecological monitoring at the national scale
- Increased use of surrogate models that relate sensor-based measurements, discrete sample data, and flow forecasts to support short-term WQ forecasts
- Shift towards integrated water availability assessments that evaluate quantity, quality, and use holistically
- Impacts to research performed by Toxics Substances Hydrology Program on CECs, HABs, contaminant fate and transport, and health effects TBD

Improve Information Delivery

- Modernize NWIS to maximize data integrity, reliability, accessibility while simplifying data delivery to the general public. This includes:
  - Upgrading NWIS data systems with latest technology
  - More rapid and accessible data delivery to support near-real time forecasts of water hazards and water availability
  - Develop decision support tools to aid in managing water supplies, flooding, drought, inundation, debris flow, water quality degradation, or other water-related hazards during extreme events and under future scenarios of changing population and climate.
  - Produce lean, consistent portfolio of national-scale water web applications available through a mobile-friendly and unified online presence.

Next Generation Water Observing System (NGWOS)

- An integrated set of fixed and mobile assets in the water, on the ground, and in the air, that will measure, collect, and deliver high temporal and spatial resolution water (quality) data in real-time
- The NGWOS strategy is to develop highly-instrumented networks in 10 medium-sized watersheds, ranging in size from about 10,000 to 20,000 square miles, that are representative of larger water-resource regions

Next Generation Water Observing System (NGWOS)

When fully implemented, the NGWOS will provide field and remote sensing data on:

- Streamflow;
- Water cycle components (ET, snowpack, soil moisture);
- Broad suite of water quality constituents that affect availability
  - Basic water-quality properties (temp, specific conductance, pH, DO, turbidity)
  - Nitrate, algal pigments, dissolved organic matter
  - Surrogate measures (TP, SSC, salinity, hardness, bacteria, metals, organics?)
- Connections between groundwater and surface water, and
- Water use

NGWOS Pilot in the Delaware

An opportunity to develop an integrated water observing system to support innovative modern water prediction and decision support systems in a nationally important, complex interstate river system.

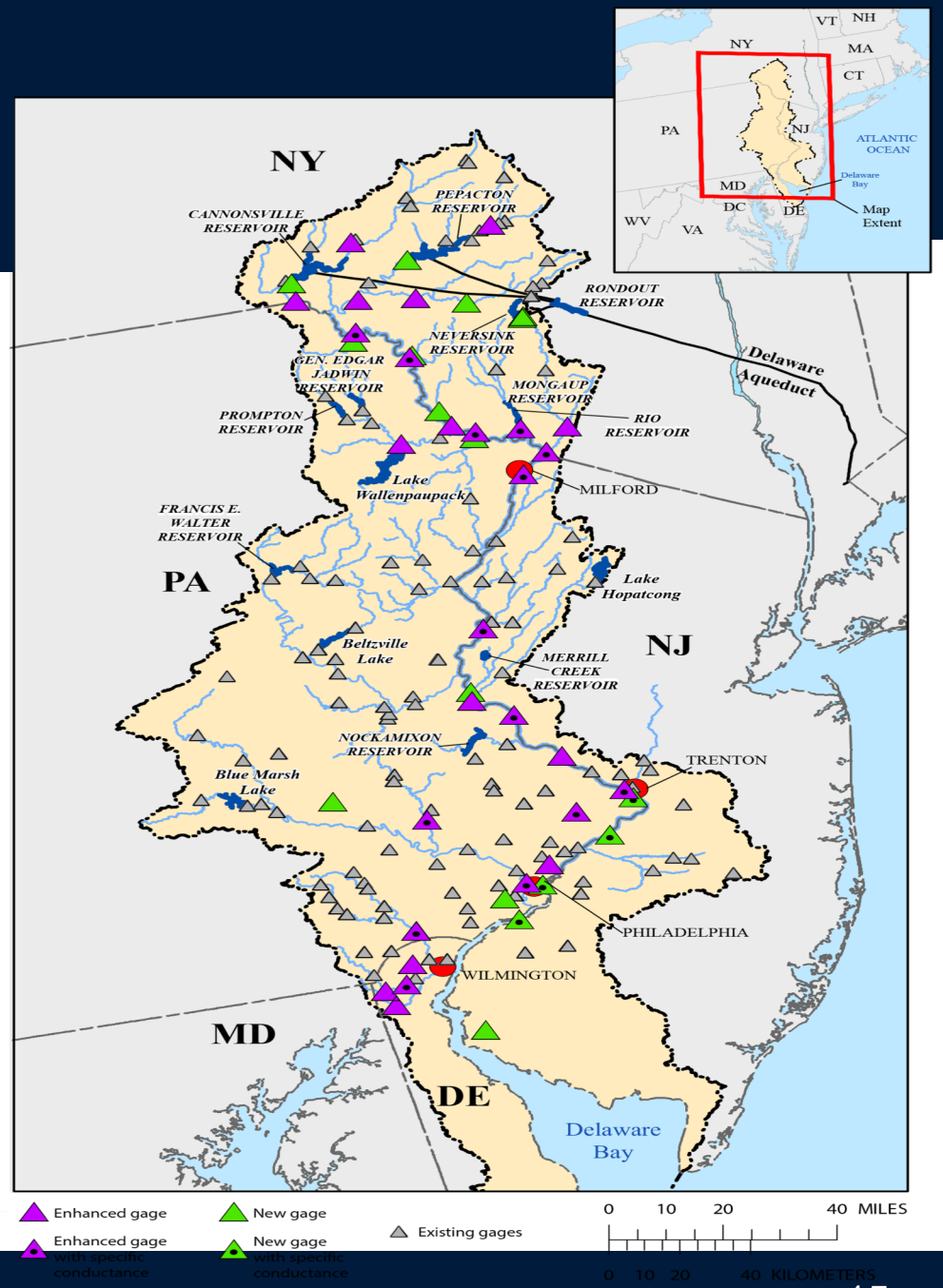
The Delaware River Basin

- Ecologically diverse and critical to the regional and national economy;
- Provides drinking water to over 15 million people;
- Long history of innovative, regional solutions to insure the long-term sustainability of this treasured resource.

Pilot NGWOS work in the Delaware begin in FY18

Pilot NGWOS Activities in the Delaware River Basin

- 17 new streamgages
- Enhanced 38 existing gages with temperature and specific conductance sensors
- Building infrastructure for advanced sensor platforms including nitrate, FDOM, and algal pigment sensors
- Data collection in support of other 2WP and IWAAs water-quality pilots

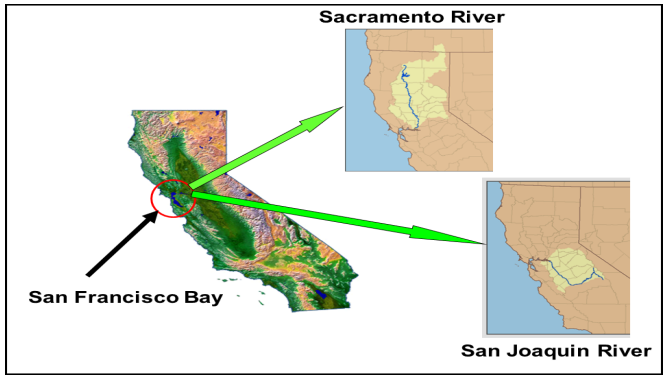


Water Prediction Work Program (2WP)

- Develop operational prediction capabilities for stream temperature, surficial processes, and in-stream transport of sediment and selected water-quality constituents across conterminous U.S.
- Goals include:
  - Improve predictive water modeling capabilities over a range of spatial scales (watershed to national) and temporal scales (short-term forecasting to management timescales) for
    - Hydrologic processes (streamflow, surface-water/groundwater interactions
    - Stream temperature
    - Suspended sediment
    - Selected water-quality constituents
  - Cultivate a broad collaborative community to enable productive research collaborations.

Prediction Across Space

- 2WP will be designed to support **national** scale and **hyper-resolution** scale predictive tools
  - National scale is the continental US (“CONUS”)
- Hyper-resolution is potentially anything below national scale e.g.
  - Watershed
  - Sub-watershed
  - Stream reach



Prediction Across Time

- 2WP predictions will be made across three time steps:
  - Short-range forecasts (hours to daily, to monthly)
  - Medium-range forecasts (seasonal to annual)
  - Long range forecasts (annual to multi-decadal)

- This provides capabilities for applications ranging from near real-time with nowcasts (e.g. spills or floods), to years or decades as a planning tool (e.g. water availability or water quality)

How will Water Quality Change? – 2WP National Forecasting of Constituents

Priority Constituents for Forecasting:

▪ nitrogen ▪ total dissolved solids ▪ total suspended solids ▪ phosphorus ▪ dissolved oxygen

▪ turbidity ▪ pH ▪ pathogens ▪ trace metals ▪ HABS indicators ▪ organic contaminants

Data Synthesis:

- high-value but underutilized data scaled wall-to-wall
- long-term model scenario building
- model-informed data needs from NGWOS

Short-term Forecasting:

- quick-slowflow dynamics of constituent sourcing to rivers
- flood-driven water-quality change
- river concentration forecasting including river spill transport estimation

Long-term Forecasting:

- coupled hydro-chemical modeling of alterations in urban/agricultural areas
- high-resolution feature modeling to quantify best management practices, e.g. tillage, pond/riparian management, stream restoration
- advanced constituent modeling, e.g. concentration saturation, coupled constituents (nitrogen/phosphorus/TSS, O_2, pathogens-turbidity)

Hour – Event – Month ← | → **Season – Annual – Decades**

▪ exceedance warnings for water intakes and recreational users

▪ river spill contaminant transport

▪ prioritize effective management practices

▪ preserve ecosystem functions and services

▪ anticipate emerging water challenges

Integrated Water Availability Assessments (IWAAs)

The IWAAs are designed to provide information to meet the goals of the National Water Census as established through the SECURE Water Act.

Objectives of IWAAs are:

- Evaluate current water supply and demand and factors that influence water availability
- Evaluate long-term trends in water availability and their causes
- Provide seasonal to decadal forecasts of water availability
- Support socioeconomic and water resource management through science, data delivery, and decision support tools

IWAA Scales

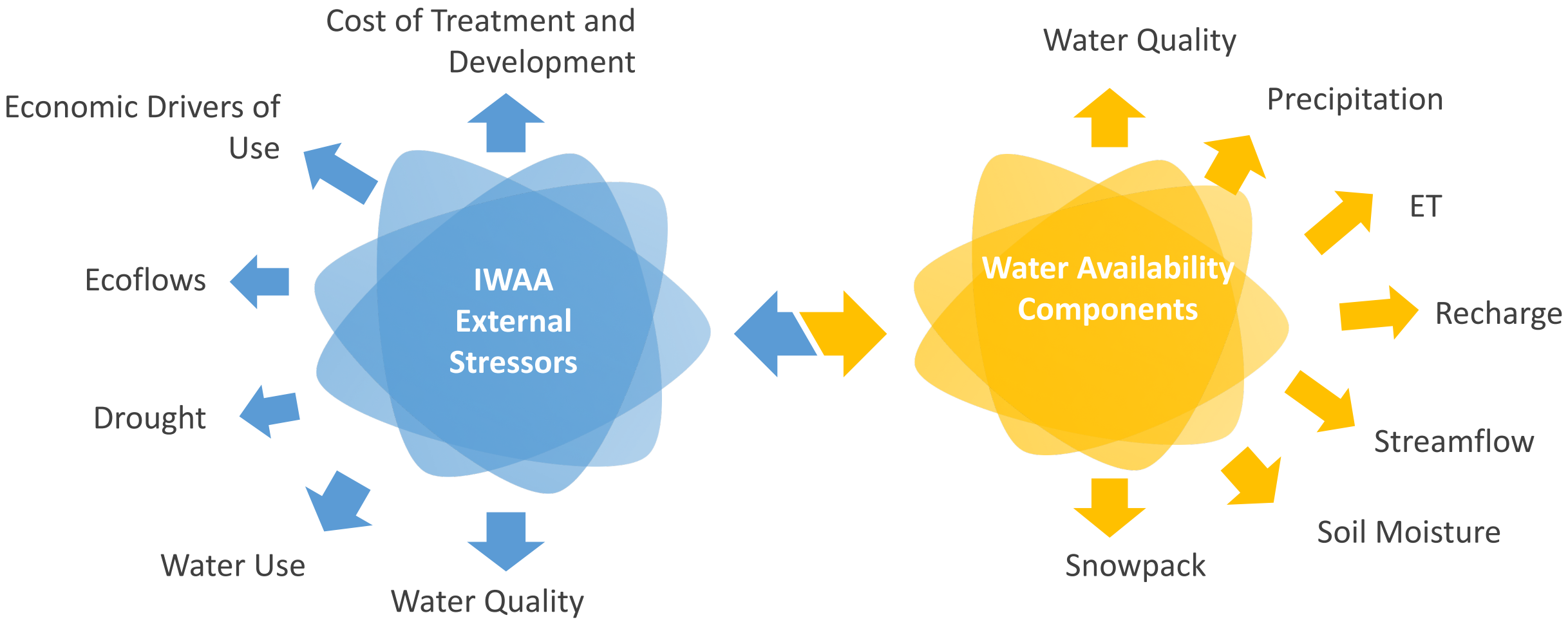
Periodic National Assessments

- Maps of "availability"
- Range of change scenarios

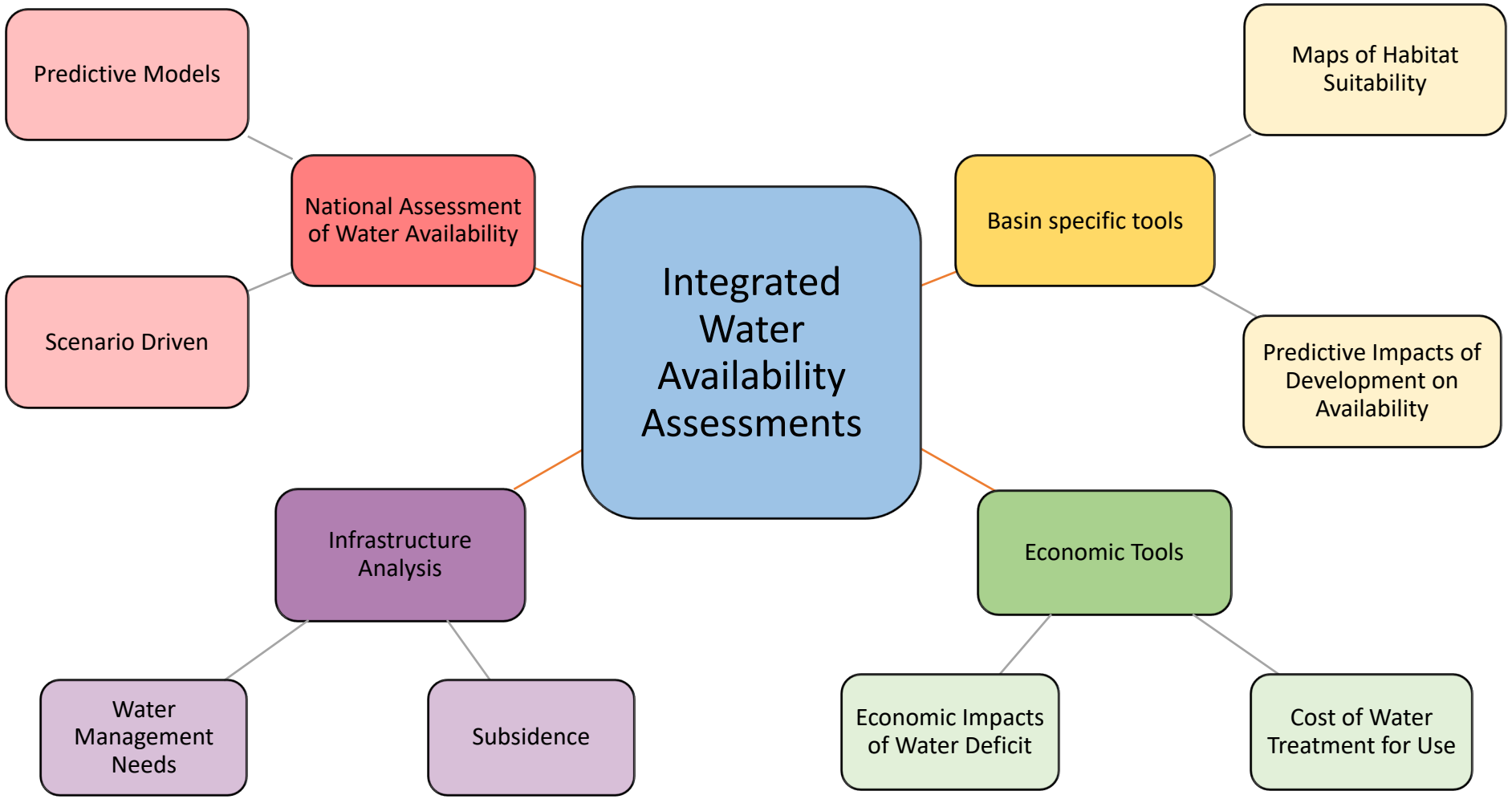
Basin Specific Assessments

- Stakeholder driven
- Improve and Inform National Assessments

IWAA
Stressors and Components



Potential IWAA Products



Take Home Messages

- WMA budget restructuring will not have significant impacts on the amount of funding spent on water quality monitoring, research, assessment, and modeling work conducted by USGS
- However, what, when, and where that work will be conducted will be shaped by the new WMA science priorities
- Significant opportunities for EPA-USGS-Council collaboration on water-quality topics of mutual interest exist
- More details will become available at planning efforts mature