



# **Metropolitan Water Reclamation District of Greater Chicago**

**Welcome to the August  
Edition of the 2022  
M&R Seminar Series**

# NOTES FOR SEMINAR ATTENDEES

- All attendees' audio lines have been muted to minimize background noise.
- A question and answer session will follow the presentation.
- Please use the "Chat" feature to ask a question via text to "All Panelists."
- The presentation slides will be posted on the MWRD website after the seminar.
- This seminar has been approved by the ISPE for one PDH and approved by the IEPA for one TCH. Certificates will only be issued to participants who attend the entire presentation.

**RICHARD G. LUTHY, Ph.D., NAE, P.E., BCEE, Fellow WEF**  
Department of Civil and Environmental Engineering  
Stanford University, Stanford, CA 94305-4020



Richard G. Luthy is the Silas H. Palmer Professor of Civil and Environmental Engineering at Stanford University, California. He directed the NSF Engineering Research Center for Re-inventing the Nation's Urban Water Infrastructure (ReNUWIt) to achieve more sustainable solutions to urban water challenges. His area of teaching and research is environmental engineering and water quality with applications to water reuse, stormwater use, and systems-level analysis of our urban water challenges. His research addresses organic contaminants and contaminants of emerging concern in both engineered and natural systems. He is a Past President of the Association of Environmental Engineering and Science Professors and past chair of the National Research Council's Water Science and Technology Board. He is a member of the National Academy of Engineering and a Fellow of the Water Environment Federation.





Metropolitan Water Reclamation Dist. of Greater Chicago

# **Sustainable Water Supplies for Semi-arid Cities**

**Richard G. Luthy**  
**Stanford University**

**[luthy@stanford.edu](mailto:luthy@stanford.edu)**

**MWRDGC, August 31, 2022**





# Water is in the news!

***How Bad Is the Western Drought? Worst in 12 Centuries, Study Finds.*** NYTimes, 2/12/22

Fueled by climate change, the drought that started in 2000 is now the driest two decades since 800 A.D.

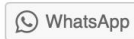
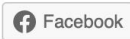
Climate crisis and systemic inequities drive push to reform California water laws

LA Times, 2/13/22

## Newsom unveils long-term strategy to bolster California water supply



BY RACHEL BECKER  
AUGUST 11, 2022



Gov. Gavin Newsom outlined a strategy to bolster the state's shrinking water supply at a press conference with a desalination plant under construction in Anaheim on Aug. 11, 2022. Photo by Martin do Nascimento, CalMatters

Cal Matters, Aug 11, 2022

NEWS > ENVIRONMENT • News

## California drought: Water conservation increasing statewide, Bay Area saving more than Southern California

Statewide urban water use fell 7.6% in June, short of Gov. Gavin Newsom's 15% target, but double the savings in May



Mercury News, August 2, 2022

## Plan For Huntington Beach Desalination Plant Is Rejected By California Coastal Commission

By [Erin Stone](#) and [Lita Martinez](#)

Published May 13, 2022 9:54 AM

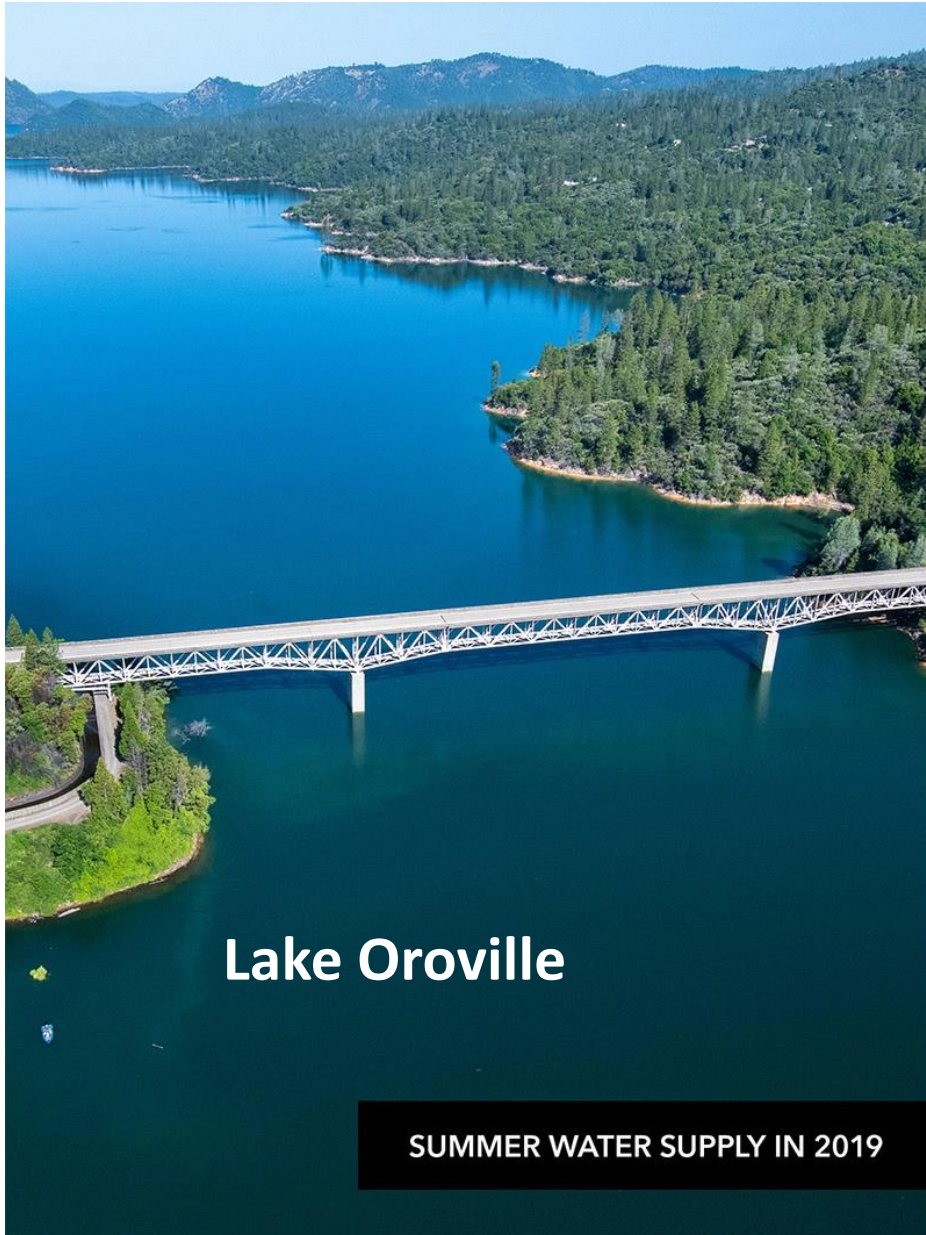


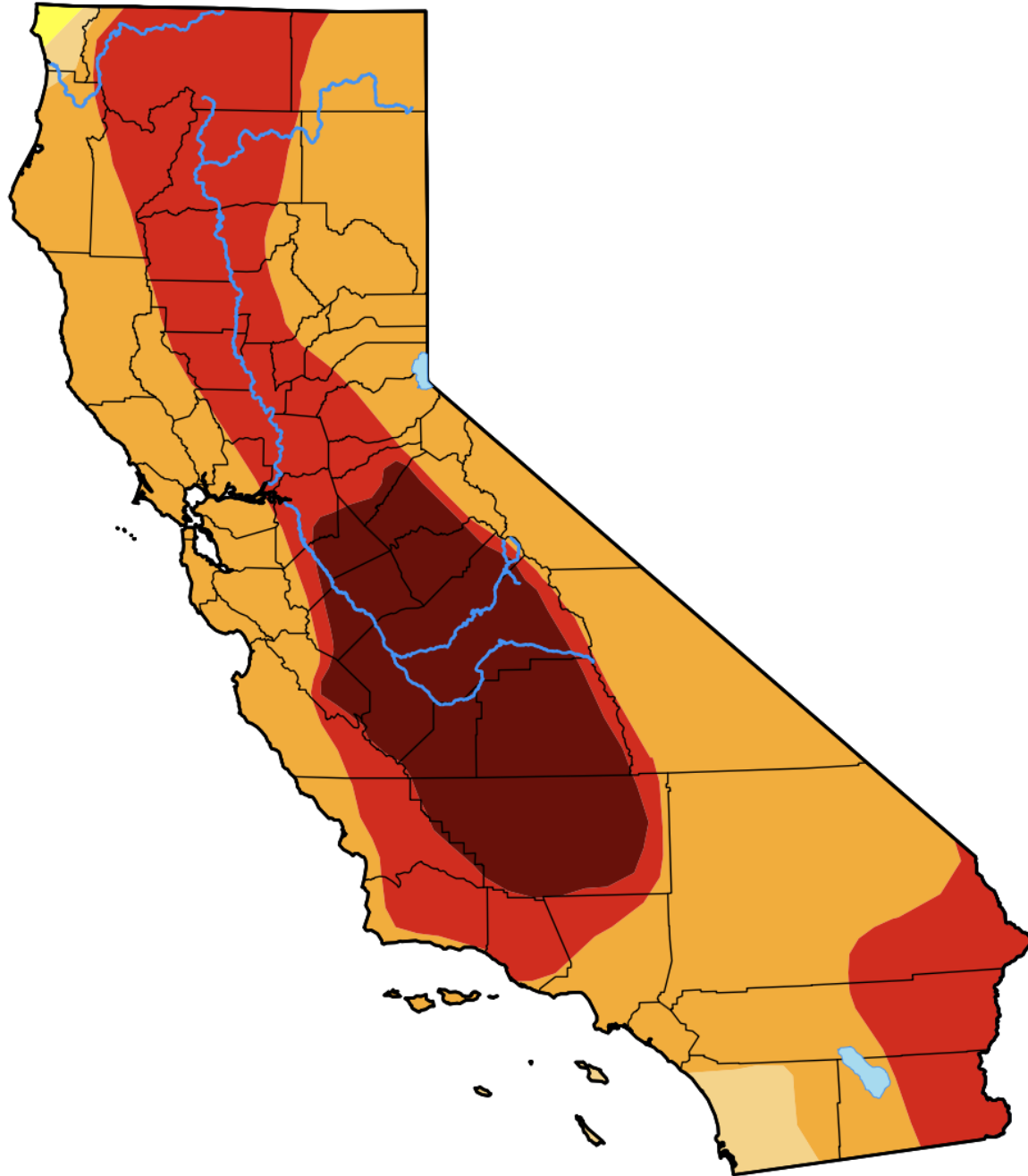
KPCC Public Radio, May 13, 2022











# We live in a semi-arid region





## Intensity

-  None
-  D0 (Abnormally Dry)
-  D1 (Moderate Drought)
-  D2 (Severe Drought)
-  D3 (Extreme Drought)
-  D4 (Exceptional Drought)

US Drought Monitor  
University of Nebraska  
Aug 16, 2022





# Architect of the Golden State

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Governor Edmond G. “Pat” Brown

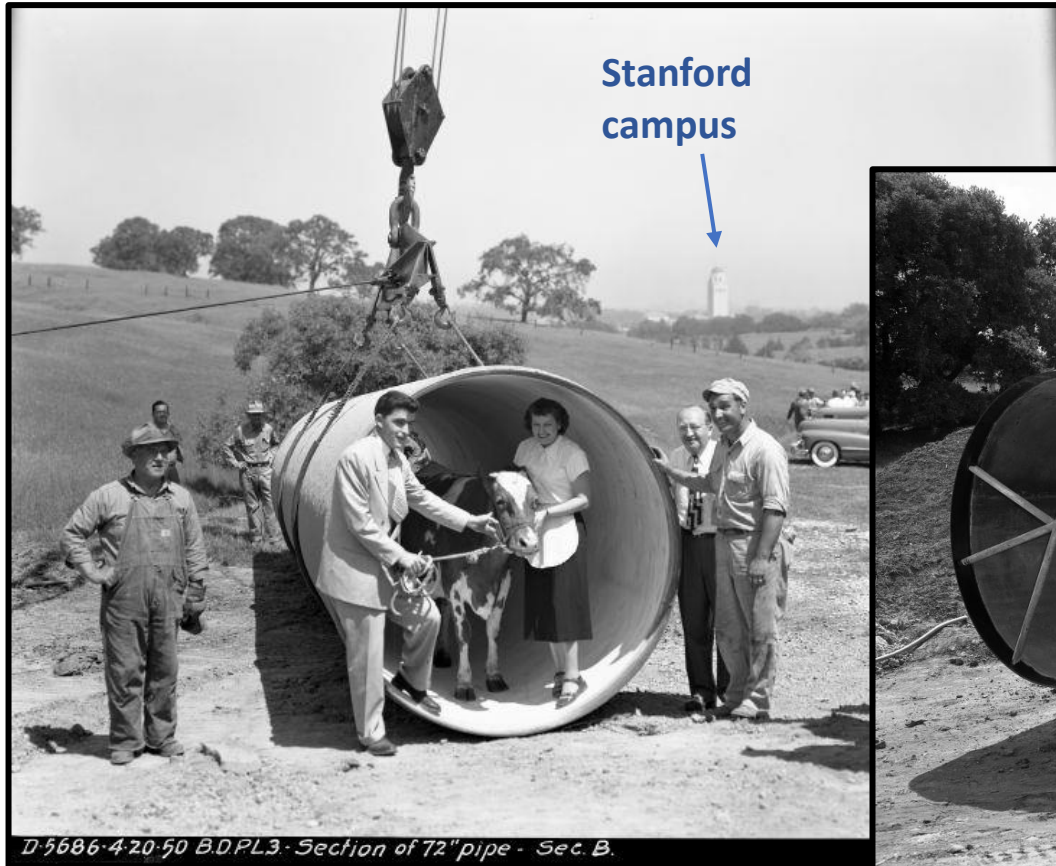
“Development of our water resources is crucial to every segment of our state— I will soon present a water program, which is rational, realistic and responsive to the needs of all the people of the state.”

First inaugural address, Jan. 5, 1959





# Hetch Hetchy & Stanford Bay Division Pipelines #3 & #4



Pipeline #3, 72", competed mid-1950s

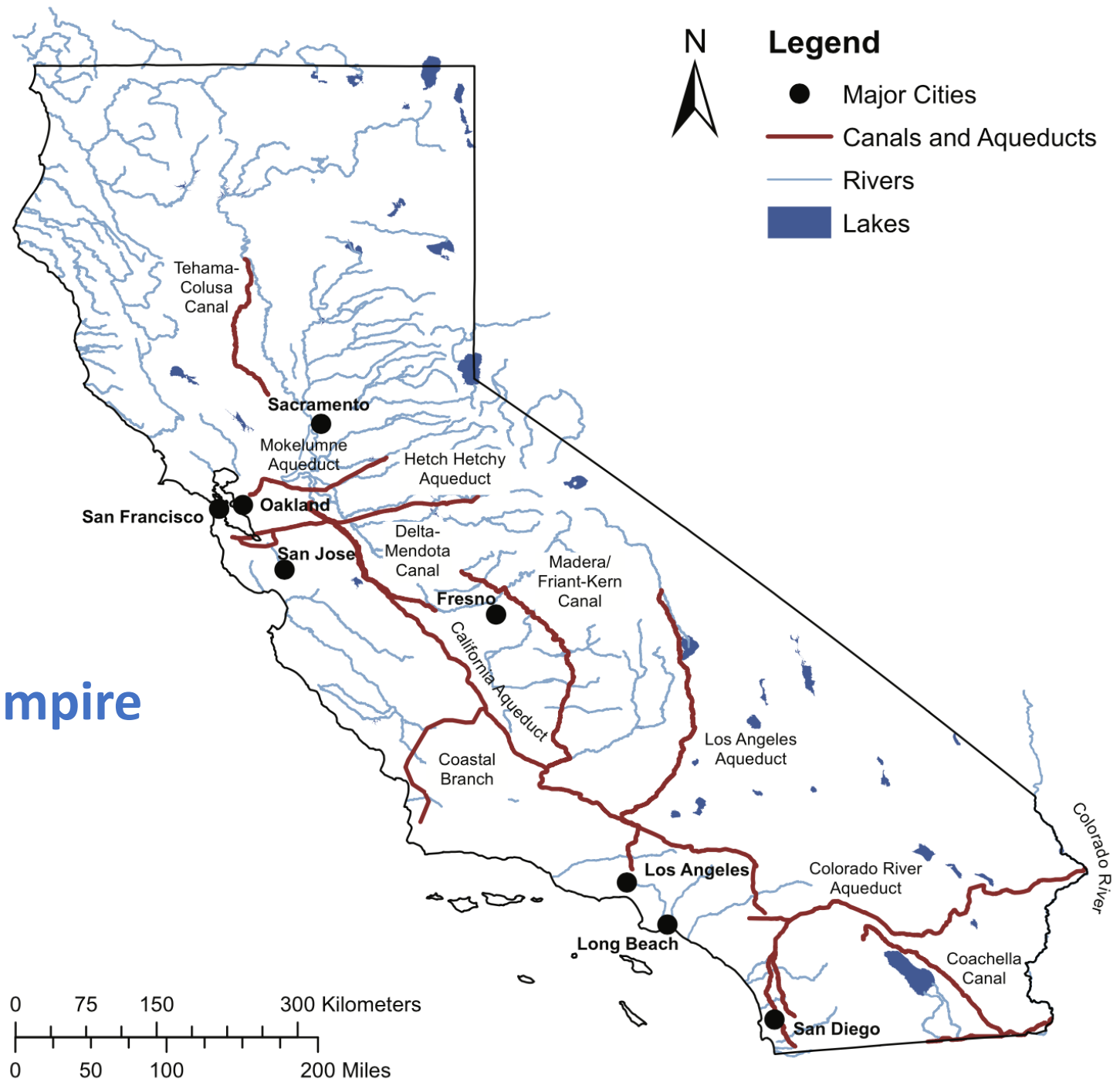


Pipeline #4, 90", May, 1964



# The 20<sup>th</sup> Century: Building the Aqueduct Empire

Luthy et al., *J Env. Eng.*  
146(7), July 2020







# Regional Imported Water System

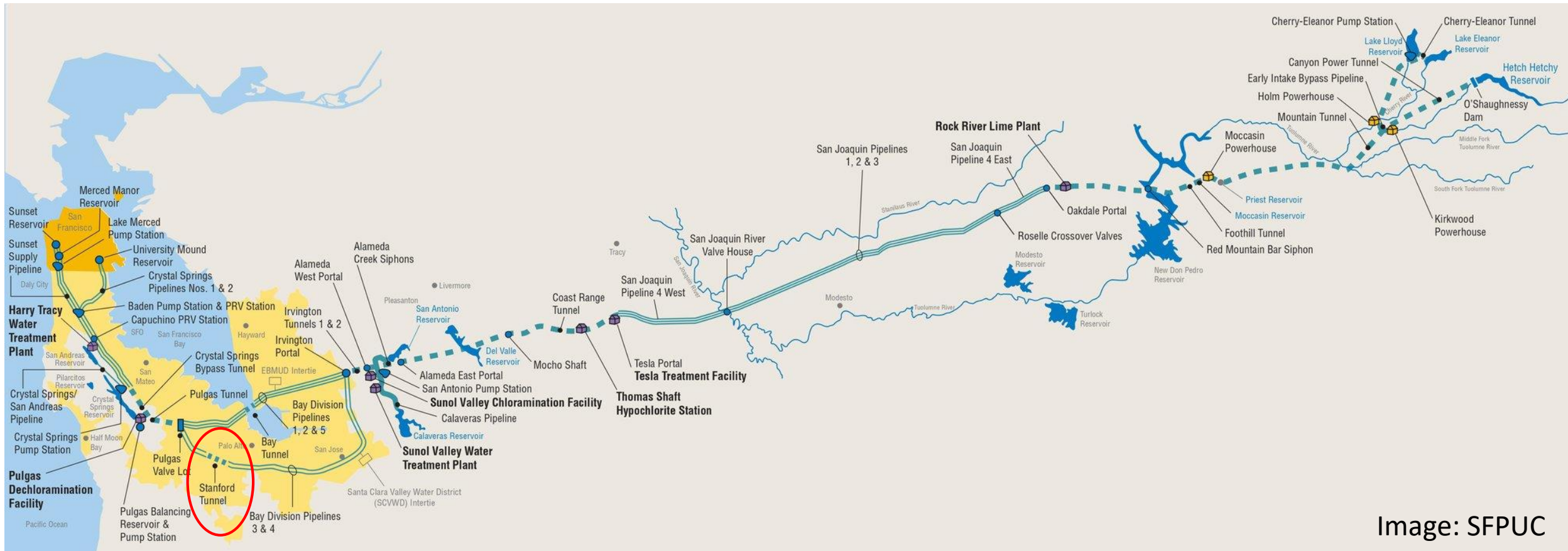


Image: SFPUC

~300 km



# Bay-Delta Plan

- Amendments adopted in 2018
- Applies to Stanislaus, Tuolumne & Merced Rivers
- Requires 40% unimpaired flow to remain in-stream during the months of February - June
- SFPUC expects to contribute 51.7% of new ecological flows

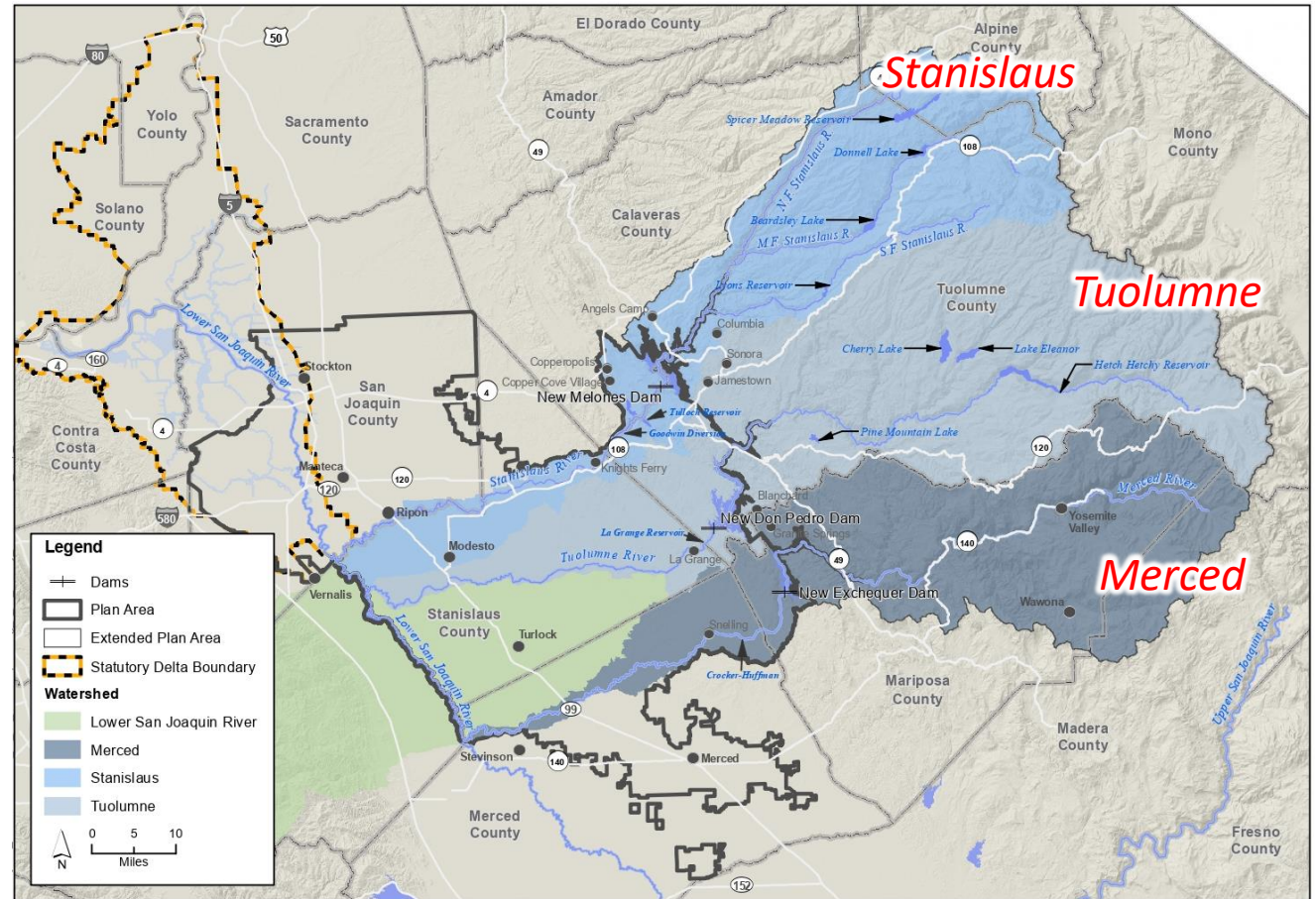


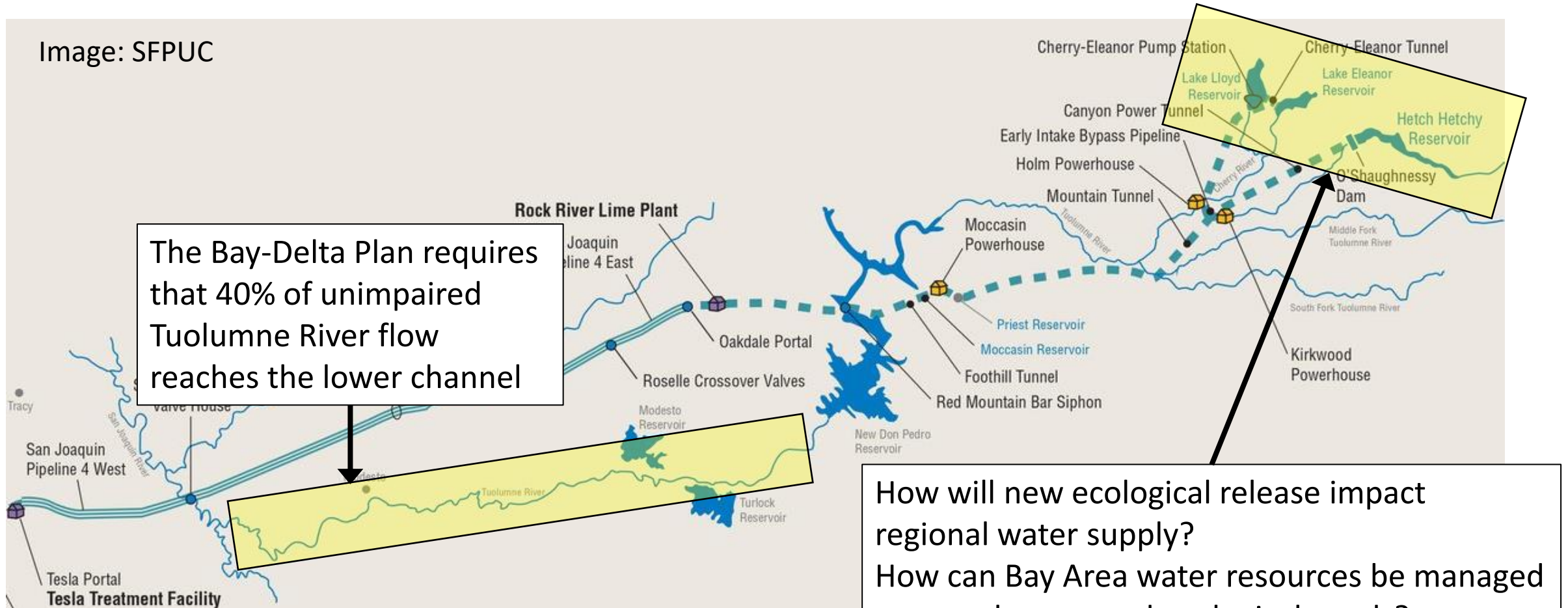
Image: SWRCB & CalEPA





# Tuolumne River System

Image: SFPUC







# All-of-the-above approaches

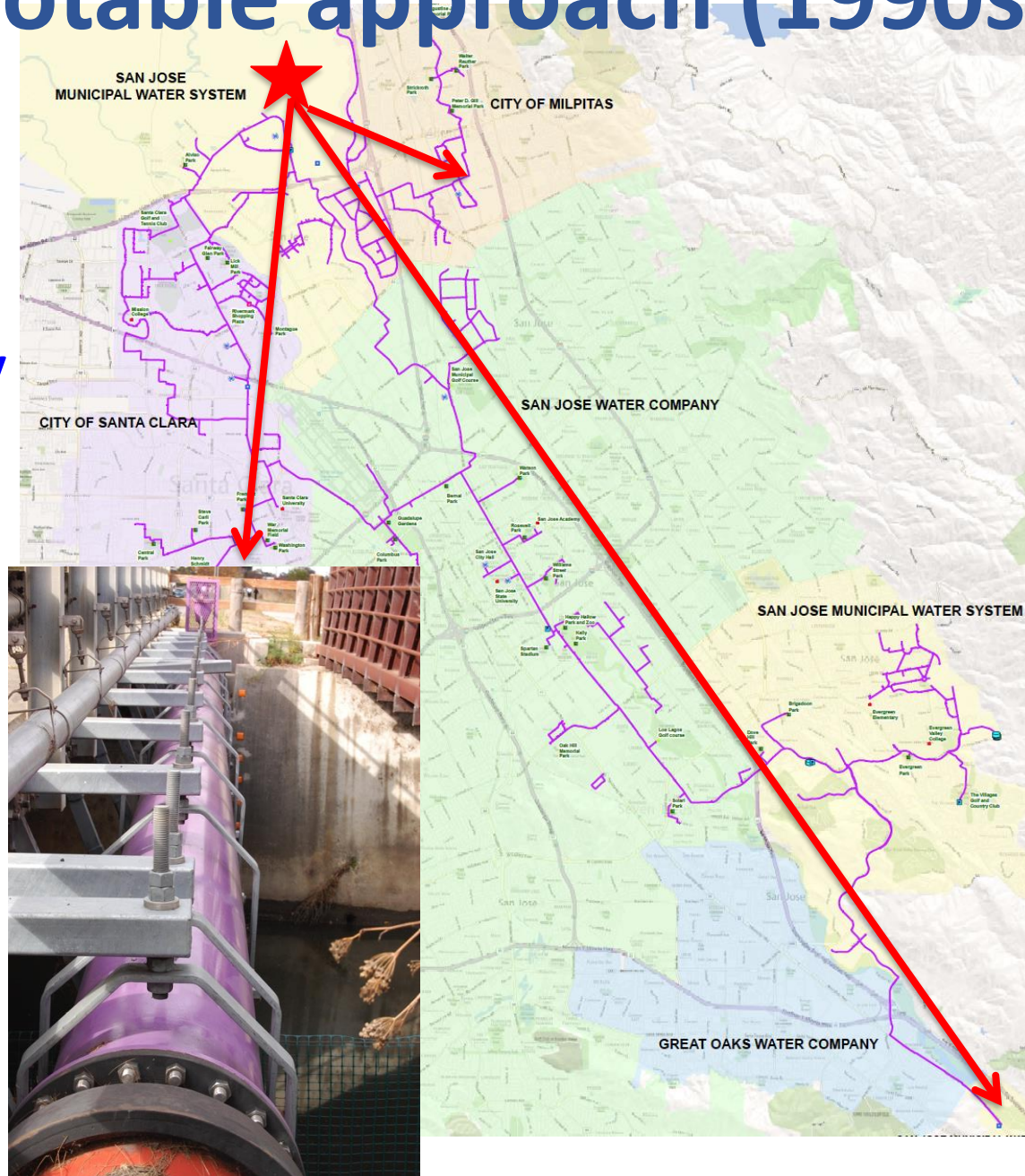




# Centralized non-potable approach (1990s)

- High cost
- \$2-5 million/mile
- Water is too salty
- Pumping water back up hill
- We can't lay enough pipe.

Bischel et al., *ES&T*, 46: 180, 2012







# Decentralized, efficient non-potable reuse

**Decentralized water  
reclamation**

**Reuse the water at the  
place where it is  
generated & needed**

**Main-stream anaerobic  
treatment with methane  
capture & energy savings**

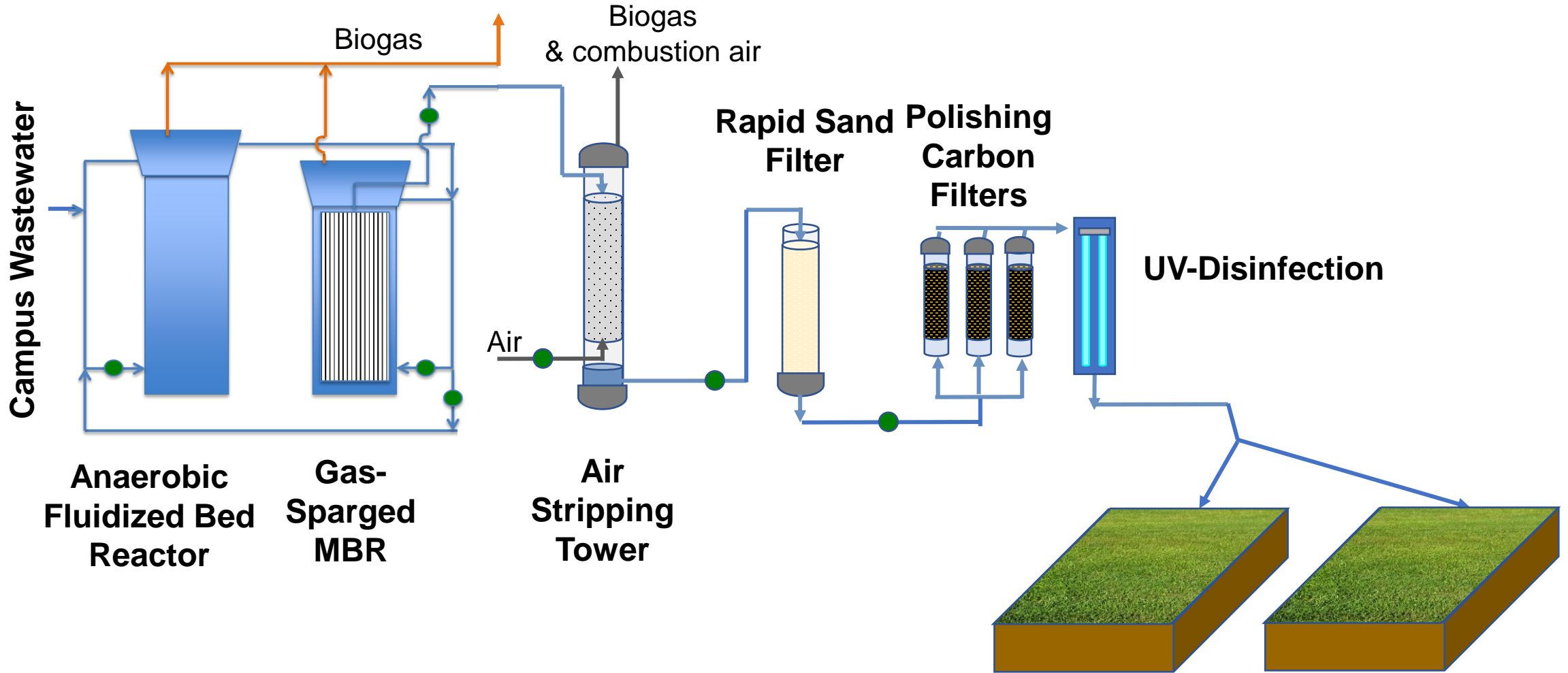


Codiga Center: Stanford demonstration facility





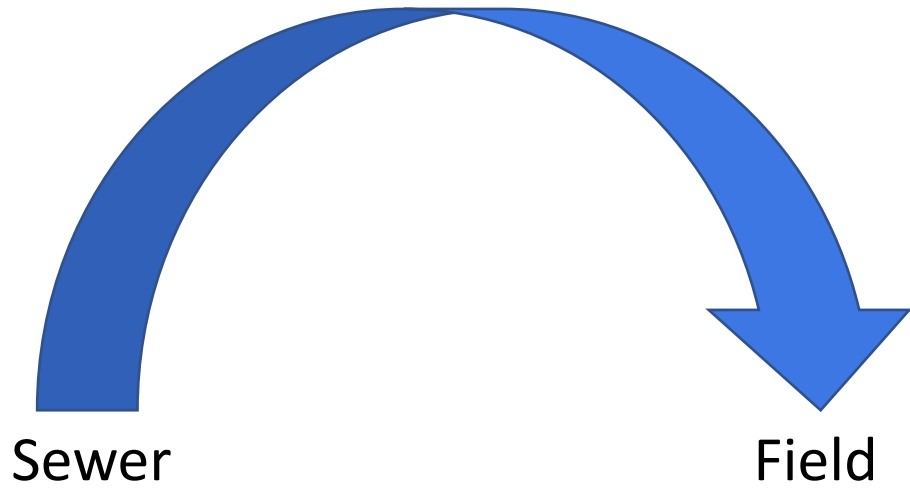
# Innovative, efficient non-potable reuse



Galdi et al., 2022

Irrigation Testbeds

# Water recycling at the Codiga Resource Recovery Center

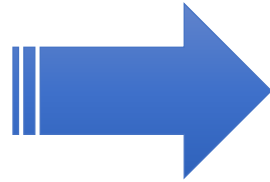






# Innovative, efficient non-potable reuse

**Decentralized  
water reclamation**



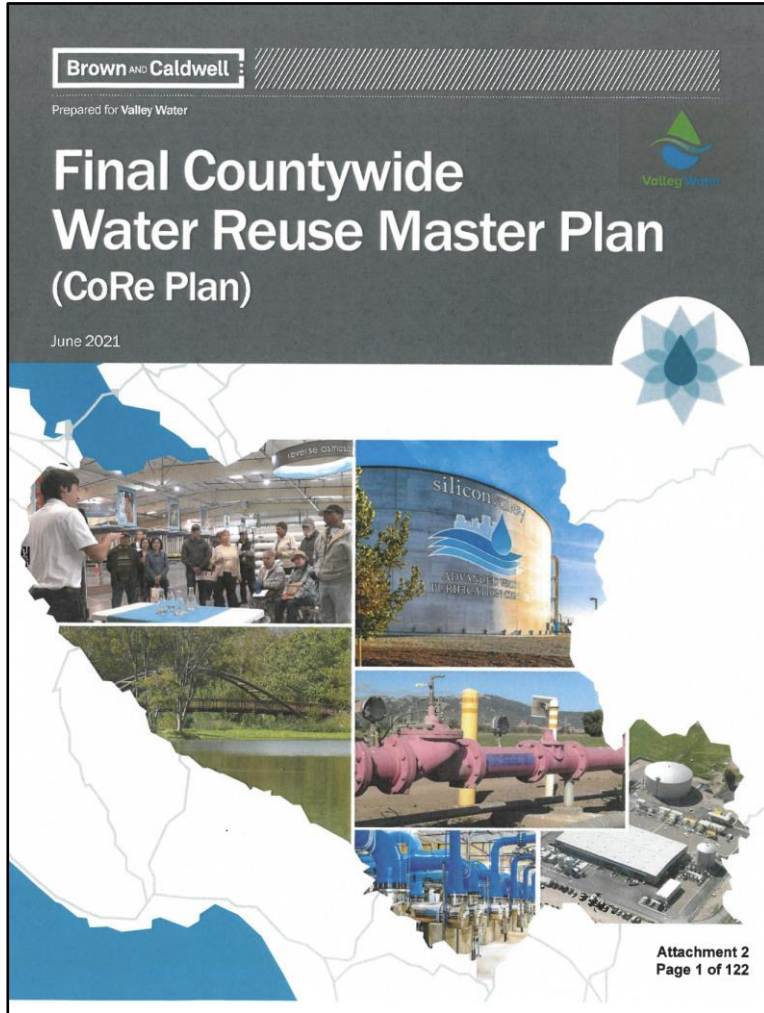
**Augment Stanford's  
non-potable distribution system**



Demonstration project  
planned for controlled  
application & monitoring



# Potable reuse



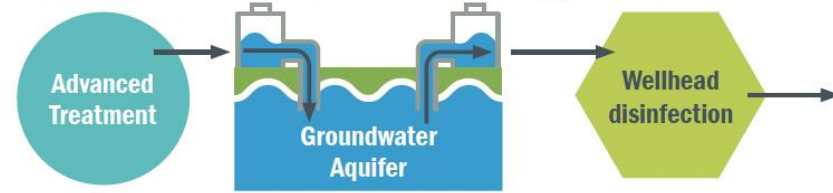
Valley Water District, County Water Reuse Master Plan, June 2021

## Indirect Potable Reuse

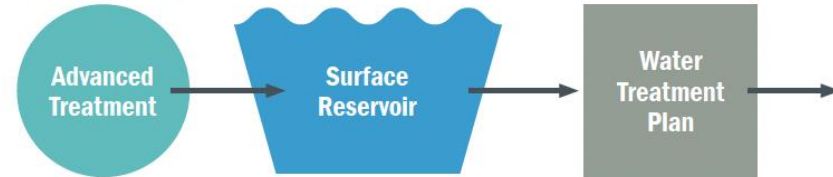
Groundwater recharge: Surface Spreading\*



Groundwater recharge: Subsurface Injection



Surface Water Augmentation



Raw Water Augmentation



Treated Water Augmentation



## Direct Potable Reuse





# Indirect potable reuse

Full advanced treatment (FAT) following conventional wastewater treatment



**Microfiltration**



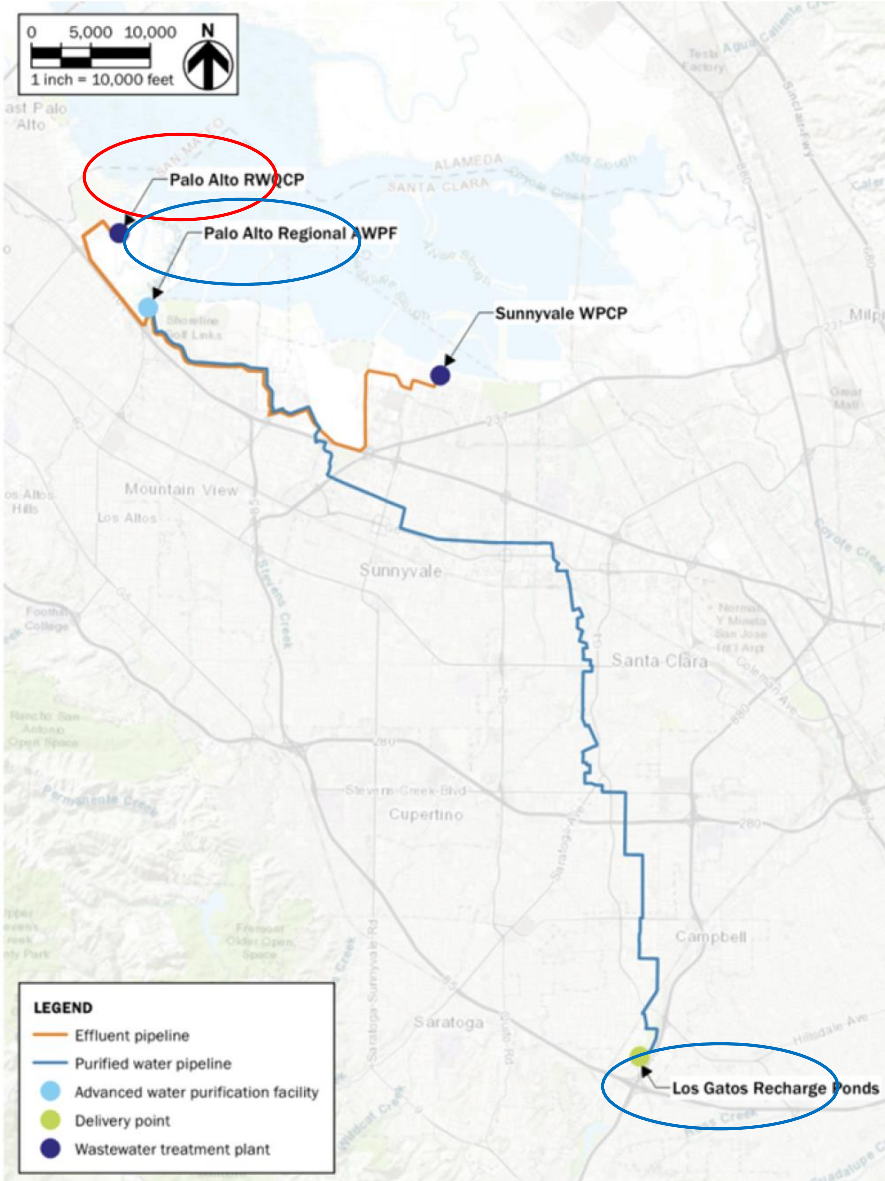
**Reverse osmosis**



**UV & advanced oxidation**



# Indirect potable reuse from Palo Alto

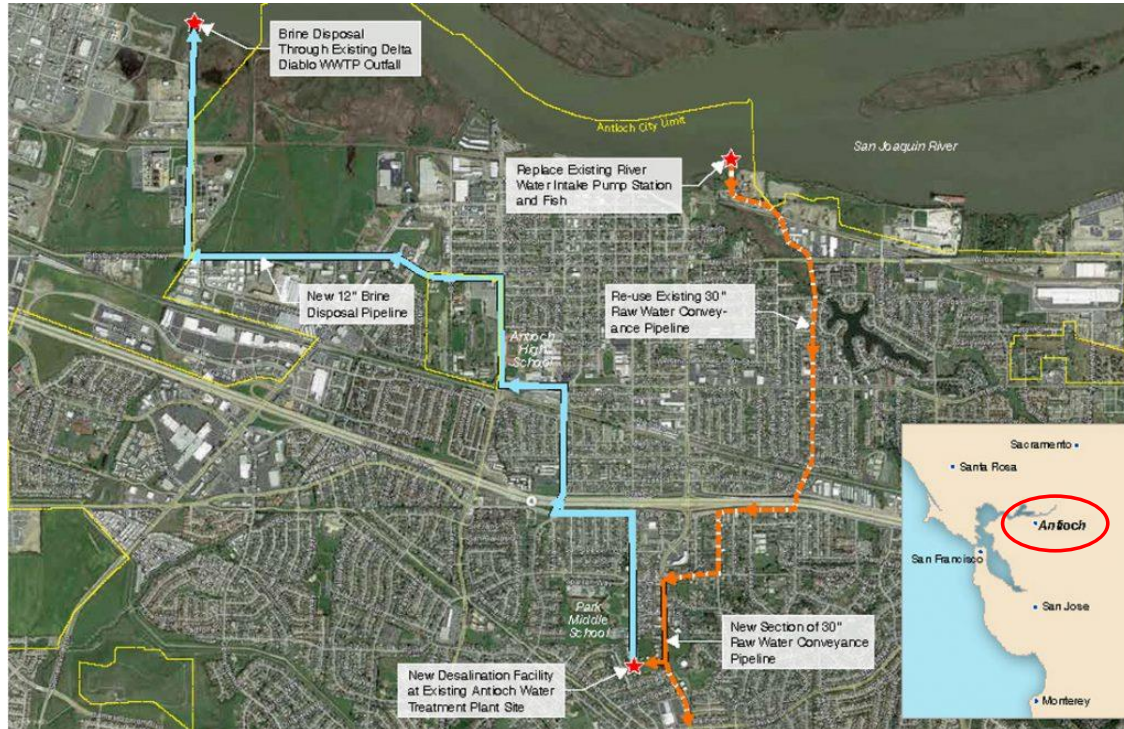


- 10 mgd (11,200 AFY) (38,000 m<sup>3</sup>/d)
- 36-in, 20 mile pipeline to recharge ponds in Los Gatos
- \$520 million capital costs
- \$2,700-3,600 AF (~\$2.60/m<sup>3</sup>)
- 60% is pipeline costs
- Future: 24 mgd with add'l from PA plus Sunnyvale, \$240 M expansion





# Desalination: brackish water



Antioch, CA  
Brackish water desalination (new 2022)  
6 mgd (23,000 m<sup>3</sup>/d)  
\$110M capital costs

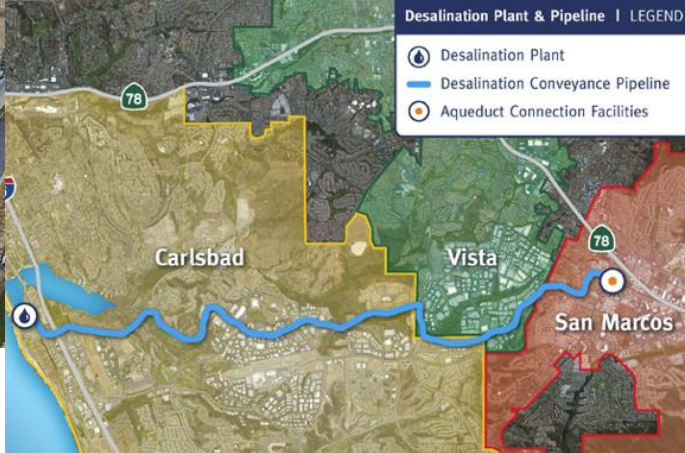


10 MGD brackish water RO plant  
Alameda County Water District, CA





# Desalination: sea water



San Diego Carlsbad seawater desalination plant—50 mgd, \$1B

## Despite Record Drought, Coastal Board Rejects Huntington Beach Desal Plant

by Reuters  
May 12, 2022

Share this: [Twitter](#) [Facebook](#) [Reddit](#) [Pinterest](#) [Email](#) [Print](#)



50 mgd, \$1.4 B, ~\$2,800/AF





# Stormwater capture: Improved dry well design, Los Angeles



Laurel Canyon Blvd, Los Angeles  
Los Angeles Dept. of Water & Power



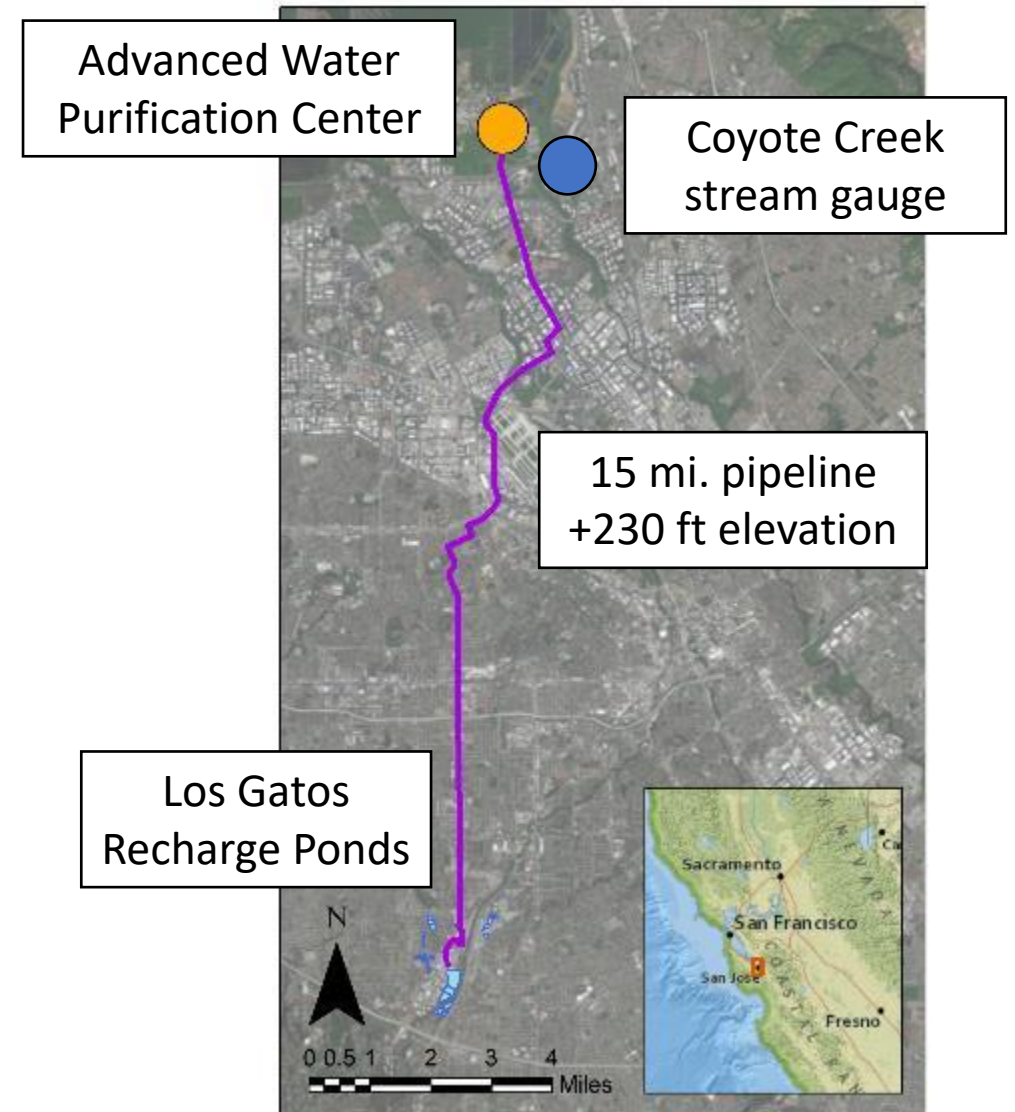
# Stormwater contribution to water supply

- Urban runoff could contribute ~10,000 AFY to Los Gatos recharge
- Centralized stormwater capture, treatment & recharge offers significant quantities compared to other stormwater options
- Costs (\$600-1800/AF) are highly dependent on treatment train

Method and tool development:

Bradshaw et al. 2019 *ES&T*, 53(6), pp. 3128

Bradshaw et al., 2019 *WRR*, 55(3), pp. 2446







# Coyote Creek sampling

- Many compounds not detected
- A few detections at low levels:
  - PFOA and PFOS
  - Benzotriazole (corrosion inhibitor)
  - Diuron (herbicide)
  - Heavy metals
  - Caffeine (wastewater indicator)



	PFOA	PFOS
Notification Level	5.1 ppt	6.5 ppt
Response Level	10 ppt	40 ppt



# Stormwater contribution to water supply

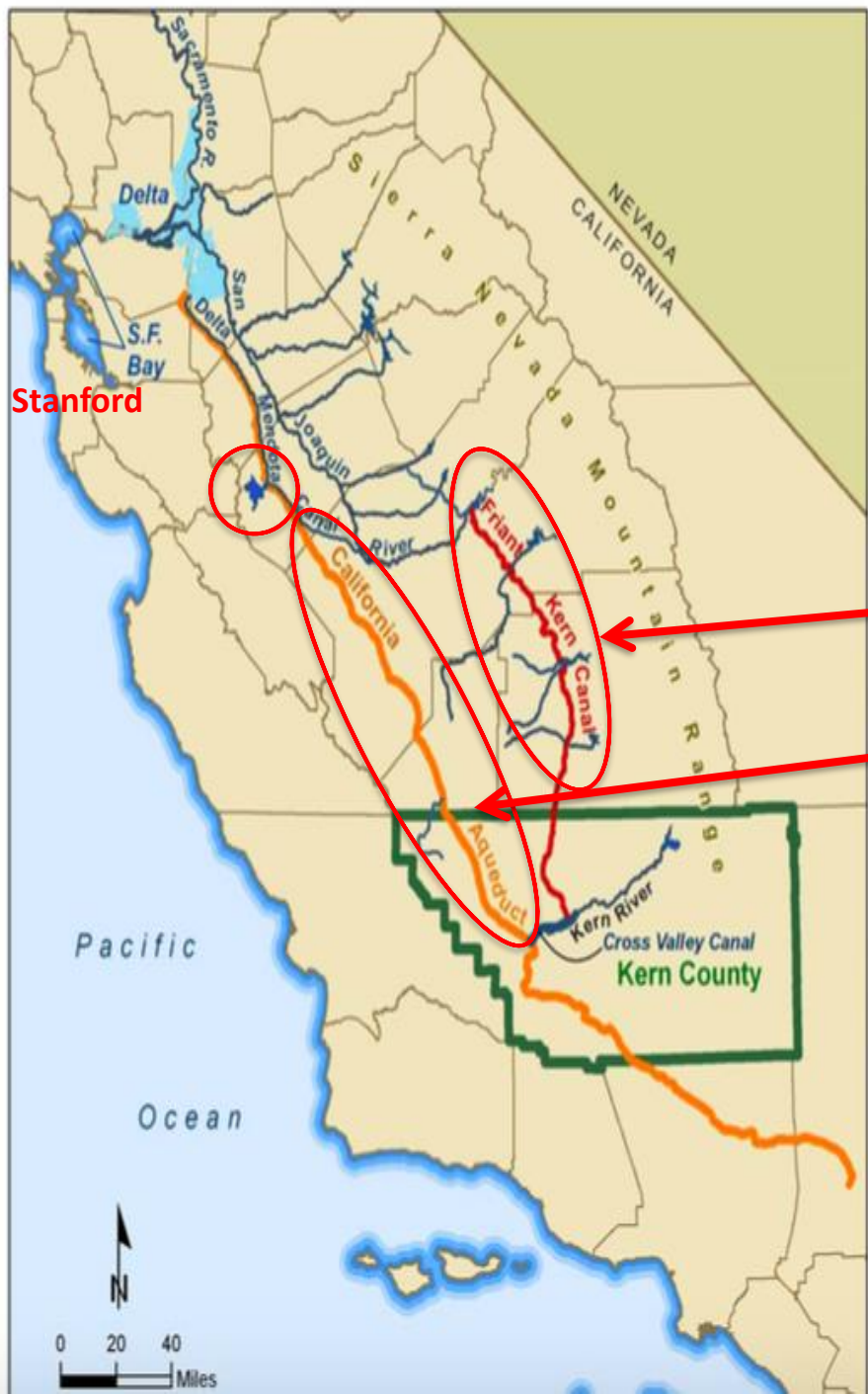


Evaluation of media for sorption of trace contaminants from urban runoff



Pritchard et al.,  
*ES&T Au*, 2022





# Water banking

Subsurface storage with favorable geology & regional connections

Fraint-Kern Canal

California Aqueduct



Banked water from out-of-basin sources

Luthy et al., *J Env. Eng.*  
146(7), July 2020



# Water banking

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- Water stored with exchanges via CA aqueduct



Isela Medina, Staff Engineer  
Semitropic Water Storage District

**Today:** Kern County:  
water storage for  
Santa Clara County:  
350,000 acre-ft  
(~400 million m<sup>3</sup>)

**Future:** distributed  
smaller-scale,  
Merced and Turlock  
Irrigation Dist. &  
SFPUC





# Take-home messages

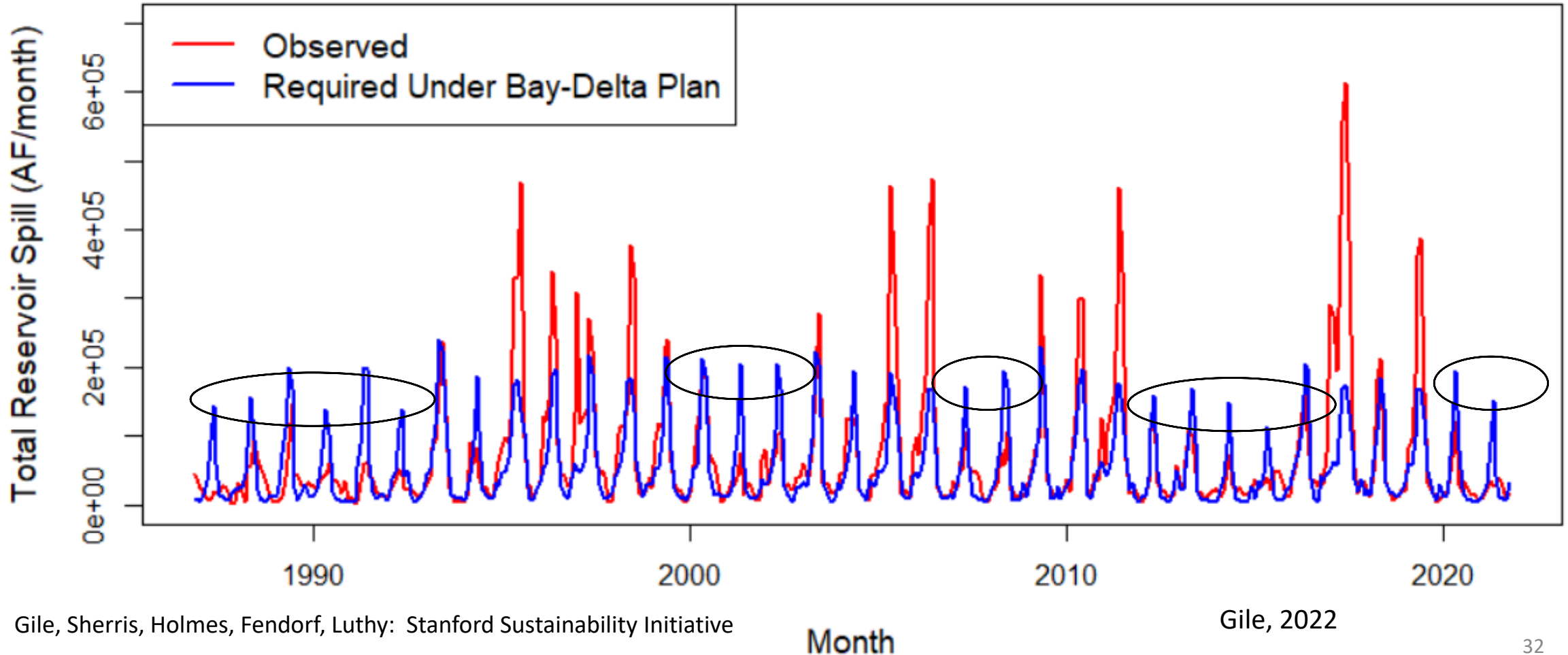
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- **We have quite a few challenges**
  - **Climate change**
  - **Population and economic growth**
  - **Competing needs, esp. ecosystem flows**
  - **Older systems and institutions**
  
- **There isn't a single issue or answer**
  
- **Work collaboratively—hopeful outcomes!**
  - **New systems and management regimes that diversifies our water supply portfolio**



# Tuolumne River System with 40% flow

Comparison between (1) historical reservoir spill and (2) reservoir spill requirement with the Bay-Delta Plan in effect (including water rights)







## Irrigated Agriculture in CA



Carrots, Imperial Valley, CA



Orchards &  
Friant-Kern Canal, near Visalia, CA  
San Joaquin Valley



# Atmospheric River

CALIFORNIA TODAY

## *Why the 'Big One' Could Be Something Other Than an Earthquake*

A new report finds that climate change has increased the risk of a monthlong superstorm.



### THE COMING CALIFORNIA MEGASTORM

A different 'Big One' is approaching. Climate  
change is hastening its arrival.

By **Raymond Zhong** | Graphics by **Mira Rojanasakul**  
Photographs by **Erin Schaff**

Aug. 12, 2022



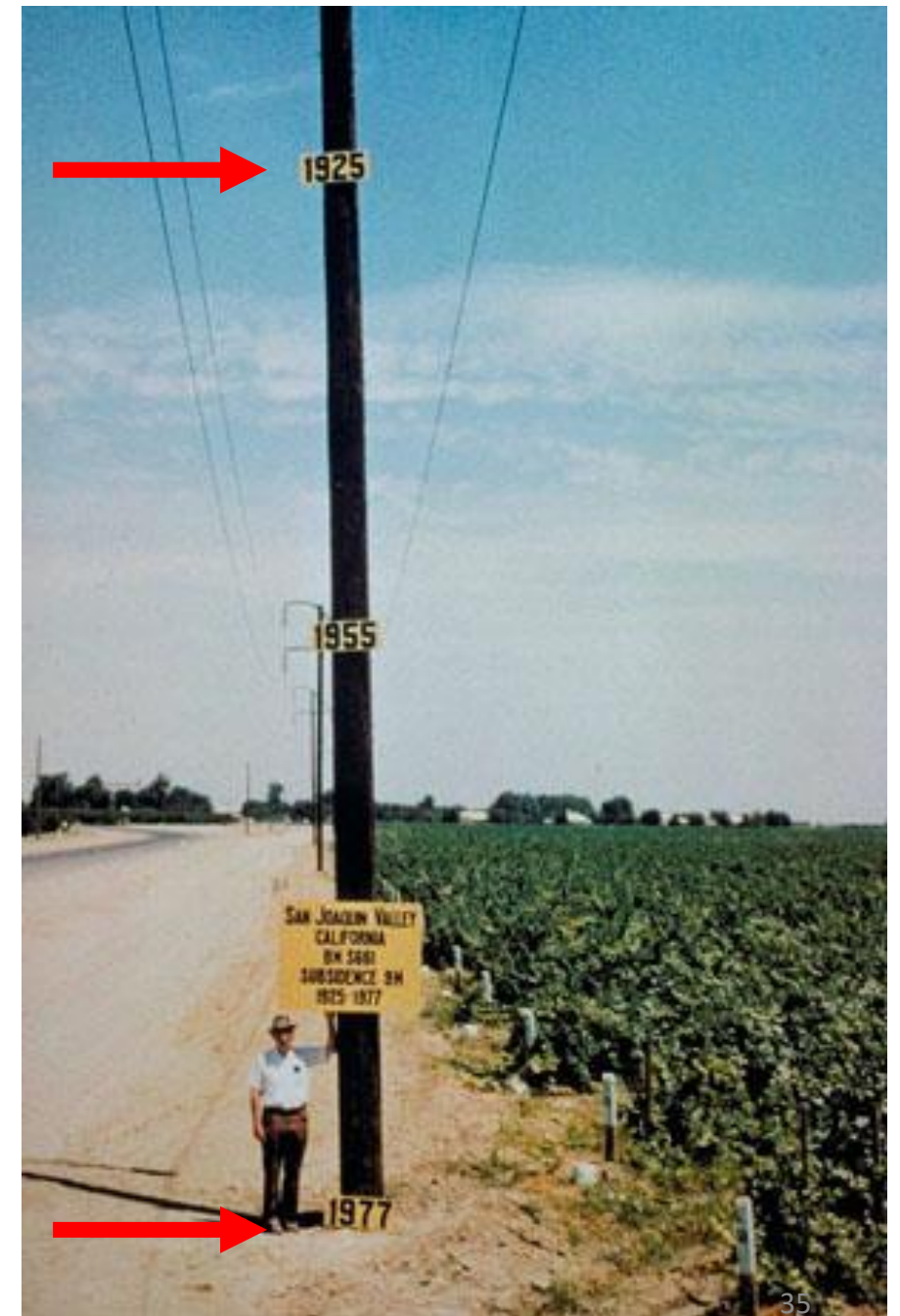


# Land subsidence

## Groundwater over-drafting

*Subsidence 10 miles southwest of Mendota, CA. Sign reads "San Joaquin Valley California, BM S661, Subsidence 9M, 1925-1977"*

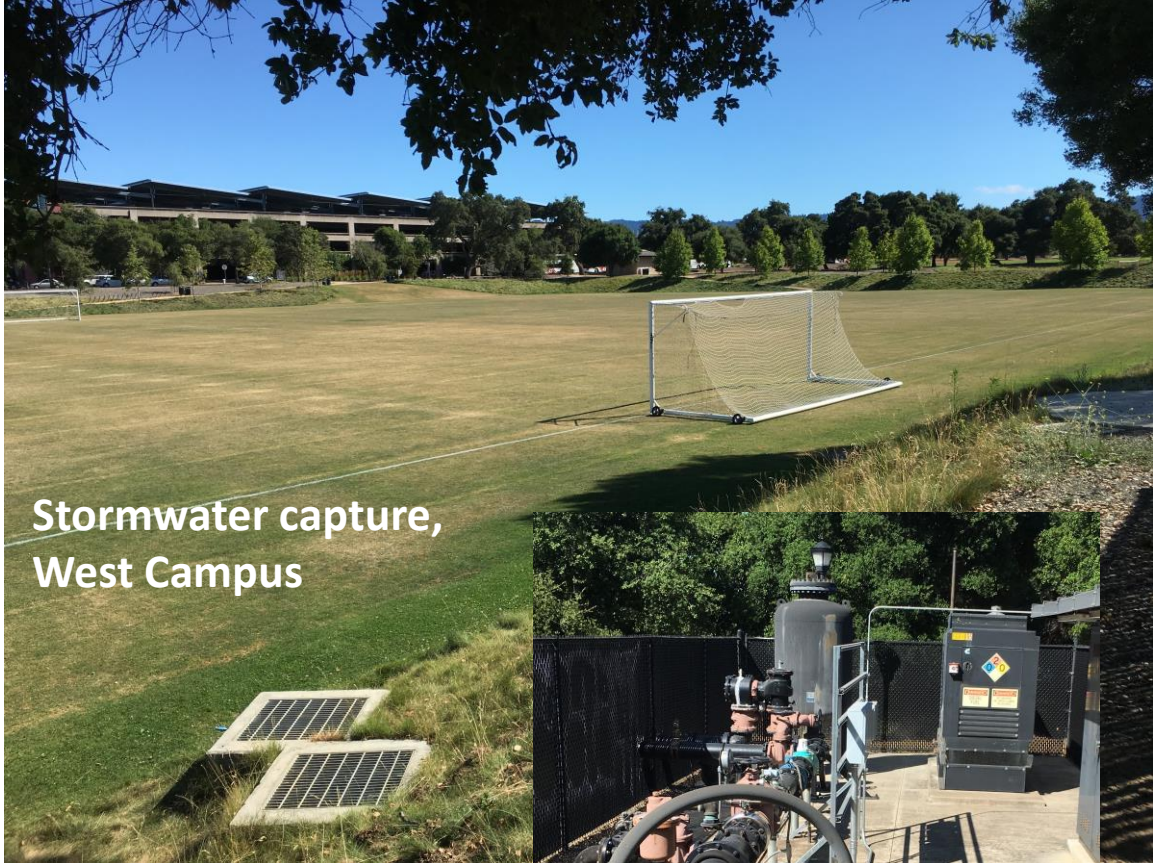
*USGS Professional Paper 1401-A, "Ground water in the Central Valley, California- A summary report"  
Photo by Dick Ireland, USGS, 1977*







# Stormwater capture and pumped storage Stanford Campus Lake Water System



Stormwater capture,  
West Campus



Stormwater capture,  
East Campus



Pumped storage to Felt Lake

robertsiegel@stanford.edu

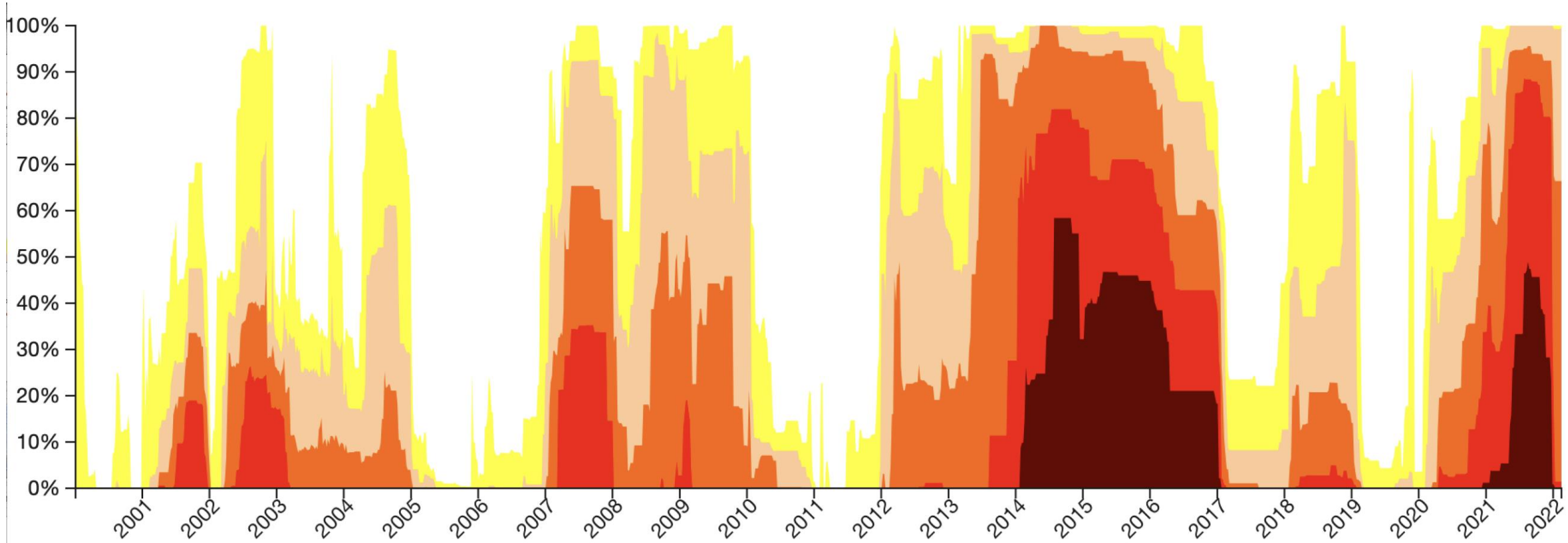




# Climate change & drought for CA

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Percent of area for California





## *In a First, U.S. Declares Shortage on Colorado River, Forcing Water Cuts*

Arizona farmers will take the initial brunt, but wider reductions loom as climate change continues to affect flows into the river.

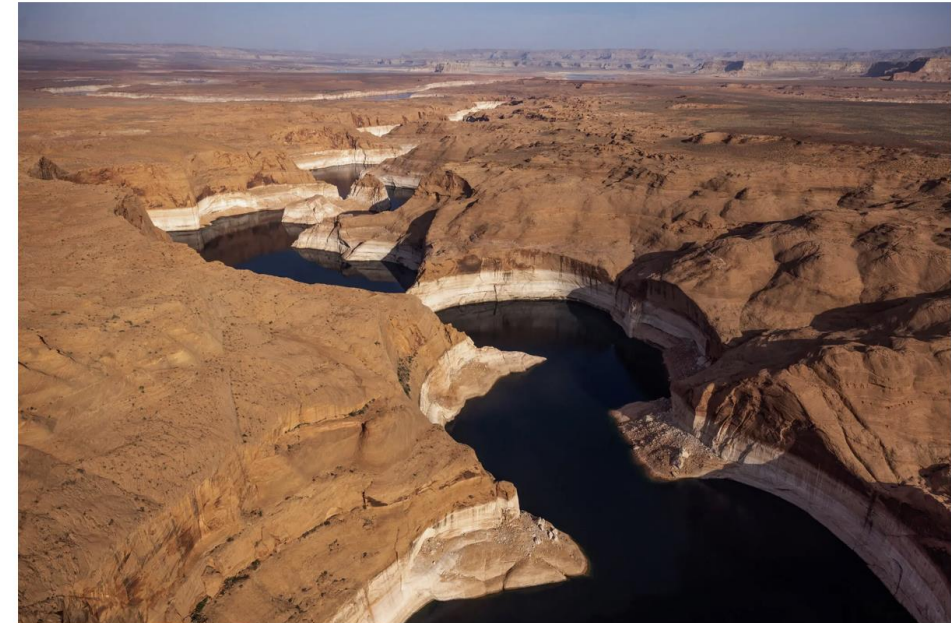
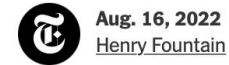


Years of drought have severely depleted the reservoirs that feed the Colorado River, and deeper restrictions on water use are expected. "Additional actions will likely be necessary in the very near future," a senior official said.

Patrick T. Fallon/Agence France-Presse — Getty Images

NY Times, Aug 16, 2021

## **A New Round of Colorado River Cuts Is Announced**



The water levels of Lake Powell, behind the Glen Canyon Dam near the Arizona-Utah border, could drop so low next year that the dam could no longer generate hydropower. Caitlin Ochs/Reuters

NY Times, Aug 16, 2022





Sacramento Bee, Aug 17, 2022

### Gavin Newsom clashes with California environmentalists on climate, water

#### Newsom: Desalination project should be approved — “We need more damn tools in the toolkit”

Final vote by California Coastal Commission on \$1.4 billion Orange County plant could influence other desalination projects statewide



San Jose Mercury  
April 29, 2022



#### California water: New \$16 billion Delta tunnel plan released by Newsom administration

Supporters say plan will keep water supply viable in climate change; opponents worry it will be a costly water grab



Cal Matters  
June 22, 2022  
San Jose Mercury  
July 27, 2022



CITY AND COUNTY OF SAN FRANCISCO



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March 16, 2017

Via Hand Delivery

Jeanine Townsend  
Clerk to the Board  
State Water Resources Control Board  
1001 "T" Street, 24th Floor  
Sacramento, CA 95814-0100



Public Comment  
2016 Bay-Delta Plan Amendment & SED  
Deadline: 3/17/17 12:00 noon

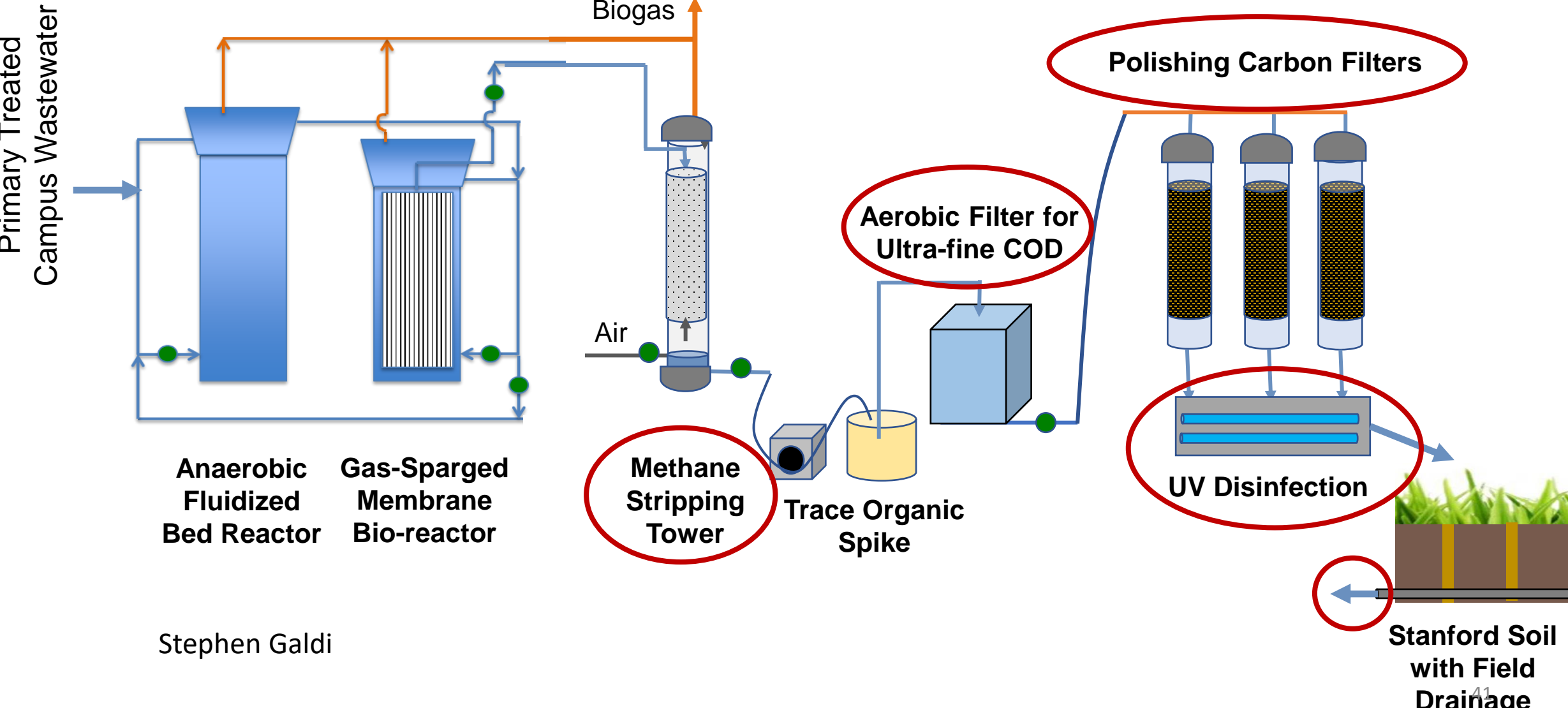
**Re: Comments by the City and County of San Francisco to the State Water Resources Control Board's Draft Substitute Environmental Document in Support of Potential Changes to the Bay-Delta Plan.**

SFPUC in this 2017 comment letter: assuming a six year drought with 1987-1992 hydrology, a 40% unimpaired flow requirement would result in about 120,00 – 130,000 acre-ft per year shortage.





# Water reuse on the Stanford campus



Stephen Galdi