Water Supply Advisory Committee Portfolio Building Block Information

8. Local Desalination (scwd^2 Desal)

working draft of 20 July 2015

1. Objectives

The technical team prepared this document as part of a series to provide our latest assessment of the anticipated costs, supply production, yields, timelines, and other relevant information for the various water supply enhancement alternatives that may serve as key components ("building blocks") in a future portfolio. Each of the major potential water supply components is now being considered individually so that each of these "building blocks" can be more carefully compared side by side. The objective is to provide WSAC with our best current assessment for each building block, so that the Committee can better evaluate its potential choices as builds portfolios for future consideration.

Disclaimer/Context

The material provided herein reflects the technical team's best assessment given currently available information. At this stage, all estimates are preliminary and suitable only for high level planning: cost estimates are prepared to a planning level, we have included a 50-percent contingency to address "known and 'unknown' unknowns," and the estimated capital and operating costs are intended to be used for comparison purposes, as Class 5 estimates with an accuracy range of -30% to +50%.[1] However, for this option, given that we are building on fairly detailed prior planning work by the City, the cost estimates are likely to be less uncertain than those of the other options being examined.

As we continue to review and refine underlying assumptions and data, and as new information becomes available, our estimates will likely evolve. More extensive analysis ultimately will need to be conducted to develop more precise estimates – including site-specific field evaluations beyond the scope and timeline for WSAC activities.

Also, please note that the total portfolio yield is not equal to the sum of the individual building block yields. This is because the components operate interactively at a system level (as captured in *Confluence* modeling).

2. Local (scwd^2) Desal -- Overview

In this document, the seawater desalination-based "Local Desal" approach is envisioned generally as:

1. The City developing a seawater desalination facility largely based on the original plans for the scwd^2 facility, though scaled up to 3 MGD (rather than 2.5 MGD) to better meet anticipated SCWD needs under DFG-5 and climate change. (The 3-MGD scale also provides a more suitable basis of

[1] Per the Association for the Advancement of Cost Engineering (AACE), *Standard Cost Estimating Guidelines*. Note too that these are considered "Class 5" planning-level estimates, which include a 50 percent contingency factor, and should also be accompanied by an accuracy range of -30% to +50%. For example, a project presented with a $100M cost including contingency allowance ($66.7 million plus $33.3 million = $100 million) likely would have a final cost between $70 million and $150 million.

comparison with the Deep Water Desalination facility option described in Building Block #7.)

2. The City distributing the Local Desal water to its customers, along with its other finished potable supplies as produced at the Graham Hill Water Treatment Plant (GHWTP), with the additional supply used to help meet water demands for Santa Cruz Water Department (SCWD).

3. Once SCWD needs are met, then any additional available supply could be made available to help meet demands in areas served by the Scotts Valley Water District (SVWD) and/or the Soquel Creek Water District (SqCWD). Such transfers help restore groundwater levels in the depleted regional aquifers (by enabling passive (in-lieu) recharge, reduce seawater intrusion into the Purisima formation, and provide stored waters that could be tapped in dry periods (including the possible return of some waters from neighboring Districts to the City).

There are numerous specific details and variations on how the Local Desal approach might be structured and implemented. These include, for example, whether technology advancements (such as forward osmosis) may become commercially viable at the municipal desalination scale and thus enable cost and/or energy use savings.

Another factor is whether any excess SCWD water might be made available to SVWD and/or SqCWD for in-lieu recharge. If this is included, issues arise regarding the scale and location of any new infrastructure (e.g., interties, pumps, wells) as may be necessary to implement the approach, and the forms of the institutional arrangements negotiated between the City and SVWD and SqCWD regarding sharing water, costs, and risks. The latter issue impacts when and how much water may be transferred to and from SVWD and SqCWD (and when), the associated improvements in yields and system reliability, how much the approach would cost, and what an equitable allocation of costs might look like.

In this paper, we aim to be as explicit as possible about the underlying assumptions and constraints that are included in our analysis and findings. Where feasible, we provide preliminary indications of the impact of some of the possible variations. If the City pursues this building block further, the information provided in this document will need to be vetted and developed in more detail to confirm assumptions and refine cost estimates..

3. Base Case Configuration and Assumptions

1. Local Desal facilities are developed at a production scale of 3 MGD supply, providing nearly 1,100 MG per year.

2. It is envisioned that the membrane process would operate continuously. Membrane processes work best when the flow is relatively steady; large diurnal variations are particularly undesirable. An equalization basin is included upstream of the treatment train to help moderate changes in flow rate. If you need to operate a facility with membrane systems such as RO at a reduced output, one approach, besides going through a shutdown and preservation process, is to rotate operation among modules. For example, you have four sets/banks of membranes and you operate each set one week in four. Thus, no set of modules sits idle for an extended period.

3. The timetable for Local Desal reflects the project planning work already accomplished.

4. The costs of the Local Desal approach are increased from the original estimates to account for both general price escalation as well as generally higher bid prices in the current economy compared to the original cost basis period. Costs are also increased to reflect the increased scale of the facility and its operation (3.0 MGD rather than 2.5 MGD).

5. The City of Santa Cruz develops the Local Desal project on its own, rather than negotiating a new agreement for a shared desal facility (such as was the case for the original $scwd^2$ plan).

6. Newell Creek Dam height and Loch Lomond operational rules remain as they currently exist.

7. If in-lieu recharge is considered part of this building block, then the costs, yields, and issues associated with the in-lieu component will depend on several factors, as described in the summary paper for Building Block #1.

8. Yield estimates for in-lieu reflect the assumption that SCWD realizes water savings from Program C Rec (i.e., that C Rec is anticipated to be part of the portfolio along with in-lieu recharge). For purposes of this building block, the assumed peak season demand reduction attained is 150 MG. If additional changes in peak season demands are agreed upon by WSAC, then associated modifications to the yields in this portfolio will be derived.

4. Necessary Capital Improvements and Related Costs[2]

Table 8.1 provides an overview of the major capital investments and other upfront costs associated with developing and operationalizing the Local Desal program.

Table 8.1 Local Desal capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost	Soft capital cost*	Total capital cost
$scwd^2$ Desalination Plant			
a. City SWRO plant capital cost (at 3-MGD scale)	N/A	N/A	138.00
b. Effluent outfall modifications	1.50	0.47	1.97
Totals	**1.50**	**0.47**	**139.97**

NOTES:
* Soft costs include engineering, construction management, permitting, City contract administration and legal.
a. Construction of 3-MGD seawater reverse osmosis (SWRO)-based treatment plant. *Source: 2012 $scwd^2$ report*; cost scaled to 3-mgd capacity and 2015 dollars. Estimate includes intake structure and pumping facility, SWRO plant, brine disposal, and solids handling.
b. Modify the existing wastewater treatment plant outfall to accommodate disposal of SWRO brine.

[2] Note that at this stage of the evaluation process, all cost estimates are highly preliminary, "Planning Level" estimates reflecting a range of –30% to + 50% (per AACE Guidelines), and subject to modification as additional information emerges.

If an in-lieu component is linked to the Local Desal approach, additional capital costs would be incurred, as outlined in Building Block summary paper #1 or Building Block summary paper #2, respectively.

5. Annual Operation and Maintenance (O&M) Costs and Energy Requirements

Table 8.2 provides additional cost and energy use information, including annual O&M costs, annualized capital costs, total annualized and present value costs, and energy requirements for the Local Desal approach.

Table 8.2 scwd^2 Seawater Desalination Used for Santa Cruz and Regional Demands

Estimates	**scwd^2 Seawater Desalination for Regional Use**
Annual O&M costs ($M/yr)	$3.9 M
Total Annualized Cost ($M/Yr)	$15.1 M
PV Costs (30 years) ($M)[1]	$343 M
Energy Use (MWH/MG)[2]	11.0

NOTES:
1. Discount rate = 2.5%; bond interest rate = 5.5%; interest on reserve = 3%; bond issuance cost = 3%.
2. Existing SCWD water production requires 1.6 MWH/MG.

If an in-lieu component is linked to the Local Desal approach, then additional O&M and other costs and energy requirements would be incurred, as outlined in Building Block summary paper #1.

6. Water Supply and Yield Implications

Table 8.3 provides the water supply production and yield estimates and for the Local Desal option, indicating that the availability of this climate-independent supply of 3 MGD (~1,100 MG annually), in combination with conservation Program C Rec addresses most anticipated future demands for SCWD (resulting in limited shortfalls). The production of local desalination waters also offers an opportunity to provide in-lieu recharge for up to half of SVWD and SqCWD winter demands.

Given that the total annualized cost of the Local Desal option of $15.0 Million, and an annual supply production of approximately 1,100 MG, the annualized unit cost of production amounts to approximately $13,740 per MG.

Table 8.3. Local ($SCWD^2$) Desalination: Estimated yields, peak season shortages, and in-lieu demands met for SVWD and SqCWD (MG)

	Santa Cruz yields		Remaining peak-season shortages (% shortfall)		Average annual combined SV and SqC demand served in-lieu of groundwater draw (% met)	Average annual separate SV and SqC demand served in-lieu of groundwater draw
	Worst-year yield	Average-year yield	Worst-year	Average-year		
Local Desalination	710	330	400 (21%)	10 (<1%)	770 (50%)	230 to SV 540 to SqC

Note that the yield estimates for the Local Desal option reflect an assumption that Program C Rec is also part of the Portfolio with Local Desal, such that some yield is also attributed to the water savings associated with conservation component.[3]

If an in-lieu component is linked to the Local Desal approach, then additional water supply production and yields may be realized, as outlined in Building Block summary paper #1.

7. Timeline for Implementation and Realizing Water Supply Benefits

The timeline for the Local Desal approach may be within 6 years if existing plans can be used. Timeline elements consist of the following:

- Permitting, other regulatory approvals, and construction of the seawater reverse osmosis (SWRO)-based facilities (intake, outfall, treatment process, and all related facilities) to develop the desalinated water.[4]
- Permitting, right of way acquisition, and construction of pipelines and pumping facilities to convey Local Desal water from the desalination plant to a suitable point in the City's existing distribution network.

8. Key Institutional Issues to Resolve

The City needs to resolve several critical institutional issues in order for a Local Desal program to proceed as envisioned here. Among these are the following:

[3] Please recall that "yields" refer to the ability of a portfolio to meet peak season gaps between supply and demand. Based on *Confluence* model runs reflecting climate change and DFG-5 fish flow requirements, the worst-year peak season shortage amounts to 1,110 MG, given the existing SCWD system portfolio. The average-year peak season shortage is 340 MG. Thus, the maximum yields of a portfolio are 1,110 MG and 340 MG for worst and average years, respectively. Program C Rec provides yields of 130 MG and 100 MG in the worst year and average years, respectively.

[4] If a new environmental document and/or other elements need to be redone for the slightly expanded Local Desal facility, the timeline could be extended. This is an issue requiring additional investigation.

- Regulatory approval and permits from the California Coastal Commission and other federal, state and local entities for development of the Local Desal facilities and all necessary pipelines, and for any mandated or desired environmental and carbon footprint mitigation or restoration/offsets.

- Public and political acceptability of Local Desal water as a part of the City's water supply portfolio, including a public vote on the question. A public outreach effort would likely be required to help inform the voting public.

- If an in-lieu component is linked to the Local Desal approach, then all the institutional issues associated with that approach (including the need for clear agreements between the City and SVWD and SqCWD on water-, risk- and cost-sharing) would need to be realized, as outlined in Building Block summary paper #1.

9. Other Key Questions, Issues, and Observations

- Given the ability of the local seawater desalination option (when coupled with Program C Rec) to meet most of SCWD's anticipated supply needs, there is limited need for return flows from a potential in-lieu recharge component. Excess Local Desal water might thus be provided to SqCWD for purchase (unless the project is developed as a shared facility with agreed-upon cost- and water-sharing agreements), and/or SVWD. Water sales or other water- and cost-sharing arrangements may be limited by whether the price set by the City was competitive with other supply options the Districts are considering.

- Developing a local seawater desalination plant enables the City to have more control over the design and operation of the facility compared to a buy-in of shares of the DW Desalination project. However, the local desalination facility is less fungible as a possible traded asset.

- The potential use of desalinated sea water provides a production supply that is largely independent of rainfall.