

Ch 3.6 Next Steps for Using Analytical Tools Including Short-term and Long-term Work Plan

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3.61 Background and Context

Past California Water Plan updates were intended for water managers and those involved in making state water infrastructure decisions. However, as various resource issues become more interconnected, and land use and resource planners consider water management in their analyses and decisions, requests are increasing for the Water Plan to address questions broader than traditional water needs.

Analytical tool development for California has not kept pace with the growing public awareness of the complexity and interaction between water-related issues. Deficits exist in current analytical capability related to supply reliability and systems issues. A critical issue facing California is the need for better data and tools to produce useful information about *environmental objectives, water quality, economic issues, equity issues, and ground and surface water interaction*. Also, there is a need to better integrate details associated with regional and local planning into the studies being conducted from a statewide perspective. For planning purposes, these tools must help planners predict future conditions and interactions on the statewide level and compare outcomes of potential actions. Many of the current tools have been developed and applied in a comparative role, and their suitability for a predictive role can vary widely. Even so, planners rely on the state to provide data and outputs that help to describe and analyze plausible future scenarios, which they can use for planning purposes.

The State has to play a leadership role in developing the overall strategy for California water management from a system-wide perspective. No tools currently exist that can be used for both predictive and comparative modes integrating all of the interactions described above. Local land use planners also rely on water management information for which the State can provide insights. Work on the Water Plan is converging with the CALFED Integrated Storage Investigation's Common Assumptions and Water Use Efficiency Comprehensive Analysis studies. Staff from these planning processes have been meeting to coordinate data management and to discuss study assumptions and quantitative methodologies.

Advisory Committee members, stakeholders interested in modeling, technical consultants for other planning processes, California Bay Delta Authority and State Water Project staff, and DWR staff have met more than 16 times as the "Modeling Work Group" to discuss the roles, validation, and confidence in available tools and data and the ability to perform studies and analyses envisioned for Update 2003. To address concerns, a series of workshops focused on the fundamental questions the Water Plan should address in general and the technical information that the tools are expected to provide in particular. Many of the issues discussed are responded to in the work plan, including quality assurance, transparency, accessibility of information, external review processes and

integrating issues like water quality, economics, the environment, groundwater, and land use.

Guiding Principles for the Analysis

Strategy:

- 1) A frequently amended strategic document will lay out DWR's strategic analysis framework and identify the technical objectives, roles, and responsibilities of major DWR data collection efforts and analytical tools and their interactions and their responsible managers.

Transparency:

- 2) All data and models should be in the public domain and available on the web.
- 3) All data and models should have significant documentation.
- 4) Known limitations should be documented.

Long-Term Viability:

- 5) Modularity: Major analytical tools will be designed and implemented to fit modularly, which allows models to be tested, refined, updated, and replaced without major adjustments to other components, in the larger strategic analysis framework
- 6) Adaptive data management framework: Major data efforts will fall within a larger data management framework, including protocols for data documentation and updating, and documentation of limitations.
- 7) A frequently updated document will outline short-term and long-term efforts, budgets, and responsibilities for continuous improvement of analytical tools and data with policy for continued user, local agency, and stakeholder involvement.

Coverage:

- 8) The spatial coverage of the basic data and analytical framework will be statewide.
- 9) Local and regional water management and resources will be explicitly represented.

Accountability and Quality Control:

- 10) In developing analytical tools, significant efforts should be made to involve local agencies and stakeholders.
- 11) Major analytical products will undergo external review by external unaffiliated experts and local agencies whose systems are included in the model(s).
- 12) DWR's strategic analysis framework will undergo periodic internal and external review.

The short and long-term work plan prepared for Update 2003 aims to improve the quantitative understanding of California water and of how to employ analytical tools to aid in developing and comparing solutions to California's water problems and decision

making. This work plan for data and tools is consistent with the three-phased approach for producing California Water Plan Update 2003, outlined in Chapter 1. The work on tools and data in the three-phased approach include:

- Phase 1: Recommend the short- and long-term work plan.
- Phase 2: Select appropriate analytical tools, data, and assumptions to provide technical analyses needed to evaluate the four possible future scenarios.
- Phase 3: Apply the analytical tools selected in Phase 2 and interpret results to evaluate performance of response strategies given several plausible future scenarios.

3.62 Technical Information Needs

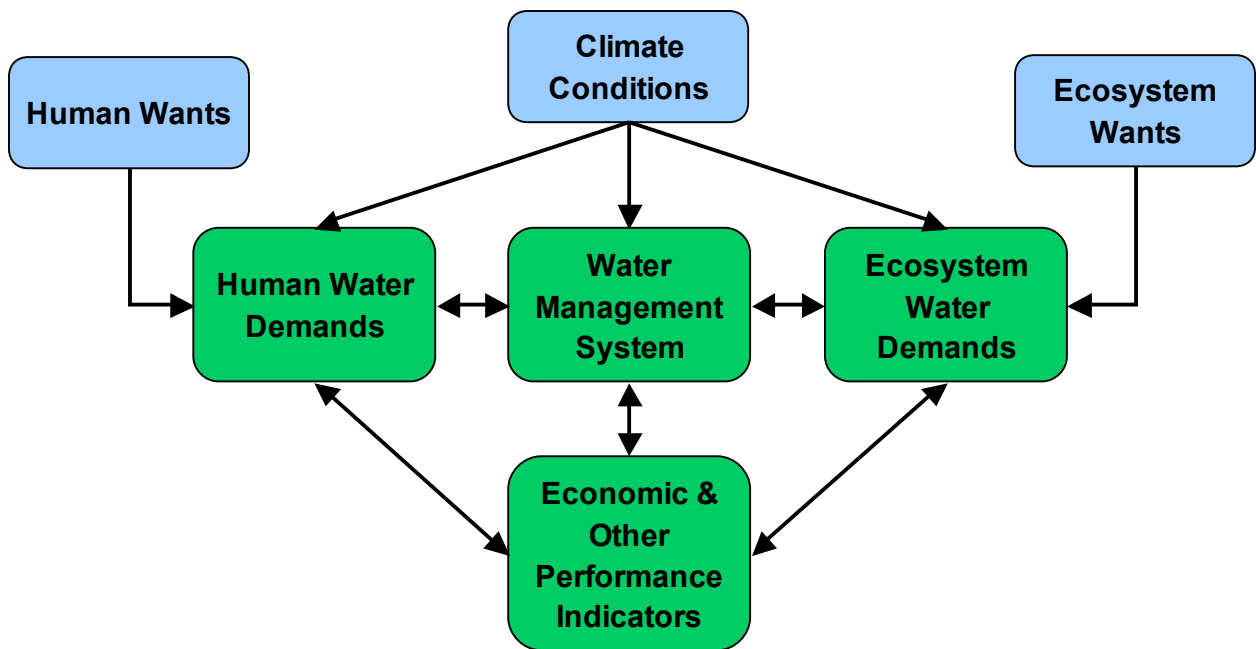
The desire to address various crosscutting issues such as environmental objectives, land-use planning, and economics in different scenarios in this Water Plan requires more technical and quantitative information than for previous Water Plans. Many discussions with the Modeling Work Group and the Advisory Committee have focused on the specific information needed to satisfy the broad objectives of the Water Plan's new planning framework (see Chapter 1) and full disclosure of all assumptions made related to technical information.

In addition to developing the new planning framework, the Advisory Committee and DWR invited land use and resource planners, academics, policy analysts, and technical experts to build on and affirm Advisory Committee understanding about issues critical for the Water Plan to address. These conversations have been captured in mind maps (available in Volume X) which represent a web of relationship and ideas. In addition to traditional needs related to projecting water supply and demand, Water Plan users seek good information related to ecosystem wants and demands; economic issues, such as tiered water pricing and the effect on demand or economic effects of transfers; water quality, such as reusing wastewater and matching water quality to use; equity issues, such as public trust and environmental justice concerns; water use efficiency; and ground and surface water interaction. Further, the Water Plan could play a critical role in linking water and land use management decision making. Land use planners need useful information about water demand as it relates to compact development and growth.

The kinds of technical information needs that have been identified can be described as:

- ***Data*** – factual information, such as measurements or statistics, used as a basis for reasoning, discussion, or calculations (e.g., gauged flows in a river, population as measured by census, and salinity of a water sample).
- ***Relationships*** (or system interactions) – descriptions of how the social, physical, and environmental systems affect or are affected by the status of water supply and water use in California (e.g., how releases from a reservoir affect water temperature at a point in a river downstream, the crop mix in a region and the expected market conditions for each crop, and snow pack conditions in February and the delivery of SWP water).
- ***Estimates*** – inferred, derived or forecasted quantities based on available data, defined relationships, and other assumptions (e.g., population forecasts for the

Figure 3.X - Conceptual Framework for Data and Estimate Interactions



Los Angeles area in 2030, groundwater flows between sub basins, and the cost to implement water conservation best management practices).

3.63 Organizing Information

Given the large quantity and complexity of data, relationships, and estimates desired the update team has organized the requested information according to their potential interactions. Figure 3.X illustrates a high-level conceptual model (framework) of the interactions. The three lighter boxes represent information that is set by the user and does not change during the analyses, such as population, population density, and hydrology. (These can be called *static* estimates.) The darker boxes contain information that will be quantified using analytical tool(s) that explicitly consider the inter-relationships with other data, relationships, or estimates (or *dynamic* estimates). Examples of dynamic estimates include: demand for agricultural water supply, the economic costs of drought management, etc. A comprehensive list of technical information needs is in Volume 3, the Reference Guide.

3.64 Planned Analyses

Based on Update 2003, the phased work plan includes three groups of analyses:

1. **Water Portfolios** that describe the available water sources, movement and uses by region, under several recent hydrologic conditions using actual data for 1998, 2000, and 2001. The portfolios present historic *data* and the *relationships* between sources and uses of water as it moves in California.
2. **Future Scenarios** for 2030 that describe plausible conditions of water use, supply, and demand throughout California in 2030. The scenarios are intended to provide quantitative *estimates* of future water conditions based on existing *data* and defined *relationships*.

3. **Performance Comparison** of different water management strategies combined to form response packages applied to the future scenarios. A list of evaluation criteria (*estimates*) that must be generated to compare the performance of different water management strategies is shown in Volume 2.

Water Portfolios

The *water portfolios* provide comprehensive water balance and flow diagrams for 10 hydrologic regions covering the entire state. The flow diagram documents sources of water, such as precipitation and inflows into the state, and tracks the water as it flows (through many different uses) to its ultimate destination. Since data for some categories is not measured for many regions of the state, the current water portfolios show gaps. Identifying additional data collection and management activities in Update 2003 is an important step in improving the water portfolios for future water plan updates.

There are a number of categories in the flow diagram where data is simply not available or very resource intensive to compile. These include:

- total groundwater natural recharge,
- groundwater subsurface inflow and outflow,
- groundwater extractions and recharge,
- evaporation from land surfaces,
- evapotranspiration from native vegetation and non-irrigated agriculture,
- total stream flow,
- total direct diversions,
- natural and incidental runoff,
- return flows and
- conveyance losses.

There are a number of data items necessary to calculate or estimate these categories. Some of the major data items needed to complete the flow diagram and water balances consist of more detailed and accessible land and water use information including information to separate out applied water use versus consumptive water use. The major data items are:

- water source of supply information,
- outflow data,
- groundwater level data,
- groundwater recharge rates,
- natural riparian water requirements,
- evapotranspiration rates for all types of vegetation,
- detailed return flow information and
- more detailed physical information about all watersheds, water systems and groundwater basins in the state.

Data is currently available for some regions and not for others. For example, methodologies and data to estimate natural runoff is available for regions like the Sacramento River and the San Francisco Bay Region where the delta is a control point, but in areas like the South Coast Region with no control point and substantial groundwater, the natural runoff is nearly impossible to estimate. In addition to natural obstacles, existing data is not easily aggregated or disaggregated to provide convenient access for all areas of interest, and resource constraints limit extensive data collection and management necessary to quantify and track all the water in the state.

Data needs are characterized by the need for detail (data monitoring in more geographic locations and for particular categories), to digitize (common electronic methods), and for a comprehensive database. The state can guide California in expanding data collection and management programs that already exist.

Future Scenarios

Developing the quantitative estimates for four *future scenarios* requires using available data and presumed relationships. A list of key factors affecting future use and supply scenarios in 2030 is shown in the appendix (Table 1). Some examples of these factors include total population, population density, agricultural water use efficiency, and energy costs. Each of these factors must be predicted or quantified, and like the data needed for the water portfolios, the availability and resolution of data needed for the future scenarios varies widely. While the key factors have been identified, much work still exists to reach agreement on the relationships between the factors and the methods that will be used to quantify the factors as described in Table 1. Some examples of the significant complexities in predicting factors such as groundwater storage or surface water storage conditions in 2030 are shown in the Factor Complexity Diagrams of Volume 2.

A report addressing some of the challenges and possible approaches for forecasting urban water demand was presented in July 2003 entitled *Water Demand Forecast Methodology for California Planning Areas: Work Plan and Model Review*. (See appendix.) The authors of the report offer recommendations for:

- near-term analyses given available data, and
- future development for long-term analyses.

The recommendations for future development identify additional data needs such as:

- water and sewer rate data for the utilities and time frames for data contained in DWR's Public Water Supply Survey database,
- correlate local/regional demographic information with per unit water use rates by area, and
- correlate climate conditions with per unit use rates over time.

This new information will allow DWR to update their statistical explanatory demand models by region based on some of these key factors. DWR will have to examine other factors and determine the best way to quantify those factors. DWR predicts that other data gaps will emerge leading to better understanding of the type of data collection and analysis needed to support the new planning framework.

Performance Comparison

A very significant difference in the new Water Plan framework is the addition of quantitative comparisons for various response packages of water management strategies. This *performance comparison* of various mixes of water management strategies under plausible future scenarios will provide planners unprecedented access to relevant technical information. This quantitative insight can be used to help guide investments in statewide water management actions. In order to help focus the quantitative analyses, a list of evaluation criteria have been identified with the Advisory Committee and Modeling Work Group that represents the technical information required to compare the response packages. A full list of the evaluation criteria are included in the Appendix. These evaluation criteria include information such as:

- percent of years agriculture receives all of its desired water supply
- change in economic benefits or losses
- statistical water supply reliability by location
- change in regional imports and exports

While this information is expected to be extremely valuable, developing the capability to complete these performance comparisons presents a significant challenge for DWR over the next several years. Conducting quantitative performance comparisons will require considerable resources (staff, time, and money) to develop and implement an acceptable approach to evaluate the broad interactions the Advisory Committee and the public wish to have performed.

Initially, this effort will focus heavily on the need, availability, and adequacy of technical tools to perform the integrated analyses. Given the high degree of interest expressed by several members of the Advisory Committee and the Modeling Work Group, DWR proposes a systematic, step-by-step approach to develop acceptable methods to complete the quantitative analyses for both the short-term (Update 2008) and long-term efforts. This step-by-step approach is outlined below, and will require extensive participation from the Modeling Work Group.

Once the methods have been defined and agreed upon, DWR will need to set up and conduct the modeling studies, perform quality control reviews of modeling results, and interpret and communicate the meanings of the analytical tool outputs.

3.65 Analytical Tools

Generating quantitative estimates for most of the information contained in the water portfolios, future scenarios, and performance comparison requires the use of one or more analytical tools. The term *analytical tool* is defined to mean “something used to study or determine the nature and relationship of the component parts of a whole”. The role of an analytical tool and the method for using it varies significantly depending on the specifics of the information being generated. Given the desire to promote understanding and transparency of analysis, the Update team has developed and will apply a systematic method to identify potential analytical tools, determine their proper use, and validate their application to generate all of the quantitative information needed for the Water Plan.

Framework to Assess an Analytical Tool

Evaluating the appropriateness of an analytical tool to produce quantitative estimates of different technical information can be extremely complicated. To help make the process as effective and transparent as possible, the team will apply the following framework, described using a series of questions, for each item on the comprehensive list of technical information needs.

- What is the job at hand?
 - Describe by task if needed, highlighting the quantitative results that would assist in accomplishing the task
- If the ideal tool to assist with the task were available, what capabilities would it have?
- Which tools are available that could produce the desired quantitative results?
- Which tool represents the best fit?
 - Evaluate the potential tools according to the desired capabilities
 - Consider limitations
- What could be done to improve the selected tool?
 - Does the improved tool produce a better product?

Parts of an Analytical Tool

In order to understand the capabilities of an analytical tool, or to assess the validity of using an analytical tool for a specific purpose, it is helpful to consider the tool in terms of its parts:

- Conceptual model: a description or analogy used to visualize something that cannot be directly observed (e.g., a road map).
- Theoretical model: a system of postulates, data, and inferences presented as a description of an entity or state of affairs (e.g., the law of gravity).
- Numerical model: an analytical tool that employs quantitative approximations to the solutions of mathematical problems.
- Data
- Data management system
- Software

Describing an analytical tool using these categories promotes more precise discussions regarding the capabilities and appropriate use of analytical tools.

3.66 Resources Needed

Generating and interpreting the quantitative information described above will require tremendous resources. The technical scope and magnitude of the desired analyses is unprecedented in California water planning. While several parts of the desired analyses have been done before, no previous quantitative study has ever been conducted so comprehensively and with such intensive stakeholder interaction. Needless to say, a large team of technical experts with diverse skills will need to be engaged over a lengthy period of time. Technical experts will be needed who can understand the complex interaction between policy-making and technical analyses, organize technical information

needs, identify and qualify subject-matter data, manage extensive data, interface with diverse stakeholders and programs like the California Bay Delta Authority, and demonstrate leadership to inspire confidence within policy and technical communities. In addition to the broad array of technical expertise required, a large number of experts will need to be assembled to accomplish the goals set forth in the given timeframe. Nonetheless, DWR is committed to leading the way in developing the methods, analytical tools, and conducting the analyses to provide the information the public of California needs in a transparent and responsive manner.

3.67 Major Tasks and Schedule

The following task and associated schedule chart outline the major steps DWR plans to take to provide the desired technical information in a timely manner. As shown on the associated schedule chart, DWR plans to perform these activities with frequent and detailed interactions with interested parties through the Modeling Work Group. This systematic approach will allow DWR to address concerns raised about validity of existing tools and questions raised about the appropriateness of quantitative methods used for previous technical studies. A related item, the peer review of the CALSIM II model being conducted in cooperation with the California Bay-Delta Authority is shown on the schedule.

1. Generate a comprehensive list of required technical information. (Complete in Q4 2003.)
2. Organize the technical information needed using the relationships of the information similar to the conceptual framework illustrated in Figure 3.X. (Complete in Q4 2003.)
3. Circulate the comprehensive list of required technical information to Modeling Work Group for review. Meet with MWG to discuss. (Complete in Q4 2003.)
4. Incorporate comments and finalize comprehensive list of required technical information. (Complete in Q1 2004.)
5. Propose a conceptual model (or models) for each piece of information needed to complete the:
 - a. Water Portfolios (Jan. – Mar. 2004)
 - b. Future Scenarios for 2030 (Feb. - Apr. 2004)
 - c. Performance Comparisons (Mar. - May 2004)
6. Distribute documents containing the proposed conceptual models to Modeling Work Group and conduct workshops to adopt preferred conceptual models used to compute each piece of technical information
7. Propose a theoretical model for each piece of required technical information including: postulates, data, and inferences (Mar. – Jun. 2004)
8. Distribute documents containing the proposed theoretical models to Modeling Work Group and conduct workshops to adopt preferred theoretical models used to compute each piece of technical information (Apr. – Jul. 2004)
9. Compare preferred theoretical models with those implemented in currently available analytical tools (May – Sep. 2004)

- a. Review existing analytical tools to determine if they incorporate some or all of the preferred theoretical models
 - b. As needed, determine if existing analytical tools can be modified for short-term use
10. Modify tools as needed and as possible for short-term use
- a. Make changes to existing analytical tools to better incorporate preferred theoretical model implementation that can be accomplished by the end of Q1 2005
 - b. Acknowledge and document where existing tools and data that will be used for Update 2008 fall short of the desired theoretical implementation and cannot be suitably modified by end of Q1 2005
 - c. Prepare a document that describes how analyses for Update 2008 will be implemented in the short-term
11. Develop a document that outlines requirements for new analytical tools and data to perform the preferred quantitative analyses for future updates
- a. Describe likely approach to obtain or develop tools that can fulfill the requirements
 - b. Develop a schedule for development and testing
 - c. Develop budget for development and testing
12. Apply existing analytical tools to quantify all required technical information for Update 2008
- a. Future Scenarios
 - b. Performance Comparison
13. Interpret and describe quantitative results for
- a. Future Scenarios
 - b. Performance Comparison

3.68 Update 2008 and Beyond

The tasks described above are focused towards identifying and developing trusted and acceptable quantitative methods over the next two years that can be applied as completely as possible in the short-term for update 2008, and as close to the preferred methods as possible for updates beyond 2008. As these requirements, data gaps, and preferred conceptual and theoretical models are adopted, DWR will also identify the requirements for a viable information management system. Given the magnitude and complexity of information, and the desire to coordinate and share this information at various levels of detail throughout the state, DWR likely will need to implement an enterprise-level information management system accessible via the World Wide Web.

Furthermore, as progress is made in developing better, more comprehensive data and analytical tools to analyze the water movement and interactions, DWR plans to foster development of decision support tools that increase planners' ability to fully utilize the new and improved technical information being provided in future Updates.