



YSGA Working Group Meeting

April 19, 2021



Agenda

- Approve Minutes
- Executive Officer Update
- GSP Development:
 - Land Subsidence – Finalize MT methodology
 - Depletions of Interconnected Surface Water
 - Identification of ISWs
 - Undesirable Results
 - Available Data
 - Monitoring Network
 - Minimum Thresholds
- Draft Chapters of the GSP, Report of Data Sharing Efforts, Scheduling Focused Workshops
 - Report of North Yolo MA Workshop on Land Subsidence
 - Report of Data Coordination Meeting with City of Winters
 - Projects and Management Actions Workshops (via Working Group Meeting)
 - Scheduling Focused Workshops

Approve Minutes

Executive Officer Update

Well Monitoring

Depth to Water Historical Comparison

(Daily Average DTW in feet)

[SCADA Links](#)[Well Map](#)[Select Date](#)

04/18/21

[Comparison Trends](#)[Comparison Table 2](#)

Well	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	<u>Δ 2020</u> <u>- 2021</u>	<u>Δ 2015</u> <u>- 2021</u>
1.	79.8	75.9	76.9	82.0	92.5	103.0	100.5	86.1	87.0	85.9	87.7	103.6	-15.8	-6
2.	29.4	26.3	29.2	44.2	35.5	41.2	37.6	23.9	30.0	24.3	30.4	34.1	-3.7	7.1
3.		39.4	39.2	41.0	49.7	63.3	56.8	36.4	39.9	36.2	40.9	48.2	-7.3	15.1
4.		22.4	25.3	32.4	33.0	48.1	40.8	20.4	28.6	22.4	33.6	49.9	-16.3	-1.9
5.		14.1	21.2	18.6	30.0	34.9	37.5	17.4	28.2	12.9	21.8	32.5	-10.6	2.4
6.			34.3		51.2	65.6	58.0	26.2	37.4	22.5	40.2	58.4	-18.2	7.2
7.					21.1	33.4	31.4	15.5	20.3	15.0	21.4	36.0	-14.7	-2.6
8.					55.3	70.0	71.4	42.2	41.5	34.7	45.3	67.8	-22.6	2.2
9.					49.0	59.9	53.3	33.5	40.2	34.2	42.2	52.3	-10.2	7.5
10.						42.3	29.3	10.1	10.7	6.8	15.3	47.6	-32.3	-5.3
11.						16.0	11.5	5.2	7.7	5.4	10.3	17.0	-6.6	-9
12.										106.5	101.1	109.0	-7.9	
13.									51.3	45.7	58.5	90.9	-32.4	
14.										8.1	11.0	11.2	-.2	
15s.										32.0	36.2	48.1	-11.9	
16.										26.1	35.6	42.7	-7.1	

GSP Development – Land Subsidence

Next Steps

- Consider thresholds in North Yolo Management Area
- Measurable Objectives and Interim Milestones
- Plan to Address Data Gaps
- Plan Projects Related to Avoiding Undesirable Results
- YSGA – Reporting Entity for Infrastructure Issues

Land Subsidence – Undesirable Results

The point at which the rate and extent of subsidence in the Subbasin causes *significant* and *unreasonable* impacts to surface land uses or critical infrastructure.

An **undesirable result** occurs when the **minimum threshold** value is exceeded in three (3) or more Management or Sub-management Areas in the same reporting year.

Within the Yolo Subbasin, a Management Area will be considered an **“undesirable result watch area”** when that Management Area exceeds its **minimum threshold** value (see next slide).

If there are multiple Management Areas on the “undesirable result watch area list” for land subsidence, an undesirable result related to land subsidence will be occurring within the Subbasin.

Undesirable Results – Draft Definition

- Minimum Threshold

The **minimum threshold** value for land subsidence is the 5-year running average of the maximum rate of subsidence for each Management or Sub-management Area as defined below.

Capay Valley:	TBD – Data Gap. Additional data and monitoring data is needed.
Dunnigan Hills:	1.8 cm/year of subsidence
North Yolo:	5 cm/year of subsidence (still under consideration by the NY MA)
East Central Yolo:	2.5 cm/year of subsidence
West Central Yolo:	1.8 cm/year of subsidence
South Yolo:	0 cm/year of subsidence
Clarksburg:	0 cm/year of subsidence

Undesirable Results – Draft Definition

- Measurable Objective

The **measurable objective** for land subsidence is the 3-year running average of the maximum rate of subsidence (set as the minimum threshold) for each Management or Sub-management Area.

- Subsidence Monitoring

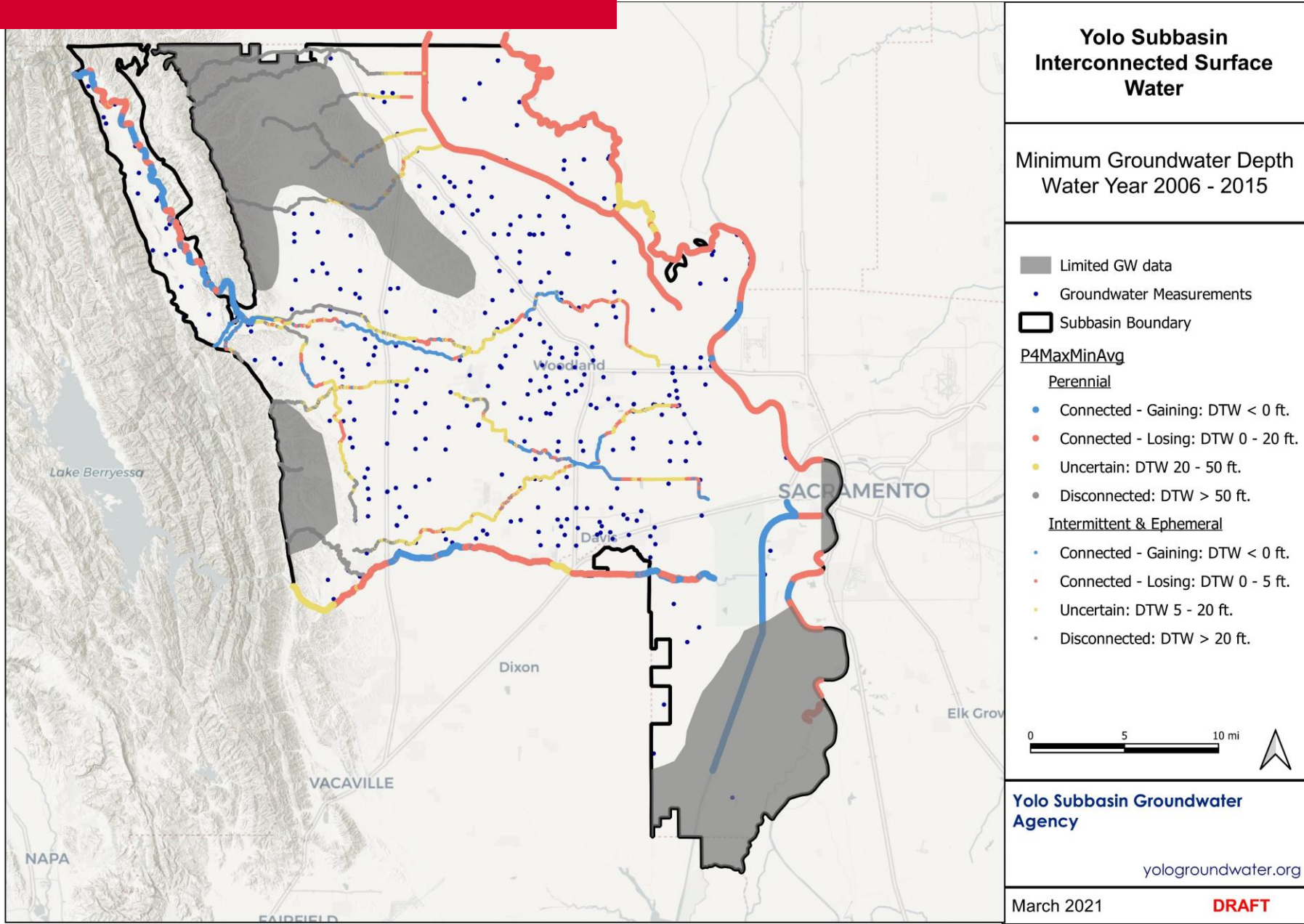
Subsidence will be measured at existing continuous GPS stations and extensometers and extrapolated over the Yolo Subbasin. InSAR monitoring supported by DWR will be used as the YSGA determines the validity of annual reports. YSGA will continue GPS-based surveys to support data gaps and the need for valid data.

GSP Development – Depletion of
Interconnected Surface Waters

Outline

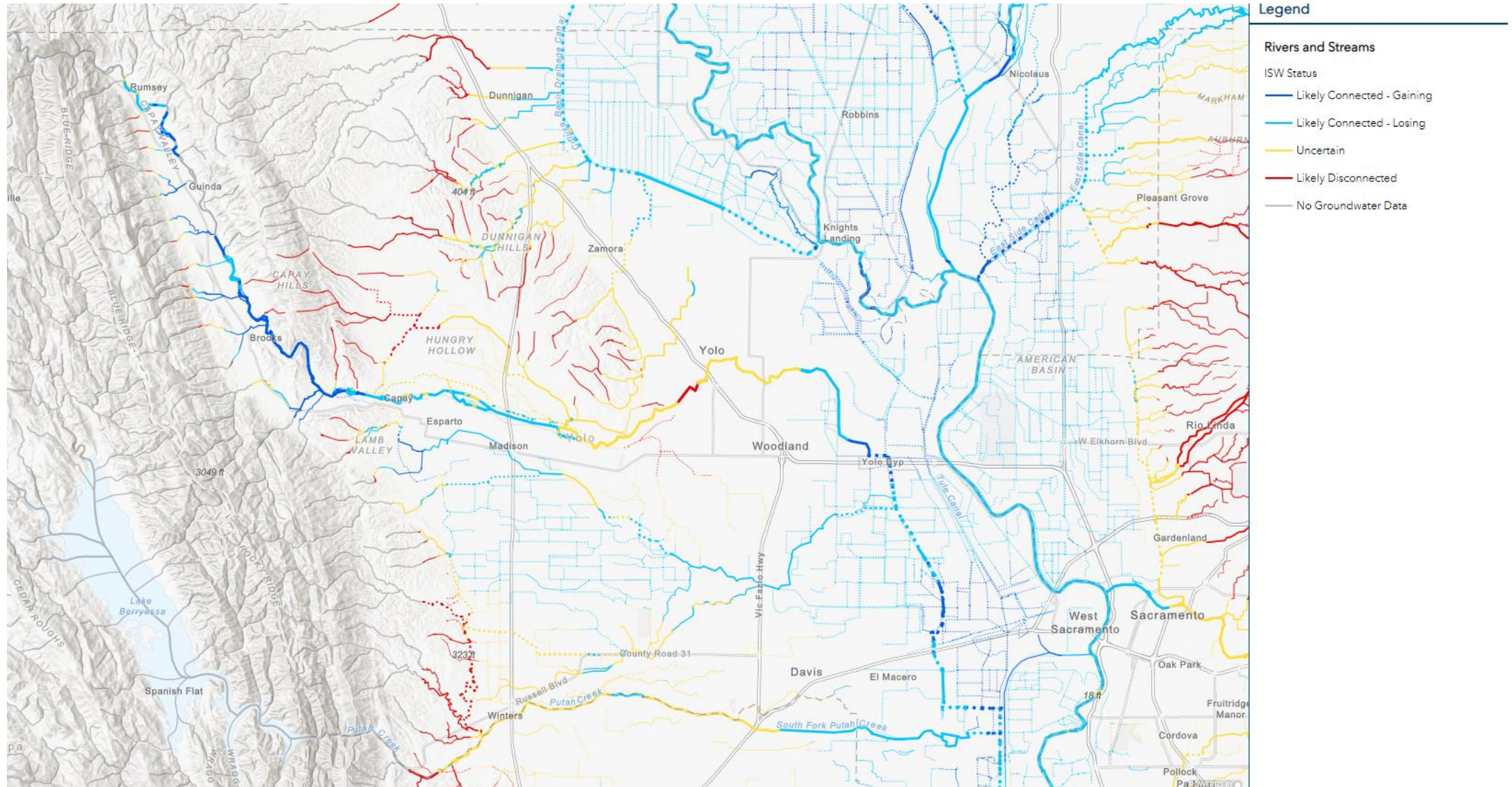
1. Identification of Interconnected Surface Waters
2. Undesirable Results
3. Available Data
4. Monitoring Network
 1. Groundwater levels as a proxy
 2. Representative well selection
5. Minimum Thresholds
6. Next Steps

ISW Identification



ISW Identification: TNC - ICONS

<https://icons.codefornature.org/>



Undesirable Results

§ 354.26. Undesirable Results

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results [applicable to the basin](#).

Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions [occurring throughout the basin](#).

§ 354.28

(c)(6) Depletions of Interconnected Surface Water. The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has [adverse impacts on beneficial uses of the surface water and may lead to undesirable results](#).

Undesirable Results: “Red Light Conditions”

GUIDE TO COMPLIANCE WITH CALIFORNIA’S SUSTAINABLE GROUNDWATER MANAGEMENT ACT – Stanford Water in the West

1. Federal and/or State Endangered Species Act ([ESA](#)) [surface flow](#) or other surface water-dependent [requirements are currently not being met](#) at least partially due to groundwater diversions
2. Other (non-ESA) legally established [instream flow requirements are currently not being met](#) at least partially due to groundwater diversions
3. [Water quality requirements](#) and/or “Total Maximum Daily Loads” (TMDLs) [are currently not being met](#) due at least partially to groundwater diversions
4. [Senior surface water rights](#) or fishing rights [are currently not being met](#) at least partially due to groundwater diversions
5. Instream flows and/or riparian areas within the boundaries of federal or state-designated [Wild and Scenic Rivers](#) are currently being [adversely affected](#) at least partially by groundwater diversions
6. Groundwater diversions have [adversely affected groundwater dependent ecosystems](#) (GDEs) not included in specially protected areas but covered by the Public Trust Doctrine
7. Surface waters or GDEs within National Parks or Monuments, National Conservation Areas, National Wildlife Refuges, National Recreation Areas, Wilderness Areas, Wilderness Study Areas, National Forests, Areas of Critical Environmental Concern (U.S. Bureau of Land Management (BLM)), Units of the California State Park System, or California Department of Fish and Wildlife Ecological Reserves or Wildlife Protected Areas are currently being adversely affected by groundwater diversions
8. Groundwater diversions are known to have caused or contributed to [substantial or irreparable surface water infrastructure damage](#)

Undesirable Results – Draft Definition

- Undesirable Results

The point at which significant and unreasonable impacts to the surface waters affect the reasonable and beneficial use of those surface waters by overlying users, including associated ecosystems.

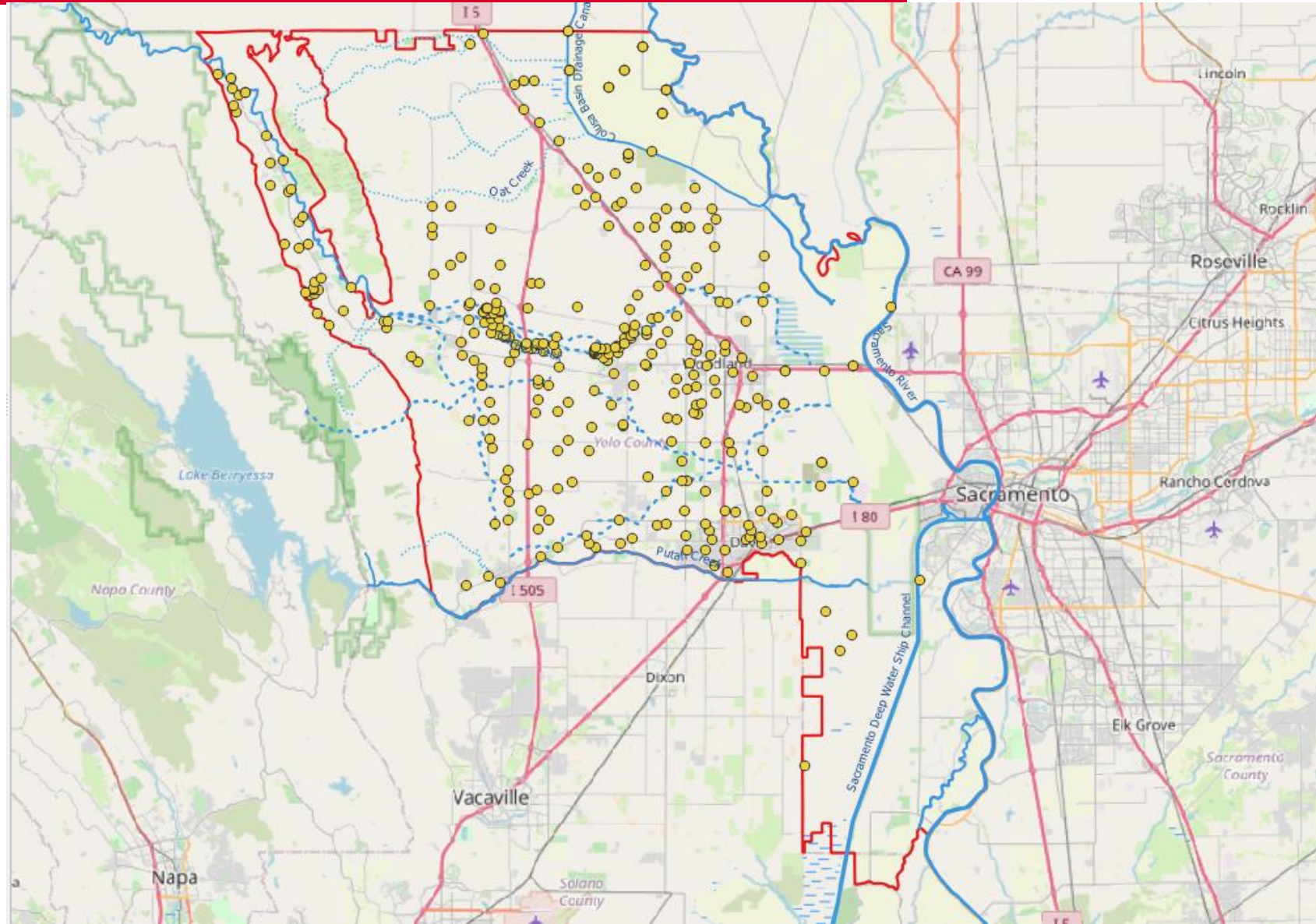
Available Data

- Studies and Programs:
 - Sacramento River
 - Putah Creek
- YSGA Monitoring Network
- YSGA Model
- Stream Gages

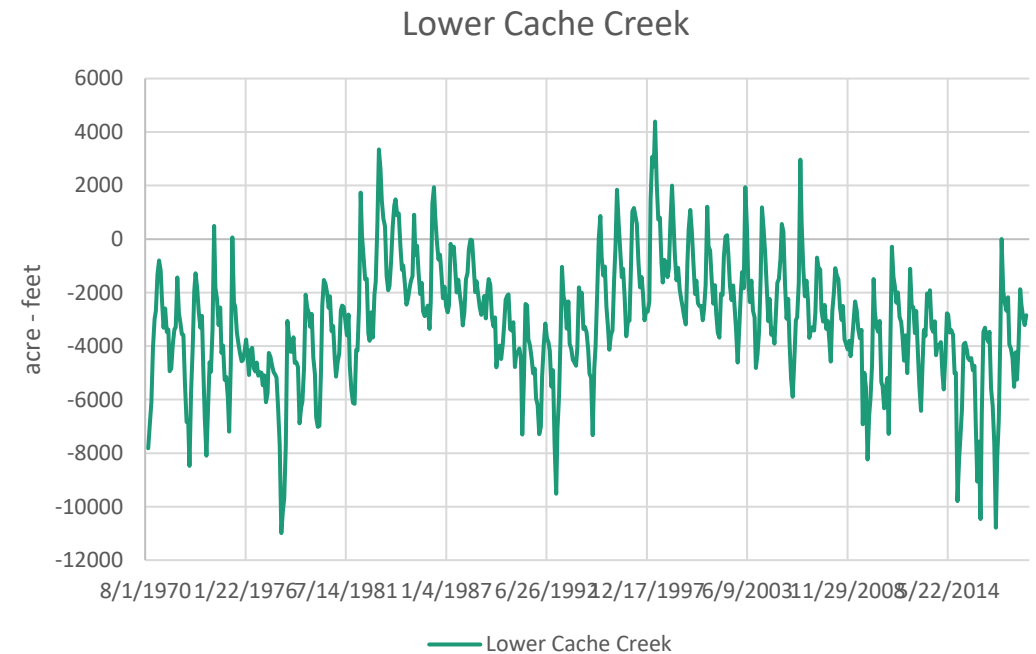
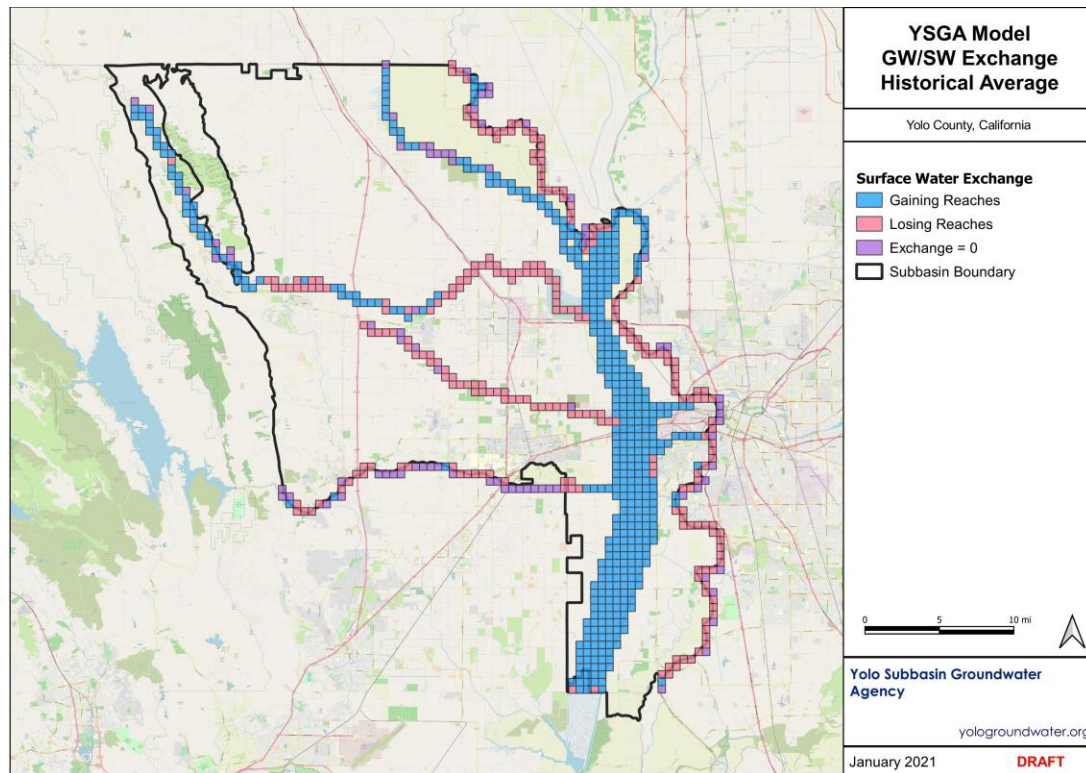
Available Data: Studies and Programs

- Sacramento River: Groundwater Substitution Transfers
 - Characterize relationship between groundwater pumping and stream depletion
 - Establish monitoring networks
 - Proposed RMW # 11N02E20K004M
- Putah Creek: Riparian Model 2005
 - Links groundwater levels in a near-stream well with depletion rate in two adjacent reaches
 - Proposed RMW # 08N01E17F001M

Available Data: YSGA Well Network



Available Data: YSGA Model

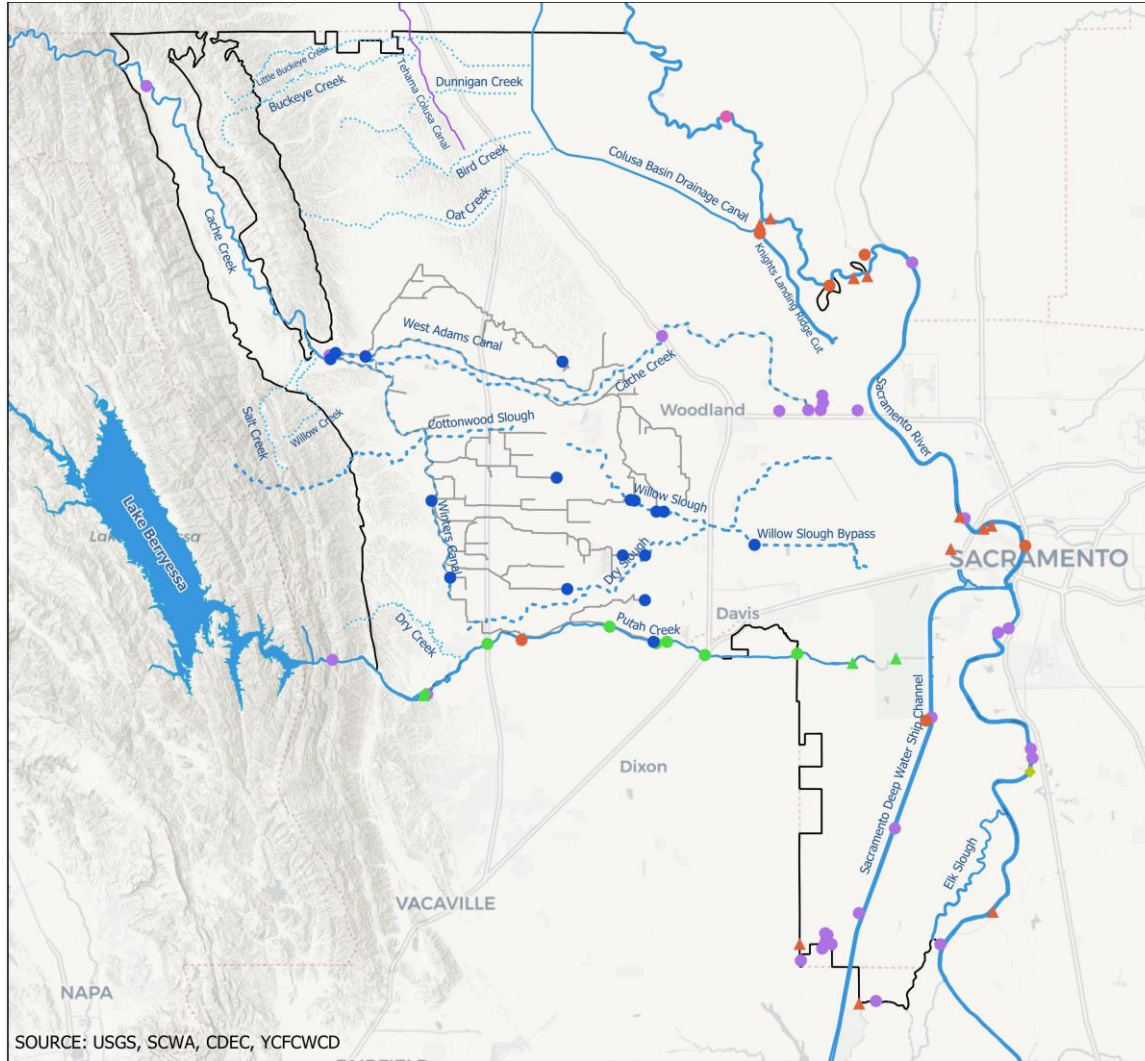


Available Data: YSGA Model

SEI's WEAP + MODFLOW

- Large scale
- Balanced accuracy between various metrics
- Should not be used to estimate groundwater levels at a single well
- Uncertainties in calibration of some streams
- Limitations of MODFLOW in estimating depletion

Available Data: Streamflow Monitoring



- Influenced by:
 - Rainfall & runoff
 - Surface water extraction
 - Surface water management
 - Evapotranspiration
 - Interflow from previous rain years
 - Subsurface geology
 - Groundwater levels

Monitoring Network: Water Levels as Proxy

- Ways to monitor depletion:
 - Pumping data
 - No pumping data
 - Streamflow
 - Influenced by too many other factors
 - Groundwater levels
 - Familiar
 - Already have network
- Must make a correlation between the GW elevation proxy and depletion

Monitoring Network: Water Levels as Proxy

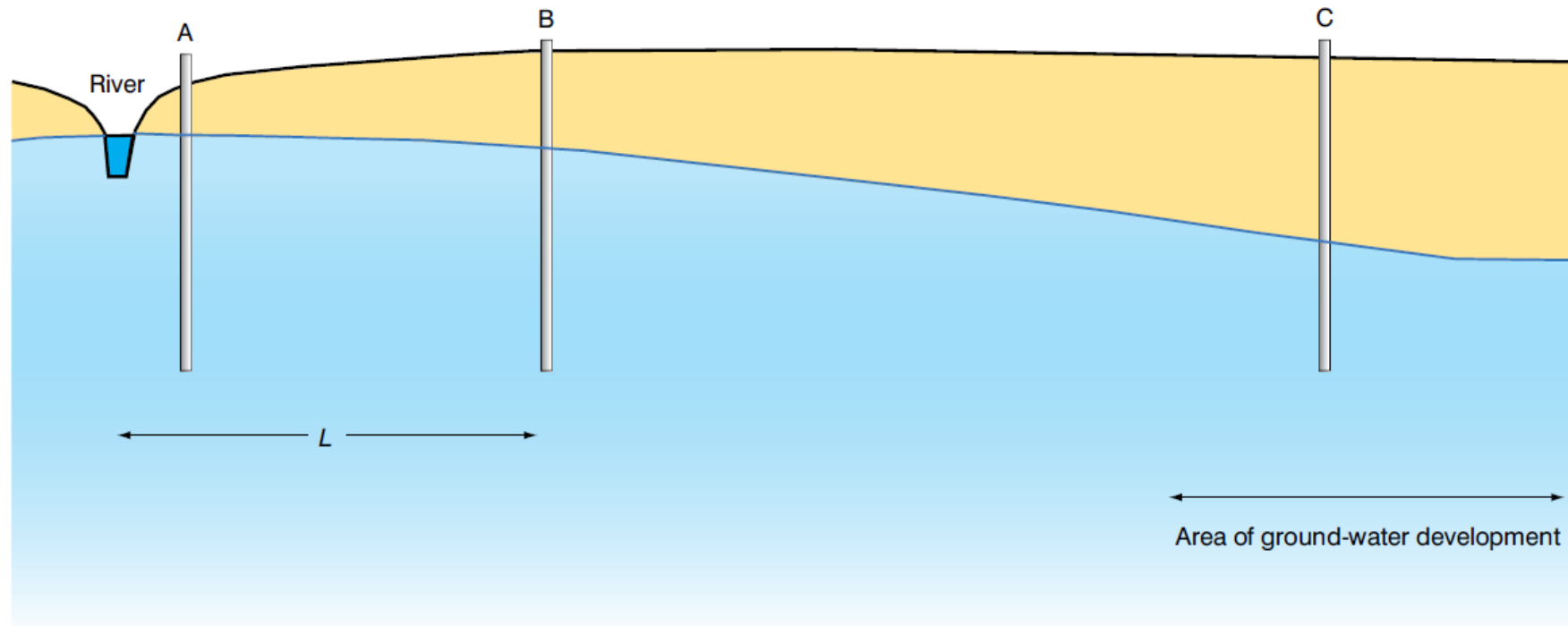
- The relationship between Water Levels and Depletion is built into the YSGA Model
 - While the stream is connected, deeper groundwater levels increase the rate of depletion
 - While the stream is disconnected, depletion is only a function of river head
- We can use the model to estimate our expected rate of depletion
- Due to model uncertainty, we are setting thresholds based on real-world data

Monitoring Network: Representative Wells

Addressing Regional Surface Water Depletions in CA, EDF

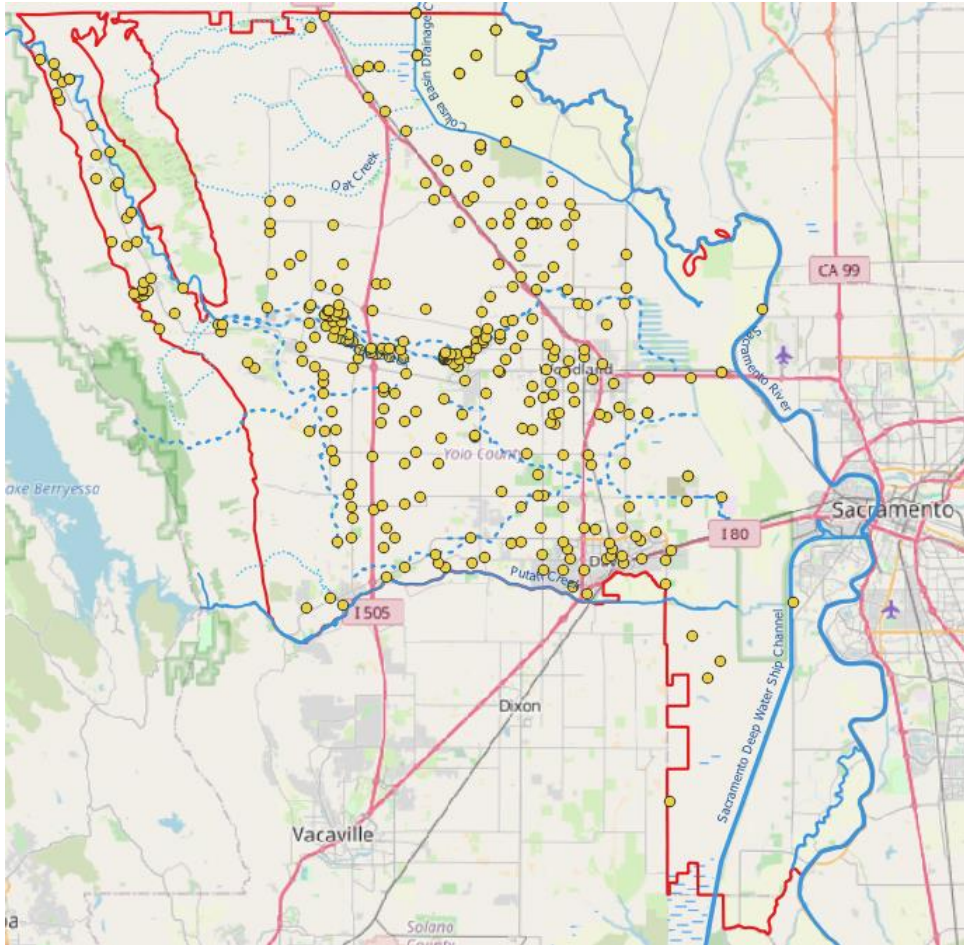
FIGURE 2

Potential water-level monitoring locations relative to a stream or river and an area of groundwater development



Location A is along the river bank, or perhaps no more than a few thousand feet from the river. Location B is intermediate between the river and the area of groundwater development, and location C is within or near the area of groundwater development (pumping).

Monitoring Network: Representative Wells



Selection Criteria

- Shallow – prefer <220 feet
- Less than 1 mile from intermittent streams
- Within 5 miles from perennial stream
- Long data record
- Prefer wells already monitored by YCFC&WCD
- Prefer Water Levels RMW
- Ideally every 4-6 miles (EDF report)

Proposed UR#6 Representative Wells

Yolo County, California

Proposed Rep Wells

- Cache Creek Lower
- Cache Creek Upper
- CBD
- Putah Creek
- Sacramento River
- Willow Slough
- Multiple Streams

Surface Water Bodies

- ⋯ Ephemeral
- - - Intermittent
- Perennial
- Subbasin Boundary

0 100 200 mi

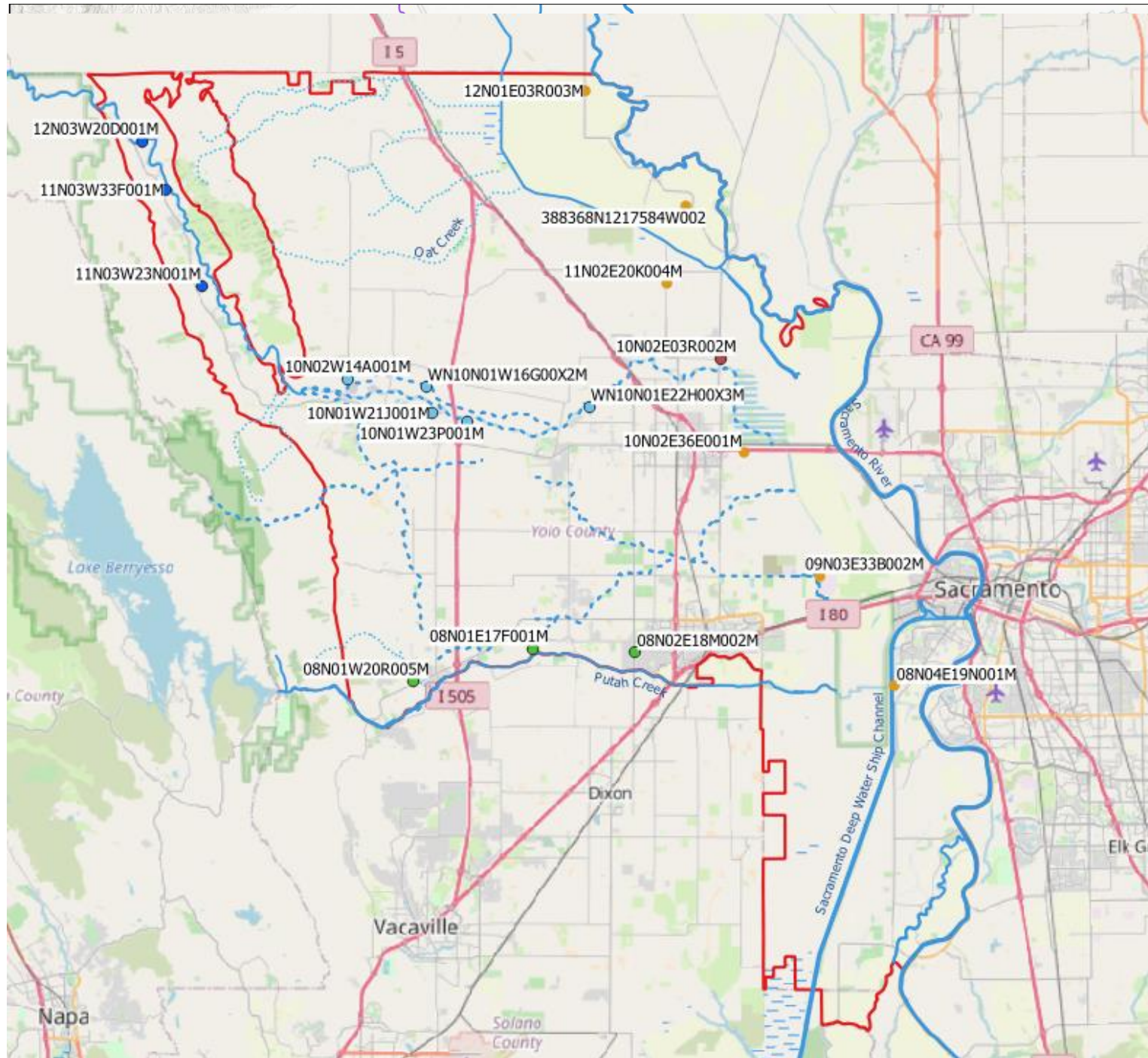


Yolo Subbasin Groundwater
Agency

yologroundwater.org

April 2021

DRAFT



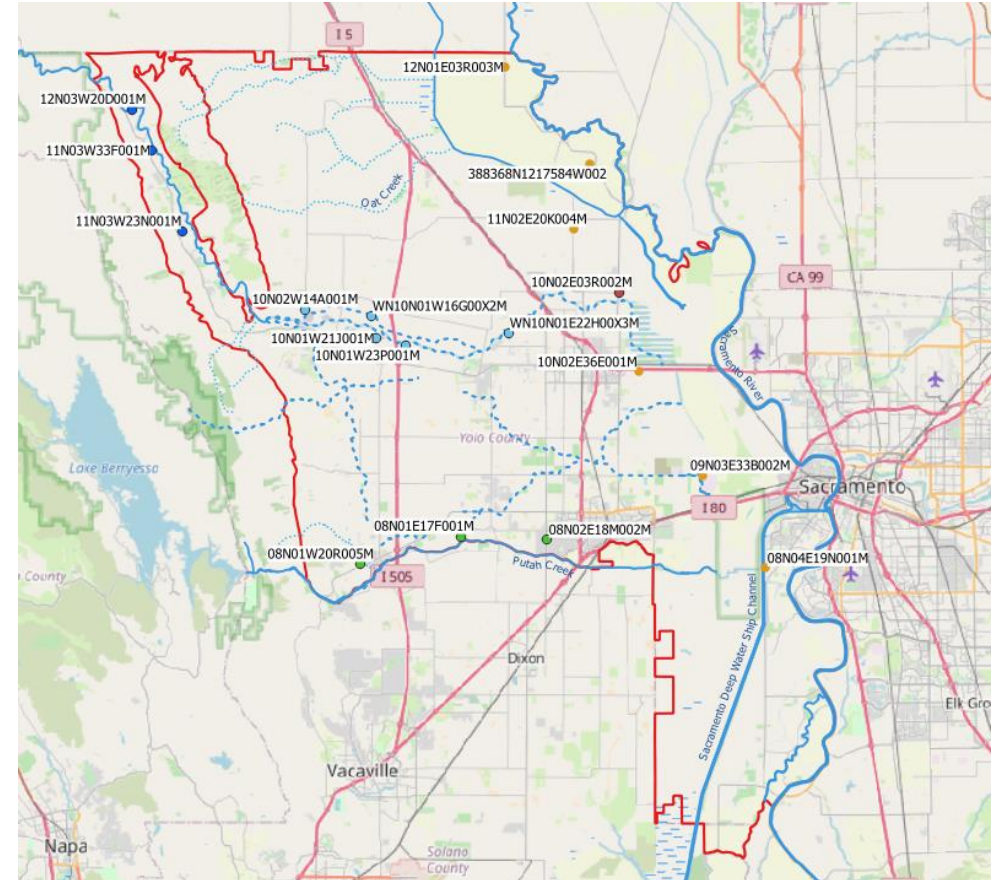
Monitoring Network: Representative Monitoring Wells (RMW)

Cache Creek Lower		
SWN	Depth	Monitored by
10N01W21J001M	152	YCFC-SCADA
10N01W23P001M	80	YCFC
10N02W14A001M	135	YCFC
WN10N01W16G00X2M	65	Teichert
WN10N01E22H00X3M	59.8	Teichert
10N02E03R002M	83.5	YCFC

Cache Creek Upper		
SWN	Depth	Monitored by
11N03W23N001M	136	YCFC
11N03W33F001M	75	YCFC
12N03W20D001M	26	YCFC

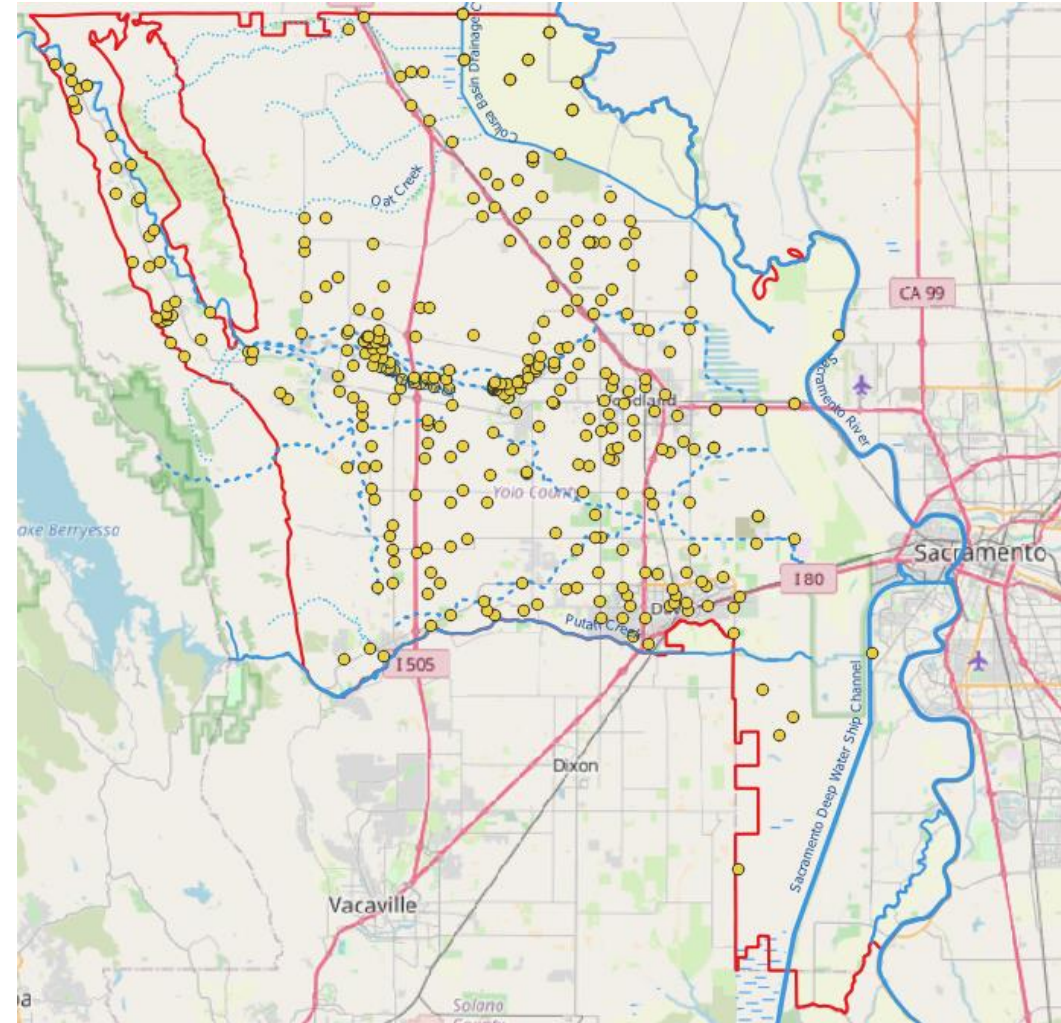
Putah Creek		
SWN	Depth	Monitored by
08N02E18M002M	156	USBR
08N01E17F001M	200	USBR
08N01W20R005M	300	YCFC

Sacramento River		
SWN	Depth	Monitored by
08N04E19N001M	260	DWR
10N02E36E001M	150	DWR
09N03E33B002M	265	DWR
388368N1217584W002	210	DWR
12N01E03R003M	350	DWR
11N02E20K004M	232	DWR



Monitoring Network: Data Gaps

- Dunnigan Hills
 - Groundwater data
 - Stream data: when do they flow?
- YCFC&WCD Canals and Sloughs
 - Surface water management effect on potential thresholds
- Sacramento River
 - Wells in intermediate location



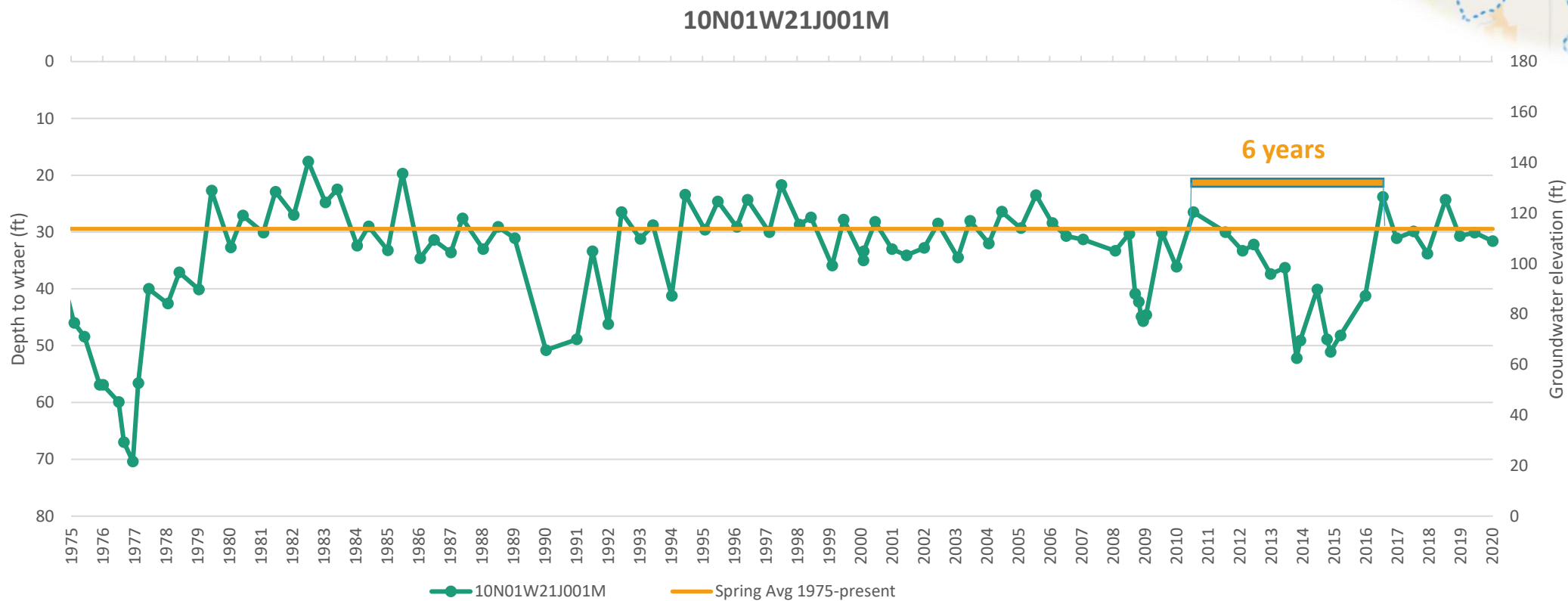
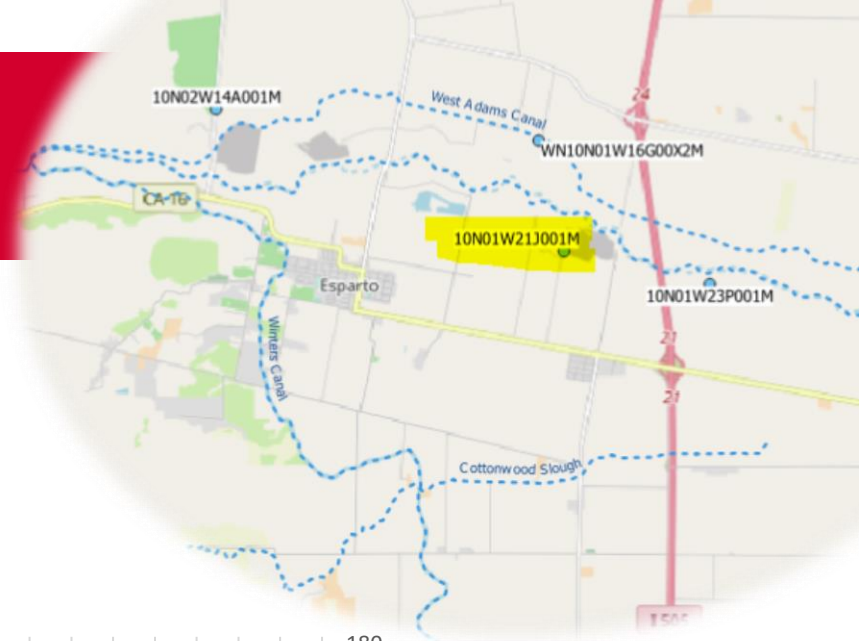
Minimum Thresholds

- **Basin-wide Goal:** Maintain historical surface water and groundwater hydrologic regime
 - Groundwater levels
 - Stream flow, depth, and temperature
 - Annual and inter-annual temporal variation

Minimum Thresholds: Intermittent Streams

- Seasonal streams (intermittent) flow during certain times of the year when smaller upstream waters are flowing and when *groundwater provides enough water for stream flow*
- Adapted to both seasonal and long-term variation
- The stream can become disconnected, but groundwater levels need to come back up to re-establish connection

Minimum Thresholds: Intermittent Streams



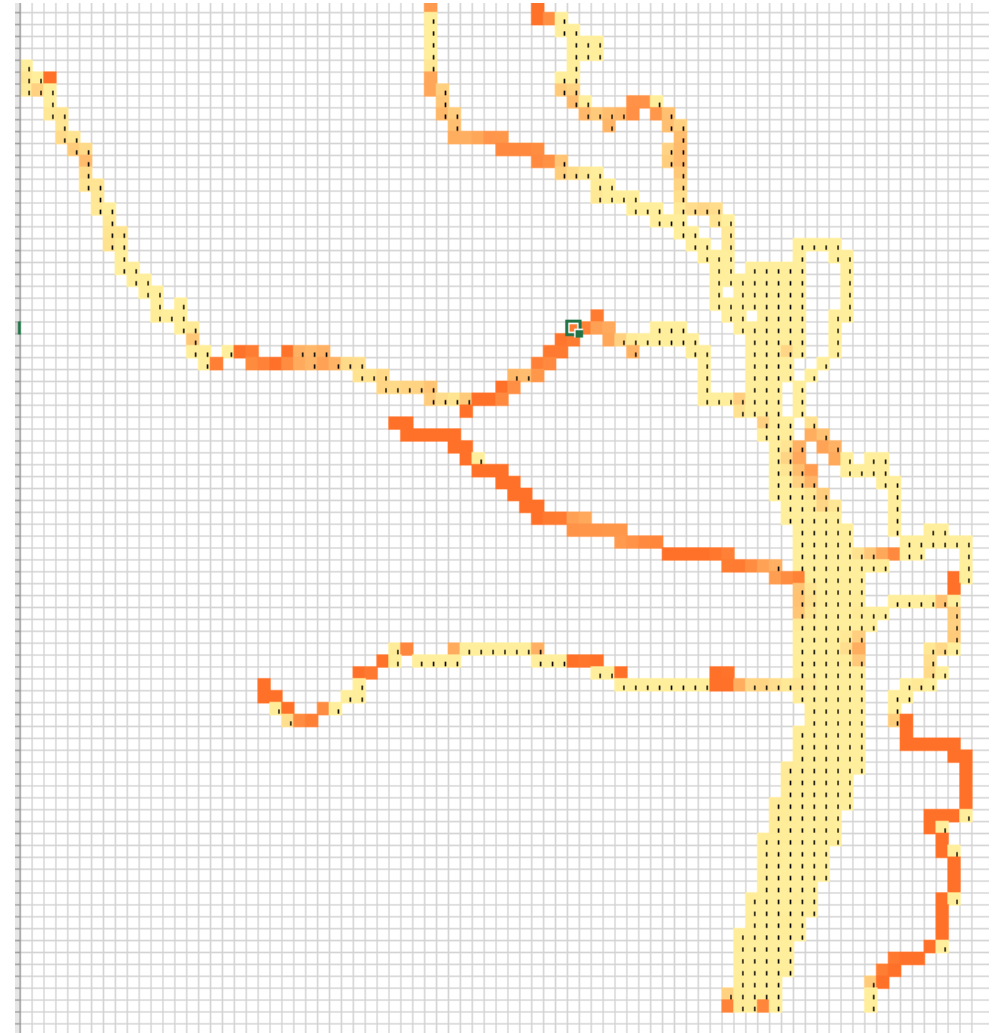
Undesirable Results – Draft Definition

LOWER CACHE CREEK (Intermittent)

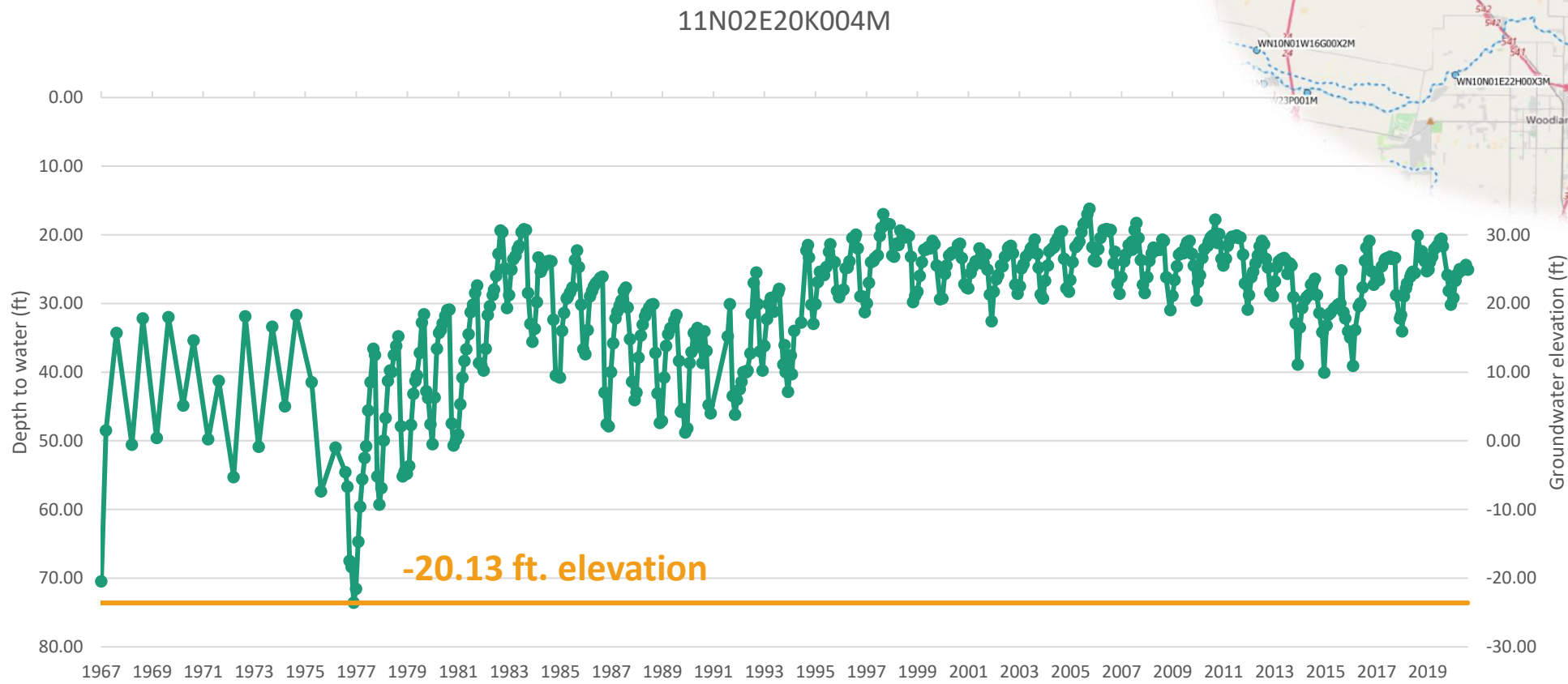
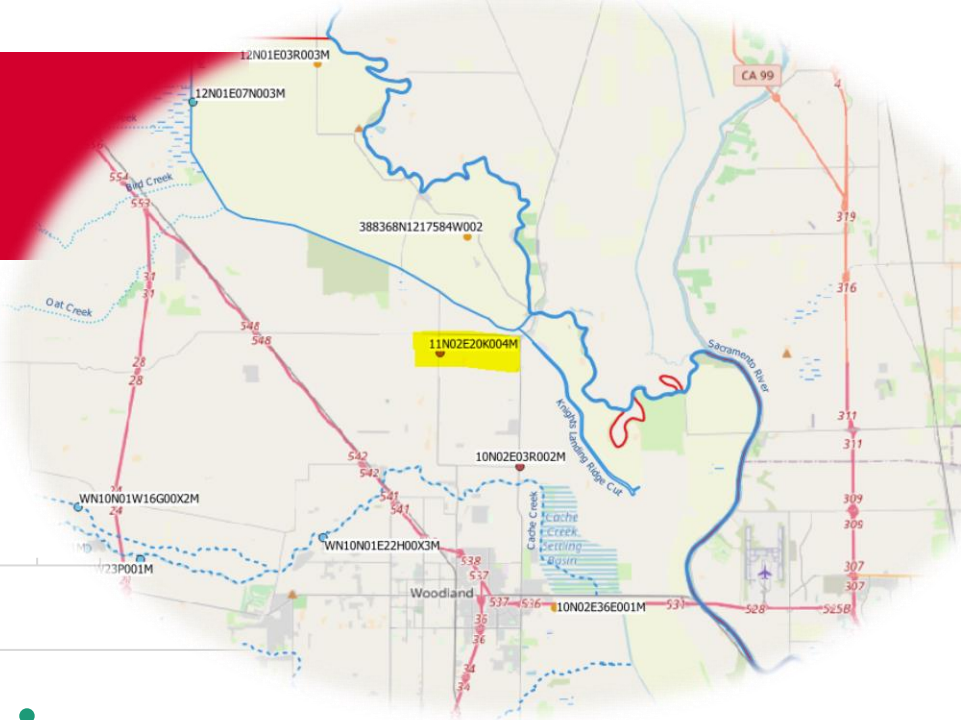
- Minimum Threshold
 - The **minimum threshold** values for depletion of interconnected surface water is the recurrence of the spring average measurement for the period of record in at least one spring in every six (6) years.
- Measurable Objective
 - The **measurable objective** values for depletion of interconnected surface water is the recurrence of a specified groundwater elevation at RMW, typically the spring average measurement for the period of record, in at least one spring in every three (3) years.

Minimum Thresholds: Perennial Streams

- The perennial streams are almost always connected to groundwater
 - Groundwater depth will almost always affect the rate of depletion
- The hydrographs of the near-stream wells display less inter-annual variation
 - The temporal method does not seem to characterize the interaction



Minimum Thresholds: Perennial Streams



● 11N02E20K004M — POR Max

Undesirable Results – *Draft* Definition

UPPER CACHE CREEK, UPPER SAC RIVER, LOWER SAC RIVER, PUTAH CREEK (Perennial)

Minimum Threshold

- **Minimum threshold** value is equal to the minimum elevation for the period of record at the RMW.

Measurable Objective

- **Measurable objective** is equal to the average groundwater elevation for the water year period of 2000 to 2011 at the RMW.

Undesirable Results – *Draft* Definition

- Undesirable Results

The point at which significant and unreasonable impacts to the surface waters affect the reasonable and beneficial use of those surface waters by overlying users, including associated ecosystems.

An **undesirable result** occurs when the **minimum threshold** values within an interconnected surface water Management Area are exceeded in 75-percent (*draft*) of the representative monitoring wells (RMW).

Draft Chapters of the GSP

Comments Received on Basin Setting (Chapter 2)

Schedule for Posting Monitoring Networks (Chapter 3)

Report of Data Coordination Efforts

Projects and Management Actions Workshops

2-page memo with draft list of projects + template
for project proponents to submit to YSGA

Projects/Management Actions

PROJECTS

- Excess storm flow diversions into canals, sloughs, etc. (China Slough to Zamora)
- Water transfers/imported water supplies
- Outreach to YCFC&WCD service area landowners: optimized conjunctive management

MANAGEMENT ACTIONS

- Maintain and enhance existing groundwater monitoring network
- Continue to coordinate with member entities, landowners, beneficial users, etc.
- Improve public access to groundwater data - transparency
- Gather information on known data gaps
 - Groundwater-dependent ecosystems (GDEs)
 - Environment beneficial users
 - Surface water groundwater interaction
 - Dunnigan Hills MA, etc.
- Adaptive Management

Projects/Management Actions

PROJECTS

- Excess storm flow diversions into canals, sloughs, etc. (China Slough to Zamora)
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Scheduling Public Workshops

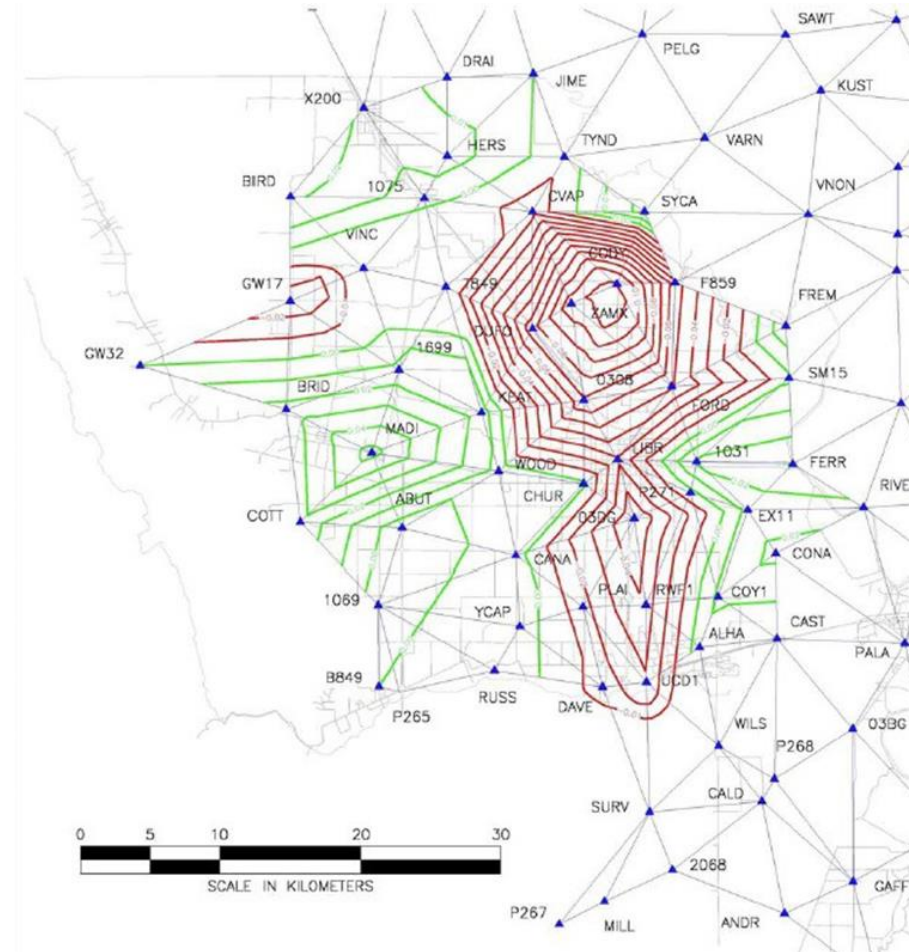
Adjourn

Additional Reference Slides for Land
Subsidence

Subsidence

GPS-Based Approach: Yolo Subsidence Network 1999-2008 Contours (Potterfield and Frame, 2009)

- Elevation gains in green, elevation decreases in red
- Total subsidence within the Subbasin ranges from +7 to -26 cm (1999-2008)
- Maximum subsidence in the Zamora area
- Average rate of subsidence: +0.8 to -2.9 cm per year

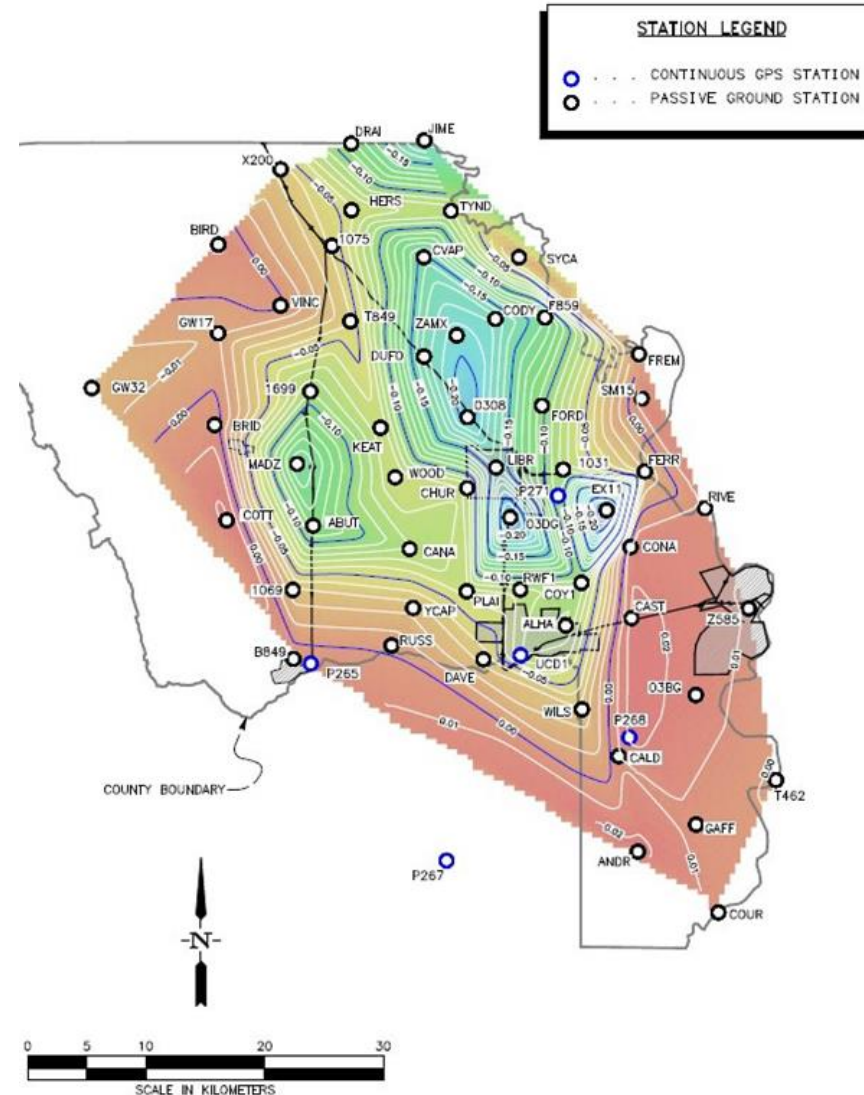


Credit: Potterfield and Frame, 2009

Subsidence

GPS-Based Approach: Yolo Subsidence Network 2008-2016 Contours (Frame, 2016)

- Elevation gains in green, elevation decreases in red
- Total subsidence within the Subbasin ranges from +2 to -20 cm (2008-2016)
- Maximum subsidence in the Zamora area
- Average rate of subsidence: +0.25 to -2.5 cm per year

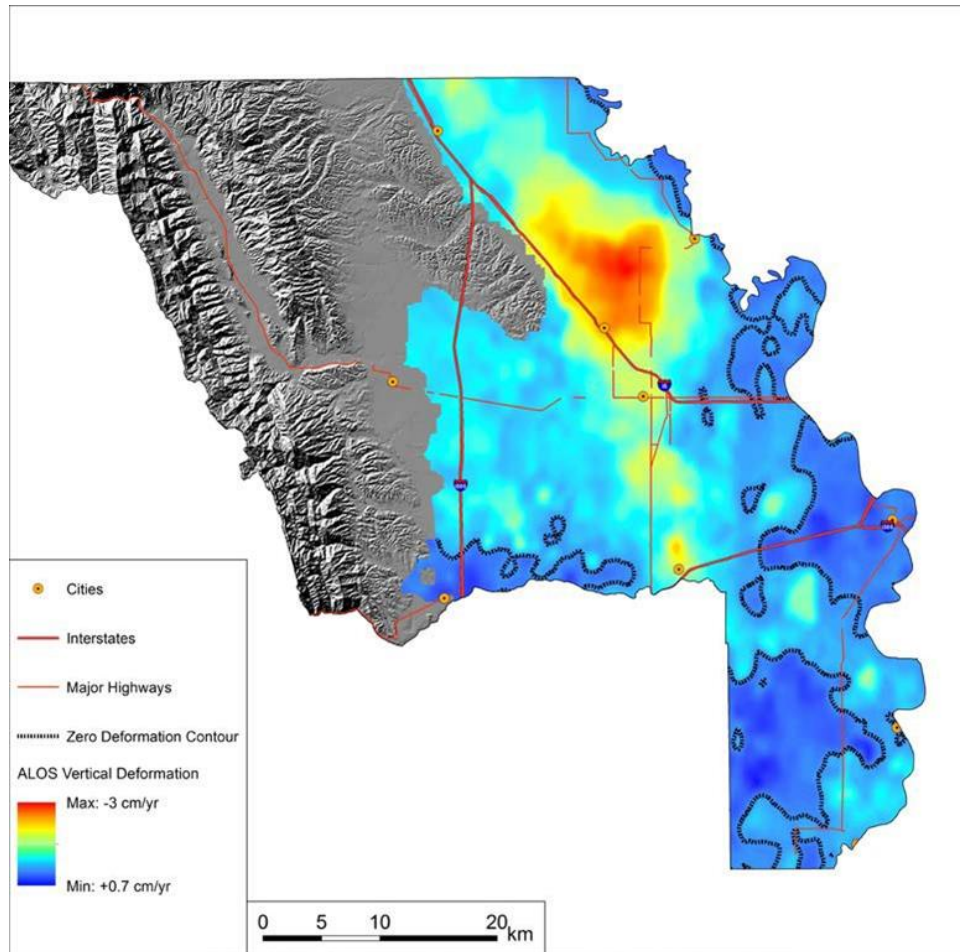


Credit: Frame, 2016

Subsidence

Interferometric Synthetic-Aperture Radar (InSAR) Results, 2007-2011 period (Crew, 2017)

- Maximum rate of subsidence between Zamora and Woodland – up to 3 cm per year
- Areas to the south and east have displayed positive elevation gains during wet years

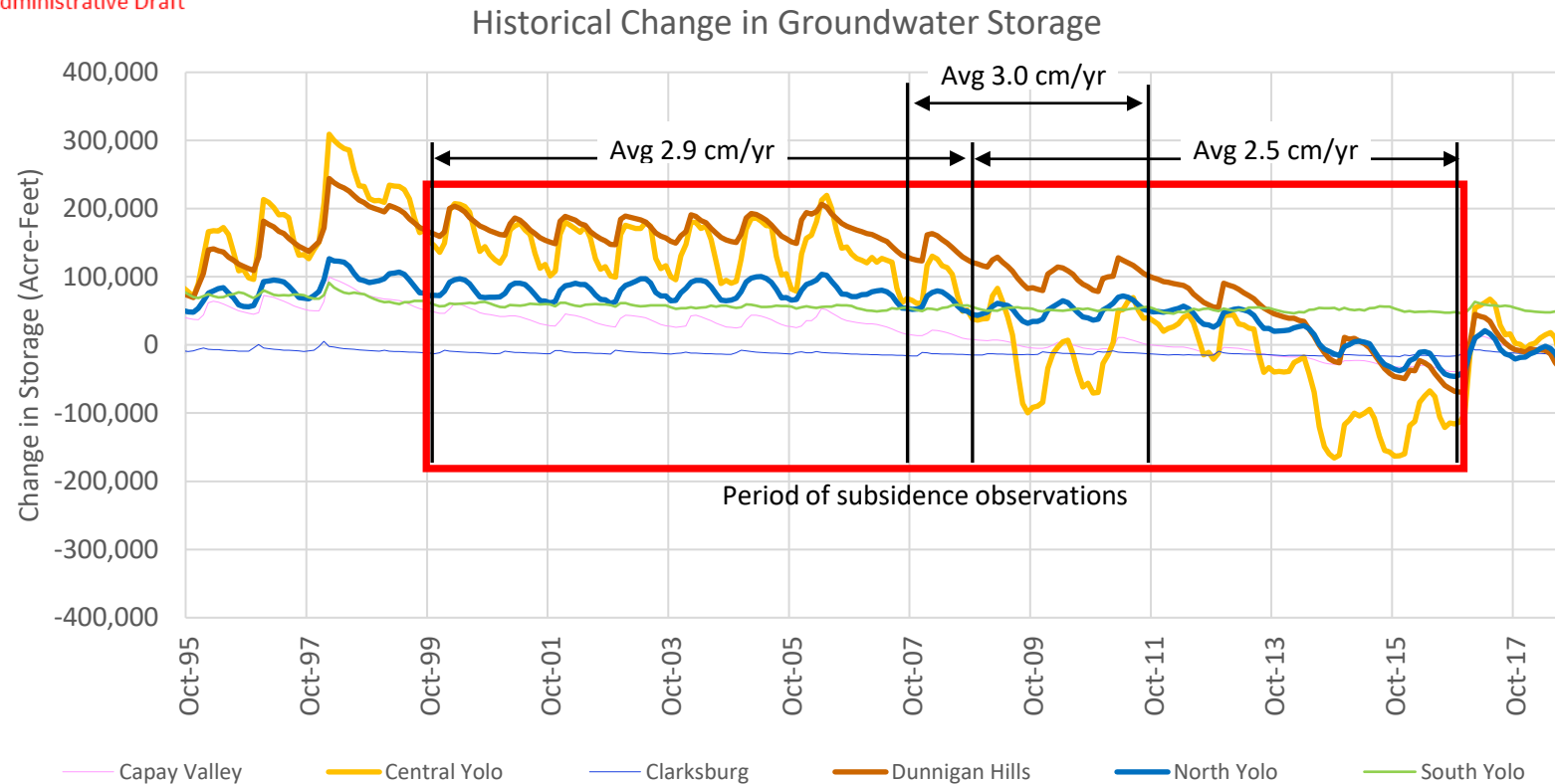


Credit: Stanford University, Crew 2017

Subsidence

Relationship between subsidence and change in groundwater storage.

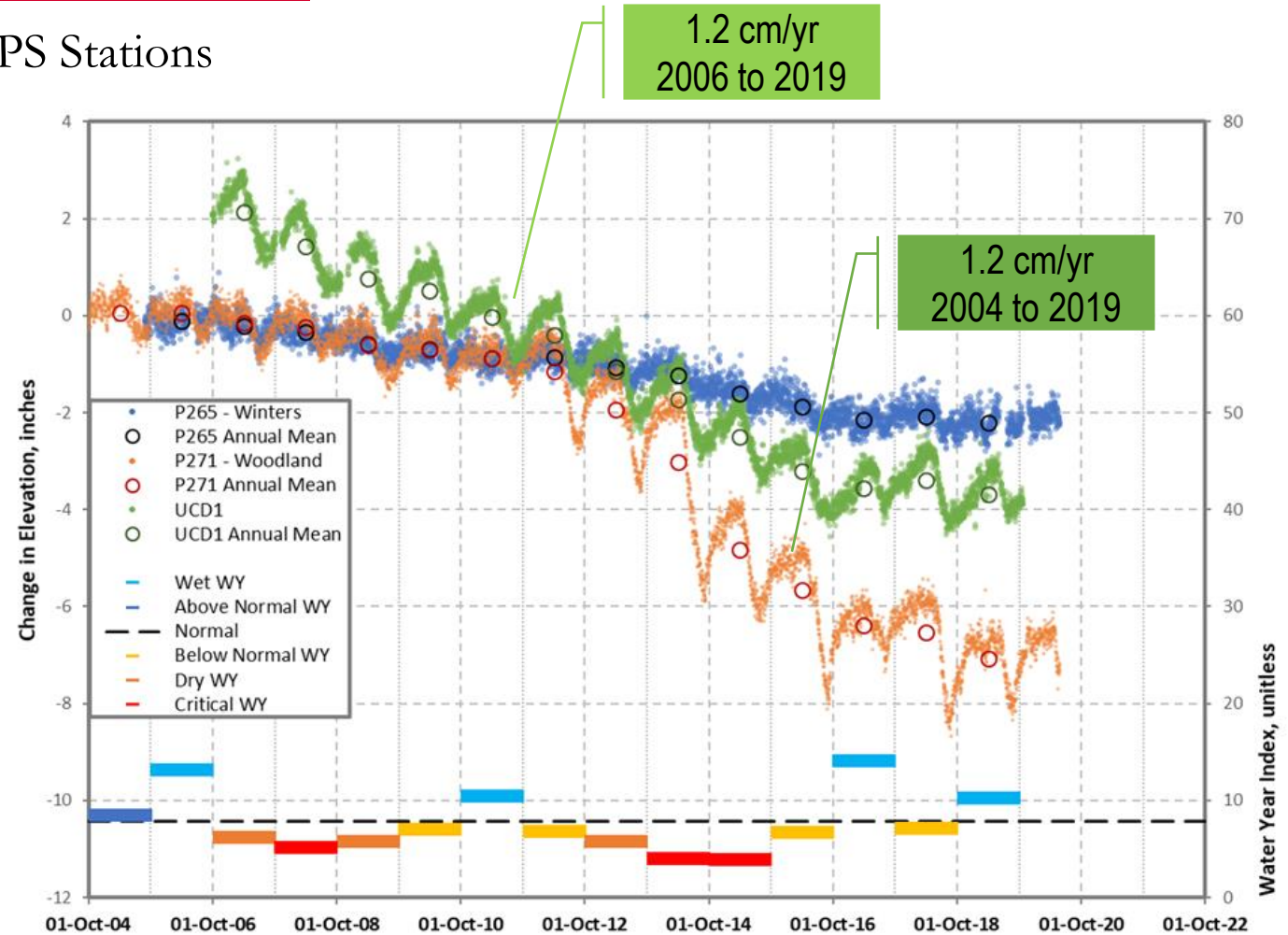
Administrative Draft



Credit: SEI, 2020

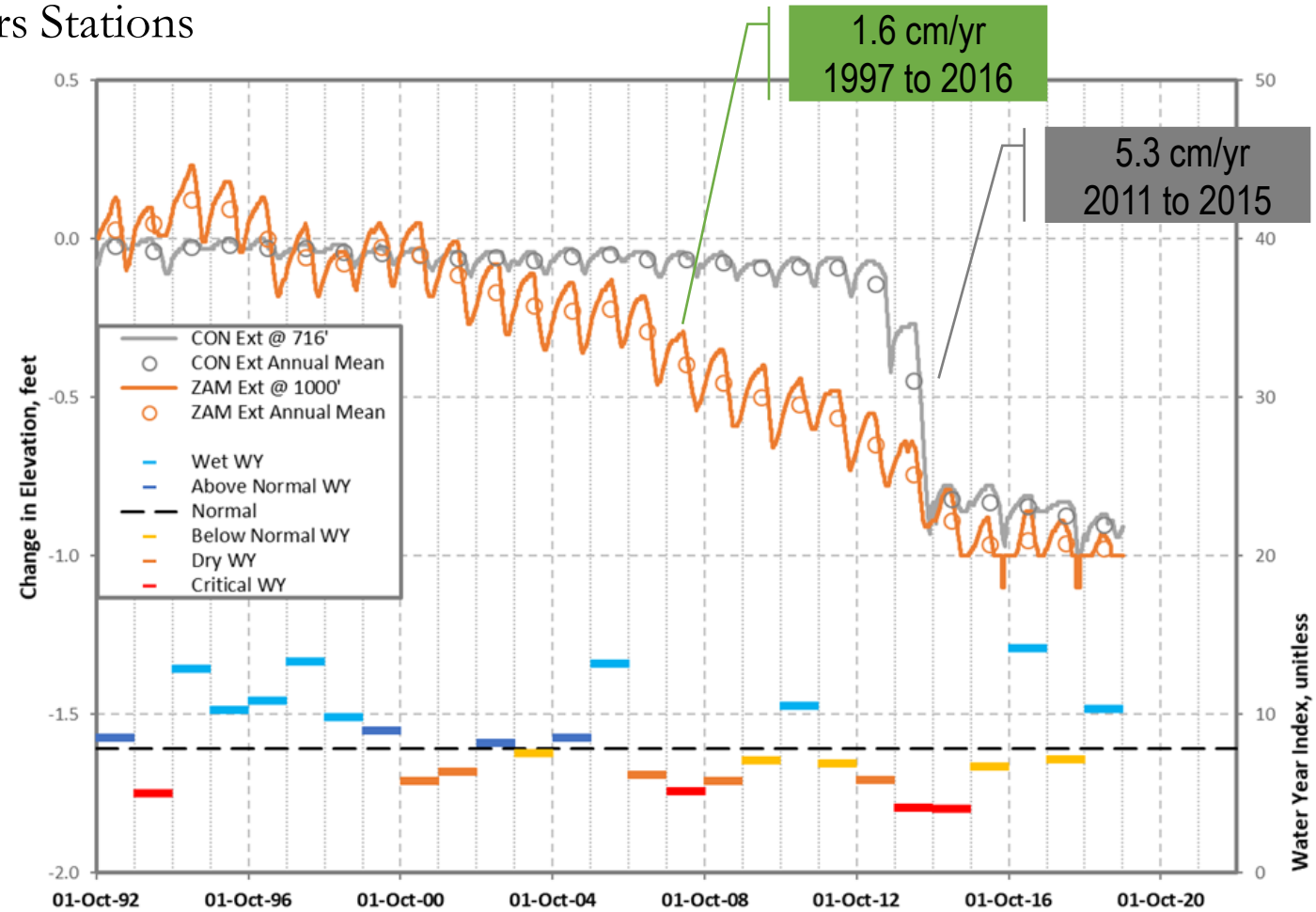
Subsidence

Continuous GPS Stations



Subsidence

Extensometers Stations



Subsidence

- Subsidence has been observed in the Subbasin, most notably in area between Woodland and Zamora, and to a lesser extent around Davis.
- Are there currently impacts to land uses?
 - Impacts could include conveyance facilities, channel gradients, or major infrastructure (roads, highways, transmission lines, buildings and facilities)
 - Currently there are no documented impacts to land uses from subsidence

Subsidence

§ 354.26. Undesirable Results

(a) Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin.

Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.

§ 354.28

(c)(5) Land Subsidence. The minimum threshold for land subsidence shall be the rate and extent of subsidence that substantially interferes with surface land uses and may lead to undesirable results.

Undesirable Results - Draft Definition

➤ Land Subsidence

- *The point at which significant and unreasonable impacts, as determined by the rate and extent of subsidence in the Subbasin, that affects surface land uses or critical infrastructure.*
- Next step is to define level of impacts that would cause significant and unreasonable impacts

Undesirable Results - Draft Definition

➤ Measurable Objective

- *The three-year running average of the maximum rate of subsidence established for each management area shall not be exceeded in 3 or more management areas (or sub-management).*

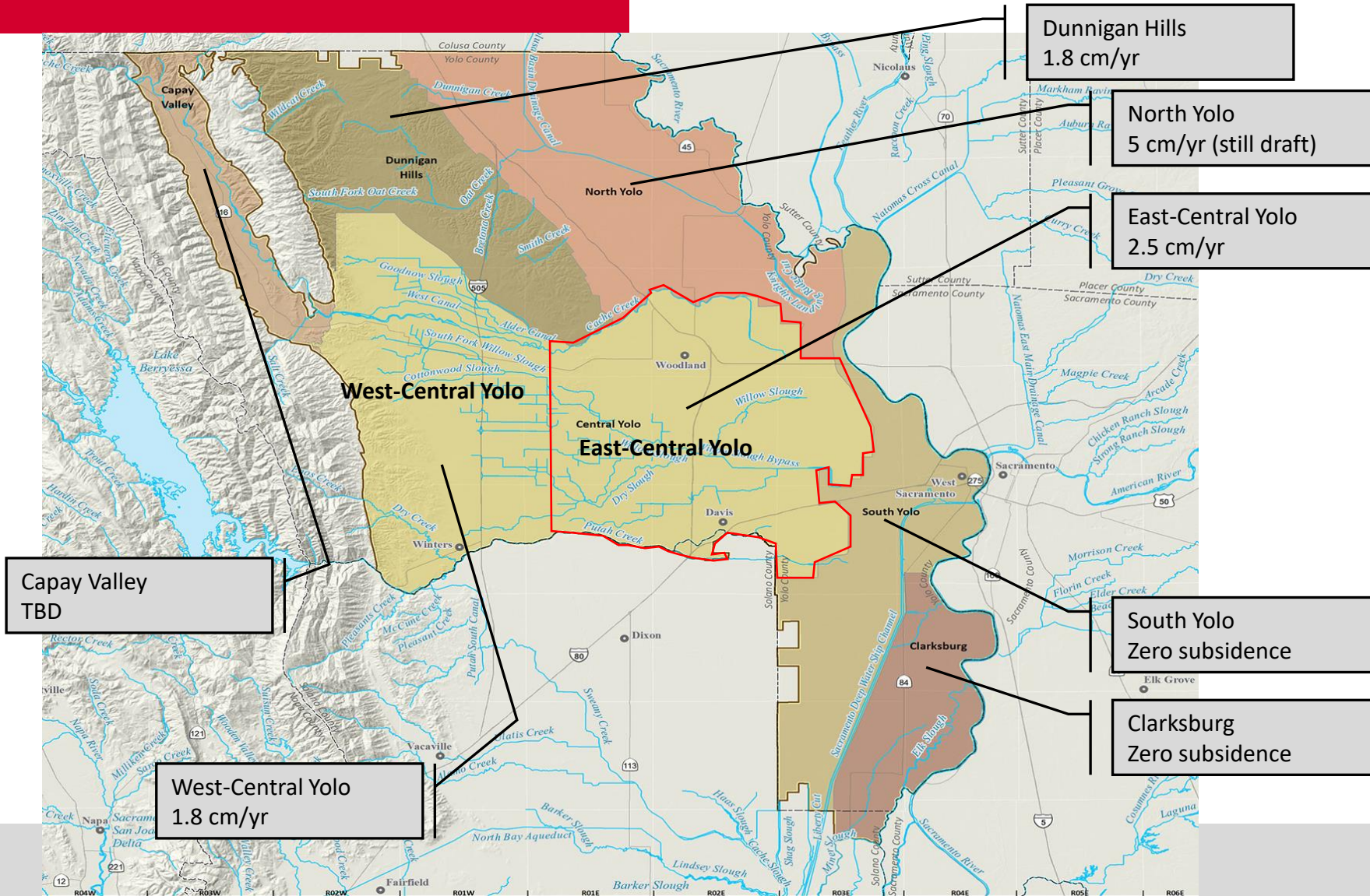
➤ Minimum Threshold

- *The five-year running average of the maximum rate of subsidence established for each management area shall not be exceeded in 3 or more management areas (or sub-management area).*

Undesirable Results - Draft Definition

- Establish a maximum rate of subsidence within a management area (or portion of a management area) that is presumed to avoid significant and unreasonable impacts
 - Require continued monitoring and reporting of the level of land subsidence occurring in the Subbasin
 - Require annual monitoring and reporting of potential impacts to land uses, critical infrastructure, and wells (domestic, production and municipal)
 - Based on observed data continue to refine the understanding of the causes of subsidence (water management vs tectonic)
 - Based on observed data quantify the amount of subsidence which causes impacts to infrastructure
 - Based on observed data consider establishing future subsidence thresholds as maximum amount of subsidence in critical areas of the Subbasin

Subsidence



Subsidence

Questions/Comments

