

Background on Basin Setting Components of a Groundwater Sustainability Plan

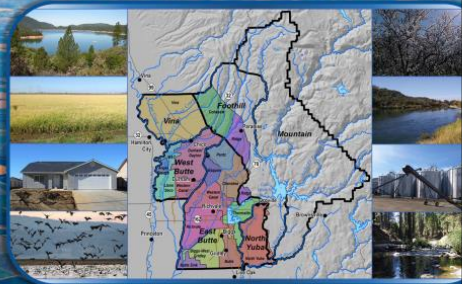
Christina Buck, PhD

Assistant Director

Butte County Water & Resource Conservation

Butte Advisory Board: February 27, 2020





Department of Water and Resource Conservation

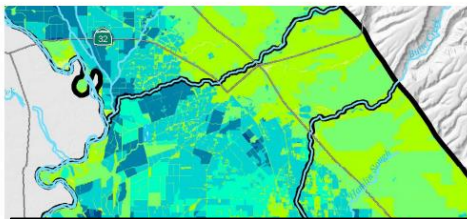


Monitoring & Special Studies



Butte County
Evaluation of Restoration and Recharge
Within the Butte County Groundwater Basins

January 2018

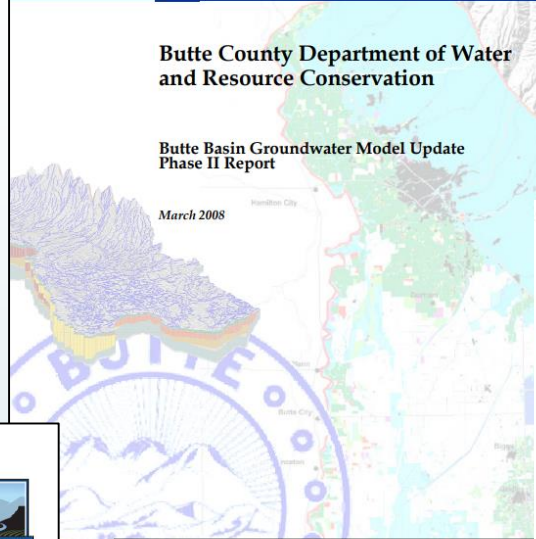


CDM

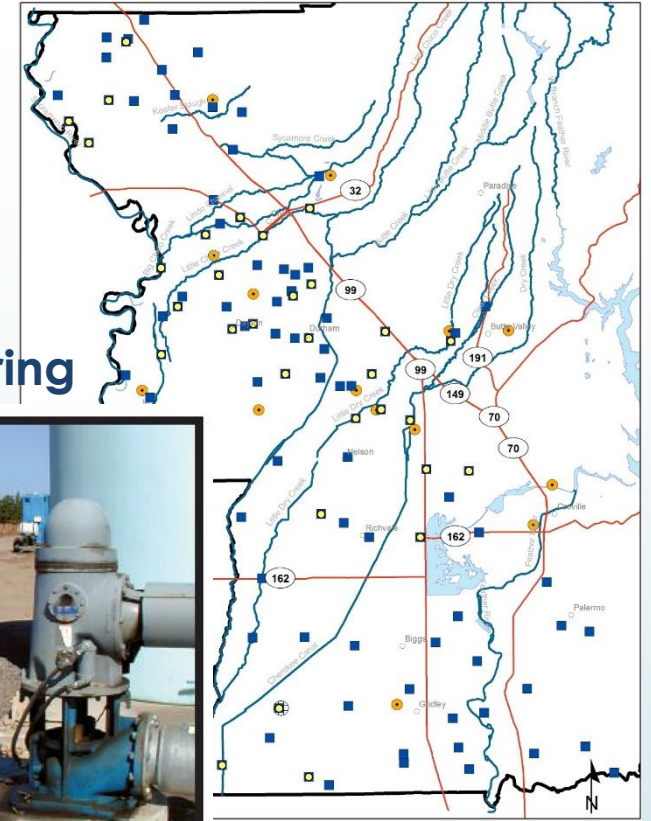
Butte County Department of Water and Resource Conservation

Butte Basin Groundwater Model Update
Phase II Report

March 2008



Monitoring



Prepared for County of Butte

September 30, 2017 | FINAL REPORT

Stable Isotope Recharge Study Final Report



Butte County Department of Water and Resource Conservation

Groundwater Status Report

2018 Water Year



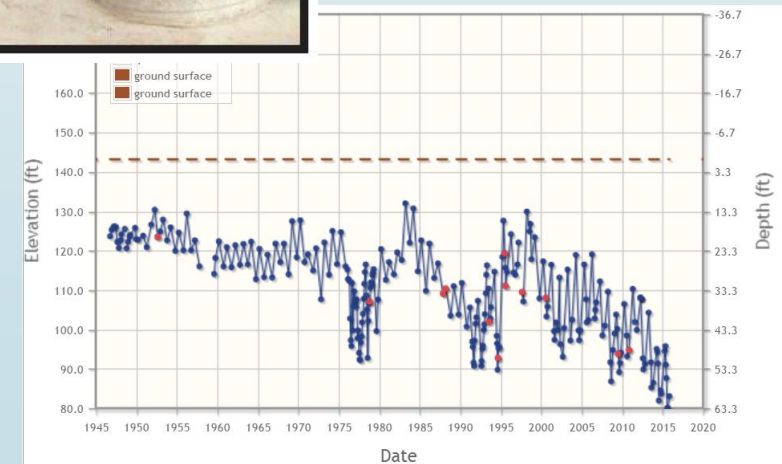
Tuscan Aquifer INVESTIGATION
May 21, 2013

Lower Tuscan Aquifer Monitoring, Recharge, and Data Management Project



Brown Caldwell

Project funded under the California Water Security, Clean Water Drinking Water, Control and Basin Protection Fund of 2002, administered by the State of California, Department of Water Resources.



Basin Setting Project- Technical Foundation

Groundwater Sustainability Plan (GSP)

➤ 1. Administrative Information

➤ 2. Basin Setting

- Hydrogeologic Conceptual Model
- Groundwater Conditions
- Water Budget
- Management Areas

➤ 3. Sustainable Management Criteria

- Sustainability Goal
- Undesirable Results
- Minimum Thresholds
- Measurable Objectives

➤ 4. Monitoring Networks

- Monitoring Network
- Representative Monitoring
- Assessment & Improvement
- Reporting Monitoring Data

➤ 5. Projects and Management Actions

**ONE project for
All THREE Subbasins**

Hydrogeologic Conceptual Model (HCM)

4

Regulations require

1. Narrative
2. Graphical Representation

To provide an overview of:

1. Physical basin characteristics
2. Uses of groundwater
3. Sets the stage for the basin setting

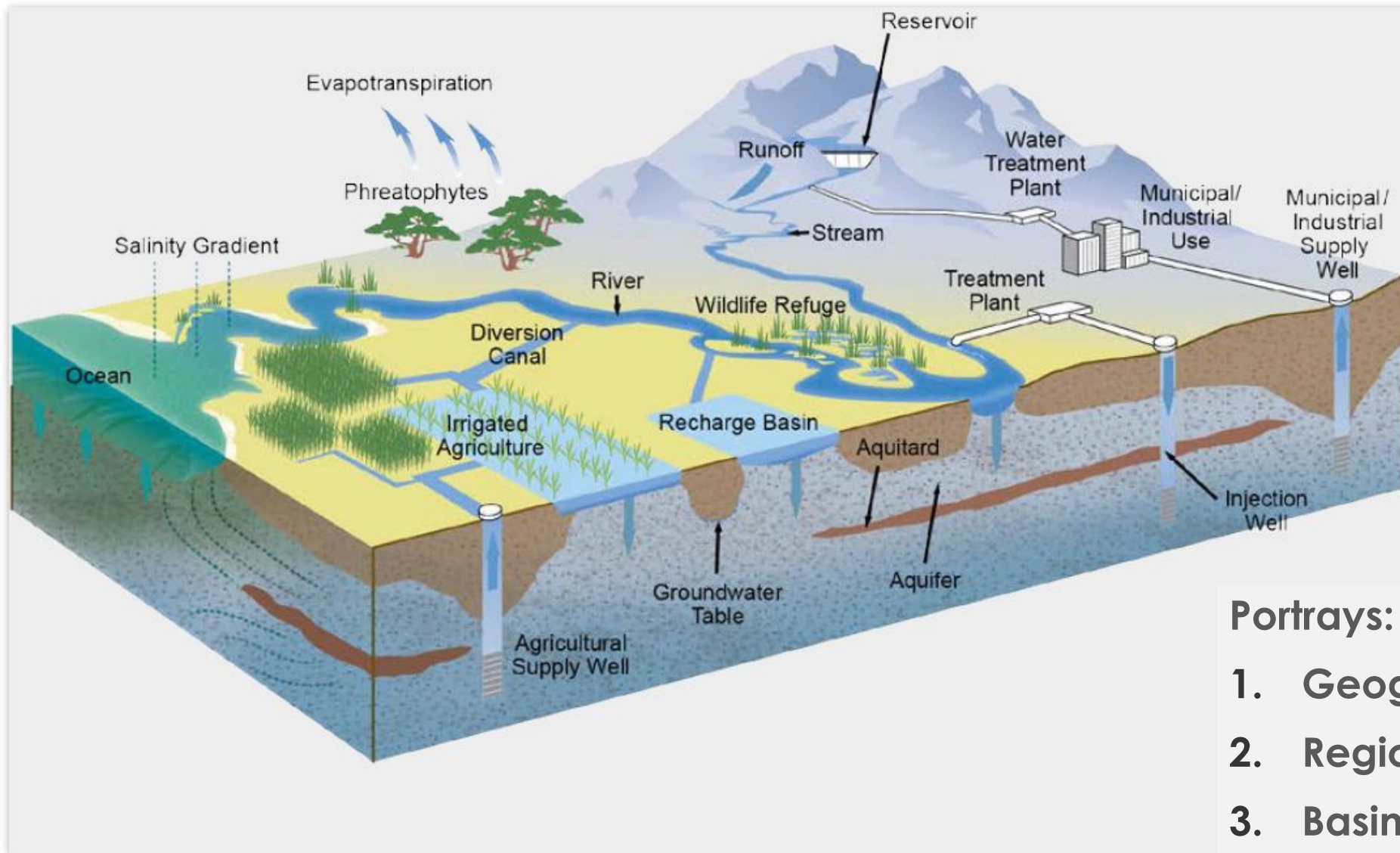


Figure 1 – Example 3-D Graphic Representing a HCM

Portrays:

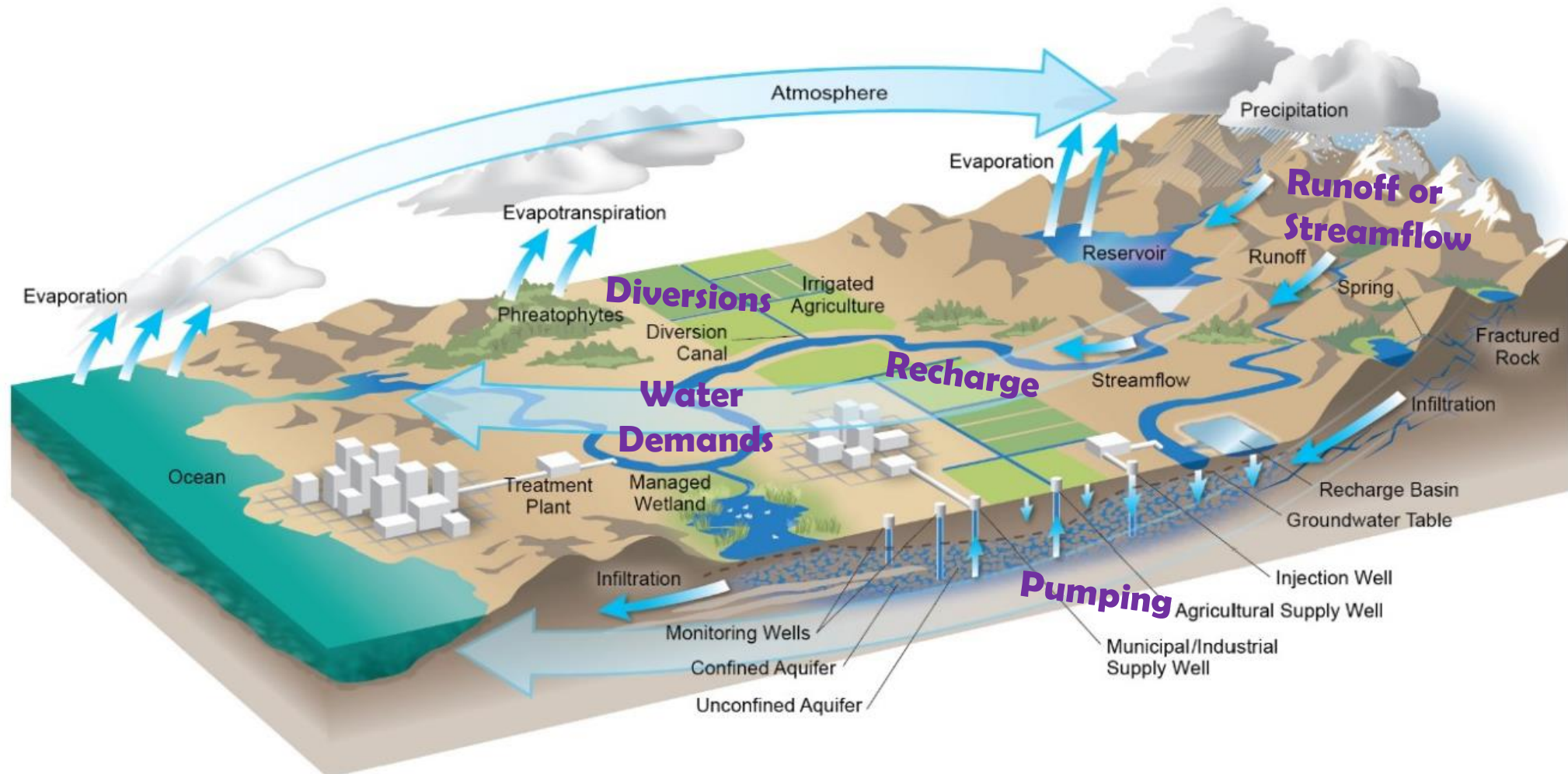
1. Geographic setting
2. Regional geology
3. Basin geometry
4. General water quality
5. Water uses



6

Water Budgets

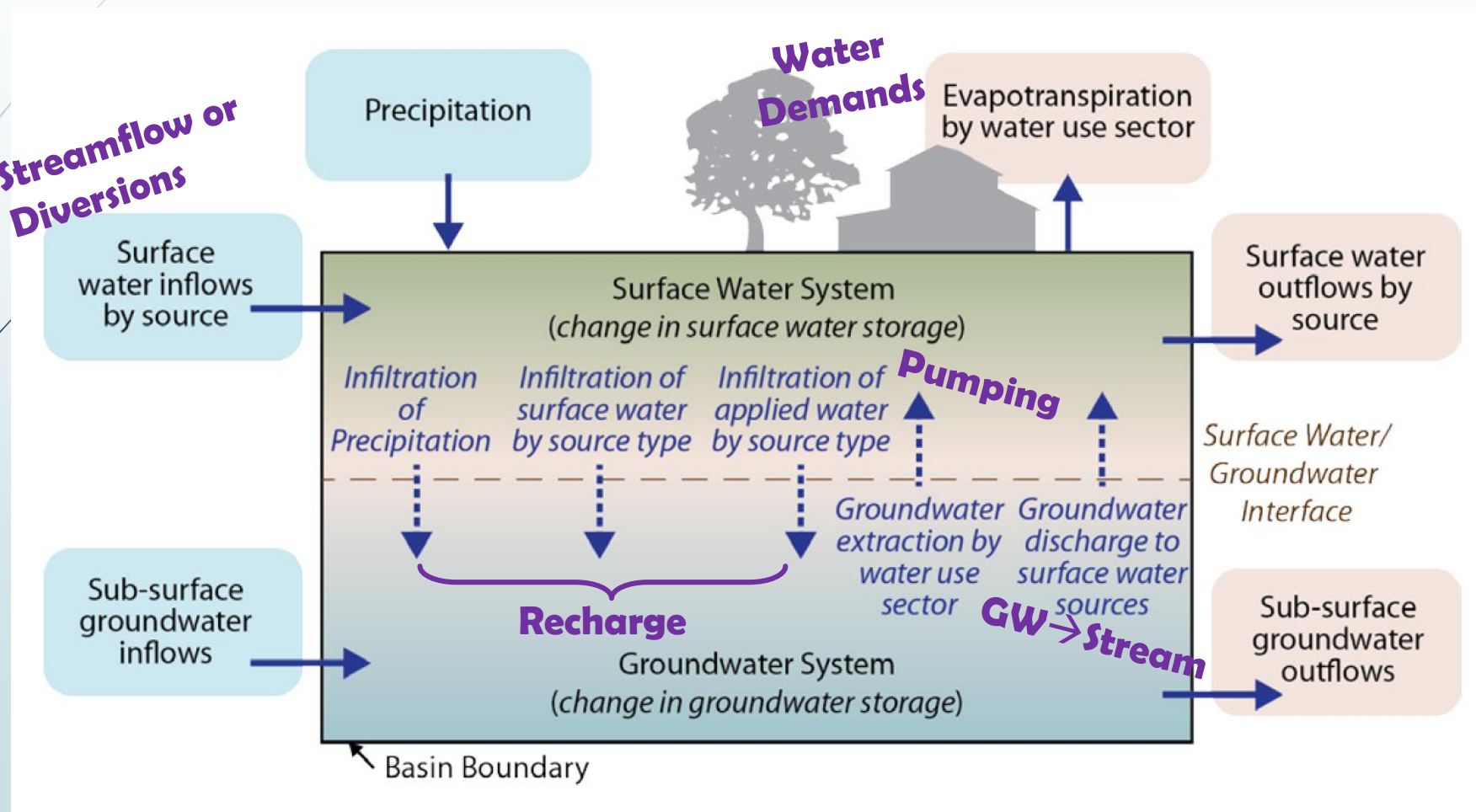
Add numbers to the narrative



Water Budget: Balance of Inflows and Outflows

Three Interacting Systems

1. Surface Water System
2. Land System
3. Groundwater System



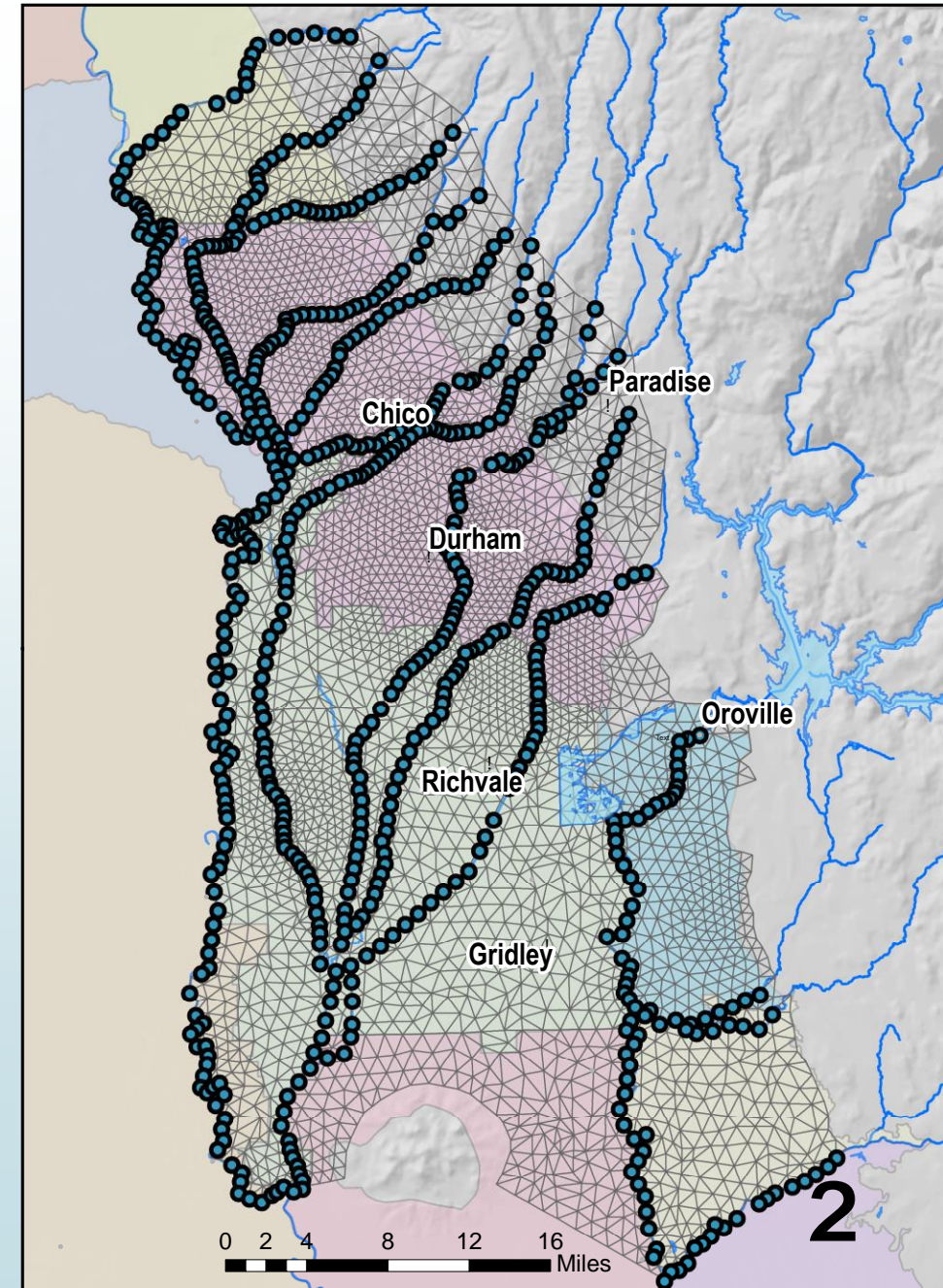
Required Water Budget components

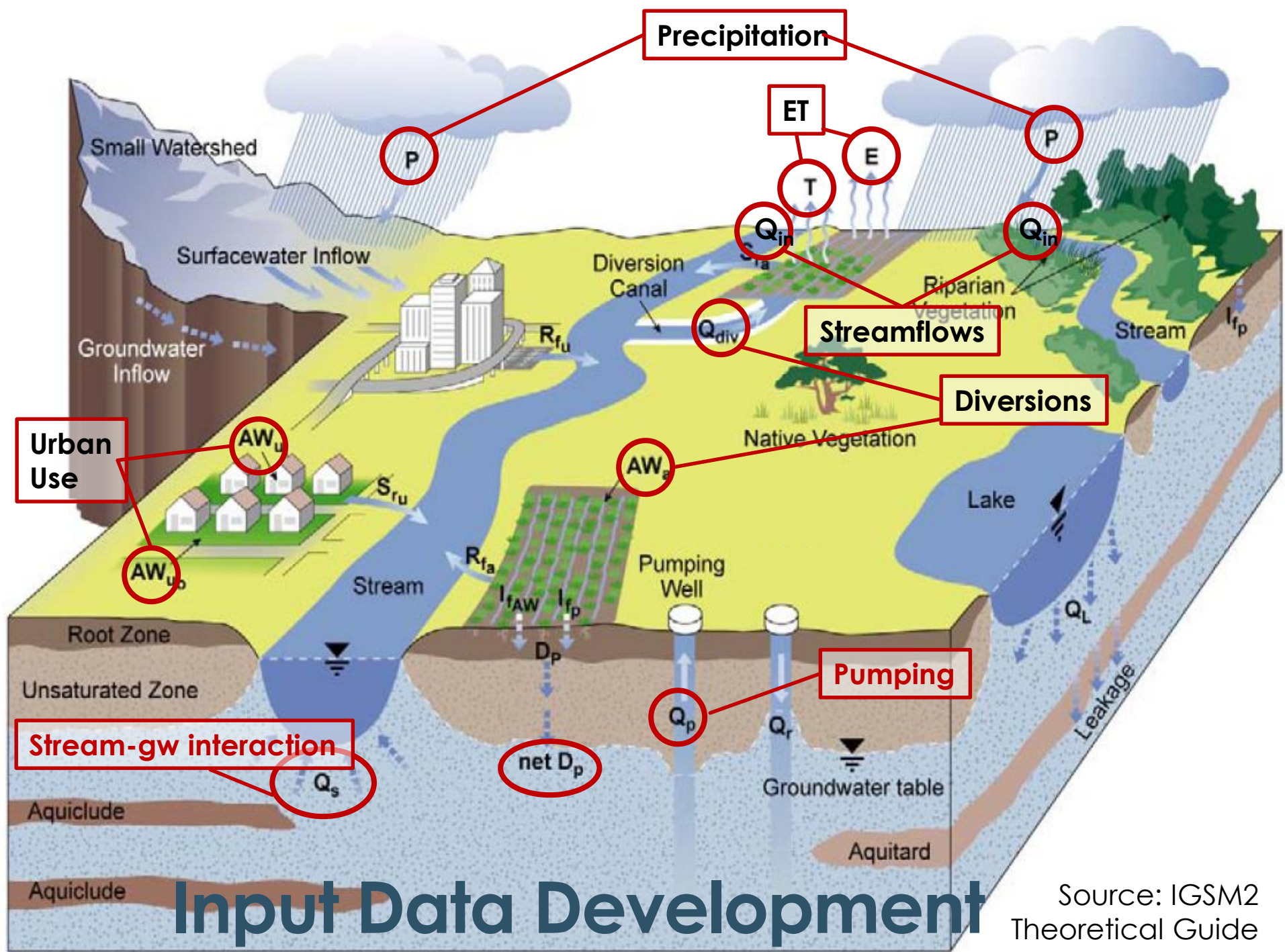
“Numerical” vs. “Conceptual” Model

Butte Basin Groundwater Model

Butte Basin Groundwater Model (BBGM)

- Chosen to support Basin Setting GSP development
- Covers the extent of the three subbasins and beyond
- Integrated Hydrologic Model meaning it includes things that happen above and below ground: All Three Systems
- Number cruncher over time and space
- Pulls together different types of data and hydrologic processes that all interact
- Used to estimate water budget numbers



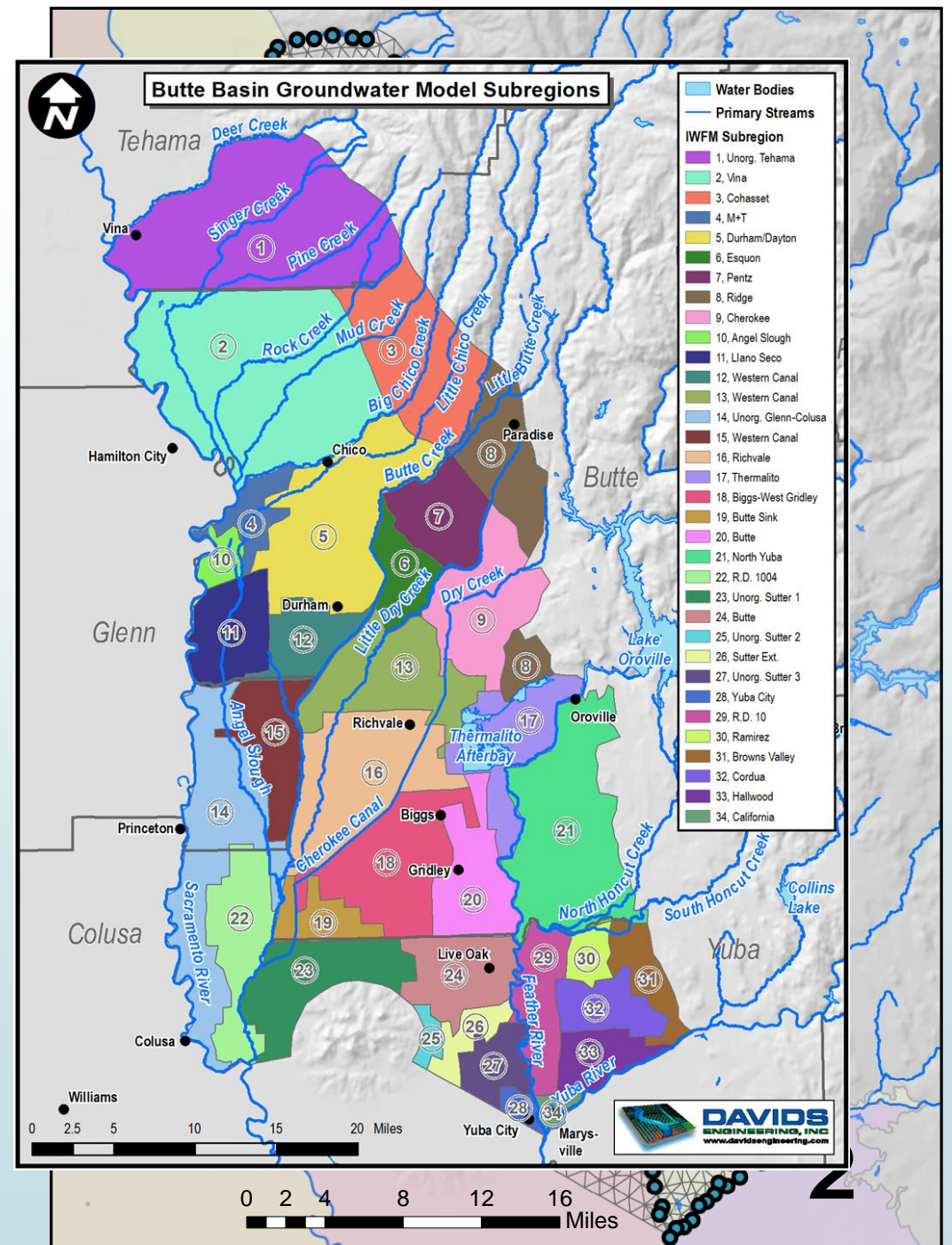


Input Data Development

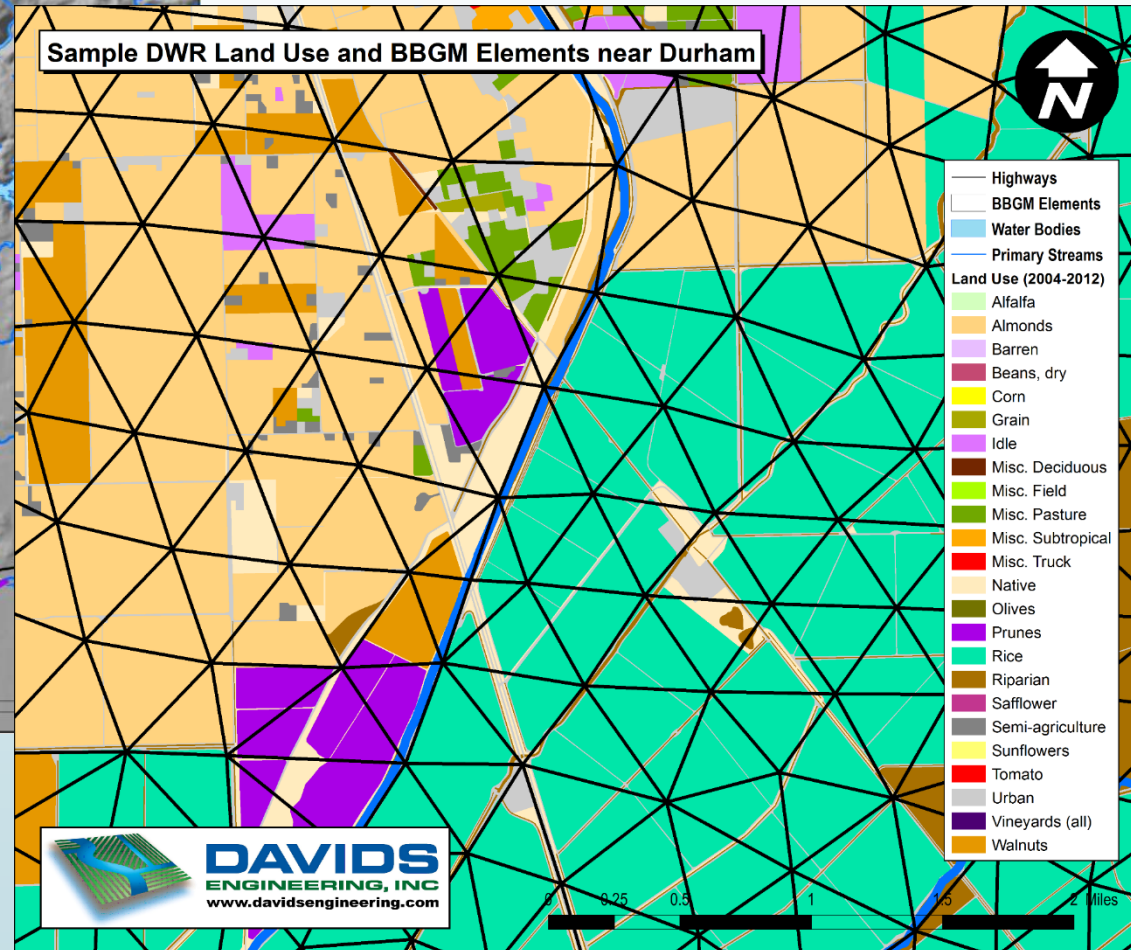
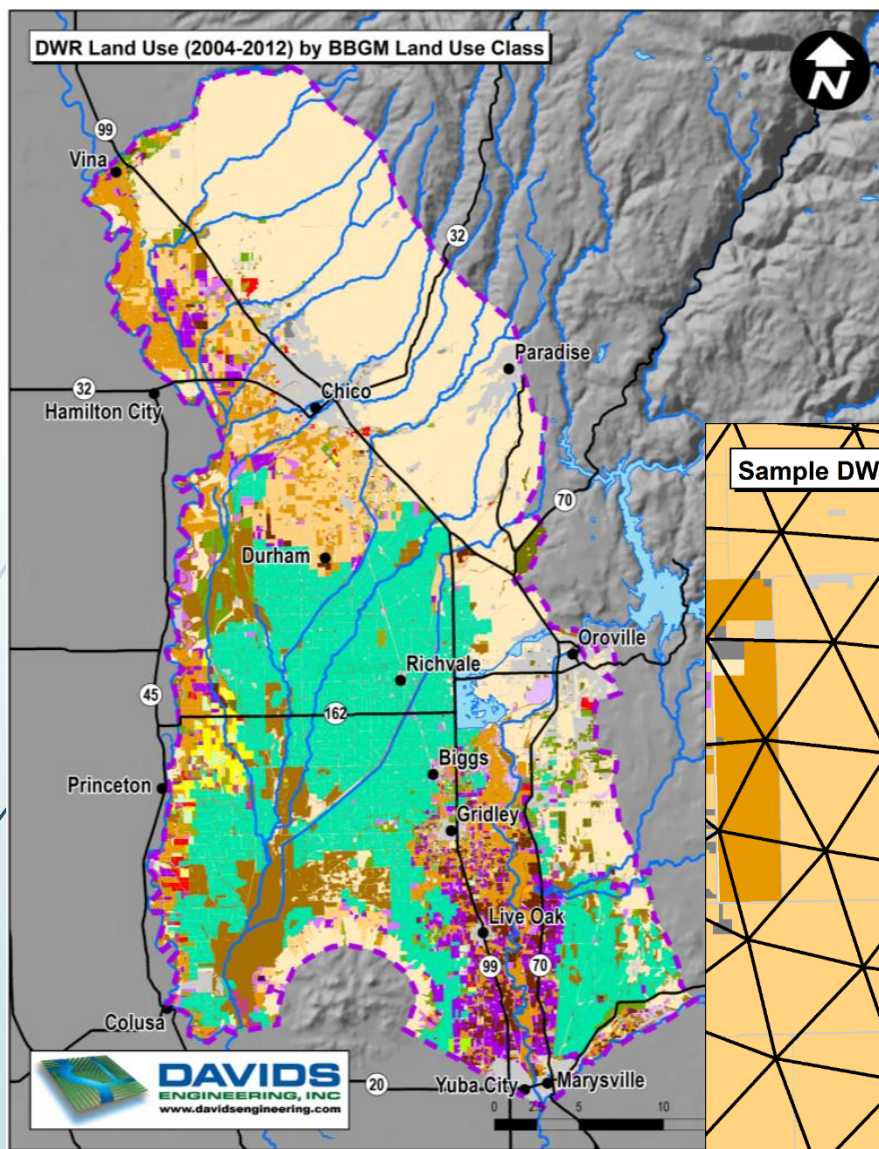
Source: IGSM2
Theoretical Guide

Butte Basin Groundwater Model

- Integrated GW-SW Model:
 - IWFM-2015 code
- 1970-2018, daily
- 1,265 square miles
- 7,200+ Individual elements
15-670 acres (Avg. 112 acres)
- Boundaries:
 - Deer Creek,
 - Sacramento River,
 - North side of Sutter Buttes/Yuba River
 - Eastern foothills



Elemental Land use



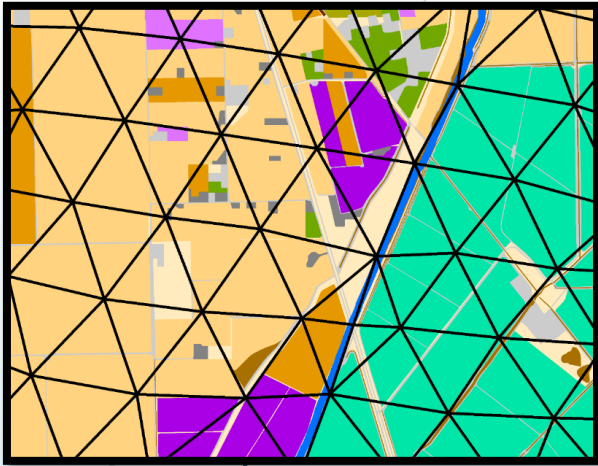
Estimates Crop Water Demand

- ▶ Given data:
 - ▶ Climate conditions (precipitation, ETC)
 - ▶ Soil and land surface physical properties
 - ▶ Land/water use management practices

- ➔ Uses Irrigation-scheduling type approach to calculate crop water demand

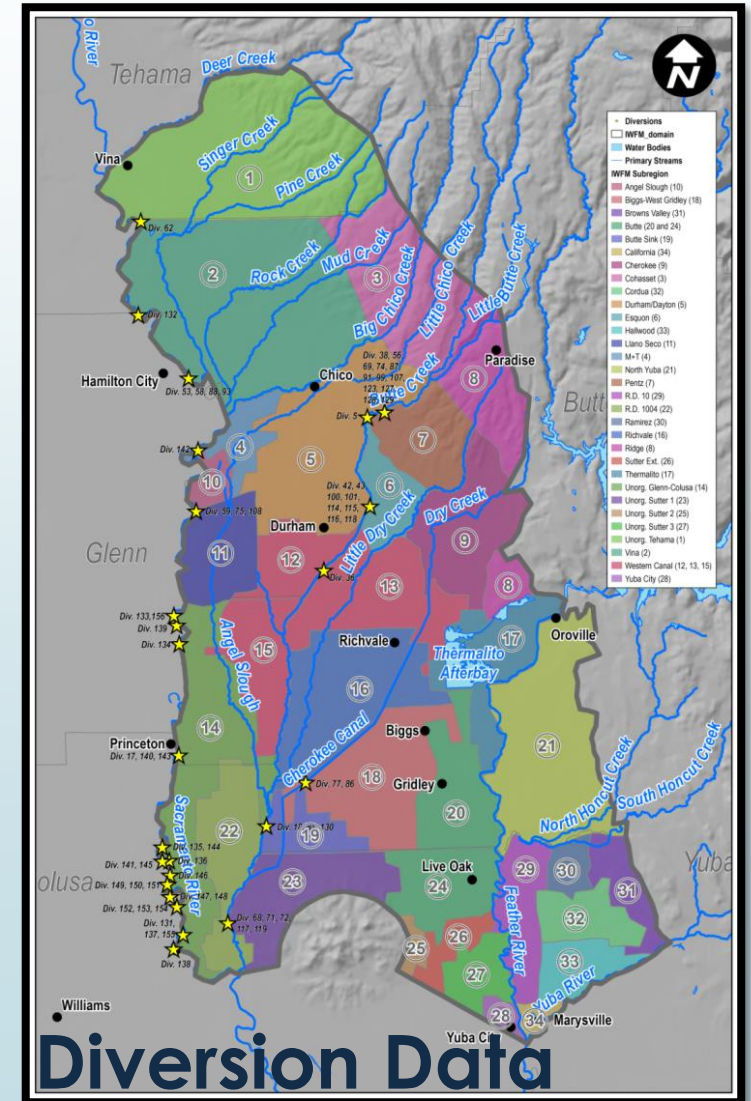


Estimating Groundwater Pumping or Diversions



Crop Water Demand
- Diversions
= Pumping

- Representative well per element adjusts pumping amount to meet demand
- Urban groundwater pumping is specified using existing data



Groundwater Conditions & Monitoring Networks

Includes groundwater elevations, water quality, and subsidence

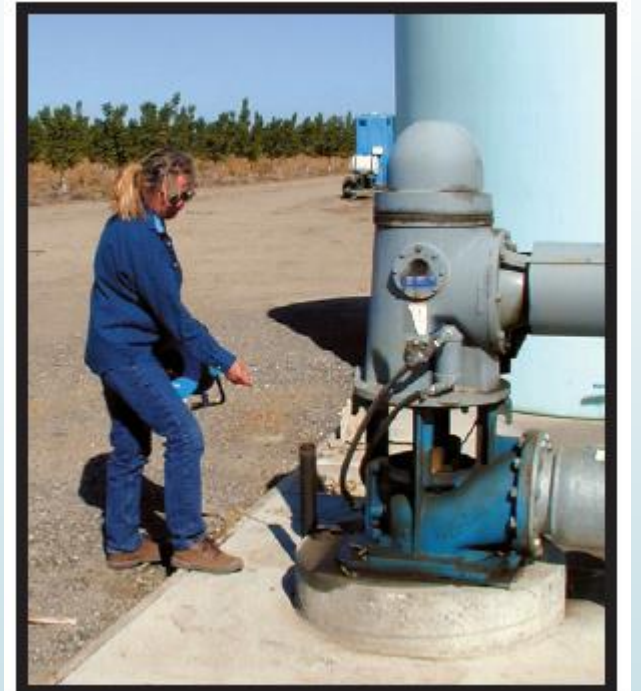
Why Monitor Groundwater Levels?

- ▶ Track changes over time
- ▶ Compare well infrastructure (depth) to groundwater levels
- ▶ Estimate groundwater flow direction
- ▶ Understand how water is moving in and through the system (i.e. aquifer dynamics)
- ▶ Understand the resource → protect and manage

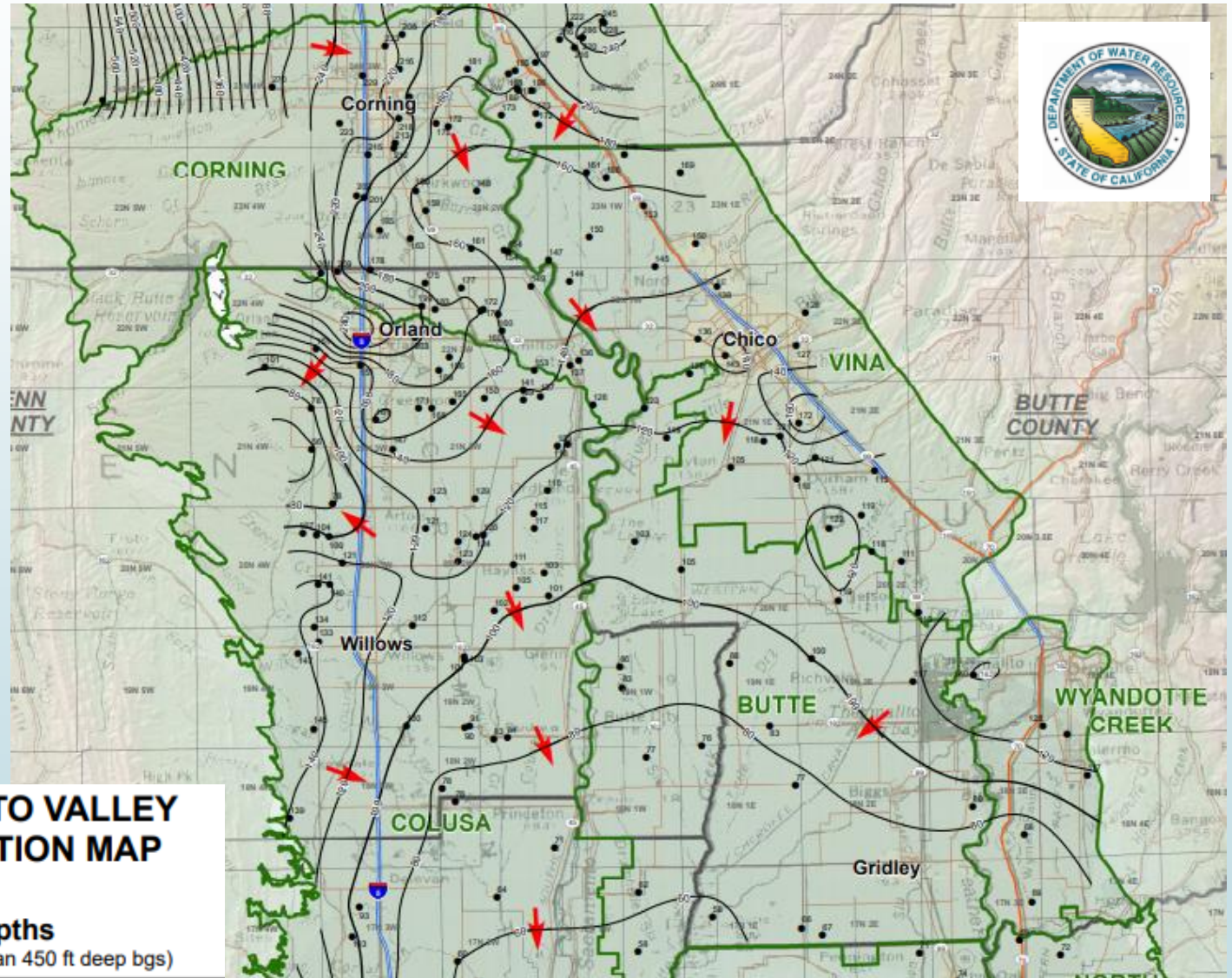


Groundwater levels reflect the cumulative effects of hydrologic variability and groundwater use

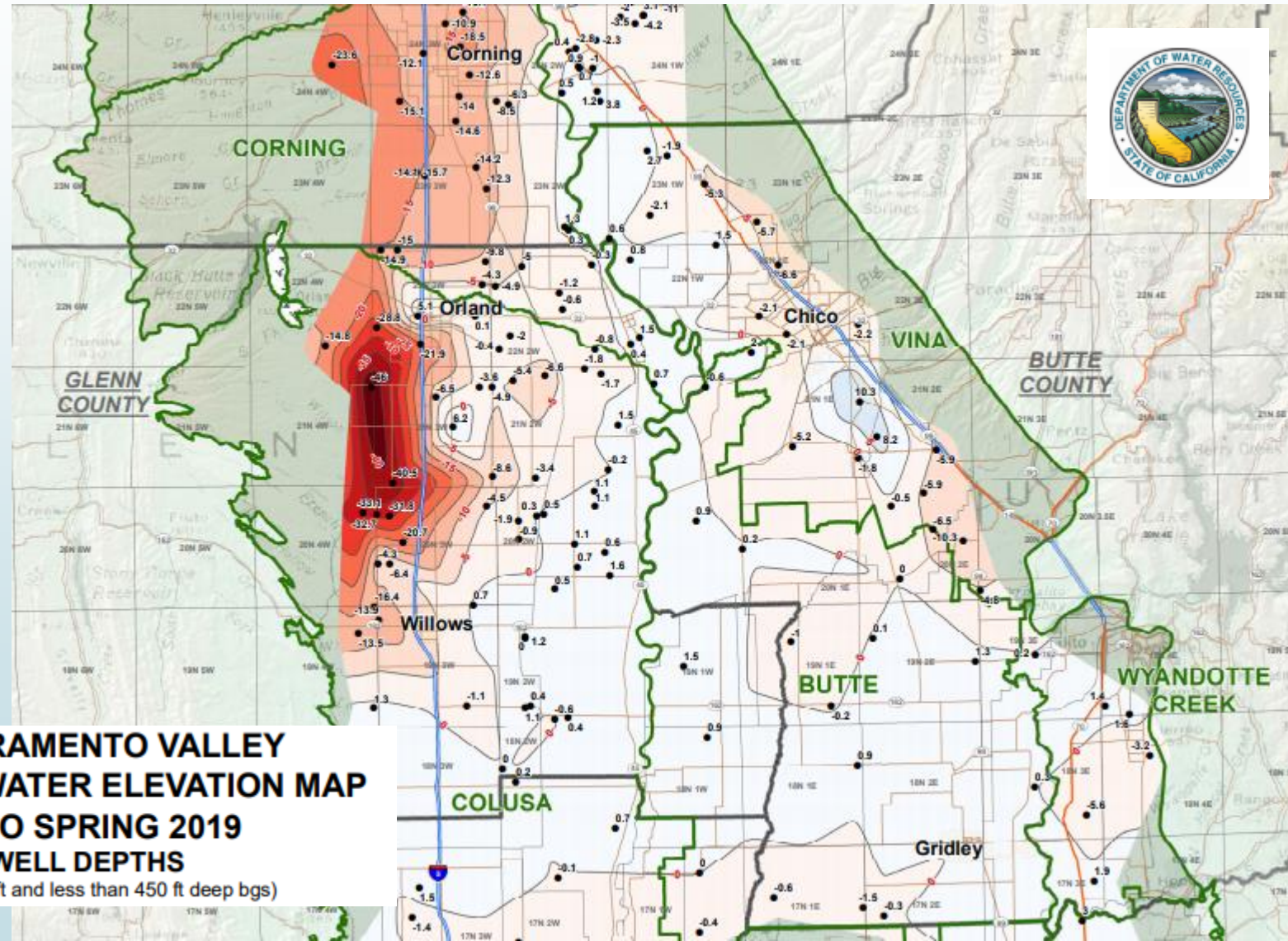
Wells are a window...



Contour Maps: GW Flow Direction

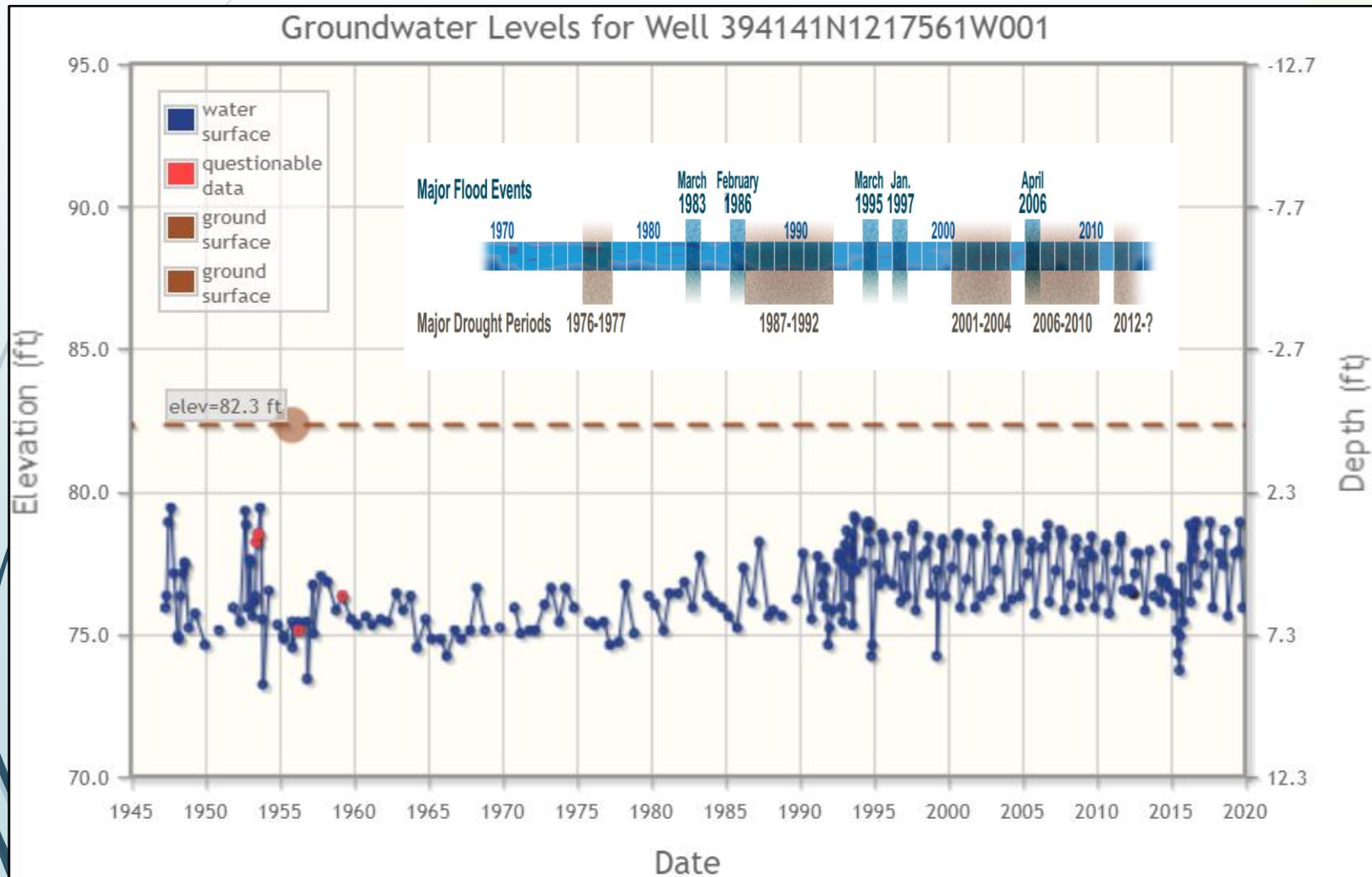
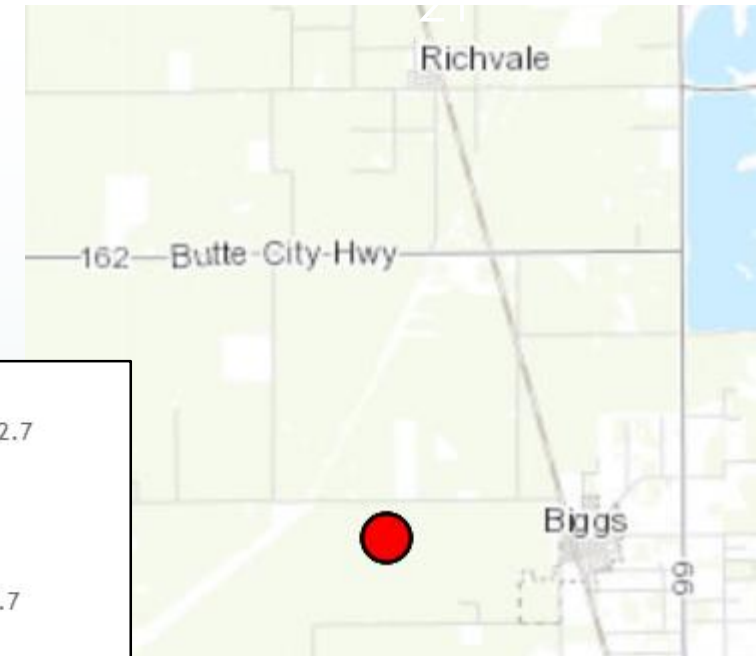


Change Maps: Changes over Space for a snapshot in Time

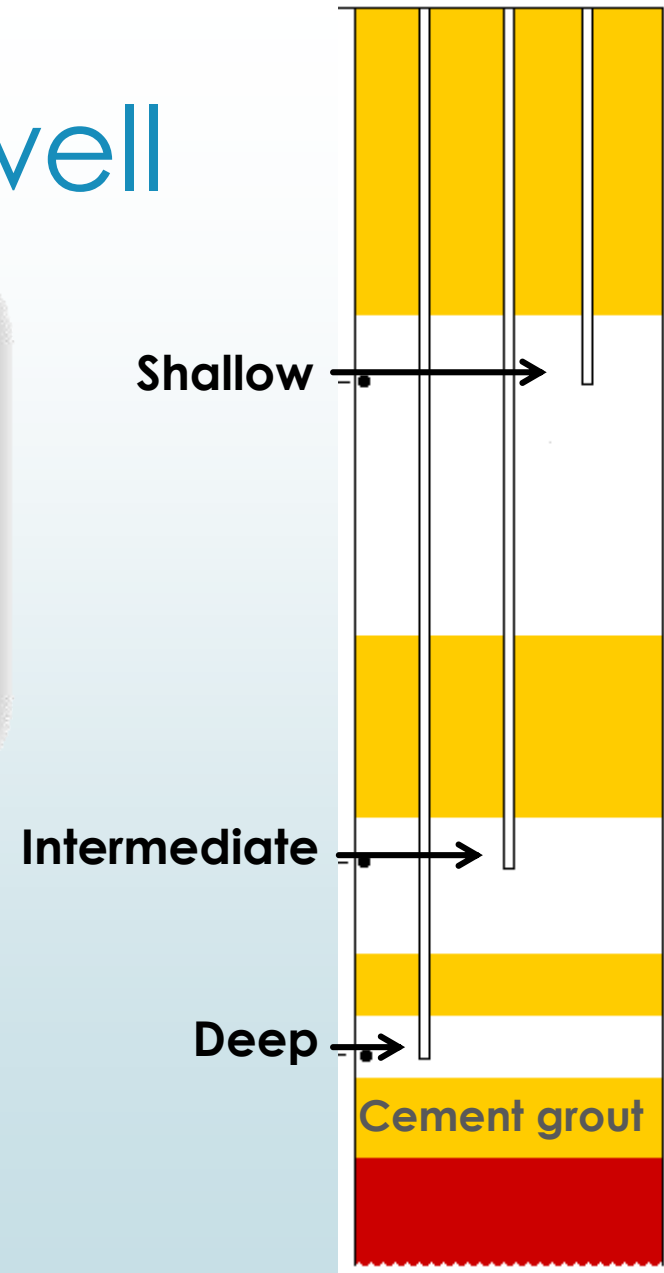


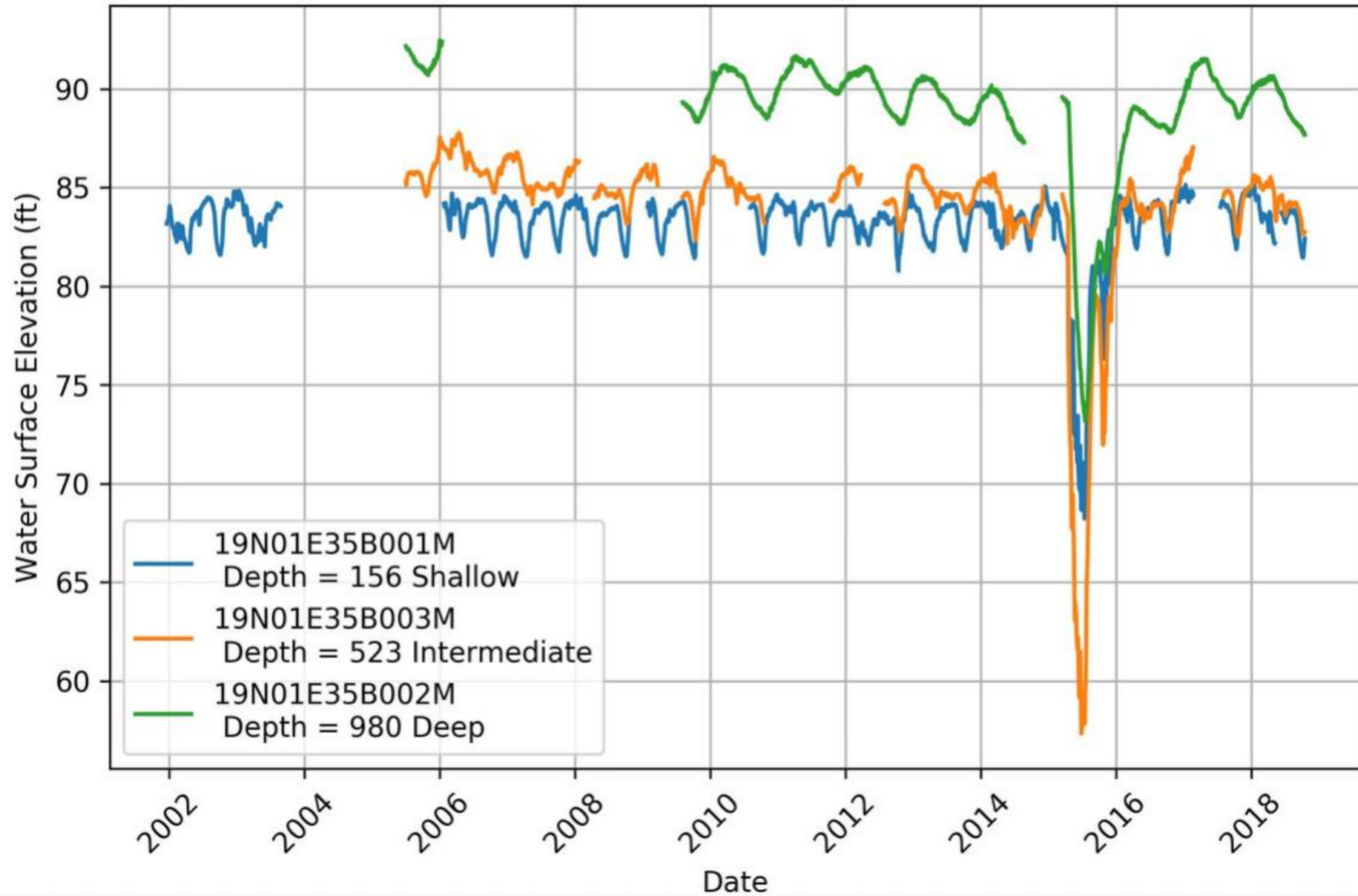
**NORTHERN SACRAMENTO VALLEY
CHANGE IN GROUNDWATER ELEVATION MAP
SPRING 2011 TO SPRING 2019
100 to 450 ft WELL DEPTHS**
(Well depths greater than 100 ft and less than 450 ft deep bgs)

Changes Over Time for One Point in Space



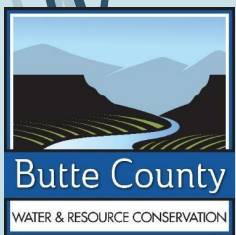
Multi-completion well



19N01E35B00
Butte Subbasin

Next Time...RESULTS!

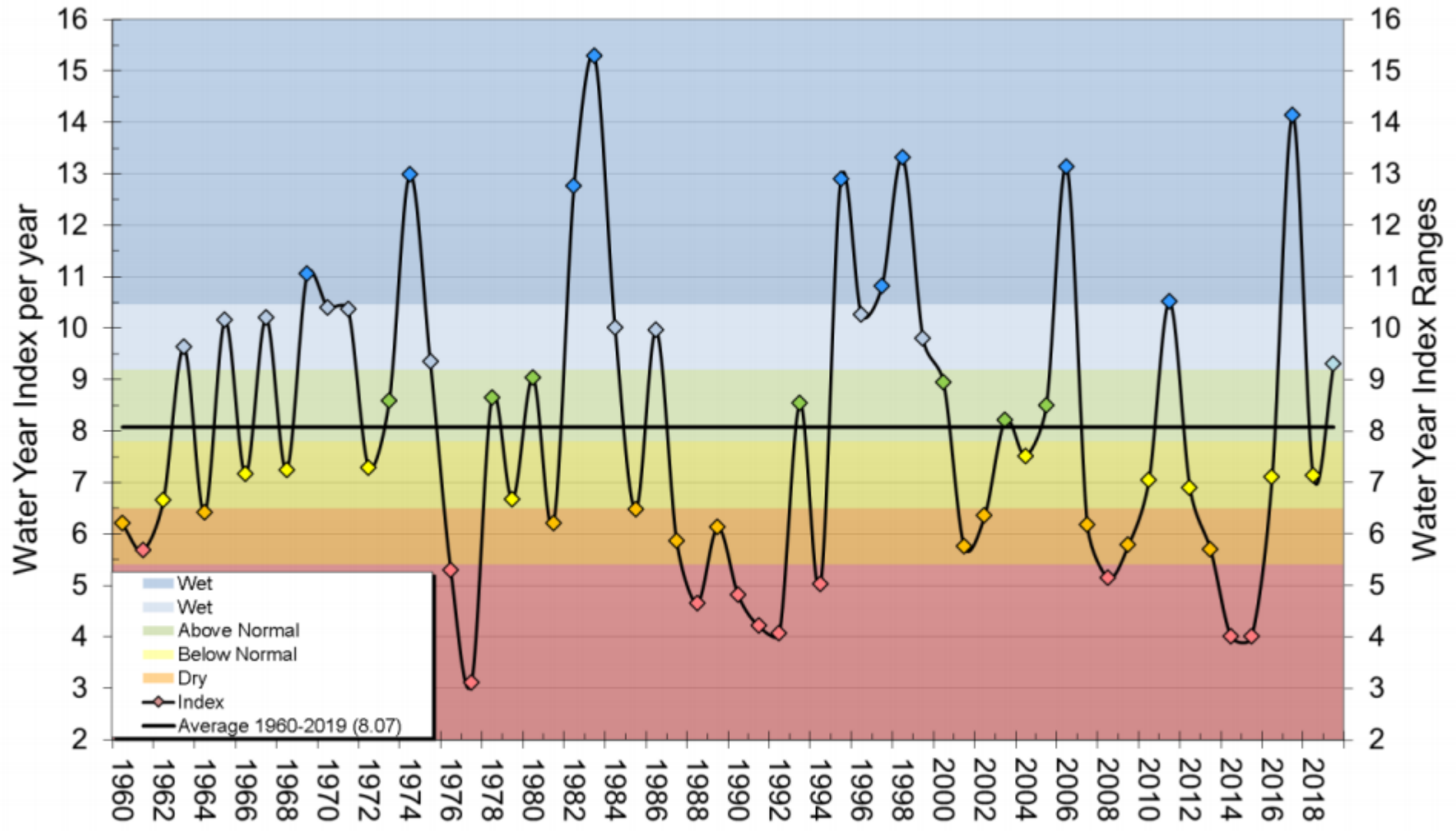
Questions?



Contact:
Christina Buck
cbuck@buttecounty.net

Back up slides...

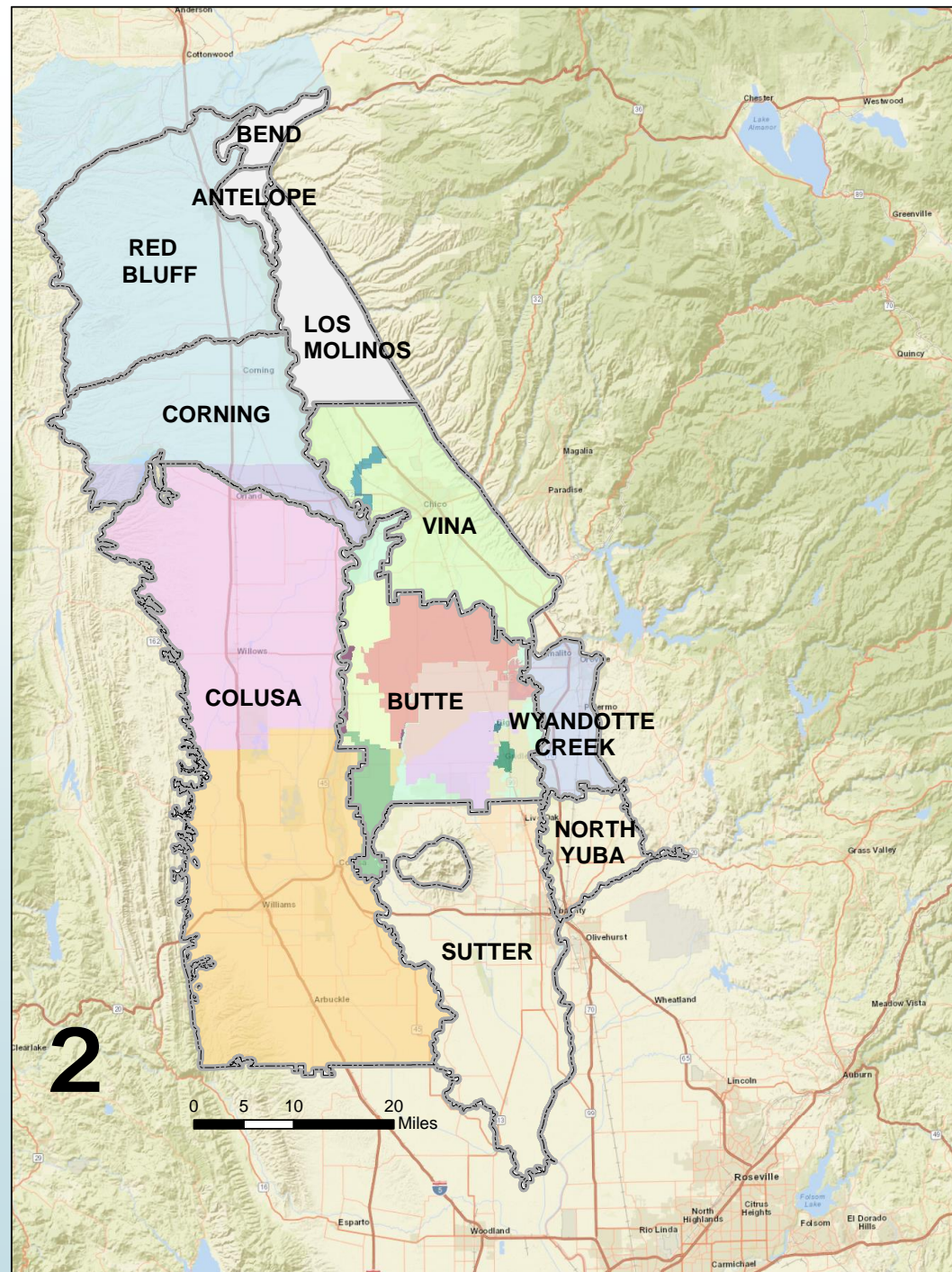
Water Year Hydrologic Classification Indices 1960-2019



Interconnected Subbasins

Sacramento Groundwater Basin

- Early coordination on a regional level
- Integrated Regional Water Management (IRWM) group
- County staff relationships

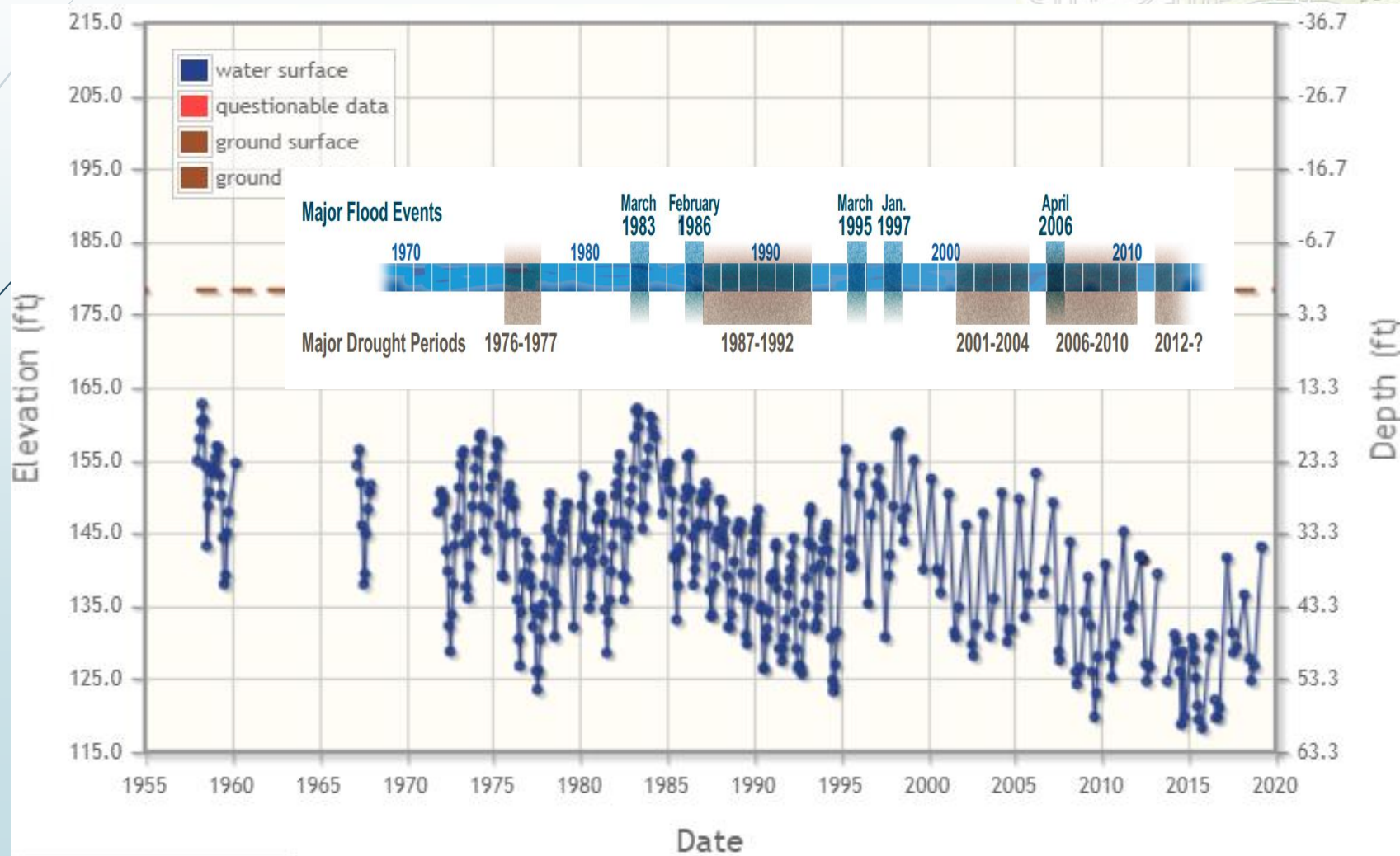
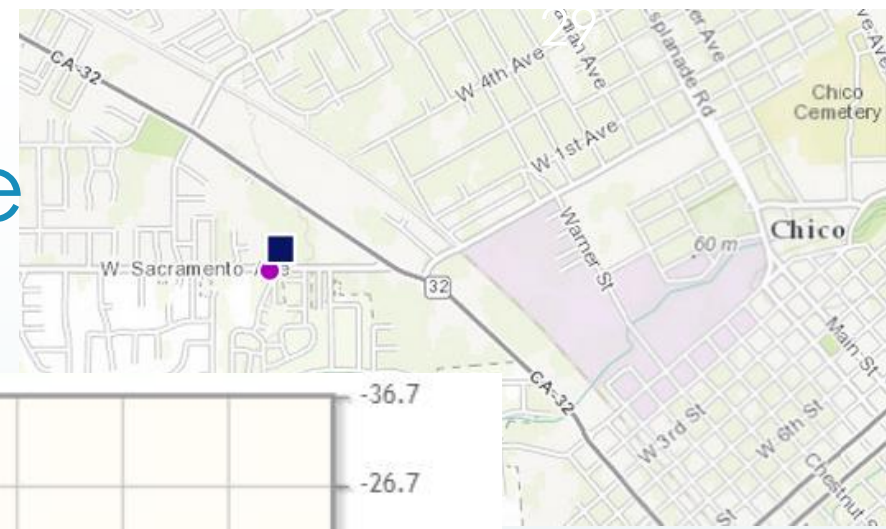


Tools of the Trade



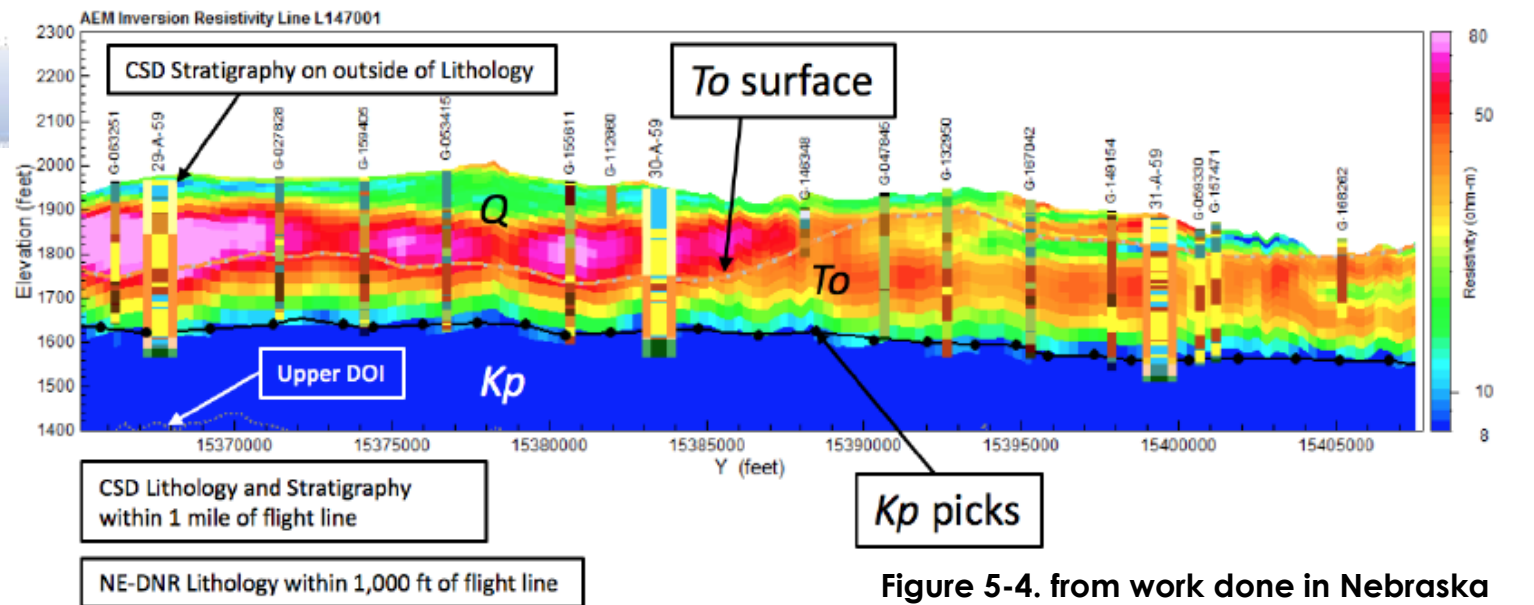
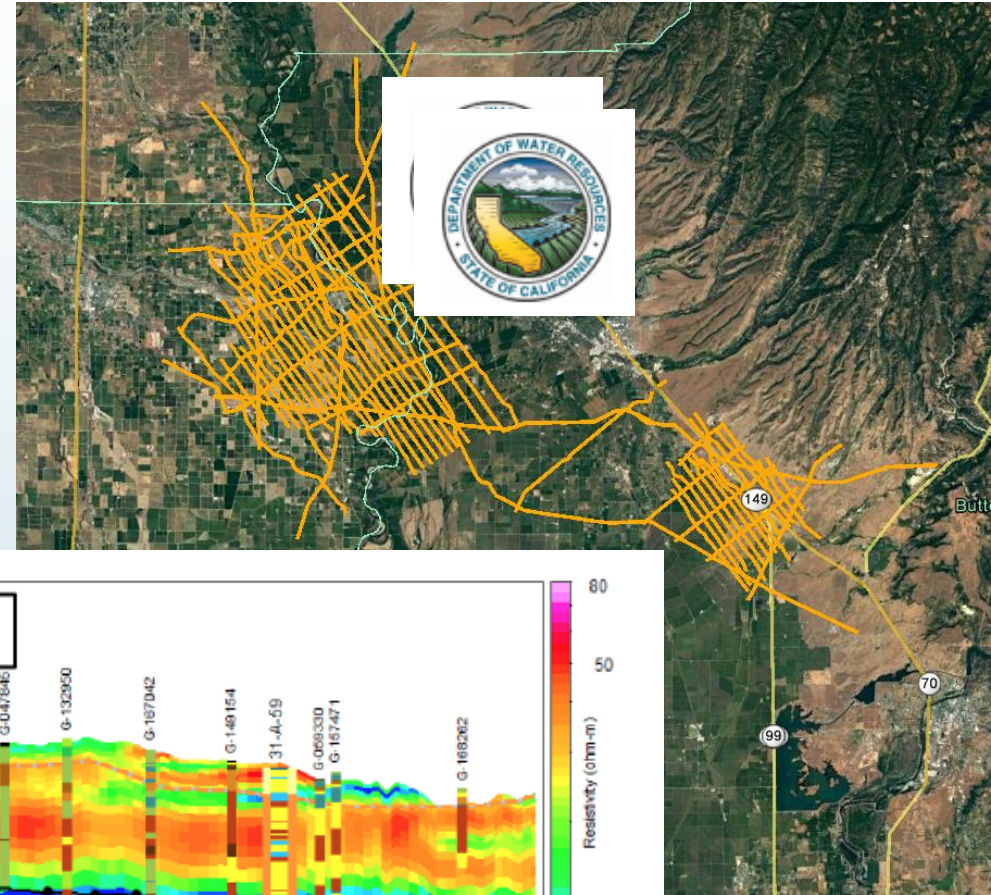
Level TROLL® 500 Data Logger
High-accuracy sensor for efficient data collection & analysis

Changes Over Time for One Point in Space

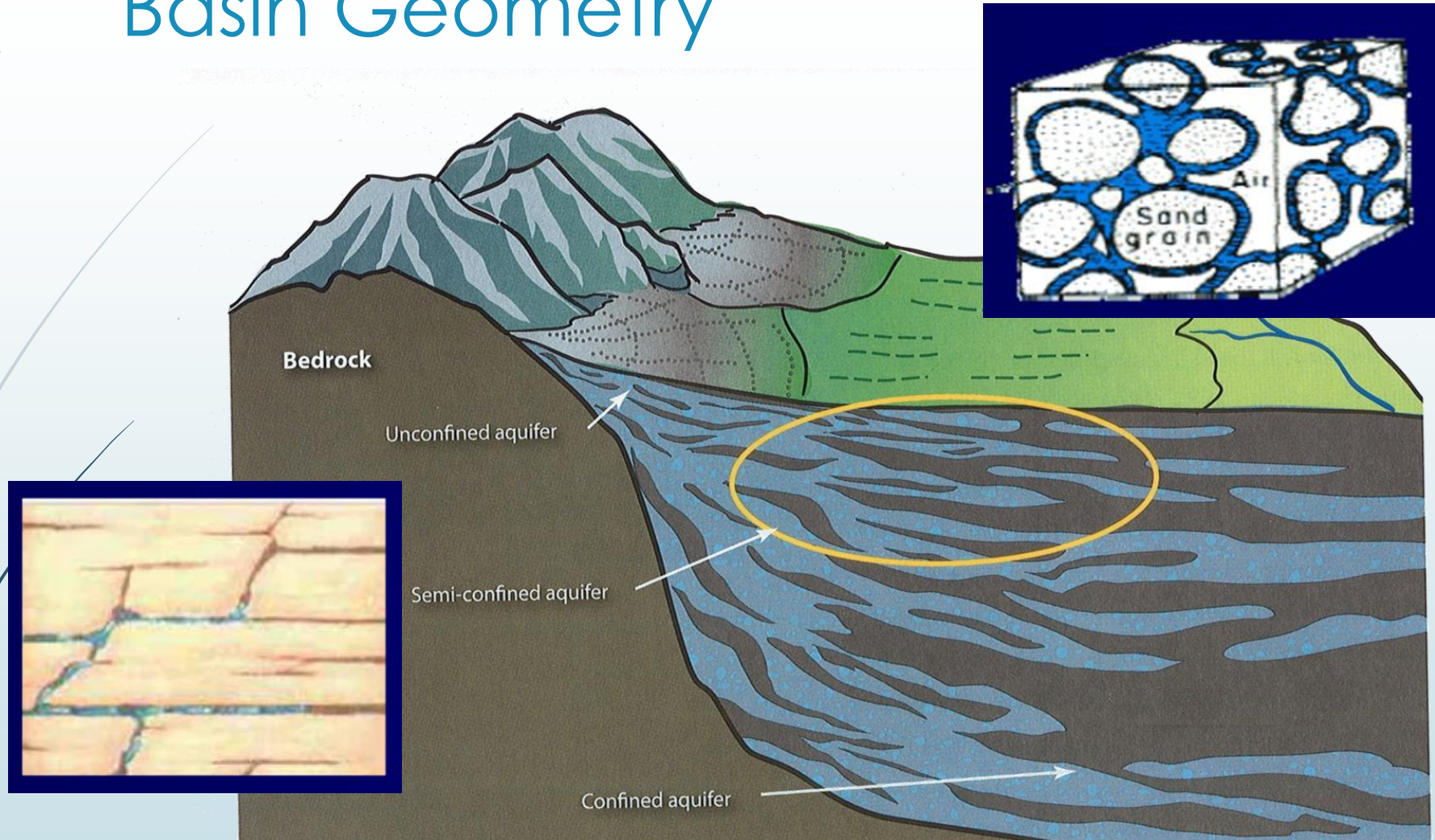


Innovative Technology and Partnerships

Airborne Electromagnetic (AEM) Survey



“Basin Geometry”



Harter and Rollins 2008: ANR Publication 3497

“Picturing” groundwater is hard

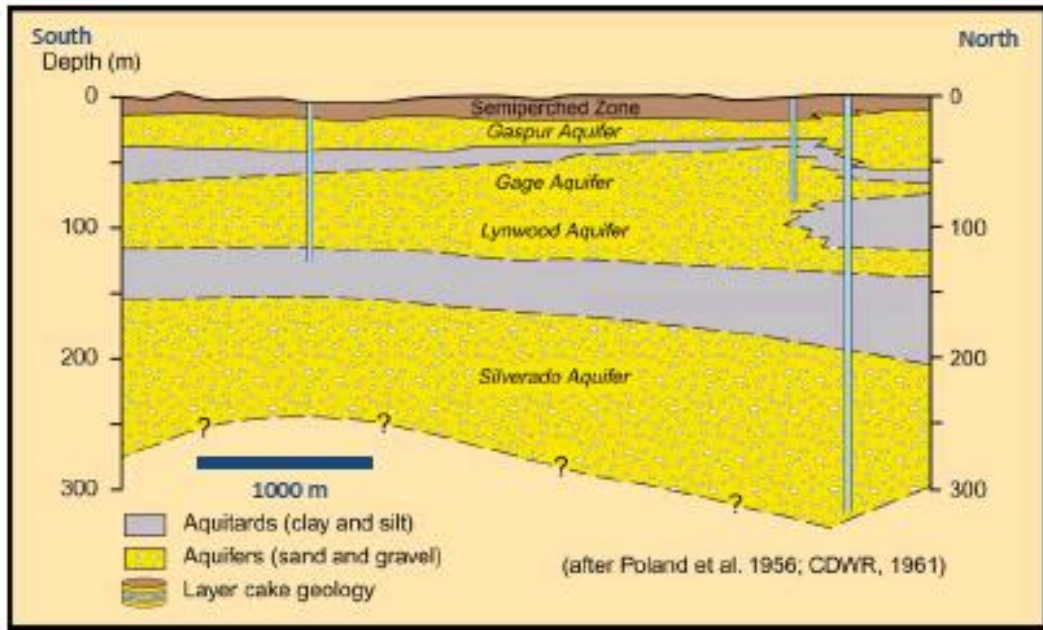


Image Credit: Rick Cramer, Burns & McDonnell

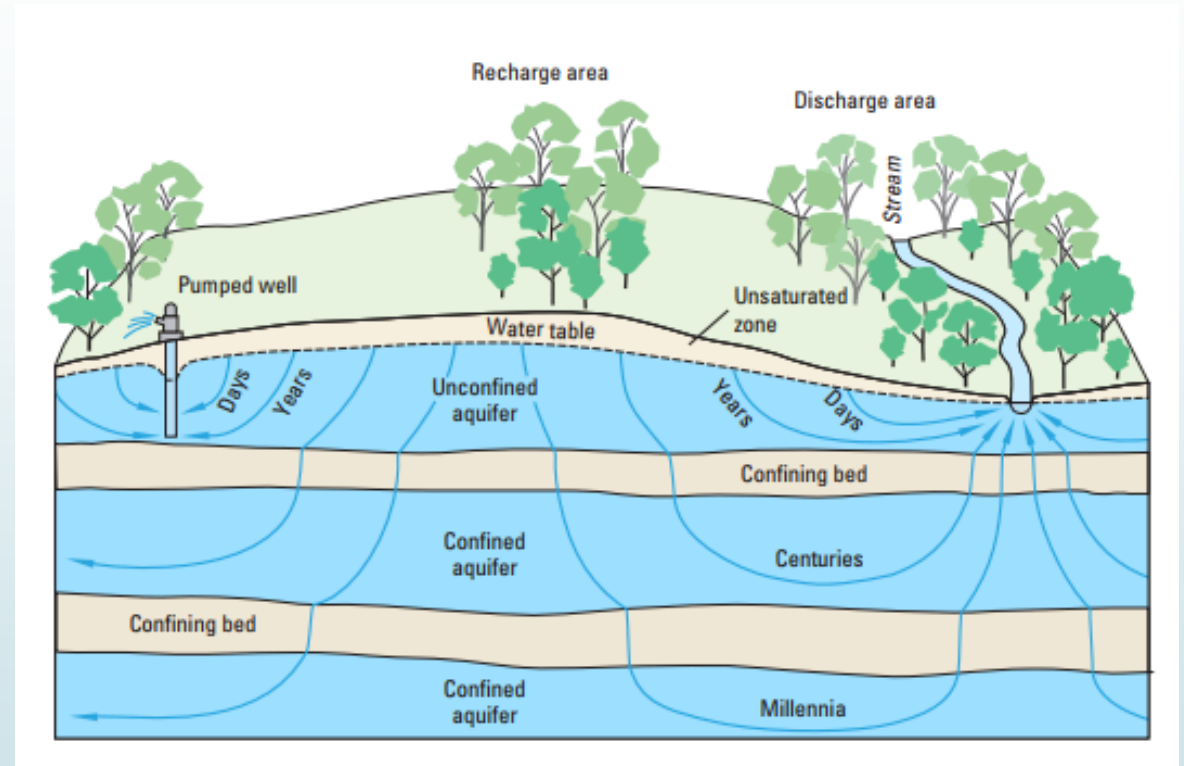


Image Credit: USGS Circular 1376

“Layer Cake” aquifer stratigraphy depict continuous layers

Simplification is necessary, but complexity abounds...

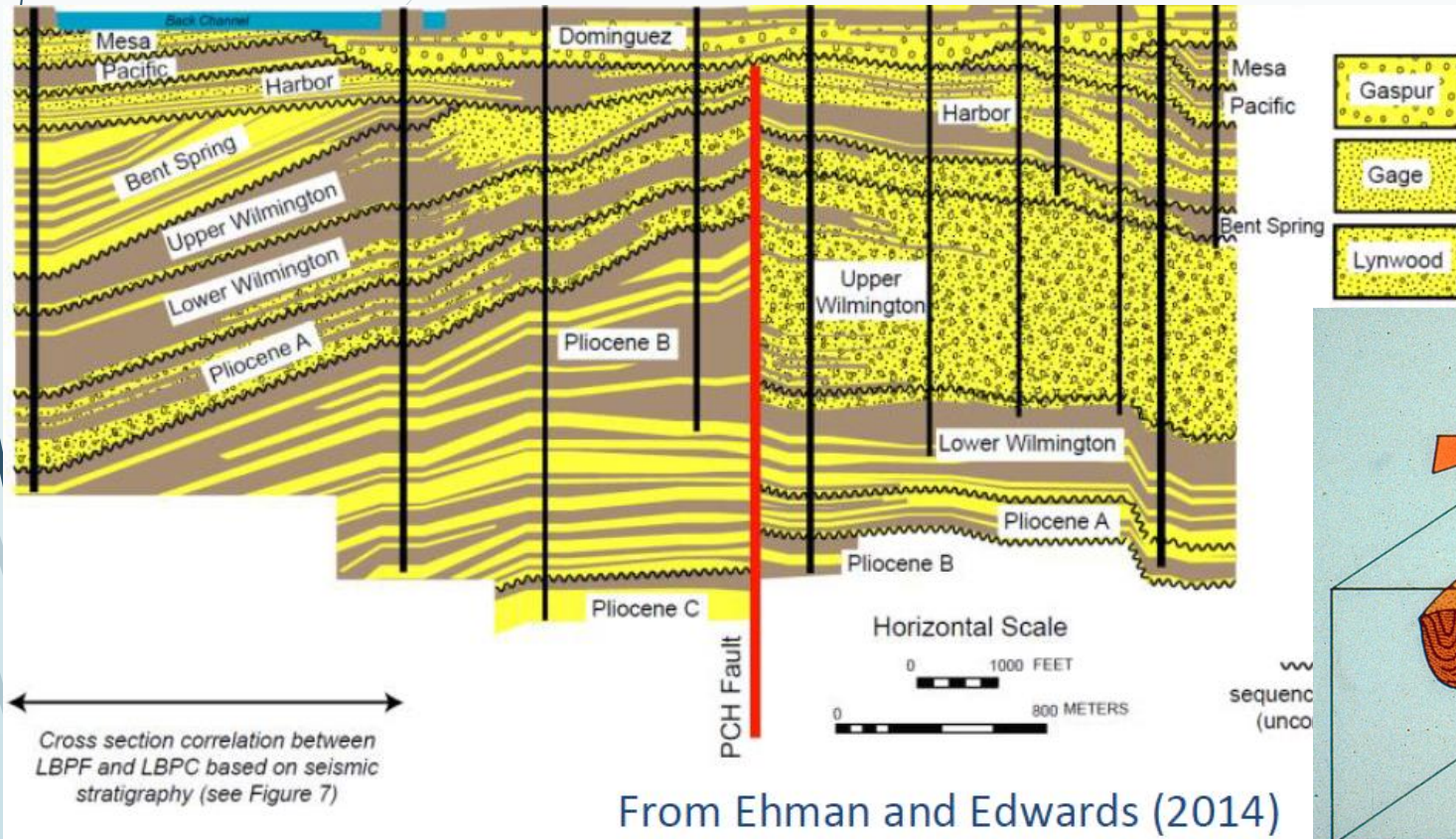


Image Credit: Rick Cramer, Burns & McDonnell

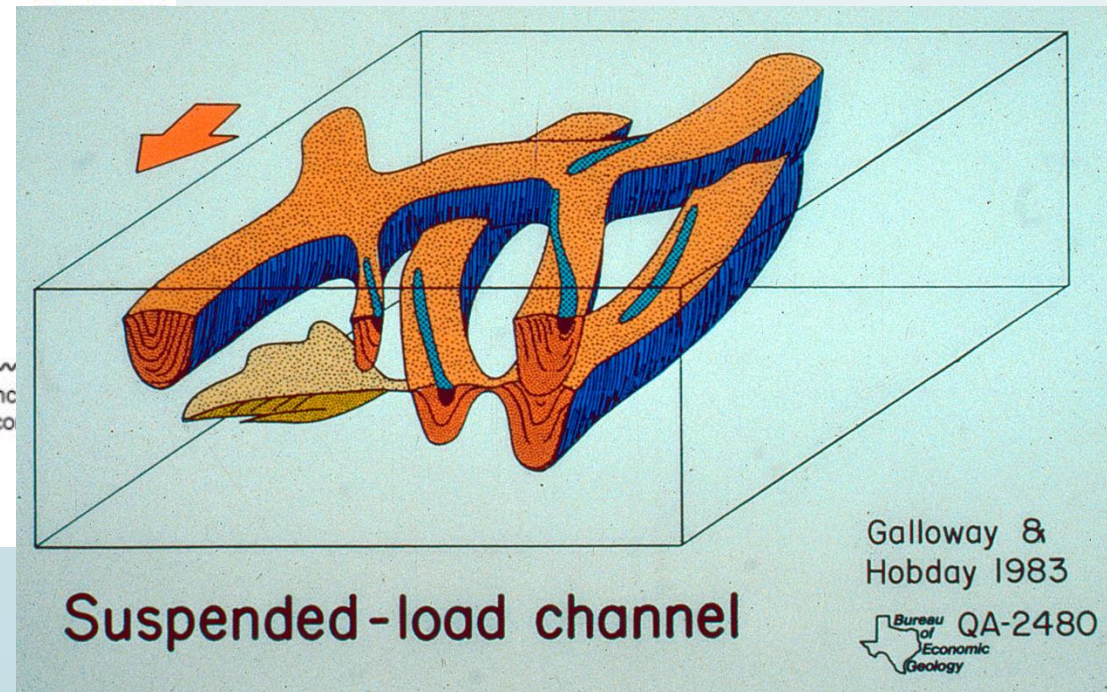
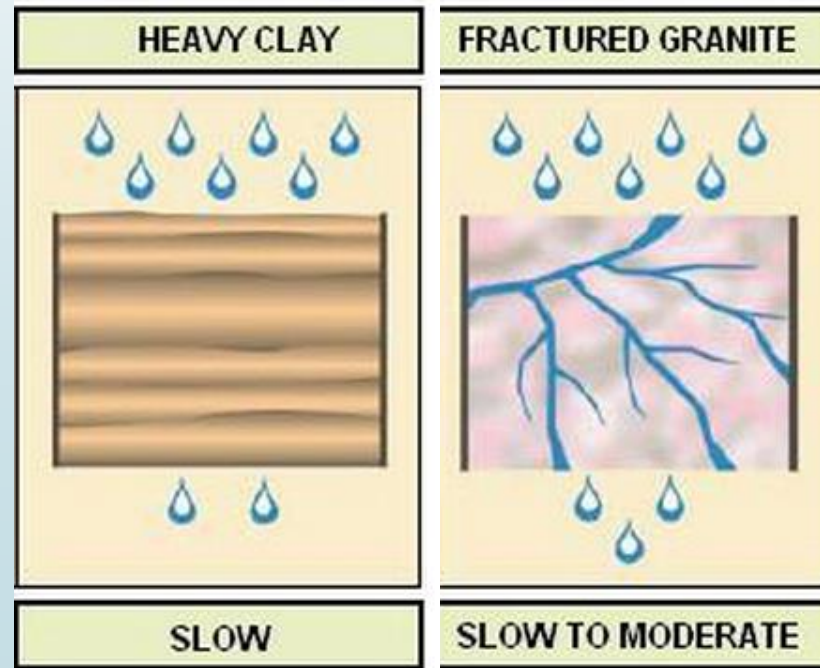
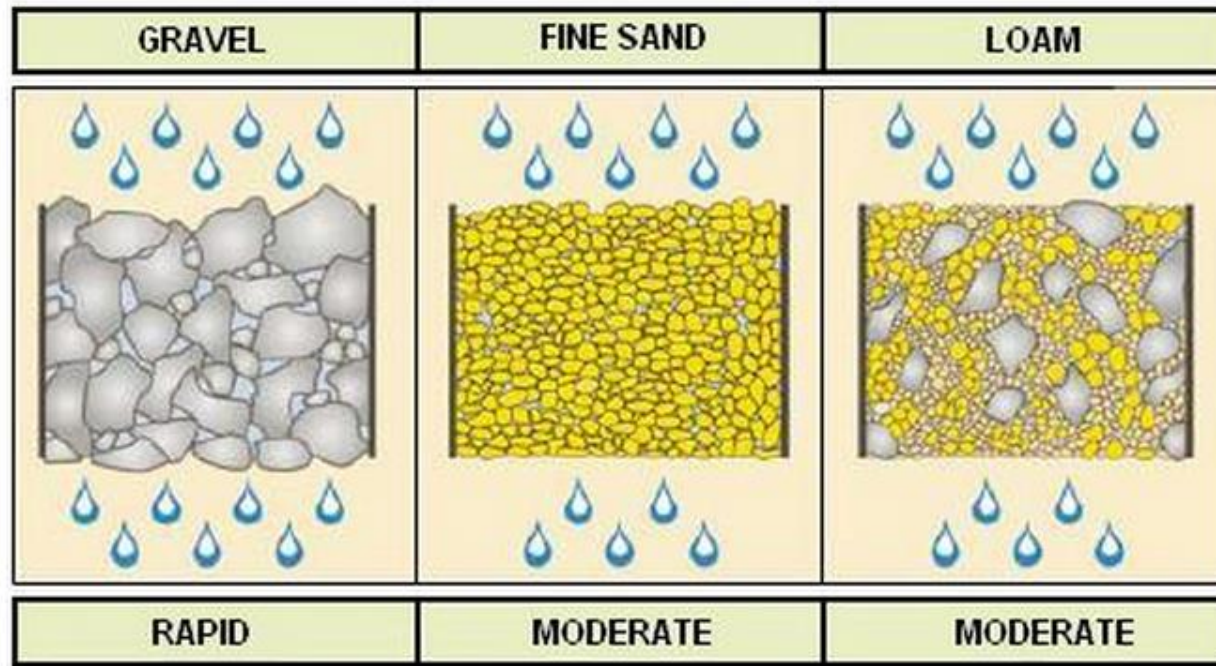
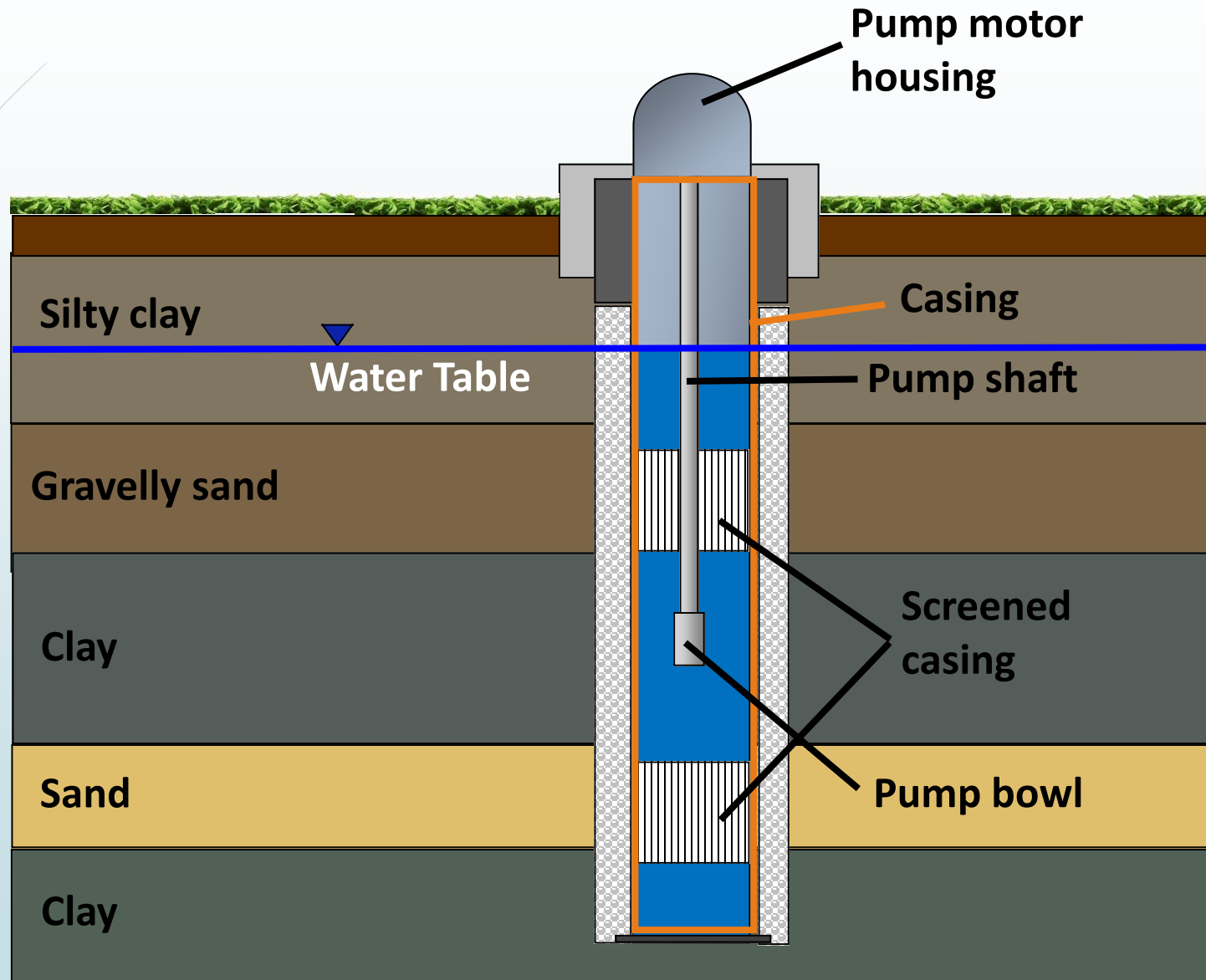


Image Credit: Dr. Graham Fogg



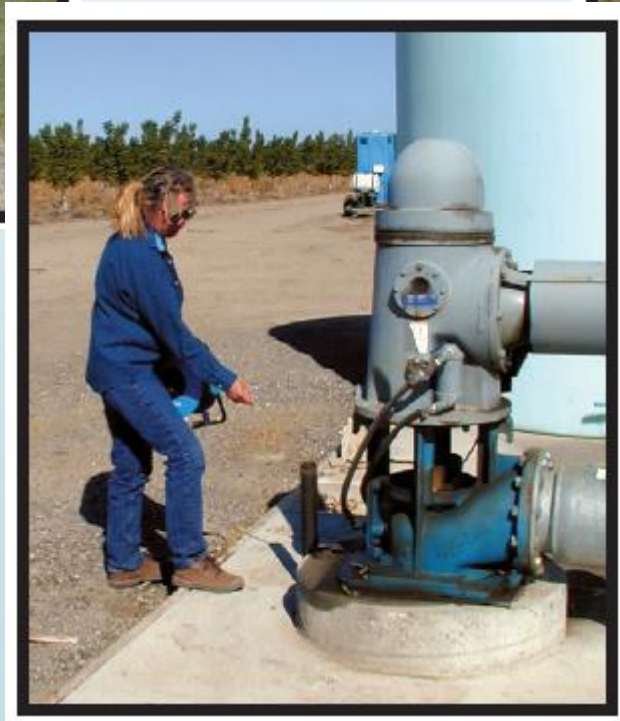




Domestic well



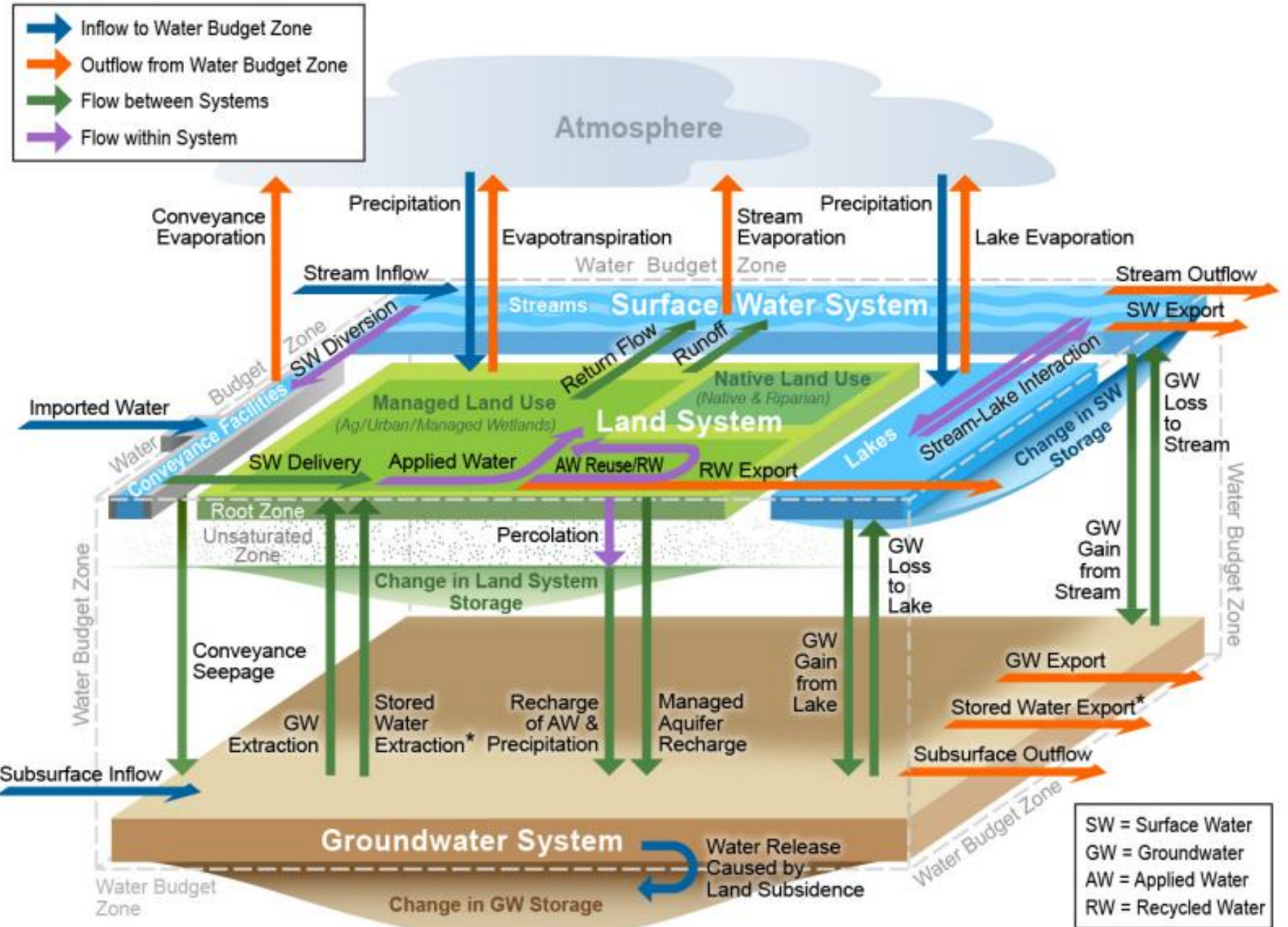
Irrigation well



Multi-completion well

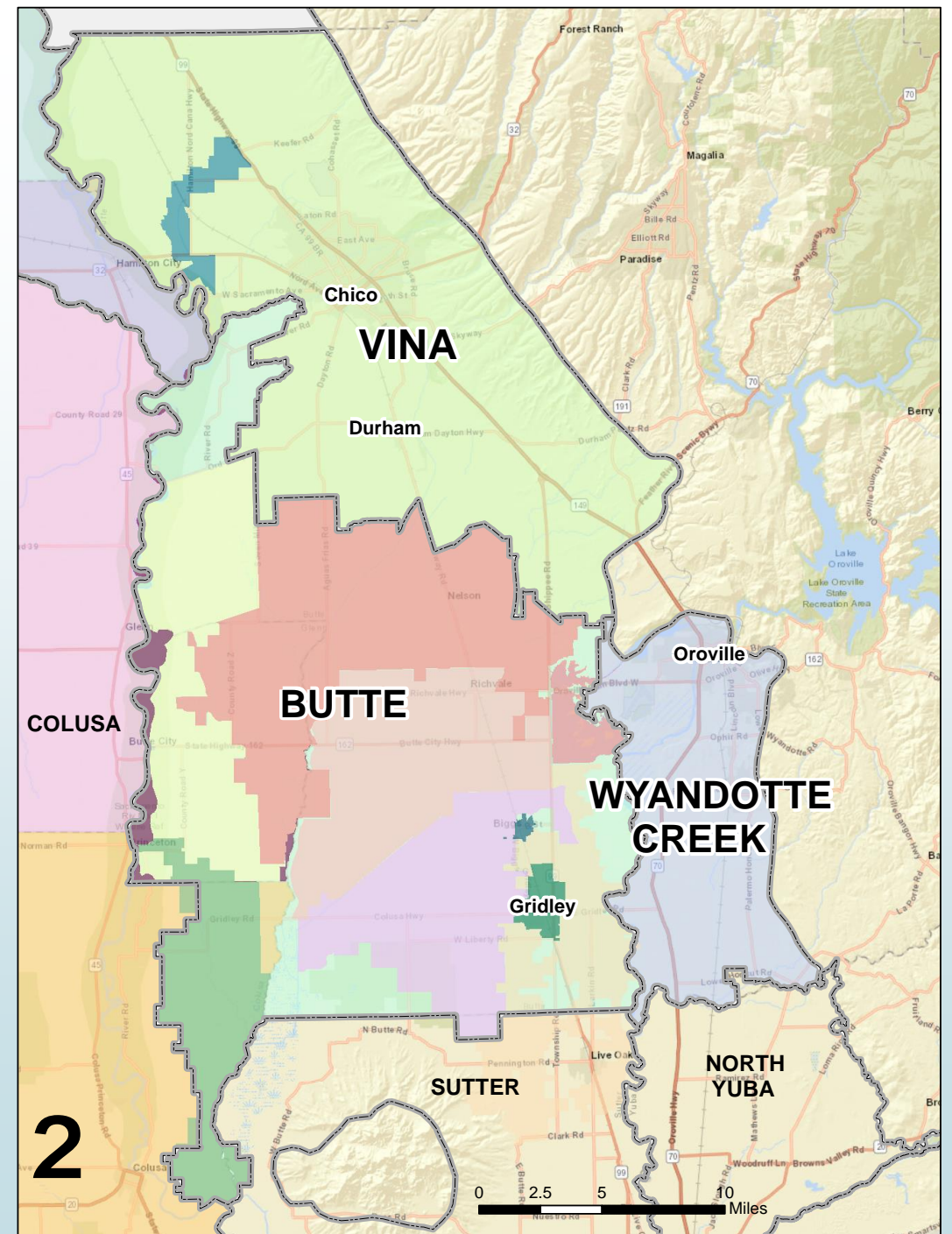


Figure 1-1 Total Water Budget Schematic



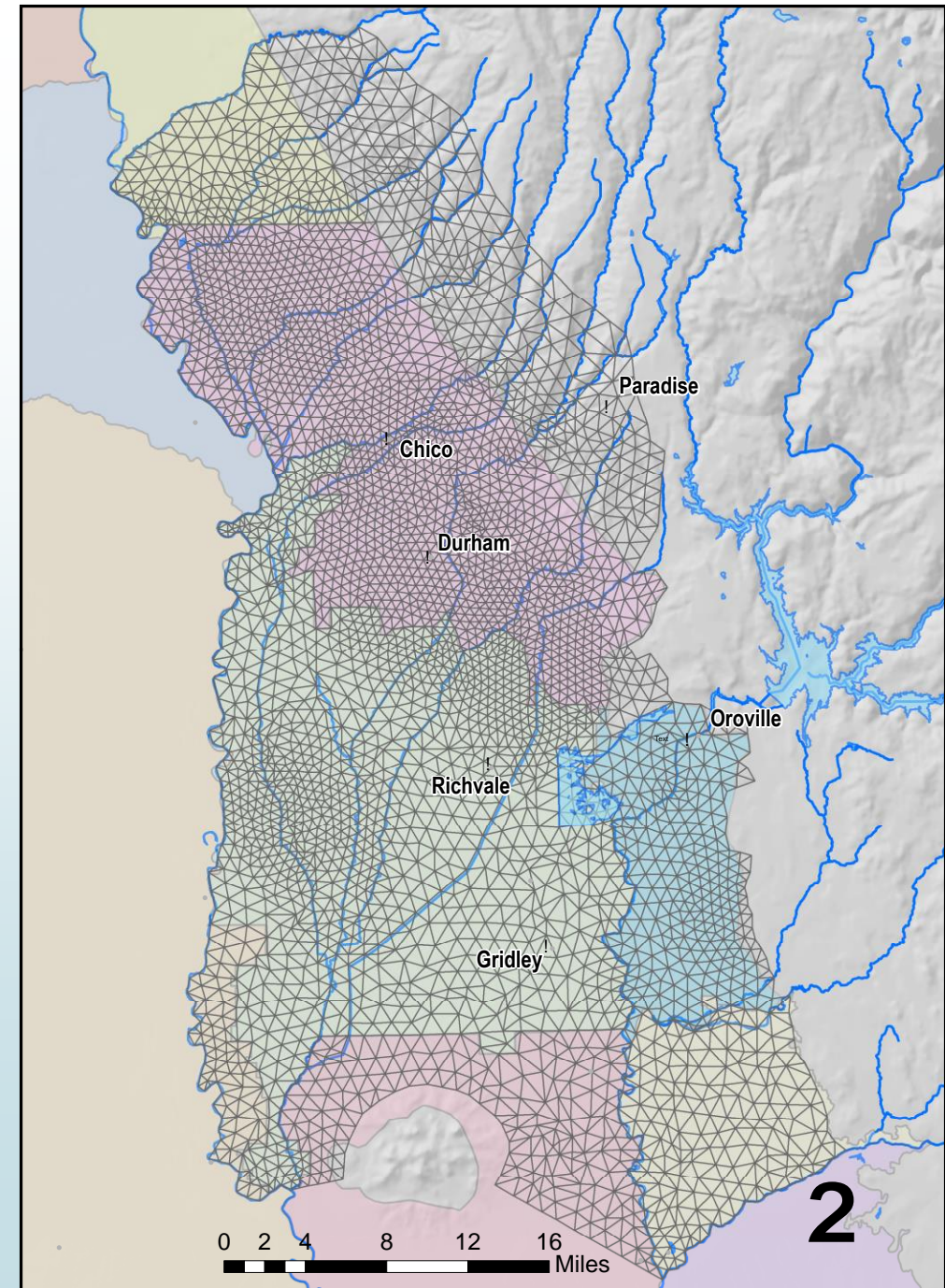
Butte County Subbasins & GSAs

1. Vina
 1. Vina GSA
 2. Rock Creek Reclamation District
2. Wyandotte Creek
 1. Wyandotte Creek GSA
3. Butte
 1. ELEVEN GSAs (Water Districts, Reclamation Districts, Cities, and Counties)



Butte Basin Groundwater Model

- Integrated GW-SW Model:
 - IWFM-2015 code
- 1970-2018, daily
- 1,265 square miles
- 7,200+ Individual elements 15-670 acres (Avg. 112 acres)
- Boundaries:
 - Deer Creek,
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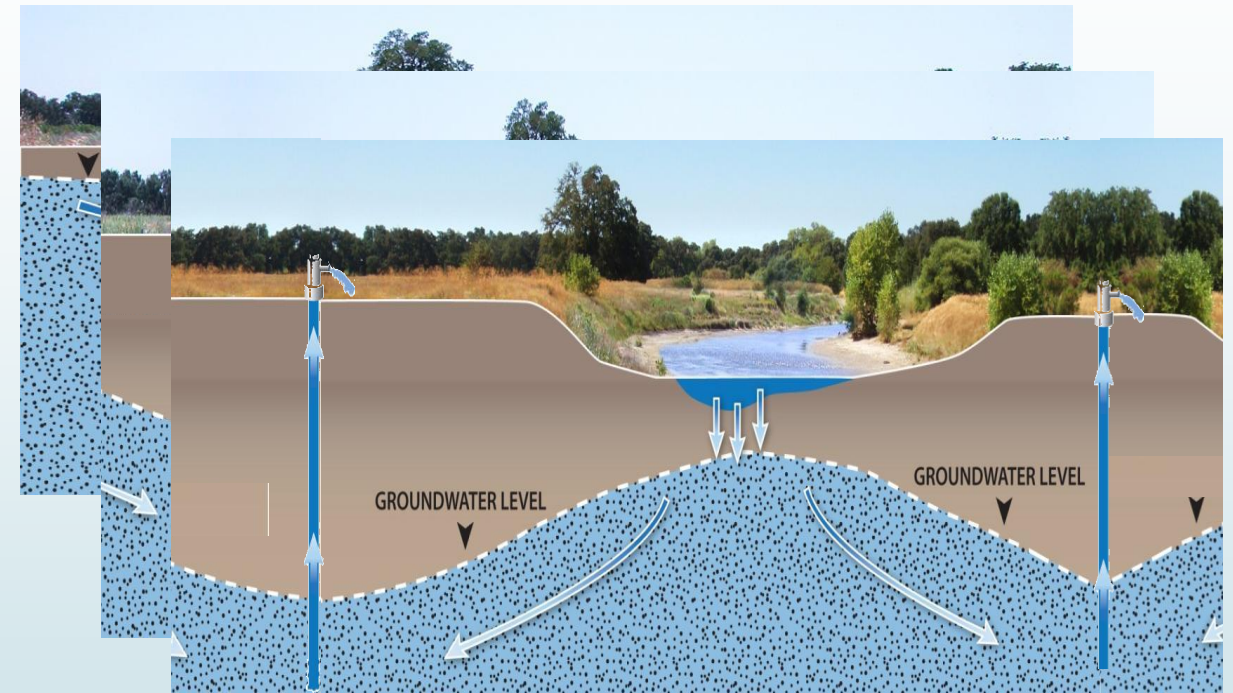


A quick word on Depletions of Interconnected Surface Water

- ▶ Potential to pose operational constraints and require Projects and/or Management Actions:
 - ▶ Chronic Lowering of Groundwater Levels (#1)
 - ▶ Depletions of Interconnected Surface Water (#6)
- ▶ Also closely tied to dynamics of groundwater level changes and declines

Depletions of Interconnected Surface Water

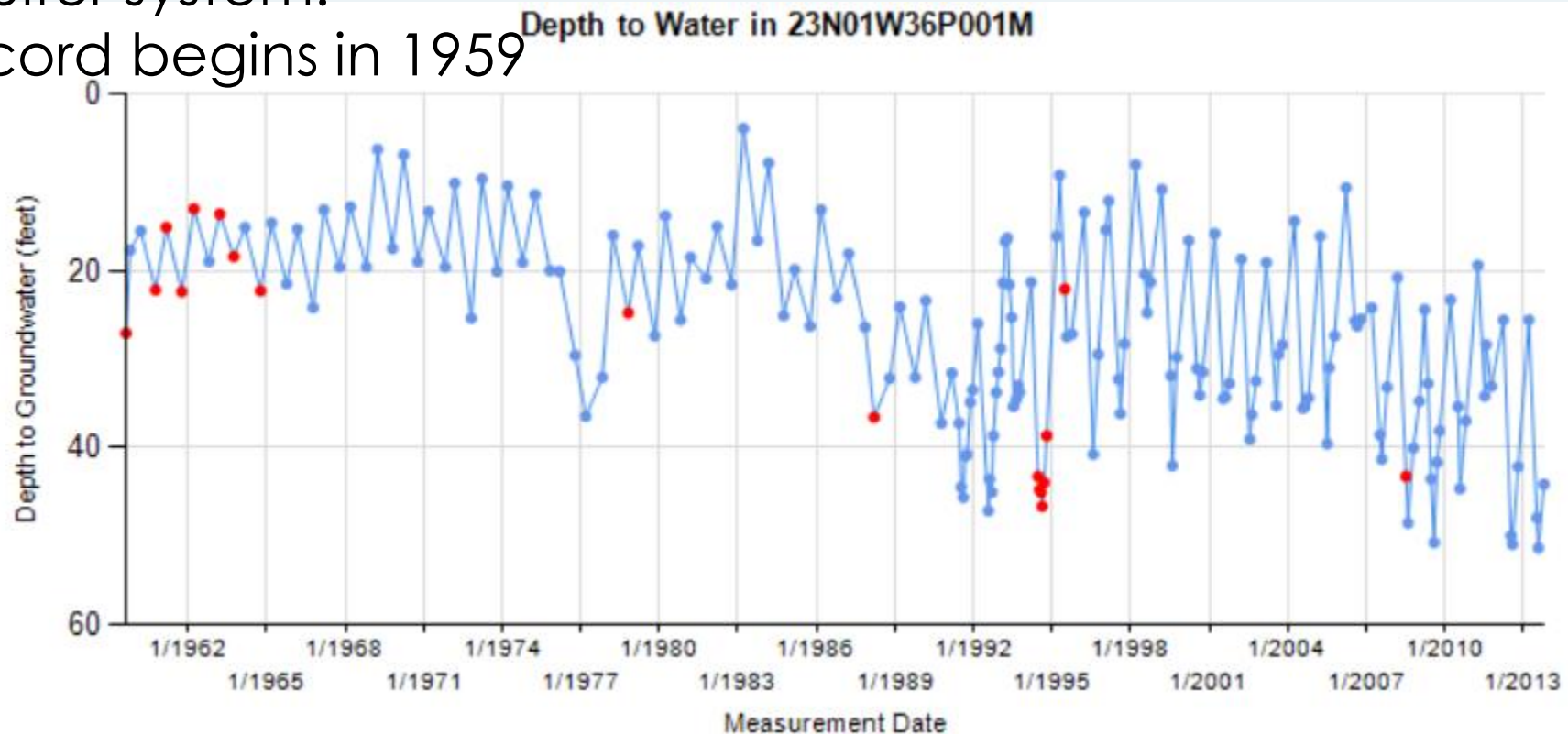
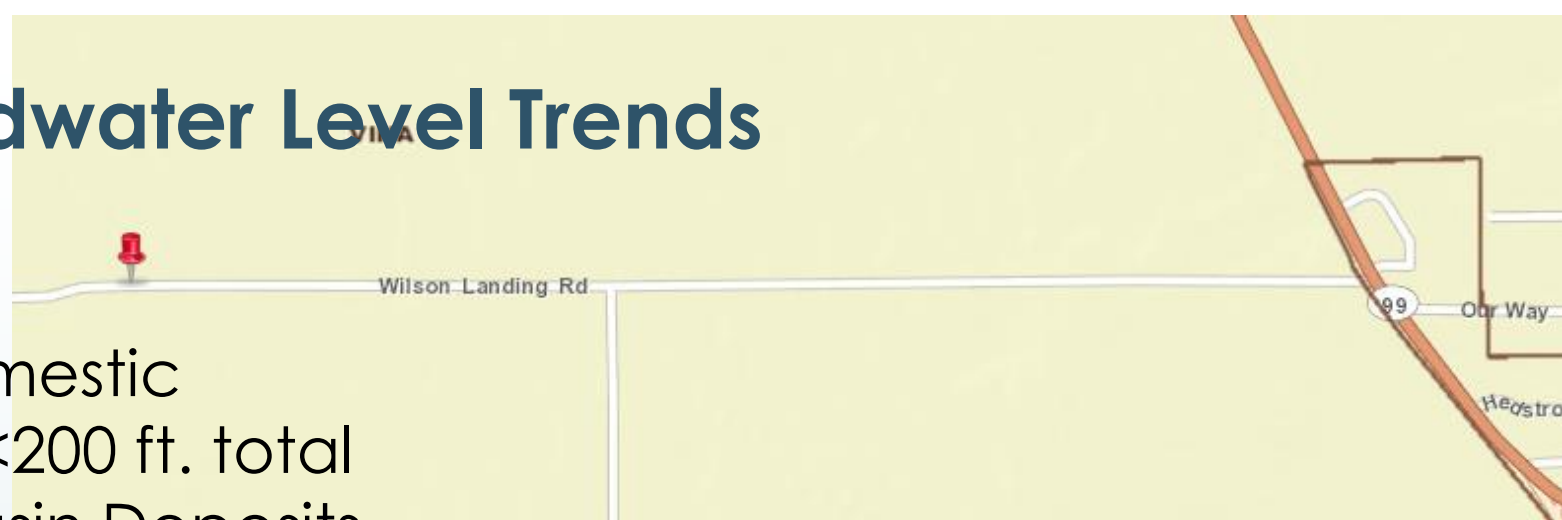
- ▶ Interaction depends on relative groundwater levels and properties of streambed and aquifer
- ▶ The uppermost groundwater sustains Groundwater Dependent Ecosystems, and river and stream flows



Groundwater Level Trends

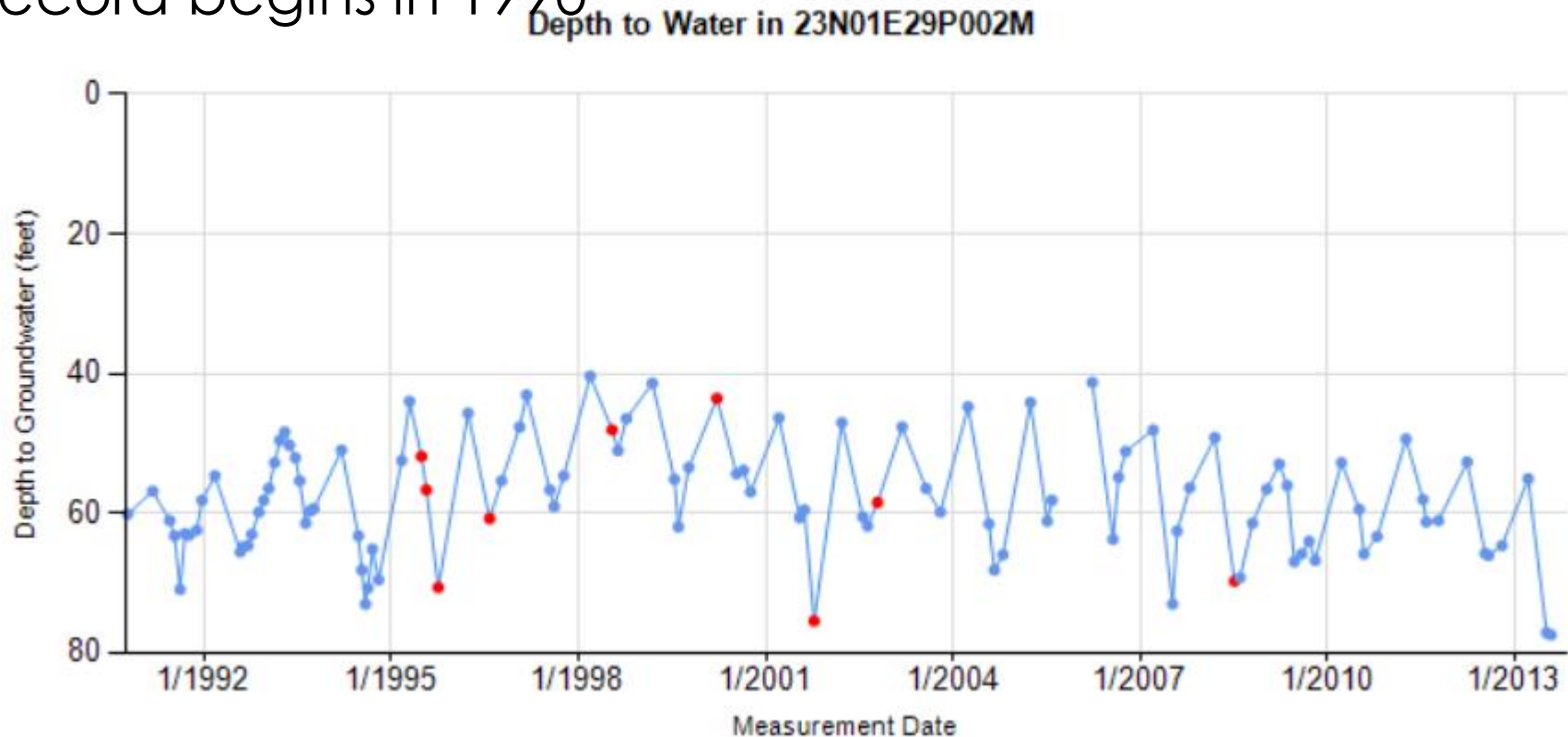
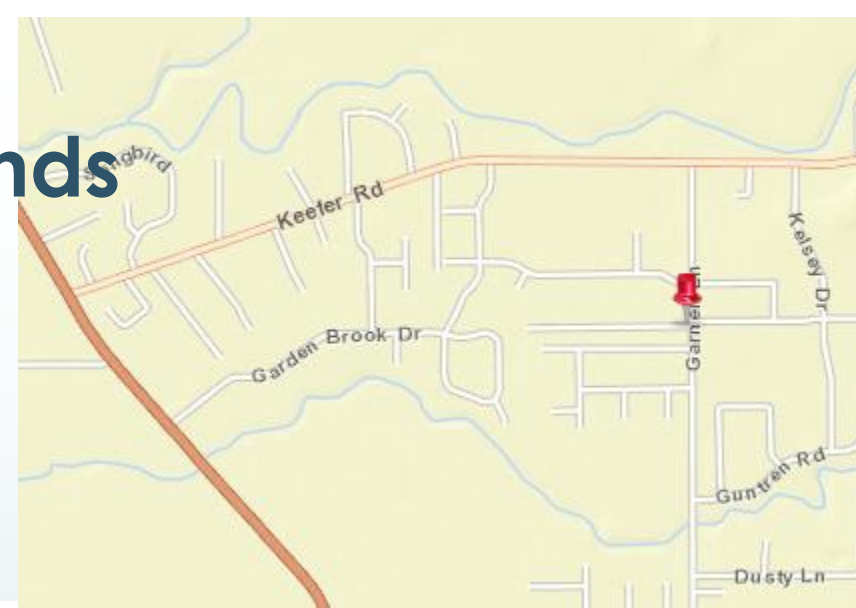
Vina: Domestic
Shallow (<200 ft. total
depth) Basin Deposits
aquifer system.

Record begins in 1959



Groundwater Level Trends

Vina: Domestic,
Shallow/Intermediate
depth Upper Tuscan
Formation
Record begins in 1990



Groundwater Level Trends

Western Canal: Domestic
Shallow well depth
Alluvial aquifer system
Record begins in 1947

