Portfolio Comparisons

This document provides a simplified analysis of two sets of Portfolios. The first analysis compares a simplified version of CA-10 Recycled Water with Aquifer Storage to CA-13 Reuse for irrigation (NPR) with groundwater exchange. The second analysis compares Simplified CA-10 Reuse with storage (IPR) with simplified CA-16 Winter flow capture and storage.

There is a great deal of uncertainty regarding all the values due to the extensive use of assumptions! The simplifying assumptions allow use to answer some very important basic questions, like:

- Is there enough winter flow water to make it worth capturing?
- And will recycled water provide enough additional supply to evaluate further?

However, other important questions remain that can only be addressed by removing the simplifying assumptions. As part of your portfolio construction in this month's meeting, we are hoping you can identify alternatives you want to explore further by removing the simplifying assumptions.

Portfolio Analysis #1: Simplified CA-10 Recycled Water with Aquifer Storage to CA-13 Reuse for irrigation (NPR) with groundwater exchange.

The Technical Team has used the criteria developed by WSAC, using the scales developed by WSAC, as a means to compare the two alternatives. Ratings are based on the Technical Team's best professional judgment.

		Alternative CA-10 recycled water with aquifer storage (IPR)	**CA-13 reuse for irrigation (NPR), with groundwater exchange**	**Comments**
1. Technical Feasibility	How feasible is this approach technically?	Widely used	Widely used	NPR more widely practiced to date than IPR
2. Legal Feasibility	Within the required timeframe for this approach, are necessary rights currently held in the form needed or feasible to acquire or modify as needed?	Can probably acquire	Can probably acquire	However – this is still an unknown!

		Alternative CA-10 recycled water with aquifer storage (IPR)	CA-13 reuse for irrigation (NPR), with groundwater exchange	Comments
3. Regulatory Feasibility	How easy or difficult would the regulatory approval process for this approach be?	Slow but with some questions due to number or complexity of regulatory issues needing to be resolved; can probably acquire; achievable within 12 to 36 months	Easy and quick; regulatory issues are limited, routine, and/or non-controversial	However – this is still an unknown!
4. Implementability	How easy or difficult would this portfolio be to implement? What degree of risk or uncertainty is would be involved in implementing the portfolio?	Moderate uncertainties and risks related to implementation – How much water could be retrieved?	Significant uncertainties and risks related to implementation –are the farmers interested?	
5. Political Feasibility	What level of political support is this approach likely to have?	Uncertain acceptability, could vary with time (possibly less acceptable than NPR to some residents)	Uncertain acceptability, could vary with time	Will the community accept any kind of water reuse project?
6. Groundwater Resources	How would this approach affect groundwater resources?	Actively restores	Does not affect	
7. Marine Ecosystem Health	How would this approach affect the health of marine ecosystems?	Does not harm	Does not harm	Potentially positive impact, by reducing effluent discharge
8. Freshwater and Riparian Ecosystem Health	How would this approach affect the health of freshwater and riparian ecosystems?	Positive effect – may allow additional flows due to the addition of a new source	Does not harm	NPR has some positive impact, but IPR has larger impact

		Alternative CA-10 recycled water with aquifer storage (IPR)	CA-13 reuse for irrigation (NPR), with groundwater exchange	Comments
9. Terrestrial Ecosystem Health	How would this approach affect the health of terrestrial ecosystems?	Does not harm	Does not harm	
10. Environmental Profile	How acceptable is the environmental profile of this portfolio?	The environmental profile of this portfolio is acceptable without mitigation	The environmental profile of this portfolio is acceptable without mitigation	Possible concerns by some over potential impacts on farm land
11. Operational Flexibility	To what extent does this approach increase operating flexibility?	Increases operating flexibility	Increases operating flexibility	Because the yields are greater with storage, CA-10 provides greater operational flexibility
12. Addresses Peak Season Demand	To what extent does this approach help address peak season demand?	All of the water produced is or can be available during the peak season (e.g., aquifer storage and recovery, off-stream storage. or peak season demand management)	The majority of the water produced is or can be available during the peak season (e.g., aquifer storage and recovery, off-stream storage, or peak season demand management)	Because the yields are greater with storage, CA-10 provides greater benefits to addressing peak season demand
13. Yield (informational only – not rated)	How much water will this approach save or produce (in MG per year)?	1,150 MG dry year 420 MG average year	850 MG dry year 410 MG average year	Climate-independent source, helps fill larger dry year gaps

		Alternative CA-10 recycled water with aquifer storage (IPR)	**CA-13 reuse for irrigation (NPR), with groundwater exchange**	**Comments**
14. Energy	How much energy will this approach/portfolio require per million gallons of water How much greenhouse gas will the approach/portfolio produce per million gallons of water?	10 MWh/mg	5 MWh/mg	Are these considering all the same elements, including all pumping??
15. Adaptive Flexibility	How adaptable or flexible is this approach/portfolio to changing conditions?	Provides adaptive flexibility	Provides adaptive flexibility	Provides a climate-independent water supply source CA-10 provides greater flexibility as it allows for greater yields
16. Regional Benefits	Would or could this portfolio provide benefits to other regional water systems?	Will provide significant regional benefits	Will provide significant regional benefits	These two CAs provide different kinds of benefits to the region
17. Local Economy	How would this portfolio affect local jobs?	Unknown	Unknown	Probably similar levels of local jobs

		Alternative CA-10 recycled water with aquifer storage (IPR)	CA-13 reuse for irrigation (NPR), with groundwater exchange	Comments
18. Infrastructure Resilience	How would this portfolio affect the system's vulnerability to natural threats?	Significantly decreases the system's vulnerability to one or more natural threats	Somewhat reduces the system's vulnerability to one or more natural threats	Provides a climate-independent water supply source; IPR also helps restore aquifers and may reduce saltwater intrusion
19. Supply Reliability	How would this portfolio affect the system's ability to consistently meet an agreed-upon level of service?	Increases the reliability of supply	Increases the reliability of supply	Provides a climate-independent water supply source (more so with IPR)
20. Supply Diversity	How does this portfolio affect the diversity of supplies?	Portfolio significantly increases the diversity of Santa Cruz's supply portfolio	Portfolio significantly increases the diversity of Santa Cruz's supply portfolio	Provides a climate-independent water supply source (CA 10 also provides storage)
21. Sustainability	How sustainable are the actions in this portfolio?	This portfolio is very sustainable	This portfolio is very sustainable	Recycling is often considered a key aspect of sustainability; but energy use may be a concern
22. Cost Metrics	What are the upfront and net present value life-cycle costs of alternatives and portfolios?	$358 M PV cost ($191 M initial capital costs)	$106 M PV cost ($60 M initial capital costs	Cost estimates highly preliminary

Portfolio Analysis # 2: CA-16 Winter Flow to CA-10 Recycled Water (with storage available for either alternative)

Information is provided in the table below on the criteria as currently developed by WSAC, using the scales developed by WSAC, and rated based on the Technical Team's best professional judgment. A simple Triple Bottom Line (TBL) analysis is also provided.

		Simplified CA-10 reuse with storage (IPR)	**Simplified CA-16 winter flow capture and storage**	**Comments**
23. Technical Feasibility	How feasible is this approach technically?	Widely used	Widely used	IPR is less widely used than stream flow capture
24. Legal Feasibility	Within the required timeframe for this approach, are necessary rights currently held in the form needed or feasible to acquire or modify as needed?	Can probably acquire	Yes, but with some ambiguities; achievable within 6 to 12 months	CA-16 may be more likely to be feasible (does not require separate extraction wells)
25. Regulatory Feasibility	How easy or difficult would the regulatory approval process for this approach be?	Slow but with some questions due to number or complexity of regulatory issues needing to be resolved; can probably acquire; achievable within 12 to 36 months	Easy and quick; regulatory issues are limited, routine, and/or non-controversial	CA-16 is probably more likely to be feasible, as IPR faces more regulatory issues
26. Implementability	How easy or difficult would this portfolio be to implement? What degree of risk or uncertainty would be involved in implementing the portfolio?	Moderate uncertainties and risks related to implementation	Minor uncertainties and risks related to implementation	Recycled water option requires separate injection and extraction wells
27. Political Feasibility	What level of political support is this approach likely to have?	Uncertain acceptability, could vary with time	Acceptable now	Assuming storage does not create issues
28. Groundwater Resources	How would this approach affect groundwater resources?	Actively restores	Actively restores	

		Simplified CA-10 reuse with storage (IPR)	Simplified CA-16 winter flow capture and storage	Comments
29. Marine Ecosystem Health	How would this approach affect the health of marine ecosystems?	Positive effect (reduces effluent discharge)	Does not harm	
30. Freshwater and Riparian Ecosystem Health	How would this approach affect the health of freshwater and riparian ecosystems?	Positive effect – allows additional flows due to the addition of a new source	Does not harm (assuming winter flows captured have no ecologic value)	
31. Terrestrial Ecosystem Health	How would this approach affect the health of terrestrial ecosystems?	Does not harm	Does not harm	
32. Environmental Profile	How acceptable is the environmental profile of this portfolio?	The environmental profile of this portfolio is acceptable without mitigation	The environmental profile of this portfolio is acceptable without mitigation	Note that CA-16 requires much larger storage, which could result in larger environmental impact
33. Operational Flexibility	To what extent does this approach increase operating flexibility?	Increases operating flexibility	Increases operating flexibility	Because the yields are greater with storage, both CAs provide greater operational flexibility
34. Addresses Peak Season Demand	To what extent does this approach help address peak season demand?	All of the water produced is or can be available during the peak season (e.g., aquifer storage and recovery, off-stream storage, or peak season demand management)	All of the water produced is or can be available during the peak season (e.g., aquifer storage and recovery, off-stream storage, or peak season demand management)	The wost year peak season yields are the same under either CA, and for both fully cover projected gaps.
35. Yield (informational only – not rated)	How much water will this approach save or produce?	420 MG average year 1,150 MG worst year	420 MG average year 1,150 MG worst year	Based on climate change estimates.

		Simplified CA-10 reuse with storage (IPR)	Simplified CA-16 winter flow capture and storage	Comments
36. Energy	How much energy will this approach/portfolio require per million gallons of water? How much greenhouse gas will the approach/portfolio produce per million gallons of water?	10 MWh/mg	5 MWh/mg	
37. Adaptive Flexibility	How adaptable or flexible is this approach/portfolio to changing conditions?	Provides adaptive flexibility	Provides adaptive flexibility	CA-10 provides greater flexibility as it allows for greater supply, from a climate-independent source
38. Regional Benefits	Would or could this portfolio provide benefits to other regional water systems?	Will provide significant regional benefits (depending on storage location and type)	Will provide significant regional benefits (depending on storage location and type)	Depends on storage location and configuration; Will it recharge a regional aquifer?
39. Local Economy	How would this portfolio affect local jobs?	Unknown	Unknown	Probably similar to local employment opportunities
40. Infrastructure Resilience	How would this portfolio affect the system's vulnerability to natural threats?	Somewhat decreases the system's vulnerability to one or more natural threats	Does not impact the system's vulnerability to one or more natural threats	CA-10 provides a diversified, supply, reducing vulnerability to reliance on SLR system
41. Supply Reliability	How would this portfolio affect the system's ability to consistently meet an agreed-upon level of service?	Increases the reliability of supply	Increases the reliability of supply	Both provide similar worst-year peak season yields

		Simplified CA-10 reuse with storage (IPR)	Simplified CA-16 winter flow capture and storage	Comments
42. Supply Diversity	How does this portfolio affect the diversity of supplies?	Portfolio significantly increases the diversity of Santa Cruz's supply portfolio	Portfolio somewhat increases the diversity of Santa Cruz's supply portfolio	CA-10 provides a climate-independent water supply source; CA-16 relies on existing streamflows and precipitation– and thus provides less diversification
43. Sustainability	How sustainable are the actions in this portfolio?	This portfolio is very sustainable	This portfolio is very sustainable	Recycling is often considered the definition of sustainability.
44. Cost Metrics	What are the upfront and net present value lifecycle costs of alternatives and portfolios?	PV cost may be is $358M (with initial capital costs of about $190 M)	PV cost approx. $80M (with initial capital costs of about $38M)	CA-10 more expensive, but reduced storage needs and other factors may offset this.

Simplified Triple Bottom. Line (TBL)

If WSAC compares reuse with storage to winter flow capture and storage, the TBL looks like the following.

Financial

- Lifecycle PV costs of reuse option higher than for winter flows: $278 ($348 M vs. $80M) (-)

- Reuse option may avoid or postpone wastewater treatment plant expansion or upgrade costs (+)

- Reuse costs may be supported by state or federal grants (+)

- Reuse option reduces size of necessary additional storage by 1.7 BG (1.3 BG vs. 3 BG), which may reduce overall costs considerably (+)

Social (uncertain – both pros and cons exist)

- Reuse enhances water supply reliability, adding a climate independent source to the portfolio (+)

- Diversifies and thus reduces water delivery risks (as may arise due to wildfire, seismic risk, or uncertainty associated with habitat conservation plans) (+)

- Public health concerns for recycled water need to be carefully and fully addressed (-)

- Reduces scale of needed additional storage (by 57%), which may reduce community disruption and enhance implementability (+)

Environmental (uncertain, as both pros and cons exist)

- Reuse option has greater energy use and carbon footprint compared to winter flow capture (-)
- Reuse option makes productive recycled use of an untapped local “waste” resource (+)
- Reuse reduces effluent discharge to coastal waters (+)
- Reuse option may enable higher instream flows (+)
- Reuse provides more water to restore groundwater levels and/or manage seawater intrusion (+)
- Potential impact on groundwater quality (?)
- Reuse reduces scale of additional storage needs by 57%, which likely reduces environmental impacts (+)

Example TBL Comparison of Reuse and Winter Flow for Storage