

*-----in Civilizations.....*

**“Demography is Destiny”**  
*French philosopher Auguste Comte*



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....but for California's historical  
development...

“Geography is Destiny”



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- Geography:

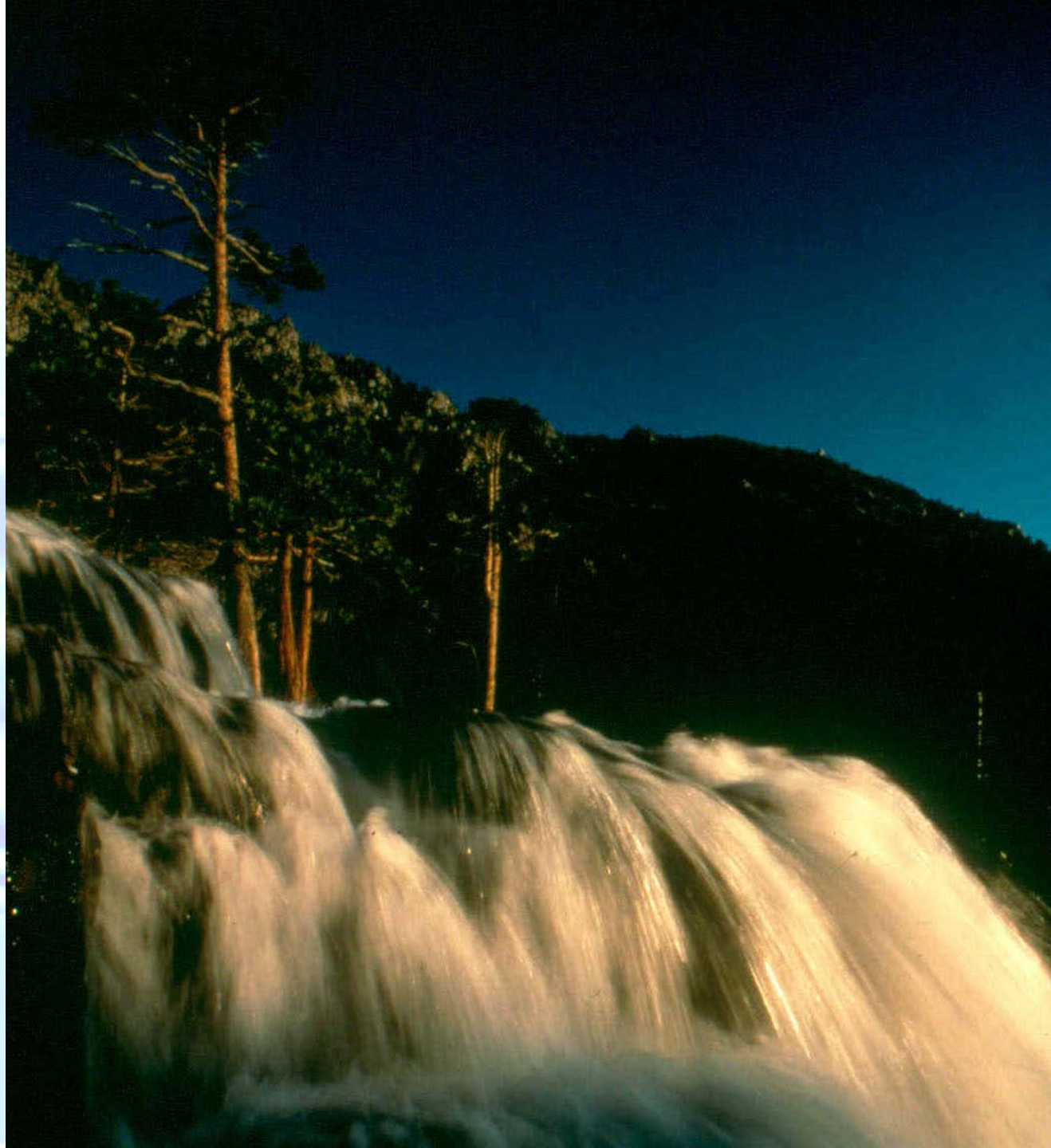
- Determined location of resources leading to California's development

- Gold
    - Arable land
    - Early irrigation systems
    - Natural harbors
    - Film industry (locations and weather)
    - WWII industrialization – economic geography

AND, WATER



**The story  
of  
California  
is the  
story of  
water.**





The Gold Rush was the start of a philosophy of putting California's water to work





# Hydraulic Mining

1853 - Used powerful jets of water to blast away hillsides



Malakoff Diggins (South Yuba River) - mined 100,000 tons of gravel per day and used 16 billion gallons (32,000 acre-feet) of water per year.

11 million ounces of gold (worth \$9.7 billion) by the mid-1880s.





## Arteries of Commerce

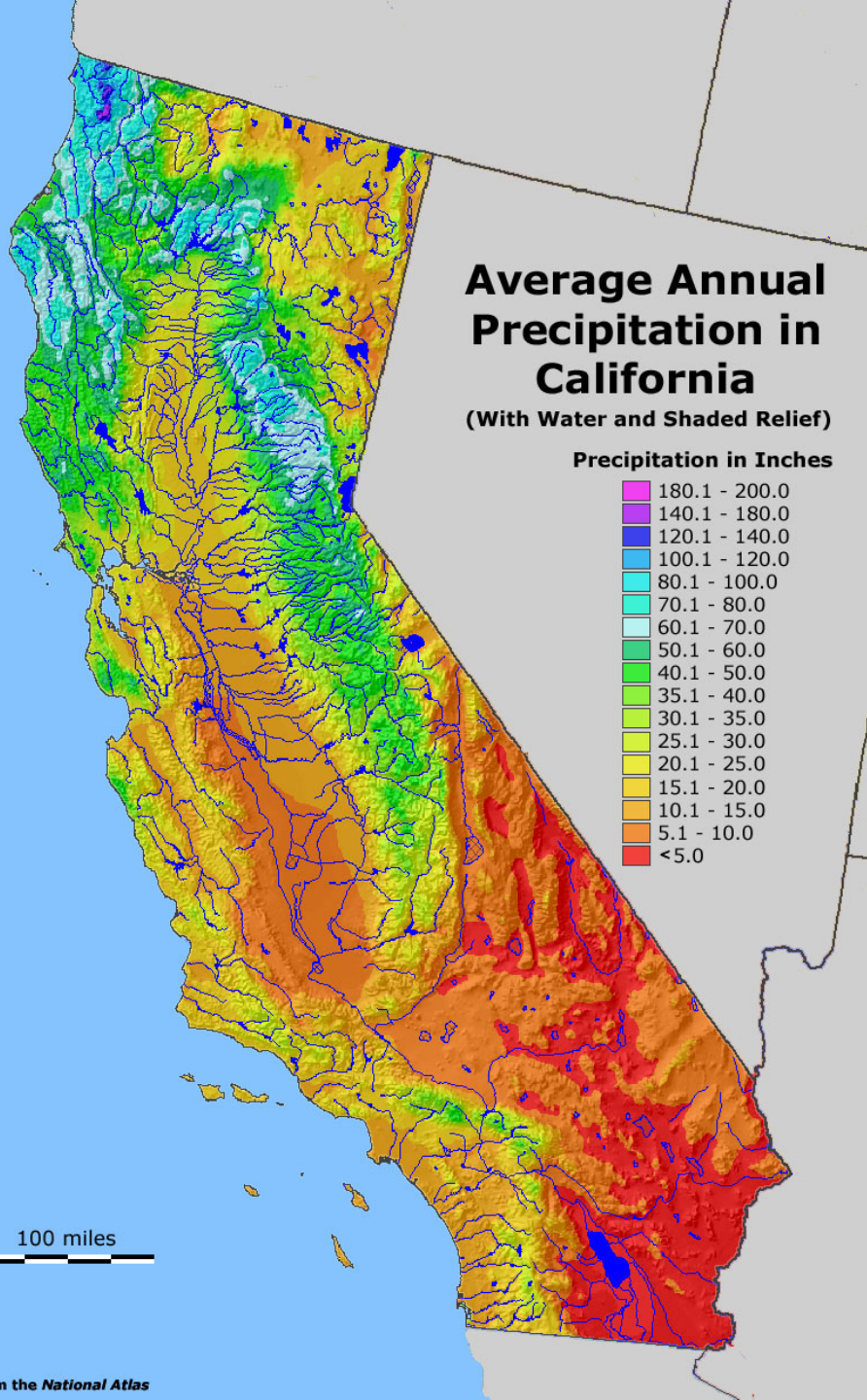






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# California Hydrology



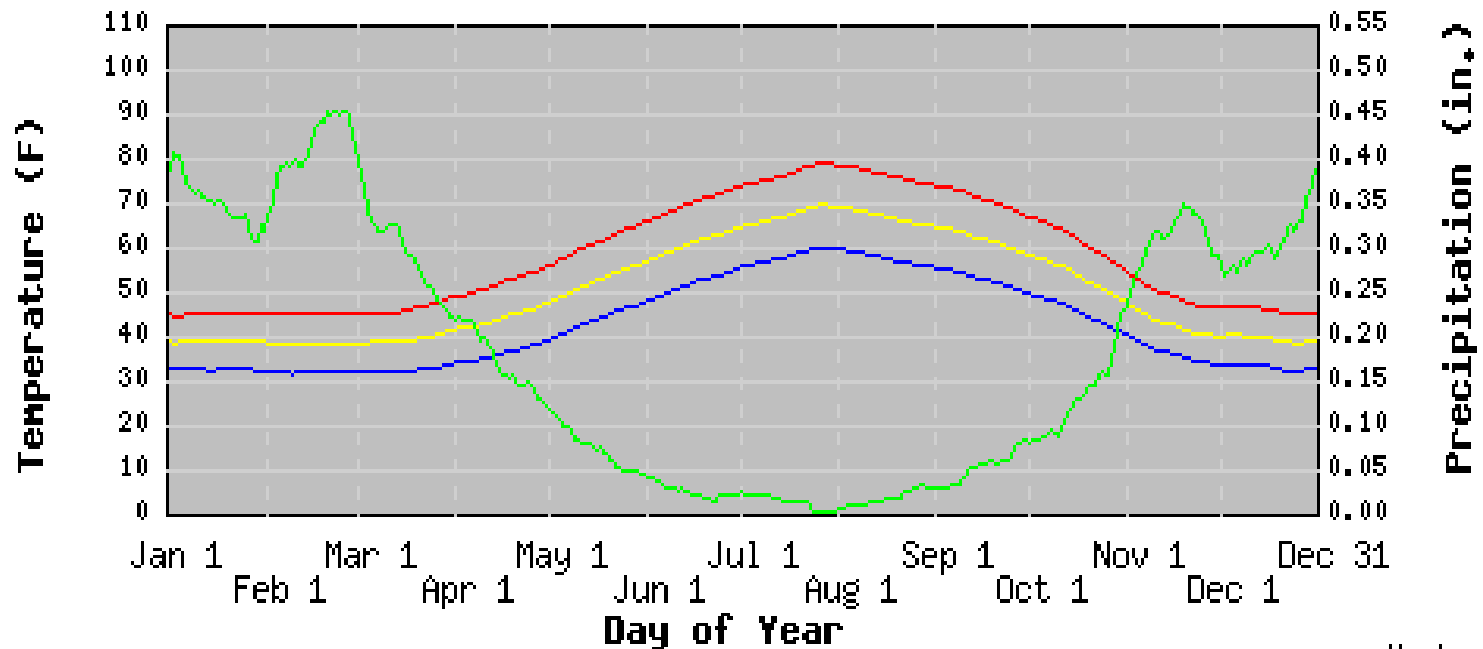
Wet in north  
Dry in south

Greatest population  
in south



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BLUE CANYON, CALIFORNIA (040897)  
1971-2000 30 Year Average

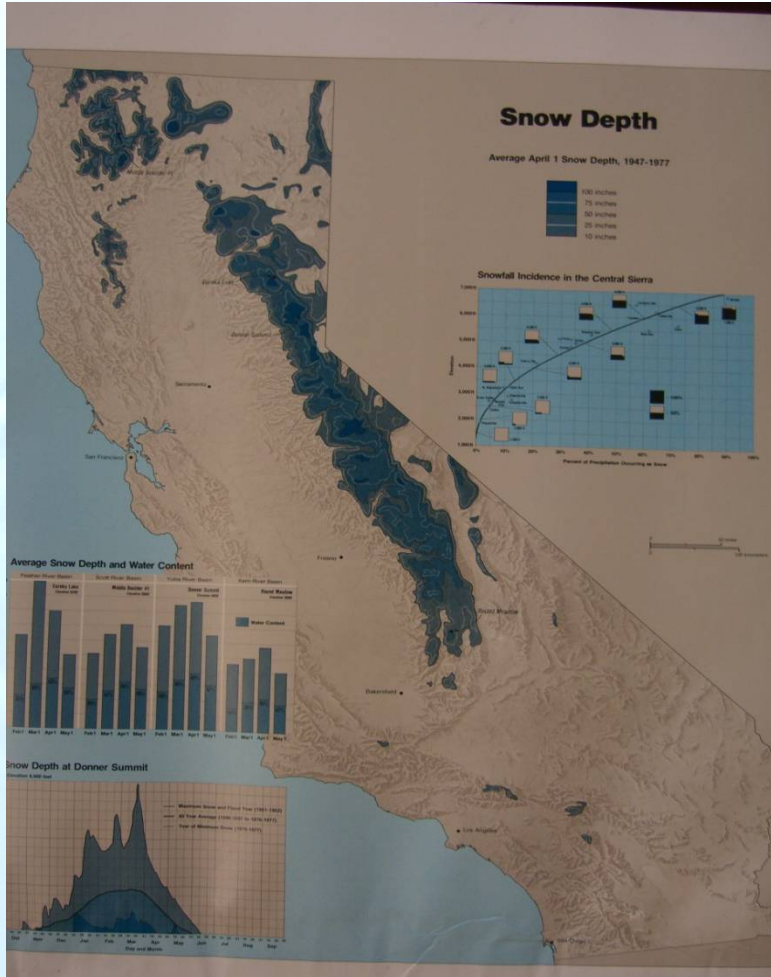


— Max Temp — Ave Temp — Min Temp — Precipitation

Western  
Regional  
Climate  
Center

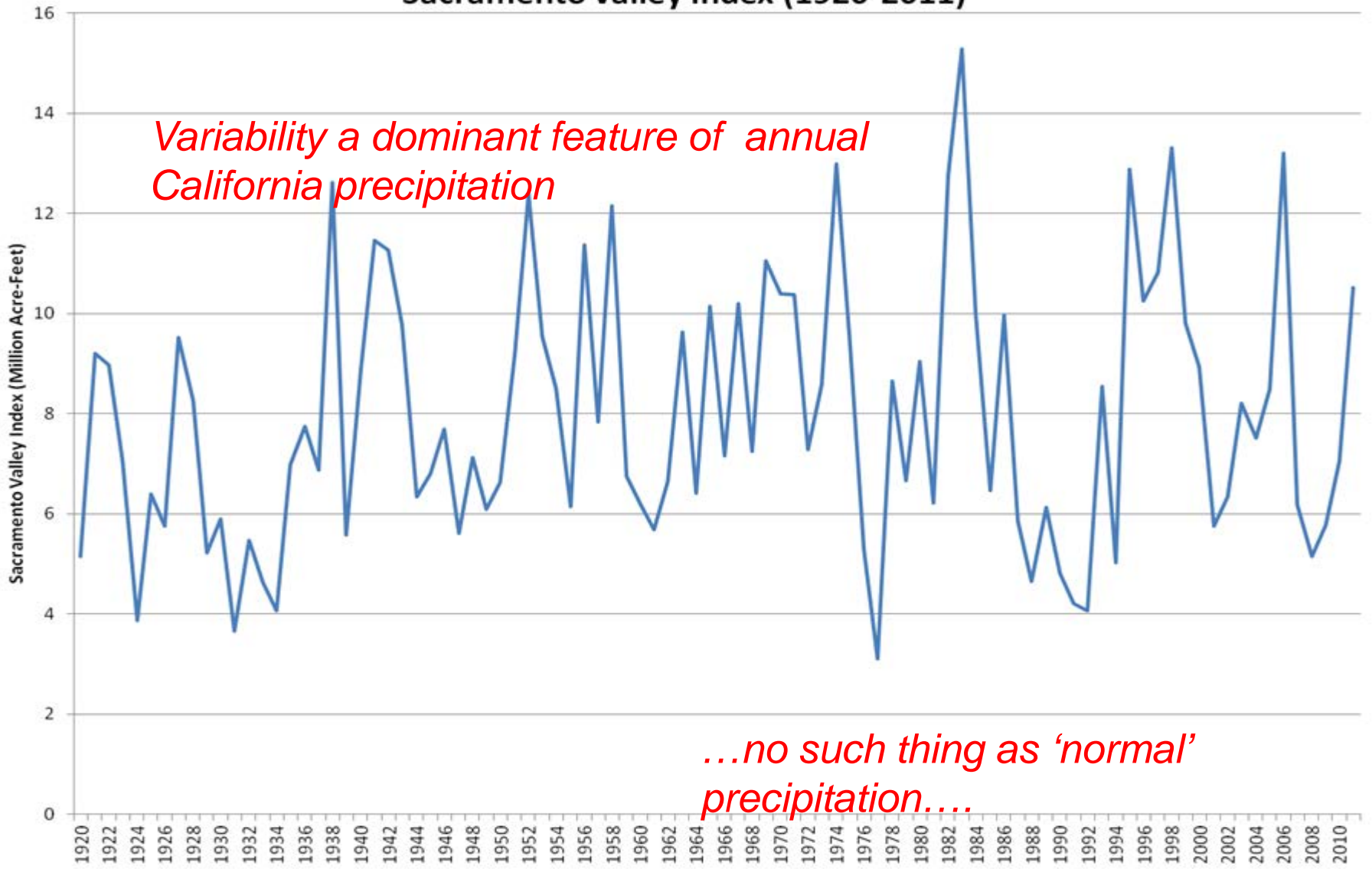


# California Hydrology



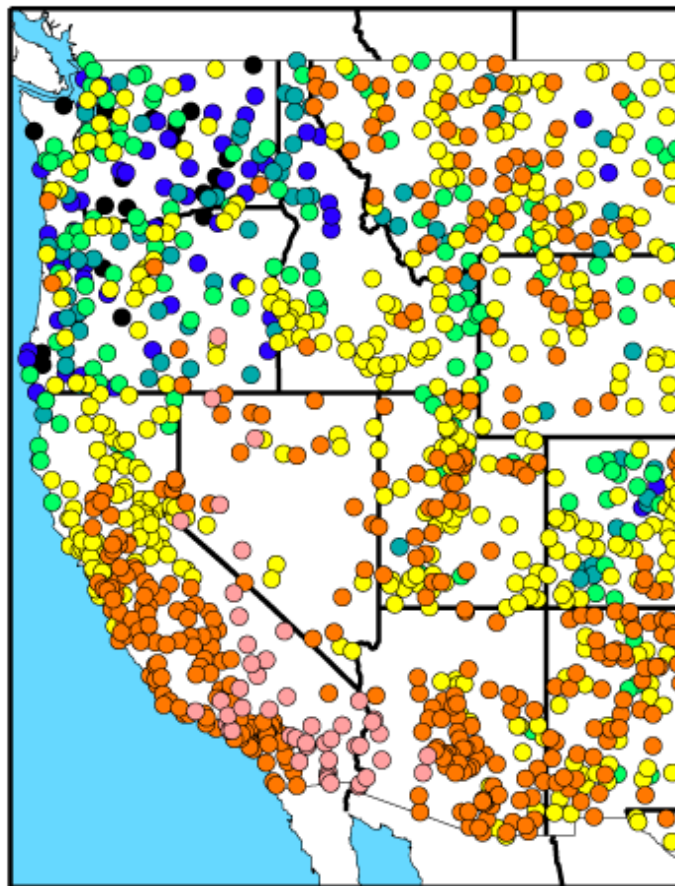
- Mediterranean climate – dry summers, mild winters
- In average year, 82 million acre-feet of water used for agriculture, environment and cities
- More precipitation in north than south, reverse of population location

## Sacramento Valley Index (1920-2011)

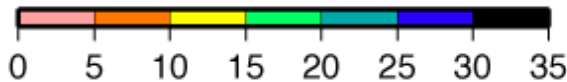


# Just a few storms each year are the core of California's water supplies

c) AVERAGE NUMBER OF DAYS/YR TO OBTAIN HALF OF TOTAL PRECIPITATION, WY 1951-2008



days/year



# The Great Projects



They were built to alleviate drought. They were built to protect against floods. And as California boomed, projects were built to generate electricity and move the water from where it occurred to where it could provide the most benefit for a booming economy – in the fields and cities.

*A*t the turn of the century, John Muir played an influential role in gaining national park status for the beautiful Yosemite Valley. But the conservationist – standing posed with President Theodore Roosevelt high above Yosemite Valley – failed to win protection for another valley just to the north, the Hetch Hetchy Valley.

The city of San Francisco selected Hetch Hetchy in 1901 as the place to dam the Tuolumne River, conveying

its pristine water by gravity to San Francisco.

Controversy over developing the valley, which was within the confines of Yosemite National Park, brewed for decades with the fight against the project led by conservationist and Sierra Club founder Muir.

In 1913, Congress passed the Raker Act, authorizing the project. Muir died two years later and in 1923, with completion of O'Shaughnessy Dam, the Hetch Hetchy Valley was flooded. •

# California Water Development



**Hetch Hetchy System**  
**San Francisco PUC**  
1913 - Raker Act

**Los Angeles Aqueduct**  
**Los Angeles DWP**  
1913

**Mokelumne River Aqueduct**  
**East Bay MUD**  
1929

**Central Valley project**  
**U.S. Bureau of Reclamation**  
1940 (C.C. Canal first)

**Colorado River Aqueduct**  
**MWD of So. Cal.**  
1941

**State Water Project**  
**California DWR**  
1960 - Burns Porter Act



# Major Water Projects



# Federally Funded Projects

- 35 federally funded dams, reservoirs and canals. Built by U.S. Army Corps of Engineers and U.S. Bureau of Reclamation



Shasta Dam

- Central Valley Project (CVP), which begins on the Sacramento River at Shasta Dam and ends near Bakersfield.



# Federally Funded Projects - CVP



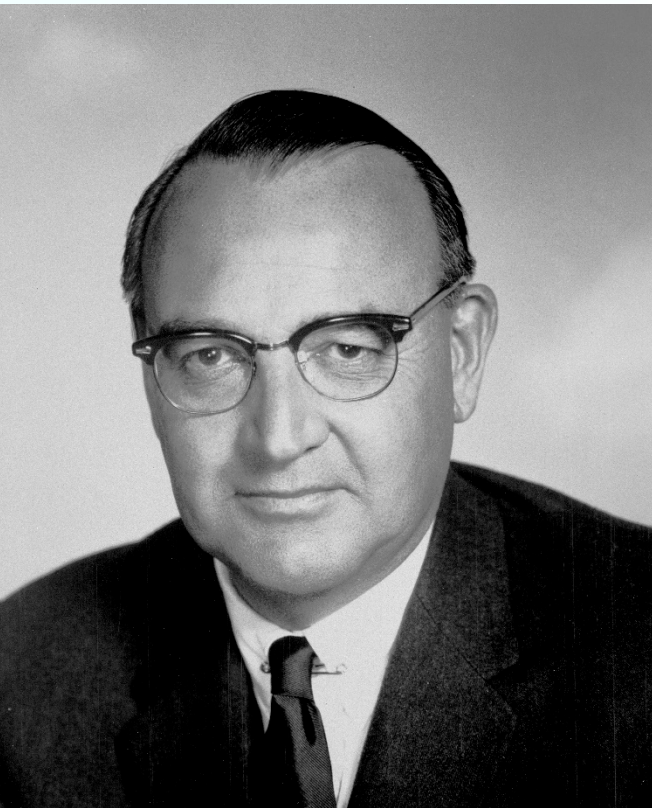
- 💧 90% used to irrigate farms in Central Valley
- 💧 Some water to urban residents in the Bay Area

## Financing

- 💧 1902: Reclamation Act – 160 acre service limitation
- 💧 1982: Act increased service limitation to 960 acres
- 💧 1992: CVPIA added environment as specific purpose created water account for environment



# Committed to the State Water Project



Governor Pat Brown was elected in 1958.

Gov. Brown made passing the State Water Project a priority of his administration.

*“I was absolutely determined that I was going to pass this California water project.”*



# Burns-Porter Act



1959 - The state Legislature authorized construction of the State Water Project through the California Water Resources Development Bond Act, also known as the Burns-Porter Act



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# State Water Project



Gov. Pat Brown at Oroville Dam

1961 – construction begins

Facilities were built from north to south – Oroville Dam to Southern California.

The State Water Project is the largest state-financed water project ever



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# State-Funded Projects - SWP

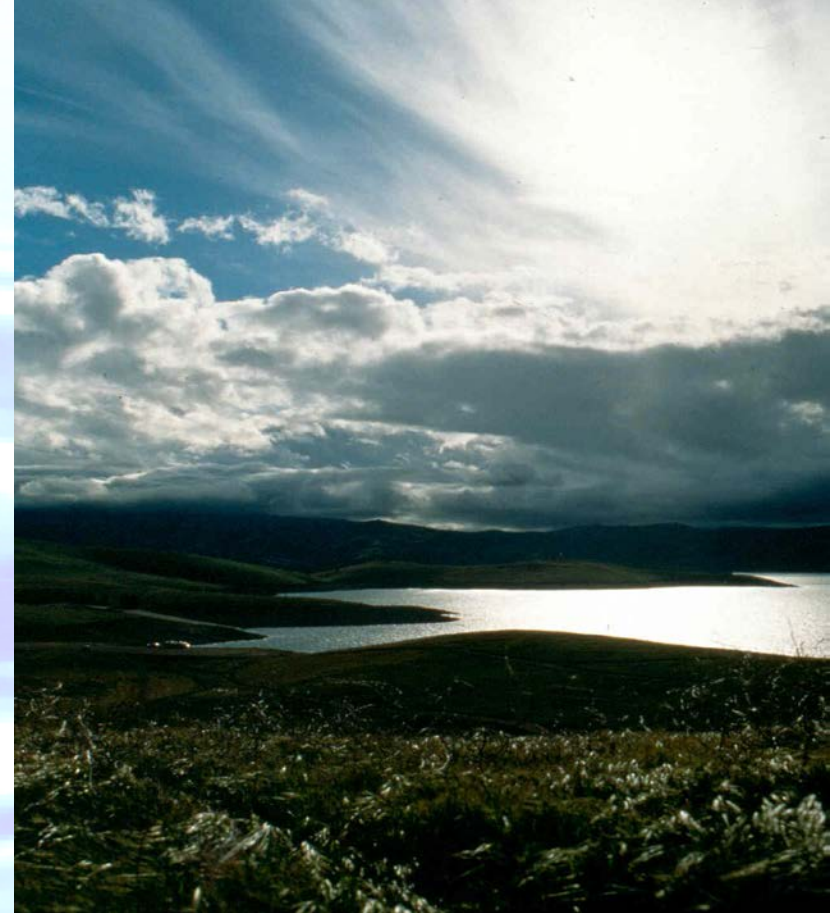


- State Water Project (SWP) consists of 29 dams and reservoirs and runs almost 600 miles from Northern- to Southern California.
- Planned to deliver 4.2 million acre-feet; actually delivers less than 3.0 million acre-feet – reliability diminished due to regulatory actions.
- About of deliveries to agriculture in the San Joaquin Valley and half for urban Southern California and the Bay Area.



# Financing the SWP

- 💧 1960 - \$1.75 billion bond
- 💧 29 contractors pay all costs, including bond interest, energy and transmission charges – whether water delivered or not.
- 💧 No acreage limitations.



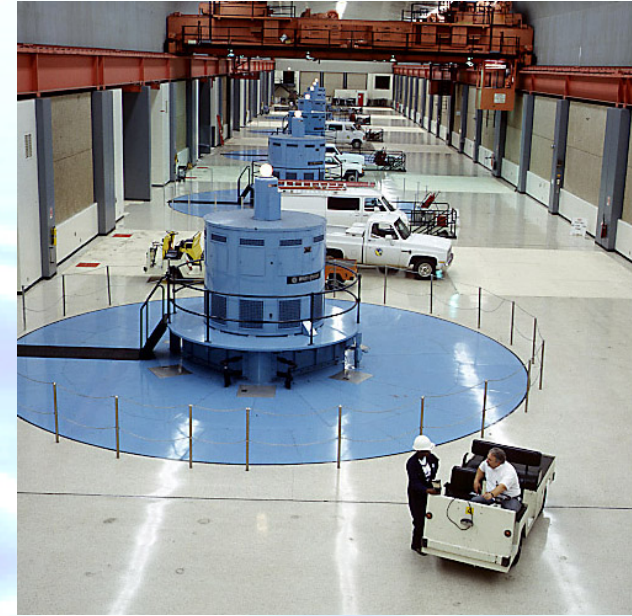
San Luis Reservoir





# Water and Energy

- 20% of state's electricity is used to bring water to consumers and send it away for sewage treatment.
- SWP is single-largest power consumer in California
- SWP is the fourth largest power generator in California, generating about two-thirds of electricity to run its facilities.



Hyatt Powerplant below Lake Oroville is in a cavern the size of two football fields.



# Operation of the CVP/SWP

- Coordinated operations – joint responsibilities for Delta Water Quality Management
- Upstream reservoirs capture water during wet season and snow runoff



# Operation of the CVP/SWP

- Water delivered to service areas by contract, subject to agreements with *senior* rights holders
  - *Sacramento River Settlement Contractors (CVP)*
  - *San Joaquin River Exchange Contractors*
  - *North Delta Water agency (SWP)*
  - *City of Sacramento*
  - Project contractors:
    - Tehama Colusa Canal, Sacramento area contractors, Contra Costa WD,
    - Export service: San Luis Delta Mendota Water Authority, Santa Clara Valley WD
- Reservoir storage, natural river conditions and regulatory requirements determine water available for export

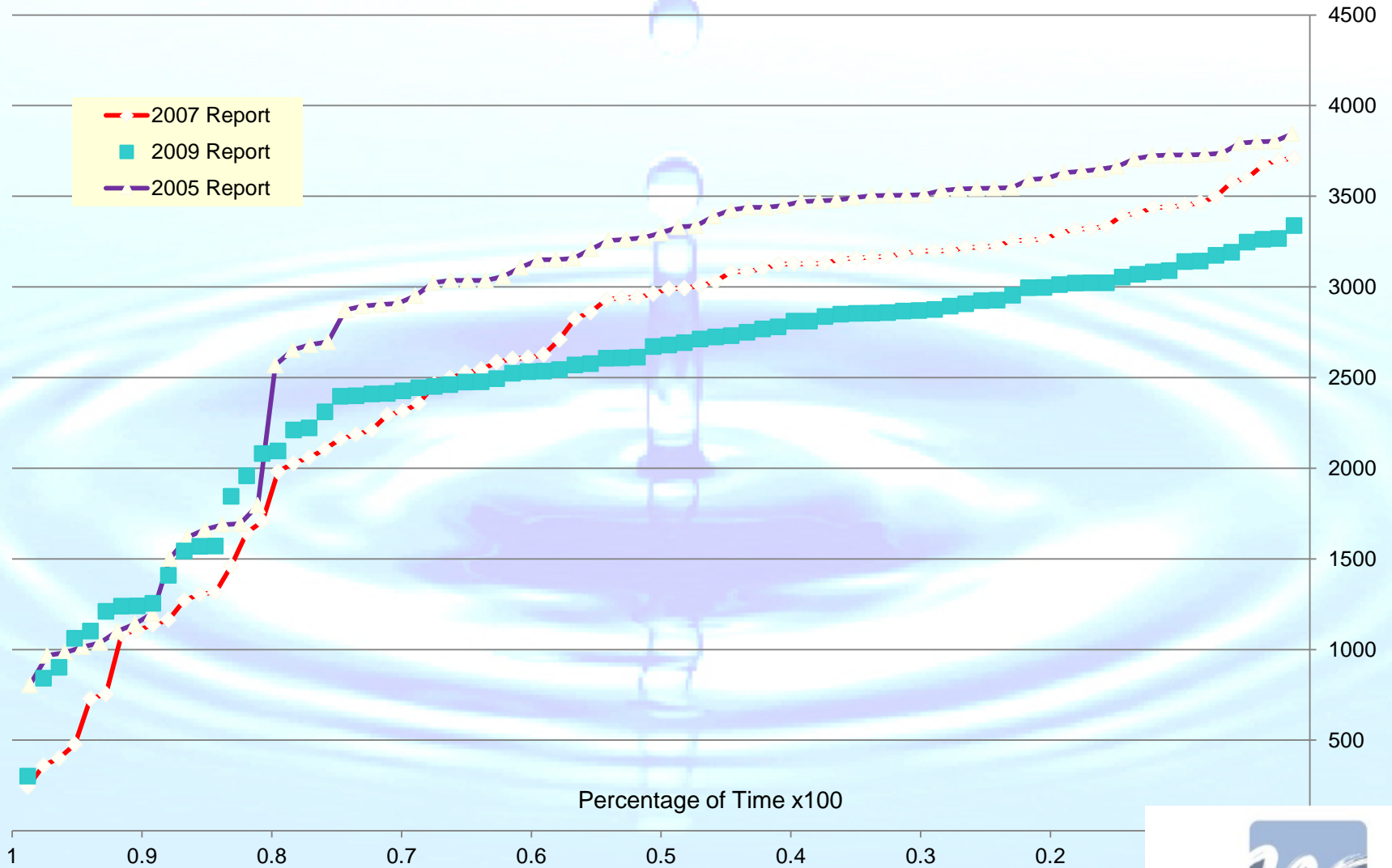


# Operation of the CVP/SWP

- Export supply determined by:  
reservoir/river supply - instream flow requirements - delta flow/water quality – export pumping limitations vs. demand.
- *If demand exists and there is pumping capacity within requirements, water can be pumped.*
- *Shift from demand limited system to regulatory constrained system*



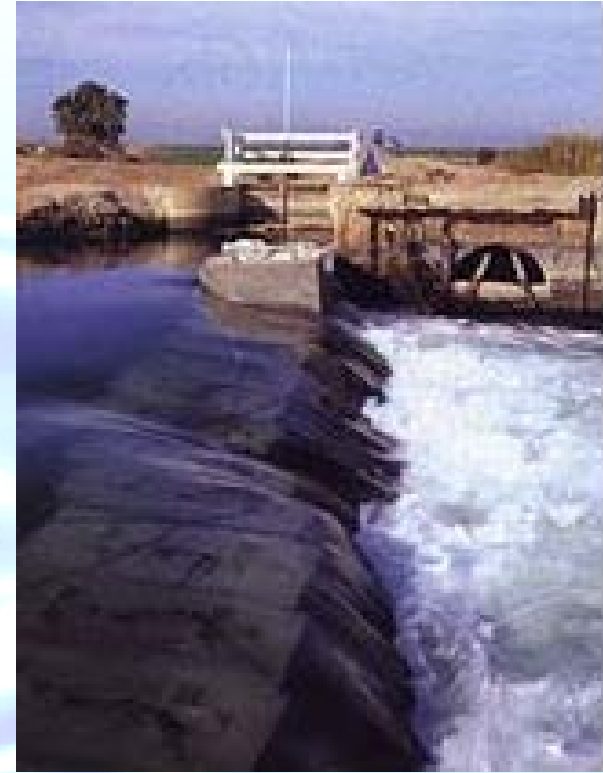
# Regulatory Restrictions Have Degraded SWP Water Reliability



# Locally Funded Projects

600 cities and local agencies provide water through local projects and imported supplies.

- Local systems –
  - San Francisco's Hetch Hetchy
  - East Bay Municipal Utility District's Pardee and Camanche Reservoirs
  - Los Angeles' Owens Valley and Los Angeles Aqueducts





# Hetch Hetchy

**Raker Act (1913):**  
federal lands in the  
Sierra Nevada  
Mountains, including  
Hetch Hetchy Valley  
in Yosemite, used to  
build the water  
system

- The Bay Area  
Water Supply and  
Conservation  
Agency (BAWSCA)
- 1.7 million citizens  
and businesses



# More Local Systems

- Metropolitan Water District of Southern California largest local district

  - operates Colorado River Aqueduct.

- Other local projects serve farmers, such as Glenn-Colusa Canal in the Sacramento Valley.



Diamond Valley Lake (MWD photo)







**SAN DIEGO AQUEDUCT  
2nd BARREL NORTH SECTION  
THE LAST PIPE**

DESIGNED United States Bureau of Reclamation  
FOR San Diego County Water Authority  
FINANCED United States Navy  
WATER FROM Metropolitan Water District of So Calif  
BUILT BY Johnson Western Constructors

# Wild & Scenic Rivers



American River

- 1972 State Wild and Scenic Rivers Act - no dams or diversion facilities on the Smith River and parts of Klamath, Trinity, Van Duzen, Scott, Eel, Salmon, Feather and American
- In 1980, some rivers added to the Federal Wild and Scenic Rivers System
- Today parts of other rivers included



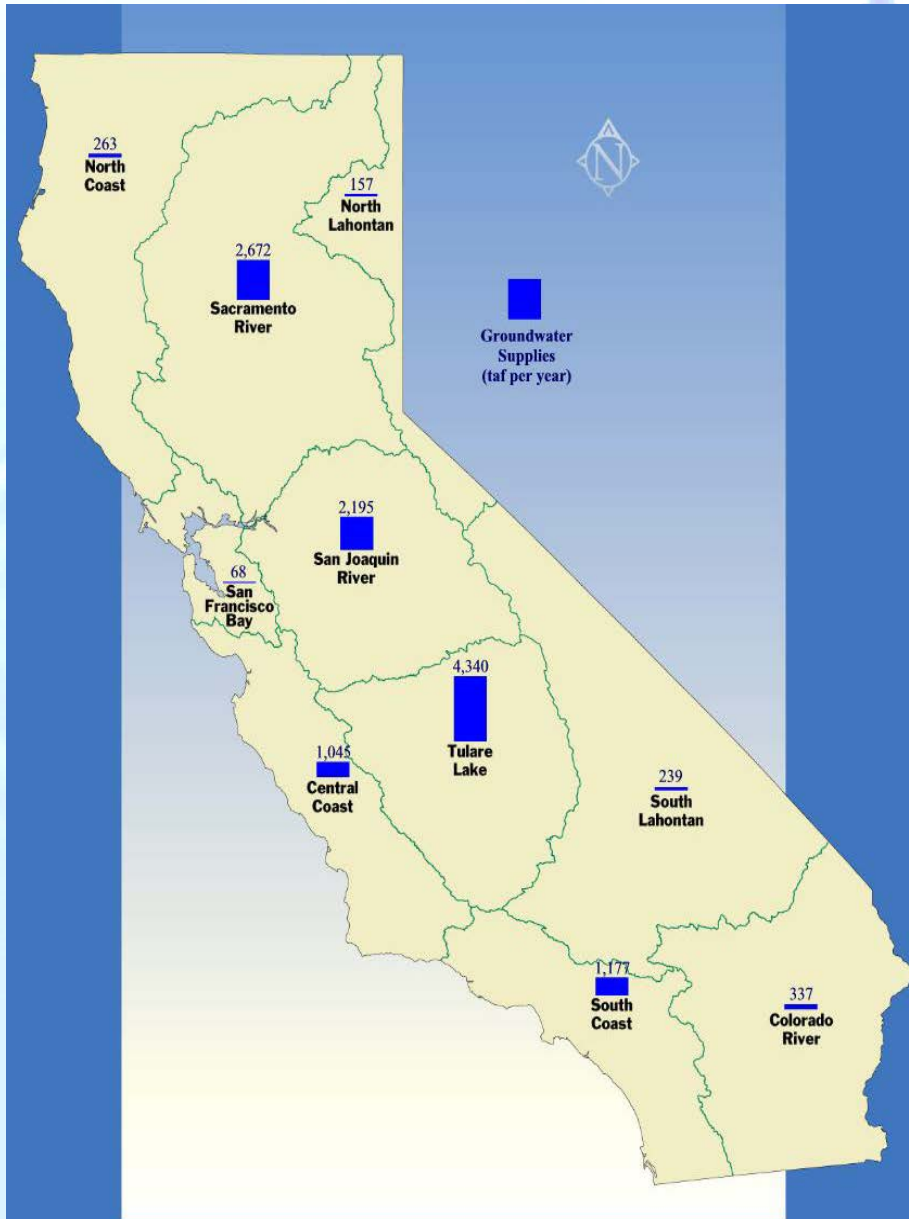
# Groundwater

Groundwater exists in aquifers – water bearing rock layers

- About 30% (15 million acre-feet) of state's water comes from groundwater in normal years; 40%-45% in drought years, or more
- California uses more groundwater than any other state – about 40% of population gets drinking water from groundwater



# Groundwater Supplies



Where is the groundwater?

DWR estimates more than 400 groundwater basins hold a total of about 850 million acre-feet of water.



# Groundwater Management

- 💧 Historic regulation of groundwater – 2014 legislation
- 💧 In Southern California, many groundwater basins have been adjudicated, with courts establishing the pumping rights of many parties. A watermaster appointed to oversee – largely exempt from new legislation



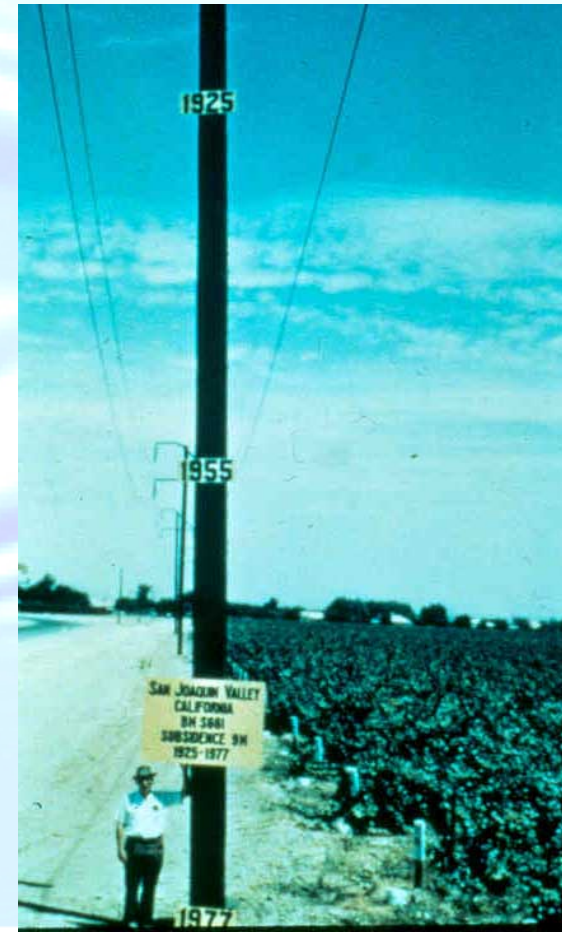
# Groundwater Overdraft

Overdraft is taking more water out of the ground than is recharged (time dimension)

- Historical overdraft in Central Valley led to construction of Central Valley project

- NASA - Central Valley has lost enormous amounts of groundwater from 2003-2009 - 24.3 million acre feet since 2003 – enough to fill Lake Powell, 2<sup>nd</sup> largest reservoir in USA

USGS scientist shows overdraft in San Joaquin Valley, 1970s



# Groundwater Pollution

Pollution is a serious threat. All the state's groundwater basins are contaminated to some degree.

- 💧 Trichloroethylene (TCE) - Used in adhesives, lubricants, paint products, pesticides, adhesives, rug-cleaners
- 💧 Perchlorate - Primary ingredient of solid rocket propellant
- 💧 Methyl tertiary butyl ether (MTBE)
  - added to gasoline to reduce air pollution in 1990s. Today leaky underground tanks



# Flood Management

- 💧 Floodplain Management
  - In next 25 years population increase of about 14 million. Development will impact floodplains
- 💧 Levee Repairs
  - Nearly 250 levee repair sites identified and work progressing



- 💧 Climate Change
  - Warming ocean water and melting ice = sea level increase by 1.6 feet by 2050 along coastlines. By 2100 sea rise could be more than 3 feet. Recent warming running ahead of predictions and estimates may be low





# Flood Management: Levees

**2005 – Hurricane Katrina**

**2006 – Ca. Preparation**

Gov. Schwarzenegger declares a State of Emergency for California's levee system

- Flood Bonds passed

**2012 – Central Valley Plan**

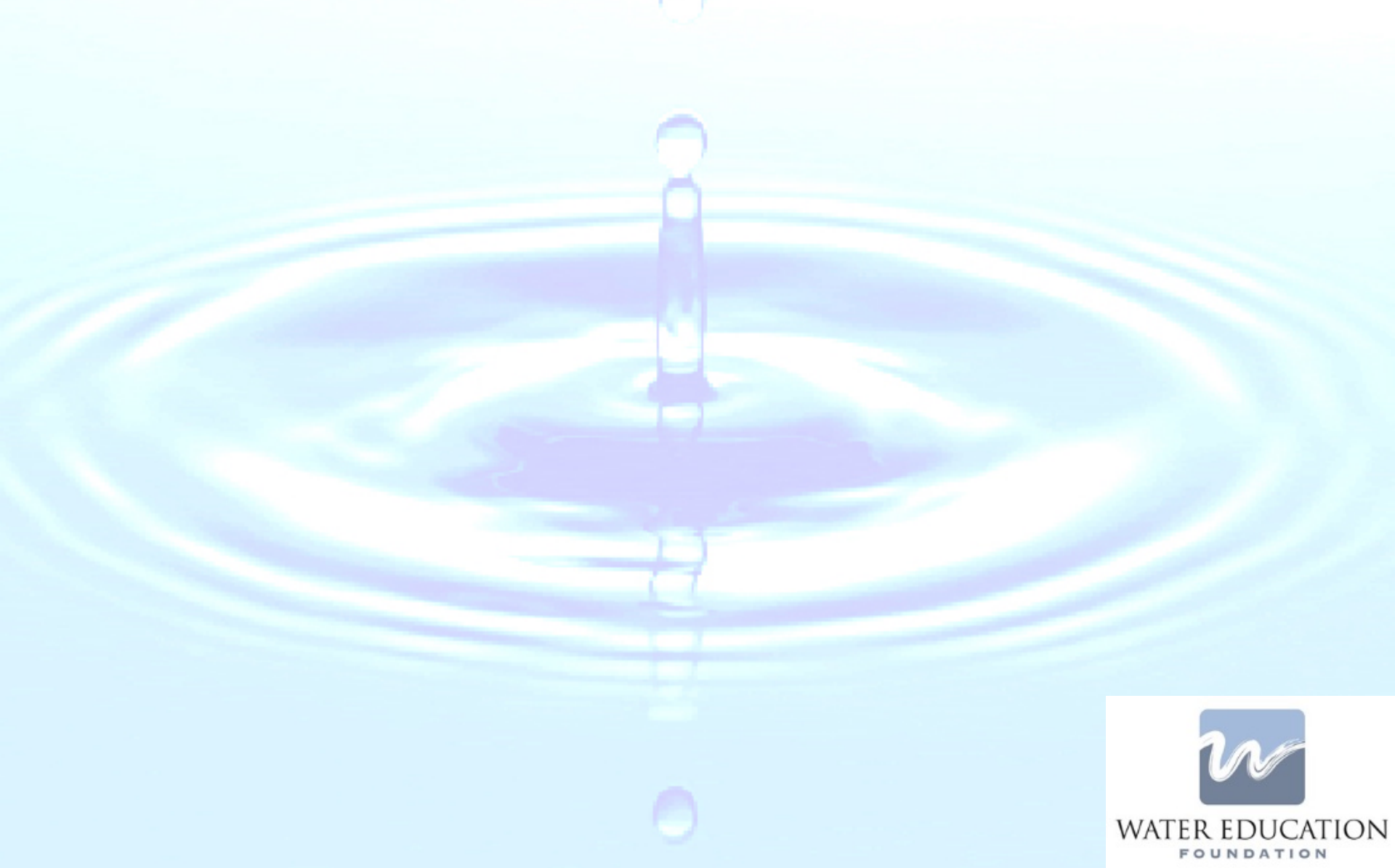
Plan will detail how to improve flood management in Central Valley

**2013 – Statewide Plan**

Plan will detail how to improve flood management statewide



# Questions?



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