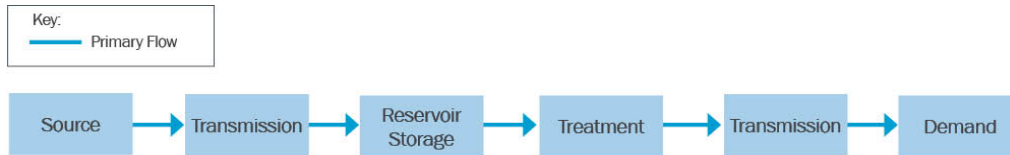


**City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary**

Consolidated Alternative 18 - Off-Stream Water Storage

This alternative uses only the Liddell quarry which would hold about 650 million gallons (MG) since its construction would not require building a dam. BC dropped the San Vicente site since the San Mateo Peninsula Open Space Trust and the Sempervirens Fund have acquired the site and initiated creation of a conservation easement over the site to prevent future development. If the City withdrew stored water over a 3-year drought cycle, production would be about 200 MG annually after allowing for evaporation and leakage losses.

This alternative has several outstanding issues, e.g., water rights (new diversion location from which to fill the reservoir, routing of fill pipeline), geotechnical and construction issues associated with installing a liner on steep slopes over a porous karst formation, preparation and approval of environmental documents, California Department of Fish and Wildlife (CDFW) and National Marine Fisheries Service (NMFS) approvals for water diversions from streams with salmonid populations, and agreements with the landowner about ownership and operations. The block diagram below presents this alternative schematically.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-18 OFF-STREAM WATER STORAGE

Description: "Storage (on-stream, off-stream, underground, and groundwater development)"

Applicable WCAs: WCA-06 ("McKinney: Expanded Treatment Capacity"), WCA - 27 ("Malone: Enhanced Storage and Recharge").

Reliability Over Time (seasonal and inter-annual variability)

Estimated Annual Yield (million gallons [MG]) [Quarry reservoir would be dry after three drought years.]	200
Costs	Best Estimate
Capital Cost	\$25M
Annual	\$20M to \$50M
Present Value	
Capital cost/MG annual capacity	\$125,000
PV Cost/MG	\$125,000 to \$250,000
Energy (KWh/MG)	15,000
	1,400 - 2,000

Key Components		Comments
1. Stabilize quarry rim to prevent landslides and protect proposed new facilities. Cleaned and recontoured quarry walls	4. Pumping stations to draw water from other City North Coast water sources.	
2. Impervious poly liner with supporting cushion layer, installed over chain link base to separate liner from remaining wall roughness.	5. Installation of Ranney collectors or new SLR WTP, so that City would use SLR water rights, allowing North Coast rights to fill new reservoir.	
3. Directionally drilled inlet/outlet pipeline, connected to Liddell Springs pipeline.	6	

Implementation Requirements Summary

Carry out preliminary planning; prepare, circulate and certify environmental documents; complete design documents; file for and obtain permits; negotiate and execute contracts with property owners; bid and construct improvements; determine if new conservation easement over San Vicente quarry site would preclude development of any sort of reservoir.

Required Land Area (acres)	50+
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Permitting Summary

Likely permits include stream bed alteration permit(s) from CA DF&W, CA Division of Safety of Dams, County building permits (s), Coastal permits, USACE (?), and NMFS (?)

EVALUATION

Technical Feasibility

More than 10 years

Legal Feasibility

Can probably acquire.
Water rights for diversion from existing stream flows; releases to maintain downstream flows; landownership and deed/land-use restrictions.

Regulatory Feasibility

**City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary
Consolidated Alternative 18 - Off-Stream Water Storage**

Very slow

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 18 - Off-Stream Water Storage

Political Feasibility

Acceptable in 10 years

Regional Water Benefits

Across County

Local Economy

Positive local job

Energy

4

Marine Ecosystem Health

Does not harm.

Remediation of limestone quarries, salmonoid population impacts and required bypass flows and other aquatic/land species, karst topography; potential energy use for pumping water into or out of storage reservoirs. Unknown impacts on other species around the reservoirs.

Freshwater and Riparian Health

Degraded ecosystem health

Terrestrial Resources

N/A

Environmental Profile

The environmental profile of this portfolio is not acceptable and/or cannot be made acceptable even with effective mitigation)

Groundwater Resources

Does not affect; may help if significantly reduces groundwater withdrawal

Infrastructure Resilience

Most challenges well

Supply Reliability

Somewhat more reliable

Scalability

Not scalable; may be difficult to scale

Preserves Future Choices

Reduces choice

Yield

200

Operational Flexibility

Moderately increases

Addresses Peak Season Demand

Yes

Implementability

Could be implemented with some challenges

Supply Diversity

Portfolio somewhat increases the diversity of Santa Cruz's supply portfolio

Sustainability

This portfolio is somewhat sustainable

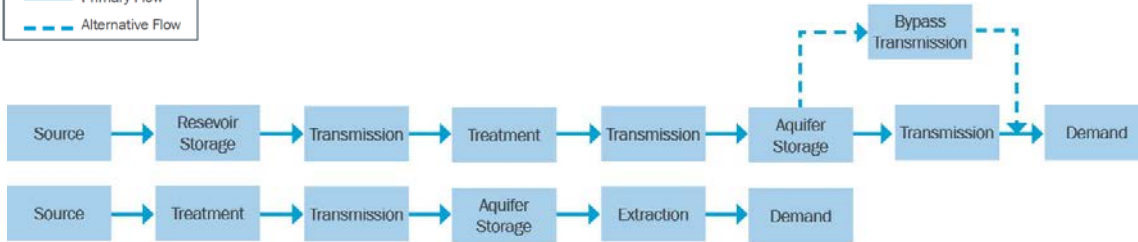
Issues to Resolve

Landownership and project compatibility with proposed easements; karst topography and geology; slopes, potential annual loss through leakage; legality of water appropriation and transfer; impact of variations in annual rainfall versus actual water production. Possibly use excess water produced by the Ranney collectors, after treatment, for groundwater recharge.

**City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary**

Consolidated Alternative 09 - Winter Flow Capture

This alternative for initial comparison would capture winter flows for treatment and storage for use during dry periods/droughts, as local rainfall and runoff patterns are large enough to possibly be stored during dry periods. Several WCAs advocate this alternative as the City of Santa Cruz can use its existing water rights to divert more flow during high runoff periods and store the runoff either in open reservoirs or as infiltrated groundwater to store until dry periods. The block diagram below presents this alternative schematically. This alternative has several outstanding issues, e.g., environmental document completion, permitting through the California Coastal Commission, and public vote approving alternative implementation.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-09 WINTER FLOWS CAPTURE

Description: Winter flows capture for potable water demands during dry periods.

Applicable WCAs: WCA - 29 ("Malone: Stormwater Capture"), WCA - 60 ("SCDA: Watershed Restoration"), WCA - 63 ("Smallman: Water Skate Parks"), WCA - 71 ("Quarry Storage/GW Recharge at Hanson Quarry"), WCA - 74 ("McGilvray - Additional Pipeline - Felton Diversion To Loch Lomond"), WCA - 76 ("Olympia Quarry").

Estimated Annual Yield (million gallons [MG])	560
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Reliability Over Time (seasonal and inter-annual variability)			
Costs	Best Estimate	Likely Range	Comments
Capital Cost			
Annual			
Present Value			
Capital cost/MG annual capacity			
PV Cost/MG			
Energy (KWh/MG)	15,000	1,400 - 2,000	

Key Components	
1	4
2	5
3	6

Implementation Requirements Summary
--

Required Land Area (acres)	
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Permitting Summary

EVALUATION

Technical Feasibility
Promising in 6-10 years

Legal Feasibility
Difficult to acquire.
Depends on the availability of the quarries/storage.

Regulatory Feasibility
Up to ten years for new regulation

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 09 - Winter Flow Capture

Political Feasibility

Enthusiasm now, acceptable now

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 09 - Winter Flow Capture

Regional Water Benefits

Across County (possibly)

Local Economy

Positive local job

Energy

4

Marine Ecosystem Health

Positive effect.

It is uncertain of the effect of capturing large amounts of winter flow and if that will negatively affect the surrounding marine environment

Freshwater and Riparian Health

Positive effect.

It is uncertain of the effect of capturing large amounts of winter flow and if that will negatively affect the surrounding freshwater/riparian environment

Terrestrial Resources

N/A

Environmental Profile

(How acceptable is the environmental profile of this portfolio: A potential scale for the portfolio Environmental Profile criterion would be:

- The environmental profile of this portfolio is acceptable without mitigation

Groundwater Resources

Actively restores

Infrastructure Resilience

Many moderately well

Supply Reliability

Somewhat more reliable (worst case scenario)

Scalability

Can scale up (uncertain)

Preserves Future Choices

Increases choice

Yield

560 MG

Operational Flexibility

Greatly increases

Addresses Peak Season Demand

Yes

Implementability

Could be implemented with some challenges

Supply Diversity

Portfolio greatly increases the diversity of Santa Cruz's supply portfolio

Sustainability

This portfolio is very sustainable

Issues to Resolve

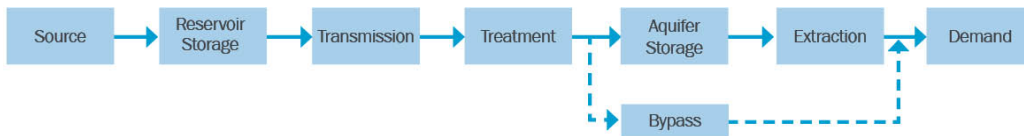
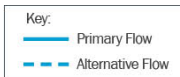
Possible closures of quarries, and possible direct health and safety concerns with the skate park.

**City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary**

Consolidated Alternative 16 - Aquifer Restoration/Storage

This alternative would use treated water sold by the City to Soquel Creek County Water District (SqCWD) during normal and wet years. SqCWD would use the transferred water either for groundwater recharge through seven 250-gallon-per-minute (gpm) recharge wells, for conjunctive use (well field resting) recharge, or both. The City would take more water from its San Lorenzo River and/or Newell Creek diversions, about 2.5 million gallons per day (MGD) or about 915 MG annually, to match the desalination alternative. If recharge occurred continuously for five years, total transferred water would be about 4,600 MG. Facilities would include Ranney collectors at the Felton Diversion, to insure that the Graham Hill Water Treatment Plant (GHWTP) could treat the diverted water continuously. During drought years the City would receive returned water (groundwater) from SqCWD. The City also would pump its Tait Street wells year round since the recharged Purisima aquifer would yield available water without causing seawater intrusion. Potential yield would be 2 MGD from the Live Oak wells and 2.5 MGD from SqCWD; 4.5 MGD total. If the City used these sources for six months, total production, after deducting out a 1-mgd production allowance for the existing wells, would be about 640 MG annually.

This alternative has several outstanding issues, e.g., water rights (modification of place of use), assembling appropriate information to site injection wells, modeling the Purisima aquifer to project better potential performance, and agreement with SqCWD on how the alternative's water would be conveyed, shared and paid for. The block diagram below presents this alternative schematically.



SCHEMATIC OVERVIEW - KEY COMPONENTS FOR CA-16 AQUIFIER RESTORATION/STORAGE

Description: Lochquifer proposal includes many sub alternatives. For comparison purposes at the Recon level, the alternative is very similar to SCDA "Aquifer Restoration" but would operate at a much larger scale. Therefore it would recharge the groundwater table much more rapidly and also would make more water available to return to the City.

Applicable WCAs: WCA-08 ("Paul: (13) The Lochquifer Alternatives"), WCA - 28 ("Malone: Regional Water Exchanges"), WCA - 49 ("Paul: (14) Upgrade Water Intertie"), WCA - 59 ("SCDA: Enhance Existing Infrastructure"), WCA -10 ("SCDA: Regional Aquifer Restoration").

Estimated Annual Yield (million gallons [MG]) [Yield likely would be available only for a short drought of 3 or 4 years.] 640

Reliability Over Time (seasonal and inter-annual variability)

Costs	Best Estimate	Likely Range	Comments Requires that the City implement either Alternative 6 or Alternative 7, in order to deliver required water reliably.
Capital Cost	\$30M	\$20M to \$45M	
Annual			
Present Value			
Capital cost/MG annual capacity	\$50,000	\$33,000 to \$75,000	
PV Cost/MG			
Energy (KWh/MG)	15,000	1,400 - 2,000	

Key Components

1. Turbidity control facilities at Felton Diversion	4
2. Major upgrades to City distribution system for water transfer to SqCWD	5
3. Seven injection wells	6

Implementation Requirements Summary

Plan, design and permit turbidity reduction facilities at Felton. Prepare, circulation, and approve CEQA documents. Develop and enter into an agreements with SqCWD for water exchanges.

Required Land Area (acres) 6

Permitting Summary

CEQA/NEPA compliance. Water rights issues for change of place of use and perfecting City water rights. CDFW and NMFS approvals for increased SLR diversions.

EVALUATION

Technical Feasibility

Demonstrated in field

**City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary**

Consolidated Alternative 16 - Aquifer Restoration/Storage

Legal Feasibility

Yes, but some ambiguities.

Water rights issues for change of place of use and perfecting City water rights

City of Santa Cruz Water Supply Advisory Committee
Solutions Phase -- Technical Summary

Consolidated Alternative 16 - Aquifer Restoration/Storage

Regulatory Feasibility

Slow but relatively sure

Political Feasibility

Acceptable in 5 years

Regional Water Benefits

Across County

Local Economy

Positive local job

Energy

4

Marine Ecosystem Health

Cumulative harm.

Potential fisheries impacts. Construction impacts at Felton diversion and through City.

Freshwater and Riparian Health

Degraded ecosystem health

Terrestrial Resources

N/A

Environmental Profile

The environmental profile of this portfolio is acceptable with appropriate and effective mitigation

Groundwater Resources

Actively restores.

Address groundwater overdraft/seawater intrusion and potential improved production from Live Oak wells

Infrastructure Resilience

Many moderately well

Supply Reliability

Makes system significantly more reliable

Scalability

Can scale up

Preserves Future Choices

Increases choice

Yield

640

Operational Flexibility

Greatly increases

Addresses Peak Season Demand

Yes

Implementability

Could be implemented

Supply Diversity

Portfolio significantly increases the diversity of Santa Cruz's supply portfolio

Sustainability

This portfolio is somewhat sustainable.

Issues to Resolve

Site-specific geotechnical conditions; preferred siting for caisson and laterals; resolution of any water rights issues.