Regional Water Supply Planning

- Review of Prior Efforts, 1950-2015
- Current Efforts
  - City of Santa Cruz
  - Soquel Creek Water District
- Relationship to Groundwater Sustainability Planning
- Public Input
- Board Discussion

History of Santa Cruz Water Supply Planning

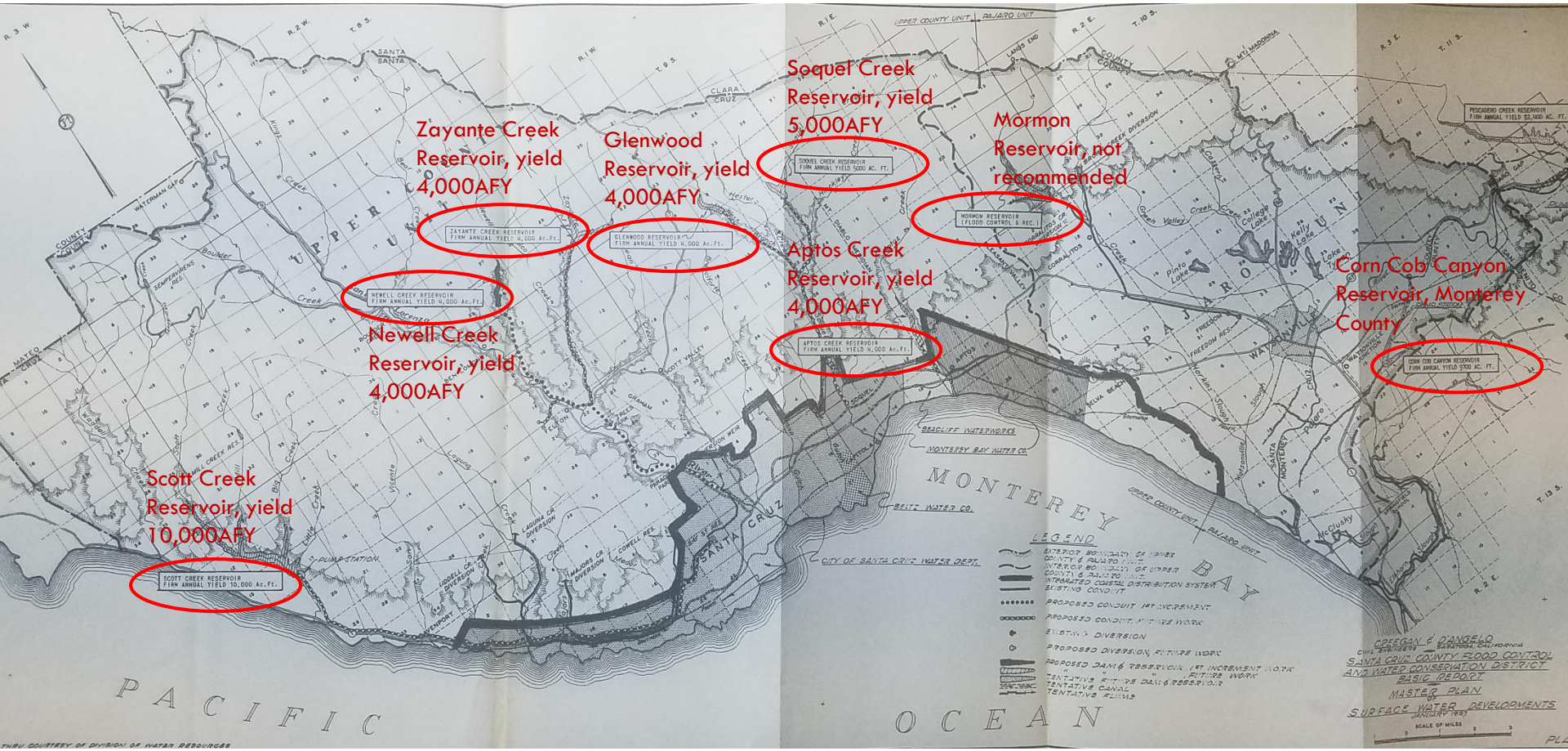
- The County and local water agencies have worked together and independently on regional water supply planning since the 1950's. Generally Speaking:
  - Early studies focused on surface water storage.
  - Later studies acknowledge the need for water conservation, groundwater management and the development of supplemental water supplies.
- Overdraft and threat of seawater intrusion in Mid-County was identified in 1968
- Recycled water and desalination projects were first considered locally in the 1960s.

Regional Efforts

- 1957, County Master Plan for Water Development
- 1968, County Water Master Plan for 2020
- 1971- Master Plan of Water Development Using Distilled Seawater for Santa Cruz City and County.
- 1985 North Santa Cruz County Water Master Plan
- 2005, 2014 - Integrated Regional Water Management Plan
- Stormwater Recharge Projects (Small)
- 2007-2013 SCWD²: Collaboration on Desalinization
- 2017, Continued regional collaboration efforts

- The Basin Implementation Group, 1995 (BIG) >
  - Soquel-Aptos Groundwater Management Committee, 2015 (SAGMC)>
  - Santa Cruz Mid-County Groundwater Agency, 2016 (MGA)

6 Santa Cruz County Reservoirs Suggested in 1957 Report



SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

City of Santa Cruz Efforts

- 1966, Loch Lomond Reservoir Completed
- 1977, Felton Diversion Dam, most recent new supplemental supply project for mid-county area

- 1989 - City of Santa Cruz Water Master Plan
- 1994 - City of Santa Cruz Water Supply Alternative Study
- 2000 - City of Santa Cruz Alternative Water Supply Study
- 2002- Evaluation of Regional Water Supply Alternatives
- 2014 - City of Santa Cruz Water Supply Advisory Committee:
  - Conservation; Aquifer Storage; Recycled Water, Desal

Soquel Creek Water District Efforts

- 1968, USGS Hydrogeologic Study of the Soquel-Aptos Area, characterization of groundwater conditions
- 1980s USGS Reports indicating overdraft (Muir) and then indicating no problem (Bloyd)
- 1997 Draft Integrated Resources Plan
- 2006 Integrated Resources Plan Update
  - 2050 demand: 7030 af; Cons: 930; Yield 4,800; supp need 1280 af
- 2012 Integrated Resources Plan Update
- 2015 Community Water Plan:
  - Conservation, Purified Wastewater, River Transfer, Desal

City of Santa Cruz Water Supply Augmentation Strategy

Santa Cruz Mid-County Groundwater Agency
July 19, 2018

Our Water, Our Future

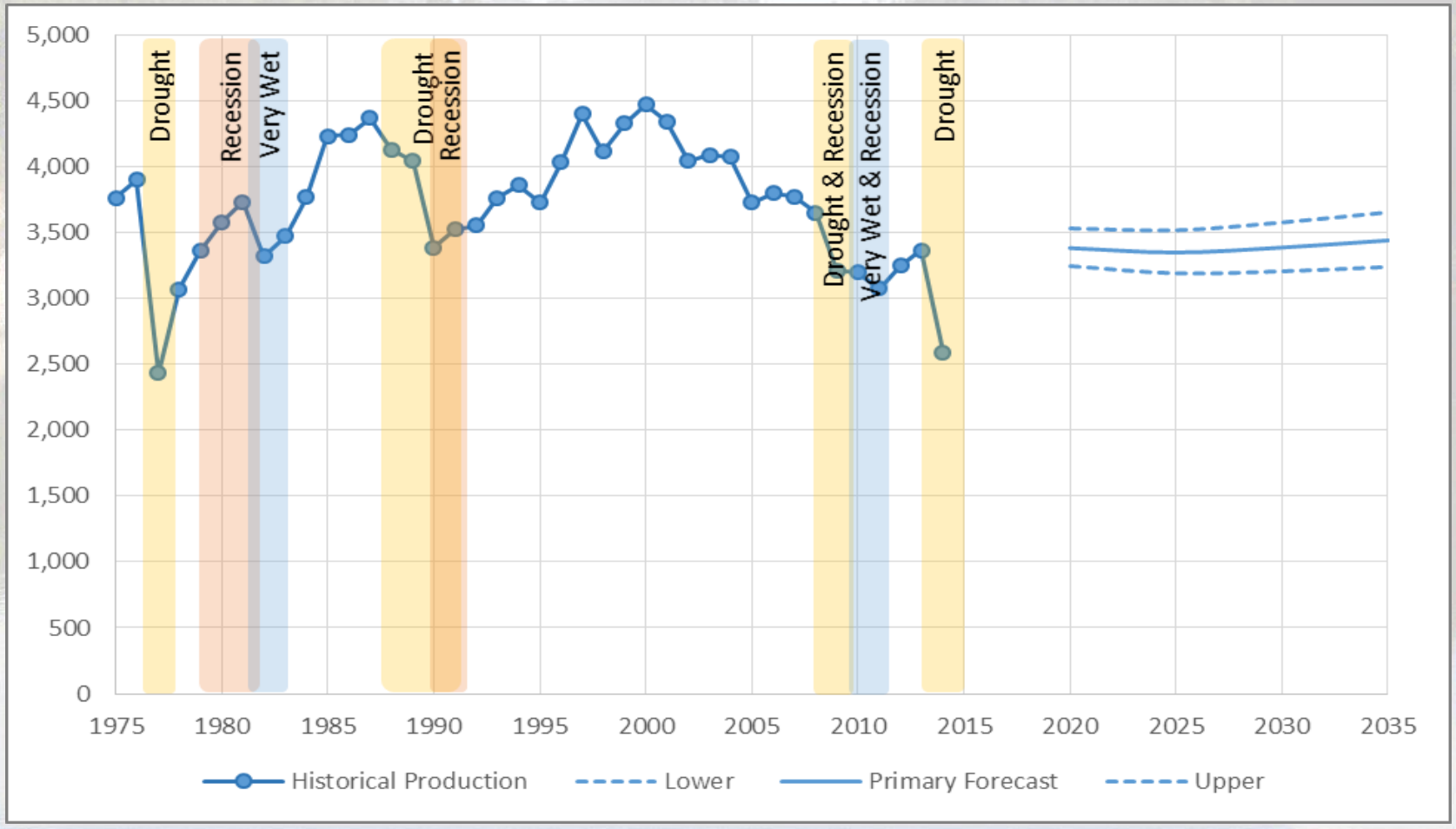
CITY OF SANTA CRUZ
Water Department

Water Supply Advisory Committee
April 2014 – October 2015

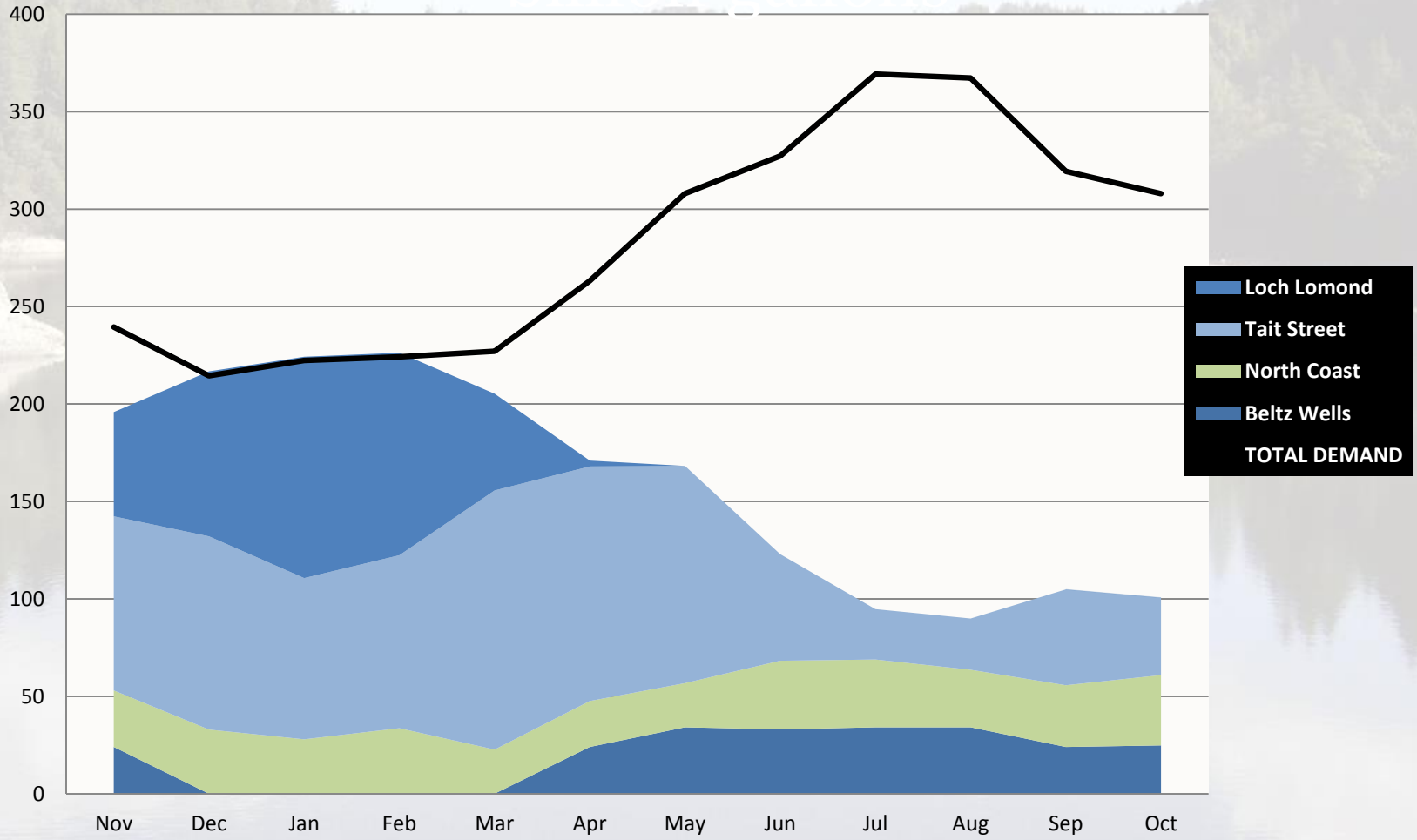
- 14 citizens appointed by the City Council
- Interests represented included: inside and outside city water customers, the Chamber, Coastal Watershed Council, Desal Alts, Sierra Club, Surfrider, Sustainable Water Coalition, the Water Commission and 3 community-at-large members.

WSAC Members not pictured:
Peter Beckman and Charlie Keutmann

The 20 year water demand forecast, including projected growth and consistency with the City's General Plan, is FLAT



The projected worst year gap is BIG – peak season shortage with DFW-5 flows is 1.2 bg



WSAC's Problem Statement July 2015

- Limited Storage
- Need to meet fish flow requirements and prepare for potential climate change impacts
- Resulting peak-season gap: ≈1.2 billion gallons worst year shortage
- Water conservation alone is not enough

Our Water, Our Future: the October 2014 "Santa Cruz Water Supply Convention," showcased more than 40 water supply solutions and attracted 350 people

Nearly 100 Alternative Water Supply Solutions Identified and Screened

- Expanded conservation, e.g.,
  - Peak season demand reduction
  - Water neutral development
- Decentralized systems, e.g.,
  - Graywater
  - Rainwater catchments
  - Water from humidity in the air
- Winter flow harvest, e.g.,
  - Passive and active recharge
  - Water transfers and exchanges
- Water reuse
  - Various approaches to non-potable and potable reuse
- Desalination
  - Various locations and technological approaches to seawater desalination

WSAC Supply Augmentation Recommendations

- Implement additional water conservation efforts
- Explore the feasibility of winter water harvest to create drought supply of 3 billion gallons to provide for 2 years of back to back drought
  - In-lieu water transfers/exchange with Soquel Creek Scotts Valley and/or San Lorenzo Valley water districts
  - Aquifer storage and recovery (ASR) in the Santa Margarita and/or Santa Cruz Mid-County Basins
- Explore the feasibility of alternative water supplies to supplement existing sources during droughts
  - Recycled water
  - Desalination

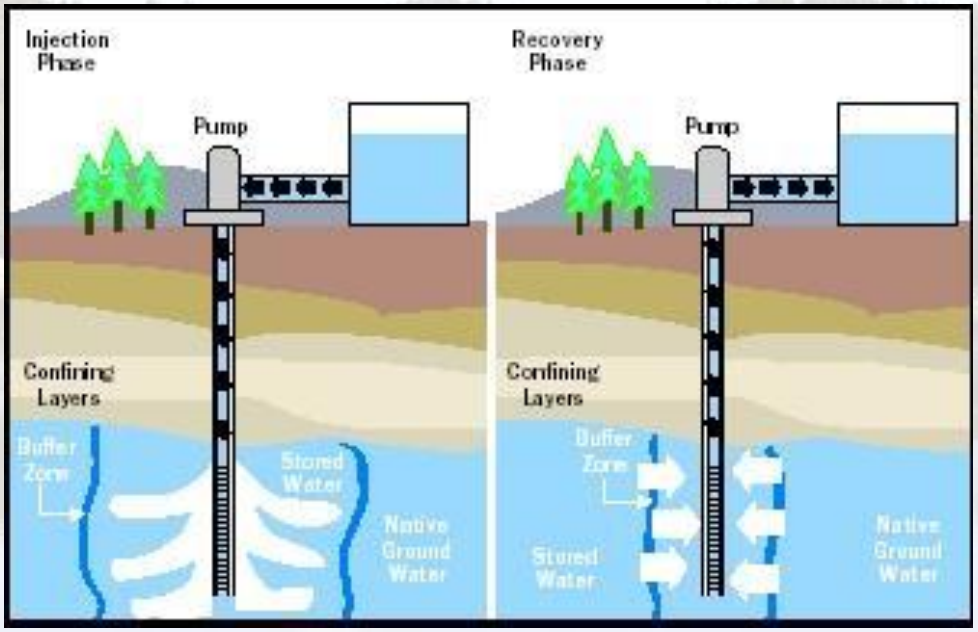
IMPLEMENTING THE WSAC RECOMMENDATIONS

Passive Recharge: In Lieu: Transfers & Exchanges

- **Concept:** Wet season water transfers and/or exchanges with Soquel Creek, Scotts Valley and/or San Lorenzo Valley water districts;
- Groundwater is "passively stored" based on districts not pumping their wells;
- Storage volumes limited by demands of 3 districts, with assumed wet season average demands of:

SqCWD	SVWD	SLVWD	Total
2.3 mgd	1.3 mgd	0.9 mgd	4.5 mgd

Active Recharge: Aquifer Storage and Recovery



- Concept: store wet season available flows in regional aquifers for future use during drought.

Key Working Assumptions for Evaluating Winter Water Harvest/Groundwater Storage Options

- Maximum combined additional storage capacity of aquifers is 3 billion gallons, with 80% of stored water (2.4 BG) available for later City withdrawal whenever needed.
- **All available flows** within existing water rights, in excess of fish flow requirements and Santa Cruz demands may be diverted for aquifer fill **year-round**.
  - Maximizes volumes stored, although volumes stored in summer months are small.
  - Year-round storage may not be consistent with operational and/or basin constraints.

Key Assumptions (continued)

- Felton and Tait Street points of diversion for water to go to storage;
- All water for in lieu and ASR to be treated to drinking water standards;
- Several existing system operating constraints in effect, including water rights quantities, fish flow requirements, diversion and treatment capacities, and turbidity and first flush constraints;
- Retain 1 billion gallon storage reserve in Loch Lomond; and
- 3 years allowed for basin fill prior to worst drought.

Refining the magnitude of problem to address multi-year droughts

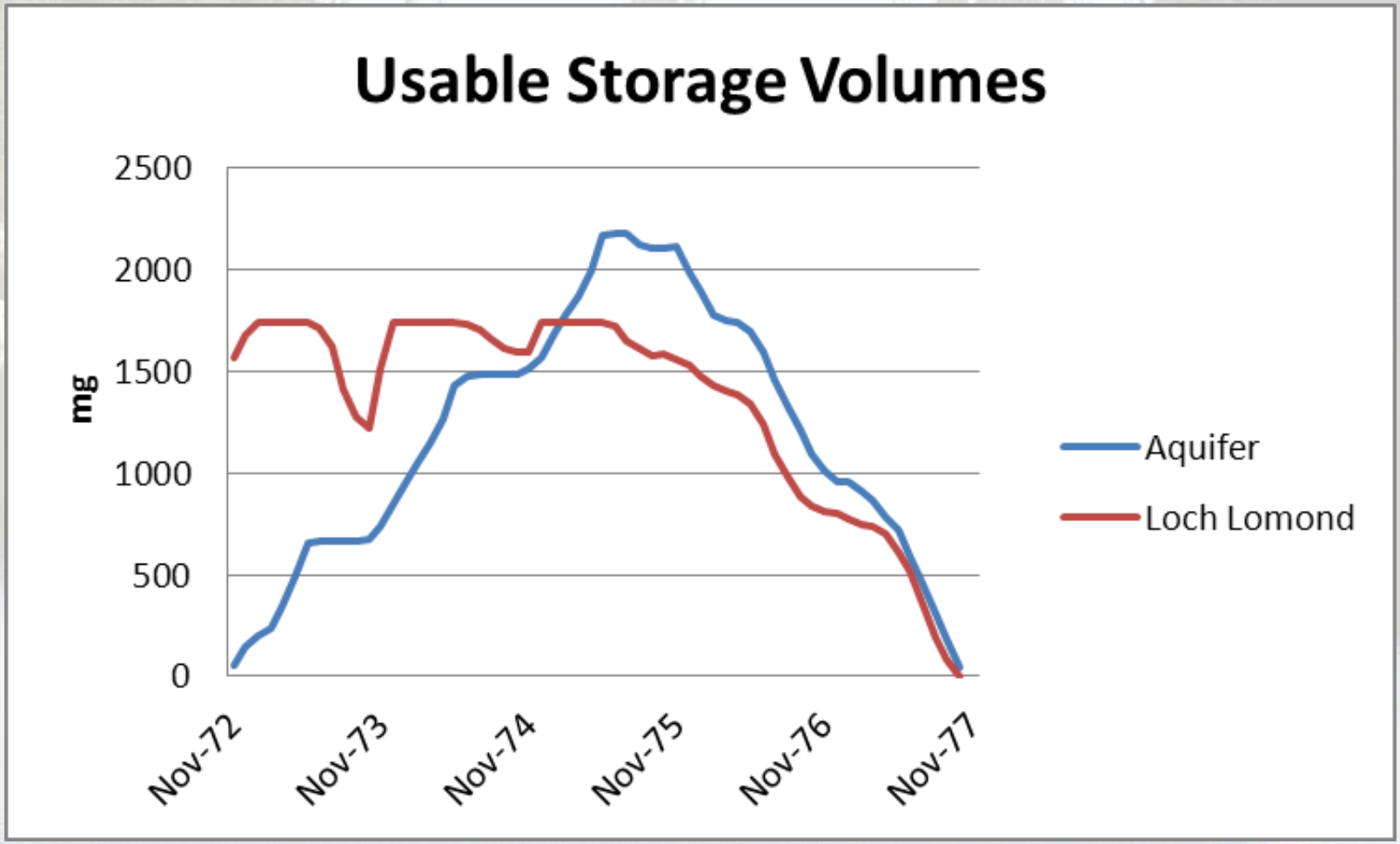
Assuming Historical Flows

Period	Peak-Season Shortage (mg)
Worst Year (1977)	1150
Worst **2-year** drought (1976-77)	1900

Assuming Climate Change

Period	Peak-Season Shortage (mg)
Worst Year	1050
Worst **3-year** drought	2550

Illustration of Joint Storage Operations



The Problem & Potential Solutions assuming Historical Flows

	POTENTIAL SOLUTIONS		
The Problem to be solved: 1900 mg Peak-Season shortage over worst drought	**In-Lieu** 3 mgd withdrawal	**ASR** 5 mgd injection; 4.5 mgd withdrawal	*In-Lieu/ASR* 1.5 mgd injection; 4.5 mgd withdrawal
	UNSOLVED PROBLEM: Remaining Total Worst-Drought Peak-Season Shortage		
	In-Lieu 350 mg *	**ASR** None	**In-Lieu/ ASR** None

* Because in-lieu storage limited by district demands.

The Problem & Potential Solutions assuming Climate Change

	POTENTIAL SOLUTIONS		
The Problem to be solved: 2550 mg Peak-Season shortage over worst drought	**In-Lieu** 7 mgd withdrawal	**ASR** 4.5 mgd injection; 8.5 mgd withdrawal	**In-Lieu/ASR** 0.5 mgd injection; 8.5 mgd withdrawal
	UNSOLVED PROBLEM: Remaining Total Worst-Drought Peak-Season Shortage		
	In-Lieu 250 mg *	**ASR** None	**In-Lieu/ ASR** None

* Because in-lieu storage limited by district demands.

Current Status of In-Lieu

- Planning for water exchange with Soquel to begin Winter 2018-19
- Continuing discussions with other agencies about their ongoing interest in water transfers.
- Continuing to refine groundwater modeling work to determine benefits to the basin(s) and ability to return water to Santa Cruz when needed for drought supply.

Current Status of Aquifer Storage & Recovery

- Completed Phase I technical analyses – No Fatal Flaws;
- Performed system modeling to assess availability of water for ASR and infrastructure sizing requirements to meet drought supply needs;
- Evaluated existing wells for pilot testing and completed siting study to establish locations of possible new wells;
- Planning for pilot test program and ongoing groundwater modeling.

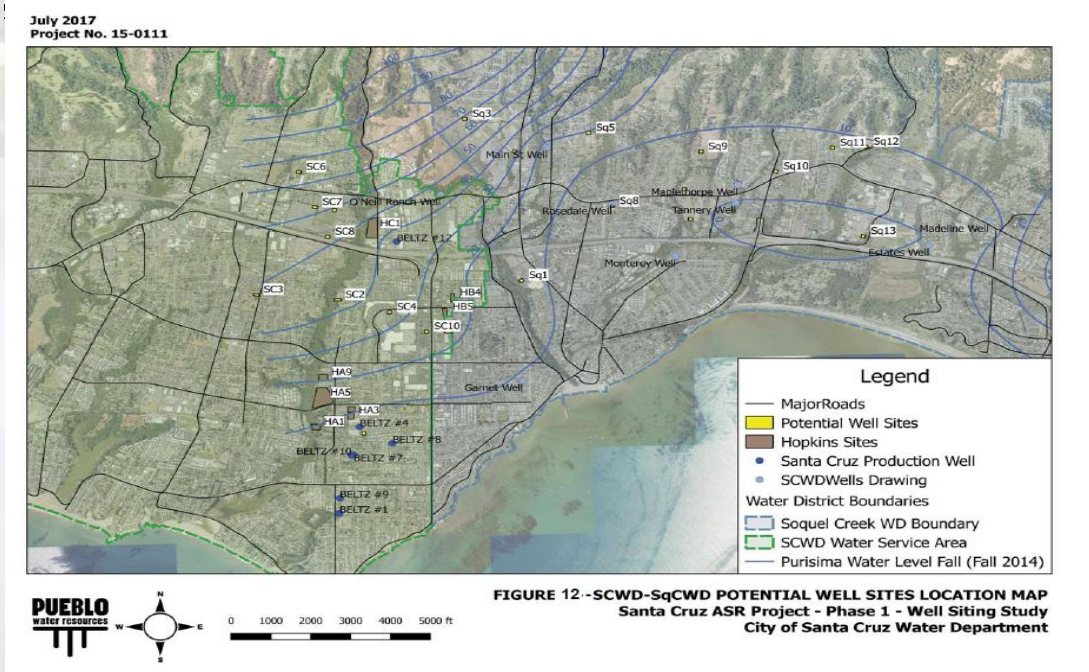
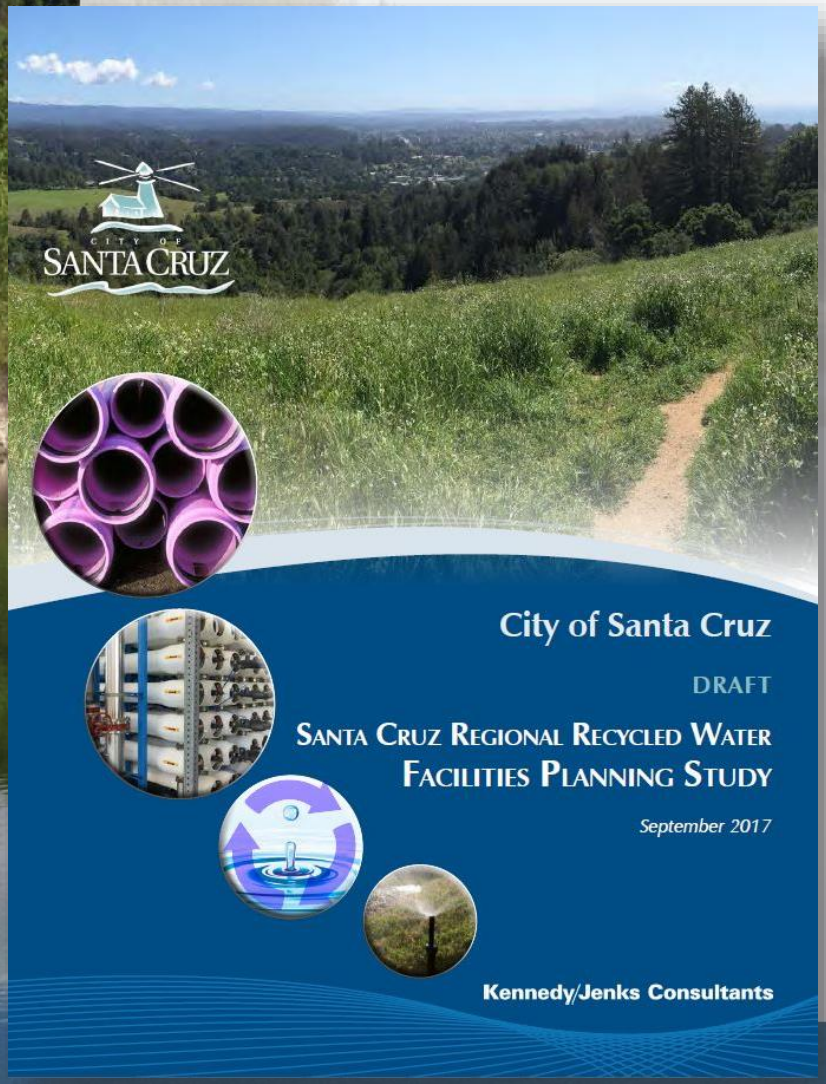


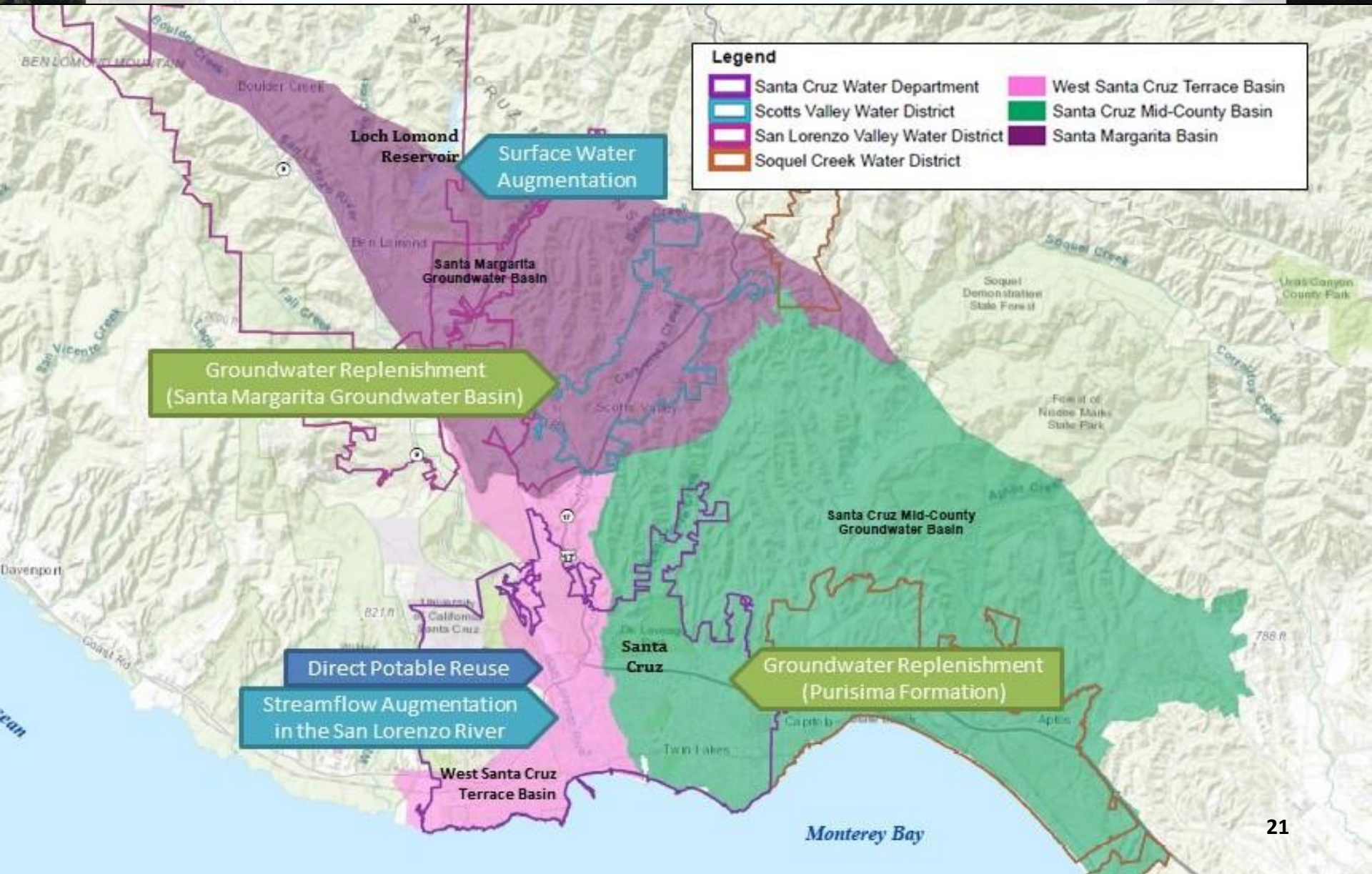
FIGURE 12.-SCWD-SqCWD POTENTIAL WELL SITES LOCATION MAP
Santa Cruz ASR Project - Phase 1 - Well Siting Study
City of Santa Cruz Water Department

Recycled Water



- **Concept:** Evaluate opportunities for beneficial reuse of treated wastewater.
- Evaluated ~40 alternatives for using recycled water.
- Study finalized in June 2018.
- Two small projects for non-potable reuse are recommended and potable reuse options continue to be evaluated.

Recycled Water Alternatives Analyzed



Recycled Water Recommended Projects

- **Santa Cruz Public Works Title 22 Project**
  - Near-term non-potable reuse project to meet in-plant demands, develop a bulk water station and irrigate the La Barranca Park.

- **BayCycle Project**
  - Expand the initial project to increase production to serve customers along Bay Street including UCSC.

Seawater Desalination Update

- Following WSAC's recommendations, the City is conducting a feasibility update for desalination with a focus on costs, timeliness and changed conditions since 2013.
- Changed regulatory conditions include a new requirement to evaluate and implement sub-surface intakes for desalination plants, if feasible.
- This work will be completed by August 2018.

Seawater Desalination

- Findings & Next Steps
  - Project can produce required yield of 1.2billion gallons per year.
  - Costs are refined based on changed conditions.
  - Timeliness of implementation likely an issue due to new regulations.

In the last half of CY2018, we will…

- **In Lieu**
  - Finalize Phase 1 of Pipe Loop Study
  - Begin full scale pilot testing of water transfers with Soquel Creek if possible
  - Continue evaluating opportunities for additional transfers water
  - Initiate water rights changes
- **ASR**
  - Begin Pilot testing injection of winter water
- **Recycled Water**
  - Continue working with SqCWD and City Public Works to explore the Pure Water Soquel project
  - Continue evaluation of other projects
- **Desalination**
  - Finalize Feasibility Update

- Analyze all alternatives at the same level (cost, time, yield)
- Continue ongoing studies: GHWTP, Operational Changes, NCP


QUESTIONS?
Our Water, Our Future
SANTA CRUZ
Water Department

For the MGA & GSP
Adv. Comm.
July 19, 2018

COMMUNITY WATER PLAN

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

Soquel Creek WD's Path to a Reliable Water Supply

Problem: Seawater Intrusion

Humanizing the Situation

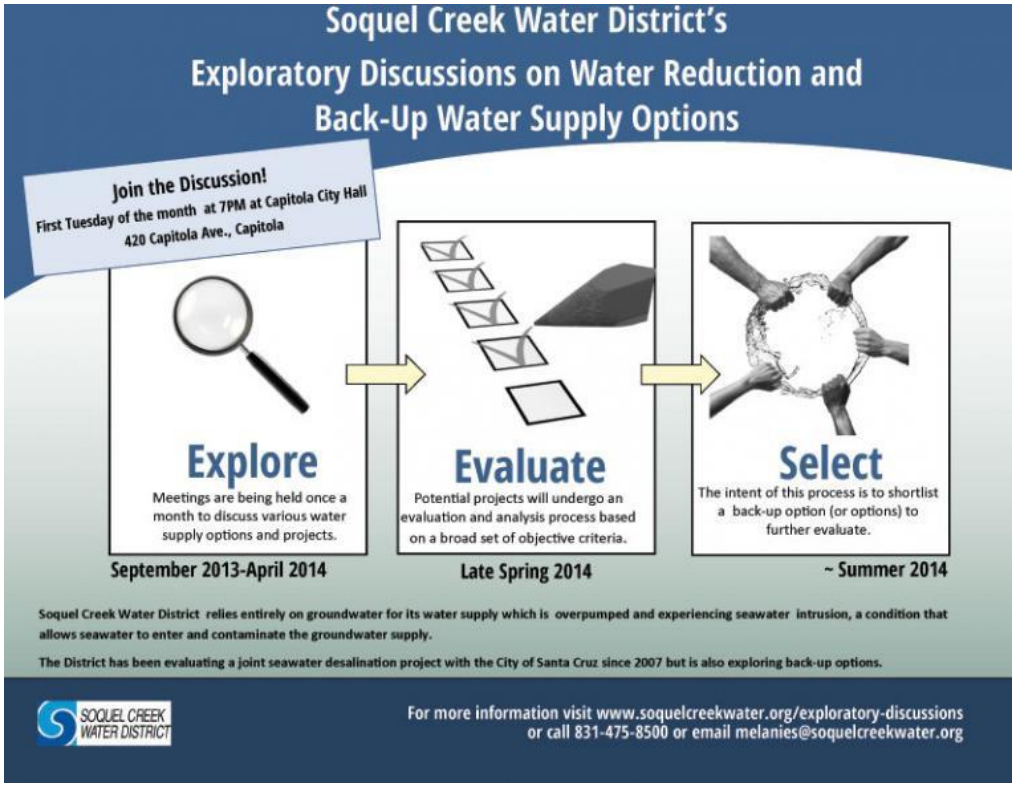
Mr. Cartwright – leased 10 acres for farming – 60 year old well recently ruined by seawater, had to refund to farmer ~ $25,000.

"It is a small problem for each farmer, but a large problem for the county."

"Ultimately it will impact the availability of safe drinking water…"

Solution: Community Water Plan

Process Matters



Community's Values for a New Supply Source:

1. **Timeliness**
2. **Water Quality**
3. **Reliability**

New Water Supplies

- **Potential Solutions - Studying New Sources of Supply for Groundwater Replenishment**

River Water Transfers

Desalination

Storm Water Capture

Water Purification

The solution may involve a combination of supplemental water supply options

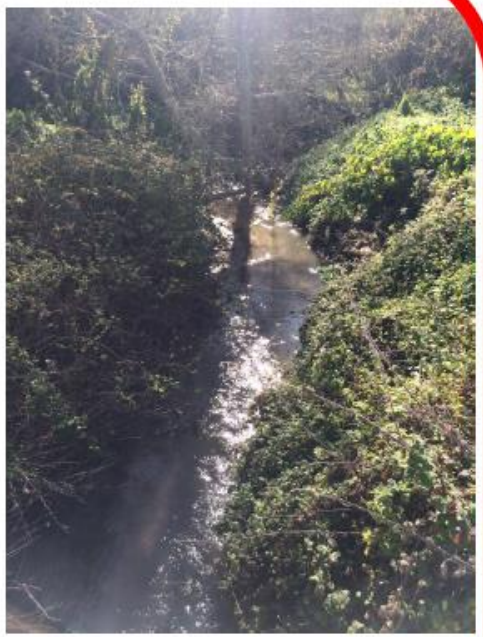
River Water Transfers

River Water Transfers

- **City's North Coast Sources**

Laguna Creek
2-25-18

Liddell Creek
3-4-18



Majors Creek
3-4-18

Included in CEQA evaluation
and Water Purchase Agreement

District's Guiding Principles for River Water Purchase/Transfer:

- Increase public education and outreach that the District is evaluating river water transfers for the two different options: The North Coast Option (short-term) and the San Lorenzo River Option (long-term) which the City of Santa Cruz is currently evaluating based on their water supply advisory committee efforts.

- Continue working with the City of Santa Cruz on the North Coast Option (5-year, short-term pilot project) to investigate and resolve potential issues related to water quality and blending of groundwater and river water within the District's system. Amend the District's Domestic Water Supply permit from the Division of Drinking Water to add the City of Santa Cruz's surface water as a supply source.

- Continue working with the City to better understand the benefits, issues, and constraints of the City's long-term San Lorenzo River Option that includes in-lieu recharge with dry-summer groundwater returns and aquifer storage and recovery.

Cooperative Water Transfer Pilot Project Agreement

G. Purchasing and using this treated surface water to meet some part of the DISTRICT's demand would enable the DISTRICT to reduce its groundwater pumping, reduce the potential for accelerating seawater intrusion, and contribute to the beginnings of a longer term process to ameliorate the overdraft condition of the groundwater basin that impacts both entities and other pumpers of groundwater from the Soquel-Aptos basin.

H. The period during which this agreement operates can be viewed as an opportunity to begin to assess the effects of reduced pumping of the basin by the DISTRICT on the shared groundwater basin. During this pilot project, the CITY and the DISTRICT intend to use this opportunity to collect information related to:

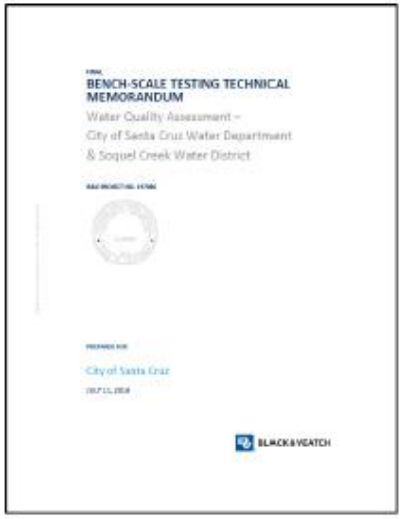
1) the physical operating system issues;
2) system water quality;
3) response of groundwater levels from in-lieu recharge; and
4) the potential opportunity of developing a longer term agreement in which the groundwater basin would be used for a combined in lieu and aquifer storage and recovery program that would help resolve the basin overdraft that would protect CITY and DISTRICT wells from addition seawater intrusion and provide needed drought storage for the CITY.

Work Completed and Planned

River Water Transfers


CITY OF SANTA CRUZ INTERTIE BLENDING ANALYSIS
Water Quality Impacts Assessment
Technical Memorandum
Soquel Creek Water District
BLACK & VEATCH


Notice of Intent to Adopt a Negative Declaration


BENCH-SCALE TESTING TECHNICAL MEMORANDUM
Water Quality Assessment –
City of Santa Cruz Water Department
& Soquel Creek Water District
City of Santa Cruz
BLACK & VEATCH

Desktop Intertie Blending Analysis June 14, 2016

CEQA Analysis January 2016

Bench scale and Jar Testing September 2016-June 2018

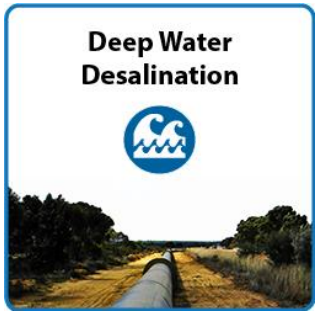
Full Scale Pilot 2018-20 ~250 AFY

COMPLETED → **COMPLETED** → **COMPLETED** → **PREPARING FOR NOV 2018**

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

Deep Water Desalination

Desalination



In May 2015, the District entered into a Memorandum of Interest (MOI) with DeepWater Desal to express the District's interest in purchasing 1,500 acre-feet per year of desalinated water

The MOI is a non-binding and does not obligate the District to make a financial commitment at this time.

The Environmental Impact Report is scheduled to be released in 2018?

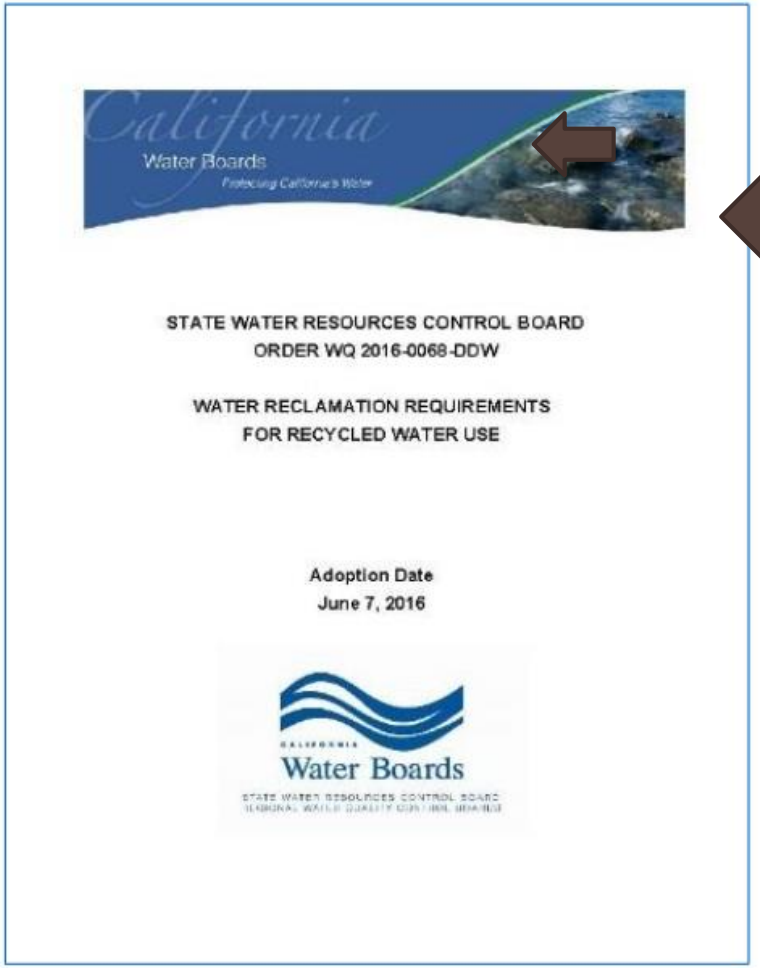
Stormwater Capture

Storm Water Capture

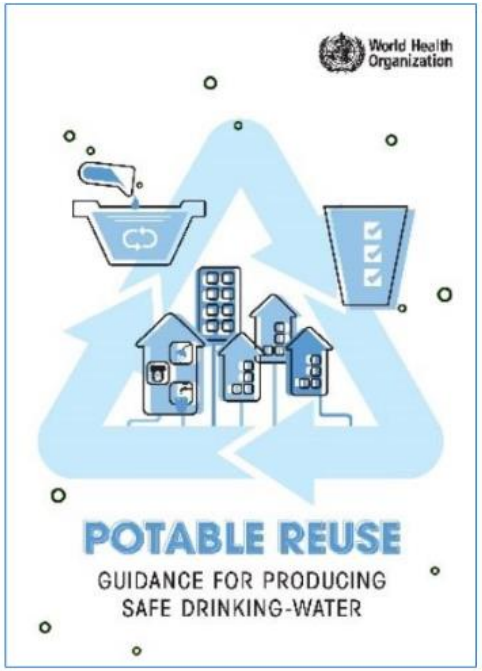
Not enough, but each drop helps.

Regulations for Indirect Potable Reuse

Water Purification

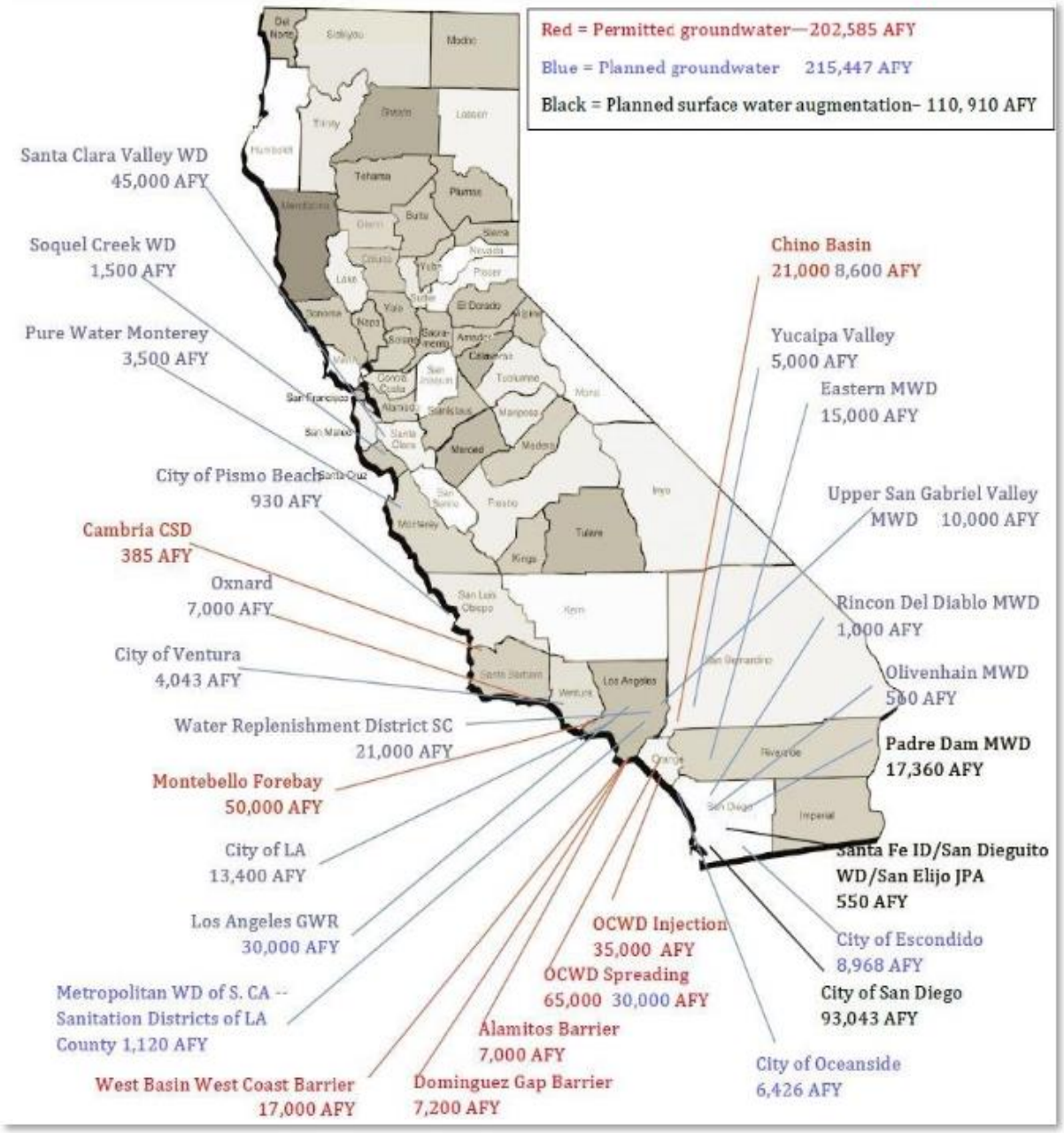


CA Potable Reuse Regs



WHO

Potable Water Reuse is Expanding in California



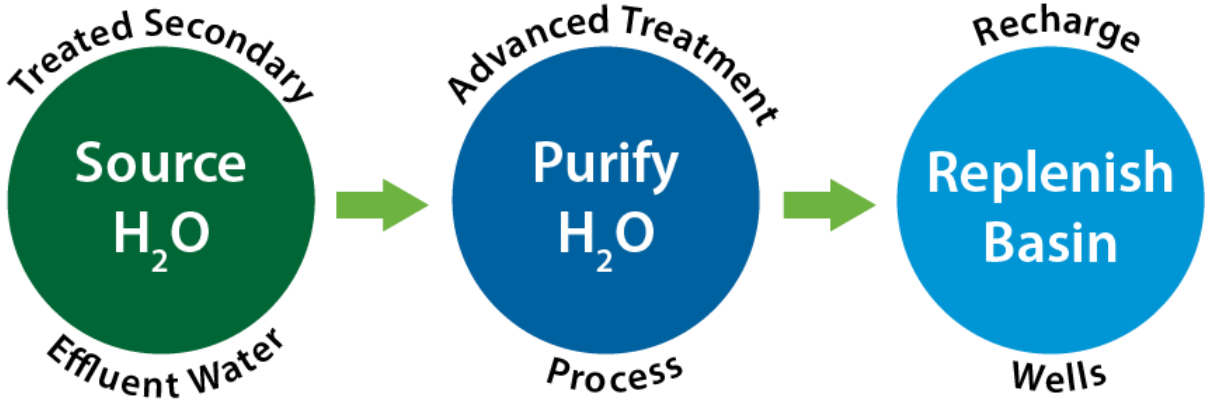
- 206 mgd today
- Plans for 400+ mgd by 2025

PUREWater Soquel

Replenishing Mid-County Groundwater

Water Purification

Recycle 25% of the ~8 million gallons per day of treated wastewater that goes out into the Monterey Bay National Marine Sanctuary



Multi-Barrier Treatment

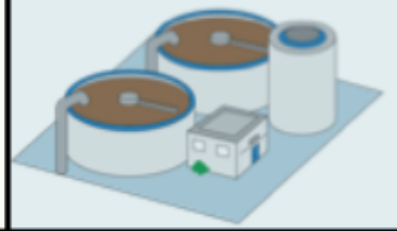
Organic matter, Trace Chemicals

Pathogens

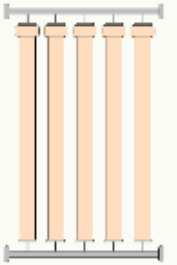
TREATMENT PROCESS

MOVAL MECHANISM

Primary, Secondary

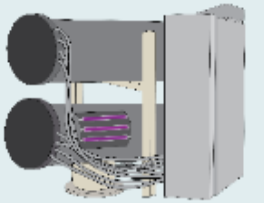


MF/UF



RO

AOP



Biodegradation

Adsorption

Physical removal

Physical removal

Physical removal

Physical degradation

Oxidation

UV light Inactivation

PUREWater Soquel

Replenishing Mid-County Groundwater

PureWater San Diego- Demonstration

(Nearly the Size of PureWater Soquel)

Water Quality: Independent Panel Oversight

"The Panel concludes that the Project is plausible, feasible, and protective of public health, with respect to the following elements: quality of the source water that would be provided by the SCWWTF and use of proven advanced treatment technologies to produce water that meets all drinking water requirements and is protective of public health and the environment." - *National Water Research Institute (NWRI) Report*

Santa Cruz Sentinel

WATER UTILITIES

News Sports The Cannifornian Entertainment Lifestyle Opinion Obituaries

Home News Business Water utilities

National expert panel gives Soquel Creek recycled water plan thumbs up

By Jessica A. York, Santa Cruz Sentinel

POSTED: 12/18/17, 7:50 PM PST | UPDATED: ON 12/18/2017 1 COMMENT

SOQUEL >> Soquel Creek Water District's proposal to purify wastewater and inject it underground to replenish overtaxed aquifers is "plausible, feasible and protective of public health," according to a third-party review.

The comment was included in a detailed report issued by an independent advisory panel

If you go

What: Soquel Creek Water District board meeting.

When: 6 p.m., Tuesday.

Where: Capitola City Council Chambers, 420

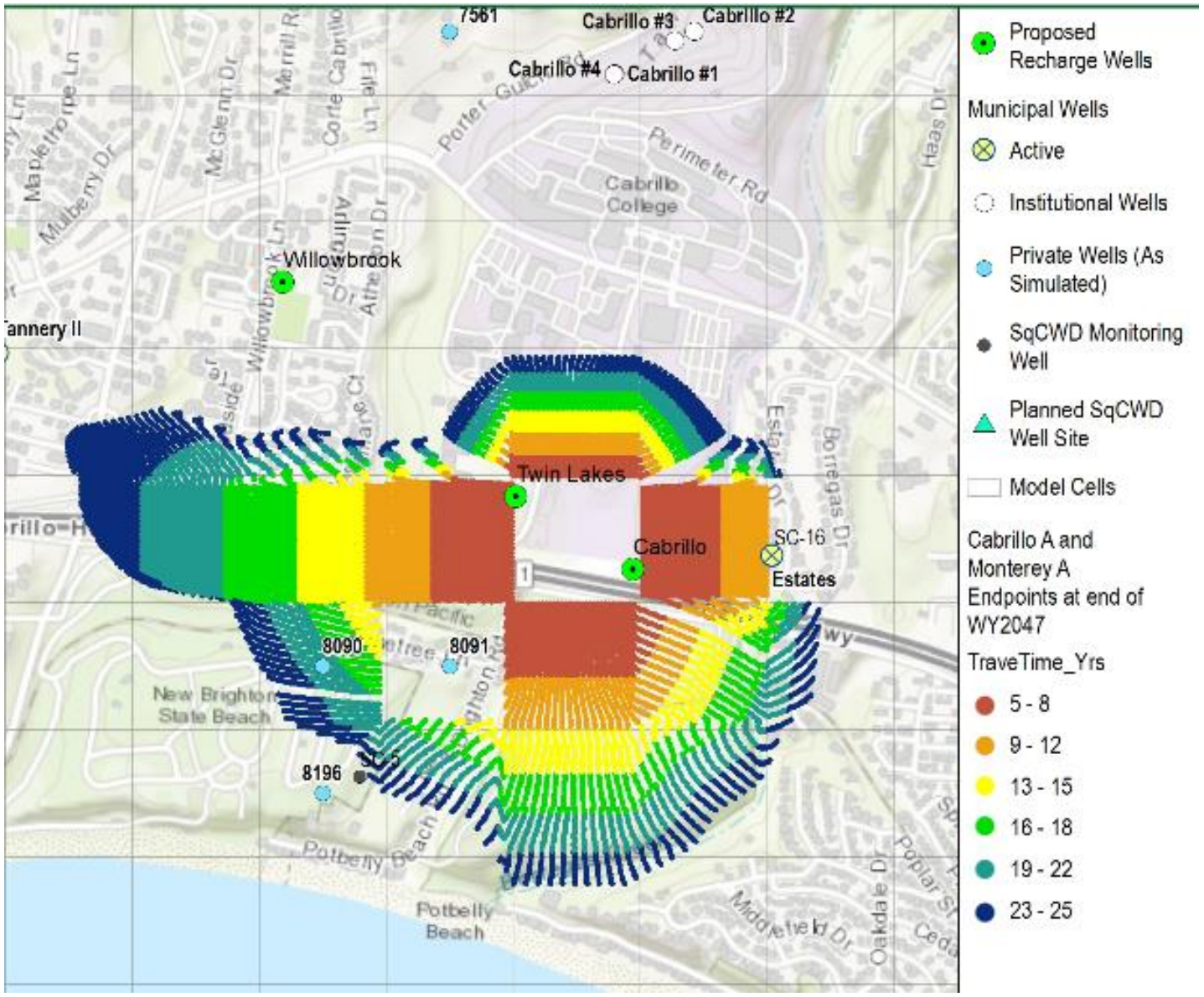
Water Reuse - Defacto

Surface Water Treatment vs. Potable Reuse Treatment

- How many times more stringent is potable reuse treatment over surface water treatment for pathogen removal?

- 100,000,000 times more stringent treatment

Groundwater Modeling Recharge Particle Tracking



Pure Water Soquel Cost

- Project Cost Estimate: $90M (range $63 - $135)

- Grants awarded:
  - $75K - SWRCB Feasibility Study (FS)
  - $150K – US Bureau of Reclamation FS
  - $2M – SWRCB Planning Grant -Prop. 1

- Potential grants:
  - Up to $50M SWRCB Construction Grant
  - Up to $20M US Bureau of Reclamation

- Costs with Grants = $20M ($90 - $70M = $20M)

Pure Water Soquel Proposed Timeline(1)

Evaluate: 2015-2018	CEQA Draft EIR: Summer 2018	Permit, Design, & Construct: 2019-2023	Goal to Replenish the Basin: 2040

(1) Assumes certified EIR


Thank you

WATER FOR SANTA CRUZ COUNTY

Using Water Transfers to Achieve Regional Water Security

July 19, 2018

A presentation of

www.waterforsantacruz.com

WATER FOR SANTA CRUZ COUNTY

Purpose of this Presentation

- The WSAC recommended water transfers as the top solution.
- The Water Chemistry Study of Santa Cruz surface and SqCWD groundwater indicates compatibility.
- Water transfers are a **go**!

WATER FOR SANTA CRUZ COUNTY

Key Questions

1. How much water does N. Coast have to ship?

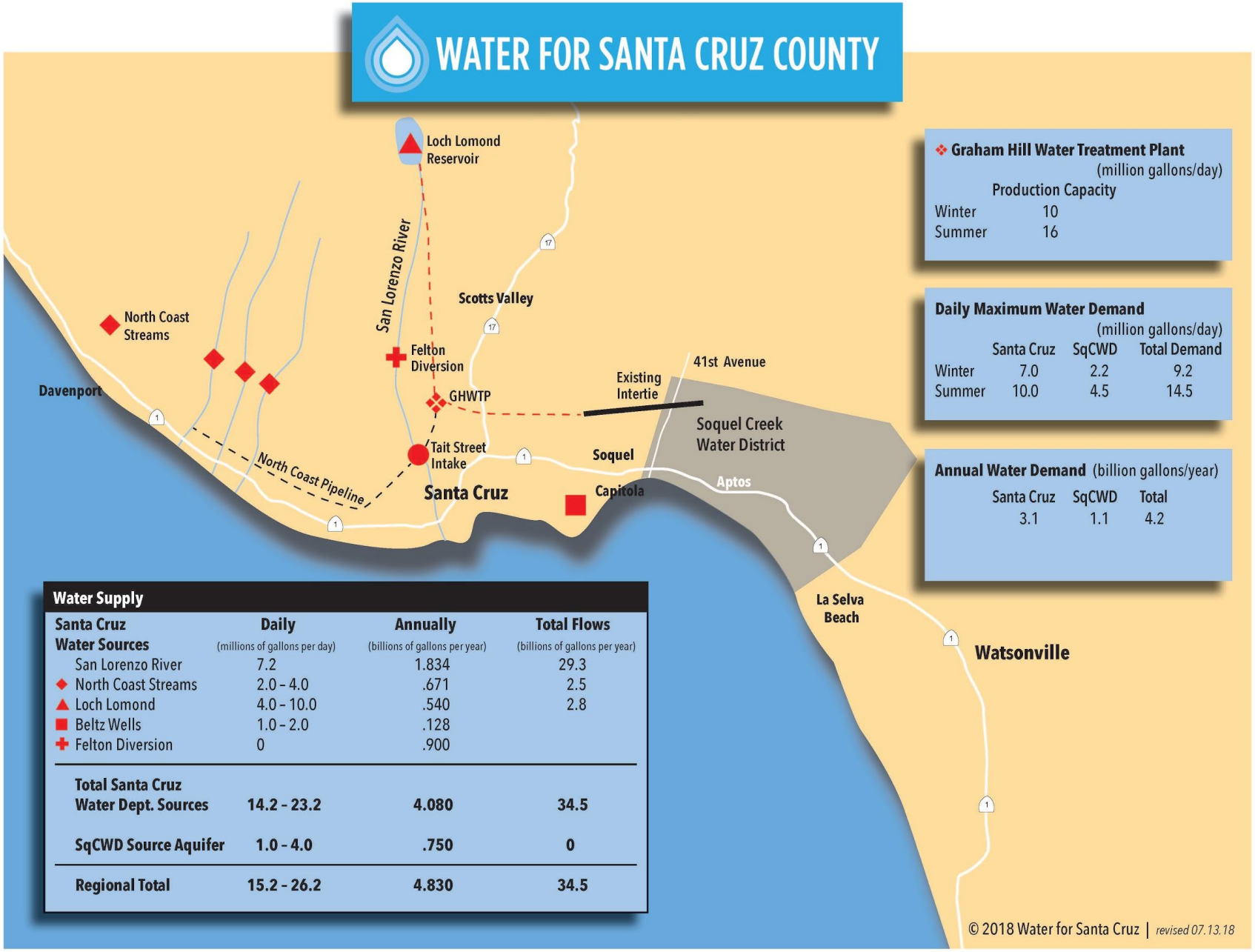
2. How can Santa Cruz replace water sent to SqCWD customers?

3. Is the infrastructure present and sufficient to treat and transfer water?

WATER FOR SANTA CRUZ COUNTY

Answers

1. N. Coast river water = 671 million gal/year.
2. The transferred water represents no risk to Santa Cruz because Santa Cruz has water rights to 900 million gallons in the San Lorenzo that it typically does not use.
3. Infrastructure is already in place to treat and transfer 1.4 million gal/day—500 million gal/year.


WATER FOR SANTA CRUZ COUNTY
Loch Lomond Reservoir
San Lorenzo River
Scotts Valley
North Coast Streams
Felton Diversion
GHWTP
Existing Intertie
41st Avenue
Davenport
Soquel Creek Water District
Tait Street Intake
Soquel
North Coast Pipeline
Santa Cruz
Capitola
Aptos
La Selva Beach
Watsonville
Graham Hill Water Treatment Plant
(million gallons/day)
Production Capacity
Winter 10
Summer 16
Daily Maximum Water Demand
(million gallons/day)
Santa Cruz SqCWD Total Demand
Winter 7.0 2.2 9.2
Summer 10.0 4.5 14.5
Annual Water Demand (billion gallons/year)
Santa Cruz SqCWD Total
3.1 1.1 4.2
Water Supply
Santa Cruz Water Sources | Daily (millions of gallons per day) | Annually (billions of gallons per year) | Total Flows (billions of gallons per year)
San Lorenzo River 7.2 1.834 29.3
North Coast Streams 2.0 – 4.0 .671 2.5
Loch Lomond 4.0 – 10.0 .540 2.8
Beltz Wells 1.0 – 2.0 .128
Felton Diversion 0 .900
Total Santa Cruz Water Dept. Sources 14.2 – 23.2 4.080 34.5
SqCWD Source Aquifer 1.0 – 4.0 .750 0
Regional Total 15.2 – 26.2 4.830 34.5
© 2018 Water for Santa Cruz | revised 07.13.18

WATER FOR SANTA CRUZ COUNTY

More Questions…

4. Santa Cruz has abundant water in wet and normal years. What about dry years?

WATER FOR SANTA CRUZ COUNTY

Answers

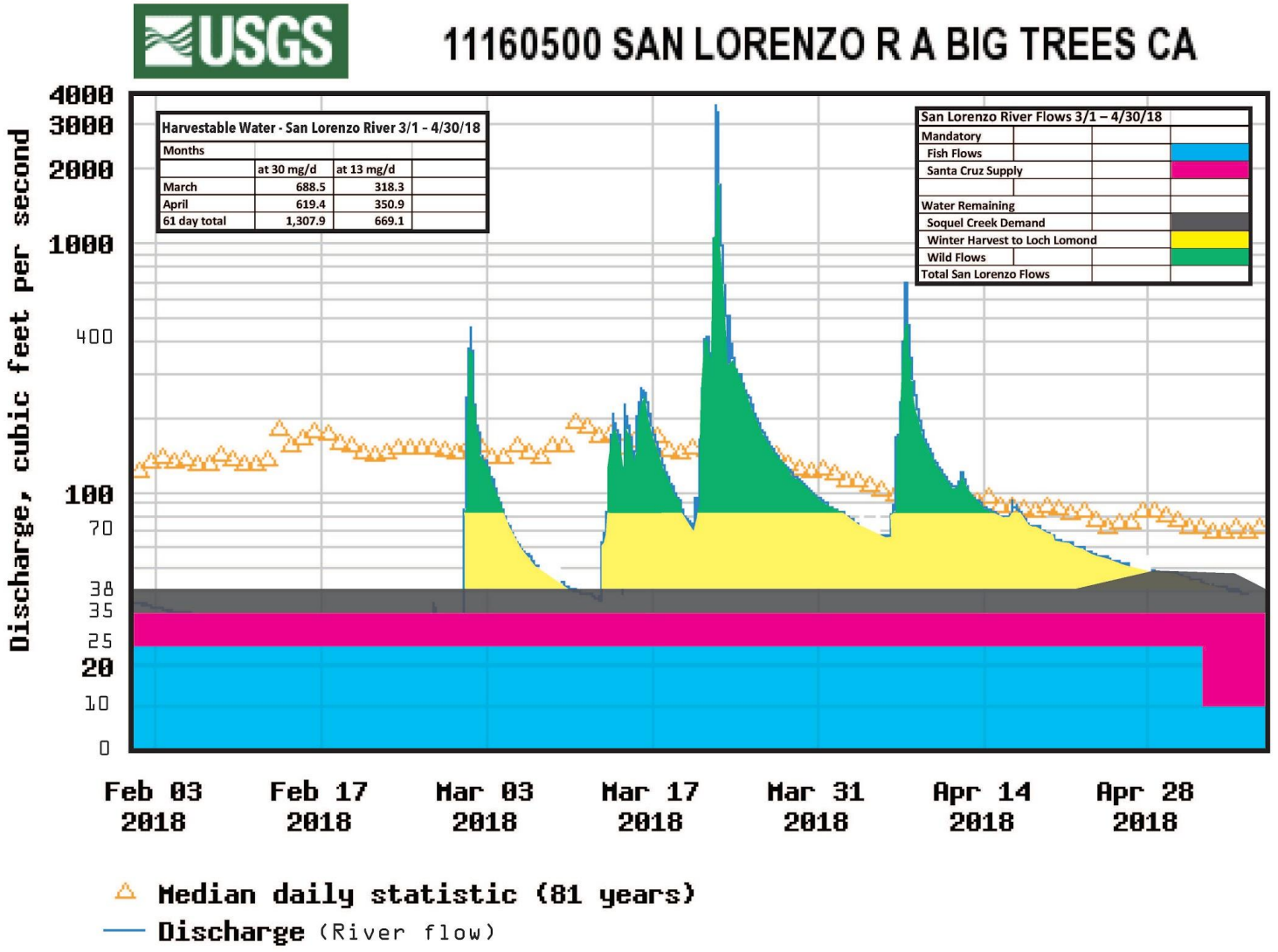
4a. 2018 is a “critically dry year.” A declared “drought emergency.”

4b. Yet, even this year,the San Lorenzo river produced 669 million gallons in two months. That water could have been harvested and transferred… but instead just ran out to sea.

WATER FOR SANTA CRUZ COUNTY

Winter Harvesting in a Critically Dry Year

A Strategy to Achieve Water Security



revised 07.13.18

WATER FOR SANTA CRUZ COUNTY

San Lorenzo River Annual Flows

Figure 1 – Water Year Classification System Based on San Lorenzo River Runoff (by year)

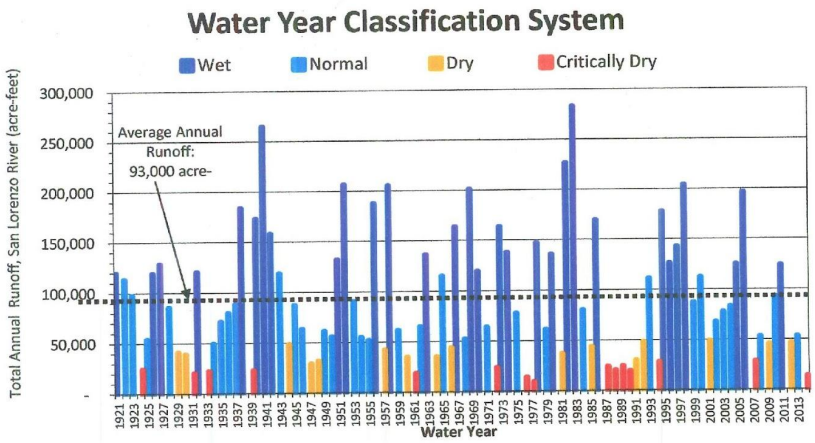
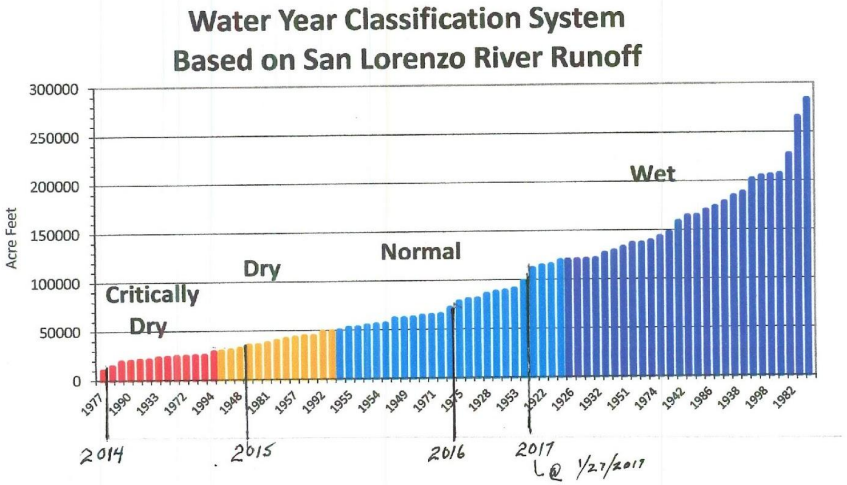


Figure 2 – Water Year Classification System Based on San Lorenzo River Runoff (by water year type)



WATER FOR SANTA CRUZ COUNTY

Conclusion

- Water is available.
- Water is compatible.
- The infrastructure already exists to effectuate water transfers.
- The Santa Cruz Water Department has publicly indicated its willingness to transfer water.

Given these facts, we urge all parties to double their current efforts to make sure water transfers happen this winter.

Lochquifer

Your Big, Fast, Cheap and Green Water Source Choice

an invited presentation to the Santa Cruz

Mid-County Groundwater Agency

July 19, 2018

by Jerome E. Paul, M.S.E.E.
Member, Water for Santa Cruz County
waterforsantacruz.com/Lochquifer

Lochquifer: "Six steps forward, one step back."

(per SCWD consultant Gary Fiske's, Confluence computer model:)

"drought proof" in as little as 3 years, against an 8-year drought

full aquifers within about one decade

-- protection against a much longer drought

If a drought lasts to within two years of Lochquifer insufficiency, THEN start building other alternatives, using versions more advanced, more appropriately sized, more proven, cheaper than today's PWS.

That day may not come for decades.

Lochquifer “Pedigree”

Engineers for Water Alternatives – a dozen professionals, e.g., CEs, geology professors

Desal Alternatives – large advocacy group with informed technical guidance

Soquel Creek Water District – dozens of Board meetings, etc.

Water Supply Advisory Committee (WSAC) commissioned by Santa Cruz City Council

- 14 appointees, 2 years
- some 100 meetings and enrichment sessions given by technical consultants.
- Lochquifer = WSAC **Portfolio 70** (instructive; see WFSC web site for current info)

Cost and scheduling data from City Gantt charts with financials, where possible

City Council and WSAC unanimously voted for water transfers over RO methods.

Water For Santa Cruz County

waterforsantacruz.com/Lochquifer

The current Lochquifer version is less costly, especially regarding water treatment.

6400 hours to date

15 feet of documents

Lochquifer Approach

Top-down

Separate the science from the politics; science first, politics later

Regional

- "middle half" of Santa Cruz County
- two aquifers
  - Purisima (Soquel Creek WD, Live Oak/Santa Cruz WD, Central WD)
  - Santa Margarita Basin (SMB)(Scotts Valley-Felton-Lompico)

Values include caring for

- Saline incursion
- Sustainability
- The people's money
- Energy
- Local businesses & institutions
- Private pumpers
- Fish habitat
- Climate change, sea level rise …

Some key questions were:

1. How much water is there, really?
2. What if the center half of the County were one unified water district?
3. A water system is like a string of 10 fire hoses: if any one is pinched, yield plummets. Which of our "fire hoses" need to be widened, and by how much?
4. How much new water is possible with minimal changes to existing infrastructure?

General Comparison of Water Sources

Note: these numbers are intended to be merely typical, and for general guidance only.

Source	Comment	$/MG [1]	$/AF [1]	Energy (feet) [2]	Fish boost [3]	Cap. cost ($M)[4]	Extra O & M ($M)[5]	Finance cost ($M)[6]	Cost Sum ($M)[7]	Cap-acity (MGY)
Conservation	28 types; range = $0 to big	(low)	(low)	(low)	A-B	(low)		~0	(low)	
Rain check for fish	store in Loch until May	245	80	300	A	0				? 500
Wells (aquifers)	Limited: aquifers overdrawn, not sustainable	600	200	140-500	D					
Streams (winter)	City contract rate with SqCWD today	1000	328	400	C	12	0	0	12	450
Lochquifer	Return stored water at "Wells" rate?	1380	450	700	A	35	5	5	45	1350 avg net
Sewer	e.g., PWS.	9200	3,000	3300	D	90	40	30	160	475
Sea	e.g., SCWD2.	15,500	5,000	4800	D	140	60	45	245	900
Sky	Catchment, once per year [8]	>15k	>5k	(low)	C					
Add ASR	Injection wells & pipe (need treated water)					$5M ea.				

1. Wholesale market pricing
2. Energy is expressed as the amount of energy it would take to elevate the water by this number of feet—useful for comparing facilities at different elevations.
3. Excellence for boosting anadromous fish (salmon) populations at a range of elevations.
4. The $12M is optional, for widening the 41st Ave. potable intertie.
5. lifetime (30-years) of excess operations & maintenance costs.
6. A guess at finance costs incurred by the institution--and by their customers as a result of higher water bills. Pay-go below $30M.
7. Sum of the 3 previous columns.
8. A tank large enough to capture winter rains and be emptied only once per year would be very expensive on the basis of capital cost per gallon consumed, especially for short-lifetime plastic tanks.

You're going to want Lochquifer anyway

Even if one of the other water alternatives winds up getting built,
you're going to want Lochquifer anyway:

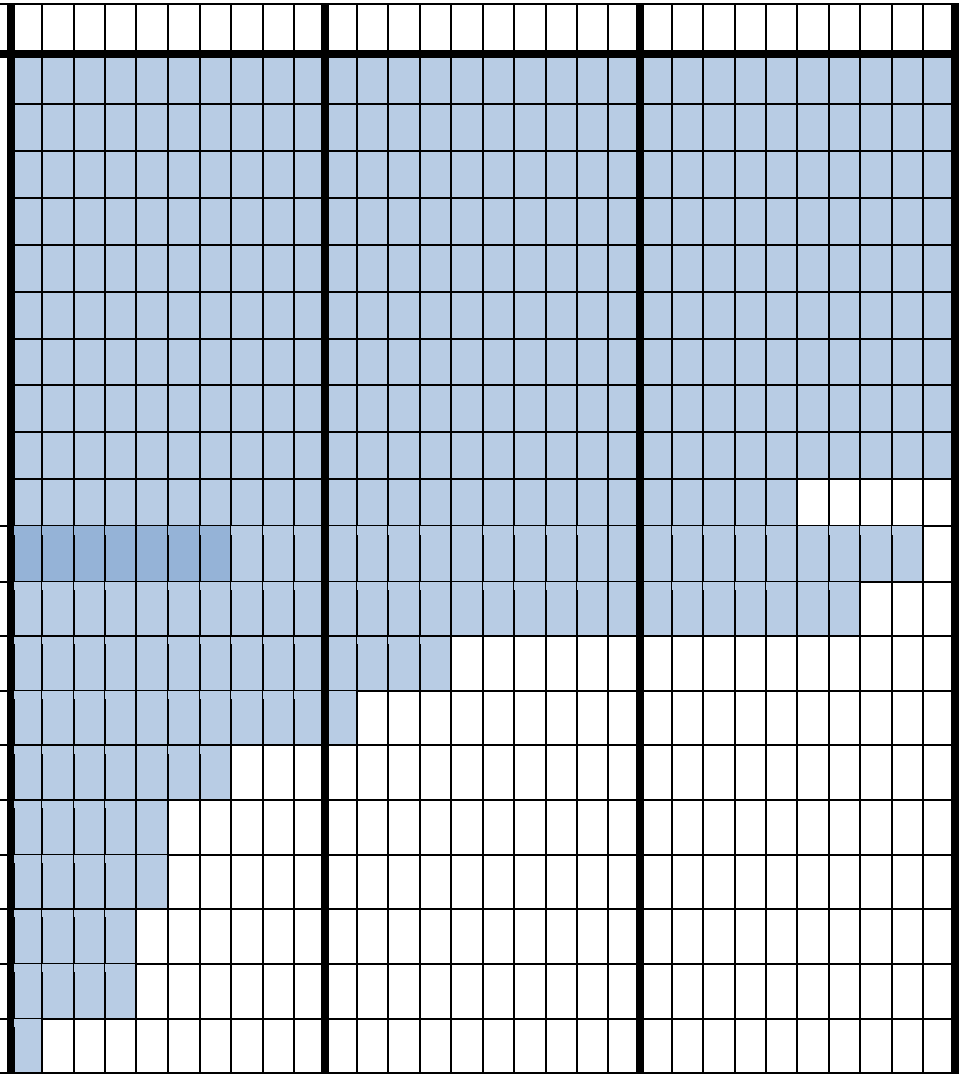
- because it produces such a huge amount of water at such small expense;

- because fish don't carry wallets: it is high time to make peace with fisheries regulators by offering a tool which provides abundant water cheaply--and helps put it at the elevations where fish want it, when fish want it, and at the cool temperatures which are vital to fish survival.

- To stay way ahead of climate change and sea level rise.

Size Matters --a sampling of average sizes and annual flows

	MG(Y)
San Lorenzo River	29,500
Loch Lomond Reservoir Size	2850
SCWD Demand	2700
Lochquifer – transfer to SqCWD	1350
SqCWD Demand	1100
SCWD North Coast pre-1914 sources	700
Lochquifer – transfer to Santa Margarita	500
Pure Water Soquel Capacity	475
SVWD Demand	460
SLVWD Demand	460
Pilot Water Transfers, SCWD to SqCWD	100



- **SCWD uses only 7% of San Lorenzo River**
- **SCWD demand ≈ Loch size. (But ~ 1/3 of demand is satisfied by N. Coast streams.)**
- **SqCWD demand ≈ 40% of Loch; so get 30% from Loch + 10% from winter streams.**

Available aquifer storage space is 3 to 6 times larger than the Loch. **It needs filling.**

Loch Lomond capacity (2.85 BG) ≈ SCWD annual demand (2.7 BG)
SqCWD demand = 40% of SCWD demand
= 40% of Loch
= 30% actually from Loch + 10% from streams in winter and not routed through Loch
ACTUAL transfer is a mix from all sources, including water from North Coast.

Make production wells reversible, to inject - more than full demand

Fire Hoses:

-- I.e., by how much does each of the 10 "fire hoses" need expanding to be a matched set?

Answer for Purisima: 2 pipe widenings, one well, joint water rights.

Answer for Santa Margarita (Scotts Valley and west):

2 short pipes, dry-times surface spreading around Scotts Valley-Felton quarries area

2 Basins, 2 Approaches

Aquifer	Recharge Method	Recovery Method
Purisima --primarily Soquel Creek WD and Santa Cruz WD	"In-lieu": SqCWD and SCWD would consume City water in lieu of well water	SqCWD wells SCWD wells
Santa Margarita Basin --3 aquifer layers under Scotts Valley-Felton-Lompico	"Dry-times surface spreading" and percolation, mostly fed by gravity from Loch Lomond	Scotts Valley Wells --feed downhill to upper-elevation SCWD users

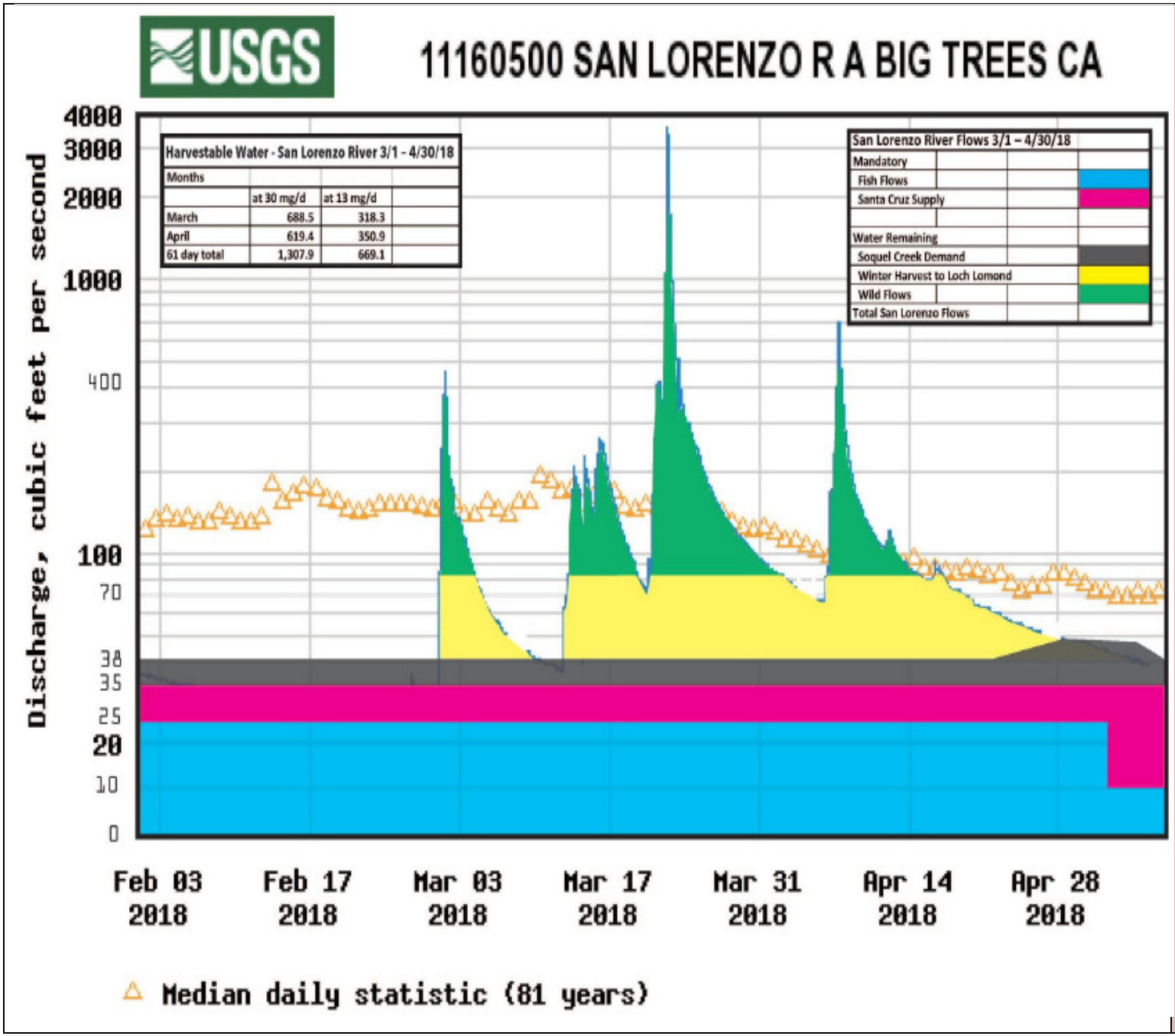
Underlining here indicates energy savings by avoiding pumping water uphill.

Install a well

Widen two pipelines,

Jointly apply for water rights for all concerned

NOTE: this is a semi-log graph carrying disproportionately **huge amounts at the top**.



"Fish Sandwich"

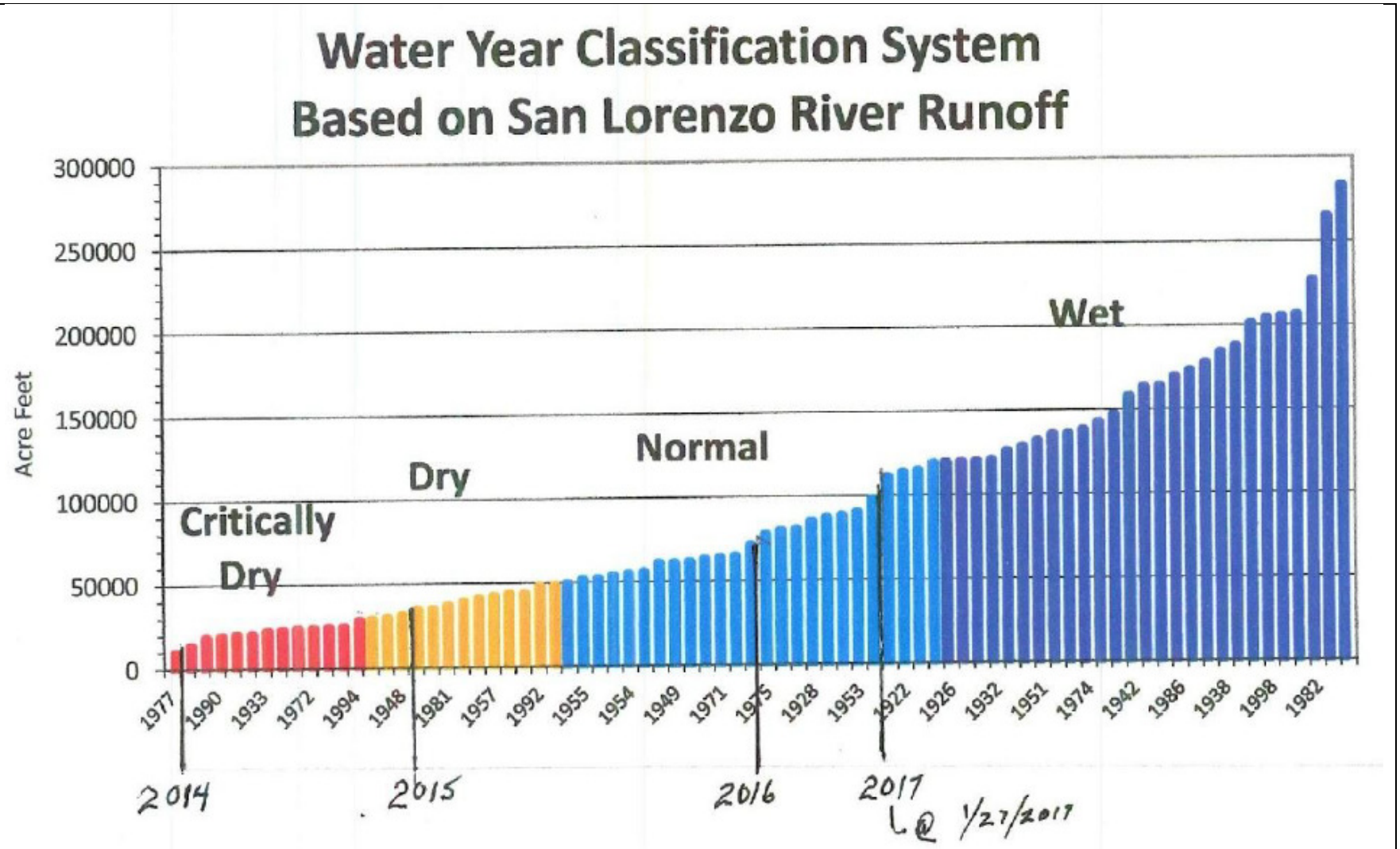
in a

Critically Dry Year:

- ← **Fish**
- ← **Loch***
- ← **SqCWD**
- ← **SCWD**
- ← **Fish**

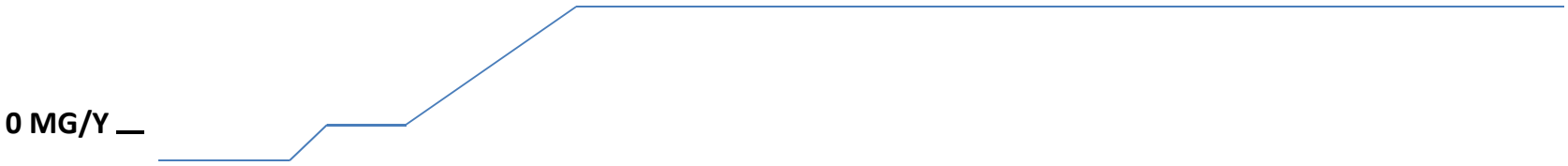
*30mgd x 40days

= 1200 mg !

Billions of Gallons	
98	
81	
65	
47	
32	
16	
0	

	Repay	*	<100%	Lochquifer Supplies 100% of SqCWD Demand

Graph:



*** No water transfers are likely in these few years in either direction, as SCWD demand would be met using other sources such as Beltz wells, Loch Lomond, Santa Margarita Aquifer, etc.**

Annual transfer capacity to/from SqCWD

(with no production-well reversals)

Year Wetness	Transfer Amount	MG/Y	AF/Y
Wettest 72% of years	full SqCWD demand	1200	3600
Next-wettest 12% of years	avg. ≈ 50% of demand	600	1800
Next-wettest 5% of years	0% of SqCWD demand (as is now)	0	0
Critically driest 11% of years	avg. ≈ 75% of excess pumping cap	-500	-1500
Net (= Weighted Average)	72% x 1200 + 12% x 600 + 11% x(-500)	880	2700

≈ 1.8 times more than PWS.

SqCWD pumping and treatment capacity:

- **Circa 2007 SqCWD actually pumped ≈ 700 MGY (2100 AFY) more than today.**
- **Circa 2011 SqCWD added significant pumping capacity.**

Increased transfer capacity using well reversals

Consuming City water rather than well water causes production wells to sit idle. Employing them as part-time injection wells would recharge aquifers much faster.

Annual transfer capacity to SqCWD with idled production wells run at 50% capacity in reverse

Year Wetness	Transfer Amount	MG/Y	AF/Y
Wettest 72% of years	full SqCWD demand	1800	4800
Next-wettest 12% of years	avg. ≈ 50% of demand	900	2700
Next-wettest 5% of years	0% of SqCWD demand (as is now)	0	0
Critically driest 11% of years	avg. ≈ 75% of excess pumping cap	-500	-1500
Net (= Weighted Average)	72% x 1800 + 12% x 900 + 11% x(-500)	1350	4050

≈ 2.7 times more than PWS. Beltz well reversals would add to this figure.

How much water?

Adding up transfers & subtracting "repayment" transfers, net average annual transfer from SCWD to SqCWD is expected to be >800 MG (2400 AF).

Lochquifer's normal-year transfer capacity to SqCWD may exceed 1500 MG (4500 AF)--if SqCWD had the capacity to accept that much. Much more water could be transferred:

- **…as SqCWD demand increases, or**
- **…if SqCWD's production wells were not just idled, but actually used "backwards", i.e., as injection wells, or**
- **…if the region decided to use Lochquifer as a low-cost source to feed an "injection fence" barrier against saltwater incursion.**

So the net average transfer to SqCWD could exceed 1300 MG/year. The main limiting factor would be GHWTP capacity to serve SCWD demand as well.

Some popular concerns, misconceptions and "straw man" arguments

- Claim: "Water transferred out of the Loch is water lost irrevocably."
  [Another view: Lochquifer transfers water simply to store it elsewhere, in an aquifer; the contract—and government agencies--will insure that a big and timely share gets returned as needed, in spite of some inevitable losses. Yearly evaporation takes 6% of the Loch. Space left in the Loch is essential to capture a new winter water harvest from the streams.]
- "Raise the Loch's dam." ($200M) [Not needed.]
- "Add ASR – injection" ($180M) [Not needed.]
- Charging for more than the necessary boost in supply ($92M) [Outside project scope]
- Charging for a longer term than an aquifer fill-up (> one decade) [May be OK]
- Failing to fully include (or properly size) one or more of the "10 fire hoses", e.g.,
  SCWD-SqCWD potable intertie widened to ~6 mgd,
  Felton-Loch pipeline widened to ~30 mgd,
  Felton well,
  Regional joint water rights,
  Felton-SV dry-times surface spreading pipeline and
  SV potable distribution downhill to high-elevation SCWD users
- Unnecessary delays
  Failure to do a preliminary design or cost-estimate as was done for RO alternatives.
  WSAC schedule, though WSAC has been defunct for years.
  Negotiating joint water rights acquisition.

$100M letter – SqCWD saves ~$100M by paying ~$30M

Bonus: If City makes future additional improvements, SqCWD might get the benefit for FREE.

Risk: PWS will run you out of $, blowing your opportunity to do Lochquifer

ACT!

- talk to peers
- talk to City Council
- talk to Supervisors
- $100M letter
- Get detailed design
- Get joint rights
- Expedite