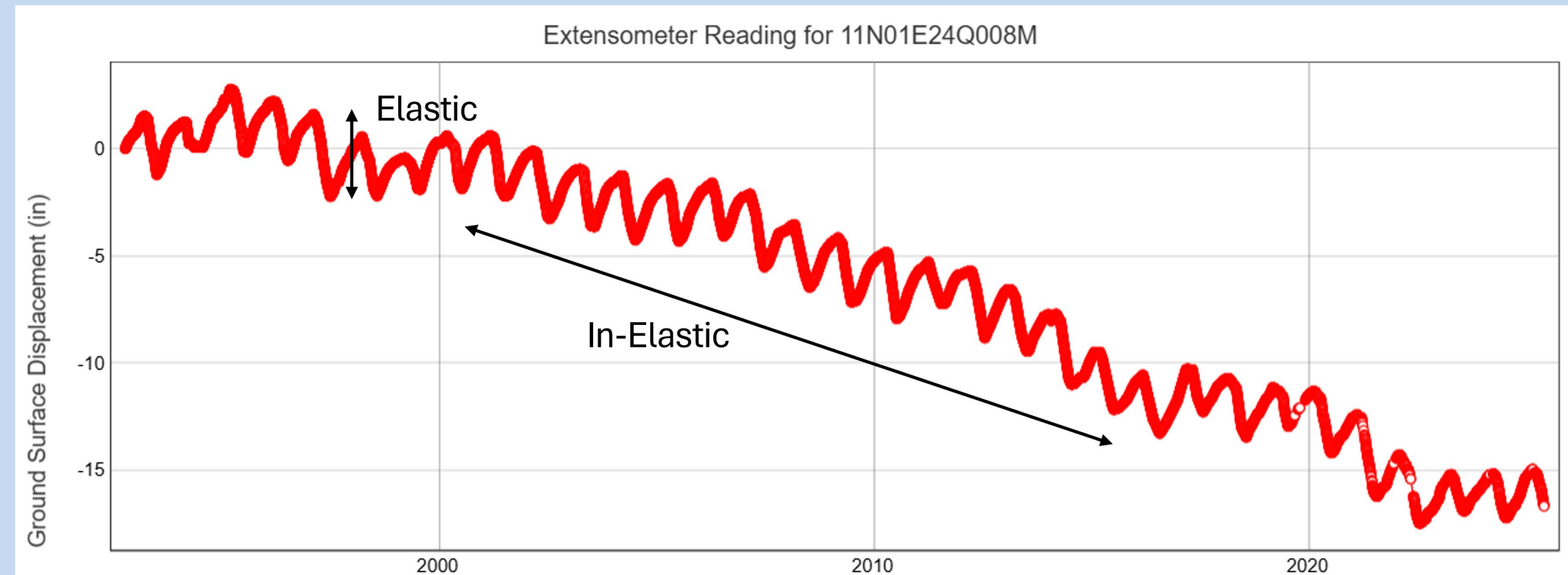
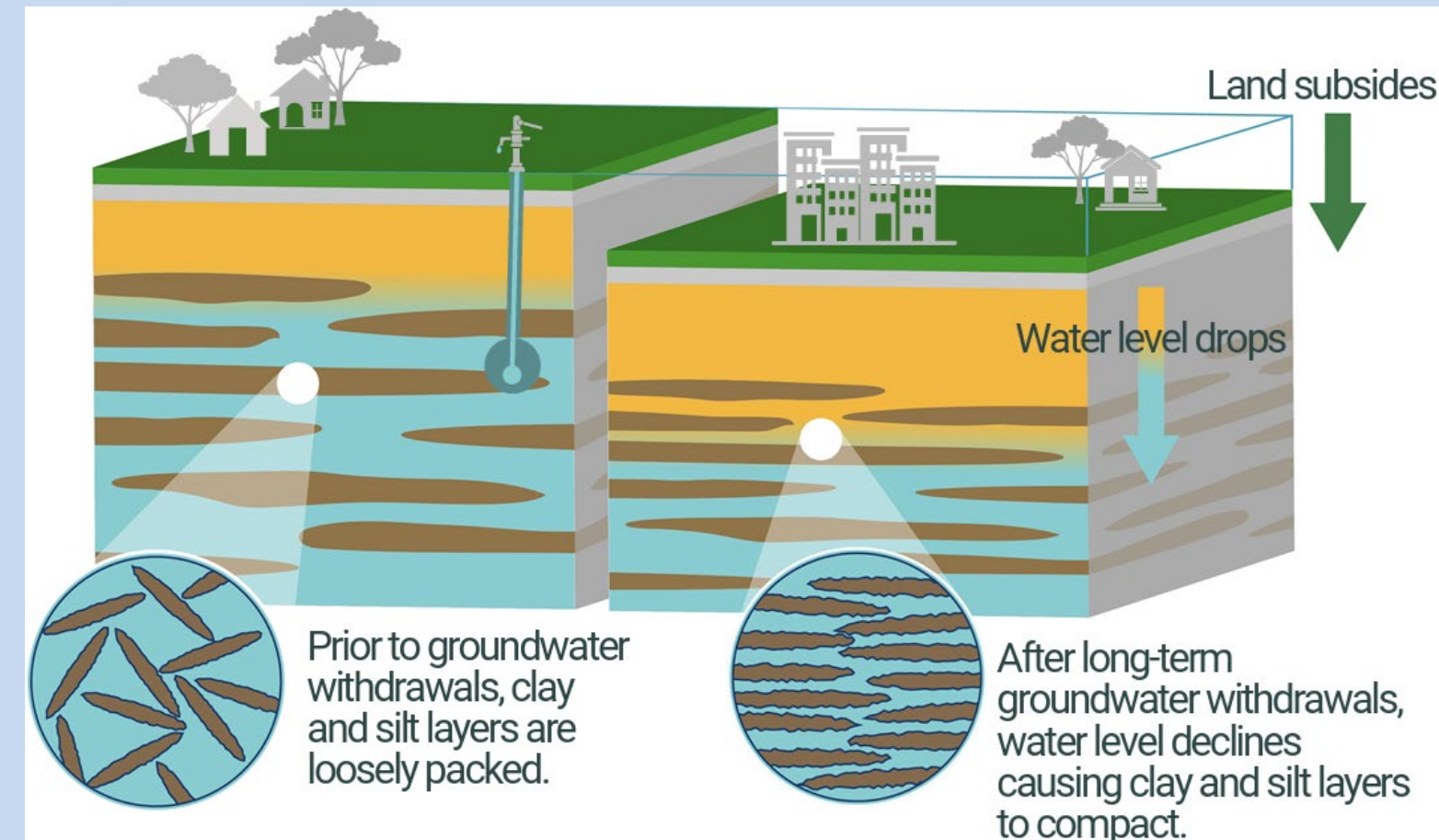


Subsidence Best Management Practice Document



Subsidence Fundamentals

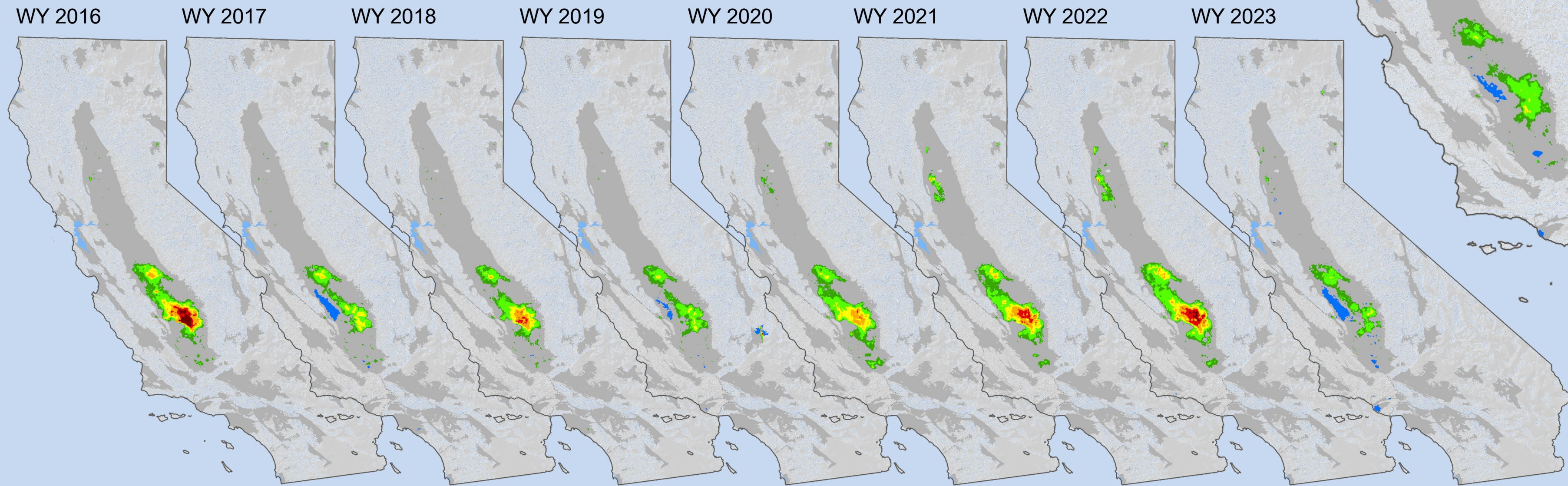
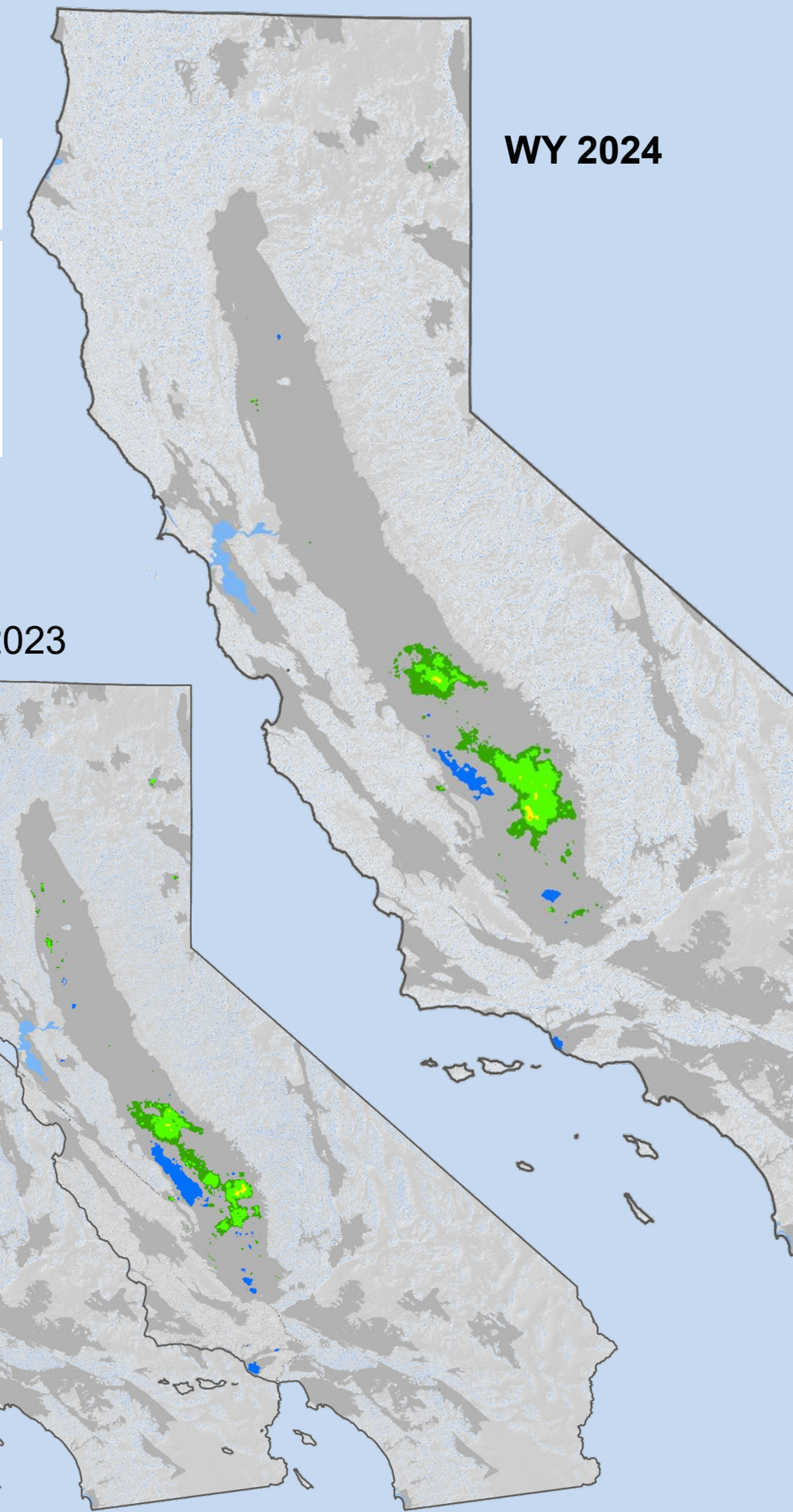
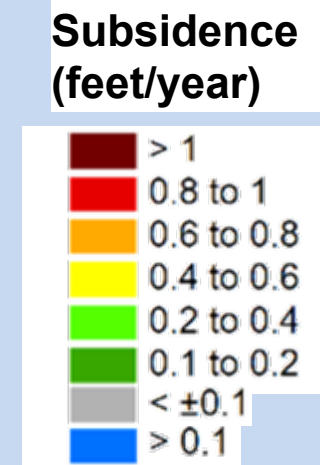
- **Compaction** - Compaction of fine-grained subsurface sediments causes land subsidence
- **Elastic (reversible) vs. inelastic (irreversible) subsidence**



Subsidence Trends

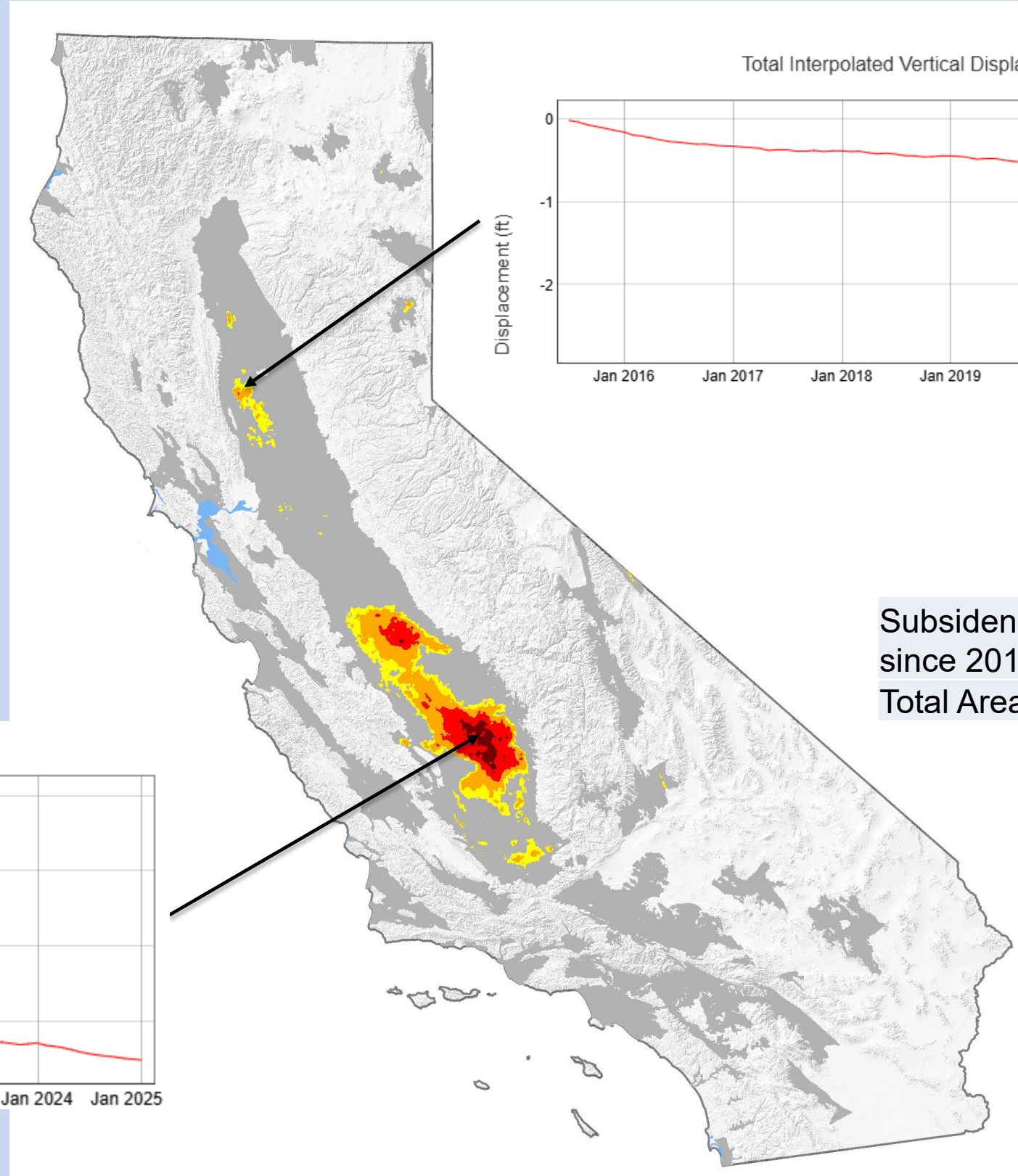
InSAR Subsidence Data

- Monthly timesteps - Quarterly Updates

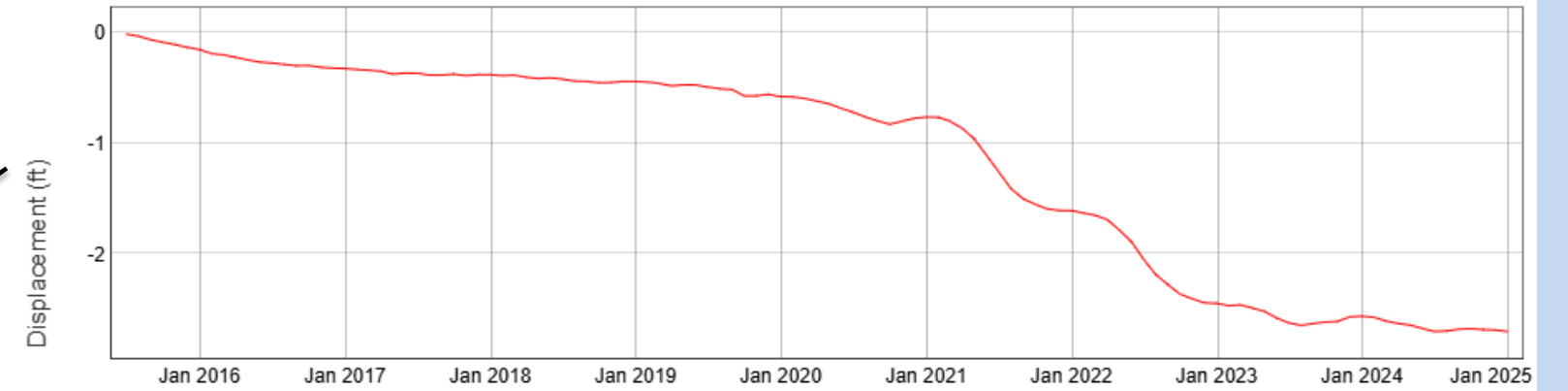


Recent Subsidence Data

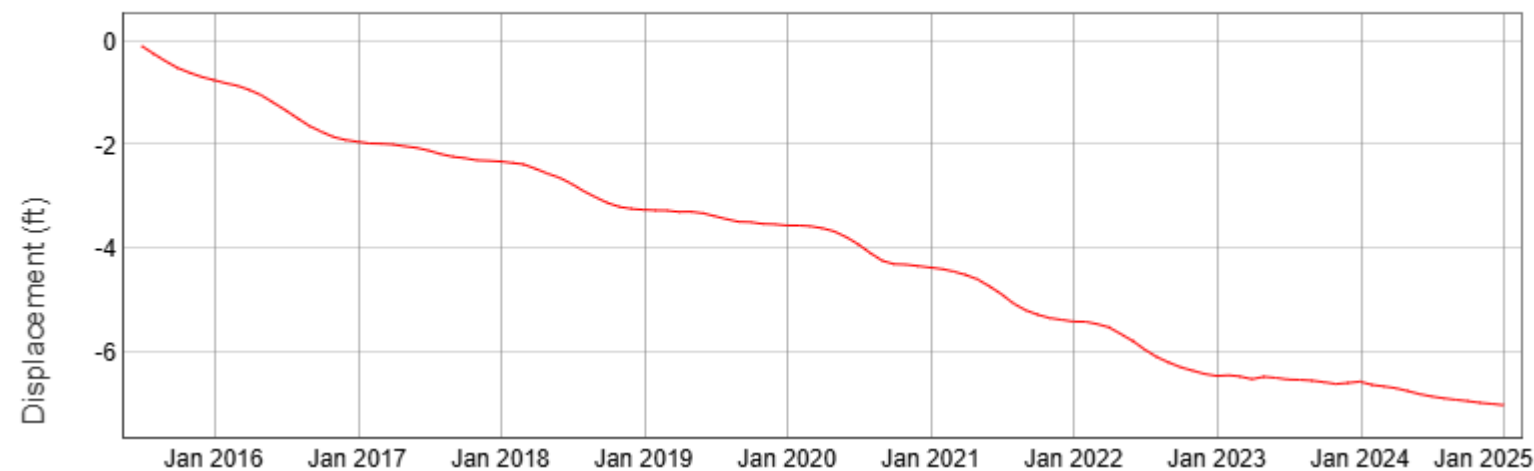
- Recurring increases in subsidence during dry years
- Minimum Threshold exceedances
- Undesirable Results



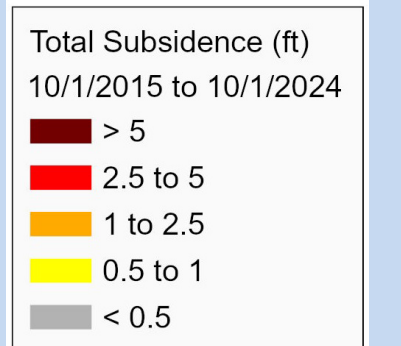
Total Interpolated Vertical Displacement (ft) for (39.01051, -122.07623)



Total Interpolated Vertical Displacement (ft) for (36.13100, -119.44789)

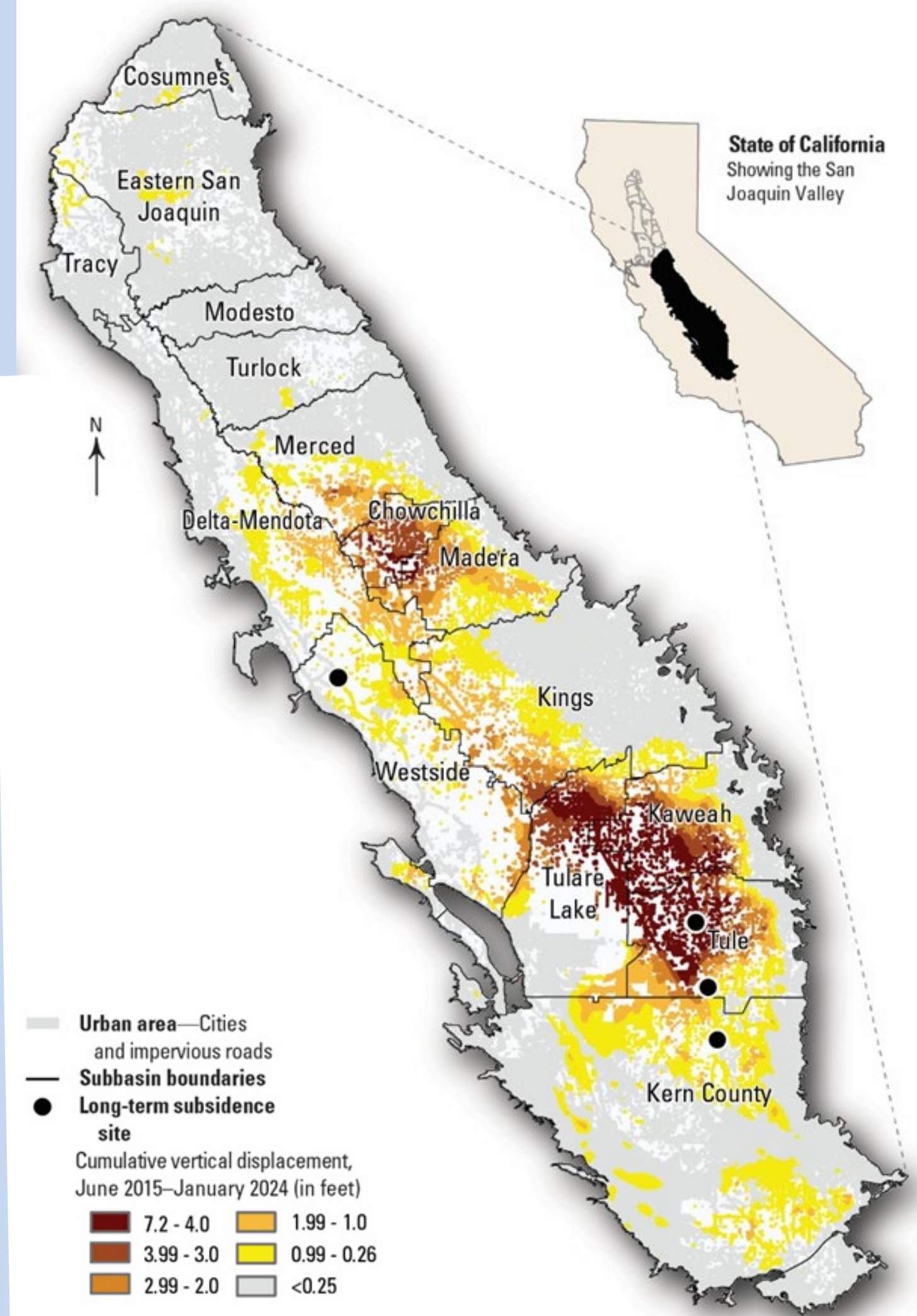


Subsidence (ft) since 2015	>0.5	>1	>2.5	>5
Total Area (sq mi)	4,959	3,256	1,384	258



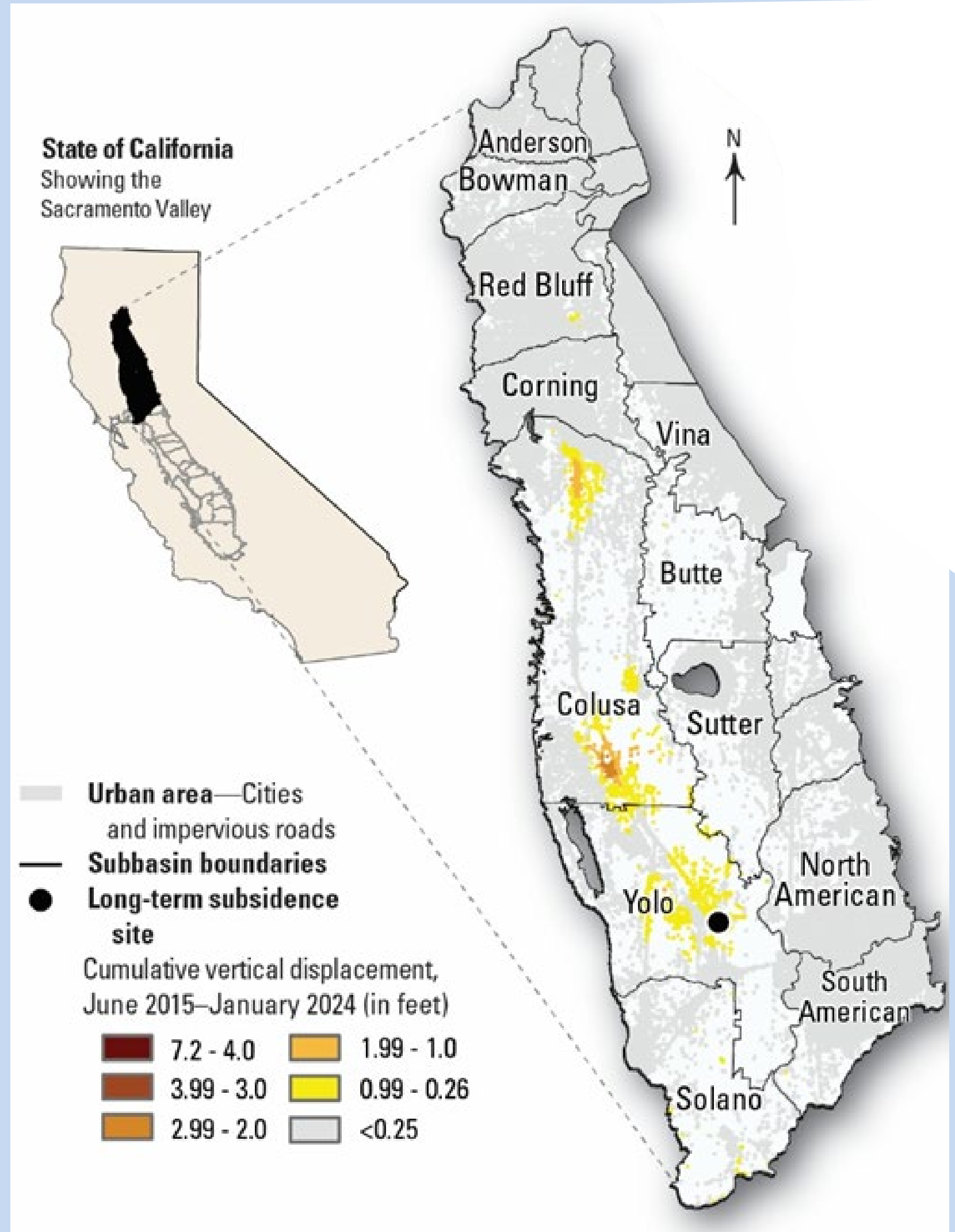
San Joaquin Valley Subsidence Conditions

- Two large merging areas
 - Chowchilla, Madera
 - Tule, Kaweah, Tulare Lake
- Impacts to infrastructure
 - Canals – Federal, State, Local
 - Flood protection
 - Wells, road, etc.



Sacramento Valley Subsidence Conditions

- Three currently isolated areas
 - Woodland / Yolo County
 - Arbuckle
 - Artois / Orland
- Impacts to infrastructure
 - Canals – Federal
 - Flood Levee / Bypasses
 - Wells, Roads, Etc.



Subsidence in the News



California's largest cities, including S.F., are sinking. Maps show exactly where

Pending state subsidence guidelines give valley water managers sinking feeling

BY LISA MCEWEN • NEWS • JUNE 10, 2025

Across America, Big Cities Are Sinking. Here's Why.

A major reason is too much groundwater is being pumped out, new research shows, threatening buildings and infrastructure nationwide.

By [Mira Rojanasakul](#) May 8, 2025

Parts of California Are Sinking, and It Could Worsen the Effects of Sea-Level Rise, NASA Study Finds

Land sinking in Red Bluff, Corning: What it means for Tehama and can it happen in Redding?

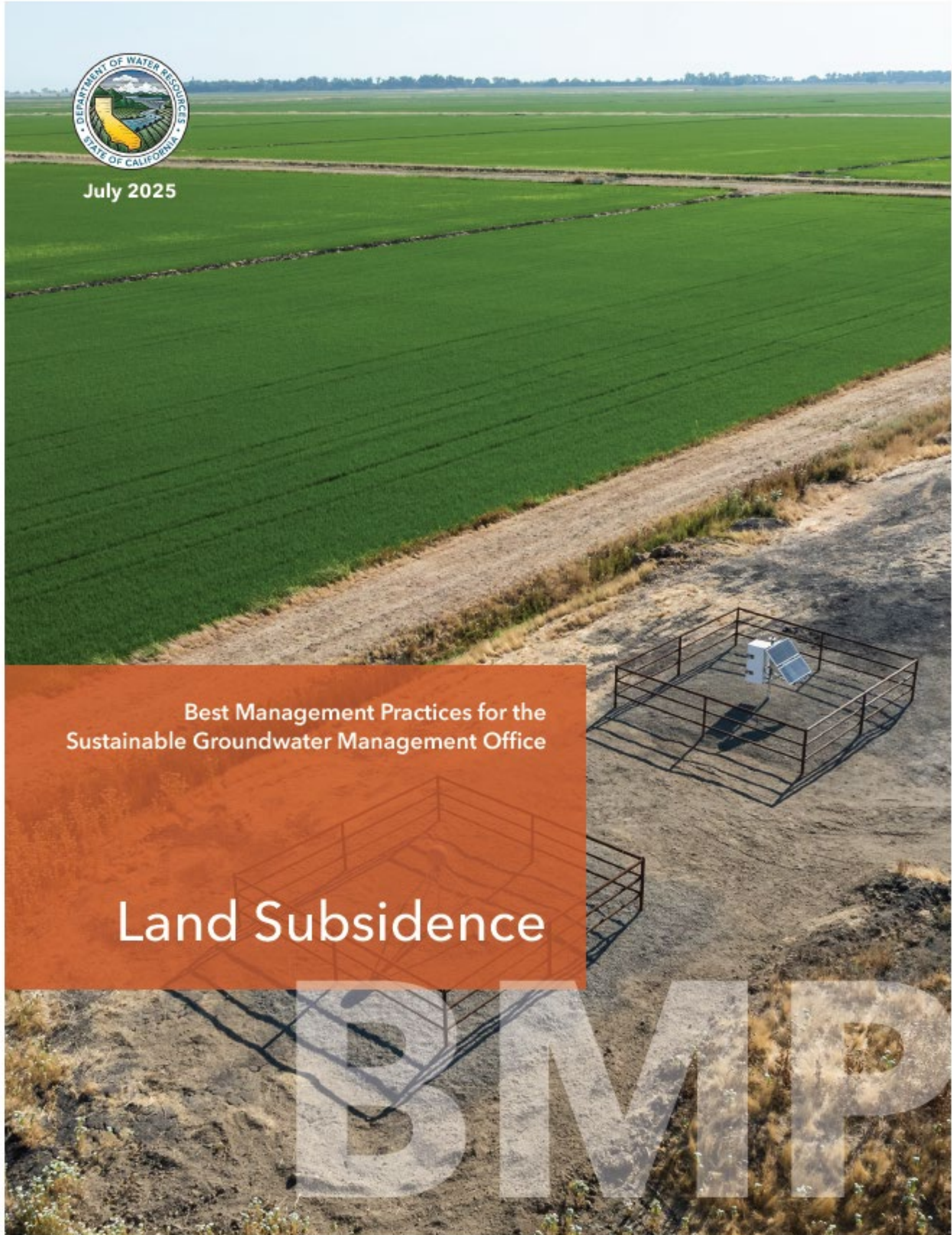
Decades-old problem growing worse as Southern California's sinking appears to be accelerating



CALIFORNIA DEPARTMENT OF
WATER RESOURCES



July 2025



Best Management Practices for the Sustainable Groundwater Management Office

Land Subsidence

BMP

Sustainability

Avoid Six Undesirable Results



Lowering of GW Levels



Reduction of GW Storage



Seawater Intrusion



Degraded Water Quality



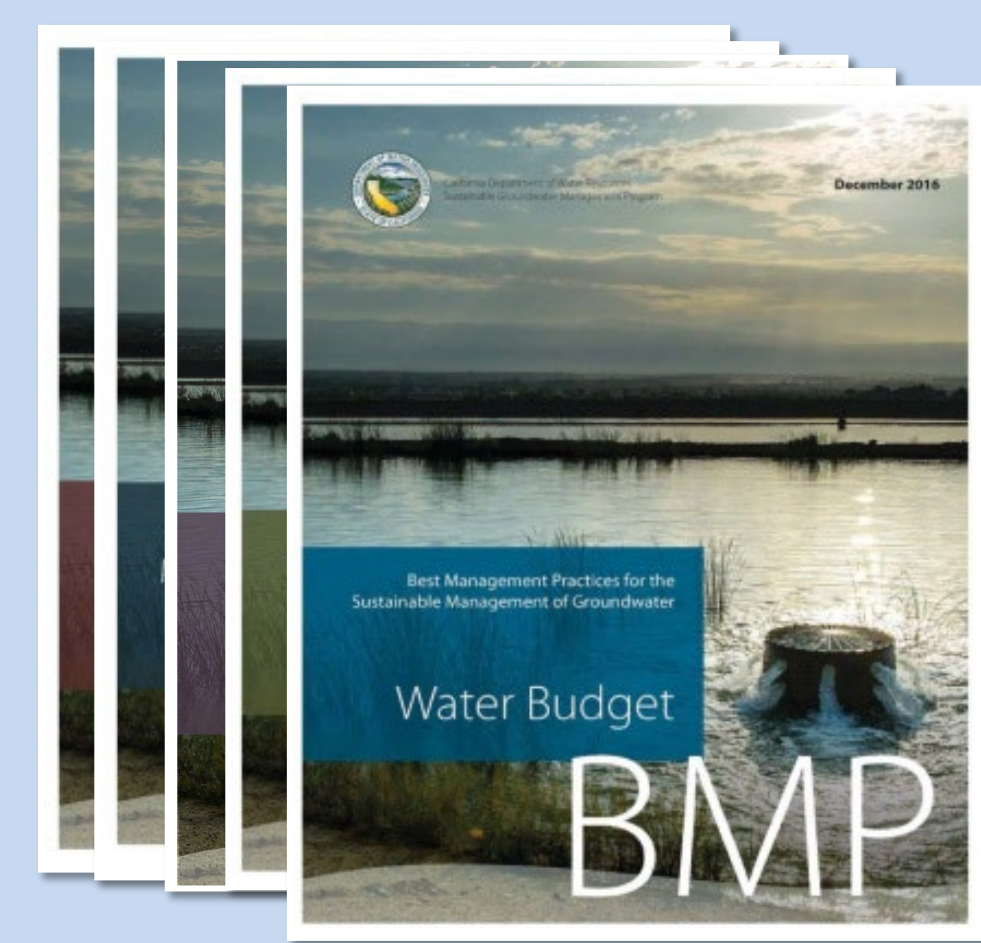
Land Subsidence



Depletion of Interconnected Streams

Subsidence BMP - Purpose

- General Purpose of BMPs
 - Identify best practices for addressing SGMA
 - BMPs can be used to streamline Regulation updates
- Specific Purpose of Subsidence BMP
 - Applicable to every SGMA basin, whether it has or hasn't experienced subsidence
 - To put a renewed focus on subsidence



Subsidence BMP

Document is approximately 45 pages of content plus six appendices:

Fundamentals of Subsidence

- What causes subsidence
- How to minimize subsidence

Technical Assistance

- How to measure and model subsidence

Subsidence Management

- What steps should be taken to manage subsidence

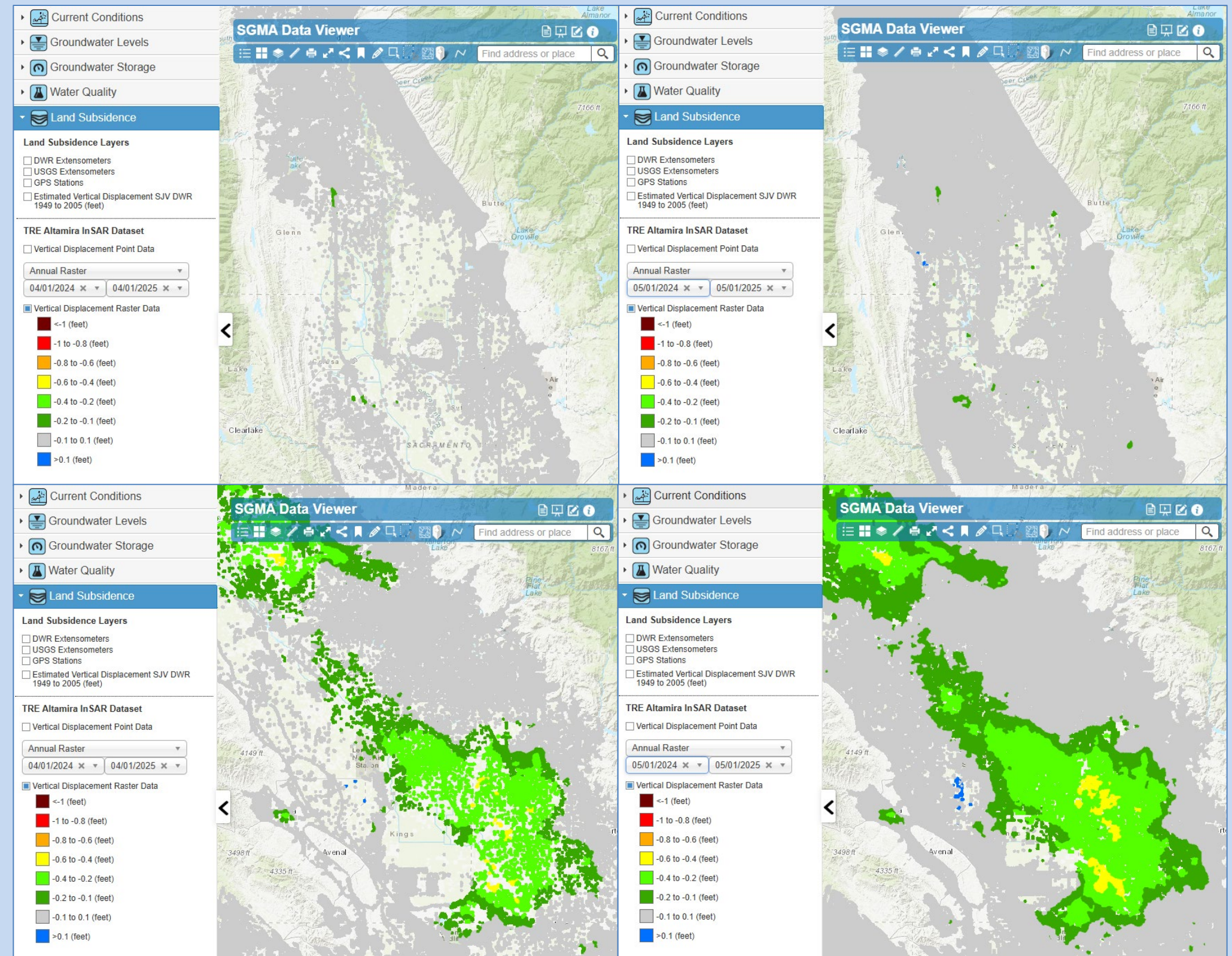


Subsidence BMP: InSAR¹¹

- Best Available Science
- Quarterly InSAR Data
 - Increased Coverage
- Data from new NISAR (NASA-ISRO Synthetic Aperture Radar) mission

Previous Coverage

Improved Coverage

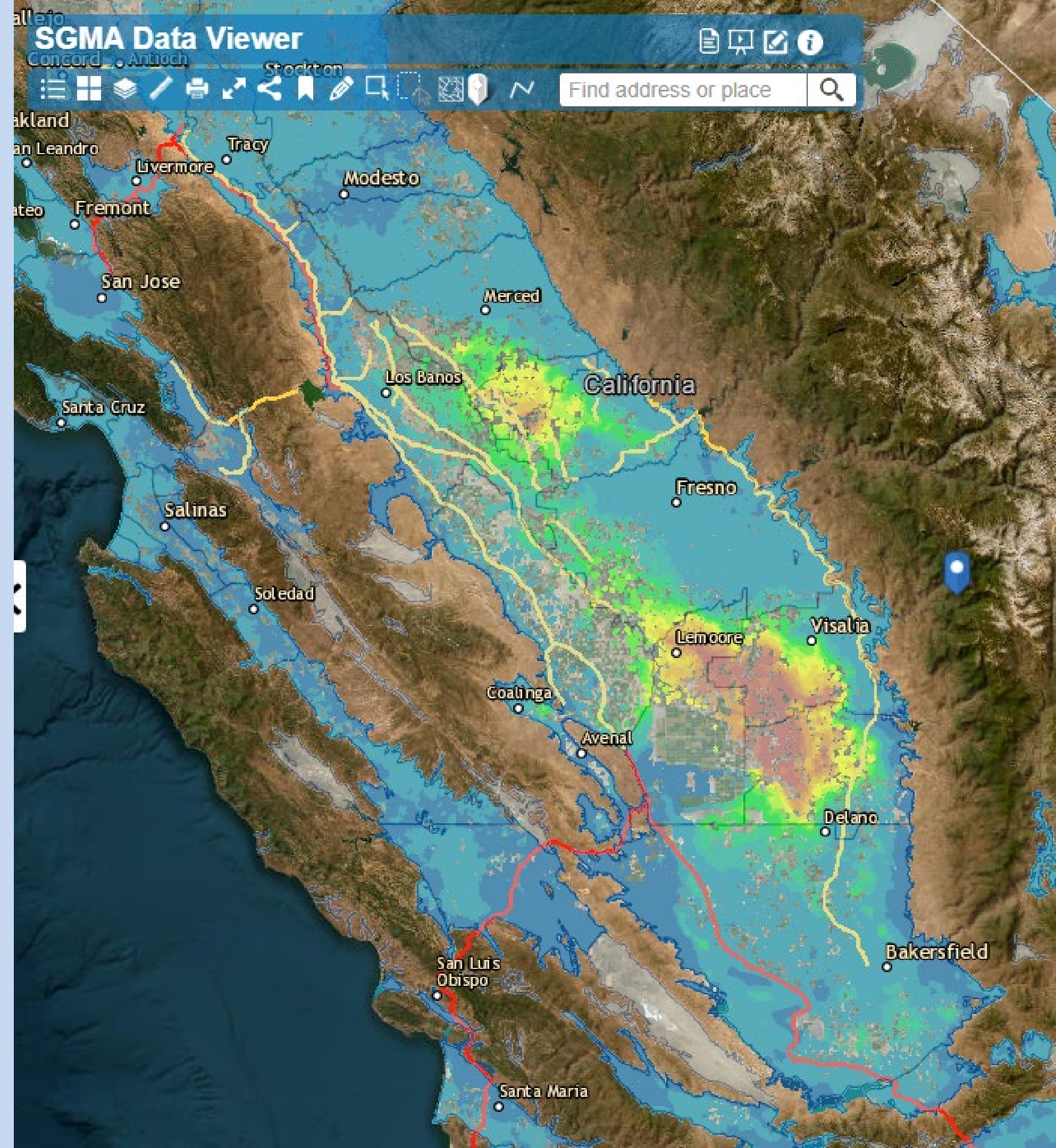


<https://science.nasa.gov/mission/nisar/get-to-know-sar>
<https://science.nasa.gov/mission/nisar/interferometry>



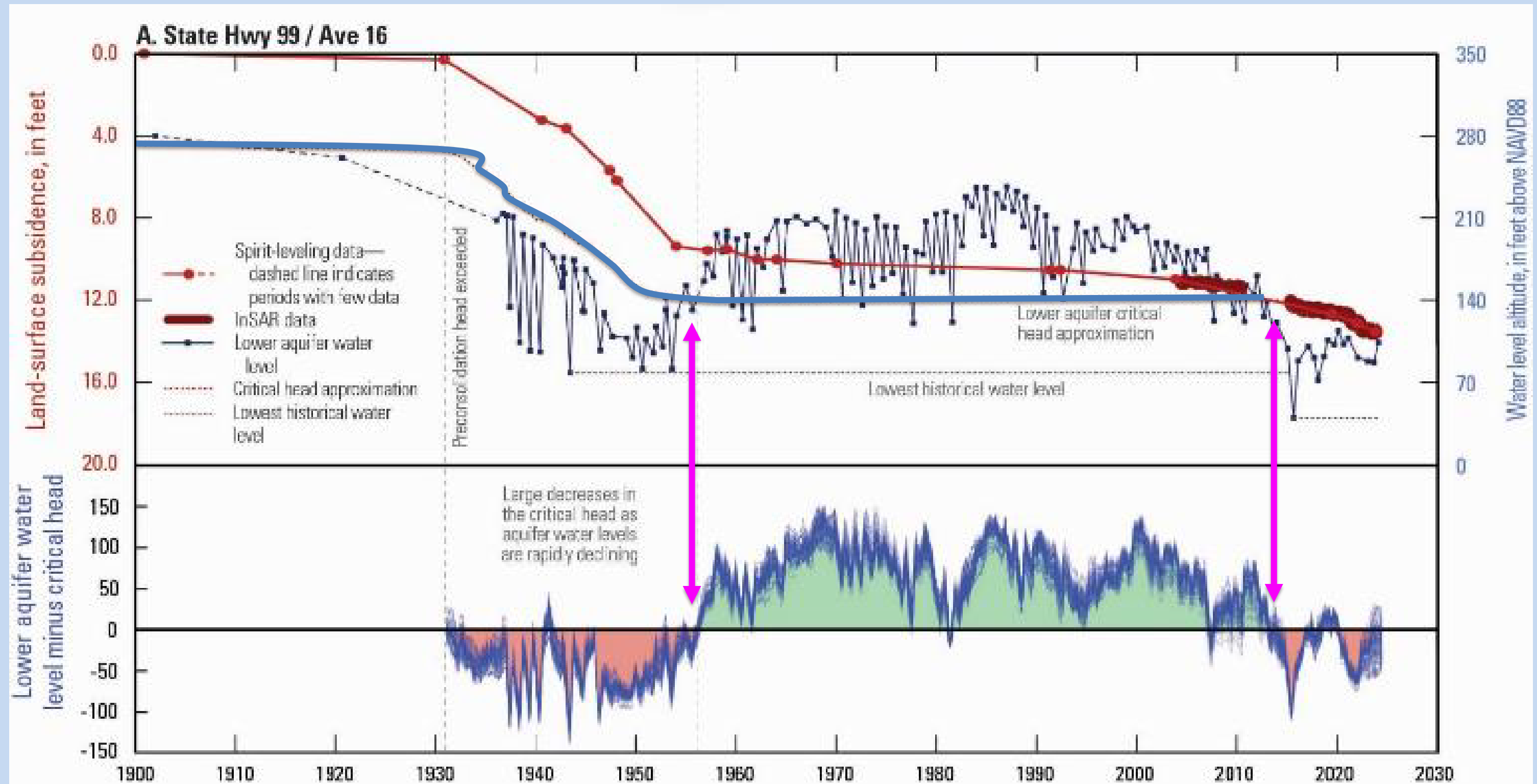
Subsidence BMP - Infrastructure

- Identify infrastructure
- Coordinate with managers of infrastructure to understand impacts and costs associated with subsidence
- Estimate future subsidence
- Calculate the critical head level and consider managing water levels above it



Subsidence BMP - Critical Head

- **Critical Head:** Groundwater level below which inelastic subsidence occurs.
- **Delayed response:** the longer levels are low, the more subsidence.



The critical head approximation shown on this figure was determined using a one-dimensional model where the groundwater level in the groundwater flow cell and the lowest groundwater level in the interbed delay cell are differenced. The critical head approximation is based on a model ensemble of about 200 realizations (individual models). Note the different y-axis scales for this figure than for figure 6.



Subsidence BMP- Management

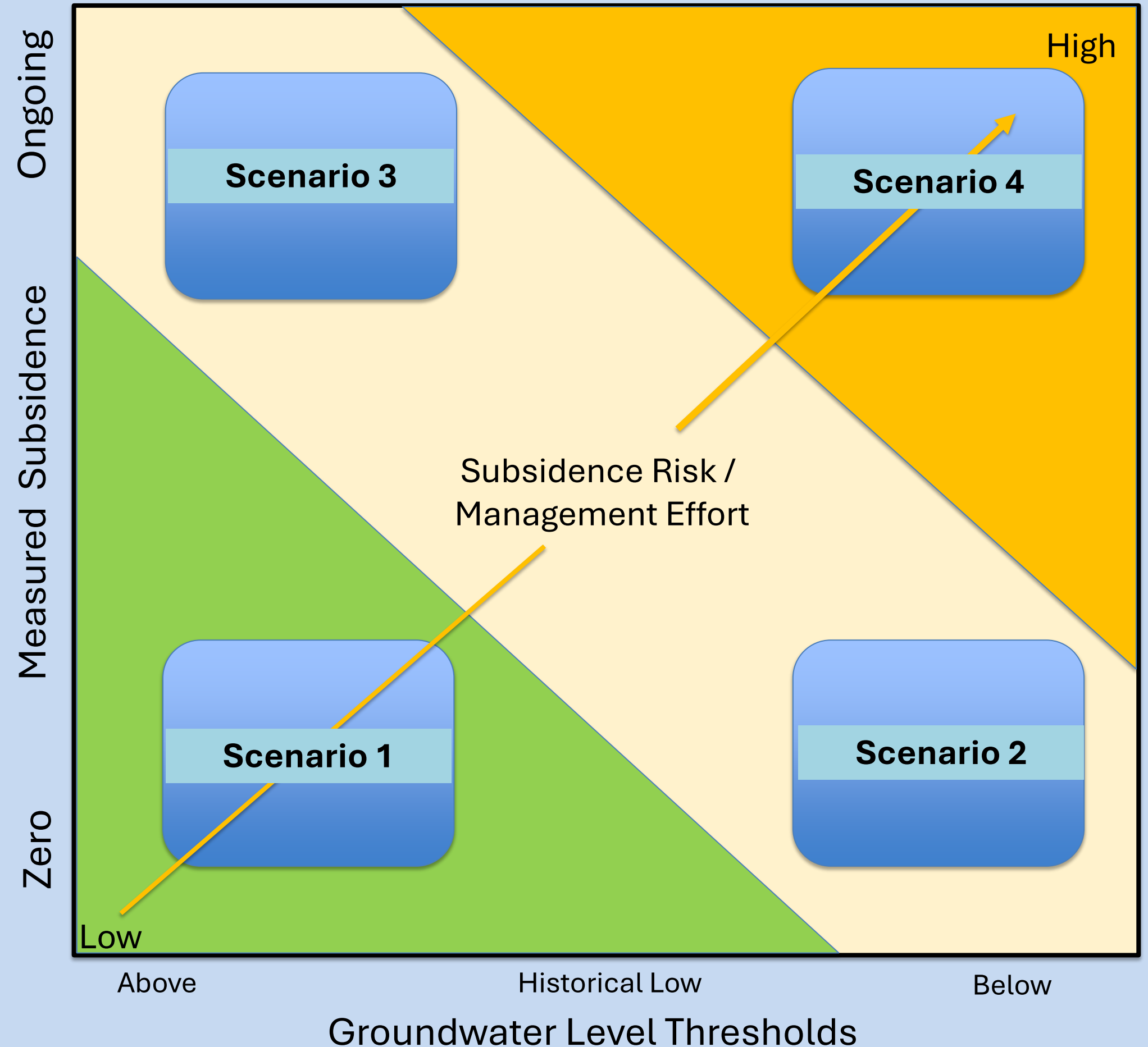
- **Identify thresholds** that consider land surface uses including infrastructure
- Evaluate **water level to subsidence relationship**
- **Align and adapt** water level thresholds to support subsidence targets
- **Coordinate** with other GSAs and GSPs
- Implement **PMA**s for subsidence



Subsidence BMP

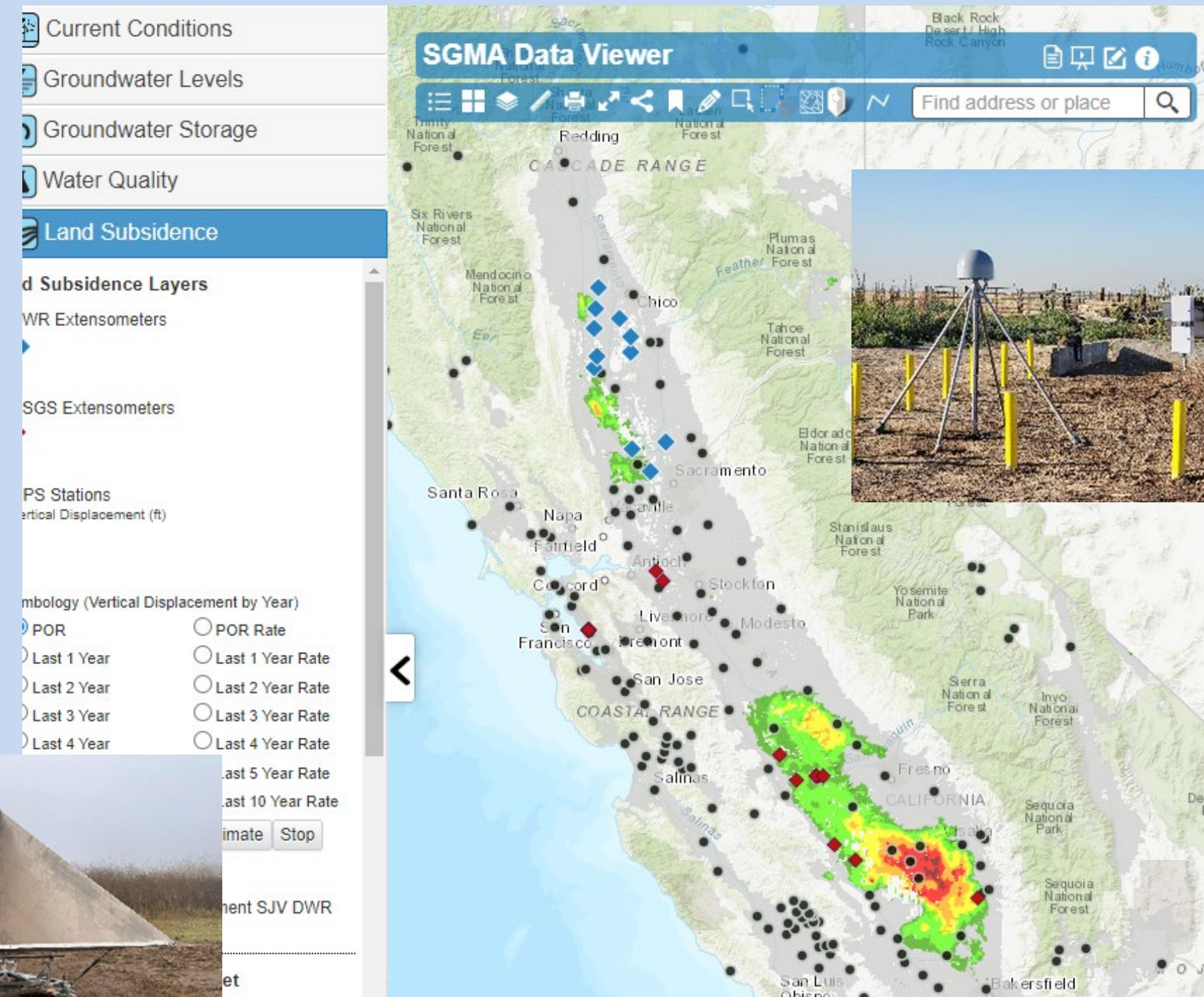
Four Hypothetical Management Scenarios

Scenarios help guide level of effort and expectations based on subsidence risk



Subsidence BMP - Support

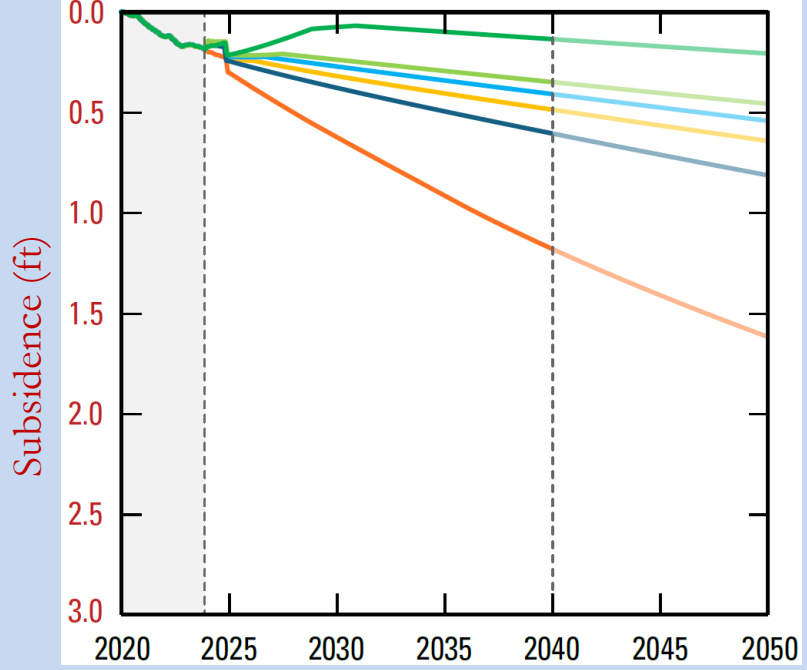
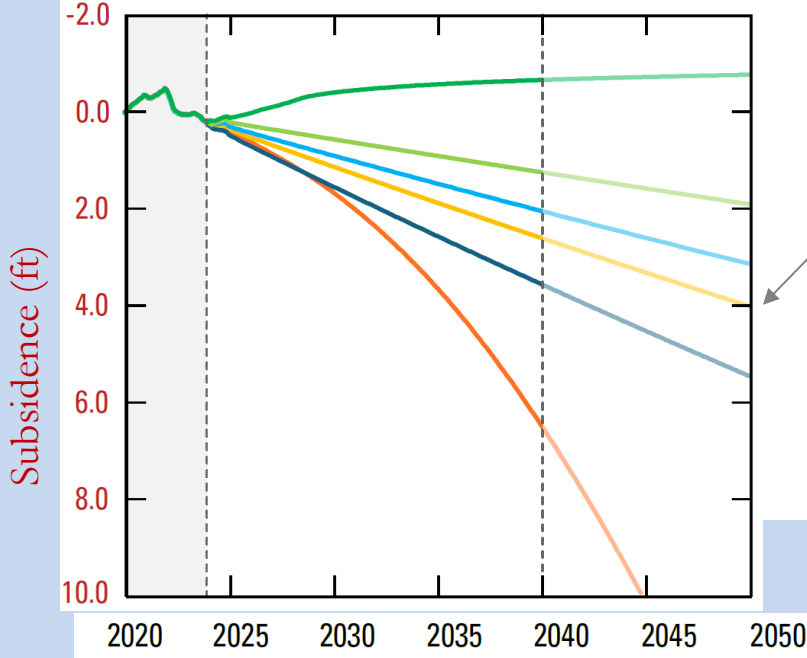
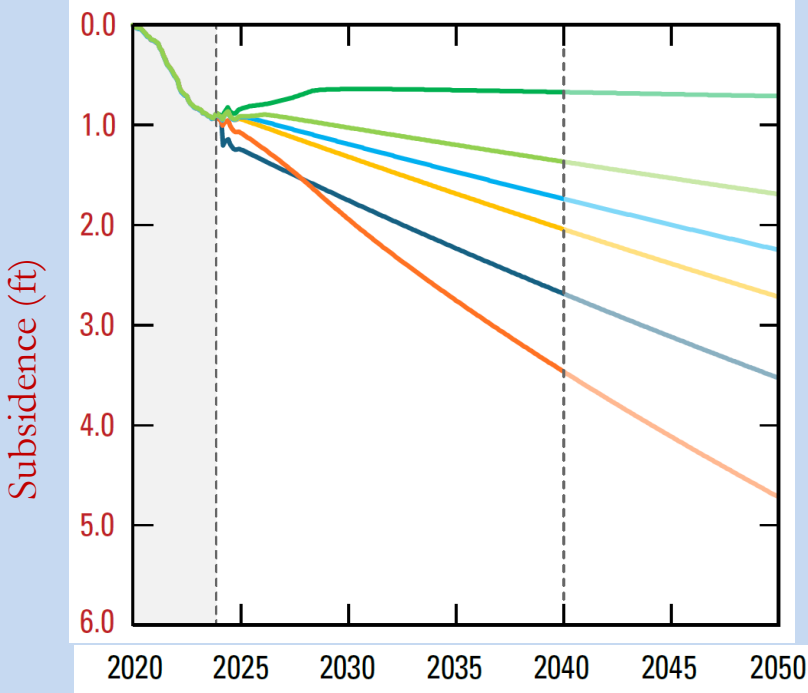
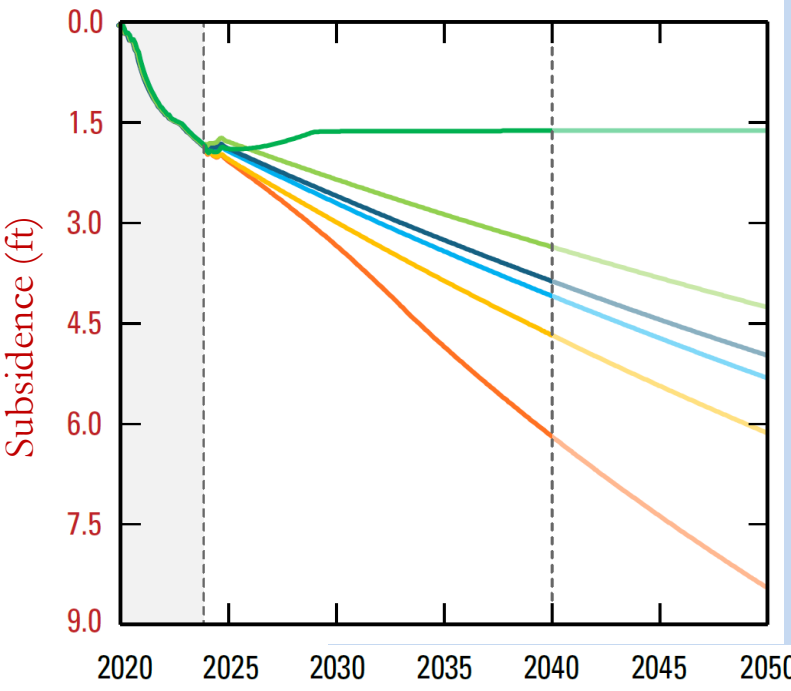
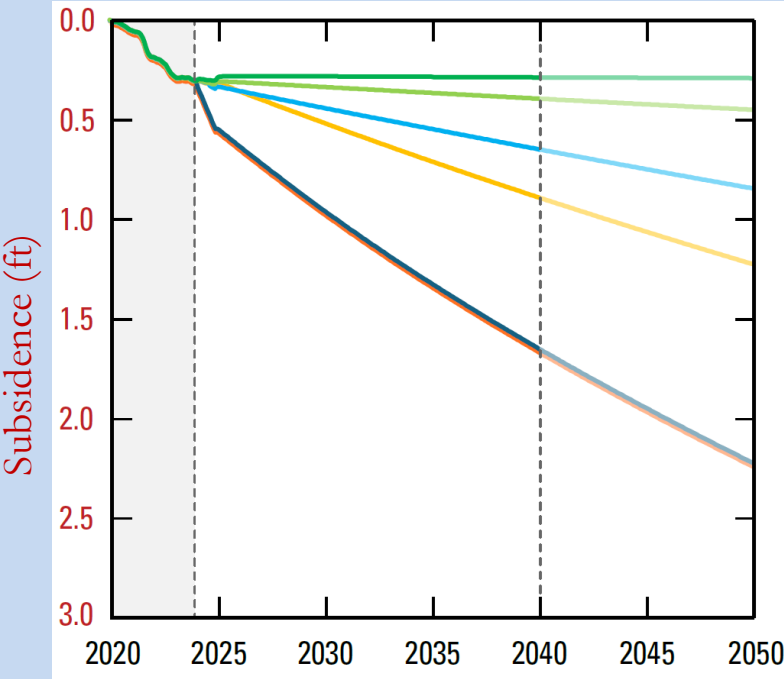
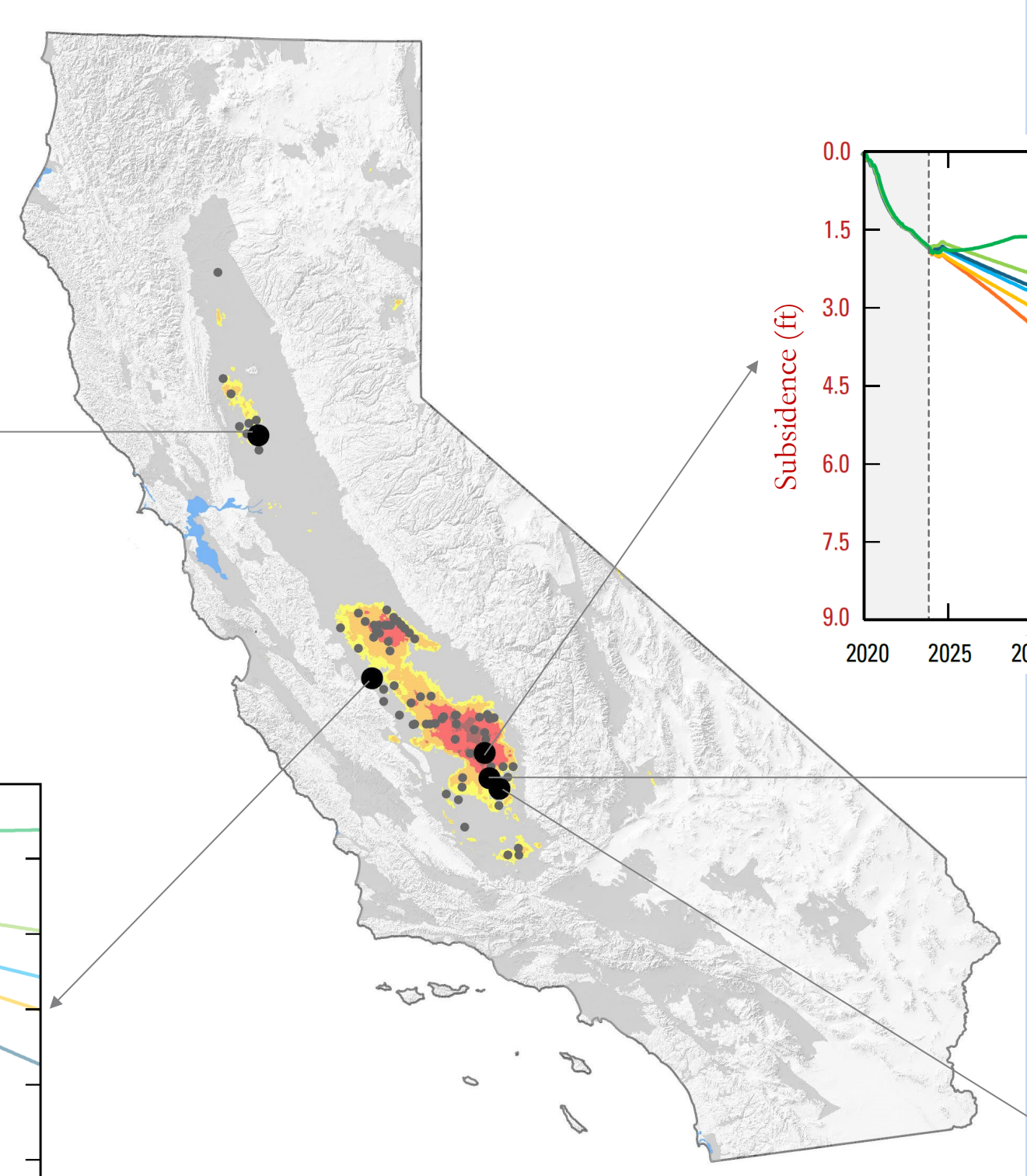
- Facilitation Support Services
- Statewide GW Monitoring
- Monitoring
 - InSAR
 - GPS Stations
 - Spirit Leveling
 - Extensometers
- Calculating Critical Head
- Identifying Infrastructure
- Modeling Subsidence



Subsidence BMP - Support

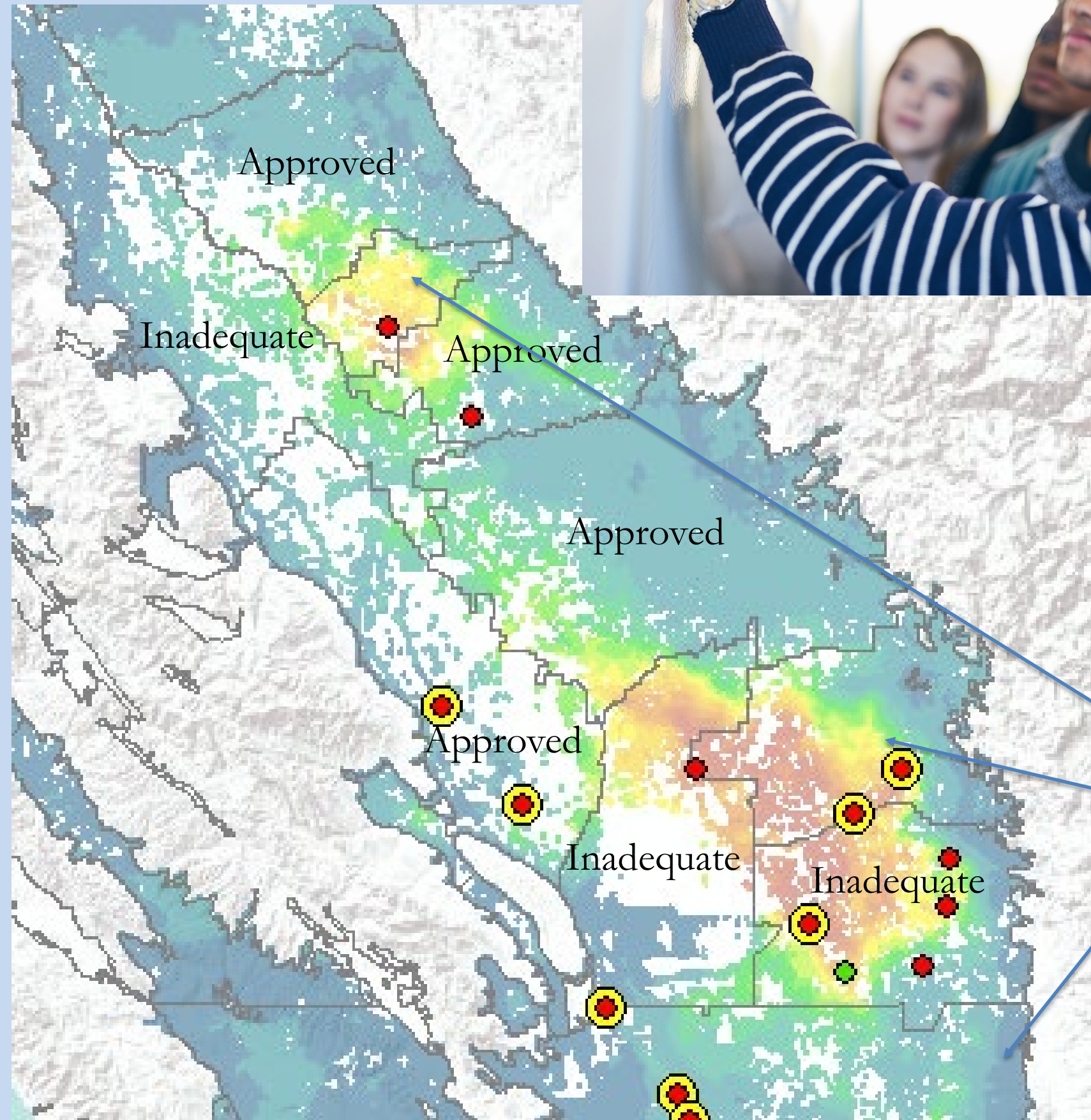
Subsidence Simulation Groundwater Level Scenario Examples

- Rebound scenario
- Critical head + 50 feet
- Critical head + 20 feet
- Critical head
- 2015 water level scenario
- Historical low scenario



BMP Implementation Strategy

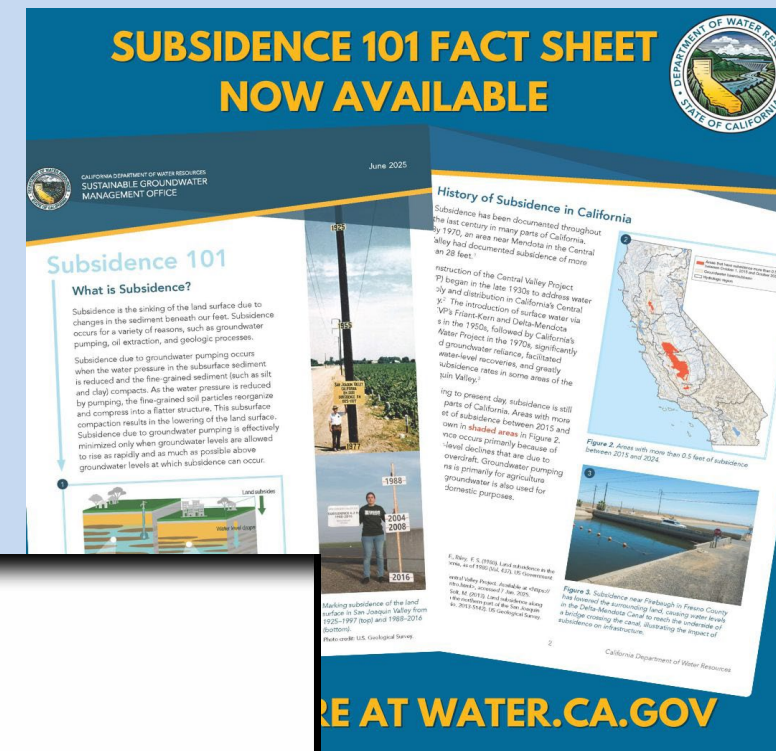
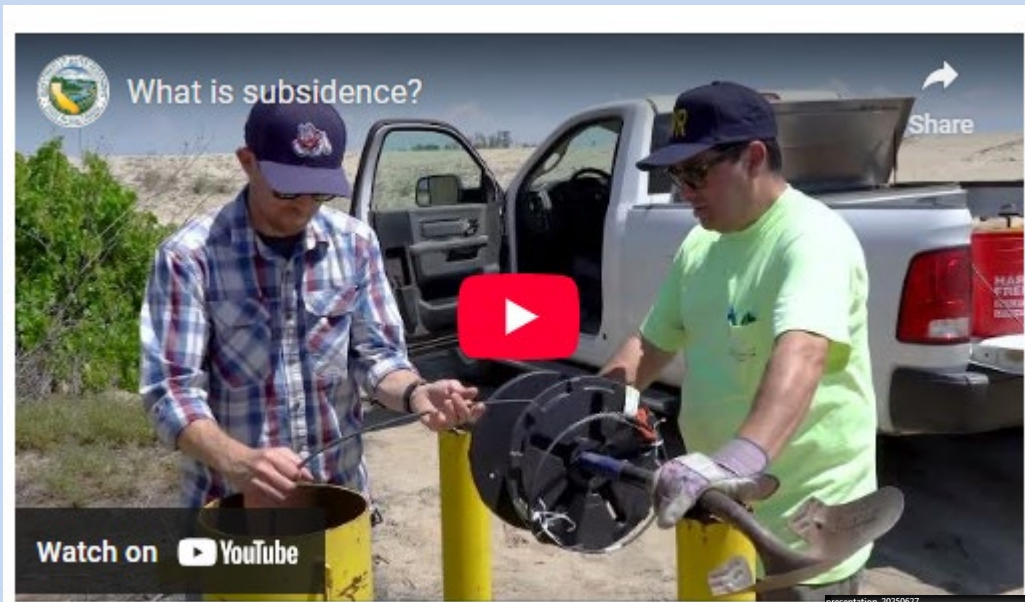
- Facilitate Regional Coordination
 - In coordination with SWRCB
 - GSA to GSA and Basin to Basin
- In-person meetings within three subsidence areas.



Returned to
DWR for
Review



Subsidence BMP – Outreach and Engagement



CALIFORNIA DEPARTMENT OF WATER RESOURCES

Critical Head

The Role of Critical Head in Managing Land Subsidence

June 27th, 2025

00:02





July 2025

Best Management Practices for the
Sustainable Groundwater Management Office

Land Subsidence

BMP

Thank You!