

Assumptions and Estimates for California Water Plan Update 2023

DRAFT

October 2022



Draft Assumptions and Estimates for California Water Plan Update 2023 Review Guidance

Overview

The California Water Plan is the State's strategic plan for sustainably managing and developing water resources for current and future generations. It presents the status and trends of California's water-dependent natural resources; water supplies; and agricultural, urban, and environmental water demands for a range of plausible future scenarios. The Water Plan recommends actions and policies informed by engagement with regional partners and prioritizes investments to guide future water management planning.

The California Department of Water Resources (DWR) is interested in receiving comments about the information presented in the draft *Assumptions and Estimates for California Water Plan Update 2023* (draft A&E Report) and welcomes suggestions about improving the usefulness of the report.

How to Submit Comments

Comments were accepted during a DWR webinar on October 18, 2022, that served as a preview of the draft A&E Report. The video of that webinar is available on the [Update 2023 website](#) under the A&E Report link near the bottom of the page.

Comments on the draft A&E Report should be provided no later than November 18, 2022, at 5 p.m. PST, and can be submitted in the following ways:

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Draft Assumptions and Estimates for California Water Plan Update 2023

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Contents

Acronyms and Abbreviations	v
Introduction	1
Statutory Requirements: California Water Code	3
Water Plan Components Required by the Water Code	3
Major Categories of Information Required by the Water Code.....	3
Key Legislative and Policy Drivers.....	4
Water Resilience Portfolio (EO N-10-19)	4
Ongoing Drought Emergency	5
Sustainable Groundwater Management Act (Assembly Bill 1739, Senate Bill 1168, and Senate Bill 1319)	5
Water Conservation (Assembly Bill 1668 and Senate Bill 606).....	5
Human Right to Water (Assembly Bill 685).....	6
Safe and Affordable Drinking Water Fund (Senate Bill 623)	6
California Climate Adaptation Strategy 2021	6
Past Climate Change Legislation.....	6
Open and Transparent Water Data Act (Assembly Bill 1755).....	7
Assumptions and Estimates	7
Data and Tools.....	8
Water Data Portfolios and Water Balances.....	8
Water Budgets and Accounting System.....	12
Data and Tool Nexus to Open and Transparent Water Data Act.....	15
Analyses	16
Climate Change and Multi-Sector Watershed Analysis	16
Future Scenarios.....	18
Initiatives	19
Equity in Water Management	20
Watershed Resilience	20
Watershed Hub	24
Resource Management Strategies	25
Integrated Watershed Programs Data and Tool Alignment.....	25
Related Plans and Programs	26
Groundwater Information and SGMA Activities.....	26
Data and Tools	26
Evaluation of Groundwater Sustainability Plans.....	26
California's Groundwater Update 2020.....	27
Flood-MAR Projects.....	28
Central Valley Flood Protection Plan	28

Aligning State Water Planning	30
--	-----------

Useful Web Links	31
-------------------------------	-----------

Table

Table 1 Summary of Hydrometeorological Data Sources to Support Vulnerability Assessment	22
--	-----------

Figures

Figure 1 Water Accounting System	13
---	-----------

Figure 2 Total Water Budget Schematic	14
--	-----------

Figure 3 Watershed Resilience Planning through Networks.....	17
---	-----------

Figure 4 Watershed Resilience Framework.....	24
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Acronyms and Abbreviations

AEM	airborne electromagnetic
AW	applied water
CalGW	California's Groundwater
Cal-SIMETAW	California Simulation of Evapotranspiration of Applied Water
CNRA	California Natural Resources Agency
CVFPP	Central Valley Flood Protection Plan
CVPA	Central Valley Planning Area
DAU	detailed analysis unit
draft A&E Report	draft Assumptions and Estimates for California Water Plan Update 2023
DWR	California Department of Water Resources
ETaw	evapotranspiration of applied water
ETc	crop evapotranspiration
ETo	evapotranspiration
Flood-MAR	flood-managed aquifer recharge
GSA	groundwater sustainability agency
GSP	groundwater sustainability plan
HR	hydrologic region
NHD	National Hydrography Dataset

California Water Plan Update 2023

QA/QC	quality assurance/quality control
RMS	resource management strategy
SGMA	Sustainable Groundwater Management Act
State Water Board	State Water Resources Control Board
Update 2018	California Water Plan Update 2018
Update 2023	California Water Plan Update 2023
Update 2028	California Water Plan Update 2028
WaDE	Water Data Exchange
Water Budget Handbook	Handbook for Water Budget Development: With or Without Models
Water Code	California Water Code
Water Plan	California Water Plan
WEAP	Water Evaluation and Planning
WRP	Water Resilience Portfolio
WY	Water Year

Introduction

The draft *Assumptions and Estimates for California Water Plan Update 2023* (draft A&E Report) describes key assumptions and estimates, data and data sources; improvements to analytical tools, methods, and approaches; and the supporting documents and companion State plans being used to prepare California Water Plan Update 2023 (Update 2023), State government's strategic plan for managing and developing water resources for sustainability and resilience. The draft A&E Report cites the statutory requirements for the California Water Plan (Water Plan), key legislative and policy drivers, assumptions, and estimates related to water data portfolios, future scenarios, water accounting, watershed resilience planning, and equity in water resource management. Also discussed are resource management strategies, the alignment of integrated watershed programs and plans, and integration and alignment of State plans.

The described data and tools, analyses, and initiatives collectively support the California Department of Water Resources' (DWR's) cutting-edge approach for risk-based climate vulnerability assessments and adaptation strategy evaluations at the watershed scale. Multi-sector collaboration, state-of-the-art science, and a commitment to equity are integral to this approach and necessary to meet the multifaceted challenges posed by climate change and extreme events. Data and tools, such as water data portfolios, water balances, and water budgets and accounting systems, are critical for establishing a shared understanding of each watershed's current conditions across multiple sectors. Water Plan analyses are informed by local planning, including integrated regional water management plans; urban water management plans; agricultural water management plans; groundwater sustainability plans (GSPs); regional flood management plans; and other local water, water quality, and resource management plans. Update 2023 will recommend how the data in these plans can be made more suitable for regional and statewide aggregation in the Water Plan.

DWR is investing in technological improvements in data collection and publication, model enhancements, and pilot studies to help the State and regions understand and prepare for future water conditions in the face of climate change, extreme events, and associated uncertainties. Data and tools are being developed for more comprehensive water accounting to more accurately describe the distribution of water throughout the hydrologic cycle, which is foundational to better watershed management.

In addition to the data and tools improvements described in the draft A&E Report, DWR is investing in state-of-the-art tools for climate observations, including prediction of atmospheric rivers and airborne snow observatory technology to improve forecasts of precipitation events and snowpack status.

Climate Change

A changing climate is altering many aspects of water resources management. Its impacts are inherently regional, affecting each watershed differently. For water planners, deep uncertainties remain about future climate projections. Climate change thus requires a fundamental shift in approaches to planning and managing water resource systems. In Update 2023, DWR is using the risk-based decision-scaling approach – highlighted in the Intergovernmental Panel on Climate Change’s (IPCC’s) [Sixth Assessment Report](#) – for its future scenarios and multi-sector watershed analyses, to help water managers “stress test” their water systems. Along with using the latest climate change projections from the IPCC, the decision-scaling approach helps quantify the probability of achieving intended water system performance across a broad range of potential climate change outcomes.

Watershed Resilience

The initiatives summarized in the draft A&E Report aim to improve regional resilience at the watershed scale. The Watershed Resilience Initiative for Update 2023 promotes regional climate resilience through collaboration among all water management and land-use sectors using an equitable, outcomes-based approach. The associated guidance, data, and tools that are being developed seek to promote more multi-sector climate resilience planning and implementation through the piloting and expansion of regional watershed networks throughout California.

Multi-sector watershed analyses from headwaters to groundwater are being conducted for the San Joaquin Valley watersheds, starting with the Merced River watershed, to quantify water supply, ecosystem, and flood vulnerabilities and evaluate the potential of promising adaptation strategies.

Equity in Water Management

Equity is a focus of the State’s vision for resilient watersheds. Many of the anticipated effects of climate change disproportionately affect underserved, vulnerable, and disadvantaged communities in California, further widening existing gaps in equity. The Equity Initiative for Update 2023 is collecting, summarizing, and sharing data to acknowledge and better understand past inequities and develop a roadmap to

achieve greater equity across water sectors. The Water Plan has more than 30 resource management strategies to provide local and regional agencies a toolbox of adaptation strategies for managing water and related resources for equity, sustainability, and resilience.

Statutory Requirements: California Water Code

State law (California Water Code [Water Code] Section 10004.6) requires DWR to release to interested persons and entities throughout the state this draft A&E Report for their review and written or oral comments. DWR will closely consider the comments when adopting the final assumptions and estimates for Update 2023.

Water Plan Components Required by the Water Code

The Water Code requires the Water Plan to have the following components as part of its data and assumptions:

- A study to determine the amount of water needed to meet the state's future needs and to recommend programs, policies, and facilities to meet those needs.
- Discussion of various strategies to pursue for meeting the state's future water needs, including the potential advantages and disadvantages of each strategy.
- A report on regional and local water projects within each of the 10 hydrologic regions of the state to improve water supplies to meet municipal, agricultural, and environmental water needs and to minimize the need for imported water from other hydrologic regions.

Major Categories of Information Required by the Water Code

The Water Code requires the following major categories of information:

- Basin hydrology.
- Groundwater supplies.
- Current and projected land-use patterns.
- Environmental water needs.
- Current and projected population.
- Current and projected water use.
- Evapotranspiration rates for major crops.
- Current and projected adoption of urban and agricultural water conservation practices.

California Water Plan Update 2023

- Current and projected water supplies provided by water recycling and reuse.
- Potential for alternative water-pricing policies to change current and projected water uses.

See detailed information about Water Code requirements on DWR's A&E Report webpage.

Key Legislative and Policy Drivers

Update 2023 addresses implementation of key legislative and policy drivers advancing water planning and management in the state. It continues to build upon previous updates in promoting water sustainability and resilience in California.

California's Water Supply Strategy

The [Water Supply Strategy](#) outlines California's strategy and priority actions to adapt and protect water supplies in an era of rising temperatures. The strategy focuses on a subset of actions identified broadly in the *Water Resilience Portfolio* that focus on actions calling for investing in new sources of water supply, accelerating projects, and modernizing how the State manages water through new technology. The strategy includes:

- Creating storage space above and below ground for as much as 4 million acre-feet of water.
- Recycling and reusing at least 800,000 acre-feet of water per year by 2030.
- Freeing up 500,000 acre-feet of water through more efficient water use and conservation.
- Making new water available for use by capturing stormwater and desalinating ocean water and salty water in groundwater basins.

These measures will help replenish the water California will lose because of a hotter, drier climate and will help generate enough water to meet the needs of agriculture and more than 8.4 million households in the state.

Water Resilience Portfolio (EO N-10-19)

[Executive Order \(EO\) N-10-19](#), issued by Governor Gavin Newsom in 2019, directs State agencies to develop recommendations to meet critical water-related challenges and enable water security for all Californians. The [Water Resilience Portfolio](#) (WRP) helps local and regional entities meet their unique challenges while delivering on the State's responsibility to provide tools and leadership, advance projects of statewide

scale, and help address challenges beyond a particular region's scope. The WRP embraces four broad approaches:

1. Maintain and diversify water supplies.
2. Protect and enhance natural systems.
3. Build connections.
4. Be prepared.

These approaches lead to a comprehensive solution that will help build resilience and ensure sustainability for the state.

Ongoing Drought Emergency

With the ongoing drought entering its third year in 2022, Governor Newsom issued [EO N-7-22](#), building on orders issued in 2021, to confront intensifying drought conditions. It calls for increased water conservation and directs the State Water Resources Control Board (State Water Board) to consider adapting emergency declarations to require urban water suppliers to implement water shortage contingency plans and to increase inspections to prevent illegal diversions or wasteful water use. An element of flexibility in the executive order is the suspension of California Environmental Quality Act requirements for “any projects and activities for the purposes of water conservation.”

Sustainable Groundwater Management Act (Assembly Bill 1739, Senate Bill 1168, and Senate Bill 1319)

The Sustainable Groundwater Management Act (SGMA), passed in 2014, requires water- and land-use agencies to come together in governance and develop plans to sustainably manage groundwater in the context of overall regional water sustainability. The success of SGMA lies primarily with regional agencies’ effective governance and their ability to balance regional supplies and demands more sustainably. DWR is responsible for implementing SGMA, with the State Water Board intervening when regions cannot achieve sustainability.

Water Conservation (Assembly Bill 1668 and Senate Bill 606)

Two pieces of water conservation legislation, Assembly Bill 1668 and Senate Bill 606, passed in 2018, together lay out a long-term water conservation framework for the

urban and agricultural sectors of California by organizing programs and initiatives around four primary goals:

1. Use water more wisely.
2. Eliminate water waste.
3. Strengthen local drought resilience.
4. Improve agricultural water-use efficiency and drought planning.

Human Right to Water (Assembly Bill 685)

The [Human Right to Water](#), passed in 2012, declares that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitation purposes. It requires State agencies to consider the human right to water when “revising, adopting, or establishing policies, regulations, and grant criteria” that affect water used for domestic purposes.

Safe and Affordable Drinking Water Fund (Senate Bill 623)

The [Safe and Affordable Drinking Water Fund](#), passed in 2019, provides \$130 million annually to enable the State Water Board to provide critical, ongoing operations and maintenance support for small community water systems that cannot meet safe drinking water standards.

California Climate Adaptation Strategy

The most recent update to the Safeguarding California report, renamed [California Climate Adaptation Strategy](#) in 2022, brings together new actions from numerous State plans and strategies to deliver on multi-sector policy goals that include strengthening protections for vulnerable communities, strengthening economic resilience against climate effects, and fostering partnerships to build climate resilience across the state.

Past Climate Change Legislation

California has enacted the following series of bills and executive orders to combat effects of climate change on California’s environment and water:

- Assembly Bill 32, passed in 2006, requires California to reduce its greenhouse gas emissions to 1990 levels by 2020 – a reduction of approximately 15 percent below emissions expected under a “business as usual” scenario.
- Executive Order B-30-15, signed by Governor Edmund G. Brown Jr. in 2015, directs State government to incorporate climate change impacts into the *California Five-Year Infrastructure Plan*, update the State climate adaptation

strategy to identify how climate change will affect infrastructure, and identify the actions needed to reduce future risks. The executive order also directs State agencies to consider climate change in their planning and investment decisions.

- Senate Bill 246, passed in 2015, establishes an Integrated Climate Adaptation and Resiliency Program for California to coordinate regional and local efforts with State climate adaptation strategies to adapt to the effects of climate change, with an emphasis on climate equity considerations across sectors and regions.
- Assembly Bill 1482, passed in 2015, establishes a framework to coordinate climate adaptation efforts across State agencies and departments. This law requires the California Natural Resources Agency (CNRA) to update the State's climate adaptation strategy by July 1, 2017, and every three years after that.
- Assembly Bill 2800, passed in 2016, requires State agencies to incorporate “current and future impacts from climate change when planning, designing, building, operating, maintaining, and investing in state infrastructure.”

Open and Transparent Water Data Act (Assembly Bill 1755)

The [Open and Transparent Water Data Act](#), passed in 2016, requires DWR, in consultation with the California Water Quality Monitoring Council, the State Water Board, and the California Department of Fish and Wildlife, to create, operate, and maintain a statewide integrated water data platform. The act calls for development of protocols for data sharing, documentation, quality control, public access, and promotion of open-source platforms and decision support tools related to water data.

Assumptions and Estimates

Update 2023, building upon previous updates of the Water Plan, focuses on three major outcomes – climate change adaptations, watershed resilience, and equity in water resource management – to address recent policy drivers on water resilience, climate change, water conservation, and sustainable groundwater management.

This section briefly describes the primary assumptions and estimates underlying Update 2023. Update 2023 reference and technical information will provide details of these components, which will support Update 2023 findings and recommendations.

Data and Tools

Data and tools are critical to understanding a watershed's current conditions and resiliency to meet the multifaceted challenges posed by climate change and extreme events. The tools described will support DWR's efforts in bringing cutting-edge analytics to meet the challenges brought on by ever-changing climate conditions and associated uncertainties.

Water Data Portfolios and Water Balances

The Water Plan presents information about current statewide and regional water conditions through water data portfolios and water balances. Water balances provide detailed information about statewide water supply sources and estimates for the primary uses of the state's supplies. They describe water distribution throughout the hydrologic cycle, water use by the urban and agricultural sectors, water in the environment, and water supply sources used to meet these uses.

Water data portfolios also furnish an accounting of all water that enters and leaves the state, as well as how water is used in regions and exchanged between the regions. The resulting information provides foundational data for all water planning activities in the state and assists regions with developing and implementing sustainable and resilient water management actions. Water data portfolios support programs and agencies responsible for analyzing, planning, and disseminating the information to interested parties. Water balances are developed by detailed analysis unit (DAU)/counties and aggregated to planning area, hydrologic region, and statewide summaries. Maps of these areas are available on DWR's [GIS and Maps webpage](#).

Update 2023 includes information for Water Years (WYs) 1998-2020, expanding California Water Plan Update 2018's (Update 2018's) water portfolio information by five water years. The five-year period of WYs 2016-2020 began with a dry year based on the eight-river index, continuing the drought, which started in WY 2012 (the drought was officially declared in WY 2014). The drought officially ended in March 2017, a wet year. The dry conditions returned in WY 2018, followed by another wet year in WY 2019. In WY 2020, dry conditions returned. Water portfolio data provides information for comparison about how water uses and supply varies among wet, average, and dry hydrologic conditions for each hydrologic region. Currently available water balance data can be found on DWR's [Water Data Portfolios webpage](#) and is available for download on the CNRA Open Data platform.

Water data portfolios are presented in Update 2023 reference and technical information and include the following major categories of information:

- Local deliveries.
- Residential interior and exterior water use.
- Large landscape water use.
- Local imported deliveries.
- Commercial and industrial water use.
- Reuse of water.
- Colorado River deliveries.
- Large landscape water use.
- Recycled water.
- Central Valley Project deliveries.
- Evaporation and evapotranspiration of applied water for agriculture.
- Evaporation and evapotranspiration of applied water for managed wetlands.
- Other federal deliveries.
- Groundwater recharge of applied water.
- Required instream flow.
- State Water Project deliveries.
- Deep percolation to a salt sink.
- Required Sacramento-San Joaquin Delta outflow.
- Groundwater extraction.
- Conveyance system irrecoverable water.
- Wild and Scenic River flows.

Remote Sensing Land-Use Data: DWR water supply and use teams have worked on several pilot projects on water data portfolios and technological improvements for inclusion in Update 2023. DWR has transitioned to statewide remote sensing land-use data for WYs 2016 and 2018–2020, with estimates made for intervening years for which remote sensing data are unavailable. Previously, DWR compared 2014 statewide remote sensing land-use and irrigated acres with existing land-use survey data for agricultural water-use analysis to inform potential methodological improvements to the processing and development of remote sensing data. The remote sensing data for 2016 and 2018–2020 incorporated these improvements and were spot-checked for consistency with data from systematic and focused land-use surveys. Moving to remote sensing data replaced a process where DWR conducted

land use analysis every year for a few counties, resulting in the process taking 10 to 15 years to accomplish statewide land-use coverage.

Cal-SIMETAW Model: The California Simulation of Evapotranspiration of Applied Water (Cal-SIMETAW) was developed to estimate daily soil water balance to determine crop evapotranspiration (ET_c), evapotranspiration of applied water (ET_{aw}), and applied water (AW) for use in the California Water Plan. The model uses near real-time reference evapotranspiration (ET_o) information from Spatial CIMIS, which is the combination of CIMIS weather station and remote sensing data to cover California on 4×4 kilometer grid spacing to provide current ET_c and ET_{aw} estimates.

Staff continues to conduct studies to investigate ET estimation of agricultural crops in the state and identify the latest technologies available to further improve the accuracy of agricultural water use in the state. Developing a better understanding of consumptive water use in the state is critical to analyses intended to enhance the state's water sustainability and resilience. The following studies focus on modifying and refining inputs and data processing to improve Cal-SIMETAW model:

- Updating information on crop coefficients and growth dates to better match current conditions. For this reason, staff is currently exploring the possibility of using Open ET to obtain real-time estimates of actual ET of agricultural crops to better estimate water demand in the state.
- Evaluating seasonal application efficiency in irrigation further to reduce uncertainty in water use analysis.
- Accounting for groundwater contribution for crop water use.
- Accounting for cover crop contribution to crop coefficients for tree and vine crops.
- Enhancing the Cal-SIMETAW model to calculate agricultural water use for a 4×4 kilometer grid over California and aggregate the information for larger areas, including DAU/county, U.S. Geological Survey hydrologic unit codes, and groundwater basins.
- Accounting for fog and dew contributions for crop water use in coastal areas.

Recycled Water Data: The recycled water sub-group formed in Update 2018 collaborates with the State Water Board to incorporate more current municipal recycled-water data and information into the water portfolios. The 2019 and 2020 recycled-water volumetric annual reports can significantly improve related data in water portfolios. Wastewater treatment plants and recycled water producers must

provide these reports to the State Water Board, consistent with the June 2019 order issued by the State Water Board's executive director.

Urban Water-Use Data: Urban water-use analysis now has improved data processing in recognition of the significant increase in public water-system data reported to the State Water Board, consistent with the requirements established in WY 2013. Staff continue to explore opportunities to improve the process. One of the improvements explored is using Python scripting to dynamically access public water-system data straight from a database instead of extracting data in spreadsheets. This process allows for quality assurance/quality control (QA/QC) directly in the database. It links the system service areas directly to the Public Water System Statistics data in a geo-database.

Investigation of Alternative Boundary for Analysis: Through several pilot projects, staff is investigating the advantages, disadvantages, and resource needs for using National Hydrography Dataset (NHD) hydrologic unit codes to organize water supply and use data instead of, or in addition to, DAUs (typically also subdivided further by counties). The goal of the pilot projects is to explore and ensure that the boundaries of analysis for the Water Plan are consistent with other State and federal agencies and in alignment with the NHD. DWR has collected water supply and use data from WY 1998 to the present by using the DAU/county boundaries. These spatial boundaries have allowed the Water Plan to present a variety of water supply and use information statewide and roll up the data to different spatial scales. This expansive statewide database has also been used extensively in various modeling efforts throughout the state and is currently the only statewide dataset of its kind. The Water Plan would like to preserve the interoperability of any future dataset with the data-rich 20-year continuous dataset at both the planning area and hydrologic region levels. A technical memorandum will present the findings and recommendations resulting from the pilot projects and will be available in Update 2023 reference and technical information.

Streamlining of Water Balances Data: In collaboration with the San Diego Supercomputer Center and in partnership with the Western States Water Council and the U.S. Environmental Protection Agency on the Data Integration and Implementation of Water Data Exchange (WaDE) Dataflow project, DWR has completed a significant database development project for water portfolio inflow-outflow data entry worksheets. The resulting tool uses PostgreSQL database management system and the WaDE database schema. The tool has streamlined previous time-consuming and error-prone multi-Excel sheets calculations. The use of

the tool has dramatically reduced the time for processing, error-checking, and synthesizing water balance data from DAU/county, to the planning area, to the hydrologic region, to the state.

WaDE delivers a platform for further coordination and shared meaning in conjunction with California's priorities, U.S. Geological Survey (Water Availability and Use Science Program), and the SECURE Water Act (Section 9508, Public Law 111-11). The water years' data currently are served publicly through the WaDE database, using an application programming interface, or API, and web services for integration with modern geographic information systems. Integration with other databases will depend on the semantics of each database, but PostgreSQL has export/import capabilities that facilitate a high degree of interoperability with other systems. There are no current plans for integration with other databases, though that could be a natural extension of this work. Database advancements will lead to more efficient and effective data exchange; QA/QC; and querying and reporting of data, including data reporting and translation at numerous spatial scales. These advances also help implement the [Assembly Bill 1755: Open and Transparent Data Platform for California](#).

Visit DWR's [Water Data Portfolios](#) webpage for more information and data about water data portfolios and water balances. Detailed information for WYs 1998-2020 will be available in Update 2023 reference and technical information.

Expected deliverables for the water data balances and water portfolios to be part of Update 2023 include the expansion of water portfolio data for WYs 2016-2020, land use data for years 2016 and 2018-2020, and updated crop coefficients for evapotranspiration.

Water Budgets and Accounting System

Implementing several actions in the WRP requires robust water accounting. These actions focus on three overarching themes:

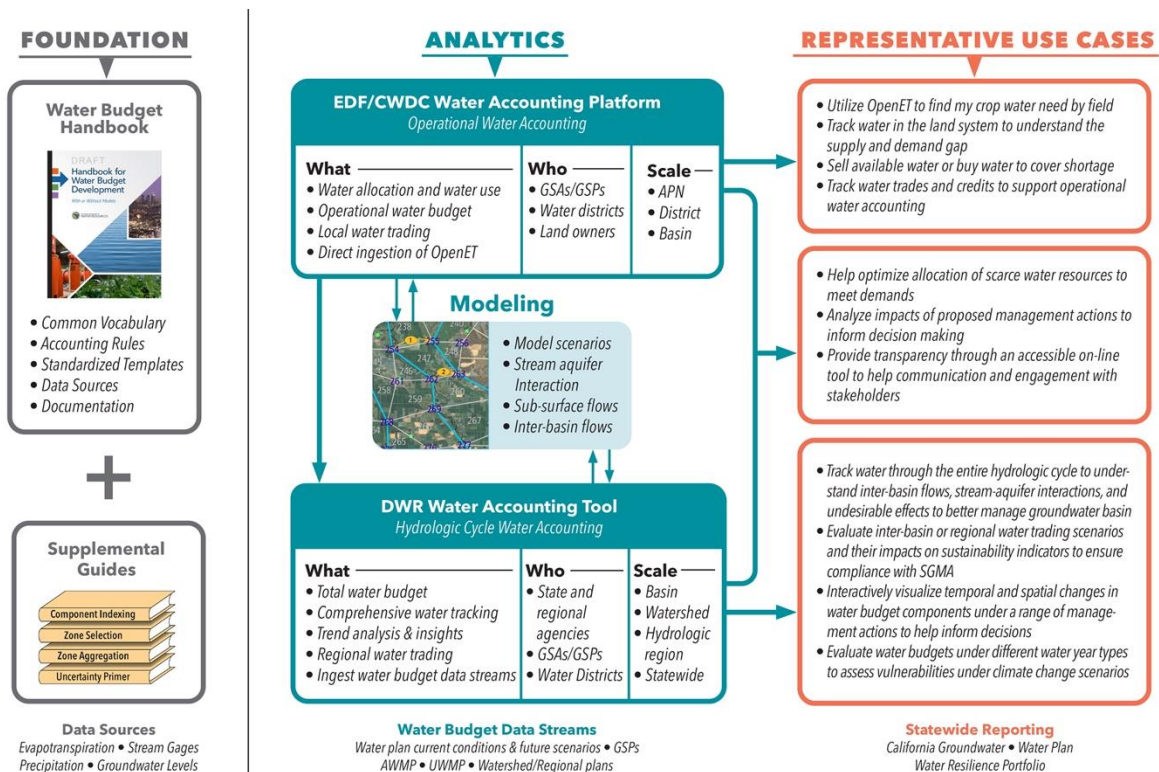
1. Develop agreed-upon approaches.
2. Align water accounting.
3. Facilitate water trading and water markets.

A comprehensive water accounting system would facilitate a more effective implementation of the WRP actions. DWR is developing a statewide water accounting system to provide technical assistance to State and local agencies (including

groundwater sustainability agencies) grappling with water sustainability and drought-related issues through easy-to-use online tools.

The foundation of the water accounting system is the water budget. A water budget accounts for all inflows and outflows from a water budget zone, which helps water managers understand historical conditions as well as how future changes to supply, demand, hydrology, population, land use, and climatic conditions will affect a geographic area's water conditions. The Water Accounting System (Figure 1) includes DWR's *Handbook for Water Budget Development: With or Without Models* (Water Budget Handbook), four water-accounting guides, a water accounting tool, and potentially the Environmental Defense Fund/California Water Data Consortium-led Water Accounting Platform. These tools will support the application of data to address water resources challenges identified as critical by water practitioners. DWR is also conducting a pilot project to create synergy between water and supply balances and water budgets.

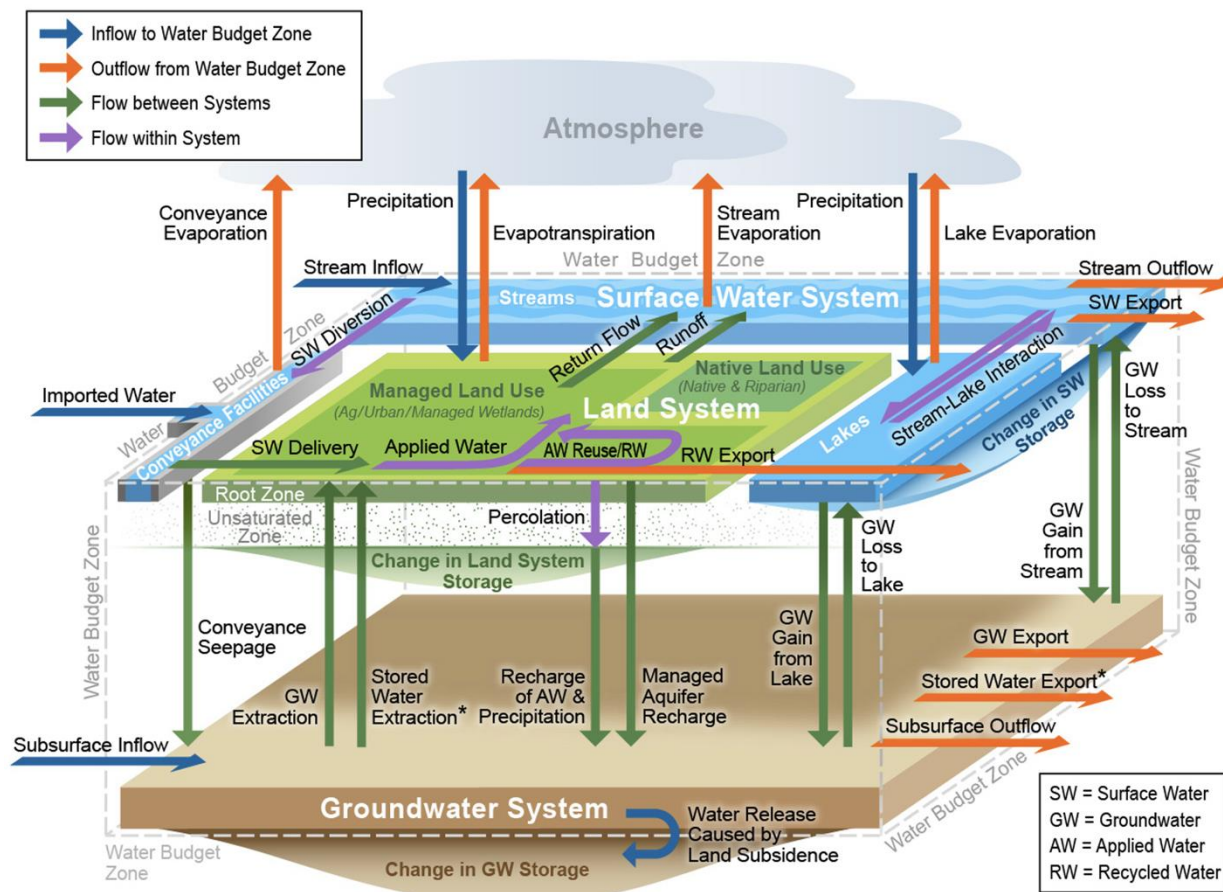
Figure 1 Water Accounting System



Last updated 2/22/22

Water Budget Handbook: The Water Budget Handbook, released in February 2020, provides comprehensive, state-of-the-art guidance for developing water budgets. The handbook includes a systems-based approach for water budgets (Figure 2), a common vocabulary, decision trees to select a modeling or a non-modeling approach, standardized water accounting templates, illustrative case studies, and a data resources directory.

Figure 2 Total Water Budget Schematic



Water Accounting Guides: DWR is supplementing the Water Budget Handbook with four water accounting guides: (1) zone selection, (2) zone aggregation, (3) water budget component indexing, and (4) uncertainty estimation in water budget components. These guides will describe the related processes, methods, and templates with examples.

Water Accounting Tool: The Water Accounting Tool is a tool for hydrologic-cycle water accounting to synthesize, visualize, and share water budget information. The tool:

- Enables total water budgets, comprehensive water tracking, trend analysis of water budget components, and regional water trading.
- Ingests water budget data from multiple streams, including the Water Plan, groundwater sustainability plans (GSPs), agricultural water management plans, urban water management plans, and watershed and regional plans.
- Will include a rapid scenario builder and analyzer to provide a high-level assessment of the effects of alternative management actions.
- Helps demystify water accounting to understand better how basins, regions, and the state as a whole use water.

Water Supply and Balance to Total Water Budget Pilot Project: A pilot project on the Merced Basin (planning areas 607, 608, and 609) was conducted to evaluate how the water supply and balance information compiled in Water Plan updates can be used to develop a total water budget. The pilot project takes existing information from the portfolio data of the Water Plan and populates the accounting templates of the Water Budget Handbook. Methods are explored to estimate data for missing information or data that cannot automatically populate the accounting templates. The project provides recommendations on how utilizing the strengths of the two approaches can lead to a more unifying, robust solution for developing water budgets.

Key milestones for Update 2023 include release of selected water accounting guides and a water accounting tool with functionalities to address selected use cases. A technical memorandum of findings and recommendations from the pilot project will also be available in Update 2023 reference and technical information.

Data and Tool Nexus to Open and Transparent Water Data Act

Update 2023 will continue to produce innovative and sought-after water data and tools that can inform and improve data-driven decision-making. The Water Plan has made its Water Data Portfolios and Water Budget Handbook available on multiple platforms, including the [CNRA Open Data](#) platform to promote openness and transparency. The continued development and usage of the platform will make water, ecosystem, flood, and water quality data from State, federal, and local agencies more accessible and useful to advance multi-sector watershed-based planning by serving as a one-stop shop to gather validated data.

As Update 2023 data and tools become available, they will be made available through the CNRA Open Data platform.

Analyses

The changing climate is testing the State's ability to manage water resources. Historical records no longer provide a defensible baseline for current and future water resources planning and management. Thus, the State's shift to risk-based climate vulnerability assessments and adaptation strategy evaluations at the watershed scale is necessary for developing robust plans in the face of the uncertainties of future climate projections. As climate change makes extreme events more frequent and likely, analyzing what the future holds is paramount to meeting the range of challenges water managers face now and in the future.

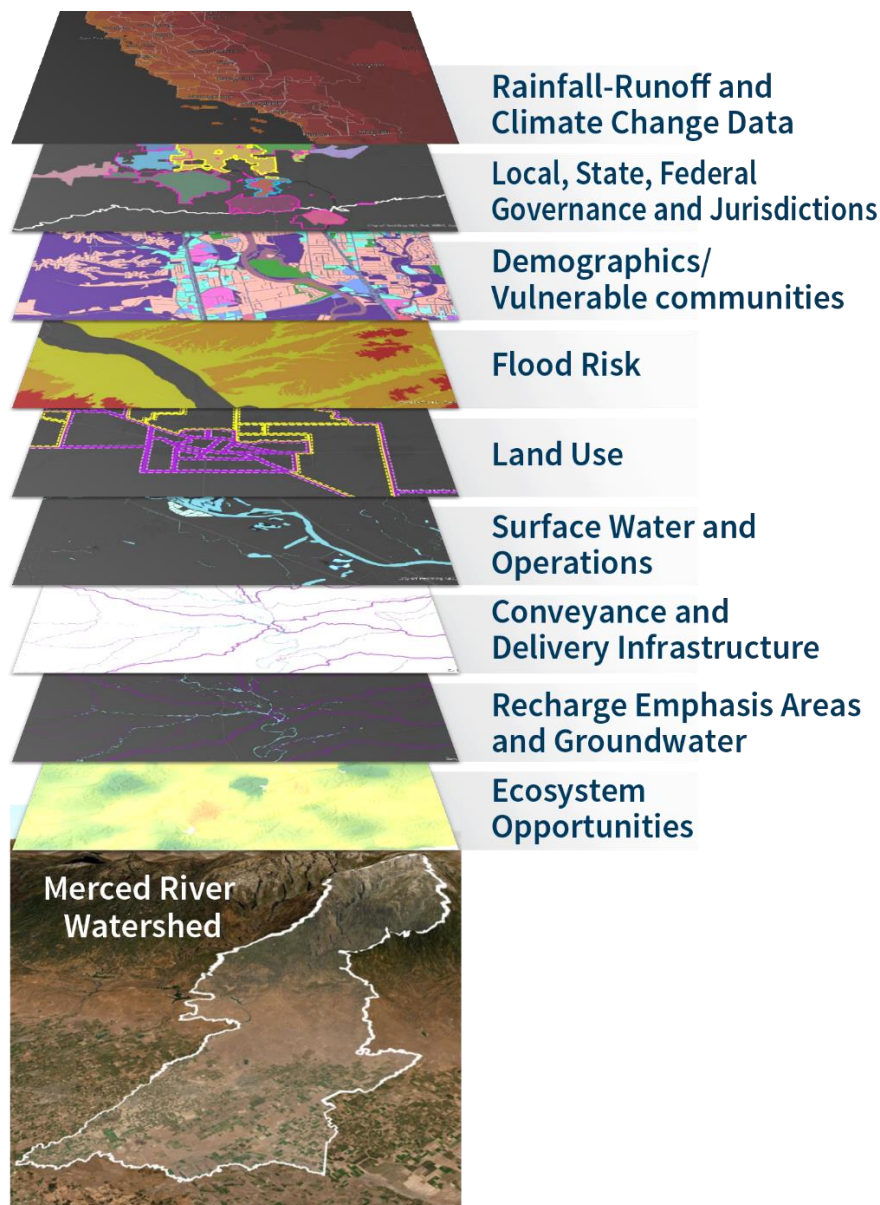
Climate Change and Multi-Sector Watershed Analysis

A priority of Update 2023 will be to understand and quantify climate change impacts and vulnerabilities at a watershed scale. Climate change is undermining the effectiveness of water infrastructure and operations designed for past hydrologic conditions. Climate projections using global climate models and downscaling give a range of outcomes for the future, but not the likelihood of such outcomes. More robust risk-based approaches to climate change analysis, such as decision-scaling, can improve regional and watershed-scale vulnerability assessments by providing probabilistic information that can be used in risk-based decision-making frameworks.

DWR conducted the [*Merced River Flood-Managed Aquifer \(Flood-MAR\) Reconnaissance Study*](#), a comprehensive headwater to groundwater analysis using a suite of models integrated for operations and water supply, groundwater, ecosystem, flood, and recharge. The goal was to evaluate the effectiveness of multi-sector, multi-benefit climate adaptation strategies such as Flood-MAR, forecast-informed reservoir operations, and aggressive reservoir reoperation coupled with groundwater recharge and storage. The study integrates watershed-network data layers for watershed resilience planning (Figure 3). Overlaying risk-based climate vulnerability on existing data layers for water sectors and institutions, demographics and vulnerable communities, fire risk, land use, surface and groundwater, water quality, and ecosystems reveals the potential for effective adaptation strategies. The study demonstrates the benefit of co-management of surface water and groundwater for more effective planning and managing of water supply, flood, and ecosystem in an integrated way.

DWR is extending these cutting-edge climate vulnerability assessments and adaptation strategy evaluation methodologies to the remaining tributary watersheds of the San Joaquin Basin. As in the Merced watershed study, these new studies will use the risk-based decision-scaling approach and consist of a headwater-to-groundwater analysis of the San Joaquin Basin watershed. The goal is to identify untapped opportunities for multi-benefit flood, groundwater, and water supply projects and to facilitate inter-watershed and regional solutions. The data, analysis, and results from these studies will inform California Water Plan Update 2028 (Update 2028).

Figure 3 Watershed Resilience Planning through Networks



California Water Plan Update 2023

Key milestones and deliverables for climate work for Update 2023 include climate vulnerability assessments and their data, analysis, and results that will help inform future updates of the Water Plan.

Future Scenarios

Update 2023 incorporates current best practices in climate change analysis by including the decision-scaling approach. The previous approach used a suite of 10 global climate models with two different emissions scenarios, and model simulation was conducted for WYs 2006–2100. The current approach examines current conditions (2020) and performs a stress test of the water system over a wide range of changes in temperature and precipitation. This stress test will be paired with information from global climate models to estimate the likelihood of any level of climate change at any future time. Update 2023 will also provide data and analysis of conditions expected to occur around 2070. The stress test will explore 63 different combinations of changes in temperature and precipitation by varying temperature from 0 °C to 5 °C with average temperature increase by one-degree increments and precipitation from -30 percent to +30 percent mean annual precipitation. Readers can find details [for decision-scaling methodology](#) on the DWR website.

Population and economic conditions have been projected based on data from the Department of Finance and the Council of Governments on likely growth rates and existing plans. By comparison, agricultural land use is not projected for Update 2023, and the same land-use data are used for 2020 and 2070, based on DWR's statewide land-use data for 2018. Lacking a reliable method for projecting future changes in land use because of many different drivers of uncertainty, prolonged drought conditions, and implementation of the 2014 SGMA legislation, the analysis will also not have a different pattern for future land use. Urban water-use efficiency is expected to increase by approximately 14 percent because of existing regulations and market trends. Other data used in the analysis, including native lands, essentially remain unchanged compared with previous future scenario analysis.

Decision-Scaling Analyses for Merced Basin Pilot Project: A fully integrated water supply and demand model based on the Water Evaluation and Planning (WEAP) modeling framework was tested to evaluate its potential for applications to the decision-scaling approach in studies of water system vulnerabilities. Decision-scaling is an emerging approach that allows a direct “stress test” of an existing system to capture the effects of extreme climatic conditions on the system. A sub-model from the larger Central Valley Planning Area (CVPA) WEAP model was developed as a pilot for the Merced River watershed at the planning-area scale. This pilot study

considered two major external factors – urban growth and Paleo-based climate – to test system vulnerability. The results showed WEAP was able to simulate the performance of the pilot area and capture the overall system response to Paleo-based climatic conditions by using a decision-scaling approach.

Decision-Scaling Analyses for Central Valley and San Francisco Bay Hydrologic

Regions: The CVPA WEAP model has been expanded to include the San Francisco Bay Hydrologic Region (HR). The CVPA model had existing water demands for regions outside the Central Valley, and these demands are now linked dynamically to the San Francisco Bay HR portion of the model. Including the San Francisco Bay HR portion in the CVPA model results in a more dynamic model that can better incorporate changes in conditions to represent water supply vulnerabilities. Additionally, lessons learned from building the San Francisco Bay HR expansion will help continue to expand the CVPA model geographically to include other hydrologic regions in future Water Plan updates.

Model Enhancements: The CVPA WEAP model is being enhanced for Update 2023. The model's representation of the Sacramento-San Joaquin Delta is being enhanced to reflect current operating conditions by including biological opinions, coordinated operation agreements, and an automated neural network to represent likely sea level rise. In addition, the groundwater representation in the model is being updated to reflect subsurface flow movement, as reflected in the California Central Valley Simulation (C2VSim) fine grid model.

The deliverables for future scenarios for Update 2023 will include a focus on quantifying the vulnerability of different aspects of water supply resulting from likely changes in population and climate for the Central Valley and the San Francisco Bay HR. Results from these analyses will inform expansion of future scenario analysis statewide in Update 2028.

Initiatives

Climate change impacts are inherently regional and may affect watersheds across the state differently. DWR's goal is to improve water resilience at the watershed scale and to focus assistance on those that will bear the full effect of these changes. Multi-sector watershed analyses, with equity integral to their development, form the backbone of these assessments. The initiatives described are part of DWR's efforts to ensure water sustainability in the state.

Equity in Water Management

For example, equitable outcomes in water management, as expressed in the US Water Alliances' briefing paper, *An Equitable Water Future*, occur when all communities have access to safe, clean, affordable drinking water and wastewater services; are resilient in the face of floods, drought, and other climate risks; have an active role in decision-making processes related to water management in their communities; and fully share in the economic, social, and environmental benefits of water systems.

The deliverables for this effort include a description and compilation of research documenting current inequities and injustices in water management, recommendations for understanding and addressing equity in water management, equity-related metrics and indicators in the [Water Hub](#), an inventory of current State agency initiatives along with discussion on potential areas for better alignment, and a summary of available resources and tools for water managers.

Watershed Resilience

In alignment with WRP actions to advance watershed resilience in California, DWR has undertaken a Watershed Resilience Initiative with the goal is to increase regional climate resilience through integrated water management at watershed scales. The Watershed Resilience Initiative seeks to support regional collaboration across water and land sectors and jurisdictions at the watershed scale (from headwaters to groundwater to ocean) to address climate change threats using an equitable, outcomes-based approach.

Key principles that are guiding the Watershed Resilience Initiative include the following:

- **Climate change adaptation:** Supporting regions to assess climate vulnerability and evaluate adaptation strategies by using best-available climate change science.
- **Integrated water management:** Promoting co-management of water and land sectors including water supply, flood, stormwater, groundwater, ecosystem, water quality, forest and fire management, upper watershed, and land use.
- **Networks:** Locally led and State-supported watershed networks that serve as a “network of networks” to create cross-sector connections and relationships to improve regional climate resilience.

- **Watershed scale:** For water and land sectors, structuring flexible networks around watersheds.
- **Equity:** Promote equity for vulnerable communities of interest to participate in regional planning and decision-making by reconnecting communities across a watershed and to ensure the fair distribution of project costs, benefits, and impacts.
- **Outcome-based:** Manage watersheds for outcomes with performance indicators and metrics to assess climate risk and track the effectiveness and return on investment of adaptation programs and projects.

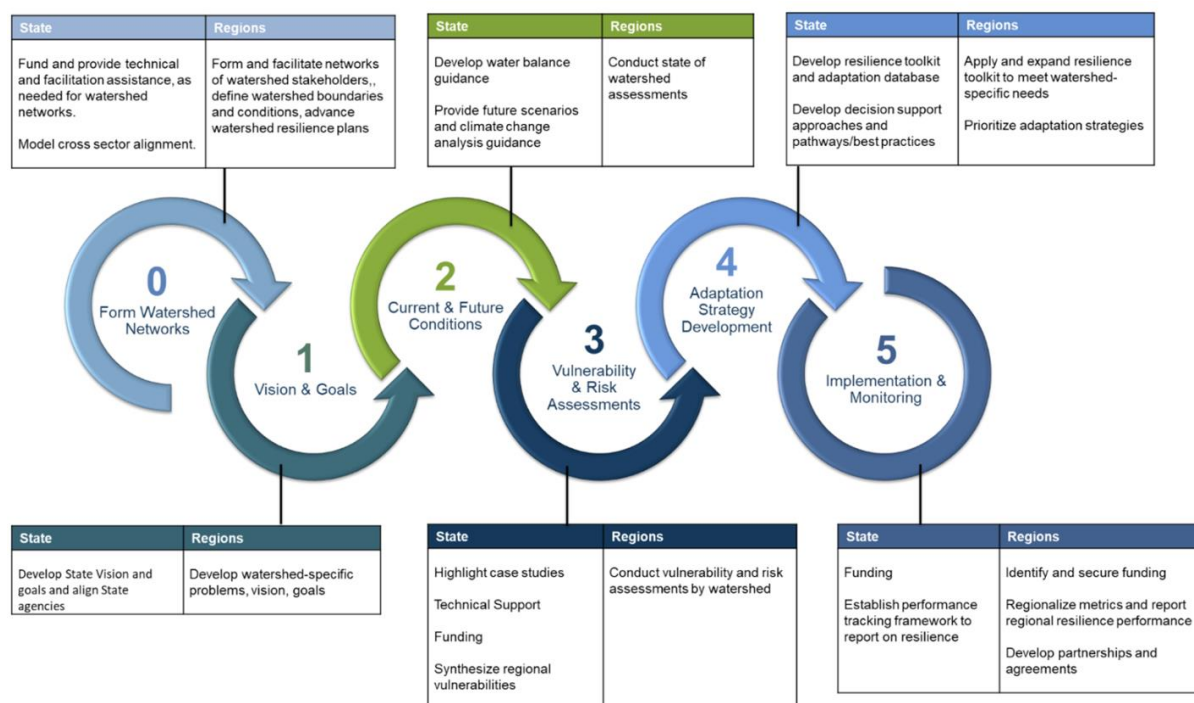
Data and Tools Products: Update 2023 is developing the following data and tools products to support the development of the Watershed Resilience Initiative.

- **Statewide climate change risk and preparedness inventory:** A statewide, qualitative synthesis of watershed resilience risk and resilience planning capacity at the watershed scale to inform how the State can best collaborate and support local and regional partners in improving their climate resilience.
 - **Vulnerability assessment approach:** The evaluation of climate vulnerability relies on existing data sets of the main drivers of climate change effects, primarily projected changes in temperature and precipitation under various climate change scenarios. In addition, anticipated hydrologic responses to these climatic changes such as flooding, drought, and wildfire risks are derived from existing sources including Cal-Adapt, DWR climate change studies, and California Climate Change Assessments (Table 1). These are mapped to the appropriate watershed scale and are used to qualitatively assess climate vulnerabilities. A simple five-point rating of climate vulnerability is assigned to each watershed for each climate vulnerability type. The vulnerability types consist of the changes in the following areas: temperature, precipitation, water supply, flooding, groundwater recharge, stream water quality, ecosystem, recreation, hydropower, drought, and wildfire. Vulnerability indicator metrics have been developed for each vulnerability type.

Table 1 Summary of Hydrometeorological Data Sources to Support Vulnerability Assessment

Data	Use in Analysis	Spatial and Temporal Resolution	Source
Precipitation and Temperature Projections from Coupled Model Intercomparison Project Phase 5 (CMIP5) Downscaled Climate Model Simulations	Use for analyzing drought, groundwater recharge, and water quality	Daily data from 1950 to 2099	Cal-Adapt: Local Climate Change Snapshot
Runoff, Baseflow, PET, AET and SWE Projections from CMIP5 Downscaled Climate Model Simulations	Use for analyzing water supply, drought, flood, groundwater recharge, ecosystem flow, hydropower, and recreation	Daily data from 1950 to 2099	Cal-Adapt: Variable Infiltration Capacity (VIC)
Historical streamflow, storage, outflow, and evaporation from reservoirs	Use for analyzing hydropower and lake recreation opportunities	Monthly data	California Data Exchange Center
Wildfire scenario from CMIP5 Downscaled Climate Model Simulations	Use for analyzing wildfire burned area and decadal probabilities	1/16-degree (~6 kilometer)	Cal-Adapt: Wildfire
Sea Level Rise Projections and Coastal Flooding	Use for analyzing coastal recreational opportunities	Projected future inundation area data	Ocean Protection Council: State of California Sea-Level Rise Guidance National Oceanic and Atmospheric Administration: Sea Level Rise Data Download

- **Preparedness assessment:** In addition to the vulnerability assessment, a climate preparedness assessment is included. Climate preparedness is defined as having the resources, either internally with staff or externally through procurement of consulting services, to understand current and future risks to resiliency of the systems. Resiliency planning capacity is determined by close inter-agency cooperation and includes developing and implementing adaptation strategies to address risks. Multiple sources were considered for evaluating watershed resiliency planning capacity. In general, sources were selected based on their relevance to water-based climate resiliency efforts, scope, and scale of relevant stakeholders and organizations within each watershed, and level of accessibility. Eleven different document types were considered:
 - Groundwater sustainability plans.
 - Integrated regional water management plans.
 - Urban water management plans.
 - Local hazard mitigation plans.
 - Agriculture water management plans.
 - Landscape conservation cooperative.
 - Reclamation basin study.
 - Regional climate collaborative.
 - Climate adaptation plans.
 - County general plans.
 - Resource conservation districts.
- **Watershed Resilience Framework and toolkit:** DWR is developing a Watershed Resilience Framework (Figure 4) that serves as a roadmap for the State and regions to carry out resilience planning for water-related sectors. The framework pairs with an online, interactive toolkit that offers planning guidance, best practices, case studies, resources, and tools to conduct each step in the framework. The toolkit will allow watershed networks to conduct resilience planning and develop and customize their adaptation strategies. The framework and toolkit will be tested with willing regional partners in pilot watersheds.
- **Preliminary watershed identification:** More than 40 watersheds throughout the state, that could serve as a geographic basis for watershed networks, have been identified. These watersheds are hydrologically consistent with U.S. Geological Survey hydrologic units and would serve as a starting point for discussions with local and State partners.

Figure 4 Watershed Resilience Framework

Key milestones for Update 2023 for Watershed Resilience Initiative include the preliminary identification of the watersheds. Ongoing work, focused on refining the initiative, will inform Update 2028.

Watershed Hub

Update 2023 is developing a watershed hub as a one-stop-shop to track regional projects and indicators related to water management. The watershed hub, designed as a performance tracking hub, includes a regional atlas and a sustainability outlook dashboard.

- **Regional atlas:** A geospatial atlas for tracking progress, communicating the value and accomplishments of past projects and investments, and building partnerships for potential multi-benefit projects.
- **Sustainability outlook:** A dashboard for developing and communicating multi-sector metrics and indicators that serve as "vital signs" for assessing conditions and trends of watersheds. The dashboard displays each water purveyor, groundwater service area, watershed, groundwater basin, and managed wetland with all water resources and their dispositions. The smallest areas of interest form the building blocks, to aggregate, to a watershed level for providing summary information while allowing drilling down to look at more granular data that build the watershed-level data.

Key milestones for the watershed hub include the deployment of the regional atlas for selected pilot projects. Continued work on the Sustainability Outlook and atlas will inform Update 2028.

Resource Management Strategies

The Water Plan provides a broad set of [resource management strategies](#) (RMSs) that can help local and regional agencies manage their water and related resources. An RMS can be a technique, program, or policy used to meet water-related management needs of a region or the entire state. While recognizing interdependencies among many of the strategies, the Water Plan's lineup of more than 30 RMSs provides a comprehensive suite of tools that can be used to achieve a variety of intended outcomes by utilizing a diverse mix of strategies.

The WRP, climate change, and the ongoing drought emergency have shaped the need to update the RMSs to help local and regional agencies achieve water resilience. For Update 2023, DWR, in collaboration with other agencies, will update seven RMSs that will help address ongoing challenges related to water security.

- Flood.
- Watershed management.
- Reservoir reoperation.
- Conjunctive use.
- Recharge area protection.
- Desalination.
- Precipitation enhancement.
- Water recycling.

Other RMSs will be updated, as needed, in an ongoing process spanning multiple Water Plan cycles.

Integrated Watershed Programs Data and Tool Alignment

The implementation of many actions in the WRP requires alignment across data and tools used by various programs and plans within DWR and other State agencies. DWR will continue to align data and tools used in various plans and programs to help implement the WRP. The Water Plan is working on aligning multiple elements of Update 2023 (e.g., the vision, data and tools, performance indicators, and recommendations) with other DWR programs, including the Central Valley Flood Protection Plan, DWR Climate Action Plan Phase III, and other programs. The aim is to

reduce duplicative efforts, leverage resources, and provide regional partners with clear and consistent information.

A key milestone in this effort includes documenting the effort to help inform future alignment of data and tools for integrated watershed management.

Related Plans and Programs

As required in Water Code Section 10004.6(c)(2), the Water Plan provides the public with information on groundwater supplies and flood protection activities.

Groundwater Information and SGMA Activities

SGMA significantly expands DWR's roles and responsibilities related to groundwater management. Essential information and companion plans developed to implement SGMA will support Update 2023 and future Water Plan updates.

Data and Tools

DWR has developed a set of statewide data and tools to assist groundwater sustainability agencies (GSAs) in assessing water conditions and taking appropriate actions toward sustainability. There are tools for local agencies to report information associated with basin boundary modifications, GSA formation, adjudicated basin water supplies and uses, alternative plans, and GSPs. DWR provides statewide data sets on groundwater levels, groundwater quality, well completion reports, land use, land subsidence, and water use. DWR is conducting airborne electromagnetic (AEM) surveys in California's high- and medium-priority groundwater basins, where data collection is feasible, to assist local water managers in implementing SGMA to manage groundwater for long-term sustainability. The AEM project provides State and federal agencies, GSAs, interested parties, and the public with basin-specific and cross-basin geophysical data, tools, and analyses. All information on the data and tools is available to the public on DWR's [Data and Tools](#) webpage.

Evaluation of Groundwater Sustainability Plans

SGMA requires high- and medium-priority basins across the state identified in California's Groundwater (CalGW) and prioritized by the Basin Prioritization process to develop and establish GSAs and develop GSPs. GSPs for critically overdrafted basins were due in January 2020; GSPs for the majority of other high- and medium-priority basins were due in 2022. DWR has two years from submittal to make a determination on a GSP. Plan evaluation is ongoing.

SGMA provides 20 years for the GSAs to reach their sustainability goals. GSAs with approved GSPs are required to submit to DWR annual reports and updates to the plans at least every five years. DWR expects the first updates to be submitted no later than January 2025 for approved GSPs, with subsequent updates to run through 2042. The data submitted as part of the GSPs will inform future updates of the Water Plan.

California's Groundwater Update 2020

CalGW, also known as Bulletin 118, is legislatively mandated by Water Code Section 12924 to be updated every five years by DWR. CalGW is the State's most up-to-date compendium of statewide data and information on the occurrence, nature, use, and conditions of California's groundwater resources and management. It builds on past progress and the state of knowledge, synthesizes the most recent data to close current gaps in knowledge, and focuses on statewide groundwater conditions and management and planning efforts, including drought planning and response. CalGW consists of report summary, [CalGW Update 2020 Highlights](#), and a detailed "[Statewide Report](#)," supported by a series of appendices and CalGW Live. [CalGW Update 2020](#) is available on the CNRA website.

CalGW Update 2020 Highlights is a stand-alone summary document describing the value and state of groundwater conditions and management in California, with findings and recommendations to foster and achieve sustainable groundwater management.

The "Statewide Report" is a detailed report on the state of groundwater in California, including a history of California's Groundwater reports, the economic value of groundwater, and groundwater management before and after the enactment of SGMA. It provides a status of statewide groundwater monitoring and the latest knowledge on statewide groundwater conditions, including groundwater levels, changes in storage, groundwater quality, and land subsidence. The "Statewide Report" also provides a hydrologic region summary and regional status of land and water use, monitoring and conditions of groundwater levels, groundwater quality, land subsidence, seawater intrusion, and surface water-groundwater interactions.

Appendices include a map and a list of all groundwater basins in each hydrologic region, with their current designated priority under SGMA's Basin Prioritization process. They also provide details supporting the content of the various chapters of the statewide report, including methods and assumptions, citations, and references.

CalGW Live is a user-friendly, interactive website that allows users to explore, analyze, and visualize California's latest groundwater data and information.

Flood-MAR Projects

DWR's Flood-MAR team is making progress on multiple floodplain restoration and recharge projects in the Upper San Joaquin watershed in partnership with the [Central Valley Flood Protection Plan](#) (CVFPP) Conservation Strategy team, South Central Regional Office, River Partners, and the San Joaquin River Conservancy. For the Ball Ranch Project, the plan is to pursue temporary and streamlined water-rights permits on Little Dry Creek, a small tributary to the San Joaquin River. DWR is also making progress on a floodplain restoration and recharge project along the Pajaro River. In addition, DWR is working with several partners to develop a regional flood management strategy for the San Joaquin River Basin. DWR and partners are developing a suite of action plans for evaluating floodplain restoration, transitory storage, and subsidence – all with connections to implementing recharge projects.

The data, analysis, and results in CalGW will inform updates of the Water Plan on an ongoing basis. Lessons learned from pilot Flood-MAR projects and CalGW Live will inform Update 2028 and future updates.

Central Valley Flood Protection Plan

The CVFPP 2022 Update continues to build on the work completed over the past 15 years to better understand and develop priorities to improve flood risk management in the Central Valley. Using new information, updated science, and innovative tools, it recommends priority actions to address flood risk in the face of climate change and population growth. The CVFPP Conservation Strategy is a primary component supporting the CVFPP. It aligns and contributes to the attainment of all CVFPP goals, specifically focusing on the improvement of ecosystem quality, quantity, function, and sustainability within the State Plan of Flood Control. Collaborative and sustainable flood management and habitat restoration is the objective of the strategy. CVFPP includes recommendations on potential structural and non-structural measures that reduce flood risk while incorporating ecosystem and other benefits. The CVFPP Conservation Strategy includes recommendations on how to achieve ecosystem benefits from flood projects.

A wealth of data and tools are compiled and developed to conduct the required analysis for CVFPP and CVFPP Conservation Strategy. The following provides a brief overview of the tools and data used:

- **Hydrology:** CVFPP uses historical hourly and daily stream gauge data for gauged watersheds, and the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) simulated flow for ungauged watersheds. The models utilized are HEC Reservoir System Simulation (HEC-ResSim) operations model and the HEC River Analysis System (HEC-RAS) routing models for translating unregulated to regulated flows; HEC-HMS for ungauged watersheds; and Variable Infiltration Capacity (VIC) model to evaluate the hydrologic response for existing (2022) and future (2072) low, medium, and high climate-change scenarios of precipitation and temperature.
- **Hydraulics:** CVFPP, for existing (2022) conditions analyses, uses riverine flow-frequency curves from Central Valley Hydrology Study hydraulic routings. For future (2072) conditions analyses, existing condition flows are updated using the results of the climate change analysis. Delta flow-frequency curves are estimated using the updated sea-level-rise conditions consistent with California Ocean Protection Council medium-high risk sea-level-rise projections. The Conservation Strategy considers existing and future hydraulic conditions for measurable objectives enhancements that include floodplain inundation and riparian habitats.
- **Soils and Geotechnical:** CVFPP, for existing (2022) conditions, uses levee-fragility curves based on the [CVFPP 2017 Update](#). For future (2072) conditions, levee-fragility curves are also based on future projects identified in *CVFPP 2017 Update*, revised with more recent information if available.
- **Ecosystem:** The Conservation Strategy uses fine-scale riparian vegetation that is updated approximately every 10 years, with minimum mapping unit of one acre and average width of more than 10 meters. The Floodplain Inundation Potential model is used to conduct analysis to achieve measurable objectives for specific ecosystem functions and habitats.
- **Economics:** CVFPP uses U.S. Army Corps of Engineers depth-damage and depth-mortality functions, Land Vision parcel data, RS Means building cost and depreciation information, and UC Davis crop production cost and revenue information. (Note: RSMeans is a database of current construction cost estimates, including materials, labor, transportation, and storage.). The models utilized are HEC-FDA for flood damage and life loss analyses; LifeSim for life loss (urban areas and small communities) analysis; and Impact Analysis for Planning (IMPLAN) for regional, secondary economic impacts analysis. The

resulting analyses include expected annual damage, expected annual life loss, and regional secondary economic impacts (total output, value added, labor income, and employment) associated with flood business and crop losses as well as proposed project construction.

Update 2023 will include the CVFPP 2022 Update actions, recommendations, and cost estimates in the statewide recommendations and funding plan, as part of the plans' assumptions, in its recommendations and policy goals.

Aligning State Water Planning

The alignment of planning efforts in water planning is important to help achieve intended outcomes. Surface and groundwater management planning, as well as the integration of flood and ecosystem planning, is necessary to achieve multi-benefit outcomes. In previous updates, the Water Plan has worked collaboratively with various State agencies, via the State Agency Steering Committee, to identify and inventory water-policy actions across State plans. In Update 2018, the number of plans identified grew to more than 190. With the help of the steering committee, almost 50 plans were featured in Update 2018 and used to inform policy recommendations and recommended actions.

WRP Action 28.2 calls for the Water Plan to broaden its impact by aligning contributing State agencies and to inventory "recurring state published water-related plans and assess whether each should be continued, modified, consolidated, or discontinued." Update 2023 will conduct a review of previously identified plans in collaboration with the Core State Agency Team (formerly the State Agency Steering Committee) to assess their impact within future water resource planning. This effort will lead to alignment between State agencies and their planning efforts by reducing duplicative actions and identifying areas of collaboration to leverage funding resources.

Useful Web Links

An Equitable Water Future

<http://uswateralliance.org/wec/framework>

Assembly Bill 1755: Open and Transparent Water Data Platform for California

<https://water.ca.gov/ab1755>

Cal-Adapt: Local Climate Change Snapshot

<https://cal-adapt.org/tools/local-climate-change-snapshot/>

Cal-Adapt: Variable Infiltration Capacity

<https://cal-adapt.org/data/download/>

Cal-Adapt: Wildfire

<https://cal-adapt.org/tools/wildfire/>

California Data Exchange Center

<https://cdec.water.ca.gov/>

California Climate Adaptation Strategy

<https://resources.ca.gov/Initiatives/Building-Climate-Resilience/2021-State-Adaptation-Strategy-Update>

California Department of Water Resources

<https://water.ca.gov>

California Department of Water Resources GIS and Maps webpage

<https://gis.water.ca.gov/app/boundaries/>

California Department of Water Resources Water Data Portfolios webpage

<https://water.ca.gov/Programs/California-Water-Plan/Water-Portfolios>

California's Groundwater Live

<https://sgma.water.ca.gov/CalGWLIVE/>

California's Groundwater Update 2020

https://data.cnra.ca.gov/dataset/calgw_update2020

California Water Plan Update 2023

California's Groundwater Update 2020 Highlights

<https://lab.data.ca.gov/dataset/californias-groundwater-update-2020-bulletin-118/a0cb0f31-c264-43c5-9775-e488450911b2>

California's Groundwater Update 2020 Statewide Report

https://data.cnra.ca.gov/dataset/calgw_update2020/resource/35d5a953-9e93-4704-a78d-76329c0c82da

California Natural Resources Agency

<https://resources.ca.gov>

California Natural Resources Agency Open Data

<https://data.cnra.ca.gov>

California Water Code

<https://leginfo.legislature.ca.gov/faces/codesTOCSelected.xhtml?tocCode=WAT>

California Water Plan

<https://water.ca.gov/Programs/California-Water-Plan>

California Water Plan Resource Management Strategies

<https://water.ca.gov/Programs/California-Water-Plan/Water-Resource-Management-Strategies>

California Water Plan Update 2023

<https://water.ca.gov/Programs/California-Water-Plan/Update-2023>

California Water Plan Update 2023 draft glossary

<https://water.ca.gov/Water-Basics/Glossary>

California Water Plan's Water Data Portfolios

<https://water.ca.gov/Programs/California-Water-Plan/Water-Portfolios>

California's Water Supply Strategy, Adapting to a Hotter, Drier Future

<https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf>

Central Valley Flood Protection Plan

<https://water.ca.gov/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan>

Central Valley Flood Protection Plan 2017 Update

https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-Planning-and-Studies/Central-Valley-Flood-Protection-Plan/Files/2017-CVFPP-Update-FINAL_a_y19.pdf

Data and Tools

<https://water.ca.gov/Programs/Groundwater-Management/Data-and-Tools>

Decision-Scaling Evaluation of Climate Change Driven Hydrologic Risk to the State Water Project

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/All-Programs/Climate-Change-Program/Climate-Action-Plan/Files/CAP-III-Decision-Scaling-Vulnerability-Assessment.pdf>

Executive Order N-7-22

<https://www.gov.ca.gov/wp-content/uploads/2022/03/March-2022-Drought-EO.pdf>

Executive Order N-10-19

<https://www.gov.ca.gov/wp-content/uploads/2019/04/4.29.19-EO-N-10-19-Attested.pdf>

Handbook for Water Budget Development: With or Without Models

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Water-Budget-Handbook.pdf>

Human Right to Water

https://www.waterboards.ca.gov/water_issues/programs/hr2w/

Intergovernmental Panel on Climate Change's (IPCC's) Sixth Assessment Report

<https://www.ipcc.ch/assessment-report/ar6/>

Merced River Flood-MAR Reconnaissance Study

<https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Flood-Management/Flood-MAR/Merced-River-Flood-MAR-Reconnaissance-Study.pdf>

California Water Plan Update 2023

National Oceanic and Atmospheric Administration: Sea Level Rise Data Download
<https://coast.noaa.gov/slrdata/>

Ocean Protection Council: State of California Sea-Level Rise Guidance
<https://www.opc.ca.gov/updating-californias-sea-level-rise-guidance/>

Open and Transparent Water Data Act
<https://water.ca.gov/ab1755>

Safe and Affordable Drinking Water Fund
https://www.waterboards.ca.gov/water_issues/programs/grants_loans/sustainable_water_solutions/safer.html

Sustainable Groundwater Management Act
<https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management>

Water Hub
<https://waterhub.org/>

Water Resilience Portfolio
<https://resources.ca.gov/Initiatives/Building-Water-Resilience/portfolio>

