Adelaida Hydrogeology Study

Evaluation of Groundwater Resources in the Adelaida Area, San Luis Obispo County, California

February 27, 2024

Atascadero Library, Atascadero, California

U.S. Geological Survey study, in cooperation with the San Luis Obispo County Flood Control and Water Conservation District;

Upper Salinas-Las Tablas Resource Conservation District

Presentation Outline

- Willow Creek Conservancy Event
- Project purpose, scope, and objectives
- Project timeline
- Adelaida area description and geology
- Hydrologic Data Collection
- Hydrogeologic Framework
- Next steps
- Questions

Photo Credit: Geoff Cromwell, USGS. Public domain.

USLT RCD invites you to Willow Creek Conservancy

UPPER SALINAS-LAS TABLAS RESOURCE CONSERVATION DISTRICT

March 8th, 2024
750 Sleepy Farm Rd

Your local hub to learn about regenerative agriculture & collaborate with technical experts in water, soil and natural resources.

Project Purpose and Scope, and Objectives

SLO County has a specific need to evaluate historical and current hydrogeologic conditions

Purpose and Scope:

- Characterize the hydrology of the Adelaida area, SLO County, California

Objectives:

- Compile and collect geologic, hydrologic, and hydraulic data
- Quantify the hydrologic budget
- Refine the hydrogeologic understanding of the area with respect to geographic, vertical, and temporal variations

Project Timeline

Task 1 – Data compilation; completed Spring 2021

Task 2 – Hydrologic data collection; Spring 2022 – Fall 2024

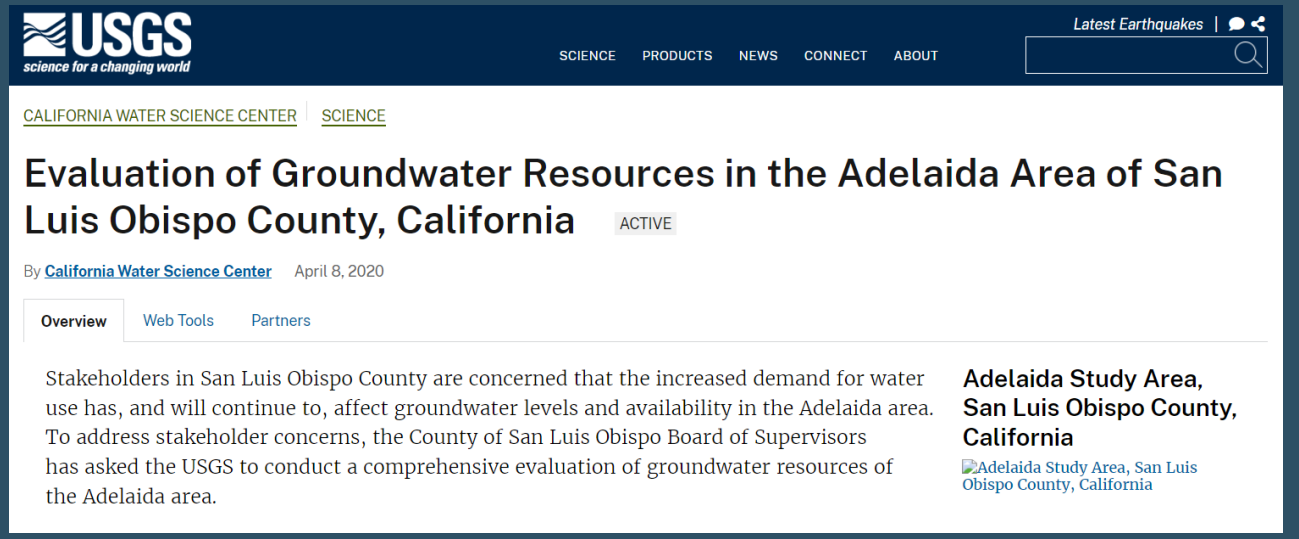
- Streamgage installation and monitoring (Fall 2022 – Fall 2024)
- Groundwater network establishment and monitoring (Fall 2022 – Summer 2024)
- Water-chemistry sampling (Winter 2023)

Task AEM –Hydrogeologic framework using airborne electromagnetic (AEM) survey data

- AEM data evaluation and reprocessing (Summer 2023)
- Hydrogeologic framework (Fall 2022 – Fall 2024)

Websites and outreach

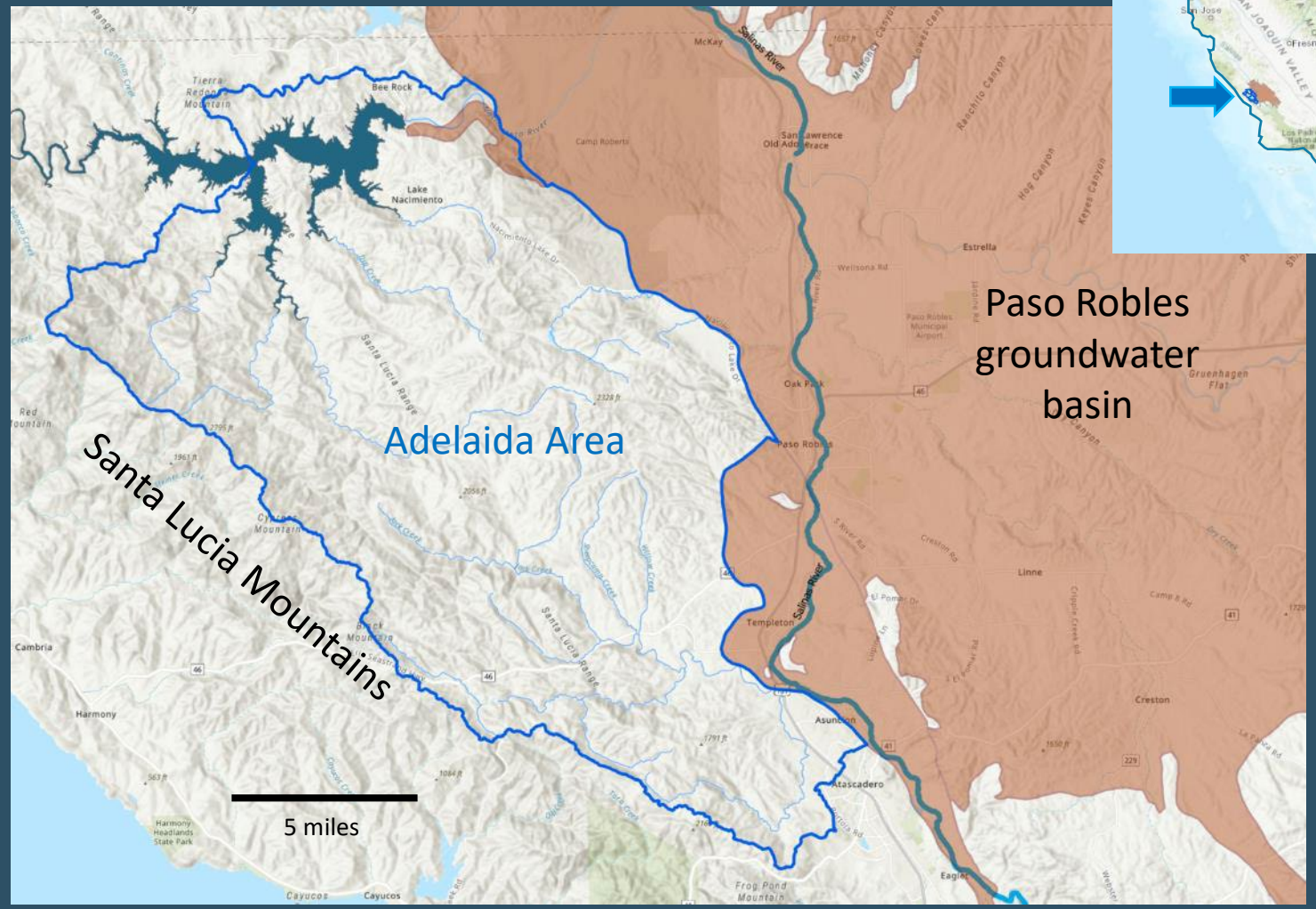
- USGS Project Website
  - Project Summary
  - Interactive map
  - General hydrologic information
  - Selected data
  - Contact information

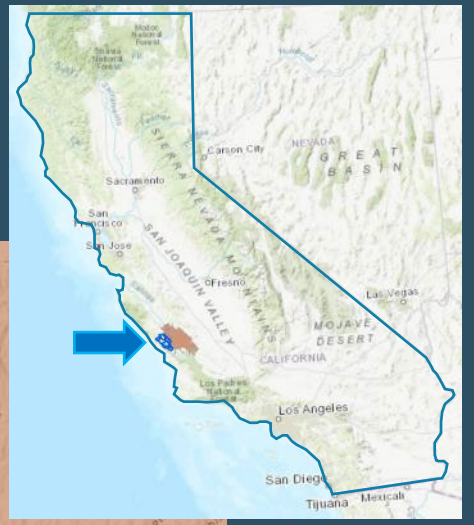


https://go.usa.gov/x7RyJ

Adelaida Area Description

- Inland coastal highlands
  - Historical average annual precipitation about 16–25 inches per year
- Rural domestic and agricultural water users
  - Increased percentage of irrigated agricultural land
- Groundwater is the predominant source of water supply
- ***Not*** a designated groundwater basin
- Little is known about the hydrogeology





California Department of Water Resources (2016); Basemap from ArcPro

USGS science for a changing world

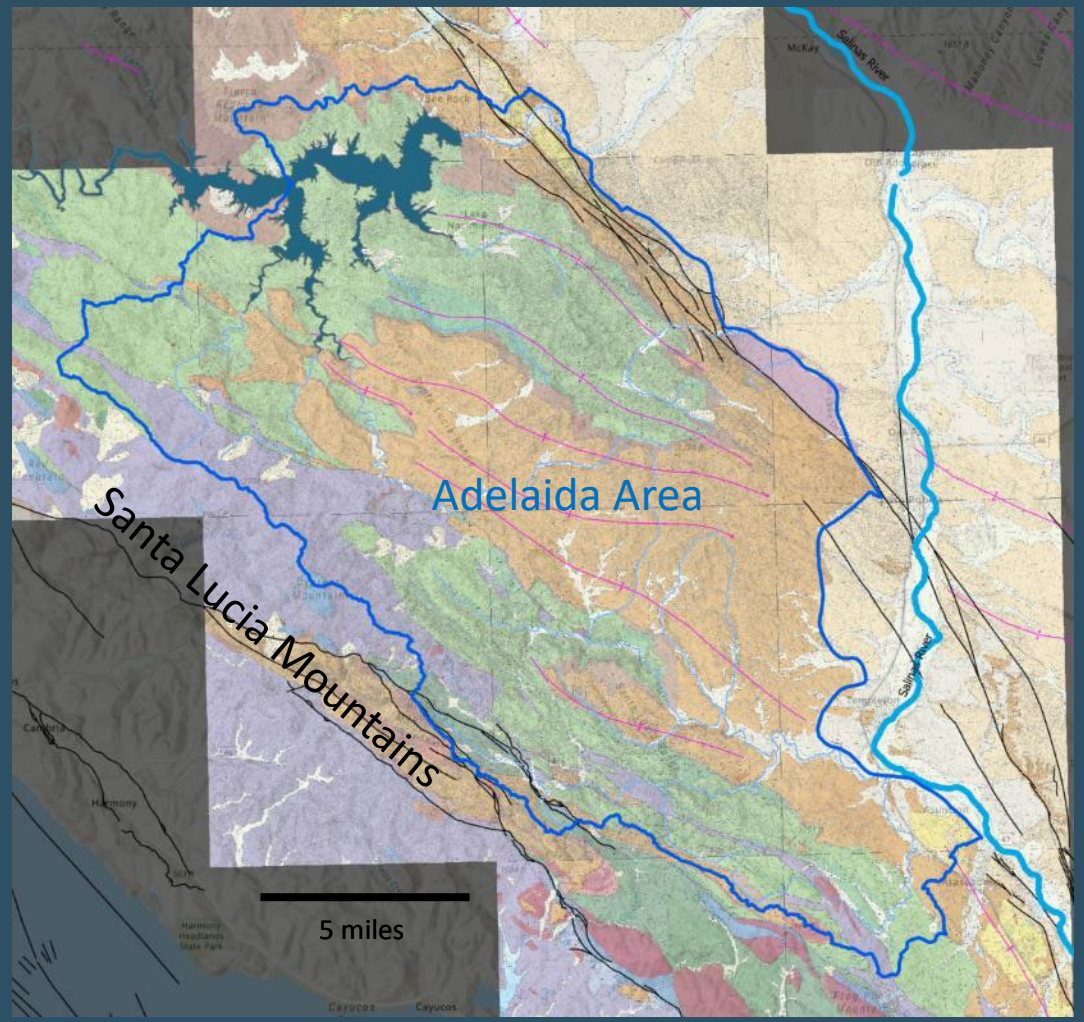
Adelaida Area Geology

Adelaida area geology

Consolidated marine sedimentary rocks

- Surficial sediment
- Monterey Shale
- Vaqueros Sandstone
- Sandstone, clay, and shale
- Franciscan Assemblage
- Serpentine
- Basalt
- Granitic basement rocks

Adelaida area is structurally complex, and comprised of consolidated, fractured sedimentary rocks



Dibblee and Minch, 2004a,b,c, 2006a,b,c,d,e, 2007a,b; Jennings, 2010; U.S. Geological Survey and California Geological Survey, 2019

Paso Robles groundwater basin geology

- Surficial sediment
- Semi-consolidated sedimentary rocks

Adelaida Area Geology

- Most rural domestic and agricultural land use located on Monterey Shale
- Monterey Shale
  - Late-early Miocene, marine
  - Siliceous shale, white-weathered, thin bedded
  - Heterogeneous end-members
- Users may be withdrawing groundwater from:
  - Monterey Shale
  - Overlying surficial sediment
  - Underlying sedimentary rocks
- Evaluate groundwater system with respect to hydrogeology

2016 irrigated farmland and urban land use

- Irrigated
- Usually irrigated
- Urban

(California Department of Conservation, 2019)

County of San Luis Obispo Planning and Building Department - Geographic Technology Section (2017)

Adelaida Area Geology

Cretaceous sandstone

Monterey Shale

Photo Credits: Geoff Cromwell

Task 2 – Hydrologic Data Collection

- Collect new hydrologic data over a period of two years
  - Establish monitoring network
  - Record present-day hydrologic conditions
  - Data can be used to evaluate groundwater system

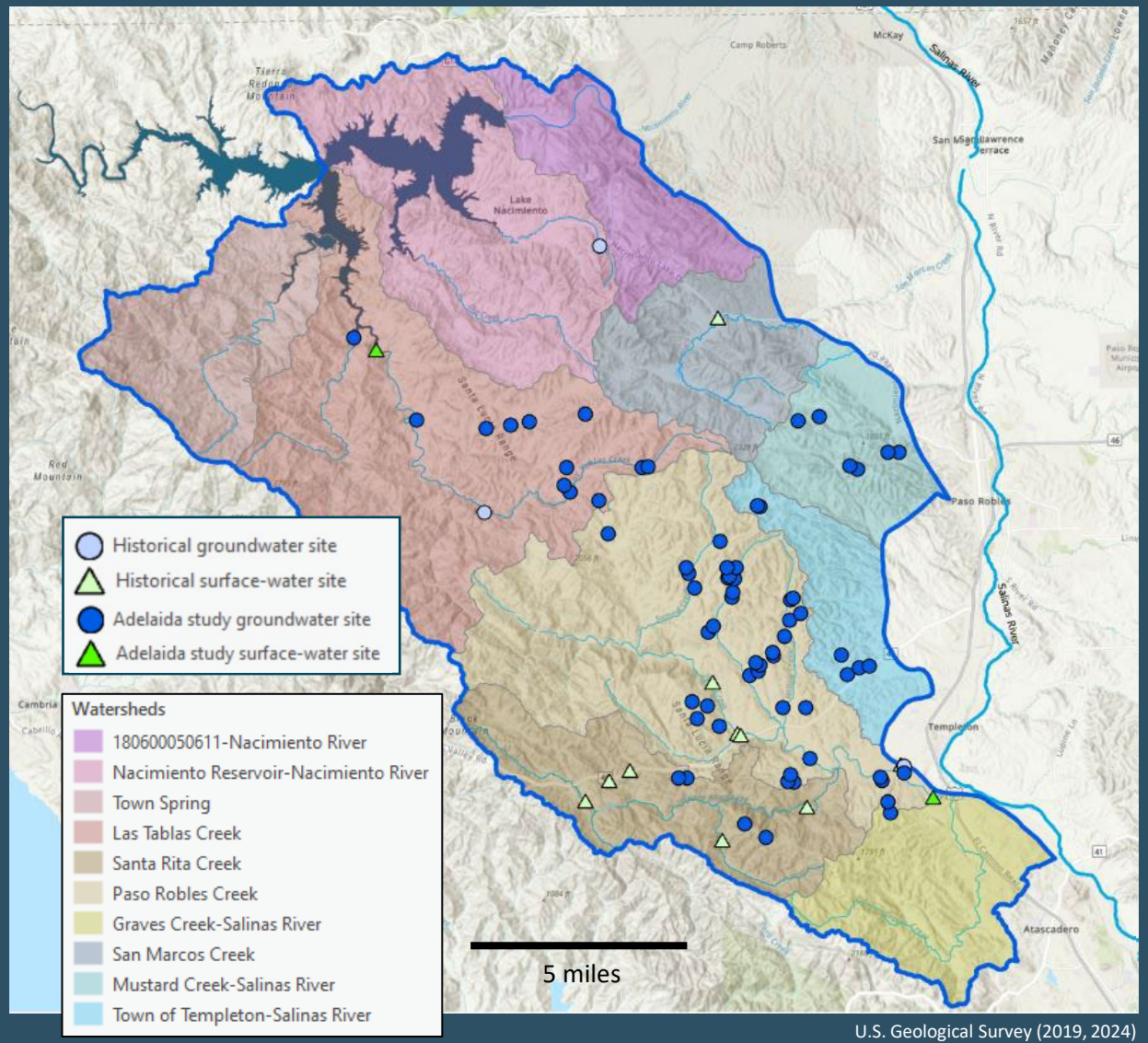
- Three types of data:
  - Surface-water flow
  - Groundwater levels
  - Water chemistry

- All USGS-collected data is publicly available in the (NWIS) database
  - https://nwis.waterdata.usgs.gov/

Task 2 – Hydrologic Data Collection

- Historical USGS sites, prior to 2021:
  - 3 groundwater wells
  - 9 surface-water sites

- USGS sites added during Adelaida study
  - 71 groundwater wells
  - 2 surface-water sites



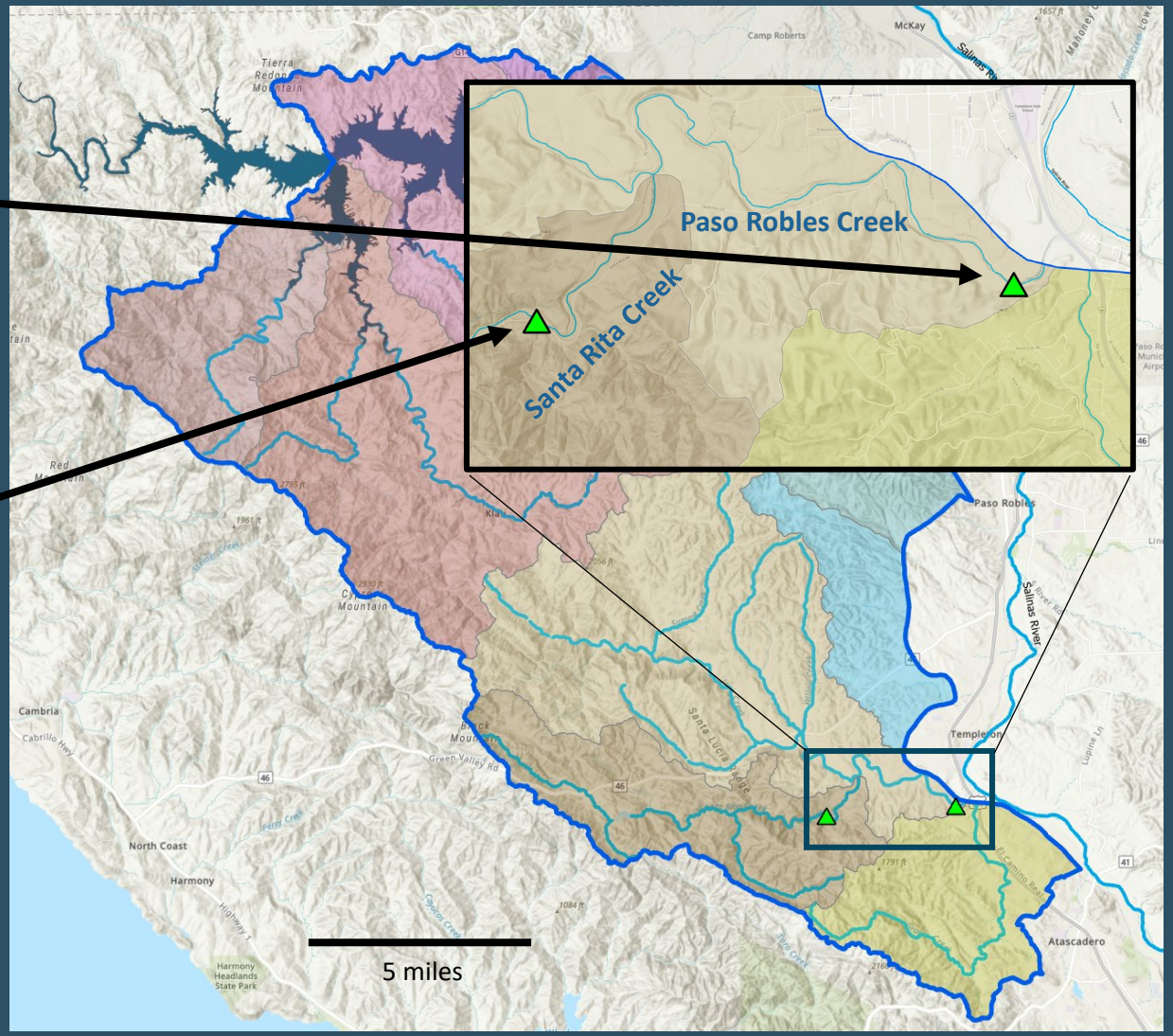
U.S. Geological Survey (2019, 2024)

Task 2 – Surface-Water Flow

- Installed a new streamgage along Paso Robles Creek
  - USGS Site Number 11147098
- Reactivated historical streamgage along Santa Rita Creek
  - USGS Site Number 11147070
- Continuously monitor each streamgage for two years
  - Fall 2022–Fall 2024
- Surface-water data can be used to evaluate the amount of discharge along a stream and be used to analyze groundwater/surface-water interactions

Task 2 – Surface-Water Monitoring

- Paso Robles Creek (11147098)
  - Activated October 25, 2022
- Santa Rita Creek (11147070)
  - Reactivated January 22, 2023
  - Previously active 1960–1994



U.S. Geological Survey (2019, 2024)

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Task 2 – Surface-Water Monitoring

- Paso Robles Creek (11147098)

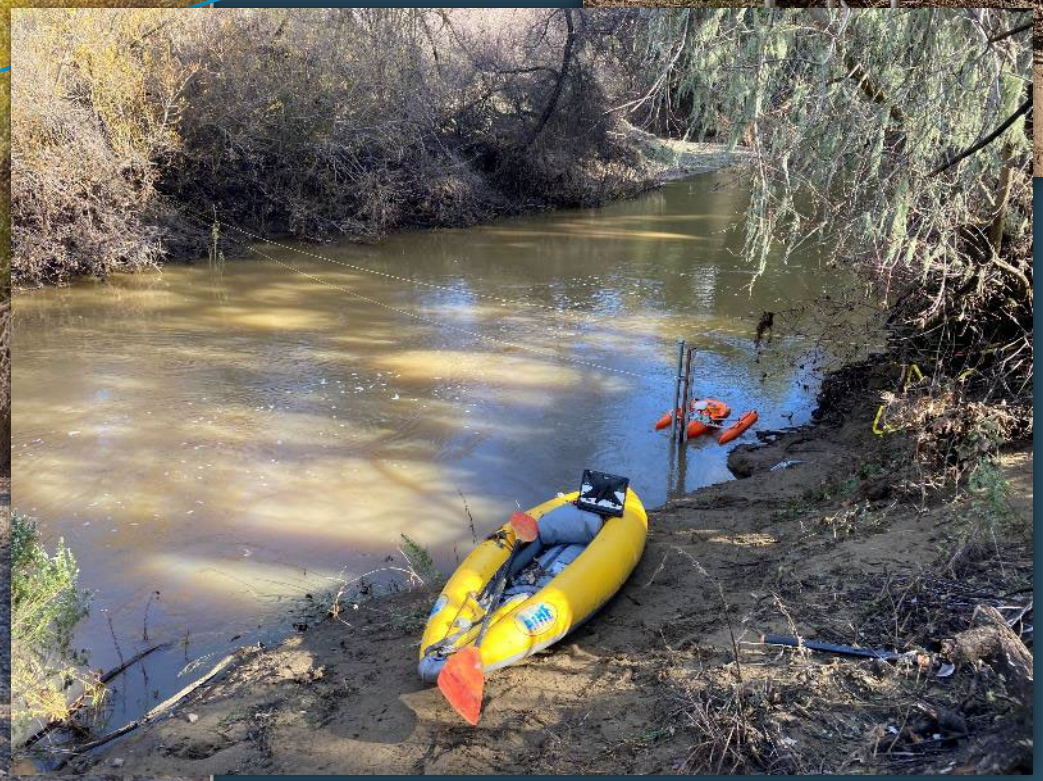

Photo Credits: James Solum

Task 2 – Surface-Water Monitoring

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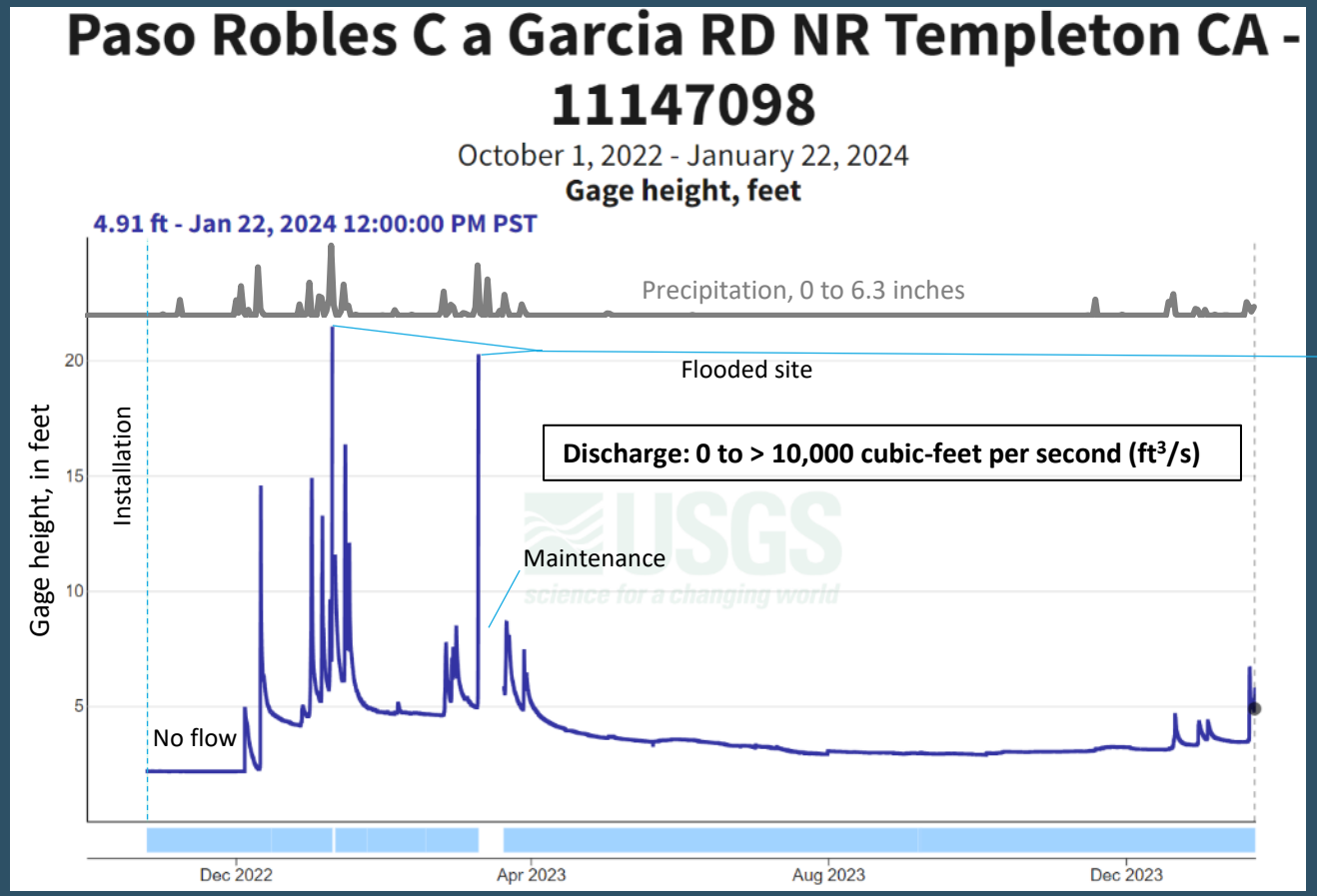

USGS Site Number 11147098 ; U.S. Geological Survey (2024); Precipitation, https://ucce-slo.westernweathergroup.com/

Preliminary Information-Subject to Revision. Not for Citation or Distribution.

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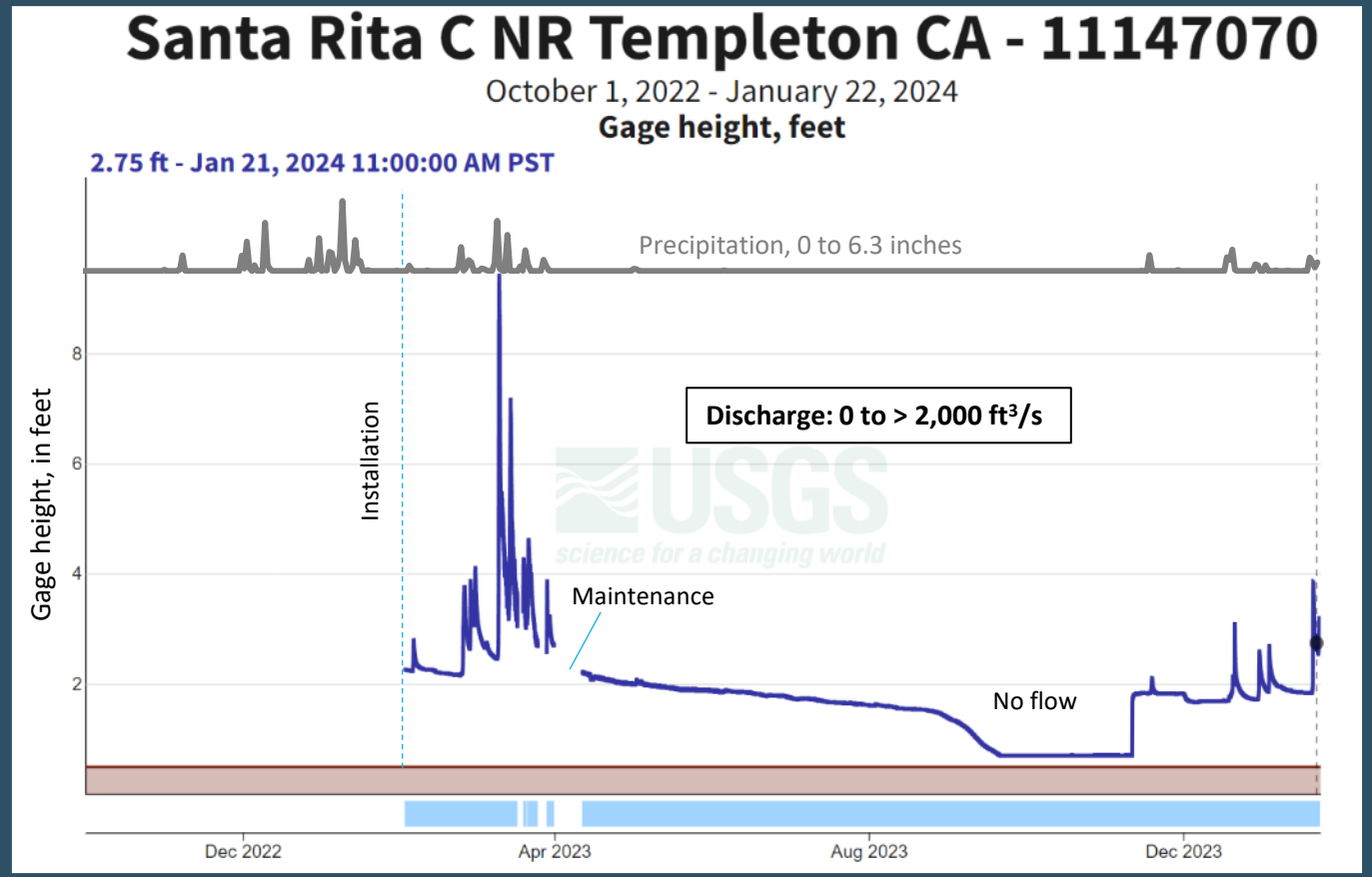
Task 2 – Surface-Water Monitoring

- Santa Rita Creek (11147070)

Photo Credits: James Solum

Task 2 – Surface-Water Monitoring

- Santa Rita Creek (11147070)

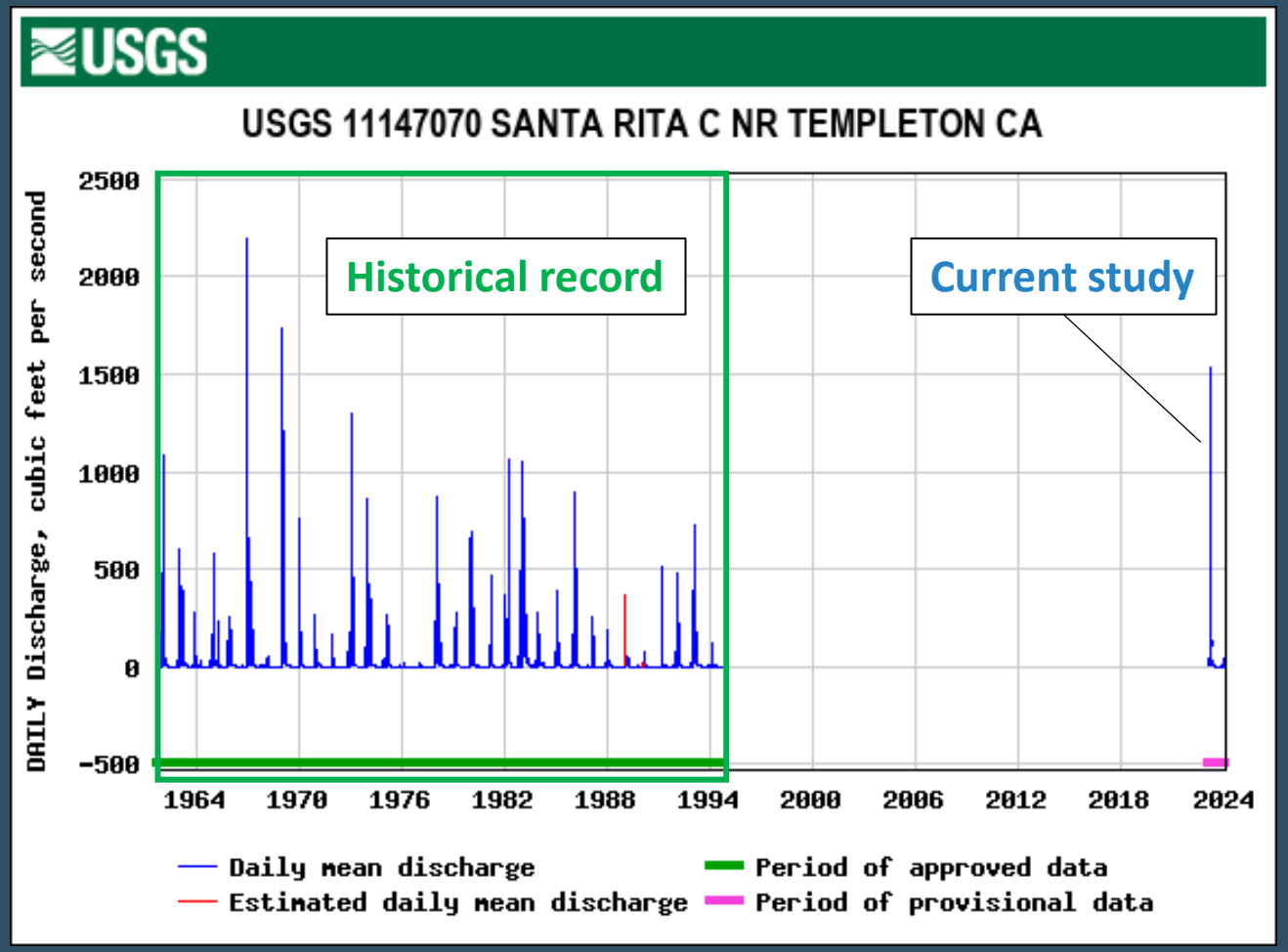


USGS Site Number 11147070; U.S. Geological Survey (2024); Precipitation, https://ucce-slo.westernweathergroup.com/

Photo Credits: James Solum

Task 2 – Surface-Water Monitoring

- Santa Rita Creek (11147070)



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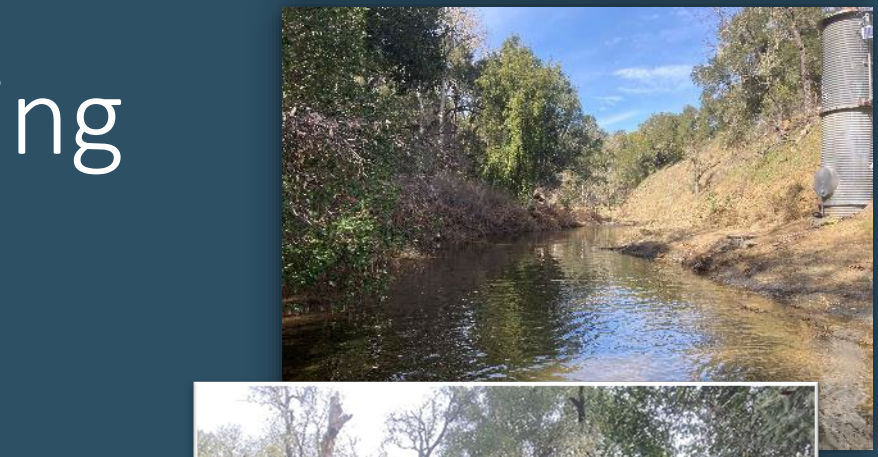
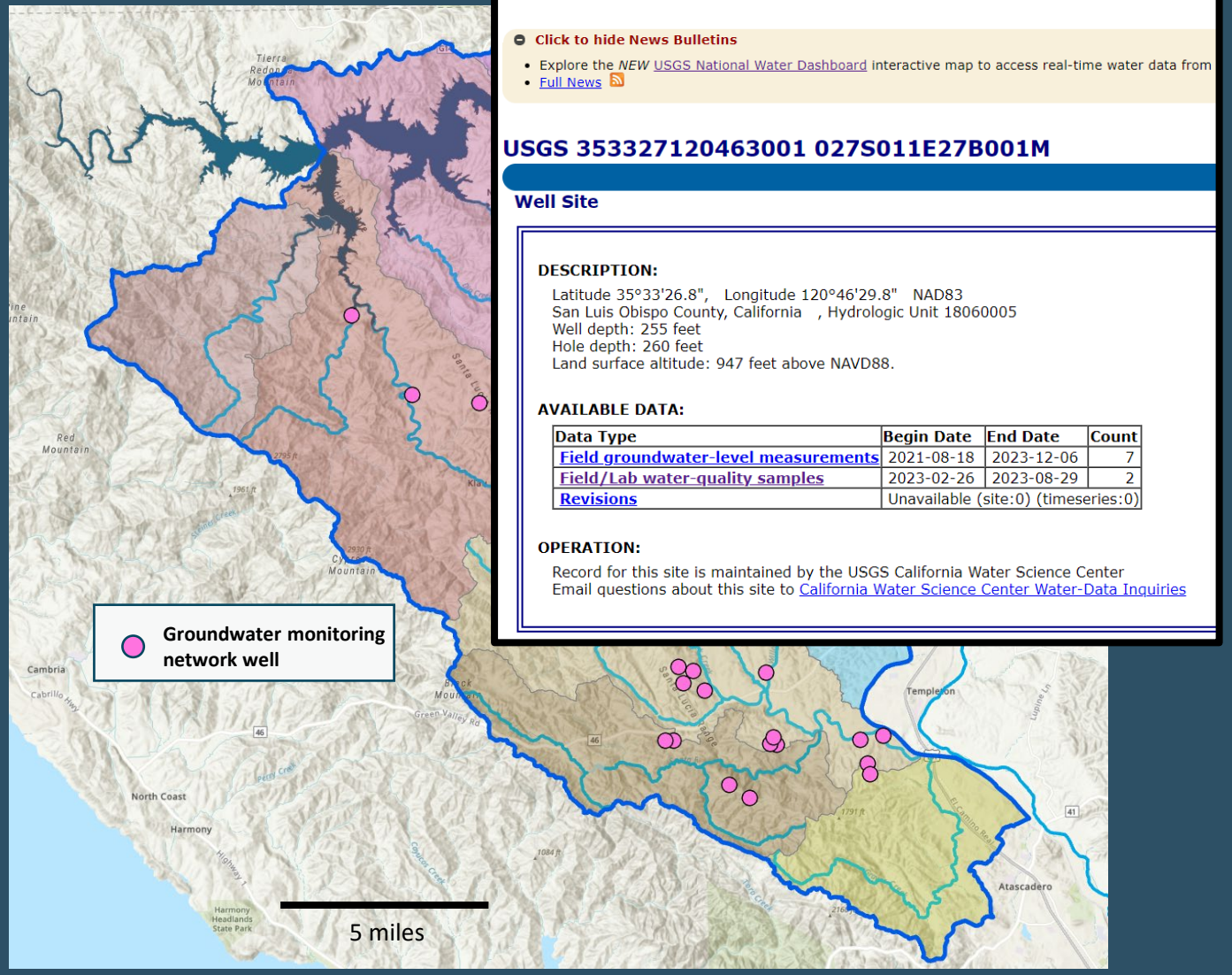


Photo Credits: James Solum

Task 2 – Groundwater-Level Mor

- Groundwater-monitoring network
  - 60 wells
    - 26 - domestic
    - 8 - irrigation
    - 18 - mixed use
    - 8 - unused
- Quarterly measurements
  - August 2022 – June 2024
- Continuous groundwater-level monitoring
  - USGS pressure transducers at 2 unused wells
  - Landowner instrumentation
- All groundwater-level data are in NWIS
  - https://nwis.waterdata.usgs.gov/



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National Water Information System: Web Interface

USGS Water Resources (District Access)

Click to hide News Bulletins

- Explore the *NEW* USGS National Water Dashboard interactive map to access real-time water data from
- Full News

USGS 353327120463001 027S011E27B001M

Well Site

DESCRIPTION:

Latitude 35°33'26.8", Longitude 120°46'29.8" NAD83
San Luis Obispo County, California , Hydrologic Unit 18060005
Well depth: 255 feet
Hole depth: 260 feet
Land surface altitude: 947 feet above NAVD88.

AVAILABLE DATA:

Data Type	Begin Date	End Date	Count
Field groundwater-level measurements	2021-08-18	2023-12-06	7
Field/Lab water-quality samples	2023-02-26	2023-08-29	2
Revisions	Unavailable (site:0) (timeseries:0)		

OPERATION:

Record for this site is maintained by the USGS California Water Science Center
Email questions about this site to California Water Science Center Water-Data Inquiries

U.S. Geological Survey (2019, 2024)

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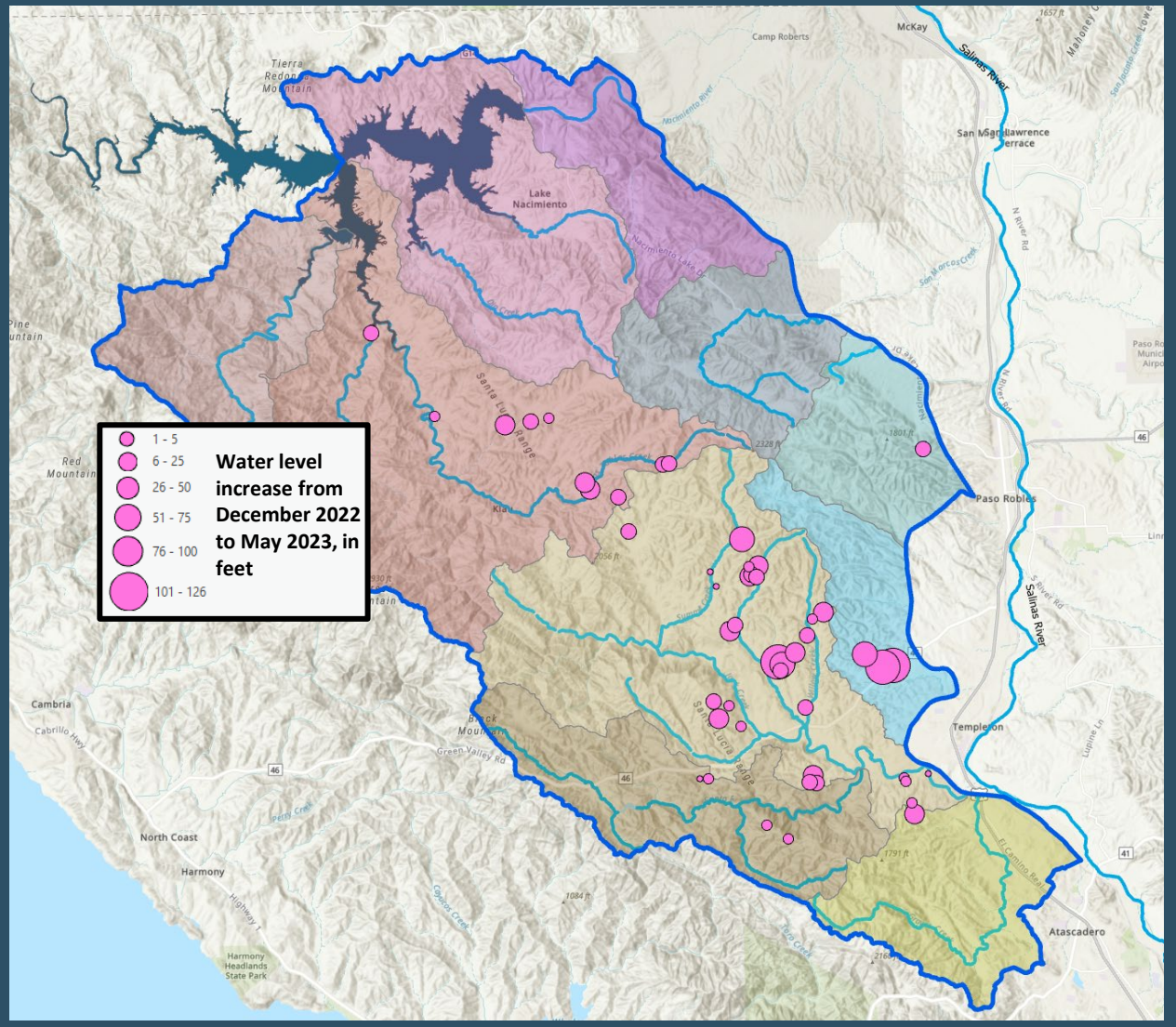
Task 2 – Groundwater-Level Monitoring

- Groundwater response to winter storms was variable
- After 2022–23 winter storms, water levels increased in all measured wells
  - <1 to 126 ft
- Peak increases in water levels occurred in about May 2023
- Since winter 2023, water levels declined in most measured wells
  - From +5 ft to -47 ft



U.S. Geological Survey (2019, 2024)

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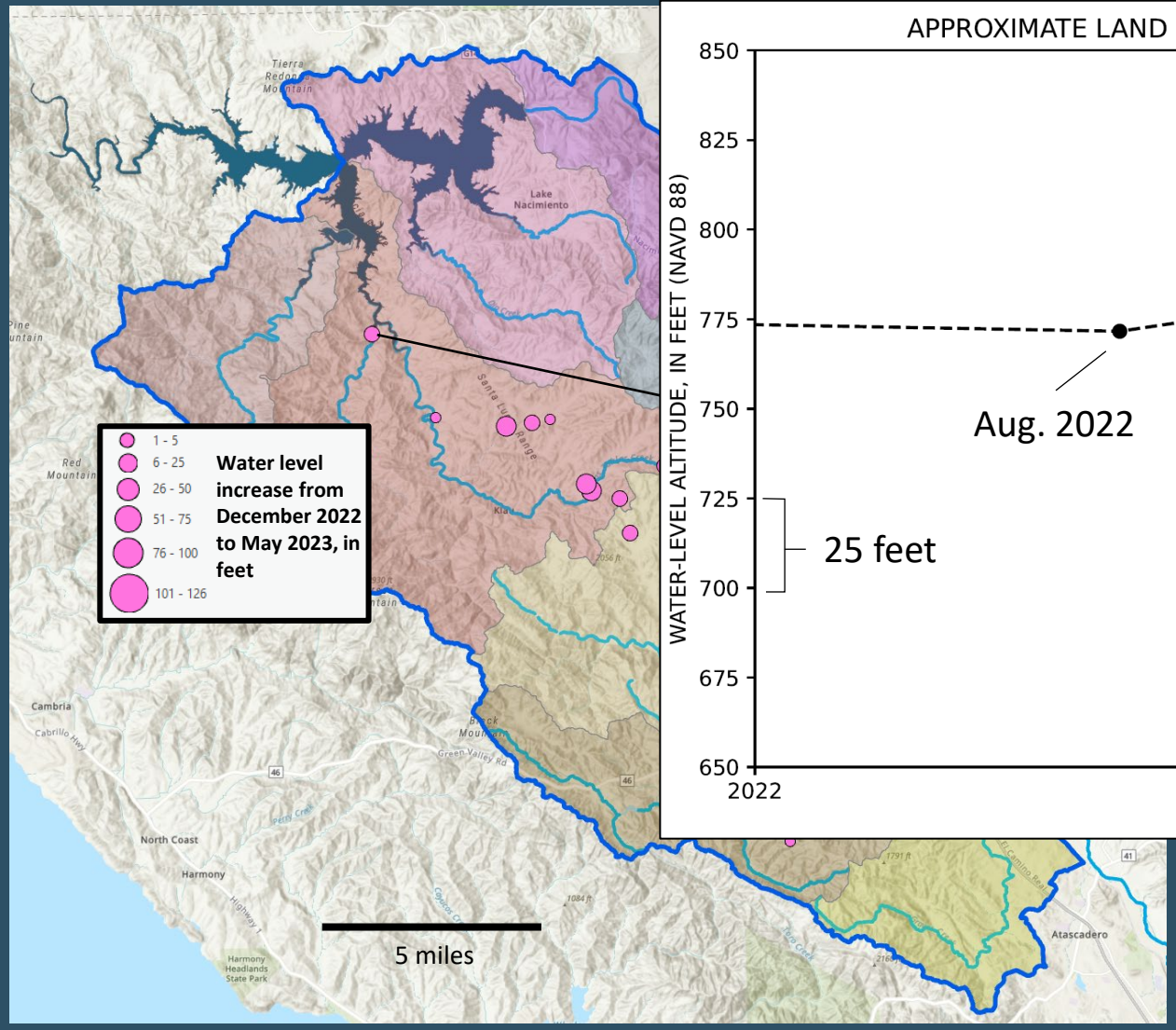

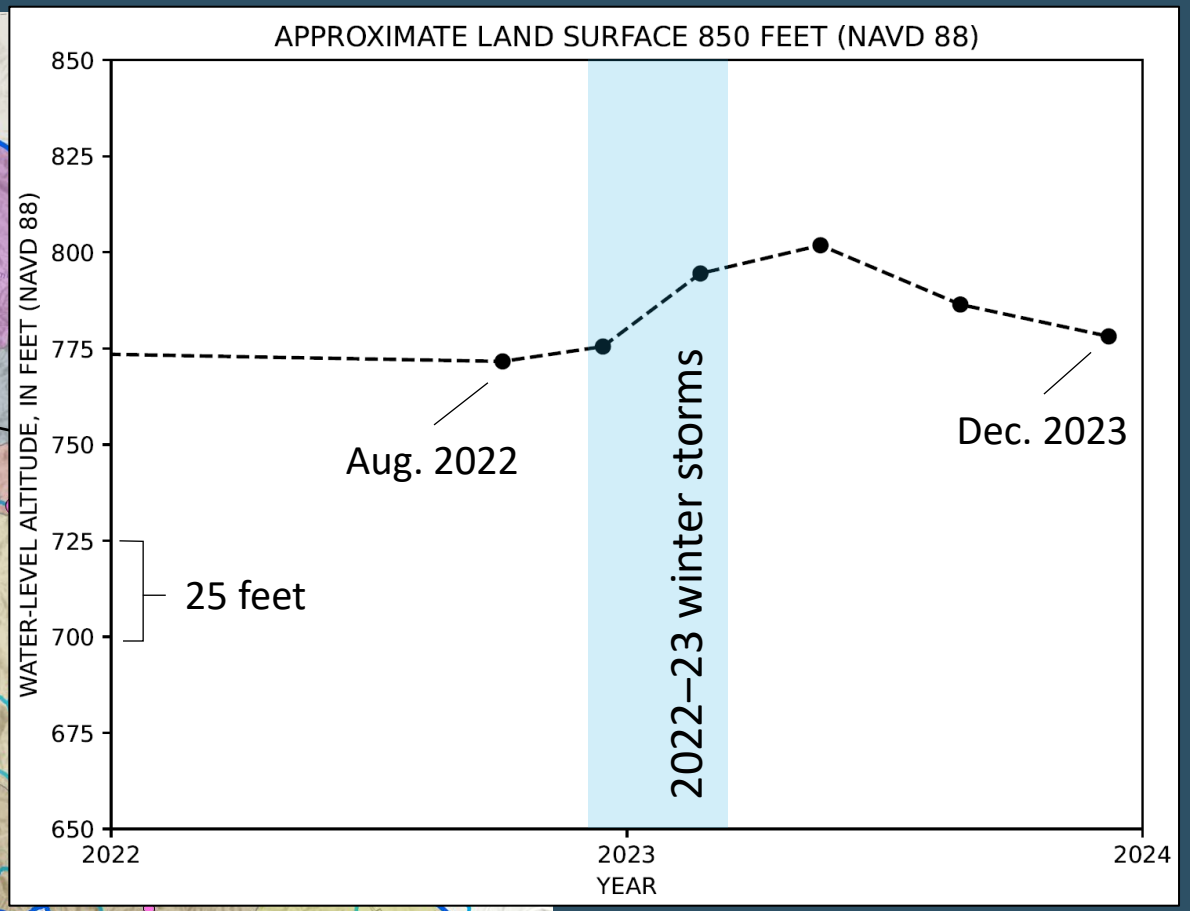

U.S. Geological Survey (2019, 2024)

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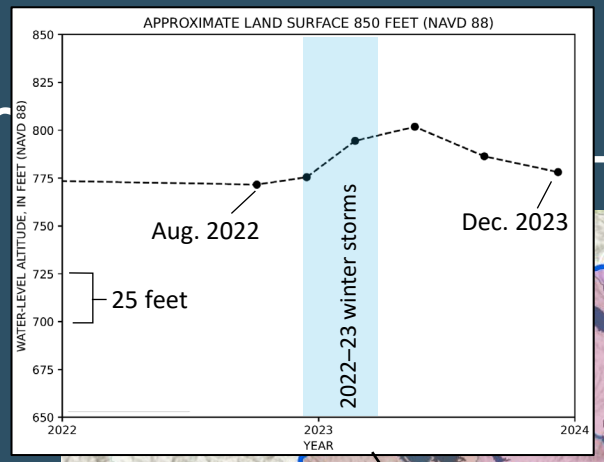
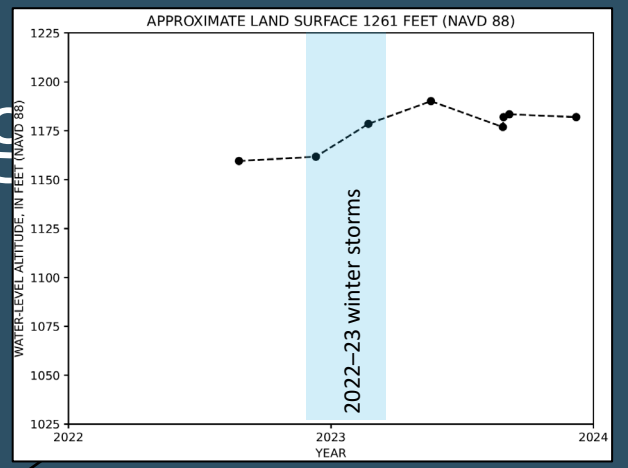
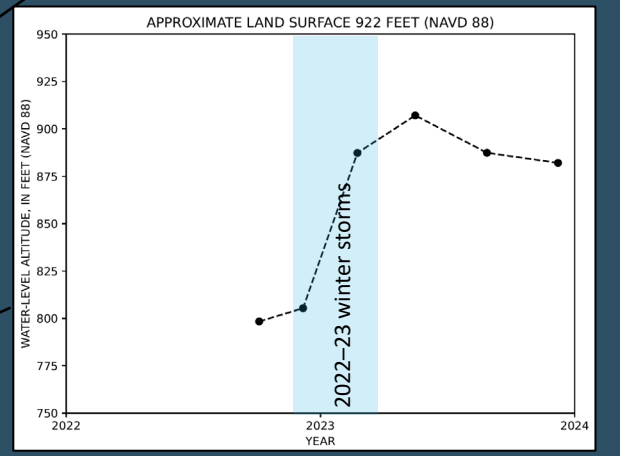
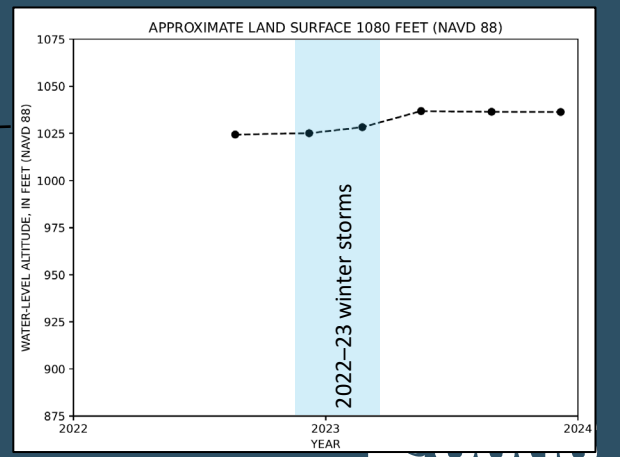
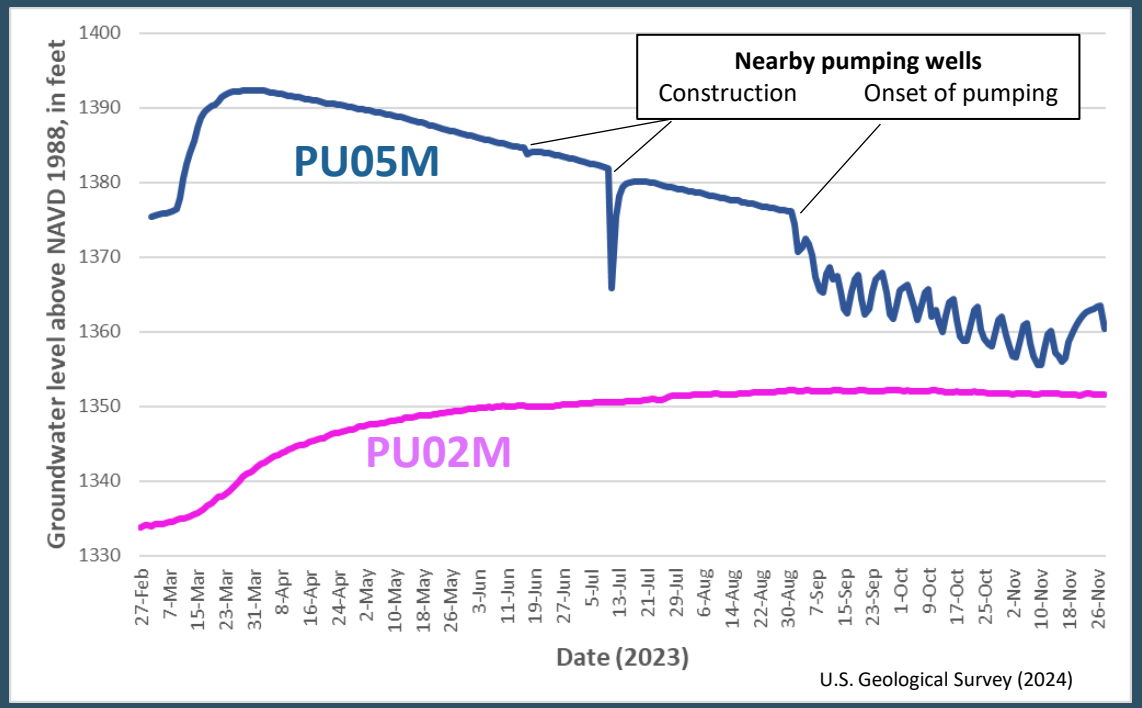








U.S. Geological Survey (2019, 2024)



U.S. Geological Survey (2024)

Continuous groundwater-level monitoring

- USGS pressure transducers
- PU02M, and PU05M

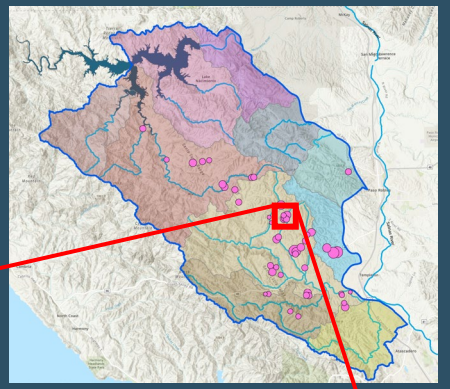
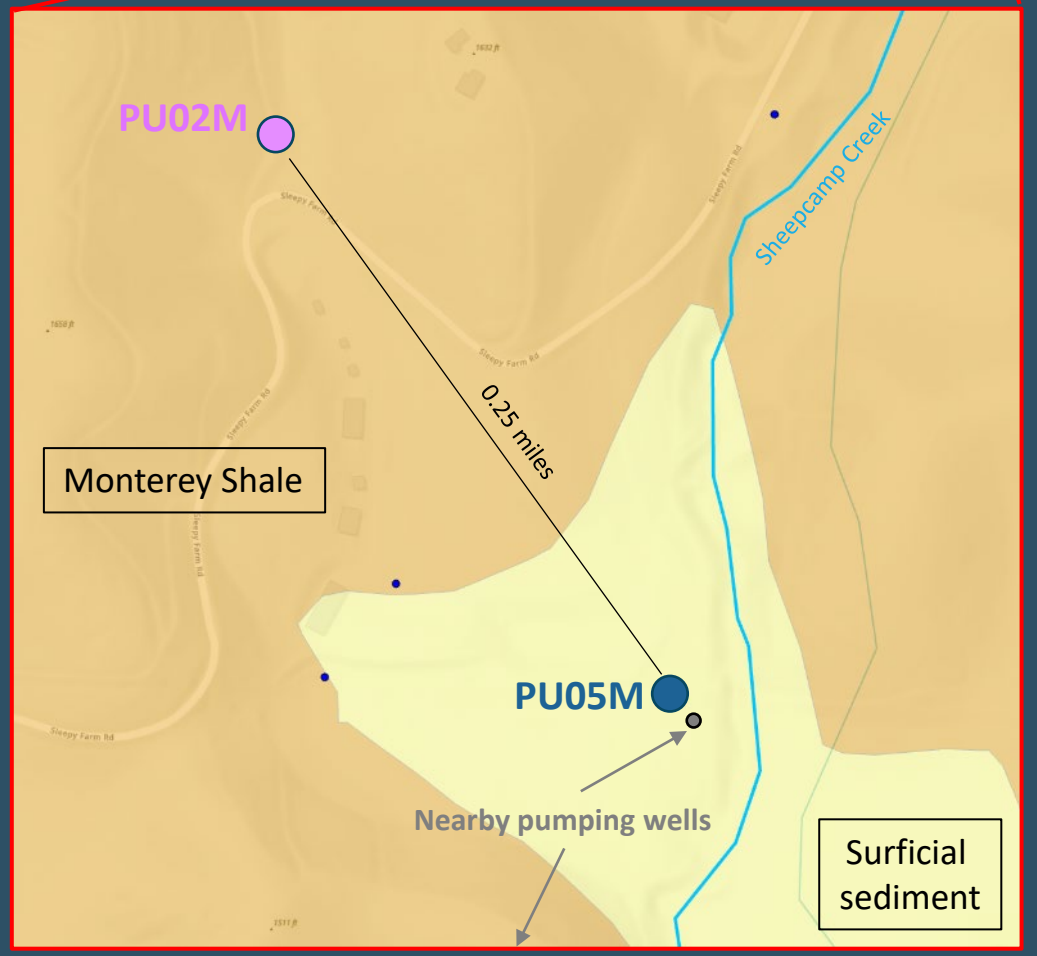


Photo Credits: Geoff Cromwell



County of San Luis Obispo Planning and Building Department - Geographic Technology Section (2017);
U .S. Geological Survey (2019)

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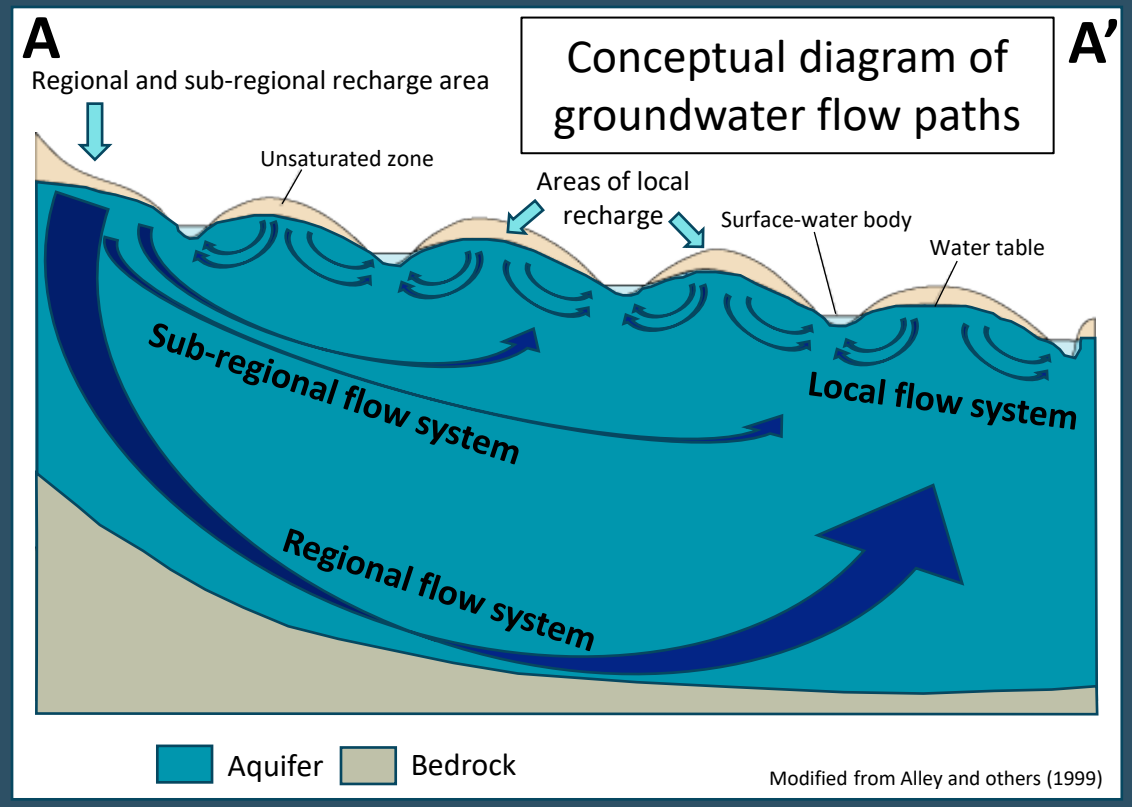
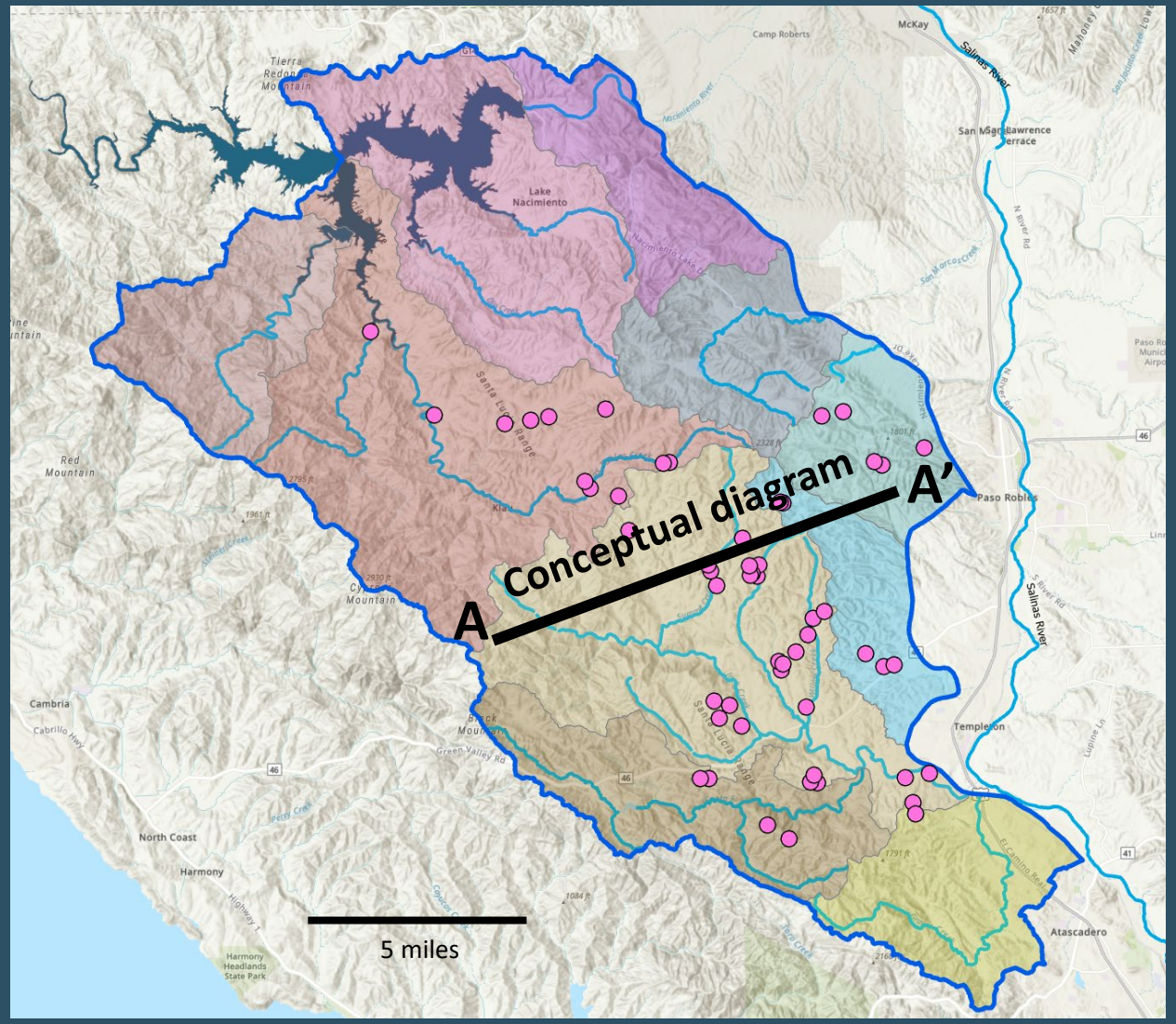
Preliminary Information-Subject to Revision. Not for Citation or Distribution.

Task 2 – Groundwater-level Monitoring

- Conceptual groundwater flow system





U.S. Geological Survey (2019, 2024)

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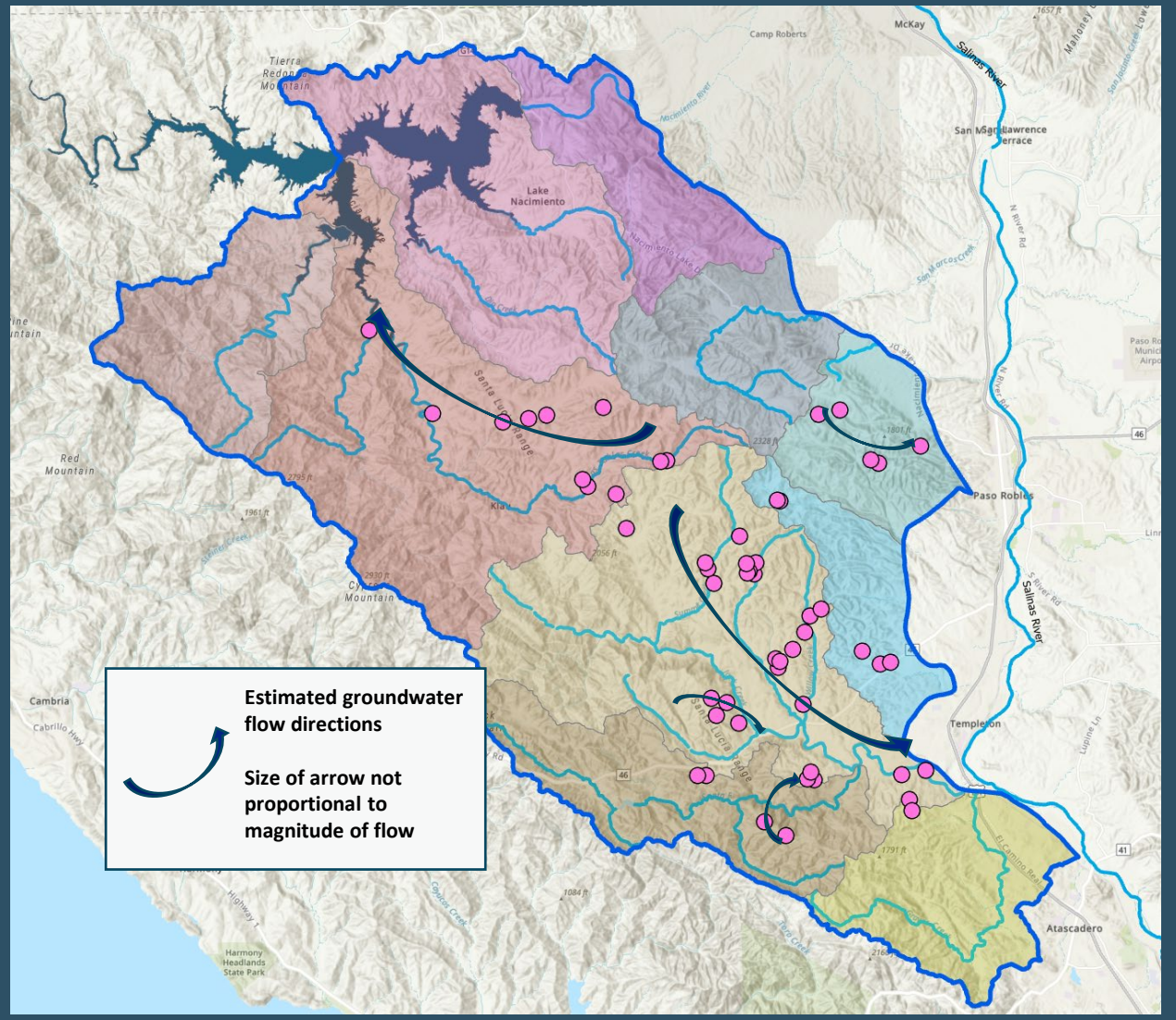
Task 2 – Groundwater-level Monitoring

- Preliminary groundwater flow directions from groundwater-level measurements
  - Flow from higher altitudes
    - Northeast and southeast from the Santa Lucia Mountains (minimal data)
    - Southeast towards Salinas River
    - Northwest towards Lake Nacimiento
  - Flow may or may not be controlled by subsurface geologic structure
  - Flow may or may not align with surface drainages
  - Can be evaluated with hydrogeologic framework, AEM data, and water quality data



U.S. Geological Survey (2019, 2024)

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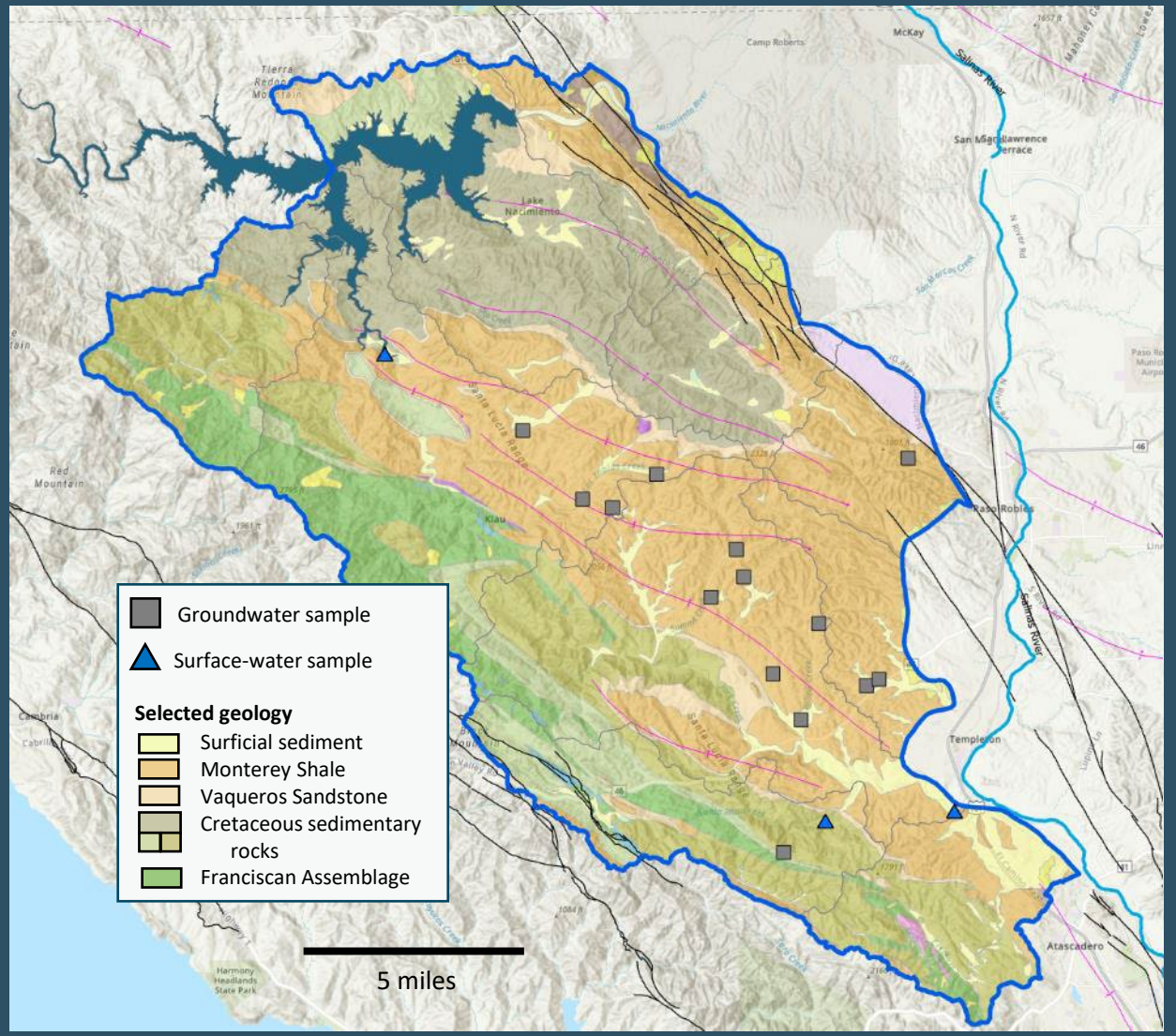
Task 2 – Water-Chemistry Sampling

- Samples collected in Feb–Mar 2023:
  - 14 wells, 3 surface-water sites
- Sampled for:
  - Major, minor, and trace ions
  - Nutrients
  - Stable isotopes of oxygen and hydrogen
  - Tritium and carbon-14/13 (wells only)
  - Field parameters (wells only)
- Water-chemistry data can be used to:
  - Characterize the source(s), movement, and age of groundwater
  - Identify the source and climatic conditions at the time of groundwater recharge



County of San Luis Obispo Planning and Building Department - Geographic Technology Section (2017); Jennings, 2010; U.S. Geological Survey and California Geological Survey, 2019

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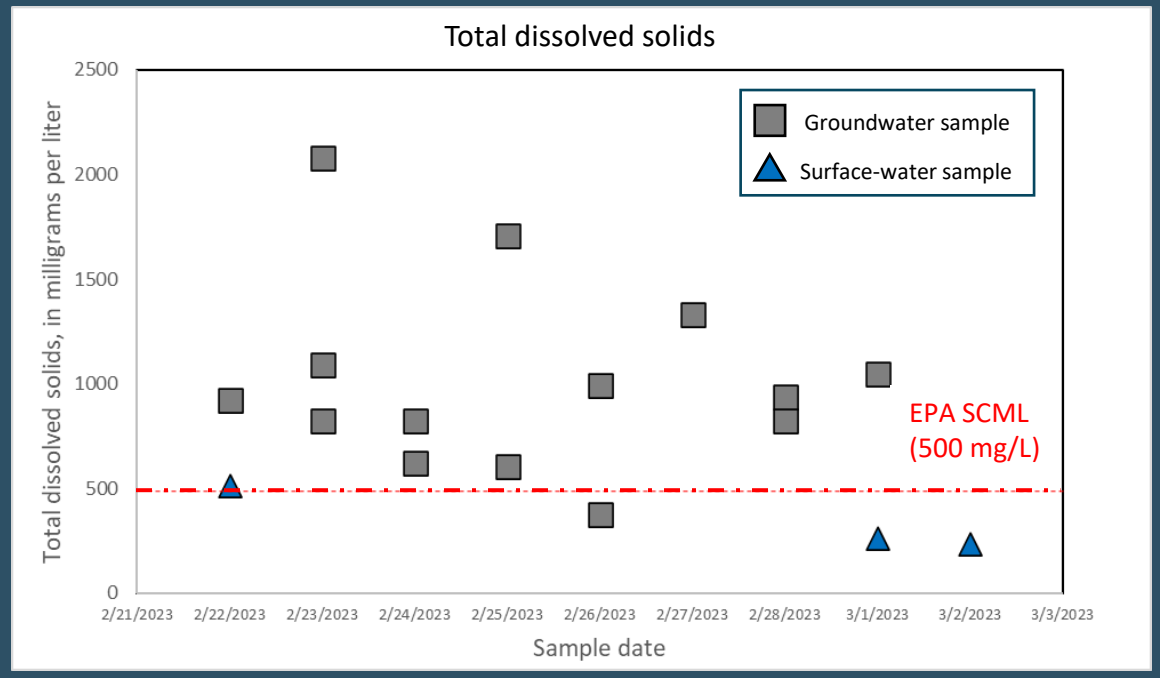
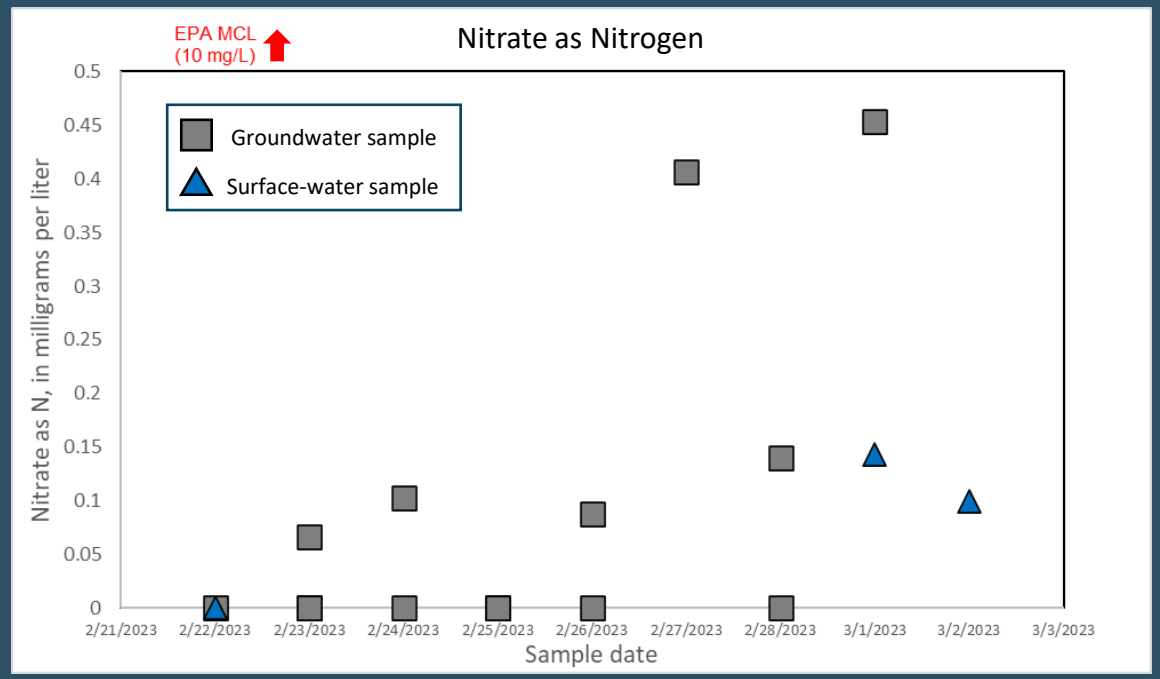
Task 2 – Water-Chemistry Sampling

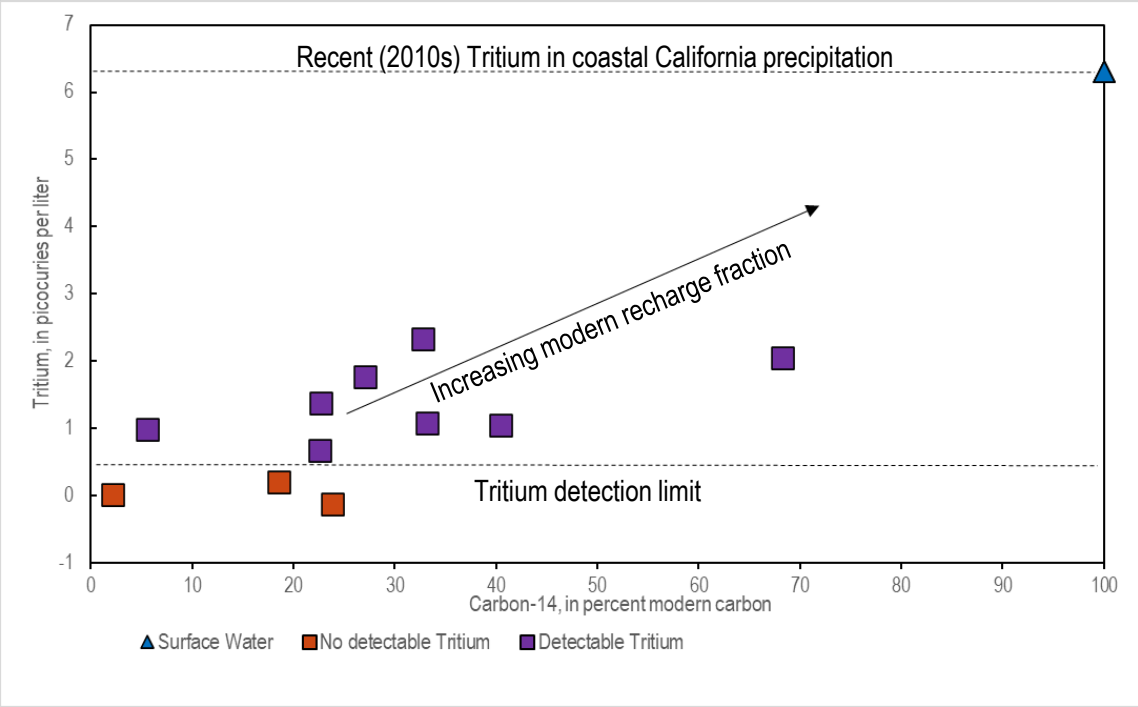
- U.S Environmental Protection Agency (EPA) contaminant levels for drinking water
  - MCL – Maximum contaminant level
  - SMCL – Secondary maximum contaminant level
- Most major ion concentrations are below their EPA MCL or SMCL
- Ion concentrations in groundwater may be associated with geologic units
- All water quality data are in NWIS
  - https://nwis.waterdata.usgs.gov/



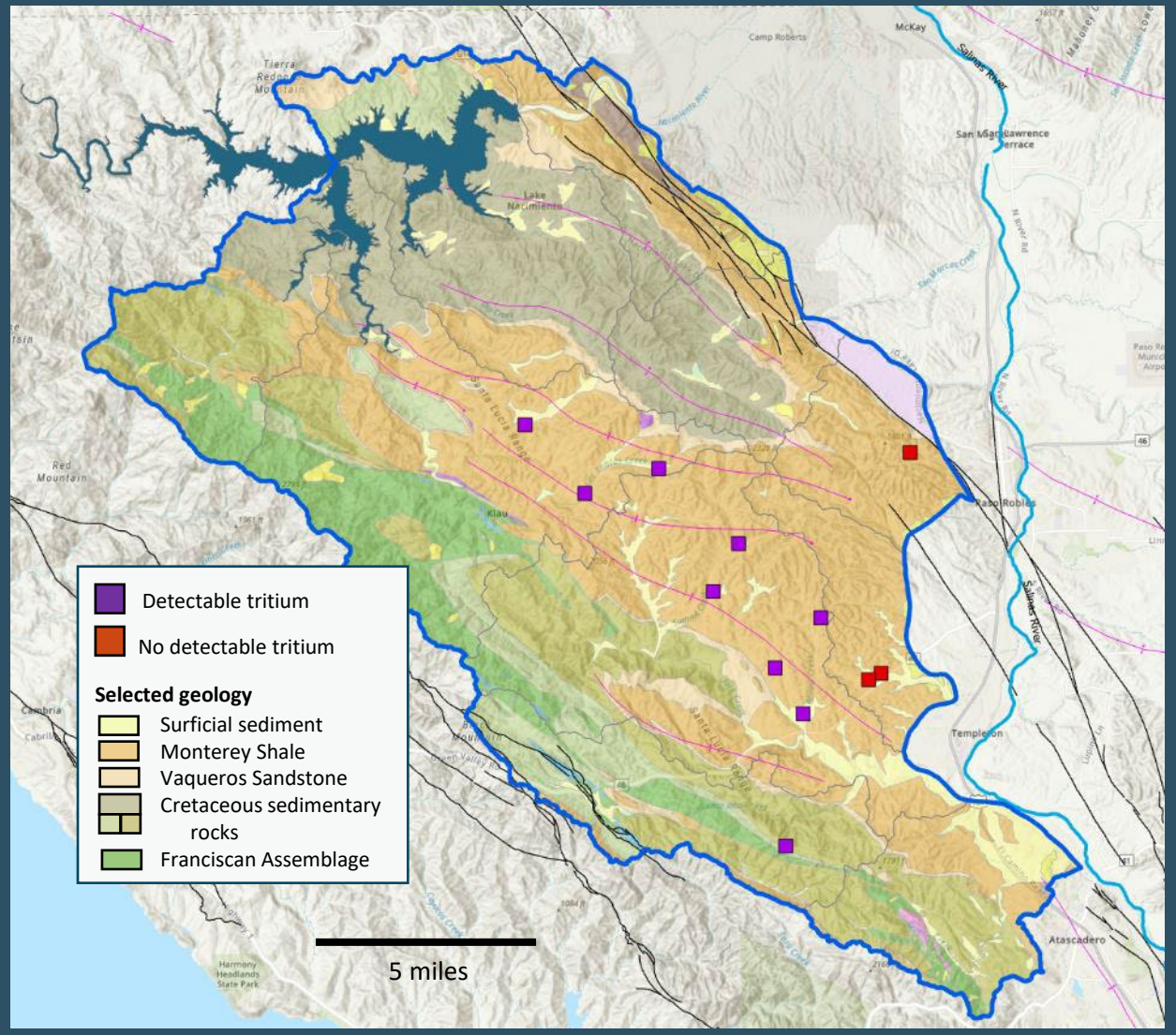


Task 2 – Water-Chemistry Sampling

- Age dating – Tritium and Carbon-14
  - Presence of tritium indicates recharge after 1952
  - More recent recharge has a greater percentage of modern carbon



U.S. Geological Survey (2024)



County of San Luis Obispo Planning and Building Department - Geographic Technology Section (2017); Jennings, 2010; U.S. Geological Survey and California Geological Survey, 2019

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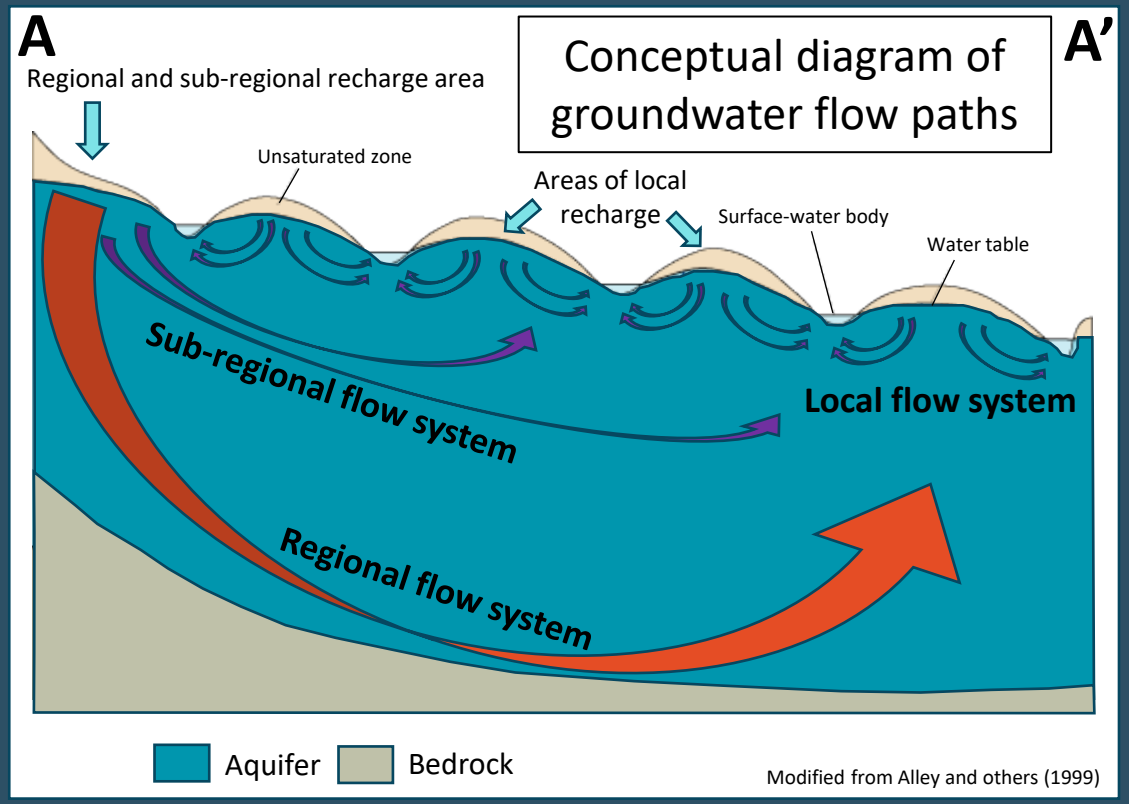

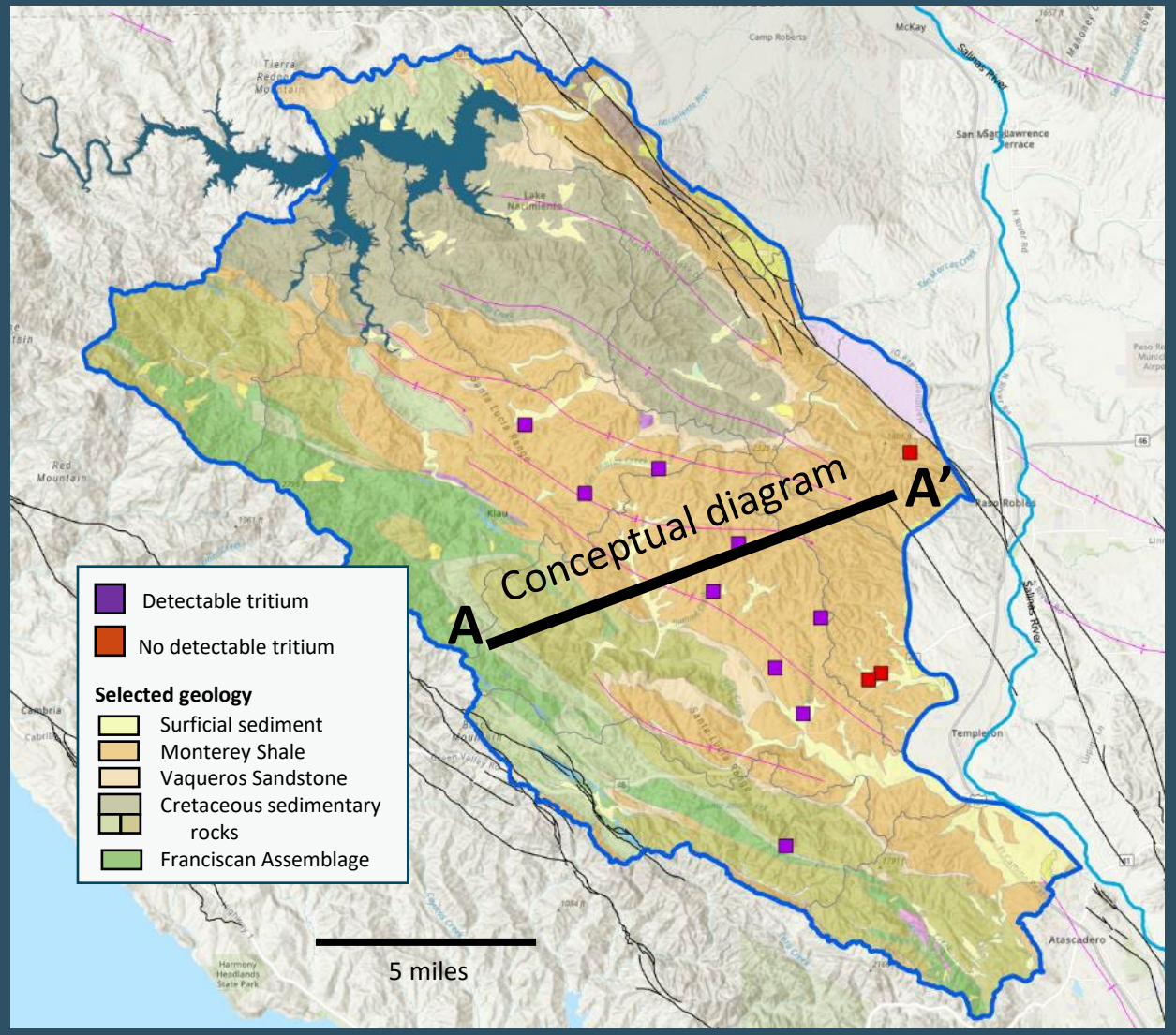

County of San Luis Obispo Planning and Building Department - Geographic Technology Section (2017); Jennings, 2010; U.S. Geological Survey and California Geological Survey, 2019

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Summary of Current Work

- **Task 2** – Hydrologic data collection
  - Installed and currently monitoring two streamgages on Paso Robles Creek and Santa Rita Creek
  - Established groundwater monitoring network
    - Currently measuring groundwater-levels at more than 60 wells
    - Continuously monitoring groundwater-levels at two unused wells
  - Collected water chemistry samples from 14 wells and 3 surface-water sites

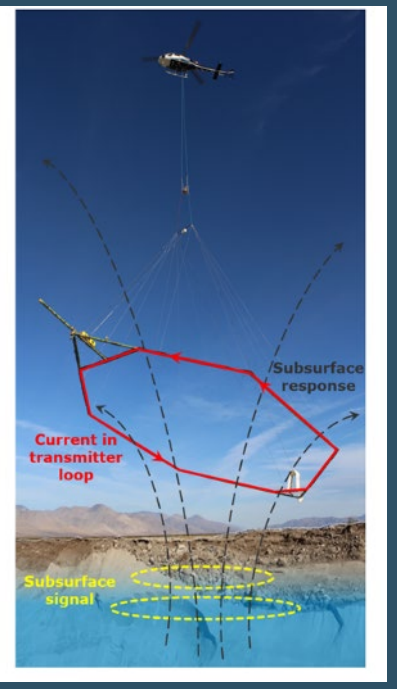
- Groundwater-level response to winter storms was variable
- Most wells have some fraction of modern recharge
- Geologic influence on recharge response and water chemistry

Task AEM – Hydrogeologic Evaluation using Airborne Electromagnetic Survey Data

- Evaluate hydrogeology using airborne electromagnetic (AEM) survey data
  - Construct 3D hydrogeologic framework
  - Support hydrologic investigation

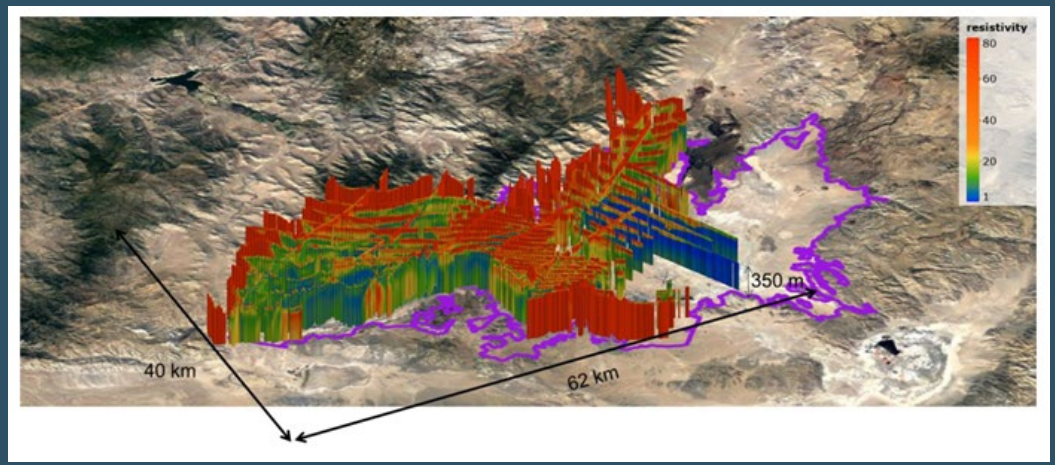
- AEM survey data collected by California DWR
  - Funded by voter-approved Proposition 68, Senate Bill 5, and general fund

- Analysis funded by USGS Integrated Water Availability Assessments (IWAAs) program



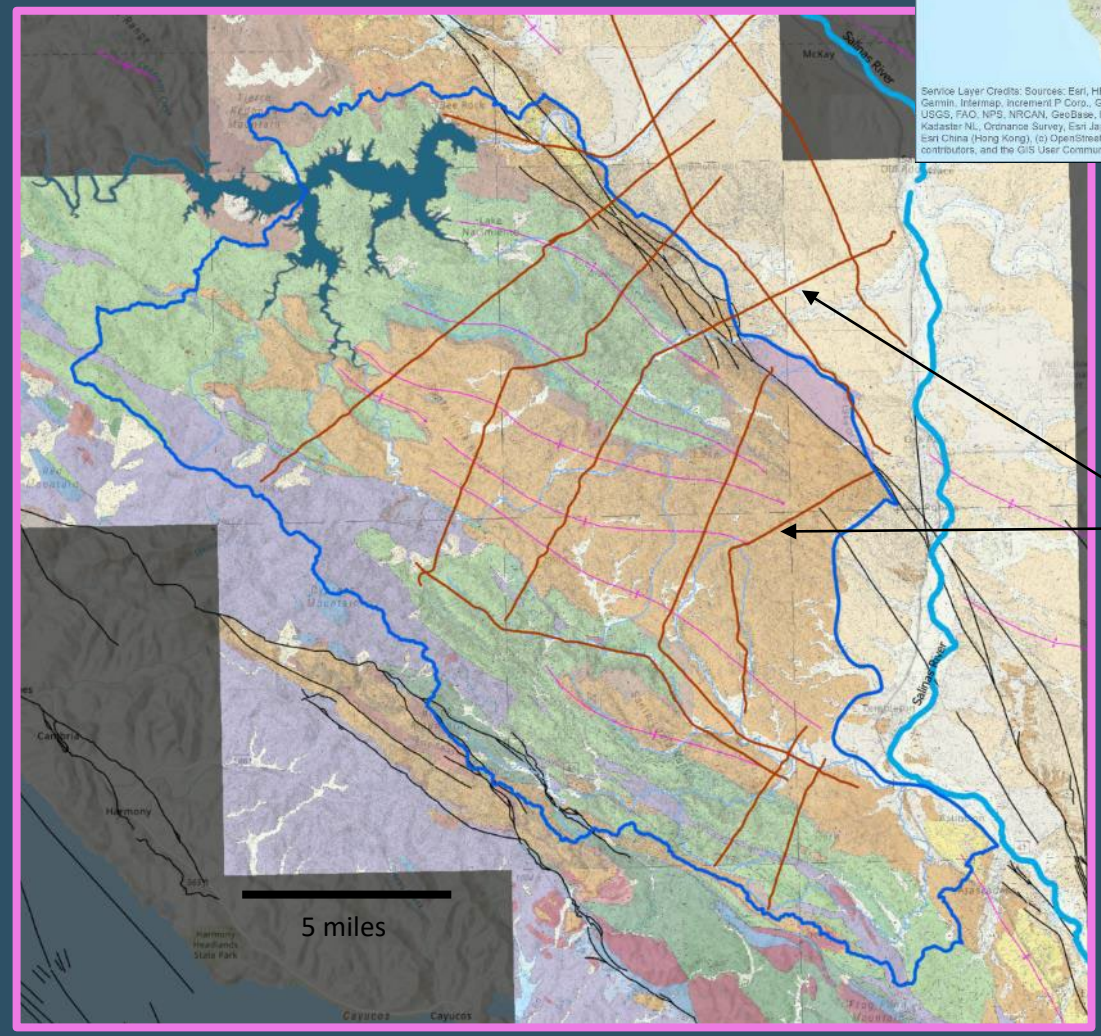
Example images of AEM survey equipment, methodology, and example data

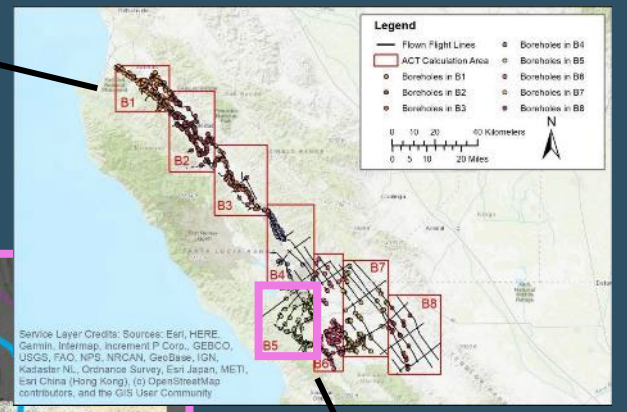
- https://water.ca.gov/Programs/Groundwater-Management/Data-and-Tools/AEM



Airborne Electromagnetic Survey Data

- AEM surveys flown in August 2021
  - Survey Area 1 – Salinas Valley
  - 152 km of line data
- Raw and processed data available
  - https://data.cnra.ca.gov/dataset/aem
- Survey lines selected to cross geologic units and structures, avoid infrastructure





California Department of Water Resources (2022)

AEM survey flightlines

Dibblee and Minch, 2004a,b,c, 2006a,b,c,d,e, 2007a,b; Jennings, 2010; U.S. Geological Survey and California Geological Survey, 2019

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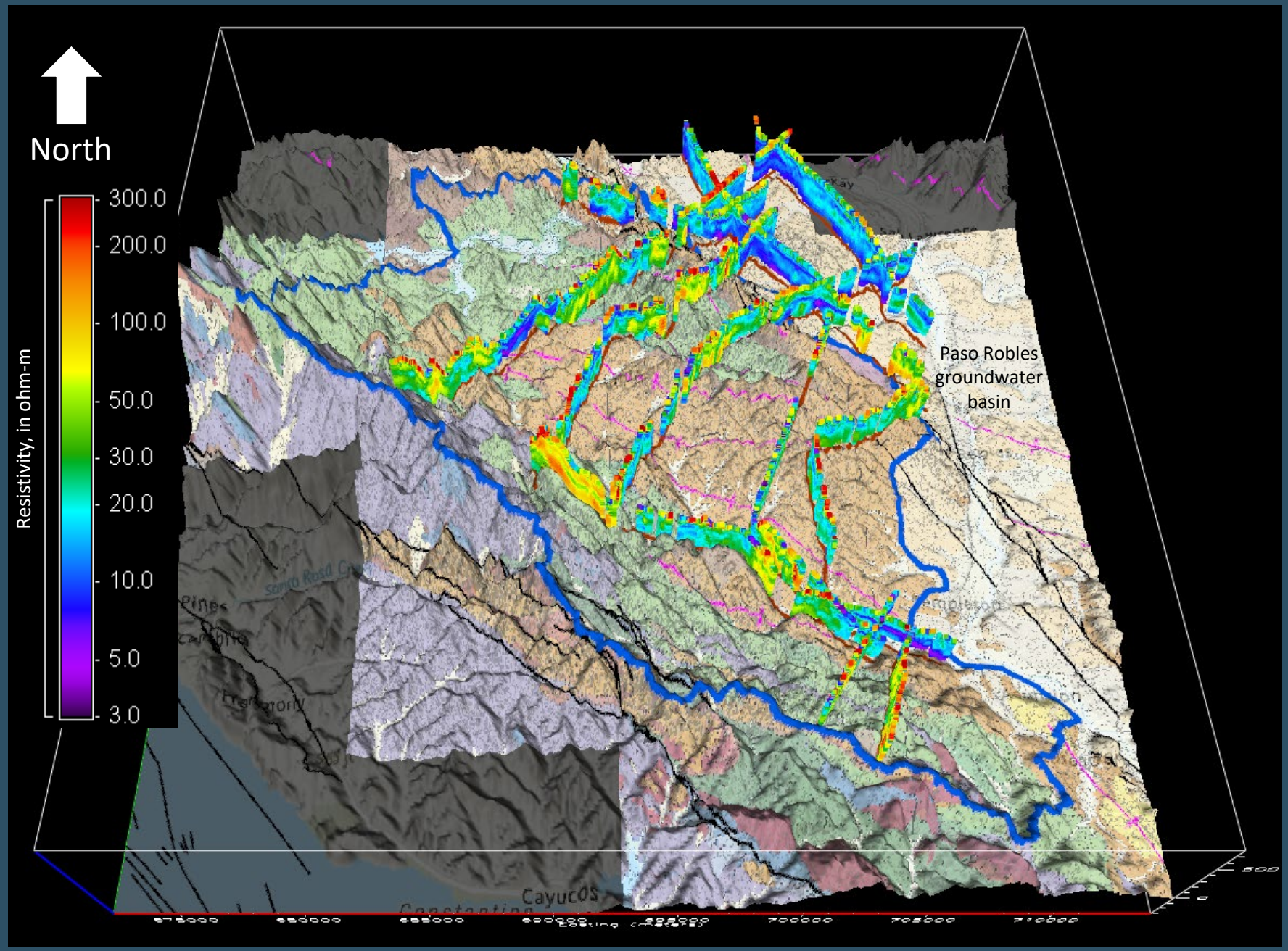
AEM Survey Data Visualization

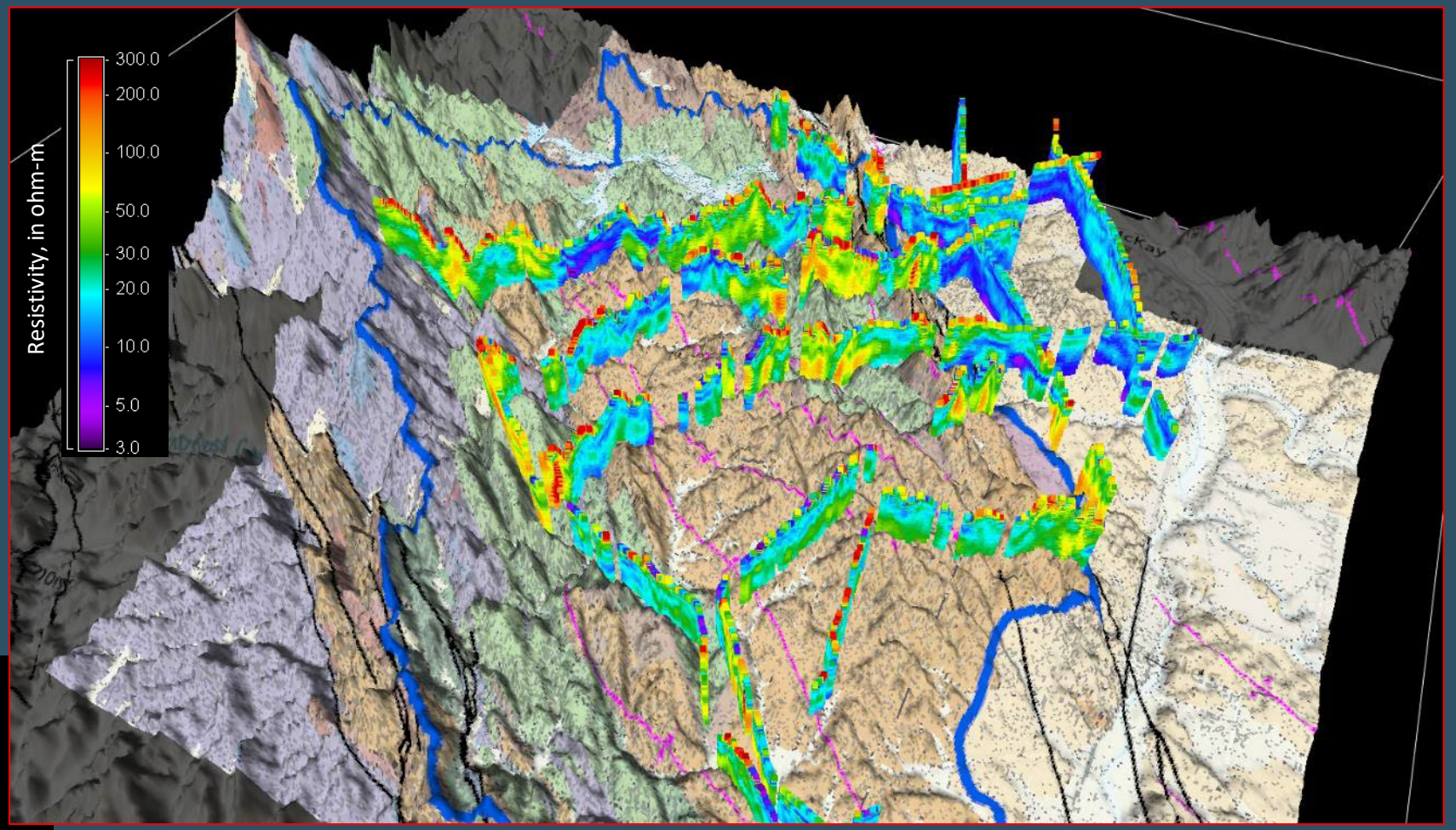
- Geologic map and AEM survey flightlines draped on land surface elevation
- 8x vertical exaggeration

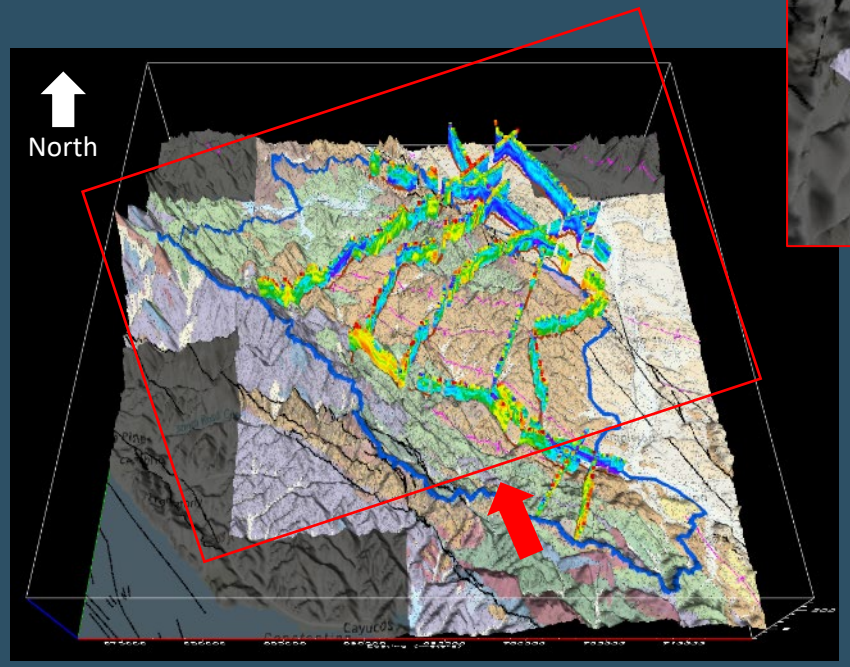


AEM Survey Data Visualization

- AEM survey data shown as XYZ points
- Resistivity in ohm-meters
  - Hot colors more resistive
  - Cold colors less resistive
- 8x vertical exaggeration

AEM Survey Data Visualization

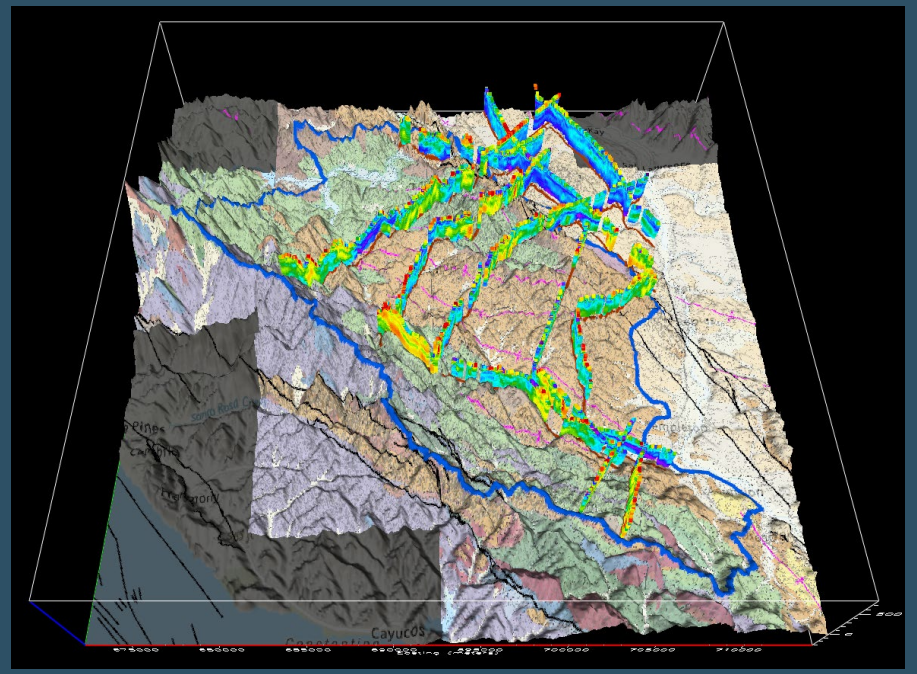




- Resistivity generally varies based on mapped geology
- Conductive features in the Paso Robles groundwater basin
- Generally resistive features in the Adelaida area, exception may be the Monterey Shale

Summary of Current Work

- **Task AEM** –Hydrogeologic evaluation using airborne electromagnetic (AEM) survey data
  - Reprocessed AEM data for use in fractured, consolidated rock setting
  - Compiled borehole lithology and geophysical data
  - Preliminary conceptual framework and analysis



Next Steps

Complete Task 2 and Task AEM

- **Task 2** – Hydrologic data collection
  - Monitor both streamgages – through December 2024
  - Collect groundwater-level measurements – March and June 2024

- **Task AEM** –Hydrogeologic framework using AEM survey data
  - Finalize hydrogeologic framework and interpretive report – Fall 2024

Next Steps

Proposal for Future Work

- Future work tasks and budget to County staff – Spring 2024
- Future work tasks may include:
    - Continued surface-water and (or) groundwater monitoring
    - Additional water chemistry sampling
    - Focused hydrogeologic evaluations
    - USGS interpretive report

Thank you!

Sign up for **EMAIL LIST** at:

https://www.slocounty.ca.gov/AdelaidaStudy

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Websites:

U.S. Geological Survey:

https://www.usgs.gov/centers/california-water-science-center/science/evaluation-groundwater-resources-adelaida-area-san

Upper Salinas – Las Tablas Resource Conservation District:

https://www.us-ltrcd.org/adelaida-hydrogeologic-study

San Luis Obispo County Flood Control and Water Conservation District:

https://www.slocounty.ca.gov/AdelaidaStudy

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