Portfolio 3: Aquifer Storage and Recovery (ASR) Accelerated with Indirect Potable Reuse for Seawater Intrusion Barrier Wells, with Direct Potable Reuse as a Fallback

Portfolio 3 includes conservation Program CRec (CA-03), coupled with the tapping of excess winter flows from the San Lorenzo River (SLR) to supply efforts to implement ASR in the regional aquifers underlying the Scotts Valley Water District (SVWD) and Soquel Creek Water District (SqCWD). In addition, from the outset, the plan would be to include purified recycled water to support seawater intrusion barrier wells along the coast in the Soquel area, to protect the coastal freshwater aquifers from seawater intrusion while also enhancing groundwater recharge.

By providing potable water for ASR and Indirect Potable Reuse (IPR) in the regional aquifers, this portfolio seeks to accelerate regional aquifer recovery by actively recharging the groundwater basins and protecting groundwater quality. If successful, this active recharge would advance the City of Santa Cruz's ability to extract groundwater in future dry years -- including those that might occur within the first 8 to 10 years of implementation -- at levels needed to meet demands in Santa Cruz without increasing the risk of saltwater intrusion. If initial efforts to explore ASR indicate that the approach will not provide adequate aquifer recharge, storage, and recovery, then the City of Santa Cruz (City) moves ahead by applying its purified recycled water to more directly meet both City and regional (SVWD and SqCWD) demands.

1. Portfolio Description

In addition to implementing conservation program CRec to accomplish water demand savings in the Santa Cruz Water Department (SCWD) service area, this portfolio includes:

- Plan A, the exploration and hoped for successful large-scale implementation of ASR, relying on winter flows to serve as the water source for active aquifer recharge. In addition, purified recycled water would be used for seawater intrusion barrier wells in the coastal aquifers, allowing for the greater extraction of native groundwater if and as needed to meet Santa Cruz's needs.

- Plan B, to be implemented if Plan A appears to be ineffective or insufficient, entails full or partial abandonment of ASR, and instead using the purified recycled water to meet SCWD needs via Direct Portable Reuse (DPR). DPR will be used to meet City and regional demands through interties to SVWD and SqCWD. This provision of purified recycled water to neighboring communities will help meet their current demands and, thereby, also provide for in-lieu recharge of regional aquifers.

- The trigger for moving from Plan A to Plan B is: If after 15 years the City is not able to reliably withdraw at least 70% of the water it puts into the ground during a normal recharge year, for use as drought supply, then the plan switches to the use of DPR as Santa Cruz's main drought supply.

2. Summary of Costs and Yields

Tables 3-1 and 3-2 provide a summary of key water supply and cost estimates for Plan A and Plan B, respectively. Key observations from these tables include:

- If ASR can be implemented successfully and functions as required, and when coupled in Plan A with water savings from Program CRec, then the expected yields are sufficient to meet all SCWD service area demands. No shortages or curtailments are anticipated under climate change and DFG-5 fish flow requirements, as modeled. Regional aquifer restoration benefits are only incidental to this effort and are not a major criterion for success.

- During the interim period while ASR is being designed, piloted and permitted – and later while it is being fully developed as the City's drought storage reservoir is being filled – any periodic shortages that occur are addressed by additional pumping of native groundwater.

- If ASR cannot be implemented or does not perform as required, then under Plan B the Complete Advanced Treatment (CAT) system -- used to produce highly purified recycled water for the sea water barrier IPR project -- can be reconfigured into a DPR source that will be used to meet all SCWD demands. No water supply shortages or curtailments are anticipated for SCWD once the DPR system is operable.

    - In addition, the DPR system will provide in-lieu recharge of 870 mg on an average year, by meeting 57% of the combined demands in SVWD and SqCWD.

- The estimated capital cost for Plan A, as reflected in Table 3-1, amounts to $232 million. The estimated total annualized cost (annualized capital costs plus annual Operation and Maintenance (O&M) costs) amounts to $29 million per year.

- If Plan B is implemented, then the combined cost of the portfolio will include the full costs of Plan A, plus the capital costs of converting the CAT-purified recycled water piping configuration from seawater barrier well use to a DPR application. The additional expense would amount to approximately $7 million for pipeline configuration changes, and $4.3 million per year increase in O&M expenses for the added pumping.

3. Project Components: Infrastructure and other Physical Needs

Key infrastructure and other physical asset needs required to implement this portfolio include the following:

<u>Portfolio 3A: ASR using Winter Flows, Coupled with IPR for Barrier Wells, Coupled with Program C Rec</u>

- ASR Elements

  - Turbidity control facilities at Felton Diversion (Ranney Collectors).
  - Major upgrades to City distribution system for water transfer to SqCWD and SVWD.
  - Eight new injection/extraction wells, four in SqCWD and four in SVWD.
  - Tait Street improvements (for larger diversions).
  - Graham Hill WTP expansion and improvements (to develop more potable quality water for ASR).
  - Land acquisition for well sites and pipelines (not included in cost estimates).
- Seawater Barrier Elements
  - Treatment facilities to produce purified water.
  - New line maintenance facility to free space at WWTP for new treatment facilities.
  - Major pipeline from WWTP through Santa Cruz into Soquel Creek.
  - Twelve new shoreline injection wells.
  - Land acquisition for well sites and pipelines (not included in cost estimates).

<u>Portfolio 3B: DPR for Regional Demands and In-Lieu Recharge, Coupled with Program C Rec</u>

- Pump station and pipeline(s) to convey water to North Coast Pipeline at Bay Street Reservoirs.
- Assumes Tait St. and WTP improvements completed in Plan A.

NOTE: If Plan B is implemented, then the combined cost of the portfolio will include the full costs of Plan A (as reflected in Table 3-1), plus the costs of converting the CAT-purified recycled water configuration from seawater well barrier use to a DPR application.

4. Institutional Arrangements Required for Implementation

Key institutional arrangement and related agreements and permits required to implement this portfolio include the following:

- Permits and rights of way, and environmental and other reviews, for all pipeline, well, and other infrastructure improvements
- Planning document development and processes related to above.
- Interagency agreements for ASR development and agreed upon extraction levels and conditions.

- Interagency agreements for ASR, IPR, and/or DPR cost- and risk-sharing (and/or water purchasing, water-sharing)
- Change in water rights to enable change in place of use

5. Implementation Schedule/Timetable

Portfolio 3A: ASR using Winter Flows, Coupled with IPR for Barrier Wells, Coupled with Program C Rec

- ASR Elements
    - Planning, Permitting, and Interagency Agreements - 2 years
    - Higher-Level Feasibility Analyses – 0.5 - 2 years (concurrent with permitting)
    - Pilot ASR Testing – 2 - 4 years (some overlap with implementation of wells)
    - Procurement of ASR Facilities Properties / ROW & Design - 1 - 2 years (could stretch out if wells are developed sequentially)
    - Bidding, Construction, and Startup – 2 - 3 years
    - Total Duration of Estimated Implementation Schedule – 7 - 11 years
- Seawater Barrier Elements
    - Planning, Permitting, and Interagency Agreements - 4 years
    - Preliminary and Detailed Design - 2 years
    - Bidding, Construction, and Startup - 2 years
    - Total Duration of Estimated Implementation Schedule - 8 years (which could be pursued concurrently with the ASR efforts)

Portfolio 3B: DPR for Regional Demands and In-Lieu Recharge, Coupled with Program C Rec

- Planning, Permitting, and Interagency Agreements - 5 years
- Preliminary and Detailed Design - 2 years
- Bidding, Construction, and Startup - 2 years
- Total Duration of Estimated Implementation Schedule - 9 years

- Note that the duration to implement Plan B may be shortened considerably in a period of extended drought, as regulatory reviews and permitting are expedited. Also some steps may be pursued concurrently rather than sequentially.
- Also, advance action (i.e., while Plan A is being explored) to address the initial planning and preliminary design steps can potentially reduce the timeline for implementation (bidding, construction, and startup) to 2 years.

6. Key Risks, Uncertainties, and Key Questions to be Addressed

- <u>Will ASR work as required?</u>
    - Will winter flows and available treatment provide enough water for recharge at target levels? What if there is a prolonged drought during the initial recharge years?
    - Can recharge occur at anticipated rates at well sites (even if water is available)?
    - Will recharged water create adverse water quality conditions in the aquifer?
    - How much recharged water will be unrecoverable due to hydraulic loss? Will this loss percentage increase appreciably as recharge levels increase?
    - Will enough water be stored by the time extractions are needed to meet dry year demands?
    - Can extracted water be treated and blended with other supplies to meet dry year needs, and maintain suitable potable water quality? Will Ranney collectors worked as required?
    - Can water rights be modified to enable change in place of use?
    - How will SqCWD and SC County control private well withdrawals from recharged aquifers?
    - Can property rights be acquired across the river from Felton to construct Ranney collectors? Can Ranney collectors be placed in that setting and will they function as required?
    - Are there environmental considerations that may preclude, delay, and/or require expensive mitigation associated with any of the added infrastructure?
    - During the interim period, while ASR is being planned/piloted and developed, can increased extraction of native groundwaters be done at levels sufficient meet otherwise unmet demands for SCWD? What adverse impacts may be associated with such pumping?

- Can suitable institutional arrangements be developed between the City and SVWD, and SqCWD (and others)?
  - For cost and risk sharing (and/or water purchase agreements and water sharing)
  - For land purchases, leases, and rights of way, as needed for pipelines and other required infrastructure.
  - For environmental reviews, approvals, and any necessary mitigation associated with added pipelines and other infrastructure requirements.
  - For extraction from regional aquifers and delivery to SCWD, in suitable quantities, in times of need?
  - How will SqCWD and SC County control private well withdrawals from recharged aquifers?

- Will DPR obtain public support and regulatory approval, in SCWD, and in SVWD and SqCWD?
  - Might there be delays associated with public support or regulatory approvals?
  - Will additional treatment or other investments need to be made in order to obtain regulatory approvals (and/or public acceptance)?
  - Will the treatment processes and delivery systems work as planned?
  - Will the public buy-in for combining purified water with the City's traditional raw water sources?

- Can IPR-based seawater intrusion barrier system be developed and operate as planned?
  - Will seawater intrusion (and ASR) wells operate as required?
  - Will there be public buy in (or opposition) for the cross town pipeline and acquisition of injection well sites.
  - Will SqCWD and the Soquel community accept placement of barrier wells in near-coastal parts of their community?
  - How much of the injected IPR water will contribute to active aquifer recharge (versus hydraulic loss), and who might ultimately extract that water?

- Will Soquel Creek public buy-in to combining purified recycled water with their traditional raw water sources (IPR, where purified recycled water injected into the seawater barrier wells may contribute recharge for the local aquifer and may later be included in some extracted yields)?

7. Potential Stranded Assets and other Adverse Consequences

- If ASR fails to operate as required, then there likely will be stranded assets in the form of some recharge/extraction wells and associated pipelines, pumps, etc. (i.e., abandoned ASR facilities).

- If IPR IS converted to DPR, then the seawater intrusion barrier wells and cross town pipeline are likely to be abandoned (though the pipeline might possibly be repurposed to replace aging infrastructure).

8. Potential Ancillary Benefits to the City and Region

- Aquifer recharge, whether attained actively through ASR or passively through DPR-enabled in-lieu recharge, may provide ancillary benefits by helping to impede seawater intrusion, and/or by providing additional baseflow to local streams.

- Regional collaboration to jointly address water supply challenges – if successful -- may provide a range of long-term benefits and efficiencies.

- Addition of a CAT facility provides valuable redundancy/back-up to GHWTP, and may improve overall system potable water quality (e.g., disinfection byproduct control).

	Table 3-1: Portfolio 3/Plan A: ASR using Winter Flows, Coupled with IPR for Barrier Wells, plus Program C Rec shaded cells to be updated when IRP details added				
	Estimates	**Component 1: Program C Rec**	**Component 2: ASR using SLR winter flows**	**Component 3: Seawater Intrusion/IRP**	**Totals [weighted average]**
A	Capital (upfront) costs ($M)	n/a	$95 M	$137 M	$232 M+
B	Annual O&M costs ($M/yr)	n/a	$ 3.7 M	$5.5 M	$9.2 M+
C	Total Annualized Cost ($M/Yr)	$1.1 M[1]	$11.3 M	$16.5 M	$28.9 M
D	PV Costs (30 years) ($M)	$23 M	$256 M	$373 M	$652 M
E	Production Supply (mgy)	173 mg[2]	560 mgy	n/a[3]	733 mg
F	Average Year peak season Yield (mg)	100 mg	240 mg	n/a	340 mg
G	Worst year peak season Yield (mg)	130 mg	980 mg	n/a	1,110 mg
H	Energy Use (MW/MG)	(1.6)	2.1	15.0	[12.7]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$20,179	n/a	[$39,468]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$21,815	n/a	[$42,909]
K	Average SV & SqCWD demand served (mg and %)	n/a	n/a	n/a	n/a

[1] 25-year average annual cost to utility and customers, omitting administrative costs borne by the Water Department

[2] Average annual water savings over 25 years; maximum savings of 220 mg attained in 2030

[3] Protects coastal aquifer from sweater intrusion, enhances recharge, and may contribute to groundwater extraction volumes

Table 3-2: Portfolio 3/Plan B: DPR for Regional demands and In-Lieu Recharge + Program C Rec				
	Estimates	**Component 1: Program C Rec**	**Component 2: Conversion of CAT to DPR for City and Regional Use**[4]	**Totals [weighted average]**
A	Capital (upfront) costs ($M)	n/a	$7 M	$7 M+
B	Annual O&M costs ($M/yr)	n/a	$4.3 M	$4.3 M+
C	Total Annualized Cost ($M/Yr)	$1.1 M[1]	$4.9 M	$6.0 M
D	PV Costs (30 years) ($M)	$23 M	$108 M	$131 M
E	Production Supply (mgy)	173 mg[2]	1,715 mgy	1,888 mg
F	Average Year peak season Yield (mg)	100 mg	240 mg	340 mg
G	Worst year peak season Yield (mg)	130 mg	980 mg	1,110 mg
H	Energy Use (MW/MG)	(1.6)	6.4	[5.7]
I	Annualized Unit Cost (C/E; $/mg)	$6,532	$2,857	[$3,194]
J	PV Unit Cost (D/PV[E*years]; $/mg)	$8,301	$2,699	[$3,212]
K	Average SV & SqCWD demand served (mg and %)	n/a	870 mg (57%)	870 mg (57%)

[4] For consistency, this option only includes 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 full operational expense for DPR configuration.