



COLUSA AND GLENN GROUNDWATER AUTHORITIES

Colusa Subbasin

GSP Development Update

April 13, 2020

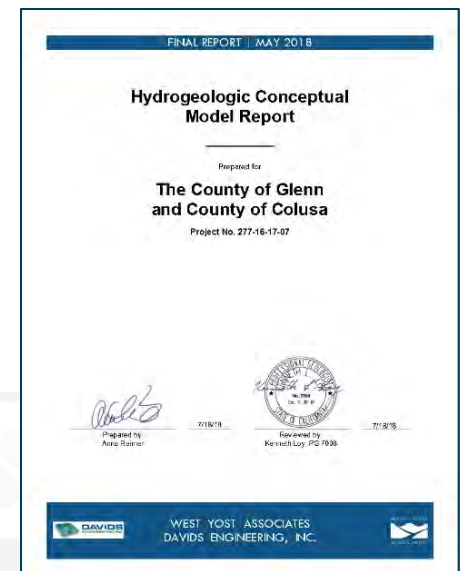
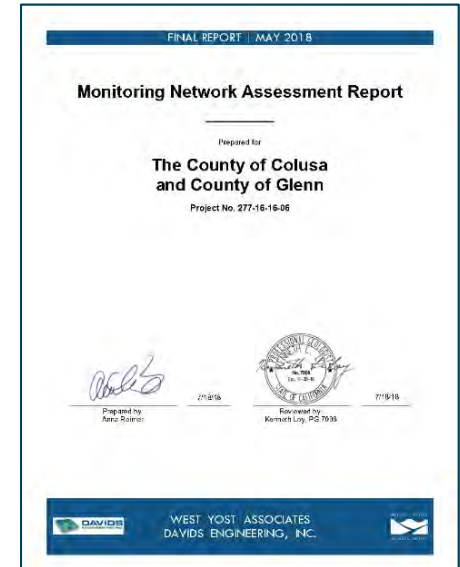
Discussion Topics

- GSP Development Timeline
- Groundwater Conditions Update
- Draft Historical Water Budget
- Future Water Budget Assumptions
- Model Calibration Status
- Preliminary Mapping of Groundwater Dependent Ecosystems (GDEs)
- Next Steps

GSP Development Timeline

GSP Development Timeline

- GSP Due to DWR January 2022
- Goal is for Draft GSP by July 2021
- Stressed Basins Grants Completed Mid 2018
 - Hydrogeologic Conceptual Model (HCM)
 - Monitoring Network and Groundwater Conditions
 - Water Budget
 - Data Management System (DMS)
 - Integrated Hydrologic Model (IHM) Evaluation



GSP Development Timeline

- Basin Setting Project Launched Late 2018
 - Updated HCM
 - Updated Groundwater Conditions
 - Updated and Expanded Water Budgets
 - Integrated Hydrologic Model
 - Public Outreach
- GSP Development Currently Underway
 - Additional Data Collection and Analysis
 - Establishment of Sustainable Management Criteria
 - Evaluation of Projects and Management Actions
 - Preparation of Draft and Final GSP
 - Review Potential Funding Mechanisms

Phased GSP Development

- Phase 1: Knowledge Building
 - Draft Basin Setting
 - Sustainability Goal
 - Existing Monitoring Network
 - Project and Management Action Brainstorming
- Phase 2: Initial GSP Development
 - Refined Basin Setting
 - Draft Sustainable Management Criteria
 - Draft GSP Monitoring Network
 - Initial Evaluation and Screening of Projects and Management Actions

Phased GSP Development

- Phase 3: GSP Refinements
 - Data Management System (DMS) Options Evaluation
 - Initial Draft GSP Chapters
 - Updated Sustainable Management Criteria
 - Project and Management Action Cost-Benefit Analysis
 - Draft Management Areas
 - Draft Funding Options Evaluation
- Phase 4: Final GSP Preparation and Adoption
 - Updated Management Areas
 - Funding Recommendations
 - Complete Draft GSP
 - GSP Adoption

Draft Schedule for GSP Sections

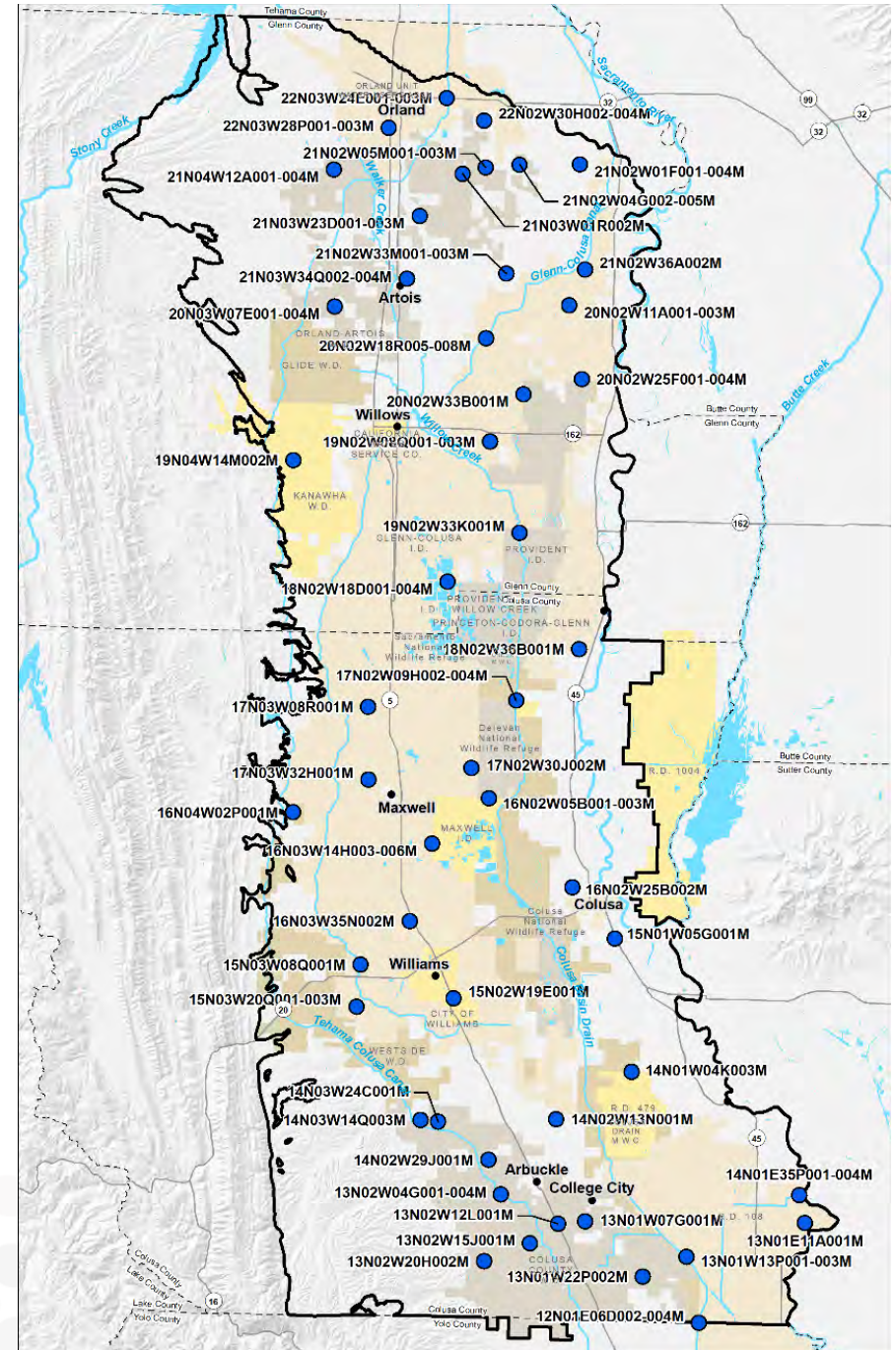
Chapter Grouping	Administrative Draft	Public Review Draft
Administrative Information, Hydrogeologic Conceptual Model, Groundwater Conditions	October 2020	December 2020
Water Budget, Model Documentation	November 2020	January 2021
Monitoring Networks, Sustainable Management Criteria	December 2020	February 2021
Management Areas, Projects and Management Actions	April 2021	June 2021
Complete Draft GSP	June 2021	July 2021

Groundwater Conditions

Groundwater Conditions

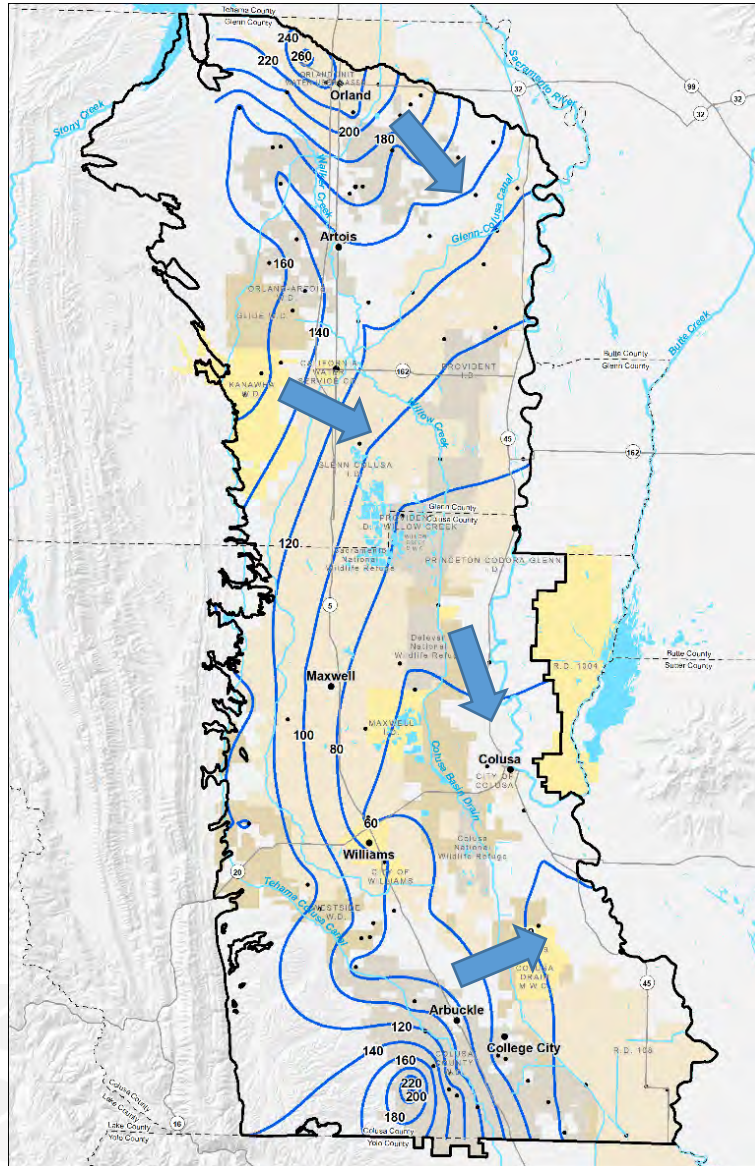
- Dynamic (time-dependent) aspects of groundwater hydrology
 - Groundwater Elevations
 - Groundwater Storage
 - ~~Seawater Intrusion~~
 - Groundwater Quality
 - Land Subsidence
 - Interconnected Surface Water and Depletions
 - Groundwater Dependent Ecosystems (GDEs)
- Must include description as of January 1, 2015

Groundwater Level Monitoring Network

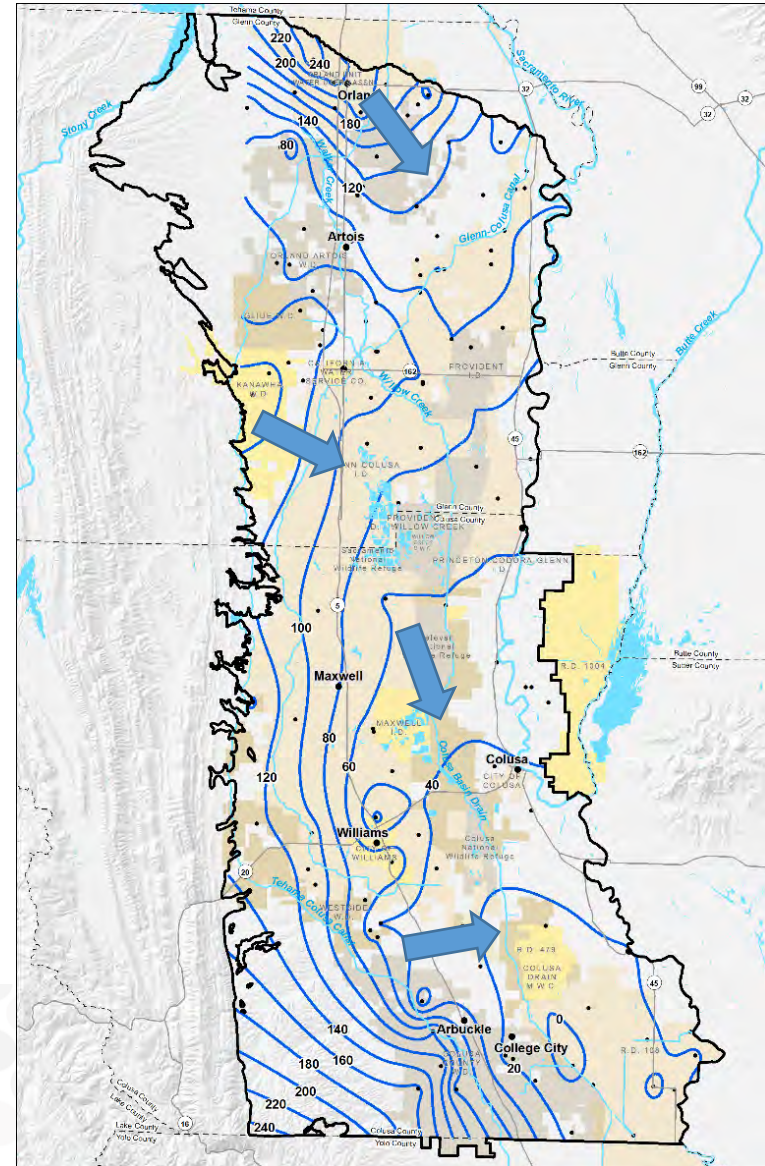


Groundwater Elevation Contours

Spring 2006

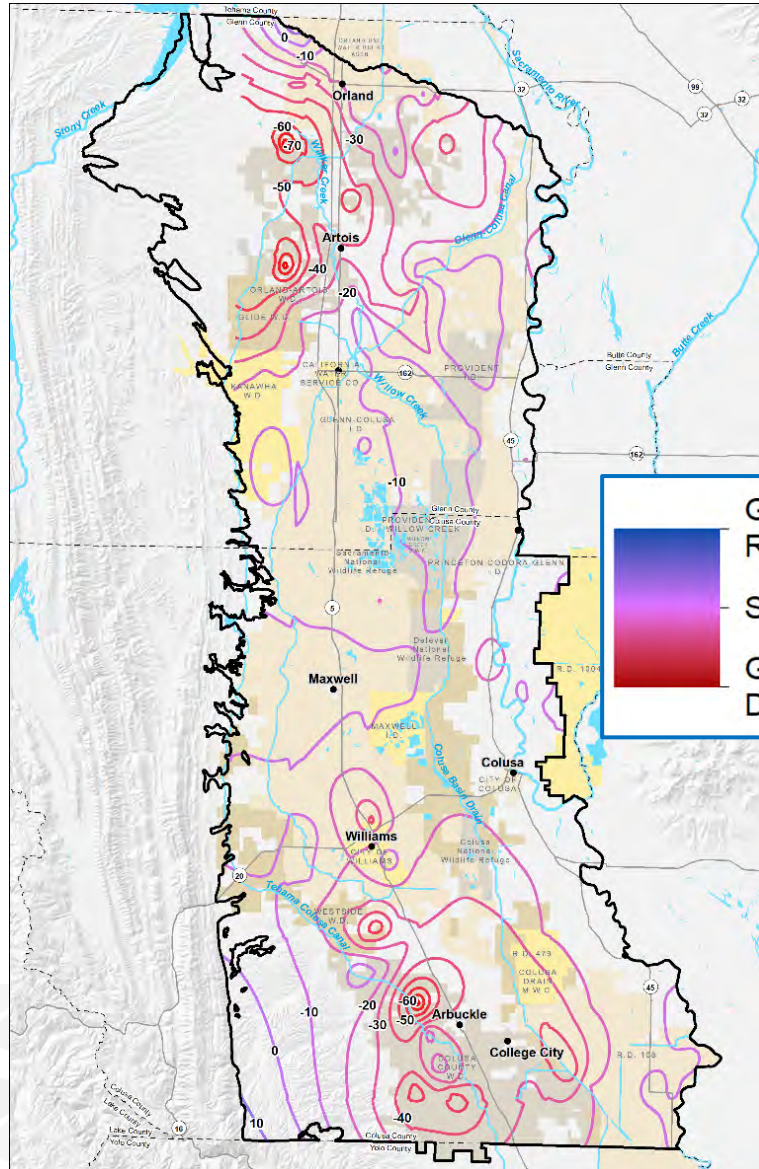


Spring 2015

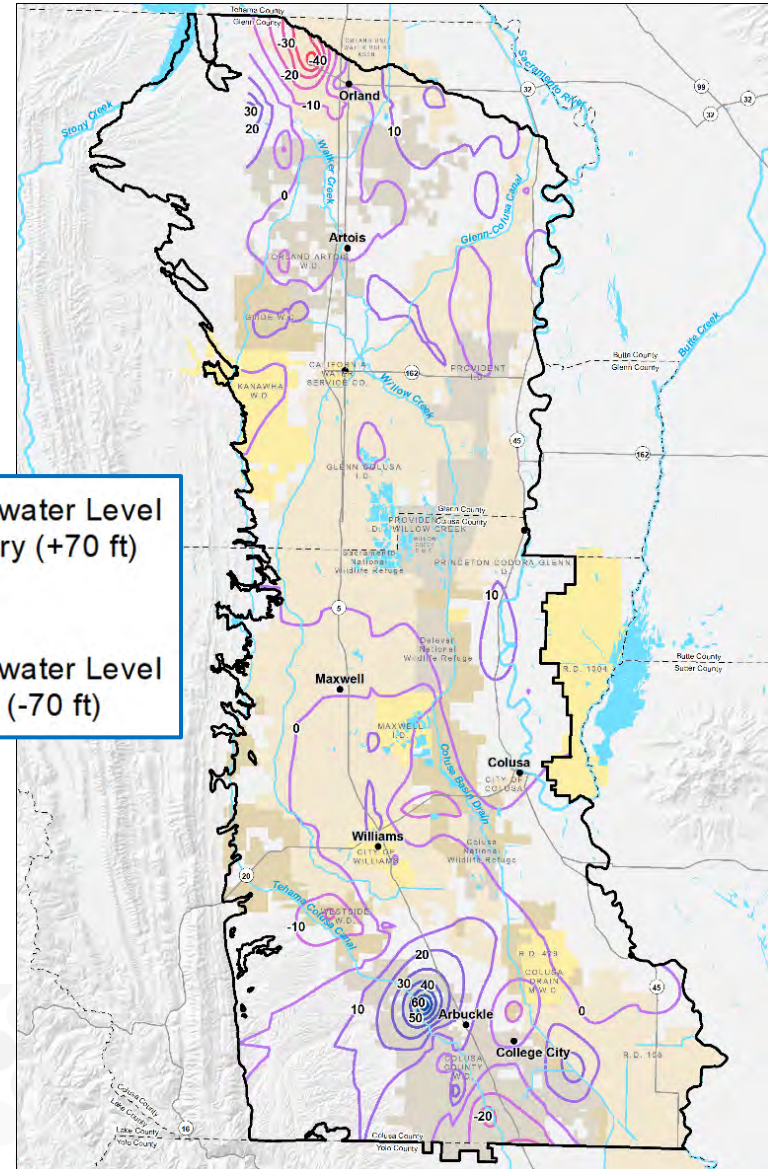


Groundwater Elevation Change

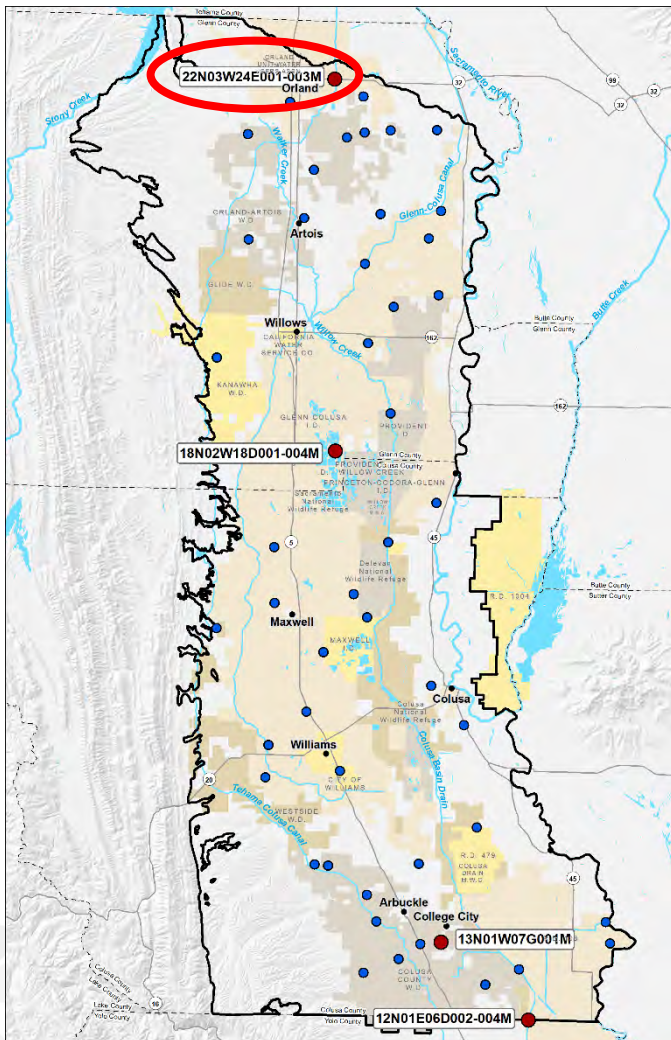
Spring 2006 to Spring 2015



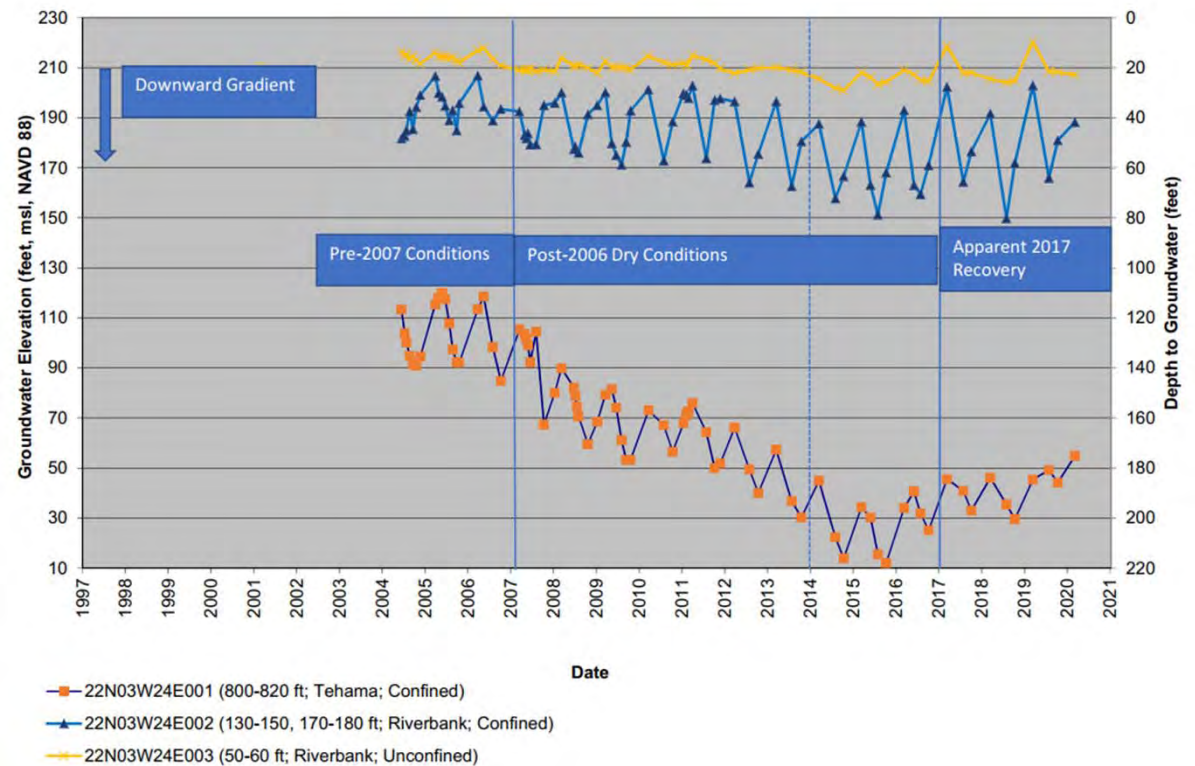
Spring 2015 to Spring 2017



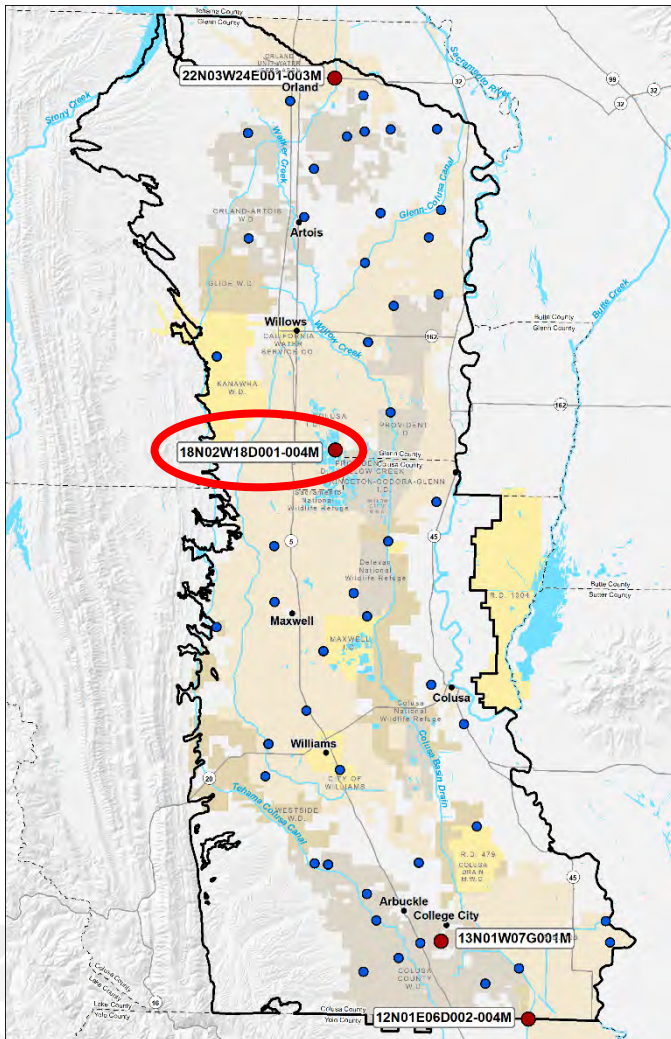
Glenn County Monitoring Well 22N03W4E001-003M



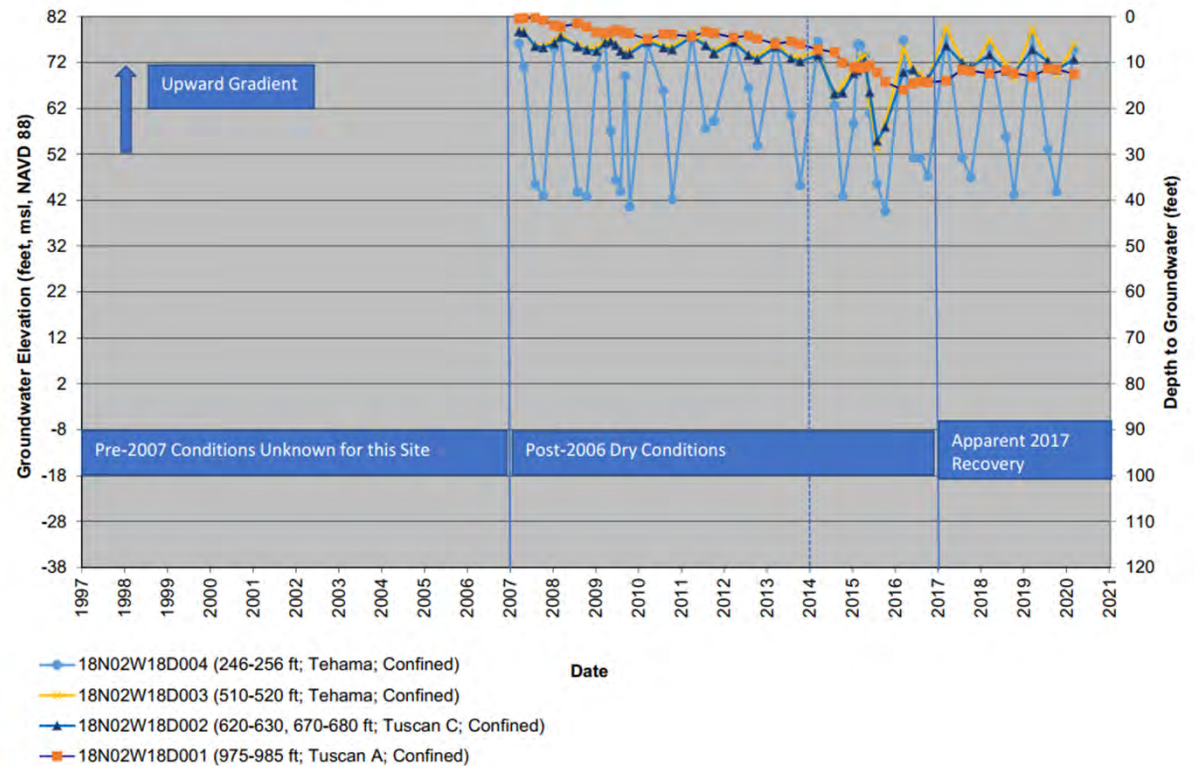
22N03W24E001-003M Active Observation Well Cluster
Ground Surface Elevation 230.51 feet msl, NAVD 88



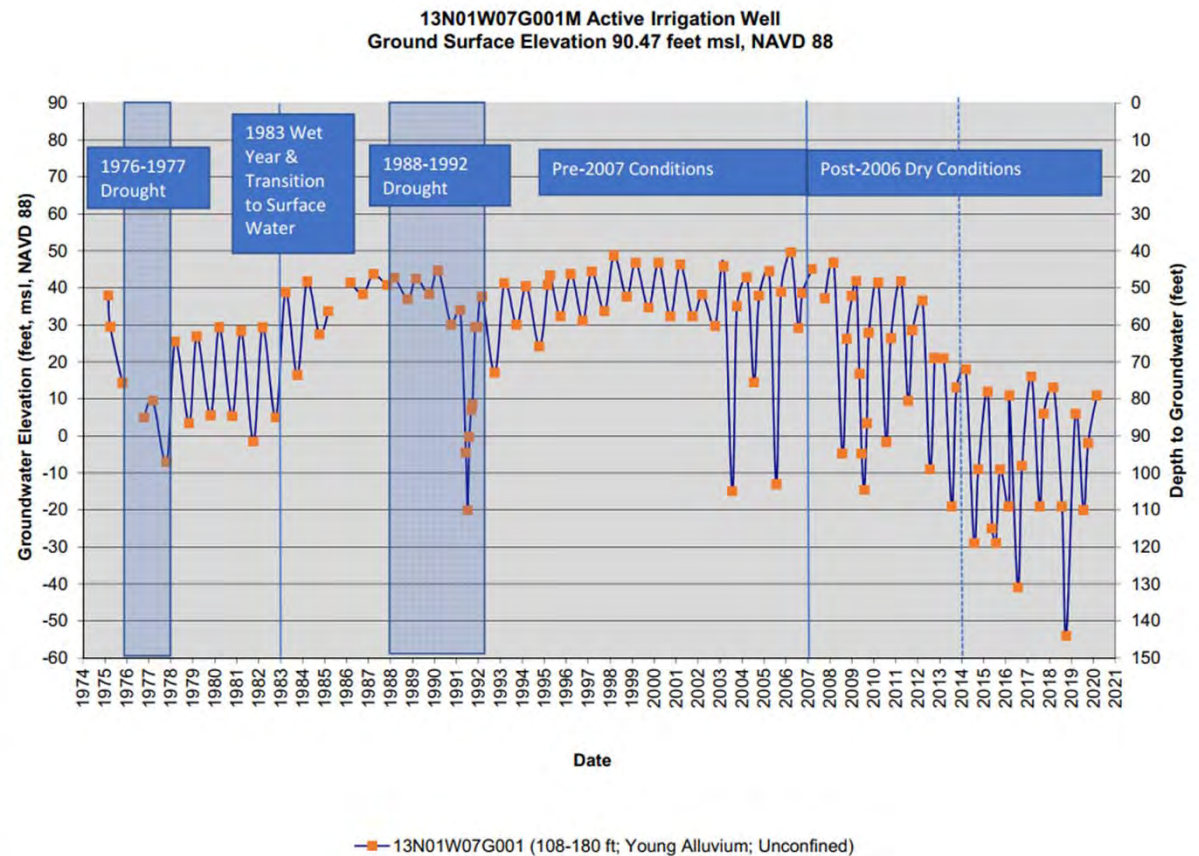
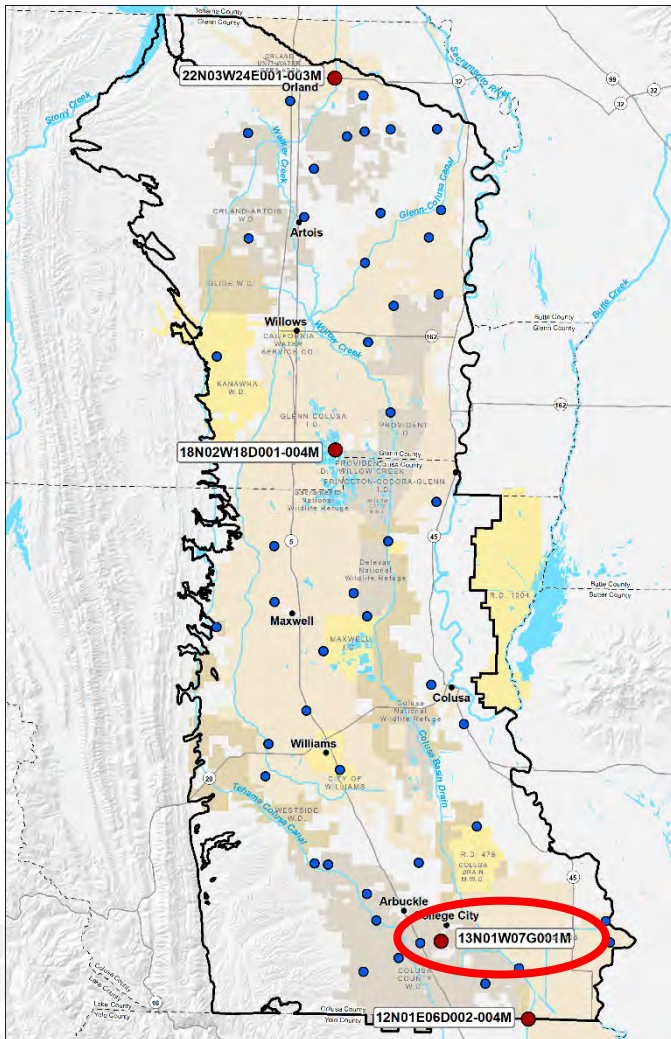
Glenn County Monitoring Well 18N02W18D001-004M



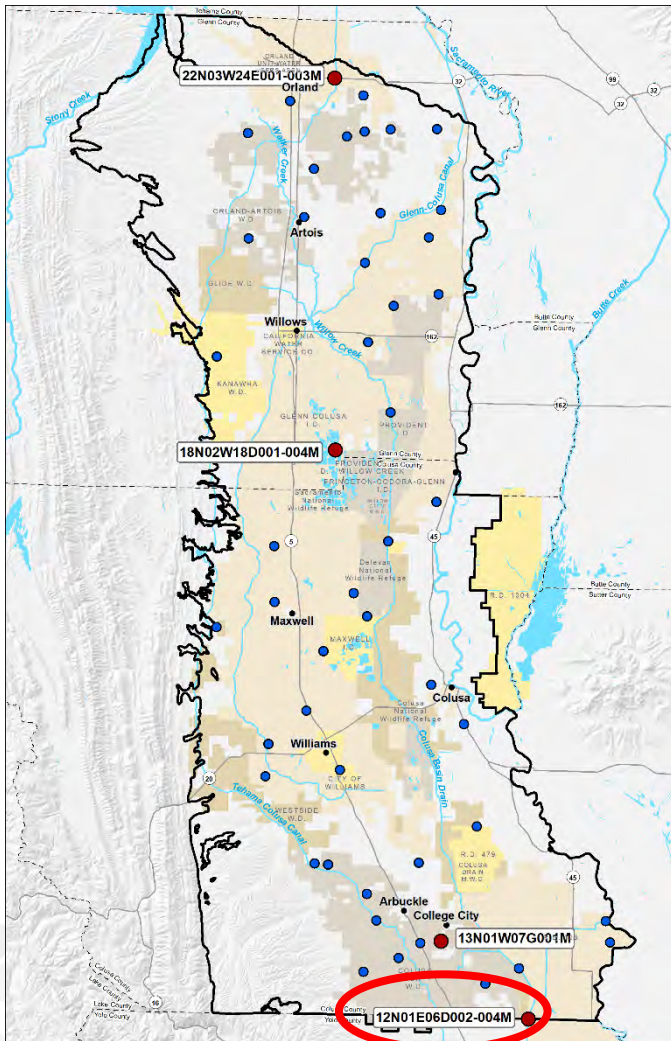
18N02W18D001-004M Active Observation Well Cluster
Ground Surface Elevation 82.43 feet msl, NAVD 88



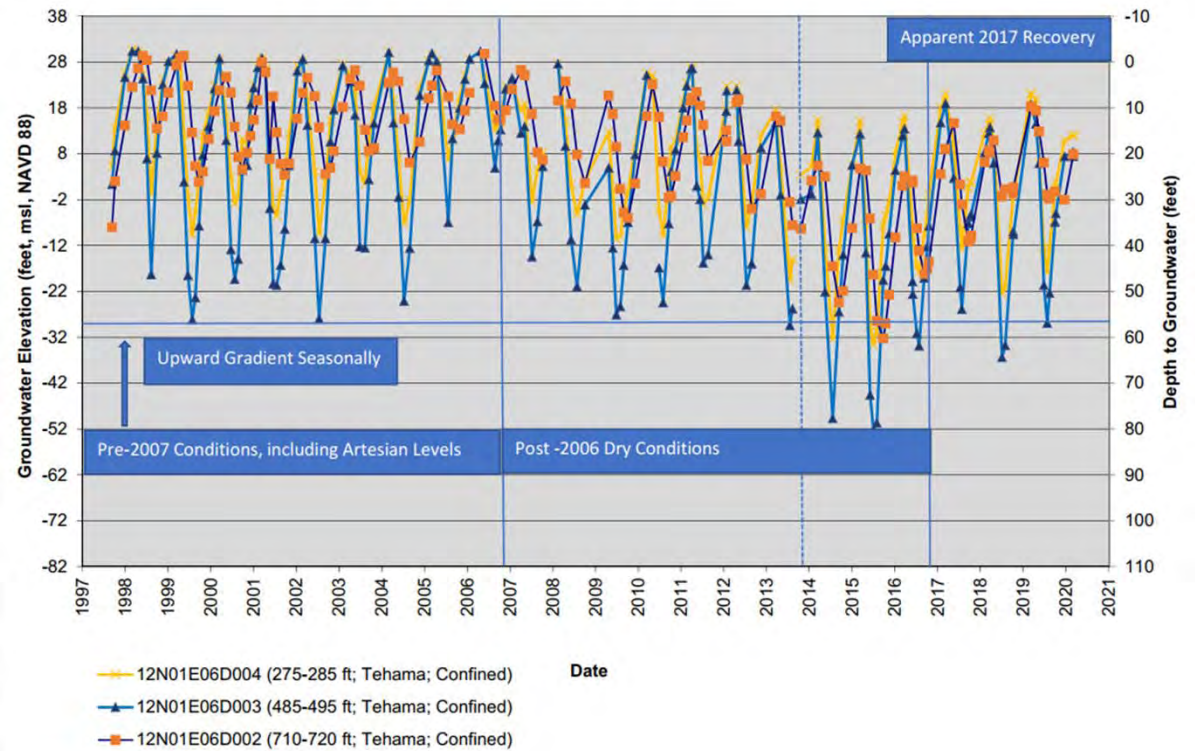
Colusa County Monitoring Well 13N01W07G001M



Colusa County Monitoring Well 12N01E06D002-004M



12N01E06D002-004M Active Observation Well Cluster
Ground Surface Elevation 27.94 feet msl, NAVD 88



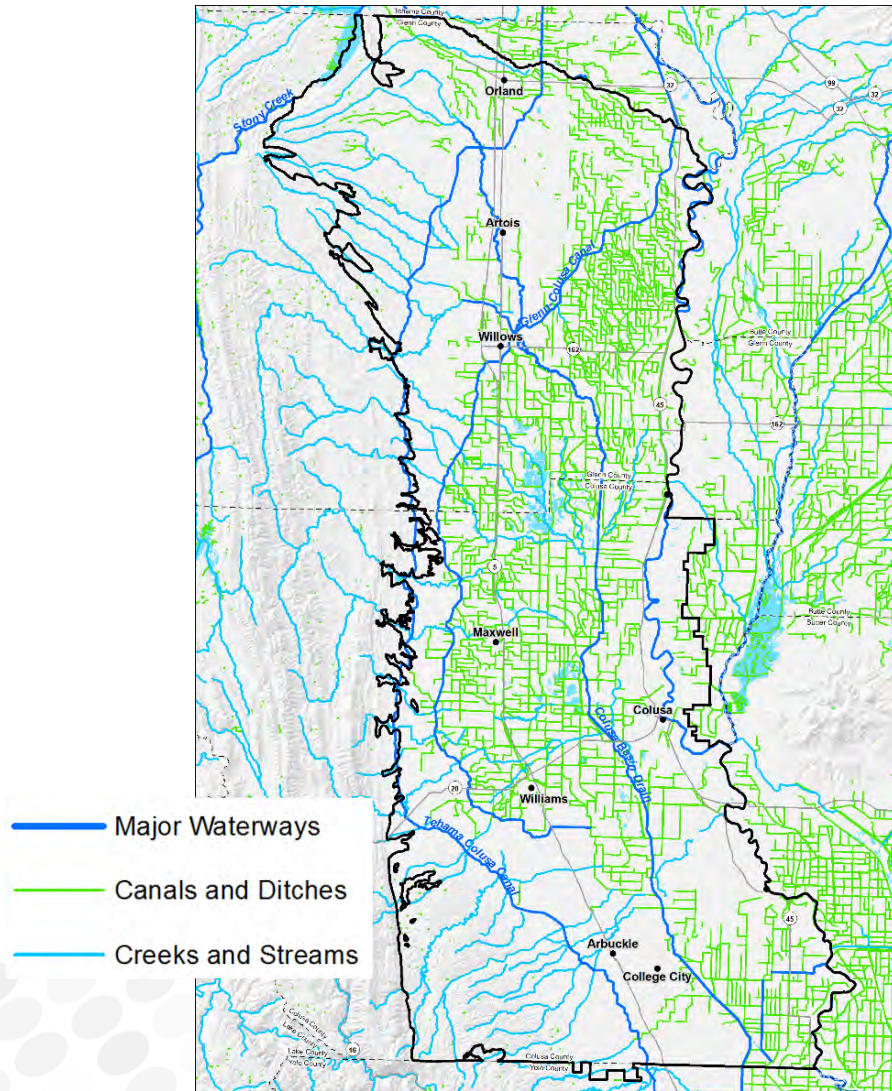
Groundwater Quality

- Current groundwater quality is generally “good” with potential for some isolated issues.
- Existing water quality monitoring programs are sufficient and not expected to change due to GSP implementation.
- Focus will be on impacts to groundwater quality due to activities after implementation of Colusa Subbasin GSP.

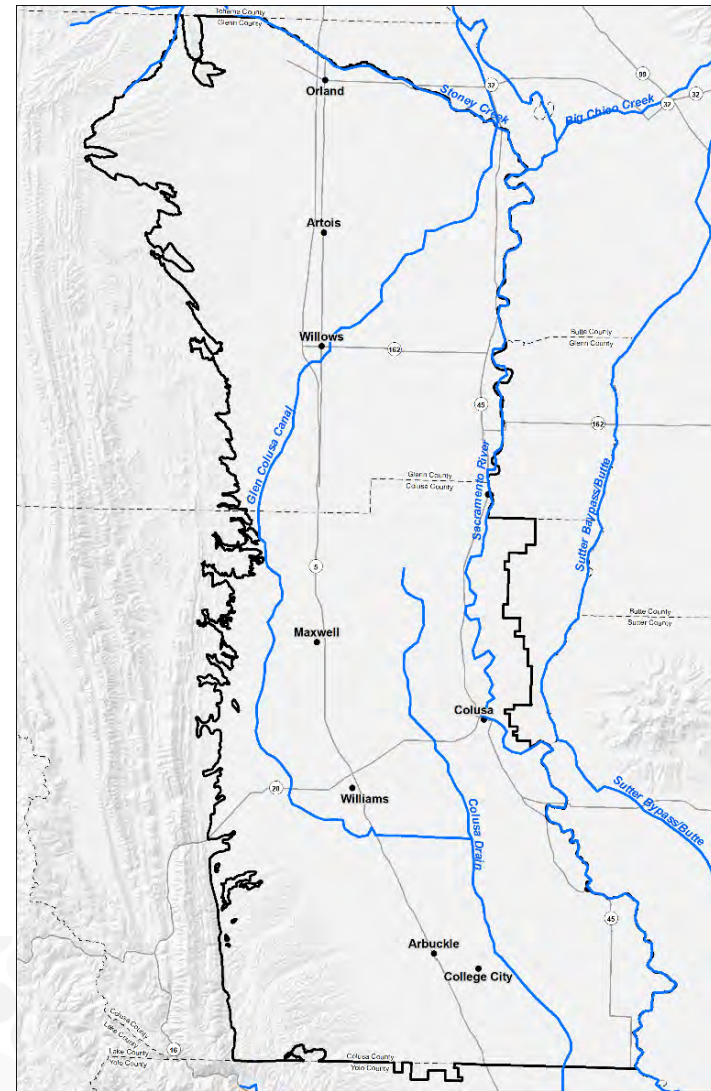


Interconnected Surface Water

Surface Hydrology

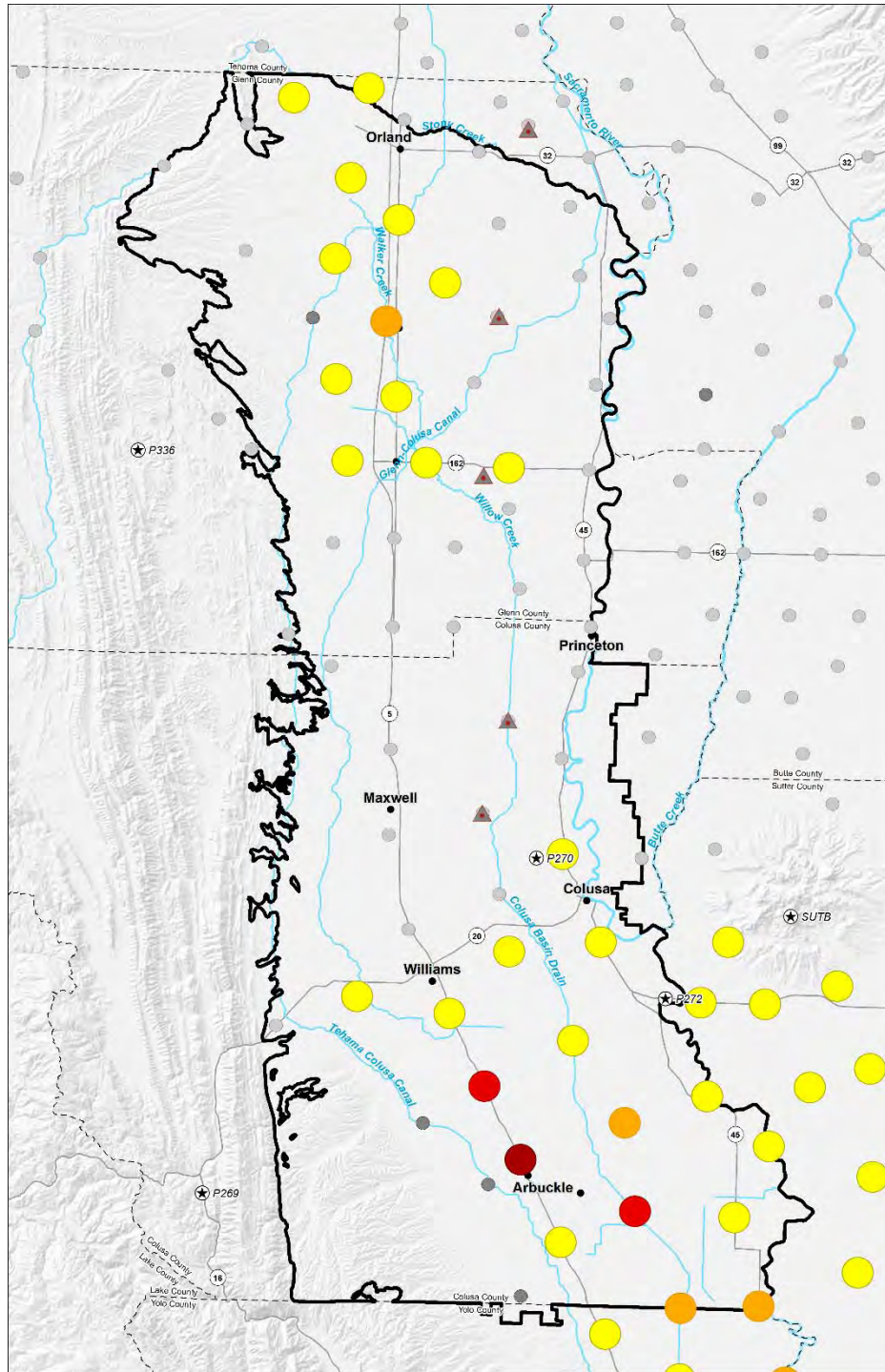


Modeled Streams

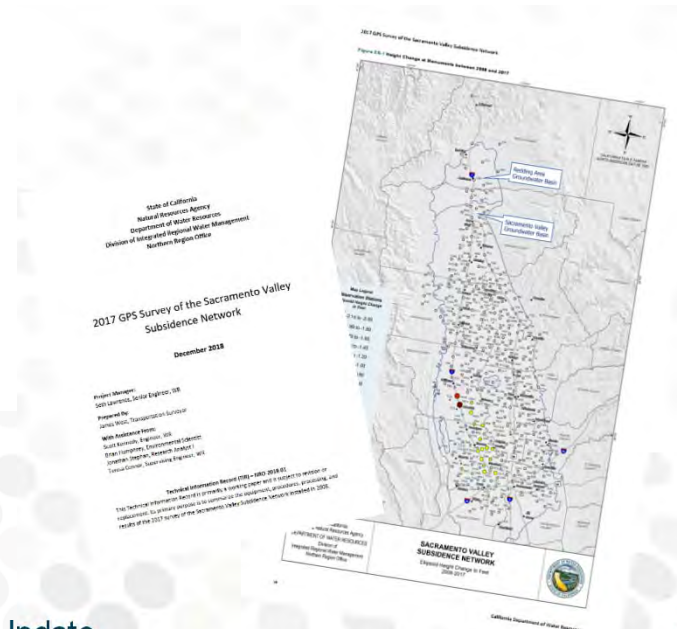


Land Subsidence GPS Survey

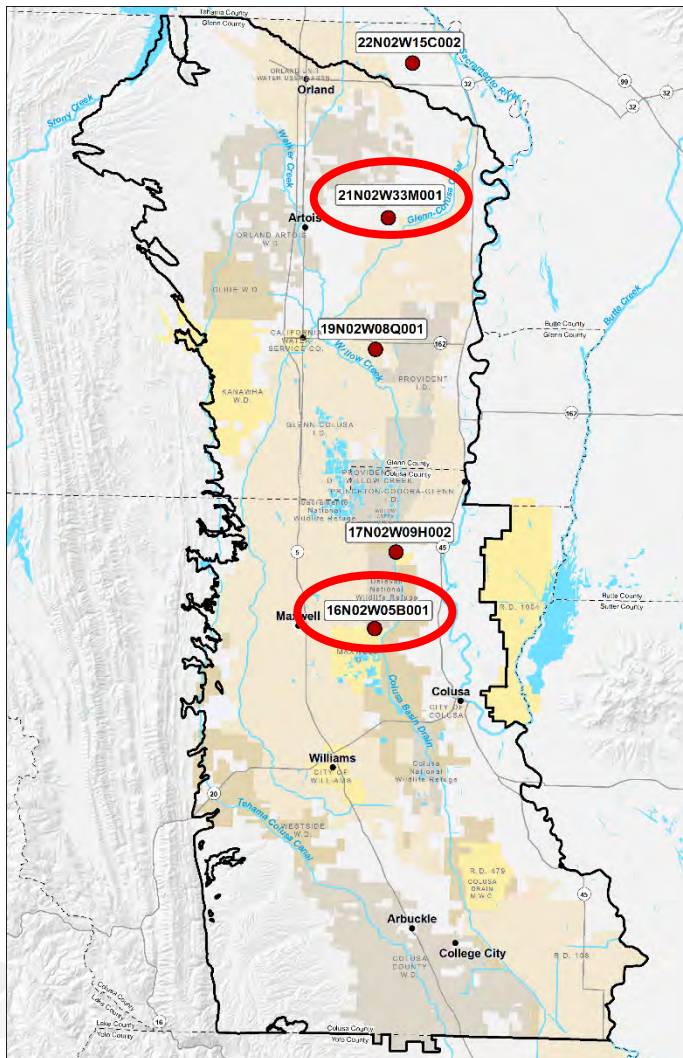
2017 GPS Survey Sacramento Valley Subsidence Network, December 2018



- ★ Continuous GPS Station
- ▲ Extensometer
- Sacramento Valley Subsidence
Benchmarks with 2008 to 2017
Height Difference**
 - ≥2 feet
 - 1 - <2 feet
 - 0.5 - <1 foot
 - 2 - <6 inches
 - < 2 inches
 - New Benchmark or Not Surveyed



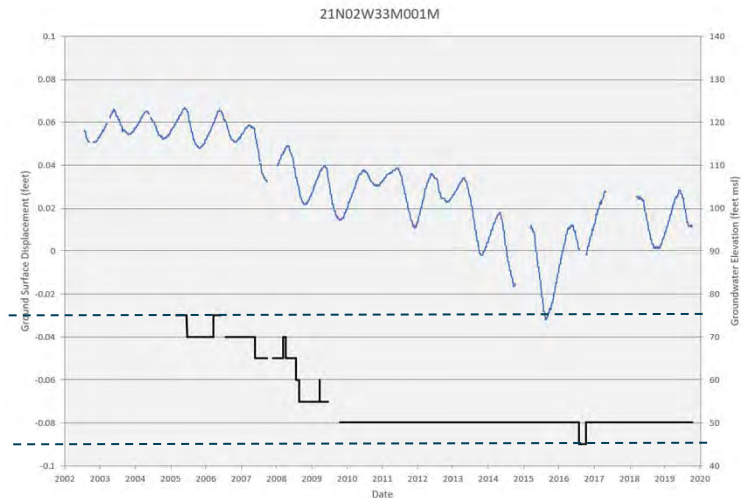
Land Subsidence Extensometers



**Ground
Surface
Displacement
Range**

-0.03 ft
-0.09 ft

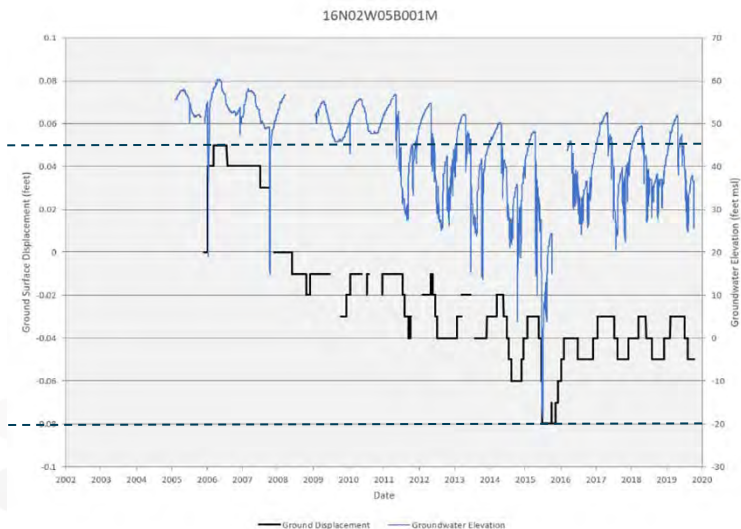
+0.05 ft
-0.08 ft



123 ft

74 ft

**Groundwater
Elevation
Range**



60 ft

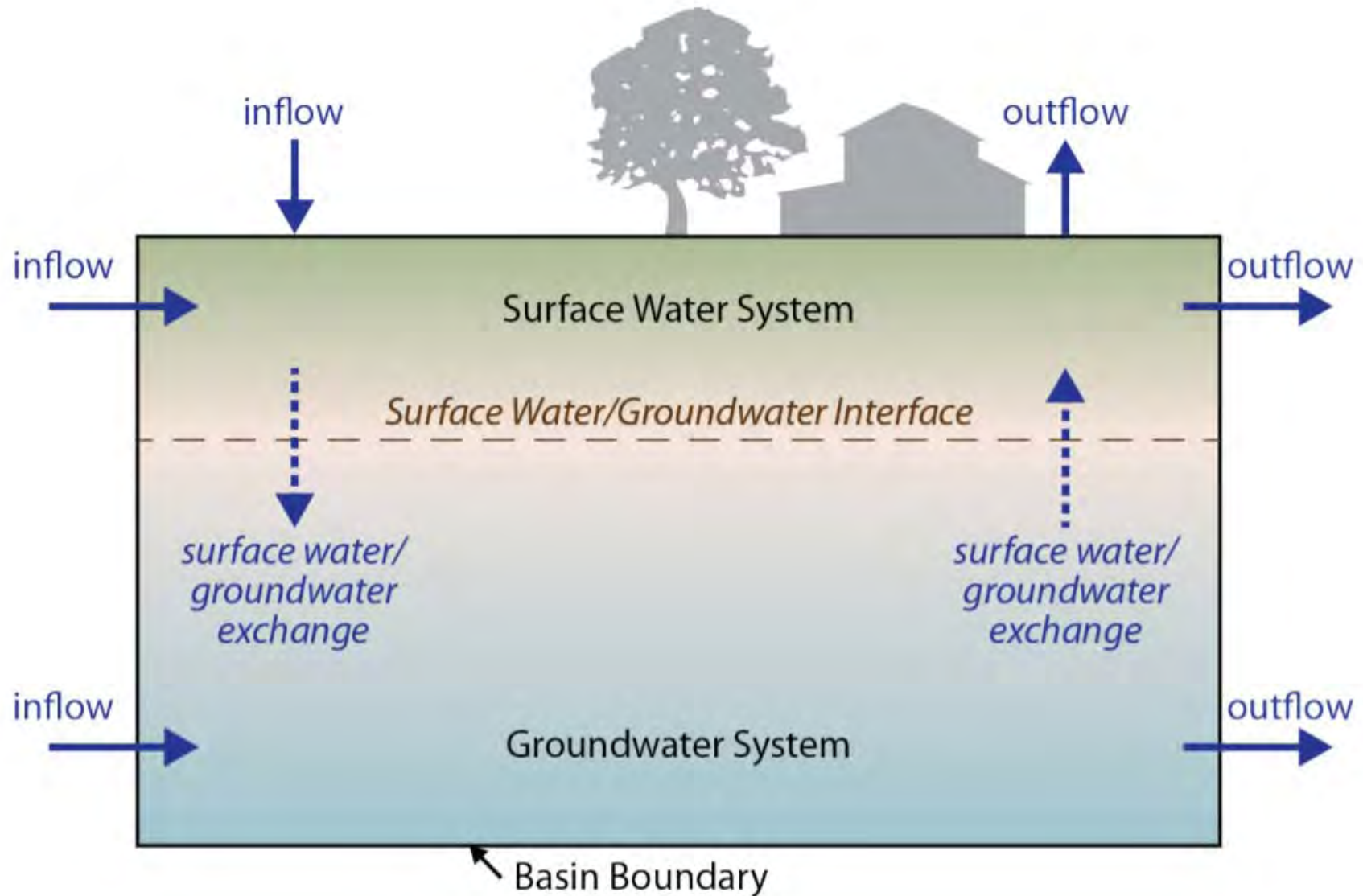
-19 ft

Draft Historical Water Budget

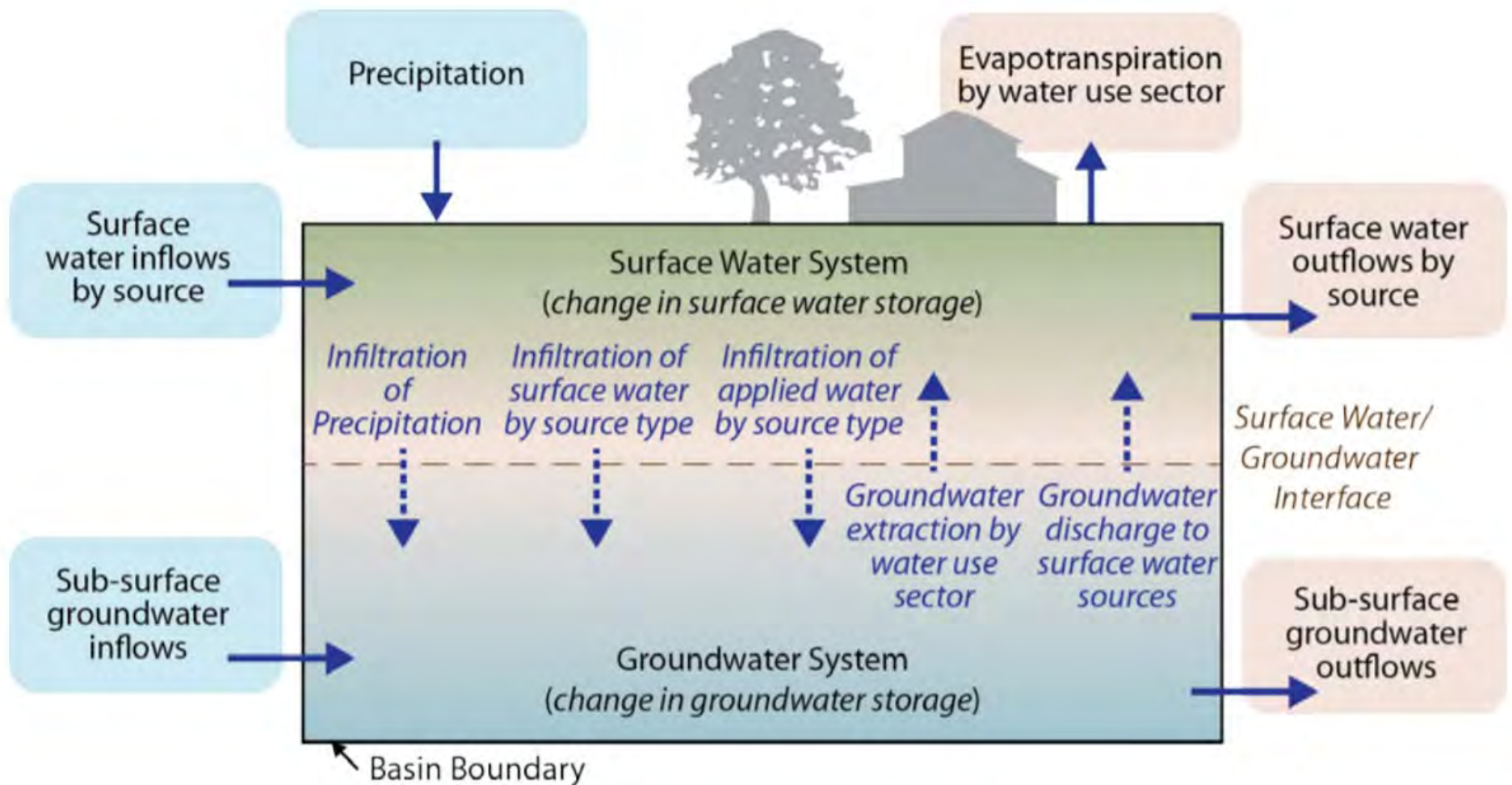
Water Budget Overview

- Complete accounting of inflows, outflows, and change in storage
- Just like a checking account:
 - Deposits – Withdrawals = Balance Change, or
 - Inflows – Outflows = Change in Storage
- Grounded in available data
- Estimated using DWR's Integrated Hydrologic Model (C2VSimFG Beta2)

Basic Water Budget Structure (DWR BMP)

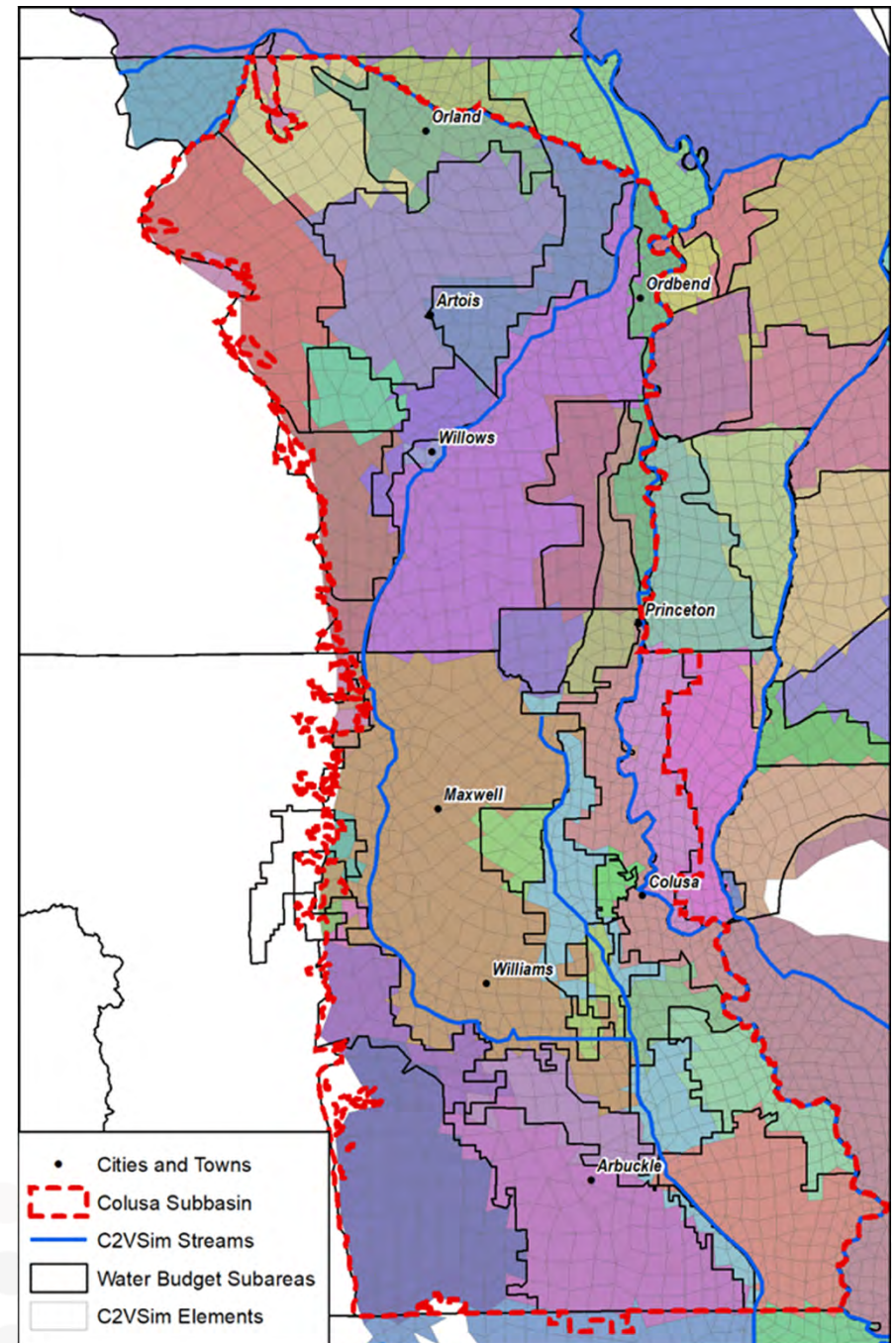


Detailed Water Budget Structure (DWR BMP)



Water Budget Approach

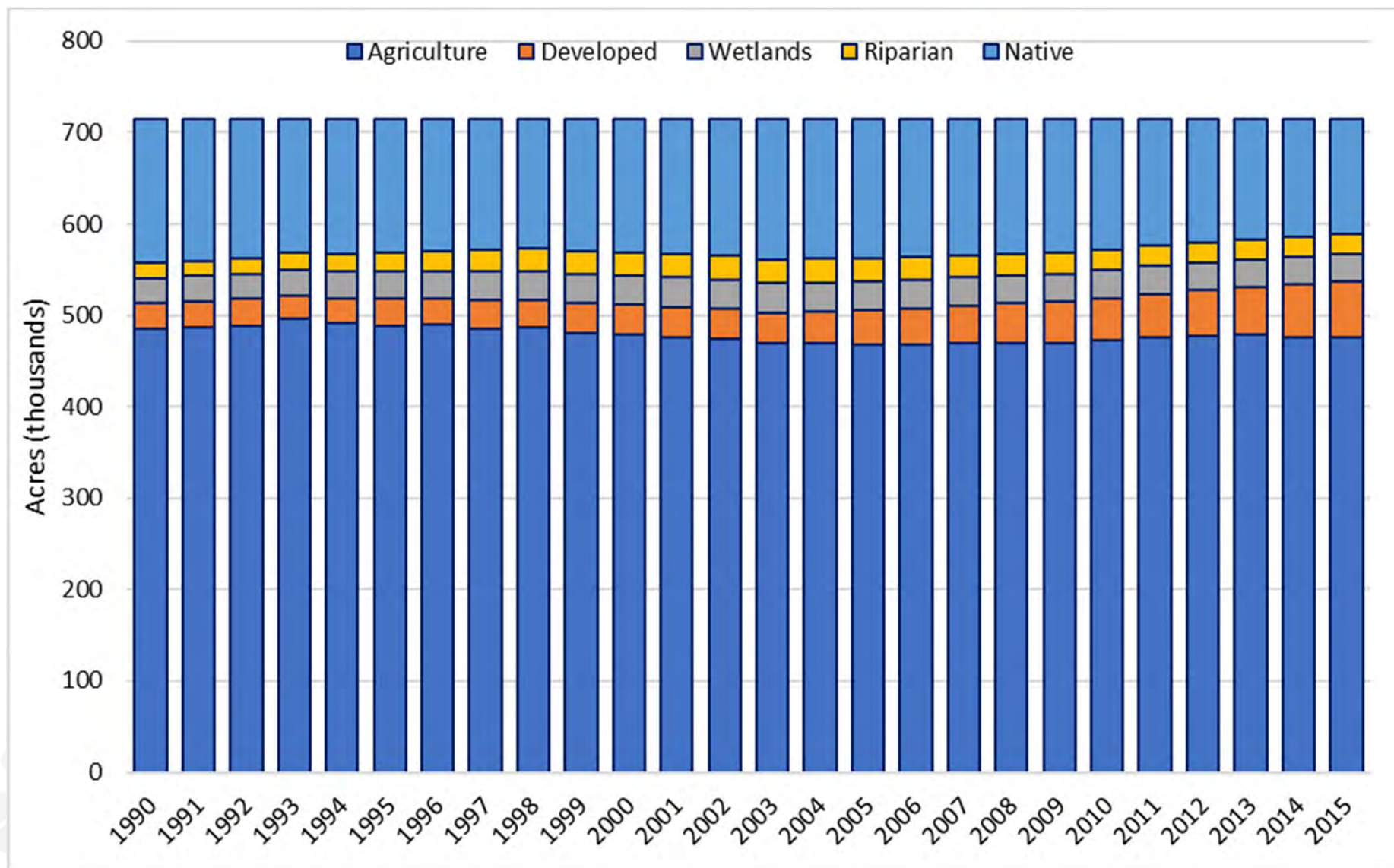
- 38 Subareas in Colusa Subbasin
 - Water Suppliers/ Diverters
 - Counties
 - GW-Only Areas
- Ability to Report Out Water Budgets to Support Intrabasin Discussions



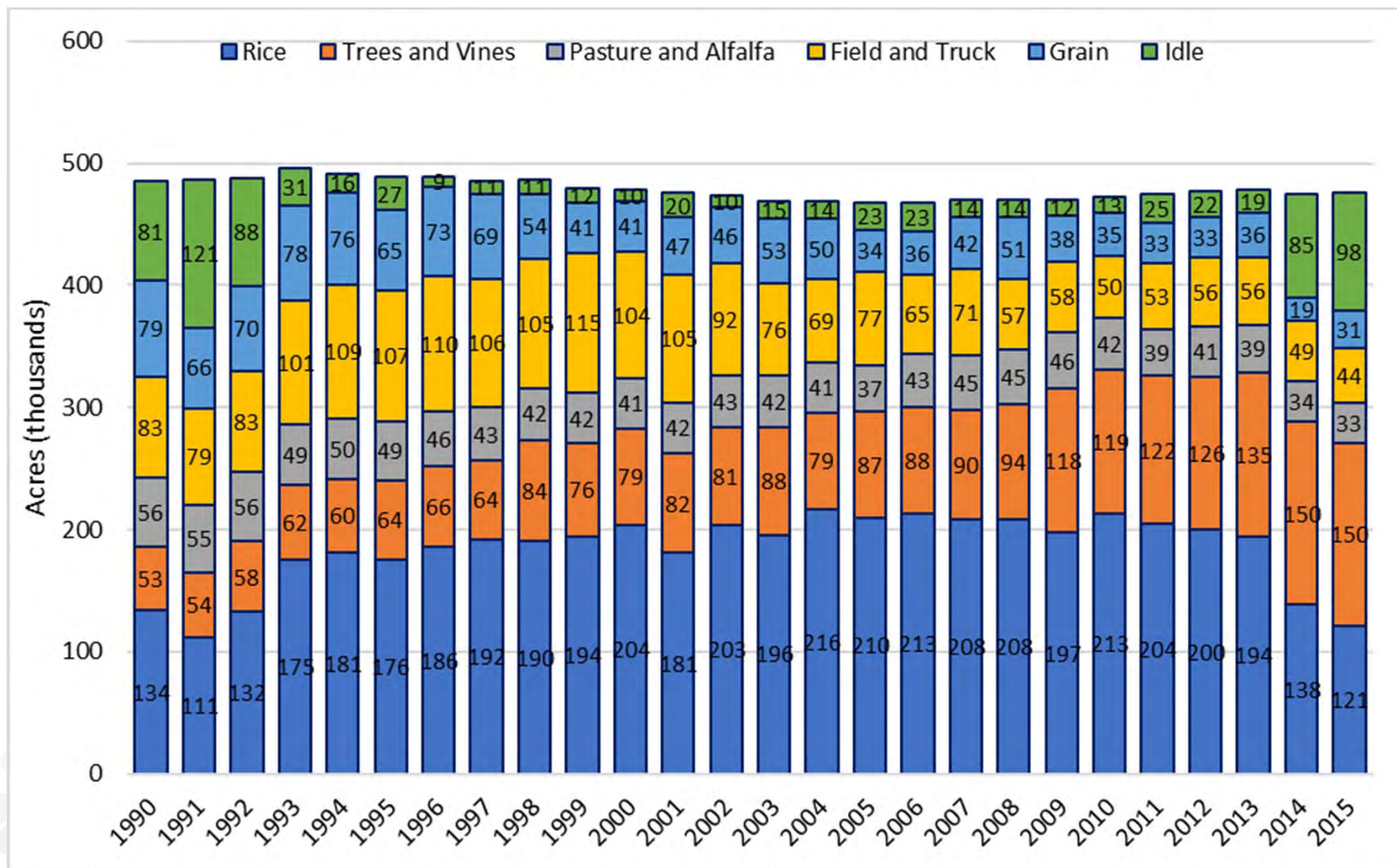
Primary Water Budget Drivers

- Land Use
- Precipitation
- Evapotranspiration
- Surface Water Supplies
- Groundwater Pumping
- Percolation
- Surface Water – Groundwater Interaction
- Interbasin Flows

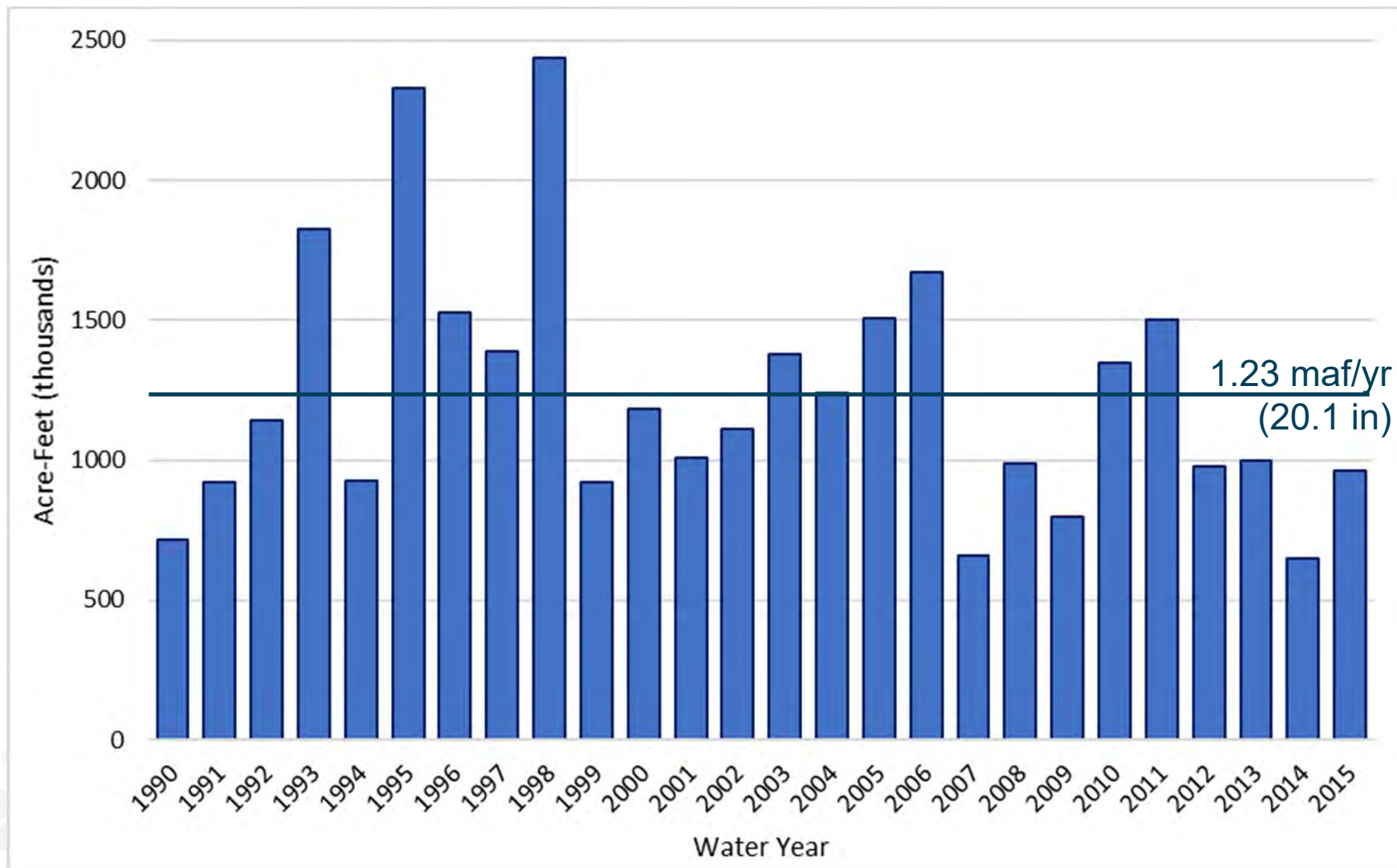
Land Use (All Categories)



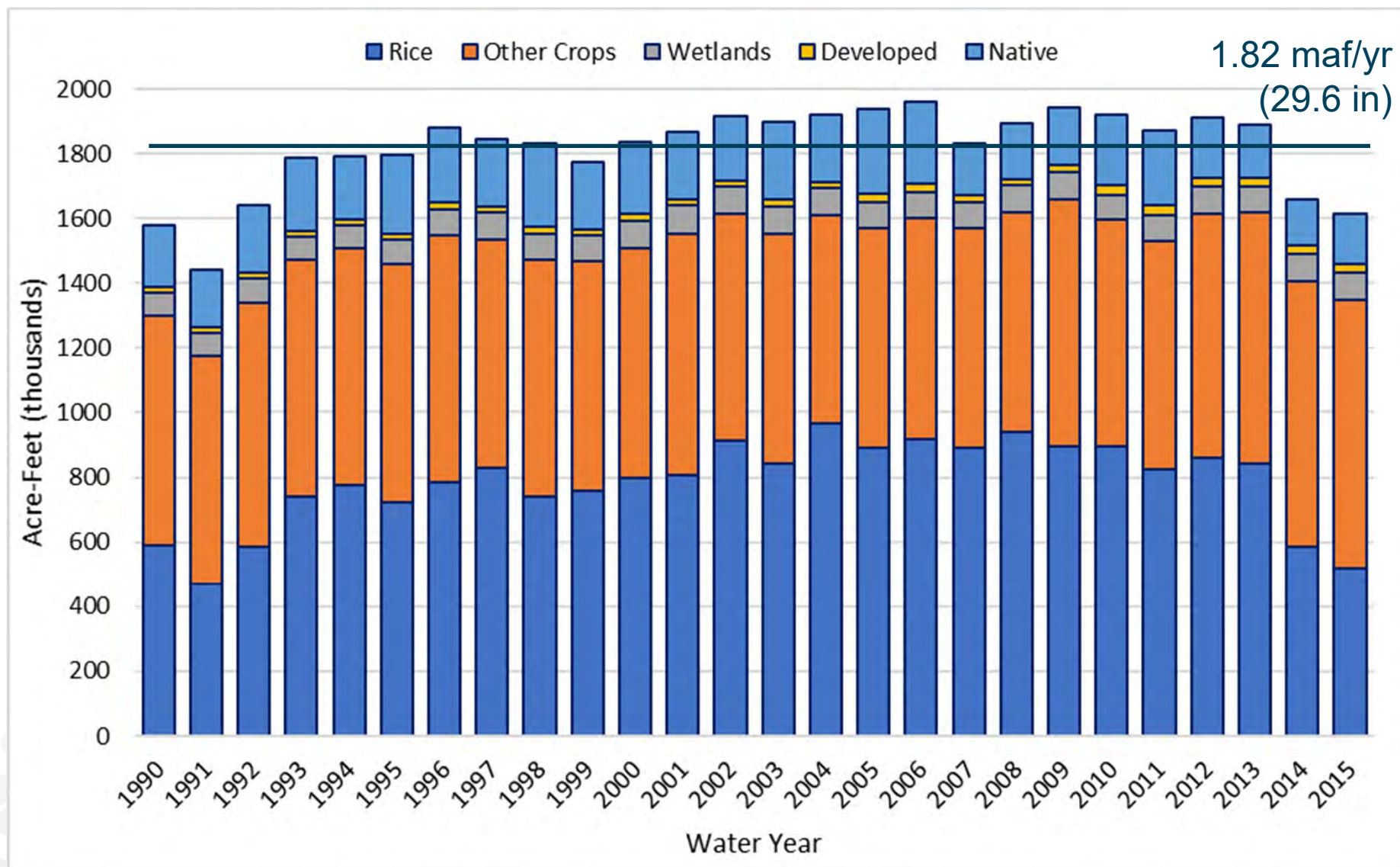
Land Use (Agricultural)



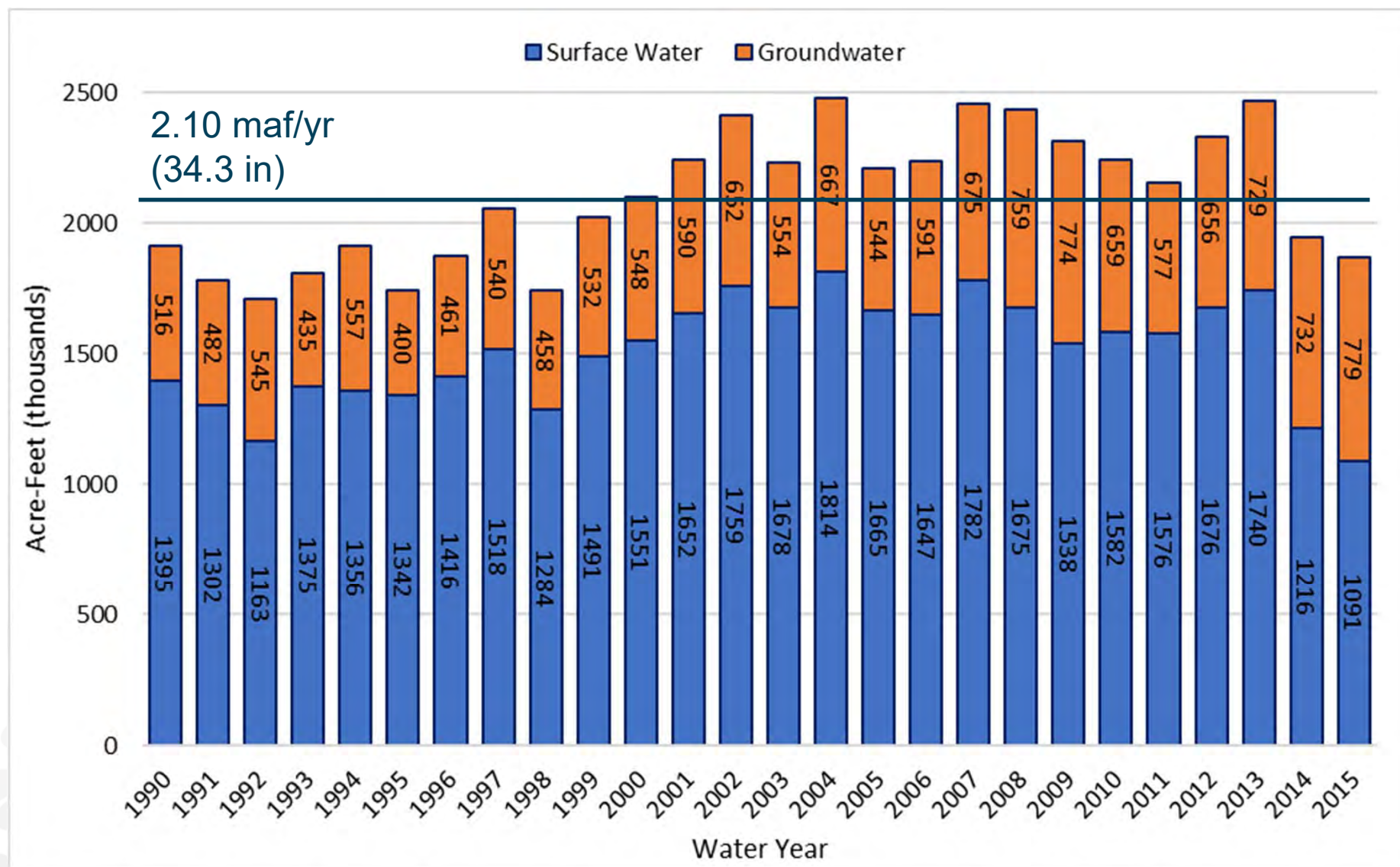
Precipitation



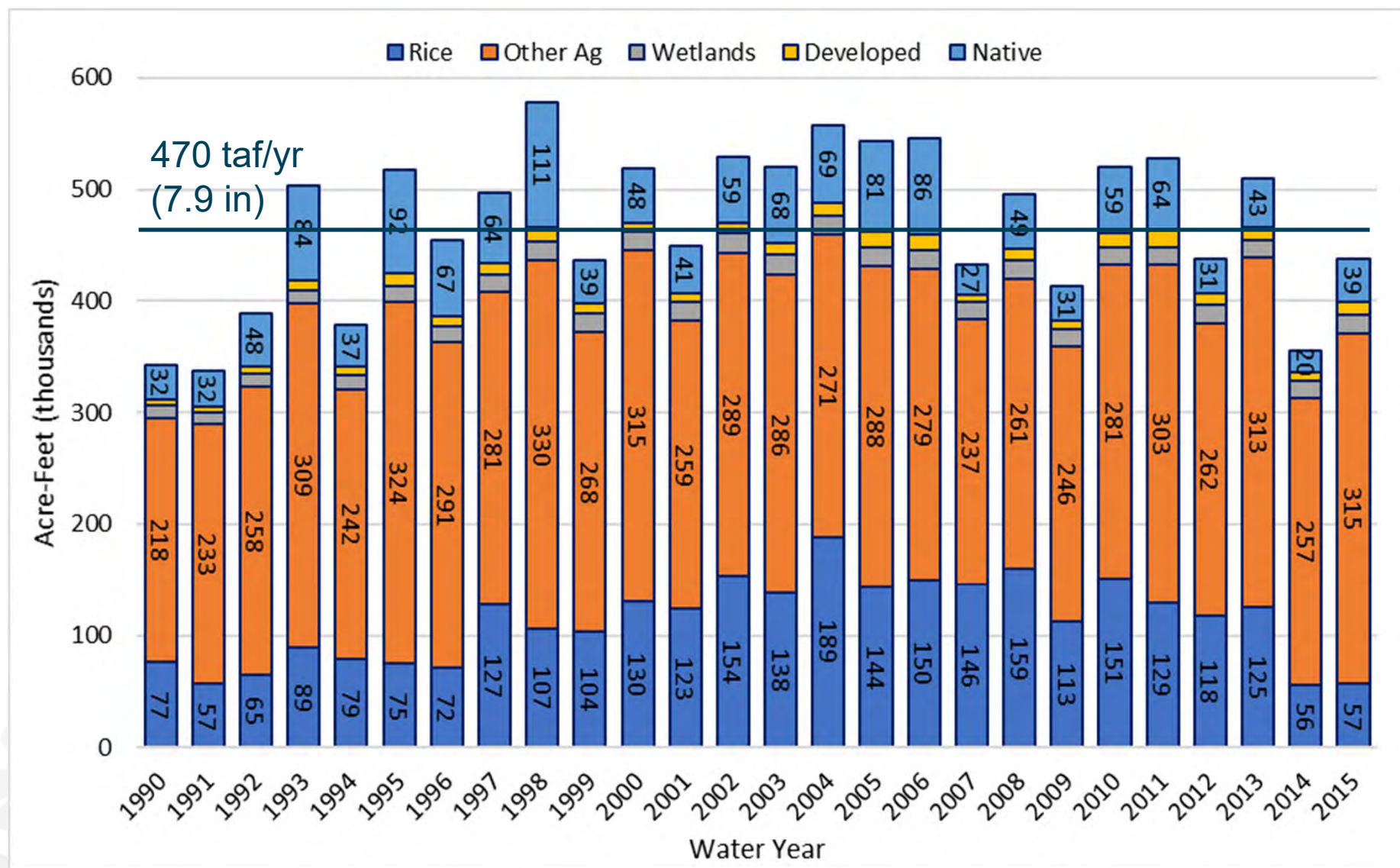
Evapotranspiration



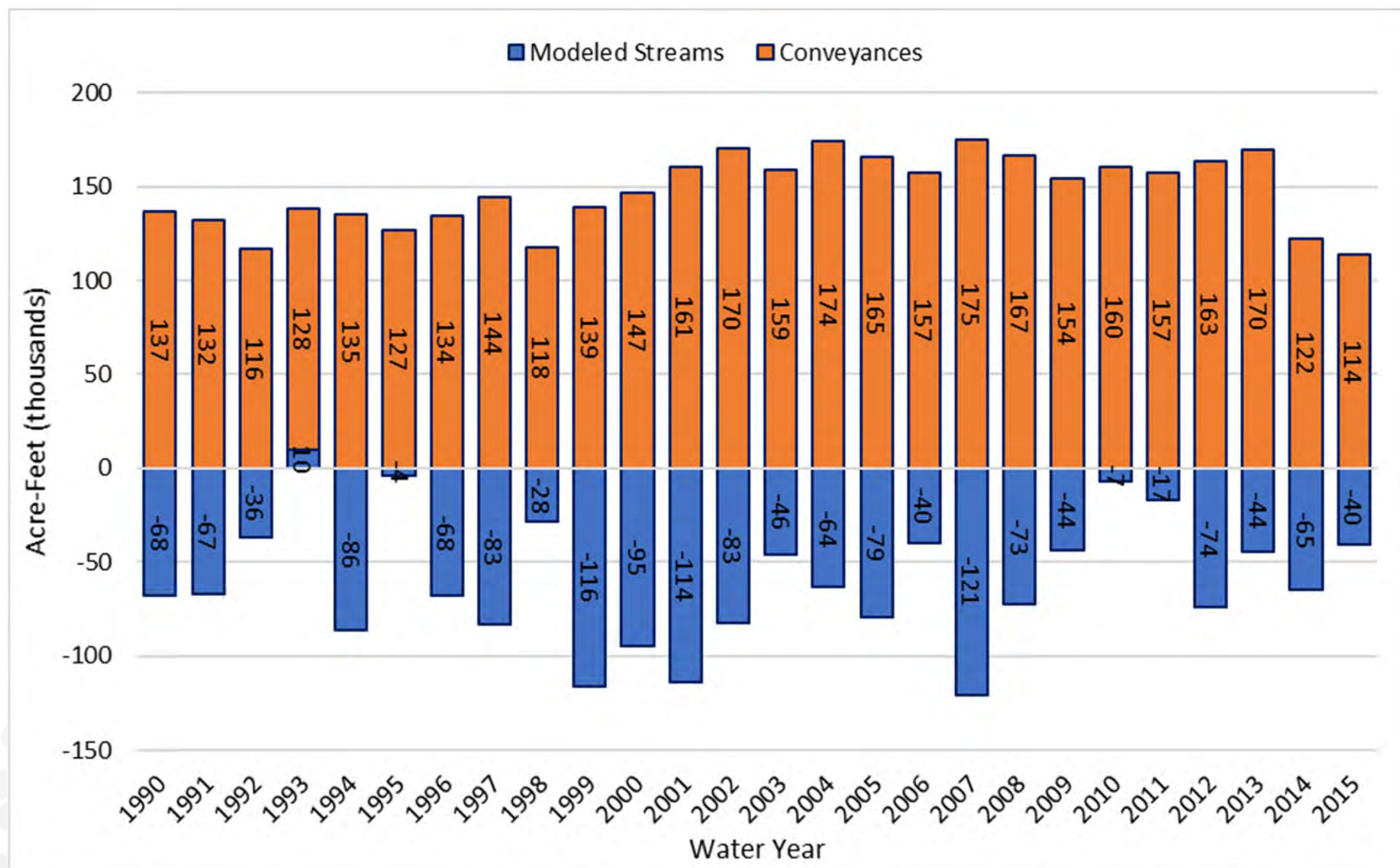
Water Supplies



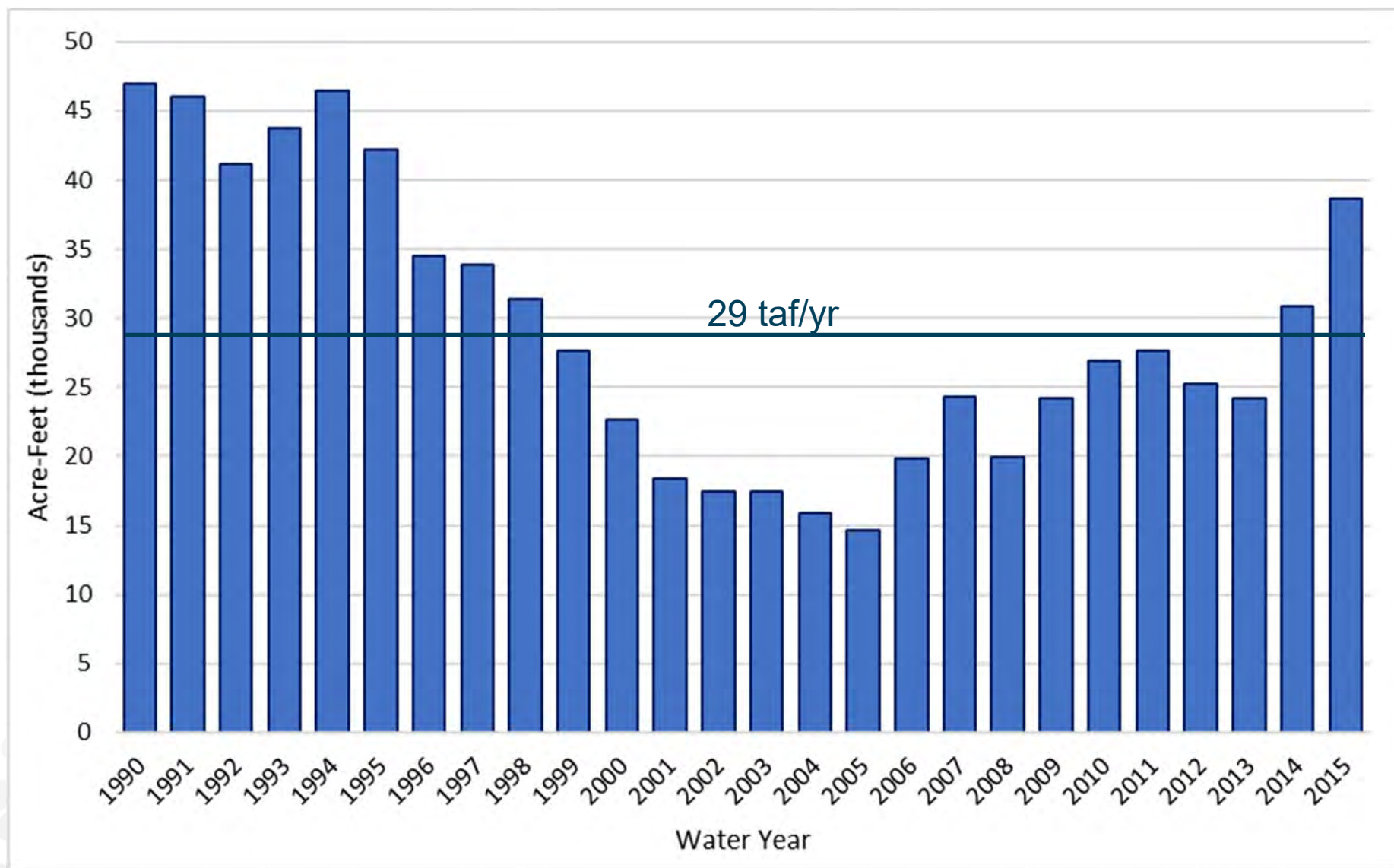
Percolation



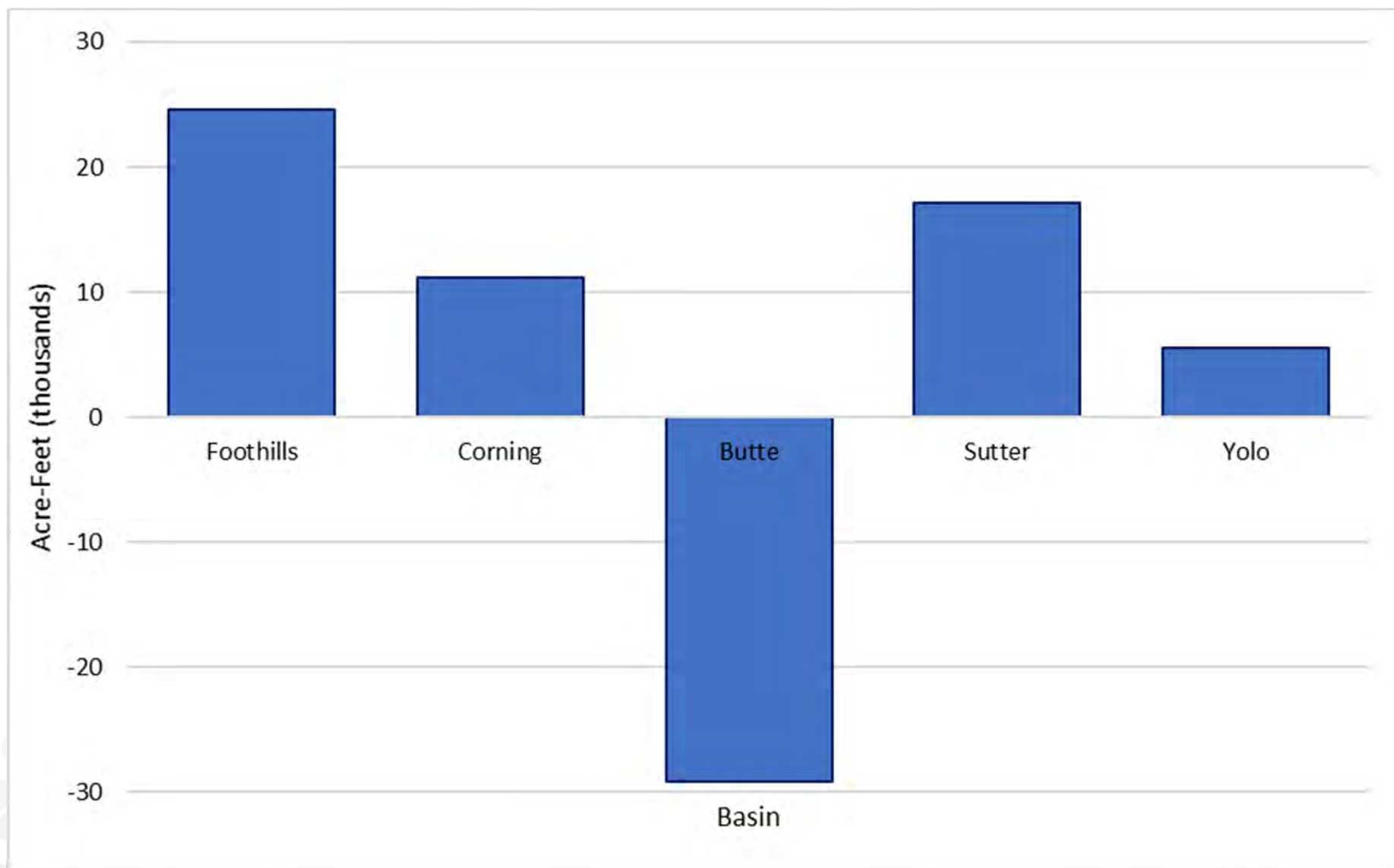
Surface Water – Groundwater Interaction



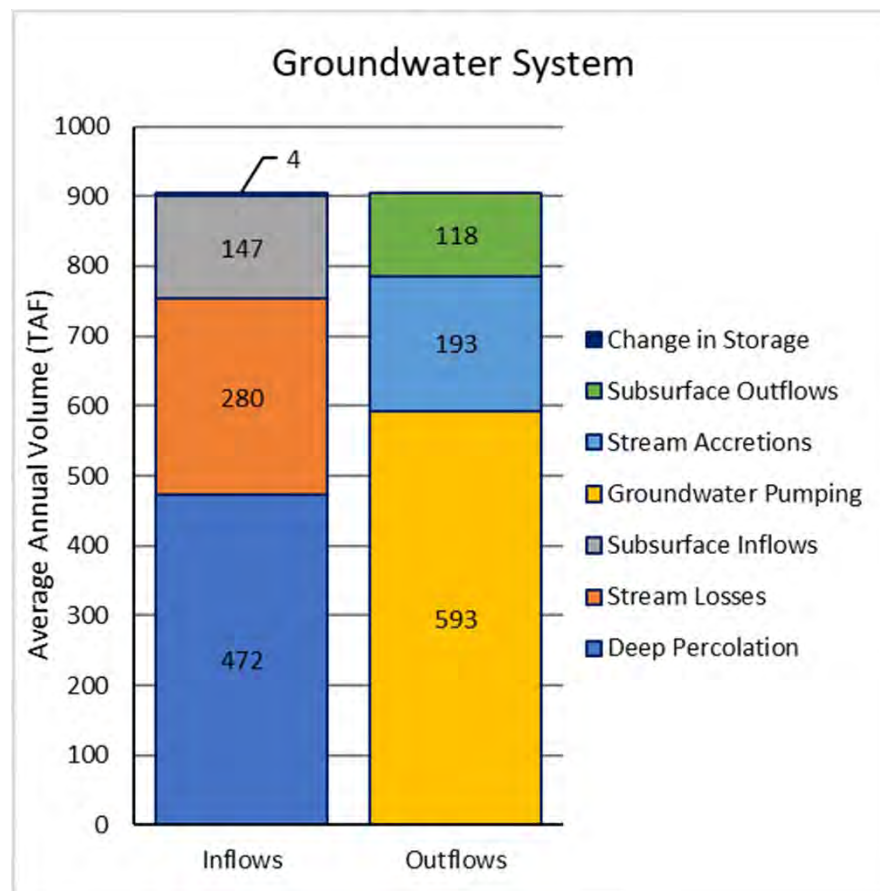
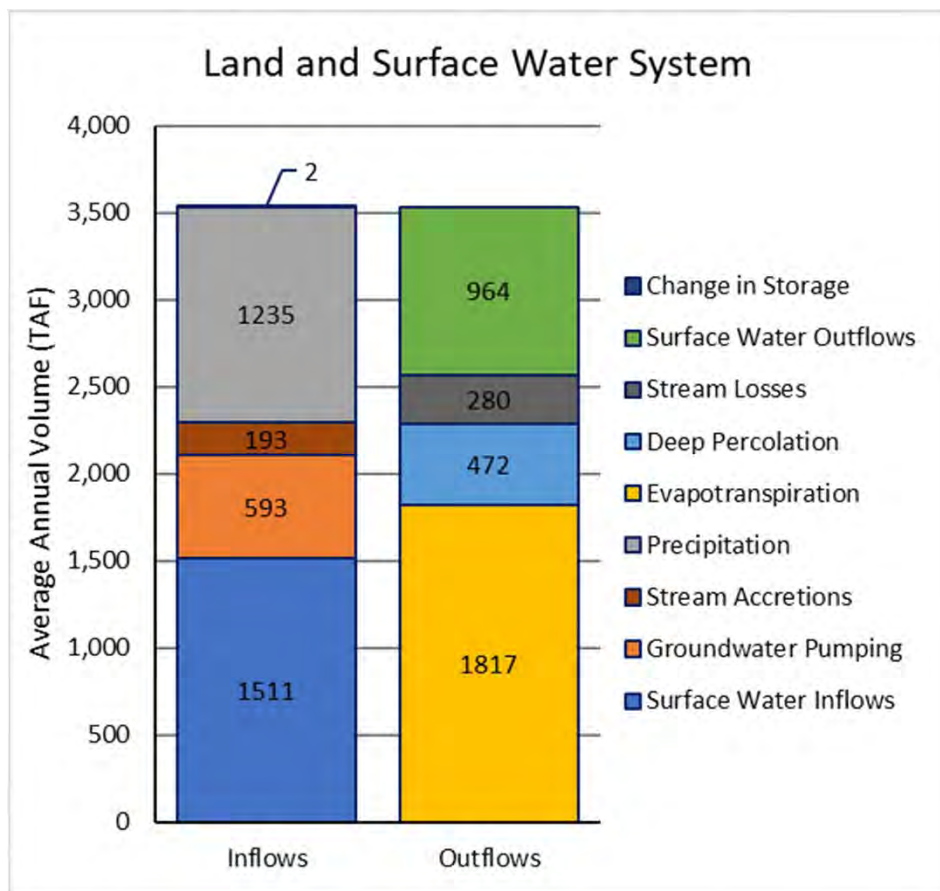
Interbasin Subsurface Inflows



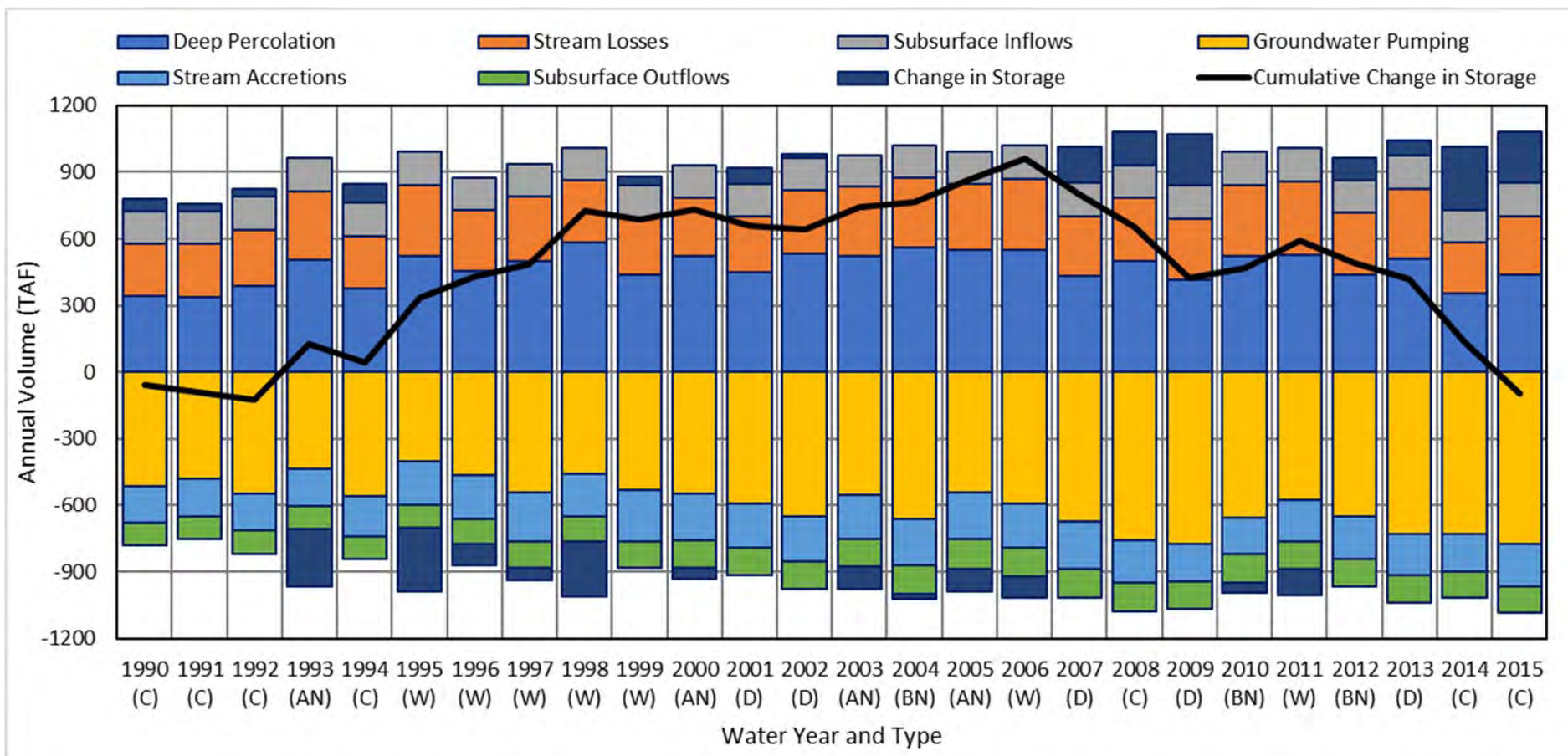
Interbasin Subsurface Inflows



Historical Water Budget Summary



Historical Water Budget Summary



Change in Storage:

1990 – 1998: **+81 taf/yr** → 1999-2006: **+29 taf/yr** → 2007-2015: **-118 taf/yr**

Historical Water Budget Takeaways

- Conditions Have Changed over Time
- Surface Water Supplies Critical to Supporting Continued Agricultural Production
- Recent Historic Drought Suggests Possible Supply-Demand Imbalance
- Need to Assess Potential Future Conditions

Projected Water Budget Assumptions

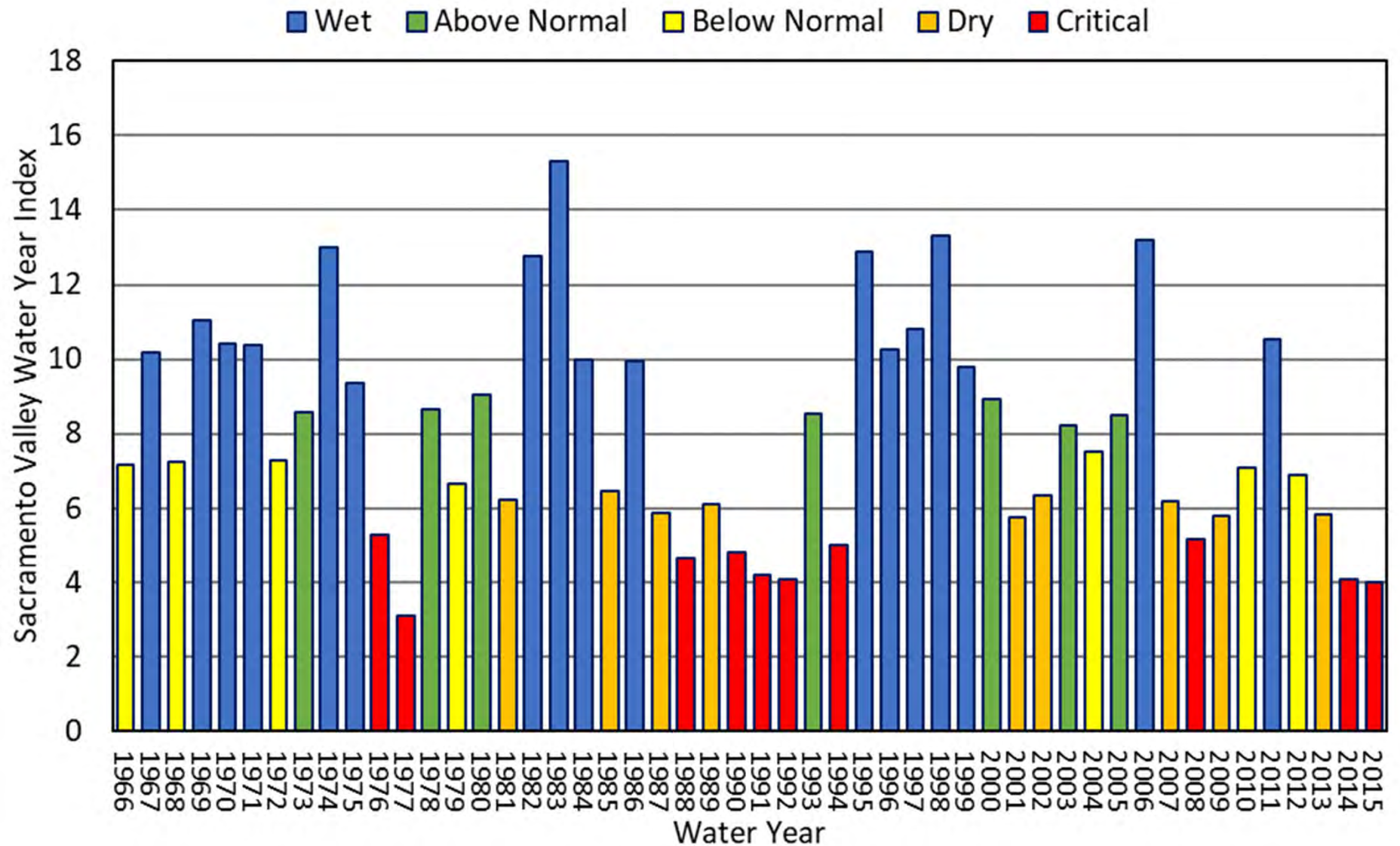
Projected Water Budget Requirements

- 50 years historical hydrology (precipitation, evapotranspiration, streamflow)
- Most recent land use and evapotranspiration
- Projected population and population growth
- Climate change
- Most recent water supply information

Proposed Approach/Assumptions

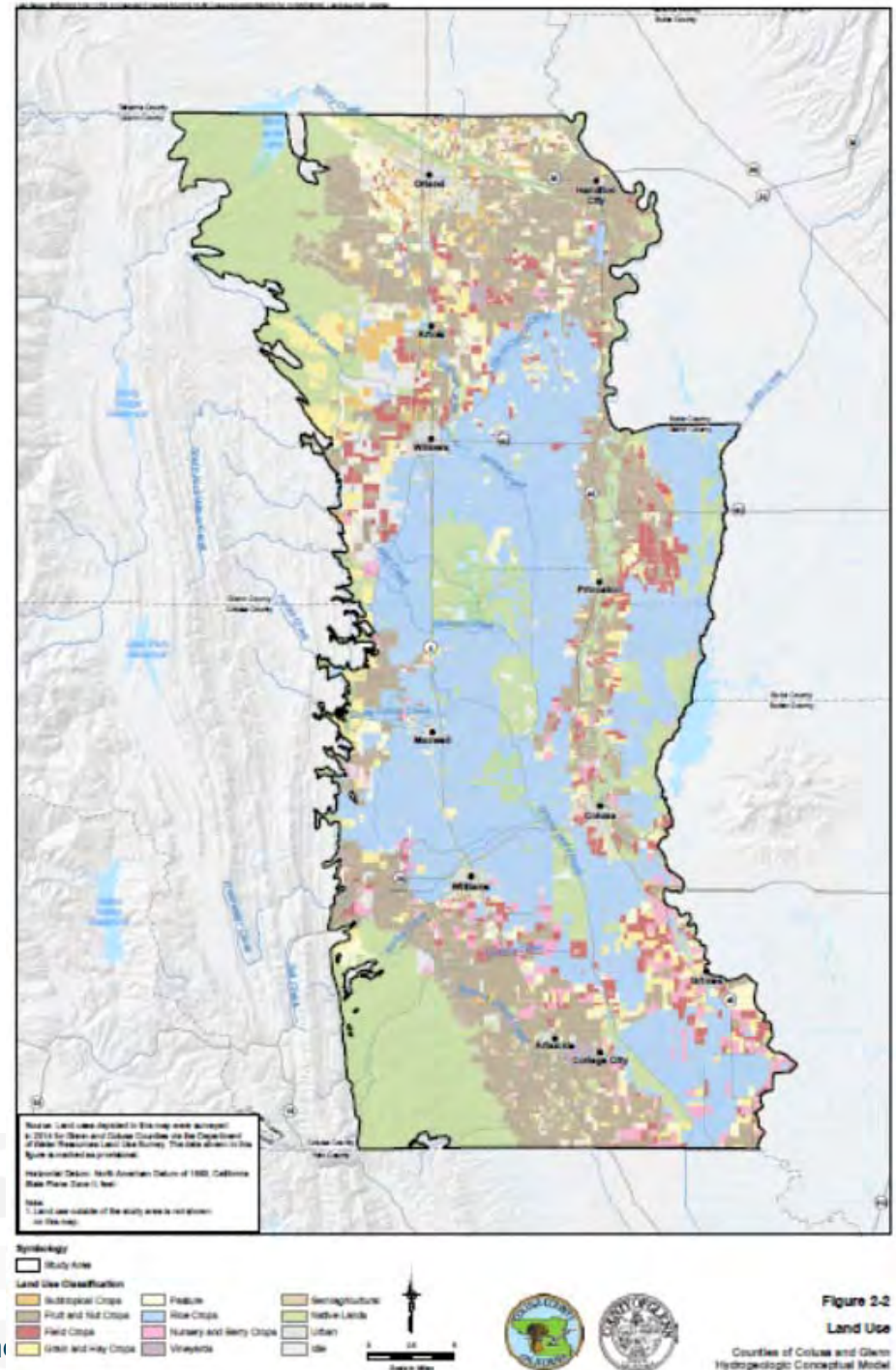
- Utilize Refined C2VSimFG Model for Colusa Subbasin
- 50 Years of Hydrology from 1966 – 2015
- Recent Historical Land Use Mapped to Curtailment/Non-Curtailment Years
- Urban Demands Based on Projected Population and Per-Capita Use
- Climate Change Based on DWR Central Tendency Scenarios
- Water Supply Based on Recent Historical Use, Mapped to Curtailment/Non-Curtailment Years

Historical Hydrology



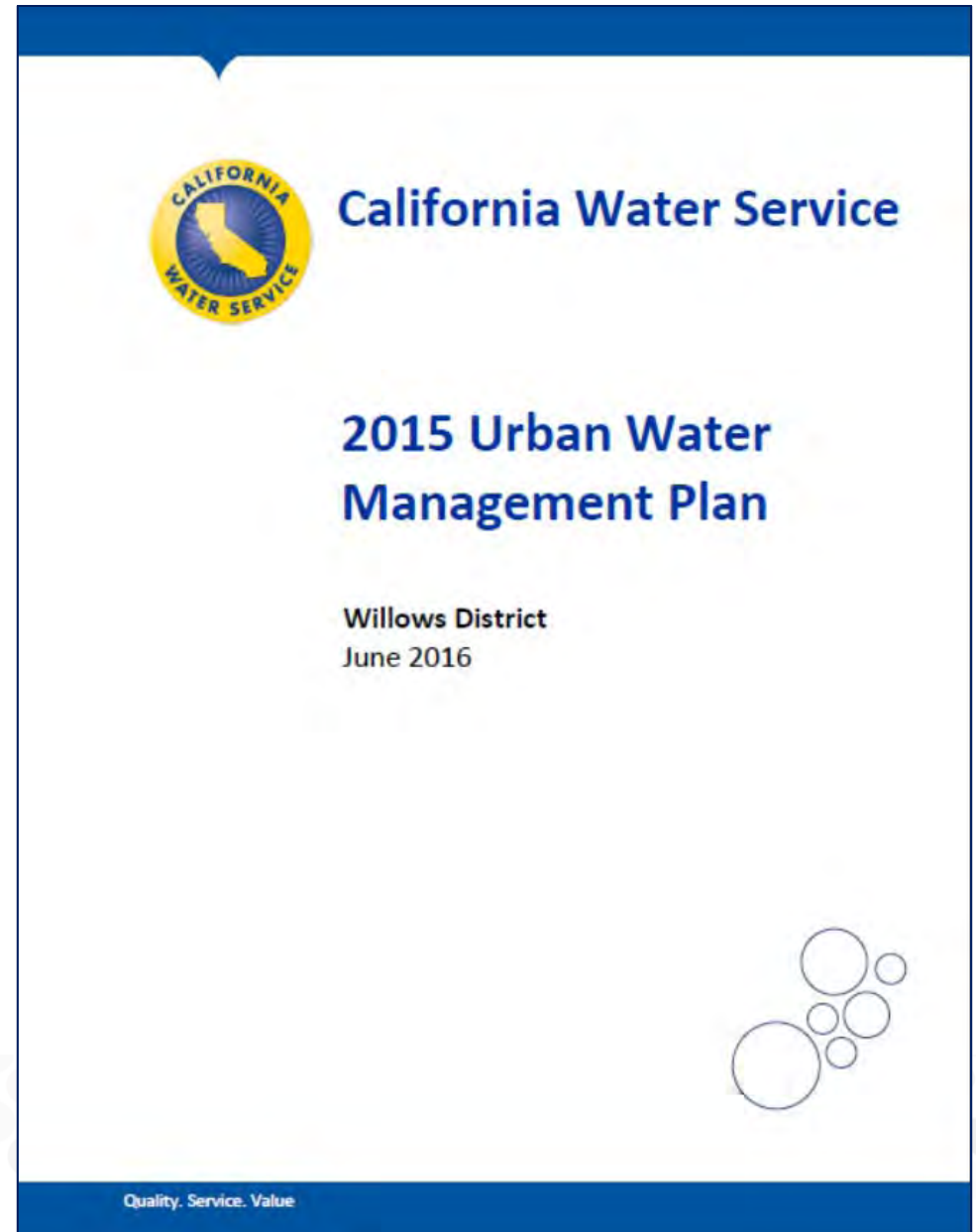
Projected Land Use

- Base on DWR Land Use Surveys
 - 2014 Statewide (Curtailment Year)
 - 2016 Statewide (Non-Curtailment Year)
- Consider Potential Future Crop Shifting?
- Consider Potential Future Crop Expansion?



Projected Urban and Rural Residential Demands

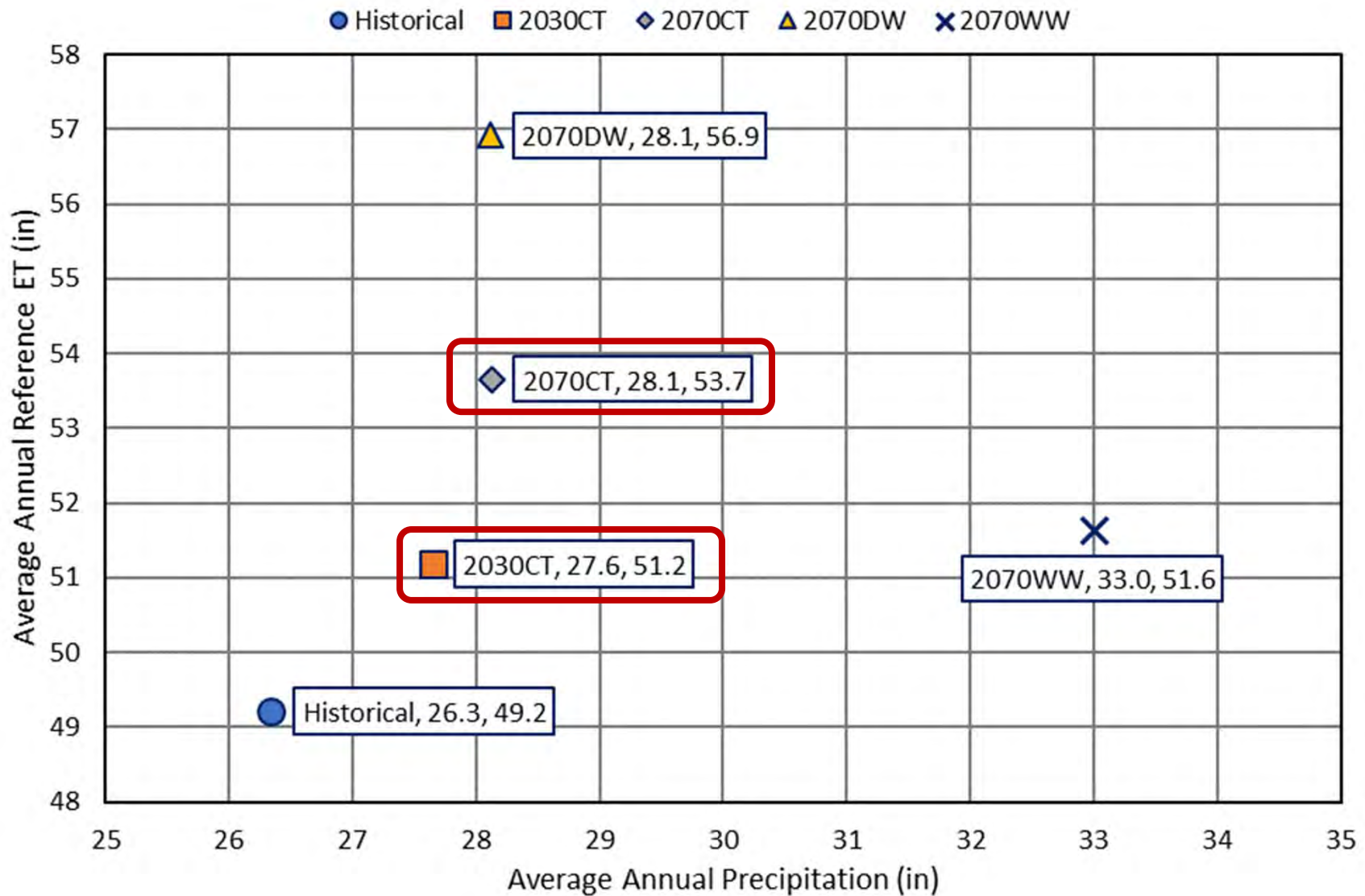
- Population Projections
 - CA Department of Finance
 - Urban Water Management Plans
- Per-Capita Water Use
 - Urban Water Management Plans
- Urban Land Use
 - County General Plans



Climate Change

- Four Scenarios Available from DWR
 - Central tendency (2030)
 - Central tendency, warmer-wetter, and hotter-drier (2070)
- Includes
 - Precipitation and evapotranspiration
 - Streamflows
 - Reservoir operations/ diversions (CalSIM II)
- Recommendation
 - 2030 and 2070 central tendency scenarios

Sacramento Valley Projections



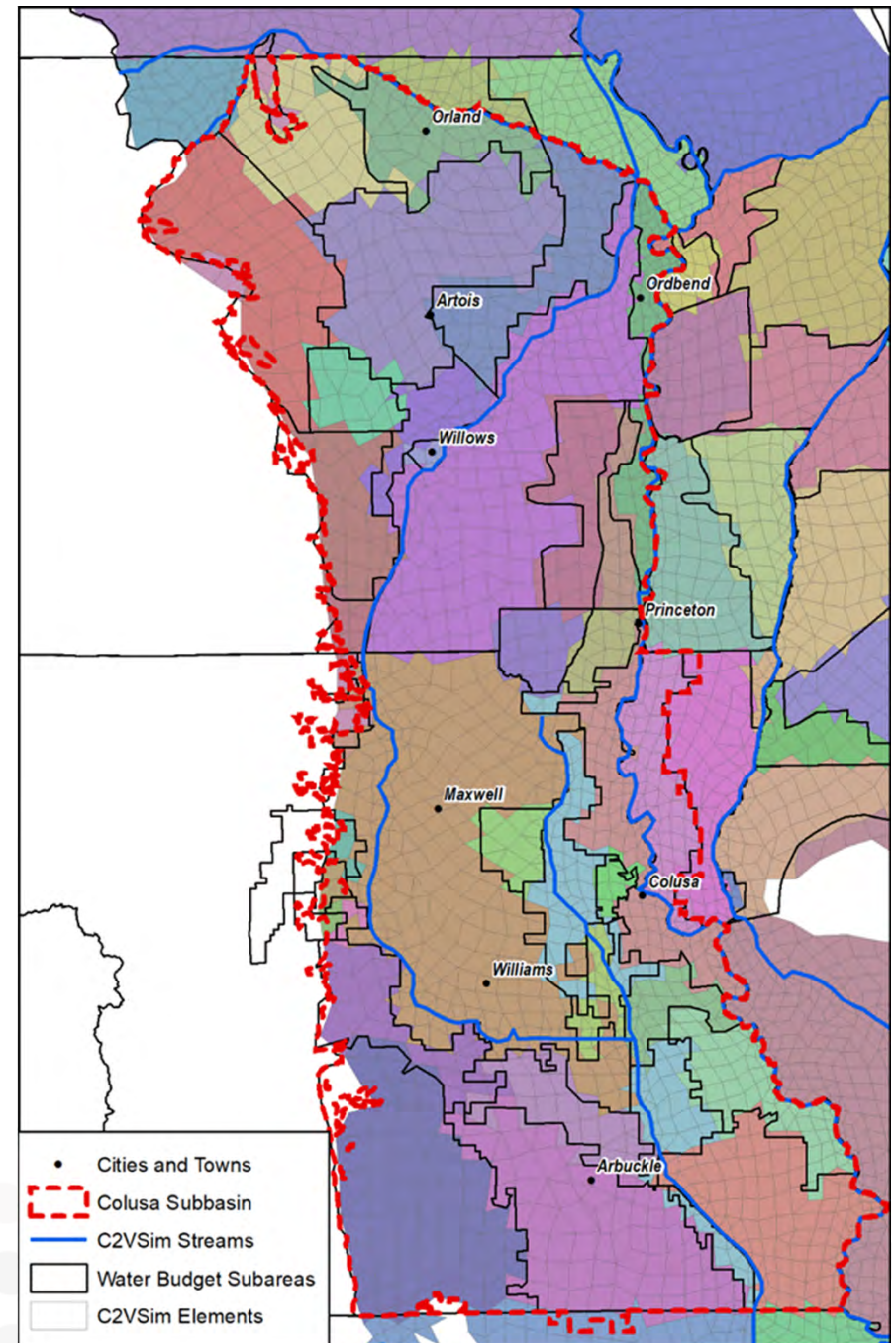
Surface Water Supplies

- Largely Tied to Shasta Annual Inflows
- Proposed Approach
 - Sacramento River Settlement Contractors
 - Map recent historical diversions to curtailment/non-curtailment years based on Shasta inflows
 - Accounts for current water management and practices
 - Tehama-Colusa Canal Contractors
 - Correlate recent historical diversions to Shasta inflows
 - Accounts for current water management, practices, and transfers

Model Calibration Status

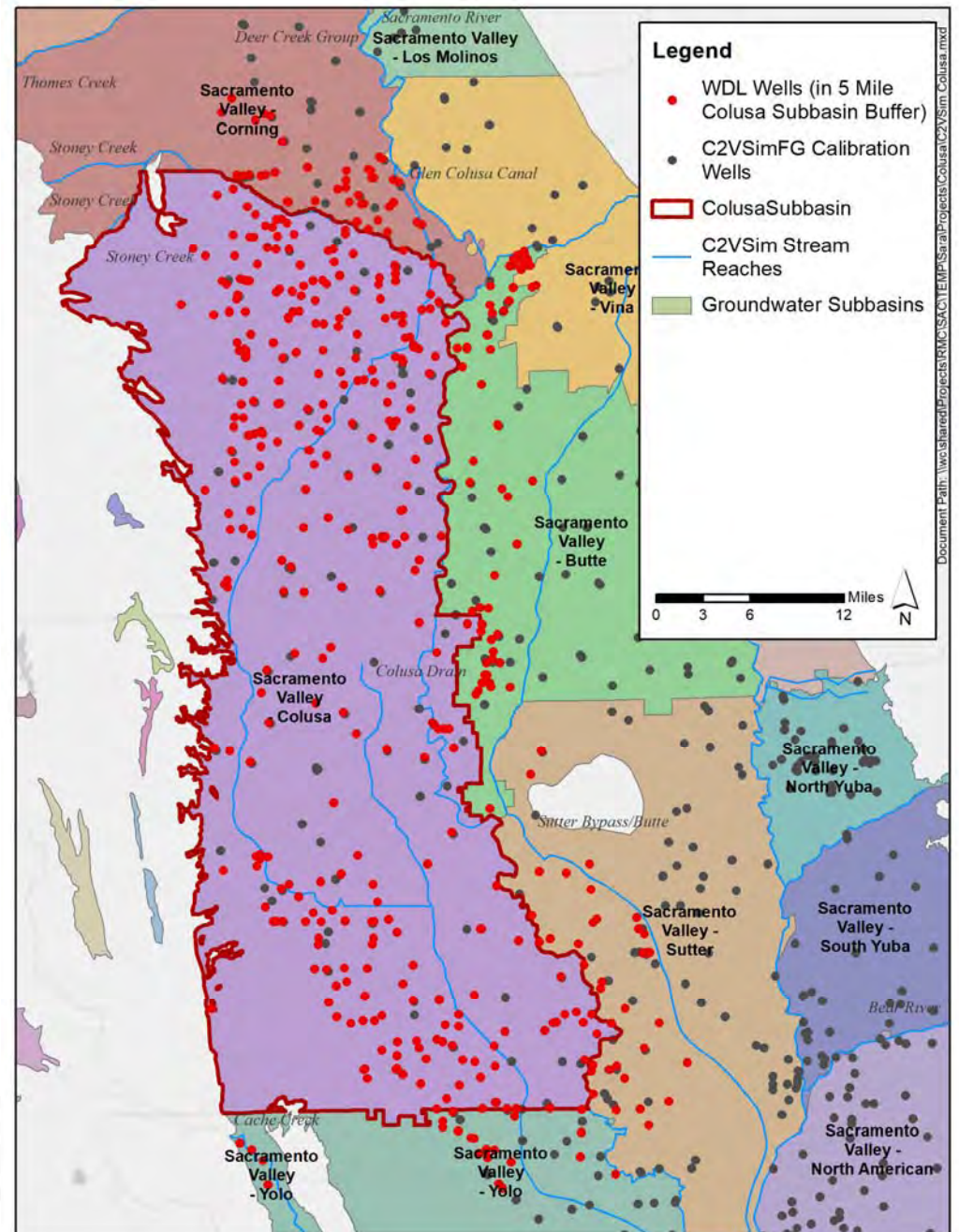
Colusa Subbasin Groundwater Model

- Being Developed through Refinement of DWR C2VSimFG Model
 - 1839 Individual Elements
 - 389 Acres, on Average
- Simulates Water Budgets, Water Levels, Streamflows, etc.
- Further Supports Evaluation of
 - Sustainable Management Criteria
 - Projects and Management Actions

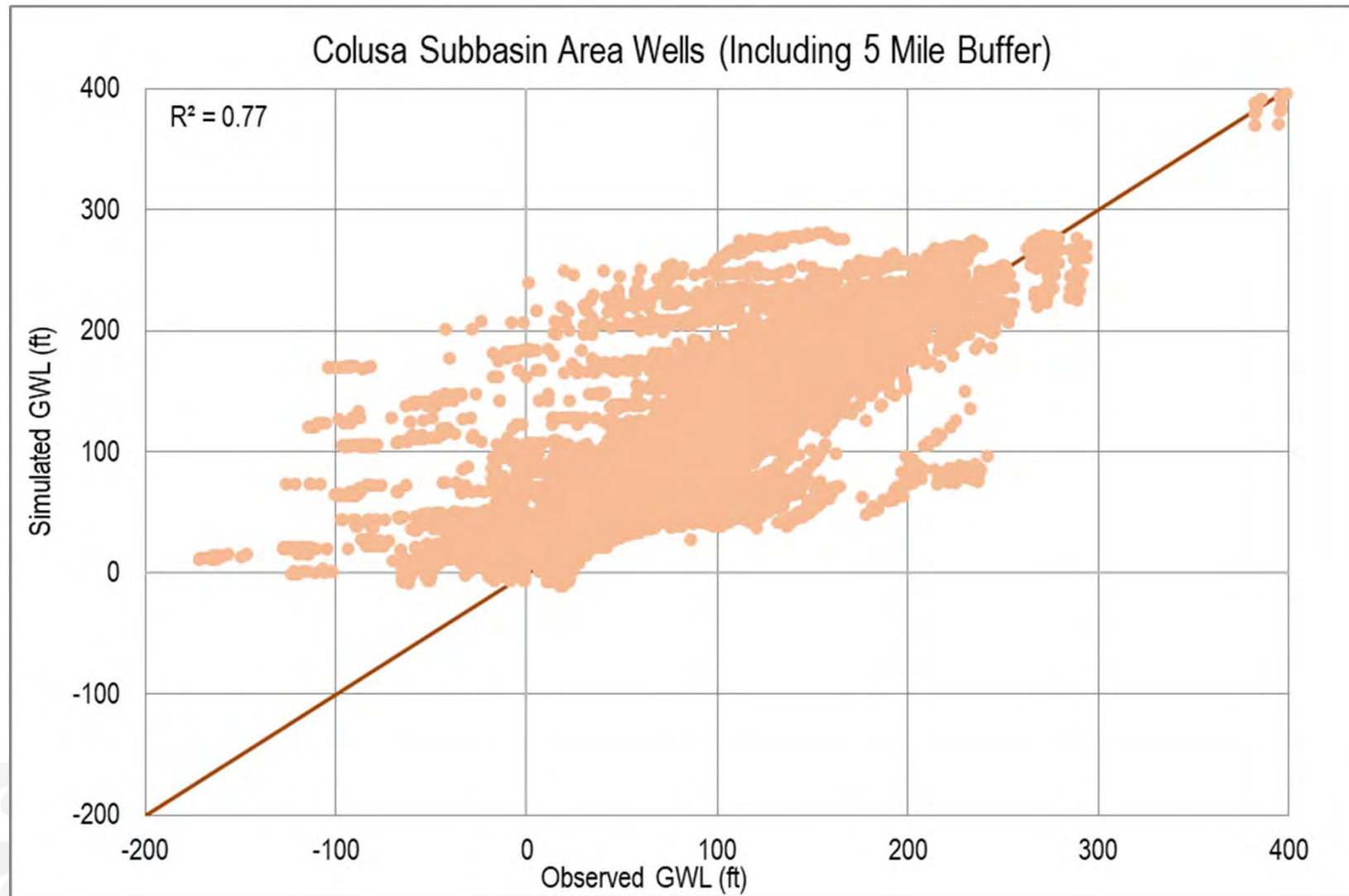


Calibration of Colusa Subbasin in C2VSimFG

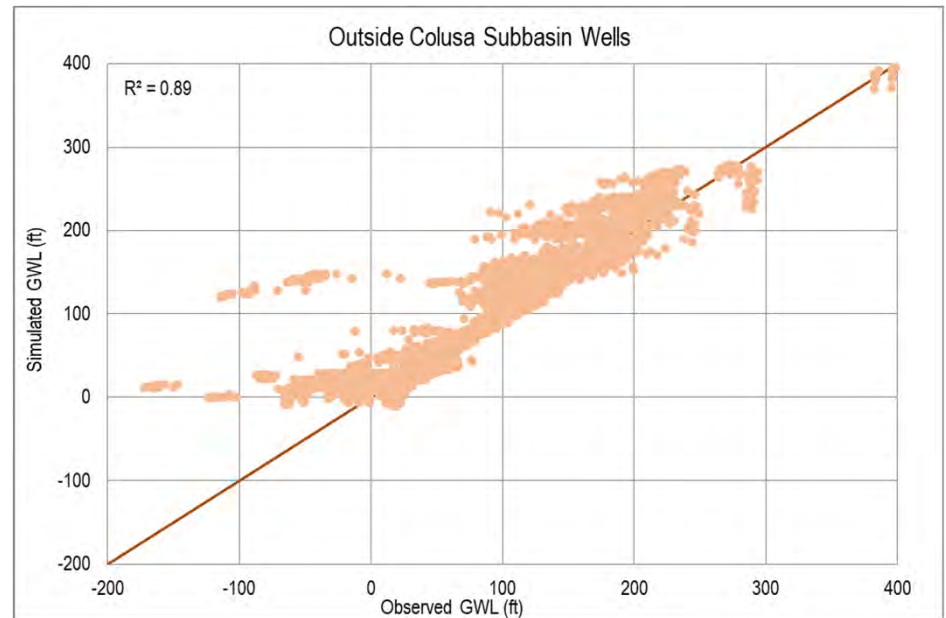
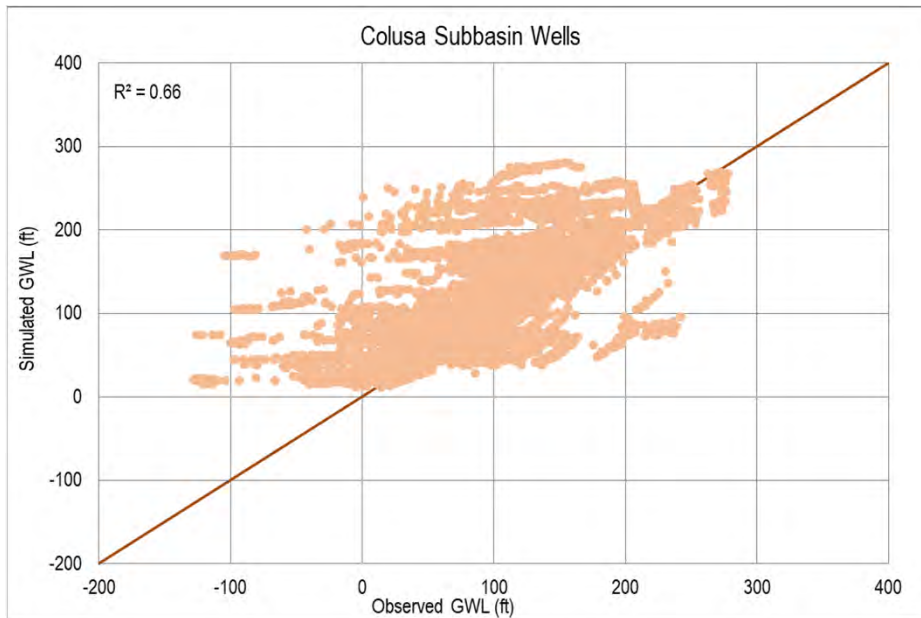
- 740 wells in DWR Water Data Library (WDL)
 - Several groupings of nested wells
- 246 wells correspond to C2VSimFG calibration well locations



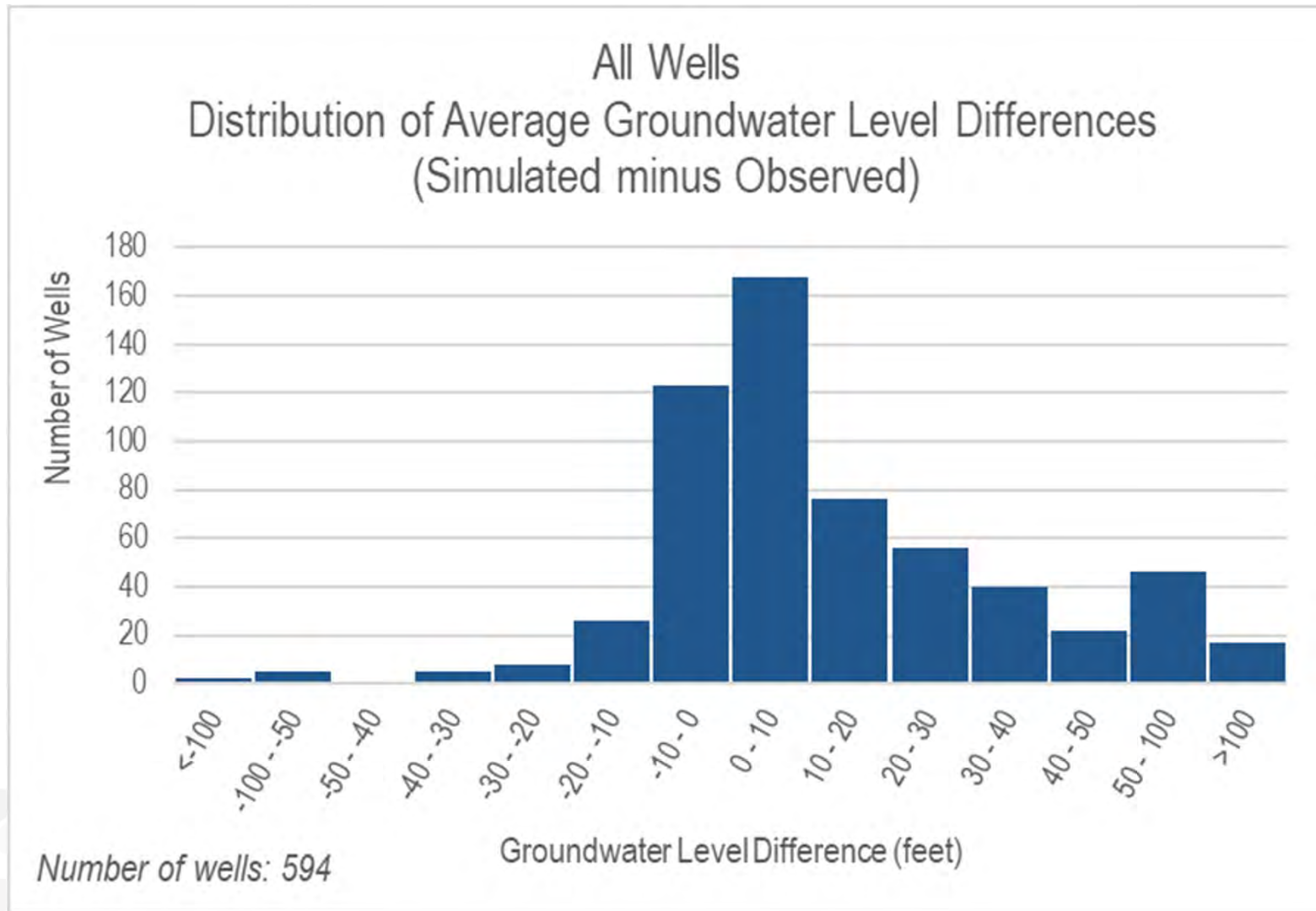
Calibration Status – Scatter Plots



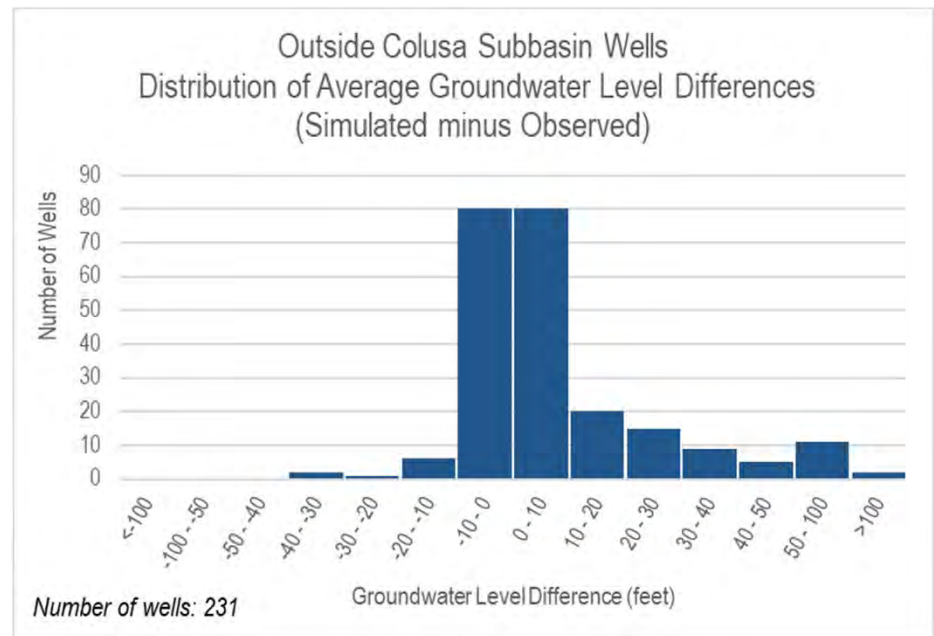
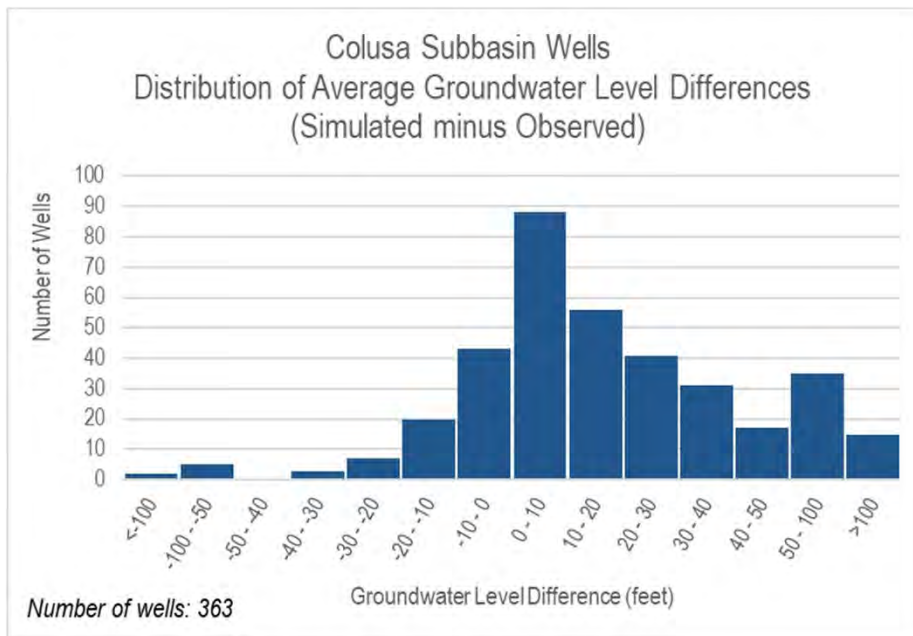
Calibration Status – Scatter Plots



Calibration Status – Residuals

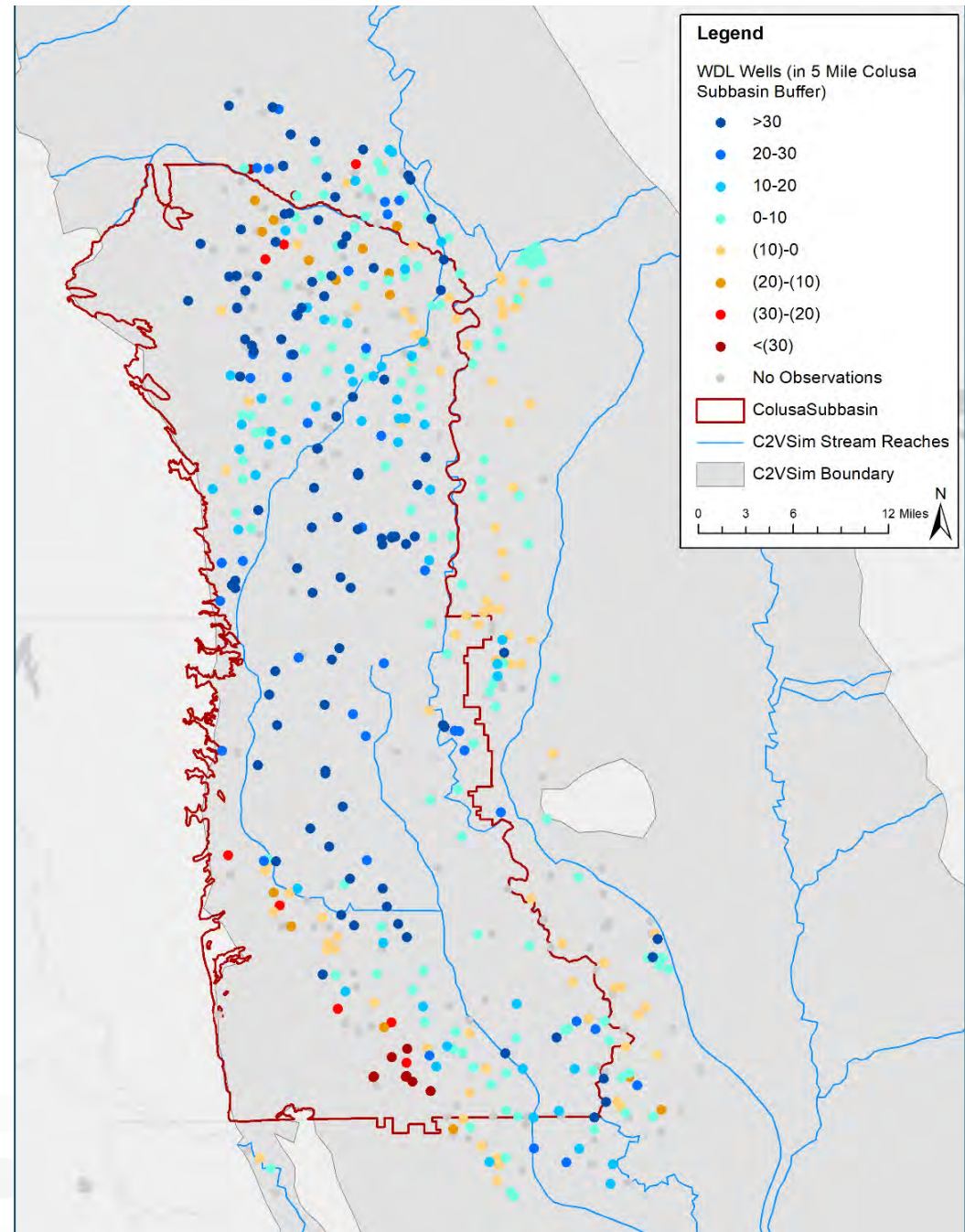


Calibration Status – Residuals

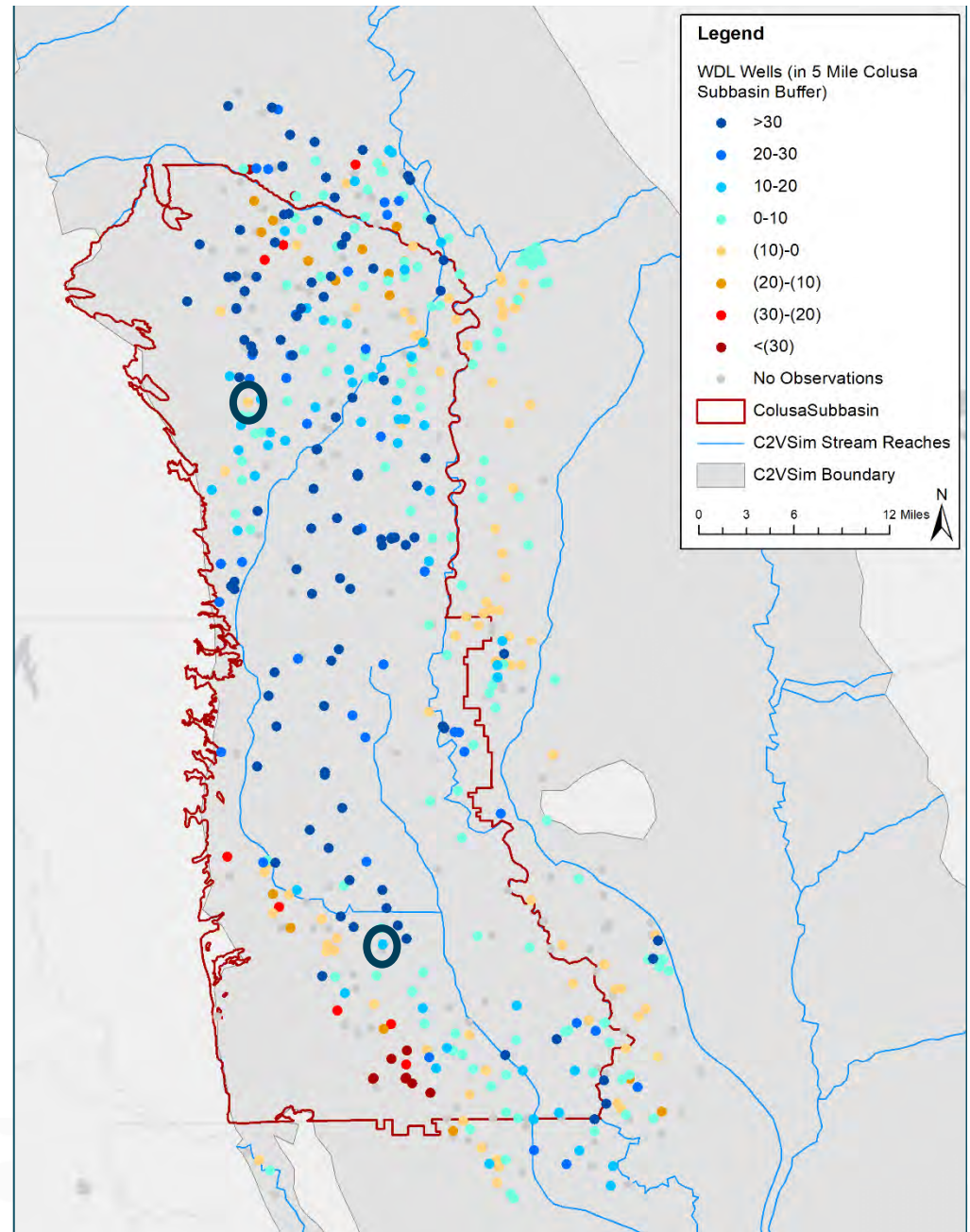
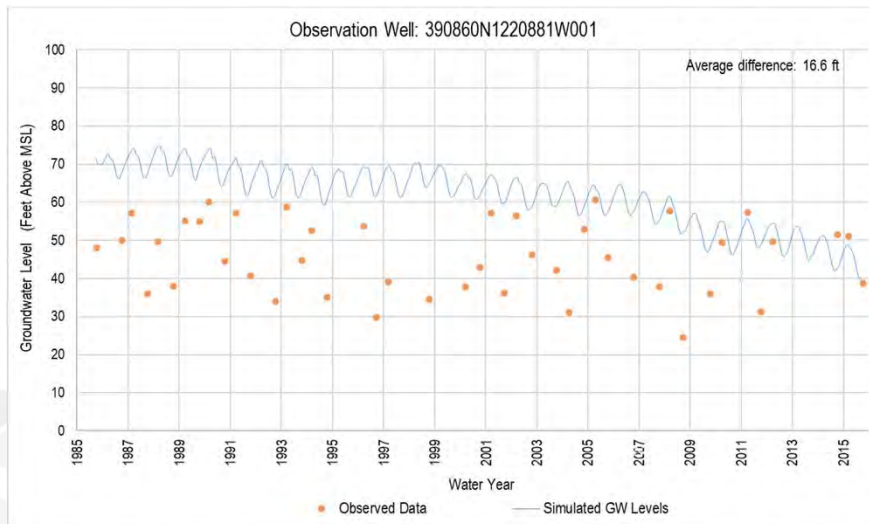
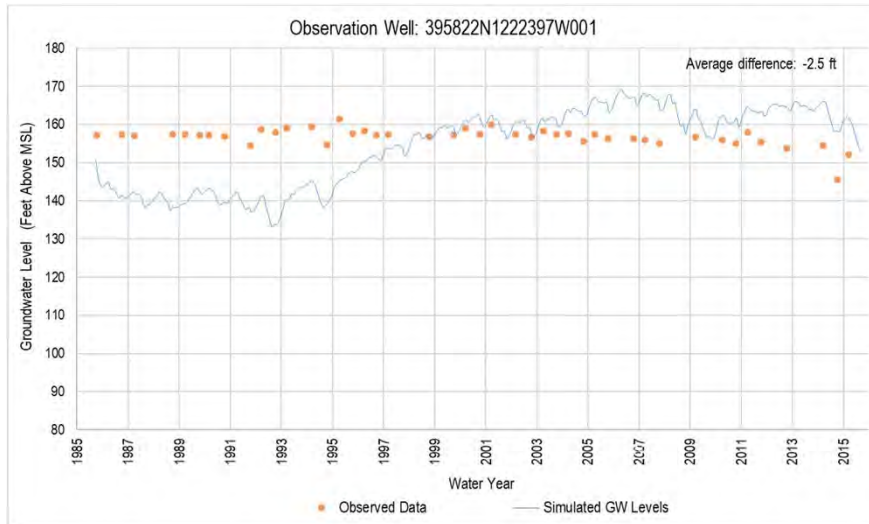


Average Residual by WDL Well

Average Groundwater Level Difference (feet)	Count of WDL Wells
>30	125
20-30	56
10-20	76
0-10	168
(10)-0	123
(20)-(10)	26
(30)-(20)	8
<(30)	12
No Calibration Data in Simulation Range (WY 1986-2015)	146



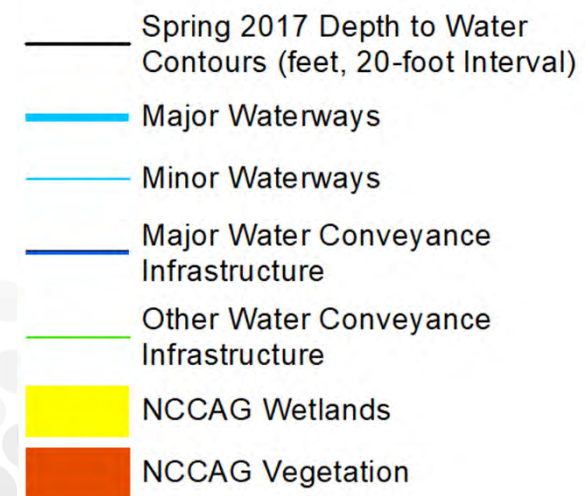
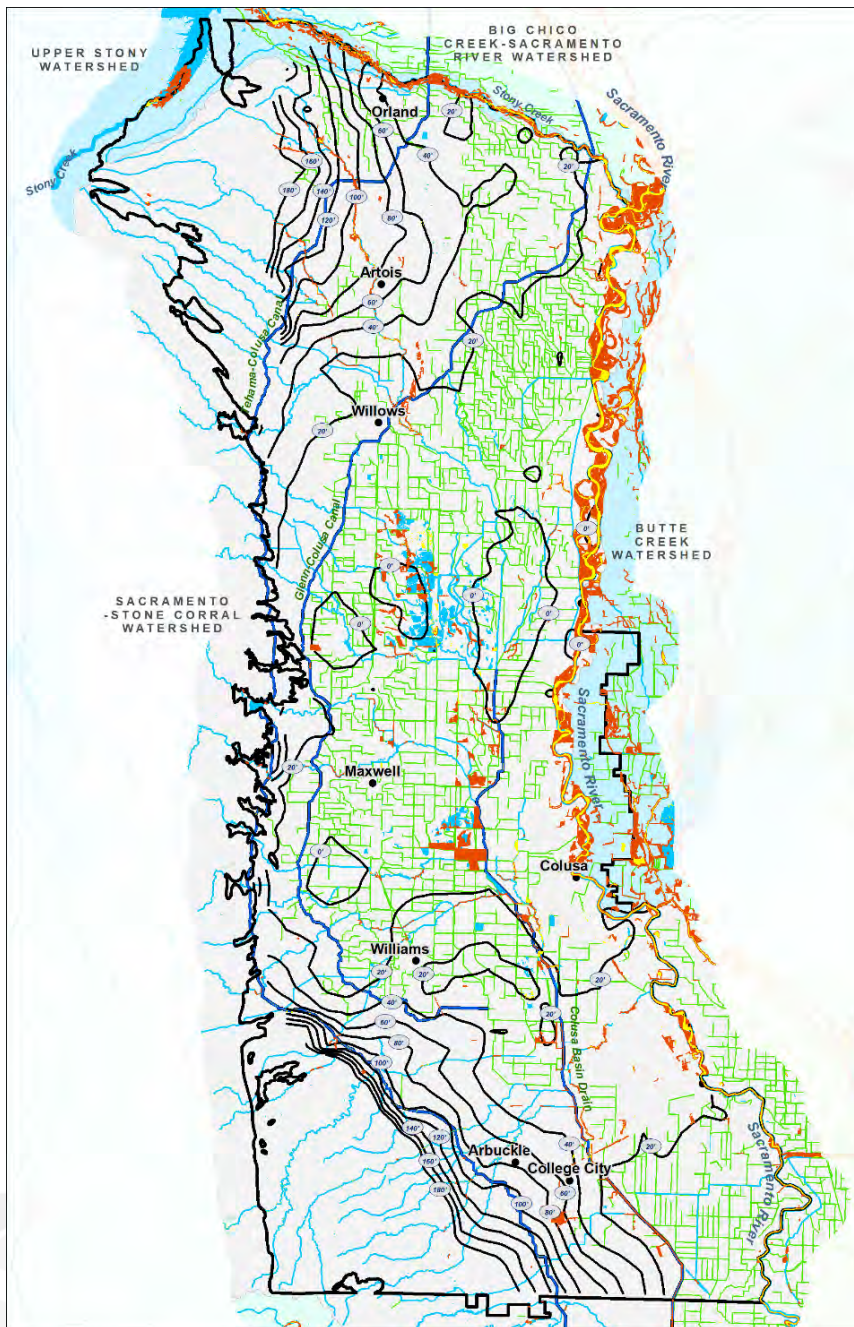
Example Hydrographs



Groundwater Dependent Ecosystems (GDEs)

Groundwater Dependent Ecosystems (GDEs)

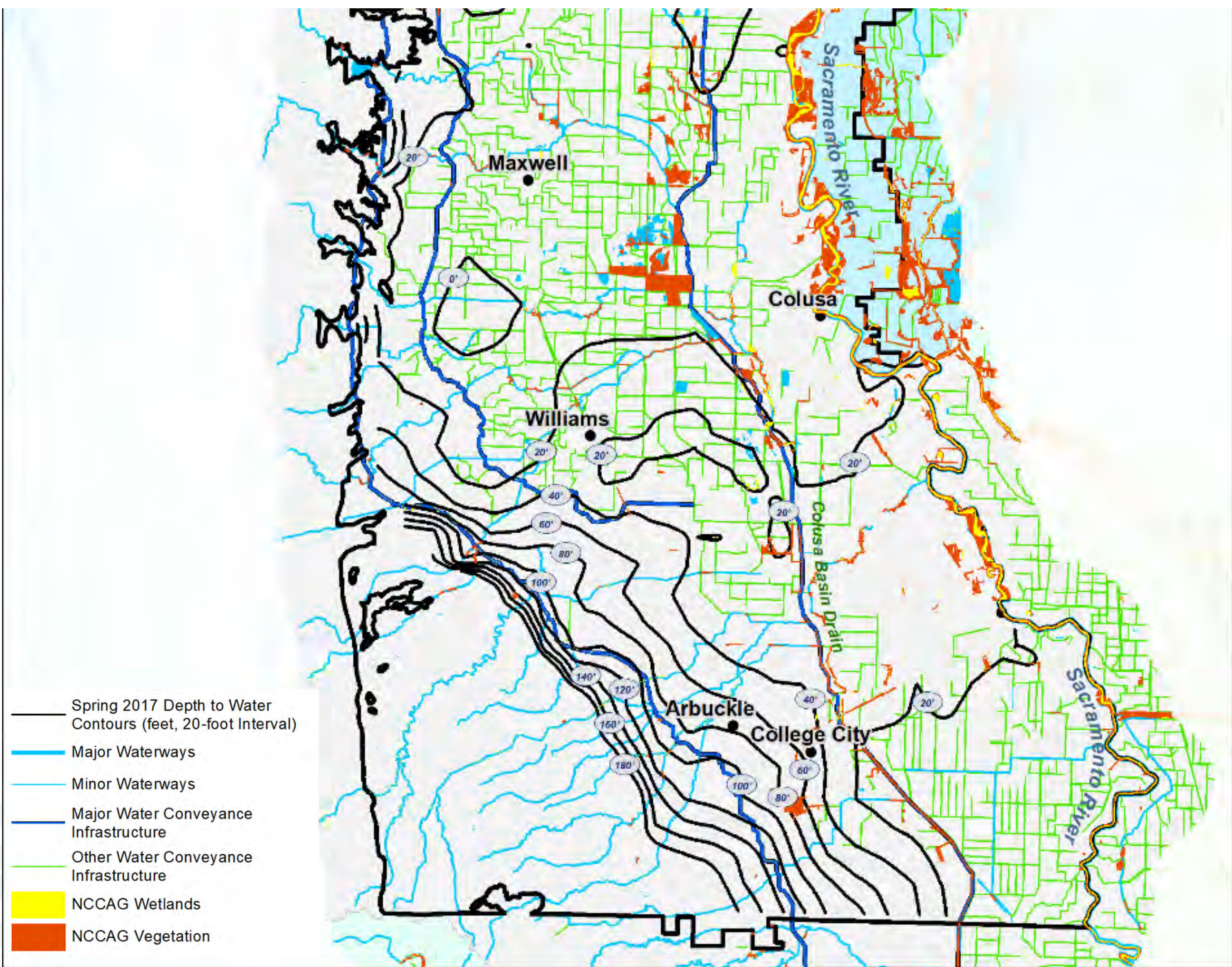
- Relatively few wetlands mapped – mostly in riparian corridors.
- Major vegetation categories
 - Cottonwood ~ 31%
 - Bulrush ~22%
 - Willows ~15%
 - Valley Oak ~13%
 - Others ~18%
 - (including Arundo ~4%)



North Basin Potential GDEs



South Basin Potential GDEs



Proposed GDE Delineation Approach

- Included in recent Prop 68 grant
- Compile additional supporting data (e.g. depth to groundwater, availability of surface water, adjacent land uses, soil survey data, etc.)
- Engage with stakeholders to further refine
- Summarize GDE evaluation for incorporation into Basin Setting, evaluations of Monitoring Networks, establishment of Sustainable Management Criteria, and Projects and Management Actions, as appropriate.

Additional Discussion of GSP Development Timeline