Chapter 13 - Water is Life

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Not Enough to Go Around, The Magic Water, Water Isn't Free, A Matter of Trust, Food or Drink? Let Me Count the Ways, What's Ours? What Should We Do? A Global Issue, References

Not Enough to Go Around

No discussion of planetary environmental destruction and actions we must take to save it is complete without water. Why? Because water is Life. Because water is energy. Because energy is water. It's all linked and it's all important. All life on the planet depends on water to survive. No water, no life. All life on the planet is made up mostly of water. Even our own bodies are about 60% water. And, when I say that we all need water, I mean that we need fresh water that's safe for drinking, at the very least. With the exception of marine life and certain microbes that can live in saltwater. And, like everything else we humans do, every decision we make about our direct water consumption impacts our CO_2 footprint that's warming our planet. And, everything we consume, from food to energy to clothes to stuff, requires water which requires energy which increases our CO_2. Think about that.

"Water is the driving force of all nature." Leonardo da Vinci

Yet, even though the habitable surface of the planet is mostly water, we're managing to run ourselves out of that, too. You might be wondering how that can be. Well, contrary to what a moronic teacher told my sons in their elementary school science class just a little more than 30 years ago, we ABSOLUTELY DO NOT have an endless supply of fresh water. It's no wonder that most people are clueless about the importance of water and why conservation is so very important. If you are a teacher, please be responsible concerning education about water. For some awesome material about the realities of our water, you can visit water.org.

Definitions of Drinking Water [1]

- Improved Water Source: Piped water, protected wells, protected springs, rainwater, and packaged or delivered water.
- Unimproved Water Source: Unprotected wells and springs, and surface water, such as rivers and lakes.
- Safely Managed Drinking Water Service: A water source that is accessible, available, and free of contamination.
- Accessibility: The water source is located on the premises, such as a tap in the house or yard.
- Availability: The water is available when needed.
- Quality: The water is free from contamination, including fecal matter and priority chemicals.

The trouble with water is that the fresh water that's actually useable and available for most life only makes up 0.4% of the total water on the planet. The rest is sea water, or is tied up in ice caps and such. Estimates of global access to clean fresh water for humans is all over the map, and estimates of global population without access to clean water can range anywhere from 11% to 50%, depending on the source of the estimates. And, in one way or another, they're all mostly right. It depends on how access and availability are defined, as well as what acceptable water quality is, along with a myriad of other criteria that can be used to define water. Also, consistency in how the data is collected by various researchers for different studies is always a challenge. Largely it's an issue of data availability, which is

scarce in some regions of the world, especially in countries where safe water is scarce.

Basically, water is complicated, as are issues surrounding water. The World Water Council estimates over a billion people don't have clean, safe water, which is about 12%,[2] while a recent study in *Science* estimates that 4.4 billion people, more than half the global population, lack access to clean drinking water.[3] The United Nations has it at 783 million people lacking access to basic drinking water, which is nearly 11% of the global population, and 2 billion people, about 25%, without access to safely managed drinking water services.[4]

The highest estimate, at 4.4 billion people, is double the U.N. estimate, and is based on a more detailed analysis than the national reporting data that is commonly used, including geospatial data, machine learning and household surveys, so it may well be closer to the truth. Which is bad, when you think about it. Even 2 billion is a bit of a shit show if you ask me. Even worse, an estimated 1.8 billion are stuck with water that's fecally contaminated. I mean, how would you like to be one of the people with no access to a consistent supply of safe drinking water? In the U.S. we're so spoiled it's embarrassing. And, yet again, I'll ask the same tired old question – if we can't supply the people that are here on the planet now, how on God's green earth do we think we can supply more? Blimey!

Even in the U.S., we have at least 2 million residents who live in homes that don't have indoor water or sanitation facilities. This is costing the economy more than $8 billion per year in health care expenses, lost productivity and other expenditures, and most of those affected are in rural, low-income areas.[5]

As we can see in Figure 1, the lion's share by far of our water goes to agriculture, and if we don't stop growing our population, it's going to get worse. I mean, sheer logic should say more people = more food = more water. Ya think? If population continues to increase, how does the math even work? Think about that. There are things we just can't change in this world, like death, taxes, laws of physics and Earth's water balance. We can't create water. What's really going to happen, if we don't do anything about our population, is that people who can't get enough water to survive will either die, migrate or go to war over this scarce and most necessary resource that all we need to survive. In fact, that's already happening, as you'll see below.

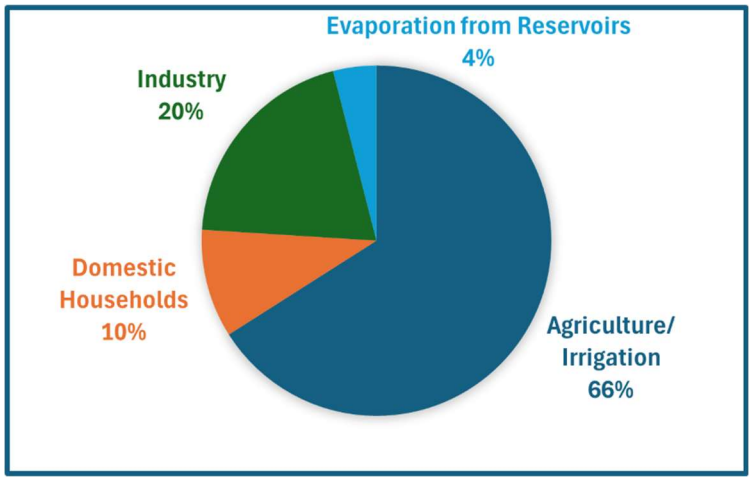


Figure 1 - Global Fresh Water Use

Water is absolutely necessary for our survival. Water is the life blood of our planet. Every living thing needs water. All terrestrial life, including all plants and animals, need fresh water to live, and available fresh water only makes up 0.4% of the total water on the planet, the rest being either sea water or water that's locked up in glaciers or permafrost. We humans can't live more than a couple days without it. We can live a lot longer without food, a couple weeks, at least, but we need water to grow that, too. A lack of water will take us out faster than anything else you can name, including

energy, transportation, shelter, and even all that stuff and junk that you bought but didn't really need. We'd better take this seriously. Just saying.

Entire ecosystems are becoming jeopardized as we continue to pump water from aquifers that can't be recharged by precipitation fast enough to satisfy our needs, causing water tables to drop. The countries in Table 1 account for 74% of global groundwater withdrawals.[6] It's no different from our horrendous overconsumption of fossil fuels that took millions of years to accumulate, that we're depleting in just a few centuries. We're using up the water underground, and it's not going to recharge for centuries, if ever, given our level of irresponsibility and cluelessness.

Table 1 - Comparison of Groundwater Withdrawals by Country

	Historical and Projected Groundwater Withdrawal, cubic miles/year		
Country	1960	2010	2099
U.S.	2.2	5.5	13.4
India	3.1	19.2	39.1
China	1.9	6.7	8.6
Pakistan	5.3	11	18
Iran	4.3	11.3	15.6
Mexico	1	2.4	6
Saudi Arabia	0.7	4.8	7.7

Sources – Aqueduct Water Risk Atlas; World Resources Institute; Yukiko Hirabayashi, Shibaura Institute of Technology; Yoshihide Wada and Marc FP Bierkens, Environmental Research Letters, October 2, 2014.

The Magic Water

In the U.S., most of us have access to safe treated drinking water, largely due to the Clean Water Act, which was passed in 1972. This was closely followed by the Safe Drinking Water Act, passed in 1974. These acts are enforced by the Environmental Protection Agency (EPA), with the goal that all Americans have access to safe drinking water. Because all of us have a right to it.

So, when you turn on the tap, do you ever think about where that water comes from? Do you know how it gets to your tap? What energy and resources are needed? How much it costs? Do you even care? If not, don't feel too bad. I was well into my engineering career before I truly understood where drinking water comes from, and what it takes to produce it.

A survey conducted at Indiana University, IU Bloomington, asked 457 IU students to explain how water moves from source to tap, and then back to the environment. 29% of the students failed to include a drinking water treatment facility, and 64% didn't realize there was a wastewater treatment plant involved. Only 7% of the students had anything near accurate.[7]

You don't have to be an engineer to at least understand what goes into treating our drinking water. For one thing, drinking water and wastewater treatment consumes a significant amount of energy, about 2% of all U.S. energy. Still, it's a lot. So, to waste water is to waste energy, which adds to carbon footprint. An understanding of the basics will go a long way towards understanding how our actions and use of our water systems impacts the environment and our wildlife. And the water sources impact the quality of our drinking water, so it's important to protect those sources for our own health as well. Just 100 years ago, life expectancy in the U.S. was 47 years, and currently it's 78 years, which is

astounding to me given how much unhealthy toxic food we subject our bodies to. A major reason for our increased longevity is clean water, which evidently overrides the adverse impacts of crappy food. Globally, where people lack access to safe water, about 4,000 children die every day from unsafe drinking water.[8] Think about that.

While I was at Colorado School of Mines pursuing a chemical and petroleum refining engineering degree, I was required to take some engineering classes outside of my discipline. Somebody suggested a water and wastewater class, so I took it and I was astounded at what I learned in that class. I also took a couple Environmental Engineering classes, and ended up with a minor in Environmental Engineering, mostly to help the oilfield service company that I worked for comply with environmental regulations. However, I was absolutely hooked on water and wastewater treatment, and when I decided to change industries it was my first choice. The water industry is truly a little-known, unsung hero when it comes to necessities in our world. If you're looking for a career, consider this a pitch. Every treatment plant in the country needs help, and there's plenty of opportunities for everybody, from operators to chemists, biologists, mechanics, electricians, all manner of administration to, of course, engineers! Many water and wastewater plants invite residents to schedule tours, and it's truly fascinating to see what goes into making our water safe. It's not magic, and there's much more to it than turning on the tap.

So, just how does our drinking water get treated anyway? How do we manage to take billions of gallons of water from rivers or lakes or subsurface water tables, even from the ocean if we're desperate enough, that could contain any number of toxins, pathogens and solids, and turn it into clean, clear water, delivered directly to your tap? That never makes you sick? Well, almost never. And, why does it take so much energy?

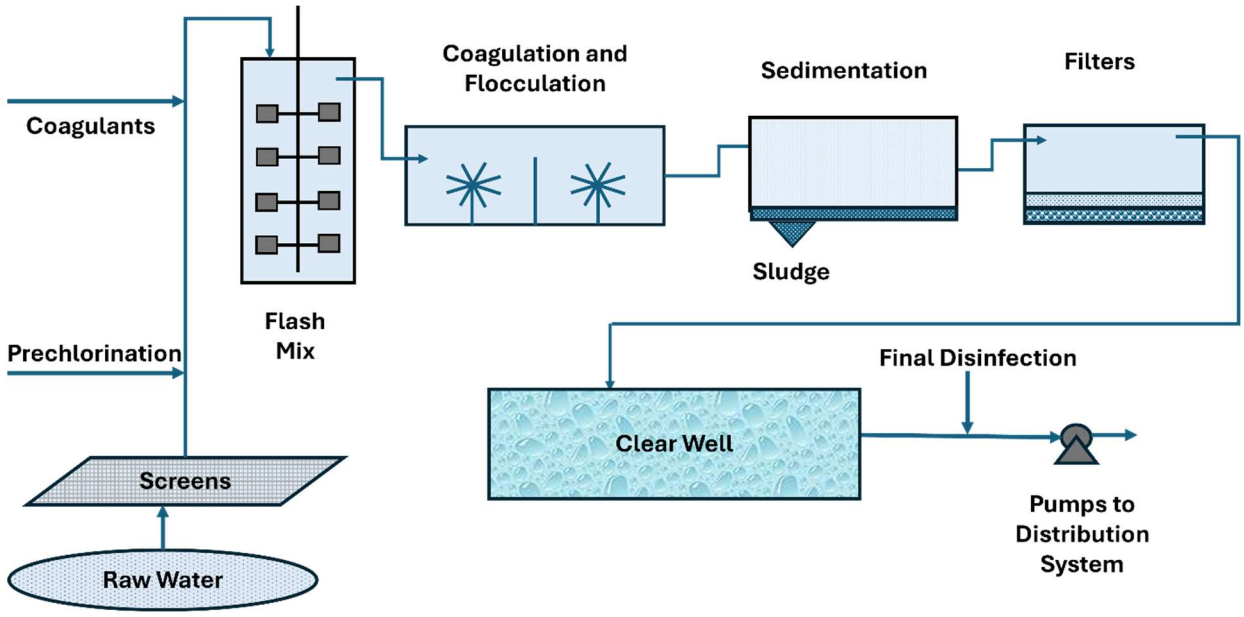


Figure 2 - Diagram of a Drinking Water Treatment Plant

Figure 2 is a very basic diagram of the general features of a drinking water treatment plant. To keep the diagram as simple as possible, the pumps between each process are not shown, but pumping water and running mixers, as well as feeding chemicals to the system all require electricity. For large

water treatment plants that supply cities that may consume hundreds of millions of gallons of water, multiple huge pumps are required. Short descriptions of each process follow:

- The raw water source may be from a surface water body, such as lake or river, or from a groundwater supply.
- The water is first screened to remove large objects like plant material, trees and fish. If the water is from a groundwater supply, screening may not be necessary.
- Chemicals may be added to screened water to help coagulate extremely fine particulates, react with toxins and other undesirable salts or compounds, or kill bacteria.
- Flash mixing is used to thoroughly mix chemicals with the water.
- Sedimentation followed by filtration removes the coagulated solids, producing a clear water.
- The clear water is pumped to a clear well, where it's held until it's pumped to the distribution system, after disinfecting.
- The distribution pumps pump the final treated water to the distribution system, which can include thousands of miles of underground pipe in large cities. These are high pressure pumps that maintain pressure in the system to prevent influx of fluids from outside the pipes that could contaminate the treated water. When the water reaches the tap in your home, the pressure will probably be 20 – 50 psi.

The source water may contain any number of dissolved chemicals, some of which are harmless salts, and some of which may be harmful. These are typically determined by laboratory testing before the treatment plant is built, if possible, so that ideally the plant can be designed to remove the chemicals. In some cases, changes to the water source may come as a surprise after the plant is built, like a new industrial or agricultural discharge to the source water, or, as mentioned in Chapter 12, runoff from a wildfire. In any case, additional process steps, possibly involving oxidation, chemical addition and precipitation or additional filtration may be needed.

Any additional processes and upgrades obviously add to costs, energy and complexity of the plant, and this is why every drinking water treatment plant in the world is unique, with no two plants the same. When the water is finally clear and free of harmful chemicals, the final step in the process is to disinfect. This involves adding a disinfectant, usually some form of chlorine bleach, to kill any bacteria that might have survived the treatment process. Enough disinfectant must be added to maintain active disinfection to the point of use, which is your tap, to make sure that no bacteria gets picked up along the miles of underground pipe between the water treatment plant and your home.

Once the disinfection step is complete, the treated drinking water is pumped into the vast piping network that serves the city or town. These pumps can be huge, as some may handle millions of gallons daily for larger towns, and hundreds of millions for big cities, like Denver, Houston or New York. Think about that. We're talking about some ginormous pumps, thousand horsepower beasts, that consume lots of electricity to run, which, along with the pumps to move the drinking water from source to plant, and through the plant process, explains the power consumption used to treat our drinking water.

The energy-water nexus is well known within the water industry. Basically, electrical energy is needed to make water, and water is needed to make energy. In a power plant, steam is raised from water, then the pressure of the steam drives a turbine generator. The feedwater also has to be purified with a reverse osmosis (RO) system, which is a specialized filter that removes dissolved salts from the water. All of this requires more than 40 gallons of water per kilowatt hour of electricity generated.

If seawater is used as a drinking water source, the desalination process includes RO, which is extremely energy intensive, and can increase electricity for the entire drinking water process by around 50%. This is why it's just silly to think that seawater is going to save the day as freshwater becomes more scarce. If we go down that road we'll run our planet past the tipping point in no time.

Some facilities use more energy than others, if they're located a significant distance from the water source, or have extremely energy-intensive processes. In California, 20% of the electricity produced in the entire state is used to move water from sources far to the north to cities in the southern part of the state.[9] In China, they pump source water 800 miles to supply Beijing and other large cities.[10] In all big water collection and distribution systems, huge pumps are located along the pipelines to keep the water moving. Make no mistake. It's a lot of energy. For water. Which is needed for energy.

As we continue to pollute our waterways with our irresponsible behavior, it's making it more and more difficult to treat the water, which, naturally, adds to energy, complexity, and costs. Examples are bacteria, unregulated agricultural runoff and pesticides, chemicals, cleaning and personal care products that contain toxins, and plastics that find their way into water supplies.

Water Isn't Free

In theory, water is a resource, like air and land, part of our planet that we all share, that should be available to all life, including all humans. But, we know it doesn't work like that. At least, not now that our overpopulation has made water, like all other resources, scarce. And, like any other scarce resource, expensive. And, in reality, any of us can make like a water deprived woman in a third-world country, carry a bucket on our head, and fill it from the nearest river, just a few miles away. And risk our lives as we drink it untreated, with all the toxic filth that's in it, because of us.

Water poverty is now a thing in the U.S. and not just undeveloped countries, mainly in urbanized and low income areas, where water costs are higher than the rest of the country, because it's so scarce. The costs continue to increase as demands exceed supply, and according to a recent EPA assessment, about 20% of U.S. families currently can't afford their water bill. Indigenous households are even worse, with about 30% of them in debt to their utilities.[11]

Among those who actually can afford their utility bills, many still moan and groan about the high costs. Yet, personally I can't really sympathize too much, when the average American household spends $850/year on unhealthy soft drinks,[12] but only $610 on water and wastewater treatment charges.[13] Figure 3 is a breakdown of average utility costs in the U.S., showing that water treatment, along with wastewater treatment, are the lowest of all utilities, and only a fraction of communications and entertainment, which are nearly 50% of our costs. Out of all these costs, the single most

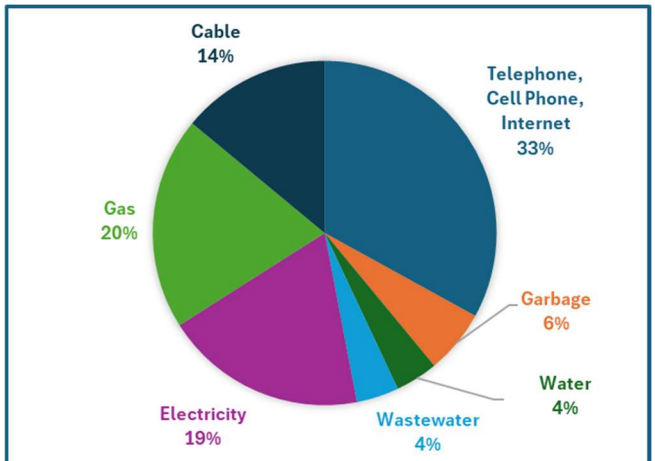


Figure 3 - Comparison of Utility Costs in the U.S.

important utility that we absolutely can't live without is the safe water. Ya think? A lot of us could use some perspective when it comes to the necessity and cost of water.

People across the globe seem to realize that water is important, but then they whine about the bill. The reality is, nothing is free, least of not safe drinking water. And, I find all the whining ironic when so much bottled water seems to sell, at 1000 times the cost of tap water, and is far less trustworthy than tap water. Just saying. Think about that. Talk about idiocy.

A Matter of Trust

In U.S., the thinking about tap water is pretty backwards. We tend to trust bottled water, which is no better, is more often worse, and is horrendous for the planet, given all the single-use containers. For one thing, bottled water is not disinfected to point of use. It may be disinfected at point of bottling, but then it sits there in the bottle, for weeks or months, as it's transported to a warehouse, then a store, where it's purchased by some brainwashed sucker, and by the time it's opened the disinfection is long gone, probably replaced with toxic plastic monomer leachates from the bottle itself. A recent study measured 240,000 plastic particles in an average liter of bottled water, 90% of which are nanoplastics, which are tiny enough to pass through lungs and intestines into the bloodstream and vital organs. It turns out that most of the plastic comes from the bottle itself.[14] A better understanding of the drinking water industry in the U.S. can help, as a general lack of understanding of how drinking water is produced and how the supply is managed leads to distrust.

To me, few things are more ridiculous than the idea of hucking water in single use containers all over the world. I remember when bottled water first came out, and how stupid I thought it was. And I was just a teenager. I would always say that if I'm gonna buy water in a bottle, at least there should be something in there besides the water. Like maybe some alcohol? Or flavoring? Or at least some fizz? I mean, if you want just water, then turn on the tap. It's so much cheaper. And you don't end up with a bottle to deal with. Yet here we are. We're really that thick. In 2023, we consumed an average of 46 gallons per person in the U.S. alone. Think about that. Do you see that as a problem? Do you have a clue how bad that is?

The reality is this. A single liter of bottled water takes a shocking 3 liters of water just to produce the bottle and fill it up, so now you are talking about a 4 to 1 ratio. And that compounds the amount of water needed to make the energy needed to make the water itself, the energy-water nexus described previously.

Even worse, the microplastics from the discarded bottles are now so widespread that they're literally everywhere. They're inside pretty much all humans and animals, they're literally destroying entire fisheries in the oceans, and research is finding that they're making wildlife and humans sick. They're finding accumulated microplastics in human brains as well as liver and lungs, and most is ingested from bottled water and tap water, since it's now everywhere.[15] The leachates from the microplastics are toxic to humans and wildlife. And, thanks to big corp brainwashing and our thickheaded cluelessness, we're pretty much stuck with them. There's no cleaning up the mess we've created. About the only useful thing we can do is stop buying freaking bottled water. That will at least stop the bleeding. Then, we wait about a thousand years for it to finally break down completely, though it would be mostly gone in 50 to 100 years, IF WE STOP IT NOW.

Globally, we now drink as much bottled water as we do milk. Not that milk is great for us either, but still. Bottled water sales in the U.S. were a whopping 16 billion gallons in 2023. Over one fifth of the water in the U.K. is sourced from overseas, even though there is plenty of good quality drinking water within the country. There have also been trends for water from remote areas, such as Fiji water, from the Fiji Islands, 1,600 miles from the nearest continent. And, to be clear, there is absolutely nothing special about Fiji water that makes it better for you than tap water, other than the perception of exclusiveness pitched by big corp to brainwash you into thinking so. Bottled water has to be the most profitable marketing scam in history. You gotta hand it to them. Think about that. Are you able to actually think for yourself and just use the tap water, a simple action that saves money and helps the planet and wildlife? A lot? Knocking it off with the bottled water is one of the quickest wins for our planet, that each and every one of us can do immediately.

About the only justification I can think of for bottled water would be emergency situations in which tap water isn't available, disasters and such that shut down the utilities. In that case it's kind of a no-brainer. But for everyday life, it's just a waste. Several organizations that I've been active in stopped using bottled water for events, and went to 5-gallon dispensers that we buy once, and then fill with local tap water and ice for events, like outdoor picnics, bike rides and such, then tell everybody not to forget their refillable water bottles. How hard is that? It saves the organization money and reduces waste. More and more public places have accessible dispensers right next to the drinking fountains to make it easy to refill your bottle. The way it should be. So, use them.

Our family even refuses to use bottled water when we travel in foreign countries known for unsafe water. We take our own reusable bottles, and fill them with local tap water. We also take a dropper bottle of Clorox, and we treat the water with 5 drops of Clorox per liter of water, and let it sit for 30 minutes before we drink it. That's basically what a water treatment plant does. If we want to do more, we also take a backpacker's water filter, and filter the water before treating it. Our son swears by his steri-pen, that you simply dip into the bottle and it kills the germs with UV light. Just don't forget to bring extra batteries!

Some reasons for distrusting tap water may be linked to taste or color. In places like Florida and West Texas it's true, because of the quality of the water sources. In reality, people shouldn't even be living in these places to begin with, and this is one of the many reasons why. Distrust could also come from something they may have heard about inadequate infrastructure, which is also true. U.S. infrastructure is definitely in a state of neglect, and needs funding. This has been raised repeatedly over decades by water professionals and organizations, but never seems to make it to the top of the congressional agenda as they bicker over immigration and gun control and whether fascism would be better for our country than democracy. However, while the state of public infrastructure is transparent to the public, the state of private corporations that produce

bottled water is absolutely not, so anything could be going on behind those factory walls, and you'll never know the truth, unless it's exposed by a whistleblower or watchdog organization.

Many are concerned about water pollution, and they should be; we can't pollute the water that we and the wildlife need for survival. But bottled water is not the solution. Most bottled water is drawn from the same sources as the tap water, with an advertising spin to make it seem exotic and classy, the same kind of brainwashing that big corp has always used to convince us to spend our hard-earned money on things we don't need.

Sometimes water systems do have drinking water violations and resulting boil orders, but this should reassure us that the utilities are honest and following the rule of law, which requires them to report water to the public if it is out of spec, even if it's embarrassing. This is a good thing, and is called transparency. The regulations that govern public drinking water are extremely stringent, as are the reporting requirements. Putting it into perspective, if we have one city in the entire U.S. that has a known drinking water violation that they are addressing transparently, and tens of thousands of other cities and towns that you never hear about that are meeting their requirements, then isn't that a glass that's more than 99.99% full? Or are you going to use the less than 0.01% empty part as a lame excuse to drink bottled water? Think about that.

Fiji Water sued over "deceptive" marketing claims

Fiji Water faces a lawsuit in the District of Columbia, filed by the Plastic Pollution Coalition, for allegedly violating the Consumer Protection Procedures Act through "false and deceptive marketing." The lawsuit claims that Fiji Water contains microplastics and bisphenol-A despite being marketed as "natural" and "untouched."

Full Story: The Cool Down (3/4/25)

Remember that treated drinking water is a privilege to be gratefully appreciated and has saved untold lives from the misery of waterborne illnesses that prevailed before we started treating our drinking water. And don't forget that when we pollute our waterways, when we buy food that is not organic, when we use pesticides on our landscapes, we are contributing to deteriorated water quality, and we are making water treatment more difficult, while sickening wildlife that relies on the water, pushing them yet closer to extinction. It's us. Think about that. Which camp are you in? Taking care of our water or trashing it, while blaming the utilities for the failures?

"We forget that the water cycle and the life cycle are one." Jacques Cousteau

Simply keeping our watersheds clean and undisturbed, so they can function as nature intended, saves untold billions of dollars downstream, in costs to treat the water to remove pollutants so the water is safe for drinking, as well as swimming, fishing and other aquatic activities. In many cases, the kinds of pollutants that enter our waterways can only be removed at great expense, to the point that the cost and energy needed to remove the pollutants may be unsustainable and, though technically feasible, not economically possible in practice. While just leaving nature to take its course and staying out of the way can provide the same or better benefits with no cost or extra energy at all.

Food or Drink?

The Central Valley of California produces about 50% of the food consumed in the U.S. Now, they have lowered the groundwater table through overuse as they try to grow too much food for too many people, and the water quality is deteriorating. As ever, the groundwater took thousands of years to accumulate, and farmers have drawn it down in just a century. At the same time, cities need the water for drinking and general use. So, we have farmers and cities fighting over the water, with the wildlife caught in between as a side-gig. Which is more important, food or drink? Does wildlife even matter? Actually, it's a trick question. Obviously, it's all important. To a point.

Each side obviously has to make serious reduction efforts to ensure they don't run out completely. In the case of the Central Valley, if that's half our food supply in the country, then we ALL play a role in Central Valley's water usage if we're consuming the products grown there. Think about that. What does that mean to you? Are there foods that you can consciously buy locally, to take the stress off Central Valley's supply? And, even more important, when you consume any sort of food, it's obviously coming from somewhere that requires water, so are you making sure you NEVER waste food? Not wasting can make a huge difference, since in the U.S. we waste about half our food.

The battle between farmers and cities is happening all over the country and the globe, because we have overpopulated our world to the point where we don't have enough water to take care of all our demands. This is true in the San Luis Valley of Colorado, the Colorado River watershed, and Utah, where they have big plans to grow population, and are trying to figure out where the additional water they need will come from. How foolish is that? Entitled idiots in a California town that's running out of water are saying "between the golf courses and agriculture, it would be better to get rid of the agriculture."[16] What does that say about sheer cluelessness about the realities of our water resources? They should turn off their water and water the golf course, just to give them a slap upside the head. Hello? Is there anybody in there? In parts of the West, annual snow mass has declined by 41%, and the snow season is 34 days shorter. Because of the climate change caused by the massive demands of our massive population, our water resources are drying up right under our noses, as we ignorantly continue to grow our population and watch sitcoms to take our minds off reality.

In 2018, Cape Town, South Africa nearly ran out of water, because of extreme population growth leading to conflicting demands on the water, which ran the reservoirs nearly dry. And this was the second global water crisis, the first being Sao Paolo, Brazil. Since then, many cities have followed, from Mexico City to Beijing to London. Water shortages are likely to worsen global conflict.[17] It turns out that, even though we humans are really good at taking water for granted and wasting it, we get really pissed when it's not available. Pretty much duh. And, to make things worse, water shortages inevitably lead to food shortages. Now, that'll really freak us out!

In Cape Town, emergency measures were implemented in order to avoid death and civil war, including restricting water to 25 gal/day/person, with fines for overuse. The city prepared for the worst-case scenario, in which they would have to force millions of residents to stand in line at 200 water distribution sites for rations of just 6.6 gallons per person. This would be the absolute minimum requirement for basic health and hygiene. The South African police and National Defense Forces would be deployed at these sites to maintain order. I guess I'd feel safer with a couple machine guns around, as long as the users know who to shoot.

Cape Town began publishing on its website the names, street names and water meter readings of the city's top 100 highest water consumers to shame them publicly. A definite invasion of privacy, but I guess you do what you gotta do. The city also installed water management devices to cut off supply when users reached their limits. Now, they're installing several desalination facilities, additional groundwater extraction facilities, and a large-scale water recycling facility. Basically, they'll be consuming more energy than ever to get water to an overpopulated region.[18] As long as population growth continues, it's just a matter of time before cities run out of both water and energy. Some moron seems to have floated the idea of hauling an iceberg to the city to save the day. Pun intended. Really?

Santa Barbara, California, is also installing a desalination facility, at a cost of $72 million as part of their plan to keep the water flowing, again, making their energy consumption ever higher. So, customers can expect higher bills along with a higher carbon footprint for their water.

Let Me Count The Ways

Globally, humanity uses about 2.9 trillion gallons every single day,[19] which works out to an average of 363 gallons per day per capita. Figure 4 shows that not all of this water is used directly in homes; domestic usage is only 12% of the total, or 44 gallons/day per capita.[20] Most of the water by far is for agriculture, producing our food, and the amount used for industry, making our stuff and our processed food. All this is 9 times what we use in our homes. This is important to understand, because it gets back to what I originally pointed out in Chapter 12, that our carbon footprint extends far beyond our homes, and impacts the entire planet and our wildlife much more than we might think. Until we think about it. This is also why we can help our planet a lot by simply not wasting food, only buying organic food, minimizing processed food, and not buying stuff that we don't need. Think about that. Look around your home. Is there anything on your shelves, in your closet or in your garage that you haven't touched in years? Think about that the next time you are deciding whether to buy something. Are you really going to use it? Are you really going to wear it? Or is it just a spur of the moment impulse purchase? Avoiding food waste is easier. When you buy food, make sure you have a plan to use it all. How hard is that? Remember, water is energy and energy is water. And food is both.

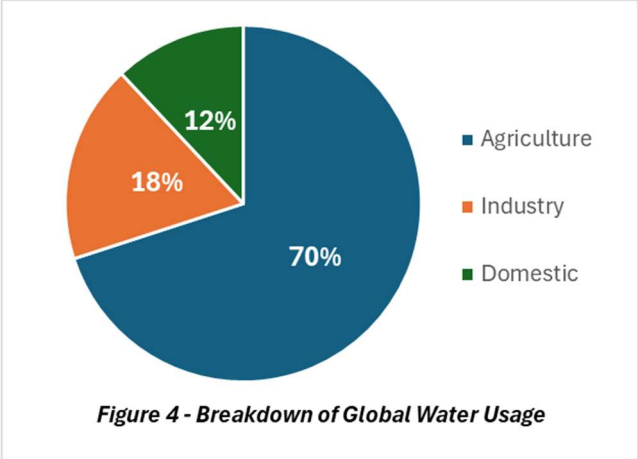


Figure 4 - Breakdown of Global Water Usage

In the U.S., we consume a total of 322 billion gallons of water per day, or 960 gallons per day per capita.[21] That's right, we consume three times as much as the global average, which isn't a huge surprise since we also spew four times more CO_2 than the global average. The U.S. population is 4.2% of the global population, yet we manage to use 11% of the water. Again, while this is embarrassing, at least to me, it also means we have lots of room to move, or to reduce our water consumption.

In the U.S., we collect more detailed water usage data, and Figure 5 is a breakdown of our usage.[22] Combining irrigation, livestock and aquaculture, producing our food is a huge consumer of water, at about 40% of the total. Our biggest water usage is thermoelectric power, which is a little more

than the water for our food. Domestic water use is public supply and self-supplied domestic, which are wells, making up 13.1% of the total. The largest consumer of water in the U.S. is electric power plants, which makes sense, since we are a huge CO_2 emitter compared to the global average. Our total power, including power plants (thermoelectric), self-supplied industrial (e.g. industries that produce their own electricity) and mining, consumes the remaining 47.2% of our water, reinforcing the "energy is water" part of the energy-water nexus.

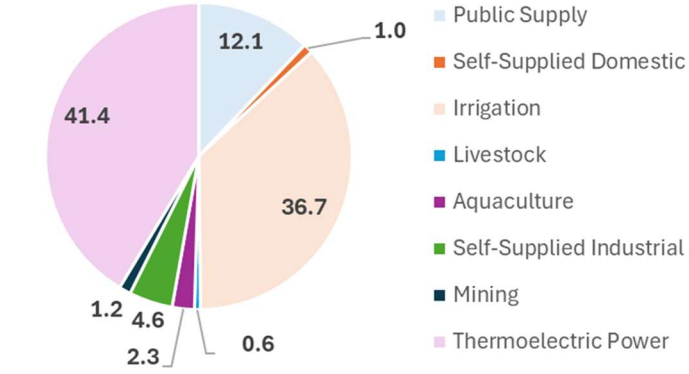


Figure 5 - Breakdown of U.S. Water Usage

Comparing the global water usage breakdown with the U.S. breakdown, the percentage of domestic is similar, but that doesn't mean the U.S. uses a similar amount of water per capita at home, because our total water usage is three times the global usage. Table 2 shows a comparison of water usages for families in different parts of the world.[23] There's little doubt that we have lots of opportunity to reduce our water consumption in this country, which would also reduce our CO_2 emissions.

Table 2 - Comparison of Domestic Water Usage in Different Countries

Country	Domestic Water Usage Gallons per Family
U.S. (New York City)	250
India	55
Jordan	50
Niger	15

If we assume the families have 4 people, strictly for the sake of illustration, Nigerians manage to scrape by with less than 4 gallons each, while in the U.S. we seem to require well over 50 gallons each, at least in New York. The reality is that in New York people probably don't have lawns, or if they do, they don't water them, because there's plenty of rain and they don't need to, while in the west, where we have lawns that shouldn't be here, we waste a lot of water on them, increasing daily usage to more like 100 – 300 gallons/person. In Niger, they're probably using water strictly for drinking and food preparation, and hopefully some hygiene, but they're definitely not showering daily or flushing yellow down the toilet.

Similar to our domestic usage, the fact that our agricultural water is 40% of our total, compared to 70% of the global total, doesn't mean we're using less water for agriculture, because our total water usage per capita is so much higher than the global average. In actual gallons, in the U.S. we're using 384 gallons daily per capita for agriculture, while globally it's 30 gallons. The agriculture comparison suggests that agriculture in the U.S. has a lot of wiggle room when it comes to water usage. It's also a reminder that we as individuals can make a huge difference by not wasting food. Ever. Think about that.

What's Ours?

Figure 6 is a breakdown of typical indoor household water usage in Denver.[24] This is only for indoor usage, which only accounts for about half the average family use. For indoor use, about 40 gallons per person is considered efficient. The other half is outdoor water for yards, which is typical in western cities. Golden is the same. In extremely dry states, like Arizona, it's a different story, with significantly less outdoor water usage, due to outdoor water restrictions that have been in place for decades.

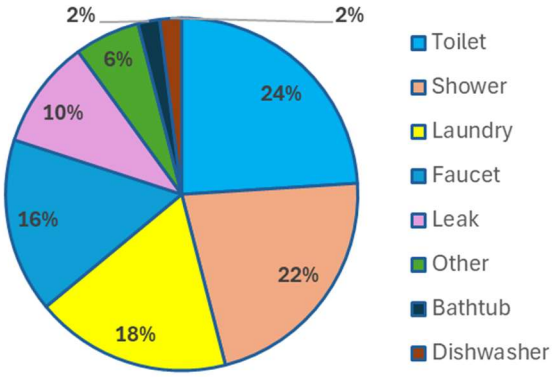


Figure 6 - Average Indoor Water Use in Denver, Colorado

Getting back to indoor water use, which applies whether you live in a house or an apartment, the biggest use is the toilet, followed by showering and laundry. Faucet usage includes water for drinking, food preparation, hand washing, and any household cleaning. Bathtubs and dishwashers use relatively minor amounts, probably because people are simply taking more showers than baths, and hand-washing dishes rather than using the dishwasher. The "other" category includes uses like hot tubs, swamp coolers and pools.

While 40 gallons per person per day is considered efficient, that's not what we do. In Denver, the average customer uses about 50 gallons daily indoors, and the national average is over 100 gallons/day, mainly because of outdoor watering. If we could get our average water usage cut in half in the U.S., allowing for a little extra for gardens and such, we would take quite a bit of pressure off the water supplies, as well as save yet another 1.7% of our carbon footprint. And this is just the domestic water use, which is a fraction of the total fresh water use in this country.

What Should We Do?

We have endless opportunities to save water. In addition to the bullet points below, there are some great tips from EPA and Denver Water.[22, 25]

Toilets

- If it's yellow, let it mellow. There's absolutely no hygienic requirement for toilet flushing unless it's brown. This is one of the savings measures that Cape Town implemented when they were running out of water.
- Low flush toilets – 0.8 – 1.1 gal/flush, a huge savings.
- Bucket flush with lightly used water, called gray water, examples are shower water and bath water. Watch a You Tube video. It's easy.
- Total savings potential of all these practices is 4,000 – 5,000 gal/year/capita.

Shower

- Low-flow showerheads only use 1.5 gal/minute, and are easy to install; you just unscrew the old one and replace with the new. They're also cheap, and many utilities and municipalities are providing rebates, especially in the West. This also saves energy, since shower water is always heated.
- Keep it short. A good rule of thumb is 5 minutes.
- Take less showers. How many do you take each week? Do you shower daily, or more than once a day? If so, why? If your day involves seriously filthy work, then I can see it, or after a workout, but think about this. Do you get really dirty every single day? Daily showers are something that we may be used to, and we may even feel unclean if we don't do it, whether we need to or not, but they're not truly necessary. Daily showers aren't even good for us. Our skin is our largest organ, and is an important barrier between all the harmful toxins in the outside world and everything contained within our bodies. Our skin doesn't work as well if it can't build and maintain the natural biome that protects us if it's constantly harassed by scrubbing and soaping. Same for our hair and scalp. Personally, I shower maybe 2 or 3 times a week, and I know a lot of people who do the same. And, I don't know of a single case of disease or undue stench from the practice. My skin is aging quite gracefully, is fairly soft and supple, and people are often surprised when they find out how old I actually am. All this without a single face-lift. Why waste water, time, energy and chemicals on something we don't even need?
- Collect excess water in a bucket, especially when running the water to warm it up. A 5-gallon bucket is ideal, and then use the water to bucket flush the toilet, using a 1-gallon pitcher to scoop the water from the bucket.
- Never, ever let hot water go down the drain if you live in a cold region where you're heating your house. By collecting it in a bucket, you are keeping this valuable heat in the house until the water cools, as the water releases the heat to the air. Then, when the water is tepid, use it for bucket flushing the toilet.
- You can save 4,000 – 5,000 gal/year with these practices.

Thanks to Margaret!

When I was in my early 20's, we were invited to spend the week on my dad's sail boat that was captained by Margaret, a popular neighborhood mother where I grew up. After raising seven children, she divorced her misogynistic abusive husband and began to live her life as she saw fit. She had a history of sailing, and my dad had a boat that needed a captain, so there she was. The first time I washed my hands on that boat, I ran the water full blast and left it running while lathering. Margaret immediately put a stop to that, saying that I just wasted as much water washing my hands as all four of us would need for an entire day. She then showed me the proper and frugal way to wash my hands. Back home, we started hearing about water supply shortages, debates about new dams, and it didn't take long for me to realize I was a water waster and needed to do better. For reals. Now, our indoor usage at home, with two of us in the house, runs less than 30 gallons/day as we continue to apply all possible means of saving water. If my math is right, that works out to 15 gallons/day/capita. It can be done. And I don't recall our frugality ever leading to any sort of diseases. The last time I got sick was in fact getting sneezed on in a grocery store. Just saying.

Laundry

- Efficient front-loading washers reduce water significantly.
- Always wash cold. Hot and warm don't get clothes any cleaner and waste energy.
- Only do full loads. Obviously.
- Only wash what needs to be washed. Don't just toss things in there because you wore them once, out of habit. I have pants that I literally haven't washed in a year, simply because they're not dirty. I only wash my hiking pants seasonally, because they're only going to get dirty again the first time I wear them anyway. Underclothes usually need more washing than outer clothes, unless you spill something on them or do something particularly messy. Unnecessary washing not only wastes water and energy, it wears out clothes faster, leading to more consumption of textiles, yet another energy hog in our world. Think about that.

Faucet

- Don't turn the water on full blast, unless you happen to filling something, like a bucket or water pitcher. If you're just washing your hands or rinsing vegetables, it's actually easier to use a lower flow rate. If you turn water on full blast, it blasts out of the tap at about 5 gallons/minute, on average, spewing water everywhere and making a mess, and only about a tenth of the water ever touches your skin or the vegetables. Most goes down the drain. What a waste!
- If you can't handle remembering to keep the flow rate down, or have kids that will never do it, then invest a small amount of money in low-flow aerators for the faucets. They're easy to install and save a lot of water.
- Don't leave the water running if you're not even using it. If you leave the water running, more will go down the drain that what is actually used. When brushing your teeth, lathering hands or scrubbing dishes, turn it off.

> "Individually we are one drop, but together we are an ocean"
> - Ryunosuke Satoro

- If you can't get over running water full blast until it's hot enough or cold enough for whatever you're doing, washing hands or getting a drink of water, for instance, then at least collect it for bucket flushing or plant watering. Honestly, if you run water slowly out of the tap for hand washing, you won't even notice the temperature. If you prefer cold water for drinking, keep a pitcher in the refrigerator.
- Yet another 4,000 – 5,000 gallons per year can be saved.

Leaks

- Toilet leaks are the most common, as flapper valves wear out. A 1990 survey found that 20% of toilets were leaking. Is yours?
- Sink drips can add up like a shopping list and are easy to fix.
- To find hidden leaks, read the water meter and don't use any water for several hours, then read it again.
- There are some useful instruction on line to help with detecting and repairing leaks.[23]
- Annual water savings can be thousands of gallons per year.

The Rest

- If you use a dishwasher, run it only when it's full. We mainly hand wash our dishes, using cold water, and then we use the dishwasher as a drying rack, basically a place to put the wet dishes away until they dry. This way, our favorite bowl or cup is always clean and available, so we don't need to wait until we can run the dishwasher. This works great for just a few people in the house. If we have a large group over for dinner, we'll fill the dishwasher and run it, just to keep the pipes flushed.
- If you feel the need to wash your car, challenge yourself how low you can go. And do it someplace where the water will stay on the ground instead of running down the through the storm drains to the river. And use a soap that will break down, like a castile soap, not a chemical-laden detergent that's dyed pink and smells like synthetic roses. Use a bucket with a cloth for scrubbing, then rinse with a low-volume spray. It can be done with less than 20 gallons of water if done consciously as long as we're not talking about a monster truck or a Hummer. Don't try to shine your car with water when a chamois will do a better job anyway.
- Hosing off sidewalks and driveways. Really? Have you ever heard of a broom? Cheeze!

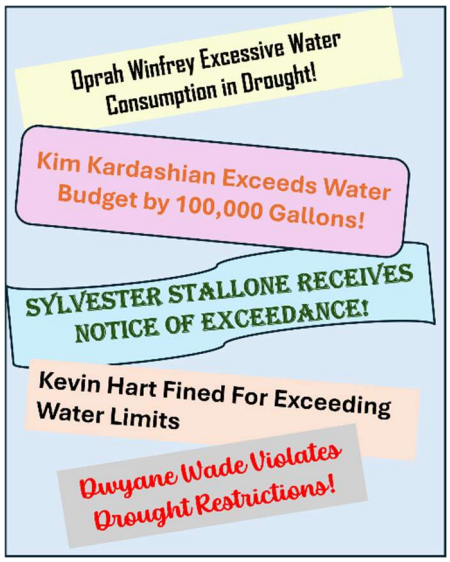
Outdoor Water

Depending on location, in the U.S. we use anywhere from a third more water to twice as much water in summer, watering lawns and gardens. We live in Golden, Colorado, where large quantities of water are needed to keep a lawn green in the heat of summer. My own opinion is that when we don't have enough water to go around, in the arid West the last thing we should be wasting treated drinking water on is green lawns. Green lawns originated as a status symbol, something that more well-to-do families had on their estates, and now we've gone so much over the top that everybody has to have a mini lawn, just to keep up with the Jones's, and now we have about 10 million acres tied up in lawns. Seriously. What good are they? I mean, if you live in regions where it rains enough to keep it wet, fine, but if not, get over it. On a flat green lawn, no wildlife can thrive, the little guys risk getting run over by lawnmowers and any that try to eat the toxic grass monoculture will probably die from poisoning. And the birds and higher life that need them for food.

In Arizona, cities such as Prescott have outlawed any kind of landscape that requires more water than can be matched with rainwater. In Golden, more and more lawns are being replaced with xeriscape landscaping, rock gardens and native landscapes. Some lawns are simply being mowed to keep the weeds down, but not watered, so they're only green when it rains. This is actually a good low-input alternative for a resident who would rather be hiking or biking than maintaining a lawn that they probably don't care about. Our son is a horticulturist at Washington Park, a huge park in Denver, and he's leading a project to convert annual flower beds to native vegetation that doesn't require as much water. He's also converted our entire front yard into a native landscape, leaving a tiny little strip along the patio for me to grow my vegetables. Our beautiful front yard is full of life and color, with flowers blooming in season, and native insects and bees buzzing everywhere. It's much more interesting than a

flat green lawn. People actually stop and admire the garden, and sometimes even pilfer flowerheads for their own use. Who would do that with a flat green lawn?

- Keep a low-water demand garden, and use rain barrels to collect water to keep it moist during dry times.
- Use mulch to help soil retain moisture, and use regenerative gardening practices for healthy soil that retains moisture.
- In the dry west, we find that ollas (a specialized long-necked porous clay pot that you bury and fill with water) is wonderful for keeping vegetables supplied with water, and you can fill them once or twice a week.
- Drip systems are much better than sprinklers, because with drip systems all the water reaches the soil, where with sprinklers a portion of the water evaporates.
- Hand spraying is better than automated systems on timers, because timers will run the system even if it just rained, wasting water. Hand spraying is more precise, and by getting out there and spraying, you stay in touch with how your plants are doing. If you can't do that, then why are you bothering? You might as well just put in a rock garden that you don't have to deal with.



- Never spray in the daytime, because too much water is lost to evaporation. Always spray in the morning or the evening.
- If your life absolutely can't be complete without a flat green lawn in front of your house, at least don't overwater it. Even in the arid west, an inch per week is plenty, and even less if it rains. Overwatering is not just a waste of water, it's not even good for the lawn.
- If I had a nickel for every time I've seen water flying down the gutters in Golden I'd be rich. I've actually followed a couple of these rivers up to their source and found absolutely ridiculous stuff, like hoses left running, sprinklers gone wild, sprinkler heads blown off, somebody washing their car with absurd amounts of water and the list goes on.

We have, in my own opinion, gone over the top, beyond what's necessary and actually healthy, to over-sanitization and cleanliness that we don't really need, that we just think we need, to the detriment of the water and associated energy supplies that this planet can provide. If we can get ourselves over that, we'll be a long way towards recovering some level of sustainability of resources for future generations. We will also find ourselves with more time on our hands for joy in life instead of constantly scrubbing and cleaning. What a waste of a perfectly good Saturday. Especially if you work all week!

A Global Crisis

If you look closely at global conflicts, at their core most of them have something in common – scarcity of water. Think about that. Time and time again, people who once managed to get along and

tolerate, if not embrace, diversity get ugly and turn on each other and get divisive if water gets scarce. The rise of the Boko Haram terrorists in Nigeria coincides with Lake Chad drying up, leading to economic disaster. The Syrian civil war and the rise of ISIS has been fueled by desperate farmers trying to find non-existent work in cities after their land dried up, then turning to radicalism in their hopelessness. And the list goes on. Across the globe, desperate populations in drought-stricken countries are migrating to more industrialized countries for a better life, and when these countries can't handle the additional people, local conflicts are soon to follow.

According to the World Economic Forum, the biggest threat to humanity in the next few decades is water shortages if we continue to grow our population.

So, do you think all is good with water? Do you think business as usual with water, waste of water and continued population growth is a good idea? I hope not. I can tell you I don't.