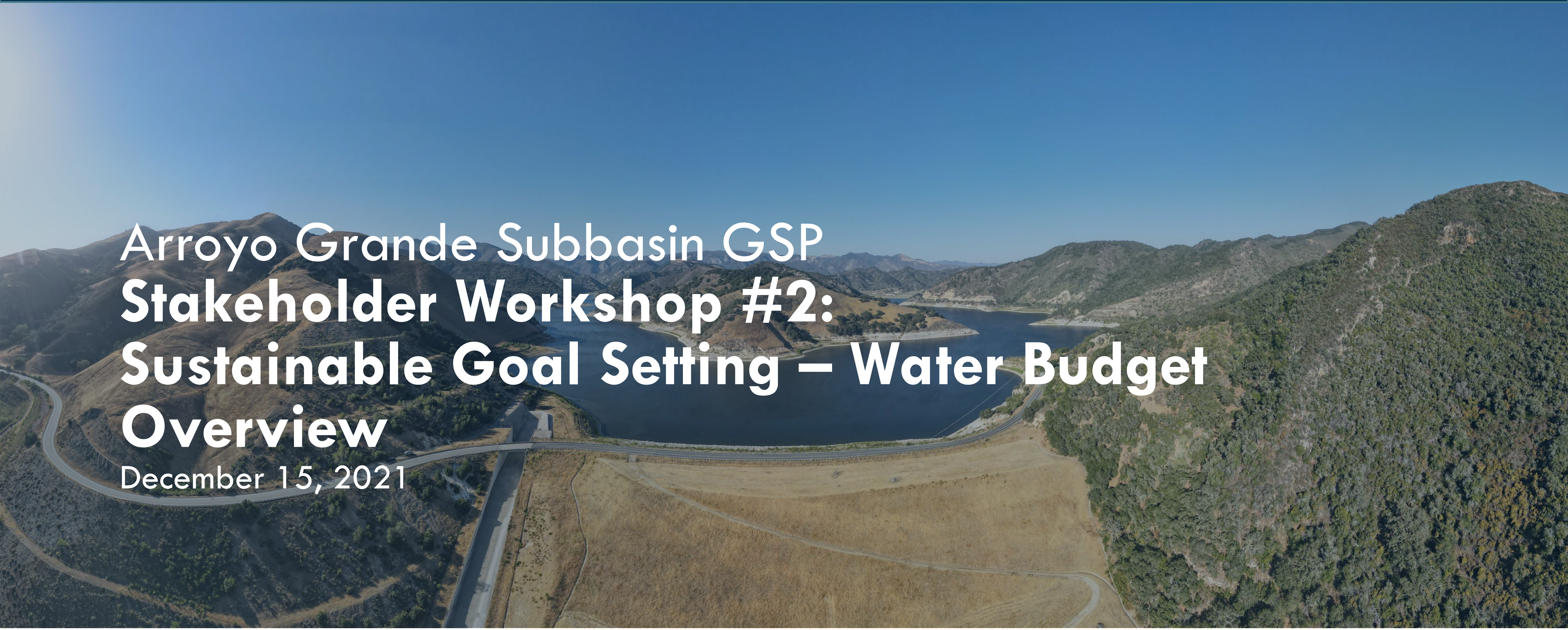
Arroyo Grande Subbasin GSP

Stakeholder Workshop #2: Sustainable Goal Setting – Water Budget Overview

December 15, 2021



COUNTY of SAN LUIS OBISPO

CITY OF ARROYO GRANDE CALIFORNIA 1911

Presenters

MICHAEL CRUIKSHANK, PG, CHG

Hydrogeologist, Water Systems Consulting

Spencer Harris, PG, CHG

Hydrogeologist, Cleath Harris Geologists

DAVID O'ROURKE, PG, CHG

Hydrogeologist, GSI Water Solutions

Q&A Panelists

COUNTY of SAN LUIS OBISPO

Brandon Zuniga

County of San Luis Obispo

CITY OF ARROYO GRANDE CALIFORNIA 1911

SHANE TAYLOR

City of Arroyo Grande

Workshop Goals

- Share project overview, timeline and alignment with other projects
- Share key requirements of SGMA
- Overview of Recently Released Chapters
- Introduction to Sustainable Management Criteria

Workshop Agenda

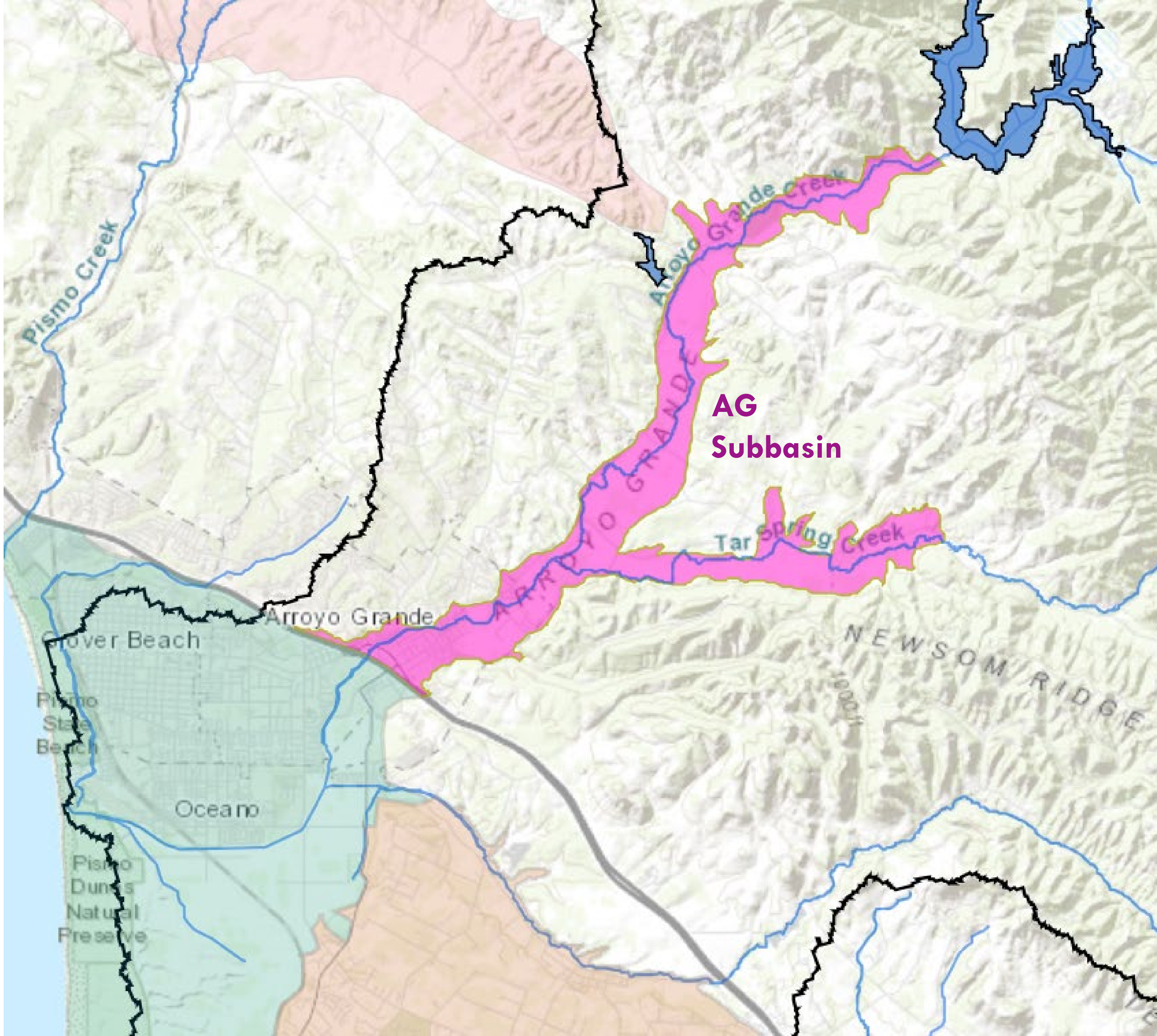
10 min	Project Overview
10 min	Overview of Chapter 4 Basin Setting
20 min	Overview of Chapter 5 Groundwater Conditions
10 min	Groundwater Dependent Ecosystems
20 min	Overview of Chapter 6 Water Budget
20 min	Introduction to Sustainable Management Criteria
5 min	What's Next

Project Overview

MICHAEL CRUIKSHANK, WSC

Continuing to secure sustainable groundwater in the Arroyo Grande Subbasin

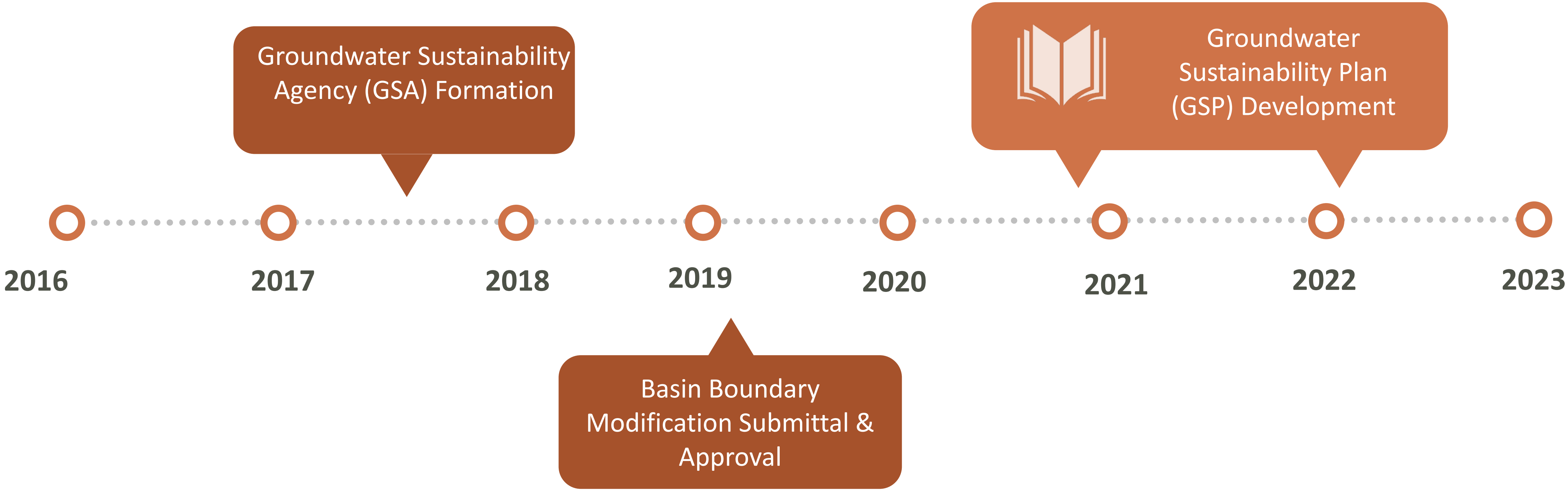
- SGMA-compliant GSP
- Not required for low priority basins
- Supports parallel efforts
- Includes development of a surface water / groundwater model



Basin Governance

GROUNDWATER SUSTAINABILITY AGENCY (GSA) MEMBERS	
Brandon Zuniga *GSA Member* Water Resources Engineer, County of San Luis Obispo	**Shane Taylor** *GSA Member* Utilities Manager, City of Arroyo Grande

Basin Governance Timeline



Sustainable Groundwater Management Act (SGMA) Deadlines

Groundwater Sustainability Plan (GSP) Grant Deadline

Basin Achieves Sustainability

2022
GSPs due per SGMA

2027
Evaluate Progress

2032
Evaluate Progress

2037
Evaluate Progress

2042
20 years to achieve goals stated in plan

Schedule and Opportunities to Inform the GSP

*Schedule subject to change

Step 1. Establish Governance Structure	Step 2. Document Basin Setting and Develop Integrated Model	Step 3. Set Sustainability Goals	Step 4. Develop Plan to Sustainability	Step 5. Complete the Plan
CHAPTERS 1-3	CHAPTERS 4-6	CHAPTERS 7-8	CHAPTERS 9-10	FINISHED PLAN
NOV '20 – JAN '21	NOV '20 – DEC '21	JAN '21 – MAR '22	FEB '22 – APR '22	APR '22 – SEP '22

STAKEHOLDER Workshop #1: Groundwater Conditions and Water Budget
DEC 15, 2020

PUBLIC COMMENT PERIOD
Q1 2021

PUBLIC COMMENT PERIOD
DEC 2021

PUBLIC MEETING PROJECT UPDATES — PER DEFINED SCHEDULE
- County Board of Supervisors SGMA Update
- City of AG City Council

STAKEHOLDER WORKSHOP #2: SUSTAINABLE GOAL SETTING
DEC 15, 2021

PUBLIC COMMENT PERIOD
MAR 2022

PUBLIC MEETING PROJECT UPDATES — PER DEFINED SCHEDULE
- County Board of Supervisors SGMA Update
- City of AG City Council

STAKEHOLDER WORKSHOP #3: PROJECTS AND MANAGEMENT ACTIONS
FEB 2022

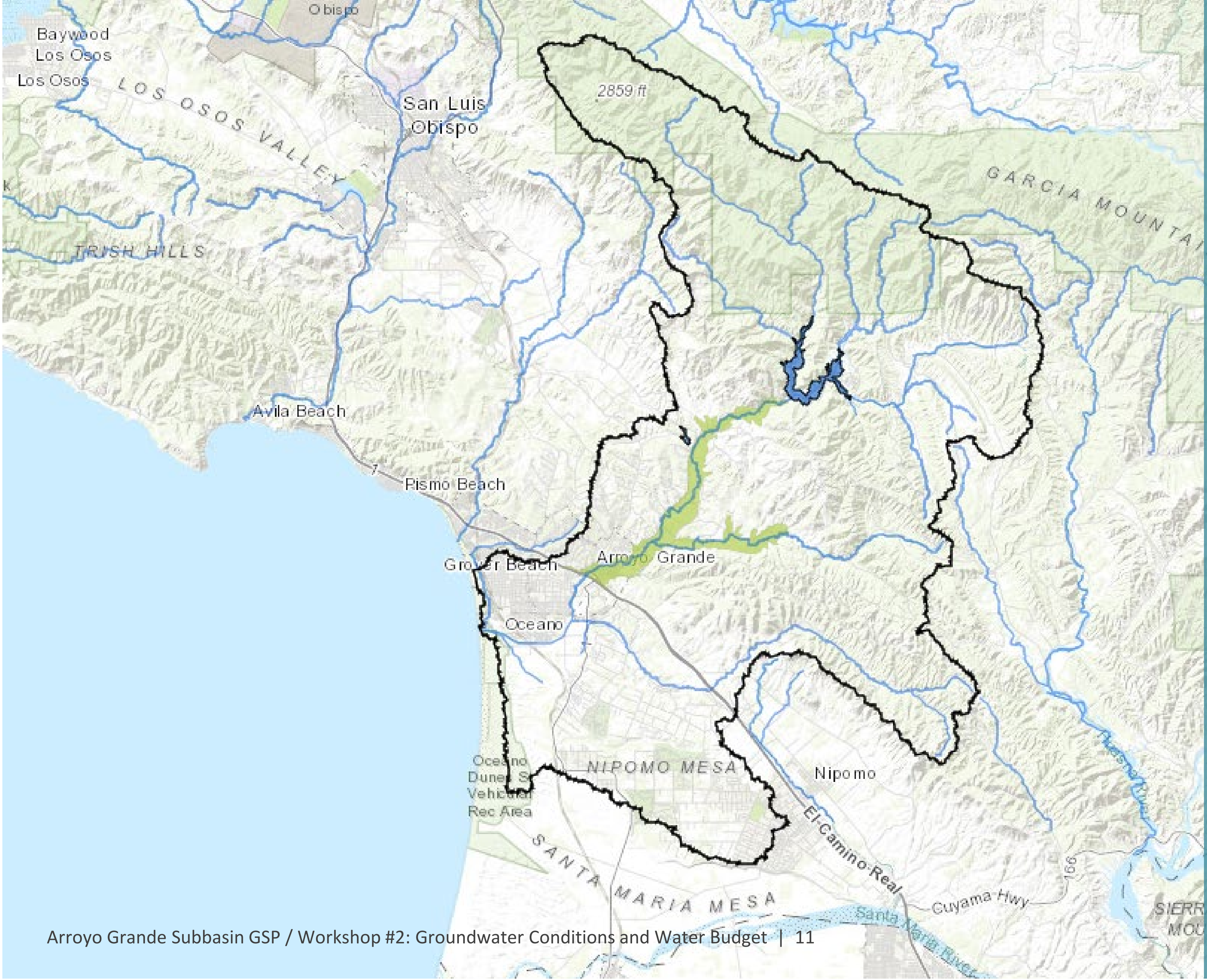
PUBLIC COMMENT PERIOD
APRIL 2022

PUBLIC MEETING PROJECT UPDATES — PER DEFINED SCHEDULE
- County Board of Supervisors SGMA Update
- City of AG City Council

FULL DRAFT GSP / PUBLIC COMMENT PERIOD
JUN 2022

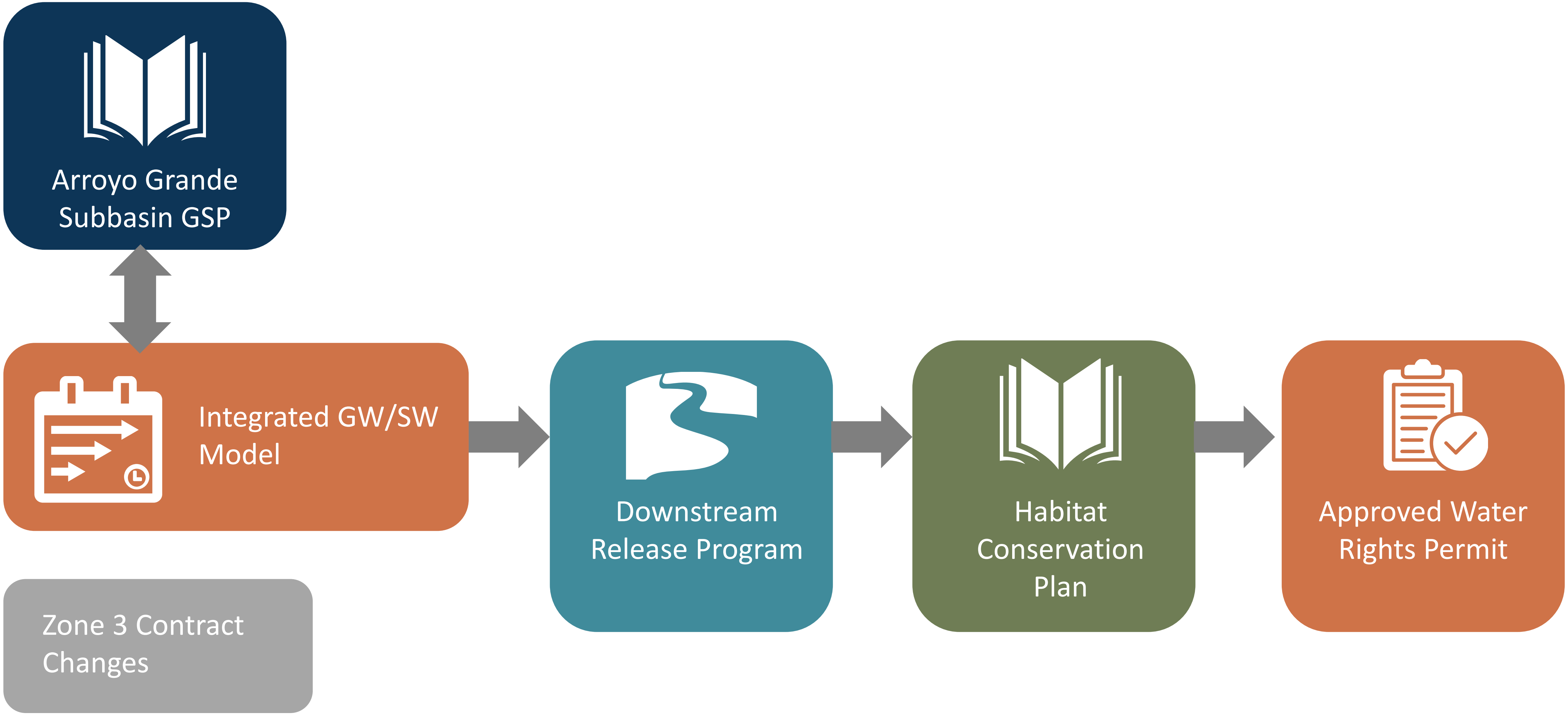
PUBLIC MEETING PROJECT UPDATES — PER DEFINED SCHEDULE
- County Board of Supervisors SGMA Update
- City of AG City Council

WE ARE HERE



The Arroyo Grande Subbasin is a critical component of a much larger regional surface and groundwater system.

GSP Supports Critical AG Creek Initiatives



GSP Project Benefits

Regulatory Compliance

- National Marine Fisheries Services (NMFS) need for enhanced modeling toolsets to support the HCP
- HCP is required for an incidental-take permit and approved water rights permit

Leveraged Grant Funding

- SGMA GSP grant provides a funding source for development of critical modeling toolsets

GSP Project Benefits

Improved Hydrologic Analysis

- Surface water/groundwater hydrologic model for entire Arroyo Grande Creek watershed
- Upper watershed (above the dam) modeling allows for more accurate evaluation of climate change and cloud seeding impacts on reservoir inflow
- Enhanced stormwater flow and capture evaluation opportunities

Enhanced Management

- The surface water/groundwater model integrated with the reservoir operations model (MODSIM)

Questions?

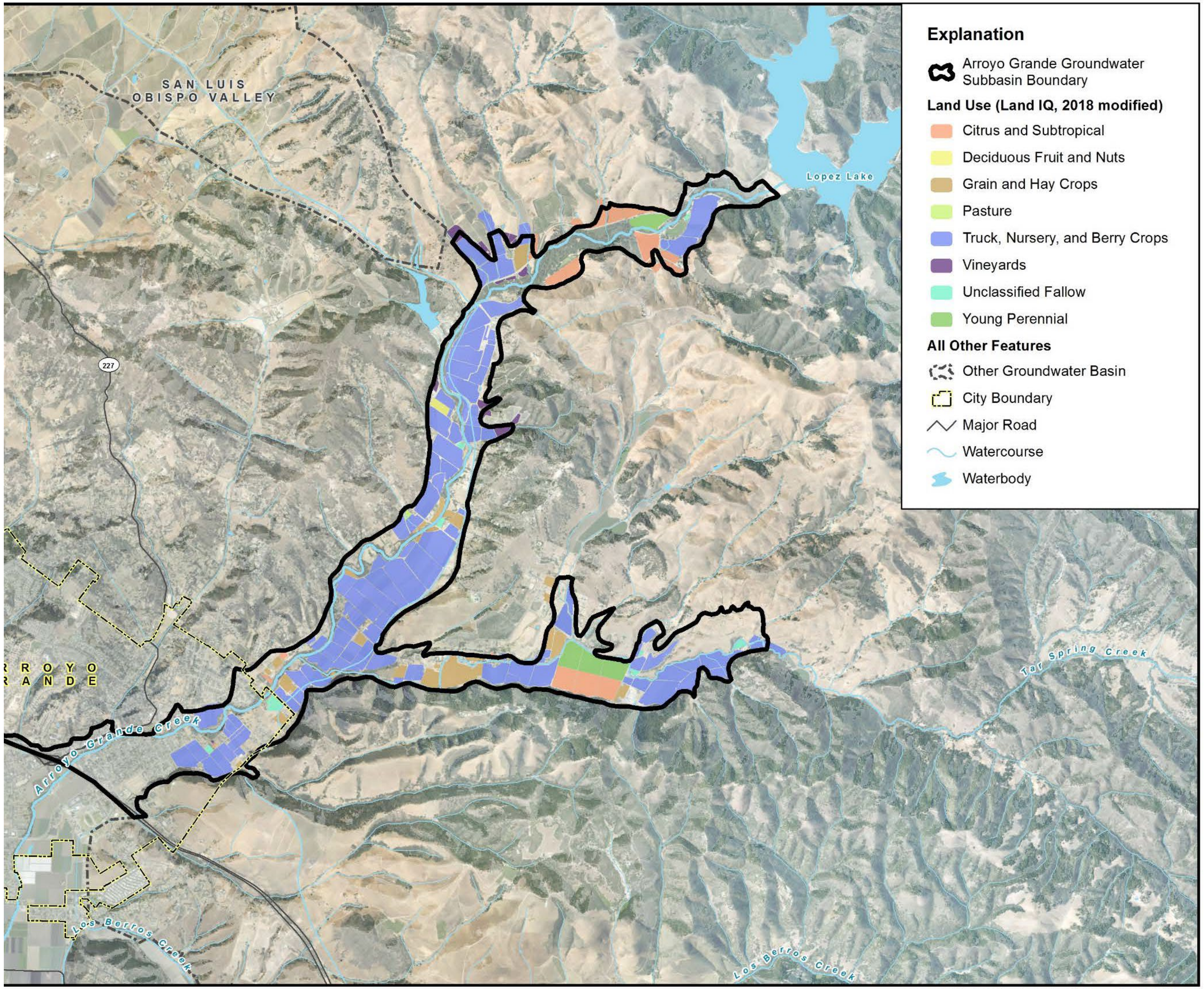
Arroyo Grande Subbasin GSP / Workshop #2: Groundwater Conditions and Water Budget | 15

Overview of Basin Setting (Chapter 4)

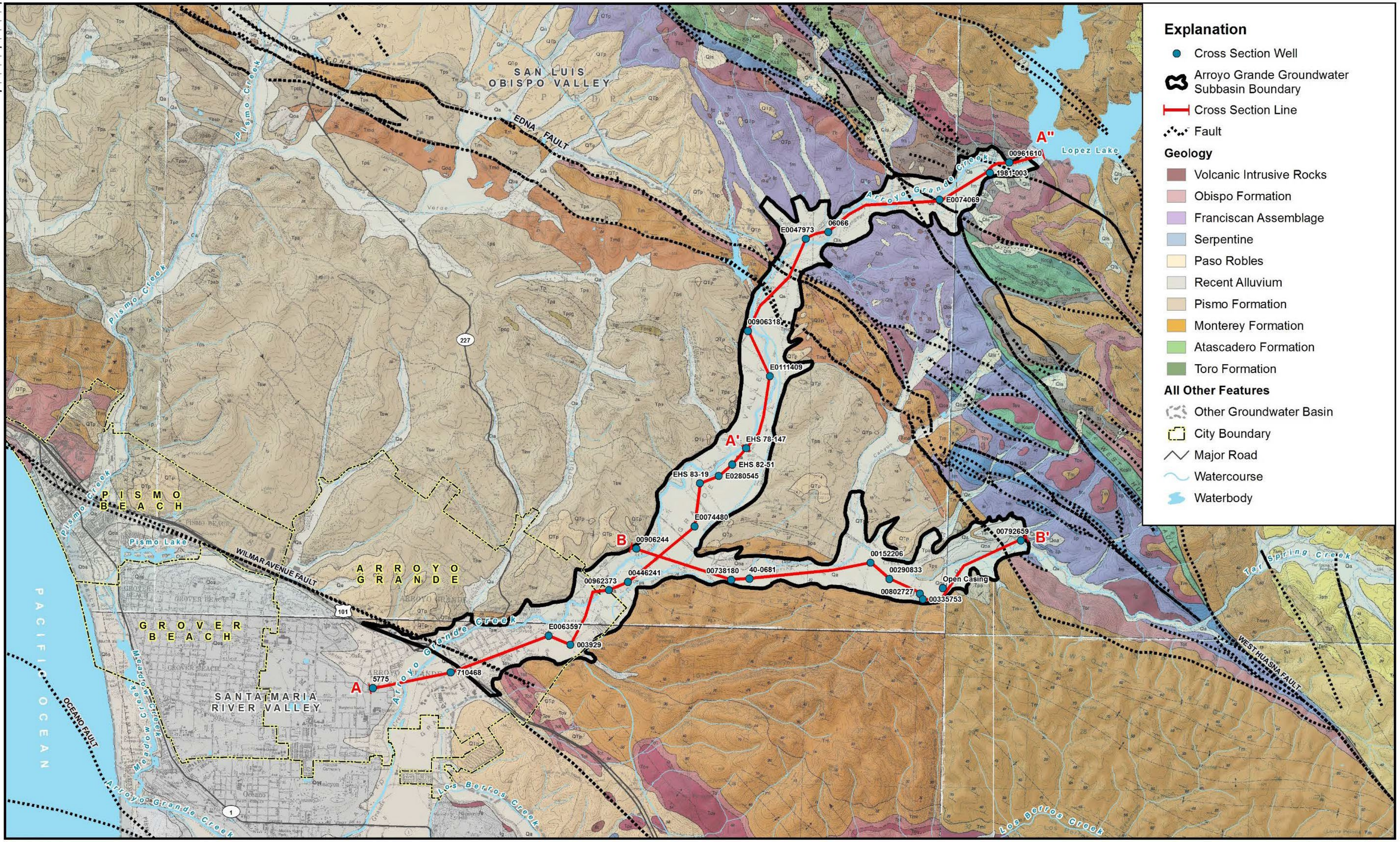
Dave O'Rourke, GSI

Agriculture

- 15-20 inches annual rainfall.
- Mostly truck and berry crops. Not dominated by vineyards like next door in Edna Valley



Geologic Map of Subbasin



Prepared for:

COUNTY OF SAN LUIS OBISPO

CITY OF ARROYO GRANDE CALIFORNIA

Author: AB

Date: 9/9/2021

ARROYO GRANDE SUBBASIN GSP

N

0 0.25 0.5 Miles

0 0.25 0.5 1 Kilometers

References:

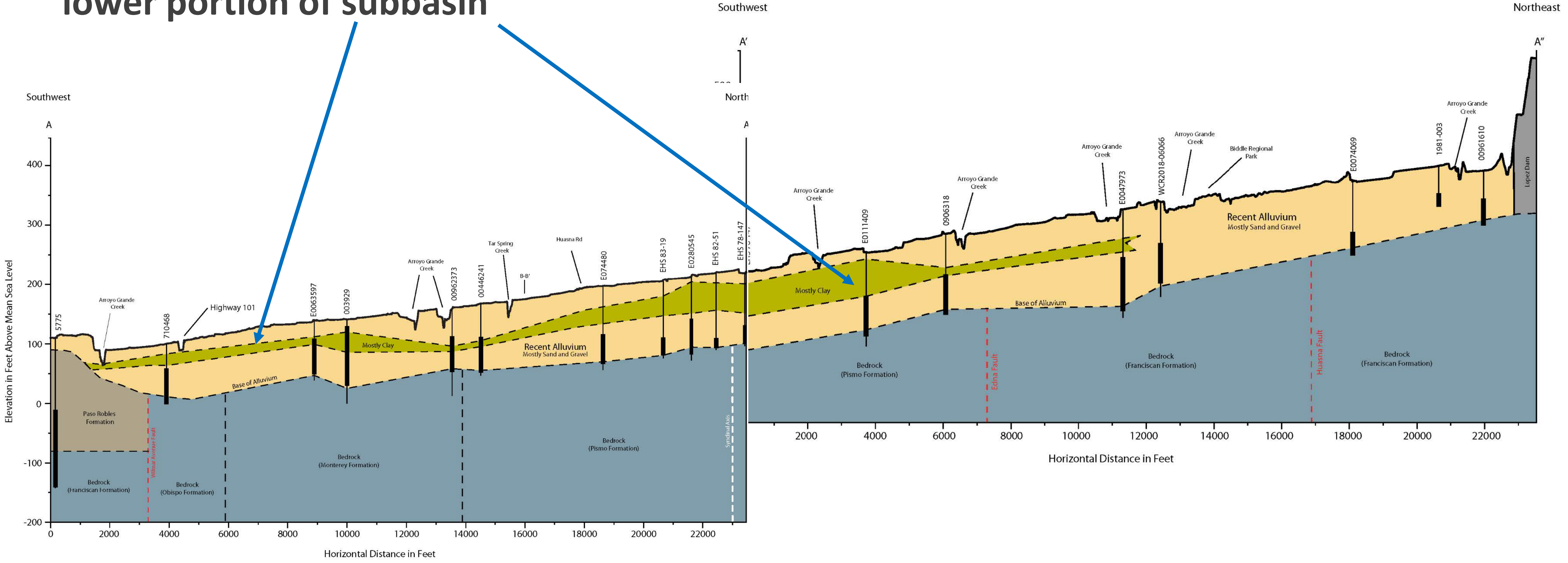
1. Coordinate System: NAD 1983 StatePlane California V FIPS 0405 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983
2. San Luis Obispo County
3. USGS

Geologic Map

Figure 4-8

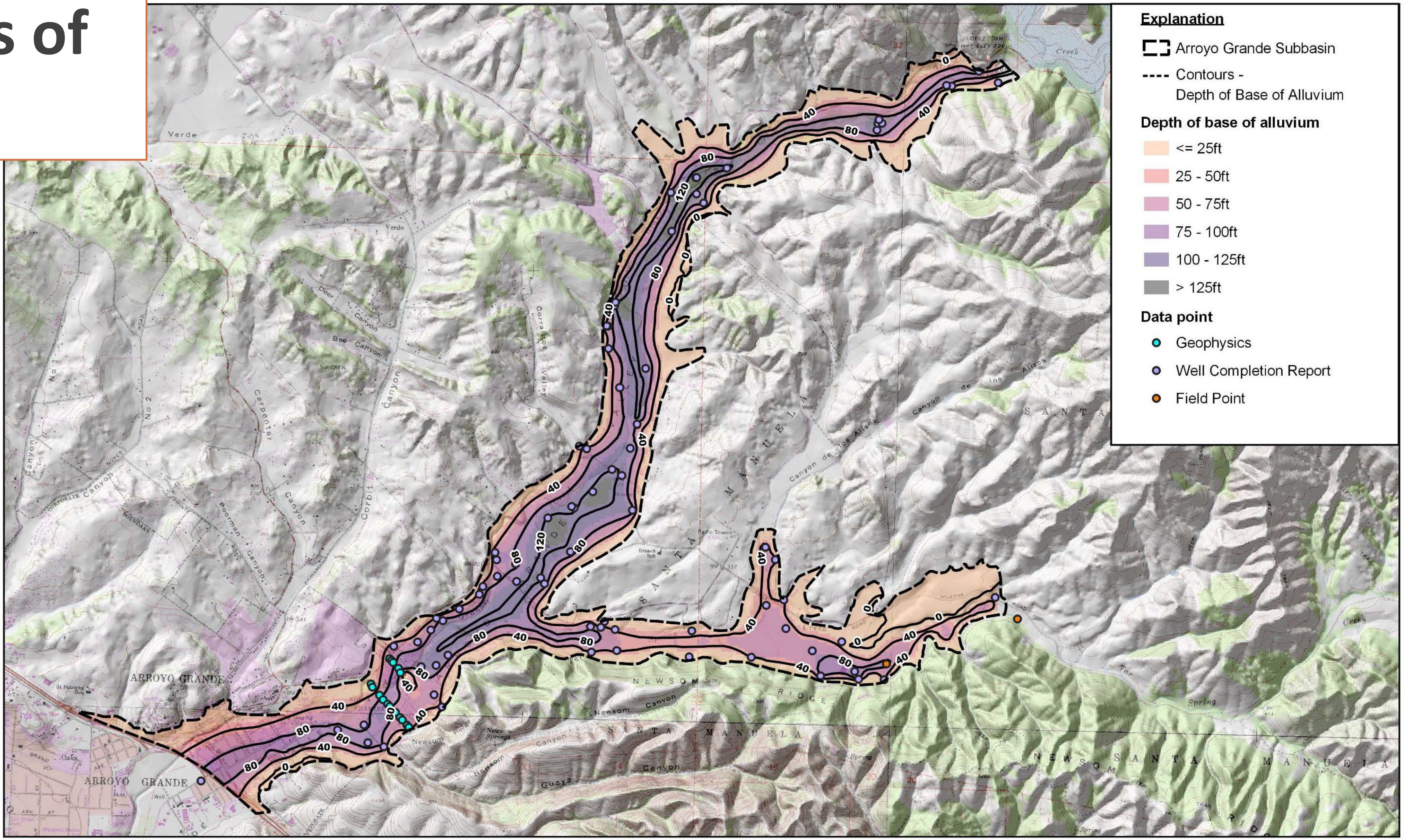
Geologic Cross-Section of Subbasin

Near surface clay layer along lower portion of subbasin

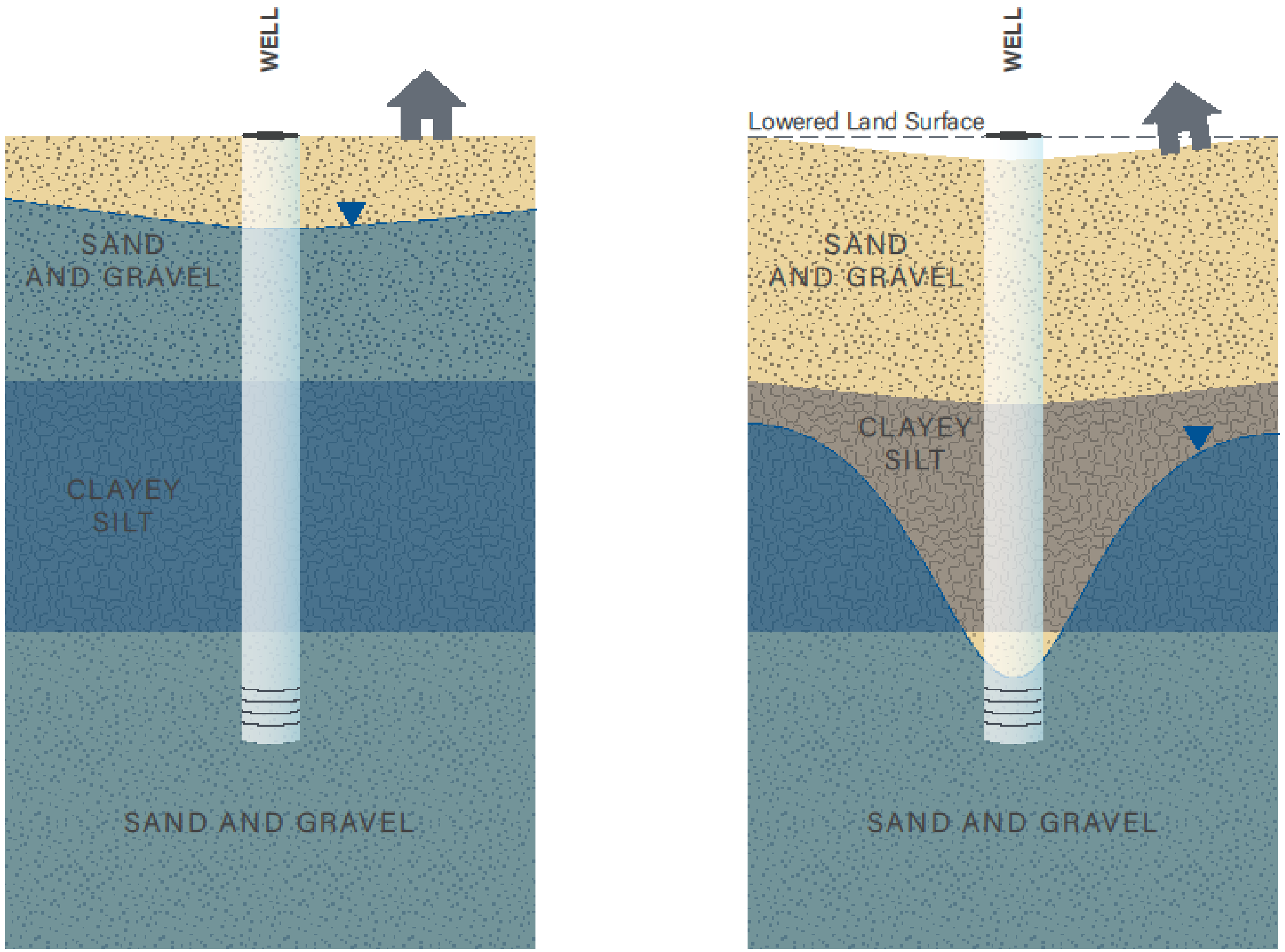


Thickness of Alluvium

Maximum thickness is about 125 feet.

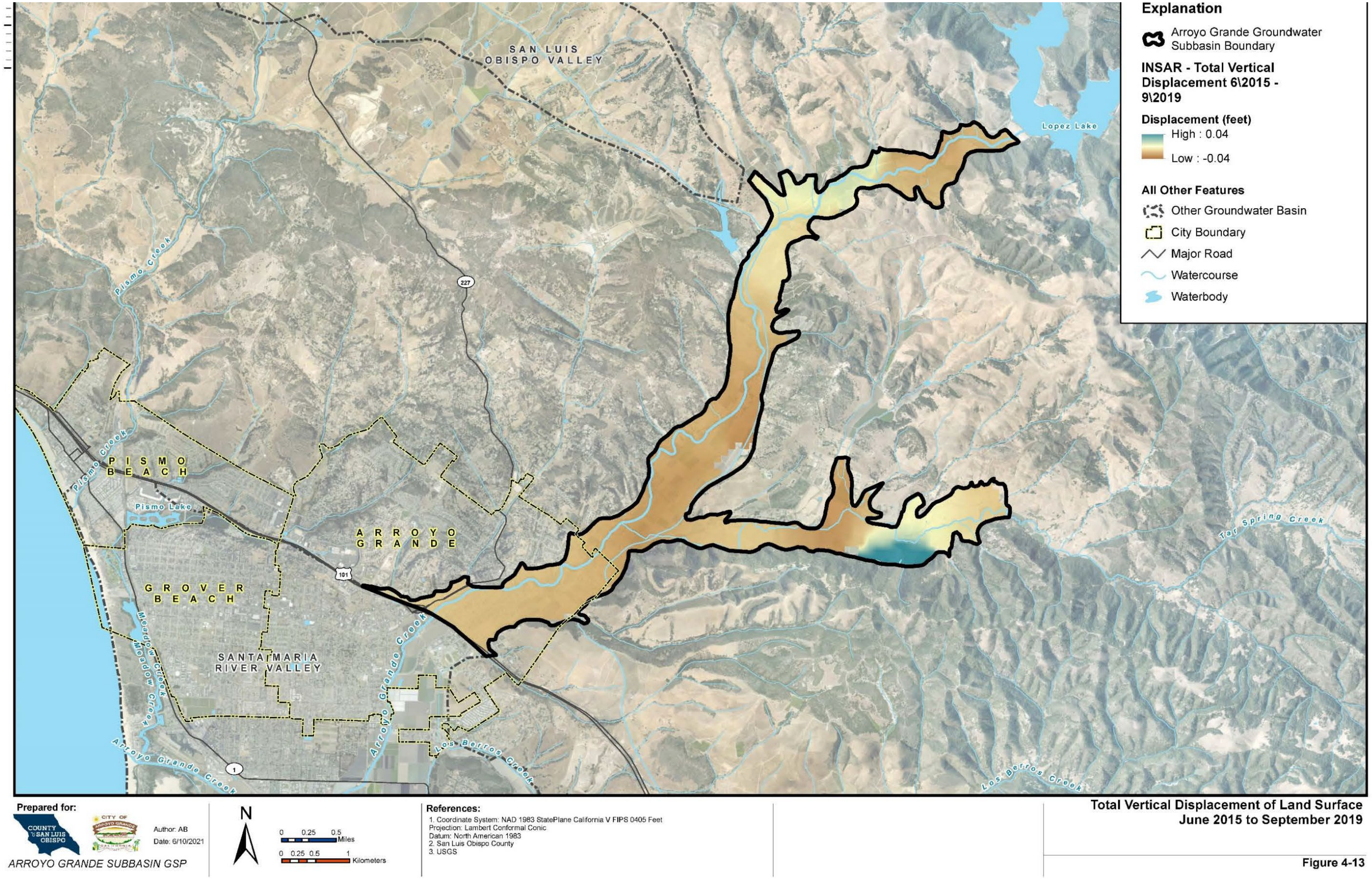


SUBSIDENCE


WELL
SAND
AND GRAVEL
CLAYEY
SILT
SAND AND GRAVEL
WELL
Lowered Land Surface
SAND
AND GRAVEL
CLAYEY
SILT
SAND AND GRAVEL

Subsidence

No significant subsidence in the Subbasin. (InSAR data: < 0.04 feet over 5 years.)



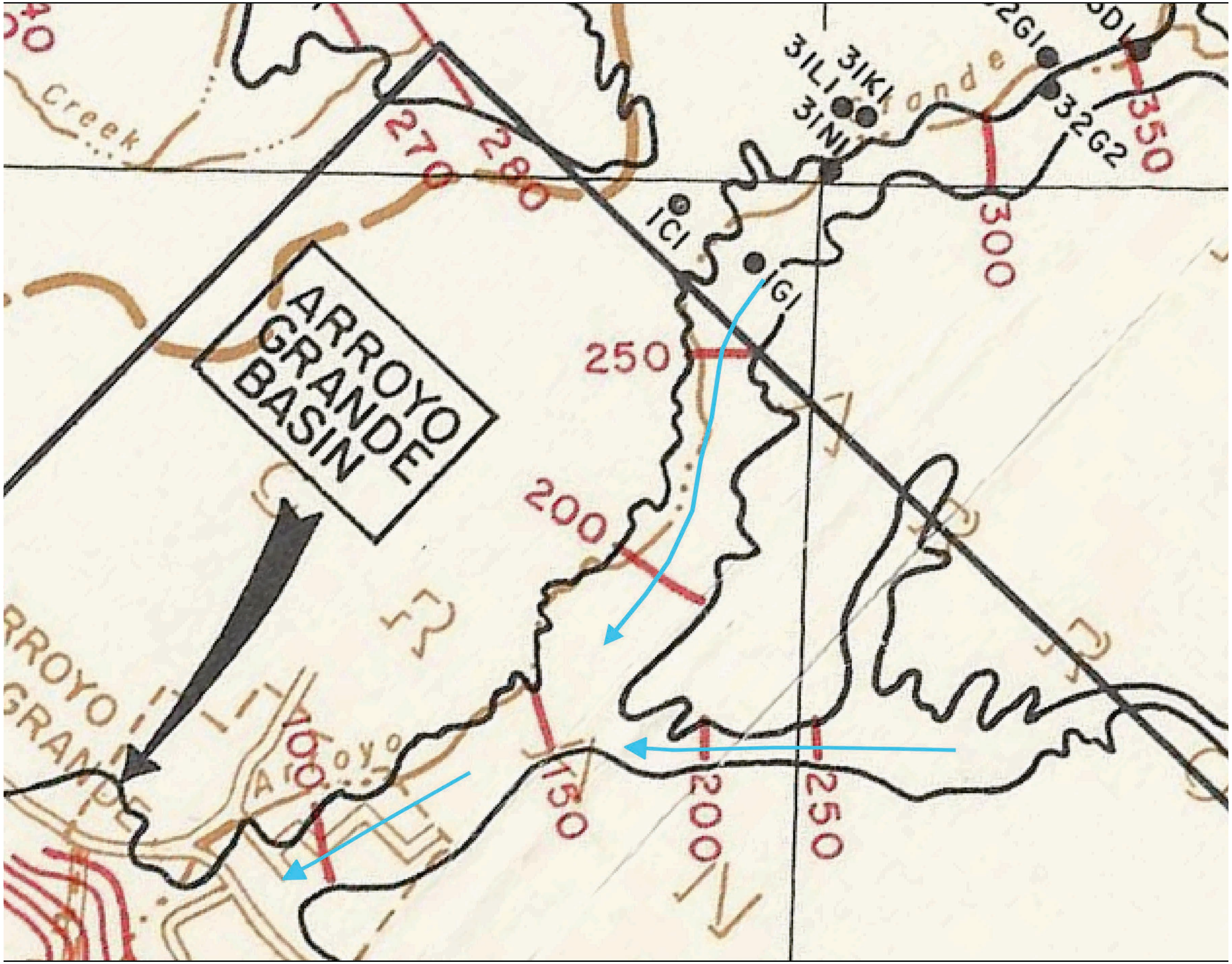
Overview of Groundwater Conditions (Chapter 5)

Spencer Harris, CHG

Groundwater Conditions

- Groundwater elevations
- Hydrographs
- Change in storage
- Seawater intrusion
- Groundwater quality
- Land subsidence
- Interconnected GW/SW
- GDE's

Current – data from Jan. 1, 2015 (effectively 2016 water year)
Historical – before Jan. 1, 2015

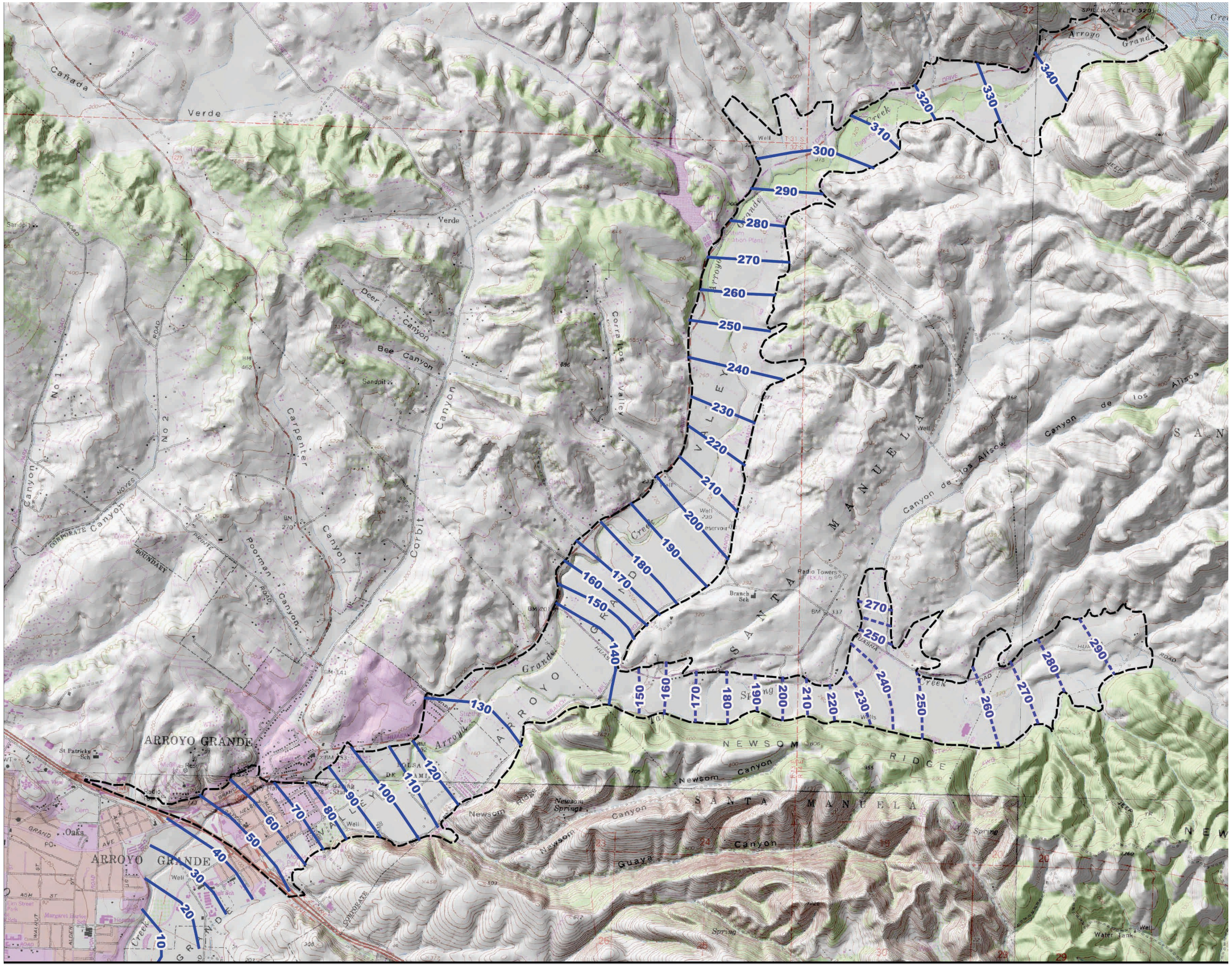


Groundwater Elevations

- Water Level Data from Wells
  - Reference Point elevation – Depth to Water = Groundwater Elevation
- Groundwater Elevation Contour Maps
  - Existing maps - 1954, 1975, 1985, 1995 from DWR
  - New maps in Chapter 5 – 1996, 2015, 2020
  - Approximately 20 wells used for contouring new maps in Arroyo Grande Valley
  - An additional 11 wells were measured in Spring 2021 and used for contouring hydraulic gradient in Tar Spring Creek tributary valley.

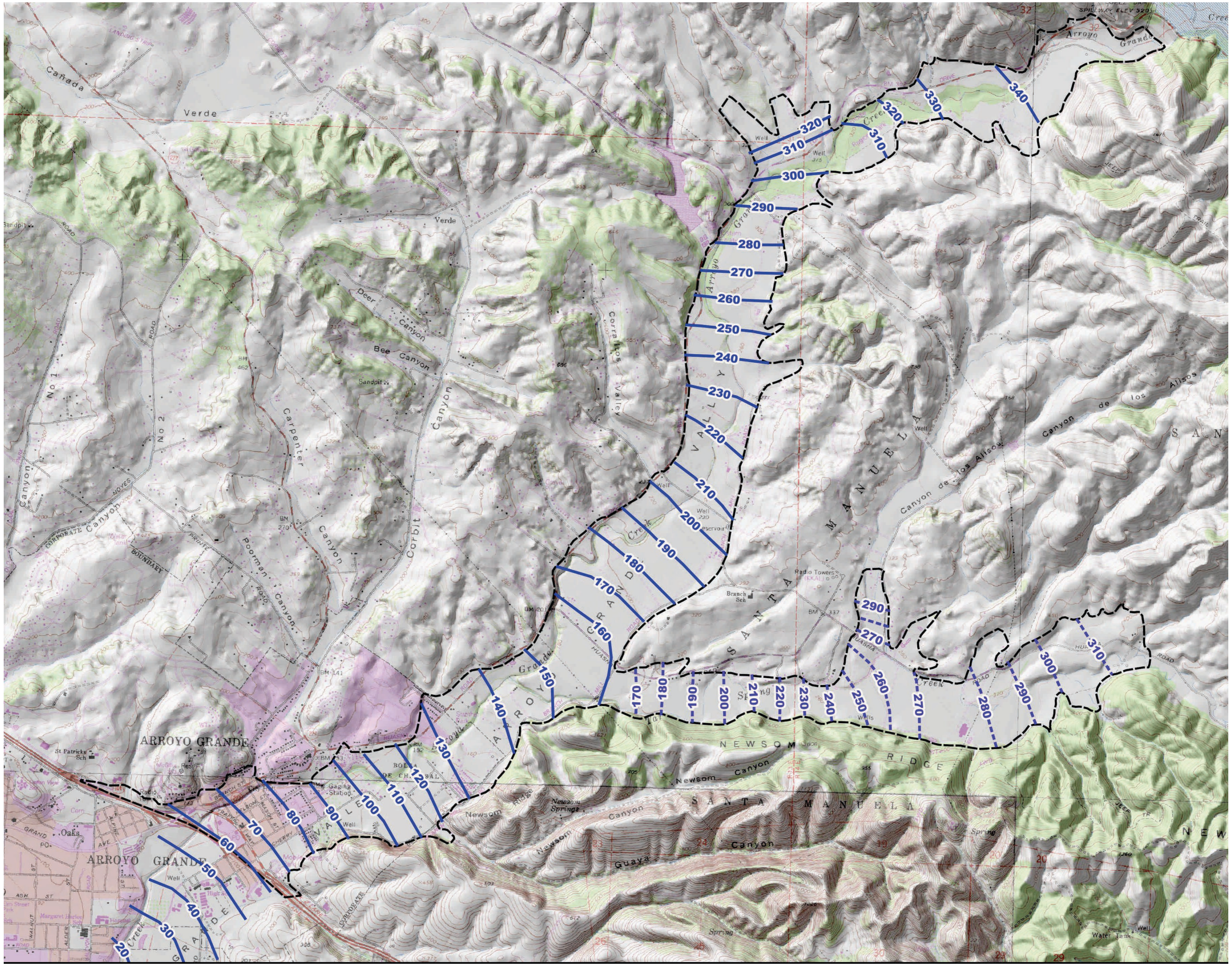
Spring 2015

- Critical drought conditions
- Below average rainfall
- Hydraulic gradient
    - 0.008 ft/ft
    - Flattens at confluence
    - Flow toward ocean
    - Consistent across boundary
- Tar Spring tributary water levels estimated based on available data from 1977 and 1989 historical drought years, with 2021 gradient



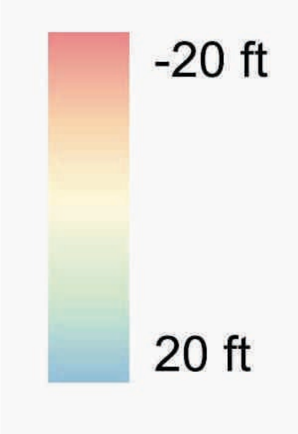
Spring 2020

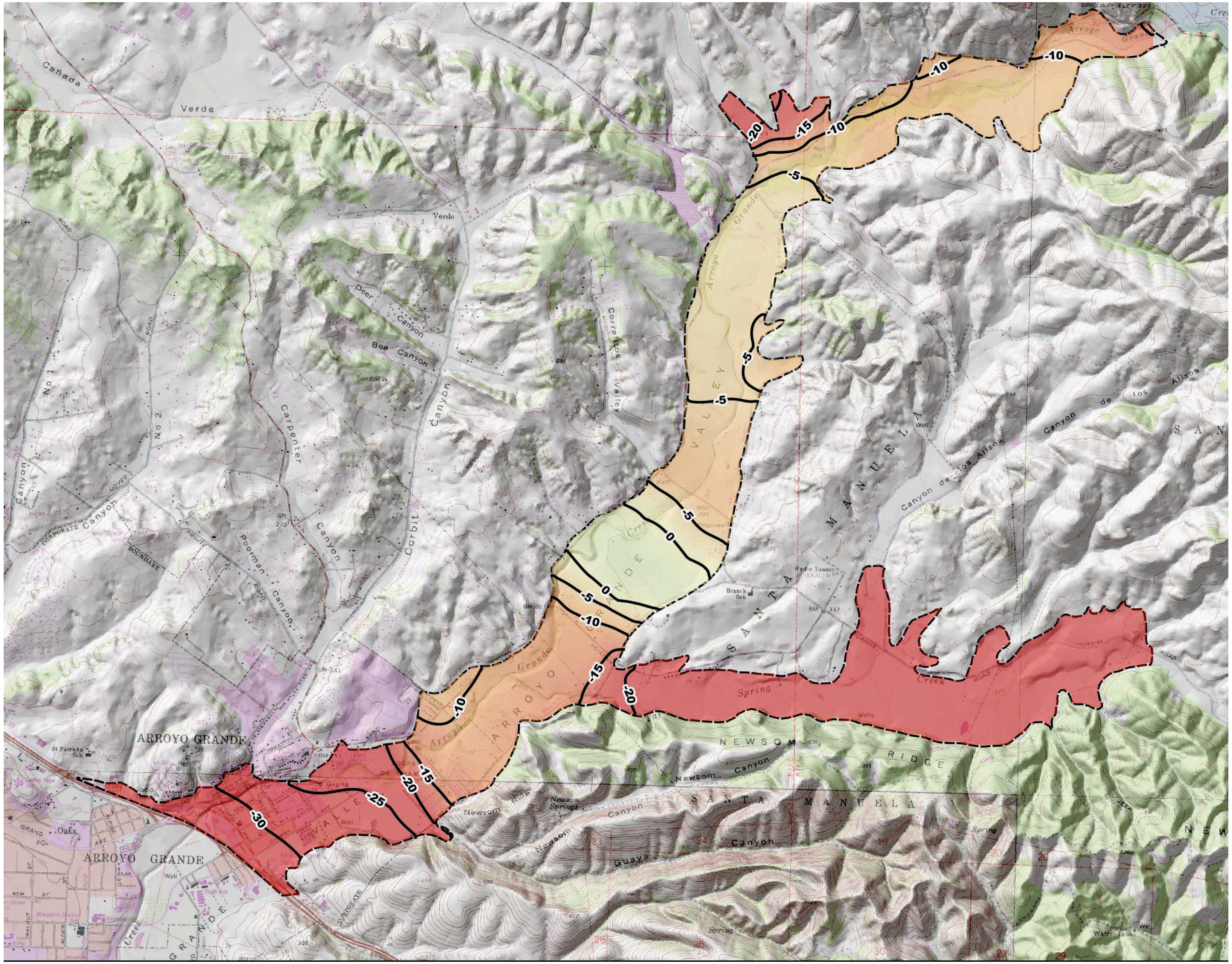
- Current conditions
- Below average rainfall
- Hydraulic gradient
  - 0.007 ft/ft – 0.010 ft/ft
  - Flattens at confluence
  - Flow toward ocean
  - Consistent across boundary
- Historical conditions similar
- Tar Spring tributary not affected by Lopez releases



Groundwater Elevation Change

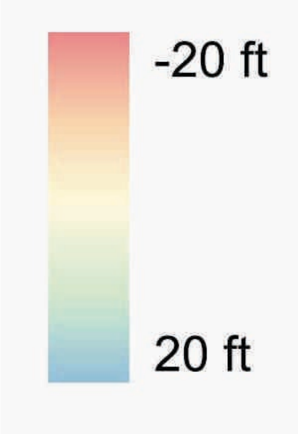
Spring 1996 – Spring 2015

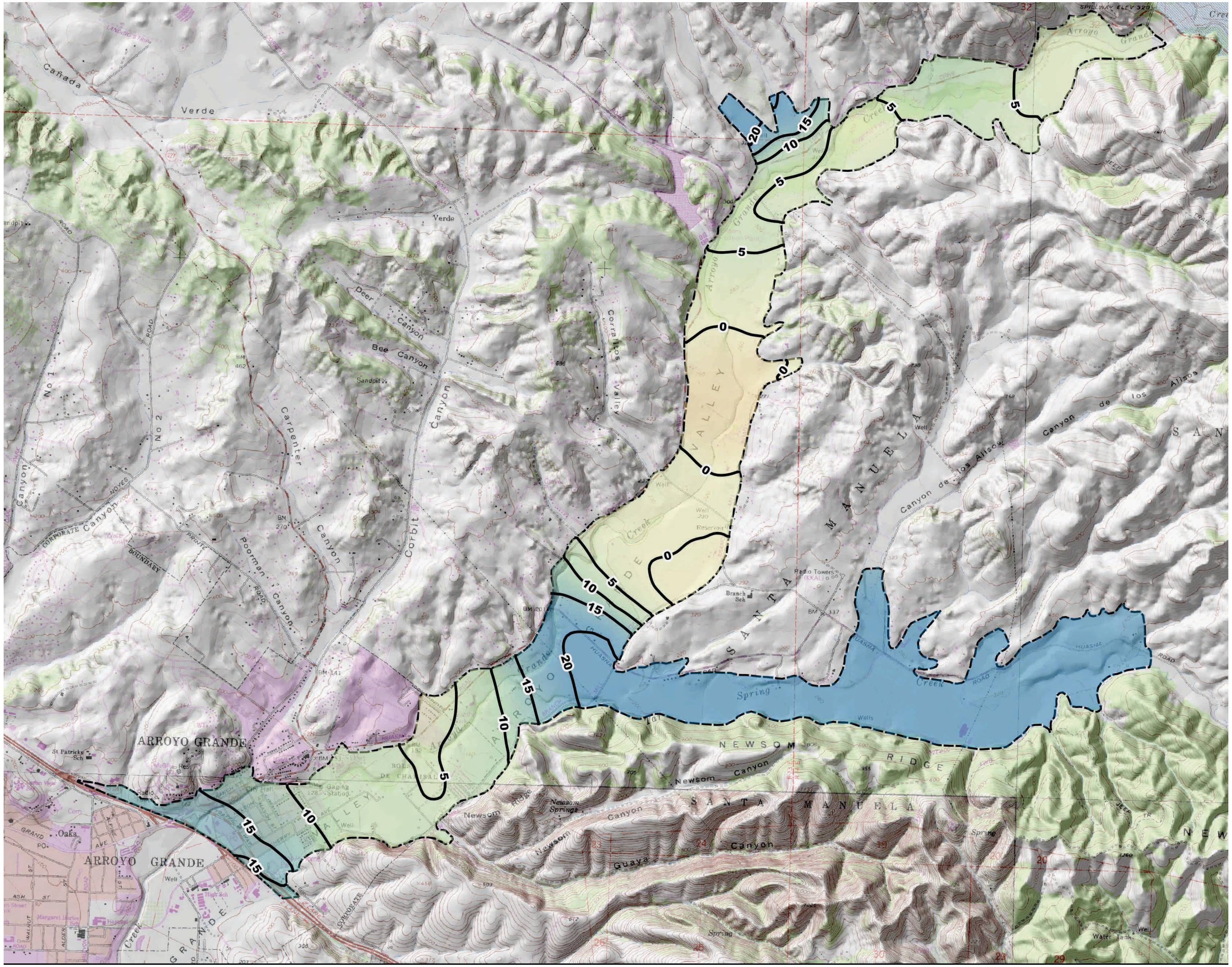




Groundwater Elevation Change

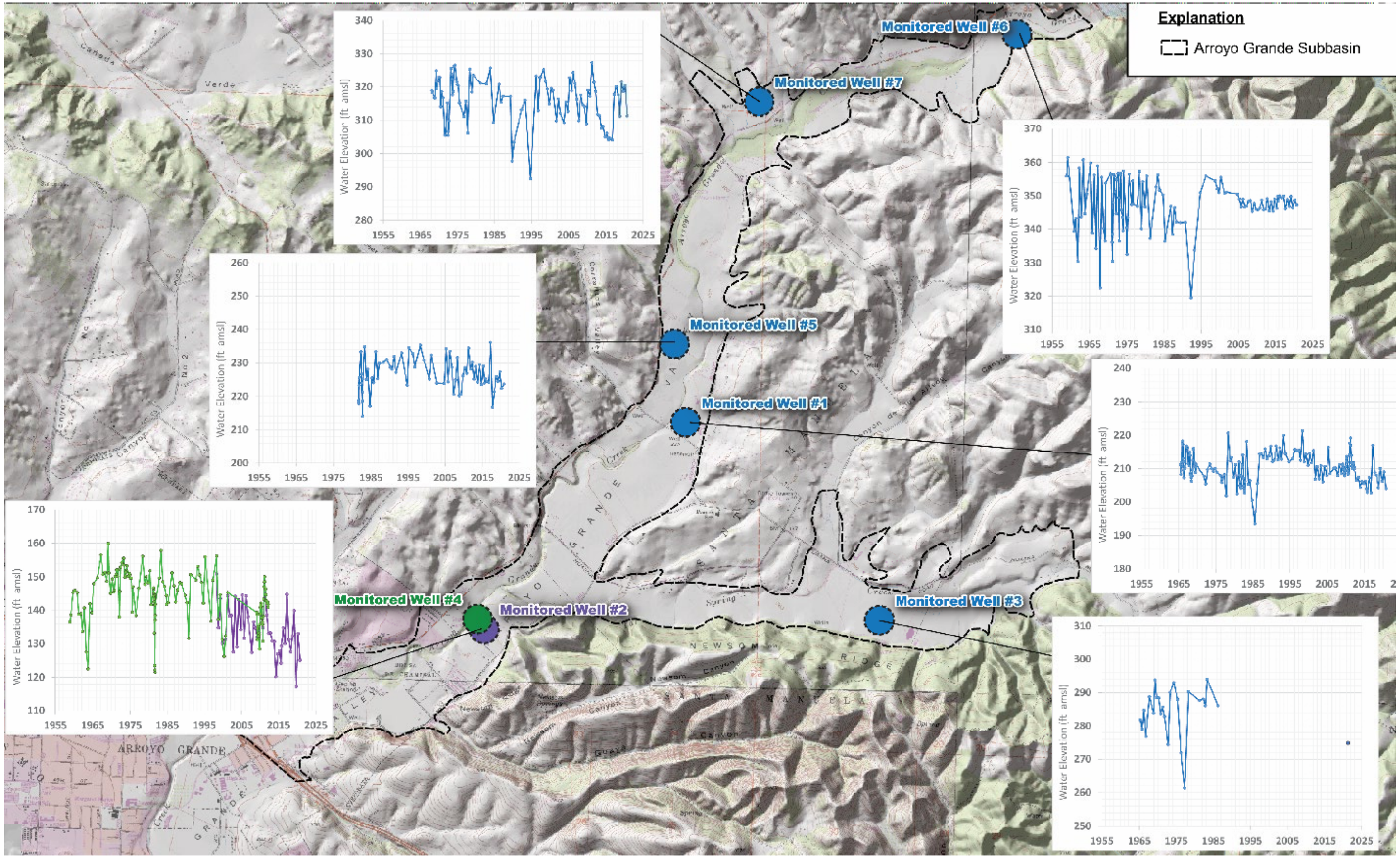
Spring 2015 – Spring 2020



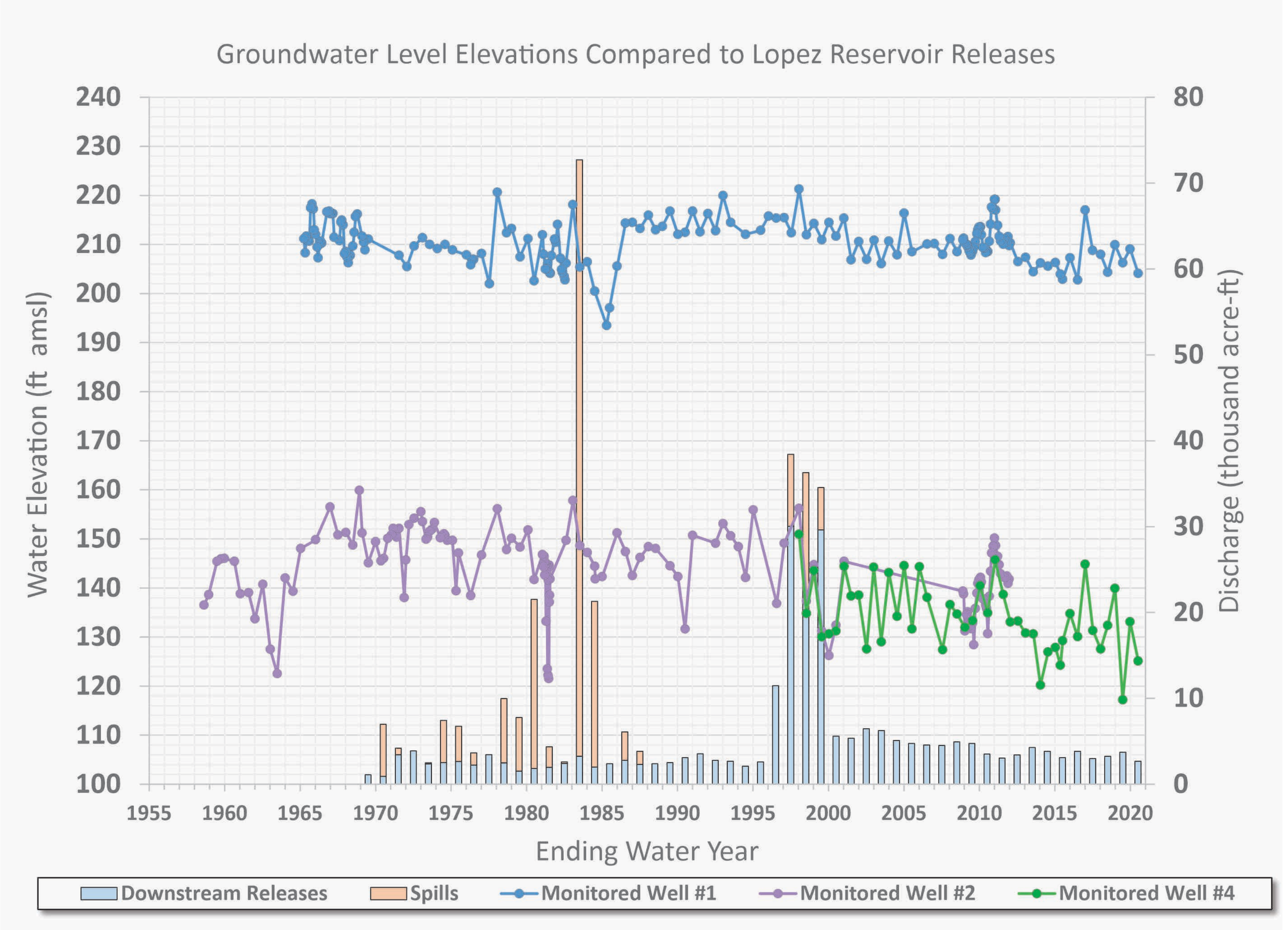


Hydrographs

- Water levels over time
- Seasonal fluctuations generally <10 feet
- Drought fluctuations variable (up to 30 feet)
- Long-term trends flat to slightly declining while following CDMP with current conditions in range of historical



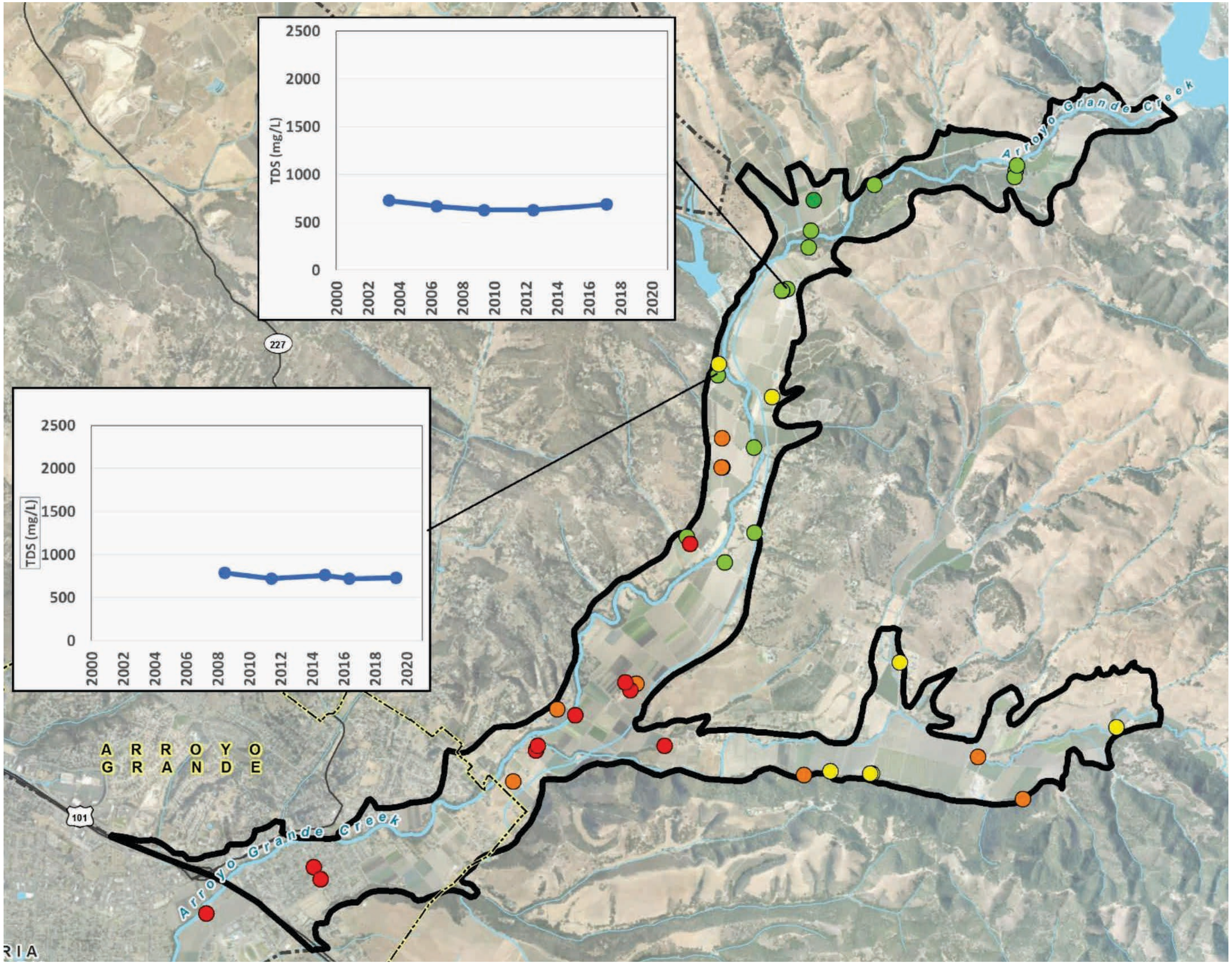
Lopez Reservoir Releases and Spills



Water Quality
TDS

Total Dissolved Solids
(mg/L)

- 0 - 500
- 500 - 750
- 750 - 1000
- 1000 - 1500
- > 1500

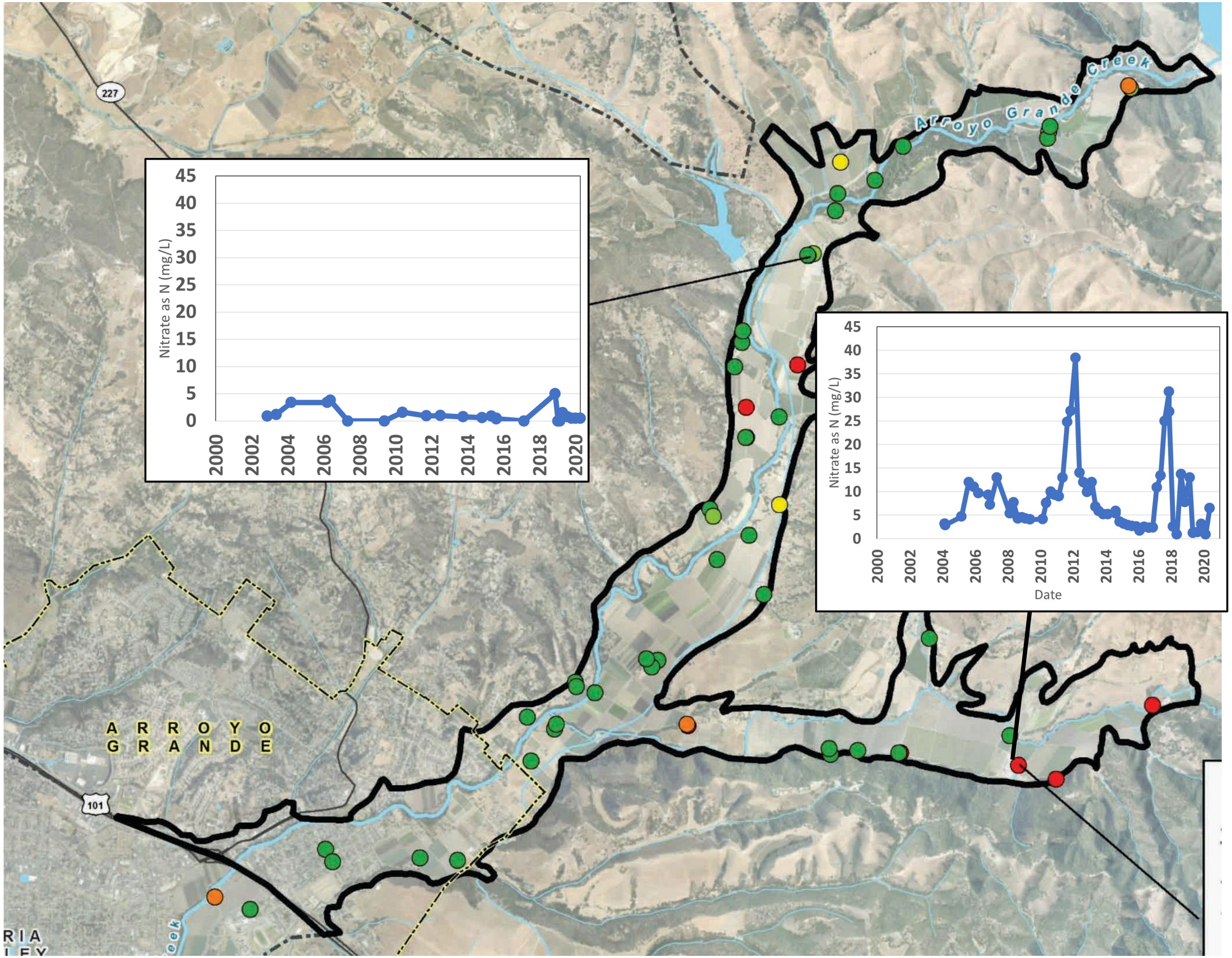


Water Quality

NITRATE as N

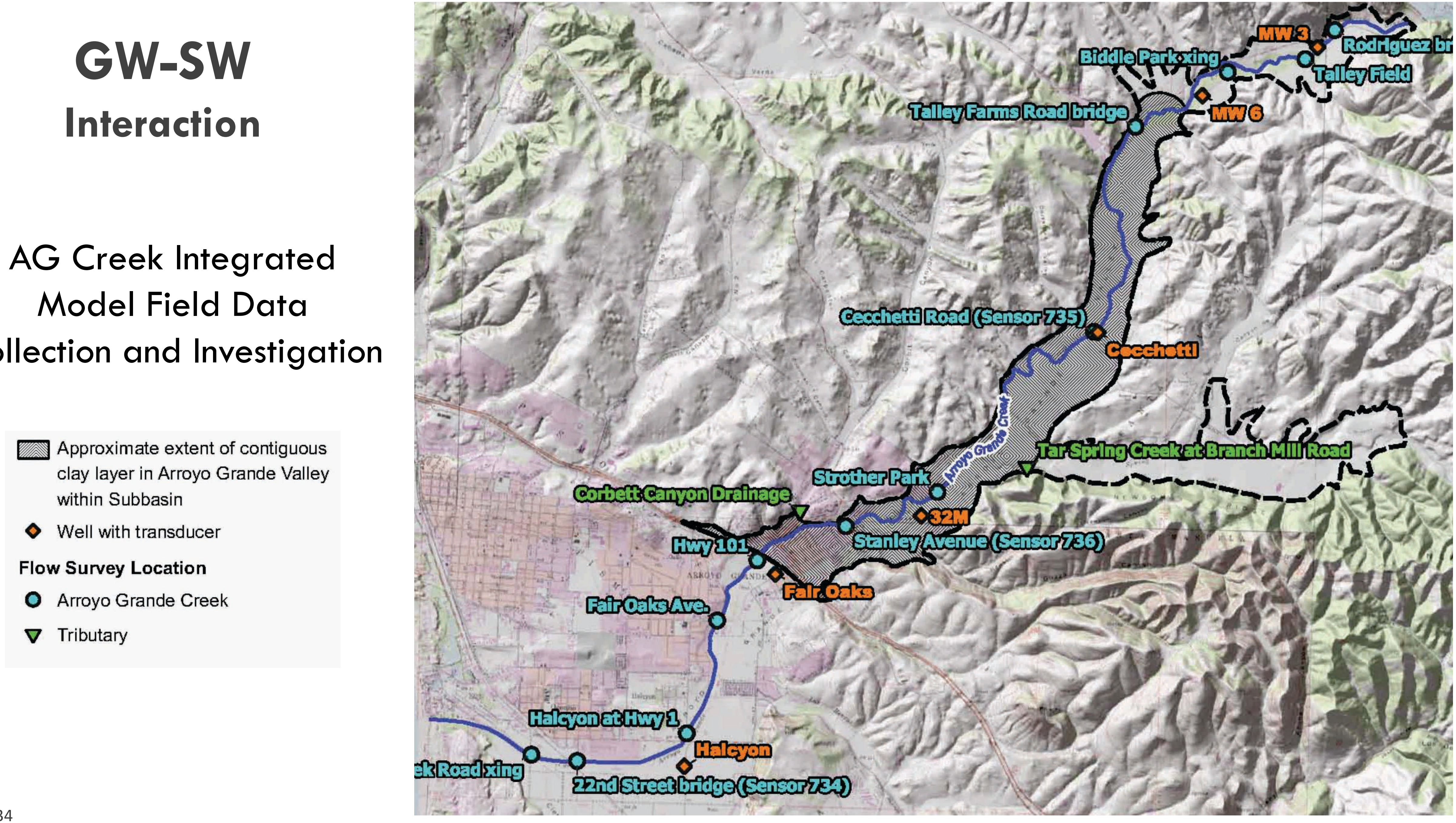
Nitrate as Nitrogen (mg/L)

●	0 - 2.5
●	2.5 - 5
●	5 - 7.5
●	7.5 - 10
●	> 10



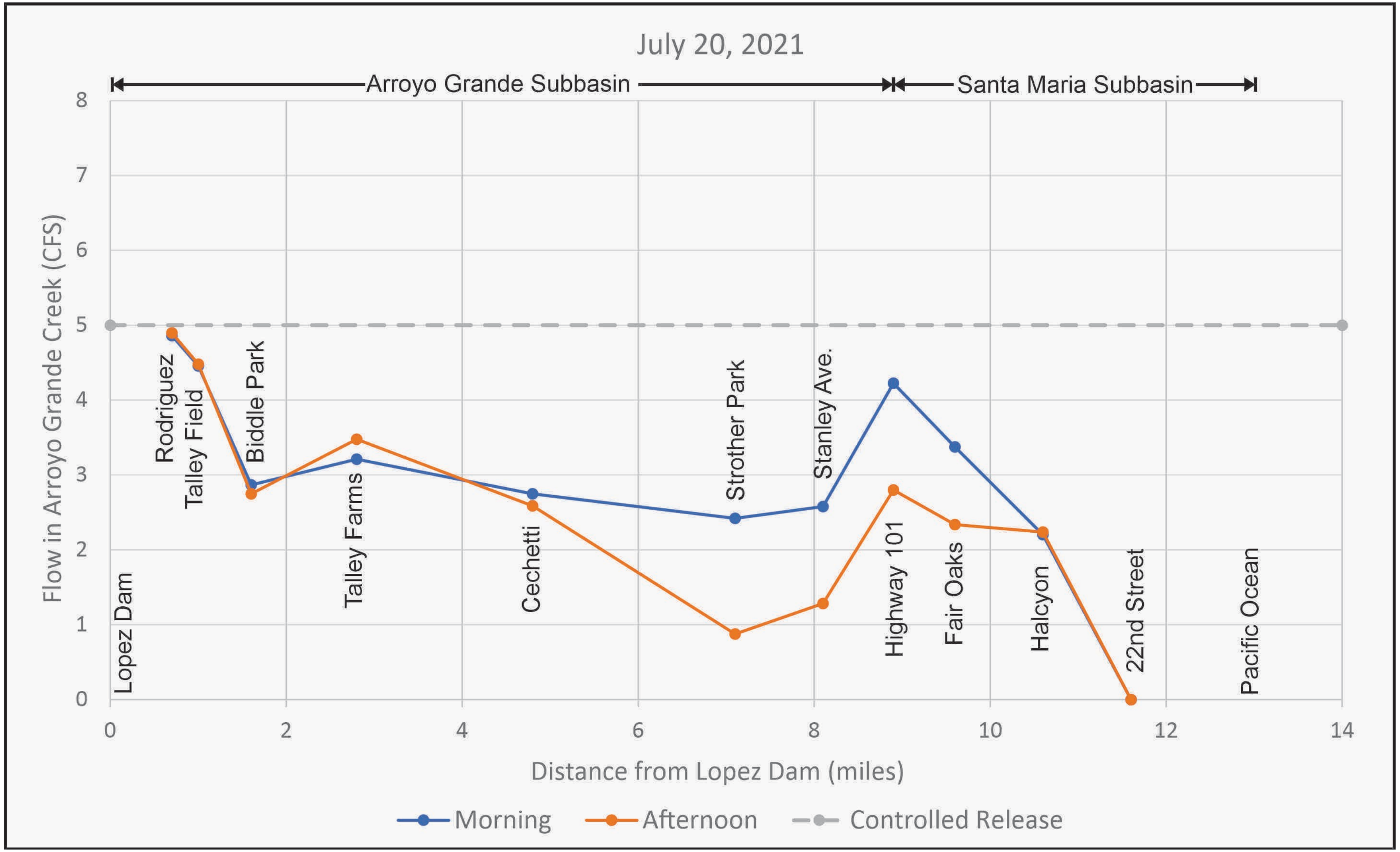
GW-SW
Interaction

AG Creek Integrated Model Field Data Collection and Investigation



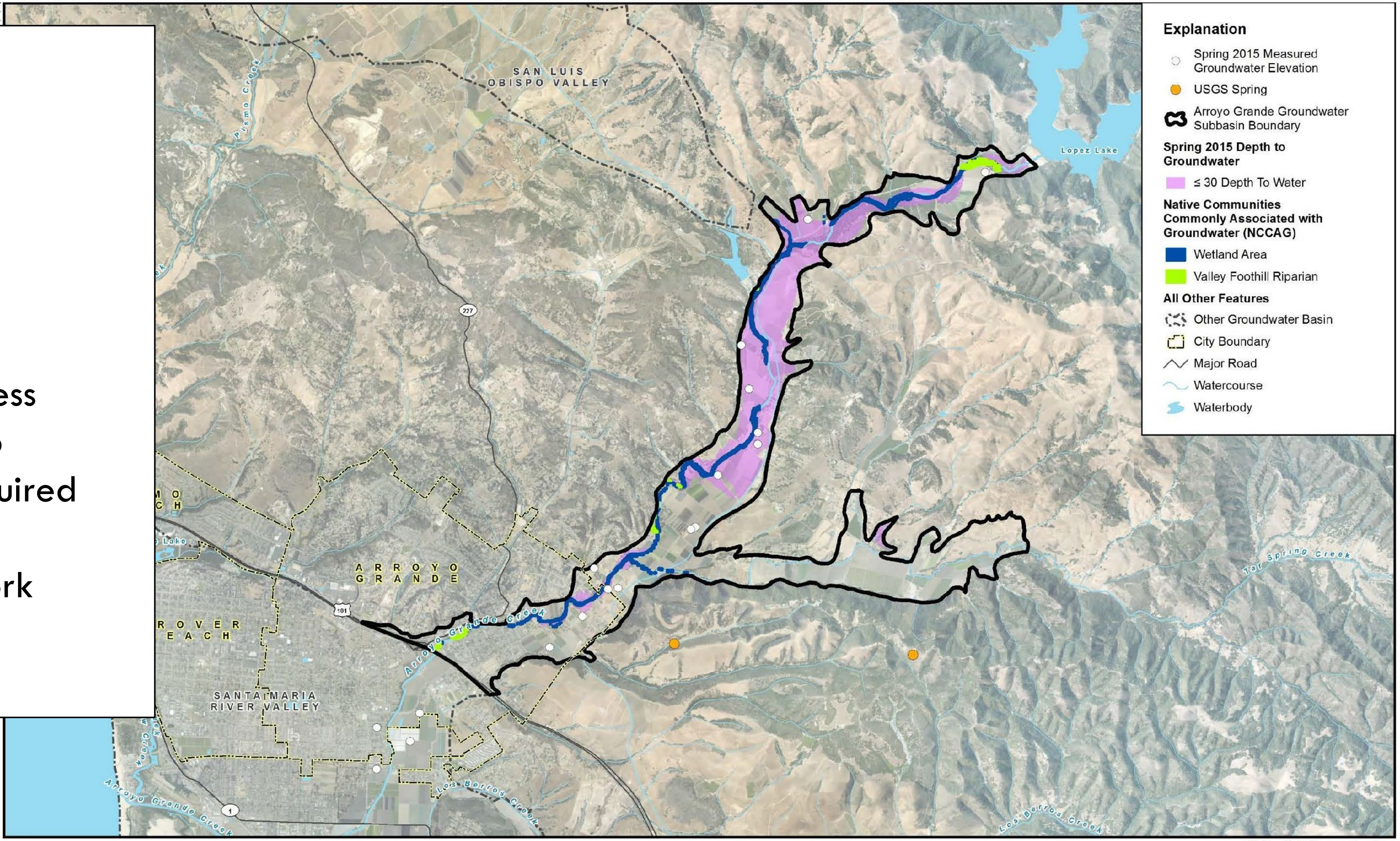
GW-SW
Interaction

- Gaining and losing reaches identified
- Net losing across subbasin
- Magnitude of stream seepage matches results of water budget
- Data being used for model development



Potential Groundwater Dependent Ecosystems (GDEs)

- Desktop analysis, subject to field verification
- NCCAG datasets with wetland and riparian mapped features
- Areas with GW less than 30 feet deep
- GDE analysis required for GSP. May be superseded by work on HCP.



CHAPTER 5: Groundwater Conditions

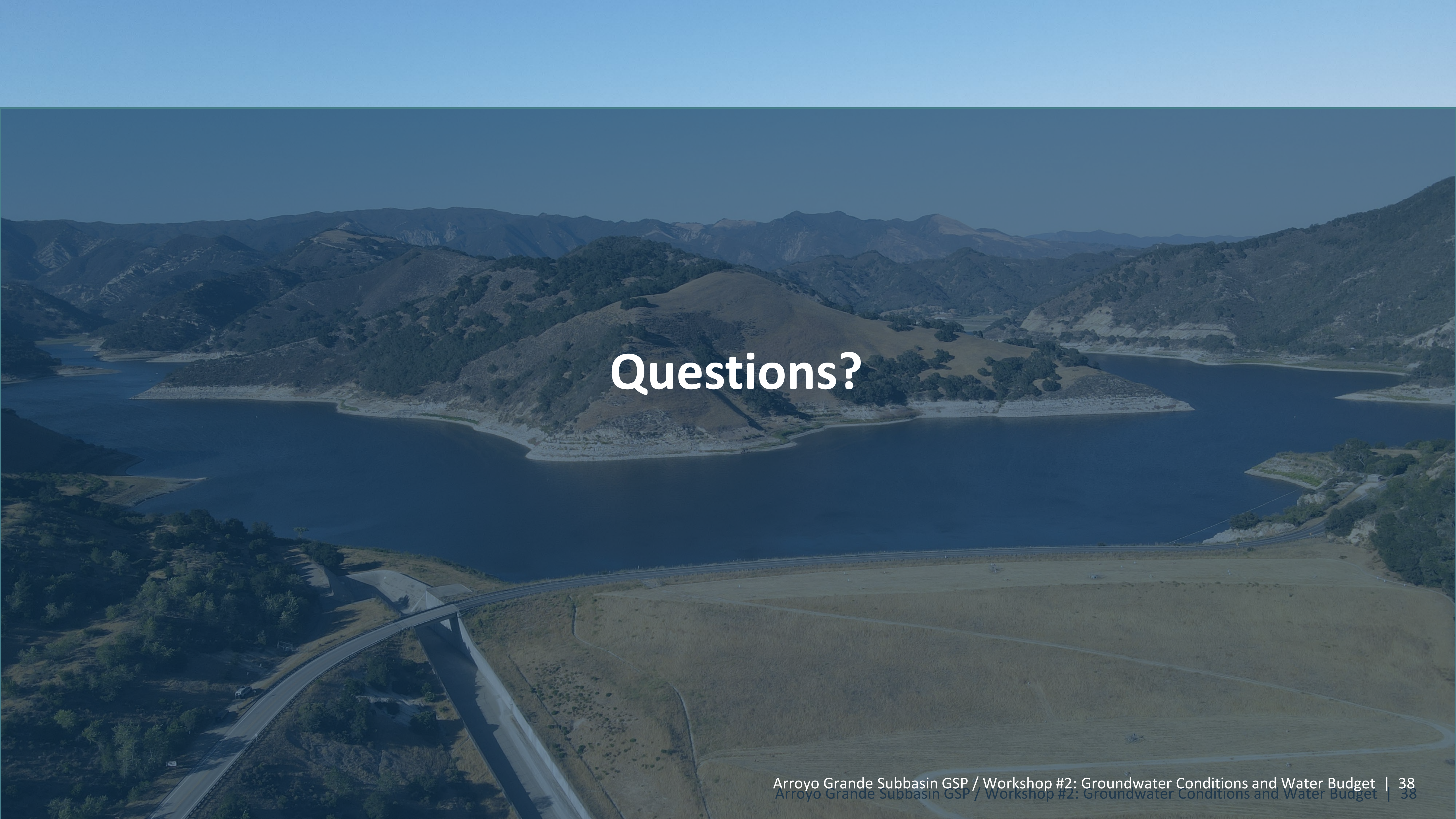
REVIEW

Chapter 5: Groundwater Conditions

Released on Nov 18, 2021

Public Comment period closes 12/20/21.

www.SLOCounty/ca/gov/AGBasin



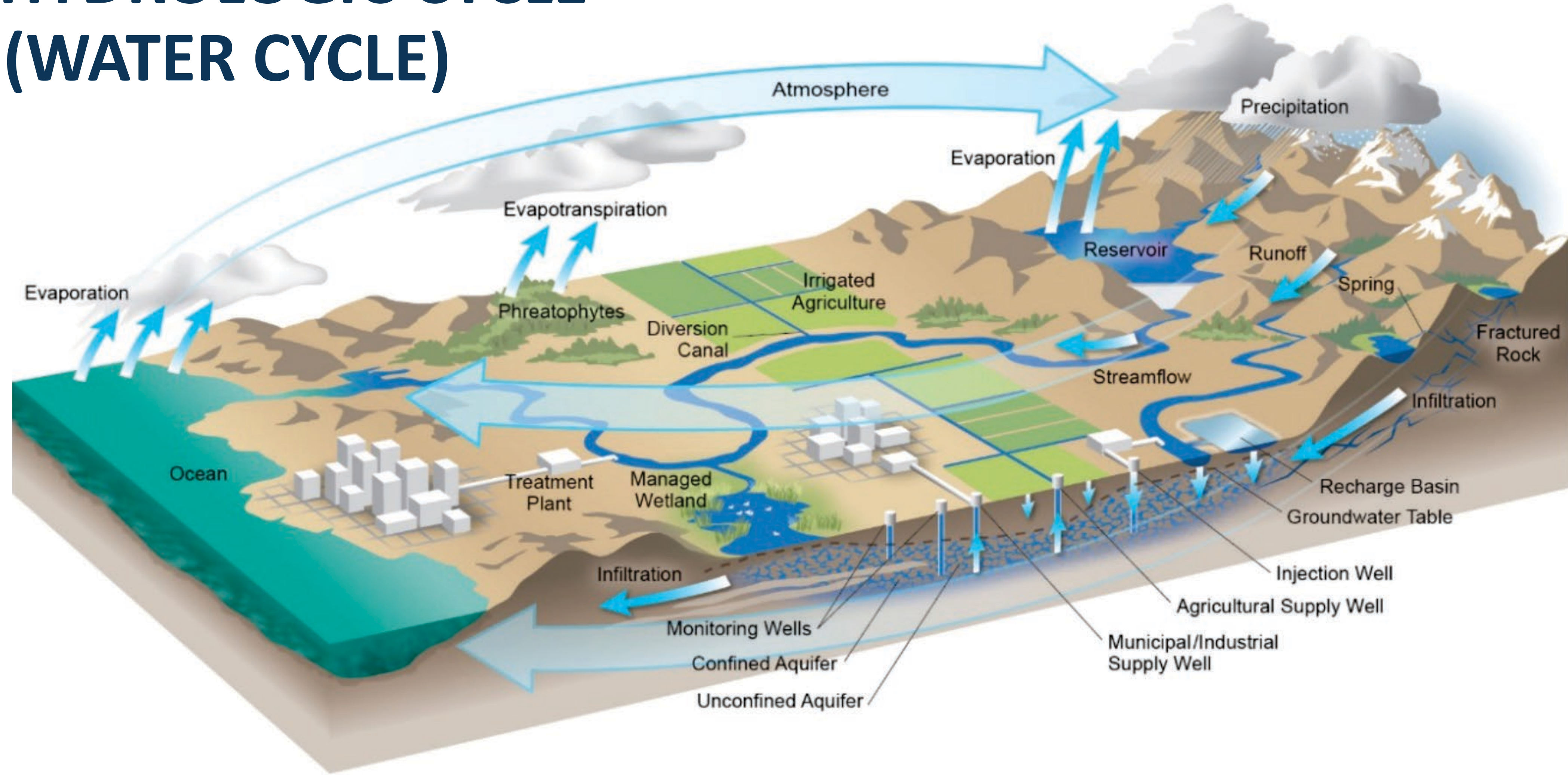
Questions?

Arroyo Grande Subbasin GSP / Workshop #2: Groundwater Conditions and Water Budget | 38

Overview of Water Budget (Chapter 6)

Spencer Harris, CHG

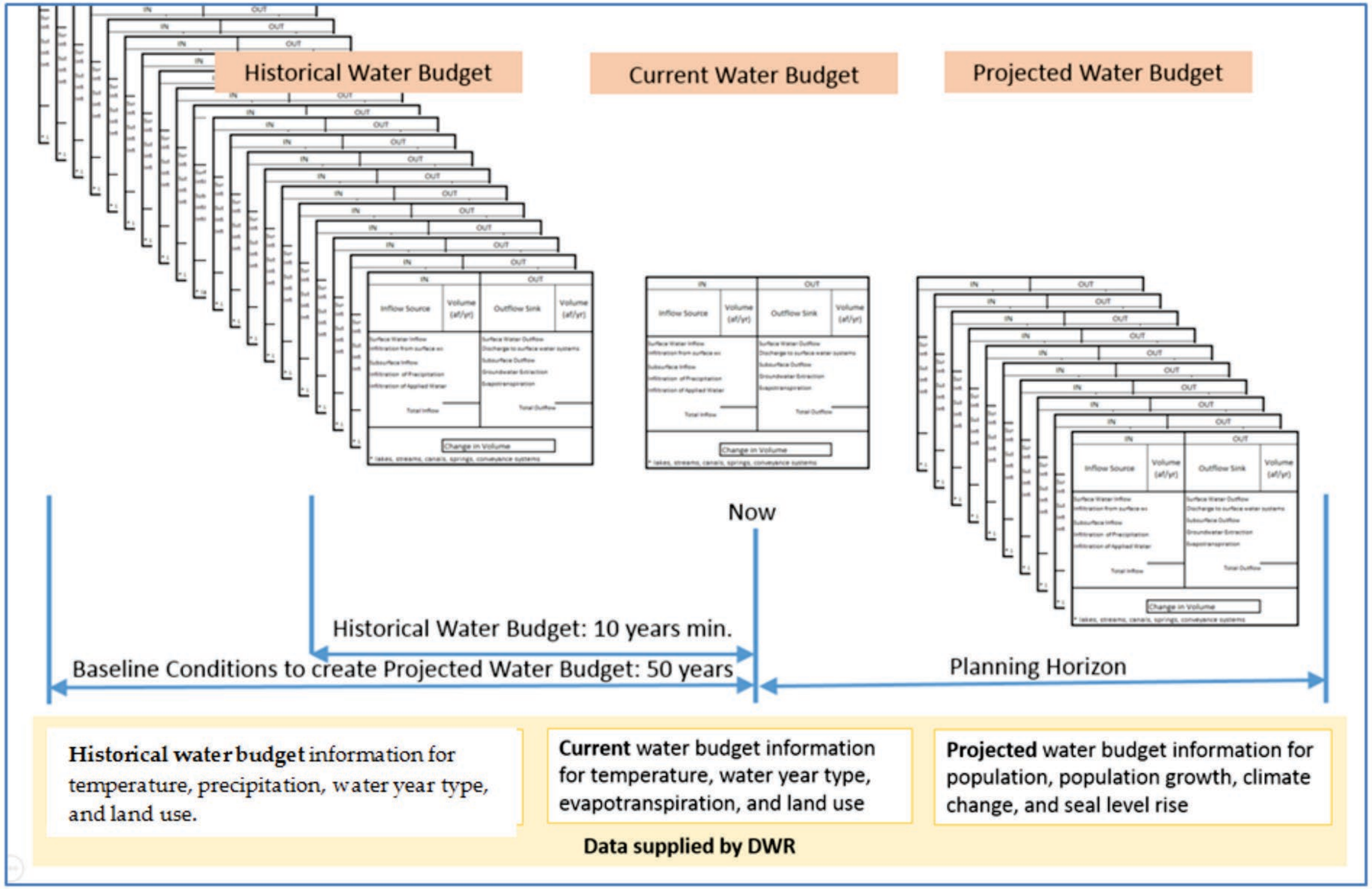
THE HYDROLOGIC CYCLE (WATER CYCLE)



Department of Water Resources (Water Budget BMP, 2016)

GSP §354.18 WATER BUDGET

(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. Water budget information shall be reported in tabular and graphical form.



Department of Water Resources (Water Budget BMP, 2016)

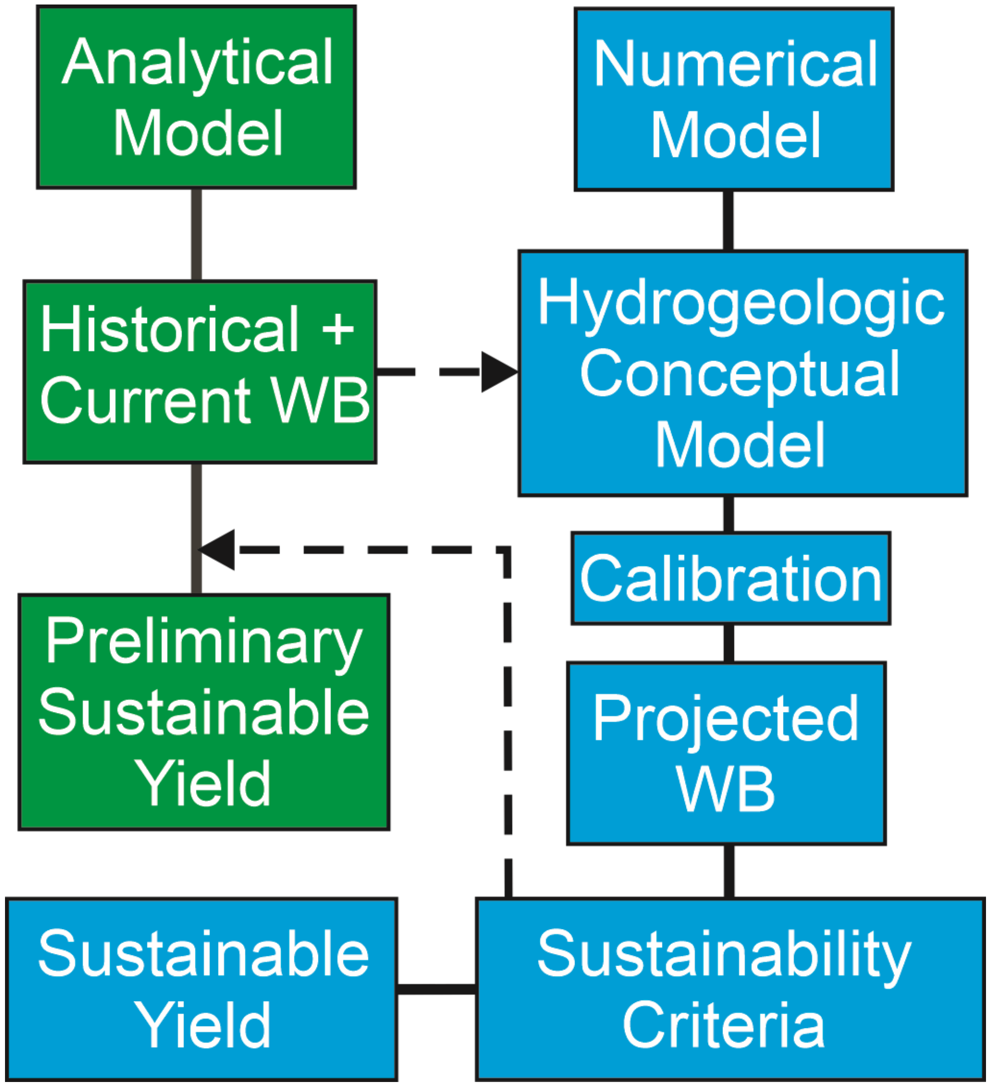
WATER BUDGET METHODOLOGY

ANALYTICAL MODEL

- Spreadsheet Model
- Inventory Method
- Specific Yield Method
- Input to HCM
- Limited input from SC
- Preliminary Sustainable Yield

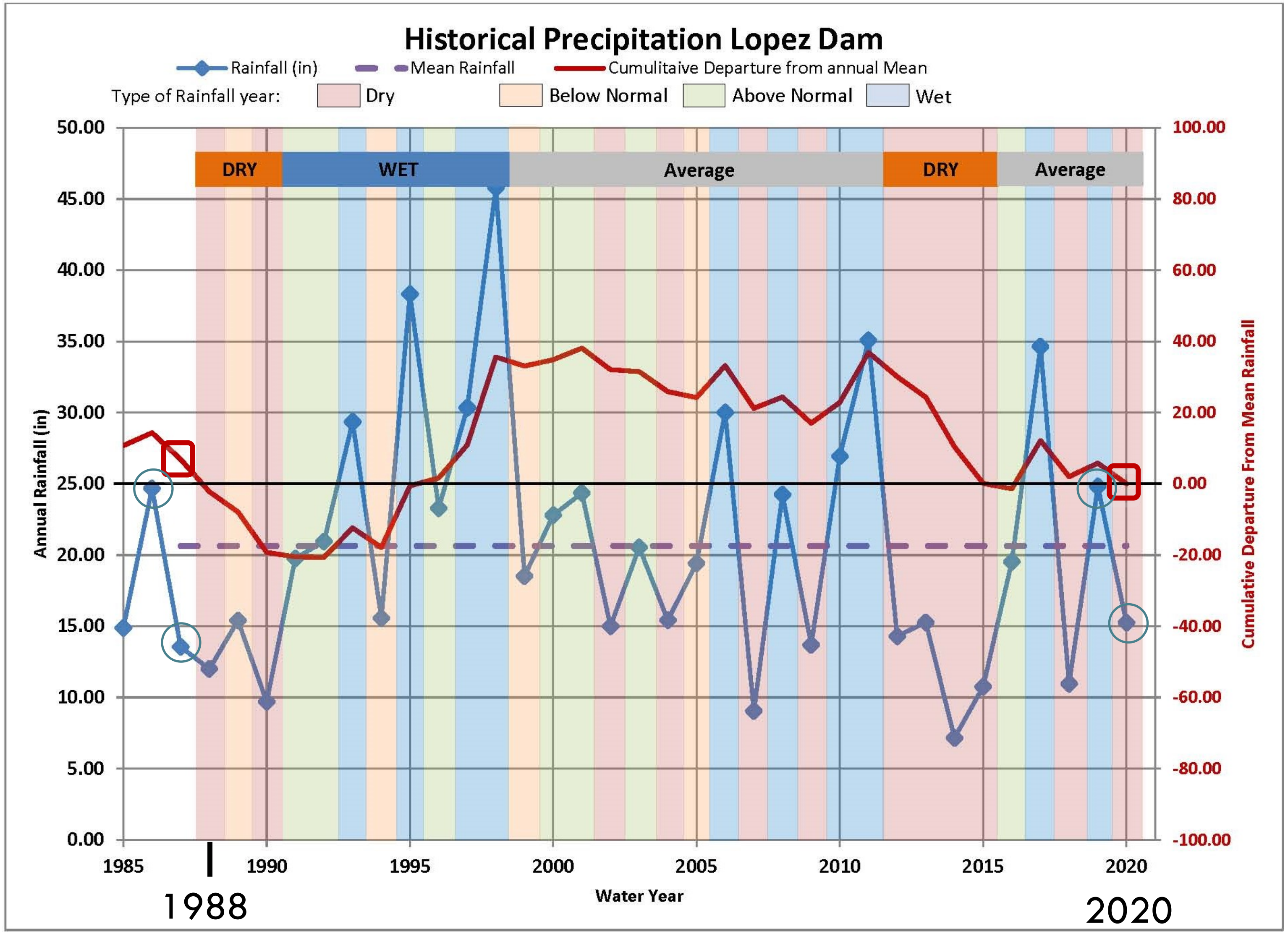
NUMERICAL MODEL

- Integrated Model (GS FLOW)
- Fully Transient / Dynamic
- Model Grid / Flow Equations
- Input from Analytical Model
- Input from Sustainability Criteria
- Final Sustainable Yield



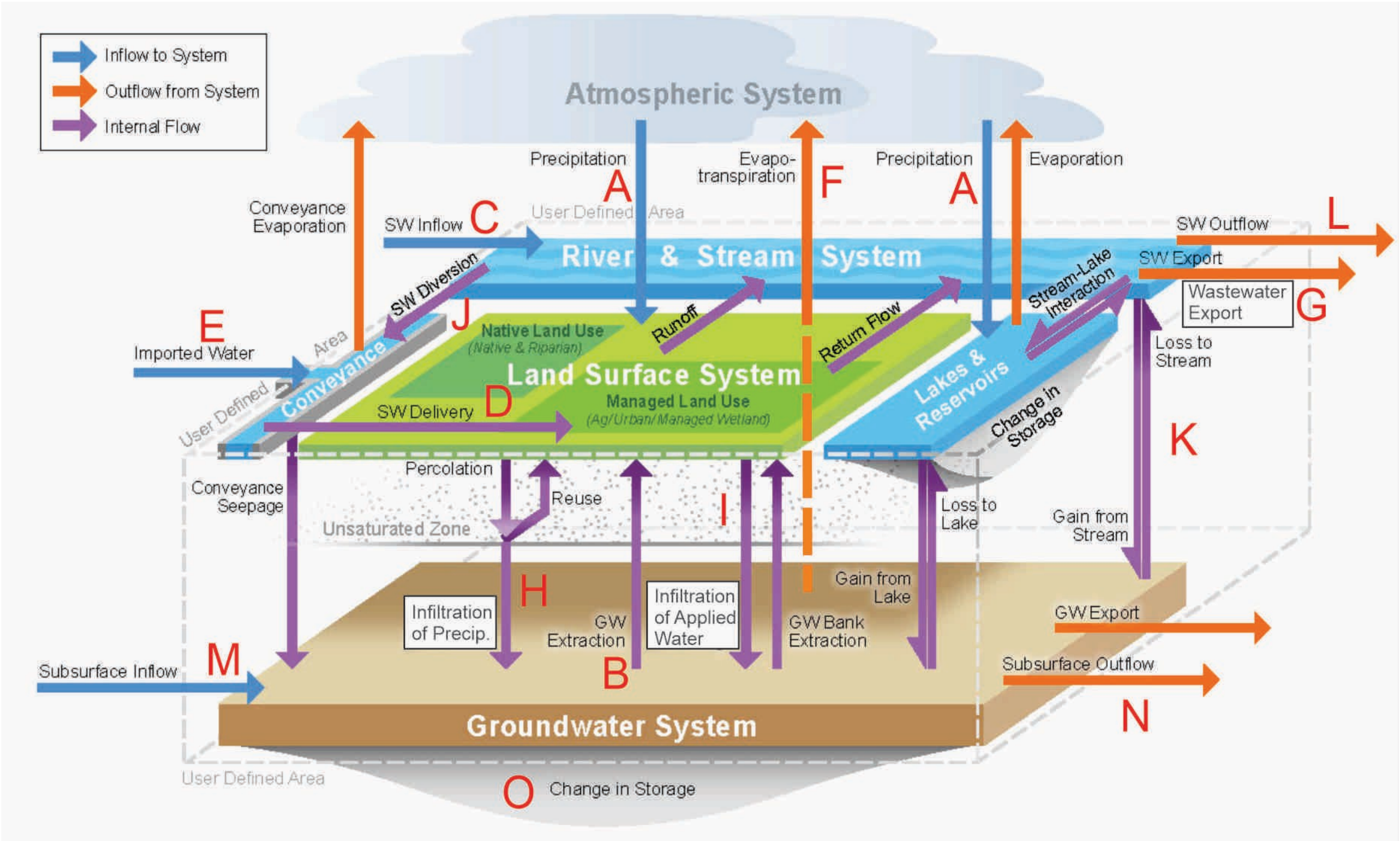
HYDROLOGIC BASE PERIOD

- **Average rainfall over 33-year base period** (1988-2020)
  20.9 inches
- **Average rainfall over full record** (1969-2020)
  21.07 inches
- **Cumulative departure from mean precip** (1988-2020)
  -6.87 inches (-0.21 in/yr)
- **Water in transit**
  - Beginning rainfall
    1986 24.68 inches
    1987 13.56 inches
  - Ending rainfall
    2019 24.82 inches
    2020 15.25 inches
- **Average rainfall over current period** (2016-2020)
  21.04 inches



WATER BUDGET EQUATION

INFLOW – OUTFLOW = CHANGE IN STORAGE



Department of Water Resources (Water Budget BMP, 2016)

TWO BUDGET SYSTEMS

- **SURFACE WATER SYSTEM**
  - Atmospheric System
  - River & Stream System
  - Land Surface System
- **GROUNDWATER SYSTEM**

15 BUDGET ITEMS

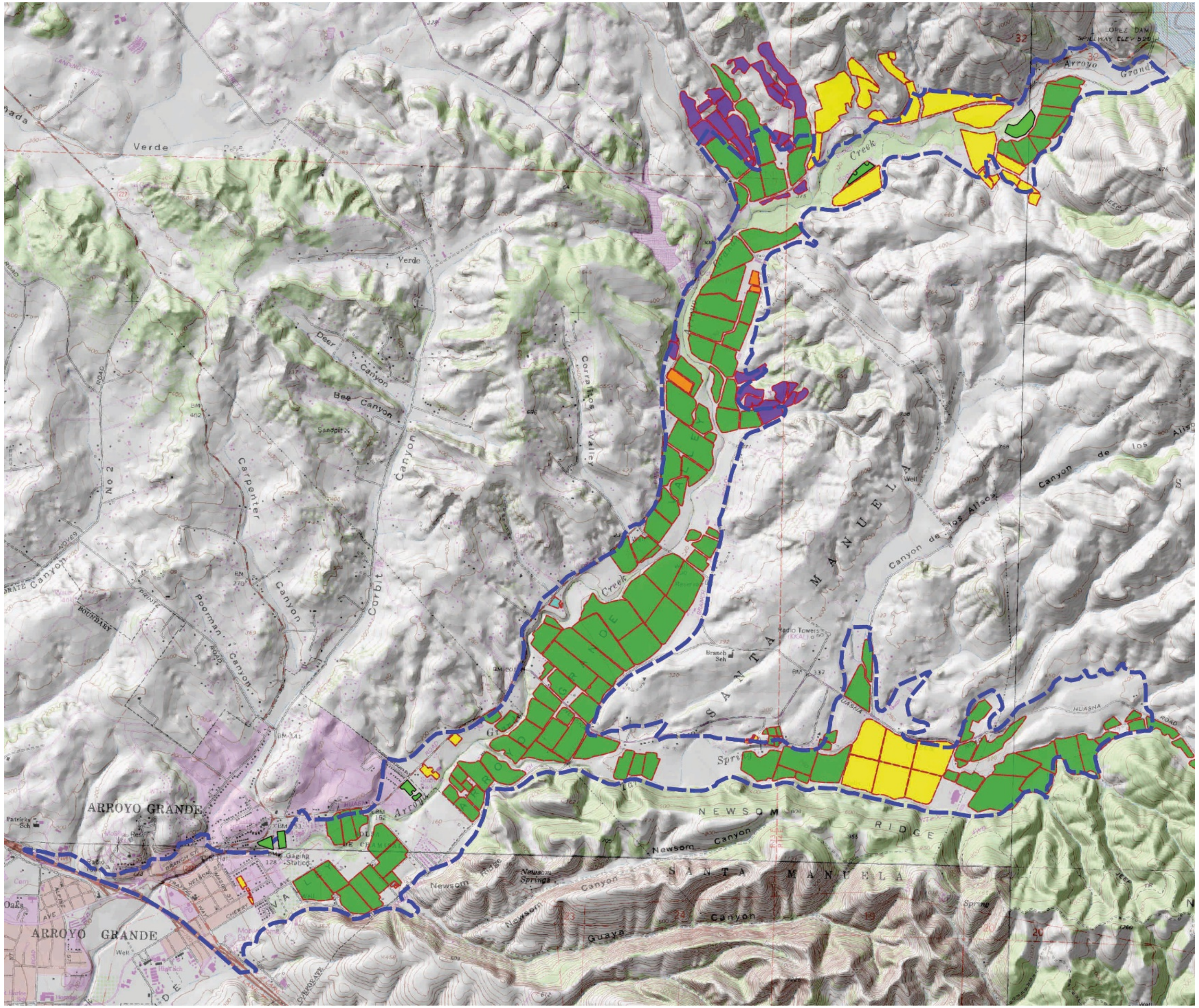
- A - Precipitation
- B – GW extractions*
- C,L – SW inflow/outflow
- D – Surface water delivery
- E – Imported water
- F – Evapotranspiration*
- G – Wastewater export
- H – Infiltration of precipitation
- I – Infiltration of applied water*
- J – Surface water diversion
- K – GW-SW interaction
- M,N – Subsurface flow in/out
- O – Change in storage
- *Urban and Agricultural sectors

SUBBASIN OVERVIEW

- ~2,900 acres total
- ~1,500 acres crops
- ~ 600 acres urban
- ~ 800 acres native
- ~103 sq. mi. watershed
- ~13,000 AF storage

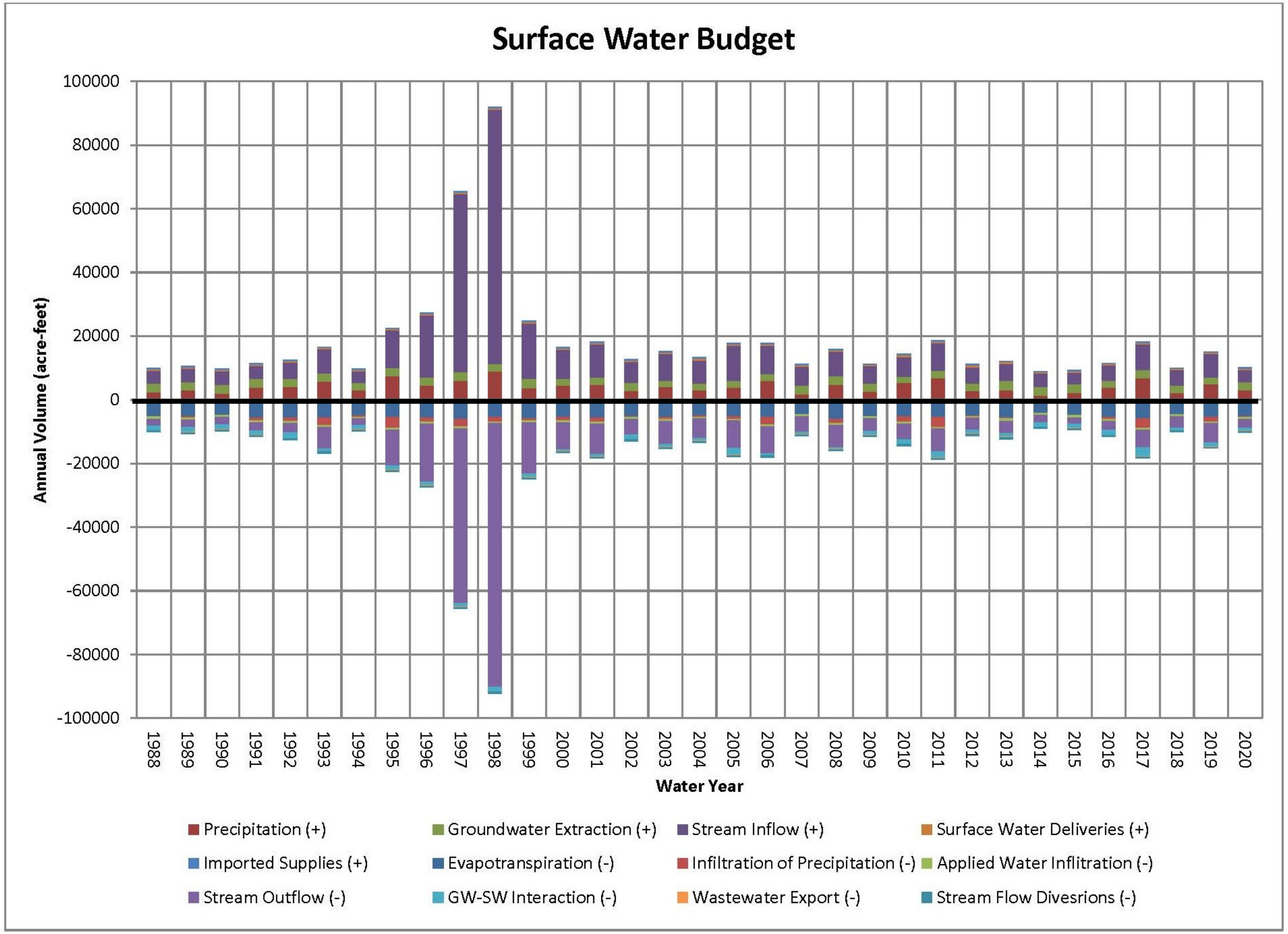
Irrigated Crop Types

- Citrus
- Deciduous
- Nursery
- Pasture
- Vegetable
- Vineyard
- Turf



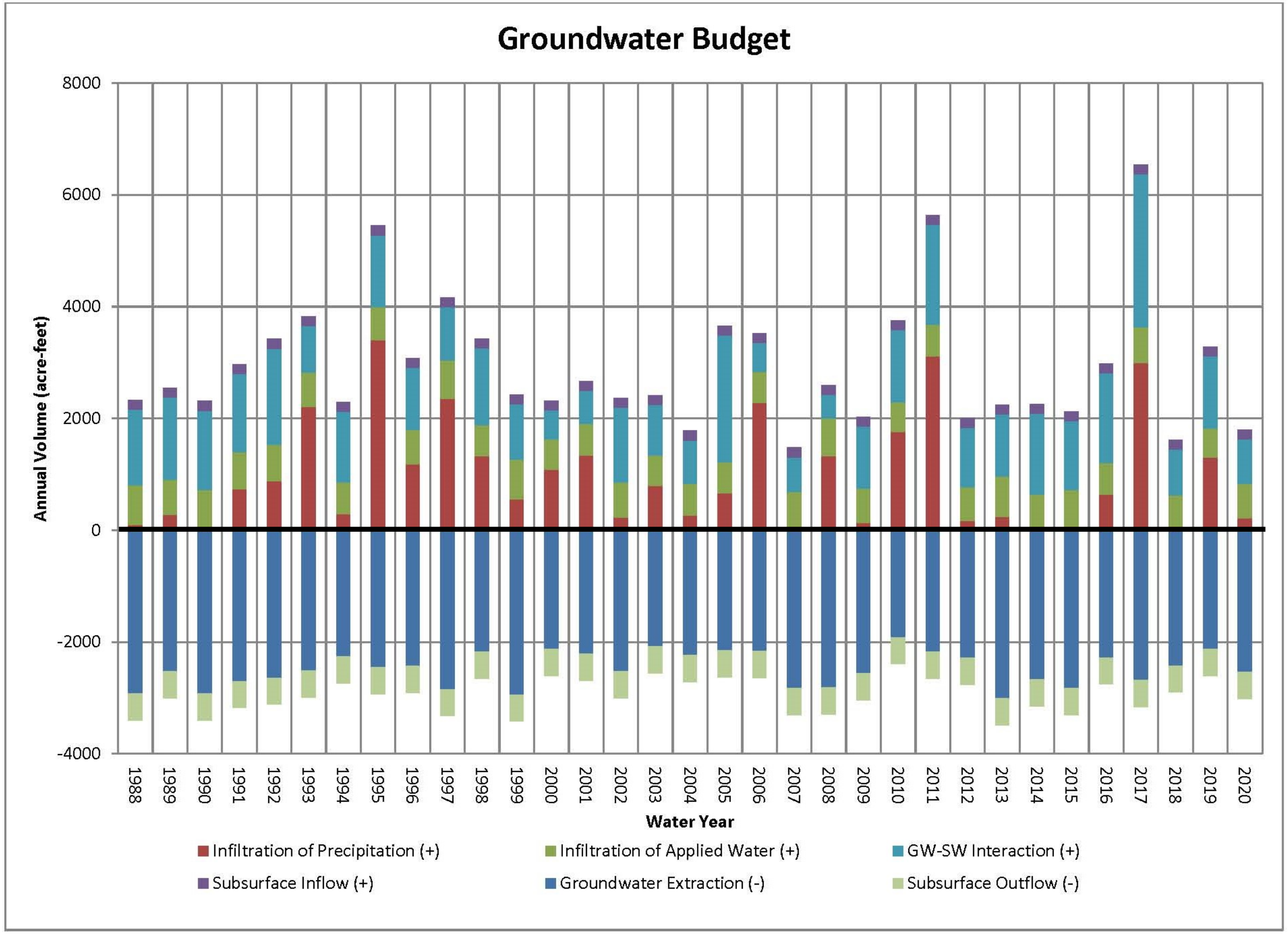
SURFACE WATER BUDGET

- Estimates the elements of the surface water budget on an annual basis
- Balanced over water year with no change in storage
- **LARGEST INFLOWS**
  - Stream Inflow
  - Precipitation
- **LARGEST OUTFLOWS**
  - Stream Outflow
  - Evapotranspiration



GROUNDWATER BUDGET

- Estimates the elements of the groundwater budget on an annual basis
- Balanced over water year with change in storage
- **LARGEST INFLOW** –
  GW-SW interaction
  Infiltration of Precipitation
- **LARGEST OUTFLOW** – Extraction from Pumping



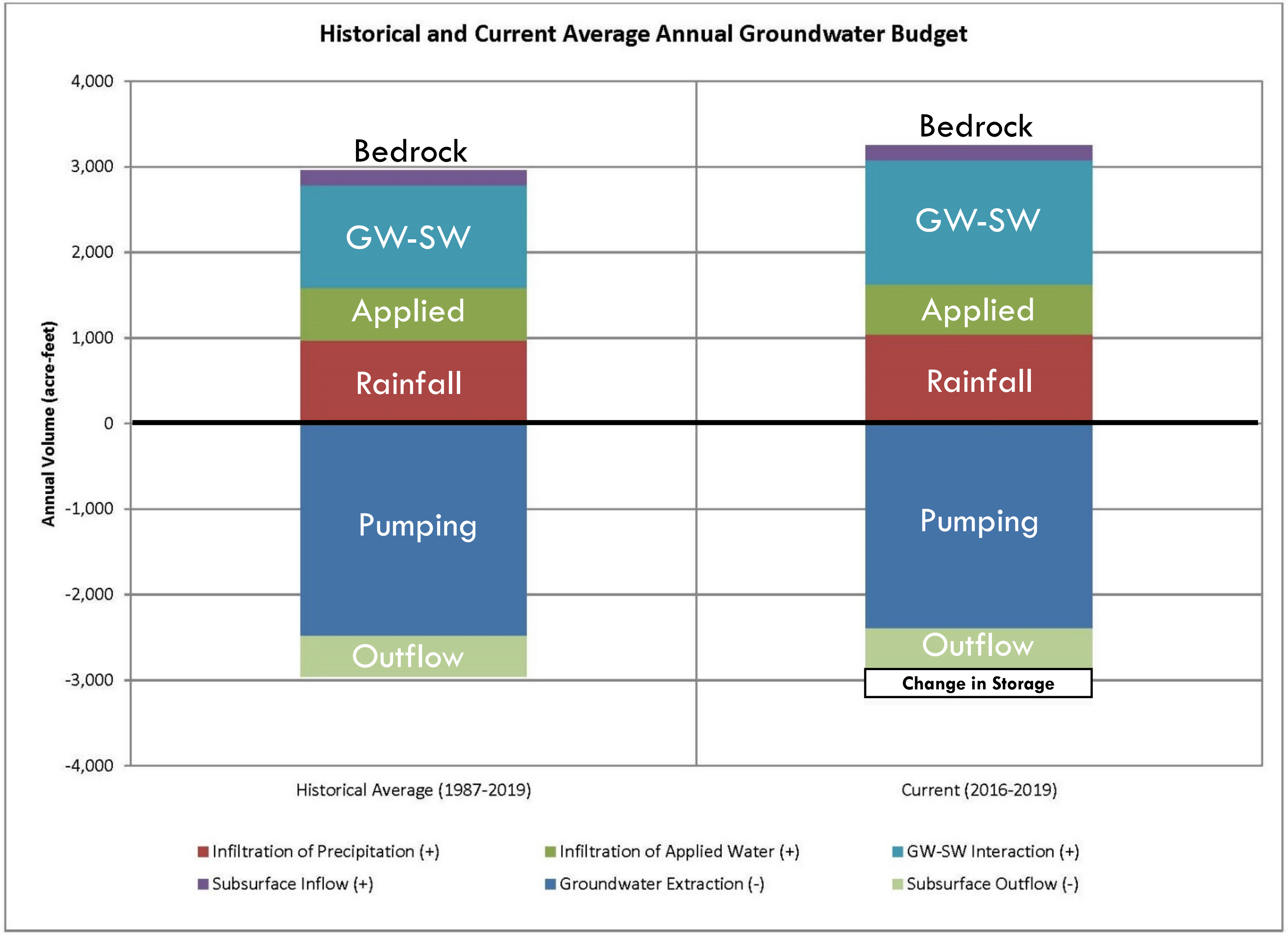
GROUNDWATER BUDGET

- **HISTORICAL AVERAGE**
  (1988-2020)
  - Rainfall (+) = 970 AFY
  - Applied (+) = 620 AFY
  - GW-SW (+) = 1,190 AFY
  - Subsurface (+) = 170 AFY
  - Pumping (-) = 2,480 AFY
  - Subsurface (-) = 480 AFY
  - Inflow – Outflow = Change in Storage

  2,950 – 2,960 = **- 10 AFY**

- **CURRENT**
  (2016 -2020)
  - Rainfall (+) = 1,040 AFY
  - Applied (+) = 590 AFY
  - GW-SW (+) = 1,450 AFY
  - Subsurface (+) = 170 AFY
  - Pumping (-) = 2,400 AFY
  - Subsurface (-) = 480 AFY
  - Inflow – Outflow = Change in Storage

  3,240 – 2,890 = **+350 AFY**



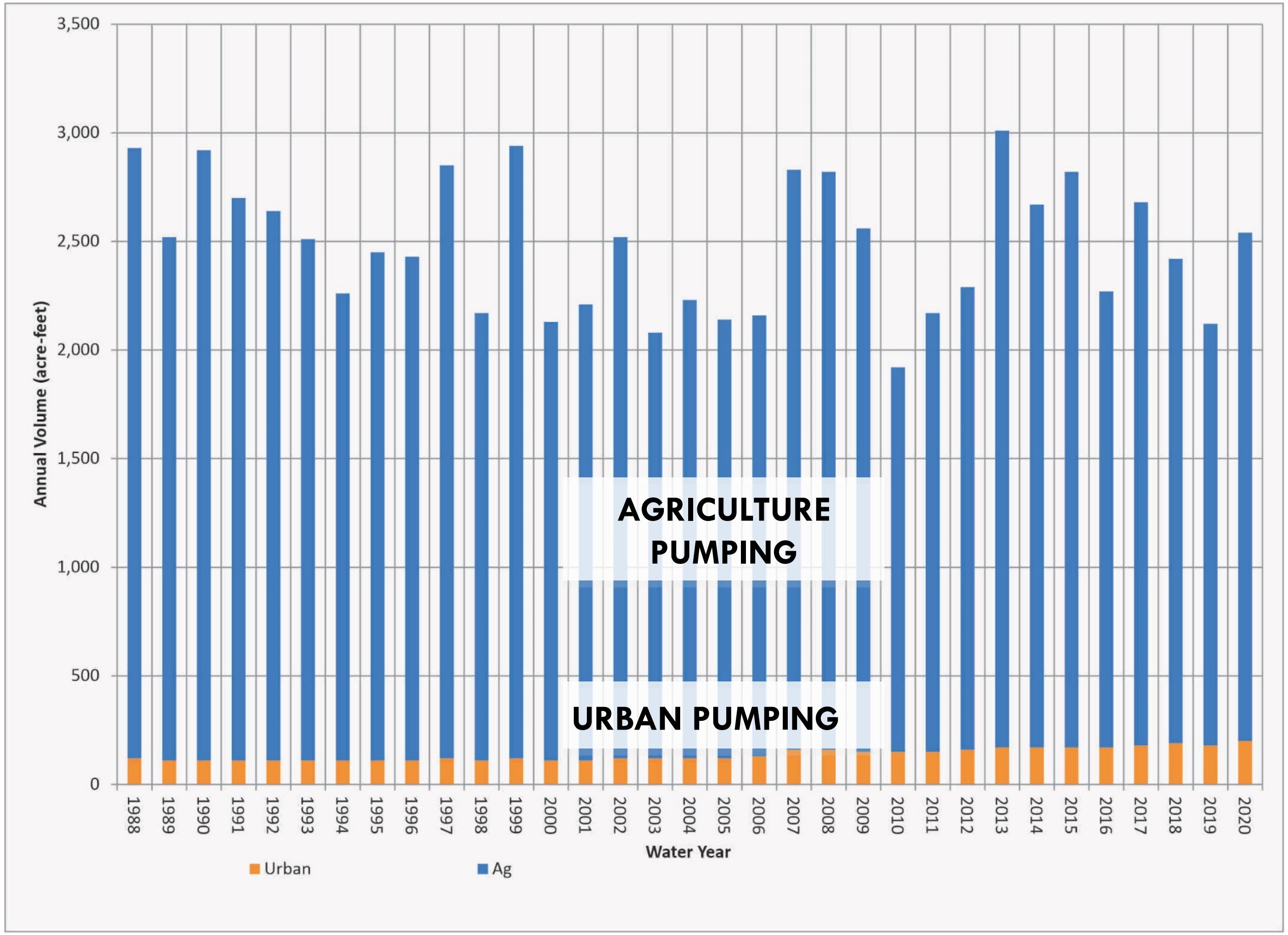
SUBBASIN GROUNDWATER PUMPING BY SECTOR

HISTORICAL AVERAGE
(1988-2020)

- Urban ~ 140 AFY
- Agriculture ~ 2,340 AFY
- Total ~ 2,480 AFY

CURRENT
(2016 -2020)

- Urban ~ 180 AFY
- Agriculture ~ 2,220 AFY
- Total ~ 2,400 AFY

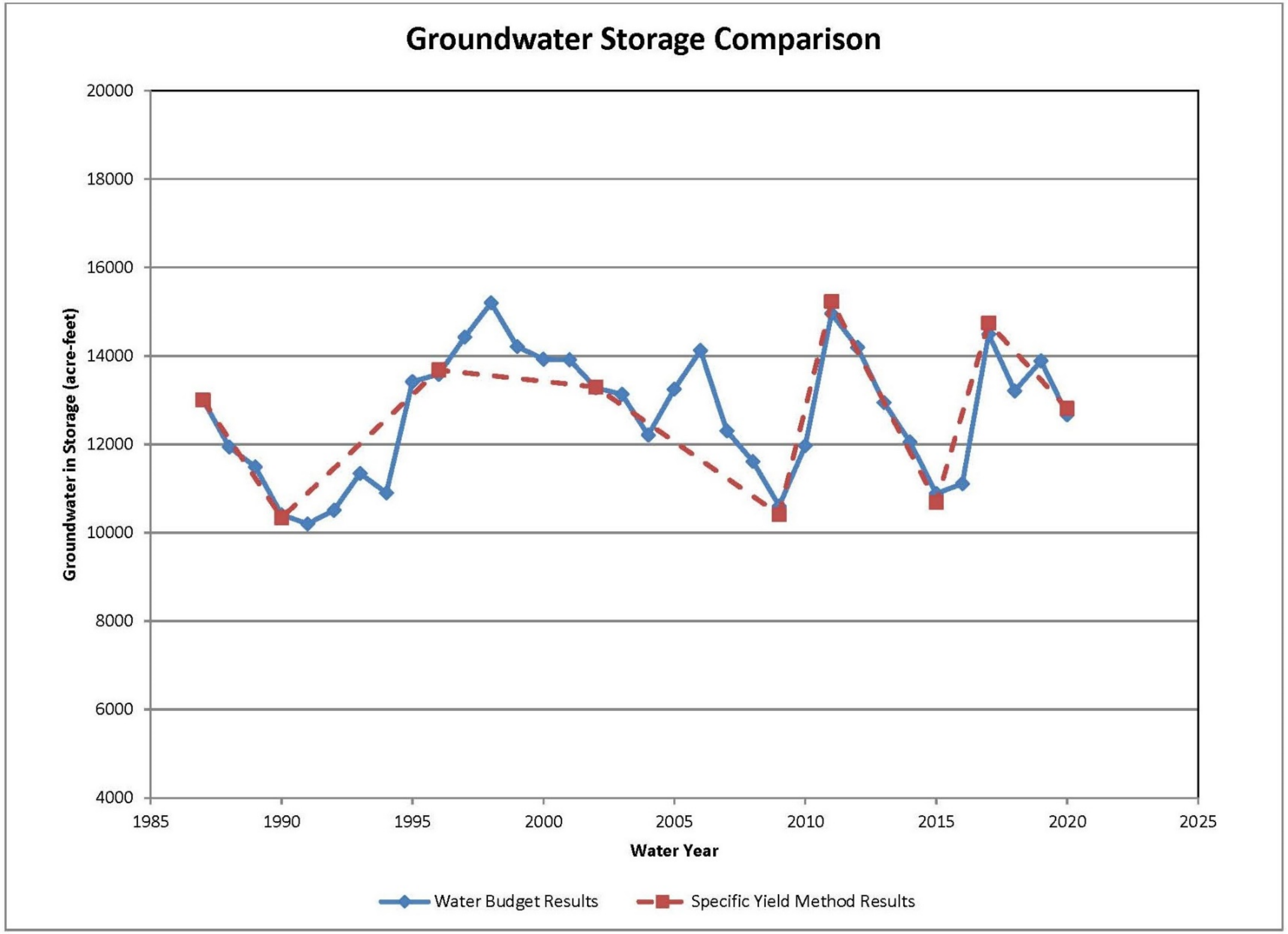


GROUNDWATER IN STORAGE

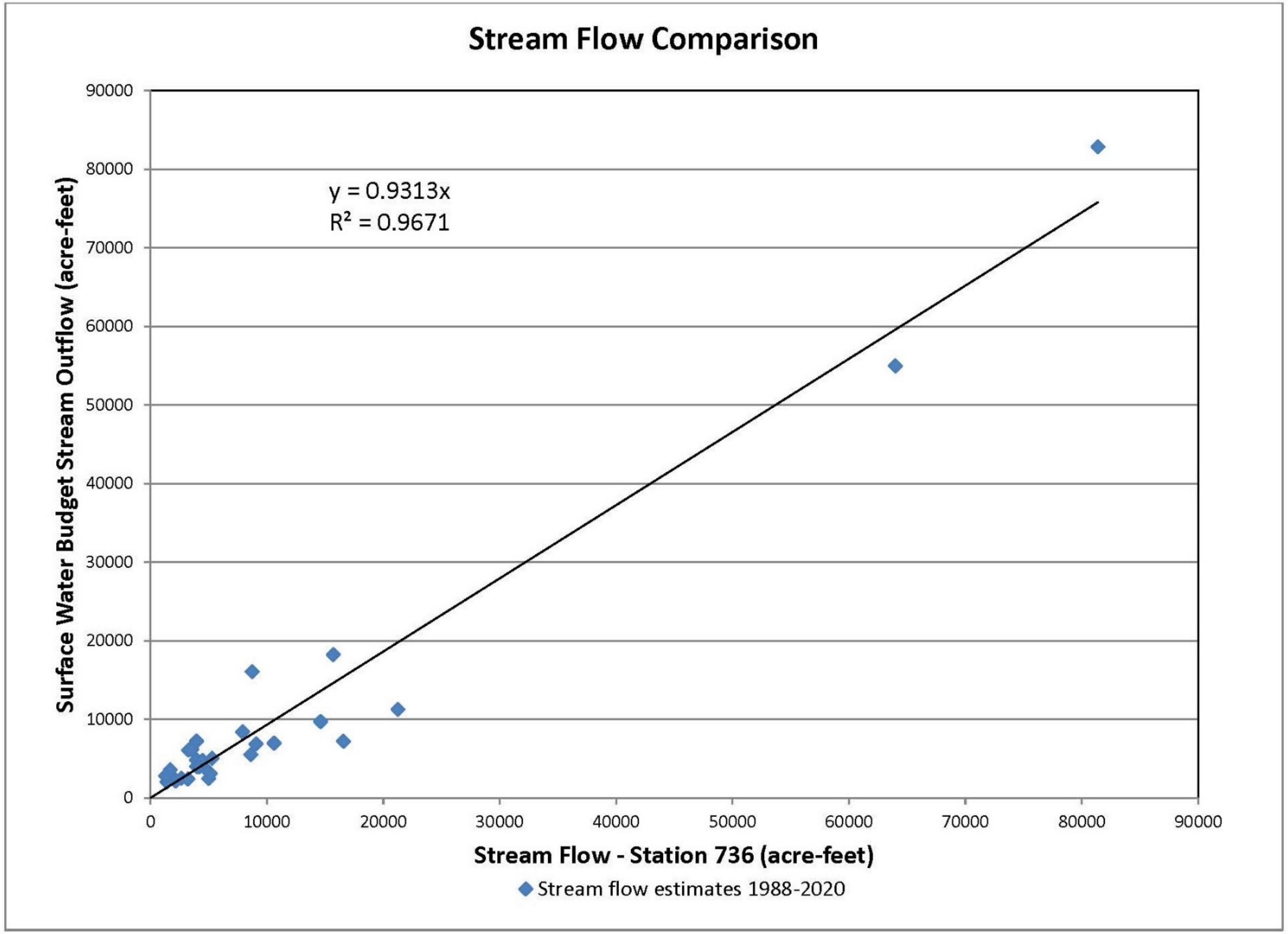
- **HISTORICAL AVERAGE**
  (1988 - 2020)

  - Basin total change in storage
  12,700 – 13,000 = **-300 AF**
  Over 33 Years = **-10 AFY**

- **CURRENT**
  (2016 -2020)
  - Basin total change in storage
  12,700 – 10,900 = **+1800 AF**
  Over 5 Years = **+360 AFY**



STREAM FLOW COMPARISON



SUSTAINABLE YIELD AND OVERDRAFT

Sustainable Yield – the maximum quantity of water, calculated over A base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result. (SGMA)

Overdraft – The condition of a groundwater basin or subbasin where the amount of water withdrawn by pumping exceeds the amount of water that recharges a basin over a period of years, during which the water supply conditions approximate average conditions. (DWR Bulletin 118)

PRELIMINARY SUSTAINABLE YIELD ESTIMATE

Recharge – Subsurface Outflow = Preliminary Sustainable Yield

2,950 – 480 = **2,470 AFY**
3,000 – 500 = **2,500 AFY**

PRELIMINARY OVERDRAFT ESTIMATE

Sustainable Yield – Pumping = +Surplus or –Deficit (Overdraft)

2,470 – 2,480 = **-10 AFY**
2,500 – 2,500 = **0 AFY (Balanced)**

CHAPTER 6: Water Budget

REVIEW

Chapter 6: Water Budget

Released on Dec 7, 2021

Public Comment period closes 1/5/21.

www.SLOCounty/ca/gov/AGBasin

Questions?

Arroyo Grande Subbasin GSP / Workshop #2: Groundwater Conditions and Water Budget | 55

Integrated Groundwater/Surface Water Model Update

DAVE O'ROURKE, GSI

Integrated GW/SW Model

We are using GSFLOW, a USGS modeling platform that incorporates

- PRMS (Precipitation Runoff Modeling System) to simulate Rainfall/Runoff modeling of surface water features, and
- MODFLOW for modeling groundwater flow.

In addition, when complete, the GSFLOW model will be linked to MODSIM, a reservoir operations model. This will benefit future reservoir licensing efforts associated with the Habitat Conservation Plan.

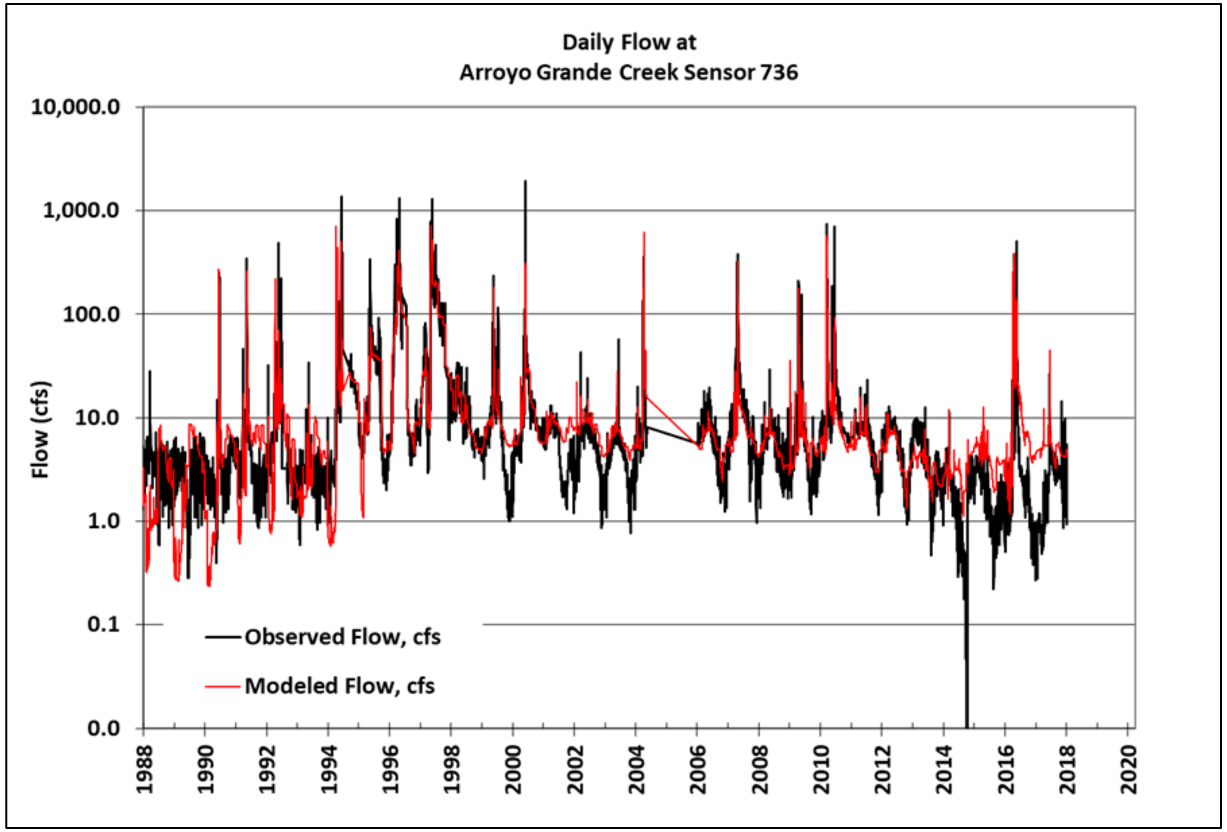
Work is not completed yet.

Model Area

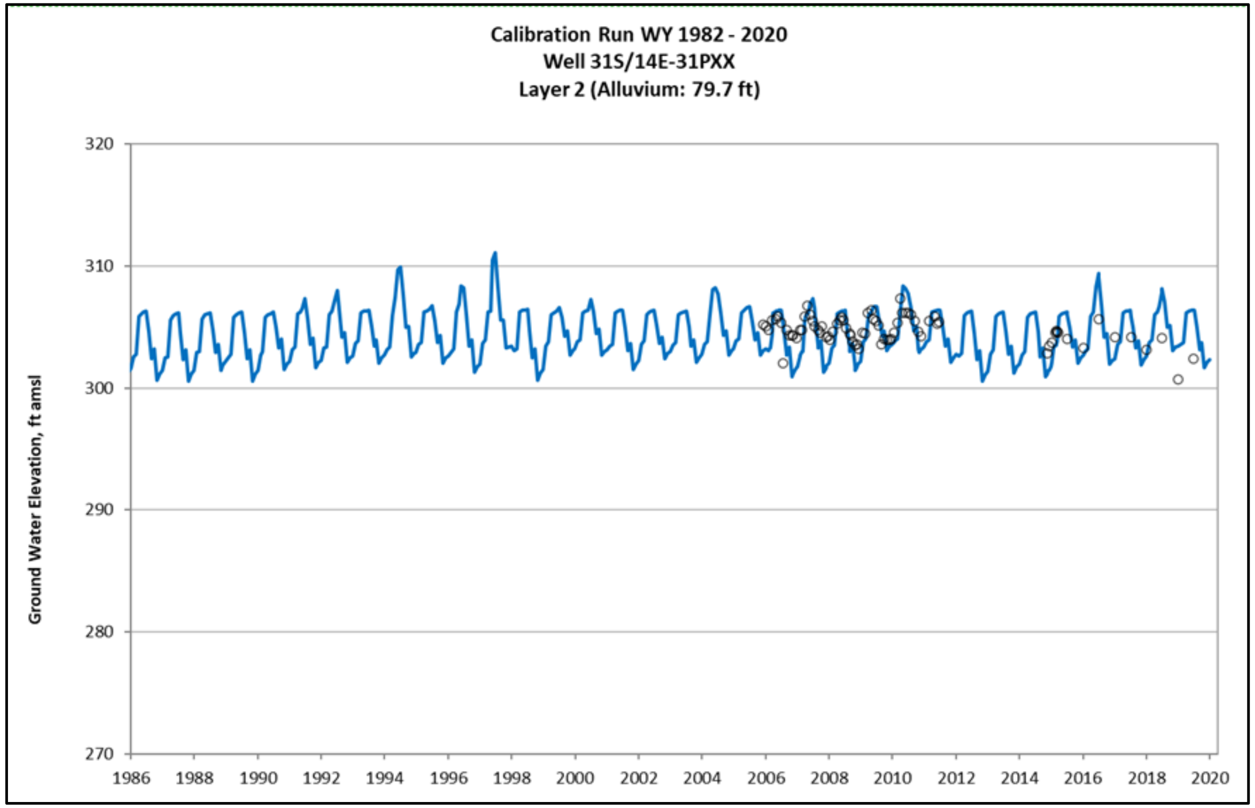
- All contributing watershed area to Arroyo Grande Creek
- Much larger area than Arroyo Grande Subbasin Boundary
- Designed to support future HCP work.

Model Calibration Examples (ongoing)

Surface Water Calibration (stream flows)



Groundwater Calibration (water levels)



Sustainable Management Criteria

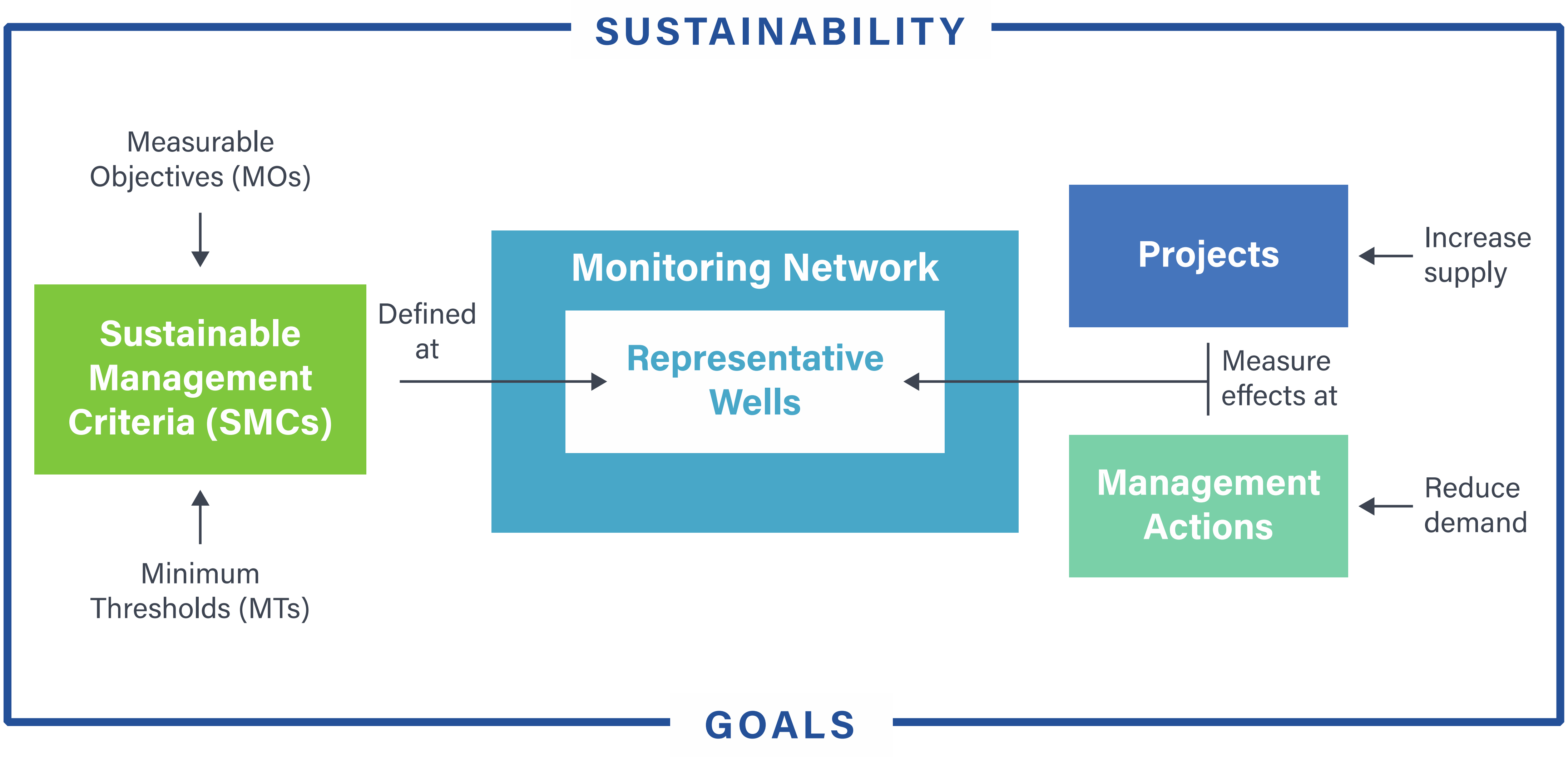
DAVE O'ROURKE, GSI

SUSTAINABLE MANAGEMENT CRITERIA

SUSTAINABILITY INDICATOR	CHRONIC LOWERING OF GROUNDWATER LEVELS	REDUCTION OF GROUNDWATER STORAGE	WATER QUALITY DEGRADATION	LAND SUBSIDENCE	INTER-CONNECTED SURFACE WATER DEPLETIONS	SEAWATER INTRUSION
METRIC(S) USED	Groundwater Elevation	Total Volume	- Migration Plumes - # of Supply Wells - Volume - Location of Isocontour	Rate and extent of land subsidence	Volume or rate of surface water depletion	Chloride Concentration Isocontour

SGMA allows all indicators but water quality to be assessed using **WATER LEVELS** as a proxy metric for direct measurement.

GETTING TO SUSTAINABILITY



REPRESENTATIVE WELLS (Representative Monitoring Sites / RMS)

Representative Wells are a <u>Subset</u> of Monitoring Network

- For reference SLO Basin has ~40 wells in monitoring network. 10 wells are designated as RMS.
- Arroyo Grande Subbasin is much smaller, likely many fewer wells in network.

Qualities desired for representative wells. (Not required at start of program.)

- Located in areas of interest or data gaps
- Accessibility of well for measurements
- Long Period of Record
- Documented Well Construction Details
- Dedicated Monitoring Well Preferred– No Pump

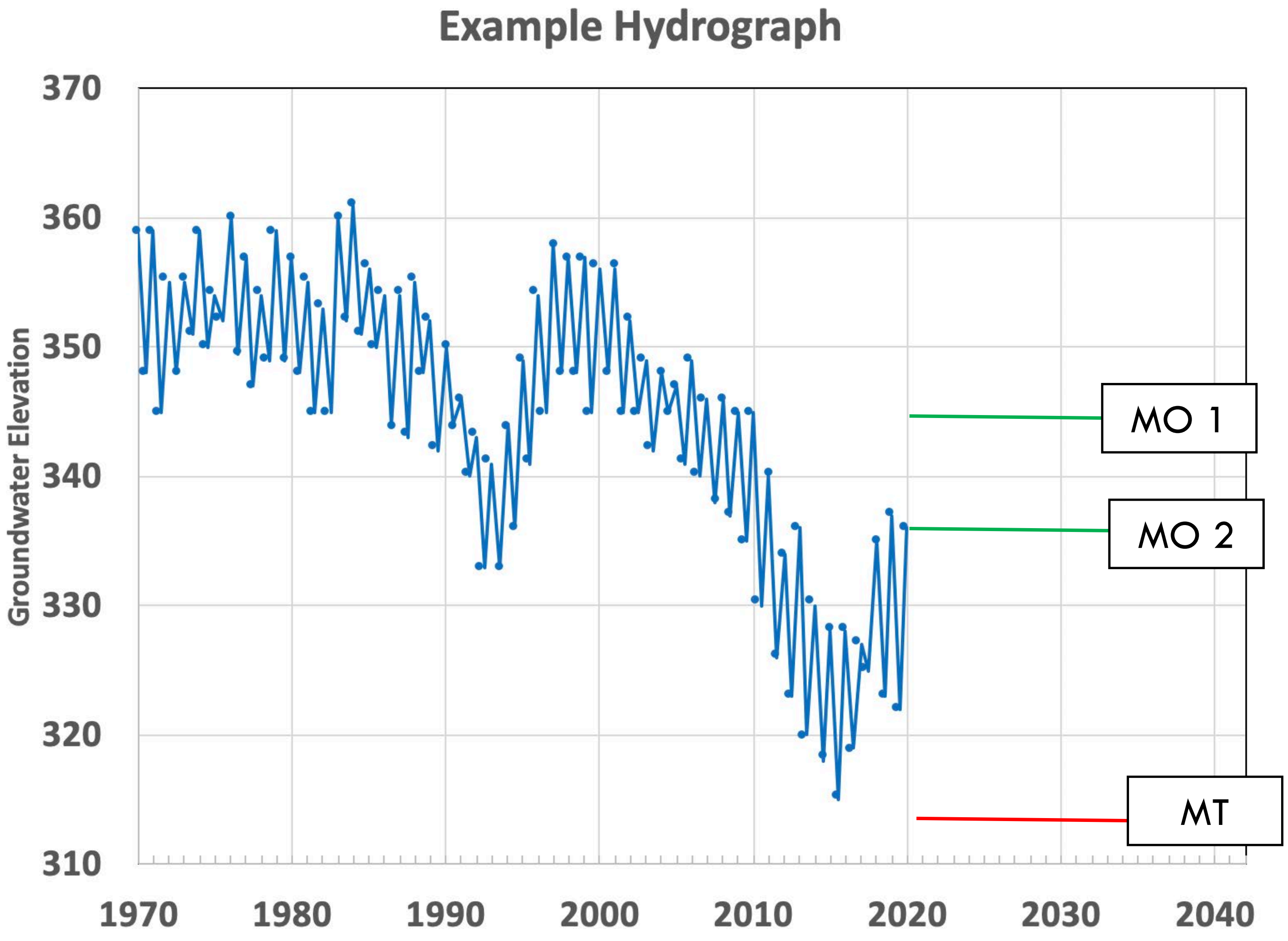
CHRONIC LOWERING OF GROUNDWATER LEVELS &

REDUCTION OF GROUNDWATER STORAGE

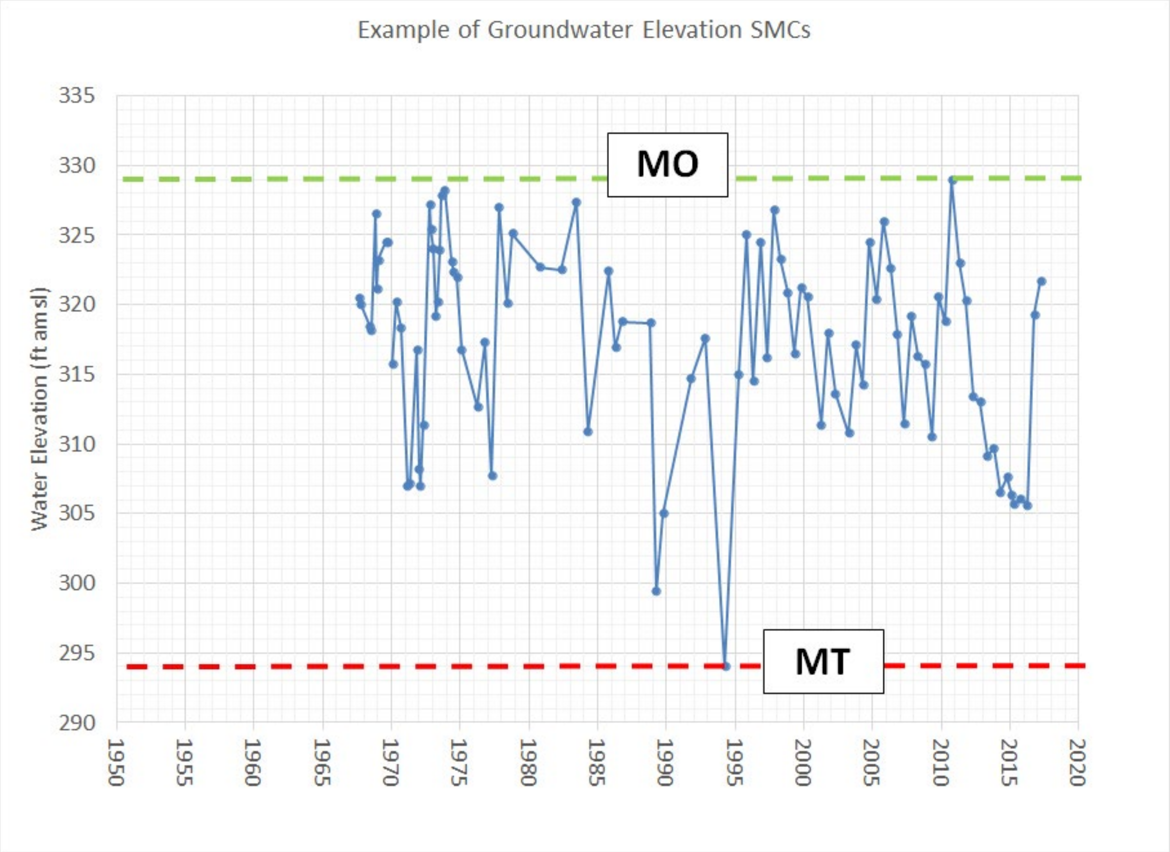
Minimum Thresholds (MTs).
The value that represents groundwater conditions at a representative monitoring site that, when exceeded individually or in combination with MTs at other monitoring sites, may cause an undesirable result(s) in the basin.

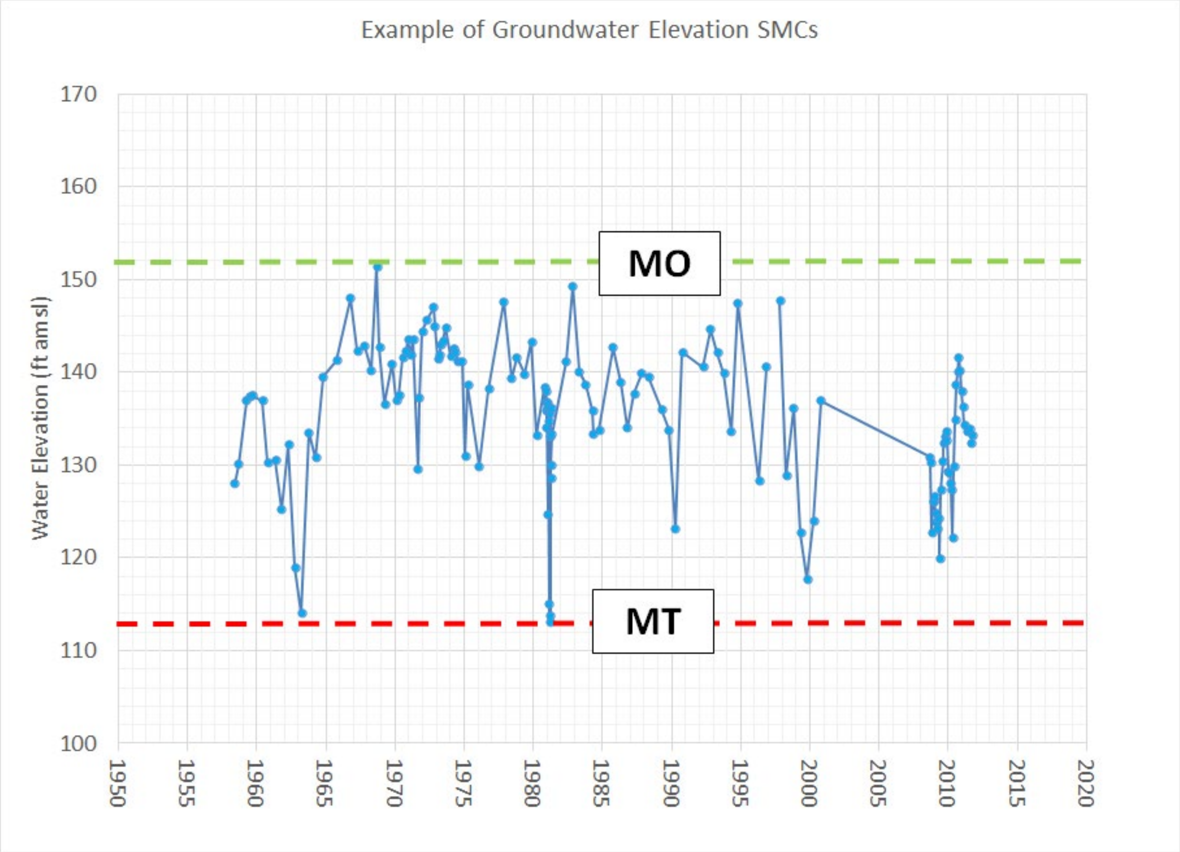
Measurable Objectives (MOs).
Measurable objectives are quantitative goals (usually water levels) that reflect the basin's desired groundwater conditions and allow the GSA to achieve the sustainability goal within 20 years.

DWR DEFINITIONS



Examples of Groundwater Elevation SMCs





Questions?

What’s Next?

Michael Cruikshank, WSC

GSP Chapter 7: Monitoring Network
GSP Chapter 8:Sustainable Management Criteria

PUBLIC COMMENT PERIOD
Open early 2022 from SLO county website

Workshop #3: Sustainable Management Criteria & Projects and Management Actions

February 2022 • TBD • Virtual via Zoom Meetings

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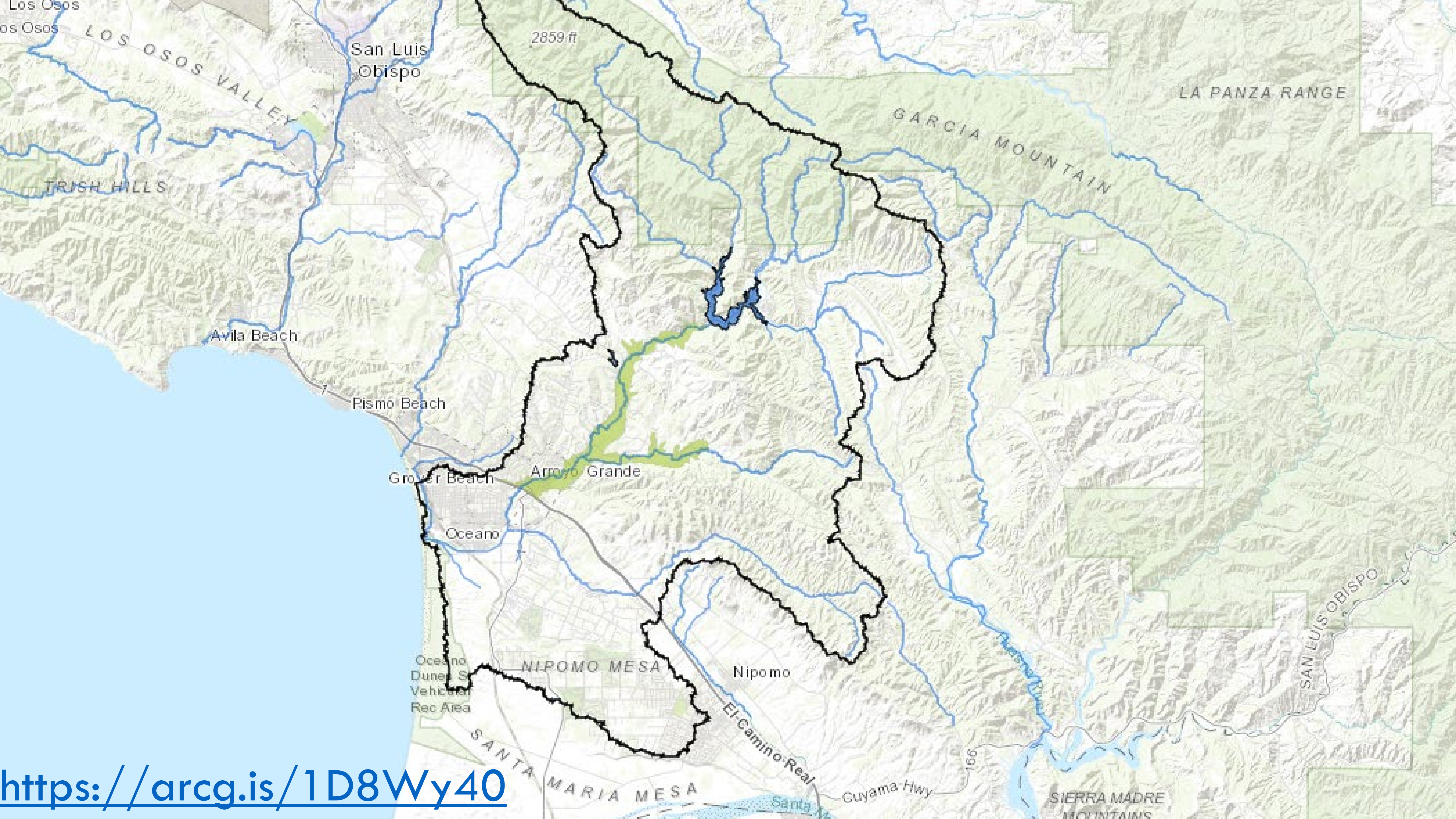

https://arcg.is/1D8Wy40