Review of Science Used to Estimate Water Supply Reliability Involving the Delta

Delta Independent Science Board

Prospectus

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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 for California is one of the State's coequal goals for managing the Delta. A reliable water supply is also critical to the other coequal goal, restoration of the Delta's ecosystem, while maintaining the values of the Delta as an evolving place. Because of the importance of water supply reliability, the Delta Independent Science Board (Delta ISB) is undertaking a review that focuses on scientific efforts and methods for estimating and evaluating reliability.

Water supply reliability is important in many ways, at many scales, and for many purposes. Reliability also changes significantly with time, location, water availability and quality, water demands, water rights, 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, trading, reuse, and other activities).

Lack of reliability leads urban and agricultural water users within and outside the Delta to invest in 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 of native species, population growth of non-native species, and undesirable concentrations of contaminants, which ultimately affect human health and economic prosperity. Water supply reliability is a pillar of environmental, food, and economic security (Srinivasan et al. 2017). Lack of reliability in water supplies is unavoidable and can have many causes. These include: natural hydrologic variability between wet and dry years, droughts, climate change, levee failures from floods or earthquakes, mechanical failures (pumps, canals, gates, etc.), water quality contamination, regulatory requirements on water sources, drinking water quality standards, and growth of water demands. Causes also can interact and are subject to management actions.

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.

Water supply reliability is commonly assessed in terms of probabilities. These probabilities include delivery availability for individual or aggregated water sources, overall water shortage for water users or uses, and estimates of economic losses and costs.

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 might benefit from additional, more consistent, or differently organized scientific and technical work on water supply reliability estimation.

This review will focus on the science and methods available and employed 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.
- Causes for lack of reliability and how they may change with time and policies.
- How to measure and communicate reliability for different purposes and uses.
- An inventory of long-term and seasonal reliability estimation efforts by various federal, state, and local agencies.
- Methods, data, and uncertainty involved in making reliability estimations.
- Management responses available when reliability estimations are imperfect and when estimates are incorrect, including costs.
- Current approaches 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, reuse, 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.

Approach

- Inventory and discussions with major analysts and stakeholders of water supply reliability (see table below).
- 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 and b) use and development of system reliability estimates.

Tentative Report Outline

1. Purposes and uses of estimation; estimation of supply reliability; water quality; long-term planning versus seasonal estimates; scales of analysis (municipal, urban, regional); changing climate, demands, regulations and policy, Delta versus overall water, technology (efficiency and transfers), groundwater availability, etc.
2. Inventory of estimations of water supply reliability, and previous efforts at reliability estimation
3. Approaches to estimating water supply reliability
    a. Level of development analyses
    b. Continuous simulations (historical, future)
    c. Stochastic continuous simulation (historical, future)
    d. Others?
4. Desirable characteristics for water supply reliability estimation
5. Comparative discussion or analysis of estimation methods
6. Approaches to managing water supply reliability – portfolios, water rights, regulations, agreements, markets, etc.
7. Trade-offs in water supply reliability – costs of reliability (financial, economic, social), quantity and quality; shortage size versus frequency (hedging), environmental costs of reliability, other?
8. Implications for the development and use of water supply reliability estimates
9. Conclusions and Recommendations

Tentative Timeline

1. Prospectus explorations with public and private discussions – 3 to 5 months
2. Workshop on November 1 or 2, 2018, and initial write-up – 2 to 4 months
    a. Morning presentations; afternoon syntheses on problems and directions
    b. Potential Workshop Invitees:
        i. DWR: Delta Modeling, Water Evaluation and Planning (WEAP), and Re-operations, etc.;

ii. State Water Resources Control Board (SWRCB): WEAP, Water rights;
iii. Water utilities: Metropolitan Water District of Southern California (MWD), East Bay Municipal Utility District (EBMUD), Santa Clara Valley Water District (SCVWD), Contra Costa Water District (CCWD), Westlands Water District, Kern County Water Agency, etc.;
iv. USBR: Sacramento office, Denver office;
v. Wildlife refuges: US Fish and Wildlife Service (FWS), California Department of Fish and Wildlife (CDFW), others.
vi. Academic: UC Davis, Cornell University, Tufts University, and others;
vii. Consulting: MBK, Jacobs, Stantec, Ford, SEI, and others.

3. Follow-up analysis and draft report – 2 to 6 months
4. Public review and revisions – 2 to 4 months
5. Possible journal paper on "Reliability of Water Supply Reliability Estimates"

Total estimated time: 9 to 27 months

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Some Further Reading

DWR. 2015. 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*, Volume 26, Pages 19-30. https://www.sciencedirect.com/science/article/abs/pii/S0095069684710023?via%3Dihub

Lund, J. California's Agricultural and Urban Water Supply Reliability and the Sacramento–San Joaquin Delta, *San Francisco Estuary and Watershed Science*, Volume 14, No. 3. https://escholarship.org/uc/item/49x7353k

Maven's Notebook. 2016. Delta Independent Science Board: Water Supply Reliability Panel, summary, posted March 9, 2016. https://mavensnotebook.com/2016/03/09/delta-independent-science-board-water-supply-reliability-panel/

Srinivasan, V., Konar, M., & Sivapalan, M. 2017. A dynamic framework for water security. *Water Security*, Volume 1, Pages 12-20. https://www.sciencedirect.com/science/article/pii/S2468312416300220