U.S. Department of the Interior
Bureau of Reclamation
WaterSMART

Internal Applied Science Tools

2020 Internal Applied Science Projects

California Great Basin Water Portfolio: Analyzing Combinations of Proposed Projects and a Tool for Presenting Model Results for Decision Making, Reclamation Funding: $200,000

The California Great Basin Water Portfolio project, led by Amanda Becker from the California Great Basin Region, proposes to begin studying combinations of proposed projects and to create a new report template that quickly summarizes the information that decision makers need while being quickly updatable for new proposed projects and new studies. The California Great Basin (CGB) Water Portfolio will use existing modeling tools to update the proposed project models and combine them to create the data in the report, and the report will be a new summary tool for managers to quickly understand and compare modeling data from multiple model scenarios.

Columbia Pacific Northwest Model Conversion: Leveraging Robust Planning Models for Real-Time and Short-Term Reservoir Operations, Reclamation Funding: $140,000

The Columbia Pacific Northwest Model Conversion: Leveraging Robust Planning Models for Real-Time and Short-Term Reservoir Operations project, led by Jonathan Rocha of the Columbia-Pacific Northwest Regional Office, proposes to develop processes and toolsets for converting existing long-term planning models into real-time and mid-term operations models. The project will result in a roadmap for performing planning-to-operations model conversions and the project will increase C-PN's technical capacity in performing real-time and mid-term operations planning.

Deployment of in situ sensors for adaptive management of algal blooms in Reclamation reservoirs, Reclamation Funding: $80,935

The Deployment of in situ Sensors for Adaptive Management of Algal Blooms in Reclamation Reservoir project, led by Daniel Deeds in the California-Great Basin, will deploy in situ optical sensor networks as a valuable decision support tool for reservoir operators managing the impacts of algal bloom events. Sensor networks will be deployed at (i) San Luis Reservoir, a water body frequently impacted by harmful algal blooms (HAB) that lower water quality and threaten fishers, jet skiers and swimmers, and (ii) Stampede Reservoir, a Sierra Nevadan reservoir with a hydroelectric dam that occasionally halts operations to remove biofouling associated with HAB events. The project is supported by partners from the U.S. Geological Survey and the California Department of Water Resources.

Developing predictive equations to forecast reservoir sedimentation rates, Reclamation Funding: $99,980

The Developing predictive Equations to Forecast Reservoir Sedimentation Rates project, led by Melissa Foster of the Technical Service Center in Denver, will use environmental and physical parameters from a contributing drainage basin to identify a suite of explanatory variables that can be used to infer reservoir sedimentation rates

in un-surveyed basins. This method has been applied to smaller basins and this project would expand the spatial scale of such methodology. The project will utilize the Reservoir Sedimentation Information database to obtain sedimentation rates for Reclamation and US Army Corps of Engineers reservoirs. Potential variables of interest include, but are not limited to: precipitation, soil/geology, climate zone, ground cover, land use, and topography.

Development of Revised Baseline Planning Models for the Boise and Deschutes River Basins, Reclamation Funding: $192,197

The Development of Revised Baseline Planning Models for the Boise and Deschutes River Basins project, led by Jennifer Johnson of the Columbia-Pacific Northwest Regional Office, will revise current basin-specific river-reservoir model structures and rulesets for broader application use. Long Term Operations and Planning Team develops and maintains many basin-specific river-reservoir models that are used to answer questions relevant to decision making. These models are often designed for a specific project and therefore are limited to only the information that is needed to answer a specific set of questions. This project seeks to develop more generalized baseline versions of these models that can be ready for broader application and develop documentation. This will benefit the Columbia Pacific Northwest region by providing an opportunity for thorough review of model logic and structure, reduce lead time on future projects, and develop models that can be used by staff members more easily.

Developing Training for the Upper Rio Grande Water Operations Model, Reclamation Funding: $198,400

The Developing Training for the Upper Rio Grande Water Operations Model project, led by Andrew Gelderloos and Dagmar Llewellyn of the Albuquerque Area Office, will increase the access to technical understanding of URGWOM, create a repository of the wealth of institution knowledge regarding Rio Grande water operations, and increase opportunities to develop and foster positive, basin-wide collaborative relationships. This project's target audience is: Reclamation employees who are new to Rio Grande water operations or are otherwise lacking access to URGWOM training; the Rio Grande water management community, where there are discrepancies in levels of URGWOM expertise; Reclamation's stakeholders and local tribes who must understand URGWOM to engage with Reclamation in operations and planning exercises; and researchers interested in incorporating Rio Grande water operations into their research questions and analysis. Objectives of this project will be accomplished by creating training modules that can be used as an extended training curriculum or as multiple shorter stand-alone topics. The modules will be reviewed for accuracy, accessibility, and adaptability to future updates.

East Canyon Dam Crack Monitoring and Photogrammetric Modeling using Remote Sensing and Terrestrial Methods, Reclamation Funding: $200,000

The East Canyon Dam Crack Monitoring and Photogrammetric Modeling project, led by Zach Nelson in the Provo Area Office, will improve the reliability of water management and operations by applying existing photogrammetric methods and analysis at East Canyon dam, located in southeast of Morgan, Utah. The first year of the project will include meeting the existing Denver Dam Safety Office's requirements outlined in their Schedule for Periodic Monitoring to match East Canyon's annual photo guide with the updated equipment and methods for transition and comparison. A ground-based photogrammetric approach with more technologically advanced handheld sensors will be conducted by taking photos from planned ground positions to create a re-constructible 3D point-cloud. Comparison data collected with the aid of unmanned aerial systems (UAS) will be collected during the second year. The final products will be georeferenced dense point-clouds that are rasterized into a mesh and overlaid with the individual models made from the sensors. This will allow the engineers to accurately measure, identify and classify characteristics of the cracks on the face of the dam each year.

Enhancement of LiDAR and Precipitation and Soil Monitoring in the Aravaipa Watershed, Reclamation Funding: $200,000

The Enhancement of LiDAR and Precipitation and Soil Monitoring in the Aravaipa Watershed project, led by Lisa Rivera and Jessica Asbill-Case of the Phoenix Area Office, will involve the installation of approximately two Soil Climate Analysis Network (SCAN) stations in the watershed to monitor precipitation and soil moisture, which will better inform Natural Resources Conservation Service (NRCS) forecasting models and United States Geological Survey (USGS) surface water models. In addition, this project will fund LiDAR on approximately 292 square miles (mi2) of the lower Aravaipa Watershed. Completion of LiDAR for the remaining watershed is a high priority for AWCA to establish baseline data for the watershed as well as to identify and prioritize areas of concern. The LiDAR data for the entire Aravaipa Watershed will be used for site verification of the SCAN stations. The Aravaipa ecosystem supports seven native fish species that depend on the watershed's water supply, two of which are federally listed as endangered. The work proposed in this project will help Reclamation and local partners predict flood risk, drought, erosion, and water quality concerns and better plan mitigation of these water management issues.

Estimating Open-Water Evaporation from Elephant Butte Reservoir using the Weather, Research, and Forecasting Model, Reclamation Funding: $199,764

The Estimating Open-Water Evaporation from Elephant Butte Reservoir using the Weather, Research, and Forecasting Model project, led by Katie Holman, will implement a version of the Weather, Research, and Forecasting (WRF) model coupled to a 1-D thermal diffusion model. The WRF model has been used by researchers and practitioners across the world to simulate regional climate and physical processes at scales relevant to decision makers. This proposal will use a coupled version of the WRF model to estimate daily, monthly, and annual evaporation across Elephant Butte Reservoir, and compare simulated totals from the WRF model with alternative estimates. Results from the proposed study will be used by team members in Reclamation's Albuquerque Area Office to support operations work, to facilitate method comparisons, and to identify future planning, operational, and research needs on the topic. Reclamation will benefit from this project through the development of an alternative estimation technique for evaporation, the production of a daily evaporation time series at a reservoir, and the broadening of NWP modeling capabilities and technical capacity within Reclamation.

GIS Mapping of Reclamation's Cathodic Protection Equipment for Improved Data Collection and Monitoring for Maintenance, Reclamation Funding: $196,300

The GIS Mapping of Reclamation's Cathodic Protection Equipment for Improved Data Collection and Monitoring for Maintenance project, led by Stephanie Prochaska in the Technical Services Center in Denver, will establish an easily accessible database for collecting and disseminating cathodic protection system information on Reclamation structures. A Tessel-based GIS database will be established to identify Reclamation CP systems and store information including location, size/diameter, material type, date of construction, depth, connection types, linings/coatings, cathodic protection, and soil resistivity/corrosivity data. Three keystone studies located in the Western Colorado Field Office, Four Corners Construction Office, and Provo Area Office, will be included to validate the process.

GIS-based Case Studies for Improving Drought Response and Management in the Colorado River Basin: A modular application of the Collaborative Conservation Adaptation Strategy Toolbox, Reclamation Funding: $199,150

The GIS-based Case Studies for Improving Drought Response and Management in the Colorado River Basin: A modular application of the Collaborative Conservation Adaptation Strategy Toolbox project, led by Genevieve Johnson of the Boulder Area Office and Adam Ricks of the Technical Service Center in Denver, will use an online geospatial database and online story map to communicate where and how managers are responding to

drought conditions, focusing on lessons learned, which are not often readily available. A synthesis of existing research, along with a summary of management actions derived from case studies, will be used to inform development of a decision support tool. The project builds on the existing Collaborative Conservation Adaptation Strategy Toolbox (CCAST) led by Reclamation and U.S. Fish and Wildlife Service (USFWS). CCAST is a multi-organizational partnership guided by over 100 individuals representing a broad array of water managers, natural resource managers, and researchers. CCAST provides an easily accessible, transparent way to communicate science and management activities to address management concerns, reduce redundancy and improve outcomes. CCAST has successfully improved access to information used by water managers, natural resource managers, and researchers.

Improvement and Assessment of a Snowpack-Runoff-Dust Decision Support Tool, Reclamation Funding: $87,050

The Improvement and Assessment of a Snowpack-Runoff-Dust Decision Support Tool project, led by Dan Broman of the Technical Service Center in Denver, proposes to evaluate a spreadsheet tool over a range of historical years with varying hydrologic and snowpack conditions and document its ability to improve reservoir management decisions. This retrospective evaluation will quantify the tool's performance across a range of hydrologic and snowpack conditions to highlight conditions where the tool provides beneficial information, and potentially conditions where the tool provides nonbeneficial, or detrimental information; offer an assessment of the tool to suggest improvements in its structure, including layout, graphics, and additional sources of data, and highlight where operators would benefit from additional data collection; and suggest where a similar tool may be useful in other Reclamation offices. A thorough evaluation of this tool will offer evidence and documentation of the tool's ability to improve operations, provide an assessment for further tool development, and identify snow observations that may be useful for operators elsewhere in the Southern Rocky Mountains and beyond.

Improvements to Modeling Capability for the Upper Snake River by Developing Two Models: a complex accounting model and a simplified physical model, Reclamation Funding: $190,691

The Improvements to Modeling Capability for the Upper Snake River by Developing Two Models: A Complex Accounting Model and a Simplified Physical Model project, led by Jennifer Johnson of the Columbia-Pacific Northwest Regional Office, will develop improved modeling tools for the Upper Snake River basin above Brownlee Reservoir. The proposal will first revise the existing complex model to use more of the accounting output will provide more accurate reporting with respect to water deliveries and annual availability of stored water. Second, the simplified physical model will allow for more efficient analysis when the accounting detail is not necessary to answer the project questions. Lastly, criteria to determine when the accounting details is needed will help modelers determine when it is necessary to invest additional time and resources in the use of the more detailed model. This project will develop criteria to determine when it is necessary to use either model as well as develop documentation for both models.

Mapping and Disseminating Reservoir Storage Capacity and Remaining Storage Life, Reclamation Funding: $200,000

The Mapping and Disseminating Reservoir Storage Capacity and Remaining Storage Life project, led by David Salas of the Technical Service Center in Denver, proposes a collaborative work plan with TSC's Geographic Applications and Analysis Group, Water Resources Engineering and Management and Sedimentation & River Hydraulics groups, to create a workflow that includes processes from data prioritization, compilation, uniform analysis, dissemination and storage. The project will initiate data collection and processing for pre-dam topography, if the data does not already exist, and data storage and dissemination. This cooperative approach will organize all reservoir bathymetry work into one organized process but also greatly improves the accessibility of water resources data across Reclamation, improves Reclamation reporting, briefing, and

stakeholder communication tools through automation and improved capability to generate maps. All data presented will be done through ArcGIS Server web services.

Model-independent Parameter Optimization and Uncertainty Analysis Tools for Hydrologic Modeling, Reclamation Funding: $156,830

The Model-independent Parameter Optimization and Uncertainty Analysis Tools for Hydrologic Modeling project, led by Douglas Woolridge of the Technical Service Center in Denver, seeks to review and adapt existing model-independent parameter optimization tools for application with numerous hydrologic modeling systems frequently used by Reclamation. When completed, the adapted parameter optimization tools will be disseminated across Reclamation and use will be immediately adopted by the Technical Service Center, leading to increased quality of hydrologic model calibrations and reduced budget and time spent the effort.

Populating Reservoir Sedimentation Databases, Reclamation Funding: $91,896

The Populating Reservoir Sedimentation Databases project, led by Blair Greimann of the Technical Service Center in Denver, will fund work to enter reservoir capacity data into an enterprise geodatabase (to be developed under the companion proposal "Mapping and Disseminating Reservoir Storage Capacity and Remaining Storage Life" by David Salas) and perform QA/QC on the data after entry into the enterprise geodatabase. This data will then be published in the Reclamation Information Sharing Environment for Reclamation-wide and/or public access and uploaded to the US Army Corps of Engineers Reservoir Sedimentation Information (RSI) database, which will create a much larger database on reservoir sedimentation. This larger RSI database will provide a larger dataset from which to develop relationships for sediment yield. These relationships can then be applied at projects that have not yet been resurveyed since construction, this work is being performed in the related proposal "Developing predictive equations to forecast reservoir sedimentation rates" (Foster, 2020). Once implemented, this proposal will make it possible for Reclamation staff and/or the public to obtain current and historical reservoir storage capacities for all Reclamation reservoirs.

Predictive Modeling of Dreissenid Mussel Invasion Risk, Reclamation Funding: $120,000

The Predictive Modeling of Dreissenid Mussel Invasion Risk project, led by Aaron Murphy of the Technical Service Center in Denver, will generate maps of mussel invasion risk. This project will fill gaps identified by the USACE modeling team and apply the model to additional waterbodies. The results of this project will allow Reclamation to dedicate limited resources to high-risk locations and to prepare facilities for potential control costs. This effort is expected to result in improvements to fund-limited mussel prevention and control programs and to add to the overall technical capacity of Reclamation.

Quantifying Risk Exposure and Tolerance of Conjunctively Managed Water Supplies to Enhance Drought Preparedness and Response, Reclamation Funding: $200,000

The Quantifying Risk Exposure and Tolerance of Conjunctively-Managed Water Supplies to Enhance Drought Preparedness and Response project, led by Collins Balcombe and Anna Hoag of the Oklahoma-Texas Area Office, aims to build upon previous work completed under Reclamation's Reservoir Operations Pilot Program and develop an Enhanced Drought Response and Reservoir Operations (EDRRO) Model for three of Reclamation's Texas reservoirs. The EDRRO Models will simulate reservoir firm yield under a range of conjunctive management scenarios that incorporates supplemental supply sources to make near-term projections, while also accounting for actual water use (i.e., enhanced drought preparedness). Simulations will include the new Droughts of Record for the reservoirs, and a range of alleged "paleo-droughts" that are known to have occurred over centuries based on data collected from tree rings. The EDRRO Models will evaluate what-if demand management scenarios and identify the associated risks of the reservoirs going dry based on different types of droughts.

Quantifying Sedimentation in Starvation Reservoir following the Dollar Ridge Wildfire Reclamation Funding: $200,000

The Quantifying Sedimentation in Starvation Reservoir following the Dollar Ridge Wildfire, led by Chris Garcia of the Provo Area Office, proposes to quantify the amount of sediment deposition in Starvation Reservoir using a combination of sonar and drone technologies. Sonar will be used to capture the underwater reservoir topography and drones to capture the topography above the water surface. Following the Dollar Ridge Fire in July 2018, operators of Starvation Dam witnessed large amounts of sediment flowing into the reservoir. More sediment and debris are anticipated to continue entering the reservoir over the next several years. By surveying the reservoir, and using information obtained from previous surveys to develop an annual sedimentation rate, the sedimentation effects of the fire can be quantified, and water storage accounted for.

Reclamation GIS Facility Viewer, Reclamation Funding: $96,040

The Reclamation GIS Facility Viewer project, led by Lindsay Grabner of the Asset Management Division in Denver, proposes to provide the ability to streamline facility data and information into a single location for viewing to allow Reclamation and our Operating Partners to meet the mission objectives of water and power delivery through Reclamation. The project will result in a single-location Facility Viewer website for Reclamation facilities and asset information for over 1,400 facilities: 900 associated facilities, over 490 dams, and over 50 powerplants. Data collected for the Viewer represents multiple Reclamation programs, the Technical Service Center (TSC), and local facility information.

Using Low Cost Micro-Controllers with eTape for Measuring Streamflow, Reclamation Funding: $51,944

The Using Low Cost Micro-Controllers with eTape for Measuring Streamflow project, led by Joseph Wright of the Technical Service Center in Denver, proposes to investigate the application of lower cost micro-controllers (MCUs) with eTape as a lower cost-alternative for measuring streamflow. This proposal will investigate the concepts presented in the awarded submission under the “Lowering the Cost of Continuous Streamflow Monitoring Stage 1” prize competition. The project proposes using eTape water level sensors and MCUs as less expensive streamflow measurement components, both of which are established technologies, independently. The eTape is a low-cost solid-state sensor designed for measuring fluid levels and MCUs are becoming widely accessible at lower costs, most famously by Arduino. The judging panel for the prize competition noted that this type of equipment may be deployed in remote locations or temporary locations.