Appendix C

SGMA Subsidence BMP and Bulletin 118 1D Compaction Models

Yolo Subbasin

1.0 Summary

In the California Department of Water Resources' (DWR) Land Subsidence Best Management Practices[1] (BMP) document (finalized January 2026) and in the Bulletin 118 Appendix I Update on Land Subsidence in California[2], four locations of one-dimensional (1D) compaction models in the Yolo Subbasin are presented (Figure 1). These models are used to estimate critical head through time (Figures 2 through 5).

These models rely on long-term groundwater level and subsidence records for aquifer parameter calibration. The top panels of Figures 2 through 5 shows the data used to construct long-term records at the model sites located in the Yolo Subbasin. Groundwater levels were stitched together using multiple wells for a "shallow" and "intermediate" aquifer depths with specifics well data and time periods noted in the footnotes. The long-term subsidence records leverage leveling, interferometric synthetic aperture radar(InSAR), extensometer, and Global Positioning System (GPS) data to calibrate the 1D model. Further details and data files regarding the 1D models can be found in Appendices A, C, and E in the Land Subsidence BMP, Appendix I of Bulletin 118, and in a Technical Memorandum[3] hosted by the California Natural Resources Agency (CNRA).

[1] California Department of Water Resources (2026a)
[2] California Department of Water Resources (2026b)
[3] Ellis et al. (2025)

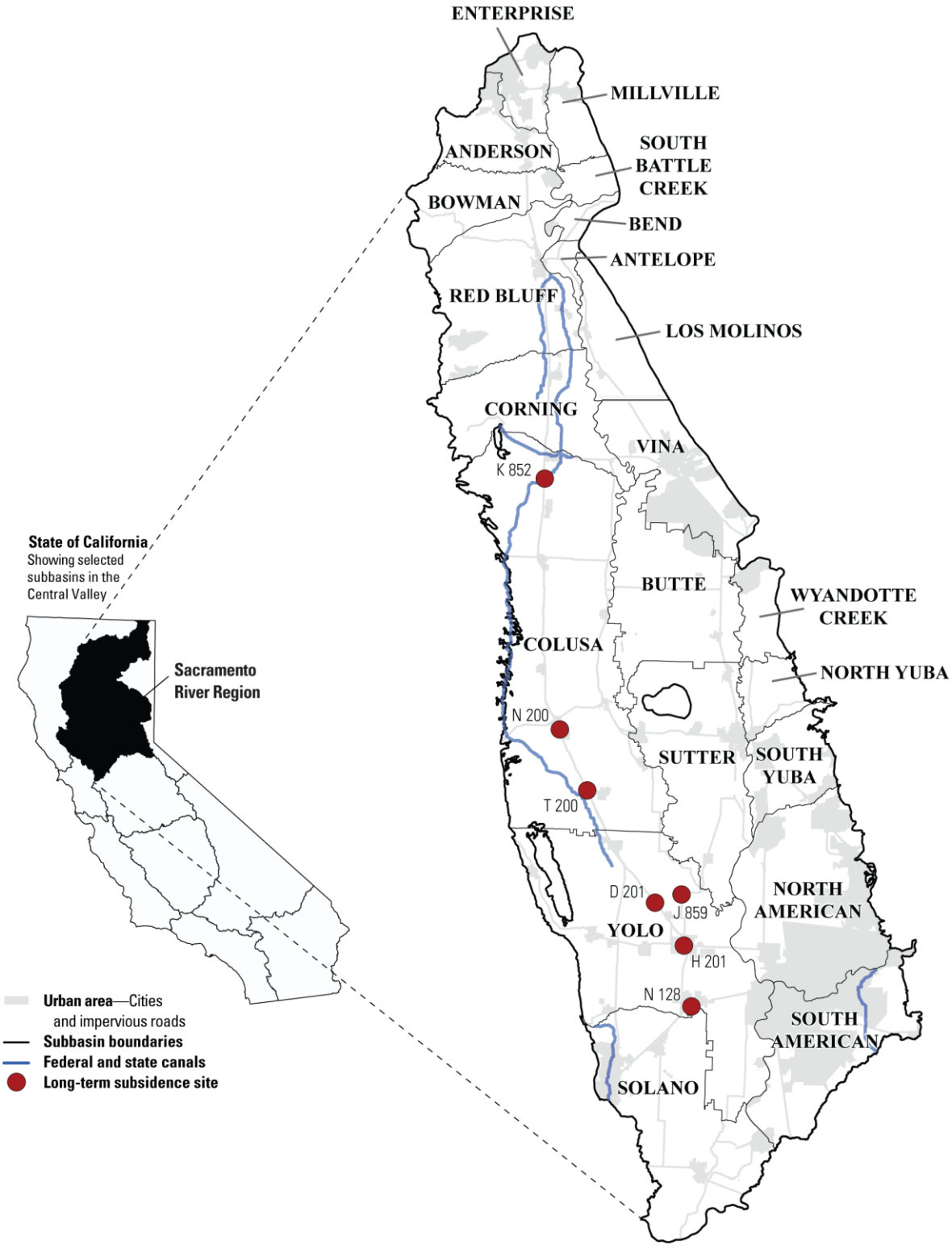
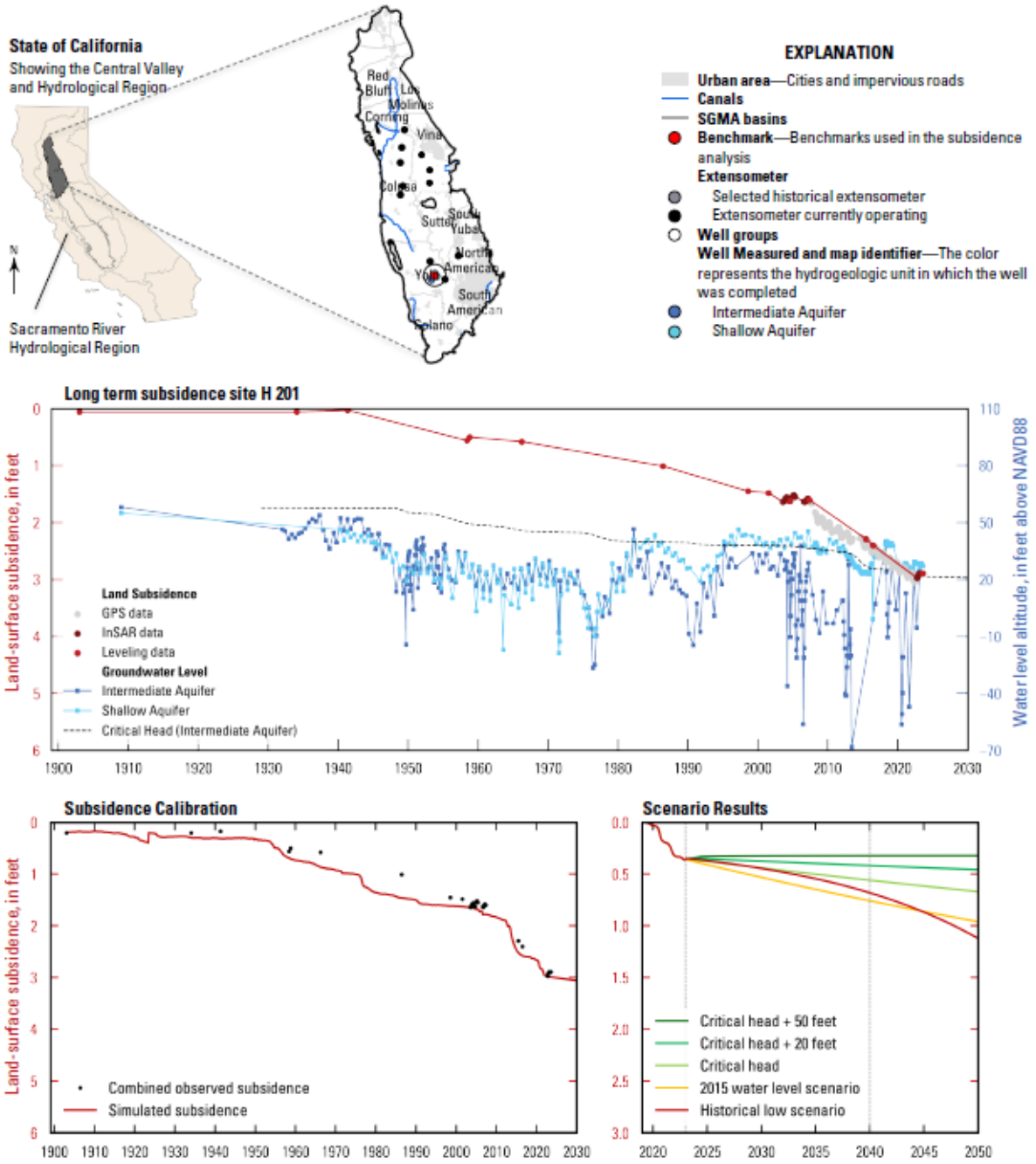


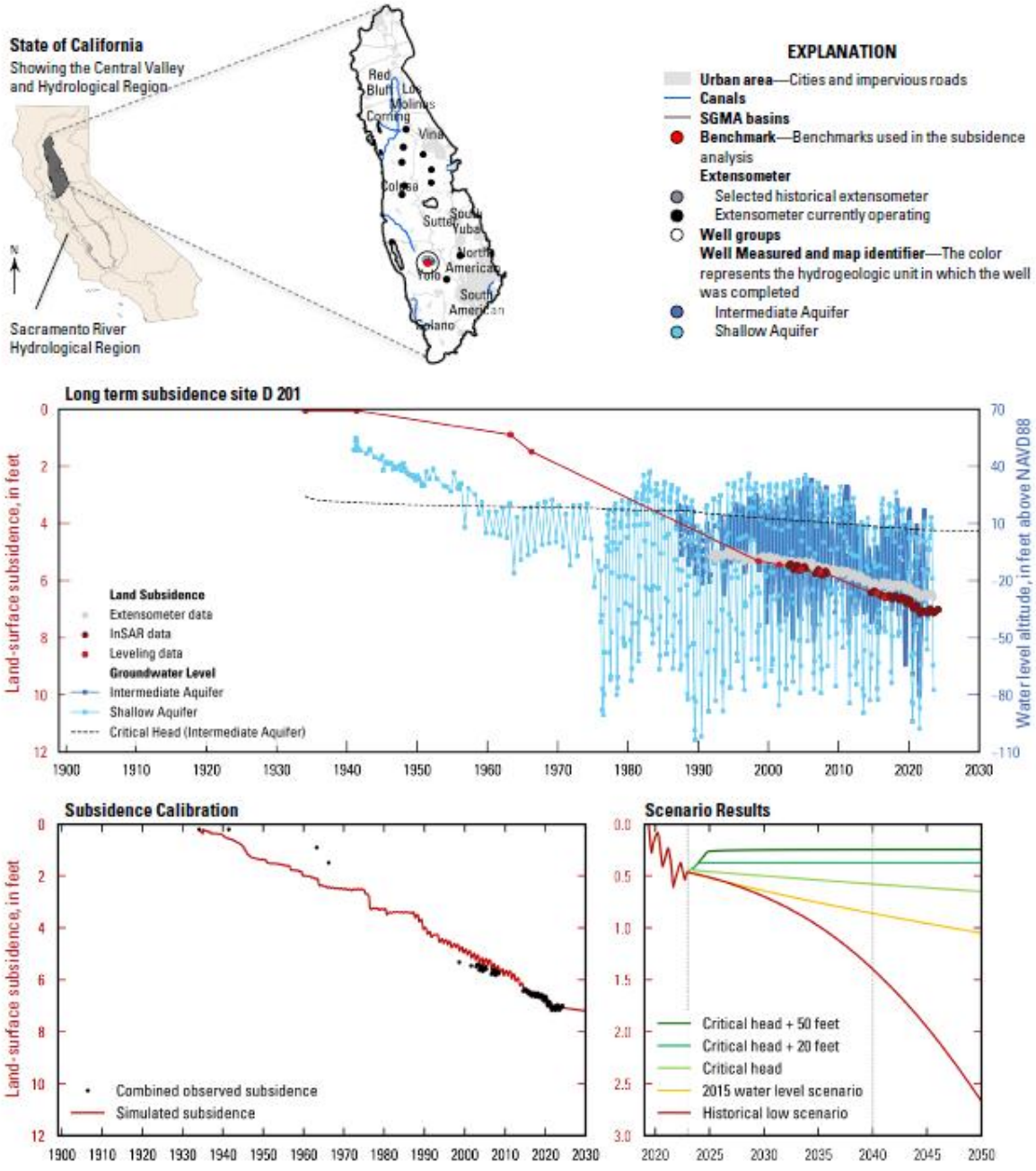
Figure 1. Sacramento Valley 1D compaction sites.

The Land Subsidence BMP and Appendix I of Bulletin 118 details how these models may be used to predict subsidence under various groundwater management scenarios. The Lower left panel in Figures 2 through 5 shows the predicted subsidence using the model (red line) compared to the observed subsidence used to calibrate the model (black dots). The lower right panel in Figures 2 through 5 shows the predicted subsidence (post-2024) using a 1) “Critical head + 50 feet” where groundwater level rise to 50 ft above the estimated critical head, 2) “Critical head + 20 feet” where groundwater level rise to 20 ft above the estimated critical head, 3) “Critical head” where groundwater level rise to the estimated critical head, 4) “2015 water level scenario” where groundwater levels return to 2015 levels, and 5) “Historical low scenario” where groundwater levels return to the historical low levels. These models demonstrate the potential for future subsidence (new and/or residual) using different groundwater level management strategies.



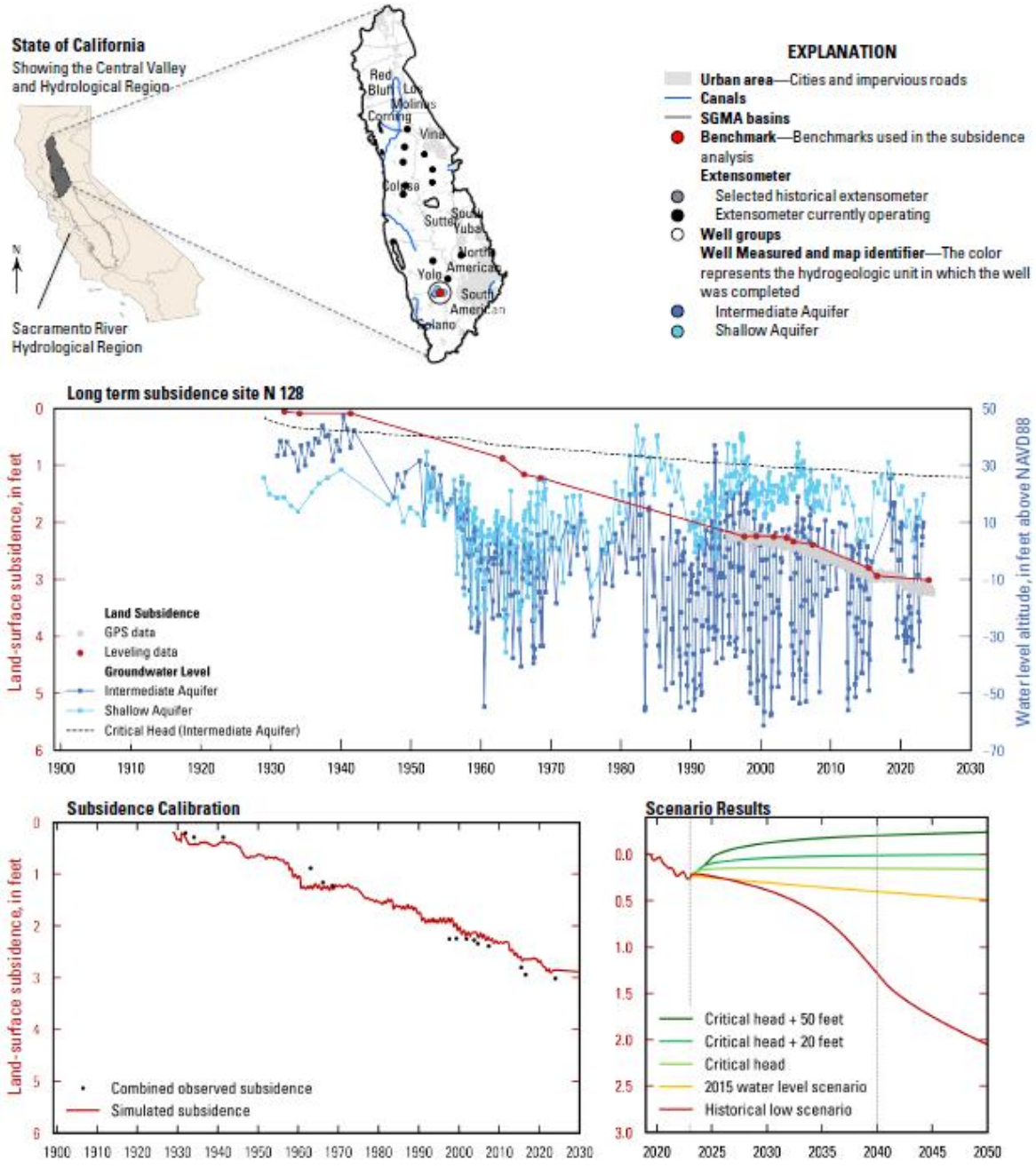
Benchmarks B 20, H 201, WOODLANDS RESET, and LIBRARY were used to determine cumulative subsidence from 1904 to 2024. GPS data from site PLSB. InSAR displacement time series from the nearest interpolated displacement values to H 201 available on the SGMA Data Viewer. InSAR is registered to the cumulative subsidence determined from the spirit leveling. Shallow Aquifer: The 1913 estimated water level is from Bryan (1923);1941-1984: 10N02E34M001M; 1984-2024: 10N02E29A001M; Intermediate Aquifer: 1933-2004: 09N02E07L001M; 2005-2024: 09N02E06B001M. This site is Figure A-2 in the Subsidence BMP.

Figure 2. H 201 1D compaction site long-term time series and simulated subsidence.



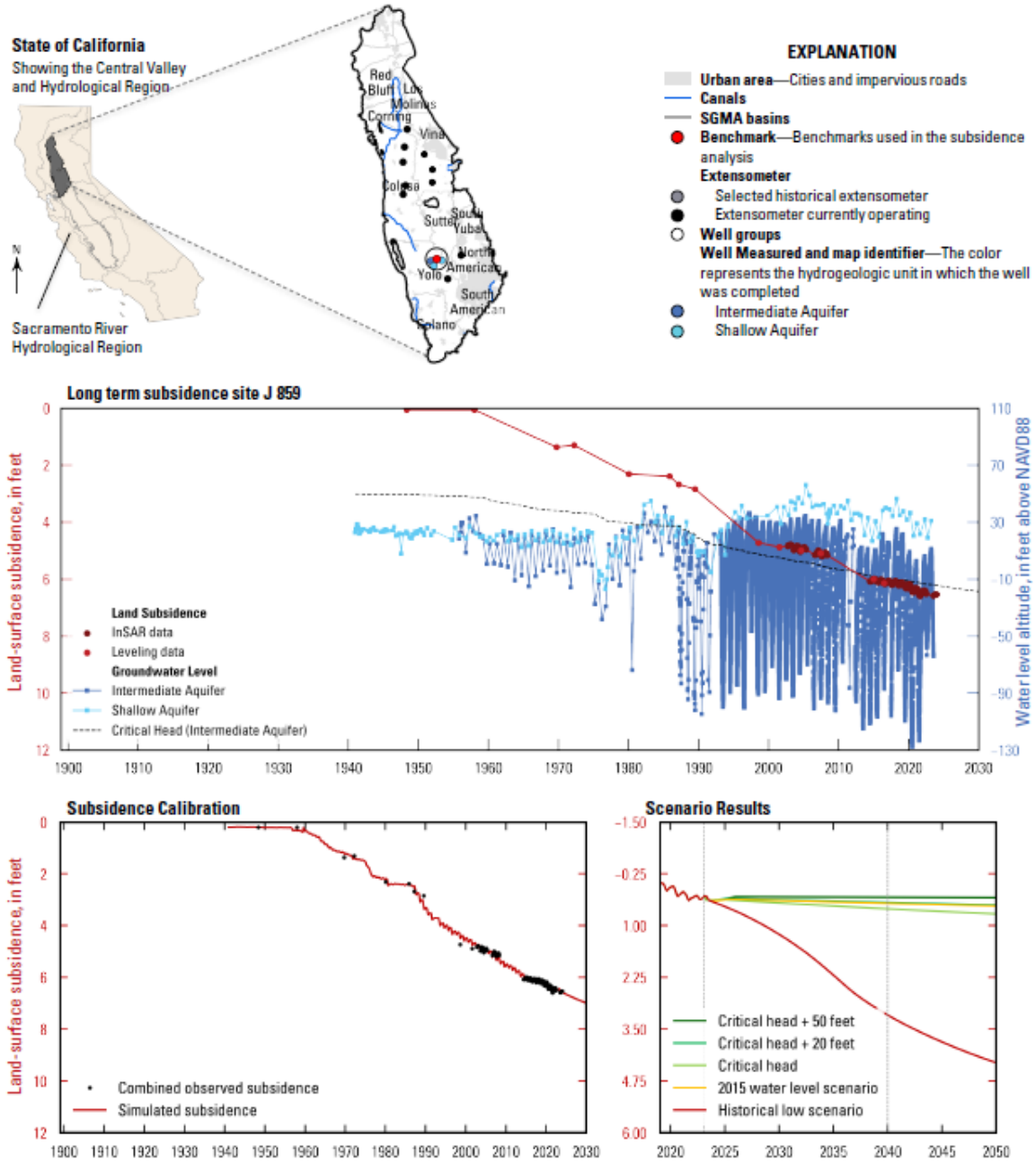
Benchmarks D 201 and DUFOUR were used to determine cumulative subsidence from 1935 to 2017. Extensometer data from extensometer 11N/1E-24Q8. InSAR displacement time series from the nearest interpolated displacement values to D 201 available on the SGMA Data Viewer. InSAR is registered to the cumulative subsidence determined from the spirit leveling. Shallow Aquifer: 1941-1957: 11N01E21Q001M; 1957-1976: 11N01E23C001M; 1977-2024: 11N01E16P001M; Intermediate Aquifer: 1956-1987: 11N01E23P001M; 1987-2023: 11N01E24Q005M; Deep Aquifer: 1987-2023: 11N01E24Q004M. The groundwater elevations used for scenario simulations at this site are -79 ft (historical low), 6ft (CH), and -15 ft (2015 scenario), referenced to altitude in feet above NAVD88.

Figure 3. D 201 1D compaction site long-term time series and simulated subsidence.



Benchmarks N 128 and UCD1 GEODETIC REF MK were used to determine cumulative subsidence from 1932 to 2024. GPS data from site UCD1. InSAR displacement time series from the nearest interpolated displacement values to N 128 available on the SGMA Data Viewer. InSAR is registered to the cumulative subsidence determined from the spirit leveling. Shallow Aquifer: 1930-1954: 08N02E13B004M; 1954-1986: 08N02E04E001M; 1986-2024: 08N02E17M001M; Intermediate Aquifer: 1931-1957: 08N02E19B001M; 1957-1972: 08N02E15M002M; 1973-1982: 08N02E14M003M; 1982-2024: 08N02E15A002M. The groundwater elevations used for scenario simulations at this site are -59 ft (historical low), 26 ft (CH), and 2 ft (2015 scenario), referenced to altitude in feet above NAVD88.

Figure 4. N 128 1D compaction site long-term time series and simulated subsidence.



Benchmarks J 859 and CODY were used to determine cumulative subsidence from 1949 to 2024. Elevations between 1970 and 1990 were obtained by the U.S. Geological Survey and the California Department of Water Resources. InSAR displacement time series from pixels D4Q00ND (Envisat) and D4R9G95 (Sentinel-1). InSAR is registered to the cumulative subsidence determined from the spirit leveling. Shallow Aquifer: 1941-1975: 11N02E23M001M; 1975-2024: 10N02E06M001M; Intermediate Aquifer: 1956-1962: 11N01E25R001M; 1960-1987: 11N01E23P001M; 1987-2022: 11N01E24Q006M; 2022-2024: 11N01E24Q502M. The groundwater elevations used for scenario simulations at this site are -125 ft (historical low), -14 ft (CH), and 4 ft (2015 scenario), referenced to altitude in feet above NAVD88.

Figure 5. J 859 1D compaction site long-term time series and simulated subsidence.

References

California Department of Water Resources, 2026a. SGMA Best Management Practices: Land Subsidence Best Management Practice. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Land_Subsidence_BMP.pdf (accessed April 2026)

California Department of Water Resources, 2026b. California's Groundwater: Bulletin 118 – Update 2025 Appendix I. Update on Land Subsidence in California. https://data.cnra.ca.gov/dataset/calgw_update2025/resource/a6caa77d-f19a-4b80-b90c-32c05c5a72da (accessed April 2026)

Ellis. J., J. White, L. Saberi, M. Earll, W. Neely, J. Hughes, A. Singh, 2025. Technical Memorandum: Documentation of Subsidence Modeling for the Central Valley. https://data.cnra.ca.gov/dataset/cv-1d-subsidence-models-and-tech-memo/resource/d6b9cbc2-7da1-4f72-acf5-4de6b6e01673 (accessed April 2026)