USGS Groundwater Data Collection & Studies in Antelope Valley

Steve Phillips &
Bob Blanchard
U.S. Geological Survey
California Water Science Center

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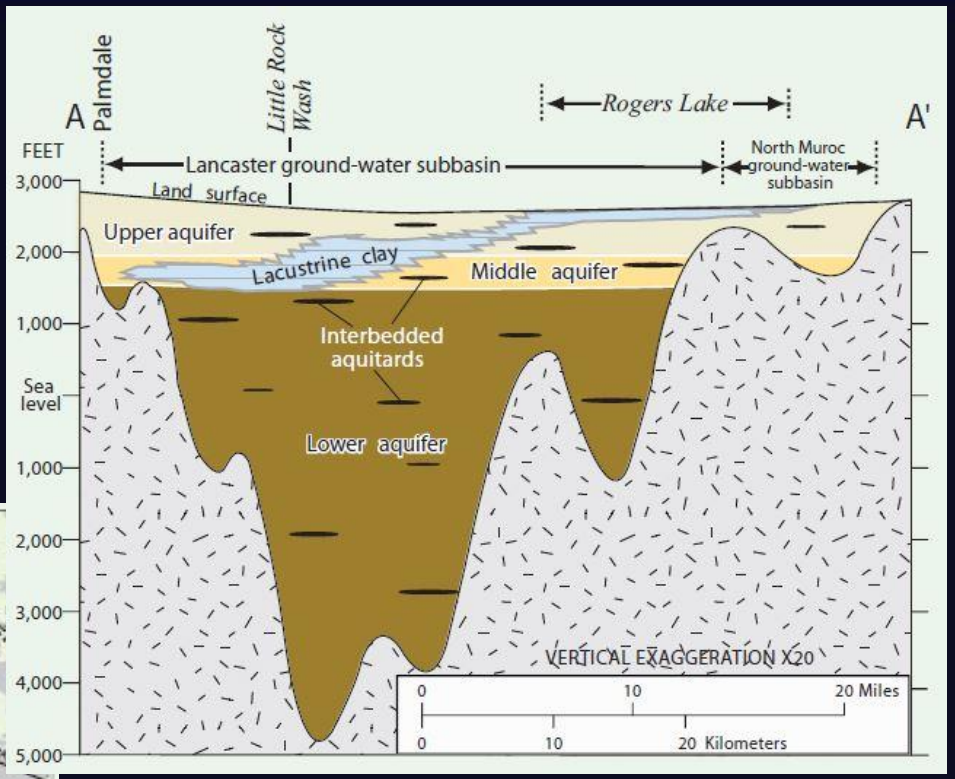
Antelope Valley Groundwater Basin

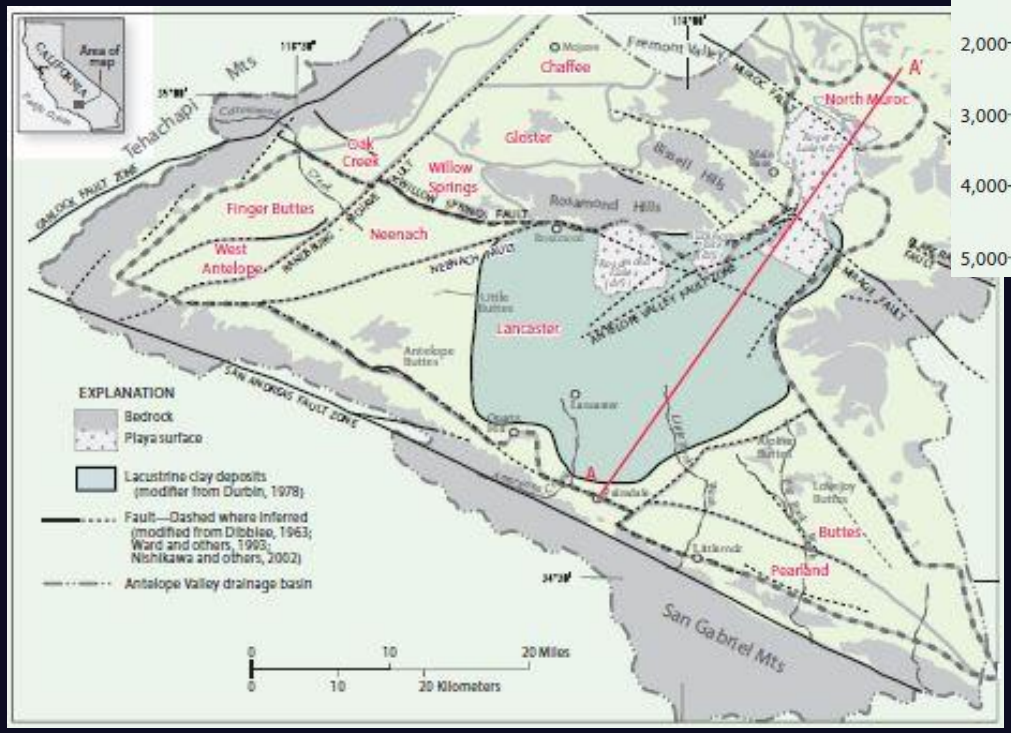
USGS studies began here in 1911, and continue to today:

- Data collection
- Water use
- Land subsidence
- Arsenic treatment
- Artificial recharge
- Groundwater modeling



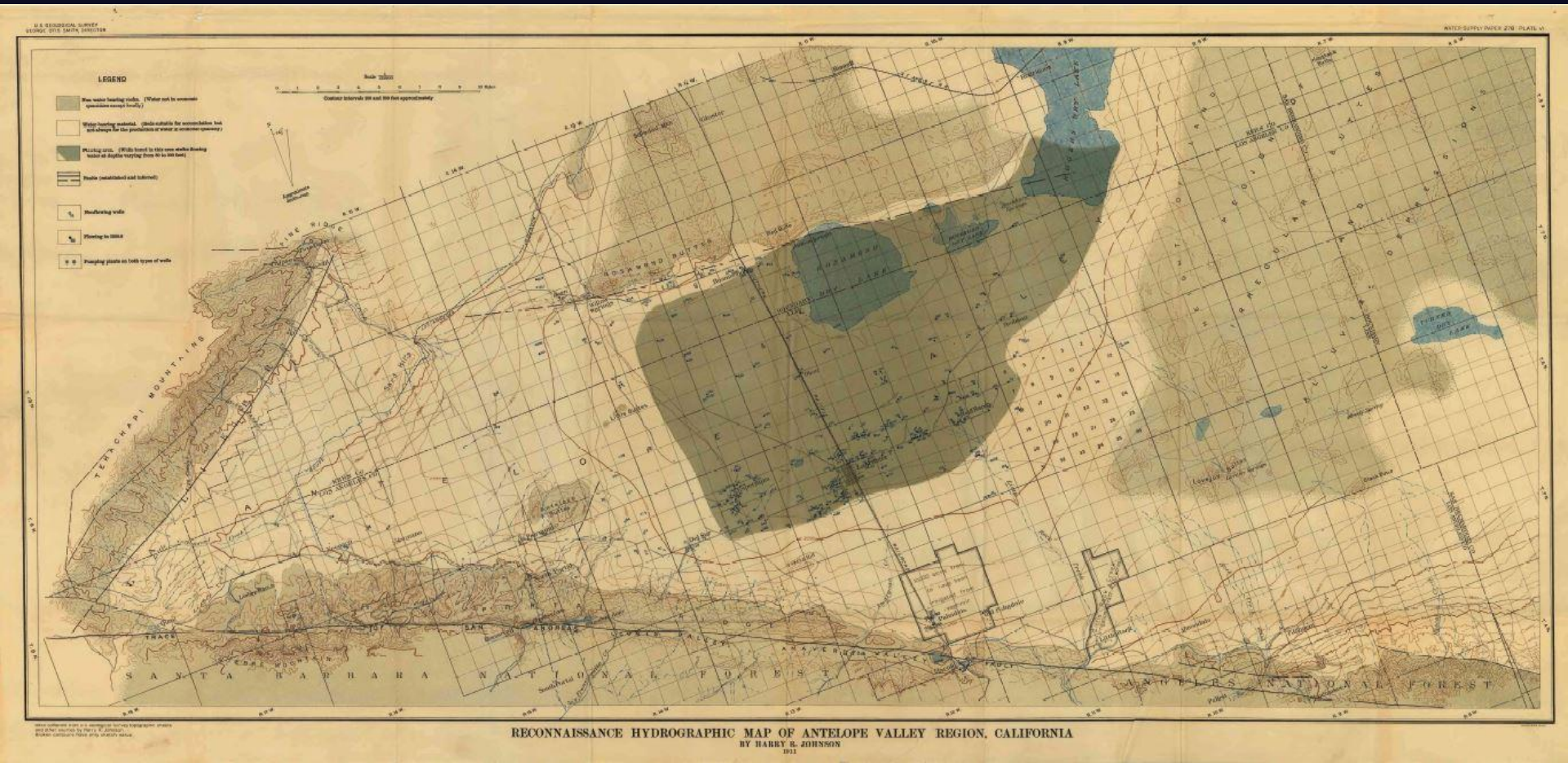
Antelope Valley Groundwater Basin





Overview of Historic & Current Groundwater Supplies

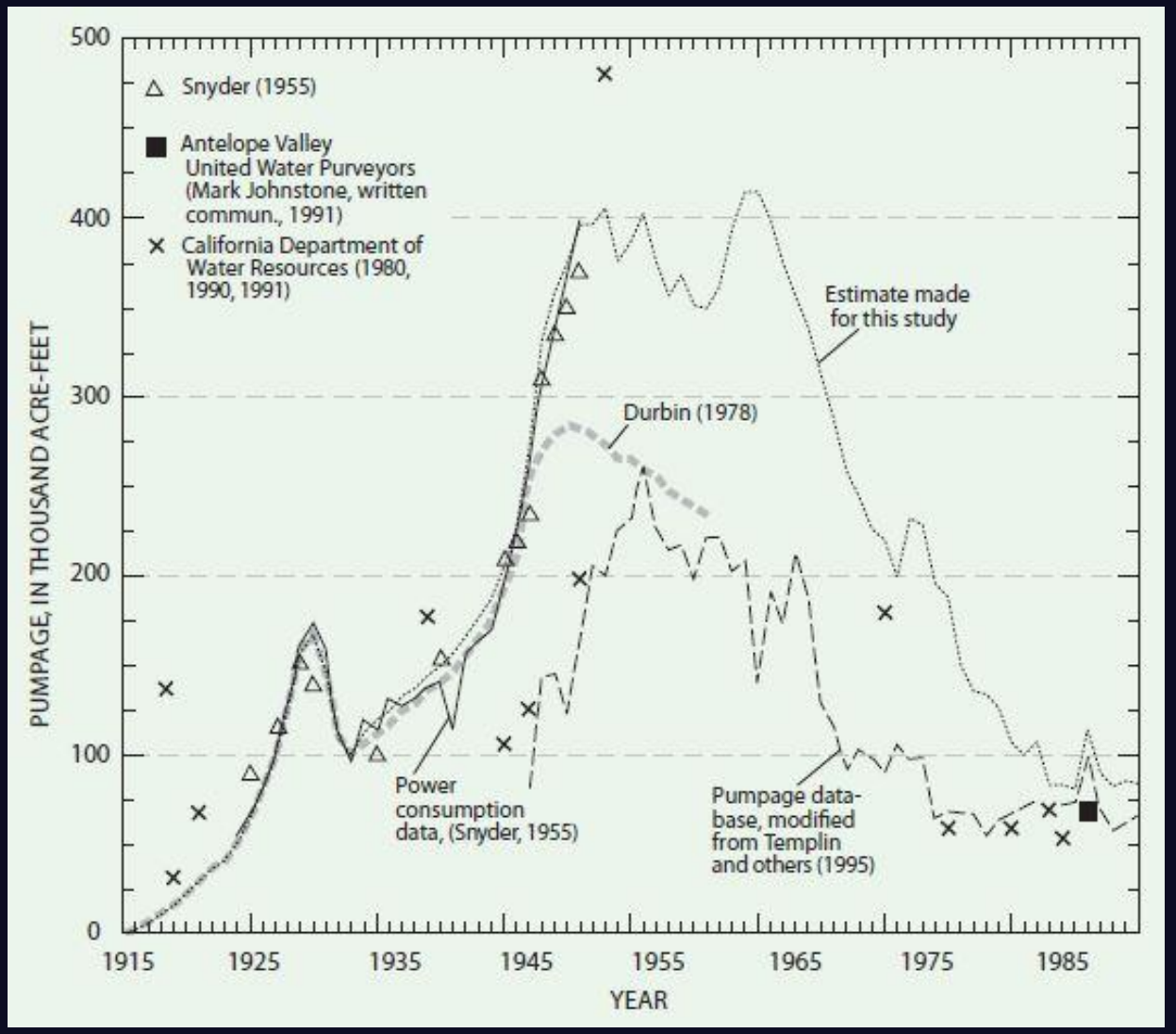
Historic area of artesian flow, from Johnson (1911)



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Overview of Historic & Current Groundwater Supplies

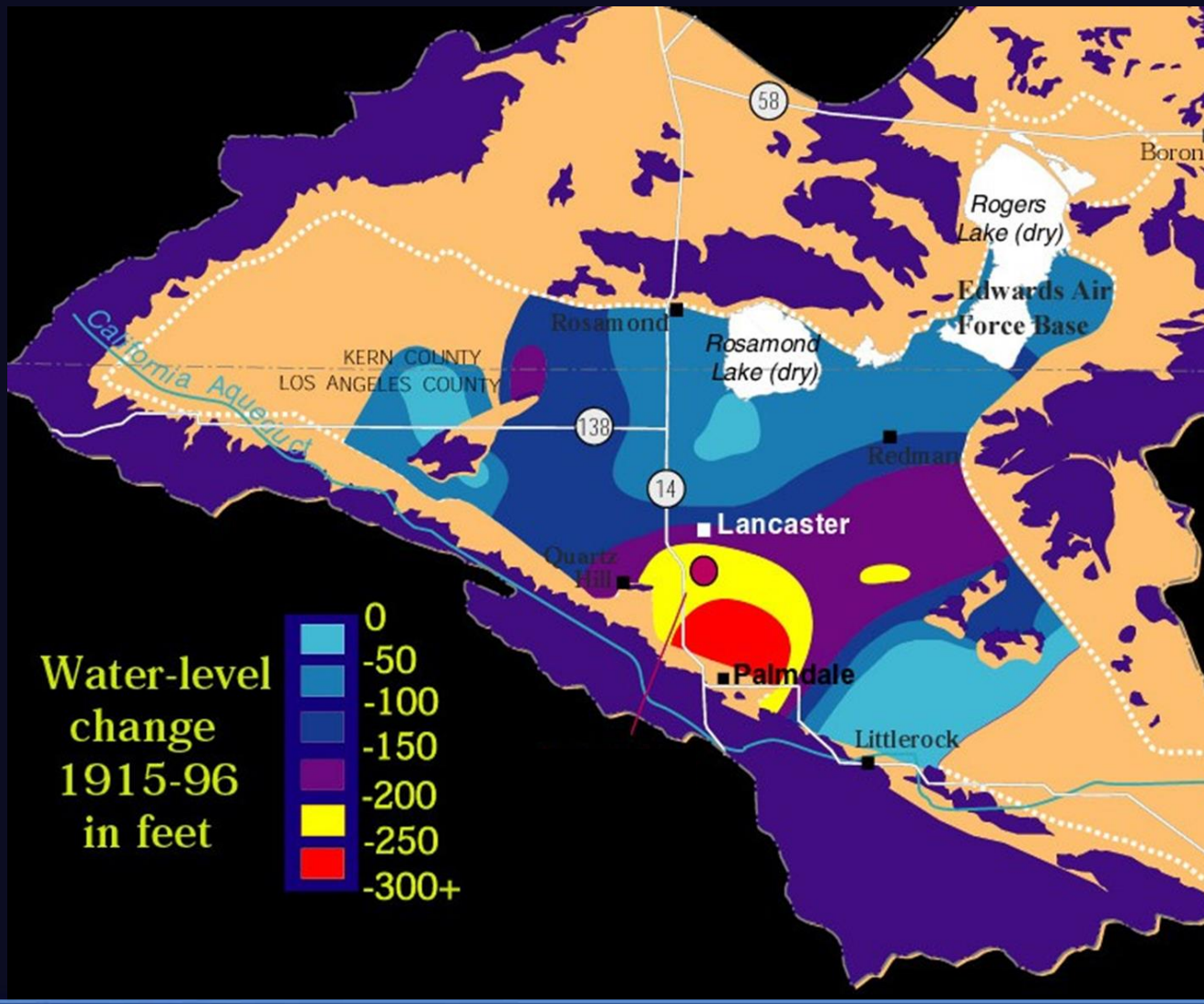
Historic pumpage greatly exceeded natural recharge of about 30,000 acre-ft per year.



USGS WRI 03-4016

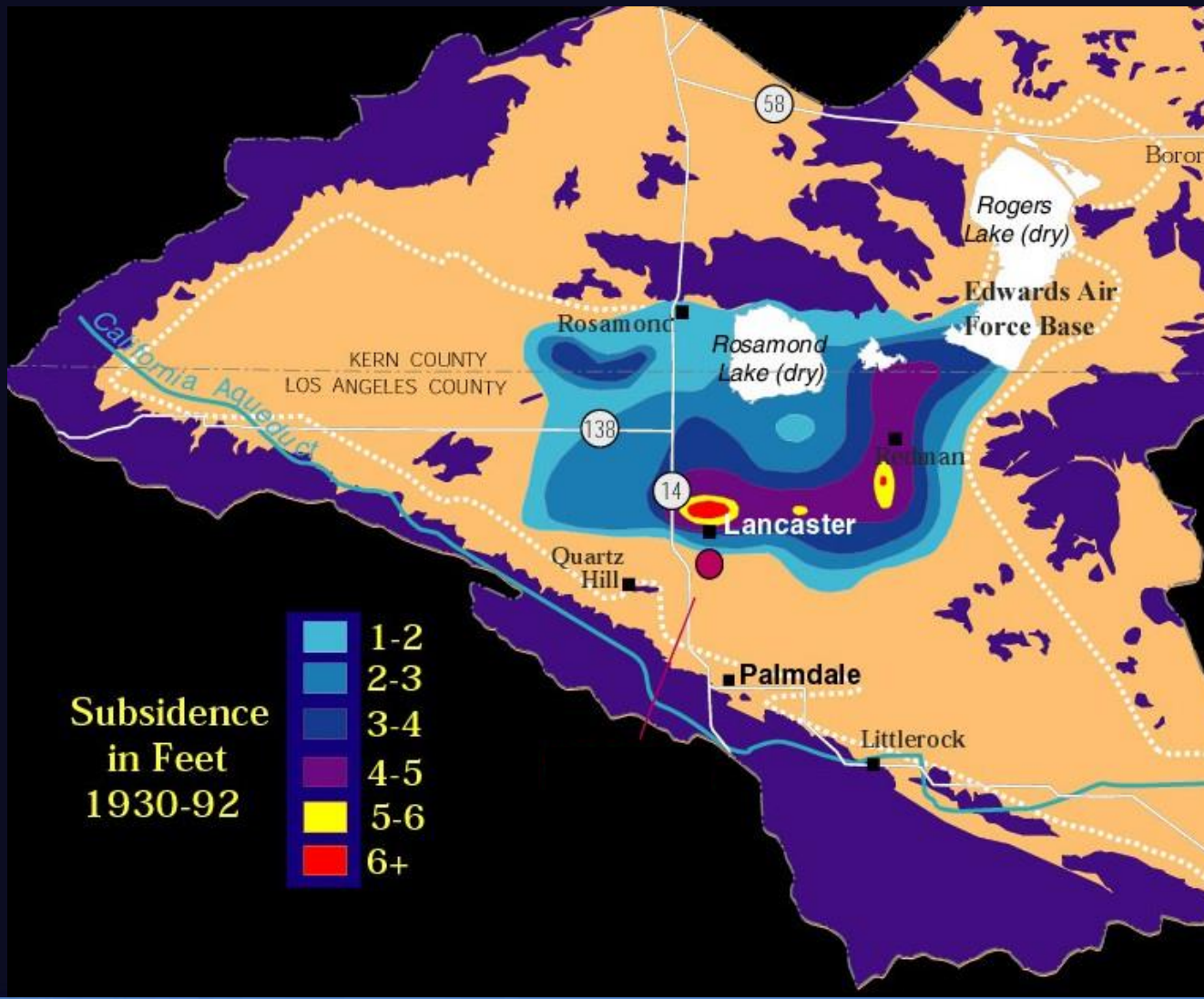
Overview of Historic & Current Groundwater Supplies

Historic pumpage in excess of recharge caused water-level decline



Overview of Historic & Current Groundwater Supplies

Historic pumpage in excess of recharge also caused land subsidence

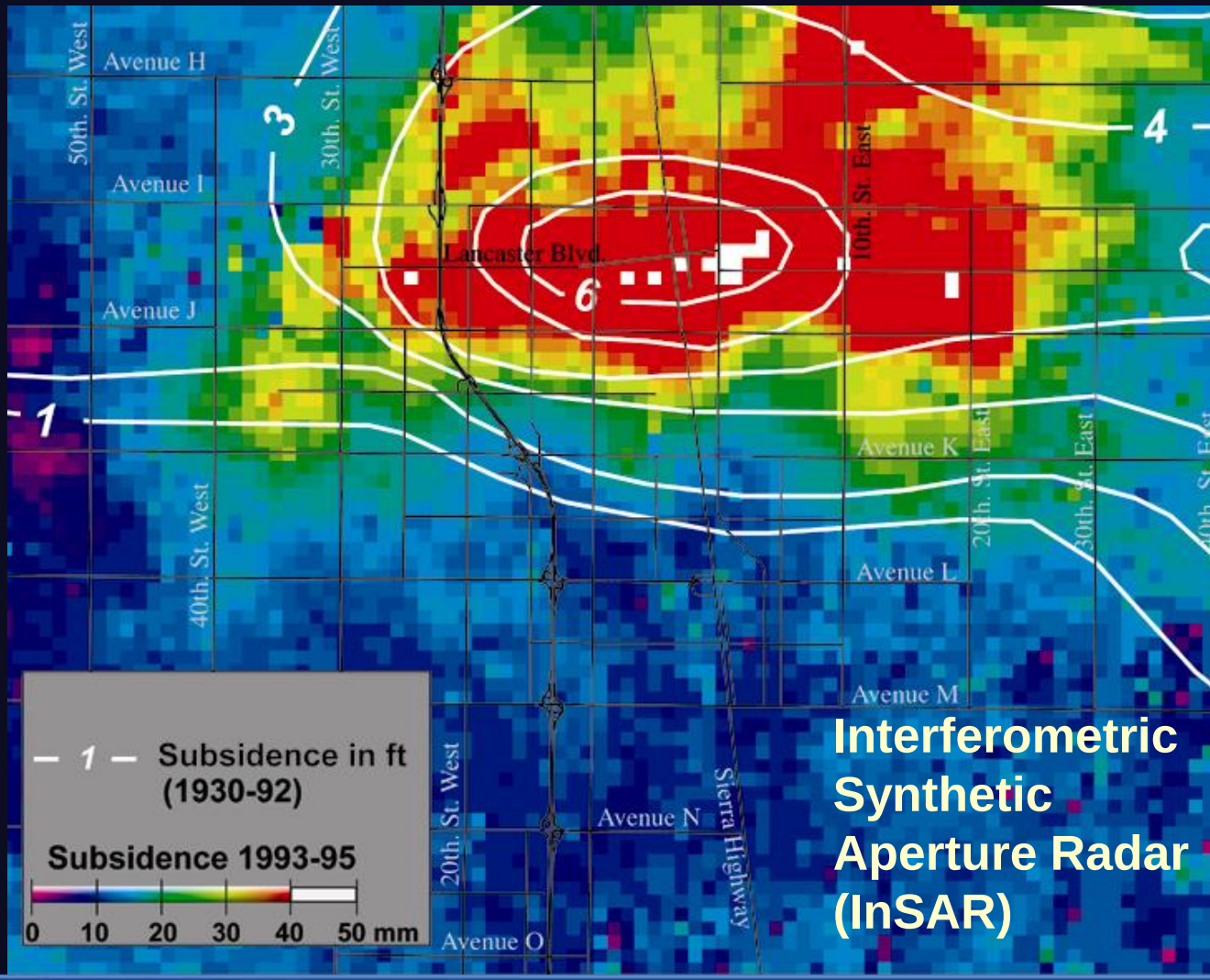


USGS WRI 94-4184

Overview of Historic & Current Groundwater Supplies

Another look at land subsidence

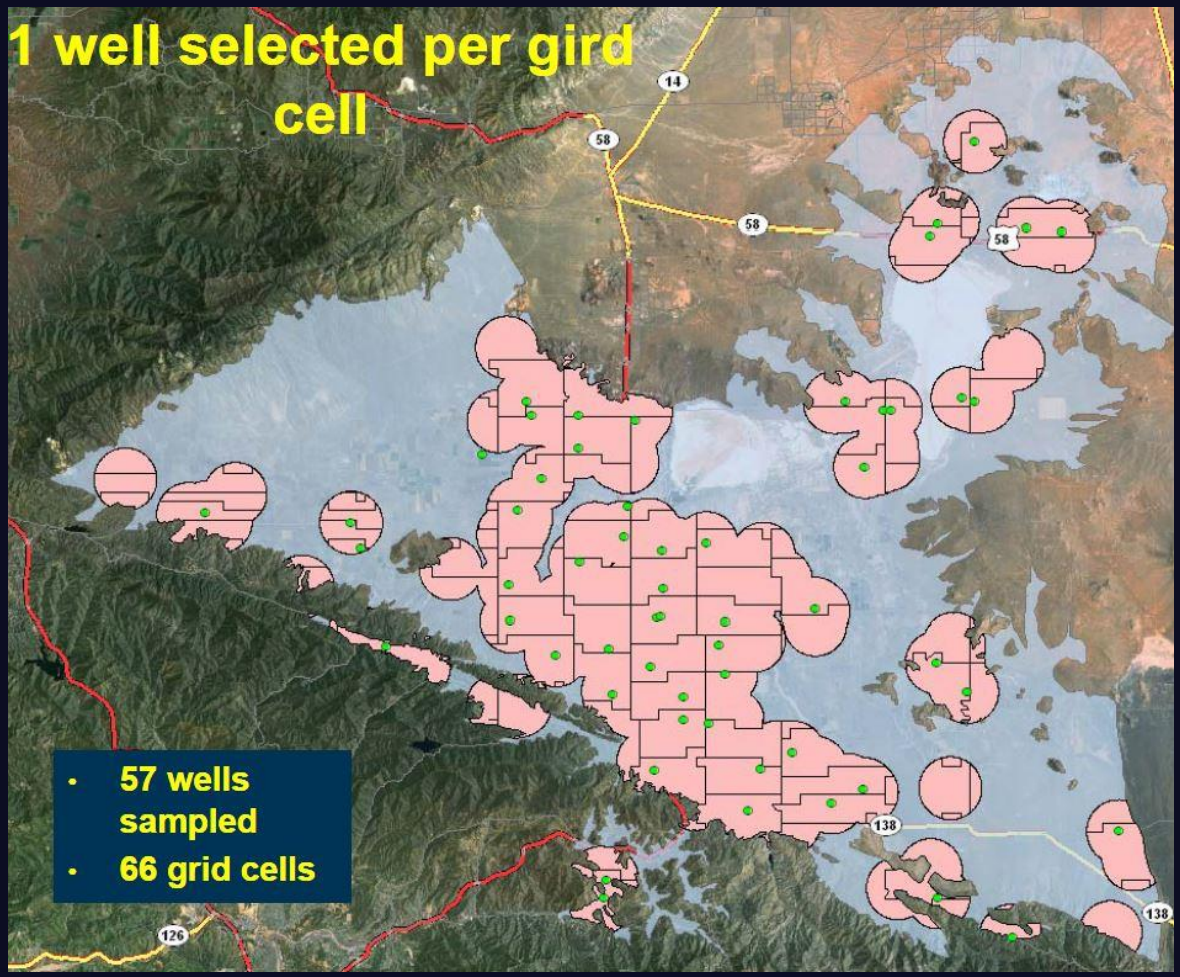
Antelope Valley was the first use of satellite radar data to measure subsidence



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Groundwater Age & Quality

USGS, as part of the statewide GAMA Program, sampled 57 wells in Antelope Valley for 162-243 constituents, and age-dating and source tracers



[GAMA Fact Sheet]

[GAMA Report]

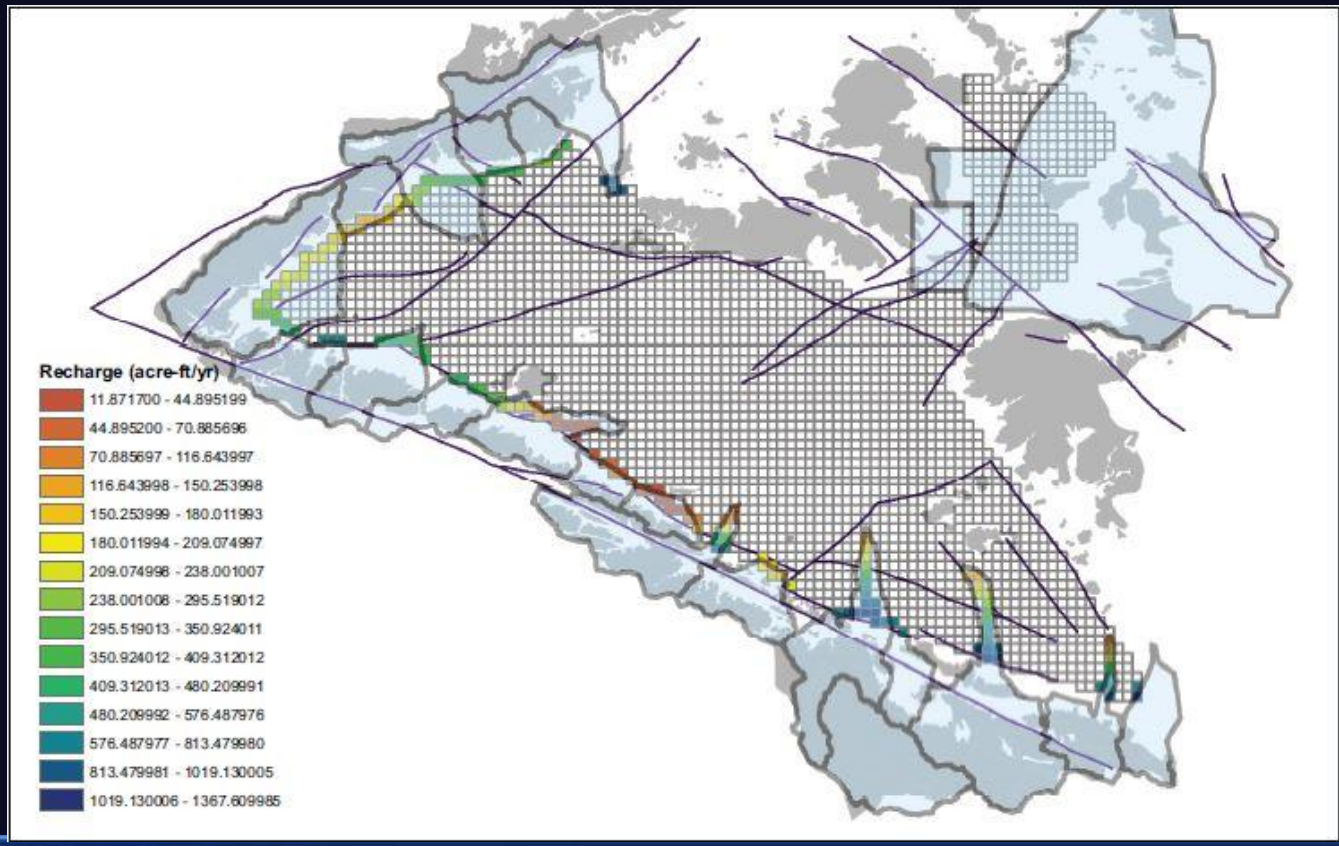
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How is Groundwater Recharged?

Groundwater has been recharged in AV both naturally and artificially

Natural

- Mountain-front
- Model estimate 30,600 acre-ft/yr
- 95% probability that it is less than 34,000



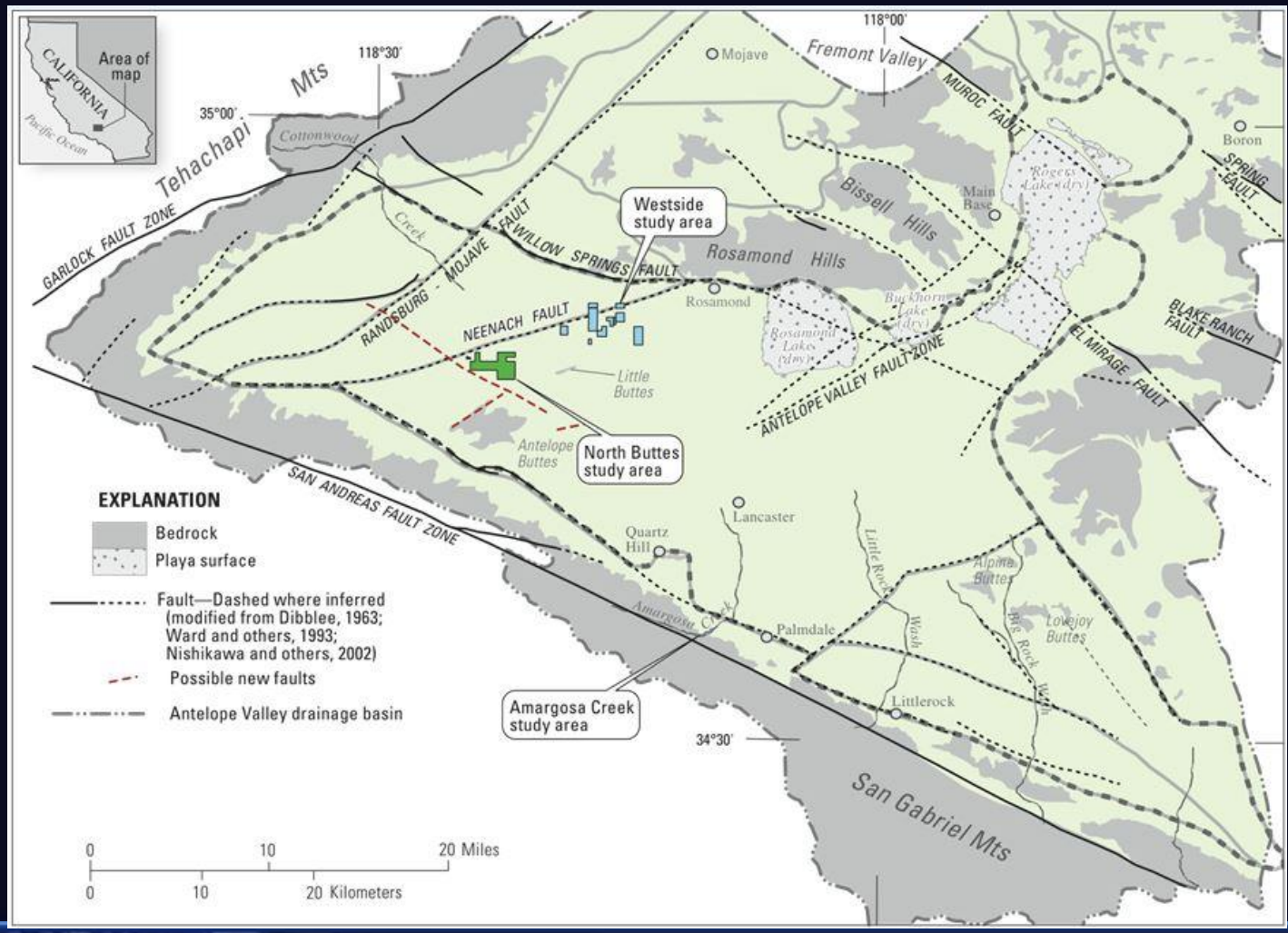
[USGS SIR 2014-5166]

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How is Groundwater Recharged? – Artificial

Types:

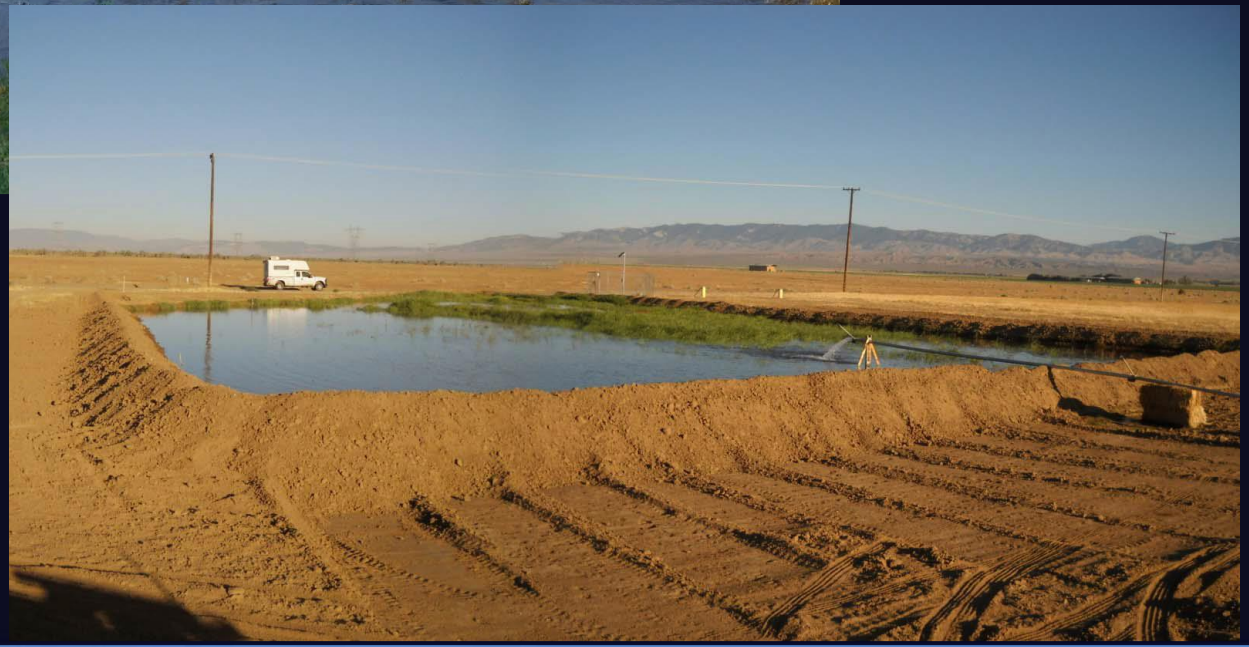
- Agricultural return flow
- Flooding of Ag lands
- Off-stream spreading
- Well injection
- Arsenic treatment



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How is Groundwater Recharged? – Artificial





How is Groundwater Recharged? – Artificial

Well injection

- Pilot test
- LA County, AVEK, & USGS
- 2 wells, 750 gpm each



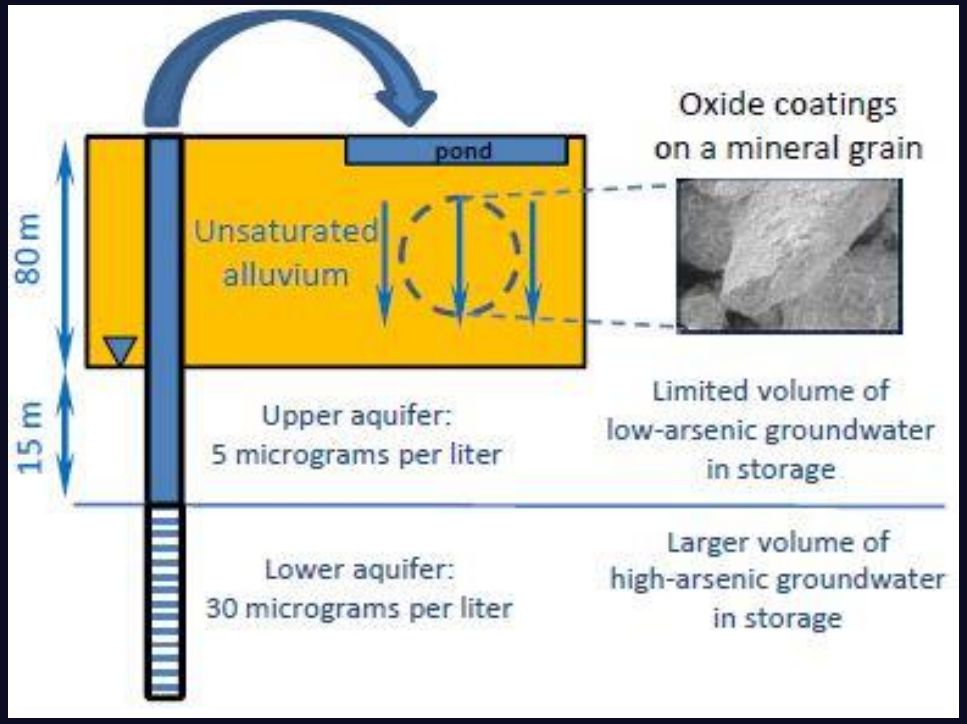
Well in southern Lancaster

How is Groundwater Recharged? – Artificial



Arsenic removal

- Pilot test
- LA County, AVEK, & USGS
- Lab & field experiments



Groundwater and Long-Term Water Reliability

Groundwater is a key resource during droughts. To maintain this resource may require artificial, or managed aquifer recharge during wetter periods.

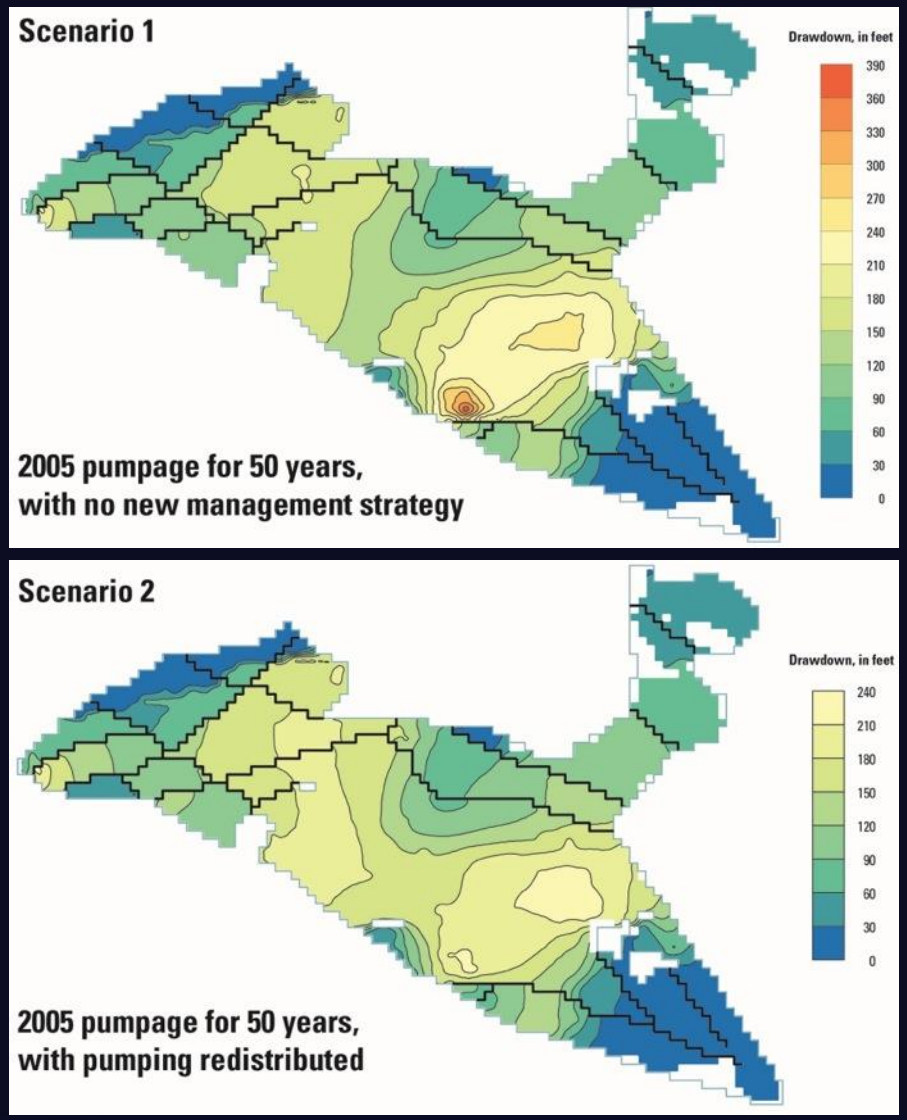
To maintain groundwater quality, it is important not to desaturate the upper & middle aquifers. Well modification may be necessary in some cases. (USGS helped to do this in Lancaster).

Groundwater and Long-Term Water Reliability

Models support quantitative analyses of management strategies, for example:

- Redistribution of pumping
- Managed aquifer recharge
- Water conservation
- Alternative water sources
- Etc.

[USGS SIR 2014-5166]




Thank you!
Questions?
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High Desert Water Summit 2015

U.S. Geological Survey Groundwater and Water Quality Cooperative Program

Antelope Valley, California

Robert Blanchard, USGS- CAWSC Redlands Field Office Chief



History

- Water level data collected in this area since the early 1900's
  - January 1, 1963 - Cooperative effort between USGS and Antelope Valley Eastern Kern Agency to monitor groundwater levels begins
- Water quality data has been collected since the early 60's
  - Current constituents analyzed include: Nutrients, Total Dissolved Solids, Radon, Ions, Trace Metals and Arsenic.







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Current Program

- Monitor groundwater levels and water-quality data for a long term Regional observation well network in Antelope Valley
- Publish a water-level contour map and maintain an interactive website for data collected in Antelope Valley





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Groundwater Levels

Total Observation Well Network ~ 200

- Measured annually

Index Observation Wells = 25

- Measured Semi-Annually; a subset of the total observation well network
- Representative of sub-basins in the study area





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Groundwater Quality

Total Wells Sampled= 24

- Specific Conductance and Water Temperature measured annually
- Water-quality samples collected from observation wells on a 3-year rotational basis
  - Group 1 - Fall 2011
  - Group 2 - Fall 2012
  - Group 3 - Fall 2013



Split into 3 geographic groups

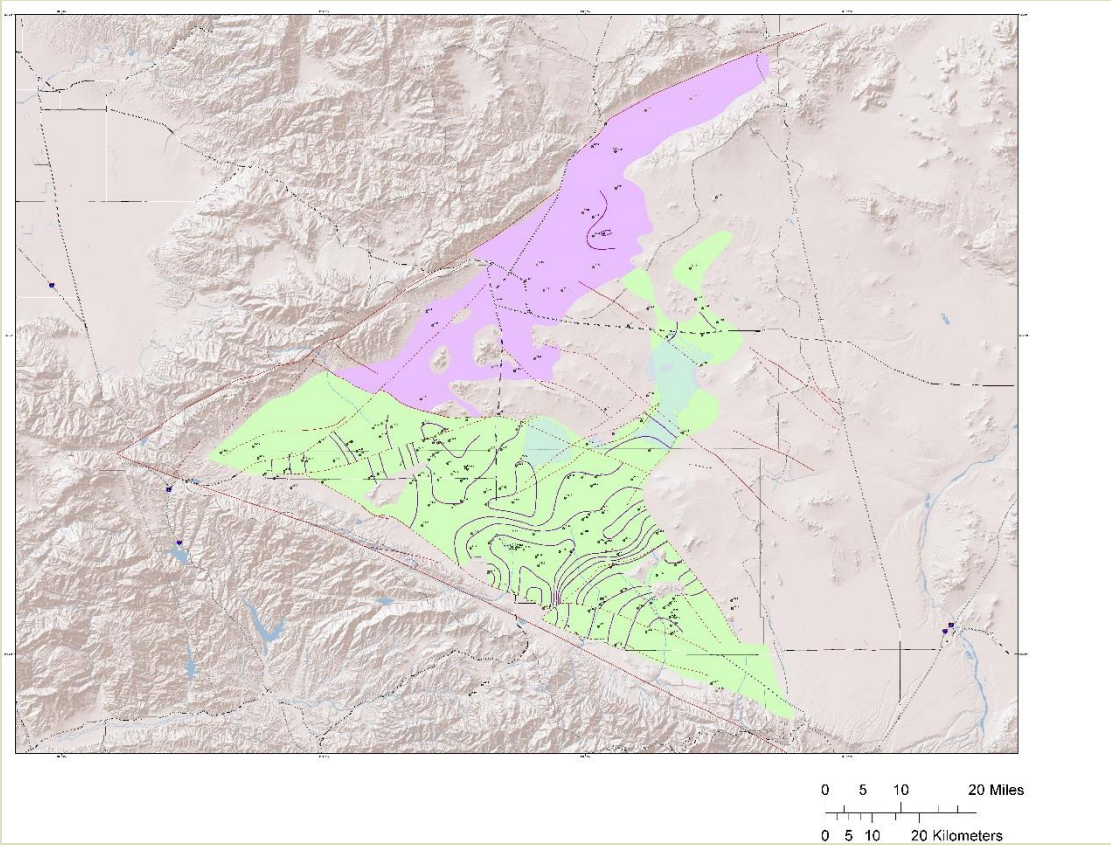
- Group 1 wells = 8
- Group 2 wells = 8
- Group 3 wells = 8

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Water-level Contour Map

- Water levels measured during March 2014 were used to construct a water level contour map
- Review and online publication of the water-level contour map is expected to be completed by Fall 2015

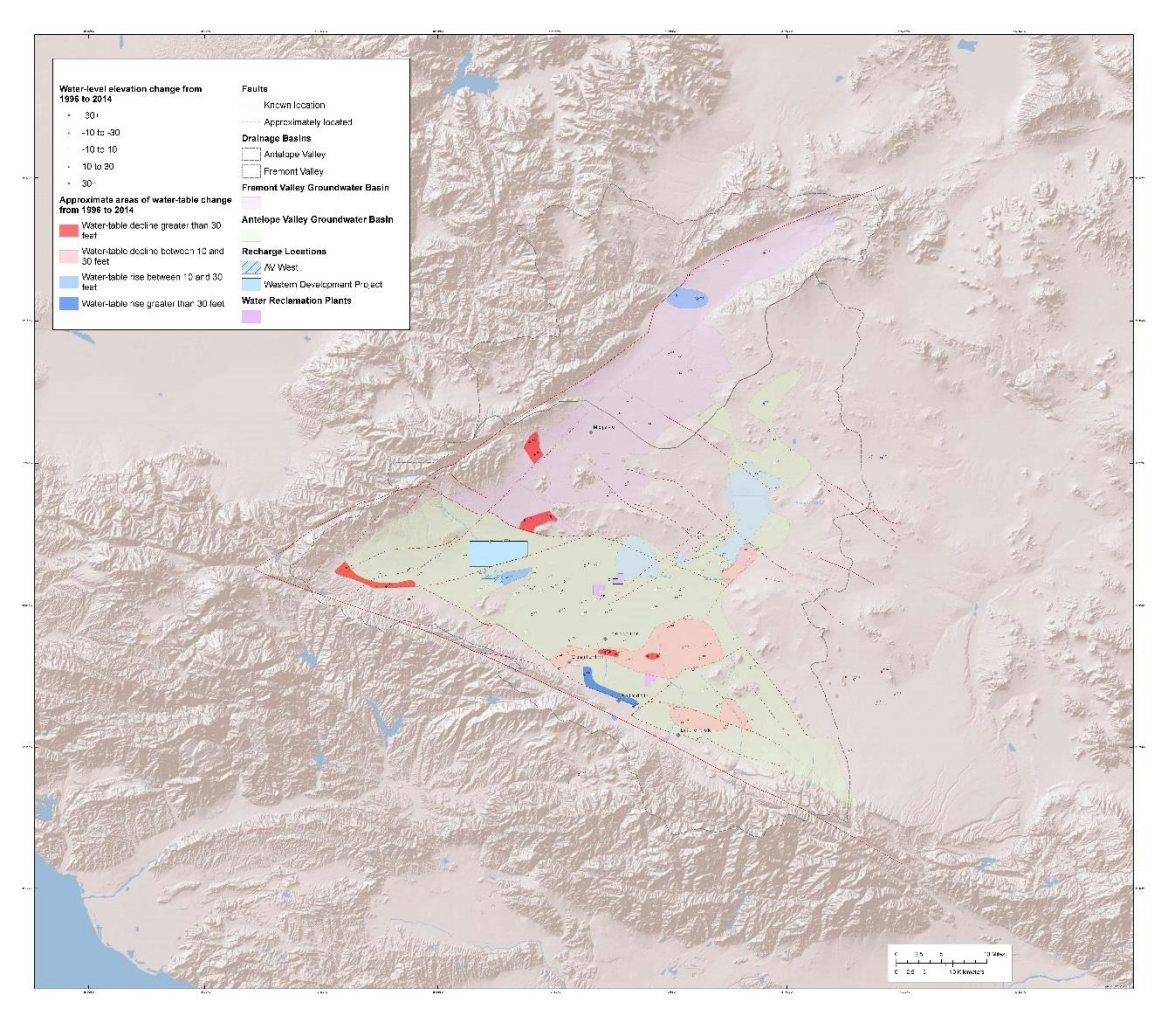


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Water-level Change Map

- Water-level elevation change from 1996 and 2014

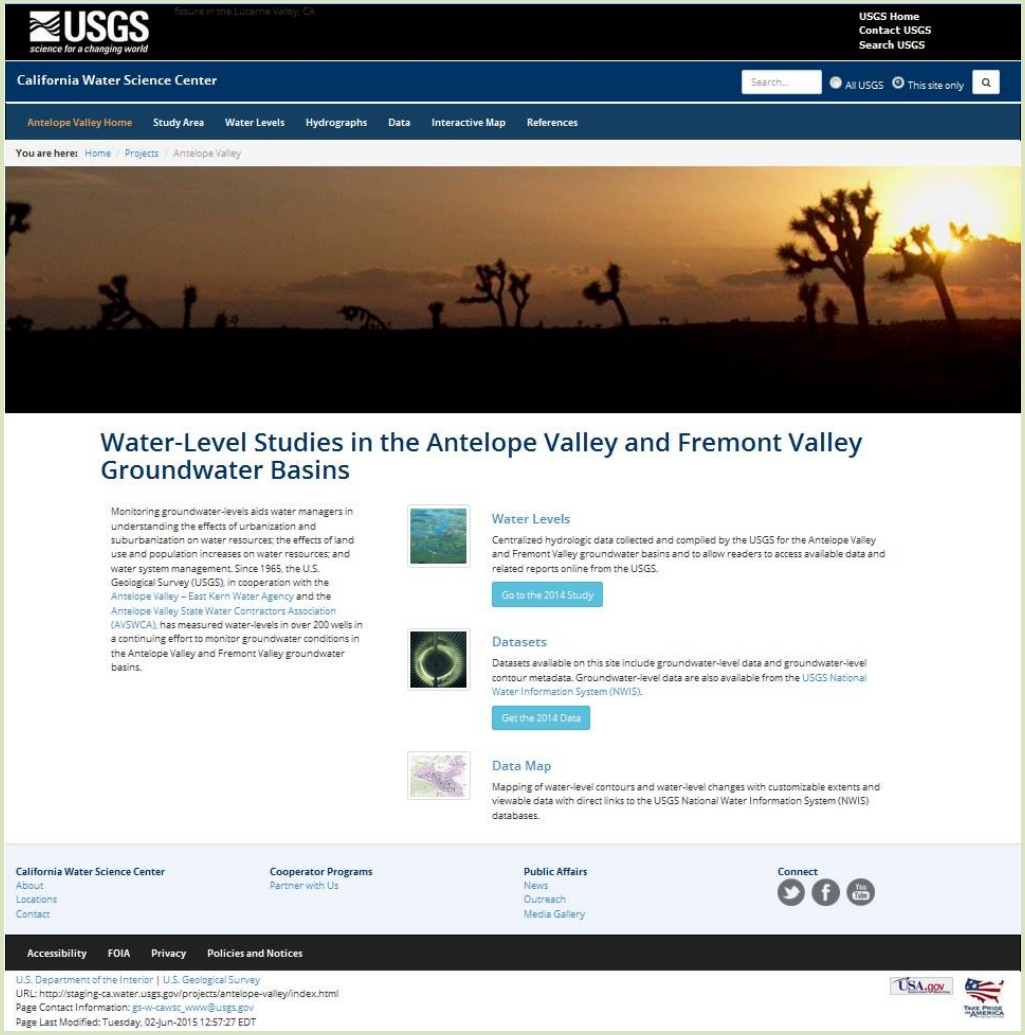


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Interactive Web Site

- In final review and expected to be available online by Fall 2015



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Interactive Web Site - continued

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Antelope Valley Water-Level Studies

Antelope Valley Water-levels by Year

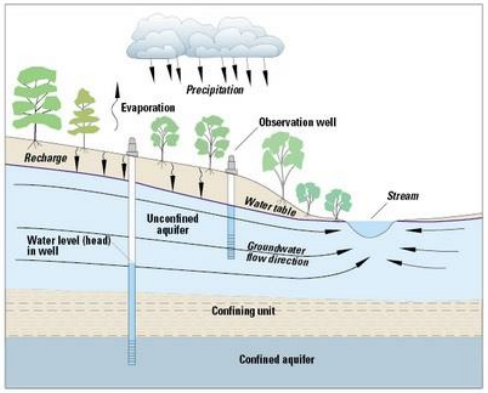
2014 Study
2012 Data
2010 Data

Groundwater systems are dynamic and adjust continually to short-term and long-term changes in climate, ground-water withdrawal, and land use. Water-level measurements from observation wells are the principal source of information about the hydrologic stresses acting on aquifers and how these stresses affect groundwater recharge, storage, and discharge. Long-term, systematic measurements of water levels provide essential data needed to evaluate changes in the resource over time, to develop groundwater models and forecast trends, and to design, implement, and monitor the effectiveness of groundwater management and protection programs.

Regional water-table maps of the Antelope Valley groundwater basin have been published in printed reports by the U.S. Geological Survey (USGS) since 1911. Beginning in 2015, water-level reports and maps will be published on this website every two years.

Methodology | Water-Level Changes

Water-Level Mapping Methodology



Cross-section sketch of a typical groundwater-flow system showing the relation between an unconfined and confined aquifer, a water table, and other hydrologic elements. Two general types of aquifers-unconfined and confined-are recognized. In unconfined aquifers, hydraulic heads fluctuate freely in response to changes in recharge and discharge. Water levels measured in wells completed in the upper part of an unconfined aquifer help define the elevation of the water table, which is the top of the saturated zone. In confined aquifers, sometimes known as "artesian" aquifers, water in the aquifer is "confined" under pressure by a geological body that is much less permeable than the aquifer itself. Water levels in tightly cased wells completed in confined aquifers often rise above the elevation of the top of the aquifer. These water levels define an imaginary surface, referred to as the potentiometric surface, which represents the potential height to which water will rise in wells completed in the confined aquifer. Many aquifers are intermediate between being completely unconfined or confined.

Water-level maps in this report show the altitude of the water table above sea level (mean) for a specific time period. They also show the general direction of ground-water flow (interactive water-level contour map of 2014). The water-level measurements used for the water-level contour maps are from wells of various depths. Although these wells may have different depths, the measured water levels reasonably represent the water-table altitude.

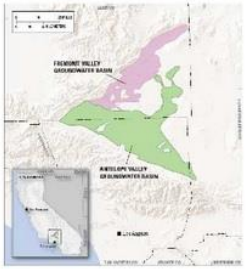
In areas where sufficient data exist, points of equal water-level altitude were connected by contour lines to show the general direction of ground-water flow. In areas where water-level data were unavailable for a particular year, the general shape of the contours was drawn using the previously published water-table map, when available. In some areas of the maps, water-level measurements were affected by recent pumping, or nearby wells that were pumping, which resulted in steep water-level gradients and water-level contours that bend abruptly around wells.

The water levels presented on the maps were measured using a steel tape or a calibrated electric tape; when neither of these methods was possible, an airline was used. The water-level altitude was determined by subtracting the water-level measurement (depth to water, in feet below land surface) from the established land-surface referenced to the North American Vertical Datum 1988 (NAVD 88).

Reports

2014 Antelope Valley Region Water-Level Study
Antelope Valley Water-Level Studies

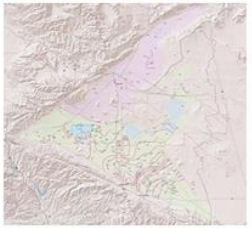
Maps



Antelope Valley Location Map



Antelope & Fremont Valleys: Detailed Basin Map



Antelope Valley Water Level Contours

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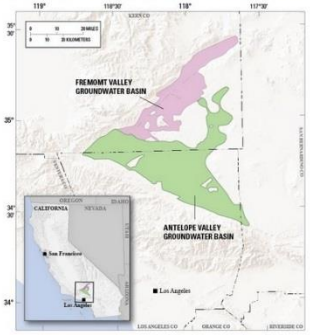
AVSWCA Antelope Valley State Water Contractors Association

Interactive Web Site - continued

Antelope Valley Home | Study Area | Water Levels | Hydrographs | Data | Interactive Map | References

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Antelope Valley and Fremont Valley Study Area



Map of the study area in relation to the Antelope Valley and Fremont Valley groundwater basins.

The Antelope Valley and Fremont Valley groundwater basins are in the western part of the Mojave Desert, northeast of Los Angeles. The Antelope Valley and Fremont Valley groundwater basins together encompass about 2,100 square miles. The climate of these basins is typical of the Mojave Desert region of southern California. Most areas of the basin floor receive less than 10 inches of precipitation per year (Rantz, 1969). Recharge to the groundwater system from direct infiltration of precipitation is negligible (Durbin, 1978).

Surface water in these basins is minimal and normally is limited to ephemeral flow (flow in a river or stream that only occurs during and immediately after rain or snow-melt) during winter and spring storms and discharge from ephemeral springs in originating in the Tehachapi and San Gabriel Mountains. The lack of significant surface-water resources has resulted in the use of groundwater as the primary source for private, agricultural, and municipal supply. Because of increasing urbanization, demands on local water supplies have created overdraft conditions in some areas of the desert basins.

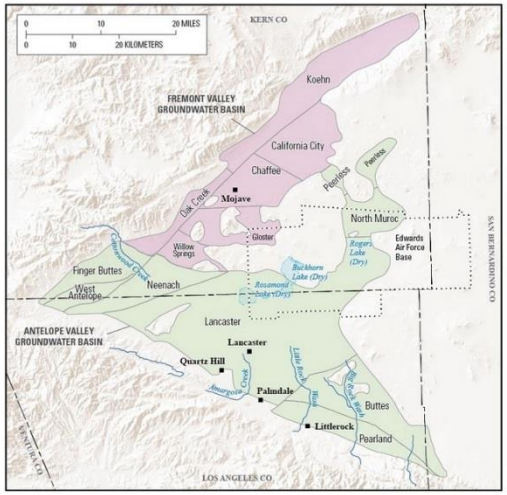
Groundwater Basins

Antelope Valley | Fremont Valley

Antelope Valley Groundwater Basin

The Antelope Valley groundwater basin is approximately 920 square miles and, for water-managment purposes, is divided into 8 subbasins: Lancaster, Finger Buttes, West Antelope, Neenach, Buttes, Pearland, North Muroc, and Peerless.

The primary source of groundwater recharge in the Antelope Valley groundwater basin is perennial runoff from the surrounding mountains. Historically, groundwater in the basin flowed north from the San Gabriel Mountains and south and east from the Tehachapi Mountains toward Rosamond Lake, Rogers Lake, and Buckhorn Lake (DWR, 2004).



Map of the groundwater subbasins comprising the Antelope Valley and Fremont Valley groundwater basins.

Reports

2014 Antelope Valley Region Water-Level Study

Antelope Valley Water-Level Studies

Maps



Antelope Valley Location Map



Antelope & Fremont Valleys: Detailed Basin Map



Antelope Valley Water Level Contours

Stakeholders

AVSWCA Antelope Valley State Water Contractors Association

Antelope Valley State Water Contractors Association (AVSWCA)

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