SESSIONS 2 AND 3
Santa Margarita Groundwater Basin Hydrogeology and Water Budget

Georgina King, P.G., C.Hg.
MONTGOMERY & ASSOCIATES

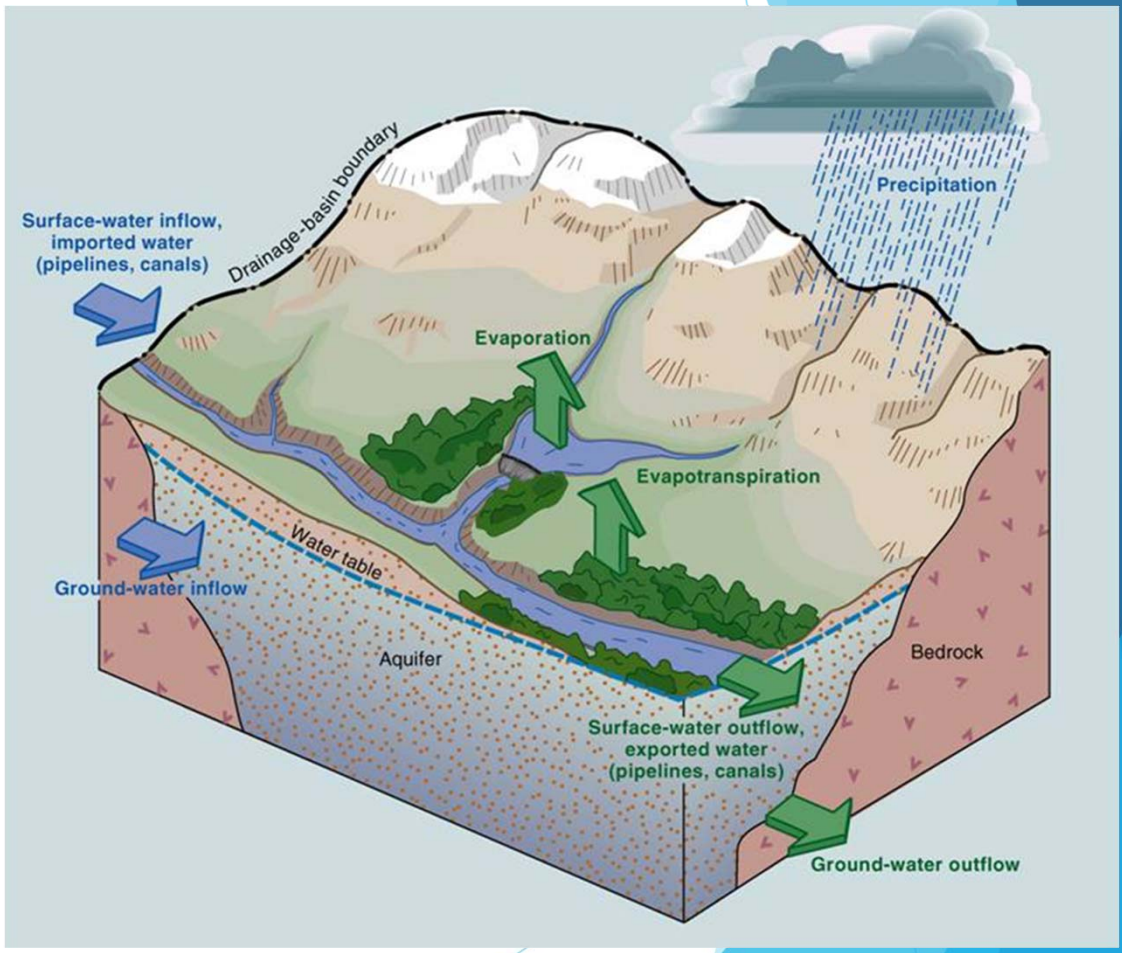
John Fio
EKI Environment & Water, Inc.

Hydrogeological Conceptual Models (HCM)

- What are they?
- What are they used for?

What is a HCM?

*23 CCR §354.14 (a): Each Plan shall include a descriptive **hydrogeologic conceptual model** of the basin based on technical studies and qualified maps that characterizes the physical components and interaction of the surface water and groundwater systems in the basin.*



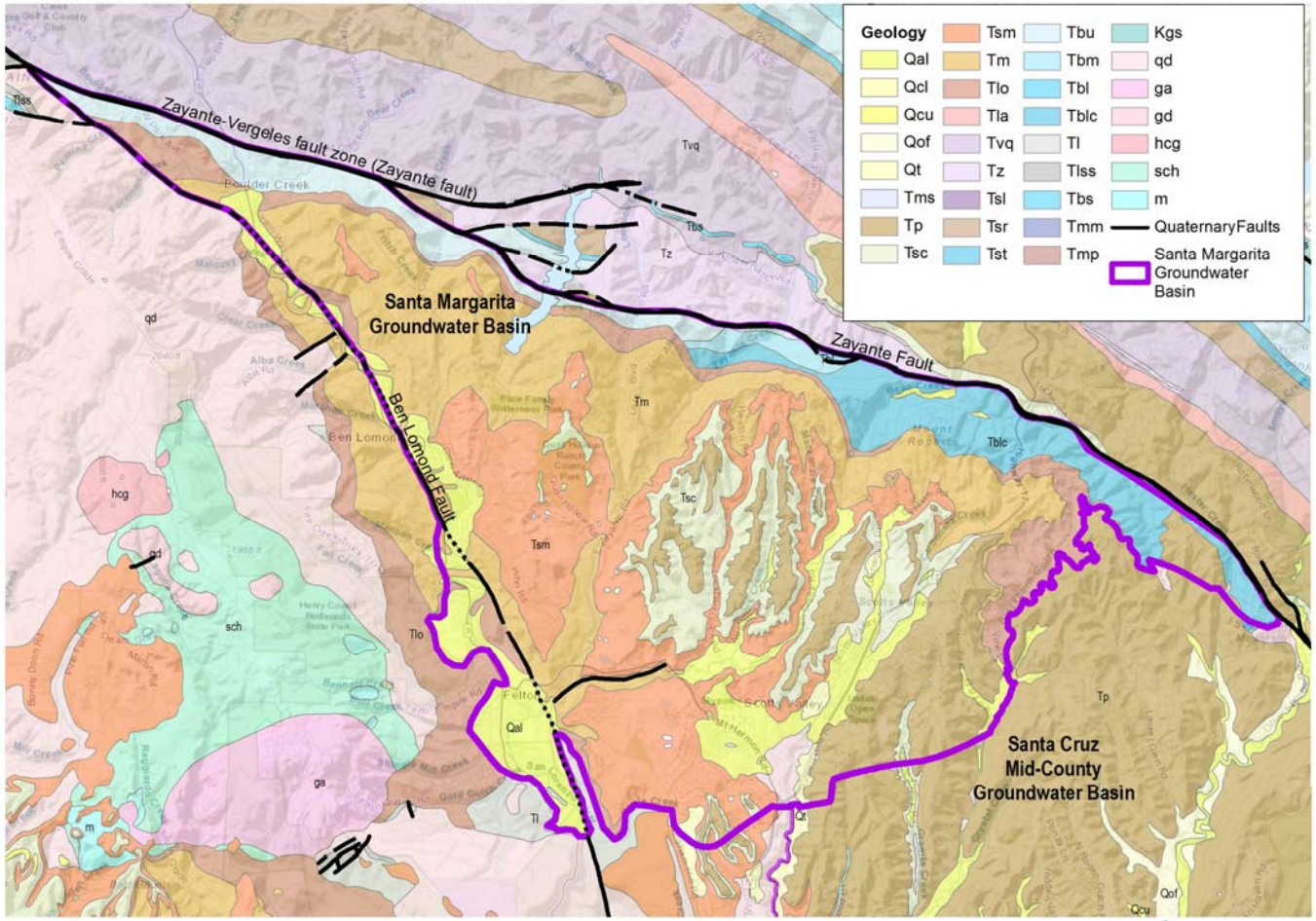
What is the HCM used for?

HCM is foundation of Groundwater Sustainability Plan

- Provide technical information in a format more easily understood to aid communication.
- Identify general water budget components.
- The basis for development and application of a quantitative model.
- Help select potential projects and management actions to achieve sustainability.
- Identify areas that are not well understood (*data gaps*).
- Inform monitoring requirements (*what needs to be measured*).
- Improve basin understanding over time.

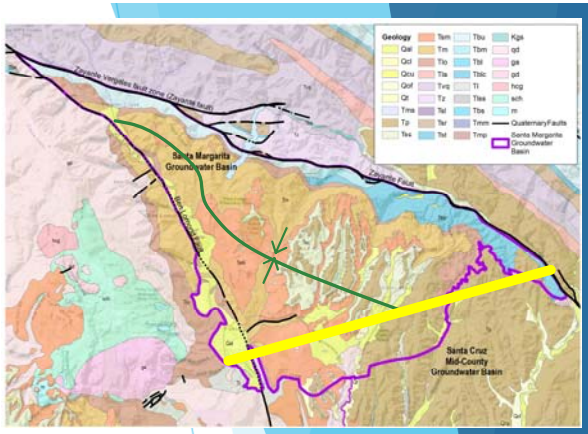
Hydrogeology of the Santa Margarita Basin

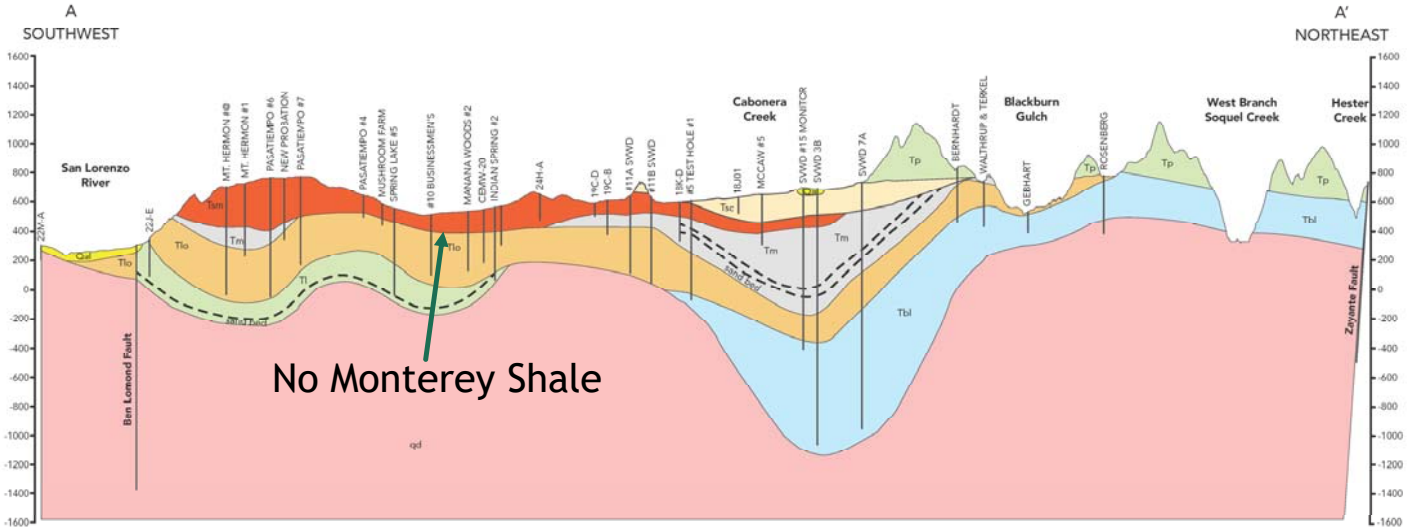
Basin Geology



Basin Geology

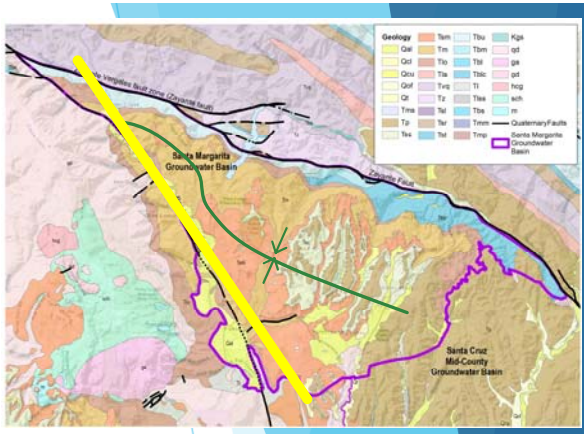
- Sequence of sandstone, siltstone, and shale folded into a geologic trough called the Scotts Valley Syncline
- Syncline bound by Ben Lomond Fault and Zayante Fault. These faults form some of the basin boundaries
- Geologically complex because of variability of layers

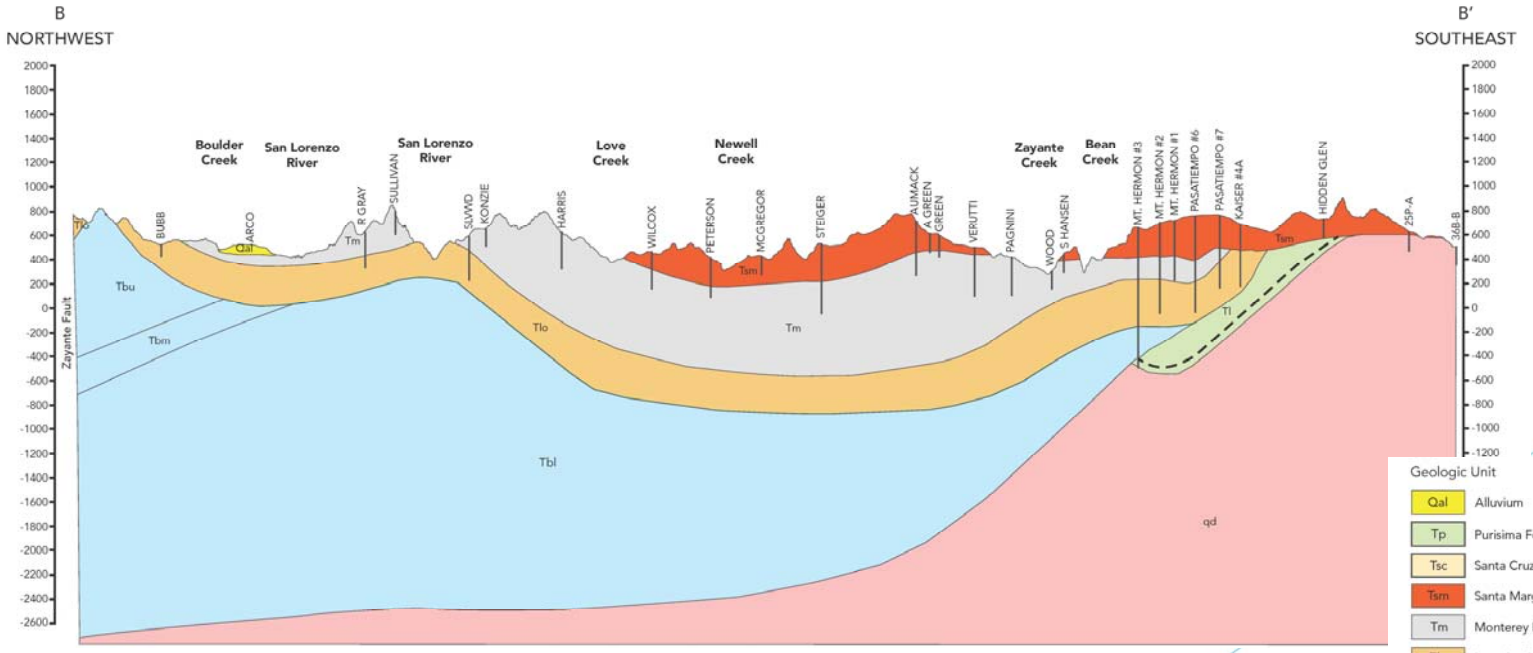




Basin Geology cont.

- Sequence of sedimentary rocks are divided into geologic formations
- Base of the basin is granitic bedrock (qd)





Geologic Unit

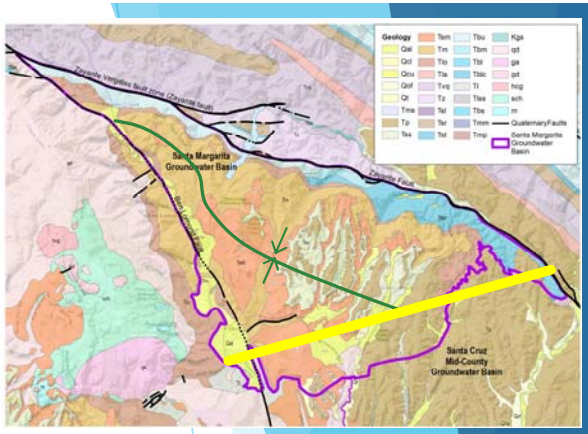
Qal	Alluvium	Tbu	Butano Formation - Upper Member
Tp	Purisima Formation	Tbm	Butano Formation - Middle Member
Tsc	Santa Cruz Mudstone	Tbl	Butano Formation - Lower Member
Tsm	Santa Margarita Sandstone	Tl	Locatelli Formation
Tm	Monterey Formation	qd	Crystalline Bedrock-Granite
Tlo	Lompico Sandstone		

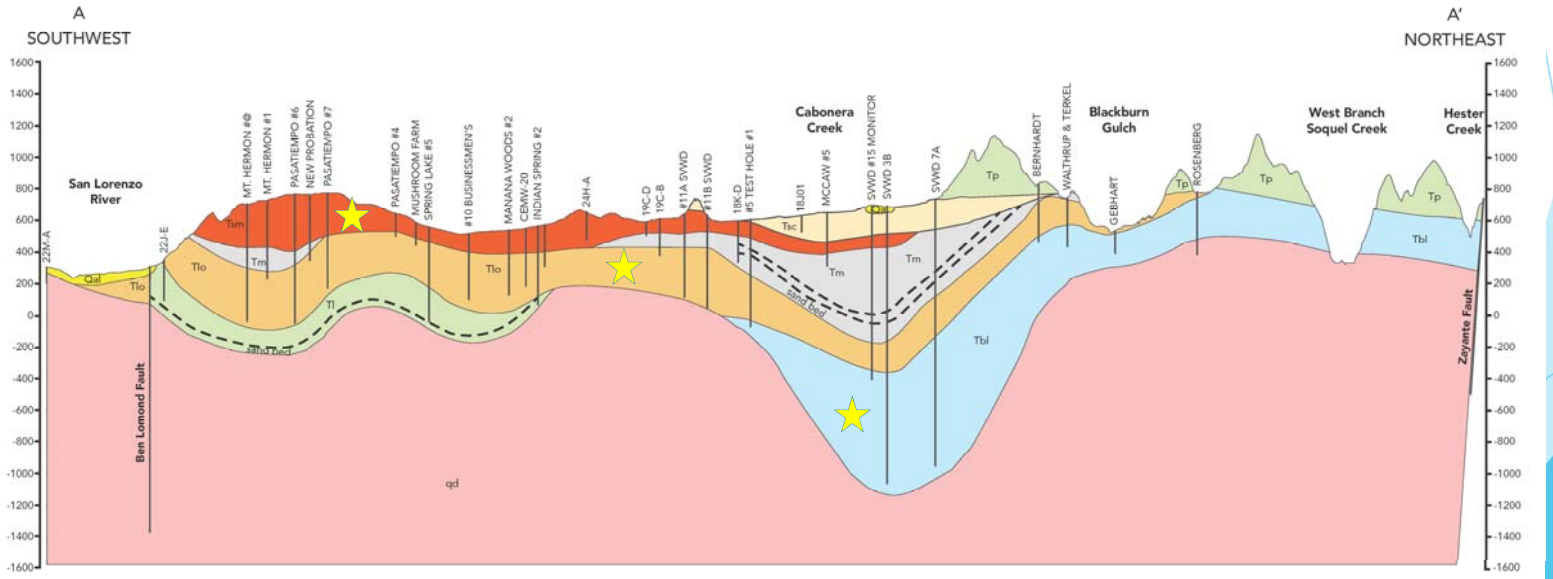
Hydrogeology

- Some geological formations yield a lot of water to wells and others much less
- The more coarse-grained the sediments the faster water can move through it and the higher yielding to wells
- Primary basin aquifers are:
  - **Santa Margarita Sandstone**
  - **Lompico Sandstone**
  - **Butano Sandstone**
- Secondary basin aquifer is the Monterey Formation (shale and sandstone)

Basin Aquifers

- ★ Santa Margarita Fm – sandstone
- Monterey Fm – shale with some sandstone
- ★ Lompico Fm – sandstone
- ★ Butano Fm – sandstone & shale
- Locatelli Fm – shale





Basin Aquifers

- ★ Santa Margarita Fm – sandstone
- ★ Monterey Fm – shale with some sandstone
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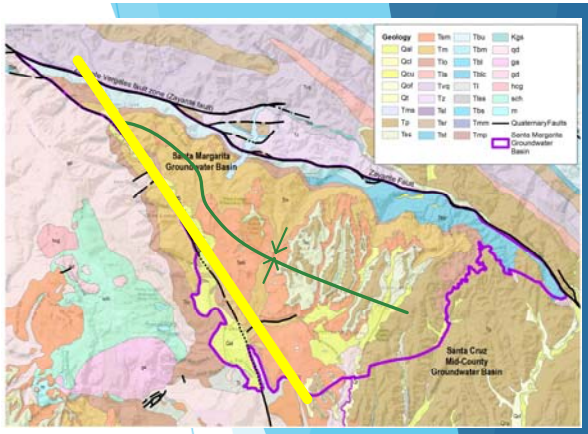
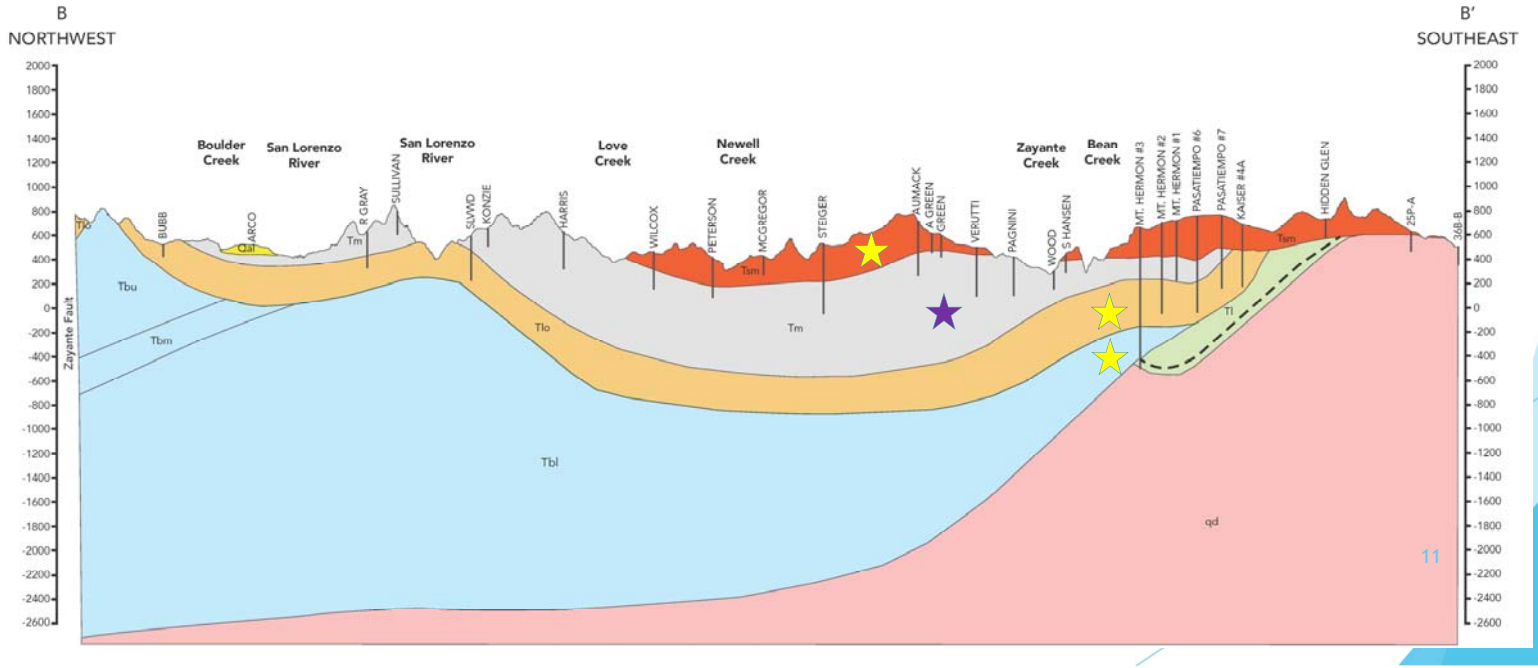
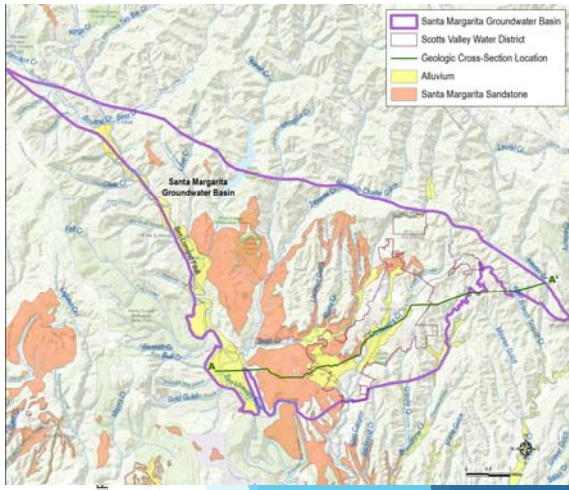
- ★ Butano Fm – sandstone & shale

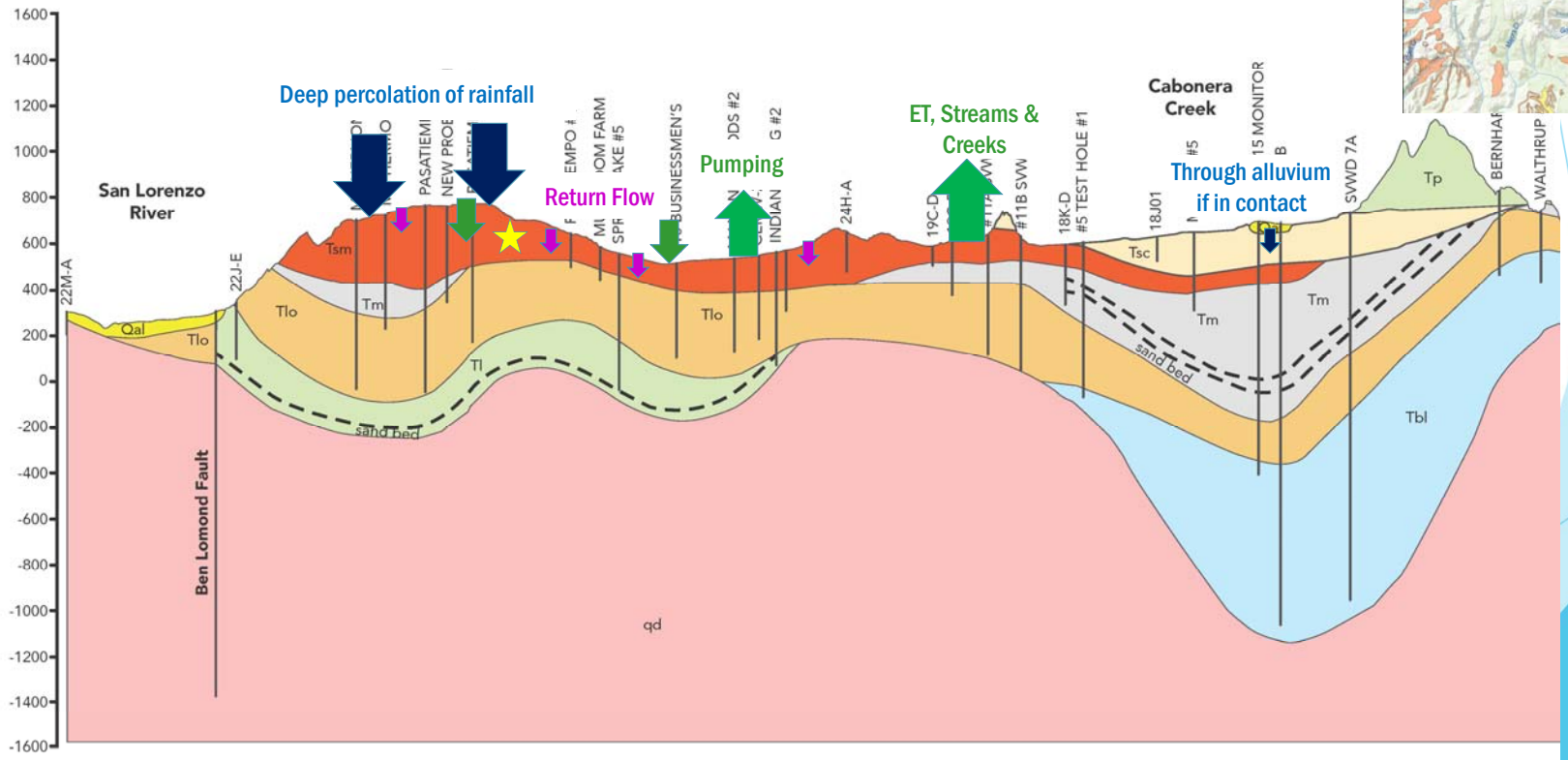
  Locatelli Fm – shale



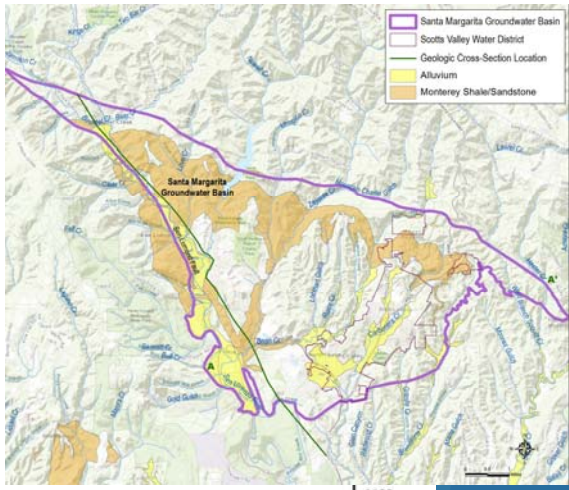


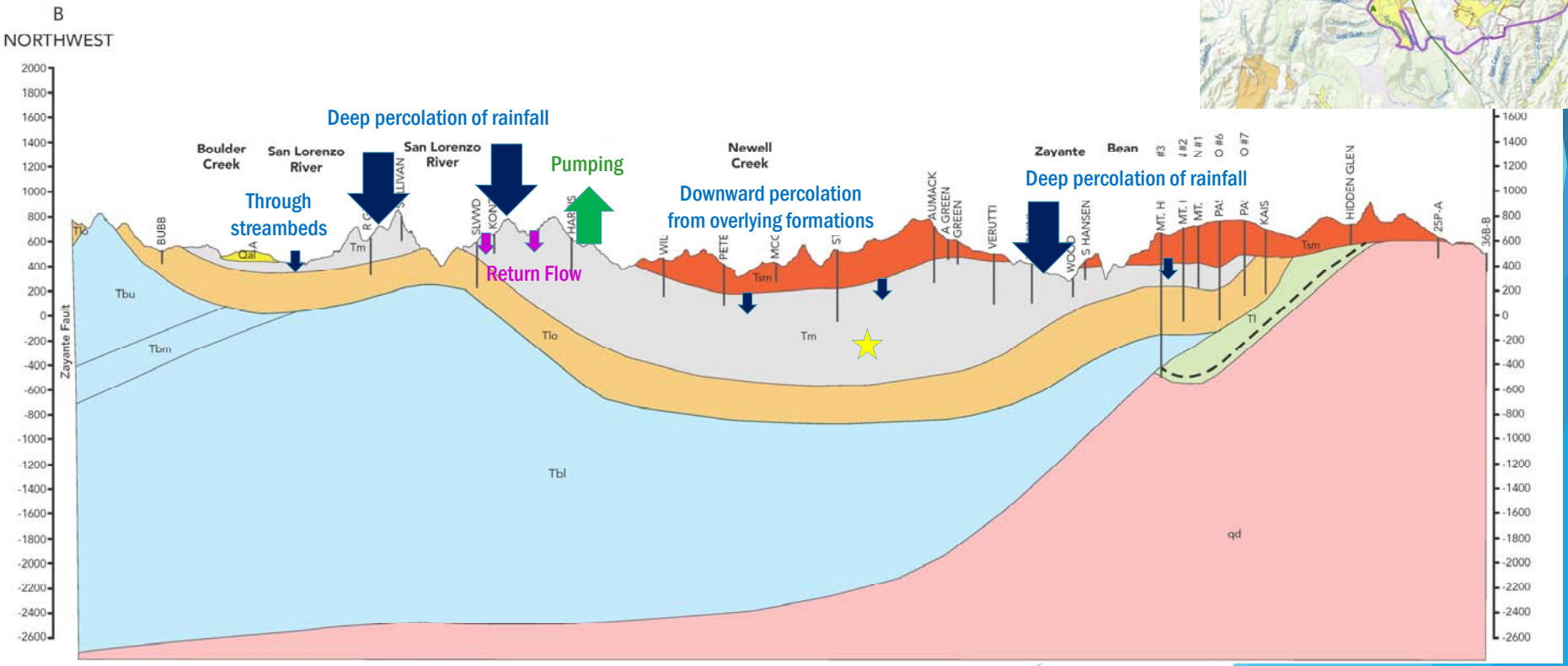
Santa Margarita Aquifer (Tsm) Recharge and Discharge



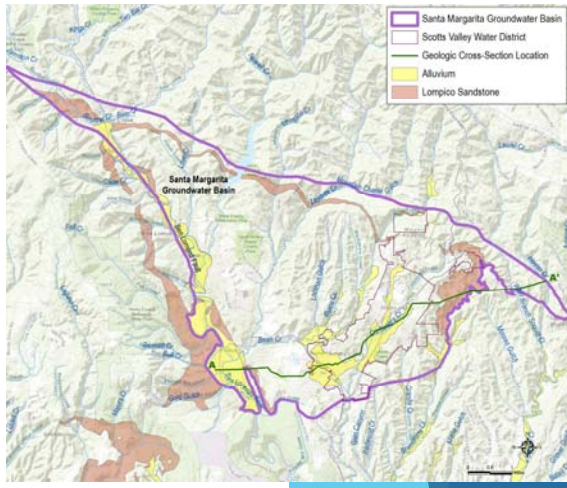


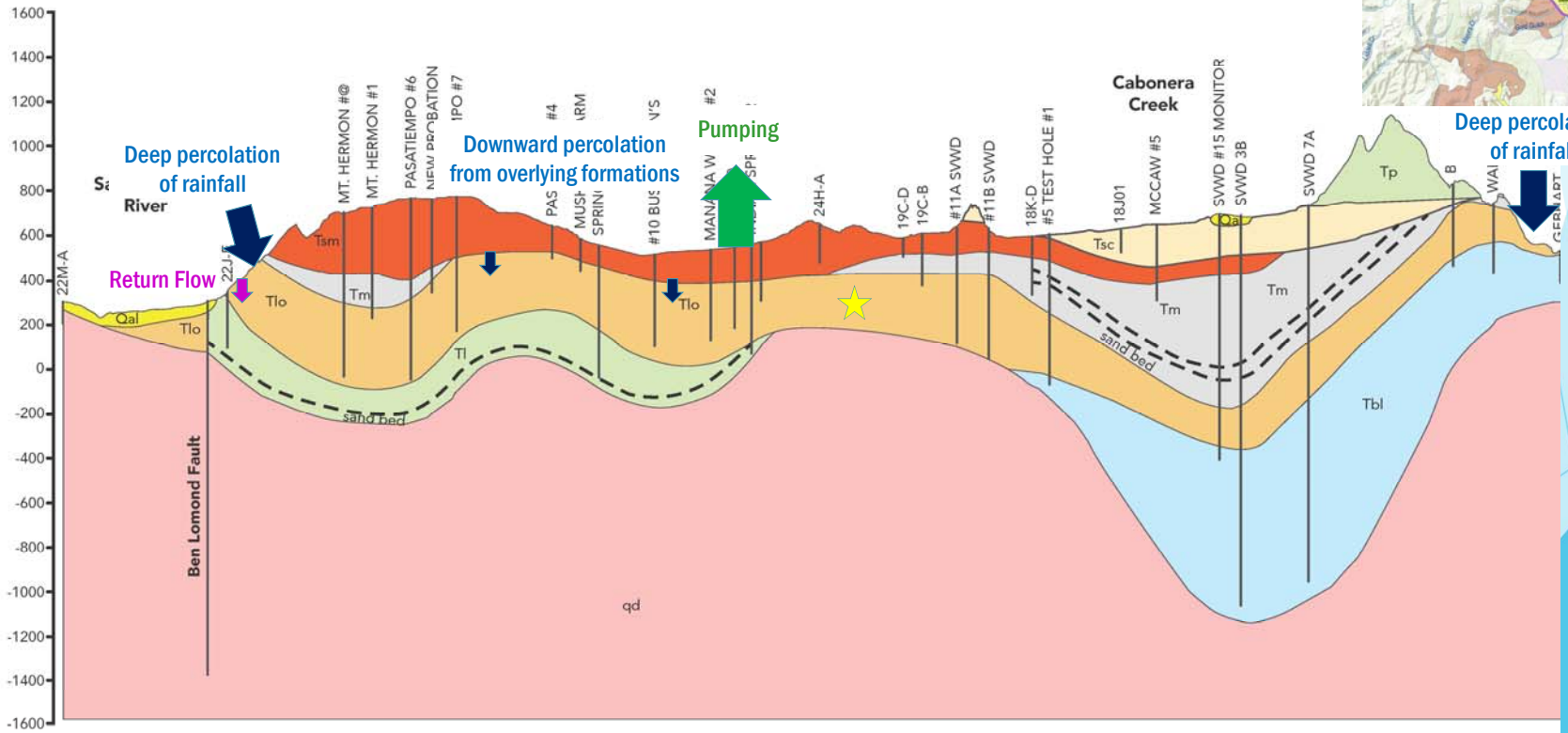
Monterey Shale & Sandstone (Tm) Recharge and Discharge



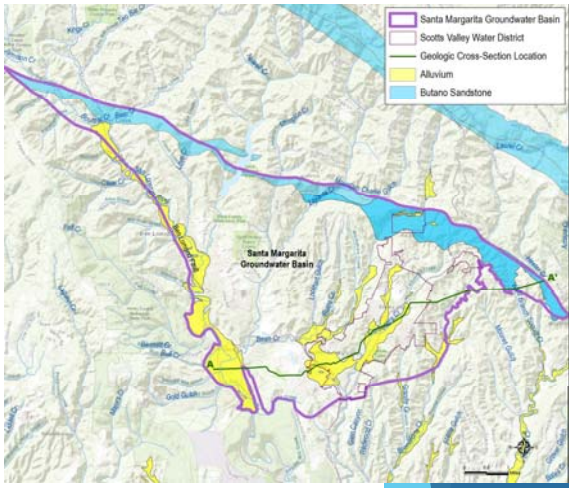


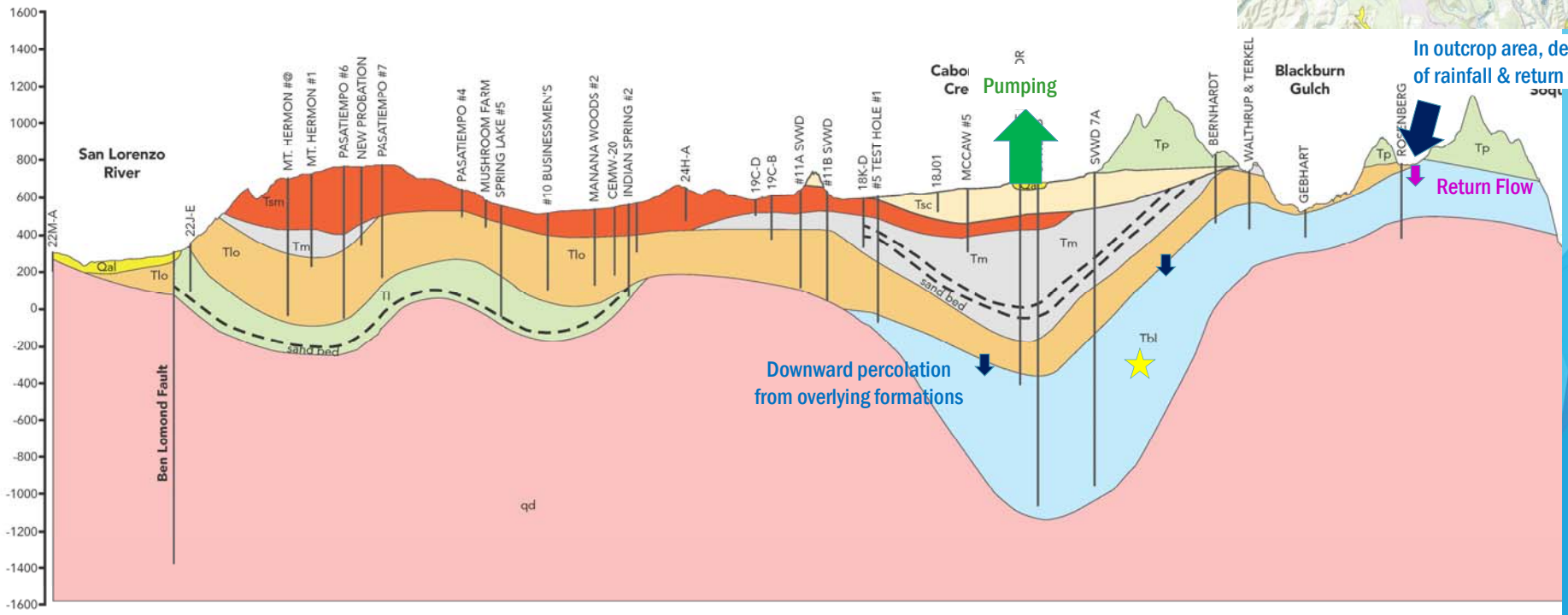
Lompico Aquifer (Tlo) Recharge and Discharge





Butano Aquifer (Tbl)
Recharge and Discharge

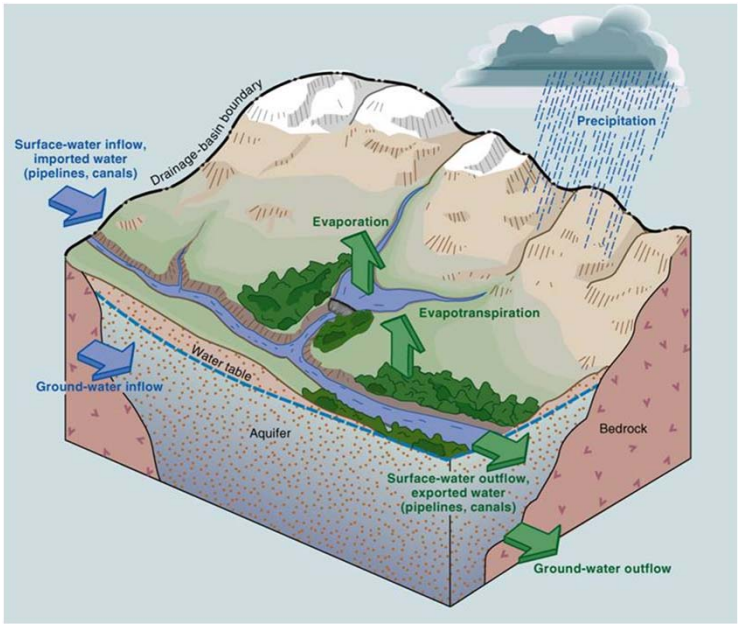




Water Budgets

- What are they?
- What are they used for?

23 CCR §354.18(a):
Each Plan shall include a water budget for the basin that provides an accounting and assessment of the total annual volume of groundwater and surface water entering and leaving the basin, including historical, current and projected water budget conditions, and the change in the volume of water stored



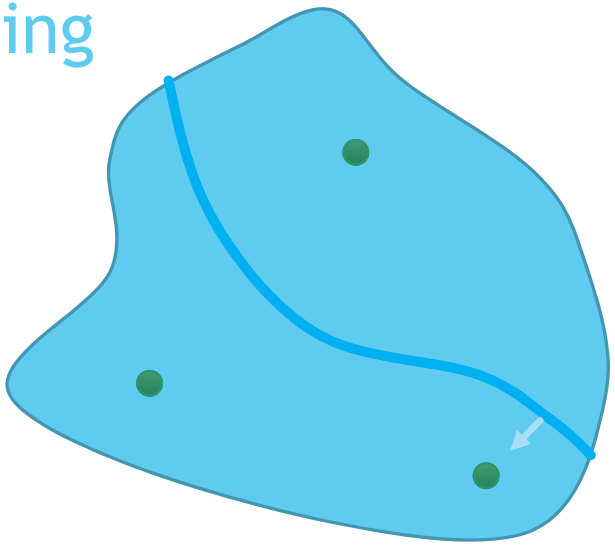
What are Water Budgets Used For?

- Usually estimated for a defined area, such as a groundwater water basin
- Based on the Hydrogeologic Conceptual Model
- Help characterize the basin
- Water budgets over different time periods can be used to assess the effects of climate variability and human activities on water resources
- Understanding of water budgets provides a foundation for effective water resource planning and management
  - Do not indicate where localized effects may be from pumping or other management actions
  - Cannot manage a basin purely based on the water budget

Localized Effects of Pumping

Same pumping

Bigger impact on stream



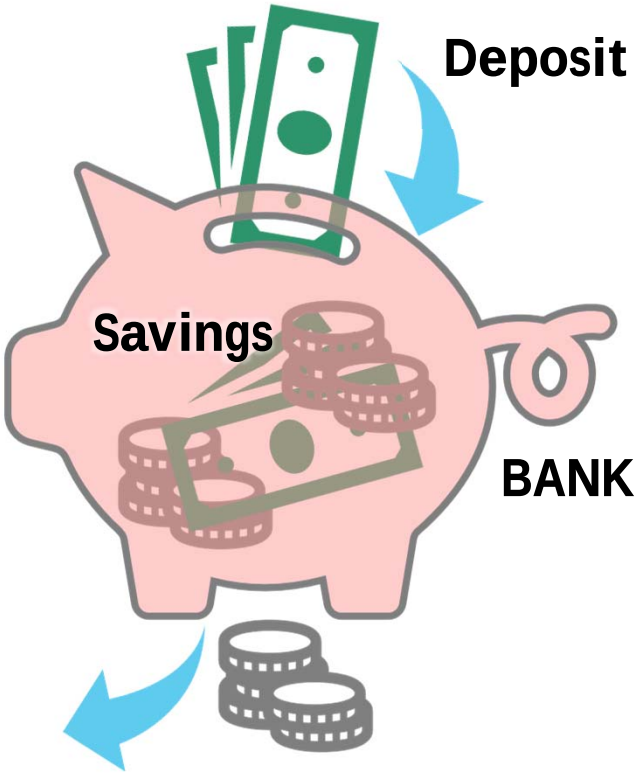
Lesser impact on stream

Preliminary Santa Margarita Basin Water Budget

Groundwater Storage

- "Water Savings Account"

Change in Savings ≈ **Change in groundwater storage**



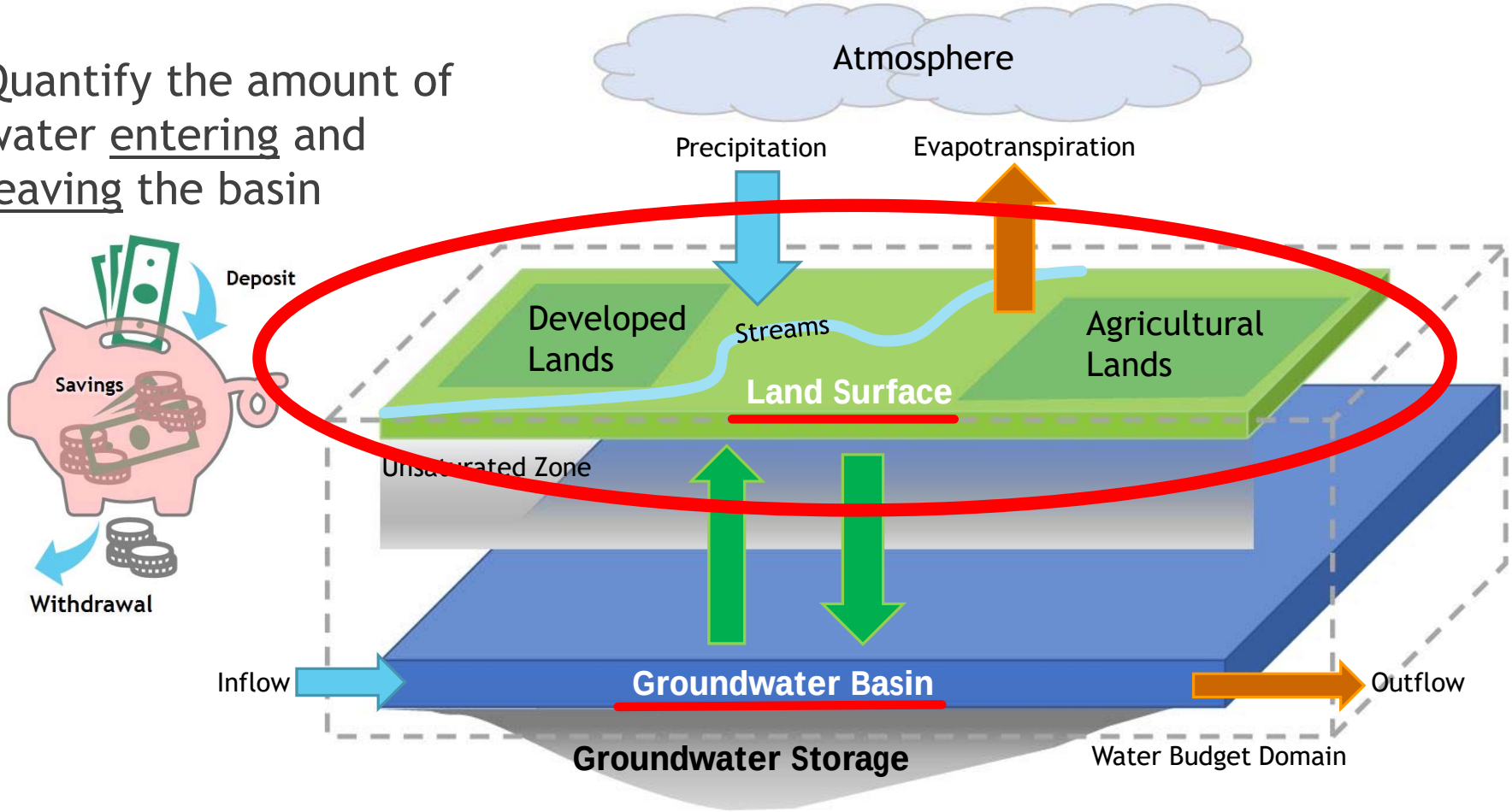
Deposit = Water Inflow

BANK = AQUIFER

Withdrawal = Water Outflow

Water Budgets

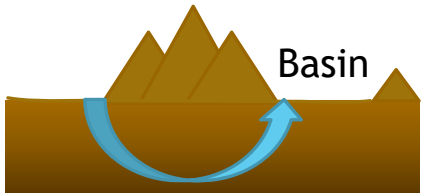
Quantify the amount of water entering and leaving the basin



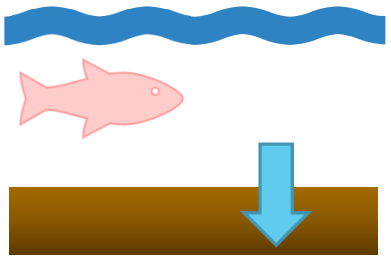
Inflows to Groundwater

Recharge

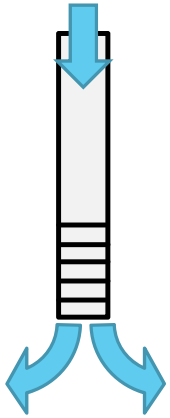
Groundwater inflow



Leakage from surface water



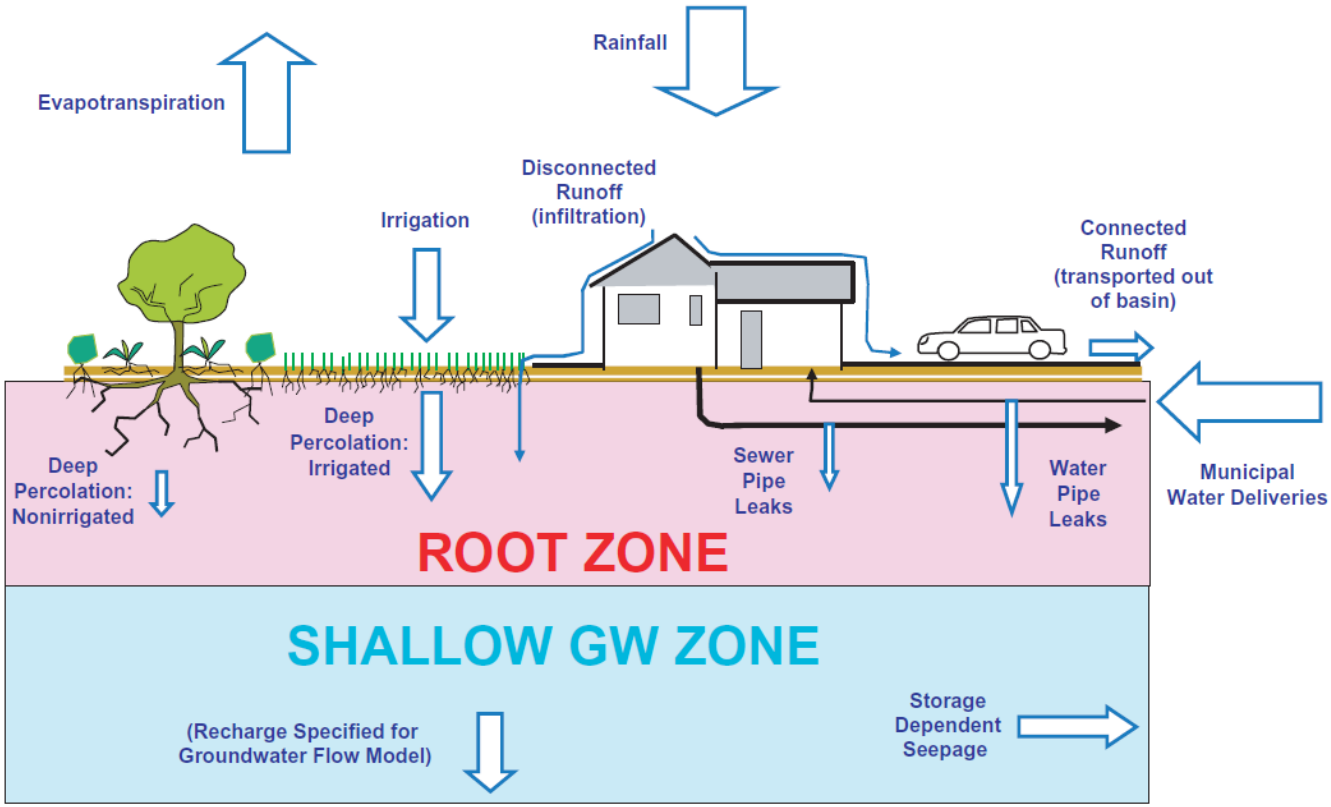
Intentional Recharge



Recharge calculated from soil zone water budget ~ **9,000 AFY** 1985-2012 Average

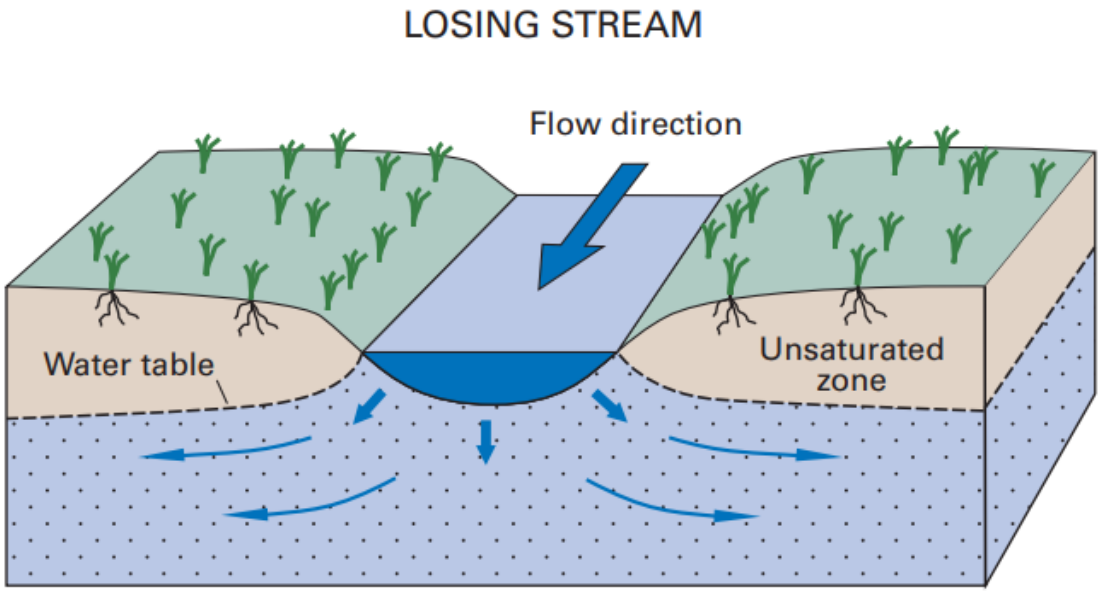
Deep Percolation of

- Rainfall
- Irrigation
- Leaky pipes
- Septic systems

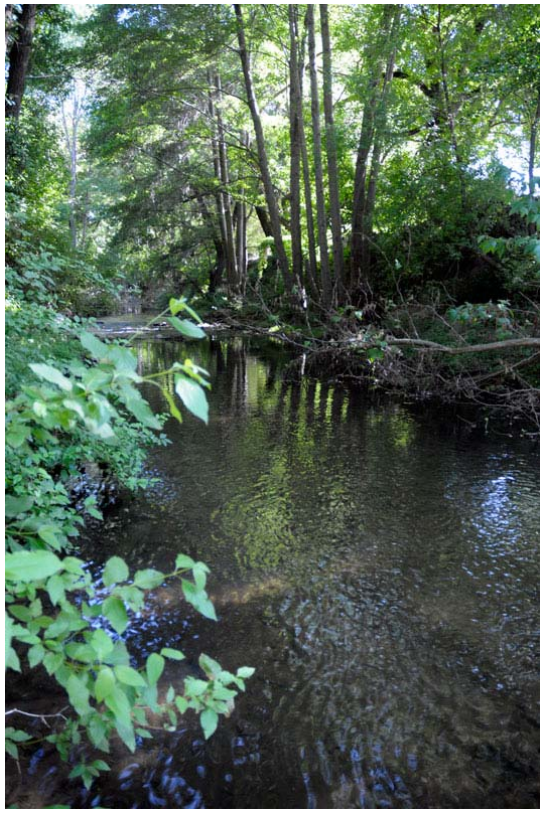


Leakage from surface water ~ **6,000 AFY**

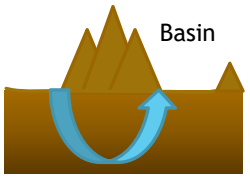
1985-2012 Average



Source: USGS Circular 1308, 2007

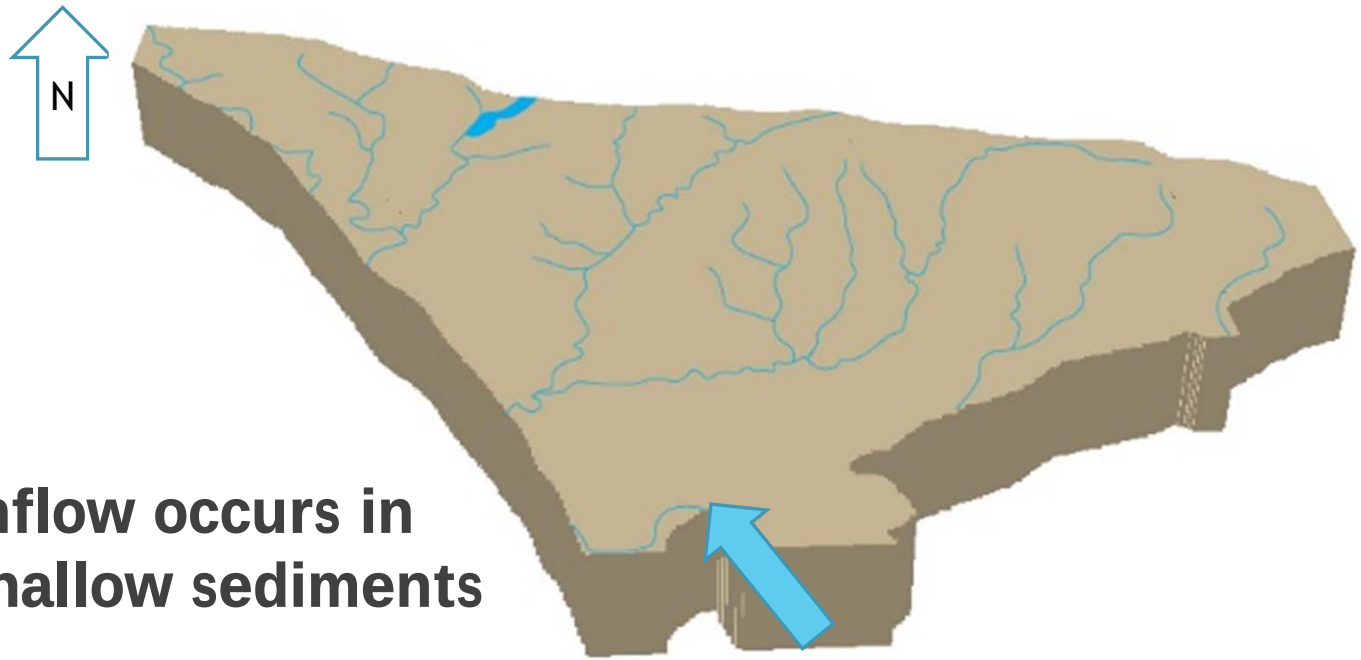


Source: localwiki.org/santacruz/Zayante_Creek

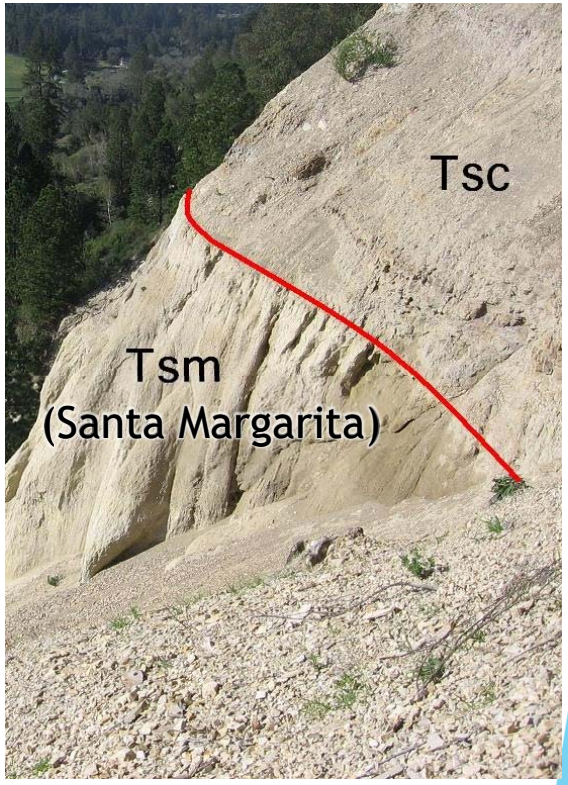


Groundwater Inflow: ~100 AFY

1985-2012 Average



Inflow occurs in shallow sediments



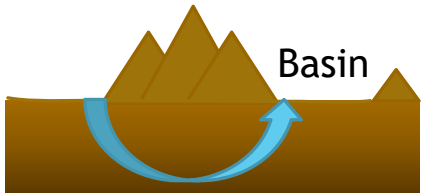
Source: sites.google.com/site/boessepaleo/field-experience/santa-margarita-sandstone-fieldwork--ca

Inflows to Groundwater ~**15,100 AFY**

1985-2012 Average

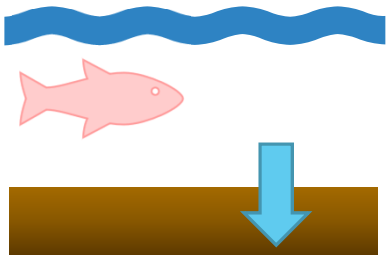
Recharge
9,000

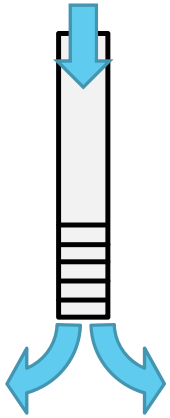
Groundwater inflow
~100



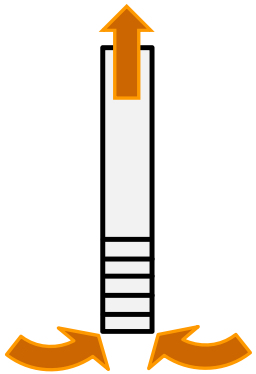
Leakage from surface water
6,000

Intentional Recharge
~0



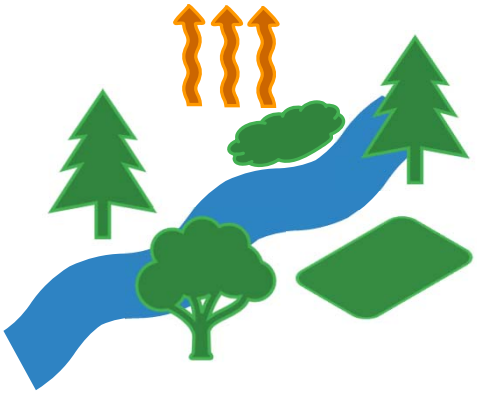


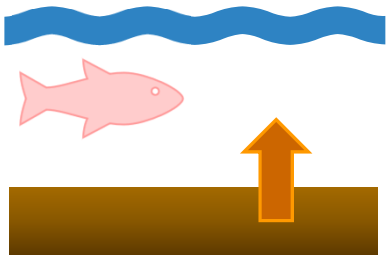
Outflows from Groundwater



Well pumping

Evapo-transpiration



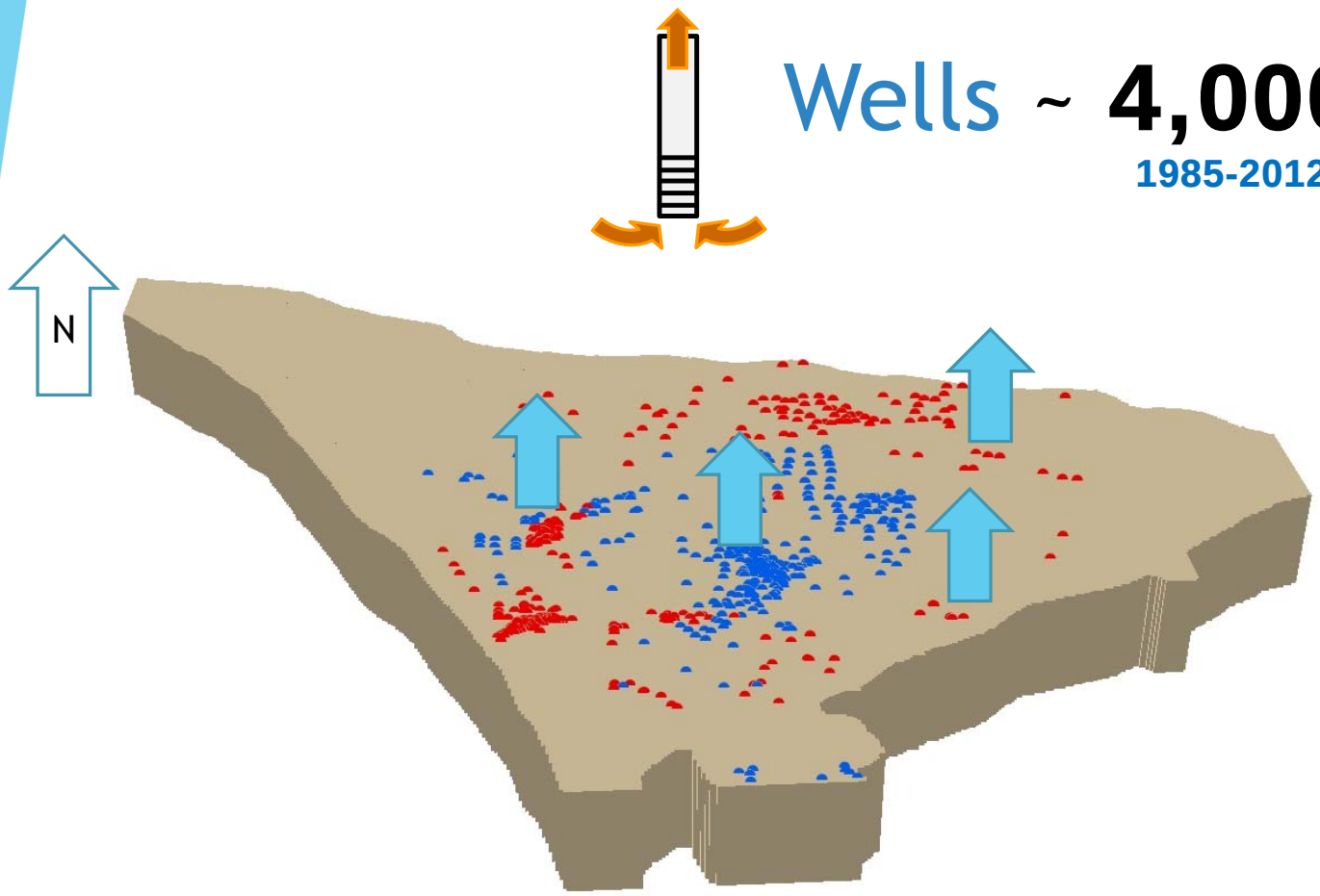


Seepage to Streams & Springs

Groundwater outflow

Wells ~ 4,000 AFY

1985-2012 Average

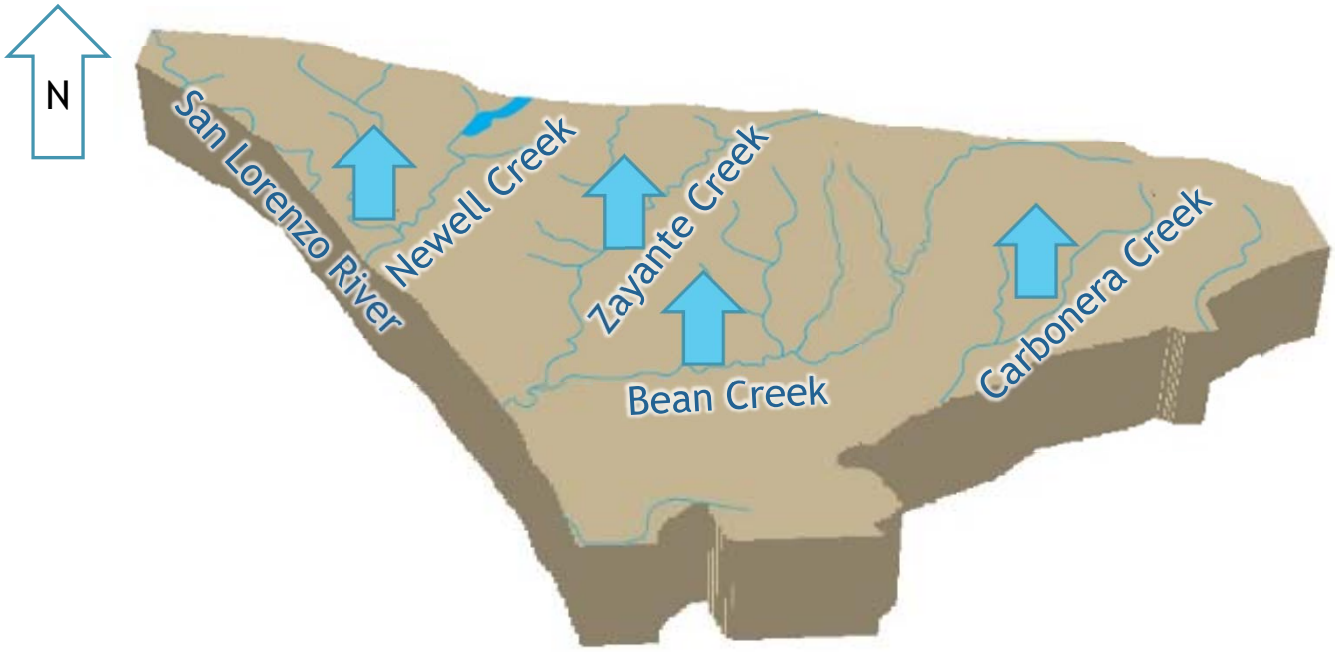


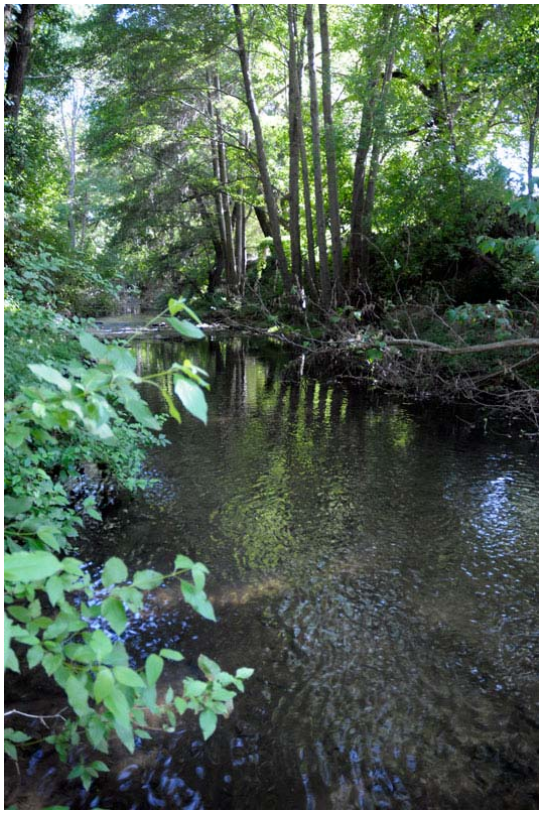
Source: www.goldenstatenewspapers.com/press_banner/updates-on-new-well-in-scotts-valley/article_c995f8e2-0cfb-11e8-bfba-f31f492b6c9b.html

- Shallow wells (Santa Margarita)
- Deep wells (Monterey, Lompico, Butano, Locatelli)

Seepage to Streams & Springs: ~11,000 AFY

1985-2012 Average

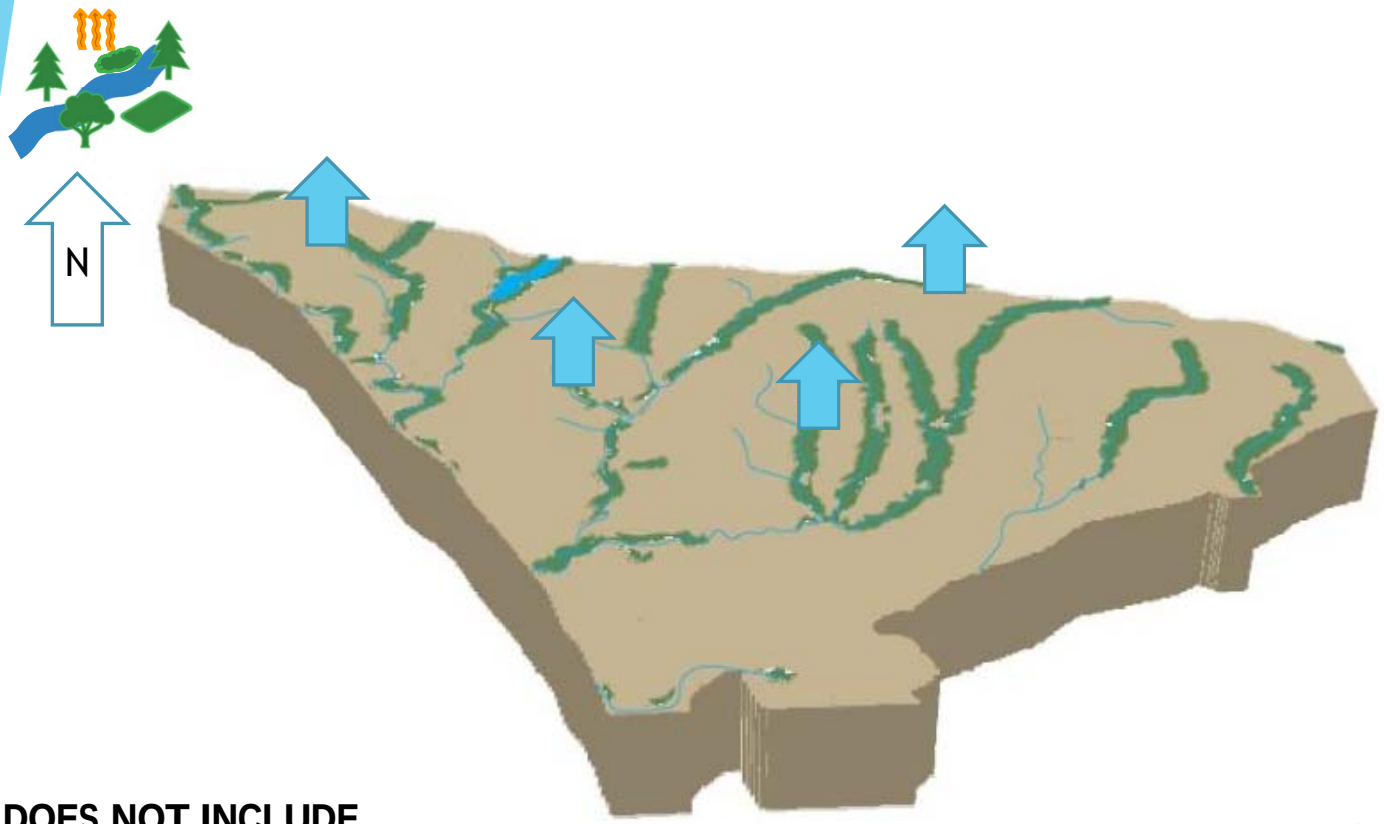




Source: localwiki.org/santacruz/Zayante_Creek

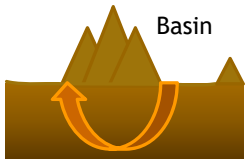
Evapotranspiration of Groundwater ~ 1,000 AFY*

1985-2012 Average



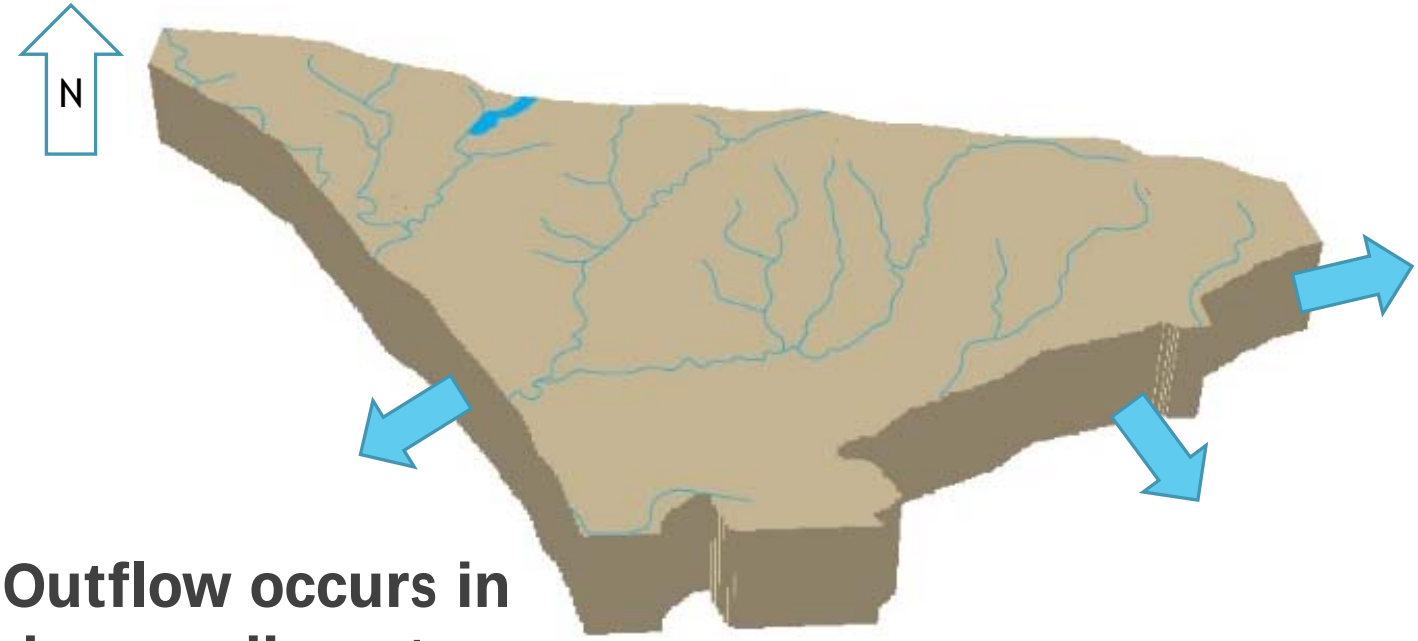
Source: SMGWA, https://smgwa.org/agency/about/

*** DOES NOT INCLUDE EVAPOTRANSPIRATION OF SOIL WATER**



Groundwater Outflow~200 AFY

1985-2012 Average

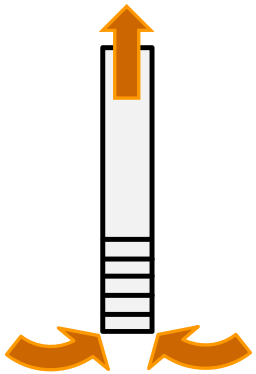


Source: California Geology, 1990, 43(11): 241 -264

Outflow occurs in deep sediments

Outflows from Groundwater ~ 16,200 AFY

1985-2012 Average

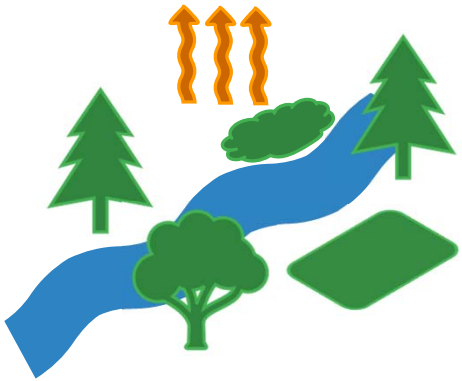


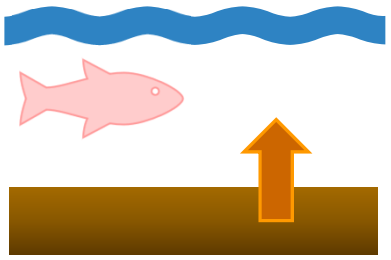
Well pumping

4,000

Evapo-transpiration of Groundwater

1,000





Seepage to Streams & Springs

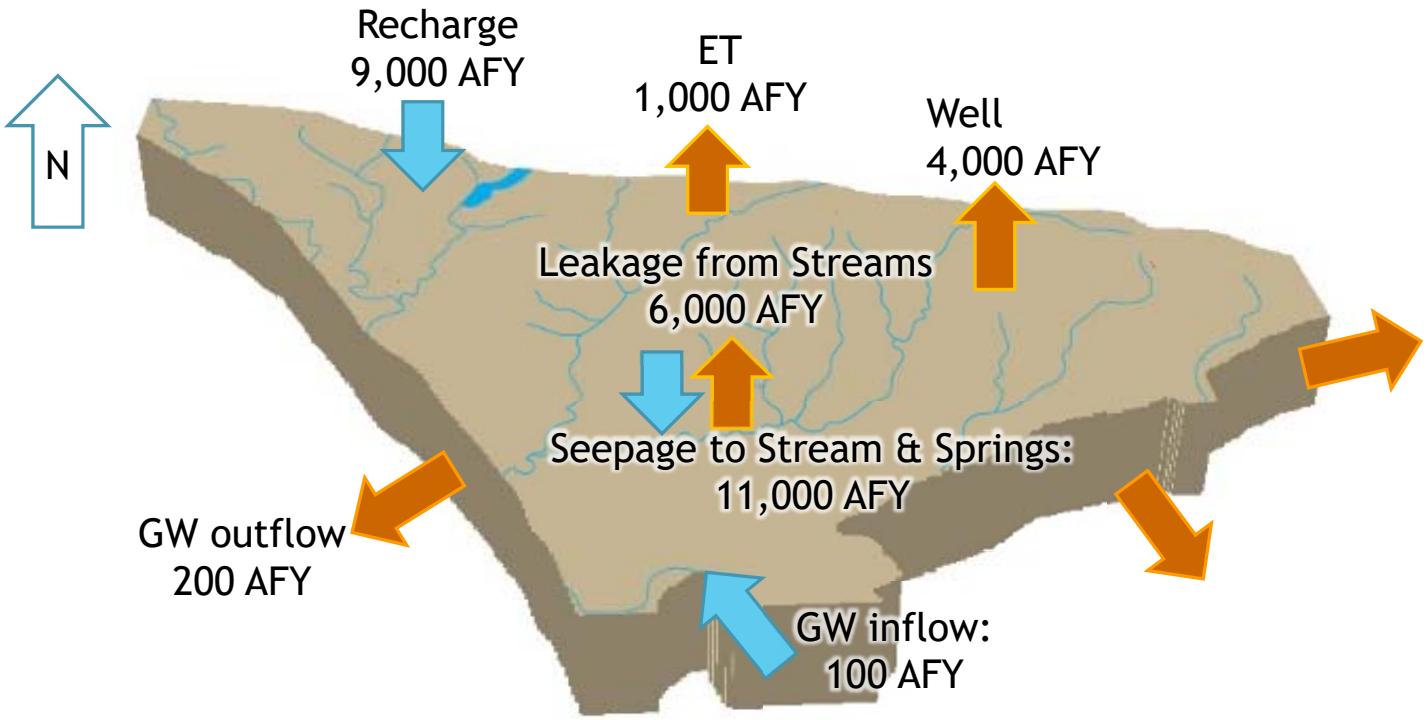
11,000

Groundwater outflow

200

Account Balance = **-1,100 AFY**

1985-2012 Average



IN – OUT = 15,100 – 16,200 = -1,100 AFY

Annual Groundwater Storage Change