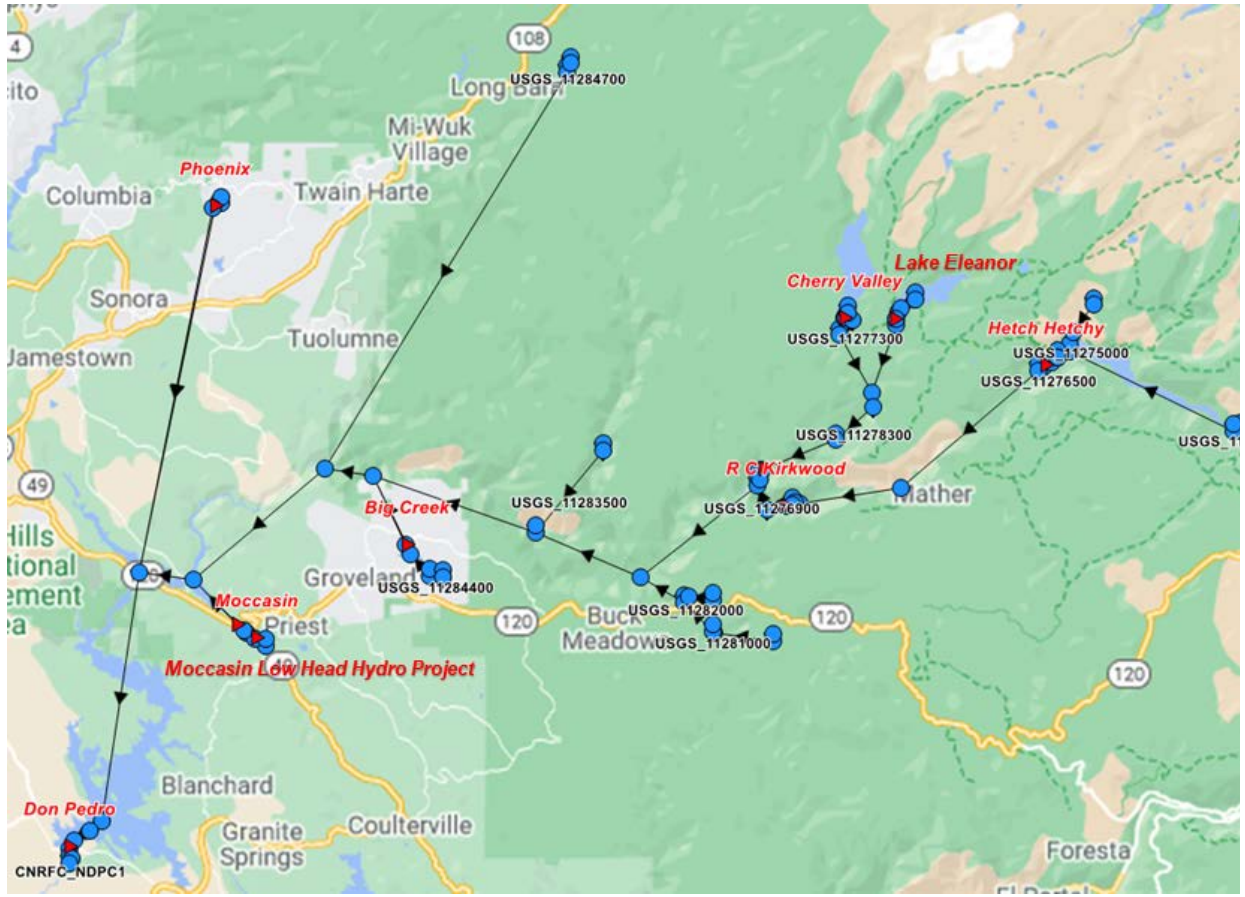
1.2.2.404 – Improving the Representation Of Hydropower in Production Cost Models



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Project Overview

Project Summary

This project's goal is to improve hydropower's representation in power system models by actively coupling river basin (hydrologic) models with grid operations (production cost) models. At the conclusion of this effort, this work will provide a foundation that allows improved available flexibility and operational constraints representation. Longer term, the work will provide a template that can be used by commercial production cost modeling software vendors to capture the nuances of hydropower operations in their software offerings.

Intended Outcomes

- ✓ Improved monthly hydropower generation limits representation for Western Electricity Coordinating Council (WECC)
- ✓ Prototypical hydropower water management models for the Northern California-based study area (Balancing Authority of Northern California [BANC] and nearby environs) that provide daily limits and capabilities information
- ✓ Demonstration of coordinated grid operation and water management modeling for a system of three cascading reservoirs.

Project Information

Principal Investigator(s)

- Greg Stark/Clayton Barrows

Project Partners/Subs

- Industry partner: RTI International

Project Status

Ongoing – will finish this fiscal year

Project Duration

- Oct. 1, 2019
- Sept. 30, 2022 (expected)

Total Costed (FY19–FY21)

$743,975

Project Objectives: Relevance

Relevance to Program Goals:

- This project supports **Hydropower Program Activity 2 – Grid Reliability, Resilience, and Integration (HydroWIRES)**.
- It addresses the "**Untapped potential for hydro and pumped storage to support a rapidly evolving grid**" challenge by **improving the representation of hydropower capabilities in power system models** near term, and it is expected to **allow improved use of the fleet's flexibility and thereby provide increased value to the power system** in the longer term.
  - Provides improved basin-wide hydropower situational awareness.
  - Enables better use of available flexibility.

Project Objectives: Approach

Approach:

- We coupled a well-respected river basin operations model (Colorado State University's MODSIM-DSS) to a grid operations model (NREL's Scalable Integrated Infrastructure Planning model) via a model-reference control algorithm.
- We used the National Oceanic and Atmospheric Administration's (NOAA's) River Forecast Center models to provide inflows.
- The river basin grid operations models periodically exchange information (e.g., daily or weekly, typically as data are available), updating each other regarding requested generation, available generation, and how much hydropower-based energy was used.

Project Objectives: Expected Outputs and Intended Outcomes

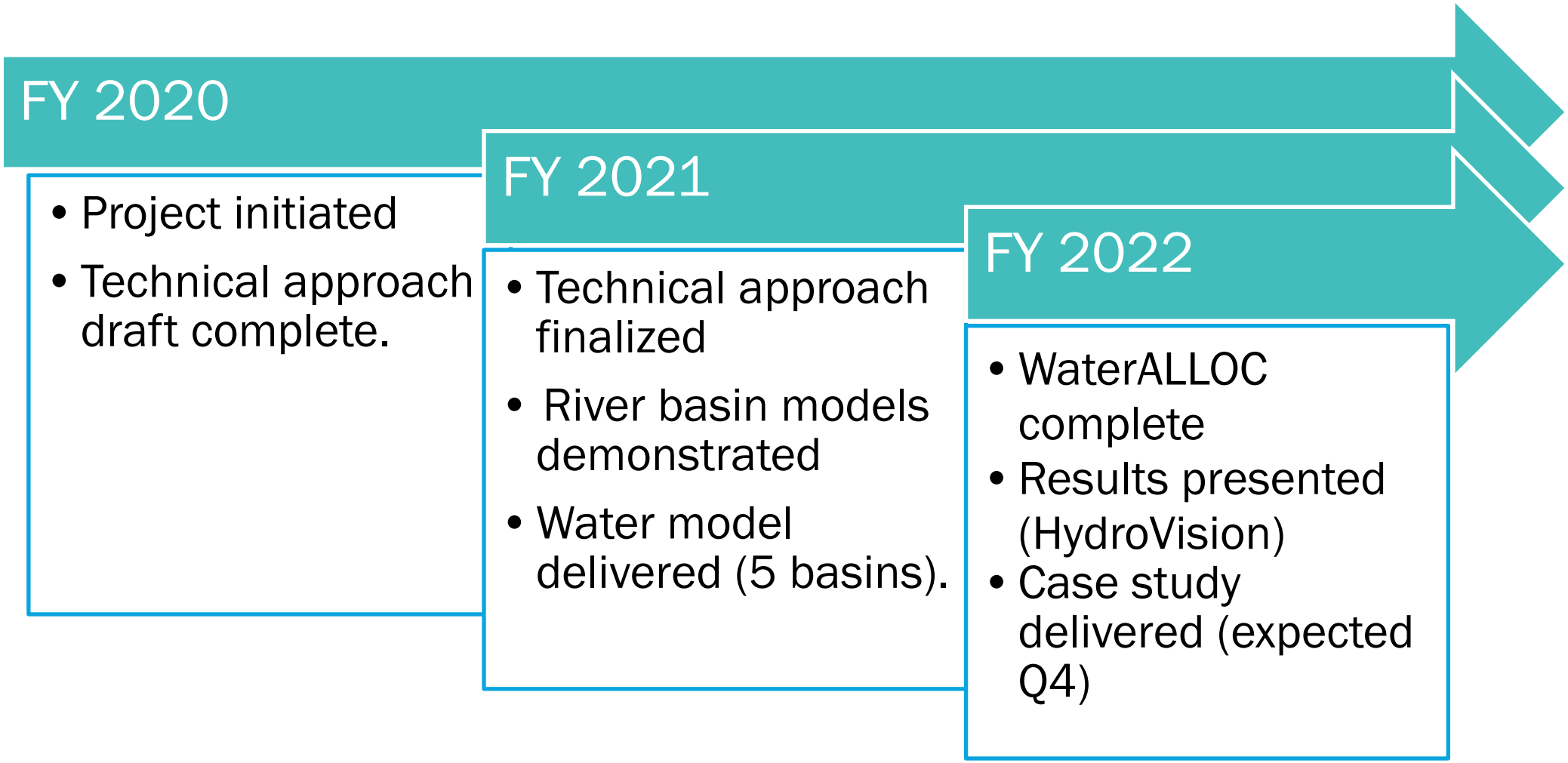
Outputs:

- Joint case study with Pacific Northwest National Laboratory (PNNL), which quantifies the value of improved info
- MODSIM and SIPP models for the five main river basins in the BANC operating area
- WaterALLOC (a stakeholder-usable framework that supports modeling, analysis, and management of river basins)
- HydroVision Extreme Events Panel Presentation.

Outcomes:

- Increased awareness of the need for and value of coupled models
- A better understanding of the need for improved situational awareness of hydropower's capabilities and constraints
- An improved foundation for multi–technology grid integration studies.

Project Timeline/Major Milestones



Project Budget

FY19	FY20	FY21	Total Actual Costs FY19–FY21
Costed	**Costed**	**Costed**	**Total Costed**
$0K	$204K	$539K	$743K

- This project was substantially delayed by COVID, and the project was extended approximately one year as a result.

End-User Engagement and Dissemination

- Stakeholder/end-user engagement strategy
  - Who benefits: stakeholders ranging from researchers to grid operators (the work provides situational awareness not previously available)
  - Industry engaged: RTI International (industry partner)
  - Rationale for industry engagement: RTI is an industry leader in this space, having aided users such as NOAA and TVA
- Dissemination plans
  - Joint case study with PNNL
  - Conference presentation(s)
  - Model publication (grid and river basin operations).

Performance: Accomplishments and Progress

- **Significance**
  - FLASH[1]: markedly improves hydropower situational awareness. It is also designed from the ground up to be scalable and applied interconnection-wide.
  - WaterALLOC: allows for relatively quick buildout of river basin models.
  - The primary metric in this work was the reduction of feasibility error.
  - Benchmark vs. the original technical targets:
    - Historically, only monthly hydropower availability data were available (Energy Information Agency data).
    - The FLASH work provides daily hydropower targets from readily available sources (NOAA/National Weather Service River Forecast Centers).
  - Technical barriers addressed:
    - How to better represent hydropower capabilities and constraints in grid models.
    - How to cost-effectively model river basin operations with limited information.

1: FLASH—Framework for the Linked Analysis of Streamflow and Hydropower

Performance: Accomplishments and Progress (Cont'd)

- **Deliverables**
  - Joint case study that quantifies the value of river basin information availability
  - MODSIM and SIPP models for the five main river basins in the BANC operating area (Upper Sacramento, Stanislaus, Trinity, Tuolumne, and Upper American watersheds)
  - WaterALLOC (a stakeholder-usable framework that supports modeling, analysis, and management of river basins)
  - Technical Approach for the Water Management Model Development, River Basin Models and User Manual
  - HydroVision Extreme Events Panel Presentation.

Future Work

- Plans and timeline for future work:
  - We're in the final phases of writing the joint case study, and it is anticipated that the draft will go to NREL Communications by August 1 for final editing, then to the Water Power Technologies Office for approval, and then on to publishing.
  - Although not a part of this project, we plan to use the improved hydropower representation developed in this project as a foundation for future grid integration work.