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U.S. Groundwater Losses Between 1900-2008: Enough To Fill Lake Erie Twice

Brett Walton

Groundwater depletion in the United States has accelerated over the last decade, according to the U.S. Geological Survey, contributing to both localized problems and global issues, like sea level rise.

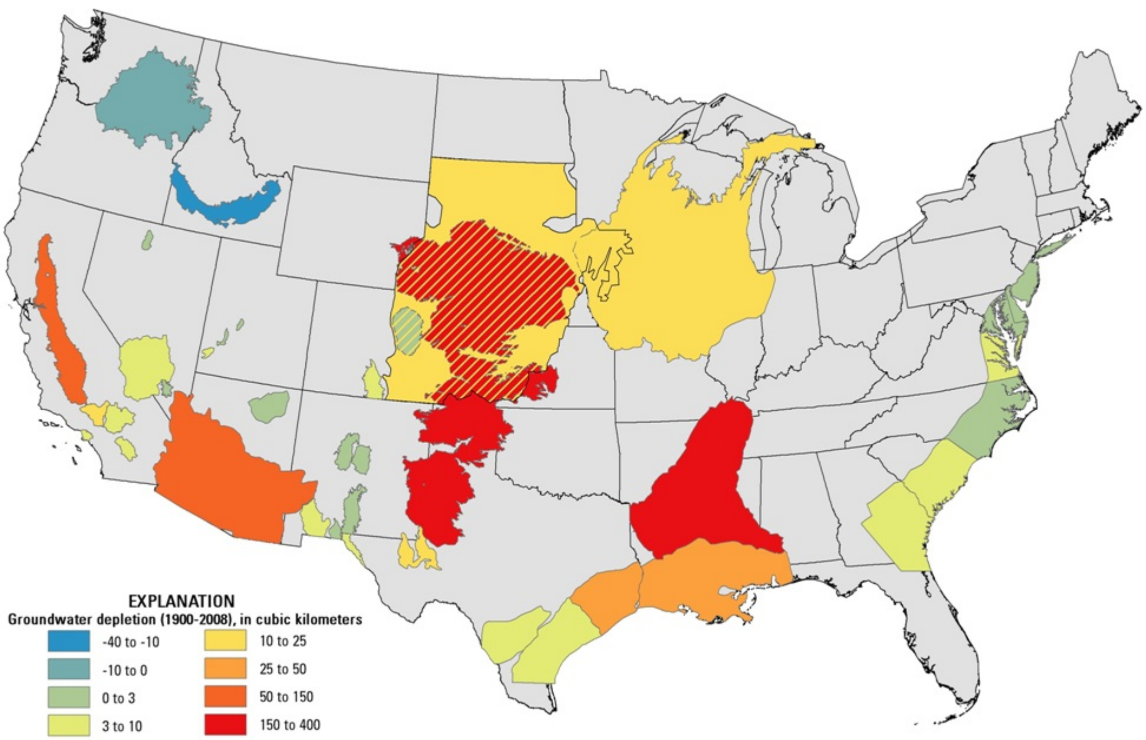

Image courtesy of Konikow / U.S. Geological Survey
The United States has lost enough groundwater to fill Lake Erie twice. The biggest declines occurred in the Southern Great Plains, the Mississippi River Delta, and the Central Valley of California. Two aquifer systems in the Pacific Northwest show net increases since 1900, but those trends have reversed in the last few decades. *Click image to enlarge.*

By Brett Walton
Circle of Blue

Groundwater is often compared to a bank account. By this analogy, the United States is making significantly more withdrawals than deposits, according to the U.S. Geological Survey's first national assessment of groundwater depletion.

"In many of these systems, we're removing water faster than it is being replenished. That is not sustainable in the long run."

–Leonard Konikow, hydrologist
U.S. Geological Survey

Between 1900 and 2008, U.S. groundwater reserves dropped by nearly 1 trillion cubic meters (264 trillion gallons), or enough water to fill Lake Erie — twice.

And the problem is getting worse. The rate of depletion from 2000 to 2008 was nearly three times greater than the average rate of depletion for the entire study period.

Groundwater is a vital part of the country's water supply system, accounting for one out of every five gallons withdrawn according to the U.S. Geological Survey. Falling groundwater tables have prompted Texas to sue New Mexico this year over the effect on flows in the Rio Grande. Wells are dropping in much of the High Plains, leading to higher energy costs for irrigation and new pumping restrictions. Groundwater depletion in the U.S. even affects global sea levels.

One Report, Dozens of Stories

The study looked at 40 major aquifer systems, so there are dozens of local stories held within this one report. The broader narrative, however, is clear, the report's author told Circle of Blue: national groundwater use is on an unsustainable course.

"In many of these systems, we're removing water faster than it is being replenished," said Leonard Konikow, a U.S. Geological Survey hydrologist. "That is not sustainable in the long run."

Two out of every three gallons of groundwater in the U.S. is used for irrigation, and the biggest depletions occurred in prime farming territory: the Mississippi River Delta, the Central Valley of California, and the Southern Great Plains, which draws from the renowned Ogallala Aquifer, the Fort Knox of the country's subterranean water banks.

Because of recent drought, wells have dropped even lower in the last three years, according to state and local data — declines that did not factor into the USGS analysis. The Texas Water Development Board, for example, reported a median decline of 1.5 meters (4.8 feet) in 101 of its 110 monitoring wells in 2011. The remaining nine wells in its network saw an increase in water levels.

Some areas, particularly the state of Arizona, have taken steps to curb groundwater use. Arizona passed a groundwater management law in 1980. The conversion of thirsty farmland around Phoenix into suburban sprawl has helped, too, as has the delivery of Colorado River water, which is pumped underground to top off the aquifers. Deliveries to Phoenix, via the Central Arizona Project canal, began in 1985. Groundwater reserves in the state are now recovering, but reliance on a Colorado River that already promises more water than it can deliver — and whose flows could be cut as much as 9 percent by 2060 because of climate change — is a risky long-term proposition.

Other aquifers in the USGS study also benefited from canal systems that brought surface water from afar. Two aquifers in the Pacific Northwest actually saw net increases in groundwater storage over the entire study period. But those trends have reversed in the last few decades, and both the Columbia Plateau and the Snake River Plain aquifers have been running deficits since the 1970s, when farmers developed groundwater irrigation schemes.

Local Solutions, Local and Global Effects

Groundwater is typically controlled locally in the United States, resulting in a buffet of strategies to cope with the declines. Pumping restrictions are common, used in Texas and Kansas. Also in Kansas, Wichita is injecting flood waters underground, and farmers in northeast Oregon want to do the same with a small fraction of the Columbia River's winter flows. Meanwhile, land-fallowing programs have sprouted in Colorado.

A number of effects follow extensive groundwater pumping. For one, it can siphon water away from rivers. In January, for instance, Texas filed a lawsuit in the U.S. Supreme Court alleging that groundwater withdrawals in New Mexico were cutting into its share of the water from the Rio Grande.

Another problem is that if too much pumping happens, the land can drop along with the water table, a process called subsidence. Stretches of California's Central Valley have dropped several meters in elevation since widespread pumping began there in the 1920s.

The least well known effect is on sea levels. According to Konikow's calculations, roughly 1.3 percent of global sea level rise in the 20th century and 2.3 percent of the rise from 2000 to 2008, when pumping accelerated, can be attributed to groundwater depletion in the United States — and that is just the contribution from one country. Add the rest of the world, and groundwater withdrawals are responsible for 6 percent of the observed rise in the oceans, Konikow reckons. (Other estimates have put the figure several times higher, but Konikow told Circle of Blue that those studies overstate the effect.)

Konikow acknowledges that his estimates for U.S. groundwater depletion are not perfect. Scientists cannot measure the volume of an aquifer directly. Instead, they extrapolate from various measurements, based on well depths and the porosity of soils. Konikow told Circle of Blue that the margin of error for the study is approximately 20 percent above and below the 1-trillion-cubic-meter (264-trillion-gallon) estimate of depletion.