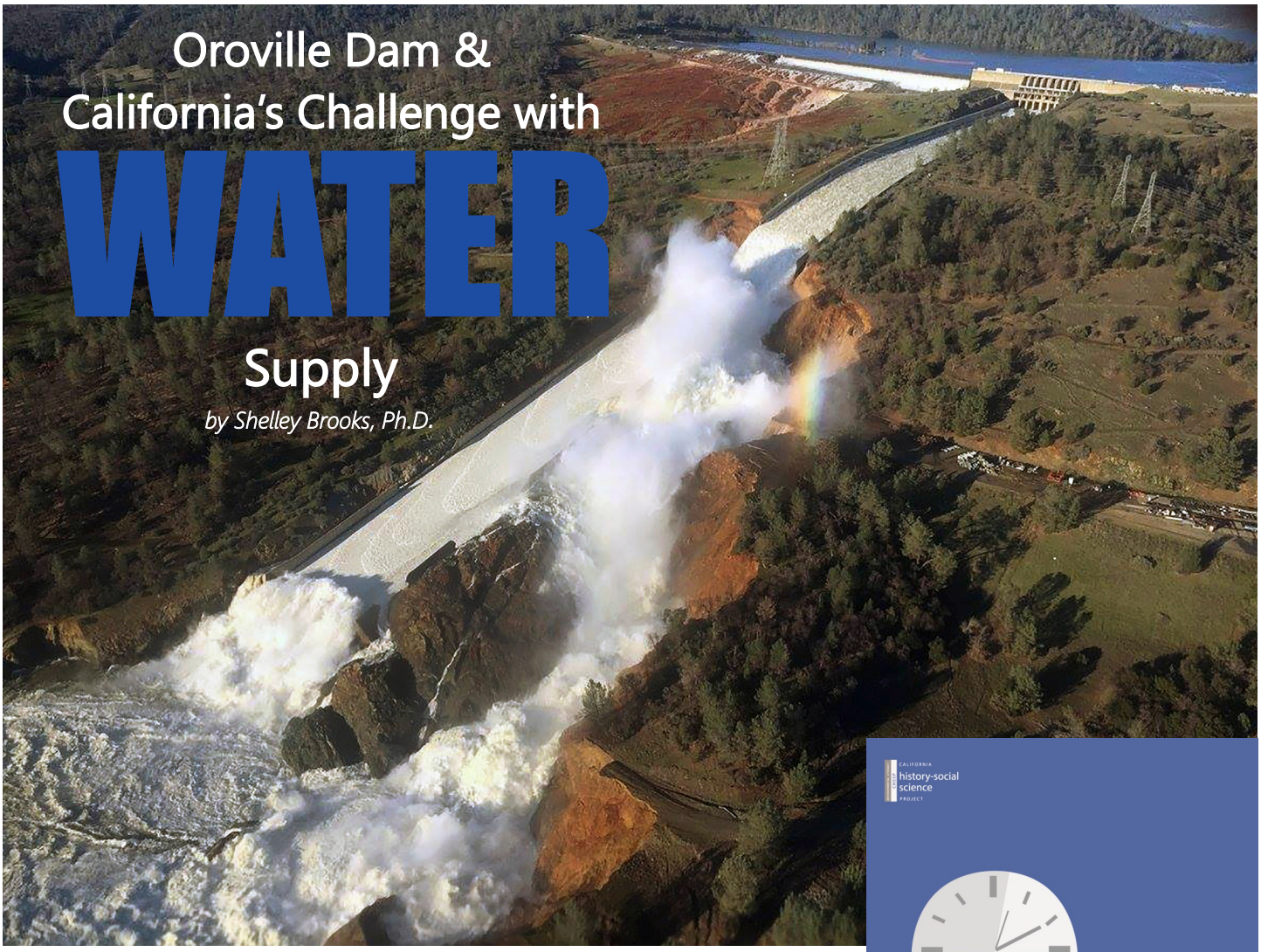


Oroville Dam & California's Challenge with WATER Supply

by Shelley Brooks, Ph.D.

CURRENT CONTEXT
A Focus on the Environment

At 770 feet high, Oroville is the nation's tallest dam and in February 2017 it almost failed. Heavy winter rains had caused the lake behind the dam to rise by fifty feet in just a matter of days. When it looked as if the dam might not be able to hold the nearly 3.5 million acre feet of water, approximately 180,000 residents downstream were required to evacuate their homes. Moreover, a rupture in the water system threatened the water supply as far away as southern California. One third of the water consumed in the L.A. area flows through Lake Oroville. Twenty-seven different urban and agricultural water districts throughout the state receive water from Lake Oroville. The threat of dam failure was "potentially catastrophic" according to a state official in the Office of Emergency Services. The state immediately began work on repairing the dam, and managed to prevent the much-feared downstream flooding. An estimated two-years' worth of work is still to be done to make the Oroville Dam fully functional, at a cost of approximately $275 million. Fortunately, the state believes the dam will be operational in time for this next season of rain. Meanwhile, there are 1,400 other dams throughout the state, the majority of which are at least as old as the Oroville Dam (built in 1968) and constructed with outdated techniques and designed to hold and move water based on averages and data from a different era.

In Search of Water Dependability

California's population and its economy are entirely dependent on the careful management of water, a resource that is sometimes called "liquid gold" due to its value in this arid state. California, like most states in the West, receives an average annual rainfall of around 20 inches or less. But the term "average" is misleading for two reasons. For one, the amount of rain can vary dramatically from year to year. Also, different regions of the state receive dramatically differ-

ent amounts (think of the densely forested northwest corner of the state, and the desert southeast). For these reasons, and because so much of the state's population lives in the southern half of the state where rainfall is relatively low, the state decided long ago to try and regulate the flow of water through California. A dependable water flow helps farmers count on a steady supply throughout the summer growing season when little rainfall occurs. Also, a dependable water flow gives residents and industries confidence to settle in parts of the state, like Los Angeles, where rainfall alone could never provide sufficient drinking water or supply all industrial needs. Finally, dams, reservoirs, canals, and levees help prevent the flooding that has historically been a challenge during wet California winters.

Changing How and Where Water Flows

Californians have long sought to manipulate water flow to serve their purposes. The Mojave and Yuma Indians in the southeastern part of the state practiced irrigation to water their crops long before contact with European settlers. In the late 1800s, many farmers came together to form irrigation districts to finance the expensive business of trying to channel water to the fields when needed, and in sufficient quantity. During the Great Depression of the 1930s, after a long drought in the state, the state and federal governments worked to create the Central Valley Project (CVP). Through a series of reservoirs, dams, canals, and power stations, the CVP brought irrigation water to 10 million more acres of farmland, generated electricity, managed flood control, and delivered water to cities and towns. Edmund "Pat" Brown, who served as governor from 1959-1967, believed in the importance of building up California's infrastructure to accommodate the continued rapid economic and population growth that World War II had sparked in the state.

The Sacramento-San Joaquin Delta

A majority of Californians agreed with Brown on this point, and voted in 1960 to approve the State Water Project (SWP) The SWP, run by state agencies, was designed to enhance the CVP. It includes a 444-mile aqueduct (the California Aqueduct) that brings water from the Sacramento-San Joaquin Delta to points further south. Today, more than two-thirds of Californians receive some of their water from the SWP.

Environmental Impact

Through projects built under the CVP and the SWP, the state has sought to protect against floods, provide water for agriculture, and supply water for residential and industrial use. The result is that the state has engineered almost the entirety of California's water system; only a very few rivers in the state lack a dam somewhere along

Key Terms

Arid – most states in the American West are arid, that is, they receive an average annual rainfall of 20 inches or less.

Climate change – changes in the Earth's weather patterns, including long-term temperature changes.

Habitat – the natural home or environment of an animal, plant, or other organism.

Levee – a ridge or built-up raised area alongside a river to prevent flooding.

Reservoir – a storage space for water, usually created by a dam.

Water infrastructure – the physical system that manages water flow – such as dams and channels and aqueducts. This is a high-cost investment by state/federal governments to support populations and economic development. At the same time, such infrastructure impacts the environment (and wildlife) by disrupting and altering the natural flow of water.

the length of them. Consequently, natural habitats have been significantly altered to accommodate the needs of California's human communities. Animals and plants along California's rivers and lakes have been forced to adapt, to suffer decline, or to disappear altogether. Some state scientists and conservation groups explore protections for these plants and animals, but we can assume that their habitats will always be compromised by the concrete canals and dams and other features that seek to control California's water flow.

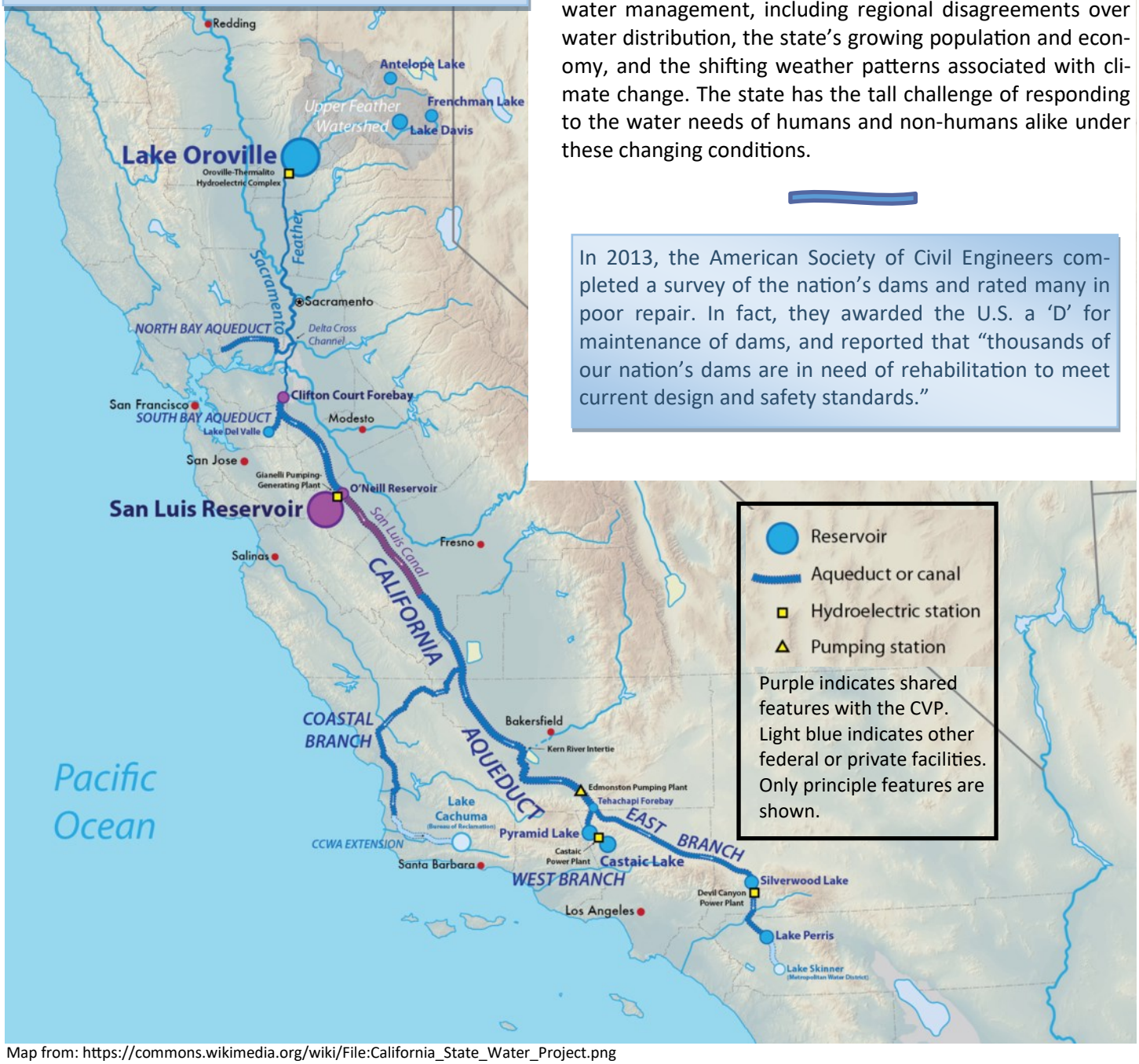
10 Days—the amount of time it takes for water to flow from Lake Oroville to Los Angeles.

California's Success Depends on Good Water Management

California's remarkable environment, its dynamic economy, and its status as the home of one-tenth of all Americans, could not continue without sufficient water. It is therefore critical that California's water infrastructure remains operational. But whether the infrastructure built over the past century will continue to be the best fit for the state remains a debatable point in California. Several factors complicate water management, including regional disagreements over water distribution, the state's growing population and economy, and the shifting weather patterns associated with climate change. The state has the tall challenge of responding to the water needs of humans and non-humans alike under these changing conditions.

In 2013, the American Society of Civil Engineers completed a survey of the nation's dams and rated many in poor repair. In fact, they awarded the U.S. a 'D' for maintenance of dams, and reported that "thousands of our nation's dams are in need of rehabilitation to meet current design and safety standards."

California's State Water Project



Map from: https://commons.wikimedia.org/wiki/File:California_State_Water_Project.png

Key Dates related to California's Water Infrastructure

Early Infrastructure Ideas

1869

John Wesley Powell explores the West and concludes that it is an arid region that will require distinctive land management in order to harness the water supply and "redeem" the lands through irrigation.

1873

President Grant commissions an Army Corps of Engineers report, which surveys the Central Valley and recommends systematic development of the Sierra Nevada watersheds.

1878

California's State Engineer office creates a report under William Hammond Hall, calling for flood control and navigation improvements on the Sacramento, Feather, Yuba, and Bear rivers and in the Sacramento-San Joaquin Delta. Like the Army Corps of Engineers' report, Hall's report argues that the Central Valley rivers should be harnessed for the "benefit of the state."

1884

California court bans hydraulic mining in the Sierra Nevada Mountains because of its negative impact on rivers – causing floods and reducing navigation.

1902

The federal Bureau of Reclamation forms to reclaim, or make productive, arid lands through federal construction projects.

Infrastructure and the Environment

1972

California Wild and Scenic Rivers Act preserves "free-flowing state" rivers with particular scenic, fish, wildlife, or recreational value. Today, rivers that receive state and federal protection under the Act include the Albion, Amargosa, American, Eel, Gualala, KlamathMerced, Trinity, and Tuolumne.

1992

Congress passes the Central Valley Project Improvement Act, to reapportion about 10% of the CVP's water to protect fisheries and endangered wildlife habitats. Also permits transfers of project water anywhere in the state, allowing rural water districts to sell a portion of their allocations to the cities.

1995

Creation of the CALFED Bay-Delta Program, a collaboration of 25 state and federal agencies working to "improve California's water supply and the ecological health of the San Francisco Bay/Sacramento-San Joaquin River Delta."

2009

Delta Reform Act to support water supply reliability, ecosystem health, and to manage the Delta. The Act created the Delta Stewardship Council, which replaced CALFED, and tasked the council with establishing an enforceable, long-term management plan for the Delta that coordinates local, state, and federal activity in the Delta.

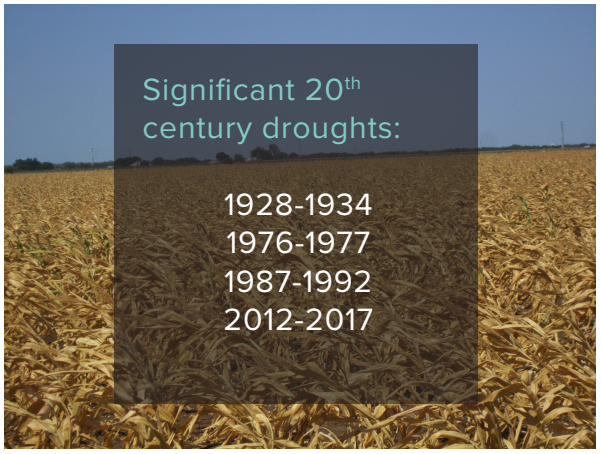
Our Recent Drought

2015

California experiences one of the driest Januarys on record, and the state has the lowest ever recorded snowpack (5% of average). By April Governor Brown issues an executive order calling for mandatory water reductions. In May, the state mandates 25% urban water use reduction.

2017

California's five-year drought ends with a heavy winter of rain and snow. In April, Governor Brown signed an executive order officially ending the drought state of emergency, but reminded residents that water conservation needed to become a permanent "way of life" in California.



Infrastructure Projects

1913

The Los Angeles Aqueduct is completed, delivering water from the Owens Valley approximately 250 miles to Los Angeles.

1934

Completion of the Hetch Hetchy Aqueduct from Yosemite, to deliver water 160 miles to the SF Bay Area.

1935

The Central Valley Project (CVP) – conceived of by California but too expensive to achieve – is launched with federal aid. Ultimately responsible for meeting current water demands, irrigating over 10 million acres of additional land, generating electricity, managing flood control, and delivering water to municipalities. A New Deal era project, the CVP was similar in intent to the Tennessee Valley Authority project in the American southeast.

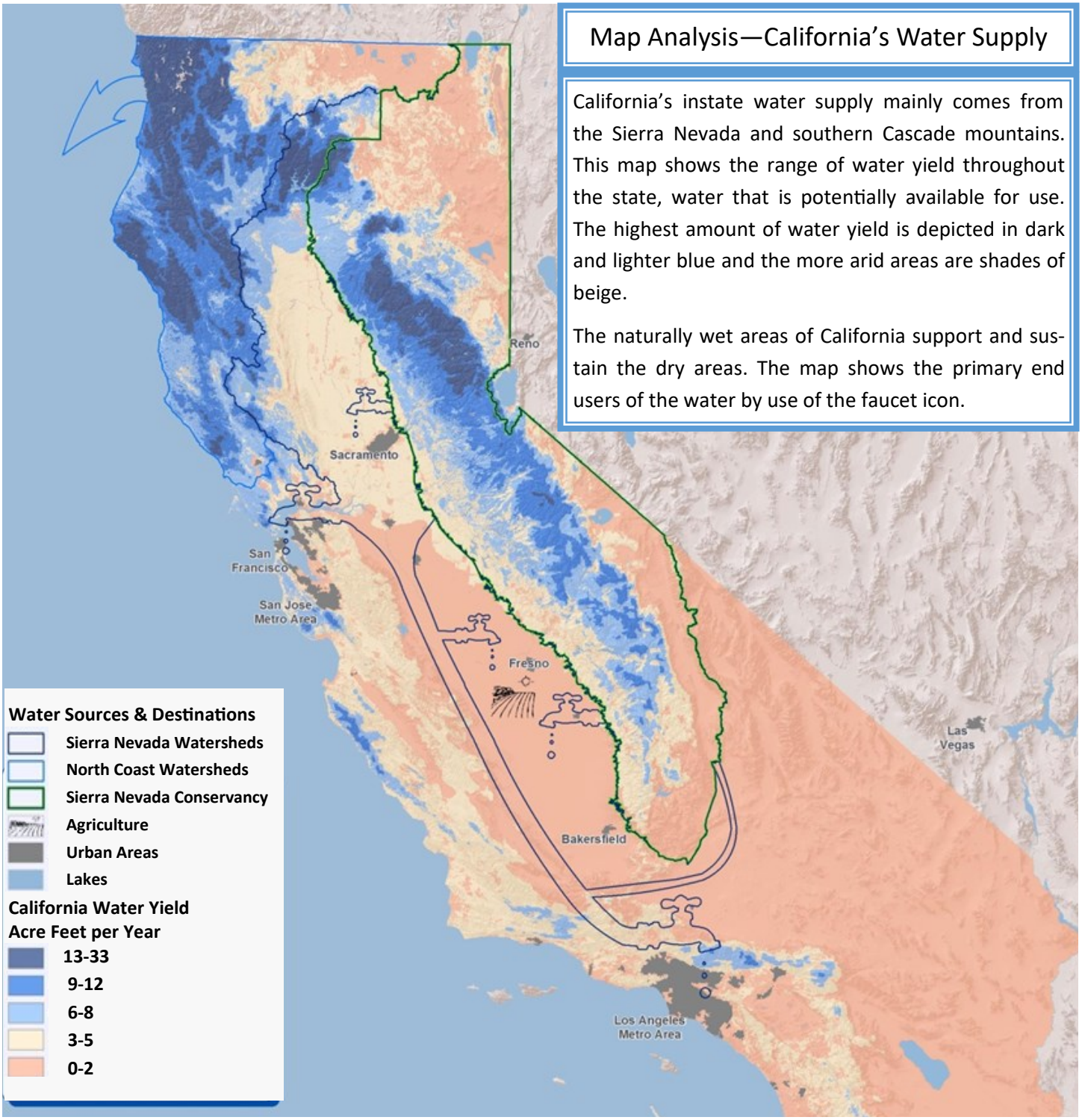
1960

California voters approve the creation of the State Water Project (SWP) to augment the CVP. The CVP and SWP make up one of the world's largest water storage and transport systems. Includes flood control; improvement of river navigation; development of hydroelectric power, irrigation, and municipal and industrial water supply; and protection of the Delta from seawater encroachment.

Map Analysis—California's Water Supply

California's instate water supply mainly comes from the Sierra Nevada and southern Cascade mountains. This map shows the range of water yield throughout the state, water that is potentially available for use. The highest amount of water yield is depicted in dark and lighter blue and the more arid areas are shades of beige.

The naturally wet areas of California support and sustain the dry areas. The map shows the primary end users of the water by use of the faucet icon.



Discuss:

Map from the Sierra Nevada Conservancy

- Where does the greatest amount of precipitation occur in California? The smallest amount?
- Where are the major population centers in California?
- Where are the major agricultural areas in California?
- What do you notice about the relationship between where the water falls in the state, where the largest cities are, and where agricultural center of the state is located?
- What does all of this tell you about the importance of California's water infrastructure?

Additional Resources

Education and the Environment Initiative (EEI) Connections (http://www.californiaeei.org/)

A program of CalRecycle's Office of Education and the Environment, EEI lessons are designed to foster environmental literacy among California students. Below is a list of units and lessons to support student learning on the topic of water use and stakeholders, water infrastructure, and environmental considerations related to water management.

Kindergarten – K.4.5. & K.6.3. *Some Things Change and Some Things Stay the Same*, Lesson 3 "When a Community Grows"

2nd Grade – 2.4.1. *From Field to Table*, Lesson 1 "How Does California Grow?"

3rd Grade – 3.1.1. and 3.1.2. *The Geography of Where We Live*, Lesson 4 "Changes in Our Local Region"

4th Grade – 4.2.6. *Cultivating California*, Lesson 4-5 "Mission San Gabriel's Influence" and "Changing Natural Systems"

4.3.3. *Witnessing the Gold Rush*, Lesson 5 "Flattening Mountains, Filling Valleys"

6th Grade – 6.2.1. *River Systems and Ancient Peoples*, Lesson 1 "The Importance of the Bay Delta to California";

6.2.2. *Agricultural Advances in Ancient Civilizations*, Lesson 1 "The Power of Agriculture"; Lesson 2 "Radical Revolution: Ancient Agricultural Advancements"

6.2.6. & 6.2.8. *Egypt and Kush: A Tale of Two Kingdoms*, Lesson 1 "Sharing a River"

6.5.1. & 6.6.1. *The Rivers and Ancient Empires of China and India*, Lesson 6 "Our Use of Rivers Today"

8th Grade – 8.8.4. *Struggles with Water*, Lesson 1 "California and the Colorado"; Lesson 5 "The Colorado River Revisited"

10th Grade – 10.3.3. *Growth of Population, Cities and Demands*, Lesson 4 "Laws and Policies to Manage Natural Resources," Lesson 5 "Government Responds to Managed Growth"

11th Grade – 11.8.6. *Postwar Industries and Emerging Environmental Movement*, Lesson 1 "Postwar Changes in the Great Cen tral Valley"; Lesson 3 "Tracking the Postwar Boom"; Lesson 4 "Effects of the Postwar Boom"

11.9.7. *The United States and Mexico Working Together*, Lesson 4 "From a Different Perspective"

12th Grade – 12.1.4. *Private Property and Resource Conservation*, Lesson 3 "Applying Utilitarianism to Water Resources"

Suggested reading:

David Carle, *Introduction to Water in California* (Berkeley: University of California Press, 2009).

Cover image: https://en.wikipedia.org/wiki/Oroville_Dam_crisis#/media/File:Oroville_dam_spillway_2017-02-11.jpg

Current Context: A Publication of the California History-Social Science Project

Produced by the California History-Social Science Project (CHSSP), *Current Context* is a series of instructional materials designed to help students understand current events in historical context. All *Current Context* materials are copyrighted by the Regents of the University of California, Davis. This issue of *Current Context* is the second in a special series dedicated to helping students understand the connections between environmental literacy and the study of history-social science, and is funded through the generous support of Ten Strands. To download this issue and others, visit: http://chssp.ucdavis.edu/current-context.

For more information about the CHSSP, visit our website, http://chssp.ucdavis.edu, write to us: chssp@ucdavis.edu, or connect with us via Facebook (californiahistorysocialscienceproject) or Twitter (CHSSP_SO). Headquartered in the Department of History at the University of California, Davis, the CHSSP is one of nine disciplinary networks that make up the California Subject Matter Projects, administered by the University of California, Office of the President.