Federal Action Plan

for

Improving Forecasts of Water Availability

Prepared Pursuant to Section 3 of the October 19, 2018 Presidential Memorandum on Promoting the Reliable Supply and Delivery of Water in the West

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Preface

On October 19, 2018, President Trump signed a Presidential Memorandum (PM) on Promoting the Reliable Supply and Delivery of Water in the West. This timely order recognizes the critical nature of water in the Western United States in terms of national security, community sustainability, and economic resilience from mountain towns in the headwaters to thriving cities along the coast. It addresses the growing need to improve water prediction, information, and related services to better inform critical decisions related to water management and use to promote the most efficient and pragmatic use of water, especially in light of competing demands. Moreover, this order recognizes that effectively addressing this challenge requires the integrated capabilities of more than one Federal agency, with leadership provided by the Departments of Commerce (DOC), the Interior (DOI), the Army (DOA), and in partnership with other Federal, Tribal, state, and local water agencies. Section 3 of the PM provides specific direction to the Secretaries of Commerce and Interior, with specific implications for the National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), the Bureau of Reclamation (Reclamation), and the U.S. Army Corps of Engineers (USACE):

> *Sec. 3. Improve Forecasts of Water Availability. To facilitate greater use of forecast-based management and use of authorities and capabilities provided by the Weather Research and Forecasting Innovation Act of 2017 (Public Law 115-25) and other applicable laws, the Secretary of the Interior and the Secretary of Commerce shall convene water experts and resource managers to develop an action plan to improve the information and modeling capabilities related to water availability and water infrastructure projects. The action plan shall be completed by January 2019 and submitted to the Chair of the Council on Environmental Quality.*

Vision

In response to the PM, DOC and DOI have identified an action plan that defines individual and joint agency activities to improve the modeling and forecasting capabilities related to water availability and water infrastructure projects. This plan also references the potential contributions of other water resources agencies and entities that can help improve modeling and forecasting capabilities. DOC and DOI will collaborate with appropriate water management agencies to deliver state-of-the-art high-resolution decadal predictions and assessments of water availability for local to regional scale decision making. These improved modeling and forecasting tools will consider integrated surface water, groundwater, water quality, and water use components. Products will include identification of areas with increased risk of experiencing hydrologic extremes such as drought, flood and degraded water quality. The actions and timelines identified in this action plan are achievable with current agency resources and budgets, including the President's 2020 Budget.

Actions and Outcomes

1. **Convene Water Experts and Resource Managers**

NOAA, USGS, Reclamation, and other Federal agencies routinely collaborate strategically in developing and applying new technologies and methodologies tactically in the real-time operations of each agency. In response to the PM, the three agencies convened two meetings of water experts and resource managers in November 2018 to aid in the development of this action plan. Future meetings will include appropriate local, state and Tribal partners, such as the Western Governors' Association, to ensure that forecasting and modeling tools meet the needs of agency constituents.

November 7 and 8, 2018: The first meeting convened resource managers and scientists from across NOAA and USGS at the NOAA Southwest Fisheries Science Center in La Jolla, California, to discuss opportunities consistent with the direction of the PM. The meeting identified key goals set forth in this action plan.

November 14 and 15, 2018: The second meeting was held at the Annual NOAA Water Meeting at the National Water Center in Tuscaloosa, Alabama. The meeting convened a broad group of water experts and resources managers from NOAA, Reclamation, USGS, Western States Water Council, USACE, U.S. Department of Energy, Booz Allen Hamilton, Esri, University of Alabama, University of North Carolina, and others. The meeting also identified key goals set forth in this action plan.

2. **Implement Weather Research and Forecasting Innovation Act of 2017 (Public Law 115-25)**

In response to the Weather Research and Forecasting Innovation Act of 2017 (Public Law 115-25), NOAA will continue to enhance weather forecasts to improve water prediction on subseasonal to seasonal (S2S) time scales. NOAA will continue efforts to enhance modeling tools for connecting accurate precipitation forecasts into surface water availability forecasts. These modeling efforts are designed to help improve water and flood control operations at Federal water infrastructure projects.

    I. **Subseasonal to seasonal forecasting:** NOAA will develop plans for improving S2S forecasting. The demand for S2S information has been steadily increasing as Federal, state, local, and Tribal authorities seek to better prepare for drought and flood events. NOAA will continue to coordinate with other water management agencies and stakeholders to identify opportunities to enhance the value of predictive tools to water management and other stakeholders.

    Milestone and Metrics.

        o **December 31, 2019:** Prior to December 31, 2019, NOAA will release a report to Congress documenting plans and goals for the continued development of S2S forecasts and related products and services. The report will outline how NOAA plans to improve S2S forecasts, products and services, enhancing value for water resource management and other sectors.

    II. **Enhanced atmospheric forecasts to inform run-off forecasts:** NOAA will enhance understanding and forecasting of atmospheric processes affecting surface hydrology. Surface water availability predictions derived from hydrology models are fully dependent on precipitation observations and predictions. NOAA will continue to coordinate with other water management agencies and stakeholders to identify opportunities to enhance the value of predictive tools to water management and other stakeholders.

    Milestone and Metrics.

- o **December 31, 2019:** Prior to December 31, 2019, NOAA will implement the initial operational model configuration of the FV3-Global Forecast System (GFS).

- o **December 31, 2021:** Prior to December 31, 2021, NOAA, USGS, and Reclamation will identify the best available information and methods to assess water supply risk for longer-term projections of water availability on multi-year to decadal timescales, including dynamical (physics-based) and non-dynamical (statistics-based) models.

3. **Improve and expand use of water forecast information to benefit water management outcomes**

DOI and DOC will continue to coordinate with water management agencies to improve forecasting tools and the use of modeling and data to improve water management decisions. The agencies have a number of actions planned to help improve forecasting capabilities at regional and national scales, as well as for short- and long-term periods. Further, the agencies are currently undertaking actions to improve the use of forecasts and modeling to improve reservoir operations that work to balance the need for water storage and flood control.

I. **Improved forecast integration in water management decision-making:** DOC and DOI will collaborate to improve and expand water forecasting tools and their use in water management operations. NOAA's Hydrologic Ensemble Forecast Service (HEFS) provides forecasts of multiple factors important to water management decisions and verification products at specific river locations that can be tailored to user needs at forecast horizons ranging from 6 hours to one year. The HEFS model allows for the incorporation of multiple weather and physical inputs to produce an expected range of outcomes. The ensemble forecasts provided by HEFS help water managers understand the range of possibilities that should be considered when planning reservoir and other water operations. Expanding the deployment of HEFS to new river systems will allow for further refinement of the models to better inform reservoir operations and decision-making.

    Milestone and Metrics.

    - o **December 31, 2019:** Prior to December 31, 2019, NOAA will deploy HEFS in two new western river systems and at least three new river locations of reservoir inflow.

    - o **December 31, 2019:** Prior to December 31, 2019, Reclamation will develop and test methods using HEFS to inform reservoir operations decision making.

II. **Improve continental scale hydrologic modeling:** NOAA and USGS are developing a pilot program to evaluate probabilistic water information and forecasts at high-spatial resolutions in western watersheds. The pilot program will be the basis for creating a comprehensive set of next-generation water modeling tools and data services. Building upon the National Water Model (NWM), these services will be deployed on multiple spatial and temporal scales. The models will provide predictive capabilities on key water budgeting components such as snow states, soil moisture, evapotranspiration, runoff, and streamflow. Reclamation will partner with NOAA to demonstrate improved water forecasts and other information services to benefit water management outcomes.

    Pursuant to the direction in both the Agricultural Improvement Act of 2018 [Sec. 12512(c)(3)] (Public Law 115-334), and the National Integrated Drought Information System

Reauthorization Act of 2018 [Sec. 2(a)(1)(D)] (Public Law 115-423), NOAA will continue to work with other federal agencies to leverage advancements in continental scale hydrologic modeling to research impacts on drought monitoring and forecasting, and low flow prediction services. This work will build upon ongoing efforts in 2018 and 2019 to advance the science of snow and soil moisture sensing and data assimilation in the NWM per [Report 115-275 that accompanies Public Law 116-6].

Milestone and Metrics.

- o **December 31, 2019:** Prior to December 31, 2019, NOAA will deploy Version 2.0 of the NWM into operations.

- o **December 31, 2020:** Prior to December 31, 2020, NOAA and USGS will develop a common strategy to support high-performance computing capabilities for water resources science and services.

- o **December 31, 2020:** Prior to December 31, 2020, NOAA, working in close collaboration with USGS, will convene Federal drought stakeholders, including the National Drought Mitigation Center, to develop requirements for emerging soil moisture simulation and low flow forecasting capabilities.

- o **December 31, 2021:** Prior to December 31, 2021, USGS will collaborate to add a shallow aquifer/groundwater module to the NWM through development of the USGS Water Prediction Work Program.

- o **December 31, 2023:** Prior to December 31, 2023, NOAA and USGS will pilot long-range water prediction in 3 watersheds in the Western United States, within the Upper Colorado, Upper Snake/Columbia, and one California river system.

- o **December 31, 2023:** Prior to December 31, 2023, NOAA, DOI, and U.S. Department of Agriculture (USDA) will evaluate the impact of enhanced soil moisture simulation and low flow forecasting capabilities on integrated products such as the Drought Monitor.

III. **Continue refinement of the next-generation water observations system:** USGS, Reclamation, and NOAA[1] will collaborate to continue development and refinement of the Next Generation Water Observation System (NGWOS). The NGWOS is being further developed under the core scientific and water management mission areas of Reclamation and USGS, with guidance and collaboration provided by NOAA and other water experts and resource managers to improve availability of real-time data on water quantity and quality. The data provided by NGWOS will provide quantitative information on streamflow, evapotranspiration, snowpack, soil moisture, a broad suite of water quality constituents (nutrients, salinity, turbidity, and wastewater indicators) and sediment transport. The NGWOS will also identify connections between groundwater and surface water and water uses in watersheds that are representative of the primary principal aquifers and major river

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[1] DOC/NOAA will define requirements for optimized modeling and forecasting, but is not anticipated to operate new water observations platforms.

basins of the United States. The NGWOS will improve access to data, forecasting, and modeling tools to help improve decision-making by water managers.

Milestone and Metrics.

- **December 31, 2019:** Prior to December 31, 2019, selection criteria and the information associated with model uncertainty and data needs for all components of the water budget will be compiled to identify priority watersheds for the expansion of NGWOS to other watersheds.

- **December 31, 2020:** Prior to December 31, 2020, priority NGWOS watersheds will be identified.

- **December 31, 2021:** Prior to December 31, 2021, design for implementation of the first Western NGWOS watershed will be complete.

IV. **Improved regional collaboration:** NOAA will strengthen regional collaboration between Reclamation and NOAA by identifying opportunities to better apply water forecast services for precipitation, snowpack, water quantity, and water quality to improve resource management. Reclamation will evaluate the quality of existing data and services as resources to guide resource management decisions and operation of water infrastructure projects.

Milestone and Metrics.

- **December 31, 2019:** Prior to December 31, 2019, NOAA will refine water temperature decision support tools for Endangered Species Act (ESA) listed salmon in California's Central Valley.

- **December 31, 2020:** Prior to December 31, 2020, Reclamation will work with NOAA to review and assess the applicability of refined water temperature decision support tools for use in reservoir operations.

V. **Finalization of Folsom Dam Water Control Manual (WCM):** Reclamation's Mid Pacific Region (California-Great-Basin Region) is working with the USACE to implement an updated WCM at the recently modified Folsom Dam. The updated WCM allows for additional water storage within available flood control space in the reservoir by leveraging forecasts to better predict and manage run-off during storm events. As a result of the updated WCM, Reclamation will be able to store up to an additional 200,000 acre-feet during flood season, allowing additional stored water to be put to beneficial use at a later date, rather than being lost to flood spill. The updated WCM is planned for implementation in water year 2019.

Milestone and Metrics.

- **November 29, 2018:** USACE approved a deviation from the previous water control plan for Folsom Dam to allow Reclamation to implement the updated WCM for water year 2019. USACE continues the effort towards formal adoption of the plan for future water years.

VI. **Operation of Statistical Water Supply Forecast Tool:** Reclamation's Great Plains Region (Missouri-Basin Region) is developing a statistical modeling tool to improve seasonal water supply forecasting in snow-dominated basins. The software allows users to analyze multiple forecasts to provide a better picture of future reservoir inflows. The tool has a user-friendly interface that allows water managers to build data sets from a wide range of online sources to meet specific needs.

Milestone and Metrics.

- **December 31, 2019:** Reclamation will complete preliminary testing and debugging of the model to evaluate accuracy and functionality of the user interface.

- **July 31, 2020:** During the 2020 run off season, Reclamation will conduct parallel testing of the Statistical Water Supply Forecast Tool with its current forecasting methods.

- **January 1, 2021:** The Great Plains Region will use the tool operationally and make it available for public use during the Spring 2021 runoff season.

VII. **Reclamation WaterSMART reservoir operations pilot studies:** Reclamation is conducting pilot studies to identify possible improvements to reservoir operations by incorporating improved scientific information and enhancing operational flexibility to maximize benefits from the existing system. Reclamation's reservoirs are operated using criteria to meet a number of different water management priorities, including reliable water deliveries, power generation, environmental requirements, navigation, and flood control management. Reservoir management practices are being evaluated to determine if there are opportunities to update these criteria to optimize reservoir operations. Reclamation selected five pilot studies in Oklahoma, Oregon, Arizona and the Upper Colorado River Basin to evaluate potential improvements to reservoir operations.

Milestones and Metrics.

- **November 2018:** Reclamation released a report that identified innovative approaches to drought resiliency within the Washita Basin in Oklahoma.

- **September 30, 2019:** Reclamation will complete the four remaining pilot studies.

VIII. **Improved forecasts of low-elevation snowmelt runoff:** Reclamation and the National Center for Atmospheric Research (NCAR) are collaborating to improve forecasting of low-elevation snowmelt runoff. The outcome will directly address needs for more skillful forecasts to support reservoir operations. Some statistical forecast methods do not represent low elevation snowpack, which can result in under-forecasting reservoir inflows and the potential for insufficient drawdown. Better forecasts provide operators the ability to mitigate runoff due to low elevation snowpack through reservoir drawdown actions. This potentially avoids damaging high releases and spill, which reduces hydropower generation.

Milestones and Metrics.

- **December 31, 2019:** By December 31, 2019, the project will complete a catalog of snow data products and develop a tool to analyze and display those products.

o **June 30, 2020:** By June 30, 2020, the project will develop and deploy streamflow forecasting models with capacity to leverage/ingest snow data from the tool.

o **December 31, 2020:** Prior to December 31, 2020, the project will produce a report documenting the project and tools, including an assessment of the forecast improvement associated with inclusion of snow information.

4. **Implement requirements of the Omnibus Public Land Management Act of 2009 (Public Law 111–11)**

Public Law 111-11, Subtitle F, also known as the SECURE Water Act, calls for the establishment of a "national water availability and use assessment program" within the USGS. Through development of the National Water Census (NWC), the USGS improved understanding of water availability and addressed calls for integrated water availability assessments at national and local basin scales. The primary focus of remaining work includes conducting national and regional assessments of water availability through Integrated Water Availability Assessments (IWAAs), estimating a complete water budget for every Hydrologic Unit Code (HUC) 12[2] basin in the conterminous United States using a fully integrated hydrologic model developed in collaboration with NOAA's National Weather Service (NWS), developing an ecohydrologic monitoring network to evaluate impacts of water availability on ecological flow needs, and improving water use reporting.

I. **National and Regional Water Availability Assessments:** Water resource managers need tools and information that support decision-making in regards to water availability for both human and ecological uses. The USGS is developing a framework that will provide data, tools, and information through IWAAs. IWAAs allow water managers to: 1) evaluate current water supply and demand; 2) evaluate long-term trends in water availability; 3) provide seasonal to decadal forecasts of availability; and 4) inform water resource decisions through development of socioeconomic tools.

Milestone and Metrics.

o **December 31, 2019:** Prior to December 31, 2019, the USGS will deliver a concept map illustrating a near-real time census of water resources nationally at the HUC 12 scale. This proof of concept will help inform the future hyper-resolution, integrated model described in Action 3 that is key to the full implementation of IWAAs. This initial concept will focus on water resource availability in terms of quantity only.

o **December 31, 2019:** Prior to December 31, 2019, the USGS will complete a regional pilot IWAA in the Delaware River Basin. Additionally, a pilot basin in the Western United States will be selected and goals for the pilot will be identified through stakeholder feedback.

o **December 31, 2020:** Prior to December 31, 2020, the USGS will deliver maps illustrating a near-real time census of water resources nationally at the HUC 12 scale that include water quality and use as factors. Additionally, priority IWAAs basins will be coordinated

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[2] Hydrologic Unit Code 12 watersheds represent local sub-watersheds.

to align with NGWOS, and a plan will be developed for sequencing NGWOS, USGS Water Prediction Work Program (2WP), and IWAAs.

- o **December 31, 2021:** Prior to December 31, 2021, the USGS will deliver maps illustrating a near-real time census of water resources nationally at the HUC 12 watershed scale. The USGS will pilot seasonal to sub-seasonal predictions of availability that incorporate projected withdrawal based on seasonal climate forecasts described in Action 1.

II. **Improvements to water use reporting:** Understanding the human component of the water budget is a key factor in fully evaluating water resources at both the national and regional scale that is currently lacking. The USGS will develop daily modeled water use estimates of withdrawal for public-supply, thermoelectric, and irrigation water use. The intent is to develop modeled water use for every HUC 12 watershed nationally. Together, these three categories represent 90% of all water used in the United States; accounting for these categories within an integrated hydrologic model is critical to ensuring a complete evaluation of water availability. Currently, water use data is reported every 5-years at the county level; these models will allow reporting to occur on a time-frame necessary to meet water resource decision-making needs and represents an important step forward in our ability to model and predict water resources at both the national and regional extent.

   Milestone and Metrics.

- o **December 31, 2019:** Prior to December 31, 2019, a modeling strategy for public supply, irrigation, and thermoelectric water use will be developed and needed data obtained.

- o **December 31, 2020:** Prior to December 31, 2020, the USGS will deliver daily estimates of water use for two of the three categories for every HUC 12 in the conterminous United States.

- o **December 31, 2022:** Prior to December 31, 2022, daily water use models for public-supply, irrigation, and thermoelectric will be fully integrated into both national and regional IWAAs.

APPENDIX

Below is a list of activities already underway that support the water availability and forecasting action plan called for in the PM. The actions and timelines identified in this action plan are achievable with current agency resources and budgets.

Supporting Activities

1. National Water Model (NWM) (NOAA, USGS, NCAR, NSF/CUAHSI)
   The NWM is a continental scale, state-of-the-science water prediction model that creates forecast guidance for over 5 million miles of rivers and streams nationwide. The NWM provides high resolution hydrologic guidance which significantly expands geographic coverage and provides water budget information. It produces a full range of hydrologic fields, which can be leveraged by a multitude of stakeholders ranging from emergency responders and drought and water resource communities to transportation, energy, recreation, and agriculture interests, to other water-oriented applications in the government, academic, and private sectors.

2. USGS Water Prediction Work Program (2WP)
   When coupled with the NWM, 2WP will drive prediction of stream temperature, surficial processes (capture of sediment/constituents coming off the landscape into waterways), and in-stream transport (of sediment/constituents in those waterways).

3. Hydrologic Ensemble Forecast Service (HEFS)
   A new operational capability, HEFS provides risk-based streamflow information for local decision makers. HEFS leverages the skill in subseasonal to seasonal weather forecasts, and quantifies and accounts for the uncertainty associated with both atmospheric forcings and hydrologic model predictions. HEFS produces reliable and skillful ensemble forecasts of streamflow at lead times ranging from one hour to one year, which are particularly useful for long-range water resource planning.

4. Forecast Informed Reservoir Operations (FIRO) – Lake Mendocino, CA
   FIRO is a proposed management strategy that uses data from watershed monitoring and modern weather and water forecasting to help water managers selectively retain or release water from reservoirs in a manner that reflects current and forecasted conditions. FIRO is being developed and tested as a collaborative effort focused on Lake Mendocino that engages experts in civil engineering, hydrology, meteorology, biology, economics, and climate from several Federal, state, and local agencies, universities, and others. FIRO envisions modern observation and prediction technology that could provide water managers more lead time to selectively retain or release water from reservoirs based on longer-term forecasts. Optimizing reservoir operations potentially benefits water supply and environmental flows while enhancing flood control and dam safety.

5. National Integrated Drought Information System (NIDIS)
   NIDIS' goal is to improve the Nation's capacity to manage drought-related risks by providing the best available information and tools to assess the potential impacts of drought, and to prepare for and mitigate the effects of drought.

It does this by coordinating and integrating drought research, building upon existing Federal, Tribal, state, and local partnerships in support of creating a drought early warning system (DEWS). The DEWS have been implemented by region and make climate and drought science readily available, easily understandable, and usable for decision makers; the DEWS also improves the capacity of stakeholders to better monitor, forecast, plan for, and cope with the impacts of drought.

6. USGS Water Census - Closing the Water Budget Nationally on the HUC 12 Scale
The USGS's NWC is designed to systematically provide information that will allow resource managers to assess the supply, use, and availability of the Nation's water. The goal of the NWC is to provide nationally-consistent base layers of well-documented data that account for water availability and use nationally. The primary building blocks of the water budget are base layers of precipitation, streamflow, evapotranspiration, water use, and change in groundwater storage. Measurements or estimates of water budget components provide a means for decision makers to evaluate the water available for human and ecological needs as well as where stresses to the budget exist or may develop. The goal is to provide resource managers with more accurate and finer scale information to support near-real time, local management decisions related to water availability and use.

7. Improving Rio Grande Seasonal Streamflow Forecasting
Reclamation's Upper Colorado Region (Upper Colorado-Basin Region) is involved in several projects with the NCAR to improve seasonal streamflow forecasting for the Rio Grande and Upper Colorado Basins, with the goal of providing necessary information to improve Reclamation's water operations. Sponsorship of a fellowship at NCAR has improved statistical streamflow forecasting. A follow-on project resulting from the fellowship work is operationalizing these improvements to incorporate into Reclamation's operations. Another effort is characterizing changes in summer monsoons and other extreme precipitation events with a goal of finding ways to better use these events to enhance water supplies.

8. Improving Short Term Forecasting for Water Management in the Southwest
Reclamation's Upper and Lower Colorado Regions are working with NOAA and NCAR to improve short-term (5-day) forecasting in order to improve in-season reservoir operations for irrigation, with the hope that better short-term forecasts can minimize unnecessary reservoir releases and preserve more water in reservoirs. The initial focus area is the Colorado River below Parker Dam; the project will also assess transferability to other basins in the Southwest.

9. NOAA Fisheries Water Temperature Modeling for West Coast River Systems
Outcome from the NWS-National Marine Fisheries Service (NMFS) Workshop held on November 7-8 in La Jolla, California: Establish a community of practice to develop a water temperature module for inclusion in later versions of the NWM, while continuing to build and improve local research and operational forecast models that inform western water decisions. Water temperature modeling will begin with water temperature but also will consider future requirements for ambient temperature, dissolved oxygen, and nutrients.

10. Habitat Assessment Improvement Plan (HAIP)

    A major focus of NOAA Fisheries' HAIP is to improve stock assessments through the incorporation of benthic (lowest level of a body of water) and pelagic (inhabiting the upper layers of the open sea) habitat information. While many stock assessments do not currently incorporate habitat information directly into the assessment models, habitat data is important to other areas of the stock assessment process. This effort is designed to improve the availability and utility of habitat information in support of the stock assessment process.

11. Coordinated Strategic Plan to Advance Desalination for Enhanced Water Security

    In accordance with the Water Infrastructure Improvements for the Nation (WIIN) Act (Public Law 114-322), the National Science and Technology Council created a multi-agency Desalination Task Force to establish desalination priorities, coordinate relevant Federal agencies, strengthen research and development (R&D) cooperation with our international partners, and to promote public-private partnerships in the area of desalination technology. This strategy identifies three overarching goals to support desalination efforts in the United States: 1) Reduce Risk and Streamline Local Planning to Support Desalination; 2) Reduce Technical and Economic Barriers to enable Desalination Technology Usage; and 3) Encourage National and International Cooperation to Innovate and Develop Desalination Technologies. The Office of Science and Technology Policy released this plan on World Water Day, March 22, 2019.

12. Water Security Grand Challenge

    In October 2018, Department of Energy (DOE) Secretary Rick Perry announced the launch of the Water Security Grand Challenge along with then-Acting Environmental Protection Agency Administrator Andrew Wheeler. The Water Security Grand Challenge is a White House-initiated, DOE-led framework to advance transformational technology and innovation to meet the global need for safe, secure, and affordable water. Using a coordinated suite of prizes, competitions, and research and development, the Grand Challenge has set five goals for the United States to reach by 2030, including: (1) Launch desalination technologies that deliver cost-competitive clean water; (2) Transform the energy sector's produced water from a waste to a resource; (3) Achieve near-zero water impact for new thermoelectric power plants, and significantly lower freshwater use intensity within the existing fleet; (4) Double resource recovery from municipal wastewater; and (5) Develop small, modular energy-water systems for urban, rural, tribal, national security, and disaster response settings.