California Water: Why It's Not Just About Using Less

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California gets its water supply from a variety of sources: surface water; underground aquifers; and the Colorado River. Water is used for environmental purposes, agricultural needs and residential uses. Some of the other statistics for water usage calls into question what can be done to cut back on that usage as the population grows. Water conservation efforts have cut back urban water usage, but agriculture conservation efforts have little impact. Environmental conservation limits how much water is available for other uses but fluctuates the most. Governments and private sector alike need to get creative and proactive about devising a solution.

INTRODUCTION

As the world's population continues to grow, and more and more of the world's habitable surface becomes repurposed for human use, we must begin to consider and plan for the eventuality that our consumption habits are no longer sustainable. Some scientists, environmentalists, and activists may even pose the argument that humanity's consumption of natural resources is unsustainable even today, and in many cases that may be true. But our planet is a complex one, and there are multiple different elements that play into the survival of the planet as we know it.

California's long ongoing drought and its effects, namely water restrictions and wildfires, have garnered national attention. Beyond its direct impact on residents in the state, however, the future implications of the water situation in California seem to remain a mystery to many.

Water is a key aspect of so many different parts of our lives, sustaining not only our direct ability to survive (through hydration) but also the crops and livestock we use for food, the clothes we wear and the cars we drive, and even our ability to keep our persons and our possessions clean. Access to clean water is an issue for 844 million people across the planet (Worland, 2017). That is just over 10 percent of the population. While not necessarily an issue for citizens of the United States, it may become one if our consumption habits do not change.

In recent years, California has become something of a poster child for water shortages, having experienced moderate-to-severe drought conditions throughout much of the state for more than 5 years (Worland, 2017). In addition to creating consequences for farmers and residents alike in the state, the drought has contributed to a serious wildfire threat that affects everywhere from southern California all the way up to the Pacific Northwest. It's put serious stress on species native to the region, and it's driven some to extreme measures in order to get access to water they need. The following discussion explores the issue of water in California in an attempt to understand its implications for the rest of the country, the continent, and perhaps even the world.

Water Sources

California gets its water supply from a variety of sources: surface water in the state managed by both state and federal water distribution systems, underground aquifers that both feed surface water systems and can be tapped directly via drilling, and the Colorado River, which supplies water to southern portions of the state. Water is used for environmental purposes (such as maintaining habitats for endangered species and maintaining water quality), agricultural needs to grow California's wide variety of crops, and, of course, to supply the residents with the water they need to drink, bathe, and otherwise live their everyday lives. Some of the other statistics for water usage in the production of a variety of consumer goods may surprise the average reader, and call into question what can be done to cut back on that usage, particularly as populations continue to grow (Burch, 2015).

The first step to understanding the water picture in California is to understand what water sources are available to the state. The state's water supply comes primarily from three major sources: state lakes; streams and rivers; underground aquifers; and the Colorado River. The state's aboveground water supply is heavily managed by federal and state regulations, and access to waters from the Colorado River is managed by a series of complex agreements collectively known as the *Law of the River*. Groundwater, on the other hand, has been virtually unprotected ever since Californians realized they could access it (Burch, 2015).

The US Bureau of Reclamation owns and operates the Central Valley Project (CVP), a river system that runs from northern California through Sacramento, Stockton, around Fresno and down to Bakersfield in southern California. It consists of multiple canals, pumping plants, hydroelectric stations/dams, and reservoirs. The main reservoirs are Lake Shasta, Lake Trinity, Black Butte Lake, Lake Folsom, New Melones Lake, San Luis reservoir, and Lake Friant, with a total capacity of just over 11 million-acre-feet (MAF) of water. In the average year, the CVP provides just less than 3 million acre-feet of water to sustain primarily environmental and agricultural needs. In dry/drought years, the CVP provides roughly another half MAF per year at the cost of depleting its reservoirs (Mulluch, 2014).

However, it's important to note that this water supply is not uniform across the entire area serviced by the CVP. Specific regions and uses get certain allotments, with some receiving higher priority over the other. It's important to note, then, that environmental uses for water have priority over agricultural needs throughout the state. Environmental water needs account for approximately half of the water supply used by the CVP. These needs include water in rivers protected as "wild and scenic", water required for maintaining habitat in streams, water that supports wetlands within wildlife preserves, and water needed to maintain water quality for agricultural and urban use (Mulluch, 2014).

The most relevant definition here is the second: water required for maintaining habitat in streams. A major hub of the CVP lies in the San Joaquin River Delta (Mount & Hanak, 2016). Located between Sacramento and San Francisco and feeding into the San Francisco Bay, this naturally occurring river delta is home to more than 500 species and 20 endangered species, including the Delta smelt, a two-to-three-inch-long silver fish that has become a symbol for environmentalists (Peterson, 2015). In order to protect these (and other) threatened species, the amount of water that flows south of the Delta has been greatly reduced during the drought years. In fact, agricultural users south of the river delta were only receiving five percent of their annual allotment of CVP water in 2016, while farmers north of the delta received their full allotment (Finley, 2016b).

In addition to the CVP, the California State Water Project (SWP) is a water management project that runs from Lake Oroville (north of Sacramento) along the same path as the CVP down to the San Luis reservoir, then continues further south along the California Aqueduct towards Los Angeles, where the western branch peters out at Castaic Lake and the eastern branch continues to Lake Perris. There is a branch that splits out from the Aqueduct just north of Bakersfield that brings water west to the coastal regions, ending just north of Santa Barbara. (Davis 2016; 2018). Unlike the CVP, which supplies water mostly for environmental and agricultural uses, the State Water Project system supplies 70 percent of its total contracted supply to urban users, with the remaining 30 percent going to agriculture users (Burch, 2015).

None of these water supplies interact directly with the final consumers of water in California. Instead they interact with the individual water districts that are then responsible for managing and distributing the water to the end users within their jurisdiction (Davis, 2016; 2018). Thus, water is apportioned at a water district level based on projected supplies and allocation requests filed by the individual districts.

Another major source of water for Southern California comes from the mighty Colorado River Basin, a system which runs from Wyoming down to the Gulf of California and passes through Colorado, Utah, Nevada, New Mexico, Arizona, and California along the way (Erie, 2016). Because of the plurality of state jurisdictions that the river passes through, it became necessary very early on for the states to come to an agreement regarding how water would be allocated between them. The series of legal documents comprising what is known today as the *Law of the River* dates all the way back to the 1920s, and even then, California's growth was a cause of major concern for the other states (Anonymous, n.d.).

The basin was divided into two regions, Upper and Lower, and the annual water supply allowed to be drawn from the river in total amounted to 15 million acre-feet, with half going to each basin (Regnacq et al., 2016). Difficult negotiations led to court proceedings which resulted in California receiving an annual allotment of that allocation of 4.4 million acre-feet, or approximately 60 percent of the water available (Gelt, 1997). However, up until around the turn of the millennium, California benefited from other states not using the full portion allocated to them under the agreement. As a result, California was able to use as much as 5.2 million acre-feet (69 percent) of the total water supply as recently as 1997 (Gelt, 1997).

Unfortunately, California's luck on that front seems to have dried up. Growing populations in neighboring states has caused the amount of "bonus" water available to California to decline as time has gone on. Arizona, which is allotted 2.8 million acre-feet of water per year through the contract, was only using approximately 1.4 million acre-feet, or half, just before the new millennium (Gelt, 1997). However, even by 2003, increases in Arizona's and Nevada's water consumption had reduced the amount of water left for California (the last user of Colorado River water before reaching the Gulf) down to the amount it was contractually allowed (Think Green, 2012).

This forced water districts that relied on that water to improvise, paying farmers a subsidy to leave land fallow to address other concerns, such as improving the ecology of the Salton Sea (Think Green, 2012). Studies show that this trend of decreasing supply is likely to continue, with a projected shortfall of 3.2m acre-feet of water across the river by 2060, enough water to supply Los Angeles for 5 years.

California's third and final source of water is a collection of aquifers that supply groundwater to several parts of the state. Four major aquifers are part of an EPA program that protects them from contamination: Fresno County, Santa Margarita, Campo/Cottonwood Creek, and Ocotillo-Coyote Wells (Davis, 2015). However, until the passage of the 2014 Sustainable Groundwater Management Act, there was no regulation of the usage of California groundwater. In fact, proactive residents of California cannot even gain access to well-drilling records, which would help understand just how much the groundwater is being depleted (Dimick, 2014).

There are only four California sources of groundwater that are federally protected from contamination, but none that are protected from usage by either state or federal mandates. Even with the passage of this act, a plan is not required until 2020 and full restrictions are not mandatory until 2040. This may not be fast enough to prevent the depletion of some groundwater sources such as the Central Valley Basin, where wells that used to strike water at 500 feet must now drill up to twice that depth in order to be able to pull water (Dimick, 2014).

Further complicating the issue surrounding groundwater aquifers in the state are those that lie under protected Native American reservations. In 2013, the Agua Caliente Band of Cahuilla Indians initiated a legal battle with local water utilities in the Coachella Valley Groundwater Basin arguing that they had a stake in how groundwater in that region was managed. The case, which may be taken up by the Supreme Court later this year, could have nationwide repercussions regarding the control of groundwater that lies under reservations (Carlton, 2017). A similar legal battle has been playing out in Montana, where muddy water rights legislation has led Native American reservations to fight contentiously for control over that state's water supply (Kavulla, 2015).

Water Uses

California's water usage is a topic that has been documented time and again as the state's water troubles have dragged on. A rudimentary breakdown is that about half of the precipitation falling in California is unmanaged, a quarter is used to maintain environmental habitats throughout the state, 20 percent is used for agricultural needs, and the remaining 5 percent is used for what is considered to be the benefits of everyday life: drinking, washing dishes/clothes, bathing, and flushing the toilet (Sheely, 2015).

As mentioned earlier, some of the specifics regarding what environmental purpose Californians had for water, but there is an important note that has not been addressed yet; most of the water designated for wild and scenic rivers is in the North Coast and includes flood flows, where there is no practical way to recover it for either agricultural or urban use (Mount & Hanak, 2016). Essentially, that water is gone, and nothing can be done to get it back. Mount and Hanak (2016) go on to point out that of the managed water, environmental usage is closer to 33 percent, and roughly a third of that amount is evapotranspiration or salt sinks and not returned to rivers or groundwater for alternative uses. So perhaps farmers are overstating how much water is used to protect fish such as the delta smelt, but you can still understand their frustration.

It is also important to note that environmental water use fluctuates the most from year to year. Mount and Hanak (2016) point out that during wet years, environmental water usage accounts for as much as 64 million acre-feet of water (MAF); that number drops to just under 22 MAF during a drought. Their 2015 study shows that water used by agriculture and urban users has not changed nearly as drastically (30.16 and 8.32 MAF in wet years vs. 30.5 and 7.93 MAF, respectively).

For agricultural users, the good news is that farmers are getting more efficient about using their water supply to grow their products; using roughly the same water allocations, while increasing the economic output of their farms by almost 35% (Hanak & Mount, 2015). The bad news is that California agriculture is not going to go away anytime soon. California is the nation's major supplier of many different food products, ranging from almonds and other nuts to melons, lettuce, vegetables, and of course, wine (McGinty, 2015). Some farmers have received stipends from federal, state, and local government programs that oversee water use within the state, such as the arrangement made by the Imperial Irrigation District in southern California (Think Green, 2012). However, the drought caused farmers to leave as much as 400,000 acres of their land unplanted as recently as 2014, causing an estimated $1.7 billion dollars in losses throughout the sector (Carlton, 2014).

Because agricultural water needs have not dropped off to balance out this decrease in supply, farmers have to get their water from somewhere else. This has led to the proliferation of water wells drilling deeper and deeper to access the groundwater reserves. The rising popularity of using groundwater has had multiple unintended consequences: first, the water table underneath California has decreased in some areas so drastically that farmers are having to drill 1000 feet under the surface to reach water, which can cost upwards of $300,000; and second, the earth is collapsing in on itself in the areas where the drills are popular, sinking as fast as one foot per year (Sabalow et al., 2016; CWSC, 2017).

How has this shortage affected urban water users? Total water use in cities essentially remains constant whether California is in a drought or not. However, this data masks the effect of the population growth California has been experiencing since the early 1990s. According to Hanak and Lund (2012), water use per capita had declined by approximately 20% from 1990 to 2010, from 232 gallons per person per day to 178 gallons/person/day. By 2015, the per capita dropped to 130 gallons per day due to drought-

related conservation (Mount & Hanak, 2016). So, it's safe to say that California residents were doing their part to be more conscious of their water usage even before the drought began, and water conservation efforts have decreased that number even further.

However, something that perhaps slips under the radar when it comes to urban water usage is the amount of water that businesses use to maintain their operations. One of the most obvious examples is the hotel industry, which uses as much as 15% of all commercial water for their restrooms, laundry, and landscaping needs (Mulluch, 2014). Some other surprising facts that are pointed out are that a single new car requires almost forty thousand gallons of water to manufacture, a cotton t-shirt requires 713 gallons, and a single slice of bread takes 10 gallons. That makes one second guess whether a sandwich for lunch every day is the best choice, given that for one person that is approximately 7300 gallons of water.

Businesses are aware, too, that the coming shortages of water are potentially going to have an impact on their operations. The Pacific Institute and Vox Global conducted a study back in 2014 that indicates that most businesses anticipate that water supplies will affect their growth opportunities, profitability, and options for facilities locations as soon as next year. Some businesses have already found ways to reduce their water usage, such as Vale S.A., a mining company which uses natural humidity found within mined ore to extract the different particles of iron used for different products (Mulluch, 2014).

Water Conservation

Water conservation efforts spurred both by increases in technology and by the drought, have significantly cut back urban water usage. Conservation efforts in agriculture, however, do little more than directly impact a farmer's bottom-line. Environmental conservation, additionally, limits just how much water is available for other uses, but the environmental usage of water fluctuates the most (Cahill & Lund, 2012).

Since 2011, California has been experiencing severe drought conditions that have garnered attention across the nation. It is one of the major causes for the frequency and severity of wildfires in California, which burnt almost 900,000 acres in 2015 alone (Navarro et al., 2017). As could be expected, this series of events has brought a lot of opinions and ideas to the table regarding what could be done to help protect the future of the state's water supply.

One of those ideas was clearly a short-term plan that did not consider its cumulative effects: patch the shortage in precipitation with groundwater from the aquifers. While this certainly may alleviate the effects of the drought for both farmers and homeowners alike, it is very clearly not a sustainable route. During dry years, California's reliance on groundwater has increased by approximately half, from comprising approximately 40% of the water supply to nearly 60% during the dry years (Cahill & Lund, 2012). This led well drillers in the Central Valley Basin to dig up to 1000 feet to hit water within that aquifer in 2014 at a cost of $300,000 or more (Dimick, 2014). Additionally, water users must wait longer than a year to get their wells drilled because of the backlog of drilling requests.

However, high drilling costs, deep wells, and long waiting lists are only part of the problem, and only the part of the problem that the individual user sees. One of the other effects of this draining of the aquifers is that it may end up depleting the rivers which the state depends on for its massive water management systems, the CVP and the SWP. One of the major water sources in southern California, the Colorado River, suffers from virtually no protection from overuse, and part is because the population depending on this water source is expected to increase by almost 50% by 2030 (Matlock, 2016). Over half of the Colorado River's water supply originates from groundwater, which is both historically under-regulated and difficult to measure. However, in 2015 NASA satellite images suggest that over 13 trillion gallons (almost 40 million acre-feet) of groundwater has been lost since 2004 (Buis & Wilson, 2015). Many states, including California, have begun to introduce new regulations to combat this problem of over-pumping.

Another issue this groundwater reliance brings on is the sinking of the earth in places where wells have proliferated. In some places, the land is sinking i.e., subsidence, as rapidly as a foot a year (Buis & Thomas, 2017). Land subsidence is a settling or sinking of the Earth's surface attributed to the subsurface compaction resulting from events such as underground mining, oil and gas extraction, natural compaction,

sinkholes and thawing permafrost (Buis & Thomas, 2017). One of the major canals that bridge the SWP and CVP from northern California to southern California is sinking because of the extraction wells that have been drilled there. In addition, river beds are sinking, and some geologists believe that the problem could create issues for other aspects of California's infrastructure if left unchecked (CWSC, 2017; Buis & Thomas, 2017).

A second option for dealing with the drought that may feel more familiar to anyone who has lived in a historically dry state i.e., Southwestern U.S., is urban water restrictions. The principle is that we tend to use water judiciously when no restrictions exist. The average individual could make the argument that since Earth is mostly made of water, and since water utilities are inexpensive, then we must be in no danger of exhausting our water supply. Thus, the state, and by extension the water districts lying therein, takes responsibility for cutting back on water consumption by imposing use restrictions on users in urban areas.

Over 50 cities in California implemented water-use restrictions, some as high as 50%, in 2014, enforcing the mandates with higher usage fees and city inspectors (Carlton, 2014). In Sacramento, inspectors issued almost 2500 water use violation notices in the first 5 months of 2014, with fines up to $1,000 (Carlton, 2014). One of the major restrictions in place at this time was to cut down on the number of days that residents could water each week. However, only about half of the homes in Sacramento, the state capital, have water meters than can measure use at that level of detail, leaving the city to rely on these state inspectors at much greater cost to them.

In addition to outdoor watering restrictions, cities have cut back within households and buildings alike by using low-flow faucets, showerheads, toilets and the like. In addition, restrictions have been put into place regarding when residential areas can water their lawns. Some cities, such as Roseville, have even offered monetary incentives to replace landscaping with flora more indigenous to the region that also uses significantly less water. The incentives can be as great as $1,000 for replacing grass with native landscaping (Carlton, 2014).

These measures have proven to be quite effective. In the 9-month span between June 2015 to February 2016, California managed to save 1.19 million acre-feet of water in the state's urban areas, roughly 96% of Governor Jerry Brown's mandated water savings goal (Carlton, 2016a). Coupled with increased precipitation in 2016, this had led to Lake Shasta being filled from 59% capacity to 89%, a tremendous uptick for a single year. Fortunately, Governor Brown also recognized this is not a problem that is going away anytime soon. Later in 2016, he issued another mandate making some water restrictions permanent, particularly those practices deemed wasteful, such as hosing off driveways (Carlton, 2016b).

Farmers, on the other hand, have had to leave a great deal of their land fallow to conserve water for other uses. Some water districts offer financial incentives to do so. Another measure that may be beneficial to implement is the use of micro-irrigation, where water is distributed more precisely than the more common flood irrigation. Some researchers believe that this type of irrigation could produce water savings of as much as 20%. Farmers could also stop growing almonds, which require anywhere from 1 to 2 gallons per almond just to grow, but that doesn't seem likely given their recent rise in popularity (McGinty, 2015).

POSSIBLE SOLUTIONS

Publicly Funded Options

One state option is California identifying money to improve the existing infrastructure of the SWP and CVP to increase the size of the reservoirs or improve the distribution of water from the relatively water-rich northern parts of the state to more drought-stricken regions. In 2015, California Senators Feinstein and Boxer proposed a bill to increase funding for dam projects in California by $600 million, following a bill by Representative David Valadao intended to streamline such projects (Carlton, 2015). Governor Brown proposed a plan to introduce a tunnel that would bypass the fragile San Joaquin Delta ecosystem to bring more water to the southern Central Valley (Webster, 2017).

However, both ideas come with their own unique challenges. Raising the height of the projects' reservoirs is expensive, with a proposed improvement to the Lake Shasta reservoir estimated to cost $1.3 billion, or more than twice Feinstein and Boxer's proposal. Additionally, environmentalists contend that such a project could pose a threat to wildlife endemic to the region and faces significant resistance from the Winnemem Wintu tribe located in the region (Carlton, 2015). Governor Brown's tunnel, on the other hand, is only estimated to raise water flows south of the Delta by 5-10%, raising questions about whether the cost of the project would be worth its benefits (Carlton, 2015).

Rather than expanding reservoirs' size, California could deploy a project to capture water run-off in flood plains to fill depleted aquifers. Infiltrating water into the aquifers is a cost-effective option as reservoir construction is calculated at $1,700 to $2,800 per acre-foot compared to filling depleted aquifers that is projected at $400 per acre-foot according to a Stanford University study (Jankowski, 2018). Storing run-off water in depleted aquifers provides more water for agriculture pumping, avoids soil erosion, and buffers streamflow for endangered fish and fowl.

The federal government has also used its broad powers to exert control over waterways within our borders, with the Environmental Protection Agency issuing mandates in 2015 that brought a great deal more surface-water under its protection (Harder & Tracy, 2016). This could help conserve water by keeping it off-limits from state or business use, but a federal judge has put a block on the order until outstanding legislation has been resolved. Additionally, the new administration has made pledges to reduce or eliminate a significant amount of regulations put into effect during the Obama administration, and the waterway protections are at the top of President Trump's list (Harder & Tracy, 2016). State governments such as California's can attempt to fight this effort by suing the EPA to keep any new mandates/reversals from going into effect.

Private Sector Options

Although the solutions provided by the various levels of government have been the most common options, they are not the only method of protecting our water supply. The private sector also offers a wide range of potential opportunities for improving the prospects of our planet's viability, and water conservation is firmly planted in many of those efforts. With the millennial generation coming of age and entering the workforce, the financial sector has seen a boon of potential investors who are determined to pass wealth on to future generations (Birkner, 2014). What makes this exciting and relevant is that millennials as a whole tend to be more interested in making investments that benefit the community or world as a whole. These investments could be companies from any sector that give back to the community or companies whose sole purpose is to help conserve water and energy, such as solar and wind energy companies.

Further increasing the attractiveness of these investments is their performance. Kleinwort Benson Investors has been investing in water since 2000, had $1.5 billion invested in water in 2014 and had experienced a 32 percent return in the prior year (Abkowitz, 2014). One of the most common investments is water infrastructure - everything from the pipes, pumps, and valves that deliver water to homes, to the drainage systems for storm water, to the irrigation systems for crops (Abkowitz, 2014). Cadiz, Inc. has been working on a plan since 1998 that would bring enough water from underneath the Mojave Desert to supply 400,000 Californians. However, this plan has been continuously blocked by California Senator Dianne Feinstein and the Whitehouse administration because of claims that doing so would deplete mountain springs and harm wildlife (Finley, 2016a). Perhaps, in this case, the President Trump's desires to reduce federal regulations would help private projects such as this fulfill its goal.

Another, albeit less savory, water investment option is wastewater or sewage. University of Florida researchers have found a way to extract 97 percent of the phosphates found in urine. These elements are used in everything from toothpaste to fertilizer; two items that it could be argued will be in regular demand for the foreseeable future (Abkowitz, 2016).

Related to sewage is the Plumbing Manufactures International study concerning water-efficient toilets that finds these toilets would save billions of gallons of water usage each year. The study focused on five states experiencing water shortage including Arizona, California, Colorado, Georgia and Texas. The

investigation found toilet flushing is the single largest user of water in the home representing 24% of the total water used in a single-family home. By replacing non-efficient toilets with efficient-water ones would save the five states 465 million gallons of potable water per day or for the nation approximately 360 billion gallons per year (Anonymous, 2017).

While these are only a few of the options available in the private sector, when a consideration of how much water is used in the production of everything from a slice of bread to a new car, the potential for investing in new strategies and technologies that rely on cutting back on water usage is large. Unfortunately, much of this behavior seems to be reactive rather than proactive and will likely have to change to achieve a permanent reduction of water consumption. The same could be said for government mandates related to water, as even California has seen some of their water restrictions loosened or removed entirely as the drought appears to lessen.

In short, the only thing certain is the California water supply is dwindling at an unsustainable rate. Though great efforts have been made to cut back on water usage in urban areas, there are countless different complex issues surrounding water management that make it difficult to find a solution - one of the first is to have a full picture of just how much water is left in aquifers that is available. This is not a problem unique to California, as aquifers across the US and all over the globe are also decreasing rapidly (Lurie, 2015). Thus, it is society's responsibility to find some viable way to keep our water supply safe for future generations.

Innovative Ideas

Even with the best water conservation efforts, California faces a major problem in terms of where it is going to get its water in the future. Precipitation is critical to replenishing both the state's aboveground and belowground water sources, but precipitation in any of its forms is far from a guaranteed phenomenon. As yet, a means has not been devised to control just when and how much precipitation is received.

Since rain cannot be controlled rain, what other options are available? The size of reservoirs can be increased, but this is costly and has pushback in some places from various interest groups. Perhaps more creativeness can be employed on how to distribute the water within the state, but this faces some of the same limitations. Other options include transporting water from other locales and finding ways to make use of water that was previously unusable.

There are two innovative options to bring water to California: tow an iceberg or build a massive pipeline from other states. The state has already been willing to build massive pipelines to transport crude oil, albeit it has become more controversial in recent years because the decision makers have been cavalier about where to put these thousand-mile pipelines. But water is significantly less damaging if there is a spill, and surely a means could implement some of the same emergency cutoff systems that are used ubiquitously in the oil and gas industry to prevent the type of spills that could be catastrophic. California may not have to go as far to find excess water since places such as Seattle could probably spare an acre-foot or two. William Shatner has already even tried to start funding for a private project doing exactly that (Pogue, 2015). It is exorbitantly expensive at $30 billion, but a high cost for water is a reality that tax payers may have to accept.

The other option is to tow an iceberg from the Artic to California. The United Arab Emirates already has a plan in motion to begin doing just that next year, since the average iceberg has enough water to supply a million people for an entire year (Osborne, 2017). California has even considered towing an iceberg in the early years of the recent drought but wrote it off due to high costs. Again, a high cost for water is a reality that will need to be accepted and funded.

If transporting water is too expensive, risky, or otherwise deemed an unworthy option, perhaps the solution is to make water potable for California's various needs. Desalination plants could potentially make more water usable for environmental and agricultural purposes, if not for drinking (Li et al., 2013). In fact, California already uses desalination plants to soften water from the Colorado River before it reaches Mexico, but it must be based on the Colorado River management agreement. This begs the question of why not use the same methods to bring water from the ocean into the cities.

Wastewater treatment systems could be upgraded to make that water potable, or at least suitable for other purposes (Mara & Horan, 2003). It is unsavory, but NASA uses the process in space travel to the international space station, so why can't California employ its utilization? No doubt that it is expensive, but necessity will be the driver behind the solutions. Scientists are constantly finding clever ways to do a lot of things with wastewater as it is, so perhaps they can find the means to utilize that wastewater to cut down on water usage in other areas, rather than recycling it back into bottled water.

CONCLUSION

With no foreseeable decline in water consumption in California, or, indeed, the rest of the western United States, governments and the private sector need to get creative and proactive about devising a solution for providing the water needed for survival. One way or another, something must be done. The water supply is dwindling in California, and population growth in the Southwest is only going to exacerbate the problem. It may sound like a doomsday prophet, but a couple of good years of rain should not influence the decision makers to ignore California's water problem.

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