Designing Water Law for Future Innovation

Topic Solution Summary

Civil Engineers can be major contributors for new water laws that encourage innovation, including:

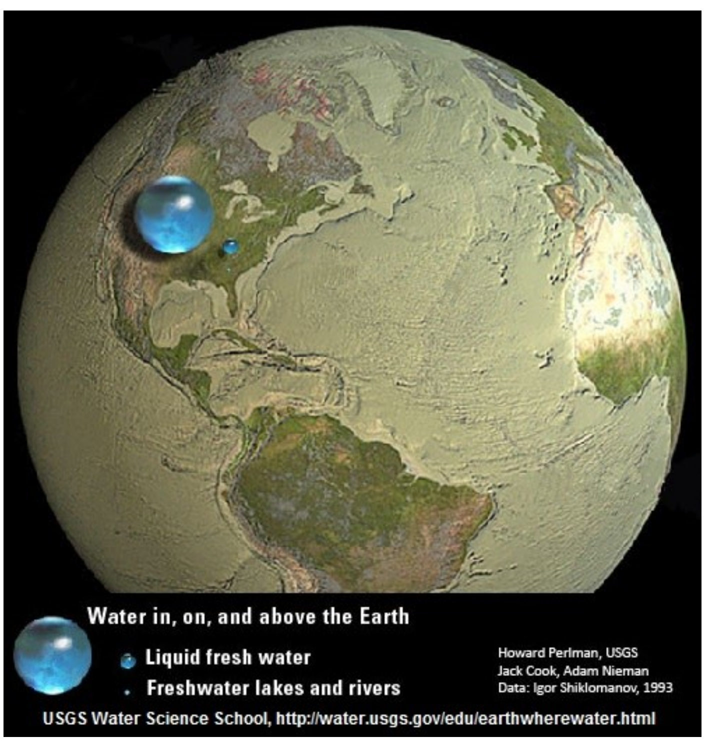
a) Limited time water rights in exchange for building new infrastructure
b) High priority for water and salt-removal trades

Proposed California Example

Nothing is permanent. Water supply and demand will change in any case. Better that water rights expire in an organized fashion appropriate to the investment made to use the water. Large water projects, like the proposed Cal Water Fix (Tunnel), are justified on a 50-year life. Smaller projects might have a shorter life. Most existing farmers, gold miners, municipalities, and others' water rights on rivers feeding California's Bay Delta and the Colorado River will be long expired. Much of the California Water Project rights will also be expiring.

As rights expire, stakeholders make new investments to reacquire rights, or not. Water and salt-removal trades help ensure that the investments are globally effective and efficient. Potential innovations/investments may include:

- Central Valley Farmers and California taxpayers fund snow storage with beaver-size dams and mini-glaciers in exchange for continued State Water Project water
- Las Vegas funds the installation of offshore flood capture or ocean desalination in coastal Southern California in exchange for a few decades of Colorado River water rights
- Southern California buys sub-sea-level islands of the Bay Delta and converts them to flood water storage in exchange for a few decades of Sacramento River water rights
- Los Angeles funds keeping the Salton Sea full with brackish groundwater, enabling Imperial Irrigation District water conservation, both receive several decades of Colorado River water rights



Submission and Supporting Evidence

Fresh water is globally scarce. Water is unlike many materials we own. We can buy and keep an ounce of gold or a ton of car. But water is so essential to life that we do not buy a gallon of water to drink or an acre-foot of water to grow food. We only rent/borrow water. We build facilities so that we have access to water.

What's more, we do not want too much, or dirty water. A tiny amount of clean freshwater keeps us alive. Slightly more clean freshwater keep us and our clothes clean. Still more fresh water transports our bodily wastes for treatment. Small amounts of water are directly essential for life and public health. Intermediate amounts are essential for playing fields and aesthetics. Large amounts are essential for food supply. Too much water can destroy property, food, and life.

Permanent water use rights do not fit the ephemeral nature of water. Certainly there are no permanent water rights over centuries. When we make water use rights temporary, we have a mechanism for adapting to long-term changes in the total amount of fresh water available each year. As a previous right expires, people re-assess the supply of water and the demand for water. Maybe water is worth less than before in one community because annual rainfall is increasing. Maybe water is worth more than before in another community as evaporation increases. Maybe one community's innovations have converted their water deficiency to a water excess[1]. In any case, the expiration of rights makes us re-optimize water use for the current situation using emerging technologies.

Temporary water rights (20 to 50 years) avoid concerns that previous users will return to assert a prior right. When Imperial Valley farmers established "first" rights to Colorado River water, no one alive at the time realized the Native American population along the Colorado River had been ten times larger than that "found" by western explorers. The new understanding of Native American water use is sketched in Charles Mann's book "1491: New Revelations of the Americas Before Columbus." The large population was quite sophisticated; using a much more water.

Current water users will sometimes assert permanent water rights as their private property. But if water rights are private property, they should be treated like private property. Americans have prevented rigid class structure via federal inheritance taxes since the 1790s. If we want to consider 50-year old water use rights as personal property, consistency requires we subject the use rights to inheritance tax appropriate to their value.

<u>Salton Sea, California Example</u>

Consider how the "expiring rights" would apply to the Imperial Valley and the Salton Sea. The Salton Sea is drying because less agricultural drainage is not keeping up with evaporation. As the Salton Sea dries, the dry seabed becomes the source for toxic dust storms costing a few $Billion for public health. (Similar to what happened around Owens Lake when Los Angeles

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[1] Let There Be Water: Israel's Solution for a Water-Starved World, 2015, Seth M Siegel

diverted Owens River water, only much worse.) The Imperial Valley farmers see this situation as a reason to maintain their fixed right to a fixed volume of Colorado River water and their continued use of the Salton Sea for salt removal.

Salton Sea level is dropping because evaporation of about 1.3 million acre-feet per year exceeds inflow. The primary inflow to the Sea is from irrigation water which either seeps into the ground or drains salts from the surrounding agriculture and landscapes. It currently takes nearly 4 million acre-feet of Colorado River water used for irrigation in the Salton Sea basin to maintain Salton Sea level.

Meanwhile, scientists and engineers now realize the Colorado River is over-allocated by a few million acre-feet per year. This realization is based on current predictions of Colorado River flow factoring both historic precipitation and future climate changes. The situation could flip-flop again in a 100 years from now.

If rights expire as we propose, the farmers and other stakeholders would be cooperating (or competing) to fund the optimal project which establishes new temporary water rights. One innovative way to keep the Salton Sea full while drawing much less Colorado River water is to pump Salton Basin groundwater into the Salton Sea. Farmers could then apply water efficiency technology. There is over a 1,000 years of water in the Salton Basin that is otherwise useless, five times saltier than people or plants can drink, but only a quarter as salty as the Salton Sea[2]. Another option is to employ salt removal technology which does not produce brine, such as WaterFX.

As we pump out brackish water, we create room to store inevitable floods in the ground.

Snow/Glacier/Groundwater Example

Farmers in the Himalayan Mountains are adapting by redirecting streams to cooler locations where the water freezes and remains frozen longer than would be the case without this minor human intervention (mini-glaciers). Also in India, farmers have built long low (< 1 m high) berms across their fields (like beaver dams). Without the berms, monsoon rains drain off their fields quickly. With the berms, slowed flows recharge groundwater aquifers.

In North America, teams of civil engineers and biologists could manage and imitate beavers[3] to make many small dams and diversion channels. Globally, civil engineers and biologists could imitate beavers. The teams would:

- Create more low dams where more water will freeze in the winter, or where the impoundment recharges groundwater, or as an additional stormwater capture tool

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[2] Lawrence Livermore National Laboratory, January 2008, "Groundwater Availability within the Salton Sea Basin"

[3] Before European settlement, beavers ranged North America from coast to coast, even in the arid American Southwest, and from the Gulf of Mexico to near the Arctic Ocean. They may have been generally absent from the Florida peninsula and parts of southern California and southern Nevada. Beavers would not be an invasive species in areas most in need of increased water storage because of decreasing snow storage. Beaver dams can be viewed as environmental restoration where human-made dams are generally not.

- Increase the strength of select beaver dams
- Build water management infrastructure around the beaver dams.

Offshore Flood Capture Example

Fresh water floats over salt water because fresh water is less dense. We can use this fact to capture flood waters and store them for later use. Figure 2 shows a river of fresh water, density near 1,000 kg/m^3, flowing into the ocean, density near 1030 kg/m^3. A drinkable layer of fresh water can extend miles out to sea, depending on factors such as the volume of the river flow and the mixing energy of waves and tides.

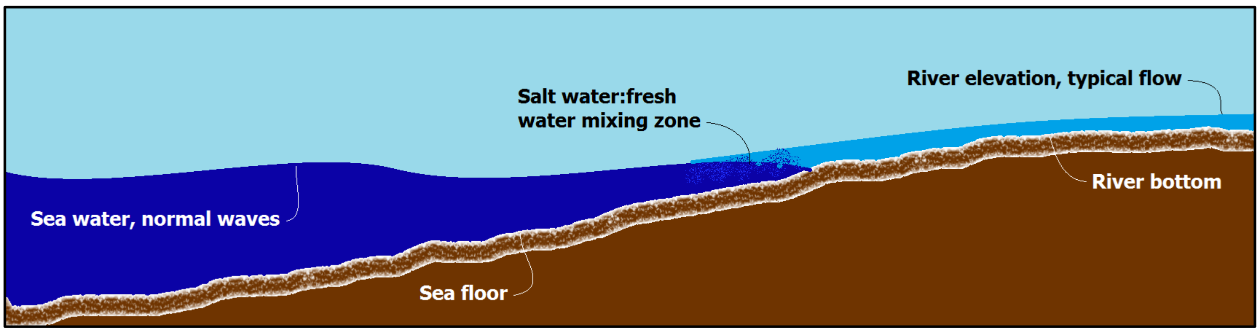

Fig. 2 – Elevation longitudinal section of river flowing into the sea

Figures 2-5 show a concept where there are no existing human water rights. The vertical scale in is exaggerated relative to the horizontal scale. A typical Southern California river might have a flood of 1 million acre-feet over a month once every ten years on average, with smaller floods at shorter intervals. 1 million acre feet would occupy a layer of water 200 feet deep in a semi-circle 4.5 miles in diameter. The diameter would be along the coast line, with the center of the circle near where the river enters the ocean or bay.

Fig. 3 – Aerial view of offshore capture

When river flows are low, the natural system of Figure 2 prevails. When river flows are high, as in Figure 4, an an invisible breakwater is deployed to calm the waves and reduce fresh and salt water mixing. The curtain will also capture any floating debris, including plastics.

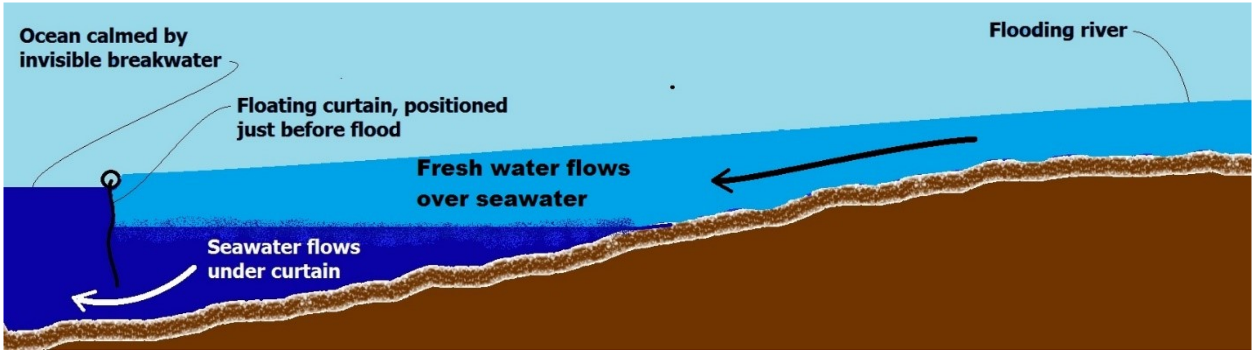

Fig. 4 – Elevation section of floating curtain during a flood

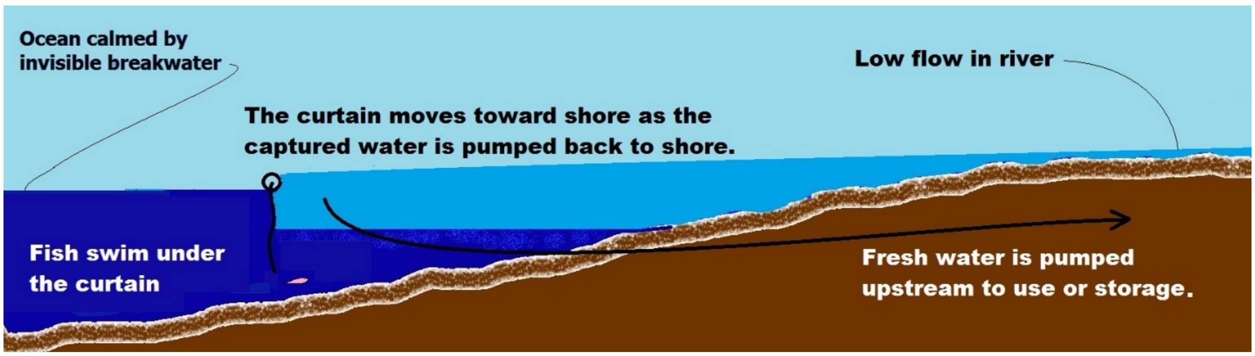

Fig. 5 – Elevation section of floating curtain contracting during fresh water storage

The breakwater system that would be invisible from the shore is not shown. It would be on the ocean-side of the curtain in Figures 4 and 5. Invisible and flexible breakwaters are explained on page 4 of the Sustainability Committee entry, "Public-Private Coastal Resilience Innovating."

Salt Balance/Trade Examples

Means to drain irrigated land (salt-removal) is as important as water supply. Without drainage, the land becomes barren or salts accumulate as liabilities[4]. New technologies, like WaterFX and others, recover salt from agriculture drainage or too-salty groundwater without a brine discharge.

Globally, 70 to 80% of fresh water use is for growing food. Humanity would not have fresh water shortages, if 30% of global food was grown in the ocean. This is virtual desalting, a term which is a take-off of virtual water. Virtual water is a term applied when dry countries grow wheat in wet countries. The dry country wheat consumption comes with virtual water consumption of perhaps 1,000 m^3 of water per ton of wheat. Virtual desalting is explained in more detail on page 3 of the Sustainability Committee entry, "Big Picture Resilience via Ocean Forests."

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[4] Westlands Water District with Kesterson National Wildlife Refuge, Imperial County farmers with the Salton Sea, etc.