COLUSA SUBBASIN

Groundwater Sustainability Plan
First Annual Report, 2022

Overview of Groundwater Conditions and Water Supply through 2021

March 11, 2022

Introductions

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Davids Engineering

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West Yost

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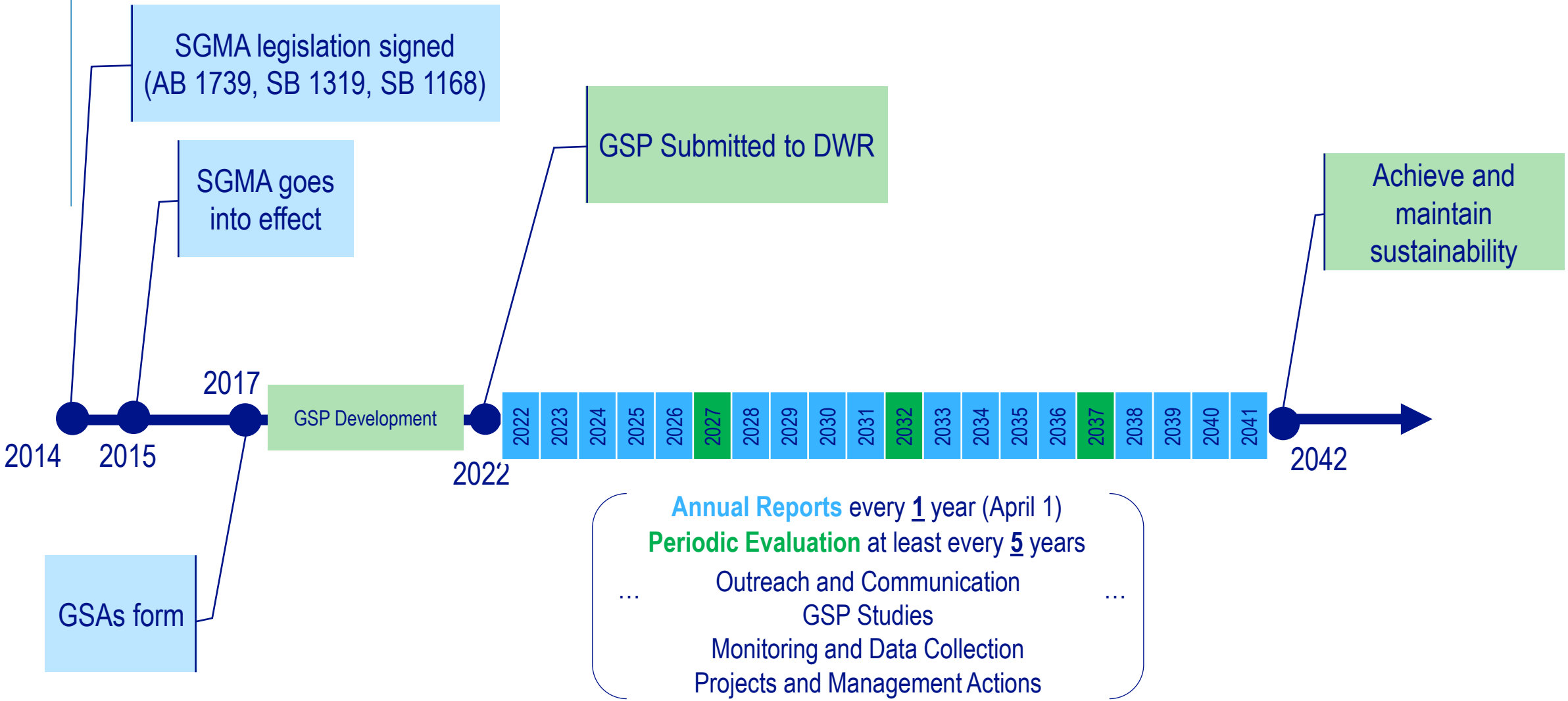
Outline

1. **Overview**
   - Colusa Subbasin GSP
   - Annual Report Requirements
2. **Groundwater Conditions**
   - Groundwater Levels
   - Change in Groundwater Storage
   - Subsidence
3. **Water Supplies and Water Use**
4. **GSP Implementation**
5. **Questions and Answers**

Overview

Katie Klug, PhD
Davids Engineering

Colusa Subbasin GSP Implementation Schedule



Colusa Subbasin Groundwater Sustainability Plan (GSP)

The Colusa Subbasin GSP was adopted by the CGA and GGA in December 2021 and was submitted to DWR in January 2022.

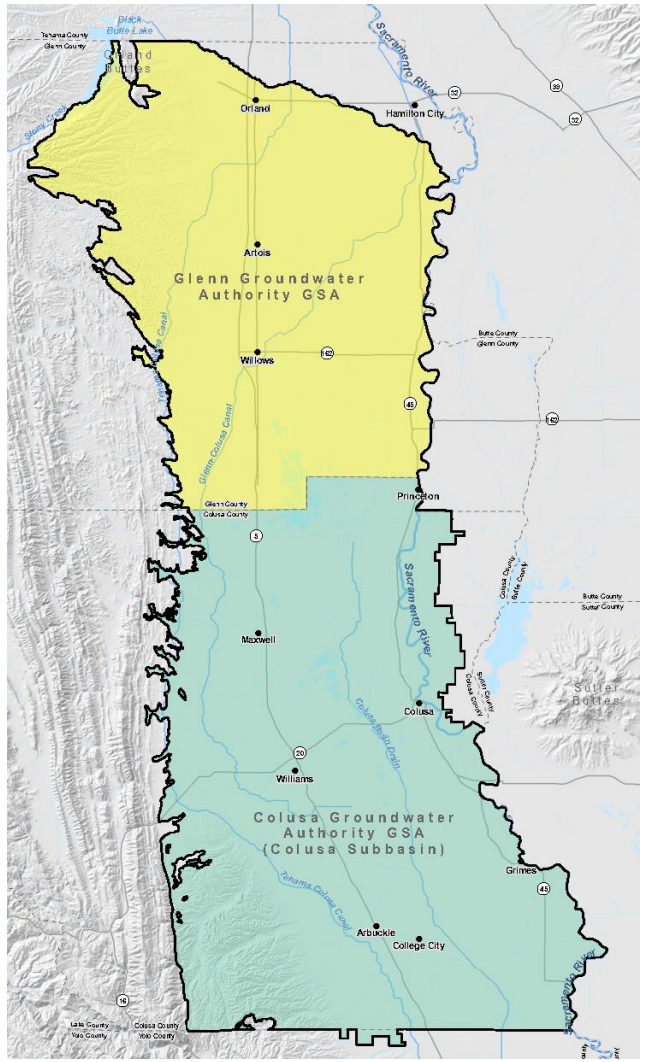
GSP implementation has begun and will continue through 2042.

The **GSP is a dynamic planning document** that will guide how groundwater will be managed over the next two decades. **As conditions change, so too will the GSP.**

GSP describes groundwater conditions and how groundwater management will avoid adverse impacts to beneficial users, including domestic, municipal, tribal, agricultural, industrial, and environmental uses.

Avoiding adverse impacts is based on the evaluation of six Sustainability Indicators:

Note: Seawater intrusion was determined to be not applicable in the Colusa Subbasin.



Annual Report Requirements (23 CCR §356.2)

- Updates on Groundwater Conditions
  - Groundwater Elevation (Hydrographs, Contour Maps)
  - Change in Groundwater Storage
  - Progress Toward Interim Milestones
    (i.e., subbasin conditions relative to the six Sustainability Indicators)

Focus of this presentation

Annual Report Requirements (23 CCR §356.2), continued…

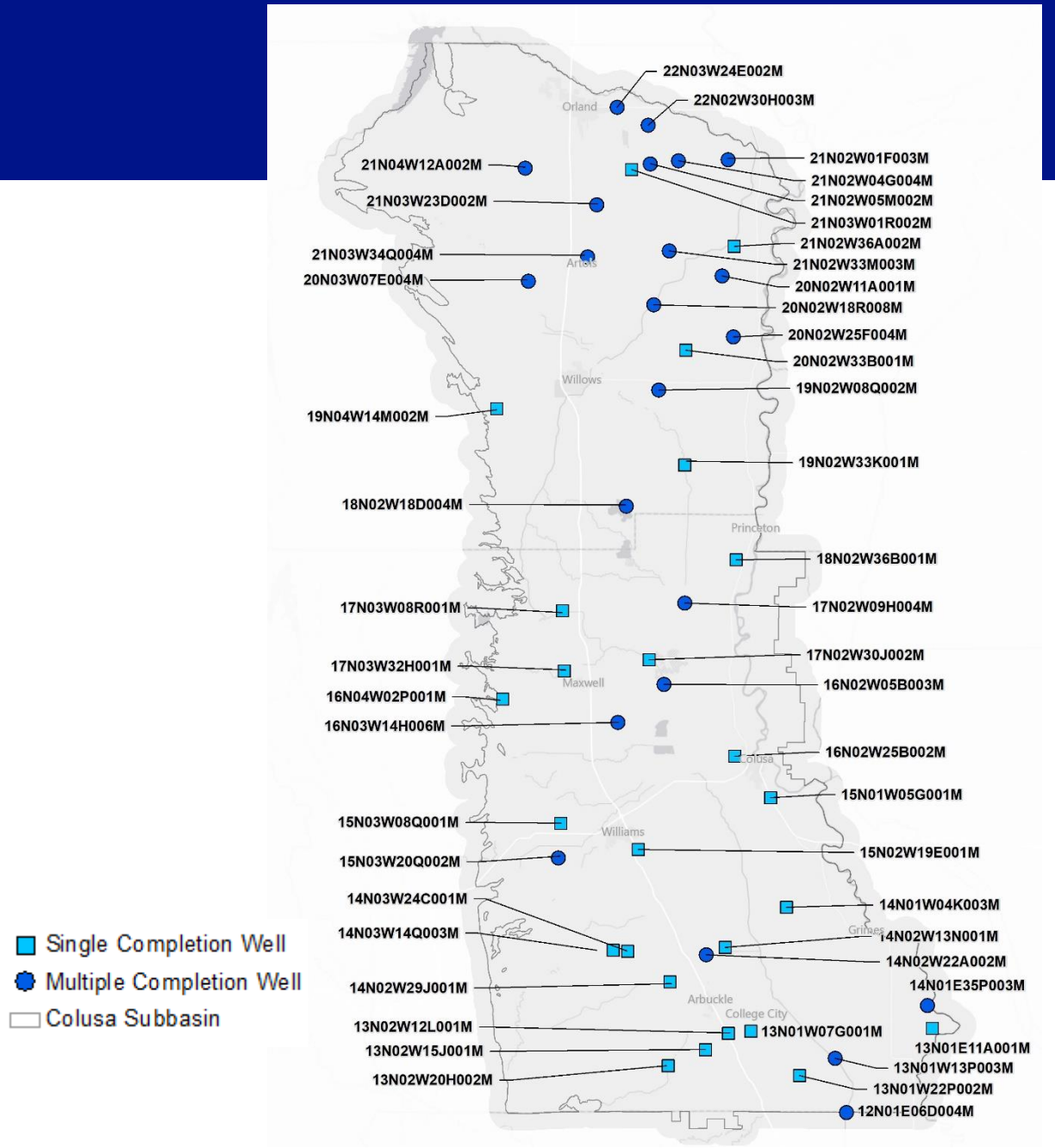
- Water Supply and Water Use
  - Groundwater Extraction
  - Surface Water Supplies
  - Total Water Use
- Progress Toward Plan Implementation
  (e.g., implementation of planned projects and management actions)

Groundwater Conditions

Anna Reimer, PG
West Yost

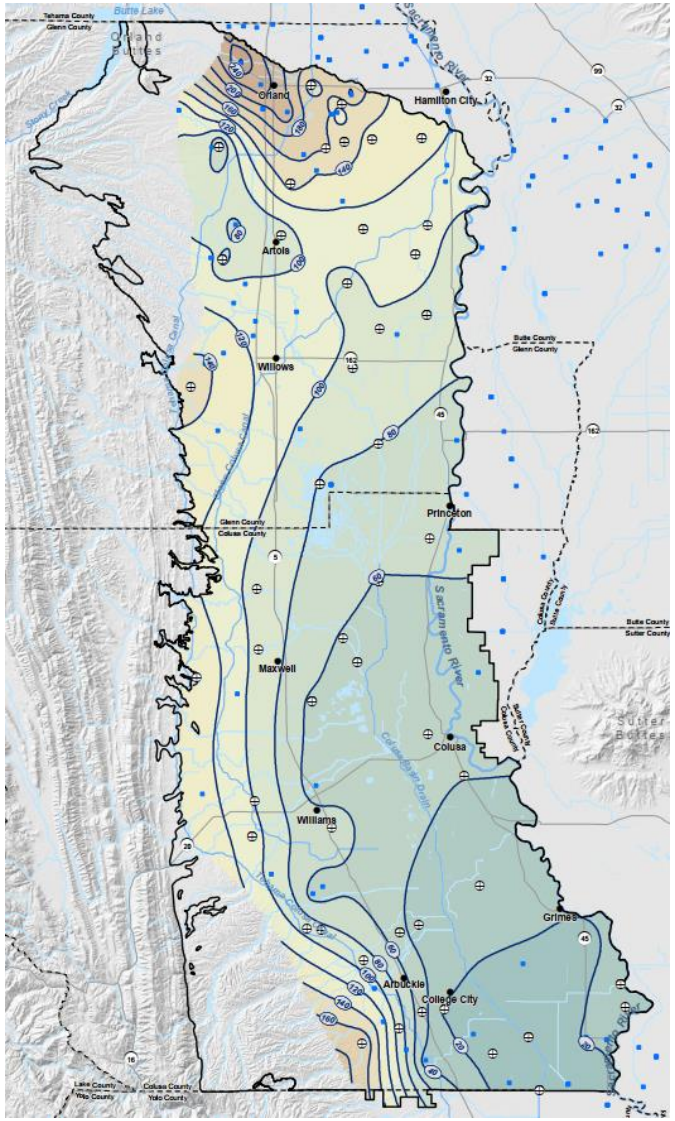
Groundwater Elevations

- Representative Groundwater Monitoring Network
  - 48 sites
  - Completion depths within multiple completion wells were selected based on median depth of domestic wells within the Thiessan polygon bounding each monitoring site.

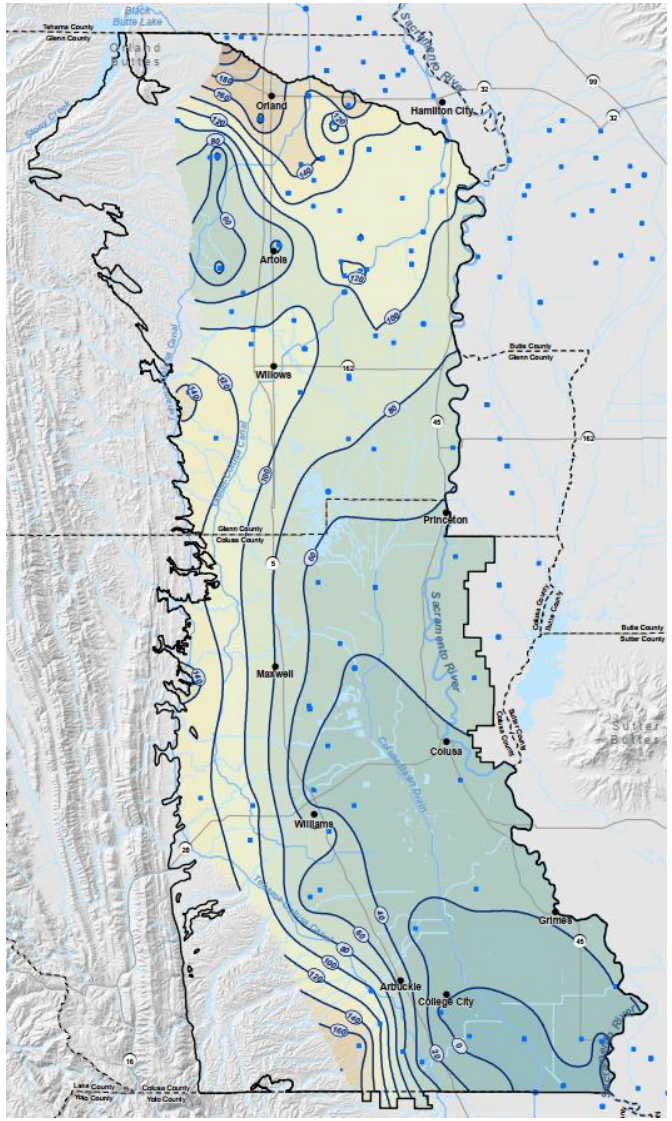


2020 Groundwater Elevation Contour Maps

Spring 2020



Fall 2020



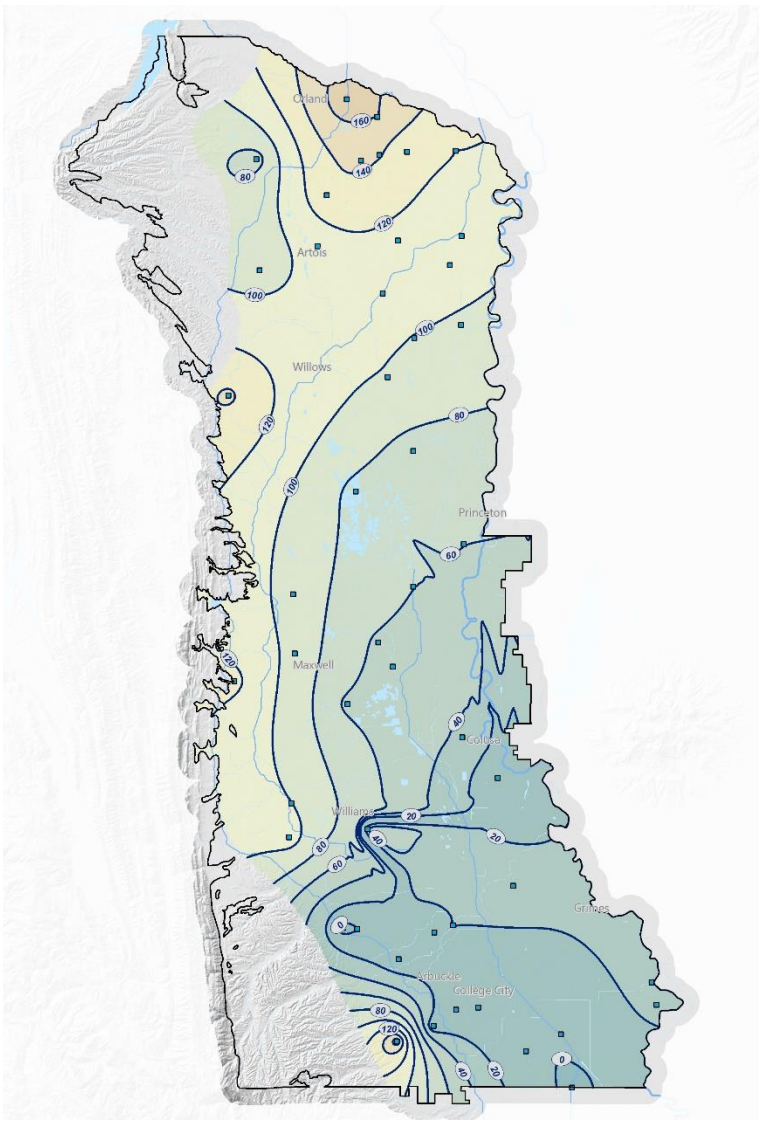
****DRAFT for Discussion****

Groundwater Elevation (ft)

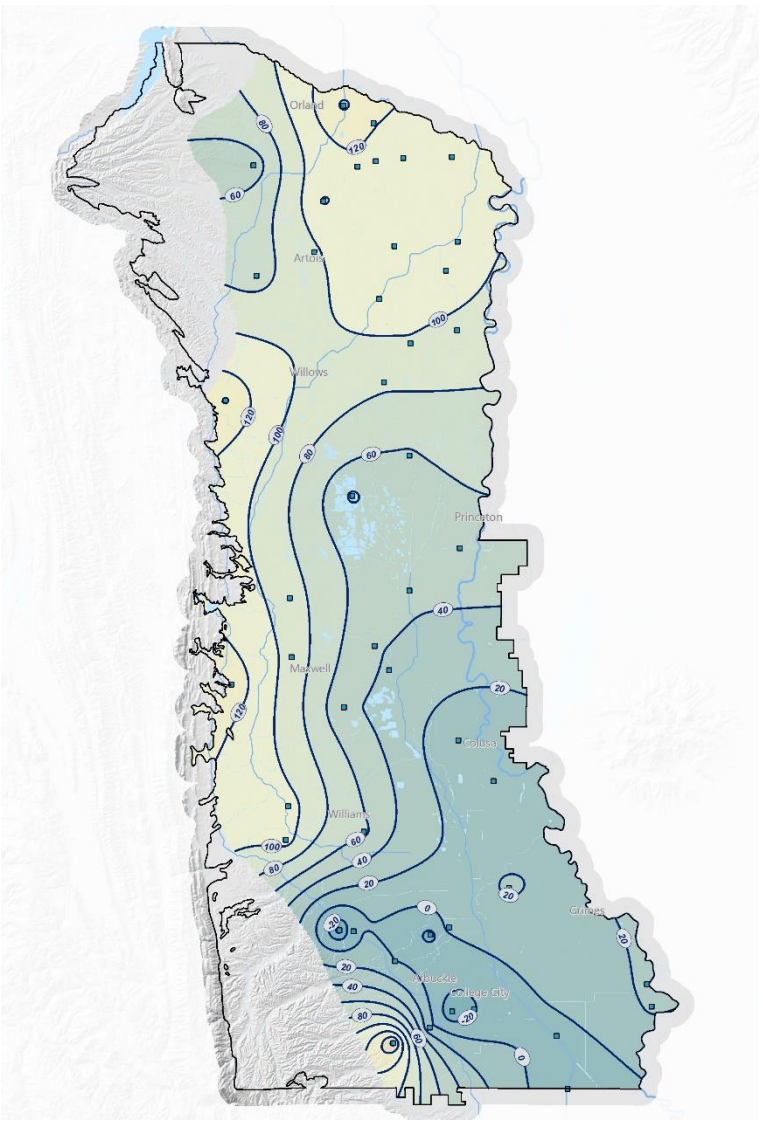
260 - 280	140 - 160	20 - 40
240 - 260	120 - 140	0 - 20
220 - 240	100 - 120	-20 - 0
200 - 220	80 - 100	-40 - -20
180 - 200	60 - 80	
160 - 180	40 - 60	

2021 Groundwater Elevation Contour Maps

Spring 2021



Fall 2021



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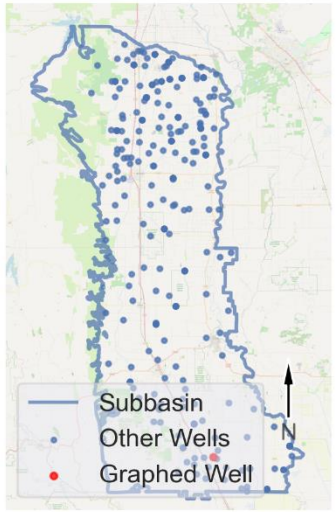
Groundwater Elevation (ft)

260 - 280	140 - 160	20 - 40
240 - 260	120 - 140	0 - 20
220 - 240	100 - 120	-20 - 0
200 - 220	80 - 100	-40 - -20
180 - 200	60 - 80	
160 - 180	40 - 60	

COLUSA Subbasin - State Well Number (SWN): 13N01W07G001M

Well Location Map

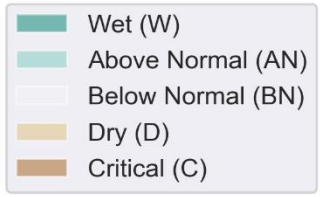


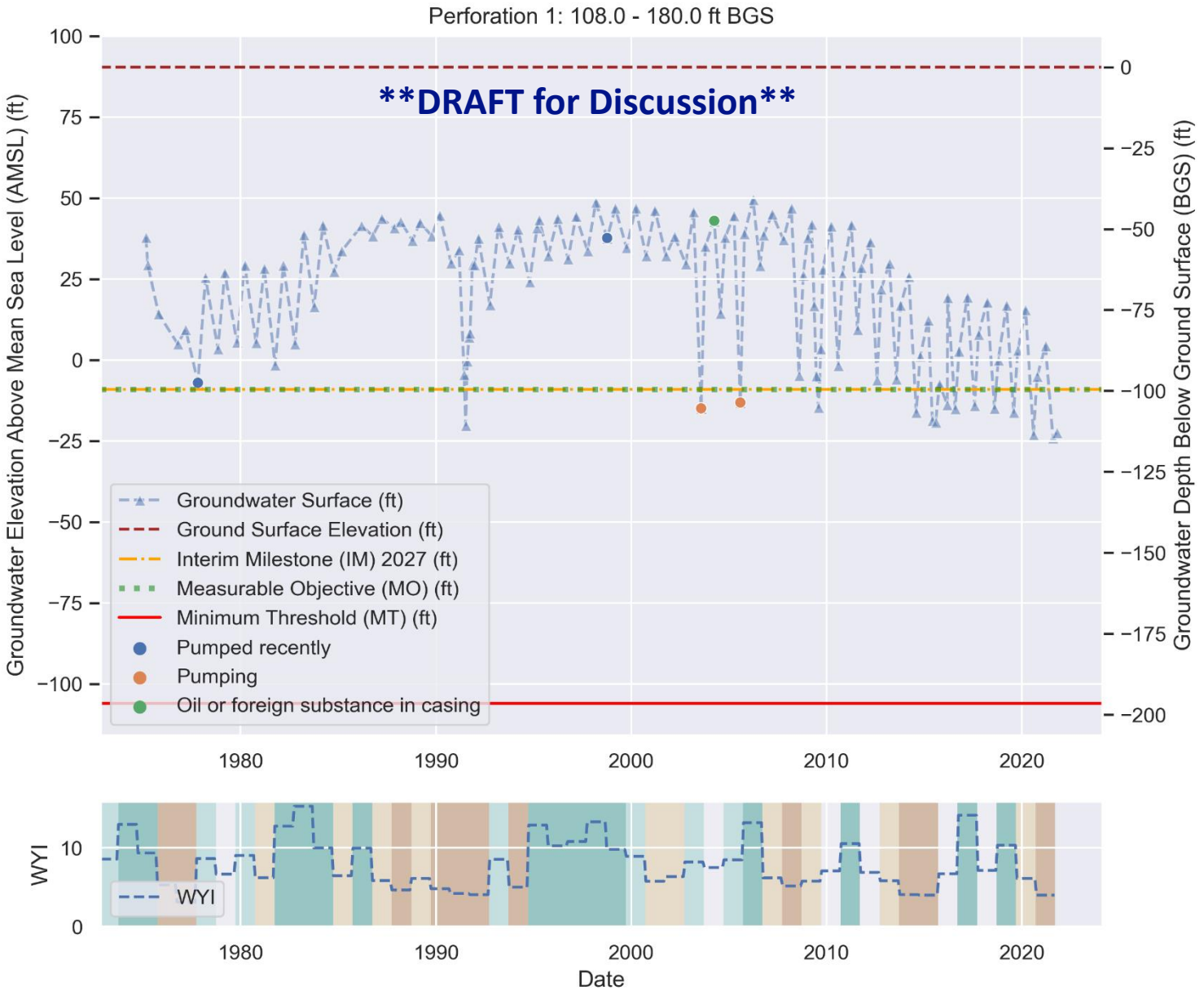
Sustainable Management Criteria:

IM (2027) = -9.0 ft AMSL
MO = -9.0 ft AMSL
MT = -106.0 ft AMSL

Minimum Threshold is 50% of Range Below Historical.

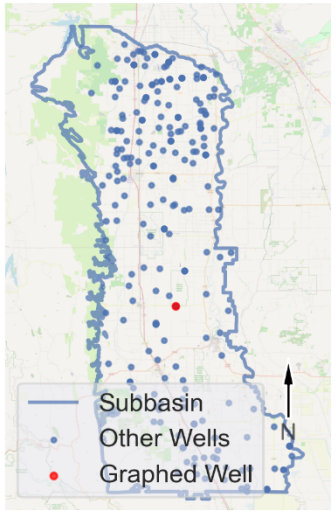
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.





COLUSA Subbasin - State Well Number (SWN): 16N02W05B003M

Well Location Map



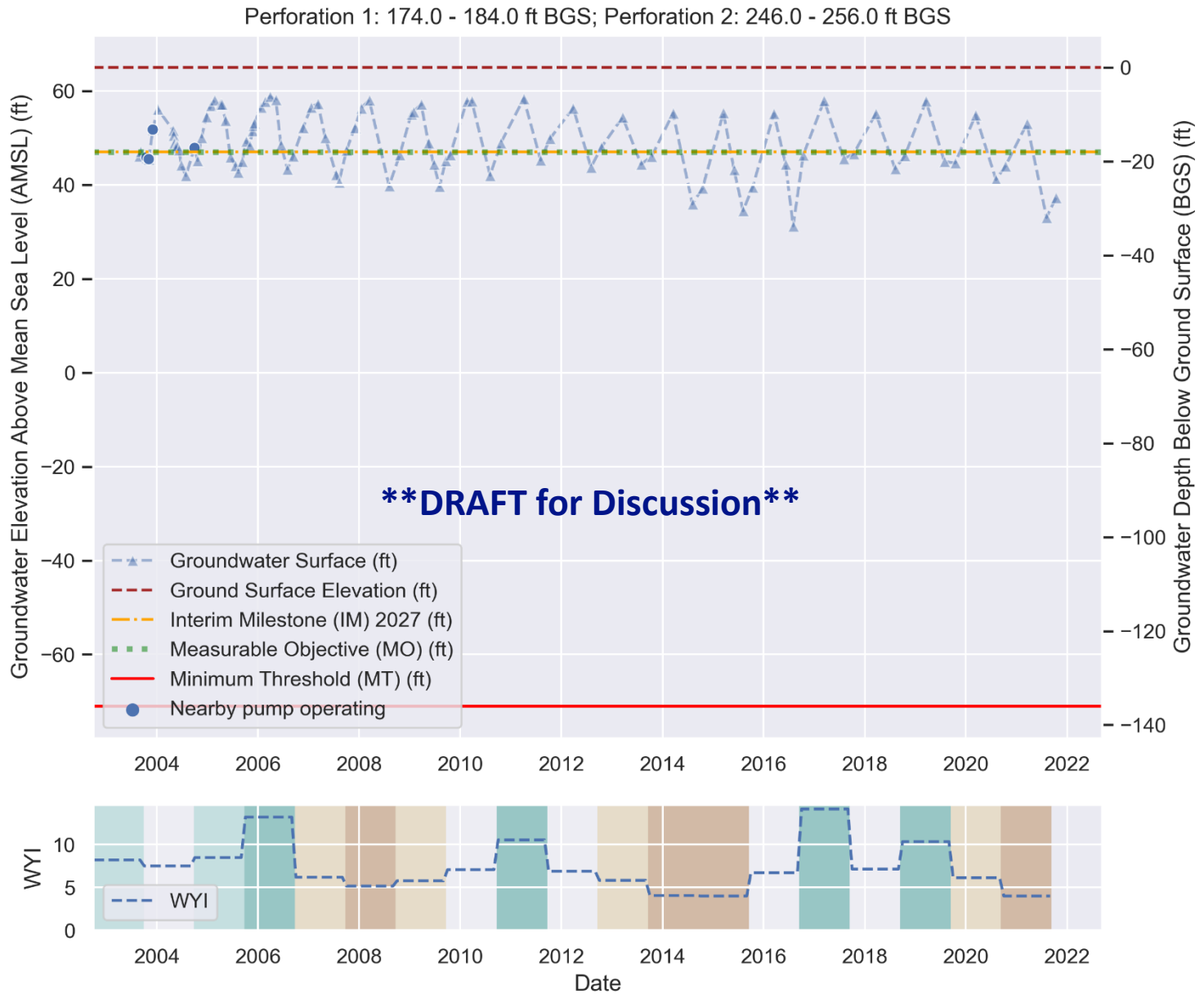
Sustainable Management Criteria:

IM (2027) = 47.0 ft AMSL
MO = 47.0 ft AMSL
MT = -71.0 ft AMSL

Minimum Threshold is the 20th Percentile of Domestic.

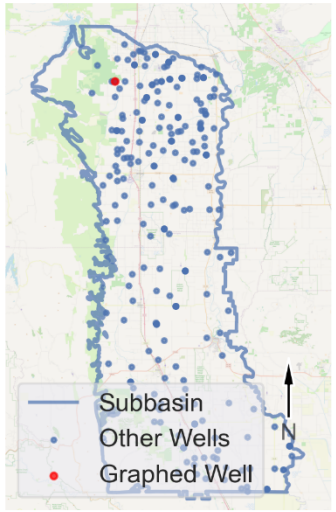
Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)



COLUSA Subbasin - State Well Number (SWN): 21N04W12A002M

Well Location Map



Sustainable Management Criteria:

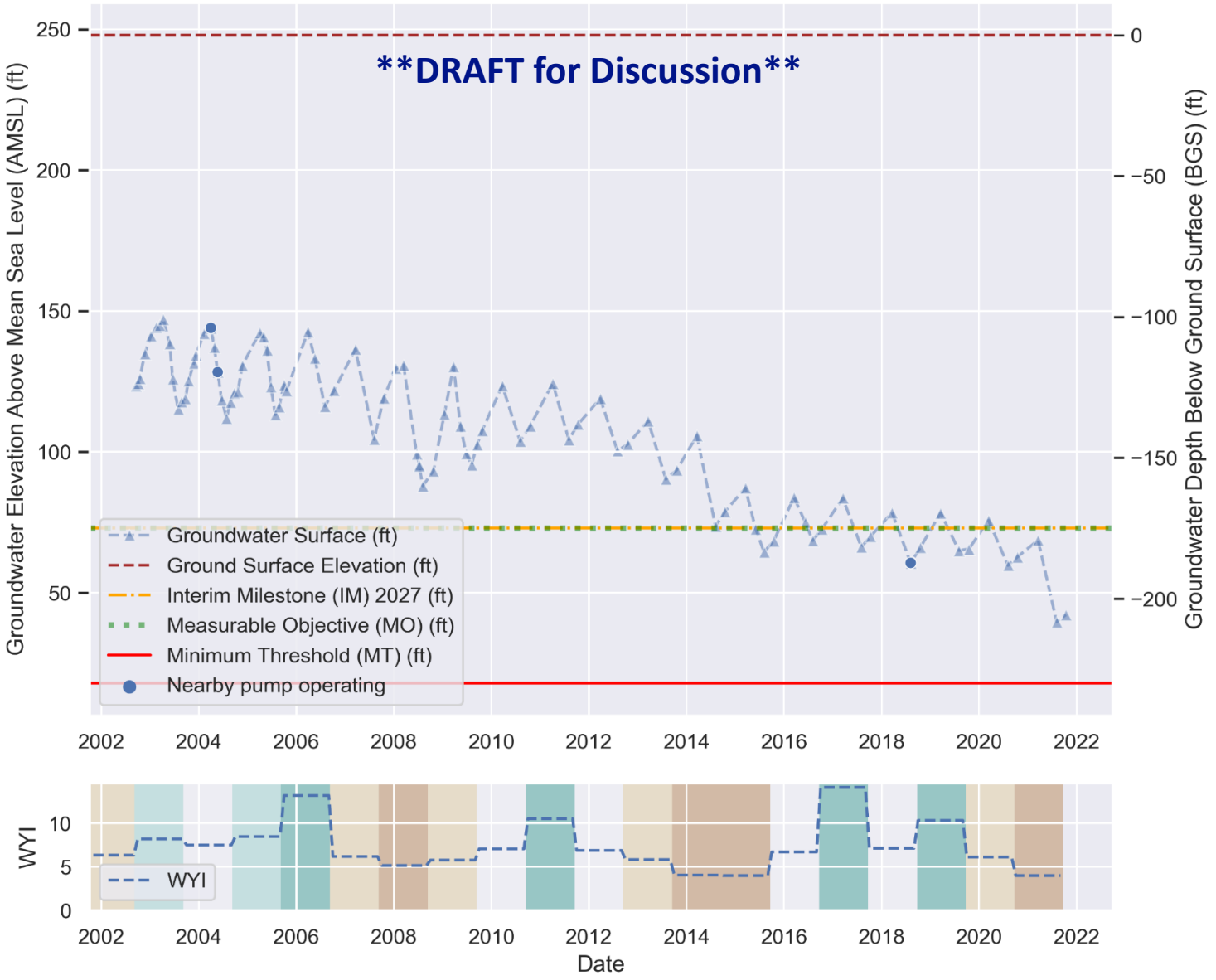
IM (2027) = 73.0 ft AMSL
MO = 73.0 ft AMSL
MT = 18.0 ft AMSL

Minimum Threshold is 50% of Range Below Historical.

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

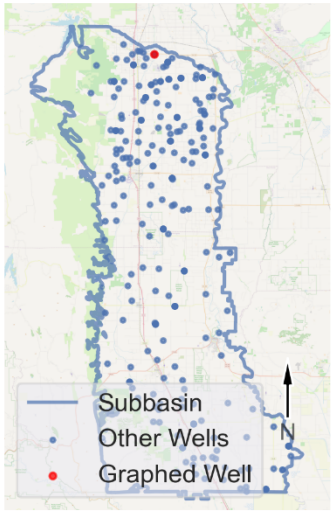
- Wet (W)
- Above Normal (AN)
- Below Normal (BN)
- Dry (D)
- Critical (C)

Perforation 1: 247.0 - 257.0 ft BGS



COLUSA Subbasin - State Well Number (SWN): 22N03W24E002M

Well Location Map

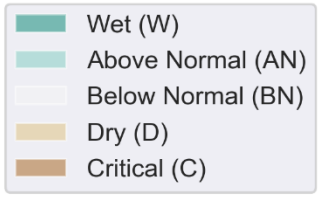


Sustainable Management Criteria:

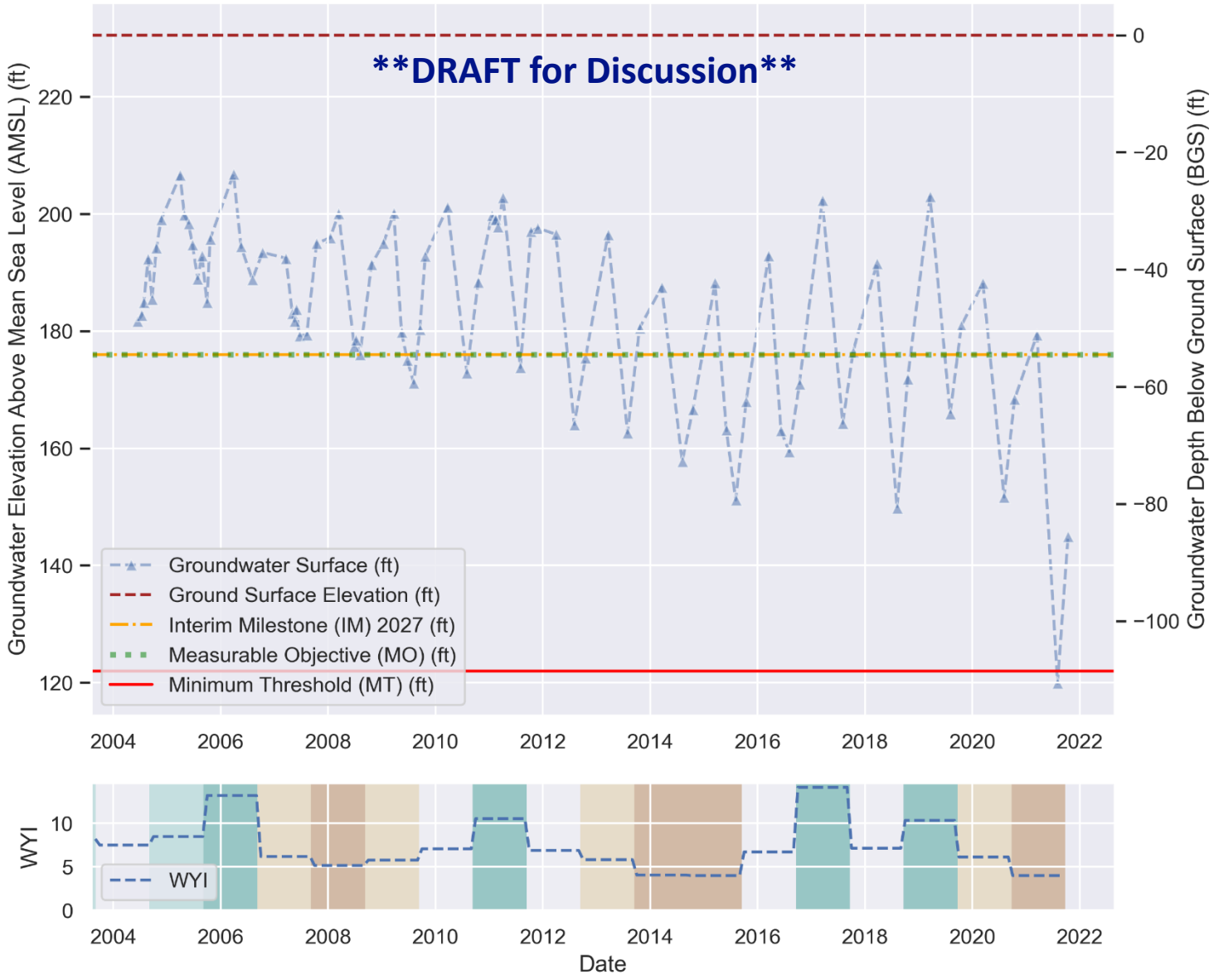
IM (2027) = 176.0 ft AMSL
MO = 176.0 ft AMSL
MT = 122.0 ft AMSL

Minimum Threshold is 50% of Range Below Historical.

Sacramento Valley Water Year Index (WYI) shown on lower right. Meaning of colors defined below.

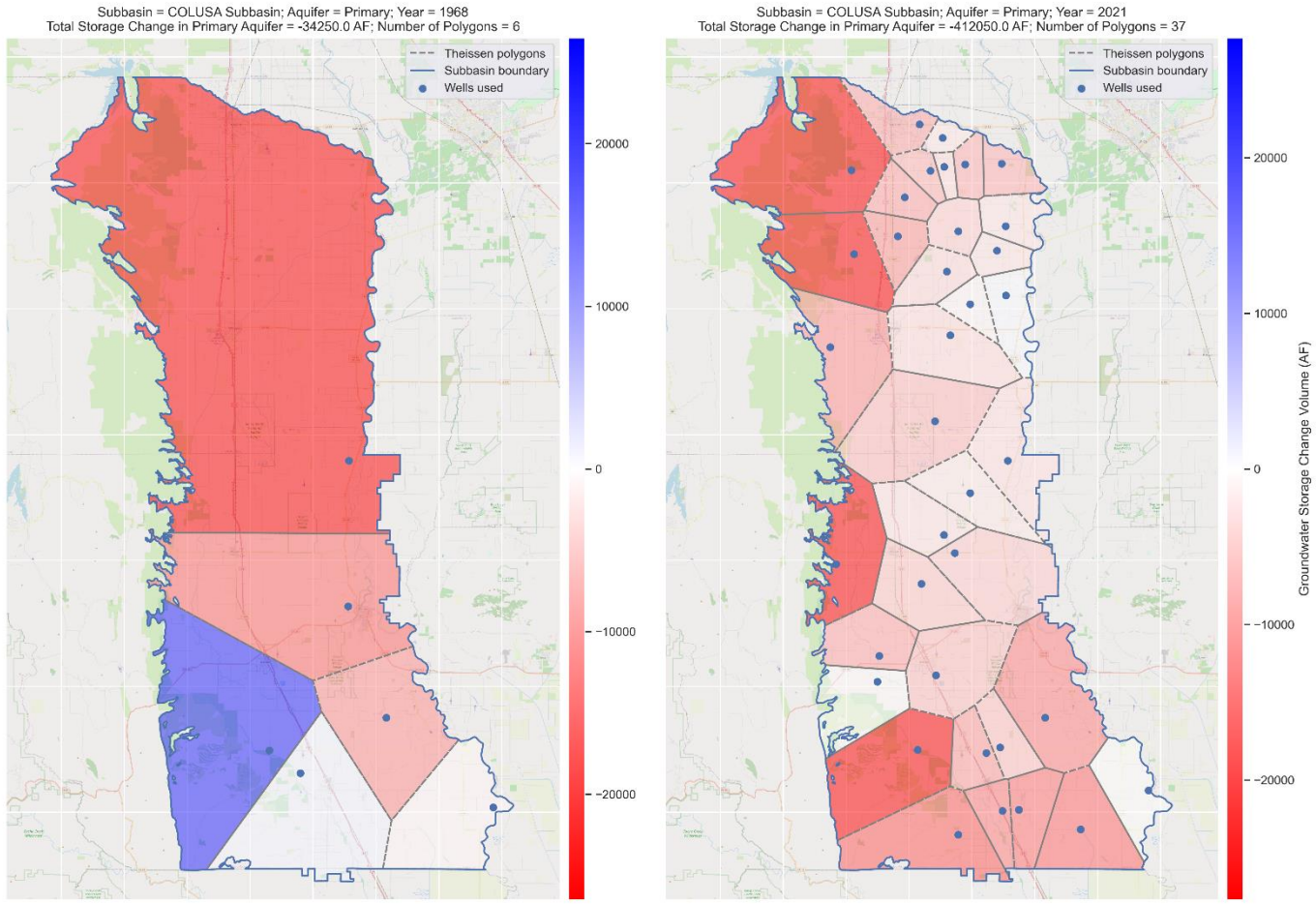


Perforation 1: 130.0 - 150.0 ft BGS; Perforation 2: 170.0 - 180.0 ft BGS



Change in Groundwater Storage Calculation

- Groundwater Elevation RMS as a Proxy
- Thiessan Polygon Method
  - Applied a spring-to-spring change in water level within each Groundwater Elevation RMS to a Thiessan polygon surrounding the RMS.
  - Annual change in storage calculated for 1968 to 2021 for each Thiessan polygon and summed for the Subbasin.
  - Cumulative change in storage calculated Subbasin-wide for 1968 through 2021.



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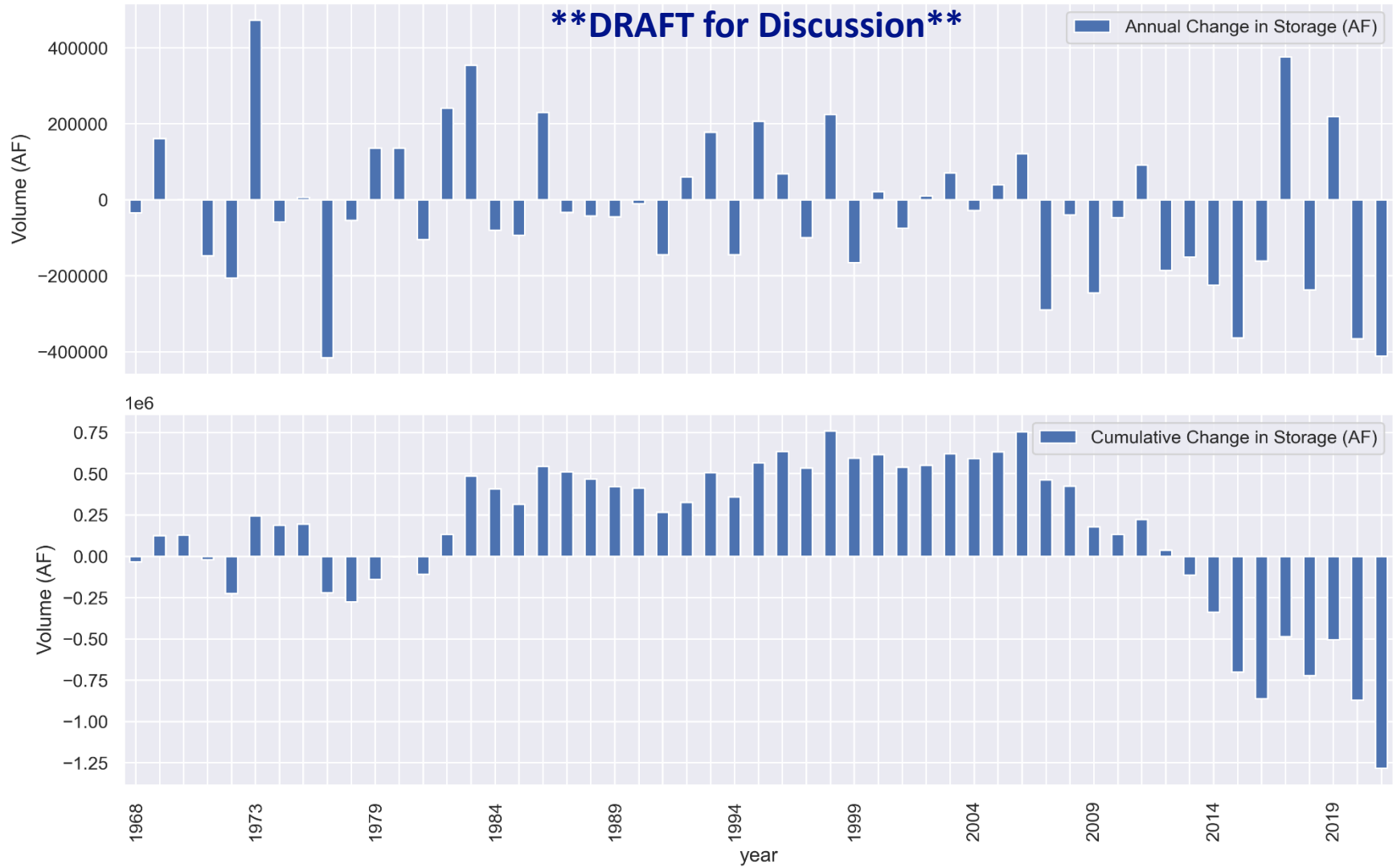
Annual and Cumulative Change in Groundwater Storage

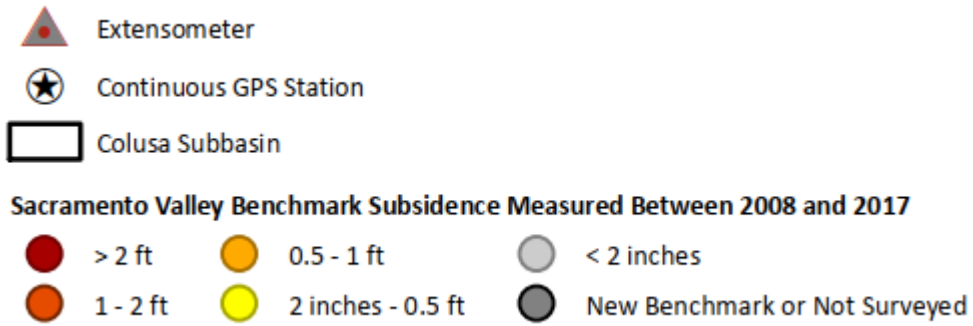


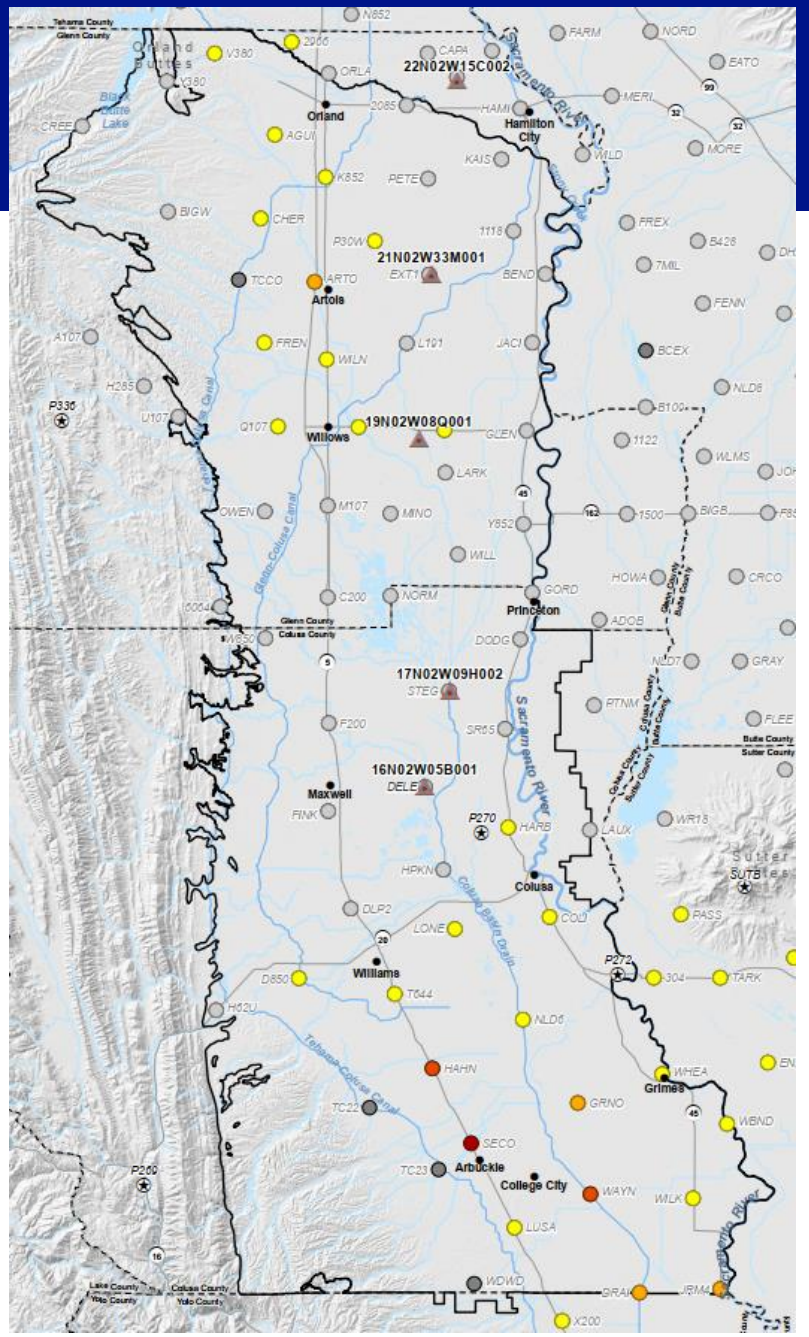
Annual

Cumulative

Measured Subsidence 2008 to 2017

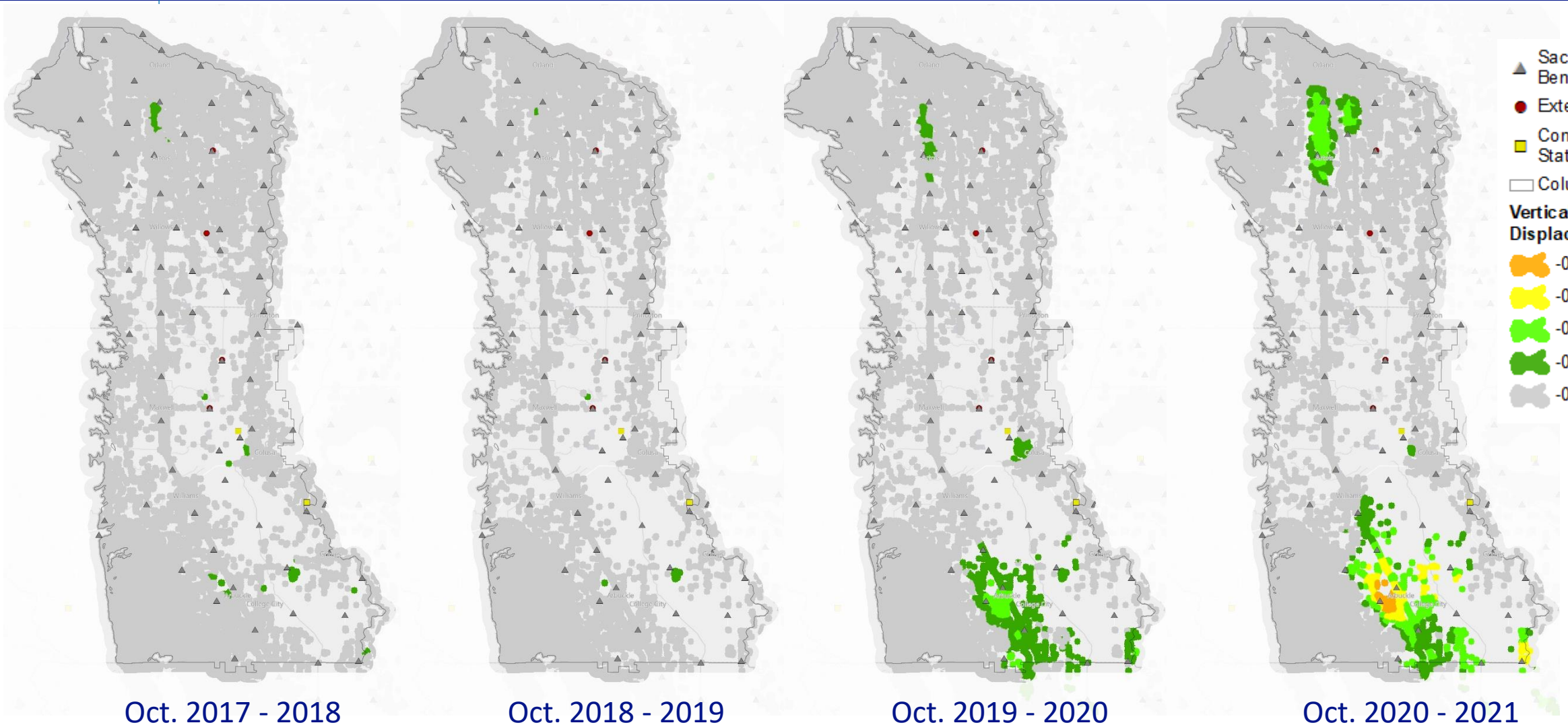
- Sacramento Valley Height Modernization Project
  - Initial Survey 2008
  - Re-Survey 2017
- Colusa Subbasin GSP, Figure 3-31





Annual Subsidence 2017 to 2021
(TRE-ALTAMIRA InSAR Land Survey)

****DRAFT for Discussion****



Oct. 2017 - 2018 | Oct. 2018 - 2019 | Oct. 2019 - 2020 | Oct. 2020 - 2021

Continuous GPS Station P270

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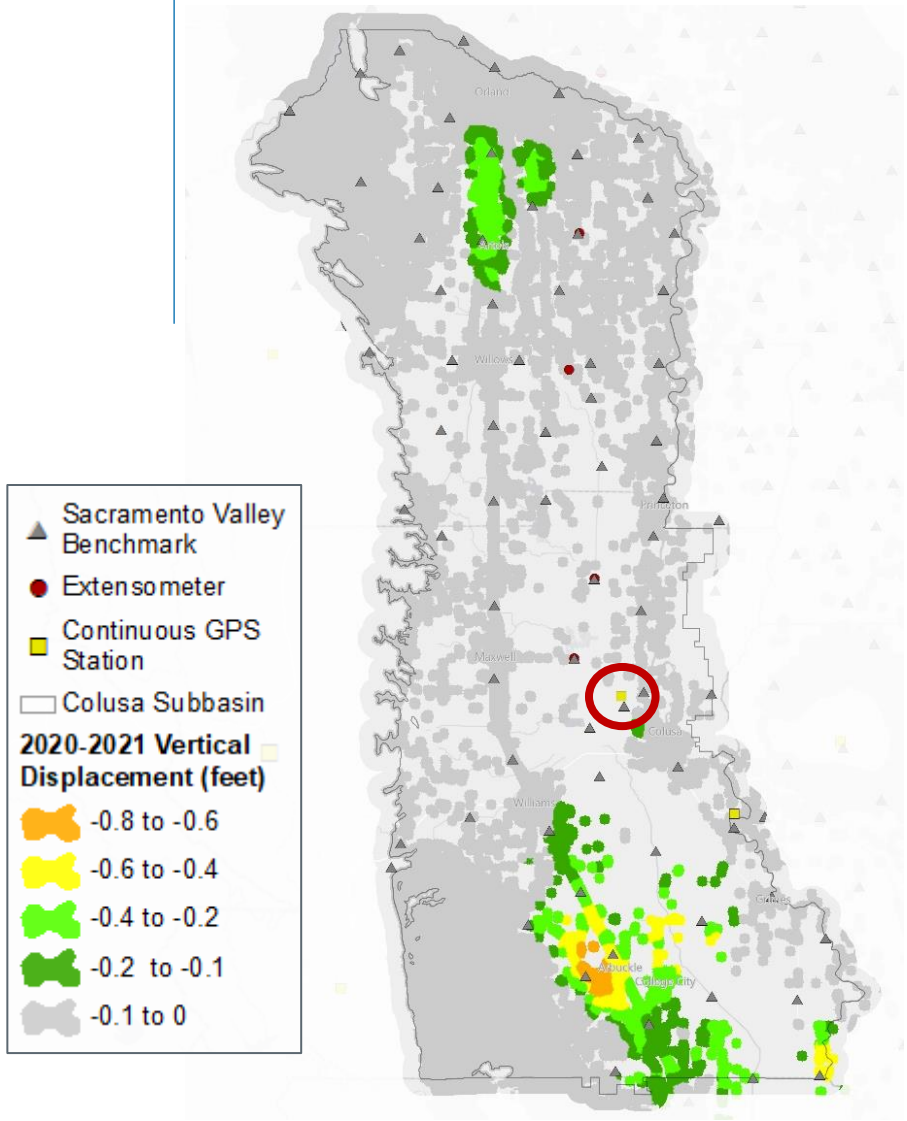

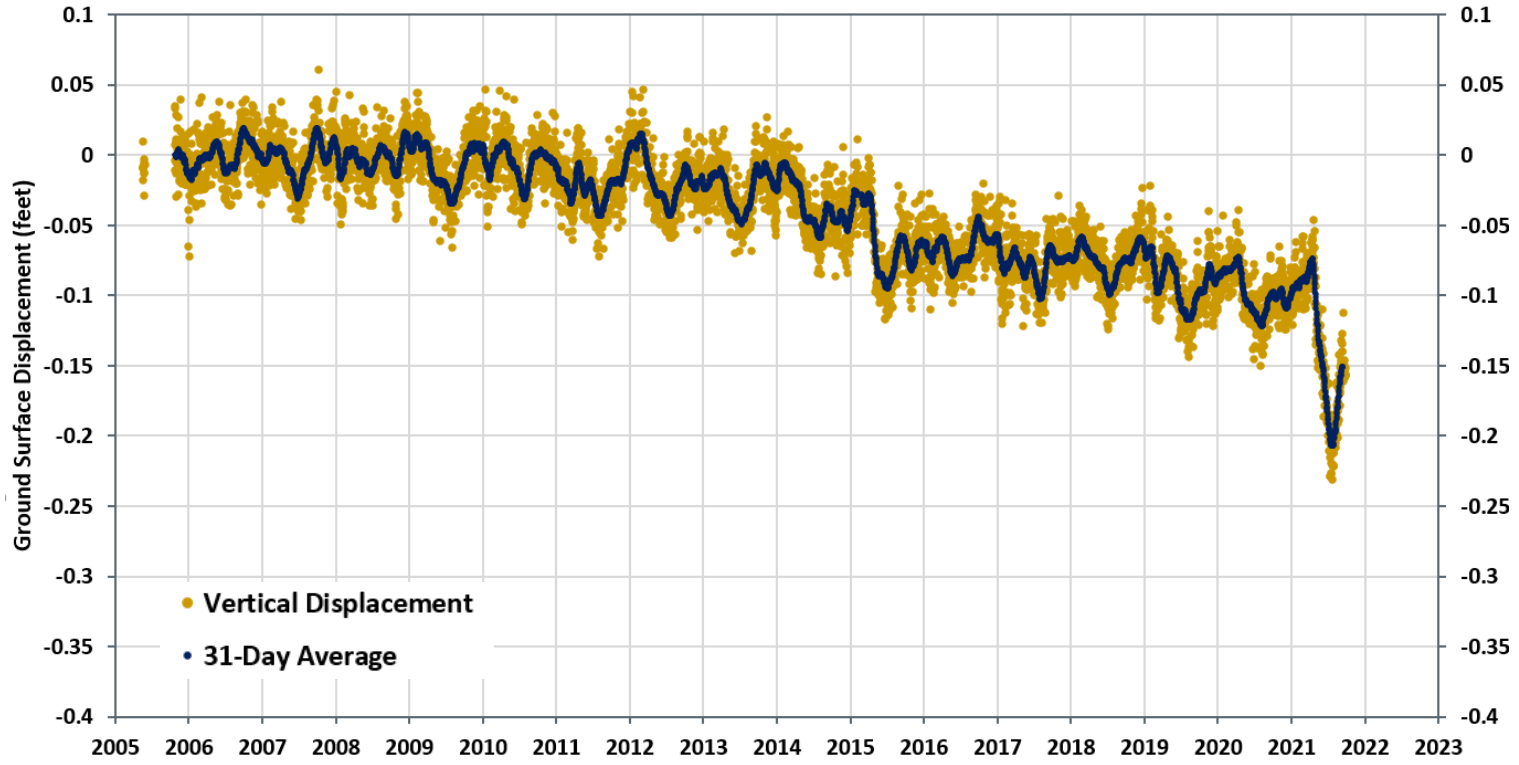

DWR Extensometer 21N02W3M001M

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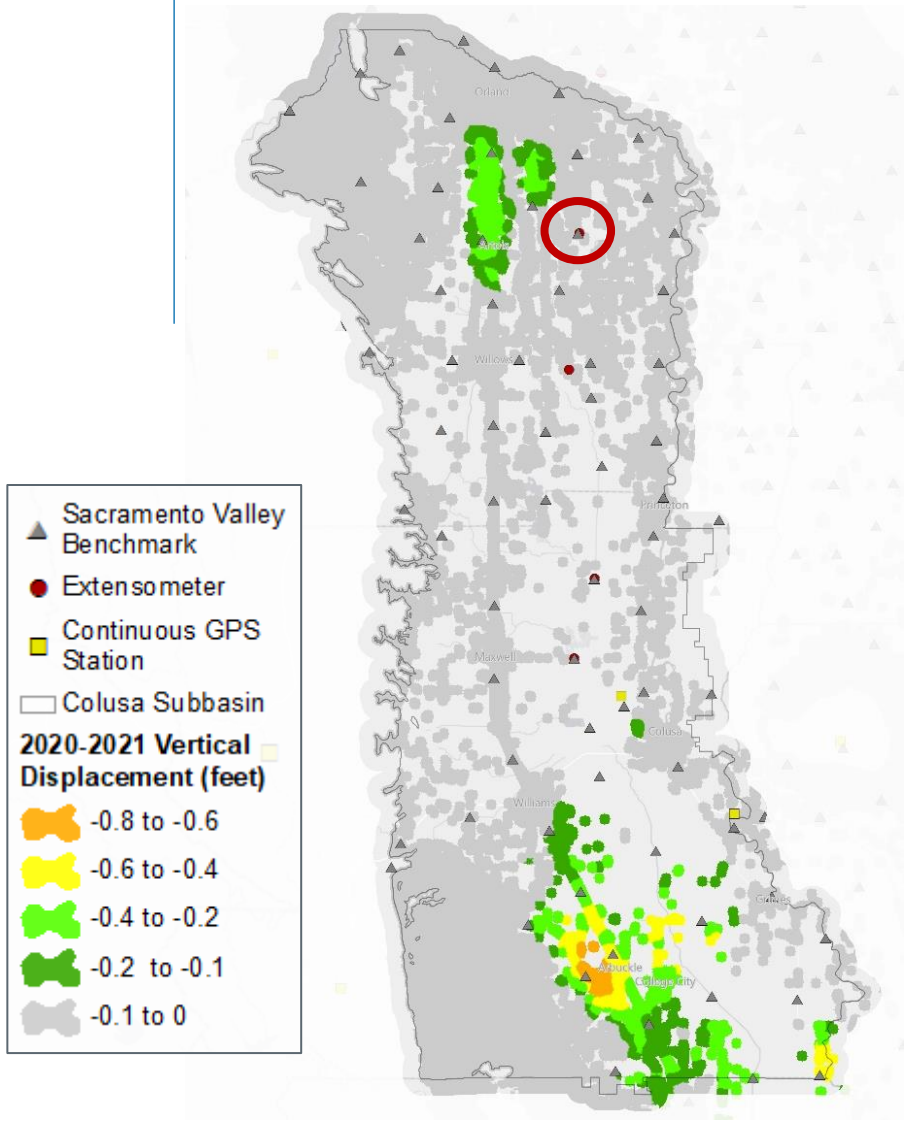
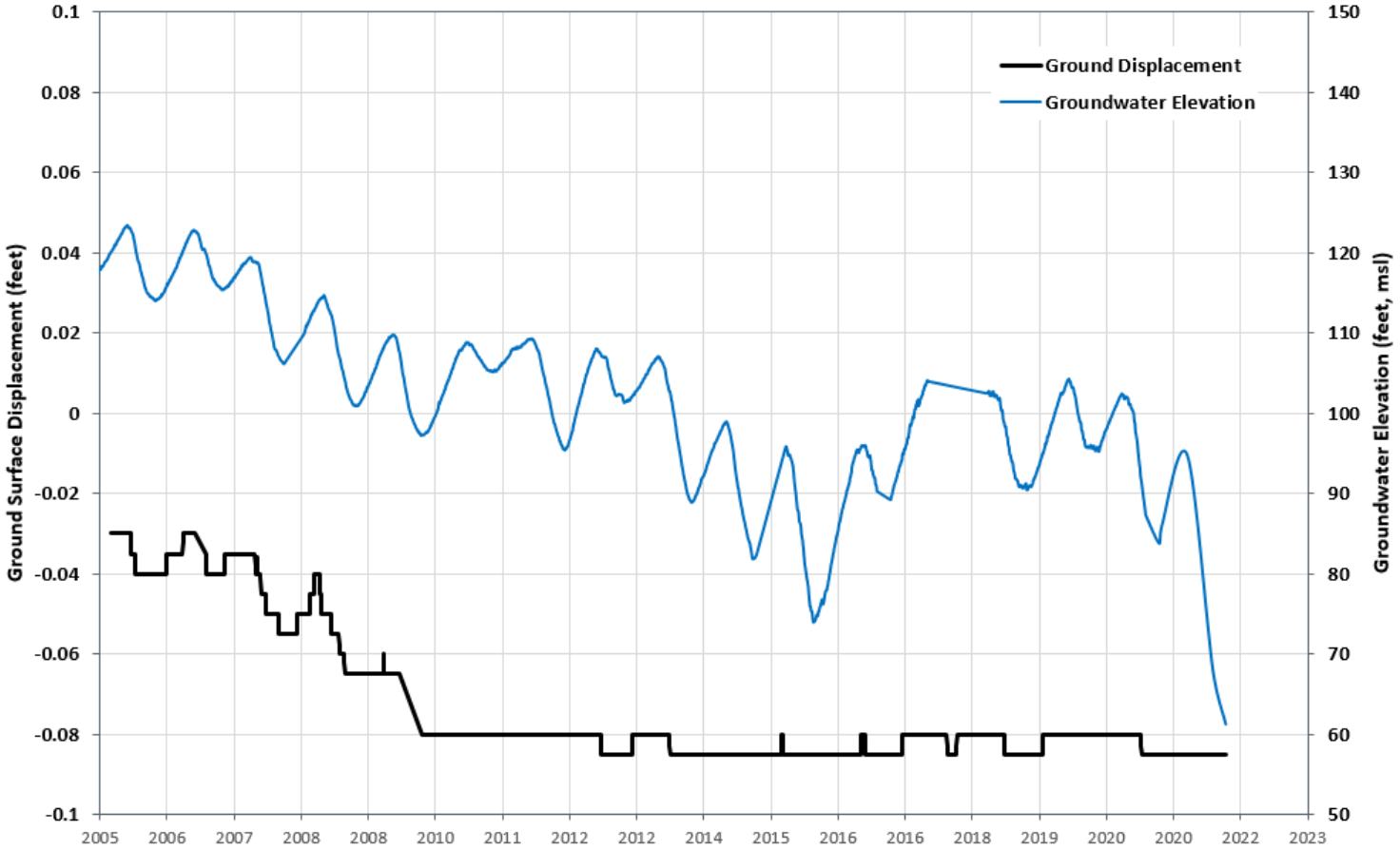


Screened Interval: 860-890 ft bgs



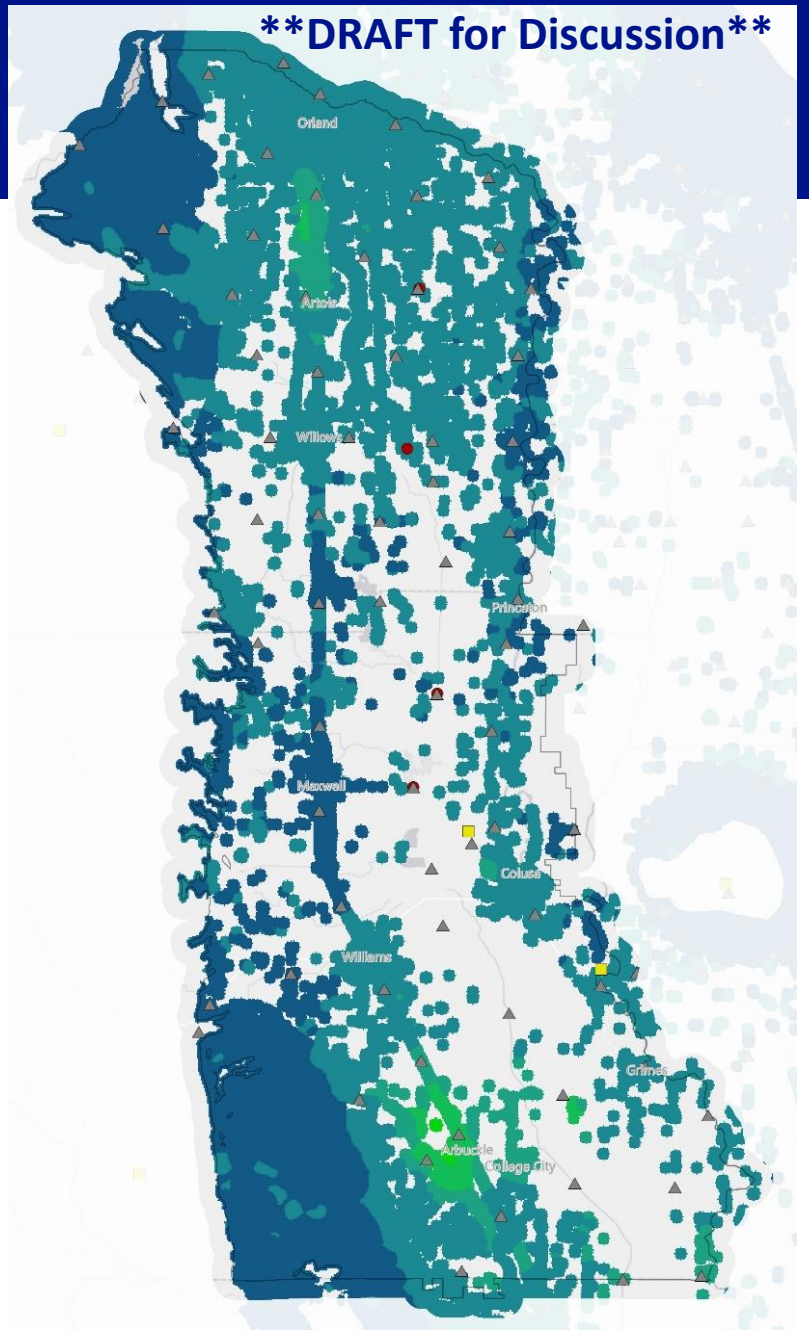
Net Land Subsidence 2015 to 2021

DRAFT for Discussion

TRE-ALTAMIRA InSAR Land Survey

Net vertical displacement Oct. 2015 to Oct. 2021

Color Code	Vertical Displacement (feet)	Annual Average (feet/year)
	-2 to -1.5	-0.33 to -0.25
	-1.5 to -1	-0.25 to -0.17
	-1 to -0.5	-0.17 to -0.08
	-0.5 to 0	-0.08 to 0
	0 to 0.5	0 to +0.08



Water Supplies and Water Use

Katie Klug, PhD
Davids Engineering

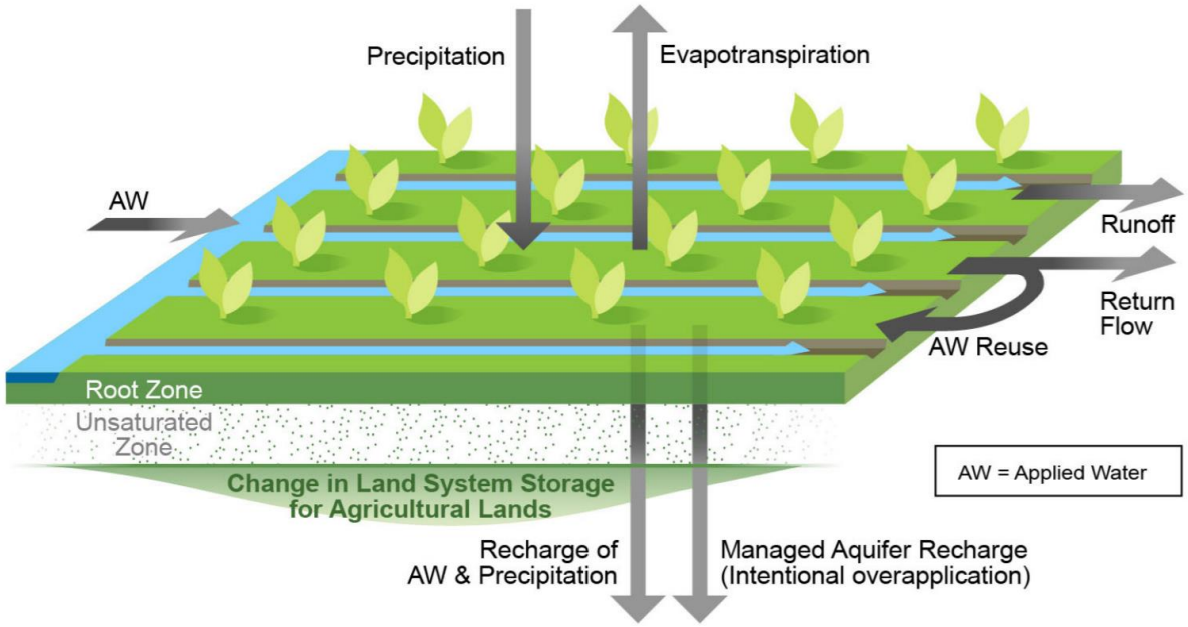
Water Supplies and Water Use

- **Groundwater Extraction**: Groundwater pumped or otherwise extracted
  - By water use sector (e.g., agricultural, urban, native vegetation, etc.)
  - By method (direct measurements, estimates, etc.)
- **Surface Water Supplies**: Surface water diverted and delivered to land for use
  - By water source type (e.g., CVP, local supplies, recycled, etc.)
- **Total Water Use**: Sum of groundwater use and surface water use

Approach for Quantifying Water Use

- Use measured data (where available)
- Estimate the remaining use through a water balance approach
- *Compare values back to GSP water budgets to ensure consistency*

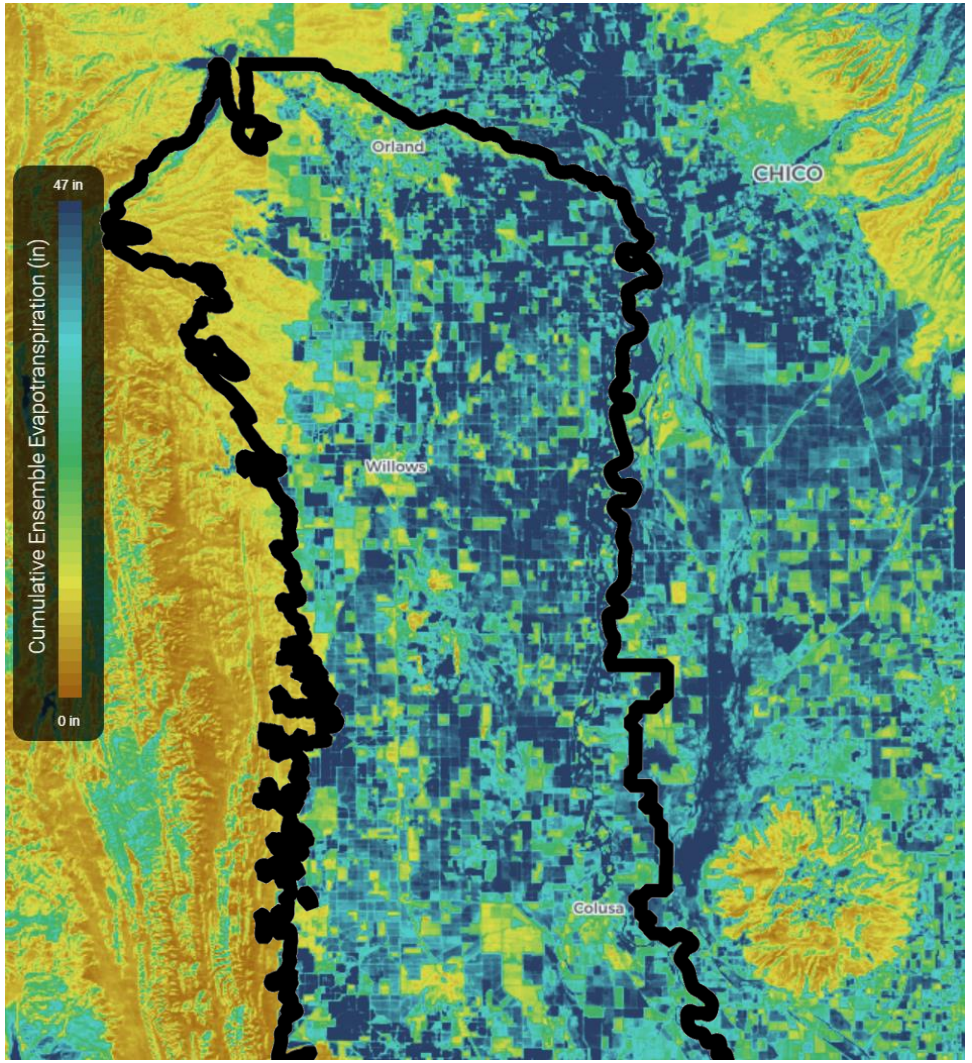
Figure 3-4 Components of Agricultural Water Use



Source: DWR. 2020. Draft Handbook for Water Budget Development With or Without Models. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Water-Budget-Handbook.pdf

Consumptive Water Use (Evapotranspiration)

- Evapotranspiration (ET) is a major driver of water use in the Colusa Subbasin
  - Water that is evaporated or consumed by plants, humans
  - Cannot be recovered or reused directly in the subbasin (unlike deep percolation, infiltration/seepage, runoff, etc.)
- Total ET quantified from OpenET data
  - Satellite-based estimates of total ET
  - Models widely-used in government and research in the U.S. and internationally
  - Source data: Landsat images
  - Spatial resolution: 30x30 m^2 (0.22 acres)
- Total ET parsed into portions derived from applied water/irrigation (ET_{aw}) and precipitation (ET_{pr}) based on precipitation, crop, and soil data



Source: https://openetdata.org/

Correspondence between OpenET Data and GSP Model Results

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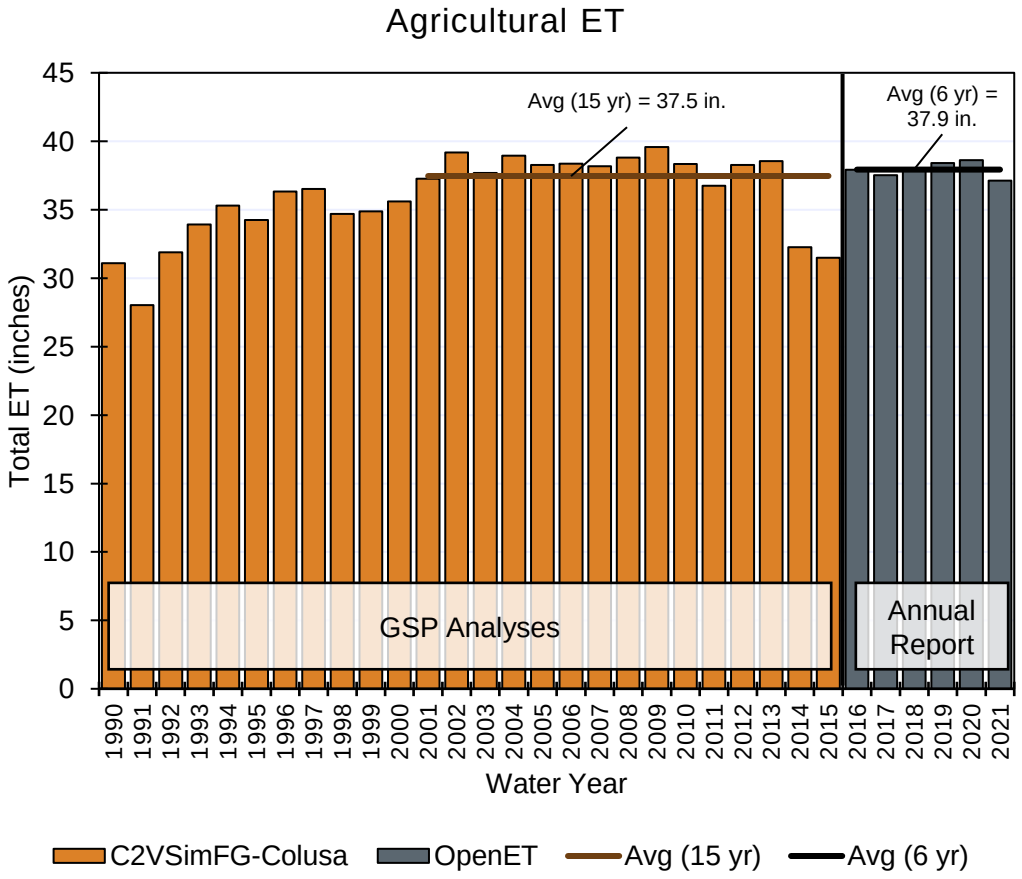
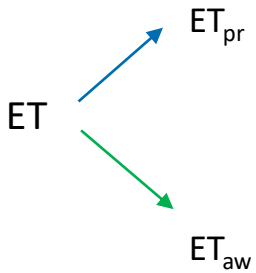
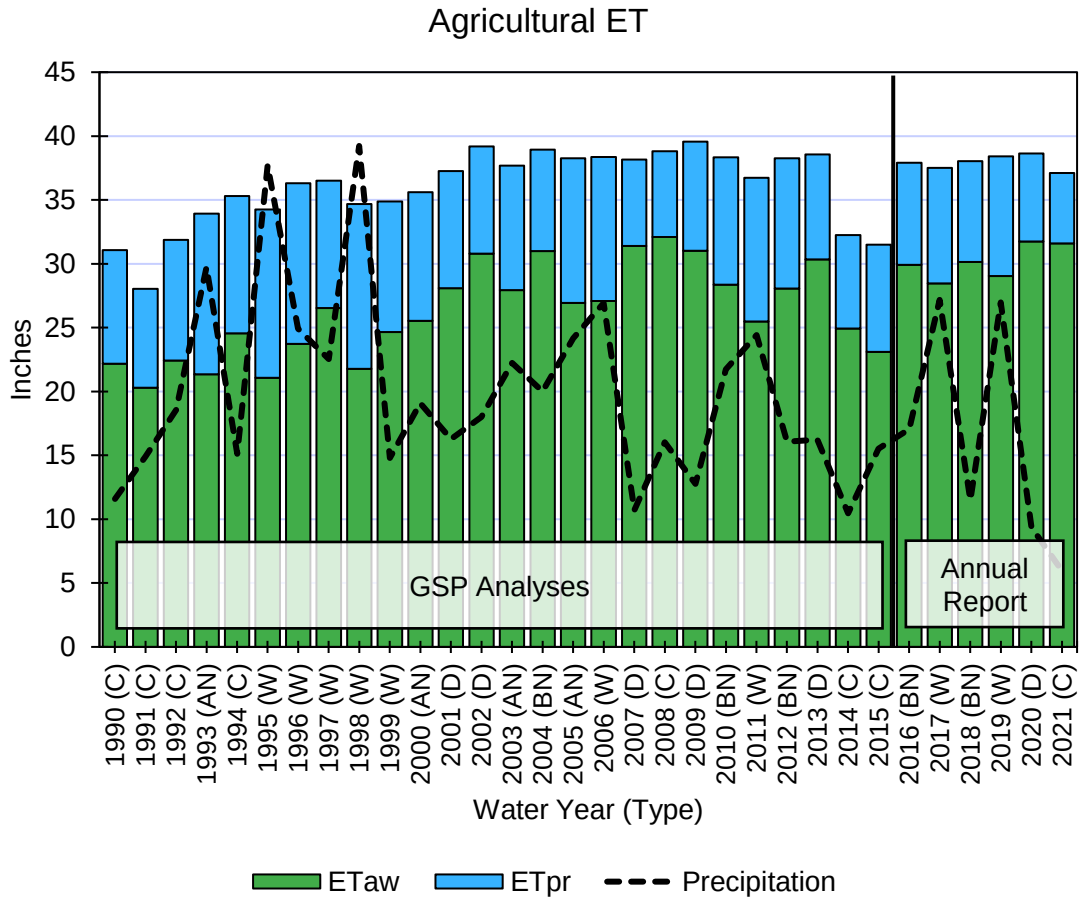




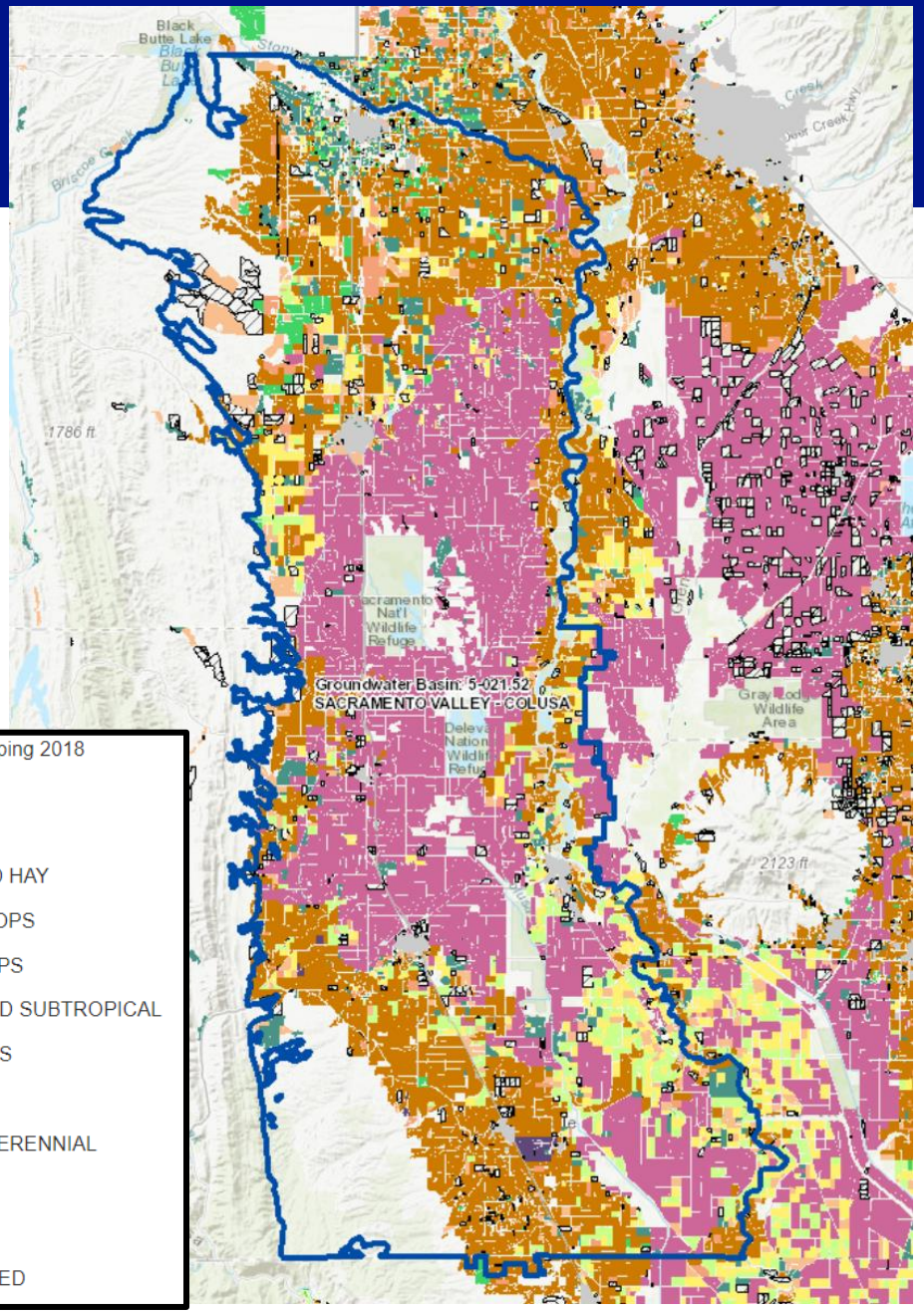


Water Use Sectors (reported in the GSP)

- Agricultural
- Urban
- Native Vegetation
- Managed Wetlands

Areas in each water use sector:

- Agricultural and urban areas identified from Land IQ 2018 data
  - Spatial crop mapping for the state of California
  - Similar data sources used in GSP (e.g., Land IQ 2014)
- Managed wetlands and native vegetation areas identified from the remaining subbasin area based on wildlife refuge boundaries and GSP analyses



Data Sources for Water Supplies

- Surface Water Supplies
  - CVP Contractor delivery records (USBR)
  - Farm Gate Deliveries data (DWR)
  - Water rights diversions (eWRIMS)
  - Other District records (where available)

- Groundwater Extraction
  - City pumping data
  - Other District records (where available)
  - Remaining use estimated based on demand, after accounting for other supplies

Surface Water Supplies Available Each Water Year

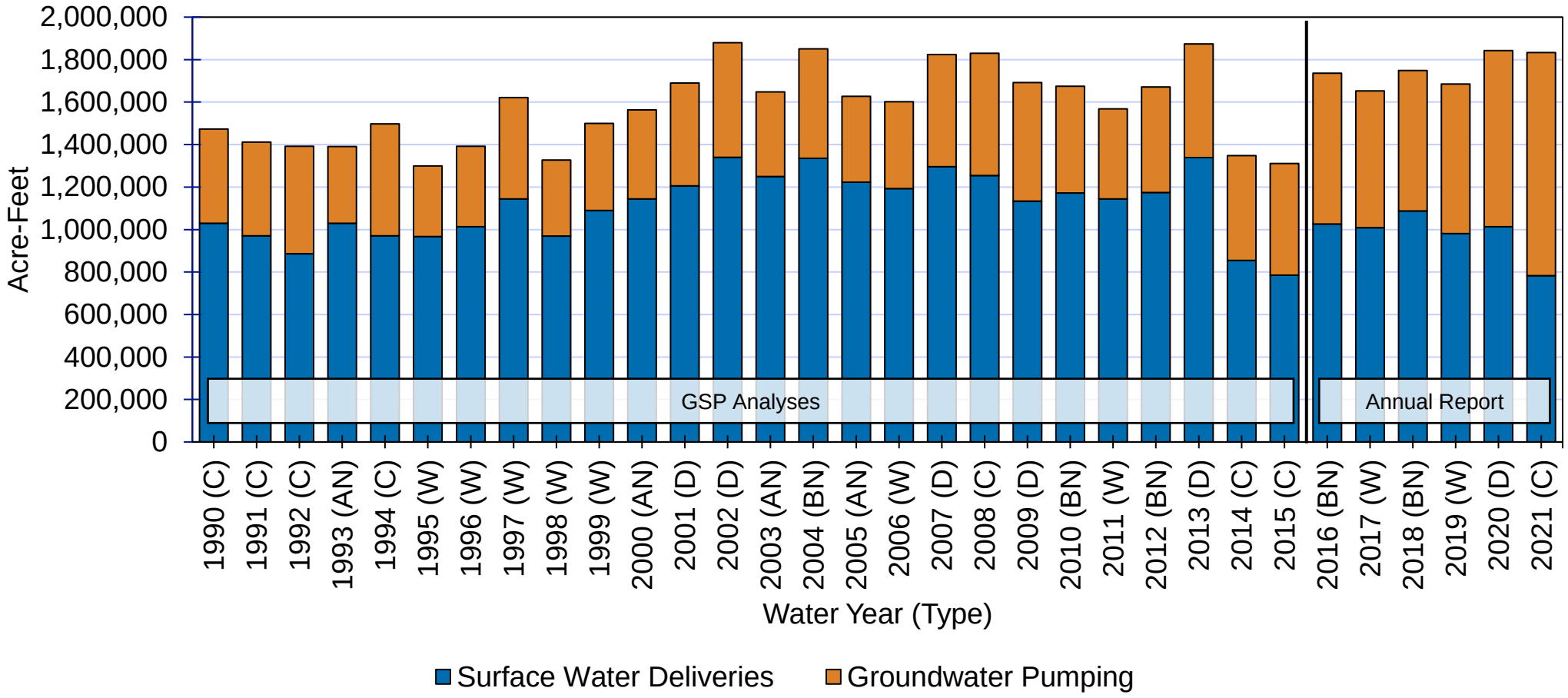
Average in 2016-2021 *(Volume in 2021)*

DRAFT for Discussion*

- CVP Contract Supplies:
  - Tehama-Colusa Canal: 181 TAF (139 TAF)
  - Sacramento River: 929 TAF (778 TAF)
- Other Supplies:
  - Orland Project (South Canal): 44 TAF (28 TAF)
  - Colusa Basin Drain: some diversions of natural flows when available (most water is passed through from other originating sources)

Total Water Use for Agriculture

DRAFT for Discussion



Water Use for Other Purposes

DRAFT for Discussion*

- **Urban and Rural Residential Groundwater Production: 10.2 TAF in 2021**
  - Measured (Williams, Orland, Willows): 4 TAF in 2021
  - Estimated (Colusa, Arbuckle, Unincorporated): 6.2 TAF in 2021
- **Managed Wetlands**:
  - Primarily Sacramento NWR, Delevan NWR, and Colusa NWR
  - Unconstrained conditions: CVPIA Full Level 4 water supplies
    - Sacramento NWR: 50,000 acre-feet,
    - Delevan NWR: 30,000 acre-feet, and
    - Colusa NWR: 25,000 acre-feet.
  - **Constrained conditions in 2021, refuges allocated 75% of this quantity**
- **Native Vegetation:** Driven by ET, most is met by precipitation

GSP Implementation

Katie Klug, PhD
Davids Engineering

Projects and Management Actions (PMAs)

- PMAs describe what needs to be done to achieve sustainable management of the Colusa Subbasin by 2042 and maintain sustainability thereafter
- Thirty-four (34) PMAs described in the GSP:
  - Five (5) Planned PMAs: identified project proponents, "on track for implementation"
  - Six (6) Ongoing PMAs: existing PMAs that could be continued and/or expanded
  - Twenty-three (23) Potential PMAs: various stages of piloting and conceptual development
- Uncertain future calls for an adaptive management approach
  - Current *actual* drought is more compelling than *modeled* future sustainability challenges
  - PMAs cast in GSP as being more aligned with near-term drought mitigation, recognizing that they will contribute to long-term sustainable groundwater management

Progress on PMAs Since GSP Development

- Colusa Subbasin Multi-Benefit Groundwater Recharge
  - Recharge conducted in 2021, only one participating field (66 acres) due to surface water restrictions
  - Applied surface water was 290 AF, recharge benefit was 220 AF
- Sycamore Slough Groundwater Recharge Pilot Project
  - First season of flooding complete (flooded field for recharge in Jan-Feb 2022), analysis in progress
  - Purchased some monitoring equipment, some repurposed from multi-benefit groundwater recharge project
- Orland-Artois Water District Land Annexation and Groundwater Recharge
  - Continued planning efforts and discussions with OAWD, TCCA, Glenn LAFCO, USBR
  - Initiated processes with OAWD and USBR to review annexation of 12,000 acres of ag land (anticipated 2023)
  - Refined benefits (targeting 15 TAF of deliveries (Shasta Non-Critical years), pumping reduction of 14 TAF)
  - Refined costs (estimated $12 million capital costs)
- Tehama-Colusa Canal Trickle Flow to Ephemeral Streams (RD 108)
  - Further concept development (identified potential streams, water sources, operating strategies)
  - Identifying discharge locations with CCWD and TCCA, coordinating monitoring/funding with landowners
  - Proof-of-concept test of trickle flow when portion of canal dewatered

Ongoing PMAs (No significant changes reported)

- RD 108 and Colusa County Water District Agreement for Five-Year In-Lieu Groundwater Recharge Project (pending extension)
- Glenn-Colusa Irrigation District Strategic Winter Water Use for Groundwater Recharge and Multiple Benefits
- Glenn-Colusa Irrigation District Expansion of In-Basin Program for In-lieu Groundwater Recharge
- Orland Unit Water Users Association Irrigation Modernization for Increased Surface Water Delivery and Reduced Groundwater Pumping
- Urban Water Conservation in Willows

Other Activities Since GSP Development

- Well Monitoring Pilot Program
  - Planning program expansion to add 16 new sites in spring 2022
  - Setting up weekly/monthly reports of groundwater levels and groundwater pumping
  - Plan for program operation through December 2024
- Hydrogeologic Investigation
  - Planning efforts to fill data gaps
  - Sample topics:
    - Shallow groundwater monitoring (GDEs, interconnected surface water)
    - Subsidence benchmarks (subsidence monitoring)
- Expansion of subsidence monitoring network (10 additional benchmarks)

Summary and Next Steps

- Recent completion of the GSP is a significant achievement, but it's also a starting point for GSP implementation (2022-2042)
- First Annual Report is due to DWR on April 1, 2022
  - Other annual reports due April 1 of each year through 2042
- Complete draft Annual Report will be available for review next week
- Comments and questions can be directed to:

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Questions and Answers

Closing Remarks