

# Memorandum

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**To:** Santa Cruz Water Supply Advisory Committee (WSAC)  
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**Date:** 2/6/2015  
**Subject:** An Overview of Risk Management

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In considering plausible future scenarios and possible additions and modifications to the current Santa Cruz system's water supply portfolio – it is important to recognize and consider the risks to which the water system is exposed. To help provide context and background for considering these risks, this technical memorandum offers a brief overview of risk management and related terms and concepts. We then offer an overview of our three-step framework for risk management and how we will apply that framework to the ongoing risk-identification exercise for WSAC.

The term “risk management” has been defined and deployed in many settings. We adopt the general convention that originates with the National Research Council (NRC, 1983), which makes a useful distinction between risk assessment and risk management. Specifically NRC distinguishes between *risk assessment* – the science of identifying and attempting to estimate the size of a risk, and *risk management* – the decision-making steps required to merge risk assessment with other information (such as economic, policy, and other considerations) to develop and implement a response for reducing the risk.

Risk management also has been more broadly defined as “the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability or impact of unfortunate events or to maximize the realization of opportunities” (Brown and Carriquiry, 2007). This definition essentially combines the risk assessment and risk management components of the NRC approach into a single suite of activities.

To help the WSAC forge a useful approach to risk management, we define the risk-management framework as consisting of the following three steps, and will structure our approach accordingly:

1. ***Risk identification:*** the process of recognizing and understanding where and to what the system is vulnerable, i.e., identifying factors that make the system vulnerable.
2. ***Risk assessment:*** using empirical estimation, ranking, or other means to characterize the level of risk posed to a system. The level of risk is defined as the probability of an event occurring, multiplied by its consequences.
3. ***Risk management:*** identifying, evaluating, selecting, and implementing strategies to increase resiliency and retain or add flexibility (i.e., to reduce the consequences or

probability of an adverse effect). Risk management strategies may include adaptive management and “no-regrets” or “low-regrets” alternatives to reduce the probability or consequences associated with a potential adverse event. An example of a risk-management strategy would be a water department adding a specific supply-side alternative to the water-supply portfolio to increase the diversity of water sources and reduce the adverse effects of frequent drought on water supply; another example would be adding seismic protections to a critical pipeline to reduce the probability of failure in the event of an earthquake.

The three-step framework helps delineate the risk-management challenges facing the Santa Cruz Water Department (SCWD) and the greater community it serves.

## 1. Risk identification

The SCWD has identified the following risks to system performance:

- ▶ Droughts
- ▶ Seismic events
- ▶ Regulatory requirements, including habitat conservation plan (HCP)-driven fish-flows
- ▶ Economic events
- ▶ Sea level rise
- ▶ Wildfire in the watershed.

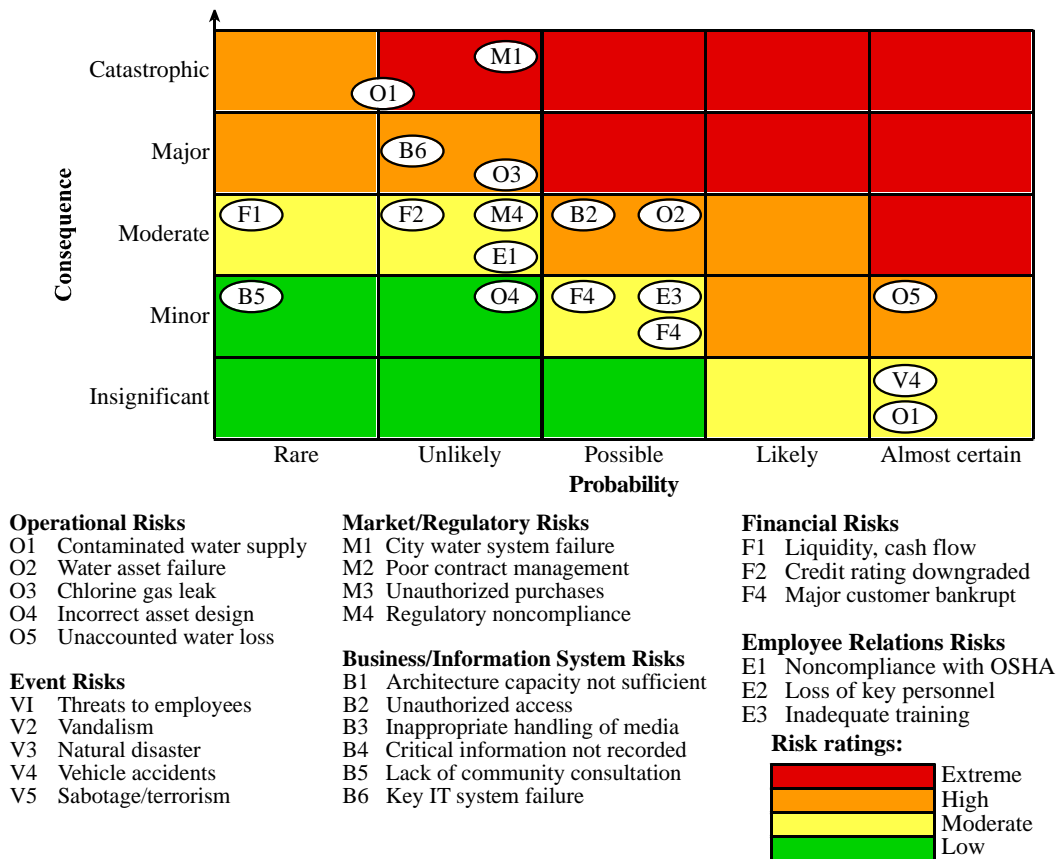
WSAC needs to inform the Technical Team if there are other, uncontrollable external events they would like us to examine as part of the risk identification exercise for SCWD.

It is important to note that we do not intend to develop a formal risk assessment or risk-management strategy as part of WSAC activities. Rather, our intent is to help identify important risks so that WSAC can consider them as they work on defining plausible future scenarios and considering how potential future portfolios might perform.

## 2. Risk assessment

The risk assessment process allows you to characterize and prioritize risks; and help determine where you may need to gather more information in order to assess, prioritize, and manage a risk. Risk assessments may be conveyed using a risk profile matrix (see Figure 1), where the X axis identifies the probability that the identified risk will occur, while the Y axis captures the consequence to the system if that event does occur.

Figure 1 provides an example of a risk profile matrix. In this fairly detailed example, the risks are organized by internal functional area (e.g., operations, information technology) and external “events” (e.g., terrorism, natural disasters).



**Figure 1. Utility risk profile: Characterizing and ranking various utility risks.**

As this figure demonstrates, a risk-profile matrix is useful in several ways. It is a visual aid for understanding how the numerous risks that a utility faces may vary along the probability and consequence dimensions. It also enables and encourages utility managers and invited stakeholders to determine which cells reflect extreme-, high-, or low-risk rankings. Risk profiling in this manner encourages utilities to consider a broad range of risks. It also allows practical judgment to enter the process because it is not simply a formula: managers need to actively consider what each category of probability or consequence means. A risk-profile matrix also helps utilities consider how any one specific type of risk, such as climate change-related risks, relate to other important risks that the utility faces.

### 3. Risk management

The WSAC will need consider how their choice of alternatives in building on SCWD’s existing portfolio may help manage the risks associated with the challenges the system faces now and into the future. The Technical Team will support WSAC risk-management

choices by assessing how a set of proposed alternatives might reduce either the probability that an identified risk will occur, or reduce the consequences of the event if it does occur.

### **Conclusion**

The WSAC will have the opportunity to ask more questions about the risk identification and risk assessment process during the February 2015 meeting. The Technical Team will also bring a short presentation about each risk to the meeting. WSAC members can use risk-assessment information to identify the risks they want to know more about, the risks they want to manage as part of scenario development, and how the alternatives can be used to help manage risks.

### **References**

Brown, C. and M. Carriquiry. 2007. Managing hydroclimatological risk to water supply with option contracts and reservoir index insurance. *Water Resources Research* 42(5). doi: 10.1029/2007WR006093.

NRC. 1983. *Risk Assessment in the Federal Government: Managing the Process*. U.S. National Research Council. U.S. Government Printing Office, Washington, DC.