

The Metropolitan Water District of Southern California



WaterSMART Applied Science Grant for Fiscal Year 2023 Notice of Funding Opportunity No. R23AS00446

Interoperable flow and temperature data for salmonid restoration scenarios: California Central Valley models and tools to support dynamic and transparent water resource and ecosystem management

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List of Acronyms

CalSim	California Simulation
CDEC	California Data Exchange Center
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DETAW	Delta Evapotranspiration of Applied Water
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
EDI	Environmental Data Initiative
FAIR	Findable, Accessible, Interoperable, Reusable
KROM	Klamath Riverware Operations Model
NTRS	Near Term Restoration Strategy
R2R	Reorienting to Recovery
SacWAM	Sacramento Water Allocation Model
SDM	Structured Decision Making
SIT	Science Integration Team
SR JPE	Spring Run Juvenile Production Estimate
SWC	State Water Contractors
SWP	State Water Project
USGS	United States Geological Survey
VA	Voluntary Agreements
WRIMS	Water Resource Integrated Modeling System

Executive Summary

Date: October 17, 2023

Applicant Name: The Metropolitan Water District of Southern California

City, County, and State: City of Los Angeles, Los Angeles County, California

Project Summary

The Metropolitan Water District of Southern California (Metropolitan), the nation’s largest wholesale water provider, will expand surface water flow and temperature modeling capabilities for California’s Central Valley through collection and management of data and development of new models to support salmonid restoration planning. Metropolitan will convene an “Interoperable Flows and Temperature Working Group,” (Working Group) which will be tasked with documenting data gaps and limitations of current water resources planning models that have been developed to assess flow operations and temperature, and to develop a new suite of tools and models that leverages these existing frameworks, proven hydrology models, and statistical techniques to support hydrology and temperature scenario development for salmonid restoration in support of dynamic and transparent water resource and ecosystem management. This project intends to leverage existing modeling frameworks to (1) improve data resolution and (2) make data accessible and reusable. Interoperable, modeled daily time step flow and temperature datasets will be generated and will be readily updated to reflect alternative operations and management scenarios for California’s Central Valley. These new data will be utilized in the Reorienting to Recovery (R2R) process and will be available to inform other regional decision-making processes related to salmonid restoration, including creation of new habitat, restoration of existing habitat, and implementation of flow actions intended to improve salmonid habitat and survival, such as Central Valley Project Improvement Act (CVPIA)¹, the Spring Run Juvenile Production Estimate (SR JPE)², and the Voluntary Agreements (VAs)³. While the project focuses on salmonid management, the outcome would have applications to species and watersheds beyond this context.

Project Timeline: The project would have a duration of 24 months.

Estimated Completion: May 1, 2026 (based on award date of 04/01/2024).

Federal Facilities: The project will not be located on a Federal facility.

¹ The CVPIA mandates changes in management of the Central Valley Project, particularly for the protection, restoration, and enhancement of fish and wildlife; and convenes a Science Integration Team (SIT) to use the Structured Decision Making (SDM) process as a science-based framework to identify priorities for Chinook salmon, steelhead, and green and white sturgeon.

² The California Department of Fish and Wildlife (CDFW) issued incidental take permit (ITP) number 2081–2019–066–00 to the California Department of Water Resources (DWR) for the operation of the State Water Project (SWP). Condition of Approval 7.5.2 of the ITP requires DWR to convene an interagency team (JPE Core Team) to support development and implementation of an annual SR JPE.

³ The VAs are an alternative Program of Implementation for the Sacramento River, Delta, and Tributary update to the San Francisco Bay/Sacramento-San Joaquin Delta Water Quality Control Plan. The VAs provide both environmental flows and habitat improvements for native fish.

Technical Project Description

Applicant Category: Category A Applicant. Metropolitan serves 26 public water agencies, including cities, municipal water districts, and one county water authority that deliver supplies directly or indirectly to 19 million people throughout Southern California with the mission of providing its service area with adequate and reliable supply of water of sufficient quality to meet present and future needs in an environmentally and economically responsible way (MWD 2023).

Detailed Project Description

California's Central Valley ecosystem and salmonid management processes are currently driven by several existing models and datasets; however, because of the framework of these existing models, interoperable flow and temperature data are not readily accessible. The lack of accessibility to these data adversely impacts efficiency of salmonid management processes. The project is intended to address this issue by developing a new suite of tools and models that leverages these existing frameworks, proven hydrology models, and statistical techniques to support hydrology and temperature scenario development for salmonid restoration. As discussed further in E.1.2, the intended outcomes of the project will result in the following benefits to water districts, water users, and salmonids:

- Identification of data gaps and limitations of existing model frameworks
- Improvements to existing model output resulting from the development of models translating monthly output to daily time step data.
- Accessible models and tools to generate interoperable daily flow and temperature data to inform water management decisions on both a local and statewide scale.
- Integration with restoration and planning efforts.

Literature Review, Data Discovery, and Synthesis

This project will build on an enormous set of data and modeling tools available for California's Central Valley river flows and water temperatures including CalSim⁴ (DWR 2023a), SacWAM (SWRCB 2023a), and the California Natural Flows Database (The Nature Conservancy 2023). Nearly all large watersheds have long-term daily flow and temperature measurements and most of the major water diversions have daily operational records. The large reservoirs have daily records of storage levels and releases. However, as discussed in E.1.2, existing tools and data are limited due to historically disparate investment in data integration. High resolution, readily accessible, and up to date flow and temperature models are critical to ecosystem management processes.

The first phase of this project will include the compilation of documentation through literature review and outreach to experts on flow operations and natural flow models, as well as documentation of the implementation method of existing tools such as those described above, including a review of model design, software development, and overall accessibility

⁴ CalSim is the foundational modeling framework for this project and will be used in the development of new models and tools.

(i.e., rules in existing models for reservoir operations, water supply diversions, and flood conveyance, minimum flows, among others). The objective of this phase is to document data gaps and limitations of existing models and software and to provide recommendations for data accessibility.

Data Gaps and Limitations Workshop

To confirm the data products produced through this project will have the highest utility for users, the project will be driven by interested parties. The suite of publicly available tools capable of generating interoperable, daily time step data sets and associated methodologies will be designed and implemented collaboratively through workshops held throughout the project.

Following the literature review, data discovery, and synthesis phase, Metropolitan will convene the Interoperable Flow and Temperature Working Group to host a Data Gaps and Limitations workshop. The goal of the workshop will be to collaborate and prioritize data gaps and limitations. During this workshop, the Working Group will identify two to three case studies to beta test tool improvements before expanding to the entire Central Valley.

Data Improvement Case Study

Phase 3 of the project will include the application of a data improvement case study, where the data improvements identified in the first phase will be implemented in up to three watersheds in the Central Valley.

While the specific methodologies and approach to improving the available flow and temperature data for the Central Valley will be determined through workshops with interested parties, based on our previous discussions and review of existing literature, we expect that improving data resolution and data accessibility will be top priority data improvements, in addition to transitioning from monthly time step models to daily time step models.

The project will seek to create an open library of the key operational rules governing surface flows in the Central Valley. This project will also create a library of measured daily flows throughout the Central Valley (compiled from the United States Geological Survey [USGS], California Data Exchange Center [CDEC], and other agency stream gages). We will compare CalSim generated monthly flows with measured daily flows for the same time periods using CalSim runs with operational rules matching the rules already in place at the time flows were measured. Subsequently, we will apply an iterative approach to determine how flows would change based on updates to the operational rules. This approach would allow users to modify measured daily time step flows under alternative sets of operational rules and create synthetic time series of daily flows and temperatures. There are a few examples of cases where monthly flows from CalSim were extrapolated to model daily flow processes including in California WaterFix where “CalSim II output was mapped to a daily time step for use in other models,” (Delta Stewardship Council 2020, p. 11) and in Water Operations Models for Delta Smelt where “CalSim monthly hydrology will be smoothed to daily values,” (Delta Stewardship Council 2020, p. 33). Our approach would leverage previously developed

frameworks and improve them with the latest statistical and analytical approaches to document these relationships and develop a reliable and accessible daily time step model.

New Databases: Since measured flows are not available at every location provided by CalSim, we will also generate a new data library for watersheds that are not currently gaged. We will use information from CalSim, the Nature Conservancy’s ecological flows tool, and mass balance analyses to create these datasets. Because most of the ungaged watersheds are not dammed and do not have extensive diversion infrastructure, this library will primarily be accessible as a source of daily flows for ecological evaluations and as tributary flows to downstream watersheds.

Planning for Limitations: We also recognize that our tools that model how changes in operational rules impact measured daily flows will be limited to relatively short time periods (typically 20 years or less) and may not be representative of the full range of daily variability possible in a given river. To combat these limitations, we will employ an iterative approach to create tools that allow the creation of “synthetic” daily flow timeseries by generating ranges of different daily variability patterns and extending time series over long time periods (e.g., up to 100 years) by specifying sequences of water year types.

After data improvements have been implemented for two to three locations, performance metrics would be developed to evaluate effectiveness of the improvements. The data improvements will be evaluated by the Working Group in the Data Improvement workshop. The goal of this workshop will be to identify areas that are not working well and recommend additional iterations, as well as identify the next steps for implementing at the Central Valley scale.

Data Management Infrastructure

Following the Data Improvement Workshop, the data management system will be designed and documented in the System Design Document which includes the Data Management Plan, architecture for data management and integration, a roadmap for implementation, and adaptive management plan for ongoing maintenance and updates.

Data Improvement Expansion

This phase involves expanding the Data Improvement Case Study to the entire Central Valley following the selected methodology described above in Data Improvements Case Study, and managing data following the plan described in the Data Management Plan.

Tool Development and Accessibility

We plan to develop an “R” coding language package aimed at running the new models developed to translate and update monthly flows and temperature to a daily timeseries that will be documented in a public, open-source and accessible GitHub repository (a code hosting platform for version control and collaboration) and include a user interface that will allow easy manipulation of input data to run the model under different scenarios.

The remaining phases of this project will focus on publication and sharing of models and data, and the implementation of the new suite of tools. The Implementation Workshop will focus on sharing information about how the interoperable flow and temperature data can be

accessed, how to use the R package and user interface for model updates and iterations, and identifying how these tools can be most effectively integrated with existing workflows. This workshop will also focus on developing a plan and schedule for ongoing data updates.

Integration with Restoration and Planning Efforts

A number of ongoing restoration and planning efforts are underway in California's Central Valley, including R2R, the CVPIA, SR JPE, and the VA. This project was developed to integrate with these efforts.

Goals and Objectives

The goal of this project is to develop a suite of publicly available tools⁵ capable of generating interoperable, daily time step datasets, including flow and temperature data. These tools and resulting data will offer more effective and powerful analytical capabilities for evaluating alternative water management operations as they pertain to salmonid management and restoration planning. The availability of daily flow and temperature data resulting from project implementation will greatly enhance the ability of large-scale water management processes to evaluate alternative flow operations, operational effects on fish and wildlife, and climate impacts.

Project Location

The geographic extent of the project is the California's Central Valley, which encompasses the Sacramento River and San Joaquin River basins (Figure 1).

⁵ Throughout this proposal the term "tools" is used to encompass models, open-source model code, and user interfaces that can be used to develop daily flow and temperature data and update these data to reflect various scenarios.

Figure 1 Geographic Extent of the Project (Highlighted in Blue)



Data Management Practices

This project includes a phase focused on the development of a Data Management Plan and System Design Document. All models and data developed through this project will follow Findable, Accessible, Interoperable, Reusable (FAIR) data principles, which were developed

in 2016 to support knowledge discovery, collaboration, and innovation through good data management (Wilkinson et al. 2016). All code and software developed through this project will be open and publicly available on GitHub and utilize off-the-shelf software to facilitate collaboration, transparency, and make ongoing maintenance easy and accessible.

The Data Management Plan will describe all data that will be used as input to the model as well as the resulting output data including data source, frequency of data collection and update, data resolution (temporal and spatial), data quality, data storage, and data access. The Data Management Plan will also contain guidance for data updates including how often the input data will be updated for use in the model and how the updates will be implemented. The System Design Document will describe the system architecture including database schemas, description of potential user interface for model deployment and manipulation of model parameters, automated procedures for model runs, and plans for ongoing system maintenance.

Evaluation Criteria

E.1.1 Evaluation Criterion A – Water Management Challenge(s) (30 points)

Water Management Challenges

Water management in California’s Central Valley is complicated due to the need to balance agricultural, urban, and ecological water needs in the face of climate change. The Central Valley supports one of the most productive agricultural economies in the world with over 250 crops with a value of approximately \$17B each year, contributing about 25% of the nation’s food; large urban areas; and a diverse ecosystem including several threatened and endangered species (CDFW 2023). The numerous water management challenges in California's Central Valley necessitate the development of modeling with capabilities of assessing day-to-day changes that impact the diverse water needs.

Our primary goal in developing an interoperable and accessible flow and temperature models is to provide the necessary granularity for understanding the effects of flow and temperature on threatened and endangered species, specifically focusing on Central Valley salmonids. However, the benefits of the tools and data produced by this project will extend beyond salmonid management. Enhancing the granularity of flow models and increasing model accessibility will enable more resilient climate change planning as models can be more readily adapted to changing conditions in critical waterways in California. Further, daily granularity will allow for a better understanding of impacts to both human and ecological communities resulting from day-to-day activities and patterns.

Daily time step granularity is critical to accurately model ecological functions within the Central Valley. Currently, the use of monthly flows in nearly all Central Valley water management processes causes inaccuracies and leads to distrust of operational decisions. This project will support other issues including the need to meet competing demands for water and the lack of reliable water supplies, drought complications, and conflicts over water allocation within the project area.

A daily time step is important for salmonid management because the daily flow variation has a large impact on fish behavior and health as well as on habitat quality, spawning and egg survival, migratory behavior, predator avoidance, temperature regulation, and food availability. A single or multi-day pulse flow during juvenile salmon outmigration is expected to improve survival as juveniles migrate to the ocean (Michel et al. 2021). Similarly, daily exceedance of temperature thresholds correlated with flows may result in adult salmon prespawn mortality (Fitzgerald and Martin 2022).

Transparent and accessible models and data are extremely important for quality, collaboration, and innovation. Models that are accessible can be more readily adapted to meet shifting data needs or updated with new information. Workshops will be held with a diverse group of interested parties including water data experts, ecologists, modelers, and water operations engineers. These workshops will provide the basis for the development of tools that will be interoperable and used to address multidisciplinary water management challenges supporting communities at the local, regional, and state level.

Concerns or Outcomes if this Water Management Challenge is not Addressed

It will not be possible to fully recover California Central Valley salmonid populations without filling the data gap of daily river flows and temperatures reflecting alternative management scenarios. Water management and ecosystem modeling efforts in the Central Valley will remain unable to capture critical nuances of salmonid (and other species) responses to fine scale flow and temperature changes, continuing to limit modeling of actions that agencies can implement to provide ecological benefits to these species through changes to water project operations and limiting the granularity in modeling trade-offs of ecological, municipal, agricultural, Tribal, and recreational water distribution. The benefits or limitations of management actions will go untested as many actions are occurring daily.

Measured flows and temperatures have high variation within months depending on daily climate conditions and variability is expected to increase because of climate change. Monthly models neglect this variation and provide inaccurate views of the system with limited utility. In addition to the importance of granular data for salmonids, flood management activities would also benefit from this information. Flooding typically occurs on the scale of weeks or days rather than monthly, making granular data critical for resilience and effective planning.

Further, the current lack of accessible and reusable models is a major limitation resulting in slow model updates that fail to support the timescale in which data are needed for planning and decision making, especially in the face of climate change.

Addressing Water Management Issues

Water supply reliability: The project will increase resolution around water supply operations, providing daily timeseries of flow and temperature data, which is critical for environmental water uses where flows or temperatures may need to be adjusted on a daily basis in response to extreme climatic events to evaluate impacts to salmonids. Abnormally high temperatures are increasing with climate change in California's streams (Leathers et al. 2022) and targeted operations to address these rising temperatures will be essential to recover and support salmonid populations.

Management of water deliveries, water marketing activities, drought management activities: This project will provide tools and data capable of giving water supply managers more certainty in their future operations. Daily time step flow and temperature datasets produced as a part of the project will be critical to managing water operations for ecological functions in drought years. Salmonids are sensitive to temperature swings and a few hot days may result in detrimental effects on salmonid survival. A study on prespawn mortality of Chinook Salmon describes that prespawn mortality rates were positively correlated with the annual maximum 7-day average maximum stream temperatures (Bowerman et al. 2017). Accessibility to daily temperature data will provide a standardized Central Valley wide view of how operations can stabilize flows and temperatures in varying conditions such as drought.

Conjunctive use of ground and surface water: This project will allow water managers to more effectively analyze potential multi-benefit projects that provide valuable floodplain rearing habitat for juvenile salmon and groundwater recharge potential. Because many impacts to surface water (e.g., flooding, or high yield groundwater pumping events) are short-term events, these occurrences are not currently reflected in existing models, and are critical to understanding the connectivity of groundwater and surface water. The California Water Data Consortium (CWDC) describes this current disconnect in the resolution of surface water and groundwater (CWDC 2023). Daily flow time step data generated by this project will provide a daily comparison that we can use with daily groundwater loggers, providing a finer scale resolution into how quickly groundwater and surface water interactions occur and can help regulators better manage surface water and groundwater.

Ability to meet endangered species requirements: This project will compile critical data needed to model and better understand changes in habitat and flows needed to recover and maintain endangered and threatened salmonid species through quantification and modeling. Central Valley salmonid movement patterns are tied to pulse flow events (NOAA 2019), which are lost in the currently available monthly flow data. Daily flow data is essential for better understanding and modeling the triggers that cause salmonids to move throughout the system and to accurately represent their survival and growth as they move.

E.1.2 Evaluation Criterion B – Project Benefits (30 points)

Describe How the Need for the Project was Identified

The need for this project has been identified in multiple SDM processes in the Central Valley including the CVPIA SIT SDM process, the SR JPE process, and the R2R SDM process. These are collaborative processes with input from multiple parties that focus on modeling effects of water project operations and restoration actions on salmonid populations in California’s Central Valley. Leaders and analysts in these processes have identified CalSim monthly flow data as being a limiting factor. Delays have resulted from the lack of available modelers to run CalSim and analyses being hampered by monthly time step flow scenarios. The Near-Term Restoration Strategy (NTRS) that documents CVPIA’s restoration priorities includes an “Information Need” priority of improved habitat data, which includes representing habitat changes at a finer time step than monthly. Similarly, the R2R process has identified that monthly flow data prevents full exploration of actions like floodplain inundation that are expected to be required for salmonid recovery in the Central Valley.

While there are a number of water resources planning models that exist in California, these products do not provide the type of information needed for salmonid management. We are also fortunate to have CalSim 3, the latest planning model for Central Valley operations that has been in development for several decades. The Water Resource Integrated Modeling System (WRIMS) code for CalSim includes the operational logic for every aspect of the Central Valley water system. Unfortunately, CalSim was originally developed to produce water supply planning scenarios at a monthly time step. It has always maintained this purpose and therefore the CalSim codebase is not amenable to producing the daily time step flow data that is now essential to improved ecosystem management scenario development.

For instance, Close et al. (2003) provided a peer review of CalSim II, which included recommendations for transitioning to a daily or weekly time step (Close et al. 2003). These recommendations were not implemented in CalSim 3 released in 2022. Further, a 2020 Delta Stewardship Council Memo on Integrated Modeling Applications in California, highlights the need for daily time step flow data and describes challenges producing daily time step data with our current modeling approaches (Delta Stewardship Council 2020).

A daily time step is particularly important for salmonid management because the daily variation in flows has a large impact on behavior and health resulting in impacts to habitat quality, spawning and egg survival, migratory behavior, predator avoidance, temperature regulation, and food availability. For instance, a single or multi-day pulse flow during juvenile outmigration is expected to improve survival as juveniles migrate to the ocean (Michel et al. 2021), whereas daily exceedance of temperature thresholds correlated with flows may result in prespawn mortality (Fitzgerald and Martin 2021). Close et al. (2003) concluded that “inadequate data development and management are principal shortcomings of CalSim II,” and that, “there has not been a sufficiently systematic, transparent, and accessible approach to the development and use of hydrologic, water demand, capacity, and operational data for CalSim II.” In the development of CalSim 3, efforts were made to improve documentation; however, regional processes that use CalSim (e.g., VAs, R2R, CVPIA SIT), rely on a very small group of experts to run the model and provide output, which often takes multiple months or even longer. Table 1 describes existing water resource planning and flow operation models and provides a summary of the limitations associated with these models.

Table 1 Existing Water Resource Planning and Flow Operation Models

Flow Model	Description	Limitations
SacWAM	SacWAM provides simulated flows on a monthly time step to inform a comparative environmental analysis of potential alternatives to the Bay-Delta Plan. Monthly time step output from SacWAM is used to estimate the changes in reservoir storage, streamflows, and water supply resulting from potential Bay-Delta Plan modifications.	<ul style="list-style-type: none"> ▪ Monthly time step ▪ Limited to Sacramento River watershed (does not include San Joaquin River watershed)

Flow Model	Description	Limitations
CalSim	The primary purpose of CalSim is to evaluate federal Central Valley Project (CVP) and SWP operations at current or future levels of development, with and without various assumed future facilities, various regulatory requirements, and with different facility management options. One of the principal outputs of the model is the estimate of CVP and SWP exports at project facilities in the south Delta and corresponding delivery reliability of the two projects. However, CalSim has also become a widely accepted modeling tool for water resources planning in the Central Valley.	<ul style="list-style-type: none"> ▪ Designed for water supply planning ▪ Monthly time step ▪ Low accessibility to run CalSim model and adjusting scenarios run in model

How and When Project Products will be Applied

The interoperable daily flow and temperature data from this project will be directly integrated into the R2R Phase 4. R2R modelers will update the salmonid life cycle model framework to allow for daily flow, temperature, and habitat data. They will then directly pull in data generated from this project and use it to inform all future modeling efforts. These data will allow them to provide performance metrics on the ecological benefits of different water operations and the tradeoffs in water deliveries to municipalities, refuges, and agriculture as well as flood safety and risk metrics. These improvements will also be presented to the CVPIA SIT and made available for use in the CVPIA process if desired.

Flow and temperature data generated from this project will also be brought directly into SR JPE as covariates to both juvenile and adult submodels. SR JPE modelers will use daily temperature data to look closely at the effect that migratory and holding degree days have on spring run adults and will use daily flow data to model the relationships between trap efficiency and flows. This will also facilitate SR JPE forecasts under various flow scenarios that will be critical in planning efforts.

This project will provide a suite of publicly available tools capable of generating interoperable, daily time step data sets for flow and temperature to improve water management and will be a collaborative project engaging diverse parties. This project will allow easy integration with other efforts due to its open-source interoperable framework and ability to update and manipulate flow scenarios.

Extent of Project Benefits

The suite of publicly available tools capable of generating interoperable, daily time step data sets for flow and temperature to improve water management produced as a part of the project will be critical to managing water operations for ecological functions in drought years (Bowerman et al. 2017). Having daily temperature data will provide a standardized Central Valley wide view of how operations can stabilize flows and temperatures in drought years.

More specifically, the R2R project will use this tool to increase its modeling capabilities and provide finer-resolution data for its SDM process. A primary R2R model limitation currently is the dependence on CalSim II monthly flow data. This project will enable the R2R model to transition to daily flow data and have increased documentation and flexibility around flow scenarios that the SDM group wants to test. The creation of a suite of publicly available tools capable of generating interoperable, daily time step data sets for flow and temperature to improve water management is supported by numerous R2R planning team members including Rene Henery (Trout Unlimited) and Darcy Austin (SWC).

Additionally, the products delivered through this project will support work being done through the VAs (SWRCB 2023b). Similar to R2R and CVPIA SIT, the habitat analysis for the VAs used a monthly time step flow operations model (SacWAM) to model changes in habitat over time based on flow to suitable habitat area relationships. This analysis is limiting in that it does not capture changes in habitat at the weekly or daily time step that has significant impacts on fish behavior and survival. For instance, in this analysis floodplain habitat is quantified using information about magnitude, frequency within a rearing season, frequency across rearing seasons, and duration; however, because flow data is only available at a monthly time step duration is not fully represented.

Improving Water Management Decisions

This project will address several water management issues as described above and will improve water management decision making by providing adequate, timely, and high-quality data for decision making processes. The CWDC documents the need for high-quality, usable, and accessible data to inform water management and a more resilient water future (CWDC 2023, p. 8) and in particular, the need for data at an adequate temporal resolution to accurately represent hydrological and ecological processes. This project will improve the input data used in many water resource and salmonid management decision making processes resulting in more accurate, representative output that is accessible and adaptable to changing conditions.

Application of Project Products

This project will be developed as an open-source and accessible data package hosted on GitHub. In-depth documentation will provide guidance on how to use the modeling tools and data so it can be easily incorporated into other processes. This dataset will be invaluable to any entity that wants to explore the Central Valley-wide flow and temperature dataset. Given the open-source development and associated documentation, no additional work would need to be done to make the project results transferable to others as that would be inherently built into the project design.

Extent Addresses Water Management Challenges

Limiting simulated flow to monthly aggregated values is a challenge for water supply reliability, management of water deliveries, and drought management. Monthly flow and temperature data also limits our ability to plan multi-benefit projects such as floodplain creation that provides juvenile salmon habitat and groundwater recharge by limiting our understanding of the interactions between surface and groundwater. Monthly flow and

temperature data also restrict the actions being considered to meet the requirements for endangered species in the Central Valley. Refining flow and temperature data to a daily time step will improve the ability of decision makers, scientists, interested parties, and water users to make informed decisions when facing water management challenges.

The project will produce tools needed to generate daily time step flow and temperature data reflecting alternative water management scenarios. For interested parties and endangered species in the Central Valley, this will allow data to match reality more closely: pulse flows will no longer be subsumed into a monthly aggregate and temperature extremes will not be lost. This will address water management challenges by improving modeling to allow for water supply operations to reflect changes in flow from the previous day or week (as opposed to the previous month); account for high temperatures during drought years and their effects on salmonid survival; improve modeling interactions between surface and groundwater by increasing the datasets for these complex relationships; and more accurately reflect conditions experienced by endangered and threatened salmonids on a day-to-day basis, which can significantly improve population models and inform decisions about pulse flows.

Complements Other Similar Efforts

Our project would use operational information from the frameworks of accepted models to increase temporal granularity. This will be complementary to other recent efforts to develop more temporally resolved flow scenario generation tools for parts of the Central Valley (e.g., the Delta Evapotranspiration of Applied Water [DETAW] [DWR 2023b], East Bay Municipal Utility District [EBMUD] and Yuba Water). Methods from such models will inform the development of this project through documentation review, workshops, and direct communication.

E.1.3 Evaluation Criterion C – Project Implementation (20 points)

The need for this work has been identified in a number of different processes including the peer review of CalSim (Close et al. 2003) and in the Survey of Recent Integrated Modeling Applications in the Delta and Central Valley (Delta Stewardship Council 2020). Delta Stewardship Council (2020) also documented that two efforts implemented a mapping of CalSim monthly flows to daily flows which provides a foundation of work to leverage in this project.

Work Plan

The work plan for this project includes several phases to be completed over two years:

Table 2 Summary of Project Work Plan

Task	Description	Deliverable	Timeline/ Cost Estimate
Project management	Project planning and strategic implementation	N/A	Month 1-24 \$17,500

Task	Description	Deliverable	Timeline/ Cost Estimate
Literature review, data discovery, and synthesis	Synthesize data availability across watersheds in the Central Valley building off past and ongoing efforts (e.g., CVPIA SIT, R2R) and conduct additional data discovery outreach, expert consultation, and literature review	Catalog of flow and temperature data. Synthesis of similarities/ differences, benefits/limitations across datasets	Month 1-6 \$99,750
Outreach	Initial outreach to engaged community within project locations to introduce project and upcoming workshops and ensure most up-to-date data captured within data discovery phase	Schedule workshops	Month 1-6 \$8,780
Data gaps & limitations workshop	Plan and facilitate workshop(s) to engage local parties in identifying data limitations and gaps and developing methodology to fill gaps; Encourage participation/ feedback; Adapt and iterate on methodology based on feedback.	Data workshop and memo summarizing workshop. Identify data gaps to be prioritized and potential methodology	Month 7 \$21,000
Data improvement case study	Plan and document methodology to improve flow and temperature data at the Central Valley scale; identify 2-3 cases studies and implement methodology; analyze performance of improvements	Working paper documenting methodology and case studies Working paper shared and reviewed by Working Group	Month 8-11 \$112,000
Data improvement workshop	Present on performance of case studies; Adapt and iterate based on group feedback; Discussion focused on application in each location.	Data improvement working paper revised based on workshop. Required revisions and next steps to implement at Central Valley scale	Month 12 \$21,000

Task	Description	Deliverable	Timeline/ Cost Estimate
Data infrastructure design	Design data management system infrastructure based on selected methodology	System design documentation and roadmap for implementation	Month 1-12 \$10,500
Data improvement expansion	Apply selected methodology to locations in the Central Valley beyond case studies to improve flow and temperature data	Interoperable flow and temperature dataset	Month 12-20 \$105,000
Data publication	Publish dataset and associated metadata on open data portal (e.g., Environmental Data Initiative [EDI])	Data published on open data portal	Month 18 \$28,000
Implementation workshop	Plan and facilitate workshop on accessing and using data	Memo of data applications to be included in data publication	Month 20 \$21,000
Iteration & improvements	Additional improvements following implementation workshop	As needed	Month 20-24 \$21,000
Sharing results	Develop documentation (e.g., manuscript, workshop, presentation) summarizing methodology and process to develop dataset; Summarize performance	Additional workshop and/or presentation at conference	Month 20-24 \$24,500

Deliverables

This project will result in a number of deliverables including interoperable flow and temperature data (Table 3).

Table 3 Summary of Project Deliverables

Deliverable Type	Description
Central Valley flow and temperature metadata catalog	This catalog would describe the availability, including temporal and geographic scale, data quality and limitations for flow and temperature data in the Central Valley

Deliverable Type	Description
Data gaps and limitations memo	Memo summarizing the Data Gaps & Limitations workshop and synthesizing prioritization of data gaps and limitations
Data improvement working paper	Working paper documenting methodology for improving data gaps and limitations
System design documentation	Document describing system design for interoperable flow and temperature data management
Interoperable flow and temperature data management system	Dataset of interoperable flow and temperature data managed according to FAIR data principles
Implementation memo	Memo describing data publication, access, and use
Sharing results	Manuscript or presentation where project results are shared

Project Partners

Alison Collins

Alison, a Senior Resource Specialist with The Metropolitan Water District of Southern California, will be the Metropolitan Project Manager. She is a technical expert in aquatic and fish ecology with 12+ years of working at the intersection of science, management, and policy decisions related to species protection and water management. Skilled at working in large multi-party collaborative processes, she has developed, managed, and led several large workshops for R2R, I:E symposium, disease workshop, and more. Her expertise framing natural resource management challenges through formal structured decision-making processes to ensure that decision processes are transparent, explicit, deliberative, and replicable will be leveraged in this effort.

FlowWest (Subrecipient)

FlowWest, LLC., is an interdisciplinary team of problem solvers specializing in complex projects at the intersection of water resources management and technology and will be providing technical support for Metropolitan on this project. FlowWest brings domain knowledge and expertise in hydrology, geomorphology, fisheries biology as well as technical skills in data science, statistics, quantitative modeling, and software development. FlowWest has led hydrodynamic modeling efforts, data management, model, and tool development for many projects throughout the Central Valley including CVPIA, VAs and the Sacramento/Delta Update to the Bay-Delta Plan, SR JPE, and R2R.

The project team can begin work immediately.

E.1.4 Evaluation Criterion D – Dissemination of Results (10 points)

Metropolitan is the primary applicant and will be a beneficiary of the project through work on the R2R project. Through work on R2R, interested parties will be identified and communicated with during the development of the project. However, the datasets produced from this project will be applicable and valuable to many parties beyond Metropolitan. As noted earlier, the need for interoperable flow and temperature datasets has been identified in several projects in the Central Valley (the CVPIA SIT SDM process and the SR JPE process). The project accounts for the necessary workshops, time for communication, and structure that will ensure project results are communicated and made available to interested parties.

The data will be available to any interested party as an open-source and accessible data package hosted on GitHub. Code used to format and model the data, instructions on use, documentation of limitations and of the process will all be tied to this data package. Comprehensive documentation will provide guidance on how to use the data so it can be easily incorporated into other processes, and the issue functionality on GitHub will allow for users to identify drawbacks or concerns with the data package. This open-source, open data approach is integral to making the data available to any project exploring Central Valley-wide flow and temperature.

The development of the package involves a series of workshops with interested parties at all stages of development; this in itself will ensure parties interested in the project will be updated on important changes, feedback, and timelines. In addition to the collaborative nature of workshops built into the project, project results will also be communicated in a report and/or manuscript which can be disseminated through the appropriate channels. Additionally, presentations on the project will be developed for conferences, management briefings, meetings with interested parties, and other venues. The project is designed to be open, malleable to different needs in the Central Valley, and interoperable; however, the key component to the project is ensuring interested parties are engaged, consulted, and drawn in to the process so when it is complete, it will be useful right away.

E.1.5 Evaluation Criterion E – Presidential and Department of Interior Priorities (10 points)

Climate Change and Resiliency: This project addresses climate change and increases resiliency by providing robust, transparent, and accessible tools that can be used to model various climate change scenarios. The ability to simulate potential impacts on salmonid populations under climate change scenarios enables communities to plan and increase resilience of these populations. As discussed above, flow and temperature data available at a daily time step is critical for modeling salmonid populations as daily variations in flows are directly related to survival. Climate change will lead to more variations in flow that will not be captured at a monthly time step, further supporting the need for this project. This project's focus on accessibility also supports climate resiliency as models and data are used broadly (i.e., by local water managers), not just by experts or technical users. Further, this project is designed to support frequent updates meaning that input data can be updated to reflect changing conditions associated with climate change.

Maintaining biodiversity is crucial in the context of climate change, as it builds ecosystem stability, resilience, and adaptability to evolving environmental conditions. The primary way this project contributes to climate change resiliency is through enhanced salmonid population management and identification of actions that are expected to improve population levels. For instance, temperature has been identified as a limiting factor for adult salmonids migrating upstream to spawn. This project will seek to reduce water pollution in the form of temperature by providing the data needed to identify when and where temperature is problematic for salmonid populations and to develop actions to reduce temperature pollution.

Drought Resilience: This project will build long-term resilience to impacts resulting from drought conditions by providing communities and planning processes with the tools to simulate long-term drought scenarios and the impact on salmonid populations which enables increased resilience through targeted actions and planning. The benefit of the project also extends beyond salmonid management to water management under extreme drought and flooding. For instance, with access to more granular flow data, water managers can make adjustments to water management on a daily or weekly time step increasing resilience in times of drought or flooding. This project will continue to facilitate long-term resilience to impacts from drought in this capacity for as long as it is maintained and for an estimated 1-5 years after maintenance is suspended. As part of this project, a plan for ongoing maintenance and funding for maintenance will be developed. Ongoing maintenance is not expected to be onerous though is necessary to update tools with new and improved information and troubleshoot bugs.

Benefits to Tribes and Disadvantaged and Underserved Communities: The geographic extent of this project (Figure 1) overlaps with several disadvantaged and underserved communities⁶ as well as tribal lands.⁷ When developing a Working Group, representatives in the water resources industry serving disadvantaged and underserved communities as well as tribes in the Central Valley will be engaged. The project's focus on accessibility and open-source products is intended to increase equity in water resources and ecosystem planning and decision making. The products developed through this project will be accessible to diverse users and interested parties, not just experts or modelers. Additionally, models will be open source and free to use such that communities with limited resources will have access to the data and models. This project will also support equitable decision making by allowing all communities and tribes in the Central Valley to have access to data with higher resolution that are critical for representative water resources and ecosystem management, not just those that have the resources to develop these models independently. These publicly accessible and transparent data and models can be used to help inform Tribal water resource planning and restoration efforts. The CWDC interviewed several diverse representatives in water resource about the importance of adequate water data, and a tribal government representative commented that, "having good data really helps us to dig down and think about how to be effective about the water we are using" (CWDC 2023, p. 12).

⁶ As identified using the Council on Environmental Quality's interactive Climate and Economic Justice Screening Tool

⁷ The geographic extent of this project is large and encompasses tribal lands including the Tachi Yokut Tribe and the Central Valley Miwok Tribe, among others.

Project Budget

This project includes 25% cost share from Metropolitan and a total request from Reclamation of \$390,000 (Table 4). The Budget Narrative is included as Appendix B.

Table 4 Summary of Project Budget

Funding Sources	Amount
Non-Federal Entities	
The Metropolitan District of Southern California	\$130,000
REQUESTED RECLAMATION FUNDING	\$390,000

Environmental and Cultural Resources Compliance

Will the proposed project impact the surrounding environment (e.g., soil [dust], air, water [quality and quantity], animal habitat)? No, the project does not involve activities that will impact the surrounding environment.

Are you aware of any species listed or proposed to be listed as a Federal threatened or endangered species, or designated critical habitat in the project area? If so, would they be affected by any activities associated with the proposed project? No, while threatened or endangered species or designated critical habitat exist within the project area, none of these species or habitats would be affected by activities associated with the project.

Are there wetlands or other surface waters inside the project boundaries that potentially fall under CWA jurisdiction as “Waters of the United States”? If so, please describe and estimate any impacts the proposed project may have. While wetlands or other surface waters inside the project boundaries fall under CWA jurisdiction as “Waters of the United States, the project would have no impacts on such surface waters.

When was the water delivery system constructed? There is no water delivery system directly related to the project.

Will the proposed project result in any modification of or effects to, individual features of an irrigation system (e.g., headgates, canals, or flumes)? If so, state when those features were constructed and describe the nature and timing of any extensive alterations or modifications to those features completed previously. The project will not result in any modifications of or effects to individual features of an irrigation system.

Are any buildings, structures, or features in the irrigation district listed or eligible for listing on the National Register of Historic Places? While there may be buildings, structures, or features in the irrigation district that are listed or eligible for listing on the National Register of Historic Places, no such feature will be impacted by the proposed project.

Are there any known archeological sites in the proposed project area? While there may be known archaeological sites in the project area, no such feature will be impacted by the project.

Will the proposed project have a disproportionately high and adverse effect on low income or minority populations? The proposed will not have a disproportionately high and adverse effect on low income or minority populations.

Will the proposed project limit access to, and ceremonial use of, Indian sacred sites or result in other impacts on tribal lands? The project will not limit access to Indian sacred sites or result in other impacts to tribal lands.

Will the proposed project contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the area? The project will not contribute to the introduction, continued existence, or spread of noxious weeds or non-native invasive species known to occur in the project area.

Additional Administrative Information

Required Permits and Approvals: None.

Overlap or Duplication of Effort Statement: There is no overlap between the project and any other active or anticipated proposals or projects.

Conflict of Interest Disclosure Statement: To the best of our knowledge, no actual or potential conflict of interest exists at the time of submission of this proposal.

Applicability: To the best of our knowledge, no actual or potential conflict of interest exists at the time of submission of this proposal.

Notification: To the best of our knowledge, no actual or potential conflict of interest exists at the time of submission of this proposal.

Restrictions on Lobbying: To the best of our knowledge, no actual or potential conflict of interest exists at the time of submission of this proposal.

Review Procedures: To the best of our knowledge, no actual or potential conflict of interest exists at the time of submission of this proposal.

Uniform Audit Reporting Statement: Metropolitan was required to complete a Single Audit for the most recently closed fiscal year (ending 2021). Metropolitan's EIN is 95-6002071 and the report is available through the Federal Audit Clearinghouse website.

Disclosure of Lobbying Activities: As this application requests more than \$100,000 in Federal funding, the applicant certifies the statements in 43 Code of Federal Regulations (CFR) Part 18, Appendix A. Standard Form-LLL, "Disclosure Form to Report Lobbying" was submitted with this application.

Letters of Support: Please see the letters of support included in Appendix A.

Letter of Partnership: Metropolitan is a Category A Applicant; therefore, a letter of partnership is not required.

Official Resolution: The Metropolitan group manager, Nina Hawk, whom Alison Collins works for, has jurisdiction from Metropolitan's board to approve funds up to \$250,000 and has approved funds for this project.

Letters of Funding Commitment: Not applicable.

October 16, 2023



To: Reclamation WaterSmart Grant Proposal Reviewers

On behalf of the State Water Contractors, an association of 27 public water agencies that contract with the Department of Water Resources to receive water from the State Water Project that provides water to 27 million Californians and 750,000 acres of farmland, I am writing to communicate our support for the Metropolitan Water District's (MWD) proposal to compile daily flow and water temperature data sets for Central Valley rivers that are interoperable and can be integrated with fish habitat data and models. This project would finally begin to fill a severe data gap that hampers the rapid development of hydrologic scenarios for water and ecosystem management evaluations. Our organization is almost continuously engaged in water resources management and ecosystem restoration in the Central Valley, and we frequently see these efforts stall due to a lack of fine-scale, interoperable flow, temperature, and habitat data that is essential to salmonid and related ecological evaluations. The hydrologic operations models currently capable of generating this type of Central Valley-wide data (e.g., Calsim, SacWAM) are extremely difficult to modify and operate on a monthly time step that is too coarse for ecological evaluations. Further, these operations models were developed for water supply planning and are not designed to support the type of decision-making that dominates the ongoing water and ecosystem management processes so common in the Central Valley.

Supporting submission of this proposal is in alignment with SWC's mission, policies, and commitment to sustainable and equitable water management. This proposal presents an opportunity to advance publicly accessible datasets to improve information used in water management and restoration efforts. We understand that MWD's proposed project will produce daily time-step, interoperable data sets for these key parameters and make them publicly available with thorough documentation. We also understand that MWD has developed its proposal collaboratively with the help of FlowWest's data science team, which has an excellent track record of developing this type of data in venues such as CVPIA and Reorienting to Recovery. We are confident that this project will be a monumental step towards more successful management and decision-making on multi-benefit programs seeking to improve the way we manage water and aquatic ecosystems in the Central Valley and beyond. We strongly urge you to support this proposal and would be happy to talk further about our support at any time.

Sincerely,

Darcy Austin

Darcy Austin
Science Manager

DIRECTORS

Robert Cheng
President

Coachella Valley Water
District

Laura Hidas
Vice President

Alameda County Water
District

Jacob Westra

Secretary-Treasurer
Tulare Lake Basin Water
Storage District

Brad Coffey

Metropolitan Water District
of Southern California

Thomas Pate

Solano County Water
Agency

Ray Stokes

Central Coast Water
Authority

Matthew Stone

Santa Clarita Valley Water
Agency

Peter Thompson, Jr.

Antelope Valley-East Kern
Water Agency

Craig Wallace

Kern County Water Agency

General Manager

Jennifer Pierre



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October 16, 2023

To: Reclamation WaterSmart Grant Proposal Reviewers

Subject: Letter of support for The Metropolitan Water District of Southern California's proposal

The Nature Conservancy (TNC) has spent decades working in collaboration with partners across California and in the Central Valley in developing science and implementing solutions to balance the water needs of nature with the water needs of our communities. We have engaged extensively in processes to design and evaluate scenarios to restore salmon populations and ecological function to rivers throughout the Central Valley, including Reorienting to Recovery, CVPIA, and the newly funded COEQWAL project. We are writing to communicate our support for the Metropolitan Water District's (MWD) proposal to develop modeling tools capable of generating daily flow and water temperature data sets for Central Valley rivers that are interoperable and can be integrated with fish habitat data and models. This project would finally begin to fill a severe data gap that hampers rapid development of hydrologic scenarios for water and ecosystem management evaluations. The Nature Conservancy is almost continuously engaged in water resources management and ecosystem restoration in the Central Valley, and we frequently see these efforts stall due to a lack of fine-scale, interoperable flow, temperature, and habitat data that is essential to salmonid and related ecological evaluations. The hydrologic operations models currently capable of generating this type of Central Valley-wide data (e.g. Calsim, SacWAM) are extremely difficult to modify and operate on a monthly time step that is too coarse for ecological evaluations. Further, these operations models were developed for water supply planning and are not designed to support the type of decision-making that dominates the ongoing water and ecosystem management processes so common in the Central Valley.

The Nature Conservancy is one of the developers of the California Environmental Flows Framework, which provides a new approach to determining flow needs for salmon and other freshwater species across California. However, functional flows operate on daily timesteps and need to be assessed for temperature outcomes, so the traditional hydrologic models used in the Central Valley do not provide the resolution of data necessary to design and evaluate functional flows approaches for Central Valley rivers. We understand that MWD's proposed project will produce a suite of tools able to generate daily time-step, interoperable data sets for these key parameters and make them publicly available with thorough documentation. We also understand that MWD has developed their proposal collaboratively with the help of FlowWest's data science team that has an excellent track record of developing this type of data in venues such as CVPIA and Reorienting to Recovery. We are confident that this project

will be a monumental step towards more successful management and decision-making on multi-benefit programs seeking to improve the way we manage water and aquatic ecosystems in the Central Valley and beyond. We strongly urge you to support this proposal and would be happy to talk further about our support at any time.

Sincerely,

A handwritten signature in black ink, appearing to read 'J. Zimmerman', with a long horizontal stroke extending to the right.

Julie Zimmerman
Director of Freshwater Science
The Nature Conservancy

October 09, 2023



108

RECLAMATION
DISTRICT

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William Vanderwaal

To: Reclamation WaterSmart Grant Proposal Reviewers

Reclamation District No. 108 is the second largest Sacramento River Settlement Contractor irrigating approximately 50,000 acres. We have been deeply involved with Sacramento River operations and leading many salmon recovery efforts for over 2 decades. Water Temperatures on the Sacramento River below Shasta Reservoir continue to be one of the largest constraints on System-wide operations during dry periods. We are writing to communicate our support for the Metropolitan Water District's (MWD) proposal to compile daily flow and water temperature data sets for Central Valley rivers that are interoperable and can be integrated with fish habitat data and models. This project would finally begin to fill a severe data gap that hampers rapid development of hydrologic scenarios for water and ecosystem management evaluations. Our organization is almost continuously engaged in water resources management and ecosystem restoration in the Central Valley, and we frequently see these efforts stall due to a lack of fine-scale, interoperable flow, temperature, and habitat data that is essential to salmonid and related ecological evaluations. The hydrologic operations models currently capable of generating this type of Central Valley-wide data (e.g. Calsim, SacWAM) are extremely difficult to modify and operate on a monthly time step that is too coarse for ecological evaluations. Further, these operations models were developed for water supply planning and are not designed to support the type of decision-making that dominates the ongoing water and ecosystem management processes so common in the Central Valley.

Planning system operations in a changing climate will help inform viable goals on each of the Sacramento Valley tributaries including the need for alternative spawning approaches as spawning on the floor of the Valley becomes less viable with a warmer climate. We understand that MWD's proposed project will produce daily time-step, interoperable data sets for these key parameters and make them publicly available with thorough documentation. We also understand that MWD has developed their proposal collaboratively with the help of FlowWest's data science team that has an excellent track record of developing this type of data in venues such as CVPIA and Reorienting to Recovery. We are confident that this project will be a monumental step towards more successful management and decision-making on multi-benefit programs seeking to improve the way we manage water and aquatic ecosystems in the Central Valley and beyond. We strongly urge you to support this proposal and would be happy to talk further about our support at any time.

Sincerely,

Lewis Bair
General Manager
Reclamation District No. 108



October 10, 2023

To: Reclamation WaterSmart Grant Proposal Reviewers

Re: Letter of support for the the Metropolitan Water District's (MWD) proposal to compile daily flow and water temperature data sets for Central Valley rivers

To whom it may concern,

On behalf of Trout Unlimited (TU), I am writing to express my strong support the Metropolitan Water District's (MWD) proposal to compile daily flow and water temperature data sets for Central Valley rivers that are interoperable and can be integrated with fish habitat data and models. This project would finally begin to fill a severe data gap that hampers rapid development of hydrologic scenarios for water and ecosystem management evaluations.

Trout Unlimited is the oldest and largest cold-water fish conservation organization in the US. Our organization is continuously engaged in water resources management and ecosystem restoration in the Central Valley, and we frequently see these efforts stall due to a lack of fine-scale, interoperable flow, temperature, and habitat data that is essential to salmonid and related ecological evaluations. The hydrologic operations models currently capable of generating this type of Central Valley-wide data (e.g. Calsim, SacWAM) are extremely difficult to modify and operate on a monthly time step that is too coarse for ecological evaluations. Further, these operations models were developed for water supply planning and are not designed to support the type of decision-making that dominates the ongoing water and ecosystem management processes so common in the Central Valley.

Over the last decade, the bulk of our work in the Central Valley has focused on the development and application of strong science to support collaborative, multi-objective resource stewardship and decision making. We consider this project to be exemplary in its focus on tools that can support multi-objective planning efforts that integrate a broad range interested party needs. We understand that MWD's proposed project will produce daily time-step, interoperable data sets for these key parameters and make them publicly available with thorough documentation. We also understand that MWD has developed their proposal collaboratively with the help of FlowWest's data science team that has an excellent track record of developing this type of data in venues such as CVPIA and Reorienting to Recovery. We are confident that this project will constitute a significant step towards more successful management and decision-making on multi-benefit programs seeking to improve the way we manage water and aquatic ecosystems in the Central Valley and beyond. We strongly urge you to support this proposal and would be happy to talk further about our support at any time.

Sincerely,

Rene E. Henery, PhD

California Science Director, Trout Unlimited

DEPARTMENT OF WATER RESOURCES

DIVISION OF INTEGRATED SCIENCE AND ENGINEERING
3500 INDUSTRIAL BOULEVARD
WEST SACRAMENTO, CA 95691



October 17, 2023

WaterSmart Grant Program
U.S. Bureau of Reclamation

RE: MWD Flow-Temperature Database Proposal for Reclamation WaterSmart Grant

Dear Proposal Reviewers,

This letter is written in support of the Metropolitan Water District's (MWD) proposal to compile a comprehensive, open-source database of daily flow and water temperature for Central Valley rivers. Increasingly, DWR and our partner agencies are relying on quantitative models to support water management decisions for water quality, and for protection of endangered and threatened fishes and fishes of concern. Many of these models indicate flow and water temperature, and their potential interaction, are key variables in these models. A frequent hindrance that often stalls, limits, or halts these modeling efforts, is the lack of a readily available and thoroughly documented database of daily historical water temperature and flow that is consistent and compatible for different locations across the California Central Valley.

While the current sources of flow and temperature data (e.g. CalSIM, SacWAM) are adequate for their original design purpose, water supply planning, they operate on a monthly time step with is often too coarse for the ecological timescales being evaluated for many current management decisions in the Central Valley, and these current data sources are extremely difficult to modify for finer-grained modeling efforts. The MWD's proposed project will provide flow and water temperature data on a daily timestep making it readily interoperable with fish habitat models and fish monitoring data available for the Central Valley, and the database will be posted on an open-source platform making it readily available for these efforts.

The team that MWD has assembled to accomplish this project is very experienced with the nuances of the data they will be working with and have established relationships with both the data producers and with many of the modelers and modeling efforts that are likely to make immediate use of a daily flow and water temperature database. This experience will ensure that the team will work efficiently and effectively toward a successful conclusion of the project, and that the database design will meet a diverse set of needs now and into the future. Please don't hesitate to contact me for further feedback regarding this proposed project.

Sincerely,

Brett Harvey

Brett Harvey,
Environmental Program Manager
DWR Division of Integrated Science and Engineering