Memorandum

To: Water Supply Advisory Committee

From: Karen Raucher and Jennifer Peers, Stratus Consulting Inc.

Date: 3/11/2015

Subject: Sustainability and water supply planning

This memorandum provides insights on sustainability issues associated with water supply planning. The information and references are provided as thought pieces by the Technical Team in support of Water Supply Advisory Committee (WSAC) application of the concept of sustainability to the city's water supply. We look forward to your response and directions for further research on this important topic.

General sustainability definitions:

- The ability to continue a defined behavior indefinitely (http://www.thwink.org/sustain/glossary/Sustainability.htm)
- Of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged (http://www.merriam-webster.com/dictionary/sustainable)
- "Development and use of groundwater in a manner that can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences" (USGS, 1999, as cited in Winstanley, 2007, slide 9)
- There is broad agreement that sustainability involves not just the conditions in the economy, but also the underlying ecological and environmental systems in which economic activity is embedded, and the larger social system of which the economy is a part (Toman et al., 1998).

Water utilities look at sustainability in terms of continued provision of clean and safe water to ensure the environmental, economic, and social health of communities (Welch, 2010; U.S. EPA, 2012). In a water supply context, sustainability recognizes present and future generations, the value of water supply, shared responsibilities, renewable but not limitless water supply, stewardship, reasonable use and acceptable impacts, maintenance of integrity of societal and ecological systems, and adaptability and flexibility to deal with uncertainties and risks (Winstanley, 2007). Planning for sustainable supply in the long-term future needs to take into account anticipated changes in population and climate change-related impacts such as shifts in precipitation and potential evapotranspiration (the evaporative loss of water from the ground surface and transpiration loss through vegetation).

Water utilities also tend to think about sustainability in terms of the water and energy nexus. The provision of clean and safe water requires significant energy and, simultaneously, electricity production requires a significant amount of water. By some estimates, 90% of a water utility's energy consumption is for moving water (Welch, 2010), although this is highly dependent on the specific water utility's circumstances (e.g., service area size and topography). The California Energy Commission (2005) found that saving water saves energy. Reducing consumption avoids consuming the amount of energy that would be needed to acquire the water, transport and treat it, deliver it, as well as treat and safely dispose of the wastewater. The California Sustainability Alliance[1] recommends that the energy and water sectors collaborate more closely to advance energy efficiency in the water sector. It also developed a summary of best practices for water utilities to reduce energy consumption within water and wastewater systems, as well as to self-produce clean energy for use in water supply and treatment (Exhibit 1; Sathe, 2013).

Water Use Cycle	Water-Energy Measures
Supply and Conveyance	• Install high efficiency pumps • Increase the use of recycled water • Optimize integration of renewable energy sources and the use of water storage for energy storage • Optimize hydropower generation • Shift water pumping from the summer months to other months
Water Treatment	• Install high efficiency pumps • Develop lower energy intensity water treatment methods • Shift water treatment to off-peak and partial peak times
Distribution	• Install high efficiency pumps • Shift water pumping to off-peak and partial peak times
End-Use	• Increase energy efficiency of water heating and pumping devices • Reduce the use of once-through cooling, thereby slowing reliance on treated water supplies • Save energy by conserving water • Optimize of the time of use of water by large customers to decrease energy needs during peak times
Wastewater Treatment	• Increase self-generation of energy by biogas • Install high efficiency pumps • Advance water treatment processes to decrease energy use • Optimize flow and storage to reduce energy use during peak times

Exhibit 1. Water energy measures.

Reproduced from http://sustainca.org/programs/water_energy/measures.

1. The California Sustainability Alliance is a program managed by Navigant Consulting, administered by Southern California Gas Co., and funded by California utility customers under the auspices of the California Public Utilities Commission. More information is available at www.sustainca.org.

It is important to consider the footprint (i.e., "area of influence") at which sustainability is the focus to be able to evaluate whether potential actions are sustainable. Urban areas in particular are often unable to be sustained only on the water resources and water disposal opportunities within their urban area boundary, and need to look to neighboring sources (Kjellén and McGranahan, 1997). Because of the need to transport supply water to and wastewater from urban areas, it may be preferable to think of sustainability in terms of a watershed or a region. Alternatively, the area of influence of different alternatives might be the focus of thinking about sustainability. For a stream-withdrawal point source, the area of influence would begin and extend downstream to a point at which the withdrawal is no longer measurable (Vigerstol, 2011).

It also may be helpful to think of defining a range of conditions that are sustainable and evaluate water supply alternatives against those conditions. To do so, you must first define your baseline condition using historical data and projections of the future (potentially incorporating projections of the effects of climate change). Then sustainability boundaries might be set as a certain percentage above and below the baseline condition (see Exhibit 2). Water withdrawal data or projections can be compared to these boundaries to evaluate whether it is sustainable.

The U.S. EPA (2012) has been working with water utilities to plan for and effectively manage infrastructure and operations to ensure sustainability. They have established a framework that focuses on the following core elements to build sustainability considerations into the planning process:

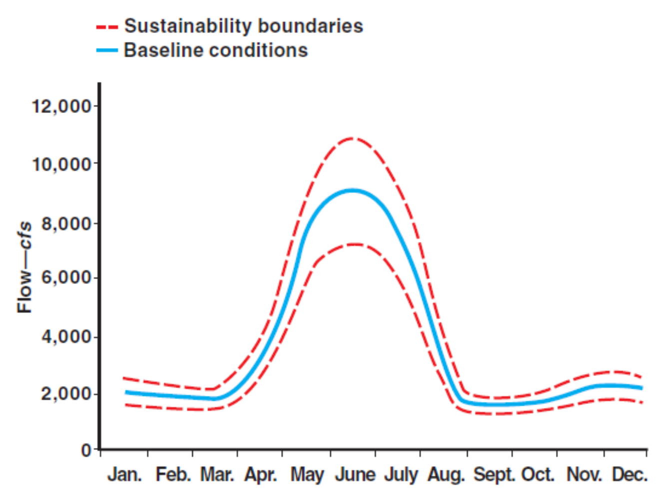
1. ***Goal-setting****:* Establish sustainability goals that reflect utility and community priorities

2. ***Objectives and strategies****:* Establish explicit, measurable objectives for each sustainability goal and identify strategies for meeting those objectives

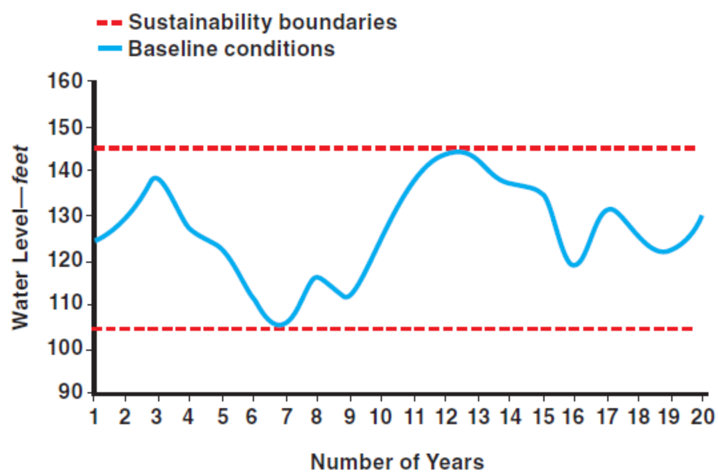
3. ***Alternatives analysis***: Based on sustainability goals and objectives, set explicit and consistent evaluation criteria to analyze a range of infrastructure alternatives

4. ***Financial strategy****:* Implement a financial strategy including adequate revenues so that the new infrastructure and operational investments – as well as the overall system – are sufficiently funded, operated, maintained, and replaced over time on a full lifecycle cost basis, with appropriate considerations for disadvantaged households.

The first three of these steps may be particularly relevant to WSAC, and in fact parallel the process WSAC is currently conducting. **Goal-setting** is a critical step for moving toward sustainability, but it is influenced by multiple factors, including the utility's mission, regulatory and legal requirements, vulnerabilities of the system, customer expectations about services and rates, as well as other community sustainability priorities. Examples of potential sustainability goals are shown in Exhibit 3.



(a)



(b)

Exhibit 2. Example of sustainability boundaries for (a) a stream and (b) an aquifer.

Reproduced from Vigerstol, 2011.

When thinking about **goal-setting**, WSAC may want to consider the related goals of the Sustainable Santa Cruz County Plan (Sustainable Santa Cruz County, 2014), which include water conservation, urban greening and urban agriculture, and energy conservation and renewable energy. Recommendations in the plan related to water conservation include requiring water-efficient landscaping, promoting compact development, and encouraging green stormwater systems.

Potential Sustainability Goals

This list describes a range of sustainability goals along with examples of utility approaches to address them. The examples are illustrative only. More information on how to use the goals to make appropriate infrastructure and operational decisions is contained in the remainder of the handbook.

Improve compliance

- *For example, establish collaborative partnerships with neighboring utilities to increase or maintain technical, managerial, or financial capacity or to share information and expertise.*

Reduce energy cost

- *For example, invest in more energy efficient equipment or explore operational changes that can enhance energy optimization (such as pumping at night when the rate is lower).*

Reduce overall infrastructure costs to communities

- *For example, partner with other community agencies to coordinate infrastructure projects such as road repairs with lead service line replacement and installation of rain gardens.*

Extend the projected adequacy of current water supplies

- *For example, implement consumer water conservation programs, implement water metering, fix distribution system leaks, or make use of reclaimed water.*

Address wet weather impacts

- *For example, implement a mix of non-traditional infrastructure alternatives such as green infrastructure solutions with integrated stormwater and combined sewer overflow control.*

Preserve critical ecological areas in the community

- *For example, adopt management programs for septic systems to reduce nutrient loadings to lakes or employ "green" treatment chemicals.*

Improve the economic vitality of the existing community

- *For example, target water infrastructure projects to support existing community infrastructure and encourage redevelopment.*

Enhance community livability.

- *For example, incorporate green space or recreational opportunities into projects.*

Reduce long-term system operational costs

- *For example, use natural treatment systems, such as functioning wetlands, to reduce the input of energy and chemicals for treatment or re-use water treatment solids.*

Improve operational resilience

- *For example, understand operational, financial, and potential climate vulnerabilities and incorporate them into alternatives analysis as part of a broader risk management strategy.*

Reduce vulnerability to water supply disruption or contamination

- *For example, conduct real-time water quality monitoring, install isolation shutoff values, or provide connections to alternative water supplies.*

Ensure a sustainable workforce

- *For example, implement steps to ensure a safe workplace, knowledge retention, and incorporating new knowledge through training.*

Exhibit 3. Potential sustainability goals.

Reproduced from U.S. EPA, 2012.

A briefing prepared by Resources for the Future suggests several types of actions to respond to the hydrologic uncertainty associated with climate change, including increasing redundancy to provide better resiliency, improving data collection and modeling, developing long-term shared solutions like deep storage reservoirs, reducing runoff and erosion through green infrastructure, and upgrading aging infrastructure (Covich, 2010).

Setting explicit and measurable objectives and strategies for sustainability goals are necessary for the third step in the framework (**alternatives analysis**). Objectives can be quantitative targets like increasing water efficiency by 25%, or they can be procedural objectives like targeting infrastructure improvements for existing communities. Whether quantitative or qualitative, the most effective objectives are specific, measurable, and realistically achievable in the timeframe specified with available resources (i.e., capacity and funding). As part of the third step in the framework, projects would be evaluated based on their ability to meet the goal. Exhibit 4 walks through two examples of sustainability goals, associated objectives and strategies, and alternatives analysis.

Energy Use Example…

Sustainability Goal:	Objective and Strategies:	Alternatives Analysis:
Utility seeks to reduce its energy use consistent with the community's energy efficiency program	Utility sets objective of reducing energy use by 25% in 5 years; it conducts an energy audit to determine its baseline energy use and identifies potential projects to meet its objective	Utility evaluates all projects, in part, on their relative lifecycle energy efficiency costs (e.g., installation of high efficiency heat pumps) and their relative ability to meet the 25% energy use reduction objective

Supporting Infrastructure in Existing Communities Example…

Sustainability Goal:	Objective and Strategies:	Alternatives Analysis:
Utility aligns itself with community goal to accommodate most expected growth by revitalizing urban areas rather than through new development	Utility sets objective to serve 75% of expected growth within its existing service boundary; it analyzes its current capacity to accommodate new growth within its existing service area and identifies strategies for increasing capacity	Utility evaluates all projects, in part, on the extent to which they increase the ability to serve growth within the service boundary (e.g., projects providing service near planned public transit services)

Exhibit 4. Examples of applying sustainability framework for two sustainability goals.

Reproduced from U.S. EPA, 2012.

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