Water Supply Advisory Committee Portfolio Building Block Information

6. Purified Recycled Water: Converting IPR for Seawater Barrier (Building Block #5) to Direct Potable Reuse (DPR)

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 they build 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]

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. Converting Purified Recycled Water from IPR (Seawater Barrier) to Direct Potable Reuse -- Overview

In this document, the conversion of an indirect potable reuse (IPR)-based seawater intrusion barrier wells application (as described in the summary report on Building Block #5) to create a new direct potable reuse (DPR)-based water supply is envisioned generally as:

1. The City continuing to operate a "Complete Advanced Treatment" (CAT) facility it has built for IPR to produce purified recycled water of potable quality.

[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.

2. Building a pipe and pumping system to blend the CAT-produced water into the North Coast water main near the Bay Street Tank site, and blending further with San Lorenzo River (SLR) water at the SLR/Coast pump station.

3. Treating the blended source waters for potable supply at the Graham Hill Water Treatment Plant (GHWTP).

4. The additional supply provided would help meet water demands for Santa Cruz Water Department (SCWD).

5. 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 Soquel Creek Water District (SqCWD). This water transfer is intended to 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 this IPR-to-DPR conversion might be structured and implemented. These include, for example, whether any excess water might be made available to SVWD and SqCWD for in-lieu recharge. If these transfers are included, issues arise regarding the scale and location of any new infrastructure (e.g., interties, pumps, wells) that 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, 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. CAT-produced potable quality water would be at provided at a scale of 4.7 MGD, for a total annual supply of 1,715 MG per year. This is based on the volume of City-owned wastewater effluent entering the City's wastewater treatment plant of 5.5 MGD, with little seasonal variation (driven by indoor water use).[2]
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

[2] The 5.5 –MGD flow does not include any effluent flow from the City of Scotts Valley

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

4. Purified recycled water – previously used for IPR –is instead blended first with North Coast source waters near the Bay Street Tanks site, then with other source waters entering the Graham Hill Water Treatment Plant (GHWTP) for additional treatment before distribution to SCWD customers.

5. 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.

6. 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[3]

Table 6.1 provides an overview of the major capital investments and other upfront costs associated with developing and operationalizing the DPR program, assuming that the CAT facility is already constructed and operational (as part of a prior IPR program), and that the major infrastructure requirements entail the piping and pumping modifications and additions required to implement the transition from IPR to DPR. Additional infrastructure requirements may be imposed by the State for DPR (vs. an IPR approach) once potable reuse regulations are more developed.

Table 6.1 DPR capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost*	Soft capital cost**	Total capital cost
DPR			
a. Pumping system (CAT to Bay St. Tanks site)	2.31	0.72	3.02
b. Pipeline installation (CAT to Bay St. Tanks site)	4.76	1.48	6.23
Totals	**7.07**	**2.20**	**9.25**

[3] 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.

Table 6.1 DPR capital improvement needs and costs (millions of 2015$)

Capital improvement item	Hard capital cost*	Soft capital cost**	Total capital cost

NOTES:
*An additional 20% contingency mark-up added to account for needed on-site modifications. Decommissioning of the IPR pipeline and well field is not included.
** Soft costs include engineering, construction management, permitting, City contract administration and legal.
a. Install pumps to pump Complete Advanced Treatment (CAT)-purified water to the Bay Street Tanks site.
b. Build pipeline to convey CAT-purified water to the Bay Street Tanks site.

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

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

Table 6.2 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 transition from an IPR to a DPR approach. The O&M costs reflect the full annual costs of operating the DPR system. The total annualized costs include only the annualized value of capital cost to convert the existing recycled water program to DPR (plus the full O&M cost of continuing to operate the system for DPR; we assume that the seawater barrier approach would be decommissioned). The full cost of the Building Block would include the capital costs from Building Block #5. Additional operational requirements may be imposed by the State for DPR (vs. an IPR approach) once potable reuse regulations are more developed, which could add costs.

Note that water quality testing would be performed at the CAT plant and there is a cost component for water quality testing contained in the O&M. There are a few direct reuse plants operating in the United States, including several implemented by small utilities in Texas, that are researching and documenting performance. In addition, CAT-based IPR projects are running in Orange County, San Jose, West Basin and elsewhere that are benchmarking reliable performance. Verifying performance, and using existing information, will be a central part of the regulations and guidance that are being developed in the state and will come out in 2016.

Table 6.2. DPR Converted from Seawater IPR	
Estimates	**Conversion of CAT to DPR for City and Regional Use[1]**
Annual O&M costs ($M/yr)	$4.8 M
Total Annualized Cost ($M/Yr)	$5.6 M
PV Costs (30 years) ($M)[2]	$119M
Energy Use (MWH/MG)[3]	6.3

NOTES:

1. For consistency, this option only includes incremental costs associated with the added infrastructure to repurpose the CAT system to DPR, rather than IPR use for seawater intrusion barriers. O&M costs reflect incremental operational expense for DPR configuration.
2. Discount rate = 2.5%; bond interest rate = 5.5%; interest on reserve = 3%, bond issuance cost = 3%.
3. Existing SCWD water production requires 1.6 MWH/MG.

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

6. Water Supply and Yield Implications

Table 6.3 provides the water supply production and yield estimates for the DPR option. This indicates that the availability of the DPR supply of 1,715 MG annually (in combination with conservation Program C Rec) addresses all anticipated future demands for SCWD (no shortfalls), and also offers an opportunity to provide in-lieu recharge for SVWD and SqCWD as well (for more than half of their combined winter demands).

The total annual supply produced by the IPR conversion to DPR approach is 1,715 MG, and given the total annualized cost of $5.6 million (assuming the initial CAT investment cost for the IPR approach is considered a sunk cost), the average annualized cost per unit of production is approximately $3,270 per MG. If the full cost of the CAT facility is included, then the average annual production cost is approximately $8,690 per MG.

Table 6.3. DPR: 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**		
DPR (converted from IPR)	1,110	340	0 (0%)	0 (0%)	870 (57%)	250 to SV 620 to SqC

Note that the yield estimates for DPR reflect an assumption that Program C Rec is also part of the Portfolio with DPR, such that some yield is also attributed to the water savings associated with conservation component.[4]

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

7. Timeline for Implementation and Realizing Water Supply Benefits

If permitting is not onerous, the timeline for converting from IPR to DPR could be quite short (2 years), reflecting the fact that only a modest amount of new infrastructure needs to be developed (and the CAT facility is already in place and operational, with regulatory approvals for IPR). The timing for such a conversion would be well into the future so it is likely that IPR and DPR regulations will be much better established, making the permitting process less uncertain.

There may be some delays associated with obtaining additional regulatory clearance and public acceptance of the transition to a DPR approach.

8. Key Institutional Issues to Resolve

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

- Regulatory approval from the State Water Resources Control Board, Division of Drinking Water (DDW), for DPR.
- Public and political acceptability of purified recycled water as a blended part of the City's direct potable supply.
- Agreements with SVWD, and perhaps the County, regarding the volume of effluent delivered to SCWD's wastewater treatment plant (as opposed to being extracted by SVWD for recycling elsewhere). The 5.5 –MGD flow referred to above does not include any raw sewage or effluent flow from the City of Scotts Valley.
- If an in-lieu component is linked to the DPR 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.

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[4] 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.

- If DPR were pursued, the City should consider a public information campaign to educate the public on the safety and benefits of potable reuse similar to those being conducted in San Diego, San José, and elsewhere.

9. Other Key Questions, Issues, and Observations

- Given the ability of the DPR option (when coupled with Program C Rec to meet all of SCWD's anticipated supply needs, there is no apparent need for return flows from a potential in-lieu recharge component. Excess DPR water might thus be sold to SVWD and SqCWD (if the cost was competitive with other supply options the Districts are considering), without any obligation or agreement for return draws on their groundwater.

- Potentially stranded assets -- pipe, pump and barrier wells – if the seawater intrusion barrier well approach is abandoned (e.g., to convert the program to a DPR approach). The City and SqCWD might find value to abandoned pipelines as part of their respective water distribution systems, eliminating the need for other improvements or water main replacement.

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