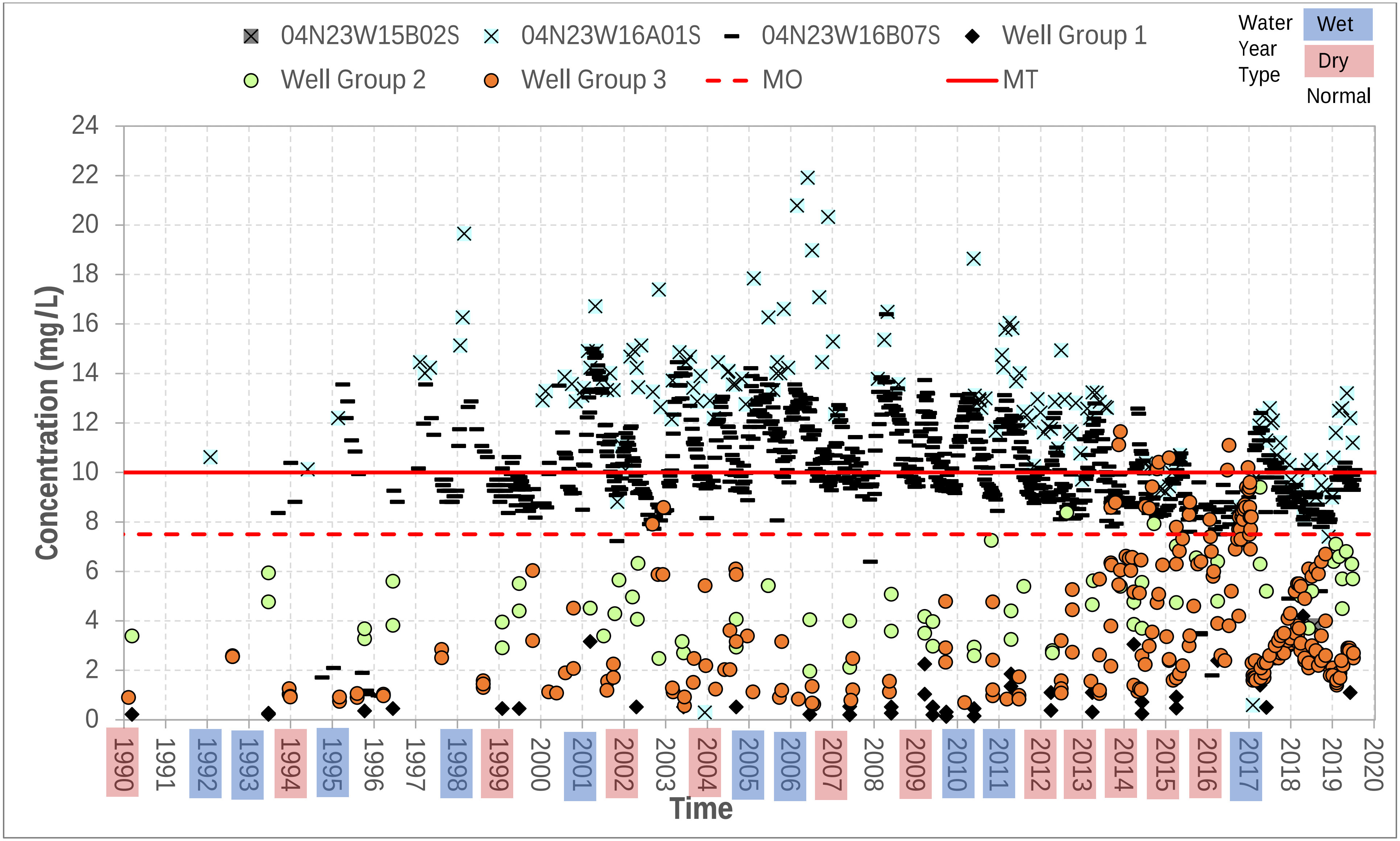


Figure I-02 Nitrate (as N) - Percolating Groundwater Areas.

Non-detects are plotted with values equal to the detection limit.

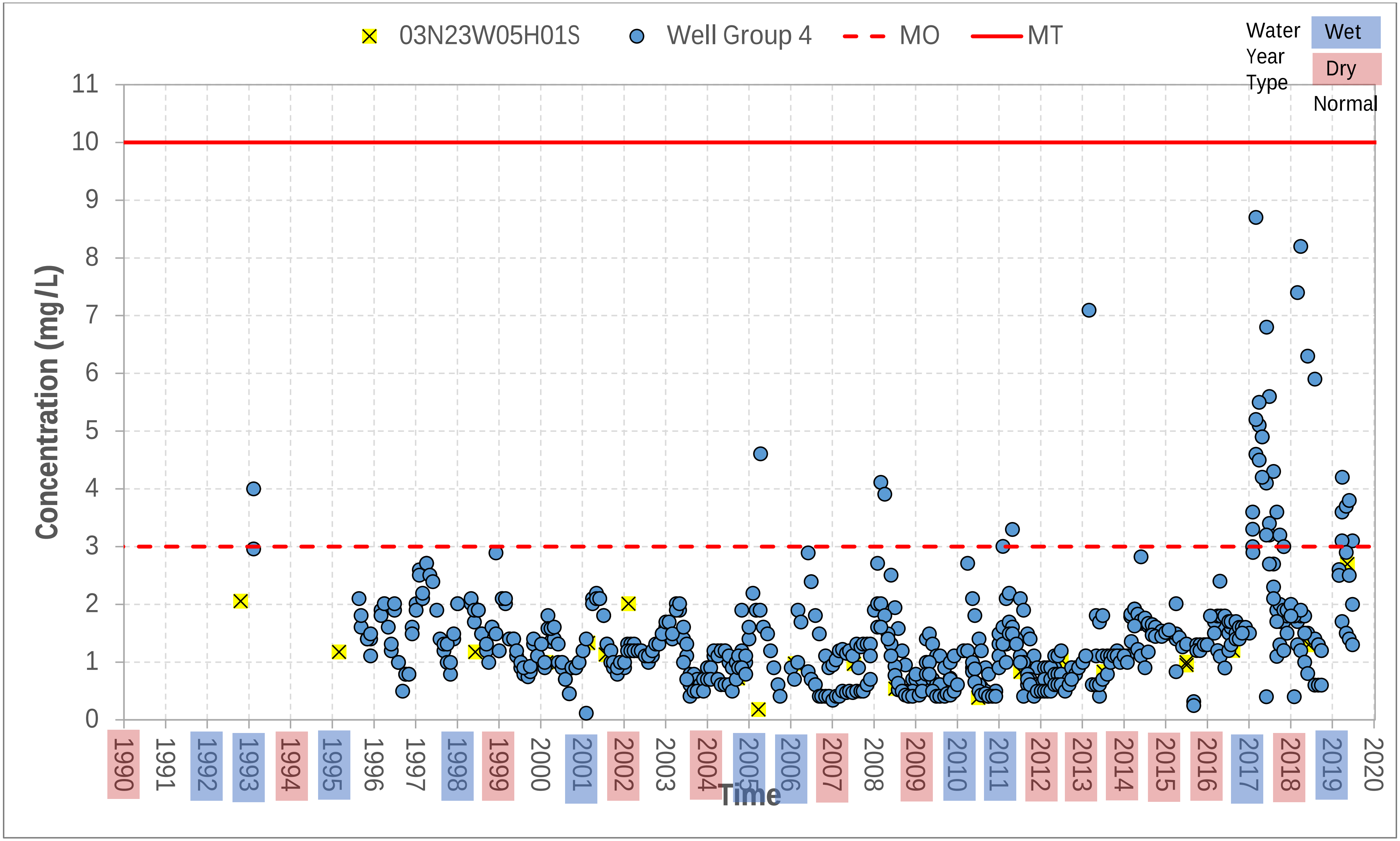


Figure I-03 Nitrate (as N) - Areas with Rising Groundwater.

Non-detects are plotted with values equal to the detection limit.

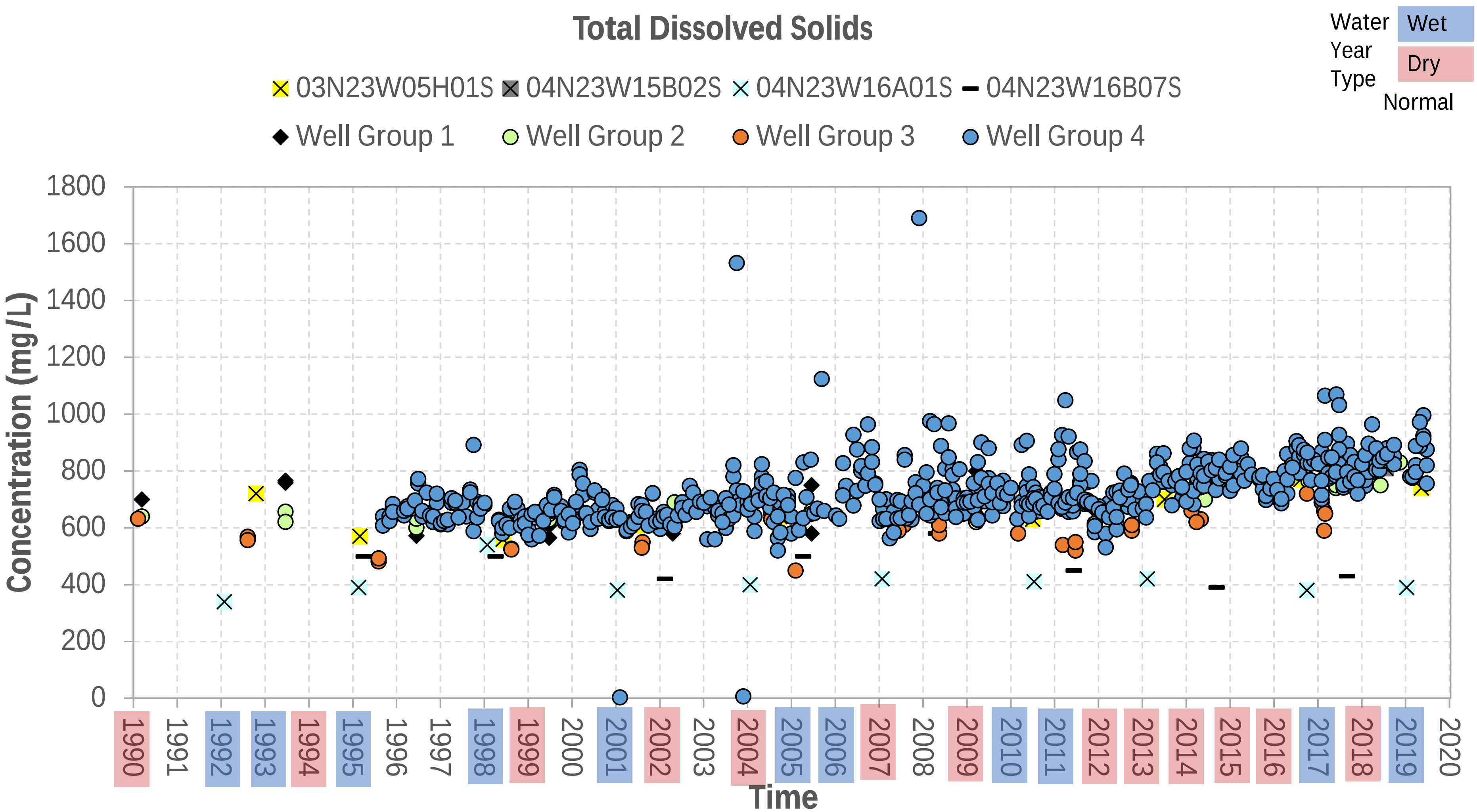


Figure I-04 Total Dissolved Solids.

Non-detects are plotted with values equal to the detection limit.

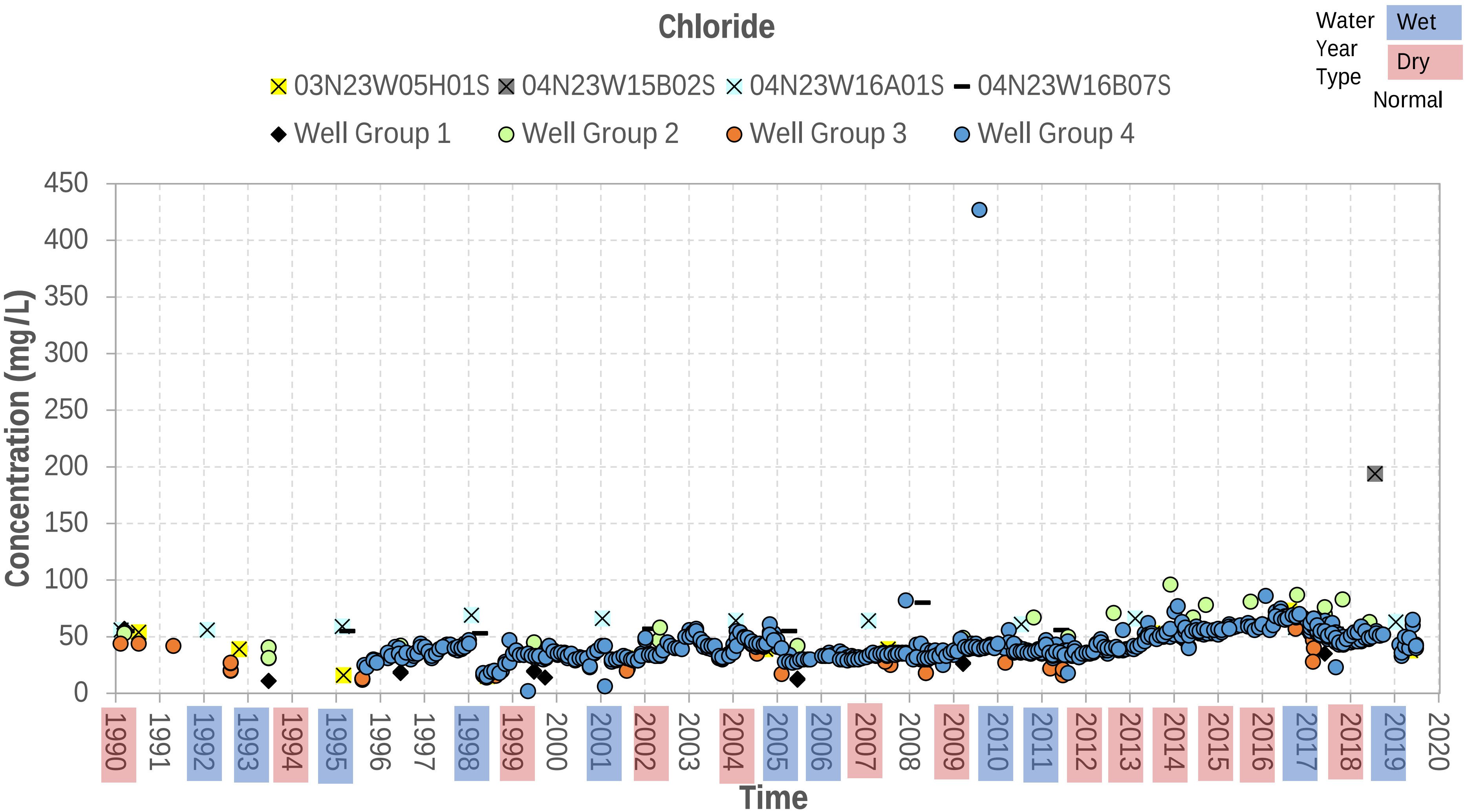


Figure I-05 Chloride.

Non-detects are plotted with values equal to the detection limit.

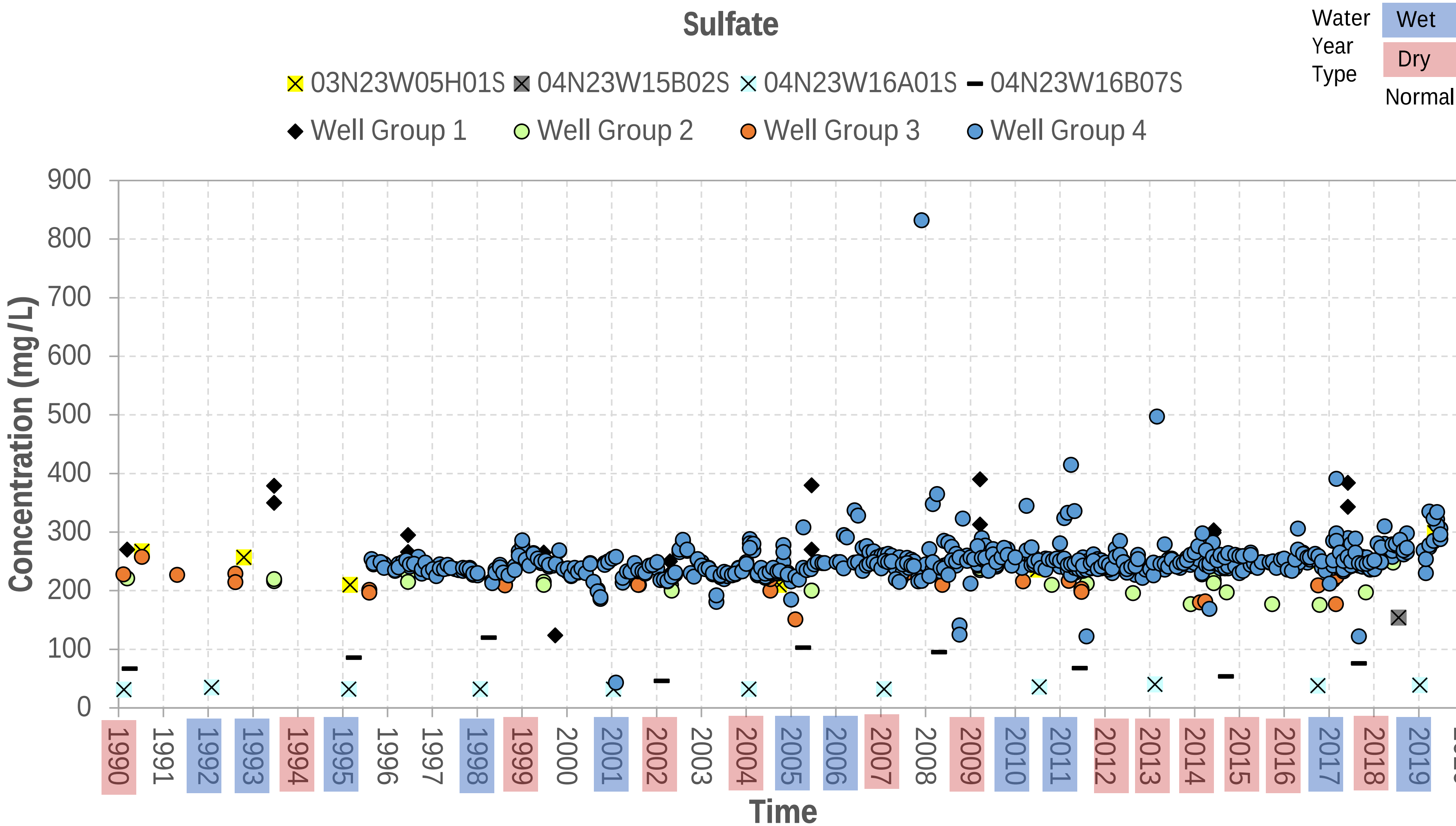


Figure I-06 Sulfate.

Non-detects are plotted with values equal to the detection limit.

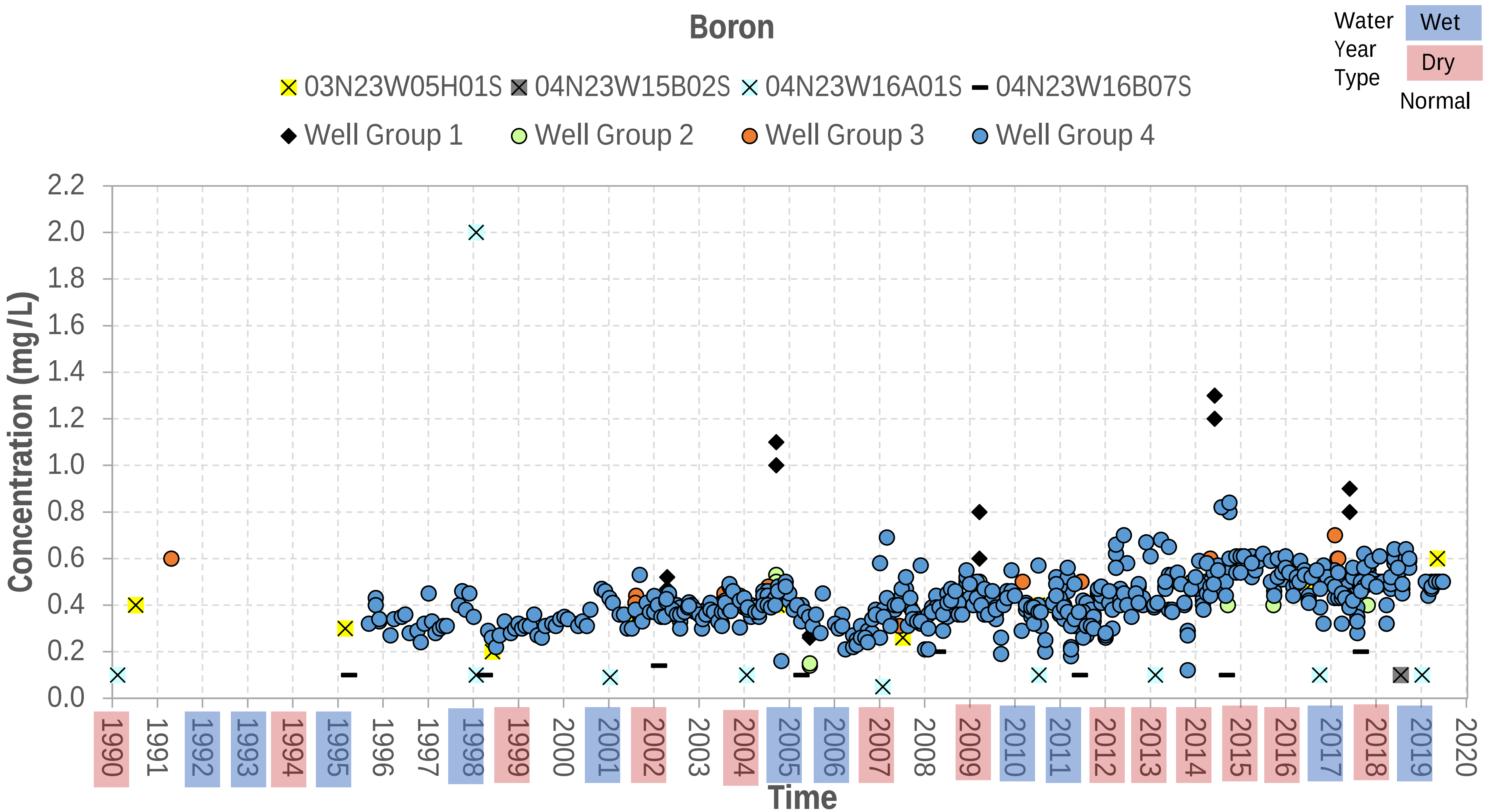
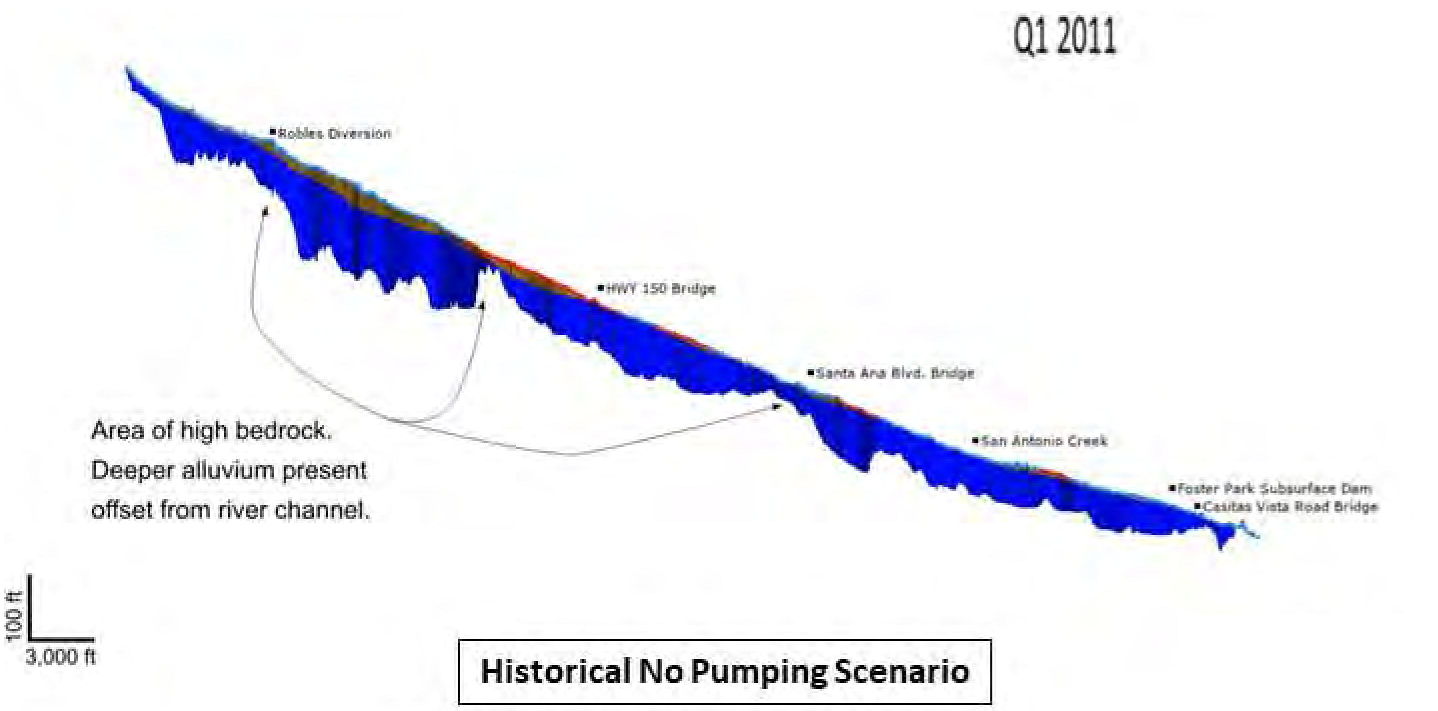


Figure I-07 Boron.

Non-detects are plotted with values equal to the detection limit.

Appendix J

Animation Screen Shots Showing River Conditions and Groundwater Levels, 2011-2017



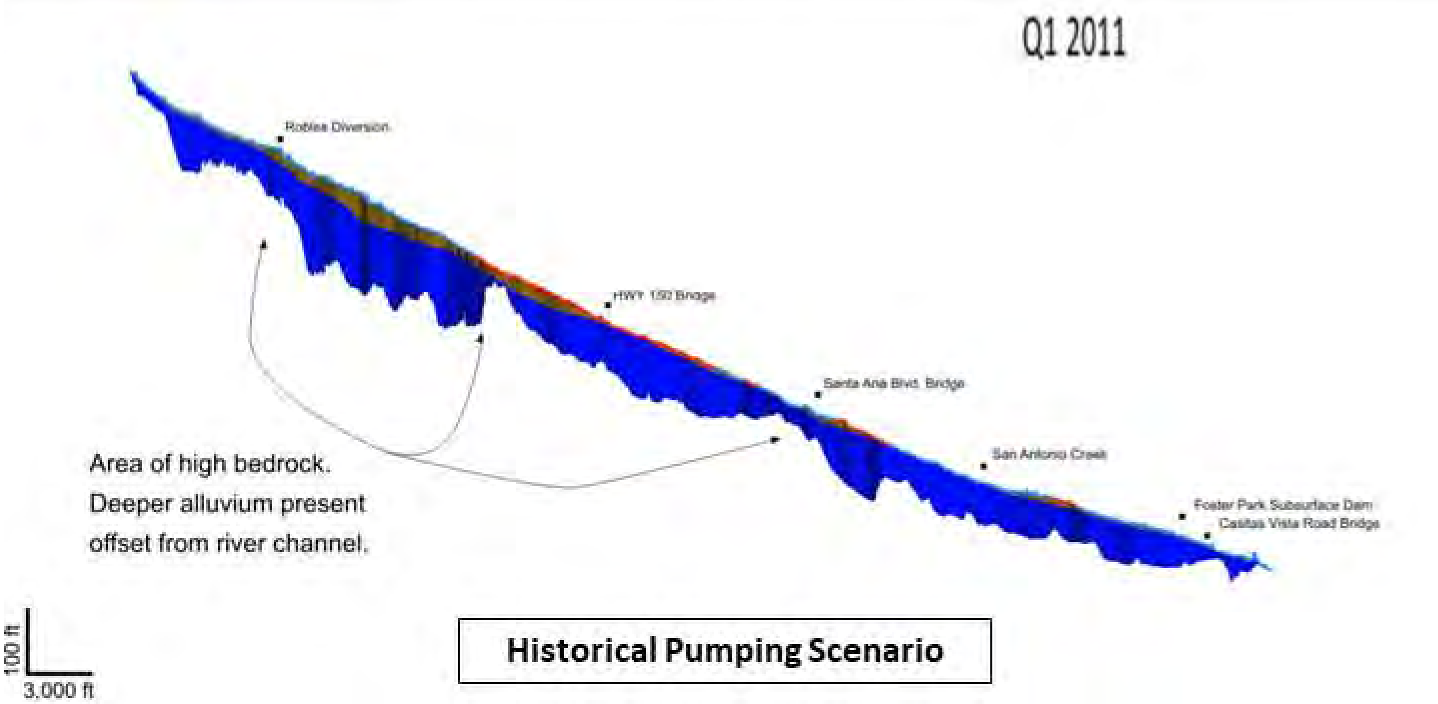
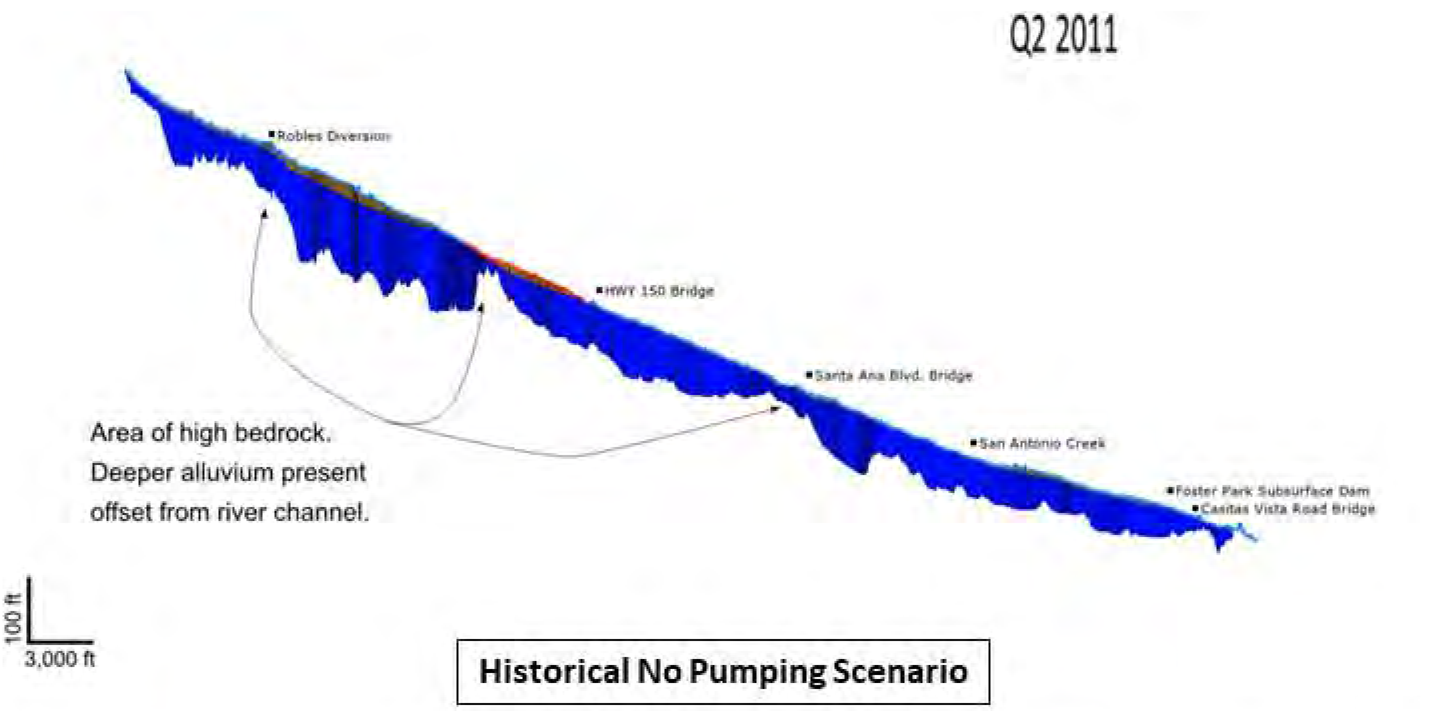


Figure J-01: Animation screenshot from January 2011 (beginning of animation).



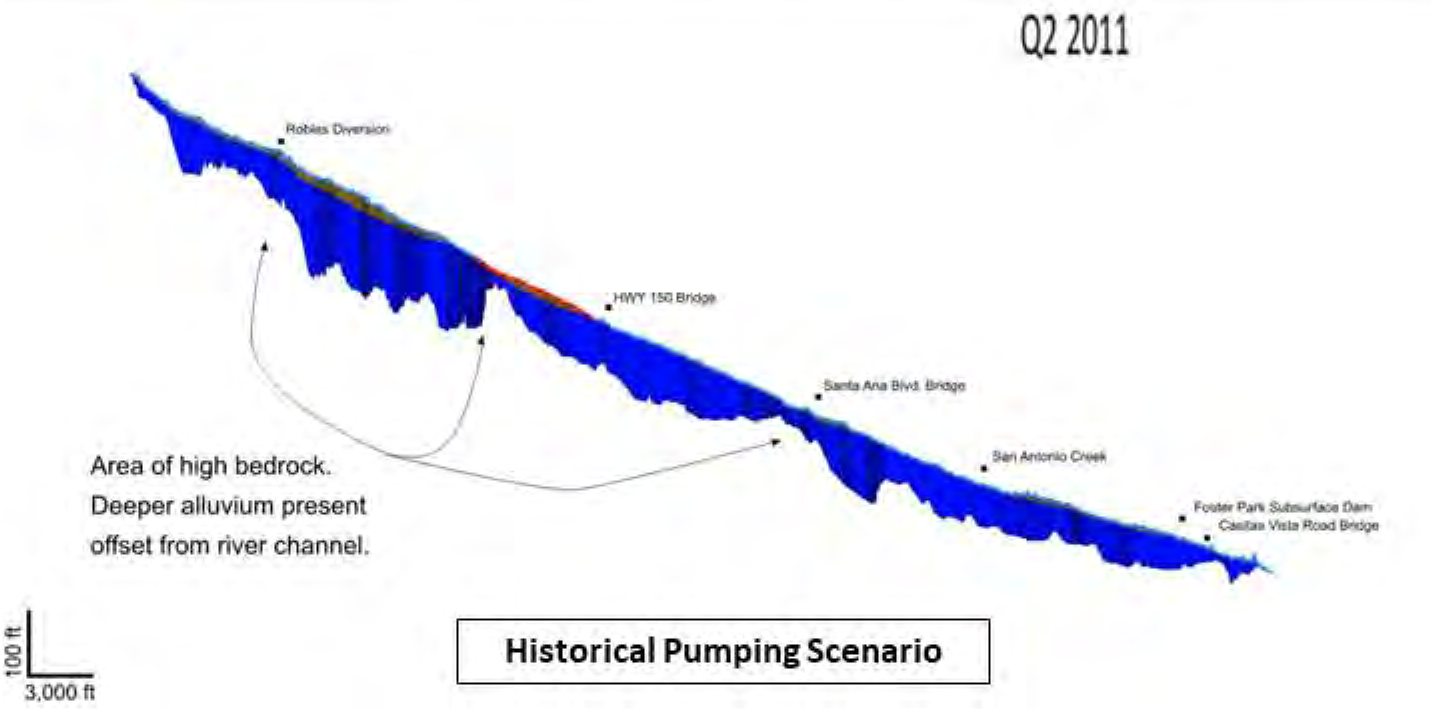
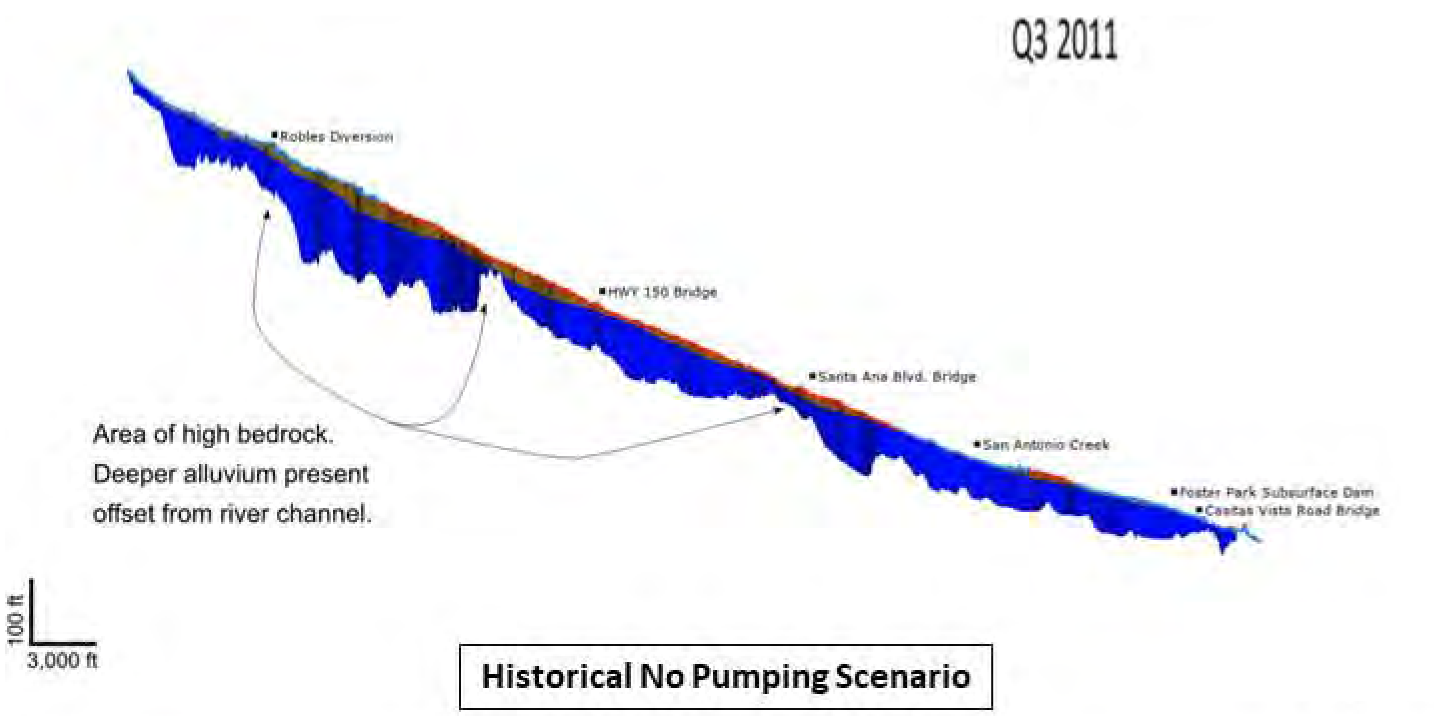


Figure J-02: Animation screenshot from April 2011.



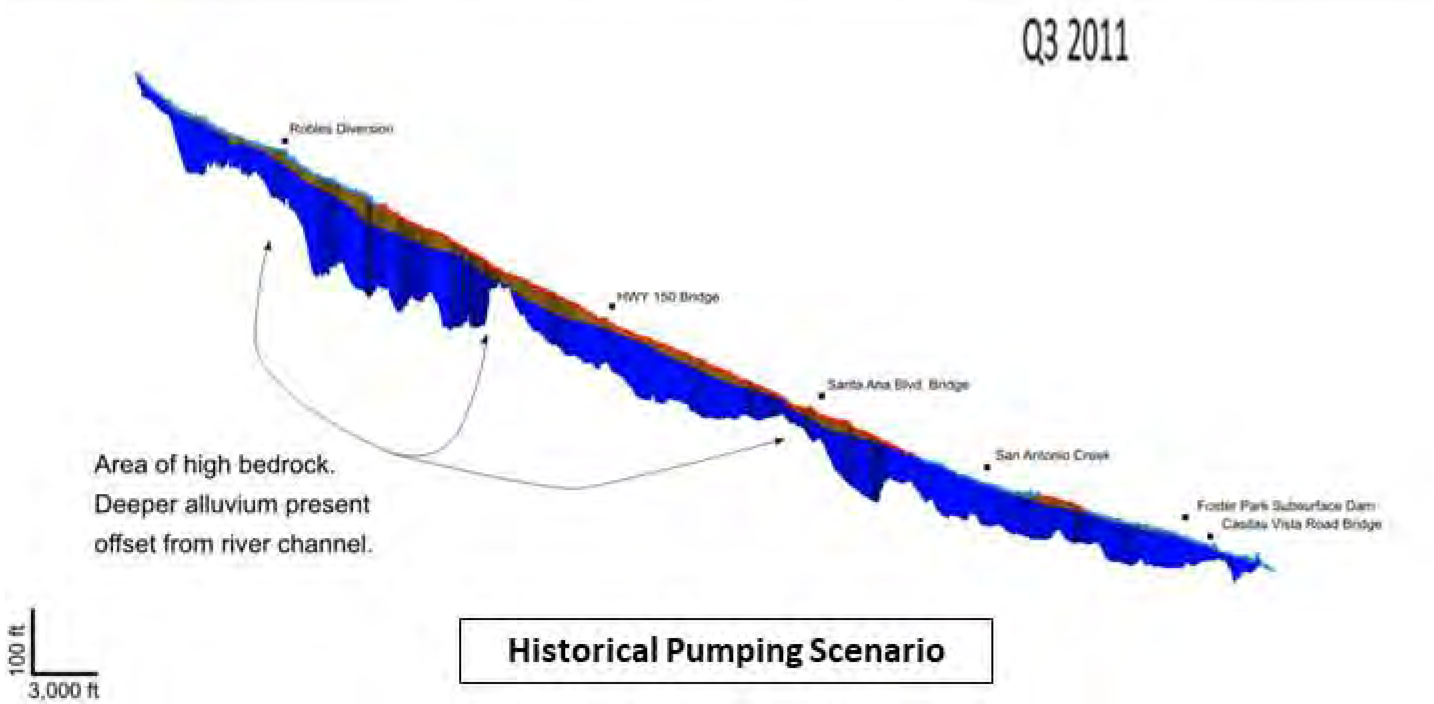
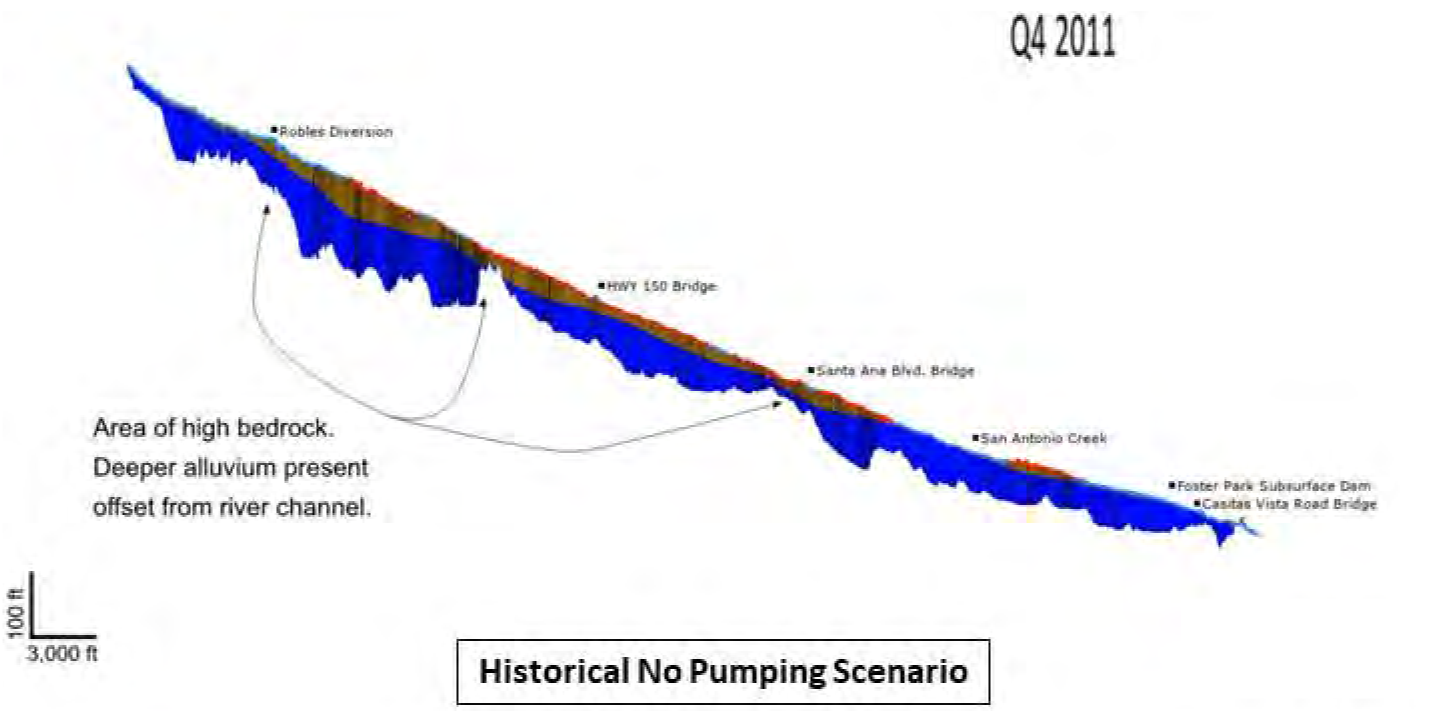


Figure J-03: Animation screenshot from July 2011.



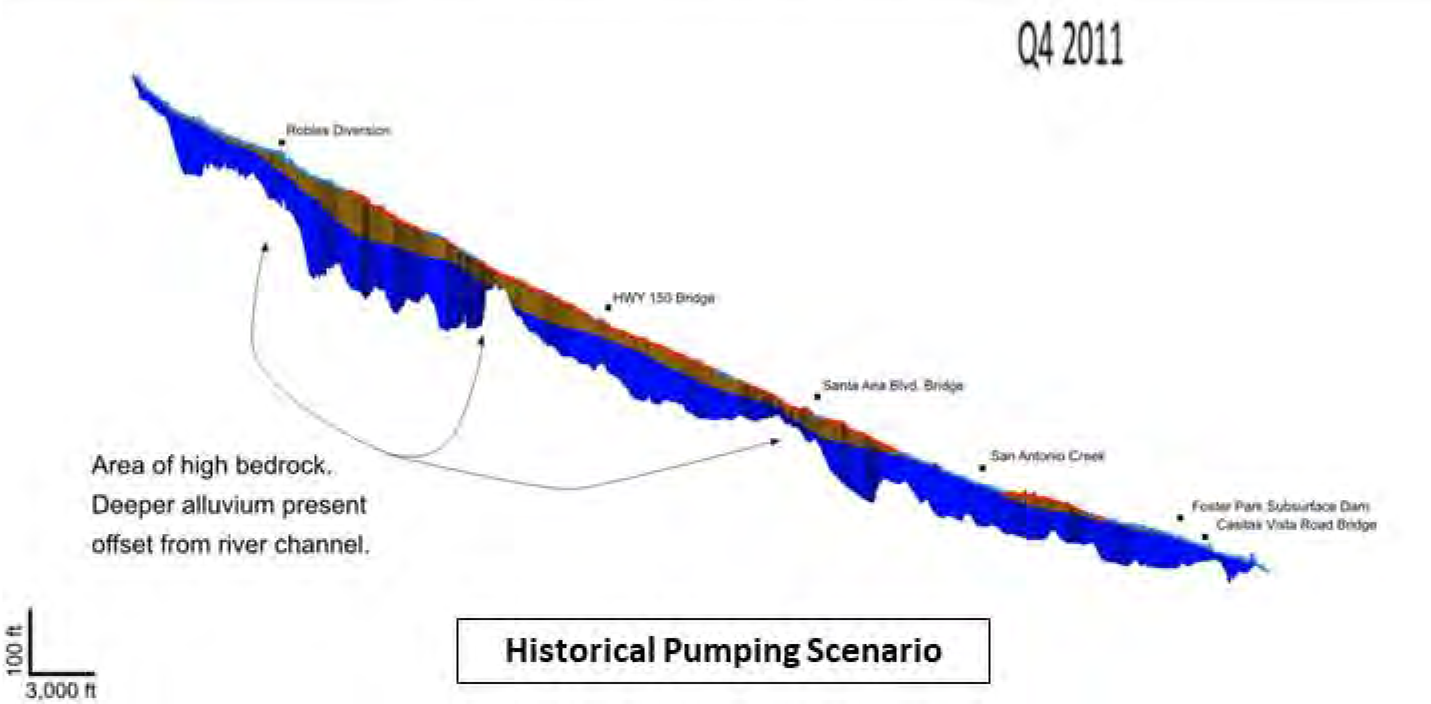
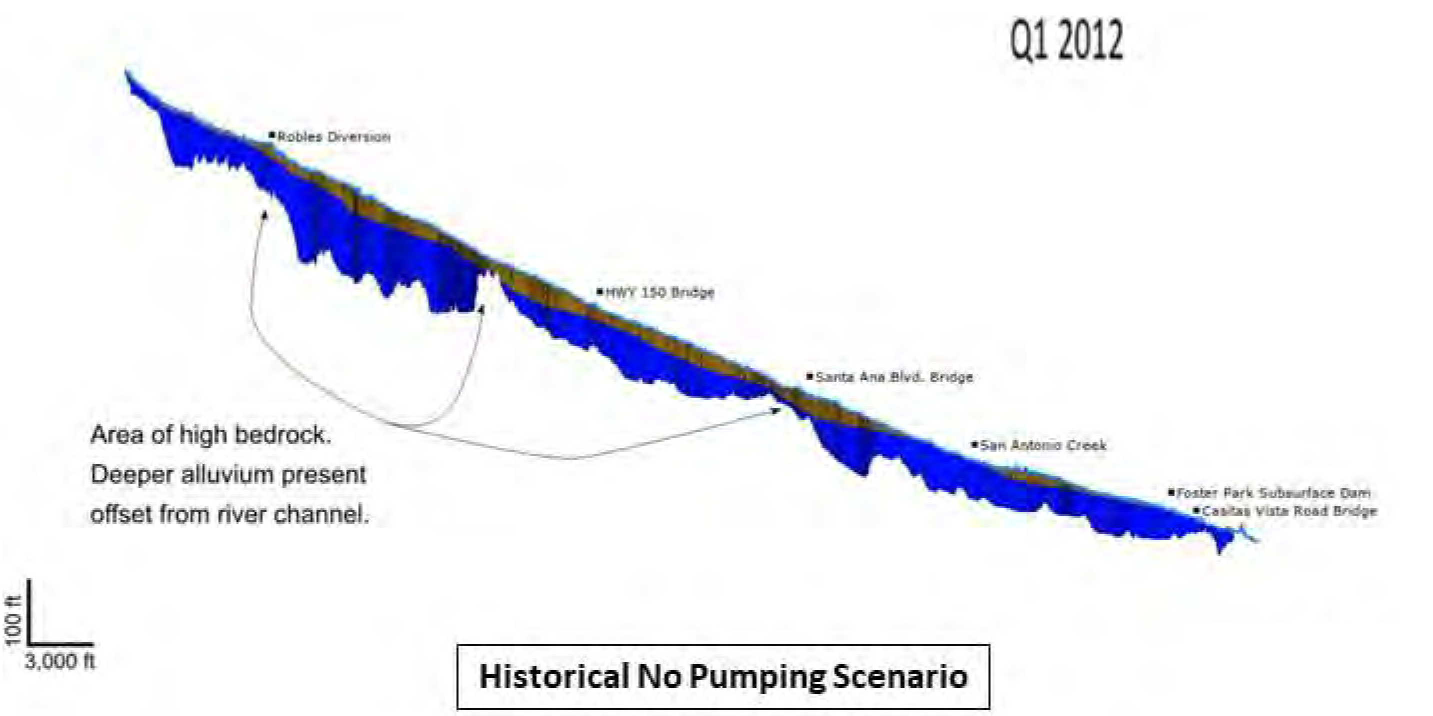


Figure J-04: Animation screenshot from October 2011.



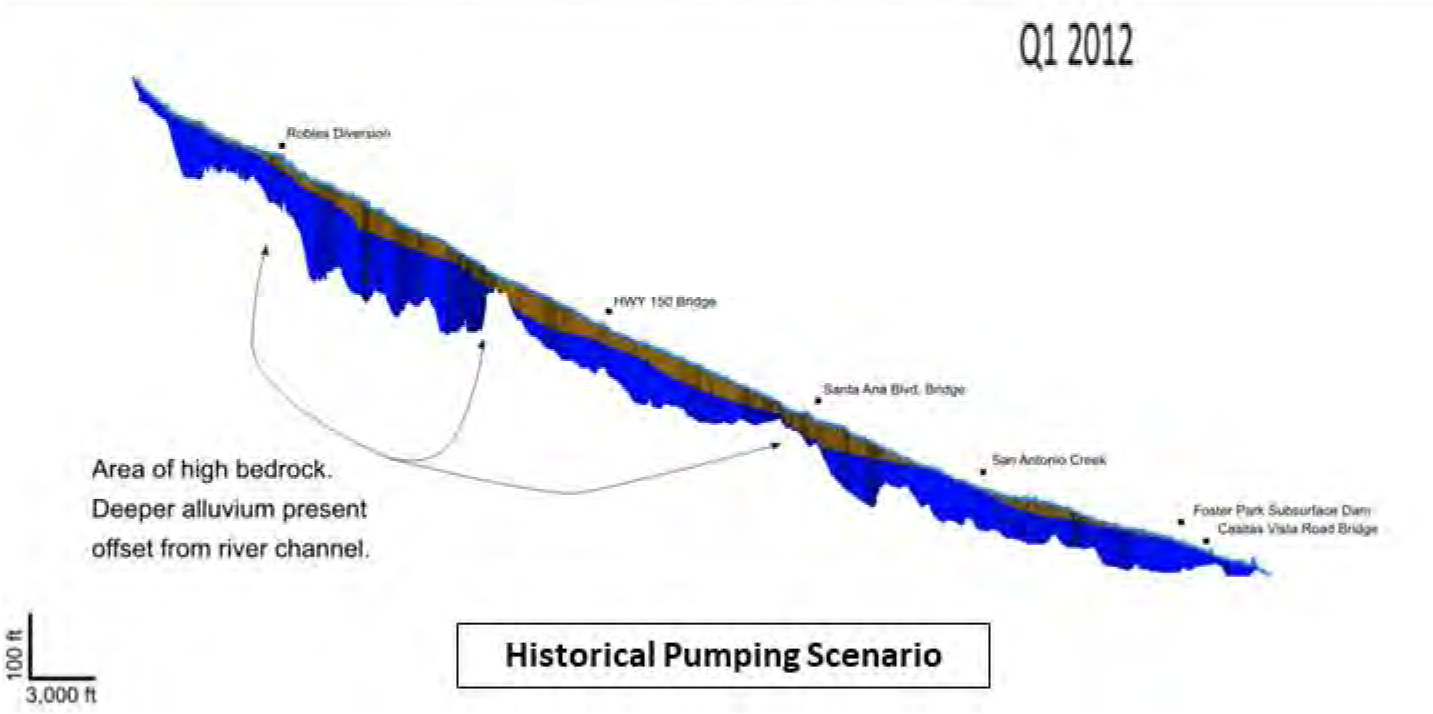
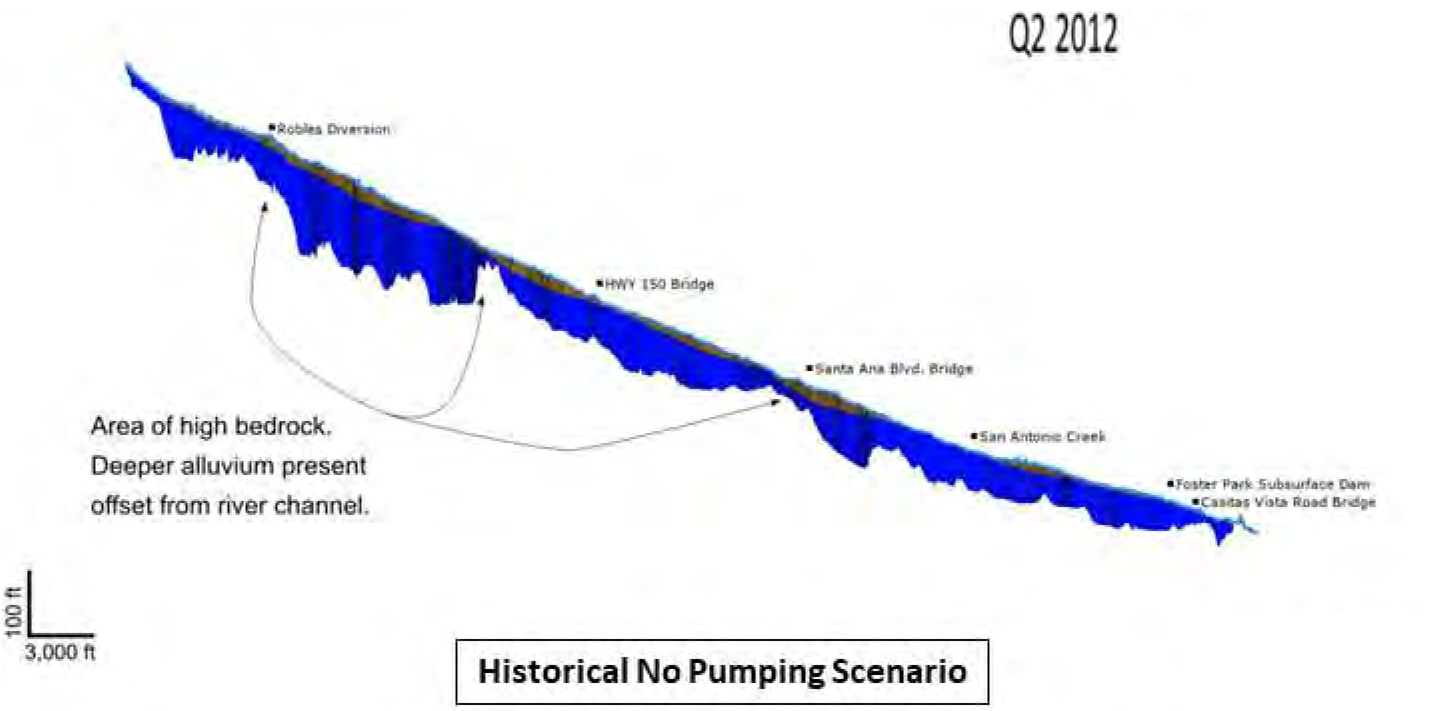


Figure J-05: Animation screenshot from January 2012.



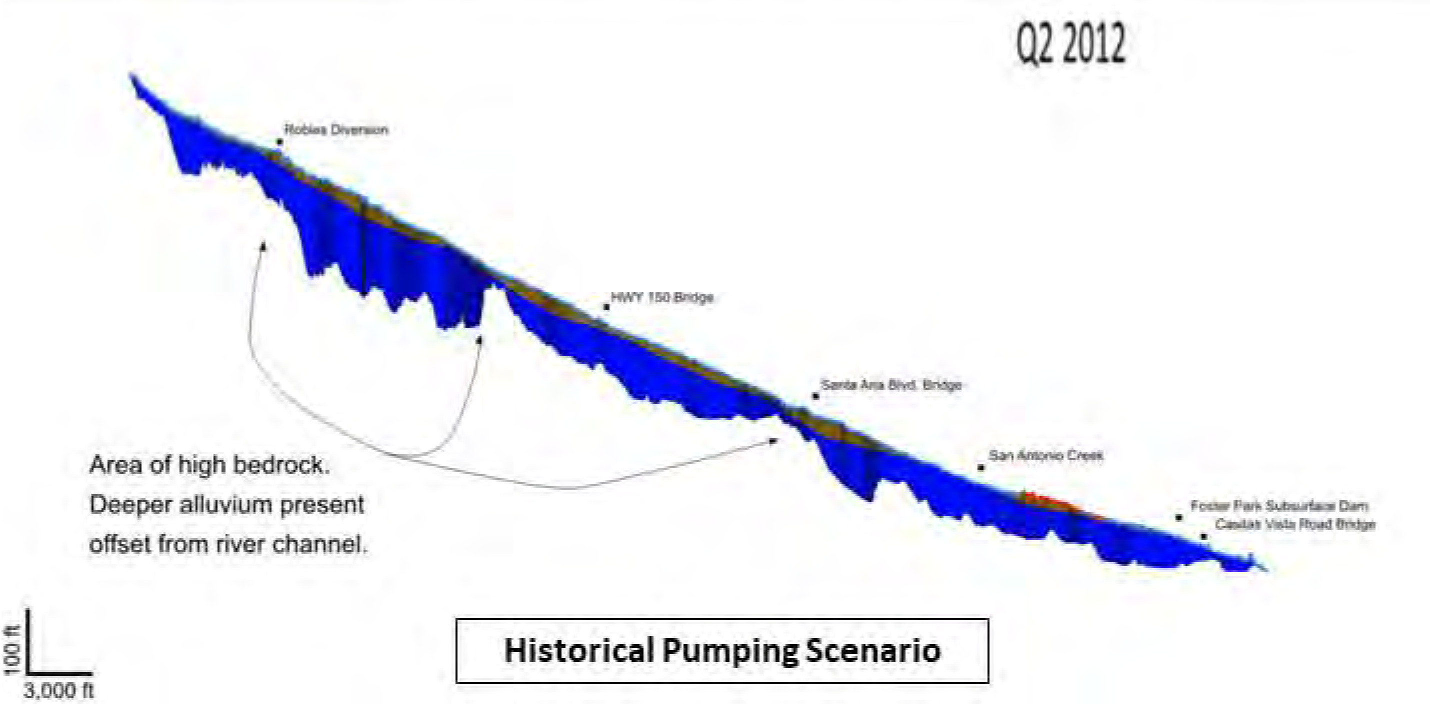
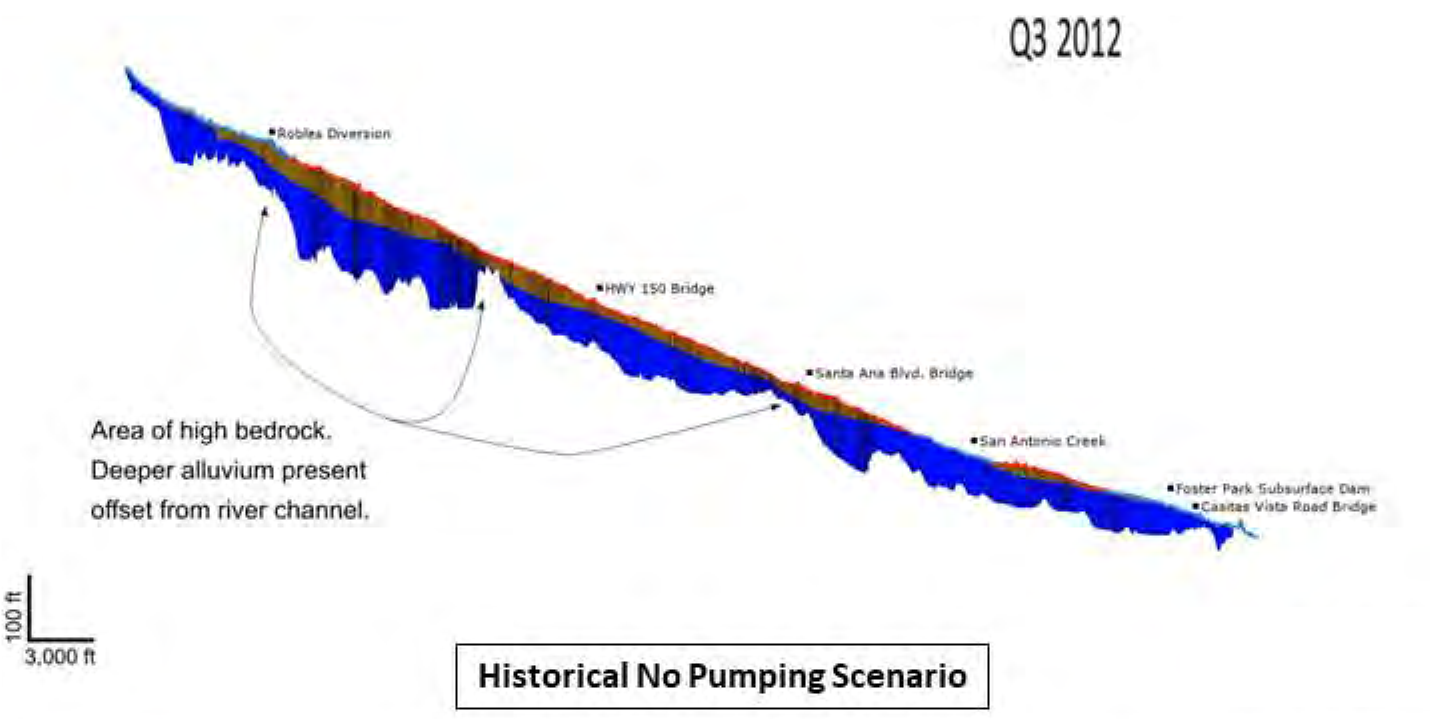


Figure J-06: Animation screenshot from April 2012.



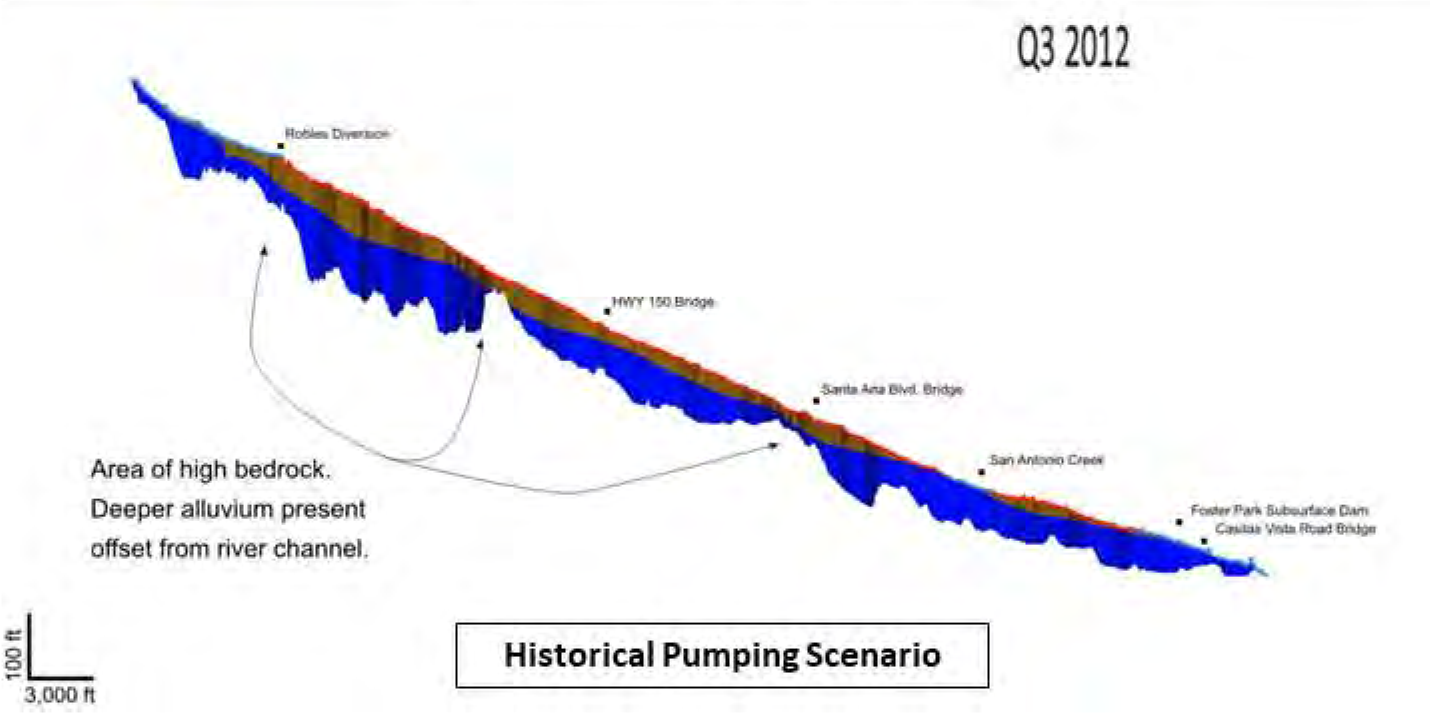


Figure J-07: Animation screenshot from July 2012.

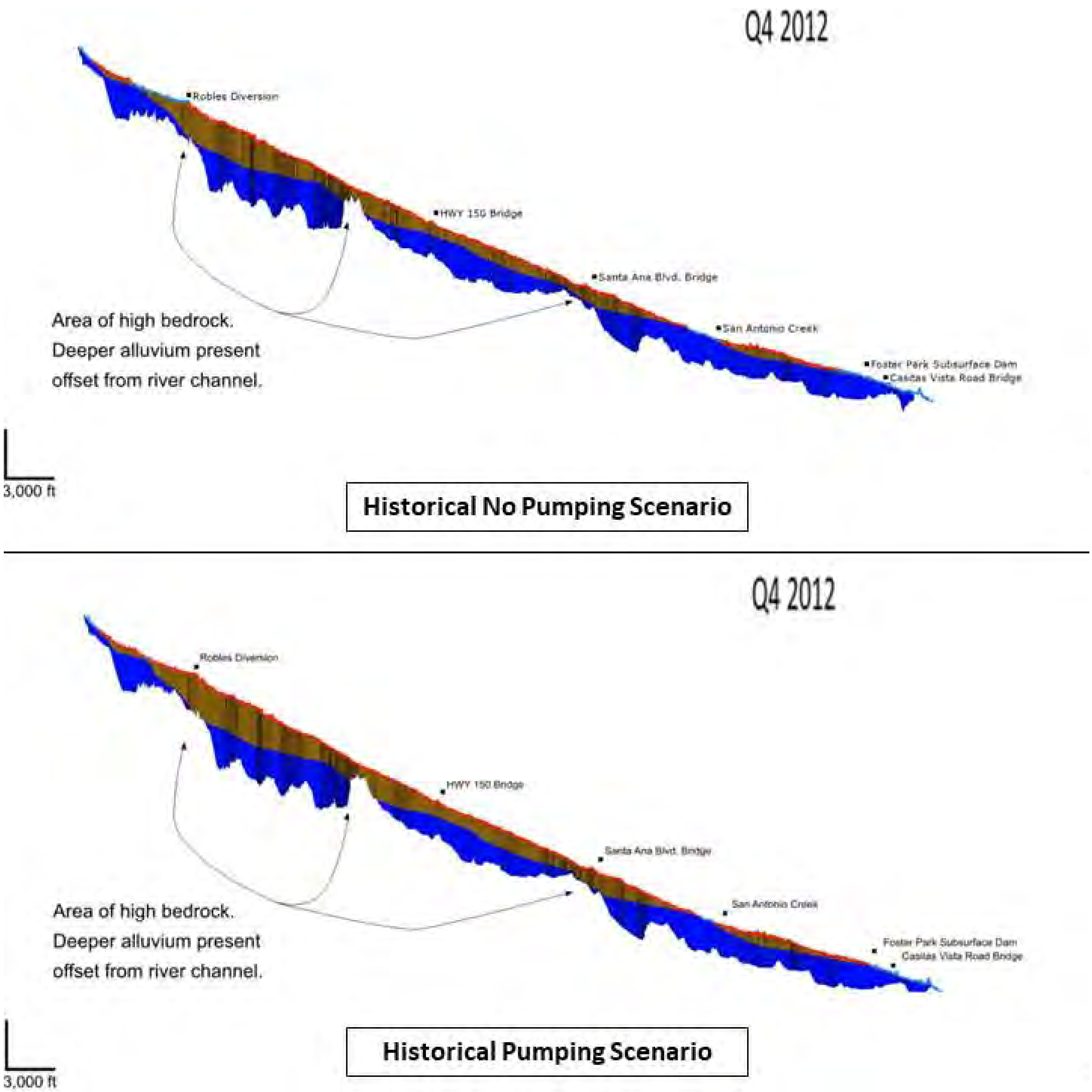
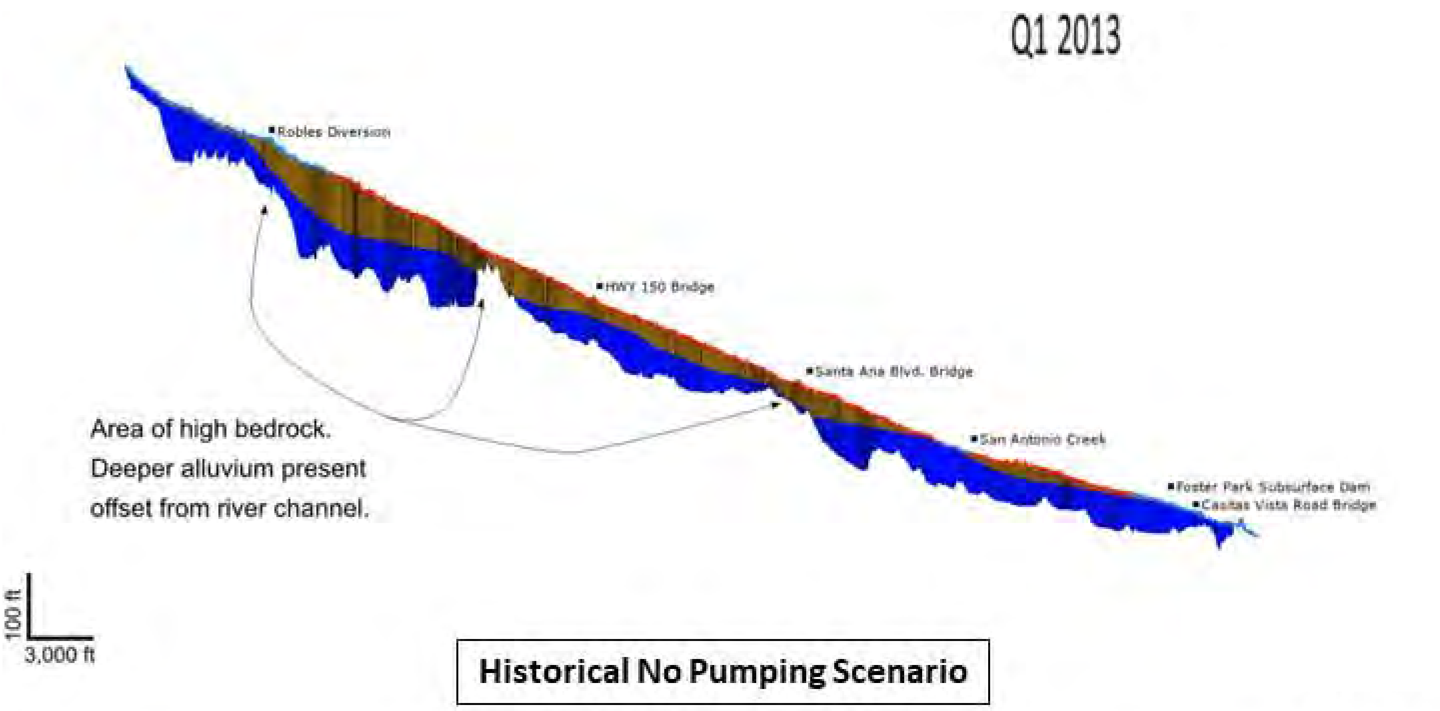


Figure J-08: Animation screenshot from October 2012.



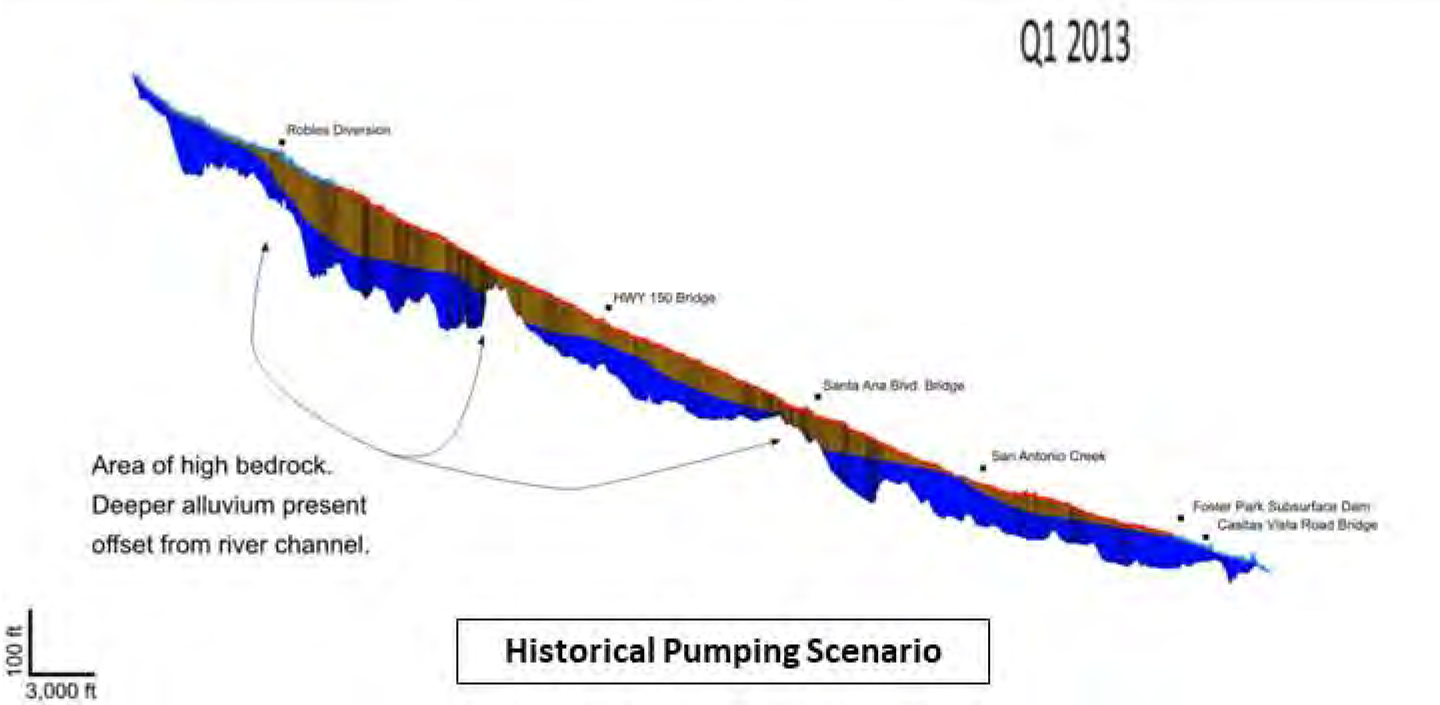
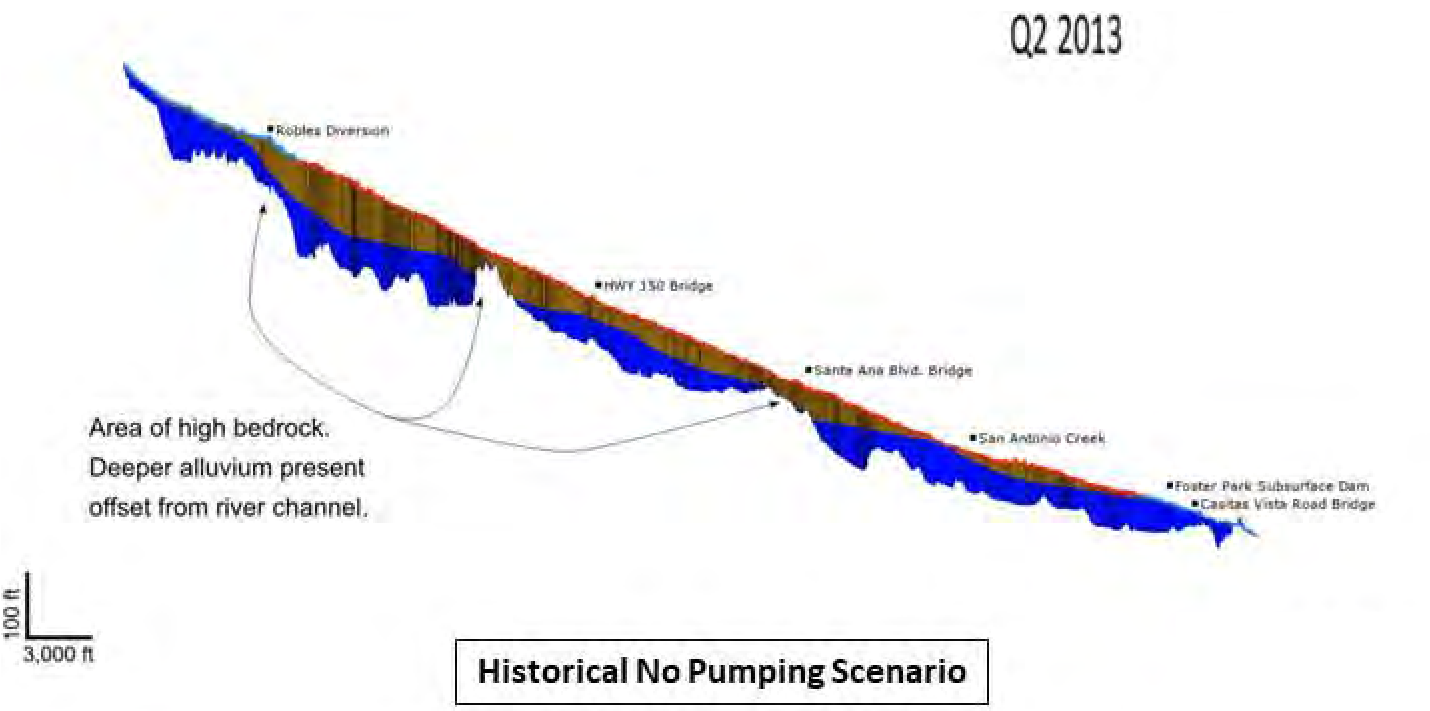


Figure J-09: Animation screenshot from January 2013.



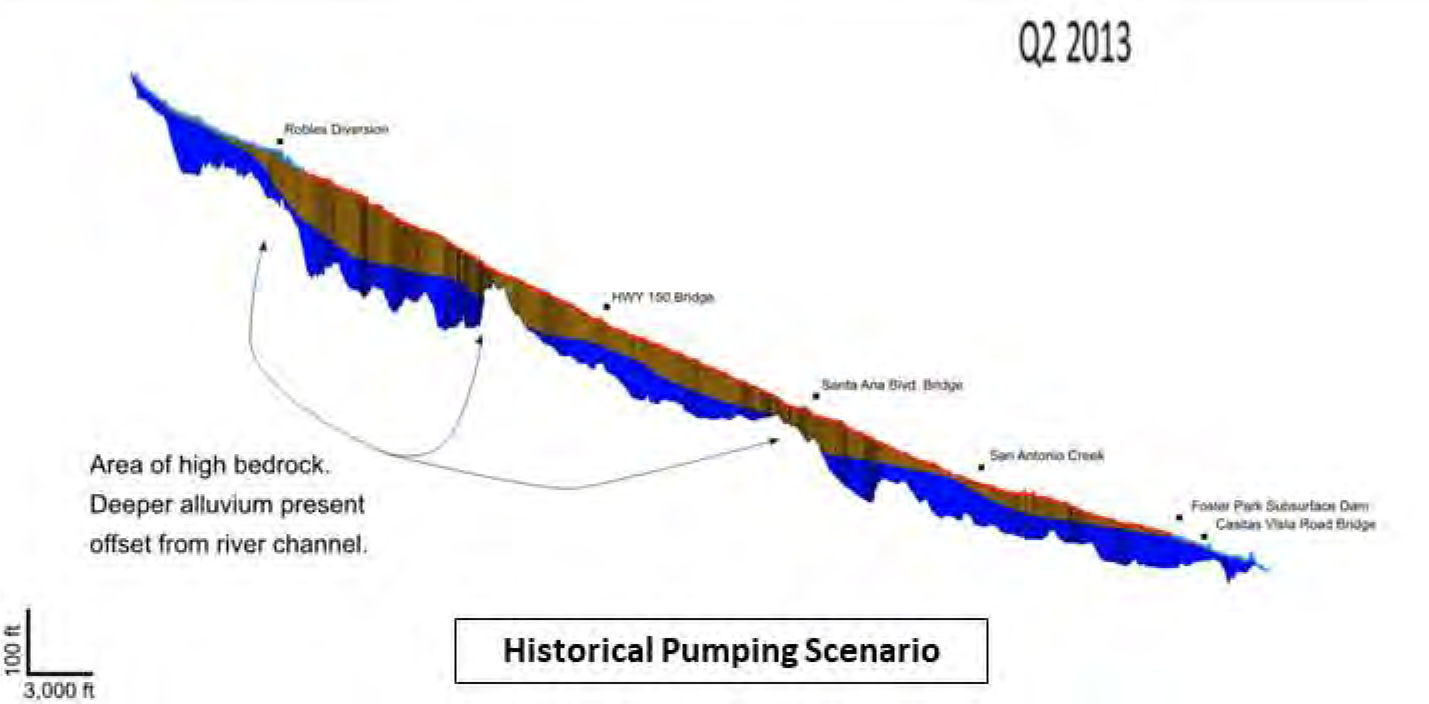


Figure J-10: Animation screenshot from April 2013.

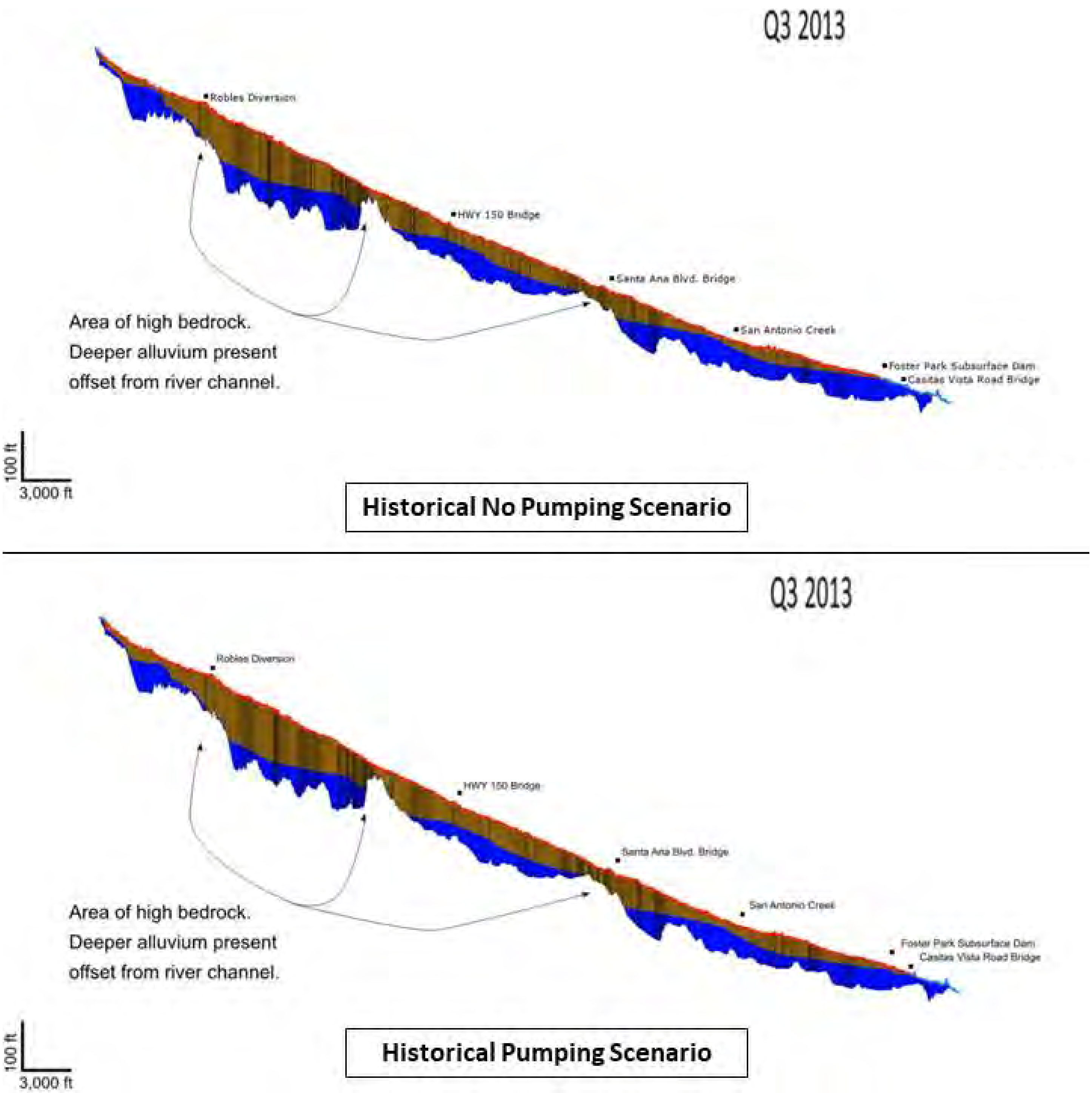


Figure J-11: Animation screenshot from July 2013.

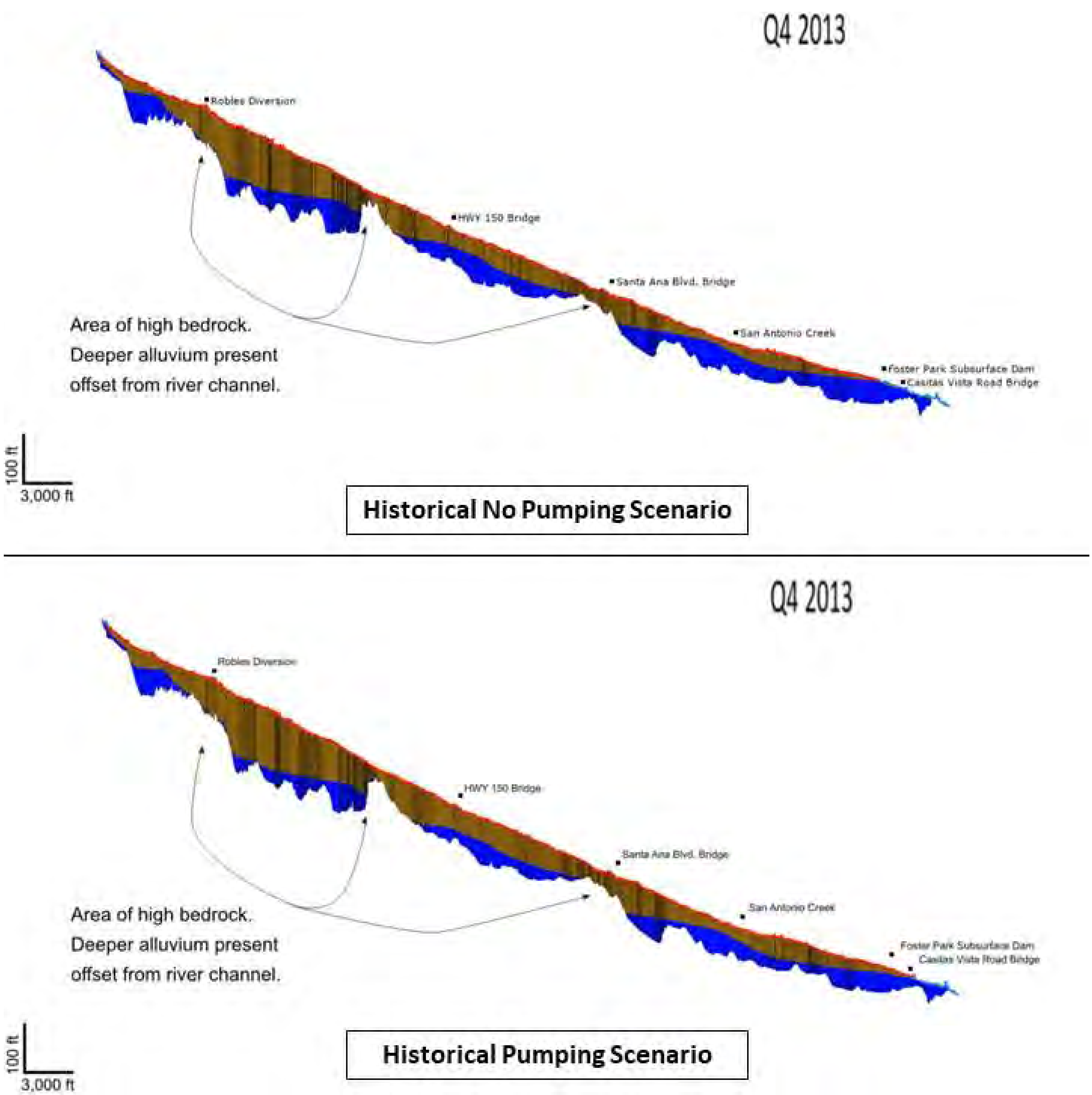
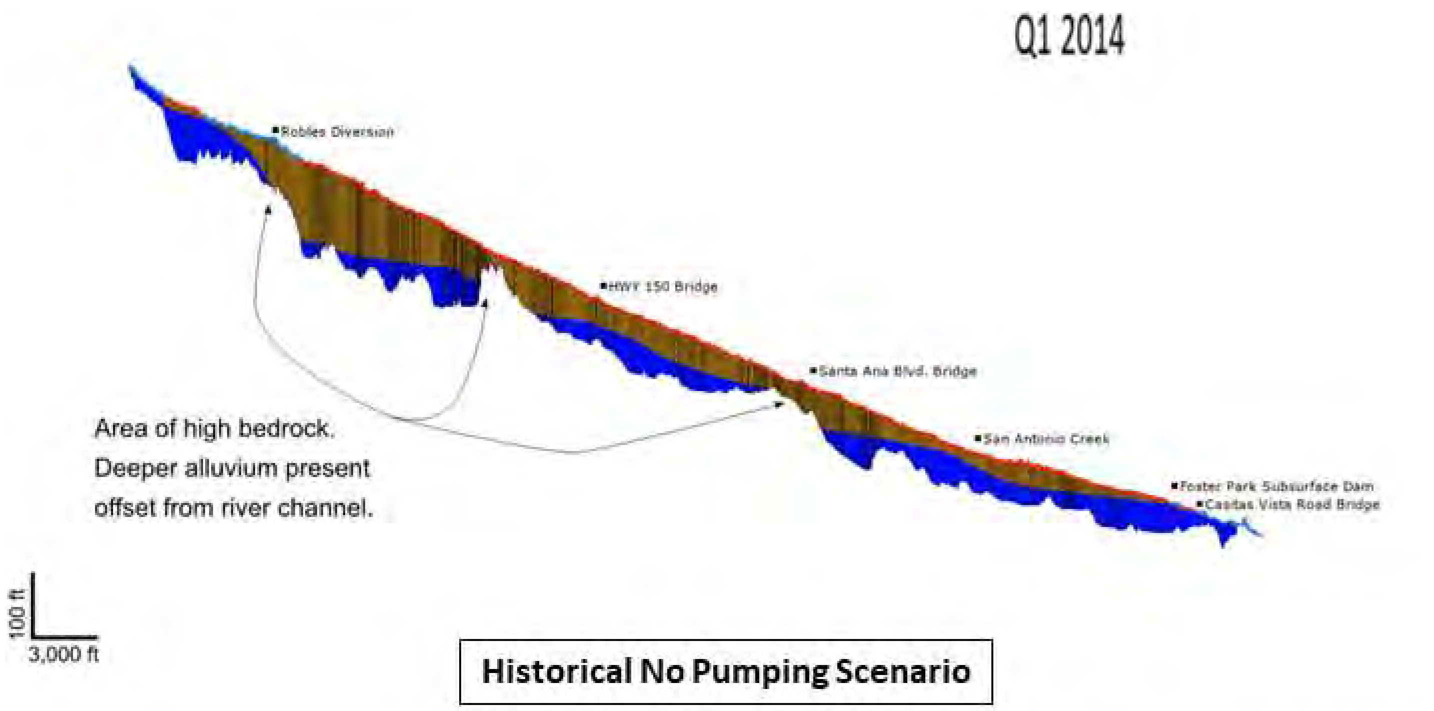


Figure J-12: Animation screenshot from October 2013.



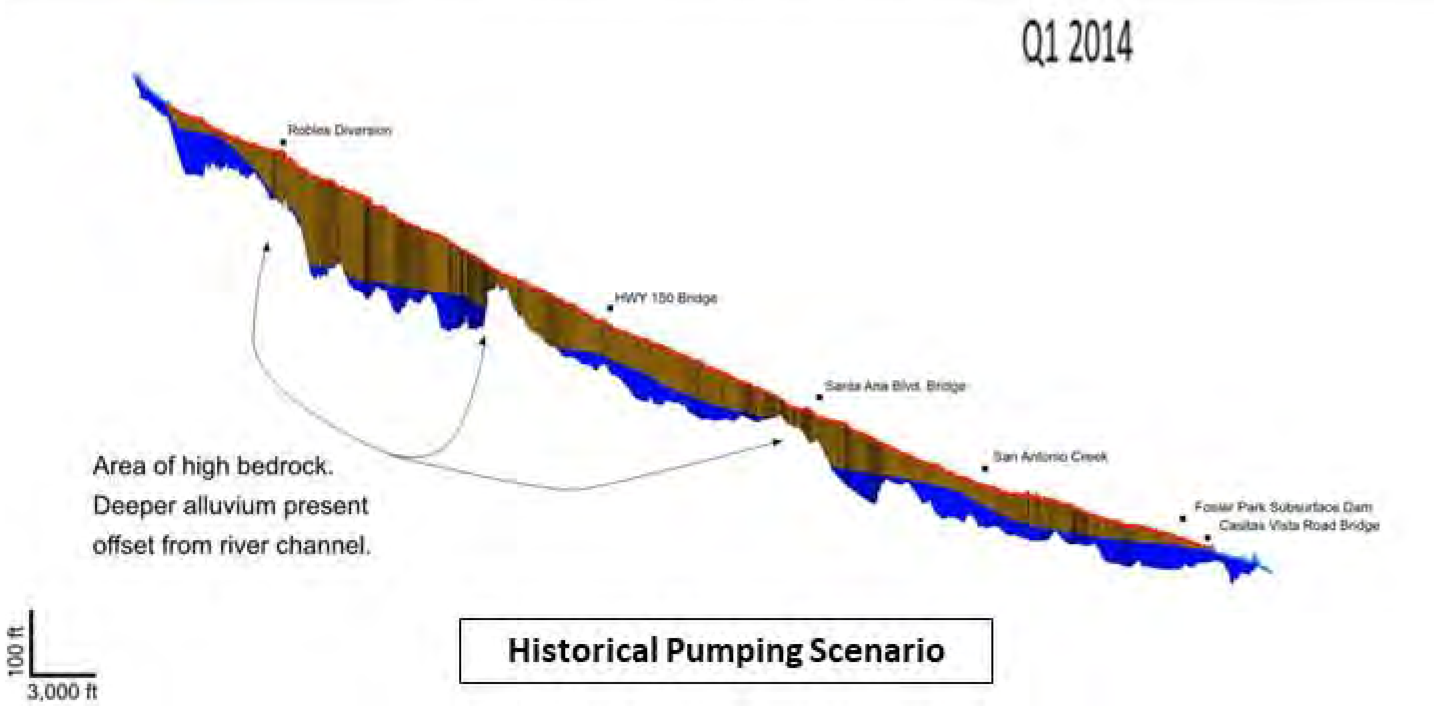
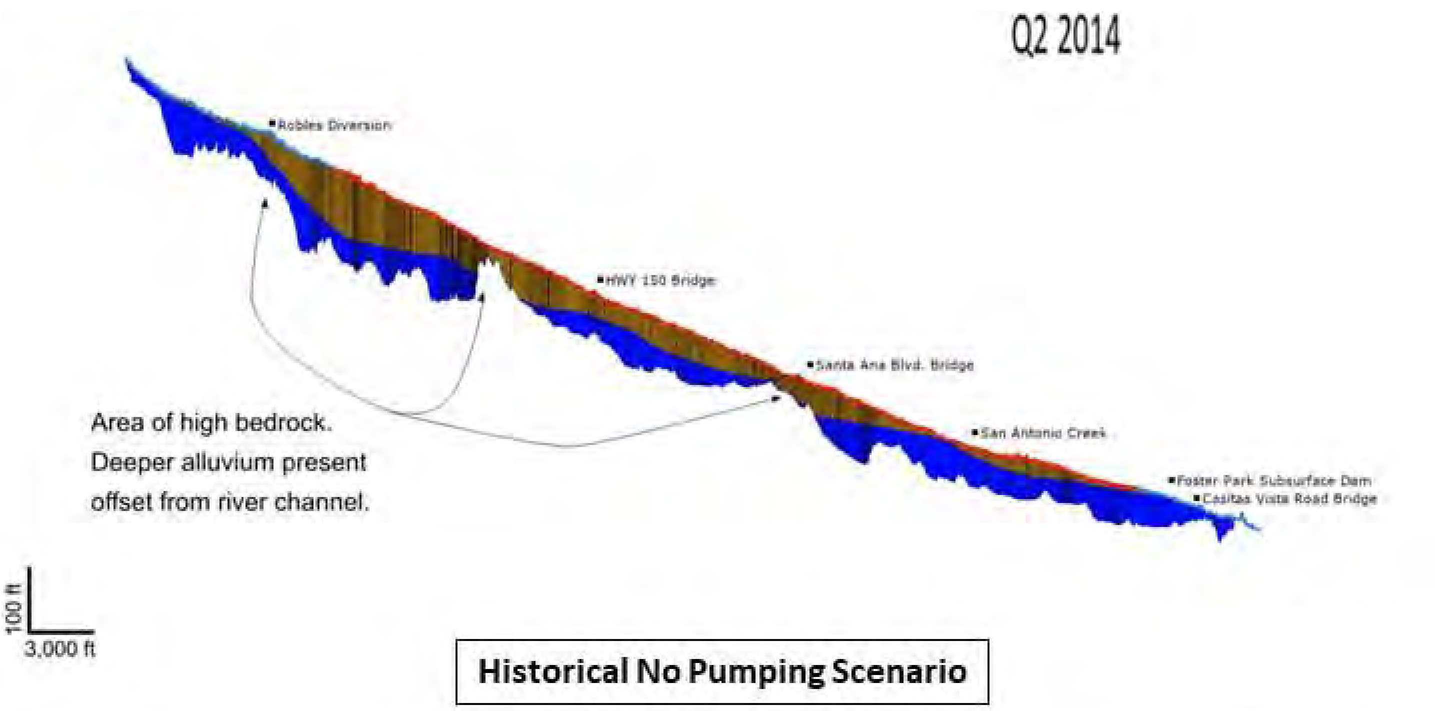


Figure J-13: Animation screenshot from January 2014.



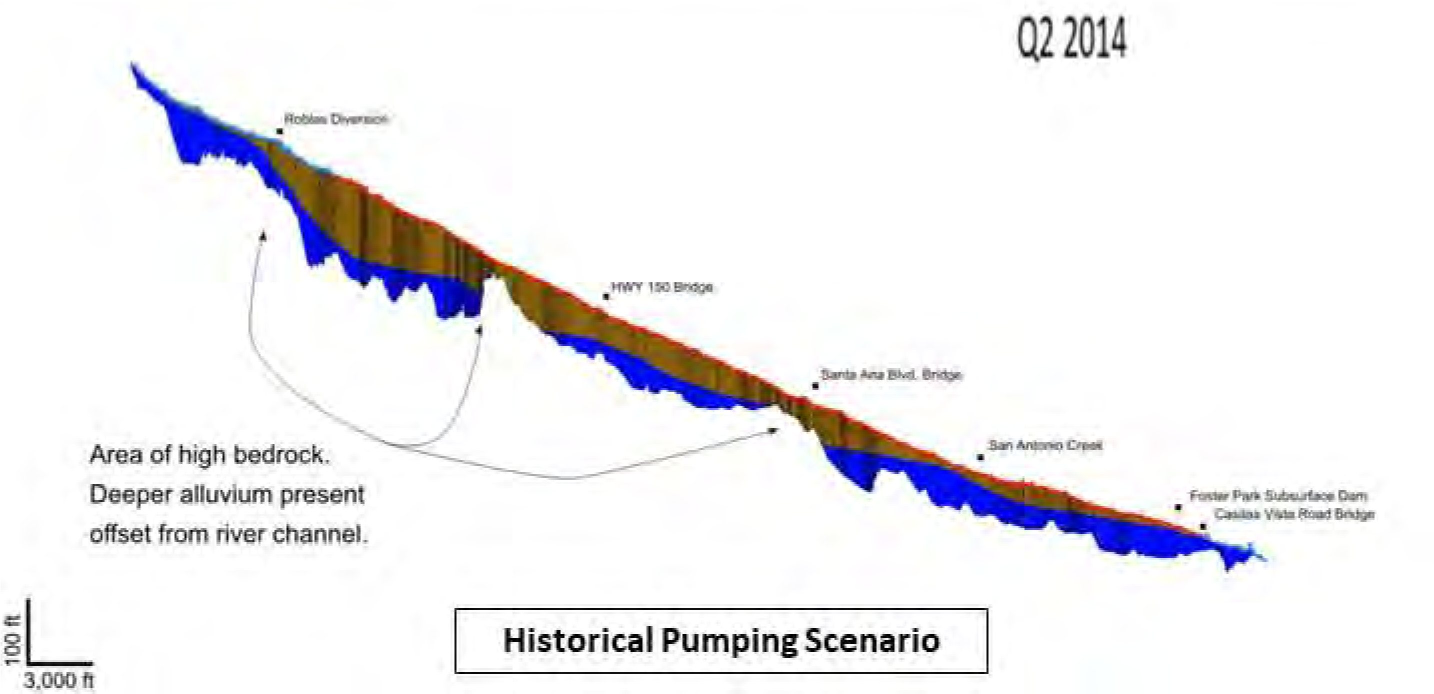


Figure J-14: Animation screenshot from April 2014.

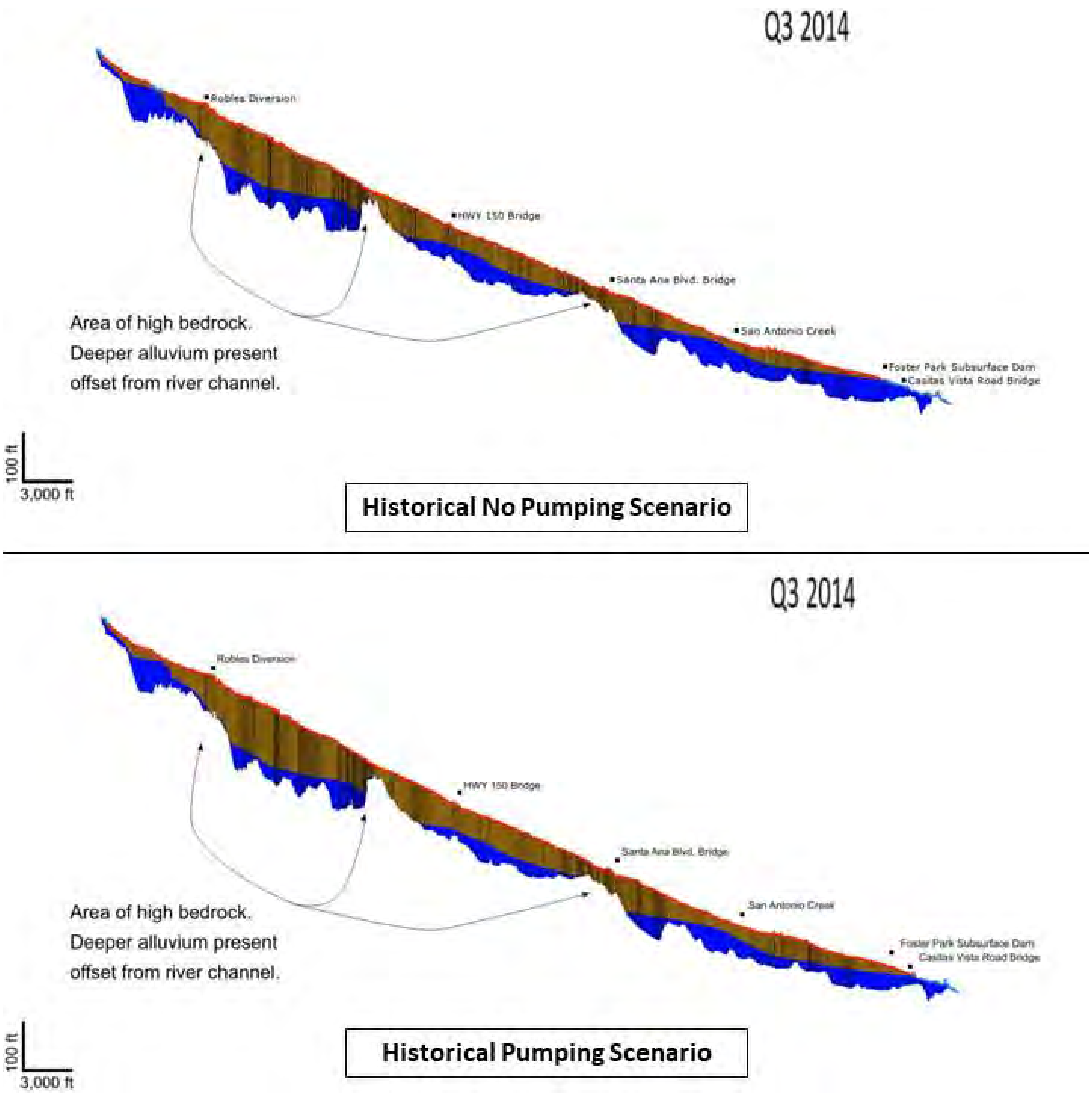


Figure J-15: Animation screenshot from July 2014.

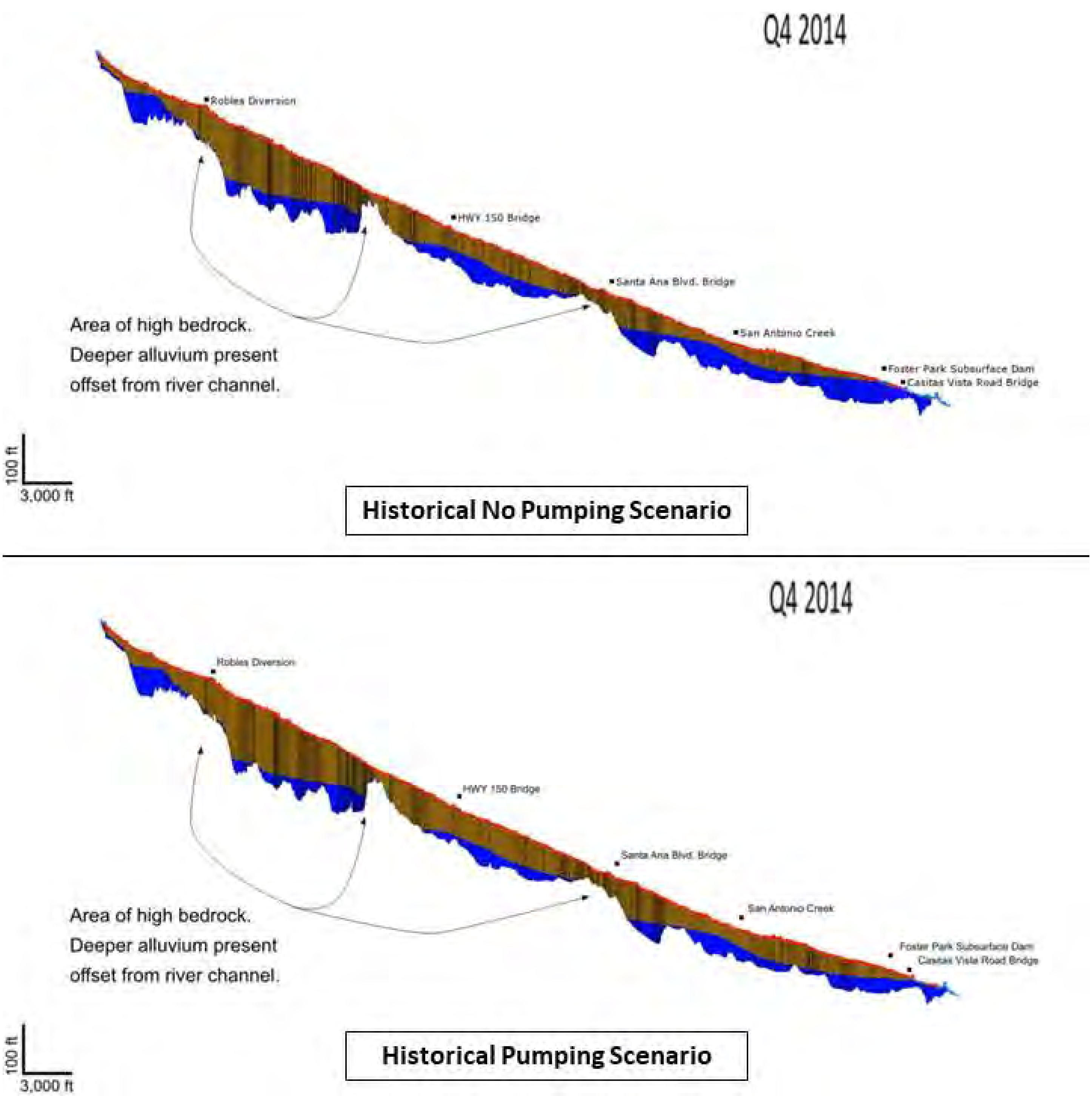
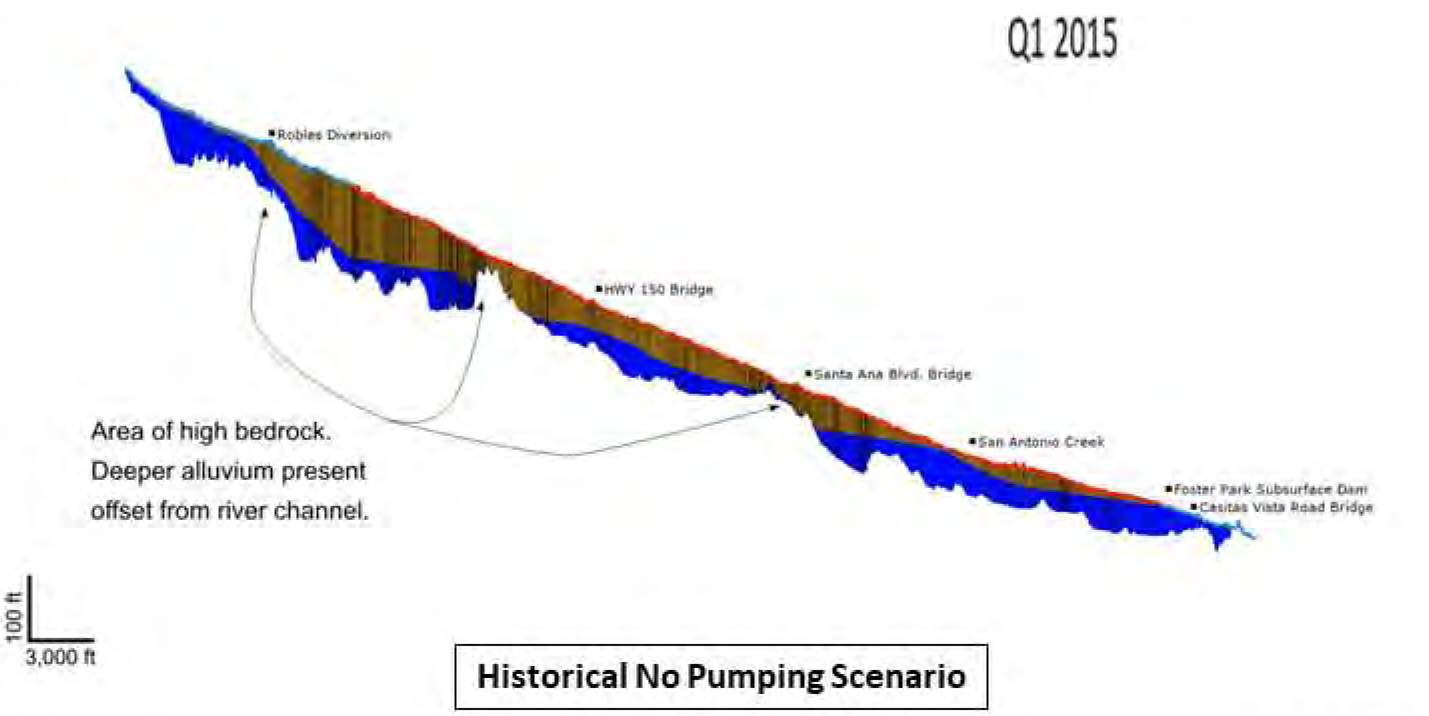


Figure J-16: Animation screenshot from October 2014.



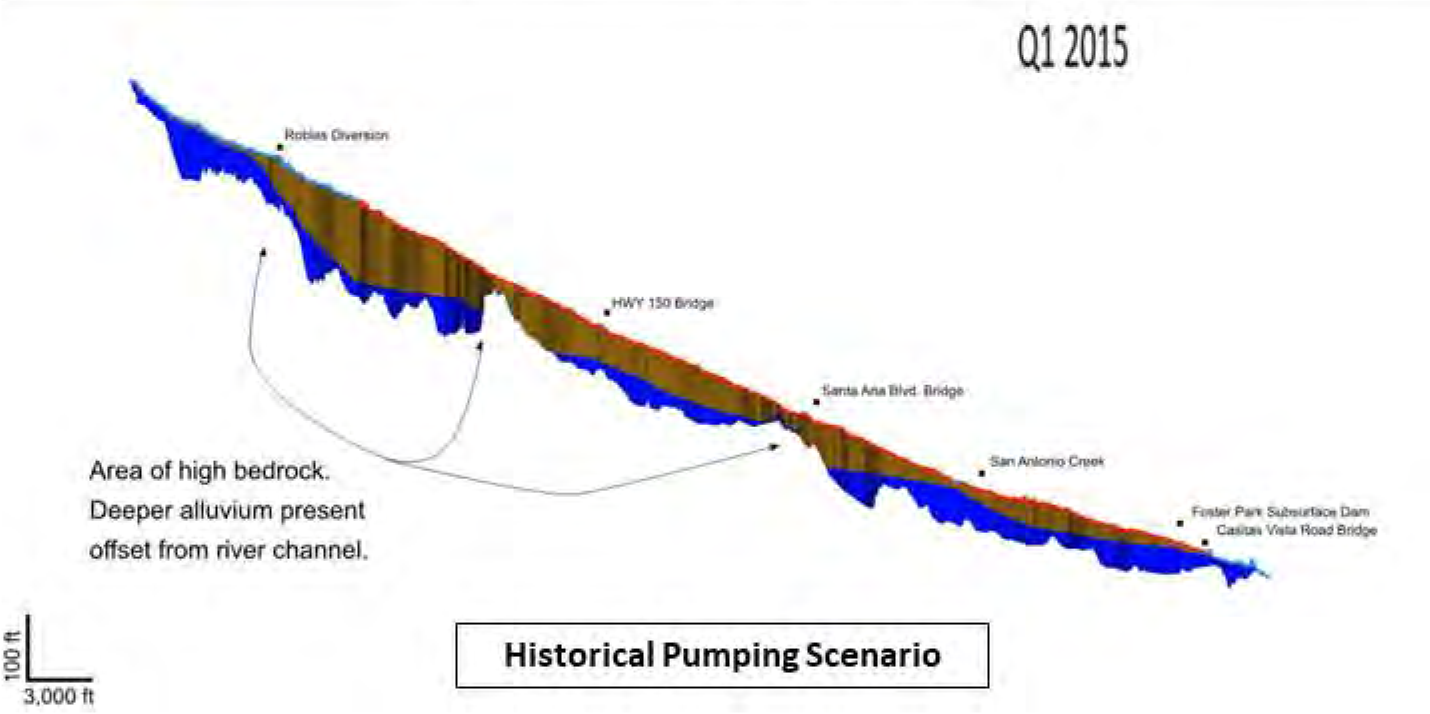
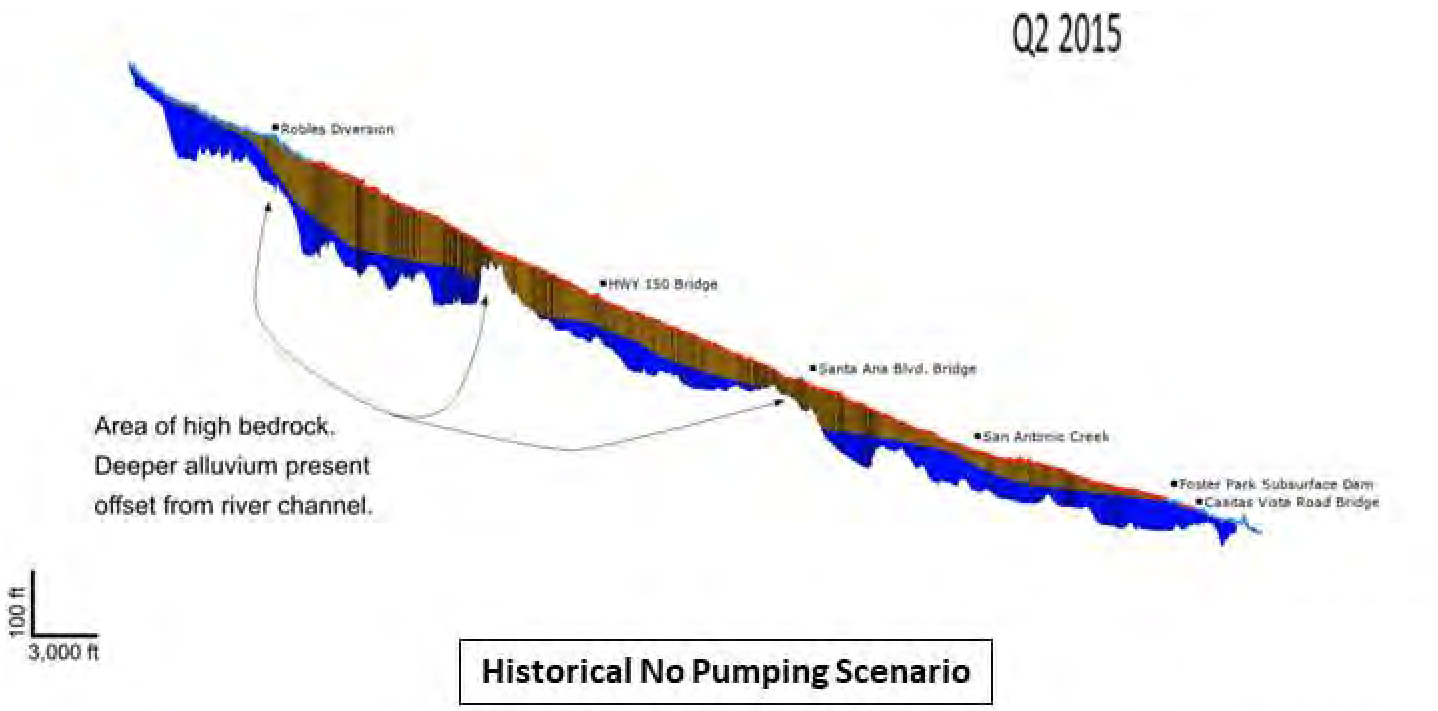


Figure J-17: Animation screenshot from January 2015.



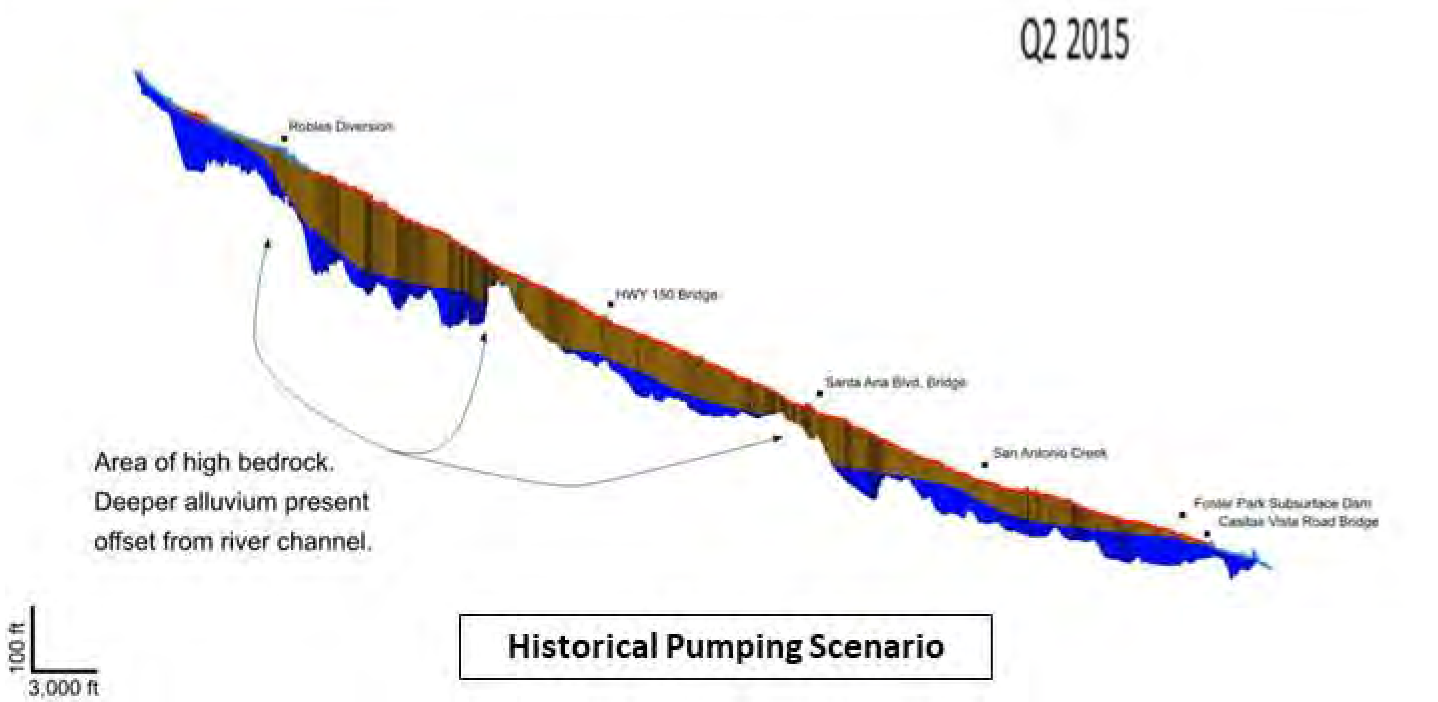
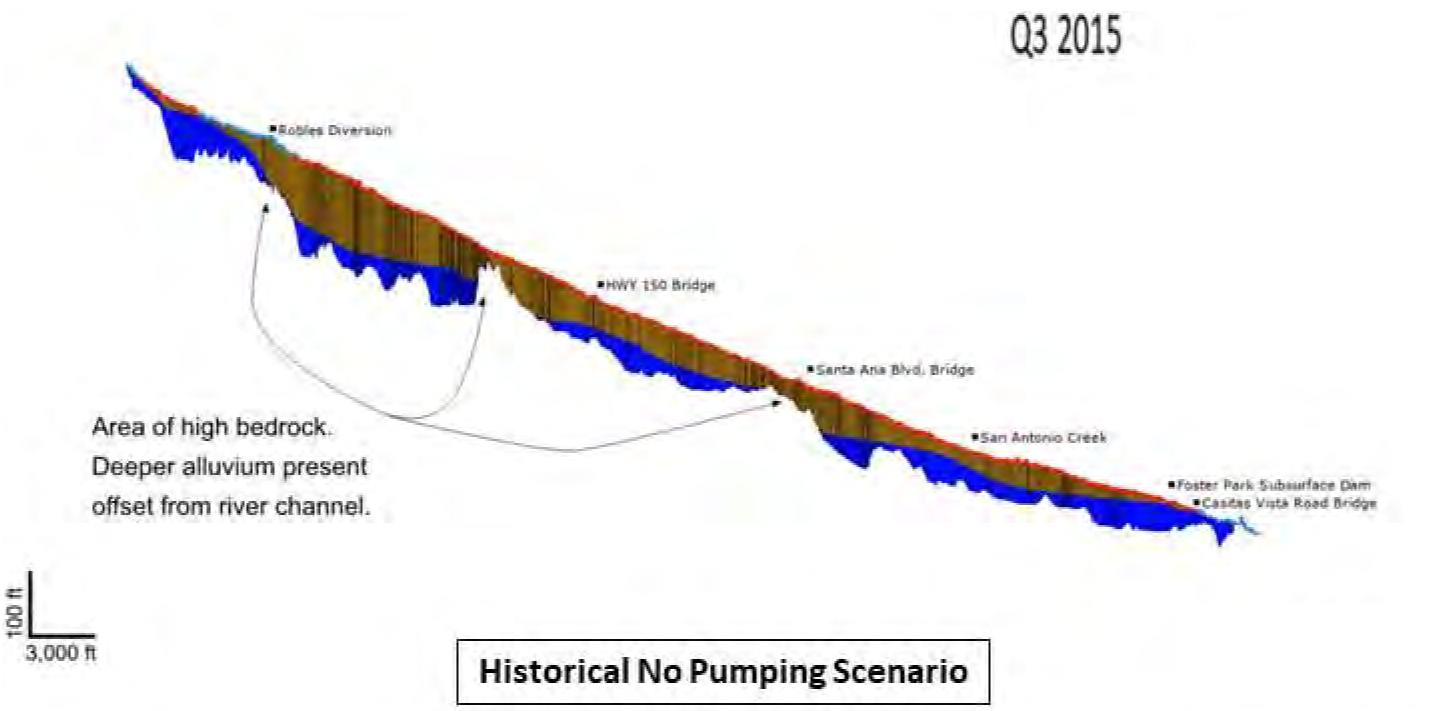


Figure J-18: Animation screenshot from April 2015.



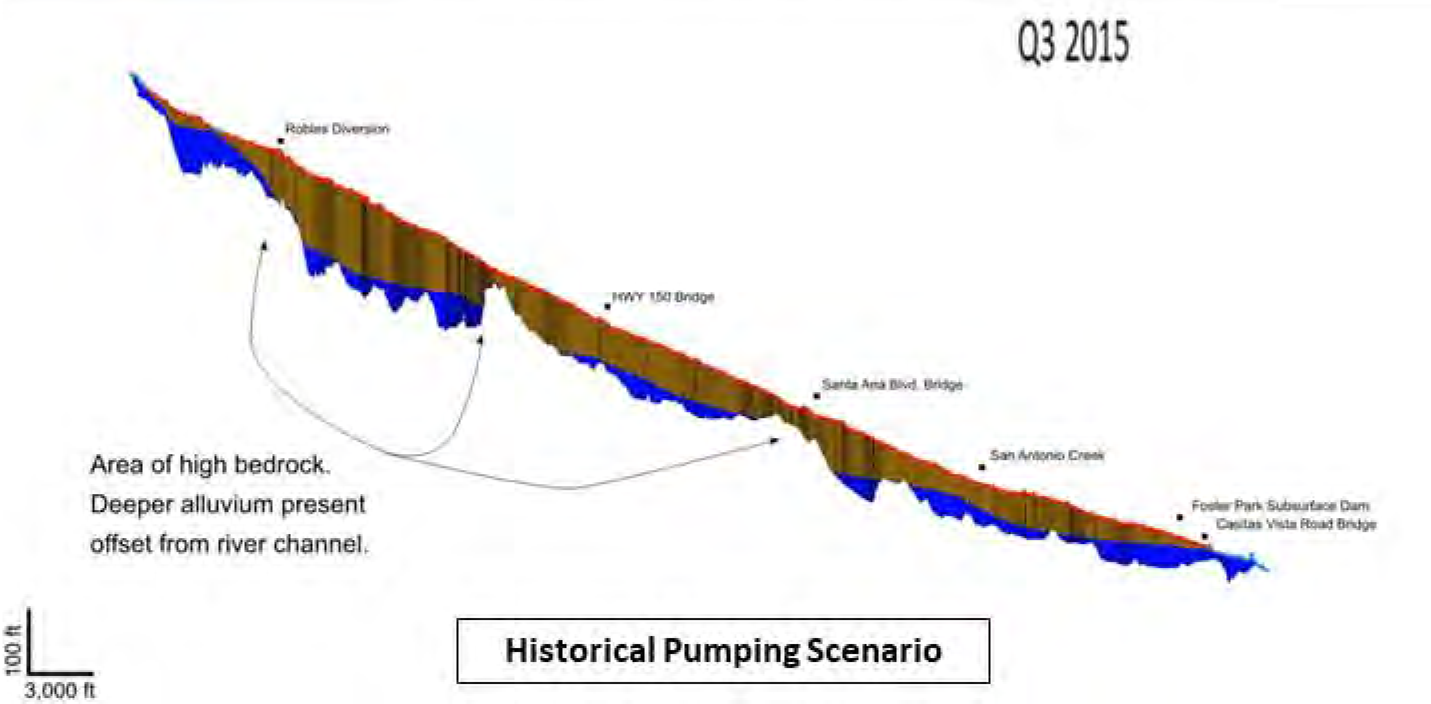
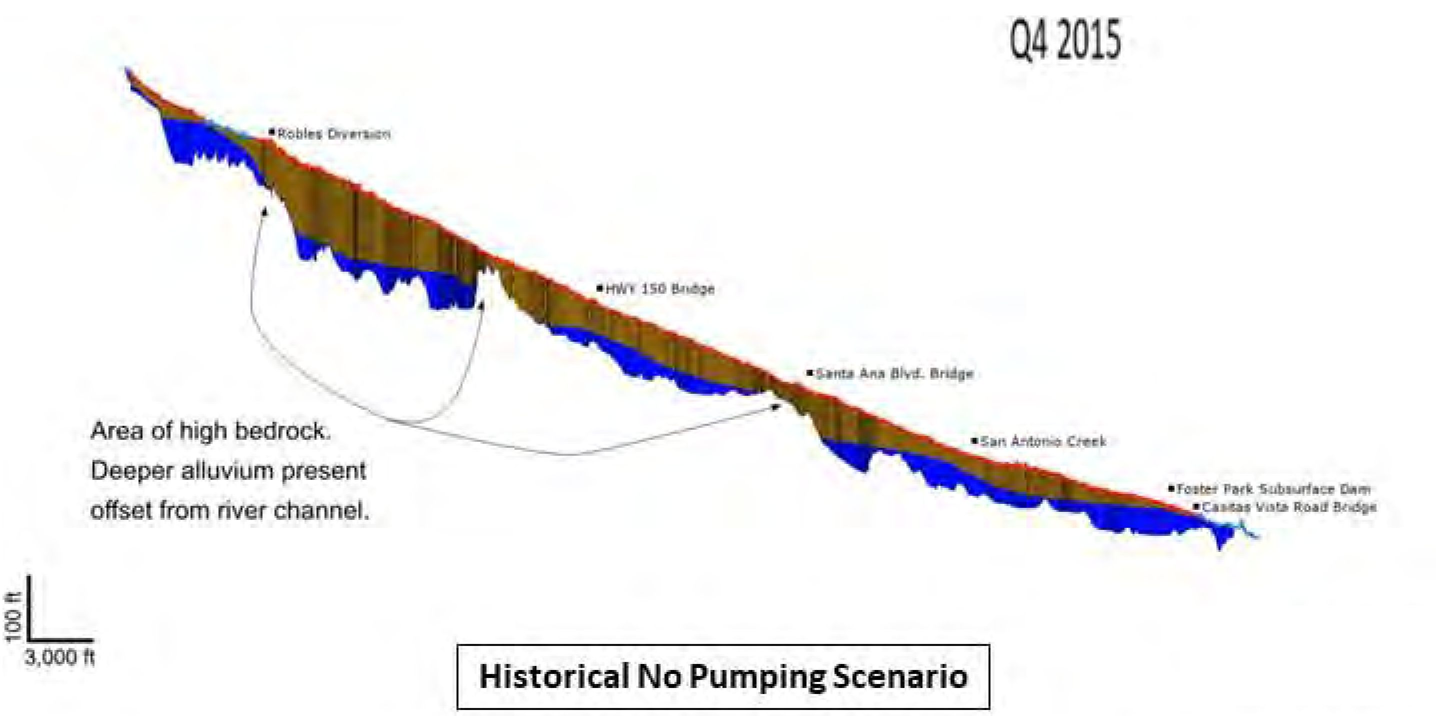


Figure J-19: Animation screenshot from July 2015.



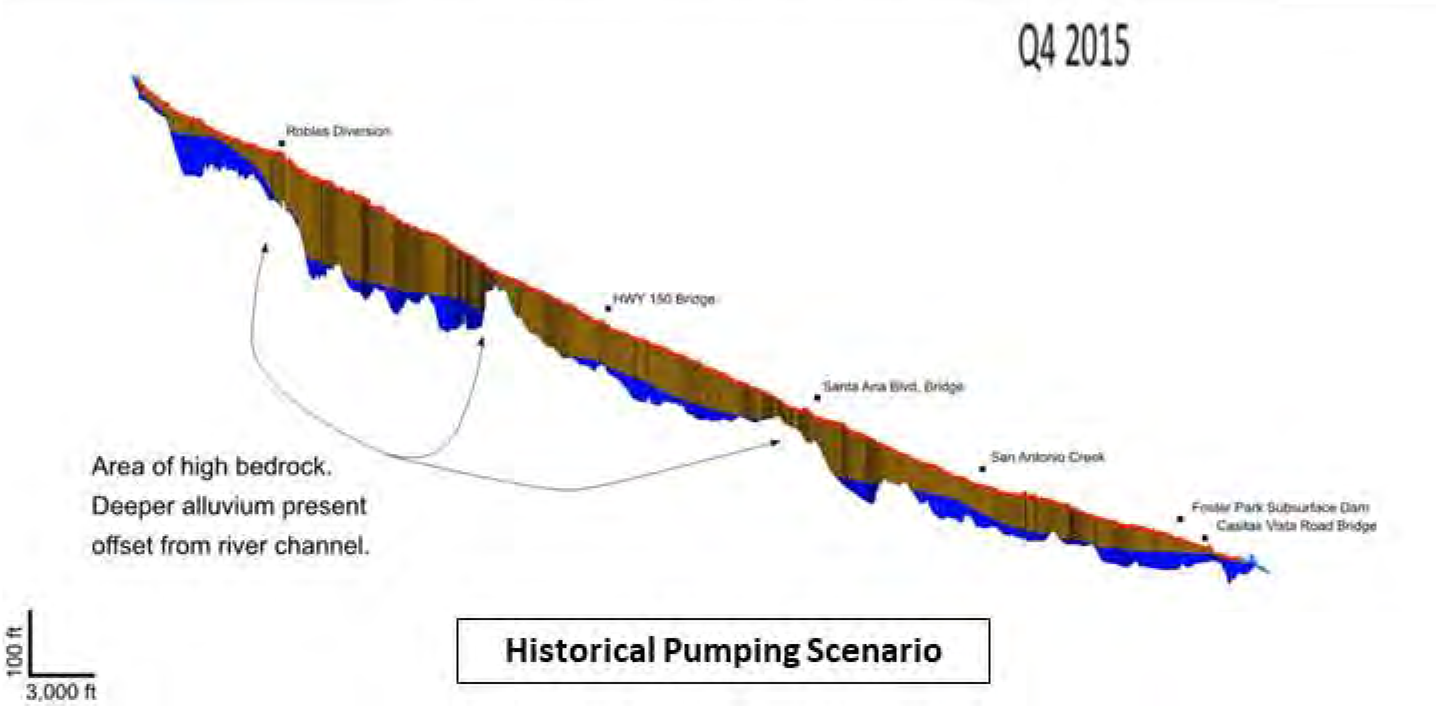
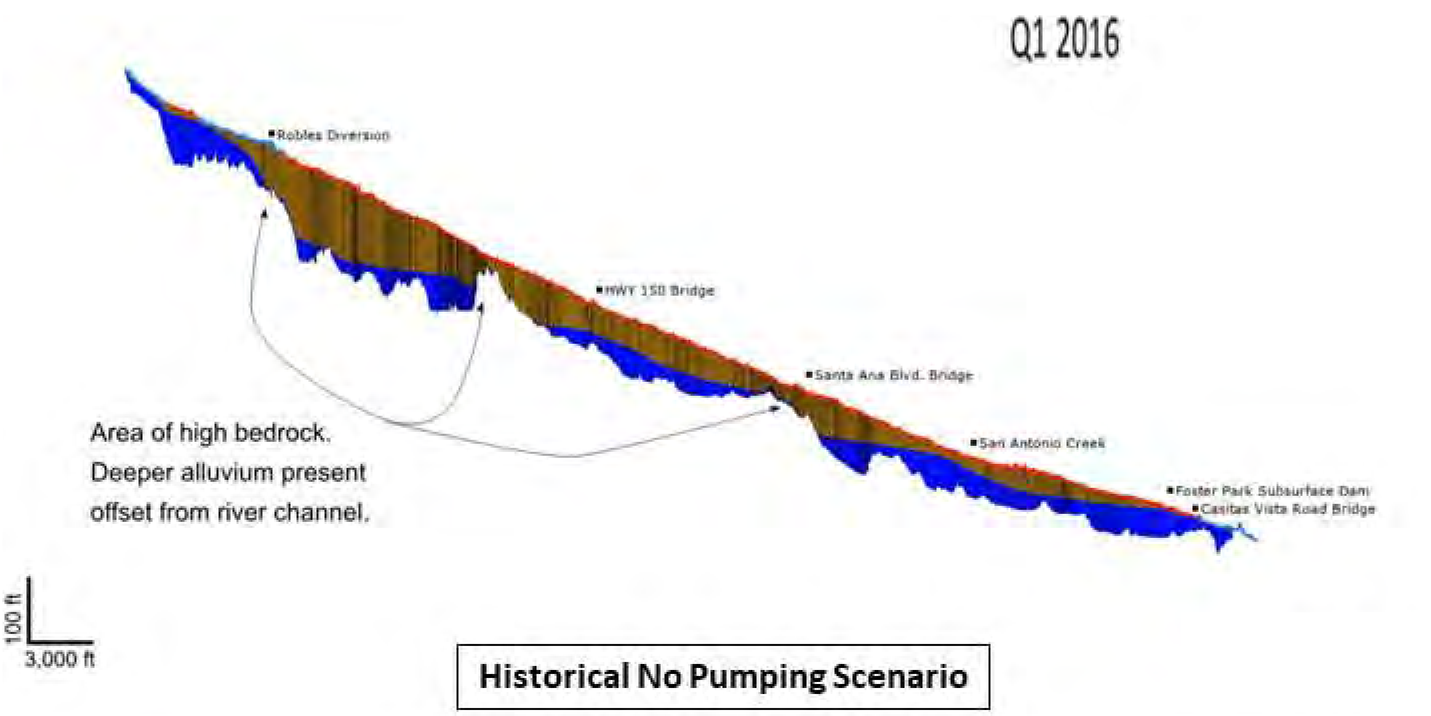


Figure J-20: Animation screenshot from January 2015.



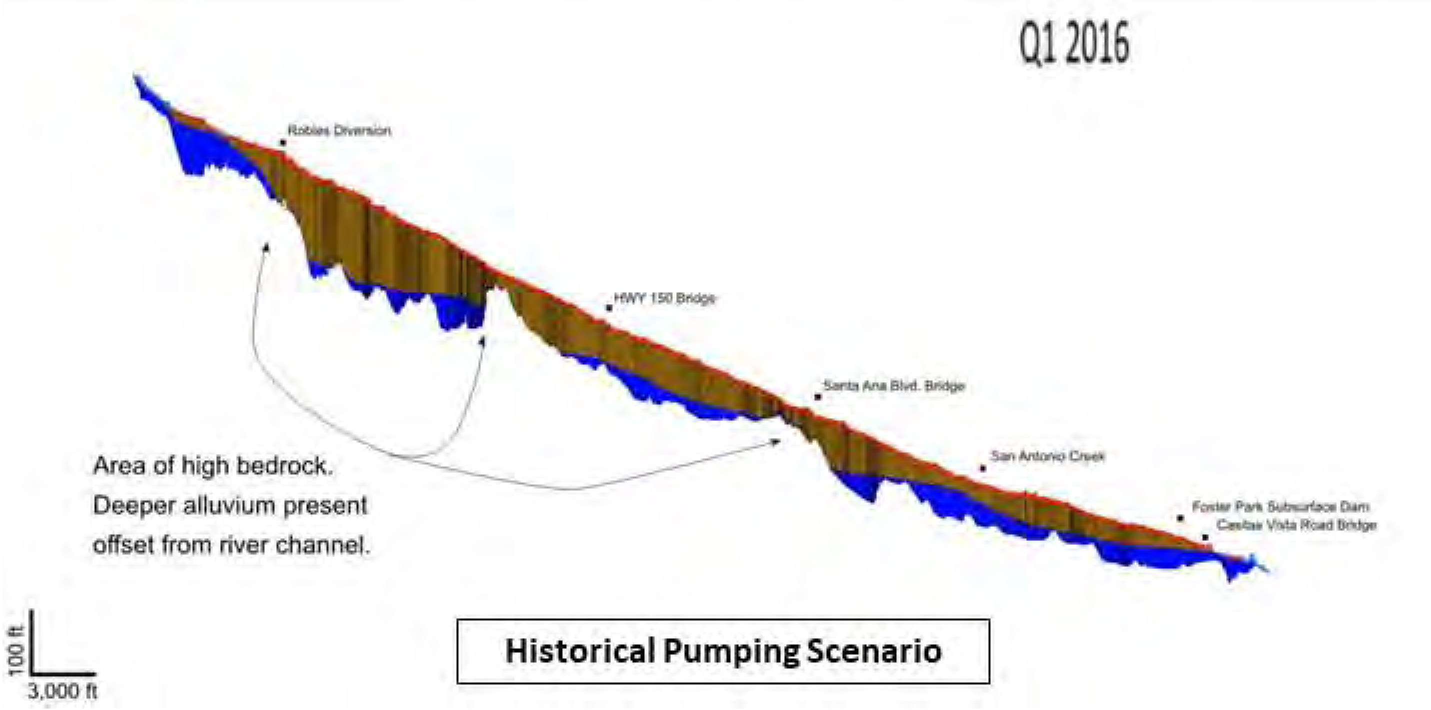


Figure J-21: Animation screenshot from January 2016.

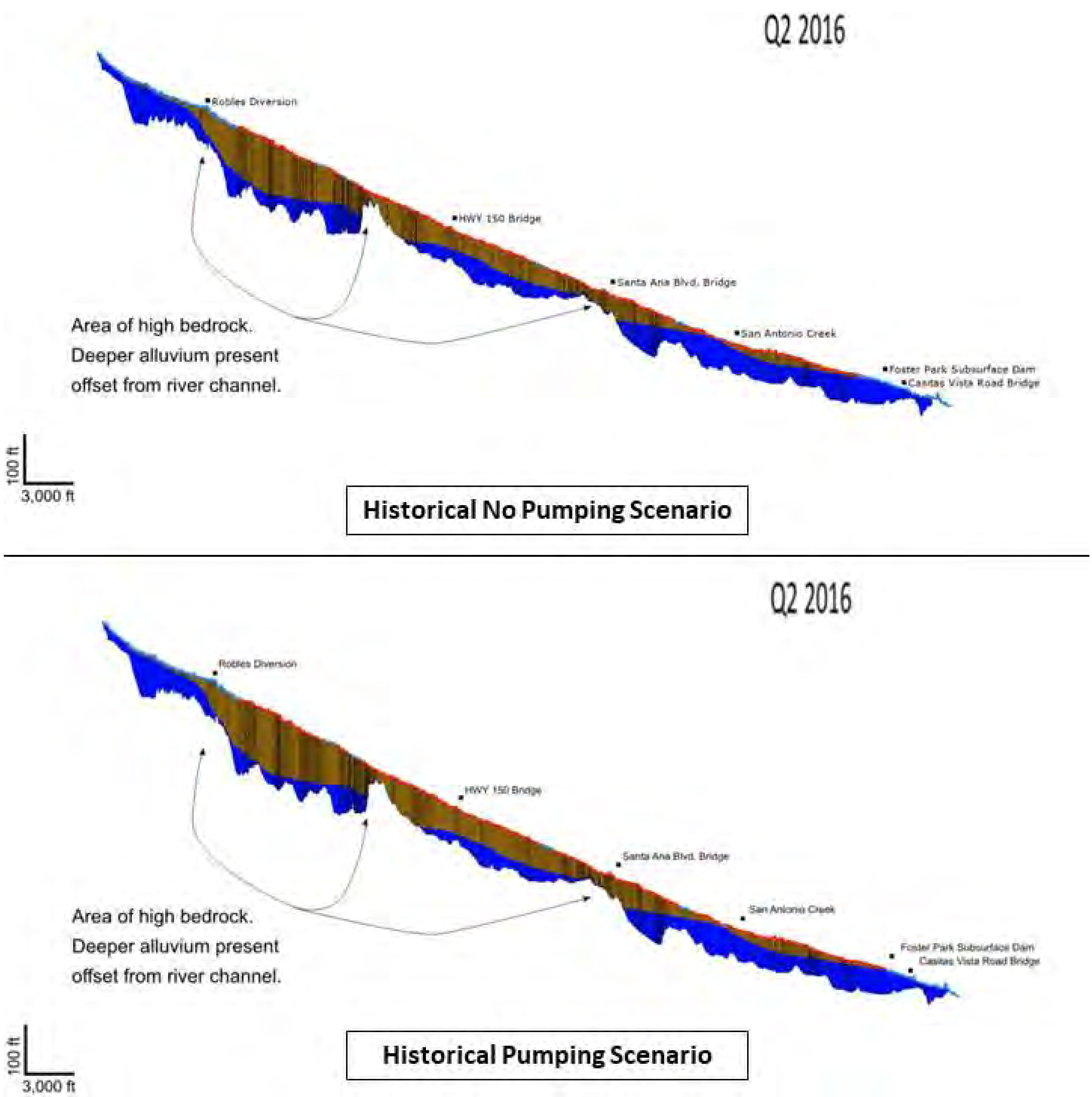
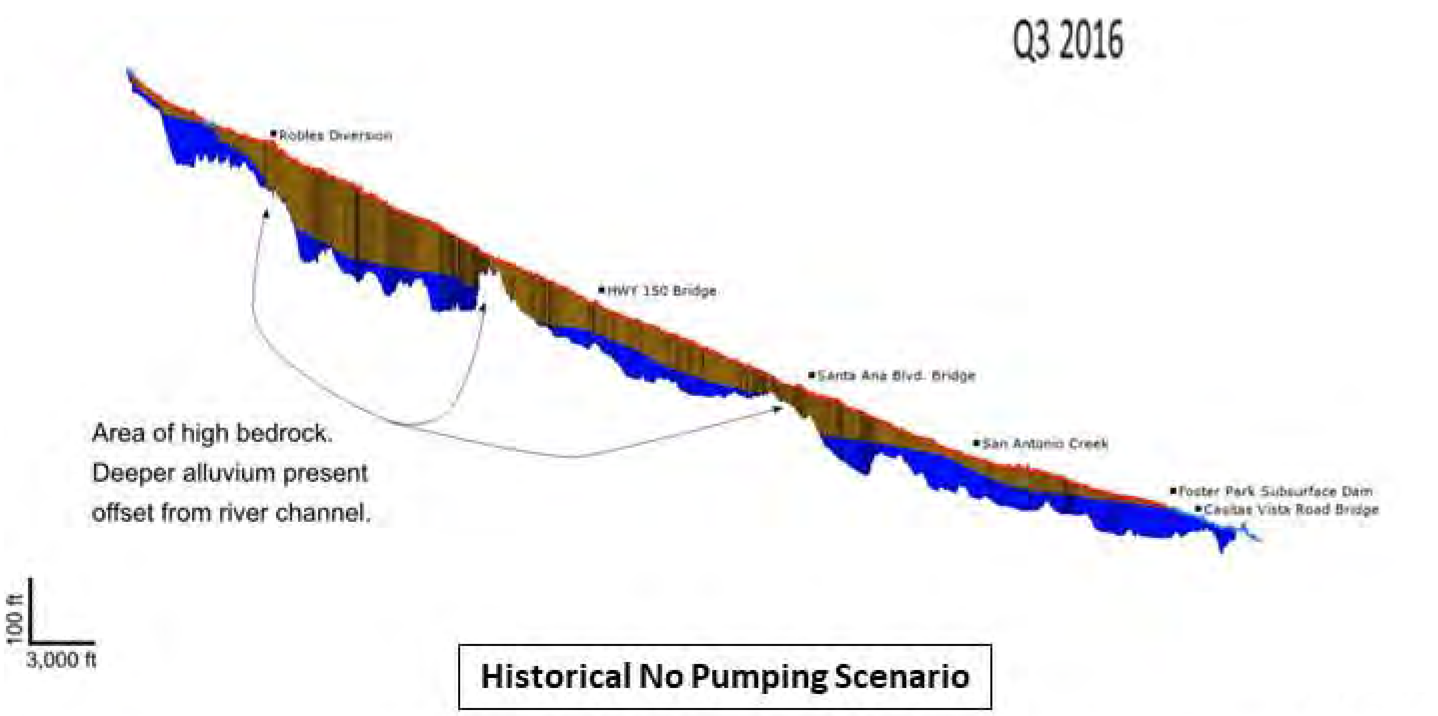


Figure J-22: Animation screenshot from April 2016.



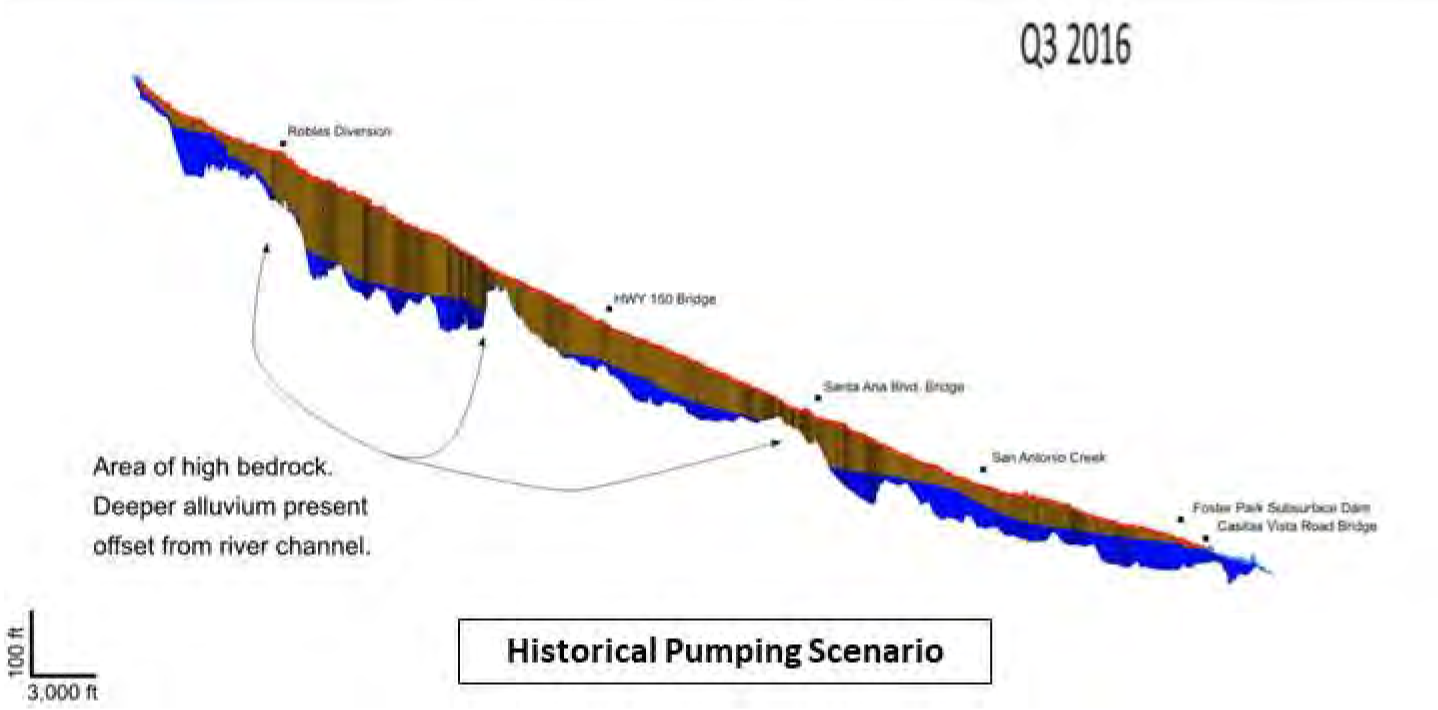
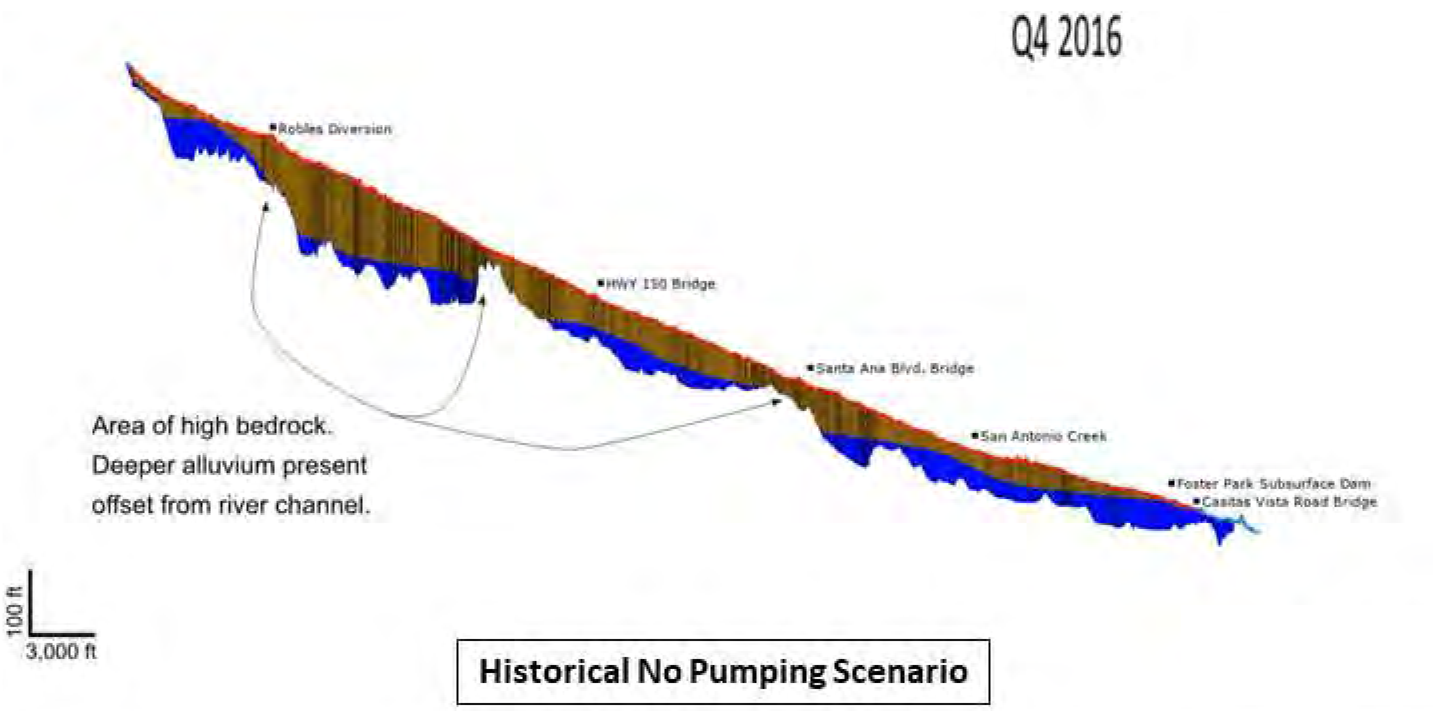


Figure J-23: Animation screenshot from July 2016.



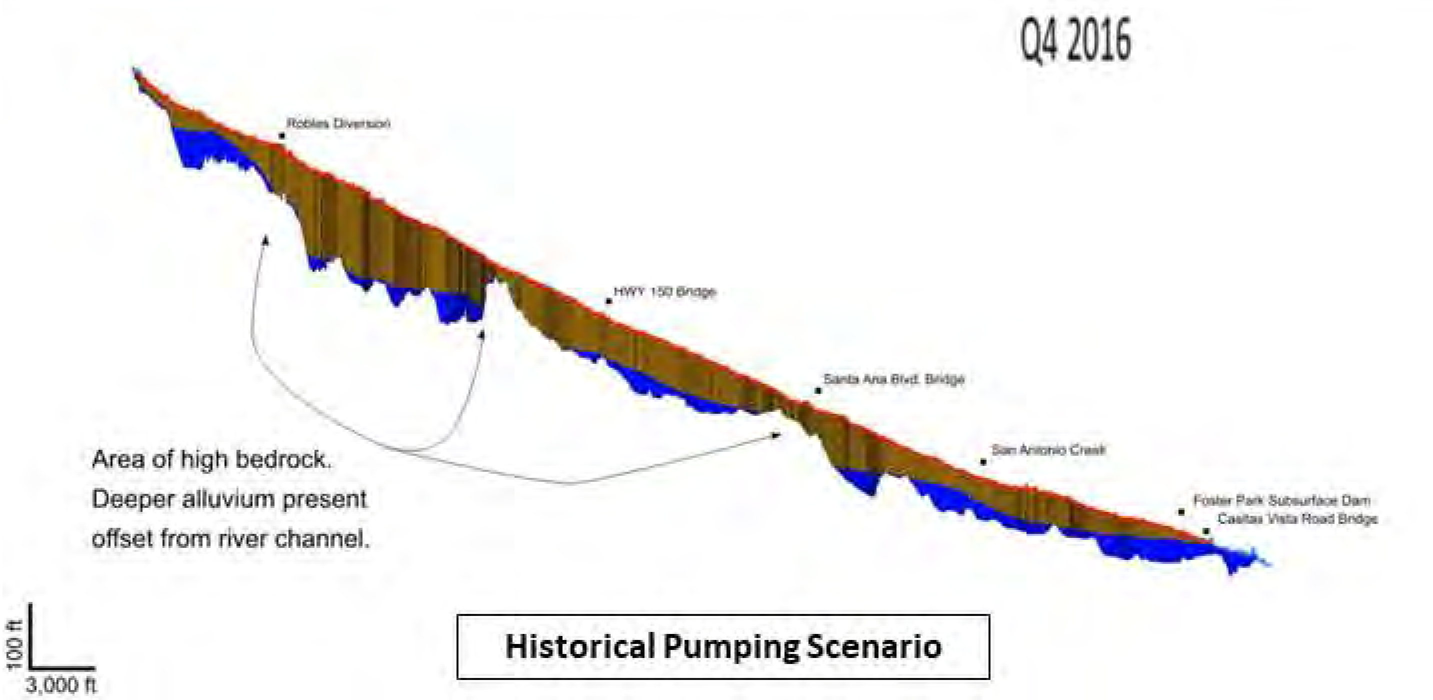
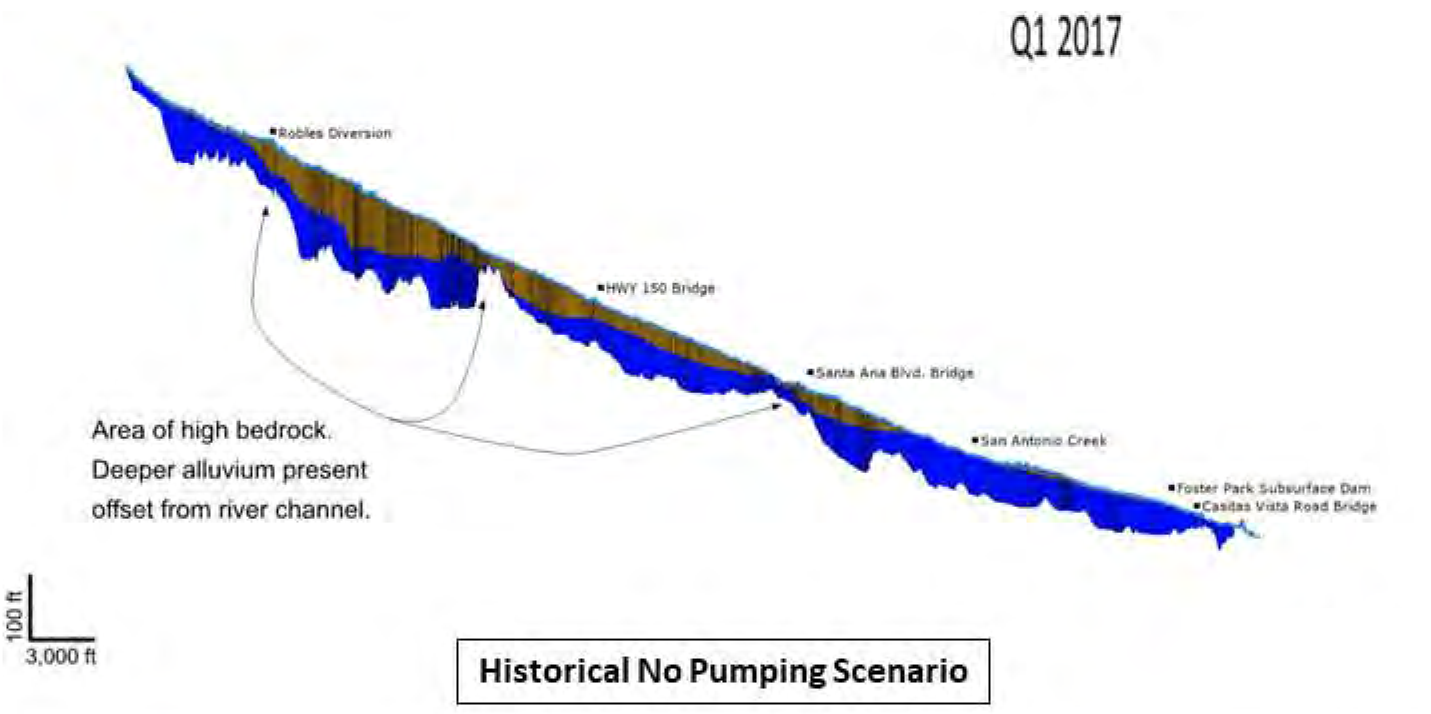


Figure J-24: Animation screenshot from October 2016.



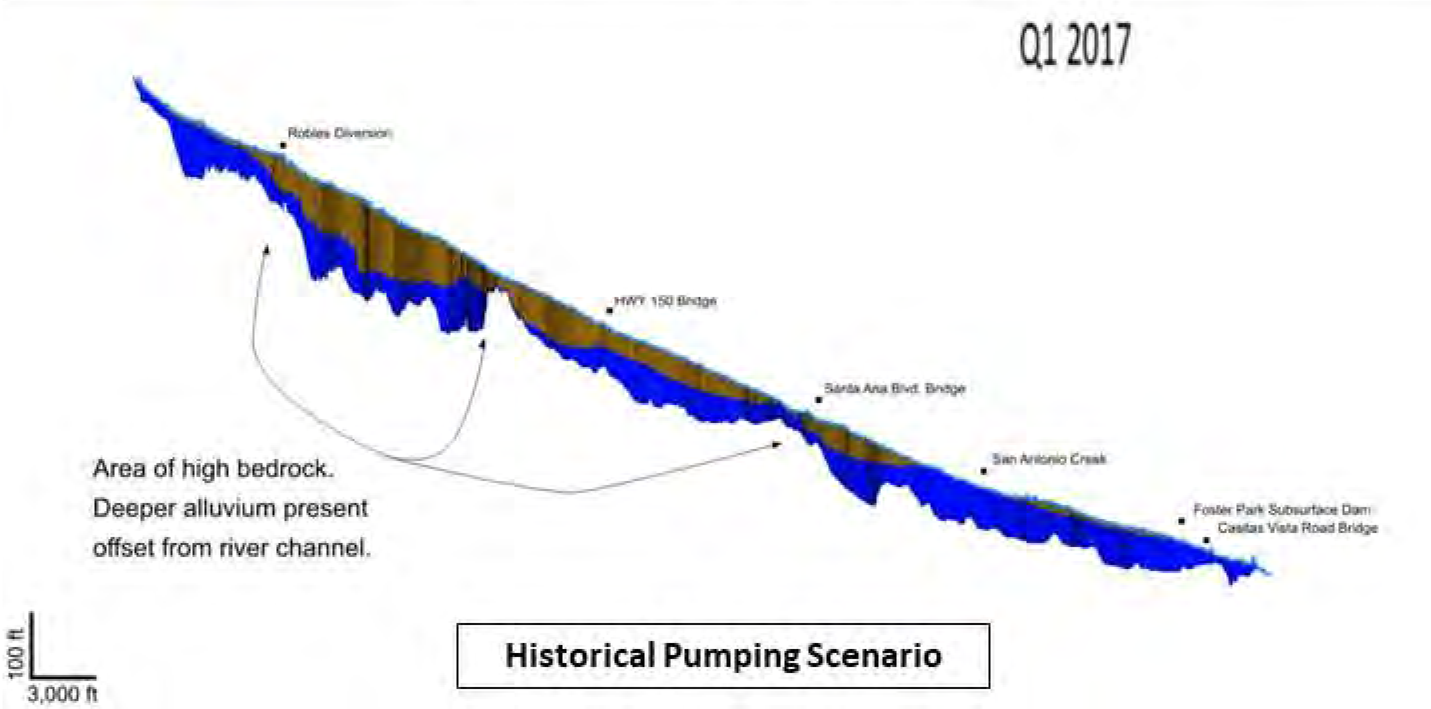


Figure J-25: Animation screenshot from January 2017.

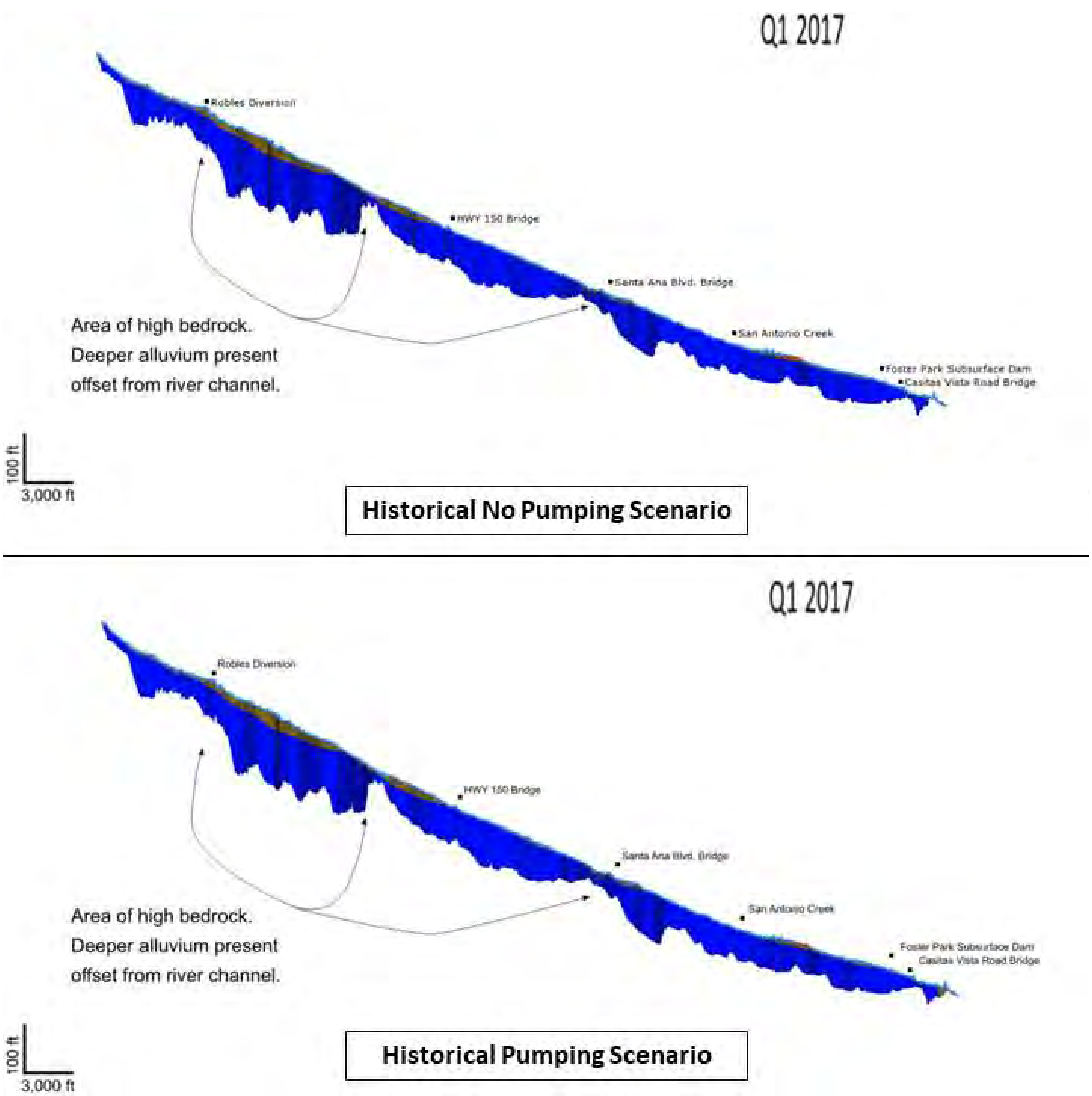


Figure J-26: Animation screenshot from March 2017 (end of animation).

Appendix K

Time Series Plots of Measured Groundwater Level Data in UVRGB

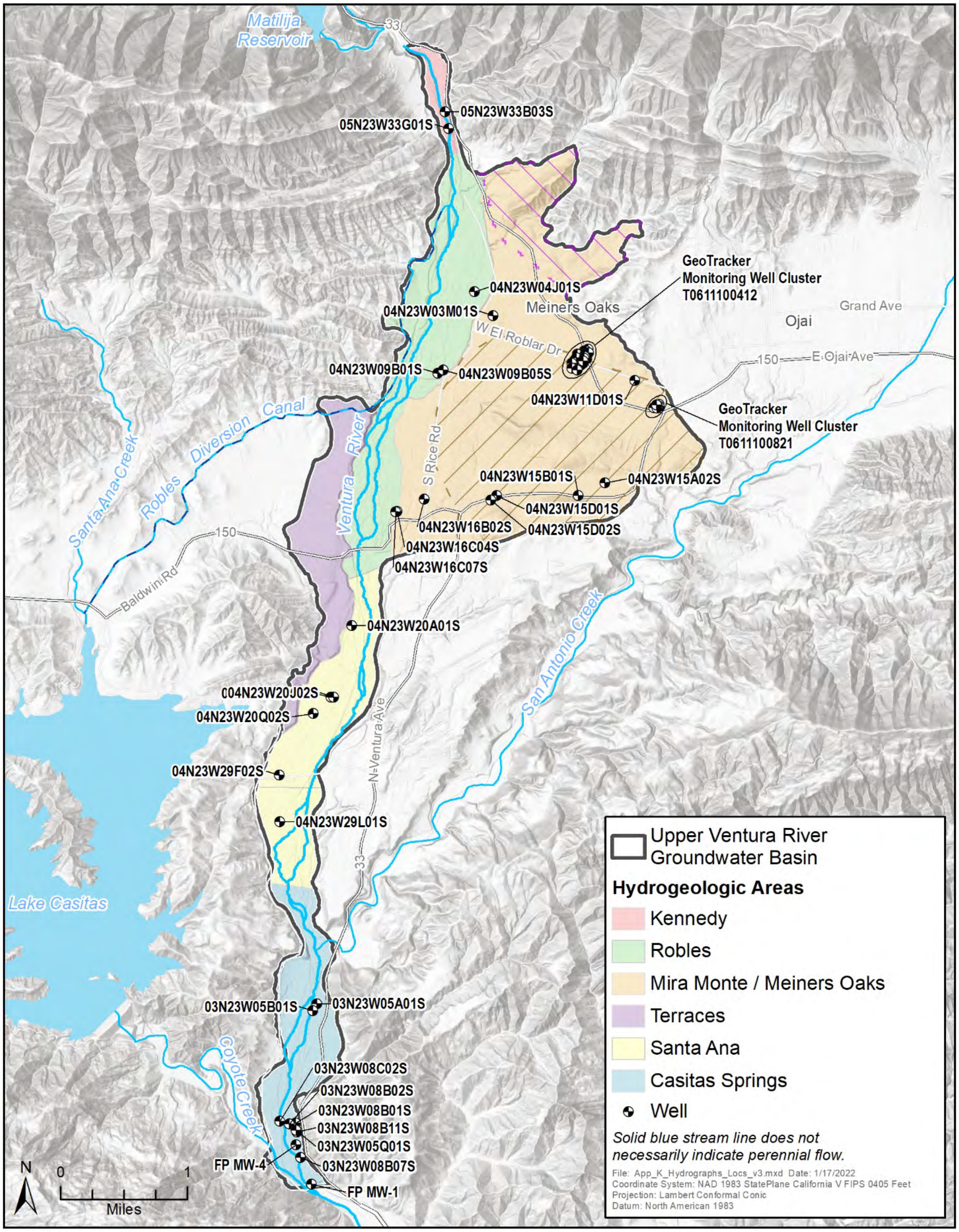


Figure K-01 All groundwater monitoring locations in the Upper Ventura River Groundwater Basin.

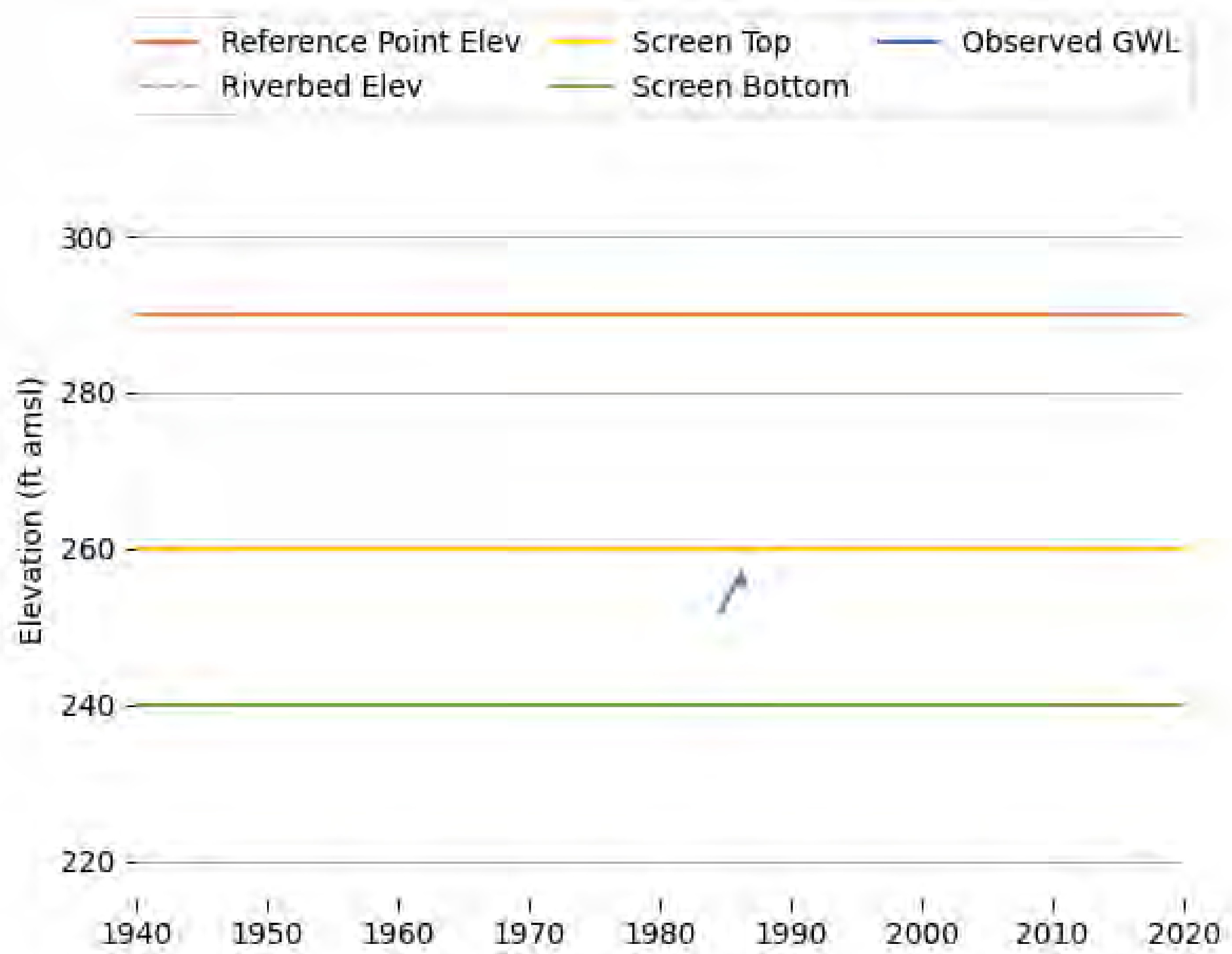


Figure K-02 Observed Groundwater Level (03N23W05A01S).

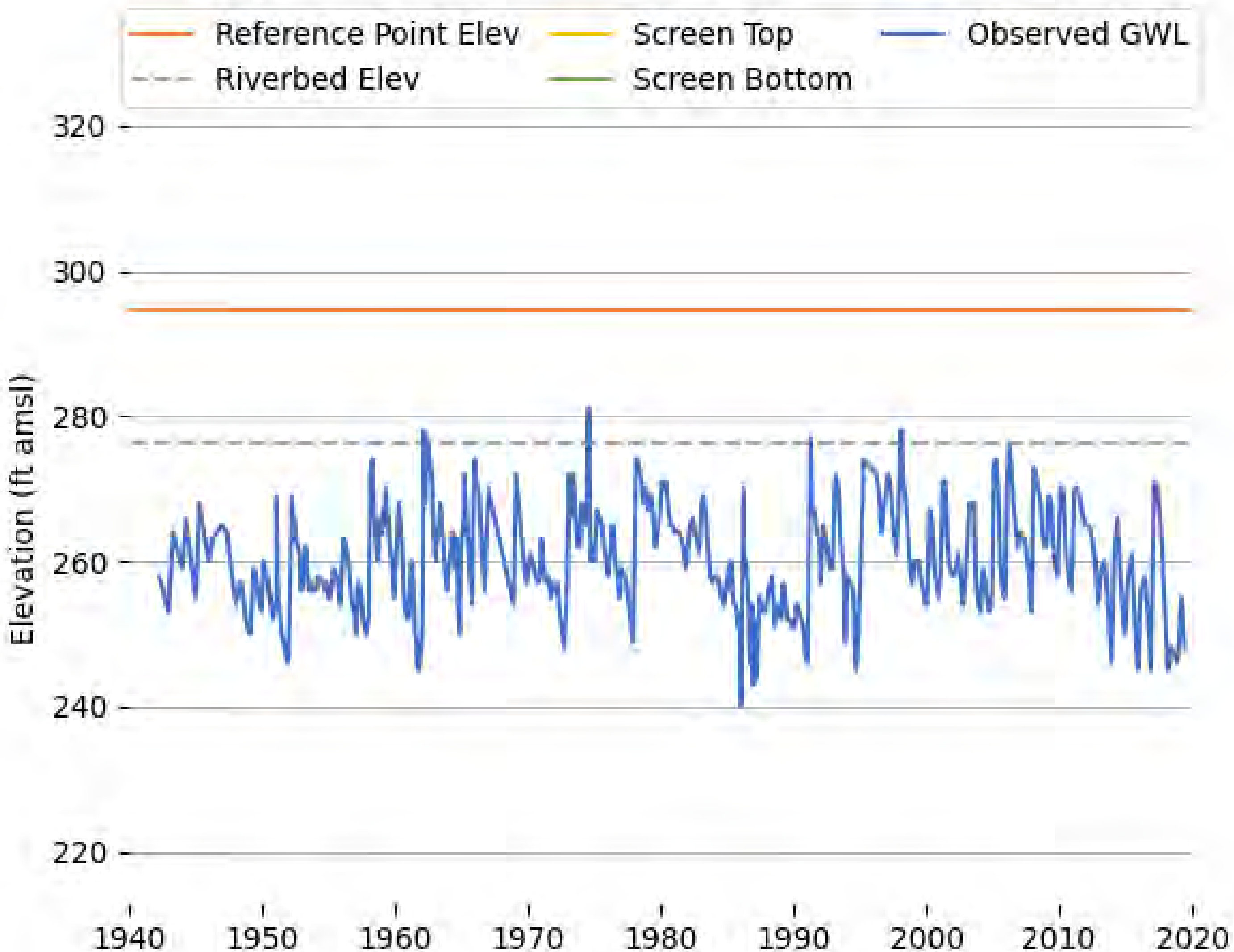


Figure K-03 Observed Groundwater Level (03N23W05B01S).

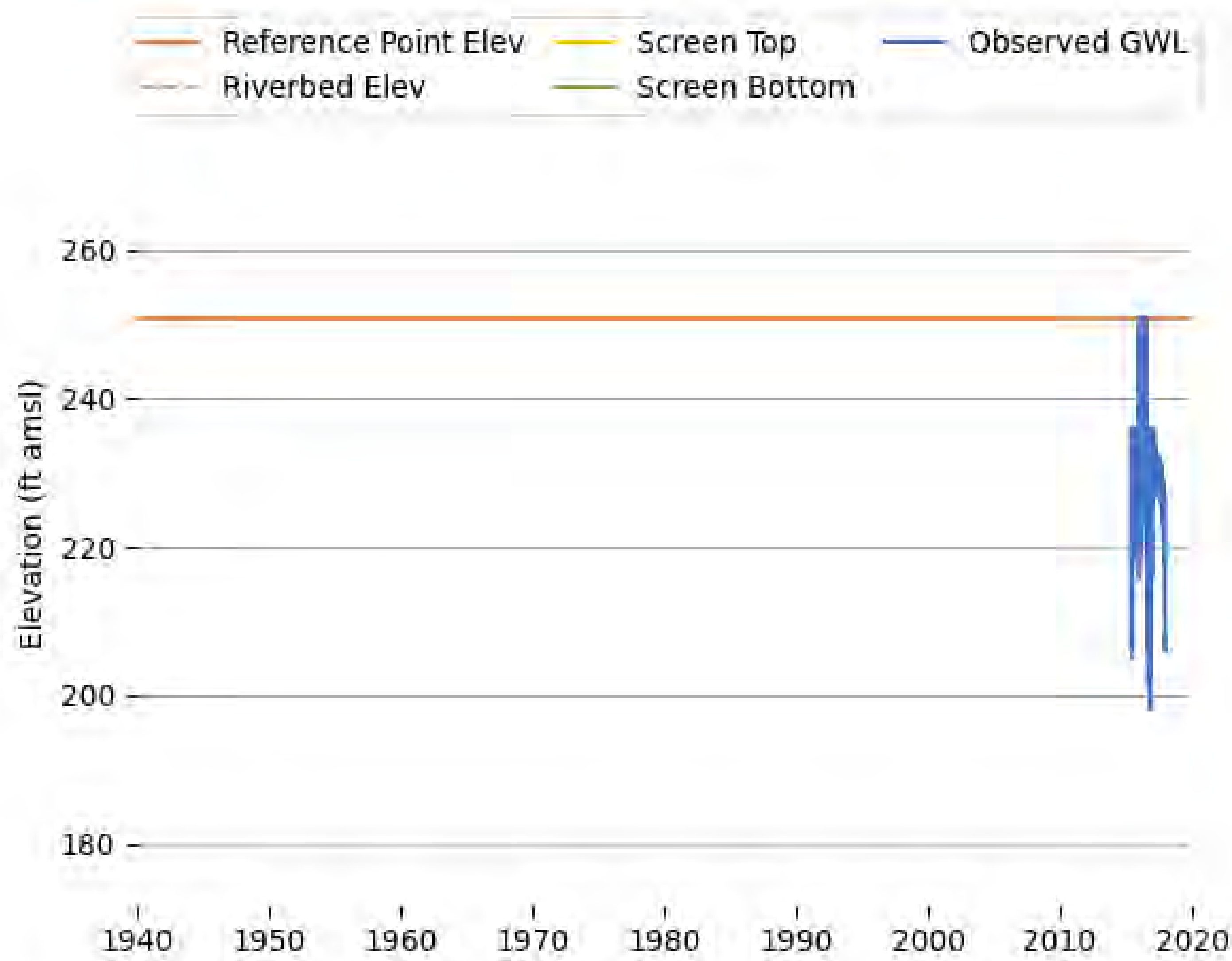


Figure K-04 Observed Groundwater Level (03N23W08B01S).

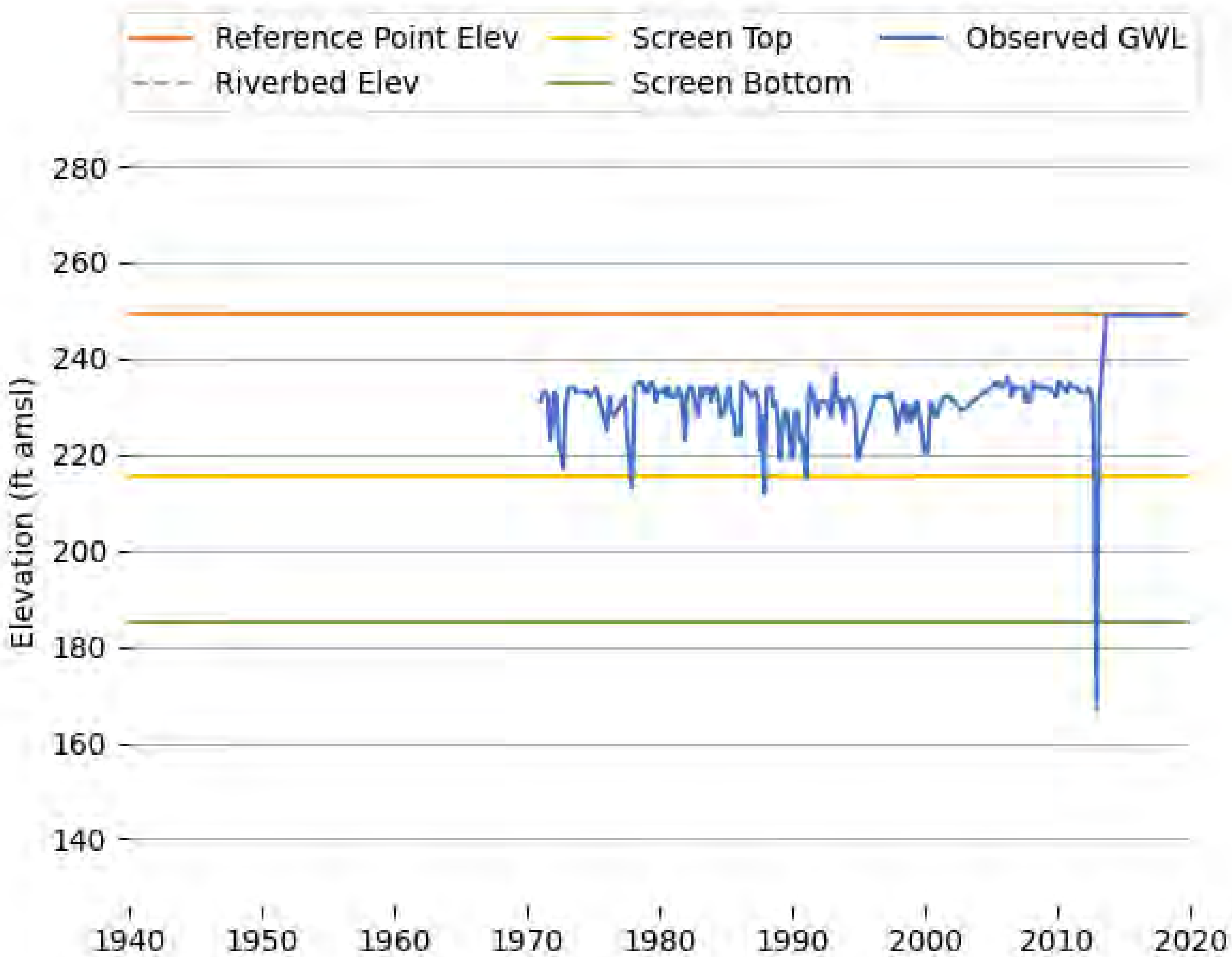


Figure K-05 Observed Groundwater Level (03N23W08B02S).

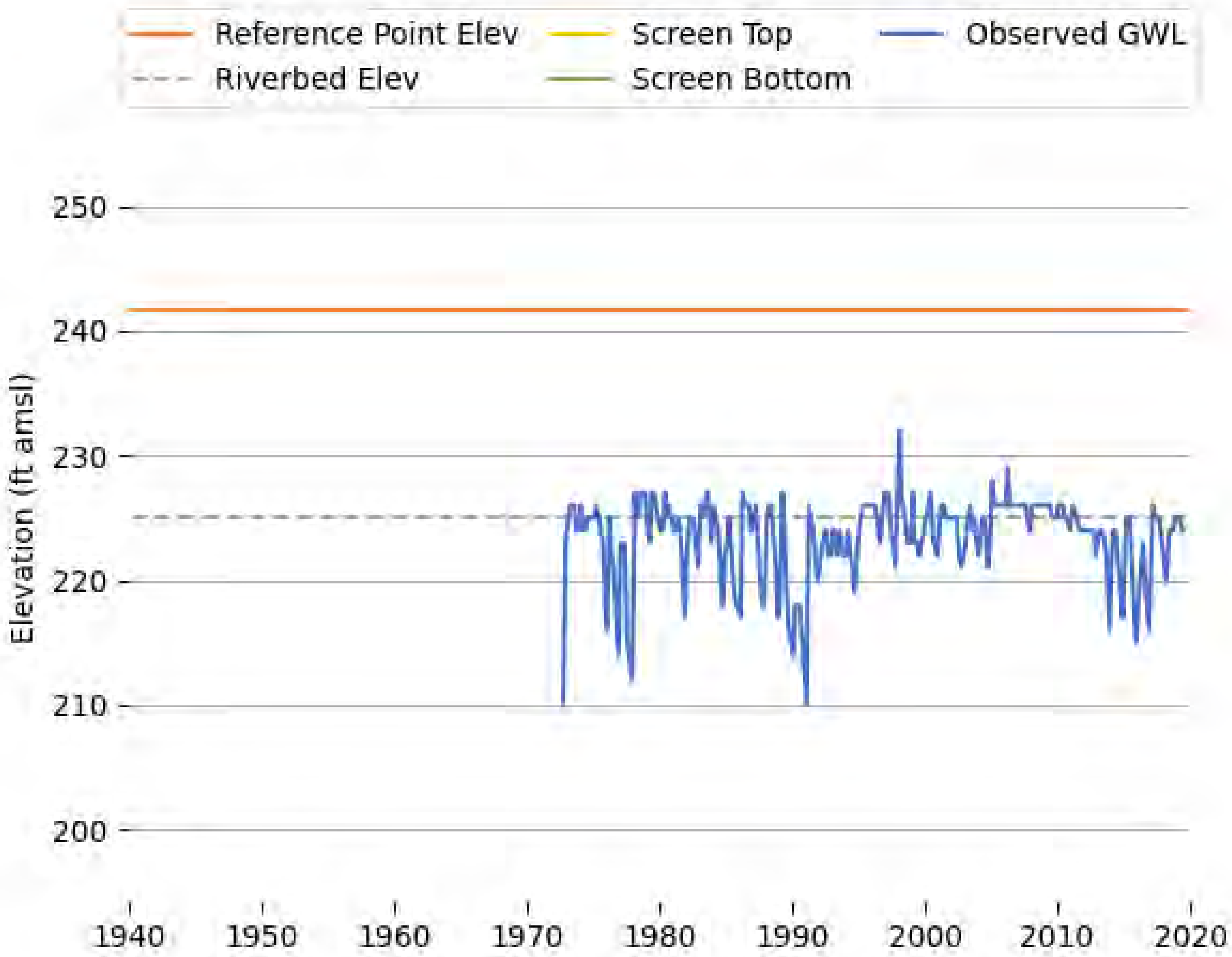


Figure K-06 Observed Groundwater Level (03N23W08B07S).

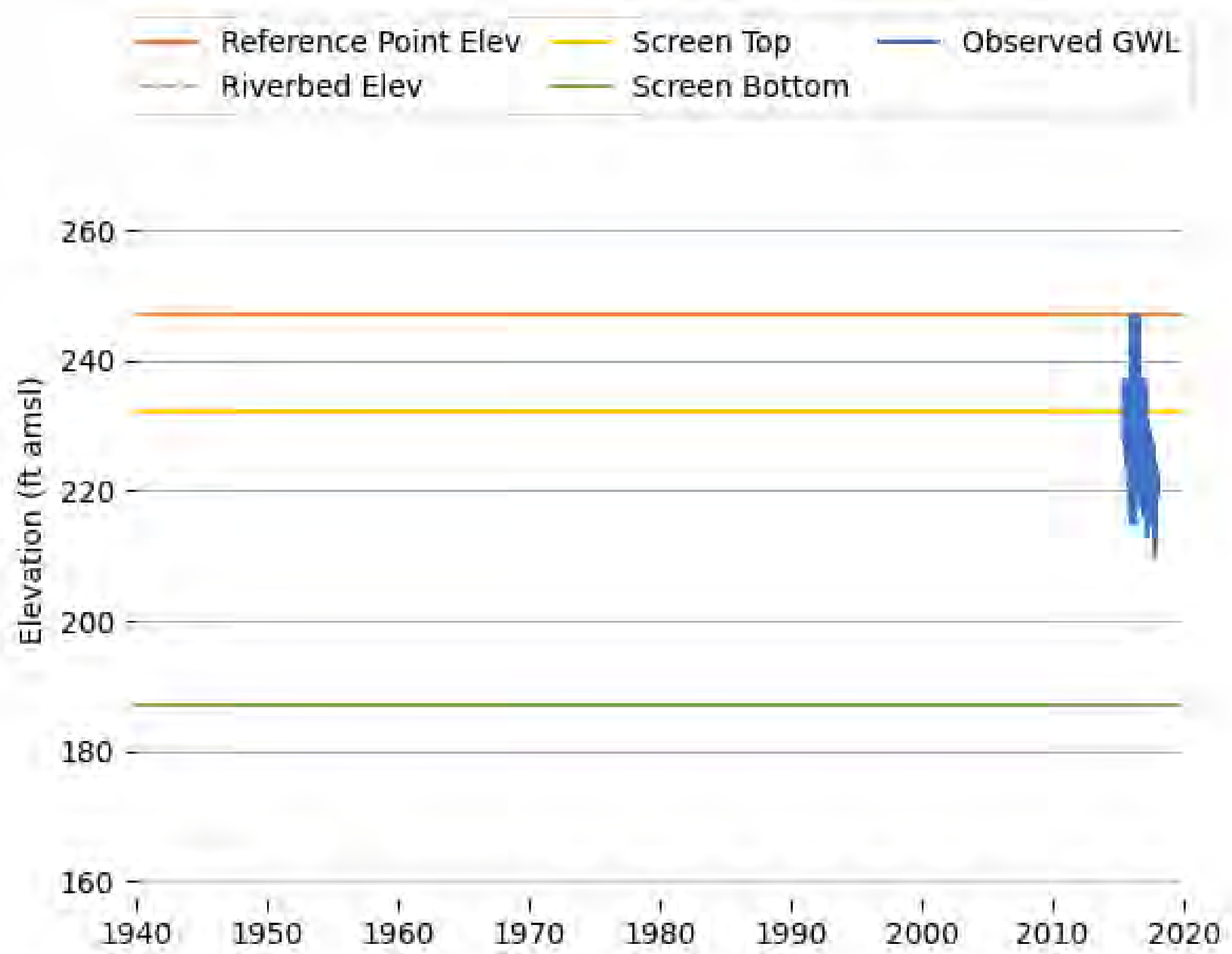


Figure K-07 Observed Groundwater Level (03N23W08B11S).

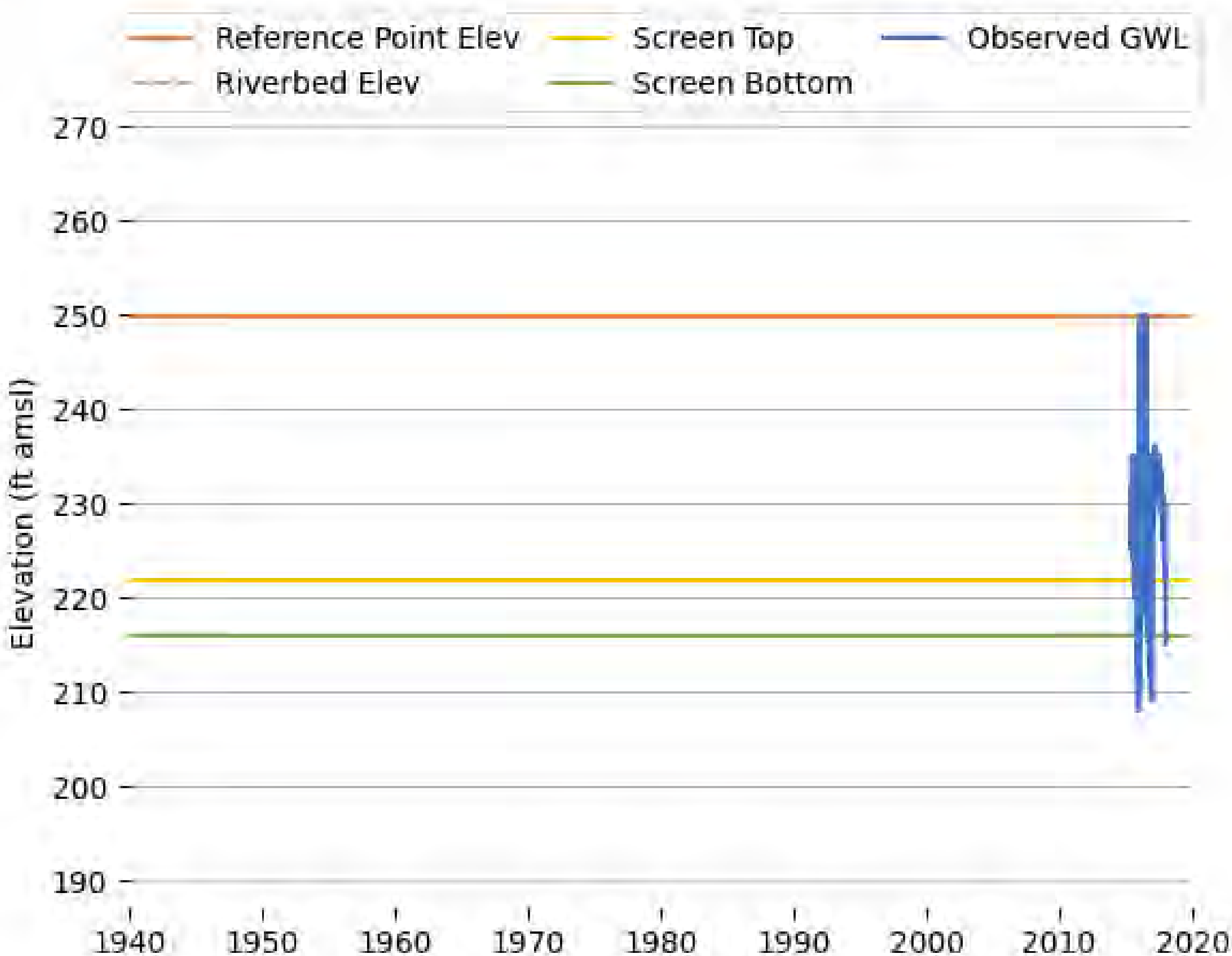


Figure K-08 Observed Groundwater Level (03N23W08C02S).

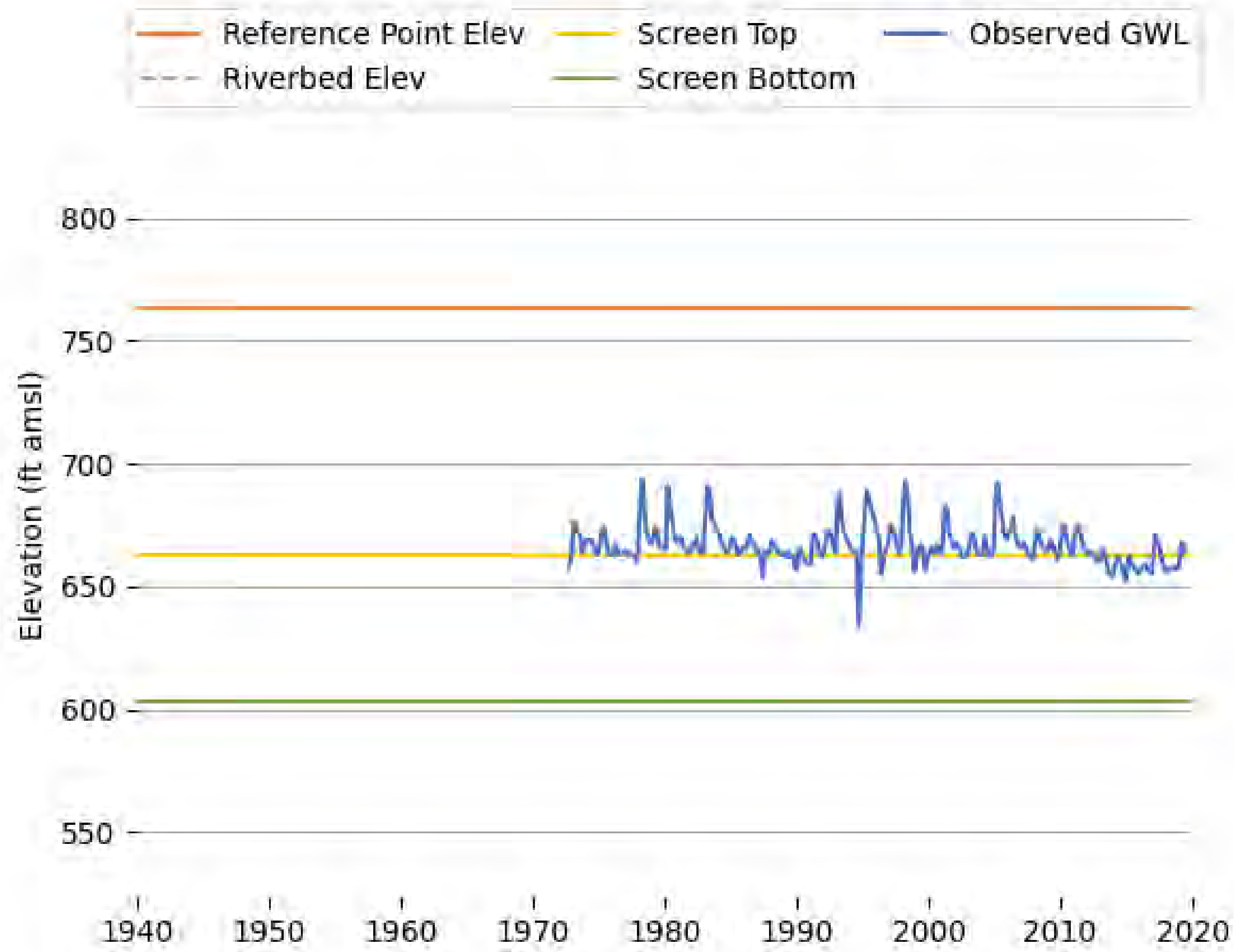


Figure K-09 Observed Groundwater Level (04N23W03M01S).

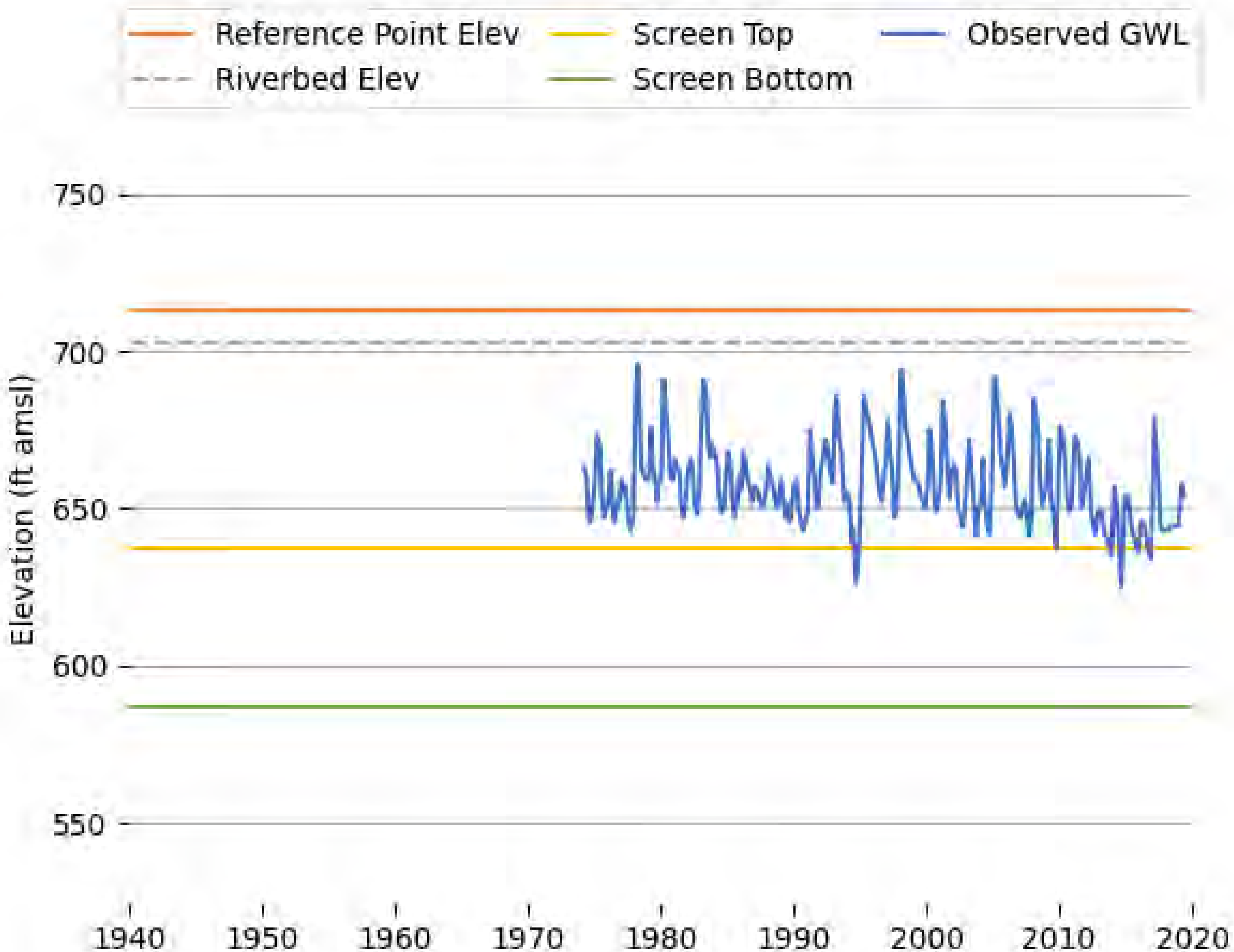


Figure K-10 Observed Groundwater Level (04N23W04J01S).

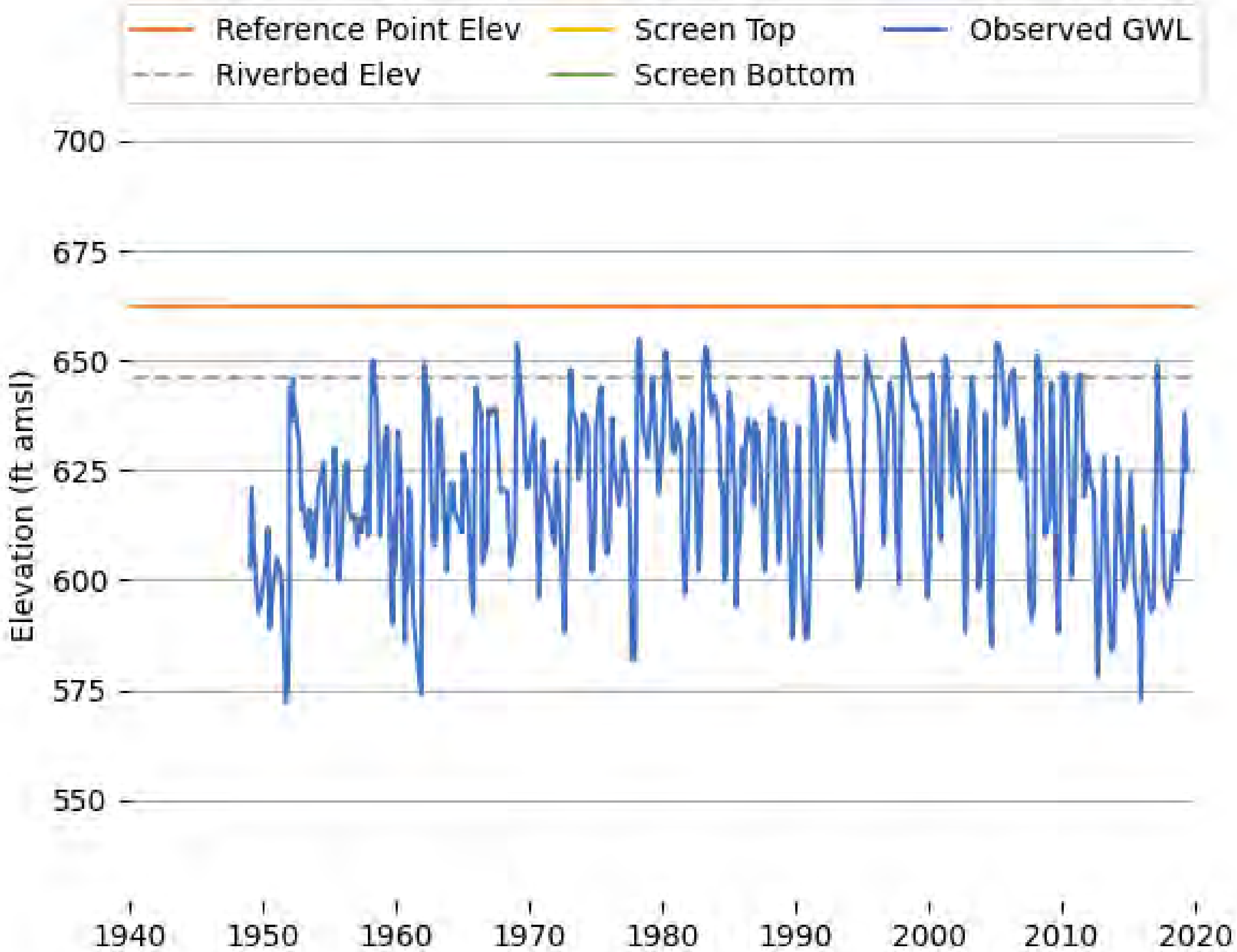


Figure K-11 Observed Groundwater Level (04N23W09B01S).

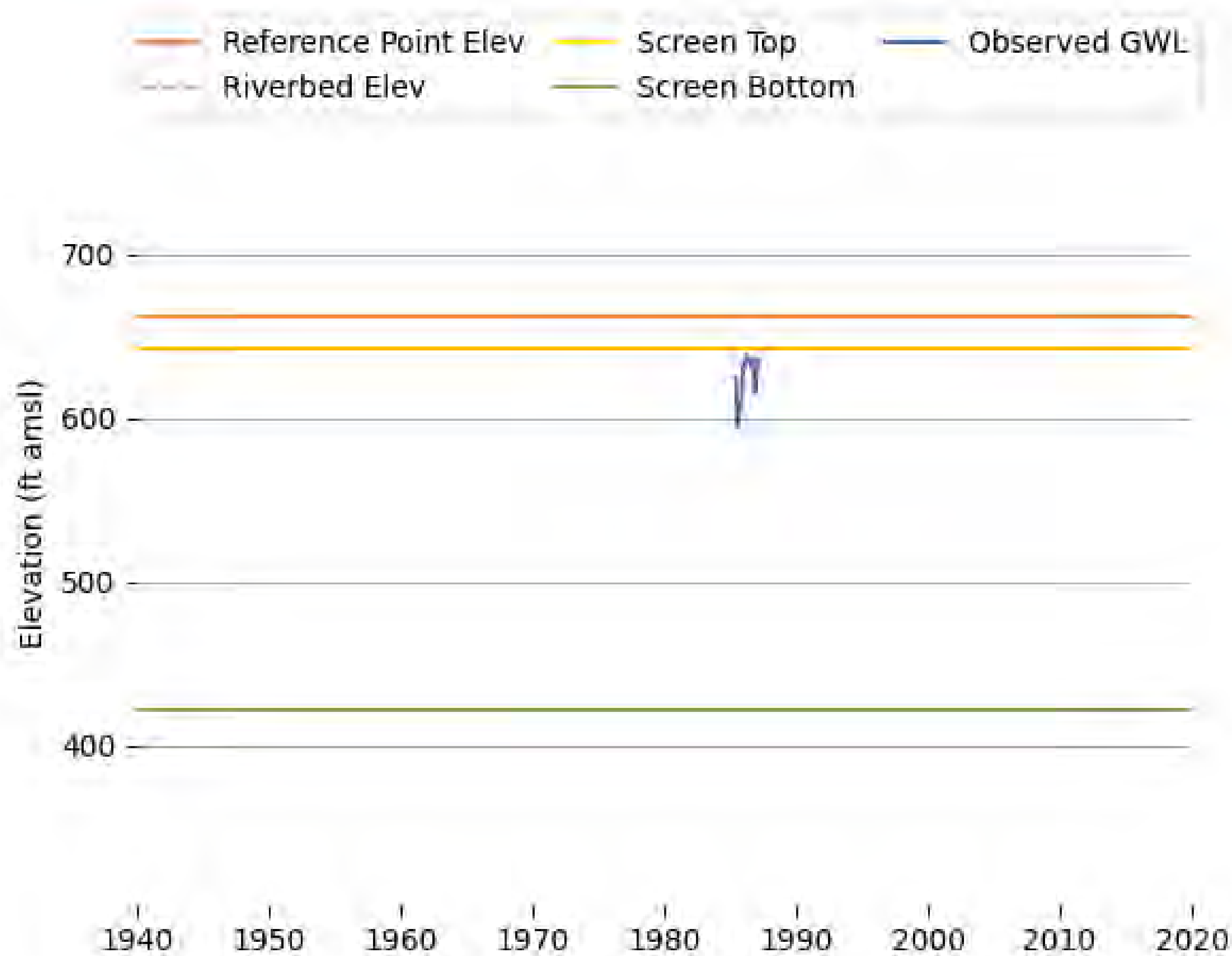


Figure K-12 Observed Groundwater Level (04N23W09B05S).

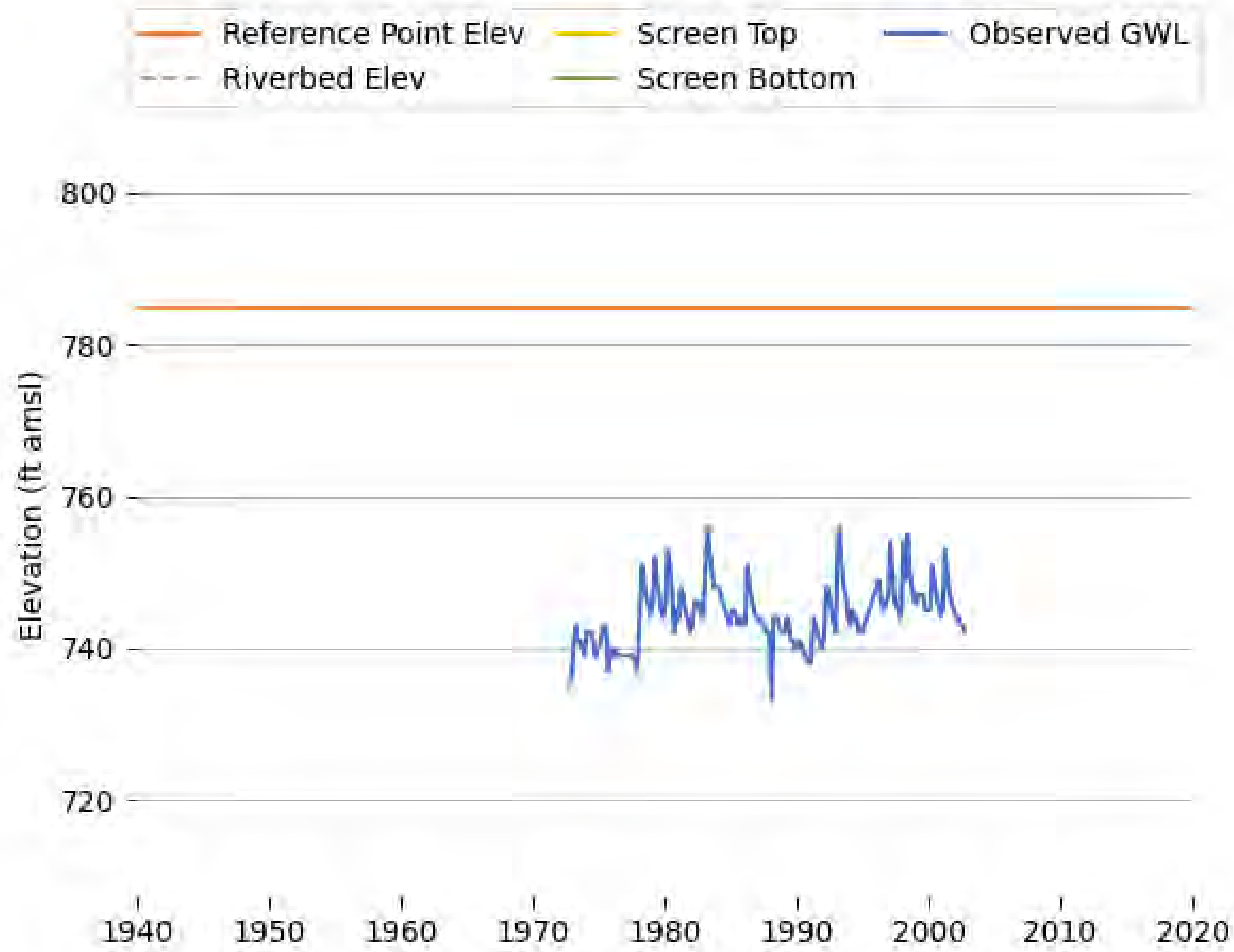


Figure K-13 Observed Groundwater Level (04N23W11D01S).

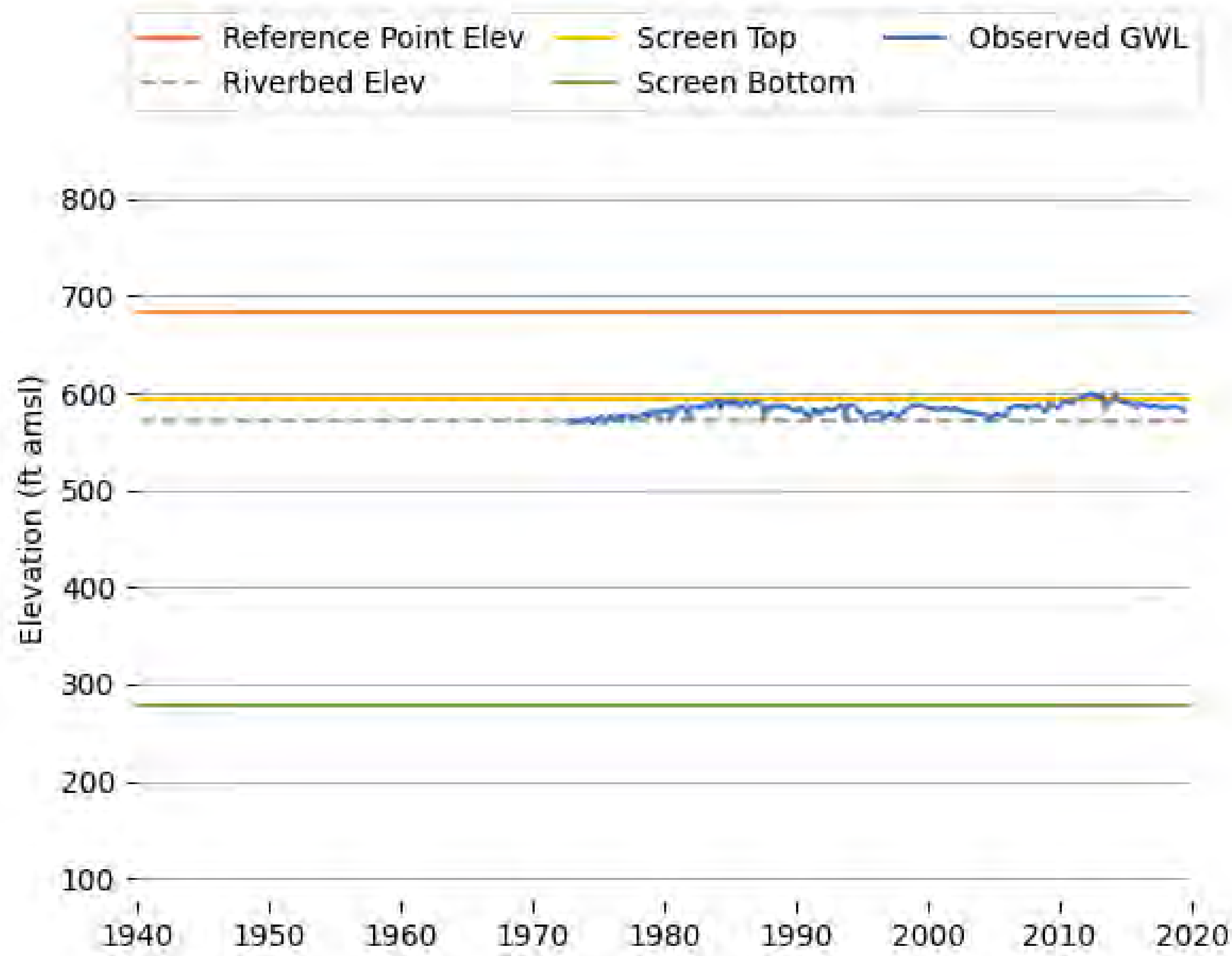


Figure K-14 Observed Groundwater Level (04N23W15A02S).

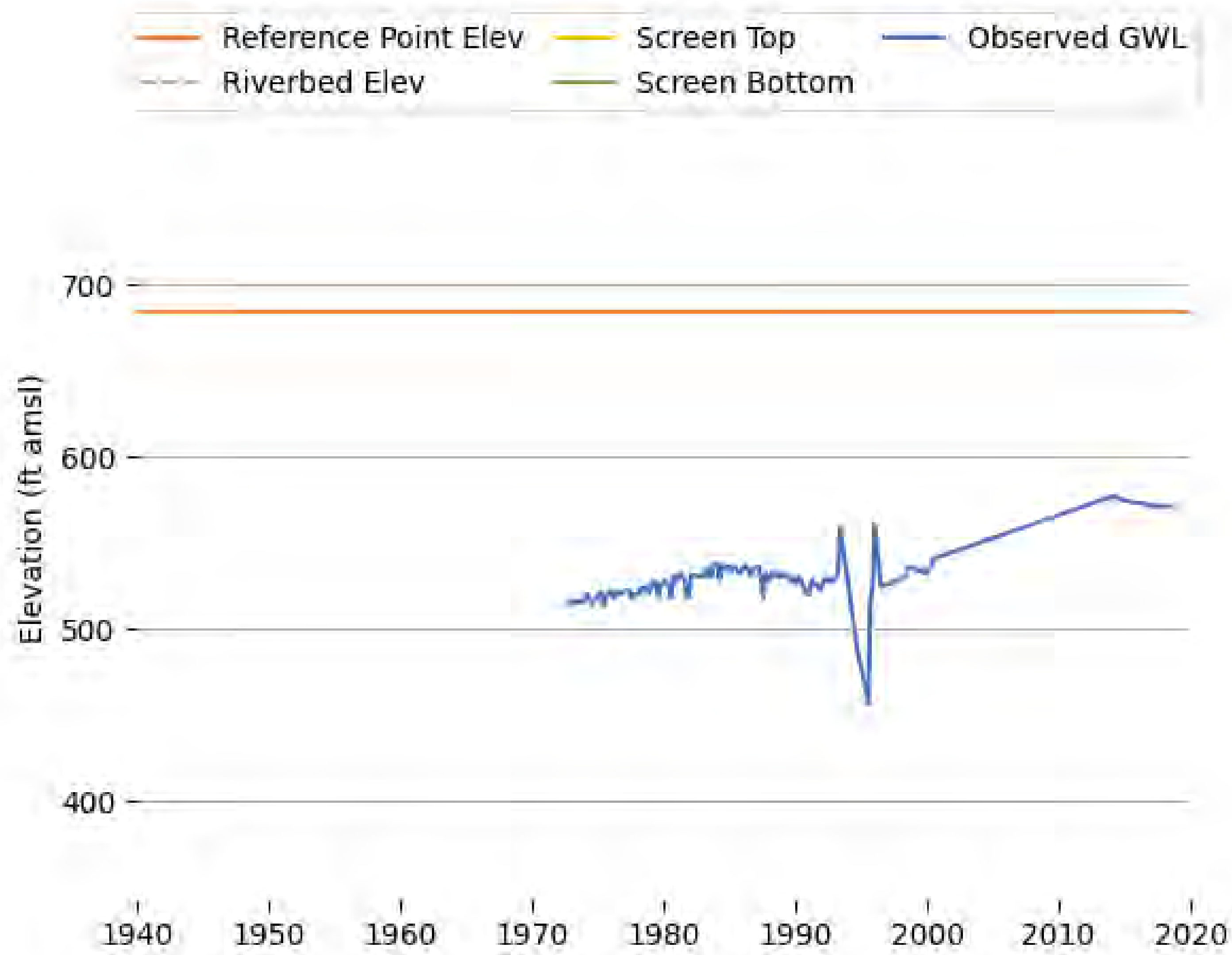


Figure K-15 Observed Groundwater Level (04N23W15B01S).

Figure K-16 Observed Groundwater Level (04N23W15D01S).

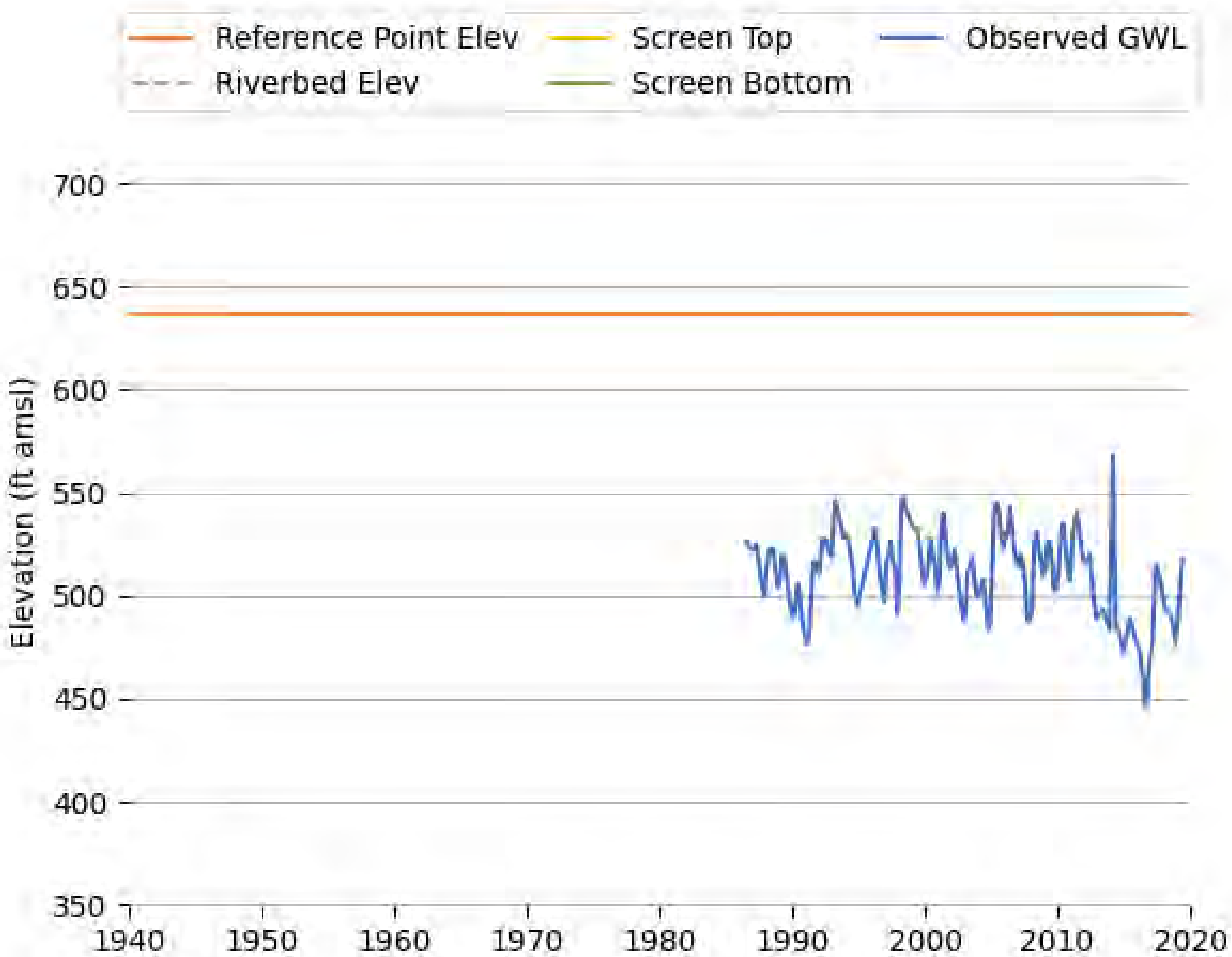


Figure K-17 Observed Groundwater Level (04N23W15D02S).

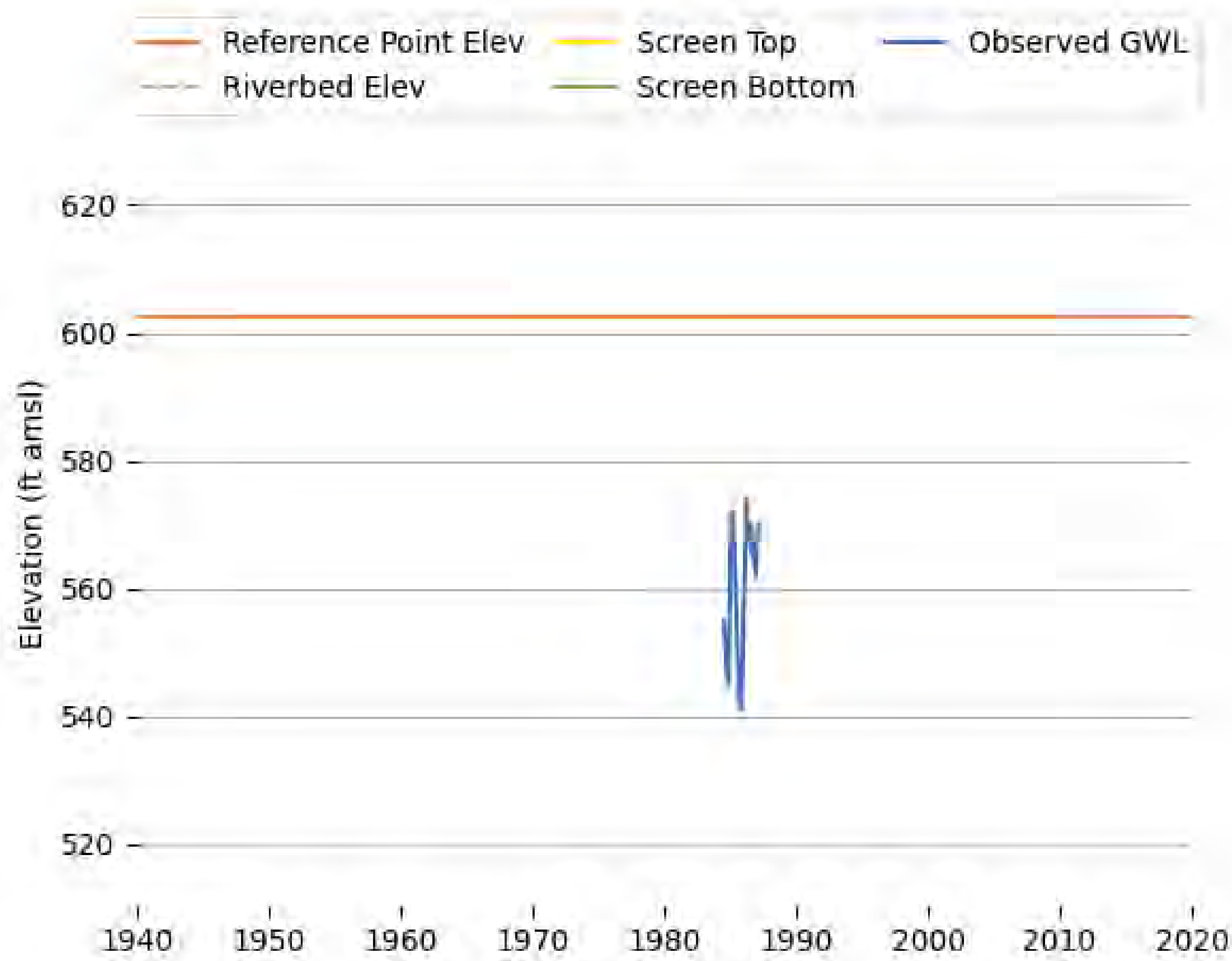


Figure K-18 Observed Groundwater Level (04N23W16B02S).

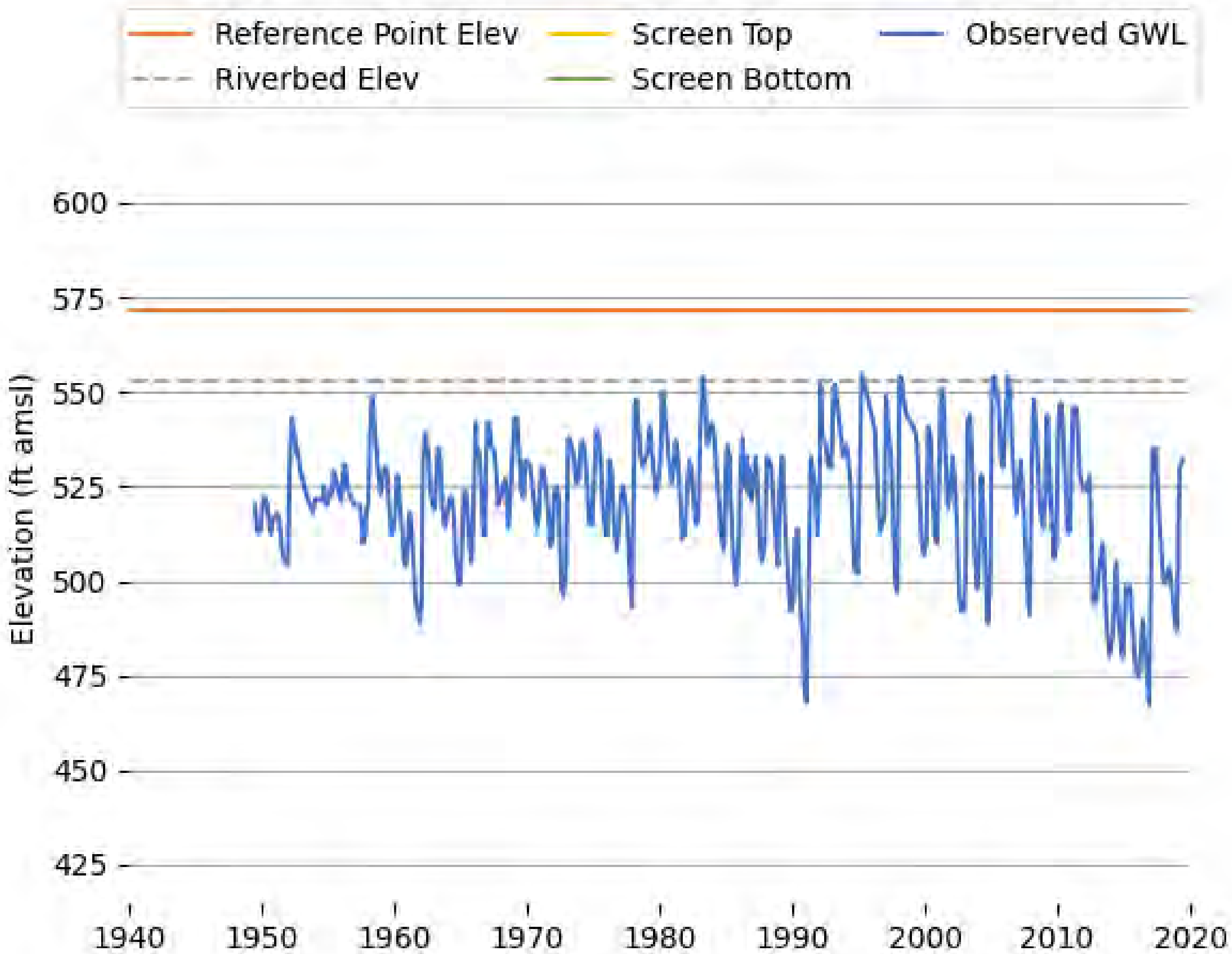


Figure K-19 Observed Groundwater Level (04N23W16C04S).

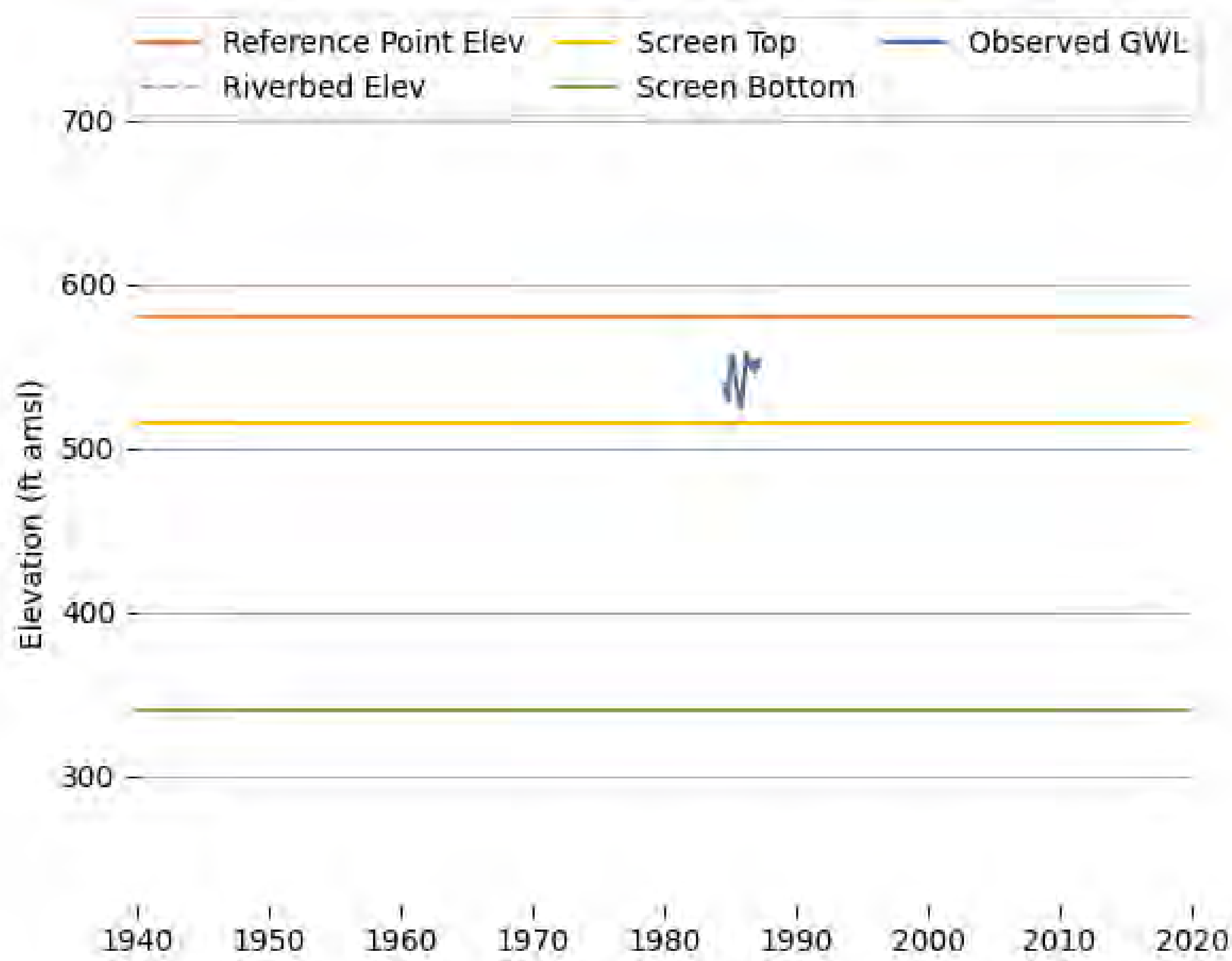


Figure K-20 Observed Groundwater Level (04N23W16C07S).

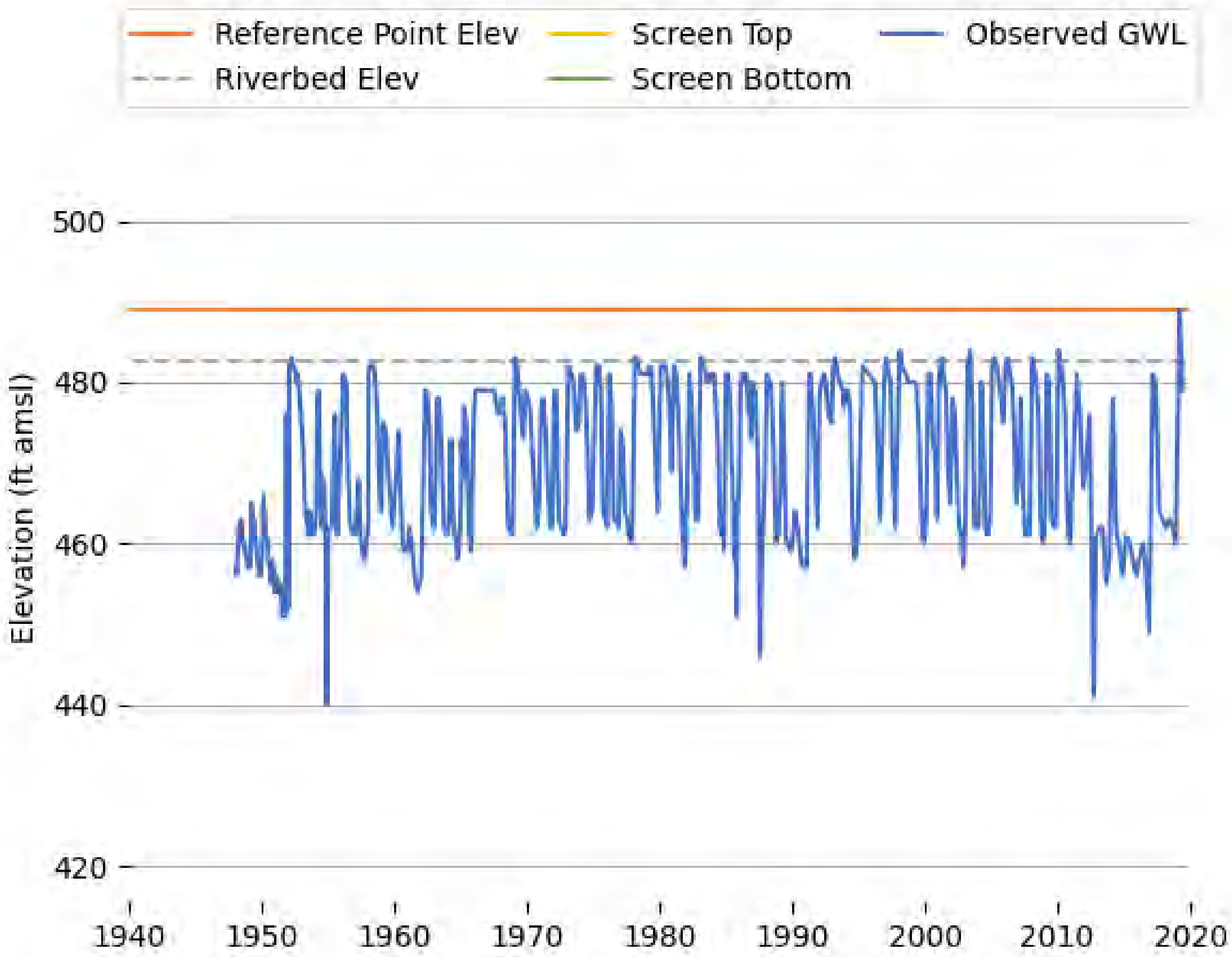


Figure K-21 Observed Groundwater Level (04N23W20A01S).

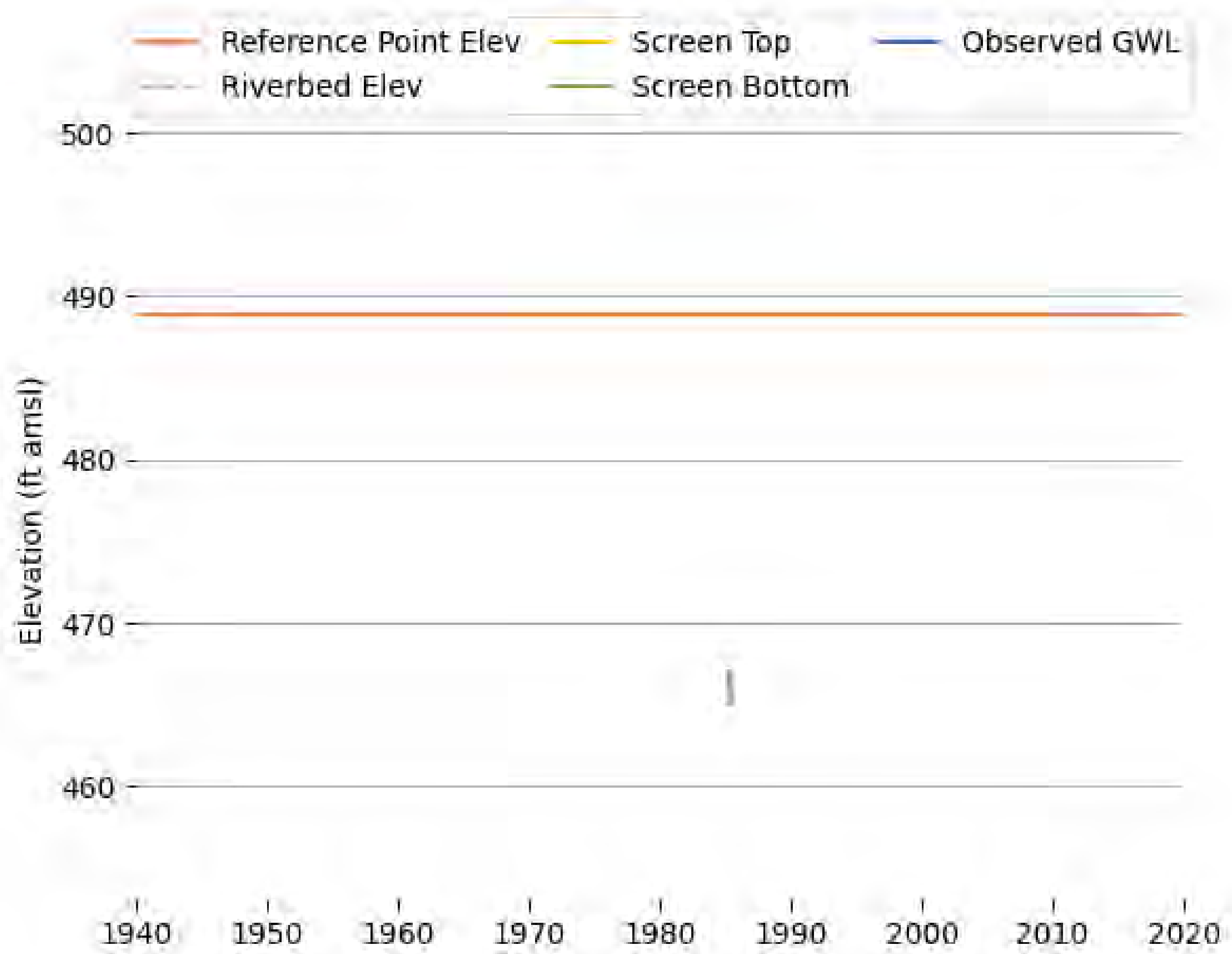
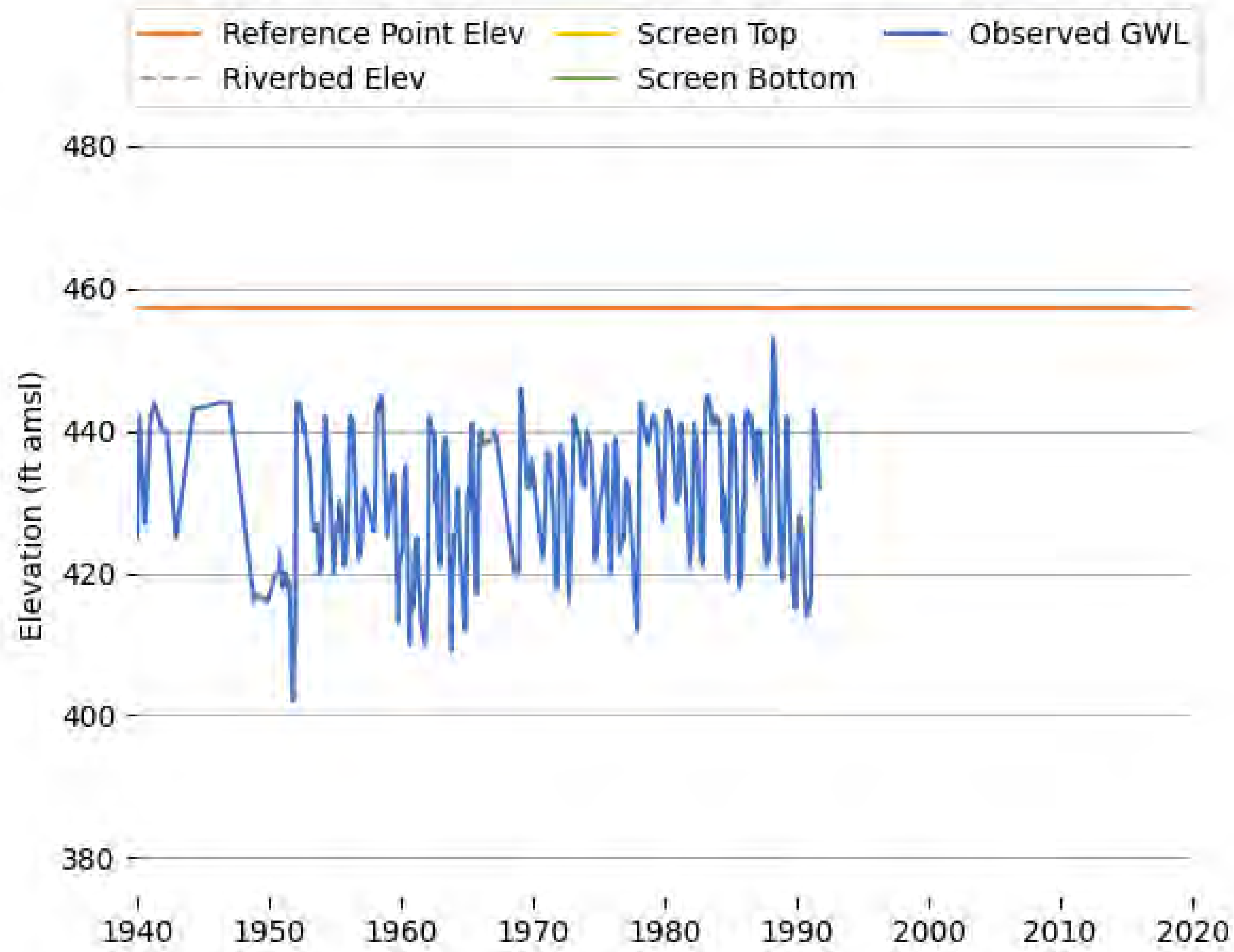


Figure K-22 Observed Groundwater Level (04N23W20J01S).



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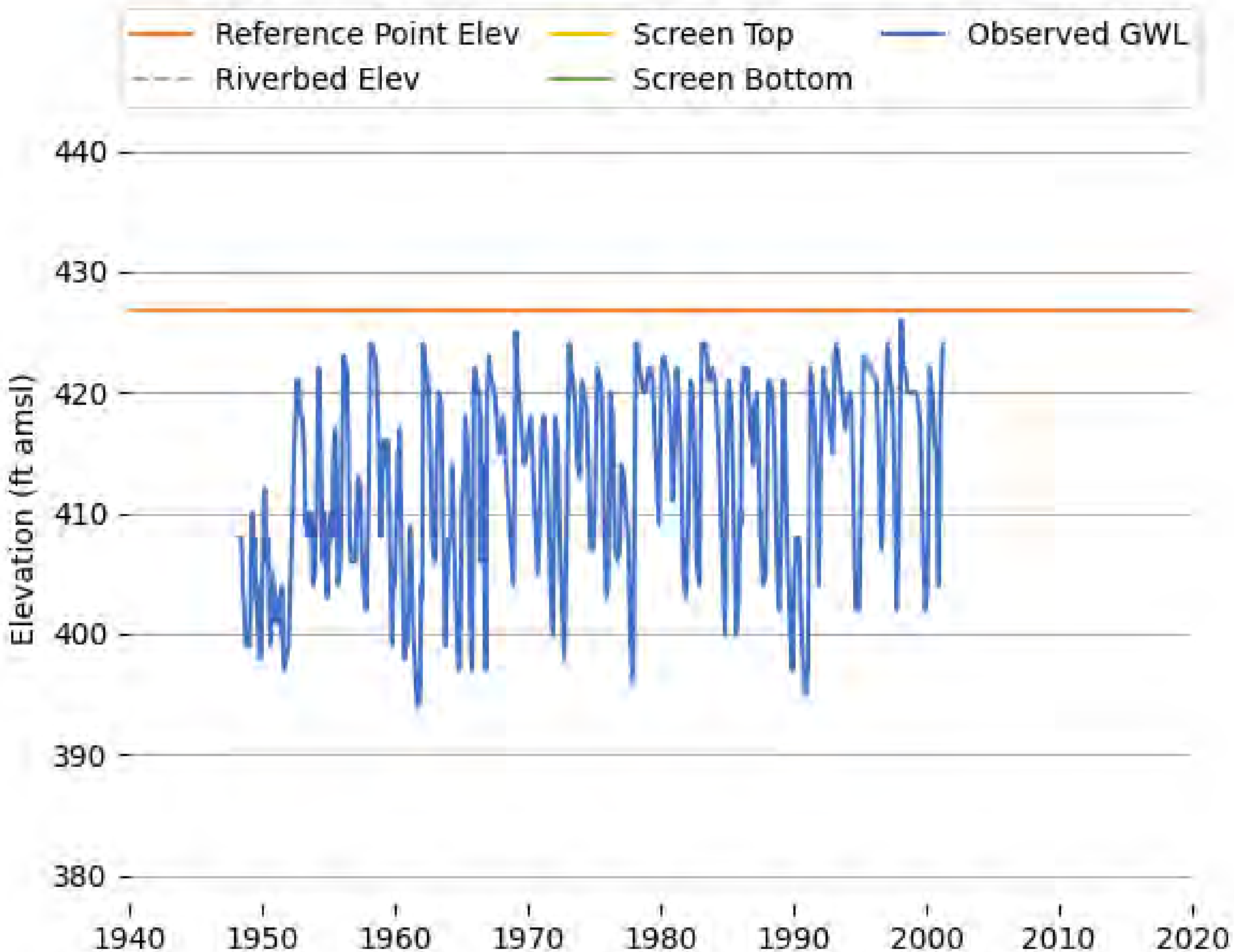


Figure K-24 Observed Groundwater Level (04N23W20Q02S).

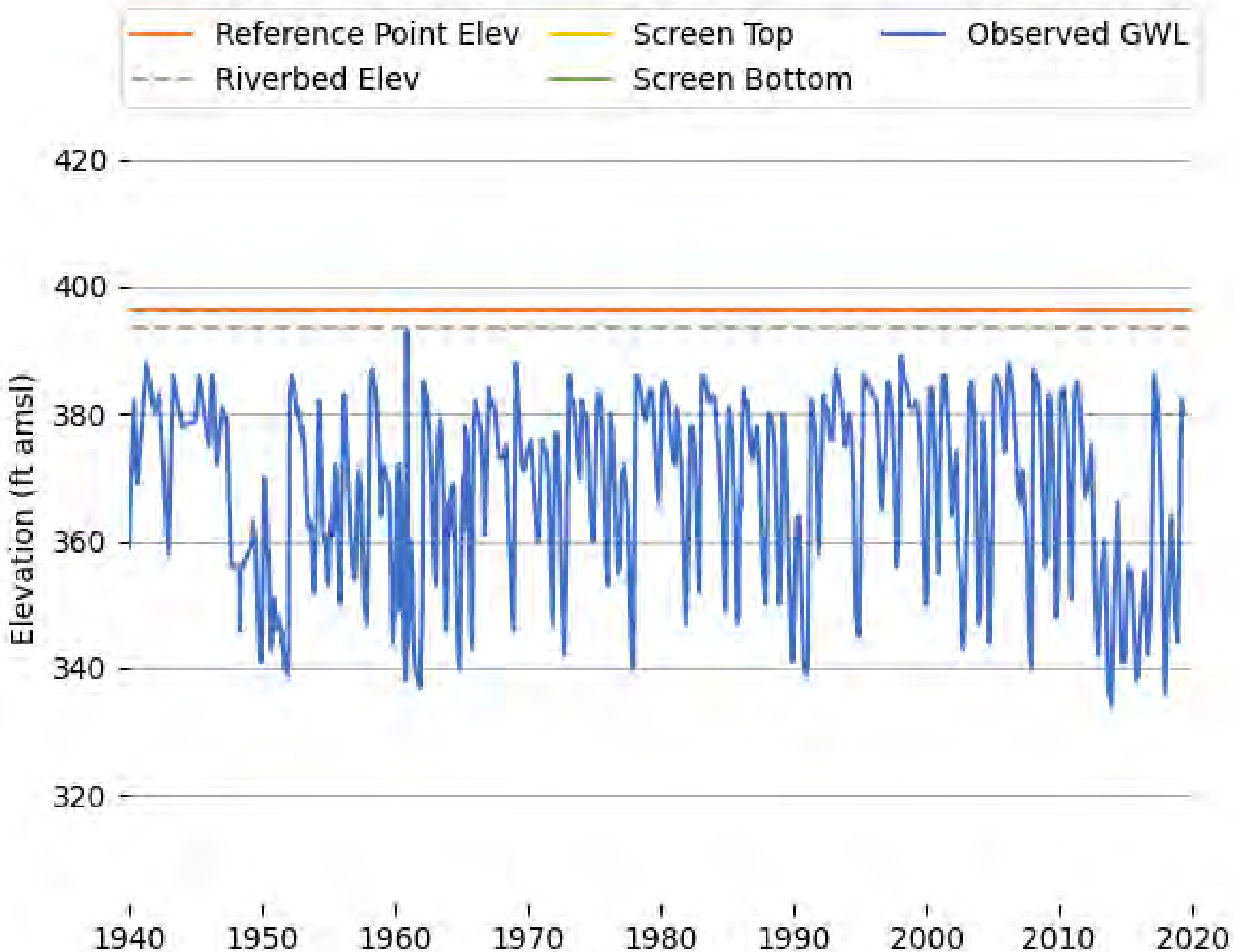
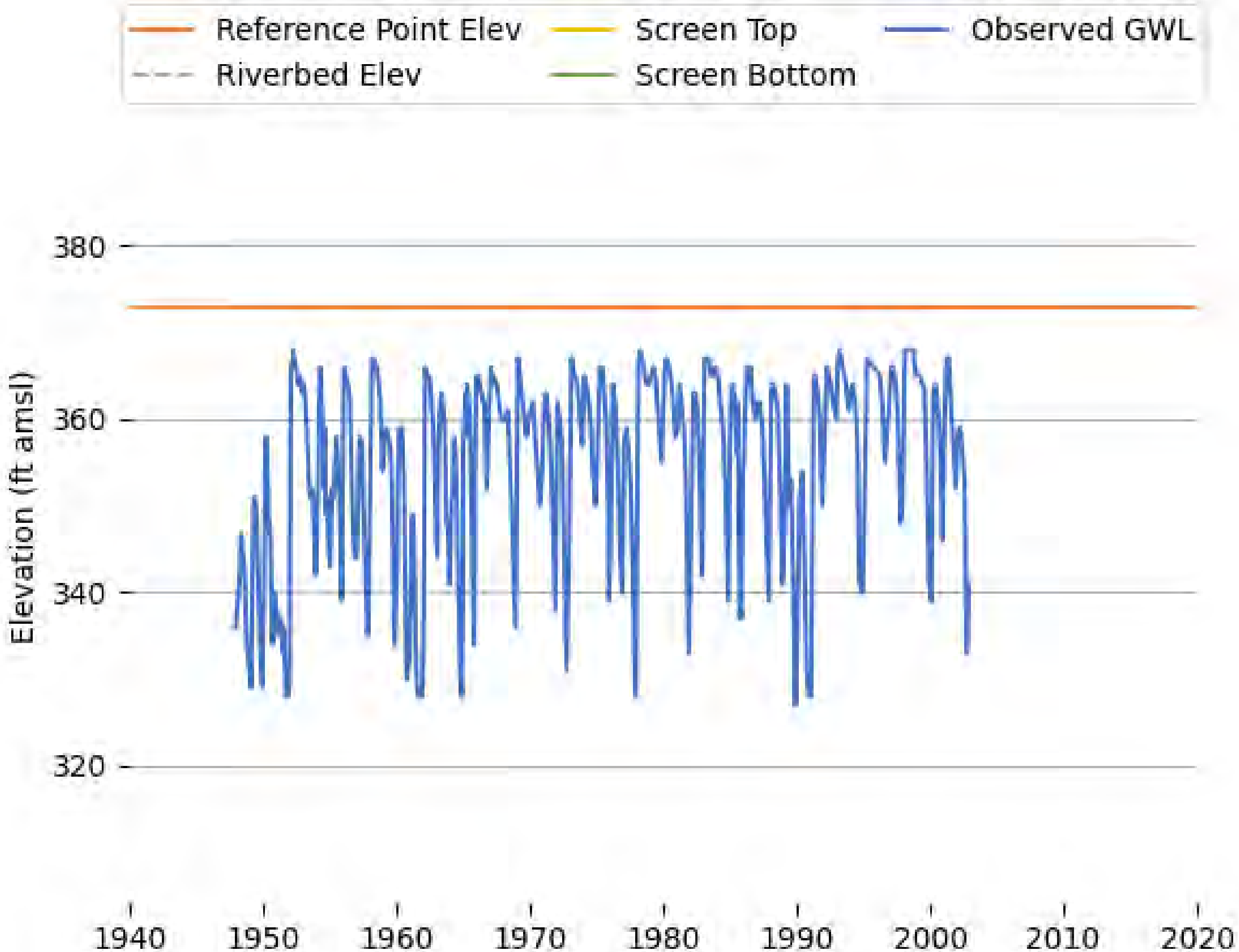


Figure K-25 Observed Groundwater Level (04N23W29F02S).



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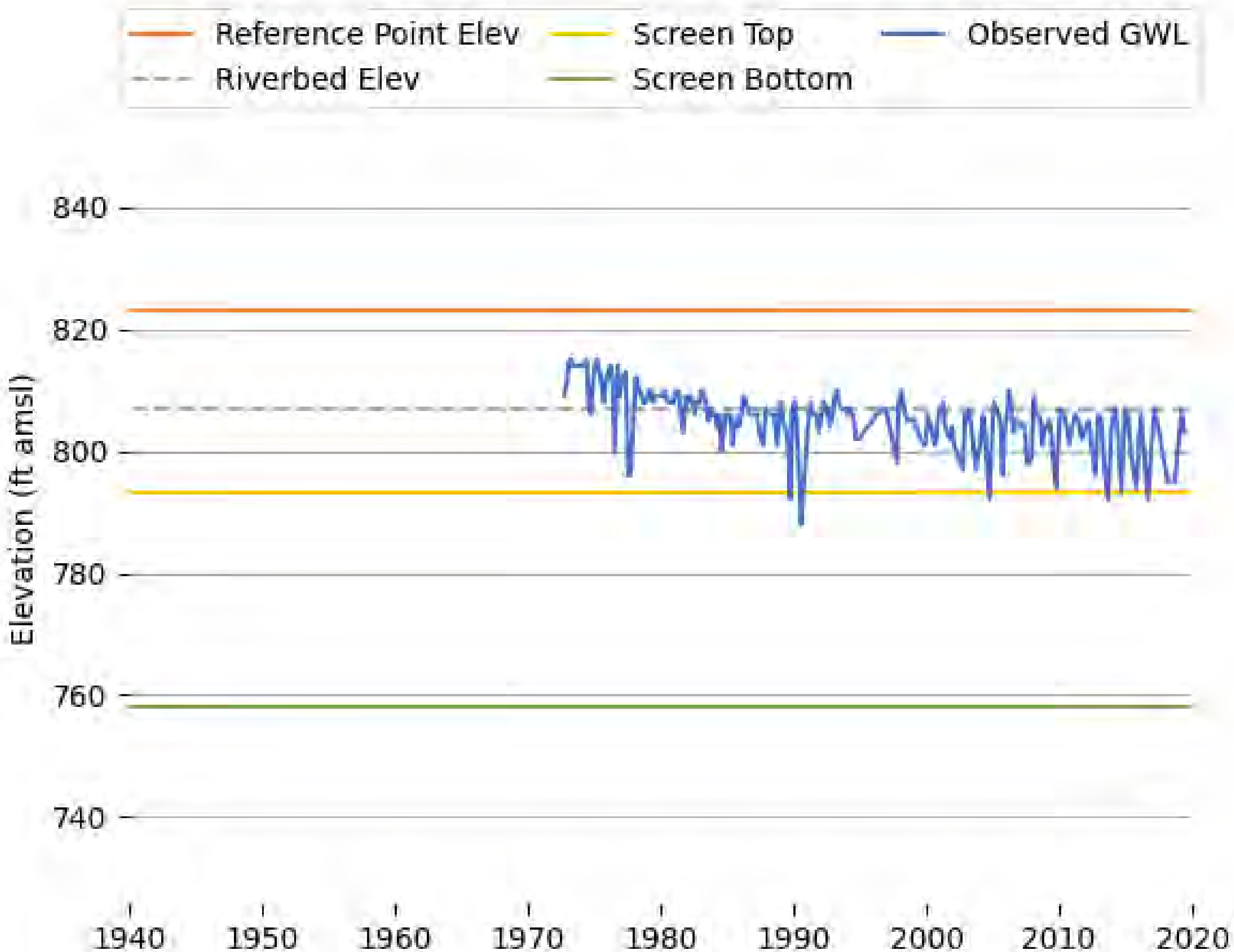


Figure K-27 Observed Groundwater Level (05N23W33B03S).

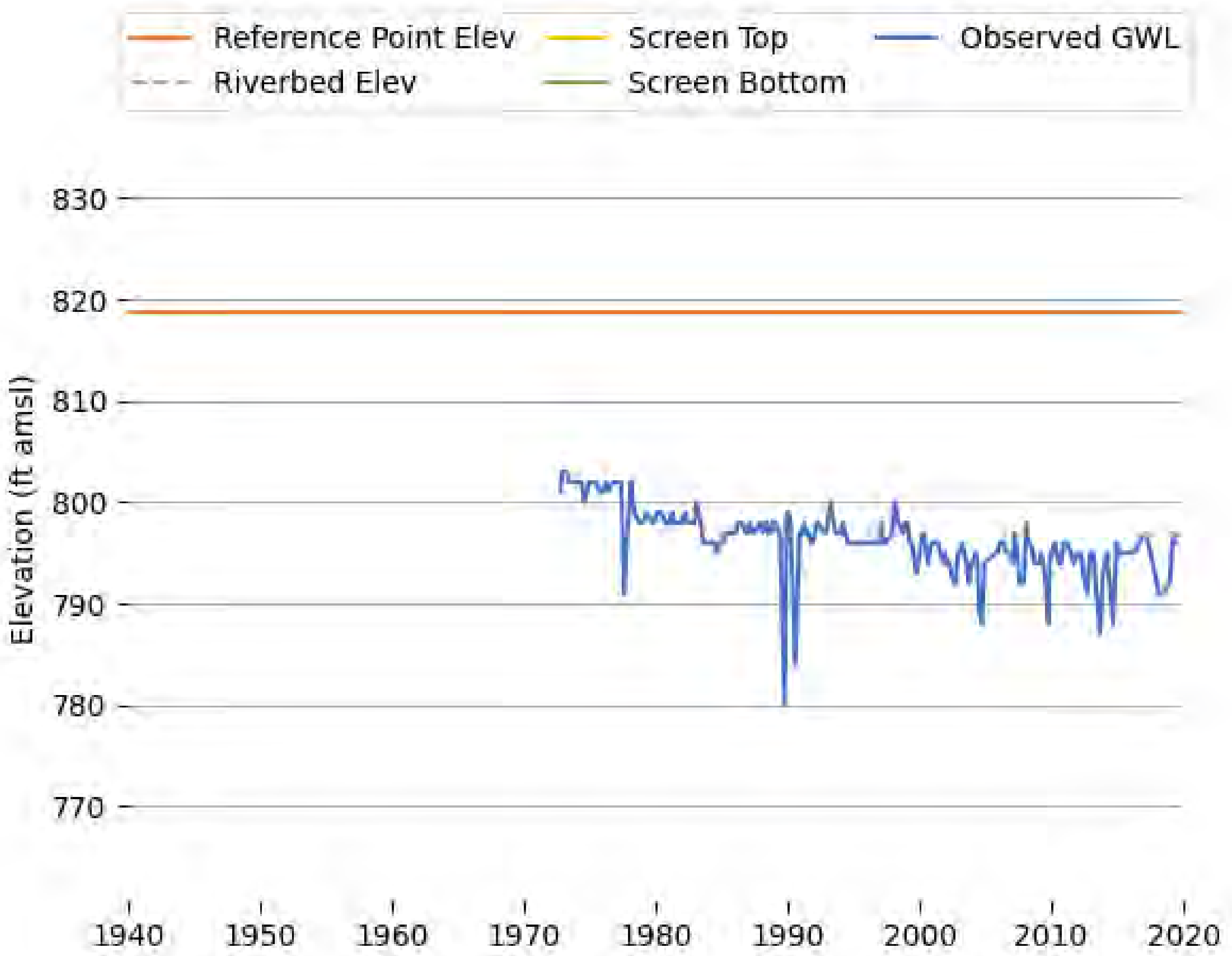


Figure K-28 Observed Groundwater Level (05N23W33G01S).

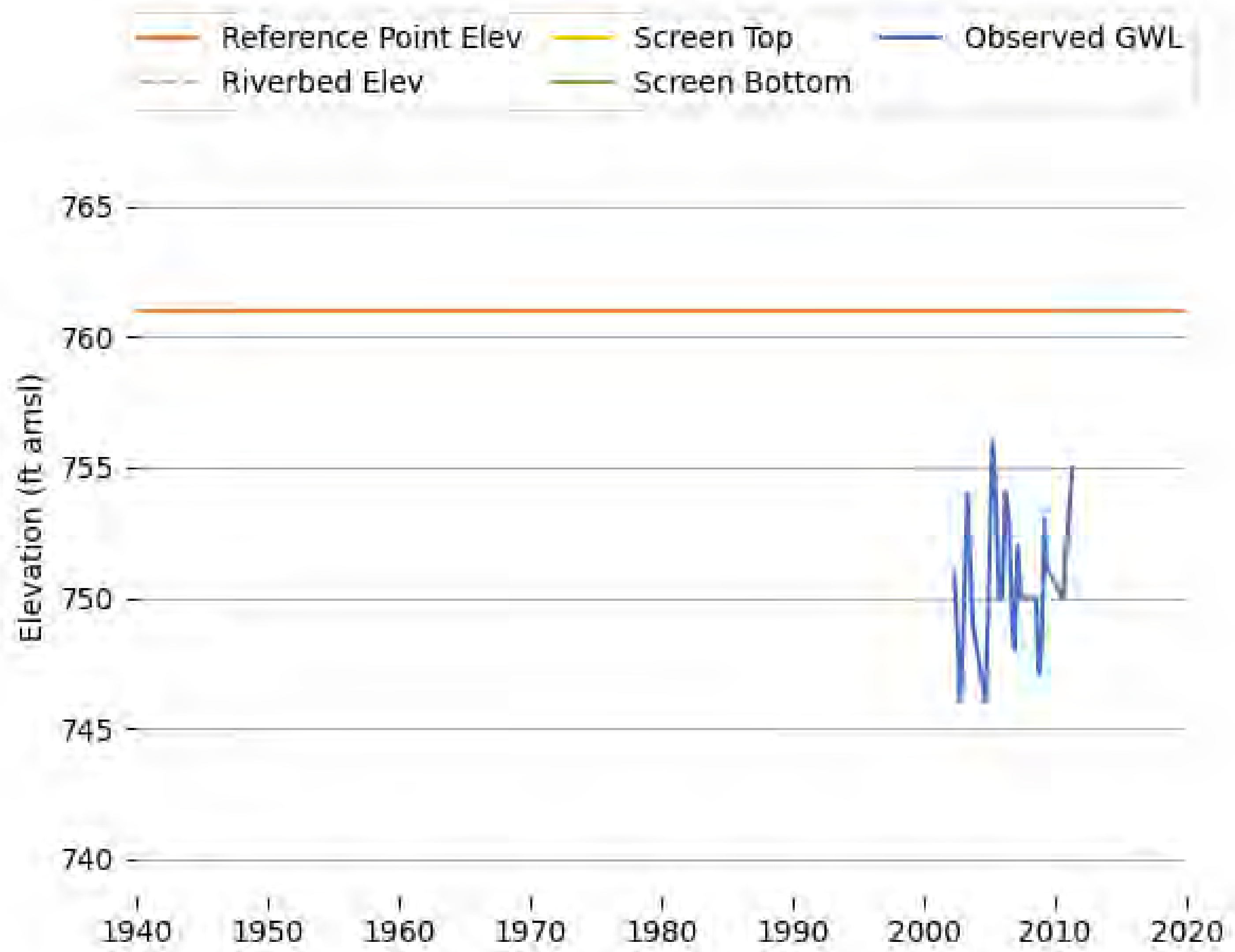


Figure K-29 Observed Groundwater Level (T0611100412_MW-1).

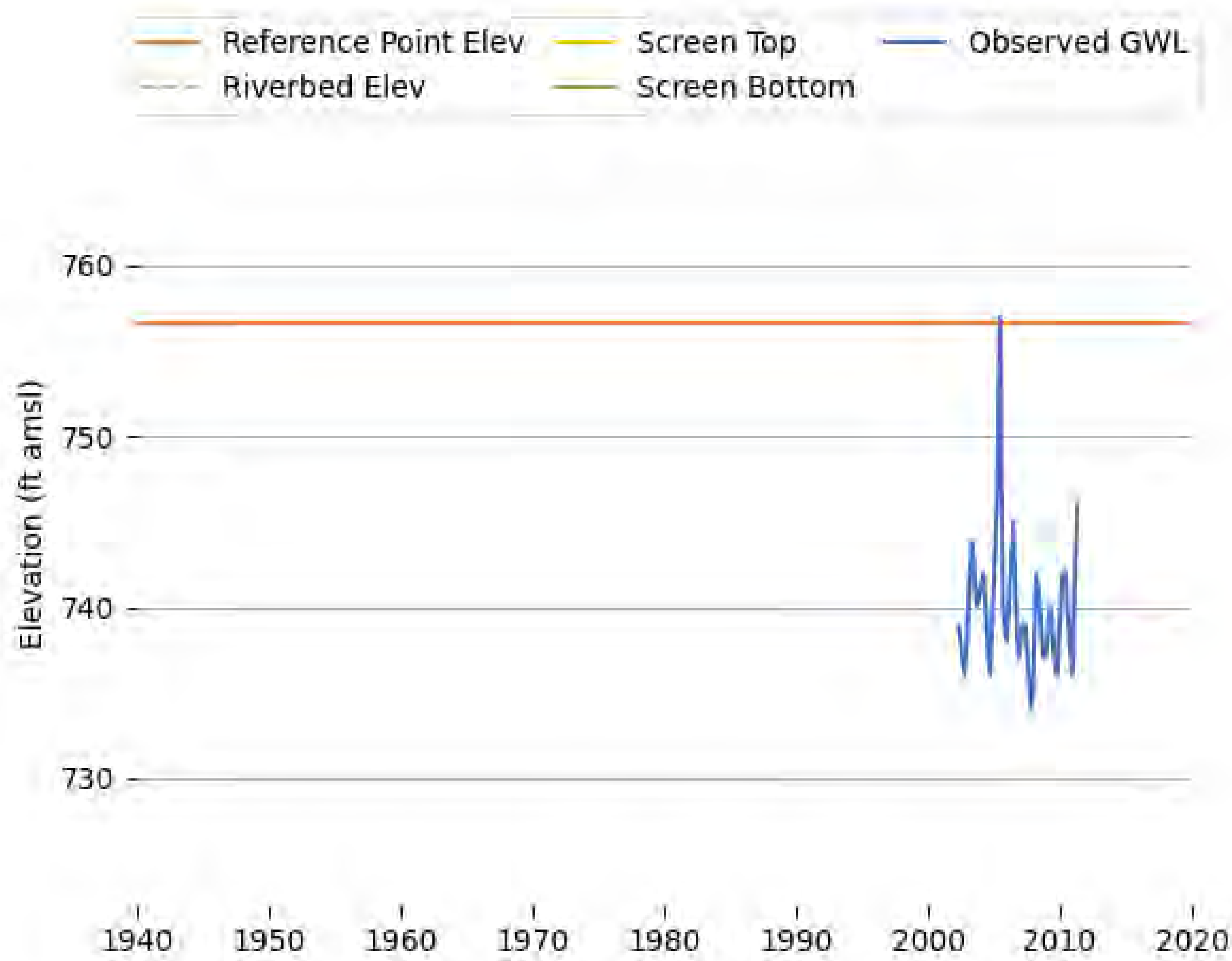
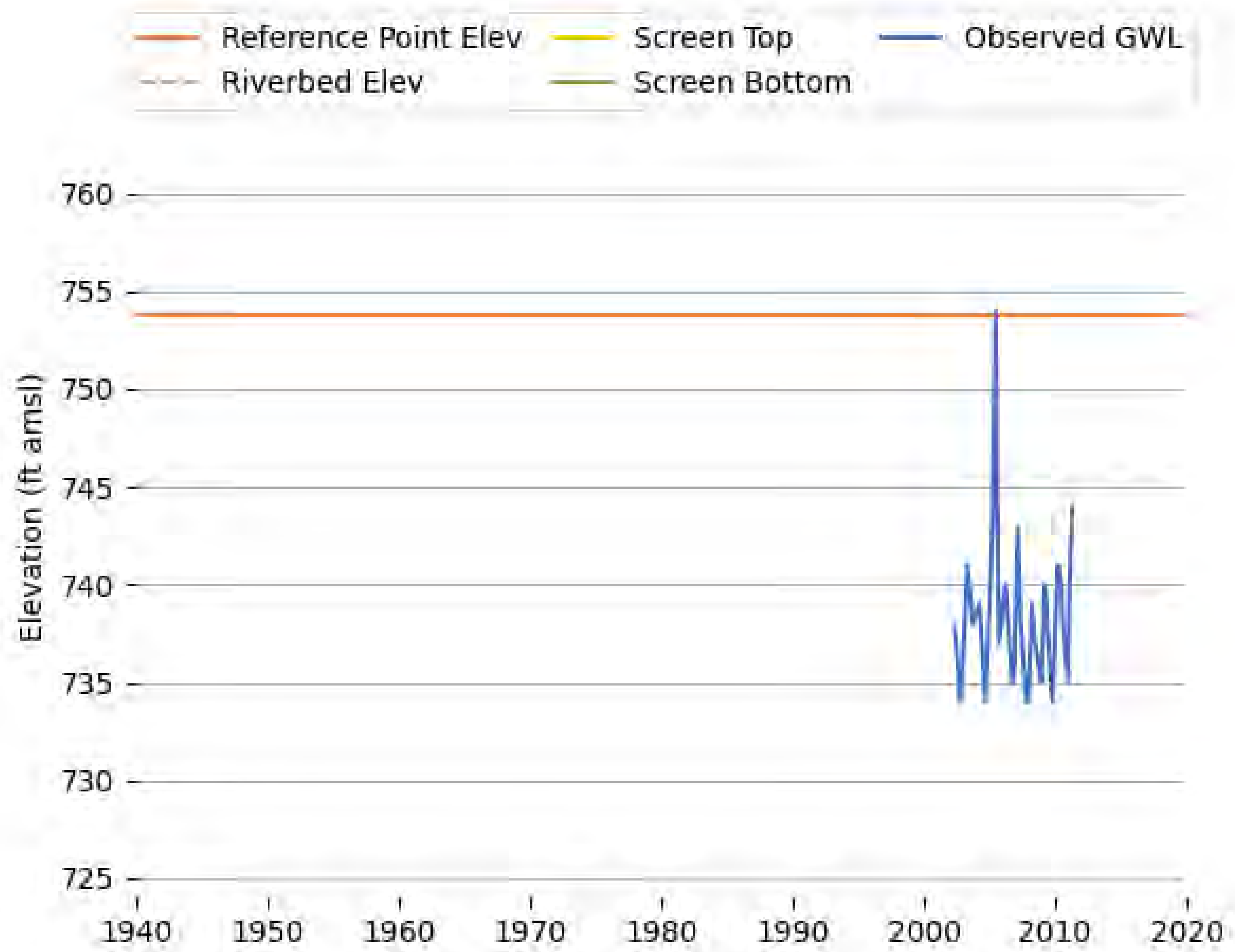


Figure K-30 Observed Groundwater Level (T0611100412_MW-2).



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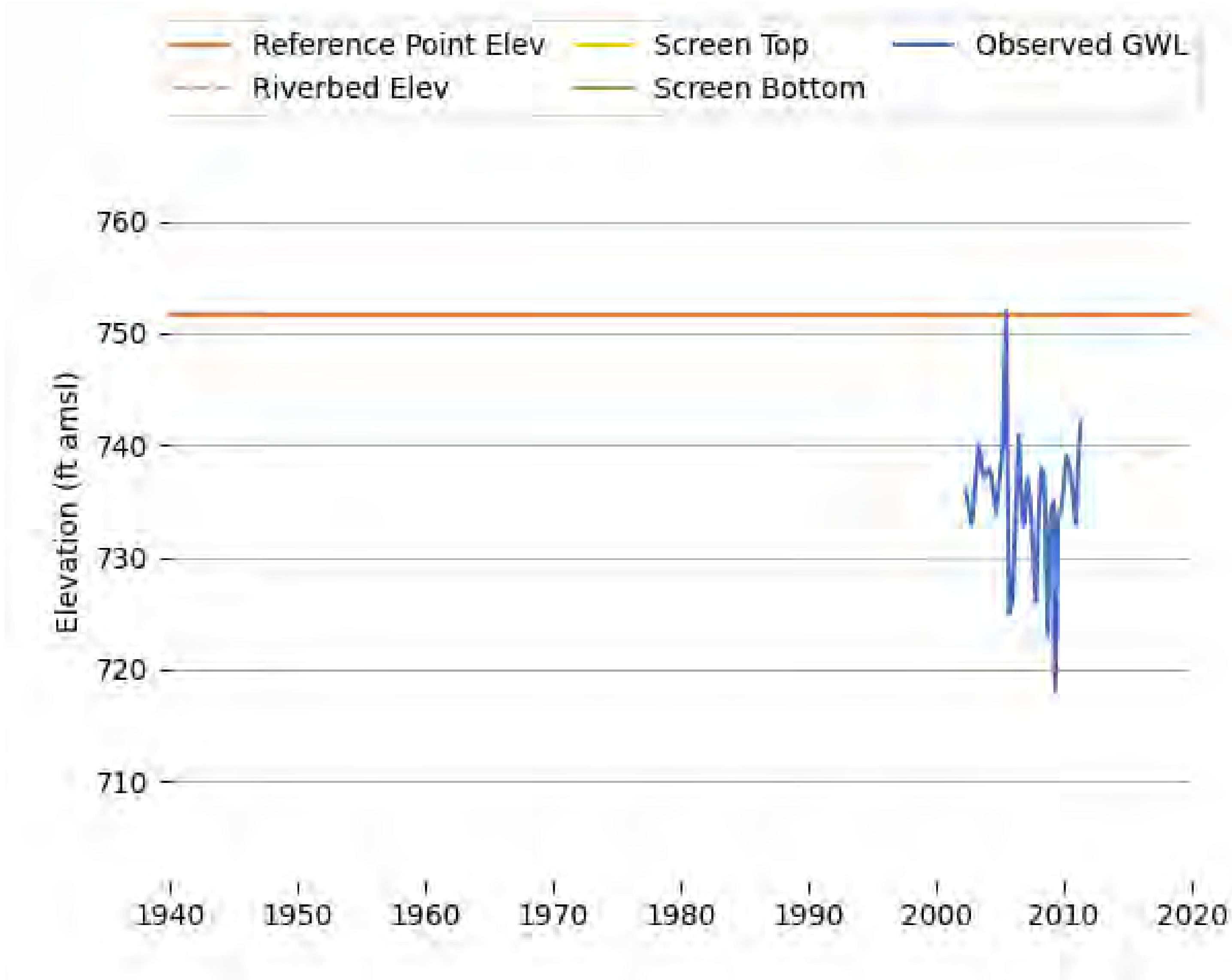

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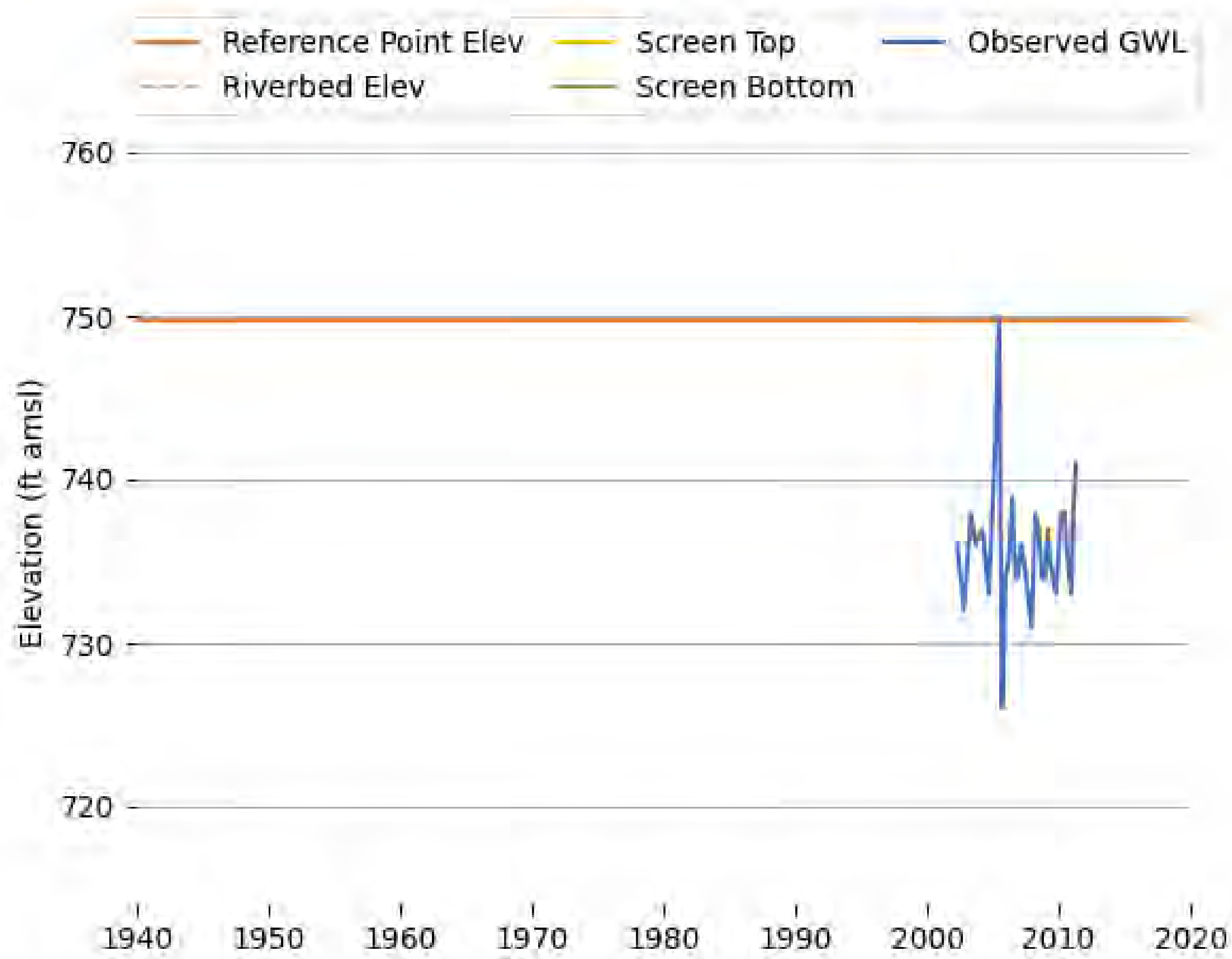

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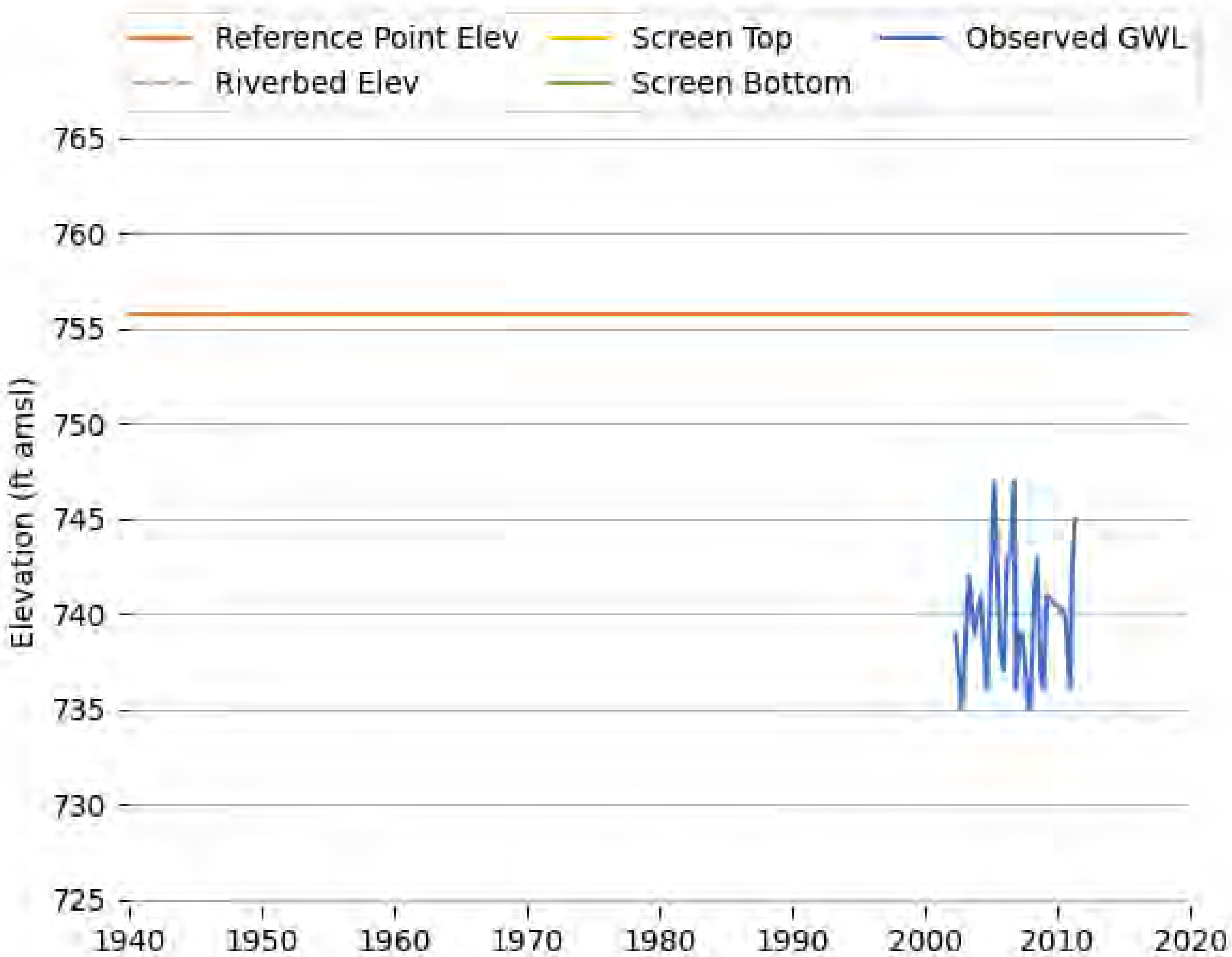

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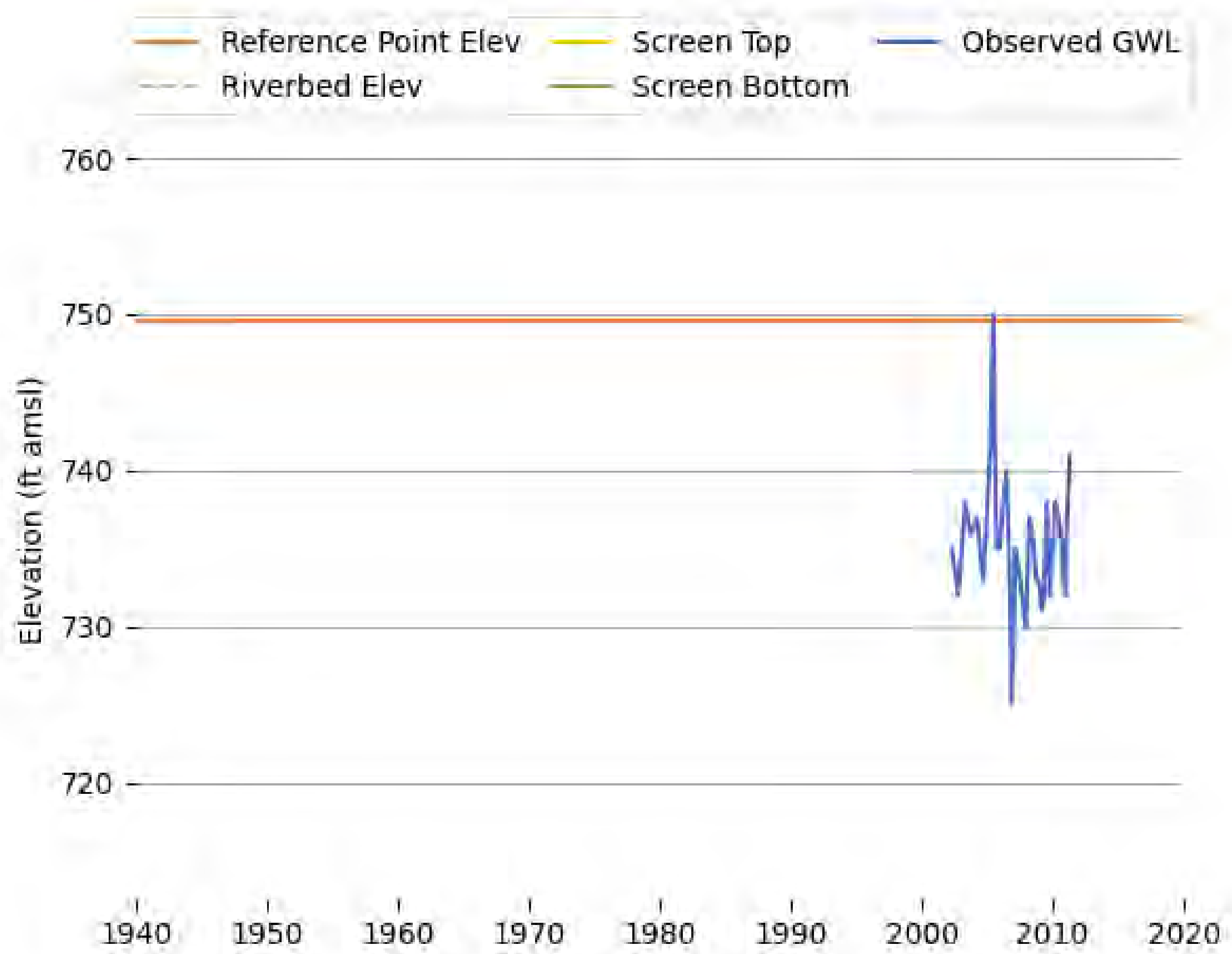
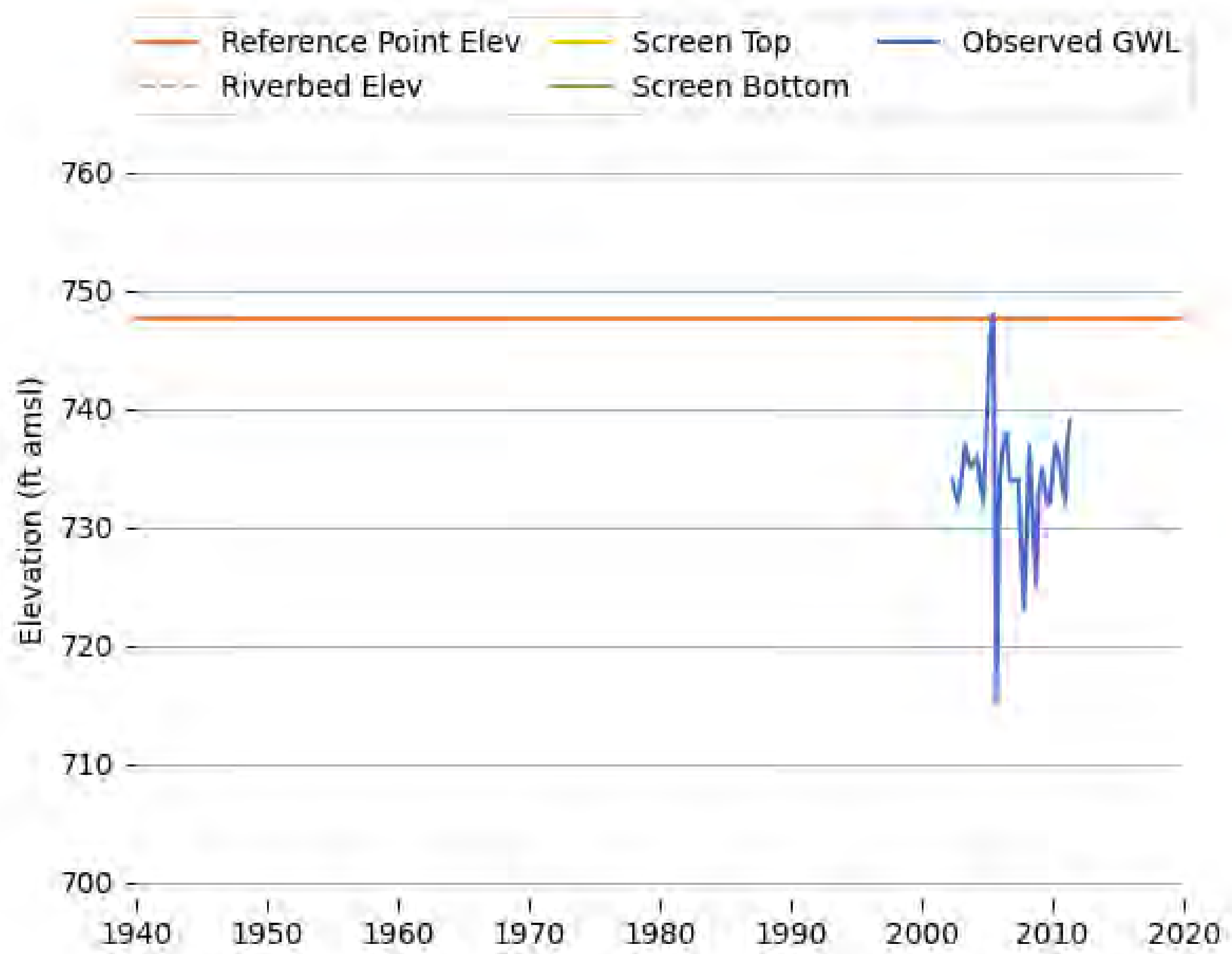


Figure K-35 Observed Groundwater Level (T0611100412_MW-7).



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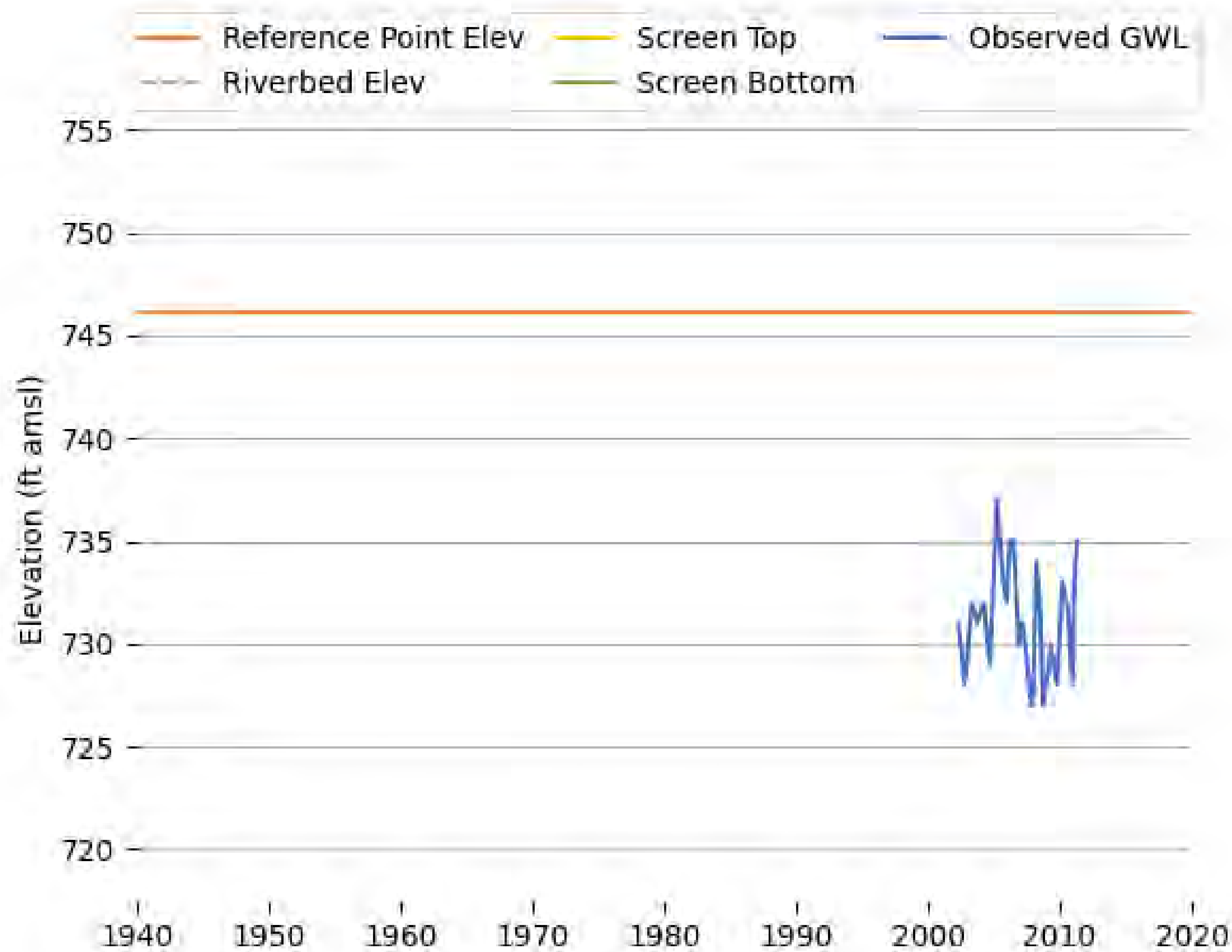
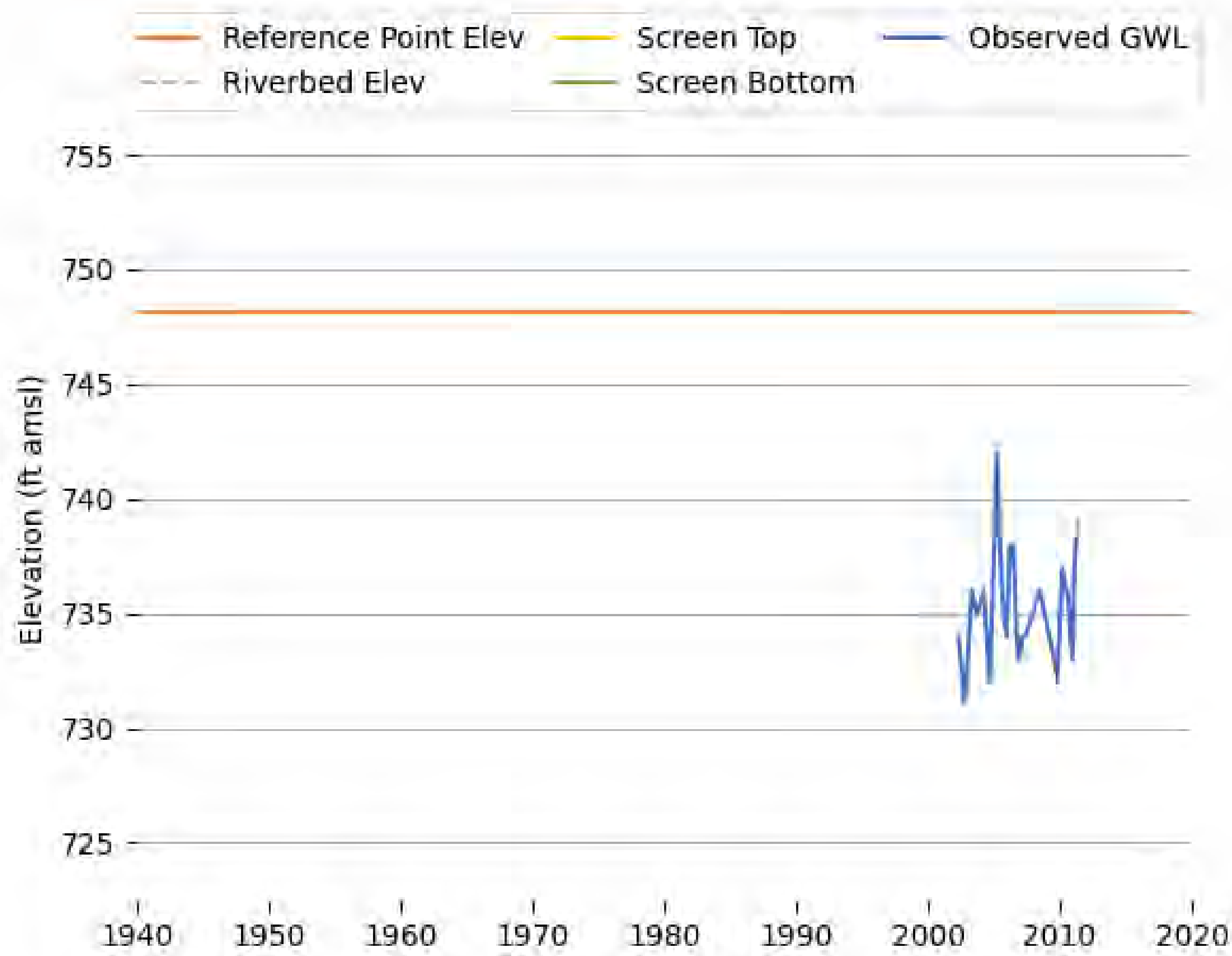


Figure K-37 Observed Groundwater Level (T0611100412_MW-9).



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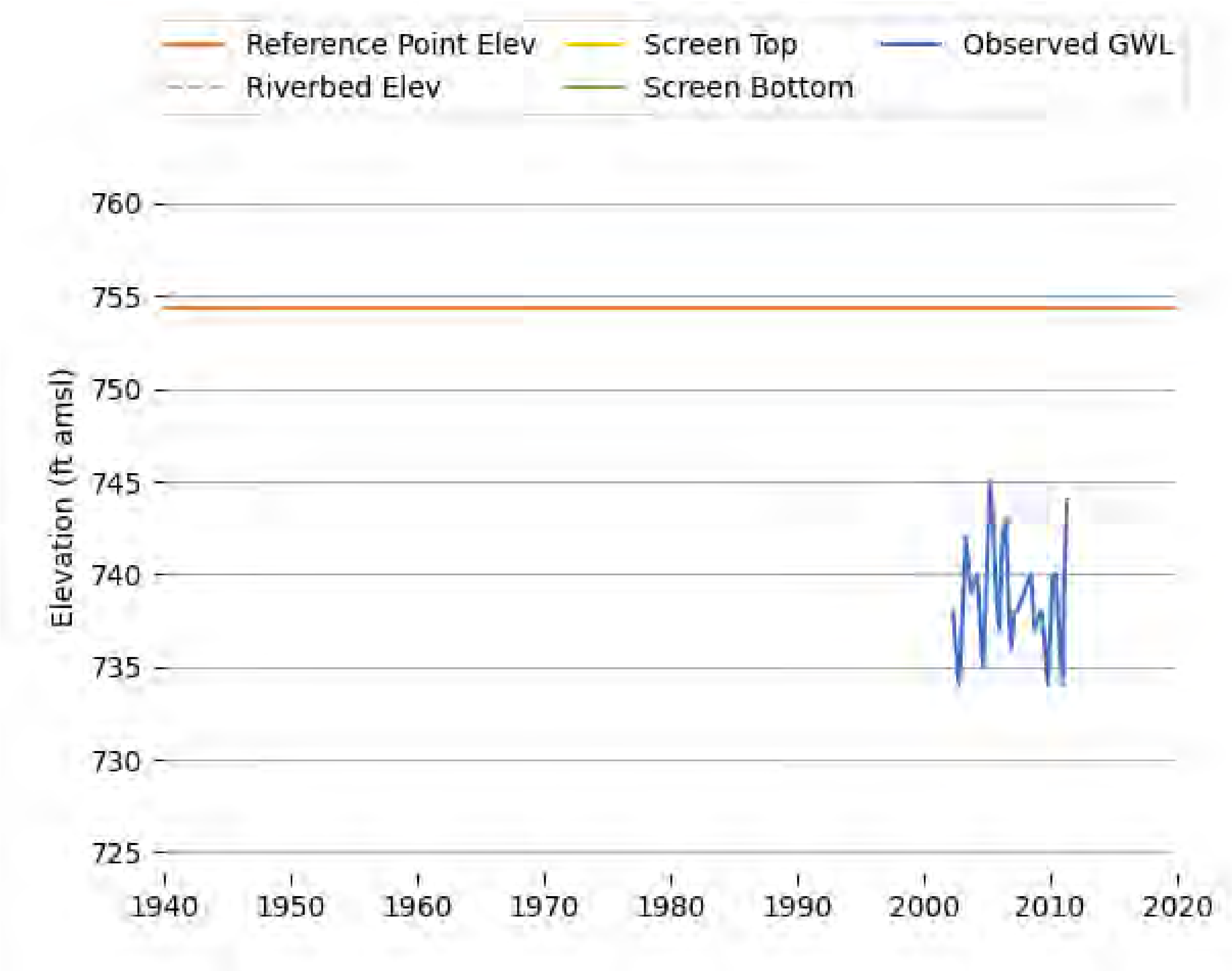


Figure K-39 Observed Groundwater Level (T0611100412_MW-11).

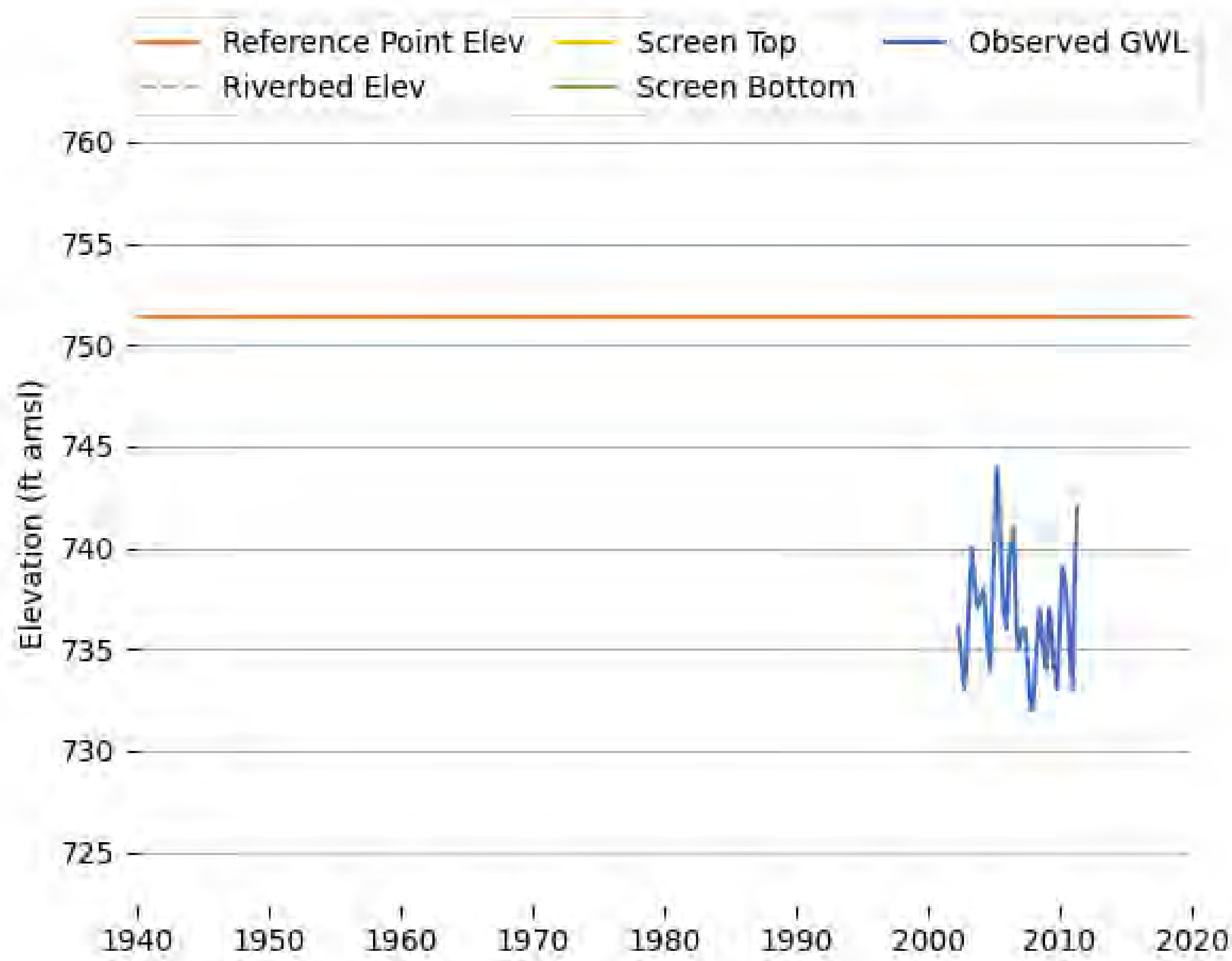


Figure K-40 Observed Groundwater Level (T0611100412_MW-12).

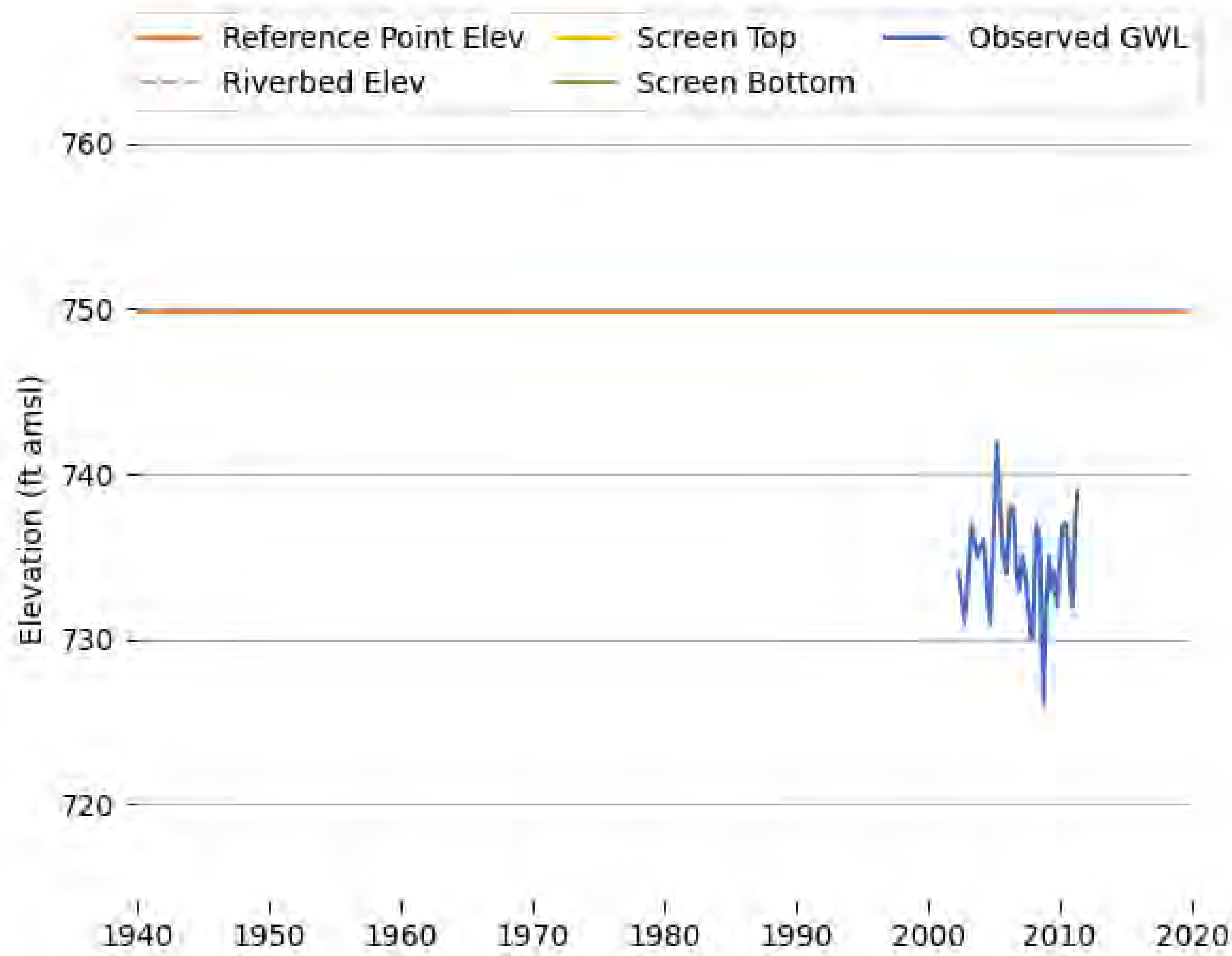


Figure K-41 Observed Groundwater Level (T0611100412_MW-13).

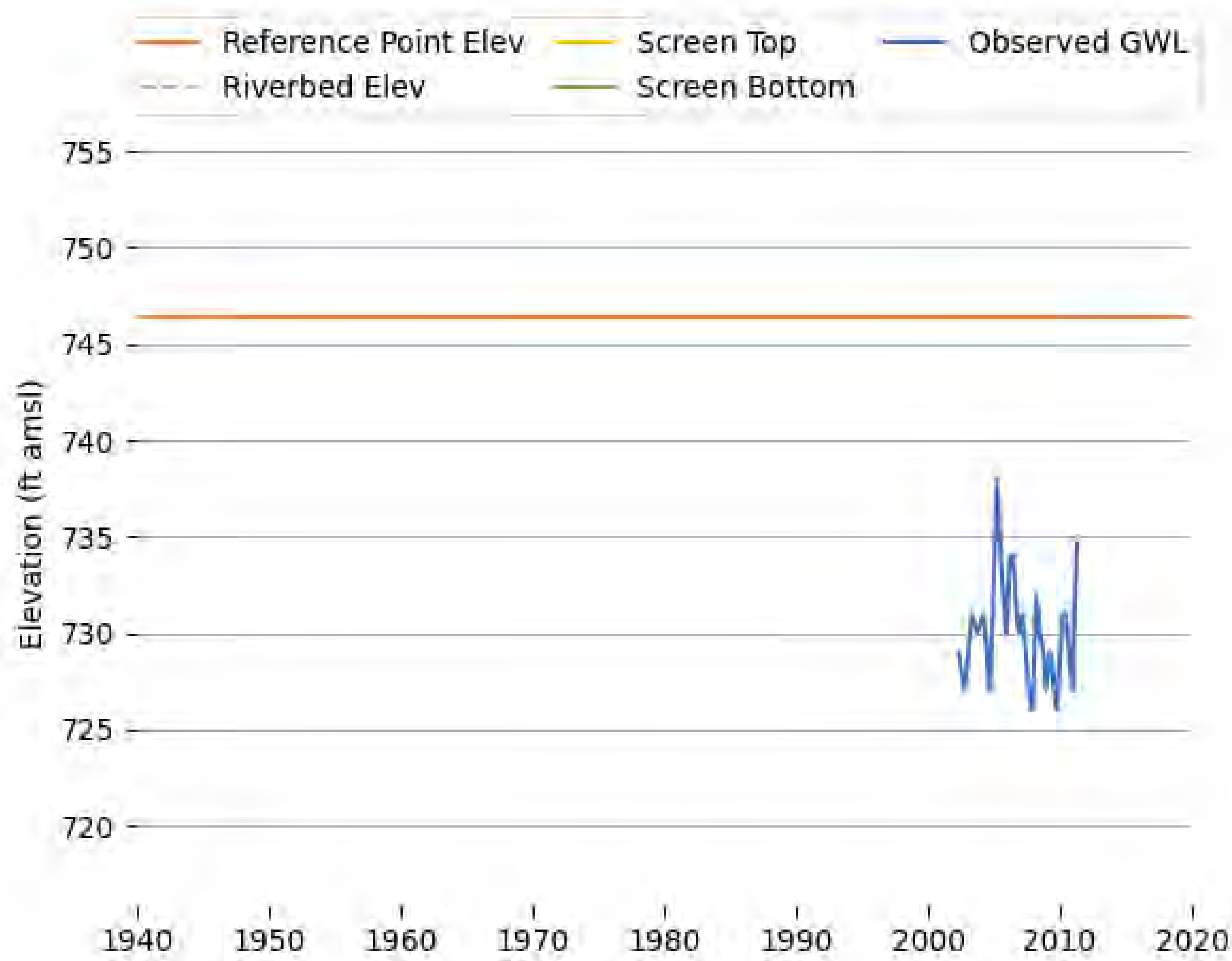


Figure K-42 Observed Groundwater Level (T0611100412_MW-14).

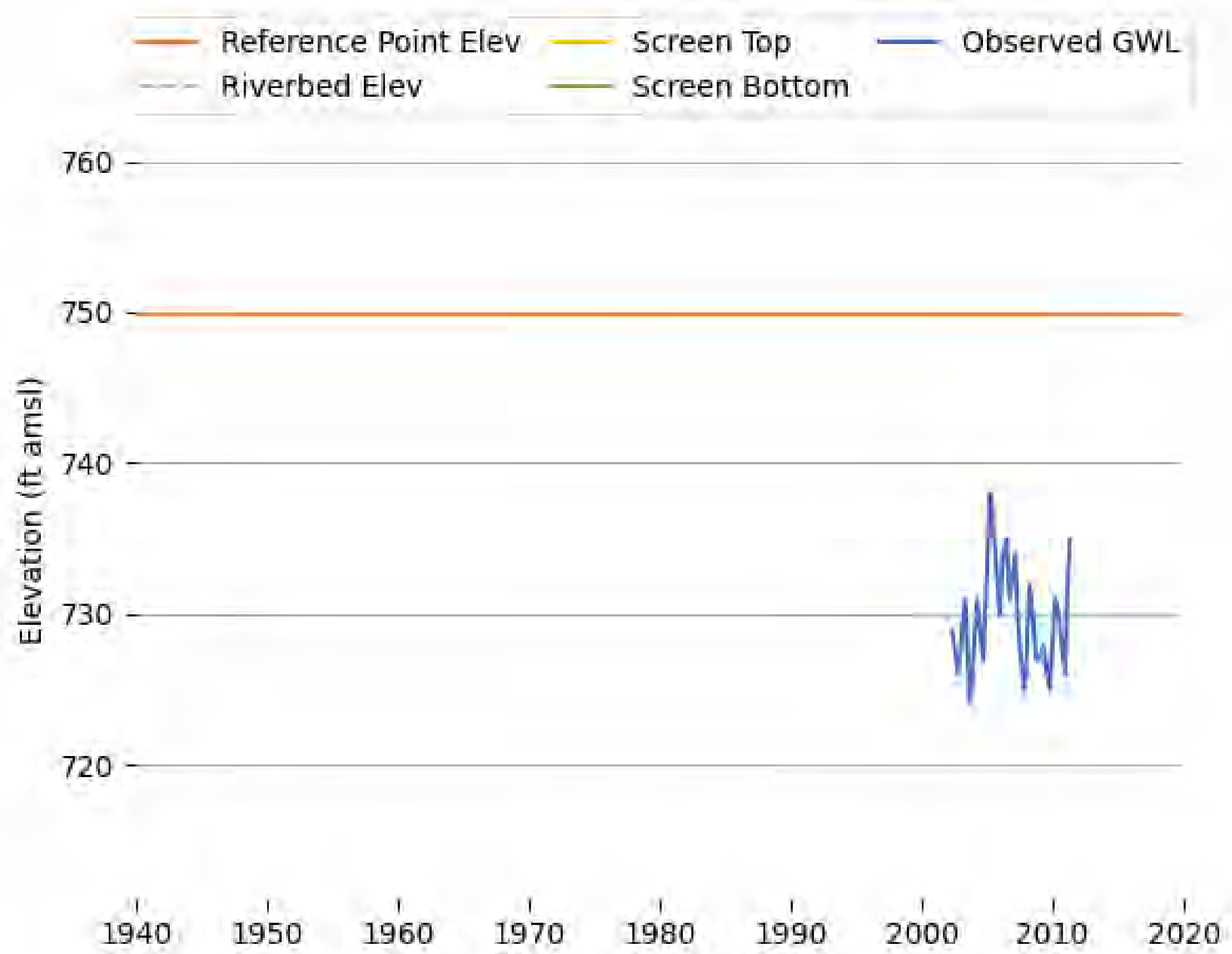


Figure K-43 Observed Groundwater Level (T0611100412_MW-15).

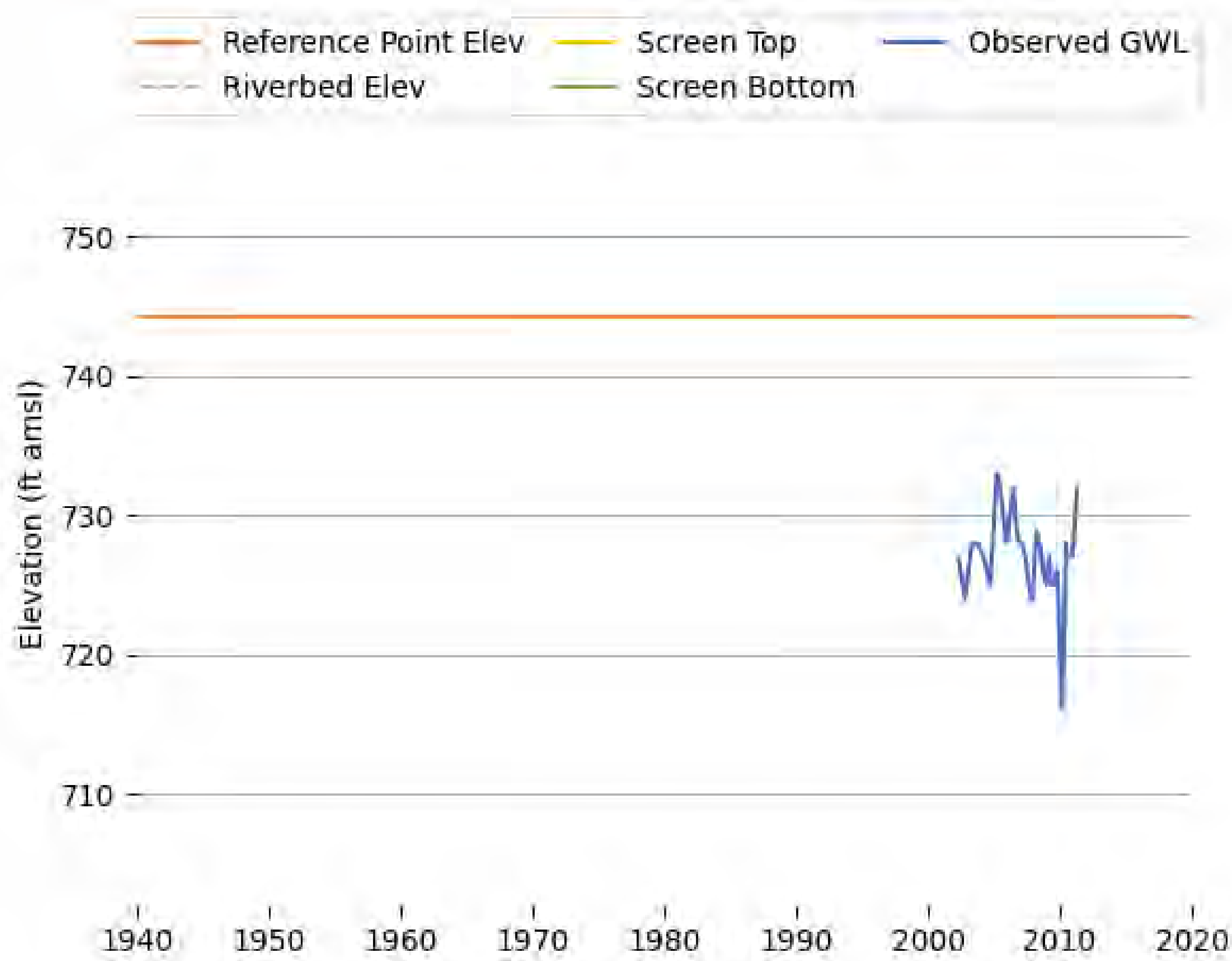


Figure K-44 Observed Groundwater Level (T0611100412_MW-16A).

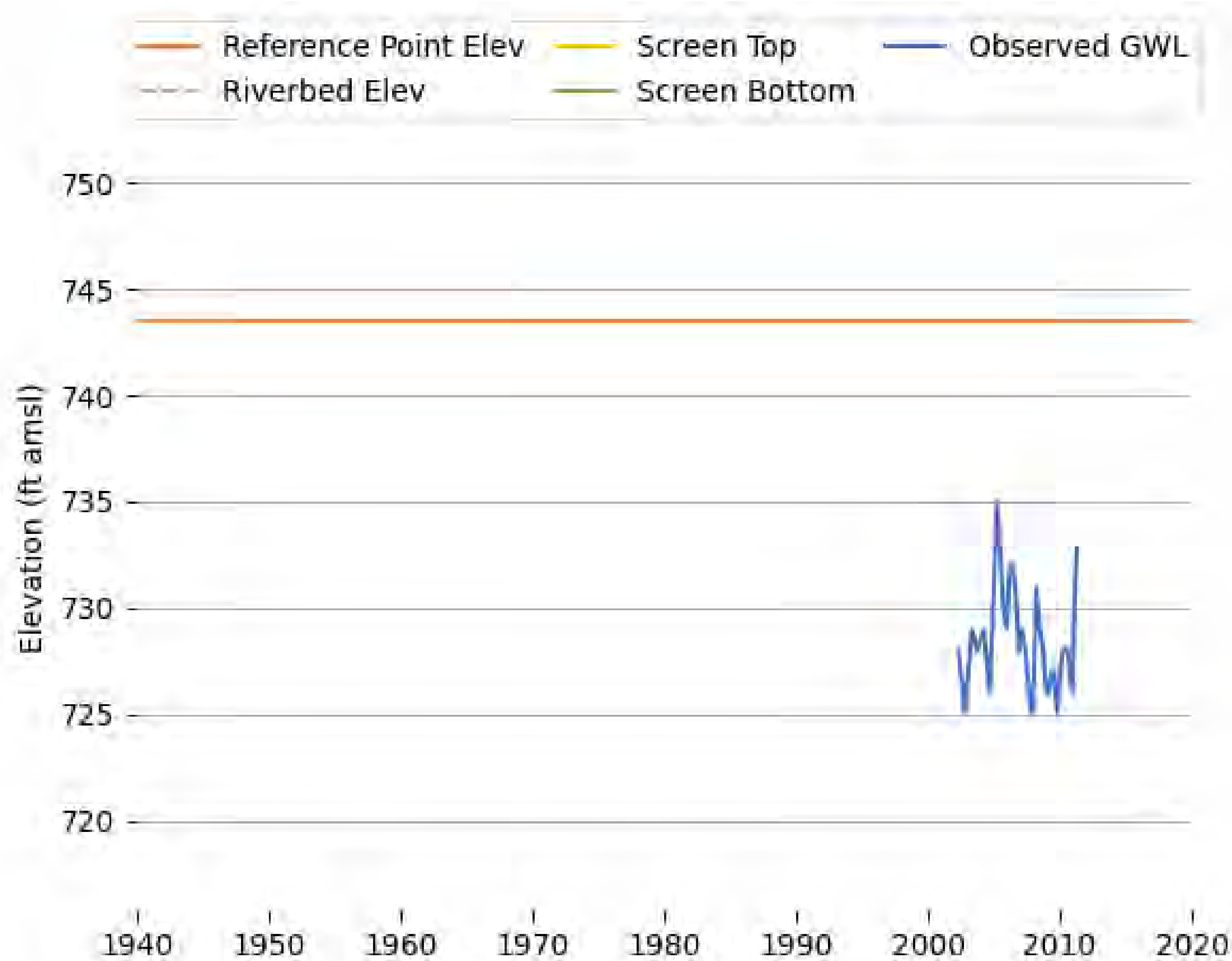


Figure K-45 Observed Groundwater Level (T0611100412_MW-17).

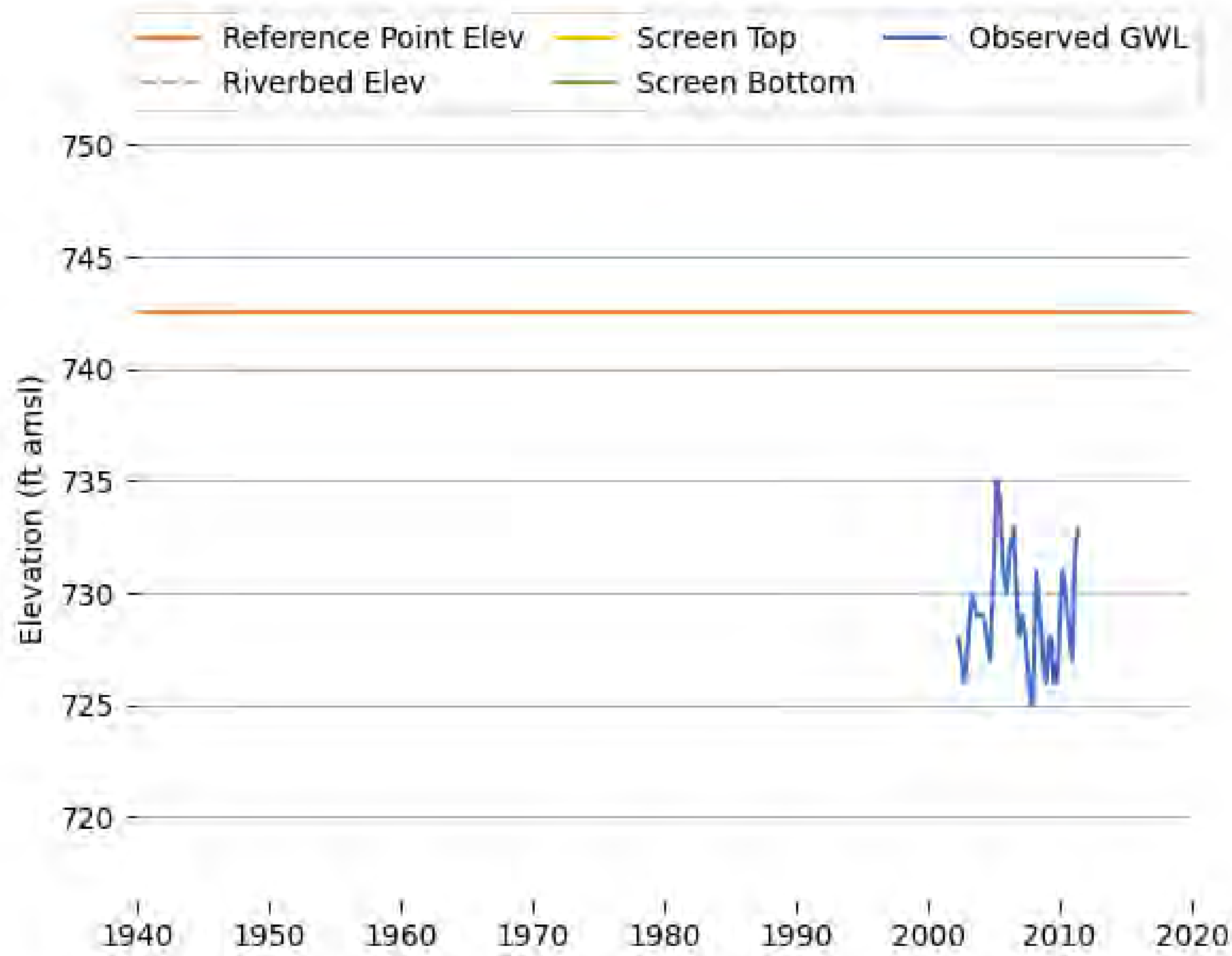


Figure K-46 Observed Groundwater Level (T0611100412_MW-18).

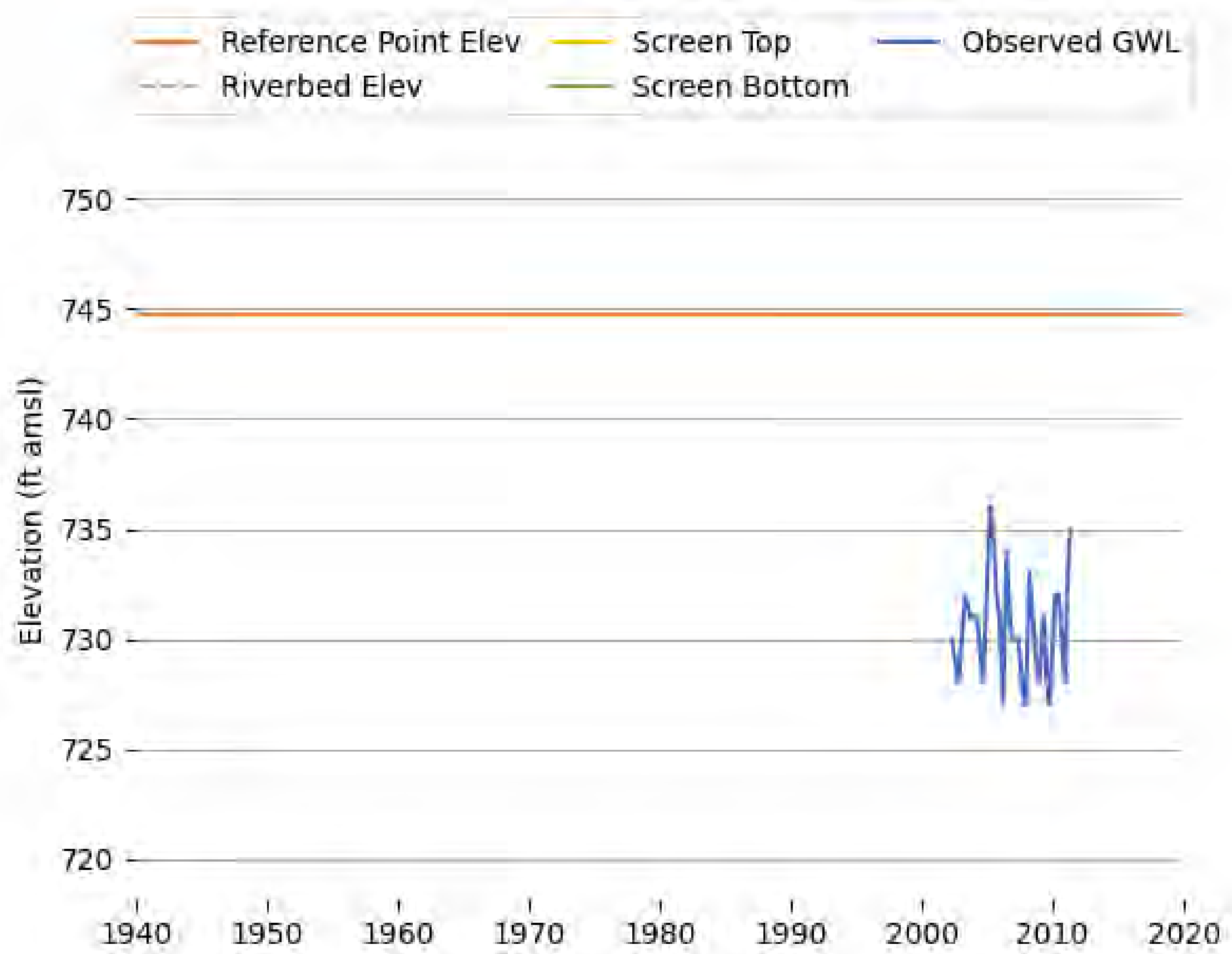


Figure K-47 Observed Groundwater Level (T0611100412_MW-19).

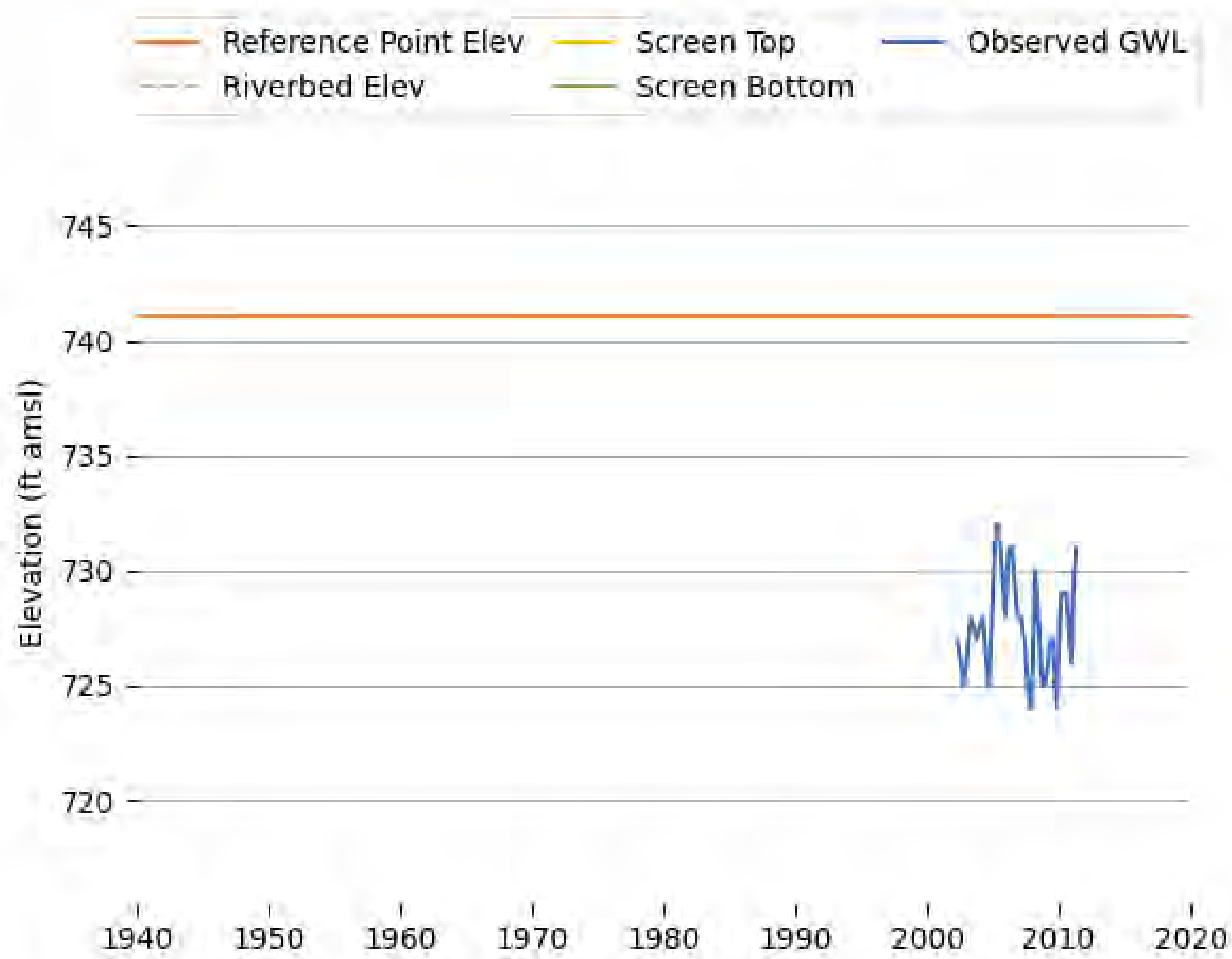


Figure K-48 Observed Groundwater Level (T0611100412_MW-20).

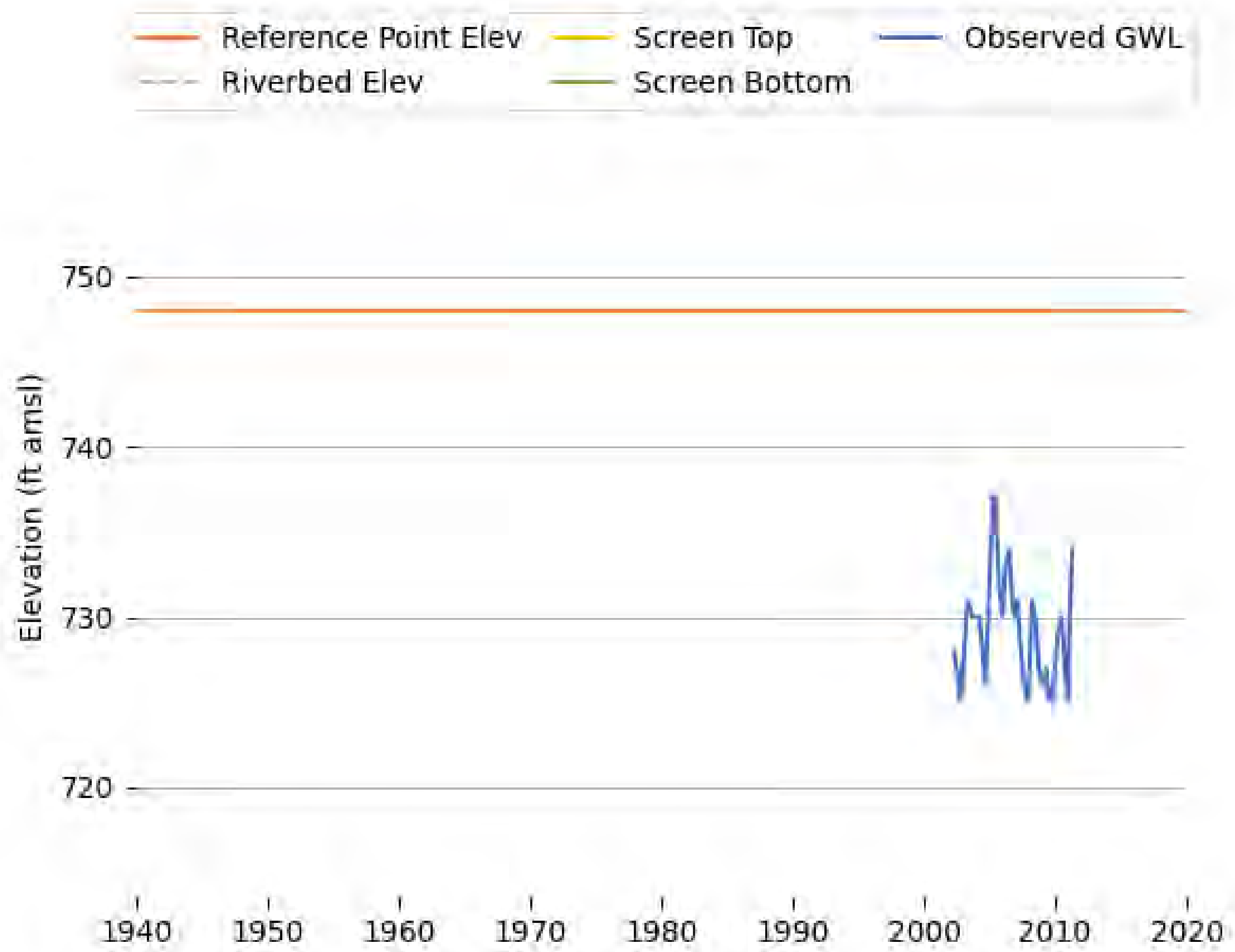


Figure K-49 Observed Groundwater Level (T0611100412_MW-21).

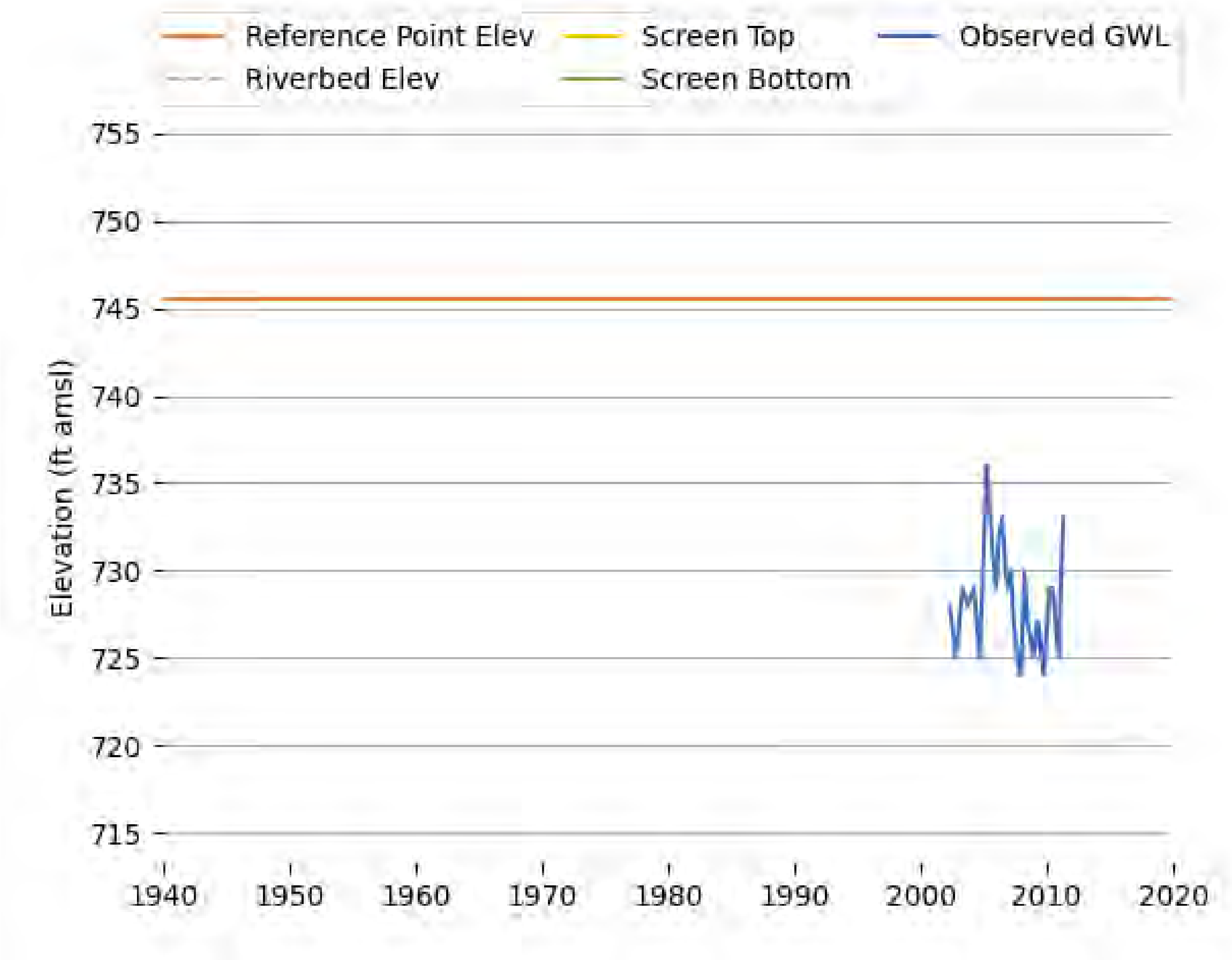


Figure K-50 Observed Groundwater Level (T0611100412_MW-22).

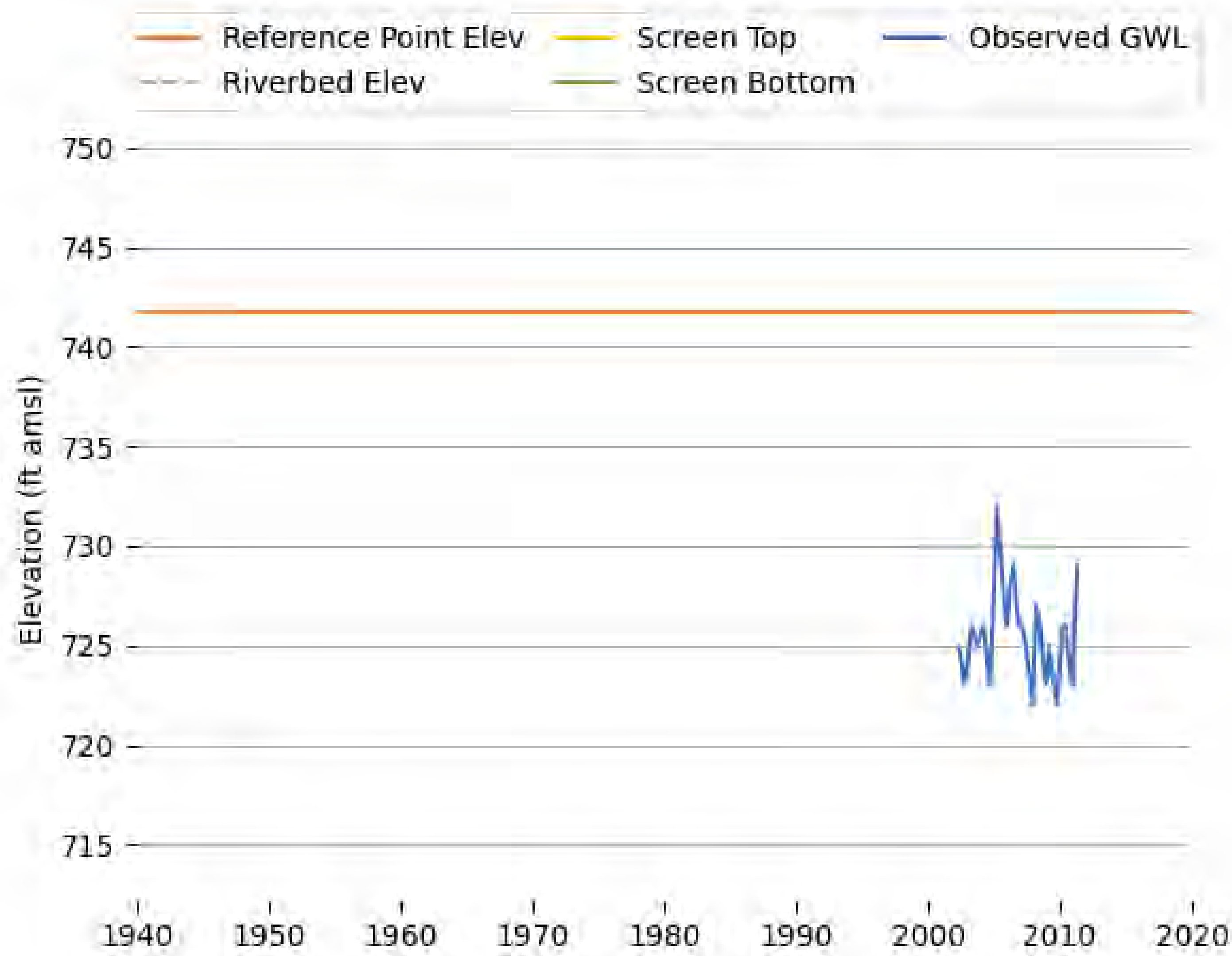


Figure K-51 Observed Groundwater Level (T0611100412_MW-23).

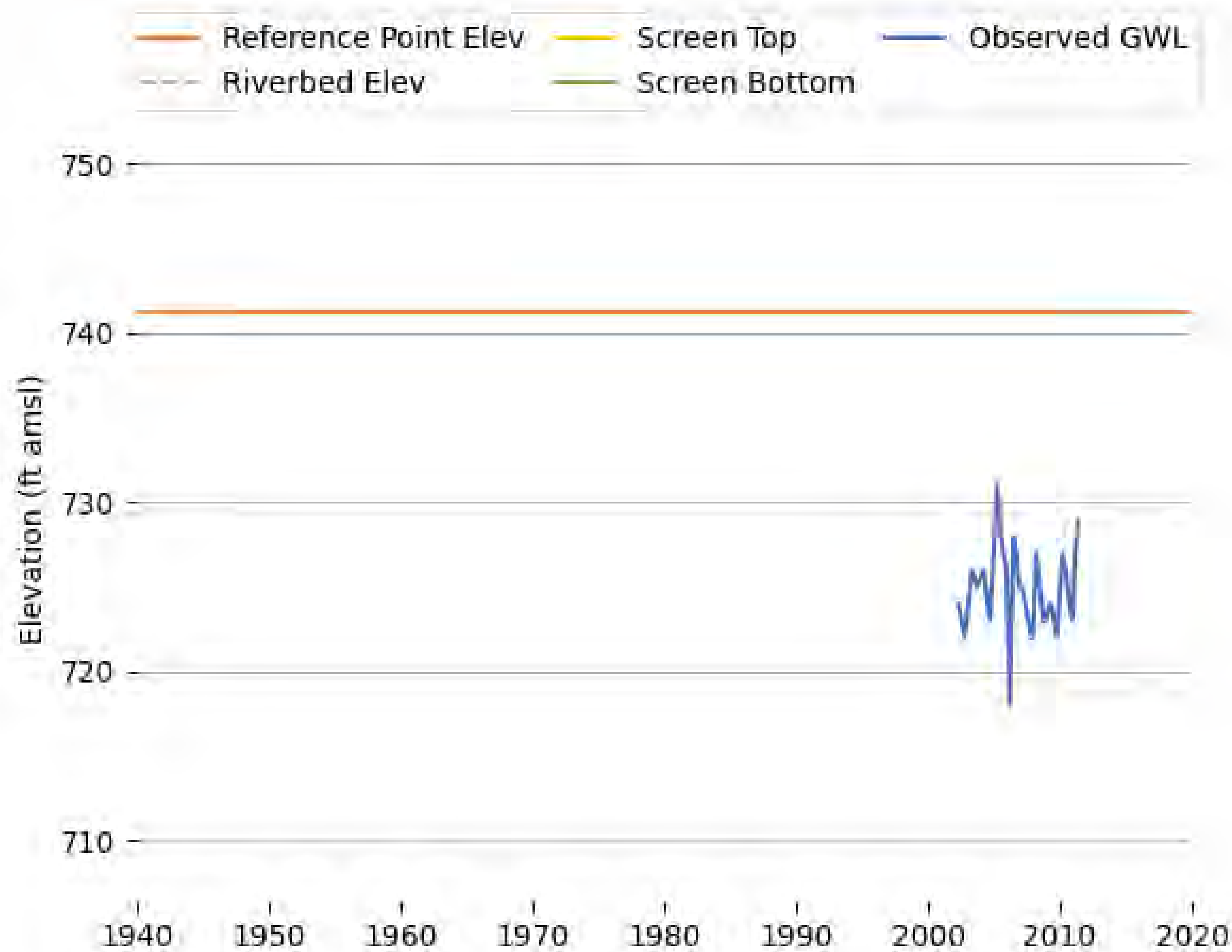


Figure K-52 Observed Groundwater Level (T0611100412_MW-24).

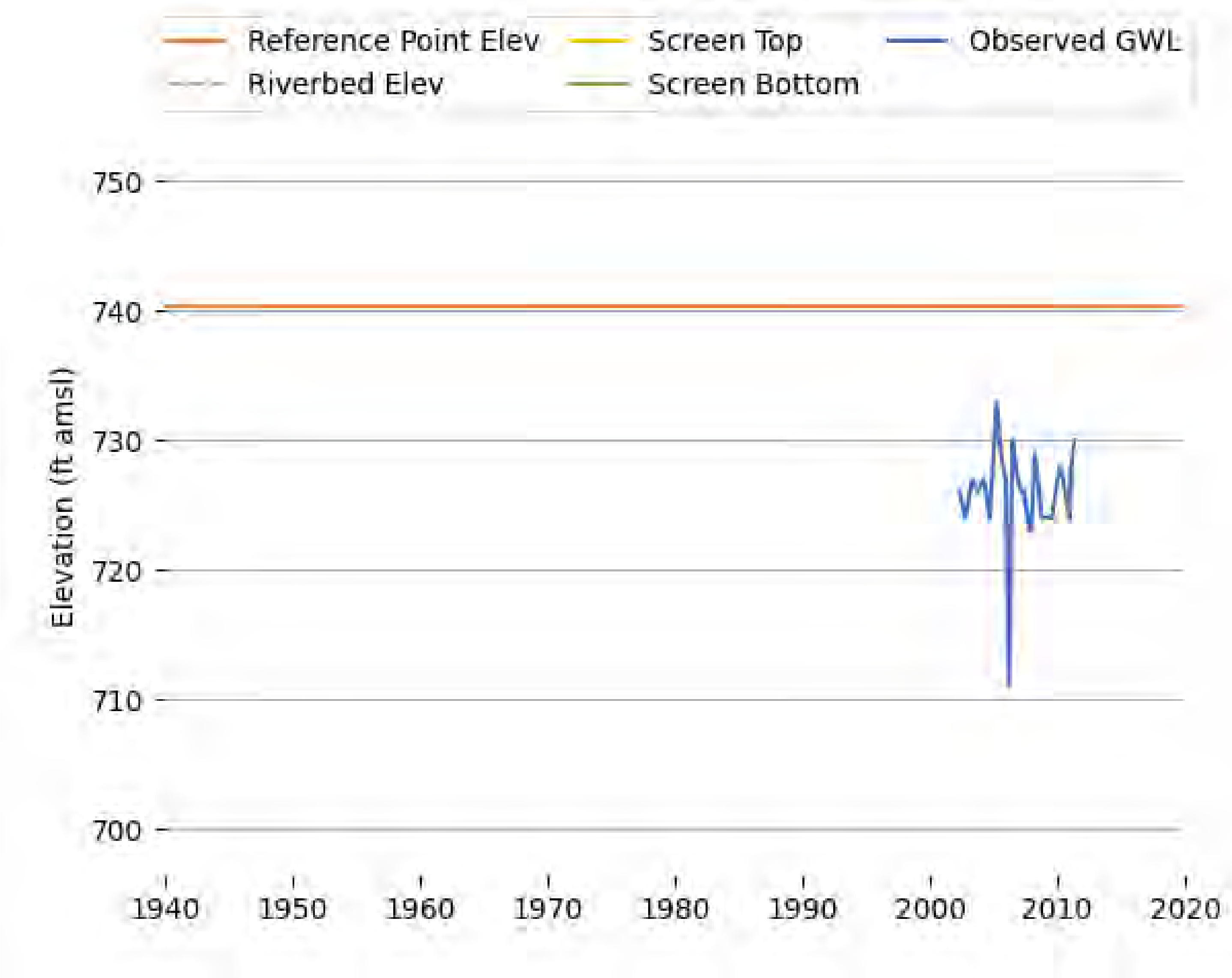


Figure K-53 Observed Groundwater Level (T0611100412_MW-25).

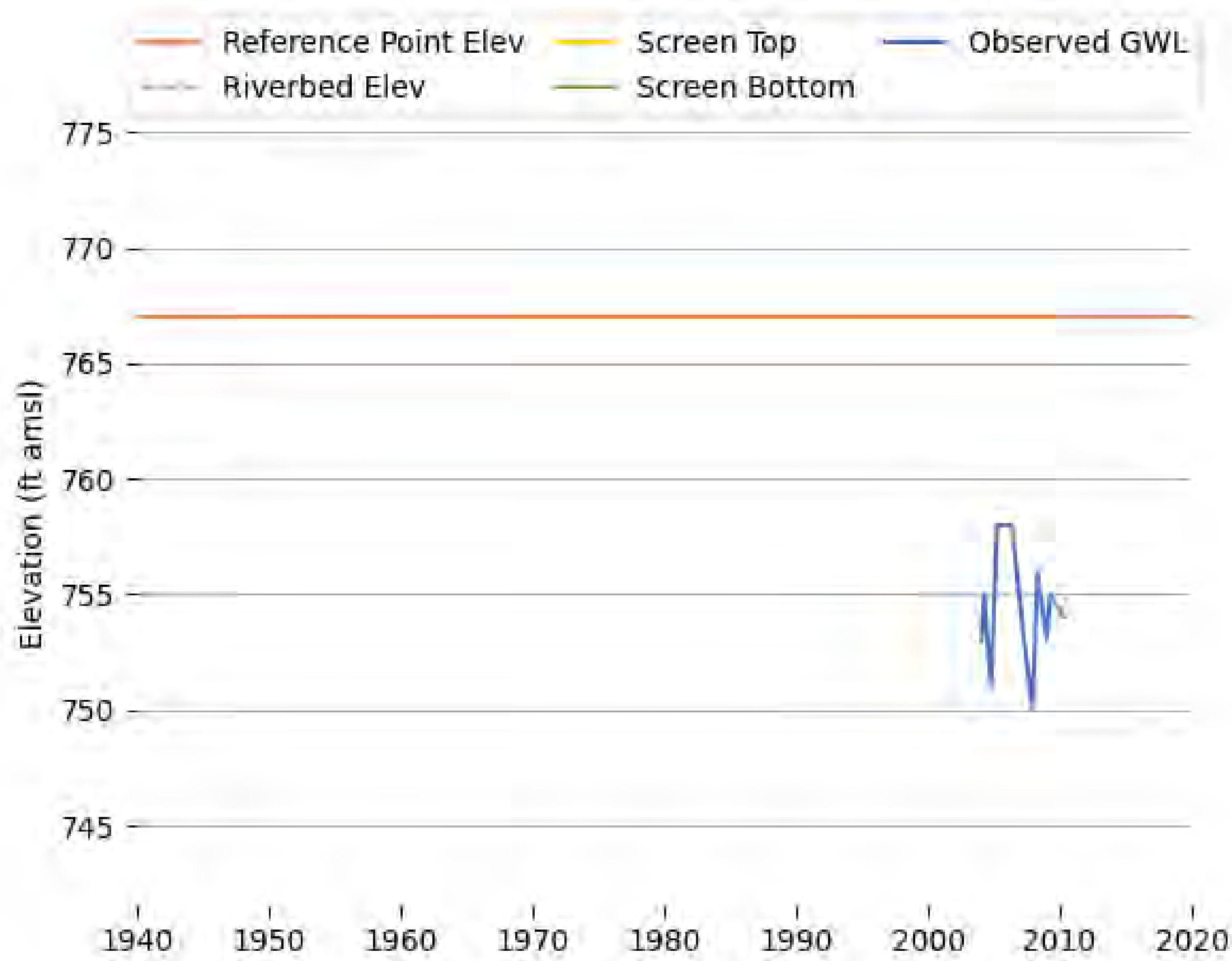


Figure K-54 Observed Groundwater Level (T0611100821_MW-1).

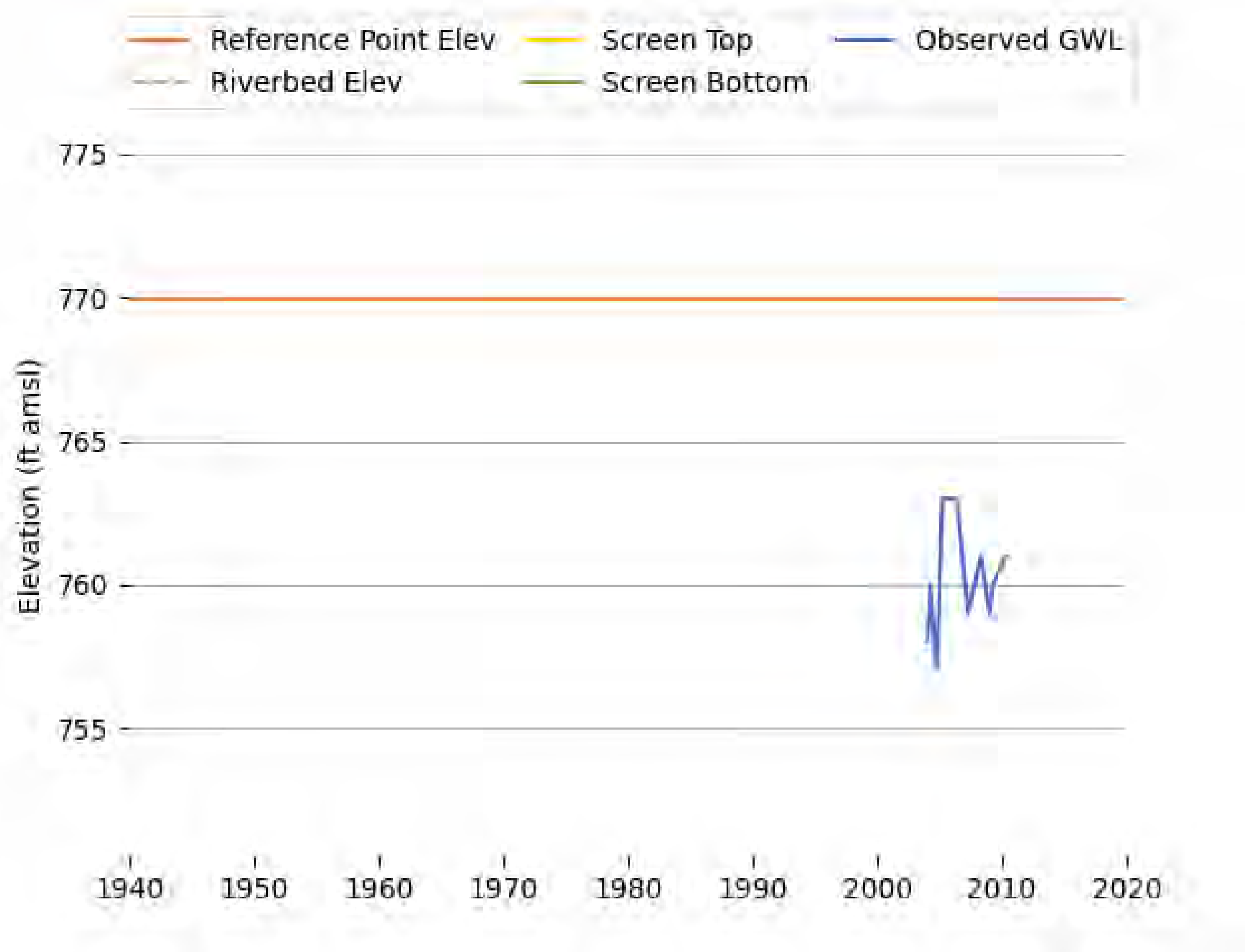


Figure K-55 Observed Groundwater Level (T0611100821_MW-2).

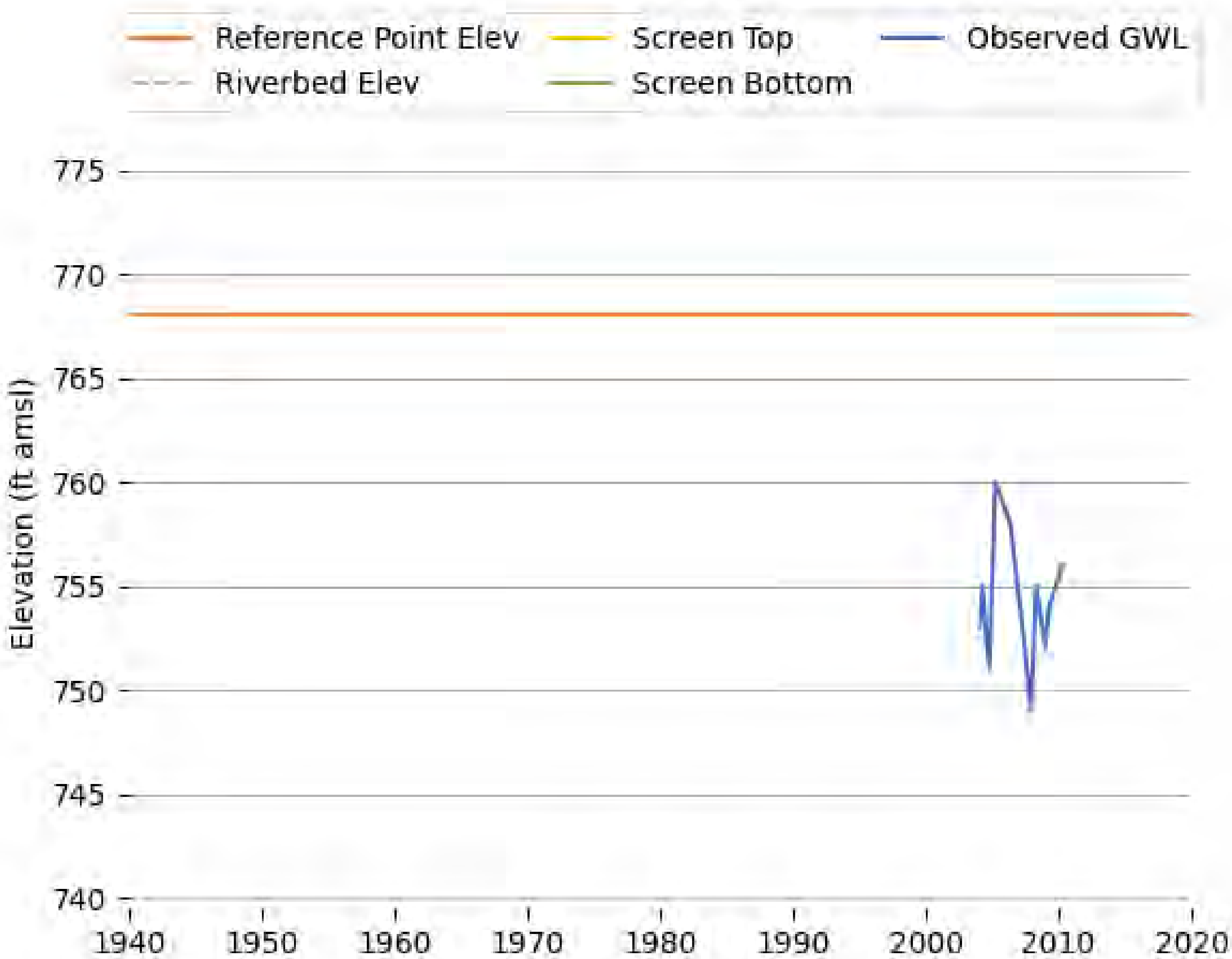


Figure K-56 Observed Groundwater Level (T0611100821_MW-3).

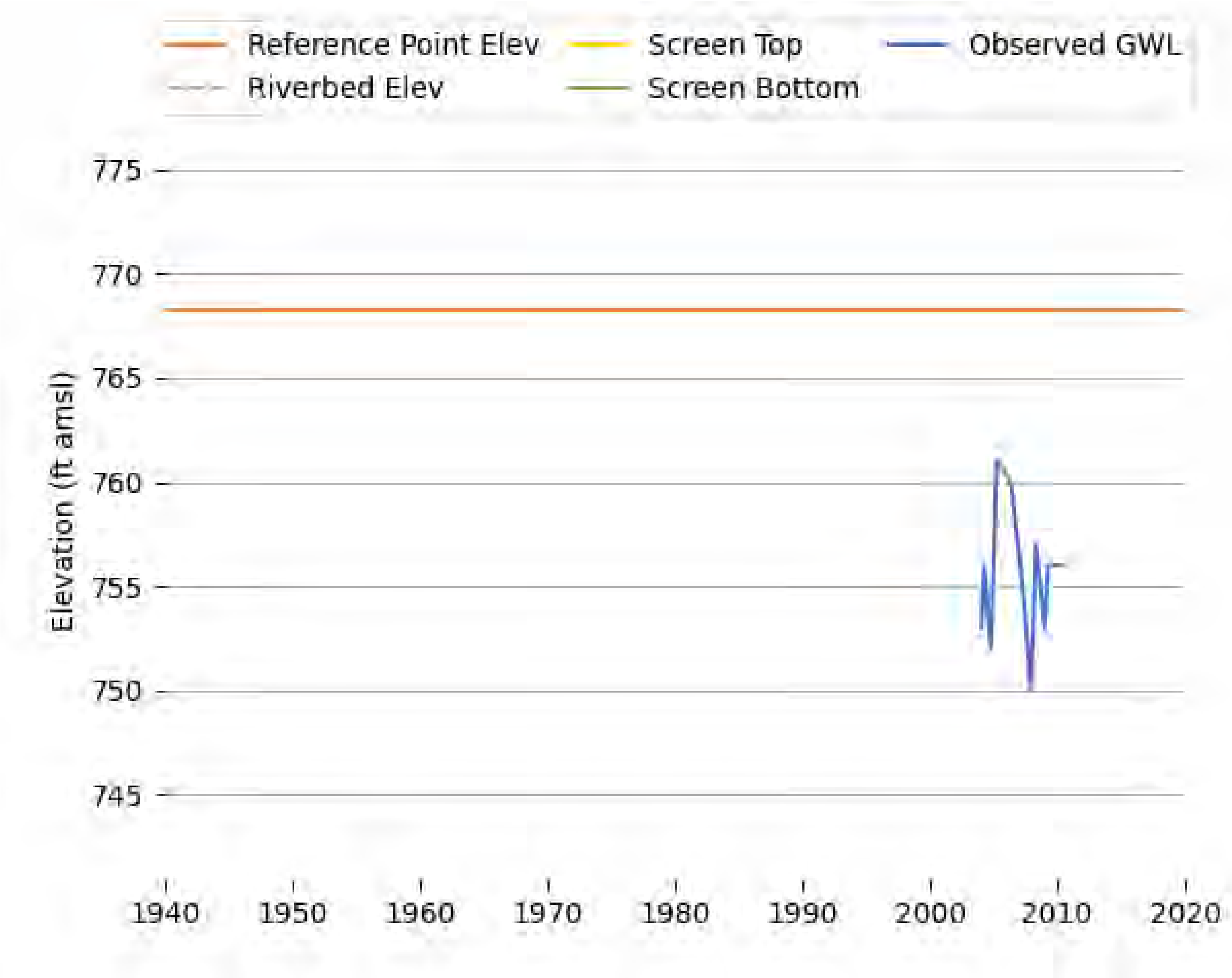


Figure K-57 Observed Groundwater Level (T0611100821_MW-4).

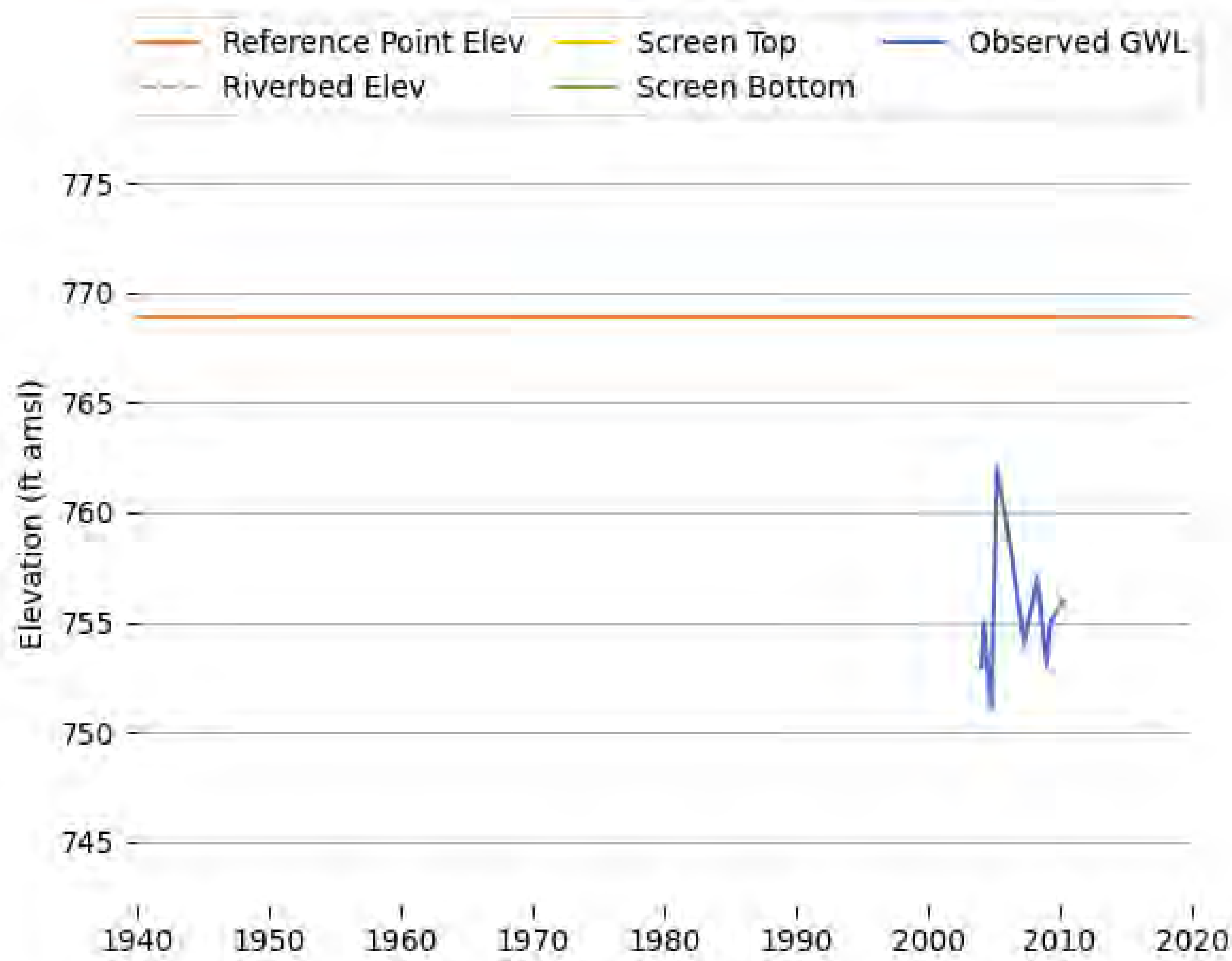


Figure K-58 Observed Groundwater Level (T0611100821_MW-5).

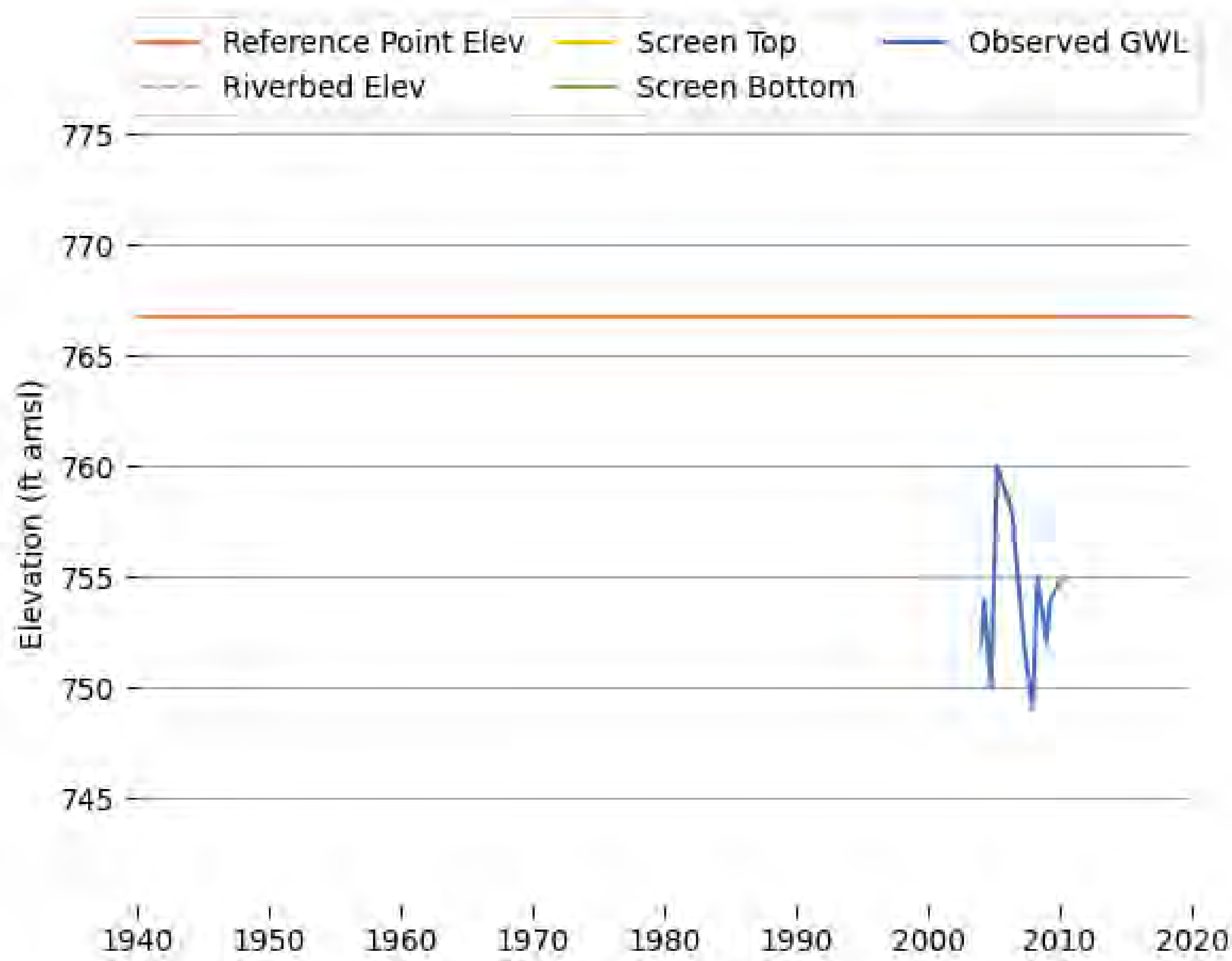


Figure K-59 Observed Groundwater Level (T0611100821_MW-6).

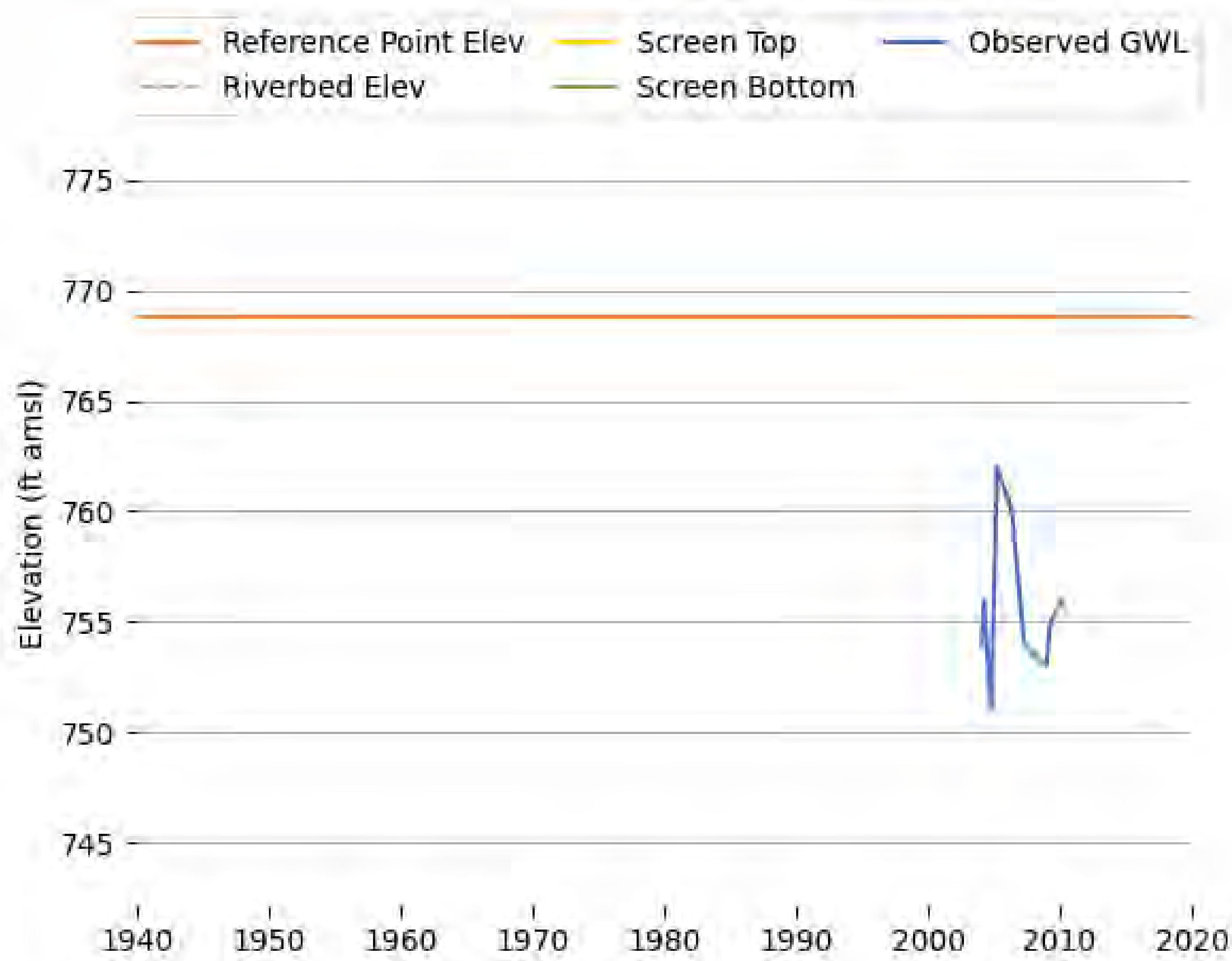


Figure K-60 Observed Groundwater Level (T0611100821_MW-7).

Appendix L

Pumping Impacts on Groundwater Levels

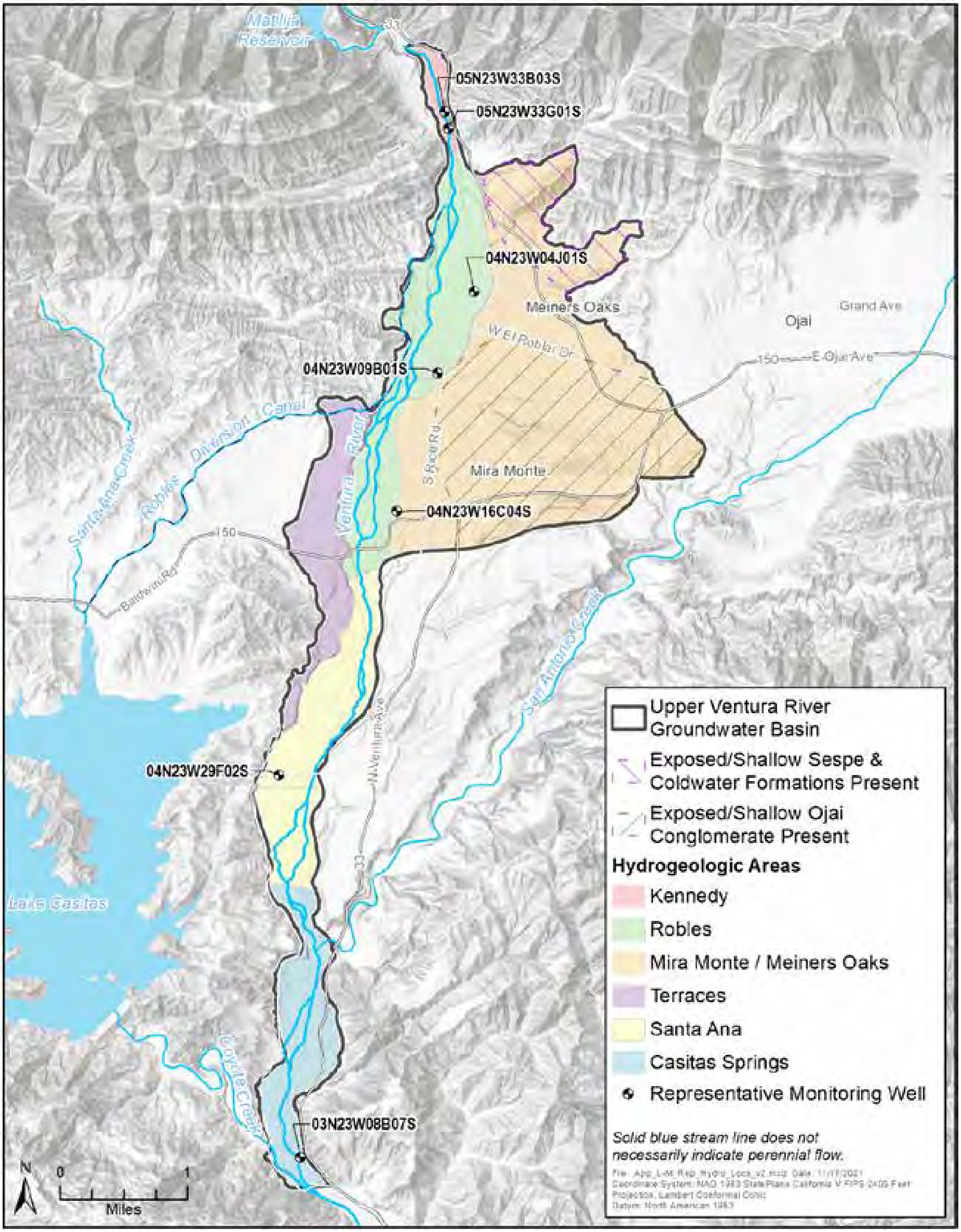
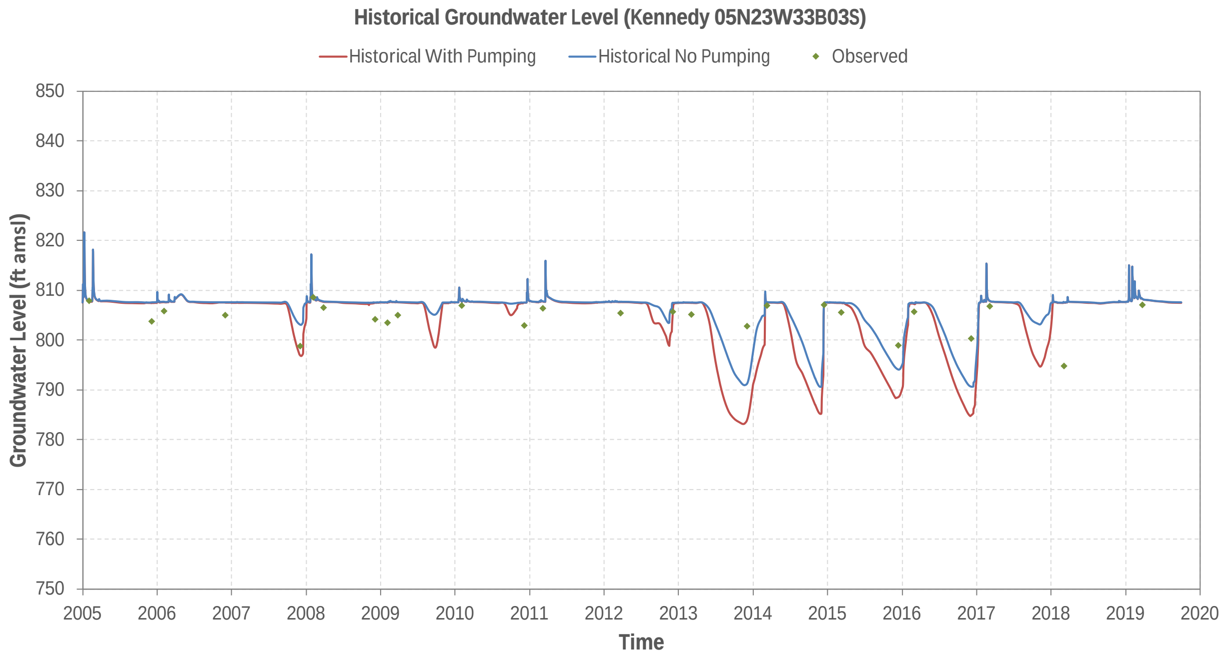


Figure L-01 Representative Monitoring Well Locations for Sustainable Management Criteria.



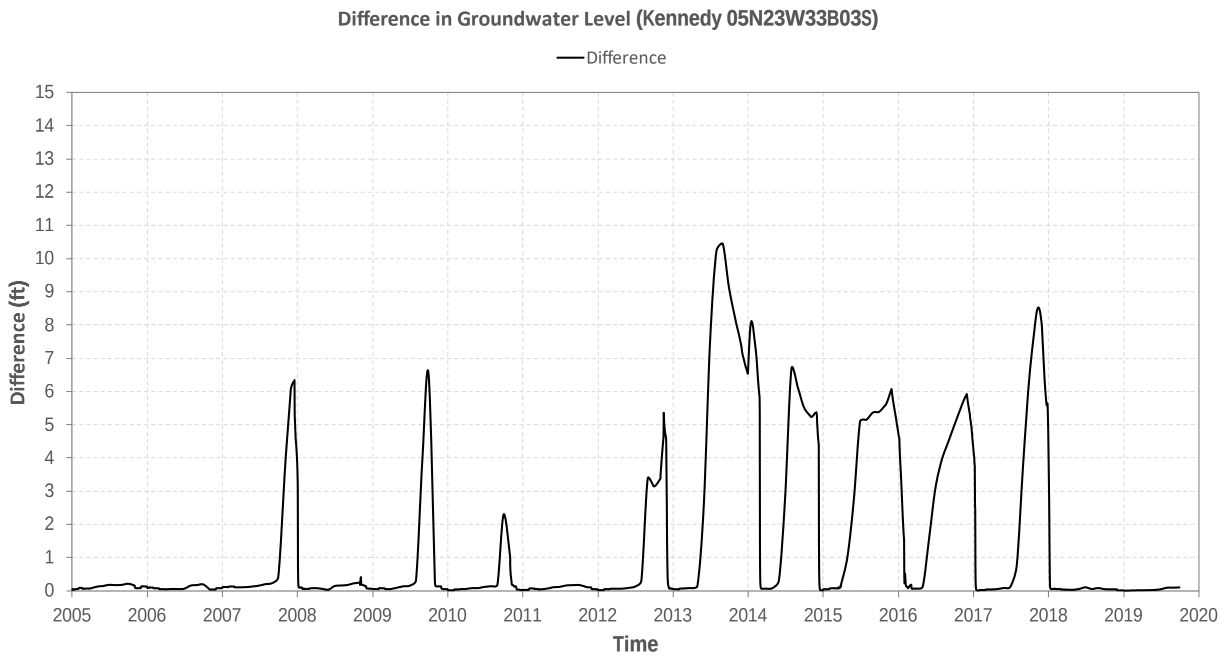
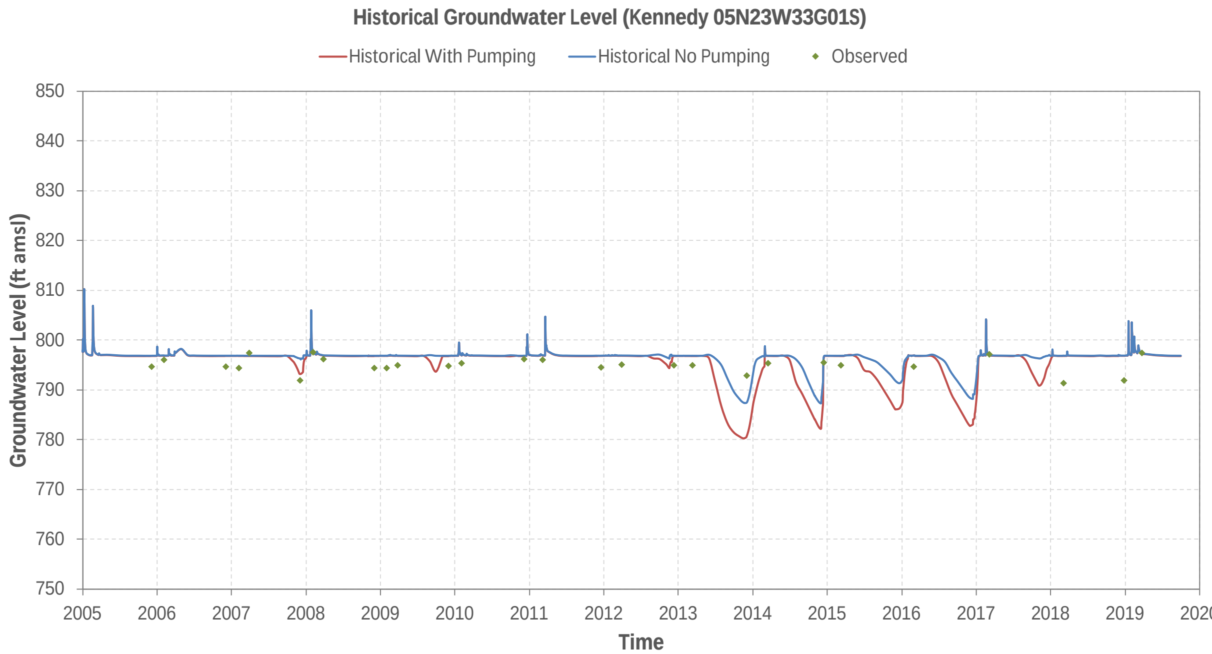


Figure L-02 Historical Groundwater Level With/Without Pumping (Kennedy 05N23W33B03S).



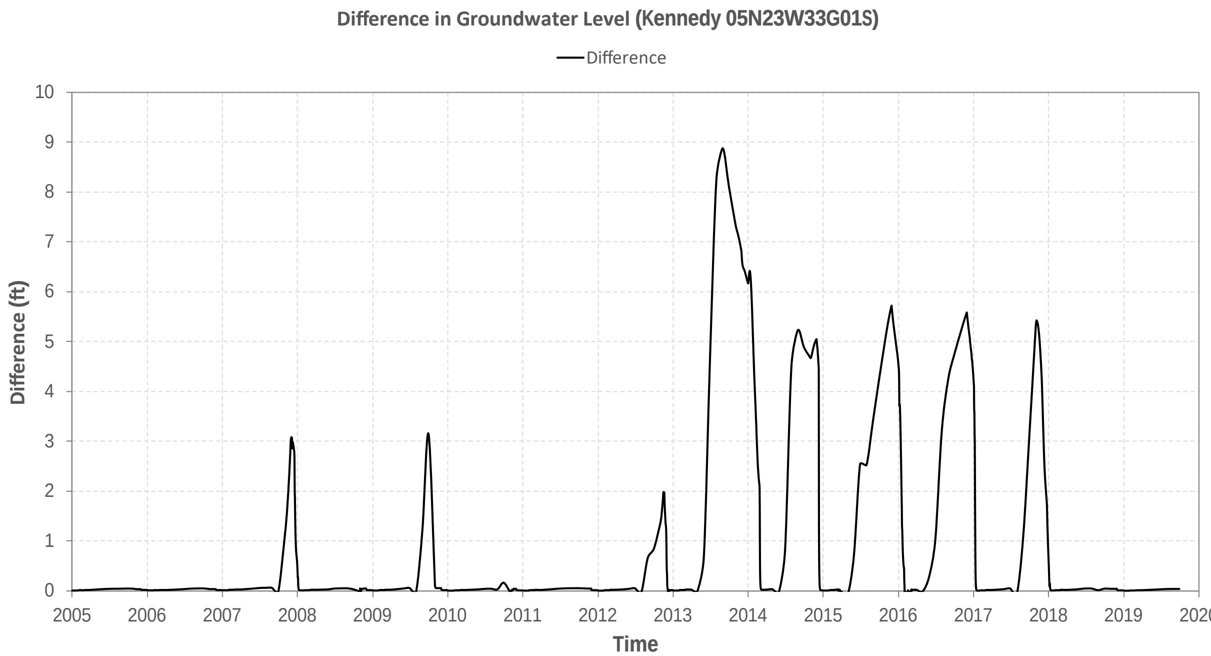
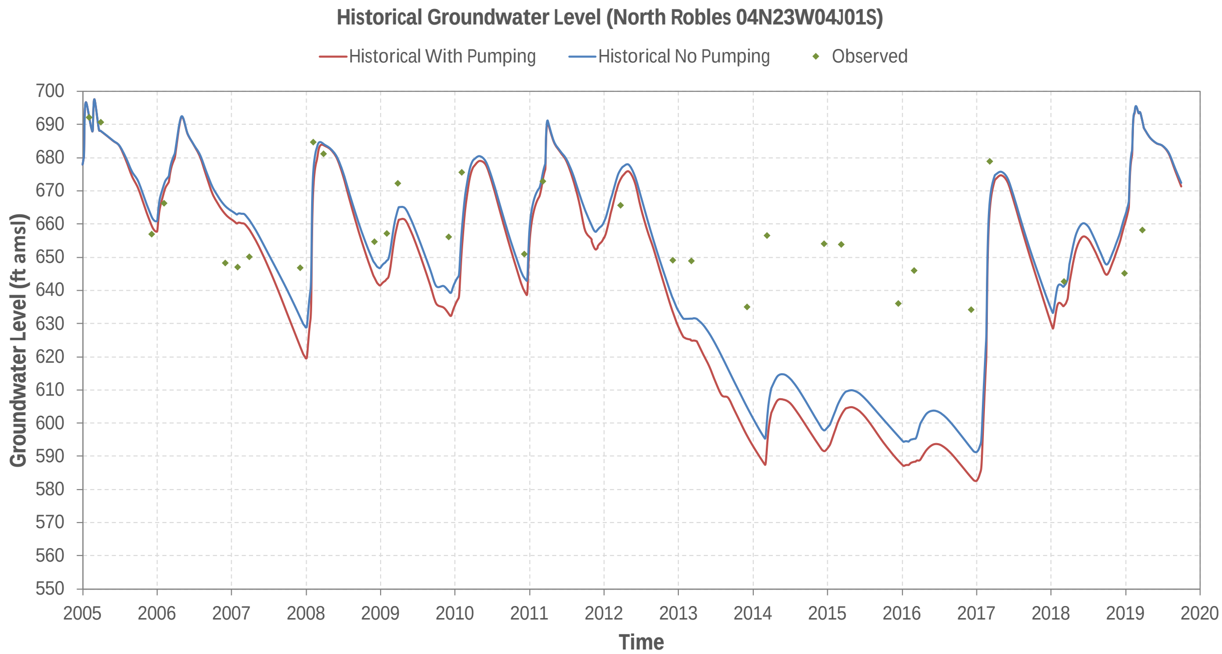


Figure L-03 Historical Groundwater Level With/Without Pumping (Kennedy 05N23W33G01S).



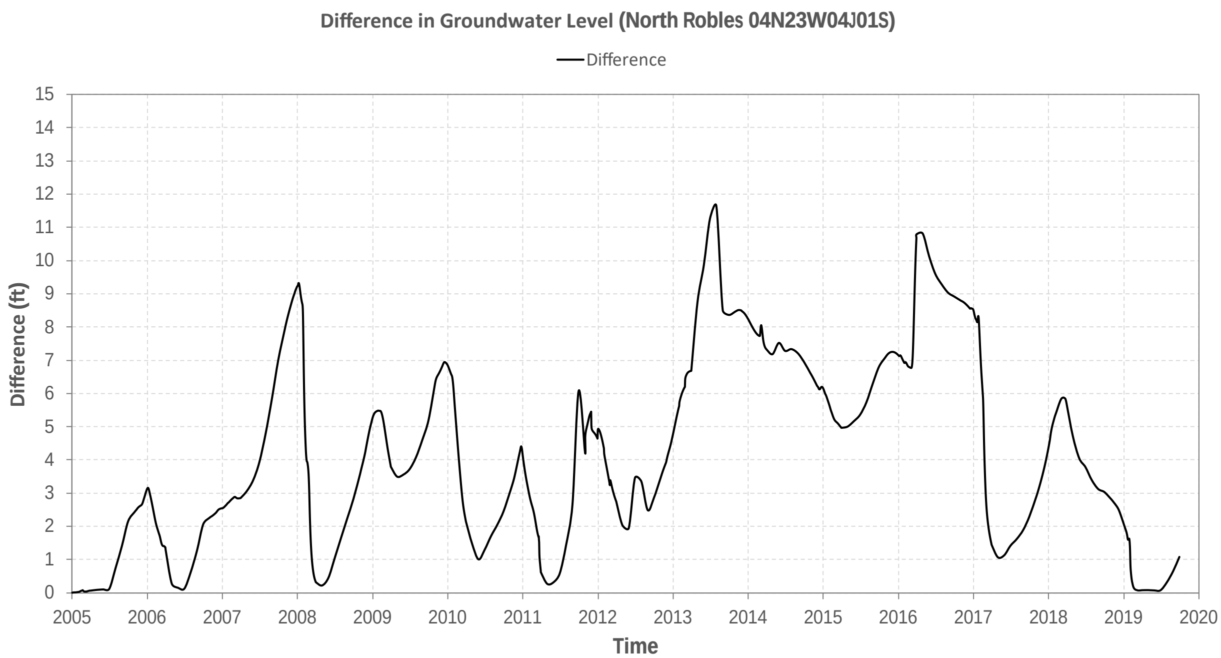


Figure L-04 Historical Groundwater Level With/Without Pumping (North Robles 04N23W04J01S).

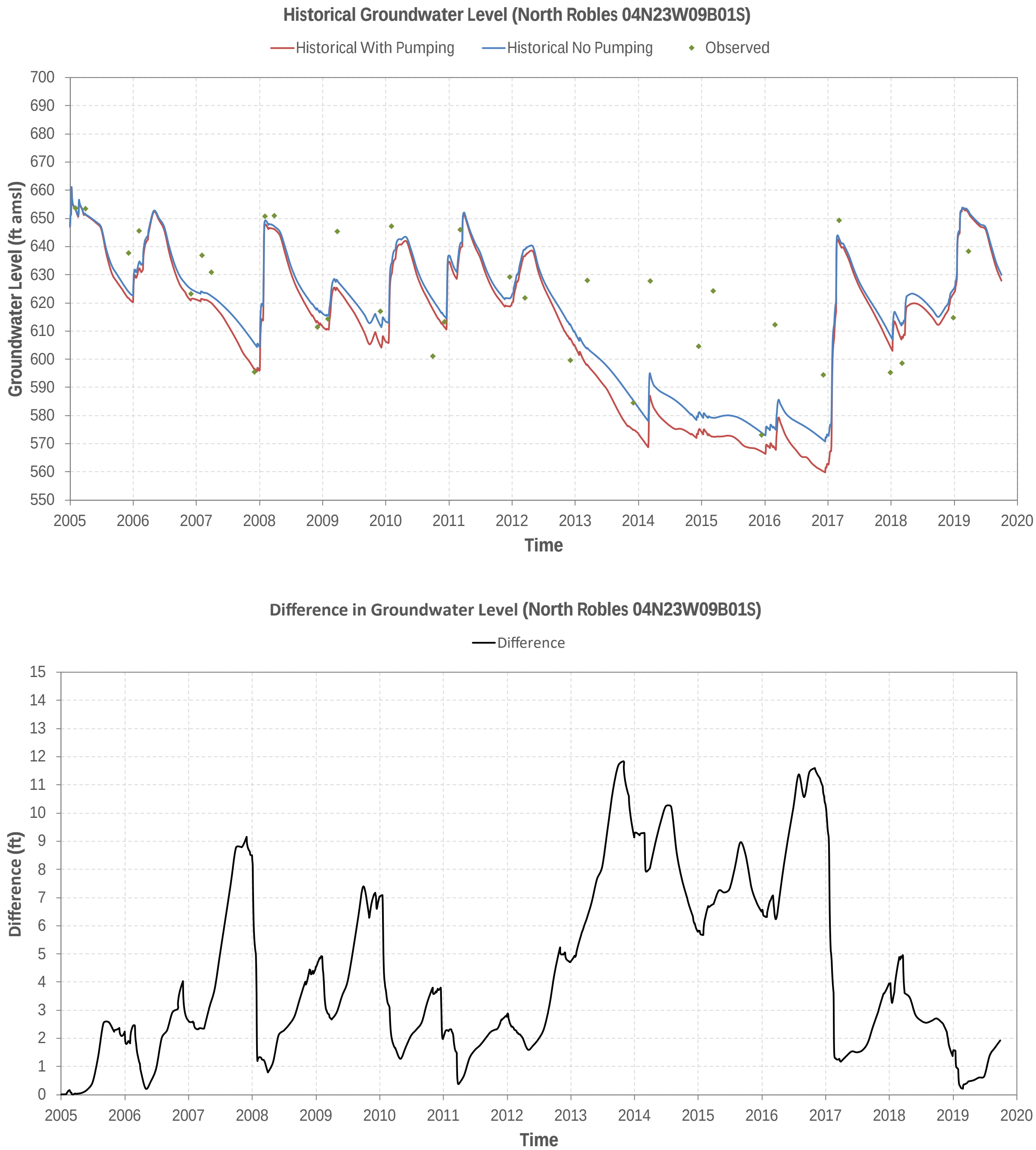
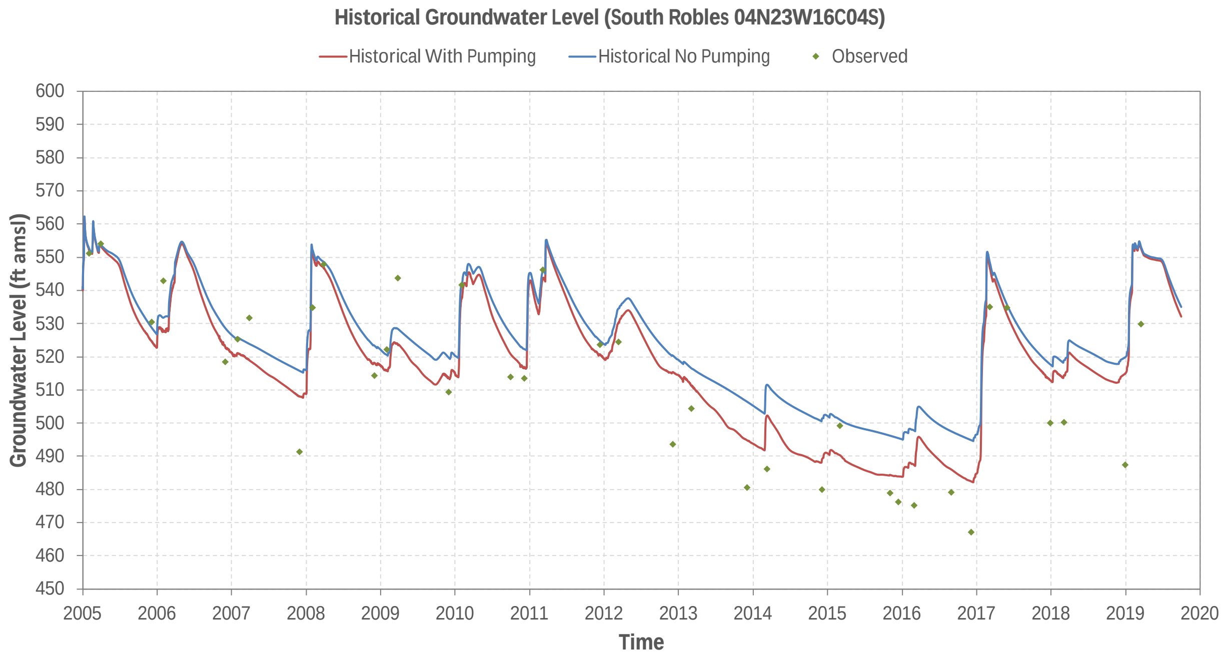


Figure L-05 Historical Groundwater Level With/Without Pumping (North Robles 04N23W09B01S).



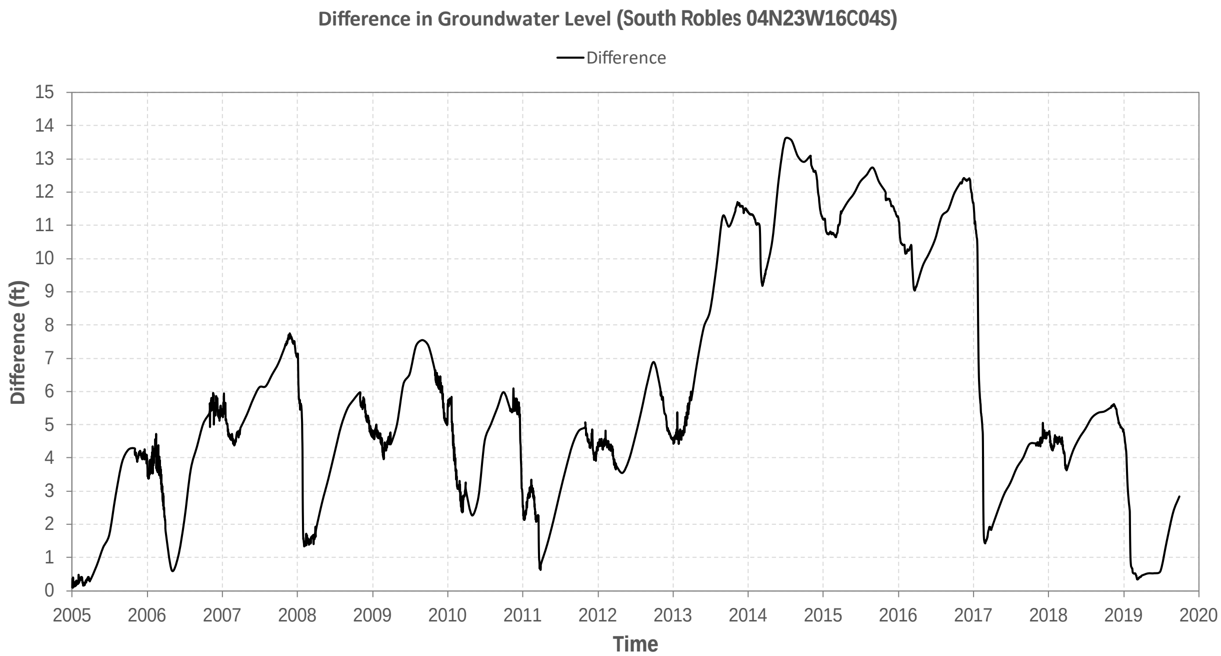
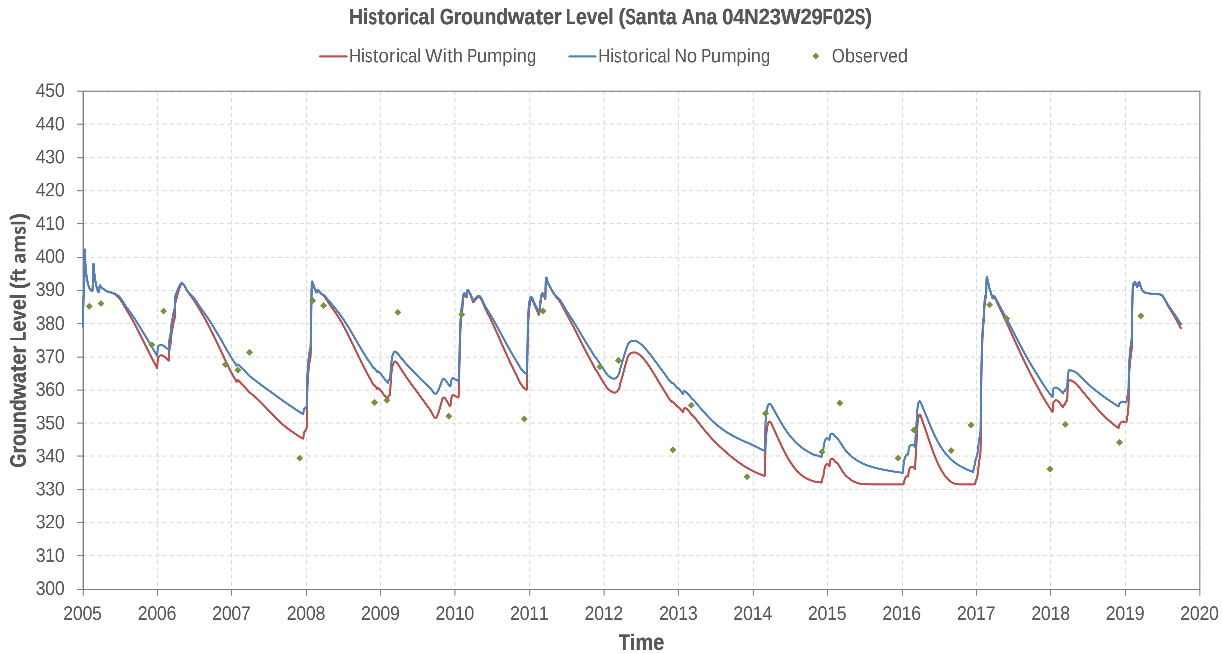


Figure L-06 Historical Groundwater Level With/Without Pumping (South Robles 04N23W16C04S).



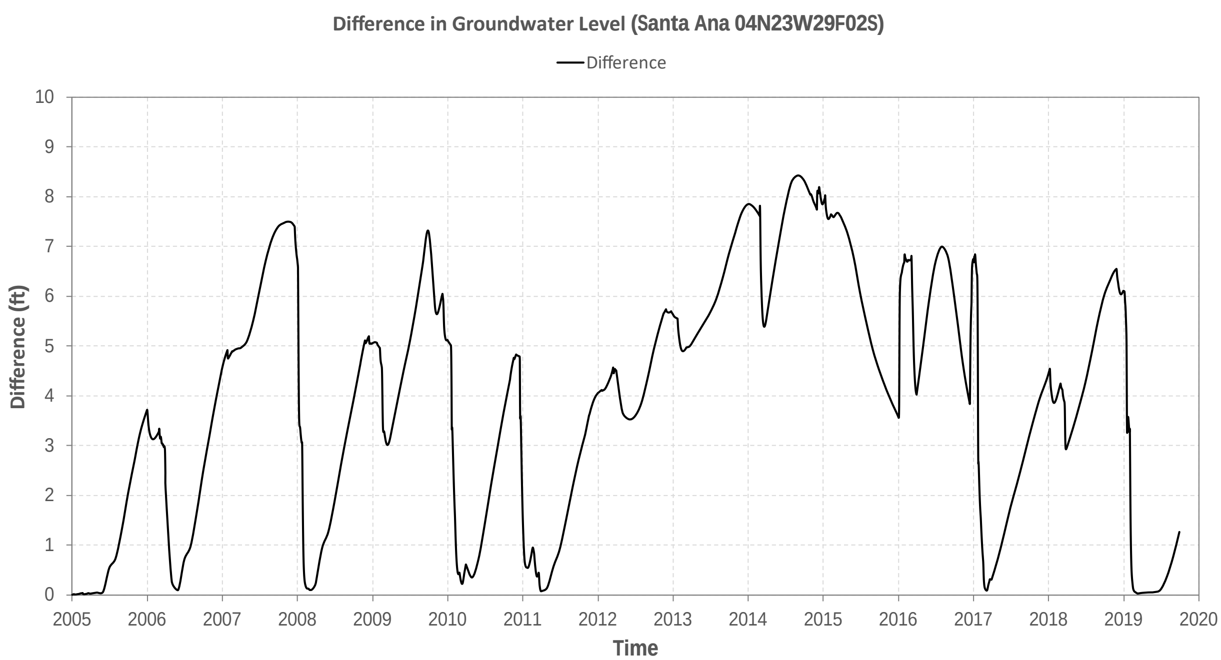
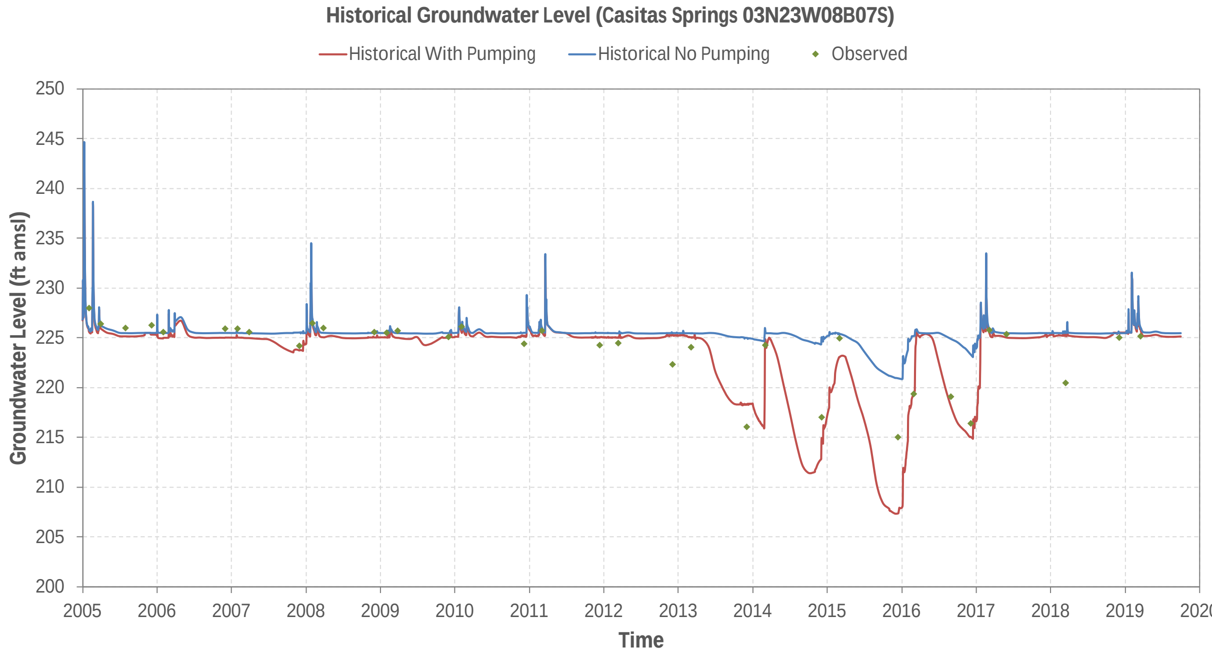


Figure L-07 Historical Groundwater Level With/Without Pumping (Santa Ana 04N23W29F02S).



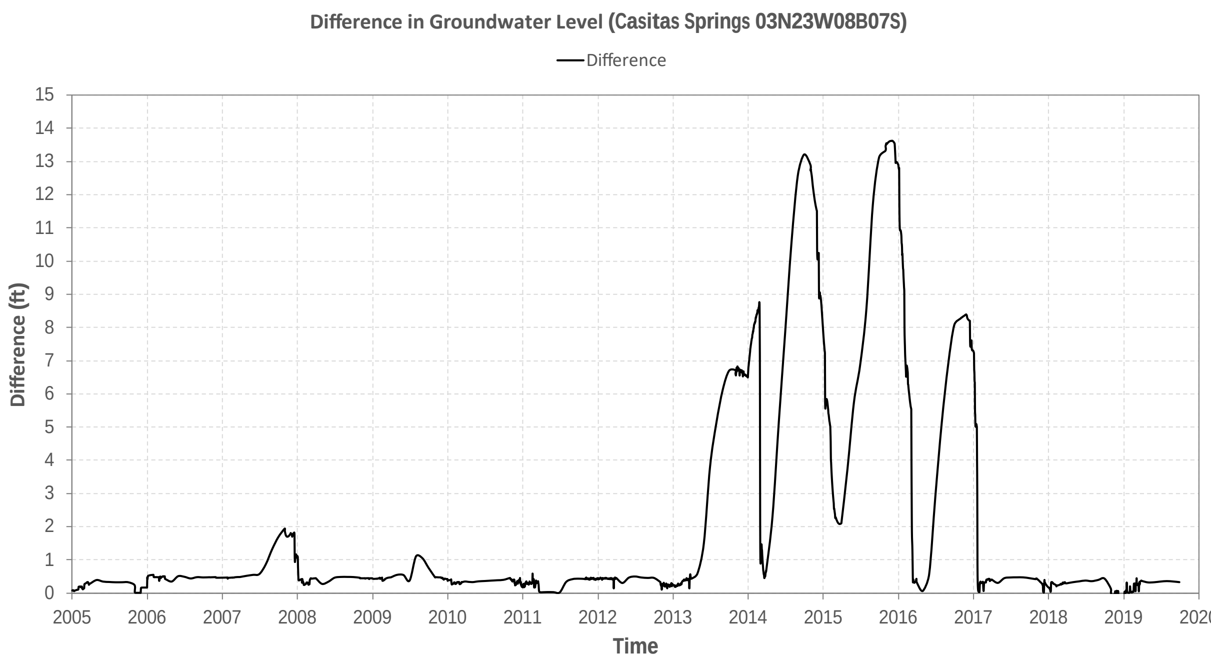


Figure L-08 Historical Groundwater Level With/Without Pumping (Casitas Springs 03N23W08B07S).

Appendix M

Storage Curve Approach to Estimating Annual Change in Storage

Appendix M
Development of a "Storage Curve" to Estimate Groundwater Storage in the Upper Ventura River Groundwater Basin Using Groundwater Level Data

Introduction/Background

This appendix provides data and methodology used to develop a relationship between the historical groundwater levels measured in the principal aquifer of Upper Ventura Groundwater Basin (UVRGB) and corresponding modeled groundwater storage. This relationship will be used to calculate the annual storage changes in UVRGB for the purpose of annual reporting required under the Sustainable Groundwater Management Act (SGMA) during years between future model updates (currently anticipated to occur approximately every 5 years).

This appendix presents an analysis of groundwater levels with modeled basin groundwater storage, to help understand the range of the relationship between groundwater storage and average basin water levels.

Data Sources and Review

Groundwater elevation data available in the UVRGB data management system were reviewed and selected for this analysis based on the following characteristics:

- Wells with a lengthy period of record (at least 15 years) of groundwater elevation measurements.

The monitoring wells 05N23W33B03S, 05N23W33G01S, 04N23W16C04S, and 03N23W08B07S as well as the private agricultural supply well, 04N23W09B01S, the private De Minimus well, 04N23W29F02S, and the M&I supply well owned by Meiners Oaks Water District, 04N23W04J01S, currently fit the criteria best. Locations of these wells are shown on Figure M-1. The arithmetic mean (average) of the groundwater elevations was calculated from the six selected wells. Averages were calculated whenever all wells had a sample within 4 days of each other as commonly water level monitoring surveys were performed over multiple consecutive days. The median date of sampling within each separate survey was chosen to represent the date for that average water level.

Groundwater storage in UVRGB were estimated using the groundwater flow model, as described in UVRGA GSP Section 3.3 (water-budget analysis) of the UVRGB GSP. An initial modeled storage was calculated using the initial groundwater levels and storage parameters for the model. MODFLOW-reported change-in-storage was then used to calculate storage for every model time-step. The representative date for each average water level was used to select the modeled groundwater storage. For dates that fell in the months of April through October, average monthly storage was used as the model simulates these months only at a monthly time-step.

Correlation Results and Development of Storage Curve

A scatterplot of annual spring-high groundwater elevation versus groundwater in storage in UVRGB (from spring of the previous year to spring of the selected year) is shown on Figure M-2. The best-fit linear regression calculated for this relationship is:

Storage (acre-feet) = 575 (acre-feet/foot) x Average groundwater elevation (feet) – 309,032 (acre-feet)

The coefficient of determination (R^2) for this relationship is 0.76. The y-intercept of this relationship is approximately 537 ft which means that at an elevation of 537 ft, there is no groundwater storage in the basin. This is the approximate elevation of the bedrock in the area.

Groundwater storage in UVRGB can be approximated using this relationship and groundwater elevation data collected from wells 05N23W33B03S, 05N23W33G01S, 04N23W04J01S, 04N23W09B01S, 04N23W16C04S, 04N23W29F02S, and 03N23W08B07S. The storage-curve will be reviewed and potentially modified whenever the numerical model is updated.

Groundwater storage change between any two water level conditions may be calculated by looking up the corresponding basin storage for the given water level condition and taking the difference between the two (Figure L2).

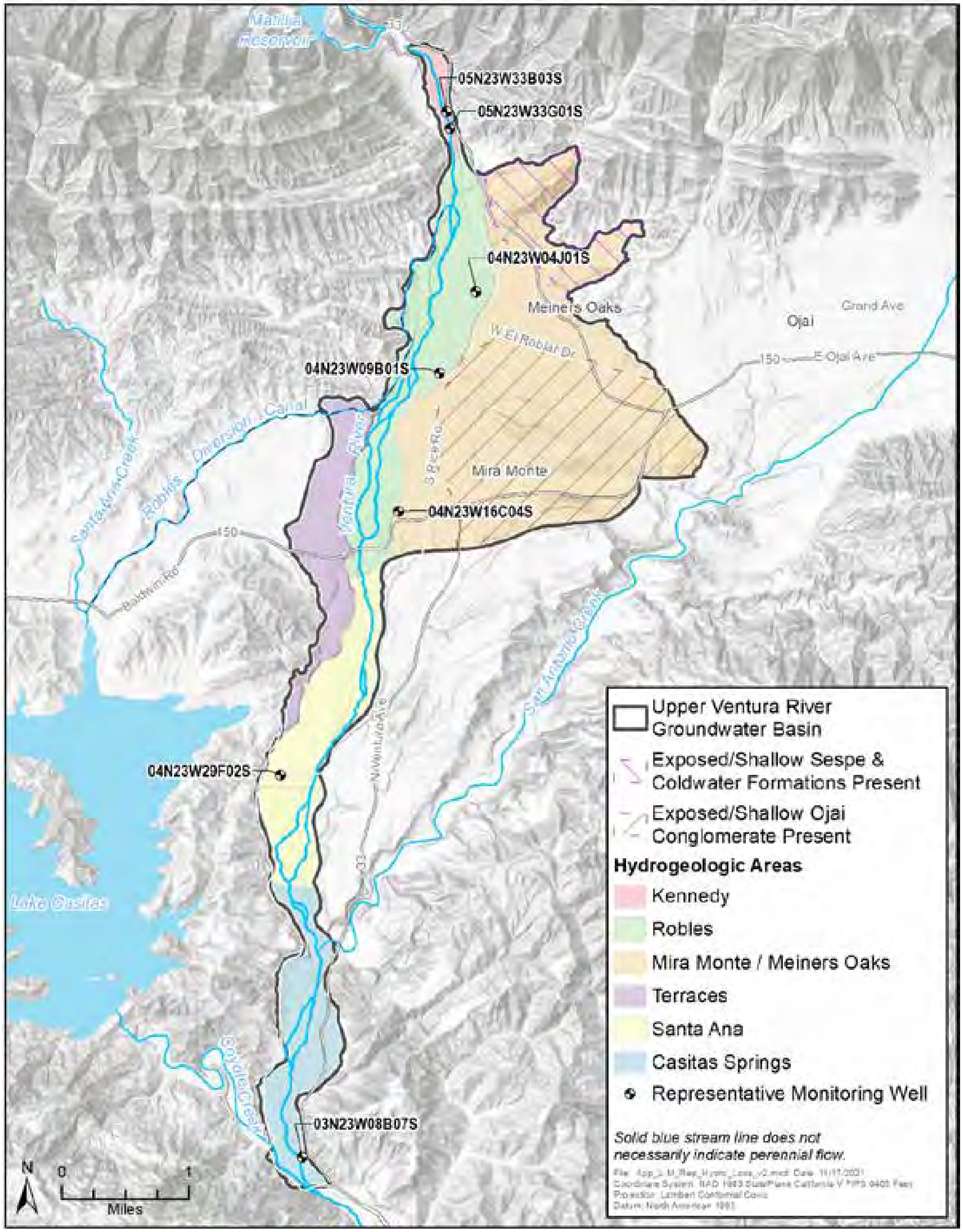


Figure M-01: Representative Groundwater Level Monitoring Wells.

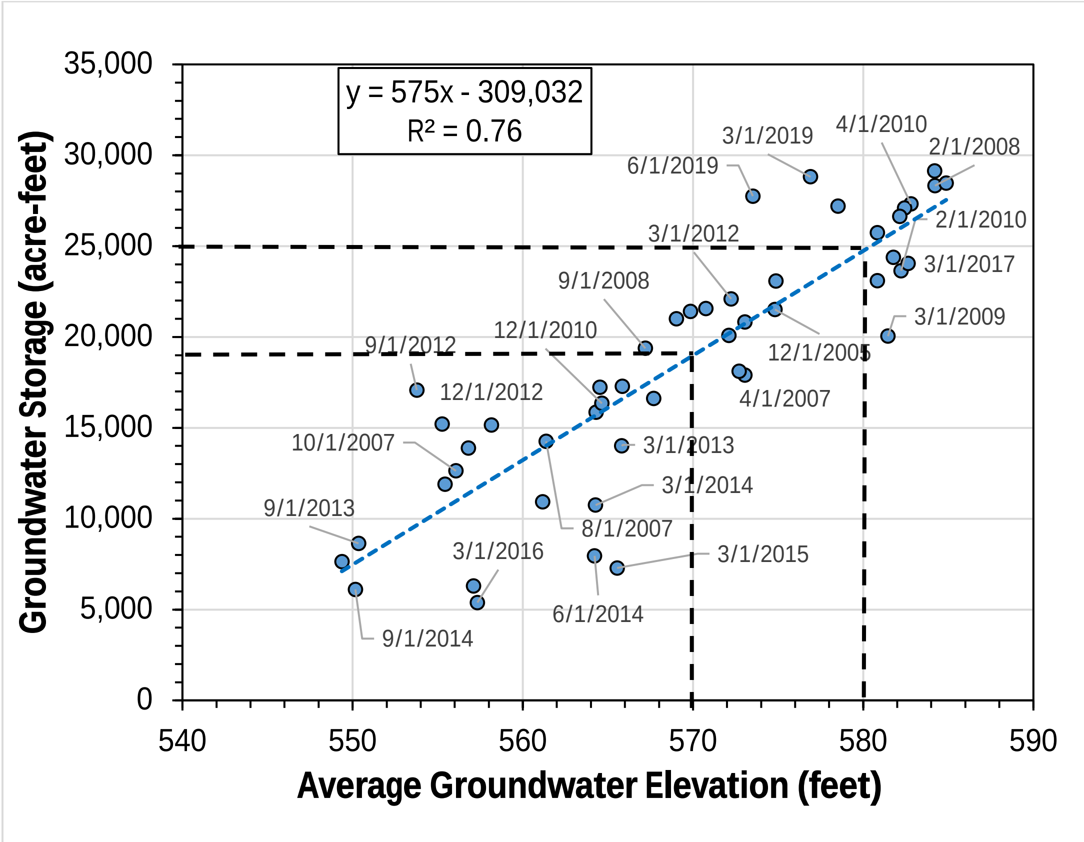


Figure M-02: Correlation Between Average Groundwater Elevations and Storage in the UVRGB

Appendix N

Pumping Impacts on Streamflow Depletions

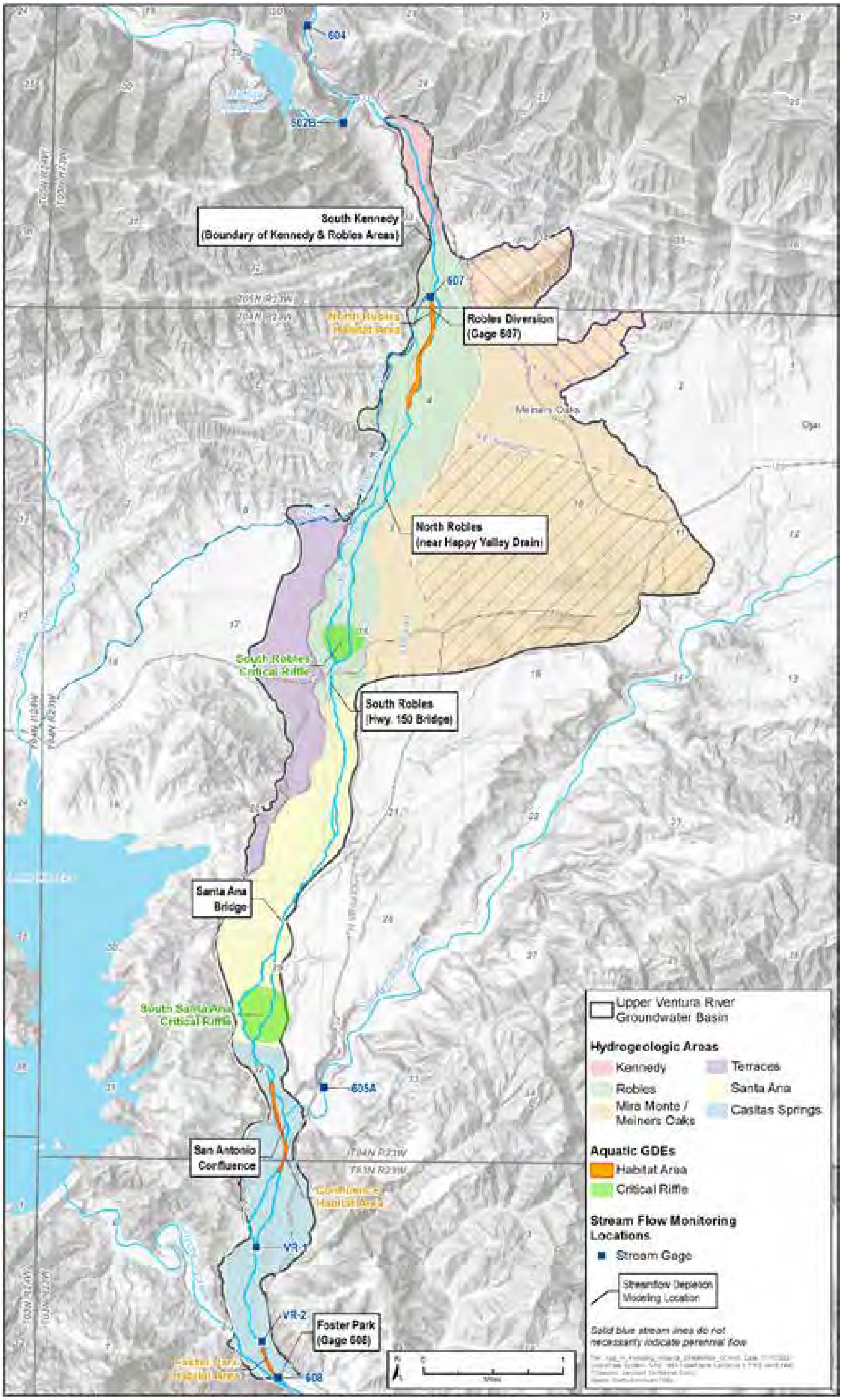
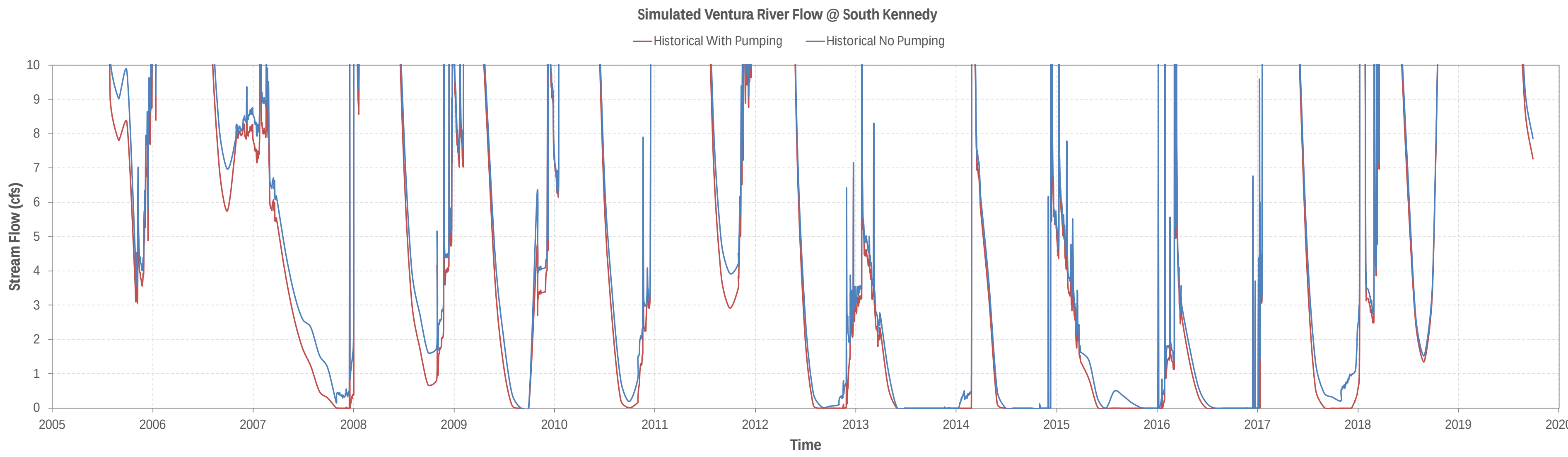
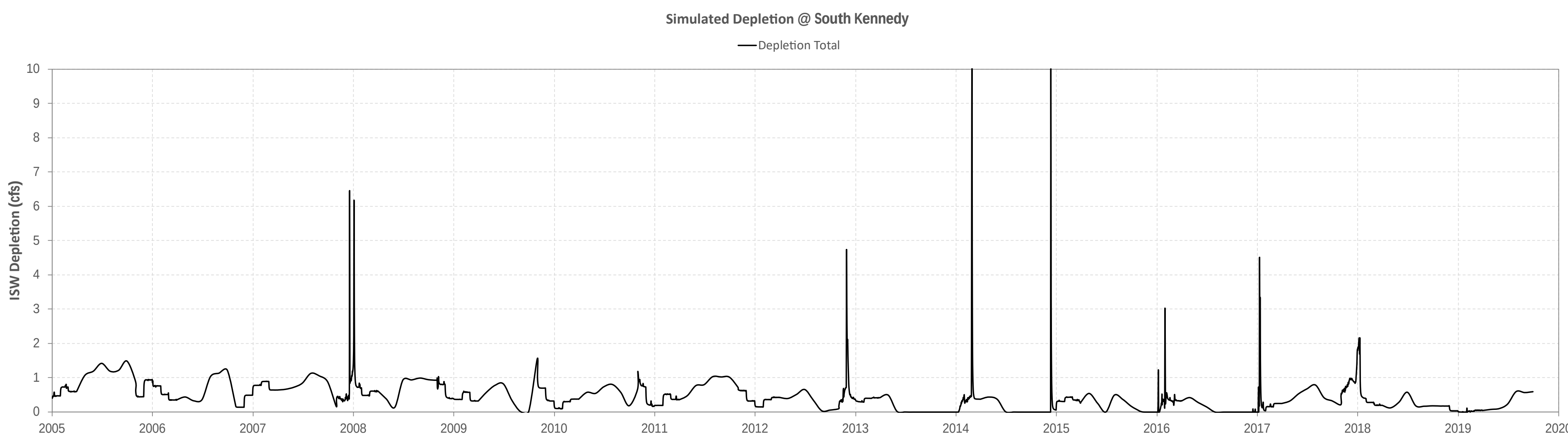


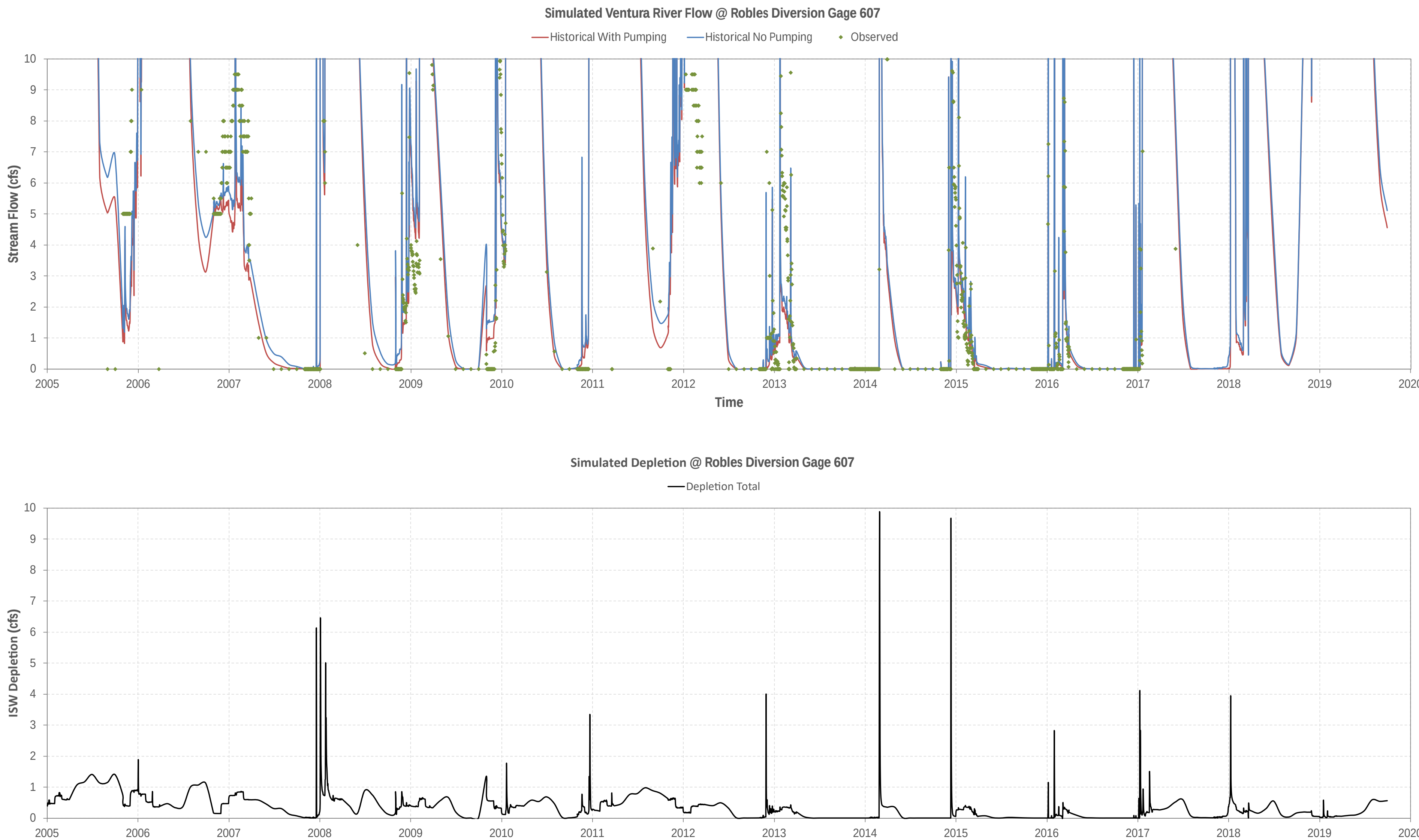
Figure N-01 Areas evaluated for streamflow depletion in the Upper Ventura River Groundwater Basin.





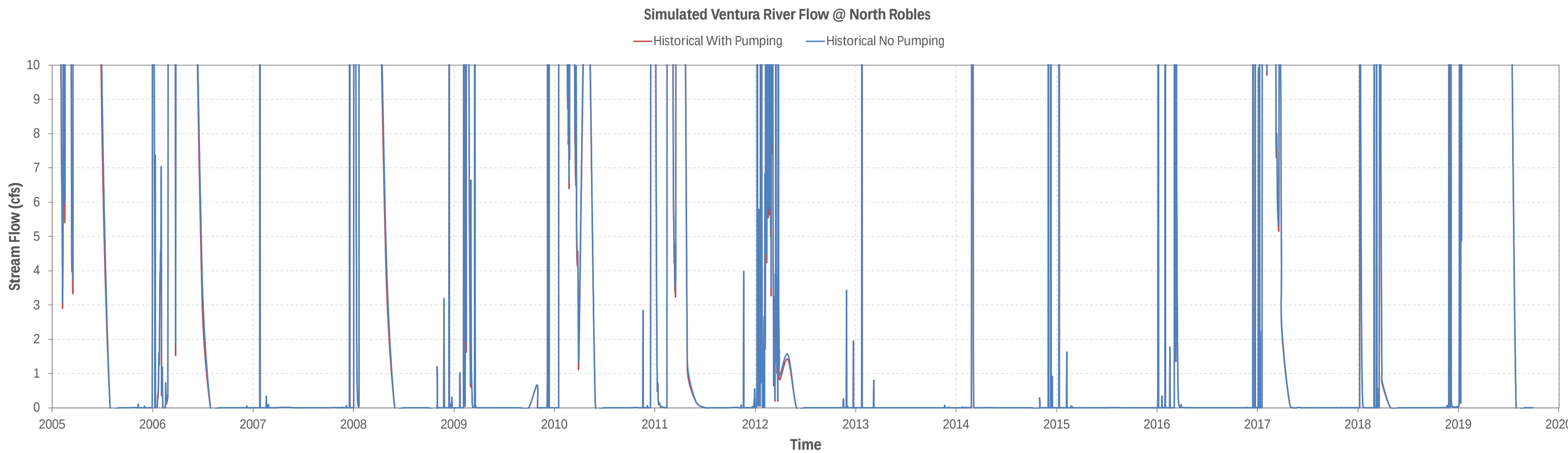
The term depletion refers to the direct or indirect reduction of stream flow resulting from groundwater extraction. Please see Section 3.2.6 for further description of direct versus indirect reductions (depletions) of surface water.

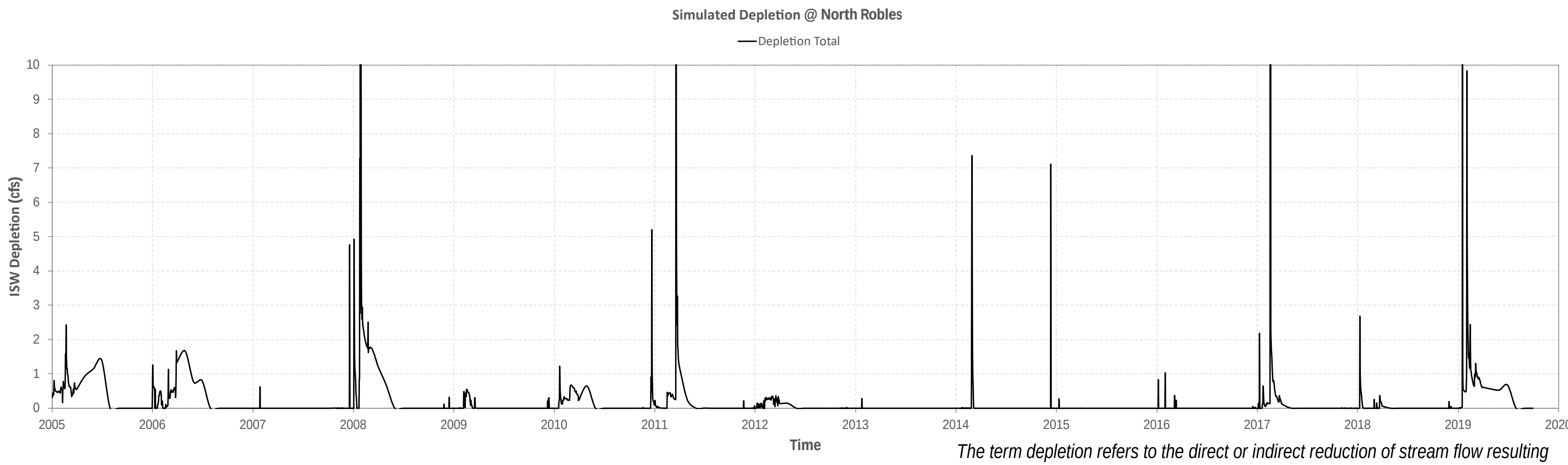
Figure N-02 Streamflow Depletion (South Kennedy).



The term depletion refers to the direct or indirect reduction of stream flow resulting from groundwater extraction. Please see Section 3.2.6 for further description of direct versus indirect reductions (depletions) of surface water.

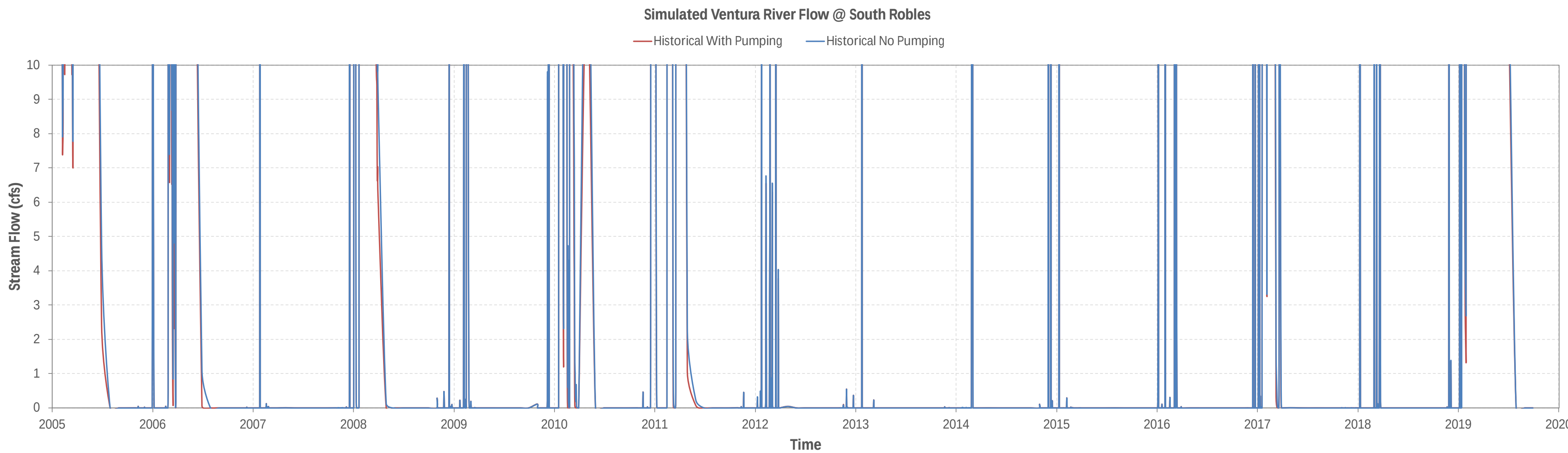
Figure N-03 Streamflow Depletion (Robles Diversion Gage 607).

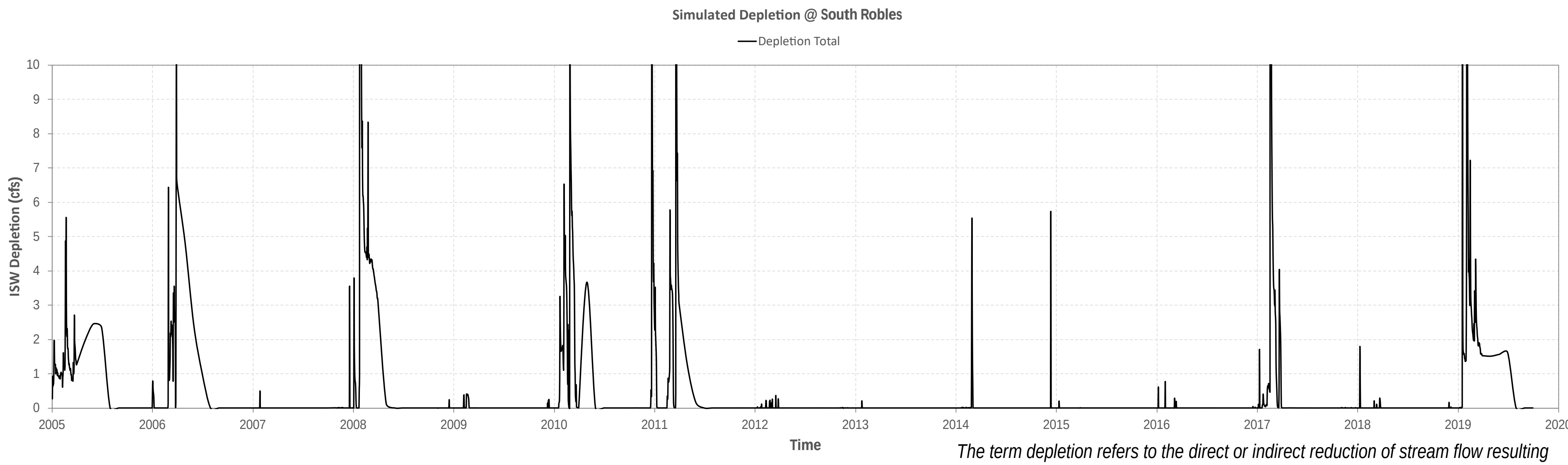




The term depletion refers to the direct or indirect reduction of stream flow resulting from groundwater extraction. Please see Section 3.2.6 for further description of direct versus indirect reductions (depletions) of surface water.

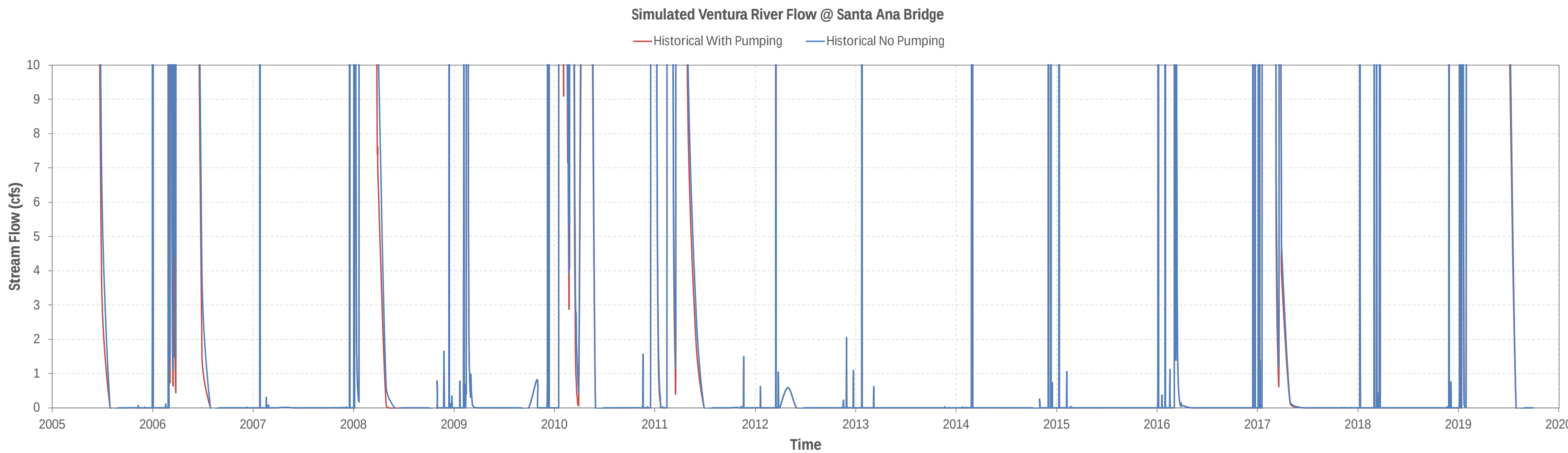
Figure N-04 Streamflow Depletion (North Robles).

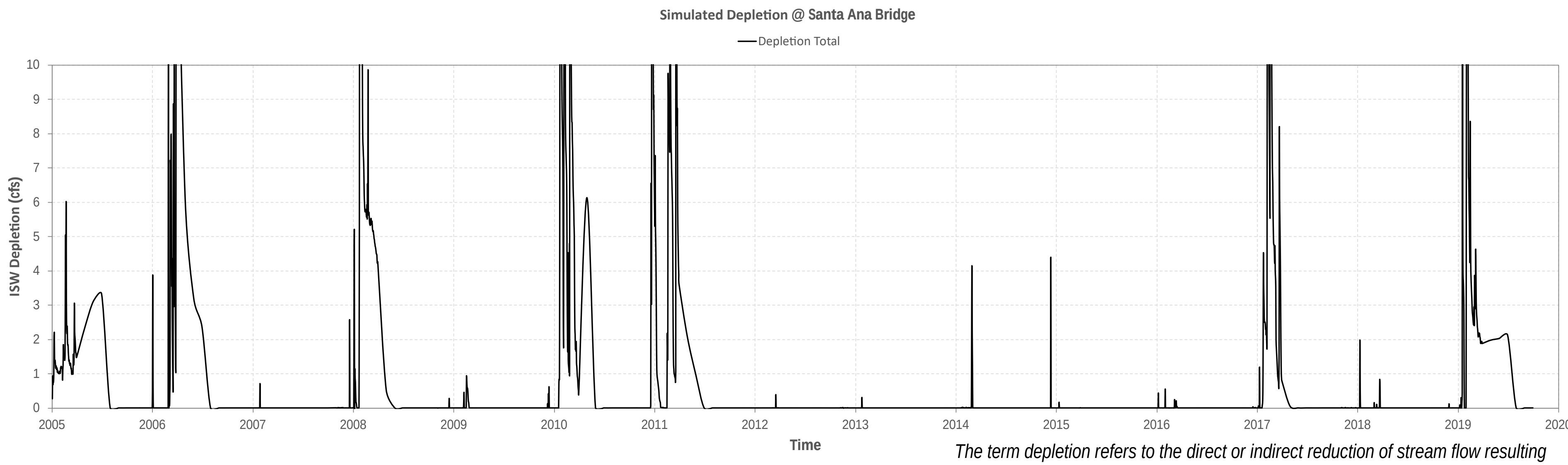




The term depletion refers to the direct or indirect reduction of stream flow resulting from groundwater extraction. Please see Section 3.2.6 for further description of direct versus indirect reductions (depletions) of surface water.

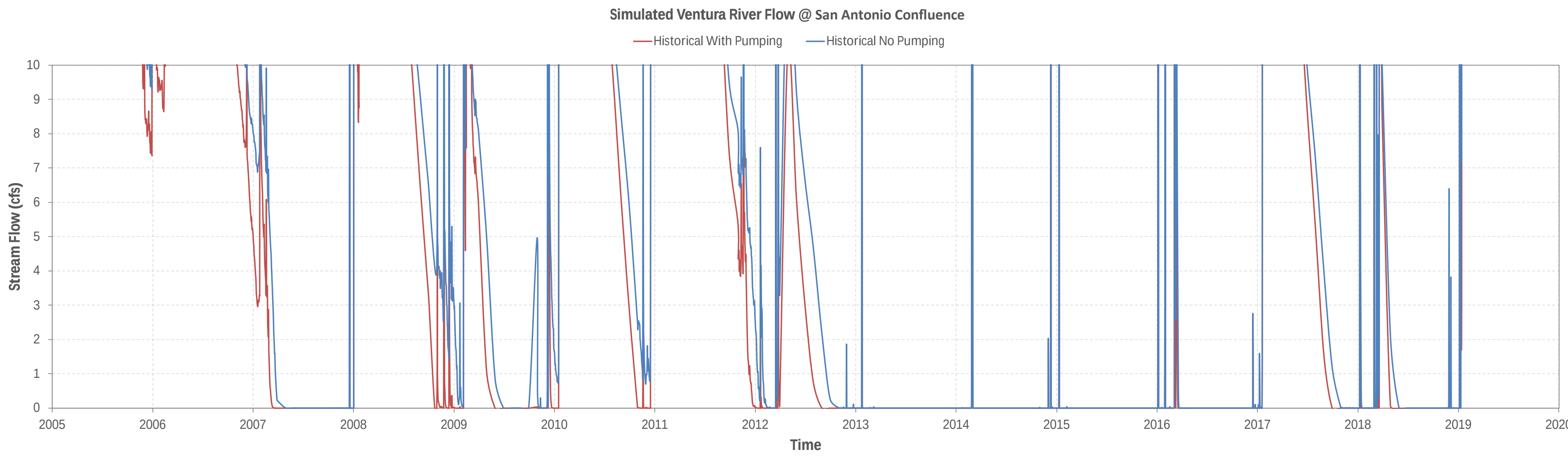
Figure N-05 Streamflow Depletion (South Robles).

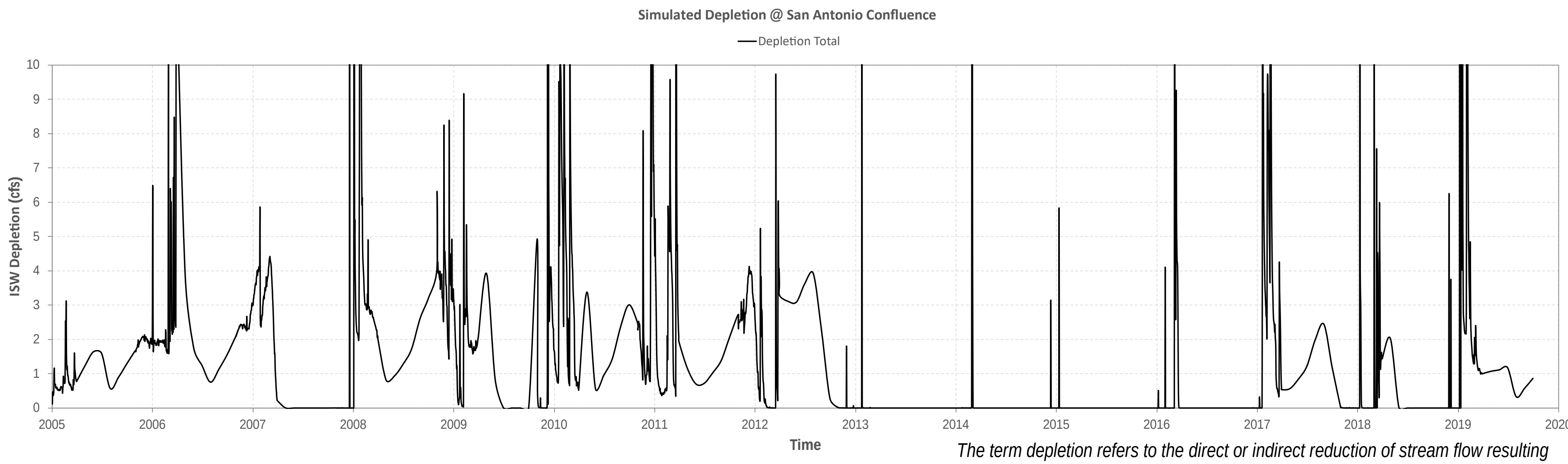




The term depletion refers to the direct or indirect reduction of stream flow resulting from groundwater extraction. Please see Section 3.2.6 for further description of direct versus indirect reductions (depletions) of surface water.

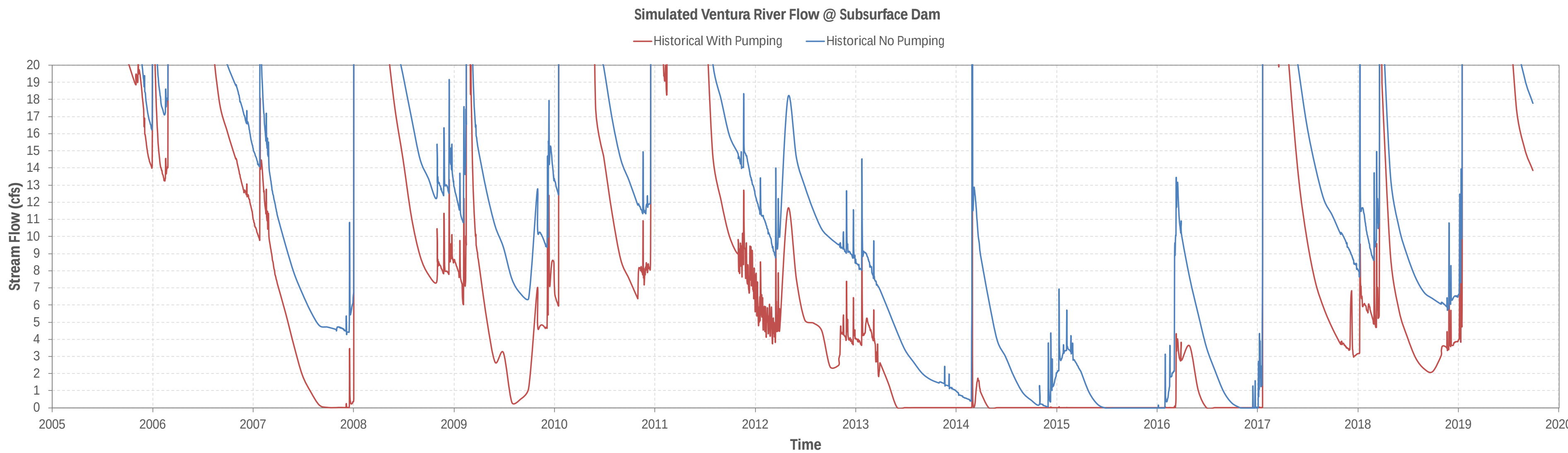
Figure N-06 Streamflow Depletion (Santa Ana Bridge).

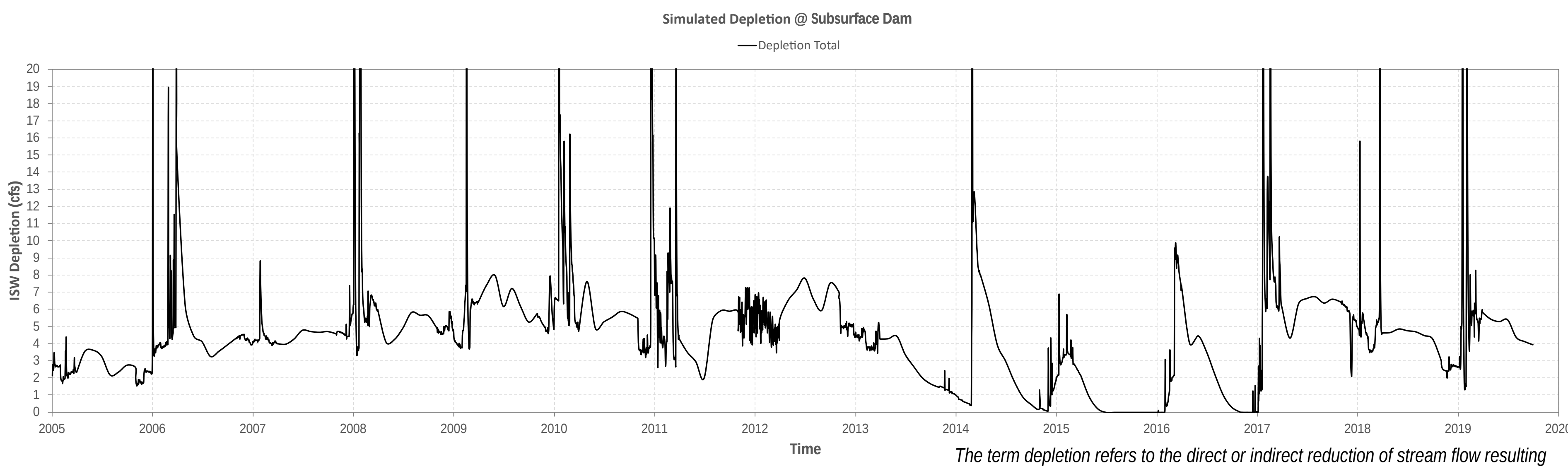




The term depletion refers to the direct or indirect reduction of stream flow resulting from groundwater extraction. Please see Section 3.2.6 for further description of direct versus indirect reductions (depletions) of surface water.

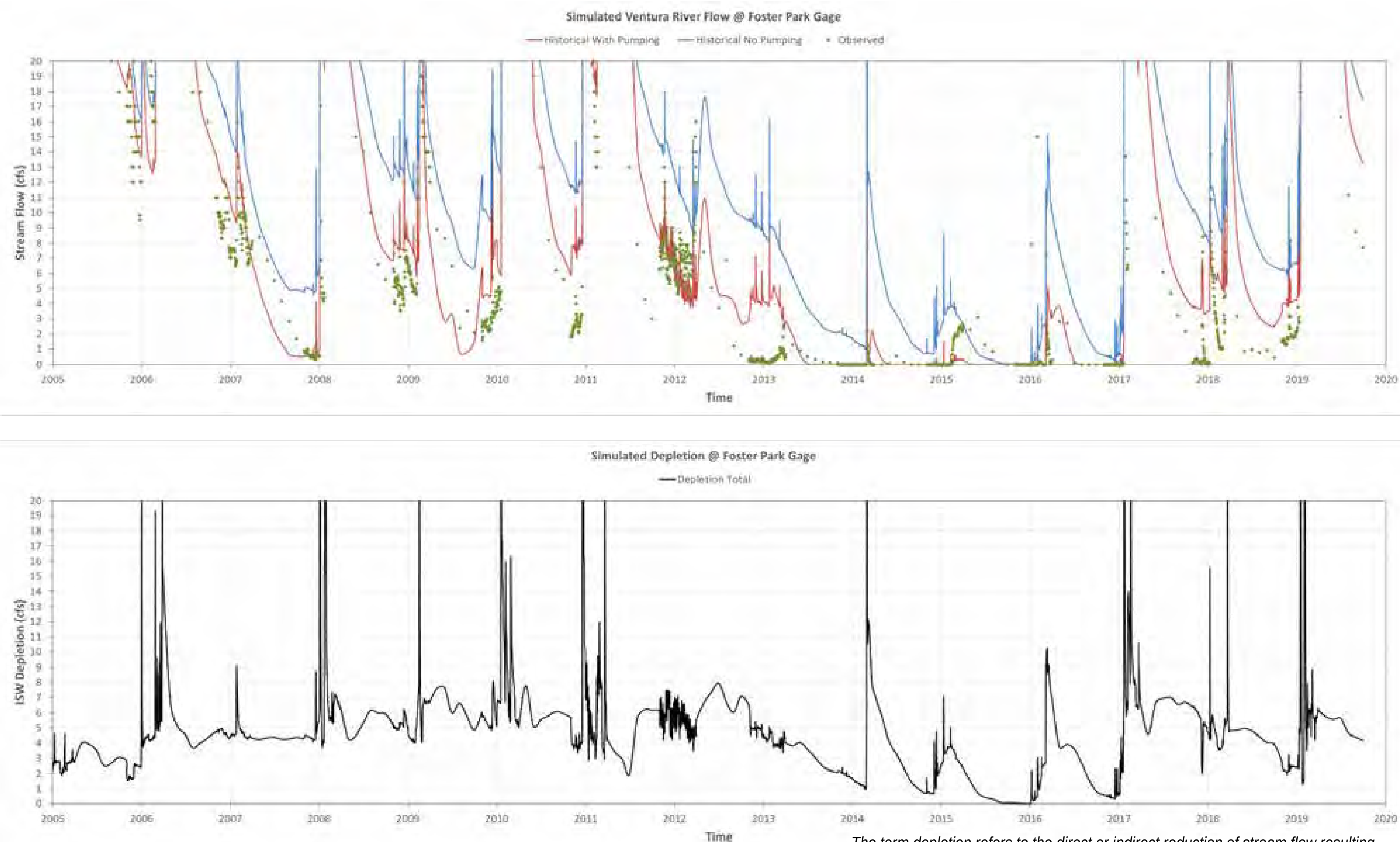
Figure N-07 Streamflow Depletion (San Antonio Confluence).





The term depletion refers to the direct or indirect reduction of stream flow resulting from groundwater extraction. Please see Section 3.2.6 for further description of direct versus indirect reductions (depletions) of surface water.

Figure N-08 Streamflow Depletion (Subsurface Dam).



The term depletion refers to the direct or indirect reduction of stream flow resulting from groundwater extraction. Please see Section 3.2.6 for further description of direct versus indirect reductions (depletions) of surface water.

Figure N-09 Streamflow Depletion (Foster Park Gage).

Appendix O

Riparian Groundwater Dependent Ecosystems Assessment, Upper Ventura River Groundwater Basin

Riparian Groundwater Dependent Ecosystems Assessment

Upper Ventura River Groundwater Basin

prepared for

Upper Ventura River Groundwater Agency
202 West El Roblar Drive
Ojai, California 93023

prepared by

Rincon Consultants, Inc.
180 North Ashwood Avenue
Ventura, California 93003

November 2021

RINCON CONSULTANTS, INC.
Environmental Scientists | Planners | Engineers
rinconconsultants.com

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Appendices

1 Introduction

This technical appendix to the Upper Ventura River Groundwater Agency (UVRGA) Groundwater Sustainability Plan (GSP) summarizes the process for identifying, characterizing, and assessing potential impacts to riparian groundwater dependent ecosystems (GDEs) in the Upper Ventura River Groundwater Basin (UVRGB). Importantly, this appendix identifies how groundwater management could affect (i.e., impact) riparian GDEs in the UVRGB and provides recommendations for establishing sustainability measurement criteria (SMC).

The Sustainable Groundwater Management Act (SGMA) requires groundwater sustainability agencies (GSAs) to identify and consider GDEs and other beneficial uses of groundwater when developing their GSPs. GDEs include vegetative communities (e.g., plants) as well as both aquatic and terrestrial species (e.g., animals) that are dependent on the habitat supported by groundwater. As is the case within the UVRGB, these ecosystems can include instream and riparian habitat, as well as vegetative habitat comprised of terrestrial plant species adapted with root systems that can reliably access groundwater.

Groundwater Dependent Ecosystems: *"Ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface"* – SGMA, 23 CCR § 351(m)

While instream and riparian habitats have various interrelated characteristics and interdependent components, this assessment focuses on riparian plant communities as well as the species that rely on plant communities. This riparian GDE assessment provides information relevant to development of sustainable management criteria (SMC) for the *groundwater level* and *groundwater storage* sustainability indicators by evaluating potential effects to these beneficial users of groundwater. Note that a separate assessment of aquatic GDEs will be conducted to support SMC development for the *depletion of interconnected surface water* sustainability indicator and will evaluate potential impacts to instream habitat and the species dependent on interconnected surface water in the UVRGB. The aquatic GDE assessment will be published under separate cover.

The following outline provides a description of each of the sections found in this appendix:

§ **Section 1. Introduction.** Provides a brief introduction to riparian GDEs and an overview of this technical document.

§ **Section 2. Riparian GDE Identification.** Provides a list of the riparian GDEs that occur within the UVRGB and describes the process of identifying and screening potential riparian GDEs and the grouping of "Riparian GDE units".

§ **Section 3. Riparian GDE Characterization.** Provides an overview of the ecological condition of the UVRGB and a detailed summary of the ecological condition of each Riparian GDE Unit within the UVRGB, including: vegetation, beneficial uses, federally designated critical habitat, special status species, and overall ecological value.

§ **Section 4. Riparian GDE Impact Analysis.** Provides an analysis of potential impacts to riparian GDEs related to changing groundwater conditions from both natural and non-natural (i.e., pumping) causes.

Note that GSP development is an iterative process, and the SMCs for GDEs in the UVRGB are subject to change based on stakeholder input, monitoring data, and forthcoming studies.

2 Riparian GDE Identification

This section summarizes the evaluation of riparian GDEs that have the potential to occur, and the identification of actual riparian GDEs that occur within the UVRGB. The approach for identifying riparian GDEs in the UVRGB generally followed the guidance provided by The Nature Conservancy (TNC) ("TNC GDE Guidance") (Rohde et al., 2018). A statewide dataset of potential riparian GDEs (iGDEs) was used as a starting point and compared against previous vegetation mapping, aerial imagery, basin-specific data on plant community rooting depths, and groundwater elevations to determine actual riparian GDEs present in the UVRGB. The actual riparian GDEs were grouped into "Units" based on areas with consistent vegetation and hydrology.

2.1 Data Used for Riparian GDE Identification

As recommended by TNC, riparian GDE identification started with spatial data of potential GDEs provided by the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (DWR 2021). The NCCAG dataset is a compilation of 48 publicly available State and Federal agency datasets that map vegetation, wetlands, springs, and seeps in California. A working group comprised of TNC, the California Department of Fish and Wildlife (CDFW) and the California Department of Water Resources (DWR) reviewed the compiled dataset. This working group also conducted a screening process to exclude vegetation and wetland types less likely to be associated with groundwater and retained vegetation types commonly associated with groundwater, based on criteria described in Klausmeyer et al., 2018. Due to uncertainty in the knowledge of when and how plants and animals depend on groundwater, the spatial database identifies ecosystems that potentially rely on groundwater. These potentially groundwater reliant ecosystems are therefore referred to as "indicators of groundwater dependent ecosystems" (iGDEs), which can also be thought of as "potential GDEs."

Additional data were accessed or developed to evaluate groundwater dependency of the potential GDEs, and ultimately identify riparian GDEs in the UVRGB. Table 1 presents the data sources used for this analysis.

Table 1 Data Used to Identify Riparian GDEs

Description	Provider	How it was Used
NCCAG dataset	TNC, CDFW , DWR	The map provides polygons representing potential GDEs, which were used as a starting point to map GDEs.
Groundwater elevations and model outputs	UVRGA (GSP work in progress)	Well-specific elevation data were used to evaluate proximal depths to water and refine iGDE polygons. Basin-wide groundwater elevations were modeled and data were used to further refine iGDE polygons.
Aerial imagery	Google Earth Pro, USDA – NAIP[1]	Aerial imagery was used for a visual analysis to manually refine iGDE polygons.
Vegetation maps/databases	CalVeg[2], NWI[3], VegCAMP[4], CDFW, VCPWA-WP[5], UVRGA (GSP work in progress)	Data on groundwater, vegetation communities, and hydrologic conditions within the UVRGB were used to identify and group GDEs into final GDE units.
Maximum rooting depths	TNC	Maximum rooting depths were defined for each iGDE and were compared to actual depth to groundwater throughout the basin to determine which communities could actually be groundwater dependent.

[1] United States Department of Agriculture – National Agriculture Imagery Program (USDA 2021a)

[2] Classification and Assessment with Landsat of Visible Ecological Groupings, U.S. Department of Agriculture (USDA) Forest Service (USDA 2021b)

[3] National Wetlands Inventory, U.S. Fish and Wildlife Service (USFWS 2021b)

[4] Vegetation Classification and Mapping Program (CDFW 2021d)

[5] Ventura County Public Works Agency – Watershed Protection (VCPWA-WP 2021)

2.2 Analysis of Potential Riparian GDEs

The iGDE dataset representing potential riparian GDEs is regional in nature and it is known that it may not be consistent with basin-specific habitat and groundwater conditions. As such, TNC suggests using the iGDE dataset as a starting point for the identification and analysis of GDEs under SGMA. Determining whether an iGDE is actually a GDE requires detailed local data about land use, vegetation, habitat, groundwater levels, surface water hydrology, and geology.

The TNC GDE Guidance recommends several steps for validating the groundwater dependency of iGDEs with basin-specific local information, which were generally followed. The process refined the iGDE polygons (spatial areas representing potential riparian GDEs) using local data, site-specific information, and aerial imagery.

The iGDEs provided by the NCCAG dataset are separated into the following two classifications:

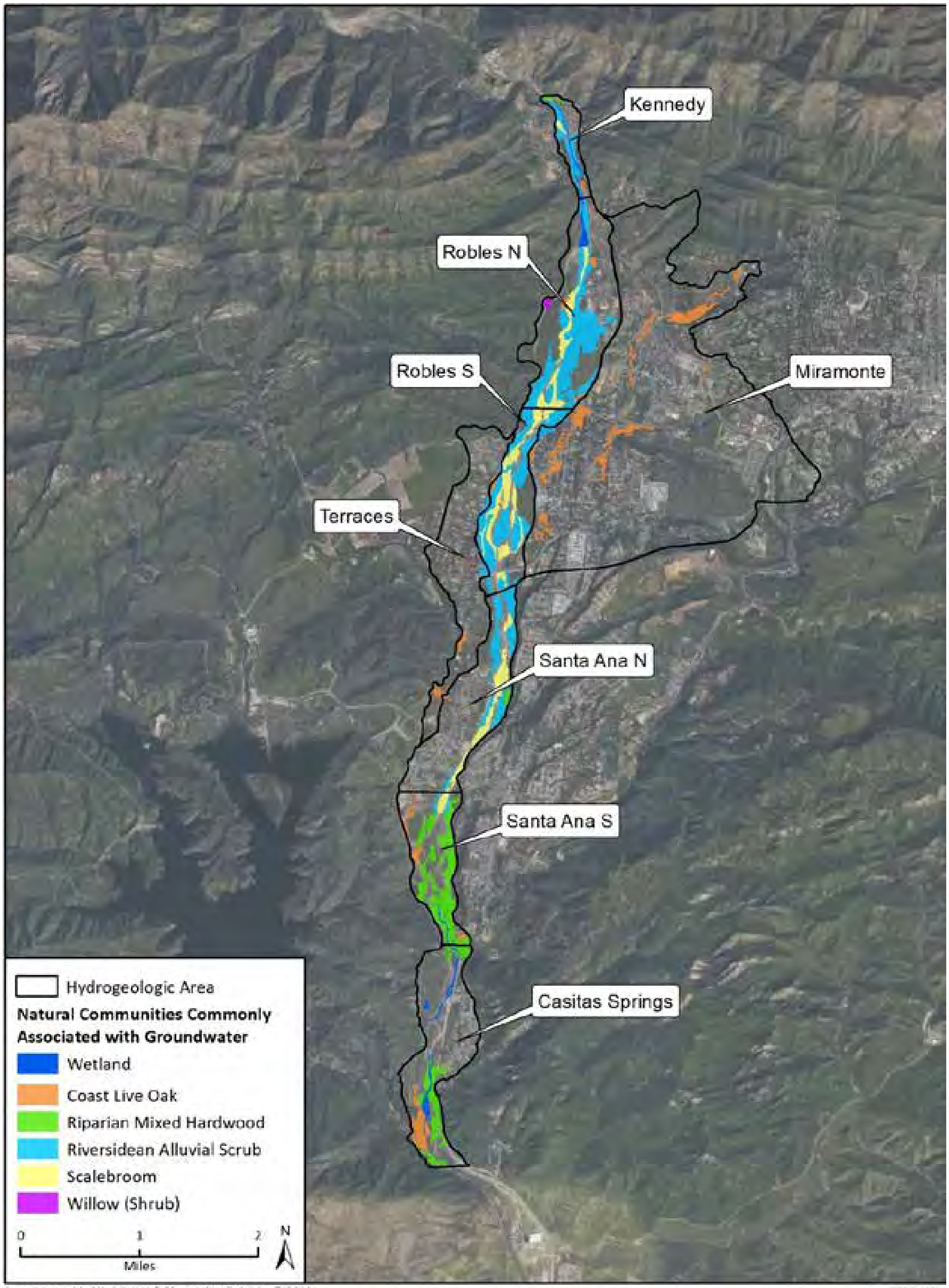
§ Wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions, such as perennial wetlands, perennial rivers, and springs

§ Vegetation types commonly associated with the sub-surface presence of groundwater (phreatophytes)

Initial Desktop Analysis of Potential Riparian GDEs

Figure 1 depicts a map of all iGDEs within the UVRGB identified in the NCCAG dataset (DWR 2021). These iGDEs were compared with CalVEG maps and vegetation communities identified in the Ventura River Management Plan (VRMP). Experienced local botanists then conducted a visual

Figure 1 iGDEs within the UVRGB (NCCAG Dataset)



Imagery provided by Microsoft Bing and its licensors © 2021.

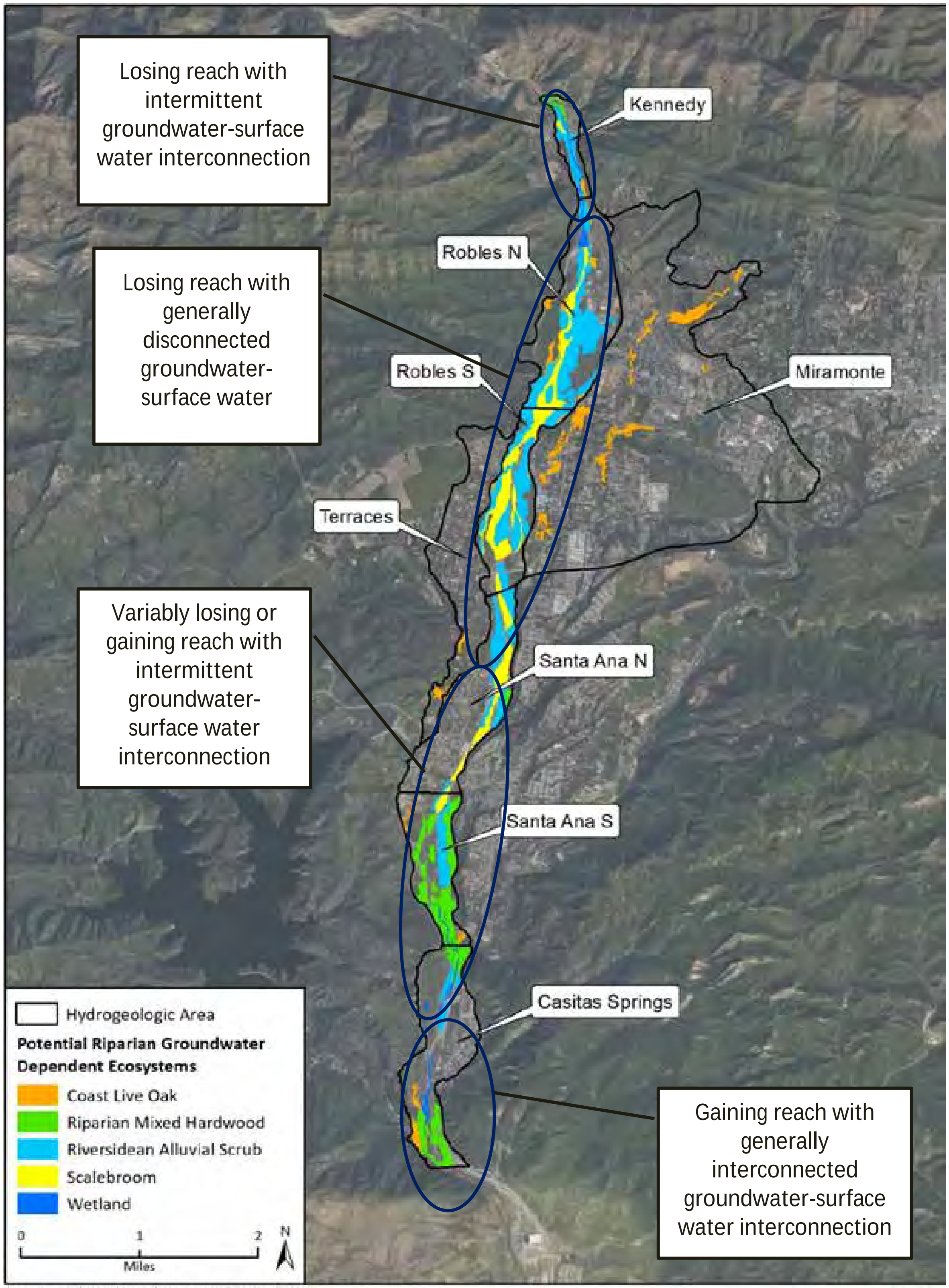
analysis of these iGDEs using aerial imagery dating back to 2005. Based on this desktop review, iGDEs within the UVRGB were visually assessed and refined to best reflect the potential riparian GDEs within the basin. This included adjustments to area and changing the classifications of specific iGDEs.

The resulting iGDEs included the following plant communities: Wetlands, Coast Live Oak, Riparian Mixed Hardwood, Riversidean Alluvial Scrub, and Scalebroom. These NCCAG classifications represent groupings of multiple species, and the classification name generally represents the dominant vegetation type. Vegetation and habitats associated with each of these classes within the UVRGB are discussed in detail in Appendix A.

Figure 2 presents the refined iGDE polygons that occur within the UVRGB, as well as the hydrogeologic areas within the UVRGB Figure 2 also depicts the interconnected surface water systems outlined in Chapter 3.2.6 of the GSP. The varying groundwater-surface water interconnection is evident in the distribution of vegetation communities that occur across the four identified reaches. These reaches consist of the following:

- A losing reach with intermittent groundwater-surface water interconnection in the Kennedy hydrogeologic area
- A losing reach with generally disconnected groundwater-surface water in the Robles North, Robles South, and northern Santa Ana South hydrogeologic areas
- A variably losing or gaining reach with intermittent groundwater-surface water interconnection in the Santa Ana North, Santa Ana South, and northern Casitas Springs hydrogeologic areas
- A gaining reach with generally interconnected groundwater-surface water in the Casitas Springs hydrogeologic area

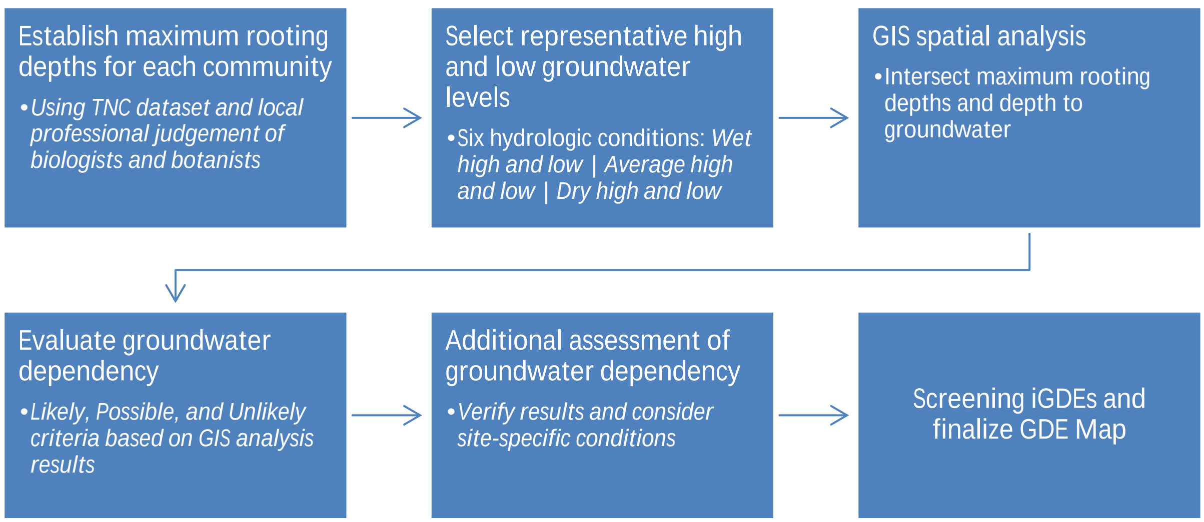
Figure 2 Potential Riparian GDEs, Hydrogeologic Areas, and Interconnected Surface Water Systems within the UVRGB



2.3 Potential Riparian GDE Screening Methods

A cursory GIS spatial analysis of maximum rooting depths and groundwater levels was completed to assess potential riparian GDE groundwater access. Depending on results from this initial assessment, further evaluations of groundwater level and rooting depth were completed. As needed, additional analysis was conducted to verify groundwater dependency. The steps of this analysis are discussed in the following section and Figure 3 presents the screening process.

Figure 3 Riparian GDE Screening Process using GIS Spatial Analysis of Rooting Depths and Groundwater Level



Maximum Rooting Depth

A literature review was conducted to establish maximum rooting depths for the dominant species found within the NCCAG classifications of potential GDEs. Maximum rooting depths for the dominant plant species found within each potential riparian GDE were evaluated and used to represent each iGDE's maximum rooting depth (Table 2). The plant species with the deepest rooting depth was selected for the maximum rooting depth, except in the case of Riparian Mixed Hardwood, which used an average of the rooting depths.[1] The maximum rooting depth for each potential Riparian GDE polygon were added to the attribute table in GIS for spatial analysis.

[1] The average rooting depth was used for this potential GDE because *Quercus agrifolia* (Coast Live Oak) is known to comprise up to 50 percent of the community. Because this species is not as prevalent as in Coast Live Oak community, we do not use this as a max rooting depth.

Table 2 Maximum Rooting Depths of Potential Riparian GDEs

Potential Riparian GDE	Maximum Rooting Depth (feet)[1]
Coast Live Oak	30.0
Riparian Mixed Hardwood	13.7[2]
Riversidean Alluvial Scrub	5.0
Wetlands	3.0
Scalebroom	6.0

[1] Raw data for maximum rooting depths were referenced from GDE Rooting Depth Database (TNC 2020).
[2] Mixed Riparian Hardwood communities can consist of up to 50 percent Coast Live Oak trees. As such, this rooting depth represents the average of species known to occur in these communities.

Groundwater Levels

Modeled groundwater levels from the UVRGA GSP numerical model provided spatially distributed depth to water (DTW) measurements throughout the basin to overlay with the iGDEs. To evaluate groundwater access for potential riparian GDEs over changing DTW conditions, varying climatic conditions were selected from the numerical model output. Water years 2005, 2010, and 2015 were selected to represent wet, average, and dry precipitation conditions, respectively.[2] Model outputs of the highest and lowest DTW conditions for each modeled year were exported to GIS for spatial analysis. This provided six hydrologic conditions that could be evaluated against plant rooting depths, corresponding with the high and low DTW value for the wet, average, and dry water years (wet-high, wet-low, average-high, average-low, dry-high, and dry-low).

Figure 4a through Figure 4d present the DTW for the six hydrologic conditions. These figures include the iGDEs with reference to the maximum rooting depth used for each classification, as well as potential basin boundary modification areas. As discussed in Section 3.1.3 of the GSP, certain areas currently within the UVRGB boundary are understood to be separate from the principal aquifer and UVRGA may seek future basin boundary modifications. As discussed in Section 2.4.2, the northeastern portion of UVRGB in the Mira Monte / Meiners Oaks Hydrogeologic Area is underlain by thin alluvium that is likely above the water table and that has limited hydraulic connectivity with the principal aquifer. Additional analysis of the iGDEs occurring in this area is provided.

GIS Spatial Analysis of Maximum Rooting Depth and Groundwater Level

A GIS spatial analysis was conducted to intersect the maximum rooting depths associated potential riparian GDEs to the six DTW categories. Table 3 presents the criteria used to screen the potential riparian GDEs based on the results from this spatial analysis. If maximum rooting depths were always deeper than the lowest DTW condition, that potential riparian GDE was classified as likely to be groundwater dependent and groundwater dependency was verified to include the confirmed riparian GDE in the UVRGB Riparian GDE map. When maximum rooting depth was never deeper than the highest DTW conditions, that potential GDE was classified as unlikely to be groundwater dependent and was excluded from the UVRGB Riparian GDE map. If maximum rooting depth for a potential riparian GDE was deeper than any of the DTW conditions (i.e., deeper than at least one hydrologic condition), it was assumed that groundwater dependency could be possible and additional evaluation of groundwater level, maximum rooting depth, and location-specific characteristics was completed.

[2] Note that the historic time period for modeling groundwater levels was limited to 2005-2019.

Table 3 Groundwater Dependency Likelihood Criteria for GIS Spatial Analysis

Groundwater Dependency Likelihood	Evaluation Criteria	Action Taken if Criteria were Met
Likely	Maximum rooting depth deeper than DTW for all low groundwater levels (wet-low, average-low, and dry-low hydrologic conditions)	Verify groundwater dependency to include in UVRGB Riparian GDE map
Possible	Maximum rooting depth deeper than DTW for any high groundwater levels (wet-high, average-high, or dry-high hydrologic conditions)	Further evaluation of groundwater level, maximum rooting depth, and location-specific characteristics to evaluate groundwater dependency
Unlikely	Maximum rooting depth never deeper than highest groundwater levels (wet-high, average-high, or dry-high hydrologic conditions)	Exclude from UVRGB Riparian GDE map

Additional Assessment

Following the GIS mapping and spatial analysis of maximum rooting depth and DTW, a desktop review was conducted to further analyze groundwater dependence for individual vegetation communities within the UVRGB. Aerial imagery of the basin was used to conduct a visual assessment of habitat features and natural characteristics, as well as topography and drainage characteristics. Potential GDEs with possible groundwater dependency based on the GIS spatial analysis were ultimately either included or excluded based on biologic understanding or included if exclusion was too difficult to determine based on available information.

2.4 Potential Riparian GDE Screening Results

The following presents the initial screening results of the spatial analysis, followed by the additional assessment of the groundwater dependency likelihood criteria.

2.4.1 GIS Spatial Analysis Results

Figure 5 presents the initial screening results of the GIS spatial analysis. Following the criteria outlined in Section 2.3, "Unlikely" groundwater dependence (represented by the red areas) indicates that no intersection of maximum rooting depth and DTW occurred. "Possible" groundwater dependence (represented by the yellow areas) indicates at least one intersection of maximum rooting depth and DTW occurred. Finally, "Likely" groundwater dependence (represented by the green areas) indicates that maximum rooting depths intersected with the DTW during all low groundwater levels.

2.4.2 Additional Assessment

The potential riparian GDEs meeting the "Unlikely" screening criteria (red areas in Figure 5) were comprised entirely of either Riversidean Alluvial Scrub or Scalebroom plant communities. The species in these communities are known to be well adapted to flood plains in alluvial basins, have shallow rooting depths, are adapted to using seasonally available soil moisture, and are understood as an unlikely groundwater dependent community. Additional assessment was conducted for the potential riparian GDEs that met the Likely and Possible GIS spatial analysis screening criteria, as presented in Figure 6.

Assessment of Potential Riparian GDEs that Met “Likely” Screening Criteria

Potential riparian GDEs met “Likely” screening criteria in the Mira Monte, Kennedy, and Terraces hydrogeologic areas. The plant communities meeting the “Likely” screening criteria in these areas consisted of Coast Live Oak, as well as Riparian Mixed Hardwood in the Kennedy hydrogeologic area. Based on geologic formation, topography, surface water inflow, and likely influence of irrigation (in the Kennedy area), it was determined that these communities are unlikely to be dependent on the UVRGB primary aquifer.

In addition, it is unclear whether Coast Live Oak communities should be included as a riparian GDE, as the species is known to occur in upland communities with deep rooting structures for access to soil moisture. For the purposes of this assessment, this NCCAG community classification will be excluded from the UVRGB Riparian GDE map in upland areas that are outside of the riparian corridor.

Kennedy Hydrogeologic Area

The Kennedy hydrogeologic area is fed by perennial surface flow, originating upstream and flowing into the UVRGB. A Riparian Mixed Hardwood iGDE was located at the northern-most extent of the UVRGB. Based on the perennial source of surface flow, it is understood that this community is dependent on surface water, and not groundwater. A Coast Live Oak iGDE was also located in the upland area along the eastern portion of the river and continued into the North Robles hydrogeologic area. These Coast Live Oak iGDEs are located along slopes immediately downgradient orchards, suggesting that these trees receive irrigation flows collecting along the slope.

Terraces Hydrogeologic Area

The Terraces hydrogeologic area consists of very thin alluvial deposits that are elevated above and separated from the principal aquifer of the Basin by bedrock. Water wells in this are believed to tap the underlying Sespe Formation (bedrock), which is not managed by the GSA. Groundwater in the thin alluvium, if any, is perched and hydraulically disconnected from the principal aquifer of the Basin. The Coast Live Oak mapped in the Terraces are located along drainage features where surface water and interflow collects, suggesting the trees are not reliant on groundwater.

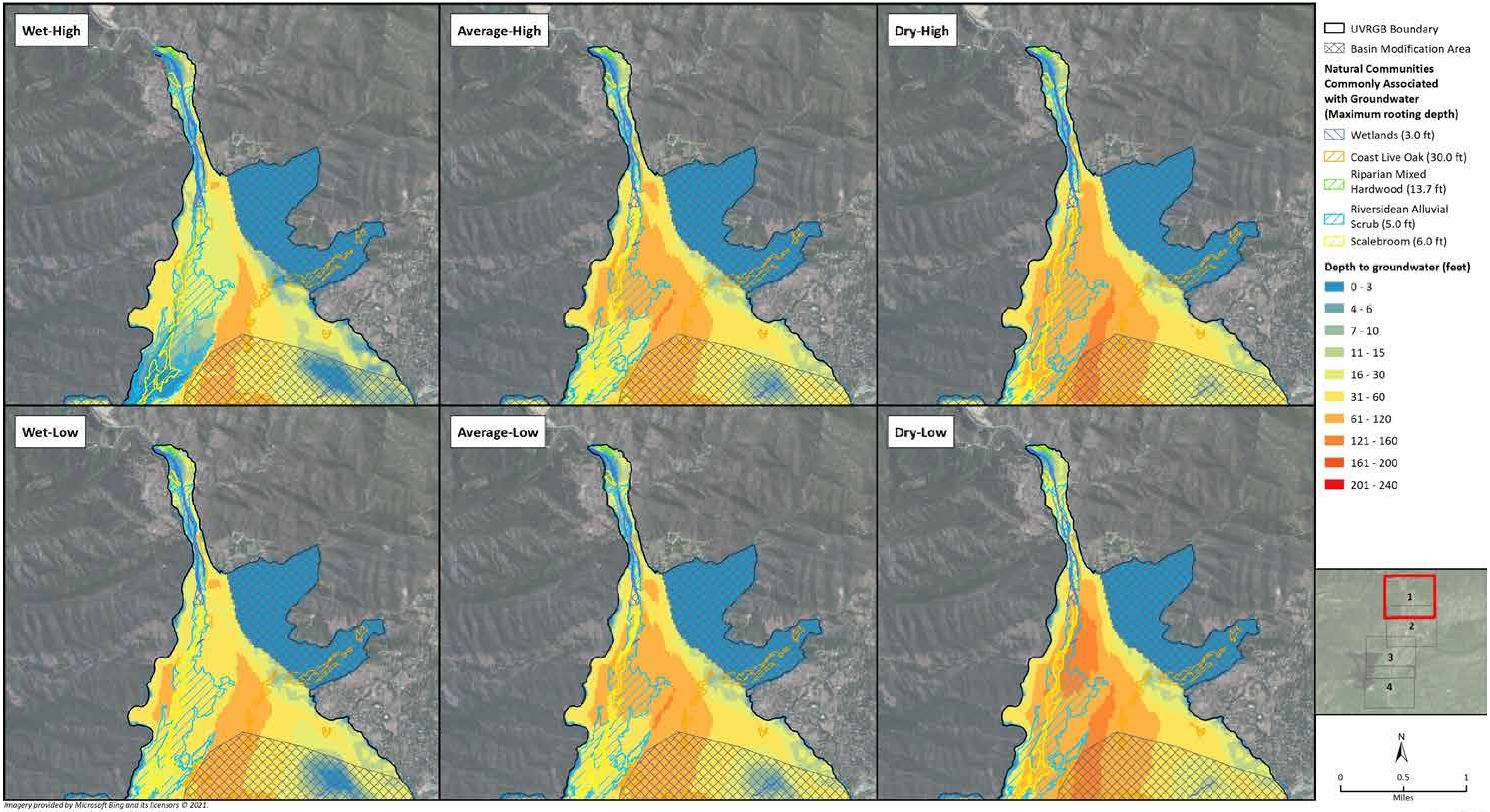
Mira Monte Hydrogeologic Area

The Coast Live Oaks identified in McDonald Canyon lie along the drainage of the canyon where surface water and interflow collects, suggesting the tress are not reliant on groundwater. This part of the UVRGB is underlain by thin alluvial deposits, which overlie bedrock of the Sespe Formation. Groundwater in the thin alluvium, if any, is perched on the Sespe Formation and has limited hydraulic connectivity with the principal aquifer of the Basin because it is elevated and thin. There are no water wells in McDonald Canyon and any potential future water wells would likely produce water from the Sespe Formation, which is not managed by the GSA.

Santa Ana South and Casitas Springs Hydrogeologic Areas

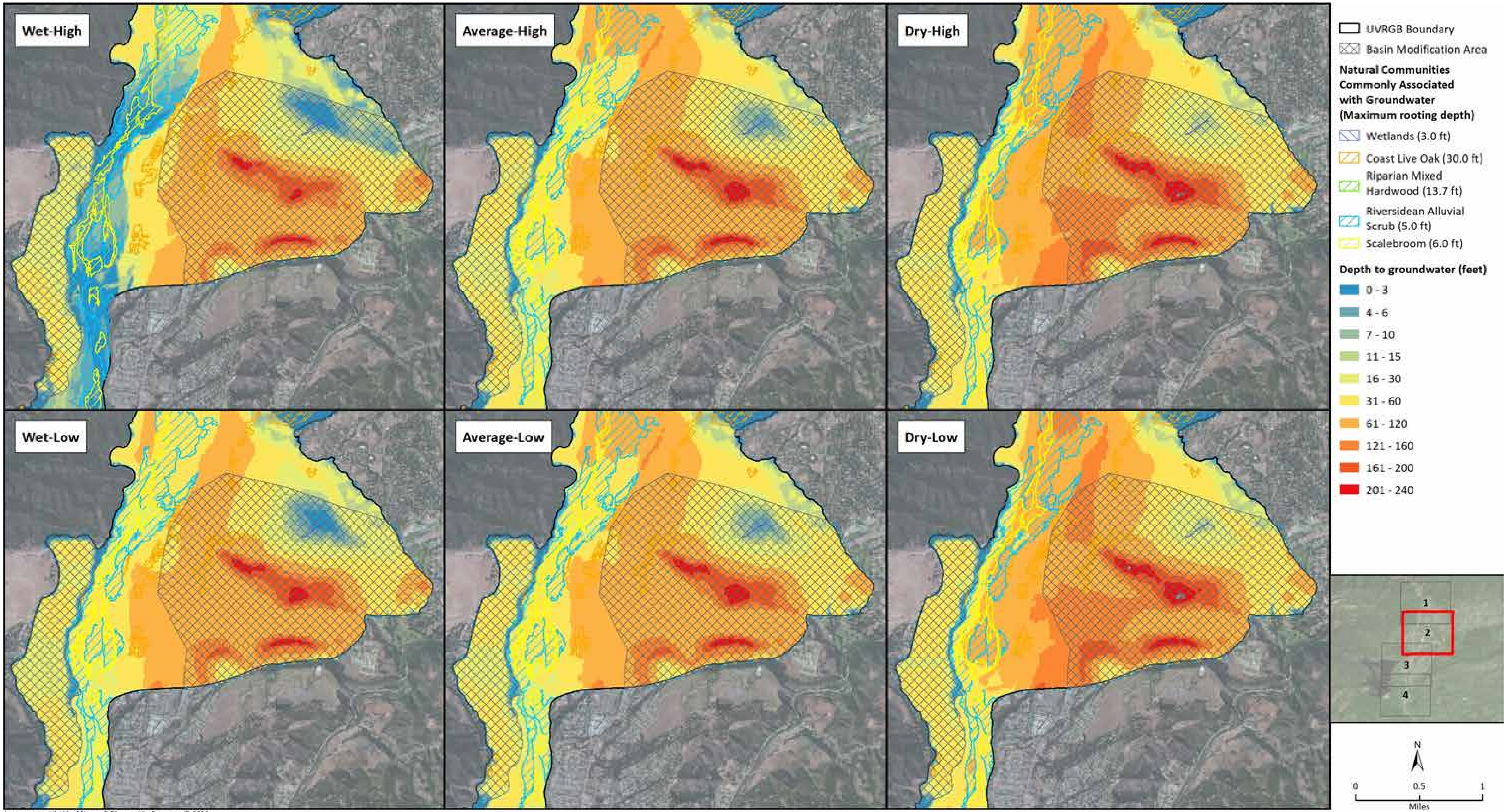
Coast Live Oak was also observed meeting the Likely screening criteria in the Santa Ana South and Casitas Springs hydrogeologic areas, primarily located in upland areas on slopes and along drainages. These trees were located in upland areas, outside of the riparian corridor, and along slopes or drainages where surface water and interflow collects.

Figure 4a Depth to Water for Six Hydrologic Conditions



Note: "Basin Modification Area" presents areas where shallow bedrock conditions exist. UVRGA may seek future basin boundary modifications based on hydrogeologic conditions, as discussed in Section 3.1.3 of the GSP

Figure 4b Depth to Water for Six Hydrologic Conditions



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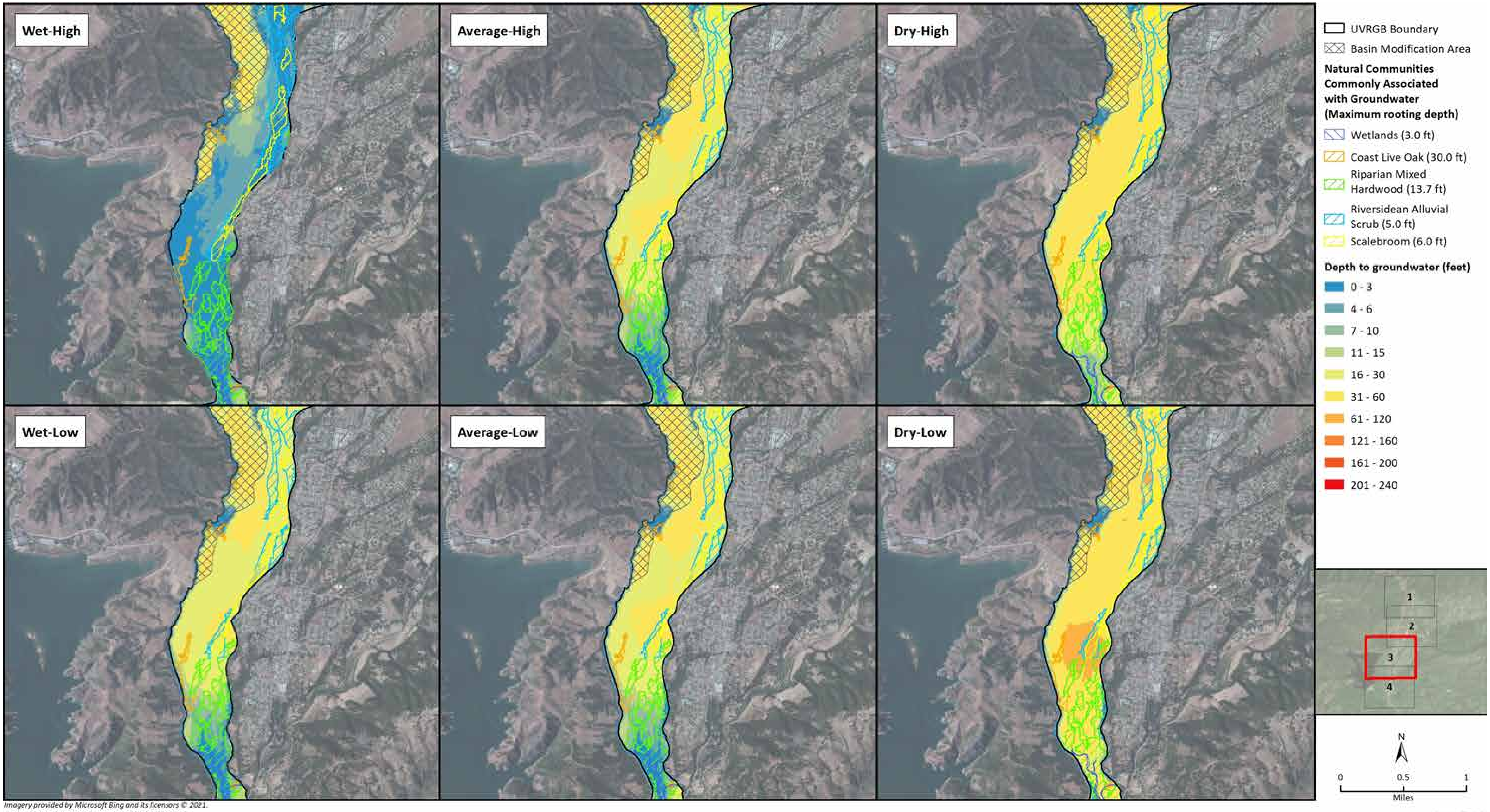
Additional data provided by UVRGA, 2021; Intera, 2021.

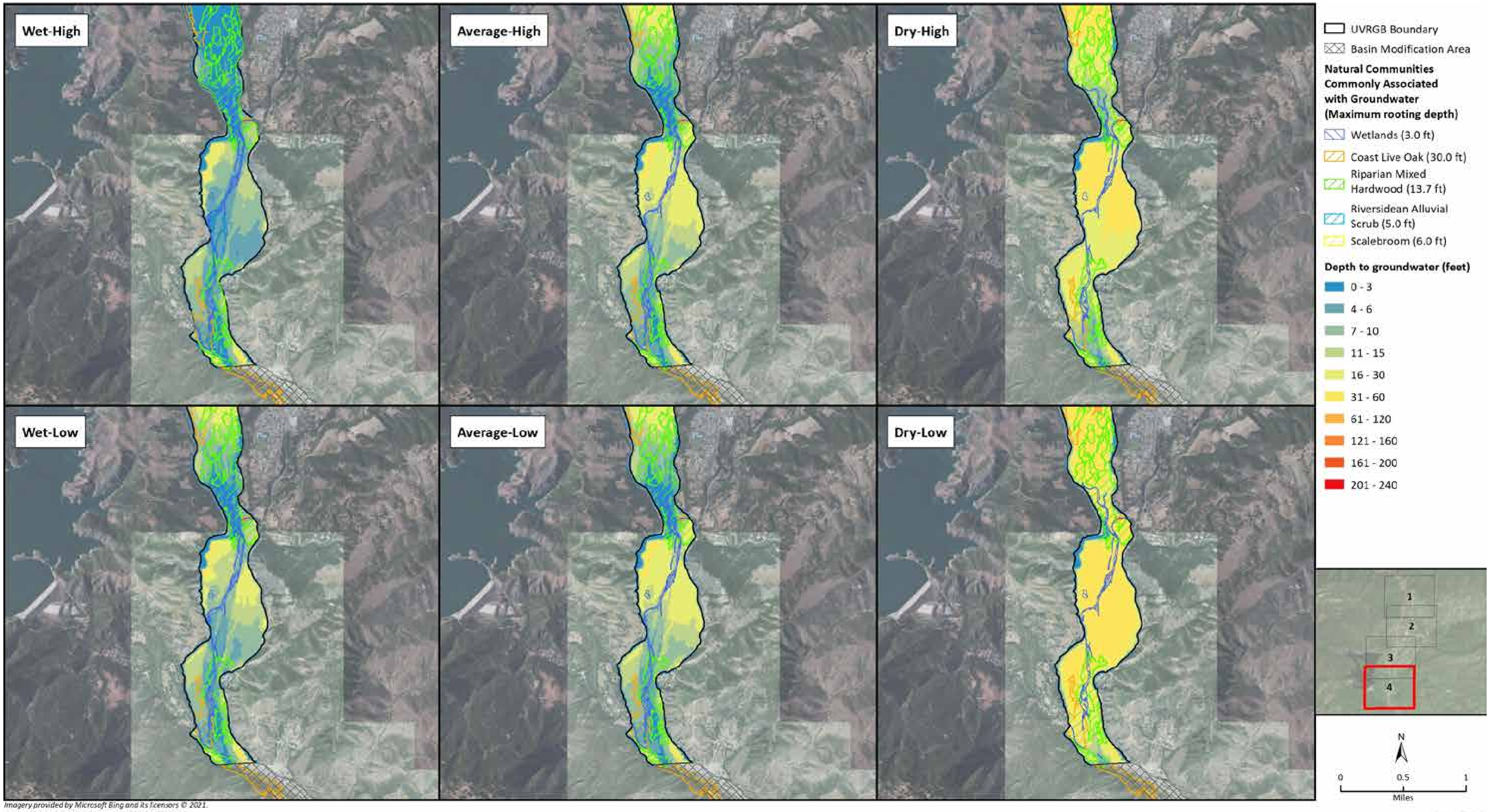
Note: "Basin Modification Area" presents areas where shallow bedrock conditions exist. UVRGA may seek future basin boundary modifications based on hydrogeologic conditions, as discussed in Section 3.1.3 of the GSP

Figure 4c Depth to Water for Six Hydrologic Conditions



Note: "Basin Modification Area" presents areas where shallow bedrock conditions exist. UVRGA may seek future basin boundary modifications based on hydrogeologic conditions, as discussed in Section 3.1.3 of the GSP

Figure 4d Depth to Water for Six Hydrologic Conditions



Note: "Basin Modification Area" presents areas where shallow bedrock conditions exist. UVRGA may seek future basin boundary modifications based on hydrogeologic conditions, as discussed in Section 3.1.3 of the GSP

Figure 5 Spatial Analysis Results for Maximum Rooting Depth and Groundwater Level

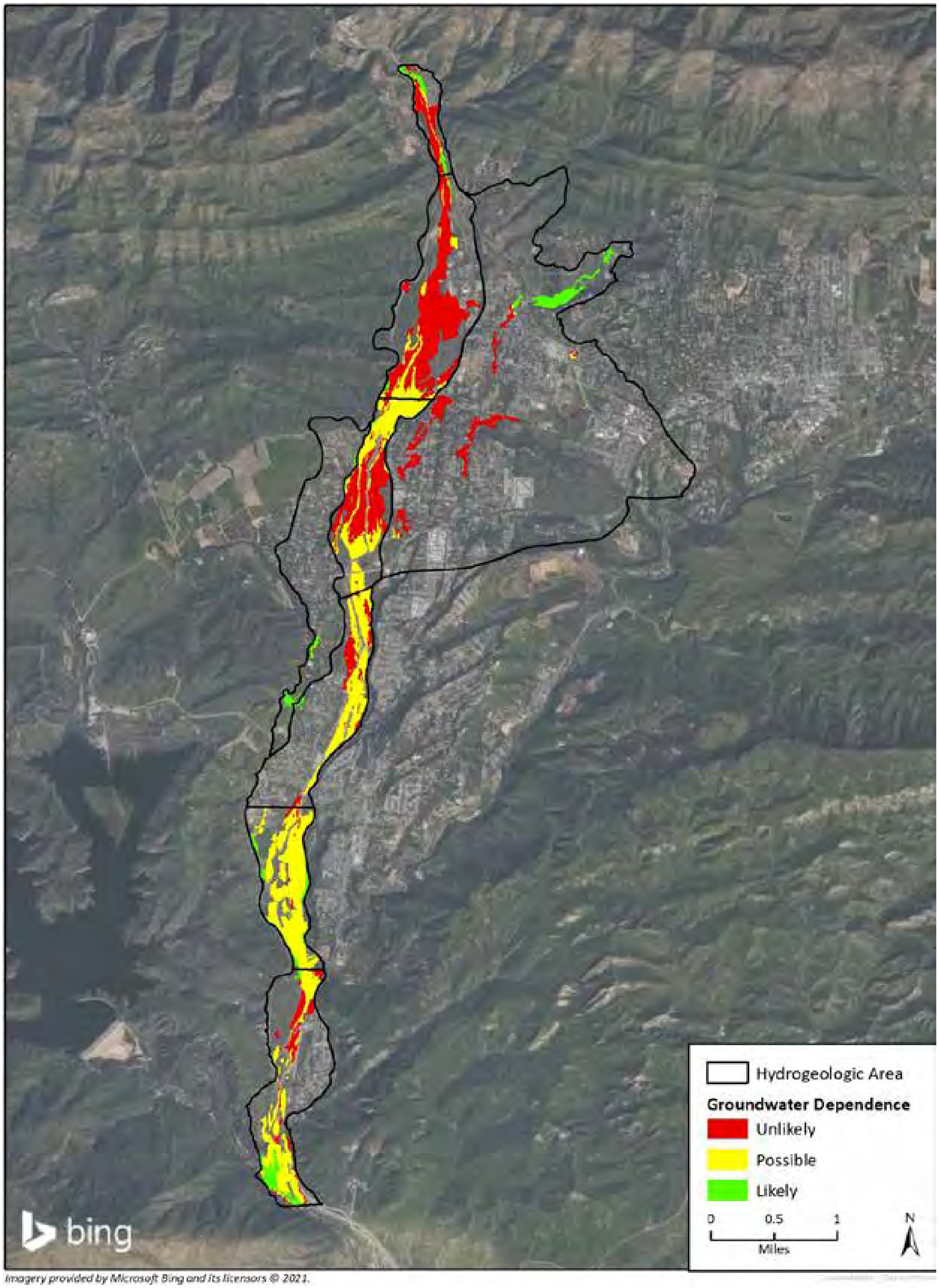
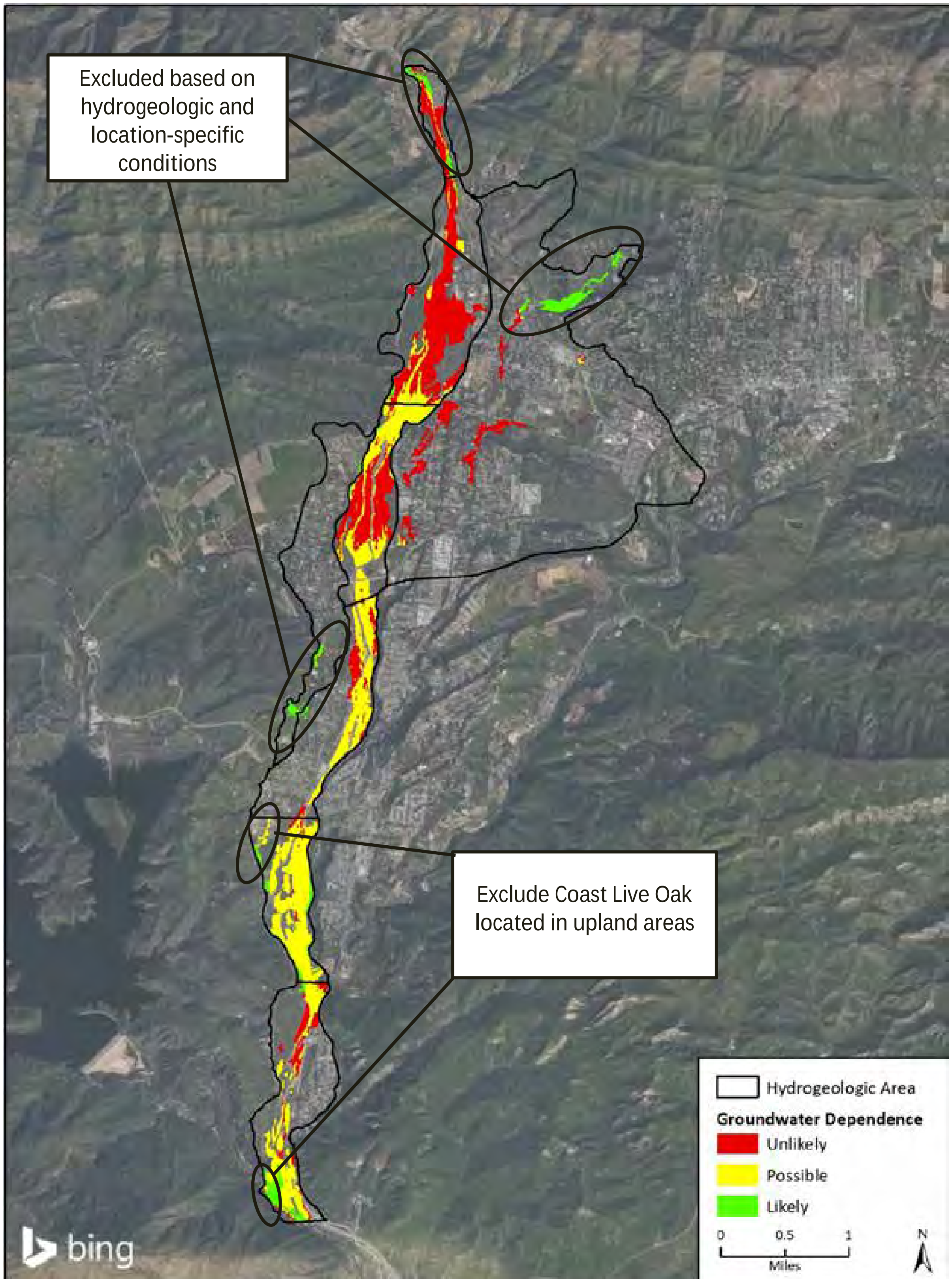


Figure 6 Additional Assessment of Spatial Analysis



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Assessment of Potential Riparian GDEs that Met "Possible" Screening Criteria

Following the criteria established in Section 2.3, additional evaluation was necessary for the majority of the potential riparian GDEs. This further evaluation was especially important due to general uncertainty inherent in the use of modeled data and the use of one maximum rooting depth for each plant community. See Section 2.4.2 for detailed information about the additional evaluation.

To further investigate groundwater level and rooting depth interactions, Figure 7 was developed to present the counts of rooting depth access to groundwater. The figure displays the groundwater access counts ranging from zero to six, reflecting the six different hydrologic conditions (wet-high, wet-low, average-high, average-low, dry-high, and dry-low). As illustrated, a large portion of the potential riparian GDEs that met the Possible screening criteria were comprised of Riversidean Alluvial Scrub and Scalebroom plant communities. In addition, these potential riparian GDEs were located in the reaches understood to have generally disconnected groundwater-surface water conditions.

Importantly, Figure 7 displays that the groundwater access counts were highest (above 3 counts) in the southern Santa Ana South and southern Casitas Springs (near Foster Park) hydrogeologic areas. The potential riparian GDEs that occur in these locations were comprised mostly of Riparian Mixed Hardwood and Wetland plant communities, with minor occurrence of Riversidean Alluvial Scrub.

Potential Riparian GDEs Excluded

Based on the information developed from the GIS spatial analysis and additional assessment, the following potential riparian GDEs were excluded from the final UVRGB Riparian GDE map:

- Scalebroom throughout the UVRGB
- Riversidean Alluvial Scrub throughout the UVRGB
- Coast Live Oak in the Mira Monte, Kennedy, and Terraces hydrogeologic area
- Coast Live Oak in the upland areas of the Santa Ana South and Casitas Springs hydrogeologic area
- Riparian Mixed Hardwood in the Kennedy hydrogeologic area

2.5 UVRGB GDE Units

Informed by screening results, the following riparian GDEs were determined to occur within the UVRGB: Coast Live Oak (within the riparian corridor), Riparian Mixed Hardwood, and Wetlands. Riparian GDEs occur within the southern Santa Ana South and southern Casitas Springs hydrogeologic areas. Based on the geographic, hydrologic, and ecological conditions, these riparian GDEs were grouped into two Riparian GDE Units. These are the South Santa Ana Riparian GDE Unit and the Foster Park Riparian GDE Unit. Table 4 provides a description of each Riparian GDE unit and Figure 8 depicts each unit within the UVRGB.

Figure 7 Groundwater Access Counts of GIS Spatial Analysis

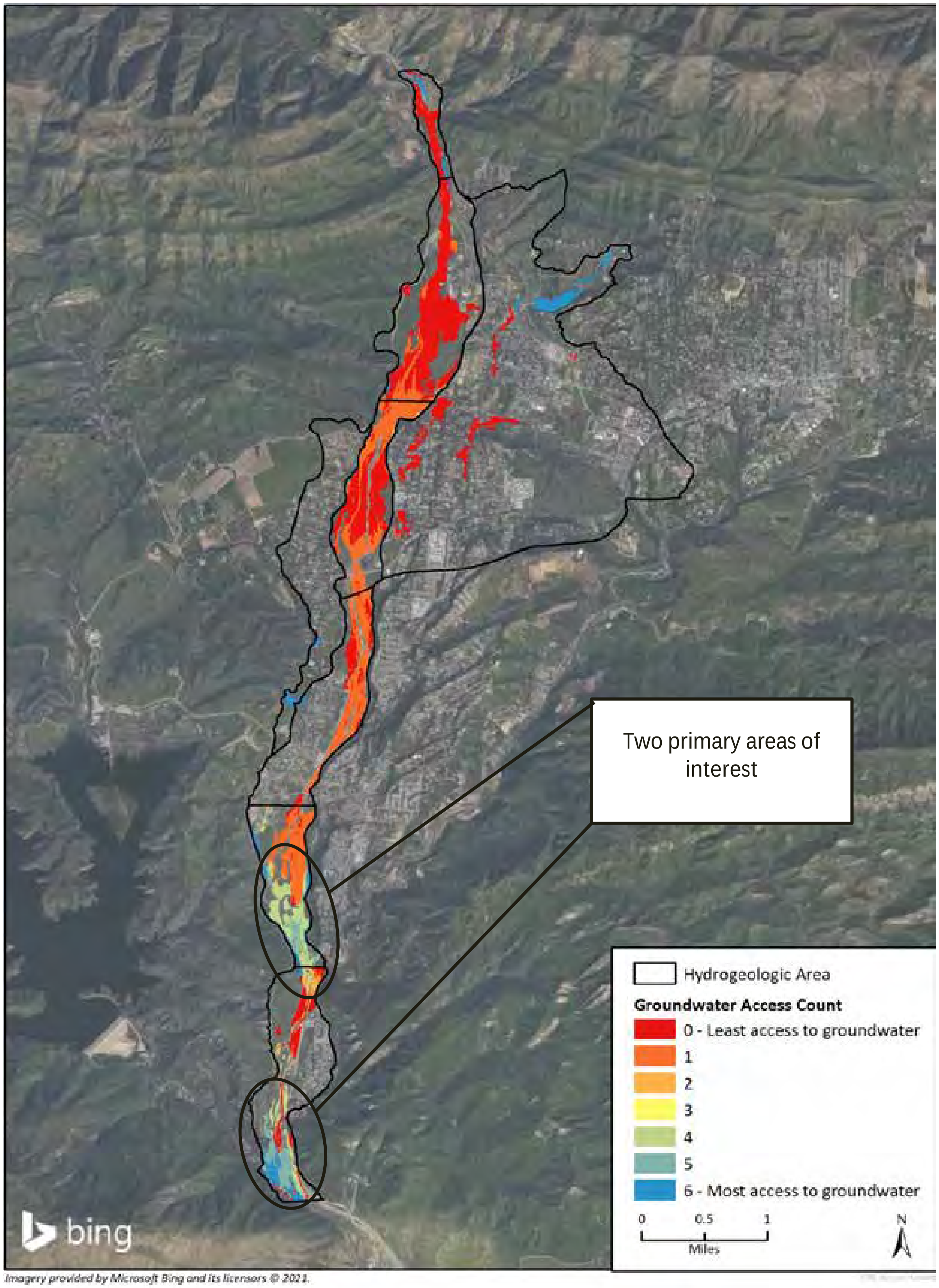

Figure 8 UVRGB Riparian GDE Map

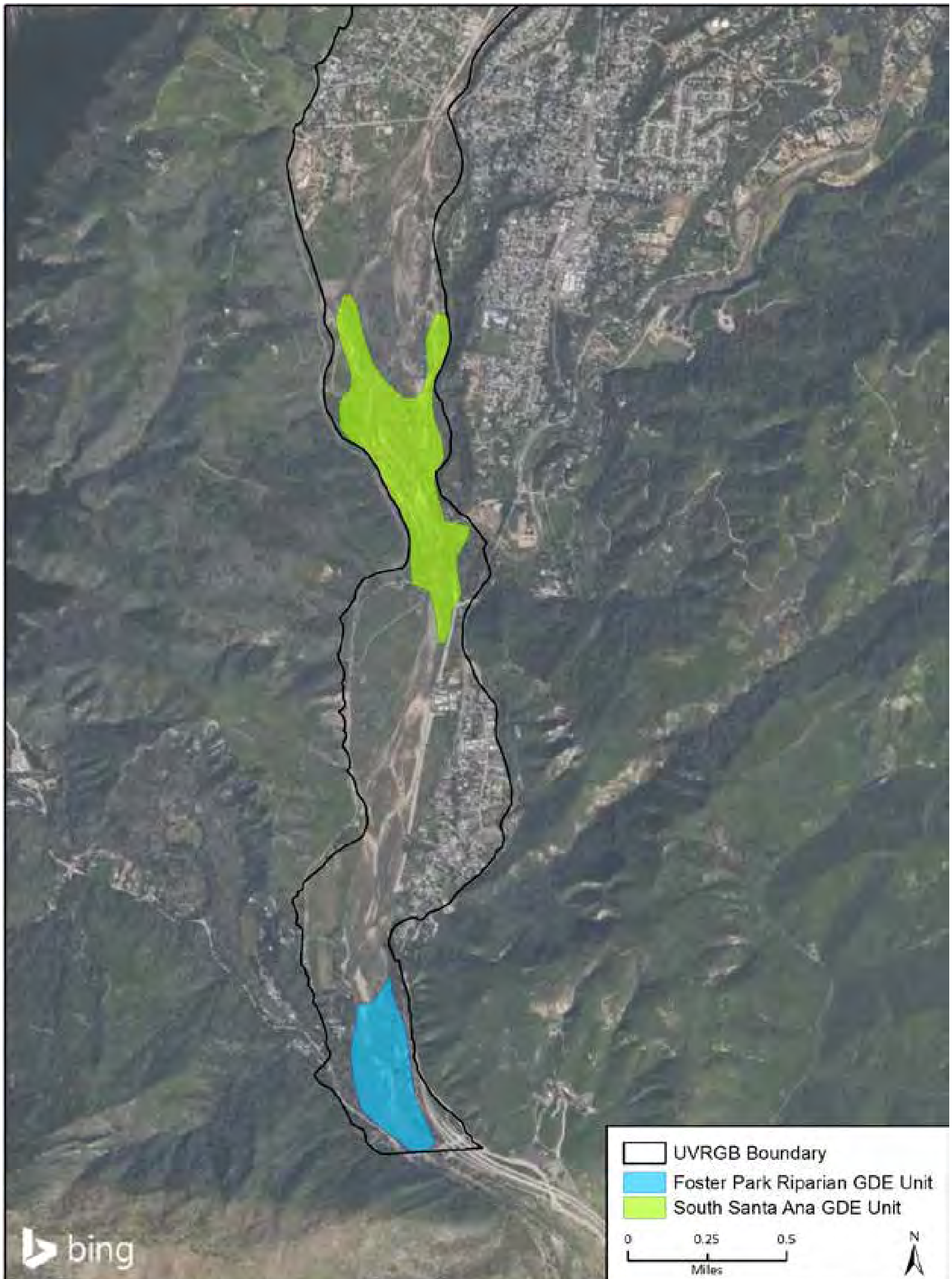

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Table 4 UVRGB Riparian GDE Units

Riparian GDE Unit	Description
South Santa Ana	This Riparian GDE unit falls primarily within the southern South Santa Ana and a small area in the northern Casitas Springs hydrogeologic area. This Riparian GDE Unit occurs near a narrow reach of the Ventura River channel, southwest of Oak View and northwest of Casitas Springs. It consists primarily of Riparian Mixed Hardwood along the river channel and adjacent slopes, areas of Wetland habitat within and adjacent to the river.
Foster Park	This Riparian GDE unit lies in the southern limit of the UVRGB and the southern portion of the Casitas Springs hydrogeologic area. This Riparian GDE Unit lies southwest of Casitas Springs, north of Casitas View Road and west of Highway 33 and includes portions of Foster Park. The unit consists primarily of Riparian Mixed Hardwood in the east and south and a small portion of Coast Live Oak in the west, with several small Wetland areas scattered throughout.

3 Riparian GDE Unit Characterization

This section provides an overview of the ecological condition of the UVRGB as a whole as well as the Riparian GDE Units, including an assessment of their relative ecological value. Descriptions of vegetation communities and critical habitat, as well as how these habitats are used by animals and special status species.

3.1 UVRGB Ecological Condition Overview

Vegetation Communities

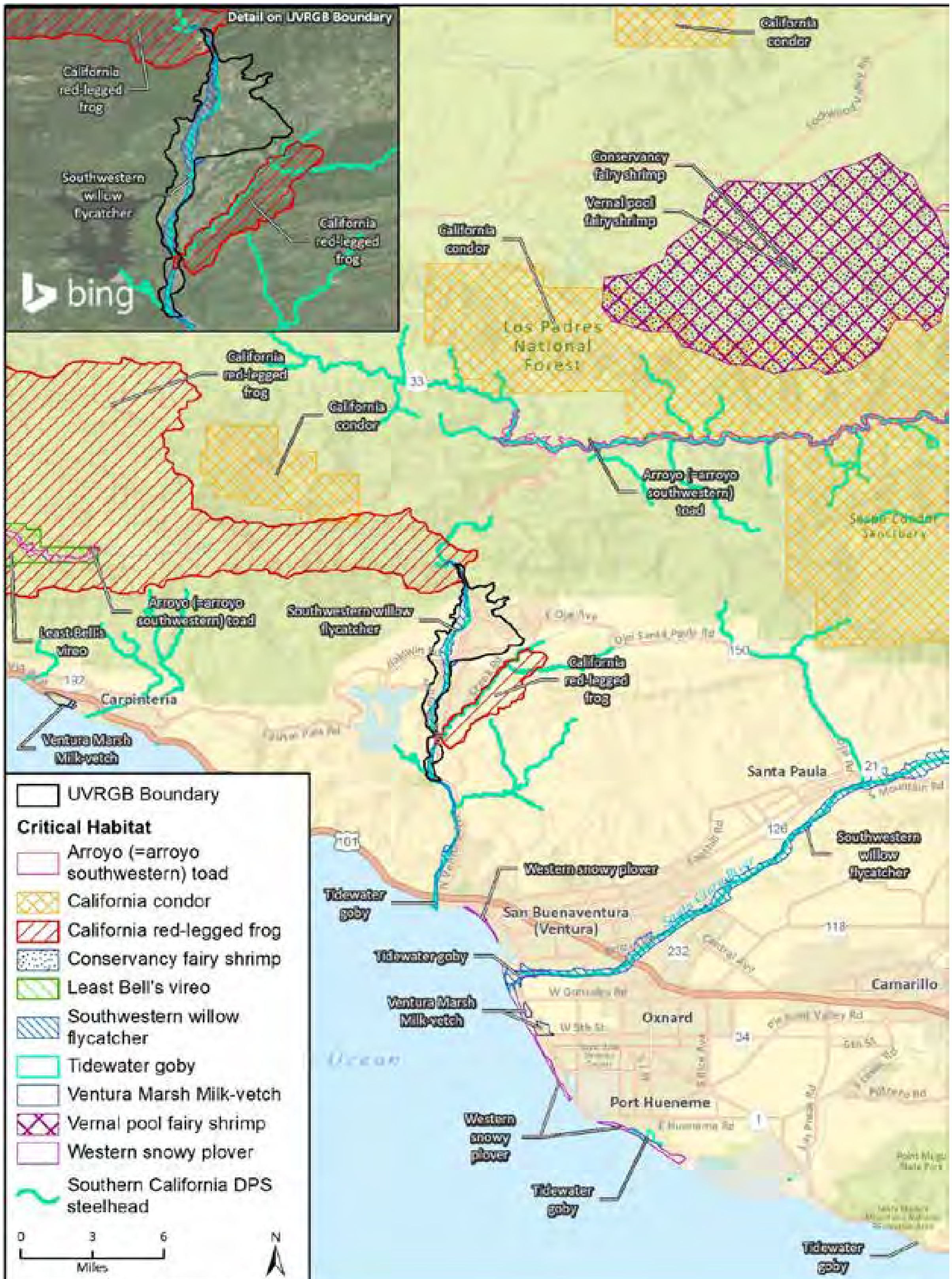
The UVRGB is home to various vegetation communities, including: Chaparral, Arroyo Willow Scrub, Coast Live Oak, Riparian Mixed Hardwood, Scalebroom, Riversidean Alluvial Scrub, and Wetlands (CDFW 2021d, CalVEG). Southern Sycamore Riparian Alder woodland, a CDFW sensitive natural community, also exists within the southern portion of the basin (CFDW 2021a). Invasive plant species, including arundo (*Arundo donax)* and sweet fennel (*Foeniculum vulgare*) occur within the Ventura River channel throughout the basin and have been documented replacing native plant species within multiple vegetation communities. Vegetation communities within the UVRGB that were identified by the NCCAG dataset as iGDEs are described in more detail in Appendix A.

Critical Habitat

Rincon queried the U.S. Fish and Wildlife Service (USFWS) Critical Habitat Portal (USFWS 2021a) and the NOAA Critical Habitat maps (NOAA 2021) for information on federally designated critical habitat within the UVRGB. The UVRGB includes designated critical habitat for three federally listed species: southwestern willow flycatcher (*Empidonax traillii extimus*), southern California DPS steelhead (*Oncorhynchus mykiss irideus*), and California red-legged frog (*Rana draytonii*) (USFWS 2013, NOAA 2005, USFWS 2010).

A map of federally designated critical habitats within the UVRGB and surrounding area is presented as Figure 9. Critical habitat for the southwestern willow flycatcher occurs within the entire Ventura River basin, as well as the Santa Clara River basin to the south. Critical habitat for southern California DPS steelhead occurs within all estuaries and streams with connectivity to the ocean from the Santa Maria River (in southern San Luis Obispo County) south to San Mateo Creek (at the border of Orange and San Diego Counties). Within the UVRGB, critical habitat for steelhead exists within the stream channel of the Ventura River up to the ordinary high-water mark (OHWM) upstream to impassable barriers. A large expanse of critical habitat for the California red-legged frog exists northwest of the UVRGB and overlaps with the northernmost portion of the basin. Critical habitat for the species also exists within San Antonio Creek to the east and overlaps with the UVRGB at the confluence of San Antonio Creek and the Ventura River (Figure 9).

Figure 9 Federally Designated Critical Habitats within the UVRGB and Region



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Sensitive Natural Communities

CDFW maintains a list of sensitive communities that are known to have generally been reduced from their historic levels statewide and are therefore a priority for conservation. Riparian types comprise a large portion of these sensitive communities as a result of water resources development and other land uses. Two groundwater dependent sensitive natural communities occur within the UVRGB: Southern California Steelhead Stream and Southern Sycamore Alder Riparian Woodland (*Alnus rhombifolia -Platanus racemosa*). Note that the statewide CDFW datasets use obsolete vegetation nomenclature that are not comparable to current vegetation lists. While additional investigation into these communities to “crosswalk” that data to current nomenclature was considered, the key takeaway is that sensitive resources occur throughout the UVRGB and within the GDEs. Further, additional sensitive natural communities that are not groundwater dependent are likely to occur throughout the UVRGB.

Special Status Species

Fourteen special status plant species were evaluated for their potential to occur within the UVRGB based on database queries (CDFW 2021a, CNPS 2021) and local knowledge. Of these, five are not expected to occur, and nine have some potential to occur within the basin. Twelve special status fish and wildlife species were evaluated for the potential to occur within the UVRGB based on database queries (CDFW 2021a) and local knowledge. Of these, nine have some potential to occur within the basin and six are known to be present within the basin. Appendix B provides a complete list of special status species evaluated, as well as the criteria used to evaluate potential for special status species to occur, as well as their potential dependency on groundwater.

3.2 Ecological Assessment of South Santa Ana Riparian GDE Unit

The South Santa Ana Riparian GDE Unit consists primarily of riparian mixed hardwood along the river channel and adjacent slopes and areas of wetland habitat within and adjacent to the Ventura River (Figure 8). The unit contains federally designated critical habitat for the southwestern willow flycatcher, California red-legged frog, and southern California DPS steelhead (Figure 9).

Nine special status fish and wildlife species are known or have potential to occur within the unit. One sensitive natural community occurs within the South Santa Ana GDE Riparian Unit: Southern California Steelhead Stream.[3] There are no special status plant species with potential to occur within the Unit. Table 5 lists each of these species and communities, as well as their status, potential to occur, and riparian GDE association.

Aquatic species rely on both instream and riparian habitats and are therefore identified in this Riparian GDE Assessment. However, a separate assessment of aquatic GDEs is being conducted to support SMC development for the *depletion of interconnected surface water* sustainability indicator. This assessment will evaluate potential impacts to instream habitat and the aquatic species dependent on interconnected surface water in the UVRGB.

[3] Note that Southern California Steelhead Stream is not a plant community. Rather, it is an overlay CDFW used to include steelhead habitat in the statewide database.

Table 5 Special status Wildlife Species and Sensitive Natural Communities with Potential to Occur Within the South Santa Ana Riparian GDE Unit

Scientific Name Common Name	Status: Fed/State ESA CDFW	Potential to Occur[1]	Riparian GDE Association[1]
Wildlife			
Actinemys pallida (Emys marmorata) Southwestern pond turtle[2]	None/None SSC	Present	Direct
Empidonax traillii extimus Southwestern willow flycatcher	FE/SE	May Occur	Indirect
Entosphenus tridentatus Pacific lamprey[2]	None/None SSC	Present	Direct
Gila orcutti Arroyo chub[2]	None/None SSC	Present (non-native)	Direct
Oncorhynchus mykiss irideus pop. 10 Southern California DPS steelhead[2]	FE/None	Present	Direct
Rana draytonii California red-legged frog[2]	FT/None SSC	Present	Direct
Setophaga petechia Yellow warbler	None/None SSC	Likely to Occur	Indirect
Thamnophis hammondii Two-striped gartersnake[2]	None/None SSC	Present	Direct
Vireo bellii pusillus Least Bell's vireo	FE/SE	Likely to Occur	Indirect
Sensitive Natural Communities			
Southern California Steelhead Stream[2]	–	Present	Direct

[1] Appendix B presents criteria for assessing species' potential to occur and riparian GDE association.

[2] Note that potential impacts to aquatic species will be evaluated as part of a separate aquatic GDE assessment.

Fed = Federal
ESA = Endangered Species Act
CDFW = California Department of Fish and Wildlife
FE = Federally Endangered
FT = Federally Threatened
SSC= CDFW Species of Special Concern
SE = State Endangered
ST = State Threatened
SCE = State Candidate Endangered

South Santa Ana Riparian GDE Unit Ecological Value

The South Santa Ana GDE Unit was determined to have high ecological value based on the following characteristics:

§ Contains federally designated critical habitat for the California red-legged frog, the southwestern willow flycatcher, and southern California DPS steelhead,

§ Provides habitat for a relatively large number of special status species (Table 5),

§ Contains mixed riparian hardwood, coast live oak, and wetland vegetation communities, which support a large number of native terrestrial and aquatic wildlife species, and

§ Located along a reach of the Ventura River with generally perennial flows discharged from groundwater.

3.3 Ecological Assessment of the Foster Park Riparian GDE Unit

The Foster Park Riparian GDE Unit consists primarily of riparian mixed hardwood in the east and south and coast live oak in the north and west, with several small wetland areas scattered throughout (Figure 8). The unit contains federally designated critical habitat for the southwestern willow flycatcher and southern California DPS steelhead (Figure 9).

Nine special status terrestrial and aquatic wildlife species are known or have potential to occur within the unit. There are no special status plant species with potential to occur within the Foster Park GDE Unit. Table 6 lists each of these species, as well as their status, potential to occur within the GDE unit, and GDE association.

Table 6 Special status Wildlife Species and Sensitive Natural Communities with Potential to Occur Within the Foster Park Riparian GDE Unit

Scientific Name Common Name	Status: Fed/State ESA CDFW	Potential to Occur[1]	Riparian GDE Association[1]
Wildlife			
Actinemys pallida (Emys marmorata) Southwestern pond turtle[2]	None/None SSC	Present	Direct
Empidonax traillii extimus Southwestern willow flycatcher	FE/SE	May Occur	Indirect
Entosphenus tridentatus Pacific lamprey[2]	None/None SSC	Present	Direct
Gila orcutti Arroyo chub[2]	None/None SSC	Present (non-native)	Direct
Oncorhynchus mykiss irideus Southern California DPS steelhead[2]	FE/None	Present	Direct
Rana draytonii California red-legged frog[2]	FT/None SSC	Present	Direct
Setophaga petechia Yellow warbler	None/None SSC	Likely to Occur	Indirect
Thamnophis hammondii Two-striped gartersnake[2]	None/None SSC	Present	Direct
Vireo bellii pusillus Least Bell's vireo	FE/SE	Likely to Occur	Indirect
Sensitive Natural Communities			
Southern California Steelhead Stream[2]		Present	Direct
Platanus racemosa Southern Sycamore Alder Riparian Woodland		Present	Direct

[1] Appendix B presents criteria for assessing species' potential to occur and riparian GDE association.

[2] Note that potential impacts to aquatic species will be evaluated as part of a separate aquatic GDE assessment.

Fed = Federal FE = Federally Endangered FT = Federally Threatened
ESA = Endangered Species Act SSC= CDFW Species of Special Concern SE = State Endangered
CDFW = California Department of Fish and Wildlife

Foster Park Riparian GDE Unit Ecological Value

The Foster Park GDE Unit was determined to have high ecological value based on the following characteristics:

- Contains federally designated critical habitat for the southwestern willow flycatcher and southern California DPS steelhead,
- Provides habitat for a relatively large number of special status species (Table 6),
- Contains mixed riparian hardwood, coast live oak, and wetland vegetation communities, which support a large number of native terrestrial and aquatic wildlife species, and
- Located along a gaining reach of the Ventura River with perennial flows discharged from groundwater.

4 Riparian GDE Impact Analysis

The applicable SGMA sustainability indicators for assessing potential effects to riparian GDEs in the UVRGB are "Lowering of Groundwater Levels" and "Reduction of Storage." Following TNC guidance, groundwater level data and two satellite-derived vegetation indices were used to analyze the potential effects to each Riparian GDE Unit caused by changing groundwater conditions. First, the susceptibility of each Riparian GDE Unit was assessed, and then the potential impacts (i.e., effects) caused by changing groundwater conditions were evaluated.

4.1 Susceptibility to Changing Groundwater Conditions

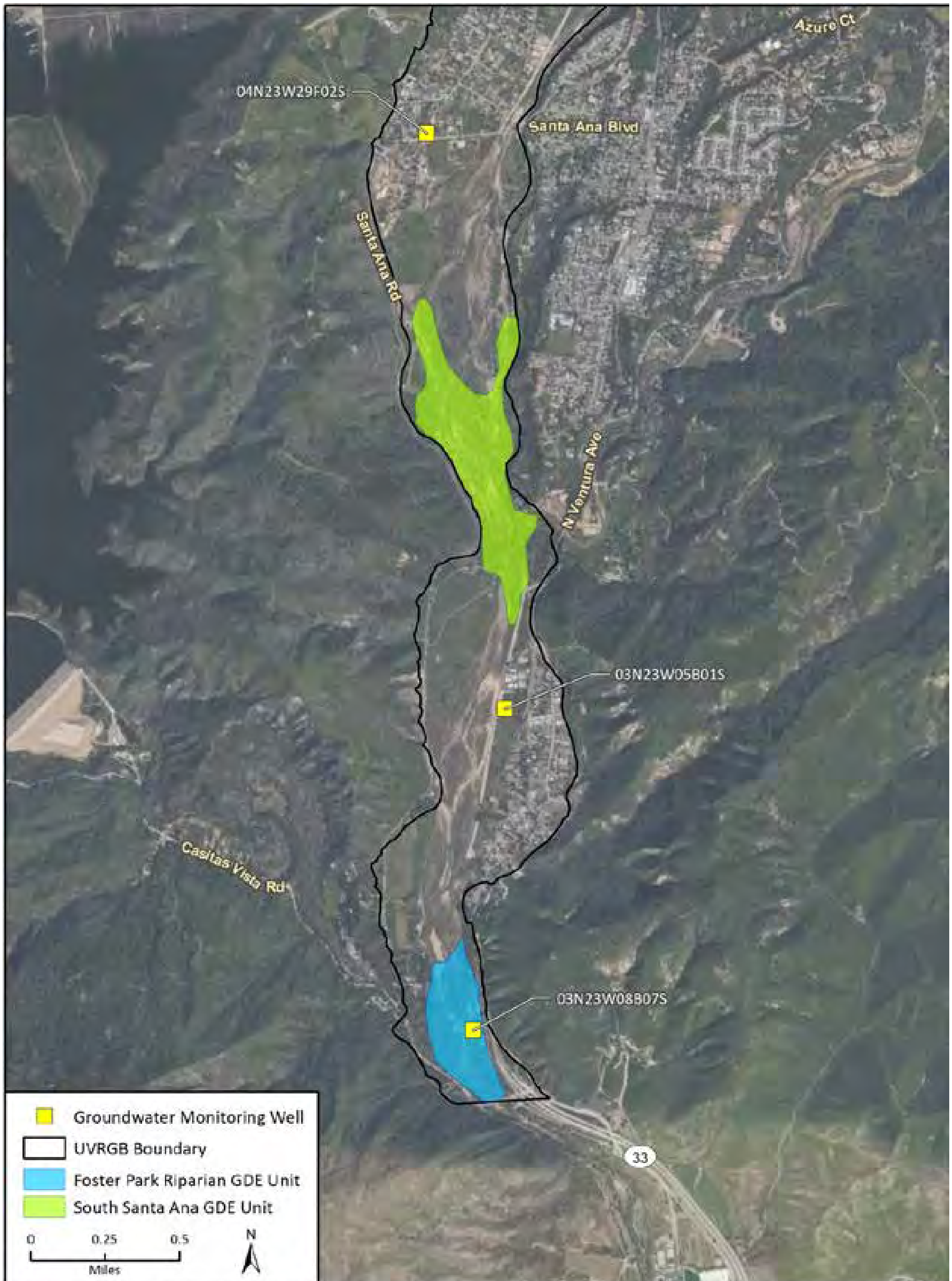
Historical groundwater level data from two groundwater monitoring wells located north and south of the South Santa Ana Riparian GDE Unit, and one groundwater monitoring well located within the Foster Park Riparian GDE Unit were used for this analysis (Figure 10).[4] Normalized Difference Vegetation Index (NDVI) and Normalized Difference Moisture Index (NDMI) were used to assess the relative health of the vegetation communities within the Riparian GDE Units.

NDVI provides an estimate of vegetation greenness, while NDMI estimates vegetation moisture, and these indices are correlated with vegetative growth (e.g., increasing values indicated increasing growth and decreasing values indicate decreasing growth). Both values are generated from surface reflectance corrected multispectral Landsat imagery corresponding to the period of July 9 to September 7 of each year, which represents the period when GDE species are most likely to use groundwater (Klausmeyer et al. 2019). NDVI and NDMI data from 1985 to 2018 were downloaded for specific GDE areas within the UVRGB from the TNC GDE Pulse website (TNC 2018). The data are provided according to iGDE polygons. The average NDVI and NDMI values for the areas overlapping with each Riparian GDE Unit were calculated and are presented in the following figures (Figure 11 and Figure 12). Additional figures for all NDVI and NDMI data are presented in Appendix C.

While these indices do not provide a definitive indication that other components of the ecosystem are thriving or under stress, they provide a reasonable first-order check on the connection between groundwater and the vegetation that compose the ecosystem. Previous work has shown that decreases in vegetation vigor are correlated to decreases in remote sensing metrics such as NDVI (e.g., Huntington et al. 2016) and that decreases in vegetation health often correlate with decreases in overall ecosystem health. NDVI and NDMI values can serve as a general indicator of ecosystem health, though they do not allow for differentiation between vegetation types, including differentiation between native and invasive species. Thus, visual analysis is necessary to confirm that NDVI and NDMI values represent canopy health/vegetation vigor of the same native plant species within a community over time, and that major species composition shifts have not occurred. Aerial imagery of each GDE Unit within the UVRGB was analyzed to confirm that the predominant plant species were consistent from 1985 to 2018.

[4] No groundwater monitoring sites are located within the South Santa Ana Riparian GDE Unit. This is a data gap that will be addressed during GSP implementation.

Figure 10 Riparian GDE Units and nearby Groundwater Monitoring Wells



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South Santa Ana Riparian GDE Unit Susceptibility

Figure 11 depicts the trends in groundwater level and average NDVI and NDMI values for the South Santa Ana Riparian GDE Unit from 1985 through 2018. DTW from a static reference point was measured quarterly at wells both north and south of the South Santa Ana GDE Unit (Figure 10). While DTW varied widely at these groundwater monitoring wells (from a high of 7.5 feet in February 1998 to a low of 62.7 feet in December 2013), it's important to understand that these wells do not reflect the actual DTW within the South Santa Ana GDE Unit, but rather provide insight to the changing groundwater conditions.[5] Nonetheless, these groundwater levels provide an indication of the relative seasonal and interannual groundwater level trends expected in the GDE unit. Annual rainfall during 1998 was the highest on record (49.20 inches) since 1906 (VRWC 2021). A period of drought occurred between 2012 and 2016, during which time groundwater levels did not rise above 20 feet below ground level. The lowered DTW to 62.7 feet below ground level in December 2013 marks the lowest groundwater level at that location since 1972. Following periods of heavier rainfall in early 2017, groundwater levels rebounded rapidly to pre-drought levels.

NDVI and NDMI values fluctuate over time and generally decrease with decreasing DTW. During drought conditions that occurred between 2012 and 2016, NDVI and NDMI values showed a persistent decline. However, these values also rebounded as DTW increased again in 2017. Analysis of aerial imagery confirmed a decrease in vegetative growth during this recent period of severe drought, followed by a resurgence of growth and canopy health in subsequent years with more rain.

Foster Park Riparian GDE Unit Susceptibility

Figure 12 depicts trends in groundwater levels and average NDVI and NDMI values for the Foster Park Riparian GDE unit from 1985 through 2018. DTW from a static reference point was measured quarterly at a well within the Foster Park Riparian GDE Unit (Figure 10). DTW varied from a high of 6.80 feet in February 1998 to a low of 29.6 feet in February 1991. During the recent drought period, DTW values lowered to 23.1 feet in February 2013 and 24.2 feet in December 2014. Following periods of heavier rainfall in early 2017, groundwater levels rebounded to almost pre-drought levels.

NDVI and NDMI values fluctuate over time and generally decrease with decreasing DTW. While a general increasing trend of NDVI and NDMI was observed for the Foster Park Riparian GDE Unit, the potential cause is currently unclear, but could be related to influences of past floods or management actions in Foster Park. Figure 13 presents a photo series beginning in 2004 and ending in 2019. This figure depicts vegetation removal and subsequent revegetation following flood events that occurred in 2005. Following a period of increasing index values from 2006 to 2012, NDVI and NDMI values declined during recent drought conditions, but then increased again in 2017 following a water year with moderate precipitation. Similar to the South Santa Ana Riparian GDE Unit, analysis of aerial imagery confirmed a decrease of vegetative growth during this recent period of severe drought, followed by rebounding growth and canopy cover in subsequent years with more rain.

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[5] UVRGA understands this is a data gap and plans to develop a monitoring well network that includes a groundwater monitoring well in the South Santa Ana Riparian GDE Unit.

Figure 11 Groundwater Level Compared to Average NDVI and NDMI for the South Santa Ana Riparian GDE Unit (1985 to 2018)

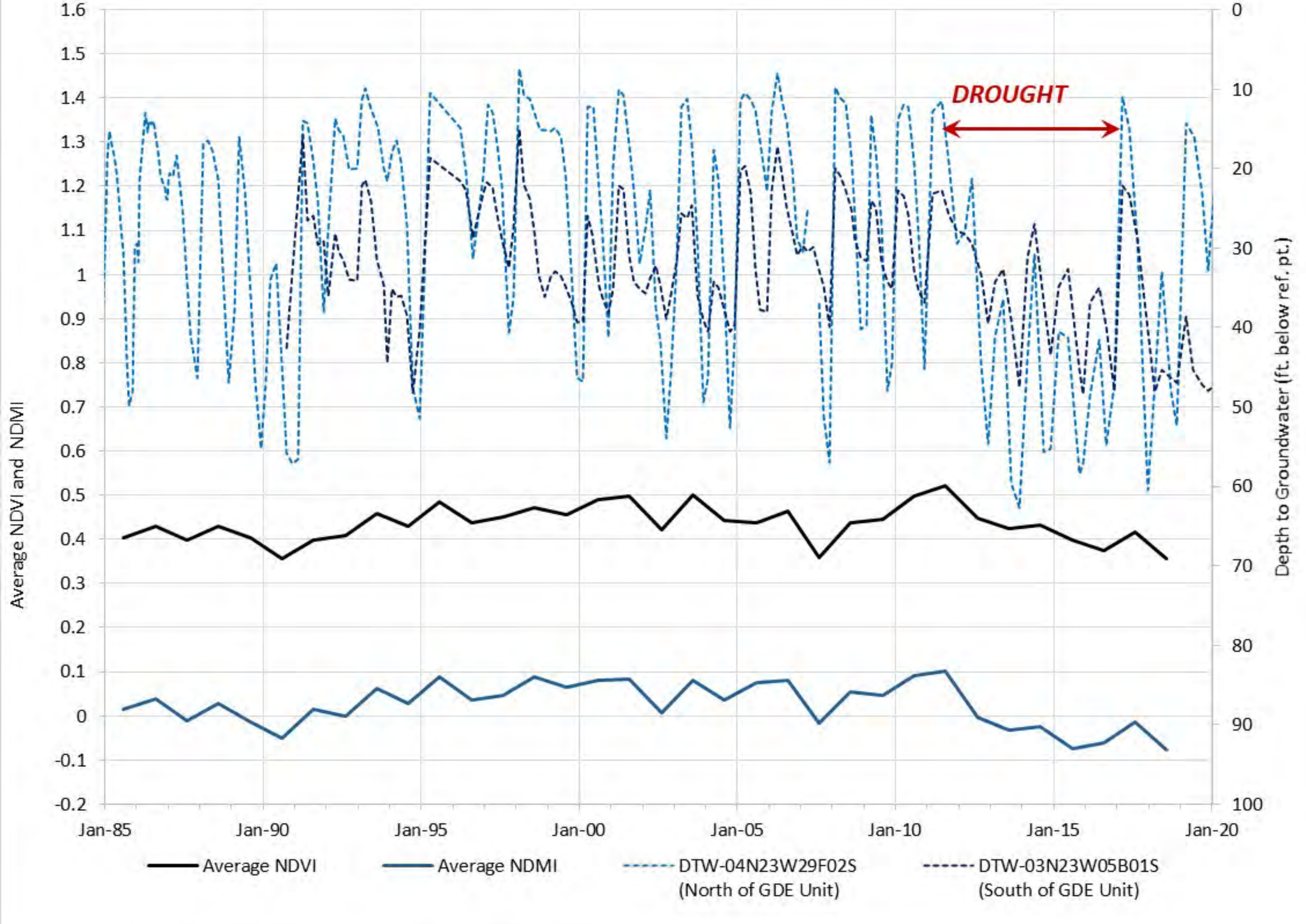


Figure 12 Groundwater Level Compared to Average NDVI and NDMI for the Foster Park Riparian GDE Unit (1985 to 2018)

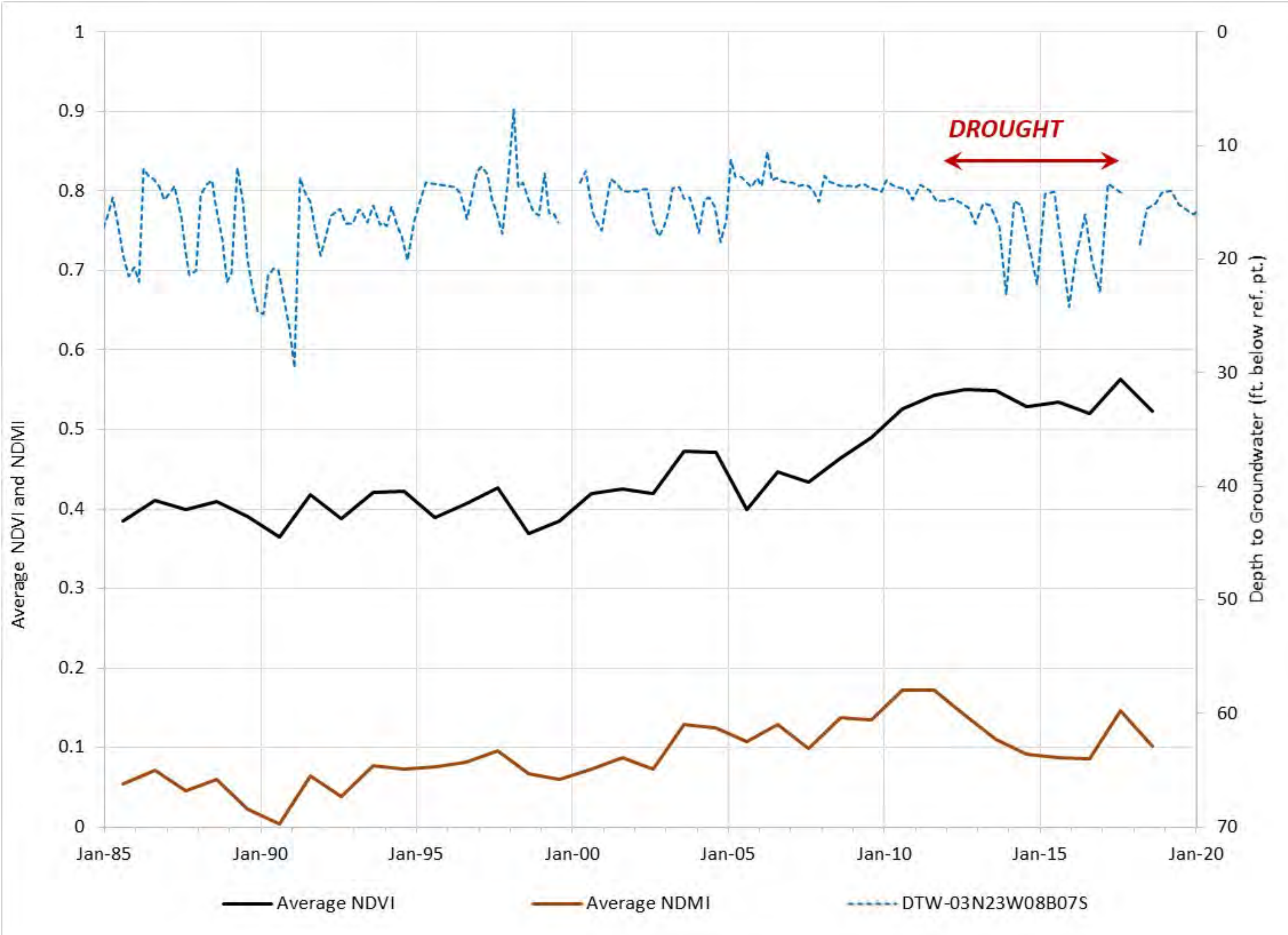
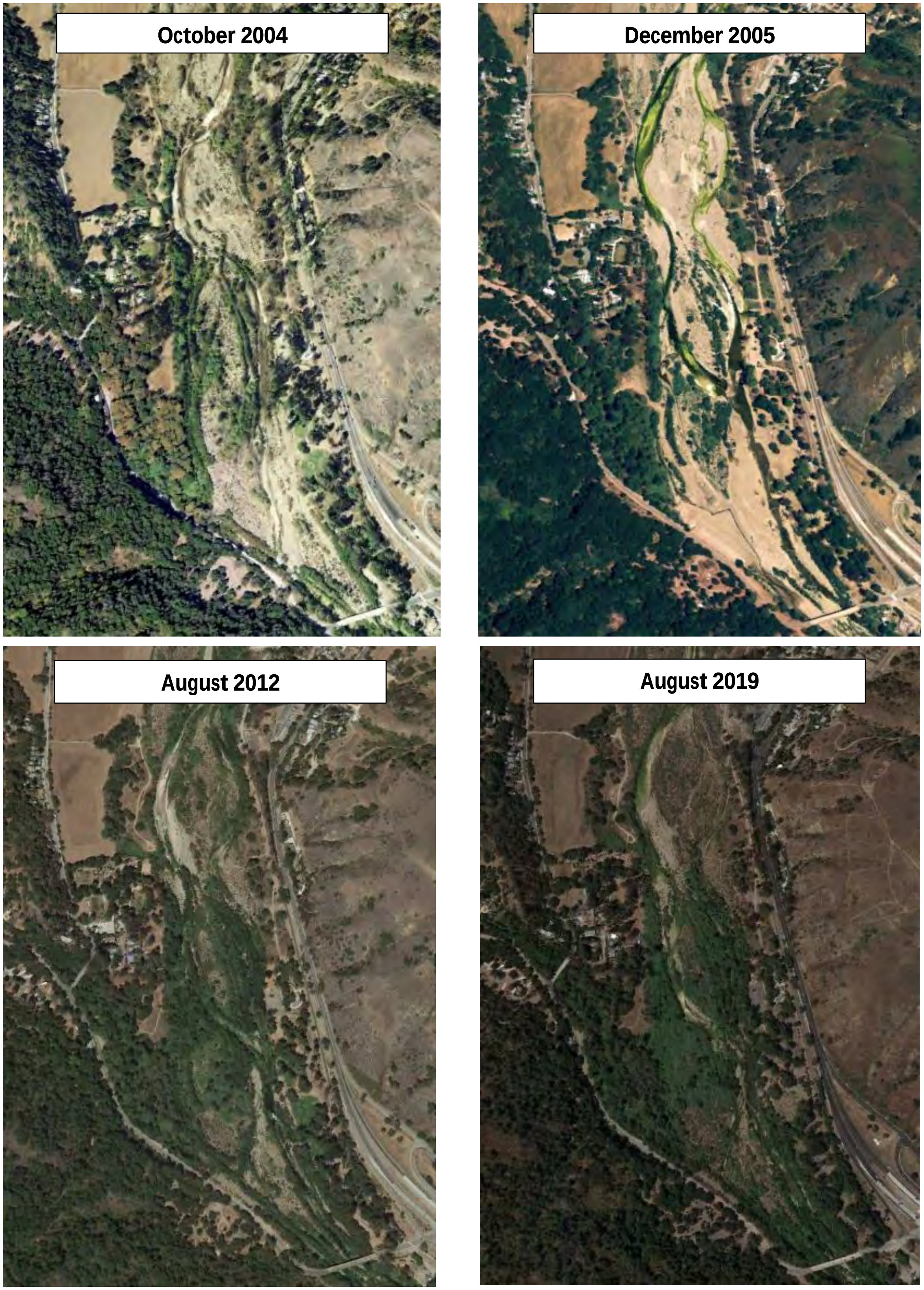


Figure 13 Aerial Imagery of Foster Park GDE Unit between 2004 and 2019



4.2 Potential Effects Caused by Changing Groundwater Conditions

Historic hydrologic conditions within the Riparian GDE Units indicate that groundwater levels are directly connected to climatic conditions and that groundwater recharge occurs following periods of rain. Based on NDVI and NDMI data, vegetative health of the communities within each Riparian GDE Unit are correlated to groundwater levels and decrease during periods of drought but rebound upon the return of relatively moderate precipitation. Based on these data, it appears that naturally occurring periods of low groundwater levels do have a negative impact on these groundwater dependent vegetation communities, but that these impacts are not permanent or prolonged. A visual analysis of the recent drought period between 2012 through 2017 confirms that the species in these vegetation communities rebound with no noticeable changes in density or composition.

Therefore, it appears that pumping is likely not the cause of impacts in the historic data, but that it is instead closely related to the varying hydrologic conditions. Based on this assessment, no permanent or prolonged impacts to GDEs within this unit are anticipated if climatic, hydrologic, and pumping conditions remain generally consistent with past trends. If groundwater levels were to remain chronically low for an extended period of time (beyond that seen in the historic dataset), pumping within the basin could exacerbate the stress on these communities and could potentially cause permanent or prolonged impacts to the GDEs. As such, ongoing monitoring of groundwater levels and vegetative health within these important ecosystems should be considered in the required 5-year GSP assessment.

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Appendix A

Communities Identified as iGDEs in the UVRGB

Communities Identified as iGDEs in the UVRGB

The Natural Communities Commonly Associated with Groundwater (NCCAG) dataset identifies multiple iGDEs within the UVRGB (DWR 2021). Most of these iGDEs exist along the mainstem of the Ventura River floodplain. However, there are a number of areas with mapped Coast Live Oak outside of the floodplain in the Mira Monte/Meiners Oaks Area. Scalebroom, Riparian Mixed Hardwood and Riverside Alluvial Scrub communities occupy a significant portion of the Ventura River floodplain with Scalebroom and Riversidean Alluvial Scrub predominantly in the northern portion of the basin floodplain and Riparian Mixed Hardwood and Coast Live Oak in the southern portion of the basin floodplain. NCCAG wetland classifications are located from the Kennedy Area to just upstream of the Robles diversion in the Kennedy and Robles areas and in the Santa Ana and Casitas Springs areas downstream of the San Antonio Creek confluence (Figure 1).

Coast live oaks within the basin are found on the banks of small streams, on high terraces away from active channels, on erosional deposits along the margins of canyon bottoms, and on the lower slopes of canyon sides (VRWC 2015). Coast live oak (*Quercus agrifolia*) is considered the most fire-resistant California tree oak (USDA 2009) yet does not tolerate extended flooding (VRWC 2015). It has evergreen leaves, thick bark and an ability to sprout from the trunk and roots, given its food reserves stored in an extensive root system (USDA 2009). Other common trees, shrubs, and vines associated with this NCCAG classification may include arroyo willow, Fremont cottonwood, valley oak, California sycamore, bigleaf maple, California bay, Mexican elder-berry, mulefat, Pacific blackberry, gooseberry, snowberry, poison oak, California sagebrush, coyote brush, horsetails, and mugwort (VRWC 2015). Reported maximum rooting depths for the coast live oak ranged from 24 to 35 feet (TNC 2020).

Riparian Mixed Hardwood communities exist in the southern portions of the Ventura River floodplain (Santa Ana and Casitas Springs Hydrogeologic Areas). Riparian Mixed Hardwood is found along perennial and intermittent streams in areas that are less frequently and less intensely disturbed by flood events than areas dominated by riparian scrub. With less scouring and flooding, the trees in this habitat have more of a chance to mature (VRWC 2015). The hardwood communities can vary from a few meters in width in narrow passageways confined by geographic features at higher elevations to much broader extents in areas where non-seasonal streams flow out of the mountains and onto flat grasslands (VRWC 2015). The species mixture includes any combination of native obligate or facultative riparian hardwoods. The Riparian Mixed Hardwood this NCCAG classification can include white alder (*Alnus rhombifolia*), willow (*Salix spp.*), California sycamore (*Platanus racemosa*), fremont or black cottonwood (*Populus fremontii, P. balsamifera ssp. trichocarpa*), bigleaf maple (*Acer macrophyllum*), coast live oak (*Quercus agrifolia*), California bay (*Umbellularia californica*), and dogwood (*Cornus spp.*). A variety of riparian shrubs and perennial species may be included in this NCCAG classification, such as California wildrose (*Rosa californica*), mugwort (*Artemisia douglasiana*), *Baccharis spp.*, *Rubus spp.*, *Ribes spp.*, etc. (USDA 2009). Riparian corridors in the Ventura River Watershed support two general riparian woodland types: cottonwood-willow-sycamore and coast live oak (VRWC 2015). Apart from Coast live oak a few of this category's primary plant species (willow, fremont cottonwood, and black cottonwood) had rooting depth information in the GDE Database (TNC 2020), with ranges from 1 to 7 ft.

Scalebroom germinates and establishes after flood events and therefore the size and distribution of scalebroom along a stream channel can be used to understand flooding history in local areas (VCRC 2015). It is a many-branched shrub that can grow up to 10 feet tall but is typically around 5 feet. It gets its name from its small leaves which form a scale-like skin, looking like part of green stems (County of Ventura 2006). Scalebroom plays an essential ecosystem role, producing abundant small yellow aromatic flowers in the fall that feed a wide variety of insects. This supports the food chain during the dry fall months and extended droughts (VRWC 2015). Roots of the scalebroom can be extensive laterally and vary in root depth, sometimes extending to the water table (County of Ventura, 2006). Roots may be deep in fluvial deposits (RCRCD 2018). Despite these general statements about root depth, specific rooting depth values were not identified for scalebroom (TNC, 2020). Species that may also be found in the Scalebroom CALVEG class include brittlebrush (*Encelia farinosa*), creosote bush (*Larrea tridentata*), chaparral yucca (*Y. whipplei*), rabbitbrush (*Chrysothamnus nauseosus*) and big sagebrush (*Artemisia tridentata*). Riparian hardwoods such as Fremont cottonwood (*Populus fremontii*) and desert willow (Chilopsis linearis) may occur on or adjacent to these sites (USDA 2009). No information about scalebroom rooting depth is provided in the GDE Rooting Depths Database (TNC 2020). However, other species associated with this NCCAG classification (brittlebrush, creosote bush, chaparral yucca, rabbitbrush, and big sagebrush) have reported maximum rooting depths in the range of 2 to 18 feet, with an average of approximately 6 feet (TNC 2020).

Riversidean Alluvial Scrub habitats are found in alluvial fans and dry washes with flood patterns. Scalebroom is also generally regarded as an indicator for this alliance (Hanes *et al.* 1989). The history of ground disturbance can play a significant contribution in the mixture of vegetation species. In addition to scalebroom, other species included in the Riversidian Alluvial Scrub CALVEG alliance are: California buckwheat (*Eriogonum fasciculatum*), California sagebrush (*Artemisia californica*), white sage (*Salvia apiana*), and *Encelia spp., Opuntia spp.*, chaparral yucca (*Yucca whipplei*), *Rhus spp.*, and California juniper (*Juniperus californica*) (USDA, 2009). As mentioned above, no information about scalebroom rooting depth is provided in the GDE Rooting Depths Database. However, the other species associated with this NCCAG classification (California buckwheat, chaparral yucca, and white sage) have reported rooting depths ranging from 2 to 5 feet (TNC 2020).

Wetlands occur where water saturation is the dominant factor influencing the nature of soil development and the types of plant and animal communities in the soil and on its surface (Cowardin et al., 1979; VRWC 2015). Agencies have different official definitions for wetlands, but all variations include the three following elements: (1) hydrology – water is at or above the soil surface for a sufficient period of time annually to influence plant types and soil chemistry, (2) hydric soils – soils that are wet of sufficient duration throughout the year to develop low-oxygen conditions, and (3) hydrophytic plants – plants are adapted to saturated soil conditions (County of Ventura 2006; VRWC 2015). Wetlands also naturally filter the water, allowing suspended sediments to drop out of the water column and for uptake of pollutants by plants and soils. They are also some of the most biologically productive natural ecosystems in the world. The shallow water and vegetation provide diverse habitats for fish and wildlife (VRWC 2015). Most of the wetlands in the UVRGB are in-channel riverine wetlands, shown in blue in Figure 1 as the NCCAG wetland classification in the Ventura River. The Ventura River and its tributaries and drainages support miles of riverine wetlands. Riverine wetlands include the “active channel” that contains flows under non-flood conditions. Since storm flows often rip out vegetation in the active channel, riverine wetlands are characterized by non-persistent vegetation that reflects this unstable environment (Ferren et al., 1995; VRWC 2015). Within the Ventura River mainstem, the riverine wetland substrate in the channel centers transitions from bedrock and large boulders in the upper reaches to mixed cobbles and gravel in the middle reaches to patchy boulders, cobbles, gravel, mud, and sand in the downstream reaches (Ferren et al. 1995; VRWC 2015). The Ventura reaches in the northern

(Kennedy Area) and southern (Casitas Springs) portion of the UVRGB that are more perennial in nature support more plant diversity than intermittent or ephemeral reaches (Robles Area and parts of Santa Ana Area). Active channels of most intermittent reaches are devoid of vegetation while perennial reaches can support a variety of herbs, and floating and submerged vegetation. Common herbaceous plants in riverine wetlands include dotted water smartweed, willow-herb, water parsnip, water primrose, iris-leafed rush, water speedwell, and California bulrush. Submerged and floating aquatic plants include leafy pondweed, fennel pondweed, horned pondweed, duckweed, duckweed fern, water cress, and green algae, which grow in slow-flowing channels (VRWC, 2015). Note, that in the Kennedy Area the Ventura River is intermittently connected to the groundwater system and is typically losing to it (Figure 2). Hence, iGDE wetlands mapped in the Kennedy Area are likely more dependent on surface water and their connection to groundwater is uncertain.

Appendix B

Evaluation Criteria and List of Special Status Species with Potential to Occur in the UVRGB

Evaluation Criteria and List of Special Status Species with Potential to Occur in the UVRGB

For the purposes of this document, special status species are defined as those:

§ listed, proposed, or candidates for listing as endangered or threatened under the federal Endangered Species Act (ESA) or the California Endangered Species Act (CESA);

§ designated by the CDFW as a Species of Special Concern (SSC) or Watchlist Species (WL);

§ designated by the CDFW as Fully Protected (FP) under the California Fish and Game Code (Sections 3511, 4700, 5050, and 5515);

§ included on CDFW's most recent Special Vascular Plants, Bryophytes, and Lichens List (CDFW 2021c) with a California Rare Plant Rank (CRPR) of 1 or 2.

§ protected by the Migratory Bird Treaty Act (MBTA) or California Fish and Game Code Section 3503.

Data Sources

Rincon queried the following databases for information on special status species and sensitive natural communities with documented occurrences within the UVRGB:

§ California Department of Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB, CDFW 2021a)

§ California Native Plant Society Online Inventory of Rare and Endangered Plants of California (CNPS 2021)

§ Calflora Database (Calflora 2021)

§ eBird Online Database of Bird Distribution and Abundance (Cornell Lab of Ornithology 2021a)

§ California Freshwater Species Database (TNC 2020)

§ VegCAMP (CDFW 2021d)

Rincon also reviewed the following sources for additional information on special status species and sensitive natural communities with potential to occur within the UVRGB:

§ CDFW Special Animals List (CDFW 2021b)

§ CDFW Special Vascular Plants, Bryophytes, and Lichens List (CDFW 2021c)

§ CDFW Natural Communities List (CDFW 2020)

§ All About Birds Online Bird Guide (Cornell Lab of Ornithology 2021b)

§ A Manual of California Vegetation, Second Edition, California Native Plant Society (Sawyer et al. 2009)

§ Biological Resources Assessment for the Foster Park Fish Passage Improvement Project: Phase 1 Subterranean Diversion Notch (Rincon 2020)

Evaluation Criteria

The following criteria were used to evaluate potential for special status species to occur, as well as their potential dependency on groundwater.

§ **Present.** The species has been observed by a qualified local biologist within the UVRGB within the past five years and/or has a documented occurrence within the basin within the past five years.

§ **Likely to Occur.** Suitable habitat is present within the UVRGB and there are documented occurrences within the basin (or nearby locations with similar habitat) within the past ten years.

§ **May Occur.** Some suitable habitat currently exists within the basin and/or there are documented occurrences in the vicinity within the past twenty years.

§ **Unlikely to Occur.** Only marginally suitable habitat for the species exists within the basin and/or there are no documented occurrences of the species within basin in the past thirty years.

§ **Not Expected.** No suitable habitat for the species exists within the basin, the species is considered extirpated in the region, and/or there are no documented occurrences of the species within the basin in the past thirty years.

Special status plant species were classified as either **likely** or **unlikely** to depend on groundwater, and therefore be associated with a GDE, based on habitat and water requirements, current distribution within the UVRGB and/or the location of documented occurrences within the basin, and depth to water data within areas of documented occurrences.

Wildlife and fish species were evaluated for potential groundwater dependence based on determinations from the Critical Species Lookbook (Rohde et al. 2019) and by evaluating known habitat preferences, life histories, and diets. Species GDE associations were assigned one of three categories:

§ **Direct.** Species directly dependent on groundwater for some or all water needs(e.g., juvenile steelhead in dry season).

§ **Indirect.** Species dependent upon other species that rely on groundwater for some or all water needs (e.g., riparian birds).

§ **No known reliance on groundwater.**

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Special status Species with Potential to Occur within the UVRGB

Scientific Name Common Name	Status	Potential to Occur within UVRGB	Habitat Requirements and Documented Occurrences within the UVRGB	GDE Association	GDE Unit
Plants					
Astragalus didymocarpus var. *milesianus* Miles' milk-vetch	None/None 1B.2	Not Expected	Annual herb. 50-385 m elevation. Occurs in coastal scrub with clay soils. Blooms Mar-Jun. There are two occurrences of the species documented in the CNDDB, one in 1945 along Casitas Road, and one of an unknown date in the Ojai Area (CDFW 2021a). There are no occurrences of the species within the UVRGB documented by Calflora. The UVRGB does not contain suitable coastal scrub habitat.	Unlikely	None
Astragalus pycnostachyus var. *lanosissimus* Ventura Marsh milk-vetch	FE/SE 1B.1	Not Expected	Perennial herb. 1-35 m elevation. Occurs in Marshes and swamps, coastal dunes, coastal scrub. Within reach of high tide or protected by barrier beaches, more rarely near seeps on sandy bluffs. Blooms Jul-Oct. There is one occurrence of the species documented within the UVRGB in the CNDDB (CDFW 2021a). This occurrence was documented in 1987 and CDFW considers the species "possibly extirpated" in the region. There are no occurrences of the species documented within the UVRGB by Calflora. This is a beach-dwelling species and no suitable habitat exists within the UVRGB.	Unlikely	None
Calochortus fimbriatus Late-flowered mariposa lily	None/None 1B.3	Likely to Occur	Perennial bulbiferous herb. 270-1435 m. Occurs chaparral, cismontane woodland, and riparian woodland in dry, open areas on serpentine soils. Blooms Jun-Aug. There is one occurrence of the species within the UVRGB documented in the CNDDB in 1946 near Kennedy Canyon in the Santa Ynez Mountains. There are two occurrences of the species documented by Calflora within the basin, one in 1915 and one in 2019. Both of these occurrences are in the Mira Monte area, west of Highway 33 and northeast of Casitas Lake (Calflora 2021).	Unlikely	None
Fritillaria ojaiensis Ojai fritillary	None/None 1B.2	May Occur	Perennial bulbiferous herb. 225-998 m. Occurs in broadleaf upland mesic forest, chaparral, cismontane woodland, and lower montane coniferous forest in rocky soil. Blooms Feb- May. Some suitable chaparral habitat exists within the basin and there are several documented occurrences of the species upland of the UVRGB. However, there are no documented occurrences of the species within the basin (CDFW 2021a, Calflora 2021).	Unlikely	None

Scientific Name **Common Name**	**Status**	**Potential to Occur within UVRGB**	**Habitat Requirements and Documented Occurrences within the UVRGB**	**GDE Association**	**GDE Unit**
Horkelia cuneata var. *puberula* Mesa horkelia	None/None 1B.1	Likely to Occur	Perennial herb. 15-1645 m. elevation. Occurs in chaparral, cismontane woodland, and coastal scrub in sandy or gravelly sites. Blooms Feb-Sep. There is one occurrence within the UVRGB documented in 1935 (CDFW 2021a). There are two occurrences of the species within the UVRGB documented by Calflora. One was documented in 1944 along the eastern bank of the river just south of Highway 150. The second occurrence was documented in 2008 in the Mira Monte region in the northeastern portion of the basin (Calflora 2021).	Unlikely	None
Imperata brevifolia California satintail	None/None 2B.1	May Occur	Perennial rhizomatous herb. 0-1215 m. elevation. Occurs in chaparral, coastal scrub, Mojavean desert scrub, meadows, alkali seeps, and mesic riparian scrub. Blooms Sep-May. Some suitable habitat for the species exists within the UVRGB, but there are no documented occurrences within the basin (CDFW 2021a, Calflora 2021).	Unlikely	None
Lasthenia glabrata ssp. *Hypoleuca* Coulter's goldfields	None/None 1B.1	May Occur	Annual herb. 1-1400 m. elevation. Occurs in coastal salt marshes, playas, valley and foothill grassland, and vernal pools. Typically in alkaline soils in playas, sinks, and grasslands. Blooms Feb-June. There is limited suitable habitat for the species within the UVRGB, but there are no documented occurrences within the basin (CDFW 2021a, Calflora 2021).	Unlikely	None
Layia heterotricha pale-yellow layia	None/None 1B.1	May Occur	Annual herb. 300-1705 m. elevation. Occurs in cismontane woodland, coastal scrub, pinyon and juniper woodland, and valley and foothill grassland. Typically in alkaline or clay soils. Blooms Mar-Jun. There is limited suitable habitat for the species within the UVRGB, but there are no documented occurrences within the basin (CDFW 2021a, Calflora 2021).	Unlikely	None

Scientific Name Common Name	Status	Potential to Occur within UVRGB	Habitat Requirements and Documented Occurrences within the UVRGB	GDE Association	GDE Unit
Monardella hypoleuca ssp. *hypoleuca* White-veined monardella	None/None 1B.3	Unlikely to Occur	Perennial herb. 50-1280 m. Occurs in chaparral and cismontane woodland on dry slopes. 50-1280 m. Blooms Apr-Nov. There is one occurrence of the species documented in the CNDDB within the UVRGB (CDFW 2021a). This occurrence was documented in 1969 in Foster Park, south of Casitas Springs in the southwestern corner of the UVRGB. Calflora documents two additional occurrences of the species within the basin. One in 1895 within the Ventura River channel in the Mira Monte area, and the other in Ojai in 1937 (Calflora 2021).	Unlikely	None
Navarretia ojaiensis Ojai navarretia	None/None 1B.1	Present	Annual herb. 275-620 m. elevation. Occurs in openings in chaparral and coastal scrub, and in valley and foothill grasslands. Blooms May-Jul. There is suitable habitat for the species within the basin and there is one occurrence of the species documented within the UVRGB in 2013, in the Miramonte area (Calflora 2021).	Unlikely	None
Navarretia peninsularis Baja navarretia	None/None 1B.2	Not Expected	Annual herb. 1400-2300 m. Occurs in openings in chaparral, as well as lower montane coniferous forest, meadows and seeps, yellow pine forest, and pinyon and juniper woodlands. Blooms May-Aug. The typical elevation range of the species is higher than the UVRGB and there are no documented occurrences of the species within the basin (CDFW 2021a, Calflora 2021).	Unlikely	None
Nolina cismontana Chaparral nolina	None/None 1B.2	Not Expected	Perennial evergreen shrub. 140-1275 m. elevation. Occurs in chaparral and coastal scrub in sandstone or gabbro. Blooms Mar-Jul. There is some suitable habitat for the species within the UVRGB, but there are no documented occurrences within the basin (CDFW 2021a, Calflora 2021).	Unlikely	None
Sagittaria sanfordii Sanford's arrowhead	None/None 1B.2	Not Expected	Perennial rhizomatous herb. 0-650 m. elevation. Occurs in marshes and swamps. Blooms May-Nov. There are three historical occurrences of the species documented within the UVRGB (in 1945, 1947, 1979; Calflora 2021). However, these occurrences were in habitat that has now been developed.	Unlikely	None

Scientific Name Common Name	Status	Potential to Occur within UVRGB	Habitat Requirements and Documented Occurrences within the UVRGB	GDE Association	GDE Unit
Sidalcea neomexicana Salt spring checkerbloom	None/None 2B.2	Unlikely to Occur	Perennial herb. 3-2380 m. Occurs in alkali springs and marshes, playas, chaparral, coastal scrub, lower montane coniferous forest, and Mojavean desert scrub. Blooms Mar-Jun. There is one occurrence of the species documented within the UVRGB (CDFW 2021a). This occurrence was documented in 1962 in Oak View, just east of Highway 33. There are no occurrences of the species documented within the basin by Calflora. Suitable habitat for the species is very limited within the basin.	Unlikely	None
Invertebrates					
Bombus crotchii Crotch bumble bee	None/SCE	Not Expected	Occurs in coastal California east to the Sierra-Cascade crest and south into Mexico. Food plant genera include: *Antirrhinum, Phacelia, Clarkia, Dendromecon, Eschscholzia,* and *Eriogonum.* One occurrence of the species is documented in the CNDDB from 1892. Food genera within the basin are very limited.	No known dependence on groundwater.	None
Fish					
Entosphenus tridentatus Pacific lamprey	None/None SSC	Present	Occurs in freshwater systems and requires adequate flows for migration, suitable substrate (i.e., gravels) for spawning, and adequate cover for pre-spawning holding. Juveniles (called ammocoetes) spend an extended period of time (between four and ten years) rearing while burrowed in sediments filter feeding on organic material and require suitable cover, flow, foraging conditions, and cool temperatures. Juvenile migrant (called macropthalmia) emigration (i.e., outmigration to the ocean) requires water conditions suitable for migration (i.e., water velocity and water depth, dissolved oxygen levels within the surface water, and water temperature suitable for passage). Pacific lamprey ammocoetes were observed in the lower Ventura River in 2005 (Howard and Swift 2009). Migration (both upstream and downstream) could occur in all surface water reaches of the UVRGB.	Direct	Santa Ana South, Foster Park

Scientific Name Common Name	Status	Potential to Occur within UVRGB	Habitat Requirements and Documented Occurrences within the UVRGB	GDE Association	GDE Unit
Gila orcutti Arroyo chub	None/None SSC Non-Native to Ventura River	Present	Native to streams from Malibu Creek to San Luis Rey River basin. Introduced into streams in Santa Clara, Ventura, Santa Ynez, Mojave & San Diego river basins. Inhabits slow water stream sections with mud or sand bottoms. Feeds heavily on aquatic vegetation and associated invertebrates. Known to be common and widely distributed in some of the streams in which it was introduced, including the Ventura River (CDFW 2015). While this fish is a SSC, the Ventura River is not part of its native range.	Direct	Santa Ana South, Foster Park
Oncorhynchus mykiss irideus pop. 10 Southern California DPS steelhead	FE/None	Present	Occurs in freshwater systems and require adequate water conditions suitable for migration (i.e., flow, dissolved oxygen levels within the surface water, and water temperature suitable for passage) and suitable substrate (i.e., gravels) for spawning. Juvenile *O. mykiss* require suitable cover, flow, foraging conditions, and cool temperatures for rearing. Juvenile emigration (i.e., outmigration to the ocean) requires water conditions suitable for migration. The Ventura River basin historically supported an abundant steelhead population (Moore 1980). Habitat within the basin has declined due to the construction of multiple dams, but the species is still known to occur within the Ventura River, and multiple life stages of the species were observed throughout the basin during surveys conducted from 2006-2012 (Allen et al. 2015).	Direct	South Santa Ana, Foster Park

Scientific Name Common Name	Status	Potential to Occur within UVRGB	Habitat Requirements and Documented Occurrences within the UVRGB	GDE Association	GDE Unit
Amphibians					
Rana draytonii California red-legged frog	FT/None SSC	Present	Occurs in lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation. Requires 11-20 weeks of permanent water for larval development. Must have access to estivation habitat. There are 35 occurrences of the species documented in the CNDDB within the UVRGB. Two occurrences of the species are documented in the CNDDB within the UVRGB, one in 2016 and one in 2017. These occurrences were documented along San Antonio Creek from its confluences with the Ventura River to 0.6 miles upstream, and within the Ventura River north of Highway 33 at Casitas Vista Road. Juvenile California red-legged frogs were relocated approximately 0.50 mile downstream of Foster Park in 2017 (Rincon 2020).	Direct	South Santa Ana, Foster Park
Reptiles					
Actinemys pallida (Emys marmorata) Southwestern pond turtle	None/None SSC	Present	Occurs in ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches with basking sites. Feeds on aquatic plants, invertebrates, worms, frog and salamander eggs and larvae, crayfish, and occasionally frogs and fish. Relies on surface water that may be supported by groundwater (Rhode et al. 2019). There are three occurrences of the species documented within the UVRGB from 2016. These occurrences were documented along the Ventura River near Casitas Springs and in the northwestern portion of the basin just southeast of the Matilija Dam (CDFW 2021a). This species is present within the UVRGB.	Direct	South Santa Ana, Foster Park
Thamnophis hammondii Two-striped gartersnake	None/None SSC	Present	Highly aquatic snake species. Found in or near permanent fresh water, often along streams with rocky beds and riparian vegetation. Prey includes fish, fish eggs, tadpoles, newt larvae, small frogs and toads, leeches, and earthworms. There are three occurrences of the species documented within the UVRGB. These occurrences were documented in 2013, 2016 and 2018 along the Ventura River in the vicinity of Casitas Springs (CDFW 2021a). The species is present within the UVRGB.	Direct	South Santa Ana, Foster Park

Scientific Name Common Name	Status	Potential to Occur within UVRGB	Habitat Requirements and Documented Occurrences within the UVRGB	GDE Association	GDE Unit
Birds					
Empidonax traillii extimus Southwestern willow flycatcher	FE/SE	May Occur	Occurs in dense brushy thickets within riparian woodland often dominated by willows and/or alder, near permanent standing water. Reliant on groundwater-dependent riparian vegetation, including for nest sites that are typically located near slow-moving streams, or side channels and marshes with standing water and/or wet soils (Rohde et al. 2019). Feeds on insects, fruits, and berries. There are no documented occurrences of the species within the UVRGB (CDFW 2021a, Cornell Lab of Ornithology 2021a. However, there is one documented observation of the species near Foster Park in April 2010 (Ryan 2010). The species is also known to occur in similar habitat within 10 miles of the UVRGB during summer months.	Indirect	South Santa Ana, Foster Park
Setophaga petechia Yellow warbler	None/None SSC	Likely to Occur	Inhabits riparian plant associations in close proximity to water. Also nests in montane shrubbery in open conifer forests in Cascades and Sierra Nevada. Frequently found nesting and foraging in willow shrubs and thickets, and in other riparian plants including cottonwoods, sycamores, ash, and alders. There are multiple observations of the species documented within the UVRGB in eBird (Cornell Lab of Ornithology 2021a). The species was also detected multiple times within the basin in 2010 (Ryan 2010).	Indirect	South Santa Ana, Foster Park
Vireo bellii pusillus Least Bell's vireo	FE/SE	Likely to Occur	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy. This species relies on groundwater-dependent vegetation in riparian areas, particularly during breeding periods (Rohde et al. 2019). Eats insects, fruits, and berries. There is once occurrence of the species from 1919 documented within the UVRGB (CDFW 2021a) and one occurrence documented in eBird in 2018 (Cornell Lab of Ornithology 2021a). Another occurrence of the species was documented near Foster Park in May 2010 (Ryan 2010).	Indirect	South Santa Ana, Foster Park

Scientific Name Common Name	Status	Potential to Occur within UVRGB	Habitat Requirements and Documented Occurrences within the UVRGB	GDE Association	GDE Unit
Mammals					
Chaetodipus californicus femoralis Dulzura pocket mouse	None/None SSC	Not Expected	Inhabit a variety of habitats including coastal scrub, chaparral & grassland (primarily in San Diego County). Attracted to grass-chaparral edges. One male and one female were collected within the northeastern portion of the UVRGB near Meiner's Oaks at an unknown date. Another female was collected near Weldon Canyon at an unknown date (CDFW 2021a). There are no other documented occurrences of the species within the basin.	No known dependence on groundwater.	None
Eumops perotis californicus Western mastiff bat	None/None SSC	Not Expected	Occurs in open, semi-arid to arid habitats, including coniferous and deciduous woodlands, coastal scrub, grasslands, and chaparral. Roosts in crevices in cliff faces and caves, and buildings. Roosts typically occur high above ground. One occurrence of the species was documented in 1907 near Weldon.	No known dependence on groundwater.	None

FE = Federally Endangered
FT = Federally Threatened
SSC= CDFW Species of Special Concern
SE = State Endangered
ST = State Threatened
SCE = State Candidate Endangered

CRPR (California Rare Plant Rank)

1A=Presumed Extinct in California
1B=Rare, Threatened, or Endangered in California and elsewhere
2A=Plants presumed extirpated in California, but more common elsewhere
2B=Plants Rare, Threatened, or Endangered in California, but more common elsewhere

CRPR Threat Code Extension

.1=Seriously endangered in California (over 80% of occurrences threatened/high degree and immediacy of threat)
.2=Fairly endangered in California (20-80% occurrences threatened)
.3=Not very endangered in California (<20% of occurrences threatened)

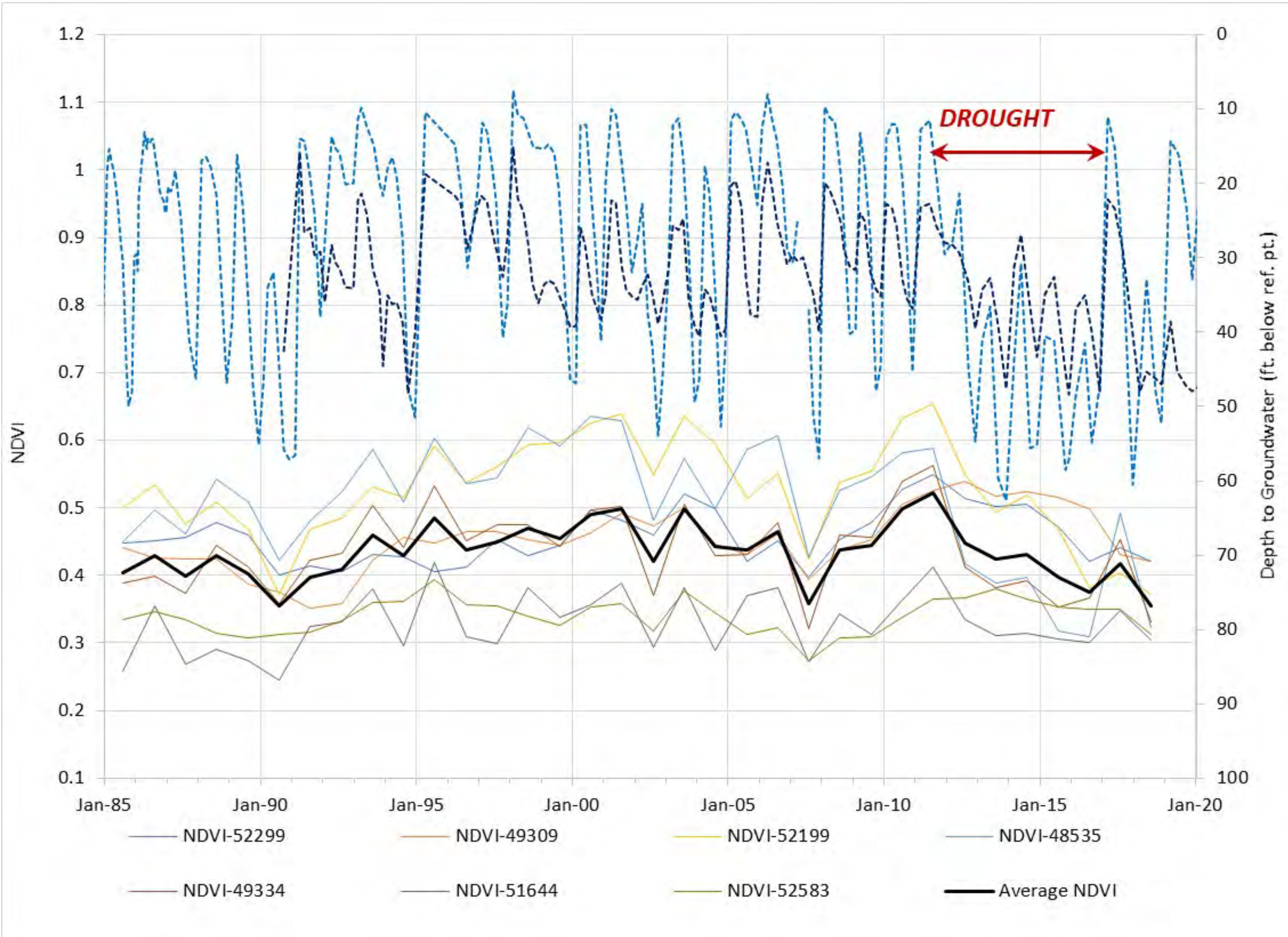
CDFW Rare

G1 or S1 = Critically Imperiled Globally or Subnationally (state)
G2 or S2 = Imperiled Globally or Subnationally (state)
G3 or S3 = Vulnerable to extirpation or extinction Globally or Subnationally (state)
G4/5 or S4/5 = Apparently secure, common and abundant
GNR/SNR= Globally or Subnationally (state) not ranked

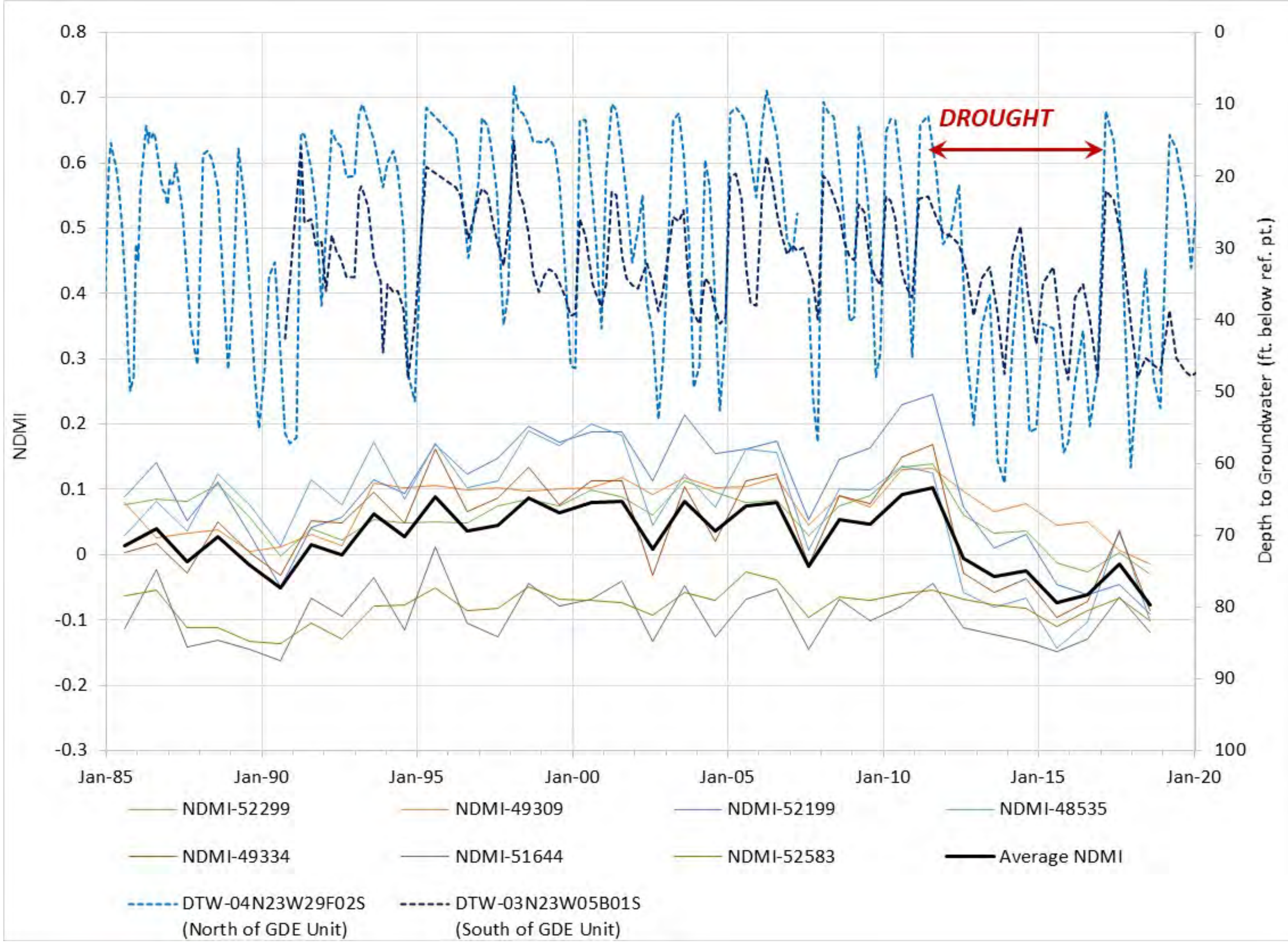
Appendix C

NDVI, NDMI, and Groundwater Level Data for each Riparian GDE Unit

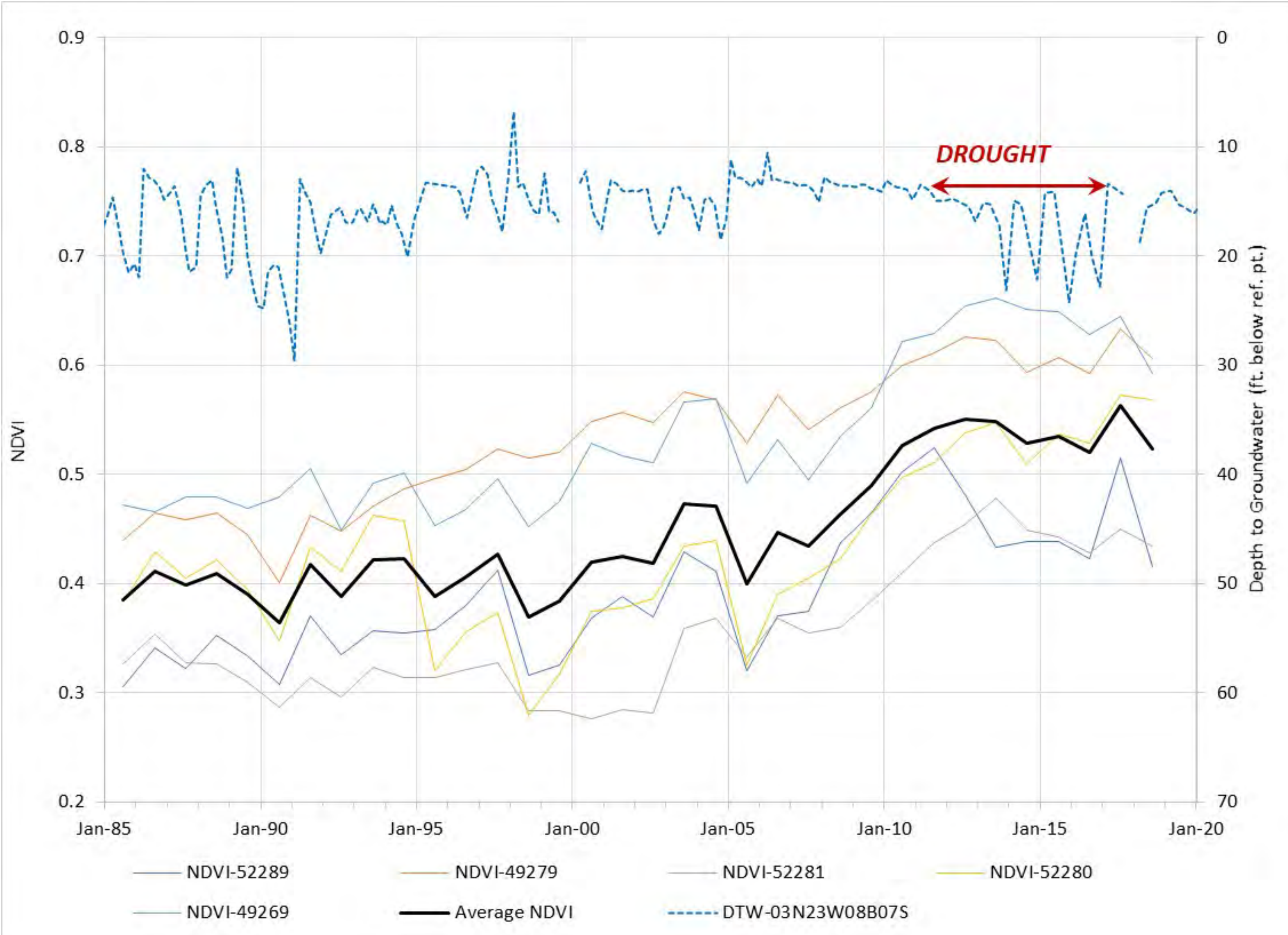
Groundwater Level Compared to NDVI for the South Santa Ana Riparian GDE Unit (1985 to 2018)



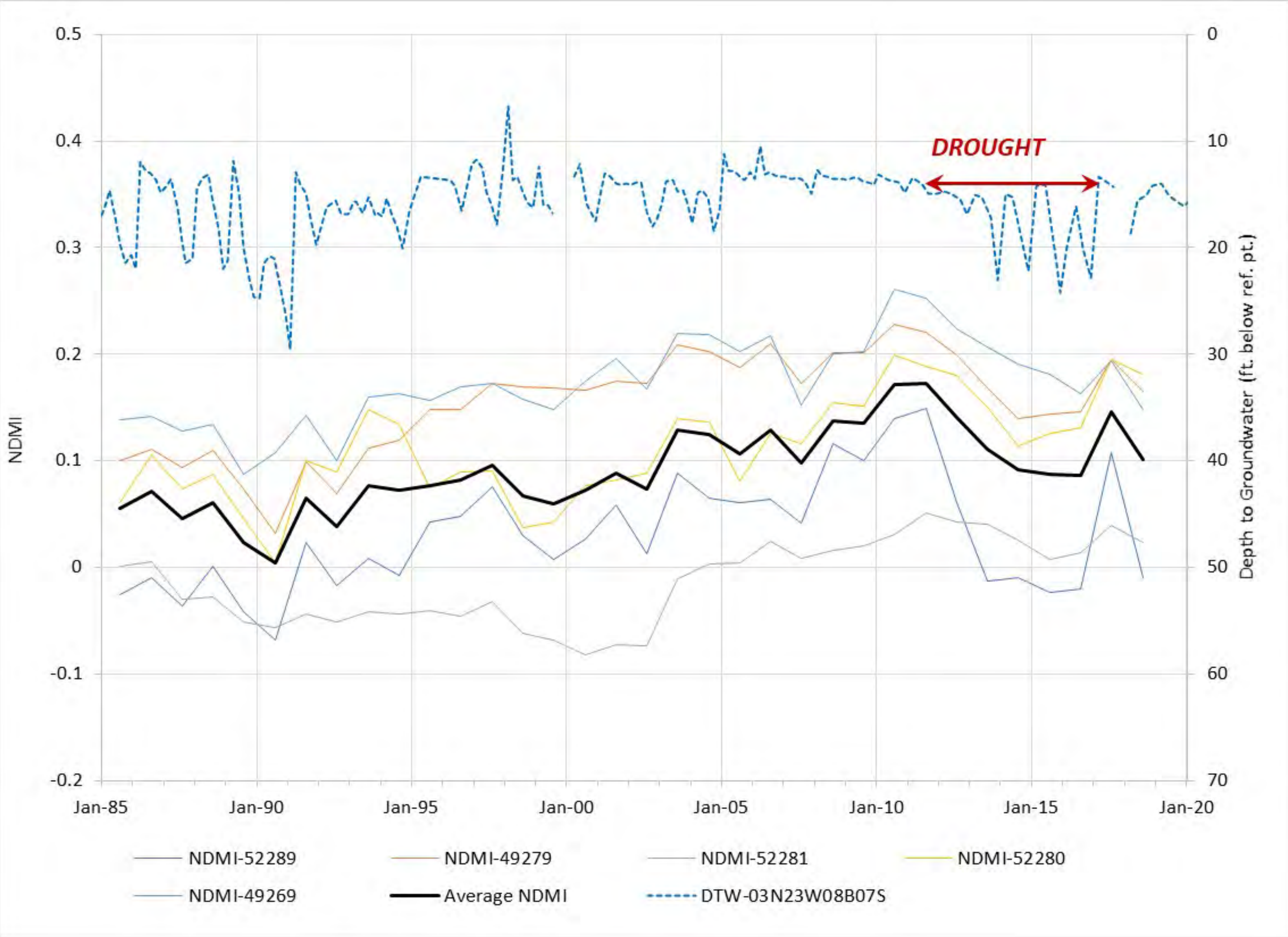
Groundwater Level Compared to NDMI for the South Santa Ana Riparian GDE Unit (1985 to 2018)



Groundwater Level Compared to NDVI for the Foster Park Riparian GDE Unit (1985 to 2018)



Groundwater Level Compared to NDMI for the Foster Park Riparian GDE Unit (1985 to 2018)



Appendix P

Aquatic Groundwater Dependent Ecosystems Assessment, Upper Ventura River Groundwater Basin

Aquatic Groundwater Dependent Ecosystem Assessment

Upper Ventura River Groundwater Basin

prepared for
Upper Ventura River Groundwater Agency
202 West El Roblar Drive
Ojai, California 93023

prepared by
Rincon Consultants, Inc.
180 North Ashwood Avenue
Ventura, California 93003

November 2021

RINCON CONSULTANTS, INC.
Environmental Scientists | Planners | Engineers
rinconconsultants.com

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Figures

1 Introduction

This technical appendix to the Upper Ventura River Groundwater Agency (UVRGA) Groundwater Sustainability Plan (GSP) summarizes the process for identifying, characterizing, and assessing potential impacts to aquatic groundwater dependent ecosystems (GDEs) in the Upper Ventura River Groundwater Basin (UVRGB). This appendix builds upon the riparian GDE assessment (Rincon 2021) and assesses the important aquatic habitat and fish passage areas reliant on interconnected surface water within the basin. The riparian GDE assessment provided an analysis of GDEs comprised of riparian vegetation communities, while this appendix focuses on aquatic GDEs comprised of instream habitat. This appendix identifies and characterizes aquatic GDEs within the UVRGB and assesses how groundwater management may affect (e.g., impact) aquatic GDEs in the UVRGB. Additionally, this appendix identifies data gaps that would require additional study in order to establish or refine sustainable management criteria (SMC) and provides recommendations to fill data gaps and monitor changing conditions related to aquatic GDEs.

> **Groundwater Dependent Ecosystems:** *"ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface"* – SGMA, 23 CCR § 351(m)

The Sustainable Groundwater Management Act (SGMA) requires groundwater sustainability agencies (GSAs) to consider GDEs and other beneficial uses of groundwater when developing their GSPs. Aquatic GDEs within the UVRGB are instream portions of the Ventura River with interconnected surface water that provide important habitat for aquatic species. Therefore, this assessment focuses on the *Depletion of Interconnected Surface Waters* SGMA sustainability indicator, whereas the riparian GDE assessment addressed the *Chronic Lowering of Groundwater Levels* and *Groundwater Storage* SGMA sustainability indicators.

The following outline provides a description of each of the sections found in this appendix:

§ **Section 1. Introduction:** Provides a brief introduction to aquatic GDEs and an overview of this technical document.

§ **Section 2. Aquatic GDE Identification:** Considers the potential aquatic GDEs that occur within the UVRGB and describes the process of identifying actual aquatic GDEs.

§ **Section 3. Aquatic GDE Characterization:** Provides an overview of the ecological condition of the UVRGB and a detailed summary of the ecological condition of each aquatic GDE within the UVRGB, including: beneficial uses, federally designated critical habitat, special-status species, and overall ecological value.

§ **Section 4. Aquatic GDE Impact Analysis:** Provides an analysis of potential impacts to aquatic GDEs related to depletion of interconnected surface water and presents initial considerations for developing SMC.

Note that GSP development is an iterative process, and preliminary considerations of SMC for aquatic GDEs are subject to change based on stakeholder input, monitoring data, and forthcoming studies.

2 Aquatic GDE Identification

This section summarizes the evaluation of potential aquatic GDEs and the identification of actual aquatic GDEs that occur within the UVRGB.

Note that a range of factors within the watershed can influence aquatic GDEs and the habitat they provide for aquatic species.[1] These can include natural climatic factors, anthropogenic factors, and hydrogeologic factors. Table 1 provides a summary of factors that influence aquatic GDEs within the UVRGB, which were considered during the process of aquatic GDE identification.

Table 1 Factors that Influence Aquatic GDEs within the UVRGB

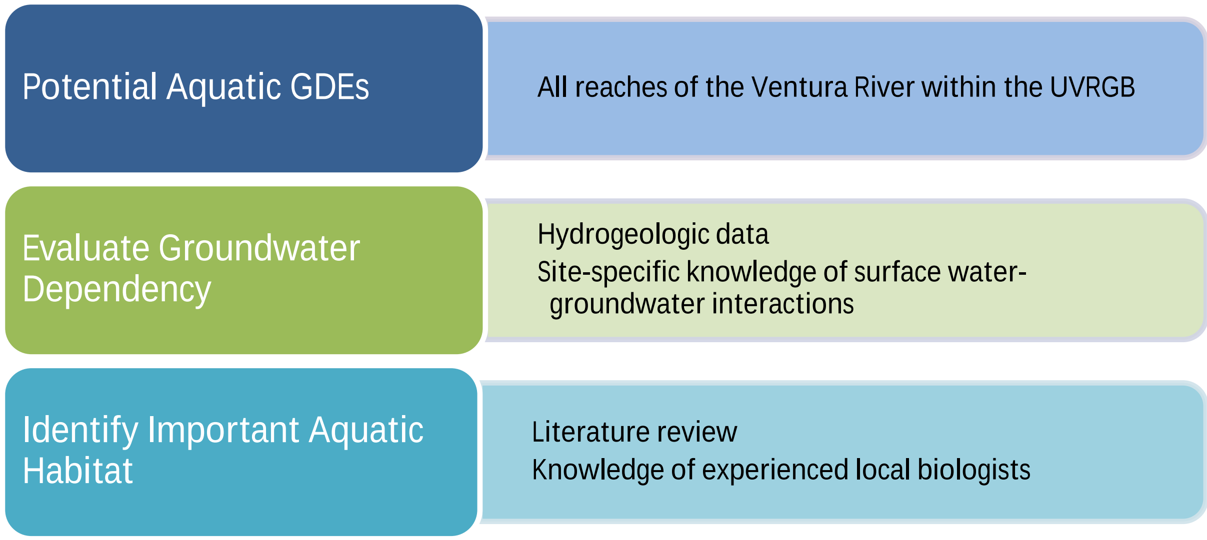
Natural Climatic Factors	Anthropogenic Factors	Hydrogeologic Factors
Storm pulses	Groundwater Pumping	Losing/Gaining Reaches
Drought	Surface Water Diversions	Depth to Groundwater

2.1 Aquatic GDE Identification Process

As mentioned in the riparian GDE assessment, the Natural Communities Commonly Associated with Groundwater (NCCAG) dataset (DWR 2021) was used to establish potential riparian GDEs within the UVRGB, which were then screened to determine actual riparian GDEs present within the basin (Rincon 2021). To determine aquatic GDEs that exist within the basin, a slightly different approach was necessary. For this analysis, all reaches of the Ventura River within the UVRGB were initially considered as potential aquatic GDEs. Local hydrogeologic data and site-specific knowledge were then used to analyze groundwater-surface water interactions within each reach of the river that falls within the UVRGB. Actual aquatic GDEs were then identified based on a review of published literature on important aquatic habitat and fish passage areas within the UVRGB (e.g., CDFW 2017, ENTRIX 1999), as well as the professional judgment of local biologists with extensive experience working in the Ventura River Watershed. Figure 1 provides an overview of the process used for identifying aquatic GDEs within the UVRGB.

[1] For this report, aquatic species are defined as those that require aquatic habitat for all or a portion of their life cycle.

Figure 1 Aquatic GDE Identification Process



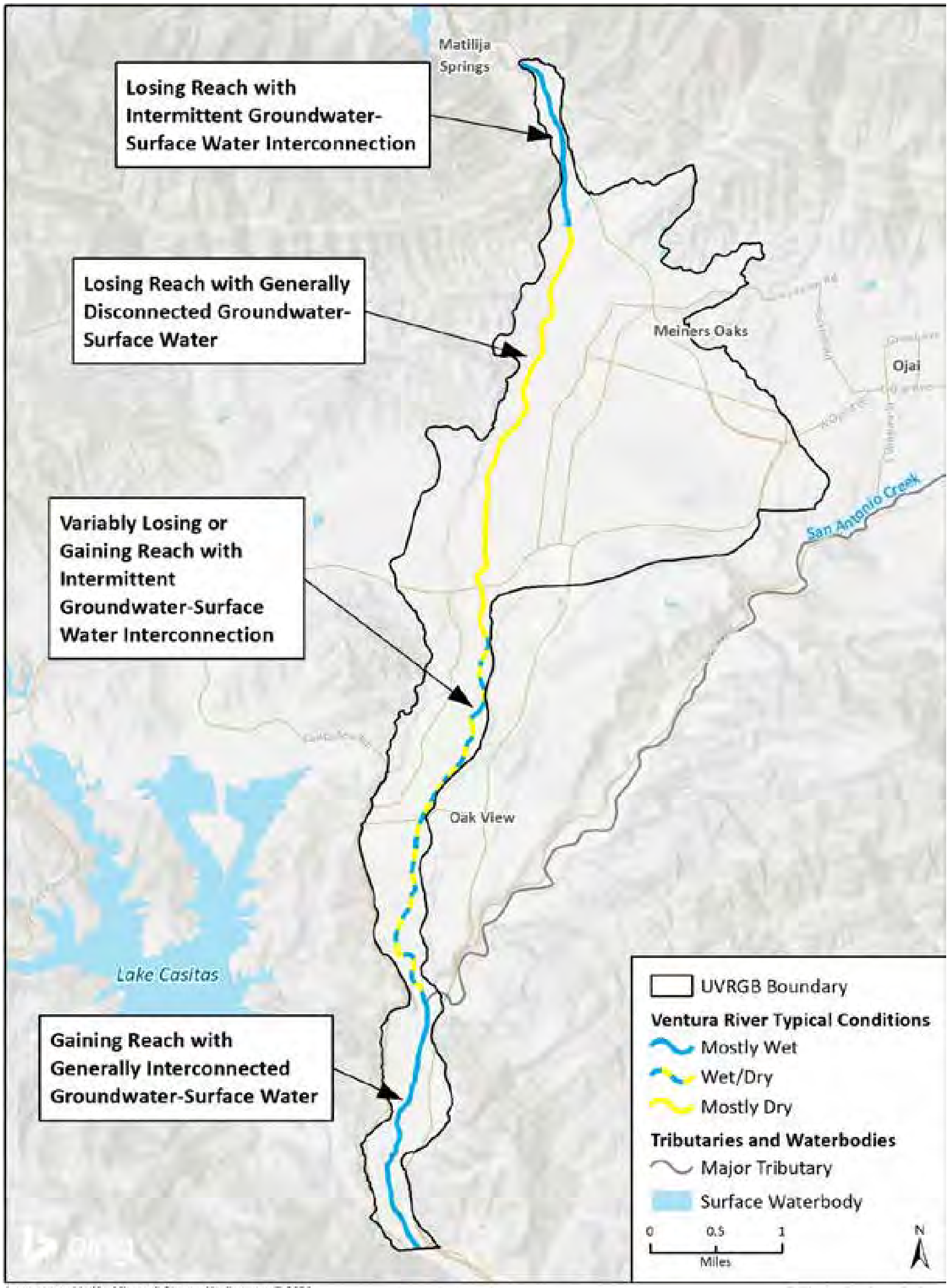
2.1.1 Potential Aquatic GDEs and Groundwater Dependency

As defined by SGMA, interconnected surface water is surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. Generally speaking, interconnected surface waters can interact with groundwater in two main ways: surface water can “gain” or “lose,” meaning that surface waters can receive water from groundwater or outflow water to groundwater.

The UVRGA GSP characterizes the Ventura River as an interconnected surface water system, with varying levels of groundwater-surface water connection. As this dynamic system, all instream portions of the Ventura River that occur within the UVRGB were initially considered as potential aquatic GDEs. Groundwater dependency was evaluated using hydrogeologic data and site-specific knowledge of groundwater-surface water interactions (Figure 2). While groundwater dependency was evaluated during the process of aquatic GDE identification, some instream areas where groundwater is generally thought to be disconnected from surface water (i.e., the Robles area, just west of Meiners Oaks) were still considered as potential aquatic GDEs. Due to the complexity of interconnected surface water interactions within the basin, it is possible that groundwater pumping could indirectly impact important instream habitats without direct groundwater connectivity, and therefore, not all of the identified aquatic GDEs occur in reaches with known interconnected surface water (B. Bondy, personal communication, 2021).

Chapter 3.2.6 of the UVRGA GSP provides additional information on the interconnected surface water system within the UVRGB.

Figure 2 Potential Aquatic GDEs and Interconnected Surface Water Systems within the UVRGB (Adapted from GSP Figure 3.2-10)



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2.1.2 Identifying Important Aquatic Habitat

Once the hydrogeology of the basin was taken into account, areas of important aquatic habitat within the basin were identified. Previous studies within the UVRGB were reviewed (e.g., Normandeau 2015, CDFW 2017, ENTRIX 1999, Hopkins 2012) to determine which areas within the basin provide important habitat and/or passage for aquatic species. Important aquatic habitat includes areas utilized by fish and other aquatic species for upstream or downstream migration, refuge, spawning or breeding, rearing, and/or dispersal. While aquatic GDEs provide important habitat and/or passage for a large number of aquatic species, many of the criteria for determining aquatic GDEs within the UVRGB were based on the habitat requirements of federally endangered southern California Distinct Population Segment (DPS) steelhead (*Oncorhynchus mykiss irideus*). Defining aquatic GDEs based on the presence of habitat elements necessary for steelhead populations follows TNC guidance (Rhode et al., 2018), and encompasses habitat requirements for other special status aquatic species within the basin, including the federally threatened California red-legged frog (*Rana draytonii*).

Potentially important aquatic habitats identified within the UVRGB in the literature review were then further analyzed by Rincon Senior Fisheries Biologist Steve Howard, who has over twenty years of experience working within the Ventura River.

2.2 Aquatic GDEs within the UVRGB: Critical Riffles and Habitat Areas

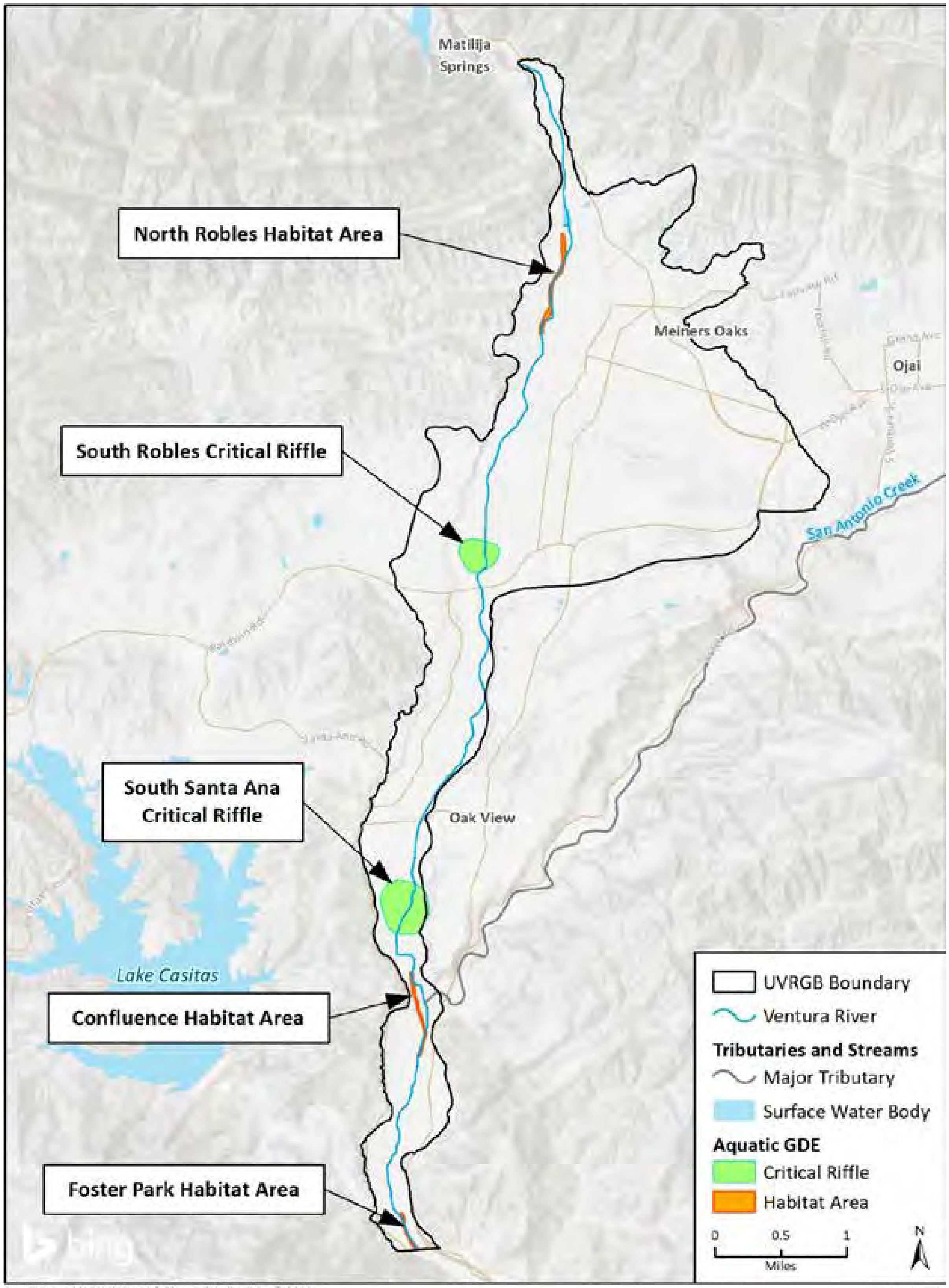
Based on the literature review and analysis described above, two types of aquatic GDES were identified within the UVRGB: *Critical Riffles* and *Habitat Areas.*

A critical riffle for a river system is an area that can limit passage for migration of steelhead and can create bottlenecks for fish as they move upstream during low flow conditions. Riffles are reaches of swift, turbulent water with gravel, cobble, boulder, or bedrock substrates. Cobbles and boulders often emerge within riffles during low flow periods (Normandeau 2015). Depletion of interconnected surface water within critical riffles has the potential to preclude or delay upstream migration and can potentially cause fish stranding or mortality.

For the purposes of this assessment, a habitat area provides steelhead and other aquatic species with refuge, rearing, and spawning or breeding habitat required for survival and/or reproduction. These areas are generally comprised of several physical elements such as glides, runs, and pools, providing adequate connection and structure for various lifecycle activities.

Five aquatic GDEs were identified within the UVRGB: the *South Robles Critical Riffle*, the *South Santa Ana Critical Riffle*, the *North Robles Habitat Area*, the *Confluence Habitat Area*, and the *Foster Park Habitat Area* (Figure 3). Each of these aquatic GDEs and their importance for aquatic species within the UVRGB are described in Section 3.

Figure 3 Aquatic GDEs within the UVRGB



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3 Aquatic GDE Characterization

This section describes the ecological condition of aquatic habitat within the Ventura River that occurs in the UVRGB. This overview presents surface water beneficial uses related to GDEs, federally designated critical habitat, and special status aquatic species (including fish, amphibians, and reptiles) that are known to occur within the basin. Each aquatic GDE identified within the UVRGB is characterized individually with a description of special status aquatic species known or with potential to occur within each GDE, critical habitat that occurs within each GDE, and a description of important habitat elements for steelhead and other aquatic species that exist within each GDE.

3.1 UVRGB Ecological Condition Overview

Surface Water Beneficial Uses Related to GDEs

The Water Quality Control Plan (Basin Plan) for the Los Angeles Region (LARWQCB 2014) identifies the surface waters in the UVRGB as having a variety of beneficial uses pertaining to fish, wildlife, and GDEs. These beneficial uses apply to inland surface waters within the UVRGB that may be fed by groundwater and vary between aquatic features. Beneficial uses related to GDEs identified within the UVRGB include:

§ Warm freshwater habitat (WARM)
§ Cold freshwater habitat (COLD)
§ Wildlife habitat (WILD)
§ Support of habitat for rare, threatened or endangered species (RARE)
§ Migration of aquatic organisms (MIGR)
§ Spawning, reproduction, and/or early development habitat (SPWN)
§ Wetland habitat (WET)

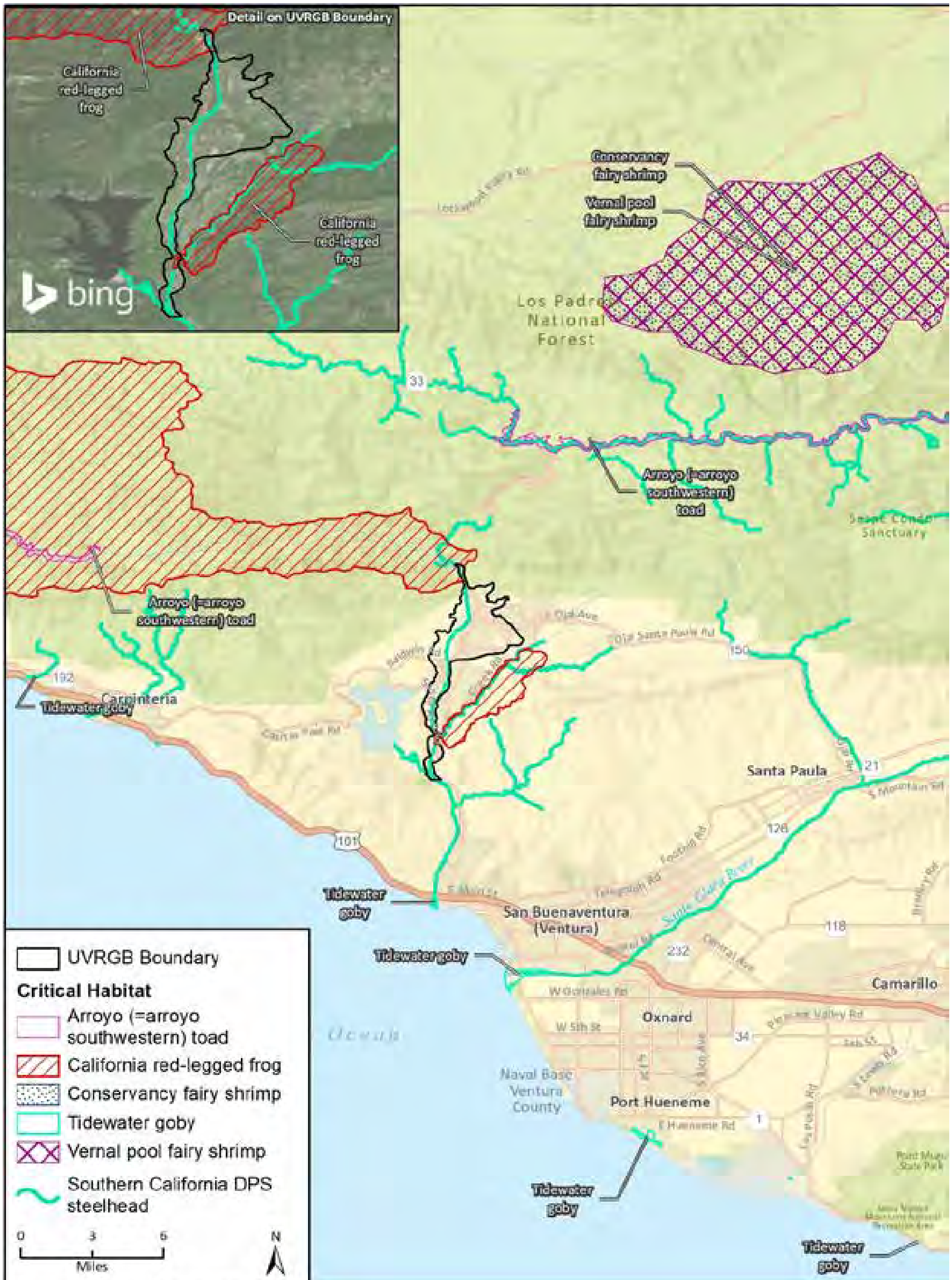
Critical Habitat

Rincon queried the U.S. Fish and Wildlife Service (USFWS) Critical Habitat Portal (USFWS 2021a) and the NOAA Critical Habitat maps (NOAA 2021) for information on federally designated critical habitat within the UVRGB. The UVRGB includes designated critical habitat for two federally listed aquatic species: southern California DPS steelhead (*Oncorhynchus mykiss irideus* pop. 10) and California red-legged frog (*Rana draytonii*) (NOAA 2005, USFWS 2010). A map of federally designated critical habitat for aquatic species within the UVRGB and surrounding area is presented as Figure 4.

Critical habitat for southern California DPS steelhead occurs within designated estuaries and streams with connectivity to the ocean up to impassible barriers in rivers and streams from the Santa Maria River (in southern San Luis Obispo County) south to San Mateo Creek (at the border of Orange and San Diego Counties). Within the UVRGB, critical habitat for steelhead exists within the entire stream channel of the Ventura River up to the ordinary high-water mark (OHWM) upstream to impassable barriers.

A large expanse of critical habitat for the California red-legged frog exists northwest of the UVRGB and overlaps with the northernmost portion of the basin. Critical habitat for the species also exists within San Antonio Creek to the east and overlaps with the UVRGB at the confluence of San Antonio Creek and the Ventura River (Figure 4).

Figure 4 Federally Designated Critical Habitat for Aquatic Species within the UVRGB and Region



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Special Status Aquatic Species

No special status aquatic plant species are known to occur within the UVRGB. For a summary of the evaluation of special status plant species with potential to occur in the UVRGB, please see Appendix B of the riparian GDE assessment (Rincon 2021).

Six special status fish and wildlife species that rely on aquatic habitat occur within the UVRGB. Table 2 provides a list of these species, as well as their regulatory status, habitat requirements, and documented occurrences within the basin. For a summary of the evaluation of special status fish and wildlife species with potential to occur in the UVRGB, please see Appendix B of the riparian GDE assessment.

3.2 Critical Riffles

Riffles are aquatic habitats in streams and rivers with shallow depth relative to other habitats (pools and runs) and swiftly flowing turbulent water. Riffles and specifically the crest of riffle habitats are considered to be the shallowest areas in a stream or river system that migrating fish, including steelhead, would migrate over to reach spawning grounds. This makes riffles a potential limiting habitat feature that could preclude upstream migration at certain flows as they recede following storm pulses. Riffles that are identified as critical riffles can be particularly shallow and sensitive to changes in stream flow. Critical riffles are often wide and can be braided or present as a split channel within the river channel, as seen in the Ventura River. As the shallowest and most susceptible part of the aquatic ecosystem, potential effects at critical riffles can be viewed as the most limiting characteristic to fish passage. As such, the presence or absence of effects at these locations would be indicative of potential fish passage effects elsewhere.

Two critical riffles within the Ventura River that could potentially limit upstream passage for adult steelhead during certain flow conditions, were identified as aquatic GDEs within the UVRGB. These two locations have been identified and evaluated for fish passage during studies conducted by environmental consultants, CDFW, and other investigators (e.g., Normandeau 2015, TRPA 2007-2010, CDFW 2017). Detailed descriptions and photographs of each critical riffle are provided below.

3.2.1 South Robles Critical Riffle

The South Robles Critical Riffle occurs within the South Robles hydrogeologic area near the center of the UVRGB (Figure 3). This area consists of a braided channel that goes dry during summer months and drought periods (Figure 5, Photograph 1). A study conducted by ENTRIX, Inc. in 1999 identified this area as a critical riffle and a potential natural passage barrier within the Ventura River at certain flow magnitudes (ENTRIX 1999). This study informed the flow release schedules from the upstream Robles Diversion to provide adequate passage conditions over this critical riffle.

3.2.2 South Santa Ana Critical Riffle

The South Santa Ana Critical Riffle occurs within the Santa Ana South hydrogeologic area in the southern portion of the UVRGB (Figure 3). This area exists in a shallow portion of the Ventura River that can go dry during summer months and drought periods (Figure 5, Photograph 2). This riffle could potentially limit upstream passage for adult steelhead during low flow conditions and was identified as a potential critical riffle by CDFW (CDFW 2017). The results of a fish passage study conducted by CDFW at this location are forthcoming.

Table 2 Special Status Aquatic Species within the UVRGB

Scientific Name Common Name	Status Fed/State ESA CDFW	Habitat Requirements and Documented Occurrences within the UVRGB
Actinemys pallida (Emys marmorata) Southwestern pond turtle	None/None SSC	Occurs in ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches with basking sites. Feeds on aquatic plants, invertebrates, worms, frog and salamander eggs and larvae, crayfish, and occasionally frogs and fish. Relies on surface water that may be supported by groundwater (Rhode et al. 2019). There are three occurrences of the species documented within the UVRGB from 2016. These occurrences were documented along the Ventura River near Casitas Springs and in the northwestern portion of the basin just southeast of the Matilija Dam (CDFW 2021a).
Entosphenus tridentatus Pacific lamprey	None/None SSC	Occurs in freshwater systems. Requires adequate flows for migration, suitable gravel substrate for spawning, and adequate cover for pre-spawning holding. Juveniles (ammocoetes) spend an extended period of time (4-10 years) burrowed in sediments, filter feeding on organic material and require suitable cover, flow, foraging conditions, and cool temperatures. Juvenile migrant (macropthalmia) outmigration to the ocean requires water conditions suitable for migration (i.e., velocity, depth, temperature, and dissolved oxygen levels within the surface water). Pacific lamprey ammocoetes were observed in the lower Ventura River in 2005 (Howard and Swift 2009). Migration (both upstream and downstream) could occur in all surface water reaches of the UVRGB.
Gila orcuttii Arroyo chub[1]	None/None SSC (Non-native to Ventura River)	Native to streams from Malibu Creek to San Luis Rey River basin. Introduced into streams in Santa Clara, Ventura, Santa Ynez, Mojave & San Diego river basins. Inhabits slow water stream sections with mud or sand bottoms. Feeds heavily on aquatic vegetation and associated invertebrates. Known to be common and widely distributed in some of the streams in which it was introduced, including the Ventura River (CDFW 2015). While this fish is a CDFW SSC, the Ventura River is not considered part of its native range.
Oncorhynchus mykiss irideus Southern California DPS steelhead	FE/None	Occurs in freshwater systems and requires adequate water conditions suitable for migration (i.e., natural flow magnitudes and duration, adequate dissolved oxygen levels, and water temperature suitable for passage and survival) and suitable substrate (i.e., clean gravels and cool, oxygenated water) for spawning. Juvenile *O. mykiss* require suitable cover, flow, foraging conditions, and cool temperatures for rearing. Juvenile (smolt) emigration (i.e., outmigration to the ocean) requires suitable flow and water quality conditions for migration. The Ventura River basin historically supported an abundant steelhead population (Moore 1980). Habitat within the basin has declined due to the construction of multiple dams, but the species is still known to occur within the Ventura River, and multiple life stages of the species were observed throughout the basin during surveys conducted from 2006-2012 (Allen et al. 2015). The current status of *O. mykiss* in the Ventura River watershed is unknown due to the effects on the watershed from the Thomas Fire in 2017-2018. Recent surveys have not successfully detected this species in the Ventura River.

Scientific Name Common Name	Status Fed/State ESA CDFW	Habitat Requirements and Documented Occurrences within the UVRGB
Rana draytonii California red-legged frog	FT/None SSC	Occurs in lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation. Requires 11-20 weeks of permanent water for larval development. Must have access to estivation habitat. There are 35 occurrences of the species documented in the CNDDB within the UVRGB. Two occurrences of the species are documented in the CNDDB within the UVRGB, one in 2016 and one in 2017 (CDFW 2021a). These occurrences were documented along San Antonio Creek from its confluences with the Ventura River to 0.6 miles upstream, and within the Ventura River north of Highway 33 at Casitas Vista Road. Juvenile California red-legged frogs were also relocated approximately 0.50 mile downstream of Foster Park in 2017 (Rincon 2020).
Thamnophis hammondii Two-striped gartersnake	None/None SSC	Highly aquatic snake species found in or near permanent fresh water, often along streams with rocky beds and riparian vegetation. Prey includes fish, fish eggs, tadpoles, newt larvae, small frogs and toads, leeches, and earthworms. There are three occurrences of the species documented within the UVRGB. These occurrences were documented in 2013, 2016 and 2018 along the Ventura River in the vicinity of Casitas Springs (CDFW 2021a).

[1] Note that arroyo chub are a CDFW SSC that is present within the UVRGB, but the fish species is not considered native to the Ventura River. Therefore, arroyo chub will not be directly discussed in the context of important aquatic species within aquatic GDEs within the UVRGB. However, habitat areas considered in the document as aquatic GDEs do include suitable habitat for arroyo chub, thus this species will be indirectly covered in this assessment.

Fed= Federal ESA= Endangered Species Act CDFW=California Department of Fish and Wildlife

FT = Federally Threatened FE = Federally Endangered SSC= CDFW Species of Special Concern

Figure 5 Photographs of Critical Riffles within the UVRGB

Photograph 1. South Robles Critical Riffle (facing north)

Photograph 2. South Santa Ana Critical Riffle (facing north)

Photographs by S. Howard, April 19, 2021

3.3 Habitat Areas

Three important habitat areas with high ecological value were identified as aquatic GDES within the UVRGB. These areas consist of aquatic habitats that provide refuge, rearing, migration, and breeding or spawning habitat for fish, amphibian, and reptile species. Detailed descriptions and photographs of each important habitat area are provided below.

3.3.1 North Robles Habitat Area

The North Robles Habitat Area is a dynamic area that includes surface flows from upstream areas that eventually go subsurface as flow enters the wide floodplain in the Ojai Valley Land Conservancy Ventura River Preserve. Steelhead have been documented migrating through this area, although rearing conditions in this reach can be unfavorable due to the high densities of non-native aquatic species (i.e., bullfrogs, bass and other sunfish) and the tendency for the area to go dry for several months each year. A few deep pools are located within the area that can provide important rearing habitats for special status aquatic species. However, these pools are known to naturally deplete in most dry seasons. Figure 6 presents photographs taken via aerial drone of the northern and southern portions of this area.

Due to the reasons stated above, conditions are currently poor for the survival of special status species rearing in the area, however, suitable habitat can exist and could provide the following:

- Spawning and rearing habitat for steelhead
- Breeding, rearing, and dispersal/migratory habitat for California red-legged frog (CRLF)
- Foraging and dispersal habitat for two striped gartersnake
- Feeding, nesting, and basking habitat for southwestern pond turtle
- Pacific lamprey spawning corridor

3.3.2 Confluence Habitat Area

The Confluence Habitat Area of the Ventura River and San Antonio Creek occurs in the southern portion of the UVRGB. This instream area is characterized by cool upwelling groundwater and inflow from San Antonio Creek, which is an important spawning tributary for southern California DPS steelhead (Normandeau 2015). The Confluence Area also includes federally designated critical habitat for steelhead and California red-legged frog (Figure 4).

San Antonio Creek provides important spawning and rearing habitat for steelhead (Payne 2009, Normandeau 2011) and fish must pass through the confluence area to reach this tributary of the Ventura River. One notable pool within the confluence area contains water even during periods of drought when many other portions of the river go dry[2] (CDFW 2017). Figure 7 presents photographs taken via aerial drone of the northern and southern portions of this area.

This area provides suitable habitat for special status aquatic species including:

- Spawning and rearing habitat for steelhead
- Breeding, rearing, and dispersal/migratory habitat for CRLF
- Foraging and dispersal habitat for two striped gartersnake

[2] Figure 3.1-8 of the UVRGA GSP provides a map of wet and dry portions of the Ventura River within the UVRGB during drought conditions.

- Feeding, nesting, and basking habitat for southwestern pond turtle
- Pacific lamprey spawning corridor and potentially rearing

3.3.3 Foster Park Habitat Area

The Foster Park Habitat Area of the Ventura River occurs in the southernmost portion of the UVRGB. The Ventura River at Foster Park is considered perennial but certain reaches of this area apparently went dry at some point over an unknown duration during the current drought (M. Garcia, personal communication, 2019). Figure 8 presents photographs taken via aerial drone of the northern and southern portions of this area.

This area has been studied by various investigators over the years including consultants, federal and state resource agencies, and local water agencies and municipal government agencies. One notable study was conducted by Hopkins Groundwater Consultants, Inc. (Hopkins) and Padre Associates Inc. (Padre) in 2012 (Hopkins 2013). The focus of this study was to understand the groundwater conditions and how pumping might impact steelhead habitat in the Foster Park area. The results of this study informed the development of low flow pumping thresholds at the City's Foster Park wells. Section 4.2.3 provides a description of this study.

This area provides suitable habitat for special status aquatic species including:

- Spawning and rearing habitat for steelhead
- Breeding, rearing, and dispersal/migratory habitat for CRLF
- Foraging and dispersal habitat for two striped gartersnake
- Feeding, nesting, and basking habitat for southwestern pond turtle
- Pacific lamprey spawning corridor and potentially rearing

Specifically, the Foster Park Habitat Area provides important pool and other rearing habitat features for juvenile and adult steelhead, Pacific lamprey ammocoetes, CRLF, two striped garter snake, and southwestern pond turtle during the dry period of the year (June and October), when reaches of the river upstream and potentially downstream of Foster Park typically run dry.

Figure 6 North Robles Habitat Area Photographs

Photograph 1. Northern portion of North Robles Habitat Area (facing south)

Photograph 2. Southern portion of North Robles Habitat Area (facing south)

Photographs by S. Howard, April 19, 2021

Figure 7 Confluence Habitat Area Photographs

Photograph 1. Northern portion of Confluence Habitat Area (facing north)

Photograph 2. Southern portion of Confluence Habitat Area (facing north)

Photographs by S. Howard, April 19, 2021

Figure 8 Foster Park Habitat Area Photographs

Photograph 1. Northern portion of Foster Park Habitat Area (facing north)

Photograph 2. Southern portion of Foster Park Habitat Area (facing north)

Photographs by S. Howard, January 22, 2020 and April 19, 2021

4 Aquatic GDE Impact Analysis

Depletion of Interconnected Surface Water is understood to be the most applicable SGMA sustainability indicator for assessing potential effects to aquatic GDEs in the UVRGB. Following TNC guidance (Rohde et al. 2018), UVRGA provided modeled streamflow with and without pumping for each aquatic GDE to determine potential interconnected surface water depletion in each of these areas. The UVRGA GSP numerical model was used to simulate streamflow under pumping and non-pumping conditions for a baseline 50-year future period, using historical hydrologic data from 1970-2019. These flows were compared at each aquatic GDE for example water years during wet, median, and dry conditions to assess interconnected surface water depletion. Chapter 3.3 of the UVRGA GSP provides additional information related to the numerical model.

This section presents the simulated hydrographs and an analysis of potential impacts to each aquatic GDE area (Critical Riffles and Habitat Areas).

4.1 Critical Riffles

The two critical riffles identified in the Ventura River occur where groundwater-surface water interconnection is intermittent or generally disconnected. Further, it is understood that steelhead migration through these passage-limiting areas generally occurs during and following peak flows caused by storm events and fish migration typically does not occur during low-flow conditions.

4.1.1 South Robles and South Santa Ana Critical Riffles

Figure 9 and Figure 10 present the simulated streamflow with and without pumping at the South Robles and South Santa Ana Critical Riffles for the wet, median, and dry example water years. As illustrated in these hydrographs, streamflow depletion (the difference between pumping and no pumping) is nearly indistinguishable and the blue lines and red lines are close together. Considering that fish pass these critical riffles during storm pulses and when flows recede following storm pulses, it appears from the modeling results that there is likely minimal or no effect on interconnected surface water in these aquatic GDEs.

4.2 Habitat Areas

The Habitat Area aquatic GDEs generally feature a complex of runs, glides, and pools that provide important habitat for refuge, rearing, migration, and breeding or spawning for fish, amphibian, and reptile species. As streamflow decreases in these areas, potential impacts to aquatic species may include stressors such as stranding and pool isolation, and if depletion reduces instream habitat enough, potentially mortality.

4.2.1 North Robles Habitat Area

Figure 11 presents the simulated streamflow with and without pumping at the North Robles Habitat Area. As illustrated in these hydrographs, streamflow depletion is nearly indistinguishable during each example water year (blue lines and red lines remain close together). The dry example year chart shows visible difference between streamflow with and without pumping, although the difference is approximately 0.2 cubic feet per second (cfs). While the simulated streamflow with pumping shows this slight depletion, it is important that this is observed during periods of natural streamflow recession. As streamflow without pumping is naturally depleting during periods of these simulated example years, it appears that there is minimal or potentially no effect on interconnected surface water in these aquatic GDEs.

The Robles Diversion Facility lies just north of the North Robles Habitat Area and diverts surface water from the Ventura River to Lake Casitas. The Biological Opinion (BO) from the National Marine Fisheries Service (NMFS 2007) for the Robles Diversion Fish Passage Facility project (NMFS 2003) requires that fish augmentation flows be maintained at or above 50 cfs during the first ten days following each migratory storm event (i.e., storms generating 150 cfs or greater, as measured at the Robles Diversion). The BO also requires that downstream flows of at least 30 cfs be maintained at the diversion facility between January 1 and June 30, as long as incoming flows at the diversion are greater than 30 cfs. Based on the models comparing streamflow with and without pumping, pumping is not significantly depleting instream flows in the North Robles Habitat Area during or following storm events. As presented in Table 3.2-01 of the GSP, the median streamflow depletion in this area for the historical simulation period (2005-2019) is 0.4 cfs or less during the migration season when flows are elevated during and following storm pulses. Fish passage flows at the Robles Diversion will continue to be maintained by Casitas Municipal Water District, as required by the BO.

4.2.2 Confluence Habitat Area

Figure 12 presents the simulated streamflow with and without pumping at the Confluence Habitat Area. As illustrated in these hydrographs, depletions of up to 4 cfs occur during the dry period of both the example wet and dry years. Note that the water year preceding the example median year appears to have been a dry year, and streamflow between October through February was at or near 0 cfs. It also appears that pumping could be accelerating the onset of dry conditions during dry years.

Based on these results, effects from pumping are potentially significant during dry periods. However, limited information related to the conditions of these aquatic GDEs during periods with depleted surface water is available. Aquatic species that live in intermittent or ephemeral environments have adapted to these conditions to survive. Aquatic species could disperse to perennial portions of this habitat area as flows recede or potentially become stranded in isolated habitat areas or killed from exposure as conditions deteriorate. The actual effects at the Confluence Habitat Area related to natural depletion without pumping are currently not known. This lack of knowledge of the specific effects of pumping to this area is a data gap, and it is unknown what type of impact (significant or not), if any, is occurring.

4.2.3 Foster Park Habitat Area

Figure 13 presents the simulated streamflow with and without pumping at the Foster Park Habitat Area. As illustrated in these hydrographs, depletions of up to approximately 8 cfs can occur during the dry period of both the example wet and median years (natural streamflow without pumping ranging from approximately 12 to 28 cfs), and up to 7 cfs during the example dry year (natural streamflow without pumping ranging from approximately 10 to 20 cfs). Based on these results and the information discussed below, it appears pumping can cause significant effects to aquatic GDEs during dry periods. However, the City of Ventura (City) has developed pumping thresholds based on studies described below to potentially avoid significant impacts to aquatic GDEs at Foster Park.

City of Ventura Flow Study

Certain operational protocols referred to as the “Foster Park Flow Protocols” are proposed by the City in the Proposed Stipulated Physical Solution and Judgment, dated September 15, 2020 (Proposed Physical Solution). The Foster Park Flow Protocols are intended to address juvenile steelhead rearing in the Foster Park Habitat Area (one of three high priority areas identified in the Proposed Physical Solution). The Foster Park Flow Protocols are based on field studies conducted in 2012 in the Foster Park and Casitas Springs reach of the Ventura River (Hopkins 2013).

Padre conducted a Rainbow Trout Habitat Suitability Indices (HSI) study in the Foster Park area, while a simultaneous surface flow data collection effort was completed by Hopkins (Hopkins 2013). Prior to this study, Hopkins completed an evaluation of interconnected surface water that demonstrated a close relationship between pumping and surface water depletion (Hopkins 2012). According to the Padre study, the HSI scores for all or the majority of the Rainbow Trout HSI variables declined as flows receded. However, the HSI score associated with average thalweg depth started to decline at around 4 cfs and then dropped precipitously at approximately 2 cfs (measured at the Casitas Vista Road bridge) (Figure 14). It appears that this was the only variable that had a sharp decline and provided a clear delineation for quantifiable surface flow thresholds.

The results of this study were apparently relied upon to develop a minimum pumping threshold at the City’s Foster Park wells. The Foster Park Flow Protocols include the reduction of City pumping when river flow is below 4 cfs and the cessation of City pumping when the river flow is below 3 cfs.

California Department of Fish and Wildlife Draft Instream Flow Recommendations

The California Department of Fish and Wildlife (CDFW) released draft instream flow regime recommendations for the lower Ventura River in February 2021 (CDFW 2021a). The recommendations apply to reaches of the Ventura River up to the confluence with San Antonio Creek, and include the Foster Park Habitat Area. The minimum flow recommendation for the reach of the Ventura River that includes Foster Park is 14 cfs defined as a “sensitive period indicator flow.”

The “sensitive period indicator flow” represents the flow in which “fish and benthic macroinvertebrates may be particularly sensitive to additional water reductions and other stressors.” The key consideration from this description when evaluating potential significant and unreasonable effects in the context of SGMA is the word “may.” As such, sensitive period indicator flows of less than 14 cfs do not necessarily mean that effects will occur, let alone be significant and unreasonable effects.

Additionally, it’s important to understand that this uncertainty of potential effects is representative of uncertainties in the sensitive period indicator flow analysis method. The methodology used to determine sensitive indicator flows was the “wetted perimeter method”, which only considers wetted perimeter as a proxy for habitat suitability. This may be an unreliable indicator because there is some subjectivity involved in picking an instream flow criterion from the resulting flow-wetted perimeter curve. Further, there is greater uncertainty in quantifying the biological significance of what the percent of bankfull wetted perimeter criterion means.

Overall, the wetted perimeter method includes uncertainties that can provide unreliable results and does not necessarily indicate the onset of significant and unreasonable effects as required under SGMA.

National Marine Fisheries Service Biological Opinion (City of Ventura)

The National Marine Fisheries Service (NMFS) provided the City of Ventura a Draft Biological Opinion (BO) for Foster Park in 2007, which recommends a minimum maintenance flow of 11-12 cfs at the Foster Park gage (USGS 1118500) to allow for natural rates of growth and high rates of survival of juvenile steelhead. This minimum maintenance flow was based on a study completed in the summer-fall baseflow periods of 1976, 1977, and 1978 (Moore 1980) and was established as a flow recommendation to maintain beneficial conditions for natural rates of growth and survival of steelhead (NMFS 2007). Set to the context of SGMA, this minimum maintenance flow defines flows for beneficial conditions to steelhead rainbow trout and does not establish a minimum threshold below which significant and unreasonable effects would occur. While the study does show that diminishing flow is a factor influencing growth and survival, the study does not identify a threshold below which significant and unreasonable effects may occur. This means that the Draft BO flow criteria or requirements are too high to use as a basis for a minimum threshold for significant and unreasonable effects from groundwater pumping.

In addition, the Moore 1980 study period included two consecutive drought years (1976 and 1977) where flows ranged on the low end between 2 and 4 cfs in 1977. This is referenced on page 12 of the Draft BO with the following statement: *"Summertime survival of wild steelhead is substantially lower (19%) during drought conditions when flows are between 2 to 4 cfs (Moore 1980)."* This statement indicates flow conditions that can have an effect on survival and is more consistent with the minimum threshold for significant and unreasonable effects. These flows are also in line with the Padre (2013) flow study.

Consideration of CDFW Draft Instream Flow Recommendations and NMFS Draft BO

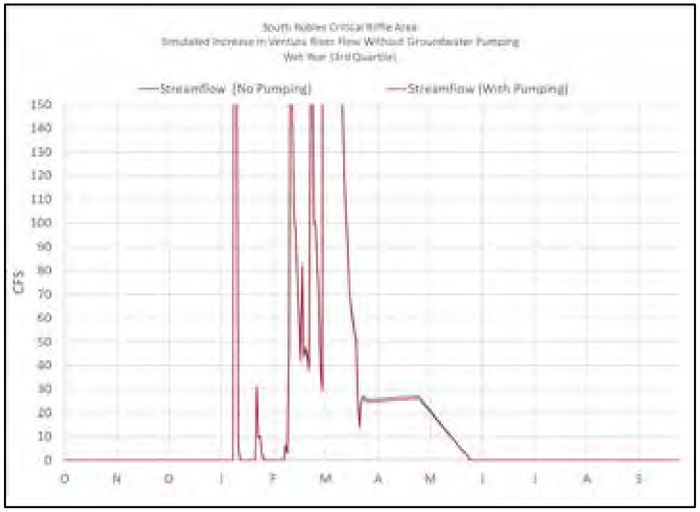
The CDFW instream flow recommendations (CDFW 2021a) and the NMFS Draft BO (NMFS 2007) provide surface flow recommendations and requirements, respectively, to maintain beneficial habitat conditions for steelhead within portions of the Ventura River, at all times. While these flows may provide beneficial conditions for steelhead, they do not represent the minimum threshold below which significant and unreasonable impacts to steelhead would occur due to the depletion of ISW, as required by SGMA.

The UVRGA agrees that surface water flows are important for maintaining the health and survival of aquatic species and their habitats, including steelhead. However, SGMA does not require UVRGA to maintain beneficial surface water conditions for riverine species, but rather to manage significant and unreasonable effects to surface flows related to groundwater pumping.

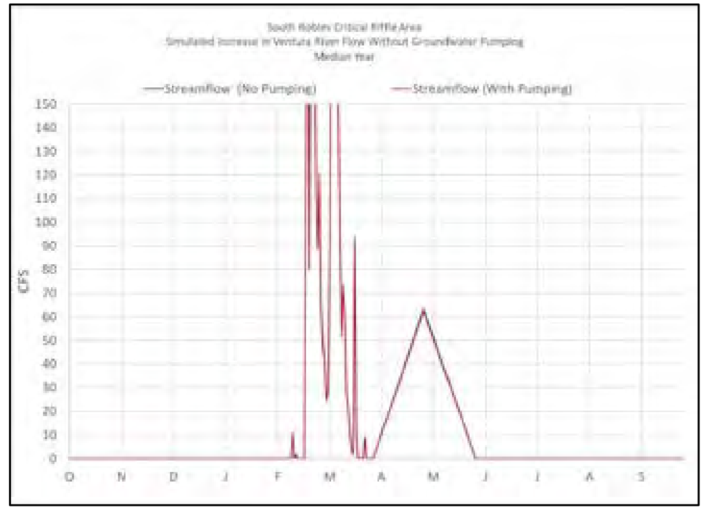
The UVRGA has taken the CDFW and NMFS recommendations into account but believes that the flow study conducted by Padre (2013) on behalf of the City of Ventura currently provides the most relevant data for developing minimum thresholds for significant and unreasonable effects due to depletion of interconnected surface flows in the Foster Park Habitat Area from groundwater pumping, as required by SGMA. However, future data collection and review of final instream flow policies can inform minimum thresholds to avoid significant and unreasonable effects.

Figure 9 Simulated Streamflow at South Robles Crticial Riffle

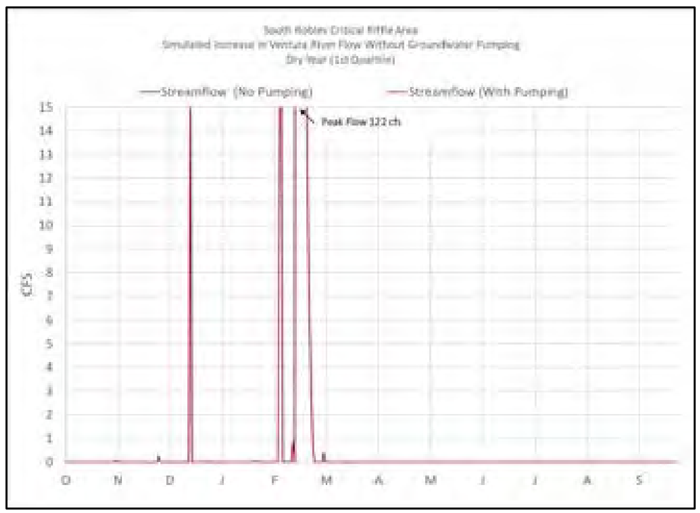
Wet Example Year



Median Example Year



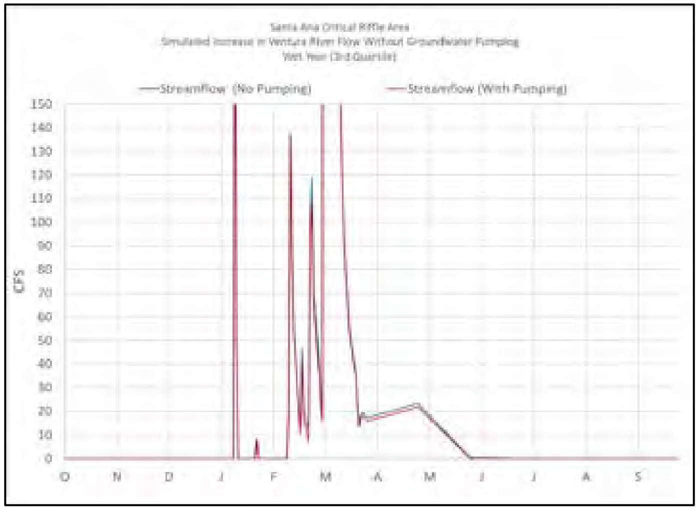
Dry Example Year



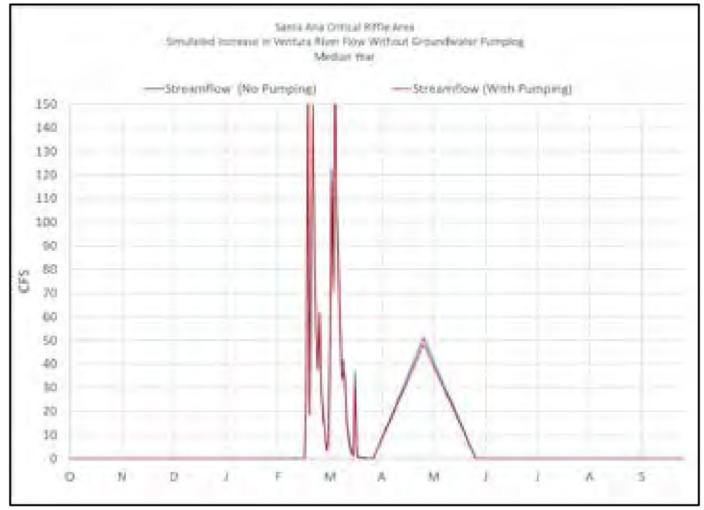
Note: Model presents data on a daily basis for November through March, and monthly for April through October

Figure 10 Simulated Streamflow at South Santa Ana Critical Riffle

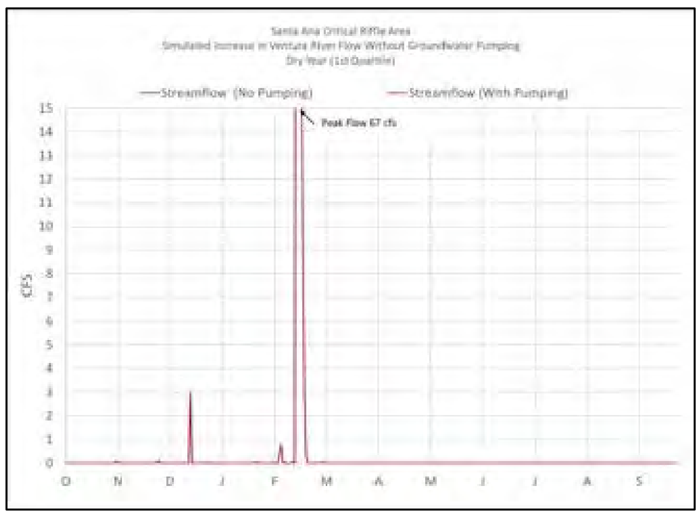
Wet Example Year



Median Example Year



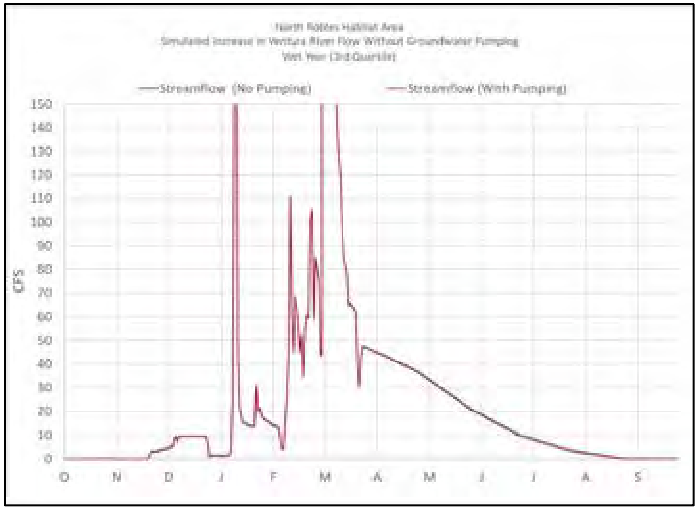
Dry Example Year



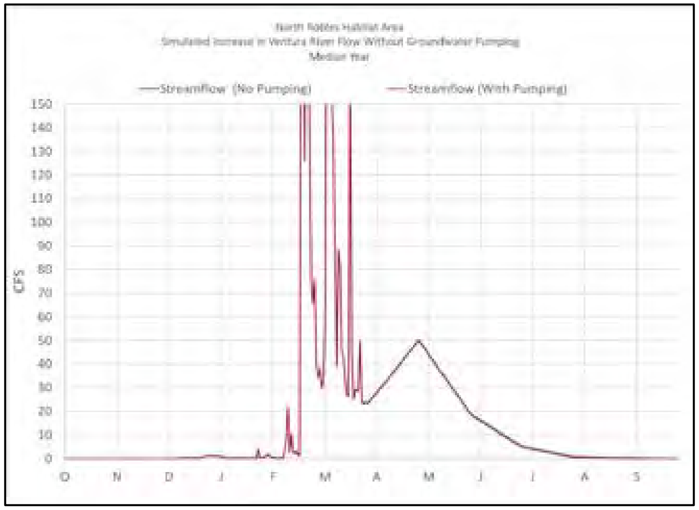
Note: Model presents data on a daily basis for November through March, and monthly for April through October

Figure 11 Simulated Streamflow at North Robles Habitat Area

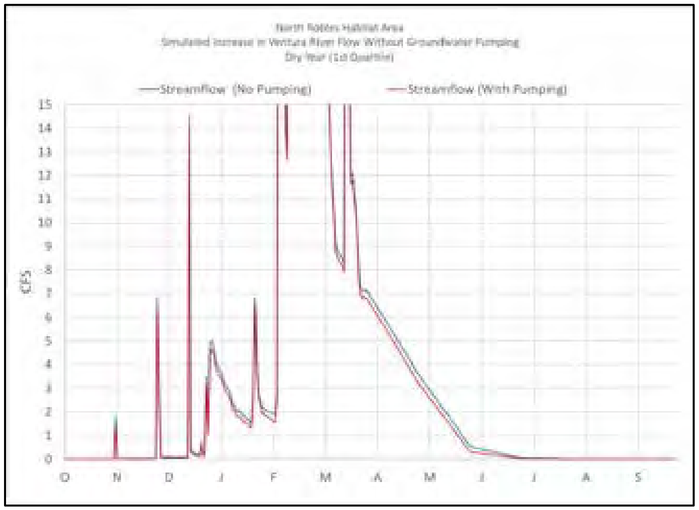
Wet Example Year



Median Example Year



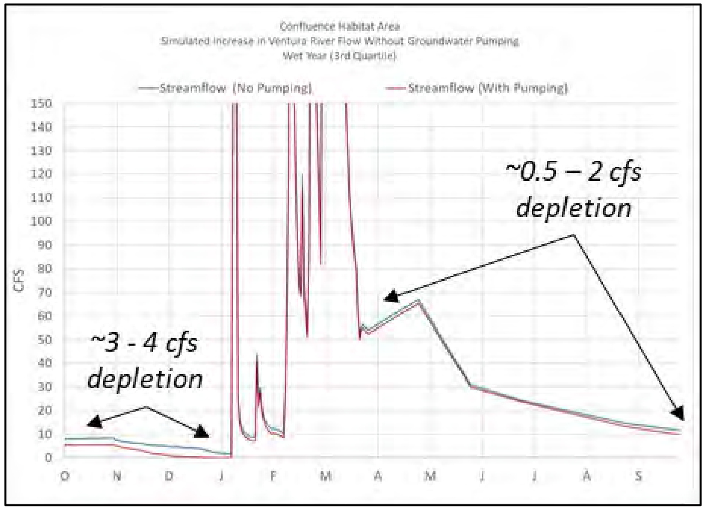
Dry Example Year



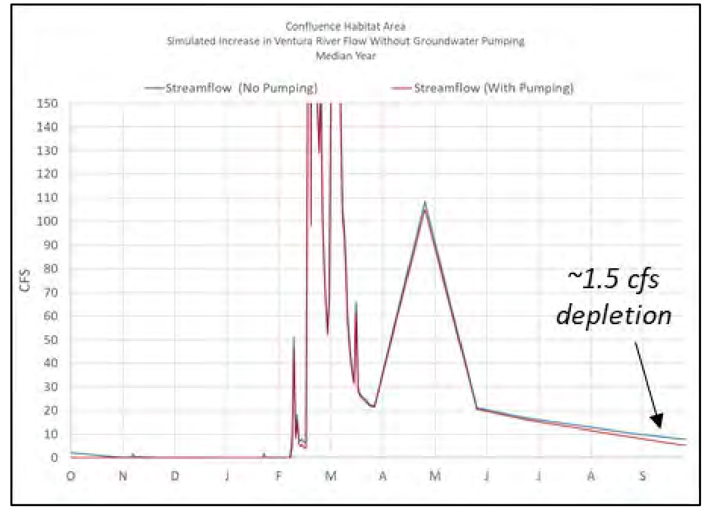
Note: Model presents data on a daily basis for November through March, and monthly for April through October

Figure 12 Simulated Streamflow at Confluence Habitat Area

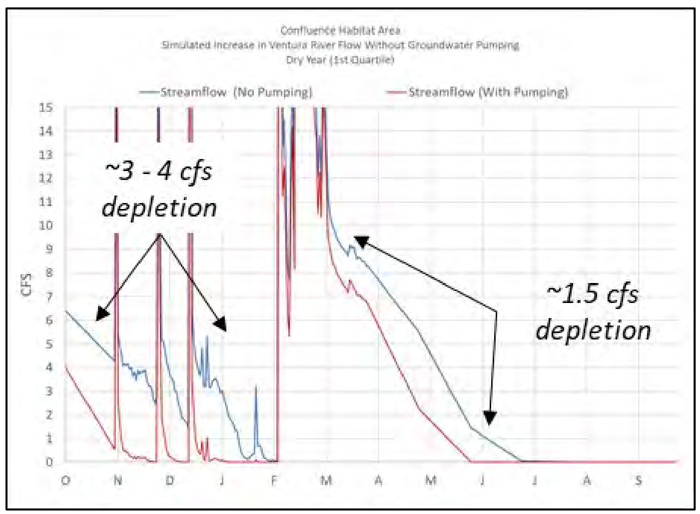
Wet Example Year



Median Example Year



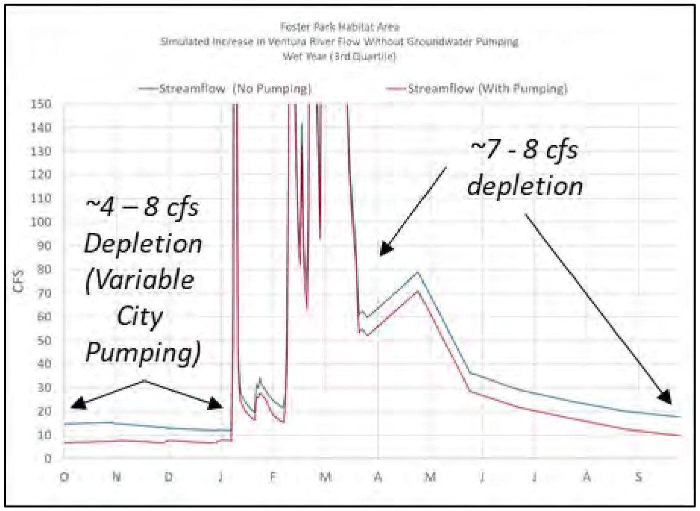
Dry Example Year



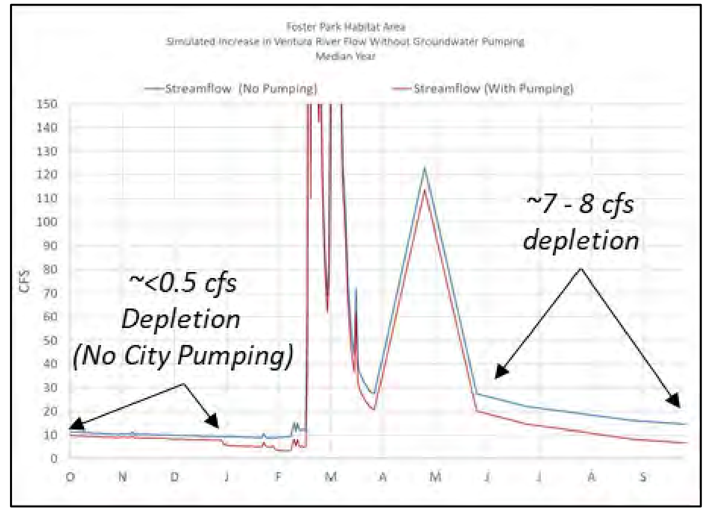
Note: Model presents data on a daily basis for November through March, and monthly for April through October

Figure 13 Simulated Streamflow at Foster Park Habitat Area

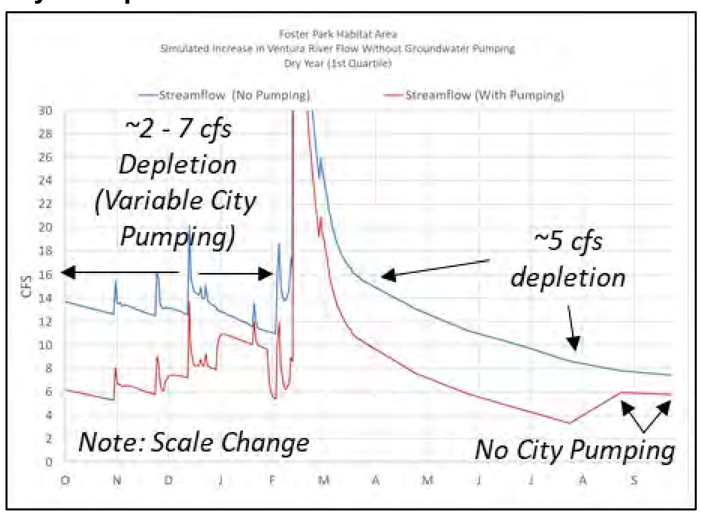
Wet Example Year



Median Example Year



Dry Example Year



Note: Model presents data on a daily basis for November through March, and monthly for April through October

Figure 14 Adult Steelhead Thalweg Depth HSI Scores Related to Flow

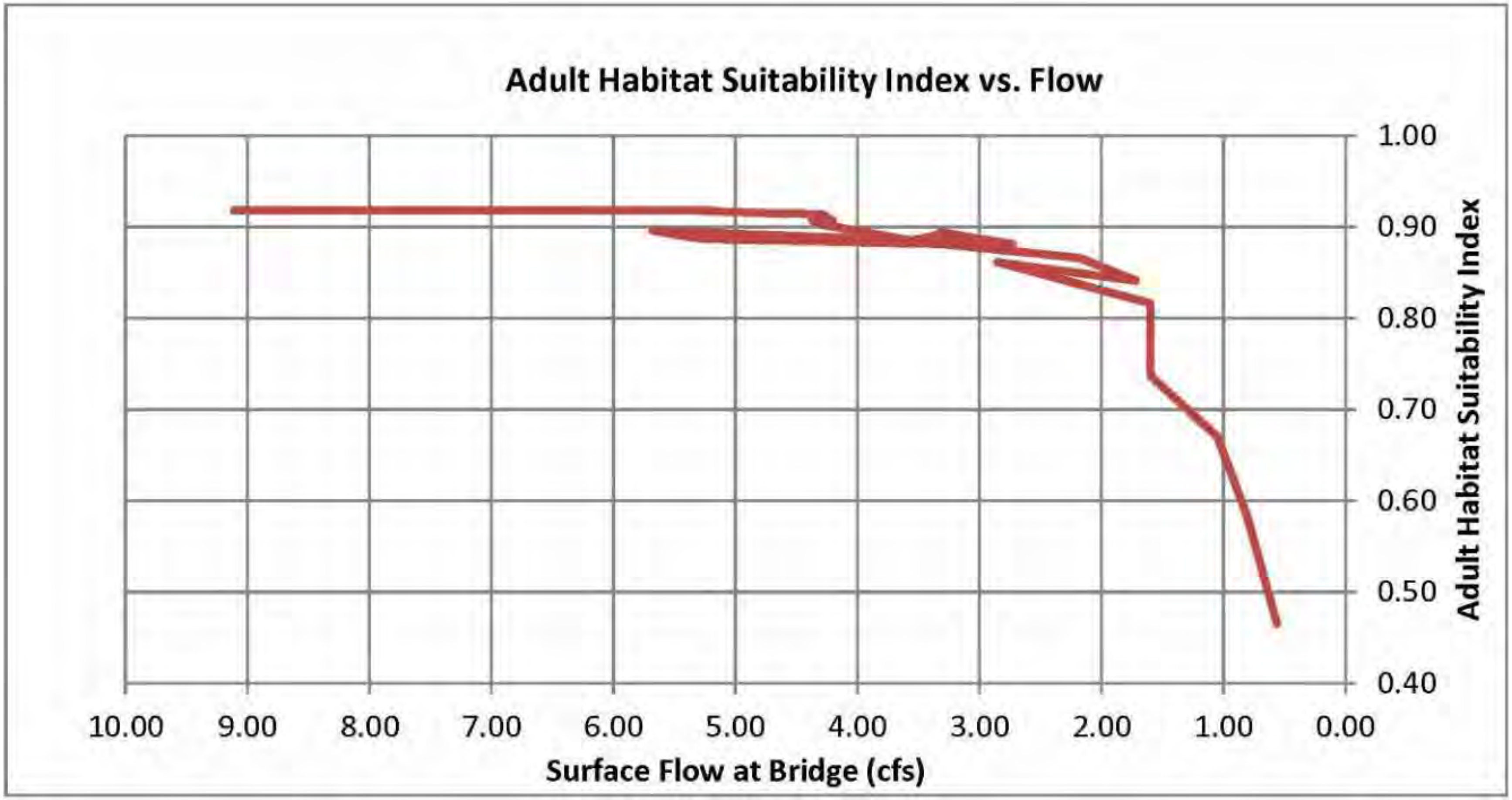


Figure taken from Hopkins 2013

4.3 Monitoring and Management Considerations

No monitoring is recommended at either of the critical riffle aquatic GDEs or the Robles Habitat Area, as impacts from pumping in these areas were determined to be minimal or non-existent.

For the Confluence Habitat Area, future monitoring is recommended to address data gaps that exist in order to determine if significant effects are occurring to the aquatic GDE. It is recommended that a formal monitoring plan be developed to understand what effects are occurring, and whether aquatic habitats are being depleted earlier in the year or for prolonged periods due to pumping. Potential elements of the monitoring could include physical monitoring and mapping during dry conditions, which could provide valuable information on the timing, frequency and duration of surface water loss from pumping and the potential impacts this could have on sensitive aquatic species. Aerial imagery could also be a valuable and cost-saving component of a monitoring plan.

For the Foster Park Habitat Area, while the City's low-flow thresholds are based on only one HSI score evaluated in the Padre study (average thalweg depth), we understand this currently provides the best available information to establish minimum thresholds for the depletion of interconnected surface water sustainability criteria. As such, these low-flow thresholds may be suitable for providing the basis for minimum thresholds in the UVRGA GSP. However, future data collection conducted by the City, UVRGA, local stakeholders, and resource agencies can inform potential adjustment of the minimum thresholds for the depletion of interconnected surface waters from groundwater pumping at Foster Park. UVRGA may conduct monitoring in this area and include monitoring results, or results of other monitoring efforts, into 5-year GSP revisions.

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Appendix Q

Time Series Plots of Measured Groundwater Level Data with Model Calibration and Predictive Simulations with Minimum Thresholds and Measurable Objectives

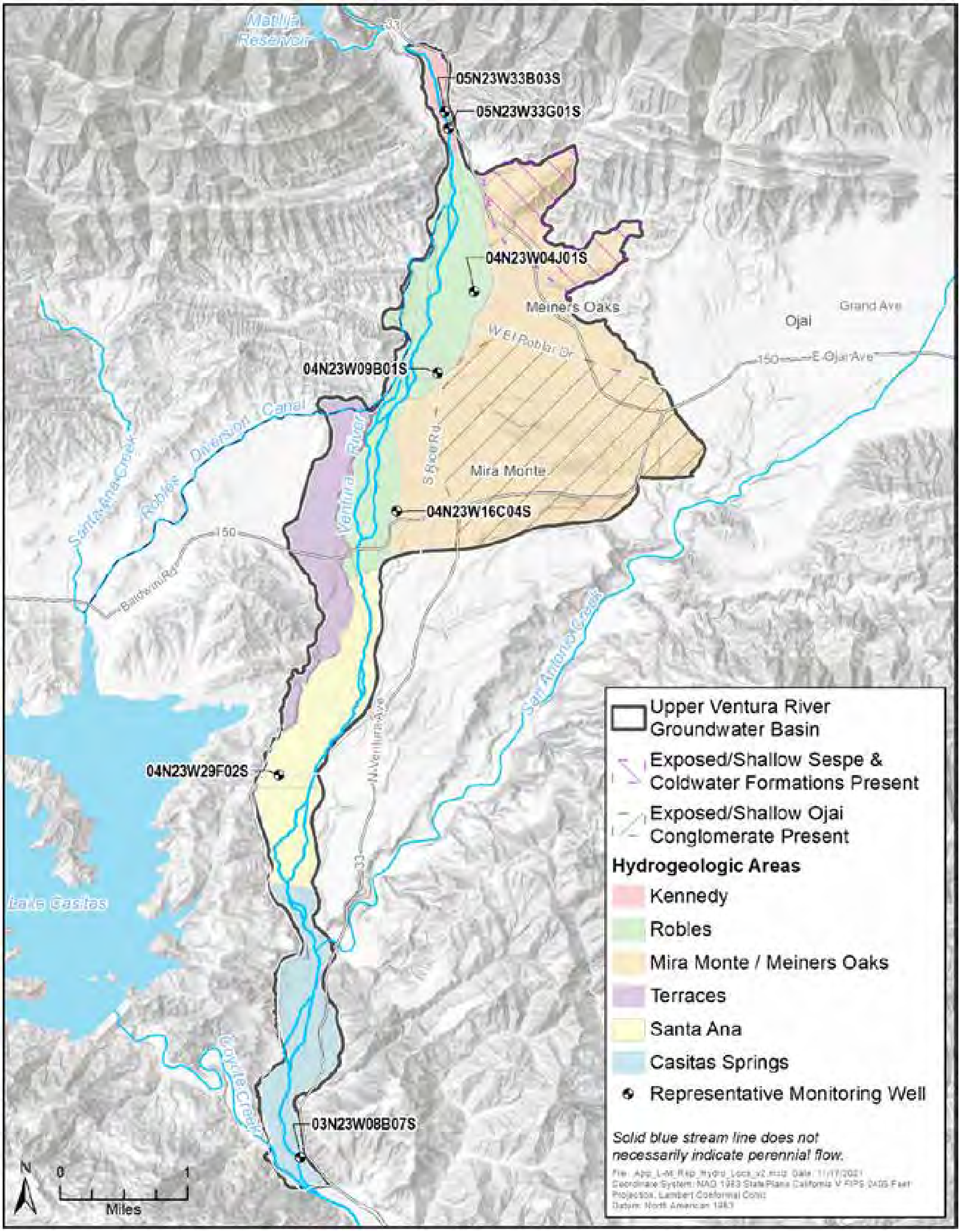
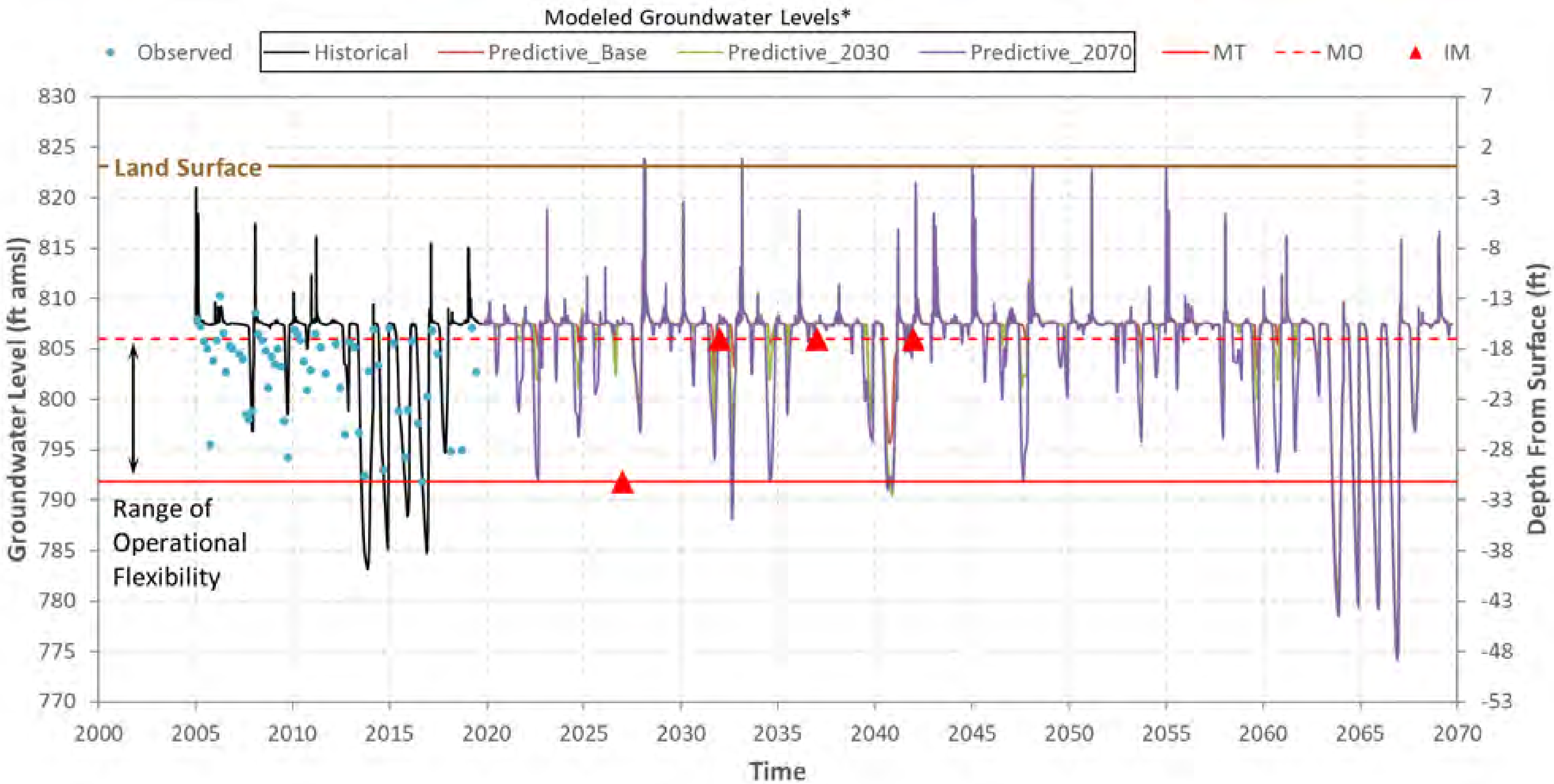


Figure Q-01 Representative Monitoring Well Locations for Sustainable Management Criteria.

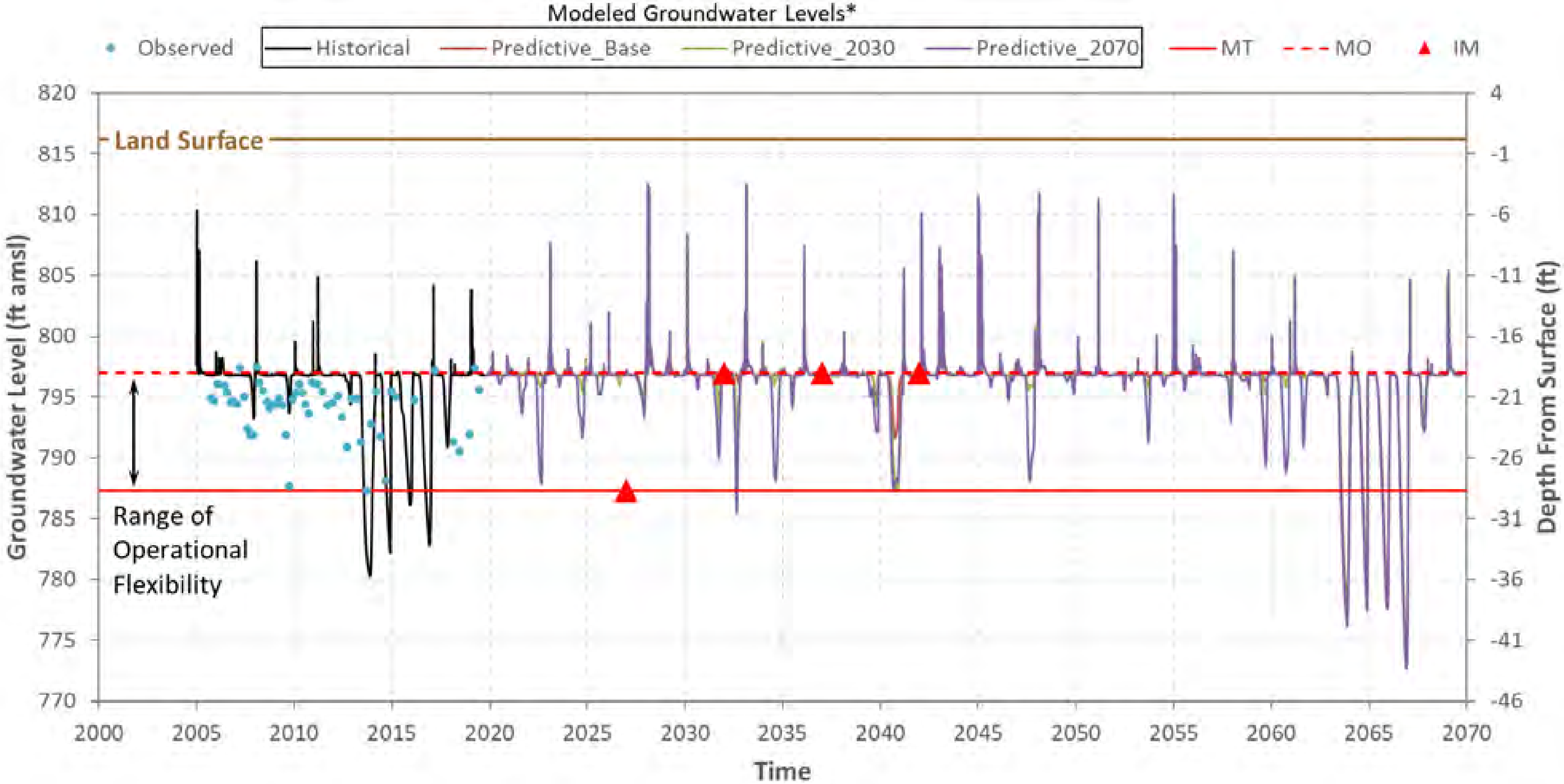
Table Q-01 Minimum Thresholds, Measurable Objectives, and Interim Milestones for Chronic Lowering of Groundwater Levels and Groundwater Storage.

State Well Identification Number	Well Name	Chronic Lowering of GW Levels MT (ft amsl)	Chronic Lowering of GW Levels MT (ft from surface)	Chronic Lowering of GW Levels MO (ft amsl)	Chronic Lowering of GW Levels MO (ft from surface)	GW Storage MT (ft amsl)	GW Storage MT (ft from surface)	GW Storage MO (ft amsl)	GW Storage MO (ft from surface)	IM 5-year (ft amsl)	IM 5-year (ft from surface)	IM 10-year (ft amsl)	IM 10-year (ft from surface)	IM 15-year (ft amsl)	IM 15-year (ft from surface)	IM 20-year (ft amsl)	IM 20-year (ft from surface)
05N23W33B03S	Kennedy 05N23W33B03S	792	-31	806	-17	792	-31	806	-17	792	-31	806	-17	806	-17	806	-17
05N23W33G01S	Kennedy 05N23W33G01S	787	-29	797	-19	787	-29	797	-19	787	-29	797	-19	797	-19	797	-19
04N23W04J01S	North Robles 04N23W04J01S	625	-82	679	-28	625	-82	679	-28	625	-82	679	-28	679	-28	679	-28
04N23W09B01S	North Robles 04N23W09B01S	573	-86	648	-11	573	-86	648	-11	573	-86	648	-11	648	-11	648	-11
04N23W16C04S	South Robles 04N23W16C04S	467	-103	546	-24	467	-103	546	-24	467	-103	546	-24	546	-24	546	-24
04N23W29F02S	Santa Ana 04N23W29F02S	334	-60	385	-9	334	-60	385	-9	334	-60	385	-9	385	-9	385	-9
03N23W08B07S	Casitas Springs 03N23W08B07S	215	-27	225	-17	215	-27	225	-17	215	-27	225	-17	225	-17	225	-17



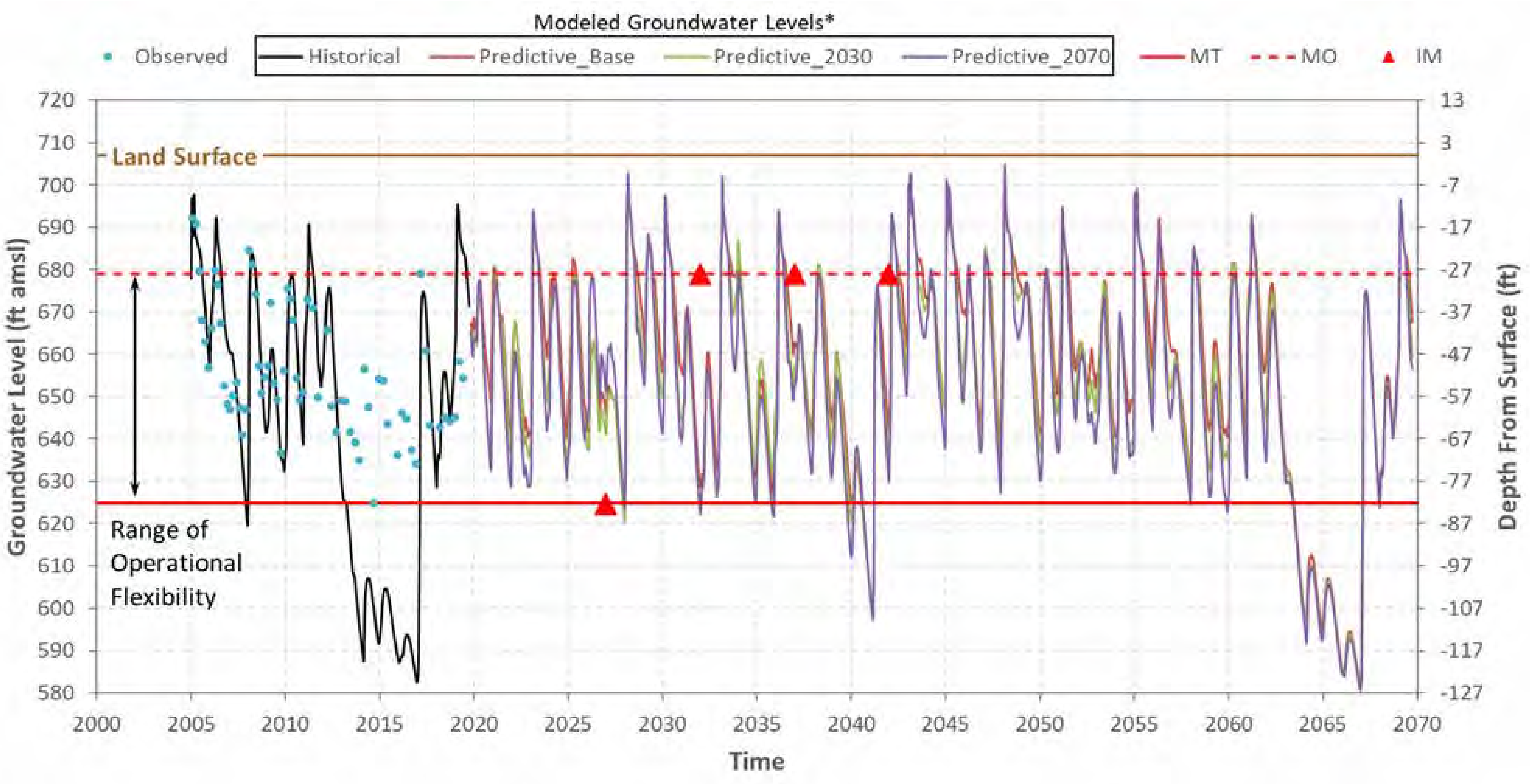
*Modeled peaks for storm events are higher than observed.

Figure Q-02 Groundwater Level – Baseline/2030/2070 (Kennedy 05N23W33B03S).



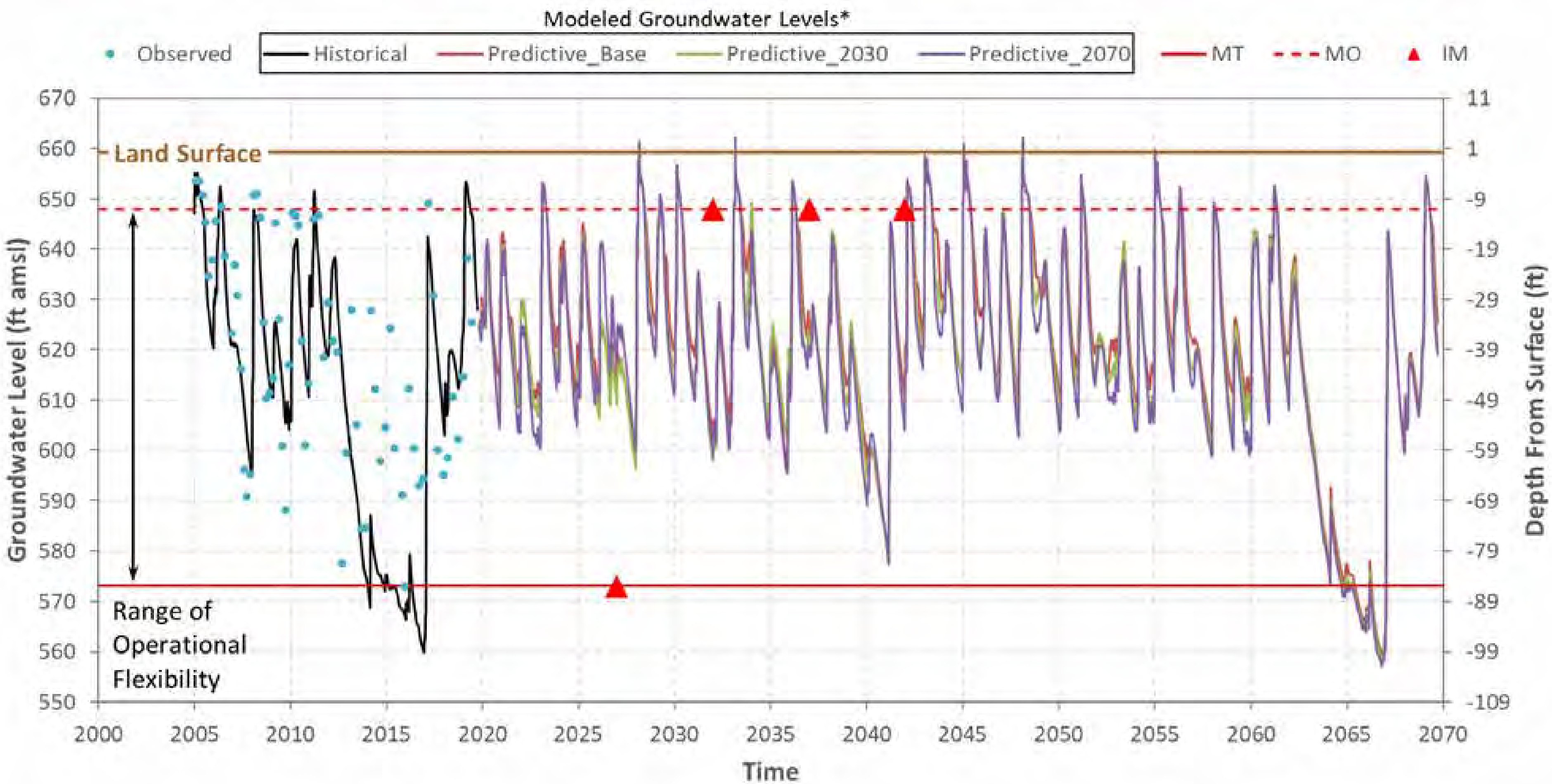
*Modeled peaks for storm events are higher than observed.

Figure Q-03 Groundwater Level – Baseline/2030/2070 (Kennedy 05N23W33G01S).



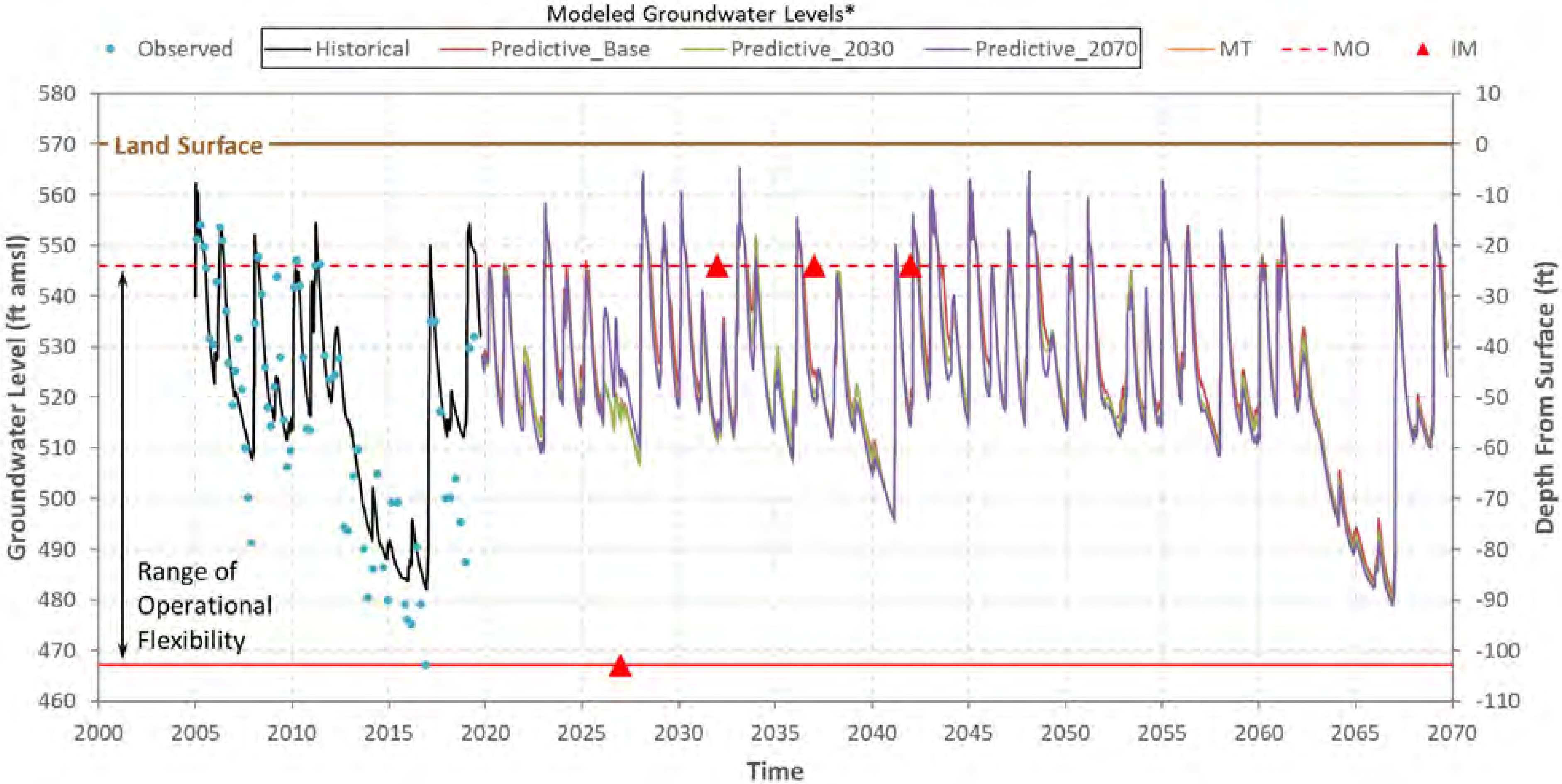
*Modeled peaks for storm events are higher than observed.

Figure Q-04 Groundwater Level – Baseline/2030/2070 (North Robles 04N23W04J01S).



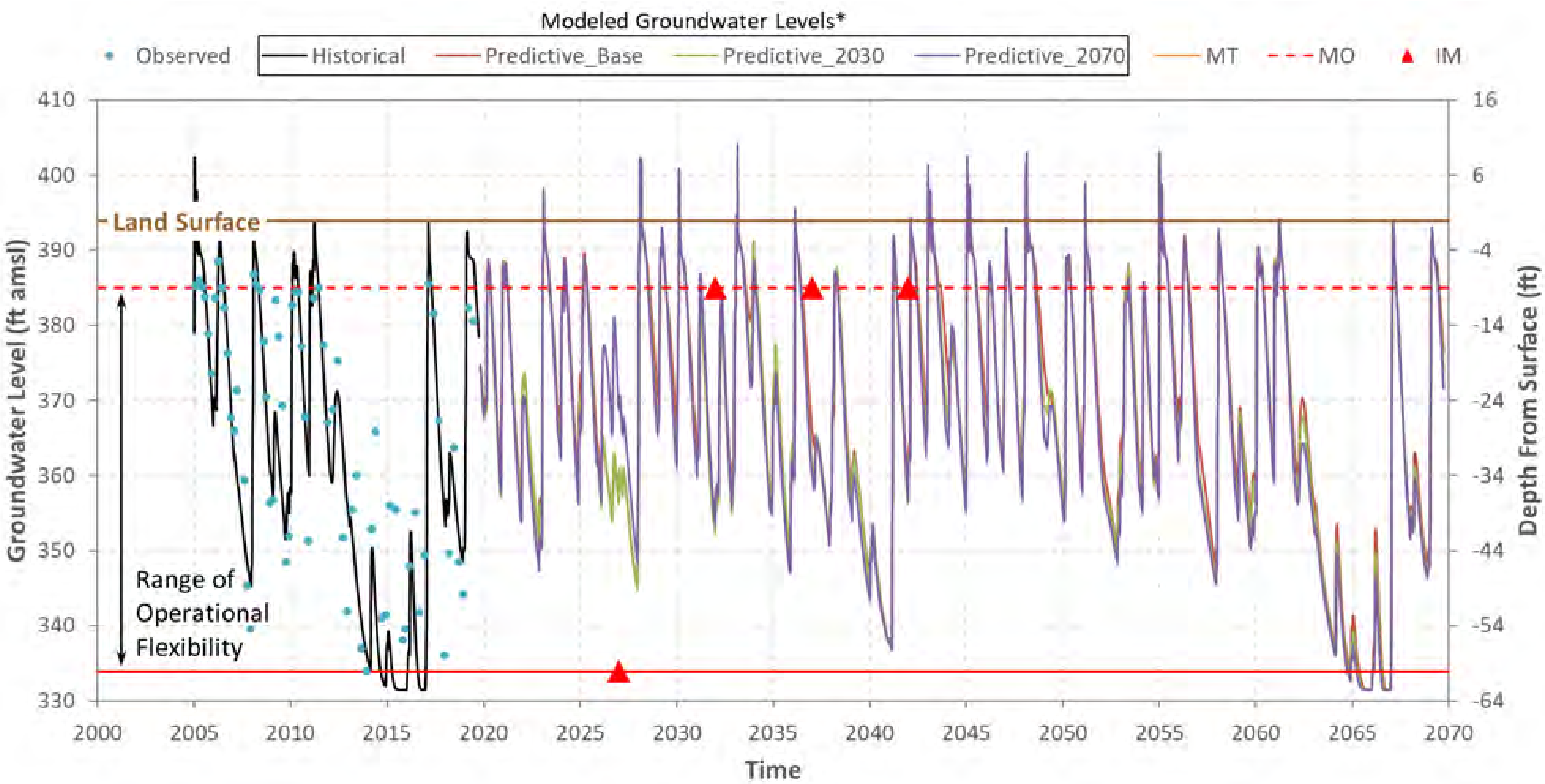
*Modeled peaks for storm events are higher than observed.

Figure Q-05 Groundwater Level – Baseline/2030/2070 (North Robles 04N23W09B01S).



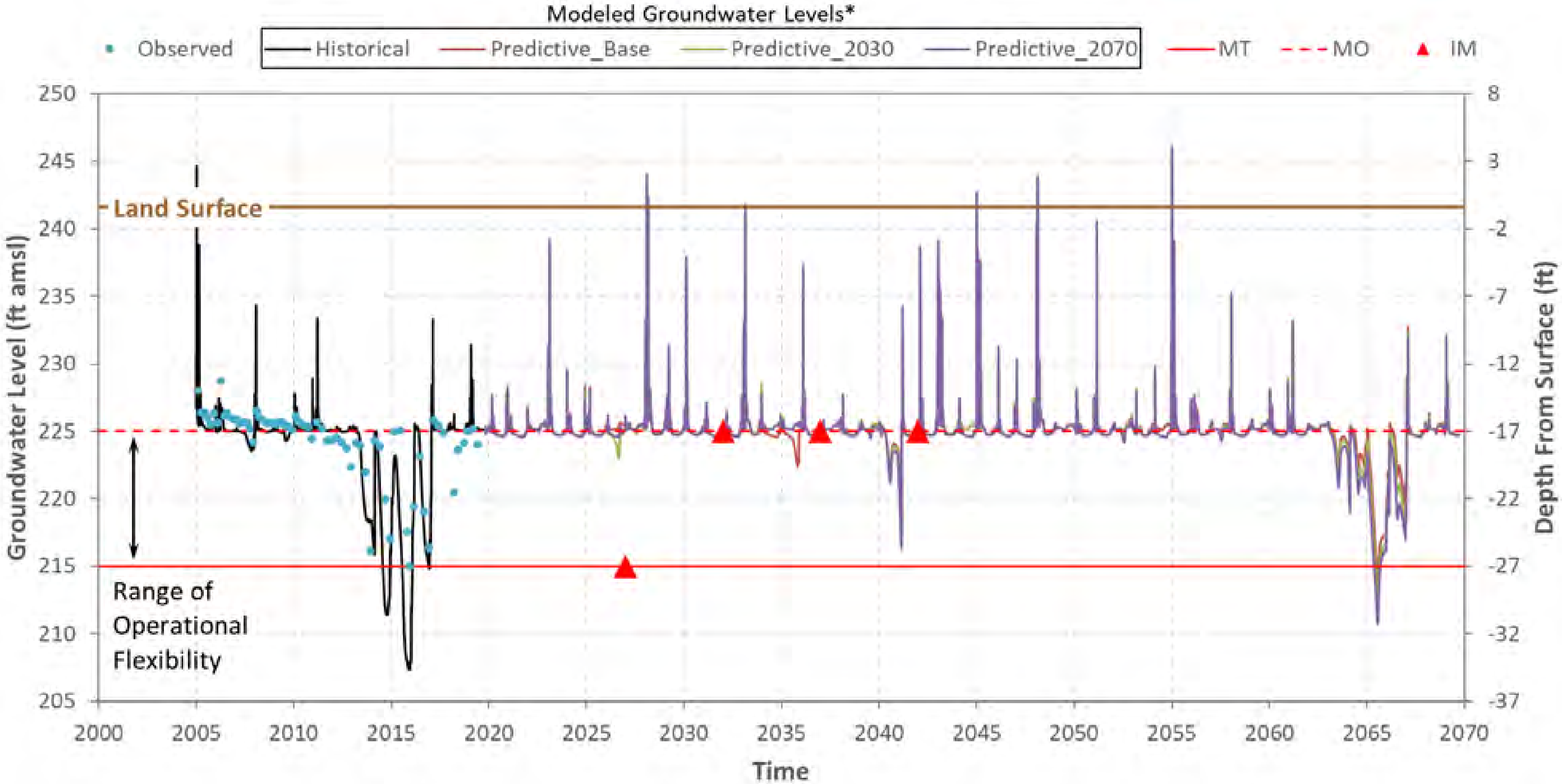
*Modeled peaks for storm events are higher than observed.

Figure Q-06 Groundwater Level – Baseline/2030/2070 (South Robles 04N23W16C04S).



*Modeled peaks for storm events are higher than observed.

Figure Q-07 Groundwater Level – Baseline/2030/2070 (Santa Ana 04N23W29F02S).



*Modeled peaks for storm events are higher than observed.

Figure Q-08 Groundwater Level – Baseline/2030/2070 (Casitas Springs 03N23W08B07S).

Appendix R

UVRGA Monitoring and Data Collection Protocols

UVRGA

MONITORING AND DATA COLLECTION PROTOCOLS

UPDATED AND ADOPTED 9-13-18

Contents

Introduction

This document describes the standard protocols that Upper Ventura River Groundwater Agency (UVRGA) staff and consultants will follow for the collection and recording of geologic and hydrologic data within the Upper Ventura River Basin (UVRB) and surrounding areas within the Ventura River watershed. Pursuant to Groundwater Sustainability Plan (GSP) Emergency Regulations § 352.2, monitoring and data collection protocols are a required element of the GSP for the UVRB. This document is intended to satisfy this requirement and will also be utilized for pre-GSP monitoring and data collection activities. Pursuant to GSP Emergency Regulations § 352.2(c), the monitoring protocols contained in this document shall be reviewed at least every five years as part of the required periodic GSP evaluation. Additionally, this document should be updated, as needed, to provide protocols for monitoring or data collection activities not currently performed.

Pursuant to GSP Emergency Regulations § 352.2(b), the Agency may rely on monitoring protocols included as part of the best management practices (BMPs) developed by the Department of Water Resources (DWR), or may adopt similar monitoring protocols that will yield comparable data. Unless otherwise indicated, this document proposes to utilize the protocols presented in DWR's BMP titled *Groundwater Monitoring Protocols, Standards, and Sites Best Management Practice*, dated December 2016 (herein referred to as the "DWR BMP") (DWR, 2016a).

The standard protocols addressed in this document are:

- Groundwater level monitoring

- Stream flow measurements

- Visual surface water flow observations

- Well construction procedures

- Water quality sampling procedures

- Groundwater Extraction Measurement

Relationship to GSP Monitoring Network Requirements

Pursuant to Subarticle 4 of the GSP Emergency Regulations, the GSP must include a monitoring network that includes monitoring objectives, monitoring protocols, and data reporting requirements. The monitoring network must be capable of collecting sufficient data to demonstrate short-term, seasonal, and long-term trends in groundwater and related surface conditions, and yield representative information about groundwater conditions as necessary to evaluate Plan implementation. Suggested practices for developing the monitoring network are provided in DWR's BMP titled *Monitoring Networks and Identification of Data Gaps Best Management Practice*, dated December 2016 (DWR, 2016b).

The primary components of the monitoring network are:

1. Monitoring Objectives: The GSP must include a description of the monitoring network objectives for the basin, which will be developed in conjunction with the sustainable management criteria during the planning process. In general, the network will need to be capable of capturing data on a sufficient temporal frequency and spatial distribution to demonstrate short-term, seasonal, and long-term trends in basin conditions for each of the sustainability indicators, and provide enough information to evaluate GSP implementation. DWR's monitoring network and monitoring protocols BMPs suggest that GSPs using the Data Quality Objective (DQO) process laid out in the U.S. EPA Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA, 2006) to develop the DQOs. Although strict adherence to this method is not required, it does provide a robust approach to consider and assures that data is collected with a specific purpose in mind, and efforts for monitoring are as efficient as possible to achieve the objectives of the GSP and compliance with the GSP Regulations. The monitoring objectives will be developed during the GSP planning process and will utilize a DQO process approved by the UVRGA Board of Directors.

2. Monitoring Protocols: Monitoring protocols are the subject of this document.

3. Data Reporting Requirements: Pursuant to GSP Emergency Regulations § 354.40, the Agency must store monitoring data in a data management system (DMS) that is capable of storing and reporting information relevant to the development or implementation of the GSP and monitoring of the basin. Monitoring data must be included in the required annual reports and submitted electronically on forms provided by DWR. The data management system will be created during the GSP development.

Training Requirements

An overarching requirement of the monitoring and data collection protocols is for all personnel to be fully trained and working under the supervision of a California Professional Geologist and Certified Hydrogeologist or Professional Civil Engineer (herein referred to as the "responsible professional") before performing any study or project-related activities. Minimum personnel requirements are established to assure that personnel performing the work meet the adequate qualifications and sufficient training to meet the data quality objectives. Similarly, laboratories utilized for chemical analysis of water samples shall be accredited by the CA Environmental Laboratory Accreditation Program (ELAP).

Training includes familiarity and understanding of the applicable protocols in this document, SGMA Requirements, UVRGA GSP and its predecessor preparatory documents, and the geography, hydrology, and geology of the watershed. Detailed written and verbal directions will be provided by the responsible professional to personnel working under their direct supervision. Manuals that include the applicable protocols in this document, field equipment instructions, equipment calibration protocols, safety manuals, and references are to be made available to all personnel performing monitoring or data collection activities.

Data Collected by Others

Many monitoring programs already exist within and surrounding the Upper Ventura River Basin. DWR encourages, to the extent possible, the use of existing monitoring data and programs to meet the needs for characterization, historical record documentation, and continued monitoring for the SGMA program. For the UVRGA, this includes data collected by other local governmental agencies, non-governmental organizations (NGOs) and the State Water Resources Control Board (SWRCB). UVRGA does not have the authority to impose compliance with its monitoring protocols. DWR recognizes this reality and, as a result, the DWR BMP recommends building in flexibility among the various methodologies available to meet the objectives based upon professional judgment, local knowledge and conditions, project needs, access, and budgetary limitations. Where possible, UVRGA will evaluate existing monitoring data to assure the data being collected meets the data quality objectives, regulatory requirements, and data collection protocol described in this document. As such, review of others' data collection protocols is just one aspect of evaluating existing and ongoing data collected by others. Review of non-UVRGA data will be addressed in more detail in the DQO process for the monitoring network.

Data and Reporting Standards

Pursuant to GSP Emergency Regulations § 352.4, the following reporting standards shall be adhered to:

Units:

- Water volumes shall be reported in acre-feet.
- Surface water flow shall be reported in cubic feet per second
- Groundwater flow shall be reported in acre-feet per year.

Units and Accuracy:

- Field measurements of elevations of groundwater, surface water, and land surface shall be measured and reported in feet to an accuracy of at least 0.1 feet relative to NAVD88, or another national standard that is convertible to NAVD88, and the method of measurement described.
- Reference point elevations shall be measured and reported in feet to an accuracy of at least 0.5 feet, or the best available information, relative to NAVD88, or another national standard that is convertible to NAVD88, and the method of measurement described.
- Geographic locations shall be reported in GPS coordinates by latitude and longitude in decimal degree to five decimal places, to a minimum accuracy of 30 feet, relative to NAD83, or another national standard that is convertible to NAD83.

Monitoring sites shall include the following information:

- A unique site identification number and narrative description of the site location (for wells – CASGEM well identification number if available);

- A description of the type of monitoring, type of measurement taken, and monitoring frequency;

- Location, elevation of the ground surface, and identification and description of the reference point.

Protocols

The following sections provide protocols for specific monitoring and data collection activities. Language taken directly from the DWR BMP is indicated by italic font.

Data Management and Quality Assurance/Quality Control

DWR provides the following data management BMP for measuring groundwater levels, which is adopted here in full and applied more generally to all forms of data that are stored in the DMS. *All data should be entered into the DMS as soon as possible. Care should be taken to avoid data entry mistakes and the entries should be checked by a second person for compliance with the data quality objectives.*

In addition to the DWR BMP for data management, UVRGA will be developing a data review process to provide data quality assurance and quality control.

Monitoring Site Information

Although not addressed in the DWR BMP, a log shall be maintained for each monitoring site that includes the following information:

- Access agreements to private property for areas not accessible as public lands, via prescriptive access easements, or commonly accessible open space land. Access agreements should include year-round site access to allow for increased monitoring frequency;

- Access instructions and point of contact (if necessary);

- Well construction information;

- Tracking and photographic documentation with date stamped images of all modifications to the monitoring site that could impact data collection activities and data quality. For wells, the reference point for groundwater level measurements should be carefully reviewed each visit and modifications noted in the log. For surface water flow measurement sites, the channel morphology should be inspected each visit and changes noted in the log.; and

- Any other information necessary to ensure accurate and repeatable data are collected, as determined by the responsible professional in charge of the monitoring or data collection activity.

Protocols for Measuring Groundwater Levels

The DWR BMP for measuring groundwater levels is adopted in full and is reprinted below, with minor additions or edits applicable to UVRGA's particular circumstances.

Groundwater levels are a fundamental measure of the status of groundwater conditions within a basin. In many cases, relationships of the sustainability indicators may be able to be correlated with groundwater levels. The quality of this data must consider the specific aquifer being monitored and the methodology for collecting these levels.

The following considerations for groundwater level measuring protocols should ensure the following:

- *Groundwater level data are taken from the correct location, well ID, and screen interval depth*
- *Groundwater level data are accurate and reproducible*
- *Groundwater level data represent conditions that inform appropriate basin management data quality objectives*
- *All salient information is recorded to correct, if necessary, and compare data*
- *Data are handled in a way that ensures data integrity*

General Well Monitoring Information

The following presents considerations for collection of water level data that include regulatory required components as well as those which are recommended.

Groundwater elevation data will form the basis of basin-wide water-table and piezometric maps and should approximate conditions at a discrete period in time. Therefore, all groundwater levels in a basin should be collected within as short a time as possible, preferably within a 1- to 2-week period.

Depth to groundwater must be measured relative to an established Reference Point (RP) on the well casing. The RP is usually identified with a permanent marker, paint spot, or a notch in the lip of the well casing. By convention in open casing monitoring wells, the RP reference point is located on the north side of the well casing. If no mark is apparent, the person performing the measurement should measure the depth to groundwater from the north side of the top of the well casing. In UVRGA Area production wells, the lower lip of the northernmost sounding tube is used as a reference point, consistent with the water levels collected by the County of Ventura.

The elevation of the RP of each well must be surveyed to the North American Vertical Datum of 1988 (NAVD88), or a local datum that can be converted to NAVD88. The elevation of the RP must be accurate to within 0.5 foot. It is preferable for the RP elevation to be accurate to 0.1 foot or less. Survey grade global navigation satellite system (GNSS) global positioning system (GPS) equipment can achieve similar vertical accuracy when corrected. Guidance for use of GPS can be found at USGS http://water.usgs.gov/osw/gps/. Hand-held GPS units likely will not produce reliable vertical elevation measurement accurate enough for the casing elevation consistent with the DQOs and regulatory requirements. County of Ventura RP elevations are recorded and hereby deemed acceptable reference points.

The sampler should remove the appropriate cap, lid, or plug that covers the monitoring access point listening for pressure or vacuum release. If a release is observed, the measurement should follow a period of time to allow the water level to equilibrate.

Depth to groundwater must be measured to an accuracy of 0.1 foot below the RP. It is preferable to measure depth to groundwater to an accuracy of 0.01 foot. Air lines and acoustic sounders may not provide the required accuracy of 0.1 foot and should only be used if it is not possible to use a water level meter. The method of measurement should be noted on the field log.

The water level meter should be decontaminated after measuring each well.

Measuring Groundwater Levels

Measure depth to water in the well using procedures appropriate for the measuring device. Equipment must be operated and maintained in accordance with manufacturer's instructions. Groundwater levels should be measured to the nearest 0.01 foot relative to the RP.

For measuring wells that are under pressure, allow a period of time for the groundwater levels to stabilize. In these cases, multiple measurements should be collected to ensure the well has reached equilibrium such that no significant changes in water level are observed. Every effort should be made to ensure that a representative stable depth to groundwater is recorded. If a well does not stabilize, the quality of the value should be appropriately qualified as a questionable measurement. In the event that a well is artesian, site specific procedures should be developed to collect accurate information and be protective of safety conditions associated with a pressurized well. In many cases, an extension pipe may be adequate to stabilize head in the well. Record the dimension of the extension and document measurements and configuration.

The sampler should calculate the groundwater elevation as:

GWE = RPE - DTW

Where:

GWE = Groundwater Elevation; RPE = Reference Point Elevation; DTW = Depth to Water

The sampler must ensure that all measurements are in consistent decimal units of feet, tenths of feet, and hundredths of feet. Measurements and RPEs should not be recorded in feet and inches.

Recording Groundwater Levels

The sampler should record the well identifier, date, time (24-hour format), RPE, height of RP above or below ground surface, DTW, GWE, and comments regarding any factors that may influence the depth to water readings such as weather, nearby irrigation, flooding, or well condition. If there is a questionable measurement or the measurement cannot be obtained, it should be noted. The field form provided in Appendix A shall be utilized for all groundwater level measurements.

The sampler should replace any well caps or plugs, and lock any well buildings, gates, or covers.

Pressure Transducers

Groundwater levels and/or calculated groundwater elevations may be recorded using pressure transducers equipped with data loggers installed in monitoring wells. When installing pressure transducers, care must be exercised to ensure that the data recorded by the transducers is confirmed with hand measurements. Because many dataloggers and pressure transducers have evolved into one and the same, the terms are used interchangeably here; UVRGA currently utilizes Solinst Leveloggers and associated direct read cables in monitored wells.

The following general protocols must be followed when installing a pressure transducer in a monitoring well:

- *The sampler must use an electronic sounder or chalked steel tape and follow the protocols listed above to measure the groundwater level and calculate the groundwater elevation in the monitoring well to properly program and reference the installation. It is recommended that transducers record measured groundwater level to conserve data capacity; groundwater elevations can be calculated at a later time after downloading.*

- *The sampler must note the well identifier, the associated transducer serial number, transducer range, transducer accuracy, and cable serial number.*

- *Transducers must be able to record groundwater levels with an accuracy of at least 0.1 foot. Professional judgment should be exercised to ensure that the data being collected is meeting the DQO and that the instrument is capable. Consideration of the battery life, data storage capacity, range of groundwater level fluctuations, and natural pressure drift of the transducers should be included in the evaluation.*

- *The sampler must note whether the pressure transducer uses a vented or non-vented cable for barometric compensation. Vented cables are preferred, but non-vented units provide accurate data if properly corrected for natural barometric pressure changes. This requires the consistent logging of barometric pressures to coincide with measurement intervals.*

- *Follow manufacturer specifications for installation, calibration, data logging intervals, battery life, correction procedure (if non-vented cables used), and anticipated life expectancy to assure that DQOs are being met for the GSP.*

- *Secure the cable to the well head with a well dock or another reliable method. Mark the cable at the elevation of the reference point with tape or an indelible marker. This will allow estimates of future cable slippage.*

- *The transducer data should periodically be checked against hand measured groundwater levels to monitor electronic drift or cable movement. This should happen during routine site visits, at least annually or as necessary to maintain data integrity.*

Protocols for Measuring Streamflow

The DWR BMP for measuring streamflow is adopted in full and is provided below, with minor additions or edits applicable to UVRGA's particular circumstances.

Monitoring of streamflow is necessary for incorporation into water budget analysis and for use in evaluation of stream depletions associated with groundwater extractions as well as gaining reaches associated with groundwater discharge. The use of existing monitoring locations should be incorporated to the greatest extent possible.

Establishment of new streamflow measurement sites should consider the existing network and the objectives of the new location. Professional judgment should be used to determine the appropriate permitting that may be necessary for the installation of any monitoring locations along surface water bodies. Regular frequent access will be necessary to these sites for the development of ratings curves and maintenance of equipment.

To establish a new streamflow monitoring station special consideration must be made in the field to select an appropriate location for measuring discharge. Once a site is selected, development of a relationship of stream stage to discharge will be necessary to provide continuous estimates of streamflow. Several measurements of discharge at a variety of stream stages will be necessary to develop the ratings curve correlating stage to discharge. The use of Acoustic Doppler Current Profilers (ADCPs) can provide accurate estimates of discharge in the correct settings. Professional judgment must be exercised to determine the appropriate methodology. Following development of the ratings curve a simple stilling well and pressure transducer with data logger can be used to evaluate stage on a frequent basis.

Key measurement locations within the UVRB include:

- Matilija Creek near Matilija Hot Springs (USGS, CMWD, Ventura County WPD)
- Camino Cielo Bridge (UVRGA, SWRCB)
- Robles Diversion (CMWD, USGS)
- Highway 150 Bridge (UVRGA)
- Santa Ana Road (County of Ventura WPD, UVRGA)
- San Antonio Creek at Highway 33 Bridge (County of Ventura WPD)
- Arroyo Mobile Home Park area (UVRGA)
- Coyote Creek at Casitas Vista Road (County of Ventura WPD)
- Casitas Vista Bridge (USGS)
- Other locations may be established, as needed to address DQOs

Many of the locations monitored by the UVRGA are measured via a current-meter measurement procedure long established by the USGS using modern equipment.

Streamflow measurements shall be collected, analyzed, and reported in accordance with the procedures outlined in USGS Water Supply Paper 2175, Volume 1. – Measurement of Stage Discharge and Volume 2. – Computation of Discharge (Rantz, et al, 1982). This methodology is currently being used by both the USGS and DWR for existing streamflow monitoring throughout the State. A field data sheet for measuring surface water flow is presented as Appendix B).

The USGS procedures are summarized below.

The first step in making a current-meter measurement is to select a reach of stream containing the following characteristics:

1. A straight reach with the threads of velocity parallel to each other.

2. Stable streambed free of large rocks, weeds, and protruding obstructions such as piers, which would create turbulence.

3. A flat streambed profile to eliminate vertical components of velocity.

It is usually not possible to satisfy all of these conditions. Select the best possible reach using these criteria and then select a cross section. After the cross section has been selected, determine the width of the stream. String a tag line or measuring tape for measurements made by wading, from a boat, from ice cover, or from an unmarked bridge. String the line at right angles to the direction of flow to avoid horizontal angles in the cross section. Next determine the spacing of the verticals, generally using about 25 to 30 partial sections. With a smooth cross section and good velocity distribution, fewer sections may be used. Space the partial sections so that no partial section has more than 10 percent of the total discharge in it. The ideal measurement is one in which no partial section has more than 5 percent of the total discharge in it, but this is very seldom the case when 25 partial or more sections are used. Equal widths of partial sections across the entire cross section are not recommended unless the discharge is well distributed. Make the width of the partial sections less as depths and velocities become greater. Space the verticals so the discharge in each vertical is about 5 percent of the discharge from the rating curve.

After the cross section has been selected and the stationing determined, assemble the appropriate equipment for the current-meter measurement and prepare the measurement note sheets to record the observations. Solo measurements may be recorded via digital audio media and transcribed at a later date. For each discharge measurement record the following information:

- Name of stream and location to correctly identify the established gaging station; or name of stream and exact location of site for a miscellaneous measurement.
- Date, party, type of meter suspension, and meter number.
- Time measurement was started using 24-hour format.
- Bank of stream that was the starting point (e.g., east or west).
- Control conditions.
- Gage heights and corresponding times.
- Water temperature.
- Other pertinent information regarding the accuracy of the discharge measurement and conditions which might affect the stage-discharge relation.

Identify the stream bank by either LEW or REW (left edge of water or right edge of water, respectively, when facing downstream). Record the time in the notes periodically, during the course of the measurement. This time usually should be synchronized with the time of punch on the digital recorder. This is important because if there is any appreciable change in stage during the measurement, the time is needed to determine the mean gage height for the measurement. When the measurement is completed, record the time and the bank of the stream where the section ends. After the equipment and the note sheet have been readied, begin the measurement. Indicate on the note sheet or voice recording the distance from the initial point to the edge of the water. Measure and record the depth at the edge of water. After the depth is known and recorded, determine the method of velocity measurement. Normally the two-point method or the 0.6-depth method is used. Compute the setting of the meter for the particular method to be used at that depth. Record the meter position (as 0.8, 0.6, 0.2, . . .). After the meter is placed at the proper depth, permit it to become adjusted to the current before starting the velocity observation. The time required for such adjustment is usually only a few seconds if the velocities are greater than 1 fps, but for lower velocities, particularly if the current meter is suspended by a cable, a long period of adjustment is needed. After the meter has become adjusted to the current, record the flow velocity of the digital readout in accordance with manufacturer instructions. If the velocity is to be observed at more than one point in the vertical, determine the meter setting for the additional observation, time the revolutions, and record the data. Move to each of the verticals and repeat this procedure; record the distance from initial point, depth, meter-position depth, revolutions, and time interval, until the entire cross section has been traversed.

Current-meter measurements by wading are preferred, if conditions permit. Wading measurements offer the advantage over measurements from bridges and cableways in that it is usually possible to select the best of several available cross sections for the measurement.

When natural conditions for measuring are in the range considered undependable, modify the measuring cross section, if practical, to provide acceptable conditions. Often it is possible to build dikes to cut off dead water and shallow flows in a cross section, or to improve the cross section by removing the rocks and debris within the section and from the reach of stream immediately upstream from it. After modifying a cross section, allow the flow to stabilize before starting the discharge measurement. Stand in a position that least affects the velocity of the water passing the current meter. This position is usually obtained by facing the bank, with the water flowing against the side of the leg. Holding the wading rod at the tag line, stand from 1 to 3 inches downstream from the tag line and 18 inches or more from the wading rod. Avoid standing in the water if feet and legs would occupy a considerable percentage of the cross section of a narrow stream. In small streams where the width permits, stand on a plank or other support rather than in the water. Keep the wading rod in a vertical position and the meter parallel to the direction of flow while observing the velocity. During measurements of streams with shifting beds, the scoured depressions left by the hydrographer's feet can affect soundings or velocities. Generally, place the meter ahead of and upstream from the feet. Record an accurate description of streambed and water-surface configuration each time a discharge measurement is made in a sand-channel stream.

A quality control measure should be implemented at least twice per year, consisting of multiple independent flow measurements made concurrently by at least two trained personnel. If possible, concurrent measurements should also be made with other entities (such as the USGS) performing flow measurements in the basin.

UVRGA Protocols for Visual Surface Water Flow Observations

The DWR BMP does not address visual monitoring of surface water flow. The following protocols were developed based on past experience in the basin.

As with many watersheds in arid and tectonically active regions, the Ventura River Watershed exhibits a very dynamic and mobile, ephemeral and intermittent network of streams. Surface flow from most streams exits the headwaters and infiltrates into the subsurface as the streams enter the groundwater basins, namely the Ojai Basin and the Upper Ventura River Groundwater Basin. Given the cobble and boulder substrate of the river beds, gauging the flow is difficult except for where bridges or impoundments exist and have created an engineered river bottom of planar concrete. A network of gauges exists at many bridge locations, but these are at areas where flow is often absent while the live reaches flow over areas where measuring the flow can be difficult and inaccurate due to the mobile river bed gravels.

To accommodate this phenomenon, it is prudent to monitor the southern edges of surface water flow on the losing reaches and the northern edges of surface water flow on the gaining reaches in this generally north-to south flowing system. By conducting this mapping on an ongoing basis using GPS tools, a long-term database can be constructed. By correlating the latitudes of the daylighting groundwater with measured flow, the latitudes can be used as a rating-shifted proxy for river and stream flow, while reducing the uncertainty of measurements in the mobile substrate. Unique to each stream system, such a network can be used to graph the relationship between flow components and simplify the flow model of the stream system and interacting groundwater.

Currently Meiner's Oaks Water District (MOWD) (one of the UVRGA member agencies), maps the latitude and longitude of the southerly terminus of active surface water flow in the northern losing reach on a weekly basis. Typically, this is done on Friday afternoons when MOWD measures south end of surface flow at the losing reach of river to the north. Additionally, UVRGA has begun weekly monitoring of the starting point of active surface water flow at the northern edge the gaining reach. Optimal times to measure data will be selected as supported by detailed continuous flow migration measurements as described below.

Each weekly observation shall include documentation of the observation time and latitude and longitude of the active flow starting point (gaining reach) or terminus (losing reach) recorded as GPS Waypoints with photographic documentation of upstream and downstream views. The observation time will be selected based on the results of the high frequency readings study described in the following section. Because the DQO is to identify the active flow starting point (gaining reach) or terminus (losing reach), stagnant or non-surface flowing water will be considered ponded and not part of the flowing stream unless it its connected to flowing water without dry break. Because determination of the flow starting point or terminus is interpretive, a quality control measure should be implemented at least once per quarter, consisting of multiple independent observations made concurrently by at least two trained personnel. A practical check will be a video-logged record of the obviously flowing portion of the river followed upstream to the point of absent standing water in the gaining reach, and conversely downstream to the point of absent standing water in the losing reach. Videos will be time-stamped, saved and archived in UVRGA digital files.

Notes of wildlife should be recorded, as well as temperature, algae, and electrical conductivity of the water at first daylighting. The field form provided in Appendix C shall be utilized for all edge of surface flow field observation.

When locating the northern edge of the gaining reach, daylighting groundwater is typically anticipated to be north of the confluence of the Ventura River with San Antonio Creek. Most traverses will commence from the OVLC Confluence Preserve and work northward. During drier periods the assumed perennial flow would be over an outcrop of bedrock in the river just south of Casitas Vista Bridge. Under such conditions, traverses would commence at Foster Park. During wetter periods, the traverses will commence at Santa Ana Road bridge over the river.

High Frequency Readings

Owing to the potential for diurnal variability in the location of the Ventura River's north edge of the live reach, the weekly surveys should be augmented with at least one high-frequency survey to assess variability in the location of the active flow starting point throughout a dawn-to-dusk period that may be resulting from diurnal cycles in evapotranspiration and pumping. The results of the high-frequency survey(s) will be used to identify the optimal time of the day for the weekly monitoring, with the goal of ensuring consistent and representative observations.

The proper time for high-frequency surveys are after the full cross-basin flow has ceased, and the Robles reach has become dry (typically by late spring or early summer). This is to be a combination tape survey, pressure-logger and GPS based survey or the migration of the northern edge of the live reach when it is in a conveniently measureable location (e.g., just south of Santa Ana Road). At a convenient time, personnel will track and map the north edge of surface flow and map (via GPS and tape, as well as a datalogger in the downstream portion that will be saturated throughout this survey time period) to monitor for diurnal fluctuations.

The typical survey shall consist of monitoring during daylight hours, with a full-time observer placed near the northern edge of daylighting groundwater. Equipment may include field note book, GPS unit, 300-ft long fiberglass tape with decimal feet gradations, timepiece, telephone, camera, whistle, headlamps, shade structure, chair, and food/drinking water supplies. Upon arrival to the designated point, the observer shall lay out the 300-ft tape with half (0-150 ft) in the submerged portion of the river and half upstream (150 to 300 ft) in the dry portion at the time of arrival. The datalogger shall be set in a flowing portion of the river downstream of the “0” mark on the tape where flow is anticipated to be continuous throughout the survey. The logger shall be placed on the stream bed, and weighted with cobbles to ensure stationarity throughout the survey. Its GPS position shall be recorded in the field notes.

The observer shall record at 10-minute intervals:

- Time of observation
- Footage reading on fiberglass tape at time
- Latitude of daylighting point
- Longitude of daylighting point
- Temperature of daylighting water

Following the survey, the following data will be compiled:

- Flow at Casitas Vista Bridge
  https://waterdata.usgs.gov/nwis/uv?site_no=11118500
- Flow at Matilija Creek near Matilija Hot Springs
  https://waterdata.usgs.gov/nwis/uv?site_no=11114495

Any relief personnel shall follow the protocol, with overlapping time of 30 minutes (three measurements) to check compatibility and consistency of data collection during a shift change. All data will be entered into an excel spreadsheet such that a diurnal chart of the latitude of daylighting groundwater on the surveyed date can be generated. Flows into and out of the basin, at a minimum, as available from the USGS websites presented above, will be recorded on the data sheets in cfs.

New Monitoring Well Construction

The DWR BMP for new monitoring well construction is adopted in full and is reprinted below, with minor additions or edits applicable to UVRGA's particular circumstances.

Where existing wells do not meet the base standard as described in the GSP Regulations new monitoring wells may need to be constructed to meet the DQOs of the GSP. The design, installation, and documentation of new monitoring wells must consider the following:

- *Construction consistent with California Well Standards as described in Bulletins 74-81 and 74-90* and County of Ventura and UVRGA permitting requirements.
- *Logging of borehole cuttings under the supervision of a California Professional Geologist and described consistent with the Unified Soil Classification System methods according to ASTM standard D2487-11.*
- *Written criteria for logging of borehole cuttings for comparison to known geologic formations, principal aquifers and aquitards/aquicludes, or specific marker beds to aid in consistent stratigraphic correlation within and across basins.* For UVRGA, this generally means differentiating between alluvium and bedrock units, which shall be noted based on drilling rate, rig behavior, and visual observation of cuttings or core samples, including rock type, mineralogy, and color. Where possible, the field geologist shall attempt to differentiate between recent and older alluvium.
- *Geophysical surveys of boreholes to aid in consistency of logging practices. Methodologies should include resistivity, spontaneous potential, spectral gamma, or other methods as appropriate for the conditions. Selection of geophysical methods should be based upon the opinion of a professional geologist or professional engineer and address the DQOs for the specific borehole and characterization needs.*
- *Prepare and submit State well completion reports according to the requirements of §13752. Well completion report documentation should include geophysical logs, detailed geologic log, and formation identification as attachments. DWR well completion reports can be filed directly at the Online System for Well Completion Reports (OSWCR) http://water.ca.gov/oswcr/index.cfm.*

Protocols for Sampling Groundwater Quality

The DWR BMP for groundwater quality sampling is adopted in full and is reprinted below, with minor additions or edits applicable to UVRGA's particular circumstances. The field form provided in Appendix D shall be utilized when collecting groundwater quality samples.

All analyses should be performed by a laboratory certified under the State Environmental Laboratory Accreditation Program. The specific analytical methods are beyond the scope of this document, but should be commiserate [sic] *with other programs evaluating water quality within the basin for comparative purposes.*

The following points are general guidance in addition to the techniques presented in the USGS National Field Manual for the Collection of Water Quality Data (Wilde, 2005).

Standardized protocols include the following:

- *Prior to sampling, the sampler must contact the laboratory to schedule laboratory time, obtain appropriate sample containers, and clarify any sample holding times or sample preservation requirements.*

- *Each well used for groundwater quality monitoring must have a unique identifier. This identifier must appear on the well housing or the well casing to avoid confusion.*

- *In the case of wells with dedicated pumps, samples should be collected at or near the wellhead. Samples should not be collected from storage tanks, at the end of long pipe runs, or after any water treatment.*

- *The sampler should clean the sampling port and/or sampling equipment and the sampling port and/or sampling equipment must be free of any contaminants. The sampler must decontaminate sampling equipment between sampling locations or wells to avoid cross-contamination between samples.*

- *The groundwater elevation in the well should be measured following appropriate protocols described above in the groundwater level measuring protocols.* It is understood that it may not be possible to measure the groundwater level in pumping wells.

- *For any well not equipped with low-flow or passive sampling equipment, an adequate volume of water should be purged from the well to ensure that the groundwater sample is representative of ambient groundwater and not stagnant water in the well casing. Purging three well casing volumes is generally considered adequate. Professional judgment should be used to determine the proper configuration of the sampling equipment with respect to well construction such that a representative ambient groundwater sample is collected. If pumping causes a well to be evacuated (go dry), document the condition and allow well to recover to within 90% of original level prior to sampling. Professional judgment should be exercised as to whether the sample will meet the DQOs and adjusted as necessary.*

- *Field parameters of pH, electrical conductivity, and temperature should be collected for each sample. Field parameters should be evaluated during the purging of the well and should stabilize prior to* *sampling. Measurements of pH should only be measured in the field, lab pH analysis are typically unachievable due to short hold times. Other parameters, such as oxidation-reduction potential (ORP), dissolved oxygen (DO) (in situ measurements preferable), or turbidity, may also be useful for meeting DQOs of GSP and assessing purge conditions. All field instruments should be calibrated daily and evaluated for drift throughout the day.*

- *Sample containers should be labeled prior to sample collection. The sample label must include: sample ID (often well ID), sample date and time, sample personnel, sample location, preservative used, and analytes and analytical method.*

- *Samples should be collected under laminar flow conditions. This may require reducing pumping rates prior to sample collection.*

- *Samples should be collected according to appropriate standards such as those listed in the Standard Methods for the Examination of Water and Wastewater, USGS National Field Manual for the Collection of Water Quality Data, or other appropriate guidance. The specific sample collection procedure should reflect the type of analysis to be performed and DQOs.*

- *All samples requiring preservation must be preserved as soon as practically possible, ideally at the time of sample collection. Ensure that samples are appropriately filtered as recommended for the specific analyte. Entrained solids can be dissolved by preservative leading to inconsistent results of dissolve analytes. Specifically, samples to be analyzed for metals should be field-filtered prior to preservation; do not collect an unfiltered sample in a preserved container.*

- *Samples should be chilled and maintained at 4 °C to prevent degradation of the sample. The laboratory's Quality Assurance Management Plan should detail appropriate chilling and shipping requirements.*

- *Samples must be shipped under chain of custody documentation to the appropriate laboratory promptly to avoid violating holding time restrictions.*

- *Instruct the laboratory to use reporting limits that are equal to or less than the applicable DQOs or regional water quality objectives/screening levels.*

- *Special Protocols for Low-Flow Sampling Equipment: In addition to the protocols listed above, sampling using low-flow sample equipment should adopt the following protocols derived from EPA's Low-flow (minimal drawdown) ground-water sampling procedures (Puls and Barcelona, 1996). These protocols apply to low-flow sampling equipment that generally pumps between 0.1 and 0.5 liters per minute. These protocols are not intended for bailers.*

- *Special Protocols for Passive Sampling Equipment: In addition to the protocols listed above, passive diffusion samplers should follow protocols set forth in USGS Fact Sheet 088-00.*

Groundwater Extraction Measurements

UVRGA has undertaken an aerial survey and is evaluating water deliveries to identify private groundwater users and develop initial estimates of their pumping for the purposes of evaluating a potential initial regulatory fee to fund the Agency's activities. Looking ahead, it is anticipated that the UVRGA will identify method(s) for measuring or estimating groundwater extractions. The DWR BMP does not provide protocols for measuring or estimating groundwater extractions from wells. This document will be updated at a later date to add protocols for the groundwater extraction measurement or estimation methods selected the Agency.

References

California Department of Water Resources, 2016a. Groundwater Monitoring Protocols, Standards, and Sites Best Management Practice, December 2016

https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-1-Monitoring-Protocols-Standards-and-Sites.pdf

California Department of Water Resources, 2016b. Monitoring Networks and Identification of Data Gaps Best Management Practice, December 2016.

https://www.water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-2-Monitoring-Networks-and-Identification-of-Data-Gaps.pdf

Rantz, S.E., and others, 1982. Measurement and computation of streamflow; U.S. Geological Survey, Water Supply Paper 2175. http://pubs.usgs.gov/wsp/wsp2175/#table

U.S. Environmental Protection Agency, 2006. Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4, February 2006.
https://www.epa.gov/sites/production/files/documents/guidance_systematic_planning_dqo_process.pdf

Wilde, F.D., January 2005. Preparations for water sampling (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A1,
http://water.usgs.gov/owq/FieldManual/compiled/NFM_complete.pdf

Appendix A – Groundwater Level Field Form

Upper Ventura River
GROUNDWATER AGENCY
SUSTAINABLE MANAGEMENT

GROUNDWATER LEVEL MEASUREMENT FIELD DATA SHEET

A	B	C	D	E	F	G	H
WELL ID	DATE	TIME	RPE (ft amsl)	RPH (ft agl)	DTW (ft)	GWE (ft amsl)	Notes
Researched	*Record*	*Record*	*Researched*	*Measured*	*Measured*	*D-F*	

Appendix B – Surface Water Flow Measurement Field Form

Page _____ of _______
Section Area.:____________________
Latitude - Longitude: ____
Date:____________________________
Personnel:__________________________ Weather:_____________________________________

Upper Ventura River GROUNDWATER AGENCY SUSTAINABLE MANAGEMENT

SURFACE WATER FLOW MEASUREMENT DATA SHEET

A	B	C	D	E	F
Cumulative Section length (ft)	Depth (ft)	Flow Velocity (ft/sec)	Sectional flow (cfs)	Cumulative flow (cfs)	Notes
Recorded	*Measured*	*Measured*	*(An-Ao)XBXC*	*Sum Dn:Do*	

Appendix C – Daylighting Groundwater Observation Field Form

Page _____ of _______
Section Area.:____________________

Upper Ventura River
GROUNDWATER AGENCY
SUSTAINABLE MANAGEMENT

Personnel:_________________________ Weather:____________________________________

EDGE OF SURFACE FLOW FIELD OBSERVATION SHEET

A	B	C	D	E	F	G	H
Date	Time	Latitiude	Longitude	Ft from RP (ft N/S)	Temp	EC (uS/cm)	Notes

Appendix D – Groundwater Quality Sampling Field Form

Page _____ of _______
Section Area.:____________________

Upper Ventura River
GROUNDWATER AGENCY
SUSTAINABLE MANAGEMENT

____

Personnel:_________________________ Weather:____________________________________

GROUNDWATER QUALITY SAMPLING FIELD FORM

A	B	C	D	E	F	G	H
Date	Time	Well ID	Temp	EC	pH	Rate (gpm)	Notes

Appendix S

UVRGA Data Quality Control Review Procedures

UVRGA

DATA QUALITY CONTROL REVIEW PROCEDURES

ADOPTED SEPTEMBER 13, 3018

Contents

Introduction

This document describes the procedures that Upper Ventura River Groundwater Agency (UVRGA) staff and consultants will follow when performing data quality control review of groundwater and surface water data collected within the Upper Ventura River Basin (UVRB) and surrounding areas within the Ventura River watershed for use in the Groundwater Sustainability Plan (GSP). Implementation of these procedures is intended to ensure data used in the GSP is credible, as required pursuant to GSP Emergency Regulations §351(h). This document may require updates to address additional types of data, as needed (e.g. biological data concerning groundwater dependent ecosystems). The procedures contained in this document are adapted from United States Geological Survey (USGS) data review procedures.

Data quality control review will be performed prior to data entry into the GSP data management system (DMS) and/or data use for GSP preparation. During its June 14, 2018 discussion of options for a data quality control review process, the Board reached a consensus for implementing data quality control review as part of the GSP workflow under the direction of the GSP PM. Thus, the GSP PM will be responsible for ensuring data is reviewed prior to use in the GSP.

Relationship to GSP Monitoring Network Requirements

Pursuant to Subarticle 4 of the GSP Emergency Regulations, the GSP must include a monitoring network that includes monitoring objectives, monitoring protocols, and data reporting requirements. Suggested practices for developing the monitoring network are provided in Department of Water Resources (DWR's) Best Management Practice (BMP) titled *Monitoring Networks and Identification of Data Gaps, dated December 2016*.

The required components of the monitoring network are:

1. Monitoring Objectives: The GSP must include a description of the monitoring network objectives for the basin, which will be developed in conjunction with the sustainable management criteria during the planning process. In general, the network will need to be capable of capturing data on a sufficient temporal frequency and spatial distribution to demonstrate short-term, seasonal, and long-term trends in basin conditions for each of the sustainability indicators, and provide enough information to evaluate GSP implementation. DWR's monitoring network and monitoring protocols BMPs suggest using the Data Quality Objective (DQO) process laid out in the U.S. EPA Guidance on Systematic Planning Using the Data Quality Objectives Process to develop the DQOs. One of the last steps in the DQO process is to determine what quality the data must have to achieve the monitoring objectives.

2. Monitoring Protocols: UVRGA adopted the Monitoring and Data Collection Protocols on May 10, 2018.

3. Data Reporting Requirements: Pursuant to GSP Emergency Regulations § 354.40, the Agency must store monitoring data in a data management system (DMS) that is capable of storing and reporting information relevant to the development or implementation of the GSP and monitoring of the basin. Monitoring data must be included in the required annual reports and submitted electronically on forms provided by DWR. The data management system will be created during the GSP development.

Data quality control is not explicitly required by the GSP Emergency Regulations but is mentioned in the BMP summary of the suggested EPA DQO process (see Monitoring Network Component No. 1). One of the last steps in the suggested in the BMP is to "Specify performance or acceptance criteria – Determine what quality the data must have to achieve the objective and provide some assurance that the analysis is accurate and reliable." DWR suggests that the data performance or acceptance criteria be defined relative to the quantitative measurable objectives and minimum thresholds for each applicable sustainability indicator that will be included in the GSP.

Applicability

The data review procedures contained in this document shall be applied to all data stored in the UVRGA DMS, regardless of the data source and regardless of whether the data is ultimately utilized to develop the GSP. Data shall be reviewed prior to storage in the DMS and/or use in developing the GSP. Data obtained from the USGS shall be considered to have met already the requirements of this section without further review, provided any USGS data qualifiers are included in the DMS (e.g. provisional status, etc.).

Data Reviewer Qualifications

An overarching requirement of SGMA is for all personnel to be fully trained and working under the supervision of a California Professional Geologist, Certified Hydrogeologist, or Professional Civil Engineer (herein referred to as the "responsible professional"). Additionally, the USGS requires that data reviewers be experienced in working with the particular type of data being reviewed and possess the expertise and tools to access and assess both the data and associated metadata.

Data Quality Control Review

The following data quality control review procedures are adapted from the USGS Data Review Checklist https://www2.usgs.gov/datamanagement/documents/DataReviewChecklist_2014.pdf. Language taken directly from the USGS checklist is indicated by italic font.

Prior to storing data in the DMS or using data for GSP purposes, data and associated metadata shall be approved by a data reviewer. Review is necessary to ensure that the data are well documented and are complete, consistent, accurate, and precise as needed to achieve the goals for which they were created. Data review may be carried out by one or more qualified reviewers, but reviewers will need to examine both data and metadata in order to understand the data and to ensure that the metadata accurately describe the data. To maintain objectivity, reviewers should not be chosen from the people who collected the data. Following review, the data, metadata, and data quality control review results should be loaded into the DMS.

Review Procedures for Data Collected by UVRGA

The review procedures consist of implementing the USGS Data Review Checklist.

Data releases require a minimum of one review of the data and one review of the accompanying metadata. The special focus of the data reviewer is the accuracy, completeness, and usability of a data product. The following checklist is provided for the assistance of data reviewers who are experienced in working with the particular type of data being reviewed. It is assumed that data reviewers have the expertise and tools to *access and assess both the data and the metadata, and are familiar with standard practices within the relevant discipline.*

In some cases, it will be unreasonable to actually check every data value, so a spot check or a check of a carefully selected sample may need to suffice. In this case, the data review report should indicate that a spot check or selected sample was examined.

A data review should consider the following:

- *Are the data what the author says they are?*
- *Are data values reasonable? Do they meet specifications for quality, accuracy, and completeness as identified by both the author and the approving official? This might include specific checks such as:*
    - *Are they in a valid range for that measurement?*
    - *Do they display seasonal or daily trends that are expected? Is there consistency between adjacent or otherwise related datasets, within the product?*
    - *Are the geographic locations given for the data reasonable?*
    - *Is the accuracy claimed for the data reasonable?*
    - *Are data anomalies or gaps explained in the metadata? Are "no data" values accurately defined?*
    - *Do analysis values add up?* (where applicable)
- *Consider any other requirements.*
    - Other requirements include but are not limited the following:
        - Adherence to UVRGA's Monitoring and Data Colleciton Protocols (which satisfies GSP Emergency Regulations § 352.2)
        - GSP Emergency Regulations § 352.4 Reporting Standards, which will be appropriately documented in the metadata:
            - Units:
                - Water volumes shall be reported in acre-feet.
                - Surface water flow shall be reported in cubic feet per second
                - Groundwater flow shall be reported in acre-feet per year.

- Units and Accuracy:

    - Field measurements of elevations of groundwater, surface water, and land surface shall be measured and reported in feet to an accuracy of at least 0.1 feet relative to NAVD88, or another national standard that is convertible to NAVD88, and the method of measurement described.

    - Reference point elevations shall be measured and reported in feet to an accuracy of at least 0.5 feet, or the best available information, relative to NAVD88, or another national standard that is convertible to NAVD88, and the method of measurement described.

    - Geographic locations shall be reported in GPS coordinates by latitude and longitude in decimal degree to five decimal places, to a minimum accuracy of 30 feet, relative to NAD83, or another national standard that is convertible to NAD83.

- Monitoring sites shall include the following information:

    - A unique site identification number and narrative description of the site location (for wells – CASGEM well identification number if available);

    - A description of the type of monitoring, type of measurement taken, and monitoring frequency; and

    - Location, elevation of the ground surface, and identification and description of the reference point.

Review Procedures for Data Collected by other Entities

In accordance with SGMA requirements, UVRGA will rely on the best available information and science to prepare the GSP, which will likely result in the utilization of data collected by other entities. To ensure data collected by other entities is credible (GSP Emergency Regulations § 351(h)), the above-listed procedures for reviewing data collected by UVRGA will be followed to the maximum extent practicable. Because other entities are not obligated to following UVRGA's Monitoring and Data Collection Protocols, the data reviewer will take additional steps to review documentation of the data collection procedures. The reviewer will also consider whether the data was collected under the supervision of a licensed professional geologist or engineer.

Review Documentation

The data reviewer shall document the data quality control review results using the following DMS database fields:

- Reviewer – Name of the responsible licensed professional
- Review_Date – Date of review
- Review_Batch – A unique identifier that will be assigned to all records in a particular data review batch (the identifier will be linked to a separate database table that provides batch documentation)
- Review_Result – The data review result:
    - Approved – data approved without condition
    - Qualified – data approved for use with caution or with data use limitation(s)
    - Rejected – data not approved for GSP use
- Review_Flag – A code that describes the reason for qualified or rejected status (applies only to qualified or rejected data)
- Review_Comment – Optional field, used as needed to provide information deemed relevant by reviewer, e.g. elaborate on reason for qualified or rejected status

APPENDIX T

Data Management System Information

Overview

This data management system (DMS) was developed for the purpose of "storing and reporting information relevant to the development or implementation of the Plan and monitoring of the basin", per section 352.6 of the GSP regulations. The DMS was developed for use by the Upper Ventura River Groundwater Agency (UVRGA).

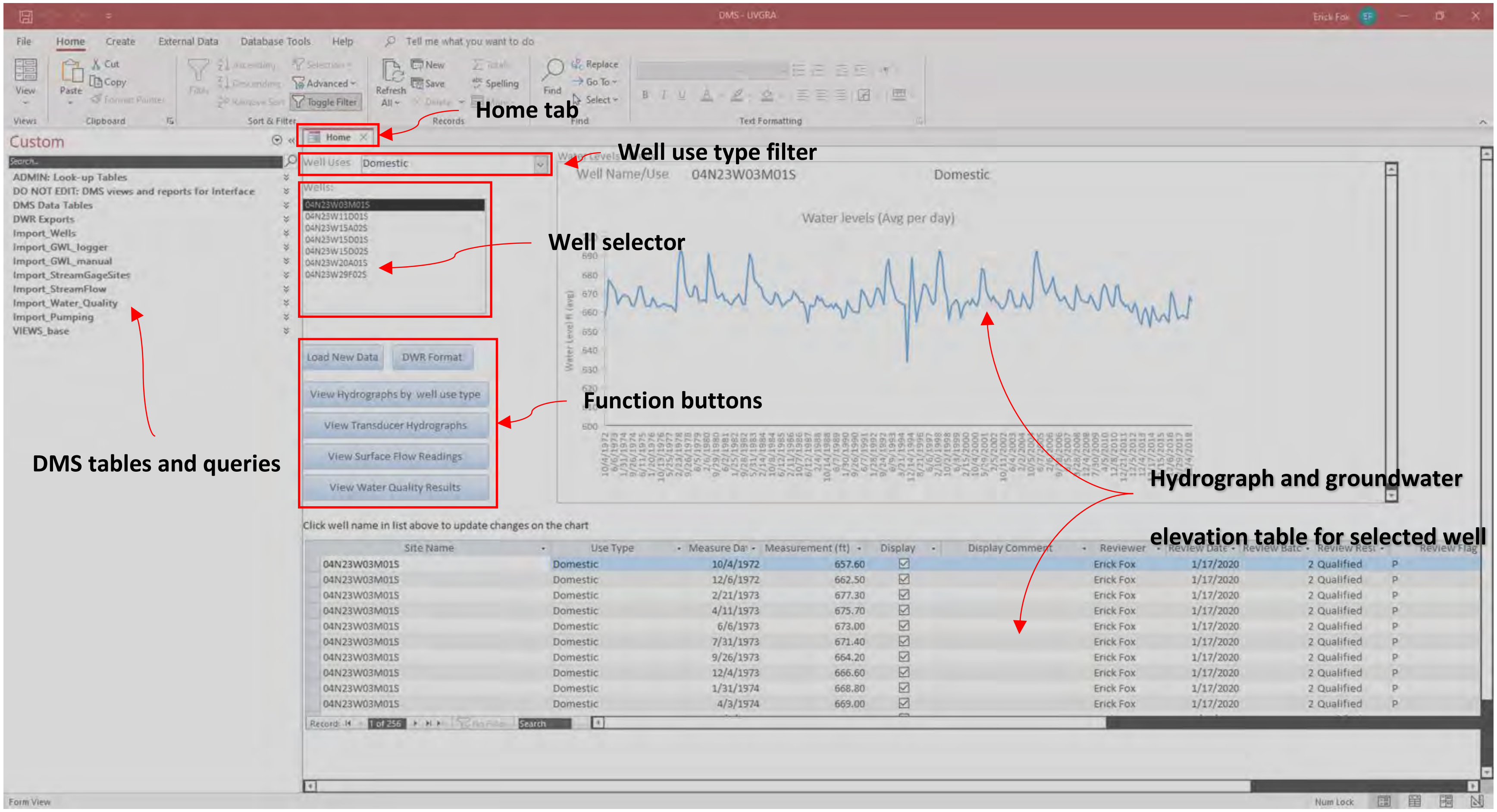
The DMS is housed in an Access database, which has the ability to import data from Excel, perform filtering and charting for some data, and export to Excel tables that are formatted according to DWR templates for upload with the GSP. The data in the DMS have undergone quality control checks prior to import in line with the UVRGA Data Quality Control Review Procedures document, adopted by the UVRGA board on September 13, 2018.

The DMS is designed to contain the following data:

- Well construction details
- Groundwater level elevations (manual measurements and logger data)
- Water quality
- Pumping
- Stream gages
- Streamflow data

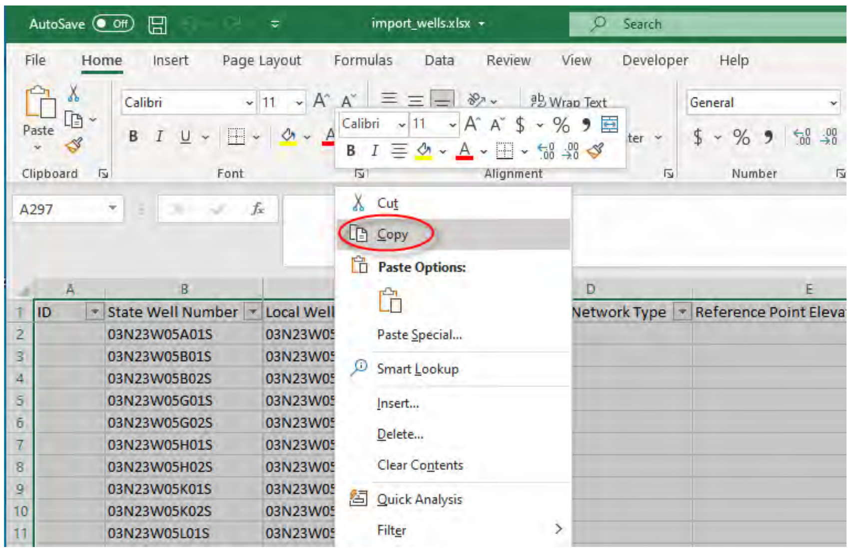
In addition to the data tables that hold the above information, the DMS also contains a number of tables and queries that are used for importing, data format verification, and other backend functions. See DMS Object Description (attached) for a description of these tables and queries. DMS Object Map (attached) shows how these tables and queries are used for the import and export functions.

The default starting view shows the Home tab that contains a dropdown list of wells filtered by use type, a hydrograph and groundwater elevation data table for the selected well, and several buttons that can be used to access certain functions of the DMS—see screenshot next page. (If the Home tab is not visible, expand the DMS views and reports for Interface group in the table of contents on the left hand side of the screen, and open chart_WaterLevels_wells.)

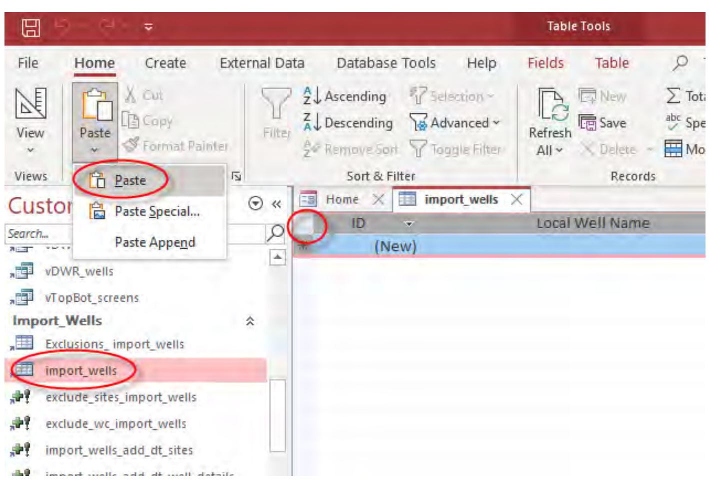

Home tab
Well use type filter
Well selector
Function buttons
DMS tables and queries
Hydrograph and groundwater
elevation table for selected well

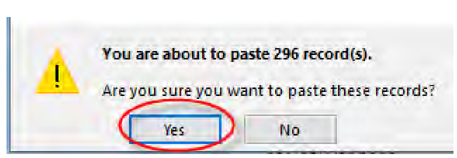
Importing Well Site Details

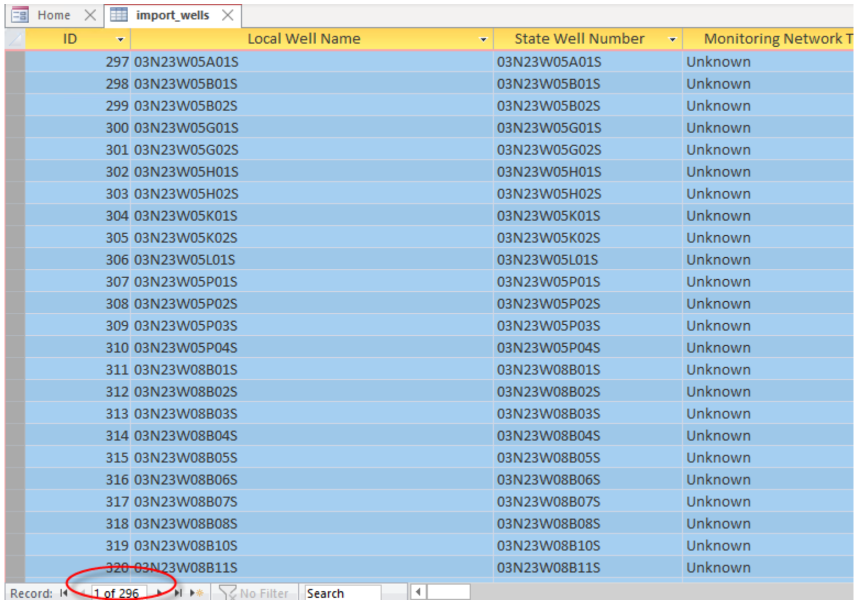
1. Format the data in Excel according to the "import_wells.xlsx" file. Select and copy the data to be imported to DMS (including column headers).



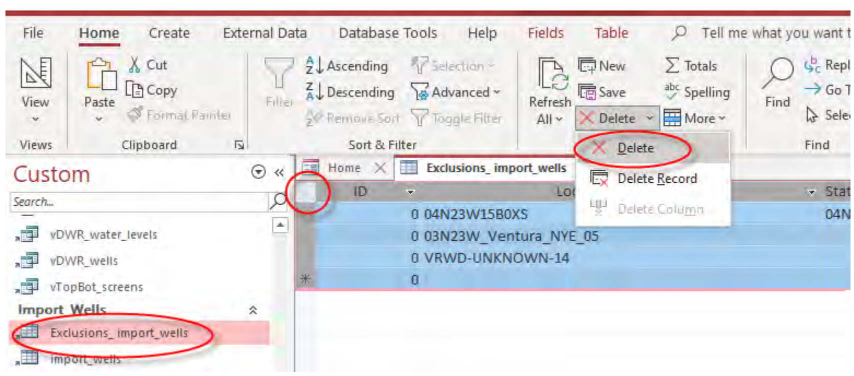
2. Import to DMS by opening the "import_wells" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_wells" table is equal to the number of rows copied from Excel.



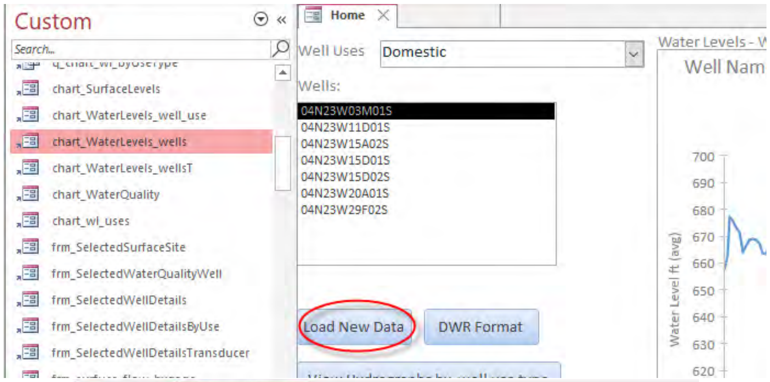


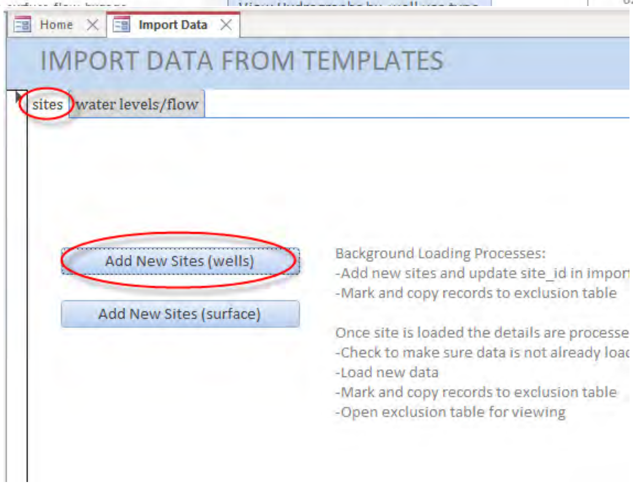


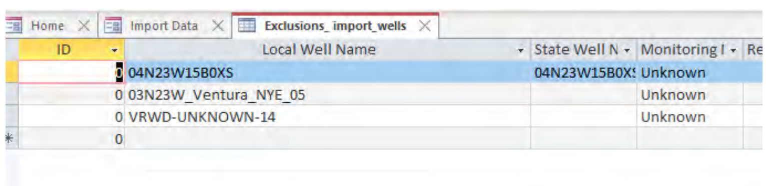
3. Open the "Exclusions_import_wells" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add New Sites (wells)" button under the "Sites" tab. This adds the new acceptable data from the "import_wells" table to the master "dt_sites" and "dt_well_details" tables and opens the "Exclusions_import_wells" table to show which new data were not added to the master tables due to missing information.



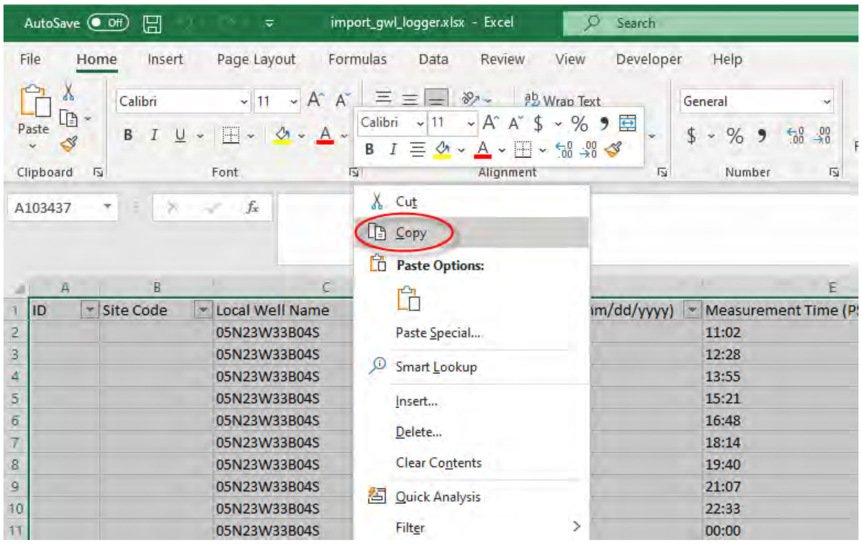




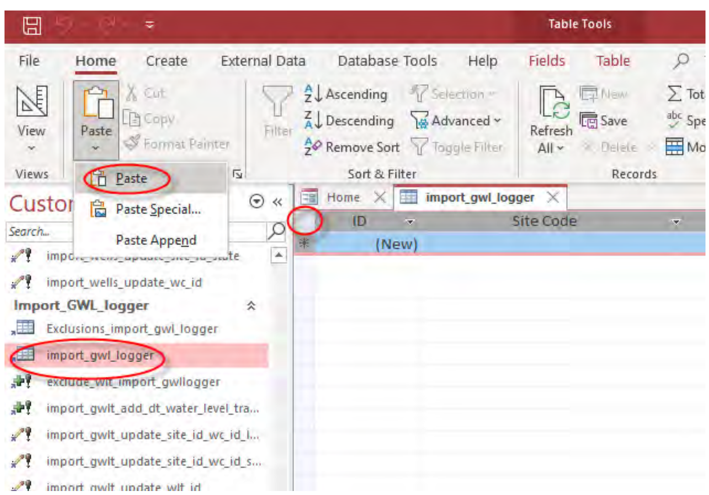
5. For the new data that were not added to the master “dt_sites” and “dt_well_details” tables (i.e., records showing up in the “Exclusions_import_wells” table), go back to the Excel template in Step 1, add the missing details (e.g., latitude, longitude, coordinates method, coordinates accuracy, and county), and repeat Steps 1 – 4.

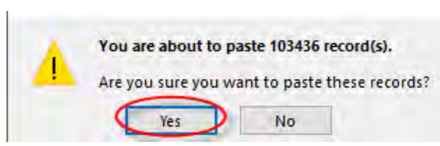
Importing Electronic Logger GWL Data

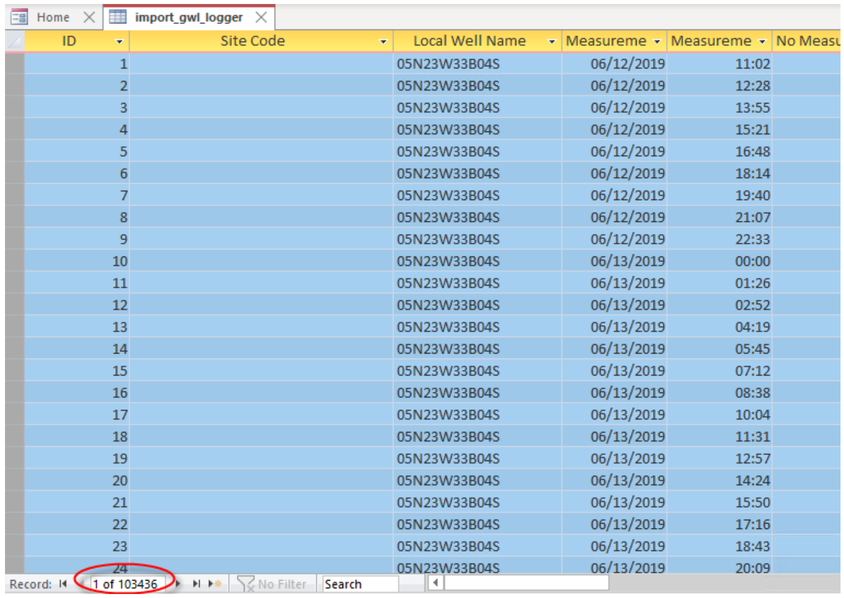
1. Format the data in Excel according to the "import_gwl_logger.xlsx" file. Make sure that the Measurement Date is in the correct format. Select and copy the data to be imported to DMS (including column headers).



2. Import to DMS by opening the "import_gwl_logger" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_gwl_logger" table is equal to the number of rows copied from Excel.

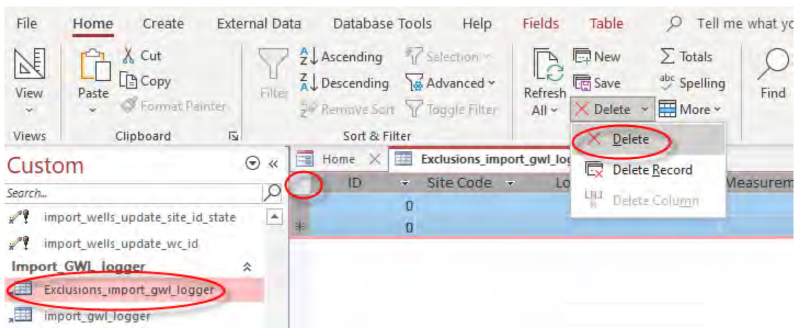




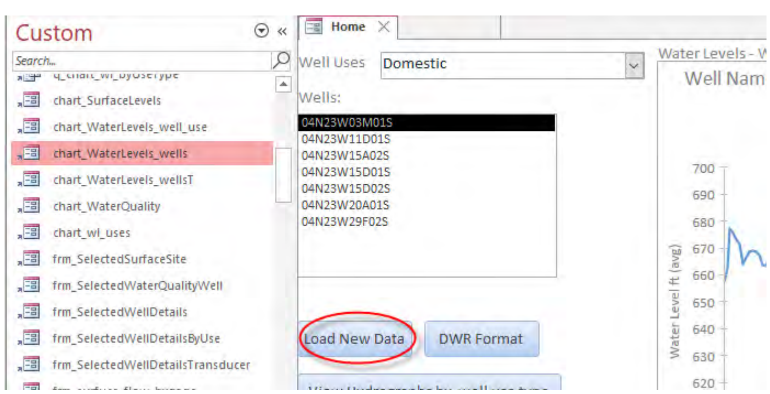


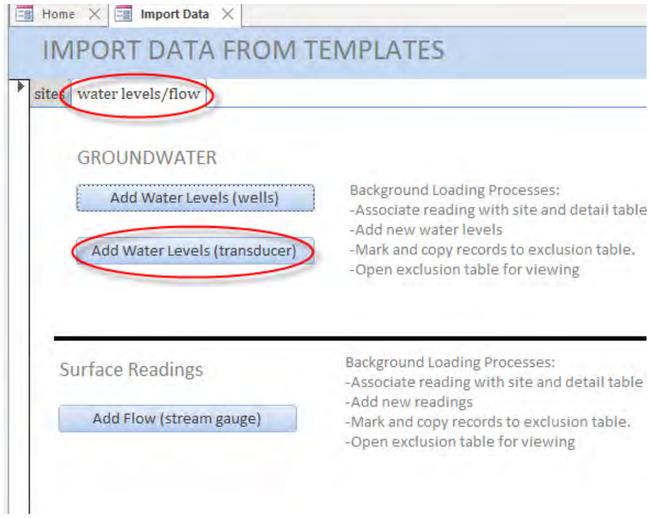
ID	Site Code	Local Well Name	Measureme	Measureme	No Measu
1		05N23W33B04S	06/12/2019	11:02	
2		05N23W33B04S	06/12/2019	12:28	
3		05N23W33B04S	06/12/2019	13:55	
4		05N23W33B04S	06/12/2019	15:21	
5		05N23W33B04S	06/12/2019	16:48	
6		05N23W33B04S	06/12/2019	18:14	
7		05N23W33B04S	06/12/2019	19:40	
8		05N23W33B04S	06/12/2019	21:07	
9		05N23W33B04S	06/12/2019	22:33	
10		05N23W33B04S	06/13/2019	00:00	
11		05N23W33B04S	06/13/2019	01:26	
12		05N23W33B04S	06/13/2019	02:52	
13		05N23W33B04S	06/13/2019	04:19	
14		05N23W33B04S	06/13/2019	05:45	
15		05N23W33B04S	06/13/2019	07:12	
16		05N23W33B04S	06/13/2019	08:38	
17		05N23W33B04S	06/13/2019	10:04	
18		05N23W33B04S	06/13/2019	11:31	
19		05N23W33B04S	06/13/2019	12:57	
20		05N23W33B04S	06/13/2019	14:24	
21		05N23W33B04S	06/13/2019	15:50	
22		05N23W33B04S	06/13/2019	17:16	
23		05N23W33B04S	06/13/2019	18:43	
24		05N23W33B04S	06/13/2019	20:09	

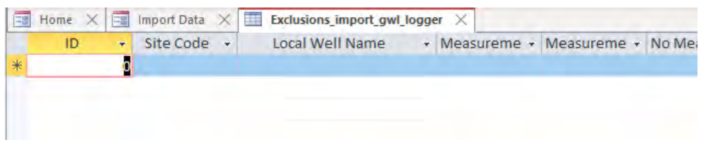
3. Open the "Exclusions_import_gwl_logger" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add Water Levels (transducer)" button under the "water levels/flow" tab. This adds the new acceptable data from the "import_gwl_logger" table to the master "dt_water_levels_transducer" table and opens the "Exclusions_import_gwl_logger" table to show which new data were not added to the master table due to missing information.







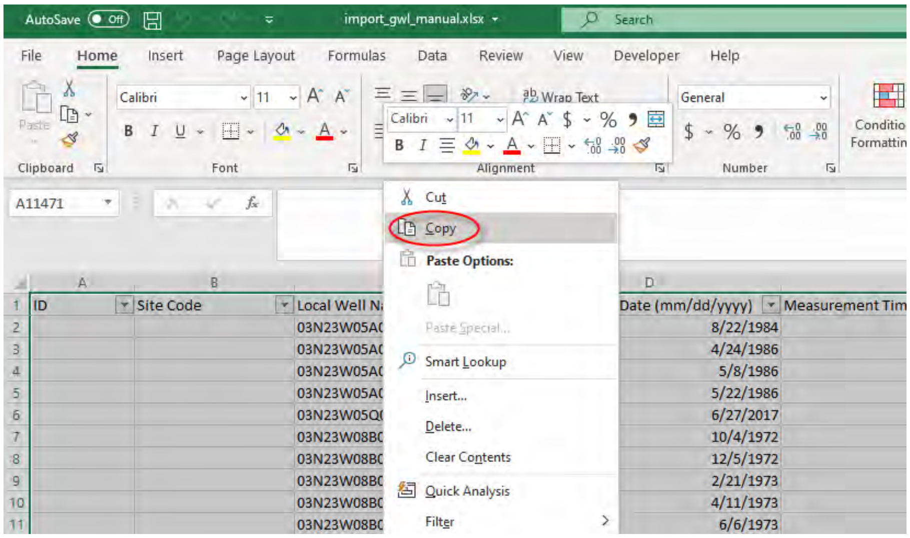
5. For the new data that were not added to the master "dt_water_levels_transducer" table (i.e., records showing up in the "Exclusions_import_gwl_logger" table), check the Site Code and Local Well Name and make sure that they exist in the "dt_sites" and "dt_well_details" tables.

   If the Site Code, Local Well Name, or any field in the GWL logger data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 4.

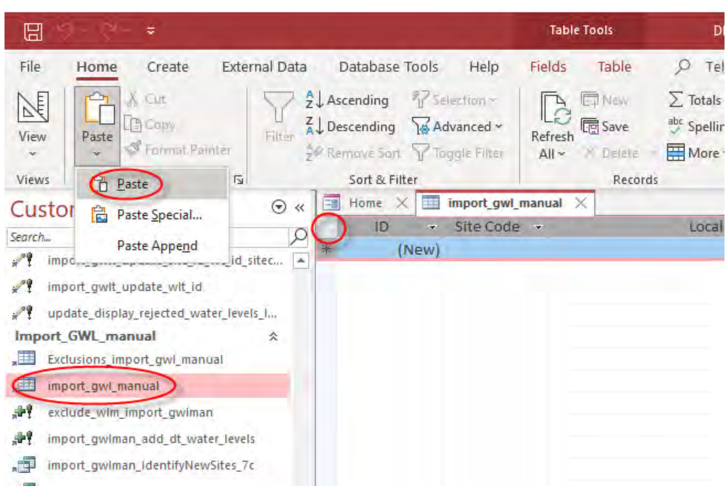
   If the well information does not exist in the "dt_sites" or "dt_well_details" table, then follow the steps for "Importing Well Data."

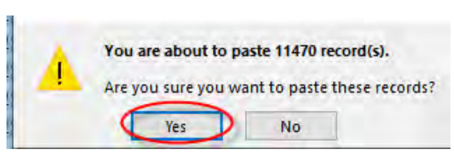
Importing Manual GWL Data

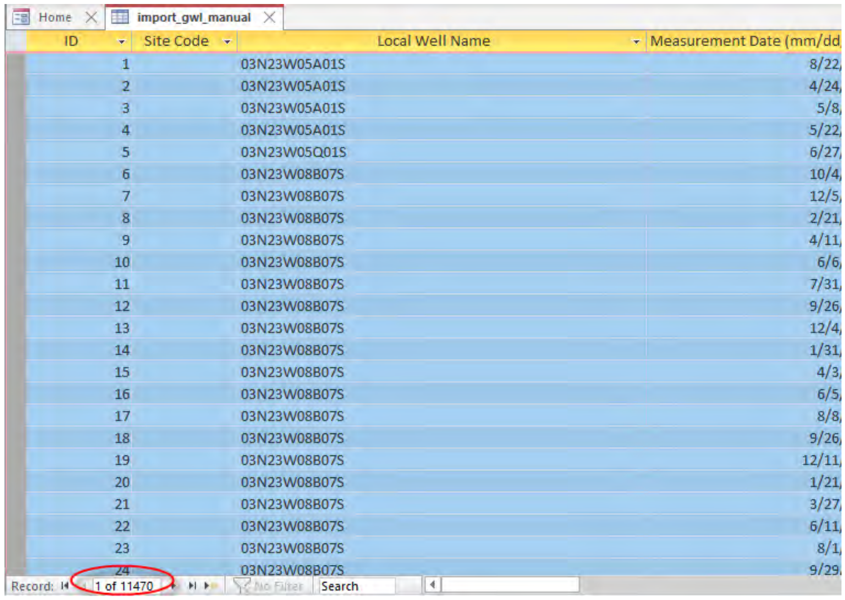
1. Format the data in Excel according to the "import_gwl_manual.xlsx" file. Make sure that the Measurement Date is in the correct format. Select and copy the data to be imported to DMS (including column headers).



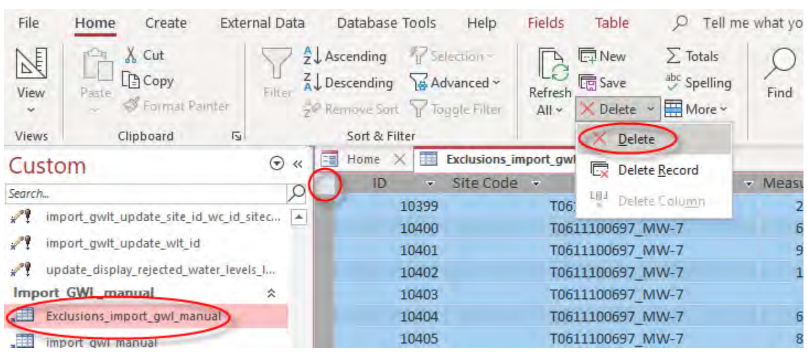
2. Import to DMS by opening the "import_gwl_manual" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_gwl_manual" table is equal to the number of rows copied from Excel.



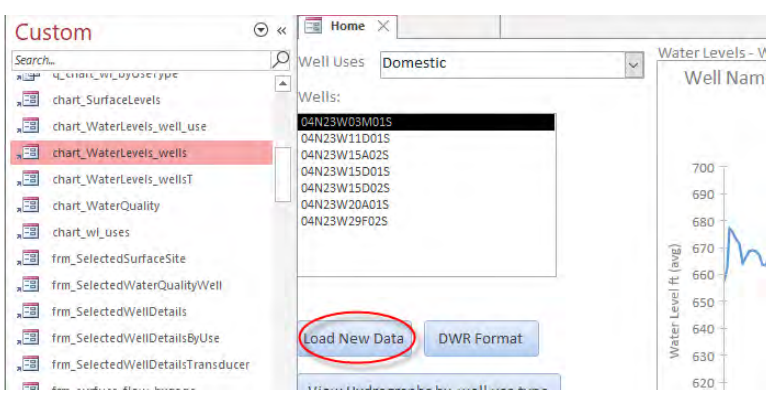


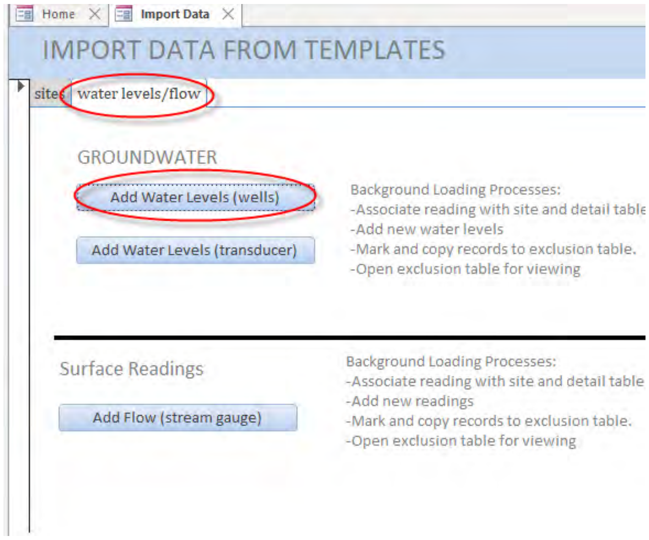


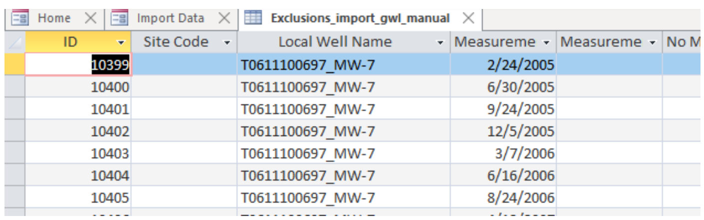
3. Open the "Exclusions_import_gwl_manual" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add Water Levels (wells)" button under the "water levels/flow" tab. This adds the new acceptable data from the "import_gwl_manual" table to the master "dt_water_levels" table and opens the "Exclusions_import_gwl_manual" table to show which new data were not added to the master table due to missing information.







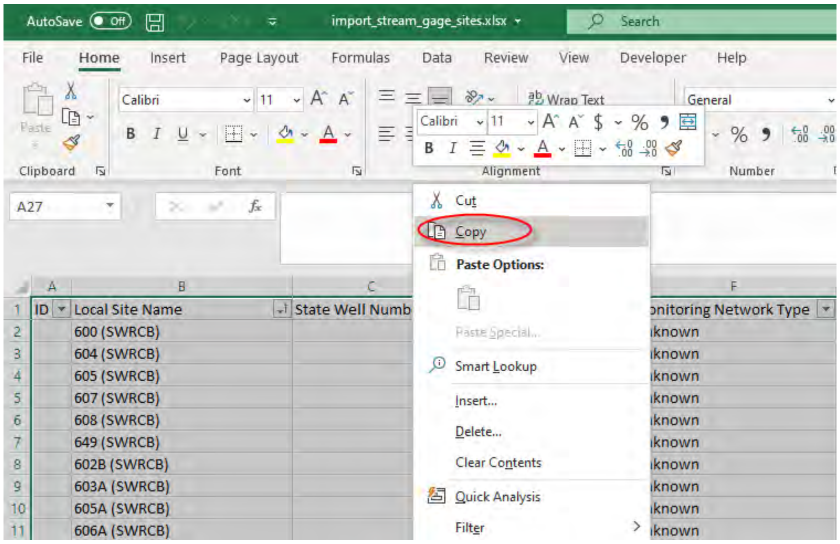
5. For the new data that were not added to the master "dt_water_levels" table (i.e., records showing up in the "Exclusions_import_gwl_manual" table), check the Local Well Name and make sure that it exists in the "dt_sites" and "dt_well_details" tables.

   If the Local Well Name or any field in the GWL manual data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 4.

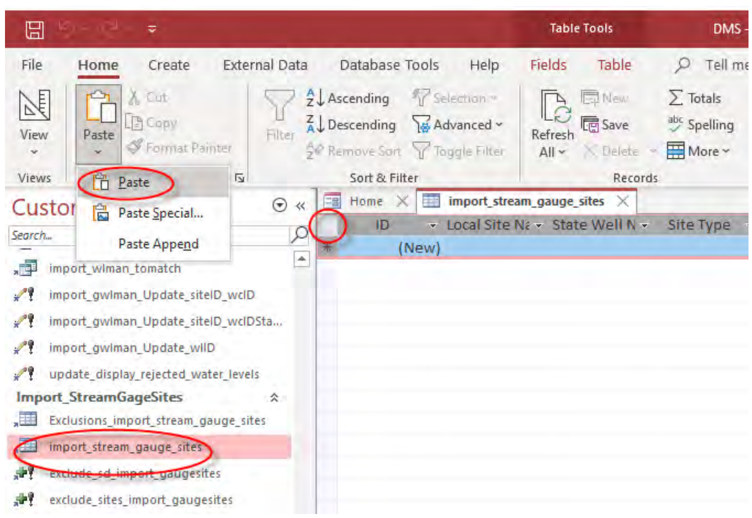
   If the well information does not exist in the "dt_sites" or "dt_well_details" table, then follow the steps for "Importing Well Data."

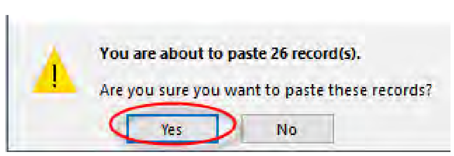
Importing Stream Gage Site Details

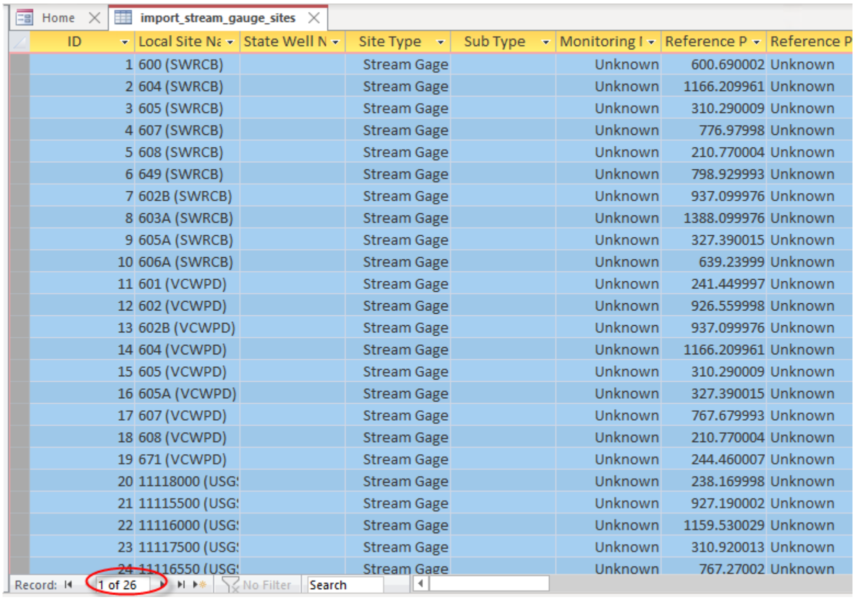
1. Format the data in Excel according to the "import_stream_gage_sites.xlsx" file. Select and copy the data to be imported to DMS (including column headers).



2. Import to DMS by opening the "import_stream_gauge_sites" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_stream_gauge_sites" table is equal to the number of rows copied from Excel.

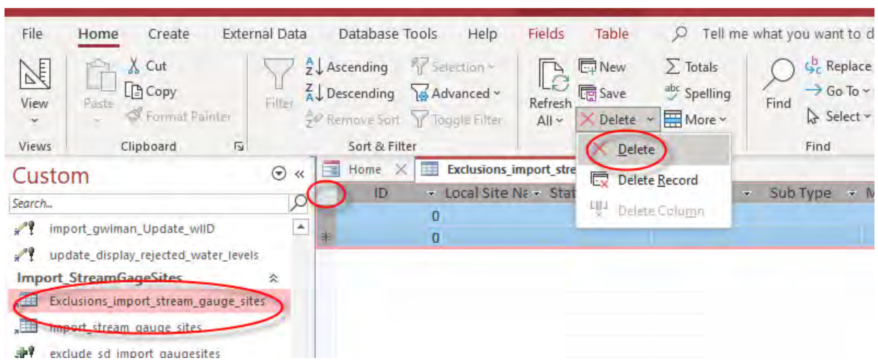




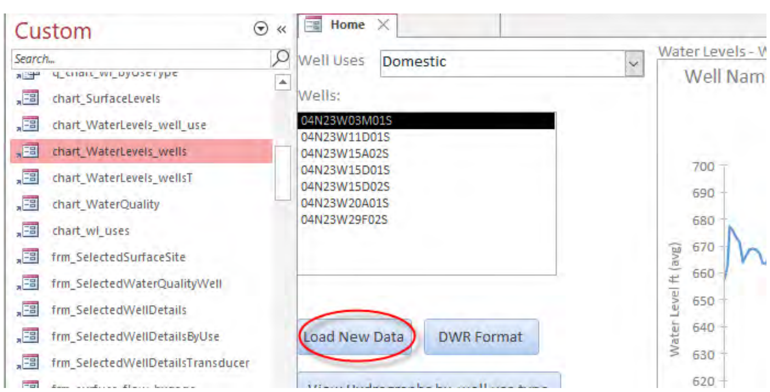


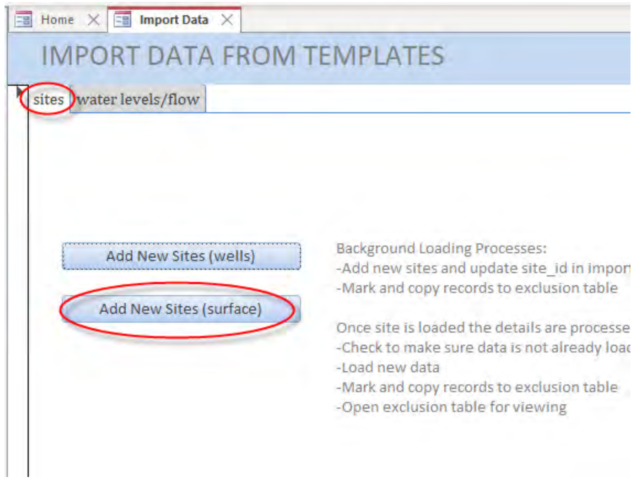
ID	Local Site Na	State Well N	Site Type	Sub Type	Monitoring I	Reference P	Reference P
1	600 (SWRCB)		Stream Gage		Unknown	600.690002	Unknown
2	604 (SWRCB)		Stream Gage		Unknown	1166.209961	Unknown
3	605 (SWRCB)		Stream Gage		Unknown	310.290009	Unknown
4	607 (SWRCB)		Stream Gage		Unknown	776.97998	Unknown
5	608 (SWRCB)		Stream Gage		Unknown	210.770004	Unknown
6	649 (SWRCB)		Stream Gage		Unknown	798.929993	Unknown
7	602B (SWRCB)		Stream Gage		Unknown	937.099976	Unknown
8	603A (SWRCB)		Stream Gage		Unknown	1388.099976	Unknown
9	605A (SWRCB)		Stream Gage		Unknown	327.390015	Unknown
10	606A (SWRCB)		Stream Gage		Unknown	639.23999	Unknown
11	601 (VCWPD)		Stream Gage		Unknown	241.449997	Unknown
12	602 (VCWPD)		Stream Gage		Unknown	926.559998	Unknown
13	602B (VCWPD)		Stream Gage		Unknown	937.099976	Unknown
14	604 (VCWPD)		Stream Gage		Unknown	1166.209961	Unknown
15	605 (VCWPD)		Stream Gage		Unknown	310.290009	Unknown
16	605A (VCWPD)		Stream Gage		Unknown	327.390015	Unknown
17	607 (VCWPD)		Stream Gage		Unknown	767.679993	Unknown
18	608 (VCWPD)		Stream Gage		Unknown	210.770004	Unknown
19	671 (VCWPD)		Stream Gage		Unknown	244.460007	Unknown
20	11118000 (USG:		Stream Gage		Unknown	238.169998	Unknown
21	11115500 (USG:		Stream Gage		Unknown	927.190002	Unknown
22	11116000 (USG:		Stream Gage		Unknown	1159.530029	Unknown
23	11117500 (USG:		Stream Gage		Unknown	310.920013	Unknown
24	11116550 (USG:		Stream Gage		Unknown	767.27002	Unknown

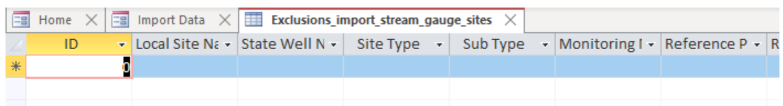
3. Open the "Exclusions_import_stream_gauge_sites" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add New Sites (surface)" button under the "Sites" tab. This adds the new acceptable data from the "import_stream_gauge_sites" table to the master "dt_sites" and "dt_site_details" tables and opens the "Exclusions_import_stream_gauge_sites" table to show which new data were not added to the master tables due to missing information.



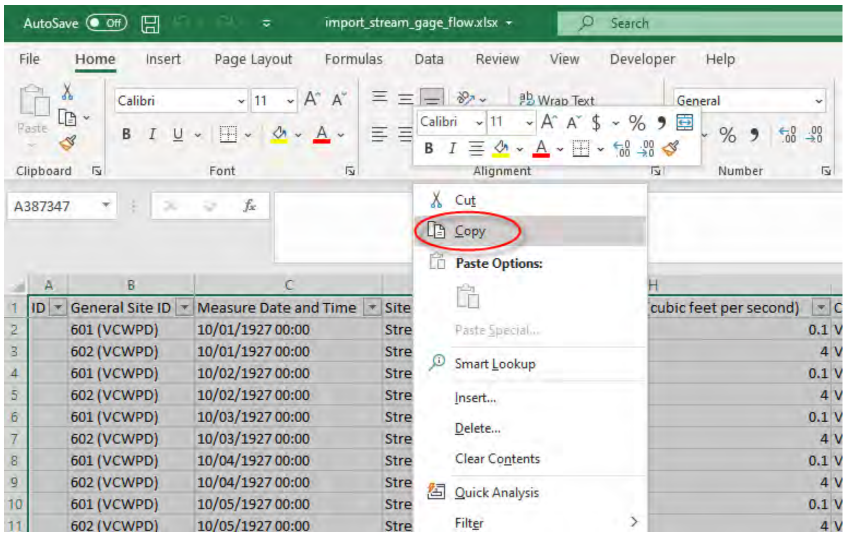




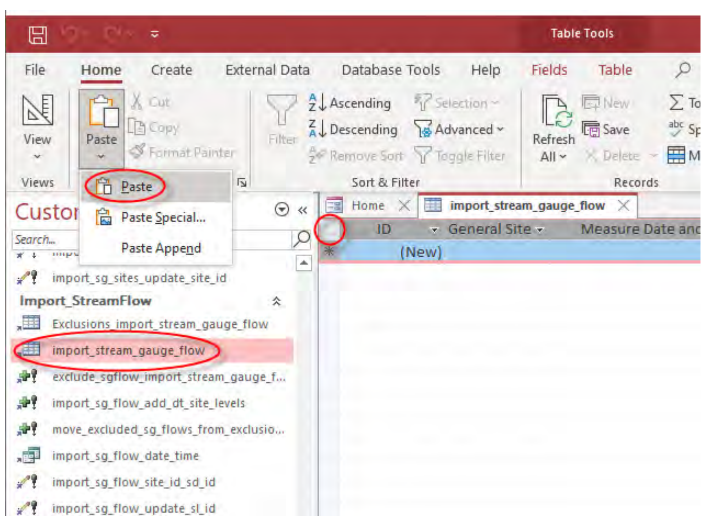
5. For the new data that were not added to the master "dt_sites" and "dt_site_details" tables (i.e., records showing up in the "Exclusions_import_stream_gauge_sites" table), go back to the Excel template in Step 1, add the missing details (e.g., latitude, longitude, coordinates method, coordinates accuracy, and county), and repeat Steps 1 – 4.

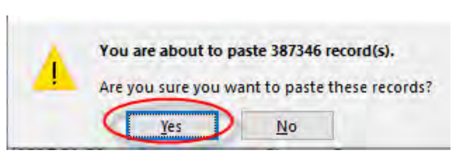
Importing Streamflow Data

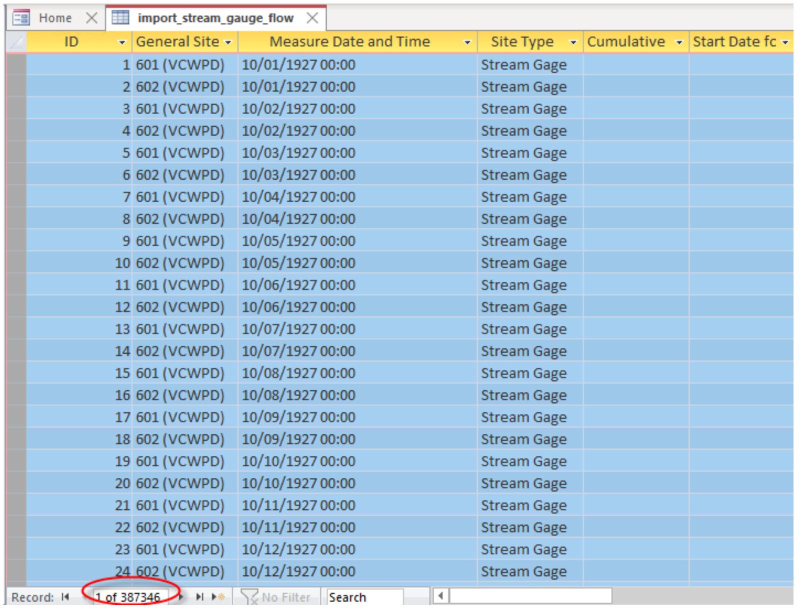
1. Format the data in Excel according to the "import_stream_gage_flow.xlsx" file. <u>Make sure that the Measure Date and Time is in the correct format and that the Surface Water Discharge (cubic feet per second) is not missing.</u> Select and copy the data to be imported to DMS (including column headers).



2. Import to DMS by opening the "import_stream_gauge_flow" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_stream_gauge_flow" table is equal to the number of rows copied from Excel.

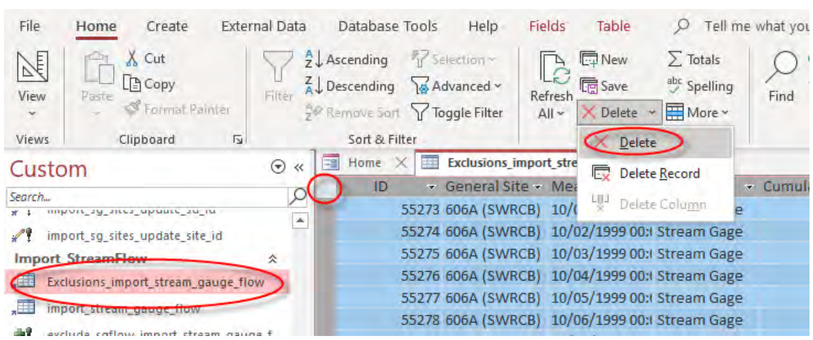




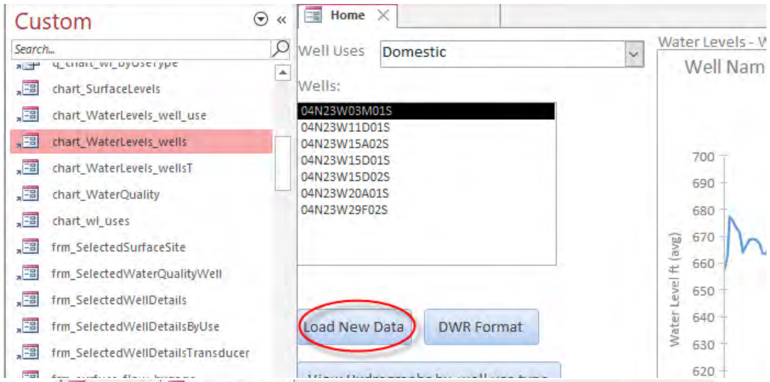


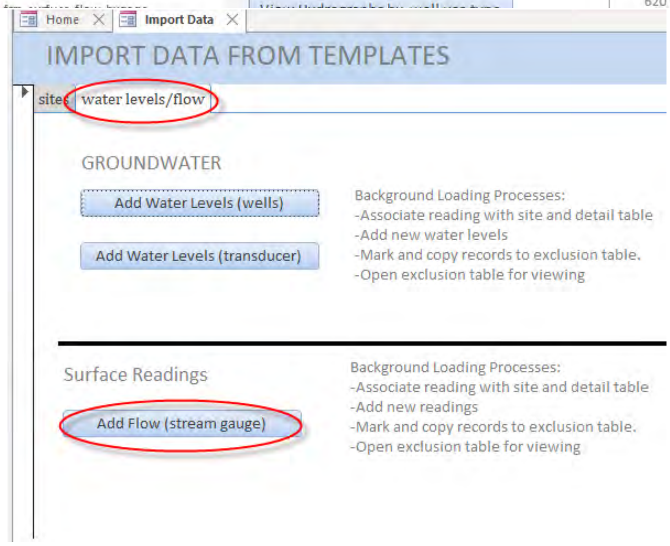
ID	General Site	Measure Date and Time	Site Type	Cumulative	Start Date fc
1	601 (VCWPD)	10/01/1927 00:00	Stream Gage		
2	602 (VCWPD)	10/01/1927 00:00	Stream Gage		
3	601 (VCWPD)	10/02/1927 00:00	Stream Gage		
4	602 (VCWPD)	10/02/1927 00:00	Stream Gage		
5	601 (VCWPD)	10/03/1927 00:00	Stream Gage		
6	602 (VCWPD)	10/03/1927 00:00	Stream Gage		
7	601 (VCWPD)	10/04/1927 00:00	Stream Gage		
8	602 (VCWPD)	10/04/1927 00:00	Stream Gage		
9	601 (VCWPD)	10/05/1927 00:00	Stream Gage		
10	602 (VCWPD)	10/05/1927 00:00	Stream Gage		
11	601 (VCWPD)	10/06/1927 00:00	Stream Gage		
12	602 (VCWPD)	10/06/1927 00:00	Stream Gage		
13	601 (VCWPD)	10/07/1927 00:00	Stream Gage		
14	602 (VCWPD)	10/07/1927 00:00	Stream Gage		
15	601 (VCWPD)	10/08/1927 00:00	Stream Gage		
16	602 (VCWPD)	10/08/1927 00:00	Stream Gage		
17	601 (VCWPD)	10/09/1927 00:00	Stream Gage		
18	602 (VCWPD)	10/09/1927 00:00	Stream Gage		
19	601 (VCWPD)	10/10/1927 00:00	Stream Gage		
20	602 (VCWPD)	10/10/1927 00:00	Stream Gage		
21	601 (VCWPD)	10/11/1927 00:00	Stream Gage		
22	602 (VCWPD)	10/11/1927 00:00	Stream Gage		
23	601 (VCWPD)	10/12/1927 00:00	Stream Gage		
24	602 (VCWPD)	10/12/1927 00:00	Stream Gage		

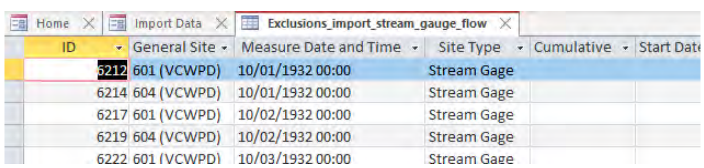
3. Open the "Exclusions_import_stream_gauge_flow" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "Load New Data" button and then the "Add Flow (stream gauge)" button under the "water levels/flow" tab. This adds the new acceptable data from the "import_stream_gauge_flow" table to the master "dt_site_levels" table and opens the "Exclusions_import_stream_gauge_flow" table to show which new data were not added to the master table due to missing information.







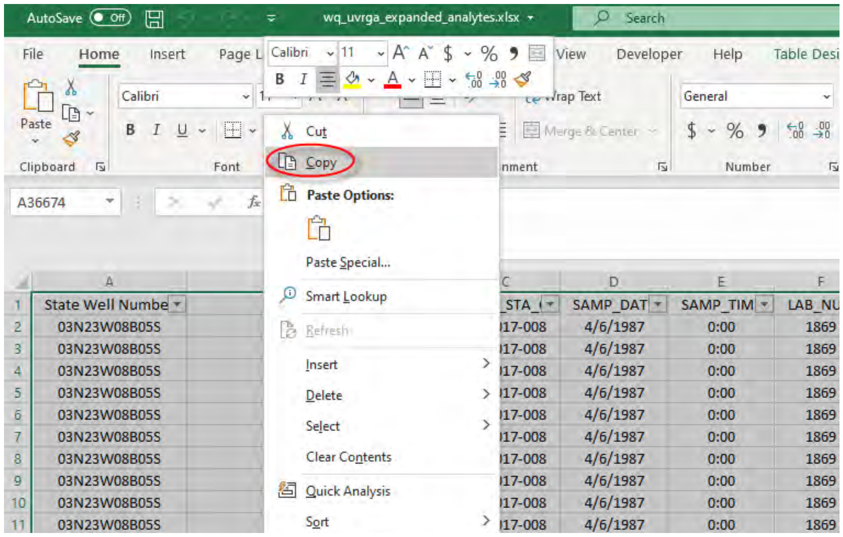
5. For the new data that were not added to the master "dt_site_levels" table (i.e., records showing up in the "Exclusions_import_stream_gauge_flow" table), check the General Site ID and make sure that it exists in the "dt_sites" and "dt_site_details" tables.

   If the General Site ID or any field in the streamflow data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 4.

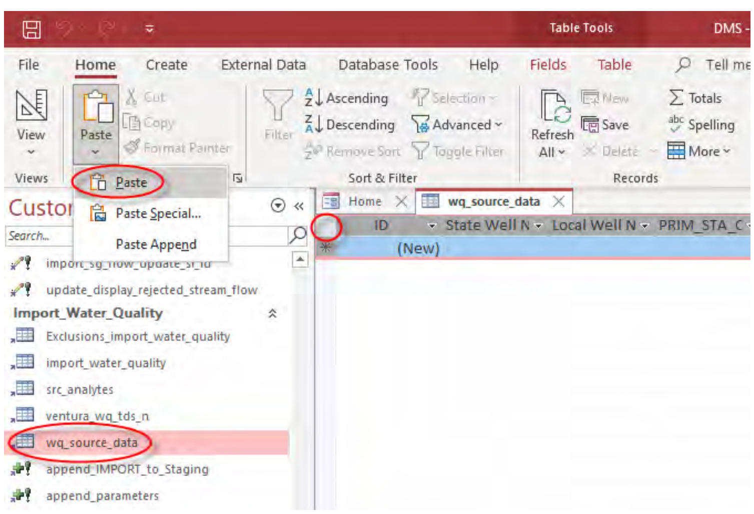
   If the site information does not exist in the "dt_sites" or "dt_site_details" table, then follow the steps for "Importing Stream Gage Site Data."

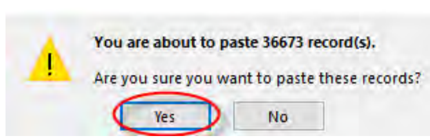
Importing Water Quality Data

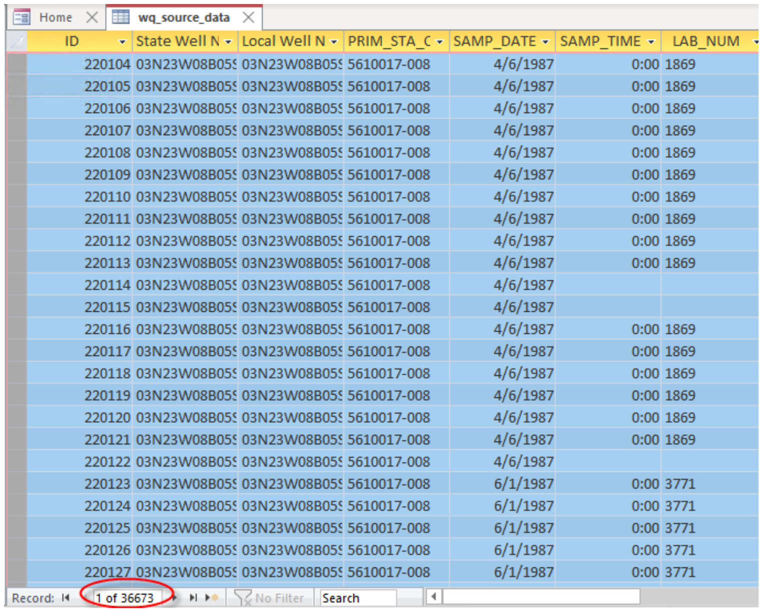
1. Format the data in Excel according to the "import_wq.xlsx" file. Select and copy the data to be imported to DMS (including column headers).



2. Import to DMS by opening the "wq_source_data" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "wq_source_data" table is equal to the number of rows copied from Excel.

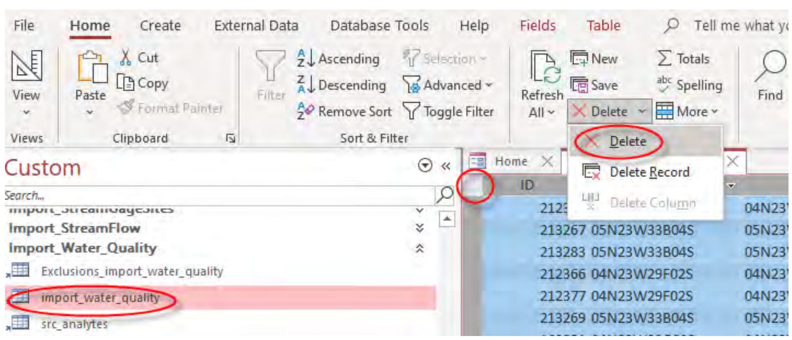




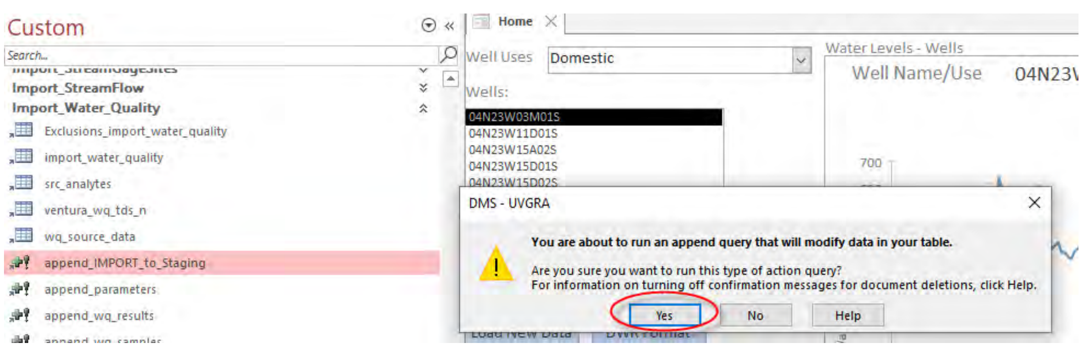


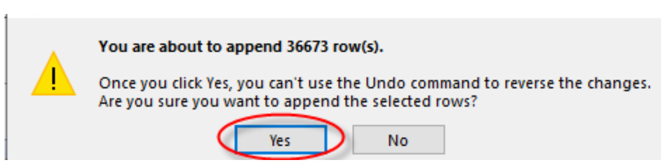
ID	State Well N	Local Well N	PRIM_STA_C	SAMP_DATE	SAMP_TIME	LAB_NUM
220104	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220105	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220106	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220107	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220108	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220109	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220110	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220111	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220112	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220113	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220114	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987		
220115	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987		
220116	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220117	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220118	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220119	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220120	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220121	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987	0:00	1869
220122	03N23W08B05S	03N23W08B05S	5610017-008	4/6/1987		
220123	03N23W08B05S	03N23W08B05S	5610017-008	6/1/1987	0:00	3771
220124	03N23W08B05S	03N23W08B05S	5610017-008	6/1/1987	0:00	3771
220125	03N23W08B05S	03N23W08B05S	5610017-008	6/1/1987	0:00	3771
220126	03N23W08B05S	03N23W08B05S	5610017-008	6/1/1987	0:00	3771
220127	03N23W08B05S	03N23W08B05S	5610017-008	6/1/1987	0:00	3771

3. Open the "import_water_quality" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.

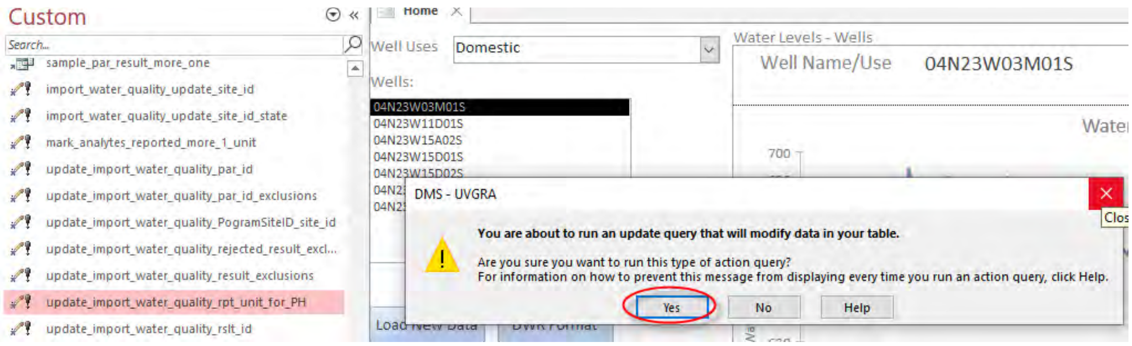


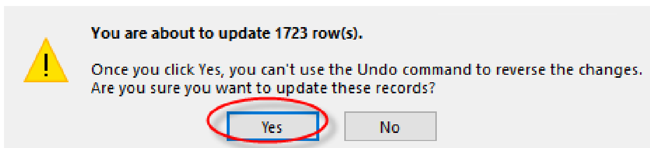
4. Run the "append_IMPORT_to_Staging" query. Click "Yes" to confirm. This adds the source data from the "wq_source_data" table to the "import_water_quality" table.





5. Run the "update_import_water_quality_rpt_unit_for_PH" query. Click "Yes" to confirm. This assigns the unit S.U. to the PH laboratory analytes.

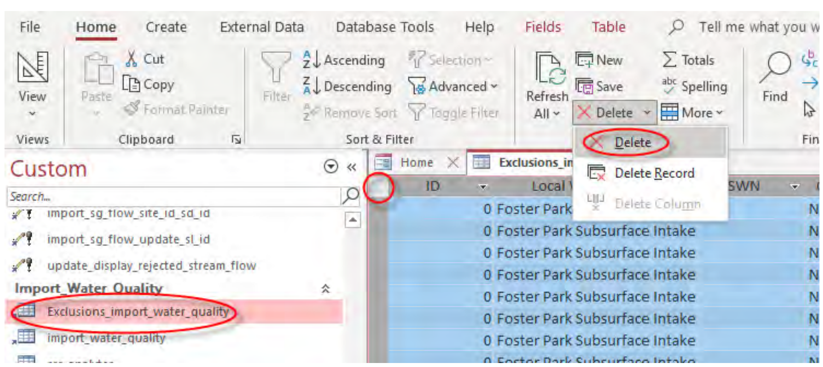




6. Run the following queries:
check_each_chem_reported_in_one_unit – to check the unit of each analyte.
chemicals_results_multiple_units – to identify the analytes reported in more than one unit.

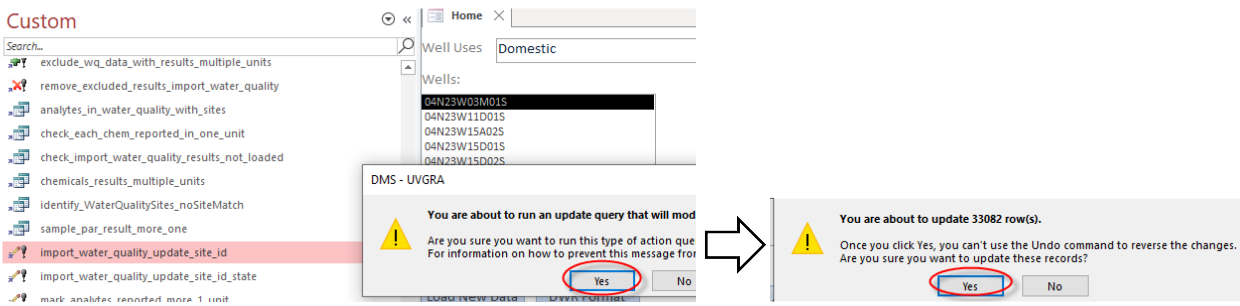
If the units need to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 5.

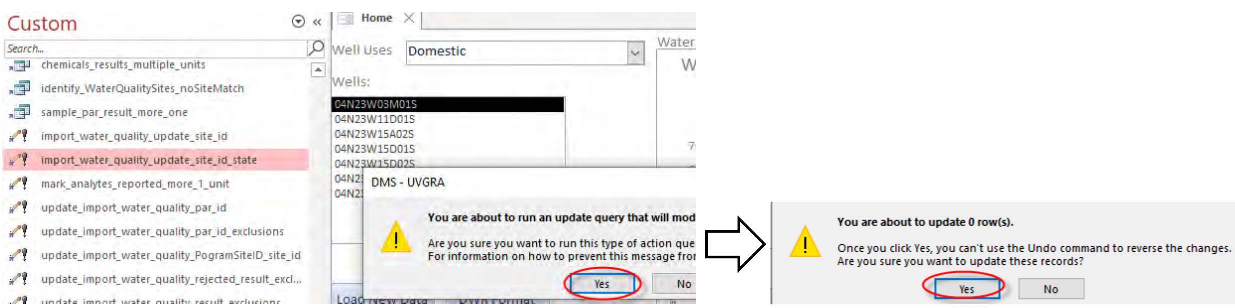
7. Open the "Exclusions_import_water_quality" table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.

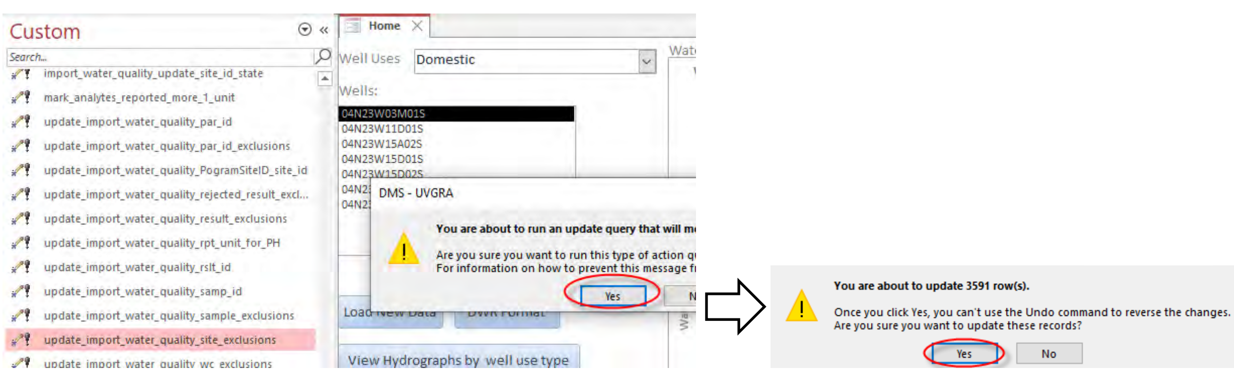


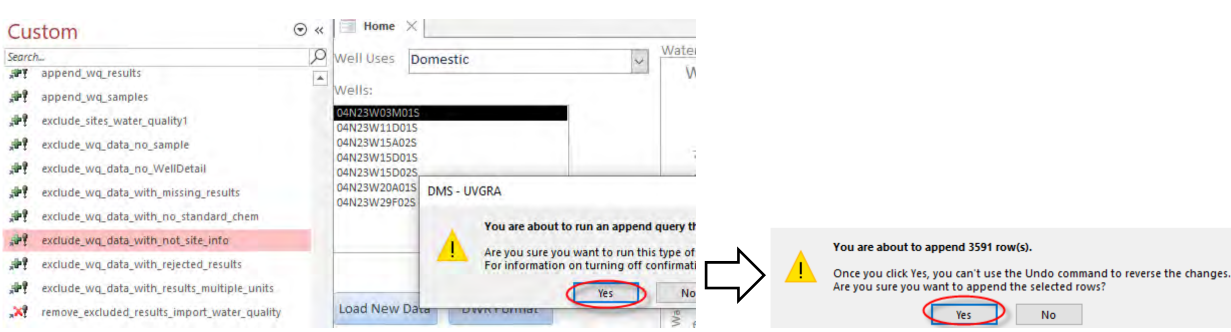
8. Run the following queries in the order shown:
   import_water_quality_update_site_id
   → import_water_quality_update_site_id_state
   → update_import_water_quality_site_exclusions
   → exclude_wq_data_with_not_site_info

   This marks the records in the "import_water_quality" table for which neither Local Well Name nor SWN exists in the "dt_sites" table and adds those records to the "Exclusions_import_water_quality" table.









9. Similar to Step 8, run the following queries in the order shown:
update_site_wc_ids_inimport
→ update_import_water_quality_wc_exclusions
→ exclude_wq_data_no_WellDetail

This marks the records in the “import_water_quality” table for which neither Local Well Name nor SWN exists in the “dt_well_details” table and adds those records to the “Exclusions_import_water_quality” table.

10. Similar to Step 8, run the following queries in the order shown:
update_import_water_quality_par_id
→ update_import_water_quality_par_id_exclusions
→ exclude_wq_data_with_no_standard_chem

This marks the records in the “import_water_quality” table for which the CHEMICAL does not exist in the “lu_parameters” table and adds those records to the “Exclusions_import_water_quality” table.

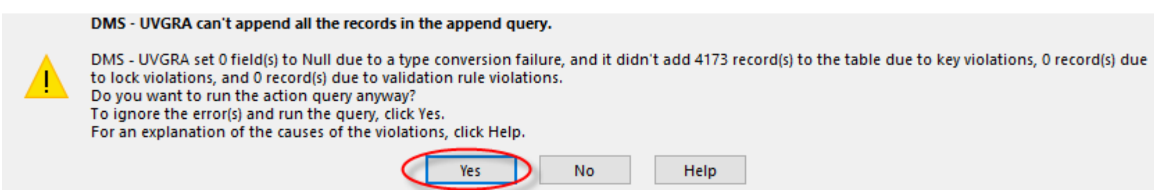
11. Similar to Step 8, run the following queries in the order shown:
update_import_water_quality_rejected_result_exclusions
→ exclude_wq_data_with_rejected_results

This marks the records in the “import_water_quality” table for which the Review_Result is Rejected and adds those records to the “Exclusions_import_water_quality” table.

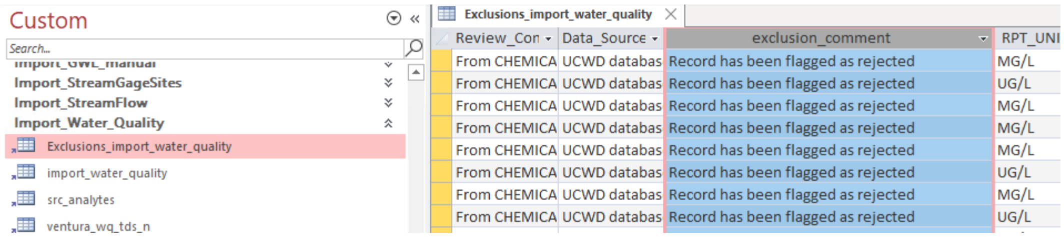
12. Similar to Step 8, run the following queries in the order shown:
update_import_water_quality_samp_id
→ append_wq_samples
→ update_import_water_quality_samp_id
→ update_import_water_quality_sample_exclusions
→ exclude_wq_data_no_sample

This adds the new acceptable data from the “import_water_quality” table to the master “dt_samples” table.

<u>Note:</u> Click “Yes” if the message below appears while running the queries.



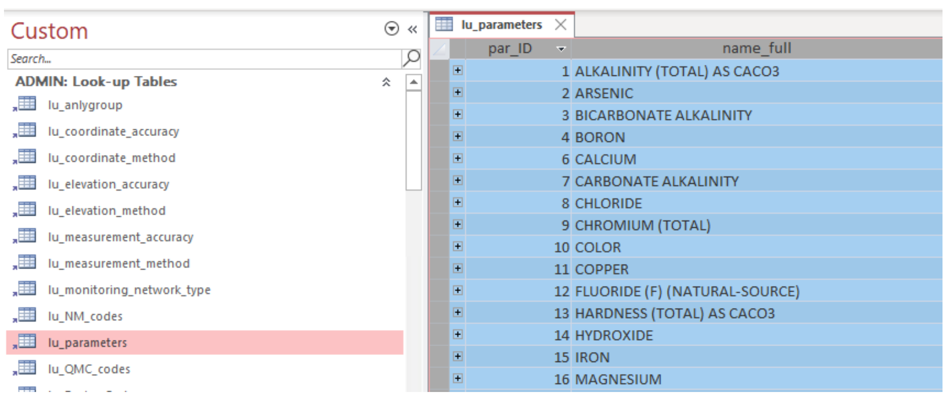
13. Open the "Exclusions_import_water_quality" table to see which new data were not added to the master "dt_samples" table and check the exclusion_comment.



If any field in the water quality data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 12.

If the well information does not exist in the "dt_sites" or "dt_well_details" table, then follow the steps for "Importing Well Data."

If the chemical information does not exist in the "lu_parameters" table, then update the "lu_parameters" table accordingly. If the chemical information exists in the "lu_anlygroup" table, then run the "update_lu_parameter_anlygroup_from_lu_anlygroup" query to copy that information to the "lu_parameters" table.



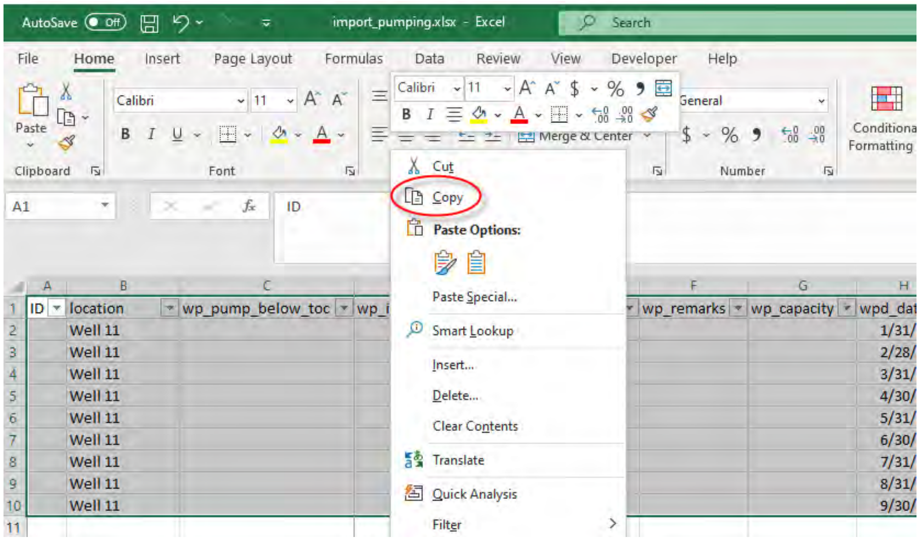
14. Similar to Step 12, run the following queries in the order shown:
update_import_water_quality_result_exclusions
→ update_import_water_quality_rslt_id
→ append_wq_results
→ update_import_water_quality_rslt_id

This adds the new acceptable data from the "import_water_quality" table to the master "dt_results" table.

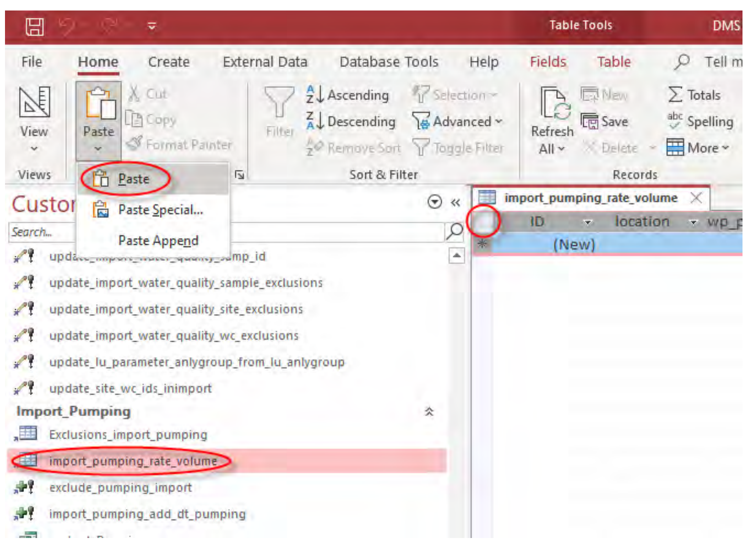
15. Run the "check_import_water_quality_results_not_loaded" query to see which new data were not added to the master "dt_results" table.

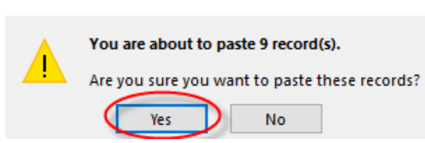
Importing Pumping Data

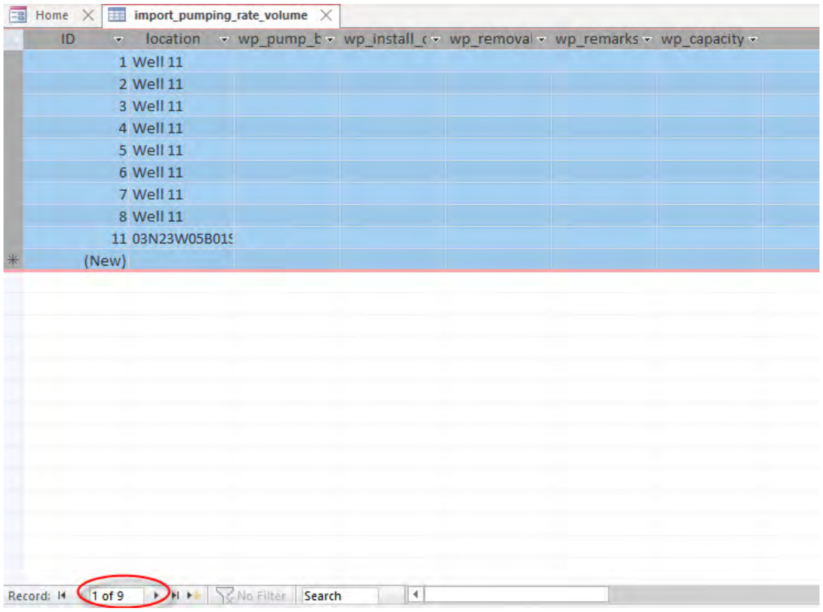
1. Format the data in Excel according to the "import_pumping.xlsx" file. Select and copy the data to be imported to DMS (including column headers).



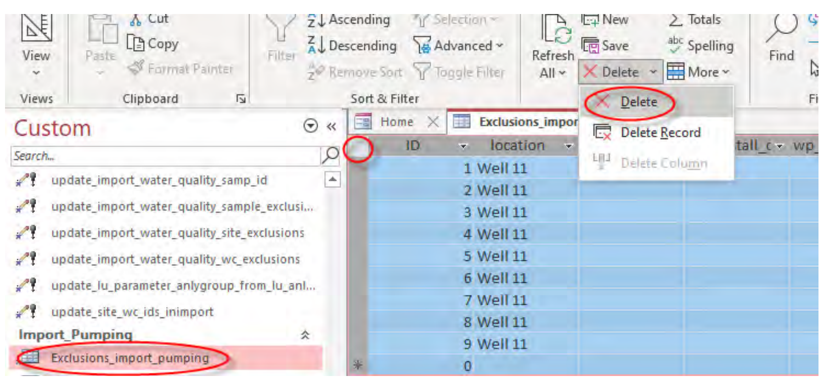
2. Import to DMS by opening the "import_pumping_rate_volume" table in Access, clicking the top left corner of the table, and pasting the copied data from Step 1. This may take a few minutes if the number of records is large. Click "Yes" to confirm. After pasting the data, verify that the number of records in the "import_pumping_rate_volume" table is equal to the number of rows copied from Excel.



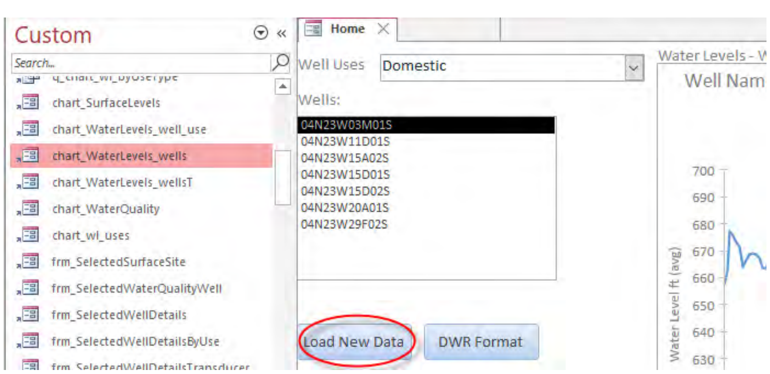


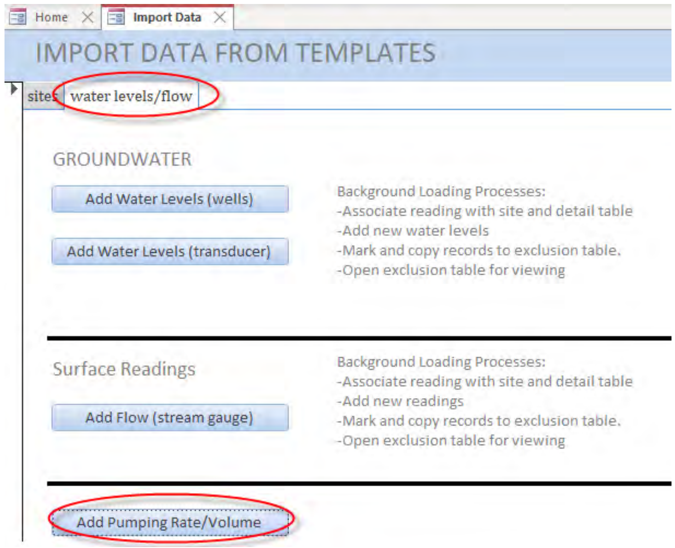


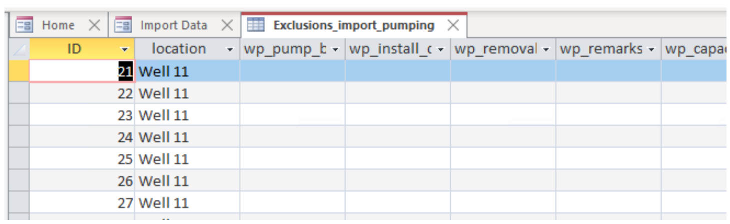
3. Open the “Exclusions_import_pumping” table. If the table is not empty, then delete all records in it. After making sure that it is empty, close the table.



4. Open the “chart_WaterLevels_wells” form, i.e. the Home tab (if not already open). Click the “Load New Data” button and then the “Add Pumping Rate/Volume” button under the “water levels/flow” tab. This adds the new acceptable data from the “import_pumping_rate_volume” table to the master “dt_pumping” table and opens the “Exclusions_import_pumping” table to show which new data were not added to the master table due to missing information.







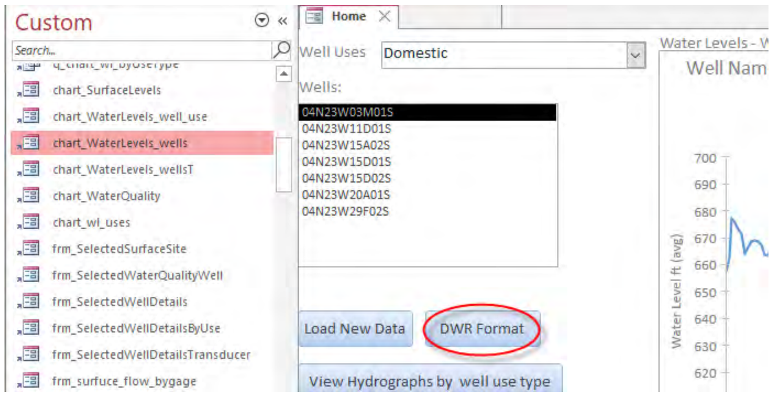
5. For the new data that were not added to the master "dt_pumping" table (i.e., records showing up in the "Exclusions_import_pumping" table), check the location and make sure that it exists in the "dt_sites" and "dt_well_details" tables.

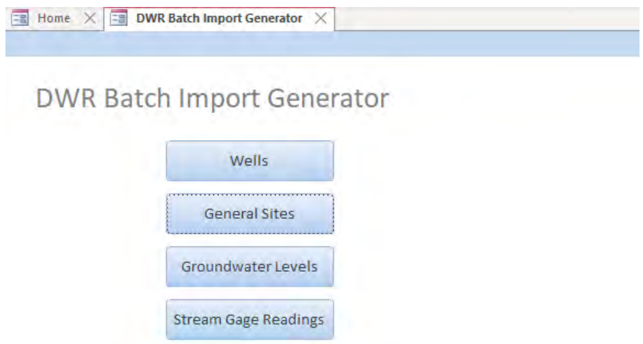
   If the location or any field in the pumping data needs to be corrected, then go back to the Excel template in Step 1, edit the information, and repeat Steps 1 – 4.

   If the well information does not exist in the "dt_sites" or "dt_well_details" table, then follow the steps for "Importing Well Data."

Exporting to DWR Templates

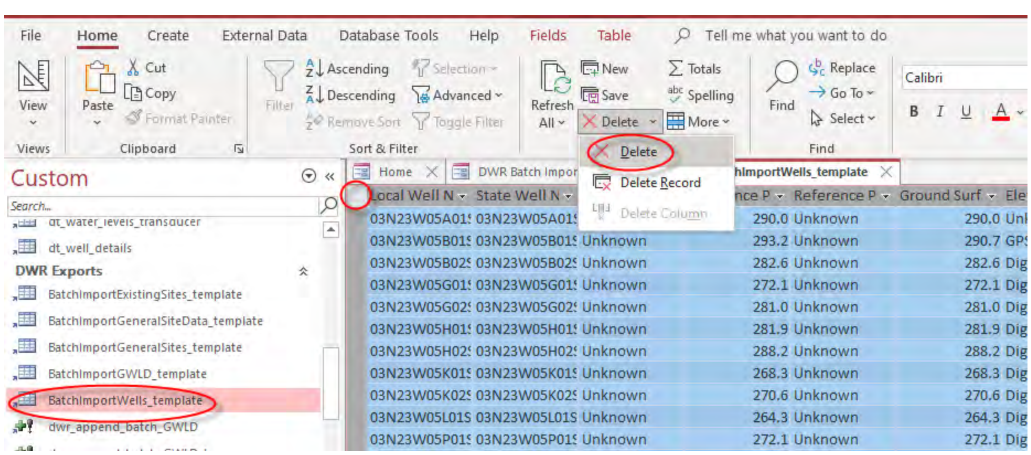
1. Open the "chart_WaterLevels_wells" form, i.e. the Home tab (if not already open). Click the "DWR Format" button. This opens the "DWR Batch Import Generator" form.





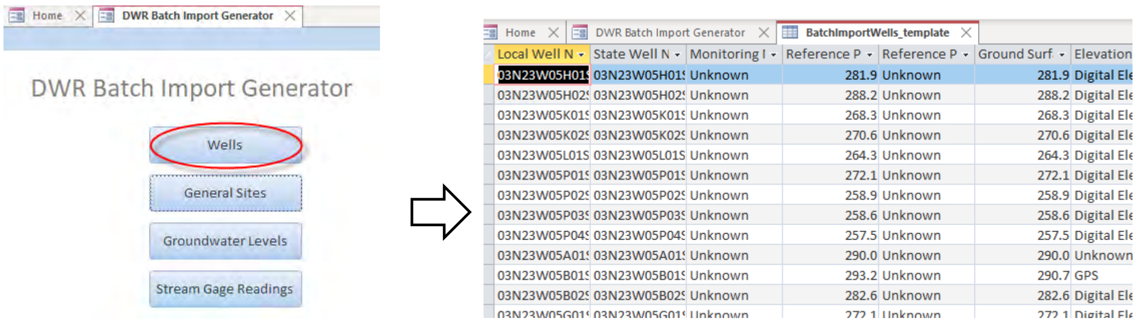
2. For the well template, open the "BatchImportWells_template" table.
   For the general site template, open the "BatchImportGeneralSites_template" table.
   For the groundwater level template, open the "BatchImportGWLD_template" table.
   For the stream gage reading template, open the "BatchImportGeneralSiteData_template" table.

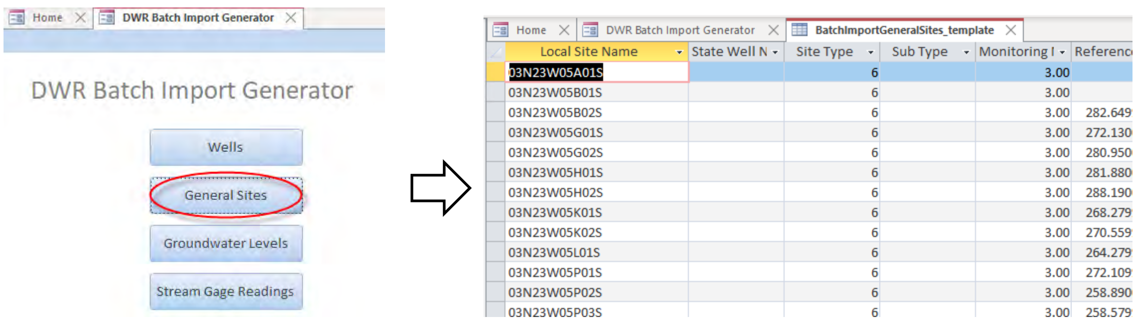
   If the table is not empty, then delete all records in it. After making sure that it is empty, close the table and go back to the "DWR Batch Import Generator" form.

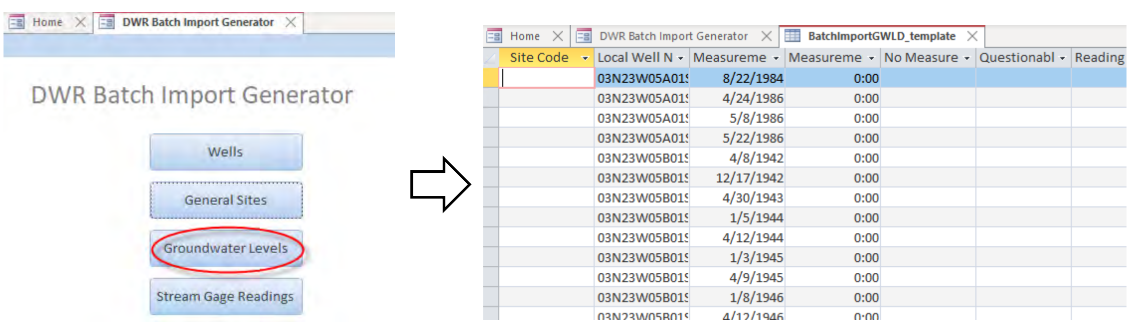


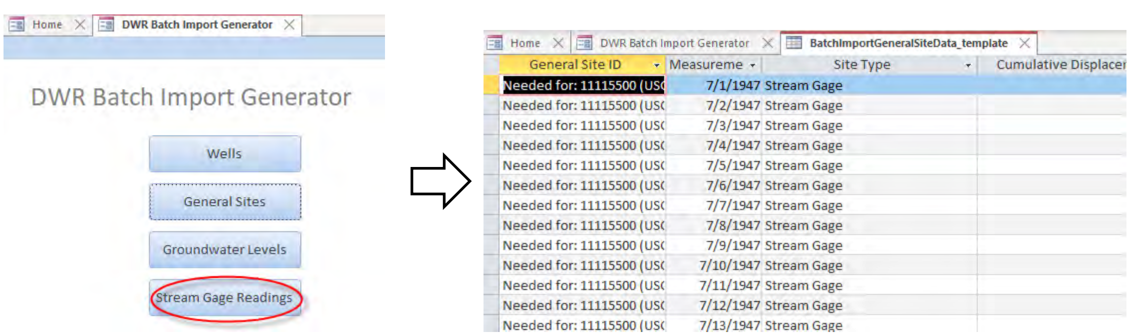
3. For the well template, click the "Wells" button.
   For the general site template, click the "General Sites" button.
   For the groundwater level template, click the "Groundwater Levels" button.
   For the stream gage reading template, click the "Stream Gage Readings" button.

   Click "Yes" to confirm. This fills the corresponding template table emptied in Step 2. The data from the template table may be copied and pasted to Excel.



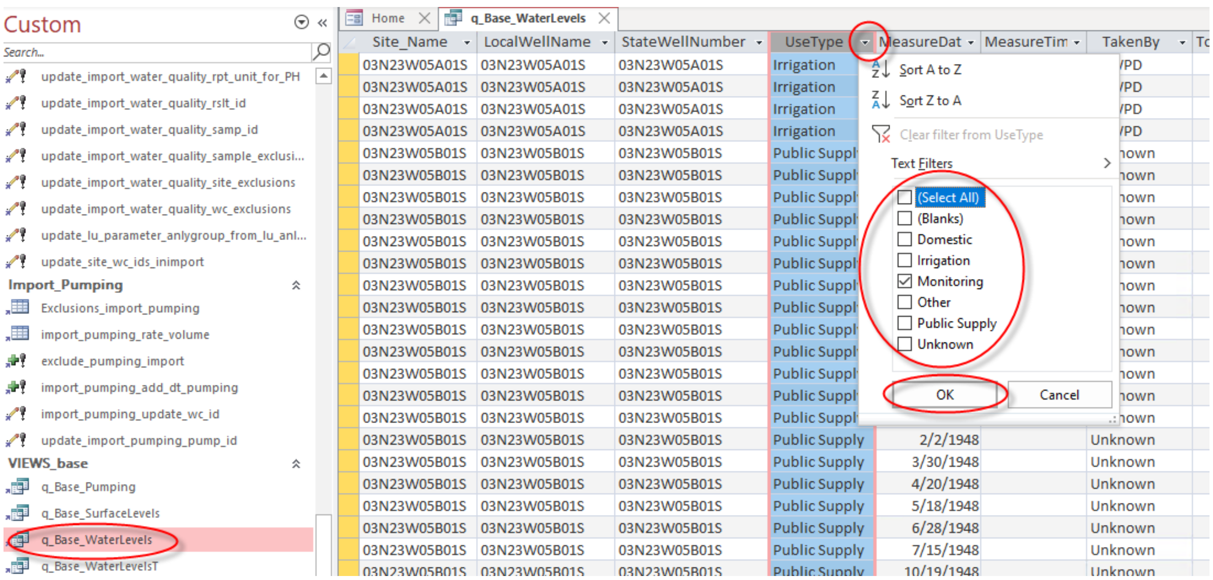


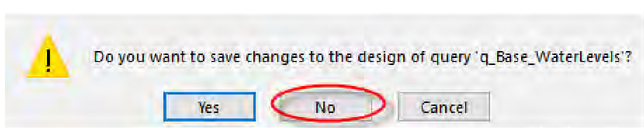




Viewing the Data Tables

1. The queries under the "VIEWS_base" group can be used to view the data saved in the production data tables. Open the query of interest and click the arrow next to the field name to see the drop-down list. The data can be filtered by checking/unchecking boxes in the drop-down list and clicking "OK." When closing the query, click "No" so that the filter criteria are not saved.





DMS OBJECT DESCRIPTION

Group	Object Name	Object Type	Description
ADMIN: Look-up Tables	lu_anlygroup	Table	Reference table.
	lu_coordinate_accuracy	Table	Reference table.
	lu_coordinate_method	Table	Reference table.
	lu_elevation_accuracy	Table	Reference table.
	lu_elevation_method	Table	Reference table.
	lu_measurement_accuracy	Table	Reference table.
	lu_measurement_method	Table	Reference table.
	lu_monitoring_network_type	Table	Reference table.
	lu_NM_codes	Table	Reference table.
	lu_parameters	Table	Reference table.
	lu_QMC_codes	Table	Reference table.
	lu_ReviewCodes	Table	Reference table.
	lu_SG_codes	Table	Reference table.
	lu_site_type	Table	Reference table.
	lu_well_completion_type	Table	Reference table.
	lu_well_status	Table	Reference table.
	lu_well_type	Table	Reference table.
	lu_well_use_type	Table	Reference table.
	map_well_status	Table	Reference table.
	map_well_use	Table	Reference table.
DMS Data Tables	dt_pumping	Table	Table for storing the pumping data.
	dt_results	Table	Table for storing the water quality results.
	dt_samples	Table	Table for storing the water quality sample data.
	dt_site_details	Table	Table for storing the gage site details.
	dt_site_levels	Table	Table for storing the streamflow data from gages.
	dt_sites	Table	Table for storing the well/gage site info.
	dt_sources	Table	Table for storing the source info.
	dt_water_levels	Table	Table for storing the water level data from wells.
	dt_water_levels_transducer	Table	Table for storing the water level data from transducers.
	dt_well_details	Table	Table for storing the well site details.
DWR Exports	BatchImportGeneralSiteData_template	Table	Table for exporting the streamflow data in DWR format.
	BatchImportGeneralSites_template	Table	Table for exporting the general well/gage site info in DWR format.
	BatchImportGWLD_template	Table	Table for exporting the water level data in DWR format.
	BatchImportWells_template	Table	Table for exporting the well site info in DWR format.
	dwr_append_batch_GWLD	Append Query	Formats the water level data from the "dt_water_levels" table and adds them to the "BatchImportGWLD_template" table.
	dwr_append_batch_GWLD_loggers	Append Query	Formats the water level data from the "dt_water_levels_transducer" table and adds them to the "BatchImportGWLD_template" table.
	dwr_append_batchGeneralSitesGages	Append Query	Formats the gage site info from the "dt_sites" and "dt_site_details" tables and adds it to the "BatchImportGeneralSites_template" table.
	dwr_append_batchGeneralSitesWells	Append Query	Formats the well site info from the "dt_sites" and "dt_well_details" tables and adds it to the "BatchImportGeneralSites_template" table.
	dwr_append_batchGenSitesData_gage	Append Query	Formats the streamflow data from the "dt_site_levels" table and adds them to the "BatchImportGeneralSiteData_template" table.
	dwr_append_batchWells	Append Query	Formats the well site info from the "vDWR_wells" query and adds it to the "BatchImportWells_template" table.
	vDWR_wells	Select Query	Extracts the well site info from the "dt_sites" and "dt_well_details" tables if SiteType = 6. Used as an intermediate step for the "dwr_append_batchWells" query.
	vTopBot_screens	Select Query	Extracts the screening info from the "dt_well_details" table. Used as an intermediate step for the "dwr_append_batchGeneralSitesWells" query.
Import_Wells	Exclusions_ import_wells	Table	Table for viewing the records from the "import_wells" table that have not been loaded to the "dt_sites" or "dt_well_details" table.
	import_wells	Table	Table for importing the well site info.

Group	Object Name	Object Type	Description
	exclude_sites_import_wells	Append Query	Adds the records from the "import_wells" table to the "Exclusions_ import_wells" table if the required well site info (e.g., latitude/longitude, coordinates method/accuracy, county) is missing.
	exclude_wc_import_wells	Append Query	Adds the records from the "import_wells" table to the "Exclusions_ import_wells" table if the required well site details are missing.
	import_wells_add_dt_sites	Append Query	Formats the well site info from the "import_wells" table and adds it to the "dt_sites" table. Does not add if a record with the same Local Well Name/State Well Number already exists in the "dt_sites" table.
	import_wells_add_dt_well_details	Append Query	Formats the well site details from the "import_wells" table and adds them to the "dt_well_details" table. Does not add if a record with the same Local Well Name/State Well Number already exists in the "dt_well_details" table.
	import_wells_update_site_id	Update Query	Adds site_id to the records in the "import_wells" table if the matching Local Well Name is found in the "dt_sites" table.
	import_wells_update_site_id_state	Update Query	Adds site_id to the records in the "import_wells" table if the matching State Well Number is found in the "dt_sites" table.
	import_wells_update_wc_id	Update Query	Adds wc_id to the records in the "import_wells" table if the matching site_id is found in the "dt_well_details" table.
Import_GWL_logger	Exclusions_import_gwl_logger	Table	Table for viewing the records from the "import_gwl_logger" table that have not been loaded to the "dt_water_levels_transducer" table.
	import_gwl_logger	Table	Table for importing the water level data from transducers.
	exclude_wlt_import_gwllogger	Append Query	Adds the records from the "import_gwl_logger" table to the "Exclusions_import_gwl_logger" table if the required well site info is missing.
	import_gwlt_add_dt_water_level_trans	Append Query	Formats the water level data from the "import_gwl_logger" table and adds them to the "dt_water_levels_transducer" table. Does not add if a record with the same Local Well Name/Site Code and Measurement Date/Time already exists in the "dt_water_levels_transducer" table.
	import_gwlt_update_site_id_wc_id_localname	Update Query	Adds site_id and wc_id to the records in the "import_gwl_logger" table if the matching Local Well Name is found in the "dt_sites" table.
	import_gwlt_update_site_id_wc_id_sitecode	Update Query	Adds site_id and wc_id to the records in the "import_gwl_logger" table if the matching Site Code is found in the "dt_sites" table.
	import_gwlt_update_wlt_id	Update Query	Adds wlt_id to the records in the "import_gwl_logger" table if the matching wc_id and Measurement Date/Time are found in the "dt_water_levels_transducer" table.
	update_display_rejected_water_levels_logger	Update Query	Sets use_flag = 0 in the "dt_water_levels_transducer" table if Review_Result = "Rejected."
Import_GWL_manual	Exclusions_import_gwl_manual	Table	Table for viewing the records from the "import_gwl_manual" table that have not been loaded to the "dt_water_levels" table.
	import_gwl_manual	Table	Table for importing the water level data from wells.
	exclude_wlm_import_gwlman	Append Query	Adds the records from the "import_gwl_manual" table to the "Exclusions_import_gwl_manual" table if the required well site info is missing.
	import_gwlman_add_dt_water_levels	Append Query	Formats the water level data from the "import_gwl_manual" table and adds them to the "dt_water_levels" table. Does not add if a record with the same Local Well Name and Measurement Date already exists in the "dt_water_levels" table.
	import_wlman_tomatch	Select Query	Formats Measurement Date in the "import_gwl_manual" table. Used as an intermediate step for the "import_gwlman_Update_wlID" query.

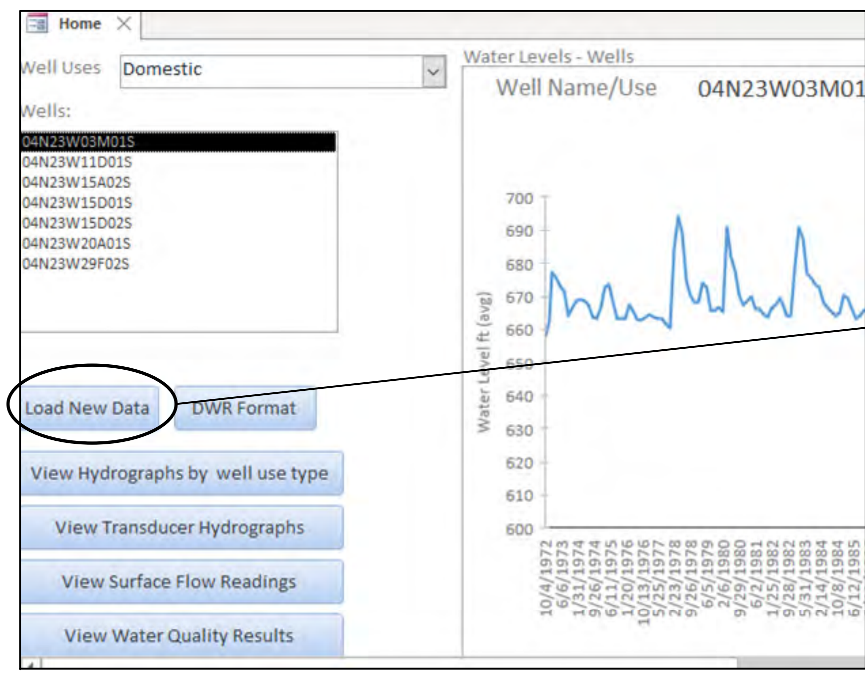
Group	Object Name	Object Type	Description
	import_gwlman_Update_siteID_wcID	Update Query	Adds site_id and wc_id to the records in the "import_gwl_manual" table if the matching Local Well Name is found in the "dt_sites" table.
	import_gwlman_Update_siteID_wcIDStateWell	Update Query	Adds site_id and wc_id to the records in the "import_gwl_manual" table if the matching Local Well Name is found in the "dt_well_details" table.
	import_gwlman_Update_wlID	Update Query	Adds wl_id to the records in the "import_gwl_manual" table if the matching wc_id and Measurement Date are found in the "dt_water_levels" table.
	update_display_rejected_water_levels	Update Query	Sets use_flag = 0 in the "dt_water_levels" table if Review_Result = "Rejected."
Import_StreamGageSites	Exclusions_import_stream_gauge_sites	Table	Table for viewing the records from the "import_stream_gage_sites" table that have not been loaded to the "dt_sites" or "dt_site_details" table.
	import_stream_gauge_sites	Table	Table for importing the gage site info.
	exclude_sd_import_gaugesites	Append Query	Adds the records from the "import_stream_gauge_sites" table to the "Exclusions_import_stream_gauge_sites" table if the required gage site details are missing.
	exclude_sites_import_gaugesites	Append Query	Adds the records from the "import_stream_gauge_sites" table to the "Exclusions_import_stream_gauge_sites" table if the required gage site info (e.g., latitude/longitude, coordinates method/accuracy, county) is missing.
	import_sg_sites_add_dt_site_details	Append Query	Formats the gage site details from the "import_stream_gauge_sites" table and adds them to the "dt_site_details" table. Does not add if a record with the same Local Site Name already exists in the "dt_site_details" table.
	import_sg_sites_add_dt_sites	Append Query	Formats the gage site info from the "import_stream_gauge_sites" table and adds it to the "dt_sites" table. Does not add if a record with the same Local Site Name already exists in the "dt_sites" table.
	import_sg_sites_update_sd_id	Update Query	Adds sd_id to the records in the "import_stream_gauge_sites" table if the matching site_id is found in the "dt_site_details" table.
	import_sg_sites_update_site_id	Update Query	Adds site_id to the records in the "import_stream_gauge_sites" table if the matching Local Site Name is found in the "dt_sites" table.
Import_StreamFlow	Exclusions_import_stream_gauge_flow	Table	Table for viewing the records from the "import_stream_gauge_flow" table that have not been loaded to the "dt_site_levels" table.
	import_stream_gauge_flow	Table	Table for importing the streamflow data from gages.
	exclude_sgflow_import_stream_gauge_flow	Append Query	Adds the records from the "import_stream_gauge_flow" table to the "Exclusions_import_stream_gauge_flow" table if the required gage site info or Surface Water Discharge (cubic feet per second) is missing.
	import_sg_flow_add_dt_site_levels	Append Query	Formats the streamflow data from the "import_stream_gauge_flow" table and adds them to the "dt_site_levels" table. Does not add if a record with the same General Site ID and Measure Date and Time already exists in the "dt_site_levels" table.
	import_sg_flow_date_time	Select Query	Formats Measure Date and Time in the "import_stream_gauge_flow" table. Used as an intermediate step for the "import_sg_flow_update_sl_id" query.
	import_sg_flow_site_id_sd_id	Update Query	Adds site_id and sd_id to the records in the "import_stream_gauge_flow" table if the matching General Site ID is found in the "dt_sites" table.
	import_sg_flow_update_sl_id	Update Query	Adds sl_id to the records in the "import_stream_gauge_flow" table if the matching sd_id and Measure Date and Time are found in the "dt_site_levels" table.
	update_display_rejected_stream_flow	Update Query	Sets use_flag = 0 in the "dt_site_levels" table if Review_Result = "Rejected."
Import_Water_Quality	Exclusions_import_water_quality	Table	Table for viewing the records from the "import_water_quality" table that have not been loaded to the "dt_samples" table.

Group	Object Name	Object Type	Description
	import_water_quality	Table	Contents from the "wq_source_data" table plus Data_Source.
	wq_source_data	Table	Table for importing the water quality data.
	append_IMPORT_to_Staging	Append Query	Adds all records from the "wq_source_data" table to the “import_water_quality” table.
	append_wq_results	Append Query	Formats the water quality data from the "import_water_quality" table and adds them to the "dt_results" table. Does not add if a record with the same Local Well Name/SWN, SAMP DATE, and CHEMISTRY already exists in the "dt_results" table.
	append_wq_samples	Append Query	Formats the water quality data from the "import_water_quality" table and adds them to the "dt_samples" table. Does not add if a record with the same Local Well Name/SWN and SAMP DATE already exists in the "dt_samples" table.
	exclude_wq_data_no_sample	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if the matching wc_id and SAMP DATE are not found in the "dt_samples" table.
	exclude_wq_data_no_WellDetail	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if neither Local Well Name nor SWN is found in the "dt_well_details" table.
	exclude_wq_data_with_no_standard_chem	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if the matching CHEMISTRY is not found in the "lu_parameters" table.
	exclude_wq_data_with_not_site_info	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if neither Local Well Name nor SWN is found in the "dt_sites" table.
	exclude_wq_data_with_rejected_results	Append Query	Adds the records from the "import_water_quality" table to the "Exclusions_import_water_quality" table if Review_Result = "Rejected."
	check_each_chem_reported_in_one_unit	Select Query	Shows the unit of each analyte.
	check_import_water_quality_results_not_loaded	Select Query	Shows the records from the "import_water_quality" table that have not been loaded to the "dt_results" table.
	chemicals_results_multiple_units	Select Query	Shows the analytes reported in more than one unit.
	import_water_quality_update_site_id	Update Query	Adds site_id to the records in the "import_water_quality" table if the matching Local Well Name is found in the "dt_sites" table.
	import_water_quality_update_site_id_state	Update Query	Adds site_id to the records in the "import_water_quality" table if the matching SWN is found in the "dt_sites" table.
	update_import_water_quality_par_id	Update Query	Adds par_id to the records in the "import_water_quality" table if the matching CHEMISTRY is found in the "lu_parameters" table.
	update_import_water_quality_par_id_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if the matching CHEMISTRY is not found in the "lu_parameters" table.
	update_import_water_quality_rejected_result_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if Review_Result = "Rejected."
	update_import_water_quality_result_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if the matching samp_id and par_id are not found in the "dt_results" table.
	update_import_water_quality_rpt_unit_for_PH	Update Query	Sets rpt_unit = "S.U." in the "import_water_quality" table if CHEMICAL = "PH, LABORATORY."
	update_import_water_quality_rslt_id	Update Query	Adds rslt_id to the records in the "import_water_quality" table if the matching samp_id and par_id are found in the "dt_results" table.
	update_import_water_quality_samp_id	Update Query	Adds samp_id to the records in the "import_water_quality" table if the matching wc_id and SAMP DATE are found in the "dt_samples" table.
	update_import_water_quality_sample_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if the matching wc_id and SAMP DATE are not found in the "dt_samples" table.

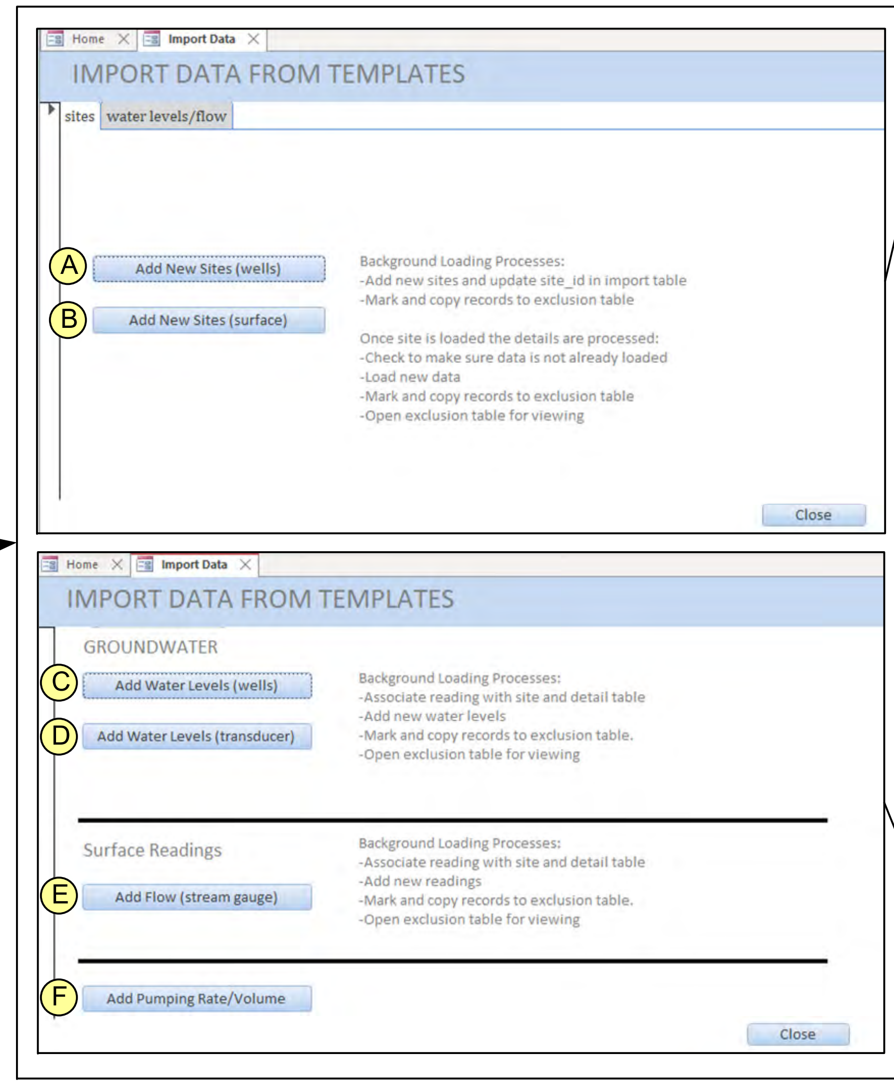
Group	Object Name	Object Type	Description
	update_import_water_quality_site_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if neither Local Well Name nor SWN is found in the "dt_sites" table.
	update_import_water_quality_wc_exclusions	Update Query	Adds exclusion_comment to the records in the "import_water_quality" table if neither Local Well Name nor SWN is found in the "dt_well_details" table.
	update_lu_parameter_anlygroup_from_lu_anlygroup	Update Query	Copies the chemical info from the "lu_anlygroup" table to the "lu_parameters" table.
	update_site_wc_ids_inimport	Update Query	Adds wc_id to the records in the "import_water_quality" table if the matching Local Well Name/SWN is found in the "dt_well_details" table.
Import_GWL_logger	Exclusions_import_pumping	Table	Table for viewing the records from the "import_pumping_rate_volume" table that have not been loaded to the "dt_pumping" table.
	import_pumping_rate_volume	Table	Table for importing the pumping data.
	exclude_pumping_import	Append Query	Adds the records from the "import_pumping_rate_volume" table to the "Exclusions_import_pumping" table if the required well site info is missing.
	import_pumping_add_dt_pumping	Update Query	Formats the pumping data from the "import_pumping_rate_volume" table and adds them to the "dt_pumping" table. Does not add if a record with the same location, wpd_date, wpd_vol, wpd_vol_unit, and wpd_vol_period already exists in the "dt_pumping" table.
	import_pumping_update_wc_id	Update Query	Adds site_id and sd_id to the records in the "import_stream_gauge_flow" table if the matching location is found in the "dt_sites" table.
	update_import_pumping_pump_id	Update Query	Adds pump_id to the records in the "import_pumping_rate_volume" table if the matching wc_id, wpd_date, wpd_vol, wpd_vol_unit, and wpd_vol_period are found in the "dt_pumping" table.
VIEWS_base	q_Base_Pumping	Select Query	Shows the contents of select fields in the "dt_pumping" table.
	q_Base_SurfaceLevels	Select Query	Shows the contents of select fields in the "dt_site_levels" table.
	q_Base_WaterLevels	Select Query	Shows the contents of select fields in the "dt_water_levels" table.
	q_Base_WaterLevelsT	Select Query	Shows the contents of select fields in the "dt_water_levels_transducer" table.
	q_Base_WaterQuality	Select Query	Shows the contents of select fields in the "dt_samples" and "dt_results" tables.

DMS Object Map: Importing Data

"chart_WaterLevels_wells" Form



"frmImportData" Form



A

Input Tables:
- import_wells
- lu_monitoring_network_type
- lu_site_type

Queries (run in order shown):
- import_wells_update_site_id
- import_wells_update_site_id_state
- import_wells_add_dt_sites
- import_wells_update_site_id
- import_wells_update_site_id_state
- exclude_sites_import_wells
- import_wells_update_wc_id
- import_wells_add_dt_well_details
- import_wells_update_wc_id
- exclude_wc_import_wells

Output Tables:
- dt_sites
- dt_well_details
- Exclusions_ import_wells

B

Input Tables:
- import_stream_gauge_sites
- lu_monitoring_network_type
- lu_site_type

Queries (run in order shown):
- import_sg_sites_update_site_id
- import_sg_sites_add_dt_sites
- import_sg_sites_update_site_id
- exclude_sites_import_gaugesites
- import_sg_sites_update_sd_id
- import_sg_sites_add_dt_site_details
- import_sg_sites_update_sd_id
- exclude_sd_import_gaugesites

Output Tables:
- dt_sites
- dt_site_details
- Exclusions_import_stream _gauge_sites

C

Input Tables:
- import_gwl_manual
- dt_sites
- dt_well_details

Queries (run in order shown):
- import_gwlman_Update_siteID_wcID
- import_gwlman_Update_siteID_wcIDState Well
- import_gwlman_Update_wlID
- import_gwlman_add_dt_water_levels
- import_gwlman_Update_wlID
- exclude_wlm_import_gwlman
- update_display_rejected_water_levels

Output Tables:
- dt_water_levels
- Exclusions_import_gwl _manual

D

Input Tables:
- import_gwl_logger
- dt_sites
- dt_well_details

Queries (run in order shown):
- import_gwlt_update_site_id_wc_id_localname
- import_gwlt_update_site_id_wc_id_sitecode
- import_gwlt_update_wlt_id
- import_gwlt_add_dt_water_level_trans
- import_gwlt_update_wlt_id
- exclude_wlt_import_gwllogger
- update_display_rejected_water_levels_logger

Output Tables:
- dt_water_levels_transducer
- Exclusions_import_gwl _logger

E

Input Tables:
- import_stream_gauge_flow
- dt_sites
- dt_site_details

Queries (run in order shown):
- import_sg_flow_site_id_sd_id
- import_sg_flow_add_dt_site_levels
- import_sg_flow_update_sl_id
- exclude_sgflow_import_stream_gauge_flow
- update_display_rejected_stream_flow

Output Tables:
- dt_site_levels
- Exclusions_import_stream _gauge_flow

F

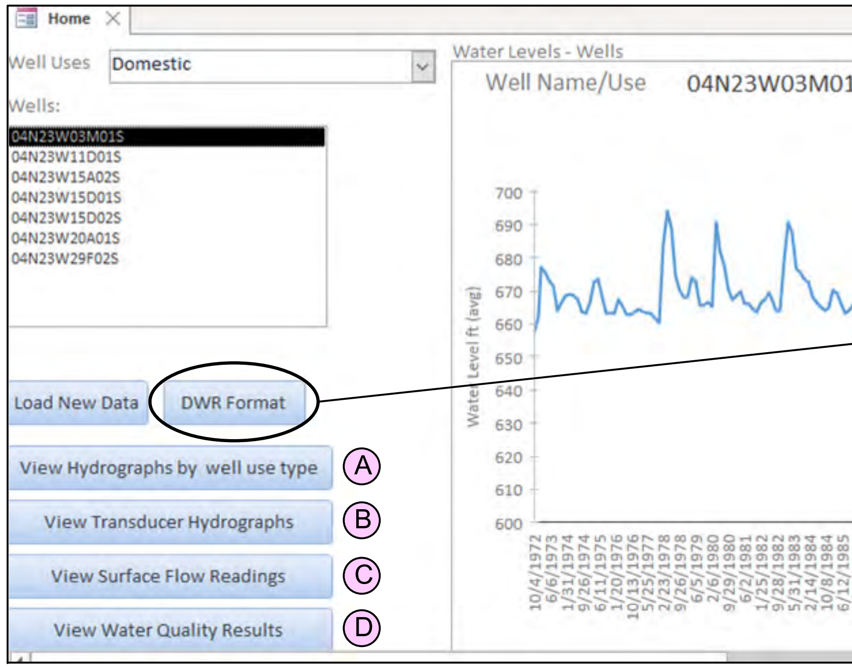
Input Tables:
- import_pumping_rate _volume
- dt_sites
- dt_well_details
- dt_sources

Queries (run in order shown):
- import_pumping_update_wc_id
- update_import_pumping_pump_id
- import_pumping_add_dt_pumping
- update_import_pumping_pump_id
- exclude_pumping_import

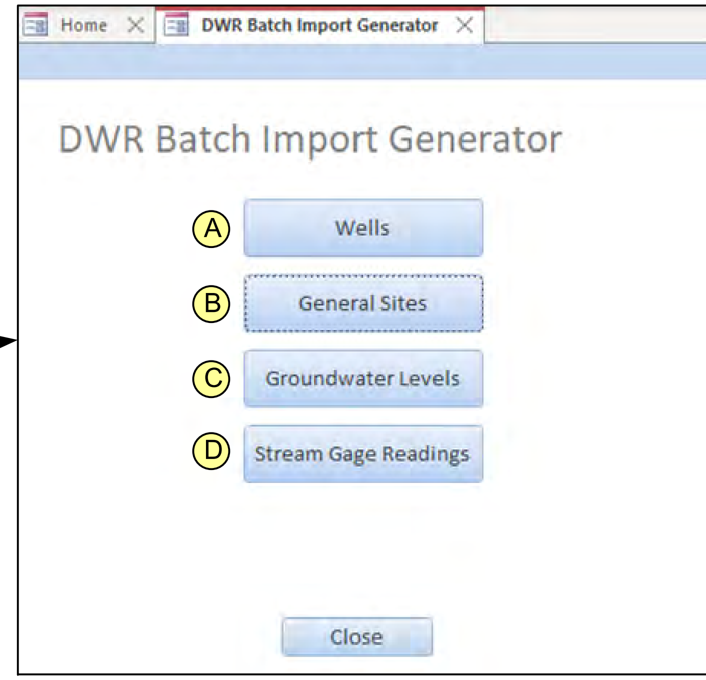
Output Tables:
- dt_pumping
- Exclusions_import_pumping

DMS Object Map: Formatting Data & Graphing

"chart_WaterLevels_wells" Form



"frmDWR_Exports" Form



(A)

Input Tables:
- dt_sites
- dt_well_details
- lu_monitoring_network_type

Queries (run in order shown):
- dwr_append_batchWells

Output Tables:
- BatchImportWells_template

(B)

Input Tables:
- dt_sites
- dt_site_details
- dt_well_details

Queries (run in order shown):
- dwr_append_batchGeneralSitesGages
- dwr_append_batchGeneralSitesWells

Output Tables:
- BatchImportGeneralSites _template

(C)

Input Tables:
- dt_sites
- dt_well_details
- dt_water_levels
- dt_water_levels_transducer

Queries (run in order shown):
- dwr_append_batch_GWLD
- dwr_append_batch_GWLD_loggers

Output Tables:
- BatchImportGWLD_template

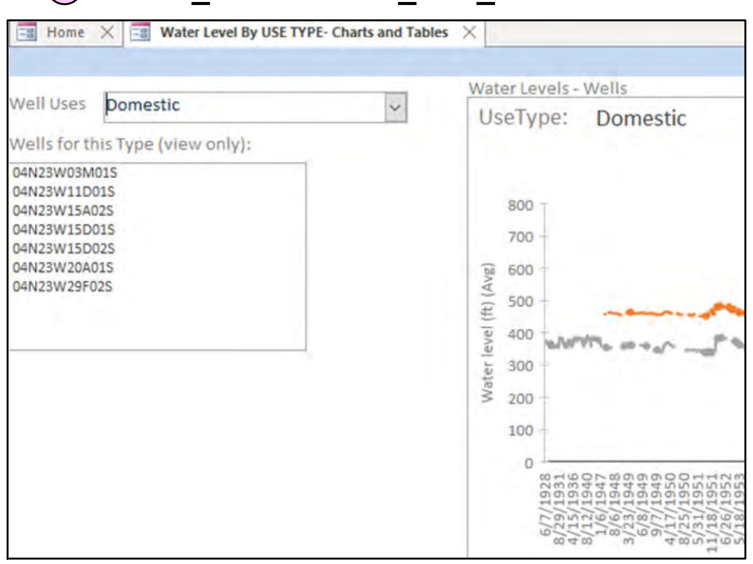
(D)

Input Tables:
- dt_sites
- dt_site_details
- dt_site_levels
- lu_site_type

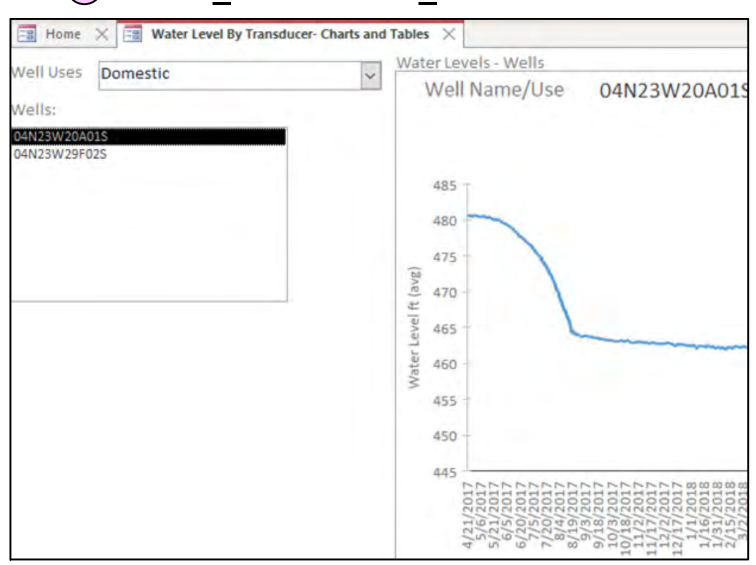
Queries (run in order shown):
- dwr_append_batchGenSitesData_gage

Output Tables:
- BatchImportGeneralSiteData _template

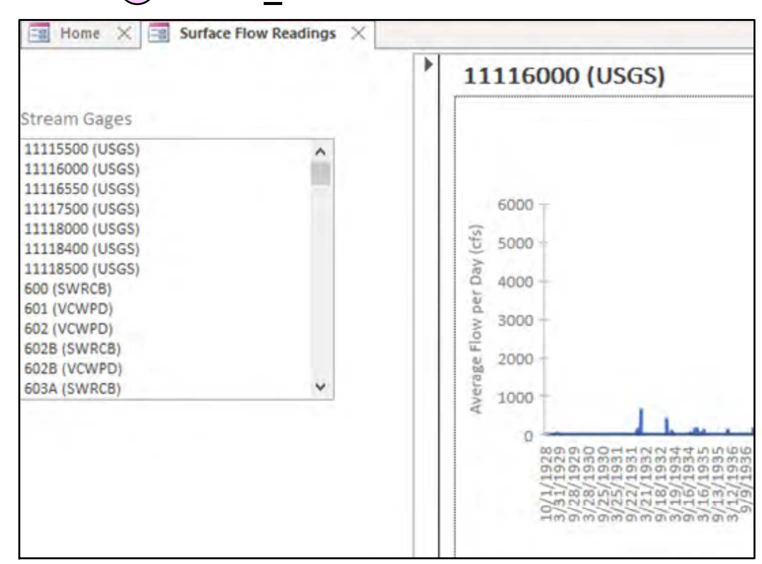
(A) "chart_WaterLevels_well_use" Form



(B) "chart_WaterLevels_wellsT" Form



(C) "chart_SurfaceLevels" Form



(D) "chart_WaterQuality" Form