



## Third SECURE Water Act Section 9505 Assessment

WBS/CID: 33456

Hydropower Program

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# Project Overview

## Project Summary

- Directed by Congress in Section 9505 of the SECURE Water Act (SWA, Public Law 111-11) of 2009, this project is to evaluate “*each effect of, and risk resulting from, global climate change with respect to—(A) water supplies used for hydroelectric power generation; And (B) power supplies marketed by each Federal Power Marketing Administration*”.
- The Secretary of Energy is designated as the lead for this assessment, and it is to be conducted in consultation with the Power Marketing Administrations and other federal and state agencies every 5 years until 2023. The 9505-V3 assessment will provide technical basis for the third DOE Report to Congress called for in the SWA.

## Project Objective & Impact

- Surface water is the “fuel” on which hydropower is based, and that resource can be directly affected by long-term hydroclimate change.
- Understanding the potential effects of long-term hydrologic change on water availability for hydropower generation is of great importance to the US renewable energy portfolio and the reliability of the electricity grid.
- Deriving from the upcoming IPCC Coupled Model Intercomparison Project Phase 6 (CMIP6), this work will produce a new understanding of future hydroelectric generation from federal facilities.
- Apart from providing technical basis for the DOE Report to Congress, the future water availability scenarios will also be provided at non-federal dams to allow for a broader use of the research outcomes.

## Project Information

### Project Principal Investigator(s)

- Shih-Chieh Kao, ORNL

### WPTO Lead

- Timothy Welch
- Simon Gore

### Project Partners/Subs

- Power Marketing Administrations
- Pacific Northwest National Laboratory
- Texas A&M University
- McKeown & Associates

### Project Duration

- Project Start Date: Oct 2017
- Project End Date: Sep 2023

## Hydropower Program Strategic Priorities

Environmental R&D and Hydrologic Systems Science

Big-Data Access and Analysis

Technology R&D for  
Low-Impact  
Hydropower Growth

R&D to Support  
Modernization,  
Upgrades and Security  
for Existing Hydropower  
Fleet

Understand, Enable,  
and Improve  
Hydropower's  
Contributions to Grid  
Reliability, Resilience,  
and Integration

## Environmental R&D and Hydrologic Systems Science

- Develop better monitoring technologies to evaluate environmental impacts
- Develop technologies and strategies that avoid, minimize, or mitigate ecological impacts
- Support development of metrics for better evaluating environmental sustainability for new hydropower developments
- **Assess potential impacts of long-term hydrologic variations to hydropower generation and flexibility**
- Improve abilities to assess potential methane emissions from reservoirs
- Better identify opportunities and weigh potential trade-offs across multiple objectives at basin-scales

- Using a series of hydro-meteorological models and methods with different spatial resolutions, this project produces a large ensemble of long-term hydrologic projections that can be used as potential future water availability scenarios to study the impacts of long-term hydrologic variations on hydropower generation and flexibility.
- As an example, the near-future water availability produced by the second 9505 assessment was used to develop future wet/dry water availability scenarios in the 2016 DOE Water Power Vision study.

Lab	FY 2018	FY 2019 (Q1 & Q2 Only)	Total Project Budget FY 2017–FY 2019 Q1 & Q2 (October 2016 – March 2019)	
Lab	Costed	Costed	Total Costed	Total Authorized
<b>ORNL</b>	\$288K	\$249K	\$537K	\$734K
<b>PNNL</b>	N/A	\$35K	\$35K	\$75K
<b>TOTAL</b>	\$288K	\$284K	\$572K	\$809K

- **Cost description**

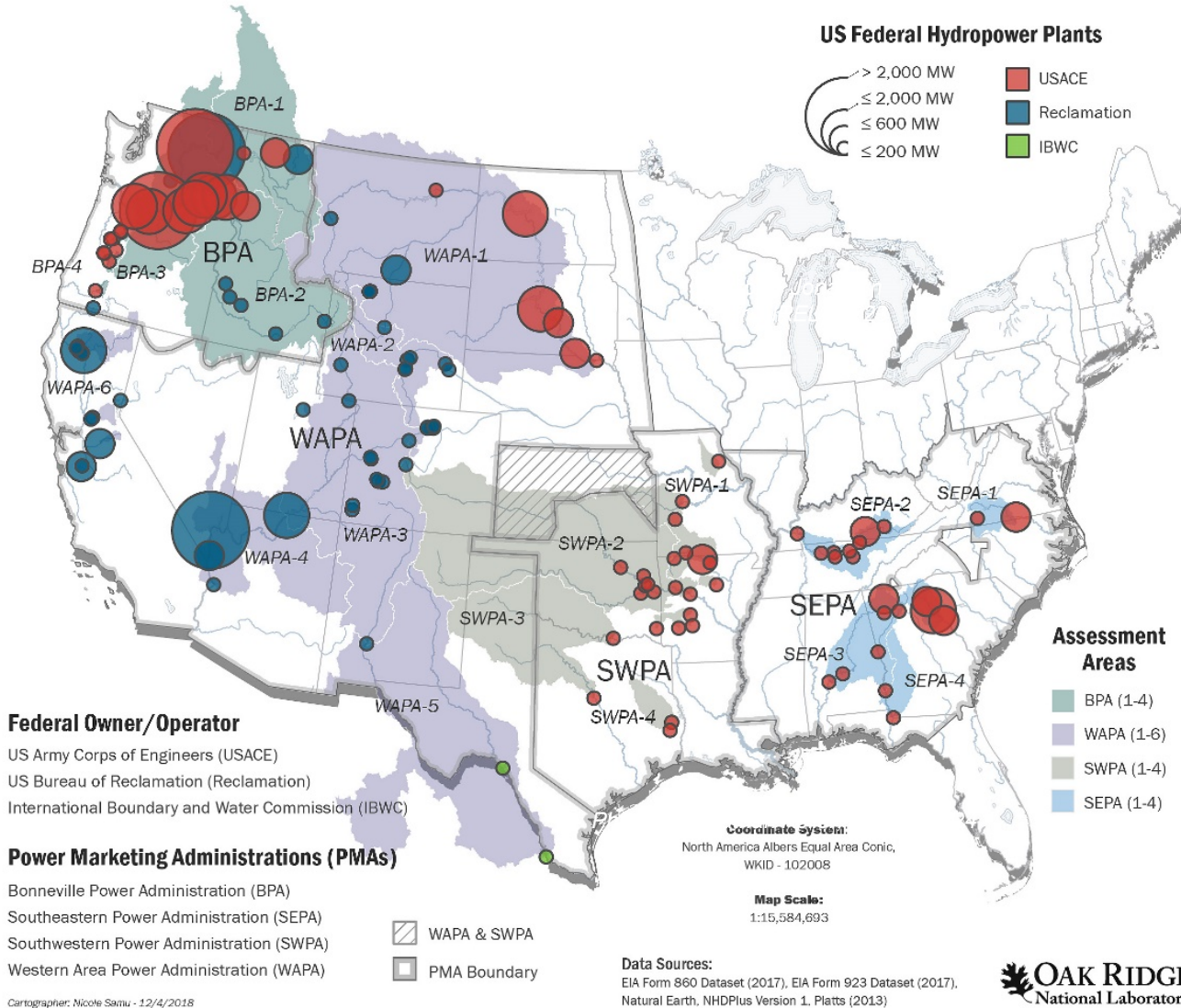
- FY18–FY19Q2: Initial methodology development and interagency workshop

- **Computational support**

- Oak Ridge Leadership Computing Facility (OLCF), no-cost



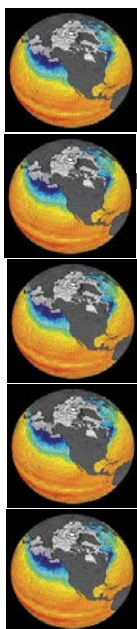
# Management and Technical Approach (I)



- 132 federal power plants in 18 study areas
- ~40% of US hydropower capacity.
- Study area defined by watershed boundary and power system.

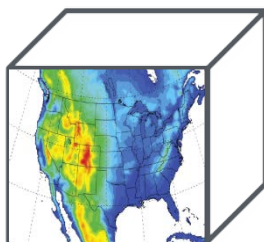
## A high-resolution multimodel modeling and analysis framework

CMIP6 GCM  
projections



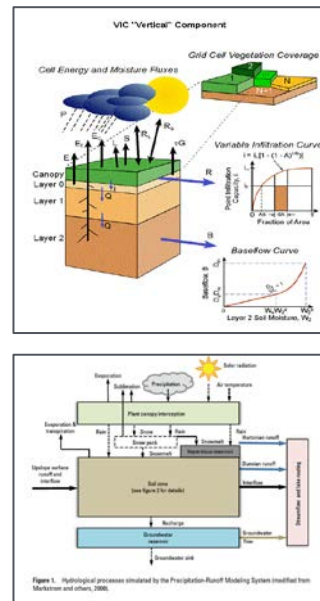
~150 km grid  
resolution

Regional  
downscaling



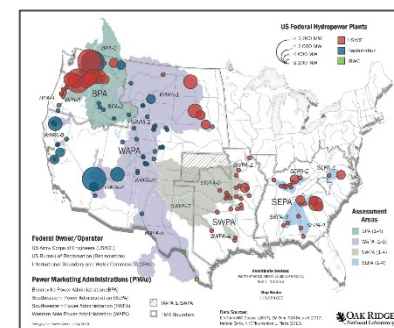
~25 km grid  
resolution

Hydrological  
modeling



~4 km grid  
resolution

Hydropower  
simulation and  
marketing analysis

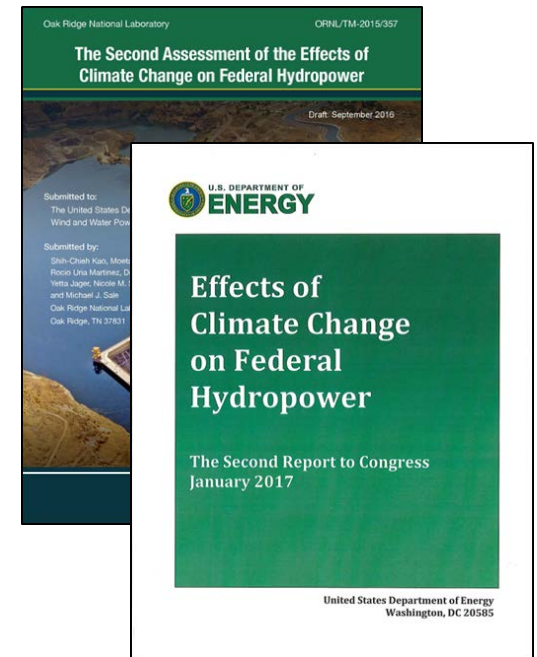


Assessment at each  
hydropower study area

- **This assessment features extensive consultation with federal hydropower stakeholders.**
  - Quarterly remote / in-person meetings:
    - Power Marketing Administrations (PMAs): Bonneville, Southwestern, Southeastern, and Western Area Power Administrations (BPA, SWPA, SEPA, and WAPA).
    - Federal hydropower plant owners/operators: US Army Corps of Engineers (USACE), and Bureau of Reclamation (Reclamation).
    - Other climate-water agencies: National Oceanic and Atmospheric Administration (NOAA), and US Geological Survey (USGS).
  - Final assessment to be reviewed by leading experts
    - E.g., over 40 external reviewers involved in the 9505-V2 review
- **We will seek to extend the 9505-V3 data support to the broader industry stakeholders.**
  - Provided hydro-climate multimodel streamflow projection data to support other hydropower–water use studies (e.g., BPA RMJOC2).
  - Currently engage through the CEATI Hydropower Operations and Planning Interest Group (HOPIG)



- Provide near-term hydropower projections for 132 U.S. federal hydropower plants, featured high-resolution conterminous US (CONUS) hydro-climate simulation.
- Establish a spatially consistent modeling and analysis approach to evaluate hydroclimate impacts on federal hydropower fleet across a wide range geographical locations.
- Completed the DOE concurrence review and submitted the second DOE report to Congress in January 2017. The report contains the major findings from 9505-V2, as well as PMA administrators' recommendations
- Since previous WPTO review, publish three peer-reviewed journal articles to support the credibility of the 9505 assessment effort.



- **1<sup>st</sup> SWA 9505 Assessment (2010–2012)**
  - Established the fundamental data, modeling, and analysis framework for all 132 federal hydropower plants covered by SWA.
  - Provided annual future hydropower projection through CMIP3-driven hydroclimate simulation (1 GCM, 5-member ensemble).
- **2<sup>nd</sup> SWA 9505 Assessment (2013–2017)**
  - Enhanced the accuracy of hydrologic and hydropower models through high-performance computing (HPC) enabled calibration.
  - Provided seasonal future hydropower projection through CMIP5-driven hydroclimate simulation (10 GCMs, 10-member ensemble).
- **3<sup>rd</sup> SWA 9505 Assessment (2018–2023), on-going**
  - To better quantify the methodological uncertainty through a multi-model and multi-forcing assessment approach
  - To perform CMIP6-driven hydroclimate simulation

- **Phase 1: Methodology Development (FY 2018–FY 2019)**
  - FY18Q1 to FY19Q1: Quarterly webinars on methodology development
  - FY19Q2: Workshop on methodology (in-person meeting) (completed)
- **Phase 2: Simulation and Analysis (FY 2019–FY 2021)**
  - FY19Q3 to FY20Q4: Quarterly webinars on initial findings
  - FY21Q1: Finalization of technical assessment results (in-person meeting)
- **Phase 3: Report Development and External Review (FY 2021–FY 2022)**
  - FY21Q3: Draft technical assessment report and external review
  - FY21Q4: Finalization of the technical assessment report
  - FY22Q1: Draft DOE Report to Congress
- **Phase 4: Concurrence Review & Report to Congress Delivery (FY 2022)**
  - FY22Q2: DOE concurrence review starts
  - FY22Q4: DOE delivery of Report to Congress (by September 30, 2022)
- **Phase 5: Non-federal Fleet Assessment Extension (FY 2022–FY 2023)**
  - FY22Q2: Non-federal fleet assessment starts
  - FY23Q3: Finalization of initial non-federal assessment report & external review
  - FY23Q4: Release of non-federal assessment report & the supporting data sets