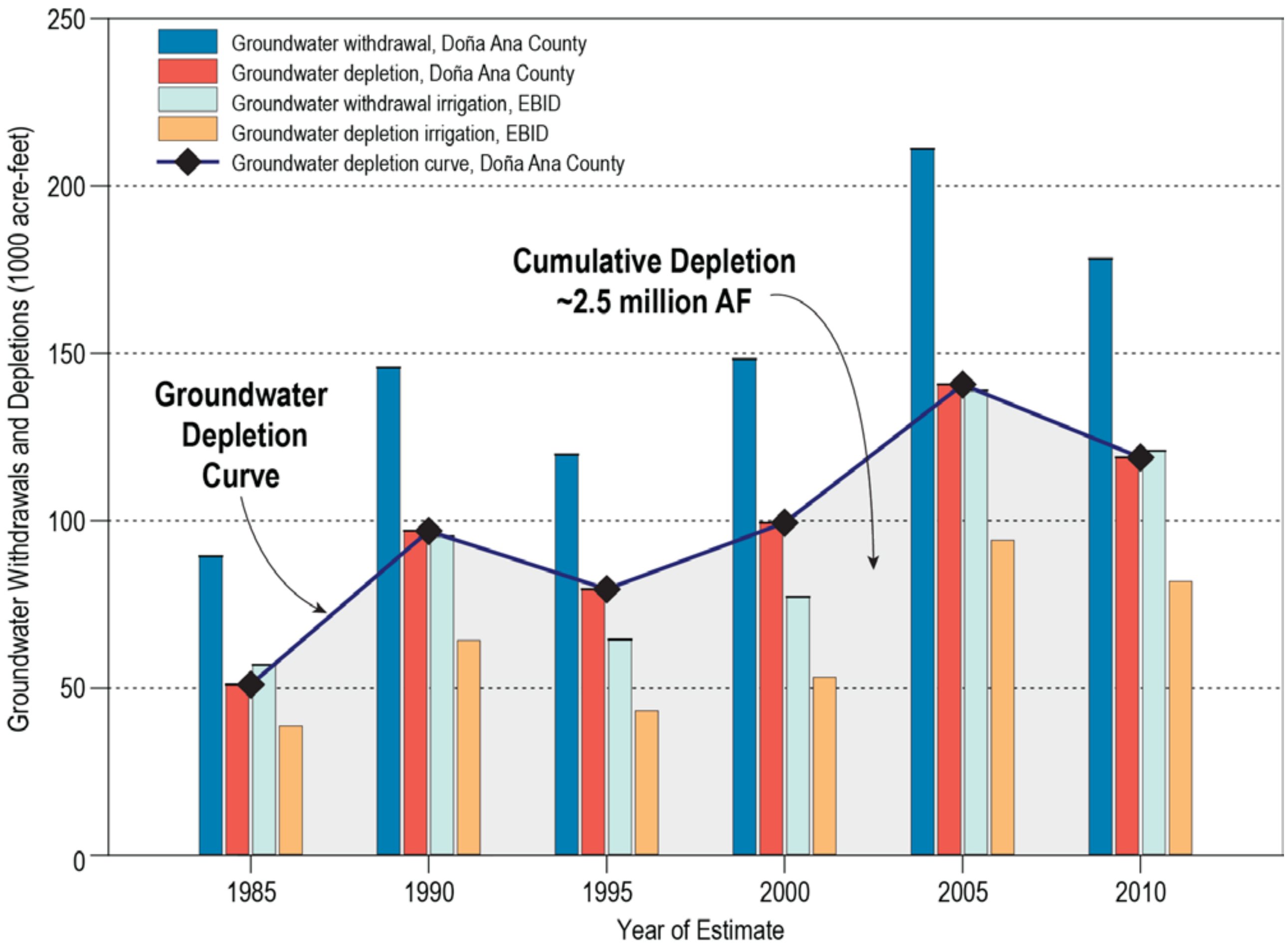
Groundwater Vulnerability During Drought

GROUNDWATER PROVIDES A VITAL, SUPPLEMENTAL WATER SOURCE DURING DROUGHT THAT COMPENSATES FOR LOST SURFACE SUPPLIES

- Water use and groundwater depletion
- Groundwater occurrence
- Declining groundwater levels with drought and pumping

Water Use and Groundwater Depletion



Depletion: "the part of a withdrawal or diversion that is evaporated, transpired, taken by crops or products, consumed by man or livestock, or otherwise removed from the aquifer"

How much groundwater is used?

Two major uses of surface water and groundwater:

- Irrigated Agriculture (⅔)
- Public Water Supply (⅓)

Groundwater provides 100% of drinking water

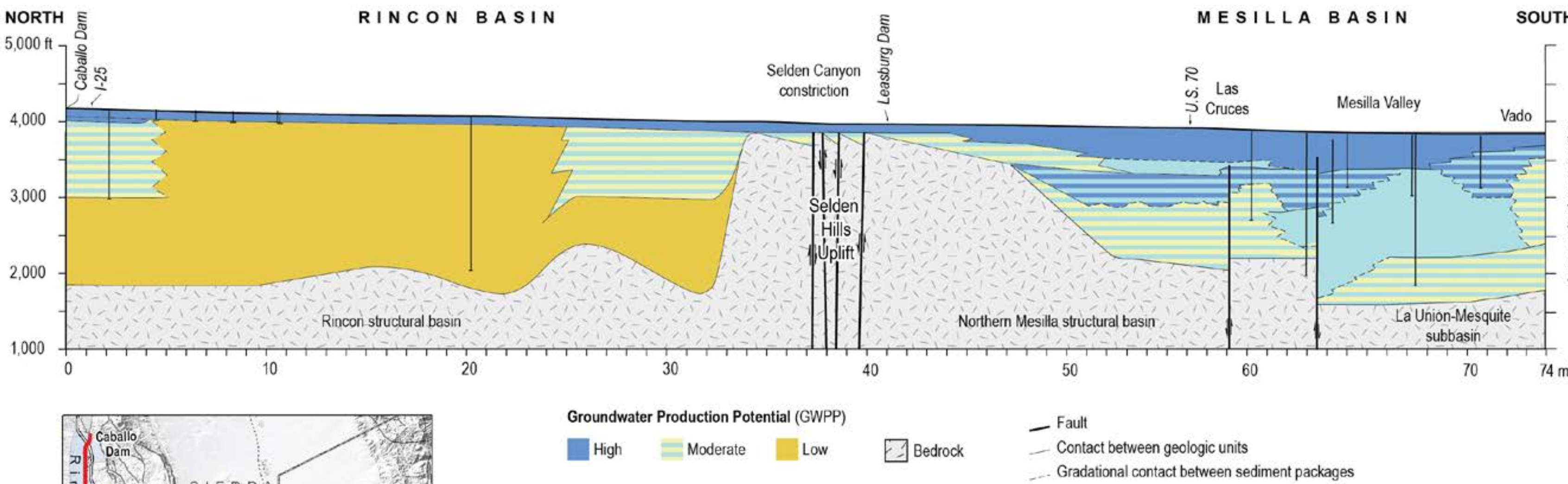
How much groundwater is depleted?

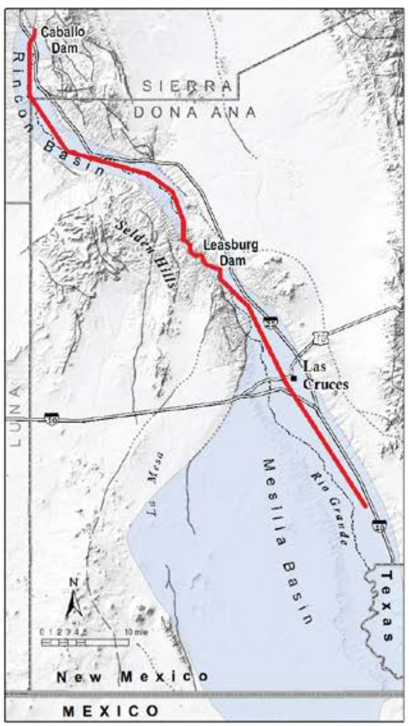
67-68% of pumped groundwater is depleted

32-33% is recycled to the river and aquifer

Estimated cumulative groundwater depletion is ~2.5 million acre-feet, comparable to the capacity of Elephant Butte Reservoir

Groundwater in the Rio Grande Valley — Caballo Dam to Mesilla





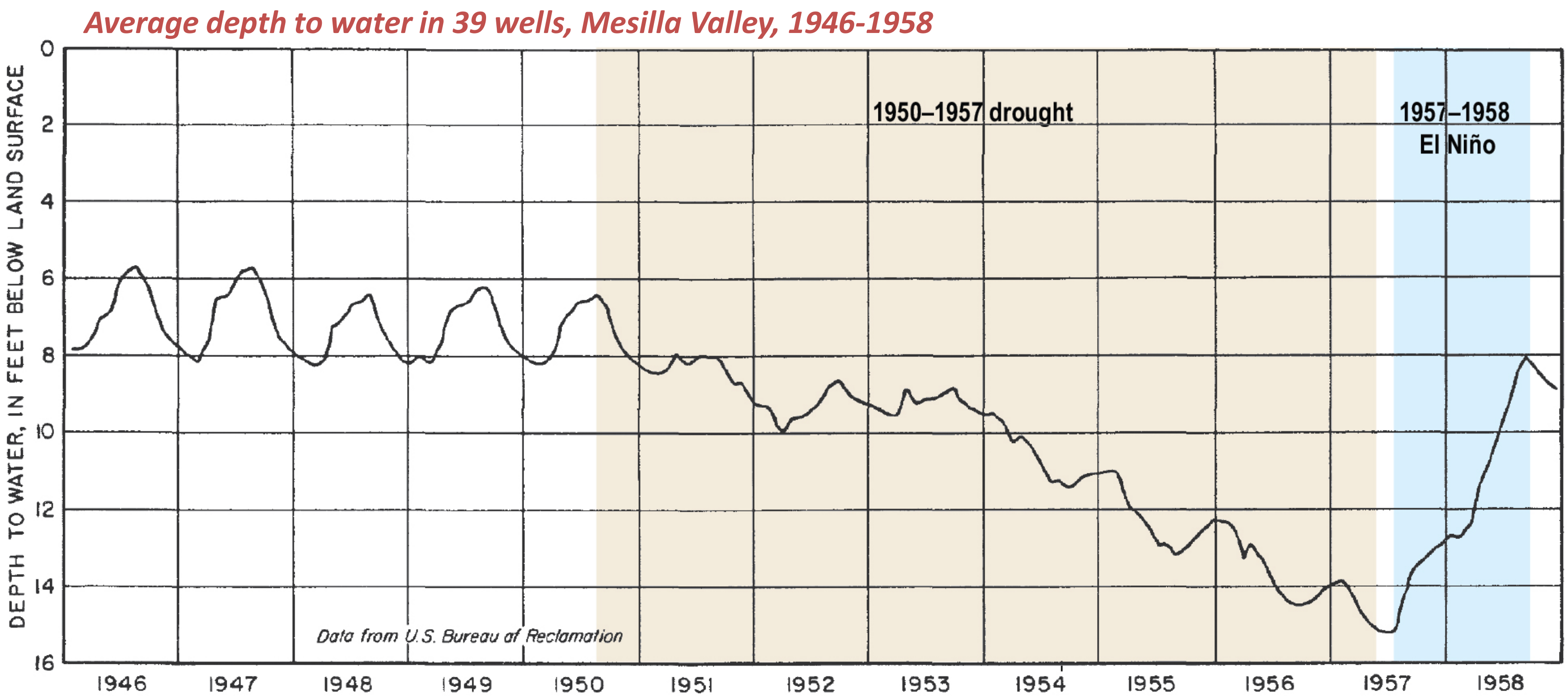
Where is the water?

Mesilla Valley near Las Cruces – contains a major sand aquifer up to 2,000 feet thick that thins to 500 feet or less at the Texas state line

Rincon Valley, Caballo to past Leasburg – the thick productive aquifer is absent; a thin aquifer extends just 60-80 feet beneath the river channel to bedrock

Productive aquifers are well-integrated with surface water system – effects of groundwater pumping, both deep and shallow, are readily transmitted to the interconnected river channel, canals and drains

Effects of the 1950s Drought on Groundwater in the Mesilla Valley



Prior to 1951 — summer water-table rise in the irrigation season and a winter drop → **recharge pattern**.

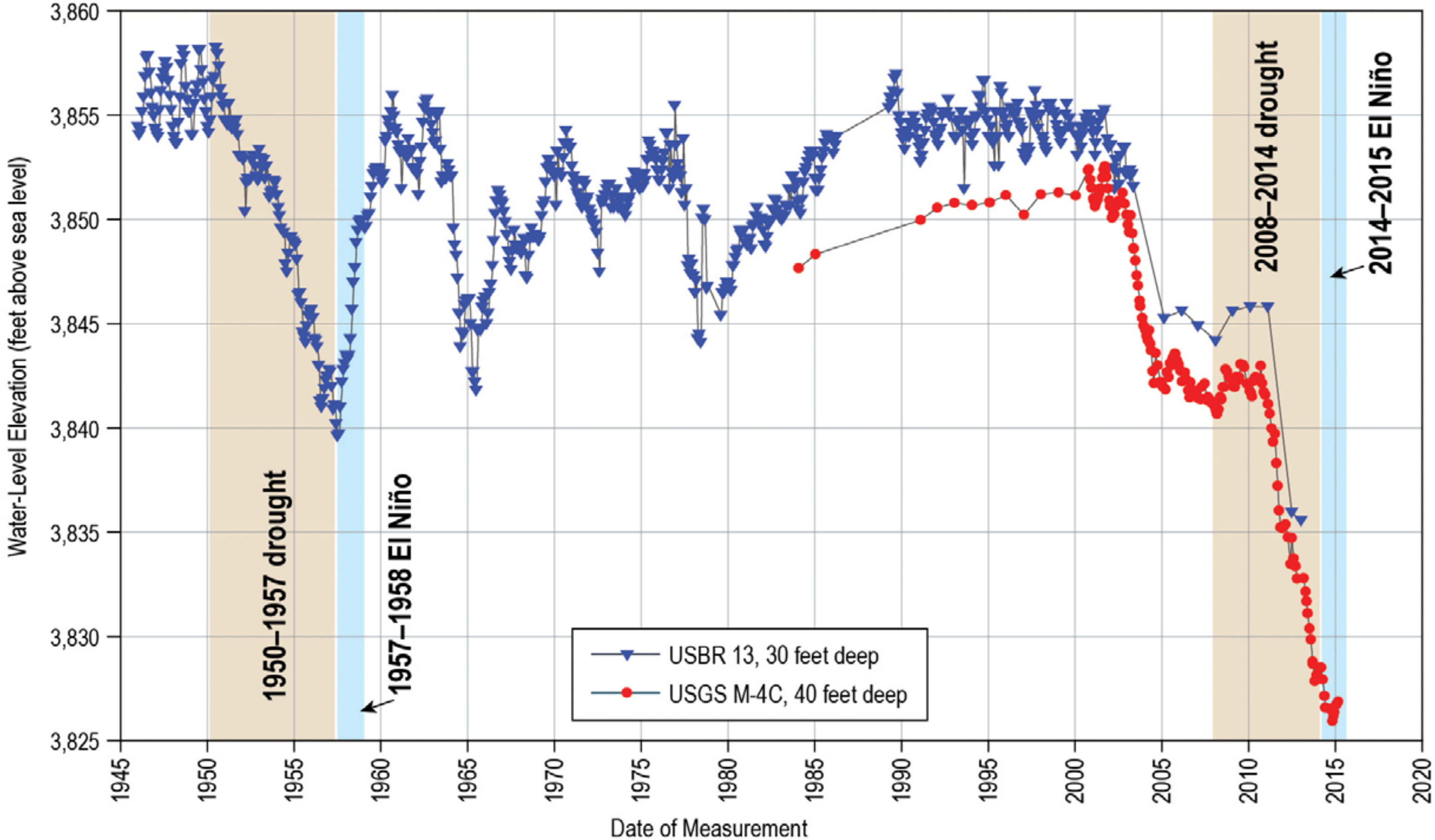
Dramatic rise in irrigation wells — 11 in 1946, 50 in 1947, and more than 1,600 by 1955.

1951–1953 — the natural recharge pattern is lost, but there is no appreciable water-level drop.

1954 to mid-1957 —wells were the main source of supply and water levels declined each year. At the end of 1956, the water level was 6 feet lower than pre-1951.

1957-1958 El Niño — water levels recovered rapidly to within 2 feet of pre-drought levels.

Effects of Drought and Pumping on Groundwater — 2 Shallow Wells 1946-2015

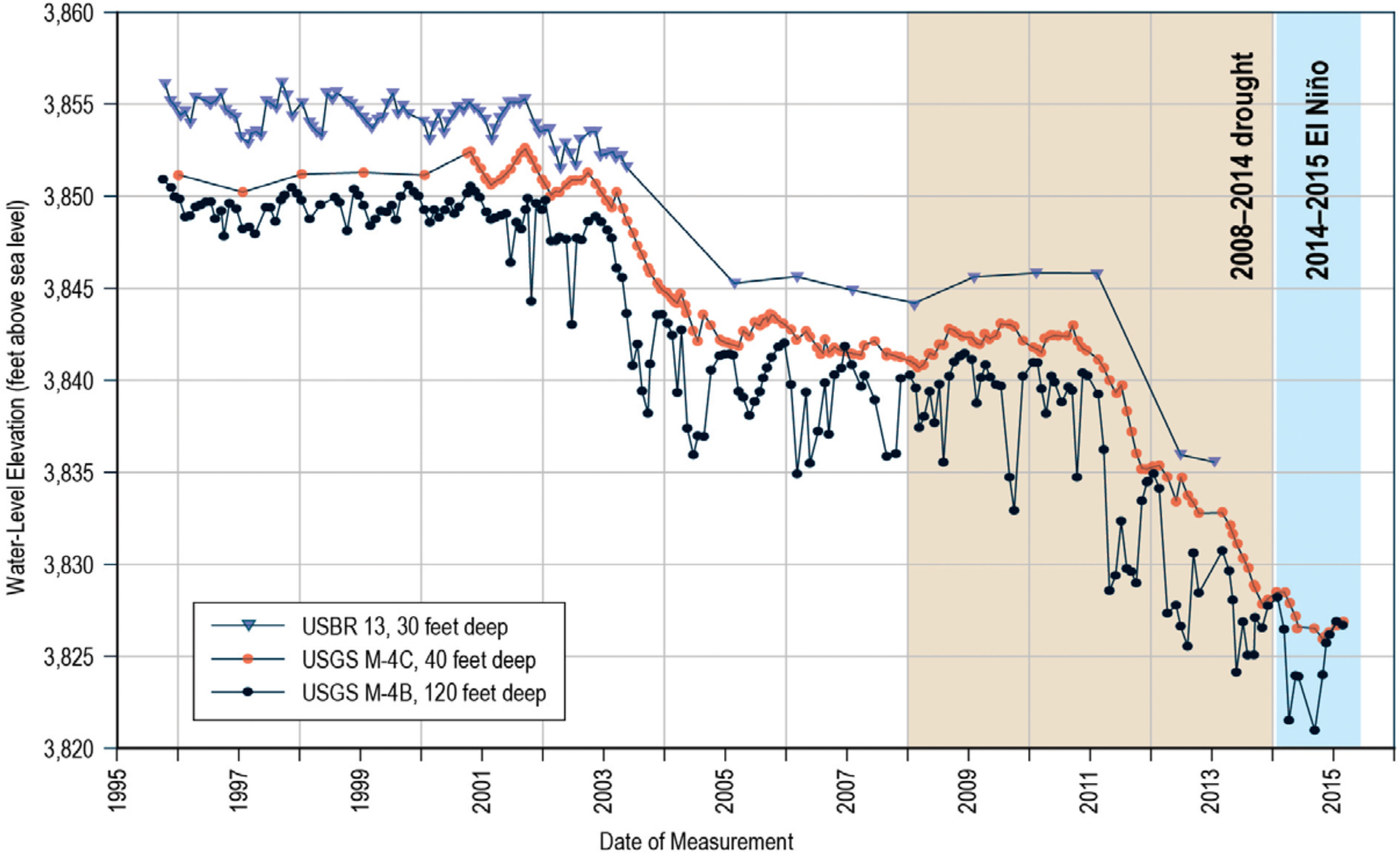


The 1950s groundwater levels in well USBR13 replicate the pattern in the average hydrograph, with a 16-ft drop.

The pre-1951 recharge pattern (summer high/winter low) was disrupted in the 1960s and 1970s, but returned during the wet years of the 1990s.

The 1990s water-level highs were 2-3 feet lower than pre-1951 levels. Was the assumption that the aquifer fully recovered following the 1950s drought and pumping correct?

Effects of Groundwater Pumping and Drought — 1995-2015

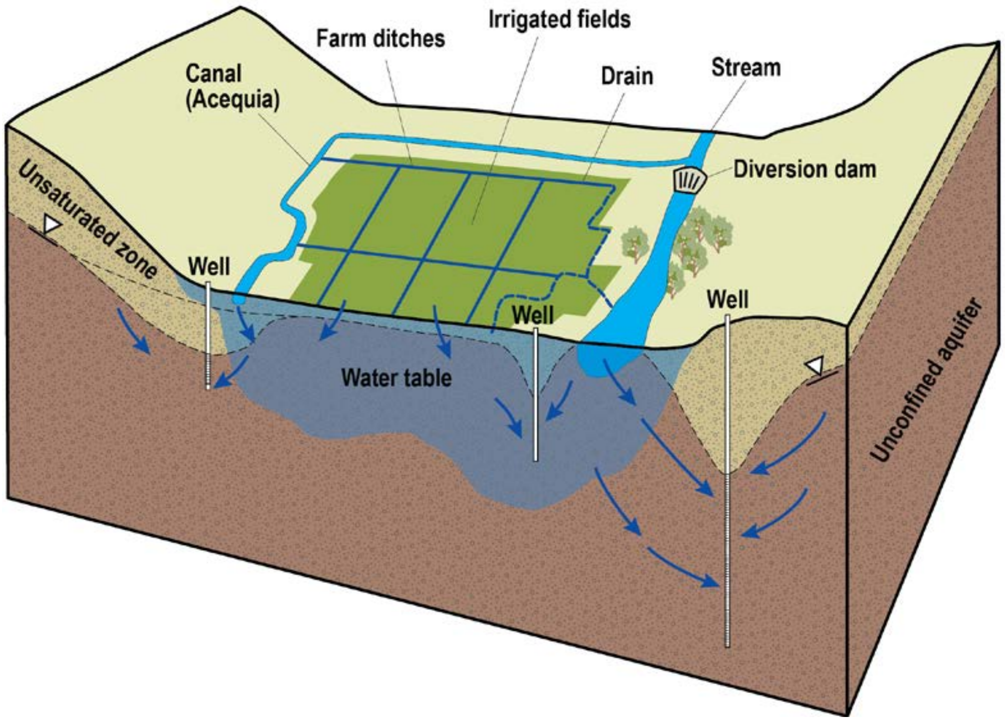


In 2003, 5years prior to onset of drought, the summer recharge pattern of the 1990s shifts to a summer pumping pattern. Water levels drop 7.5 feet. →→ Early groundwater storage loss is due to pumping

April 2011 to June 2015, 18.5 foot water-level drop in well M-4C (red) →→ Late groundwater storage loss due to drought-impaired recharge and intensive pumping.

Total water-level decline 2002–2015 June is 26 feet. No sign of recovery despite shift to wet El Niño conditions.

The Surface-Water Groundwater System – How it can fail



Groundwater Vulnerabilities During Drought

1. The availability and distribution of groundwater recharge is reduced
2. Surface shortages trigger intensive groundwater pumping , which drives groundwater declines and compounds storage losses and depletion
3. The groundwater system may decouple from surface sources, which drives excessive seepage and conveyance losses.