



## Deeper well drilling an unsustainable stopgap to groundwater depletion

**Americans are drilling deeper to access groundwater, but drilling deeper is likely no more than a stopgap to water scarcity or water quality issues.**

**Groundwater** — water stored under the ground in cracks in rock and spaces in sediments — provides vital fresh water for household use, food production, and industry. In many key regions, groundwater resources are threatened by depletion, impacting access to reliable fresh water. Groundwater wells are critical infrastructure for accessing groundwater, yet little is known about the locations and depths of groundwater wells nor the purposes for which groundwater wells have been constructed.

**New research** published in *Nature Sustainability* compiles nearly 12 million groundwater well drilling records. The researchers map, for the first time, groundwater well locations, depths and purposes across the United States. These data create the highest resolution map of infrastructure that people use to pump groundwater. Analyzing the well records, the researchers show that Americans are drilling deeper wells over time.

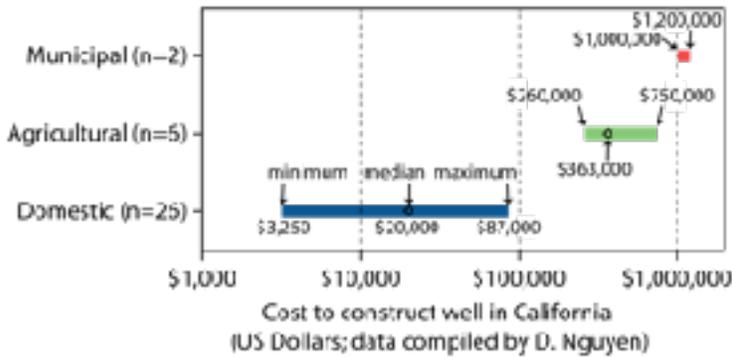
**Deeper well drilling** is likely an unsustainable stopgap for a number of reasons.

1. Drilling deeper is impractical hydrogeologically in some places — that is, wells drilled into deep rocks may not be able to pump sufficient water at a useful rate.
2. Deep groundwater is often saltier than shallow groundwater, meaning costly water treatment may be required before using the water.
3. Deep wells are more costly than shallow wells to construct. Constructing new, deeper wells may not be feasible socio-economically (see California well completion costs in figure on the next page).
4. Deeper wells tend to have deeper water levels, implying that drilling deeper may increase the energy intensity of pumping, potentially increasing CO<sub>2</sub> emissions per unit water pumped.



Groundwater well drilling in Carpenteria, California. Photo credit: Martin Feeney

# Research Brief



**Many factors** may lead groundwater users to drill deeper wells: improved well and pump technologies; discoveries of deep, fresh groundwater reserves; differing permitting requirements for wells accessing deeper aquifers; inadequate water yields or declining water levels; and poor groundwater quality in shallow aquifers because of near surface activities.

**Regardless** of the driving factors, Americans are drilling deeper for groundwater. Drilling deeper may be impractical in places where (a) deeper groundwaters are too saline or are too poor in their quality to be used straightforwardly, or (b) deeper groundwaters are stored in rocks that are not permeable enough for wells to pump water at useful rates.

## About the Research

This brief is based on the paper "[Deeper well drilling an unsustainable stopgap to groundwater depletion](#)" published in *Nature Sustainability* on July 22, 2019.

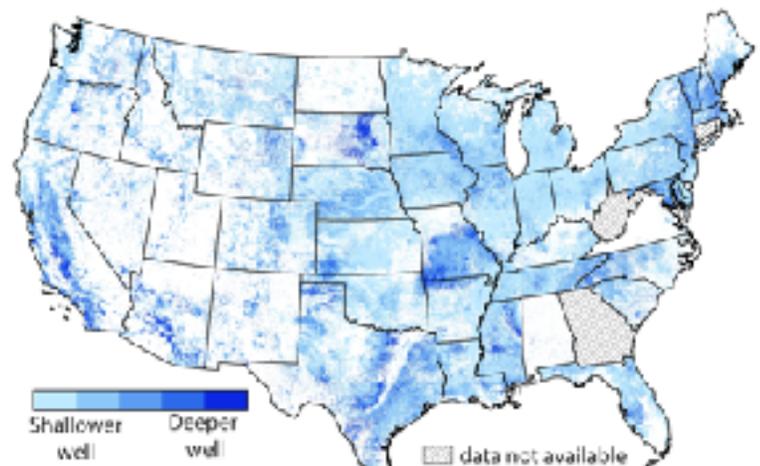
## About the Researchers

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**The study** also finds that declining groundwater levels are not always met by deeper drilling. Because groundwater levels are declining, yet wells are not being drilled deeper, some wells have already run dry; if groundwater levels continue to decline in these areas, more wells will run dry. For example, in portions of the "High Plains" of southern Kansas, western Oklahoma, western Texas and eastern New Mexico, wells can no longer be drilled deeper without penetrating rock layers of low permeability that also contain brackish groundwater. Groundwater levels are declining in these same areas. The ramification is that food production that relies on irrigated agriculture in these areas may be impacted as more wells go dry, should groundwater levels decline further. America is the world's largest food exporter, meaning disruptions to agricultural yields in the United States induced by the drying up of irrigation wells could have global implications.

**Groundwater resources**—vital to domestic water access, growing food, and supporting local economies—are under threat from unsustainable use and pollution in parts of the United States. This latest work shows that Americans are drilling deeper to access groundwater, which may be no more than a band-aid 'solution' to water scarcity.



Debra Perrone, Scott Jasechko (2019)  
*Nature Sustainability*, doi: 10.1038/s41893-019-0325-z