Sierra Valley Technical Advisory Committee

December 7, 2020

Plumas County 1854 California

Sierra Valley Groundwater Management District

LWA

DBS&A engineering geoscience hydrology

KJ Kennedy Jenks

Stillwater Sciences

Agenda

- Comments from the past meeting?
- Review: Assessing Sustainability
- Water Quality SMC
- Subsidence SMC
- Discussion

Comments and suggestions from the November meeting?

- Nov TAC Notes
- Summary of comment cards inputs in upcoming slides
- Any new thoughts, comments, or concerns?

Prioritization of Sierra Valley

- Based on the DWR SGMA 2019 Basin Prioritization technical process.
- Full documentation of the process and results can be found on the DWR website:

https://water.ca.gov/Programs/Groundwater-Management/Basin-Prioritization

- Prioritization is only a starting point, should not influence or limit the work to comply with SGMA.

Prioritization

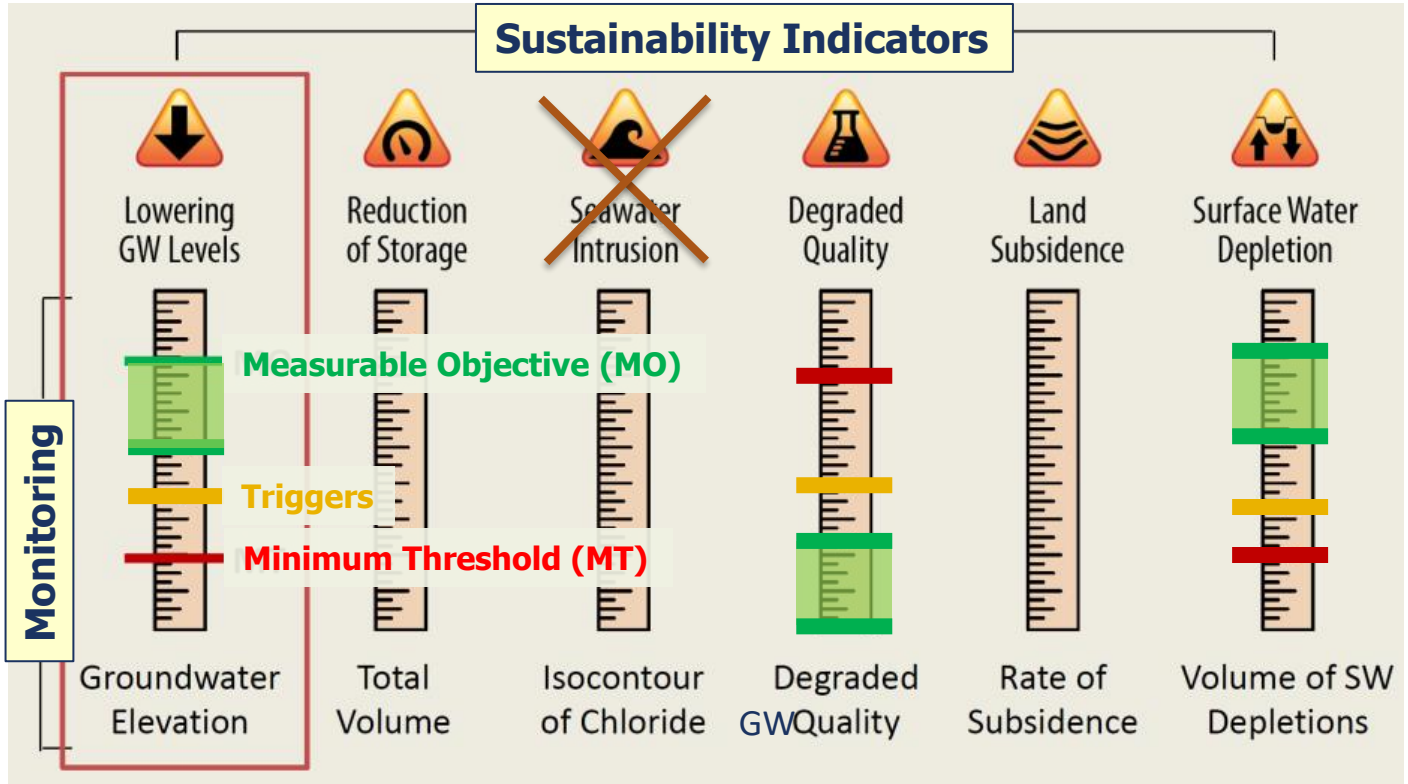
Component	Description	Priority Points	Sub-component Points	Notes
1	Population	1		2010 Population of 2,192
2	Population Growth	0		Plumas and Sierra County projected to lose population through 2050
3	Public Supply Wells	1		10 Public Supply Wells / 0.05 per square mile
4	Total Wells	2		594 Production Wells / 3.24 per square mile
5	Irrigated Acres	2		16,592 irrigated acres
6	Groundwater Reliance	2		Average of 6a and 6b equals Priority Points
6a	Groundwater Use	--	2	Estimated 12,480 acre-feet
6b	Groundwater Supply	--	2	36% of water supply is groundwater
7	Impacts	4		Table 11 Prioritization Documentation shows Priority Point conversion
7a	Declining GW Levels	--	7.5	Hydrographs show groundwater level decline
7b	Subsidence	--	10	Documented reports of subsidence
7c	Salt Intrusion	--	0	N/A
7d	Water Quality	--	1	Based on MCL exceedance
8	Habitat and Other	5		Priority points is sum of sub-component
8a	Streamflow	--	2	Existing habitat and streamflow
8b	Other	--	3	Complicated water management scenario
Total		17		Medium Priority

Agenda

- Comments from the past meeting?
- Review: Assessing Sustainability
- Water Quality SMC
- Subsidence SMC
- Discussion

Monitoring and Managing Sustainability

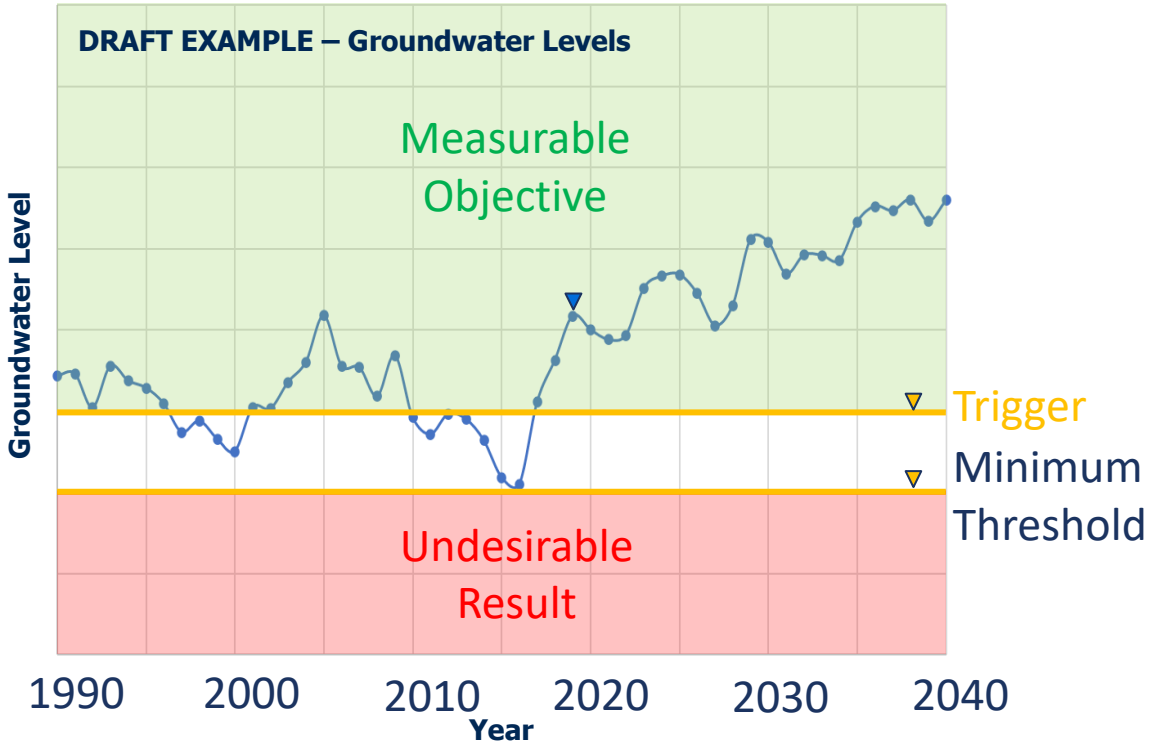
Sustainable Management Criteria (SMCs) are defined ***locally*** and based on ***basin conditions*** to avoid significant and unreasonable ***undesirable results*** for five SGMA ***sustainability indicators***.



modified from Ca DWR 2016

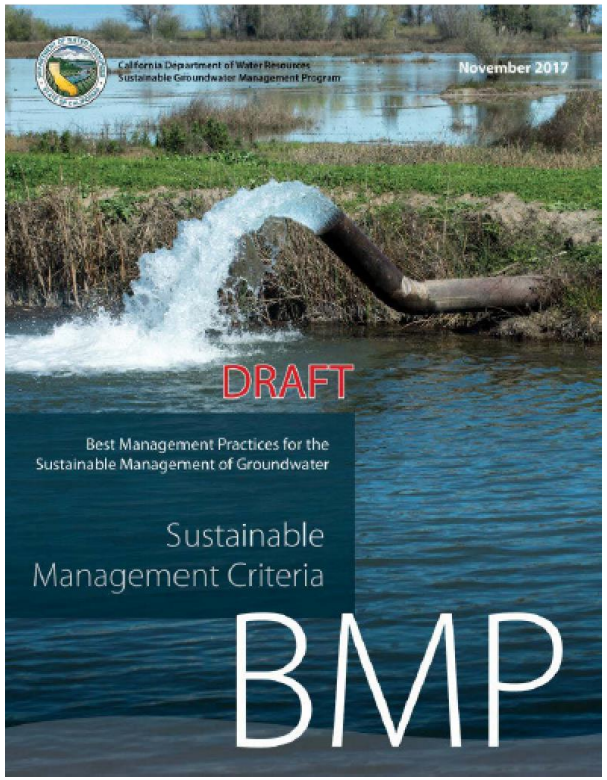
Review of Sustainable Management Criteria Components

- Undesirable Results
- Minimum Thresholds
- Measurable Objectives
- Sustainability Goal



Interconnected SGMA Activities that Inform Sustainable Management Criteria

- Understand the basin setting:
  - Hydrogeologic conceptual model
  - Current and historical conditions
  - Estimated water budget
  - Potential management areas
- Inventory existing monitoring programs and evaluate and build potential representative monitoring points
- Engage interested parties (i.e. beneficial uses and users of groundwater)



Initial Exploration of a Sustainability Goal

Key SGMA text (GSP Emergency Regulations 354.24)

"Each agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results"

From the November TAC meeting… initial Exploration of a Sustainability Goal

1. What social and natural qualities do you want to see maintained in the Sierra Valley Basin, long into the future?
2. What do you not want to see happen in the Sierra Valley Basin?
3. What qualities might others want to see maintained in the Basin?

Vision for Sustainability – What to Keep, What to Prevent

KEEP

- Ability of property owners to drill domestic well with sufficient water quantity for domestic needs
- Healthy plant and vegetation communities
- Habitat protections (for animals and plants)
- Open space (e.g., Feather River Land Trust)
- Access for birding, walking, nature hikes
- Dark skies
- Quiet environment
- Wetlands
- Birds, plants and animals
- Good water quality
- Viable agriculture economy
- Pastoral setting
- Resilience
- Maintain the balance between commercial and natural systems
- Maintain a rural environment
- Opportunity for planned growth
- Maintain pond levels without having to pump, green grass most of year
- Traditional Ecological Knowledge
- Synergy

PREVENT

- Groundwater pumping allocation reductions due to overdrafting
- Congestion (roads or buildings)
- Housing developments
- Industrial farms
- Monocrops
- Becoming a bedroom community for Reno
- Wells going dry
- Movement of water contaminants
- Drying of wet meadows, streams, channels
- Drinking water quality degradation
- Competition
- Depletion
- Contention
- Neighbors needing to deepen wells due to other neighbors use
- Sale of agricultural lands that leads to unlimited growth
- Significant impacts to water quality goals per Plumas NF Land & Resource Mgmt. Plan

Agenda

- Comments from the past meeting?
- Review: Assessing Sustainability
- Water Quality SMC
- Subsidence SMC
- Discussion

Groundwater Quality Sustainable Management Criteria

- Available data
- List of potential Constituents of Concerns (COCs)
- Selection of COCs for defining Sustainable Management Criteria
- Groundwater Quality monitoring network

Sierra Valley: Groundwater Quality Data

- GAMA Groundwater Information System
  - Groundwater Ambient Monitoring and Assessment Program (GAMA)
  - Data for Plumas and Sierra County
  - https://gamagroundwater.waterboards.ca.gov/gama/datadownload.asp
- Total number of wells = 206 wells with data in SV Basin
    - 31 Deep (> 200 ft. below ground surface (bgs))
    - 29 Shallow (< 200 ft. bgs)
    - 146 Unknown
- Well Type
  - Monitoring (51), Municipal (17), Unknown (138)
- Parameters
  - 189 unique analytes
- Time period (earliest to latest)
  - 5/11/1955 – 7/6/2020

Sierra Valley: Groundwater Quality Data

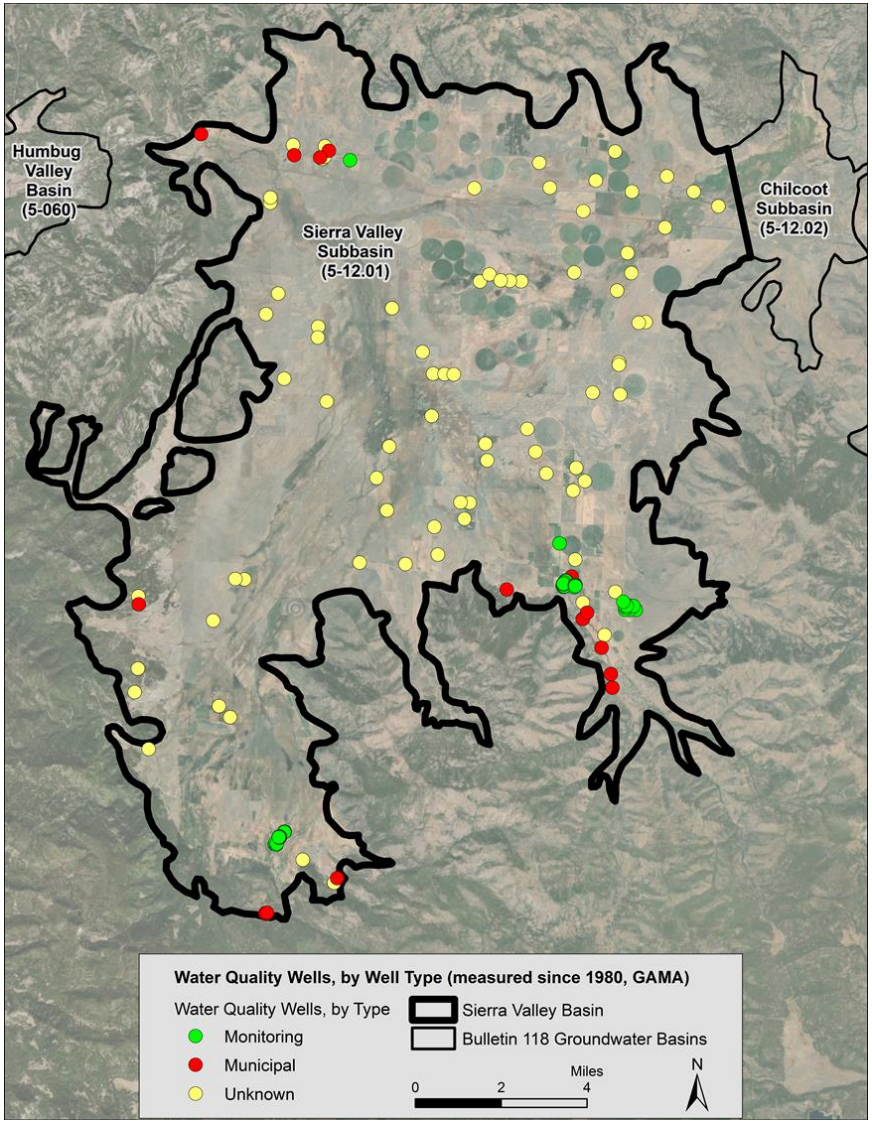
GAMA Groundwater Information System includes data from:

- Department of Pesticide Regulation (DPR)
- Department of Water Resources
- GAMA Domestic Wells
- GAMA Special Studies
- GAMA – Priority Basin Project
- Monitoring Wells (Water Board Regulated Sites)
- Public Water System Wells
- US Geological Survey (USGS) National Water Information System

Sierra Valley: Data Selection and Approach

150 Wells Sampled Since 1980

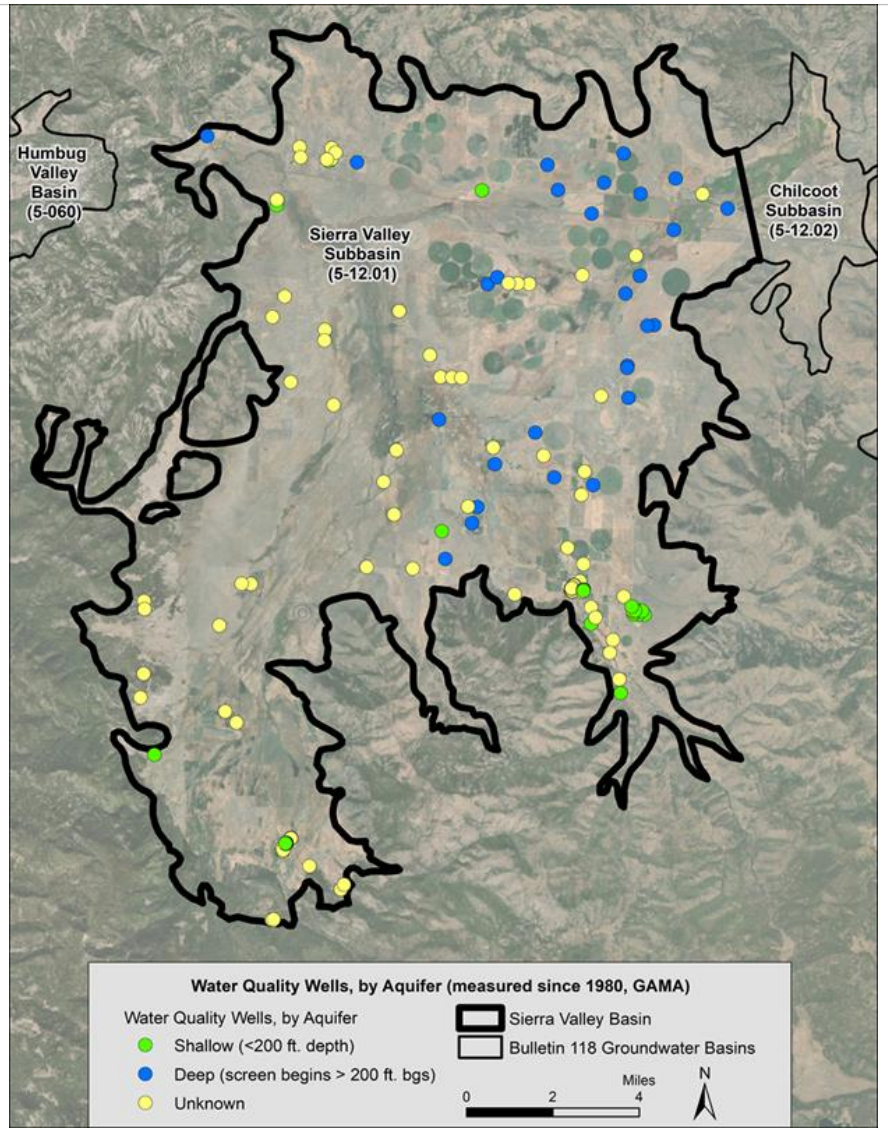
- Monitoring = 51 (green)
- Municipal = 17 (red)
- Unknown = 82 (yellow)



Sierra Valley: Data Selection and Approach

150 Wells Sampled Since 1980

- Deep = 29 (blue)
- Shallow = 27 (green)
- Unknown = 94 (yellow)



GSP Projects & Management Actions for Groundwater Quality

- "Medical Treatment" Options for "Thermometer" out of balance
- Existing regulatory agencies (and programs)
- GSAs are the main steward of groundwater basin sustainability (closer to the "pulse" than state)
- GSAs have monitoring duties
- In case of man-made pollution: GSAs may act as a proactive "facilitator" to move forward on processes that protect groundwater quality
- For recharge / pumping projects:
  - Consider effects on existing man-made pollution
  - Consider effects on existing naturally occurring contaminants

Potential Chemicals of Concern (Shortlist)

- Potential Chemicals of Concern (COCs) developed from document review of past work
- Constituent either (a) shows exceedances of a threshold, (b) shows a strong likelihood of exceeding a threshold, or (c) is commonly addressed in other GSPs.
- This list is not all-inclusive or exhaustive, but a first pass
- Refinements based on TAC input

Potential COCs

- Total Dissolved Solids (TDS)
- Boron
- Iron
- Manganese
- Arsenic
- Nitrate (as N)
- Fluoride
- Chloride

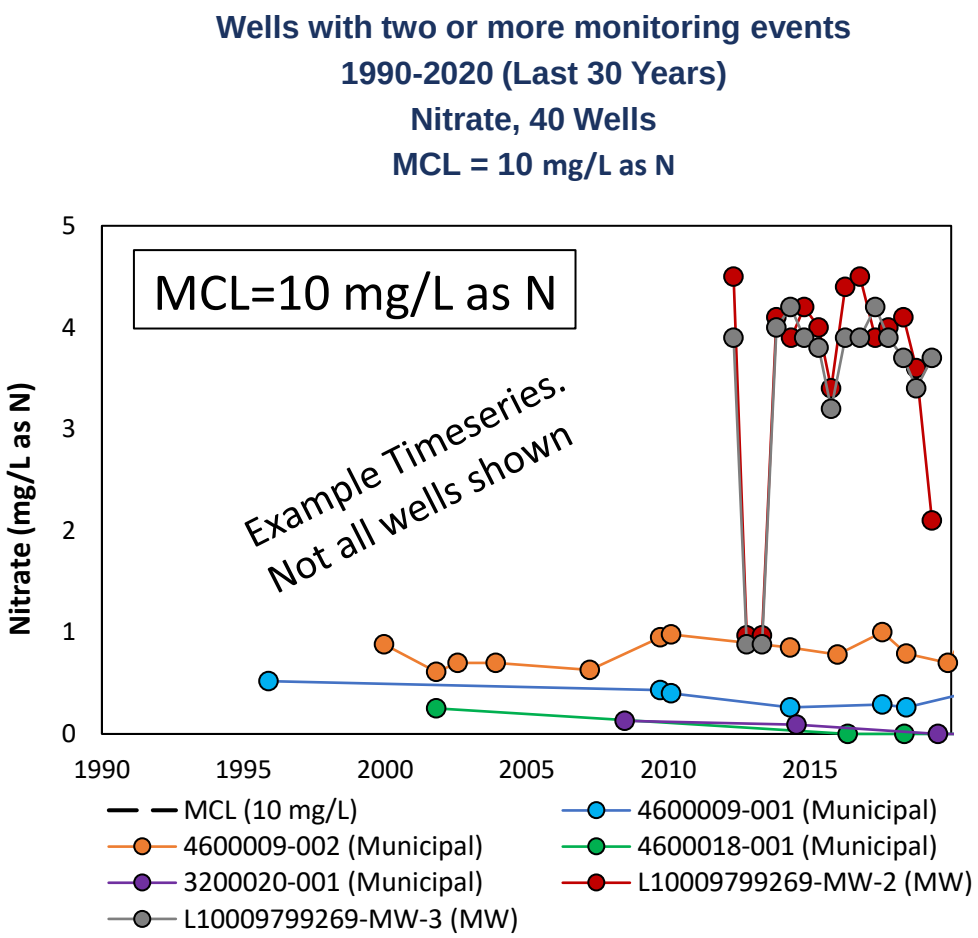
Maximum Contaminant Levels (MCLs), Notification Levels (NLs), and Water Quality Objectives (WQOs) for a handful of COCs

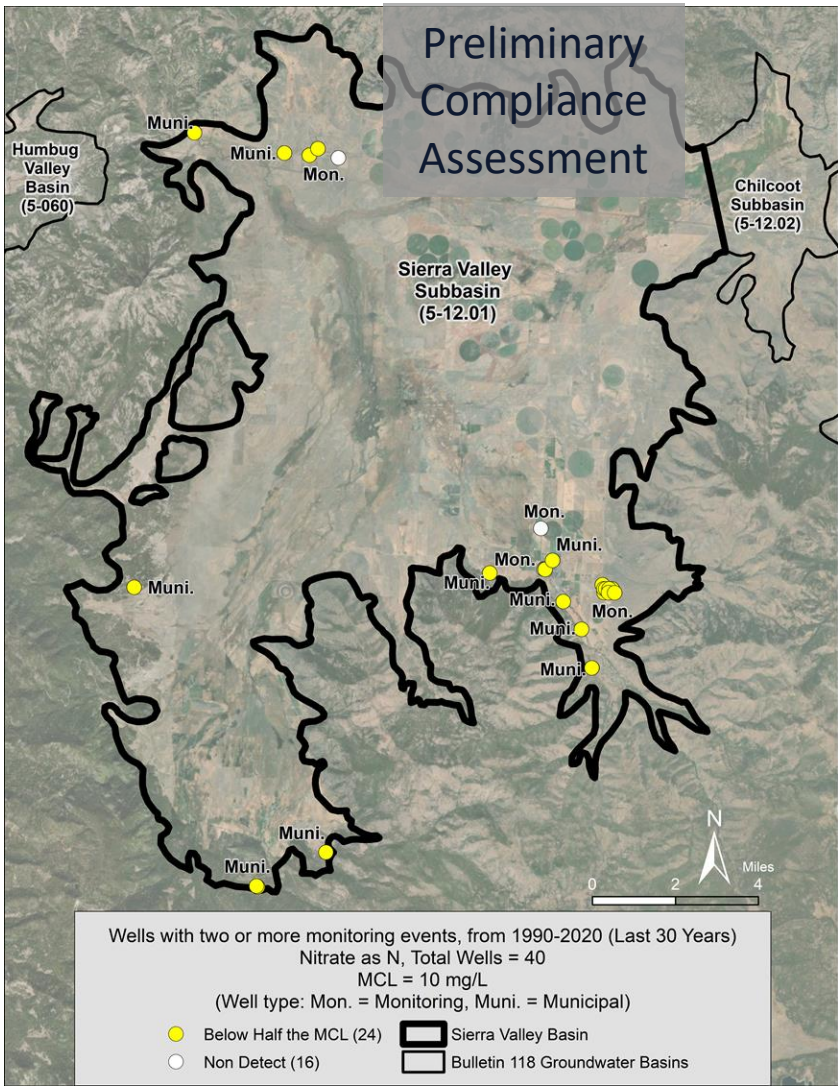
Constituent	Units	Applicable Regulation	Regulatory Threshold
Arsenic	µg/L	Primary MCL	10
Boron	mg/L	CA-NL	1
Chloride	mg/L	Secondary MCL	250
Fluoride	mg/L	Secondary MCL	2
Iron, Total	µg/L	Secondary MCL	300
Manganese, Total	µg/L	Secondary MCL	50
MTBE	µg/L	Primary Secondary	13 5
Nitrate	mg/L as N	Primary MCL	10
TDS	mg/L	Secondary MCL	500 (Recommended) 1,000 (Upper)

No Exceedance

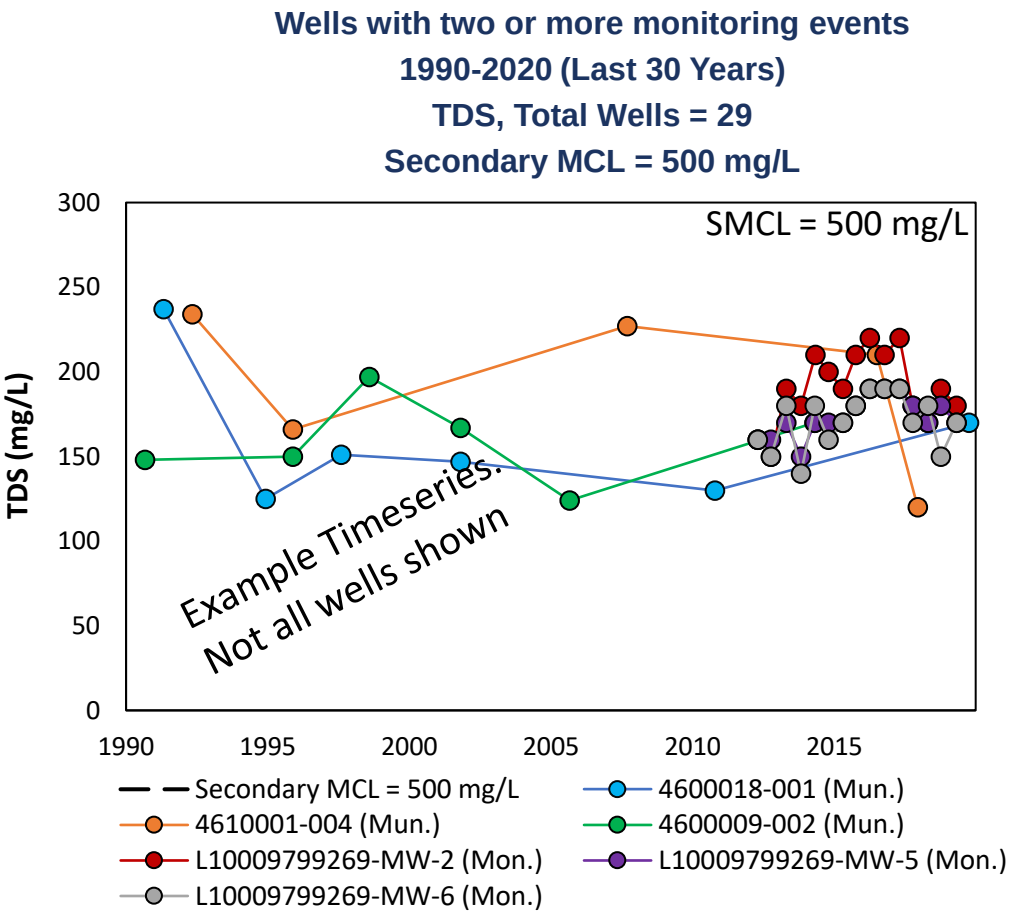
Measured Exceedance

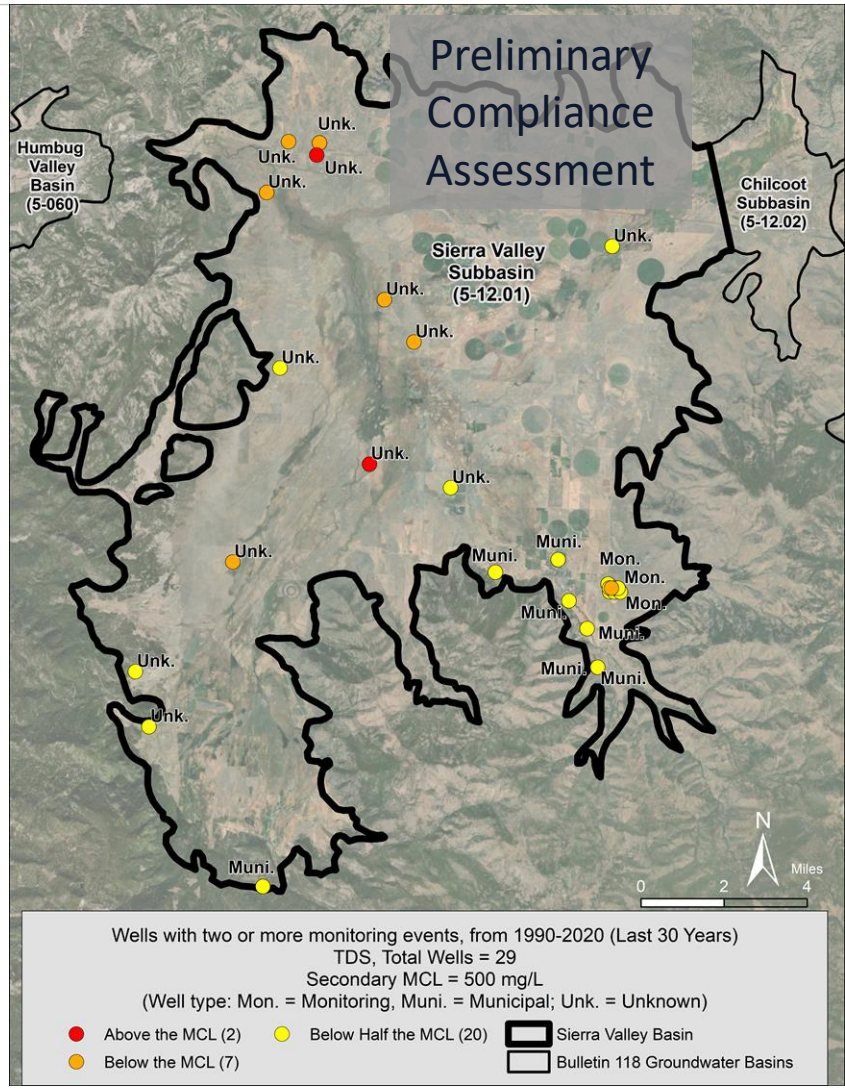
Nitrate – Two Views of Example Data



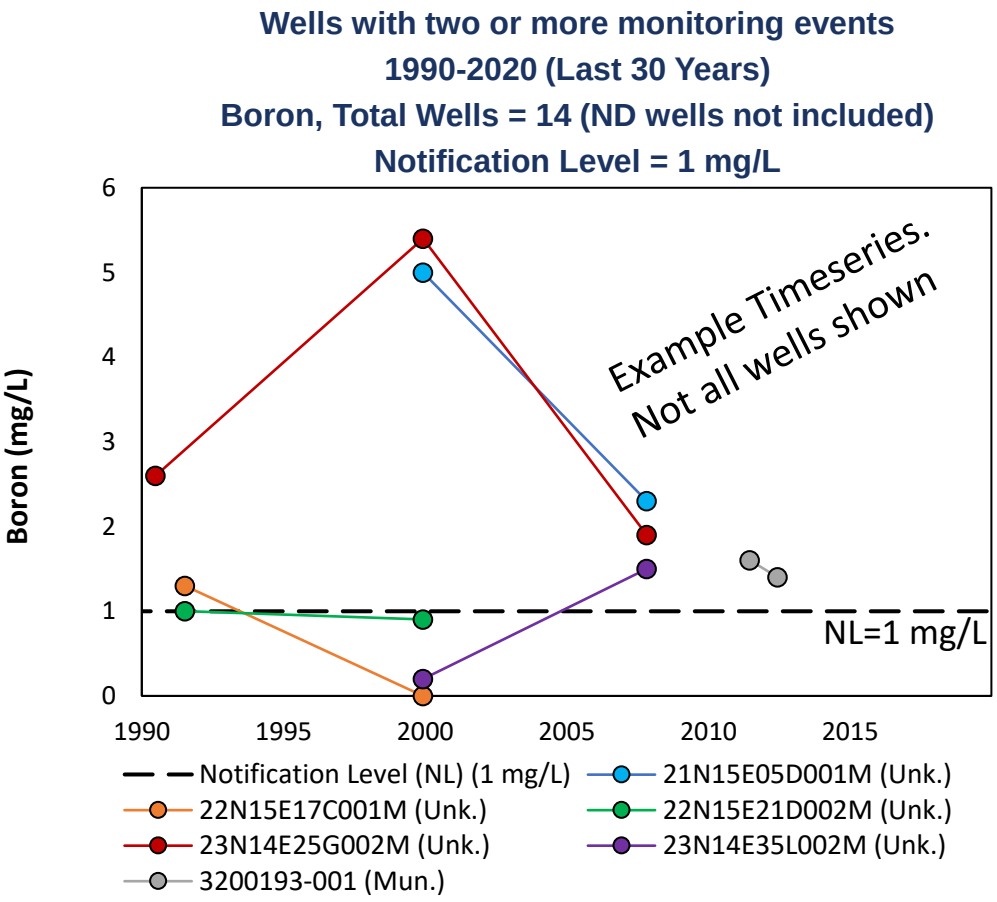


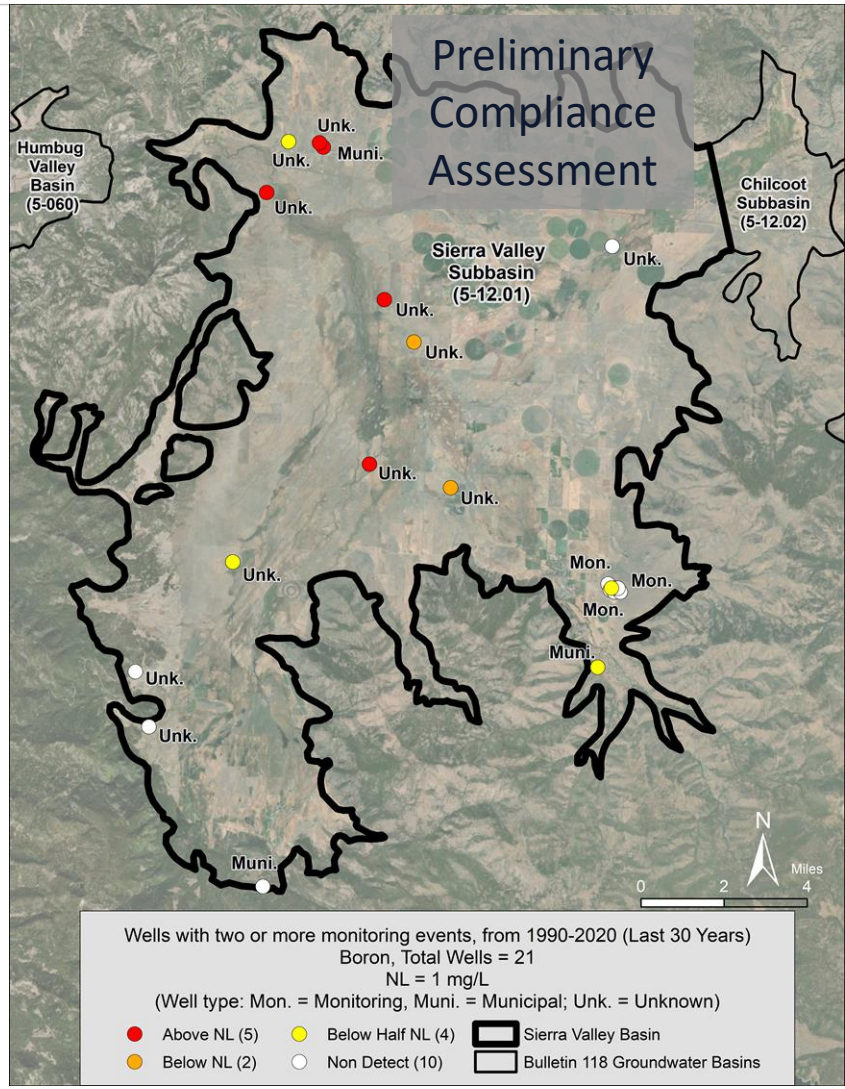
TDS– Two Views of Example Data



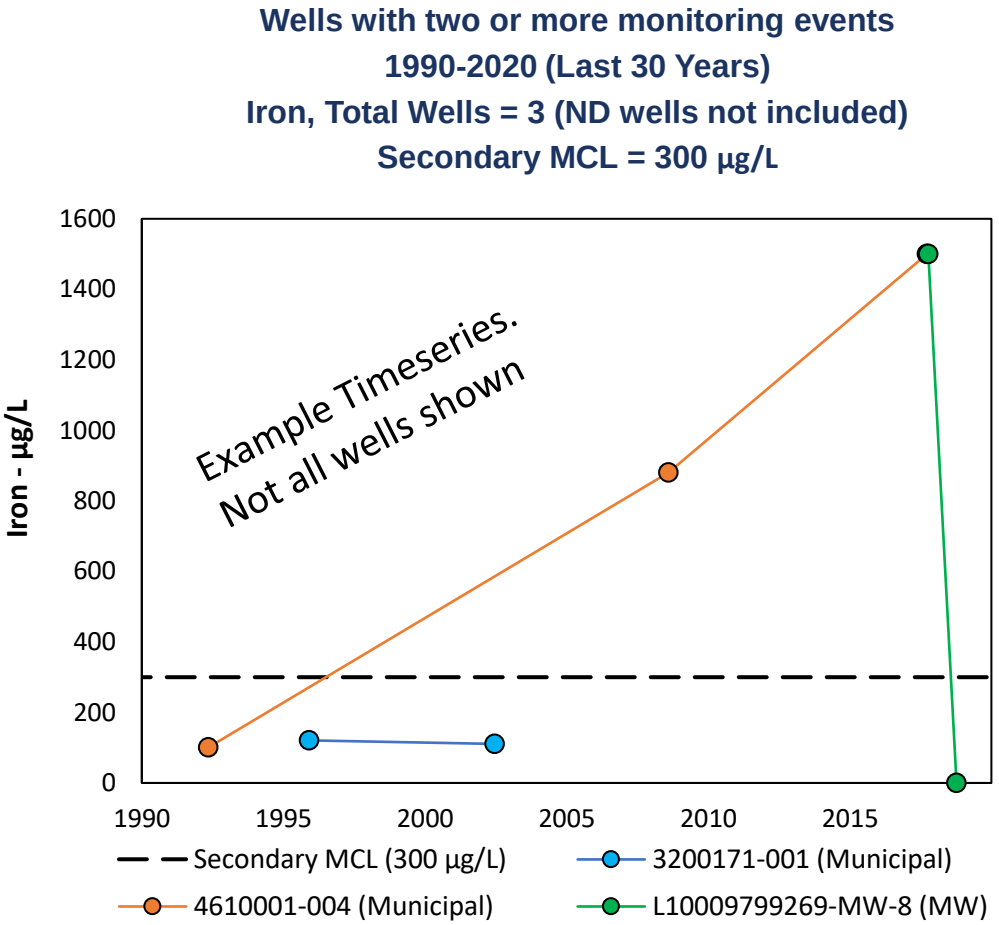


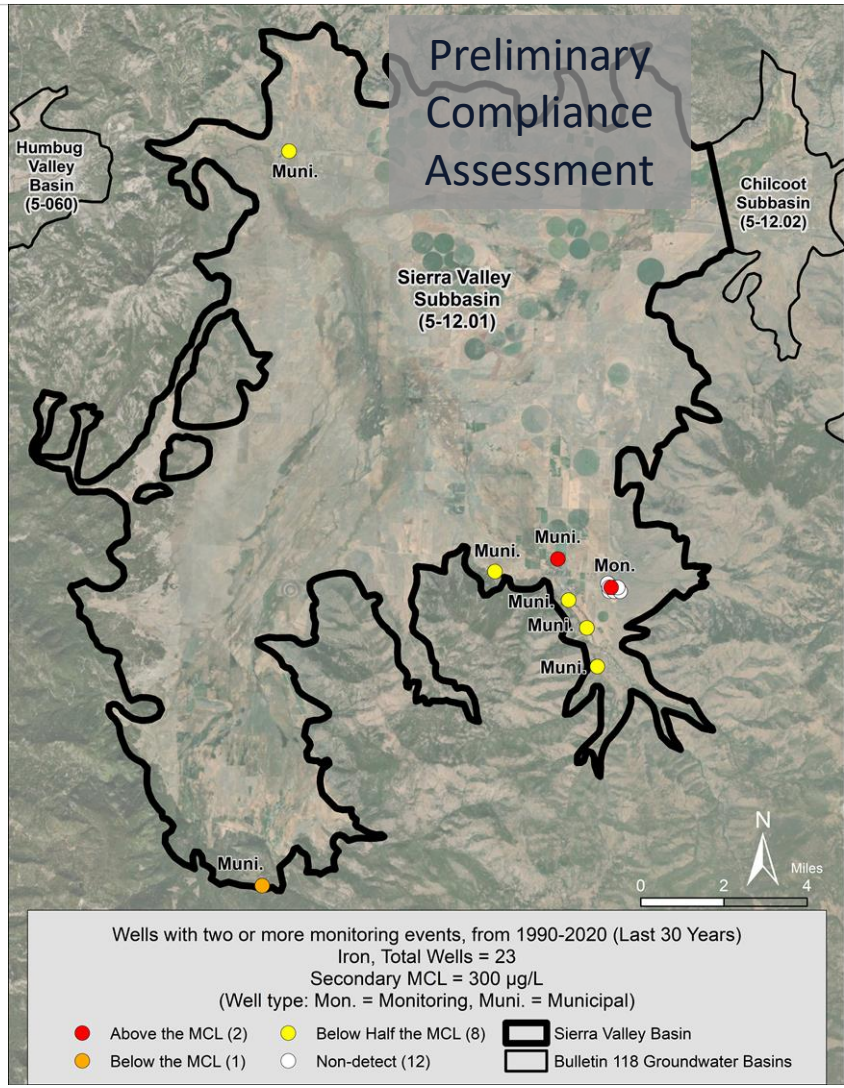
Boron – Two Views of Example Data





Iron – Two Views of Example Data





Examples from other GSPs

Basin	Constituents of Concern	SMCs Set For:	Approach
Mid- County Santa Cruz	Fe, Mn, Cr, Cr(VI), As, NO_3^-, TDS, ClO^-_4, organic compounds	All but Cr (VI)	SMCs set for all constituents of concern
Eastern San Joaquin	Salinity, NO_3^-, As , point-source contamination	TDS	No SMCs set for point-source contaminants or naturally occurring contaminant
Greater Kaweah	As, NO_3^-, Cr (VI), DBCP, TCP, PCE, Cl^-, Na, TDS, ClO^-_4	All	SMCs set for all constituents of concern
Cuyama	TDS, As, NO_3^-	TDS	SMCs set only for TDS
Delta Mendota	TDS, NO_3^-, B	All	SMCs set for all constituents of concern

Naturally occurring constituents

contamination/ contamination sites

How are other GSPs defining SMCs?

Basin	Maximum Threshold	Measurable Objectives	Undesirable Result
Mid- County Santa Cruz	State drinking water standards	Defined for each RMP, is the 2013-2017 average concentrations	Any RMP exceeds state drinking water standard due to groundwater pumping or MAR.
Eastern San Joaquin	upper limit SMCL	Recommended SMCL with added buffer	>25% of RMP wells exceed MTs for water quality for two consecutive years and area due to groundwater management activities
Greater Kaweah	Drinking water limit or Ag WQO based on primary use of the well	75% of MT	½ of all Subbasin RMPs exhibit MT exceedance associated with GSA actions
Cuyama	20% of total range above the 90th percentile at a representative well sites	mot recent measurement or 1,500 mg/L if latest measurements were above 1,500 mg/L	30% of RMPs exceed MT for a constituent for two consecutive years
Delta Mendota	upper SMCL, primary MCL, agricultural WQO or current water quality if MT exceeded	Current water quality conditions, upper limit of concentration range at each site	Exceedances of MCLs or WQOs for COCs for 3 consecutive samples in non-drought years OR water quality degradation from recharge projects greater than 20% of an aquifer's assimilative capacity

Next steps

- Define unreasonable and undesirable results for groundwater quality
- Refine the shortlist of constituents
- Some constituents will be presented in the Groundwater Sustainability Plan (Chapter 2), but no need to set limits (SMCs) within the Plan
- Need to develop the monitoring network for groundwater quality

Example of “Significant and Unreasonable” Undesirable Results for groundwater quality

- WQ impacts to safe drinking water
- WQ impacts to irrigation water use
- WQ impacts to stream baseflow (from groundwater)
  - Can be refined by development of groundwater-surface water (GW-SW) Sustainability Indicator

Review- Process to Identify COCs

Data set filtered to identify list of potential constituents of concern

- Data limited to those collected in the past 30 years (1990-2020)
- Limited to wells with three or more water quality measurements
- Timeseries and maps generated to compare data with regulatory thresholds (Title 22 and/or Basin Plan)

All COCs will be presented in Chapter 2 and can be monitored as needed, but we do not need to set SMCs for all of them

1) Arsenic (*Naturally-occurring, wood preservatives, pesticides*)

2) Boron (*Naturally-occurring, industrial wastes, sewage, fertilizers*)

3) Chloride *(Naturally occurring, brine concentrate, irrigation, industrial effluent)*

4) Iron *(Naturally-occurring, industrial effluent, mine waste)*

5) Manganese *(Naturally-occurring, industrial effluent, mine waste)*

6) MTBE *(Industrial effluent, fuel additive)*

7) Nitrate *(Fertilizers, animal waste, septic tanks*)

8) Total Dissolved Solids - *Salts (naturally occurring, brine concentrate, irrigation, industrial effluent)*

9) Fluoride *(naturally occurring, industrial waste)*

Suggested Constituents to Set SMCs For:

~~1) Arsenic (*Naturally-occurring, wood preservatives, pesticides*)~~

~~2) Boron (*Naturally-occurring, industrial wastes, sewage, fertilizers*)~~

~~3) Chloride (Naturally occurring, brine concentrate, irrigation, industrial effluent)~~

~~4) Iron (*Naturally-occurring, industrial effluent, mine waste*)~~

~~5) Manganese (*Naturally-occurring, industrial effluent, mine waste*)~~

~~6) MTBE (*Industrial effluent, fuel additive)*~~

7) Nitrate as Nitrogen (*Fertilizers, animal waste, septic tanks*)

8) Total Dissolved Solid - Salts (*naturally occurring, brine concentrate, irrigation, industrial effluent*)

~~9) Fluoride (*naturally occurring, industrial waste*)~~

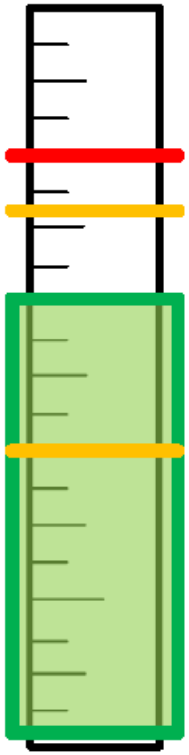
Thresholds and Measurable Objectives

- Maximum Threshold (Concentrations)
  - Regulatory Thresholds (Title 22 Drinking Water Standards)
  - Triggers (if applicable)
- Measurable Objectives
  - Well-specific
  - Within range of values measured in the past 30 years (1990-2020) at a particular well

    If historical values have exceeded the maximum threshold, the measurable objective will be 75% of the MT (Benzene)

Thresholds and Measurable Objectives: Nitrate example

Nitrate as Nitrogen

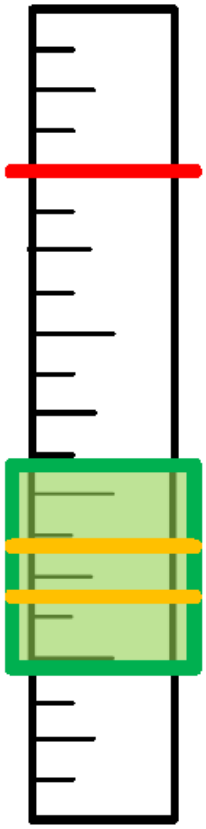


Maximum Threshold (MT) 10 mg/L as N
Trigger 9 mg/L as N

Trigger 5 mg/L as N
Measurable Objective (MO) 0.12 – 7.5 mg/L as N

Thresholds and Measurable Objectives: TDS example

Total Dissolved Solids (based on 6 example wells)



Maximum Threshold (MT) 500 mg/L

Trigger 210 mg/L

Measurable Objective (MO) 120 – 273 mg/L

Trigger 170 mg/L

Undesirable Results

- "The criteria used to define when and where the effects of the groundwater conditions cause undesirable results for each applicable sustainability indicator. The criteria shall be based **on a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the basin**."

Quantification of Undesirable Results

Exceedance of maximum thresholds for concentration in over 20% of wells in the monitoring network

AND/ OR

Significant increasing trend in degradation of water quality as indicated by an increase by more than 1% per year, on average over ten years, in more than 20% of wells in the monitoring network.

How do we select the monitoring network for groundwater quality?

- If possible, build on existing networks (such as municipal or water district networks already collecting data)
- Which wells have been regularly monitored in the past years?
- Are there data gaps (both as location and COC) that the GSAs should cover?

Sierra Valley: Groundwater Quality Data

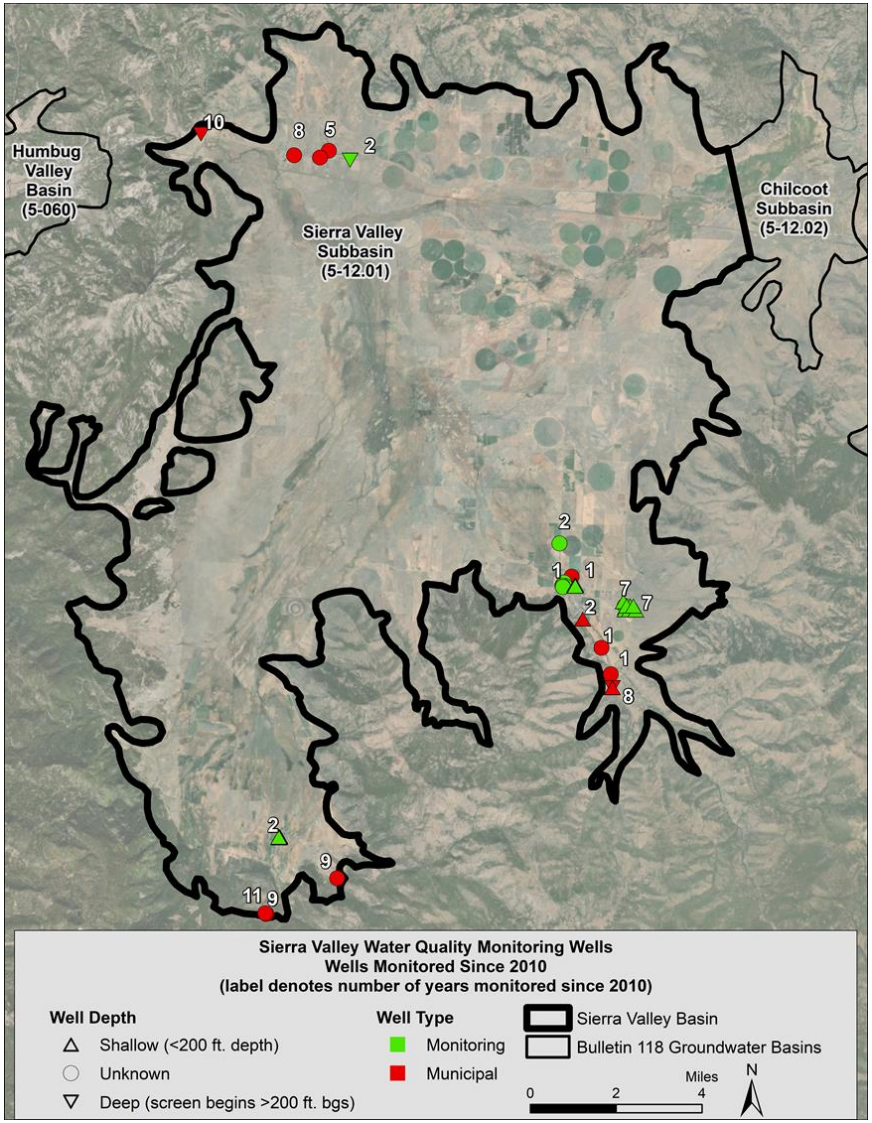
49 Wells Sampled Since 2010

- Monitoring = 36
- Municipal = 13

- Deep = 3
- Shallow = 22
- Unknown = 24

Between 3 – 143 unique constituents analyzed per well

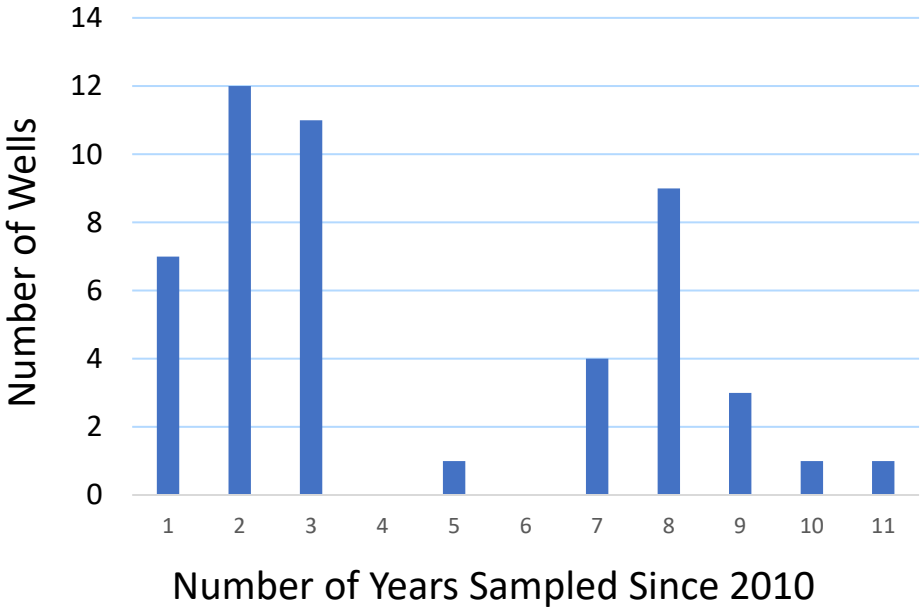
- At a minimum, MUN wells analyzed for Nitrogen

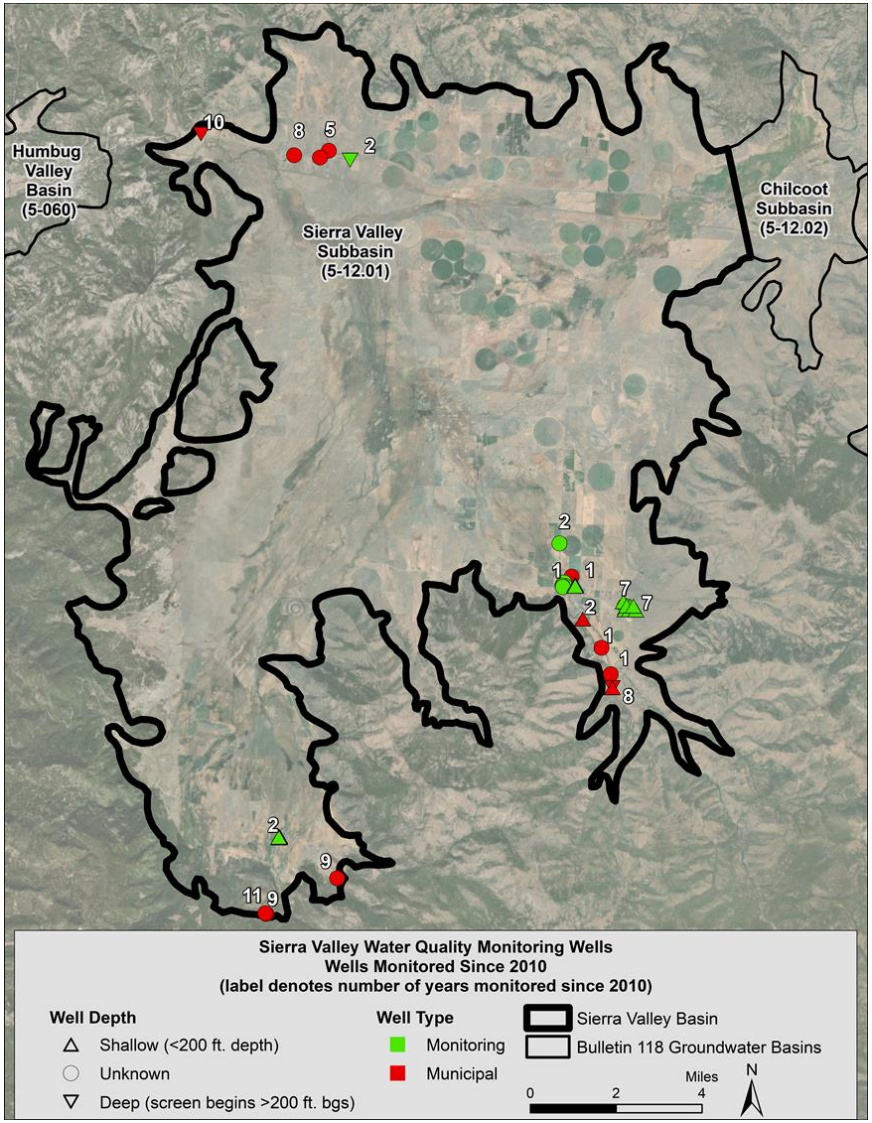


Sierra Valley: Groundwater Quality Data

1 well has been sampled every year since 2010

3 wells have been sampled 9 years since 2010





In summary

- Do you agree with our selection approach for COCs to be included either in the current condition (Chapter 2) or for which we will set SMCs (Chapter 3)?
- Do you think we are missing available data?
- Can we build on existing network? Should we increase the number of wells to be monitored?

Water Quality SMC Discussion

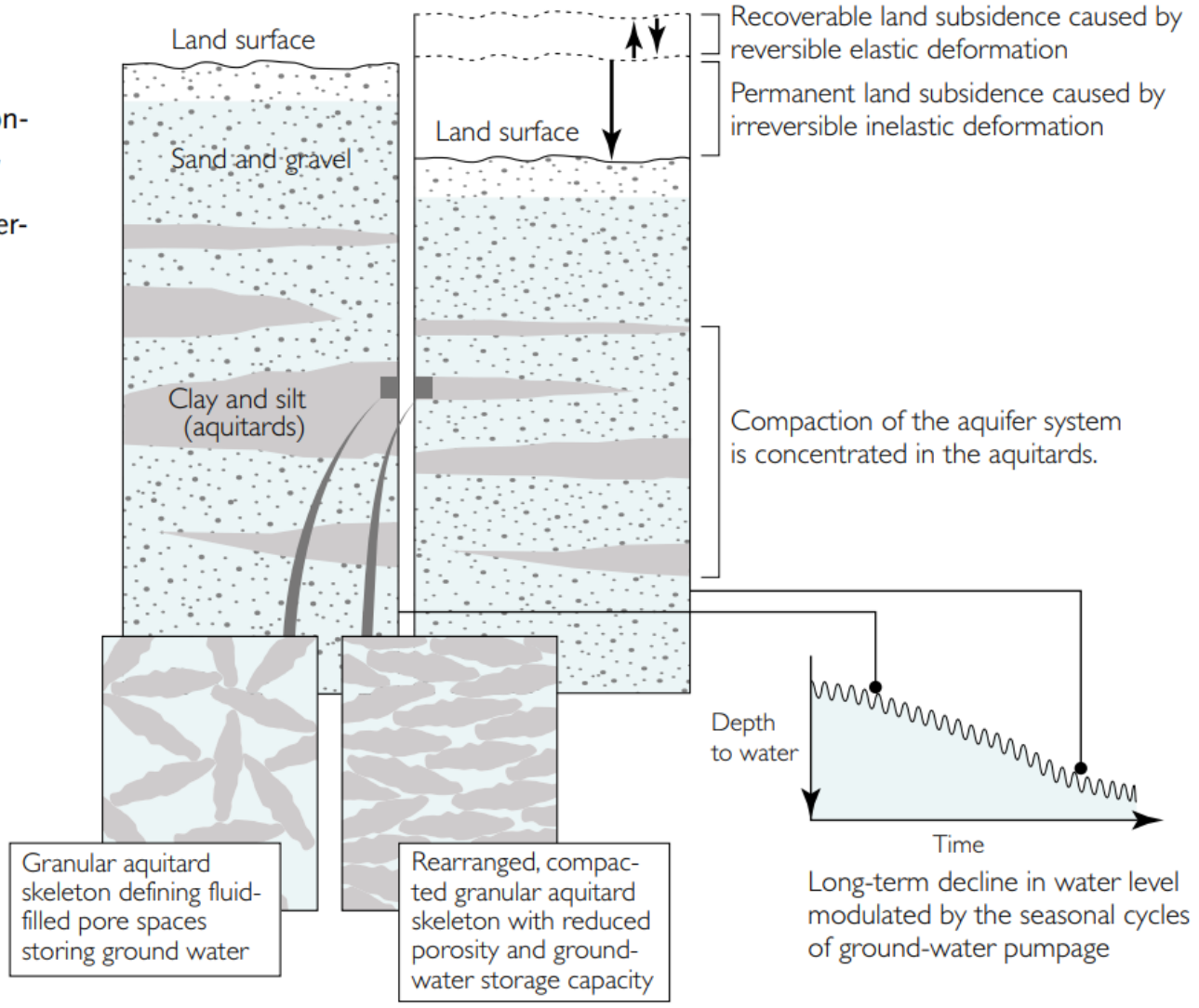
BREAK

Agenda

- Comments from the past meeting?
- Review: Assessing Sustainability
- Water Quality SMC
- Subsidence SMC
- Discussion

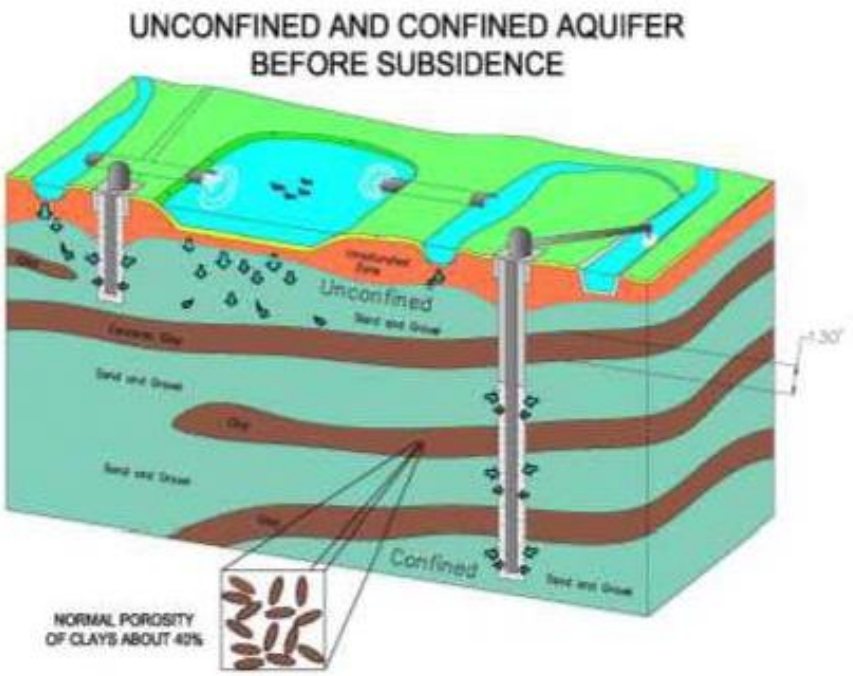
What is subsidence? (Elastic vs. inelastic)

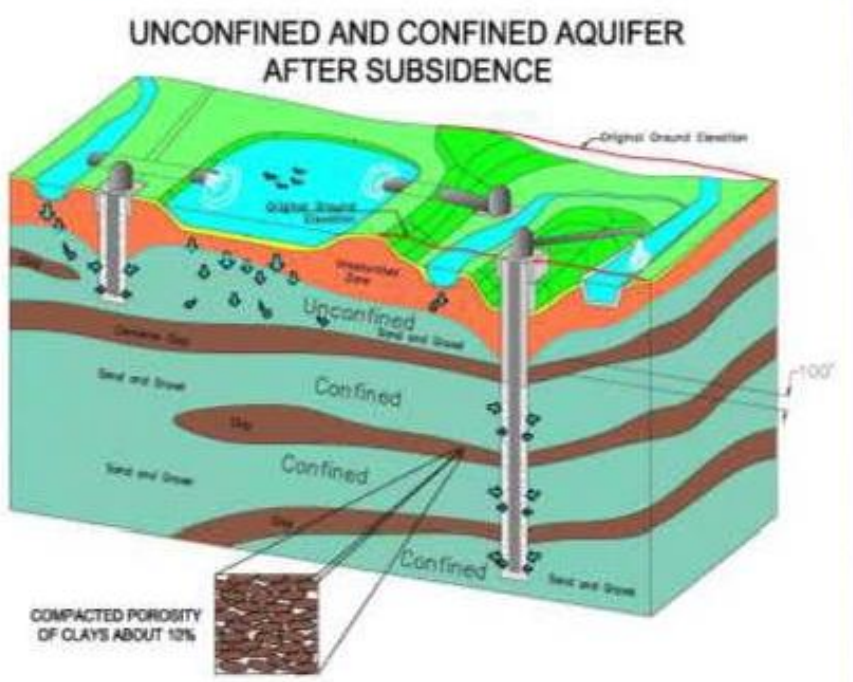
When long-term pumping lowers ground-water levels and raises stresses on the aquitards beyond the preconsolidation-stress thresholds, the aquitards compact and the land surface subsides permanently.



USGS science for a changing world

What is subsidence?





Redtop Gas Well

Redtop water well

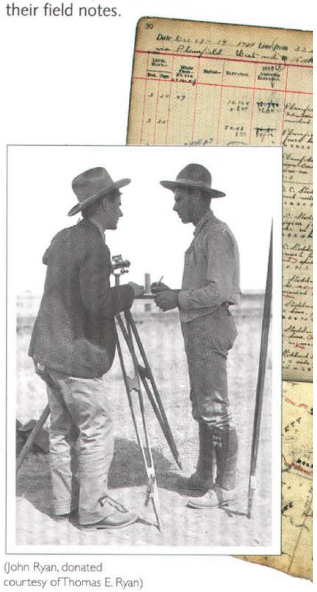
EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

What would subsidence concerns look like for Sierra Valley?

- Public infrastructure impacts
  - Roads
  - Tracks
- Private infrastructure impacts
  - Irrigation ditches
  - Well damage
- Basin impacts
  - Reduced Storage
  - Streams
  - Wetlands
- How much is too much?

Subsidence Study Methods

USGS survey party spirit leveling near Colusa, Sacramento Valley, in 1904 and their field notes.

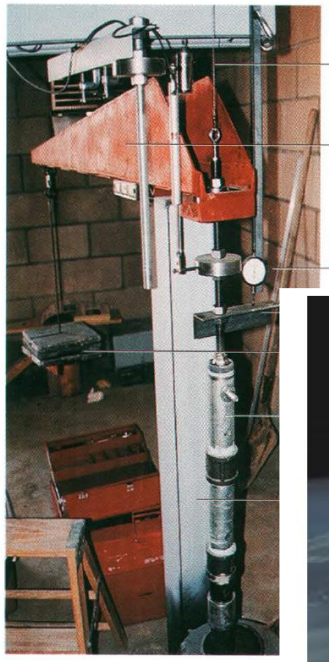


(John Ryan, donated courtesy of Thomas E. Ryan)

A full constellation of the Global Positioning System (GPS) includes 24 satellites in orbit 12,500 miles above the Earth. The satellites are positioned so that we can receive signals from six of them at any one time from any point on the Earth.

(Jay Prendergast, 1992)

A GPS antenna mounted on a tripod at a known distance above a geodetic mark near Monterey, California, receives signals from GPS satellites. The operator is entering station information into a receiver that stores the signals for later processing.



Part of a two-stage counter-weighted pipe extensometer that measures compaction in a shallow aquifer near Lancaster,

Ground elevation surveying

Satellite GPS

Extensometers

Airborne or Satellite (InSAR)

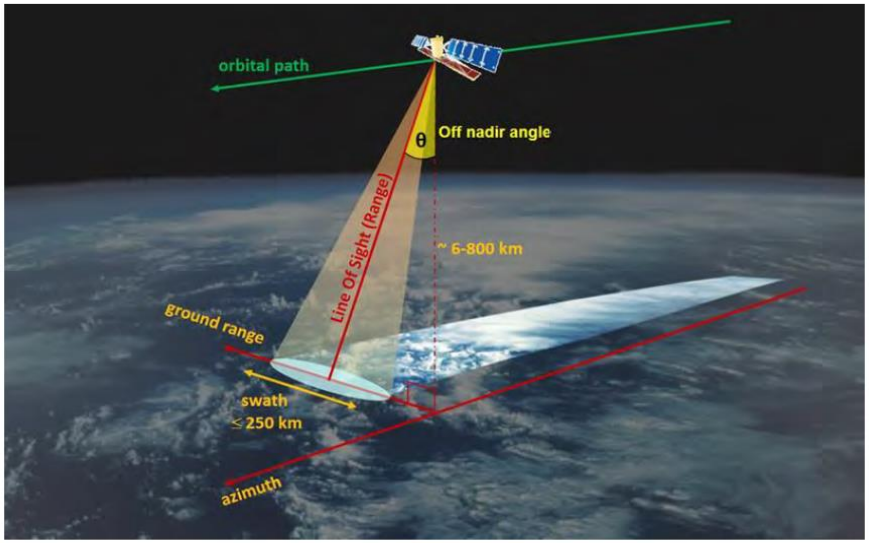


Figure 4: Schematic of the SAR satellites acquisition geometry. The Line of Sight (LOS) θ angle is different for each satellite track.

LARRY WALKER ASSOCIATES
Science. Policy. Solutions.

Figure credits: USGS, DWR, & TRE Altamira

Sierra Valley Subsidence: Data Sources

Ground Surveying

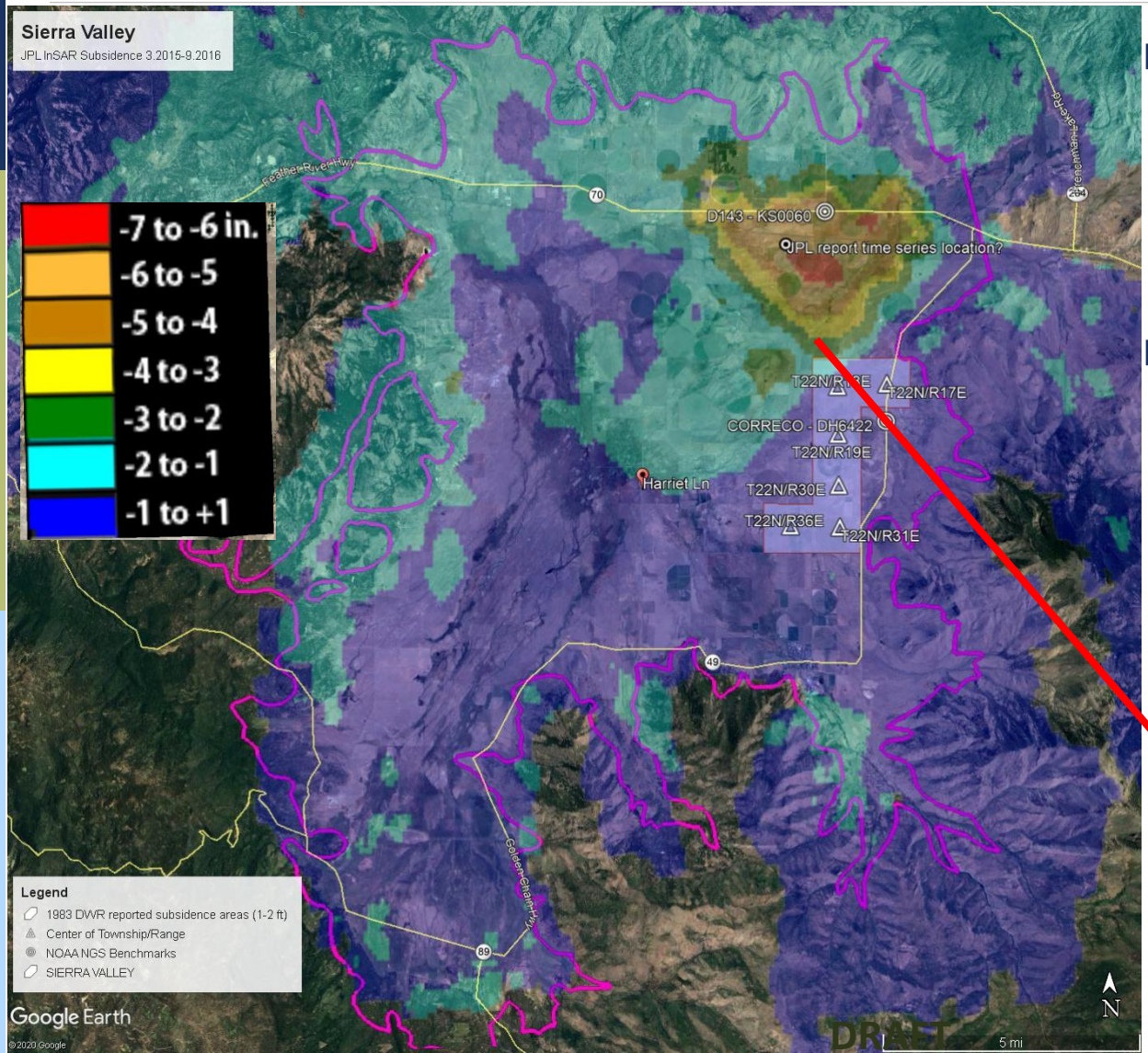
- 1983 DWR report on SVGMD Tech Report
  - Evaluated well casing elevations
  - 1.5 feet subsidence in Eastern portion between 1950 and 1983
  - Groundwater level declines of ~3-20 feet in the area
- 1983 Plumas County Road Survey
  - USGS Benchmarks compared to 32 Wells
  - 1 to 2 feet subsidence from 1958 to 1983
- 2016 Caltrans

Sierra Valley Subsidence: Data Sources

Satellite InSAR

- 2016 JPL Report
- DWR/TRE Altamira/Towill Study (2015-2019+)
- Re-analysis from JPL (2015-2019)

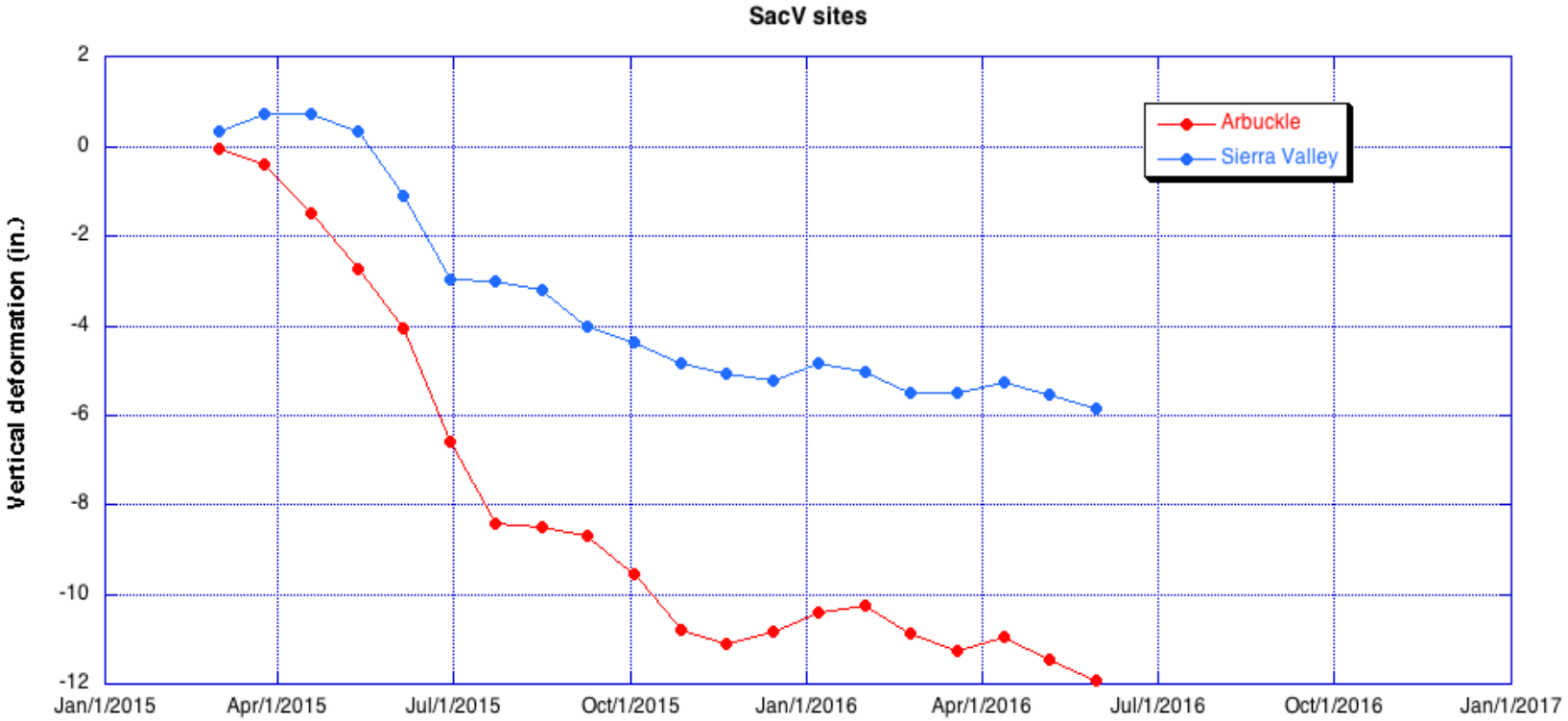
Subsidence Studies: 2015-2016 NASA JPL Study (Satellite InSAR)



- March 2015-May 2015: ~1” of swelling (surface rises)
- May 2015 - June 2016: up to 6” of subsidence (NE part of Valley)

Area of ~1-2’ of subsidence documented by DWR for period 1960-1983

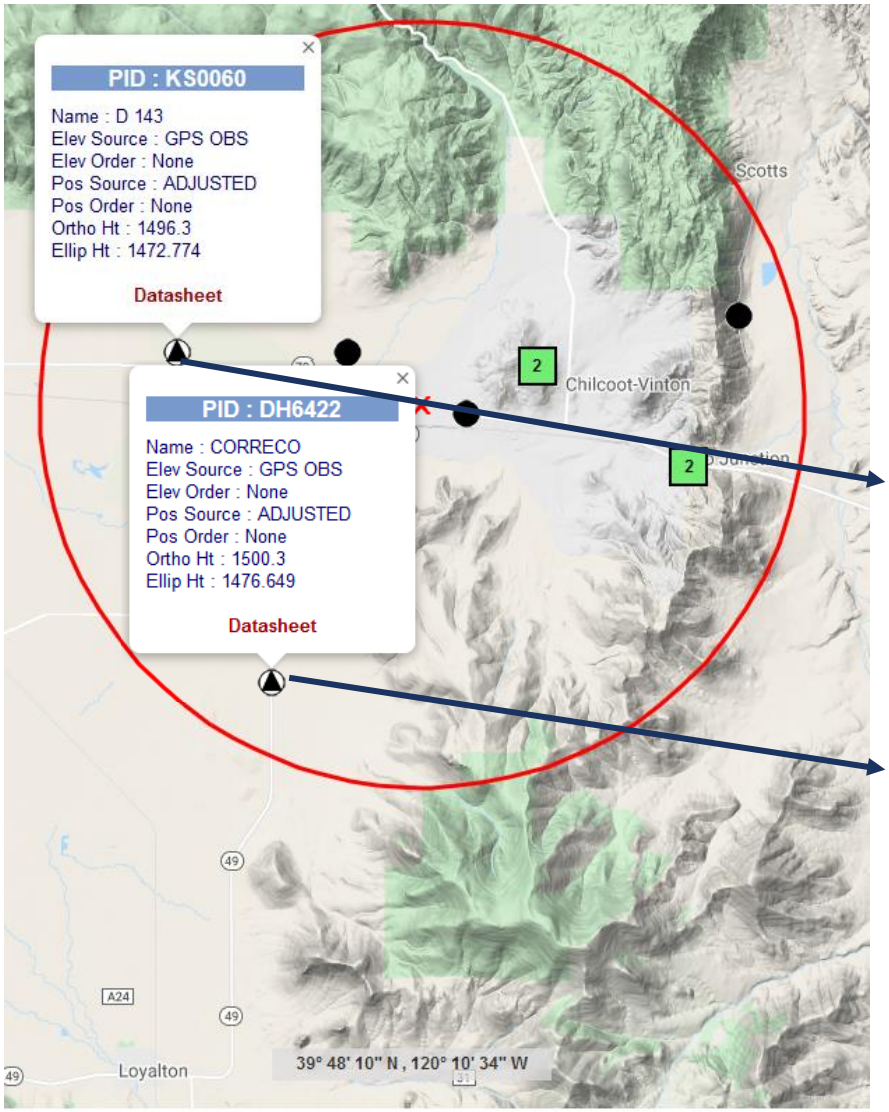
Subsidence Studies: 2015-2016 NASA JPL Study (Satellite InSAR) – continued



- March 2015-May 2015: ~1” of swelling (surface rises)
- May 2015 - June 2016: up to 6” of subsidence (NE part of Valley)

DRAFT

Subsidence Studies: 2012-2016 CalTrans Study (Ground Surveying)

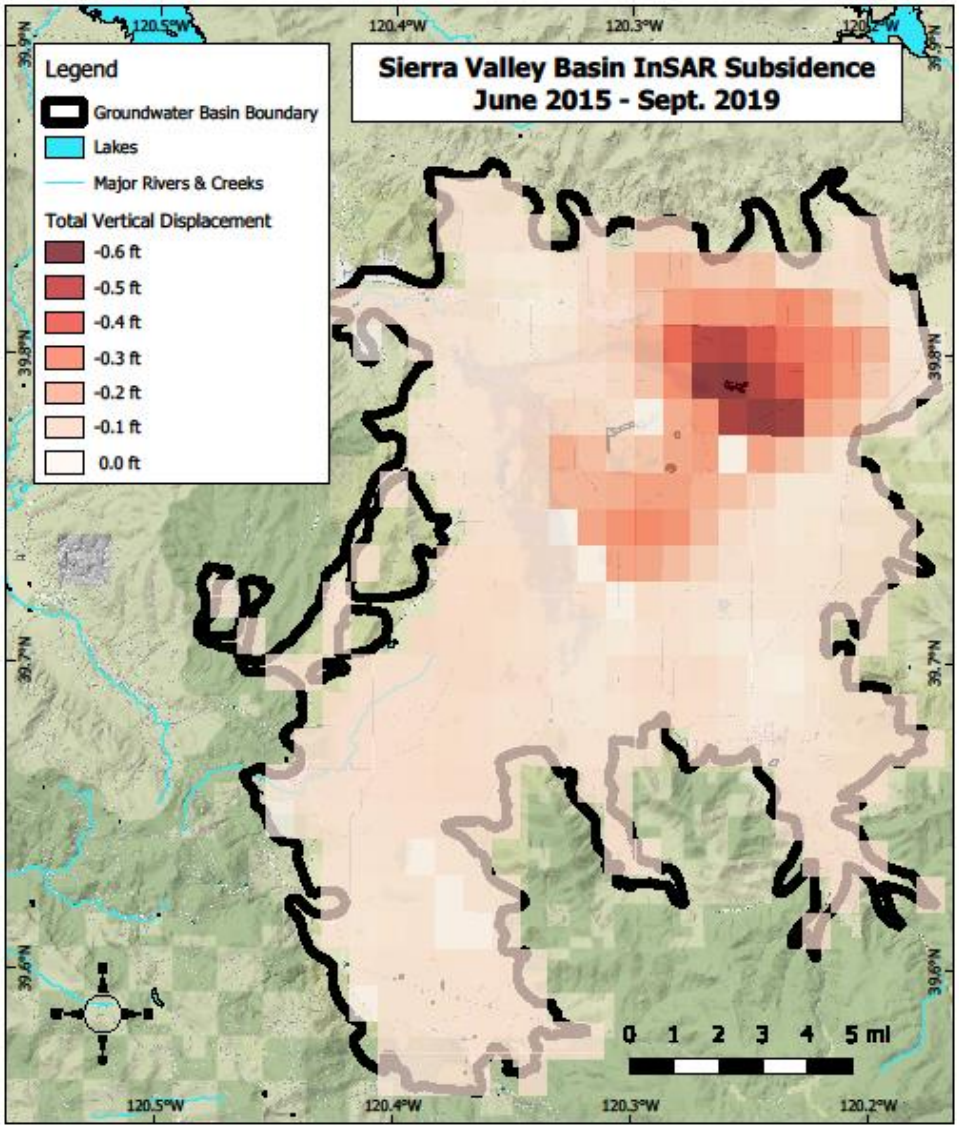


- NE and E Valley NOAA NGS survey monuments subsided by 1.9 and 0.3 feet, respectively

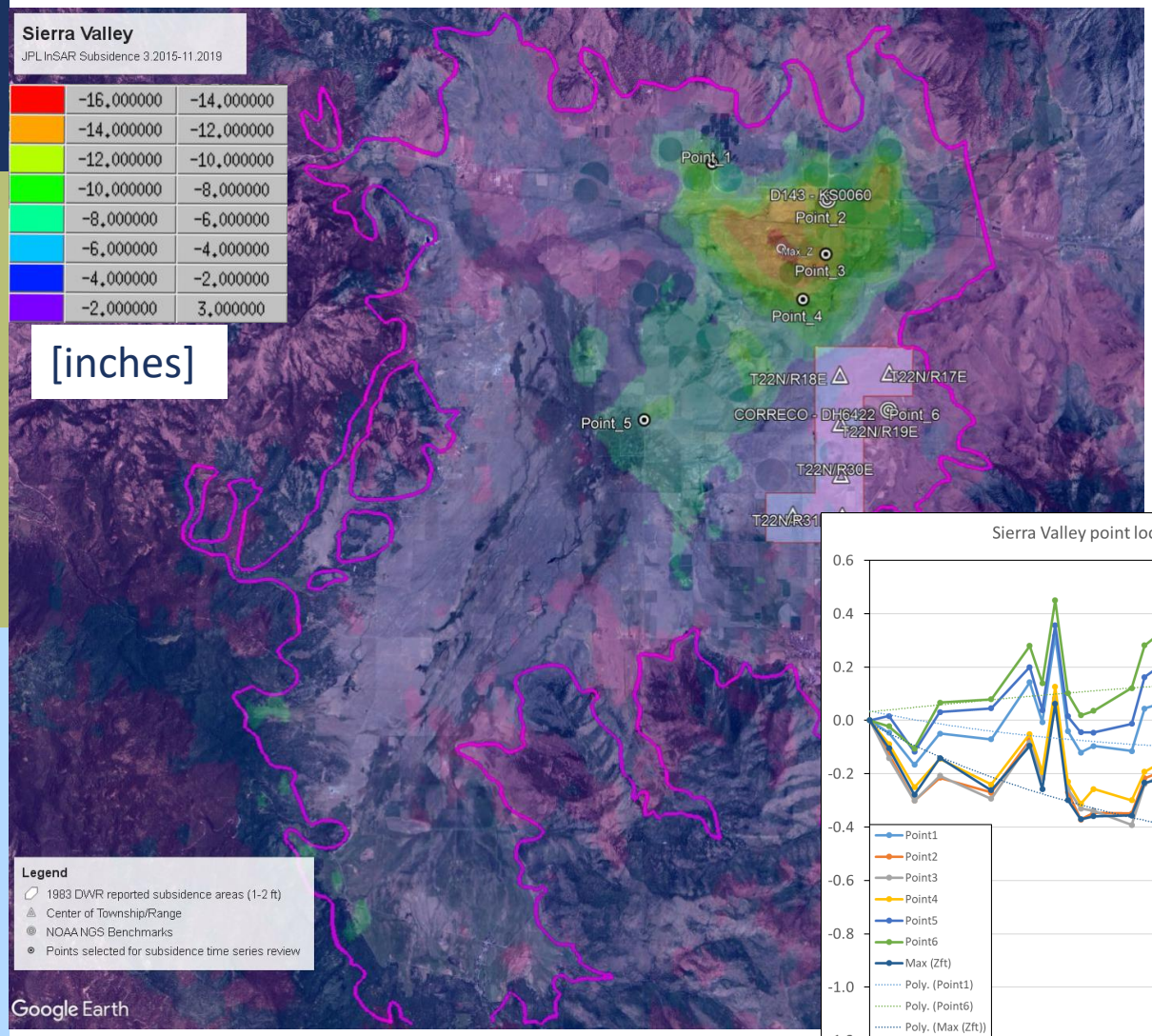
- Monument D143 → <u>-1.9 feet</u>
  - 6-27-2012: 4,909.12 feet
  - 10-26-2016: 4,907.22 feet

- Monument CORRECO → <u>-0.3 ft</u>
  - 6-27-2012: 4,922.24 feet
  - 10-26-2016: 4,921.94 feet

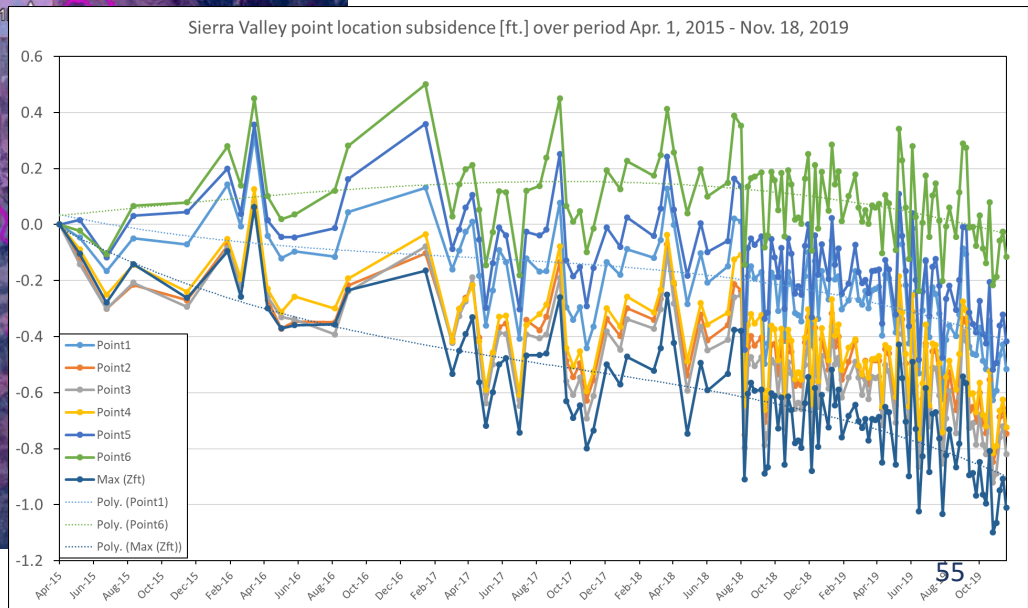
Subsidence Studies: Satellite InSAR DWR/TRE Altamira/Towill Study (2015-2019)



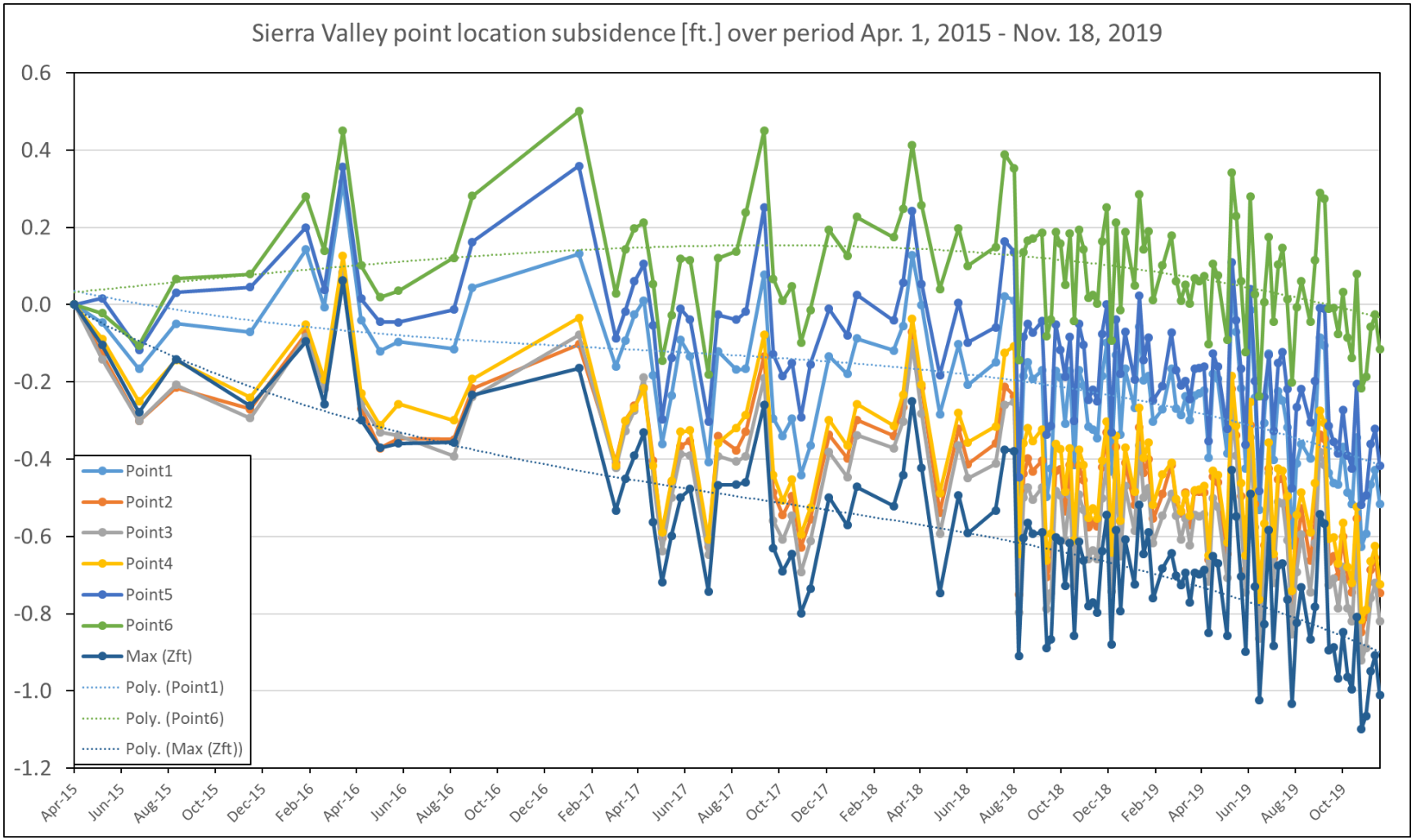
Subsidence Studies: Satellite InSAR NASA JPL Study (2015-2019)



- Mar 2015-Nov 2019: up to ~14” [1.2 ft] of subsidence (NE part of Valley)



Subsidence Studies: Satellite InSAR NASA JPL Study (2015-2019) – continued

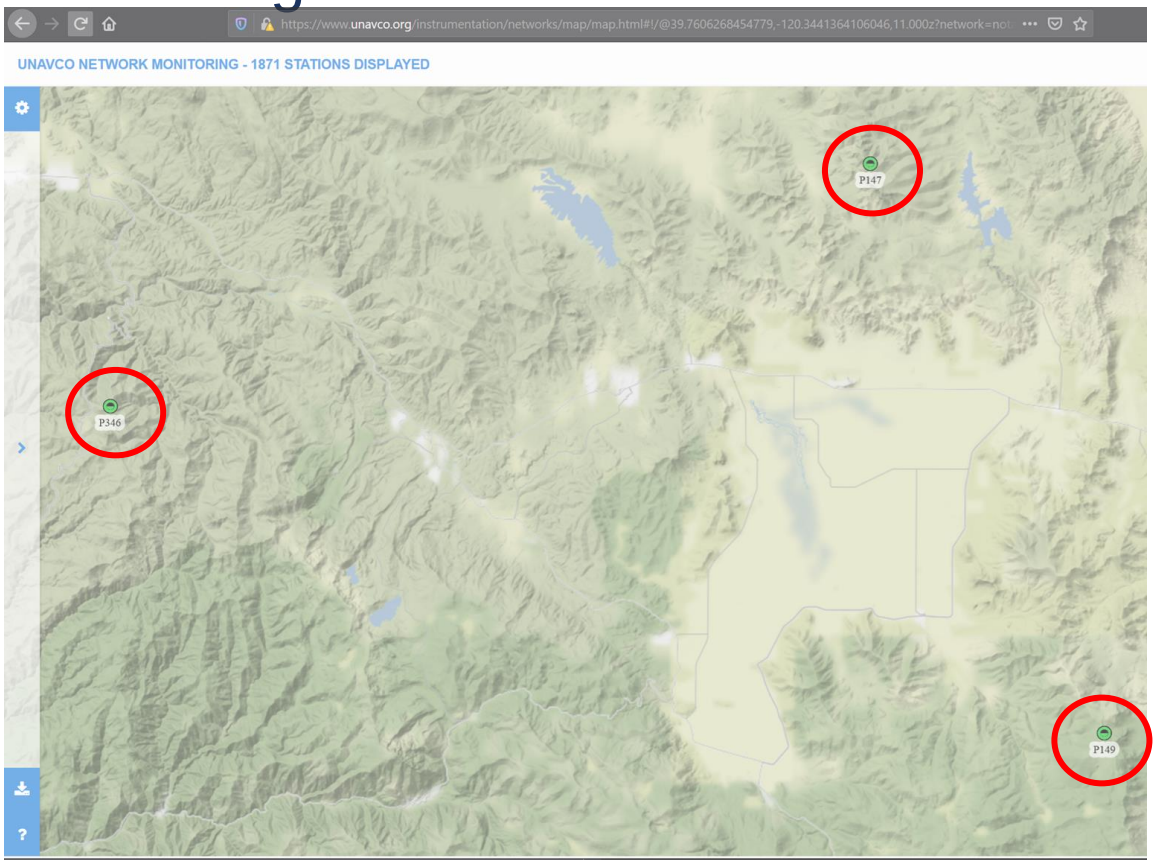


Future Monitoring Possibilities

- Usage and availability of DWR/TRE Altamira InSAR data
  - Uncertain availability after 2022
- Ground elevation surveys
  - Likely follow Plumas Co. and CalTrans survey grids for historical information
- Extensometers installed and monitored
  - Currently none installed
  - Expensive, potential funding can be investigated

Future Monitoring Possibilities

- Install GPS stations and monitor (see map)
  - None currently in UNAVCO network
  - Investigate possible funding
- Groundwater elevation proxy



Subsidence Summary

- DWR (1983): inelastic subsidence occurred in the basin consistent within expected ranges for the amount of groundwater decline observed (~1-2+ feet down during period of ~1960-1983)
- Subsidence during 1983-2012 is unaccounted for (as far as we know at present)
- CalTrans survey data suggest subsidence of 0.3-1.9 feet occurring during the period of 2012-2016
- NASA JPL InSAR data show widespread subsidence in the NE part of the Valley of up to 1.2 feet during the period of 2015-2019
- DWR /TRE Altamira InSAR data show subsidence of up to 0.6 feet over widespread areas, potentially higher in smaller areas, during the period of 2015-2016
- Methodologies exist and are feasible for Sierra Valley to manage subsidence for SGMA GSP compliance

Next Steps

- Establish undesirable results of land subsidence within Sierra Valley.
  - What has happened within the last ten years?
- Develop Sustainable Management Criteria (SMCs) within the Plan.
  - What infrastructure needs to be protected?
- Develop monitoring network for subsidence.

Subsidence SMC Discussion