CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER MANAGEMENT OFFICE

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Subsidence 101

What is Subsidence?

Subsidence is the sinking of the land surface due to changes in the sediment beneath our feet. Subsidence occurs for a variety of reasons, such as groundwater pumping, oil extraction, and geologic processes.

Subsidence due to groundwater pumping occurs when the water pressure in the subsurface sediment is reduced and the fine-grained sediment (such as silt and clay) compacts. As the water pressure is reduced by pumping, the fine-grained soil particles reorganize and compress into a flatter structure. This subsurface compaction results in the lowering of the land surface. Subsidence due to groundwater pumping is effectively minimized only when groundwater levels are allowed to rise as rapidly and as much as possible above groundwater levels at which subsidence can occur.

1

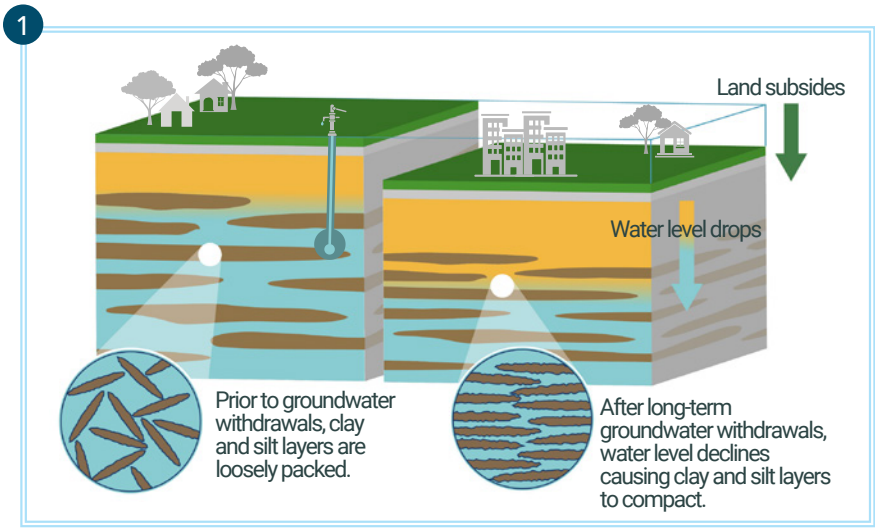

Figure 1. *Subsidence is the sinking of the land surface due to changes in the sediment beneath our feet.*

Figure 1 courtesy of Harris-Galveston Subsidence District.

Marking subsidence of the land surface in San Joaquin Valley from 1925–1997 (top) and 1988–2016 (bottom).

Photo credit: U.S. Geological Survey.

History of Subsidence in California

Subsidence has been documented throughout the last century in many parts of California. By 1970, an area near Mendota in the Central Valley had documented subsidence of more than 28 feet.[1]

Construction of the Central Valley Project (CVP) began in the late 1930s to address water supply and distribution in California's Central Valley.[2] The introduction of surface water via the CVP's Friant-Kern and Delta-Mendota Canals in the 1950s, followed by California's State Water Project in the 1970s, significantly reduced groundwater reliance, facilitated groundwater-level recoveries, and greatly slowed subsidence rates in some areas of the San Joaquin Valley.[3]

Transitioning to present day, subsidence is still an issue in parts of California. Areas with more than 0.5 feet of subsidence between 2015 and 2024 are shown in **shaded areas** in Figure 2. This subsidence occurs primarily because of groundwater-level declines that are due to groundwater overdraft. Groundwater pumping in these regions is primarily for agriculture use, although groundwater is also used for municipal and domestic purposes.

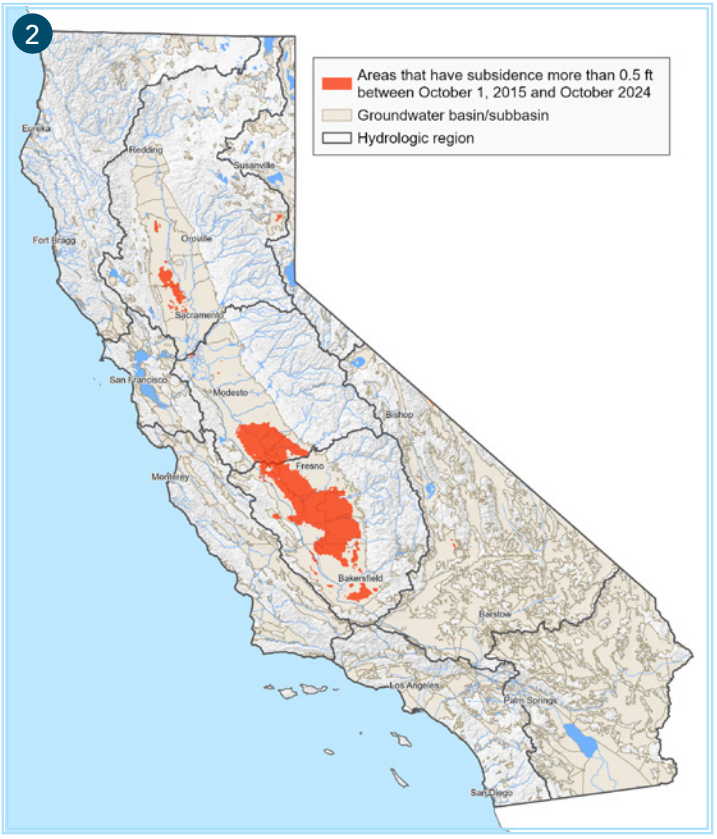

Figure 2. *Areas with more than 0.5 feet of subsidence between 2015 and 2024.*

Figure 3. *Subsidence near Firebaugh in Fresno County has lowered the surrounding land, causing water levels in the Delta-Mendota Canal to reach the underside of a bridge crossing the canal, illustrating the impact of subsidence on infrastructure.*

1 Ireland, R. L., Poland, J. F., Riley, F. S. (1980). Land subsidence in the San Joaquin Valley, California, as of 1980 (Vol. 437). US Government Printing Office.

2 Stene, E. A. (2015). The Central Valley Project. Available at <https://www.usbr.gov/history/cvpintro.html>, accessed 7 Jan. 2025.

3 Sneed, M., Brandt, J. T., & Solt, M. (2013). Land subsidence along the Delta-Mendota Canal in the northern part of the San Joaquin Valley, California, 2003-10 (No. 2013-5142). US Geological Survey.

What are the Impacts of Subsidence?

Subsidence impacts vary across the State and can be grouped into a few broad categories: (1) infrastructure, (2) flood control, and (3) groundwater wells. Infrastructure impacts include damage to roads, pipelines, bridges, and water canals. Examples of impacted infrastructure include the State Water Project, Friant-Kern Canal, and local irrigation projects. Flood control system impacts include the lowering of levees and loss of channel capacity to move water during storm events. These impacts are occurring primarily in the San Joaquin River and Tulare Lake hydrologic regions, and worsen the risk of flooding over time. Subsidence can also damage groundwater well casings and render some wells unusable.

Figures 4 and 5. *Subsidence near El Nido has exposed the underside of a concrete pad supporting a water well (left) and the casing of an abandoned gas well (right) (LSCE et al., 2014).*

Where Can I Learn More?

DWR's Subsidence Website
https://water.ca.gov/Programs/Groundwater-Management/Subsidence

Sustainable Groundwater Management Act (SGMA) Program
https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management

Data Viewer to see historical and ongoing Subsidence
https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

DWR's Groundwater Assistance & Engagement Program
https://water.ca.gov/Programs/Groundwater-Management/Assistance-and-Engagement