Draft Prospectus: Review of the organization, development, and use of science in estimating water supply reliability involving the Sacramento-San Joaquin Delta

Delta Independent Science Board

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The Sacramento-San Joaquin Delta is California's main hub for agricultural and municipal water supply involving upstream and in-Delta diversions. Water supply reliability is one of the State's coequal goals for managing the Delta. As a result, the Delta Independent Science Board (Delta ISB) will undertake an initial review that focuses on scientific efforts and methods for estimating and evaluating water supply reliability.

Reliability is important at many scales, in many ways, for many purposes. Reliability also changes significantly with time, location, conditions, regulations, and management. Water supply is typically managed adaptively, at least in an informal sense, through a portfolio of water sources and supply and demand management actions (e.g., various surface and groundwater supplies, managed conjunctively with water conservation, water trading, and other activities). Lack of reliability leads urban and agricultural water users within and outside the Delta to make water supply investments from other water sources or suffer costs or inconvenience from reduced water deliveries to their customers. Lack of water supply reliability for environmental and ecosystem objectives can lead to declines in native species, growth in non-native species populations, and undesirable concentrations of contaminants, all of which ultimately affect human health and economic prosperity. Water supply reliability is a pillar of water security (Srinivasan et al. 2017).

Water supply reliability is commonly assessed in terms of probabilities. These include the probability of delivery availability for individual or aggregated water sources, probabilities of different amounts of overall water shortage for water users or uses, and averages or probability distributions of estimated economic losses and costs.

Unreliability in water supplies is unavoidable and can have many causes. These include: natural hydrologic variability between wet and dry years, climate change, earthquake disruptions, mechanical failures, water quality contamination, regulatory requirements on water sources, and drinking water quality standards. Causes of unreliability interact and are subject to management actions. Much is written on water reliability for various purposes, metrics, and sources of unreliability. Unreliability also has many effects, some expected and some unforeseen.

Water quality is an important aspect of Delta water supply reliability. Delta lands, being near sea level, will always have ready physical access to water. But the quality of water in the Delta is a longstanding issue for both in-Delta users and water exporters, determining the suitability of Delta water for different uses.

A wide range of local, state, federal, academic, consulting, and non-governmental organization efforts analyze water supply reliability for the Delta. Reliability is commonly estimated for individual Delta projects as well as the overall water supplies for local and regional water users. For many water users, reliability involves many sources and a portfolio of water management actions.

Perhaps the most public effort to estimate Delta water supply reliability is the California Department of Water Resources' (DWR's) biennial report that estimates delivery capability for the State Water Project (e.g., DWR 2015). Other agencies routinely provide or fund planning estimates that involve long-term and seasonal operations of water delivery reliability. Similarly, major water systems worldwide provide water supply reliability forecasts that might offer lessons for California.

Many Delta policy and management discussions draw on existing and past scientific and technical work on water supply reliability. These discussions might benefit from additional, more consistent, or differently organized scientific and technical work on water supply reliability estimation.

A comprehensive review of all scientific work related to water supply and the Delta would be overwhelming and ponderous. Such a review would encompass the detailed science of urban and agricultural water conservation, reservoir operations, groundwater supplies, evapotranspiration estimation and management, diversion fish screens, water supply effects of environmental flows, climate change, long-term changes in water demands, water quality effects on water supply, and integration of water supply portfolios.

Therefore, this initial review will focus on the science and methods available to estimate and evaluate water supply reliability. Topics covered in this review might include:

- How the reliability of Delta water supplies differs from overall water supply reliability for local water users and uses, who often rely on a portfolio of supplies.
- Different causes of unreliability and how they are likely to change with time and policies.
- How reliability can be measured and communicated for different purposes and uses.
- An inventory of long-term and seasonal estimation efforts by various federal, state, and local agencies.
- An evaluation of the methods, data, and uncertainty involved in making such estimations.
- Management responses available when reliability is imperfect and when estimates are incorrect, and their costs.
- Approaches being taken to estimate changes in reliability with changes in climate, endangered species conditions, and alternative water supply and conservation infrastructure and management.
- Opportunities to jointly manage water for both water supply and ecosystem purposes.
- Relative roles of surface water, groundwater, and water demand management.

The review's depth and breadth would be managed adaptively. The minimum outcome will be a short initial review that might suggest some areas for further work, agency coordination, and perhaps reporting back. A more ambitious option is wide-ranging and analytical review that delves deeply into one or more of the topics listed above.

Review Process Ideas

- Inventory and discussions with major analysts of water supply reliability
- Panel presentations, interviews, survey/questionnaire
- Informal discussion and presentation workshop (format similar to the earlier levee workshop by the Delta ISB) with two main sessions on a) estimators of water supply reliability on methods and b) use and development of system reliability estimates for water users

- Comparative analysis of various available estimates of reliability

Tentative report outline

1. Estimation of Delta and overall water supply reliability, potential problems and relevance (long-term, seasonal estimates), scales of analysis (municipal, urban, regional)
2. Inventory of estimations of water supply reliability
3. Approaches to estimating water supply reliability
4. Comparative analysis
5. Conclusions and Recommendations

Tentative timeline

1. Prospectus explorations with public and private discussions – 3-5 months
2. Workshop and initial write-up – 2-4 months
3. Follow-up analysis and draft report – 2-3 months
4. Public review and revisions – 2-4 months
5. Possible journal paper on "Reliability of Water Supply Reliability Estimates"

Total estimated time: 9-24 months

Some Further Reading

DWR, State Water Project Delivery Capability Report 2015 and Appendices, and previous reports for 2002, 2005, 2007, 2009, 2011, and 2013. http://baydeltaoffice.water.ca.gov/swpreliability/

Howe, C.W. and M.G. Smith (1994), "The Value of Water Supply Reliability in Urban Water Systems," *Journal of Environmental Economics and Management*, 26, 19-30 (1994)

Lund, J. "California's Agricultural and Urban Water Supply Reliability and the Sacramento–San Joaquin Delta," *San Francisco Estuary and Watershed Science*, Vol. 14, No. 3, October 2016.

Maven's Notebook, Delta Independent Science Board: Water Supply Reliability Panel, summary, posted March 9, 2016.

Srinivasan, V., Konar, M., & Sivapalan, M. (2017). A dynamic framework for water security. *Water Security*, Volume 1, July 2017, Pages 12-20