FATHOM DROUGHT WATCH

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THAT SINKING FEELING

Groundwater is often thought of as an emergency fund to get through the tough times of water scarcity—particularly during drought conditions, when surface water, snowpack and precipitation fail—and we are in danger of overdrafting our water checking accounts. Our expectation is that when the drought breaks and precipitation returns, not only will our checking account run deep, but we will also replenish our emergency fund.

That characterization is flawed in many ways:

» We do not have a way of understanding the real, available volume of water in our emergency fund. In fact, NASA's GRACE program has identified that about one third of Earth's largest groundwater basins are being rapidly depleted by human consumption, despite having little accurate data about how much water remains in them.[1] This presents a clear a recipe for disaster, particularly in multi-year drought areas like California where reductions in precipitation have severely affected not only surface water, but the amount of natural recharge occurring; and

» Removal of groundwater can have some significant unintended consequences, including subsidence and a permanent deformation of the soil matrix. The result is anything from cracked foundations to wholesale collapses of the ground, and a permanent loss of groundwater storage capability and capacity.

In short, not only do we not know definitively how big our emergency fund is, each time we use it we run the risk of permanently reducing the available funds for the next emergency.

HOW MUCH GROUNDWATER ARE WE USING?

The United States Geological Survey (USGS) has estimated that during the period of 1900 to 2008, approximately 1,000 cubic kilometers of groundwater has been withdrawn from aquifers in the United States.[2] That's equivalent to a six-foot deep pool that is over 500 miles wide and 500 miles long—or more than twice the volume of Lake Erie.[3]

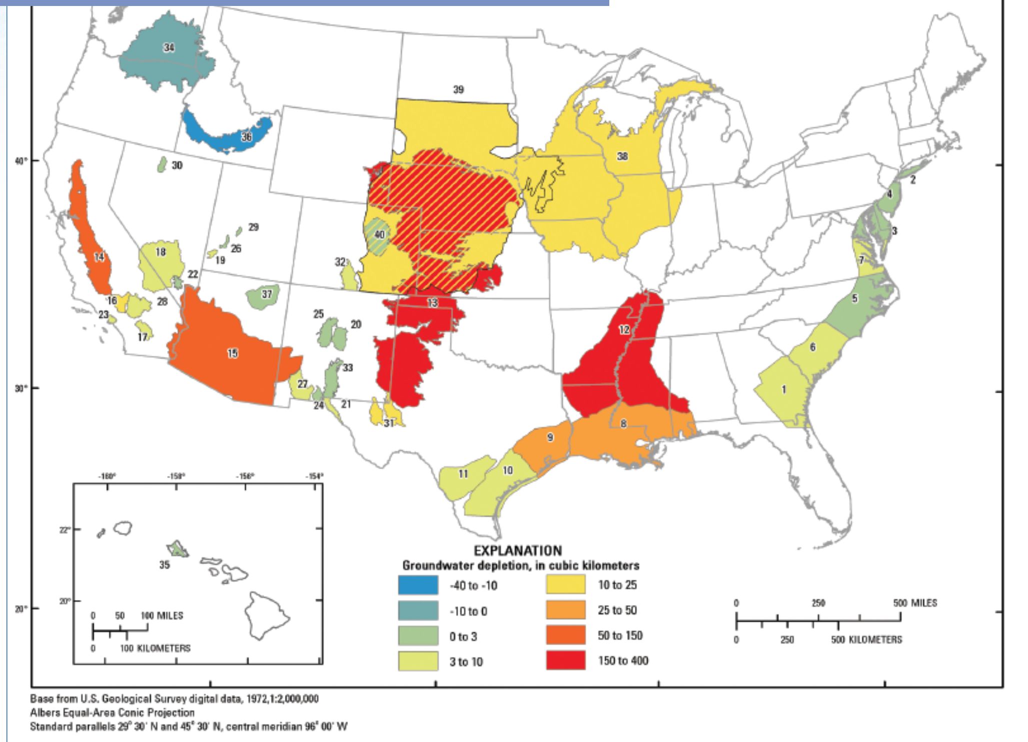
LAKE ERIE

More importantly, the average annual groundwater withdrawal rate between 2000 to 2008 (25 cubic kilometers) was over 2.5 times higher than the average depletion rate for the prior century (9.8 cubic kilometers).

In 2011 the withdrawal rate in the western United States exceeded the natural recharge rate by more than 85 trillion gallons[4]—and that was prior to the intense drought conditions that have put increasing pressure on our groundwater resources. These withdrawals are driving significant declines in water tables with some aquifers dropping more than 400 feet.

When we think of groundwater as an emergency fund, we expect that we will be able to refill it when we have some extra water. Unfortunately, in some areas we find that the physical capacity of the fund is shrinking and is no long capable of taking our deposit.

CUMULATIVE WATER DEPLETION

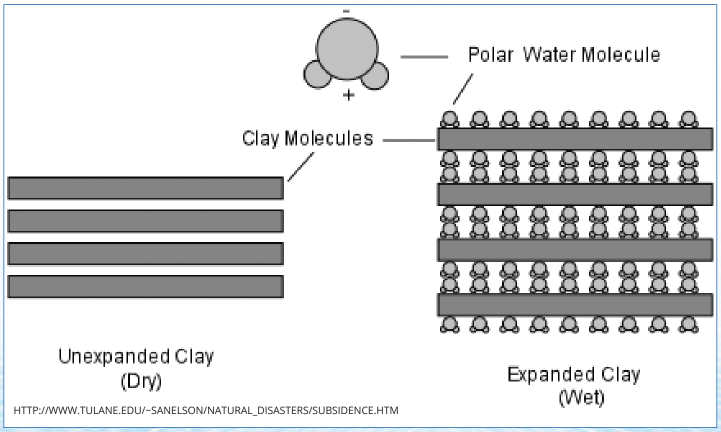


MAP OF THE UNITED STATES (EXCLUDING ALASKA) SHOWING CUMULATIVE GROUNDWATER DEPLETION, 1900 THROUGH 2008, IN 40 ASSESSED AQUIFER SYSTEMS OR SUBAREAS.[2]

“AM I WRONG? OR IS THE WORLD RISING?” – “I DON’T KNOW, BUT WHATEVER IT IS, I HATE IT.”[5]

Under normal circumstances, soil and water are in an equilibrium condition. The incompressible nature of water, combined with the mass of soil above, creates pressure that balances the soil column—keeping the soil particles, at a microscopic or even molecular level, apart.

When that water is removed, the interstitial pressure is reduced and the soil particles can move closer together. The result is that the soil column compacts and the land surface declines. This is referred to as subsidence.



Subsidence can result in fissures at the surface, impacting building foundations, bridge supports and buried infrastructure such as water mains and sewer lines. It can also result in sinkholes suddenly opening up, swallowing houses and cars.

The results can be dramatic. One fissure created by land subsidence in the Picacho Basin, northwest of Tucson, Arizona, is 10 miles long.

And in some cases, the results can be dramatic despite occuring over decades. A famous USGS photograph shows the approximate location of maximum subsidence in the United States as identified by the research efforts of Dr. Joseph F. Poland. The site is in the San Joaquin Valley southwest of Mendota, California. Signs on pole show approximate altitude of land surface in 1925, 1955, and 1977. This long-term subsidence has already destroyed thousands of public and private groundwater well casings in the San Joaquin Valley.[6]

Depending on the type of soils and the amount of groundwater withdrawal, these subsidence effects can become permanent:

This means that the soil's ability to store water has been permanently destroyed, eliminating its use as our emergency fund for future droughts.

> In confined aquifer systems that contain significant clay and silt layers and are subject to large-scale ground-water withdrawals, the volume of water derived from irreversible compaction commonly can range from 10 to 30 percent of the total volume of water pumped. This represents a one-time mining of stored ground water and a permanent reduction in the storage capacity of the aquifer system.[7]

There are other potential catastrophic impacts as well. A recent letter published in the journal Science identifies land subsidence as a potential risk for flood control levees:

> Land subsidence can increase the risk of water rising over the top of the levees. Australia's Millennium Drought (1997–2009) is often considered the type of event for which California should prepare. At the peak of the drought (i.e., 2008 to 2009), Australia experienced disastrous failures of alluvial river banks along the Murray River. Similar failures occurred in other parts of the world during extreme drought conditions, such as the 2003 Wilnis Levee failure in the Netherlands.[8]

PRESERVING OUR EMERGENCY FUND

Clearly, using groundwater is not without its consequences. In order to prevent the impacts on the supporting soil matrix and the subsequent permanent reduction in water storage, we need to rethink the way that we use groundwater. Not only do we need to understand how much water is in the aquifer, but we have to understand the impacts of removing that water. In the end, we can't use all the water in our emergency fund.

Better data and proactive conservation can address these issues. FATHOM MDM and FATHOM U2You allow for an across-the-board reduction in the amount of water required within a community—up to 20 percent. Through active customer engagement and increased consumption data granularity, each tied together within a geospatial framework, we can more fully understand how, why and where we are using water and use this information to minimize withdrawals.

With the FATHOM Store, utilities can select technologies that increase the amount and type of information available from their groundwater sources. Groundwater level sensors, digitized drilling logs and groundwater transport modelling systems can provide natural recharge assessments and early warning of potential subsidence conditions.

Understanding the capacity of our water emergency fund, and managing the dynamic capacity of those funds will provide us with a sustainable way to access this water.

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