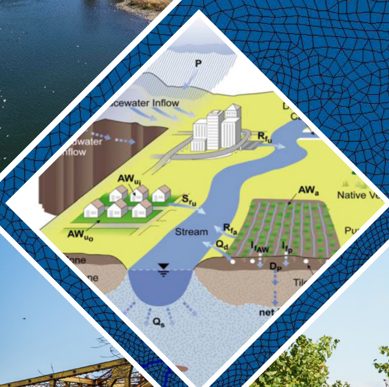
CoSANA

An Integrated Water Resources Model of the Cosumnes, South American, and North American Groundwater Subbasins

NOVEMBER 2021




WOODARD & CURRAN

COSANA:

AN INTEGRATED WATER RESOURCES MODEL OF THE COSUMNES, SOUTH AMERICAN, AND NORTH AMERICAN GROUNDWATER SUBBASINS

NOVEMBER 2021

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ABBREVIATIONS

2070CT	2070 Central Tendency
2070HD	2070 Hot and Dry
AFY	acre-feet per year
ARBS	American River Basin Study
ASR	aquifer storage and recovery
ASTM	American Standard Testing Method
AWMP	Agricultural Water Management Plan
C2VSimFG	California Central Valley Groundwater-Surface Water Simulation Model
Cal Am	California American Water Company
CalSIMETAW	California Simulation of Evapotranspiration of Applied Water
CASGEM	California Statewide Groundwater Elevation Monitoring
CDEC	California Data Exchange Center
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CoSANA	Cosumnes-South American-North American Integrated Water Resources Model
CoSb	Cosumnes Subbasin
CSD	Community Services District
CWD	community water district
DEM	digital elevation model
DWR	California Department of Water Resources
ESJ	Eastern San Joaquin Groundwater Subbasin
ET	evapotranspiration
ET_o	reference ET
ET_c	crop coefficient
GSA	groundwater sustainability agency
GSP	groundwater sustainability plan
GWMP	City of Sacramento's 2017 Groundwater Master Plan
ID	irrigation district; identifier
IDC	IWFM Demand Calculator
IGSM	Integrated Groundwater and Surface Water Model
IWFM	Integrated Water Flow Model
JVID	Jackson Valley Irrigation District
METRIC	Mapping Evapotranspiration at High Resolution with Internalized Calibration
NASb	North American Subbasin
NRCS	Natural Resource Conservation Service
PCWA	Placer County Water Agency
PRISM	Precipitation-Elevation Regressions on Independent Slopes Model
Reclamation	United States Bureau of Reclamation
RMCSD	Rancho Murieta Community Services District
RMSE	root mean square error
RWA	Regional Water Authority
SacIWRM	Sacramento Area Integrated Water Resources Model
SAFCA	Sacramento Area Flood Control Agency
SASb	South American Subbasin
SCGA	Sacramento Central Groundwater Authority
SCWA	Sacramento County Water Agency
SGA	Sacramento Groundwater Authority
SGMA	Sustainable Groundwater Management Act

SMUD	Sacramento Municipal Utility District
SSCAWA	Southeast Sacramento County Agricultural Water Authority
SSURGO	Soil Survey Geographic Database
STATSGO2	Digital General Soil Map of the United States
SVSim	Sacramento Valley Groundwater-Surface Water Simulation Model
TNC	The Nature Conservancy
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WA	water agency
WC	water company
WD	water district
WDL	Water Data Library
WY	water year
YGM	Yuba Groundwater Model

ACKNOWLEDGEMENTS

The Cosumnes-South American-North American Integrated Water Resources Model (CoSANA) was developed in a collaborative effort with representatives of the North American Subbasin (NASb), South American Subbasin (SASb), and the Cosumnes Subbasin (CoSb). This collaborative approach spanning three subbasins improves the ability for local water managers and stakeholders to use CoSANA to for a range of regional planning efforts.

Funding of the CoSANA model was also a collaborative effort, with contributions from the Sacramento Groundwater Authority (SGA), Regional Water Authority (RWA), Sacramento Central Groundwater Authority (SCGA), Sacramento Area Flood Control District (SAFCA), and Southeast Sacramento County Agricultural Water Authority (SSCAWA). Contributions from SGA, SSCAWA, Sacramento Water Forum, Sacramento County, and the seven groundwater sustainability agencies (GSAs) represented by the Cosumnes Subbasin Sustainable Groundwater Management Act (SGMA) Working Group supported by grants from the California Department of Water Resources' Proposition 1, Round 2 Sustainable Groundwater Planning Grant Program

A technical committee consisting of working groups from each of the three subbasins provided technical support and quality assurance throughout the model development. Working groups included agencies and consultant teams representing the NASb, SASb, and CoSb with knowledge of the area. Participation by representatives of regional water agencies and GSA representatives, including SGA, RWA, SCGA, SAFCA, SSCAWA and the Sacramento Water Forum, allowed for incorporation of information related to stakeholders within those organizations and beyond. Further progress was shared at meetings associated with development of groundwater sustainability plans (GSPs) to gain additional input and information.

Model development was led by RWA and supported by input and efforts of many entities and their consultants, including:

- RWA/SGA
  - Rob Swartz
  - Monica Garcia
- SCGA
  - John Woodling
  - Ramon Roybal
  - Bob Gardner
- The Sacramento Water Forum
  - Tom Gohring
- SAFCA
  - Gary Bardini
- Department of Water Resources
  - Can Dogrul
  - Tyler Hatch
  - Tariq Kadir
- Each GSA within the North American, South American, and Cosumnes Subbasins and their representatives
- Many other water purveyor and remediation site representatives that provided information to better simulate their areas and operations.

Woodard & Curran was the lead consultant for development of the CoSANA model with substantial assistance from stakeholders, subbasin representatives, and their consultants. The Woodard & Curran project team included:

- Ali Taghavi
- Jim Blanke
- Sebastien Poore
- Sara Miller
- Sevim Onsoy
- Brian Van Lienden
- Sercan Ceyhan
- Mesut Cayar

Other consultants who contributed to the model development included:

- EKI Environment and Water
  - John Fio
  - Dave Leighton
  - Christina Lucero
- GEI Consultants
  - Jonathan Goetz
  - Richard Shatz
- Larry Walker Associates
  - Laura Foglia
  - Rich Pauloo
- MBK Engineers
  - Lee Bergfeld
  - Angela Bezzone
  - Kyle Knutson

The CoSANA team is grateful for the many entities that provided assistance or data to characterize the groundwater and surface water systems in the greater Sacramento region, including many urban water purveyors, agricultural entities, environmental groups, GSA representatives, managers of contamination remediation operations, project proponents, private domestic and rural residential well owners. The team is also appreciative of the California Department of Water Resources for their assistance in implementing the CoSANA model on the Integrated Water Flow Model (IWFM) platform.

EXECUTIVE SUMMARY

CoSANA, the Cosumnes-South American-North American, Integrated Water Resources Model, is a regional integrated water resources model developed as an upgrade and enhancement of the existing Sacramento Area Integrated Water Resources Model (SacIWRM). The enhanced integrated groundwater and surface water simulation capabilities afforded by CoSANA are intended to assist in a broad range of water management activities in the Sacramento Region. CoSANA is built on the Integrated Water Flow Model (IWFM) framework, which is specifically designated in Sustainable Groundwater Management Act (SGMA) Groundwater Sustainability Plans (GSP) regulations as being supported by the California Department of Water Resources for water budget development within GSPs. The model is developed with specific features to support development of sustainable groundwater management strategies and policies and compliance with SGMA, as well as to support the planning and implementation of regional conjunctive use and water banking efforts and other water management activities.

> ***CoSANA at a Glance***
>
> **Model area**: North American, South American, and Cosumnes Groundwater Subbasins
>
> **Modeling Platform**: IWFM
>
> **Layering**: 5 layers representing major formations to the base of fresh water
>
> **Elements**: 24,171 elements with an average element area of 37 acres
>
> **Stream system**: 27 simulated streams with 51 reaches
>
> **Land Use:** 24 land use types, including 20 agricultural crops
>
> **Water Supply:** Surface water, groundwater, and recycled water supply to agricultural and urban water purveyors
>
> **Remediation Pumping:** Groundwater extraction and cleanup at 4 remediation sites
>
> **Hydrologic period**: Water Years 1970-2019 on a monthly time step

Stakeholder participation was a key component in the development of CoSANA, which enabled the model development team to work in a collaborative and transparent environment and to obtain the local data necessary to develop a detailed model, gain input and insight from those most knowledgeable about the subbasins, and to gain stakeholder buy-in, which is necessary for broad regional acceptance. Outreach activities included coordination with representatives of regional water agencies and groundwater sustainability agencies, including the Regional Water Authority, Sacramento Groundwater Authority, Sacramento Central Groundwater Authority, Sacramento Area Flood Control Agency, Southeast Sacramento County Agricultural Water Authority, and the Sacramento Water Forum. Further, progress was shared at meetings associated with development of GSPs for each of the three subbasins to gain additional input and information.

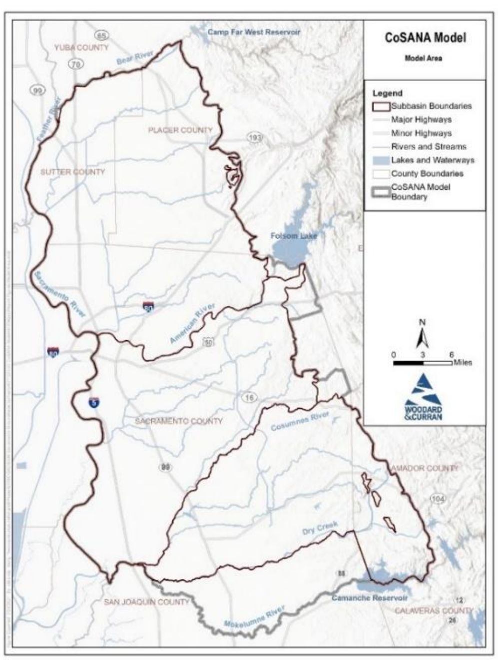


Figure ES-1: Model Area

ES.1 Model Area

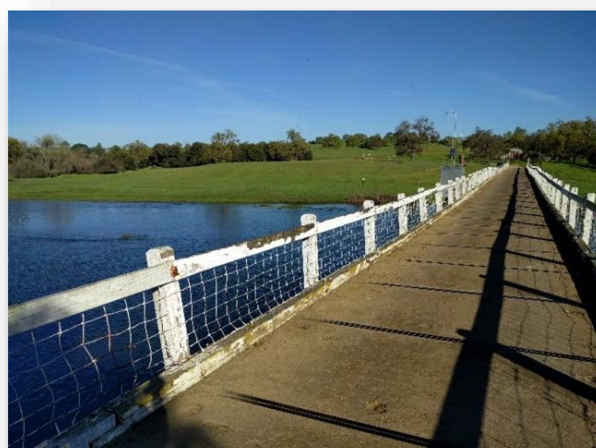
The model area covers nearly 900,000 acres (approximately 1,400 square miles) and is bounded in the north by the Bear River, in the south by the Mokelumne River, in the west by the Sacramento River, and in the east by the Sierra Nevada foothills. This area includes the entirety of the North American, South American, and Cosumnes Groundwater Subbasins. Portions of the Eastern San Joaquin Subbasin are included for consistency with past efforts but are not updated or calibrated to the same level as the North American, South American, and Cosumnes Subbasins. The physical model boundaries are shown in Figure ES-1.

CoSANA performs calculations related to water flow by breaking down the model area into smaller areas both horizontally and with depth. This is known as discretization. Smaller areas and more layers allow for more detailed modeling, but optimal discretization is found by weighing these benefits against limitations of data availability and computational power. The CoSANA model grid contains 24,171 finite elements and 22,274 nodes with an average element area of 37 acres. The overall node spacing is 1,170 feet on average with a maximum of 2,210 feet and a minimum of 300 feet. Smaller node spacing is present near streams and near areas of significant groundwater contamination, where more accurate calculations are called for. The subsurface is characterized by five model layers representing the different geologic conditions from the ground surface to the shallower of the bedrock or base of fresh water. These layers represent:

- Layer 1: Recent alluvium and the Riverbank Formation
- Layer 2: Laguna Formation
- Layer 3 Mehrten Formation
- Layer 4: Valley Springs Formation
- Layer 5: Ione Formation

The development of CoSANA included collection and compilation of a broad range of data related to land use, water use, hydrologic conditions, and hydrogeologic conditions, including:

- Geologic stratification
- Aquifer parameters
- Stream configuration
- Stream flows
- Small watersheds
- Precipitation
- Land use
- Evapotranspiration
- Soil properties
- Population
- Per capita water use
- Groundwater pumping
- Groundwater levels
- Surface water deliveries
- Boundary conditions
- Initial conditions



These and other datasets were developed based on local data, state databases, and federal databases and provided as input to CoSANA, on a monthly time step.

ES.2 Historical Simulation and Model Calibration

The CoSANA model simulates historical conditions in the basin for the period of water years 1970 through 2018 (October 1, 1969 through September 30, 2018). While the modeling time period begins in water year 1970, consistent with the SacIWRM, the focus of this modeling effort was water years 1990 – 2018, which includes substantially more refined data than the earlier years. Water years 1990 – 1994 are used as a warm-up period for the model, and water years 1995-2018 are used for model calibration. Additionally, the entire period of water year 1970-2018 is then used to perform a verification of the model performance over longer hydrologic period.

The simulation of historical conditions is intended to both help better understand and quantify the groundwater flow system and to calibrate the overall groundwater model. The calibration process involves comparison of simulated and observed data combined with adjustments to certain parameters. Data related to groundwater levels, streamflows, and water budgets were incorporated into the calibration process. Parameter adjustments were made within certain tolerance ranges that are reflective of the uncertainties associated with each parameter. The calibration process included both manual calibration by reviewing results and making appropriate adjustments as needed to reflect the long-term trends and short-term seasonal changes in observed data. Additionally, the PEST software package was employed to refine the calibration results by adjusting the soil, aquifer, and stream parameters within a reasonable range and distribution to achieve a better match between observed and simulated data. In this manner, the model is able to improve estimates for parameters lacking comprehensive data, such as agricultural groundwater production or certain aquifer parameters, resulting in better overall model performance.

ES.3 Baseline Simulations

Baseline simulations were developed to represent a set of pre-established hydrologic, land and water use, water demand, water supply, and basin operational conditions. In addition to providing valuable information on the groundwater flow system, these baselines can be implemented to evaluate effects of particular projects or management actions. The baselines incorporate 50 years of hydrology (water years 1970 – 2019) to meet SGMA requirements and to provide climatic variability necessary to assess future projects and management actions. Baseline simulations were developed for four different conditions:

- **Current Conditions:** The CoSANA Current Conditions Baseline (CCBL) is a representation of long-term average conditions assuming that a recent level of development and water demand persists over a long-term period of hydrologic conditions.
- **Projected Conditions:** The CoSANA Projected Conditions Baseline (PCBL) is a representation of the projected land and water use conditions of 2040, applied to the same long-term hydrologic conditions. Projected conditions are generally based on information from land use agencies and from Urban Water Management Plans or other planning documents from water purveyors.
- **Projected Conditions with Climate Change:** The CoSANA Projected Conditions Baseline with Climate Change (PCBL with Climate Change) shares many of the same inputs as the PCBL, but with additional factors to incorporate potential climate change conditions. Climate change conditions are represented through incorporation of information on 2070 Central Tendency (2070CT) conditions as documented by the US Bureau of Reclamation in the American River Basin Study (ARBS). In addition to the 2070CT, sensitivity of the model results and groundwater levels and storage was evaluated using a 2070 Hot and Dry (2070HD) climate scenario from the ARBS.

ES.4 Simulated Groundwater Conditions

Groundwater conditions associated with the historical simulation and the baseline simulations are presented in the report as contour maps, hydrographs, and water budgets. A summary-level groundwater budget for the three groundwater subbasins in the model area is presented in Table ES-1, below. This groundwater budget shows positive change in storage for the historical conditions, Current Conditions Baseline, and Projected Conditions Baseline, and a negative change in storage for the Projected Conditions with Climate Change Baseline (based on 2070CT). Generally, positive change in storage is associated with rising groundwater levels as the system seeks a new equilibrium with the surface water system and surrounding subbasins, while negative change in storage is associated with declining groundwater levels.

Table ES-1: Groundwater Budgets for the Combined North American, South American, and Cosumnes Subbasins

Model Version	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
Historical (1995–2018)	667,460	428,359	206,837	18,335	7,003*	11,302	26,702
CCBL	643,595	413,447	188,397	16,758	33,656	8,147	16,768
PCBL	685,501	396,714	230,109	16,402	36,561	8,726	2,969
PCBL+ Climate Change	726,028	377,207	261,089	16,427	40,481	11,378	-19,486

Note: all values presented in acre-feet per year (AFY)

CoSANA provides substantial detail that can allow for disaggregating these results spatially and temporally. For instance, as shown in Table ES-2, the North American Subbasin shows the most positive change in storage and the Cosumnes Subbasin shows the most negative change in storage, with values for the South American Subbasin in the middle. Similar differences exist within the subbasins as well, with areas receiving surface water and/or using little groundwater having generally more positive change in storage and groundwater levels and areas using more groundwater and/or receiving little surface water having generally more negative change in storage and groundwater levels. Groundwater conditions and model output are complex, and substantial detail is presented in the main report.

Table ES-2: Estimates of Average Change in Groundwater Storage by Subbasin

Model Version	North American Subbasin (AFY)	South American Subbasin (AFY)	Cosumnes Subbasin (AFY)	Total (AFY)
Historical (1995–2018)	26,661	5,551	-5,510	26,702
CCBL	14,843	2,158	-233	16,768
PCBL	5,390	-1,128	-1,293	2,969
PCBL+ Climate Change	-3,502	-6,222	-9,762	-19,486

ES.5 Recommendations

Like the SacIWRM before it, the CoSANA model is intended to be a living model, with refinements and updates occurring over time to meet the changing needs of the region and to incorporate the latest conditions, data, and modeling platforms. During the development of the model, several items were identified for future refinements to improve the capability of CoSANA to be a long-term defensible and reliable water resources model for the area, as listed below with additional detail in the main report.

- Continue collaboration and engagement with local GSAs, water purveyors, groundwater users, and water managers
- Collaborate with DWR
- Develop a model update schedule
- Enhance representation of variability of potential evapotranspiration
- Map Soil Survey Geographic Database (SSURGO) rootzone parameters directly to CoSANA
- Refine surface water deliveries in the North American and South American Subbasins
- Improve inflow estimates for tributary streams
- Improve return flow routing within IFWM and CoSANA
- Improve data and simulation of Auburn Ravine flows
- Develop improved rating tables for major streams
- Improve simulation of complex water systems
- Improve data for Mather AFB remediation operations
- Improve model information and data sets on the eastern areas

ES.6 Summary

The CoSANA model is built upon the previous SacIWRM by migrating to the IWFM platform, providing finer resolution spatially and with depth, and by refining and extending the data incorporated into the model. CoSANA provides a robust, comprehensive, defensible model for assessing water resources conditions in the Sacramento Region through integrated modeling of land surface, groundwater, and surface water conditions using detailed local and regional data and the most widely accepted modeling platform. This includes simulation under historical, current, projected, and projected with climate change conditions. The tool is well calibrated and ready to be used in various water supply and management studies and is flexible enough to be updated and refined to meet future needs of the region, including implementation of sustainable groundwater management strategies, regional water accounting and allocation frameworks, evaluation of well protection plans and programs, and regional conjunctive use and projects assessments, including the regional water bank.

1. INTRODUCTION

The North American, South American, and Cosumnes Groundwater Subbasins are simulated under a unified model to provide a regional integrated water resources model suitable for a variety of regional water management needs. With a comprehensive long-term hydrologic period, robust and accurate water supply and use data for urban water purveyors, land use and cropping patterns based on the latest statewide and regional land use surveys, geologic and hydrogeologic information based on the statewide numerical and texture models, and surface water hydrologic data, The Cosumnes-South American-North American Integrated Water Resource Model, or CoSANA, is a comprehensive integrated water resources model to serve the North and South American and Cosumnes groundwater subbasins. CoSANA incorporates all relevant data from the Sacramento Area Integrated Water Resources Model (SacIWRM).

1.1 Goals of Model Development

The primary goal of development of CoSANA is to have a robust, technically sound, publicly accepted analytical computer tool that simulates the details of the integrated land surface system; stream and river system; and groundwater hydrologic and hydrogeologic system in the model area for use in regional water management.

This goal represents continuation of successful use of the SacIWRM, which was implemented for numerous diverse water management efforts over three decades. Updating, refining, and modernizing SacIWRM into the new state-of-the-art CoSANA platform has a goal of providing a technical and analytical tool through conducting the work in a collaborative and open environment to gain regional acceptance in the water community of the greater Sacramento region. Together, the tool and regional acceptance can allow for a broad, regional, consistent modeling approach that can provide defensible, robust, consistent results in a more efficient manner.

While CoSANA is intended to assist in a broad range of water management activities in the area, the model is developed with specific features to support development of sustainable groundwater management strategies and policies and compliance with the Sustainable Groundwater Management Act (SGMA), as well as to support the planning and implementation of regional conjunctive use and water banking efforts.

CoSANA is used for the development of the groundwater sustainability plans (GSPs) for North American Subbasin (NASb), South American Subbasin (SASb), and Cosumnes Subbasin (CoSb), including work related to:

- Hydrogeologic conceptual model
- Sustainable management criteria
- Water budgets and sustainable yield
- Monitoring networks
- Projects and management actions to achieve sustainability
- Outreach, reporting, and ongoing analysis

CoSANA is also intended to support work associated with a Sacramento regional water bank, including:

- Identification of benefits and impacts
- Water bank accounting
- Quantification of losses
- Integration with surface water reservoir operations models
- FloodMAR opportunities assessment and design
- Outreach, reporting, and ongoing analysis

CoSANA is developed to support analysis of a broad range of regional water management efforts.

1.2 Cosumnes, South American, and North American Subbasins

CoSANA simulates the North American (5-021.64), South American (5-021.65), and Cosumnes (5-022.16) Groundwater Subbasins, along with a small portion of the Eastern San Joaquin (ESJ) (5-022.01) Groundwater Subbasin. The focus of the model is the NASb, SASb, and CoSb subbasins, with less detail provided for the ESJ Subbasin. Figure 1-1 shows the model domain and the boundaries of the associated subbasins. Portions outside of the groundwater subbasins were included in the model area to avoid breaking up larger urban areas, including the City of Folsom and Rancho Murieta Community Services District (RMCSD). The model area includes portions of Amador, Placer, Sacramento, San Joaquin, and Sutter Counties. The CoSANA model domain is similar to the SacIWRM model domain, with some differences due to changes in groundwater subbasin boundaries.

NASb and SASb are categorized as high priority groundwater subbasins and CoSb is categorized as a medium priority groundwater subbasin under the California Statewide Groundwater Elevation Monitoring (CASGEM) program. None of these three subbasins are identified by the California Department of Water Resources (DWR) as critically overdrafted. As such, groundwater sustainability agencies (GSAs) in these three subbasins must develop GSPs by January 31, 2022 that detail how each subbasin will be managed in a sustainable manner by 2042. CoSANA is developed to assist in that process.

Table 1-1 lists 17 GSAs covering the NASb, SASb, and CoSb Subbasins. The GSAs include the major urban water purveyors, agricultural water purveyors, or other agencies which supply water or have land use authority within the subbasin. The water purveyors are shown in Figure 1-2 and the GSAs are shown in Figure 1-3.

Table 1-1: Groundwater Sustainability Agencies by Subbasin

Subbasin	GSA
North American Subbasin	Reclamation District 1001
	Sacramento Groundwater Authority
	South Sutter Water District
	Sutter County
	West Placer County
South American Subbasin	Sacramento County
	Northern Delta
	Omochumne-Hartnell Water District
	Sacramento Central Groundwater Authority
	Sloughhouse Resource Conservation District
Cosumnes Subbasin	Amador County Groundwater Management Authority
	City of Galt
	Clay Irrigation District
	Galt Irrigation District
	Omochumne-Hartnell Water District
	Sacramento County
	Sloughhouse Resource Conservation District

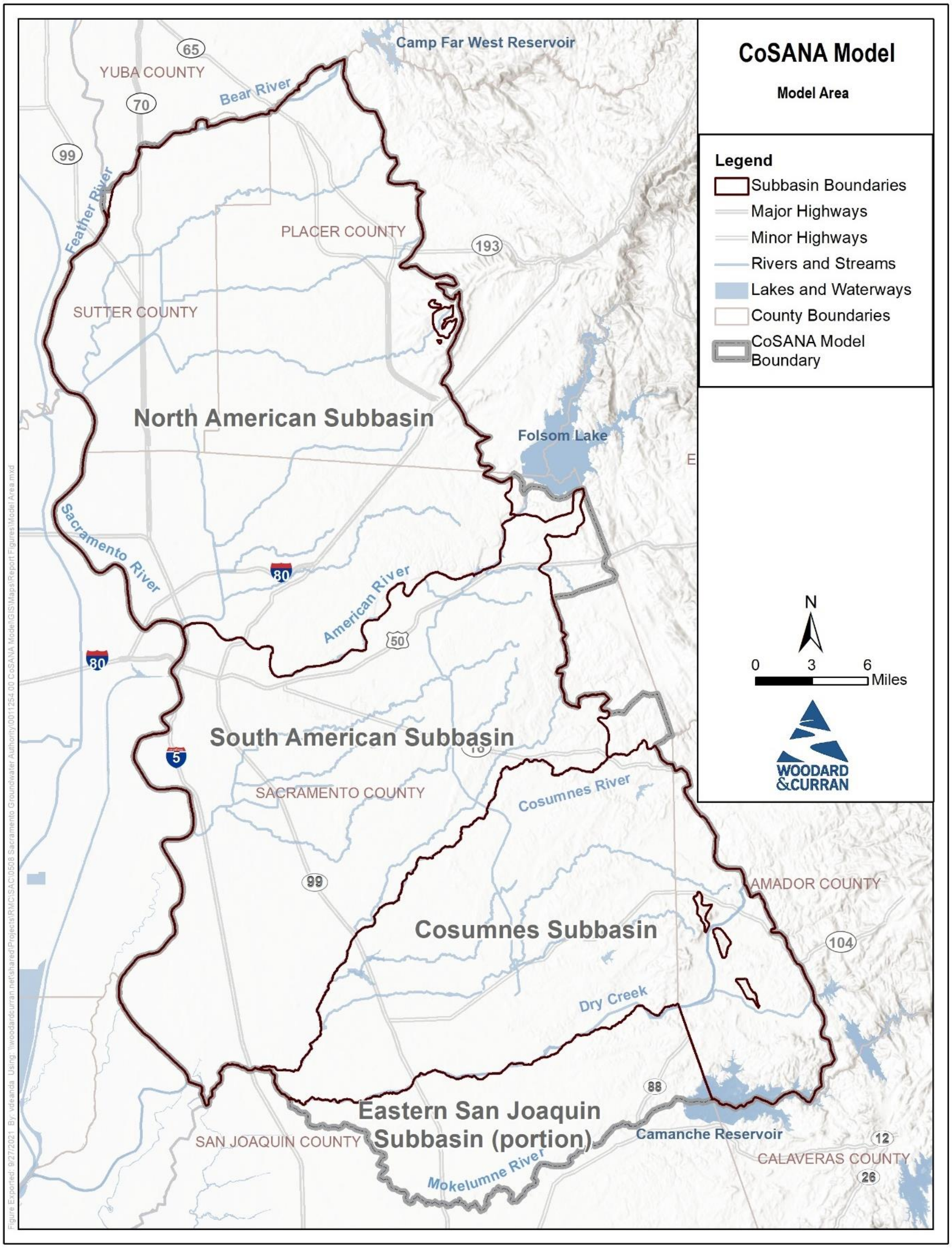
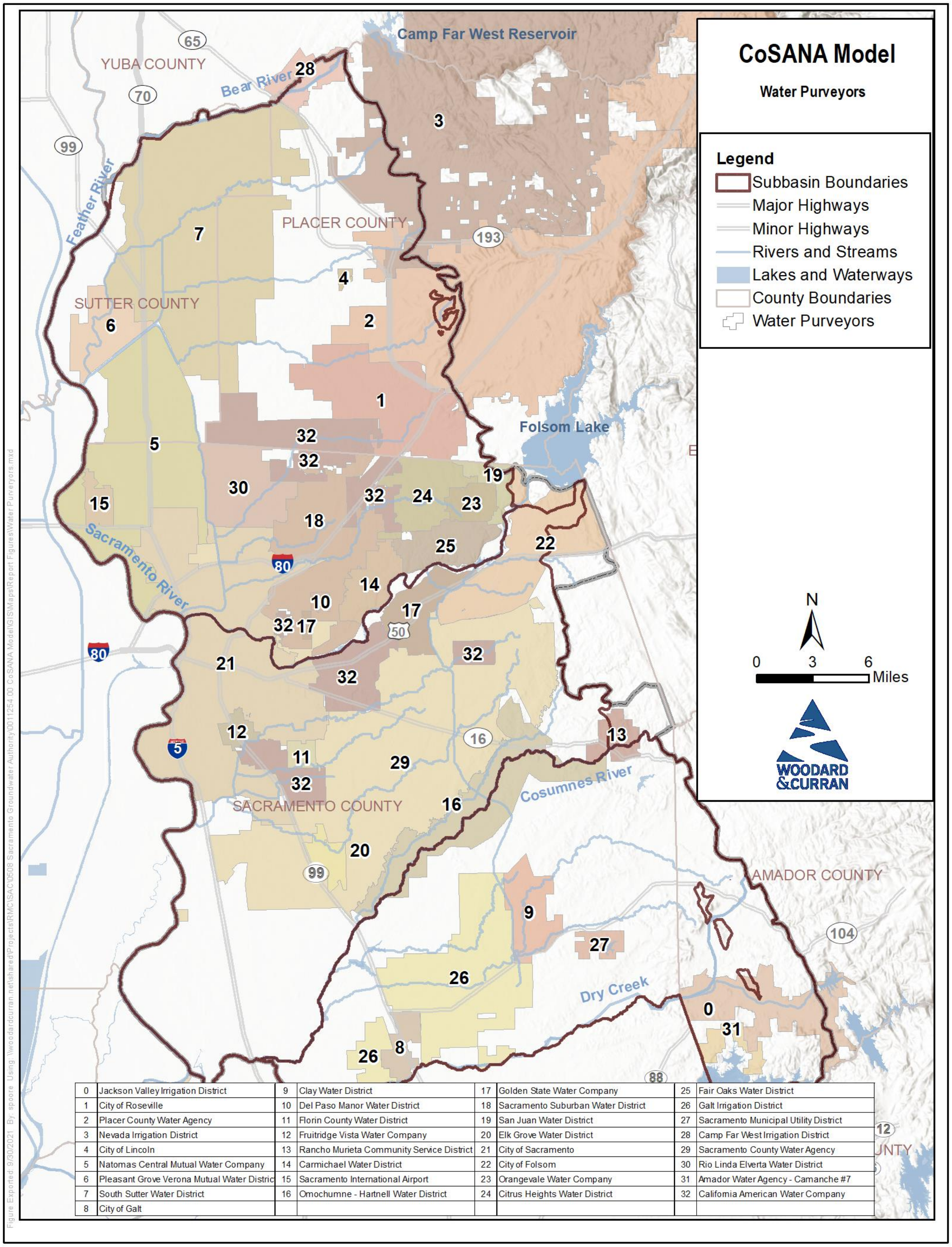


Figure 1-1: Model Area and Groundwater Subbasin Boundaries



0	Jackson Valley Irrigation District	9	Clay Water District	17	Golden State Water Company	25	Fair Oaks Water District
1	City of Roseville	10	Del Paso Manor Water District	18	Sacramento Suburban Water District	26	Galt Irrigation District
2	Placer County Water Agency	11	Florin County Water District	19	San Juan Water District	27	Sacramento Municipal Utility District
3	Nevada Irrigation District	12	Fruitridge Vista Water Company	20	Elk Grove Water District	28	Camp Far West Irrigation District
4	City of Lincoln	13	Rancho Murieta Community Service District	21	City of Sacramento	29	Sacramento County Water Agency
5	Natomas Central Mutual Water Company	14	Carmichael Water District	22	City of Folsom	30	Rio Linda Elverta Water District
6	Pleasant Grove Verona Mutual Water Distric	15	Sacramento International Airport	23	Orangevale Water Company	31	Amador Water Agency - Camanche #7
7	South Sutter Water District	16	Omochumne - Hartnell Water District	24	Citrus Heights Water District	32	California American Water Company
8	City of Galt						

Figure 1-2: Major Water Purveyors

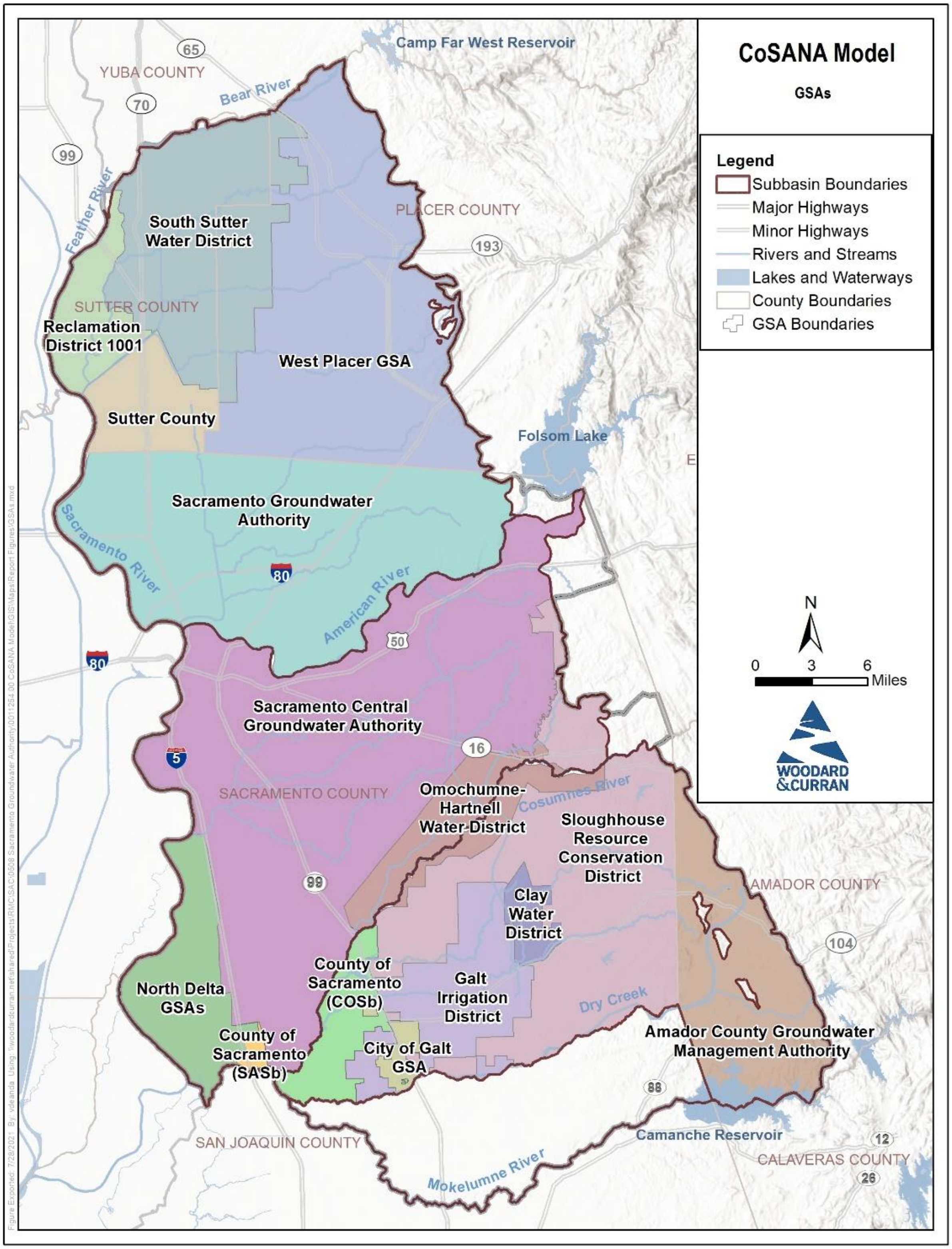


Figure 1-3: Groundwater Sustainability Agencies

1.3 Collaborative and Open Environment

Model development was conducted in a collaborative and open environment and was coordinated with various entities representing the three groundwater subbasins, including Sacramento Groundwater Authority (SGA), Sacramento Central Groundwater Authority (SCGA), Sacramento Area Flood Control Agency (SAFCA), Sacramento County, Regional Water Authority (RWA), the Sacramento Water Forum, the Cosumnes Subbasin SGMA Working Group (referred to as the "Working Group"), GSAs, and associated consultants.

The development of CoSANA took place in an open and transparent process and in a collaborative environment, with regular meetings between technical and working group members discussing model technical specifics and sharing model data, assumptions, data analysis and development, calibration approach and process, as well as interim and final results. The modeling team additionally met with local agencies individually to review model data and gather additional information to support refining model and data assumptions during model development.

Participation by representatives of regional water agencies and GSA representatives, including SGA, RWA, SCGA, SAFCA, Southeast Sacramento County Agricultural Water Authority (SSCAWA), the Sacramento Water Forum, and the Cosumnes Subbasin Working Group allowed for incorporation of information related to stakeholders within those organizations and associated subbasins. Further, progress was shared at meetings associated with development of GSPs for each of the three subbasins to gain additional input and information. These presentations provided details on the goals and progress of CoSANA development and also served as a method to request information and data from stakeholders.

In addition to coordination activities during development of the CoSANA model, the completed model was compared to models in the surrounding subbasins to assess consistency. The assessment focused primarily on subsurface flows, although other components, including stream seepage, were also reviewed. The assessment included meetings with modeling representatives from surrounding subbasins, including the Yolo, Yuba, and Solano Subbasins. Subsurface flows were found to be similar in magnitude, although in some cases in opposite directions. These differences were not considered substantial enough to impact the ability to use model results for management purposes within the GSP. This is due to the relatively small differences in comparison to other components of the groundwater budget and due to the calibrated nature of the models, where small differences in subsurface flows may be balanced out by similar differences in other calibrated components of the model. Coordination is expected to continue in the future, where information gained by recent modeling in the various subbasins can be incorporated into future refinements of CoSANA and the neighboring models to reduce the differences and improve model performance.

1.4 Model Platform and Historical Modeling of the Region

SacIWRM and predecessor models have been used to simulate and analyze the North American, South American, and Cosumnes Subbasins since 1992. The models have contributed to many regional and local studies, including supporting the Water Forum Agreement and implementation of groundwater management plans (Table 1-2). SacIWRM was developed based on the Integrated Groundwater and Surface Water Model (IGSM) code, developed in the early 1990s by DWR and the United States Bureau of Reclamation (Reclamation) to simulate Central Valley operations. SacIWRM underwent six major upgrades since first being developed, with the last major update to the northern portion of the model in 2007 and to the central portion in 2016. SacIWRM includes data from 1970 through 2011 and is still in active use for various projects.

CoSANA is developed by porting and refining the data from the older model SacIWRM into the newer DWR code that replaced IGSM in the early 2000s, called Integrated Water Flow Model (IWFM). IWFM is an open-source, finite element simulation code that supports triangular and quadrilateral elements (Dogrul et al., 2017a). It is specifically designated in the GSP regulations as being supported by DWR for water budget development within GSPs. It is also the code used for DWR's California Central Valley Groundwater-Surface Water Simulation Model (C2VSimFG), which supports SGMA activities throughout the Central Valley at the regional scale (Brush et al., 2013; DWR, 2020). The IWFM Demand Calculator (IDC) is the stand-alone root zone component of IWFM that simulates land surface and root zone flow processes (Dogrul et al., 2017b). It calculates agricultural and urban water demands using inputs including climate conditions, soil parameters, and land use types and distribution. It can be run separately or combined with IWFM. IDC was run combined with IWFM, and data development and results in this documentation are included as part of overall IWFM datasets and results.

The model area covers 888,548 acres and is bounded in the north by the Bear River, in the south by the Mokelumne River, in the west by the Sacramento River, and in the east by the Sierra Nevada foothills. The physical model boundaries are shown in Figure 1-1.

Table 1-2: SacIWRM History and Application

Year	Study
1992	City-wide Model
1993	County-wide Model
1996	American River Water Resources Investigation
1996	Northridge Conjunctive Use Study
1996	Rio Linda Water Supply Analysis
1996	Hydrology Update
1996	Water Forum- Basin Yield
1999	Sunrise Douglas Water Supply Analysis
1999	Zone 40 (North Vineyard Well Field)
2000	American River Basin Cooperating Agencies Studies
2002	Aerojet Surface Water Discharge Permit
2004	Zone 40 Water Supply Master Plan Update
2005	Natomas Central Mutual Water Company Impacts Assessment
2005	Rio Del Oro Impacts Study
2007	Sutter Measure M Impact Study
2007	Sun Creek Development
2008	Model Comprehensive Update
2009	SCGA Well Protection Program
2009	Cosumnes River Hydrologic Study
2010	RWA Water Accounting Framework
2011	The Nature Conservancy (TNC) Reservoir Re-Operation Study
2012	South County Recycled Water Feasibility Study
2012	TNC Conjunctive Use Study
2012	TNC/California Water Foundation Central Valley Hydrologic Study
2014	TNC Groundwater Banking Feasibility
2015	SCGA Biennial Groundwater Management Plan Report
2016	Sacramento Regional County Sanitation District Climate Change Assessment & Environmental Impact Report Support
2017	Harvest Water, Water Storage Investment Program, City of Sacramento Groundwater Master Plan
2018	Dynamic linkage with the Yolo IGSM
2020	Grandpark Specific Plan Development

1.5 Report Organization

The remainder of this report is organized as follows:

- Chapter 1 is this introductory chapter.
- Chapter 2 describes the historical model development, including the design of the model grid, layering, and input data for the root zone, groundwater, surface water, and land surface modules.
- Chapter 3 describes model input data for water supply and demand. Assumptions associated with agricultural and urban water use are described in this chapter.
- Chapter 4 describes the methodology used for the calibration of model parameters. Final parameters used in the model are provided along with model results and comparisons to observed data. This chapter also includes a sensitivity analysis of model results with perturbed input parameters.
- Chapter 5 describes the baseline conditions. The Current Conditions Baseline (including the input data for water supply and demand and the model results), Projected Conditions Baseline (including the land use, water supply and demand data used and the model results), and Projected Conditions with Climate Change Baseline (including the hydrologic data used and the model results) are described in this chapter.
- Chapter 6 presents a summary of the report and provides recommendations for future activities.
- Chapter 7 presents a list of references used in this report.

2. MODEL DEVELOPMENT

This section presents the source and analysis of input data used in the development of CoSANA. This includes spatial and temporal information for hydrologic, hydrogeologic, water use, water supply, and operations data sets included in the model, as well as physical settings, parameters, and assumptions.

2.1 Model Input Data

IWFM model files and corresponding major data sources used in the development of CoSANA are presented in Table 2-1 along with the report sections where the model data and data sources are described.

Table 2-1: CoSANA Input Data

Major Data Category	Minor Data Category	Data Source	Report Section
Hydrogeological Data	Geologic Stratification	Local information	2.10
	Aquifer Parameters	USGS texture model	4.5.3
Stream Data	Stream Configuration	C2VSim SVSim SacIWRM Local information	2.4
	Stream Inflow	USGS & CDEC stream gages Local information	2.4
	Calibration Gages	USGS & CDEC stream gages	4.2.3
Hydrological Data	Precipitation	PRISM & CalSIMETAW	2.6
Agricultural Water Demand	Land Use	DWR county surveys CropScape DWR statewide mapping Local information	2.7
	Evapotranspiration	C2VSim METRIC Local information	2.8
	Soil Properties	SSURGO STATSGO2	2.9
Urban Water Demand	Population	U.S. Census Bureau tract data	3.3.1
	Per Capita Water Use	Local information California Water Plan	3.2
Water Supply	Groundwater Pumping	Local information SacIWRM	3.1.2
	Surface Water Deliveries	Local information SacIWRM	3.1.1
Other	Boundary Conditions	C2VSim Local information	2.12
	Initial Conditions	Water Data Library	2.13
	Small Watersheds	C2VSim	2.11
	Calibration Wells	DWR Local information	4.2.2

Abbreviations: C2VSim: California Central Valley Groundwater-Surface Water Simulation Model; CalSIMETAW: California Simulation of Evapotranspiration of Applied Water; CDEC: California Data Exchange Center; DWR: California Department of Water Resources; METRIC: Mapping Evapotranspiration at High Resolution with Internalized Calibration; SacIWRM: Sacramento Integrated Water Resources Mode; PRISM: Precipitation-Elevation Regressions on Independent Slopes Model; SSURGO: Soil Survey Geographic Database; STATSGO2:Digital General Soil Map of the United States; SVSim: Sacramento Valley Groundwater-Surface Water Simulation Model; USGS: United States Geological Survey

2.2 Simulation Period and Temporal Discretization

The CoSANA model simulates the historical conditions in the basin for the period of water years (WY) 1970 through 2018 (October 1, 1969 through September 30, 2018). Monthly data was used as model input, and the model simulation uses a monthly time step. Model output can be reported on a monthly or annual time increment, as needed.

Model data development efforts were divided into two periods, as follows:

- WY 1970-1989 – The data for this period is primarily mapped over from SacIWRM. As such, CoSANA inherits the spatial and temporal resolution of SacIWRM. As much of the source data for land use, water use, and water supply are not readily available in digital form, the mapped data from SacIWRM was used without substantial refinement. However, the hydrologic data sets, including rainfall and streamflows, are refined based on the latest sources of data.
- WY 1990-2018 – The data for this period is much more refined, as digital source data are used in development of the model input data. Additionally, the groundwater level and streamflow observation data are available in a more consistent quality and format. Therefore, this period is used for the WY 1995-2018 model calibration period, plus a WY 1990-1994 warm up period. Further discussion on calibration period selection is provided in the model calibration section of the report.

Beyond the two time periods, the entirely of the WY 1970-2018 period is used for verification of consistency of model simulation, long-term water budgets, long-term trends in groundwater levels and stream-aquifer interaction, and long-term trends in the groundwater storage changes. WY 2019 is added to the baselines to achieve 50 years of hydrology as required by SGMA (see Section 5).

2.3 Model Grid and Subregions

A model grid provides a discrete geographic representation of the physical, hydrologic, hydrogeologic, jurisdictional, land use, water use, and water supply features at a small enough size to support the basis for robust mathematical representation of the features and the inter-relationship between various components of the system.

A grid network was developed for the CoSANA model, based on principles of finite element numerical analysis, to reflect hydrological, hydrogeological, physical, jurisdictional, and operational conditions in the groundwater subbasins represented in CoSANA. The finite element grid for CoSANA was developed using Aquaveo's GMS-Groundwater Modeling System software with spatial processing using Esri's ArcGIS. The grid includes quadrilateral and triangular elements based on selected input lines and control points. Features included in the development of the model grid are shown in Figure 2-1 and include:

- Streams
- GSA boundaries
- Water purveyor boundaries
- County boundaries
- Areas of groundwater contamination
- Geological features
- Model grids in neighboring subbasins

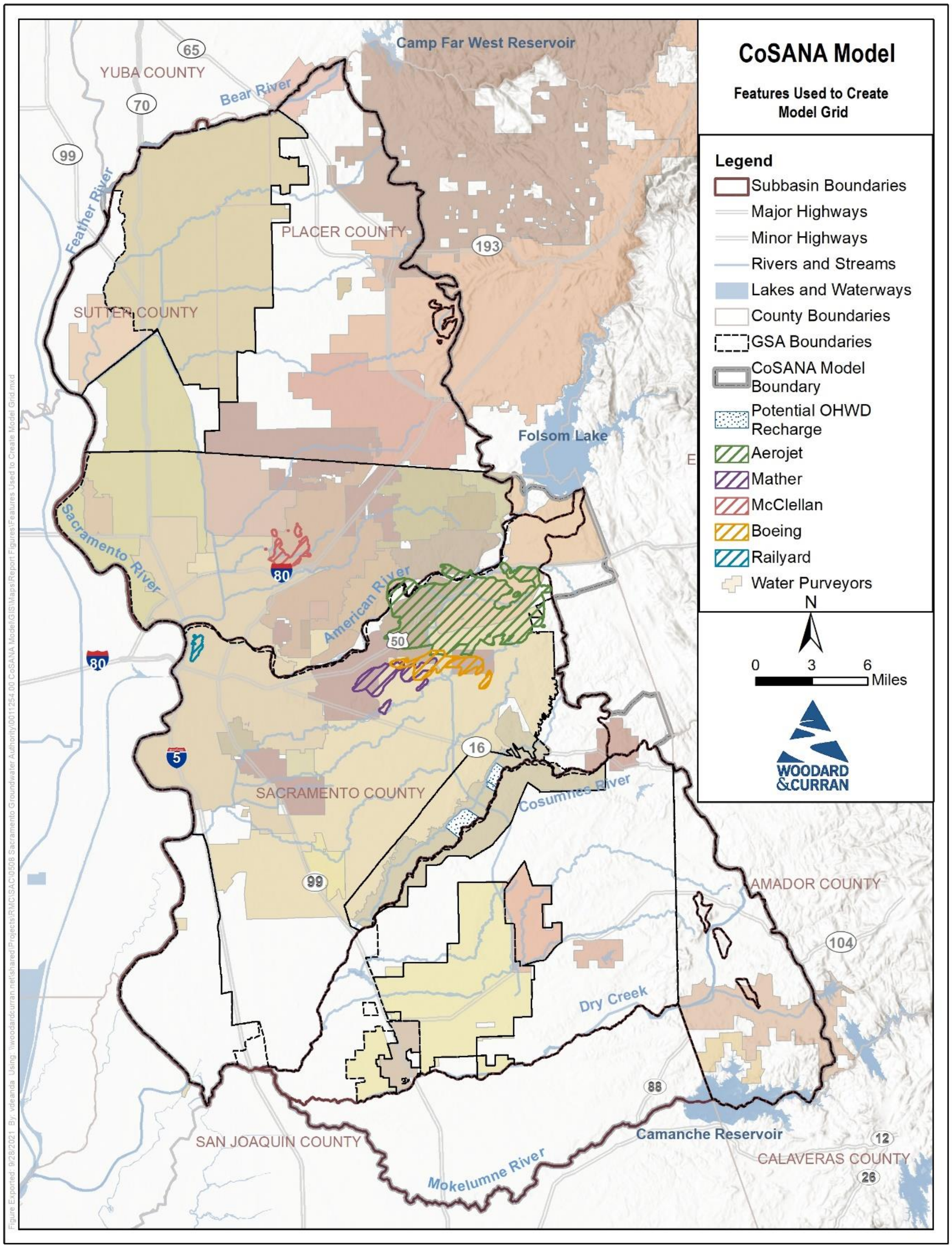


Figure 2-1: Features Used to Create Model Grid

The CoSANA model grid contains 24,171 elements and 22,274 nodes with an average element area of 37 acres (Figure 2-2). The node discretization interval for most features was set at 2,000 feet with more refined spacing in specific areas, such as near streams (described below) and areas of significant groundwater contamination (1,000 feet spacing for the Mather, Aerojet, and McClellan areas). The overall node spacing was 1,170 feet on average with a maximum of 2,210 feet and a minimum of 300 feet.

Streams in the model domain were separated into three tiers, described further in Section 2.4. The first two tiers are simulated in the model. Tier 3 streams are minor streams that are included in the model grid for drainage routes but are not directly modeled in CoSANA.

Border model nodes were aligned with the model grids for the Yuba Groundwater Model (YGM), which is directly adjacent and also uses the IWFM platform, to improve the potential for future direct interaction with this model (Figure 2-3). Node spacing along other boundaries for other neighboring models, including the Yolo and Eastern San Joaquin models were used as guidelines, however, CoSANA provides smaller node spacing along these boundaries compared to the neighboring models. There was no direct coordination on node spacing along the boundaries bordering the Solano or Sutter Subbasins.

The southern boundary of CoSANA is the Mokelumne River, which provides coverage for the Cosumnes Subbasin and a portion of the Eastern San Joaquin Subbasin, as well as a hydrologic boundary. The Cosumnes Subbasin is covered by both CoSANA and the Eastern San Joaquin Subbasin model (Eastern San Joaquin Water Resources Model). Generally, the CoSANA model has limited focus on the Eastern San Joaquin Subbasin, and the Eastern San Joaquin model has limited focus on the Cosumnes Subbasin. The CoSANA node spacing is refined along the Mokelumne River and the data and information in CoSANA's representation of the Cosumnes Subbasin is refined by the Cosumnes Subbasin GSAs and consultants. The Cosumnes Subbasin GSAs used CoSANA in development of their GSP.

The model elements are grouped into 87 model subregions (Figure 2-4) that are used to organize input data and to report standard model water budget output. Subregions were delineated using boundaries of cities, water agencies, GSAs, subbasins, and counties. A listing of model subregions, including the associated subbasin and the number of model elements they contain, is provided in Table 2-2.

Table 2-2: CoSANA Subregions

Subregion Number	Subregion Name	Groundwater Subbasin	Number of Elements
1	Camp Far West ID	North American	142
2	Sutter Co. 1	North American	12
3	South Sutter WD GSA	North American	1296
4	Placer County WA	North American	997
5	Nevada ID	North American	161
6	Lincoln	North American	235
7	RD1001	North American	359
8	Pleasant Grove Verona MWC	North American	162
9	Sutter Co. 2	North American	60
10	Natomas MWC (Sutter Co.)	North American	252
11	Sutter Co. 3	North American	76
12	Roseville SOI	North American	42
13	City of Roseville	North American	478
14	Cal Am (West Placer)	North American	166
15	Natomas MWC (Sacramento Co.)	North American	423

Subregion Number	Subregion Name	Groundwater Subbasin	Number of Elements
16	Sacramento International Airport	North American	48
17	Metro Air Park	North American	26
18	Sac Co. 1	North American	63
19	Sac Co. 2	North American	27
20	Sac County WA (Northgate 880)	North American	13
21	Rio Linda Elverta	North American	221
22	Sac Co. 3	North American	16
23	Cal Am (Antelope)	North American	55
24	Cal Am (Lincoln Oaks)	North American	92
25	Citrus Heights WD	North American	171
26	San Juan WD (Placer Co.)	North American	29
27	San Juan WD (Sacramento Co.)	North American	88
28	Orange Vale WC	North American	73
29	Lake Natoma/Mississippi Bar	North American	116
30	Fair Oaks WD	North American	354
31	Carmichael WD	North American	297
32	Sacramento Suburban WD (North)	North American	471
33	Sacramento Suburban WD (South)	North American	293
34	Del Paso Manor WD	North American	18
35	Golden State WC Arden	North American	21
36	Cal Am (Arden)	North American	27
37	Sac County WA (Arden Park Vista)	North American	76
38	City of Sacramento (North)	North American	777
39	City of Sacramento (South)	South American	1212
40	Cal Am (Suburban Rosemont)	South American	410
41	Sac Co. 4	South American	33
42	Golden State WC (Cordova)	South American	548
43	Sac Co. 5	South American	111
44	City of Folsom	South American (partial)	869
45	Cal Am (Security Park)	South American	76
46	Fruitridge Vista WC	South American	46
47	Florin County WD	South American	31
48	Cal Am (Parkway)	South American	98
49	Sac Co. 6	South American	104
50	Sac County WA (North/Central)	South American	1451
51	Sac County WA (South)	South American	240
52	Elk Grove WD (Service Area 2 - Intertie)	South American	97
53	Elk Grove WD (Service Area 1 - GW)	South American	62
54	Cosumnes River West	South American	734
55	RD744	South American	76
56	Franklin Drainage District	South American	197

Subregion Number	Subregion Name	Groundwater Subbasin	Number of Elements
57	RD813	South American	70
58	RD755	South American	22
59	RD1002	South American	94
60	RD551	South American	272
61	RD369	South American	36
62	RD2110	South American	88
63	Sac Co. 7	South American	54
64	Rancho Murieta (North)	South American (partial)	244
65	Sloughhouse RCD (North)	South American	422
66	OHWD (South American Subbasin)	South American	990
67	OHWD (Cosumnes Subbasin)	Cosumnes	601
68	Rancho Murieta (South)	Cosumnes	87
69	Sloughhouse RCD (East)	Cosumnes	1219
70	Wilton	Cosumnes	255
71	Sloughhouse RCD (West)	Cosumnes	254
72	Galt ID (East)	Cosumnes	615
73	Clay WD	Cosumnes	125
74	Clay	Cosumnes	67
75	SMUD Rancho Seco	Cosumnes	50
76	Cosumnes River South	Cosumnes	308
77	Galt ID (West)	Cosumnes	78
78	Sac Co. 8	Cosumnes	408
79	City of Galt	Cosumnes	86
80	Sloughhouse RCD (South)	Cosumnes	35
81	Amador Co. 1	Cosumnes	443
82	Ione	Cosumnes	44
83	Jackson ID	Cosumnes	213
84	Camanche	Cosumnes	355
85	Amador County WA	Cosumnes	57
86	Mokelumne	Eastern San Joaquin	1944
87	City of Galt WWTP	Cosumnes	7

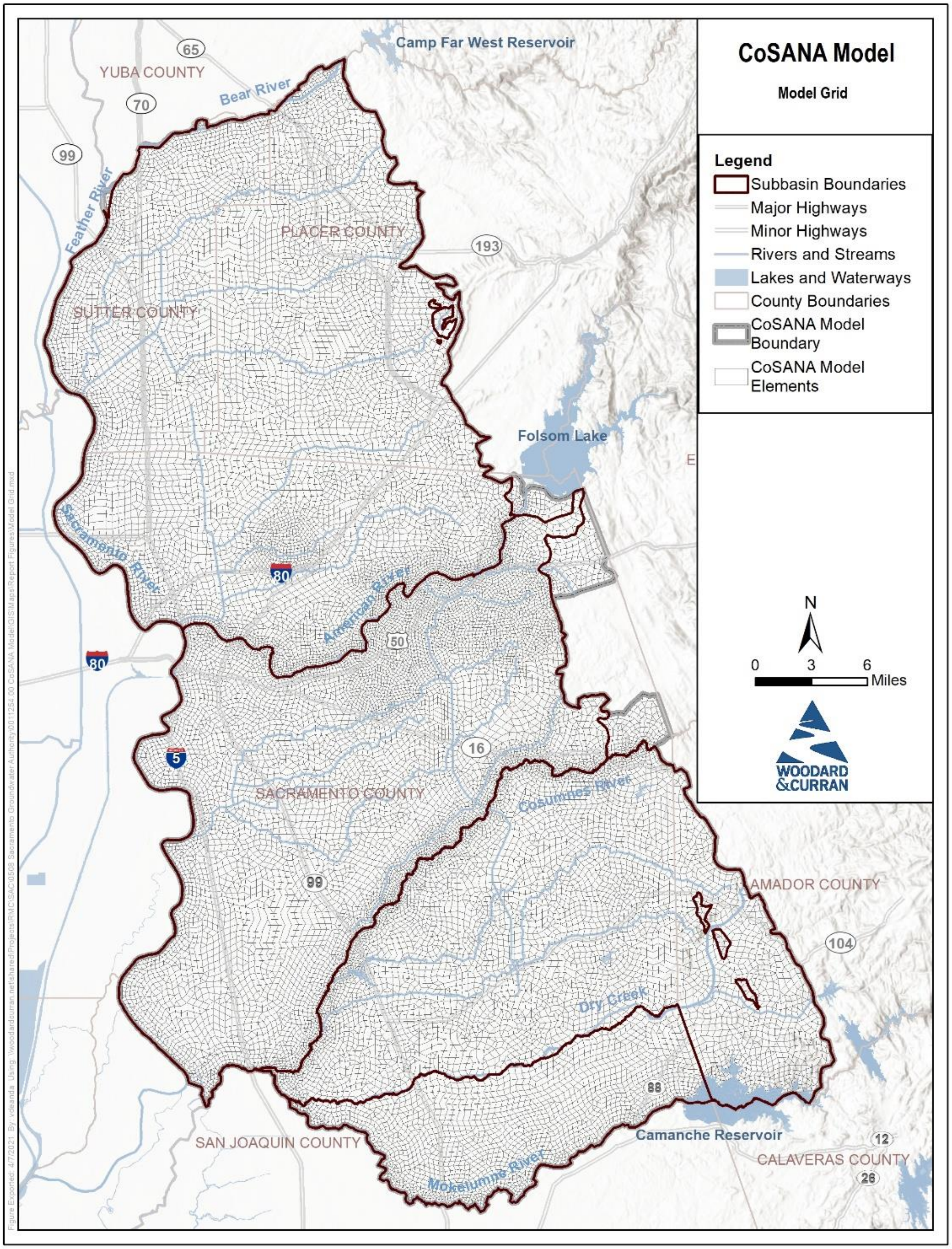


Figure 2-2: CoSANA Model Grid

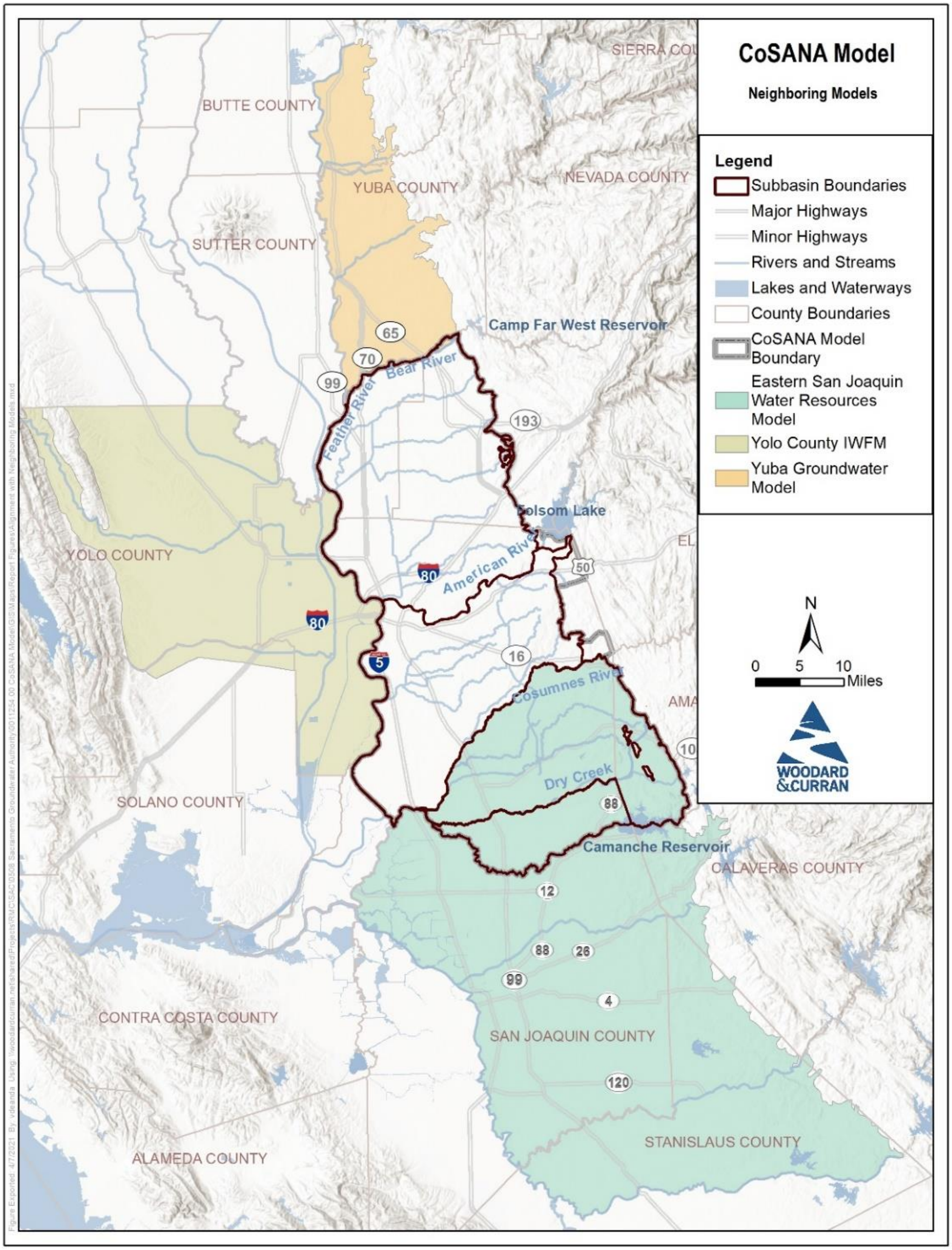


Figure 2-3: Alignment with Neighboring Model Grids

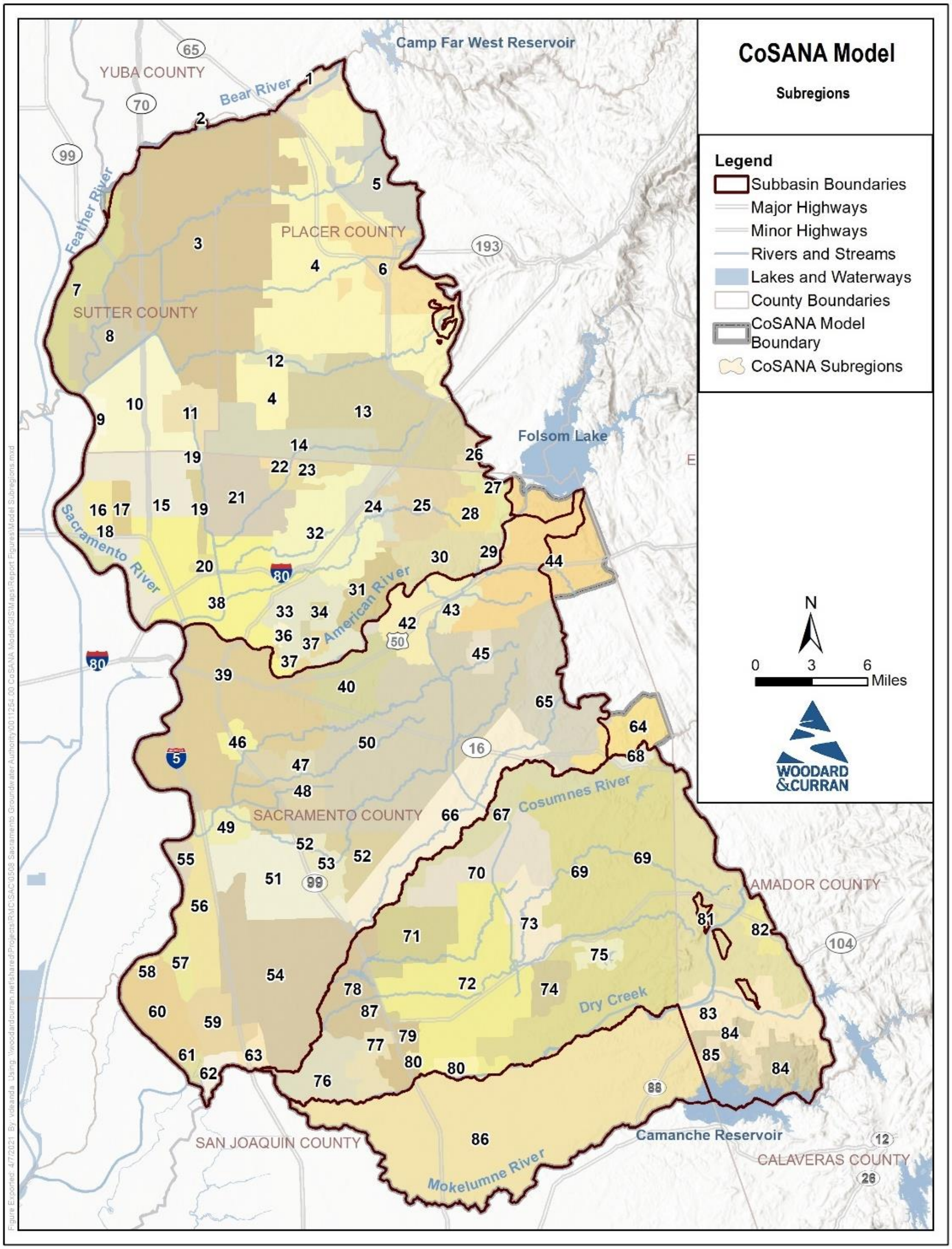


Figure 2-4: CoSANA Subregions

2.4 Stream Configuration and Inflow

Model hydrology is represented by 51 modeled stream reaches representing 27 streams, rivers, and canals, which are largely defined to start and/or end at confluences. Streams in the model domain are separated into three tiers, as shown in Table 2-3 and Figure 2-5. The discretization interval for stream node spacing and buffers included around the streams to transition from the finer to coarser node spacing vary based on the tier, as follows:

- Tier 1 includes major streams and were discretized to 750 feet (Cosumnes and American Rivers) or 1,000 feet (Sacramento, Feather, Bear, and Mokelumne Rivers). The fine level of discretization allows for better representation of surface water-groundwater interaction. A buffer, the distance within which the finer discretization is applied, of 5,280 feet (1 mile) was applied.
- Tier 2 represents important streams with standard feature discretization intervals (largely 2,000 feet). Exceptions included Deer Creek with discretization of 1,250 feet and a 2,640 feet (0.5 mile) buffer and Folsom South Canal with discretization of 1,500 feet and a 5,280 feet (1 mile) buffer.
- Tier 3 includes minor streams and drainages, and were not simulated as streams, but included for drainage routes (discussed further in section 2.5). Discretization for these streams was standard (largely 2,000 feet). While these hydrologic features represent drainage and conveyance water courses in the model, they are not directly used as simulated streams in the model due to lack of sufficient information such as channel geometry and streamflow records.

The streams and creeks are represented in the model by 2,388 stream nodes. The number of stream nodes and their refined resolution provide an increased level of accuracy when depicting stream-groundwater interaction. Physical channel characteristics, including the stream invert elevation, channel width, and stream flow rating tables, were obtained from the closest C2VSimFG stream nodes, SacIWRM, and United States Geological Survey (USGS) digital elevation models (DEM).

Time series of stream inflow data is available from 7 USGS gaging stations, additionally several tier 2 streams in the NASb use inflows developed by MBK Engineers or model derived flows from C2VSimFG or YGM. Table 2-4 presents stream input data and Figure 2-6 shows available stream gage locations.

Table 2-3: CoSANA Streams and Tiers

Stream	Groundwater Subbasin	Stream Tier
American River	North American	1
Arcade Creek	North American	2
Auburn Ravine	North American	2
Bear River	North American	1
Cross Canal	North American	2
Curry Creek	North American	3
Dry Creek	North American	2
East Side Canal	North American	2
Feather River	North American	1
Magpie Creek	North American	2
Natomas East Drain	North American	2
Ping Slough	North American	3
Pleasant Grove Creek	North American	2
Racoon Creek	North American	2
Sacramento River	North American	1
South Branch Pleasant Grove Creek	North American	3
Alder Creek	South American	2
American River	South American	1
Beacon Creek	South American	2
Buffalo Creek	South American	2
Cosumnes River	South American	1
Deer Creek	South American	2
Elder Creek	South American	2
Folsom South Canal	South American	2
Laguna Creek	South American	2
Morrison Creek	South American	2
Sacramento River	South American	1
Arkansas Creek	Cosumnes	3
Badger Creek	Cosumnes	2
Brown's Creek	Cosumnes	3
Cosumnes River	Cosumnes	1
Deadman Gulch	Cosumnes	3
Dry Creek	Cosumnes	2
Folsom South Canal	Cosumnes	2
Griffith Creek	Cosumnes	3
Hadselville Creek	Cosumnes	2
Jackson Creek	Cosumnes	2
Laguna Creek	Cosumnes	2
Mokelumne River	Cosumnes	1
North Fork Badger Creek	Cosumnes	3
Rolling Draw	Cosumnes	3
Skunk Creek	Cosumnes	3
Sutter Creek	Cosumnes	3
Willow Creek	Cosumnes	3
Windmill Draw	Cosumnes	3

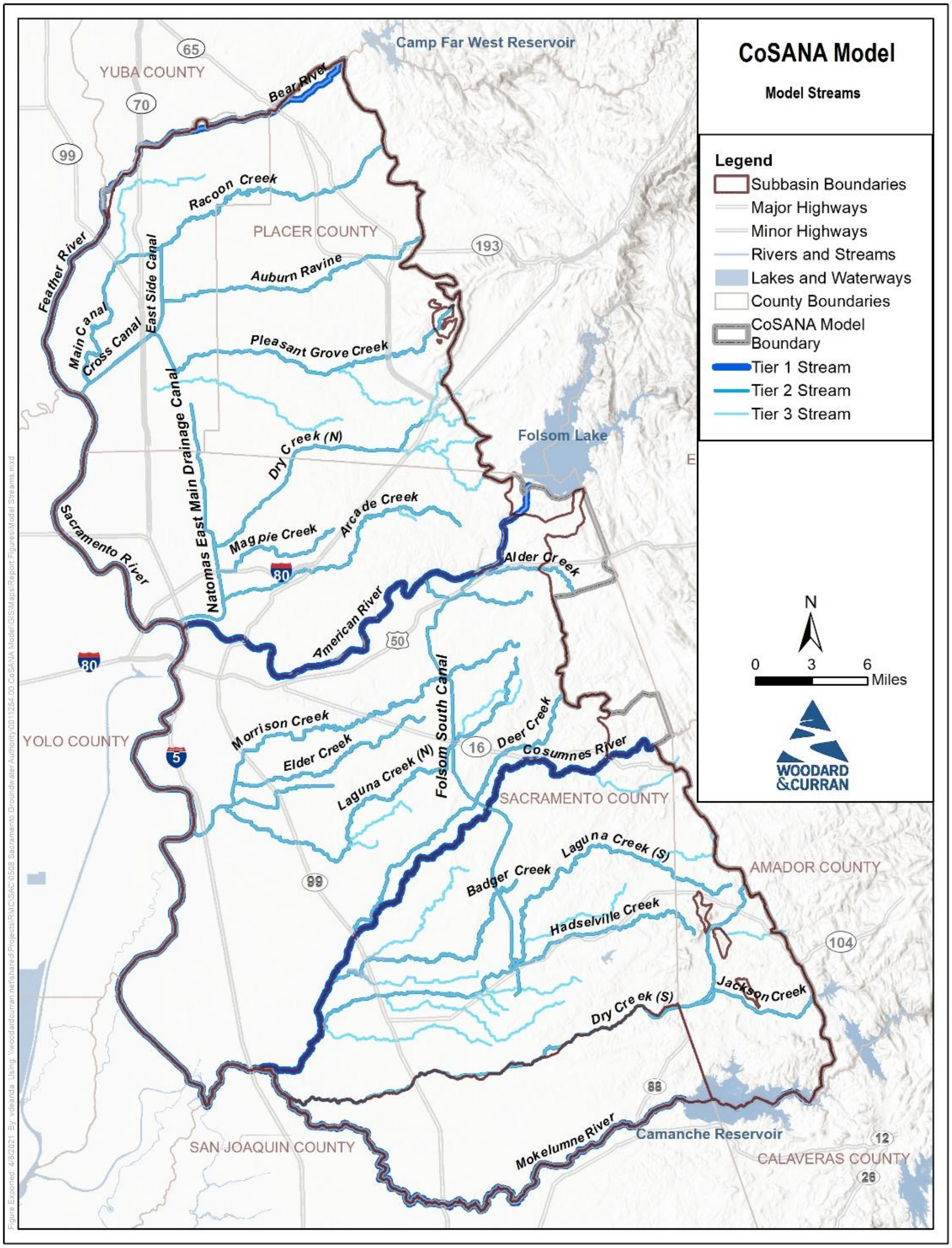


Figure 2-5: CoSANA Streams

Table 2-4: Stream Inflows

Stream	Stream Node	Source	Gage Name	Period of Record (WY)	Average Annual Streamflow (acre-feet)
Sacramento River	155	USGS	Sacramento River near Verona (USGS Gage 11425500)	1929 - 2021	14,461,848
American River	734	USGS	American River at Fair Oaks (USGS Gage 11446500)	1904 - 2021	2,745,469
Cosumnes River	1490	USGS	Cosumnes River at Michigan Bar (USGS Gage 11335000)	1907 - 2021	396,807
Mokelumne River	2080	USGS	Mokelumne River below Camanche Dam (USGS Gage 11323500)	1905 - 2020	568,754
Bear River	1	USGS	Bear River near Wheatland (USGS Gage 11424000)	1928 - 2021	325,546
Raccoon Creek	158	MBK Engineers	Raccoon Creek	1976 - 2018	28,848
Auburn Ravine	248	MBK Engineers	Auburn Ravine	1976 - 2018	19,353
Pleasant Grove Creek	301	MBK Engineers	Pleasant Grove Creek	1976 - 2018	28,827
Dry Creek[1]	502	MBK Engineers	Dry Creek (North American Subbasin)	1976 - 2018	35,944
Feather River	86	YGM	Feather River	1987 - 2015	5,314,464
Dry Creek[1]	1911	C2VSimFG	Dry Creek (Cosumnes Subbasin)	1970 - 2015	30,020
Jackson Creek	1936	JVID	Jackson Creek below Lake Amador Dam	1980 – 2009, 2017 – 2019	7,198
Morrison Creek	1024	USGS	Morrison Cr near Sacramento	1997 - 2017	15,158
Laguna Creek (SASb)	1169	USGS	Laguna Cr. near Elk Grove	1995 - 2018	8,336

C2VSimFG = California Central Valley Groundwater-Surface Water Simulation Fine Grid Model
JVID = Jackson Valley Irrigation District
USGS = United States Geological Survey
YGM = Yuba Groundwater Model
[1] There are two distinct streams named "Dry Creek" within the model domain: one in the North American Subbasin, and one in the Cosumnes Subbasin

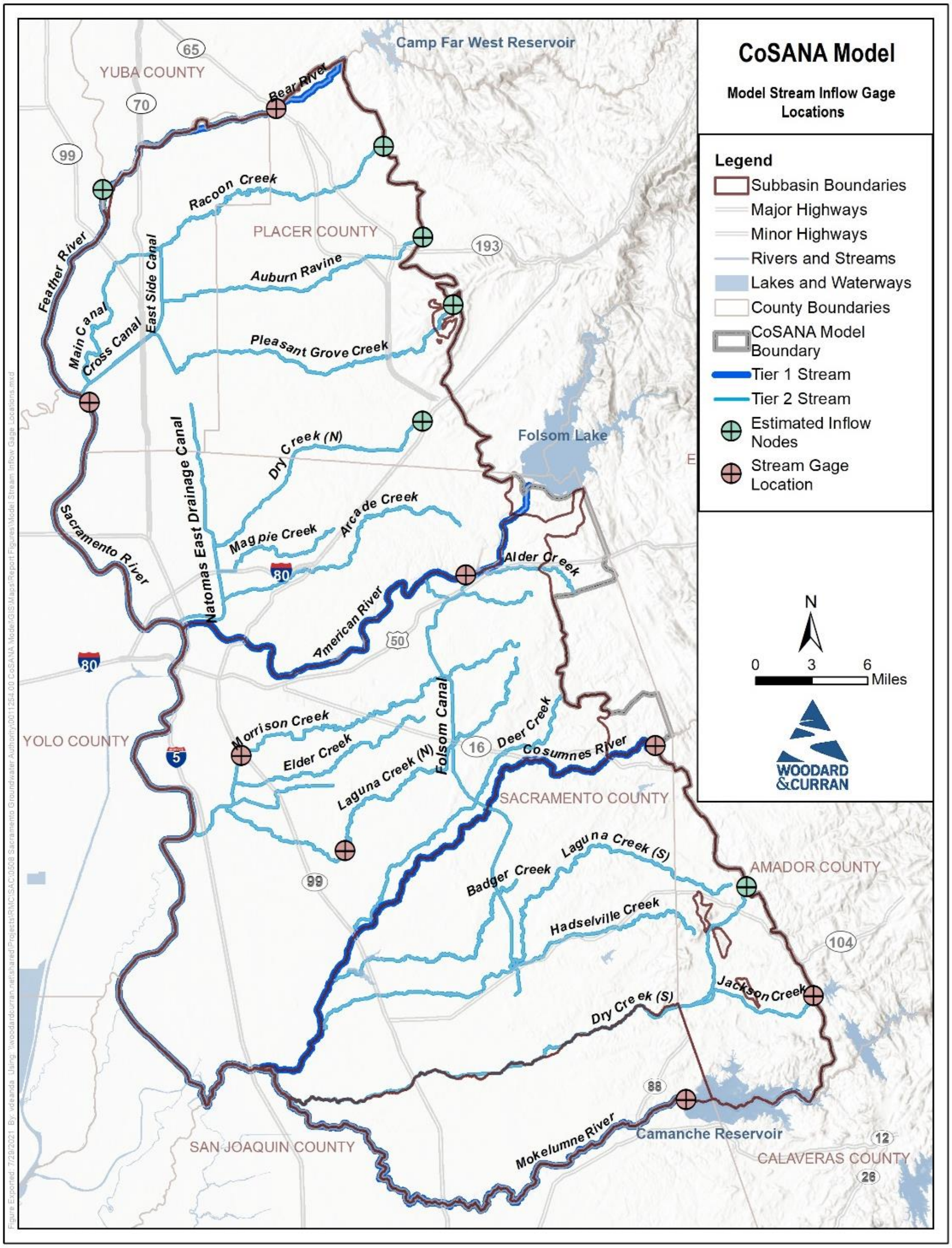


Figure 2-6: CoSANA Stream Inflow Gage Locations

2.5 Surface Drainage Pattern

Surface water drainage (e.g., runoff from rainfall and excess applied water) for each model element is assigned to a stream node representing where the drainage ultimately flows to. These drainage patterns were delineated using the USGS Watershed Boundary Dataset for 12-digit hydrologic units, also called subwatersheds. Each 12-digit hydrologic unit located within the model boundaries was associated with the model stream node it ultimately drained into through both visual analysis as well as information provided on the subwatersheds. Elements falling within the hydrologic units were assigned to the model stream node indicating the ultimate surface water drainage direction. Additional refinement was done along the Cosumnes River to simulate where agricultural return flow would return to the stream with more precision. A total of 62 unique stream nodes receive surface water drainage in CoSANA from 58 subwatersheds. Figure 2-7 shows these stream nodes and the subwatersheds mapped to the model elements.

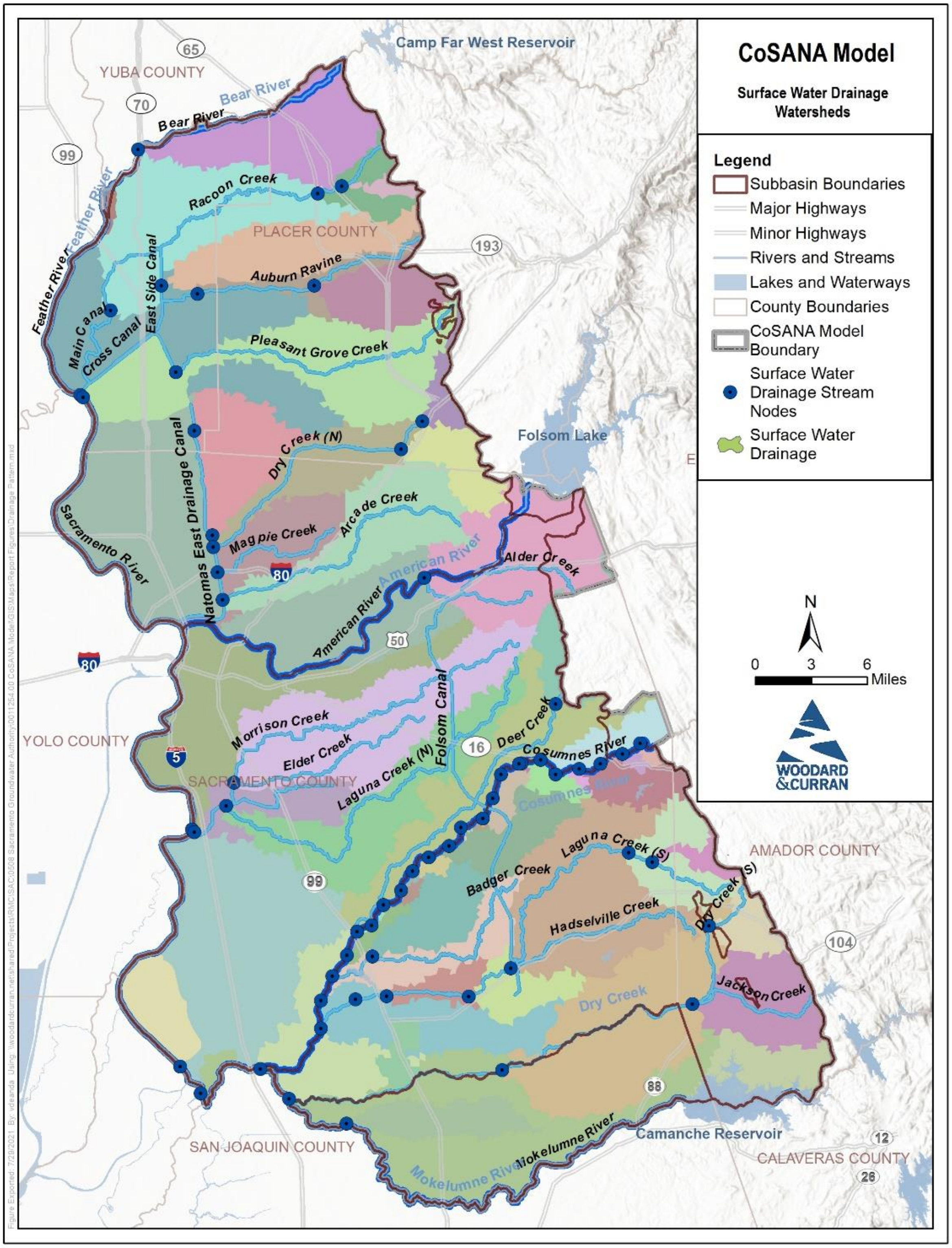


Figure 2-7: CoSANA Drainage Network

2.6 Precipitation

Rainfall data for the model area was derived from the PRISM (Precipitation-Elevation Regressions on Independent Slopes Model) database used in the DWR's CALSIMETAW (California Simulation of Evapotranspiration of Applied Water) model. The database contains daily precipitation data from October 1, 1921, to September 30, 2018, on an 800-meter grid throughout the model area. CoSANA has monthly rainfall data defined for every model element in order to preserve the spatial distribution of the monthly rainfall. Each of the model elements was mapped to the nearest PRISM reference node and the resulting average annual precipitation is shown in Figure 2-8.

Figure 2-9 shows the annual rainfall in the model area and the cumulative departure from mean, which is an indication of long-term rainfall trends in the area. For the 1995-2018 calibration period, the minimum precipitation was in 2007 with 11.0 inches, while the maximum occurred in 1998 with 34.4 inches, the average annual precipitation over this period was 20.1 inches. Based on the Sacramento Valley Water Year Index, there were 3 critical, 5 dry, 5 below normal, 3 above normal, and 8 wet years.

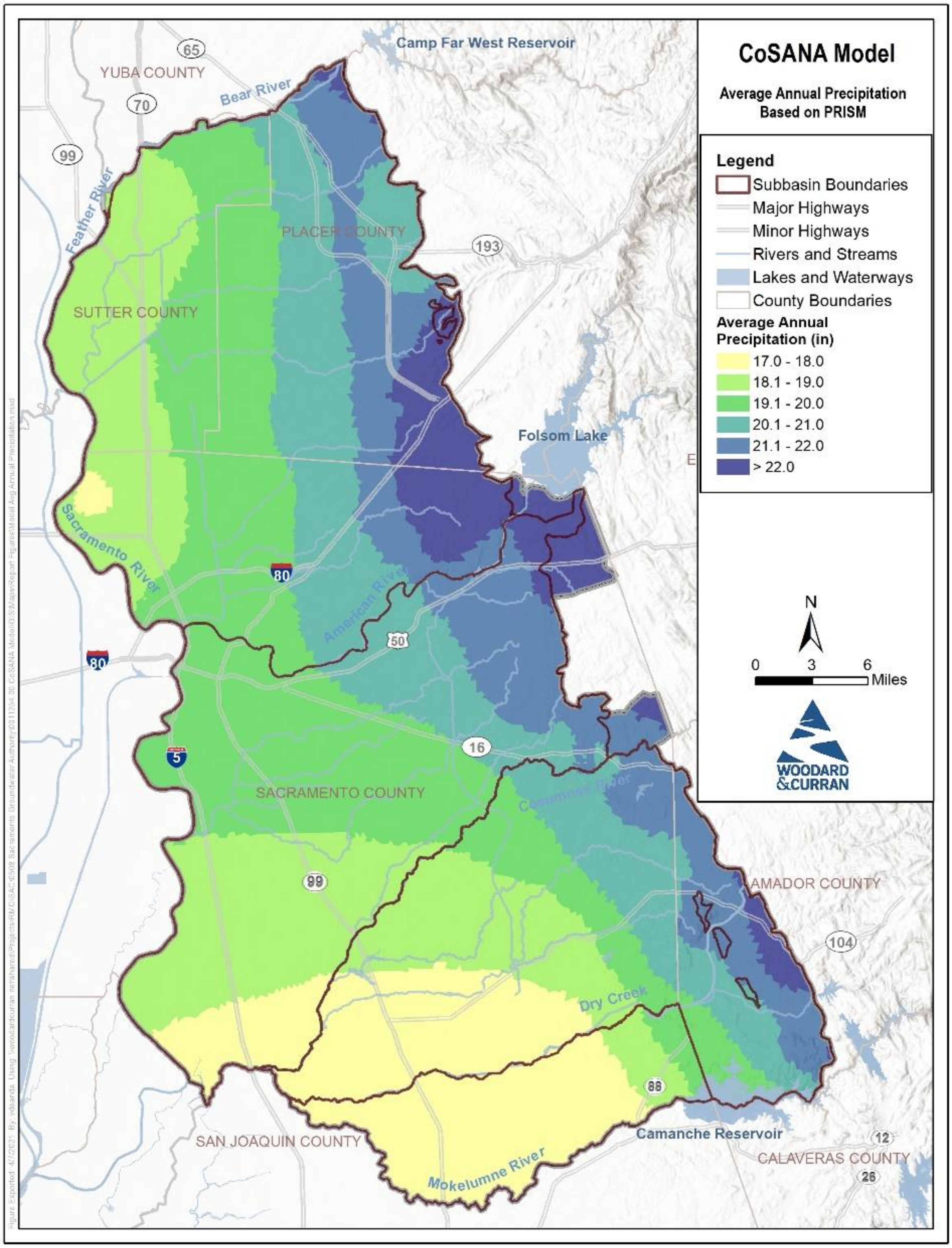


Figure 2-8: CoSANA Average Annual Precipitation

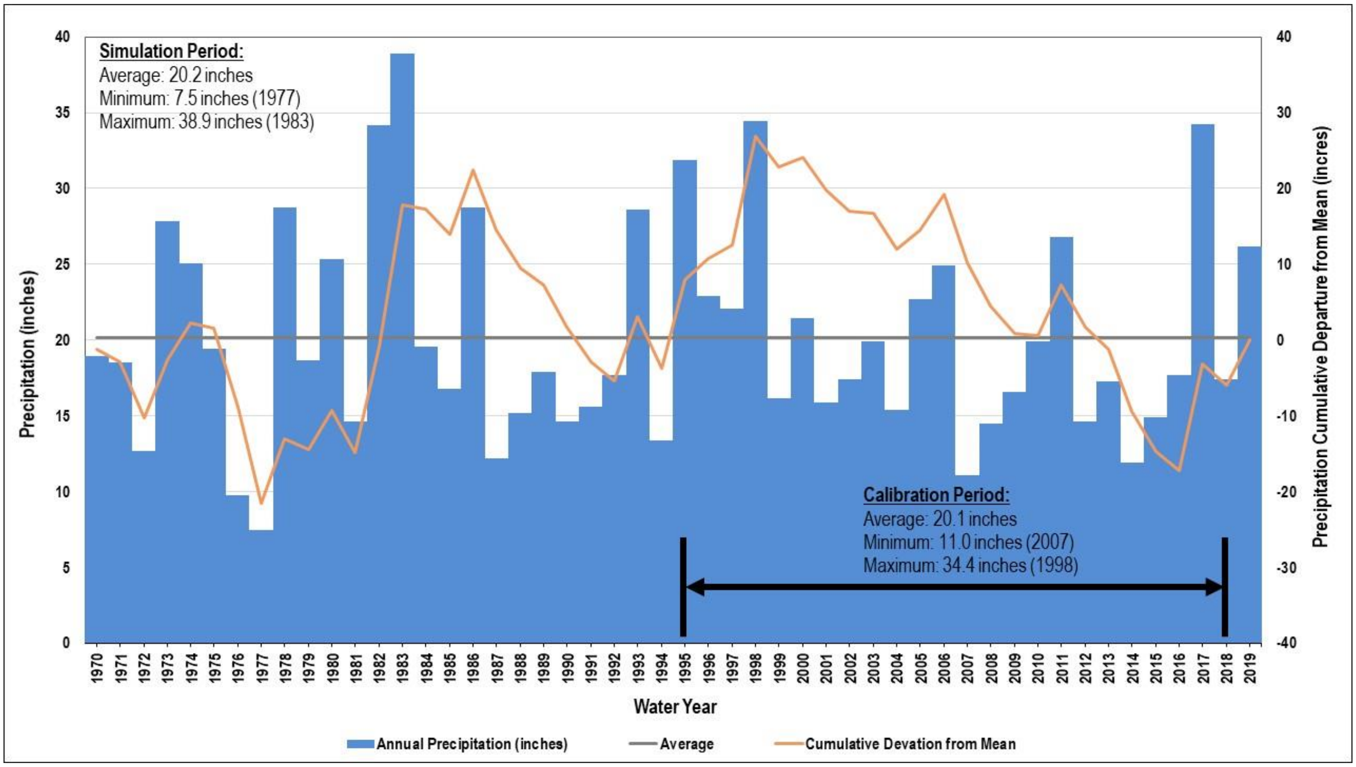


Figure 2-9: CoSANA Average Annual Precipitation with Statistics

2.7 Land Use and Cropping Patterns

Land use and cropping patterns are major data sets that drive the estimation of water demand for agricultural water use as well as rainfall runoff and deep percolation conditions throughout the model area. Land use surveys were used to map the agricultural crops into 4 general land use types and 20 irrigated crop categories, consistent with C2VSimFG, and as shown in Table 2-5. The digital land use surveys were mapped to each of the model elements, so as each model element contains all information to estimate the agricultural, native, and riparian water demand on a monthly time step. All irrigated crop categories except for rice are simulated as non-ponded crops, meaning they are grown without standing water. Rice is simulated as both no decomposition and flooded decomposition to represent the current understanding of local rice growing practices. Assumptions of rice decomposition practices were based on local information and estimated as proportion of rice acreage each year that underwent no decomposition or flooded decomposition. This information aligns with rice practices simulated in other models, including the Yuba Groundwater Model and C2VSimFG. Table 2-5 lists the land use categories. The crop categories are nearly identical to those in C2VSimFG, the only difference being CoSANA has one category of tomatoes, whereas C2VSimFG has two.

Table 2-5: Land Use Categories

Land Use Type	Model Category
Irrigated Crops	Grain
	Cotton
	Sugar Beets
	Corn
	Dry Beans
	Safflower
	Other Field Crops
	Alfalfa
	Pasture
	Tomato
	Cucurbits
	Onions & Garlic
	Potatoes
	Other Truck Crops
	Almonds & Pistachios
	Other Deciduous
	Citrus & Subtropical
	Vineyards
	Idle
	Rice
Other Land Use	Urban Landscape Water Surface Riparian Vegetation Native Vegetation

Spatial land use data were used to specify land use types and crop acreages for each model element for each year. The three major reference sources include DWR county land use surveys, DWR Statewide Crop Mapping, and CropScape. As crop categories were not consistent across all the land use data sources, individual mappings matched up each crop type to the appropriate model land use category. These data were available for different years for different counties. To approximate the land use across the entire model area, digital land use coverages were created from multiple datasets covering different years. These three snapshot years of land use coverage are assumed to represent conditions for 1995, 2005, and 2015 using data from a year close to that snapshot year (see Table 2-6). Linear interpolation was used represent land use for years between snapshot years. As no land use data for 2005 was available for Amador and San Joaquin Counties, land use in elements in those areas was linearly interpolated between 1995 and 2015.

Table 2-6: Sources of Data for Land Use Coverages

Data Source	Coverage Area	Year
1995 Land Use Coverage		
DWR Land Use Survey	Sutter County	1998
DWR Land Use Survey	Placer County	1994
DWR Land Use Survey	Sacramento County	1993
DWR Land Use Survey	San Joaquin County	1996
DWR Land Use Survey	Amador County	1997
2005 Land Use Coverage		
DWR Land Use Survey	Sutter County	2004
Local Information	Placer County	2009
DWR Land Use Survey	Sacramento County	2000
2015 Land Use Coverage		
DWR Statewide Crop Mapping	Sutter and Placer Counties (except for urban in Placer County)	2014
CropScape	Urban extent for Roseville-Lincoln	2015
DWR Land Use Survey	Sacramento County	2015
DWR Statewide Crop Mapping	San Joaquin and Amador Counties	2014

Land use development methodologies differed between DWR county land use surveys and DWR statewide crop mapping for 2014. Because the 2014 survey focused only on irrigated and urban areas, areas such as roads or strips between fields or buildings were assumed to be undeveloped or unirrigated land. This created issues in interpolation where longstanding rice fields would be shown as growing smaller and developed urban footprints were decreasing in acreage. In order to preserve the accuracy and refinement of the 2014 dataset, a reduction of 5% was applied to land use acreages developed from DWR county surveys assumed to represent 1995 and 2005. This 5% was estimated based on analysis of differences in estimated crop acreages for parcels known to be cultivated in both 1995 and 2015. Additionally, interpolation in dense urban areas was adjusted to have urban acreage remain the same or increase over time, to avoid erroneous reductions in urban land due to survey methodologies. Further refinement was also performed in the Elk Grove area to more accurately capture the timing of some of the large-scale agricultural-to-urban land use conversions in that area.

Refinement was also performed to capture drought-period fallowing. Growers indicated they fallowed fields in areas of Sutter and Placer Counties during 2014 in response to drought; these same fields were mostly returned to crops after the drought. The 2014 statewide survey categories for these idle plots were overwritten with 2016 and 2017 CropScape data to better reflect the total crop acreage in Sutter and Placer Counties for interpolation purposes. The idled acreage was added back in for the year 2014 after interpolation between the compositive areas was performed.

Figure 2-10, Figure 2-11, and Figure 2-12 show the spatial distribution of the land use coverages for CoSANA for 1995, 2005, and 2015. Figure 2-13 through Figure 2-16 show the annual cropping patterns for the entire CoSANA and individual subbasins.

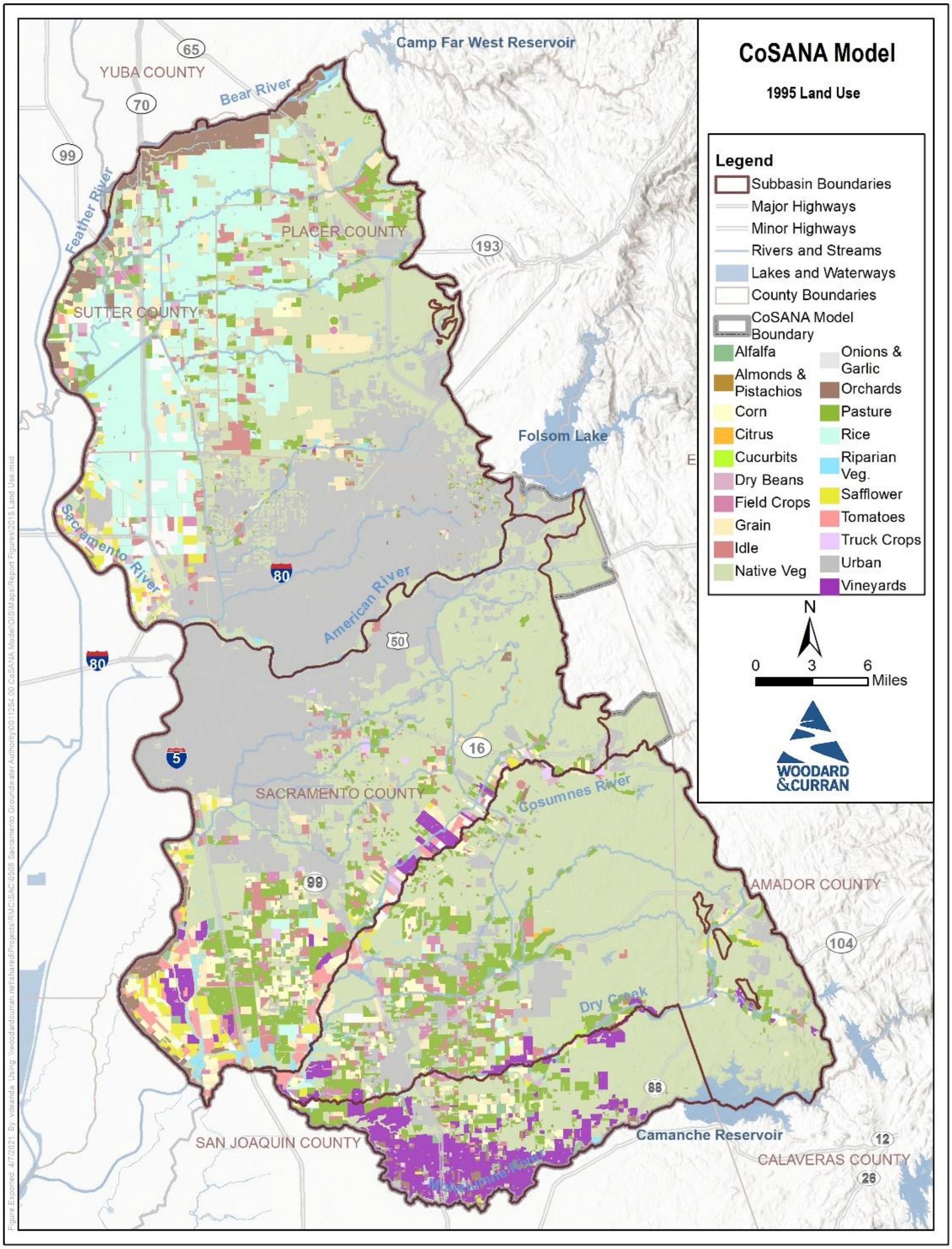


Figure 2-10: 1995 Land Use Coverage

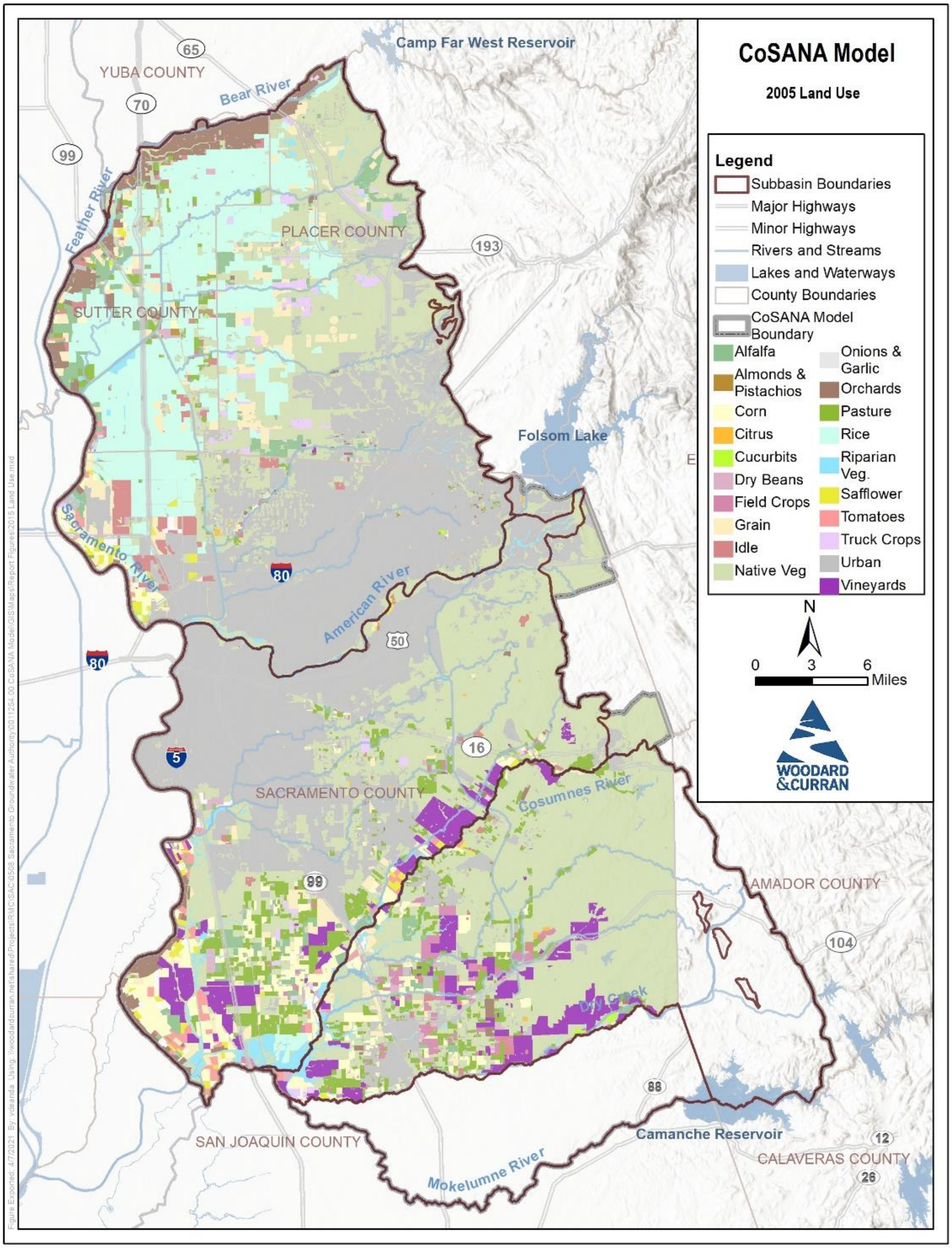


Figure 2-11: 2005 Land Use Coverage

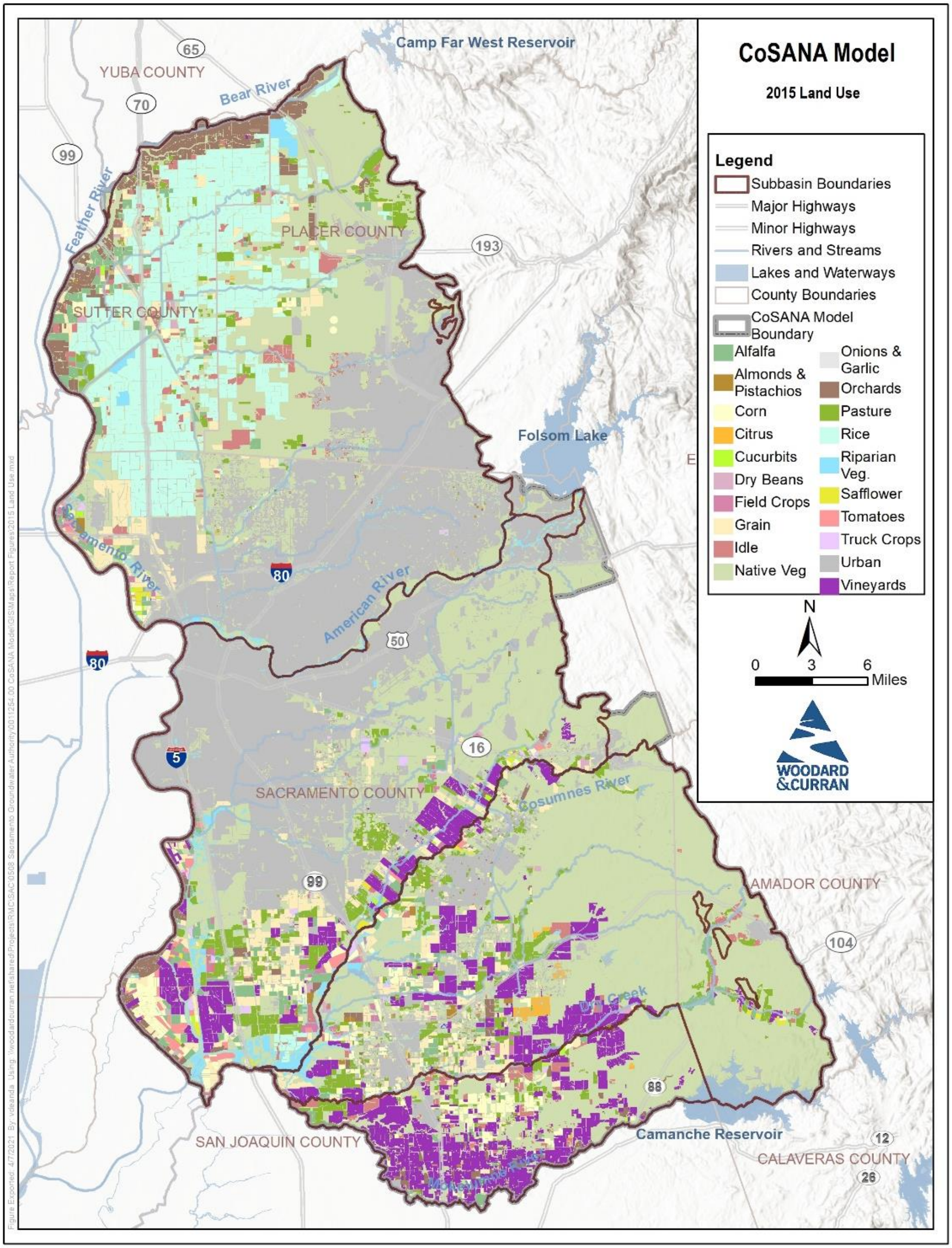


Figure 2-12: 2015 Land Use Coverage

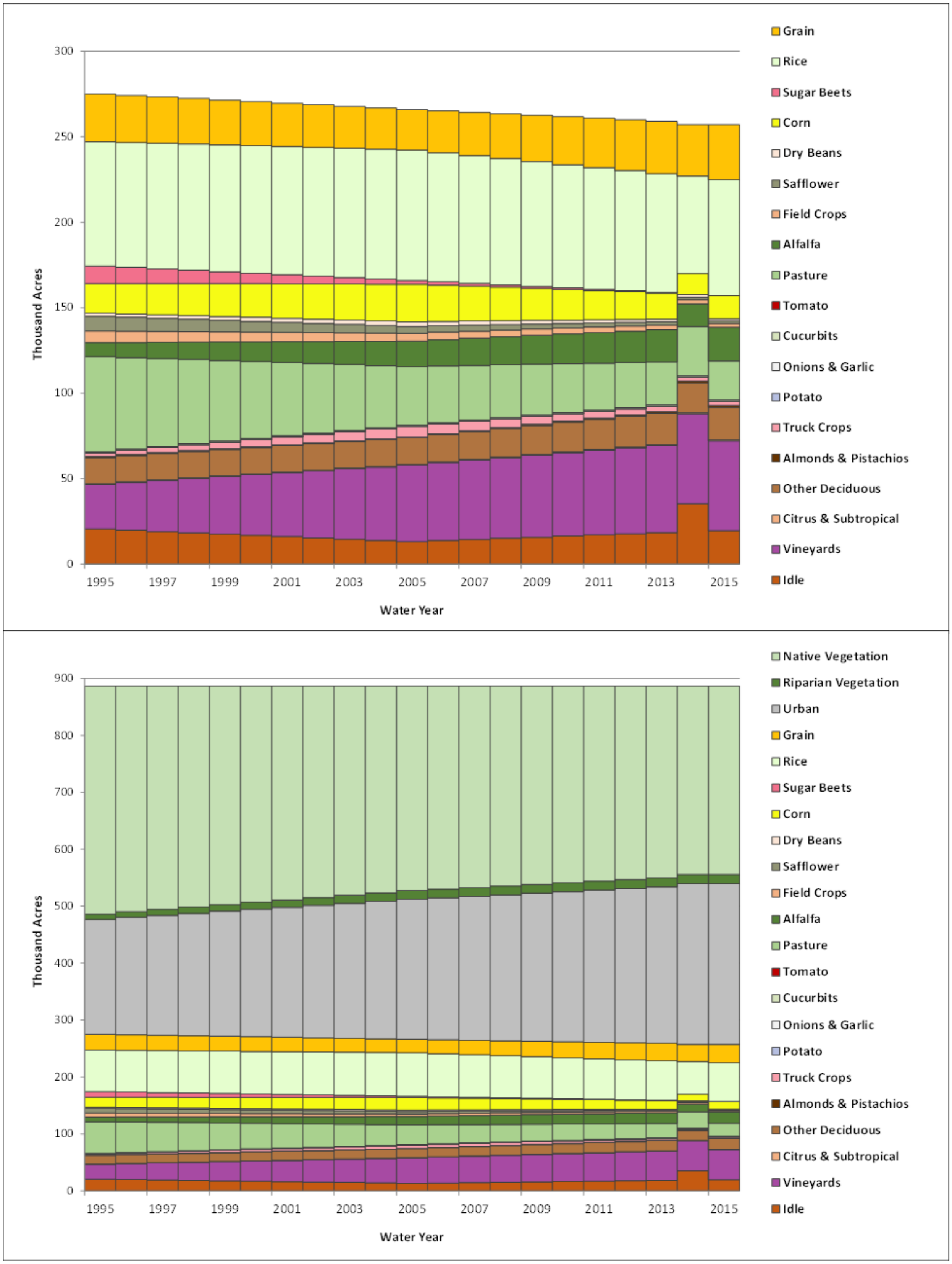


Figure 2-13: Annual Land Use for CoSANA

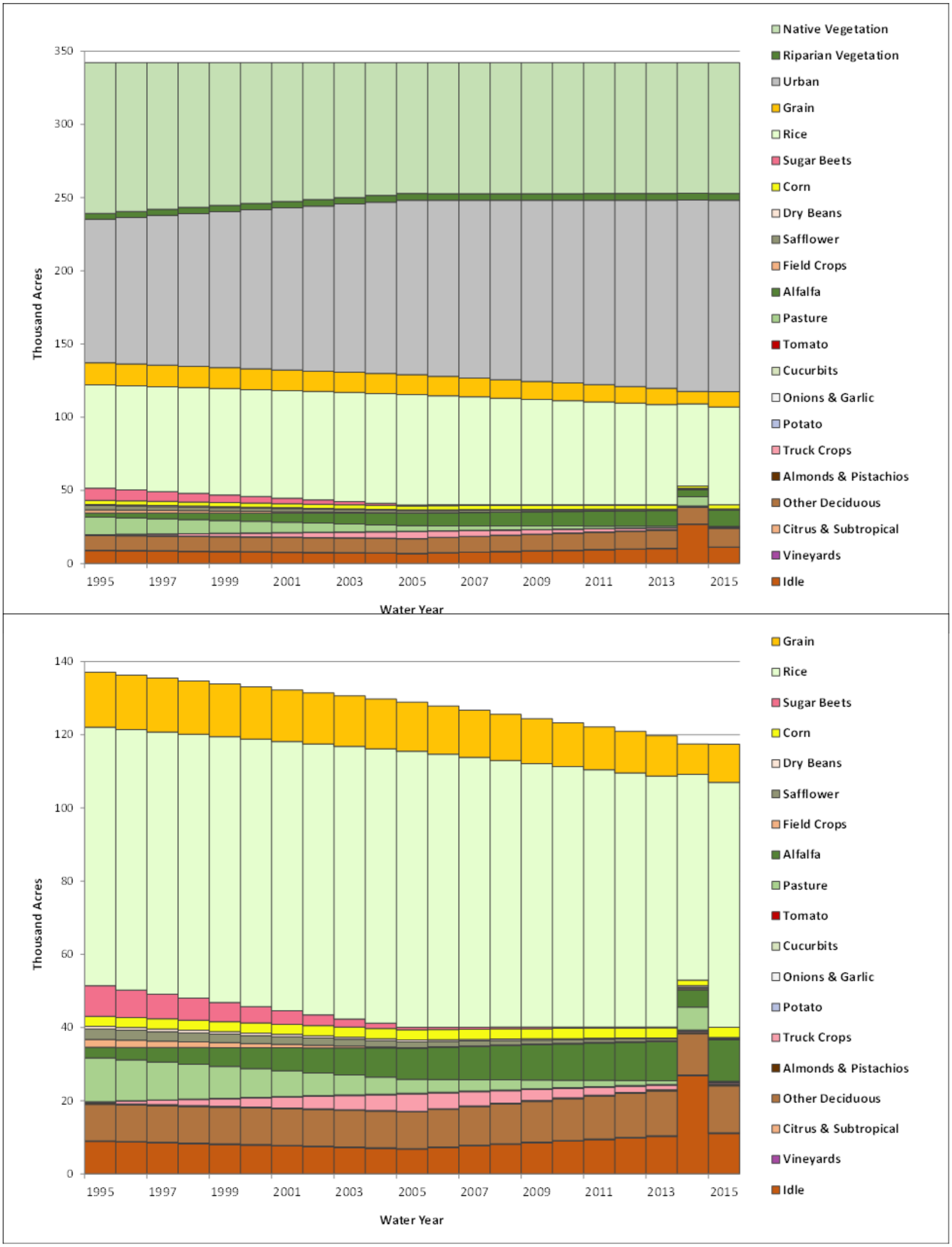


Figure 2-14: Annual Land Use for North American Subbasin

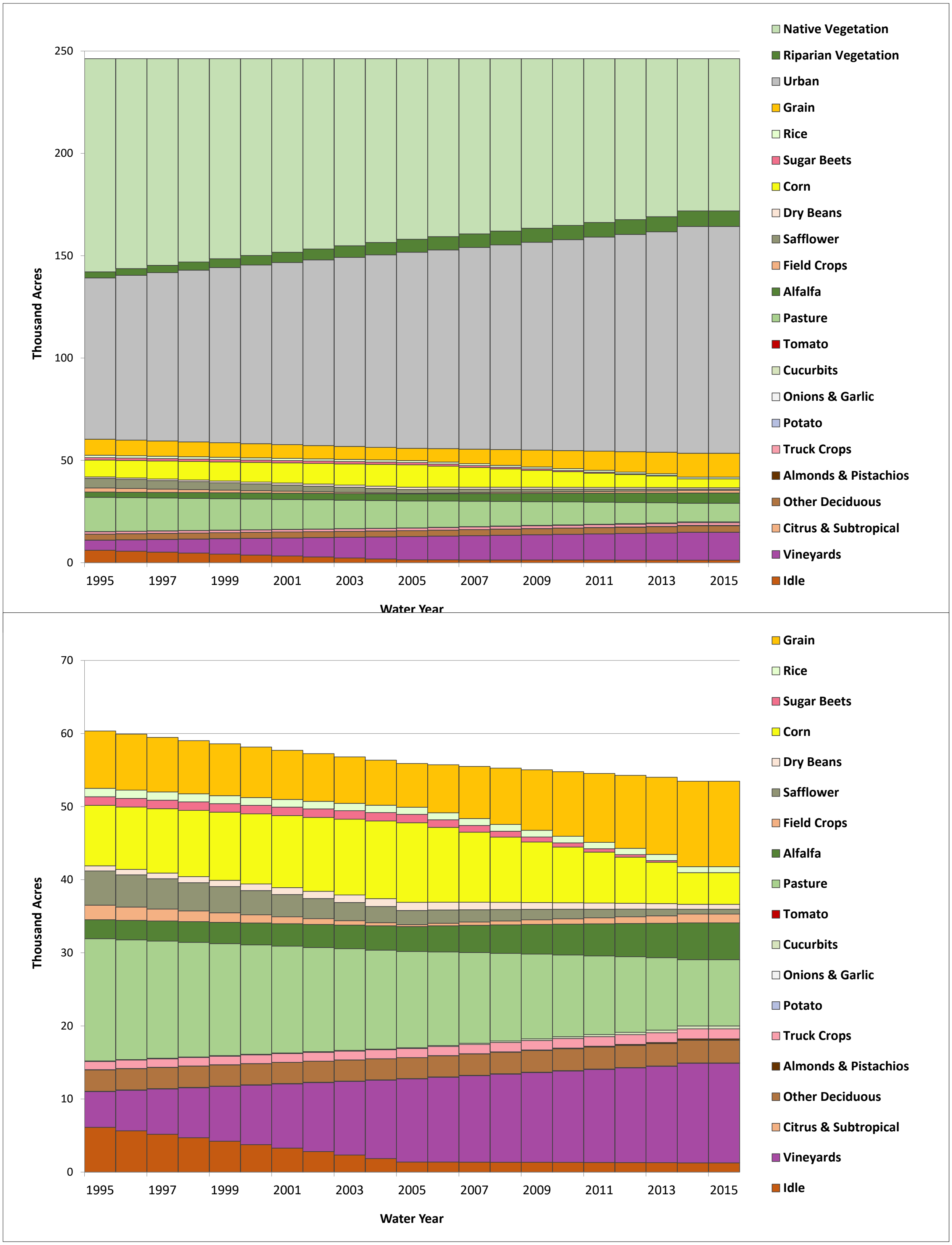
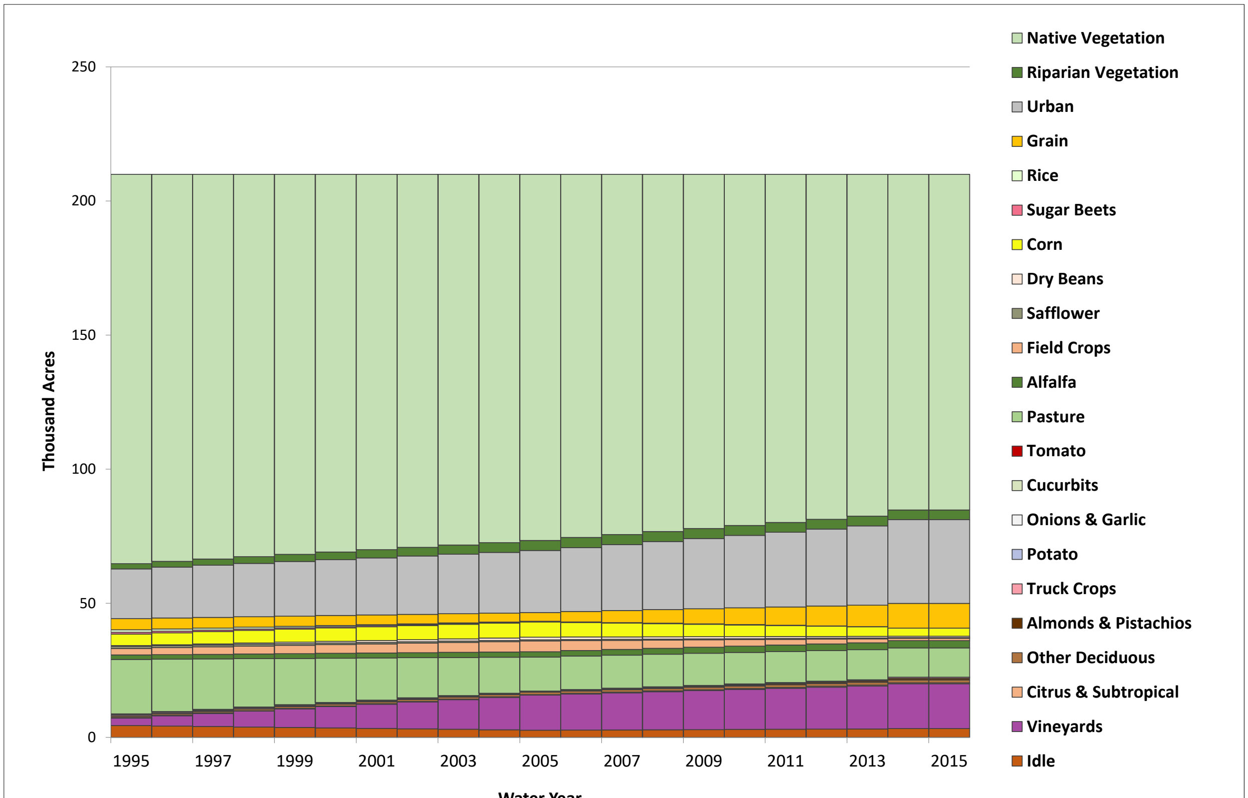


Figure 2-15: Annual Land Use for South American Subbasin



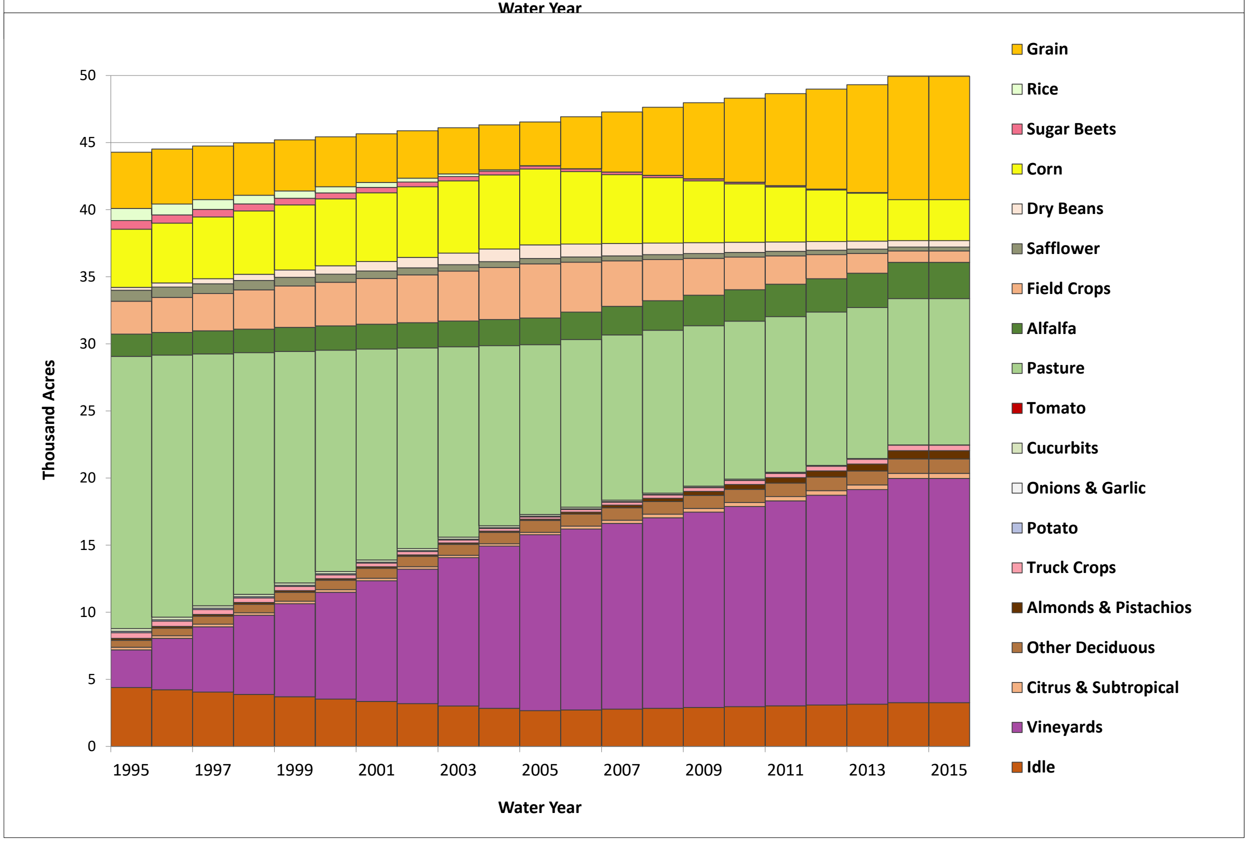


Figure 2-16: Annual Land Use for Cosumnes Subbasin

Land use trends in the North American Subbasin for 1995 through 2015 show decreases in total and irrigated agricultural acreage, with about 137,900 irrigated acres in 1995 and about 117,700 acres in 2015. During this same period, urban area increases from about 98,000 acres to about 130,800 acres. The increased urban area is due to both conversion of agricultural lands to urban areas, as well as conversion of native vegetation areas to urban. Most of the urban growth occurs in the Placer County area of the subbasin. In terms of irrigated acreages, decreases are observed in grain, rice, sugar beets, safflower, other field crops, and alfalfa/pasture. These decreases are due to urbanization and grower crop choices. The only irrigated crop showing substantial increases in acreage are orchards.

Land use trends in the South American Subbasin for 1995 through 2015 show decreases in total and irrigated agricultural acreage, with about 65,000 irrigated acres in 1995 and about 55,800 acres in 2015. During this same period, urban area increases from about 78,800 acres to about 110,800 acres. Increased urban area is due to both conversion of agricultural lands to urban areas, as well as conversion of native vegetation areas to urban. Most urban growth is observed to occur in the Elk Grove and Rancho Cordova areas. In terms of irrigated acreage, decreases are observed in corn, safflower, alfalfa/pasture, and tomatoes. These decreases are due to urbanization and grower crop choices. The largest increases in agricultural acreage are seen with the growth of grain and vineyards.

Land use trends in the Cosumnes Subbasin for 1995 through 2015 show increases in total and irrigated agricultural acreage, with about 45,200 irrigated acres in 1995 and about 50,200 acres in 2015. During this same period, urban area increases from about 18,500 acres to about 31,300 acres. Both urban and agricultural growth occur largely as a result of conversion of native vegetation areas. The majority of urban growth occurs as rural residential development in the Wilton area. In terms of irrigated acreage, decreases are observed in field crops (sugar beets, corn, safflower, and other field crops), and alfalfa/pasture. These decreases are due to urbanization and grower crop choices. Increases are observed in grain and permanent crops such as orchards and vineyards.

2.8 Evapotranspiration

Evapotranspiration (ET) is an important factor in demand estimation for crops and native vegetation. Every CoSANA land use type and crop category, as well as the small-stream watersheds, are assigned monthly values for the entire simulation period, which provides the monthly and annual hydrologic variability in ET estimates for the period of simulation.

The starting ET values through September 2015 were derived from C2VSimFG values for the C2VSimFG Subregion 7, which represents the NASb and was chosen as being most representative of the agricultural practices of the greater Sacramento region as modeled in CoSANA. Additional modifications were made during model calibration to the rice ET based on local information. Also, grain, vineyards, field crops, and safflower ET was updated using typical year monthly crop evapotranspiration information developed by the Irrigation Training and Research Center (ITRC) at California Polytechnic State University, San Luis Obispo by DWR's CIMIS (California Irrigation Management Information System) Zone. CIMIS zones represent areas with similar long-term average reference ET (ET_o) values, there are in total 18 zones to represent ET variability across California (https://cimis.water.ca.gov/App_Themes/images/ etozonemap.jpg). CoSANA uses average data for both Zone 12 and Zone 14.

To extend this data to 2018, ET_o data were downloaded for CIMIS station 131 (Fair Oaks). Monthly crop coefficient (ET_c) data for the extended period were estimated using the ratio of ET_o between annual data and the 2015 data.

Of 20 agricultural land uses in CoSANA, 7 crop types account for nearly 95% of irrigated cropland (for the 2015 land use survey). The monthly ET requirements of these crops are shown in Figure 2-17, Figure 2-18, and Figure 2-19, as well as for urban, riparian vegetation, and native vegetation land use types. Annual ET demands for the major land use types are 19.0 inches/year for grain, 29.7 inches/year for corn, 47.6 inches/year for alfalfa, 49.8 inches/year for pasture, 45.6 inches/year for orchards, 30.4 inches/year for vineyards, 32.3 inches/year for rice, 42.9 inches/year for urban, 18.2 inches/year for native vegetation, and 63.4 inches/year for riparian vegetation.

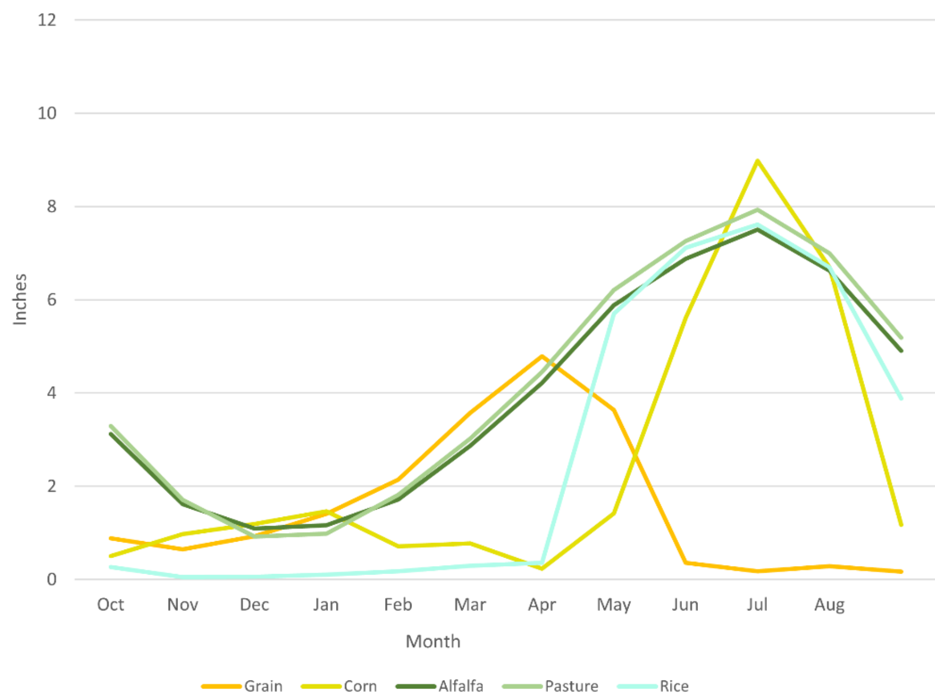


Figure 2-17: Average Monthly Evapotranspiration by Land Use Type, Major Field and Row Crops

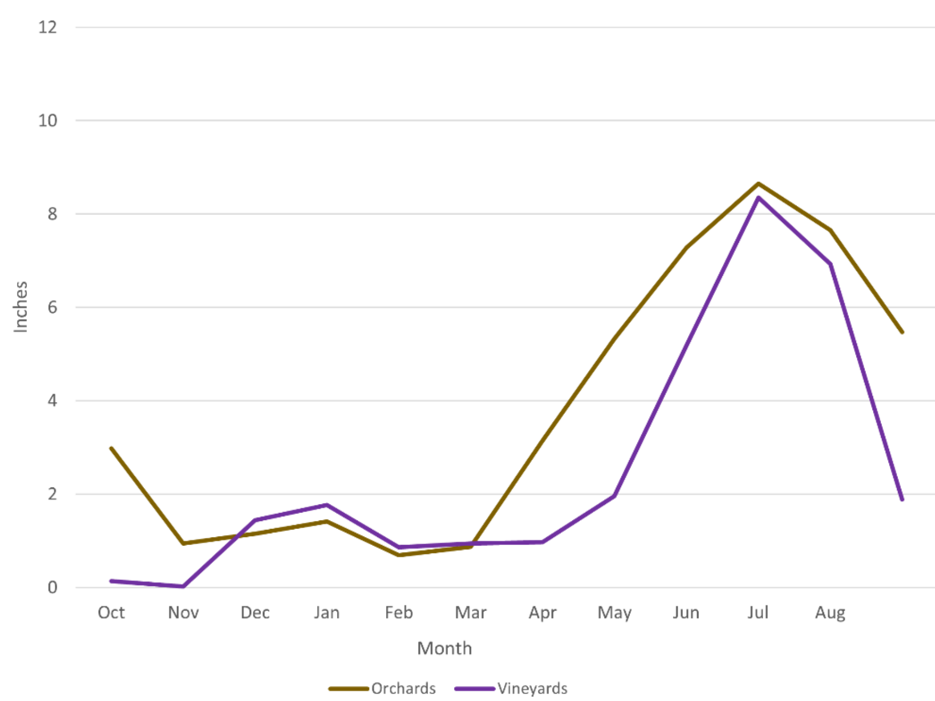


Figure 2-18: Average Monthly Evapotranspiration by Land Use Type, Orchards and Vineyards

Figure 2-19: Average Monthly Evapotranspiration by Land Use Type, Urban, Native, and Riparian

2.9 Root Zone Soil Parameters

The soil properties specified in CoSANA are field capacity, wilting point, total porosity, saturated hydraulic conductivity, and pore size distribution index. The soil properties are used to calculate rainfall runoff and infiltration through the soil zone for each model element. Data from C2VSimFG was used to populate the five soil properties for each model element. The soil parameters were modified during the calibration process; the final soil parameter values and their spatial distributions are discussed and shown in figures in Section 0.

Model elements are also associated with the four hydrologic soil groups according to their runoff potential and infiltration characteristics. CoSANA elements with their corresponding hydrologic soil group are shown in Figure 2-20. The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS; USDA NRCS, 2007) defines these hydrological soil groups as follows:

- Soils in Group A have low runoff potential when thoroughly wet. Water is transmitted freely through the soil. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. Some soils having loamy sand, sandy loam, loam, or silt loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
- Soils in Group B have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded. Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and have loamy sand or sandy loam textures. Some soils having loam, silt loam, silt, or sandy clay loam textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.

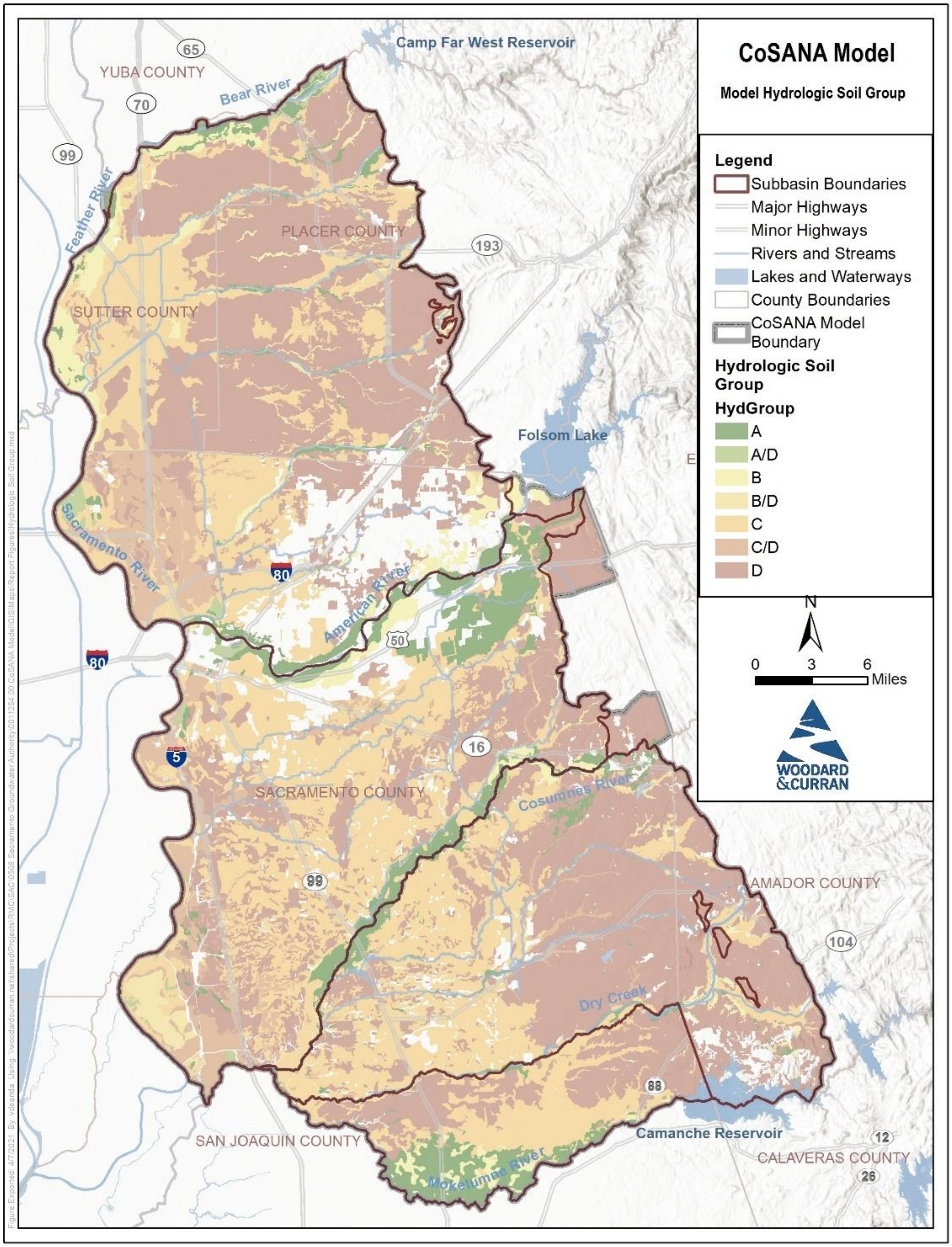


Figure 2-20: USDA Hydrologic Soil Groups

- Soils in Group C have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Some soils having clay, silty clay, or sandy clay textures may be placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments.
- Soils in Group D have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted. Group D soils typically have greater than 40 percent clay, less than 50 percent sand, and have clayey textures. In some areas, they also have high shrink-swell potential.

2.10 Geologic Structure and Model Layering

The following section highlights development and refinement of CoSANA stratigraphy.

2.10.1 Model Layer Development and Approach

Layering for a groundwater model is guided by many factors, several of which are described as follows:

- Hydrostratigraphy of the study area. The thickness and extent of model layers and the overall extent and depth of the model was developed based on available geologic and hydrogeologic reports, including available maps and cross-sections, to reflect the physical system being simulated. Information from neighboring subbasins was also considered for consistency with the modeling efforts in those areas.
- Stream-aquifer interaction. CoSANA will support the investigation of stream-aquifer interaction in the modeled subbasins, notably for the American, Sacramento, and Cosumnes Rivers. This requires a realistic and accurate representation of the aquifer, pumping volumes, and pumping locations and a grid that is discretized sufficiently fine horizontally and vertically. Representing the recent alluvium and Riverbank Formation as a separate layer provided a finer vertical discretization underneath and around the streams.
- Available information on screen/perforation depths for monitoring and production wells. If available, information on the vertical distribution of pumping is used to layer the model such that it corresponds to the depths at which those stresses occur. At present, there is limited information on the vertical distribution of well screens and perforations in the study area, particularly for private agricultural and domestic wells. Furthermore, many wells in the area were constructed with long sections of perforation or open boring, making it difficult to determine the elevations of greatest groundwater production.
- Importance of vertical gradients and the availability of vertically distributed head data. There are several multi-completion monitoring wells installed in the study area. At the most there are only five completions in an individual well cluster. Vertical discretization beyond that level would require estimation of parameters that control vertical movement of water (e.g., vertical hydraulic conductivity) that could not be evaluated by comparison of simulated and observed data.
- Model run time. All other considerations being equal, model run times will increase with the number of layers that are used. Run time was identified as an important consideration early in the planning process for CoSANA due to the benefits seen from faster model run time for SacIWRM. The ability to perform many model runs quickly is a desired outcome in the model development, particularly when iterative modeling scenarios are performed.

The selection of the number of layers and their elevations requires balancing these factors and the overall objectives of the project.

2.10.2 Model Layer Definition

The subsurface is characterized in CoSANA by five model layers representing the different geology from the ground surface to the shallower of bedrock or the base of fresh water. The ground surface elevation, the upper boundary of the topmost layer, is based on the USGS DEM at a resolution of 30 meters. Descriptions of each of the model layers are listed below, from top to bottom. DWR's Bulletin 118-3 (1974) and data from the Western Placer County Groundwater Management Plan (Roseville, City of, et al., 2007) provided cross sections that were used to support development of all layers, while surficial geology maps (California Geological Survey 2009, 2011) were used primarily to support the extent of layers at the surface. Figures 23-27 show the extent and thickness of each model layer as described below.

- Layer 1 represents the recent alluvium and Riverbank Formation. Layer 1 is up to 188 feet thick and is generally constrained to be at least 30 feet thick. This layer was developed using California Geological Survey (2009; 2011), DWR's Bulletin 118-3 (1974), and data from the Western Placer County Groundwater Management Plan (Roseville, City of, et al., 2007) (Figure 2-21).
- Layer 2 corresponds to the Laguna Formation. Layer 2 is up to 502 feet thick and is generally constrained to be at least 50 feet thick (Figure 2-22).
- Layer 3 corresponds to the Mehrten Formation. Layer 3 is up to 1,487 feet thick and is generally constrained to be at least 50 feet thick (Figure 2-23).
- Layer 4 corresponds to the Valley Springs Formation. Layer 4 is up to 824 feet thick and is generally constrained to be at least 50 feet thick (Figure 2-24). The bottom of the Valley Springs Formation was supported by the work of Page (1974) in addition to the sources described earlier.
- Layer 5 corresponds to the portion of the Ione Formation that is above the base of fresh groundwater. Base of fresh water is defined based on Berkstresser (1973) and represents the depth where electrical conductivity is approximately 3,000 microsiemens per centimeter. Very few borings penetrate far below the base of freshwater, and it is expected that very little pumping occurs from this depth. Layer 5 is up to 795 feet thick and is generally constrained to be at least 50 feet thick (Figure 2-25).

A set of cross-sections were developed to show model stratigraphy in various locations and are presented as an overview map and 12 cross sections in Figure 2-26 through Figure 2-38.

Within each model layer, CoSANA aquifer parameters were estimated based on the texture dataset of the Sacramento Valley (DWR, 2018a). Aquifer parameters assigned to pilot point locations covering the model domain were distributed to model nodes using the sediment-based texture information to provide the spatial variability of parameters.

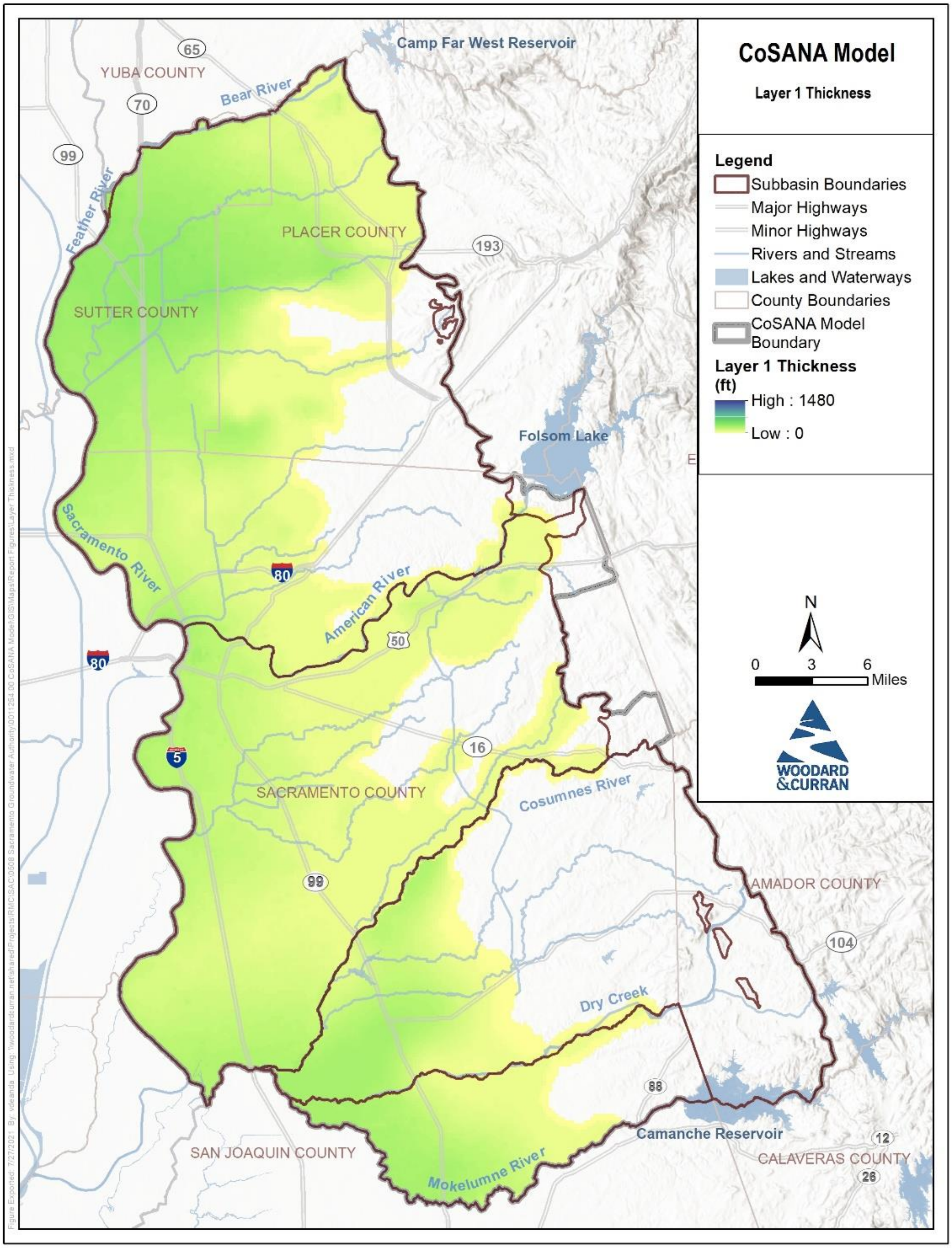


Figure 2-21: Thickness of Layer 1

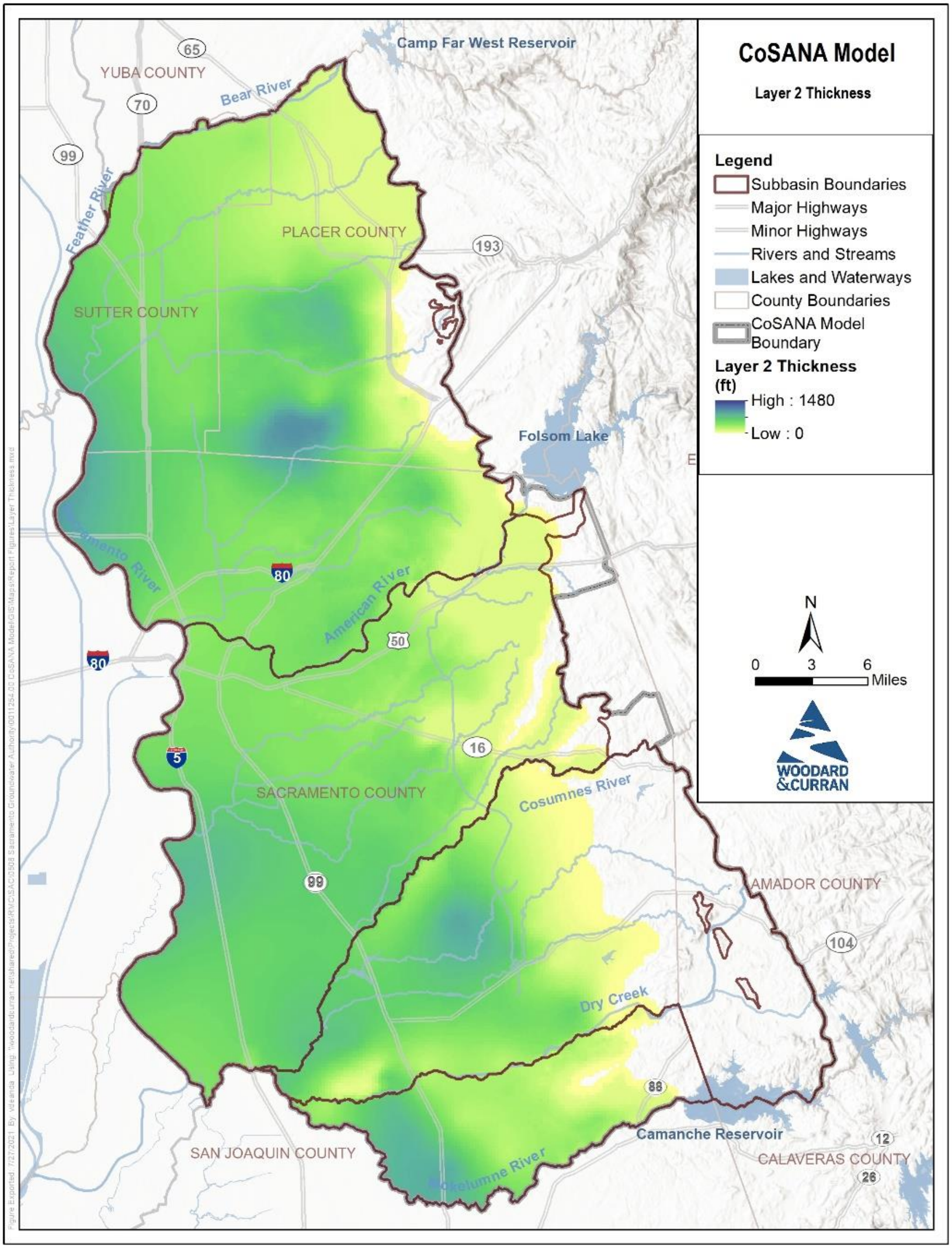


Figure 2-22: Thickness of Layer 2

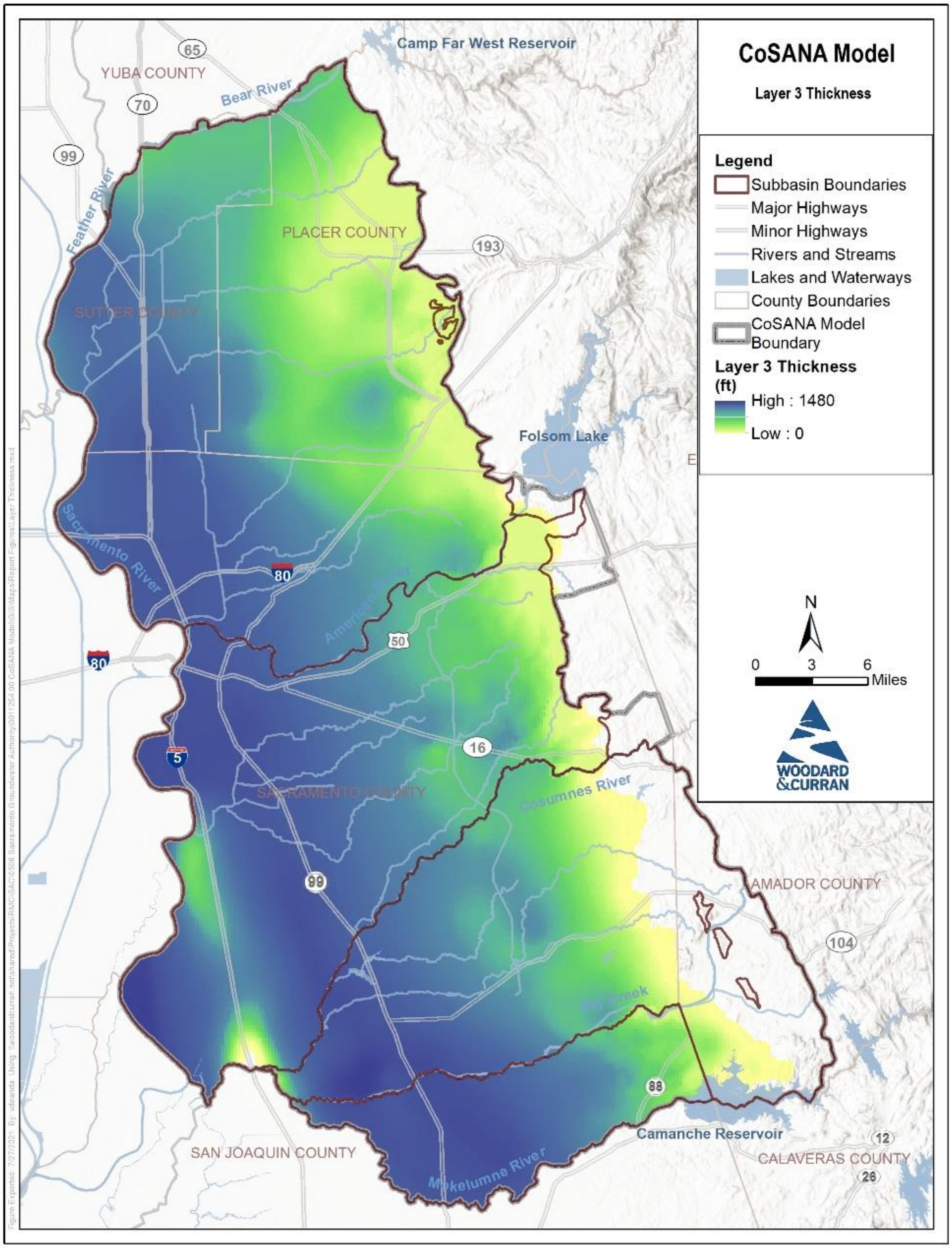


Figure 2-23: Thickness of Layer 3

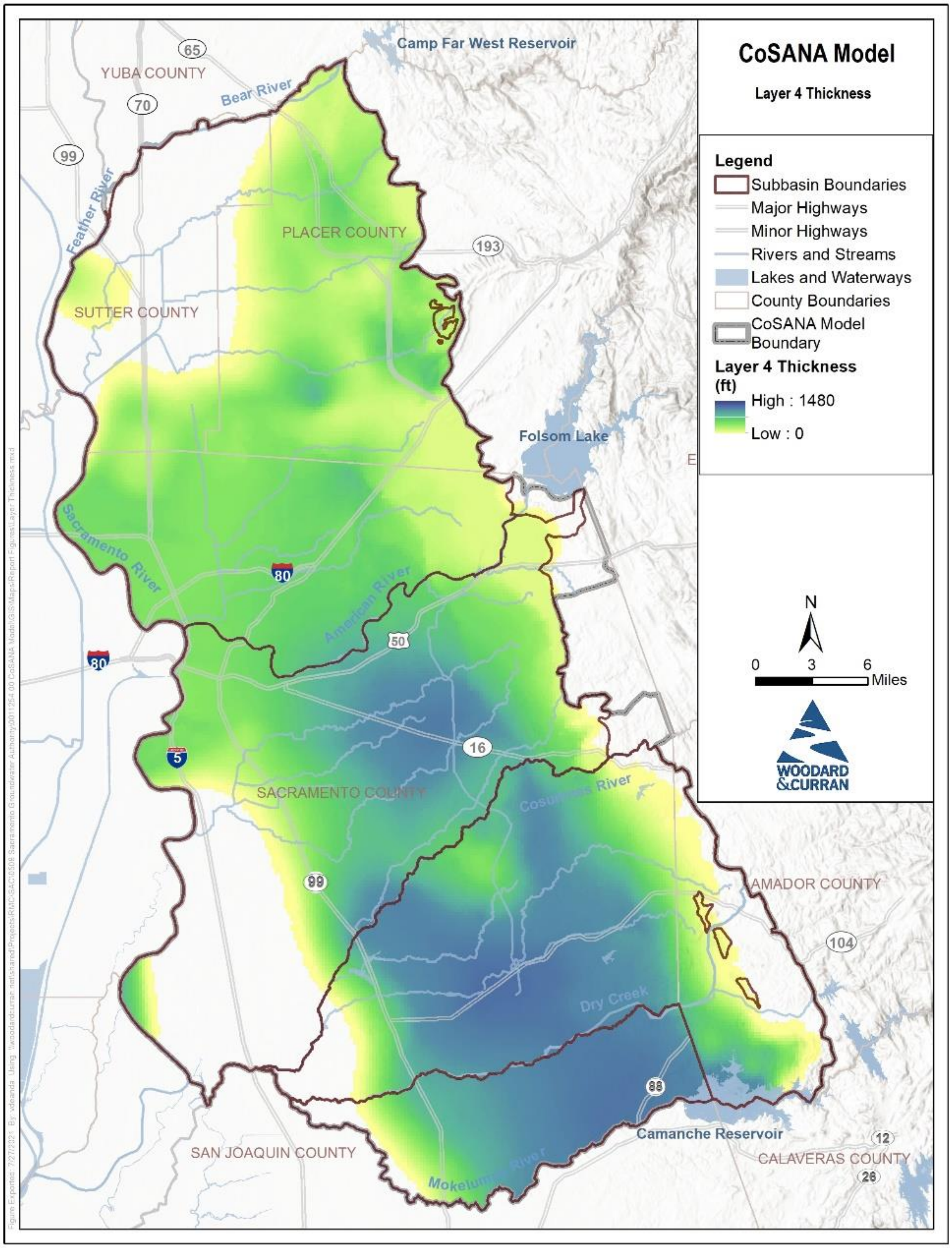


Figure 2-24: Thickness of Layer 4

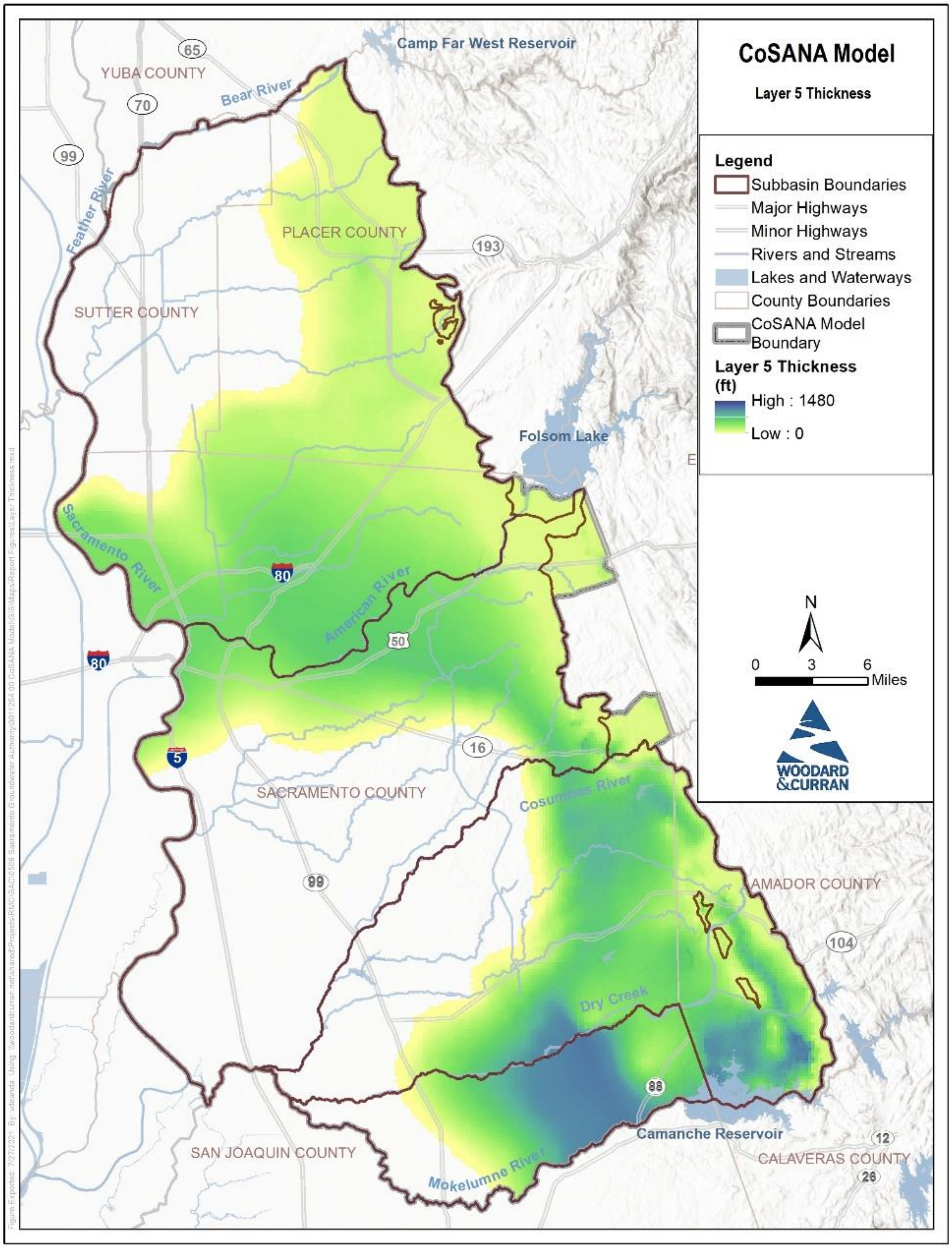


Figure 2-25: Thickness of Layer 5

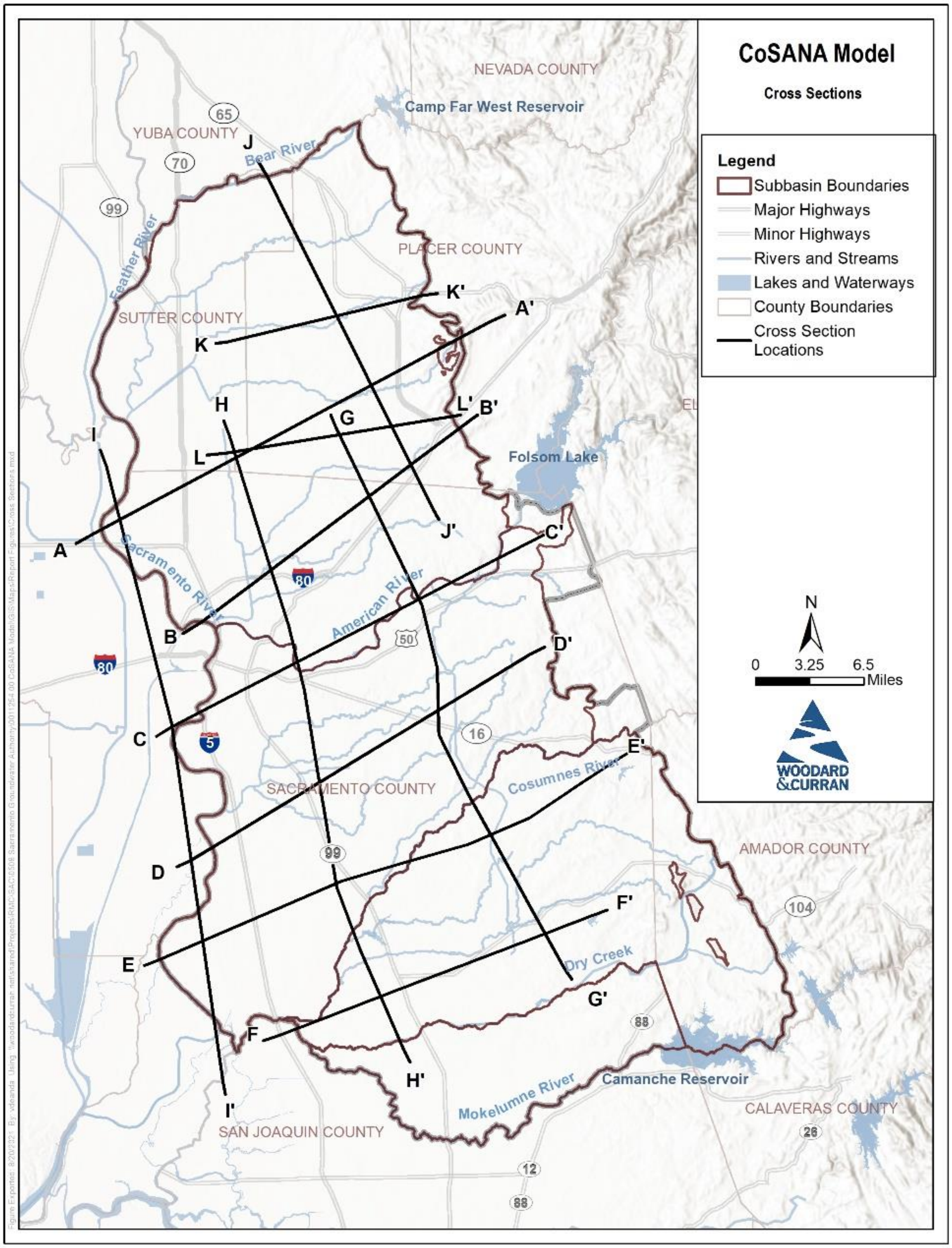


Figure 2-26: CoSANA Cross Sections

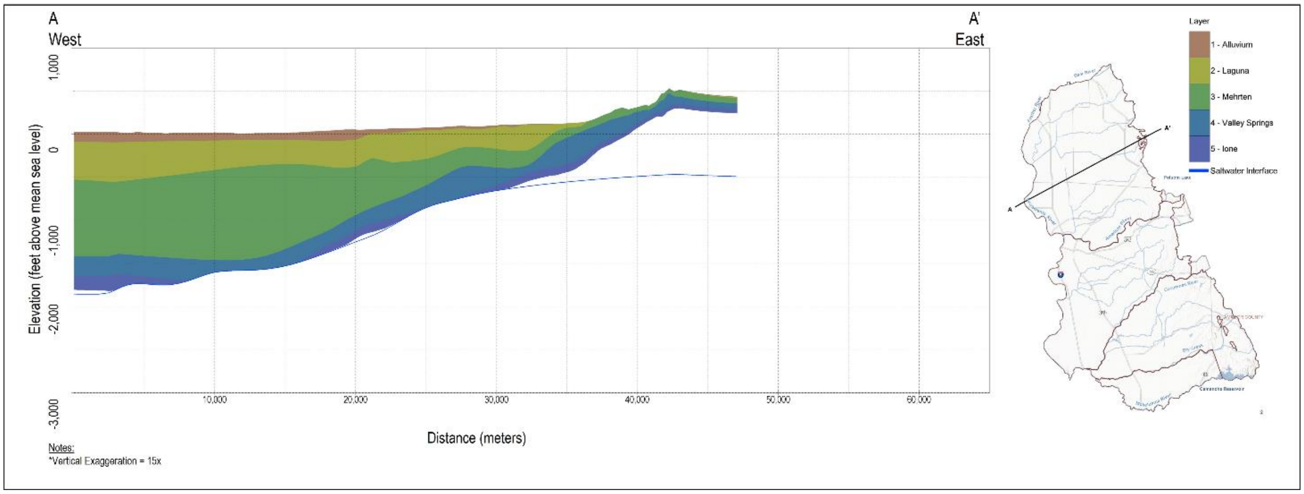


Figure 2-27: CoSANA Cross Section A-A'

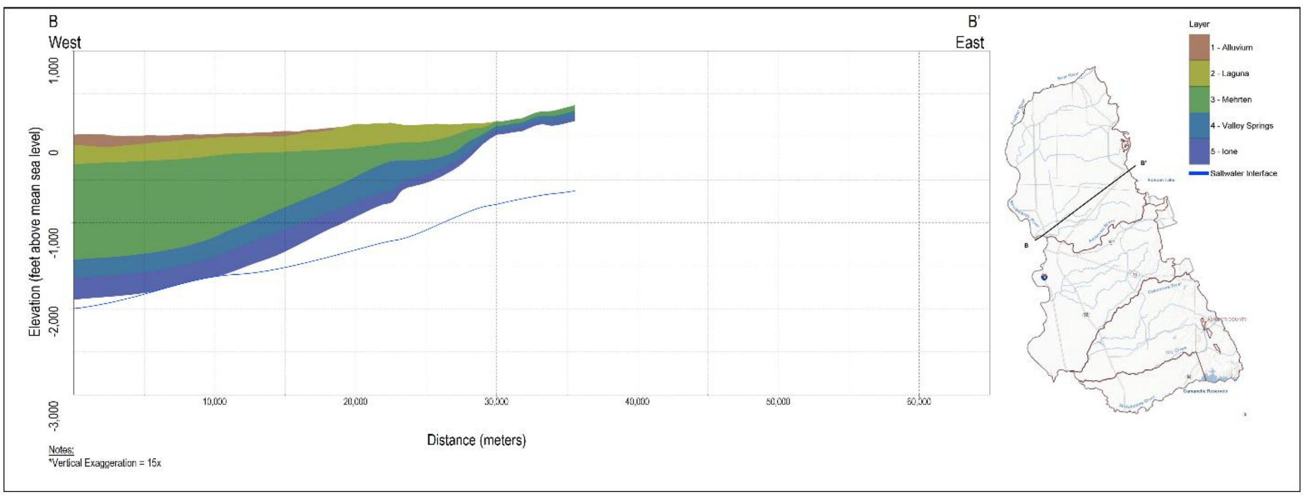


Figure 2-28: CoSANA Cross Section B-B'

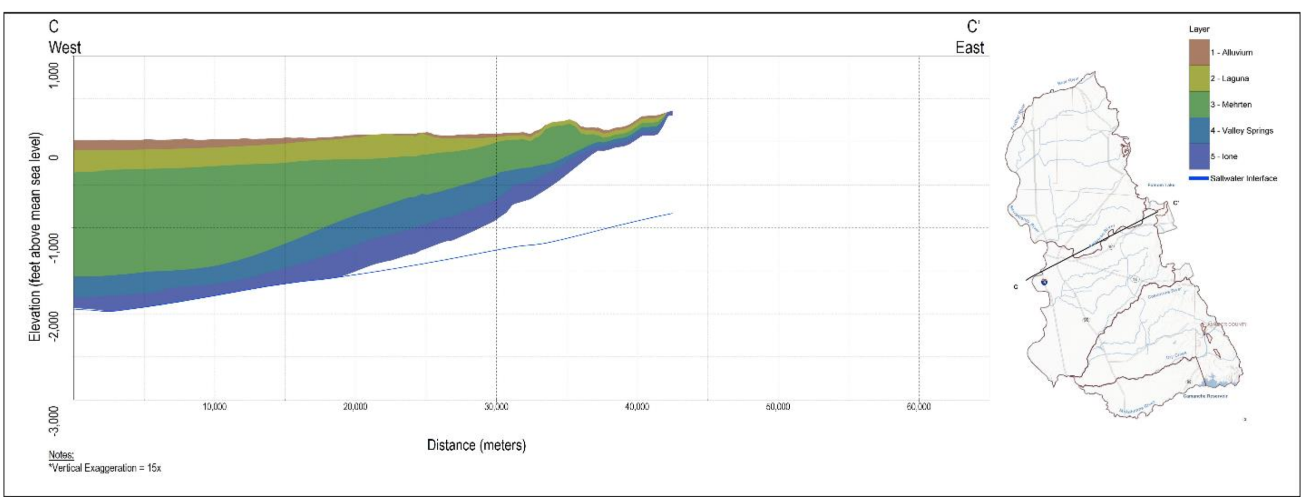


Figure 2-29: CoSANA Cross Section C-C'

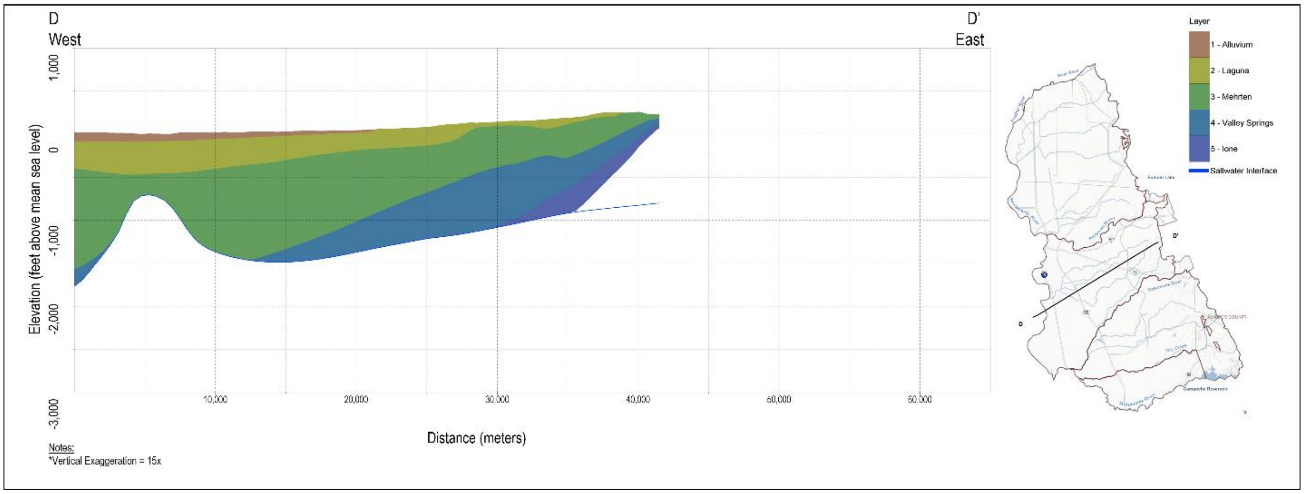


Figure 2-30: CoSANA Cross Section D-D'

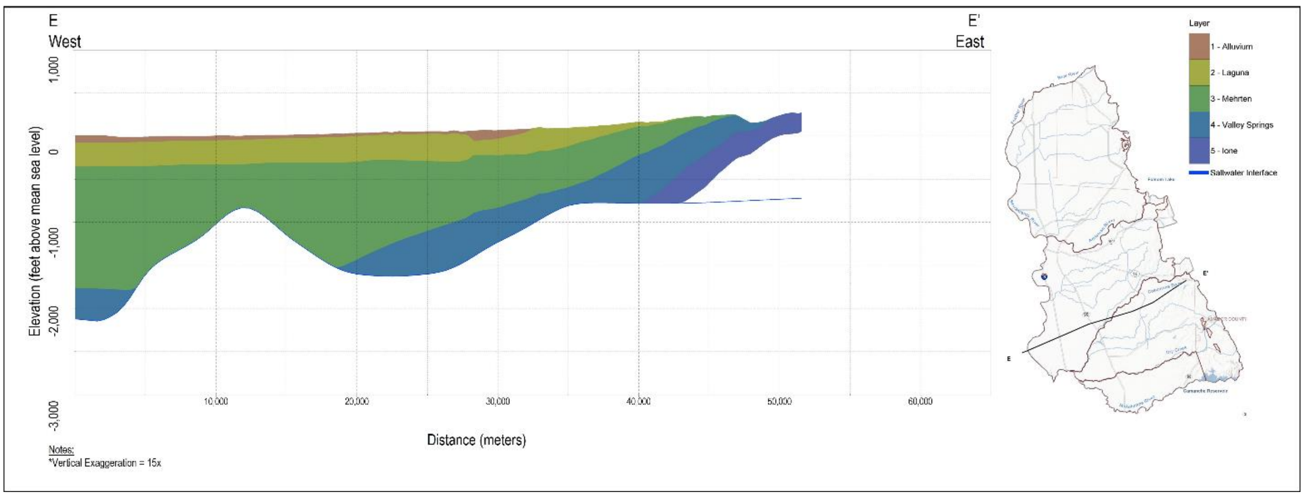


Figure 2-31: CoSANA Cross Section E-E'

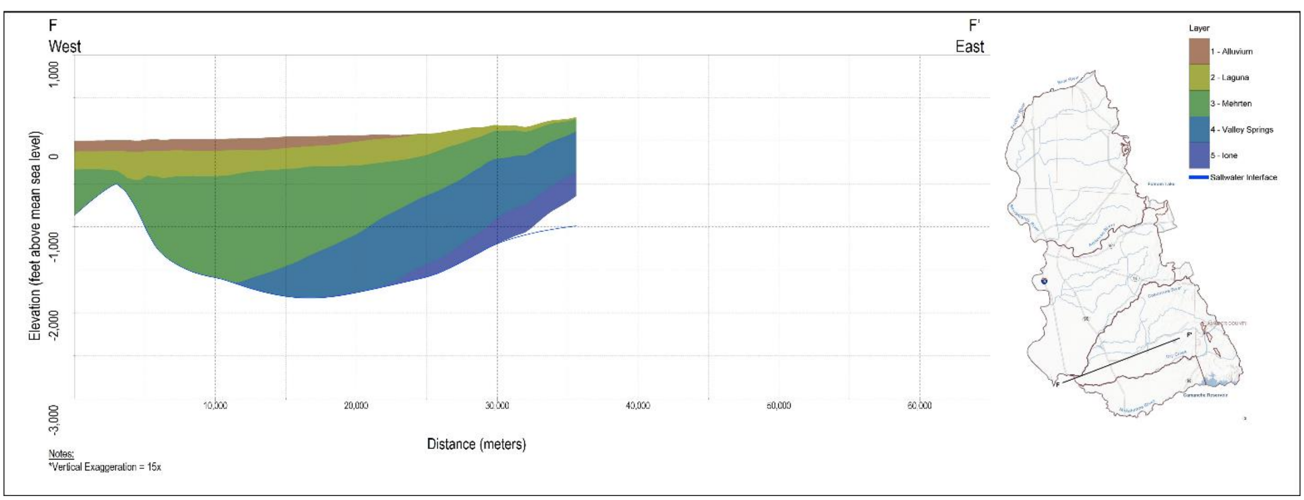


Figure 2-32: CoSANA Cross Section F-F'

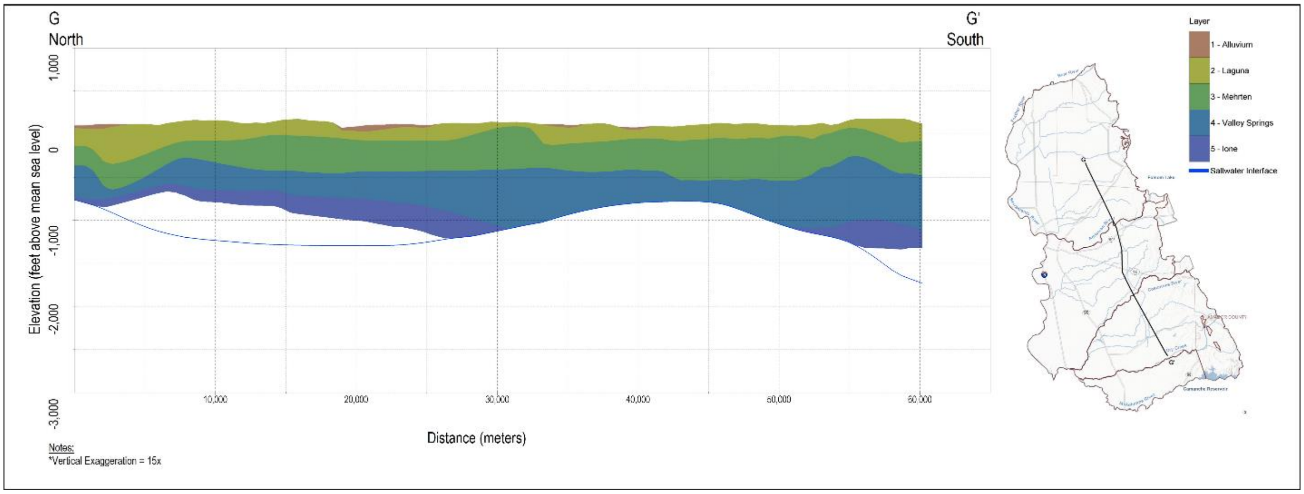


Figure 2-33: CoSANA Cross Section G-G'

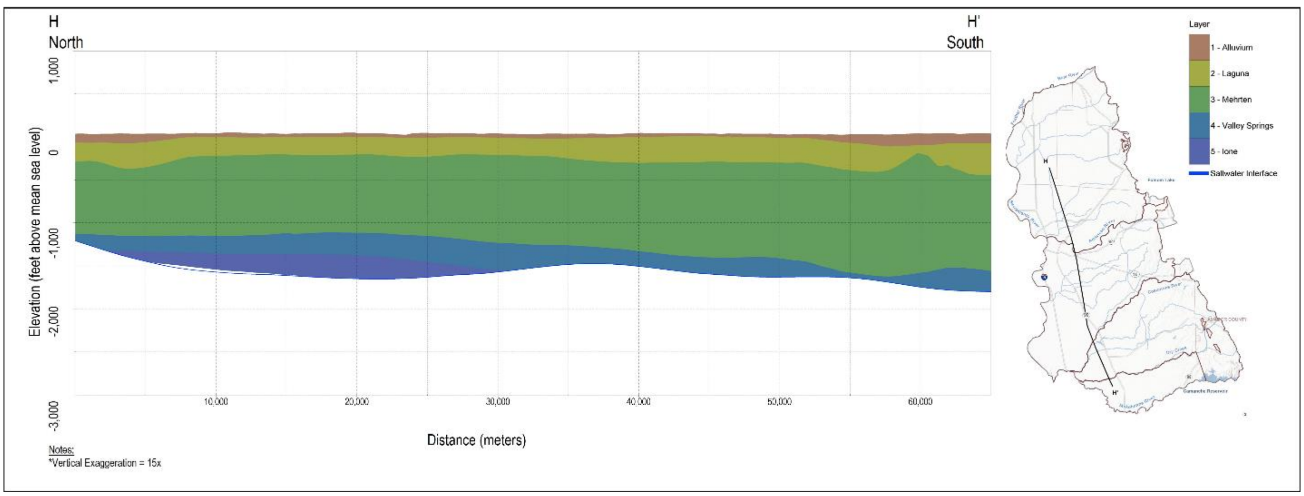


Figure 2-34: CoSANA Cross Section H-H'

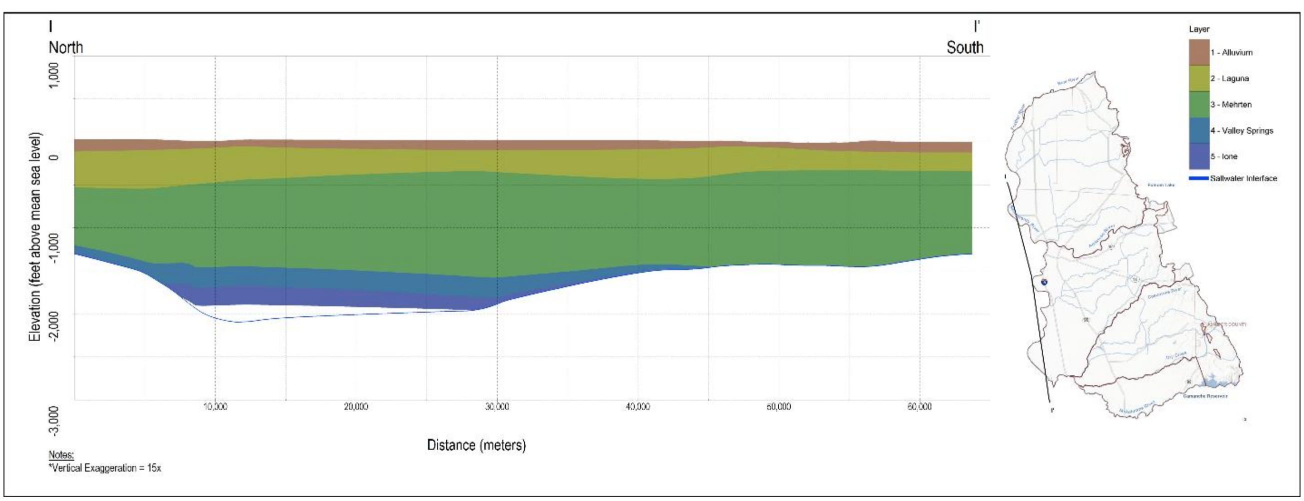


Figure 2-35: CoSANA Cross Section I-I'

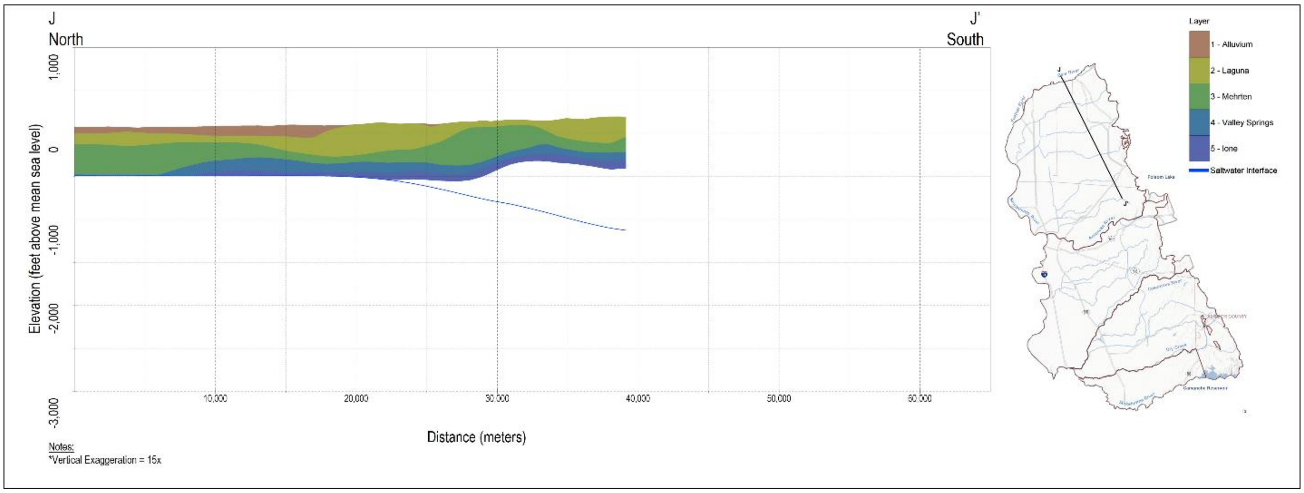


Figure 2-36: CoSANA Cross Section J-J'

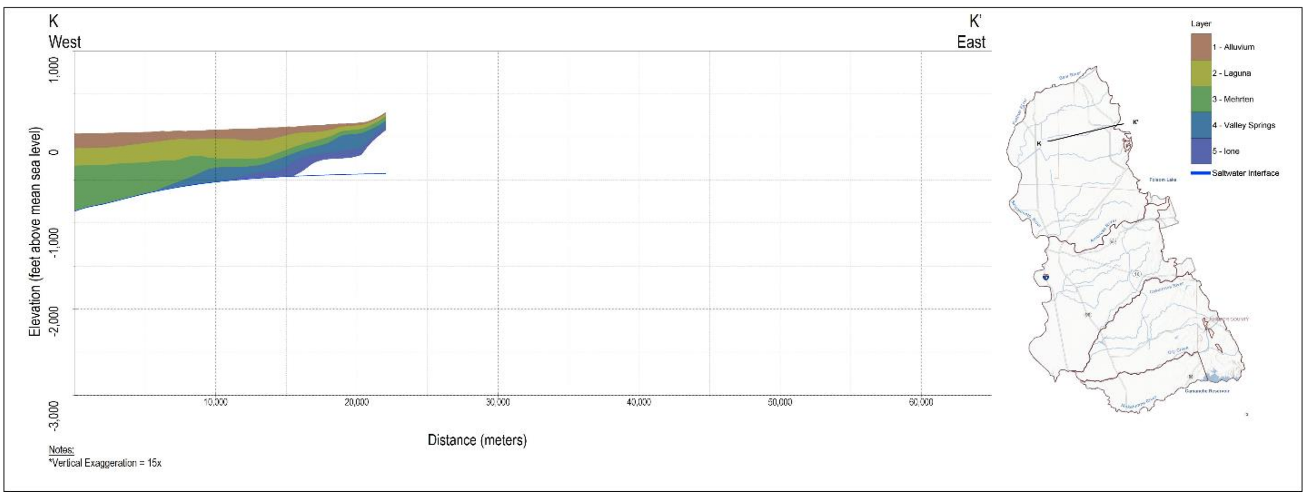


Figure 2-37: CoSANA Cross Section K-K'

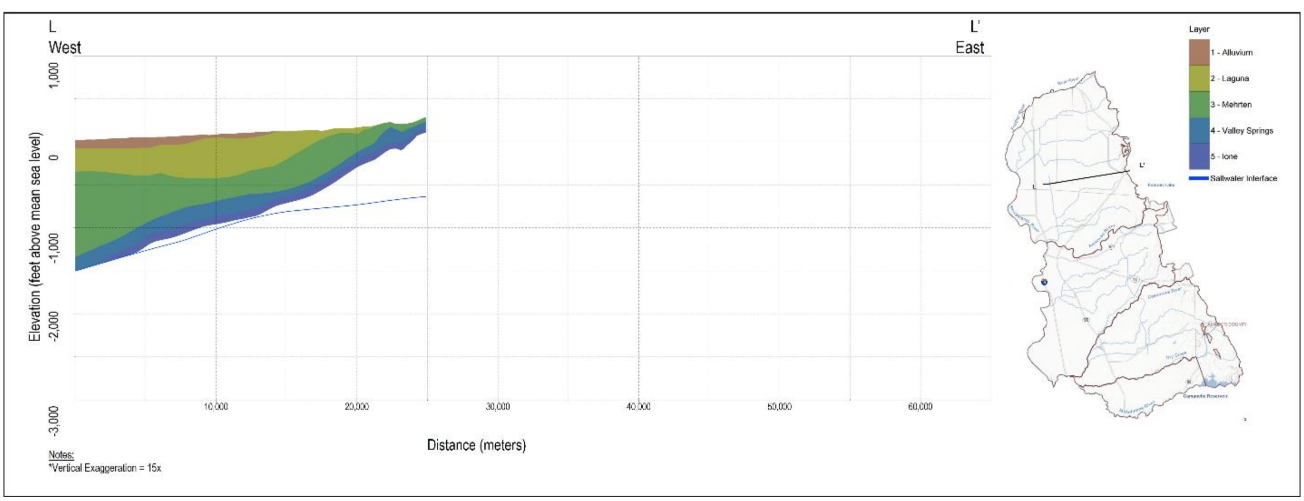


Figure 2-38: CoSANA Cross Section L-L'

2.11 Tributary Watersheds

The inflow from the eastern boundary of the model (i.e., Sierra Nevada foothills) originates from tributary watersheds, including both gaged and ungaged watersheds. The simulation of runoff and inflows from the gaged watersheds (i.e., stream inflows into the model) was discussed in Section 2.4. The simulation of surface and subsurface flows from the ungaged watersheds is explained in this section.

CoSANA simulates the ungaged eastern inflow using 32 small watersheds (Figure 2-39), based on the latest version of C2VSimFG. Flow from ungaged small watersheds is estimated based on precipitation rates and characteristics assigned to each identified ungaged watershed, again based on parameters from C2VSimFG. A portion of flow from the small watershed enters the model area as surface runoff and flows to simulated streams. The remaining small watershed flow contributes as subsurface boundary flow to the groundwater system.

All subsurface inflows from these small watersheds are routed to model Layer 5 along specified groundwater nodes, with a defined maximum percolation rate at each node. Excess flows that do not infiltrate to groundwater enter the simulated streams at specified locations, delineated using the USGS Watershed Boundary Dataset (HUC12 watersheds).

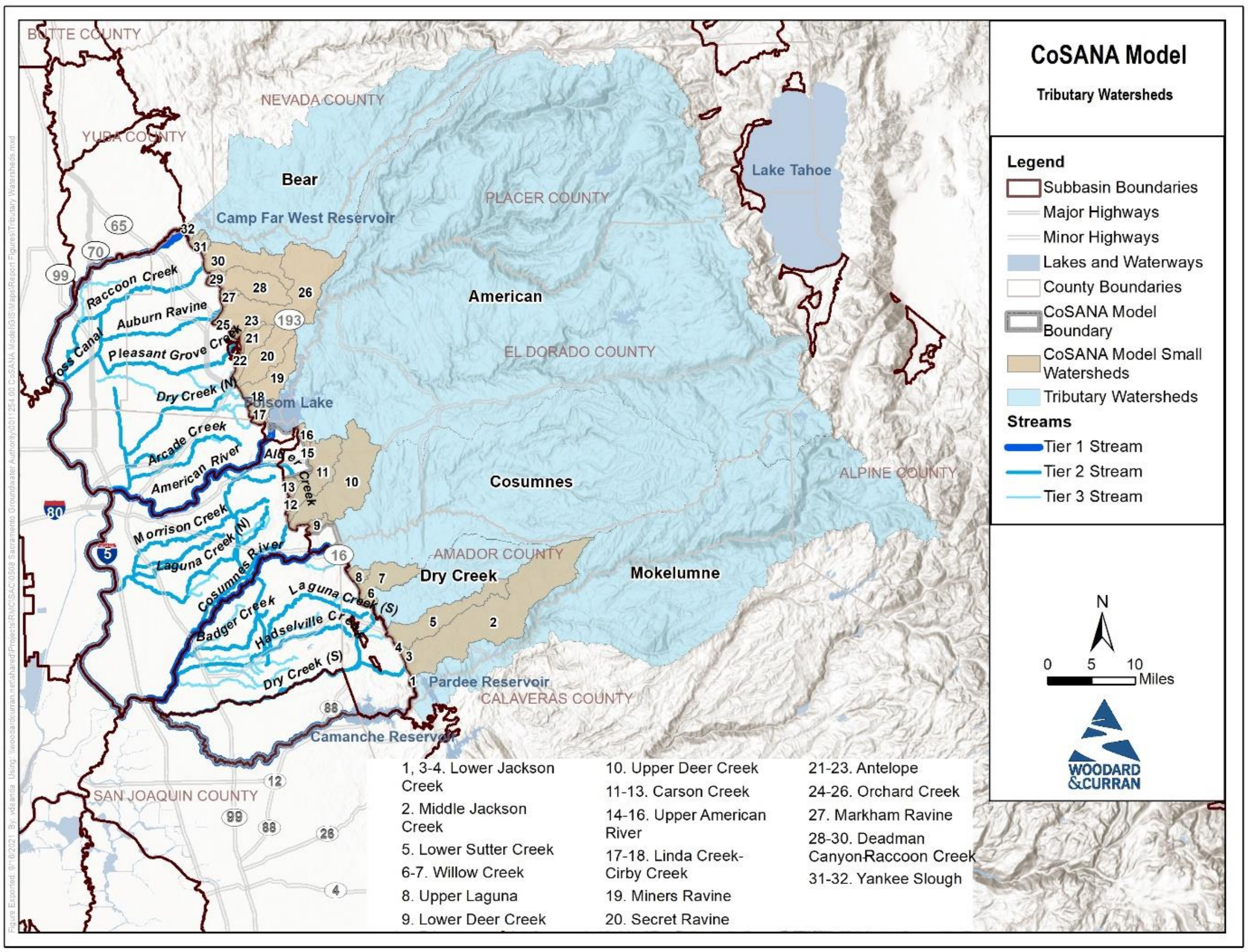


Figure 2-39: Tributary Watersheds

2.12 Boundary Conditions

Boundary conditions define the subsurface inflows for the northern, western, and southern borders of the model. The following boundary conditions are set in CoSANA:

2.12.1 General Head

Time-series general-head boundary conditions representing groundwater levels outside of the model area were defined for all active layers for 713 boundary nodes on the northern, western, and southern limits (i.e., along Bear River, Sacramento River, and Mokelumne River). General head boundary conditions, for each model node that it is defined, use a defined conductance and a reference groundwater level time series at a location outside the model domain with a known distance. The conductance values at the boundary condition nodes were calculated from the horizontal hydraulic conductivity, distance to the reference point, layer thickness, and the length of the boundary section represented by each node.

Groundwater level time-series data at a distance of approximately 3,000 feet from the boundary were extracted from the C2VSimFG model. The extracted values were compared with observed groundwater elevations from DWR's Water Data Library (WDL) and modified to better fit the observed elevations by trend and bias correction while protecting the spatial variation provided by C2VSimFG.

2.12.2 Small Watersheds

As discussed in the previous section, subsurface inflows and surface runoff contributions along the eastern boundary of model are represented using small watersheds.

2.12.3 Constrained Head

Additional boundary conditions were defined to simulate known water elevations for Camanche Reservoir. Seepage from Camanche Reservoir was represented by constrained head boundary conditions for the uppermost layer of the 228 groundwater nodes representing the reservoir elevations.

2.13 Initial Conditions

Groundwater heads for each model node and each layer at the beginning of the calibration simulation (October 1, 1989) were developed using DWR's WDL database. Over 815 wells with data were analyzed for use in building the initial groundwater heads. Due to the availability of data in different wells, a hierarchy of data was used to compile sufficient coverage over the model domain for development of initial conditions:

- Fall 1989 (August through October) where available
- Extended Fall 1989 (July through November)
- Surrounding years data, averaged (Fall 1988 or Fall 1990)
- Surrounding two years data, averaged (Fall 1987 or Fall 1991)
- Other timeframes were selected by examining hydrographs and groundwater level trends
- Where all above unavailable outside of the model boundary, depth to water was extrapolated

Observation data were interpolated to develop a raster representing initial groundwater levels over the model domain. Due to the lack of construction information for many of the WDL monitoring locations, the groundwater heads described above are used for all layers. The model "warm up" period from WY1989 to WY1994 allows the model time to equilibrate the groundwater conditions to smooth any issues that might arise from lack of data or erroneous data. The initial conditions for CoSANA representing October 1, 1989 are shown in Figure 2-40.

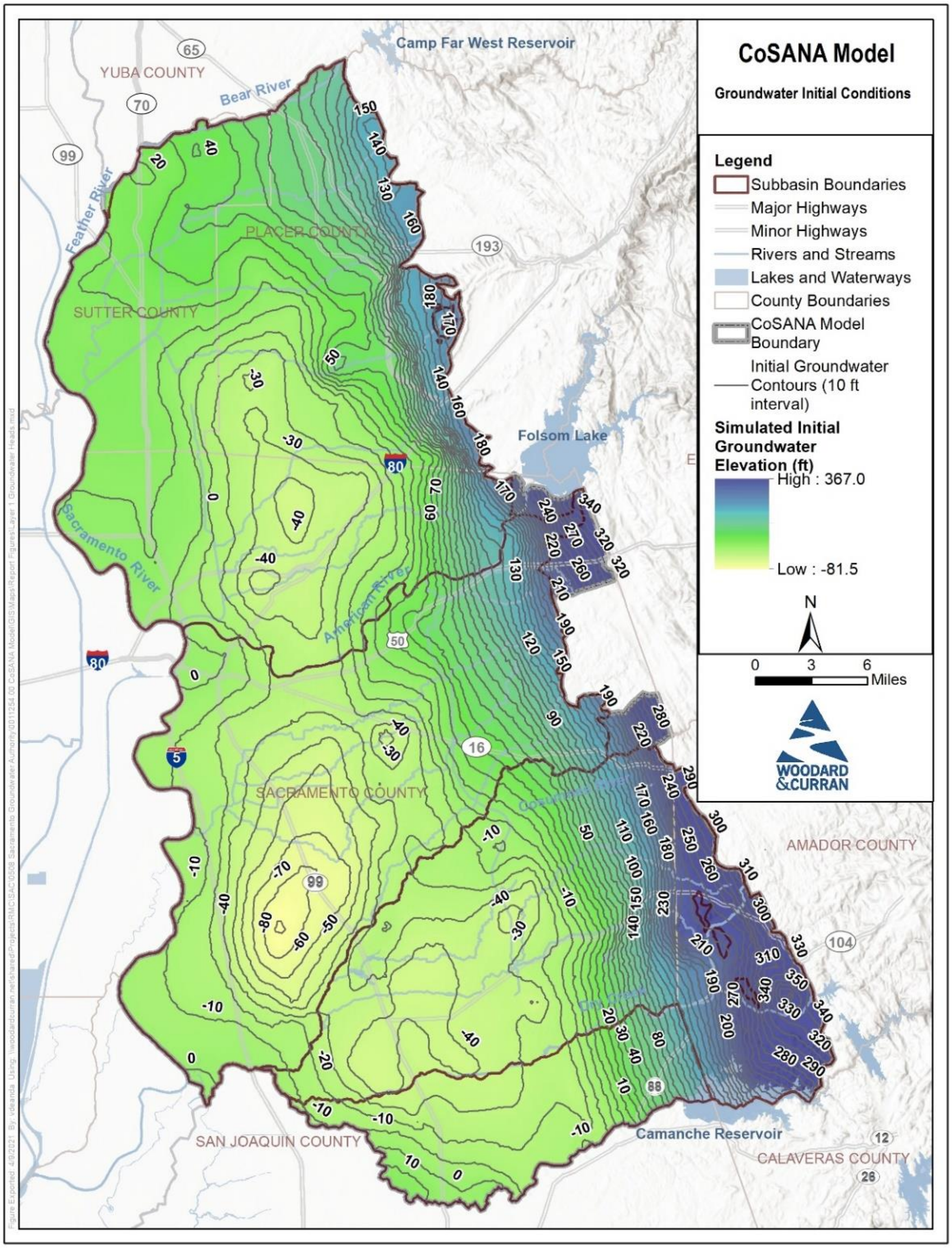


Figure 2-40: Initial Conditions, Groundwater Heads, Fall 1989

3. WATER SUPPLY AND DEMAND DATA

The following sections describe the data and methodology for developing CoSANA water demand and supply input data. Typically, agricultural and urban supplies are specified in IWFM's groundwater pumping and surface water diversion data, and agricultural and urban demands are calculated using the IWFM IDC. In the case of CoSANA, the urban demands for historical period were provided for each one of the urban water purveyors and were input in the model directly.

3.1 Water Supply

Both the agricultural demands estimated by IDC and the urban demands are primarily met through the IWFM representation of surface water diversions and groundwater pumping. Other sources of water simulated in IWFM to meet demand include recycled water, remediated (reuse) water, precipitation, and existing moisture in the soil.

3.1.1 Surface Water Supply

Historical surface water diversions for the simulation period were compiled from a combination of sources discussed in more detail in Sections 3.2 and 3.3, including gage data, water rights reports, Urban Water Management Plans (UWMPs), Agricultural Water Management Plans (AWMPs), and other sources. Some diversions were estimated based on historical demands. A summary of diversions simulated in the model is provided in Appendix A, along with the actual percentage of diverted water that is delivered after the delivery losses are accounted for. Delivery losses comprise recoverable losses (i.e., seepage along delivery and unlined canals) and non-recoverable losses (i.e., evaporation from canals).

Many diversions provide water across two or more model subregions, so deliveries are assigned to a group of elements representing the delivery area, rather than a subregion. Diversions are either assigned to a stream node near the point of diversion or they are treated as imports if the point of diversion is outside model area. Figure 3-1 to Figure 3-3 show schematic diagrams of the surface water delivery system simulated in CoSANA.

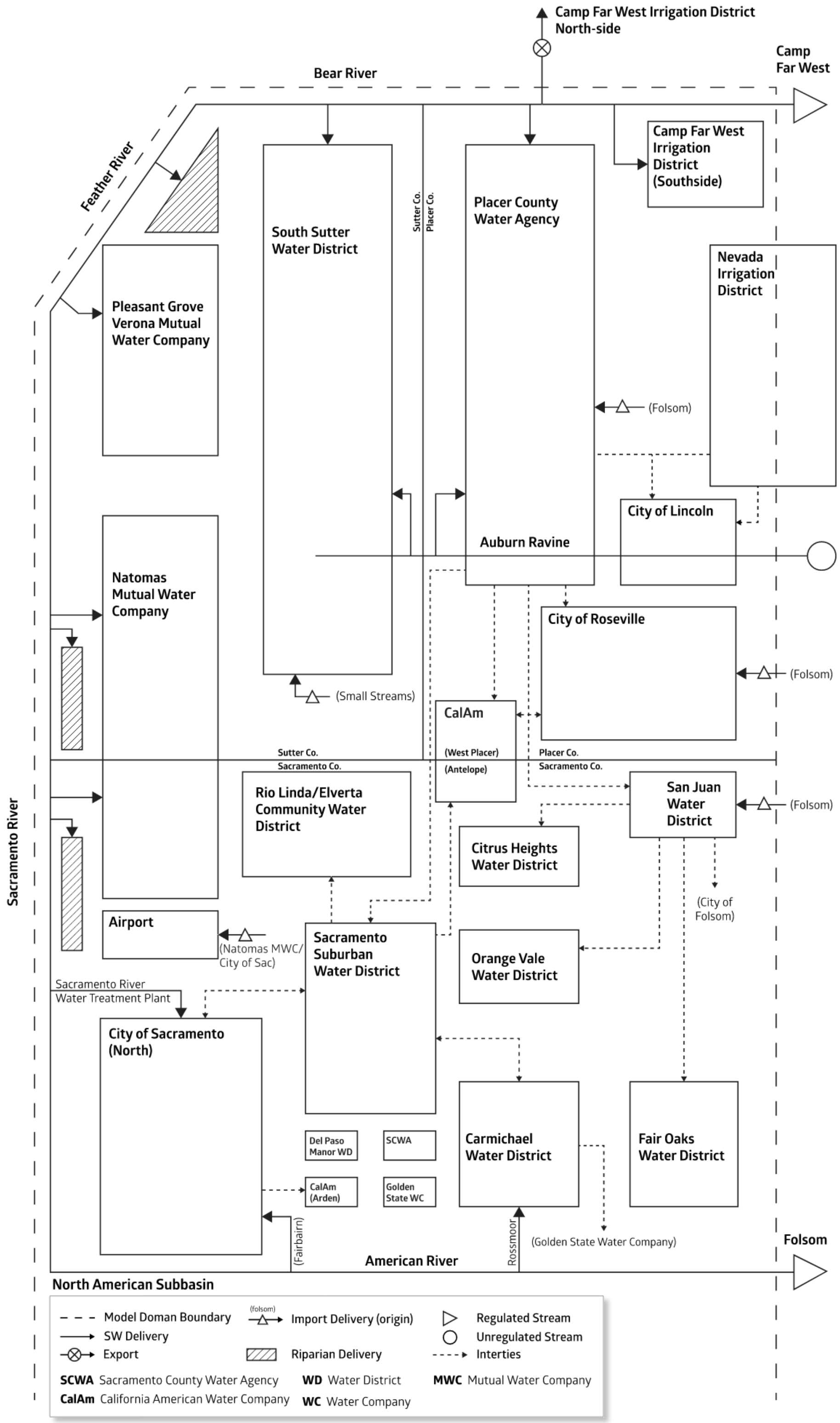


Figure 3-1: CoSANA NASb Surface Water Delivery Schematic

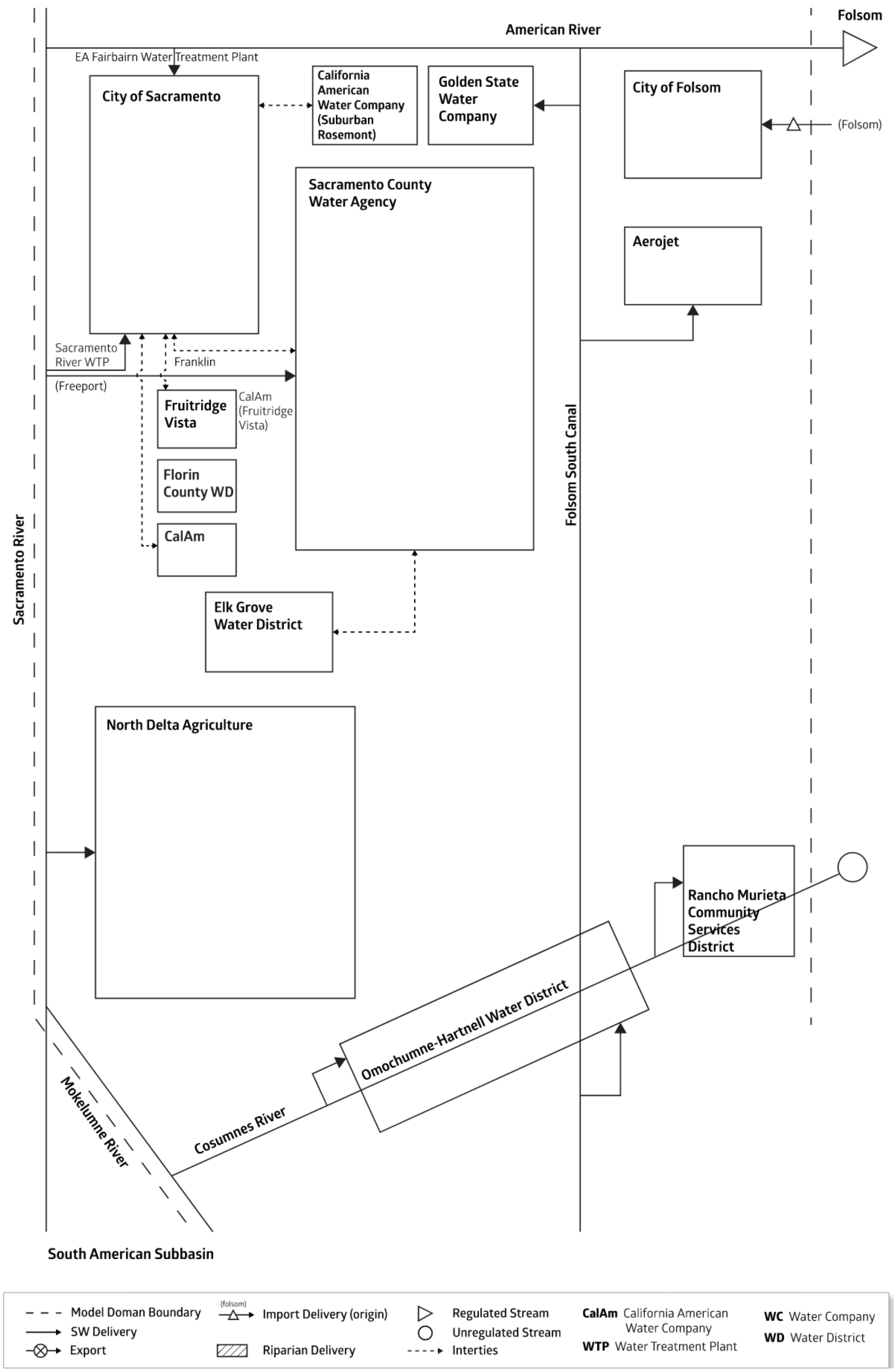


Figure 3-2: CoSANA SASb Surface Water Delivery Schematic

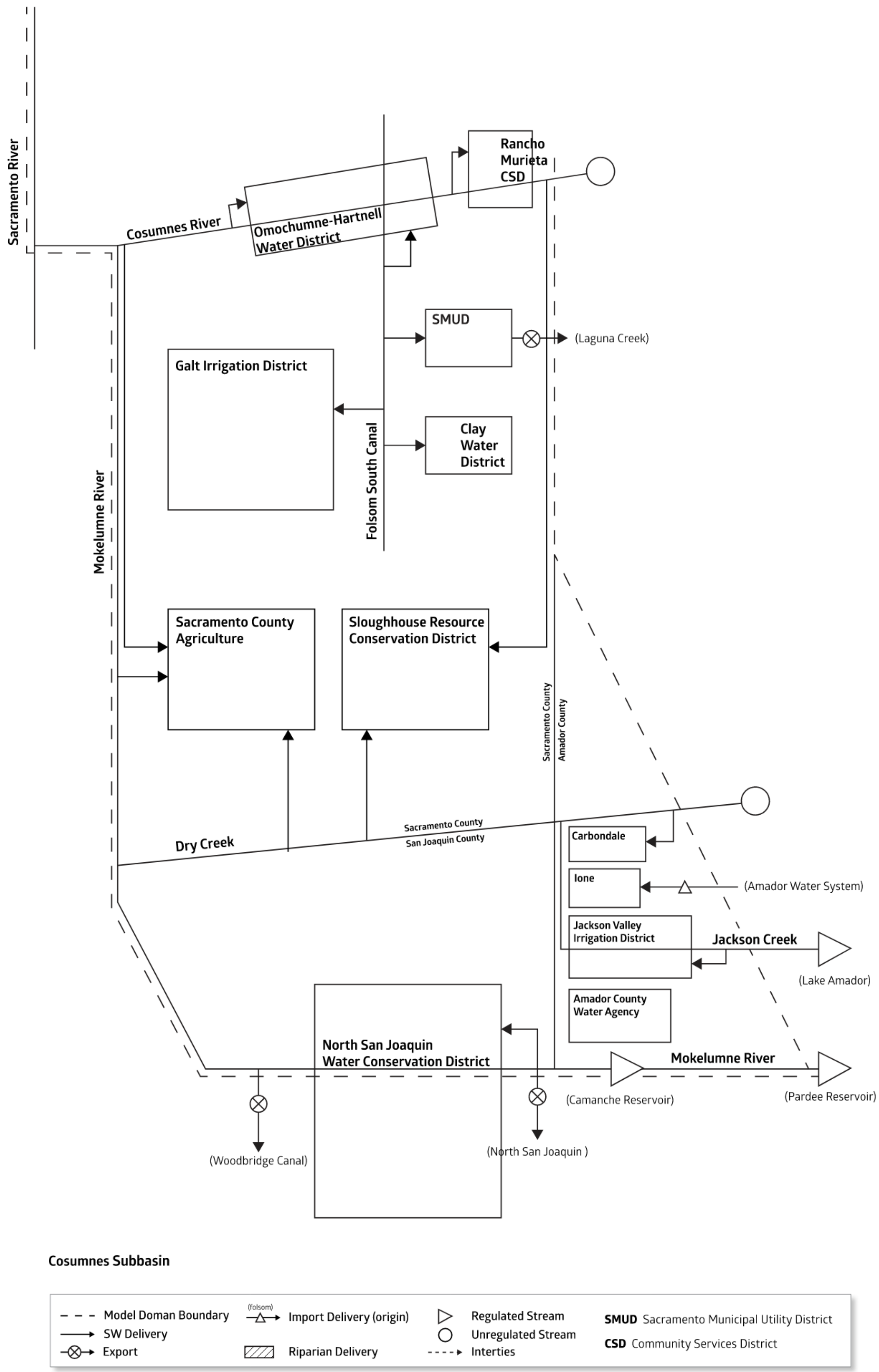


Figure 3-3: CoSANA CoSb Surface Water Delivery Schematic

3.1.2 Groundwater Pumping

Groundwater pumping within CoSANA is separated into pumping by wells and pumping by elements. The former largely includes agency-operated wells that deliver groundwater to a public water supply system, as well as groundwater contamination remediation operations where data are available by well. The latter includes estimated agricultural and domestic (including rural residential) groundwater pumping.

Where available, pumping data are specified on a monthly basis throughout the historical simulation period. Data provided typically included well locations, total depth, screen perforation depth, use (agricultural, urban, or remediation) and historical monthly pumping records. Agricultural and rural residential pumping volumes are not typically known and were estimated by the model to meet demands not satisfied through other sources (e.g., well pumping and surface water deliveries.)

3.2 Urban Water Demand and Supply

Urban demands are provided by the urban water purveyors for the historical model period. The monthly urban demands are directly inputted into the model for each urban purveyor.

It was assumed that an annual average of 60% of urban water is used indoors and 40% is used outdoors. CoSANA uses monthly fractions for indoor and outdoor use, with the majority of urban water demand due to indoor activities from November through March and up to 60% of urban water used outdoors for the remainder of the year. Assumed monthly fractions for City of Galt indoor and outdoor use were adjusted to better match those reported by the City of Galt.

Table 3-1 lists the number of wells by type and purveyor included in CoSANA. Figure 3-4 shows the locations of the urban pumping wells in CoSANA, including those shown in Table 3-1 and some additional smaller users including Sacramento International Airport, fish farms, and others.

Table 3-1: Summary of CoSANA Well Pumping by Urban Purveyor

Purveyor	Number of Municipal Pumping Wells	Average Annual Municipal Pumping (WY 1995-2018, acre-feet)
California American Water Company	135	39,666
Cal Am (formerly Fruitridge Vista WC)	20	4,220
Camanche Village (Amador County WA)	6	258
Carmichael WD	17	4,025
Citrus Heights WD	14	987
City of Galt	25	4,716
City of Lincoln	5	717
City of Roseville	6	18
City of Sacramento	68	20,427
Del Paso Manor WD	10	1,536
Elk Grove WD	17	5,144
Fair Oaks WD	12	1,262
Florin County WA	10	2,624
Golden State WC	33	9,897
Orange Vale WC	2	0
Rio Linda Elverta CWD	13	2,990
Sacramento County WA	118	27,510
Sacramento Suburban WD	119	29,905
Total Average Annual Pumping (acre-feet)		155,902

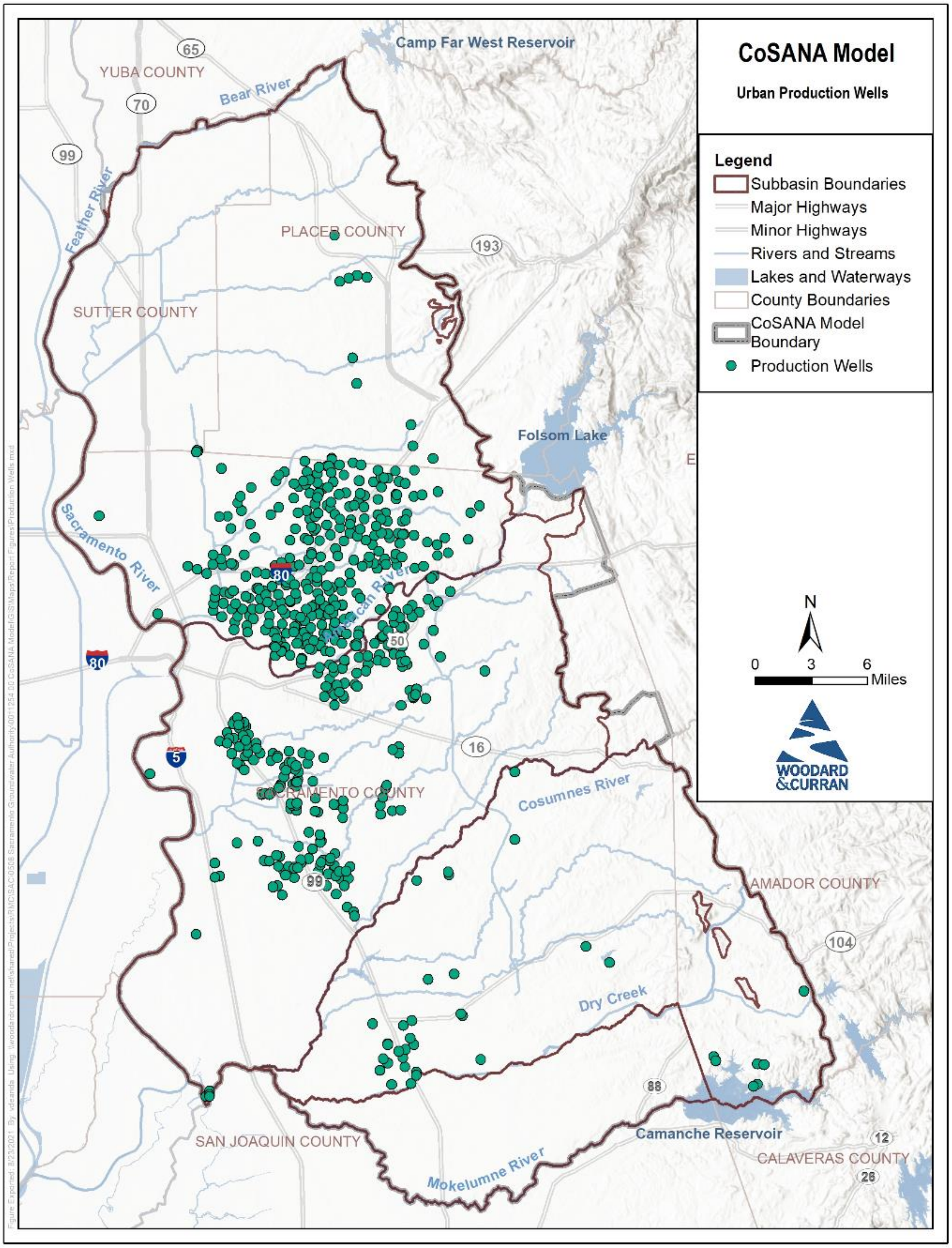


Figure 3-4: Locations of Urban Groundwater Production Wells

The following sections provide a brief description of water supplies for each of the urban water purveyors in each Subbasin.

3.2.1 North American Subbasin

This section briefly describes the urban demand and supply assumptions used in the historical CoSANA for the purveyors within the NASb. Averages presented are for the calibration period, WY 1995-2018. RWA (M. Garcia, personal communication, August 29, 2019) provided data for many of the individual entities listed below.

3.2.1.1 California American Water Company (Antelope)

California American Water Company (Cal Am) Antelope receives an average of 170 acre-feet per year (AFY) of surface water supplied via an intertie with Sacramento Suburban Water District (WD). Groundwater supply meets remaining demand with an average of 5,621 AFY. Data sources include SacIWRM (to 2004), RWA (service area data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.1.2 California American Water Company (Arden)

Cal Am Arden is primarily supplied by groundwater, an average of 2,830 AFY, with approximately 2 AFY being met by surface water supplied by the City of Sacramento. Data sources include SacIWRM (to 2004), RWA (service area data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.1.3 California American Water Company (Lincoln Oaks)

Cal Am Lincoln Oaks receives an average of 245 AFY of surface water supplied via an intertie with Sacramento Suburban WD. Groundwater supply meets remaining demand, with an average of 8,869 AFY. Data sources include SacIWRM (to 2004), RWA (service area data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.1.4 California American Water Company (West Placer)

Cal Am West Placer service area supply includes 725 AFY of surface water sourced from Placer County Water Agency (PCWA). RWA provided data for 2011-2018. Data prior to 2011 is estimated based on annual data provided by GEI Consultants (R. Shatz, personal communication, March 5, 2020).

3.2.1.5 Carmichael Water District

Carmichael WD uses an average 7,155 AFY of surface water from the American River and 4,080 AFY of groundwater from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.6 Citrus Heights Water District

Citrus Heights WD supply includes 16,015 AFY of surface water sourced from San Juan WD and 952 AFY of groundwater from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.7 Del Paso Manor Water District

Supply for Del Paso Manor WD is met entirely by groundwater pumping from district wells and averages 1,549 AFY. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.8 Fair Oaks Water District

Fair Oaks WD supplies include an average of 11,145 AFY of surface water received from San Juan WD and 1,183 AFY of groundwater from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.9 Golden State Water Company (Arden)

Golden State Water Company (WC) Arden supply includes an average of 1,169 AFY of groundwater pumping from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.10 City of Lincoln

On average, 6,218 AFY of the City of Lincoln's water supply comes from surface water supplied by PCWA and Nevada Irrigation District. The remaining 739 AFY of supply is provided by groundwater production from city wells. Data for 2008-2018 was provided by the City of Lincoln. Data for 2005 to 2008 is estimated based on annual data from the City of Lincoln UWMPs (2010, 2015). Data prior to 2005 is from SacIWRM

3.2.1.11 Orange Vale Water Company

Orange Vale WC on average receives 4,191 AFY of surface water sourced from San Juan WD. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.12 Placer County Water Agency (City of Rocklin Retail Service Area)

PCWA serves the City of Rocklin for retail customers. Remaining portions of PCWA's service area within the model are served by other retail water purveyors or are self-supplied by groundwater. Supply to the City of Rocklin is on average 4,578 AFY, based on data from PCWA (R. Cox, personal communication, July 17, 2019) for WY 2016-2018. All demand is assumed to be met by surface water. Lacking other data sources, data from 2016 was used for previous years.

3.2.1.13 Rio Linda / Elverta Community Water District

Rio Linda/Elverta CWD is primarily supplied by groundwater pumping, averaging 3,010 AFY. The remaining 5 AFY is from surface water sourced from an intertie with the City of Sacramento. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.14 City of Roseville

The City of Roseville receives, on average, 27,943 AFY of surface water sourced from Folsom Reservoir, with the remaining 126 AFY of supply met by groundwater pumping from city wells. Data were provided by the City of Roseville for 1986-2018. Gaps in data existed for 1999-2000 and 2008-2009; these were filled by interpolating data from surrounding years. Data prior to 1986 is from SacIWRM. Data from the City of Roseville also included details on groundwater injection as part of the city's aquifer storage and recovery program.

3.2.1.15 Sacramento Suburban Water District

Sacramento Suburban WD supply mix includes 32,396 AFY of groundwater production from district wells and 10,024 AFY from surface water sourced via intertie with PCWA and the City of Sacramento. Data sources include SacIWRM (to 2004), and RWA (after 2004).

3.2.1.16 City of Sacramento

The City of Sacramento receives on average 97,488 AFY of surface water from their water treatment plants on the American and Sacramento Rivers. Remaining demand is met by groundwater production from city wells that averages 20,225 AFY. This demand is spread across both the NASb and the SASb. Data sources include SacIWRM (to 2004), and RWA (after 2004).

3.2.1.17 Sacramento International Airport

The Sacramento International Airport receives on average 175 AFY from the City of Sacramento (based on data from RWA). Remaining demand of 968 AFY is assumed to be met by groundwater (based on SacIWRM demand).

3.2.1.18 San Juan Water District

San Juan WD average supply is estimated to be 5,196 AFY within the model area and is met entirely by surface water from Folsom Lake. This is based on retail data for the district supplied by RWA (after 2004) and assumes that 37% of the districts retail service area is within the CoSANA boundary. Data prior to 2004 is based on SacIWRM.

3.2.1.19 Sacramento County Water Agency (Arden Park Vista)

Demand for the Sacramento County Water Agency (SCWA) Arden Park Vista service area averages 3,911 AFY and is met entirely by groundwater pumping from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.1.20 Sacramento County Water Agency (Northgate)

Supply for the SCWA Northgate service area averages 940 AFY and is met entirely by groundwater pumping from district wells. Data sources include SacIWRM (to 2004) and RWA (after 2004).

3.2.2 South American Subbasin

This section briefly describes the urban demand and supply assumptions used in the historical CoSANA for the purveyors located within the SASb.

3.2.2.1 California American Water Company (Fruitridge - formerly Fruitridge Vista Water Company)

Cal Am Fruitridge Vista is serviced almost entirely by groundwater production from Cal Am wells. Some small surface water transfers are reported, which average to 1 AFY. Data sources include SacIWRM (to 2011), HydroDMS (2012-2013), and SCGA (2014-2018).

3.2.2.2 California American Water Company (Parkway)

Cal Am Parkway receives on average 592 AFY of surface water delivered via an intertie with the City of Sacramento; the remaining 10,699 AFY is supplied from groundwater production from Cal Am wells. Data sources include SacIWRM (to 2011), RWA (service area data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.2.3 California American Water Company (Security Park)

Cal Am Security Park averages 31 AFY demand, met by groundwater production from Cal Am wells. Data sources include SacIWRM (to 2011), RWA (service area level data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.2.4 California American Water Company (Suburban Rosemont)

Cal Am Suburban Rosemont receives on average 110 AFY of surface water delivered via an intertie with the City of Sacramento, with the remaining 12,296 AFY supplied from groundwater production from Cal Am wells. Data sources include SacIWRM (to 2011), RWA (service area level data including surface water diversions for 2011 onwards), and Cal Am (well-by-well pumping data for 2004-2018).

3.2.2.5 Elk Grove Water District (Service Area 1)

Supply for Elk Grove WD Service Area 1 averages 5,189 AFY and is met by groundwater production from district wells. Data sources include SacIWRM (to 2009) and Elk Grove Water District (after 2009).

3.2.2.6 Florin County Water District

Florin County WD supply averages 2,623 AFY, entirely sourced by groundwater production from district wells. Data is from SacIWRM. Actual production values are not known for this area, and demand is estimated.

3.2.2.7 City of Folsom

The City of Folsom has an average demand of 20,451 AFY, with 100% of its supply coming from surface water diverted from Folsom Lake. Data sources include SacIWRM (to 2011) and RWA (after 2011).

3.2.2.8 Golden State Water Company (Cordova)

Golden State WC Cordova receives on average 6,287 AFY of surface water, primarily from water diverted from the American River via the Folsom South Canal. The remaining 8,977 AFY of demand is met by groundwater production from Golden State wells. Data sources include SacIWRM (to 2011) and RWA (after 2011).

3.2.2.9 Rancho Murieta Community Service District

Rancho Murieta CSD supply averages to 1,833 AFY, which is fully met by surface water diverted from the Cosumnes River. This is based on data on the number of service connections and water use from the 2006 Rancho Murieta Community Services District Integrated Water Master Plan and the 2010 Update.

3.2.2.10 City of Sacramento

(See North American Subbasin)

3.2.2.11 Sacramento County Water Agency (Hood)

SCWA Hood service area has an average demand of 47 AFY which is supplied by groundwater production from agency wells. Data sources include SacIWRM (to 2011) and RWA (after 2011).

3.2.2.12 Sacramento County Water Agency (Laguna Vineyard)

SCWA Laguna Vineyard service area (including Elk Grove WD Service Area 2) has an average supply mix of 17,340 AFY of groundwater production from agency wells, 3,314 AFY of surface water primarily sourced from the Sacramento River, and 232 AFY of recycled water. Data sources include SacIWRM (to 2011), HydroDMS (2012-2013), and SCGA (2014-2018).

3.2.2.13 Sacramento County Water Agency (Mather)

SCWA Mather service area average supply mix that includes 3,958 AFY of groundwater production from agency wells, and 233 AFY surface water primarily sourced from the Sacramento River via the Vineyard Surface Water Treatment Plant. Data sources include SacIWRM (to 2011), HydroDMS (2012-2013), and SCGA (2014-2018).

3.2.3 Cosumnes Subbasin

This section briefly describes the urban demand and supply assumptions used in the historical CoSANA for the purveyors located within the CoSb.

3.2.3.1 Amador County Water Agency (Camanche Village)

Amador County WA Camanche Village service area has an average supply of 257 AFY which is met 100% by groundwater production from agency wells. Data sources include monthly pumpage from four Camanche wells and two Camanche north shore wells, as reported by Amador County Water Agency (G. Mancebo, personal communication, April 29, 2019).

3.2.3.2 Amador County Water Agency (Ione)

Amador County WA supply to the City of Ione averages 2,130 AFY which is entirely surface water. Ione supply was estimated from reported wastewater treatment plant flows and population. Data sources include treated wastewater flows from Amador Water Agency (B. Cook, personal communication, December 9, 2019) and population data from the California Department of Finance.

3.2.3.3 City of Galt

The City of Galt has an average supply of 4,737 AFY, which comes entirely from groundwater production from municipal wells. Data sources include monthly pumpage from a total of 18 wells, as reported by the City of Galt (M. Clarkson, personal communication, March 22, 2019).

3.2.3.4 Rancho Murieta Community Service District

(see South American Subbasin section)

3.2.4 Fish Farms

The 2011 South Basin Groundwater Management Plan reported that there is approximately 11,000 AFY pumping to supply water to fish farms in the Cosumnes Subbasin. This annual pumping estimate was allocated to six fish farms based on the relative area of each fish farm and the annual pumping rate was converted to monthly rates in proportion to monthly ET_o rates. Inspection of aerial photos in Google Earth was used to determine when each fish farms was developed and when pumping from each fish farm was likely to have begun.

3.2.5 Galt Wastewater Treatment Plant Effluent

All effluent and stormwater from the City of Galt is routed to the wastewater treatment plant, where it is ultimately either released to Skunk Creek (tributary of Laguna Creek) or used for irrigation of surrounding fields. The 2011 South Basin Groundwater Management Plan (South Area Water Council, 2011) reported that the City of Galt applies an average of approximately 700 AFY to fields for irrigation. The wastewater treatment plant came online in 1983. As such, a variable monthly application rate based on an assumed monthly supply requirement was specified for 1983 through 2019.

3.3 Agricultural Water Demand and Supply

Agricultural water demand is the amount of irrigation water that is required to satisfy the crop evapotranspiration requirement and to meet other irrigation practices. IDC is designed to estimate the agricultural water demand for each model element through consumptive use methodology. IDC dynamically calculates crop demand at each model time step based on factors including crop type, crop evapotranspiration, rainfall, hydrologic soil type, and irrigation practices. The IDC calculations rely on model input data for historical crop acreage, irrigation practices (e.g., return and reuse fractions, irrigation period), soil moisture requirements, effective rainfall (the portion of rainfall available for crop consumptive use), crop evapotranspiration, and localized soil parameters. These data were compiled, analyzed, synthesized, and processed for input in CoSANA.

Precipitation, land use, evapotranspiration, and soil properties are discussed in the relevant sections in Chapter 2. The irrigation period, using data from C2VSimFG, defines irrigation as either on or off for each crop and for each month of the model simulation period. Most trees are assumed irrigated from April through October, vineyards from April through November, most field crops from May through September, and most truck crops from April through September. Crops with irrigation assumed year-round include citrus and subtropical trees, irrigated pasture, and alfalfa. Fractions to represent return flow (i.e., irrigation flow following the model drainage pattern discussed in Section 2.5) and reuse (i.e., the fraction of applied irrigation water to be reused for irrigation) are based on data from C2VSimFG. All non-ponded CoSANA agricultural lands are assigned a 5% return flow and 1% reuse factor. Rice during the growing season is assigned an average 13% return flow and an average 9% reuse factor, with variability depending on the month of the year. Riceland when flooded for decomposition in the non-growing season is assigned an average 9% return flow and an average 6% reuse factor, also with variability depending on the month of the year. Urban landscape areas are assumed to have 0% return flow and 0% reuse.

3.3.1 Rural-Residential Pumping

Private groundwater pumping quantities on an individual well basis are largely unknown; therefore, private rural-residential pumping in CoSANA is estimated by IWFM on an element basis. Water demands at each relevant element are used to calculate pumping necessary to meet the urban demand estimated by IDC after water purveyor pumping and surface water has been distributed.

The perforation interval, which dictates the layers a simulated well extracts water from, were assigned separately to the domestic (i.e., rural residential) and agricultural wells. Rural residential wells used a statistical analysis of perforation interval developed for C2VSimFG. Perforation interval data were compiled by DWR using data from the CASGEM and Online System for Well Completion Reports databases. Simulated perforation intervals were assigned as the 5th and 95th percentiles of the well perforation interval data for each township/range block.

Demand for rural residential areas, or areas outside of those supplied by a public water system, was based on estimated population and water consumption outside of areas supplied by a public water system. To estimate demand in these areas, the areas themselves were isolated spatially by removing all areas served by a public water system. Population density for the rural residential areas is developed based on census tract data, and estimated per capita water use is developed for a typical household based on information from the California Water Plan (DWR, 2018b).

For the rural-residential area within the CoSb, outdoor water use was estimated from per-parcel water demand and approximate total number of rural-residential parcels. The estimated average per-parcel outdoor water demand is 2.5 AFY based on a detailed inspection of land use for 10 random parcels. Visual inspection of Google Earth aerial photographs identified approximately 3,200 rural-residential parcels, resulting in an average annual outdoor water use of 8,000 AFY. All indoor water use was assumed to return to the subsurface through septic systems and was therefore not explicitly modeled.

3.3.2 Agricultural Pumping

Private groundwater pumping volumes, location, and pumping depth for agricultural water supplies are largely unknown, though aggregate estimates for private pumping are often included in planning documents (e.g., AWMPs, groundwater management plans). Therefore, agricultural pumping in CoSANA is estimated by IWFM on an element basis. Water demand at each relevant element is used to calculate any additional pumping necessary to meet the agricultural demand estimated by IDC after public water system pumping and surface water has been distributed.

3.3.3 Agricultural Groundwater Substitution Transfers

CoSANA includes 55 agricultural groundwater substitution transfer pumping wells, shown in Figure 3-5. All agricultural groundwater substitution transfer pumping operations occur in the NASb and include Pleasant Grove Verona MWC (PGVMWC) and Natomas MWC (NMWC). South Sutter WD also operates a transfer program that is similar in many respects to a groundwater substitution transfer. Transfer pumping volumes are known for PGVMWC and NMWC on a well-by-well basis. The volume of groundwater pumped is assumed to be applied to meet agricultural demand in the respective service areas. South Sutter WD transfer wells and pumping volumes are not known, but it is assumed that a reduction in surface water deliveries to the service area creates increased pumping demand, resulting in transfer pumping operations. A summary of agricultural transfer pumping wells in CoSANA is shown in Table 3-2.

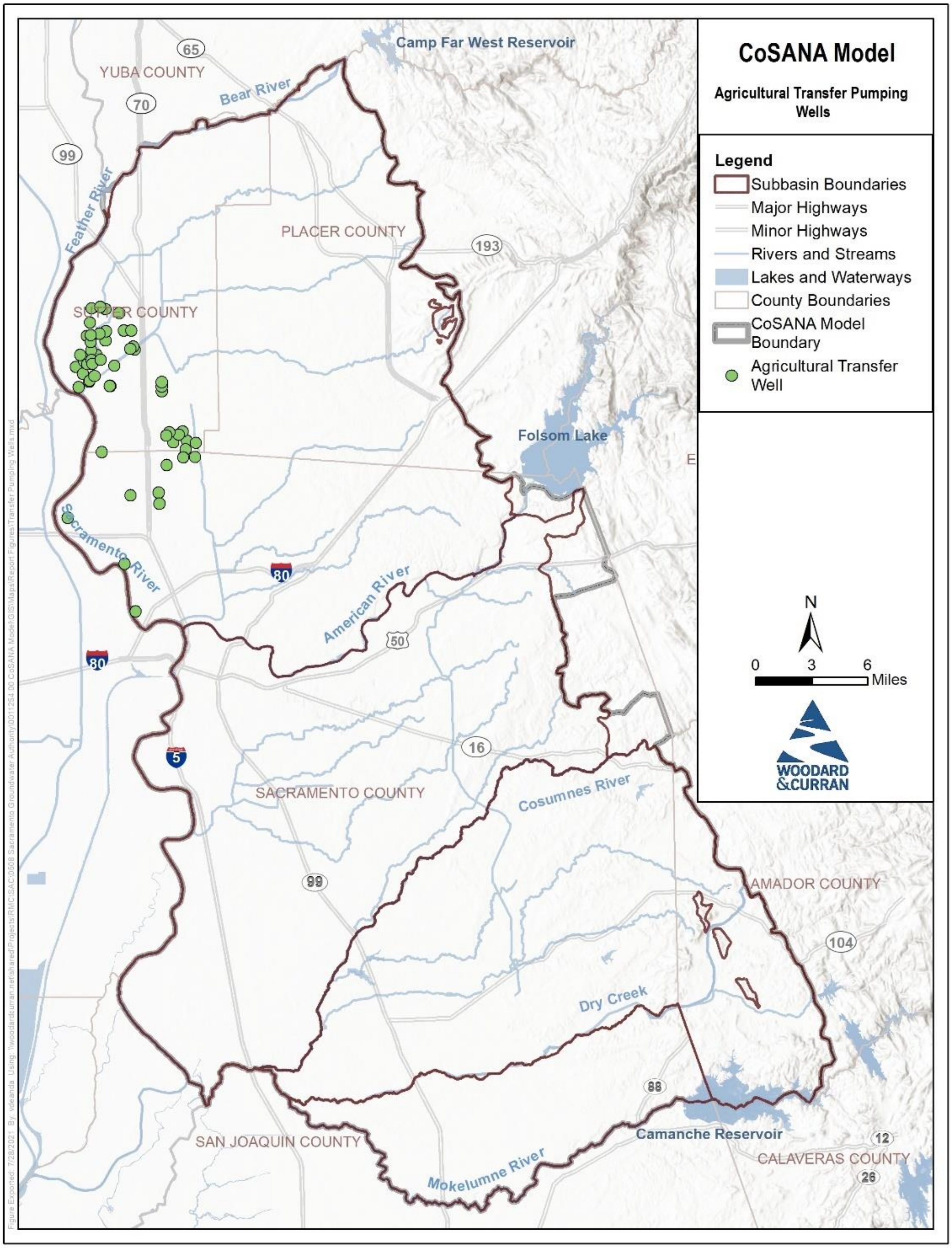


Figure 3-5: Locations of Agricultural Groundwater Substitution Transfer Pumping Wells

Table 3-2: Summary of Agricultural Groundwater Substitution Transfer Pumping

Agency	Number of Groundwater Transfer Pumping Wells	Number of Simulated Transfer Years	Average Annual Pumping in a Transfer Year WY 1995-2018, (acre-feet)
Pleasant Grove Verona MWC	30	6	7,668
Natomas MWC	25	4	8,412
Total Average Annual Pumping (acre-feet)			16,080

3.4 Remediation Pumping

CoSANA includes 344 remediation wells (Figure 3-6) simulating remediation operations for Aerojet/IRCTS, McClellan AFB, Mather AFB, and Kiefer landfill. Data for Aerojet and IRCTS operations were provided by Aerojet (personal communication, J. Fourie, January 16, 2020); McClellan AFB remediations data were provided by McClellan AFB (G. Yuki, personal communication, October 23, 2020) and AECOM (P. Graff, personal communication, October 10, 2020); Mather AFB data were developed based on annual reports; data for Kiefer Landfill operations were provided by Sacramento County (M. Koza, personal communication, June 11, 2020). Remediation pumping volumes by entity are shown in Table 3-3. An annual summary of remediation pumping volumes by extraction entity is provided in Appendix B. Further, annual simulated pumping volumes for the major remediation efforts in the CoSANA model area are summarized by subregion in the land and water use budgets in Appendix C.

Table 3-3: Summary of CoSANA Remediation Operations:

Remediation Area (Subbasin)	Number of Groundwater Remediation Pumping Wells	Average Annual Remediation Pumping (WY 1995-2018, acre-feet)
Aerojet/IRCTS (NASb)	15	1,970
Aerojet/IRCTS (SASb)	190	19,703
Kiefer Landfill (SASb)	15	969
Mather AFB (SASb)	4	207
McClellan AFB (NASb)	113	1,899
Total Average Annual Pumping (acre-feet)		24,748

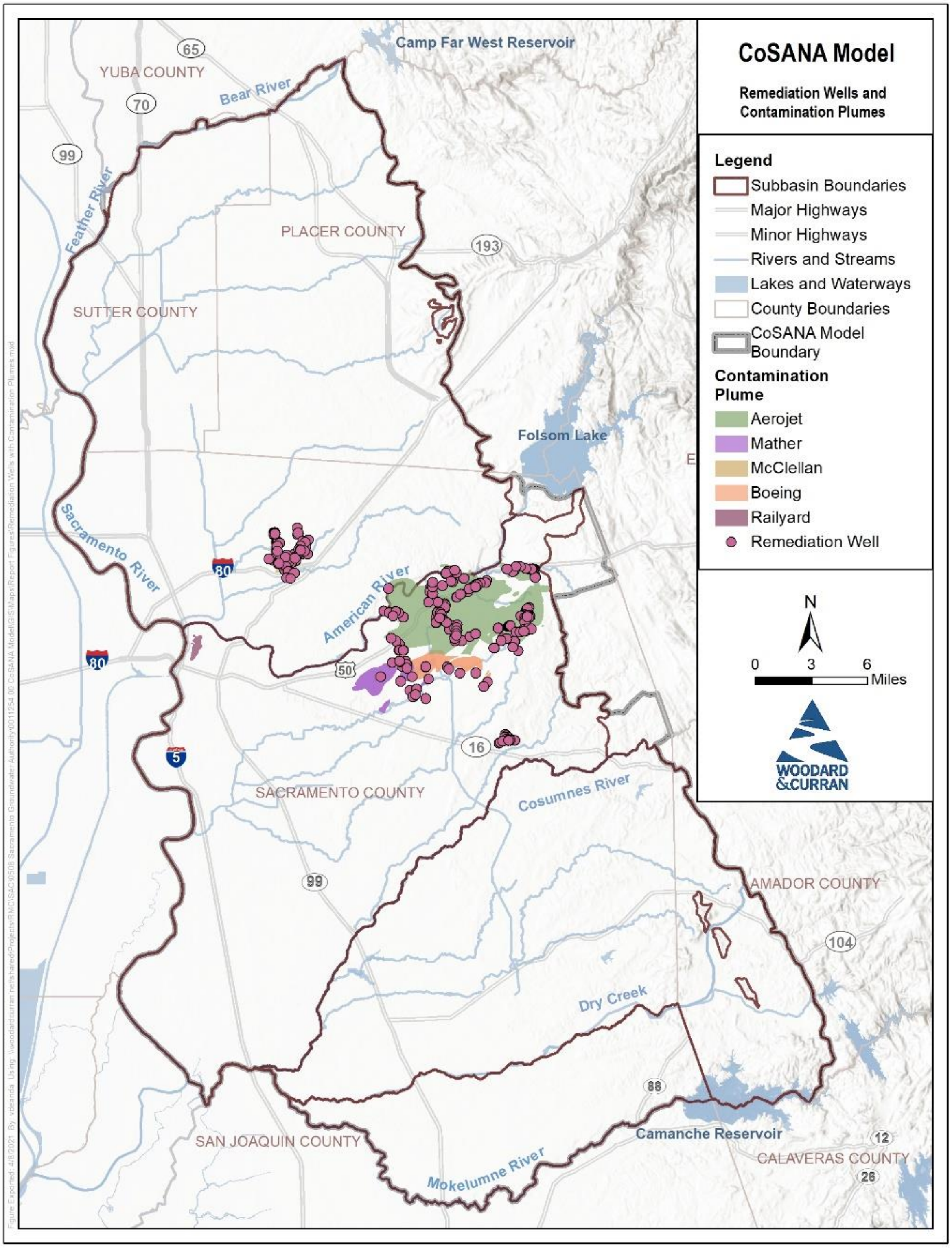


Figure 3-6: Locations of Remediation Pumping Wells

4. MODEL CALIBRATION AND SENSITIVITY ANALYSIS

CoSANA model is an integrated water resources model developed to simulate the integrated nature of the various components of the hydrologic system. Model calibration is an important part of model development, performed to meet the following objectives:

- Develop water budgets that properly represent various geographic scales, including the subbasin, GSA, and subregion scales, at both monthly and annual time scales,
- Represent the regional distribution of groundwater conditions, as well as the seasonal and long-term trends in groundwater levels at target calibration wells,
- Represent appropriate level of stream-aquifer interaction by simulating the modeled streams in such a way that the monthly and long-term streamflows at specific gaging stations properly represent the observed stream flow or stream stage data,
- Properly represent the interbasin flows across the boundaries internal to the CoSANA between the three subbasins modeled, as well as those between the neighboring subbasins outside the model area, in specific, Yuba, Yolo, Solano, and Eastern San Joaquin Subbasins.

Due to the complexities of calibrating an integrated water resources model, a hybrid approach for calibration was utilized to perform a manual calibration on initial water budgets and regional groundwater conditions and an automated calibration using PEST (Doherty, 2015) to achieve a refinement of the calibrated parameters that would result in a more accurate simulation. This calibration approach and process is similar to that used for calibration of the Central Valley's C2VSimFG, with special focus and attention to the regional and local data sets and information.

4.1 Calibration Goals

The goals of model calibration are to:

1. Represent the physical understanding of the model parameters within a range of reported values
2. Obtain a reasonable representation of water budgets for each of the hydrologic systems modeled (i.e., land and water use, stream flow, and groundwater budgets)
3. Achieve a reasonable general pattern of groundwater levels and flow directions
4. Optimize the agreement between simulated results and observed values for short-term seasonal and long-term trends in groundwater levels at selected calibration well
5. Optimize the agreement between simulated results and observed streamflow hydrographs or stream stage gages at selected gaging stations.

These goals are achieved through careful review of model input data and adjustments to model parameters. The model results also provide insight to key components of the groundwater basin including historical recharge, subsurface flows, gains/losses from/to streams and changes in groundwater storage.

CoSANA was calibrated to local data and knowledge, surface water flows, groundwater levels, and groundwater contours. The sources used include local knowledge (mainly gathered during the GSP Working Groups meetings), AWMPs, UWMPs, other local planning efforts, observed groundwater levels and associated contours, and observed streamflow data.

Due to uncertainty in the initial conditions, a "warm up" period is included to allow groundwater levels to stabilize. As previously noted, CoSANA includes data starting in October 1969 (WY 1970). To reduce run time, the model used for the historical calibration begins in October 1989 (WY 1990). The CoSANA calibration period begins after a five-year warm up period, in October 1994, and ends in September 2018; thus, the full period for model calibration is WY 1995 through 2018 (24 years).

4.2 Calibration Process

The calibration process is conducted as shown in Figure 4-1 and as described in the following subsections.

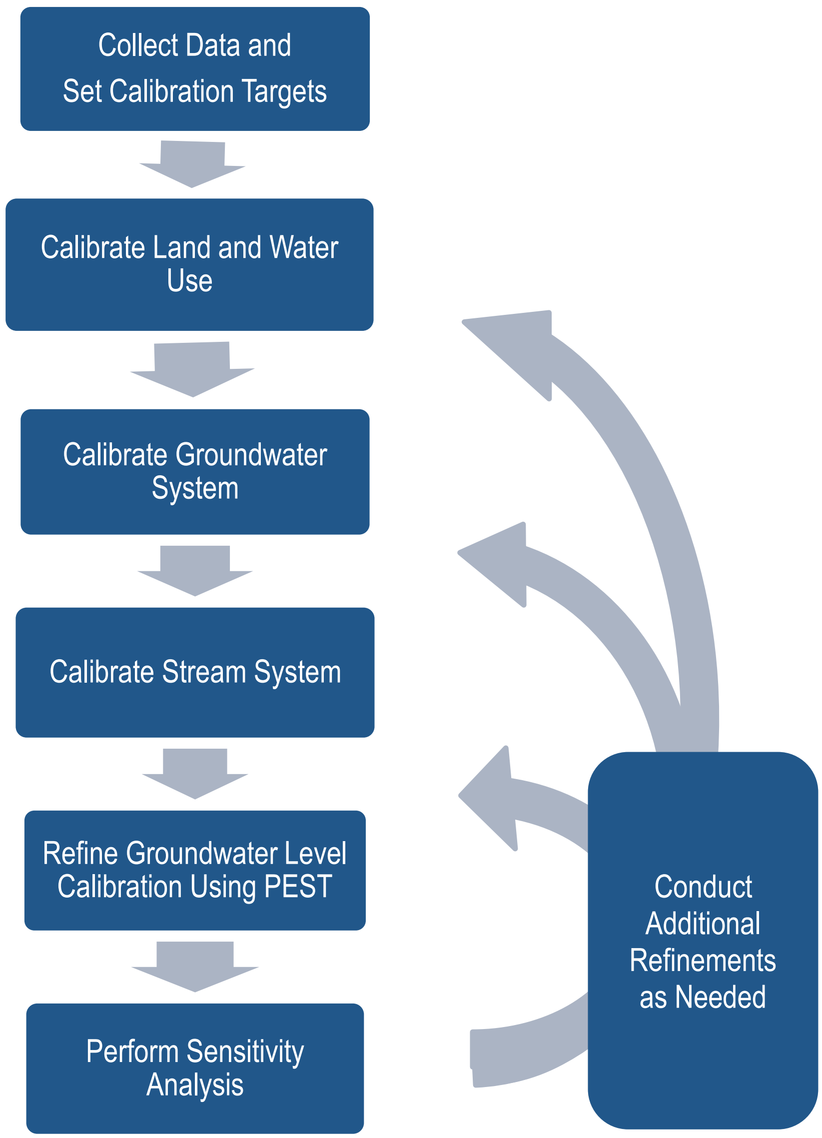


Figure 4-1: CoSANA Calibration Process

4.2.1 Water Budget Calibration

Water budgets are calibrated to improve the accuracy of the representation of the hydrologic characteristics of the groundwater basin. A water budget balances supplies, demands, and any subsequent change in storage occurring within that specific portion of the hydrologic cycle. IWFM automatically outputs budgets at the subregion scale for processes involving groundwater, the surface layer, streams, the root zone, small watersheds, and the unsaturated zone. IWFM can output budgets down to a single element or any specific grouping of elements.

During this step of the calibration process, model results are reviewed and summarized into monthly and annual (by water year) budgets. The primary budgets reviewed for calibration are the groundwater budget and the land and water use budget. Other budgets, notably the stream budget (see Appendix D), are also reviewed as part of the calibration process. After extensive budget analysis, key model datasets and parameters are adjusted, particularly groundwater aquifer parameters, to better match local budgets from local agricultural water purveyors and local planning efforts. The CoSANA water budget results are summarized in the following sections.

4.2.1.1 Land and Water Use Budget

The land and water use budget represents the balance of the IDC-calculated water demands with the water supplied and includes two different versions, agricultural and urban. Both the agricultural and urban versions include the same components that make up the water balance:

- Demands:
  - Demand (either agricultural or urban)
  - Surplus (if applicable)
- Supplies:
  - Groundwater pumping
  - Surface water deliveries (including recycled water deliveries)
  - Shortage (if applicable)

As part of the calibration of the land and water use budget, root zone parameters are adjusted as needed to achieve reasonable estimates of agricultural demand and to develop the components of a balanced root zone budget. IDC calibration serves as the foundation of the IWFM calibration for agricultural areas, as demand estimated often translates directly to groundwater pumping, which is the primary stress on the groundwater system. To adjust agricultural demand, element-level root zone parameters, particularly the soil hydraulic conductivity and the pore size distribution index, were adjusted in accordance with the hydrologic soil group and subregion. Spatial representation of these calibrated parameters is shown in Figure 4-2 through Figure 4-6. The IDC model was calibrated to achieve an irrigation efficiency of approximately 68% to 72%, consistent with agricultural water use values reported by irrigation districts in their AWMPs, as well as data from DWR's California Agricultural Water Use Model and California Water Plan.

The average annual water demand and supply mix used to meet the demand is summarized in Table 4-1. The average annual simulated land and water use budgets for the calibration period are presented in Figure 4-7 through Figure 4-14, showing the agricultural and urban demands and supplies in CoSANA both model wide and by subbasin. Additional detail on the Land and Water Use budget is included in Appendix C.

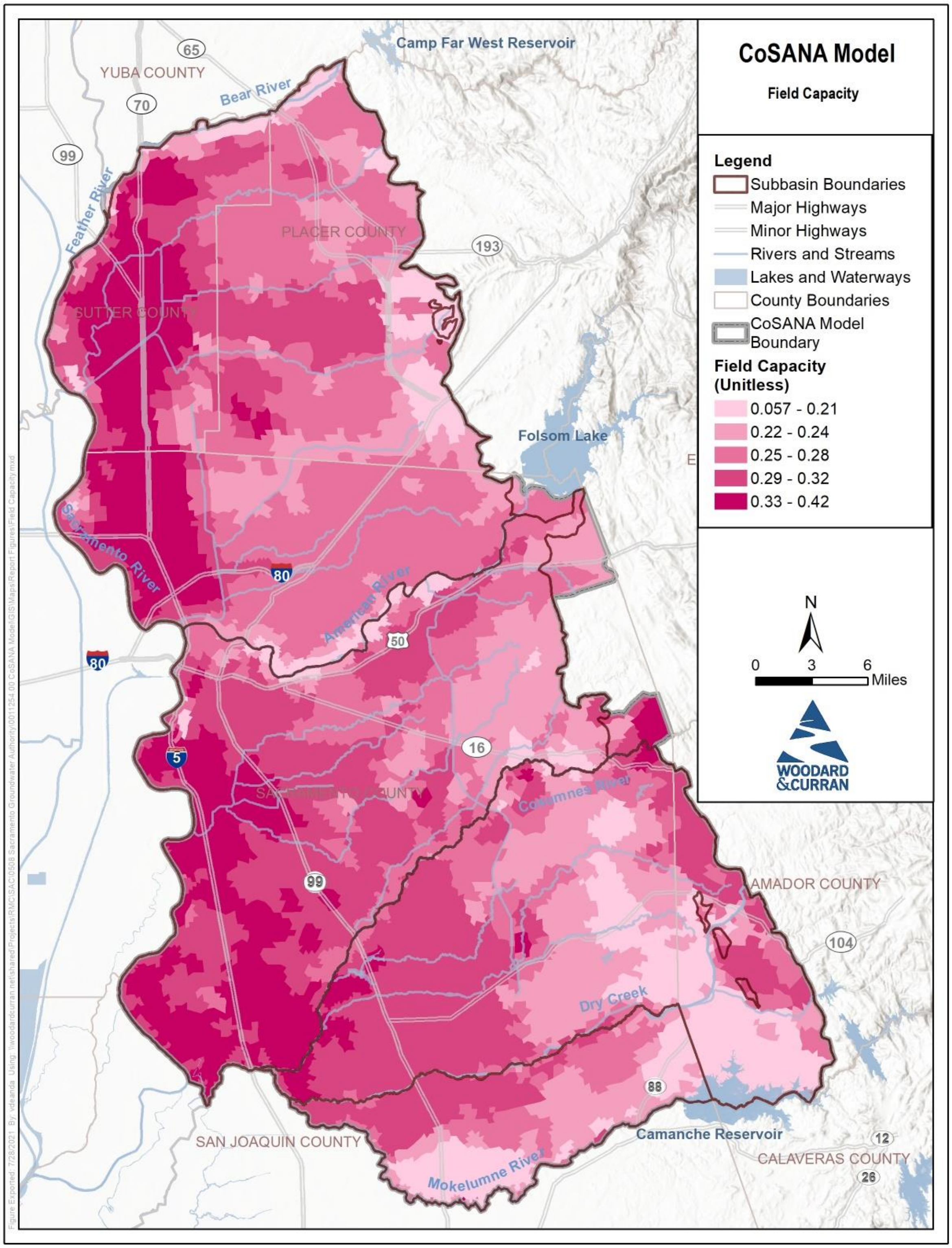


Figure 4-2: CoSANA Field Capacity

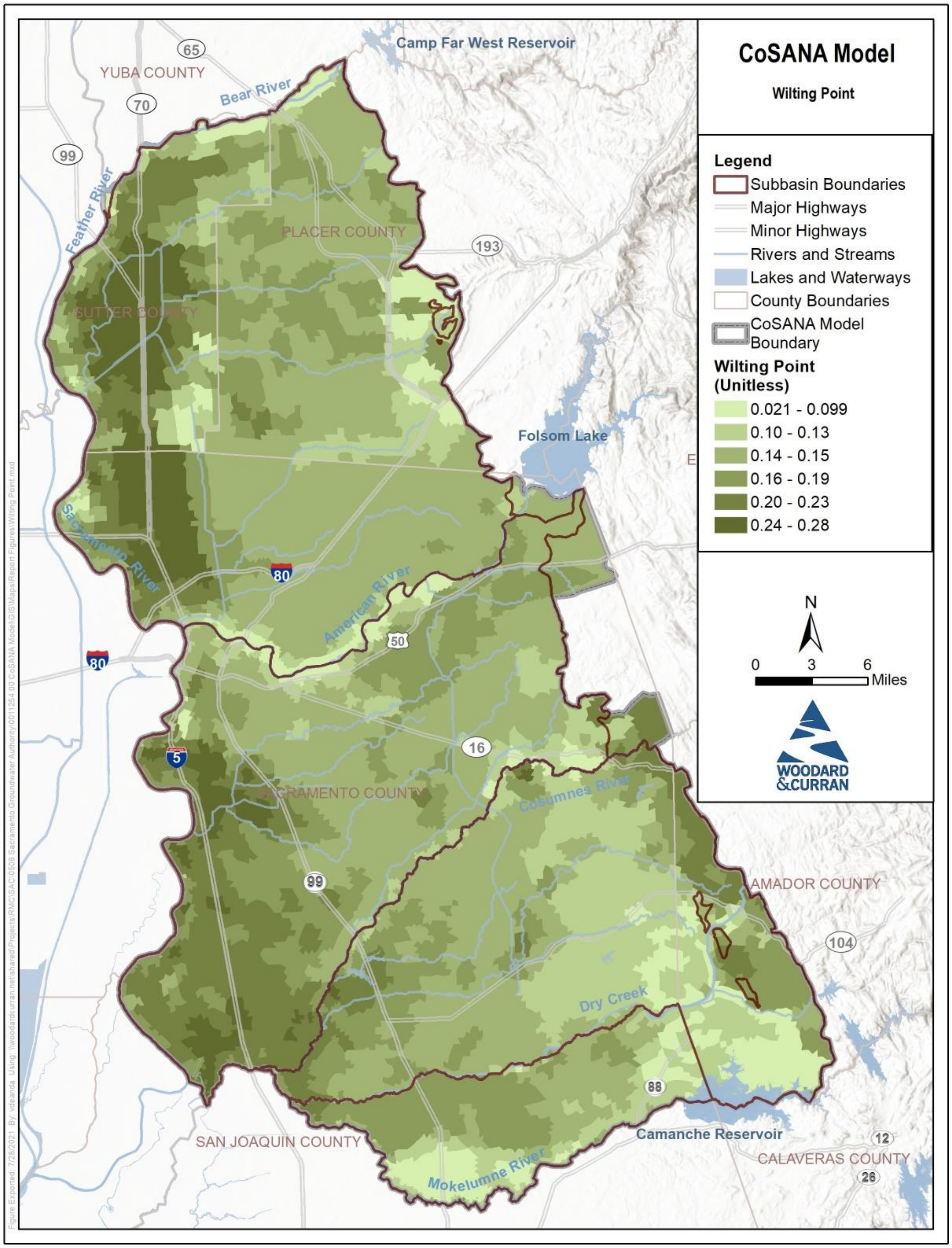


Figure 4-3: CoSANA Wilting Point

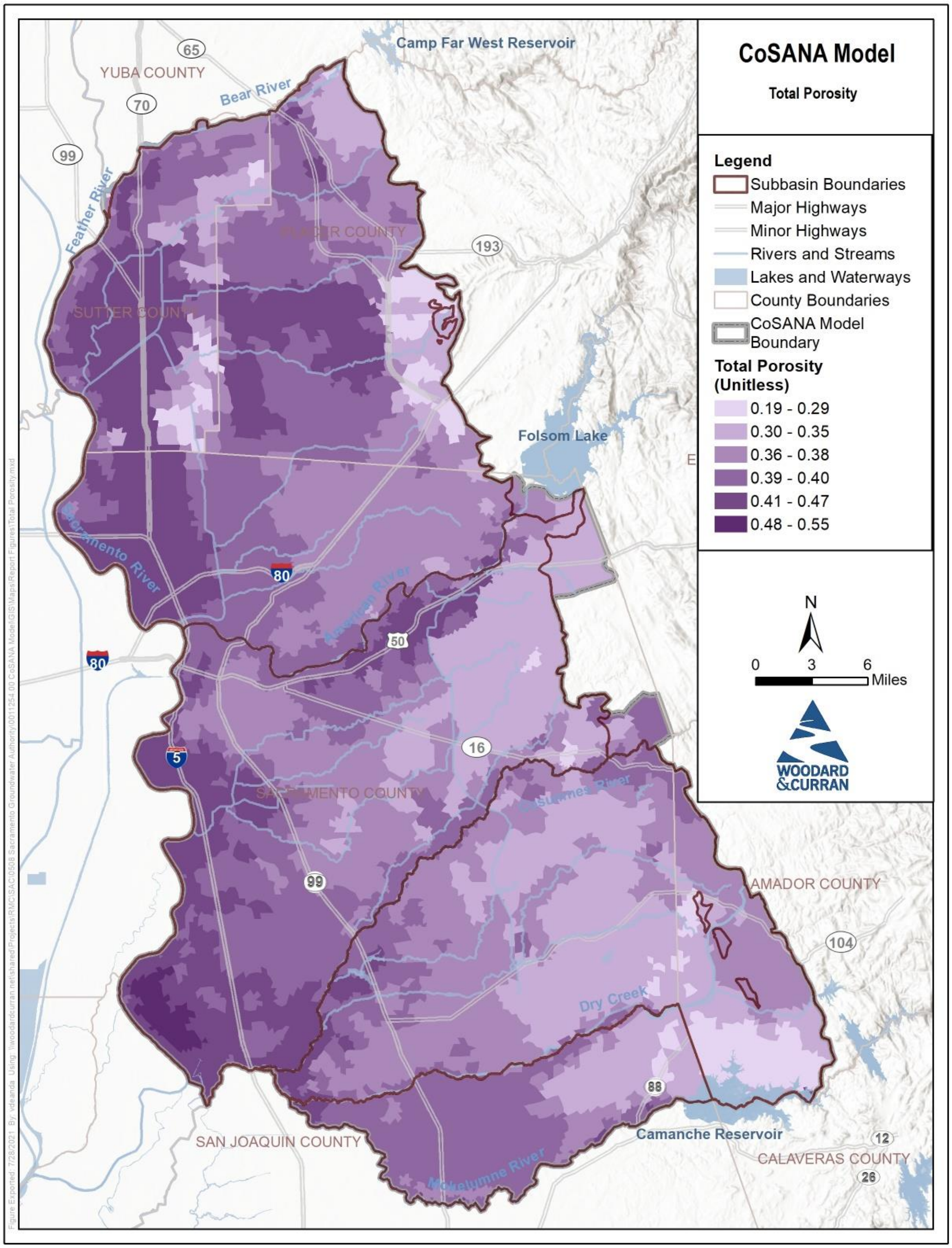


Figure 4-4: CoSANA Total Porosity

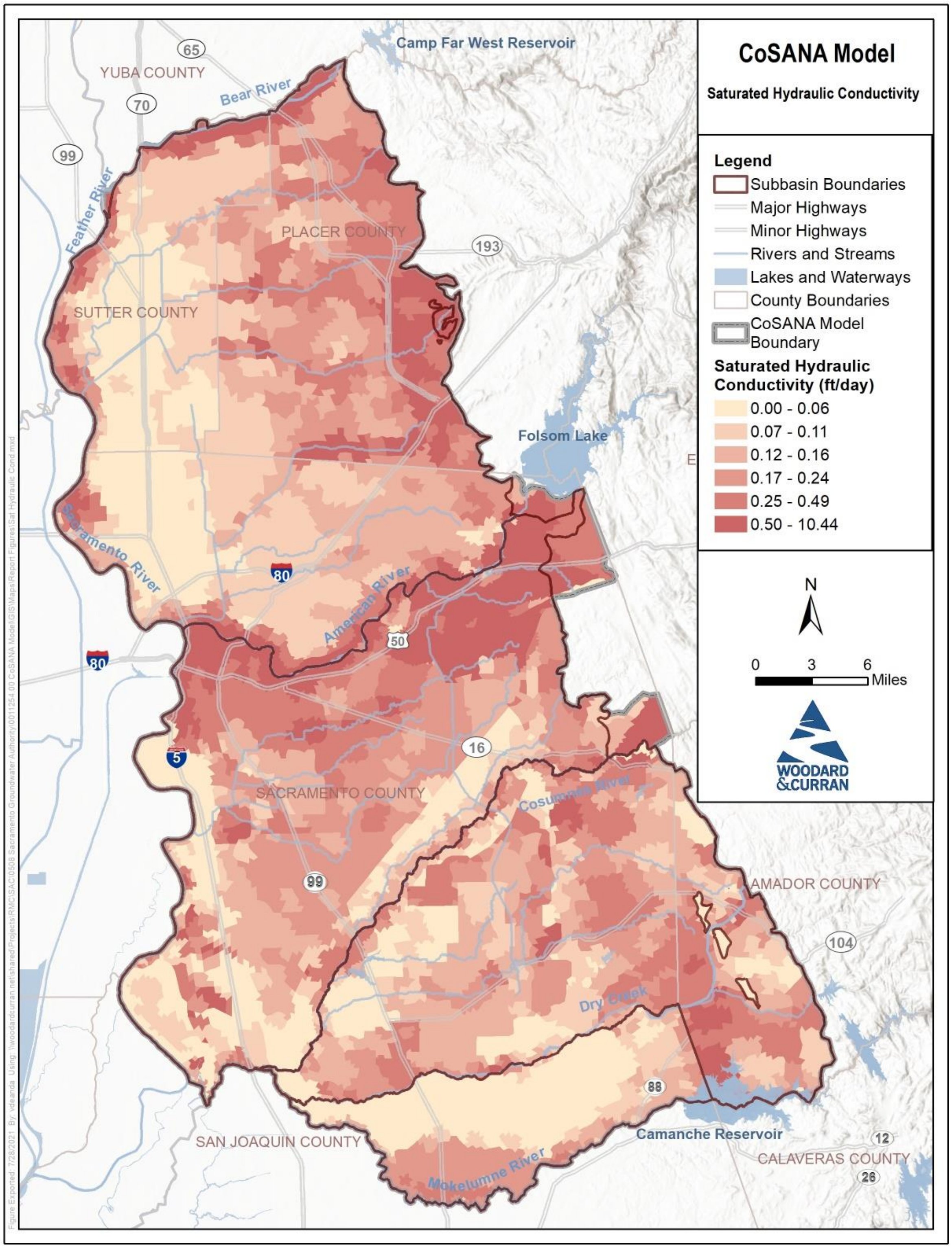


Figure 4-5: CoSANA Saturated Soil Hydraulic Conductivity

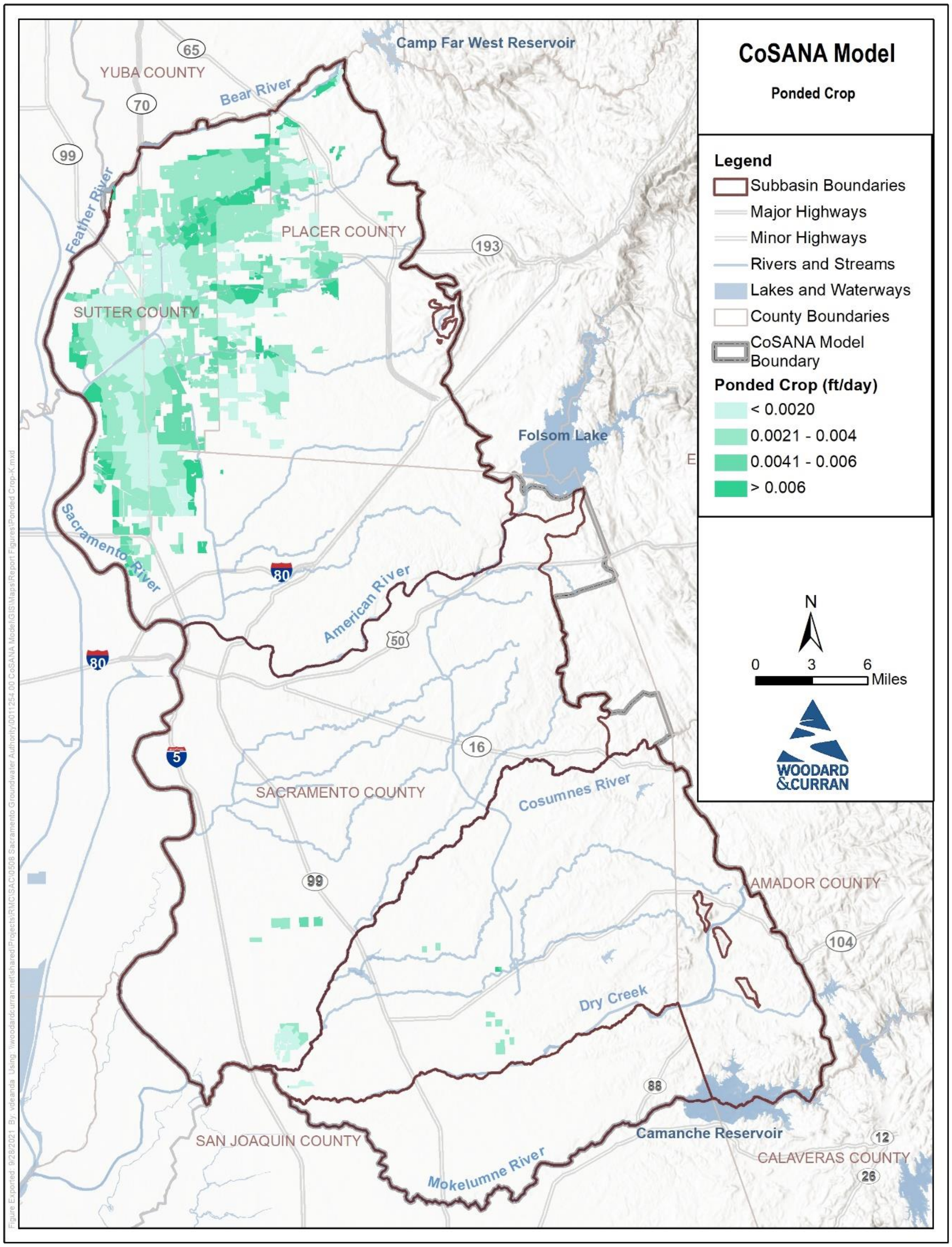
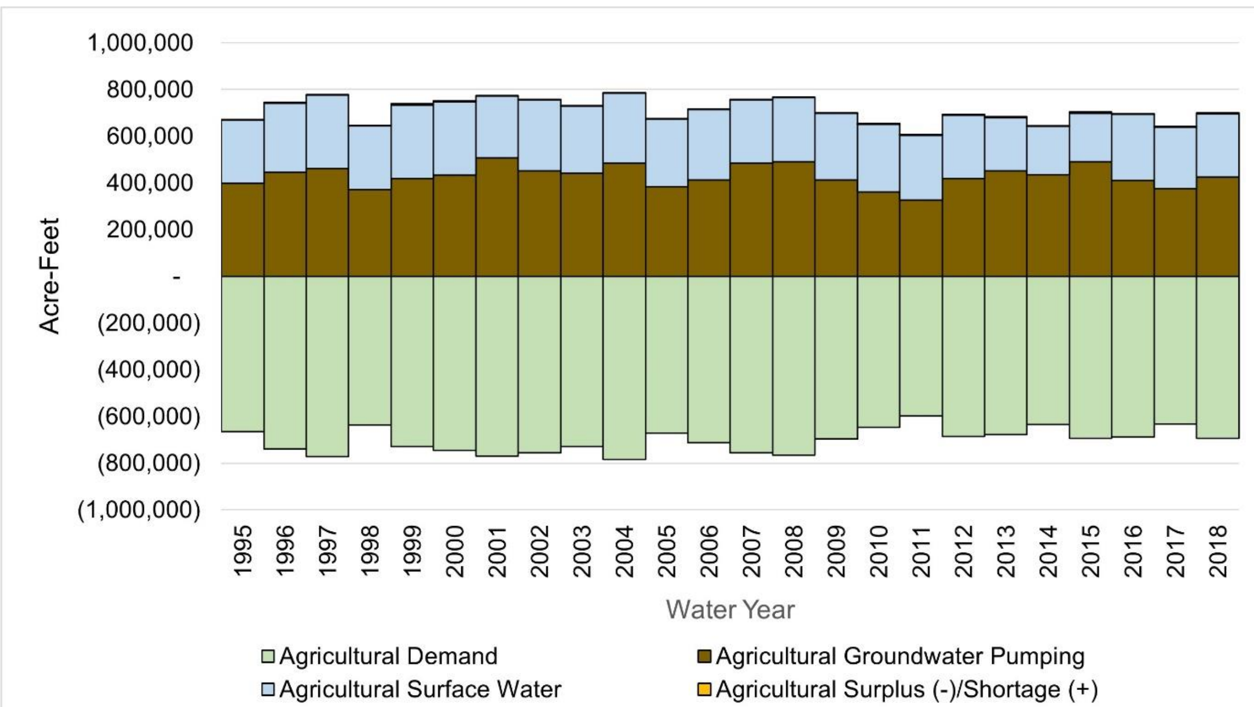


Figure 4-6: CoSANA Ponded Crop Saturated Soil Hydraulic Conductivity

Table 4-1: Land and Water Use Budget Demand and Supply Mix
(Average Annual for the Period WY 1995-2018)

Subbasin	Ag. Demand (AFY)	Ag. Ground-water Use (AFY)	Ag Surface Water Deliveries (AFY)	Urban Demand (AFY)	Urban Ground-water Use (AFY)	Urban Surface Water Deliveries (AFY)	Urban Recycled Water (AFY)	Remediation Pumping (AFY)
NASb	410,136	205,563	207,225	215,951	91,263	124,687	0	3,869
SASb	160,694	116,397	44,667	182,760	93,515	89,324	232	20,879
CoSb	132,690	107,167	25,576	26,861	22,881	2,417	0	0
Total	**703,520**	**429,127**	**277,468**	**425,572**	**207,659**	**216,428**	**232**	**24,748**

Note: Small differences exist between total supplies and total demands. These shortages and surpluses are delivered and applied regardless of the demand specified in the model. Surpluses tend to result in deep percolation. Remediation pumping is not considered part of demand in the L&WU budget but is shown for information purposes. CoSANA total is a summation of the three subbasins (NASb, SASb, and CoSb) and excludes areas in the Eastern San Joaquin subbasin and areas outside of B118 subbasins.



Note: This figure is a summation of NASb, SASb, and CoSb values and excludes areas outside of these subbasins

Figure 4-7: CoSANA Agricultural Land and Water Use Budget

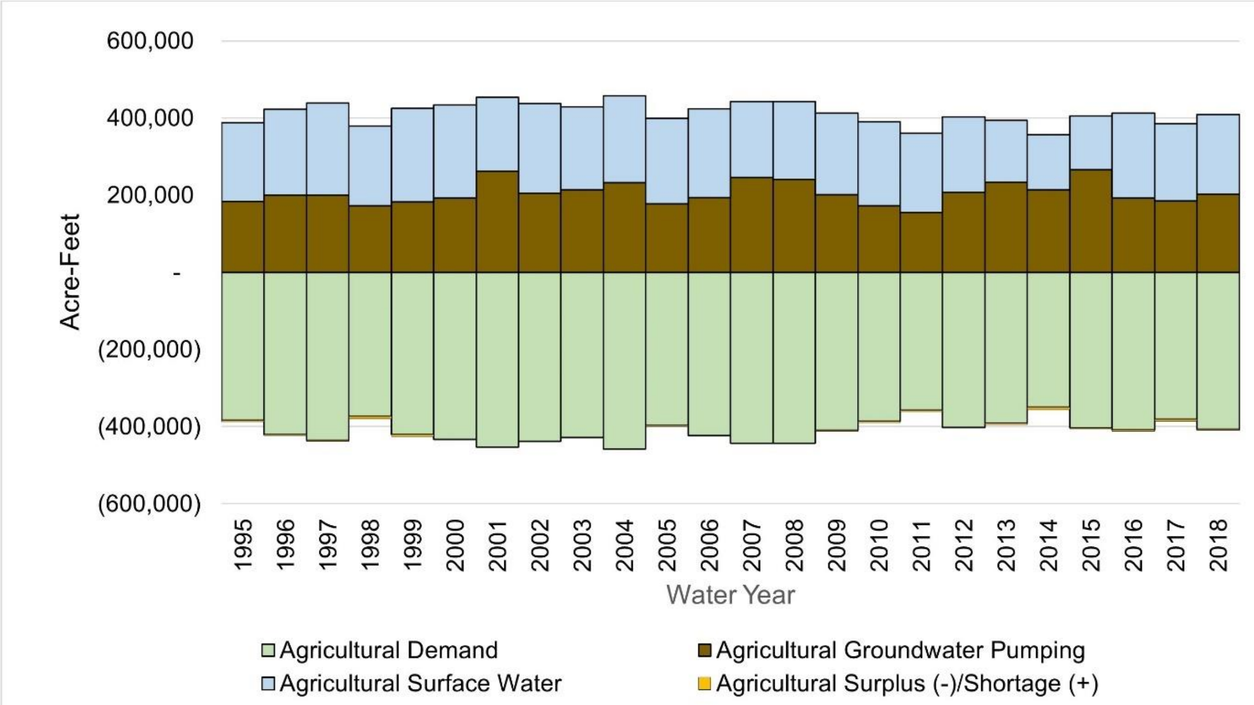


Figure 4-8: NASb Agricultural Land and Water Use Budget

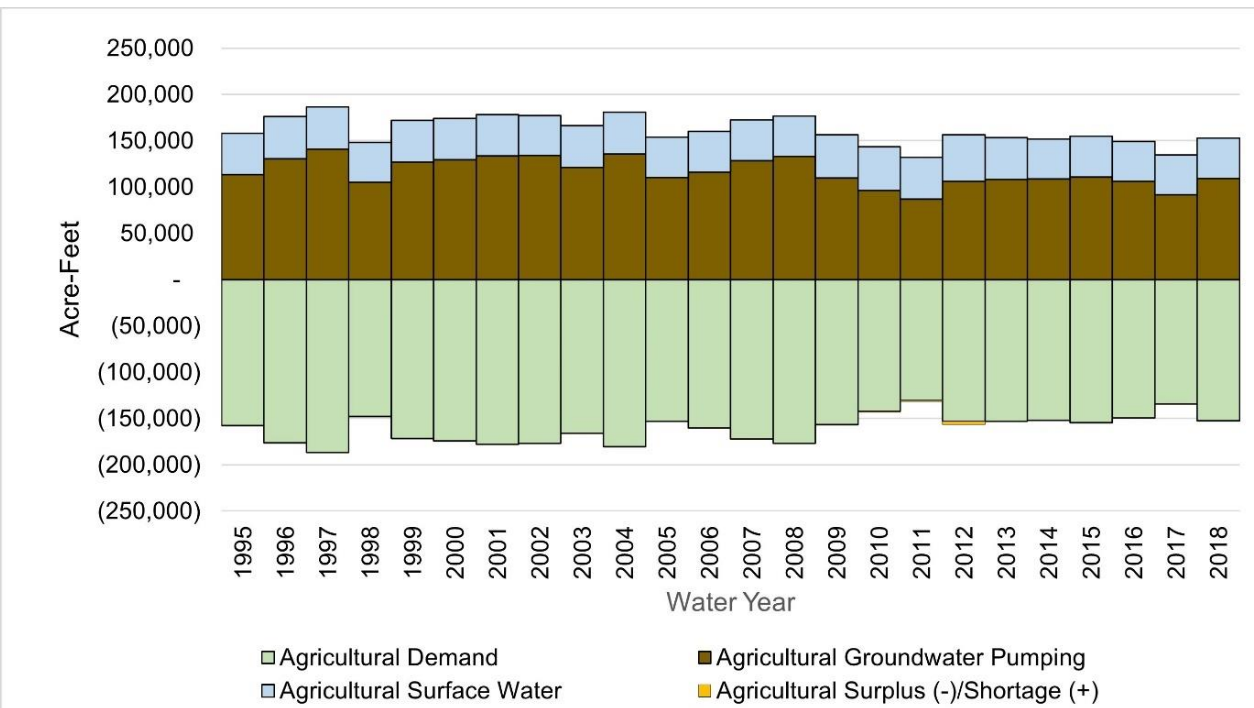


Figure 4-9: SASb Agricultural Land and Water Use Budget

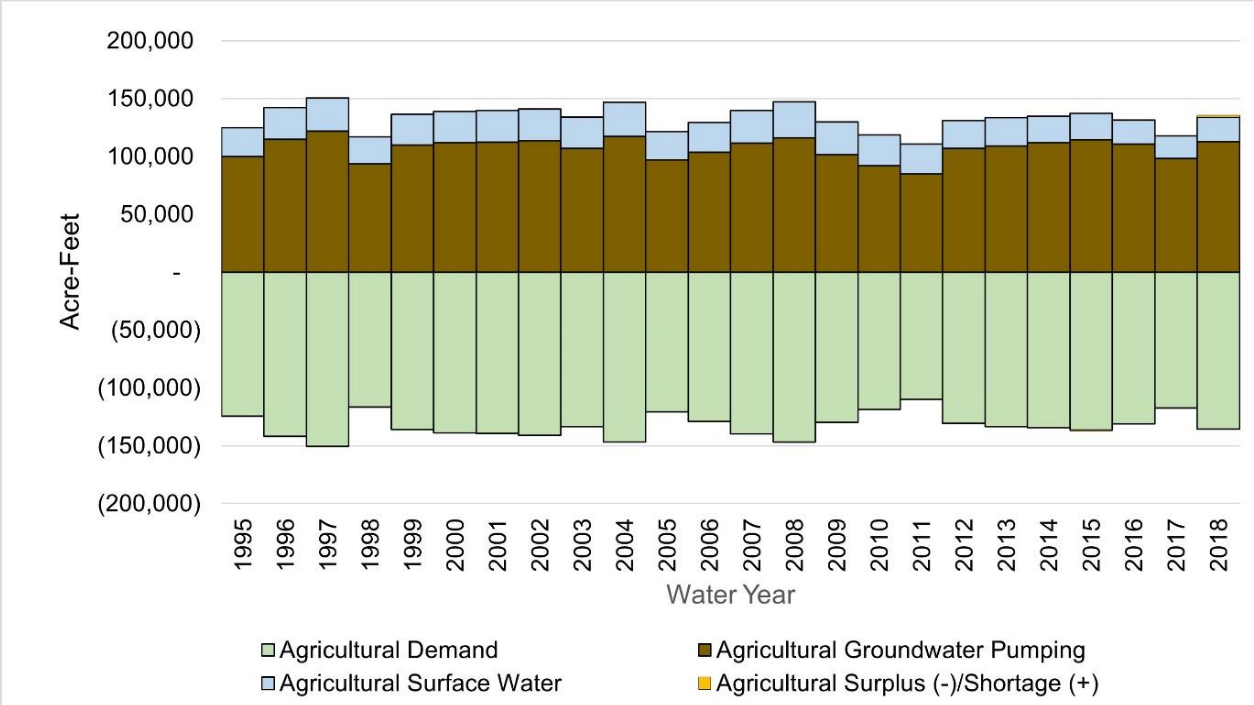
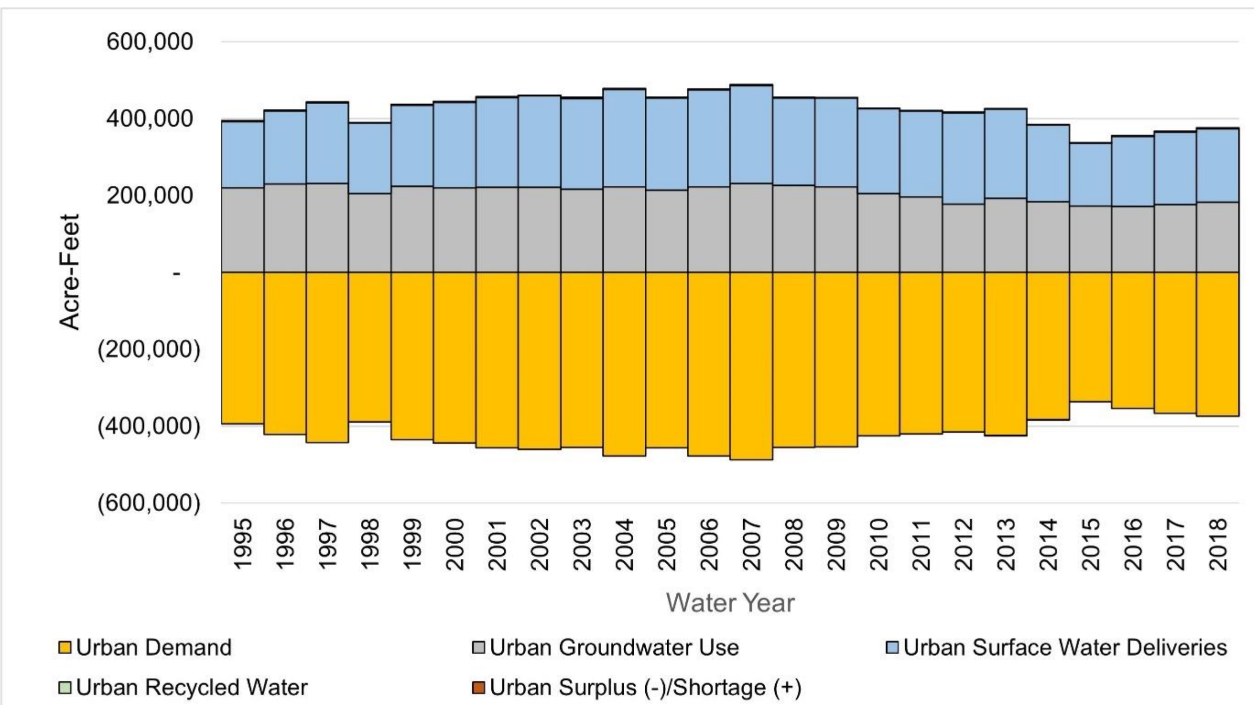


Figure 4-10: CoSb Agricultural Land and Water Use Budget



Note: This figure is a summation of NASb, SASb, and CoSb values and excludes areas outside of these subbasins

Figure 4-11: CoSANA Model Urban Land and Water Use Budget

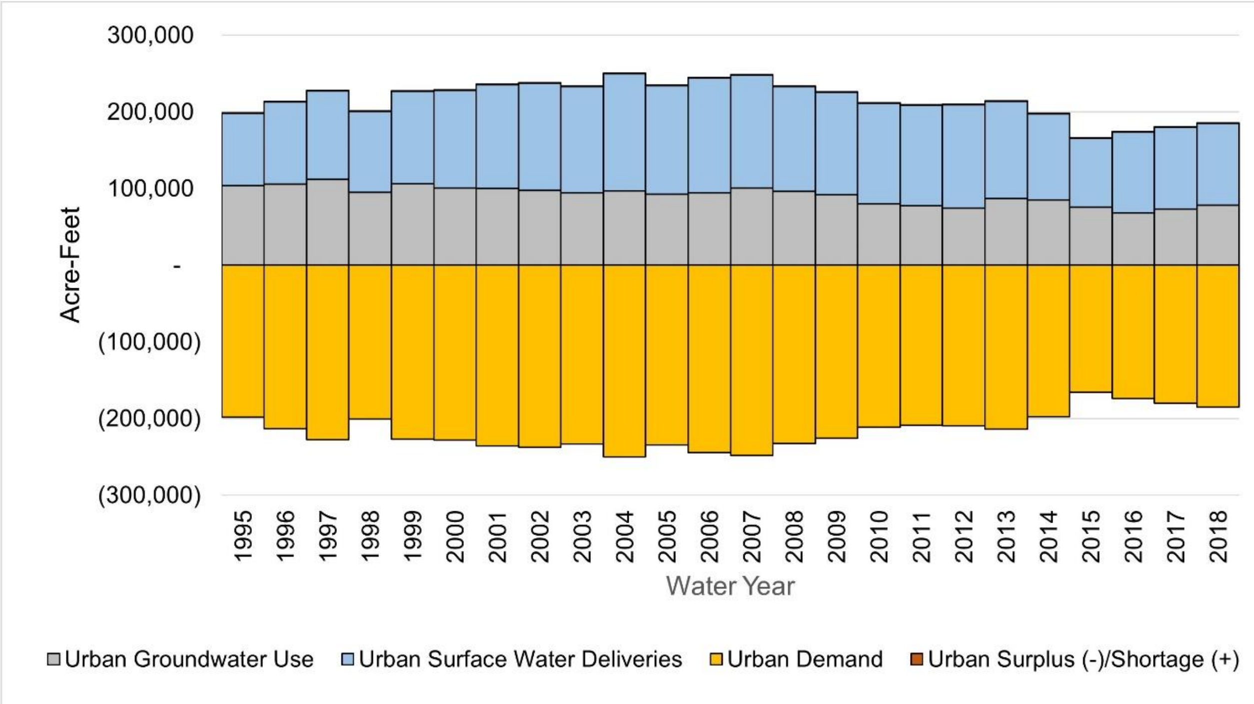


Figure 4-12: NASb Urban Land and Water Use Budget

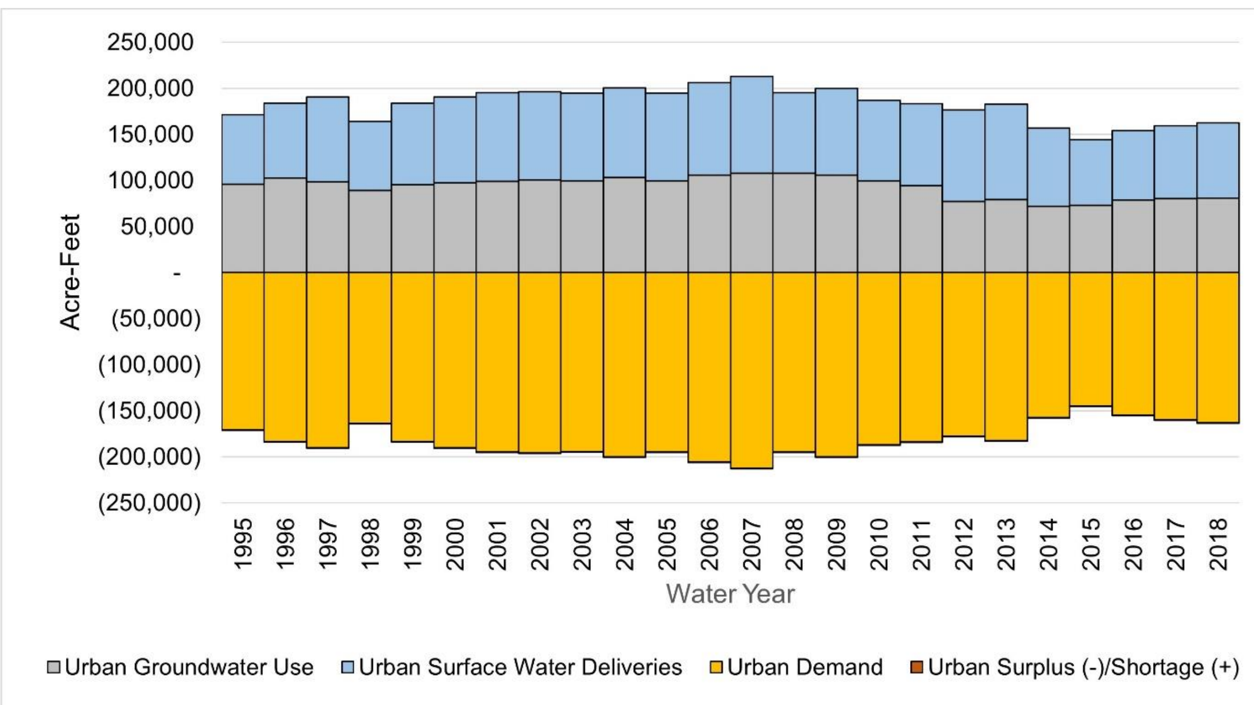
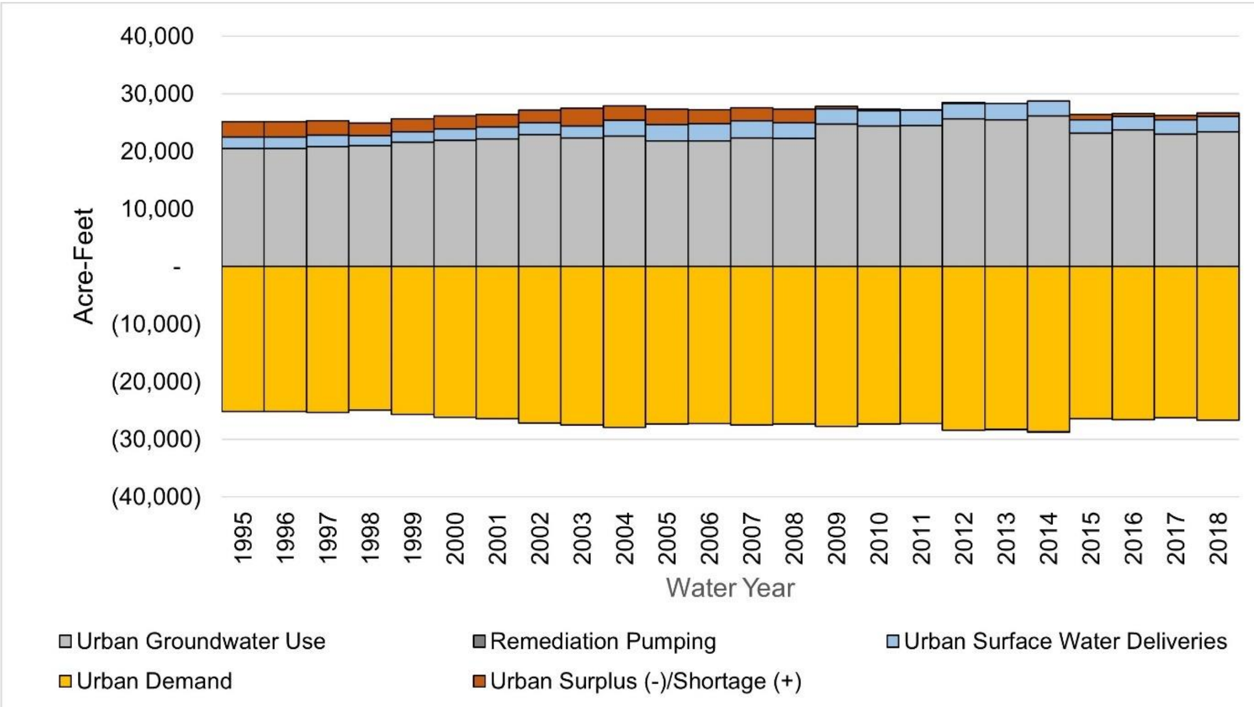


Figure 4-13: SASb Urban Land and Water Use Budget



Note: Urban groundwater use is specified in the CoSb model input data set. The model-calculated surplus/shortage in urban demand is therefore not utilized to calculate the CoSb groundwater budget.

Figure 4-14: CoSb Urban Land and Water Use Budget

4.2.1.2 Groundwater Budget

The groundwater budget quantifies inflows and outflows from the groundwater system. The primary components of the groundwater budget, corresponding to the major hydrologic processes affecting groundwater flow in the model area, are:

- Inflows:
  - Deep percolation (from rainfall and irrigation applied water)
  - Gain from stream (recharge due to stream seepage)
  - Recharge (from other sources such as irrigation canal seepage and recharge ponds)
  - Boundary inflow (from outside the model area)
  - Net subsurface inflow (from adjacent subregions)
- Outflows:
  - Groundwater pumping
  - Loss to stream (outflow to streams and rivers)
  - Boundary outflow (to outside the model area)
  - Subsurface outflow (to adjacent subregions)
- Change in groundwater storage (positive indicates withdrawal from groundwater storage, and negative indicates contribution to groundwater storage)

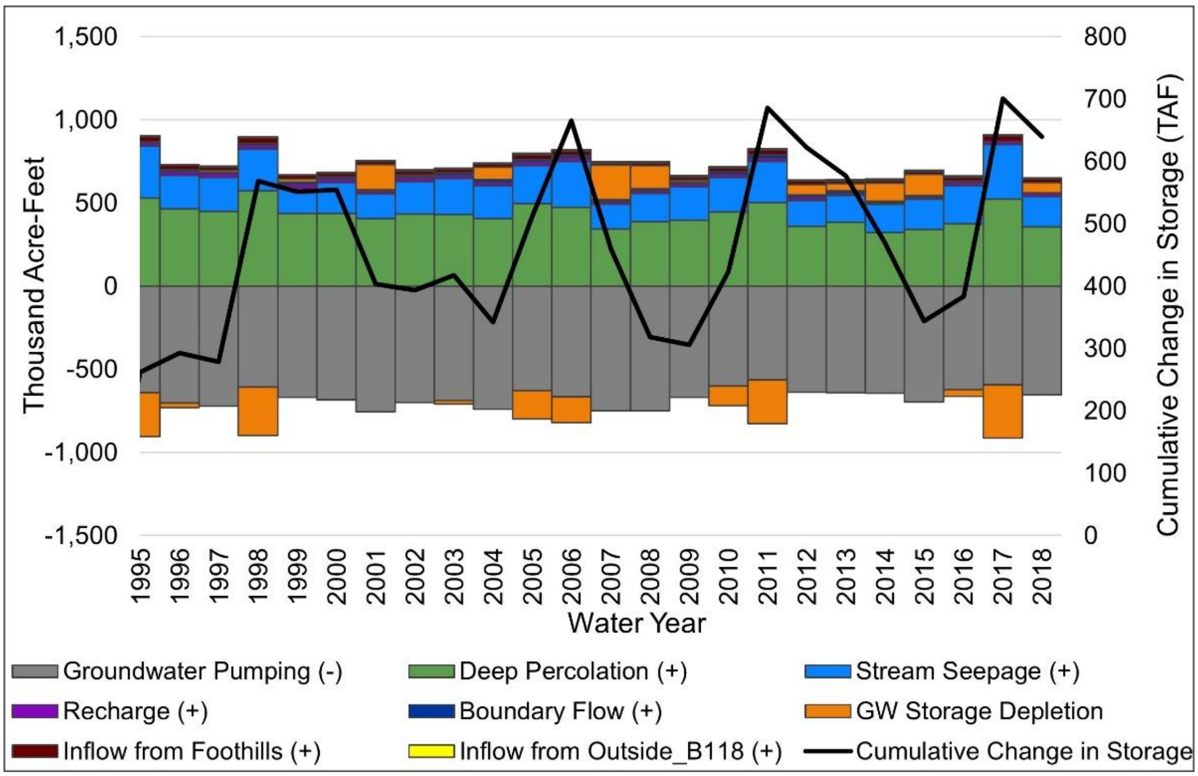
The groundwater budgets, including cumulative change in storage, are summarized in Table 4-2 and shown in Figure 4-15 through Figure 4-18 for three subbasins combined and for the NASb, SASb, and CoSb, respectively. Though results vary area to area, the primary sources of groundwater inflows are deep percolation and interaction with the model streams.

Subregion-level budgets are provided in Appendix E.

Table 4-2: Summary of CoSANA Groundwater Budget
(Average Annual for the Period WY 1995-2018)

Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Subsurface Inflow (AFY)	Boundary Flows (AFY)	Change in Storage (AFY)
NASb	315,794	189,988	85,907	18,320	18,220	30,019	26,661
SASb	221,618	130,317	101,953	15	-8,884	3,769	5,551
CoSb	130,048	108,054	18,977	0	-2,333	-162	-5,510
Total	**667,460**	**428,359**	**206,837**	**18,335**	**7,003***	**11,302**	**26,702**

Note: CoSANA total is a summation of NASb, SASb, and CoSb values and excludes areas outside of these subbasins.
* The model-wide subsurface inflow value includes subsurface flows to and from areas outside of the combined NASb, SASb, and CoSb area.



Note: This figure is a summation of NASb, SASb, and CoSb values and excludes areas outside of these subbasins

Figure 4-15: CoSANA Groundwater Budget

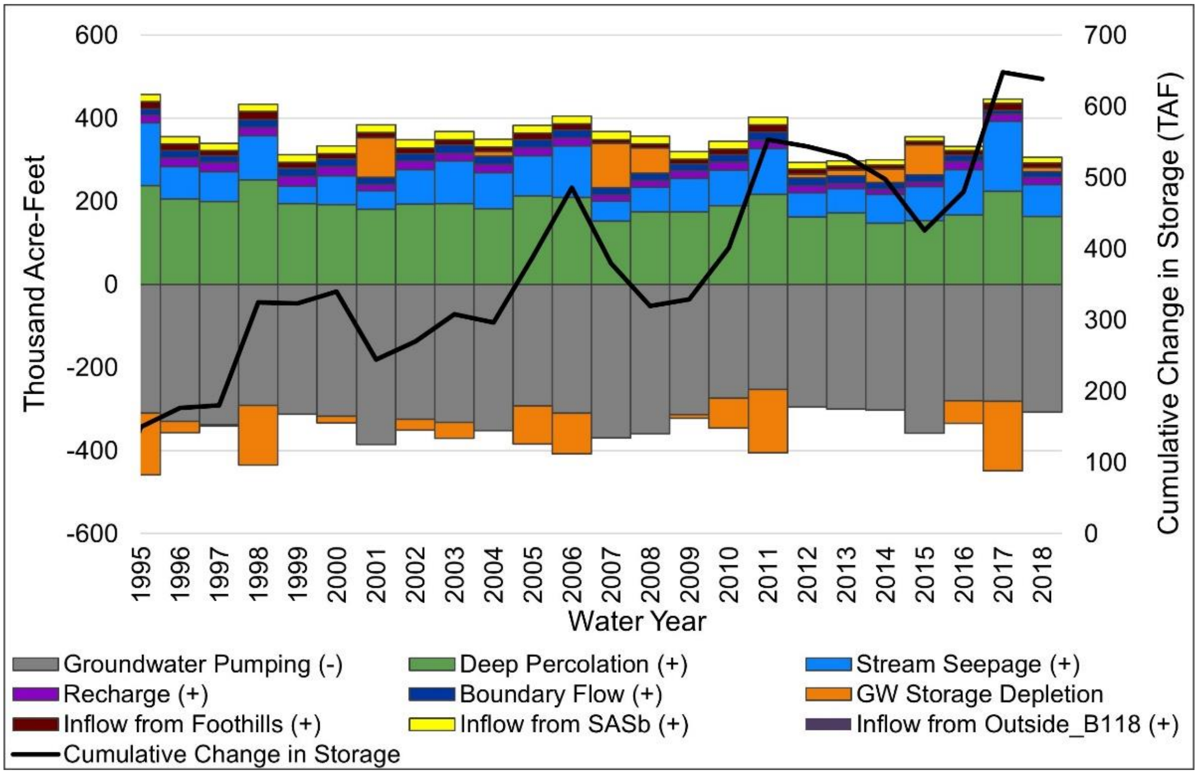


Figure 4-16: NASb Groundwater Budget

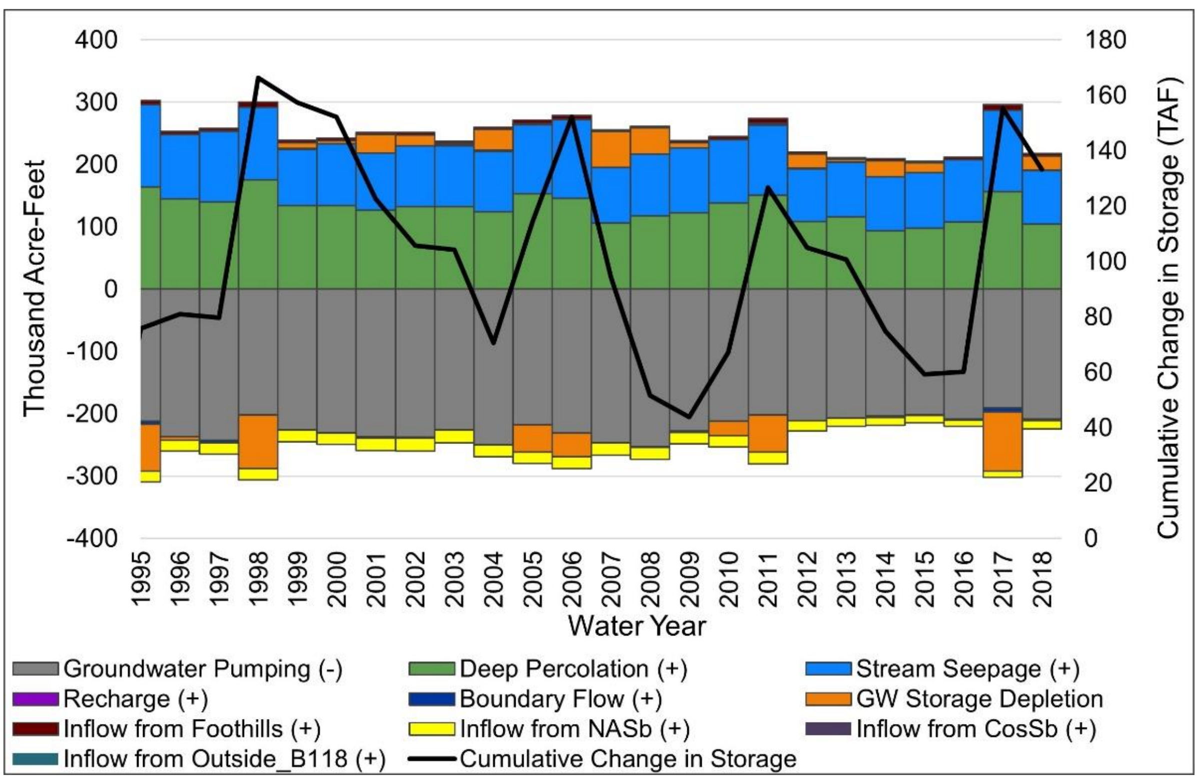


Figure 4-17: SASb Groundwater Budget

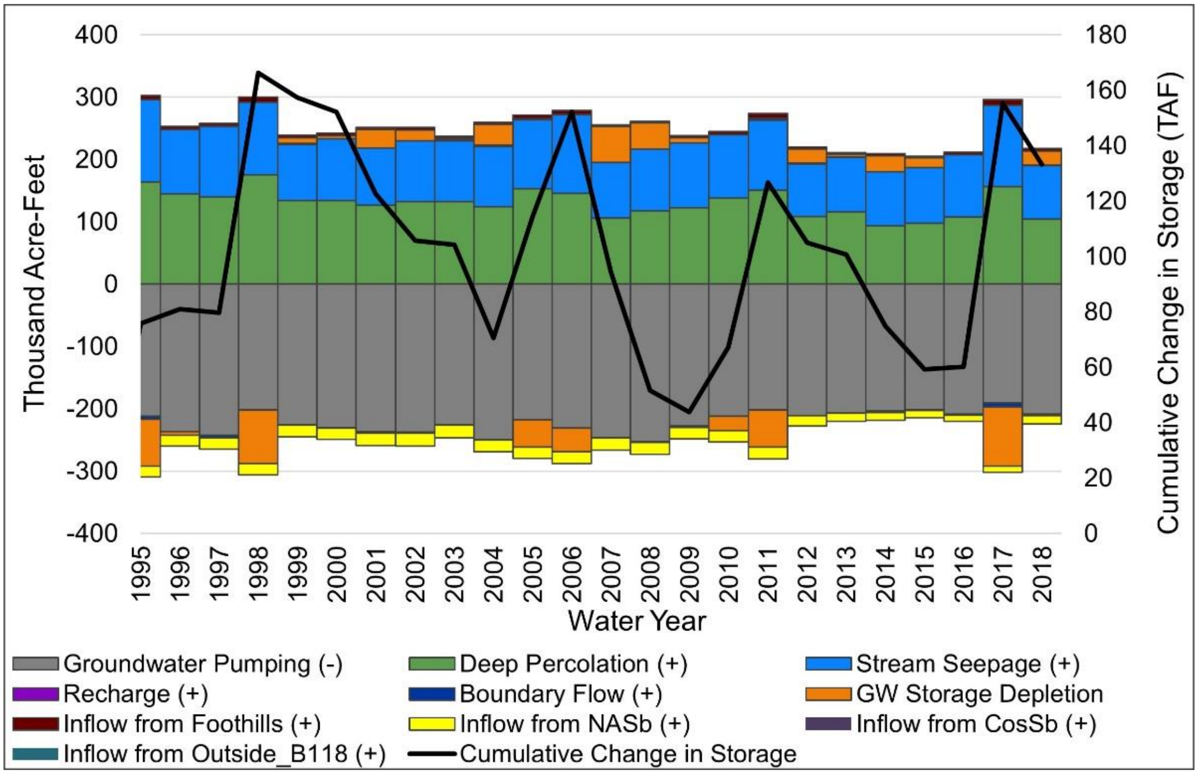


Figure 4-18: CoSb Groundwater Budget

4.2.2 Groundwater Level Calibration

Groundwater levels are calibrated to achieve acceptable agreement between the simulated and observed values (in this case, groundwater levels at the calibration wells). Within CoSANA, over 1,600 wells were evaluated for developing groundwater observation locations (calibration wells) to allow CoSANA's calibration at both a regional and local scale. Data for these wells were obtained from DWR's CASGEM program, DWR's Water Data Library, and local monitoring data from Aerojet, Elk Grove Water District, The Nature Conservancy, and the University of California - Davis. The calibration wells were selected based on their period of record, availability of observation data, spatial distribution across the model, representative nature of the data, and trends of nearby wells. After a review of the available observation data, a working set of 761 wells was selected to be used for the calibration process.

The groundwater level calibration process included both manual refinements to the model as well as automated calibration using the PEST software package. The set of 761 wells with associated observations was used to perform PEST calibration. Of the identified 761 wells, a refined subset of 403 wells that are considered representative of the long-term conditions of groundwater levels both at a local and regional scale were selected for analysis in each PEST run. The location and number of observations for the full set of 761 wells are shown in Figure 4-19, the period of record for each of these wells is shown in Figure 4-20. Maps showing the locations of each of the 403 wells in the subset and calibration hydrographs are shown in Appendix F.

With the observation data identified, a preliminary manual calibration was performed to adjust the water budgets, primarily the land and water use budgets and the small watershed budgets, to have a reasonable starting point for calibrating the aquifer parameters. Simulated groundwater levels are calibrated to observed levels through adjustments to hydrogeologic parameters or aquifer parameters including hydraulic conductivity, specific storage, and specific yield (discussed in Section 4.4). Input datasets were also refined where the calibration process identified issues. The goal of groundwater level calibration is to achieve the maximum agreement between simulated and observed groundwater elevations at calibration wells while maintaining reasonable values for aquifer parameters.

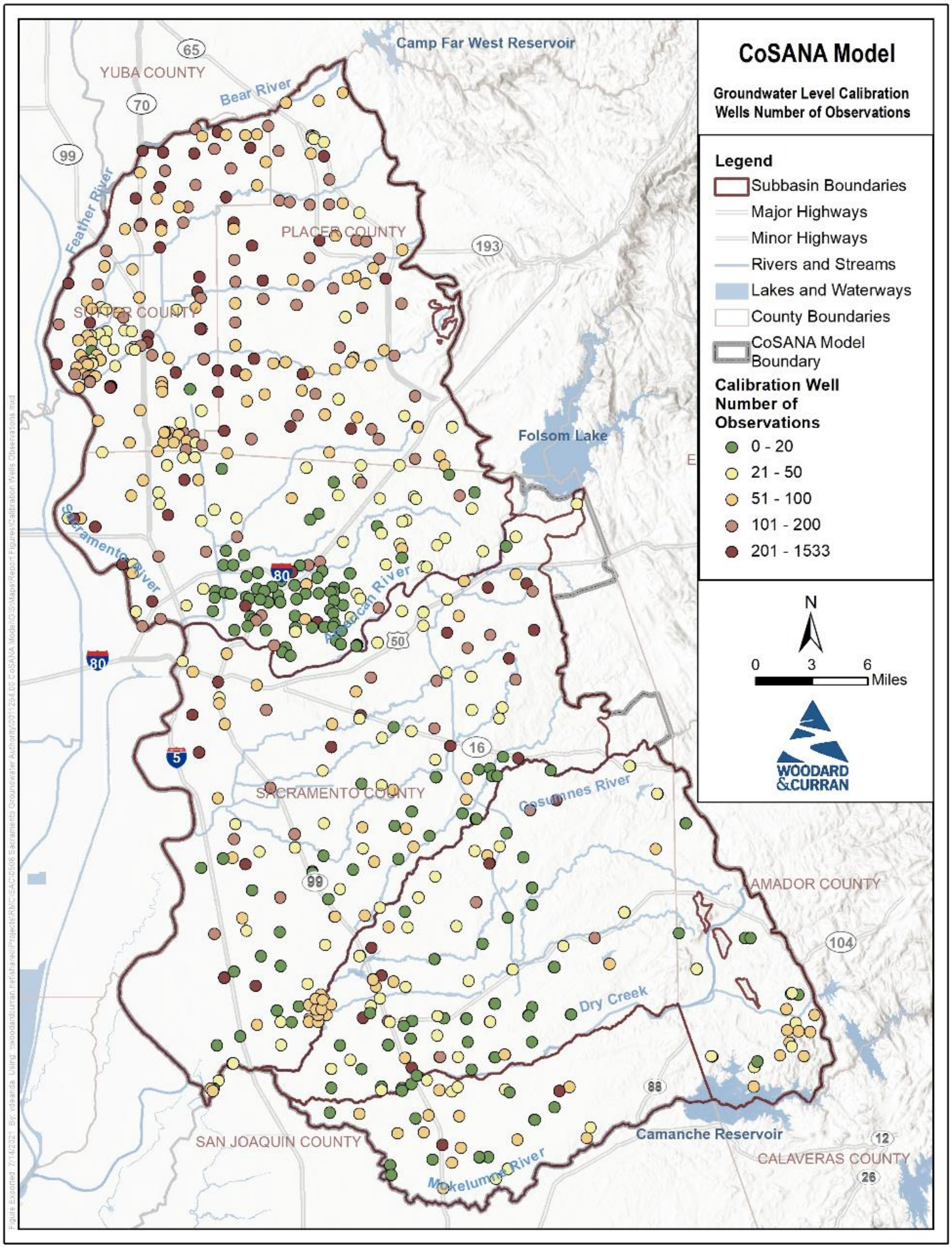


Figure 4-19: Number of Observations for Calibration Wells

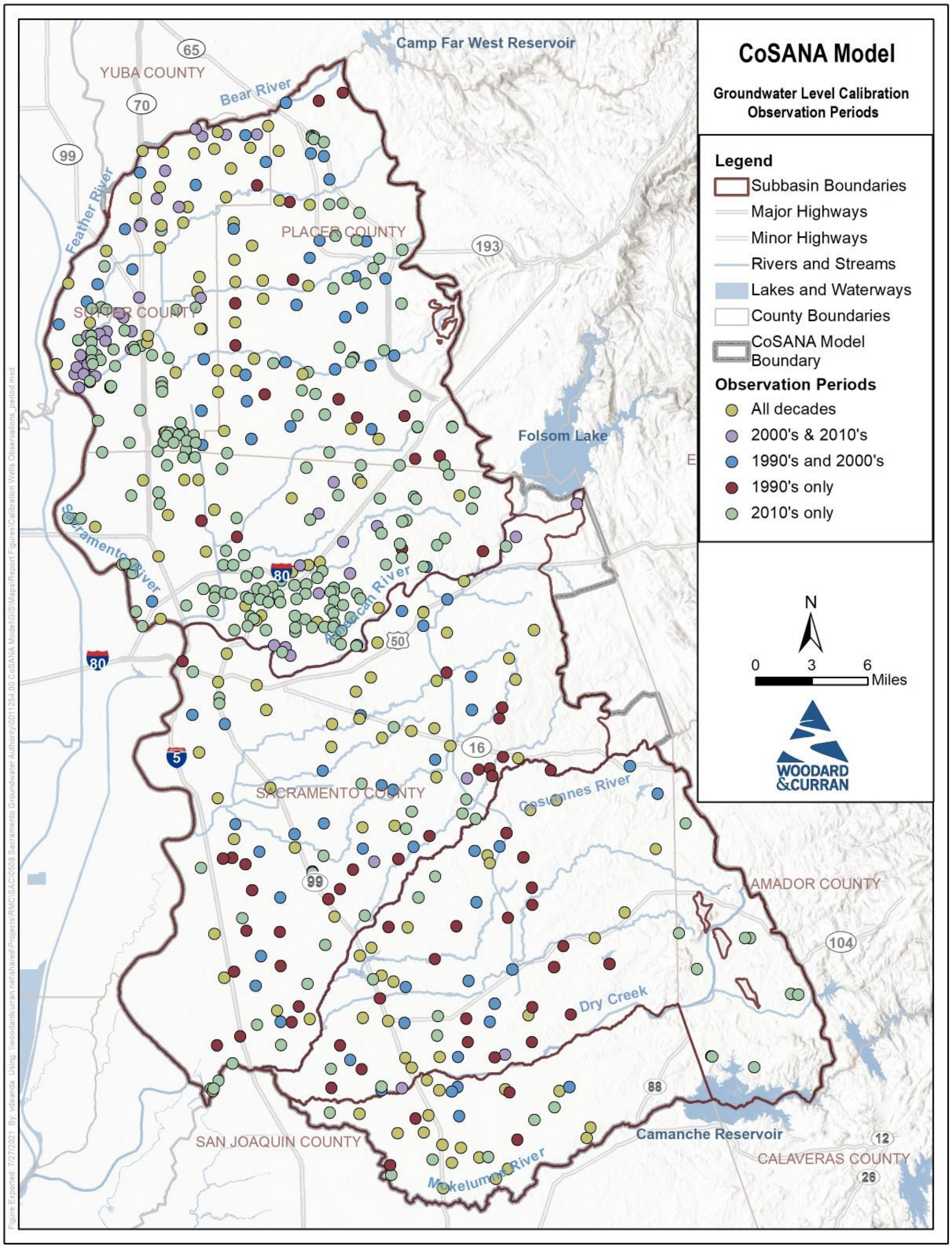


Figure 4-20: Period of Record for Calibration Wells

The automated parameter estimation tool, PEST, was used to assist in refinement of aquifer parameters to improve model calibration. PEST-assisted calibration is performed to interact with CoSANA via input and output files and iteratively modifies parameter values to reduce an objective function representative of the model residual error. These modifications are made within identified bounds of reasonable values for each parameter. PEST-assisted calibration focused on the aquifer parameters such as horizontal and vertical conductivities and storage parameters.

Between PEST-assisted calibration iterations, the modeling team revisited the land system and small watershed budgets and made manual adjustments where needed, until calibration goals were met.

Simulated groundwater level contours and observed values for calibration wells are shown in Figure 4-21, Figure 4-22, and Figure 4-23 for spring 1998, fall 2015, and fall 2018, respectively. Simulated groundwater level hydrographs and observations for selected wells (locations shown in Figure 4-24) are shown in Figure 4-25 through Figure 4-49. Simulated values represent the layers screened at that well, except for 7223 and 7224 which do not have screened interval information.

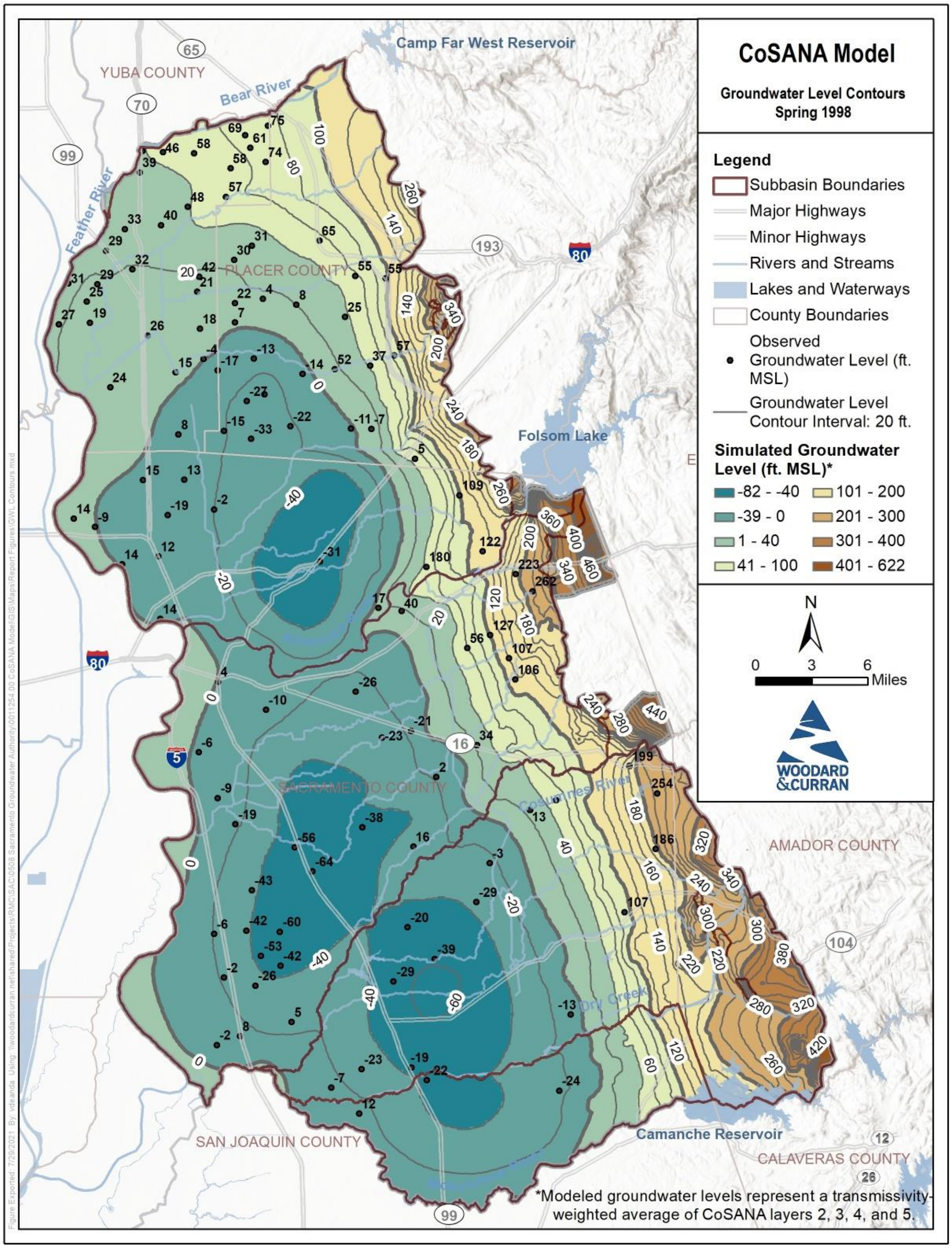


Figure 4-21: CoSANA Groundwater Level Contours – Spring 1998 (End of Wet Period)

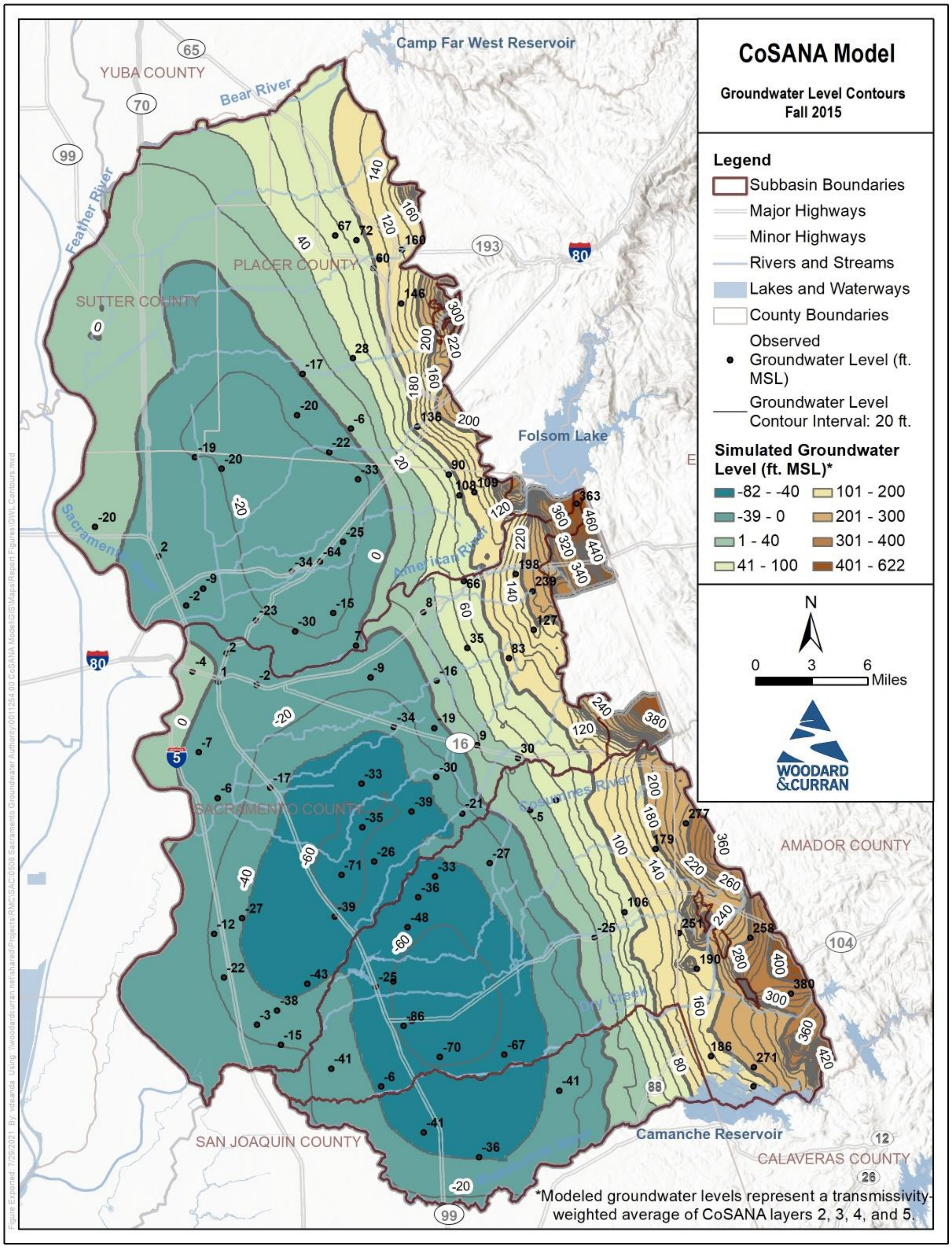


Figure 4-22: CoSANA Groundwater Level Contours – Fall 2015 (End of Drought Period)

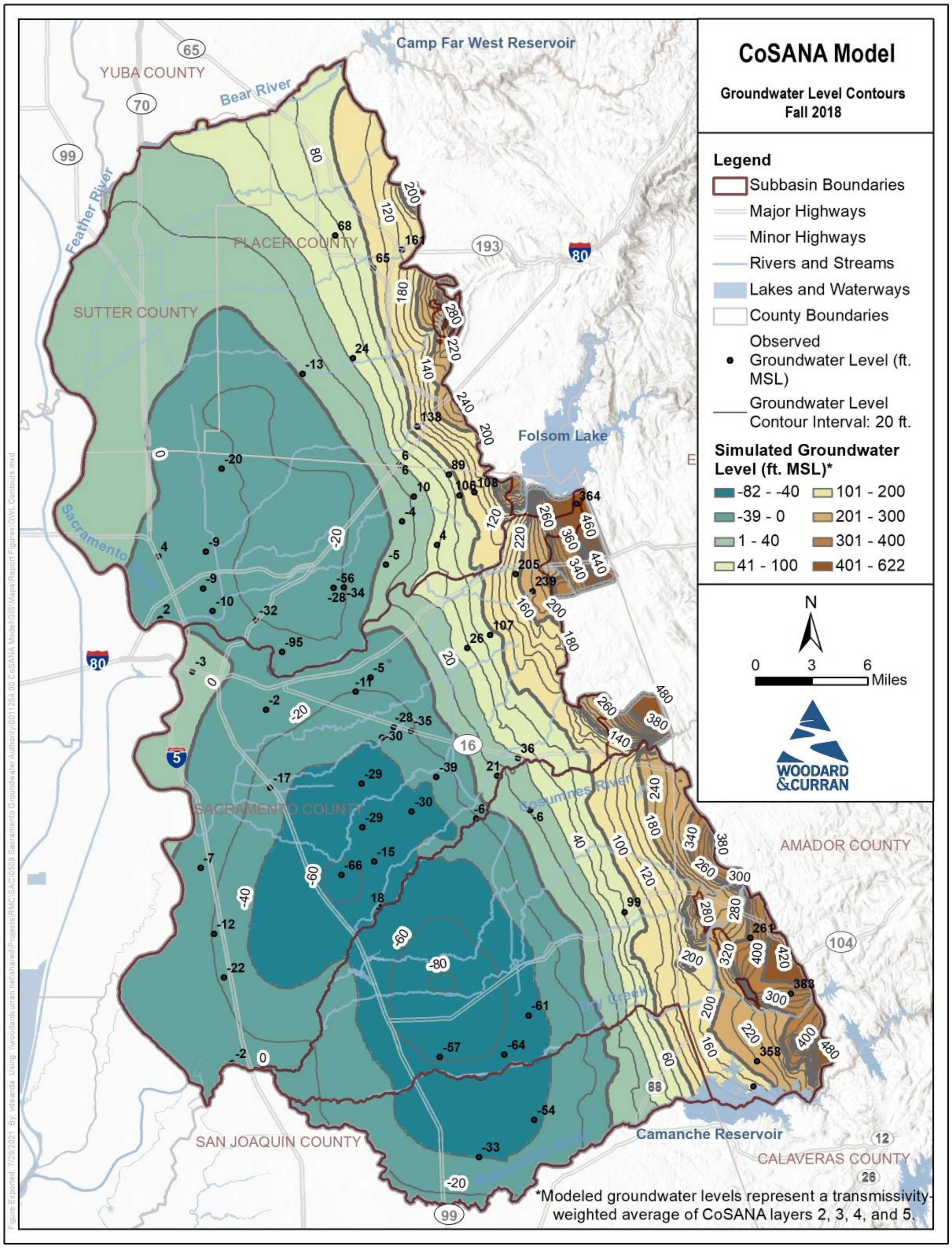


Figure 4-23: CoSANA Groundwater Level Contours – Fall 2018 (End of Simulation)

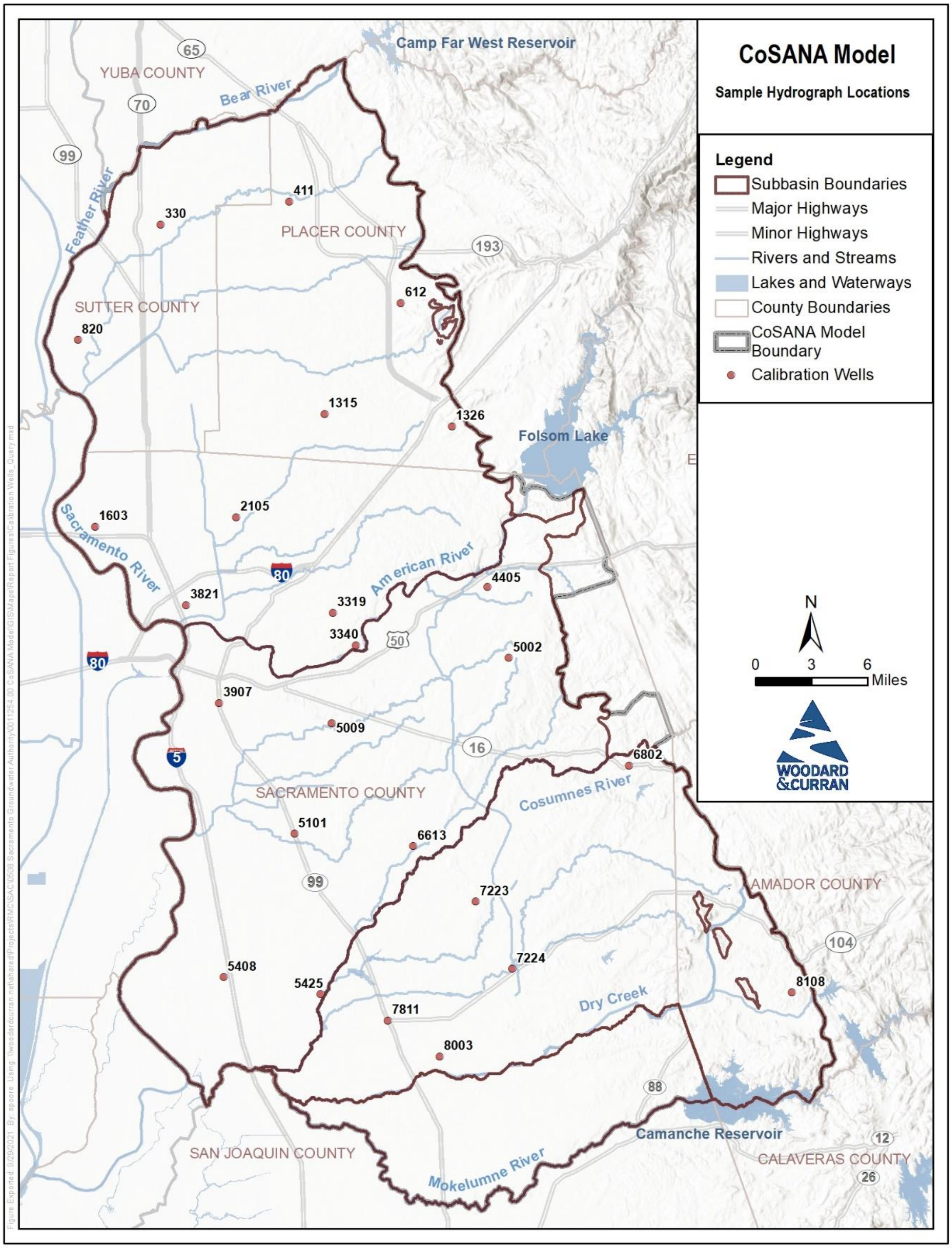


Figure 4-24: Location of Sample Hydrographs

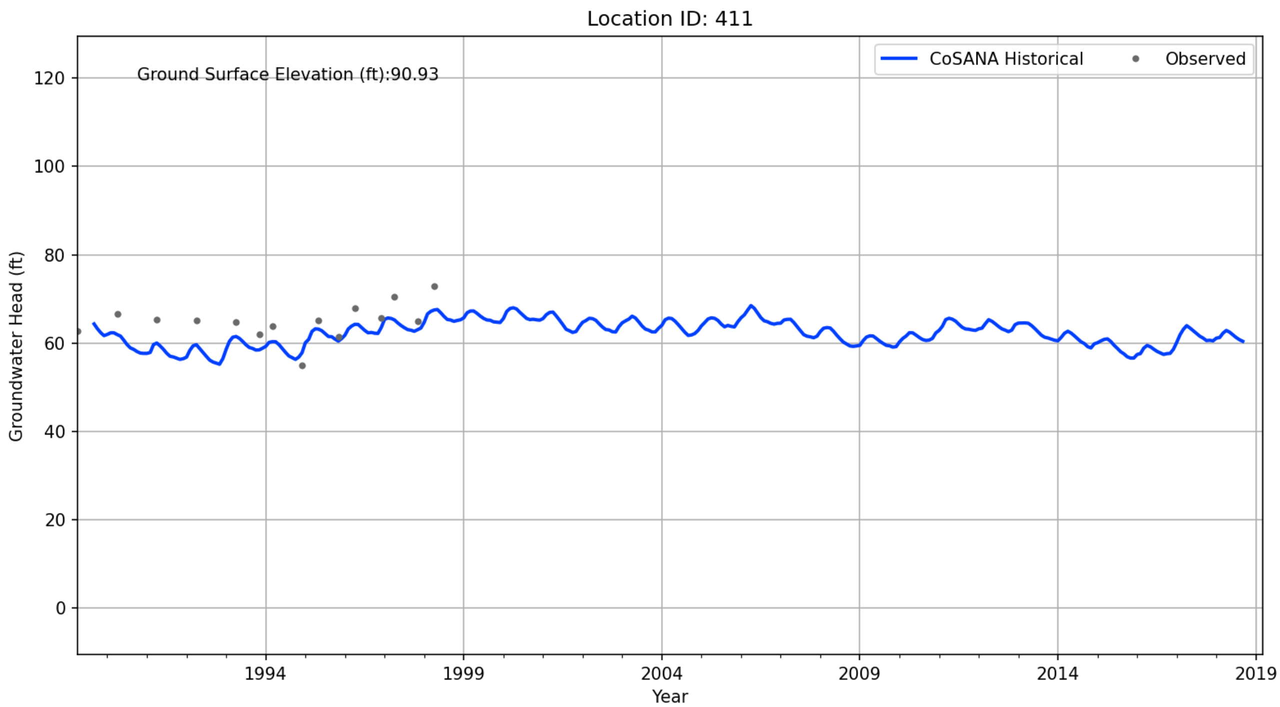


Figure 4-25: CoSANA Groundwater Level Hydrograph – Hydrograph #1

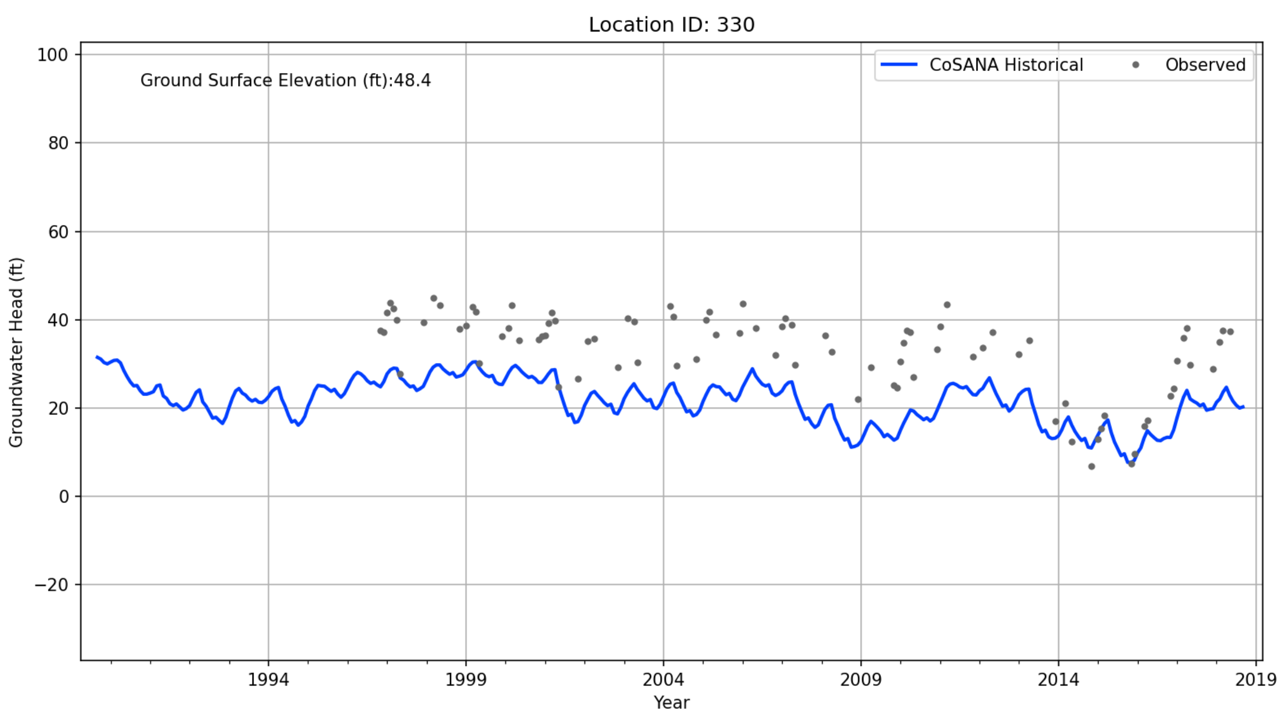


Figure 4-26: CoSANA Groundwater Level Hydrograph – Hydrograph #2

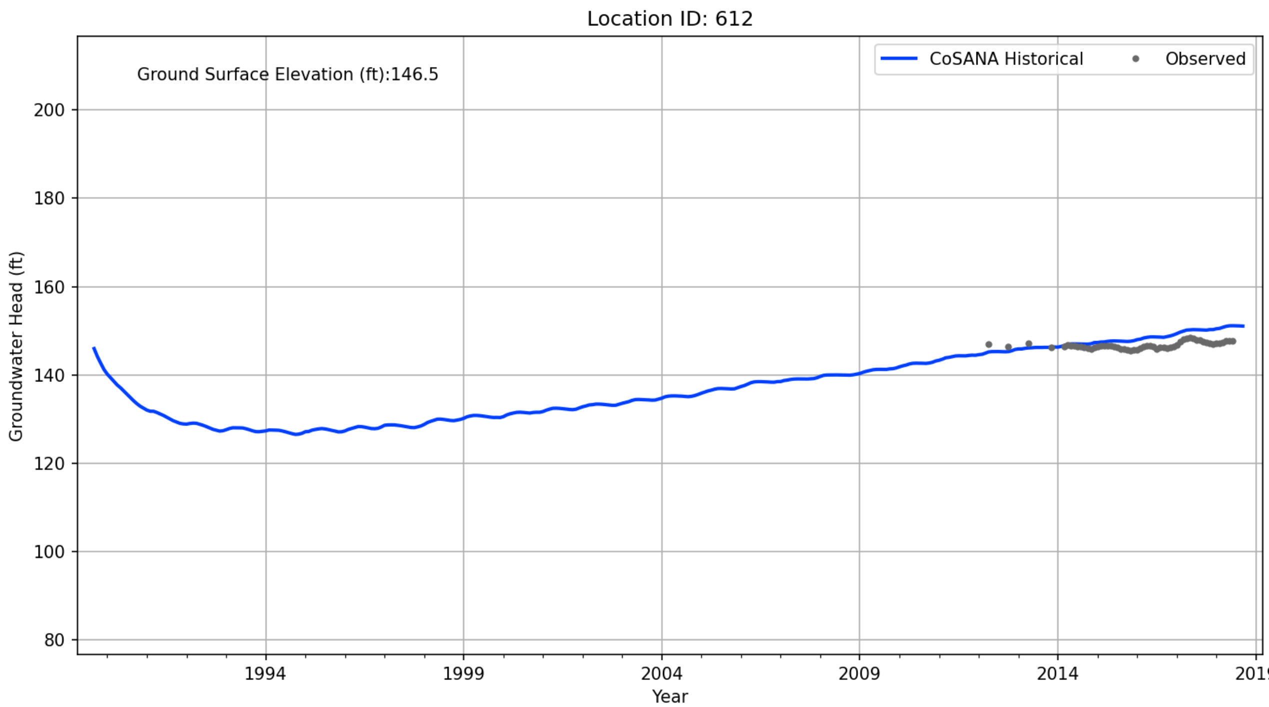


Figure 4-27: CoSANA Groundwater Level Hydrograph – Hydrograph #3

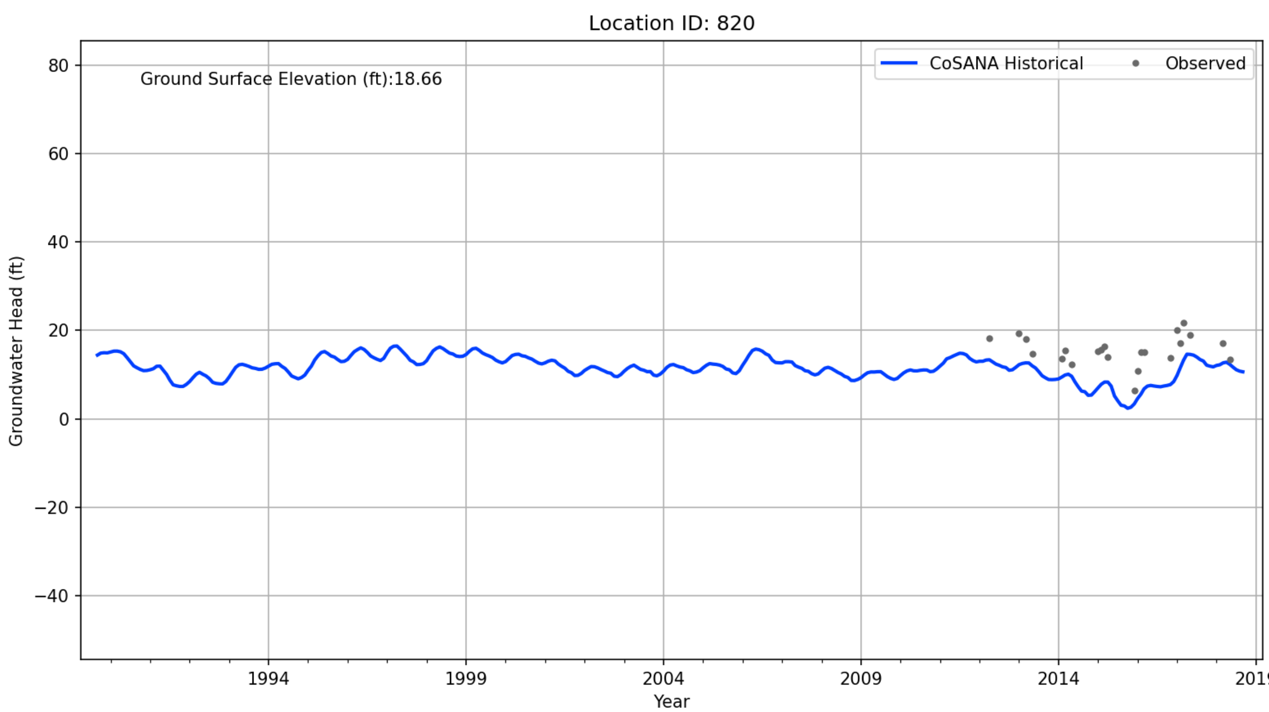


Figure 4-28: CoSANA Groundwater Level Hydrograph – Hydrograph #4

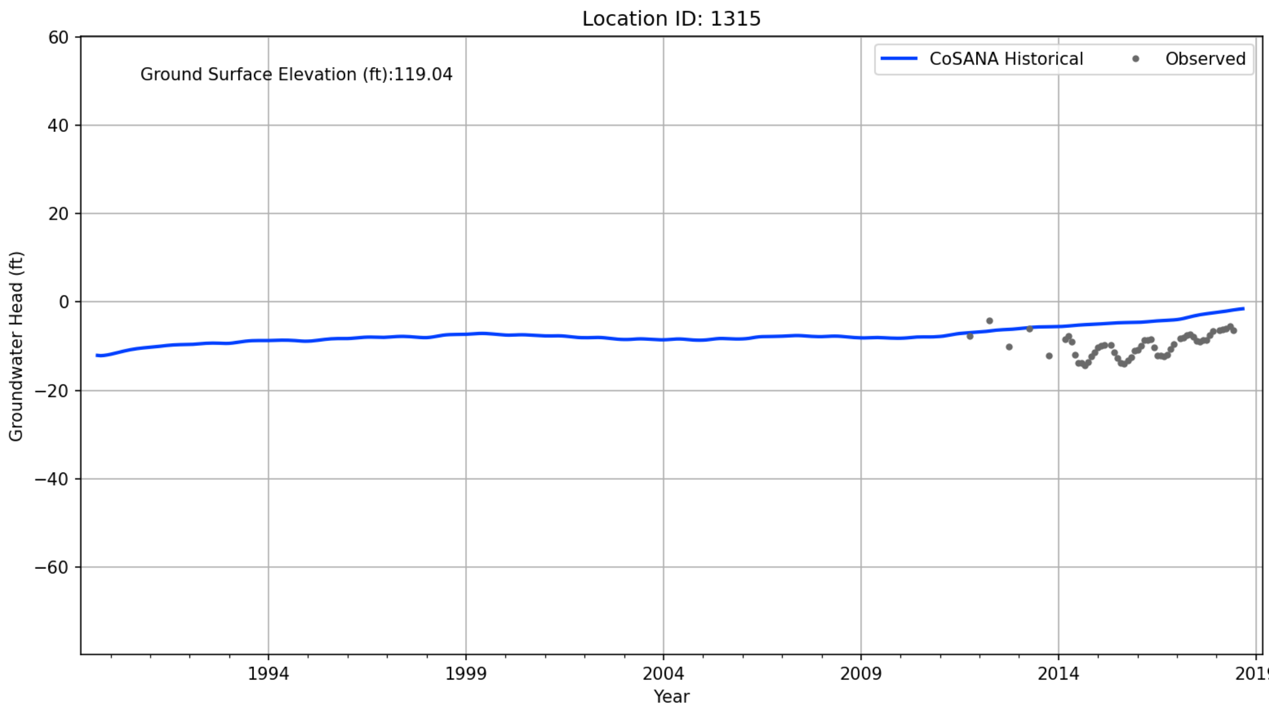


Figure 4-29: CoSANA Groundwater Level Hydrograph – Hydrograph #5

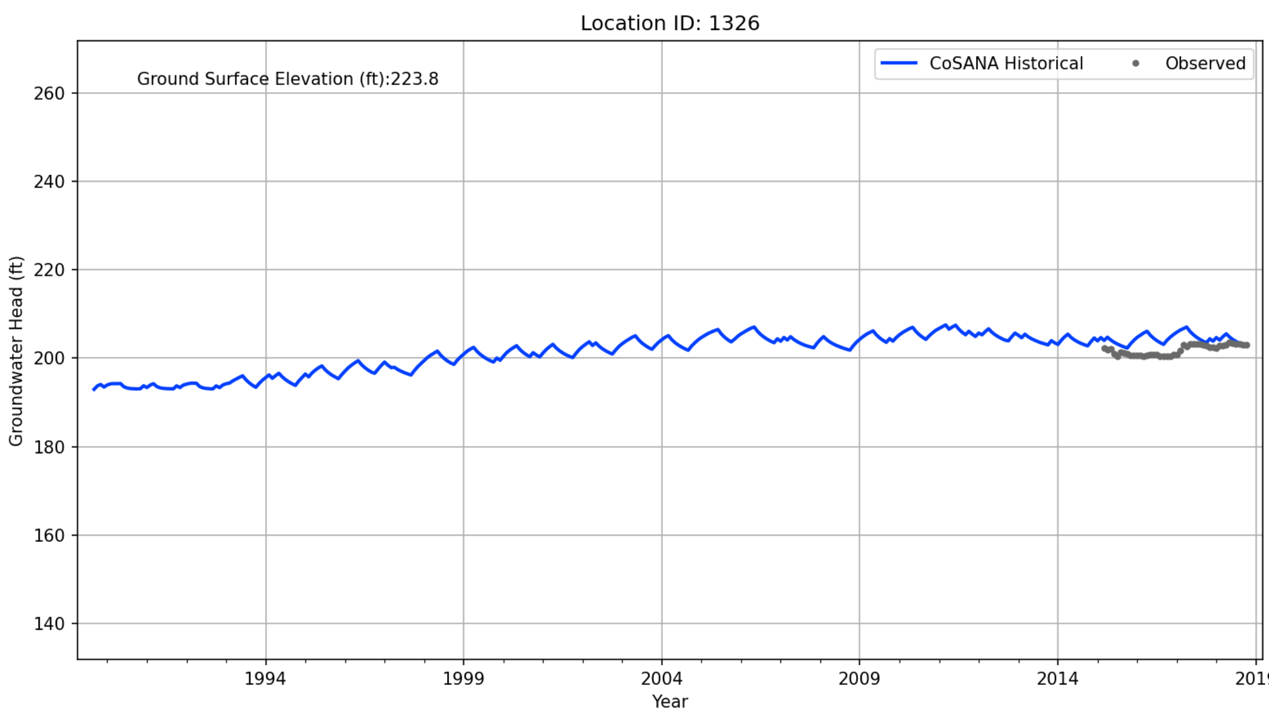


Figure 4-30: CoSANA Groundwater Level Hydrograph – Hydrograph #6

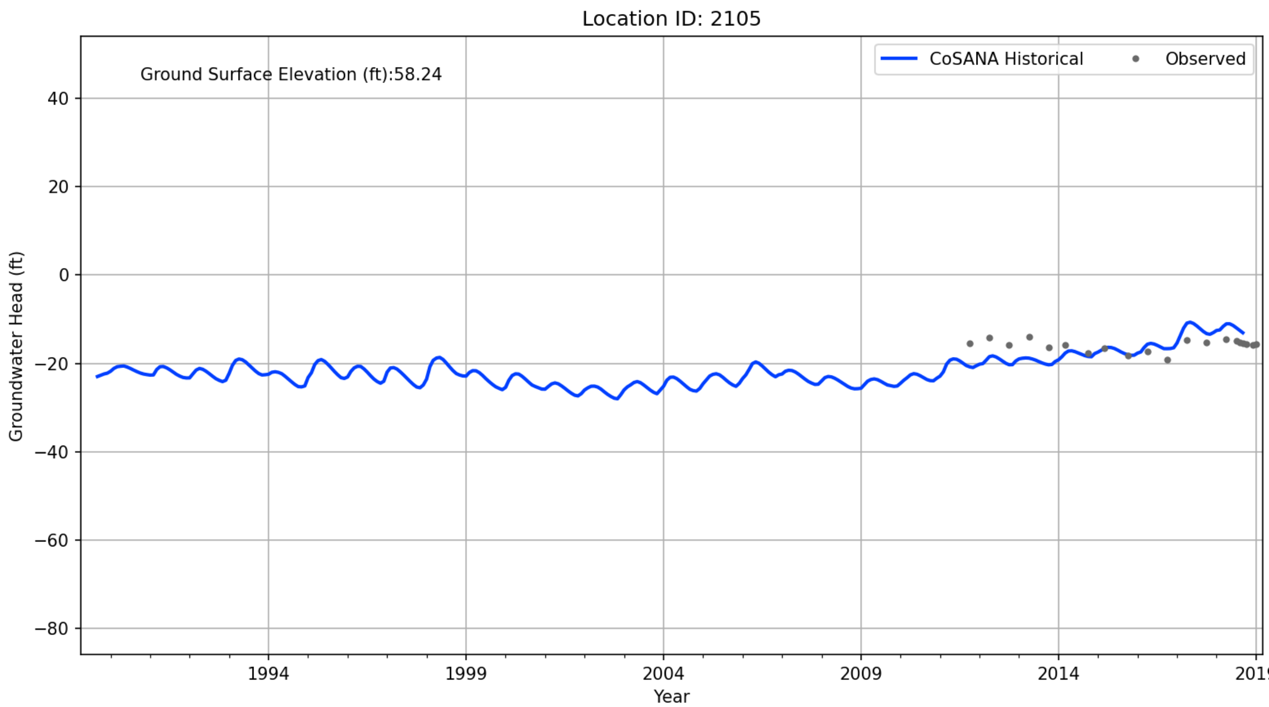


Figure 4-31: CoSANA Groundwater Level Hydrograph – Hydrograph #7

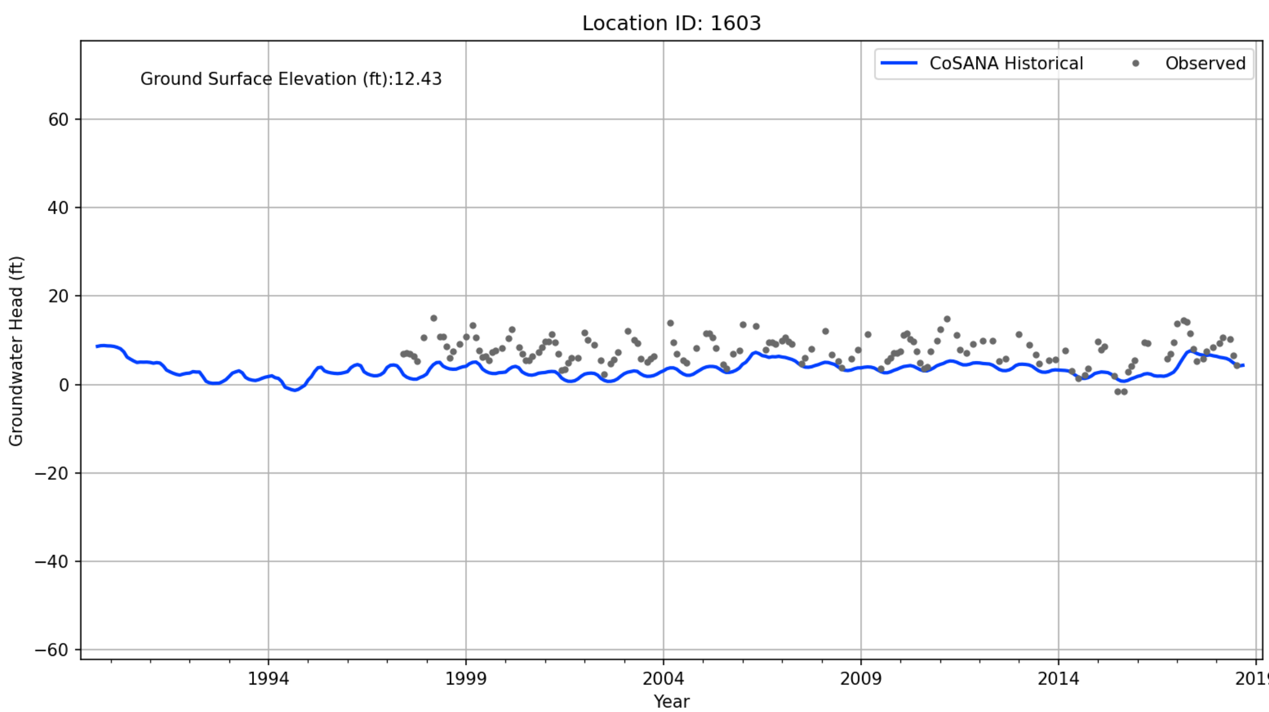


Figure 4-32: CoSANA Groundwater Level Hydrograph – Hydrograph #8

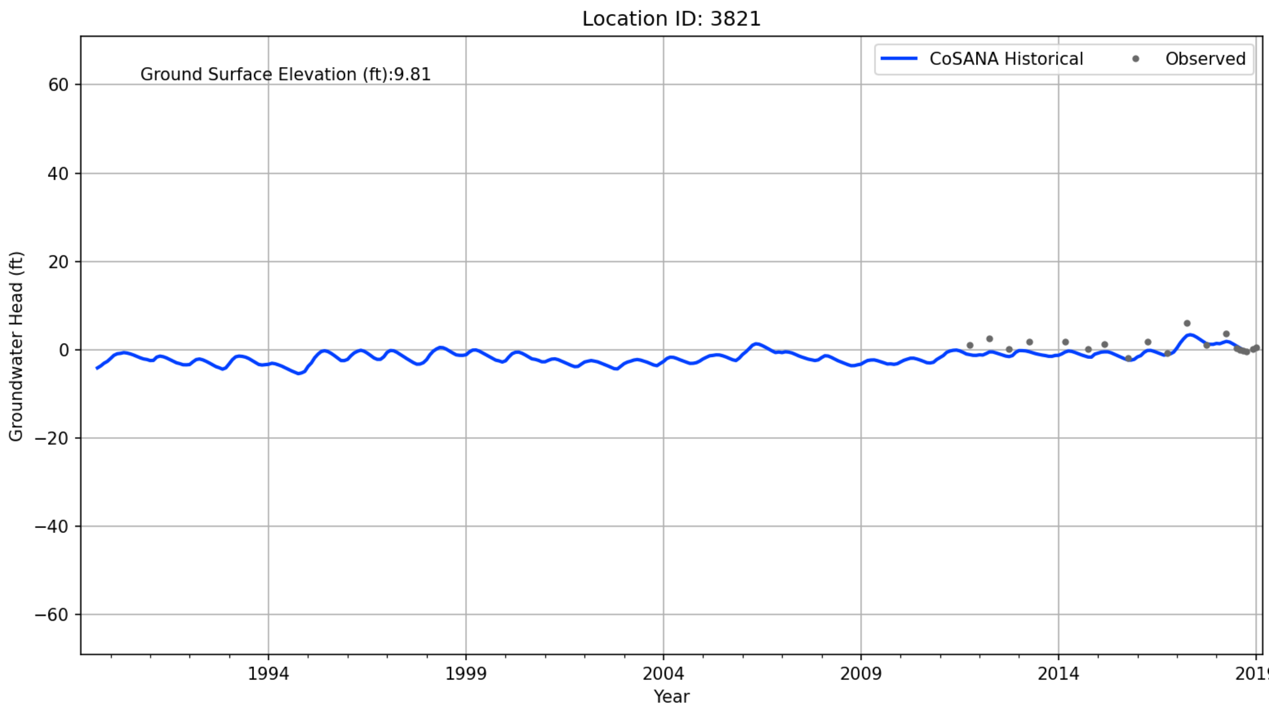


Figure 4-33: CoSANA Groundwater Level Hydrograph – Hydrograph #9

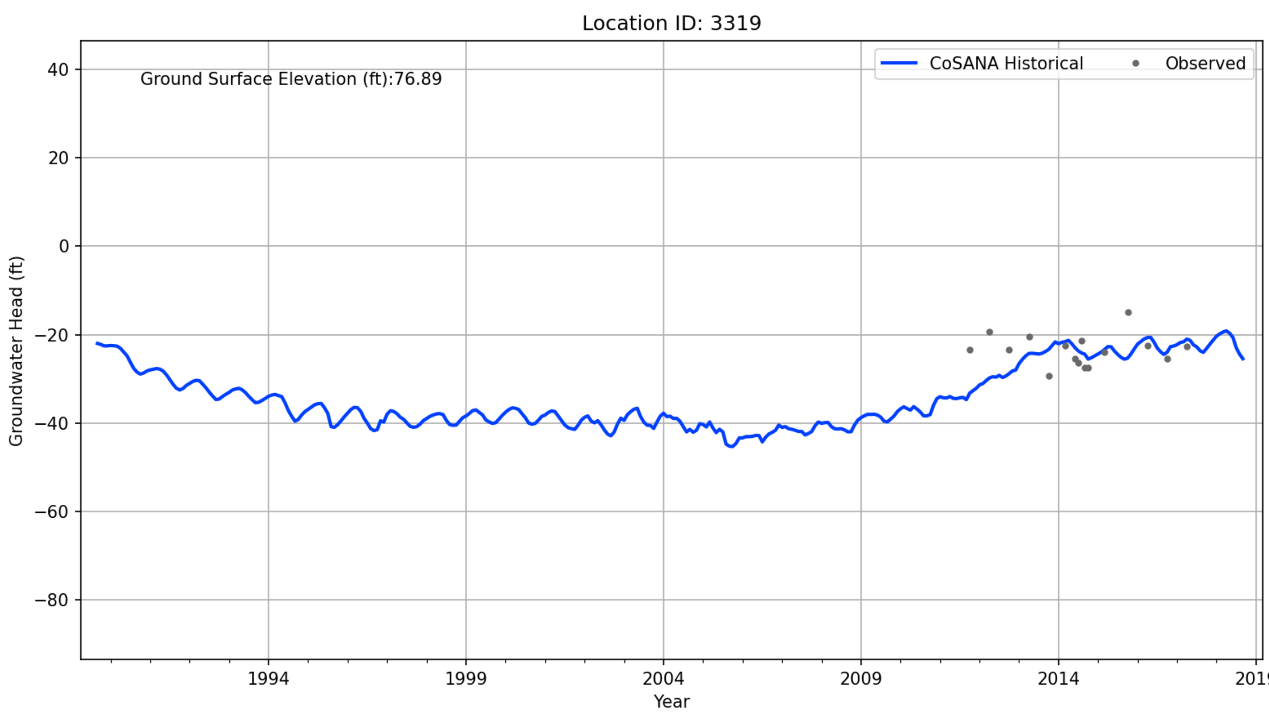


Figure 4-34: CoSANA Groundwater Level Hydrograph – Hydrograph #10

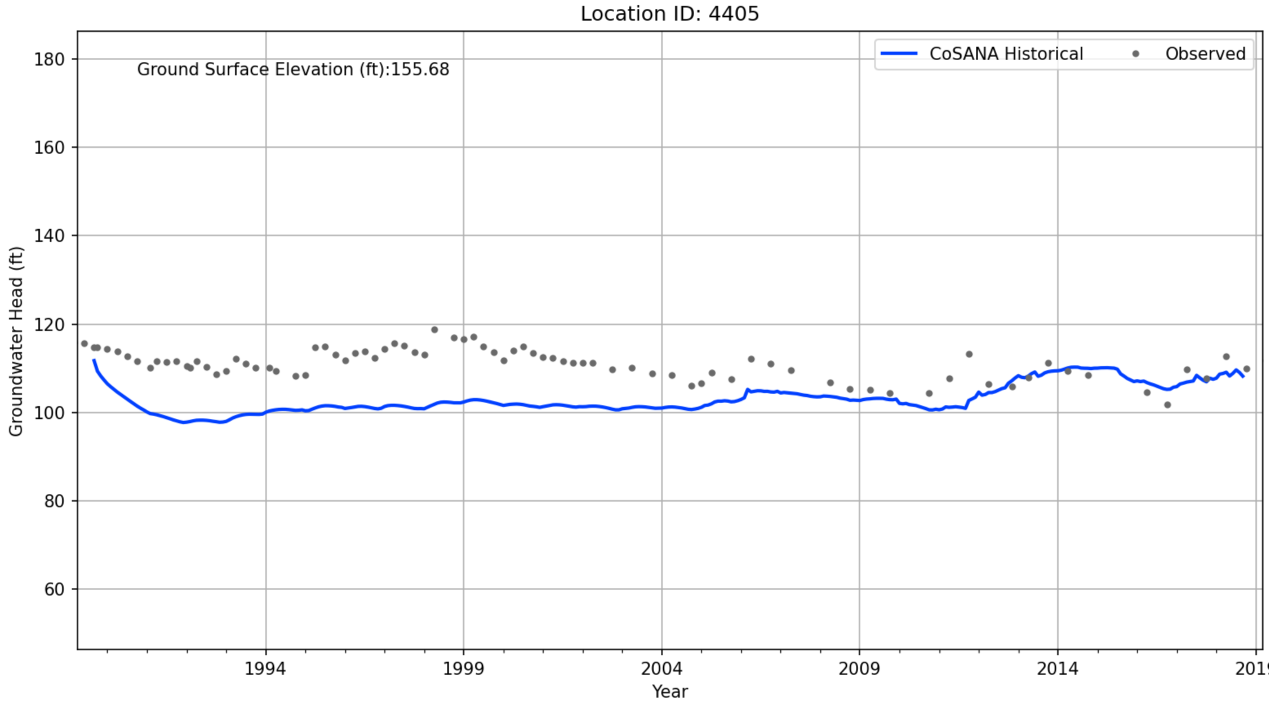


Figure 4-35: CoSANA Groundwater Level Hydrograph – Hydrograph #11

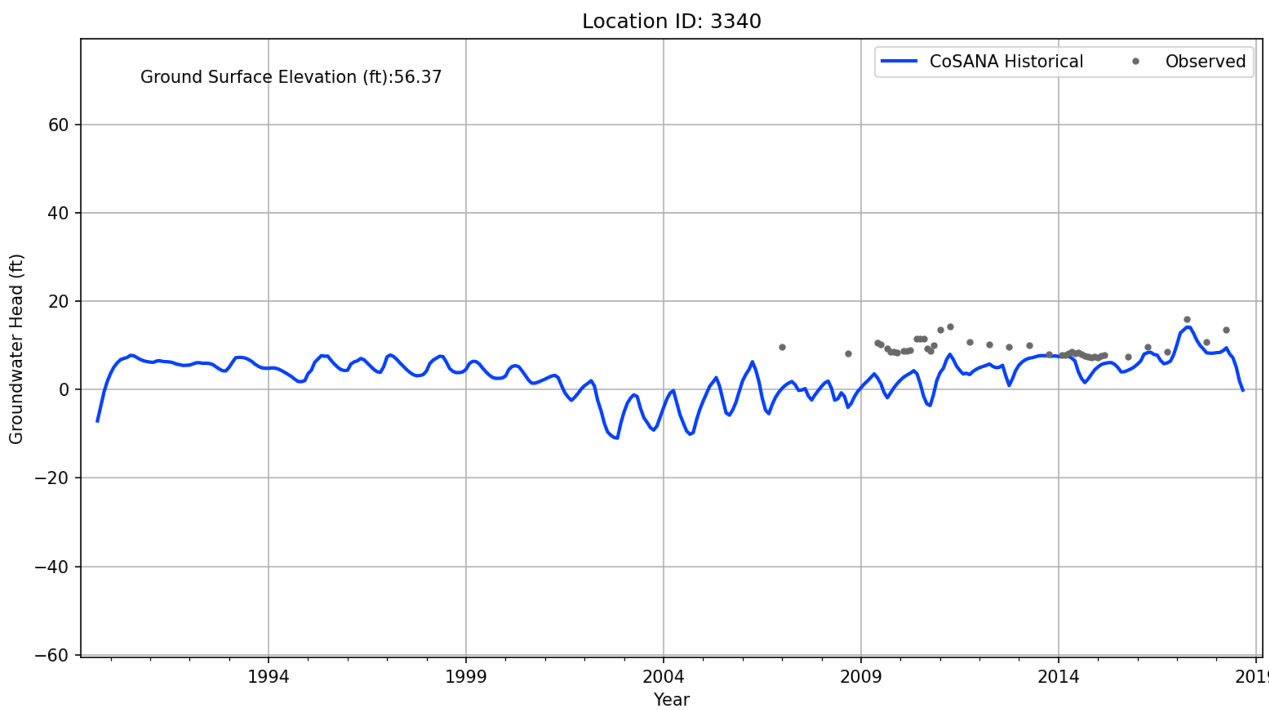


Figure 4-36: CoSANA Groundwater Level Hydrograph – Hydrograph #12

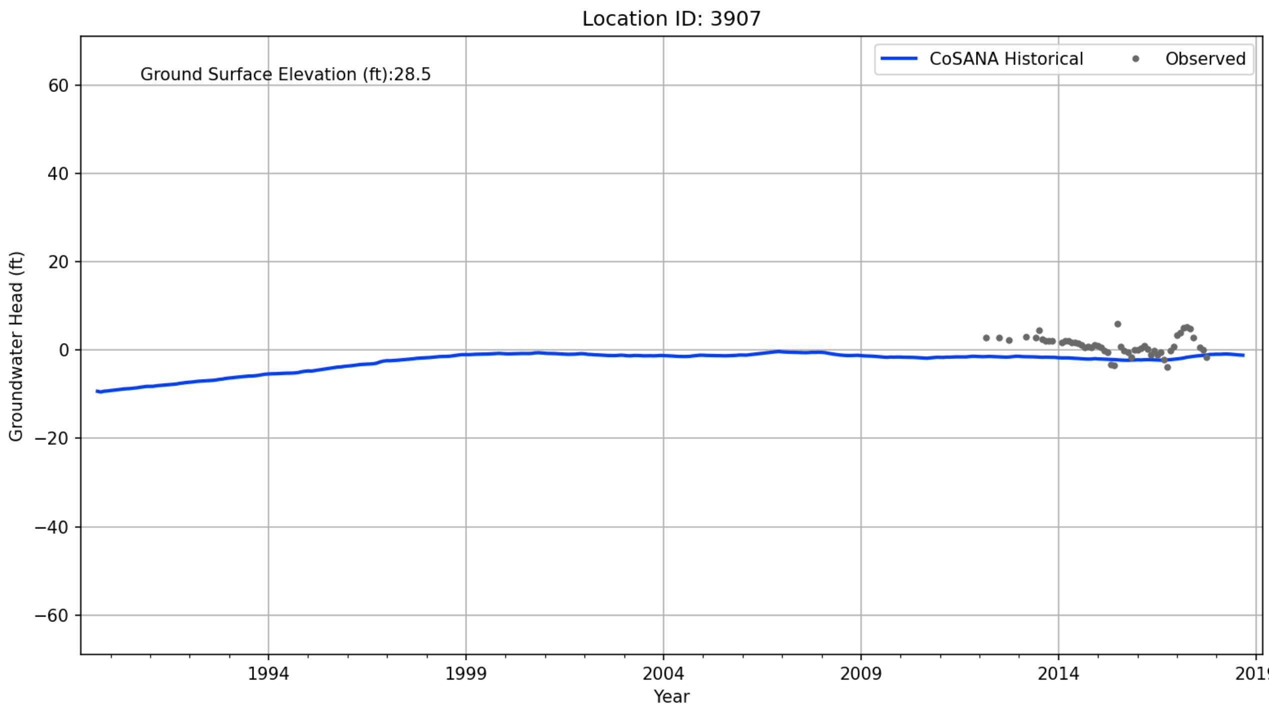


Figure 4-37: CoSANA Groundwater Level Hydrograph – Hydrograph #13

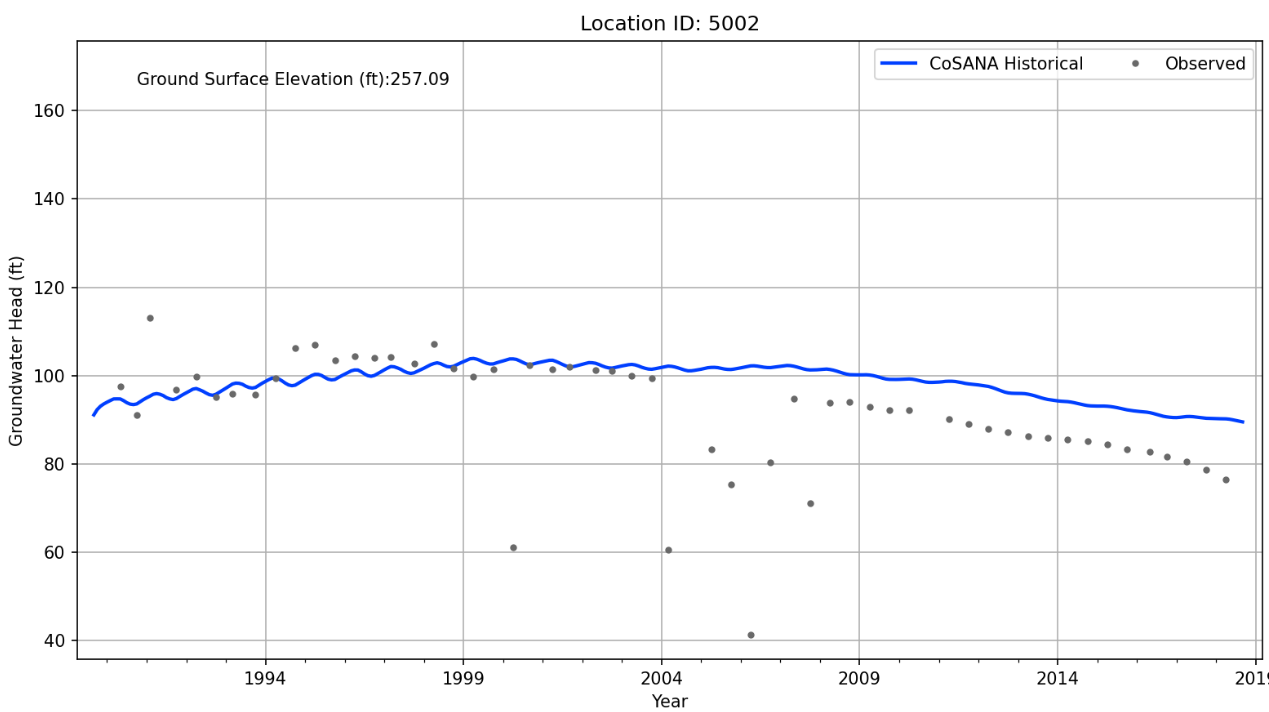


Figure 4-38: CoSANA Groundwater Level Hydrograph – Hydrograph #14

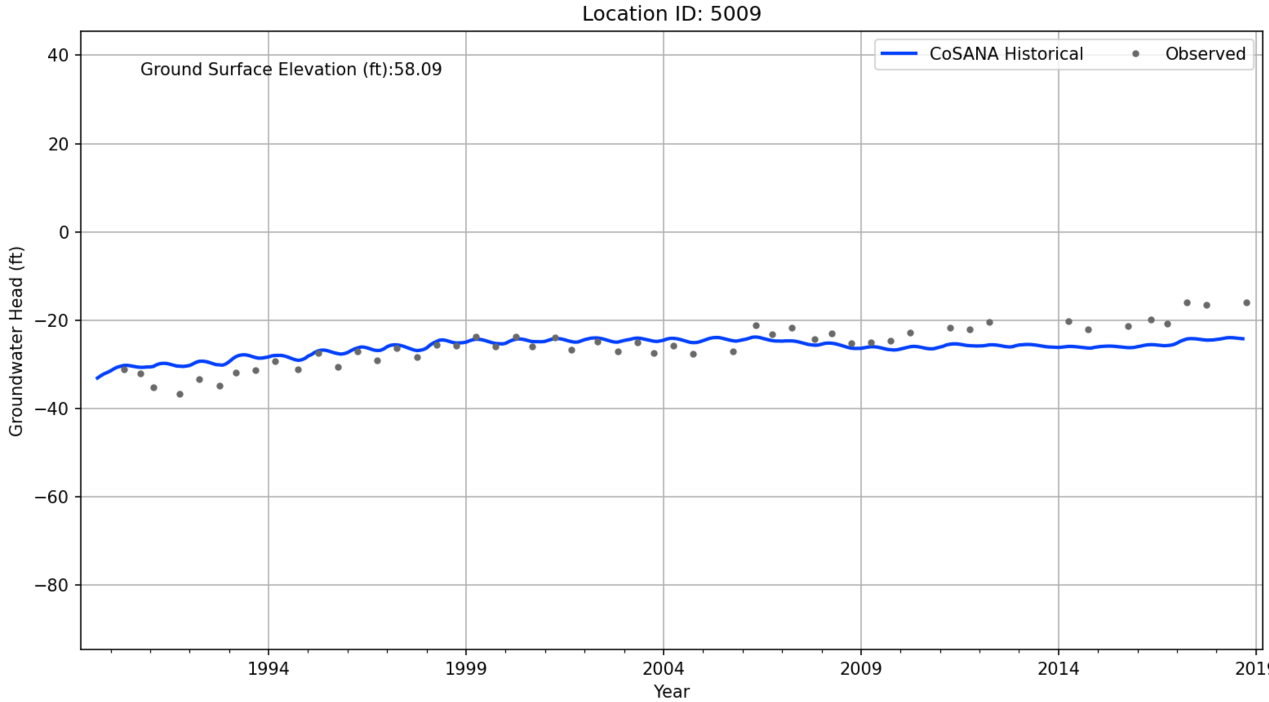


Figure 4-39: CoSANA Groundwater Level Hydrograph – Hydrograph #15

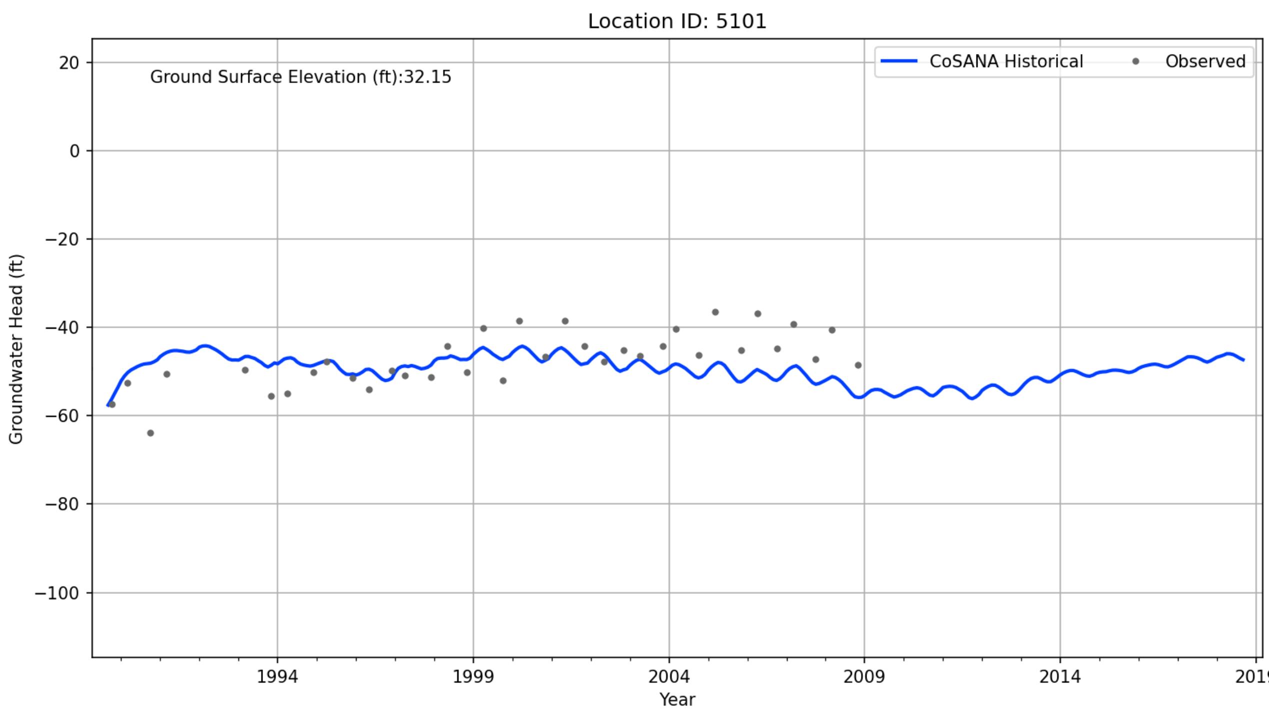


Figure 4-40: CoSANA Groundwater Level Hydrograph – Hydrograph #16

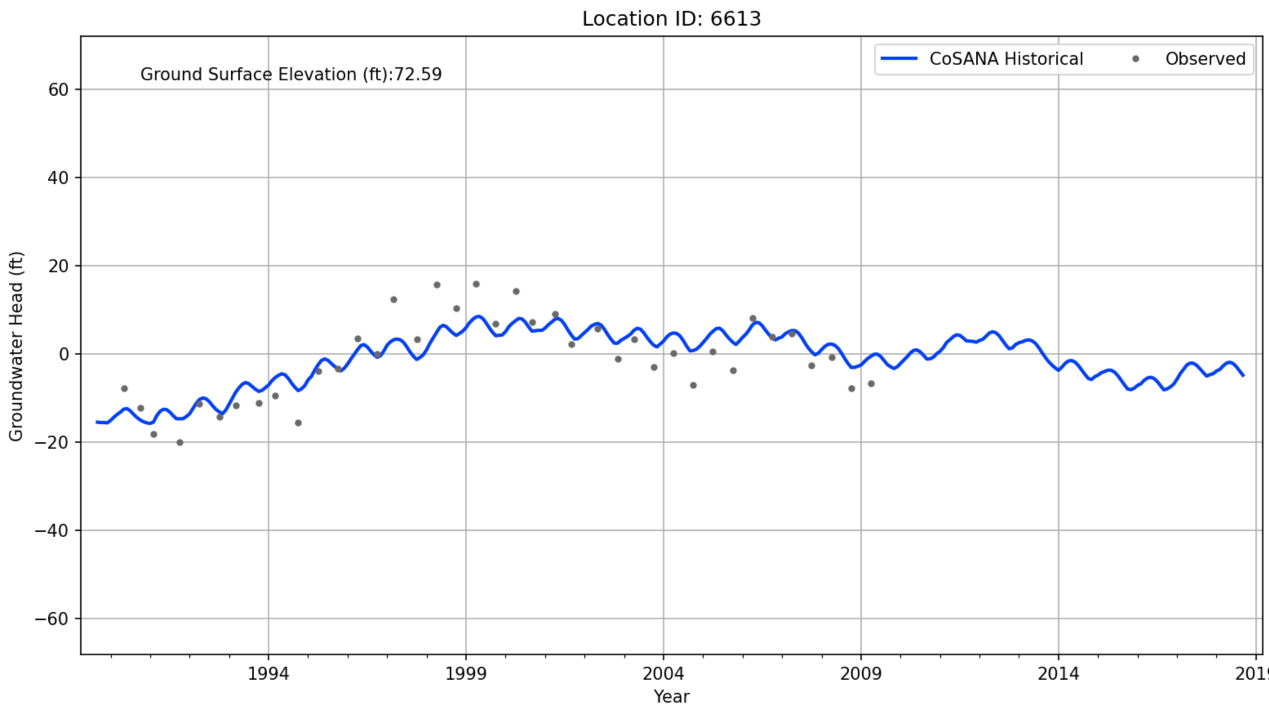


Figure 4-41: CoSANA Groundwater Level Hydrograph – Hydrograph #17

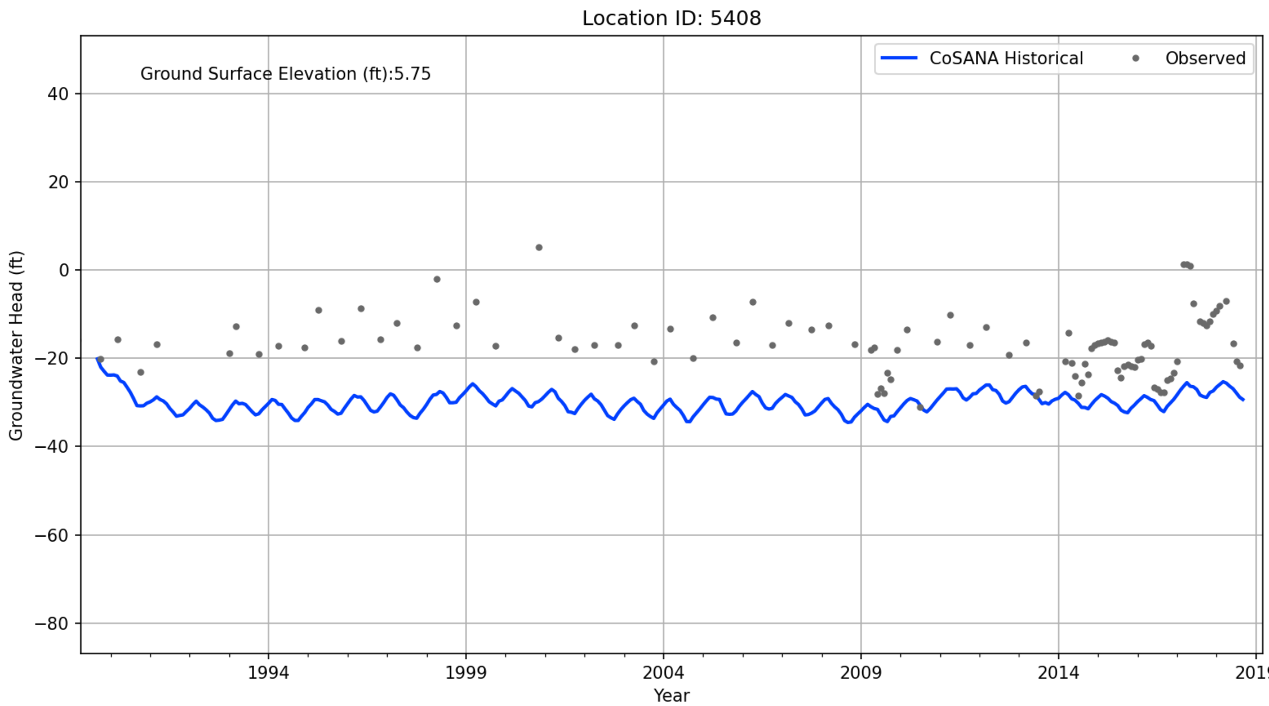


Figure 4-42: CoSANA Groundwater Level Hydrograph – Hydrograph #18

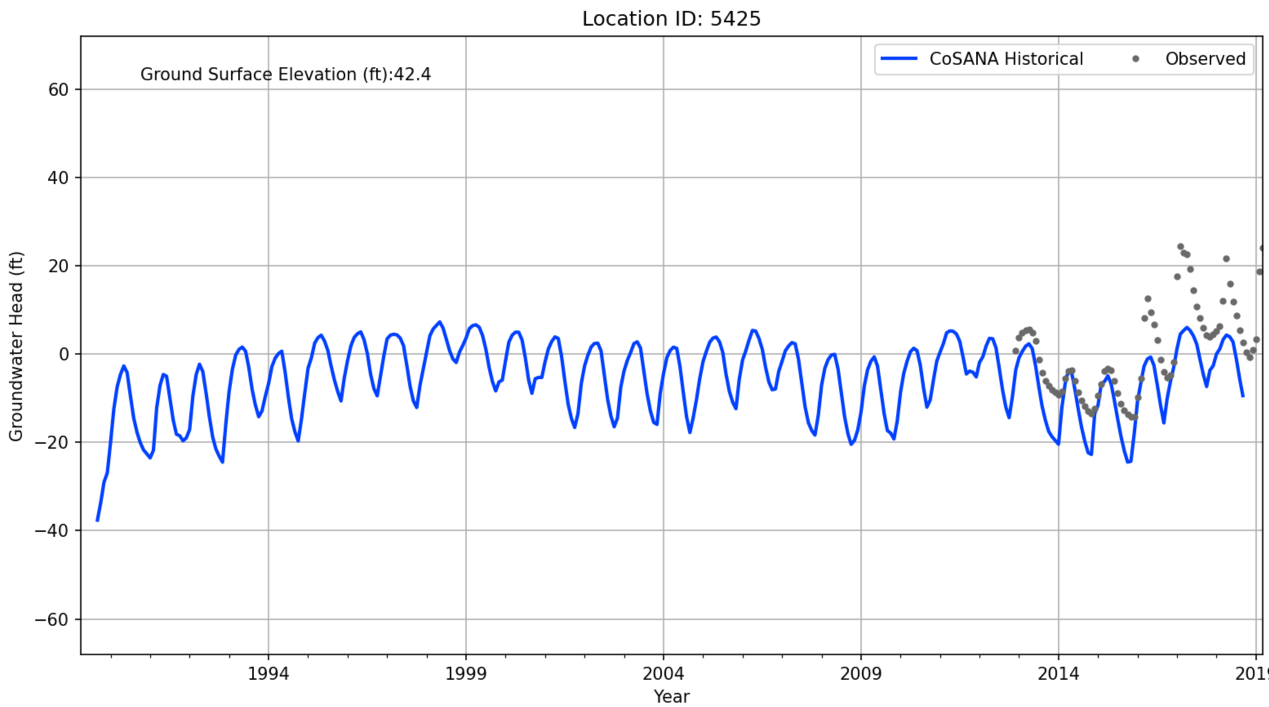


Figure 4-43: CoSANA Groundwater Level Hydrograph – Hydrograph #19

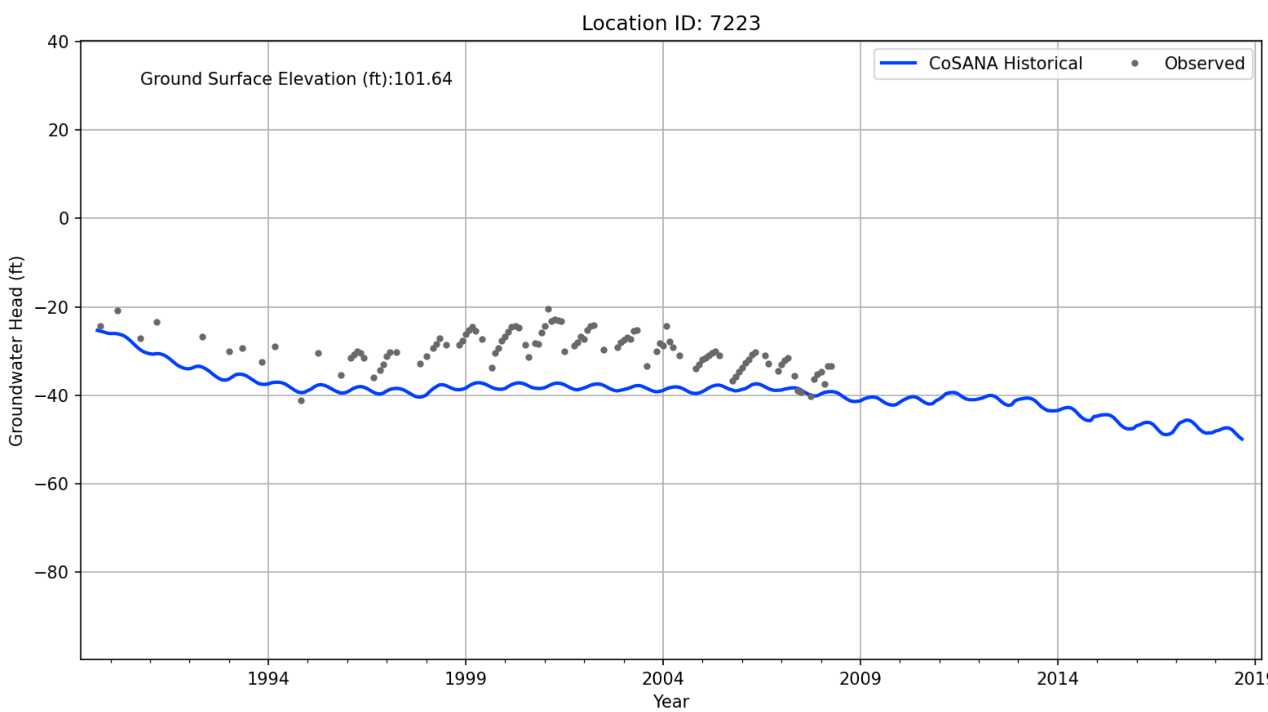


Figure 4-44: CoSANA Groundwater Level Hydrograph – Hydrograph #20

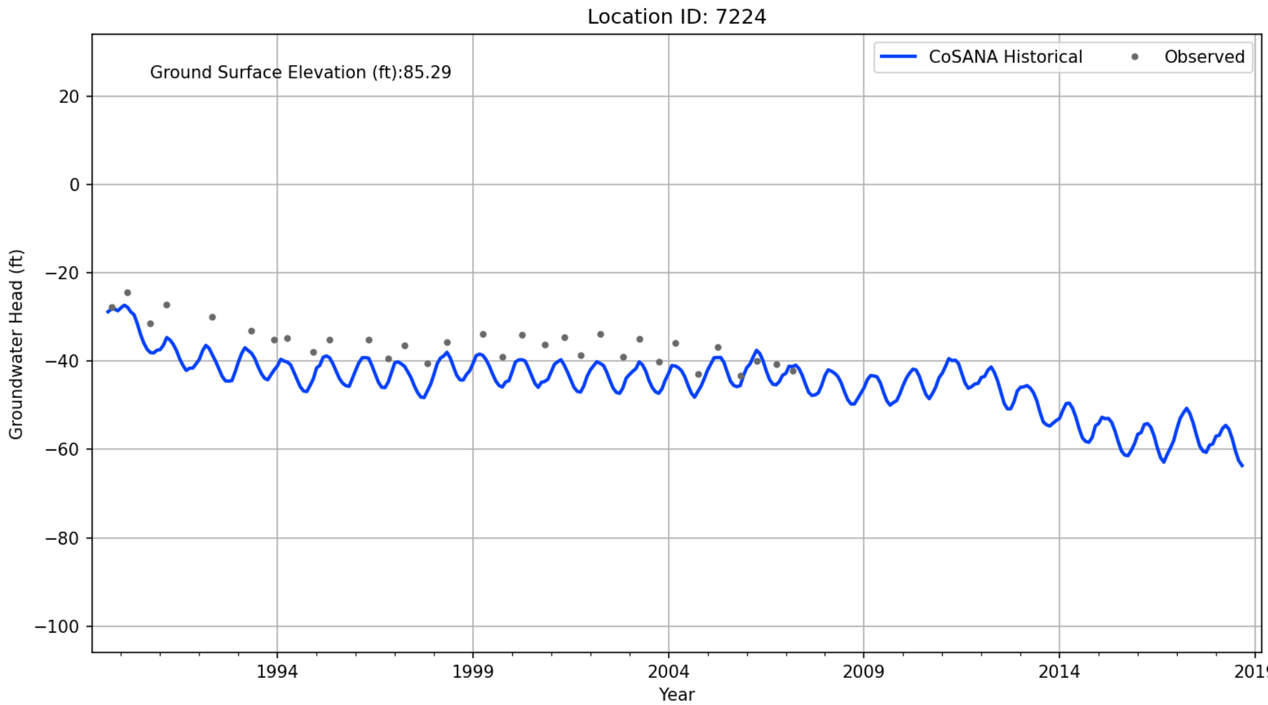


Figure 4-45: CoSANA Groundwater Level Hydrograph – Hydrograph #21

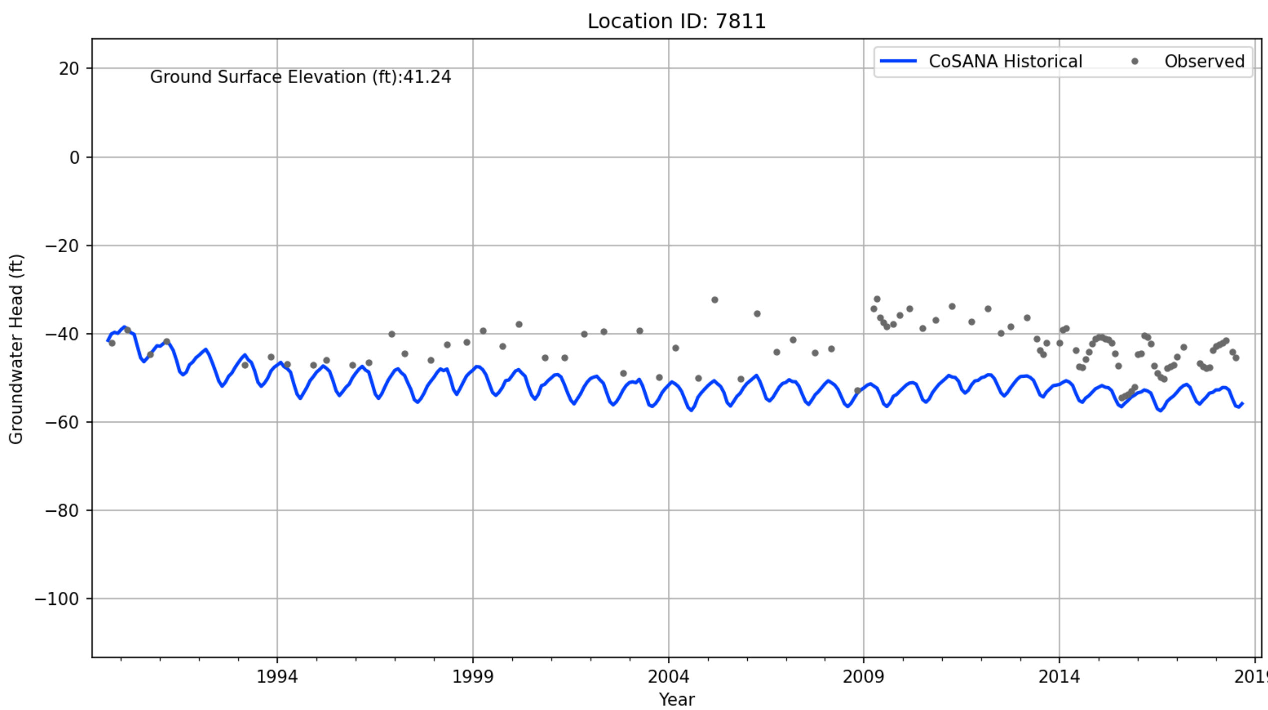


Figure 4-46: CoSANA Groundwater Level Hydrograph – Hydrograph #22

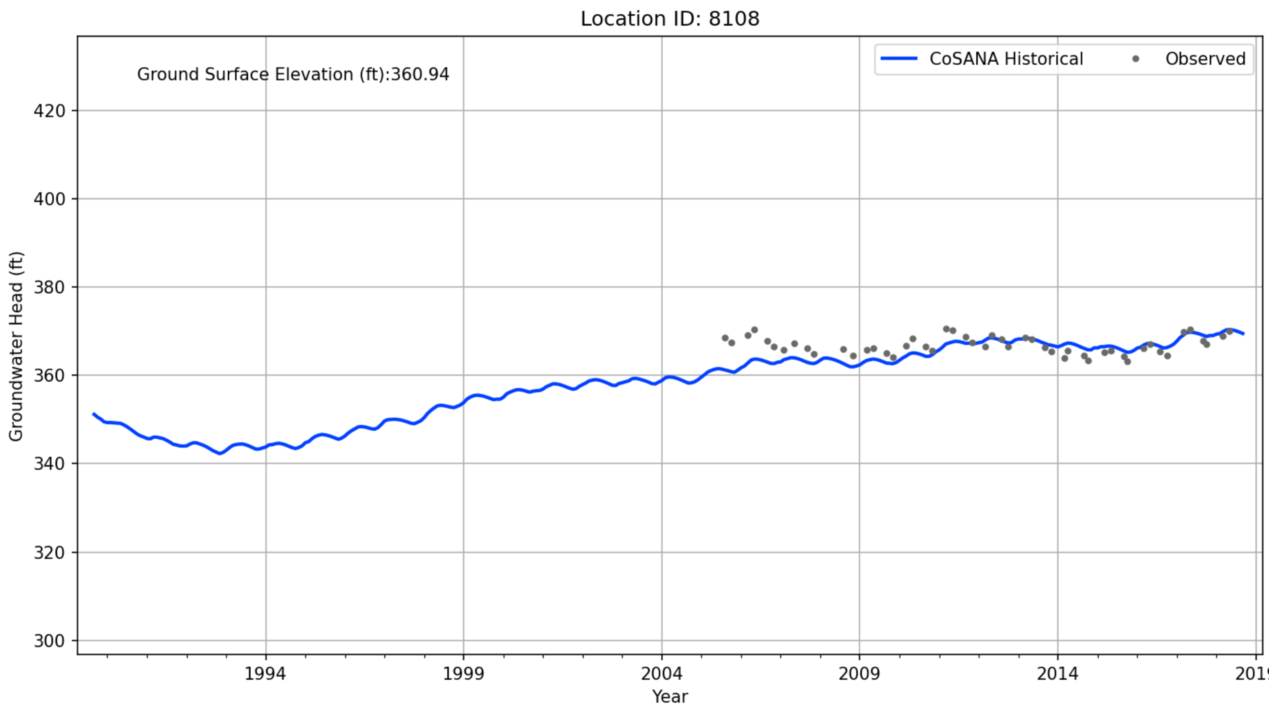


Figure 4-47: CoSANA Groundwater Level Hydrograph – Hydrograph #23

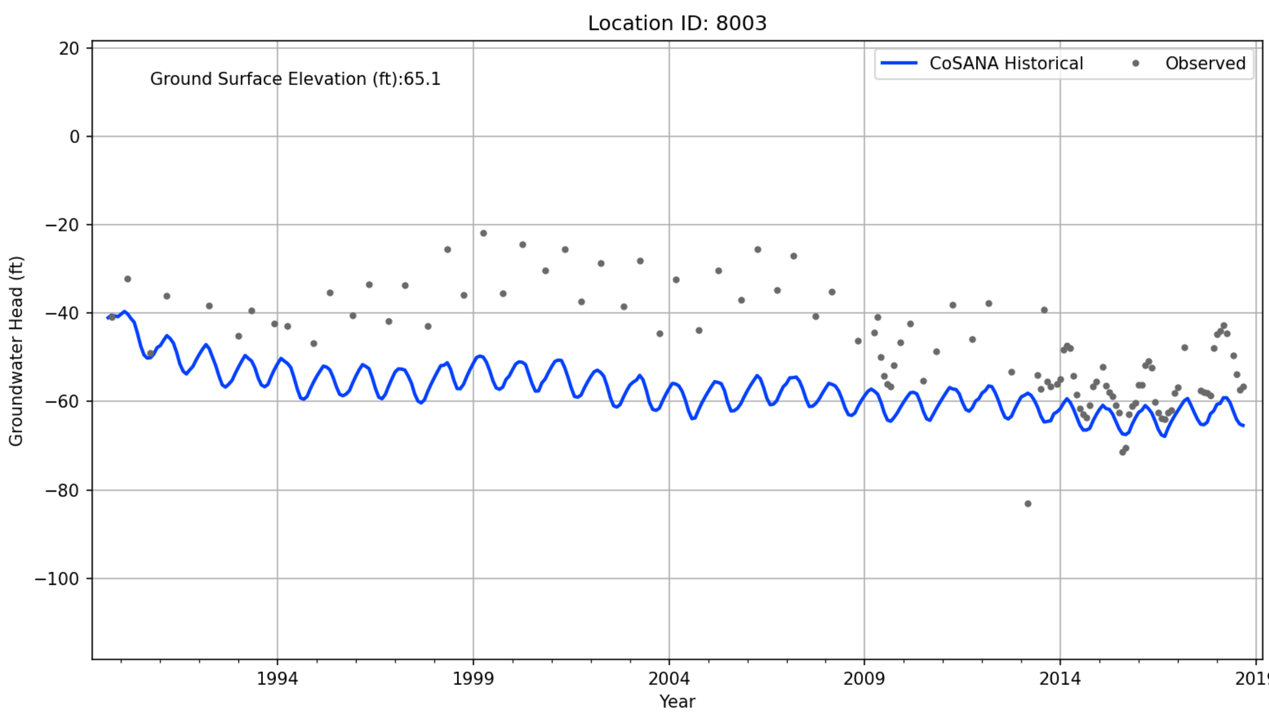


Figure 4-48: CoSANA Groundwater Level Hydrograph – Hydrograph #24

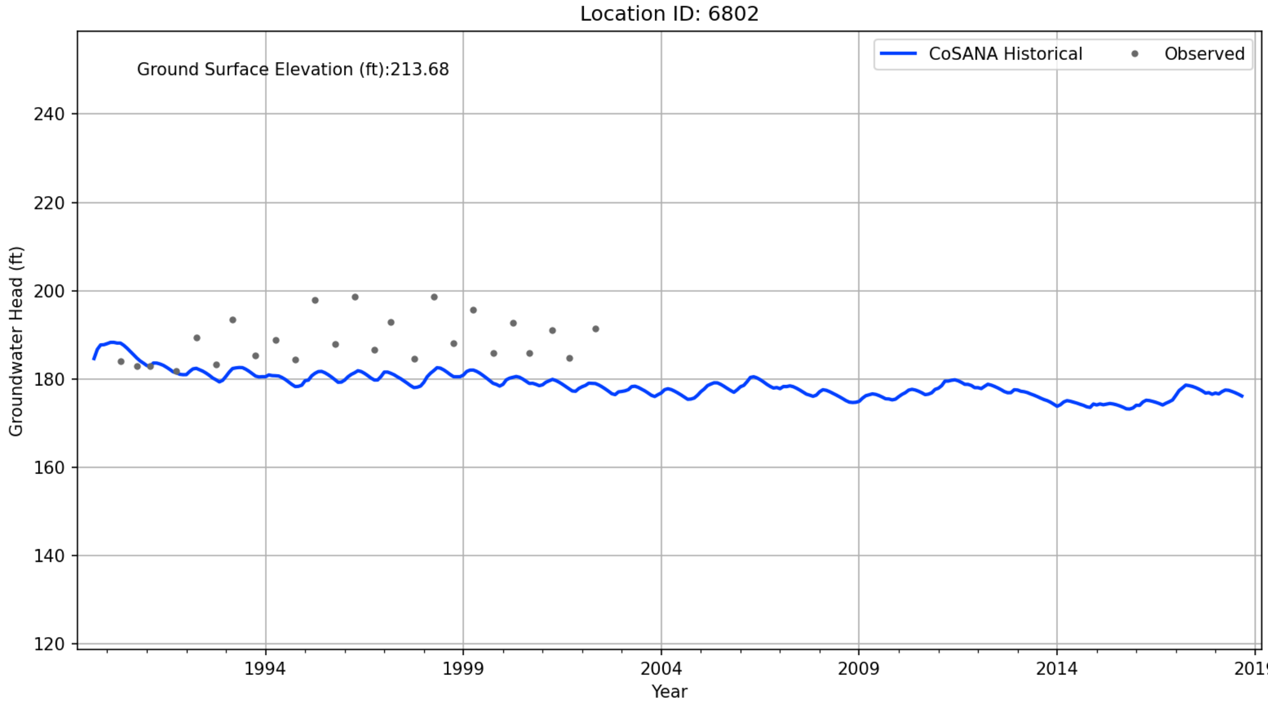


Figure 4-49: CoSANA Groundwater Level Hydrograph – Hydrograph #25

4.2.3 Streamflow Calibration

Similar to the process for groundwater levels, streamflows are calibrated to achieve reasonable agreement between the simulated and observed values (in this case, streamflows at the gaging stations). Streamflow gaging stations near the eastern boundary of the model are often used for inflow data (see Section 2.4). Other streamflow gaging stations are downstream of these inflow points and associated observed streamflow data can be compared to simulated streamflow in the calibration process. The comparison assists in modifications to parameters associated with stream aquifer interaction.

Streamflow calibration is primarily performed by comparing the simulated streamflow with local data from 15 stream gages (Table 4-3 and Figure 4-50). Data for these gages came from USGS or the California Data Exchange Center (CDEC).

Table 4-3: Summary of CoSANA Stream Calibration Gages

Stream	Stream Node	Description	Agency	Station ID	Period of Record
American River	895	American R at H St Bridge	CA DWR	CDEC ID: HST	1986 - Present
Arcade Creek	619	Arcade Cr at Winding Way	Sacramento County	CDEC ID: AMC	1995 - Present
Arcade Creek	625	Arcade Cr near Del Paso Heights	USGS	11447360	1995 - Present
Arcade Creek	600	Arcade Cr at Sunrise Blvd	Sacramento County Dep't Public Works	CDEC ID: ARD	1997 - Present
Bear River	49	Bear R at Pleasant Grove Rd	CA DWR	CDEC ID: BPG	2005 - Present
Cosumnes River	1667	Cosumnes R at McConnell, CA	USGS	11336000	1941 to 1982
Dry Creek (NASb)	510	Dry Cr at Vernon St. Bridge	City of Roseville	CDEC ID: VRS	1995 - Present
Dry Creek (CoSb)	1998	Dry Cr near Galt	USGS	11329500	1926 - 1997
Feather River	107	Feather R near Nicolaus	CA DWR	CDEC ID: NIC	1984 - Present
Laguna Creek (SASb)	1202	Laguna Cr near Eagles Nest Rd.	Sacramento County	CDEC ID: EGN	1996 - Present
Mokelumne River	2212	Mokelumne R at Woodbridge	EBMUD	CDEC ID: WBR	1997 - Present
Morrison Creek	1105	Morrison Cr at Mack Rd	Sacramento Dep't Public Works	CDEC ID: MCM	1998 - 2009
Sacramento River	947	Sacramento R at I St Bridge	CA DWR	CDEC ID: IST	1984 - Present
Sacramento River	1020	Sacramento R at Freeport	USGS	11447650	1948 - Present

Streamflow calibration included refinement of the streambed hydraulic conductivity originally from C2VSim. The calibrated streambed hydraulic conductivity is shown in Figure 4-51. Simulated streamflows were compared with observed records, and exceedance charts were also used to check the model performance when simulating high and low flows at each gage location. Calibration results for the Sacramento River at Freeport are shown in Figure 4-52 and Figure 4-53. Calibration results for the Cosumnes River at McConnell are shown in Figure 4-54 and Figure 4-55 (note that stage data but not flow data are available at McConnell).

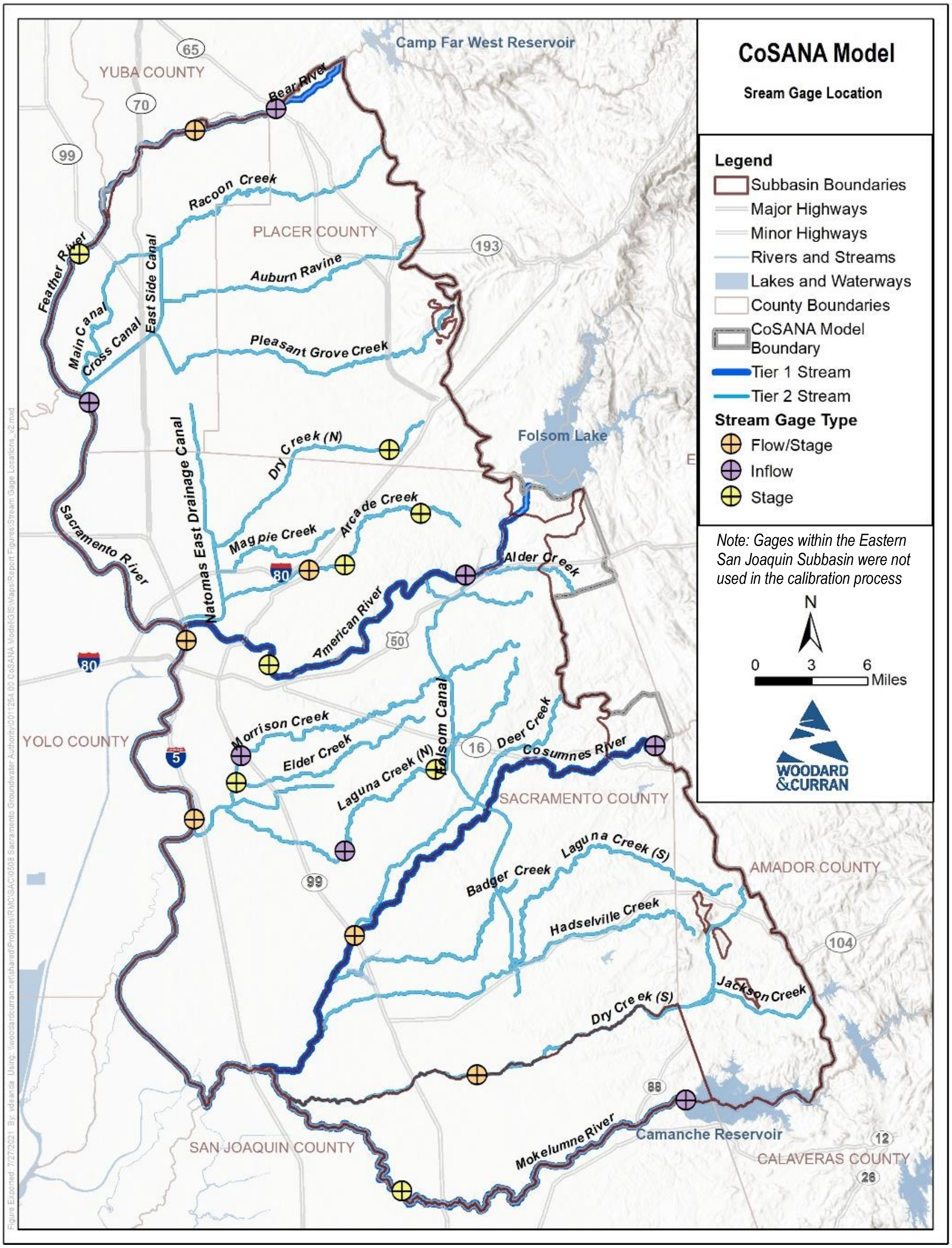


Figure 4-50: Stream Gage Locations

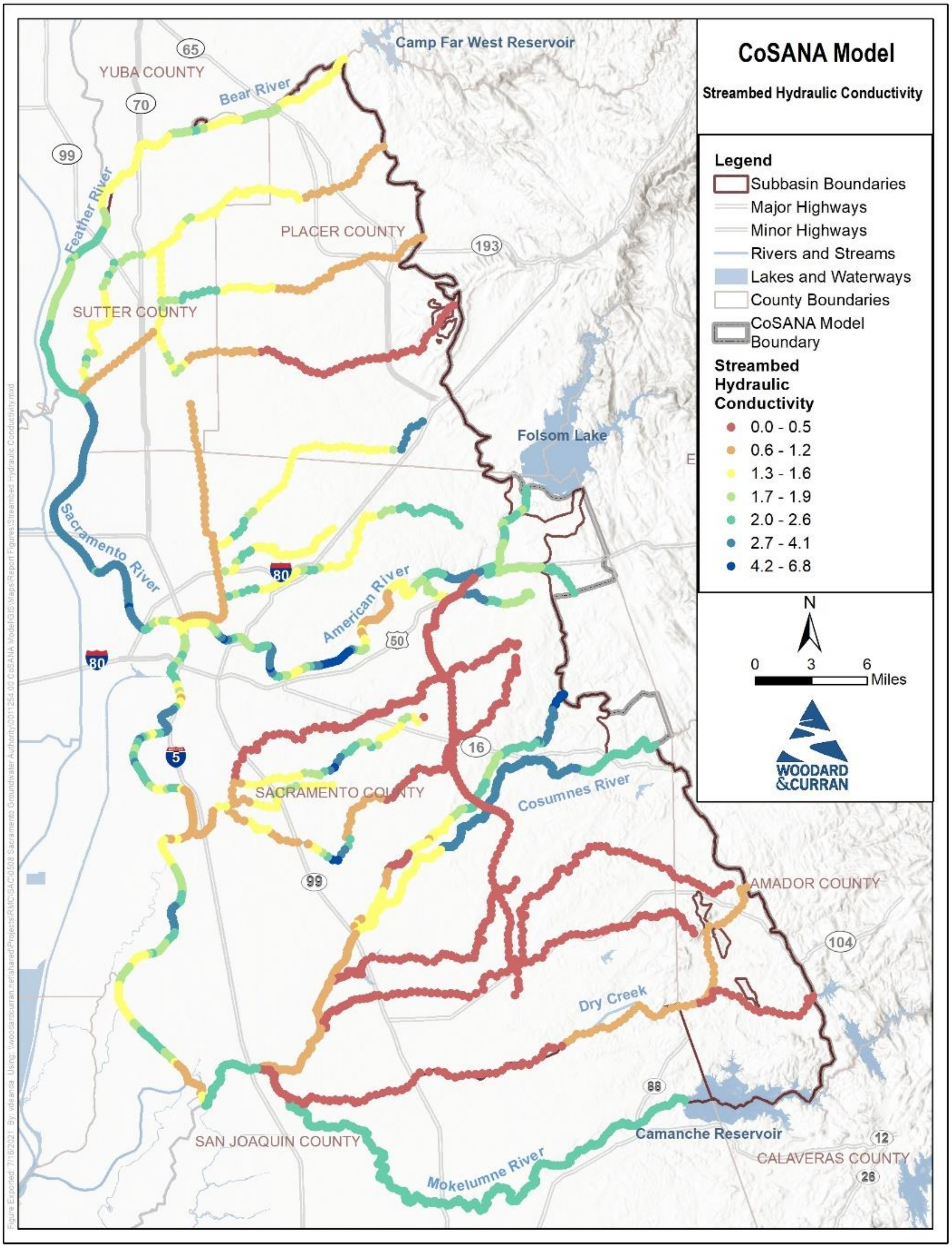


Figure 4-51: CoSANA Streambed Hydraulic Conductivity

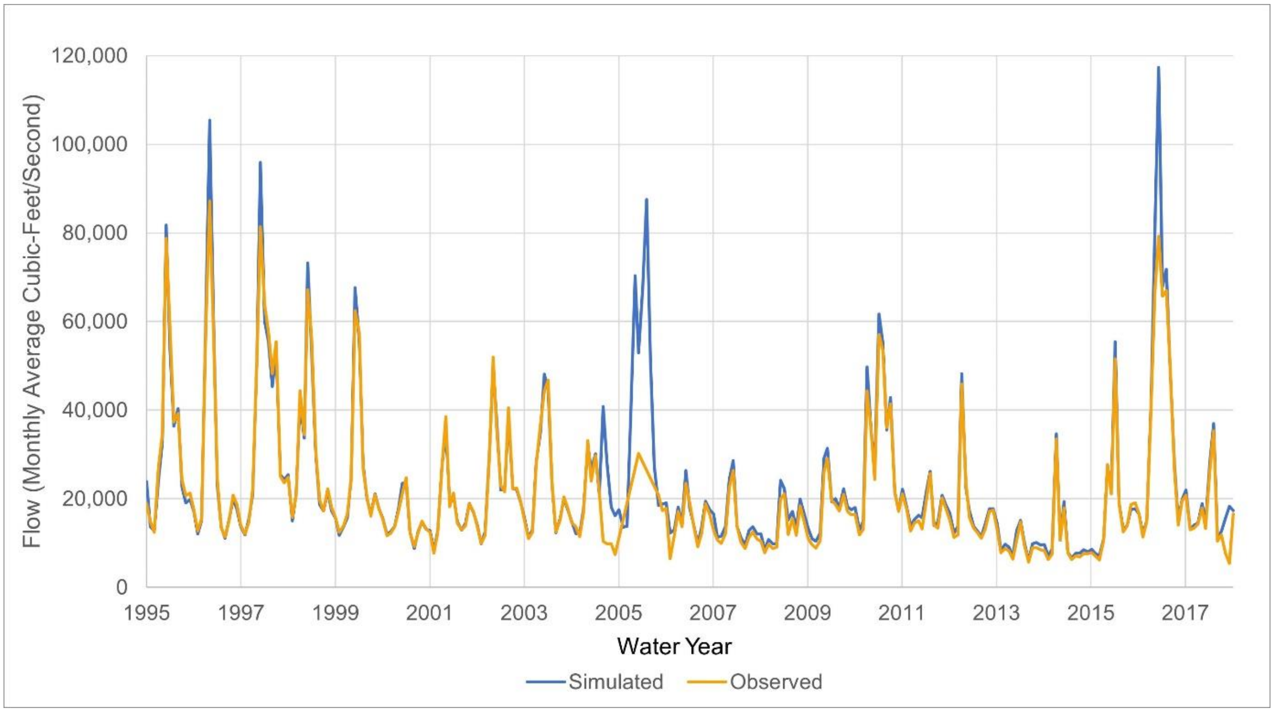


Figure 4-52: Streamflow Hydrograph for Sacramento River at Freeport, Simulated and Observed

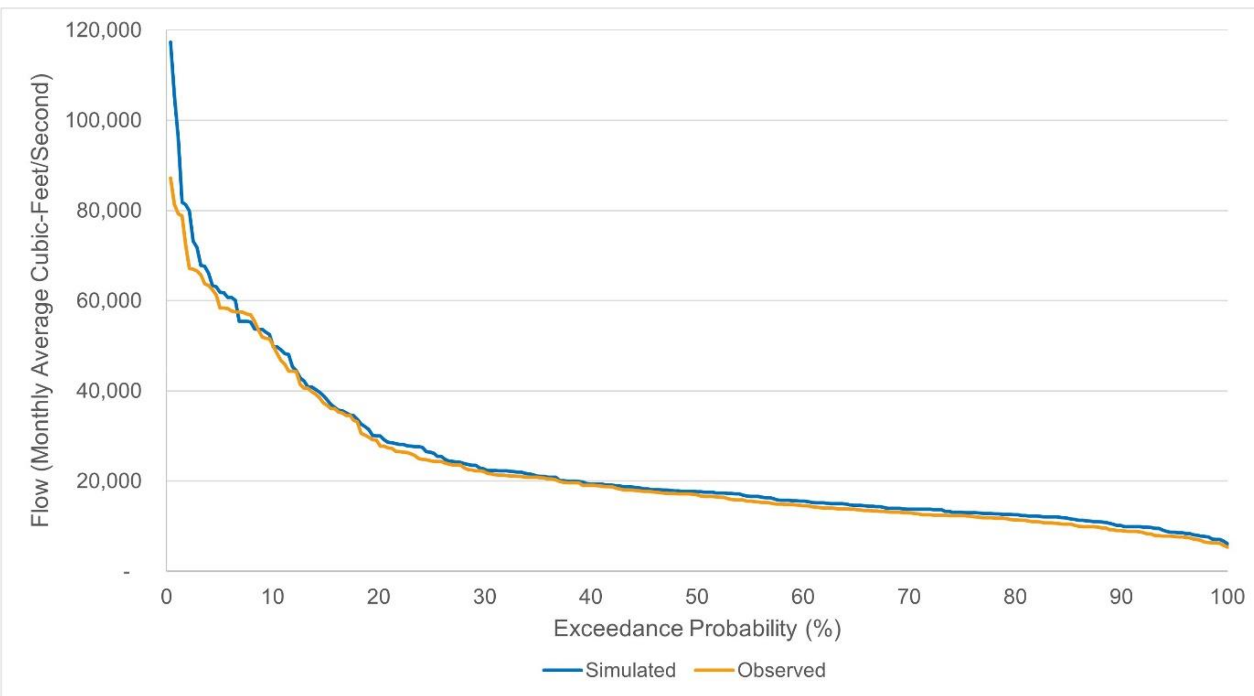


Figure 4-53: Sacramento River at Freeport Streamflow Exceedance, Simulated and Observed

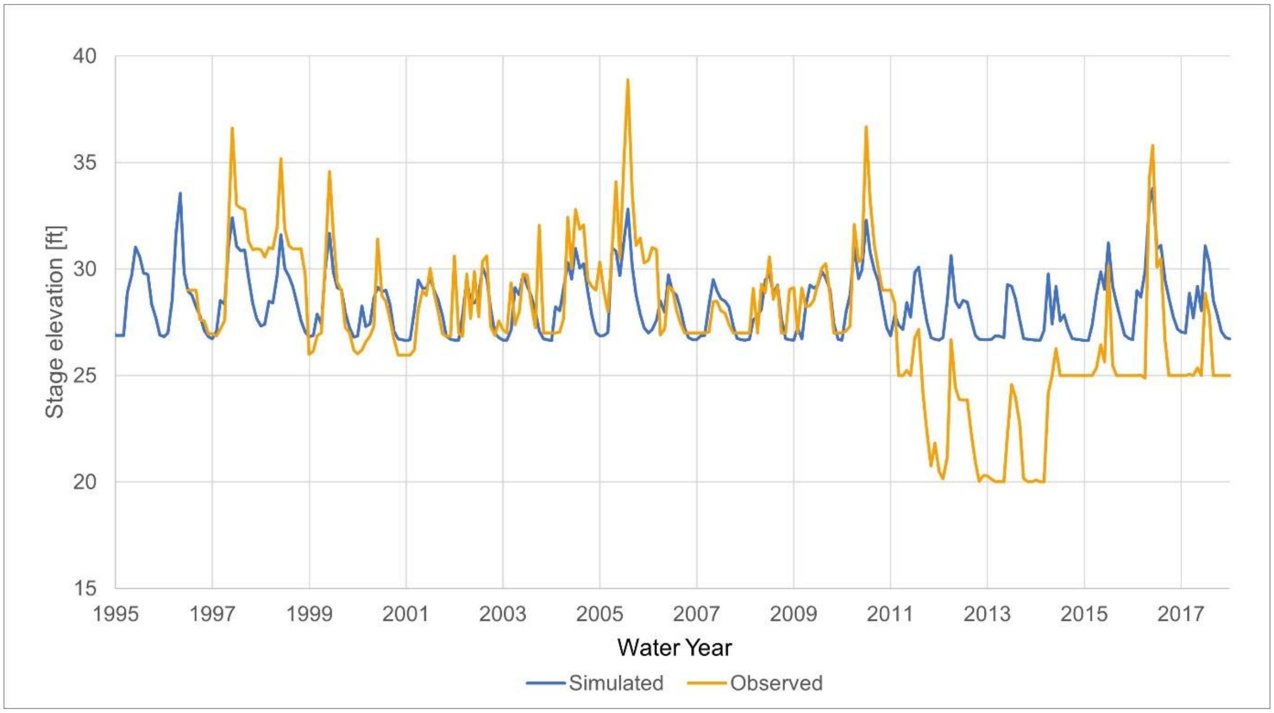
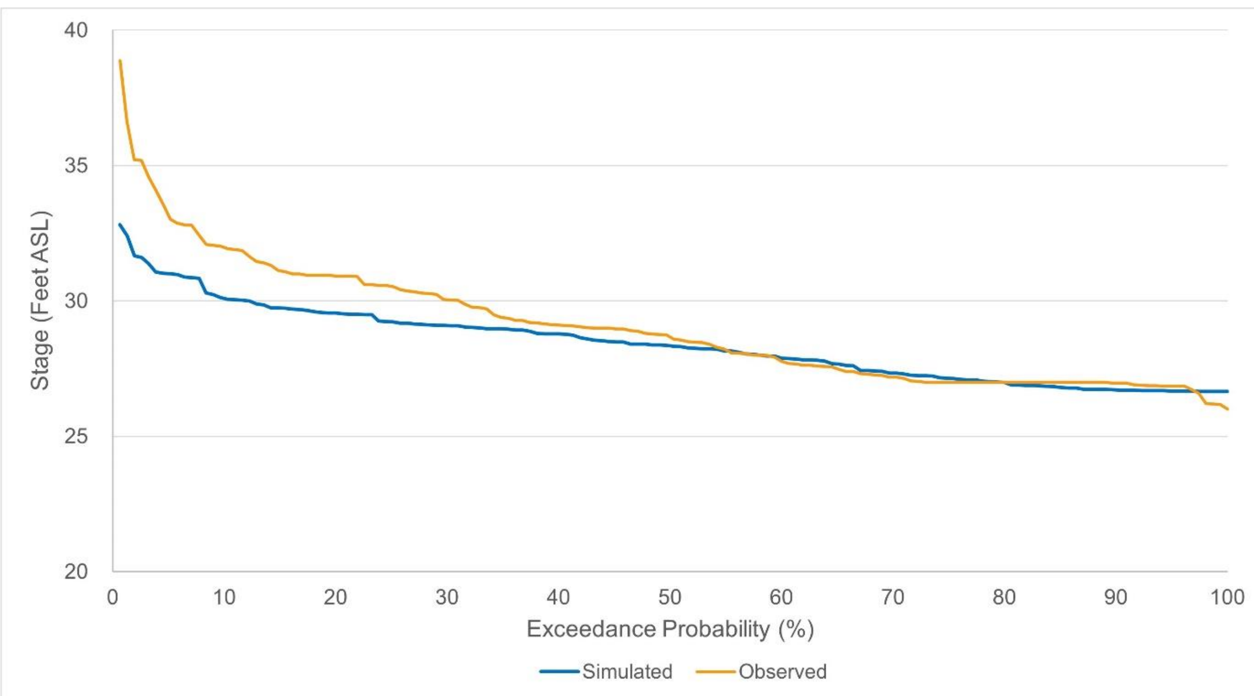


Figure 4-54: Stage for Cosumnes River at McConnell, Simulated and Observed



Note: due to apparent vertical datum issues (shown in Figure 4 53) the above exceedance chart shows data from only Mar-1997 to Sept-2010

Figure 4-55: Cosumnes River at McConnell Stage Exceedance, Simulated and Observed

4.2.4 Small Watershed Calibration

As discussed in Section 2.11, small watersheds are used to simulate inflows into the model from ungaged watersheds. The small watershed contributions are split between surface water runoff that enters the stream system, percolation that occurs during transport to the streams, and baseflow entering the groundwater system at the model boundary. Groundwater level hydrographs along the model boundary selected for groundwater level calibration (Section 4.2.2) were referenced to confirm and edit, as necessary, the various parameters of the small watersheds.

The distribution of small watershed inflows between surface runoff, percolation, and baseflow is primarily driven by the maximum recharge rate and recession coefficients. The recession coefficient governs how much of the total water enters the system as surface water and groundwater. The maximum recharge controls the percolation from runoff. Observed groundwater hydrographs along the model boundary were used to assess how much watersheds contributed to groundwater levels with a focus on seasonal fluctuations. Parameter adjustments were implemented across the small watersheds to maintain reasonable groundwater elevations and streamflows. Additionally, some small watersheds were turned off where additional data were available to characterize the inflows.

There is considerable uncertainty in subsurface conditions and nature of hydraulic interactions between the small watersheds adjacent and upslope to the Cosumnes Subbasin. Two small watersheds adjacent to Cosumnes Subbasin were set to zero area to minimize adjacent flooding of the Foothills Subarea (flooding refers the condition when model-calculated water levels exceed land surface). As Jackson Creek is controlled by Lake Amador dam, it was instead specified as a stream inflow. The Lower Sutter Creek watershed area is the next largest contributing small watershed whose surficial geology is composed of Jurassic-age bedrock, and therefore was assumed that no baseflow or subsurface percolation to groundwater occurs from this watershed. Even with these specifications, model-calculated water budgets and groundwater levels indicated additional data and model refinements are needed to improve reliability in this portion of the Cosumnes Subbasin.

4.3 Calibration Statistics and Goodness of Fit

The CoSANA calibration was primarily assessed using two metrics: groundwater level trends and the correlation between simulated and observed groundwater levels. In addition to quantifiable metrics, the CoSANA calibration included comparisons and modifications to result in regional groundwater flow directions and water budgets that are consistent with available information on observed conditions and consistent with the understanding of basin conditions by stakeholders.

Statistics related to the differences between simulated and observed groundwater levels were evaluated relative to the American Standard Testing Method (ASTM) standard. The “Standard Guide for Calibrating a Groundwater Flow Model Application” (ASTM D5981) states that “the acceptable residual should be a small fraction of the head difference between the highest and lowest heads across the site.” The residual is defined as the simulated head minus the observed head. An analysis of all calibration water levels within the model indicated the presence of a range in groundwater levels of approximately 500 feet. Using 10 percent as the small fraction, the acceptable residual level would be 50 feet. The calibration exceeds that standard, as shown by the following statistics.

- 56% of observed groundwater levels are within +/- 10 feet of its respective simulated values
- 83% of observed groundwater levels are within +/- 20 feet of its respective simulated values
- 94% of observed groundwater levels are within +/- 30 feet of its respective simulated values

The residual histogram for the CoSANA is shown in Figure 4-56. Additionally, a scatter plot of simulated versus observed values is shown in Figure 4-57.

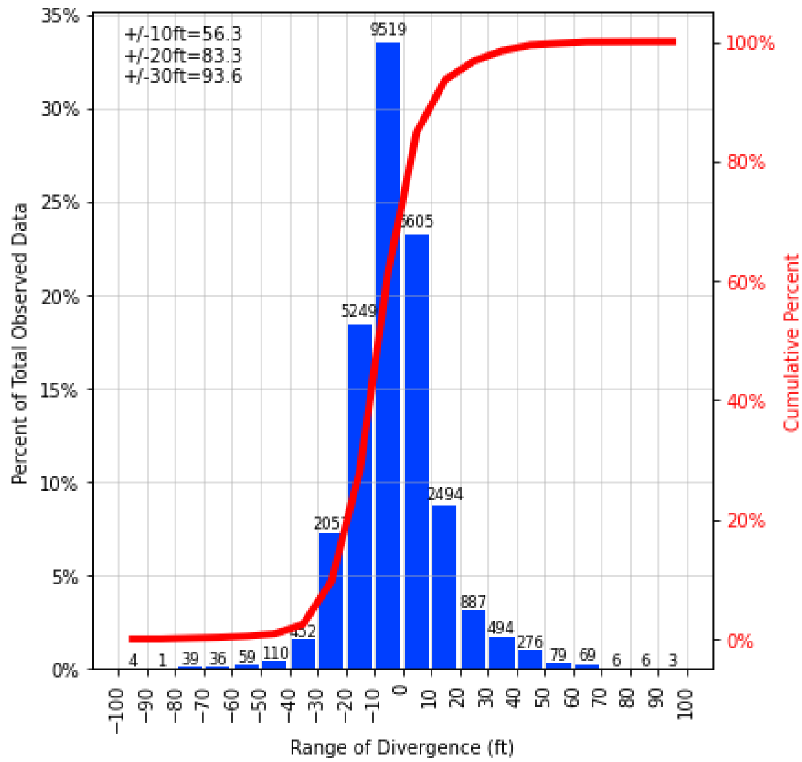
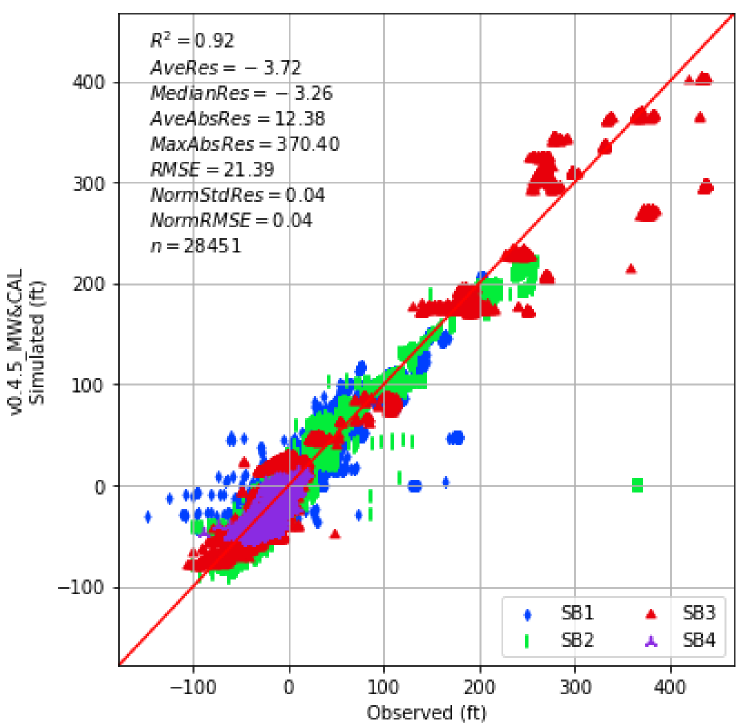


Figure 4-56: Residual histogram for the CoSANA Model



Note: SB1 = NASb, SB2 = SASb, SB3 = CoSb, SB4 = Eastern San Joaquin Subbasin

Figure 4-57: Scatter Plot of CoSANA Simulated versus Observed Values

4.4 Final Calibration Parameters

The parameters resulting from the calibration process are listed in Table 4-4. The spatial distribution of horizontal hydraulic conductivity is presented in Figure 4-58 through Figure 4-62.

Table 4-4: Range of Aquifer Parameter Values

Data		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
Horizontal Hydraulic Conductivity (ft/day)	Minimum	2.1	1.9	0.65	0.58	0.33
	Average	33.9	24.1	16.3	14.1	10.2
	Maximum	108.3	86.8	51.9	42.0	37.6
Vertical Hydraulic Conductivity (ft/day)	Minimum	0.012	0.0066	0.00045	0.0020	0.0012
	Average	0.99	0.73	0.19	0.42	0.35
	Maximum	4.6	5.2	2.0	2.6	2.3
Specific Storage (1/ft)	Minimum	2.67×10^{-6}	1.88×10^{-6}	1.54×10^{-6}	1.15×10^{-6}	9.80×10^{-6}
	Average	6.30×10^{-5}	6.40×10^{-5}	5.95×10^{-5}	6.09×10^{-5}	7.52×10^{-5}
	Maximum	4.73×10^{-4}	4.59×10^{-4}	4.68×10^{-4}	4.91×10^{-4}	4.96×10^{-4}
Specific Yield (unitless)	Minimum	0.057	0.068	0.056	0.073	0.052
	Average	0.13	0.12	0.13	0.13	0.11
	Maximum	0.24	0.22	0.24	0.24	0.22
Transmissivity (ft^2/day)	Minimum	0.64	0.067	0.077	0.25	0.23
	Average	2,765	5,128	9,679	3,489	1,726
	Maximum	15,005	24,090	69,562	17,019	11,078

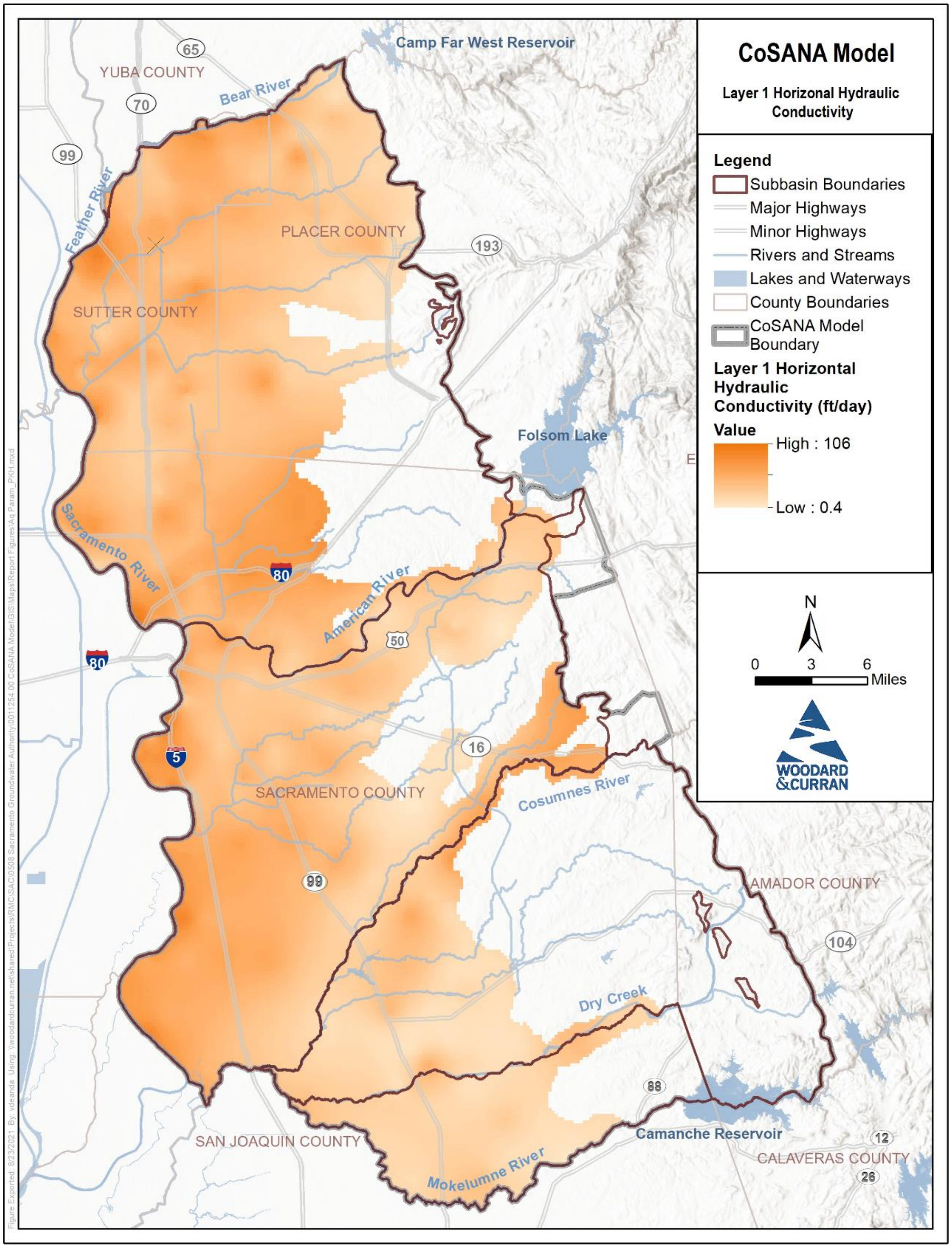


Figure 4-58: Distribution of CoSANA Layer 1 Horizontal Hydraulic Conductivity (K_H)

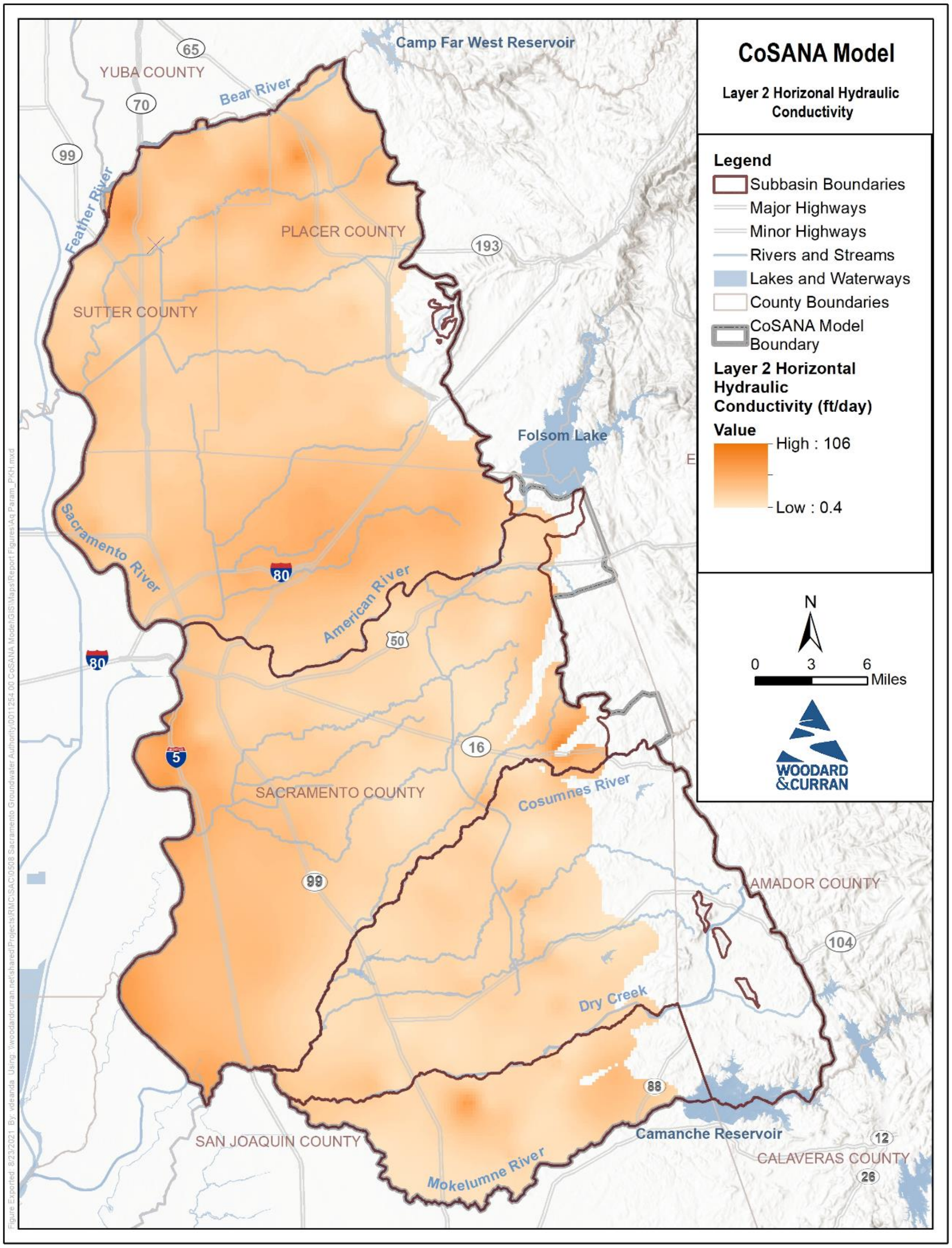


Figure 4-59: Distribution of CoSANA Layer 2 Horizontal Hydraulic Conductivity (K_H)

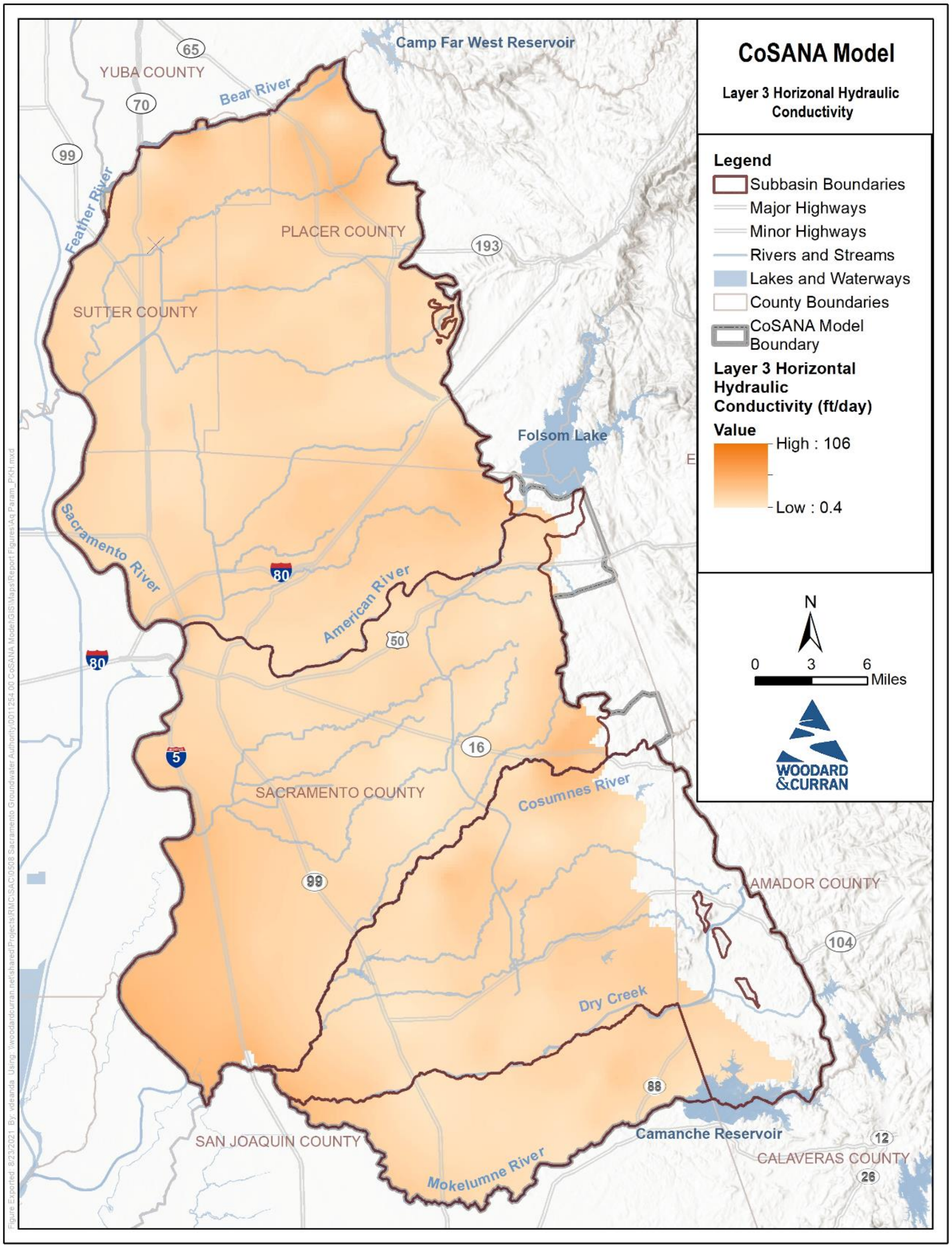


Figure 4-60: Distribution of CoSANA Layer 3 Horizontal Hydraulic Conductivity (K_H)

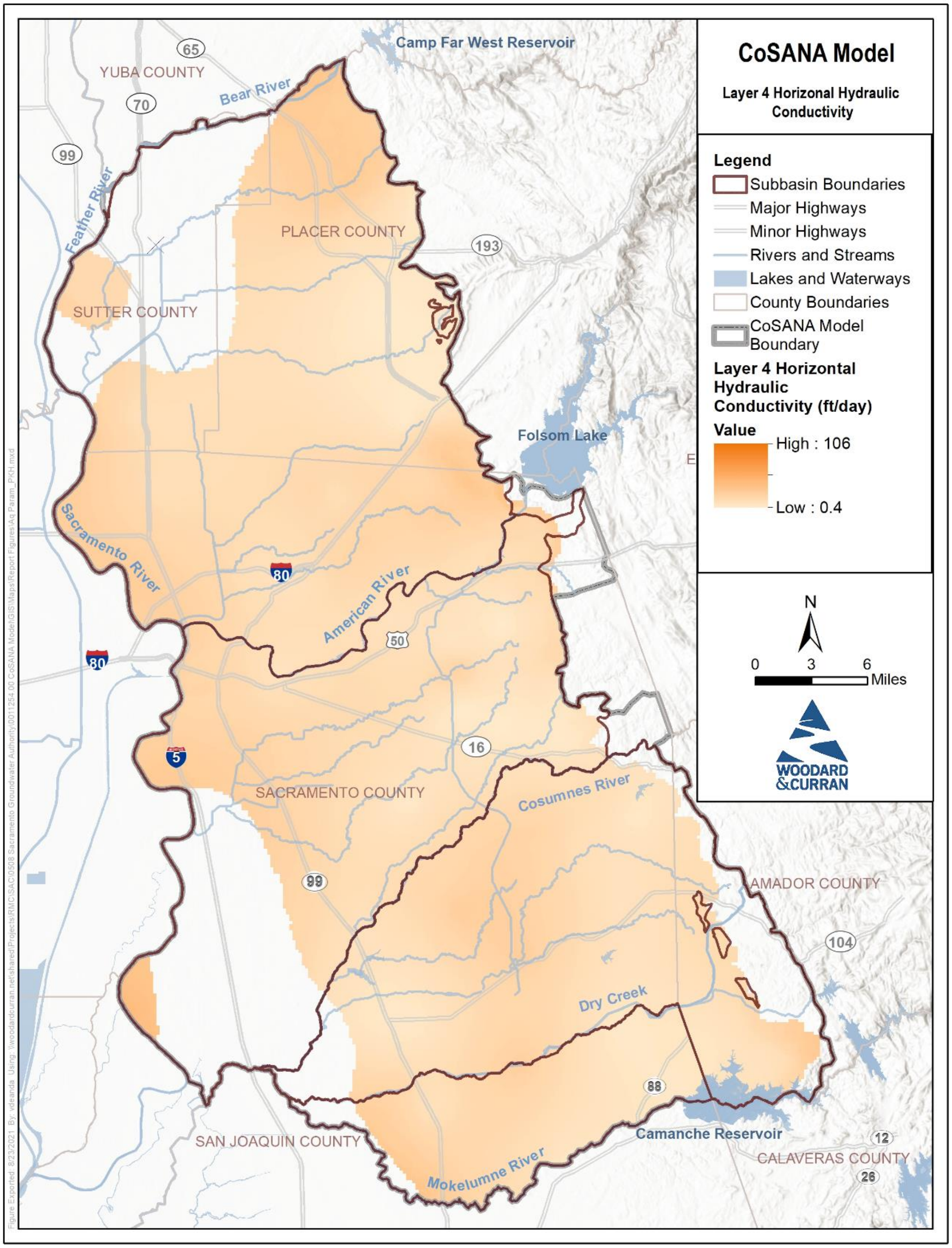


Figure 4-61: Distribution of CoSANA Layer 4 Horizontal Hydraulic Conductivity (K_H)

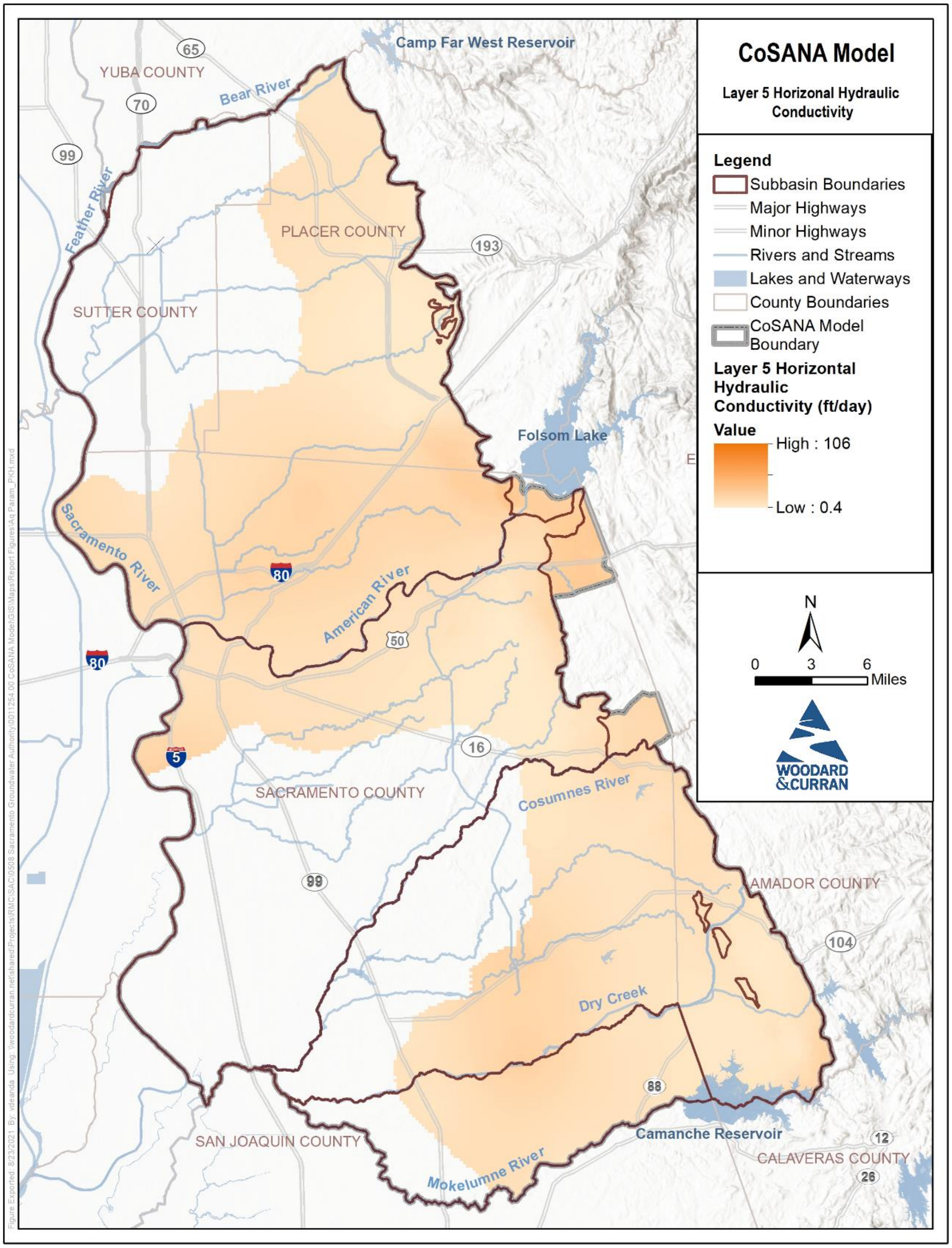


Figure 4-62: Distribution of CoSANA Layer 5 Horizontal Hydraulic Conductivity (K_H)

4.5 Model Features, Strengths, and Limitations

CoSANA has been developed based on years of integrated model development expertise and experience for the Sacramento area, including the SacIWRM and other groundwater planning and analysis efforts in the area. As such, the model data sets, conceptual representation of the groundwater system, the interaction with the surface water and land surface processes, and model calibration conditions are built on a strong foundation and reflect the experience and expertise of hydrologic and hydrogeologic conditions and modeling in the area. Having said that, the model has certain limitations that are outlined as follows:

4.5.1 Spatial Extent and Resolution

The accuracy of the model simulation is a function of spatial resolution of the data, as well as spatial discretization of the finite elements. As the spatial data such as land use or soil conditions are mapped to the elements, the size of elements reflect the accuracy of the underlying data sets as mapped. Much of the spatial data has been reviewed and verified against available statewide and local data available. The model is calibrated to target levels based on the spatial resolution in the model. However, when using the model for local scale analysis and modeling, the experienced user is encouraged to perform further validation of the underlying spatial data prior to use of the model for analysis of projects or management actions.

4.5.2 Temporal Scale

CoSANA includes monthly hydrologic data for the period WY 1970-2018. The model is calibrated for the period WY 1995-2018. Additionally, the model simulations are verified for the entirety of the period WY 1970-2018 for long-term trends and short -term seasonal conditions for groundwater levels and groundwater storage. The monthly time step is a reasonable one for a regional model and reflects the resolution of much of the recorded and reported data. However, the monthly time step at times may pose limitations for simulation of some of the model features, such as streamflows during high and peak flows. This is not of major concern as the regional model context and utilization of model for most long-term water supply planning needs is not affected by this limitation.

4.5.3 Geology and Hydrogeology

CoSANA includes an updated aquifer stratigraphy based on available maps and cross sections. CoSANA also uses the aquifer texture model used in C2VSimFG and SVSim (DWR, 2018a), which is based on the USGS aquifer texture data. The texture data is used in the model calibration and distribution of aquifer properties based on a field level set of lithologic log information. The details of the texture model affect the model performance and calibration in simulation of the various hydrogeologic conditions. The user is reminded to consider variabilities and uncertainties in the texture model as the model results are being interpreted and used for policy and planning purposes.

4.5.4 Land Use Data

Land use is one of the key data sets that affect water demand estimation as well as rainfall runoff, infiltration, and recharge conditions. This data set was developed based on numerous DWR county-level land use surveys, land use and cropping data available from the recent statewide DWR land use surveys, and local sources. This information was assembled, analyzed, and discrepancies were reconciled, which resulted in annual crop data by each model element. Mapping of land use data from various maps to element level within the model and temporal interpolation of land use changes between years of available data may introduce inaccuracies that need to be considered in evaluation of land use conditions at smaller spatial scales, such as parcel level, and for years in between dates of source data.

4.5.5 Water Demand Estimates

Water demands in the model are estimated for three user categories, urban purveyors, agricultural entities, and rural residential areas. The urban demands are based on the reported water supply and demand data from the urban purveyors. The agricultural demand estimates are based on respective model data sets and calibration of the model for each agricultural area. While care has been given to estimation of agricultural water use estimates, and the results have been shared and reviewed by the agricultural entities within the model area, inaccuracies in the source data or those mapped to the model may introduce inaccurate estimates in certain conditions. The rural residential water use estimates have also been shared and presented to the representatives of the rural residential water users at a number of public workshops. In general, the model user is encouraged to validate the estimates with additional local data and is also requested to share their findings with the model developers for future refinements of the model.

4.5.6 Water Supply Data

The surface water delivery data set in the model is one of the most reliable data sets as it is provided by the purveyors. However, some surface water diversions by the agricultural entities are subject to more uncertainty, which affects the model simulation results. Local entities are encouraged to review the surface water delivery data and provide feedback to the model developers as issues arise or inaccuracies are identified.

4.5.7 Groundwater Pumping Estimates

CoSANA includes groundwater wells for all urban purveyors and groundwater pumping rates are, with a few exceptions, provided by the urban purveyors. The model includes estimated monthly groundwater pumping by each model element for the agricultural water use and rural residential users. Agricultural groundwater pumping is estimated as the balance of agricultural demand estimates and surface water that is available to meet the demand for each element and at each model time step. The contamination remediation groundwater extractions are based on data supplied by the entity performing the remediation and are assumed to be accurate. However, these remediation systems are complex, and some details of extraction and the fate of extracted water may be missing or inaccurate. Notably, details on individual well pumping volumes and injection volumes at Mather are not known, although overall pumping and injection volumes are incorporated into CoSANA. Where data were not available, values have been estimated for the model to the best of the model development team's knowledge.

4.5.8 Water Budgets

CoSANA provides detailed water budgets at each model element, which, when aggregated, can provide water budgets for a selected geographic area representing a subregion, subbasin, water/irrigation district, a GSA, or other geographies. The model water budgets have been verified for major model subregions against data and information available from local sources. Additionally, the subbasin-scale model water budgets have been reviewed and verified by the respective technical staff and/or representatives of the GSAs to check the accuracy and reliability of the water budgets for GSP use. When using the CoSANA for more detailed analysis, the user is encouraged to verify the water budgets for reasonableness and consistency with local data and information.

4.5.9 Groundwater Flow and Levels

CoSANA has been calibrated against long-term groundwater trends and seasonal groundwater level changes at approximately 761 wells throughout the model area. The calibration process included adjustments to model input data and/or parameters to ensure that reasonable water budgets are achieved for each model subregion, and long-term simulated groundwater levels match the observed levels within acceptable tolerances. Subsequently, an automated calibration process using PEST was performed to further refine the model calibration by adjusting the aquifer hydraulic properties throughout the model domain. The process of automated calibration also used aquifer texture data for spatial distribution of aquifer parameters. Inaccuracies in observation and reported groundwater levels may influence the quality of calibration. Further, lack of detailed well construction information in many of the calibration wells limited the ability to use data at those sites to properly calibrate the model with depth.

4.5.10 Streamflows

CoSANA simulates streamflows many rivers and streams, including the Sacramento, American, and Cosumnes Rivers. CoSANA stream budgets have been developed and reviewed for several key stream reaches, including reaches along the major river reaches. Additional care has been given to the nature of stream-aquifer interaction to allow proper representation of the stream reaches that potentially have hydraulic connection to the groundwater system, as well as reaches that are gaining or losing. In specific, published information by various non-governmental organizations, such as TNC have been used in model calibration. The quantity and quality of data on the physical nature, extent, and rate of stream-aquifer interaction is, in general, low throughout the state. The Sacramento region and the CoSANA model area is not an exception to this lack of quality data, despite improvements over the past decades. Government agencies and non-governmental organizations are encouraged to allocate additional research to this area for better representation of the nature, extent, and conditions of stream-aquifer relationship.

4.6 Modeling Uncertainties

A model is a numerical representation of physical process and inherently possesses uncertainties that affect the calibration, performance, and results of the model. Integrated hydrologic models are complex models that involve simulation of complex physical systems and interrelationships and require many different types of data, each of which may be available at different temporal and spatial scales. Uncertainties in the performance of an integrated hydrologic model can arise from uncertainties in how the physical processes are conceptualized and formulated, inaccuracies in the underlying data, calibration process and eventually the assumptions used in applications of the model to evaluate projects, including projections of future conditions. The following are additional details on each of these uncertainty categories.

4.6.1 Structural Uncertainties

First set of model uncertainties can arise due to the structural framework of the model, which can include:

- Representation of Physical Features- In order to properly represent natural conditions, the physical and natural features need to be well understood so that they can be conceptualized in a simplified manner for development of theoretical formulations.
- Theoretical Concepts and Representation of the Natural and Physical Systems- This type of uncertainty can be attributed to the conceptualization of the physical and natural systems in the form of mathematical functions and formulas that govern the movement of groundwater and surface water systems and the interrelation of these systems. These formulas are typically referred to as governing equations for each of the hydrologic or hydrogeologic features modeled.
- Formulation, Code Development, Solution Techniques, and Assumptions- The governing equations are typically so complex that analytical solutions to these equations are either not available or are so simplified that they would add to the inaccuracies in the representation of complex hydrologic systems. Therefore, numerical solutions are employed, including finite element or finite difference techniques, which require their own set of assumptions. Computer software is used to implement the theoretical formulations.
- Model Spatial and Temporal Resolution- The governing equations representing the natural and/or physical systems are either solved at two levels:
    - Lumped solution- At this level, the formulation represents a lumped parameter system, and the solution will be for an aggregated system at the large scale. This aggregated and lumped scale can be both for the spatial and temporal scale of the problem. Lumped level solutions are typically employed in conditions where there is a lack of accurate information or where the system is small enough that further spatial or temporal breakdown of the system is not possible due to lack of data and information.

- Distributed Solution- At this level, the system is subdivided in further spatial resolution to take advantage of spatial variability in the data and information that is available at smaller scales. Additionally, the solution to the formulation of the system is also subdivided in smaller temporal scales, such as a monthly or daily time step, so that short-term and long-term variability in the data over time is properly represented in the solution.

4.6.2 Data Uncertainties

This category of uncertainty is related to the data and information that is used and employed in development of a model.

- Data and Information Accuracy, Data Gaps, and Estimates- Collection and compilation of data for natural and physical systems, including precipitation, streamflow, land use, cropping patterns, population, water use, crop evapotranspiration, soil conditions, groundwater levels, streamflow, surface water use, groundwater pumping, infrastructure, facilities, and operations all include a certain level of inaccuracy and uncertainty. This uncertainty is exacerbated when data gaps and inconsistencies exist. The methodology used to identify and fill data gaps can introduce levels of uncertainty.
- Data Spatial and Temporal Resolution- In addition to the above, the spatial and temporal resolution of data may contain inaccuracies and uncertainties that would affect the data that are used in the model.

4.6.3 Calibration Uncertainties

- Estimates of Hydrologic and Hydrogeologic Parameters- Often, data and/or information for specific parameters that are used to represent the governing equations in the model may not be available. In these circumstances, the modeler uses professional judgement, or adopts conditions from similar areas, which may introduce uncertainties and inaccuracies in model simulations.
- Calibration Approach, Target Characteristics, and Accuracy- Model calibration requires certain quality, consistency, and care, so that the model properly represents the natural and physical conditions observed in the field. In addition to the quality and uncertainties in data and methodologies, the approach employed, tools and techniques used, and experience and expertise of the model developer affects the quality of model calibration and accuracy of the results. Often, the calibration targets are prone to uncertainty or lack of information. For example, information on the depth of the screened interval, as well as pumping rate and depth at the well, whether the recorded groundwater level reflects static or pumping conditions, and whether a well is under the influence from other nearby wells or a nearby stream can have significant bearing on the approach and quality of the calibration.

4.6.4 Application Uncertainties

- Assumptions and Project Applications, Including Data Projections and Forecasting Methods- It is imperative that model application be defined and considered in such a way that is supported by model calibration. Assumptions on a model application to analyze a particular project can often be generalized with little knowledge of the conditions. For example, significant uncertainties exist with respect to the following data, which can affect the quality and results of the model output for planning and policy making:
  - Hydrologic conditions and rainfall patterns
  - Land use and cropping patterns
  - Population and water use
  - Water supply conditions
  - Climate change conditions

While modeling uncertainties need to be considered in use and application of models for evaluation of project conditions for potential impacts, benefits, and design of plans and facilities, the model should be considered a reasonably robust tool to support the major decisions, including GSPs, projects and management actions, and sustainability analysis.

4.7 Sensitivity Analysis

Sensitivity analysis is a way of investigating how sensitive certain model results are to changes in certain model parameters. A sensitive parameter is when the simulation results are greatly affected by changes in that parameter within its valid range. Conversely, an insensitive parameter means the changes in that parameter within its valid range do not affect the simulation results greatly.

Model parameters that are sensitive can be the largest sources of error and uncertainty when not precisely measured and well understood. For this reason, sensitivity analysis is an important step of the model calibration process. The sensitivity analysis serves the following purposes:

- To improve the understanding of input-output relationships
- To quantify the impact of inaccuracies in model parameters
- To evaluate the stability and robustness of the model
- To understand the overall range of accuracy of the model results

For these purposes, the following set of calibration parameters were selected for investigation under CoSANA Model sensitivity analysis:

- Aquifer horizontal hydraulic conductivity (PKH) changed globally by factors of 0.5, 0.67, 1.5, 2.0
- Aquifer vertical hydraulic conductivity (PL) changed globally by factors of 0.5, 0.67, 1.5, 2.0
- Specific yield (PN) changed globally by factors of 0.8, 1.2
- Specific storage (PS) changed globally by factors of 0.1, 0.2, 5, 10
- Streambed conductivity (CSTRM) changed globally by factors of 0.2, 0.5, 2.0, 5.0
- Small watersheds curve number (CNS) changed globally by -10, -5, 5, 10
- General head boundary condition head time series (BHTS) changed globally by -10, 10 feet

4.7.1 Metrics of the Sensitivity Analysis

In the process of evaluating the sensitivity of model results to certain parameter changes, the results from the sensitivity runs were analyzed for the NASb, SASb, and CoSb and compared to the calibrated model in terms of the groundwater residual statistics.

The changes to the input parameters for sensitivity analysis were made globally. Therefore, the changes in the model performance should be considered on a global scale. An improvement in the model performance based on changes in one parameter at a global scale does not necessarily mean improvements in the overall model performance and/or calibration, as the model is calibrated to a number of target parameters, only some of which may be included in the performance assessment during the sensitivity analysis. The residual statistics for this sensitivity analysis was used as the performance indicator.

4.7.2 Results of the Sensitivity Analysis

Figure 4-63, Figure 4-64, and Figure 4-65 present the relative change in the three groundwater level residual statistics used in the evaluation of model calibration performance for 10 sensitive parameters in NASb, SASb, and CoSb respectively. These three statistics are:

- Root mean square error (RMSE): This statistic is a measure of how spread out the residuals are.
- Average residual: This statistic measures how inaccurate simulation results are with respect to the corresponding observations on average.

- Correlation coefficient (R2): This statistic is a measure of the strength of the linear relationship between the simulated and observed pairs.

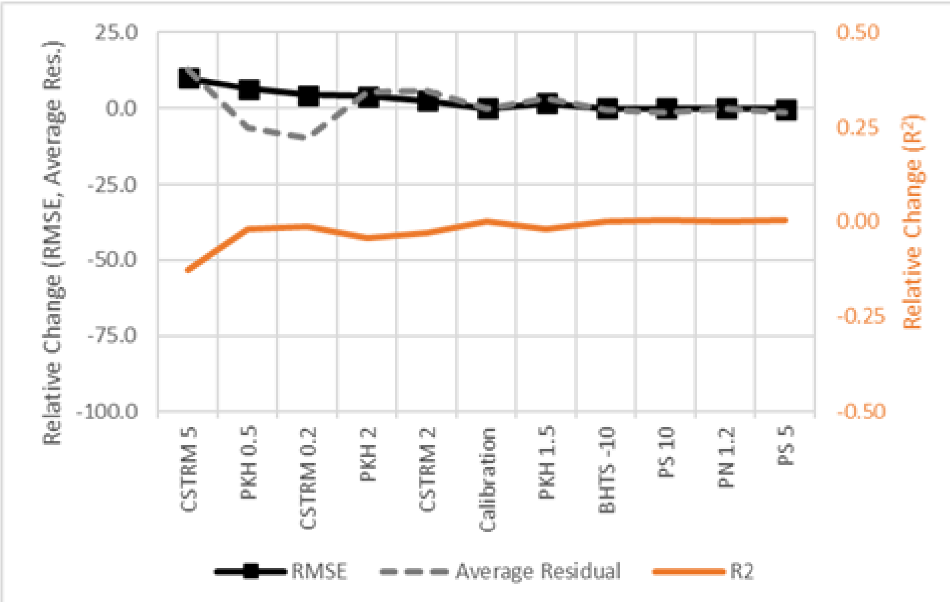


Figure 4-63: Sensitivity of Groundwater Level Residual Statistics in NASb

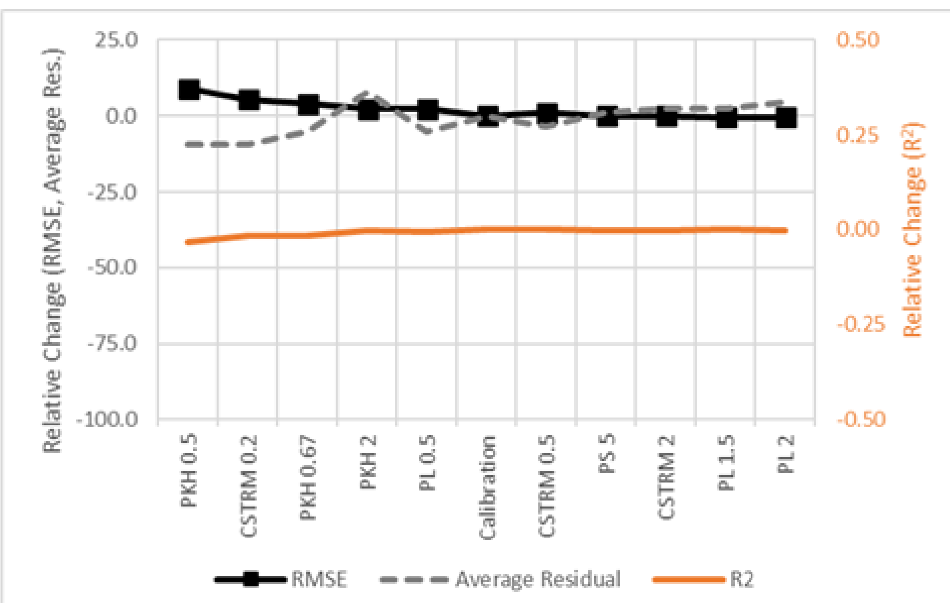


Figure 4-64: Sensitivity of Groundwater Level Residual Statistics in SASb

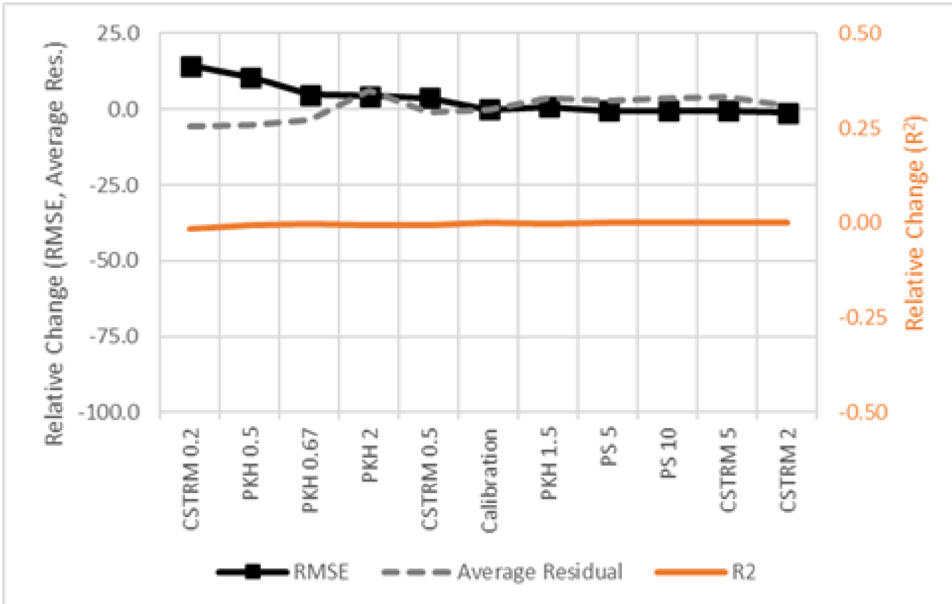


Figure 4-65: Sensitivity of Groundwater Level Residual Statistics in CoSb

None of the sensitivity runs resulted in a significant improvement in these statistics for any of the subbasins. This means that the model is stable and that the calibration is at or near an optimal point when global parameter changes are considered.

5. BASELINE CONDITIONS

Integrated hydrologic and water resources models are used to evaluate effects, benefits, and impacts of particular projects and management actions under a set of baseline conditions. These baseline conditions can represent a set of pre-established hydrologic, land and water use, water demand, water supply, and basin operational conditions. As part of the development of the GSPs for the NASb, SASb, and CoSb, three sets of baseline conditions have been defined for the CoSANA model. These represent the current, projected, and projected under climate change baseline conditions.

Following are descriptions of the assumptions and results for each of these baseline scenarios.

5.1 Current Conditions Baseline

The CoSANA Current Conditions Baseline (CCBL) is a representation of long-term average conditions assuming that a recent level of development and water demand persists over a long-term period of hydrologic conditions. Initial groundwater levels and soil conditions in the CCBL represent those at the end of the simulation period of the historical CoSANA (representing September 30, 2018).

5.1.1 Hydrology

The CCBL uses a 50-year historical hydrology from water years (WY) 1970 through 2019 (October 1, 1969 through September 30, 2019) for precipitation, evapotranspiration, and streamflow.

5.1.1.1 Precipitation

Precipitation in the historical simulation, discussed in Section 2.6, uses the PRISM database for the entire period of record. The precipitation used in the historical simulation was extended through WY 2019 for use in the CCBL. The average CCBL precipitation across the entire model area is 20.2 inches, with a minimum of 7.5 inches in WY 1977 and a maximum of 38.9 inches in WY 1983.

Figure 5-1 graphically illustrates the cumulative departure of the spatially averaged rainfall within the CoSANA model area. The figure includes bars displaying annual precipitation for each water year from WY 1970 through 2019 and a horizontal line representing the long-term mean precipitation of 20.2 inches. The cumulative departure from mean precipitation is displayed as a line that highlights wet periods with upward slopes (positive departure) and dry periods with downward slopes (negative departure). More severe events are shown by steeper slopes and greater changes.

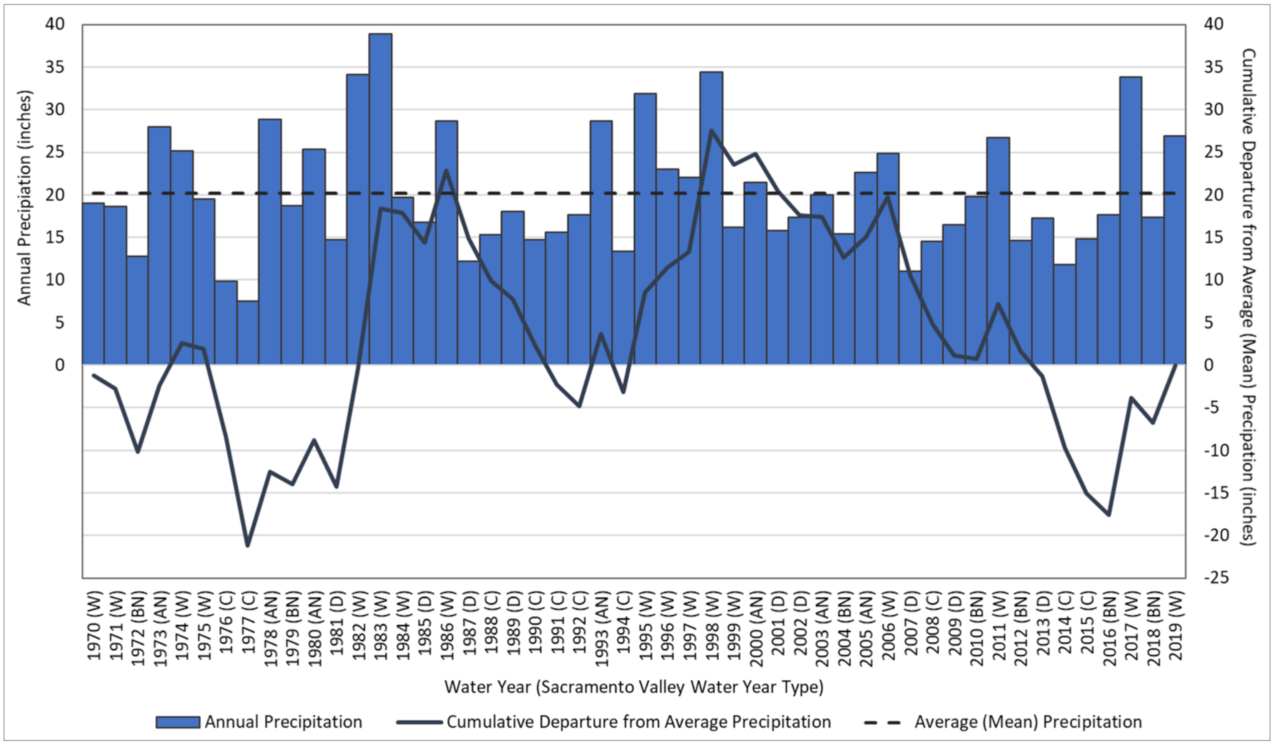


Figure 5-1: 50-Year Historical Precipitation and Cumulative Departure from Mean Precipitation

5.1.1.2 Evapotranspiration

As discussed in Section 2.8, the crop ET requirement was based on values from regional modeling (C2VSimFG) and associated CIMIS Zones 12 and 14. The ET used in the historical simulation was extended through WY 2019 for use in the CCBL.

5.1.1.3 Stream Inflow

As discussed in Section 2.4, stream inflows are from stream gaging stations at the upstream area of CoSANA river reaches. The stream inflow points and gaging stations are described in Section 2.4 and listed in Table 2-4. As the CCBL uses the historical hydrologic conditions as the basis for planning the baseline conditions, the stream inflows used in the historical simulation were extended through WY 2019 for use in the CCBL.

5.1.1.4 Hydrologic Year Types

The 50 years of the CCBL, from WY 1970 through 2019, represent a range of hydrologic conditions, as identified by the water year types in the Sacramento Valley Water Year Hydrologic Classification, which classifies water years 1901 through 2020 as Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critical (C) based on inflows to major reservoirs or lakes. A description of how this index is calculated and the specific data used to calculate this index is available online from CDEC at http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST. In the 50 years of hydrology used in the CCBL, there are 10 Critical years, 9 Dry years, 7 Below Normal years, 7 Above Normal years, and 17 Wet years.

To facilitate assumptions for baseline water supplies and demands, these five water year types were simplified into three water year types. Critical and Dry years are combined into one category in the baseline water year types (called Dry years), Above Normal and Below Normal years are also combined into one category (Normal years), and Wet years remain in one category (called Wet years). With this breakdown, the three baseline water year types have a distribution of 19 Dry years, 14 Normal years, and 17 Wet years. These baseline water year types (Table 5-1) are used in the remainder of the CCBL data development and results discussion.

Table 5-1: Hydrologic Water Year Types

Baseline Year	Water Year	Sacramento Valley Water Year Hydrologic Classification	Baseline Year Type		Baseline Year	Water Year	Sacramento Valley Water Year Hydrologic Classification	Baseline Year Type
1	1970	Wet	Wet		26	1995	Wet	Wet
2	1971	Wet	Wet		27	1996	Wet	Wet
3	1972	Below Normal	Normal		28	1997	Wet	Wet
4	1973	Above Normal	Normal		29	1998	Wet	Wet
5	1974	Wet	Wet		30	1999	Wet	Wet
6	1975	Wet	Wet		31	2000	Above Normal	Normal
7	1976	Critical	Dry		32	2001	Dry	Dry
8	1977	Critical	Dry		33	2002	Dry	Dry
9	1978	Above Normal	Normal		34	2003	Above Normal	Normal
10	1979	Below Normal	Normal		35	2004	Below Normal	Normal
11	1980	Above Normal	Normal		36	2005	Above Normal	Normal
12	1981	Dry	Dry		37	2006	Wet	Wet
13	1982	Wet	Wet		38	2007	Dry	Dry
14	1983	Wet	Wet		39	2008	Critical	Dry
15	1984	Wet	Wet		40	2009	Dry	Dry
16	1985	Dry	Dry		41	2010	Below Normal	Normal
17	1986	Wet	Wet		42	2011	Wet	Wet
18	1987	Dry	Dry		43	2012	Below Normal	Normal
19	1988	Critical	Dry		44	2013	Dry	Dry
20	1989	Dry	Dry		45	2014	Critical	Dry
21	1990	Critical	Dry		46	2015	Critical	Dry
22	1991	Critical	Dry		47	2016	Below Normal	Normal
23	1992	Critical	Dry		48	2017	Wet	Wet
24	1993	Above Normal	Normal		49	2018	Below Normal	Normal
25	1994	Critical	Dry		50	2019	Wet	Wet

5.1.2 Initial Conditions

The initial conditions for the 50-year CCBL are defined as the groundwater, surface water, and hydrologic conditions for the end of WY 2018 from the end of simulation of the CoSANA historical model. Figure 5-2 shows a map of initial groundwater levels used in the CCBL. The initial conditions for the CCBL are also used for other baseline models.

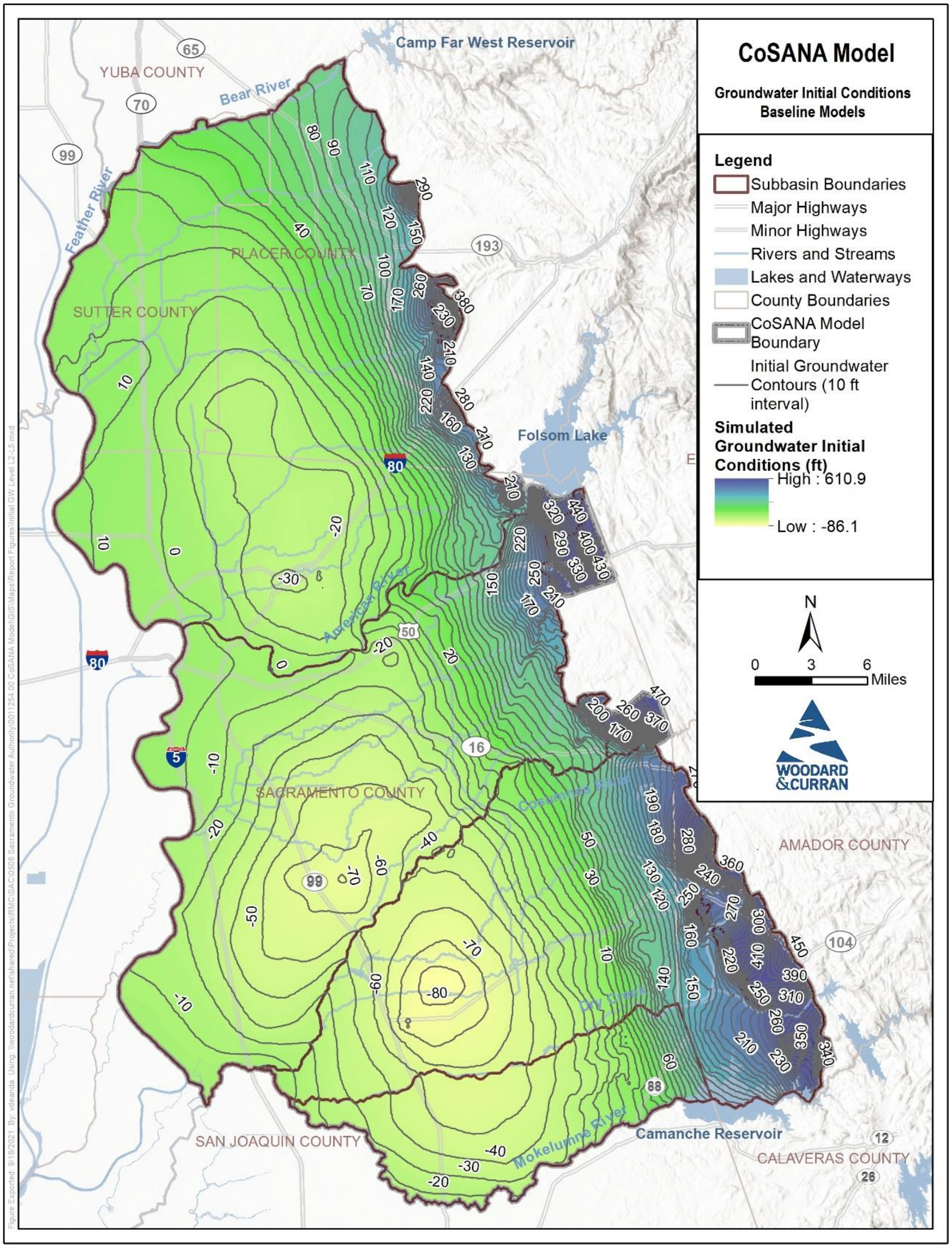


Figure 5-2: Initial Groundwater Levels for CoSANA Baseline Models

5.1.3 Boundary Conditions

CCBL boundary conditions are based on an average for each baseline water year type (normal, wet, and dry) during the last 10 years of the historical simulation (WY 2009-2018). This averaging is applied to the constrained head boundary conditions that represent Lake Camanche in the southeast corner of the model, and the general head boundary conditions that represent groundwater levels to the north, south, and west of the model boundary. Water year type averaging is not applied to the small watersheds form the eastern boundary of the model, as these are driven by hydrology (precipitation and evapotranspiration.) Further detail of how boundary conditions are applied in CoSANA are provided in Section 2.12.

5.1.4 Land Use

The CCBL used the land use from the last year of the historical simulation, discussed in Section 2.7. The last year of the historical simulation represents the digital land use coverage developed to represent 2015 (see Figures 15-21). As also described in Section 2.7, certain lands regarded as temporarily fallowed due to drought were represented as their typical land use for purposes of historical interpolation and for purposes of the CCBL. Minor changes to specified land use conditions were made to account for recent changes. Land use in Sutter County and Placer County was updated to incorporate recent conversions of rice fields to orchards. In the Cosumnes Subbasin, the land use was updated to incorporate recent conversion of vineyards or pasture to almonds and native land to agricultural and urban uses. A spatial representation of the CCBL land use is shown in Figure 5-3. The time-series of land use for the CoSANA CCBL is shown in Figure 5-4, highlighting the constant nature of land and water use in the baseline conditions. Figure 5-5 through Figure 5-7 show time-series of land use for the NASb, SASb, and CoSb, respectively.

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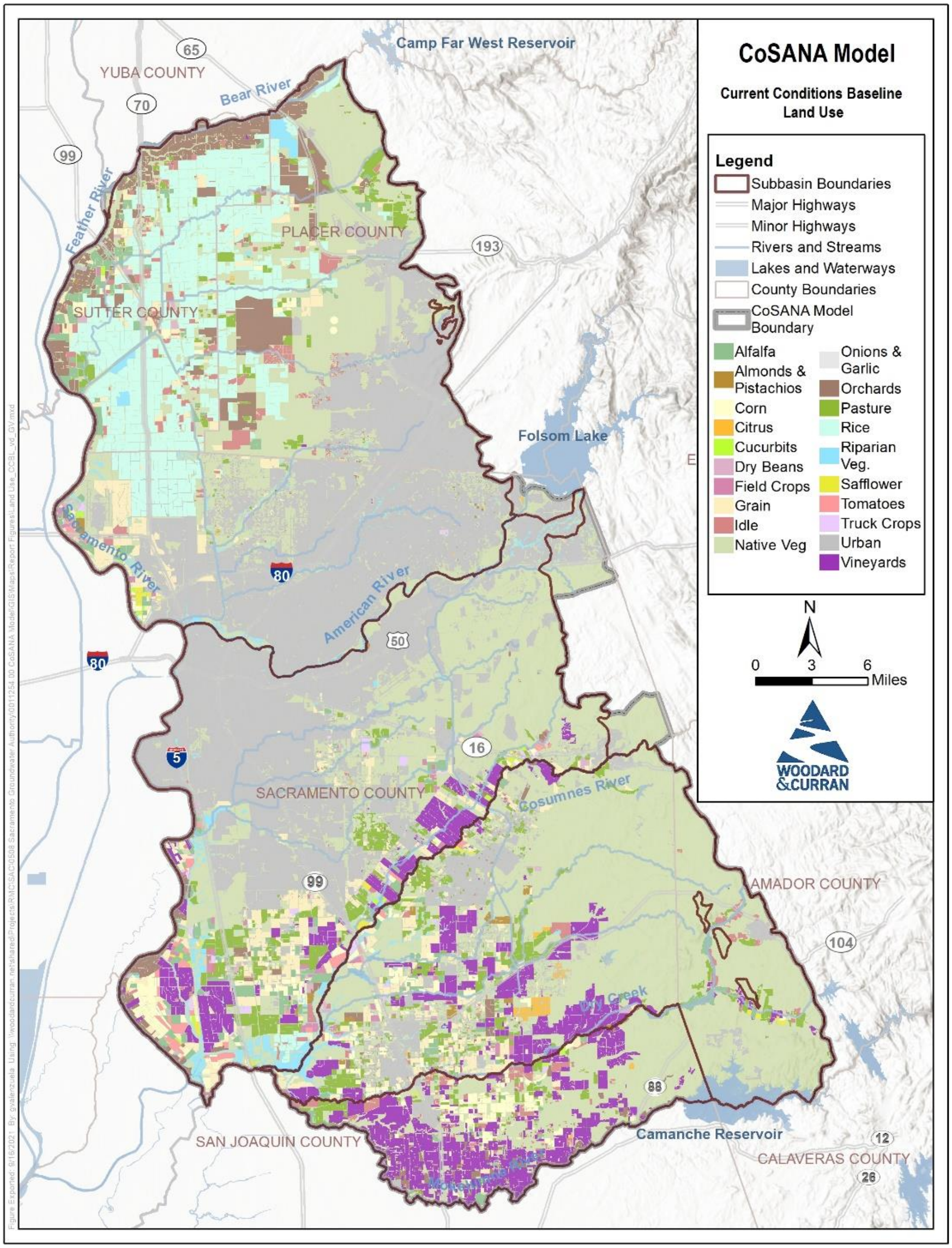


Figure 5-3: Current Conditions Baseline Land Use

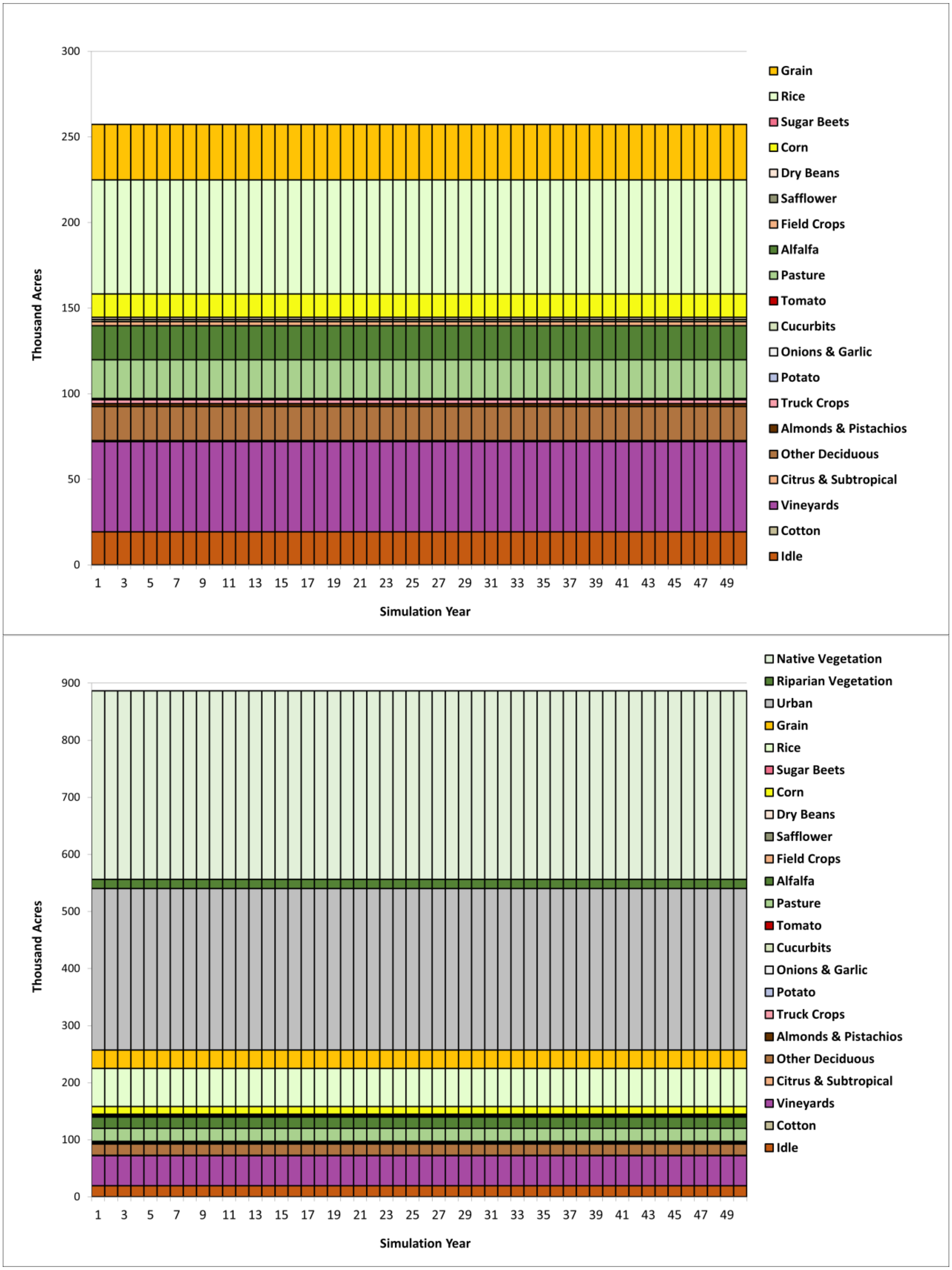
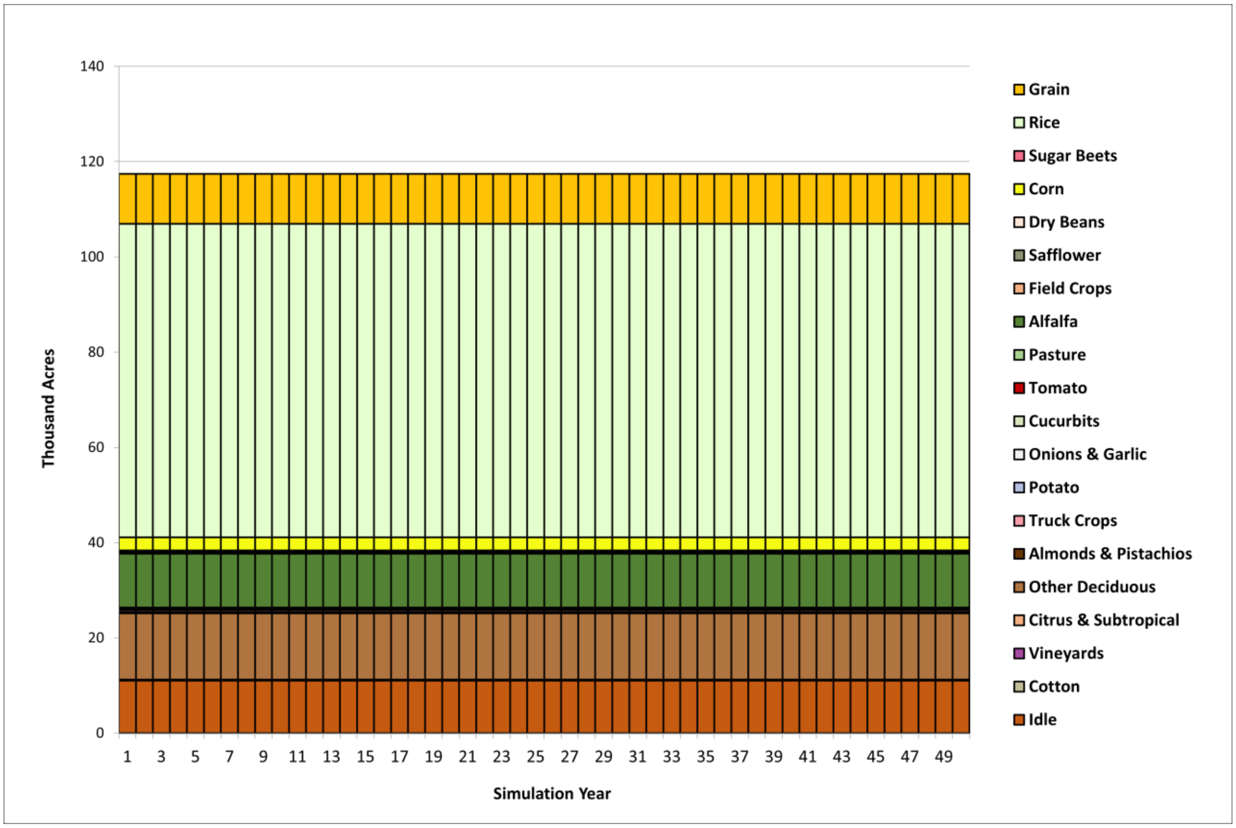


Figure 5-4: Current Conditions Baseline Land Use for CoSANA



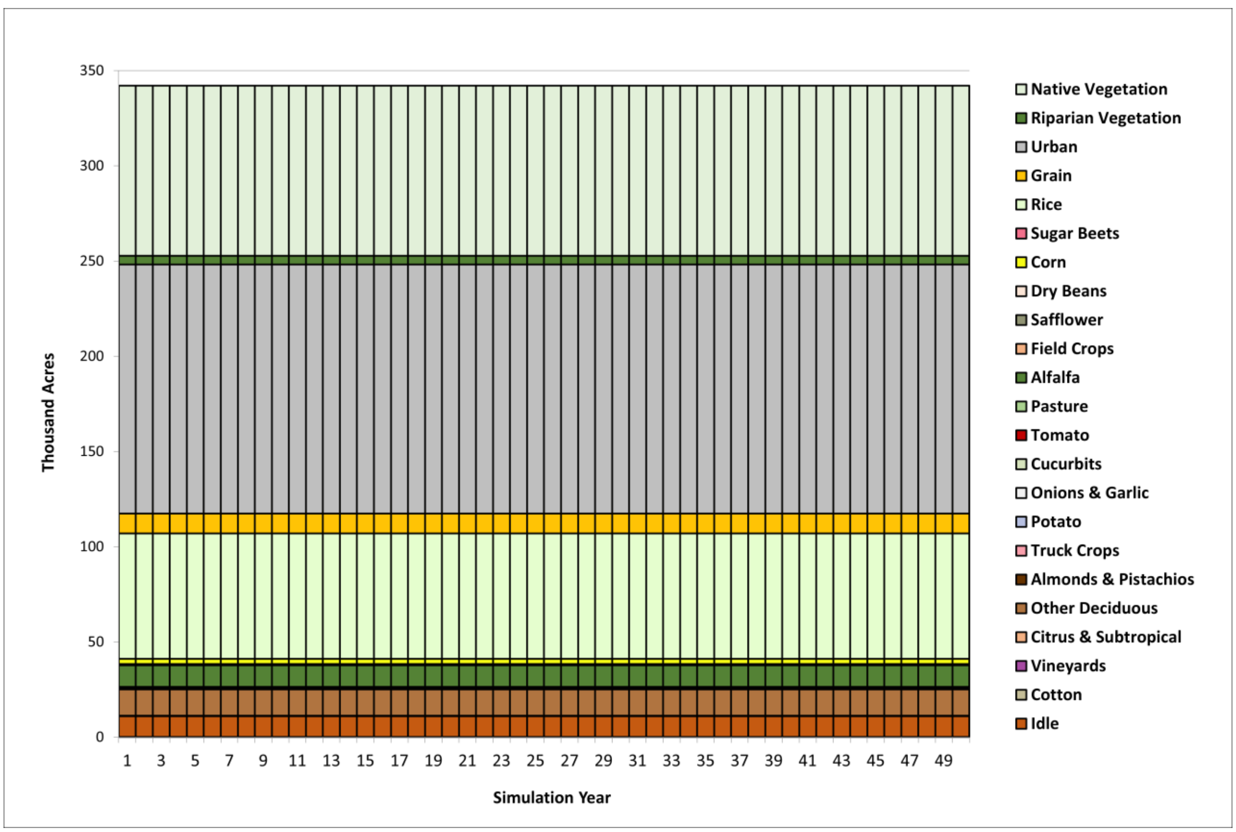
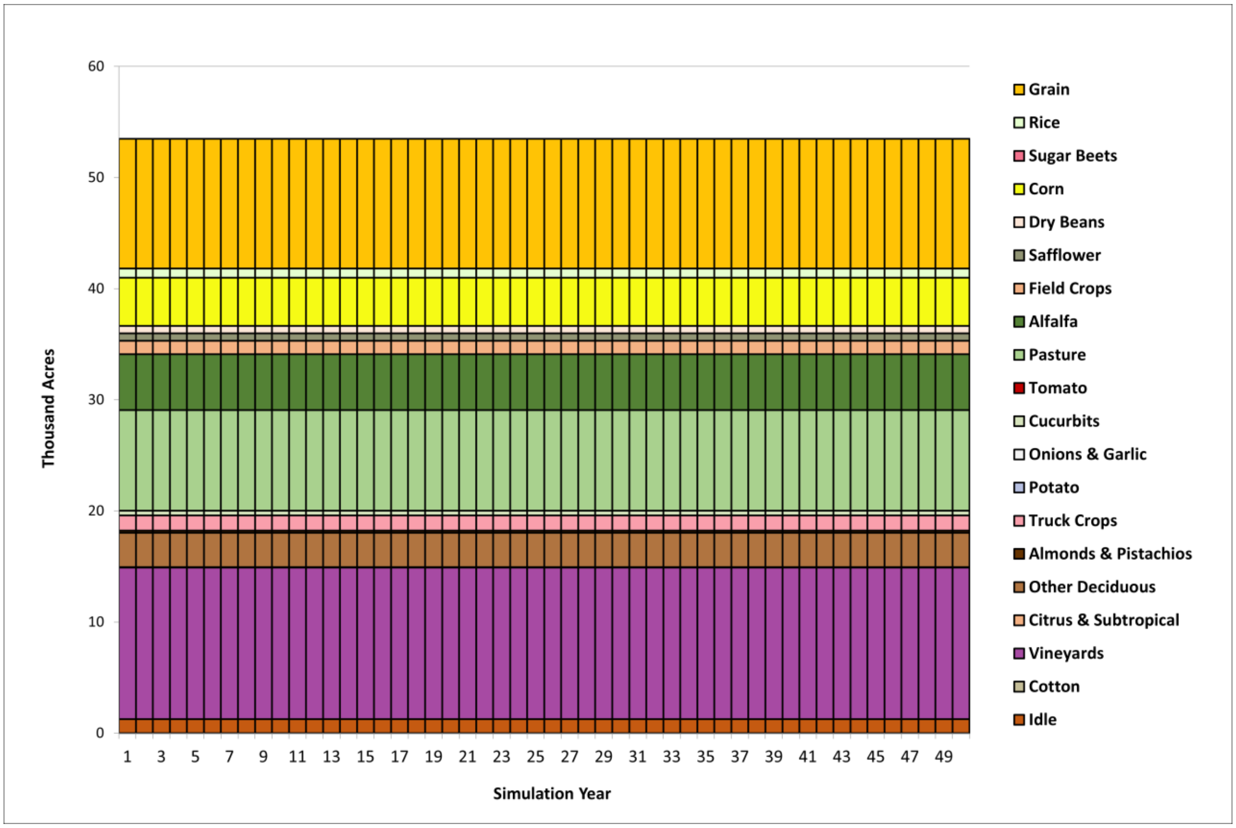


Figure 5-5: Current Conditions Baseline Land Use for North American Subbasin



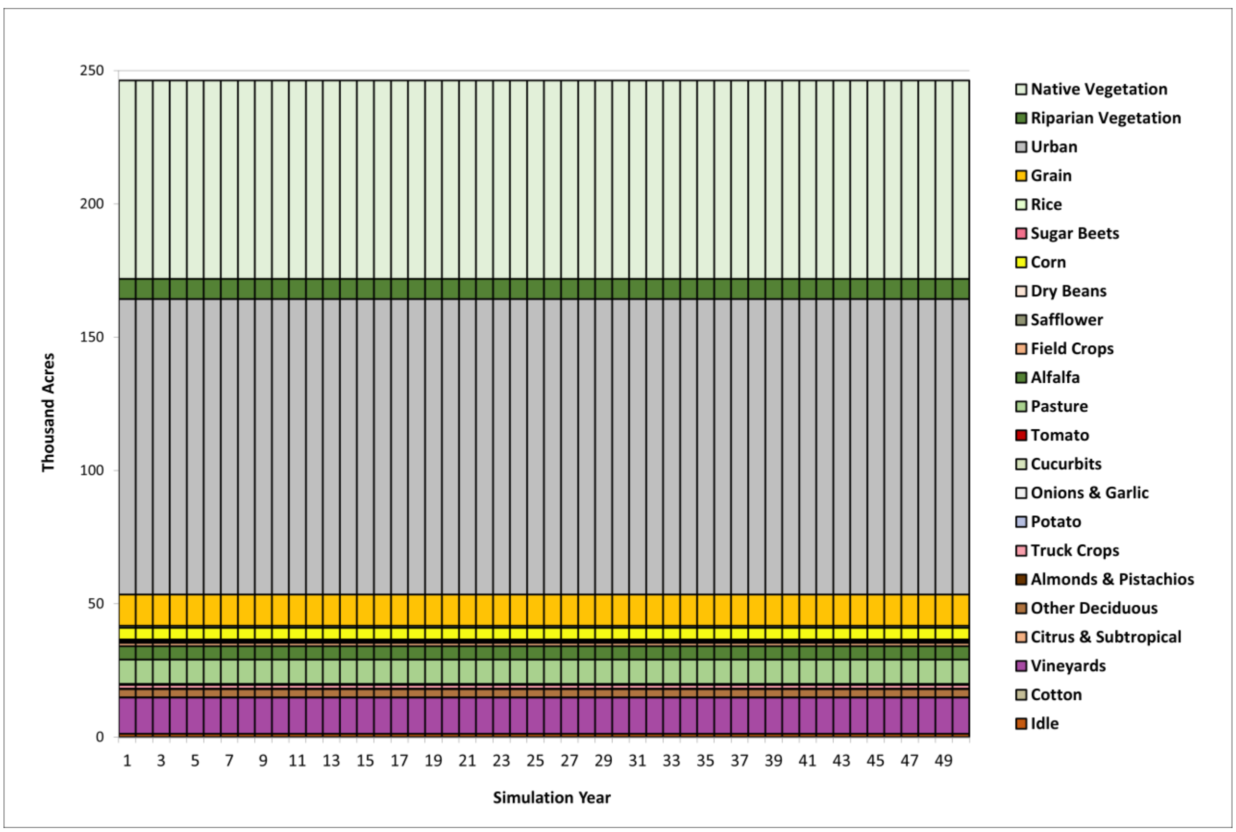
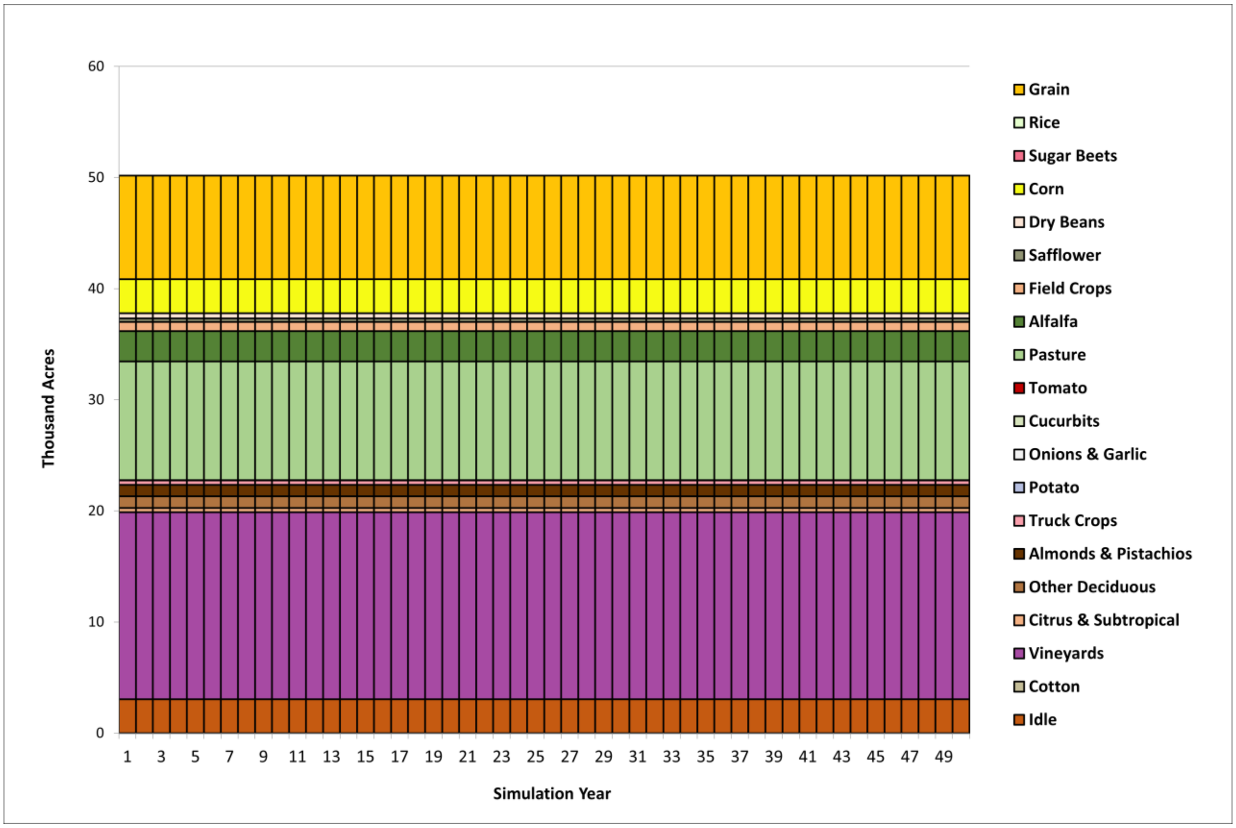


Figure 5-6: Current Conditions Baseline Land Use for South American Subbasin



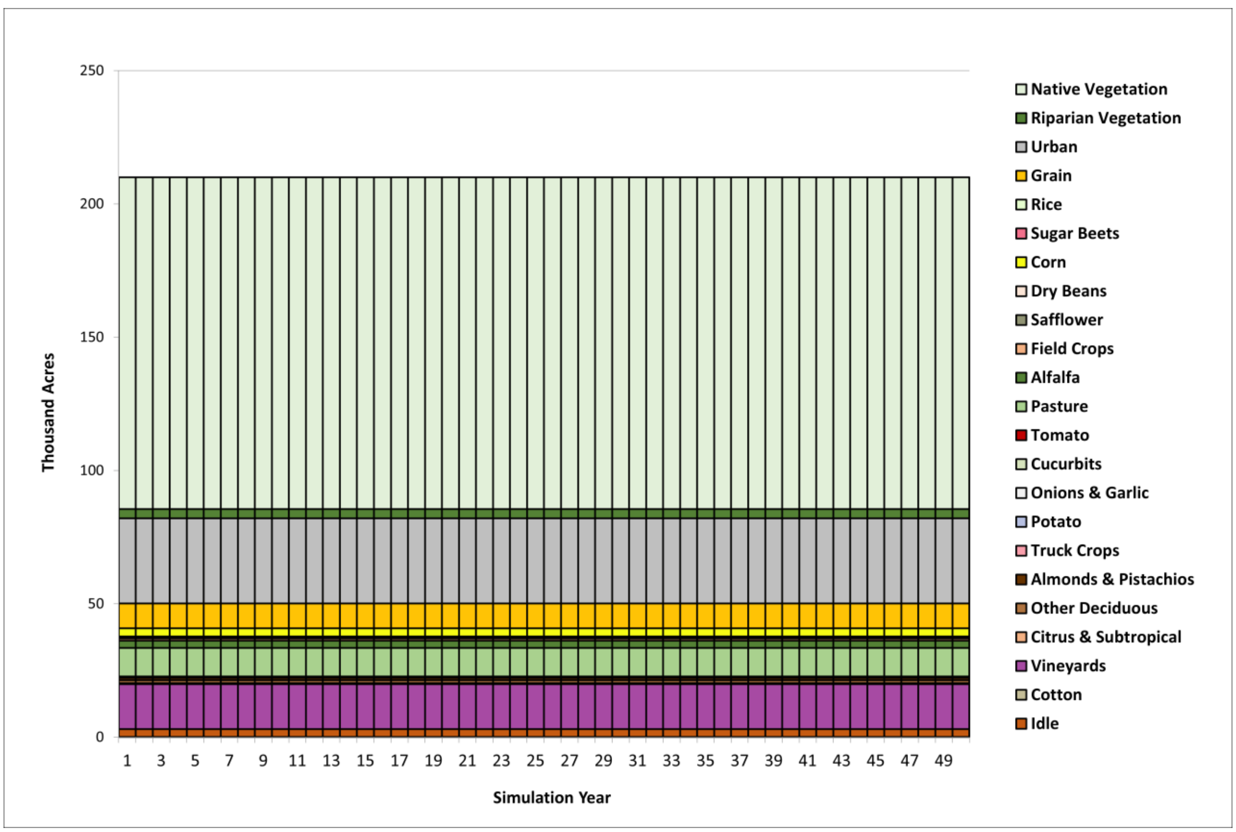


Figure 5-7: Current Conditions Baseline Land Use for Cosumnes Subbasin

5.1.5 Urban Demand and Supply

Urban demand is represented for each urban area based on supply data. Like the CoSANA historical model, each baseline assumes that urban supply (combined groundwater, surface water, and other sources such as recycled water) is equal to urban demand.

Urban water supply, including surface water deliveries, groundwater pumping, recycled water, and remediated water, are all calculated using the method described below, unless exceptions are listed in the individual purveyor sections that follow. To estimate CCBL water supply, the information for the last 10 years of the historical simulation (WY 2009 through 2018) was averaged by the three baseline water year types (normal, wet, and dry) described in Section 5.1.1.4. WY 2009 through 2018 contains four normal years (2010, 2012, 2016, and 2018), two wet years (2011 and 2017), and 4 dry years (2009, 2013, 2014, and 2015). Appendix G shows subregion/purveyor urban demand and supply for each entity for the three WY types (normal, wet, and dry). The water supply conditions for these three baseline year types were applied to the 50 years of hydrology within the CCBL.

For urban groundwater pumping, a well was assumed active in the CCBL if there was historical recorded pumping in WY 2016-2018. Average pumping by baseline year type was distributed in the CCBL to all active wells by purveyor based on their proportion of the historical simulation purveyor totals.

As previously noted, urban demand and supply were calculated using averages developed from the last 10 years of the historical simulation for all agencies except those specified otherwise in the following subsections.

5.1.5.1 North American Subbasin

The following subsections present demand and supply assumptions for purveyors within the North American Subbasin whose assumptions are different from the standard methodology outlined above.

5.1.5.1.1 City of Sacramento

City of Sacramento's demand was based on the last 10 years of the historical simulation. Demand varies slightly with water year types from 34,702 AFY for wet years to 35,274 AFY for dry years. Approximately 35% of the demand was assumed to be in the NASb portion of the model, based on urban area.

The City of Sacramento's current supplies include groundwater pumping and surface water supplies that vary by five water year types (as opposed to three water year types used for other purveyors) based on the City of Sacramento's 2017 Groundwater Master Plan (GWMP) (City of Sacramento, 2017). Groundwater pumping assumptions for the CCBL were consistent with the Future Conditions Baseline scenario developed in the 2017 GWMP, based on the discussions with the City of Sacramento (B. Ewart, personal communication, December 2020). Monthly pumping assumptions by each well were incorporated into the CCBL based on well locations and monthly well operations, as specified in the 2017 GWMP. Groundwater pumping in the NASb varies from 6,989 AFY during wet years to 41,841 AFY during driest years. Demand after groundwater pumping was assumed to be supplied by surface water.

The City of Sacramento also has specific wells that supply certain larger parks and green areas within the city. These irrigation wells are simulated using six representative irrigation wells that pump 2,400 AFY. Based on the locations of the irrigated parks and green areas, approximately half of the irrigation pumping was estimated in the NASb and the remaining half in the SASb.

5.1.5.1.2 Sacramento County Water Agency (Arden Park Vista and Northgate)

Due to changing supply conditions over the last 10 years of the historical simulation, the SCWA service areas of Northgate and Arden Park Vista in the CCBL use groundwater pumping from WY 2018 for normal and dry baseline years and WY 2019 for wet baseline years.

5.1.5.2 South American Subbasin

The following subsections present demand and supply assumptions for purveyors within the South American Subbasin whose assumptions are different from the standard methodology.

5.1.5.2.1 City of Sacramento

The discussion also applies to the portion of the City of Sacramento that lies within the South American Subbasin; the portion within the NASb was discussed above in Section 5.1.5.1. Groundwater pumping in the SASb by the city varies from 1,761 AFY during wet years to 11,885 AFY during driest years, based on the Future Conditions Baseline scenario developed in the 2017 GWMP and the discussions with the City of Sacramento (B. Ewart, personal communication, December 2020). Monthly pumping assumptions by each well and by each water year type were incorporated into the CCBL based on well locations and monthly well operations, as specified in the 2017 GWMP. Demand after groundwater pumping was assumed to be supplied by surface water.

5.1.5.2.2 Sacramento County Water Agency (Hood, Laguna Vineyard, and Mather)

Due to changing supply conditions over the last 10 years of the historical simulation, including construction of the Vineyard Surface Water Treatment Plant (online in WY 2011), the SCWA service areas of Hood, Laguna Vineyard, and Mather in the CCBL use surface water deliveries, groundwater pumping, recycled water, and remediated water from WY 2018 for normal and dry baseline years and WY 2019 for wet baseline years.

5.1.5.3 Cosumnes Subbasin

The following subsections present demand and supply assumptions for purveyors within the Cosumnes Subbasin whose assumptions are different from the standard methodology.

5.1.5.3.1 City of Galt

The average historical groundwater production for WY 2015-2018 for the City of Galt was used to estimate groundwater pumping for all CCBL years. This pumping occurs at six active wells.

5.1.5.3.2 City of Ione

To estimate CCBL surface water supply to the City of Ione, the average for WY 2015-2018 was used for all CCBL years.

5.1.5.3.3 Camanche Village

To estimate CCBL groundwater pumping water supply for Camanche Village from six active wells, the average for WY 2015-2018 was used for all CCBL years.

5.1.5.3.4 Sacramento Municipal Utility District

The imported Central Valley Project water from the American River via the Folsom South Canal to the Sacramento Municipal Utility District (SMUD) facility uses the average for WY 2015-2018 for all CCBL years.

5.1.5.4 Fish Farms

In the North American Subbasin, four wells were used to simulate 3,480 AFY of pumping for Sterling Caviar, which is located near the Sutter/Sacramento County line just east of Highway 99.

Groundwater pumping at fish farms in the South American Subbasin and Cosumnes Subbasin uses the average for WY 2015-2018 for all CCBL years.

5.1.6 Agricultural Demand and Supply

Agricultural demand in the CCBL is calculated within the model using land use, evapotranspiration, precipitation, and other information, as described for the historical simulation in Section 3.3.

Agricultural supply in the CCBL made of up primarily of surface water deliveries and groundwater pumping. Surface water deliveries are based on water year types (normal, wet, and dry) averages calculated using the last 10 years of the historical simulation (WY 2009-2018). Demand not met by surface water is assumed to be met by groundwater pumping, which is pumped within the associated model element, rather than coming from specific agricultural pumping wells.

5.1.6.1 Rural-Residential Pumping

Rural residential pumping for the current conditions baseline is assumed to be the same as the historical model for water year 2018. Refer to Section 3.3.1 in the historical model documentation.

5.1.6.2 Galt Wastewater Treatment Plant Effluent

The reclaimed water use from the Galt Wastewater Treatment Plant (WWTP) uses the average for WY 2015-2018 for all CCBL years, regardless of baseline water year type.

5.1.6.3 Agricultural Groundwater Substitution Transfers

Pumping associated with agricultural water transfers occurs in three entities in the North American Subbasin: Natomas Mutual Water Company (NMWC), Pleasant Grove-Verona Mutual Water Company (PGVMWC), and South Sutter Water District. NMWC and PGVMWC participate in groundwater substitution transfers under certain conditions. South Sutter Water District is different from the other two, as they transfer water based on a hybrid approach. The water made available is released from storage in Camp Far West Reservoir. Generally, a similar volume of groundwater is pumped by private well owners within the district. This volume is not directly measured and is assumed to be slightly less than the amount released from storage. This is represented in the CCBL by delivering less surface water during dry years than normal or wet years, with averages calculated using the data from the last 10 years of the historical simulation. The groundwater pumping is calculated internally in the model and therefore automatically adjusts for years with less or more surface water.

For NMWC and PGVMWC, historical groundwater substitution transfer pumping data was provided for water years 2020 and 2021 (2019 was not a transfer year). For the CCBL estimates of groundwater substitution transfer pumping, dry year averages were calculated using historical data for WY 2012-2021. During this 10-year period, all groundwater substitution transfer pumping occurs in the five dry years (2013, 2014, 2015, 2020, and 2021). The estimated dry year transfer pumping for NMWC and PGVMWC was distributed among all transfer wells in the same proportion as in the historical data. The surface water deliveries to NMWC and PGVMWC in the CCBL are adjusted based on the amount of dry year transfer pumping.

5.1.7 Remediation Operations

Remediation operations for Mather, McClellan, Kiefer, and Aerojet, discussed for the historical simulation in Section 3.4, in the CCBL are held constant at the WY 2018 level of pumping for the entire CCBL. The number and location of the remediation wells is assumed to remain the same as in the historical simulation. Mather remediation pumping is set at 209 AFY, McClellan remediation pumping is set at 2,409 AFY, Kiefer remediation pumping is set at 621 AFY, and Aerojet remediation pumping is set at 32,040 AFY.

5.1.8 Results

This section provides a summary of the CoSANA CCBL results.

5.1.8.1 Land and Water Use Budget

The land and water use budget provides details on the urban and agricultural demand and the water supply meeting the demand (groundwater pumping, surface water deliveries, recycled water, or remediation pumping). Average annual CCBL model results by groundwater subbasin are shown in Table 5-2. Annual agricultural water demand and supply by subbasin are shown in Figure 5-8 through Figure 5-10. Annual urban demand and supply by subbasin are shown in Figure 5-11 through Figure 5-13. Appendix H includes model subregion land and water use budgets for the baselines.

Table 5-2: CCBL Average Annual Land and Water Use Budget

Subbasin	Ag. Demand (AFY)	Ag. Ground-Water Use* (AFY)	Ag Surface Water Deliveries (AFY)	Urban Demand (AFY)	Urban Ground-Water Use** (AFY)	Urban Surface Water Deliveries (AFY)	Urban Recycled Water (AFY)	Remediation Pumping (AFY)
NASb	392,619	206,201	188,962	200,913	83,319	117,596	-	5,515
SASb	142,961	98,369	44,804	174,487	79,948	93,871	856	29,765
CoSb	126,838	105,049	21,458	27,520	22,825	2,483	-	-
Total	**662,418**	**409,619**	**255,224**	**402,920**	**186,092**	**213,950**	**856**	**35,280**

Note:
* Agricultural groundwater use presented in the above table may differ slightly from the values shown in the respective GSP due to minor difference in the methodology on calculation of rural residential water use.
** Urban groundwater use in the above table represents water used that originated from groundwater production but can include water that was pumped in areas outside of the respective subbasin.

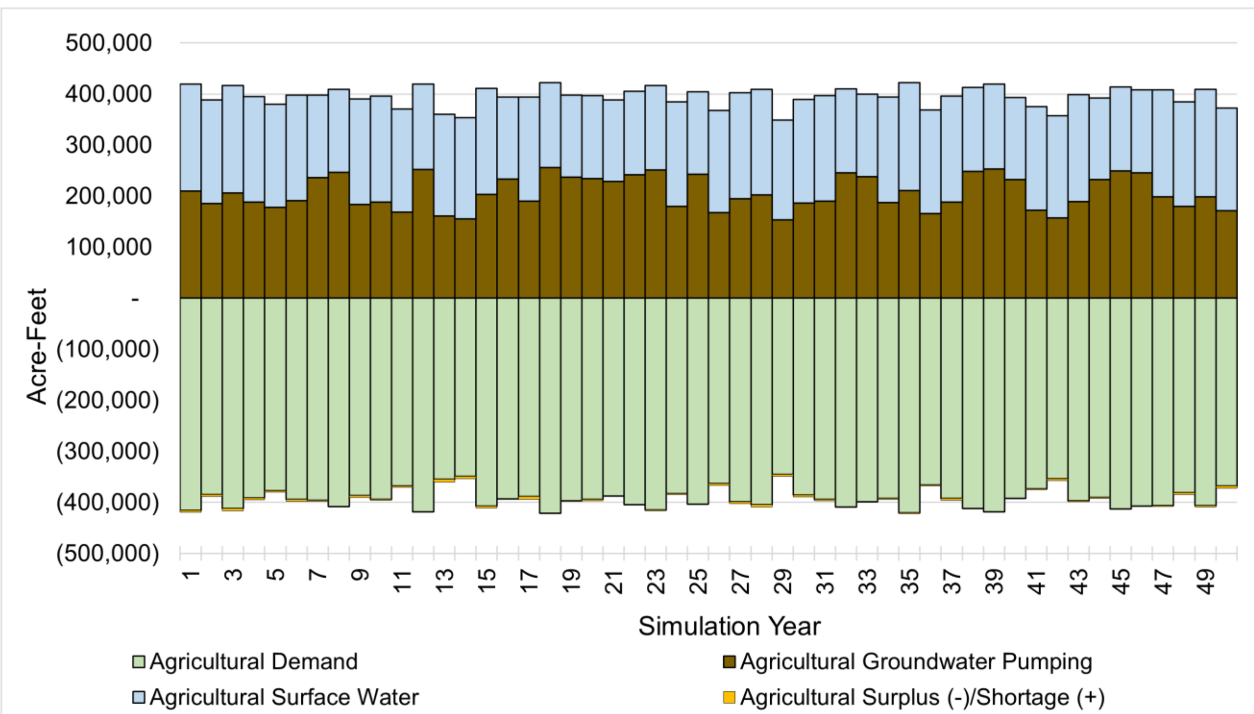


Figure 5-8: Annual Agricultural Water Demand and Supply – North American Subbasin, Current Conditions Baseline

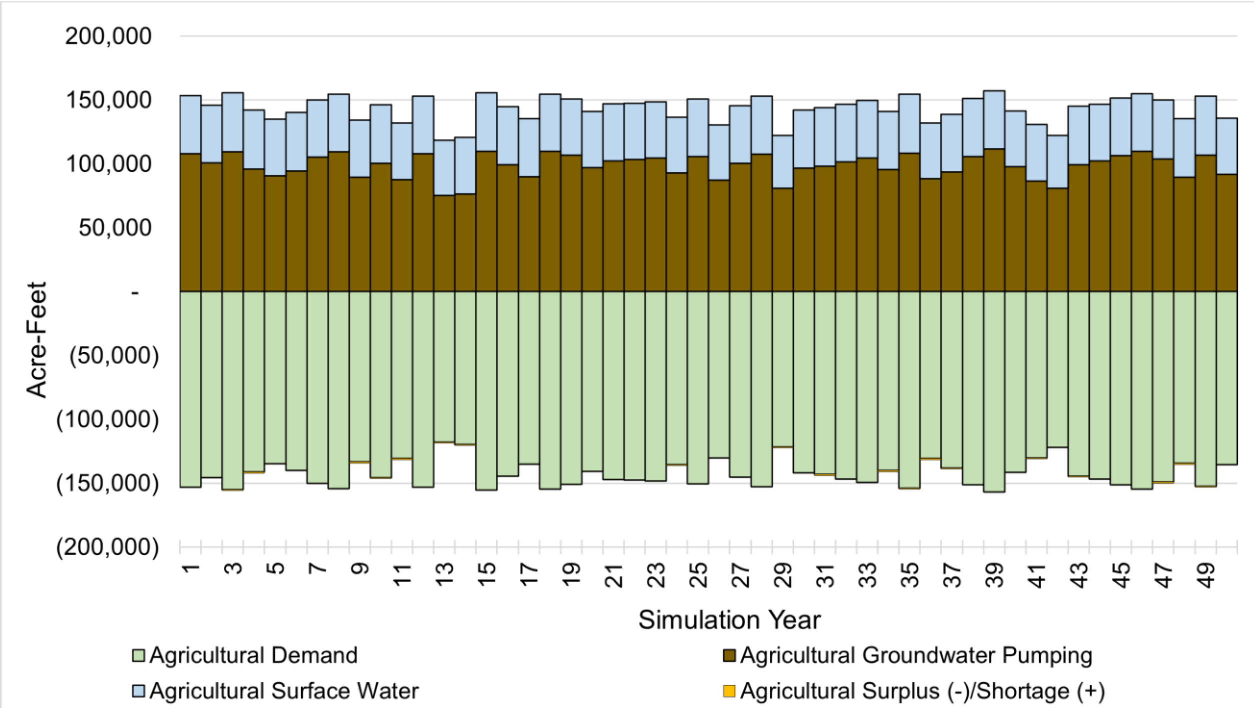


Figure 5-9: Annual Agricultural Water Demand and Supply – South American Subbasin, Current Conditions Baseline

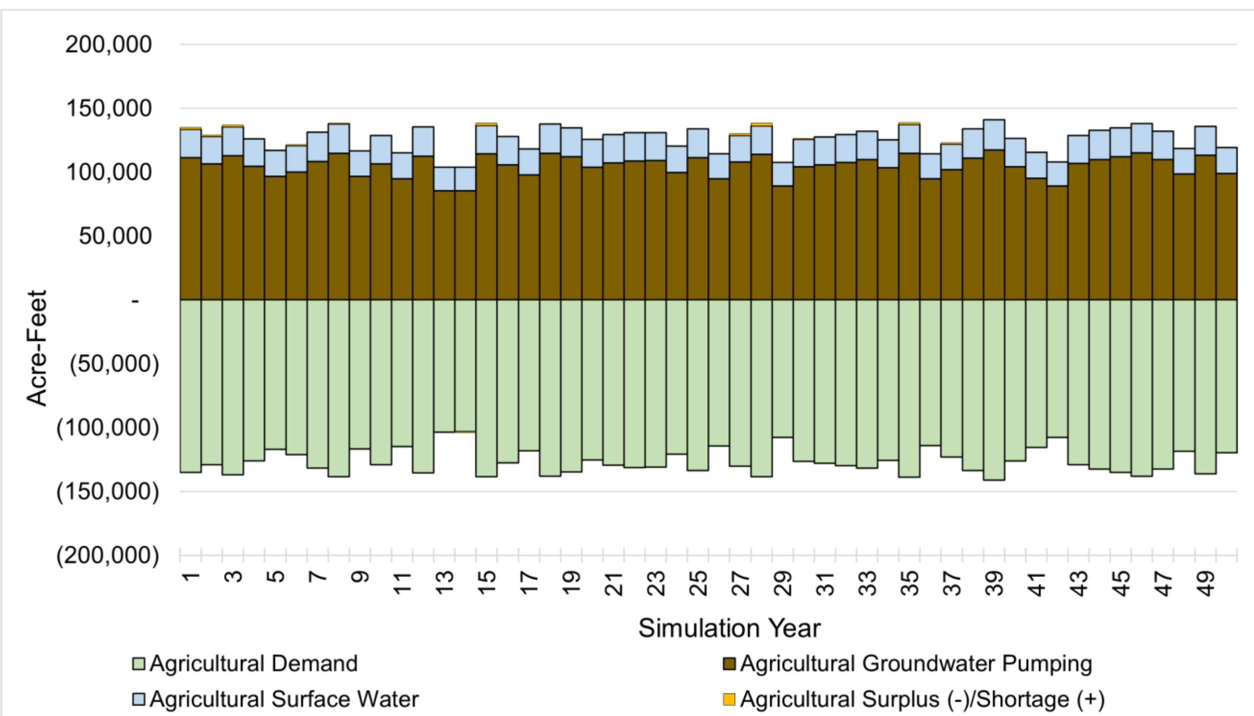


Figure 5-10: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Current Conditions Baseline

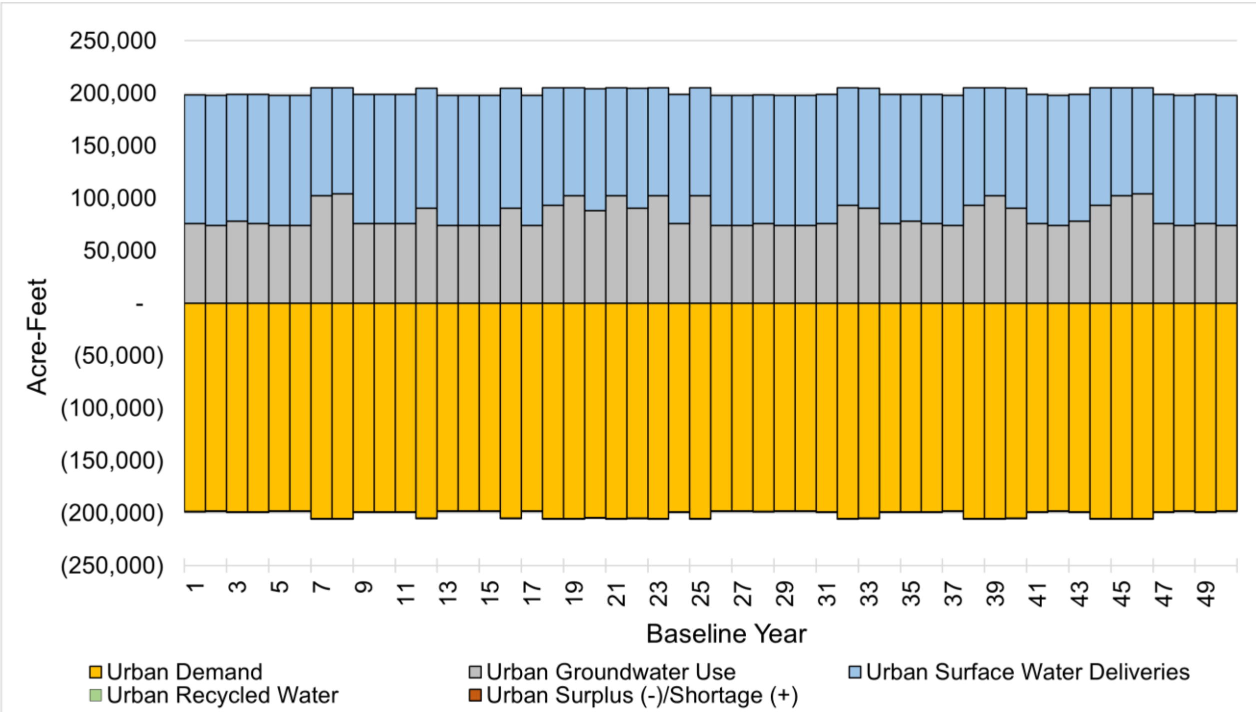


Figure 5-11: Annual Urban Water Demand and Supply – North American Subbasin, Current Conditions Baseline

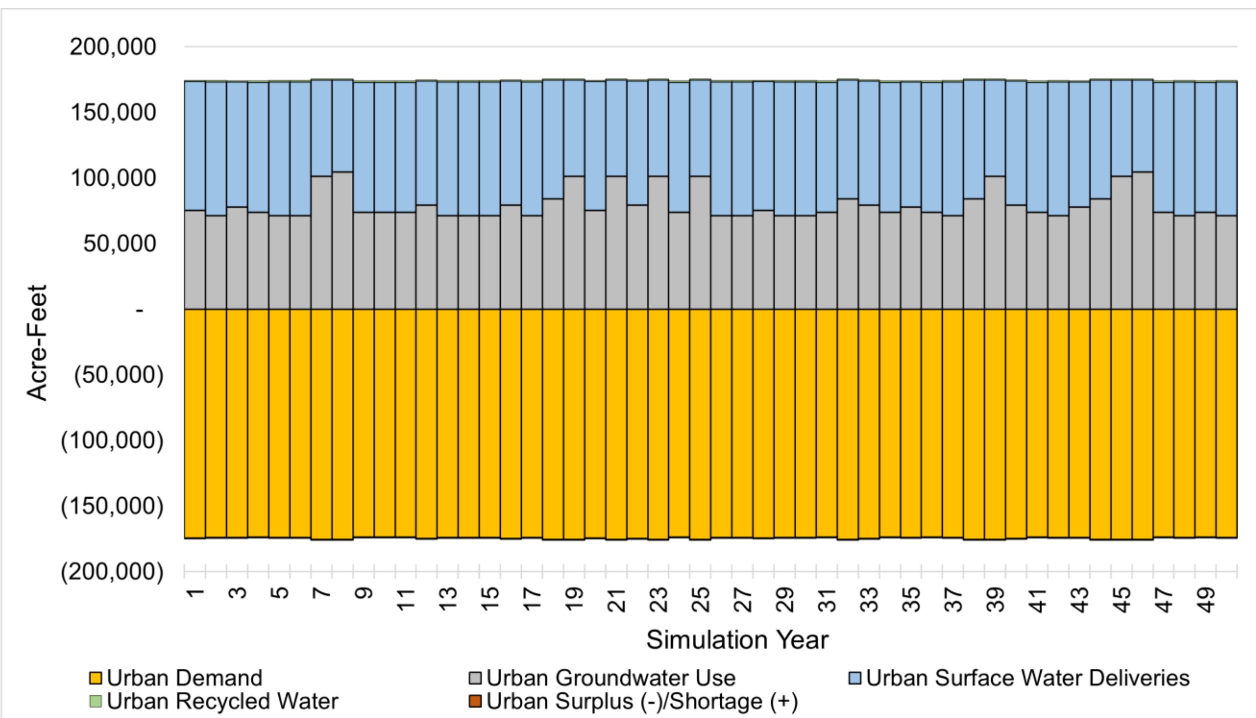
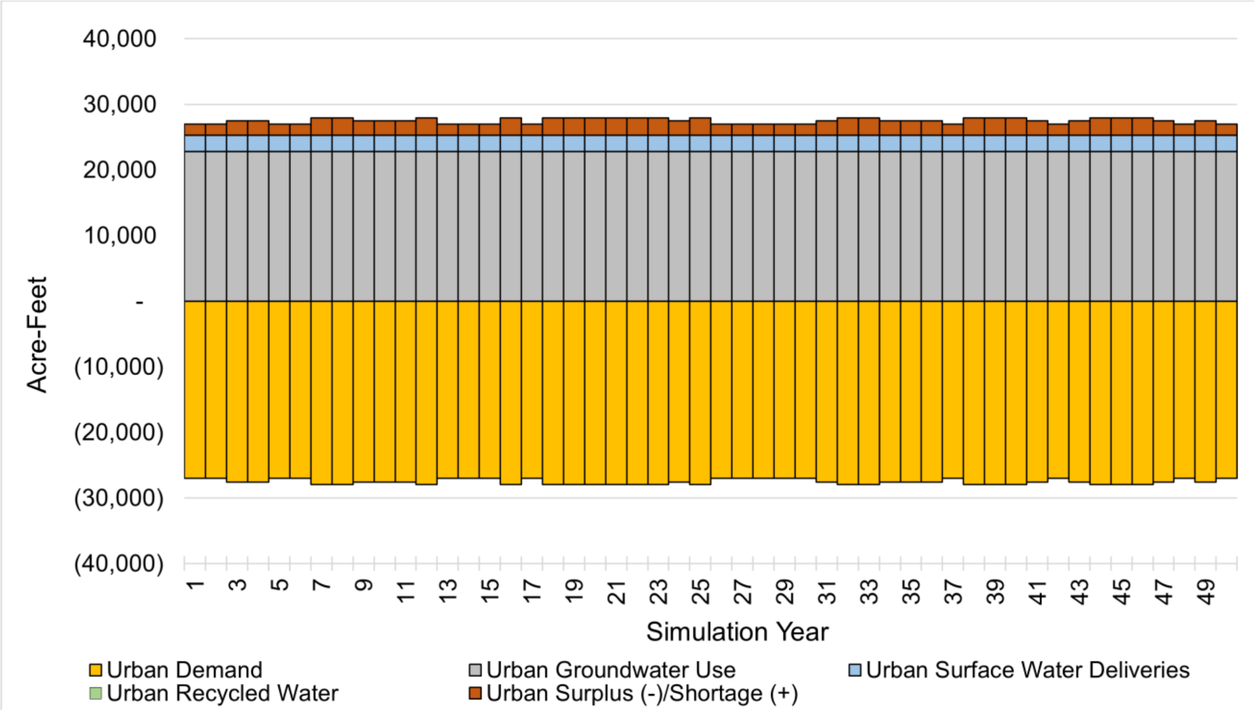


Figure 5-12: Annual Urban Water Demand and Supply – South American Subbasin, Current Conditions Baseline



Note: Urban groundwater use is specified in the CoSb model input data set. The model-calculated surplus/shortage in urban demand is therefore not utilized to calculate the CoSb groundwater budget.

Figure 5-13: Annual Urban Water Demand and Supply – Cosumnes Subbasin, Current Conditions Baseline

5.1.8.2 Groundwater Budget

The groundwater budget provides all inflows and outflows to the groundwater aquifer system. Average annual CCBL model results by groundwater subbasin are shown in Table 5-3. Annual groundwater budgets with cumulative change in storage by subbasin are shown in Figure 5-14 through Figure 5-16. Appendix I includes model subregion groundwater budgets for the baselines. Appendix J includes a set of sample hydrographs for the baseline models.

Table 5-3: CCBL Average Annual Groundwater Budget

Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
NASb	303,094	183,468	81,494	16,732	28,125	8,161	14,843
SASb	212,626	120,915	91,328	26	4,089	-1,573	2,158
CoSb	127,875	109,064	15,575	0	1,442	1,559	-233
Total	**643,595**	**413,447**	**188,397**	**16,758**	**33,656**	**8,147**	**16,768**

Note: Boundary Flows term includes flow between areas outside of the CoSANA model domain and baseflow from small watersheds. Subsurface Inflows includes flow between the simulated subbasins in CoSANA and areas outside of Bulletin 118 subbasins.

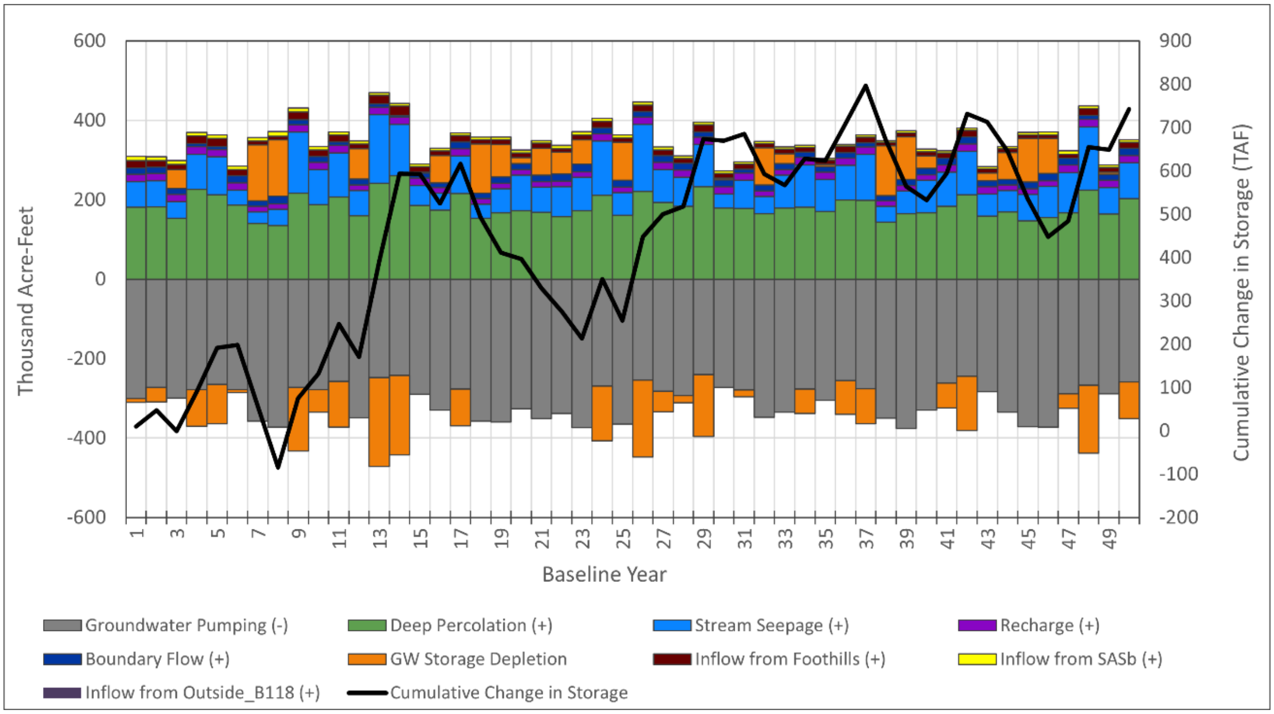


Figure 5-14: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Current Conditions Baseline

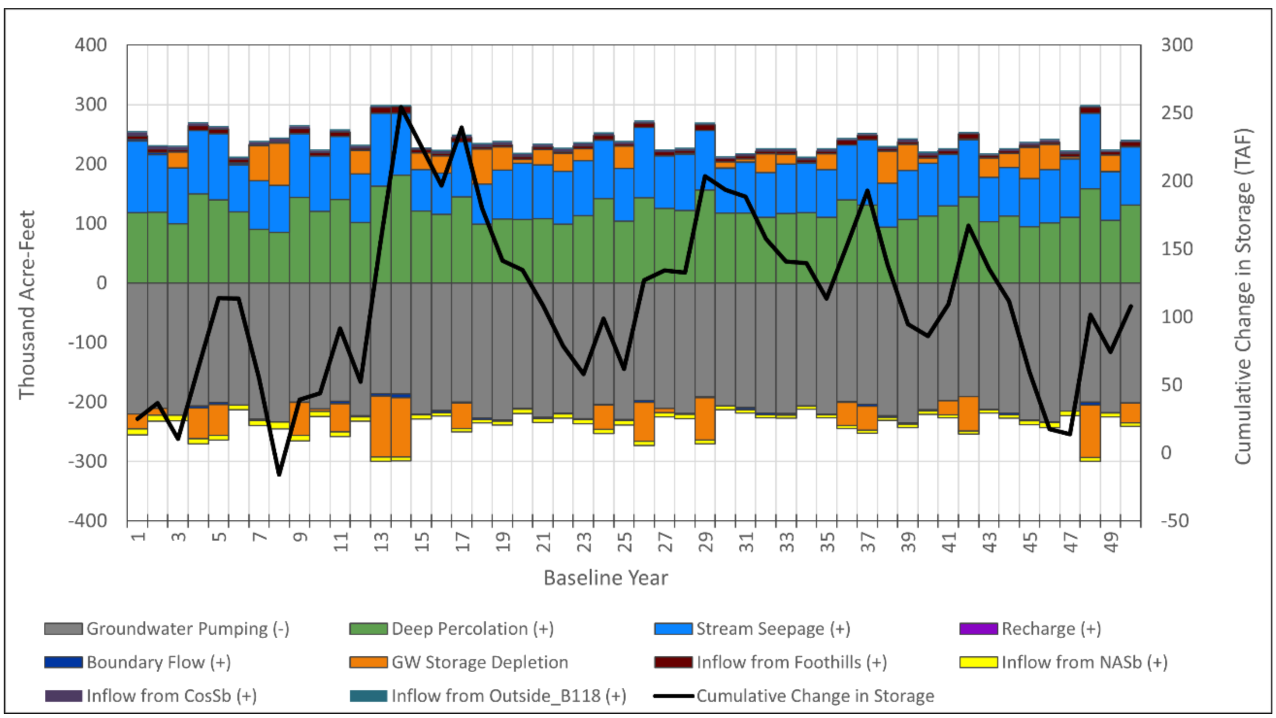


Figure 5-15: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Current Conditions Baseline

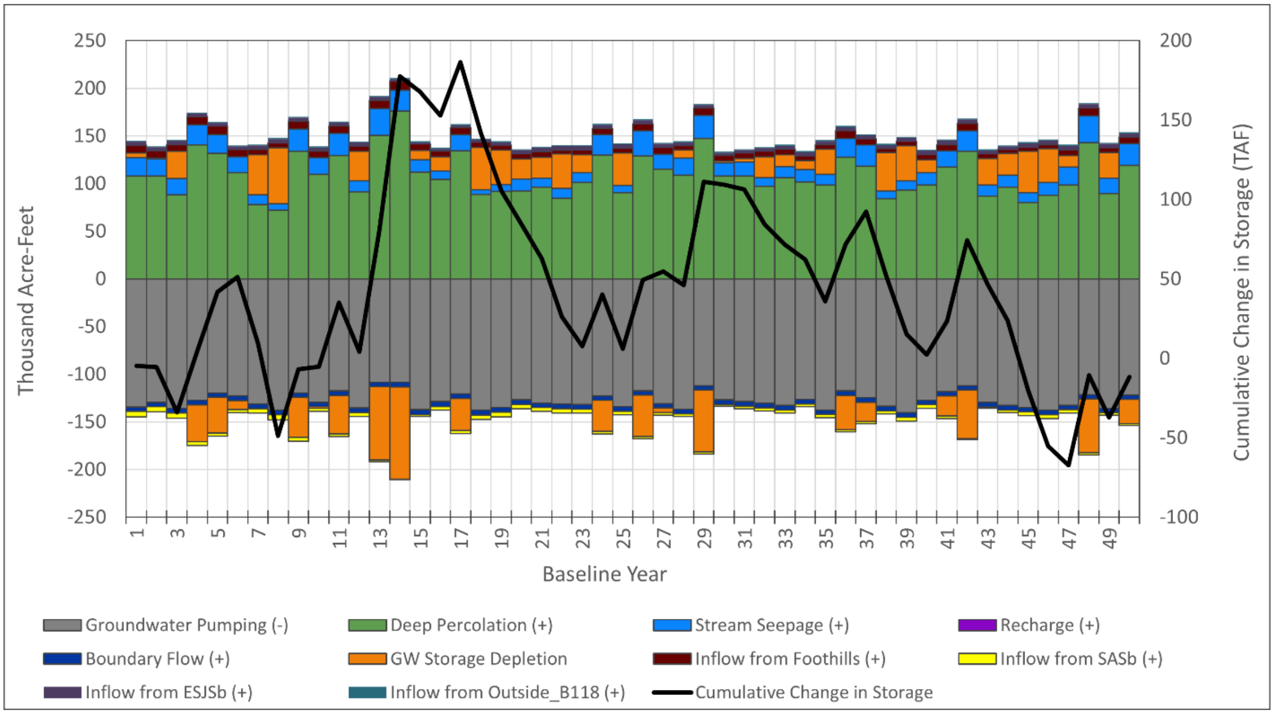


Figure 5-16: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Current Conditions Baseline

5.2 Projected Conditions Baseline

The CoSANA Projected Conditions Baseline (PCBL) is a representation of the projected land and water use conditions of 2040, or the closest information available from planning documents. This section presents the key data sources and assumptions used to develop the PCBL and provides the model results. Initial groundwater levels and soil conditions in the PCBL represent those at the end of the simulation period of the historical CoSANA (September 30, 2018).

5.2.1 Hydrologic Period

The PCBL uses the 50-year historical hydrology from WY 1970 through 2019 (October 1, 1969 through September 30, 2019) for precipitation, evapotranspiration, and streamflow. This is the same as for the CCBL, discussed in Section 5.1. The hydrologic year types discussed in Section 5.1.1.4 are used in the PCBL to develop projected water demands and supplies.

5.2.2 Land Use

The PCBL incorporates the proposed new developments to reflect the 2040 land use conditions or the closest data available from planning documents. The existing land use data for 2015 conditions used in the CCBL were modified to incorporate the future projected urban footprint. The urban footprint for the proposed new developments, urban demand, and urban supply projections including the new developments were incorporated into the model, as further explained below.

Table 5-4 lists the proposed new developments incorporated into the PCBL. A total of 62 proposed new developments were identified, including 34 in the NASb, 25 in the SASb, and 3 in CoSb. In the CoSb, urban land was expanded around existing developed areas, as projected in planning documents.

The main data source for identifying the new developments in Sacramento County was information and GIS files provided by the Sacramento County Office of Planning and Environmental Review (T. Smith, personal communication, October 2020). In addition, public information available from the Sacramento Area Council of Governments (SACOG) was also collected and reviewed for identifying and confirming the developments within Placer and Sutter Counties. Placer County also reviewed the list of the new developments and provided inputs (J. Byous, personal communication, December 2020). Information was also available for many of the developments in Sutter and Placer Counties (R. Shatz, personal communication, December 2020).

The majority of the new developments in the NASb are located in Placer County near the City of Rocklin (Sunset Ranchos and Clover Valley), City of Lincoln (SUD A, SUD B, SUD C, Village 1, Village 2, Village 3, Village 4, Village 5, Village 6, and Village 7), City of Roseville (Amoruso Ranch, Creekview, HP Campus Oaks, North Area, Northwest Roseville, Sierra Vista, Sun City Roseville [or Del Webb] and West Roseville Specific Plans), and Cal-Am West Placer (Placer Vineyards Specific Plans East and West and Riolo Vineyards). Other proposed developments include the Placer Ranch and Regional University in Placer County, Sutter Pointe in Sutter County; and Grandpark Specific Plan, Elverta, Greenbrier, Panhandle, Northborough, and Upper Westside in Sacramento County.

The majority of the proposed new developments in the SASb are located within the SCWA service areas (Arboretum, Jackson Township, Laguna Ridge, Ranch at Sunridge, Rio del Oro (partially in the Cal-Am service area), Southeast Planning Area (Meridian), Sterling Meadows, SunCreek, SunRidge, Vineyards, Cordova Hills, Florin Vineyard Gap, Mather South, NewBridge, North Vineyard Station, Vineyard Springs, Lent Ranch, and West Jackson Highway Master Plan). Other proposed developments are located around or within the City of Folsom (Easton, Folsom South Area, and Glenborough), Rancho Murieta Community Service District (Rancho Murieta), and Elk Grove Water District (Triangle).

In the CoSb, urban land in the City of Galt was expanded based on 2030 projections in the City's General Plan, and areas in the vicinity of Ione ("Urban Planning Area") and Camanche Village ("Rural Residential") were expanded based on Amador County's General Plan. The footprint of the Buena Vista Rancheria was converted from native to urban.

The proposed new developments and future land use conditions are shown in Figure 5-17. The time-series of land use for the CoSANA PCBL is shown in Figure 5-18, highlighting the constant nature of land and water use in the baseline conditions. Figure 5-19 through Figure 5-21 show time-series of land use for the NASb, SASb, and CoSb, respectively.

Table 5-4: Proposed New Developments

Proposed Development Name	ID		Proposed Development Name	ID
Village 4	1		Greenbriar	32
SUD A	2		Panhandle	33
Village 3	3		Upper Westside	34
Village 5	4		Westborough	35
SUD B	5		Easton	36
Village 2	6		Glenborough	37
Village 1	7		Folsom South Area	38
Village 6	8		Rio Del Oro	39
Village 7	9		Mather South	40
SUD C	10		Ranch At Sunridge	41
Sunset Ranchos	11		SunRidge	42
Amoruso Ranch Specific Plan	12		SunCreek	43
Clover Valley	13		Cordova Hills	44
Placer Ranch	14		West Jackson Highway Master Plan	45
Creekview	15		Jackson Township	46
West Roseville	16		NewBridge	47
North Area Specific Plan	17		Arboretum	48
Sun City Roseville	18		Rancho Murrieta	49
HP Campus Oaks	19		Florin-Vineyard	50
Sierra Vista Specific Plan	20		North Vineyard Station	51
North Area Specific Plan 2	21		Delta Shores	52
Northwest Roseville Specific Plan	22		Vineyards	53
Sutter Pointe	23		Vineyard Springs	54
Regional University	24		Triangle	55
Riolo Vineyards	25		Laguna Ridge	56
Placer Vineyards Specific Plan (east)	26		Southeast Planning Area (Meridian)	57
Placer Vineyards Specific Plan (west)	27		Sterling Meadows	58
Dry Creek-West Placer Community Plan	28		Lent Ranch	59
Grandpark Specific Plan	29		Galt Sphere of Influence	60
Elverta Specific Plan	30		Camanche Village Rural Residential	61
Northborough Boundary	31		Ione Urban Planning Area	62

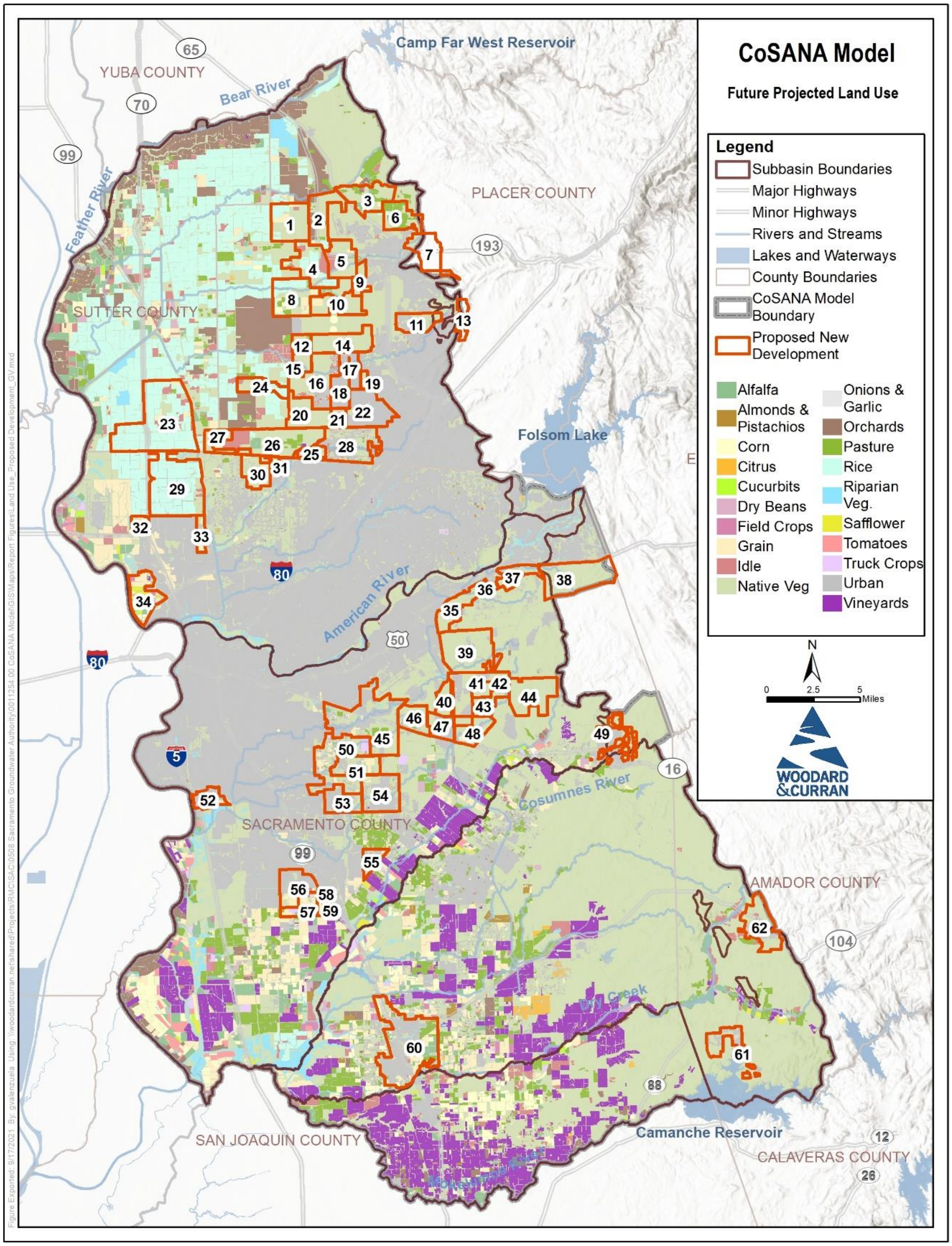
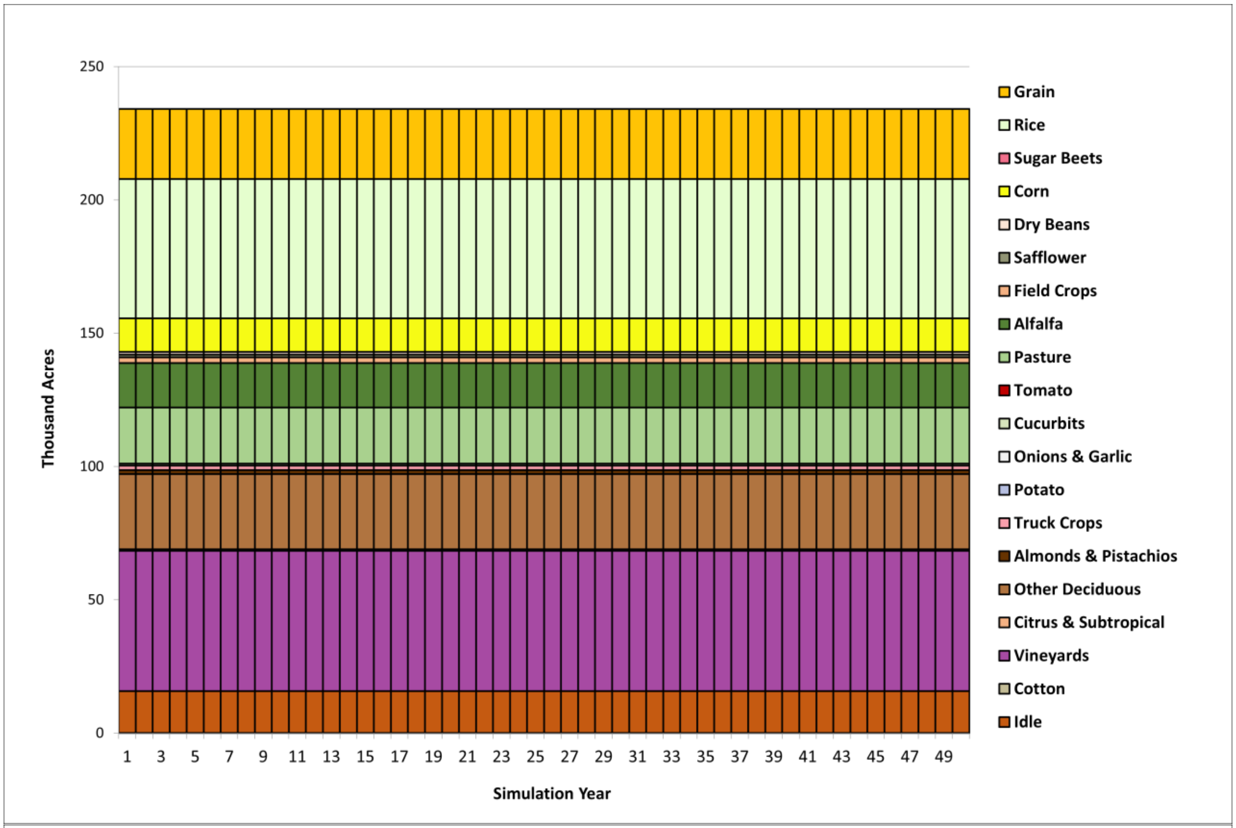


Figure 5-17: Projected Land Use and Proposed New Developments



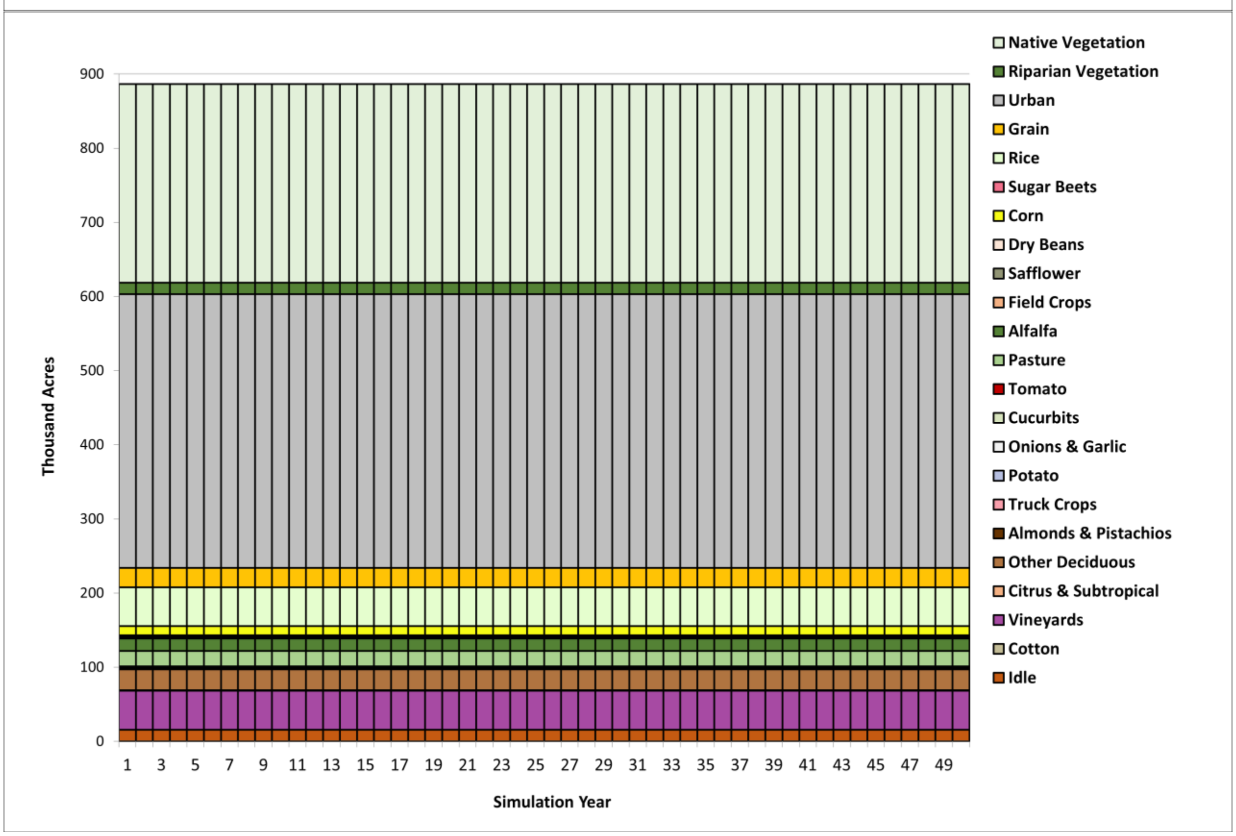


Figure 5-18: Projected Conditions Baseline Land Use for CoSANA

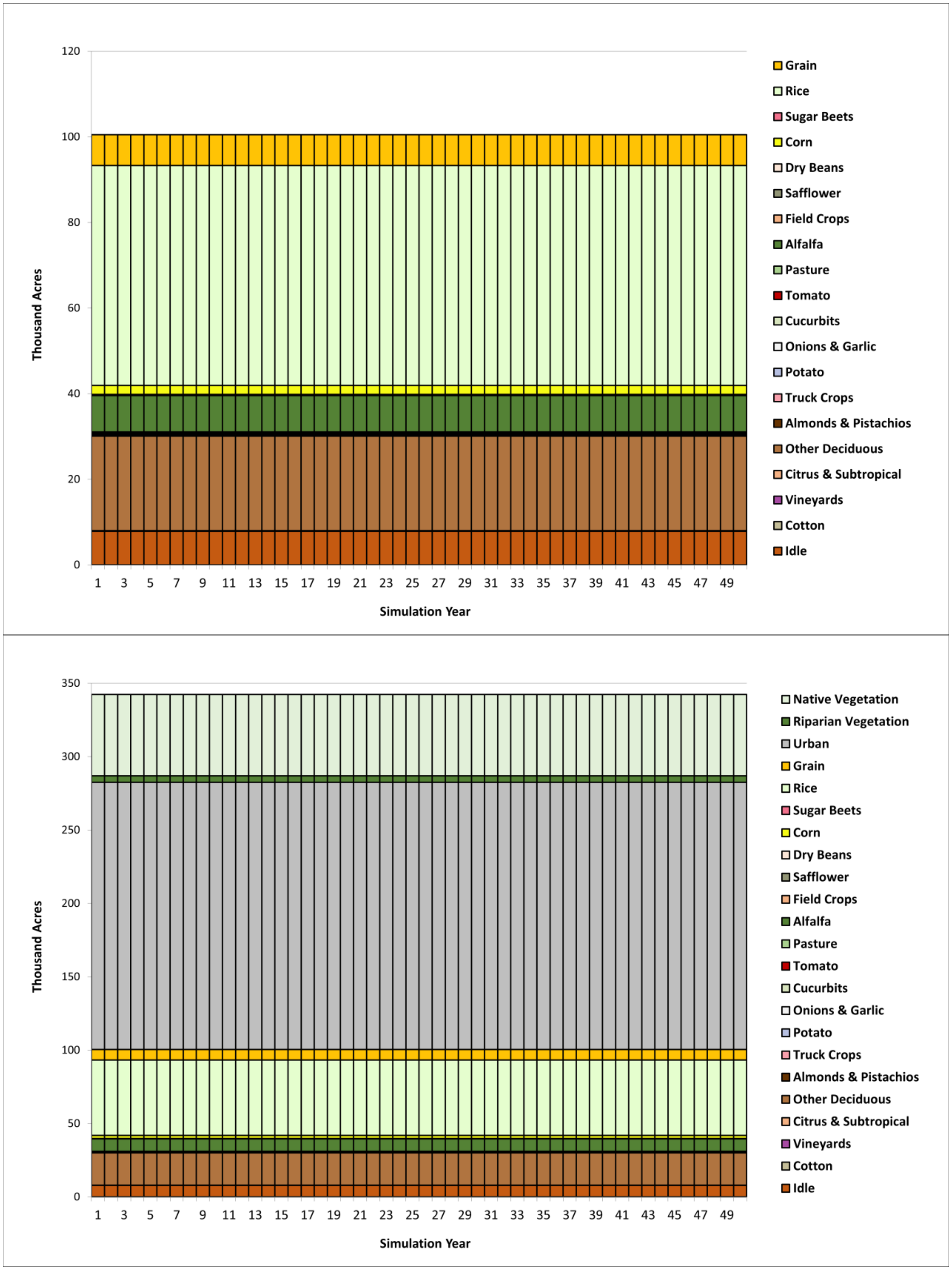


Figure 5-19: Projected Conditions Baseline Land Use for North American Subbasin

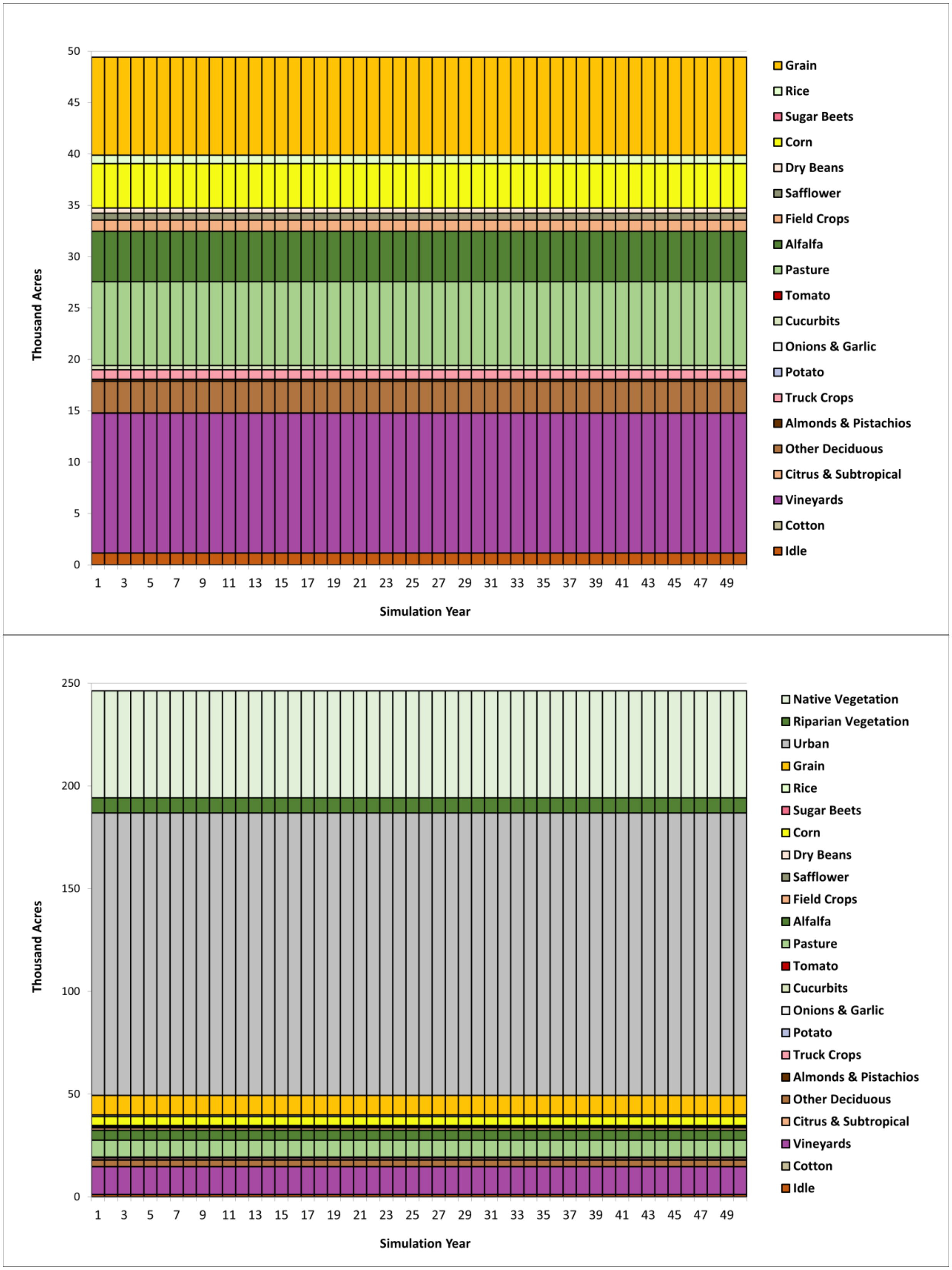
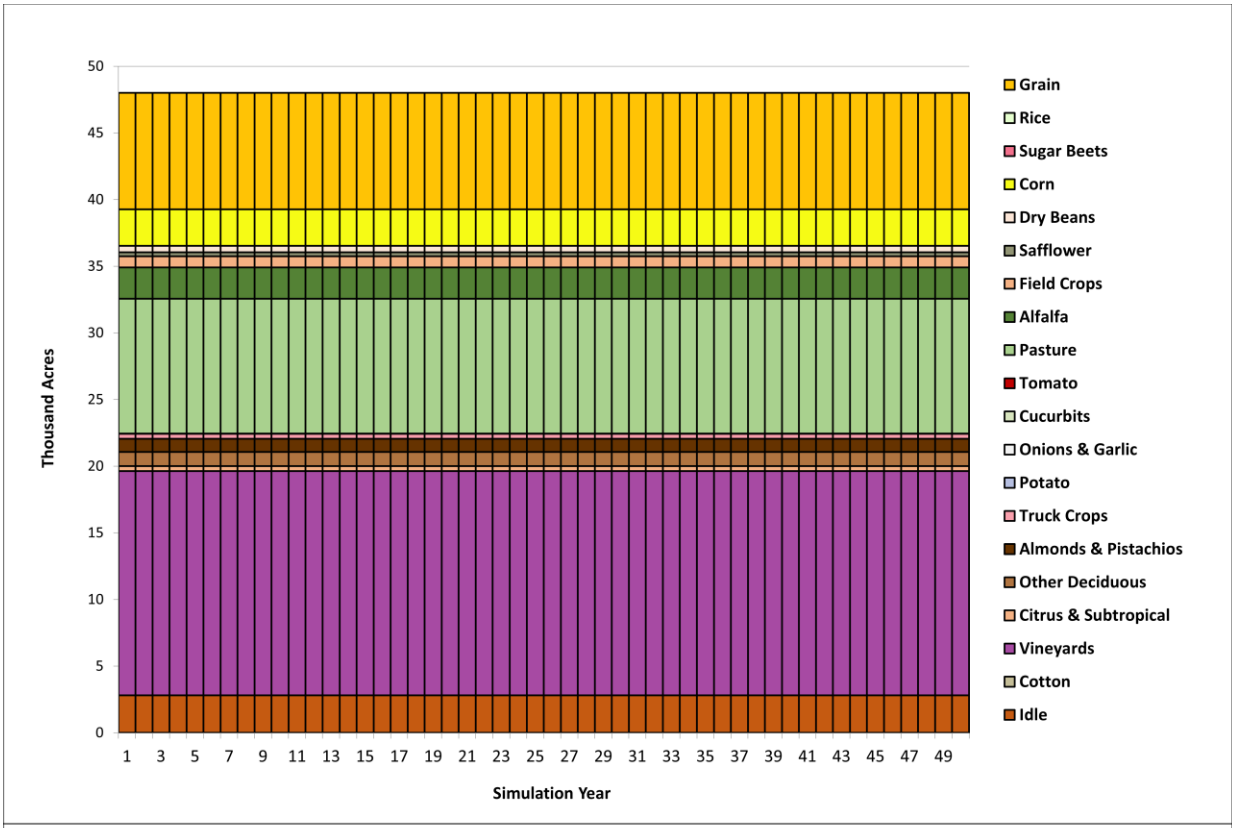


Figure 5-20: Projected Conditions Baseline Land Use for South American Subbasin



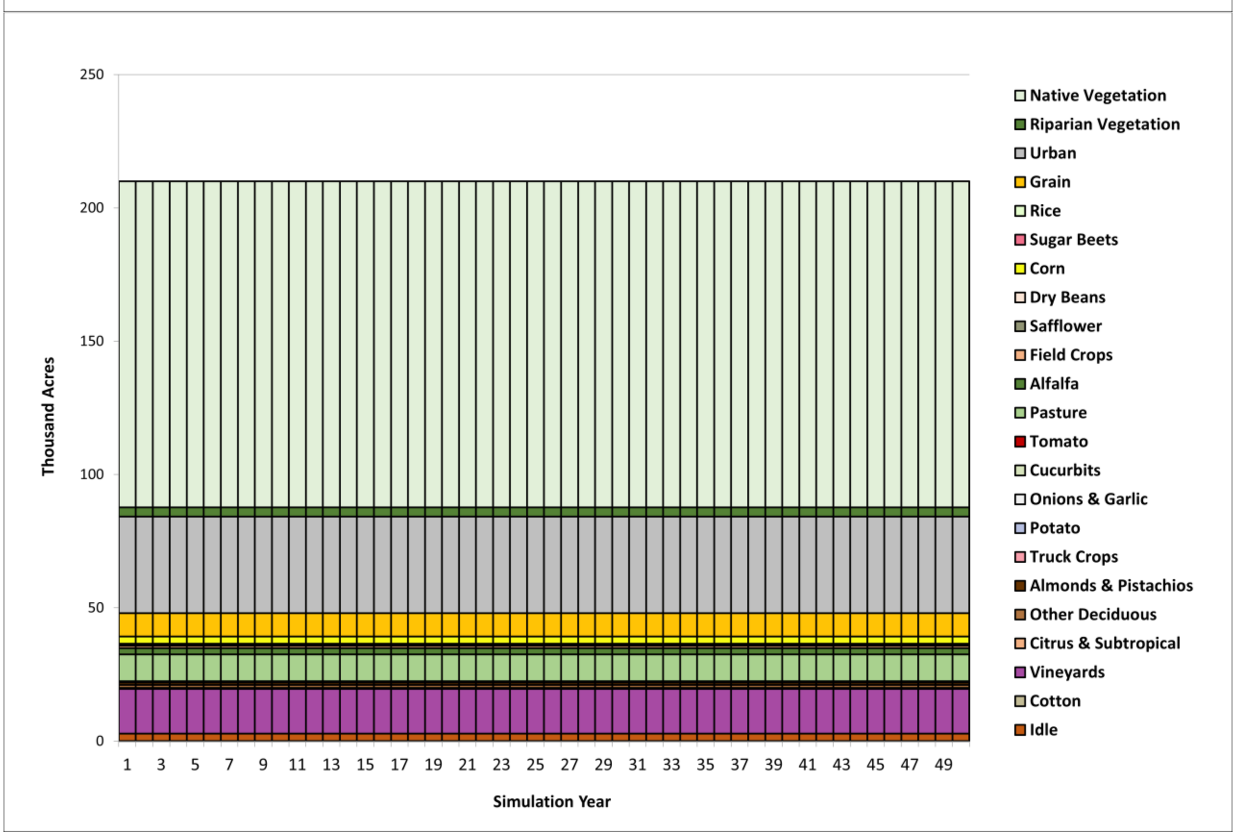


Figure 5-21: Projected Conditions Baseline Land Use for Cosumnes Subbasin

5.2.3 Urban Demand and Supply

Urban water demand in the PCBL is generally reflective of 2040 conditions. Demand and supply projections were generally available for 2040 conditions; when data for 2040 was not readily available, 2035 projections were used as the latest information. Water demand and supply assumptions are based on the 2015 UWMPs, general plans, other planning documents, or most current information provided by purveyors. Note that the 2020 UWMPs were not available at the time of model development. Appendix G presents the annual average demand and supply assumptions used in the PCBL by three water year types for each purveyor and five water year types for the City of Sacramento. Urban demand and supply projections were defined by three water year types for wet, normal, and dry conditions, using the same water year types as in the CCBL. All dry year projections were assumed to be single dry year projections based on the information available. Projections for wet years were assumed to be the same as normal conditions when wet year projections were unavailable. For the purpose of the modeling, supply was assumed to meet the demand with no surplus.

2015 UWMPs and other planning and environmental permitting documents were reviewed to estimate demand and supply sources for the proposed developments. Review of the publicly available information suggested that demand and supply projections were generally included in the purveyors' projected demand and supply estimates as reported in the 2015 UWMPs with the exception of two new developments - Sutter Pointe and Grandpark Specific Plans. Sutter Pointe and Grandpark Specific Plans were assumed to be on a mix of groundwater pumping and surface water supplies based on available documentation. It was assumed that all new developments in Placer County would be on surface water supplies.

This section briefly describes the demand and supply assumptions used in the PCBL for each purveyor. Similar to the approach in the CCBL, demand and supply information is described for purveyors grouped by the three subbasins NASb, SASb, and CoSb.

5.2.3.1 North American Subbasin

This section briefly describes the demand and supply assumptions used in the PCBL within the NASb.

5.2.3.1.1 Placer County Water Agency – Rocklin Retail Area

- **Demand**: The City of Rocklin's future demand of 18,942 AFY was based on the Placer County Water Agency's 2015 UWMP (Table 4-9; PCWA, 2016) with a partial demand estimated and incorporated into the PCBL to represent the portion of the City of Rocklin within the model domain. It is estimated that approximately 33% of the City of Rocklin's demand was within the model area. Demand was adjusted by water year type based on the trends seen in the CCBL, with slightly lower demand during dry years than normal and wet years.

- **Supply**: All future demand was assumed to be met by surface water.

5.2.3.1.2 City of Lincoln

- **Demand**: 2040 demand projections were 20,336 AFY for normal and wet years and 20,947 AFY for dry years, based on the 2015 UWMP (Table 4-6 and Table 7-2) (City of Lincoln, 2016a).

- **Supply**: Demand was assumed to be met by 3,300 AFY of groundwater pumping, 6,063 AFY of recycled water, and the remaining demand met by surface water. These values were based on the Water Master Plan (Tables 3-10 and 3-11; City of Lincoln, 2016b) and the latest information available (R. Shatz, personal communication, December 2020). The City of Lincoln's proposed future wells to support the proposed developments were incorporated into the PCBL.

5.2.3.1.3 City of Roseville

- **Demand**: The 2040 demand projection was based on the 2015 UWMP (City of Roseville, 2016) and information provided by the City of Roseville (T. Joseph, personal communication, December 2020). Demand was assumed at 56,865 AFY during normal and wet years and reduced to 46,708 AFY during dry years, which accounts for a reduction of 11,677 AFY through water conservation.
- **Supply**: Demand was assumed to be met by 5,958 AFY of recycled water in all years, based on the 2015 UWMP (Table 6-11); the remaining demand was assumed to be met by surface water and the city's aquifer storage and recovery (ASR) program. The PCBL incorporated the ASR program at buildout with 15 ASR wells operating and included well information (well IDs, well locations, and well screens) and annual extraction and injection schedules provided by the City of Roseville. With the ASR program, the city assumes no net take on groundwater supply over the long-term, based on the following ASR operations by water year types:
    - During dry years, the City of Roseville's ASR wells extract 6,907 AFY of groundwater.
    - During wet years, the City of Roseville recharges groundwater through injection of 6,200 AFY of surface water into aquifer.
    - During normal and wet years, ASR wells pump a small volume of 25 AFY for maintenance.

5.2.3.1.4 California American Water Company (West Placer, Antelope, Lincoln Oaks, and Arden)

- **Demand**: A 2035 demand projection was developed for each service area based on the 2015 UWMP (Table 4-2; Cal-Am, 2016). Demand remains the same in all water year types.
- **Supply:** Supply projections by service area were based on the 2015 UWMP as follows:
    - West Placer was assumed to be all surface water provided to Cal-Am by the wholesaler, PCWA.
    - Antelope and Lincoln Oaks were assumed to be on surface water from Sacramento Suburban WD (only during normal and wet years) and groundwater pumping. The 2,000 AFY of surface water supply was assumed to be distributed as 60% to Antelope and 40% to Lincoln Oaks (2015 UWMP Table 5-9); the remaining supply comes from groundwater.
    - The City of Sacramento supply of 4,831 AFY was distributed between Arden (NASb), Parkway (SASb), and Suburban Rosemont (SASb) based on the 2015 UWMP (Table 5-9).

5.2.3.1.5 Sacramento International Airport

- **Demand**: Demand was estimated based on the average of 2017 and 2018 in the CCBL.
- **Supply**: Demand was assumed to be met by surface water and groundwater, proportional to the volumes in 2017 and 2018.

5.2.3.1.6 Rio Linda / Elverta Community Water District

- **Demand**: A 2035 demand projection of 7,462 AFY for normal and wet years (Table 4-2) and 8,208 AFY for dry years (Table 7-3) was assumed based on the 2015 UWMP (RLECWD, 2016).
- **Supply**: Demand was assumed to be met by groundwater, similar to the CCBL conditions (UWMP Table 6-9).
- **Proposed Development**: The PCBL incorporates the Elverta and Northborough Specific Plans, which are located outside of the RLECWD's current service area.

5.2.3.1.7 Sacramento Suburban Water District

- **Demand**: A 2040 demand projection of 41,304 AFY was assumed based on the 2015 UWMP (Table 3-5) (Sacramento Suburban WD, 2016). Demand remains the same for all water year types.

- **Supply**: Demand was assumed be met by a maximum groundwater pumping of 35,000 AFY during dry years, based on the 2015 UWMP (Table 5-11); the remaining demand was assumed to come from surface water. For normal and wet years, the groundwater and surface water supply mix was assumed to be proportional to CCBL conditions.

5.2.3.1.8 Citrus Heights Water District

- **Demand**: 2035 demand was assumed as 18,210 AFY for normal and wet years and 15,478 AFY for dry years, based on the 2015 UWMP (Table 4-2 and Table 7-3; Citrus Heights Water District, 2016).

- **Supply**: Demand was assumed be met by 900 AFY of groundwater pumping, with the remaining demand from San Juan WD surface water, based on the 2015 UWMP (Table 6-9).

5.2.3.1.9 Orange Vale Water Company

- **Demand**: 2035 demand was assumed as 4,981 AFY for normal and wet years and 4,234 AFY for dry years, based on the 2015 UWMP (Table 4-2 and Table 7-3; Orange Vale Water Company, 2016).

- **Supply**: Demand was assumed be met by San Juan WD surface water, similar to the CCBL.

5.2.3.1.10 San Juan Water District

- **Demand**: A 2040 demand projection of 19,393 AFY was assumed for retail demand, based on the 2015 UWMP (Table 4-2b; SJWD, 2016).

- **Supply**: Demand was assumed to be met by surface water, based on the 2015 UWMP (Table 6-9).

5.2.3.1.11 City of Sacramento

- **Demand**: A 2040 demand projection of 161,029 AFY was assumed based on the 2015 UWMP (Table 4-2) (City of Sacramento, 2016). Demand remains the same for all water year types. Approximately 35% of the demand was assumed to be in the NASb portion of the model, based on urban area.

- **Supply**: Supply projections include groundwater pumping and surface water supplies that vary by five water year types (as opposed to three water year types used for other purveyors) based on the City of Sacramento's 2017 GWMP (City of Sacramento, 2017). Groundwater pumping assumptions were consistent with the Maximum Groundwater Use scenario developed in the 2017 GWMP, based on the discussions with the City of Sacramento. Monthly pumping assumptions by each well were incorporated into the PCBL based on well locations and monthly well operations, as specified in the 2017 GWMP. Groundwater pumping in the NASb varies from 11,553 AFY during wet years to 38,261 AFY during driest years. Demand after groundwater pumping was assumed to be supplied by surface water. The City of Sacramento also has specific wells that supply some of the larger parks and green areas within the city boundaries. These irrigation wells are simulated using six representative irrigation wells that pump 2,200 AFY. Based on the locations of the irrigated parks and green areas, approximately half of the irrigation pumping was estimated in the NASb and the remaining half in the SASb.

5.2.3.1.12 Sacramento County Water Agency (Arden Park Vista and Northgate)

- **Demand**: 2045 demand projections for Arden Park Vista and Northgate were based on the Draft 2020 UWMP (Tables 4-10(b) and 4-10(c)) provided by SCWA and input from SCWA (M. Grinstead, personal communication, April 2021).
- **Supply**: Arden Park Vista and Northgate were assumed to be on groundwater, similar to the CCBL conditions.

5.2.3.1.13 Del Paso Manor Water District

- **Demand**: Demand was estimated based on the average of 2017 and 2018 in the CCBL.
- **Supply**: Demand was assumed to be met by groundwater, similar to the CCBL.

5.2.3.1.14 Golden State Water Company (Arden)

- **Demand**: Demand for the Arden service area was assumed to remain the same as in the CCBL conditions.
- **Supply**: Arden service area was assumed to be on groundwater, consistent with the CCBL conditions.

5.2.3.1.15 Carmichael Water District

- **Demand**: A 2040 demand projection was assumed as 10,334 AFY for normal and wet years and 10,851 AFY for dry years, based on the 2015 UWMP (Table 4-6 and Table 7-2) (Carmichael Water District, 2016).
- **Supply**: Demand was assumed to be met by groundwater pumping and surface water, proportional to the CCBL conditions.

5.2.3.1.16 Fair Oaks Water District

- **Demand**: A 2035 demand projection of 12,726 AFY was assumed based on the 2015 UWMP (Table 4-2) (Fair Oaks Water District, 2016).
- **Supply**: Demand was assumed to be met by groundwater pumping and surface water, proportional to the CCBL conditions.

5.2.3.1.17 Sutter Pointe

- **Demand**: A demand projection of 15,786 AFY was assumed, based on the Phase 2+B proposed water supply program from the *Supplement to the Water Supply Assessment for Lakeside at Sutter Pointe* (Golden State Water Company, 2020).
- **Supply**: Demand was assumed to be met by a mixture of groundwater pumping and surface water. Groundwater pumping is assumed to meet 10,919 AFY of demand, and surface water is assumed to meet the remaining 4,867 AFY of demand.

5.2.3.1.18 Grandpark

- **Demand**: A demand projection of 12,030 AFY was assumed, based on build out projections for the project (K. Giberson, pers comm. Feb 14, 2019).
- **Supply**: Demand was assumed to be met by a mixture of groundwater pumping and surface water. Groundwater pumping is assumed to meet 2,407 AFY of demand during normal and wet years, and 3,007 AFY

of demand during dry years. Surface water is assumed to meet 9,623 AFY of demand during normal and wet years, and 9,395 AFY of demand during dry years.

5.2.3.2 South American Subbasin

This section briefly describes the demand and supply assumptions used in the PCBL for the purveyors located within the SASb. All new developments were assumed to be on supplies projected by the purveyors.

5.2.3.2.1 City of Sacramento

- **Demand**: As described above in Section 5.2.3.1.11, a city-wide 2040 demand projection of 161,029 AFY was assumed, based on the 2015 UWMP (Table 4-2) (City of Sacramento, 2016). Approximately 65% of the demand was assumed to be in the SASb portion of the model, based on urban area.
- **Supply**: As with the NASb, supply projections include groundwater pumping and surface water that vary by five water year types (as opposed to three water year types used for other purveyors) based on the City of Sacramento's 2017 GWMP (City of Sacramento, 2017). Groundwater pumping follows the Maximum Groundwater Use scenario specified in the 2017 GWMP. Based on the specific well pumping assumptions, groundwater pumping in the SASb varies from 12,749 AFY during wet years to 43,029 AFY during driest years. Remaining demand after groundwater pumping was assumed to be supplied by recycled water (1,000 AFY) and surface water. As described above in Section 5.2.3.1.11, the City of Sacramento also has specific wells that supply some parks and green areas within the city boundaries. These irrigation wells are simulated using six representative irrigation wells that pump 2,600 AFY. Based on the locations of the irrigated parks and green areas, approximately half of the irrigation pumping was estimated in the SASb.

5.2.3.2.2 California American Water Company (Suburban Rosemont, Security Park, and Parkway)

- **Demand**: As described above in Section 5.2.3.1.4 for Cal Am service areas within the NASb, demand projections reflect the 2035 conditions based on the 2015 UWMP (Tables 4-2) (Cal-Am, 2016). Demand remains the same in all water year types.
- **Supply:** Supply projections by service area were based on the 2015 UWMP as follows:
  - Security Park was assumed to be all on groundwater and served water from SCWA, similar to the CCBL conditions.
  - As described above in Section 5.2.3.1.4, surface water supply from the City of Sacramento was distributed between Arden (NASb), Parkway (SASb), and Suburban Rosemont (SASb), based on the 2015 UWMP (Table 5-9). Remaining demand is met by groundwater from Cal Am wells.

5.2.3.2.3 California American Water Company (former Fruitridge Vista Water Company)

- **Demand**: A 2035 demand projection of 4,957 AFY was assumed, based on the discussions with Cal-Am.
- **Supply**: Supply projections include local groundwater pumping and surface water wholesale supply from the City of Sacramento, with 50% of demand met by groundwater and the remaining 50% of demand met by surface water.

5.2.3.2.4 Golden State Water Company (Cordova)

- **Demand**: A 2040 demand projection of 19,572 AFY was assumed for the Cordova service area, based on the 2015 UWMP (Table 4-4) (GSWC, 2016).

- **Supply**: Cordova's supply projections include groundwater pumping of 9,752 AFY, 5,000 AFY of remediated water from the Aerojet Granted Water Supply, and 5,000 AFY of American River diversion from Folsom South Canal, as reported in the 2015 UWMP (Table 6-12).

5.2.3.2.5 City of Folsom

- **Demand**: A 2040 demand projection was assumed as 29,923 AFY for normal and wet years and 30,819 AFY for dry years, based on the 2015 UWMP (Table 4-2 and Table 7-2) (City of Folsom, 2016).

- **Supply**: City of Folsom supply was assumed all surface water, as with the CCBL conditions.

5.2.3.2.6 Florin County Water District

- **Demand**: Demand was estimated based on the average of 2017 and 2018 in the CCBL.

- **Supply**: Demand was assumed to be met by groundwater, consistent with CCBL conditions.

5.2.3.2.7 Sacramento County Water Agency (Hood, Laguna Vineyard, and Mather)

- **Demand**: The 2045 demand projection for Hood was based on the Draft 2020 UWMP (Table 4-10[e]), provided by SCWA and input from SCWA (M. Grinstead, personal communication, April 2021). Demand projections for Laguna Vineyard and Mather reflect 2052 conditions based on the 2021 Zone 40 Water Supply Master Plan Amendment (Tables B-6, B-7, and B-8) (SCWA, 2021), and discussions with SCWA (M. Grinstead, personal communication, April 2021). Laguna Vineyard in the PCBL represents the South Service Area and Central Service Area; and Mather represents the North Service Area.
- **Supply**: Hood was assumed to be on groundwater, consistent with the CCBL. Supply projections for Laguna Vineyard and Mather reflect 2052 conditions based on a mix of groundwater, surface water, recycled water, and remediated water, as reported in the 2021 Zone 40 Master Plan Amendment (Tables B-6, B-7, and B-8). Recycled water of 1,700 AFY would be available in the Laguna Vineyard demand area (South Service Area) and remediated water of 8,900 AFY would be available every year.

5.2.3.2.8 Elk Grove Water District

- **Demand**: A 2045 demand projection was assumed be 8,080 AFY for normal and wet years and includes demand both for Service Area 1 and Service Area 2 based on the 2015 UWMP (Table 4-6; EGWD, 2016). Dry year demand projection was assumed to 8,323 AFY based on the 2015 UWMP (Table 7-2) and was assumed to be distributed to Service Area 1 and Service Area 2 proportional to demand in normal and wet years in the two service areas.
- **Supply**: The 2015 UWMP does not break future supply projections into groundwater and surface water supplies by service areas. It was assumed Service Area 1 was served with groundwater and Service Area 2 served with a mix of groundwater and surface water by SCWA.

5.2.3.2.9 Rancho Murieta Community Service District

- **Demand**: Demand for the entire service area was assumed to be 3,477 AFY based on a medium growth projection of 3,659 AFY at buildout with 20% reduction (or 2,927 AFY potable demand) and additional recycled water demand of approximately 550 AFY, based on the information available from the Rancho Murieta Community Services District's (CSD) 2010 Integrated Water Master Plan Update (Figure ES-1, Table 2-3, and Table 3-2; Rancho Murieta CSD, 2010). Approximately 32% of demand falls within the SASb based on urban area.
- **Supply**: Demand was assumed to be met by surface water for potable demand and recycled water of 550 AFY for golf course irrigation.

5.2.3.3 Cosumnes Subbasin

This section briefly describes the demand and supply assumptions used in the PCBL for the purveyors located within the CoSb.

5.2.3.3.1 Rancho Murieta Community Service District

Several proposed developments were identified within the Rancho Murieta CSD and incorporated into the PCBL. Note that the majority of the developments would occur outside of the three subbasins but within the model boundary.

- **Demand**: As described above in Section 5.2.3.2.9, total demand was assumed to be 3,477 AFY. Approximately 22% of the demand falls within the CoSb based on urban area, compared to 32% within the NASb. The remaining demand of 46% falls outside of the NASb, SASb and CoSb, but within the model boundary.
- **Supply**: As described above in Section 5.2.3.2.9, demand was assumed to be met by surface water for potable demand and recycled water.

5.2.3.3.2 City of Galt

- **Demand**: A 2040 groundwater demand projection of 7,663 AFY was assumed based on the 2015 UWMP (Table 4-3; City of Galt, 2016).
- **Supply**: Demand was assumed to be met by groundwater with pumping distributed between six active CCBL wells proportional to their historical maximum annual yield. Dry year supply projections were assumed to be the same as normal year supplies.

5.2.3.3.3 Amador County Water Agency

- **Demand**: 2040 demand projections were updated based on supply assumptions, as discussed below, and distributed to the expanded urban land use areas.
- **Supply**: Supply projections include surface water and recycled water for the City of Ione and groundwater, surface water, and recycled water for Camanche Village. CCBL City of Ione surface water supply was doubled based on the projected demand increases from the Amador Water Agency 2015 UWMP; there was no change to the recycled water use relative to the CCBL. CCBL groundwater pumping for Camanche Village from the four active wells was doubled based on expansion and development of currently vacant parcels (Dunn Environmental, 2012). CCBL groundwater pumping for Camanche North Shore from the two active wells was increased by a total of 11 AFY based on a projected maximum daily treated water demand increase from the *Camanche Area Regional Water Supply Plan Feasibility Study and Conceptual Design* (RMC Water and Environment, 2012). Specified groundwater pumping to three wells operated by the Buena Vista Rancheria are based on reported May 2019-April 2020 pumping, in which the seasonal average pumping rates were distributed to associated months.

5.2.3.3.4 Sacramento Municipal Utility District

No change in demand or supply relative to the CCBL.

5.2.3.4 Fish Farms

No change in demand or supply relative to the CCBL.

5.2.4 Agricultural Demand and Supply

Agricultural demand and supply in the PCBL is similar to the discussion in the CCBL (Section 5.1.6), with demand being driven by the land use changes in the PCBL discussed in Section 5.2.2 and much of the supply being internally calculated within the model or based on the last 10 years of the historical simulation.

5.2.4.1 Galt Wastewater Treatment Plant Effluent

No change in treatment plant effluent use relative to the CCBL.

5.2.4.2 Rural Residential

Refer to section 3.3.1 in the historical model report for a description of the methodology used to estimates rural residential pumping.

Rural residential demand in the PCBL version of CoSANA accounts for the urbanization of areas that would lead to a decrease in the rural residential population. It is assumed that the projected urbanization of areas previously used for agricultural purposes would result in a decline in rural residential population, and therefore demand. These areas are subsequently served by an urban water purveyor.

In the CoSb, rural residential demand was assumed to increase as a result of projected population increases. Assuming a rural residential population, and associated demand increase of 1% per year, total projected annual groundwater consumption was estimated to be 9,448 AFY and was proportionally distributed monthly as specified in the CCBL.

5.2.4.3 Agricultural Groundwater Substitution Transfers

As discussed for the CCBL, two purveyors engage in agricultural groundwater substitution transfer pumping in the NASb: NMWC and PGVMWC, Additionally, South Sutter Water District operates a transfer program that behaves very similarly to a groundwater substitution transfer. South Sutter Water District uses a hybrid approach to groundwater substitution transfer pumping similar to the CCBL model. Dry year decreases of surface water deliveries from Camp Far West Reservoir are offset by an increase in groundwater pumping.

For NMWC and PGVMWC, agricultural transfer pumping was assumed to occur in 16 years of the baseline (15 of the 19 dry years and one normal year), with timing and pumping volumes based on information included in the Long-Term Water Transfer (LTWT) EIS/R (Reclamation, 2019). The estimated transfer pumping for NMWC and PGVMWC was distributed among all transfer wells in the same proportion as in the historical data. NMWC surface water deliveries are automatically adjusted to meet total agricultural demand, and PGVMWC surface water deliveries are estimated using the last 10 years of historical simulation data, reduced by the amount of agricultural transfer pumping estimated to occur in the PCBL.

5.2.5 Remediation Operations

Information about future remediation operations is not available, so remediation operations in the PCBL are the same as in the CCBL, discussed in Section 5.1.7.

5.2.6 Results

This section provides a summary of the CoSANA PCBL results.

5.2.6.1 Land and Water Use Budget

The land and water use budget provides details on the urban and agricultural demand and the water supply meeting the demand (groundwater pumping, surface water deliveries, recycled water, and remediation pumping). Average annual PCBL model results by groundwater subbasin are shown in Table 5-5. Annual agricultural water demand and supply by subbasin are shown in Figure 5-22 through Figure 5-24. Annual urban demand and supply by subbasin are shown in Figure 5-25 through Figure 5-27. Appendix H includes model subregion land and water use budgets.

Table 5-5: PCBL Average Annual Land and Water Use Budget

Subbasin	Ag. Demand (AFY)	Ag. Ground-Water Use* (AFY)	Ag Surface Water Deliveries (AFY)	Urban Demand (AFY)	Urban Ground-Water Use** (AFY)	Urban Surface Water Deliveries (AFY)	Urban Recycled Water (AFY)	Remediation Pumping (AFY)
NASb	349,317	202,228	149,868	328,654	108,492	220,161	-	5,515
SASb	135,956	91,599	44,369	301,060	116,385	167,661	17,200	29,765
CoSb	121,676	99,886	21,460	30,168	28,445	3,943	-	-
Total	**606,949**	**393,713**	**215,697**	**659,882**	**253,322**	**391,765**	**17,200**	**35,280**

Note:
* Agricultural groundwater use presented in the above table may differ slightly from the values shown in the respective GSP due to minor difference in the methodology on calculation of rural residential water use.
** Urban groundwater use in the above table represents water used that originated from groundwater production but can include water that was pumped in areas outside of the respective subbasin.

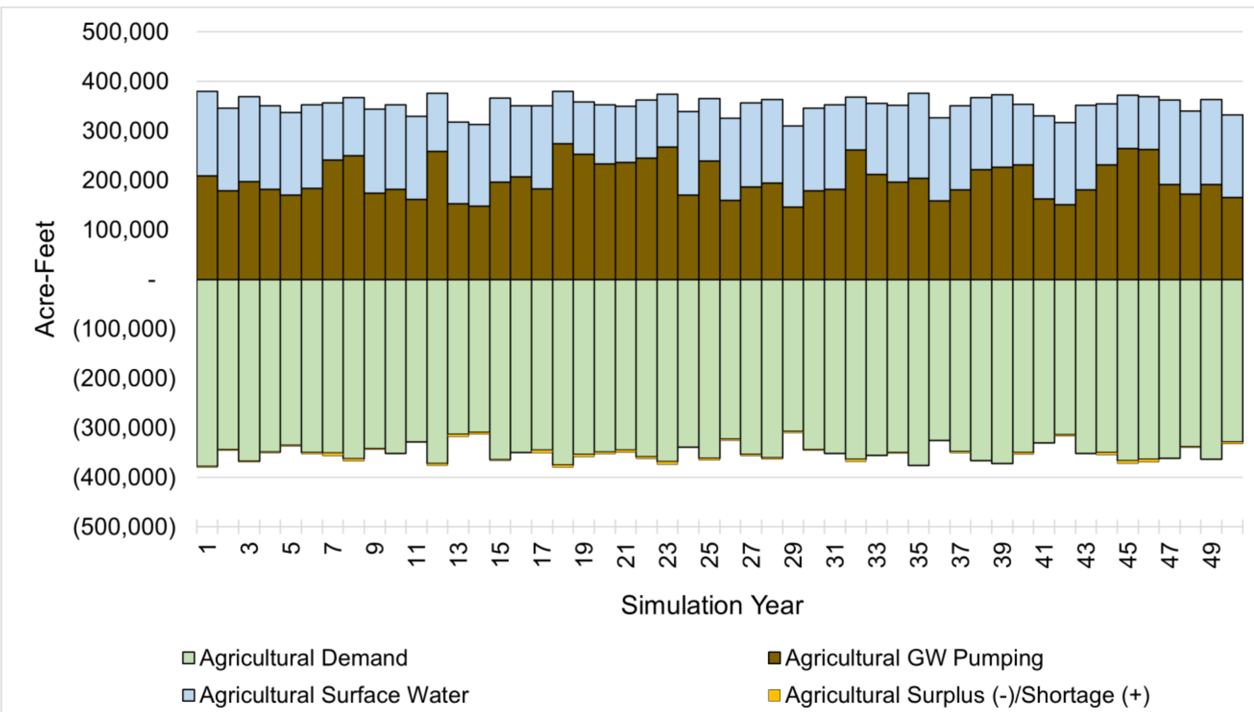


Figure 5-22: Annual Agricultural Water Demand and Supply – North American Subbasin, Projected Conditions Baseline

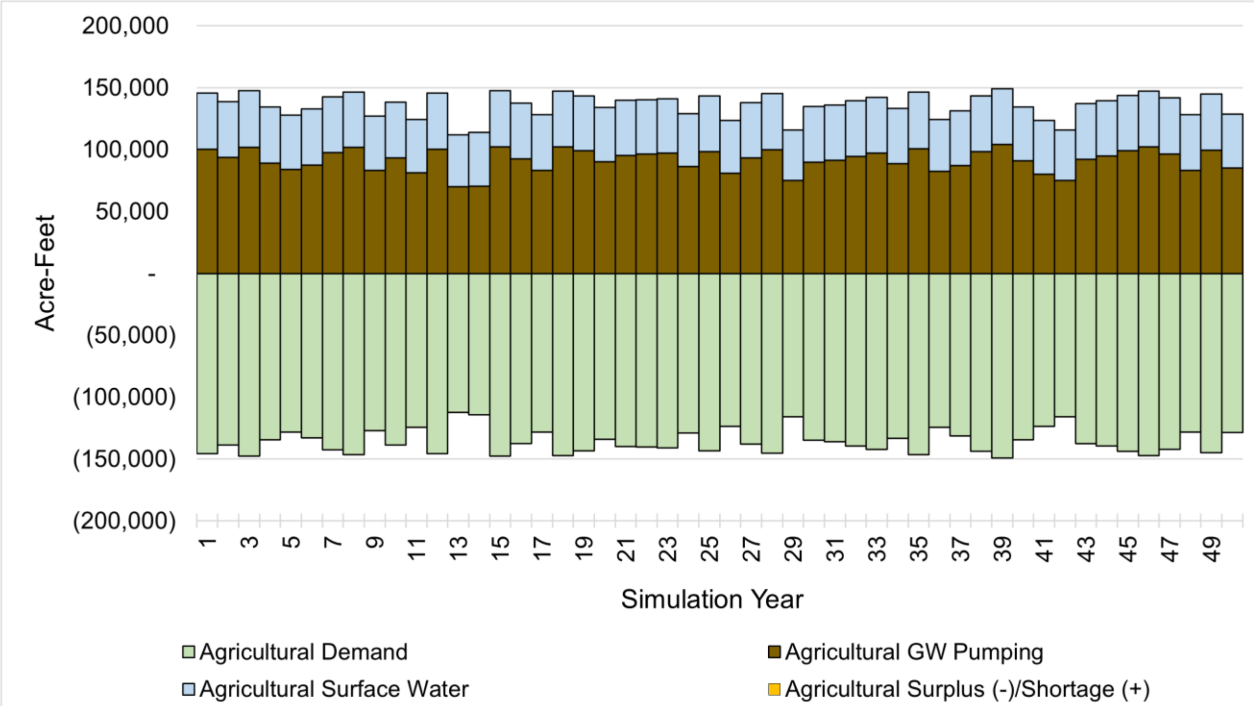


Figure 5-23: Annual Agricultural Water Demand and Supply – South American Subbasin, Projected Conditions Baseline

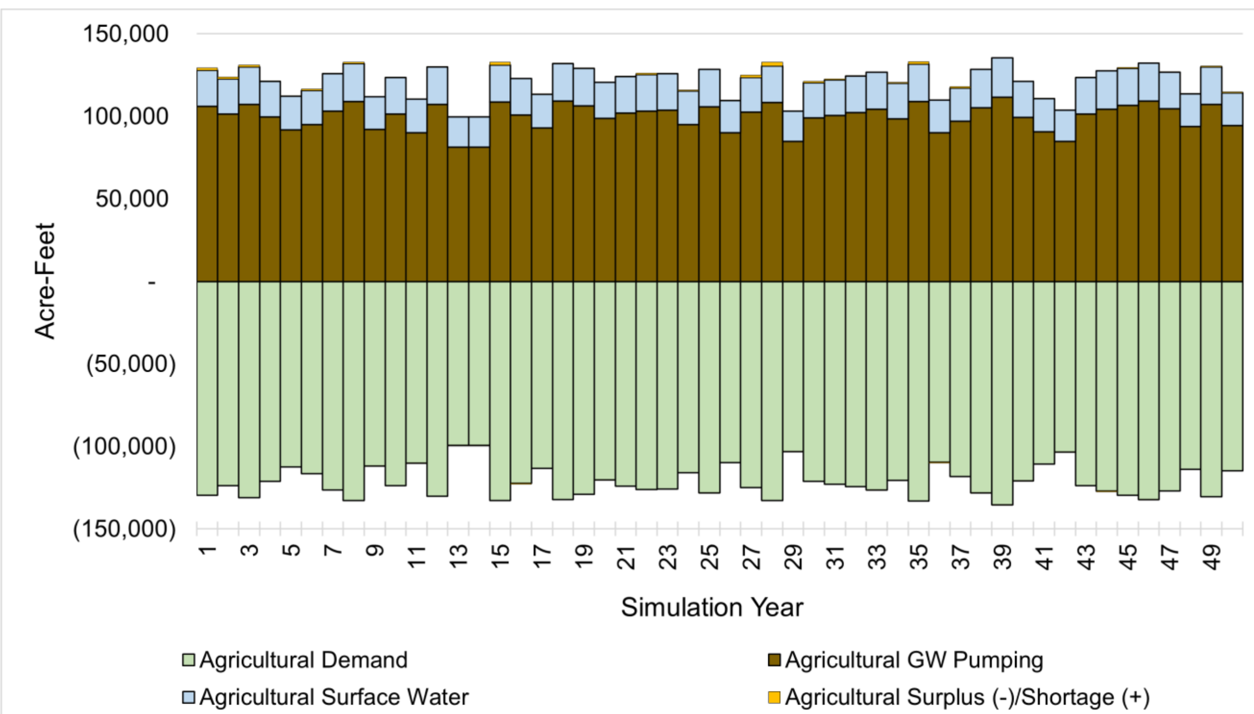


Figure 5-24: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline

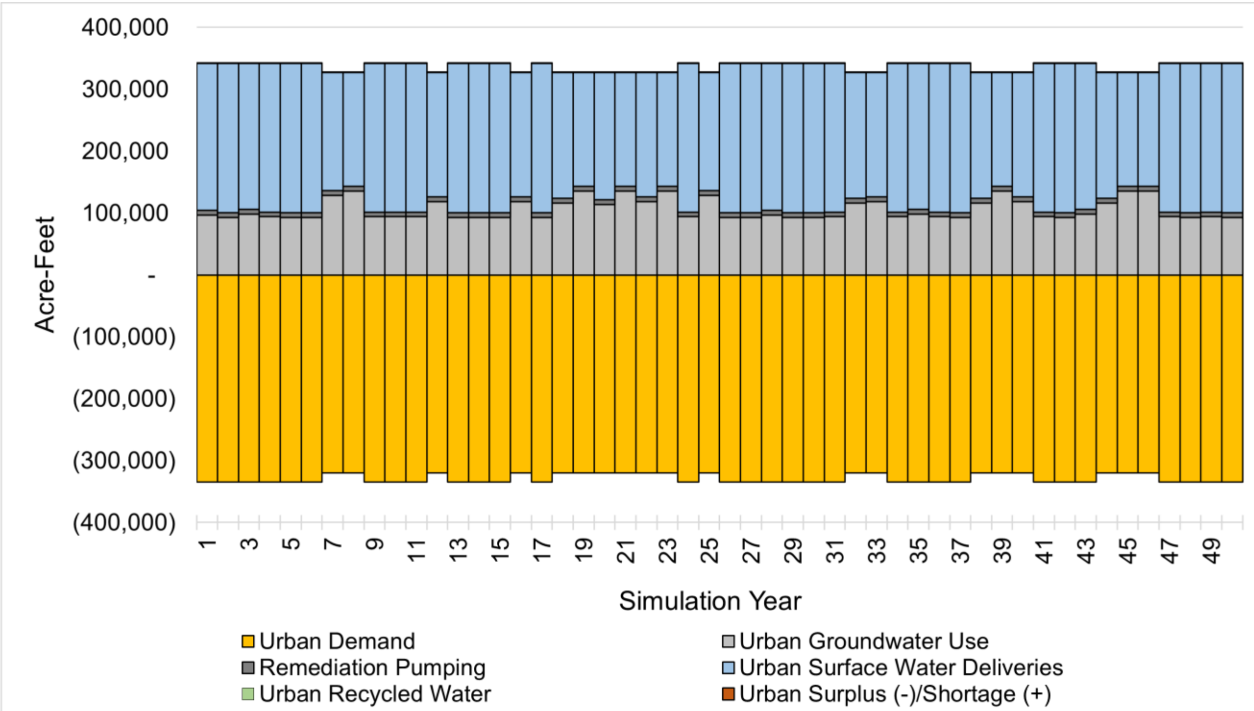


Figure 5-25: Annual Urban Water Demand and Supply – North American Subbasin, Projected Conditions Baseline

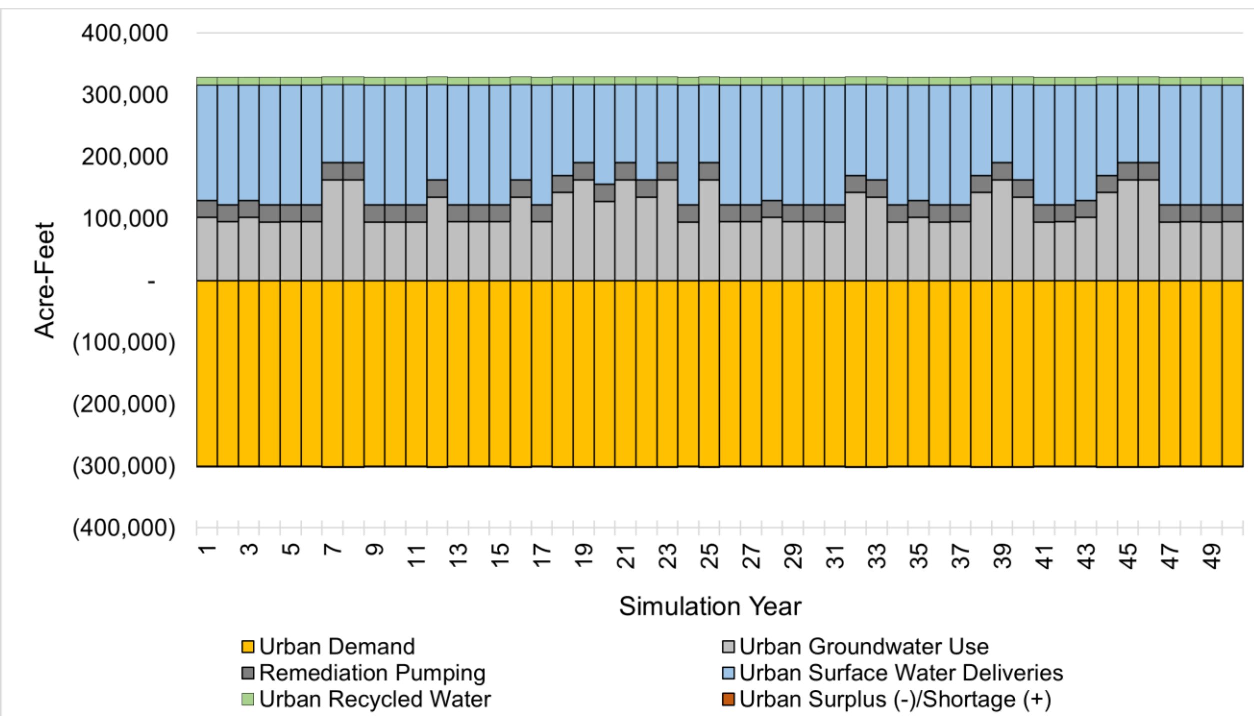
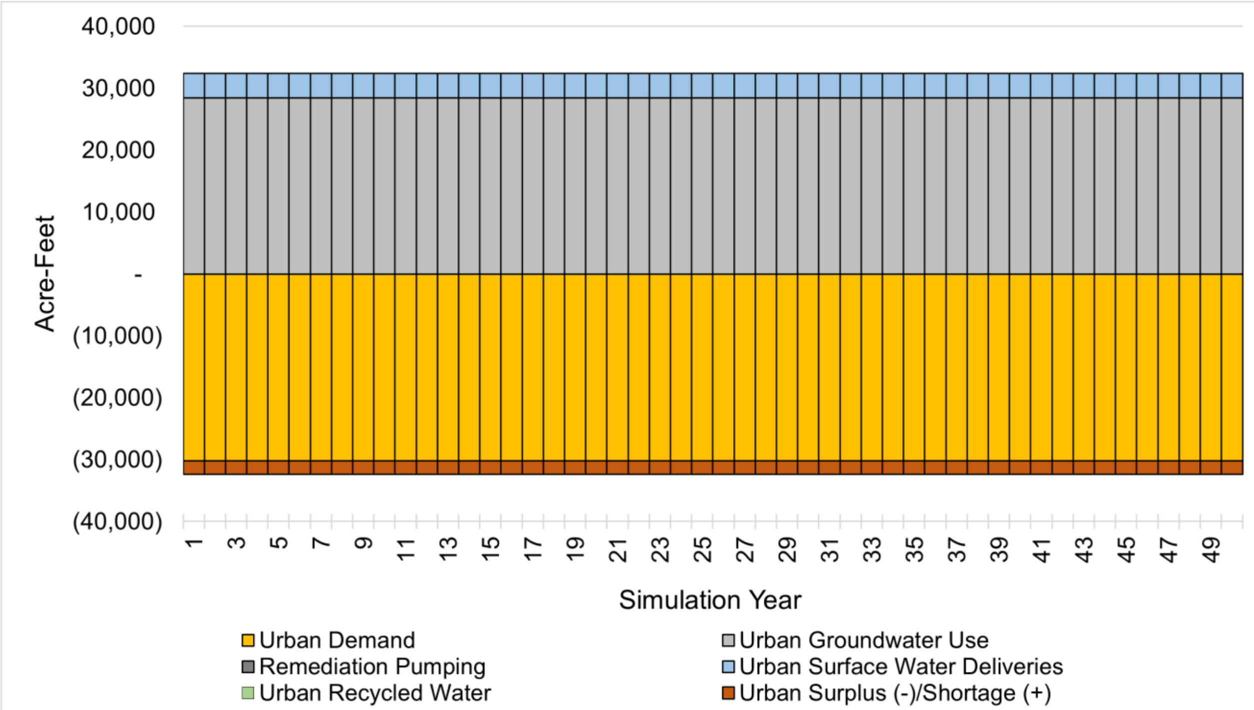


Figure 5-26: Annual Urban Water Demand and Supply – South American Subbasin, Projected Conditions Baseline



Note: Urban groundwater use is specified in the CoSb model input data set. The model-calculated surplus/shortage in urban demand is therefore not utilized to calculate the CoSb groundwater budget.

Figure 5-27: Annual Urban Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline

5.2.6.2 Groundwater Budget

The groundwater budget summarizes all inflows and outflows to the groundwater aquifer system. Average annual PCBL model results by groundwater subbasin are shown in Table 5-6. Annual groundwater budgets with cumulative change in storage by subbasin are shown in Figure 5-28 through Figure 5-30. Appendix I includes model subregion groundwater budgets. Appendix J includes a set of sample hydrographs for the baseline models.

Table 5-6: PCBL Average Annual Groundwater Budget

Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
NASb	323,167	167,424	107,950	16,376	30,140	6,710	5,390
SASb	234,003	121,313	105,665	26	4,886	986	-1,128
CoSb	128,332	107,977	16,494	0	1,536	1,030	-1,293
Total	**685,501**	**396,714**	**230,109**	**16,402**	**36,561**	**8,726**	**2,969**

Note: Boundary Flows term includes flow between areas outside of the CoSANA model domain and baseflow from small watersheds. Subsurface Inflows includes flow between the simulated subbasins in CoSANA and areas outside of Bulletin 118 subbasins.

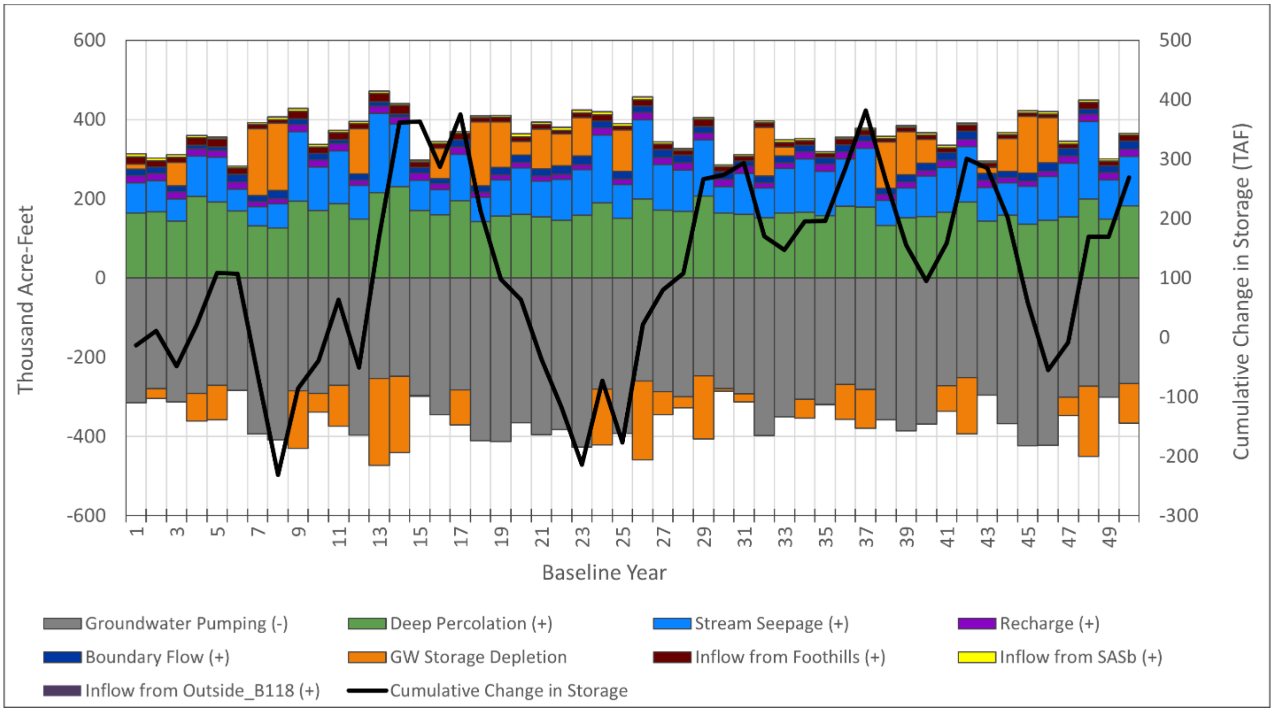


Figure 5-28: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Projected Conditions Baseline

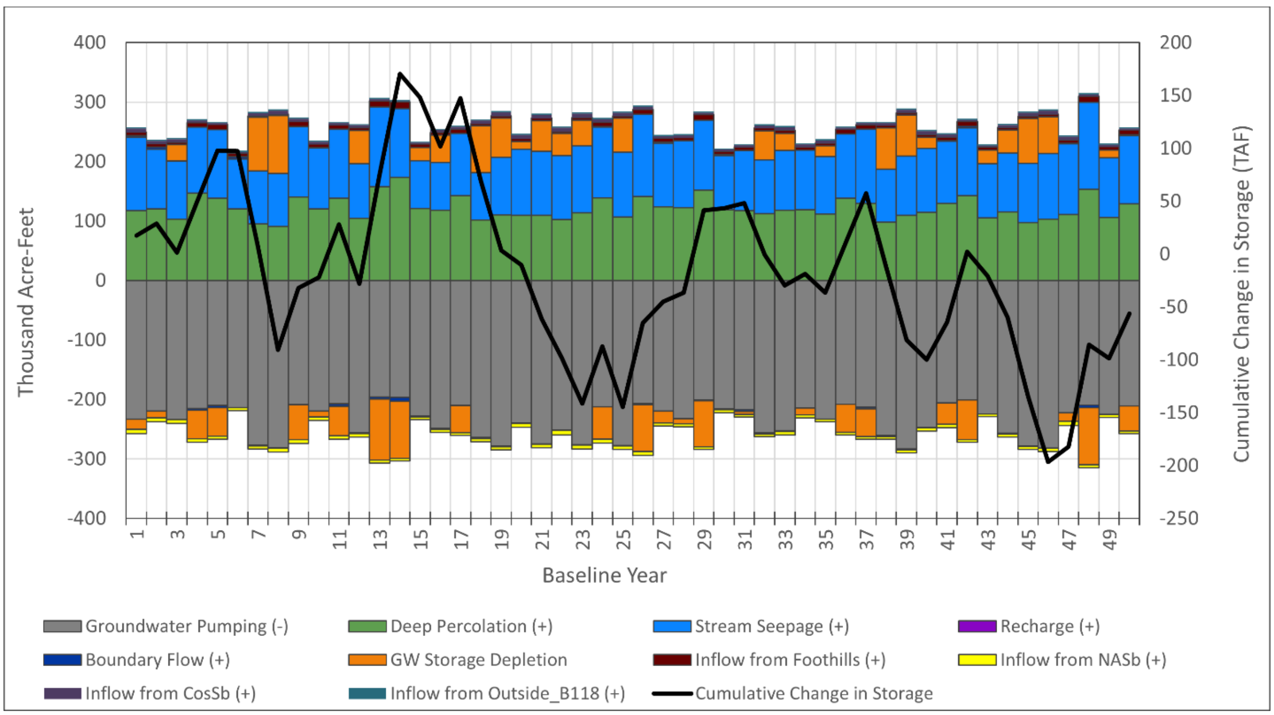


Figure 5-29: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Projected Conditions Baseline

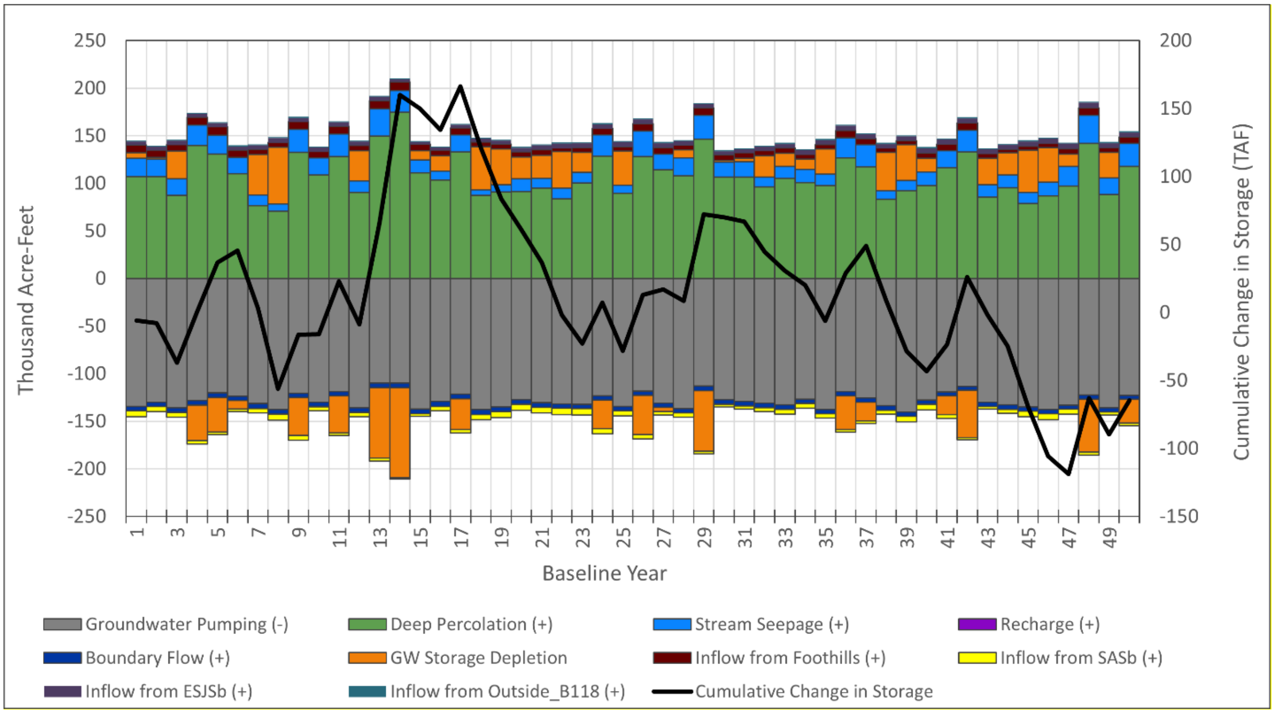


Figure 5-30: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Projected Conditions Baseline

5.3 Projected Conditions Baseline with Climate Change

The CoSANA Projected Conditions Baseline with Climate Change (PCBL with Climate Change) shares many of the same inputs as the PCBL, but with additional factors to incorporate potential climate change conditions. These conditions affect the hydrologic cycle as changes in precipitation and temperature. In the CoSANA model files, the change in precipitation is incorporated by the precipitation rate and stream inflow inputs while the change in temperature is reflected by the change in evapotranspiration rate and stream inflow inputs. Changes in water use are incorporated by estimation of agricultural water demands within CoSANA based on changes in precipitation and evapotranspiration. Urban water use is assumed to remain unchanged, based on assumed changes in conservation and landscape choices.

5.3.1 Hydrologic Period

The hydrologic period used for the projected conditions baseline with climate change is the same as the projected conditions baseline (WY 1970 to 2019), modified according to the methodology explained below to incorporate climate change conditions.

5.3.1.1 Methodology

In order to incorporate climate change conditions, precipitation, stream inflow, and evapotranspiration time series data from the projected conditions baseline are modified using the findings from the American River Basin Study (ARBS; Reclamation, in press). ARBS aims to examine the water management challenges around the American River Basin under recent changes in conditions, regulatory requirements, and the science of climate change. Towards this goal, ARBS provides regional climate change data with improved resolution that can be used with other modeling and planning studies.

ARBS used 64 downscaled climate projections with 1/16-degree grid resolution from 32 global climate models under RCP4.5 and RCP8.5 emissions scenarios. These 64 scenarios are then evaluated for three future periods (2040-2069, 2055-2084, and 2070-2099) and grouped into five climate scenarios based on percentiles of projected changes to simulate possible temperature and precipitation effects: Warm-Wet, Warm-Dry, Hot-Wet, Hot-Dry, and Central-Tendency.

The ensemble of climate models used in the study found clear trends with projected temperature changes. Precipitation trends were not found to be as consistent with around half of the projections indicating an increase in precipitation, and the other half indicating a decrease in precipitation.

Upon evaluation of these climate scenarios, the Central Tendency scenario for the 2055-2084 period, also commonly called as 2070CT conditions, was selected for groundwater sustainability planning because it was determined that it has the highest probability and likelihood to be experienced. Other climate scenarios are subject to significantly more uncertainty and less likely to occur. Additionally, to assess uncertainty and the effects of a possible extreme condition, the 2055-2084 Hot-Dry (2070HD) scenario was also simulated, with results presented in Section 5.3.7.

In ARBS, the downscaled climate variables of the scenarios were then used with the Variable Infiltration Capacity (VIC) hydrology model to simulate hydrologic conditions at the land surface. VIC uses a spatial grid that covers the entire CoSANA model domain. This grid was used to resample the precipitation time series from 2070CT and 2070HD conditions to the CoSANA model grid and for the small watersheds using area weighted averaging.

ARBS uses the outputs from the VIC model to develop corresponding inputs to the operations model CalSim 3.0 that covers the entire Sacramento and San Joaquin River Basins. One of those inputs is the evapotranspiration rates for each crop type. For the PCBL with Climate Change scenarios in CoSANA, evapotranspiration time series input from the PCBL were perturbed with the perturbation factors calculated between the 2070CT and 2070HD climate change scenarios and the 2015 baseline scenario for each crop type averaged across the CoSANA domain. Additionally, stream inflow time series input at six locations (Sacramento River at Verona, Folsom Reservoir releases, Cosumnes River, Camanche Reservoir release, Bear River, and Feather River) were replaced with the simulated flows by CalSim 3.0 in ARBS.

A summary comparison table of the ARBS historical baseline hydrology and percent changes to different system components in the 2070CT and 2070HD is shown in Table 5-7.

Table 5-7: Percent Change in Annual Climatic and Hydrologic Indicators in the American River Basin Study*

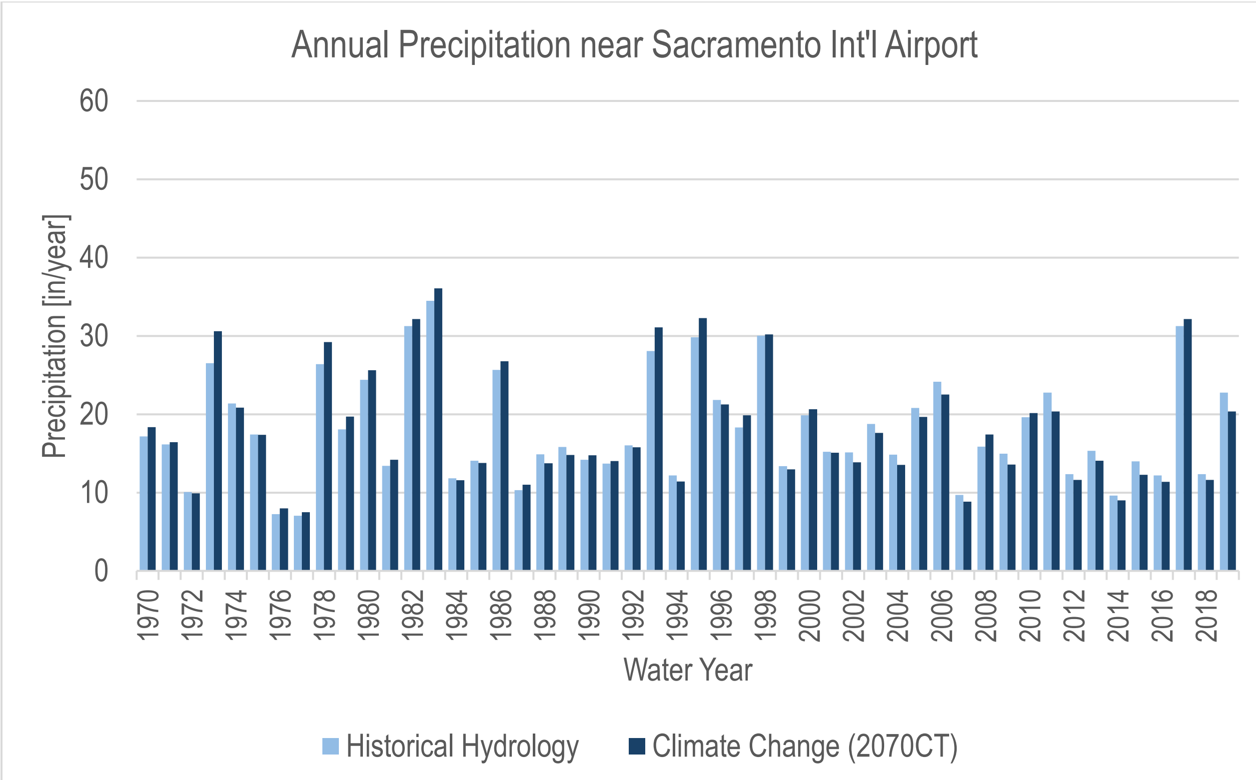
Climate Scenario	Precipitation	Temperature (average)	Potential Evapotranspiration	Runoff
Historical Observations (1915-2015 average)	38.2 inches	54.8^{0}F	42.8 inches	1,458,000 AFY
2070 Central-Tendency	-3%	+11%	+10%	-6%
2070 Hot and Dry	-9%	+14%	+12%	-13%

* The values are for the entire American River Basin Study area and are based on Table 2-4 in the study report.

5.3.1.2 Precipitation

Annual precipitation near Sacramento International Airport and on the small watershed areas are shown in Figure 5-31 for with- and without-climate change conditions for comparison purposes. As a result of the 2070CT climate change conditions, average annual precipitation increased from 17.5 inches to 17.8 inches on the valley floor and increased from 30.6 inches to 30.9 inches on the small watersheds.

Figure 5-32 illustrates the changes in average monthly precipitation before and after climate change conditions are applied. For both the valley floor and the small watersheds, a slight shift in the distribution of precipitation can be observed.



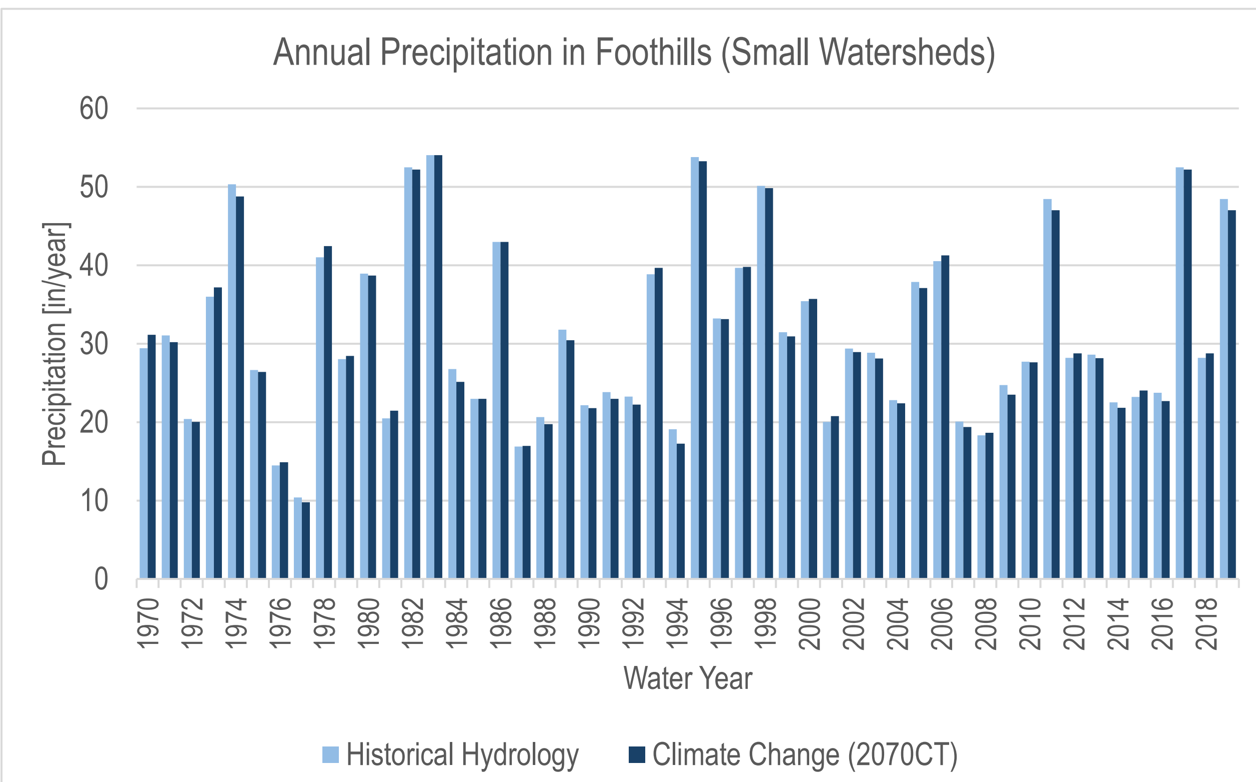
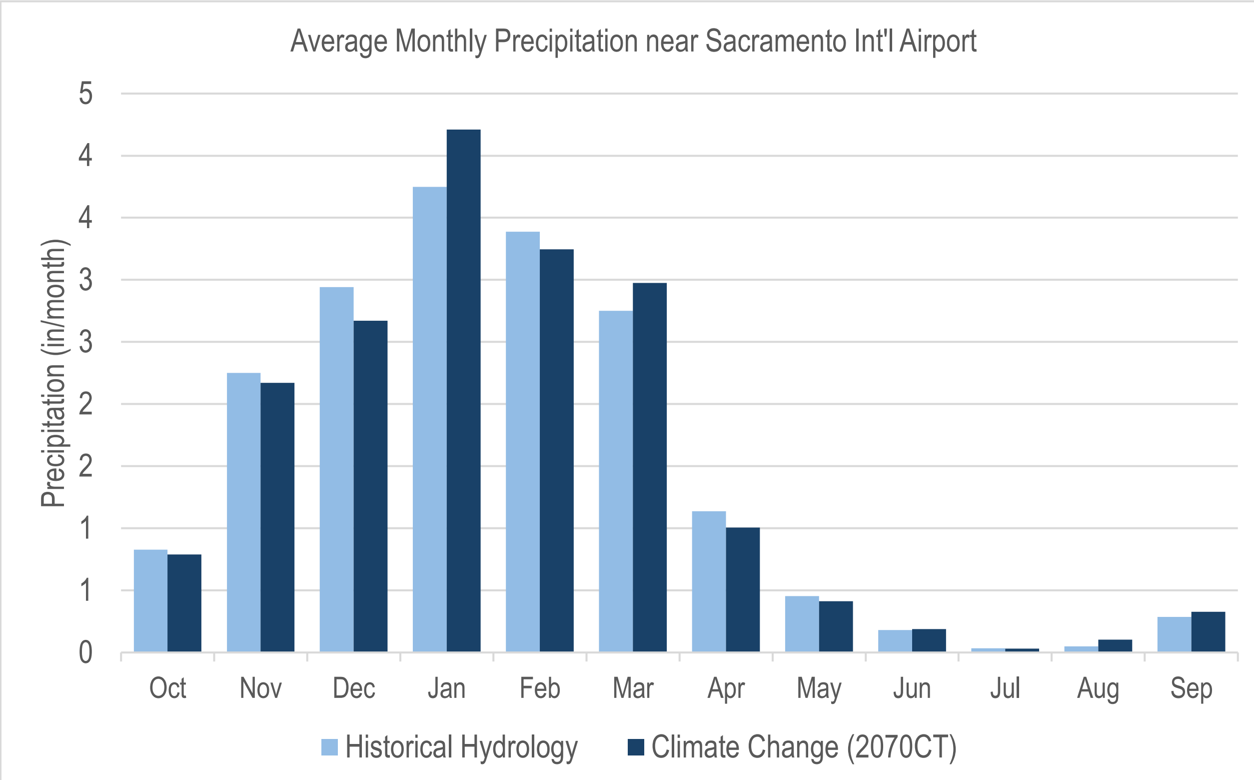


Figure 5-31: Annual Precipitation with and without Climate Change



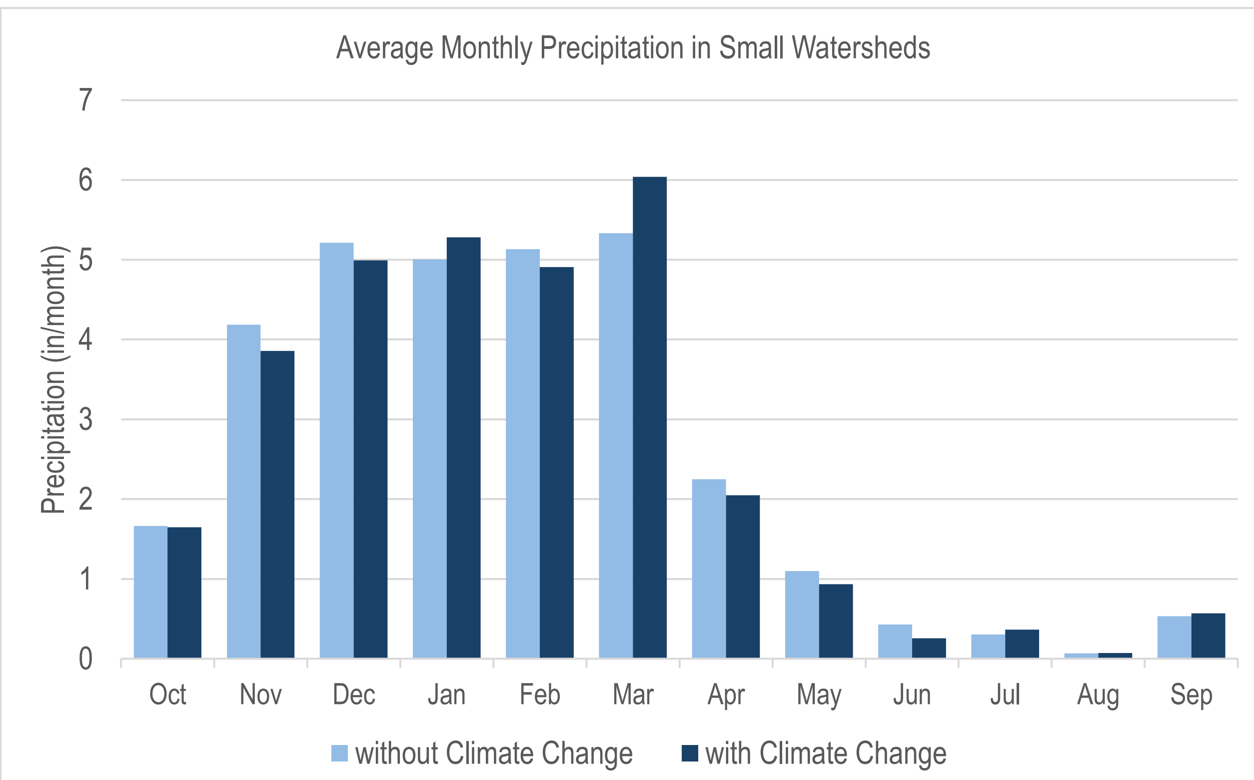


Figure 5-32: Average Monthly Precipitation with and without Climate Change

5.3.1.3 Stream Inflow

Major stream flows entering to the CoSANA domain were modified to accommodate the climate change according to 2070CT conditions. In Figure 5-33, American River releases from the Folsom Reservoir are shown with and without climate change for comparison purposes. As a result of the 2070CT climate change conditions, average annual stream flow on the American River below Folsom Reservoir is decreased from around 3,500 cubic feet per second (cfs) to around 3,000 cfs.

Figure 5-34 illustrates the changes in average monthly stream inflow before and after climate change conditions are applied. According to this chart average flows in early winter and late spring decrease, while March flows increase.

An exceedance chart comparing the monthly Folsom Reservoir Release to American River is given in Figure 5-35 According to this chart, peak monthly flows show an increase in probability, while the probability of lower flows show a slight decrease.

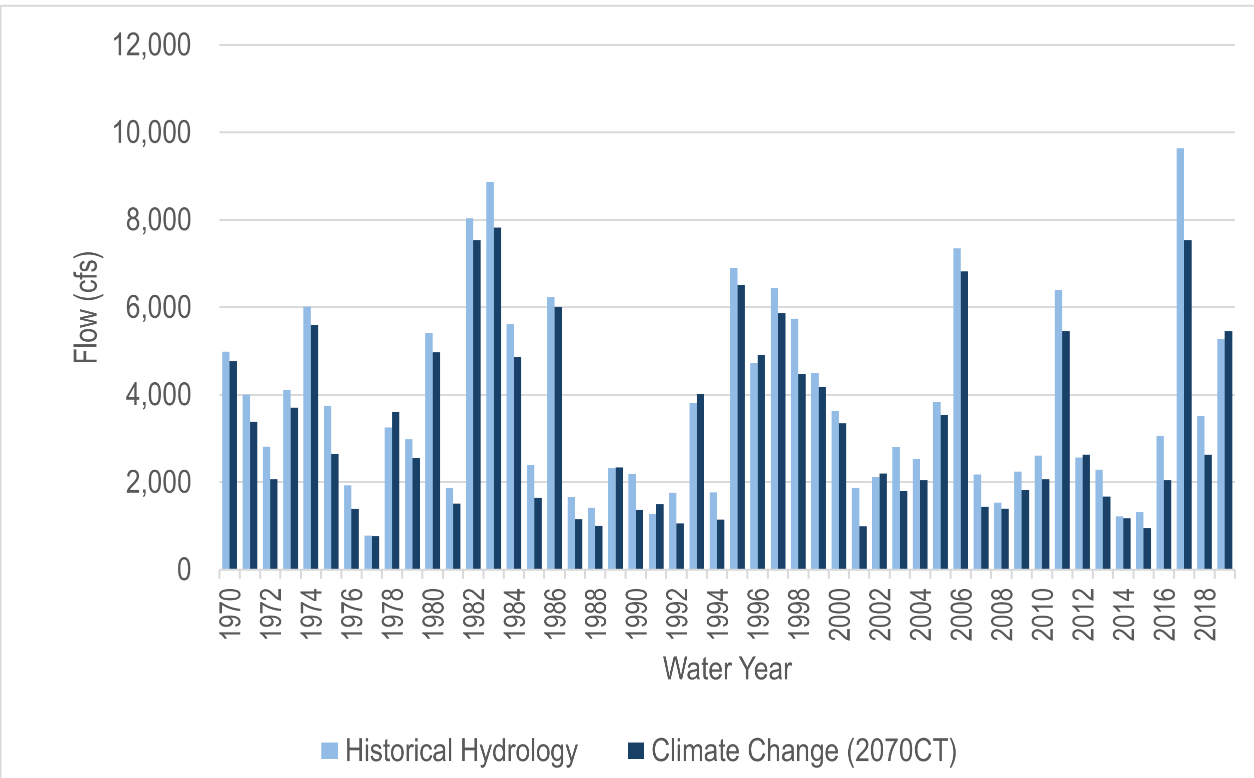


Figure 5-33: Annual Folsom Reservoir Releases to American River with and without Climate Change

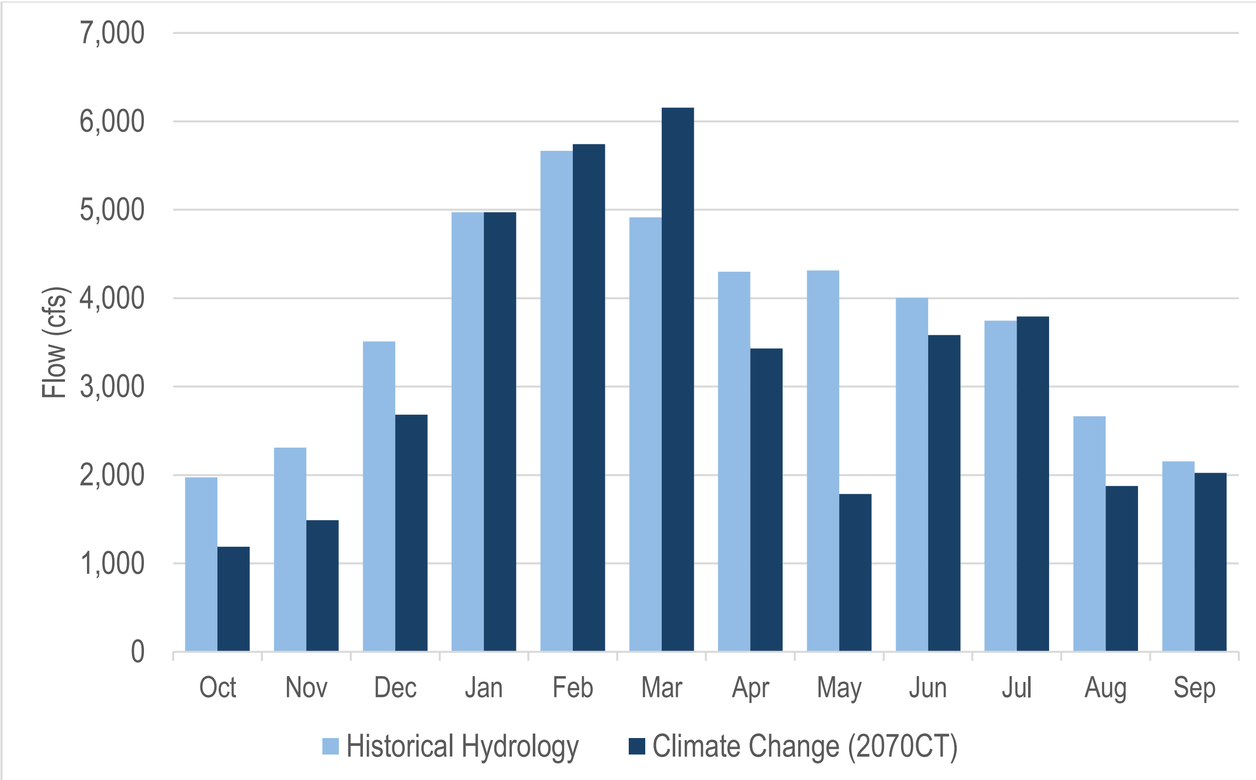


Figure 5-34: Monthly Average Folsom Reservoir Releases to American River

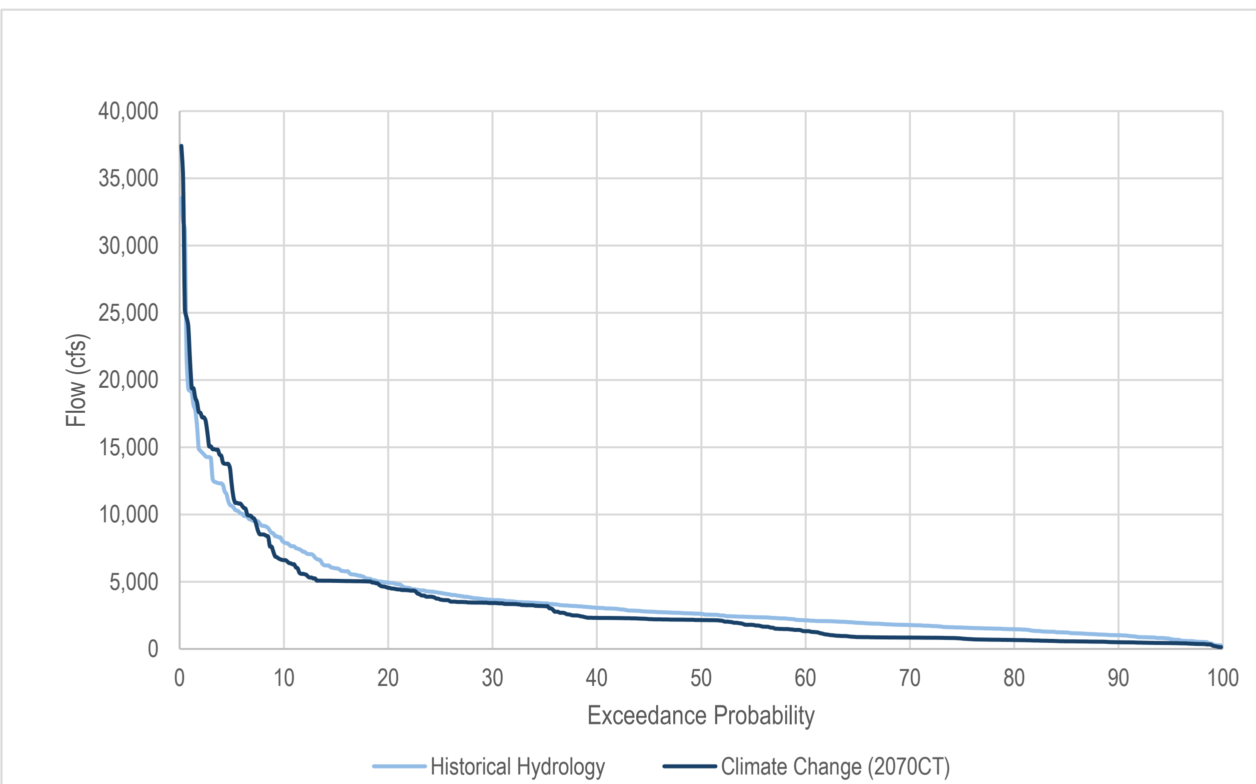


Figure 5-35: Exceedance Chart for the Monthly Folsom Reservoir Releases to American River

5.3.1.4 Evapotranspiration

Potential evapotranspiration time series data for each land cover type in CoSANA were modified to accommodate climate change according to 2070CT conditions. 2070CT conditions predict higher temperature than historical conditions which will result in higher potential evapotranspiration rates. Annual potential evapotranspiration for pasture over the valley floor is shown in Figure 5-36 for with- and without-climate change conditions for comparison purposes. Among all the land cover types defined in CoSANA, pasture was chosen here for its similarity to the reference evapotranspiration. As a result of the 2070CT climate change conditions, average annual potential evapotranspiration for pasture is expected to increase from 49.9 inches to 54.6 inches. Figure 5-37 illustrates the changes in average monthly potential evapotranspiration for pasture before and after climate change conditions are applied.

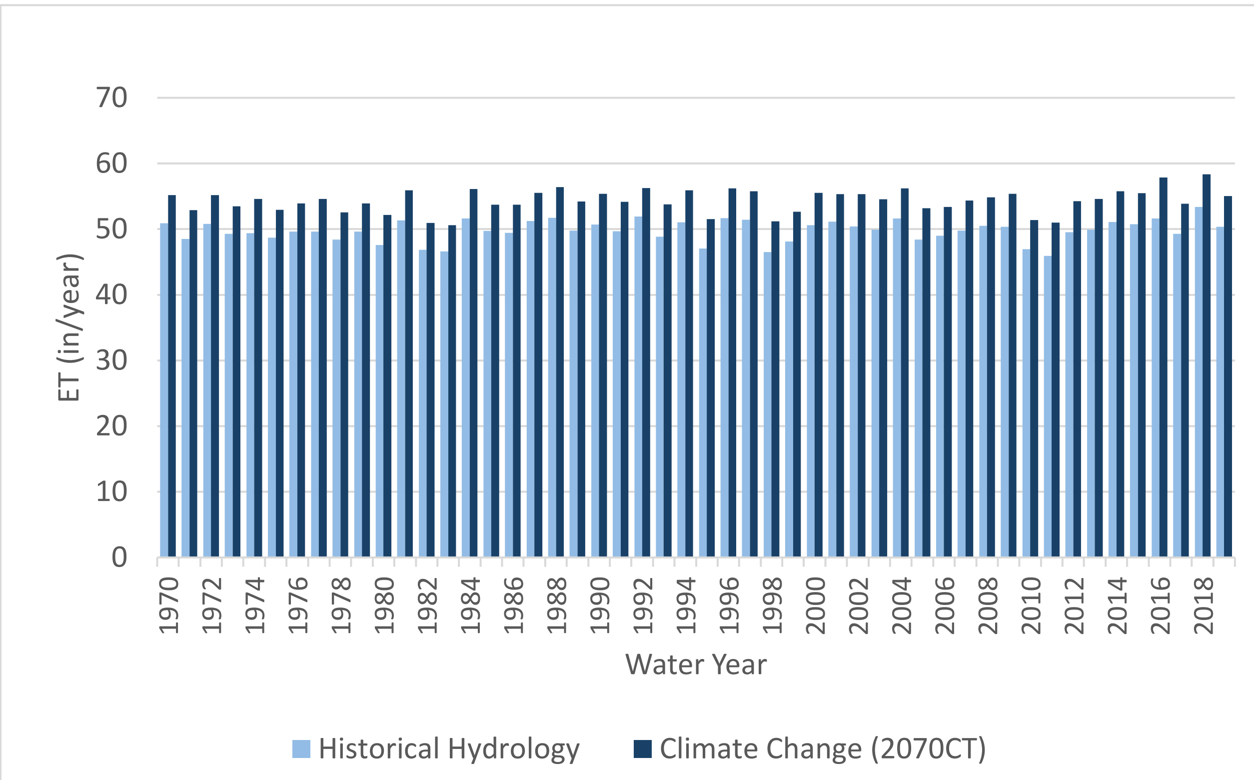


Figure 5-36: Annual Potential Evapotranspiration for Pasture

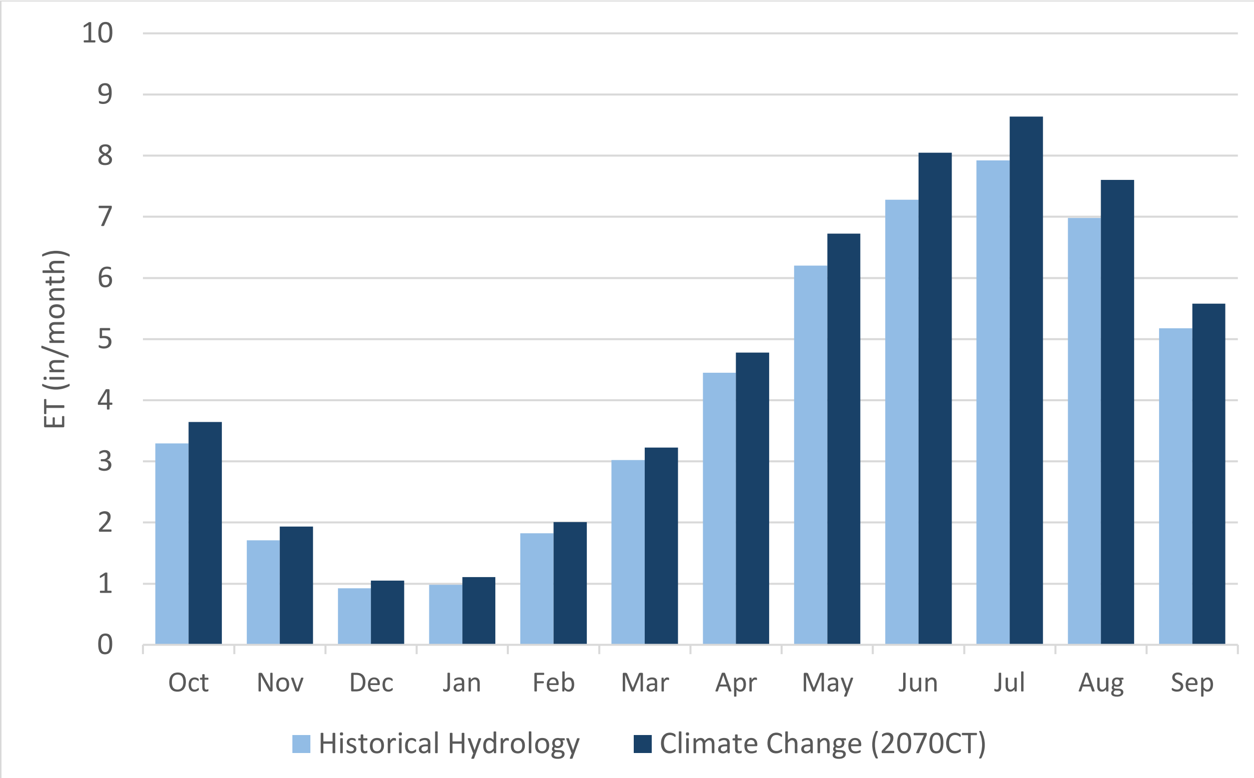


Figure 5-37: Monthly Average Potential Evapotranspiration for Pasture.

5.3.2 Land Use

The PCBL with Climate Change land use is the same as the PCBL, described in Section 5.2.2.

5.3.3 Urban Demand and Supply

The PCBL with Climate Change urban demand and supply is the same as the PCBL, described in Section 5.2.3. It is noted that water demands for urban landscape will increase with increasing ET under climate change, however demand and supply remain unchanged in the baseline due to likely changes in ordinances and likely changes in landscaping practices.

5.3.4 Agricultural Demand and Supply

The PCBL with Climate Change agricultural demand and supply is based on the PCBL, described in Section 5.2.4. The agricultural demand under the climate change conditions is impacted by the effect of climate change on the hydrology, notably evapotranspiration, which increases demands. The increased supply needed to meet this demand is typically met by additional groundwater pumping.

5.3.5 Remediation Operations

Information about future remediation operations is not available, so remediation operations in the PCBL with Climate Change are the same as in the CCBL, discussed in Section 5.1.7.

5.3.6 Results

This section provides a summary of the CoSANA PCBL with Climate Change results.

5.3.6.1 Land and Water Use Budget

The land and water use budget provides details on urban and agricultural demand and the water supply meeting the demand (groundwater pumping, surface water deliveries, recycled water, and remediation pumping). Average annual PCBL with Climate Change model results by groundwater subbasin are shown in Table 5-8. Annual agricultural water demand and supply by subbasin are shown in Figure 5-38 through Figure 5-40. As discussed in Section 5.3.3, urban demand and supply for the PCBL with Climate Change are the same as the PCBL; refer to Figure 5-25 through Figure 5-27 for urban land and water use budgets. Appendix H includes model subregion land and water use budgets.

Table 5-8: PCBL with Climate Change Average Annual Land and Water Use Budget

Subbasin	Ag. Demand (AFY)	Ag. Ground-Water Use* (AFY)	Ag Surface Water Deliveries (AFY)	Urban Demand (AFY)	Urban Ground-Water Use** (AFY)	Urban Surface Water Deliveries (AFY)	Urban Recycled Water (AFY)	Remediation Pumping (AFY)
NASb	372,286	222,061	152,544	328,654	108,492	220,161	-	5,515
SASb	148,520	103,348	45,178	301,060	116,385	167,661	17,200	29,765
CoSb	132,348	108,831	22,744	30,168	28,445	3,943	-	-
Total	**653,154**	**434,240**	**220,466**	**659,882**	**253,322**	**391,765**	**17,200**	**35,280**

Notes:
* Agricultural groundwater use presented in the above table may differ slightly from the values shown in the respective GSP due to minor difference in the methodology on calculation of rural residential water use.
** Urban groundwater use in the above table represents water used that originated from groundwater production but can include water that was pumped in areas outside of the respective subbasin.

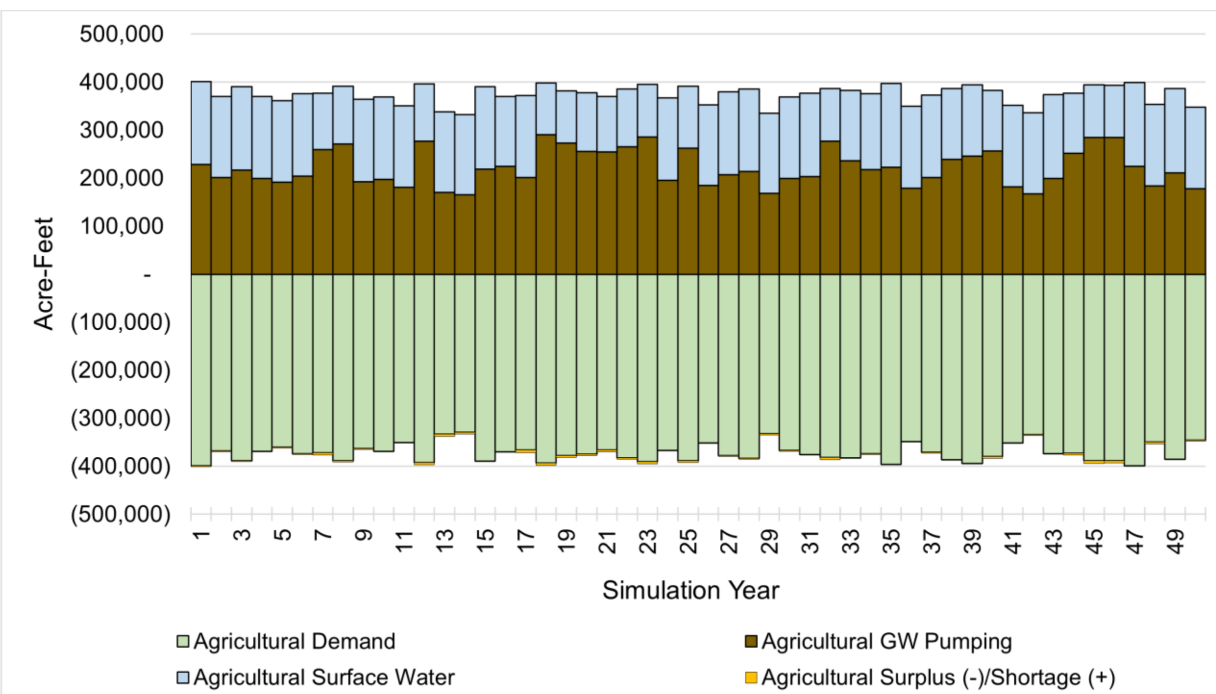


Figure 5-38: Annual Agricultural Water Demand and Supply – North American Subbasin, Projected Conditions Baseline with Climate Change

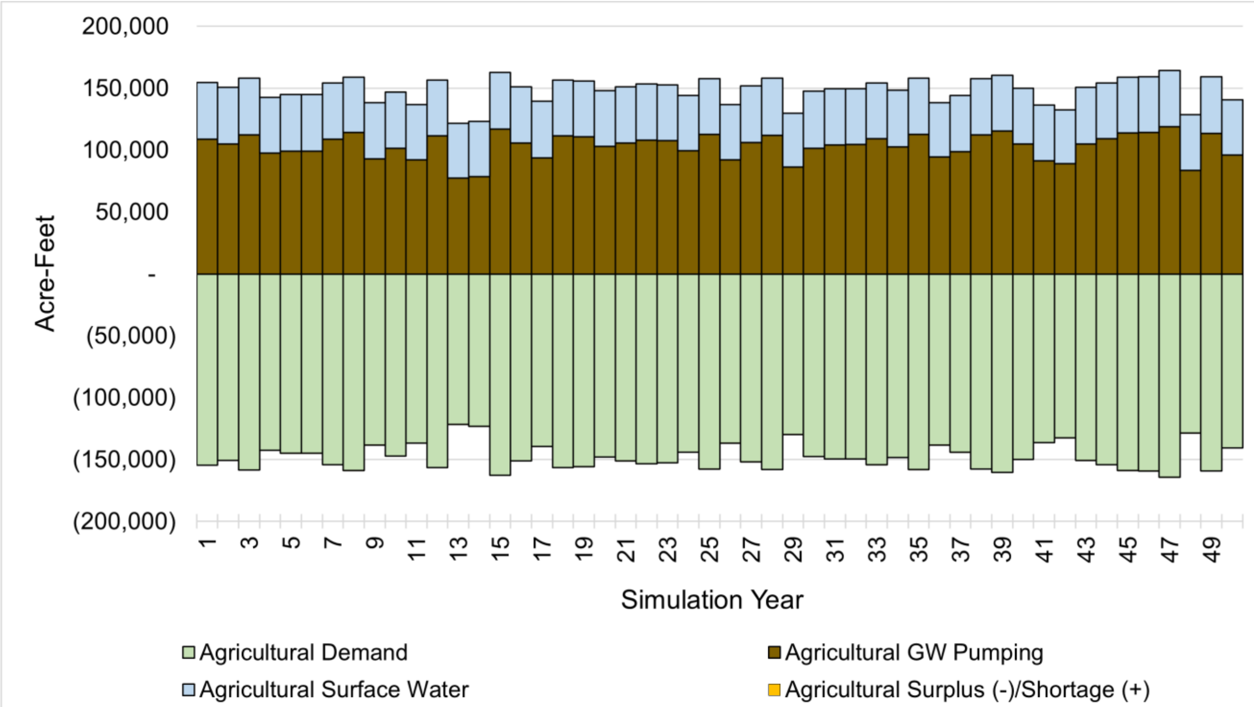


Figure 5-39: Annual Agricultural Water Demand and Supply – South American Subbasin, Projected Conditions Baseline with Climate Change

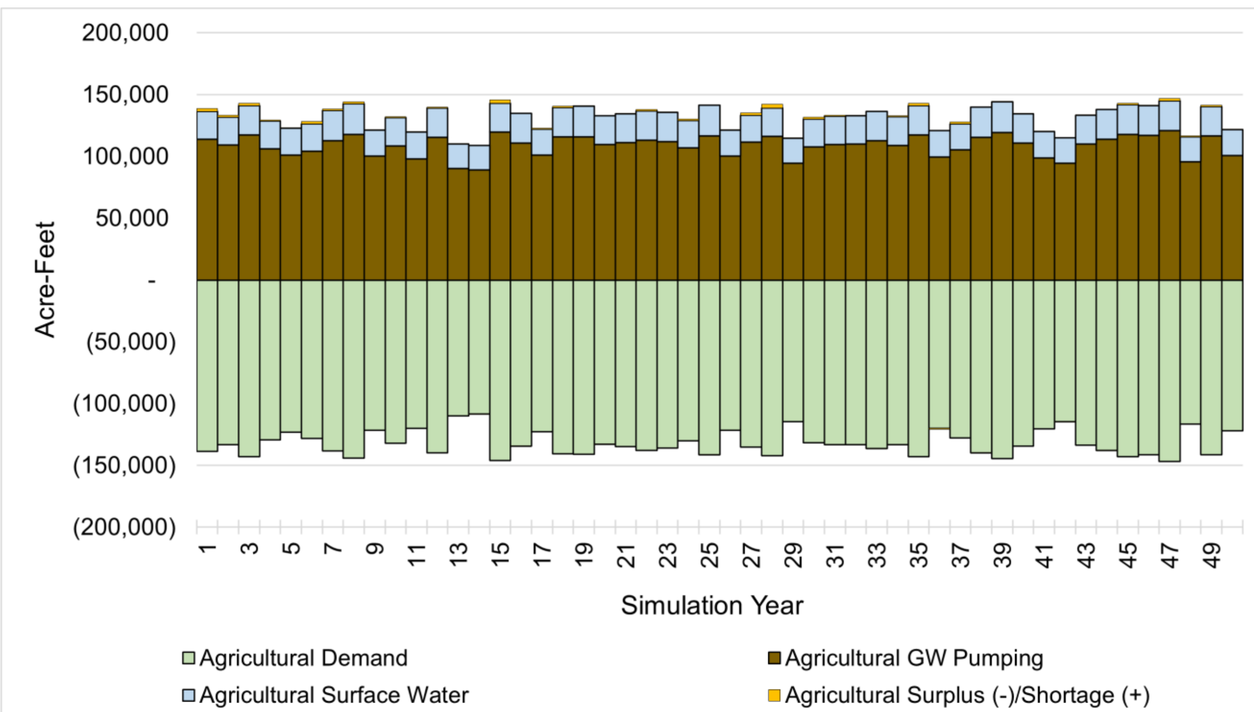


Figure 5-40: Annual Agricultural Water Demand and Supply – Cosumnes Subbasin, Projected Conditions Baseline with Climate Change

5.3.6.2 Groundwater Budget

The groundwater budget provides all inflows and outflows to the groundwater aquifer system. Average annual PCBL with Climate Change model results by groundwater subbasin are shown in Table 5-9. Annual groundwater budgets with cumulative change in storage by subbasin are shown in Figure 5-41 through Figure 5-43. Appendix I includes model subregion groundwater budgets. Appendix J includes a set of sample hydrographs for the baseline models.

Table 5-9: PCBL with Climate Change Average Annual Groundwater Budget

Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
NASb	343,000	160,987	122,181	16,401	32,744	7,228	-3,502
SASb	245,752	114,730	118,164	26	6,198	411	-6,222
CoSb	137,276	101,490	20,744	0	1,540	3,739	-9,762
Total	**726,028**	**377,207**	**261,089**	**16,427**	**40,481**	**11,378**	**-19,486**

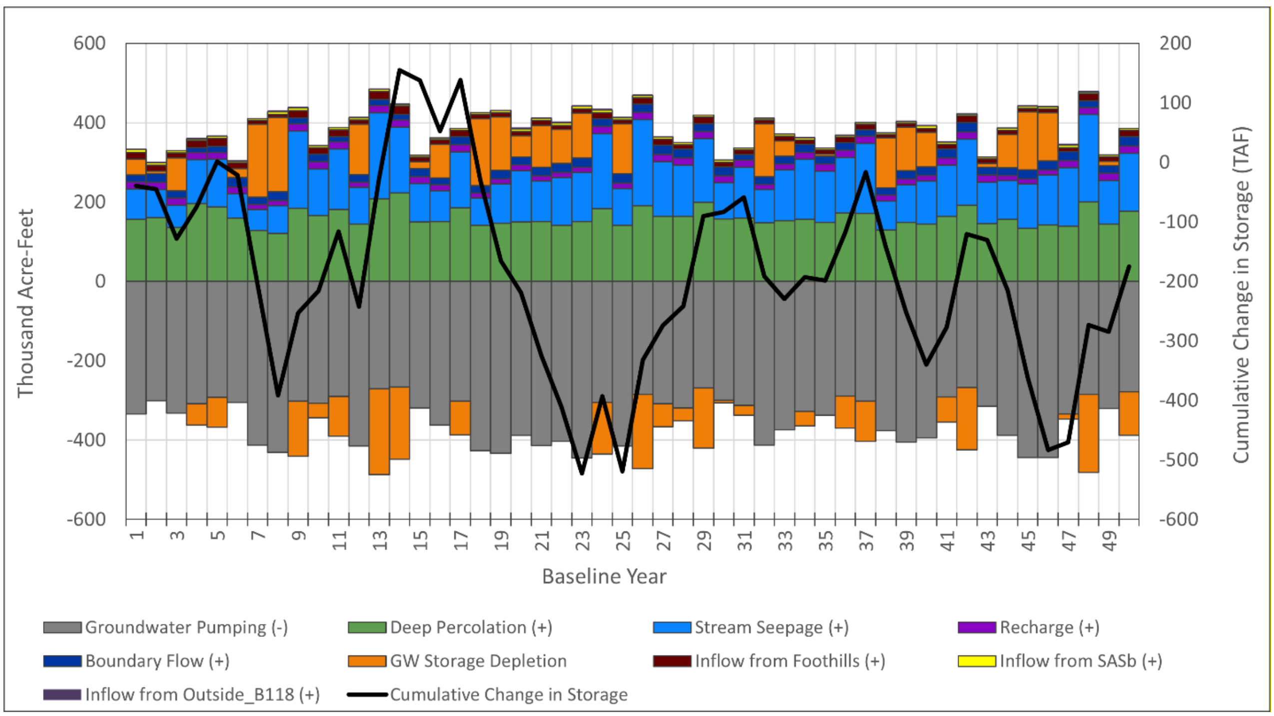


Figure 5-41: Annual Groundwater Budget and Cumulative Change in Storage – North American Subbasin, Projected Conditions Baseline with Climate Change

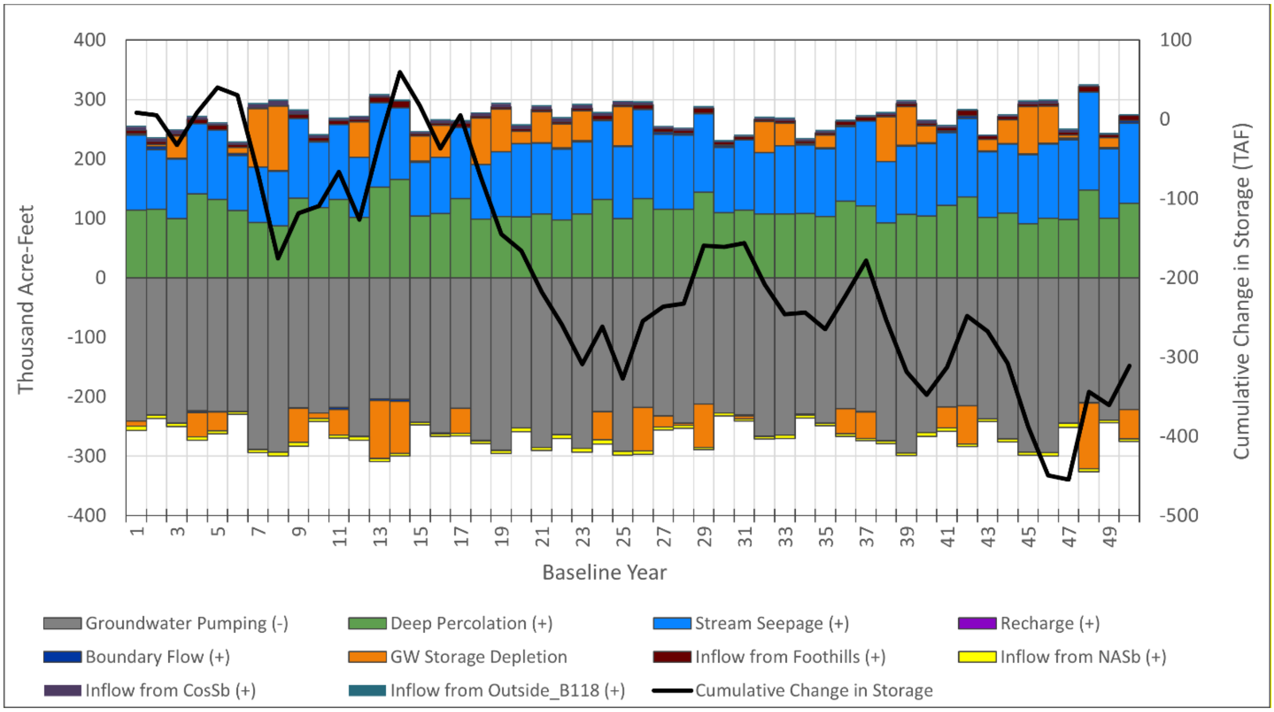


Figure 5-42: Annual Groundwater Budget and Cumulative Change in Storage – South American Subbasin, Projected Conditions Baseline with Climate Change

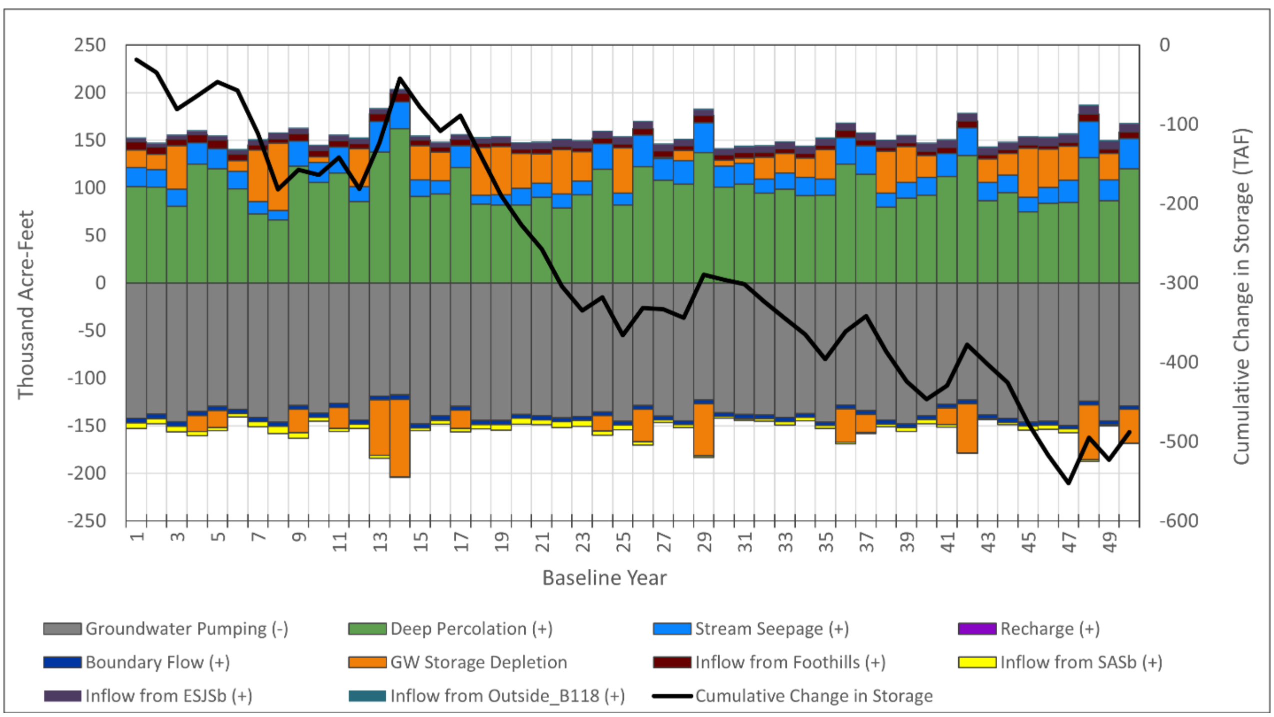


Figure 5-43: Annual Groundwater Budget and Cumulative Change in Storage – Cosumnes Subbasin, Projected Conditions Baseline with Climate Change

5.3.7 Sensitivity Analysis: Hot-Dry Scenario

The 2070HD scenario was analyzed as an extreme case to determine the potential effects of the 2070HD scenario on the groundwater and surface water systems. 2070HD simulates lower overall precipitation, and higher temperature, than the 2070CT. A comparison of groundwater budgets (summation of the 3 subbasins, does not include areas outside of NASb, SASb, and CoSb) can be seen in Table 5-10 below.

Table 5-10: Comparison Groundwater Budgets of CoSANA Climate Change Models to the Projected Conditions Baseline

Model Version	Subbasin	Pumping (AFY)	Deep Percolation (AFY)	Gain from Stream (AFY)	Recharge from Canals (AFY)	Boundary Flows (AFY)	Subsurface Inflow (AFY)	Change in Storage (AFY)
PCBL	NASb	323,167	167,424	107,950	16,376	30,140	6,710	5,390
PCBL	SASb	234,003	121,313	105,665	26	4,886	986	-1,128
PCBL	CoSb	128,332	107,977	16,494	0	1,536	1,030	-1,293
PCBL	**Total**	**685,501**	**396,714**	**230,109**	**16,402**	**36,561**	**8,726**	**2,969**
PCBL+CC (2070CT)	NASb	343,000	160,987	122,181	16,401	32,744	7,228	-3,502
PCBL+CC (2070CT)	SASb	245,752	114,730	118,164	26	6,198	411	-6,222
PCBL+CC (2070CT)	CoSb	137,276	101,490	20,744	0	1,540	3,739	-9,762
PCBL+CC (2070CT)	**Total**	**726,028**	**377,207**	**261,089**	**16,427**	**40,481**	**11,378**	**-19,486**
PCBL+CC (2070HD)	NASb	351,979	155,616	128,609	16,410	33,728	7,482	-10,179
PCBL+CC (2070HD)	SASb	250,445	110,570	122,767	26	7,058	614	-9,409
PCBL+CC (2070HD)	CoSb	140,677	97,337	22,515	0	1,439	4,838	-14,545
PCBL+CC (2070HD)	**Total**	**743,100**	**363,524**	**273,892**	**16,436**	**42,224**	**12,934**	**-34,133**

As shown in Table 5-10, the 2070HD scenario leads to an overall increase in pumping of approximately 2% above the 2070CT, this is largely due to increased evapotranspiration causing an increase in agricultural demand. Decreases in deep percolation are largely attributable to decreasing precipitation. Increases in stream seepage, boundary flows, and subsurface flows are all due to lower groundwater levels being observed in the 2070HD scenario.

6. SUMMARY AND RECOMMENDATIONS

6.1 Summary

The CoSANA model is built upon the previous SacIWRM by migrating to the IWFM platform, providing finer resolution spatially and with depth, and by refining and extending the data incorporated into the model. CoSANA provides a robust, comprehensive, defensible model for assessing water resources conditions in the Sacramento region through integrated modeling of land surface, groundwater, and surface water conditions using detailed local and regional data and the DWR-supported IWFM modeling platform. This includes simulation under historical, current, projected, and projected with climate change conditions. The tool is well calibrated and ready to be used in various water supply and management studies and includes flexibility for updates and refinements to meet future needs of the region.

CoSANA simulates historical hydrology for the water year 1970 – 2018 on a monthly time step, with a focused calibration period of water years 1995 – 2018. Model calibration is based on water budgets, regional groundwater level and flow trends, groundwater level elevations at designated calibration wells, streamflows at selected stream gaging stations, interaction between the stream and the aquifer system along major river courses, surface and subsurface flow contributions from the tributary watersheds to the east, and subsurface flow directions and rates among the three groundwater subbasins within the model.

Three baseline scenarios are developed to support SGMA activities, development of the GSPs within the three subbasins, and other potential water resources planning needs. The Current Conditions Baseline, Projected Conditions Baseline, and Projected Conditions with Climate Change Baseline allow for assessment of water budgets under respective hydrologic, land and water use, and operations conditions and also facilitate analysis of future projects and management activities. The baselines incorporate 50 years of hydrology (1970-2019) to meet SGMA requirements and to provide climatic uncertainty based on 2070 Central Tendency climate change to assess future projects and management actions. A sensitivity analysis was also performed to assess the groundwater conditions under the 2070 Hot and Dry climate conditions.

6.2 Recommendations

CoSANA is intended to be a living model, which would evolve over time for better and more accurate representation of the surface and groundwater systems in the greater Sacramento area. Model refinements and updates need to take place on a regular basis to ensure the most recent and best representation of the changing needs of the region and to incorporate the latest conditions, data, and modeling platforms. During the development of the model, several items were identified for future refinements to improve the capability of CoSANA:

- **Continue collaboration and engagement with local GSAs, water purveyors, groundwater users, and water managers**. Continue working with local agencies and groundwater users in the region to further understand the local operations of the groundwater system and improve representation of groundwater users in the CoSANA.
- **Collaborate with DWR.** The fine grid version of C2VSim as well as the SVSim were developed by DWR to evaluate the integrated surface water and groundwater conditions at a regional scale, and to assess surface water-groundwater interaction and stream depletions at regional scale. CoSANA, being a local scale model with significantly more detail data and information provides a much better platform for evaluation of stream-aquifer interaction for the Sacramento area. It would be important to support the DWR in increasing the accuracy of the regional groundwater conditions in the fine grid C2VSim and SVSim, so that the regional scale results and policy decisions are consistent with the analysis at the local scale. It is therefore recommended that coordination occur with DWR to provide data and information for further refinement and update of the C2VSimFG and SVSim in the CoSANA area.
- **Develop model update schedule.** In order to keep the CoSANA up-to-date and current for analysis of water resources and especially for supporting SGMA implementation, it is recommended that the model

hydrology and land and water use data be updated and used for preparation of the GSP Annual Reports on an annual basis. It is further recommended that the model be updated for other major data sets, as well as enhanced for additional features every 5 years. This 5-year update would include an update of the model calibration and would be developed for use in the 5-year GSP updates for the three subbasins in the model area.

- **Enhance representation of variability of potential evapotranspiration**. The current version of the IDC used for estimation of the consumptive use of crops in the CoSANA uses monthly potential ET values that are uniform across the model domain. Future refinements are recommended to incorporate spatial variability of ET.
- **Map Soil Survey Geographic Database (SSURGO) rootzone parameters directly to CoSANA:** CoSANA used C2VSim rootzone parameters mapped to the CoSANA grid. Due to the difference in grid resolution, this may lead to a loss of detail on the original rootzone parameters. Remapping of the rootzone parameters should be considered to improve this resolution.
- **Refine surface water deliveries in NASb/SASb:** Some surface water diversions have limited detail on the delivery area, with some of this water sent to the appropriate subregion, but not specifically to the delivery area. Additional information on delivery areas is recommended for incorporation into CoSANA, including those in OHWD, and PCWA zone 5.
- **Improve inflow estimates for tributary streams:** Tributary streams were found to have a substantial effect on simulation of groundwater levels during calibration. Improvements could include flow measurements on small streams and/or developing improved regression analyses. Some tributary streams are not connected to a small watershed or receive very little flow from the small watershed simulation (for example: Magpie Creek and Arcade Creek in NASb, Elder Creek in SASb). Finally, subsurface conditions and simulated inflows from small watersheds east of the Cosumnes Subbasin require refinement to address model-calculated water levels that are significantly above land surface (flooded conditions).
- **Improve return flow routing within IWFM and CoSANA:** IWFM allows only one location for return flows, thus surface runoff must be routed to the same stream node as urban wastewater. In much of the Sacramento region, urban wastewater is routed to the Sacramento Regional Wastewater Treatment Plant northwest of Elk Grove. However, surface runoff is typically routed to the nearest surface water course. Coordination with DWR's IWFM development team is recommended to allow flexibility to route these differently according to the physical system.
- **Improve data and simulation of Auburn Ravine flows:** Auburn Ravine has complex operations that include inflows and diversions from several different entities. Currently, CoSANA simulation of Auburn Ravine flows is based on a regression analysis that uses flows from nearby Dry Creek. Though these may represent a reasonable estimate of natural flows that could occur in Auburn Ravine, this analysis does not capture any of the operational flows that occur through the ravine. There is a streamflow gage that is installed in Auburn Ravine, but the gage does not read flows above 200 cfs and therefore cannot be used to develop model inflows. It is recommended that streamflow measurements be taken on Auburn Ravine to either provide a data series for model input or to allow for an improved regression.
- **Develop improved rating tables for major streams:** many of the major stream rating tables are based on C2VSim/SVSim (Sacramento Valley Groundwater-Surface Water Simulation Model) rating tables from a flood study. These rating tables are heavily biased towards high flows that rarely occur in the model. The lower first or second interval includes almost all of the flows observed in a 10-point rating table. This results in the model not having much stage sensitivity, which may affect groundwater / surface water interaction as well as calibration of flow and stage. It is recommended that future efforts to develop rating tables include more focus on low flow conditions that are important for water resource management.
- **Improve simulation of complex water systems:** CoSANA incorporates substantial detail on complex public water systems. In some cases, additional detail on where water is produced, how much water is

lost in transmission, and where water is used can improve the simulation and improve the ease of reporting data from the model. This is typically most relevant to larger public water systems with mixed surface water and groundwater supplies and those systems that utilize interties or perform transfers.

- **Improve data for Mather AFB remediation operations:** Pumping data was received, but well location information is not known. Incorporation of the locations of wells could improve simulation of remediation operations.
- **Improve model information and data sets on the eastern areas:** The model geologic, hydrogeologic, and land use information for the eastern areas of the model near the foothills will need to be further enhanced, once additional data are collected. Such data may include boring logs, groundwater data, or geophysical data such as from airborne electromagnetic surveys. Model calibration will need to be improved upon collection of additional groundwater level data from the representative monitoring wells on the east side.

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APPENDIX A: MODEL SURFACE WATER DELIVERIES

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
1	North-Side Bear River Diversion - Import to Camp Far West ID for Agriculture	Import	Subregion 1	Agriculture	0.14	0.04	1	5,888	SacIWRM	
2	Bear River Diversions - Import to South Sutter WD for Agriculture	Import	Subregion 3	Agriculture	0.14	0.04	1	93,421	SacIWRM, MBK	
3	Auburn Ravine Diversions to South Sutter WD for Agriculture	Auburn Ravine	Subregion 3	Agriculture	0.14	0.04	1	1,529	MBK	
4	Small Stream Diversions - Import to South Sutter WD for Agriculture	Import	Subregion 3	Agriculture	0	0	1	331	MBK	
5	Auburn Ravine Diversions to Zone 5 - Import to Placer County Water Agency for Agriculture	Import	Subregion 4	Agriculture	0.14	0.04	1	9,998	SacIWRM, Placer County Water Agency	
6	Hemphill Canal - Import to Nevada Irrigation District for Agriculture	Import	Subregion 5	Agriculture	0.07	0.02	0.25	19,583	C2VSim, Nevada Irrigation District	Estimated portion of volume coming into model area
7	Auburn Ravine Diversions - Import to Nevada Irrigation District for Agriculture	Import	Subregion 5	Agriculture	0.07	0.02	0.25	3,497	C2VSim, Nevada Irrigation District	Estimated portion of volume coming into model area
8	From PCWA/NID Intertie - Import to City of Lincoln for Urban	Import	Subregion 6	Urban	0	0	1	6,218	SacIWRM, City of Lincoln	
9	Feather River Riparian Diversions for Agriculture	Feather River	Subregion 7	Agriculture	0.12	0.03	1	11,000	SacIWRM	
10	Sacramento River Diversions to Pleasant Grove Verona MWC for Agriculture	Sacramento River Upstream Cross Canal	Subregion 8	Agriculture	0.12	0.03	1	14,528	C2VSim, USBR	
11	Sacramento River Riparian Diversions below Feather River confluence for Agriculture	Sacramento River Upstream Natomas East Drain	Subregion 9	Agriculture	0.12	0.03	1	1,260	SacIWRM	
12	Natomas Mutual Water Company USBR Diversions for Agriculture	Sacramento River Upstream Natomas East Drain	Element group representing / NMWC	Agriculture	0.01	0.0033	1	61,850	SacIWRM, Natomas Mutual Water Company	
13	NOT USED	N/A	Out of model	Agriculture	0	0	0	0	N/A	Not used
14	Folsom Diversions - Import to City of Roseville for Urban	Import	Subregion 13	Urban	0	0	1	27,943	City of Roseville	
15	From PCWA Intertie - Import to City of Roseville for Urban	Import	Subregion 13	Urban	0	0	1	0	N/A	Placeholder, no data
16	From PCWA Intertie - Import to Cal-Am West Placer for Urban	Import	Subregion 14	Urban	0	0	1	725	RWA, GEI	
17	Import to Sacramento Int’l Airport for Urban	Import	Subregion 16	Urban	0	0	1	175	SacIWRM, RWA	
18	Sacramento River Riparian Imports near Sacramento Int’l Airport	Import	Subregion 18	Agriculture	0	0	1	3,124	SacIWRM	
19	Import to Rio Linda Elverta CWD from SSWD Intertie for Urban	Import	Element group representing / Rio Linda Elverta CWD Service Area	Urban	0	0	1	5	RWA	
20	From SSWD Intertie - Import to Cal-Am Antelope for Urban	Import	Subregion 23	Urban	0	0	1	170	RWA	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
21	From SSWD Intertie - Import to Cal-Am Lincoln Oaks for Urban	Import	Subregion 24	Urban	0	0	1	245	RWA	
22	Folsom Diversions Via SJWD Intertie - Import to Citrus Heights WD for Urban	Import	Subregion 25	Urban	0	0	1	16,015	RWA, SacIWRM	
23	From PCWA Intertie - Import to San Juan WD for Urban	Import	Subregion 26	Urban	0	0	1	0	N/A	Placeholder, no data
24	Total Folsom Diversions Inc. Wholesale - Import to San Juan WD for Urban	Import	Out of model	Urban	0	0	1	33,020	RWA	
25	Retail Only - Import to San Juan WD for Urban	Import	Element group representing / SAN JUAN WD RETAIL AREA	Urban	0	0	0.37	14,043	RWA, SacIWRM	
26	Sac Suburban North District Total GW Production	Import	Subregion 32	Urban	0	0	1	16,044	RWA	
27	From SSWD Intertie - Import to San Juan WD for Urban	Import	Subregion 26	Urban	0	0	1	0	N/A	Placeholder, no data
28	From PCWA Intertie - Import to San Juan WD for Urban	Import	Subregion 26	Urban	0	0	1	0	N/A	Placeholder, no data
29	Folsom Diversions via SJWD Intertie - Import to Orange Vale WC for Urban	Import	Subregion 28	Urban	0	0	1	4,191	RWA, SacIWRM	
30	Folsom Diversions Via SJWD Intertie - Import to Fair Oaks WD for Urban	Import	Subregion 30	Urban	0	0	1	11,145	RWA, SacIWRM	
31	American River Diversions to Carmichael WD for Urban	American River	Subregion 31	Urban	0	0	1	7,155	RWA, SacIWRM	
32	From Sac Suburban Intertie - Import to Carmichael WD for Urban	Import	Subregion 31	Urban	0	0	1	0	N/A	Placeholder, no data
33	From CHWD Intertie - Import to Carmichael WD for Urban	Import	Subregion 31	Urban	0	0	1	0	N/A	Placeholder, no data
34	Sac Suburban North District Imports - Import to Sac Suburban North for Urban	Import	Subregion 32	Urban	0	0	1	8,987	RWA, SacIWRM	
35	From City of Sac Intertie - Import to Sac Suburban South for Urban	Import	Subregion 33	Urban	0	0	1	1,037	RWA	
36	From SSWD SSA Intertie - Import to City of Sacramento for Urban	Import	Element group representing / CITY OF SACRAMENTO	Urban	0	0	1	161	RWA	
37	From PCWA - Import to City of Rocklin for Urban	Import	Element group representing Rocklin	Urban	0	0	1	4,578	Placer County Water Agency	
38	Metro Air Park - Import to Metro Air Park for Urban	Import	Subregion 17	Urban	0	0	1	0	N/A	Placeholder, no data
39	From City of Sac Intertie - Import to Cal-Am Arden for Urban	Import	Subregion 36	Urban	0	0	1	2	RWA, SacIWRM	
40	City of Sacramento - American River Diversions to City of Sacramento for Urban	American River	Out of model	Urban	0	0	1	48,211	RWA	
41	City of Sacramento - Sacramento River Diversions to City of Sacramento for Urban	Sacramento River Upstream Morrison Crk	Out of model	Urban	0	0	1	52,300	RWA	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
42	City of Sacramento - Retail SW Delivery Volumes - Import to City of Sacramento for Urban	Import	Element group representing / CITY OF SACRAMENTO	Urban	0	0	1	97,195	RWA, SacIWRM	
43	Sac Suburban South District Total GW Production - Import to Sac Suburban South for Urban	Import	Subregion 33	Urban	0	0	1	16,351	RWA, SacIWRM	Represents total GW production for service area
44	NOT USED - Import for Agriculture	Import	Out of model	Agriculture	0	0	0	470	N/A	
45	Arcade American River Diversions to Arcade for Urban	American River Upstream Sacramento R.	Subregion 39	Urban	0	0	1	132	SacIWRM	
46	From City of Sac Intertie - Import to Cal-Am Suburban Rosemont for Urban	Import	Subregion 40	Urban	0	0	1	85	RWA	
47	FSC/American River Diversions - Import to Golden State Water Company Cordova for Urban	Import	Subregion 42	Urban	0	0	1	5,922	SacIWRM, RWA	FSC operations not currently simulated
48	From Carmichael WD - Import to Golden State Water Company Cordova for Urban	Import	Subregion 42	Urban	0	0	1	366	RWA	
49	Aerojet FSC Diversions - Import to Aerojet FSC for Urban	Import	Out of model	Urban	0	0	1	1,083	SacIWRM	FSC operations not currently simulated
50	Folsom Diversions, Estimated Prior to 1983 - Import to City of Folsom for Urban	Import	Subregion 44	Urban	0	0	1	20,451	SacIWRM, RWA	
51	SJWD Intertie) - Placeholder No Dat - Import to City of Folsom for Urban	Import	Subregion 44	Urban	0	0	1	0	N/A	Placeholder, no data
52	From SCWA Intertie - Import to Cal-Am Security Park for Urban	Import	Subregion 45	Urban	0	0	1	0	N/A	Placeholder, no data
53	From City of Sac Intertie - Import to Fruitridge Vista WC for Urban	Import	Subregion 46	Urban	0	0	1	1	RWA	
54	From City of Sac Intertie - Import to Cal-Am Parkway for Urban	Import	Subregion 48	Urban	0	0	1	592	RWA	
55	GW Imports - Import to SCWA - Arden Park Vista for Urban	Import	Subregion 37	Urban	0	0	1	3,911	SacIWRM, RWA, SCWA	Represents total GW production for service area
56	SW Imports - Import to SCWA - Arden Park Vista for Urban	Import	Subregion 37	Urban	0	0	1	0	N/A	Represents total SW delivered to service area
57	RW Imports - Import to SCWA - Arden Park Vista for Urban	Import	Subregion 37	Urban	0	0	1	0	N/A	Represents total RW for service area
58	GW Imports - Import to SCWA - Hood for Urban	Import	Element group representing SCWA - Hood	Urban	0	0	1	47	SacIWRM, RWA, SCWA	Represents total GW production for service area
59	SW Imports - Import to SCWA - Hood for Urban	Import	Element group representing SCWA - Hood	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total SW delivered to service area
60	RW Imports - Import to SCWA - Hood for Urban	Import	Element group representing SCWA - Hood	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total RW for service area

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
61	GW Imports - Import to SCWA - Northgate for Urban	Import	Subregion 20	Urban	0	0	1	940	SacIWRM, RWA, SCWA	Represents total GW production for service area
62	SW Imports - Import to SCWA - Northgate for Urban	Import	Subregion 20	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total SW delivered to service area
63	RW Imports - Import to SCWA - Northgate for Urban	Import	Subregion 20	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total RW for service area
64	GW Imports - Import to SCWA - Laguna Vineyard for Urban	Import	Element group representing SCWA - South and Central Service Areas (including Elk Grove)	Urban	0	0	1	17,340	SacIWRM, RWA, SCWA	Represents total GW production for service area
65	SW Imports - Import to SCWA - Laguna Vineyard for Urban	Import	Element group representing SCWA - South and Central Service Areas (including Elk Grove)	Urban	0	0	1	3,314	SacIWRM, RWA, SCWA	Represents total SW delivered to service area
66	RW Imports - Import to SCWA - Laguna Vineyard for Urban	Import	Element group representing SCWA - South and Central Service Areas (including Elk Grove)	Urban	0	0	1	232	SacIWRM, RWA, SCWA	Represents total RW for service area
67	GW Imports - Import to SCWA Mather for Urban	Import	Element group representing SCWA - NSA	Urban	0	0	1	3,958	SacIWRM, RWA, SCWA	Represents total GW production for service area
68	SW Imports - Import to SCWA Mather for Urban	Import	Element group representing SCWA - NSA	Urban	0	0	1	233	SacIWRM, RWA, SCWA	Represents total SW delivered to service area
69	RW Imports - Import to SCWA Mather for Urban	Import	Element group representing SCWA - NSA	Urban	0	0	1	0	SacIWRM, RWA, SCWA	Represents total RW for service area
70	North Delta WA Ag Diversions - Import to North Delta WA for Agriculture	Import	Element group representing NDWA	Agriculture	0	0	1	43,072	SacIWRM	
71	Cosumnes River diversion 1 for ag use in element group 4 within Cosumnes River South and Sac Co. 8 subregions to for Agriculture	Cosumnes River Upstream Mokolumne R. / EKI	Element group representing CosSb_4	Agriculture	0	0	1	356	eWRIMS	
72	Cosumnes River diversion 2 for ag use in element group 4 within Cosumnes River South and Sac Co. 8 subregions to for Agriculture	Cosumnes River Upstream Laguna Crk /EKI	Element group representing CosSb_4	Agriculture	0	0	1	4	eWRIMS	
73	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	752	eWRIMS	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
74	East Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_3	Agriculture	0	0	1	103	eWRIMS and Mark Stretars	
75	Cosumnes River diversion 3 for ag use in element group 4 within Cosumnes River South and Sac Co. 8 subregions for Agriculture	Cosumnes River Upstream Badger Crk / EKI	Element group representing CosSb_4	Agriculture	0	0	1	1,119	eWRIMS	
76	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	1,143	eWRIMS	
77	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	130	eWRIMS	
78	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	307	eWRIMS	
79	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_1	Agriculture	0	0	1	2,153	eWRIMS	
80	Cosumnes Subbasin Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_2	Agriculture	0	0	1	354	eWRIMS	
81	East Subregion for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Element group representing CosSb_3	Agriculture	0	0	1	42	eWRIMS	
82	Cos and S Am Subbasins for Urban	Cosumnes River Upstream Deer Crk / EKI	Out of model	Urban	0	0	1	3,755	eWRIMS	
83	Dry Creek diversion for ag use in element group 7 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Out of model	Agriculture	0	0	1	432	eWRIMS	
84	Dry Creek diversion for ag use in element group 8 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Out of model	Agriculture	0	0	1	2,238	eWRIMS	
85	Dry Creek diversion 1 for ag use in element group 9 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk / EKI	Element group representing CosSb_9	Agriculture	0	0	1	31	eWRIMS	
86	Dry Creek diversion 2 for ag use in element group 9 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Element group representing CosSb_9	Agriculture	0	0	1	62	eWRIMS	
87	Dry Creek diversion 3 for ag use in element group 9 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Element group representing CosSb_9	Agriculture	0	0	1	3	eWRIMS	
88	Dry Creek diversion 4 for ag use in element group 9 within Amador Co. 1 subregion for Agriculture	Dry Creek Upstream Jackson Crk	Element group representing CosSb_9	Agriculture	0	0	1	1	eWRIMS	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
89	Dry Creek diversion 1 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	5,398	eWRIMS	
90	East Subregion to for Agriculture	Dry Creek Upstream Mokolumne R.	Element group representing CosSb_6	Agriculture	0	0	1	413	eWRIMS	
91	East Subregion for Agriculture	Dry Creek Upstream Mokolumne R.	Element group representing CosSb_6	Agriculture	0	0	1	59	eWRIMS	
92	Dry Creek diversion 2 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	547	eWRIMS	
93	East Subregion for Agriculture	Dry Creek Upstream Mokolumne R.	Element group representing CosSb_6	Agriculture	0	0	1	19	eWRIMS	
94	Dry Creek diversion 3 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	1,748	eWRIMS	
95	Dry Creek diversion 4 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	1,748	eWRIMS	
96	Dry Creek diversion 5 for ag use in element group 5 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_5	Agriculture	0	0	1	1,748	eWRIMS	
97	East Subregion for Agriculture	Badger Creek	Element group representing CosSb_15	Agriculture	0	0	1	10	eWRIMS	
98	West Subregion for Agriculture	Badger Creek	Element group representing CosSb_12	Agriculture	0	0	1	35	eWRIMS	
99	Laguna Creek diversion for ag use in element group 21 within Clay WD subregion for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing CosSb_21	Agriculture	0	0	1	301	eWRIMS	
100	East Subregion for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing CosSb_11	Agriculture	0	0	1	362	eWRIMS	
101	East Subregion for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing CosSb_11	Agriculture	0	0	1	3	eWRIMS	
102	East Subregion for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing CosSb_10	Agriculture	0	0	1	49	eWRIMS	
103	Jackson Creek diversion for ag use in element group 14 within Jackson ID subregion - Import for Agriculture	Import	Element group representing CosSb_14	Agriculture	0	0	1	10,558	eWRIMS	
104	Mokelumne River diversion 1 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Dry Creek Upstream Mokolumne R. / EKI	Element group representing CosSb_16	Agriculture	0	0	1	2,376	eWRIMS	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
105	Mokelumne River diversion 2 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	436	eWRIMS	
106	Mokelumne River diversion 3 for ag use in element group 16 within Cosumnes River South subregion to for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	232	eWRIMS	
107	Mokelumne River diversion 4 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	933	eWRIMS	
108	Mokelumne River diversion 5 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	4	eWRIMS	
109	Mokelumne River diversion 6 for ag use in element group 16 within Cosumnes River South subregion for Agriculture	Mokolumne River Upstream Cosumnes R.	Element group representing CosSb_16	Agriculture	0	0	1	141	eWRIMS	
110	East Subregion - Import for Agriculture	Import	Element group representing CosSb_19	Agriculture	0	0	1	1,263	eWRIMS	
111	East Subregion - Import for Agriculture	Import	Element group representing CosSb_17	Agriculture	0	0	1	651	eWRIMS	
112	East Subregion - Import for Agriculture	Import	Element group representing CosSb_18	Agriculture	0	0	1	142	eWRIMS	
113	Diversion from unmodeled stream or spring for ag use in OHWD Cosumnes Subbasin subregion - Import for Agriculture	Import	Subregion 67	Agriculture	0	0	1	232	eWRIMS	
114	East Subregion - Import for Agriculture	Import	Subregion 69	Agriculture	0	0	1	200	eWRIMS	
115	Diversion from unmodeled stream or spring for ag use in Wilton subregion - Import for Agriculture	Import	Subregion 70	Agriculture	0	0	1	11	eWRIMS	
116	Diversion from unmodeled stream or spring for ag use in Sloughhouse RCD West subregion - Import for Agriculture	Import	Subregion 71	Agriculture	0	0	1	133	eWRIMS	
117	Diversion from unmodeled stream or spring for ag use in Galt ID East subregion - Import for Agriculture	Import	Subregion 72	Agriculture	0	0	1	10	eWRIMS	
118	Diversion from unmodeled stream or spring for ag use in SMUD Rancho Seco subregion - Import for Agriculture	Import	Subregion 75	Agriculture	0	0	1	455	eWRIMS	
119	Diversion from unmodeled stream or spring for ag use in Cosumnes River South subregion - Import for Agriculture	Import	Subregion 76	Agriculture	0	0	1	5	eWRIMS	

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
120	Diversion from unmodeled stream or spring for ag use in Amador Co. 1 subregion - Import for Agriculture	Import	Subregion 81	Agriculture	0	0	1	217	eWRIMS	
121	Diversion from unmodeled stream or spring for ag use in Jackson ID subregion - Import for Agriculture	Import	Subregion 83	Agriculture	0	0	1	91	eWRIMS	
122	Diversion from unmodeled stream or spring for ag use in Comanche subregion - Import for Agriculture	Import	Subregion 84	Agriculture	0	0	1	80	eWRIMS	
123	Diversion from unmodeled stream or spring for ag use in Amador County WA subregion - Import or Agriculture	Import	Subregion 85	Agriculture	0	0	0	3	eWRIMS	
124	East Subregion - Import to for Agriculture	Import	Element group representing CosSb_20	Agriculture	0	0	1	150	eWRIMS	
125	Cosumnes Subbasin Subregion - Import for Agriculture	Import	Subregion 67	Agriculture	0	0	1	180	SacIWRM	
126	East Subregion - Import for Agriculture	Import	Subregion 72	Agriculture	0	0	1	1,128	SacIWRM	
127	Tailwater Reuse from fish farms for ag use in Clay WD subregion - Import to for Agriculture	Import	Subregion 73	Agriculture	0	0	1	150	SacIWRM	
128	East) Subregion - Import for Agriculture	Import	Subregion 69	Agriculture	0	0	1	300	SacIWRM	
129	Import to Ione for local surface water supply - Import for Urban	Import	Subregion 82	Urban	0	0	1	1,878	SacIWRM	
130	Recoverable Loss from Rancho Seco Export Water to Laguna Creek - Import for Agriculture	Import	Out of model	Agriculture	0	0	0	12,028	SacIWRM	
131	NOT USED - Import for Agriculture	Import	Out of model	Agriculture	0	0	0	786	N/A	
132	Cosumnes Subbasin) Subregion to O-H for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 67	Agriculture	0	0	0.34	0	SacIWRM	
133	South American) Subregion to O-H for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 66	Agriculture	0	0	0.66	0	SacIWRM	
134	East Subregion to Galt ID for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 72	Agriculture	0	0	1	2,279	SacIWRM	
135	Clay ID FSC diversions to Clay ID subregion to Clay ID for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 73	Agriculture	0	0	1	1,051	SacIWRM	
136	SMUD FSC diversions to SMUD Rancho Seco subregion to SMUD FSC for Agriculture	Folsom South Canal (South of Cosumnes R.)	Subregion 75	Agriculture	0	0	1	14,615	SacIWRM	
137	SCWA Freeport Diversions for Mather and Vineyard SW Supply	Sacramento River at Freeport	Out of model	Urban	0	0	1	3,154	RWA	Retail delivery handled with Divs 65, 68

Model Diversion ID	Description	Diversion Location	Delivery Area	Use	Fraction			Average Annual Diversion 1995-2018 (acre-feet)	Data Source	Notes
					RL	NL	Delivery			
138	Deer Creek diversion to SRCD to Deer Creek for Agriculture	Deer Creek	Subregion 65	Agriculture	0	0	1	29	eWRIMS	
139	Deer Creek diversions to OHWD to Deer Creek for Agriculture	Deer Creek	Subregion 66	Agriculture	0	0	1	175	eWRIMS	
140	Cosumnes River diversion to RMCSD area Ag to Cosumnes River for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Subregion 64	Agriculture	0	0	1	570	eWRIMS	
141	Cosumnes River diversions to OHWD to Cosumnes River for Agriculture	Cosumnes River Upstream Deer Crk / EKI	Subregion 66	Agriculture	0	0	1	1,388	eWRIMS	
142	Not Used	Import	N/A	N/A	1	0	1	0	N/A	
143	Diversion from water stored in Loch Lane for at use, adjusted to meet demand	Import	Element group representing / CosSb_22	Agriculture	0	0	1	2,670	eWRIMS	
144	Galt WWTP flows through Laguna Creek to Galt WWTP for Agriculture	Laguna Creek (Cosumnes Subbasin)	Element group representing / Galt WWTP	Agriculture	0	0	1	700	South Basin Groundwater Management Plan, Robertson-Bryan Inc. and WRIME, 2011	
145	Rancho Murieta diversion from stored water to meet estimated demand. - Import to Rancho Murieta for Urban	Import	Element group representing CosSb_13	Urban	0	0	1	1,833	RMCSD	

RL: Recoverable Loss
NL: Non-recoverable Loss

APPENDIX B: REMEDIATION PUMPING BY ENTITY

Water Year	Aerojet Remediation (NASb) (acre-feet)	Aerojet Remediation (SASb) (acre-feet)	Kiefer Landfill Remediation (acre-feet)	Mather Air Force Base Remediation (acre-feet)	McClellan Air Force Base Remediation (acre-feet)
1995	0	14,568	102	157	745
1996	0	15,189	468	209	1,145
1997	0	14,672	517	209	1,157
1998	270	16,916	898	209	1,167
1999	2,018	14,586	870	209	1,032
2000	1,900	12,747	1,500	209	2,020
2001	1,672	13,297	1,339	209	1,440
2002	1,583	12,657	1,793	209	1,105
2003	1,551	15,267	1,531	209	1,098
2004	1,695	18,682	1,622	209	1,569
2005	1,953	17,591	1,333	209	1,446
2006	2,069	18,892	1,280	209	2,272
2007	2,382	19,568	1,555	209	2,838
2008	2,287	21,786	1,391	209	2,743
2009	2,093	21,383	1,321	209	2,386
2010	2,424	24,938	1,111	209	2,369
2011	2,674	26,618	1,141	209	2,406
2012	3,394	26,058	575	209	2,483
2013	2,125	18,808	488	209	2,394
2014	2,479	21,932	522	209	2,317
2015	2,689	20,137	494	209	2,213
2016	3,482	28,274	375	209	2,432
2017	3,430	29,362	422	209	2,395
2018	3,105	28,935	621	209	2,409
Average WY 1995-2018	**1,970**	**19,703**	**969**	**207**	**1,899**

APPENDIX C: SUBREGION LAND AND WATER USE BUDGETS

Historical Water Use Budget Summary, Annual Average for WY 1995 - 2018																
Subregion	Description	Ag Area	Ag Demand	Ag Water Duty	Urban Area	Urban Demand	Urban Water Duty	Total Water Demand	Total Ag Water Supply (Acre-Feet/Year)		Total Urban Water Supply (Acre-Feet/Year)			Total Supply (Acre-Feet/Year)	Remediation Operations	
		(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acre-Feet)	GW Production	SW Deliveries	GW Use	SW Deliveries	Other Supply[2]		Extraction	Injection
1	Camp Far West ID	1,760	9,327	5.3	169	150	0.9	9,477	4,472	4,990	150	-	-	9,612	-	-
2	Sutter Co. 1	147	643	4.4	2	1	0.4	644	643	-	1	-	-	644	-	-
3	South Sutter WD GSA	52,398	183,202	3.5	1,962	1,490	0.8	184,693	103,768	80,796	1,490	-	-	186,055	-	-
4	Placer County WA[1]	12,243	31,383	2.6	7,202	8,308	1.2	39,692	22,996	8,473	3,730	4,578	-	39,778	-	-
5	Nevada ID	3,168	11,467	3.6	482	397	0.8	11,864	6,030	5,770	397	-	-	12,196	-	-
6	Lincoln[1]	527	1,275	2.4	4,573	6,958	1.5	8,233	1,275	-	739	6,218	-	8,233	-	-
7	RD1001 [1]	7,476	28,604	3.8	371	165	0.4	28,769	19,039	9,565	165	-	-	28,769	-	-
8	Pleasant Grove Verona MWC	6,813	23,943	3.5	99	45	0.5	23,988	12,036	12,633	45	-	-	24,714	-	-
9	Sutter Co. 2	985	3,447	3.5	87	39	0.5	3,486	2,278	1,169	39	-	-	3,486	-	-
10	Natomas MWC (Sutter Co.)	11,694	41,428	3.5	436	197	0.5	41,625	717	40,744	197	-	-	41,658	-	-
11	Sutter Co. 3	2,912	9,152	3.1	440	289	0.7	9,441	9,152	-	289	-	-	9,441	-	-
12	Roseville SOI	1,127	3,037	2.7	44	105	2.4	3,141	3,037	-	105	-	-	3,141	-	-
13	City of Roseville	488	623	1.3	16,617	28,069	1.7	28,692	623	-	126	27,943	-	28,692	-	-
14	Cal Am (West Placer)	3,223	6,459	2.0	2,146	725	0.3	7,184	6,459	-	-	725	-	7,184	-	-
15	Natomas MWC (Sacramento Co.)	13,037	41,942	3.2	1,357	2,973	2.2	44,915	687	41,291	2,973	-	-	44,951	-	-
16	Sacramento International Airport	946	893	0.9	1,621	1,143	0.7	2,037	893	-	968	175	-	2,037	-	-
17	Metro Air Park	1,643	1,458	0.9	37	-	0.0	1,458	1,458	-	-	-	-	1,458	-	-
18	Sac Co. 1	928	1,896	2.0	139	604	4.3	2,500	100	1,796	604	-	-	2,500	-	-
19	Sac Co. 2	793	2,636	3.3	141	17	0.1	2,653	2,636	-	17	-	-	2,653	-	-
20	Sac County WA (Northgate 880)	43	52	1.2	792	940	1.2	992	52	-	940	-	-	992	-	-
21	Rio Linda Elverta	630	905	1.4	5,873	8,941	1.5	9,846	905	-	8,936	5	-	9,846	-	-
22	Sac Co. 3	327	250	0.8	214	335	1.6	584	250	-	335	-	-	584	-	-
23	Cal Am (Antelope)	4	8	1.8	2,664	5,790	2.2	5,798	8	-	5,621	170	-	5,798	-	-
24	Cal Am (Lincoln Oaks)	3	8	2.3	4,254	9,114	2.1	9,122	8	-	8,869	245	-	9,122	-	-
25	Citrus Heights WD	66	262	3.9	7,706	16,967	2.2	17,229	262	-	952	16,015	-	17,229	-	-
26	San Juan WD (Placer Co.)	41	18	0.4	1,130	1,817	1.6	1,835	18	-	-	1,817	-	1,835	-	-
27	San Juan WD (Sacramento Co.)	79	246	3.1	2,043	3,378	1.7	3,624	246	-	-	3,378	-	3,624	-	-
28	Orange Vale WC	119	618	5.2	2,839	4,191	1.5	4,809	618	-	-	4,191	-	4,809	-	-
29	Lake Natoma/Mississippi Bar	1	35	36.0	128	-	0.0	35	35	-	-	-	-	35	-	-
30	Fair Oaks WD	97	284	2.9	6,159	12,328	2.0	12,611	284	-	1,183	11,145	-	12,611	1,401	-
31	Carmichael WD	0	0	3.5	5,255	11,234	2.1	11,234	0	-	4,080	7,155	-	11,234	568	-
32	Sacramento Suburban WD (North)	154	74	0.5	13,736	25,031	1.8	25,105	74	-	16,130	8,902	-	25,105	1,843	-
33	Sacramento Suburuban WD (South)	-	-	0.0	7,765	17,388	2.2	17,388	-	-	16,387	1,001	-	17,388	-	-
34	Del Paso Manor WD	-	-	0.0	614	1,549	2.5	1,549	-	-	1,549	-	-	1,549	-	-
35	Golden State WC Arden	-	-	0.0	496	1,169	2.4	1,169	-	-	1,169	-	-	1,169	-	-
36	Cal Am (Arden)	-	-	0.0	640	2,832	4.4	2,832	-	-	2,830	2	-	2,832	-	-
37	Sac County WA (Arden Park	-	-	0.0	1,348	3,911	2.9	3,911	-	-	3,911	-	-	3,911	-	-
38	City of Sacramento (North)	3,522	4,546	1.3	17,106	37,754	2.2	42,300	4,546	-	6,459	31,296	-	42,300	56	-
	Total NASb	127,396	410,120	120	118,685	216,346	58	626,466	205,605	207,227	91,384	124,961	-	629,177	3,869	-
39	City of Sacramento (South)	735	1,230	1.7	35,588	79,828	2.2	81,058	1,146	84	13,767	66,193	-	81,190	-	-
40	Cal Am (Suburban Rosemont)	291	938	3.2	7,186	12,381	1.7	13,318	938	-	12,296	110	-	13,343	131	-
41	Sac Co. 4	65	29	0.4	15	-	0.0	29	29	-	-	-	-	29	-	-
42	Golden State WC (Cordova)	72	76	1.1	6,310	15,264	2.4	15,341	76	-	8,977	6,287	-	15,341	4,422	-
43	Sac Co. 5	-	-	0.0	269	3	0.0	3	-	-	-	3	-	3	7,351	-
44	City of Folsom[1]	53	55	1.1	9,505	20,451	2.2	20,507	35	-	-	20,451	-	20,487	3,137	-
45	Cal Am (Security Park)	-	-	0.0	171	31	0.2	31	-	-	31	0	-	31	48	-
46	Fruitridge Vista WC	-	-	0.0	1,894	4,224	2.2	4,224	-	-	4,387	1	-	4,388	-	-
47	Florin County WD	1	4	3.9	1,369	2,623	1.9	2,628	4	-	2,623	-	-	2,628	-	-
48	Cal Am (Parkway)	5	11	1.9	5,007	11,291	2.3	11,302	11	-	10,699	592	-	11,302	-	-
49	Sac Co. 6	463	898	1.9	1,056	57	0.1	955	598	300	57	-	-	955	-	-
50	Sac County WA (North/Central)	4,080	11,378	2.8	12,881	16,425	1.3	27,803	11,378	-	14,874	1,435	92	27,779	4,819	207
51	Sac County WA (South)	3,303	8,188	2.5	7,996	11,375	1.4	19,564	8,188	-	9,397	1,851	128	19,564	-	-
52	Elk Grove WD (2 - Intertie Service Area)	639	1,717	2.7	2,374	3,430	1.4	5,147	1,717	-	2,833	558	38	5,147	-	-
53	Elk Grove WD (1 - GW Service Area)	33	115	3.5	2,934	5,189	1.8	5,305	115	-	5,189	-	-	5,305	-	-
54	Cosumnes River West	18,072	56,004	3.1	1,824	4,533	2.5	60,536	51,495	4,509	4,533	-	-	60,537	-	-
55	RD744	1,294	2,738	2.1	102	60	0.6	2,798	702	2,036	60	-	-	2,798	-	-
56	Franklin Drainage District	2,825	8,515	3.0	250	158	0.6	8,673	3,180	5,336	125	33	-	8,674	-	-
57	RD813	2,075	4,676	2.3	82	48	0.6	4,724	1,287	3,389	33	15	-	4,724	-	-
58	RD755	354	1,497	4.2	26	16	0.6	1,513	520	978	16	-	-	1,513	-	-
59	RD1002	4,303	10,037	2.3	254	166	0.7	10,203	2,889	7,148	166	-	-	10,203	-	-
60	RD551	7,927	22,522	2.8	423	245	0.6	22,767	6,062	16,462	245	-	-	22,768	-	-
61	RD369	108	382	3.5	37	23	0.6	406	130	252	23	-	-	406	-	-
62	RD2110	1,401	2,033	1.5	52	28	0.5	2,061	409	1,624	28	-	-	2,061	-	-
63	Sac Co. 7	306	680	2.2	88	94	1.1	773	176	504	94	-	-	773	-	-
64	Rancho Murieta (North)[1]	381	1,239	3.2	1,098	1,415	1.3	2,654	740	499	153	1,262	-	2,654	-	-
65	Sloughouse RCD (North)	575	1,318	2.3	631	616	1.0	1,934	1,290	28	584	31	-	1,934	-	-
66	OHWD (Sth American Subbasin)	9,592	24,431	2.5	2,469	1,970	0.8	26,401	23,282	1,517	1,554	431	-	26,784	969	-
	Total SASb	58,954	160,714	62	101,890	191,942	33	352,656	116,398	44,668	92,742	99,252	258	353,318	20,879	207
67	OHWD (Cosumnes Subbasin)	2,633	7,608	2.9	1,049	975	0.9	8,583	5,202	2,407	1,053	-	-	8,661	-	-
68	Rancho Murieta (South)	4	20	4.7	365	465	1.3	485	6	14	-	412	-	432	-	-
69	Sloughouse RCD (East)	8,331	21,515	2.6	1,303	1,322	1.0	22,838	19,813	1,702	109	128	-	21,752	-	-
70	Wilton	1,018	3,611	3.5	3,502	2,742	0.8	6,353	3,600	11	4,352	-	-	7,963	-	-
71	Sloughouse RCD (West)	4,111	10,694	2.6	324	242	0.7	10,936	10,562	132	8	-	-	10,701	-	-
72	Galt ID (East)	14,401	41,762	2.9	6,071	5,336	0.9	47,098	38,080	3,682	9,526	-	-	51,288	-	-
73	Clay WD	1,918	7,109	3.7	172	479	2.8	7,588	5,634	1,474	-	-	-	7,109	-	-
74	Clay	61	180	2.9	2,805	1,945	0.7	2,126	180	-	1,903	-	-	2,084	-	-
75	SMUD Rancho Seco	21	36	1.7	137	138	1.0	174	-	36	7	-	-	43	-	-
76	Cosumnes River South	4,405	12,174	2.8	191	315	1.6	12,488	9,159	3,046	-	-	-	12,205	-	-
77	Galt ID (West)	1,847	5,355	2.9	1,331	1,222	0.9	6,577	5,355	-	707	-	-	6,062	-	-
78	Sac Co. 8	2,882	6,480	2.2	623	924	1.5	7,404	5,124	1,356	165	-	-	6,645	-	-
79	City of Galt	182	361	2.0	3,035	4,650	1.5	5,011	361	-	4,737	-	-	5,099	-	-
80	Sloughouse RCD (South)	1,034	2,418	2.3	320	497	1.6	2,915	2,418	-	56	-	-	2,474	-	-
81	Amador Co. 1	1,812	3,278	1.8	1,832	2,530	1.4	5,809	1,259	2,018	0	-	-	3,277	-	-
82	Ione	153	425	2.8	1,109	2,130	1.9	2,555	425	0	-	1,878	-	2,303	-	-
83	Jackson ID	2,693	9,258	3.4	361	456	1.3	9,713	-	9,018	-	-	-	9,018	-	-
84	Camanche	63	-	0.0	133	164	1.2	164	-	-	76	-	-	76	-	-
85	Amador County WA	0	-	0.0	199	245	1.2	245	-	-	181	-	-	181	-	-
87	Galt WWTP	148	209	1.4	57	88	1.5	297	-	698	-	-	-	698	-	-
	Total CoSb	47,717	132,494	49	24,918	26,866	26	159,360	107,180	25,594	22,881	2,417	-	158,072	-	-
86	Mokelumne	34,664	79,056	2.3	3,200	4,222	1.3	83,278	79,056	-	4,222	-	-	83,278	-	
	Total Other	34,664	79,056	2.3	3,200	4,222	1.3	83,278	79,056	-	4,222	-	-	83,278	-	-
CoSANA Grand Total (NASb, SASb, CoSb)		234,067	703,329	231	245,493	435,154	116	1,138,482	429,183	277,488	207,008	226,630	258	1,140,568	24,748	207

Footnotes:
1. Subregion includes areas that fall outside of DWR B118 subbasin boundaries
2. Other Supply includes recycled water deliveries

APPENDIX D: STREAM REACH BUDGETS

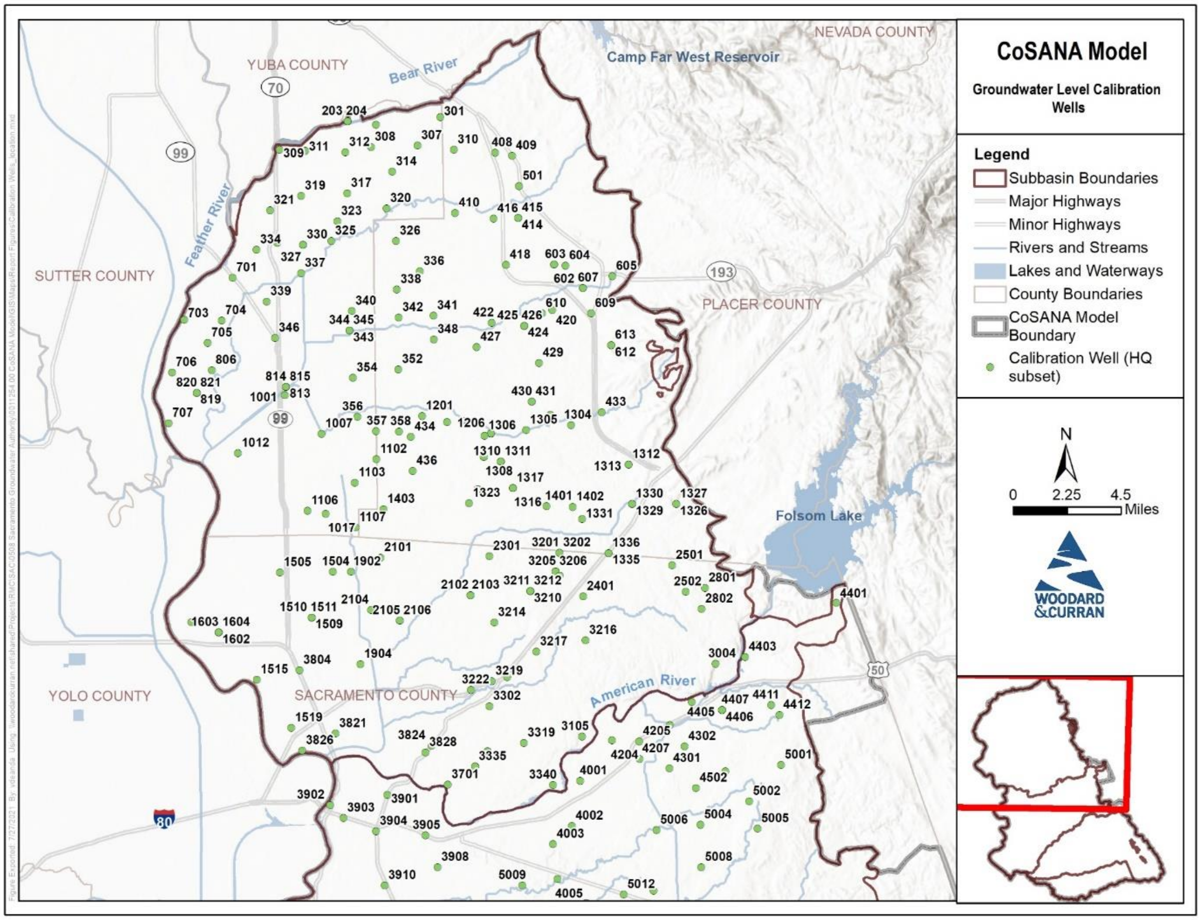
Reach Number	Reach Description	Upstream Inflow (acre-feet)	Downstream Outflow (acre-feet)	Tributary Inflow (acre-feet)	Runoff (acre-feet)	Return Flow (acre-feet)	Gain from Groundwater (acre-feet)	Riparian ET (acre-feet)	Runoff (acre-feet)	Diversion Shortage (acre-feet)
1	Bear River	325,762	362,711	1,587	15,179	3,535	16,654	0	0	0
2	Feather River	5,680,692	5,643,013	0	0	0	-26,679	0	11,000	0
3	Sacramento River Upstream Cross Canal	14,471,419	14,512,137	0	31,663	8,137	15,455	0	14,528	0
4	Racoon Creek (formerly Coon Creek)	28,867	73,106	21,978	35,599	7,876	-21,201	0	0	0
5	East Side Canal I	0	21,499	334	17,074	4,405	-307	0	0	0
6	Auburn Ravine	19,365	26,950	0	13,451	3,115	-7,449	0	1,528	1
7	East Side Canal II	48,450	47,304	0	0	0	-1,146	0	0	0
8	Pleasant Grove Creek	28,846	76,604	386	38,745	12,405	-3,773	0	0	0
9	Pleasant Grove Creek Canal	76,604	73,288	0	0	0	-3,321	0	0	0
10	Cross Canal 1	120,591	114,705	0	0	0	-5,881	0	0	0
11	Cross Canal 2	187,811	189,809	0	0	0	1,998	0	0	0
12	Sacramento River Upstream Natomas East Drain	14,701,946	14,624,027	0	0	0	6,551	0	84,471	0
13	Natomas East Drain Upstream Dry Crk	0	128,860	0	86,007	50,192	-7,347	0	0	0
14	Dry Creek (North American Subbasin)	35,968	47,216	2,438	16,213	7,721	-15,123	0	0	0
15	Natomas East Drain Upstream Magpie Crk	47,216	96,191	0	30,091	20,647	-1,752	0	0	0
16	Magpie Creek	2,470	1,915	0	0	0	-554	0	0	0
17	Natomas East Drain Upstream Arcade Crk	98,107	155,478	0	34,602	26,267	-3,498	0	0	0
18	Arcade Crk	0	0	0	0	0	0	0	0	0
19	Natomas East Drain Upstream Sacramento R.	155,478	147,333	0	0	0	-8,144	0	0	0
20	Sacramento River Upstream American R.	14,771,360	14,777,536	0	0	0	6,176	0	0	0
21	Alder Creek	0	3,728	999	0	0	2,729	0	0	0
22	Buffalo Creek	7,203	53,112	0	32,572	16,776	-3,438	0	0	0
23	American River Upstream Alder Crk	2,747,286	2,754,396	409	0	0	6,700	0	0	0
24	American River Upstream Buffalo Crk	2,758,124	2,750,442	0	0	0	-7,682	0	0	0
25	American River Buffalo Crk to H St Bridge	2,815,189	2,718,995	0	0	0	-40,829	0	55,365	0
26	American River Upstream Sacramento R.	2,718,995	2,736,106	0	0	0	17,242	0	132	0
27	Sacramento River Upstream Morrison Crk	17,513,642	17,502,205	0	42,933	35,792	-34,708	0	55,453	0
28	Morrison Creek Upstream Elder Crk	17,995	77,197	0	41,487	20,118	-2,388	0	0	0
29	Elder Creek	0	0	0	0	0	0	0	0	0
30	Morrison Creek Upstream Beacon Crk	77,197	74,208	0	0	0	-2,989	0	0	0
31	Beacon Creek	0	57	0	0	0	57	0	0	0
32	Morrison Creek Upstream Laguna Crk	74,265	111,174	0	28,492	9,394	-970	0	0	0
33	Laguna Creek (South American Subbasin)	8,342	2,940	0	0	0	-5,402	0	0	0
34	Morrison Creek Upstream Sacramento R.	114,114	134,109	0	11,790	7,076	1,133	0	0	0
35	Sacramento River Upstream Mokolumne Confluence	17,636,315	17,649,814	0	38,822	12,907	-38,209	0	0	0
36	Deer Creek	1,214	104,376	87,005	23,491	2,701	-9,833	0	197	6
37	Cosumnes River Upstream Deer Crk	397,070	409,057	0	25,669	3,406	-8,031	1,239	7,818	197
38	Cosumnes River Upstream Badger Crk	513,433	505,527	0	662	182	-7,340	640	769	0
39	Badger Creek	0	6,524	0	6,425	486	199	579	0	45
40	Cosumnes River Upstream Laguna Crk	512,051	522,840	0	17,105	1,617	-7,584	340	4	0
41	Laguna Creek (Cosumnes Subbasin)	21,012	96,118	17,138	52,214	7,685	1,003	1,544	1,388	0
42	Cosumnes River Upstream Mokolumne R.	618,958	617,231	0	8,449	2,085	-10,375	1,817	68	0
43	Dry Creek Upstream Jackson Crk	30,040	53,117	0	19,708	1,448	4,570	0	2,649	75
44	Jackson Creek	30,295	36,670	804	0	0	5,570	0	0	0
45	Dry Creek Upstream Mokolumne R.	89,787	119,068	0	46,628	6,563	-18,302	1,614	3,955	505
46	Mokolumne River Upstream Dry Crk	569,130	534,845	0	5,415	1,306	-41,001	0	0	0
47	Mokolumne River Upstream Cosumnes R.	653,913	649,754	0	0	0	-3,591	281	290	0
48	Mokolumne River Upstream Sacramento R. Confluence	1,266,985	1,278,877	0	0	0	11,894	0	0	0
49	Folsom South Canal (North of Cosumnes R.)	0	0	0	0	0	0	0	0	0
50	Folsom South Canal (South of Cosumnes R.)	0	0	0	0	0	0	0	0	0
51	Hadselville Creek	12,039	11,985	0	0	0	-27	27	0	0

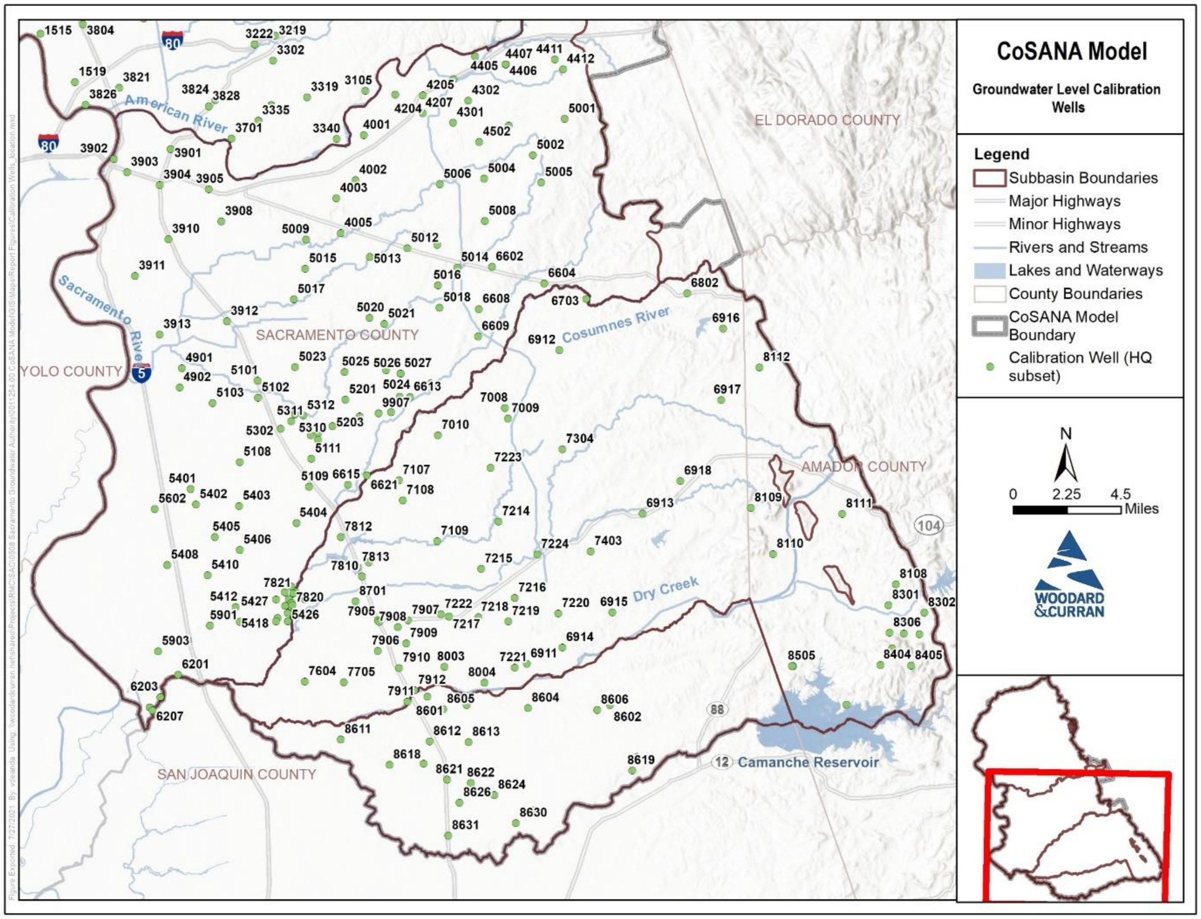
APPENDIX E: SUBREGION GROUNDWATER BUDGETS

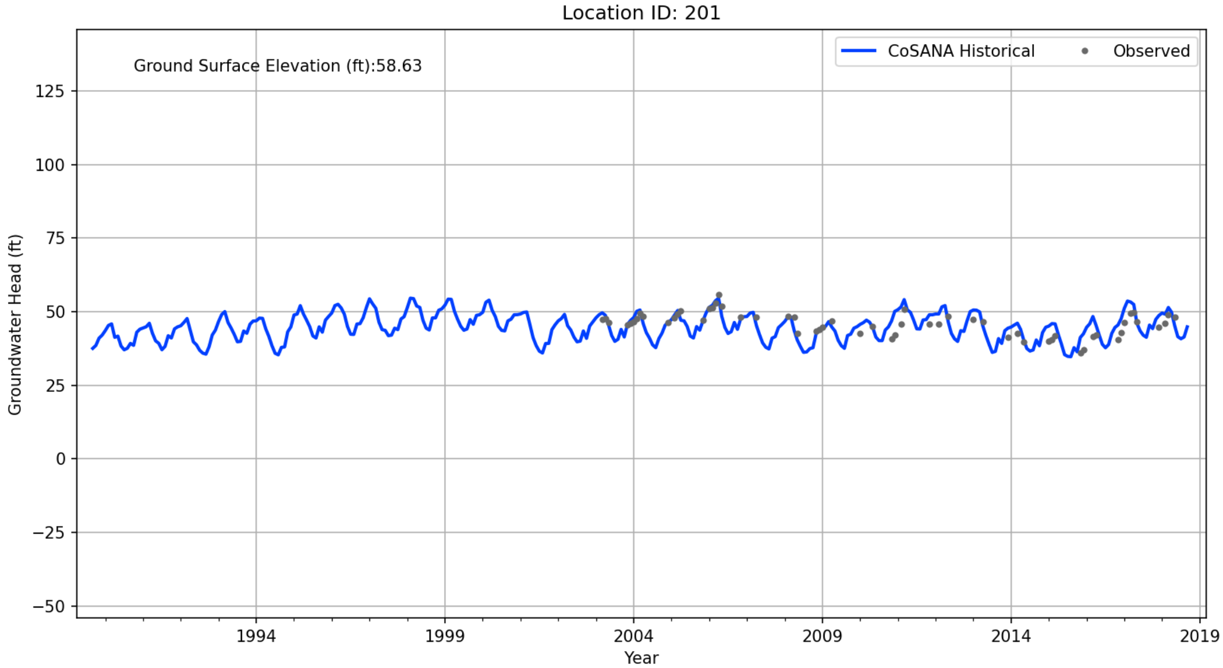
Historical Groundwater Budget Summary, Annual Average for WY 1995 - 2018							
Subregion	**Description**	**Deep Percolation**	**Gain from Stream**	**Recharge (Recoverable Loss)**	**Boundary Inflow**	**Net Subsurface Inflow**	**Pumping**
		(Acre-Feet)	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*
			North American Subbasin				
1	Camp Far West ID	6,135	-5,792	699	2,385	1,193	4,622
2	Sutter Co. 1	309	19	0	1,042	-723	644
3	South Sutter WD GSA	53,729	24,620	11,265	3,832	12,707	105,258
4	Placer County WA	32,625	3,435	1,186	1,469	-4,129	26,874
5	Nevada ID	7,990	850	1,616	4,455	-8,249	6,426
6	Lincoln	6,143	933	0	505	-1,859	1,866
7	RD1001	15,990	3,411	1,148	741	-1,978	19,204
8	Pleasant Grove Verona MWC	5,444	2,754	1,516	0	2,447	12,081
9	Sutter Co. 2	1,438	-2,571	140	1,429	1,889	2,318
10	Natomas MWC (Sutter Co.)	7,966	5,839	306	72	-10,265	3,933
11	Sutter Co. 3	3,321	938	0	0	5,114	9,441
12	Roseville SOI	1,287	1,178	0	0	1,043	3,141
13	City of Roseville	5,768	6,041	145	2,486	-8,724	749
14	Cal Am (West Placer)	4,747	4,279	0	0	-1,597	6,465
15	Natomas MWC (Sacramento Co.)	11,773	-3,535	514	4,246	-8,920	3,477
16	Sacramento International Airport	1,060	0	0	0	982	1,862
17	Metro Air Park	878	0	0	0	745	1,468
18	Sac Co. 1	964	-2,655	0	4,068	-1,619	704
19	Sac Co. 2	1,336	2,281	0	0	-242	3,286
20	Sac County WA (Northgate 880)	77	603	0	0	238	846
21	Rio Linda Elverta	2,156	5,736	0	0	2,732	9,840
22	Sac Co. 3	231	793	0	0	-356	584
23	Cal Am (Antelope)	618	663	0	0	4,262	5,134
24	Cal Am (Lincoln Oaks)	618	0	0	0	8,459	8,402
25	Citrus Heights WD	1,760	0	0	476	-292	1,680
26	San Juan WD (Placer Co.)	434	0	0	1,159	-1,751	18
27	San Juan WD (Sacramento Co.)	649	-488	0	811	-931	246
28	Orange Vale WC	1,338	0	0	0	-1,018	618
29	Lake Natoma/Mississippi Bar	1,516	-4,959	0	30	3,461	35
30	Fair Oaks WD	2,910	5,159	0	0	-5,449	2,877
31	Carmichael WD	1,165	6,118	0	0	-1,996	4,906
32	Sacramento Suburban WD (North)	2,802	53	0	0	16,599	17,456
33	Sacramento Suburban WD (South)	954	7,379	0	0	9,721	17,166
34	Del Paso Manor WD	84	0	0	0	1,550	1,549
35	Golden State WC Arden	45	0	0	0	956	931
36	Cal Am (Arden)	481	0	0	0	1,492	1,901
37	Sac County WA (Arden Park	237	991	0	0	1,819	2,896
38	City of Sacramento (North)	4,793	19,148	0	1,130	1,947	25,074
	Total NASb	191,772	83,222	18,535	30,336	19,257	315,980
			South American Subbasin				
39	City of Sacramento (South)	16,041	15,444	0	1,403	-28,141	3,252
40	Cal Am (Suburban Rosemont)	1,950	7,140	0	0	4,865	13,511
41	Sac Co. 4	301	2,827	0	0	-3,093	29
42	Golden State WC (Cordova)	6,644	14,347	0	0	-7,641	13,361
43	Sac Co. 5	1,939	0	0	0	5,527	7,351
44	City of Folsom	17,068	-2,544	0	2,135	-10,936	3,171
45	Cal Am (Security Park)	1,608	37	0	0	-1,613	79
46	Fruitridge Vista WC	306	235	0	0	3,194	3,621
47	Florin County WD	158	0	0	0	2,209	2,315
48	Cal Am (Parkway)	857	303	0	0	9,845	10,762
49	Sac Co. 6	1,228	3,807	0	228	-4,544	655
50	Sac County WA (North/Central)	18,508	3,649	207	0	8,510	32,290
51	Sac County WA (South)	5,692	203	0	0	14,360	19,306
52	Elk Grove WD (2 - Intertie Service Area)	1,525	1,066	0	0	1,132	3,758
53	Elk Grove WD (1 - GW Service Area)	493	632	0	0	6,665	7,568
54	Cosumnes River West	23,325	11,899	0	0	21,878	56,028
55	RD744	885	6,948	0	-718	-6,346	762
56	Franklin Drainage District	3,383	6,324	0	-205	-6,030	3,365
57	RD813	1,648	3,037	0	-91	-3,265	1,320
58	RD755	549	1,415	0	-249	-1,180	535
59	RD1002	3,199	0	0	0	-115	3,055
60	RD551	8,934	6,259	0	-1,397	-7,491	6,307
61	RD369	441	2,023	0	-201	-2,110	153
62	RD2110	865	-745	0	516	-197	437
63	Sac Co. 7	407	1,342	0	29	-1,507	270
64	Rancho Murieta (North)	5,053	-1,984	0	0	-1,382	893
65	Sloughouse RCD (North)	4,971	93	0	2,791	-5,805	1,874
66	OHWD (Sth American Subbasin)	11,701	15,439	15	64	-969	25,837
	Total SASb	139,681	99,195	222	4,307	-14,179	221,865
			Cosumnes Subbasin				
67	OHWD (Cosumnes Subbasin)	5,590	5,181	0	0	-4,272	6,255
68	Rancho Murieta (South)	1,070	-1,843	0	0	768	6
69	Sloughouse RCD (East)	22,178	3,548	0	1,116	-9,591	19,922
70	Wilton	4,641	45	0	0	3,051	7,953
71	Sloughouse RCD (West)	4,099	381	0	0	5,687	10,570
72	Galt ID (East)	20,192	1,970	0	0	23,121	47,606
73	Clay WD	3,514	1,115	0	0	629	5,634
74	Clay	1,051	3	0	0	733	2,084
75	SMUD Rancho Seco	473	0	0	0	-666	7
76	Cosumnes River South	4,860	9,984	0	-523	-5,018	9,159
77	Galt ID (West)	2,736	776	0	0	2,631	6,062
78	Sac Co. 8	4,301	8,367	0	0	-7,323	5,289
79	City of Galt	1,744	668	0	0	2,623	5,099
80	Sloughouse RCD (South)	1,225	993	0	0	224	2,474
81	Amador Co. 1	13,266	-5,448	0	3,367	-8,492	1,259
82	Ione	1,513	0	0	0	-602	425
83	Jackson ID	8,648	-6,775	0	507	-2,429	0
84	Camanche	5,130	0	0	-4,621	-1,420	81
85	Amador County WA	1,477	0	0	5	-1,559	176
87	Galt WWTP	344	0	0	0	-352	0
	Total CoSb	108,054	18,964	0	-149	-2,255	130,062
			Other				
86	Mokelumne	29,317	49,564	0	3,650	-2,823	83,278
	Total Other	29,317	49,564	0	3,650	-2,823	83,278
CoSANA Total (NASb, SASb, CoSb)		439,507	201,381	18,757	34,495	2,823	667,907

APPENDIX F: CALIBRATION HYDROGRAPHS

***Note:** hydrographs developed for this appendix use a transmissivity-weighted average of layers 2 through 5 for simulated groundwater heads.*




CoSANA Model
Groundwater Level Calibration Wells
Legend
Subbasin Boundaries
Major Highways
Minor Highways
Rivers and Streams
Lakes and Waterways
County Boundaries
CoSANA Model Boundary
Calibration Well (HQ subset)
N
0
2.25
4.5
Miles
WOODARD &CURRAN
EL DORADO COUNTY
SACRAMENTO COUNTY
YOLO COUNTY
AMADOR COUNTY
SAN JOAQUIN COUNTY
American River
Sacramento River
Cosumnes River
Dry Creek
Camanche Reservoir
80
5
88
12
104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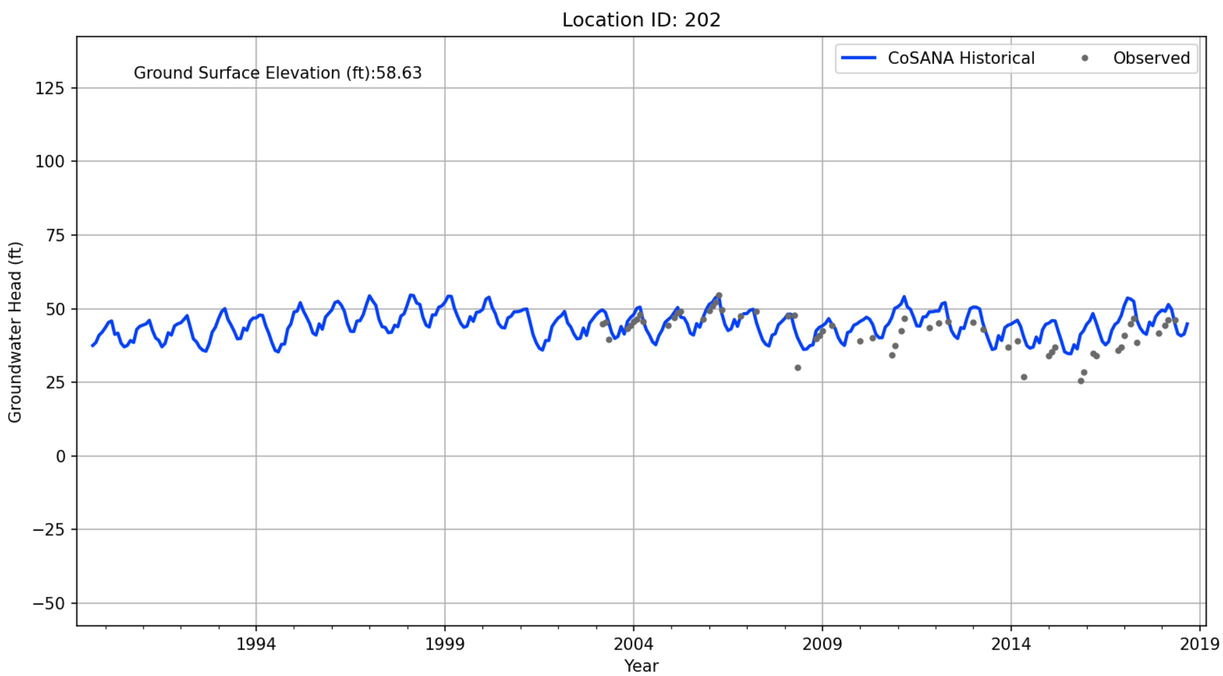
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year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CoSANA Historical
Observed
Groundwater Head (ft)
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100
75
50
25
0
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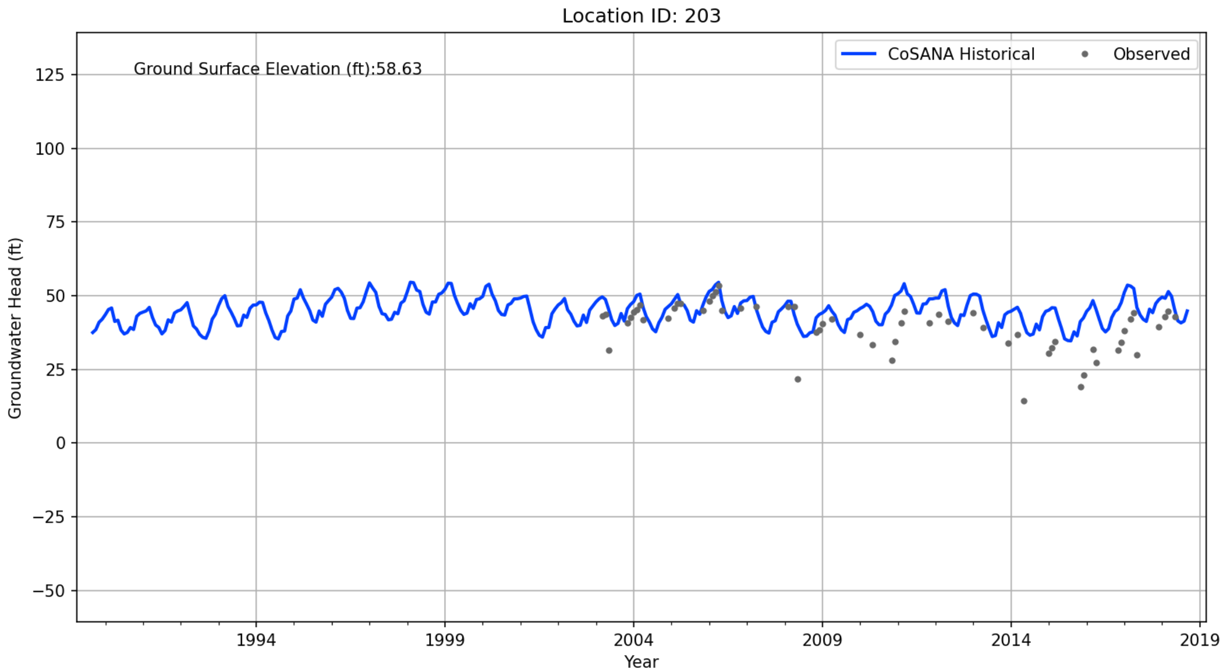
1999
2004
2009
2014
2019
Year



Location ID: 203
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CoSANA Historical
Observed
Groundwater Head (ft)
Year
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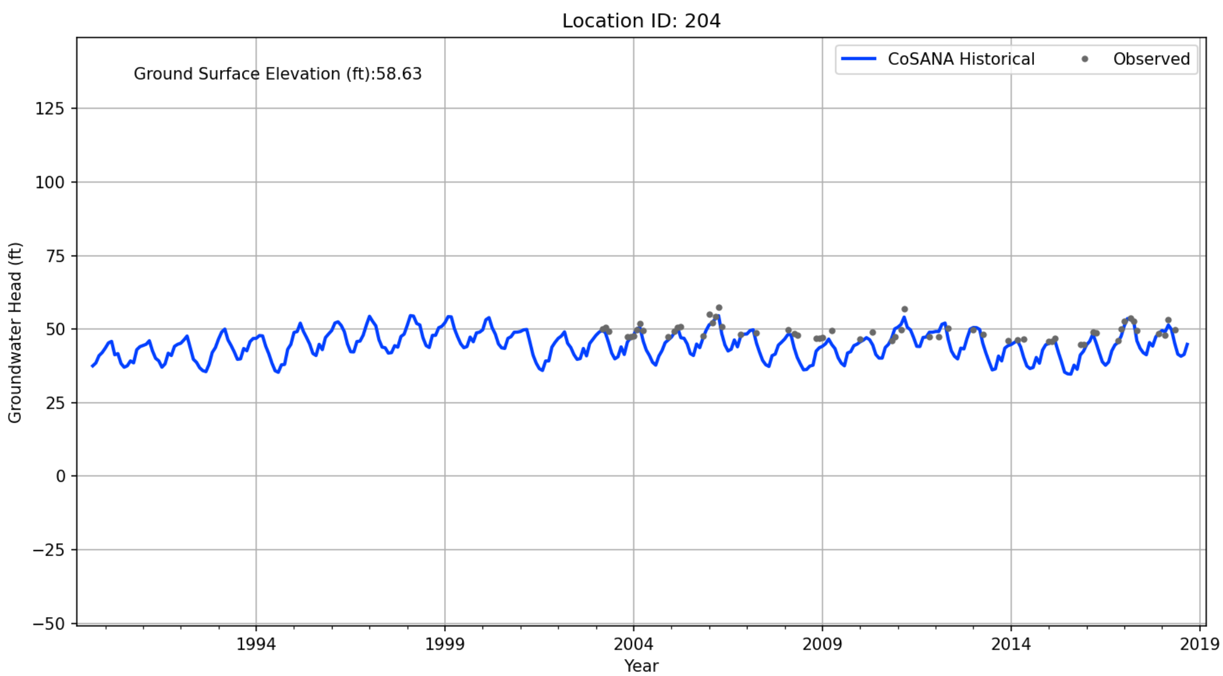
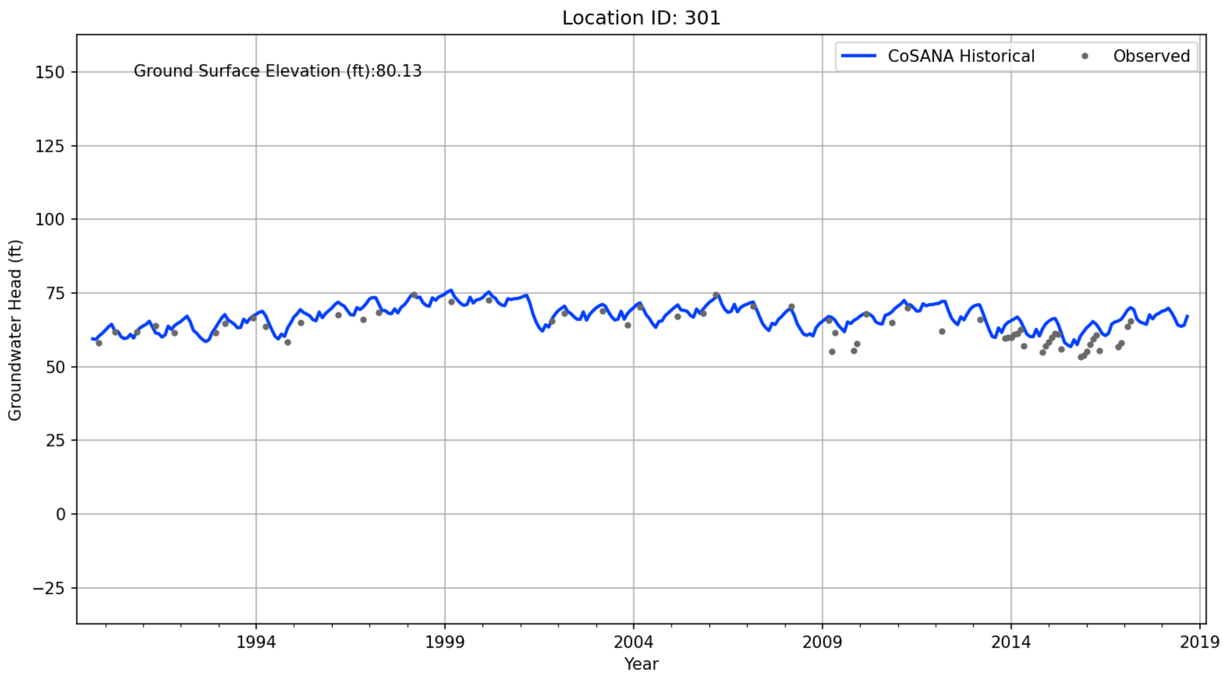
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019



Location ID: 204
Ground Surface Elevation (ft):58.63
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019



Location ID: 301
CoSANA Historical
Observed
Ground Surface Elevation (ft):80.13
Groundwater Head (ft)
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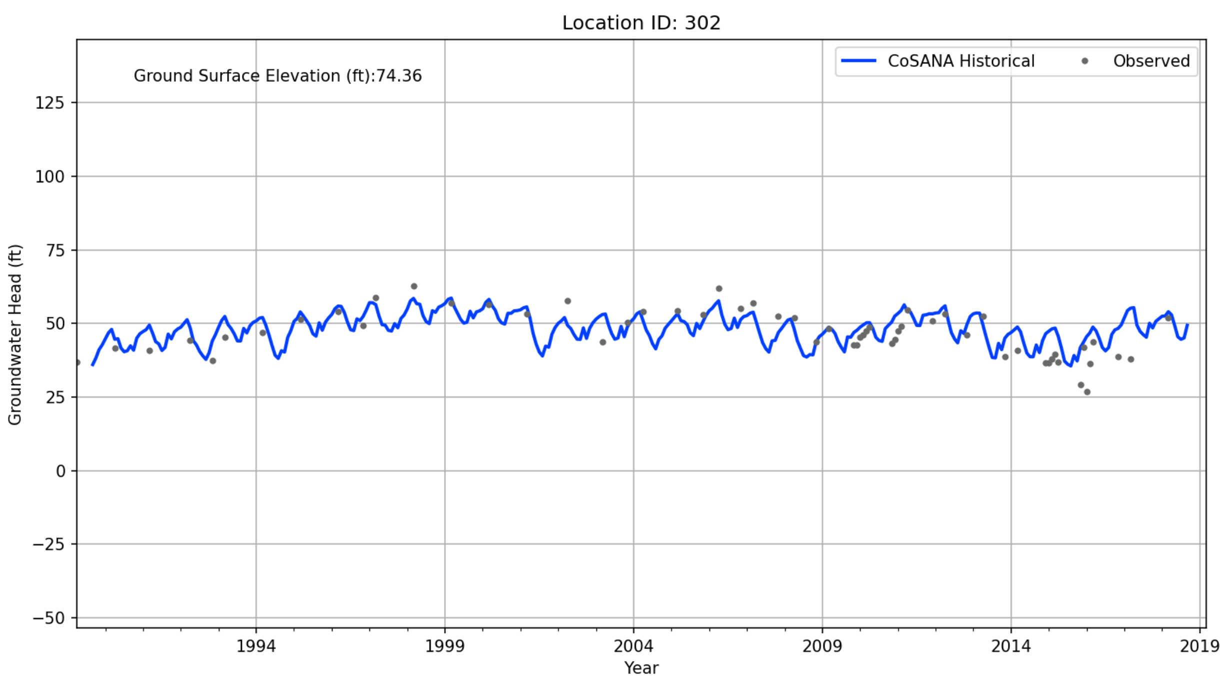
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year



Location ID: 302
CoSANA Historical
Observed
Ground Surface Elevation (ft):74.36
Groundwater Head (ft)
125
100
75
50
25
0
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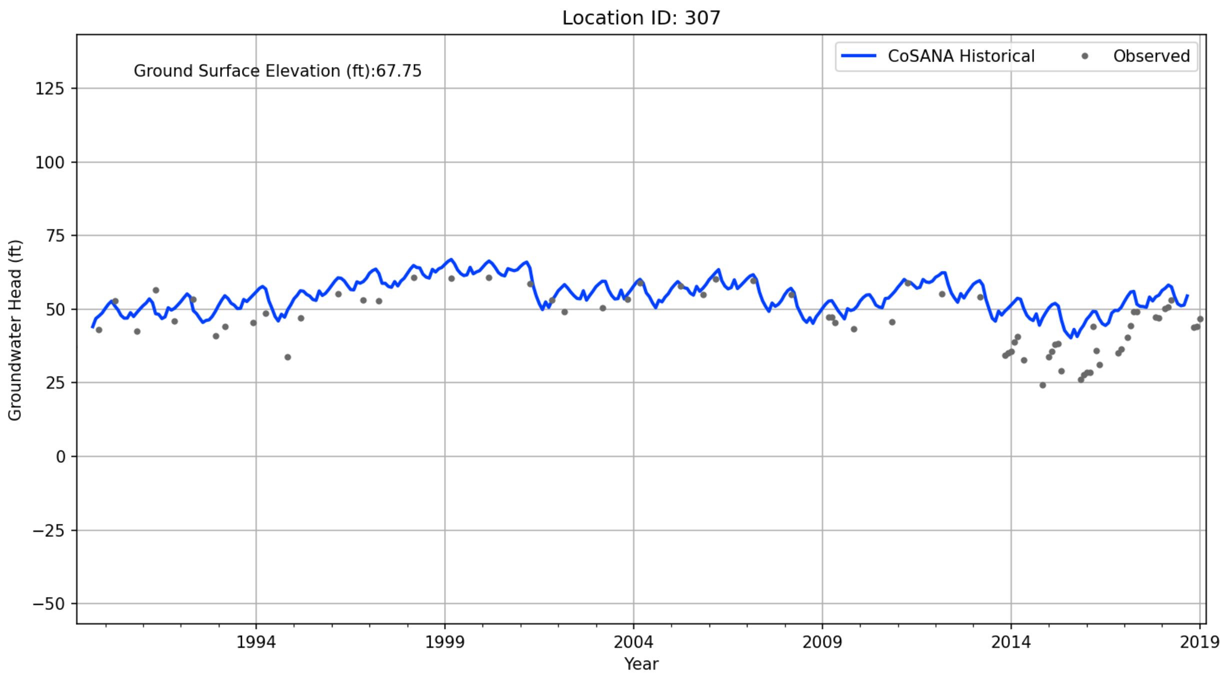
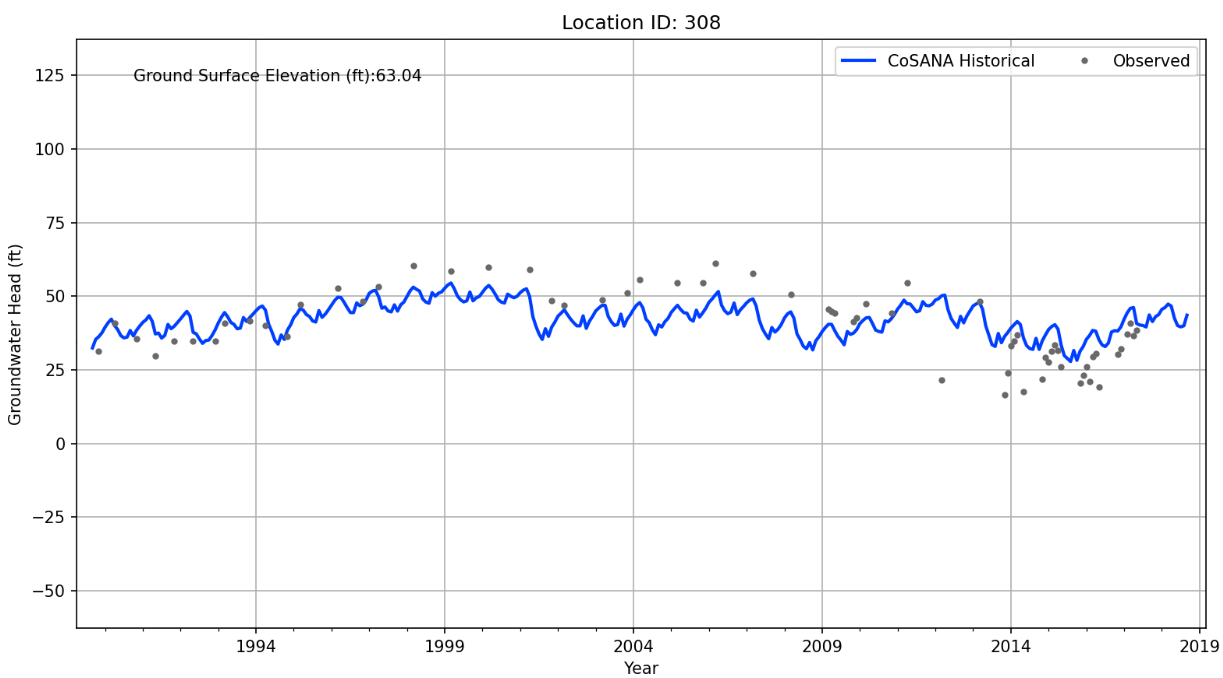
1994
1999
2004
2009
2014
2019
Year



Location ID: 307
Ground Surface Elevation (ft):67.75
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year



Location ID: 308
Ground Surface Elevation (ft):63.04
CoSANA Historical
Observed
Groundwater Head (ft)
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100
75
50
25
0
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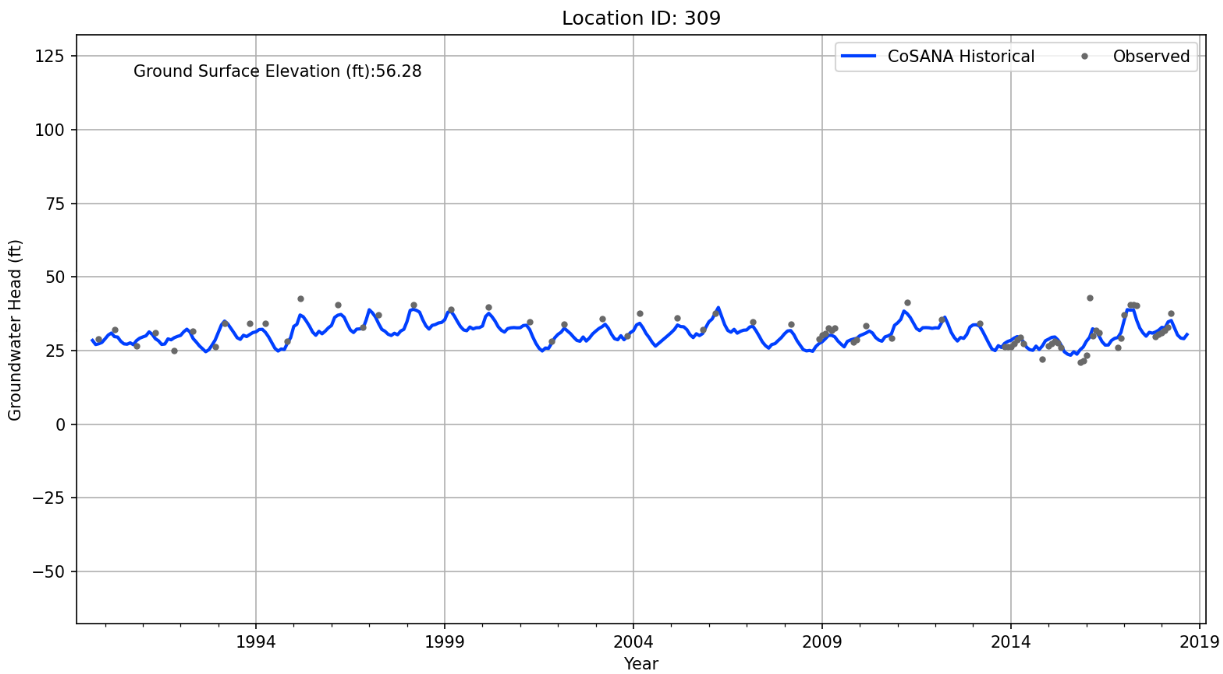
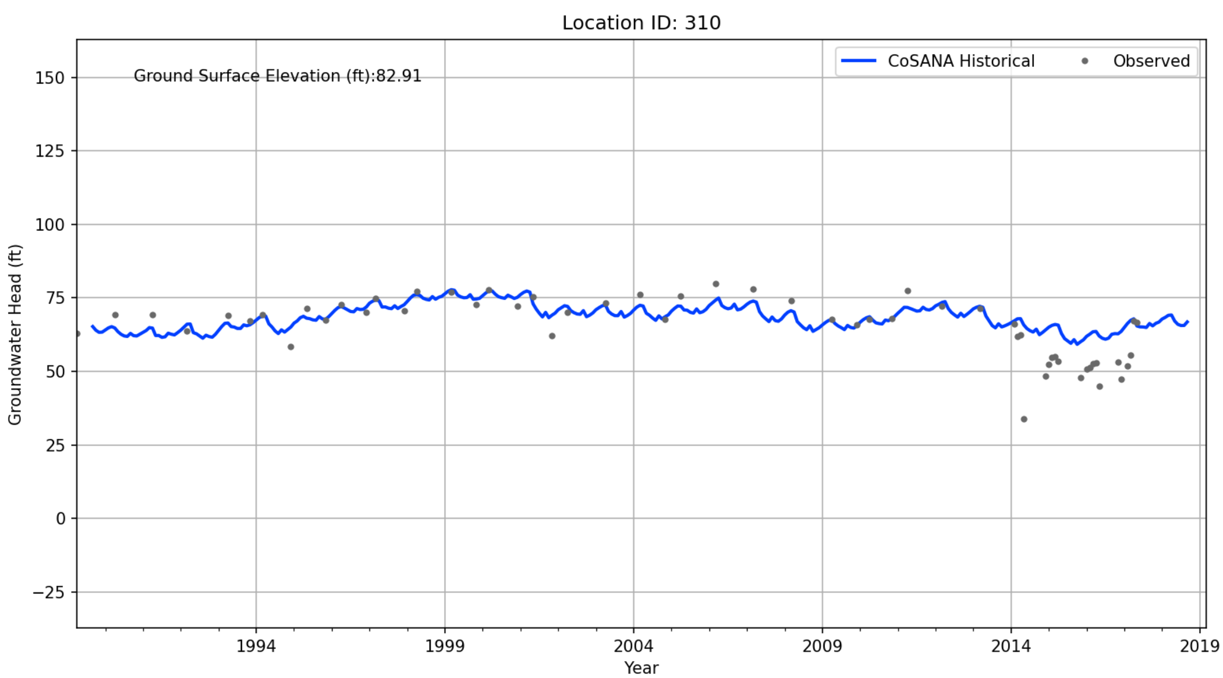
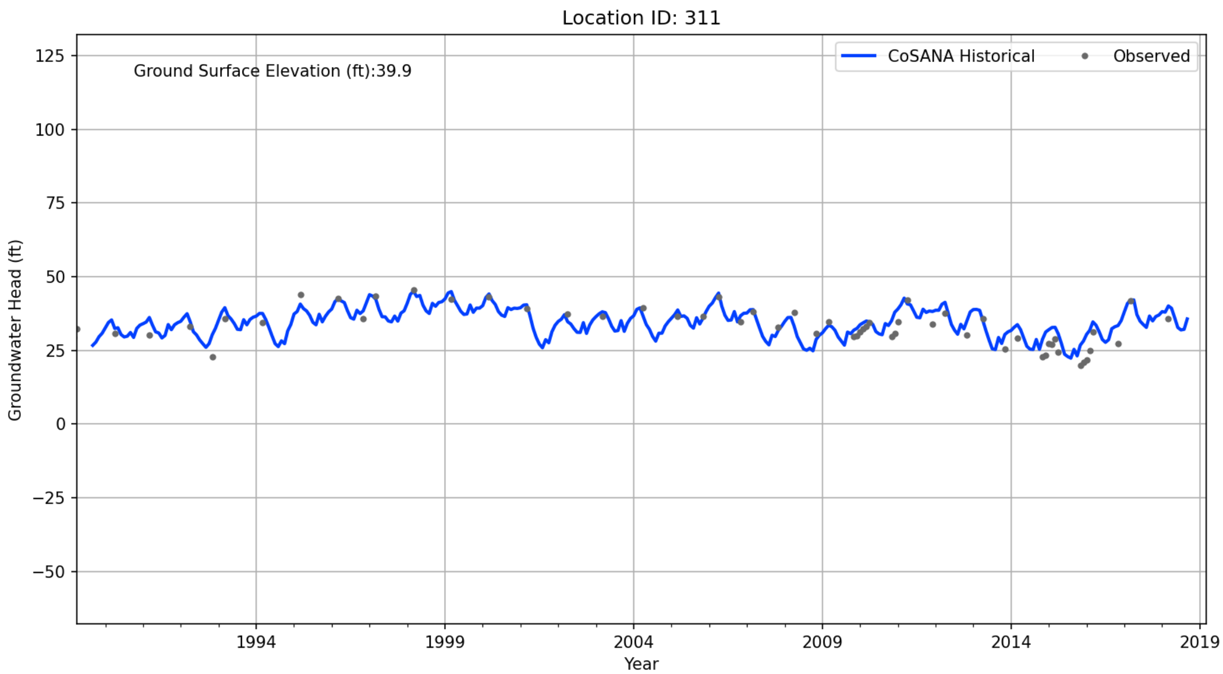
1994
1999
2004
2009
2014
2019
Year

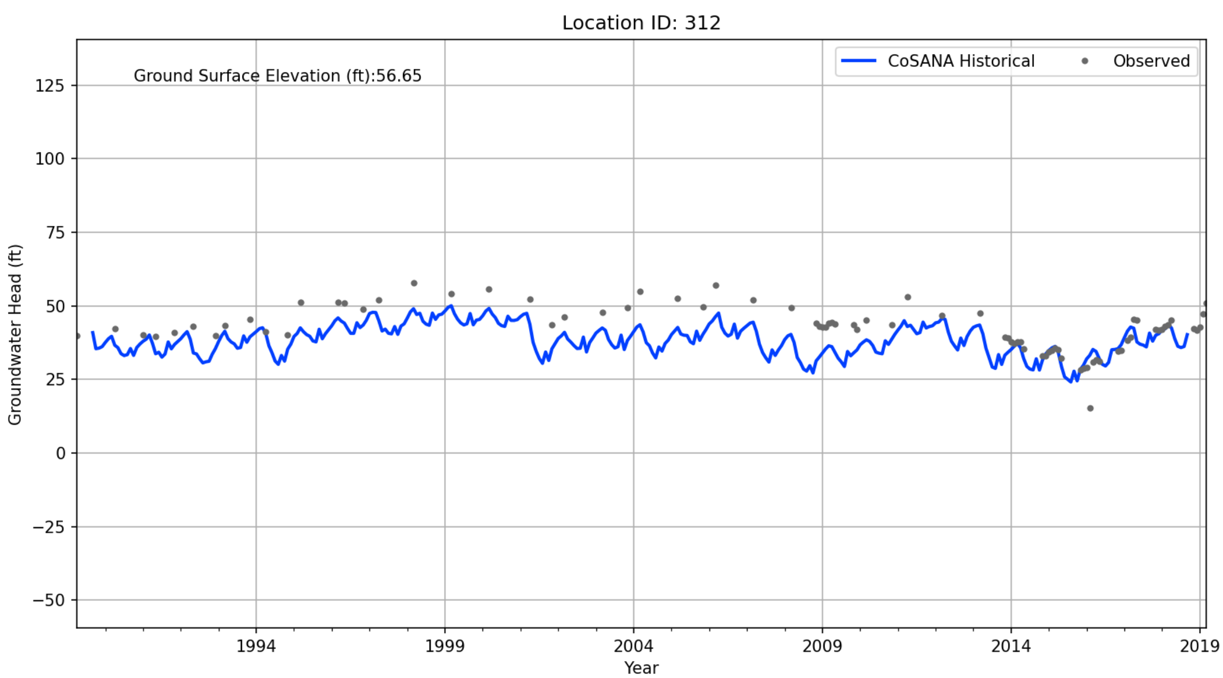


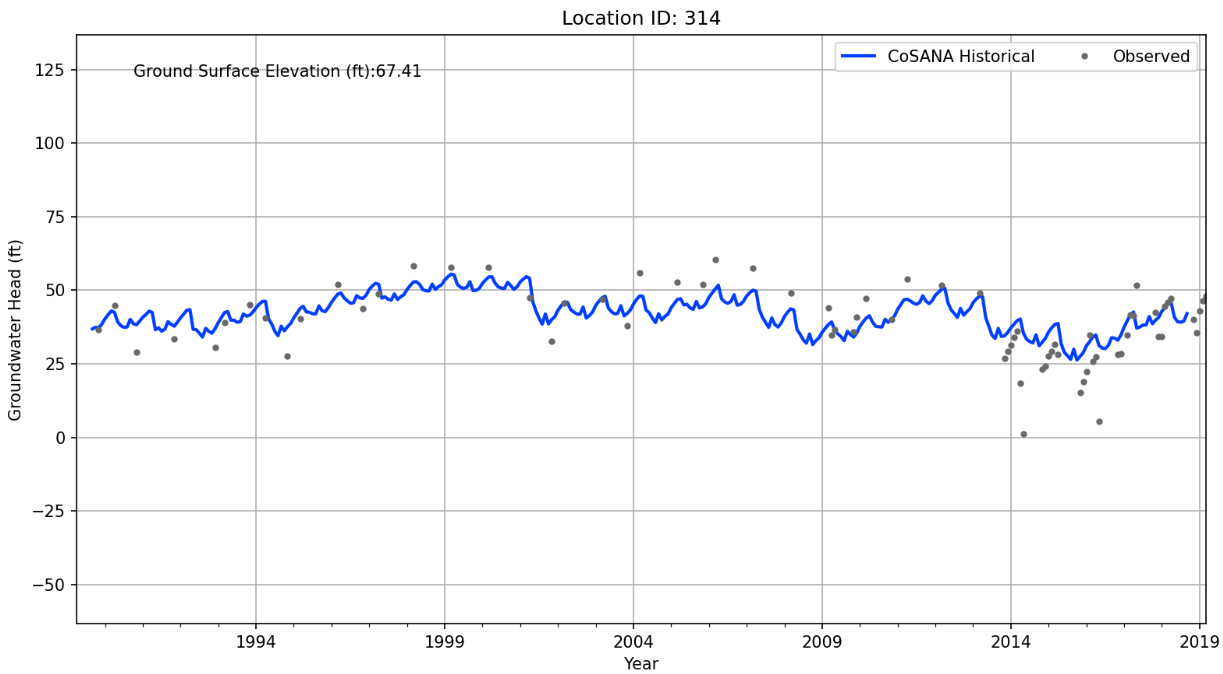
Location ID: 309
Ground Surface Elevation (ft):56.28
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

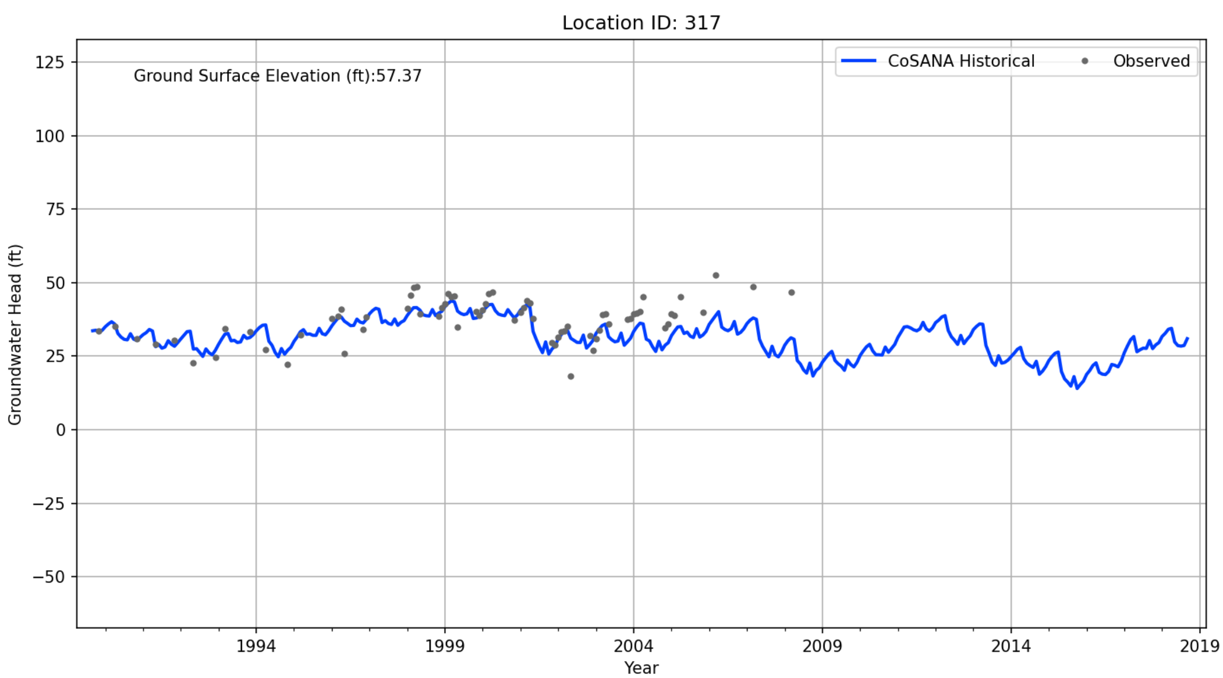


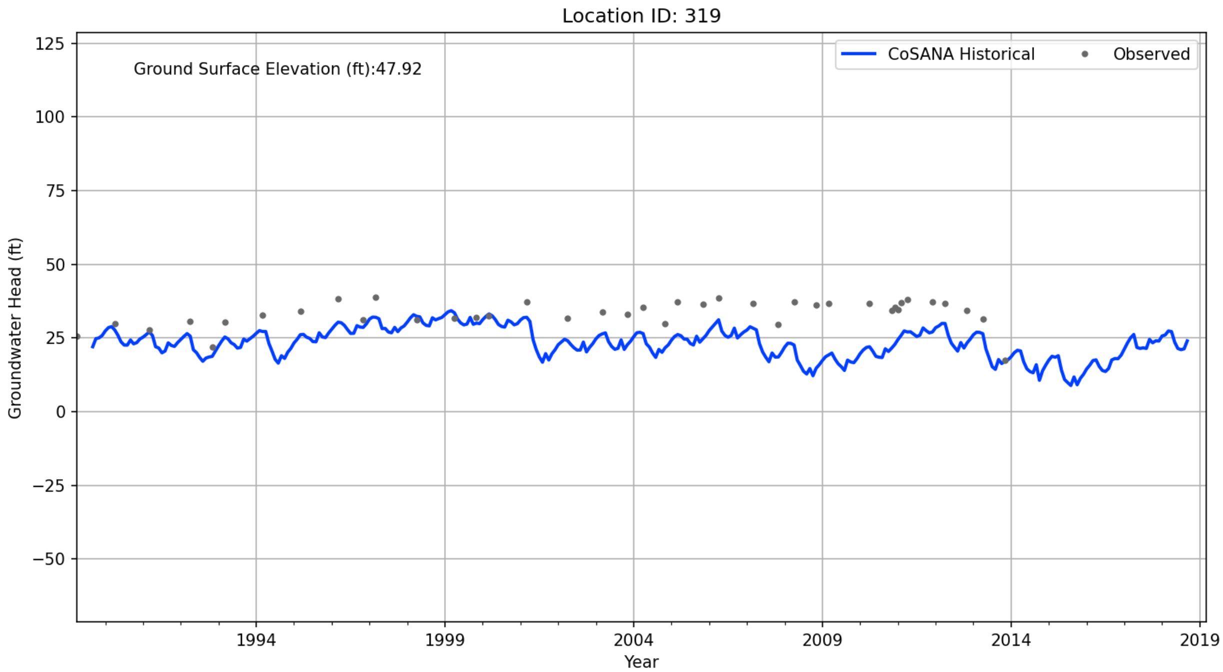
Location ID: 310
Ground Surface Elevation (ft):82.91
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

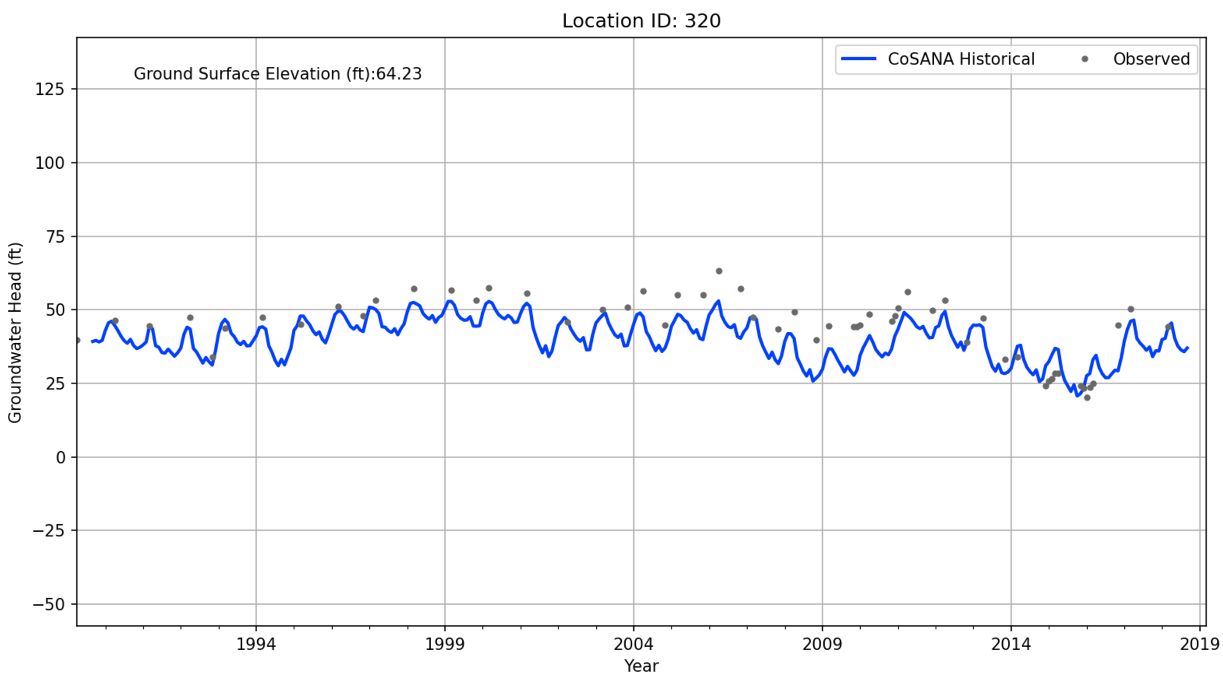

Location ID: 311
Ground Surface Elevation (ft):39.9
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

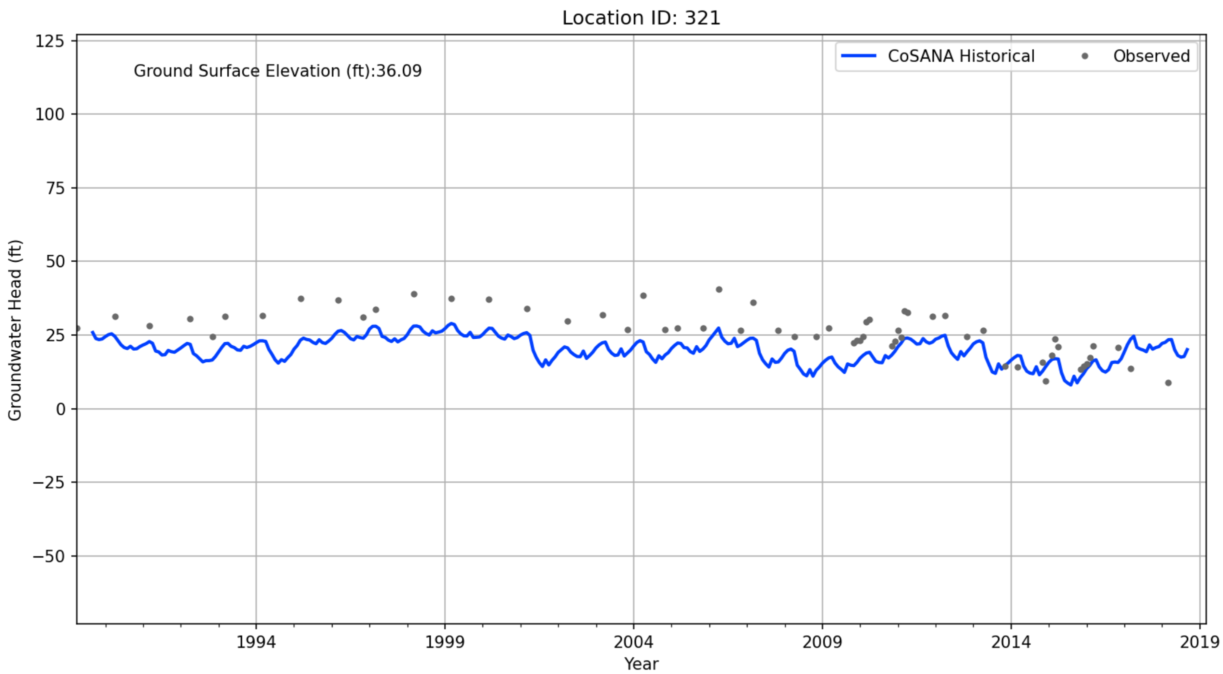

Location ID: 312
Ground Surface Elevation (ft):56.65
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019


Location ID: 314
Ground Surface Elevation (ft):67.41
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

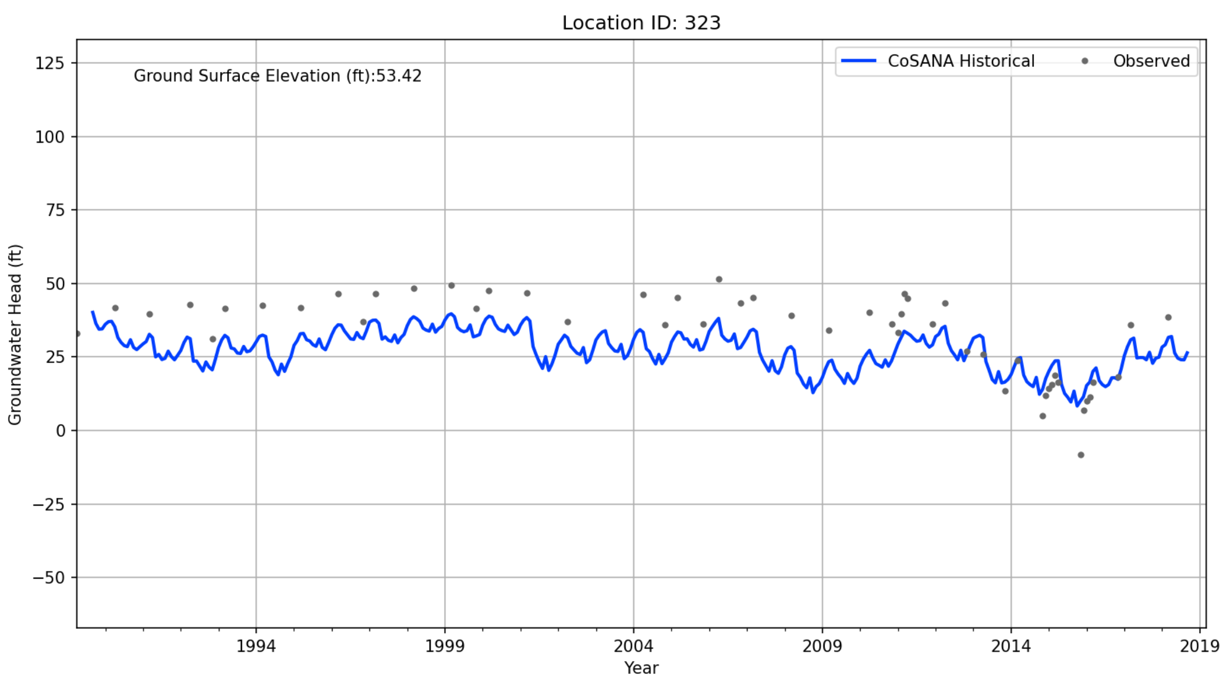

Location ID: 317
Ground Surface Elevation (ft):57.37
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019


Location ID: 319
Ground Surface Elevation (ft):47.92
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

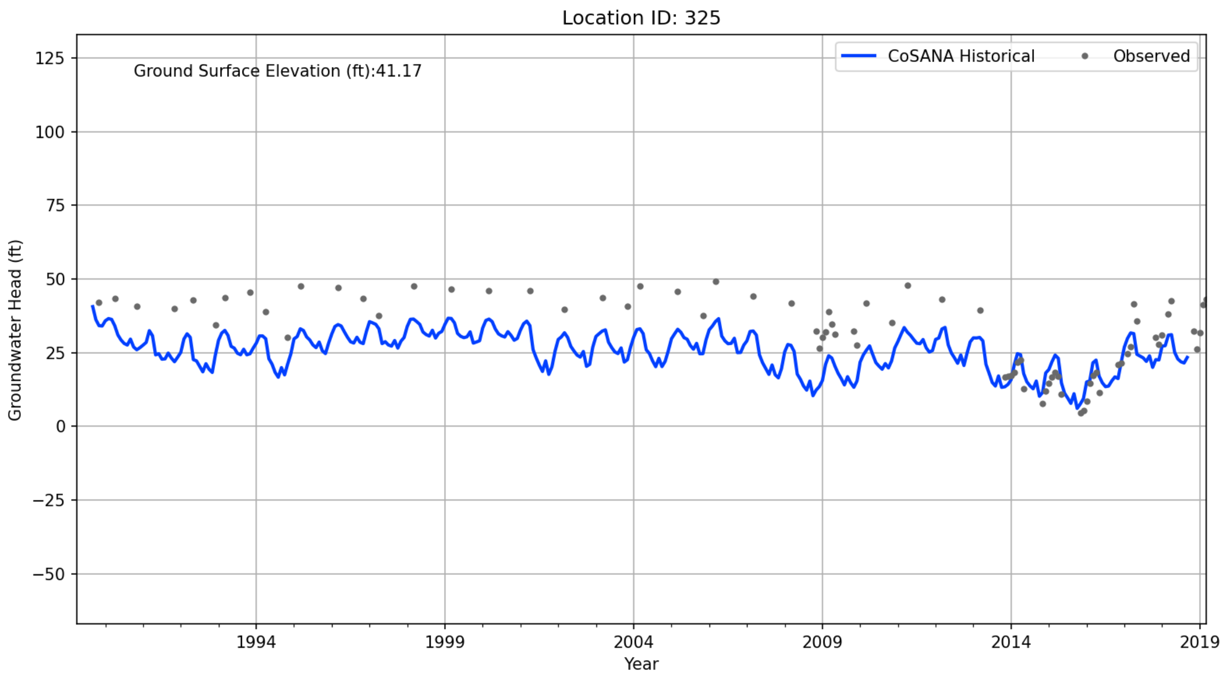

Location ID: 320
Ground Surface Elevation (ft):64.23
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

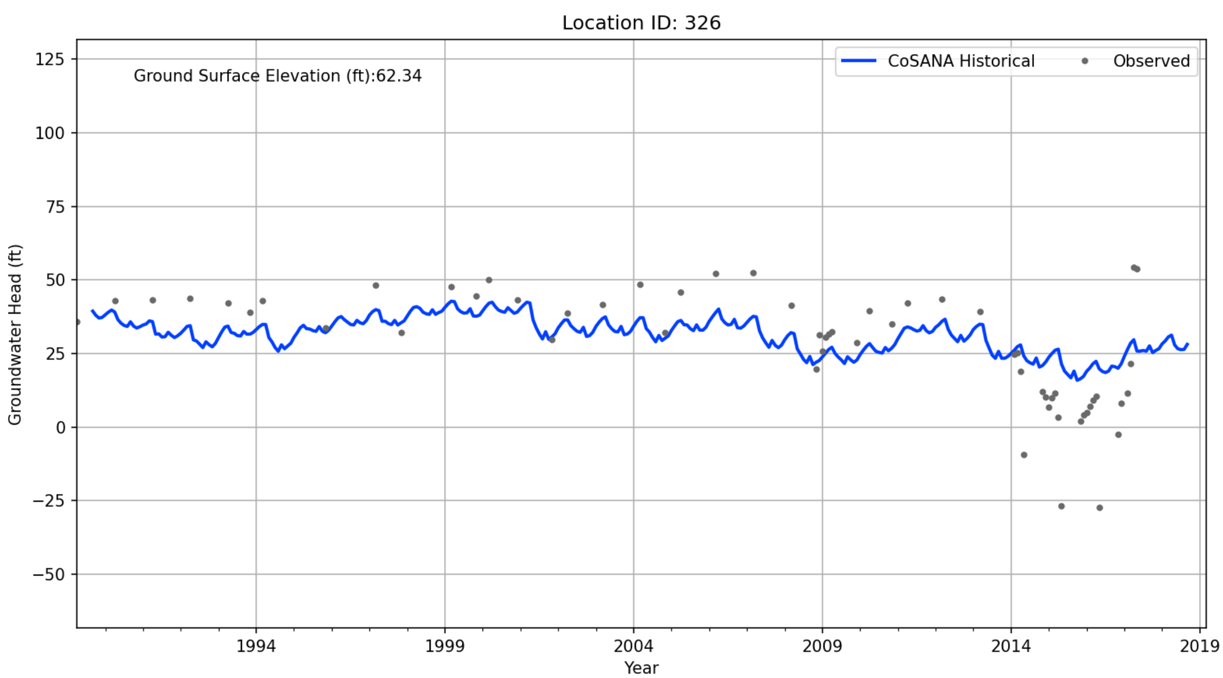


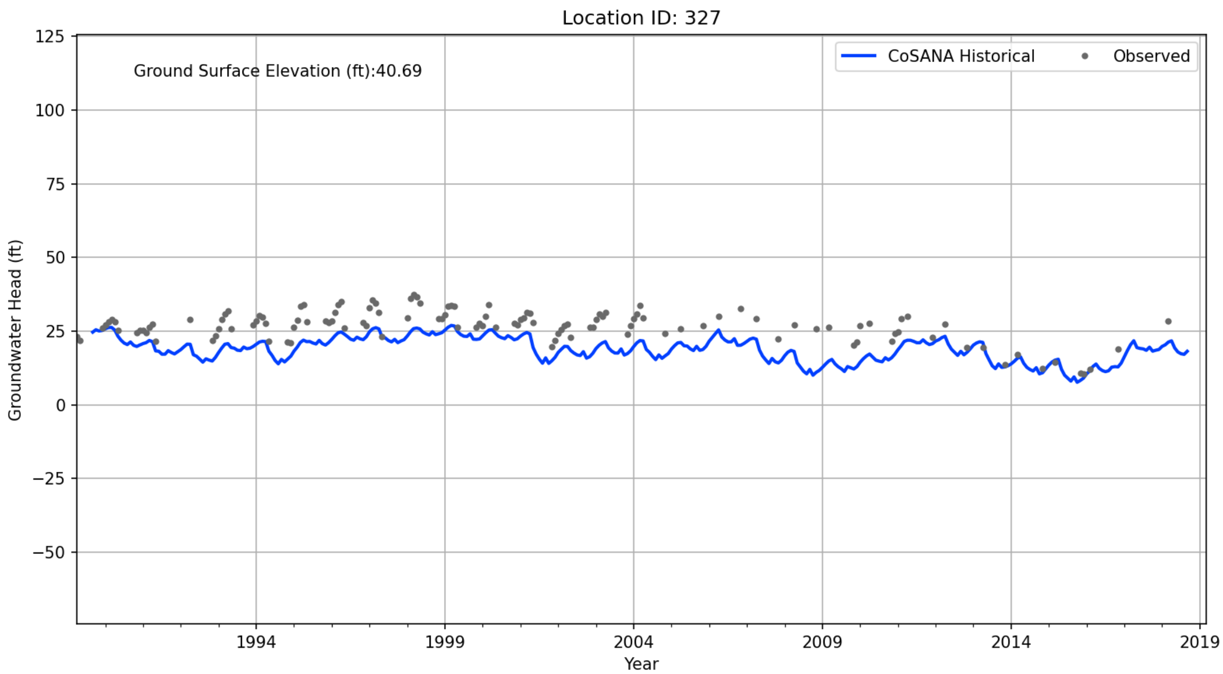
Location ID: 321
Ground Surface Elevation (ft):36.09
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019



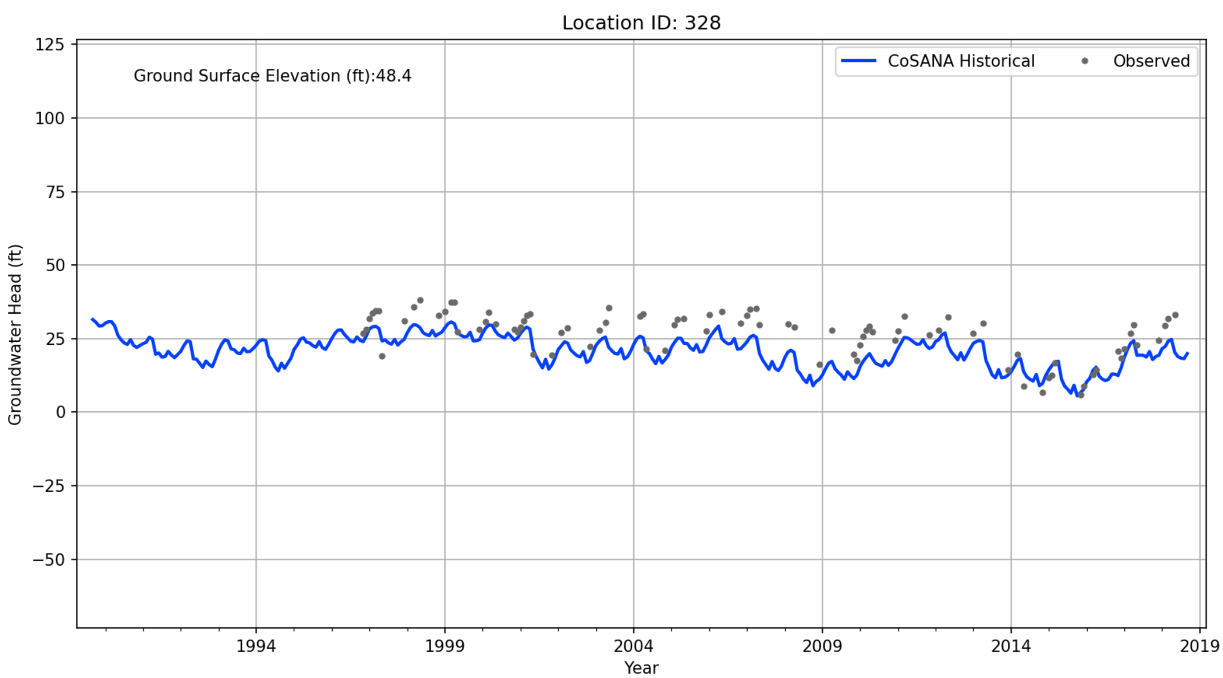
Location ID: 323
Ground Surface Elevation (ft):53.42
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019


Location ID: 325
Ground Surface Elevation (ft):41.17
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

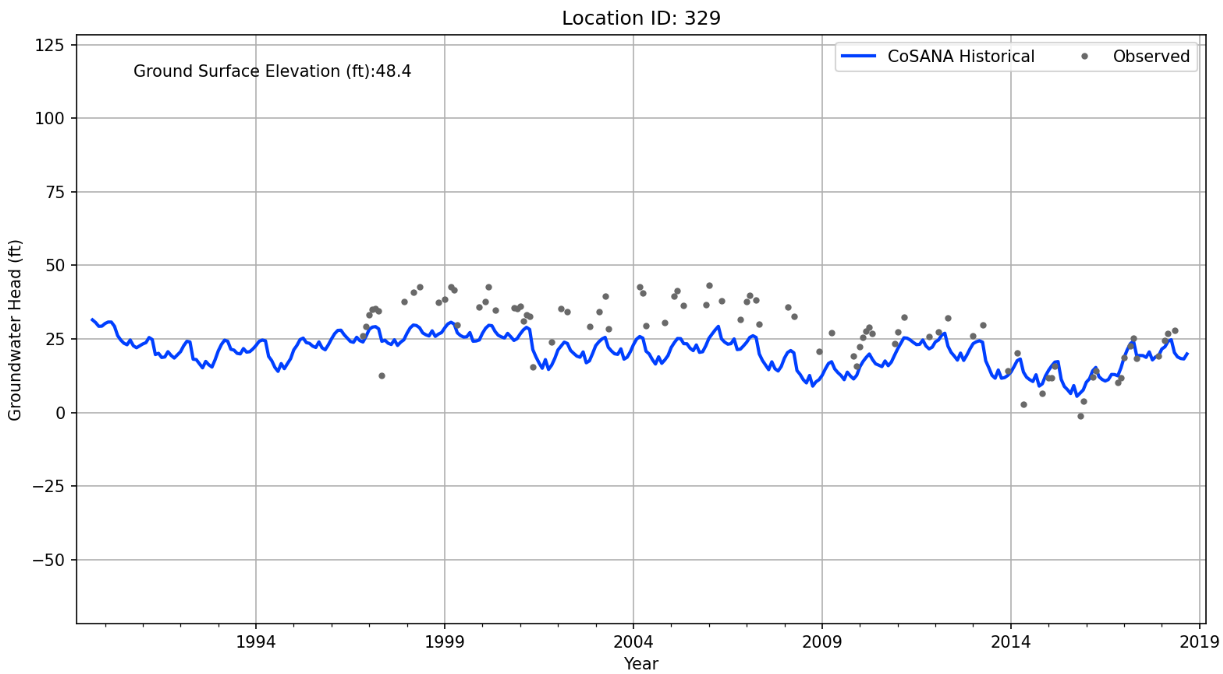

Location ID: 326
Ground Surface Elevation (ft):62.34
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

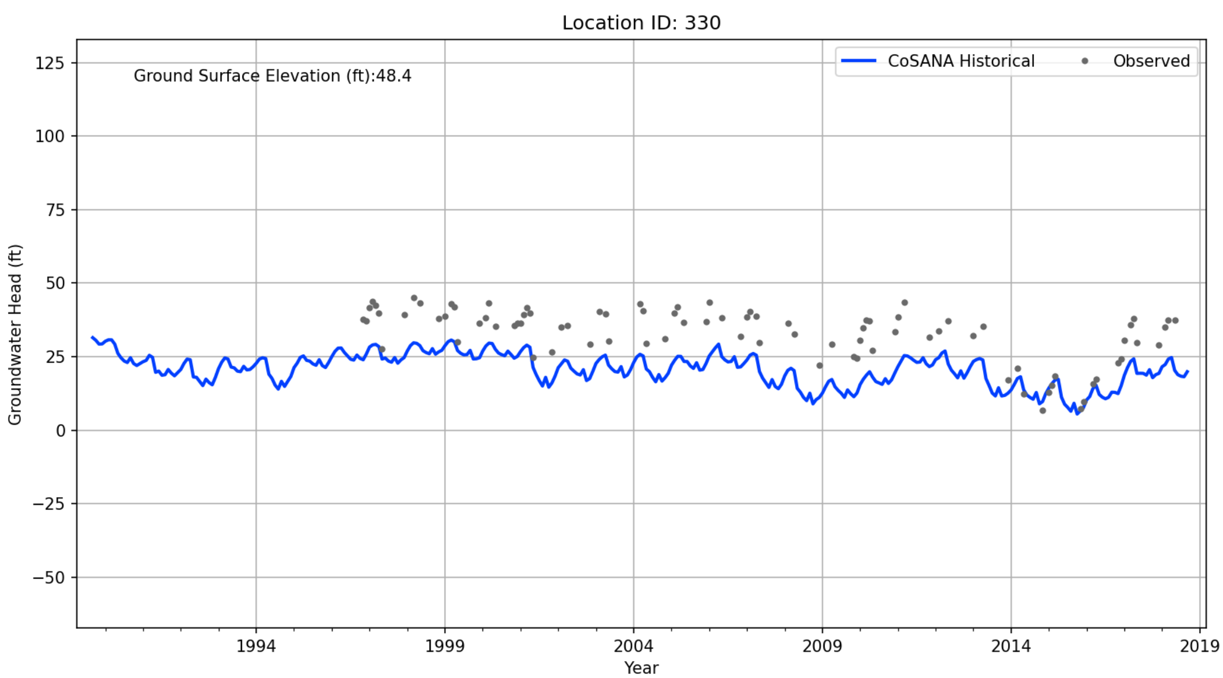


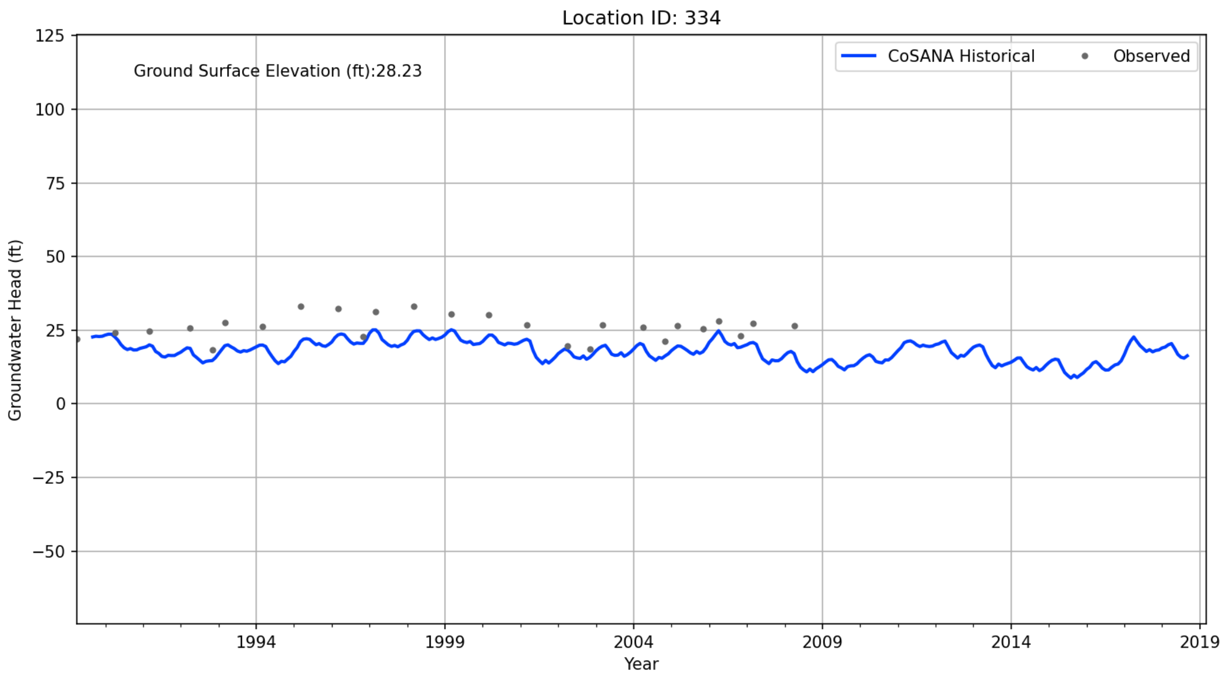
Location ID: 327
Ground Surface Elevation (ft):40.69
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019



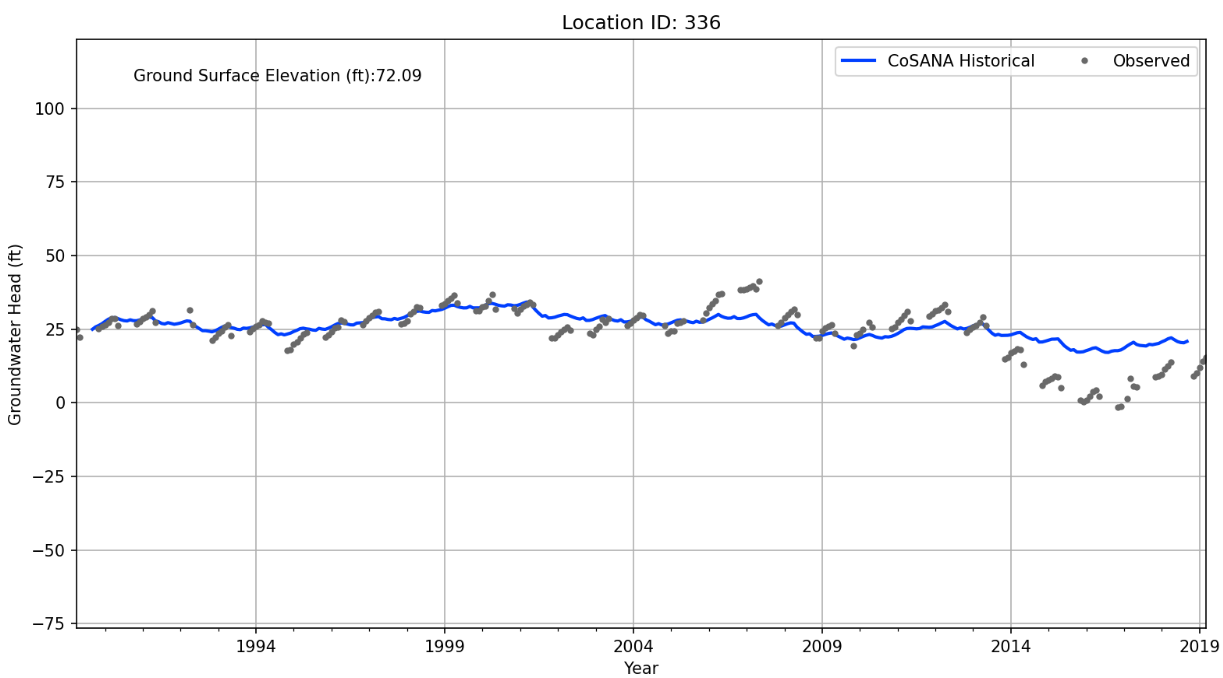
Location ID: 328
Ground Surface Elevation (ft):48.4
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019


Location ID: 329
Ground Surface Elevation (ft):48.4
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

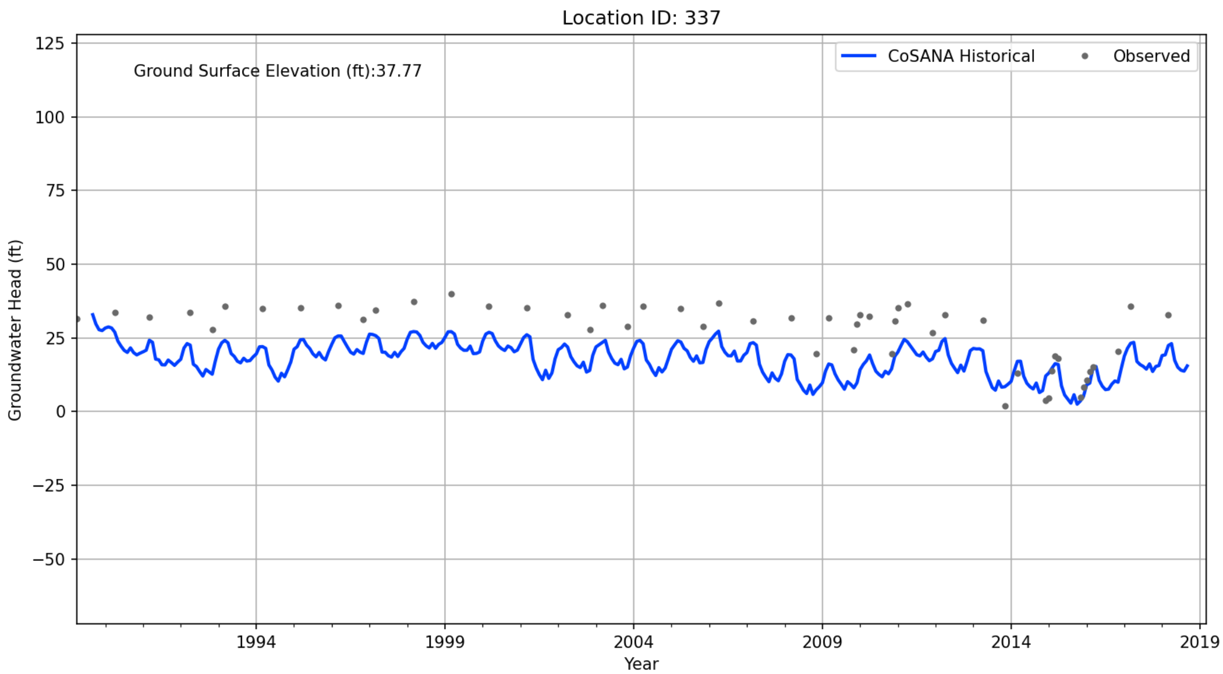

Location ID: 330
Ground Surface Elevation (ft):48.4
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

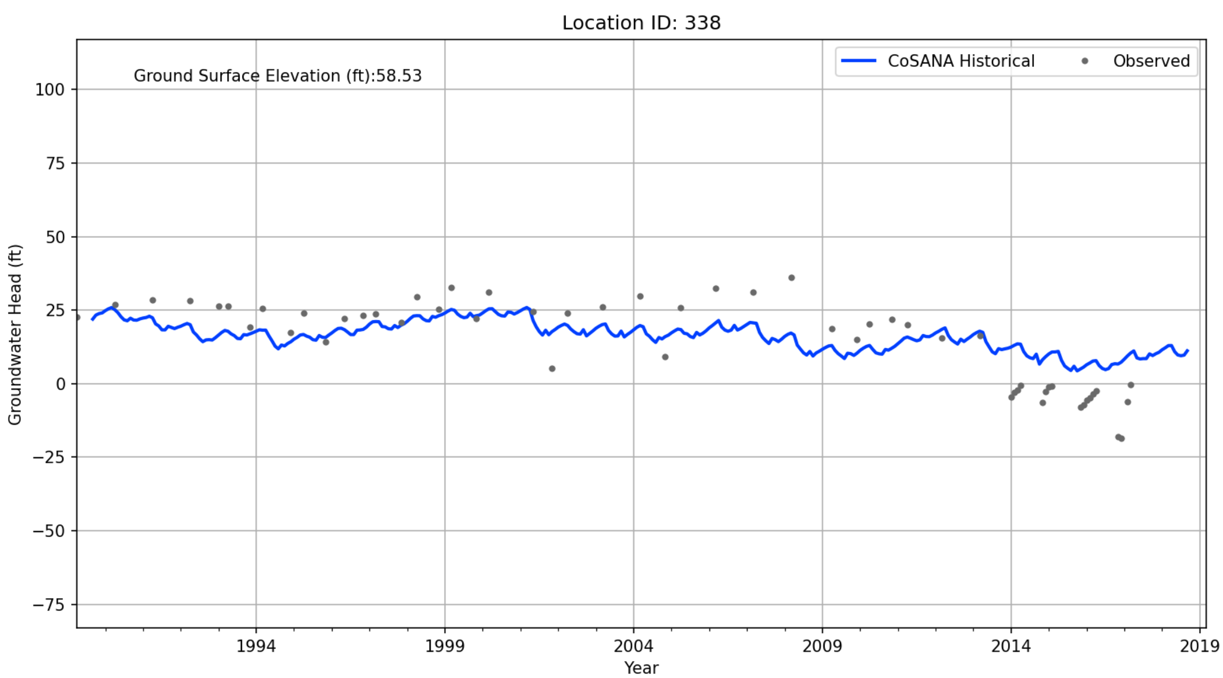


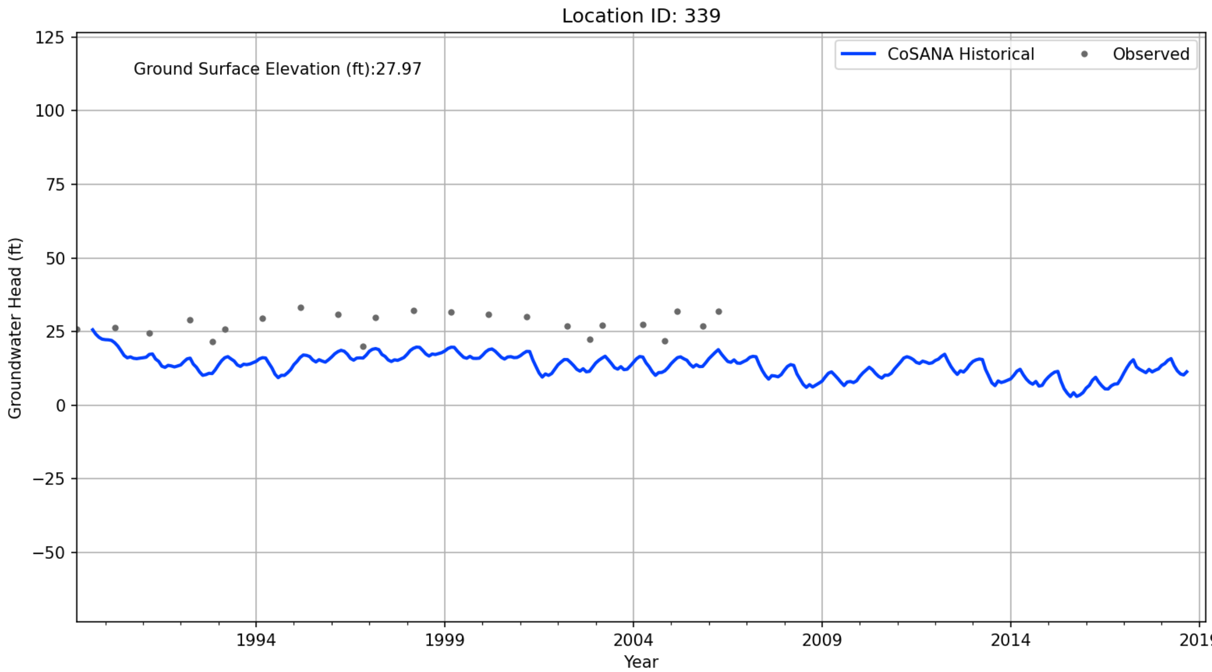
Location ID: 334
Ground Surface Elevation (ft):28.23
CoSANA Historical
Observed
Groundwater Head (ft)
Year



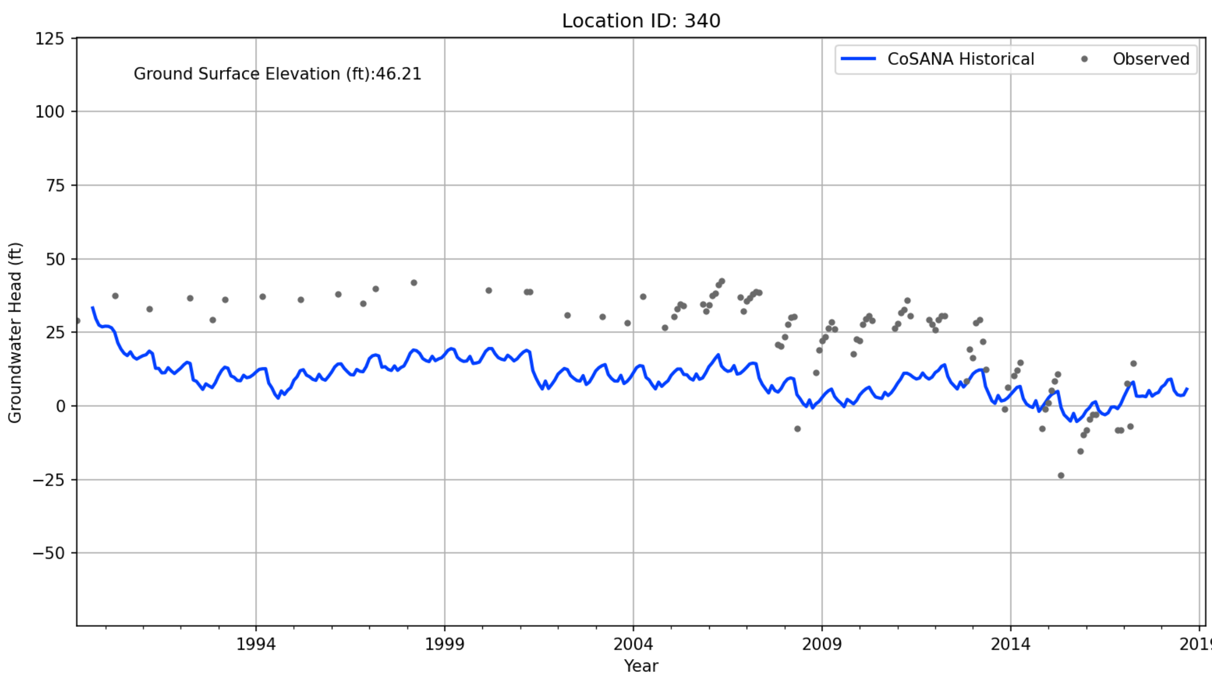
Location ID: 336
Ground Surface Elevation (ft):72.09
CoSANA Historical
Observed
Groundwater Head (ft)
Year


Location ID: 337
Ground Surface Elevation (ft):37.77
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

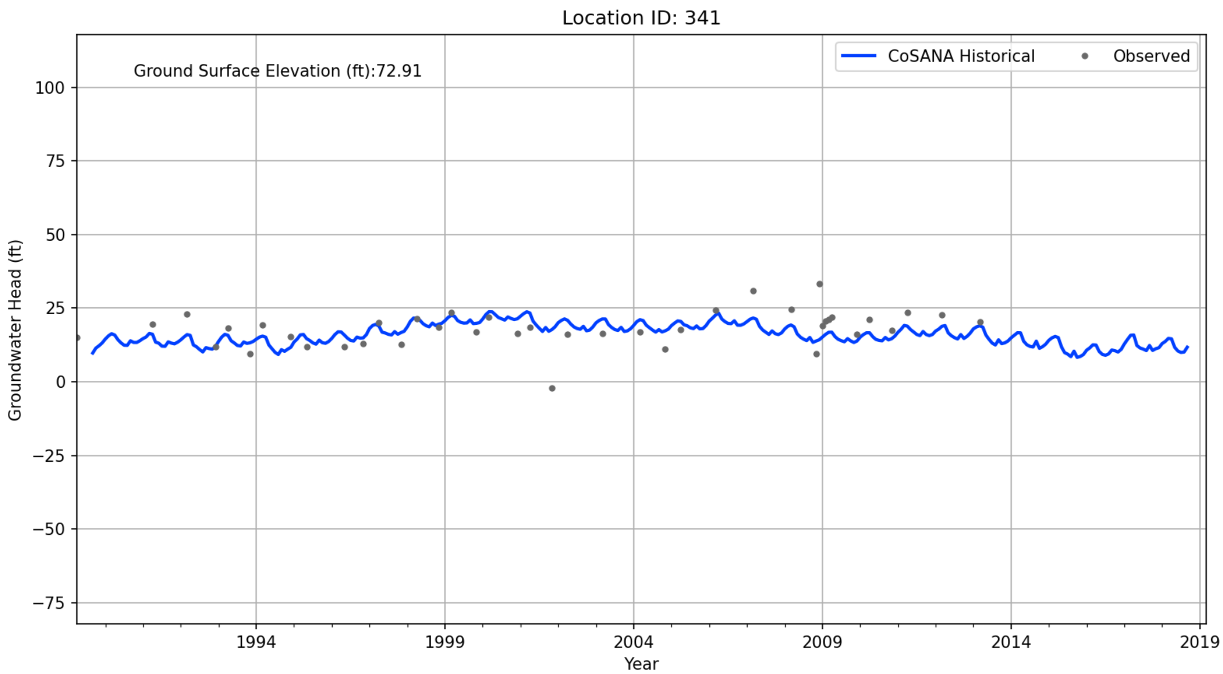

Location ID: 338
Ground Surface Elevation (ft):58.53
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

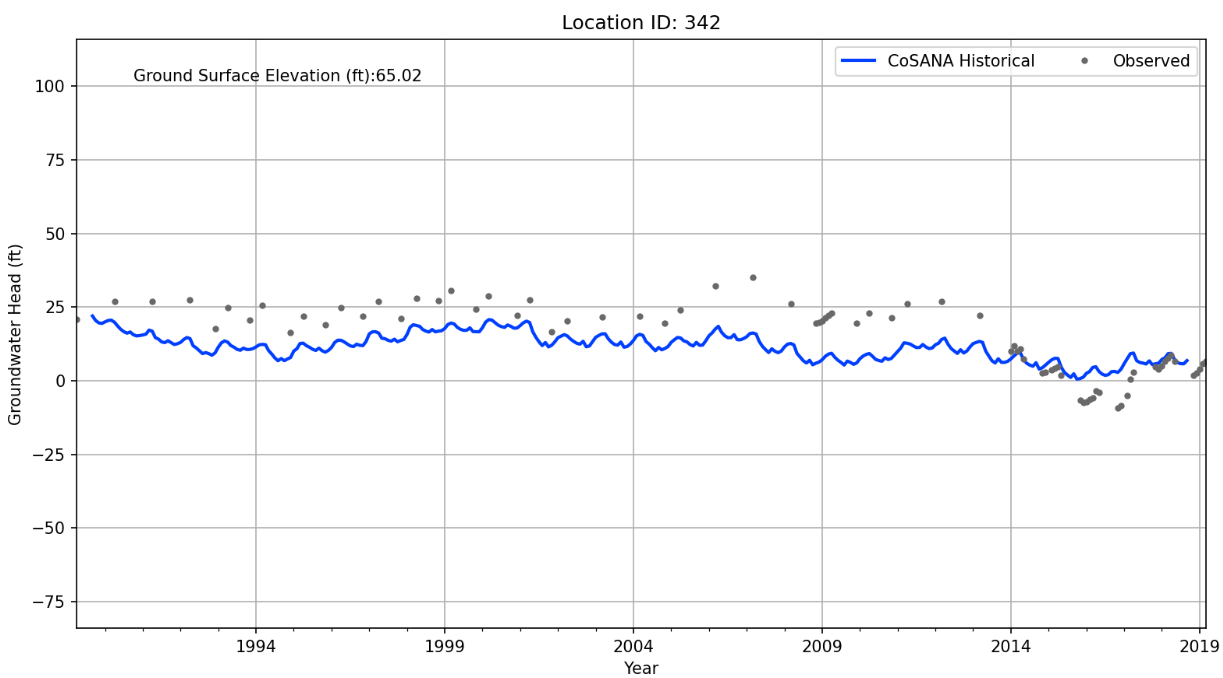


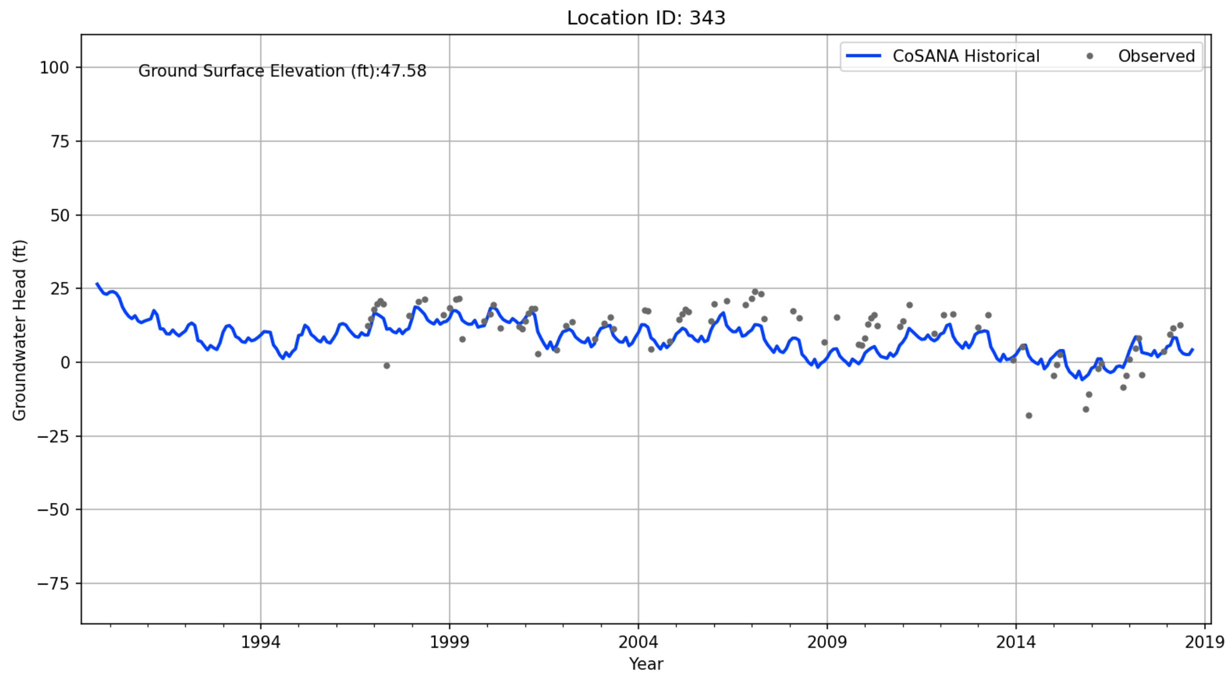
Location ID: 339
Ground Surface Elevation (ft):27.97
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

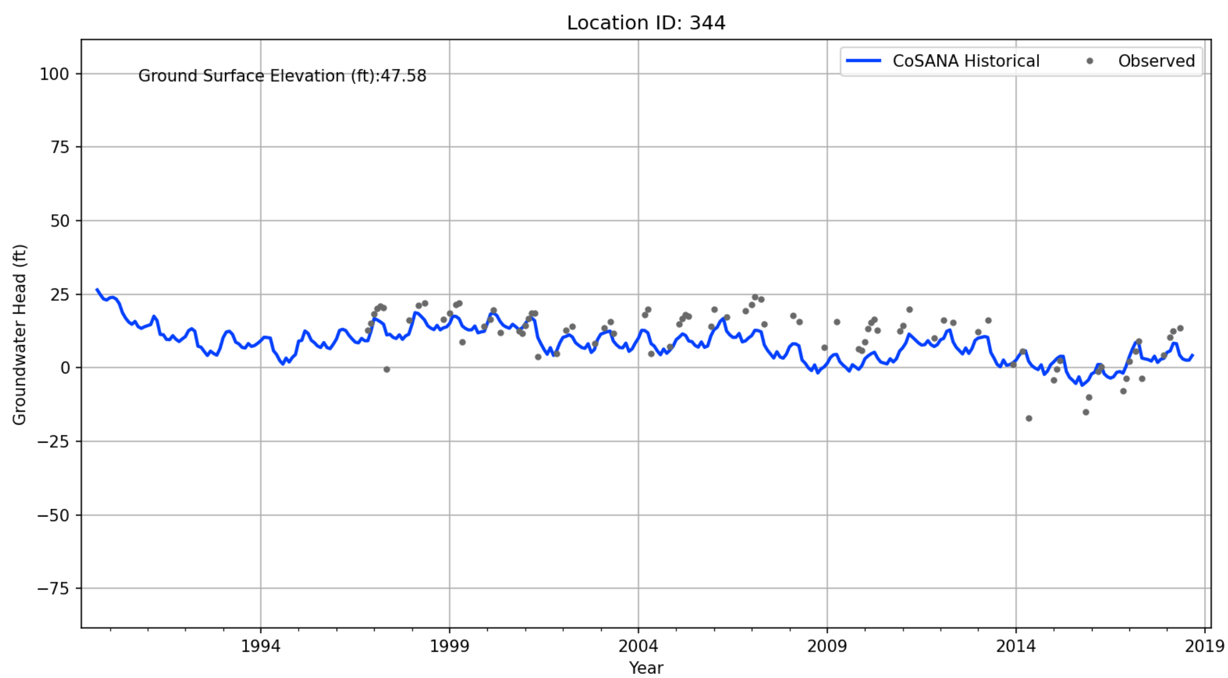


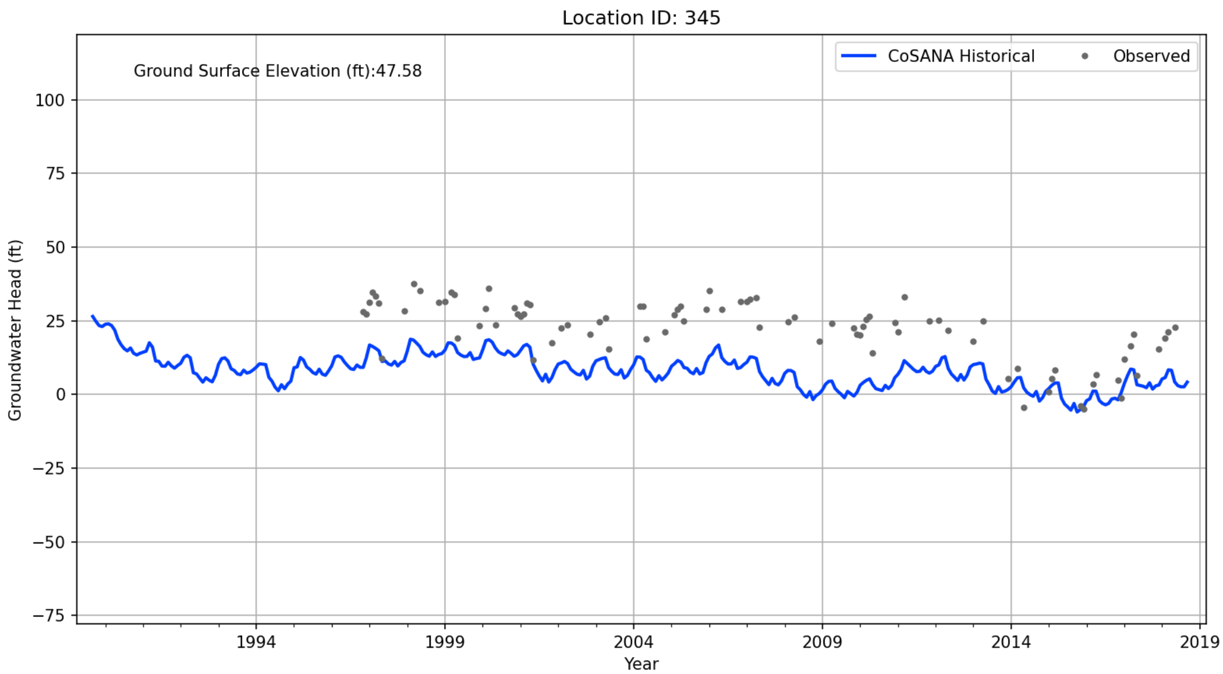
Location ID: 340
Ground Surface Elevation (ft):46.21
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

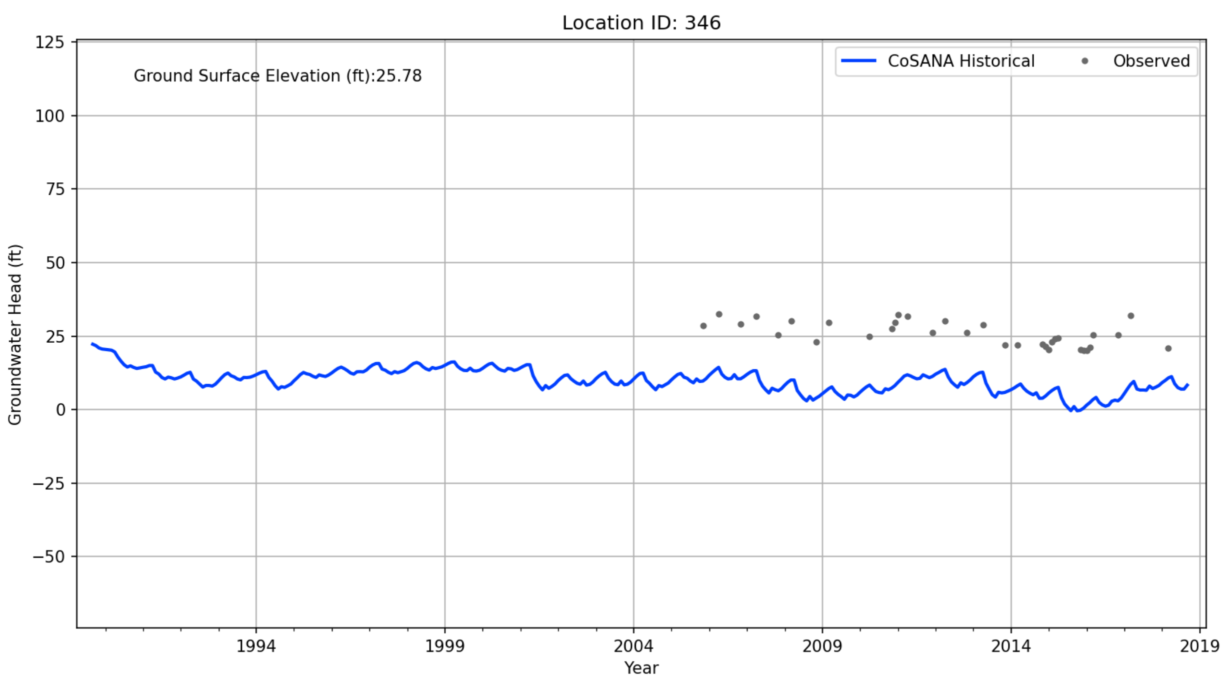

Location ID: 341
Ground Surface Elevation (ft):72.91
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

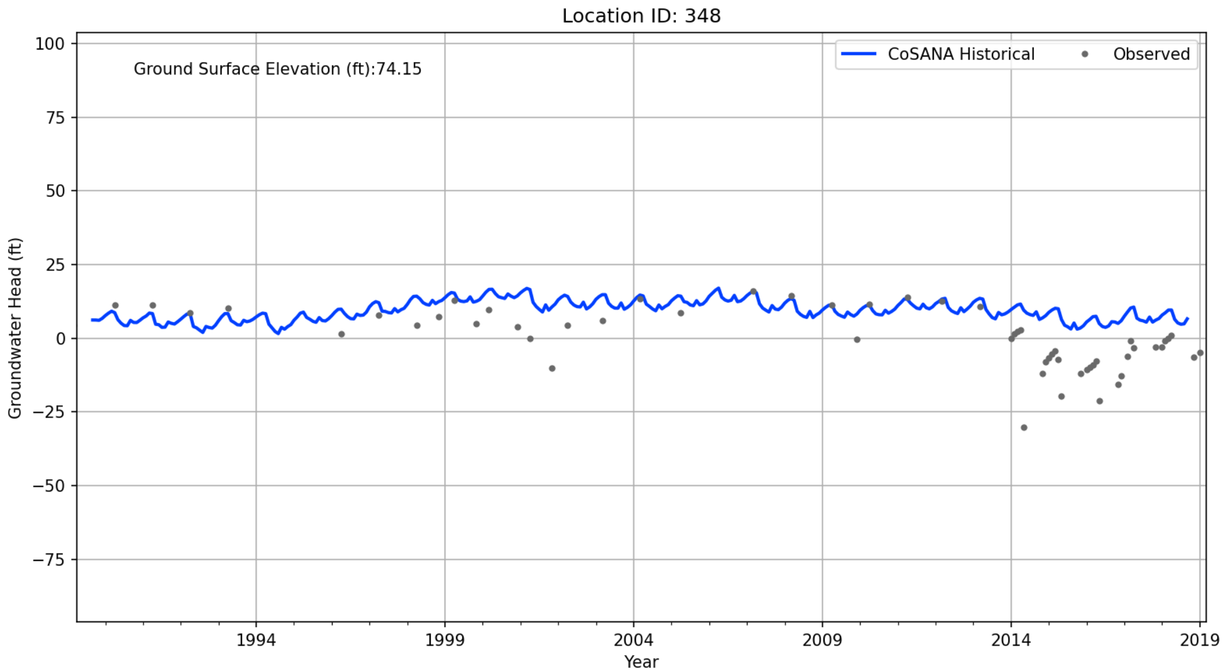

Location ID: 342
Ground Surface Elevation (ft):65.02
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

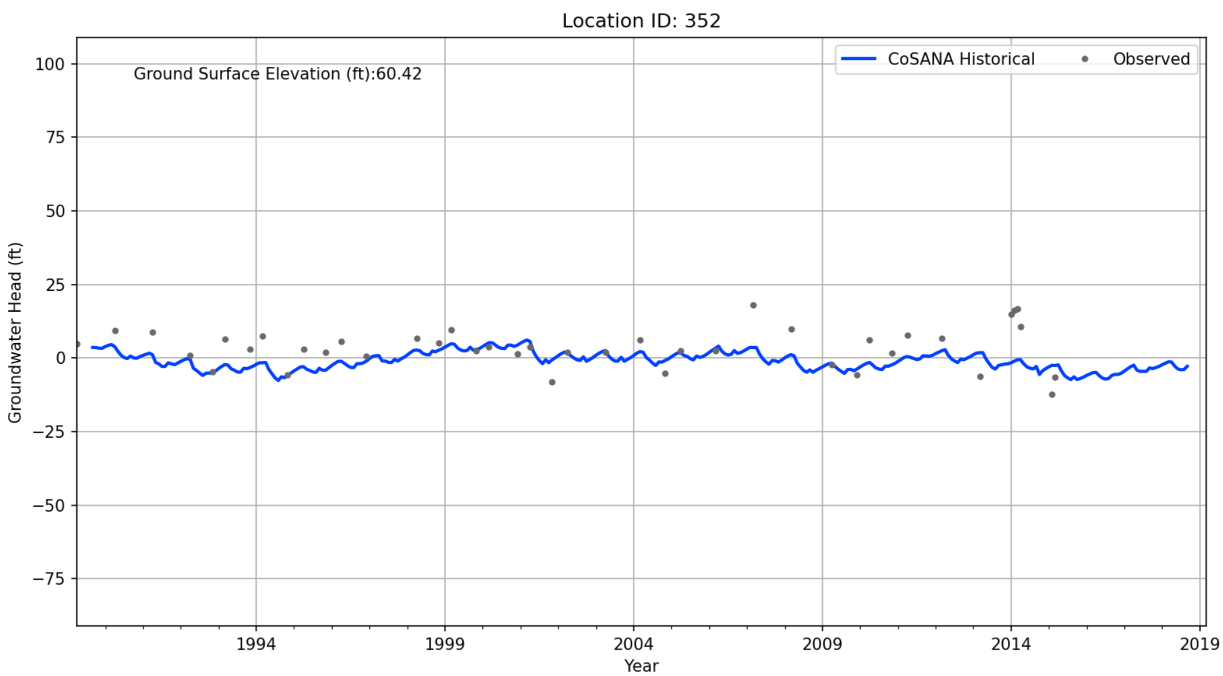

Location ID: 343
Ground Surface Elevation (ft):47.58
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 344
Ground Surface Elevation (ft):47.58
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 345
Ground Surface Elevation (ft):47.58
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 346
Ground Surface Elevation (ft):25.78
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year


Location ID: 348
Ground Surface Elevation (ft):74.15
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019


Location ID: 352
Ground Surface Elevation (ft):60.42
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
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0
−25
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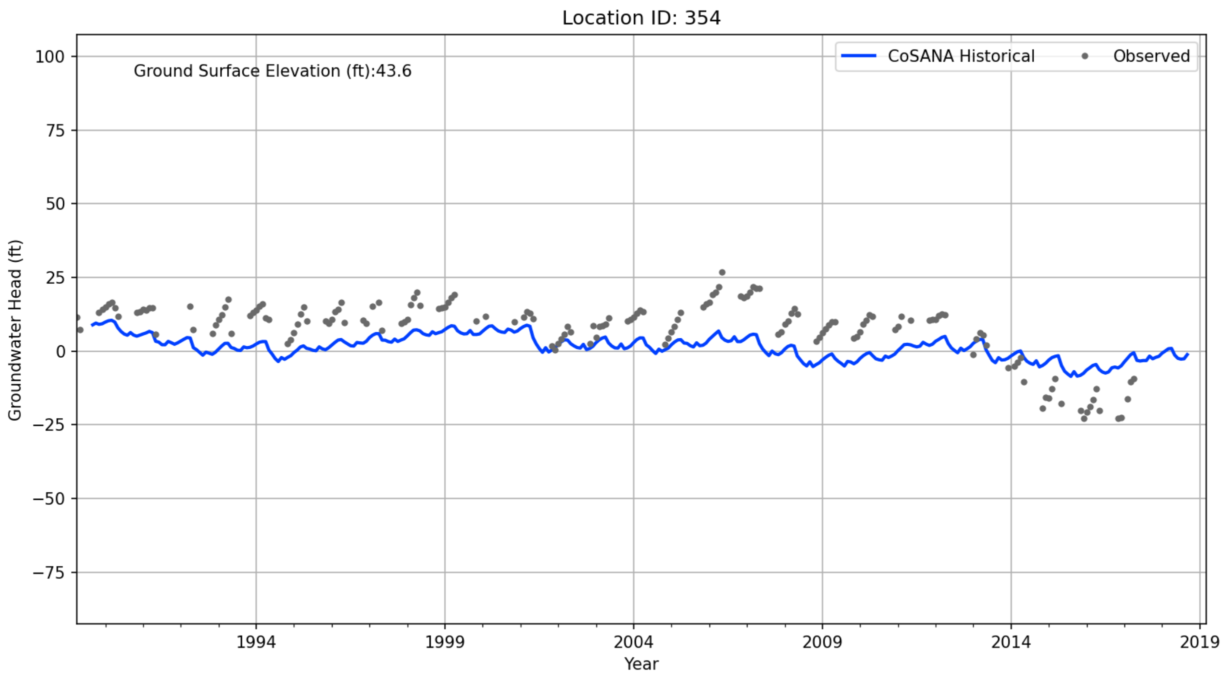
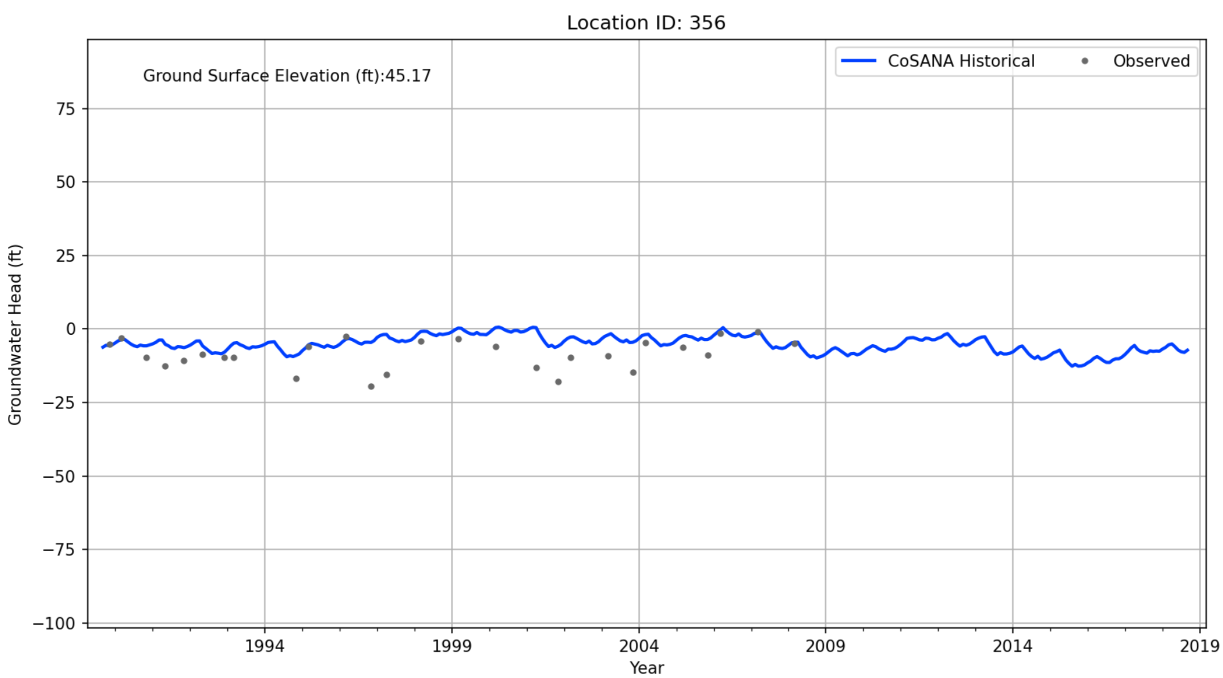
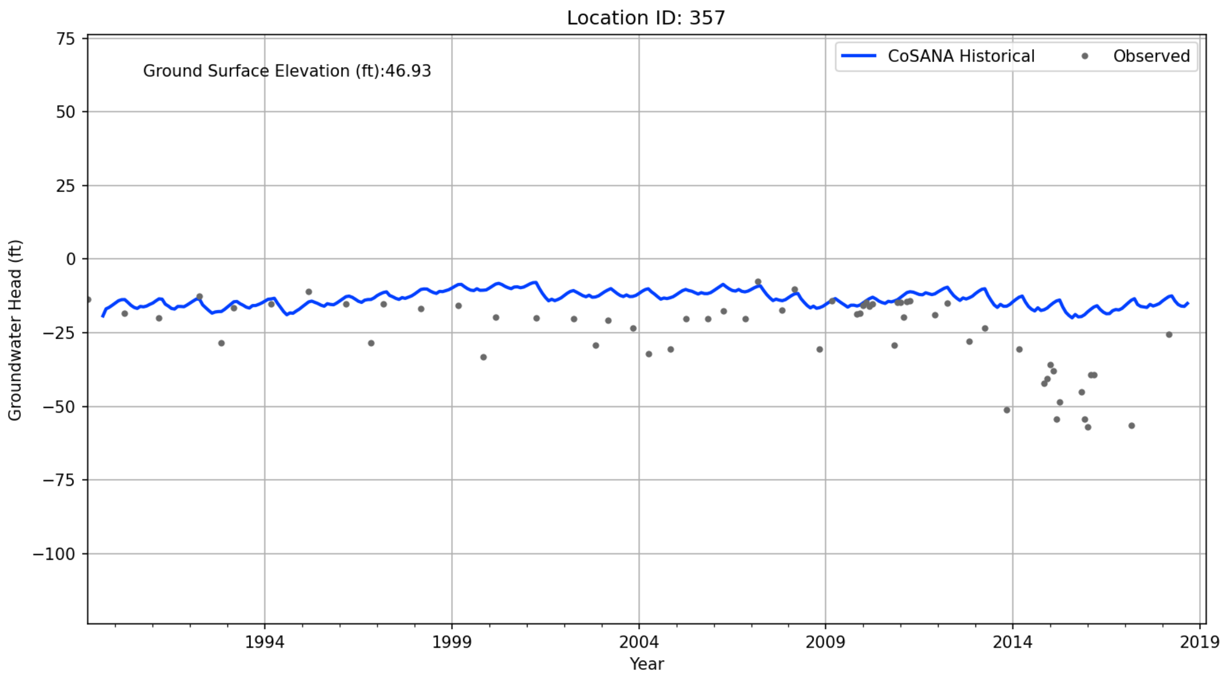
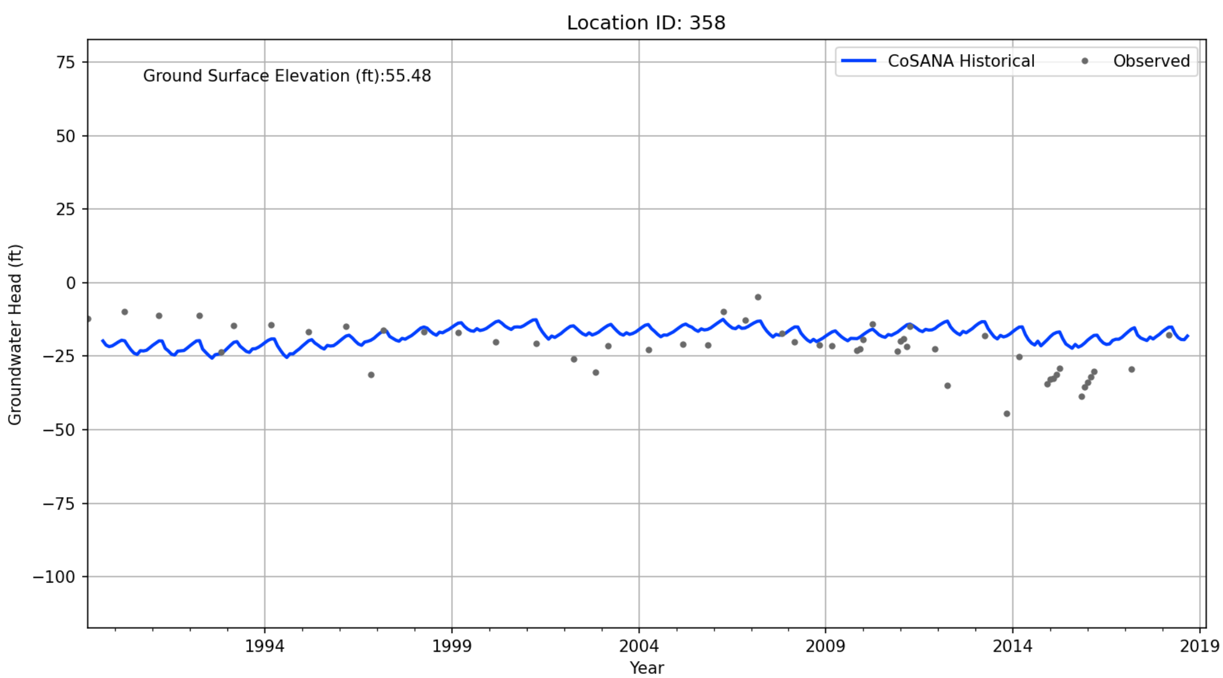
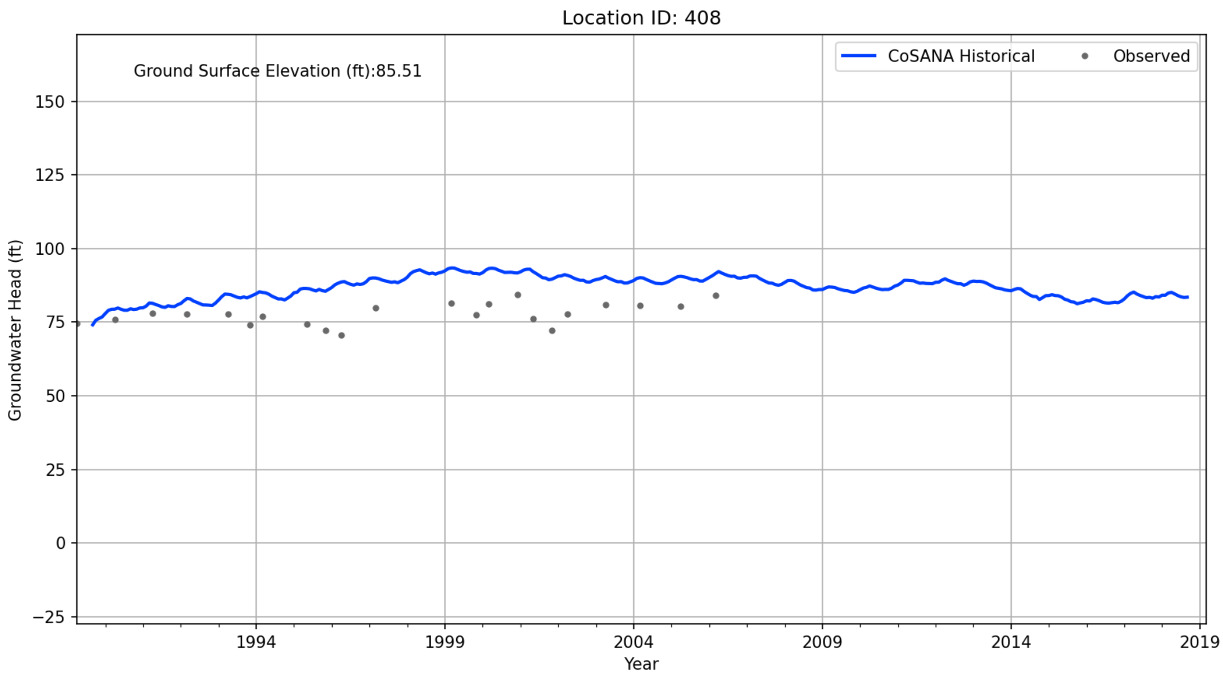
−75
1994
1999
2004
2009
2014
2019

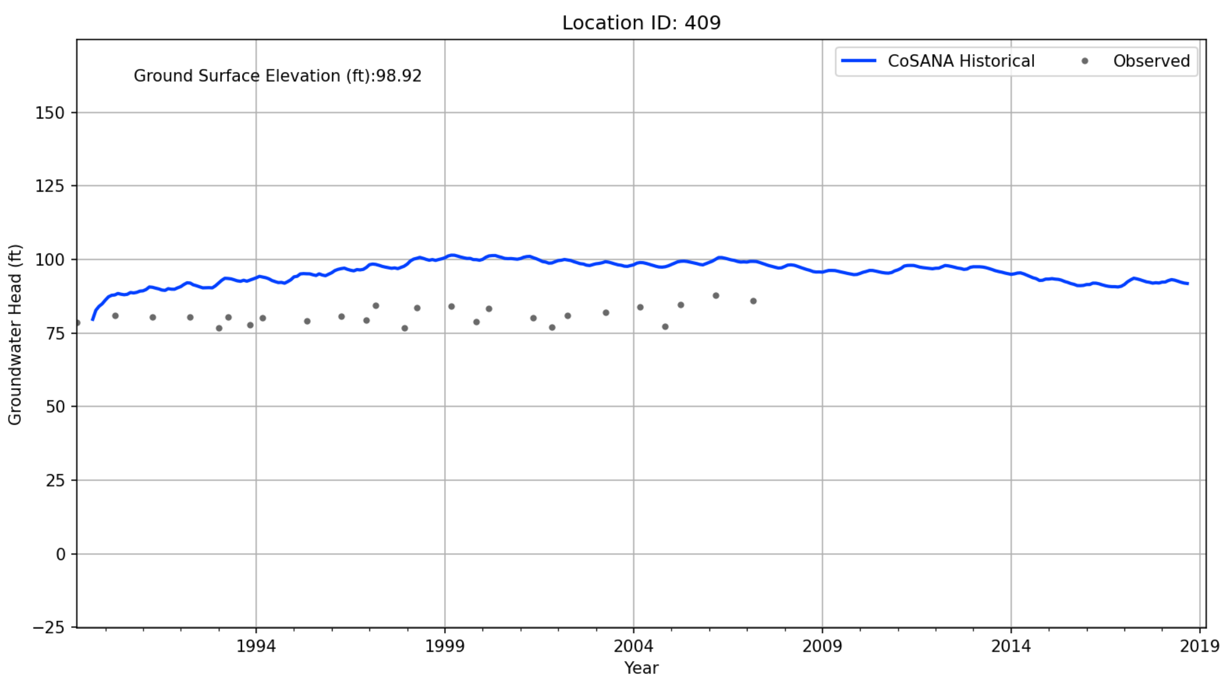

Location ID: 354
Ground Surface Elevation (ft):43.6
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

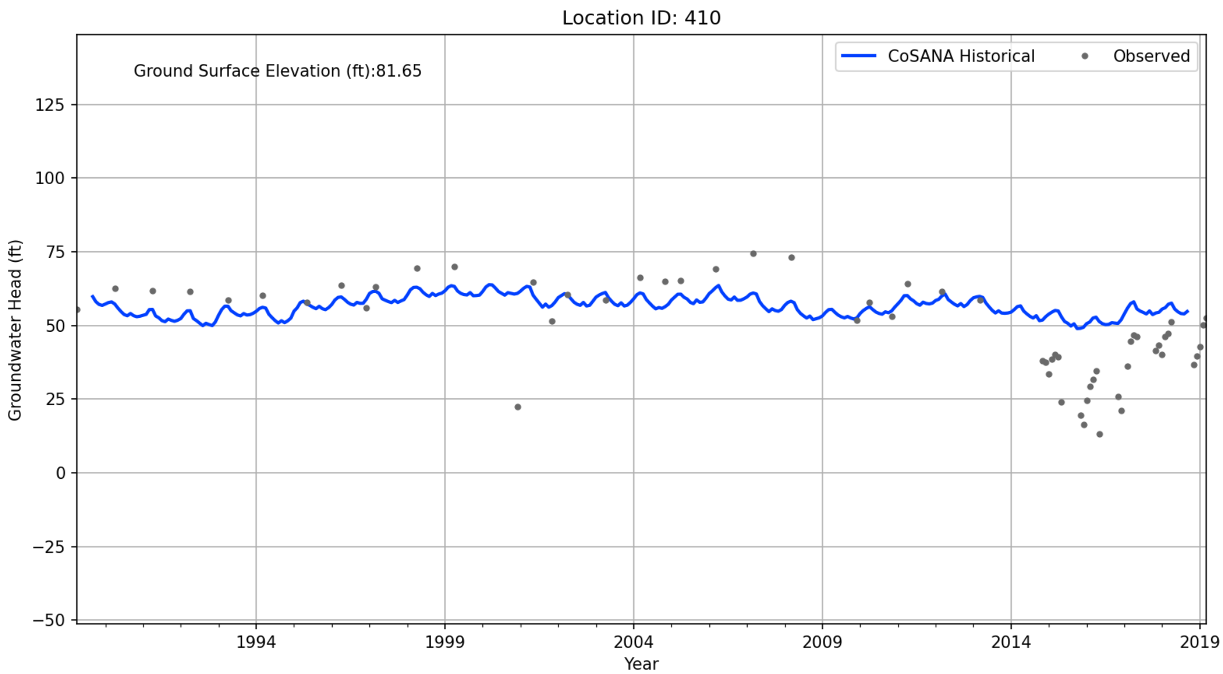

Location ID: 356
Ground Surface Elevation (ft):45.17
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

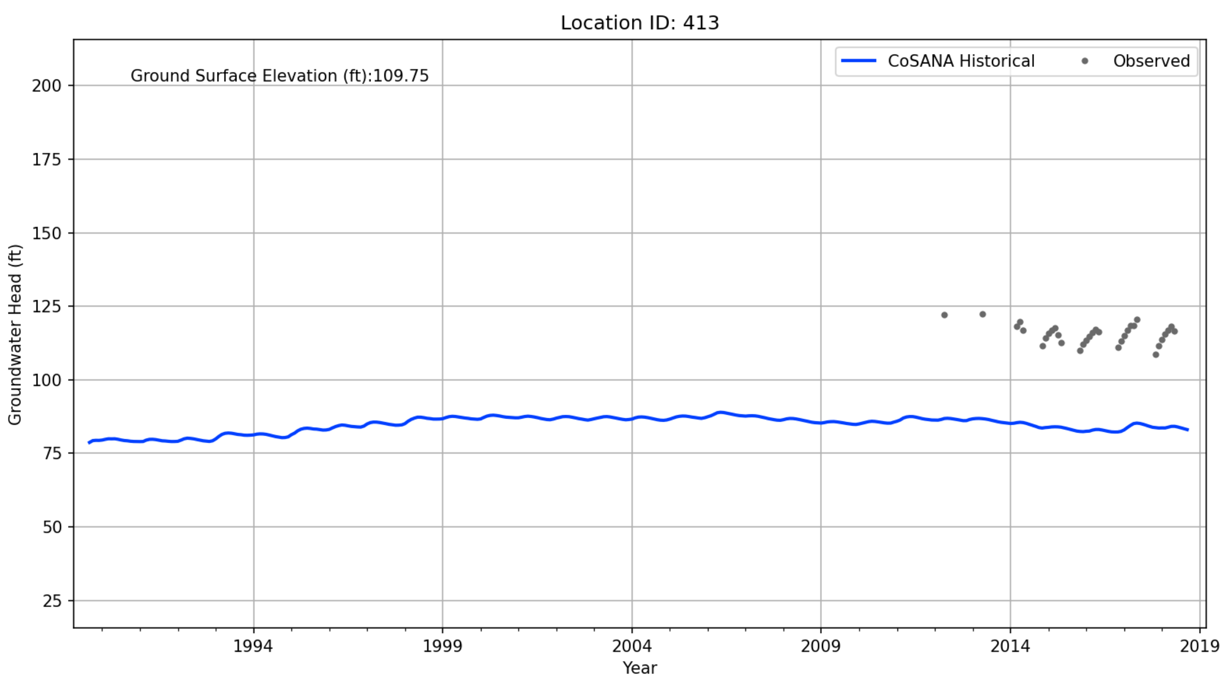

Location ID: 357
Ground Surface Elevation (ft):46.93
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

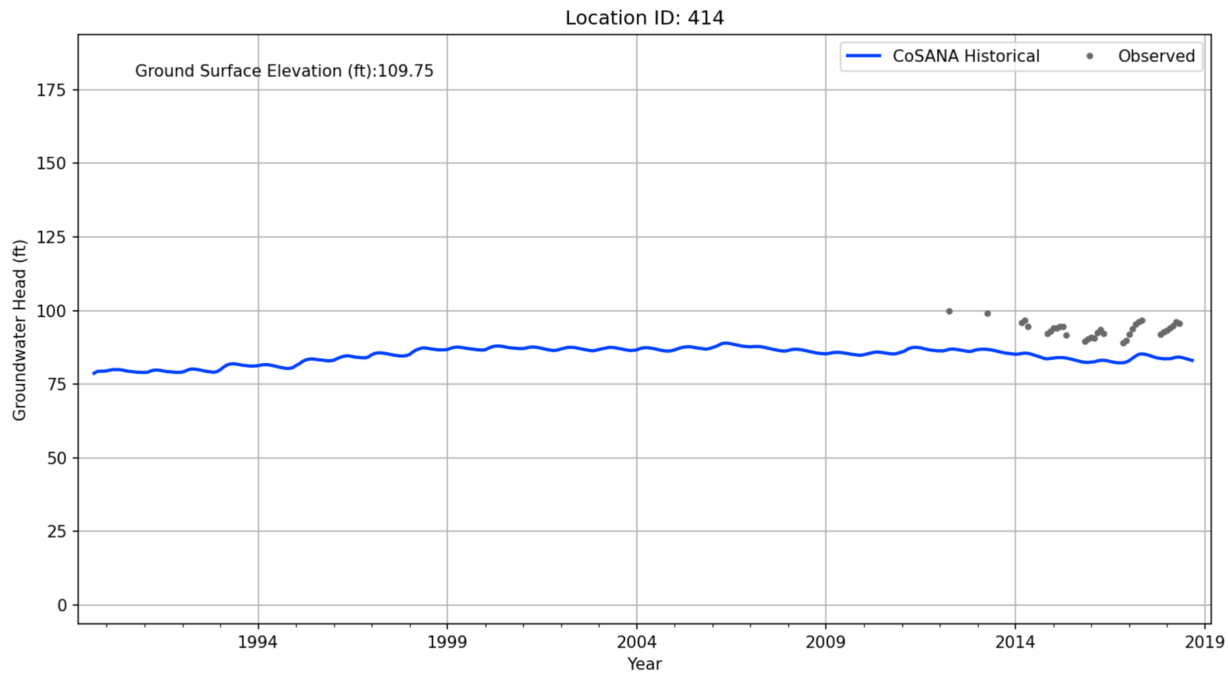

Location ID: 358
Ground Surface Elevation (ft):55.48
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

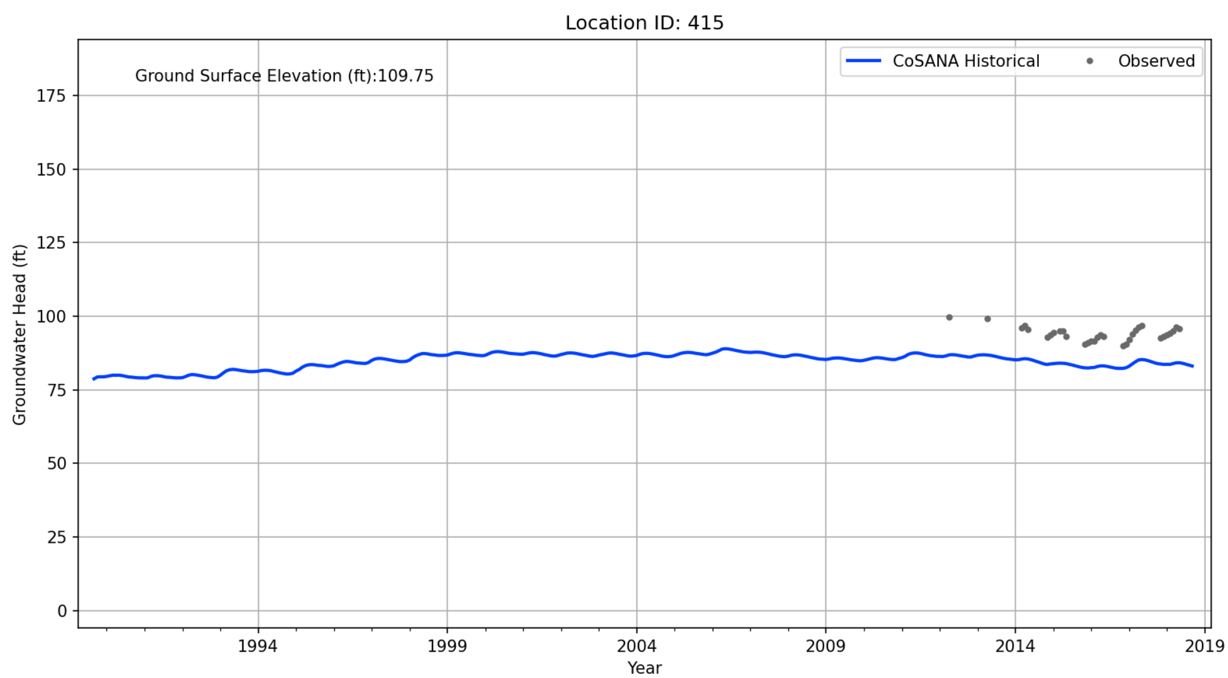

Location ID: 408
Ground Surface Elevation (ft):85.51
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

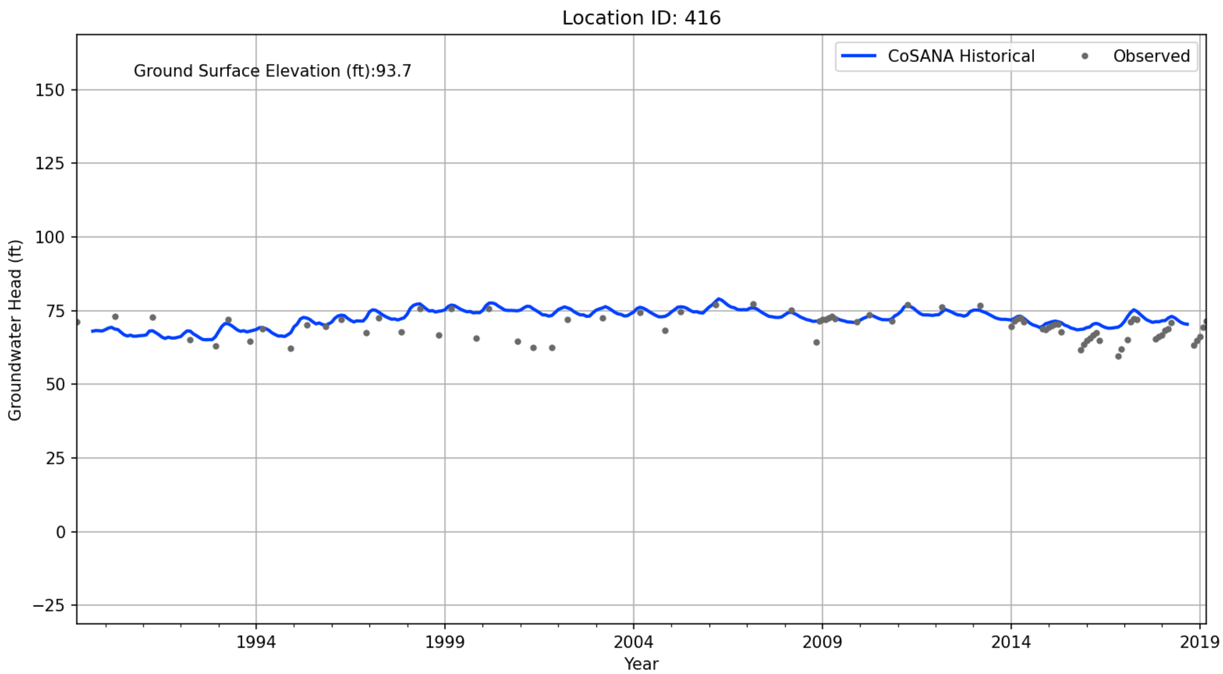

Location ID: 409
Ground Surface Elevation (ft):98.92
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019


Location ID: 410
Ground Surface Elevation (ft):81.65
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

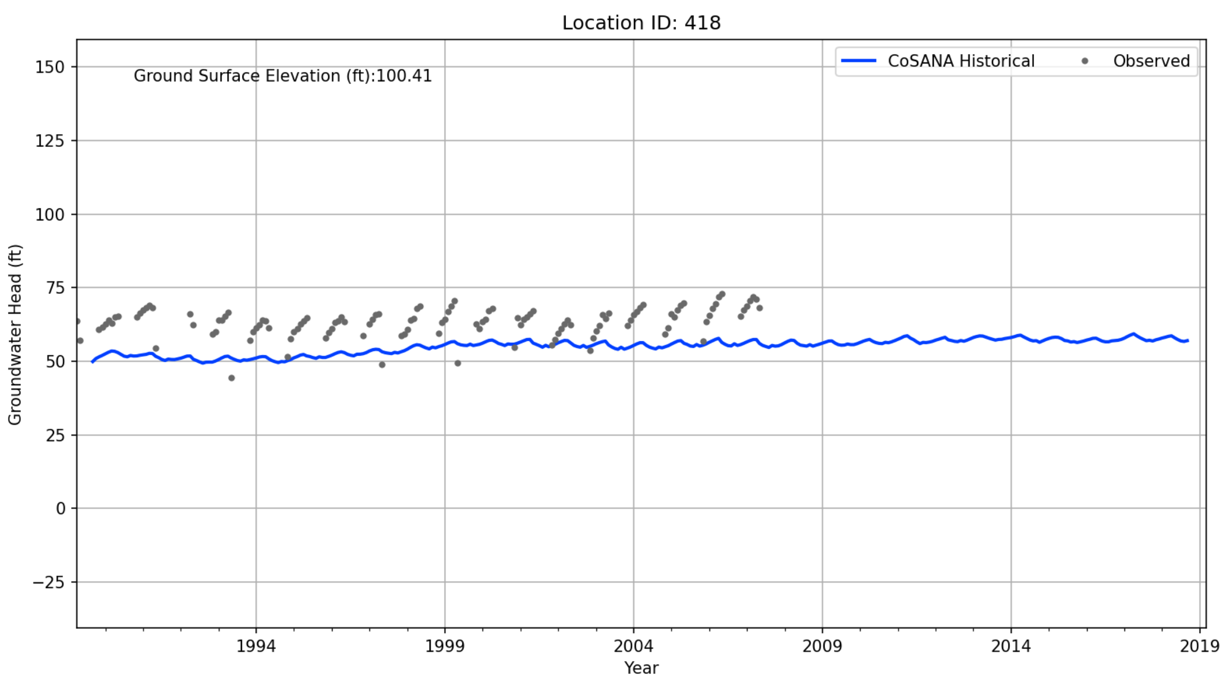

Location ID: 413
Ground Surface Elevation (ft):109.75
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019


Location ID: 414
Ground Surface Elevation (ft):109.75
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

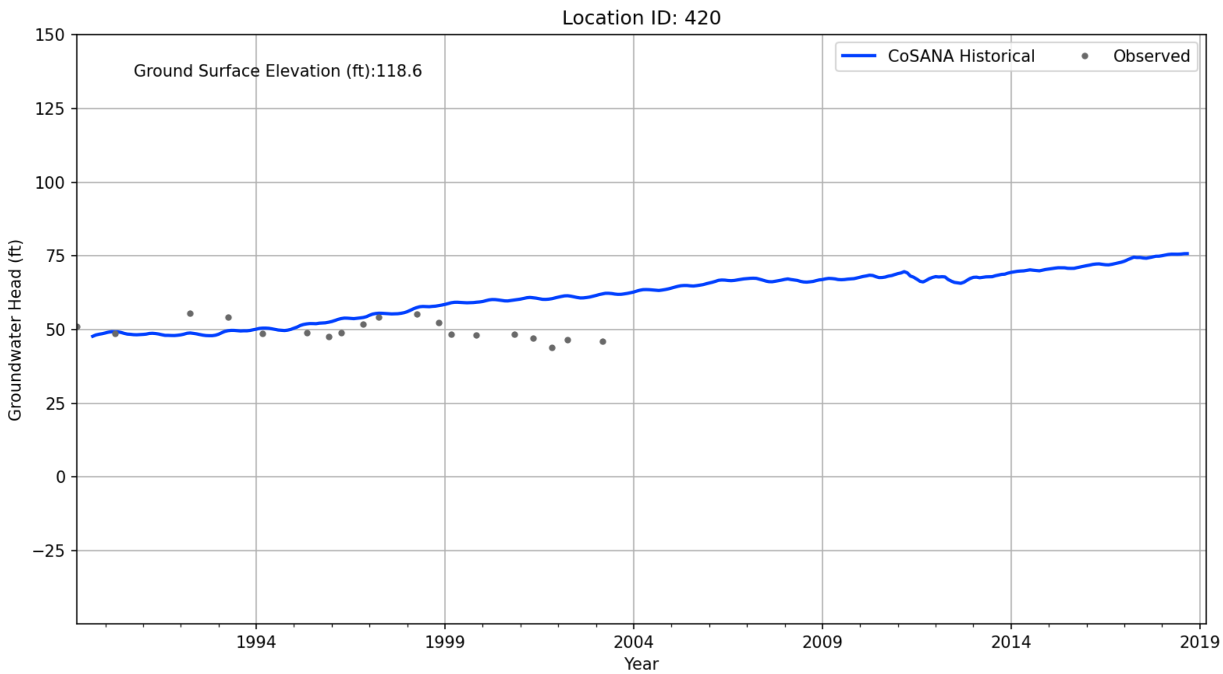

Location ID: 415
Ground Surface Elevation (ft):109.75
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

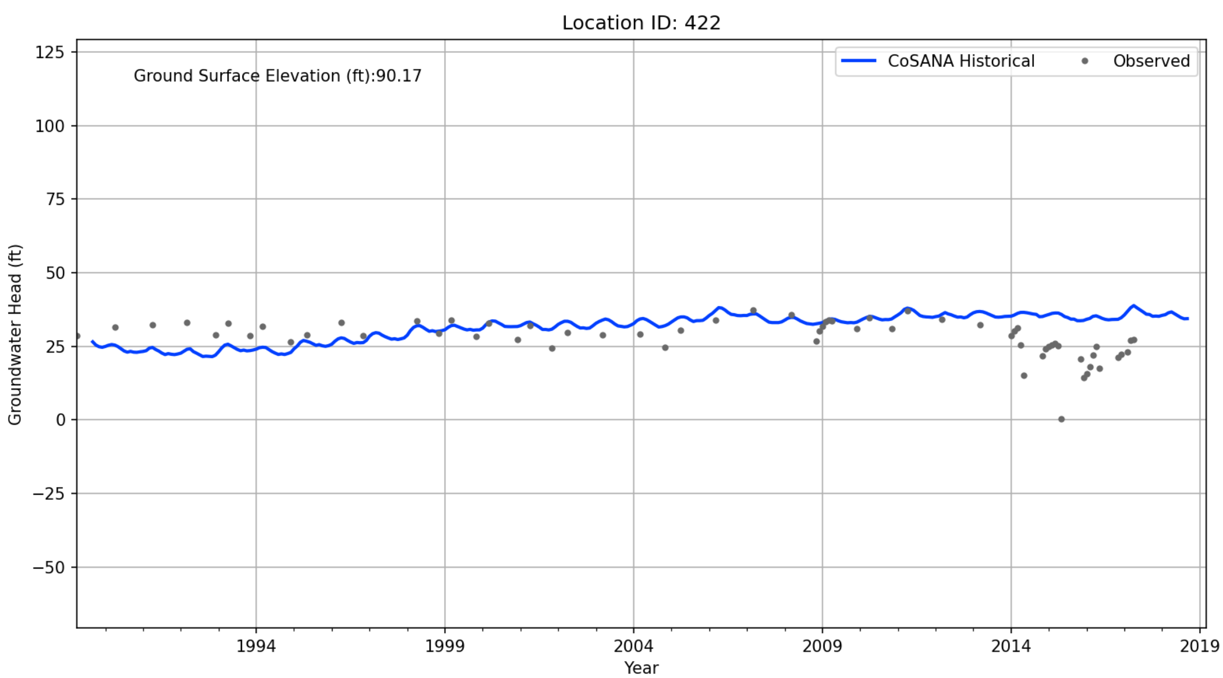


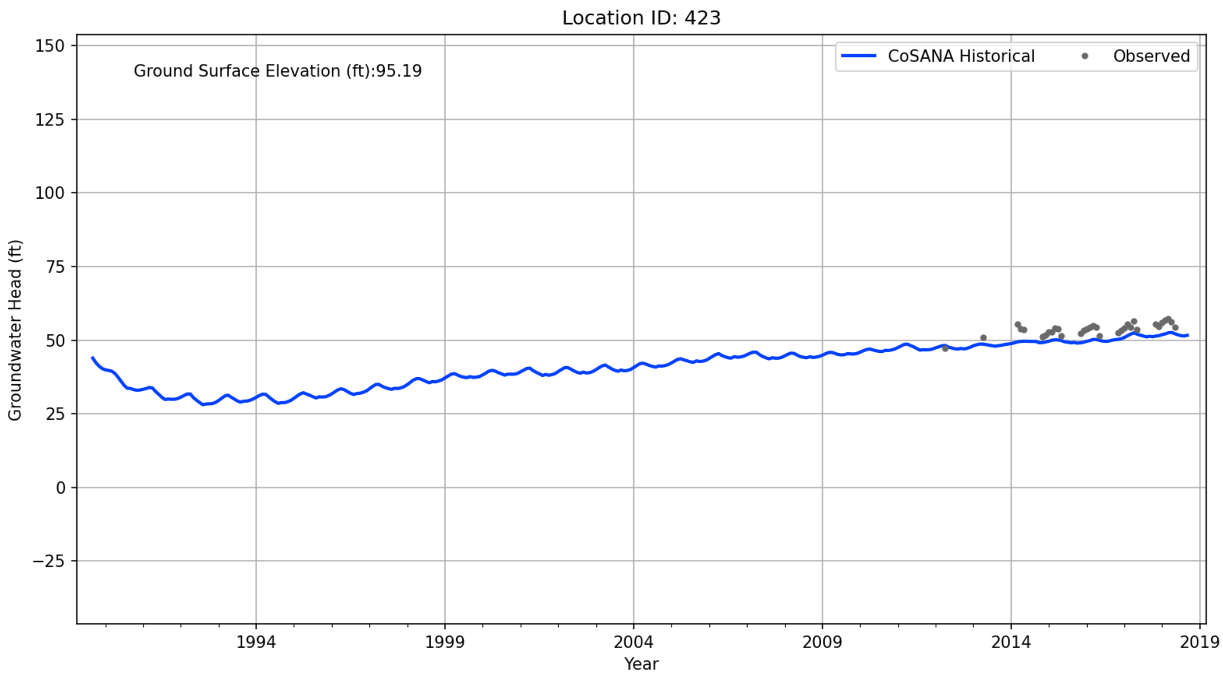
Location ID: 416
Ground Surface Elevation (ft):93.7
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019



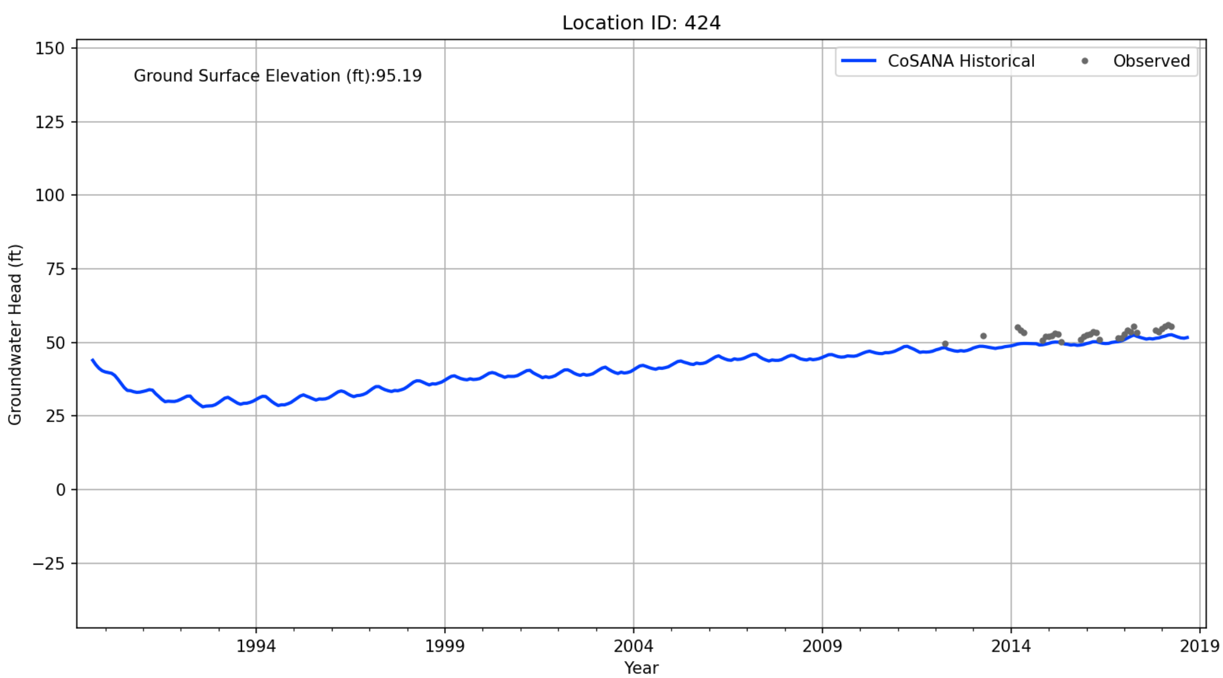
Location ID: 418
Ground Surface Elevation (ft):100.41
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019


Location ID: 420
Ground Surface Elevation (ft):118.6
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

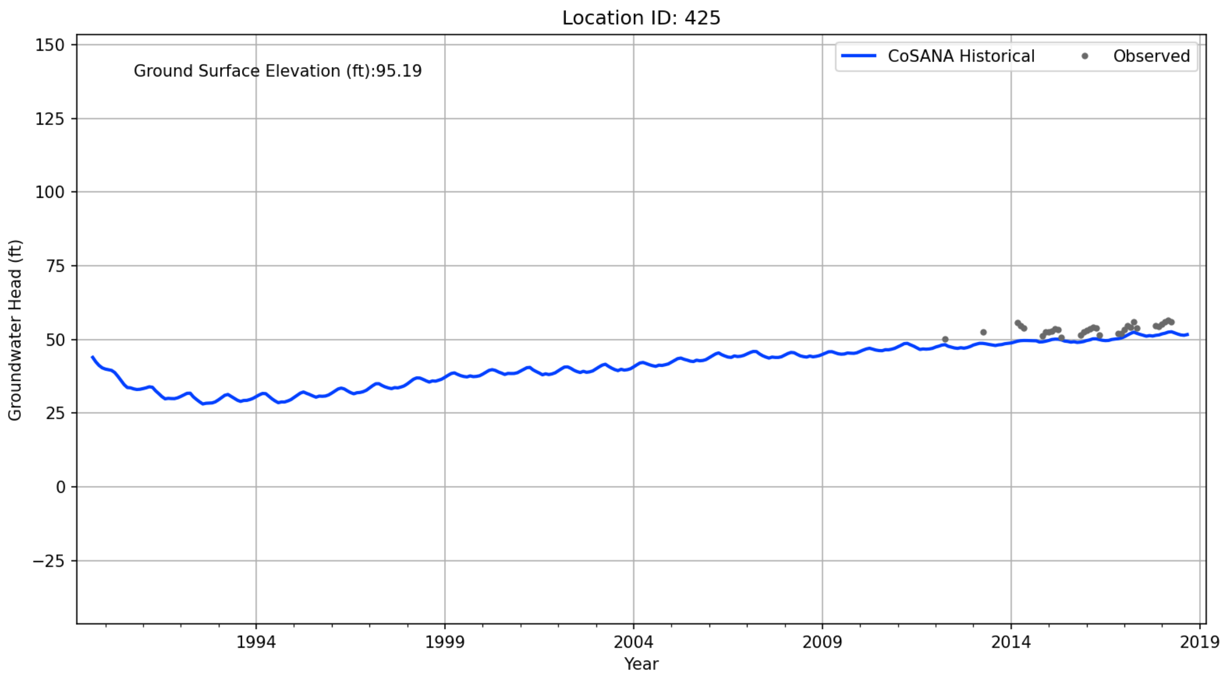

Location ID: 422
Ground Surface Elevation (ft):90.17
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

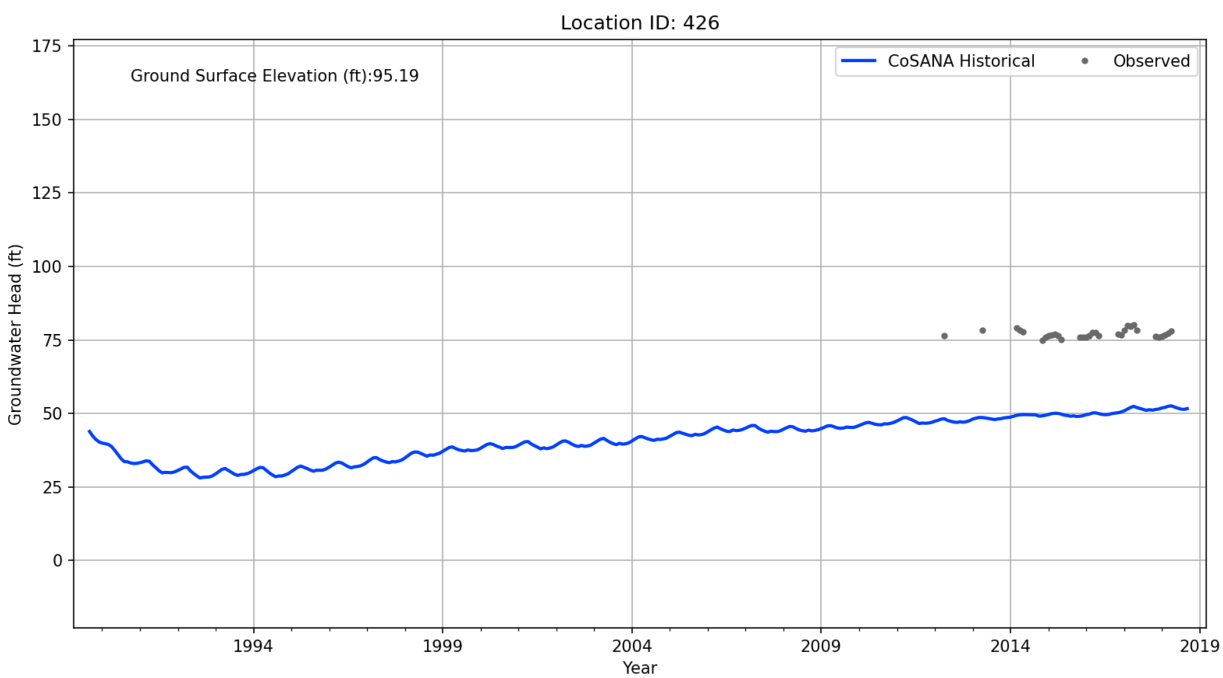


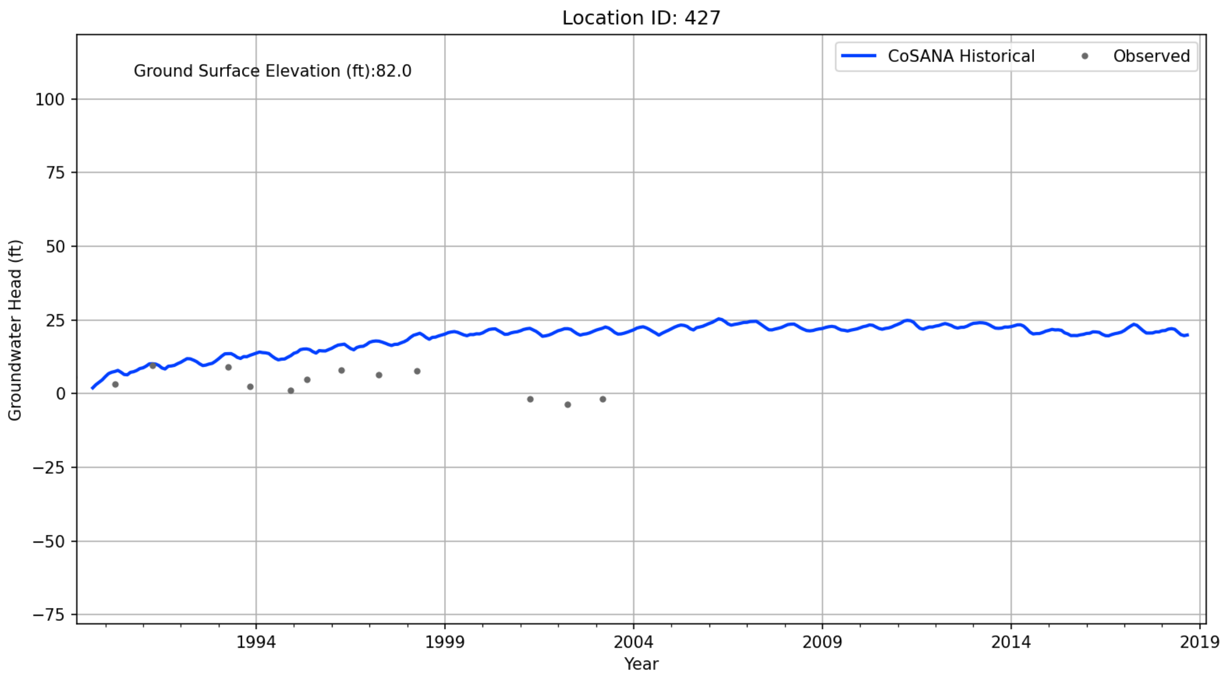
Location ID: 423
Ground Surface Elevation (ft):95.19
CoSANA Historical
Observed
150
125
100
75
50
25
0
−25
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year



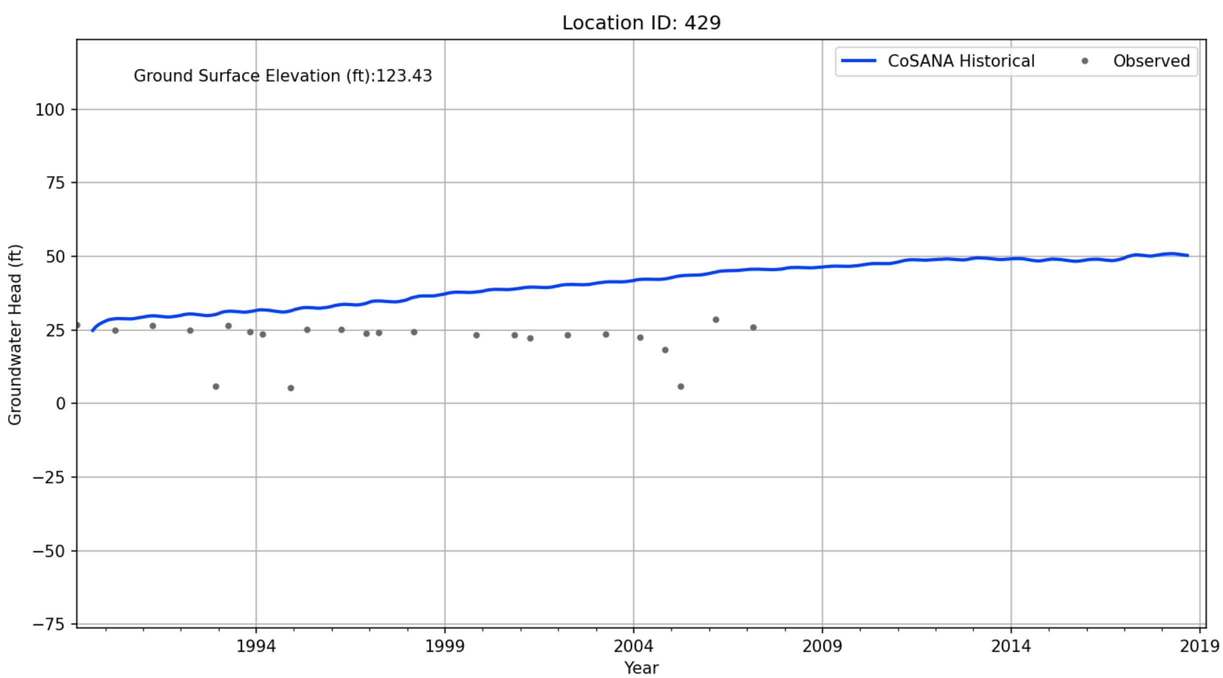
Location ID: 424
Ground Surface Elevation (ft):95.19
CoSANA Historical
Observed
150
125
100
75
50
25
0
−25
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year


Location ID: 425
Ground Surface Elevation (ft):95.19
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

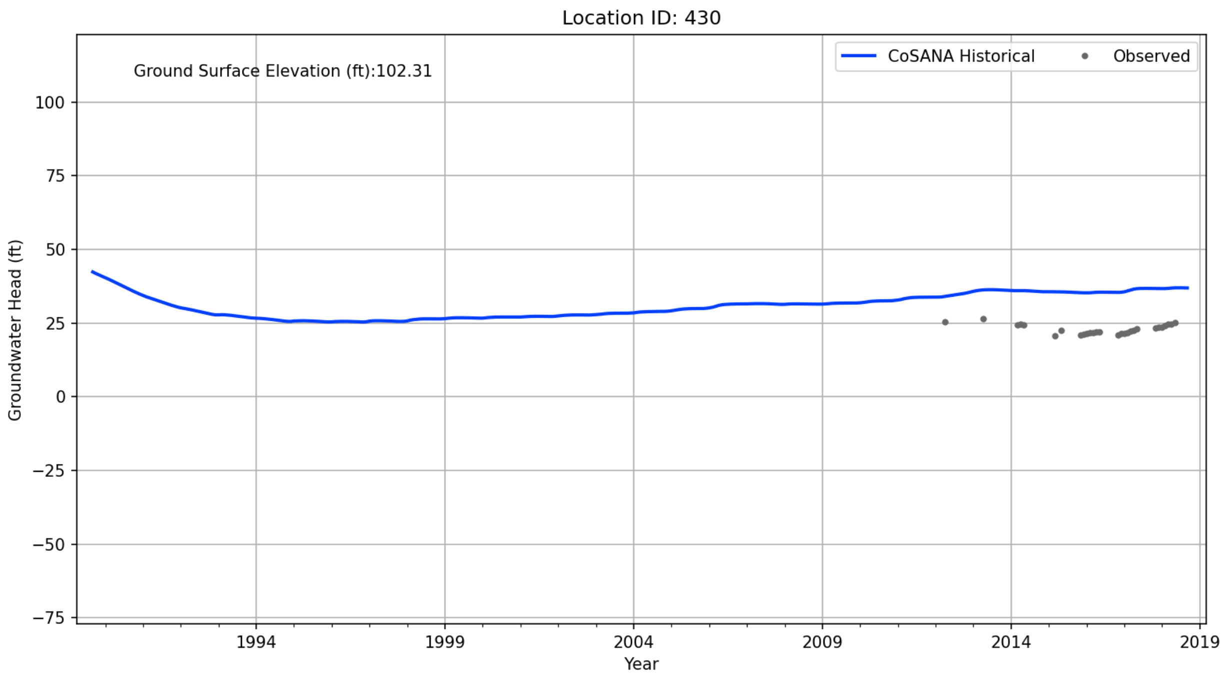

Location ID: 426
Ground Surface Elevation (ft):95.19
CoSANA Historical
Observed
Groundwater Head (ft)
Year
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019

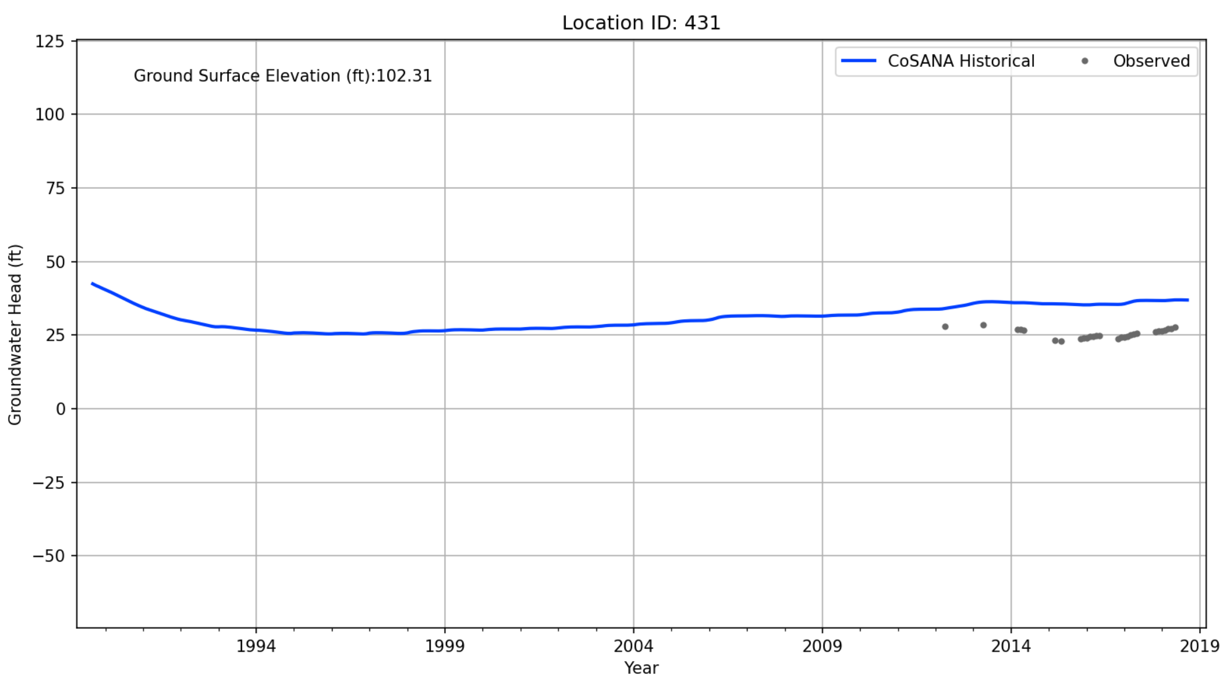


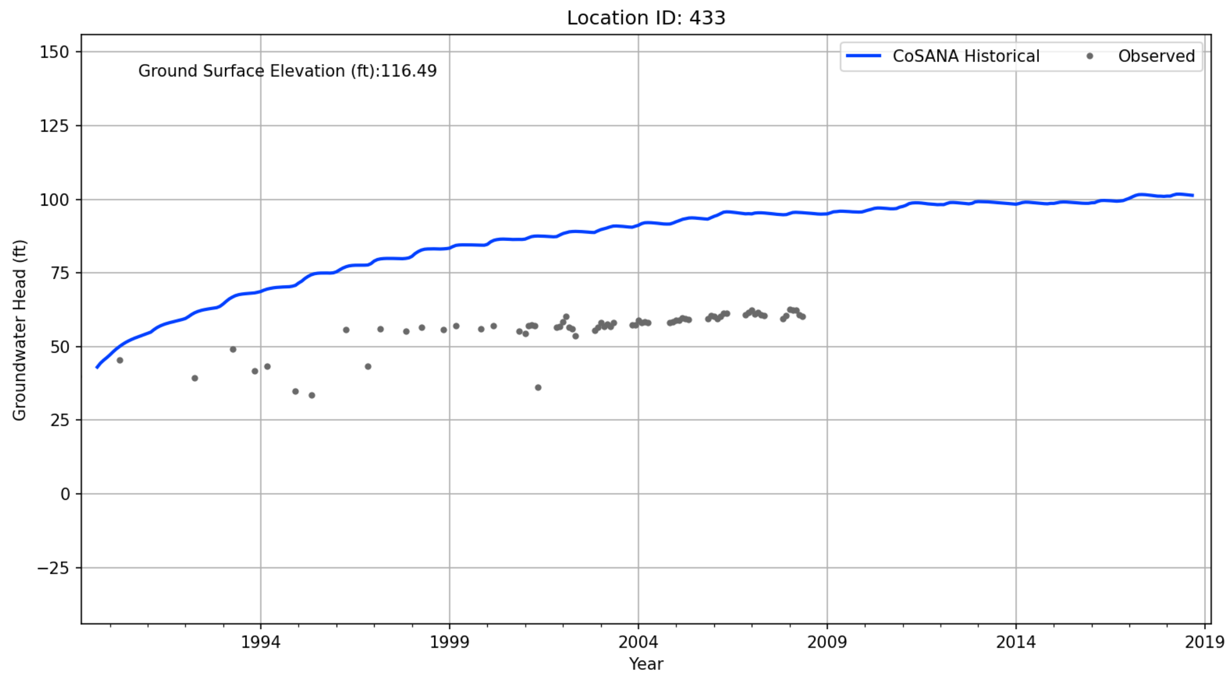
Location ID: 427
Ground Surface Elevation (ft):82.0
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

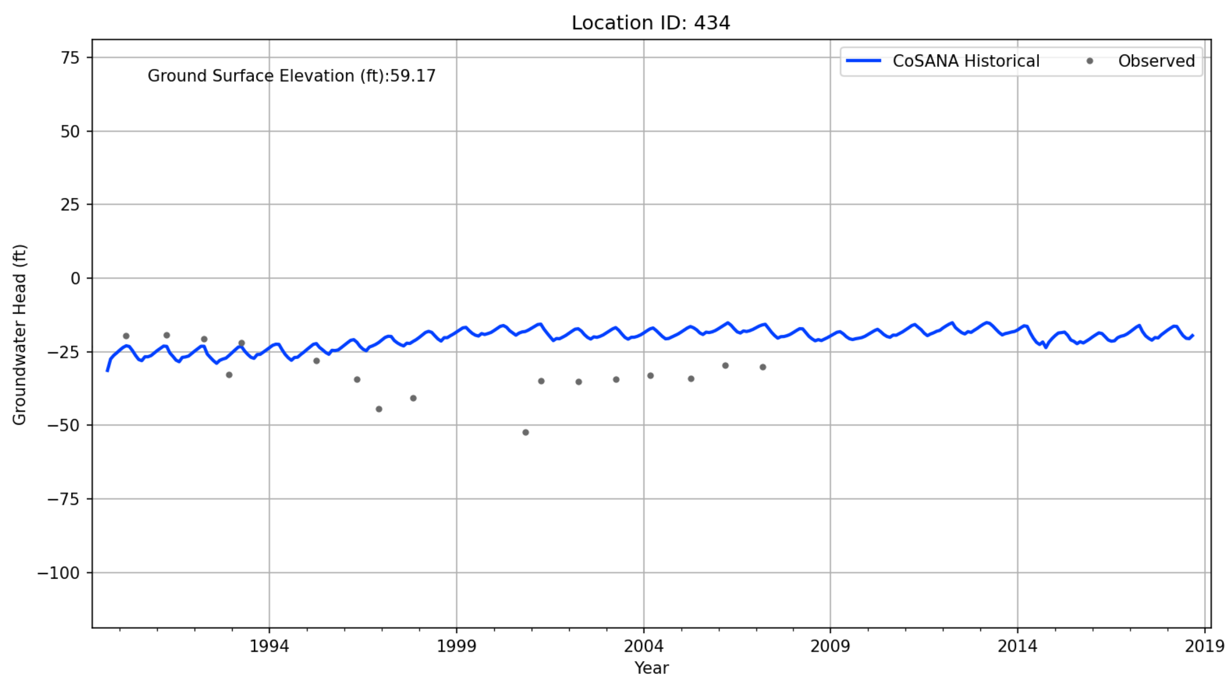


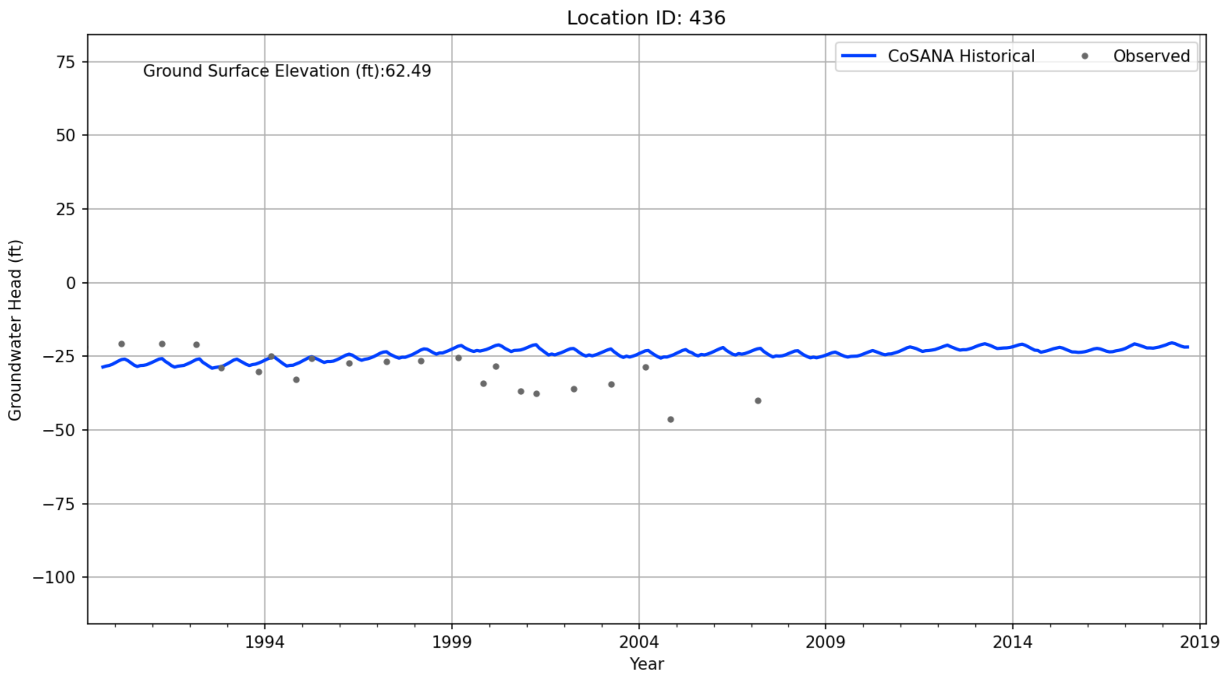
Location ID: 429
Ground Surface Elevation (ft):123.43
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

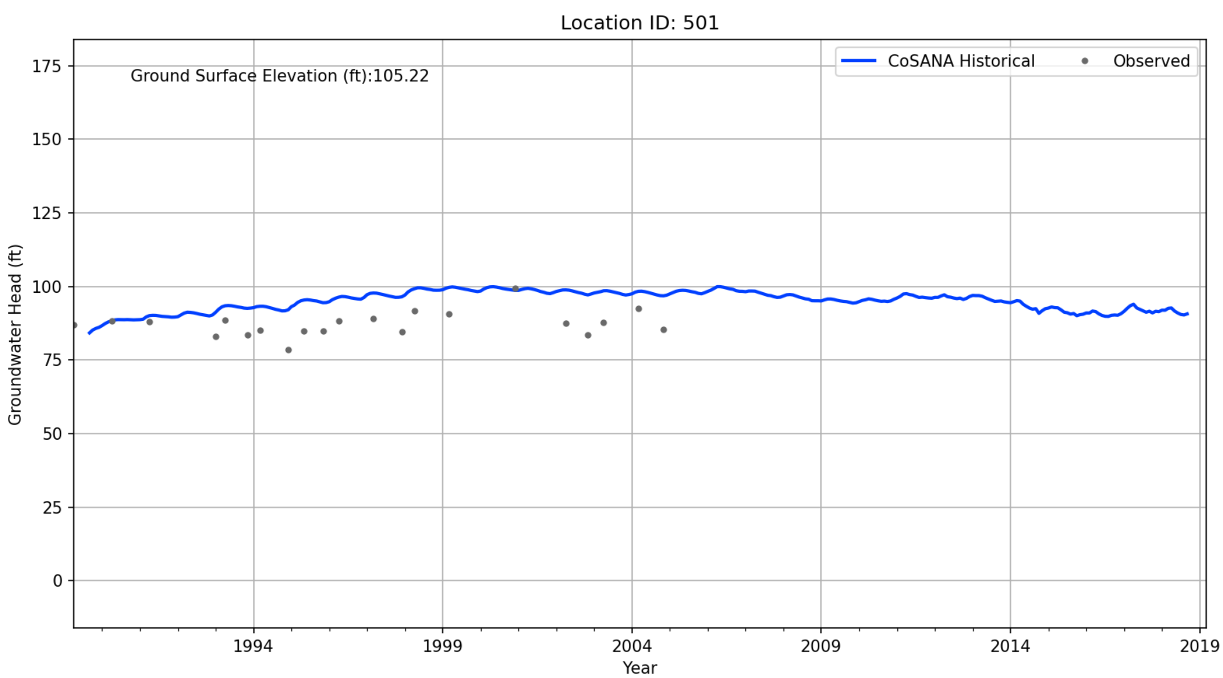

Location ID: 430
CoSANA Historical
Observed
Ground Surface Elevation (ft):102.31
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

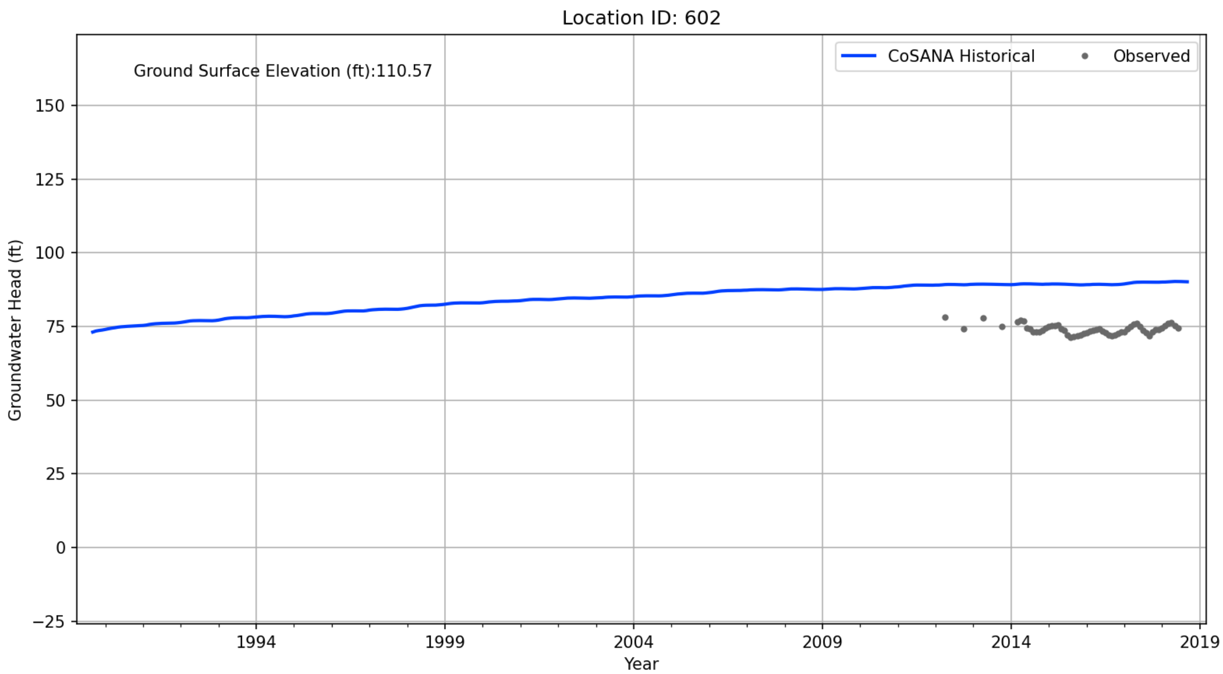

Location ID: 431
CoSANA Historical
Observed
Ground Surface Elevation (ft):102.31
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

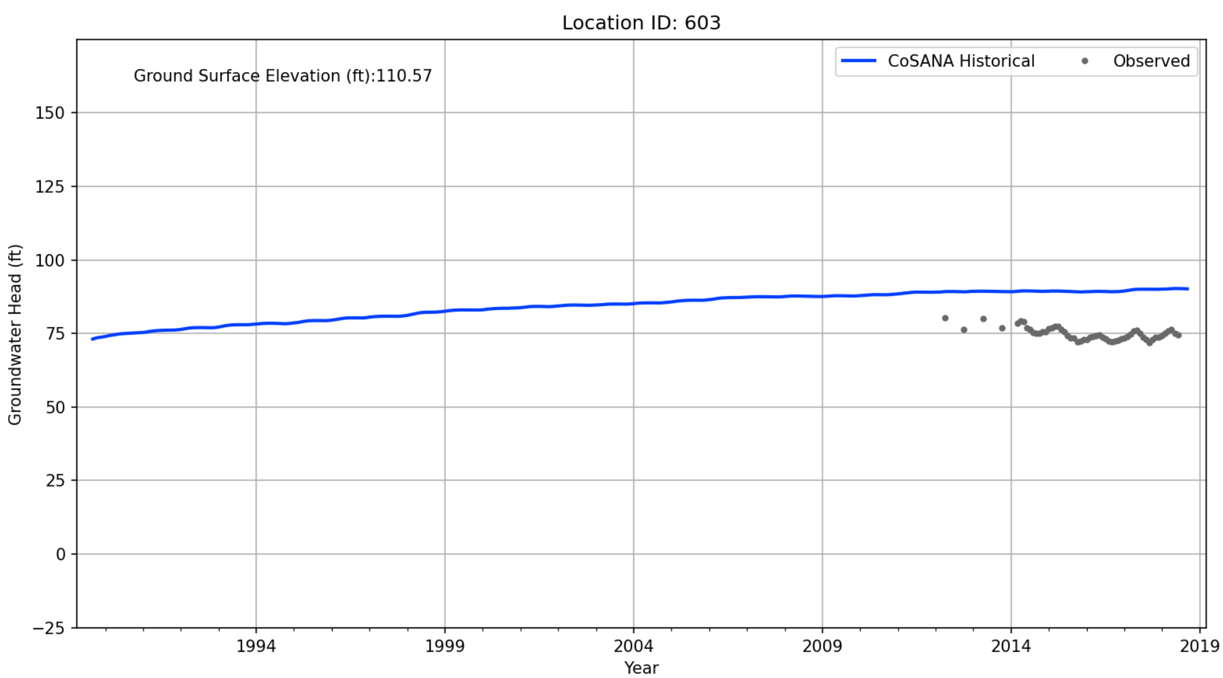

Location ID: 433
Ground Surface Elevation (ft):116.49
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

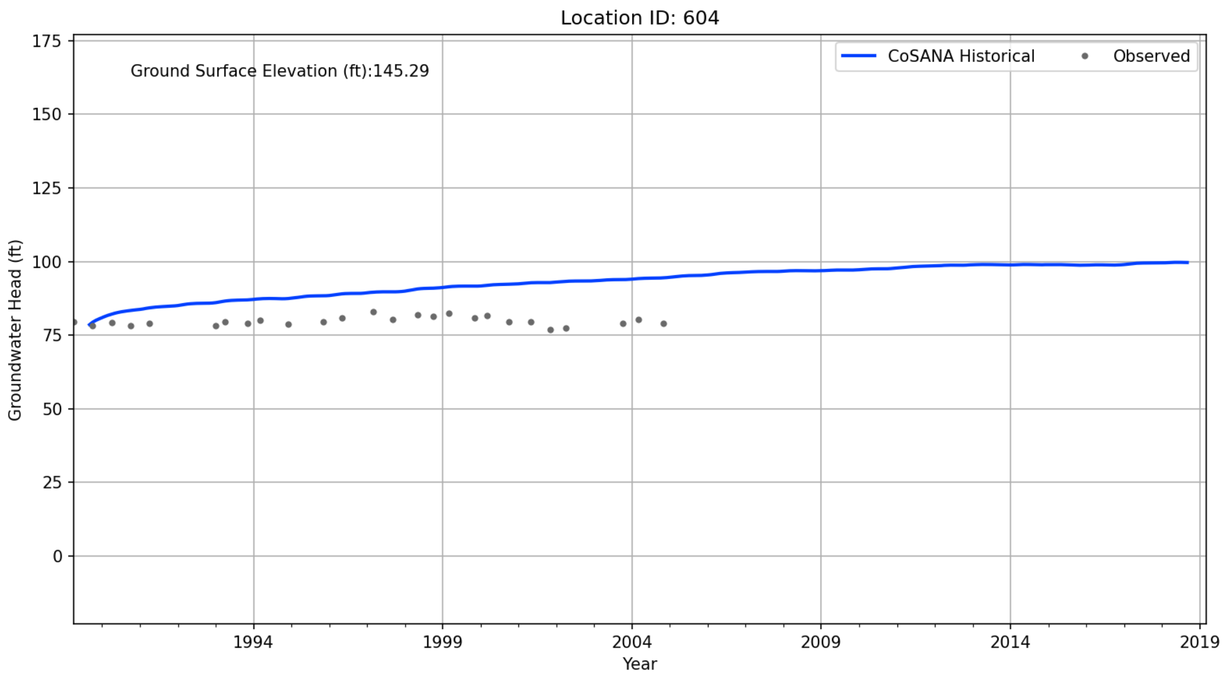

Location ID: 434
Ground Surface Elevation (ft):59.17
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 436
CoSANA Historical
Observed
Ground Surface Elevation (ft):62.49
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

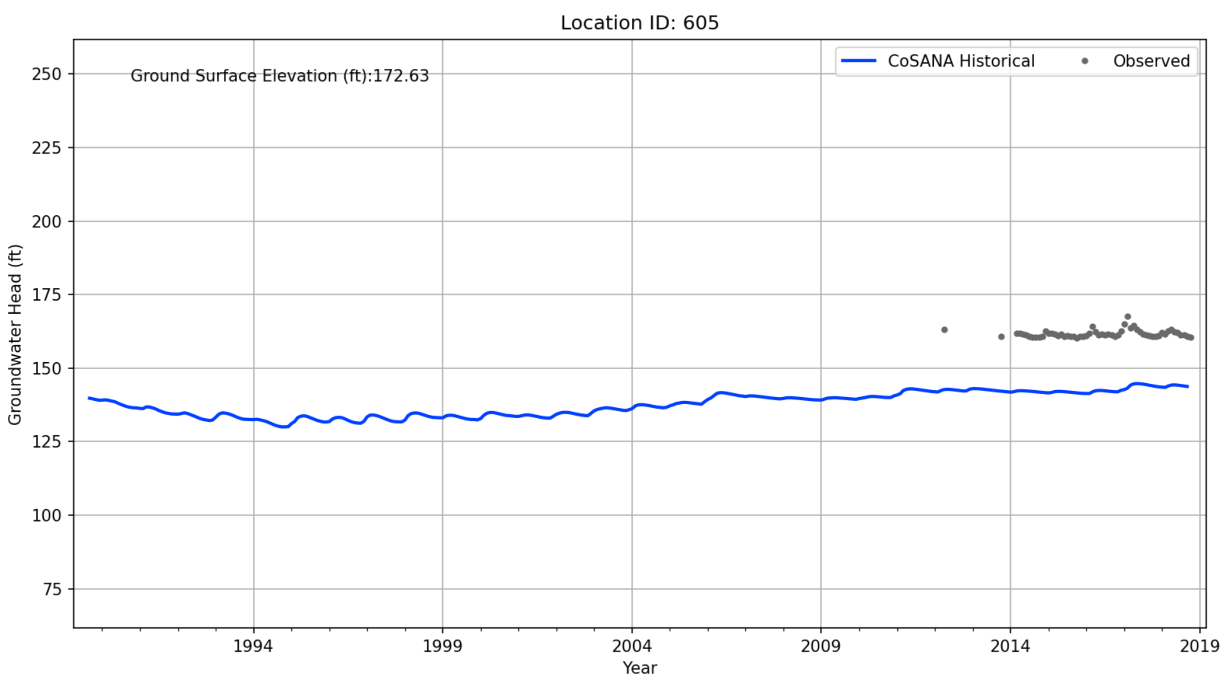

Location ID: 501
CoSANA Historical
Observed
Ground Surface Elevation (ft):105.22
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year


Location ID: 602
CoSANA Historical
Observed
Ground Surface Elevation (ft):110.57
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

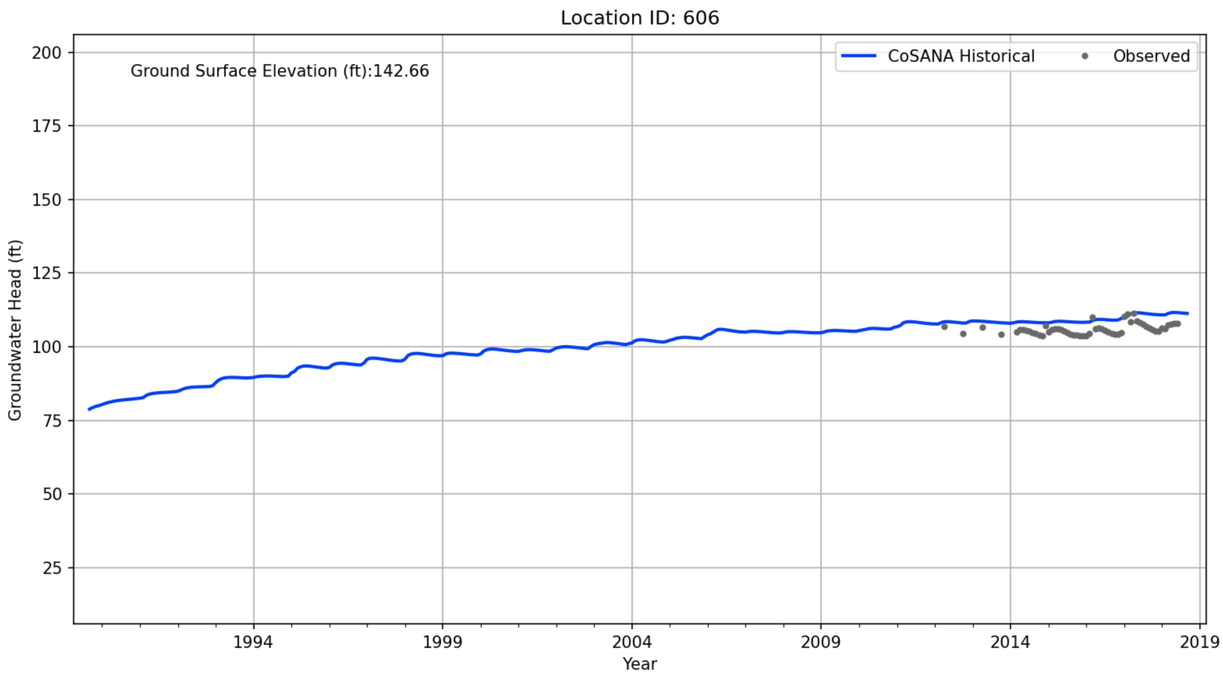

Location ID: 603
CoSANA Historical
Observed
Ground Surface Elevation (ft):110.57
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

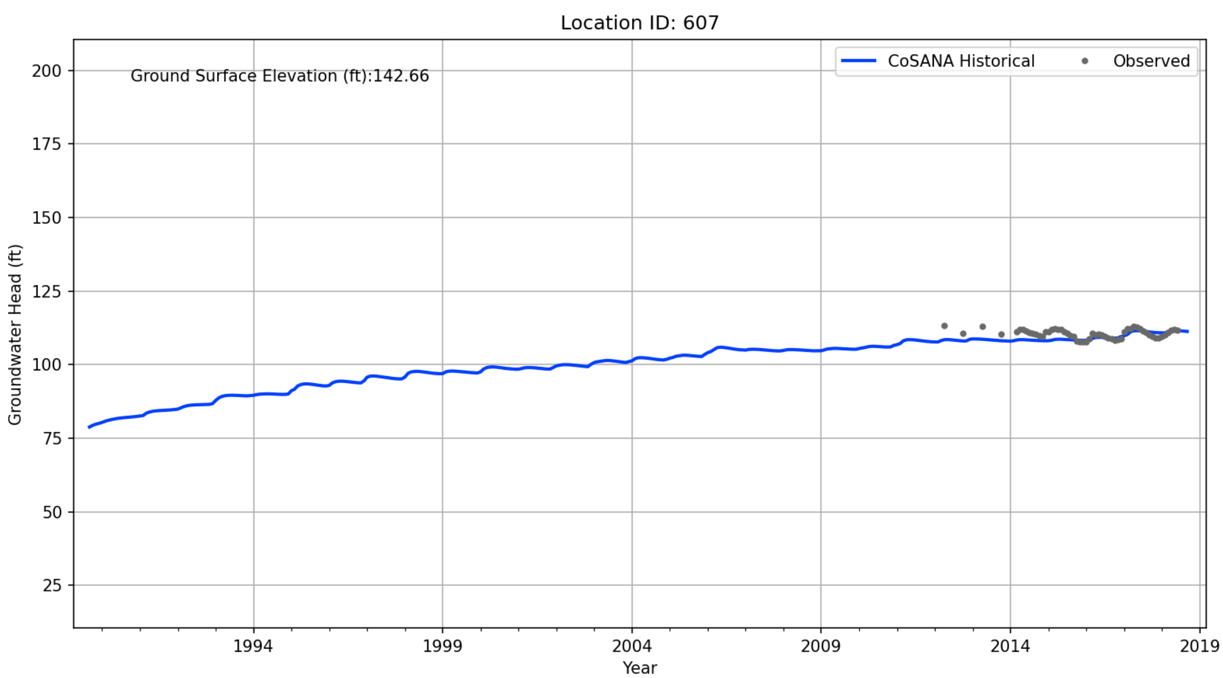


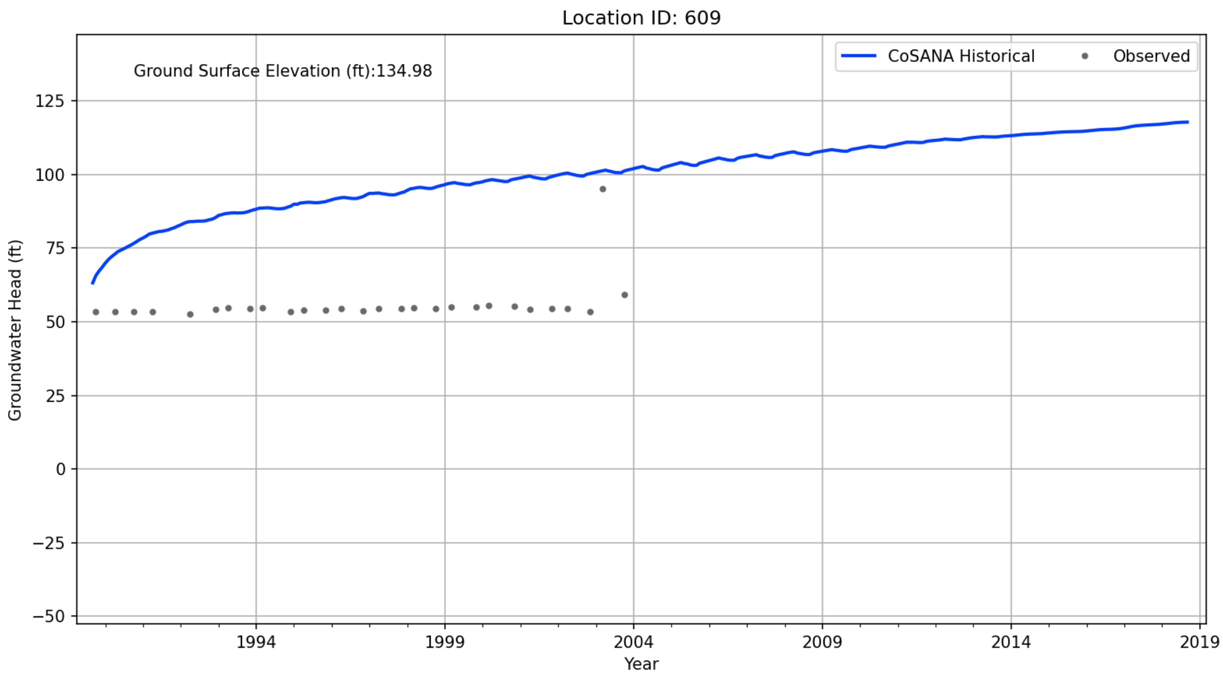
Location ID: 604
Ground Surface Elevation (ft):145.29
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

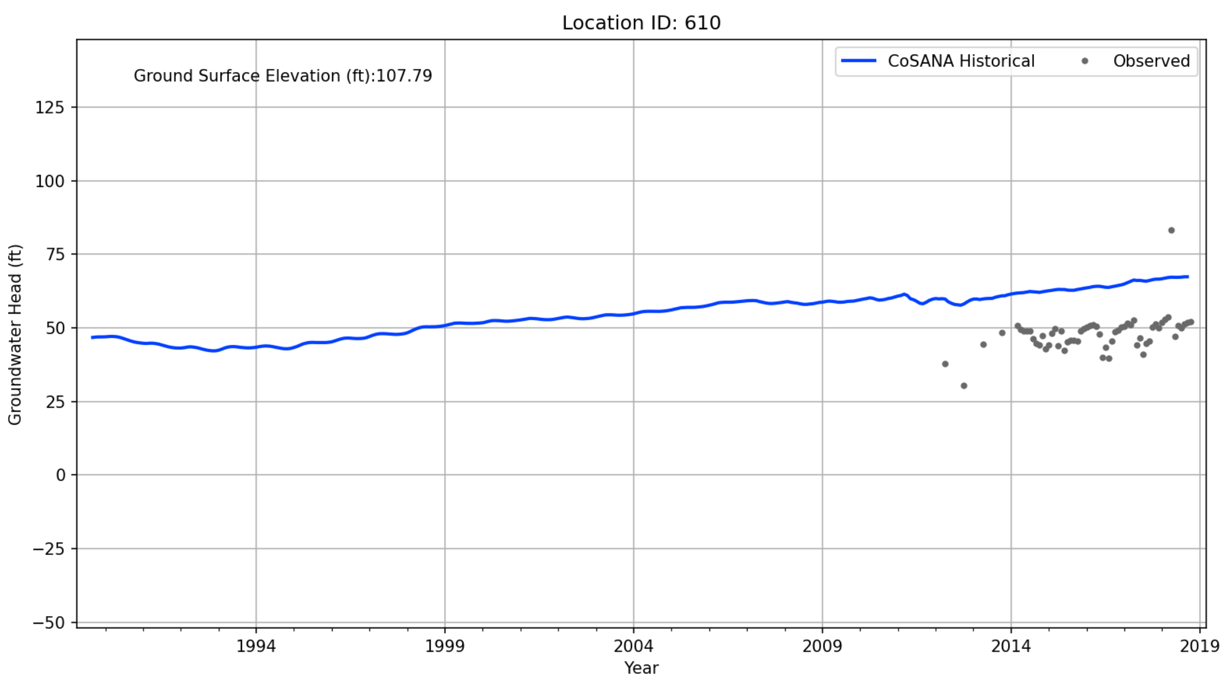


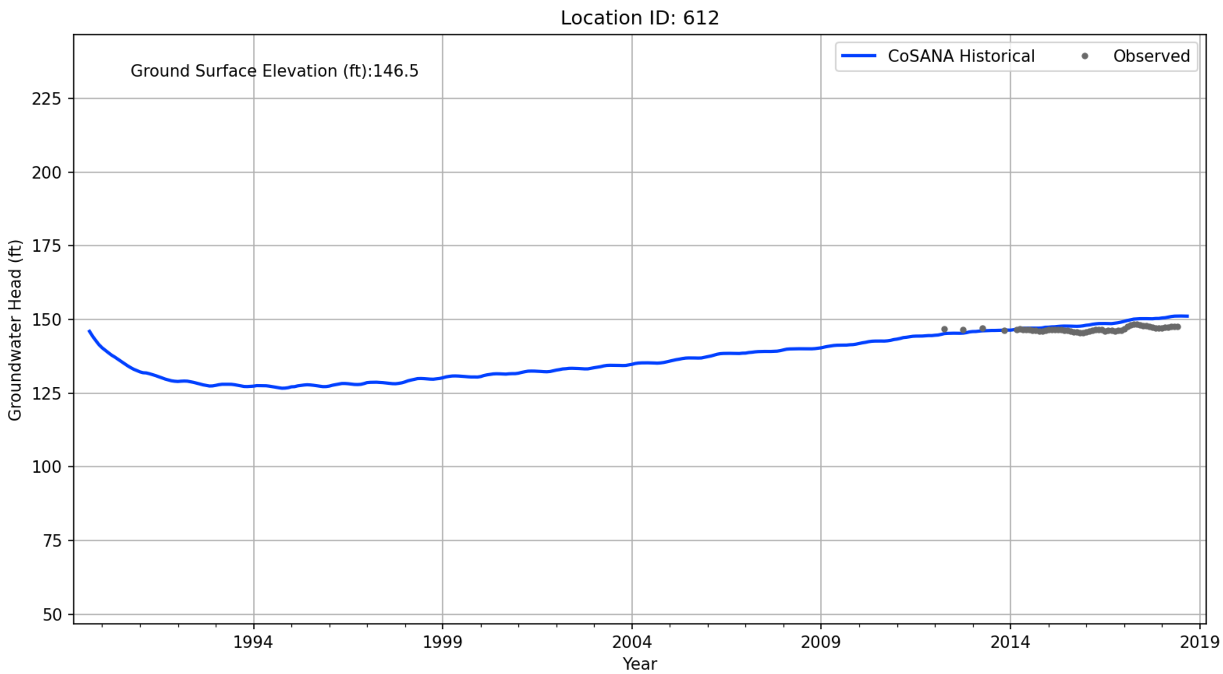
Location ID: 605
Ground Surface Elevation (ft):172.63
CoSANA Historical
Observed
Groundwater Head (ft)
250
225
200
175
150
125
100
75
1994
1999
2004
2009
2014
2019
Year

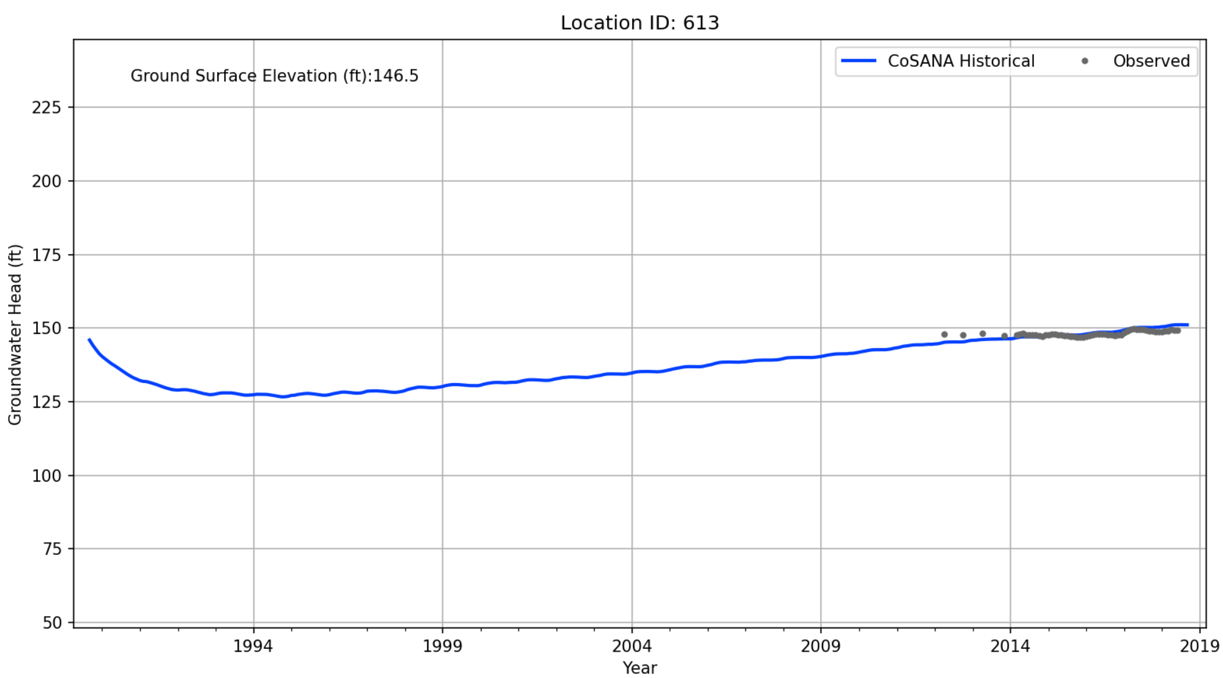

Location ID: 606
CoSANA Historical
Observed
Ground Surface Elevation (ft):142.66
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year

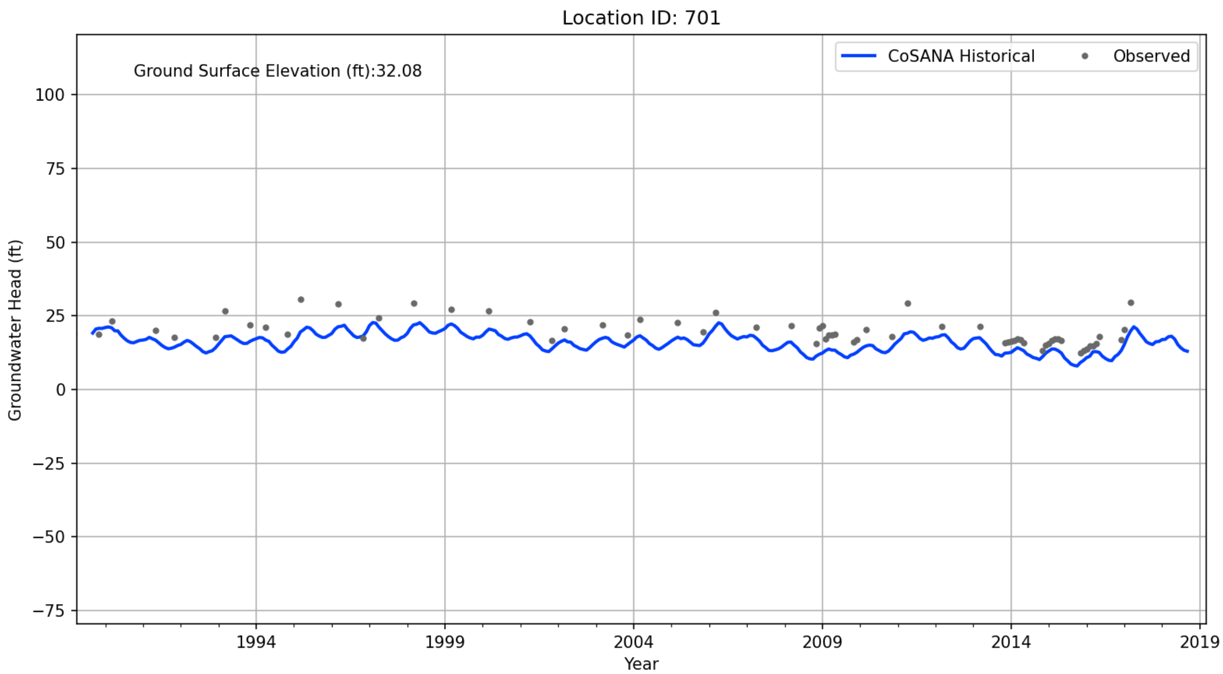

Location ID: 607
CoSANA Historical
Observed
Ground Surface Elevation (ft):142.66
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year


Location ID: 609
Ground Surface Elevation (ft):134.98
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

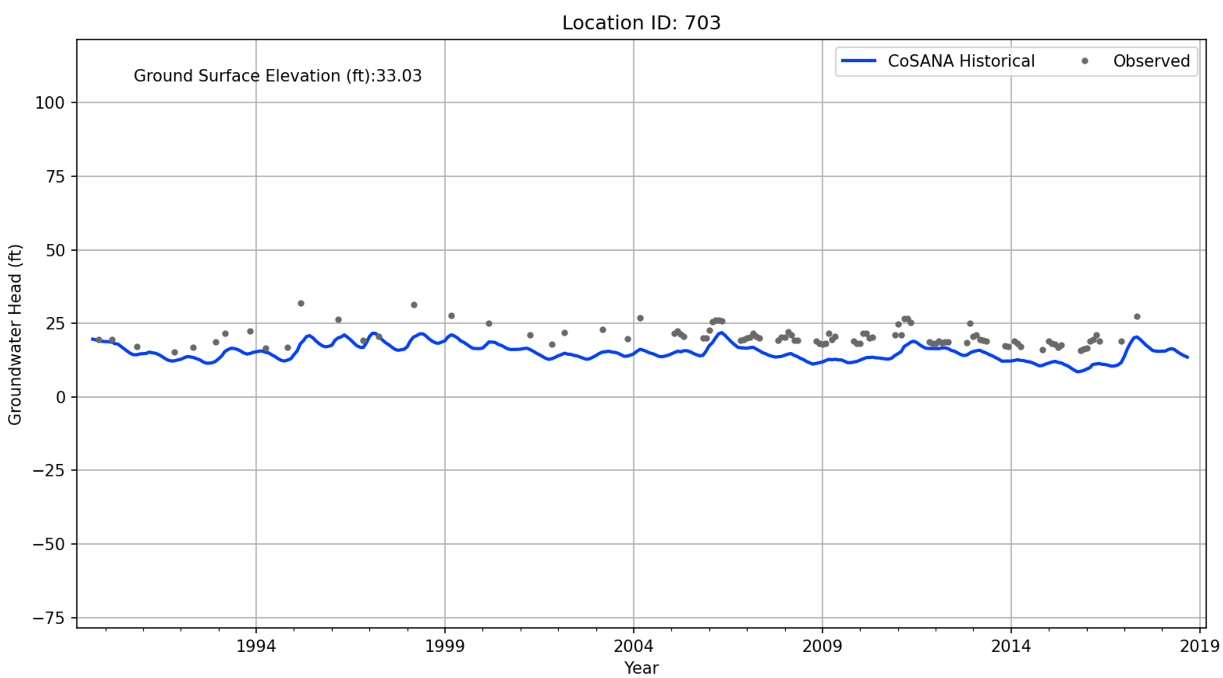

Location ID: 610
Ground Surface Elevation (ft):107.79
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019


Location ID: 612
Ground Surface Elevation (ft):146.5
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

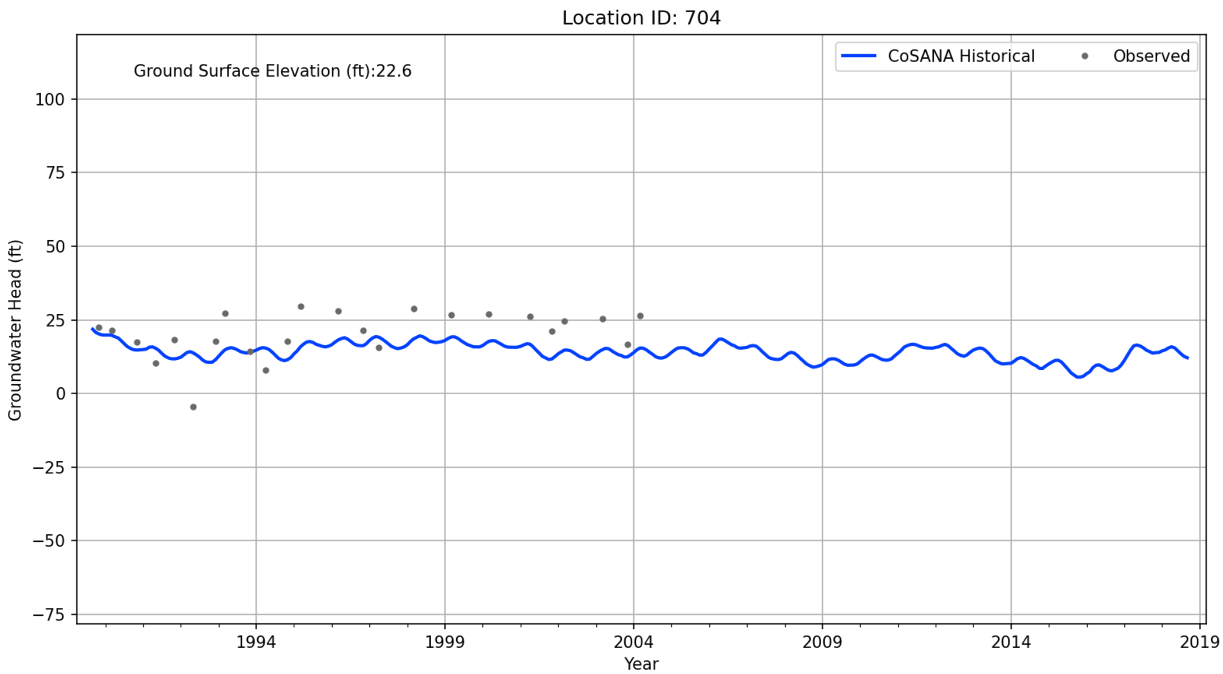

Location ID: 613
Ground Surface Elevation (ft):146.5
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

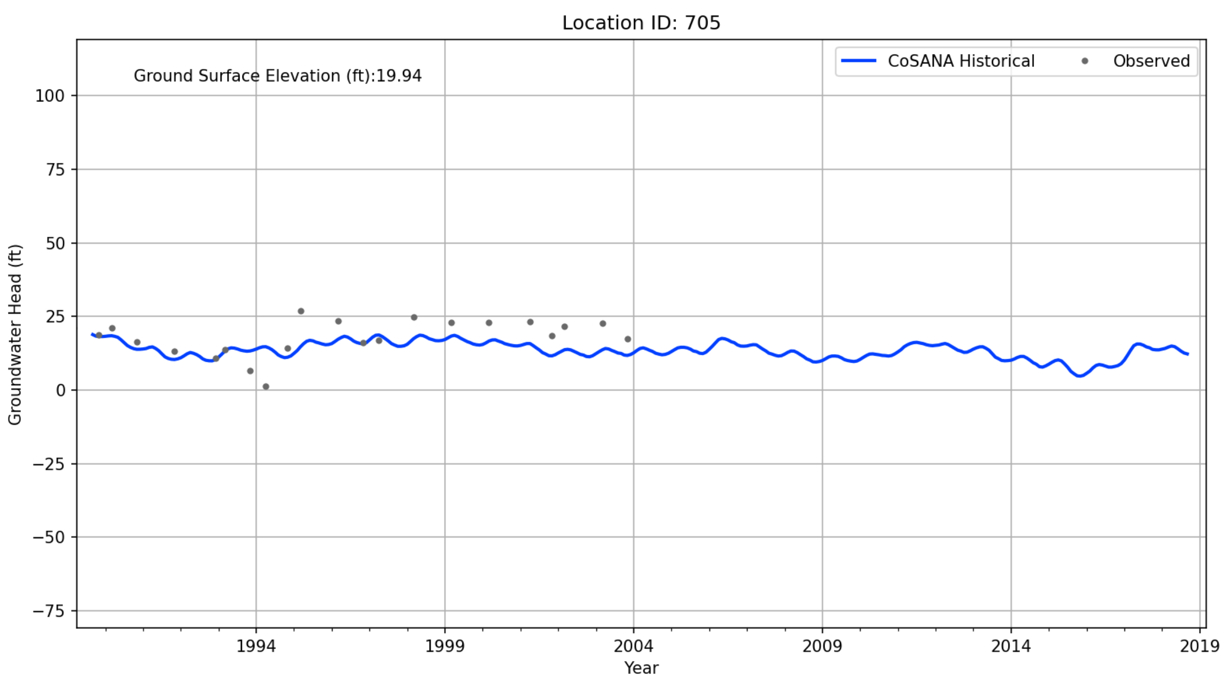


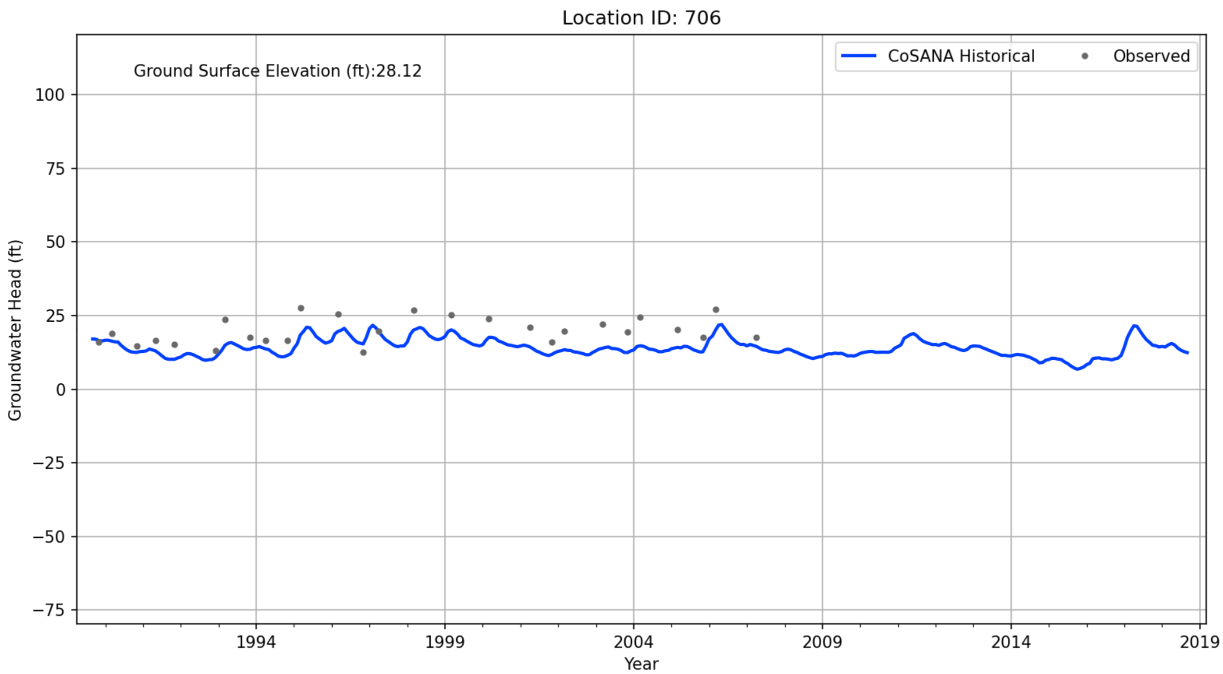
Location ID: 701
Ground Surface Elevation (ft):32.08
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year



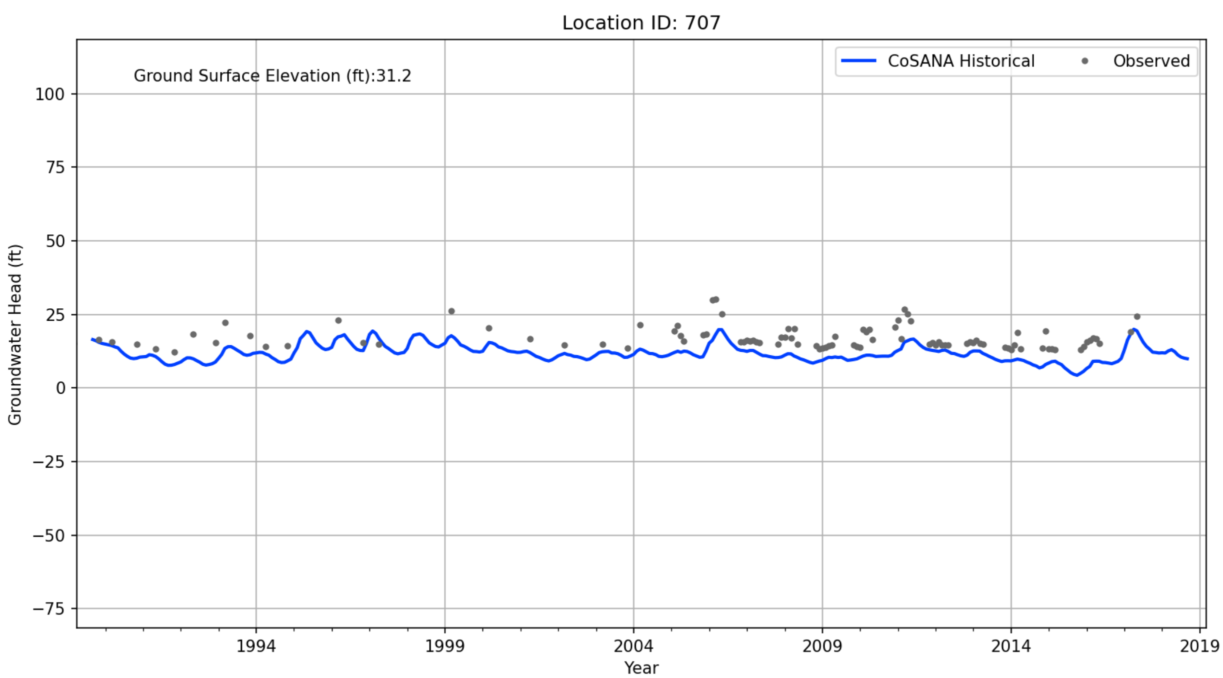
Location ID: 703
Ground Surface Elevation (ft):33.03
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 704
Ground Surface Elevation (ft):22.6
CoSANA Historical
Observed
Groundwater Head (ft)
Year

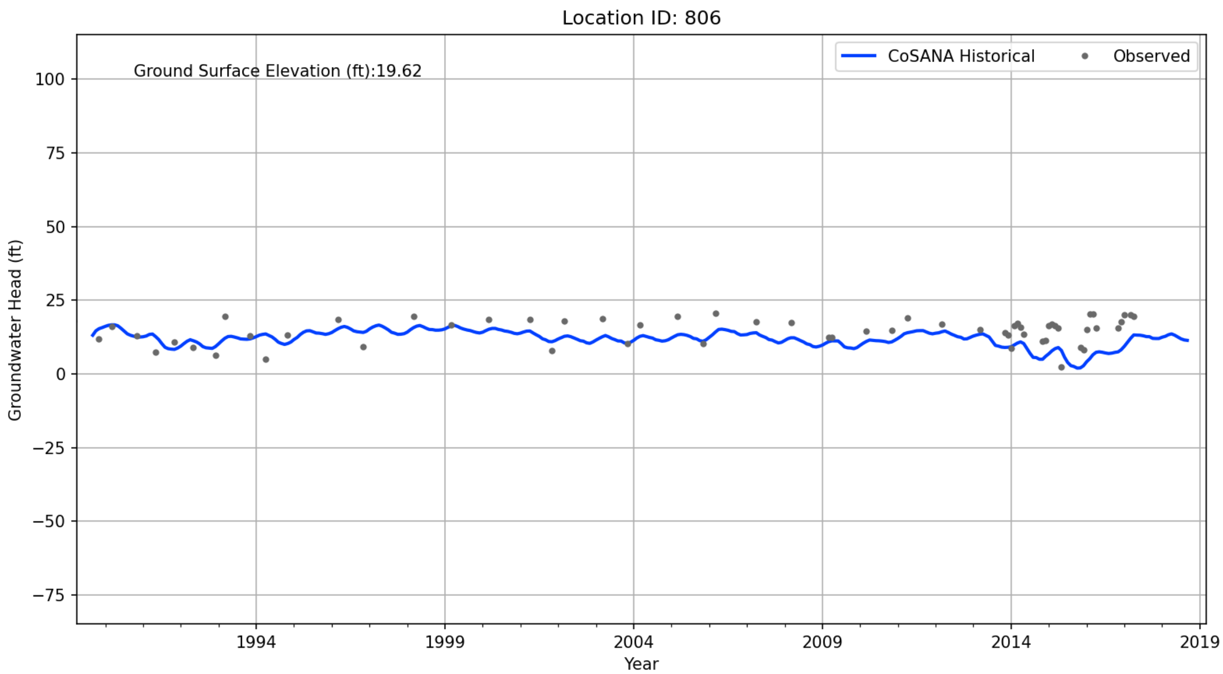

Location ID: 705
Ground Surface Elevation (ft):19.94
CoSANA Historical
Observed
Groundwater Head (ft)
Year

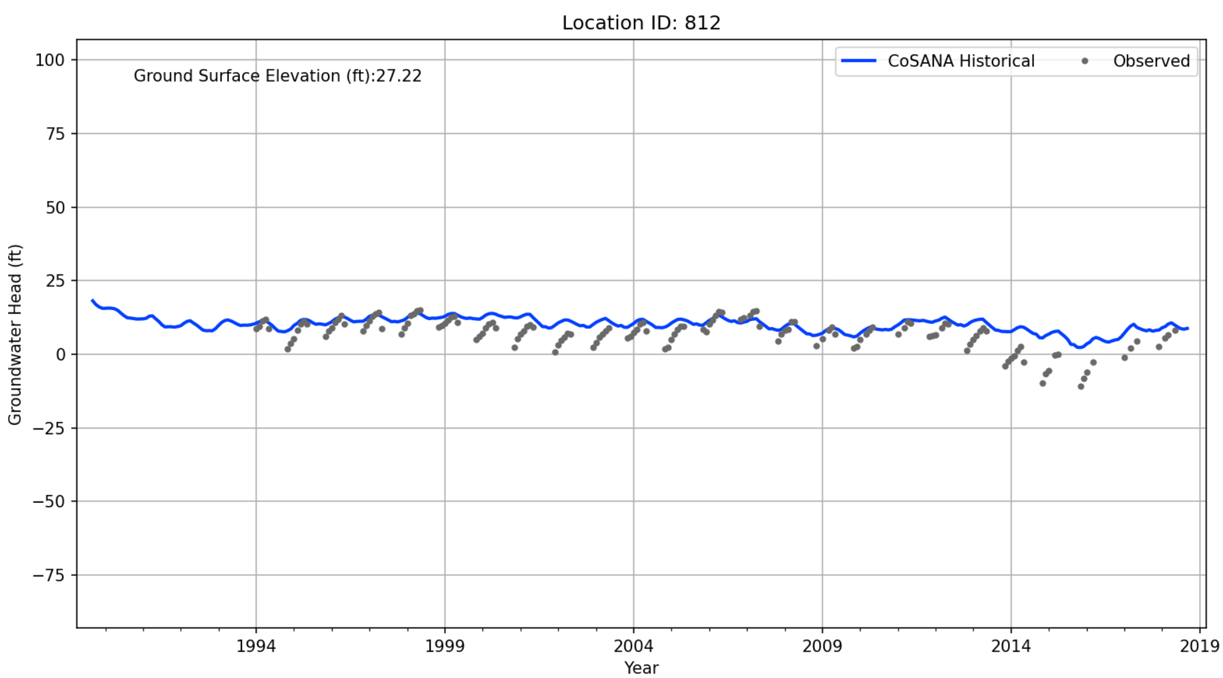


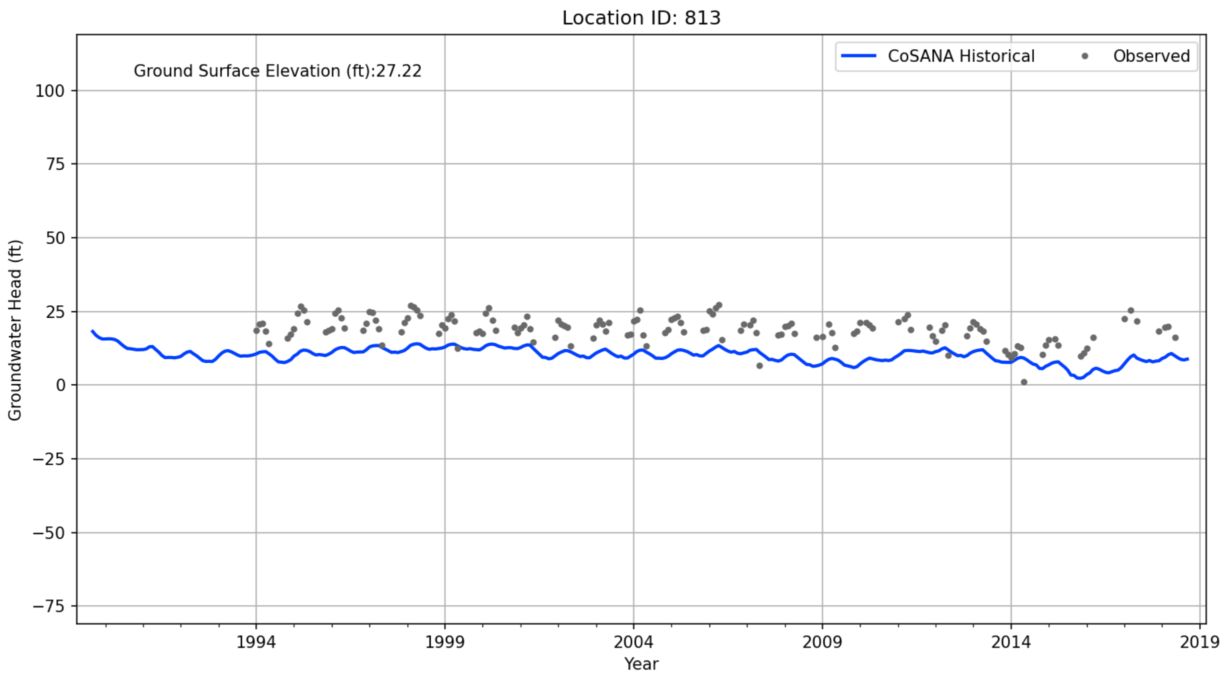
Location ID: 706
Ground Surface Elevation (ft):28.12
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

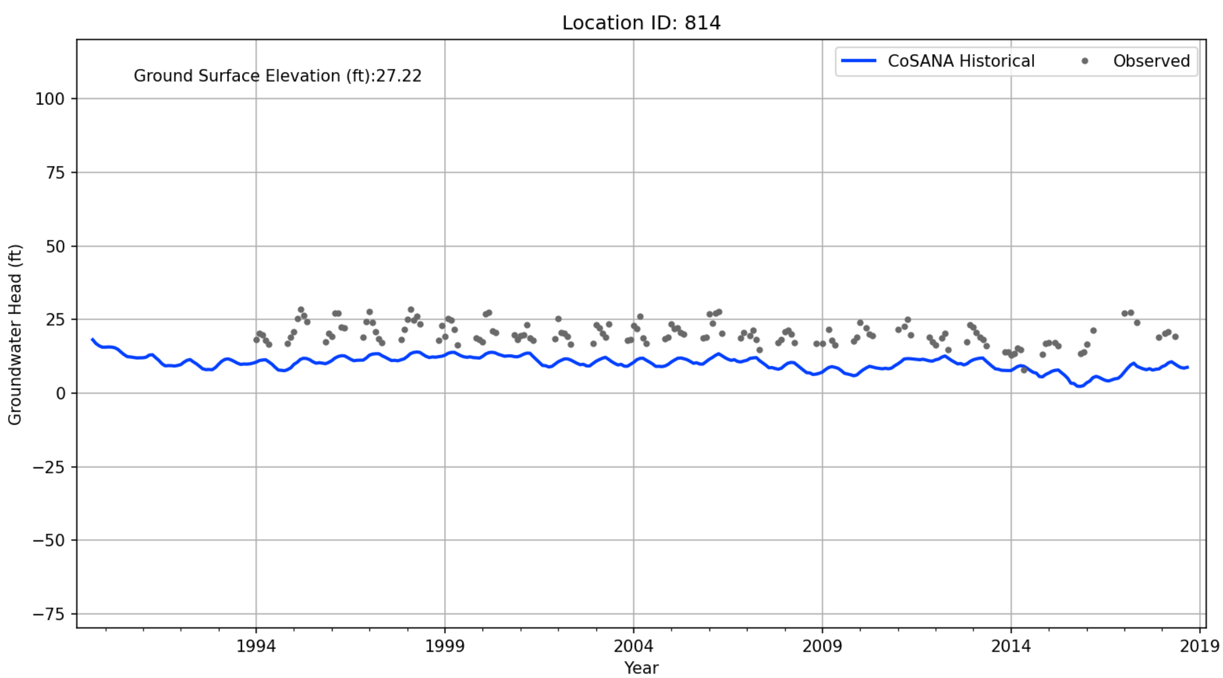


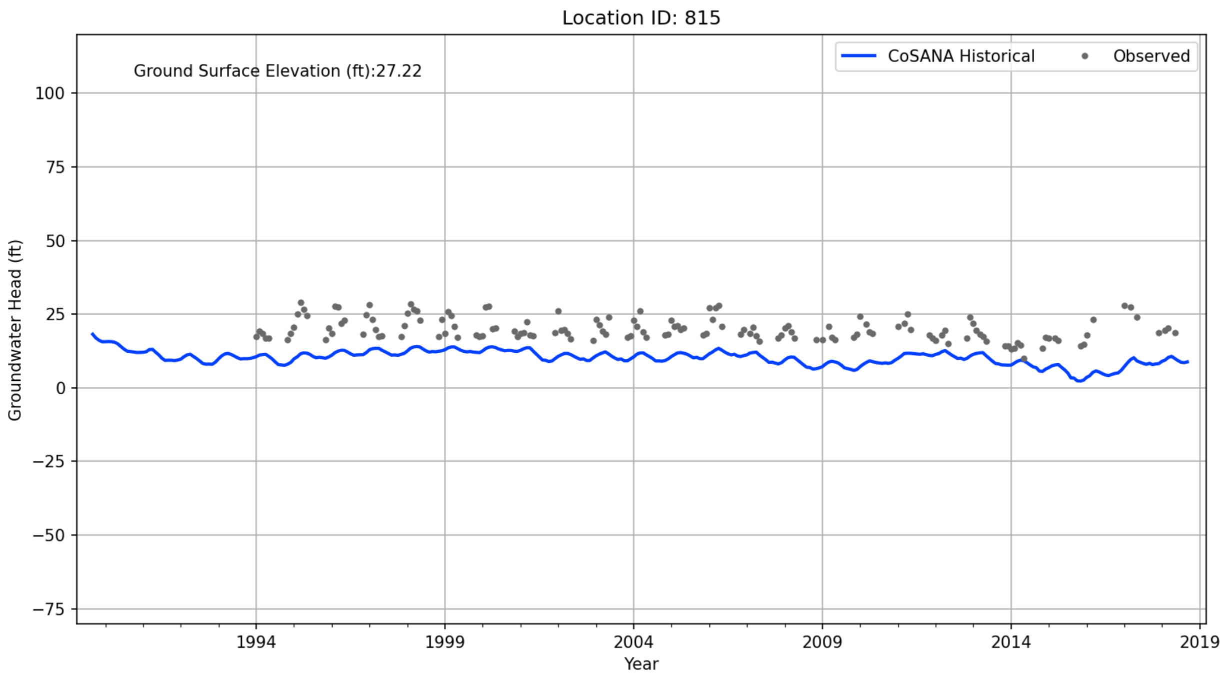
Location ID: 707
Ground Surface Elevation (ft):31.2
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

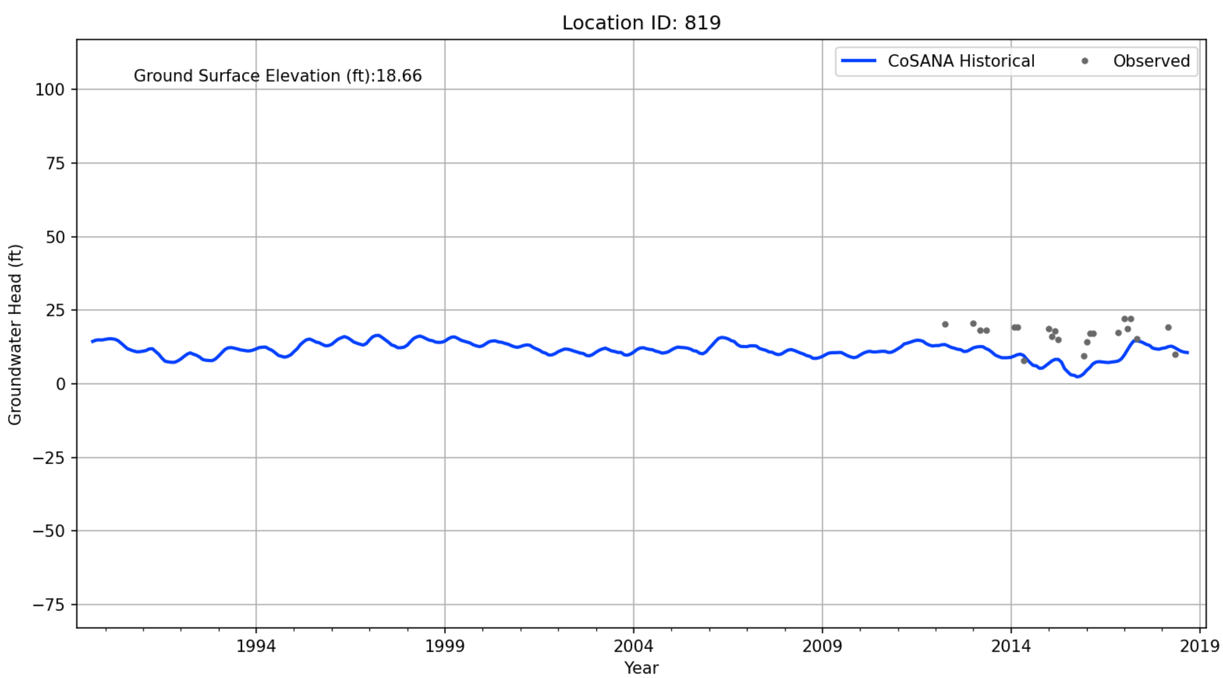

Location ID: 806
CoSANA Historical
Observed
Ground Surface Elevation (ft):19.62
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

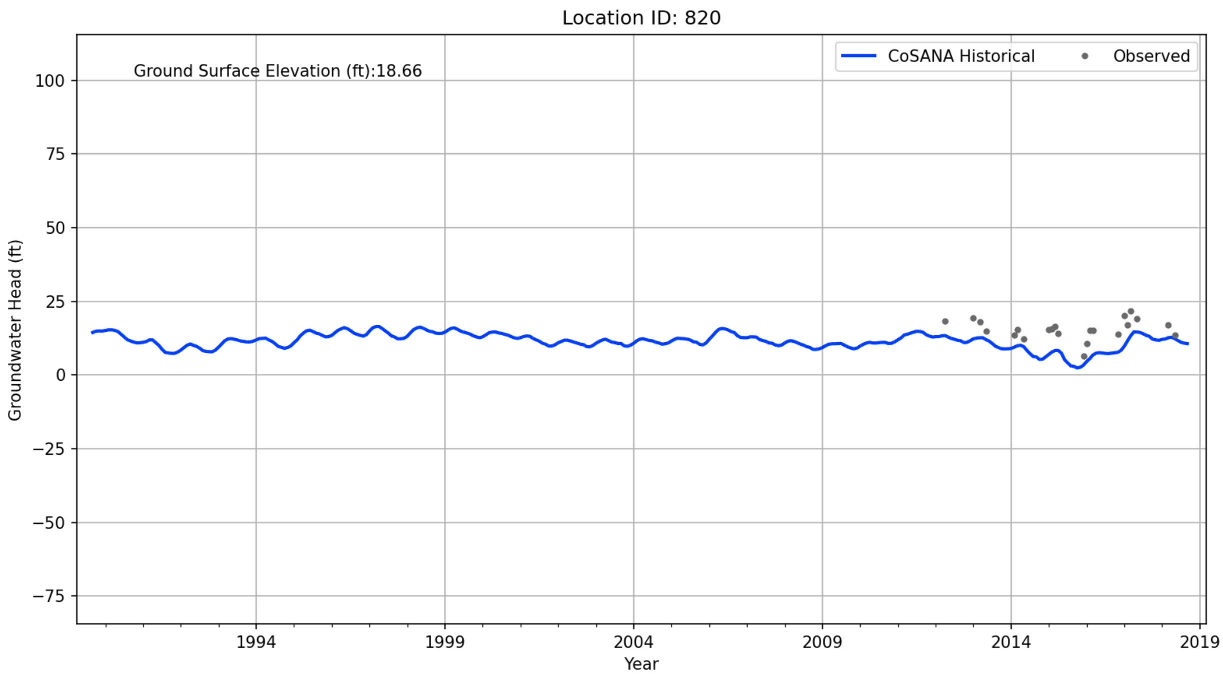

Location ID: 812
CoSANA Historical
Observed
Ground Surface Elevation (ft):27.22
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 813
Ground Surface Elevation (ft):27.22
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

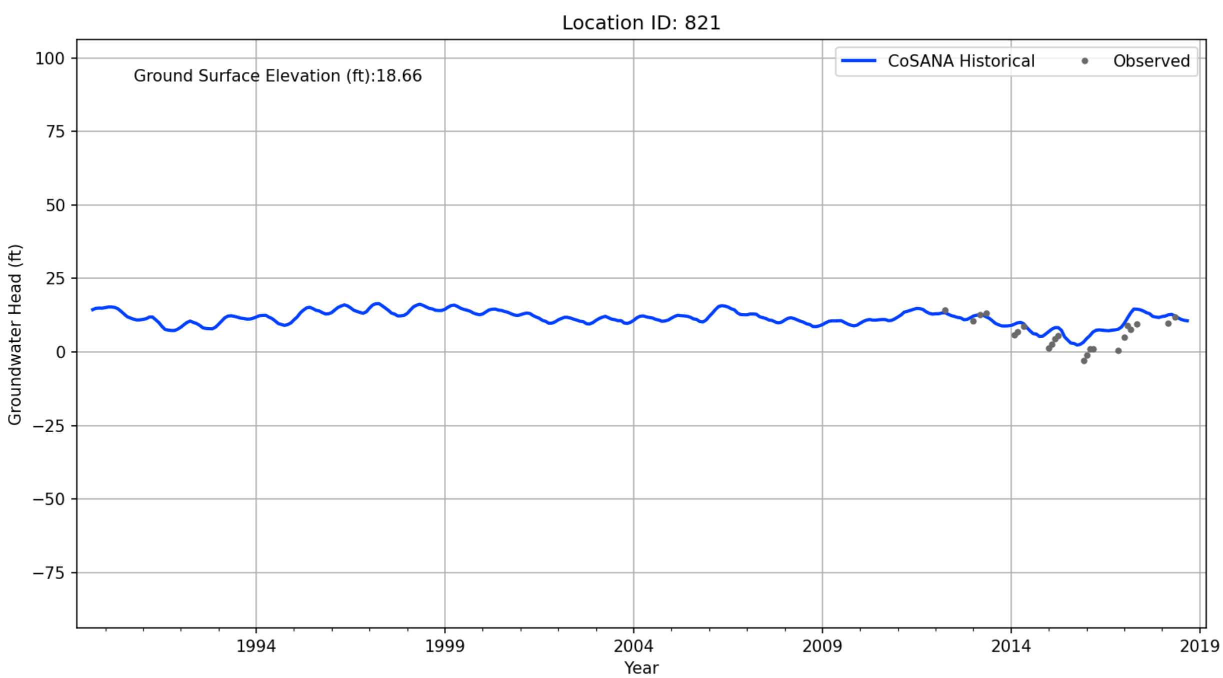

Location ID: 814
Ground Surface Elevation (ft):27.22
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019


Location ID: 815
Ground Surface Elevation (ft):27.22
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

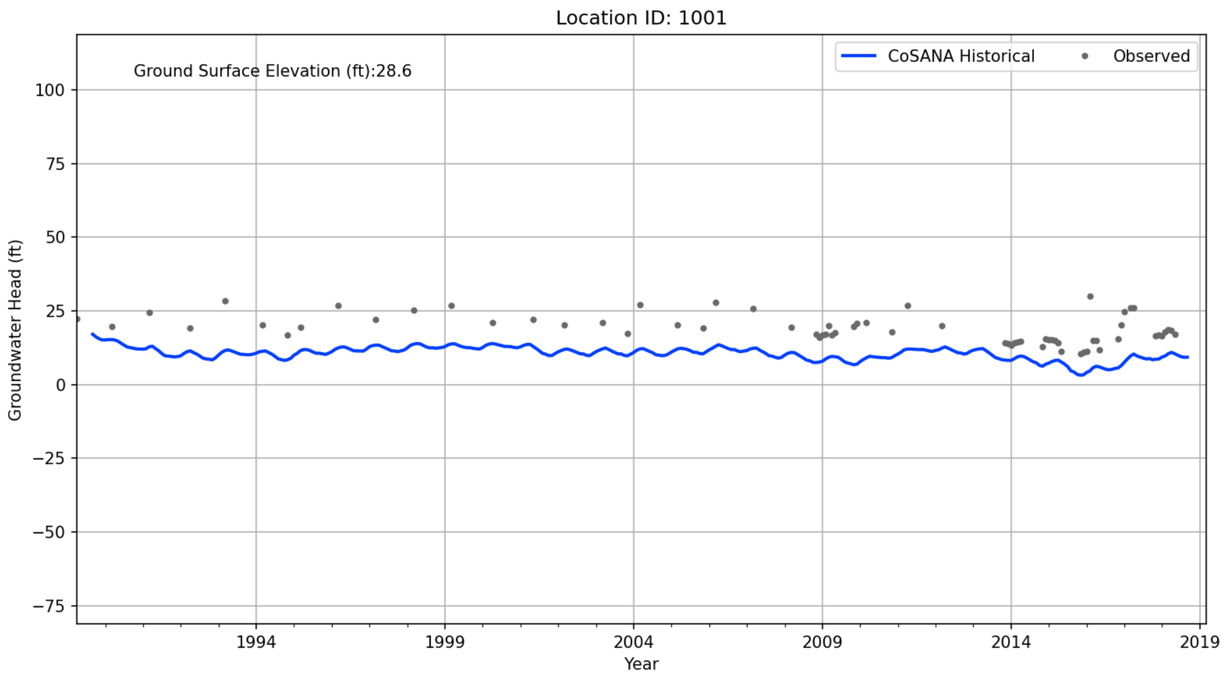

Location ID: 819
Ground Surface Elevation (ft):18.66
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019



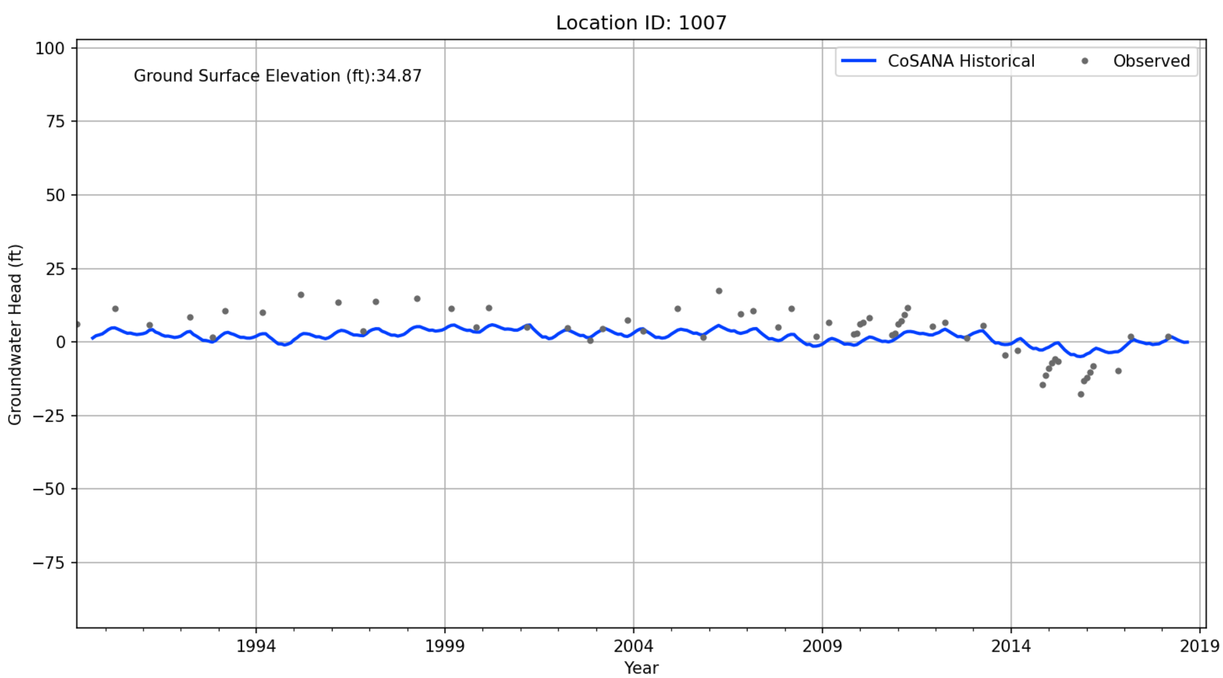
Location ID: 820
Ground Surface Elevation (ft):18.66
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019



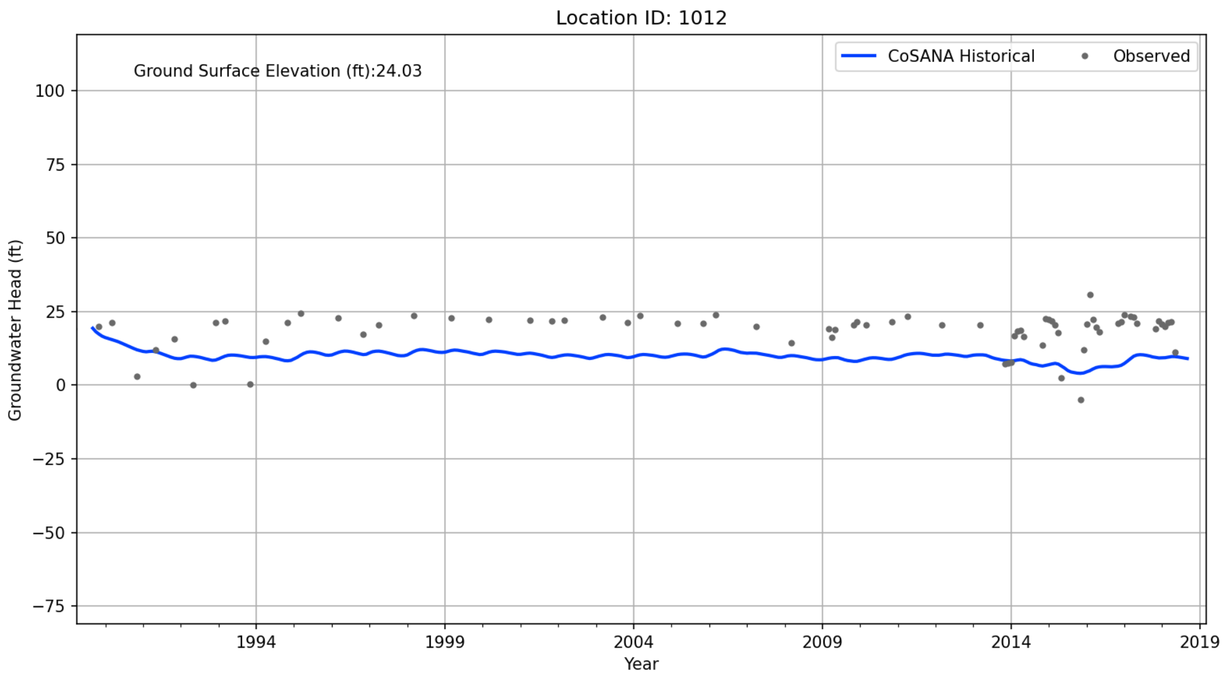
Location ID: 821
Ground Surface Elevation (ft):18.66
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

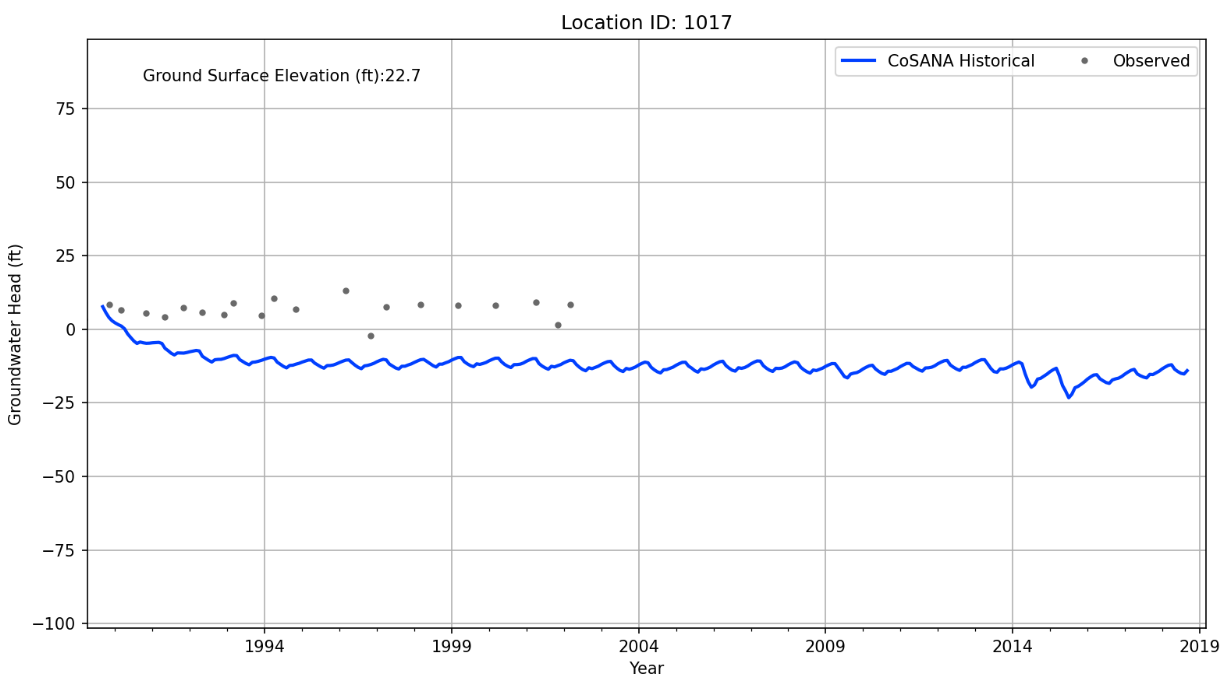


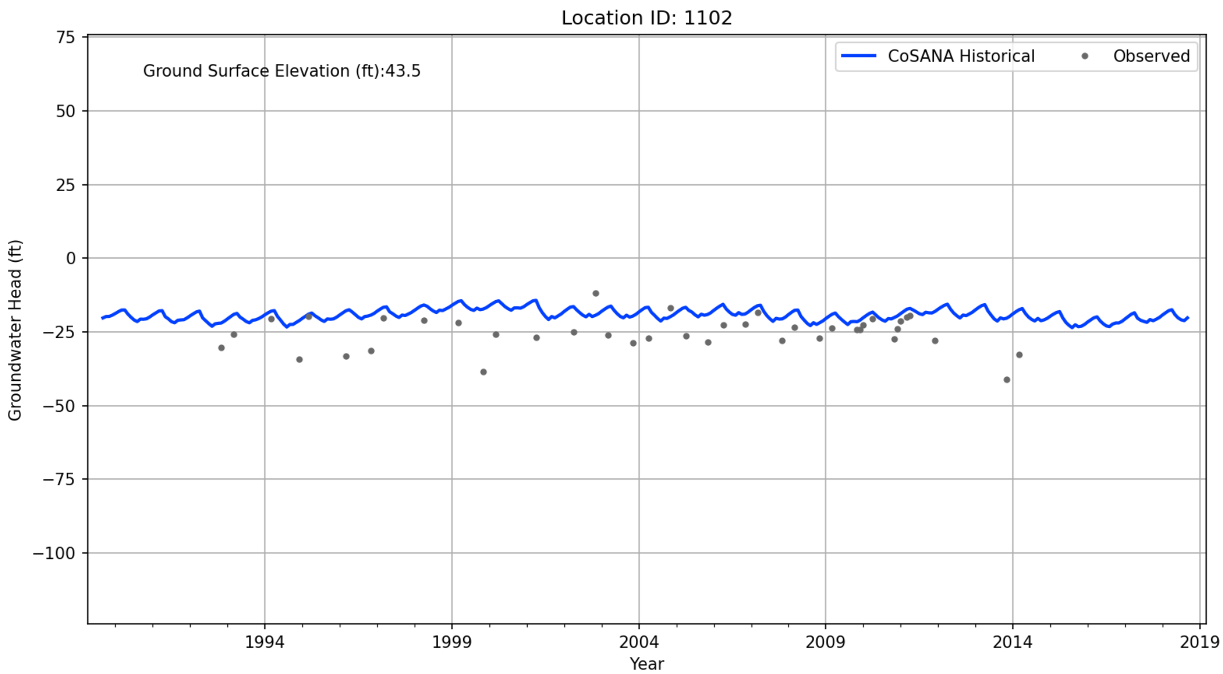
Location ID: 1001
Ground Surface Elevation (ft):28.6
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

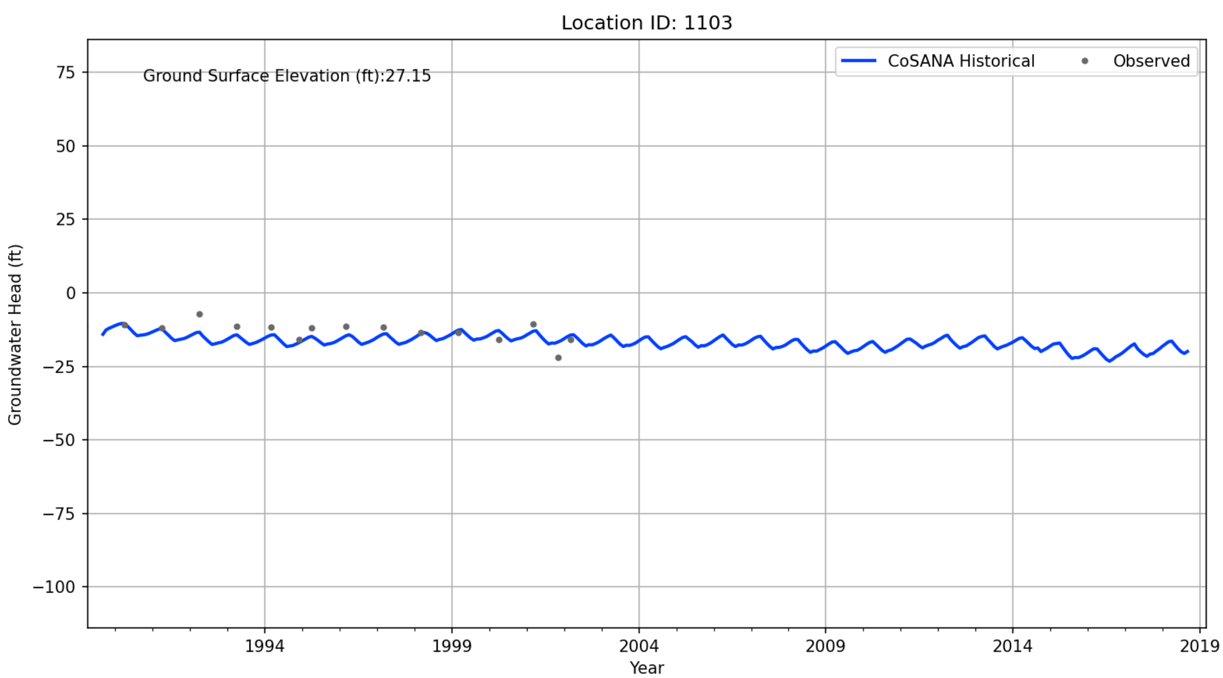


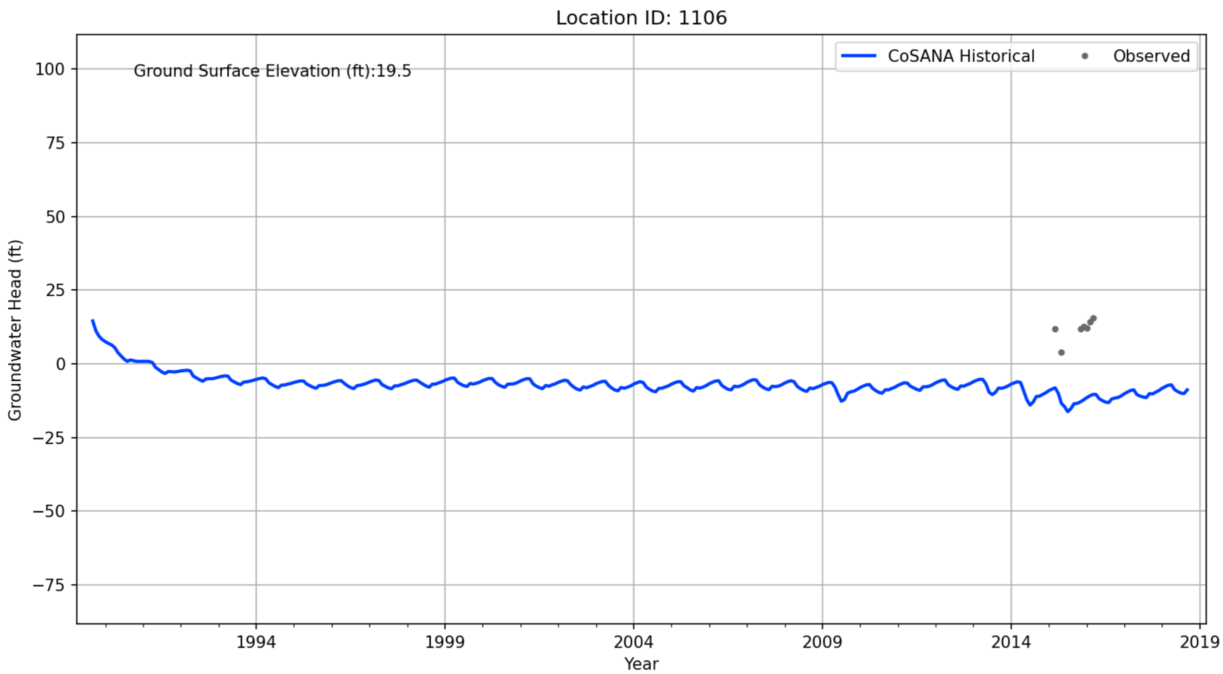
Location ID: 1007
Ground Surface Elevation (ft):34.87
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019


Location ID: 1012
Ground Surface Elevation (ft):24.03
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

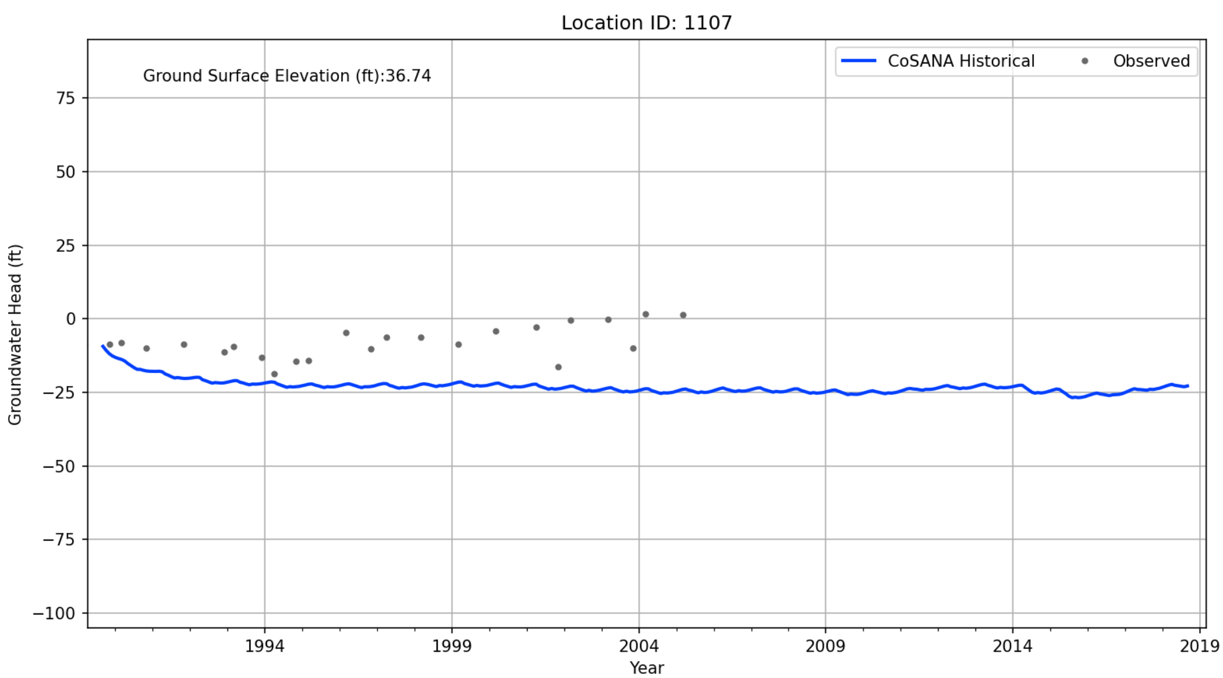

Location ID: 1017
Ground Surface Elevation (ft):22.7
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 1102
Ground Surface Elevation (ft):43.5
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

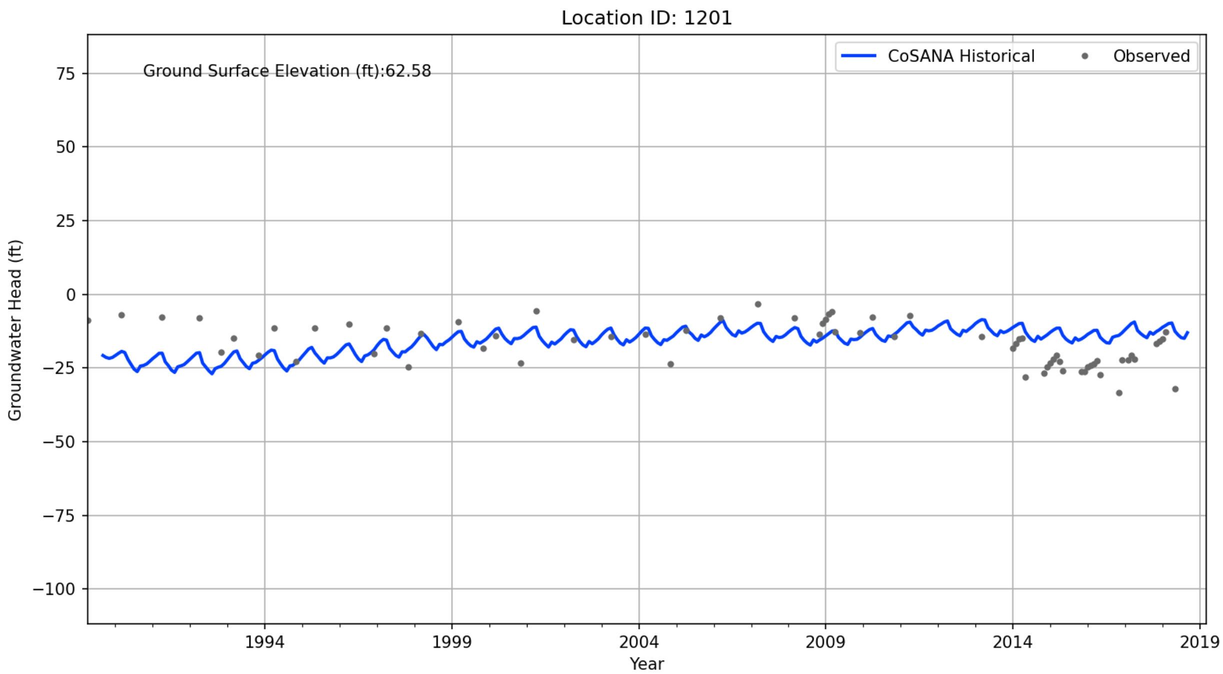

Location ID: 1103
Ground Surface Elevation (ft):27.15
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

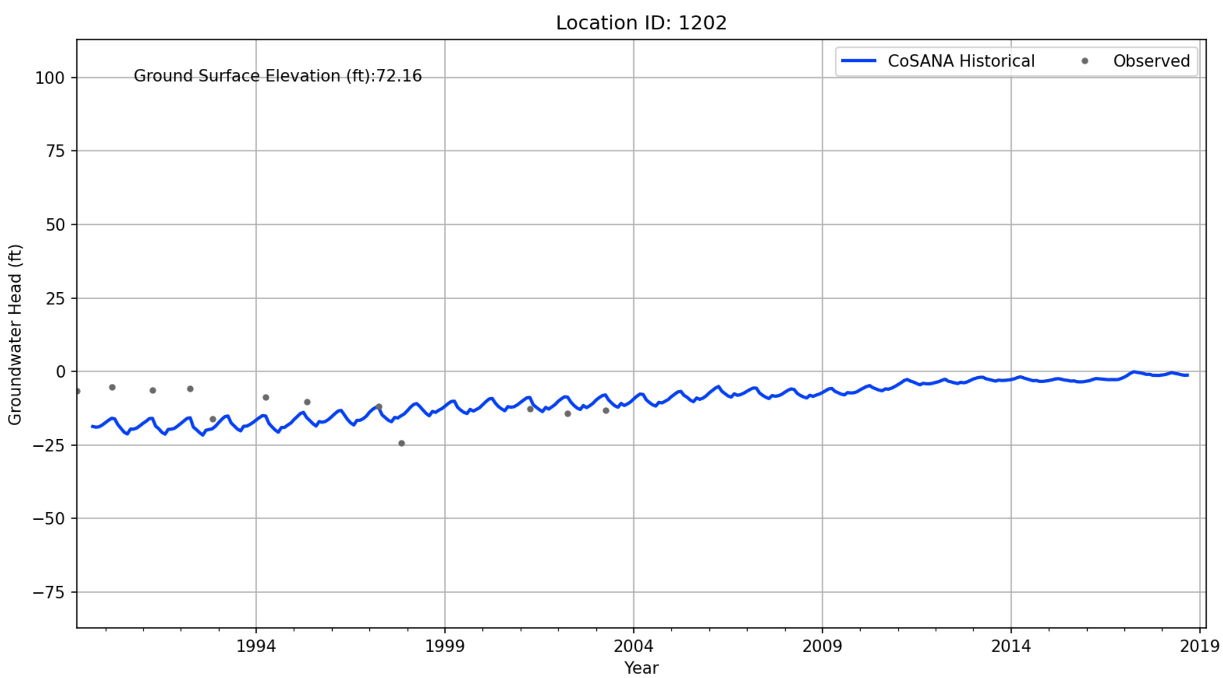


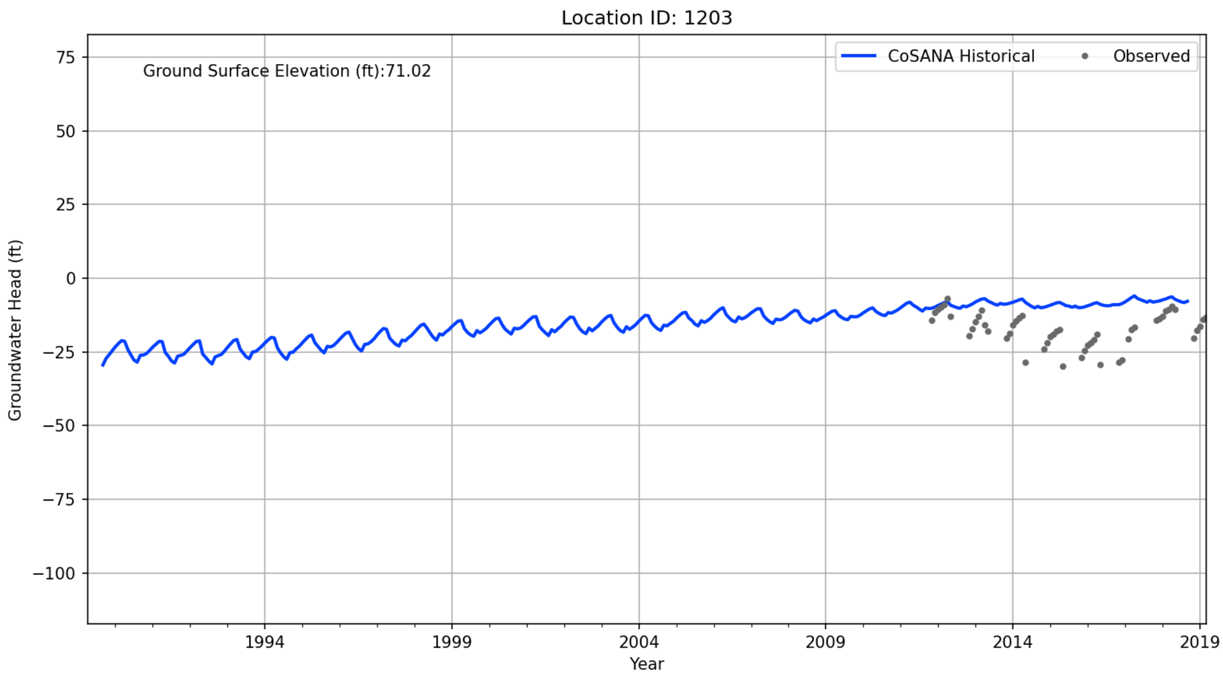
Location ID: 1106
Ground Surface Elevation (ft):19.5
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

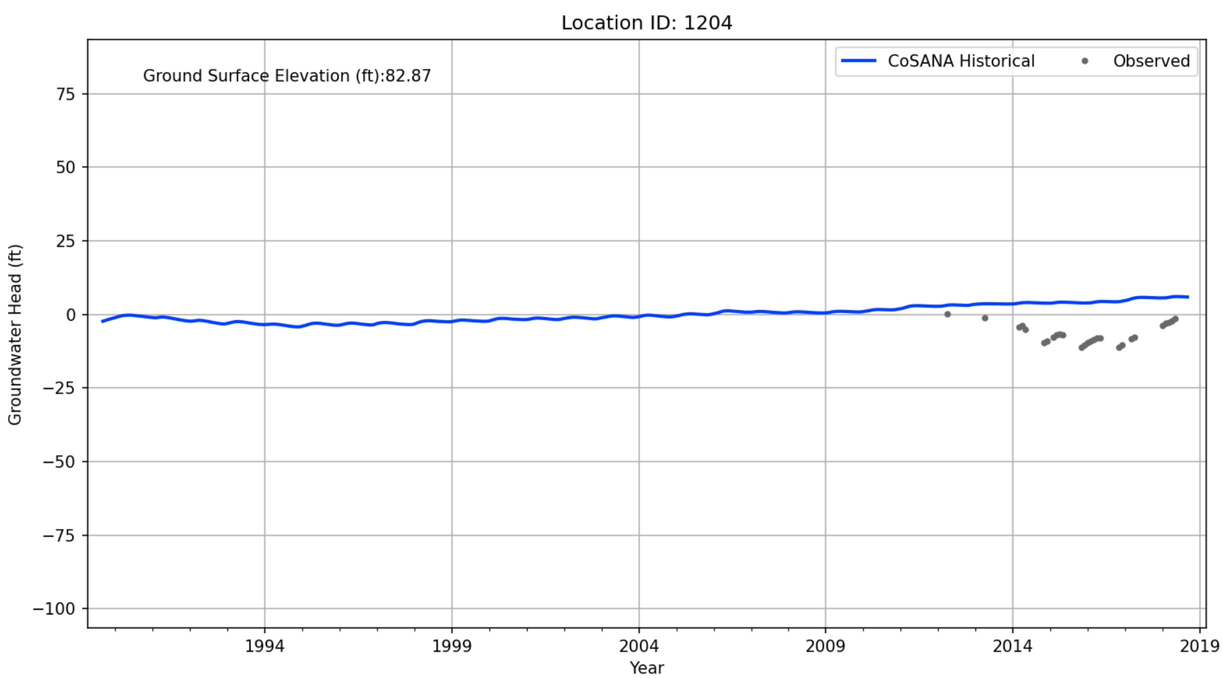


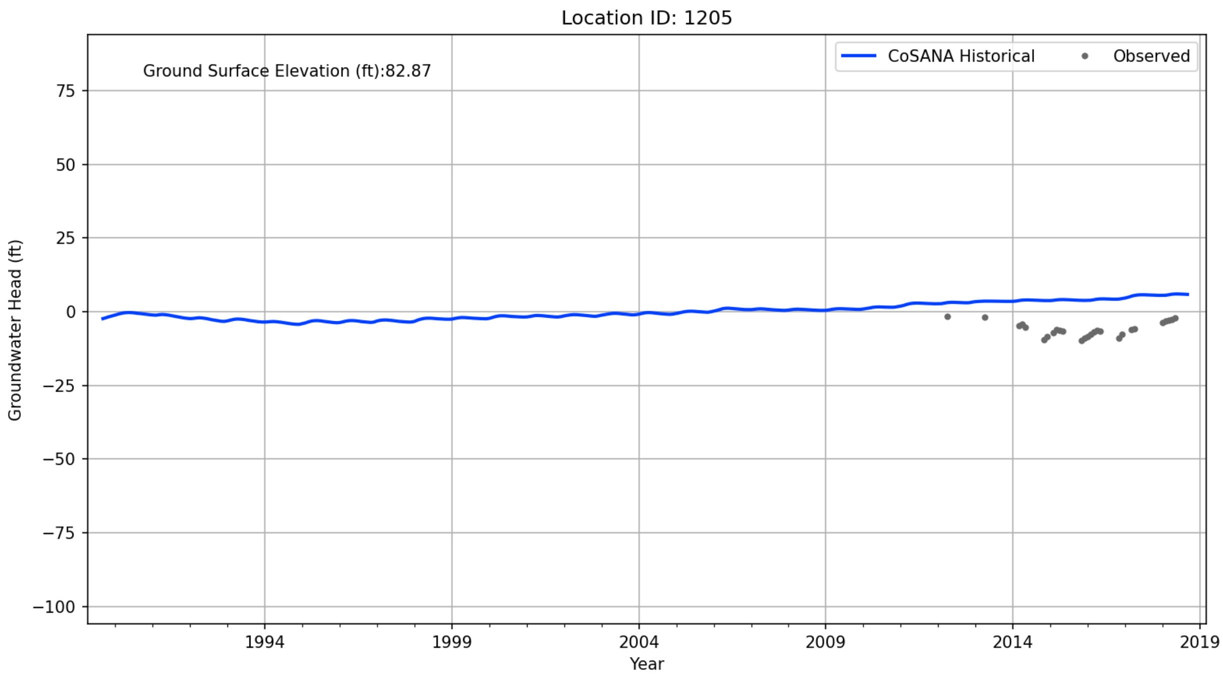
Location ID: 1107
Ground Surface Elevation (ft):36.74
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

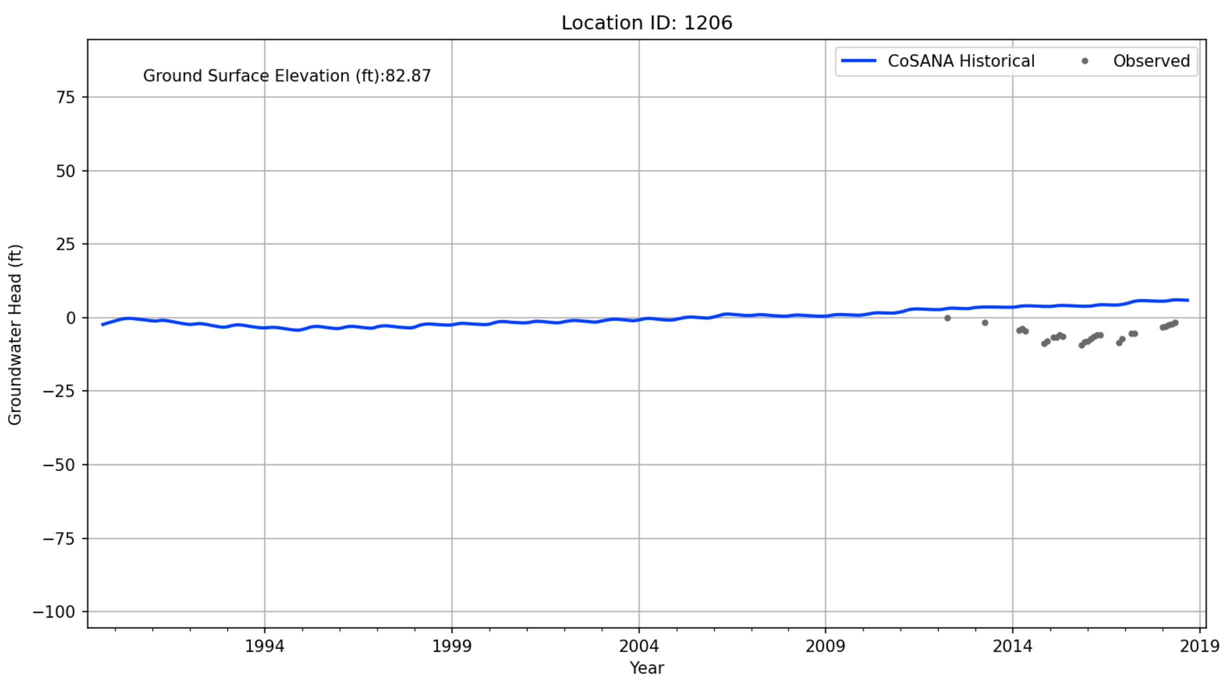

Location ID: 1201
Ground Surface Elevation (ft):62.58
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

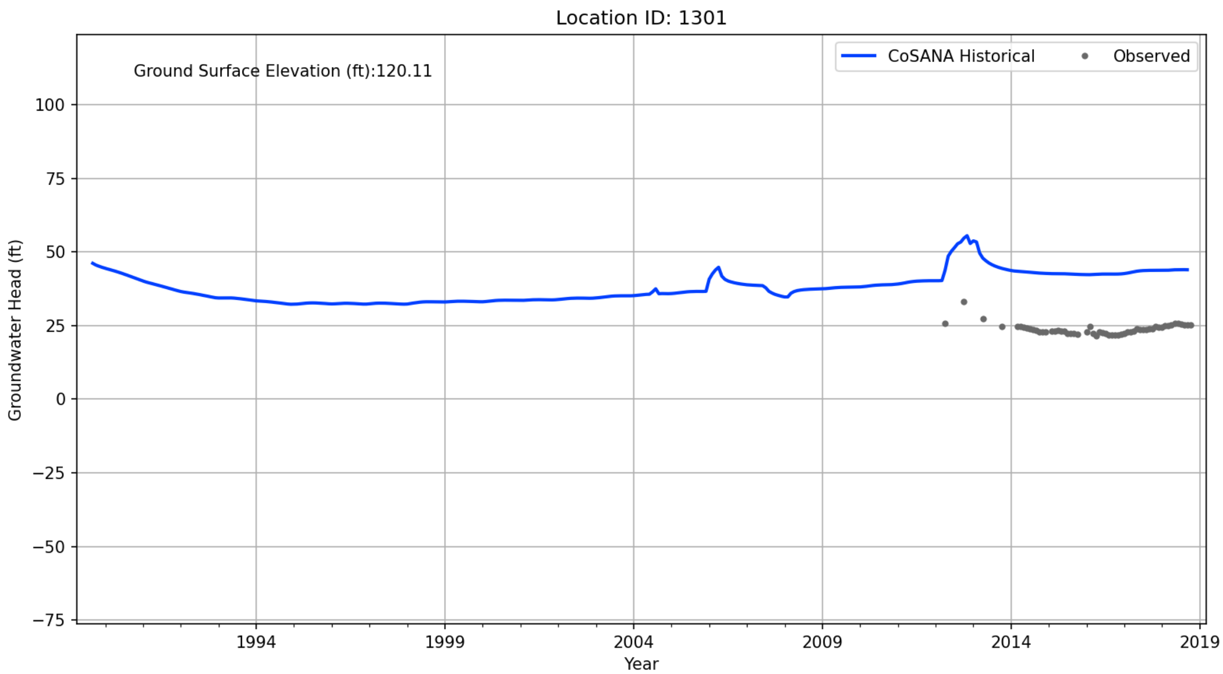

Location ID: 1202
Ground Surface Elevation (ft):72.16
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

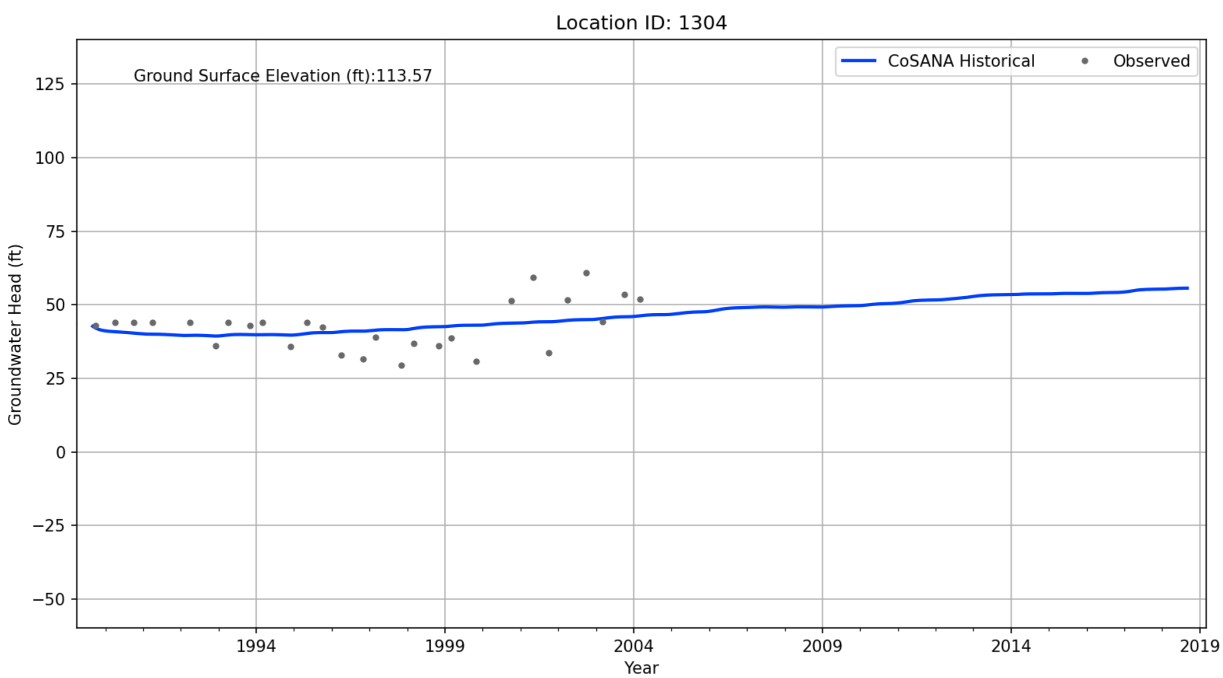

Location ID: 1203
Ground Surface Elevation (ft):71.02
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

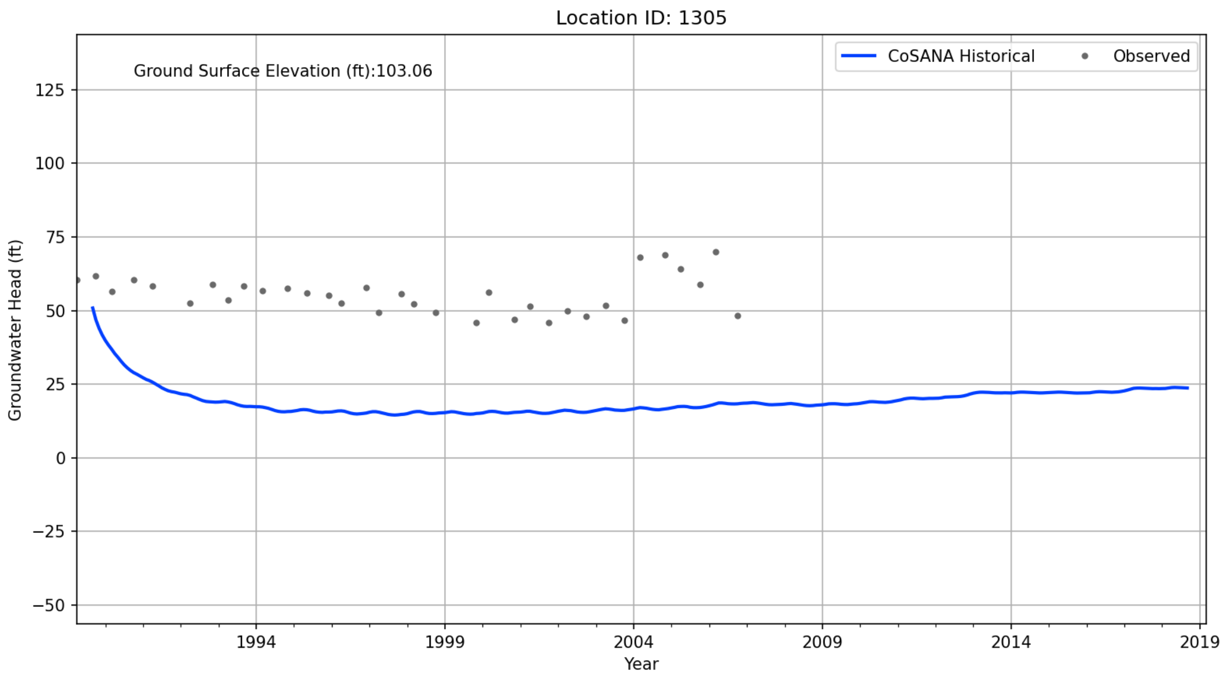

Location ID: 1204
Ground Surface Elevation (ft):82.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 1205
Ground Surface Elevation (ft):82.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

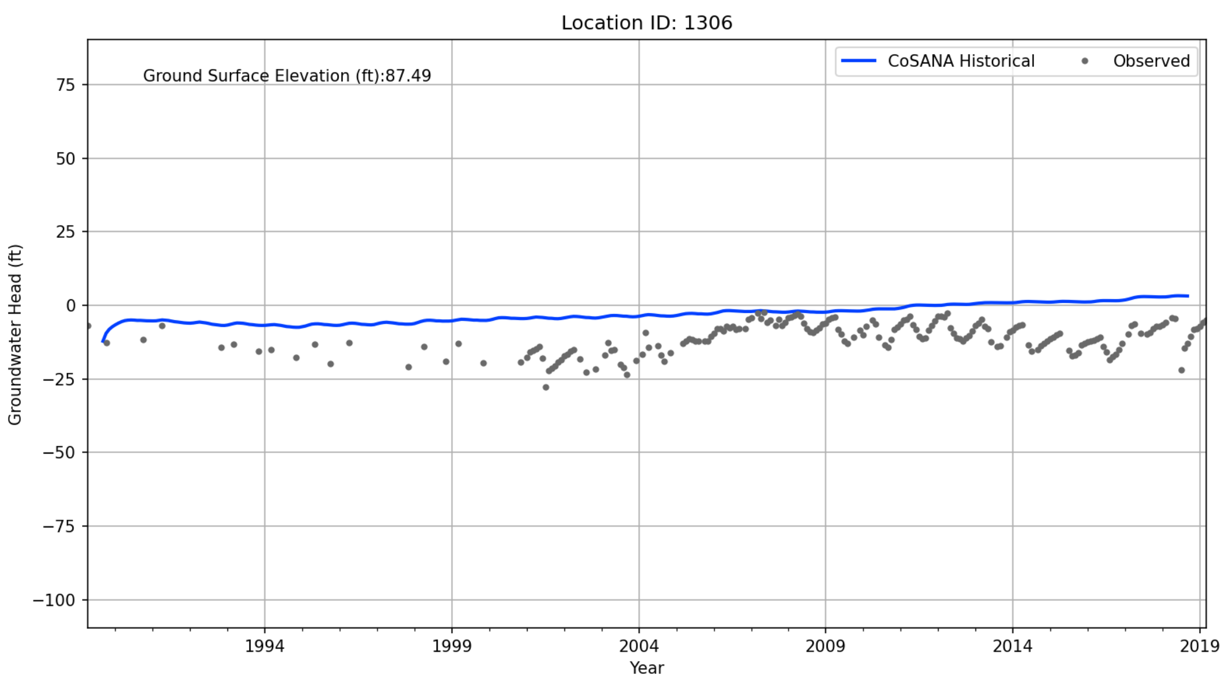

Location ID: 1206
Ground Surface Elevation (ft):82.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 1301
Ground Surface Elevation (ft):120.11
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

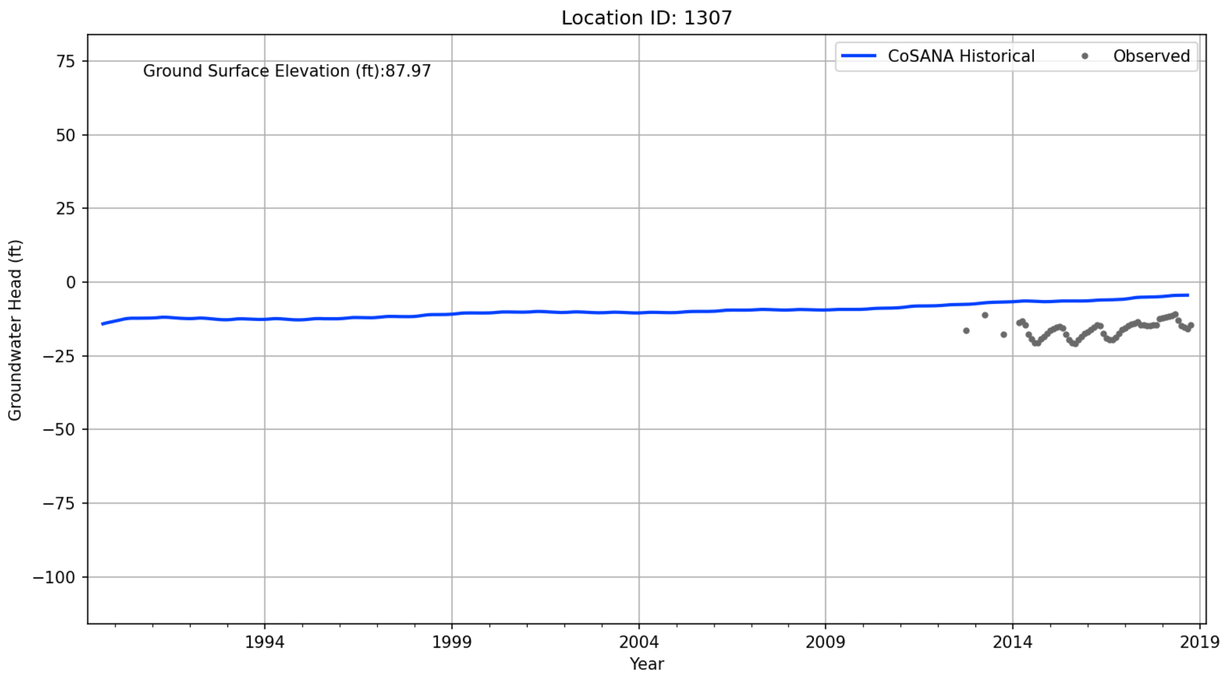

Location ID: 1304
Ground Surface Elevation (ft):113.57
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

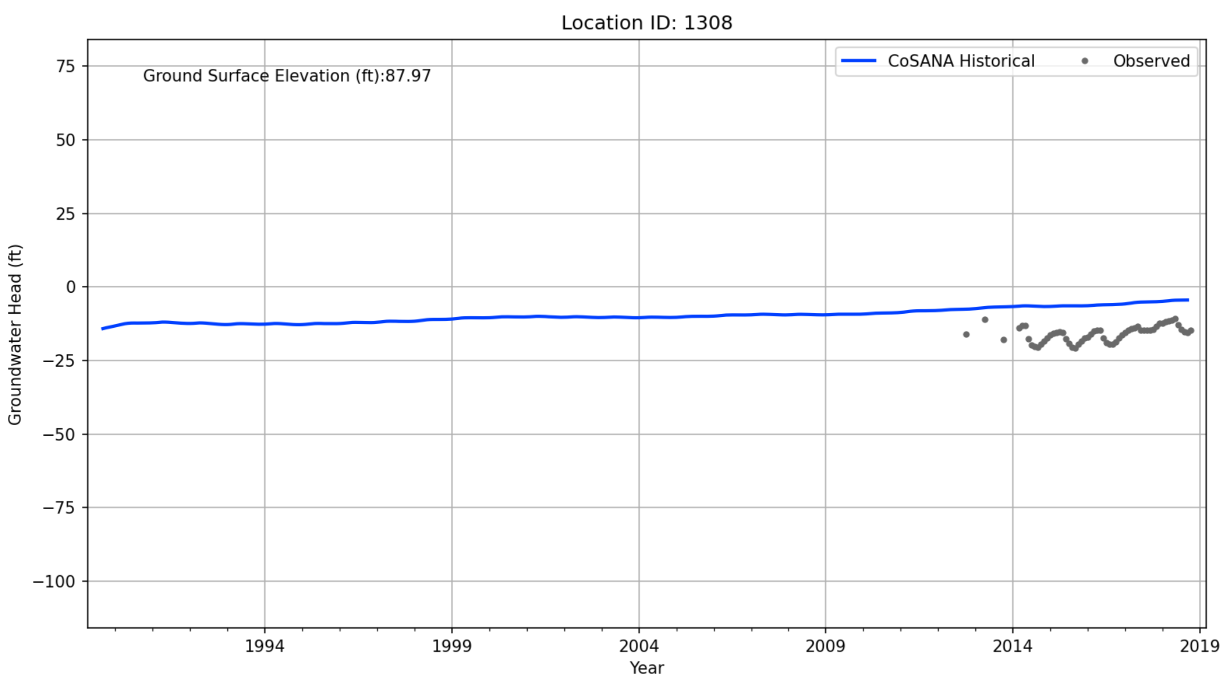


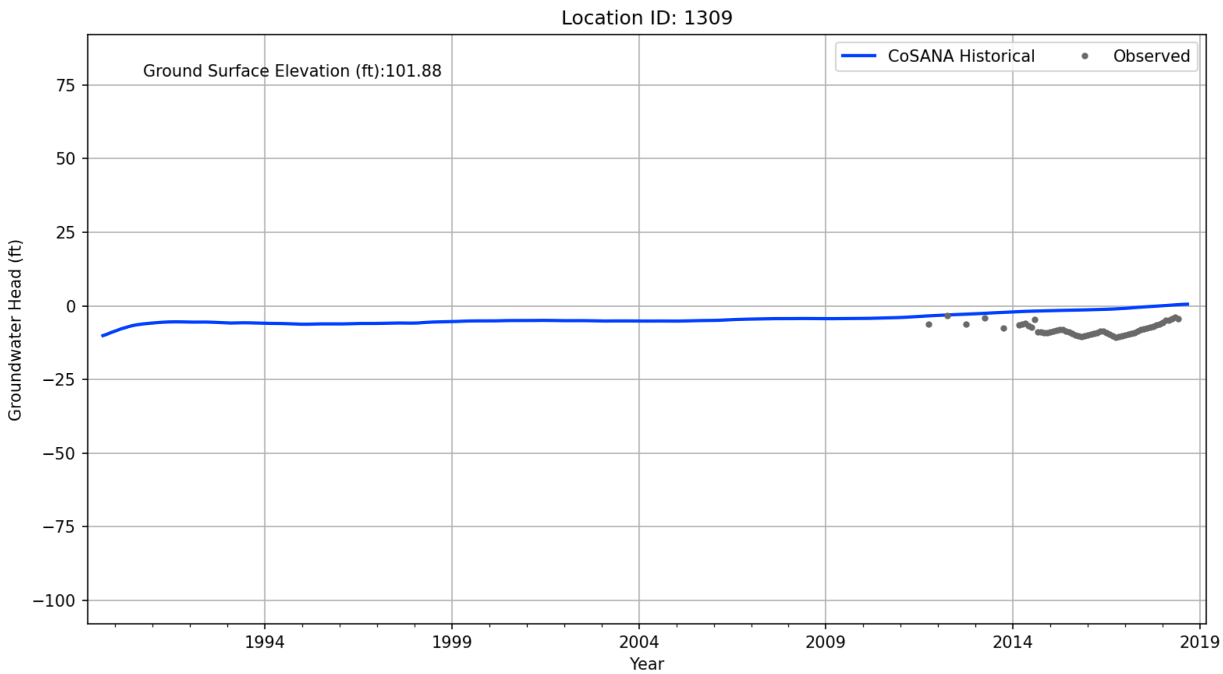
Location ID: 1305
Ground Surface Elevation (ft):103.06
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

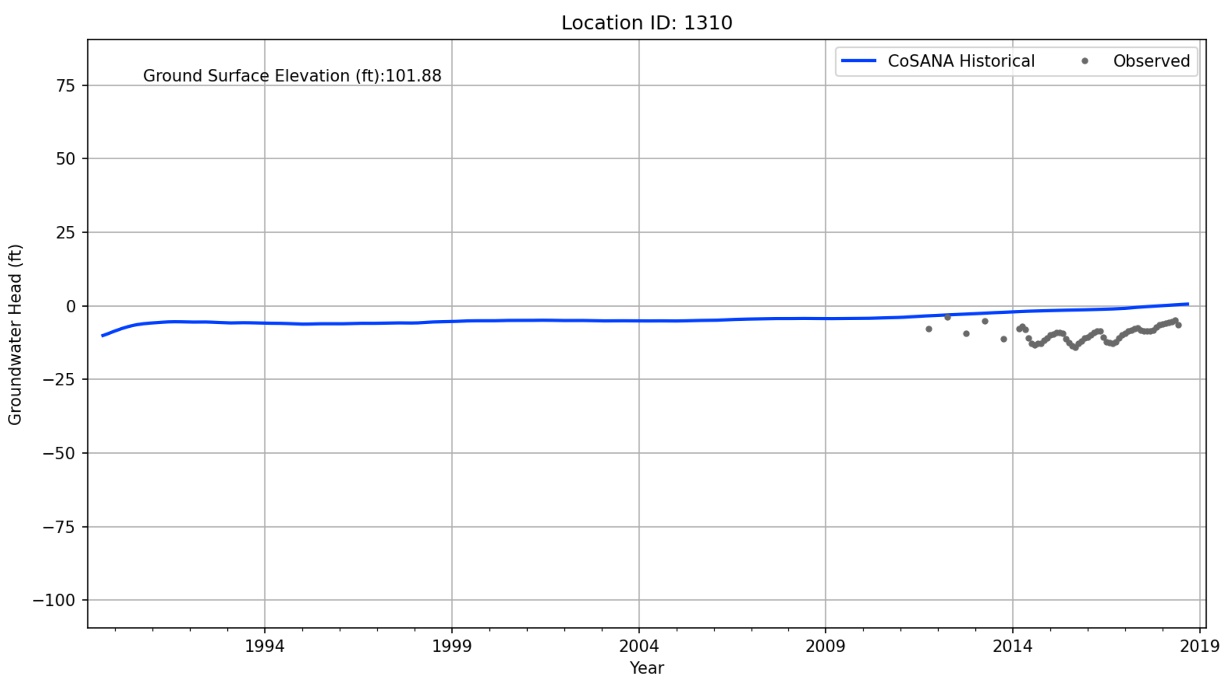


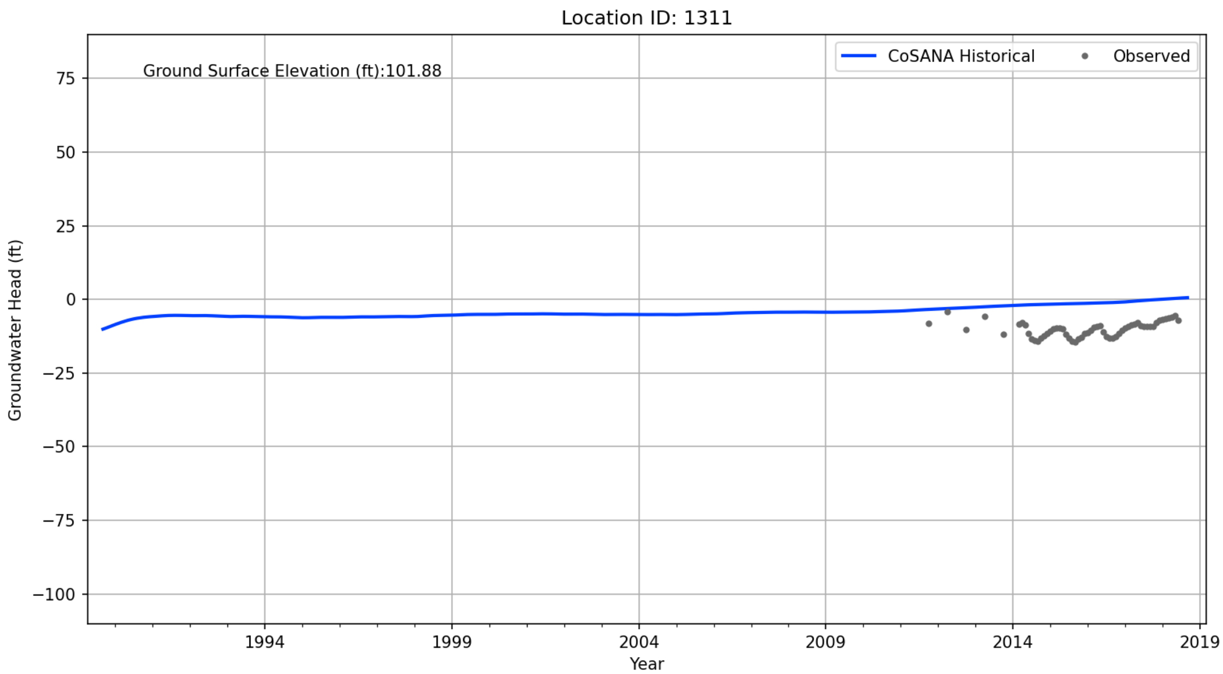
Location ID: 1306
Ground Surface Elevation (ft):87.49
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 1307
Ground Surface Elevation (ft):87.97
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

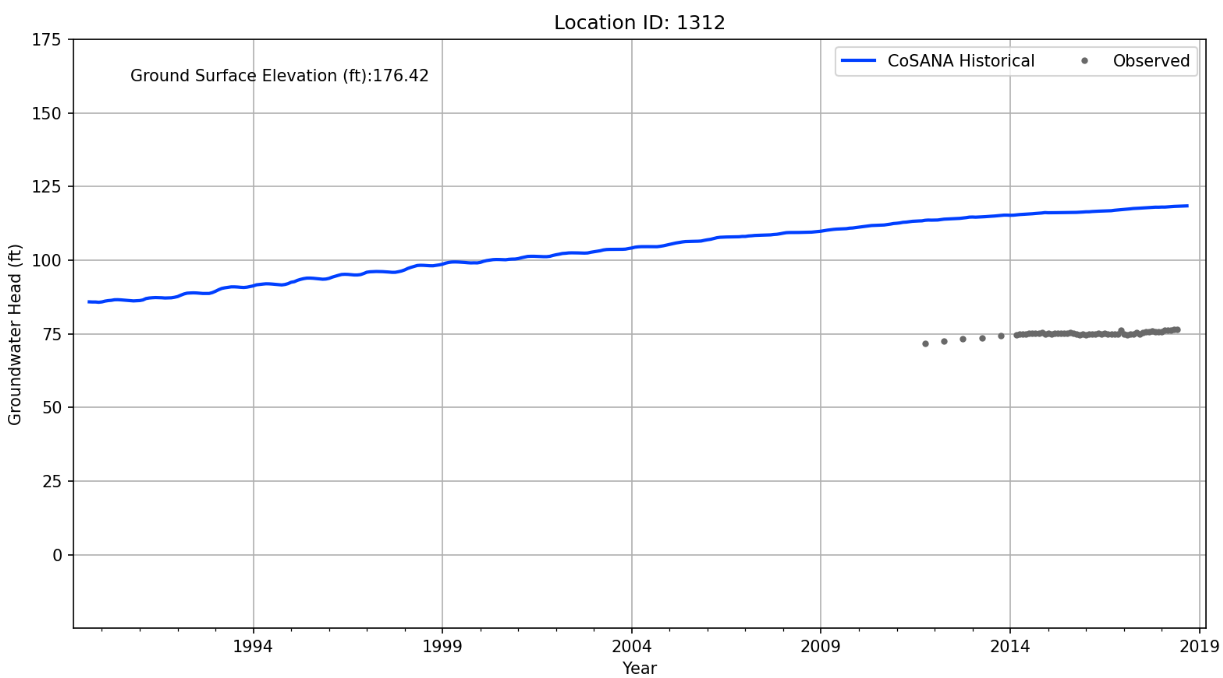

Location ID: 1308
Ground Surface Elevation (ft):87.97
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 1309
Ground Surface Elevation (ft):101.88
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

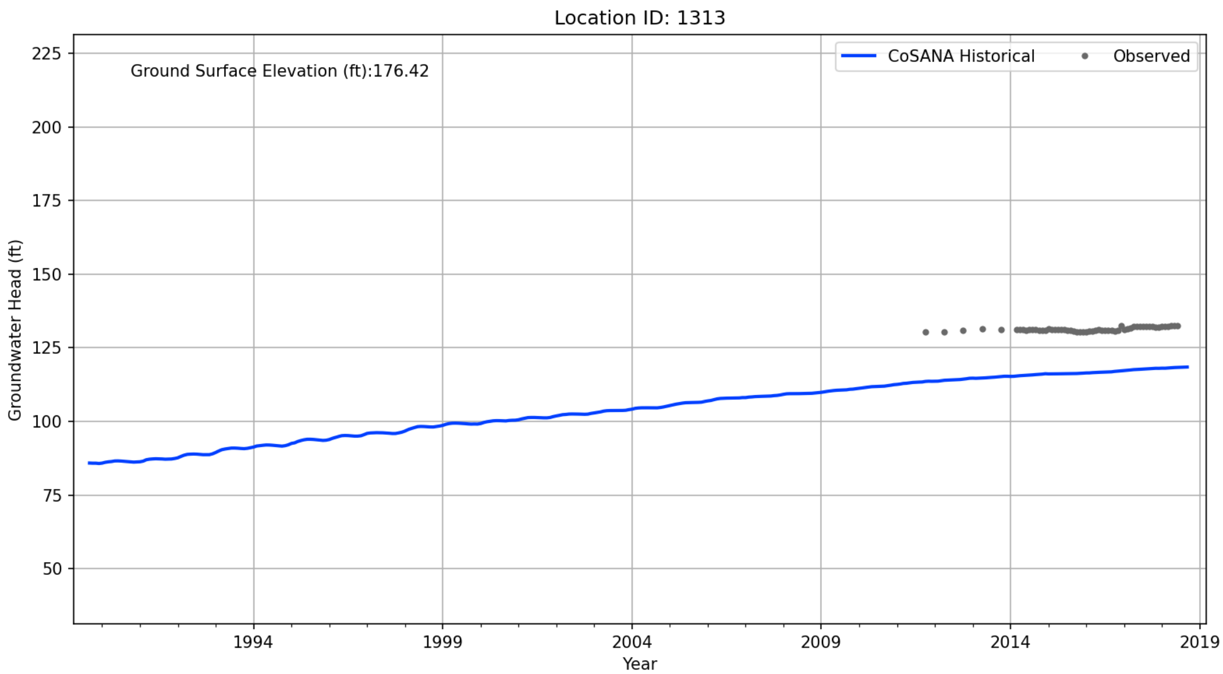

Location ID: 1310
Ground Surface Elevation (ft):101.88
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

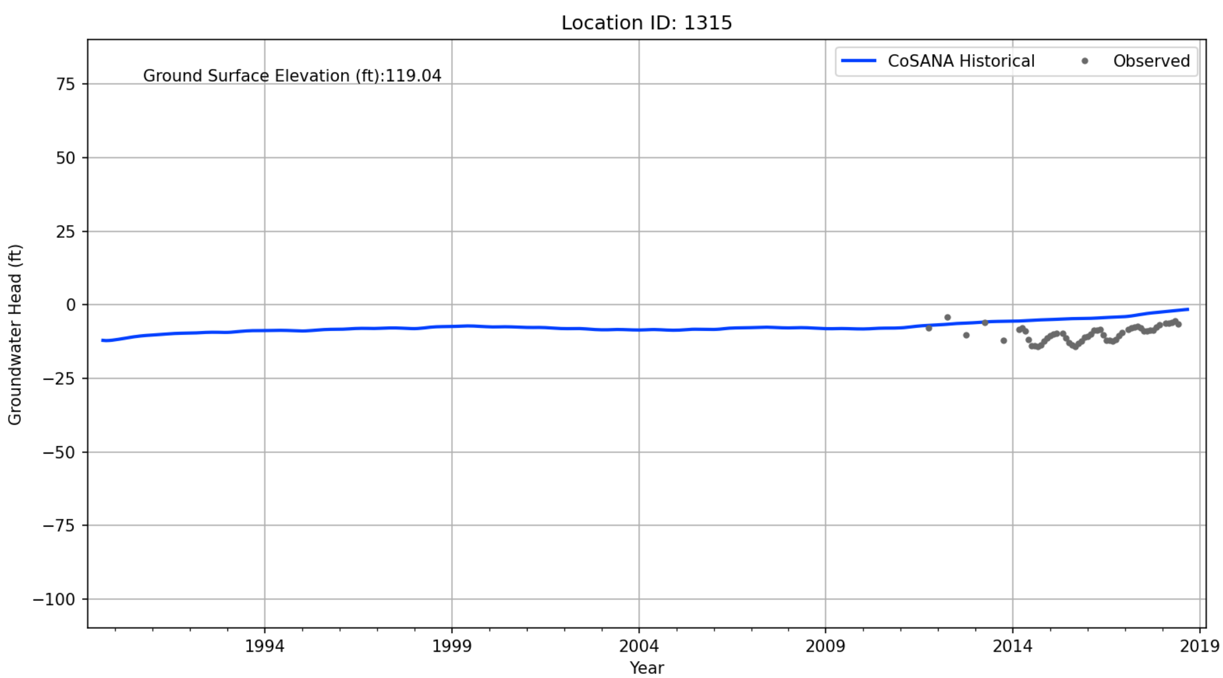


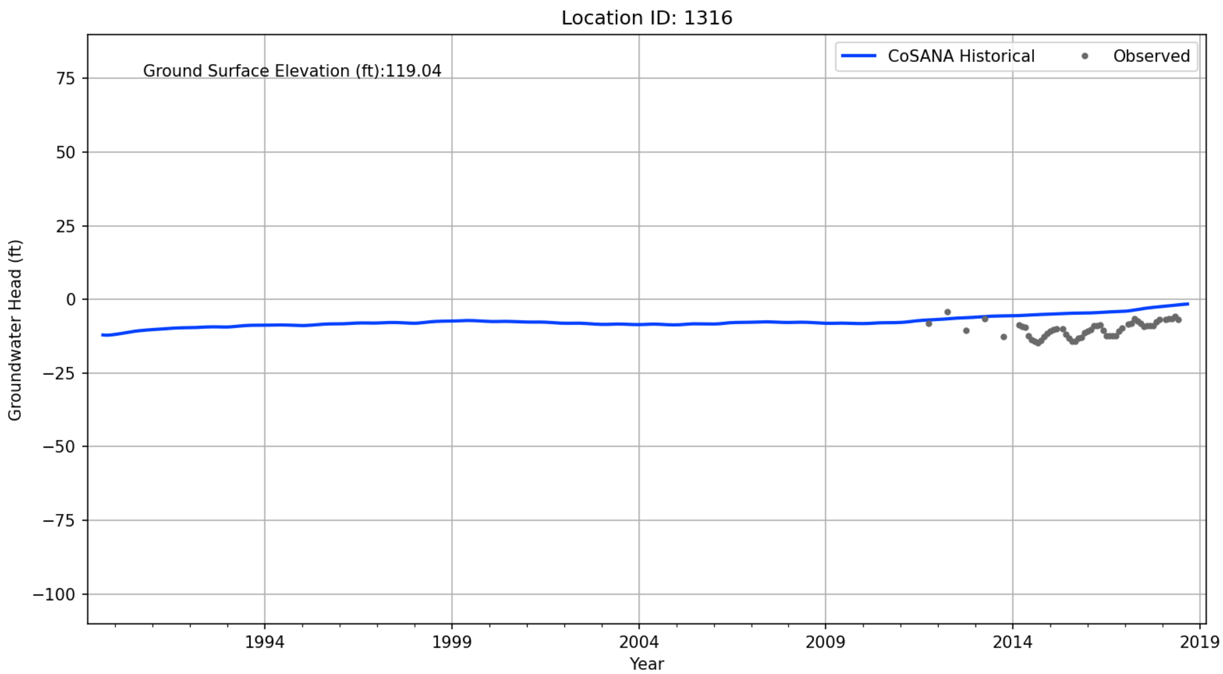
Location ID: 1311
Ground Surface Elevation (ft):101.88
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

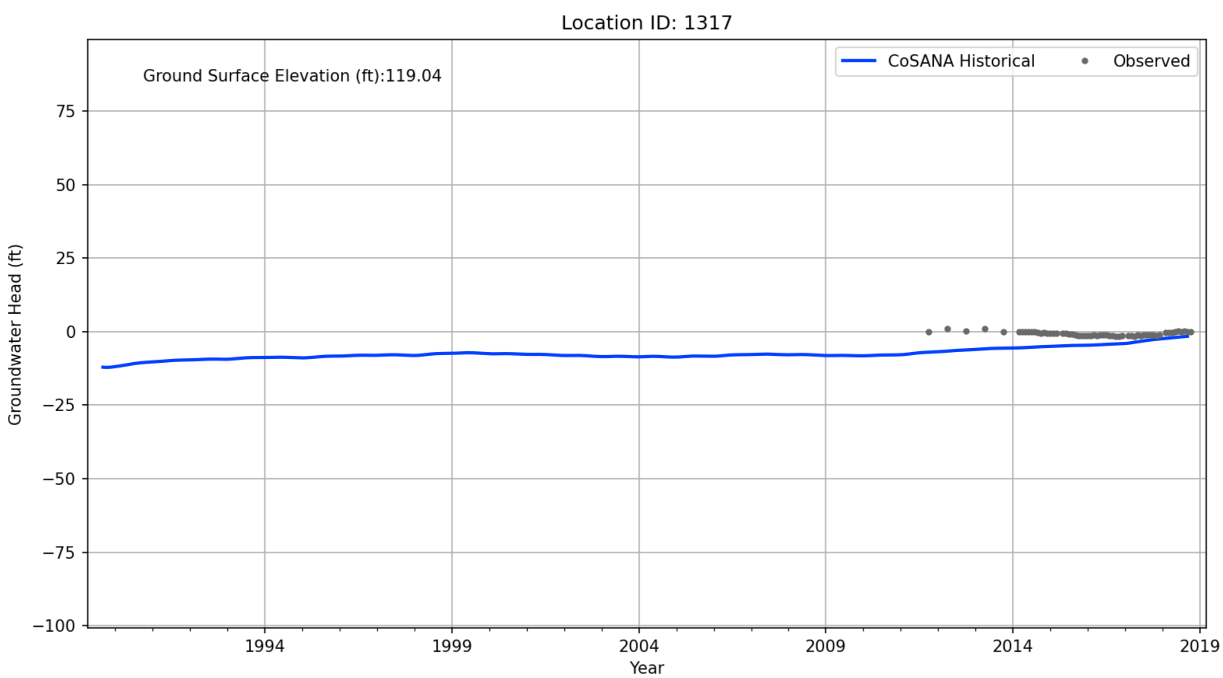


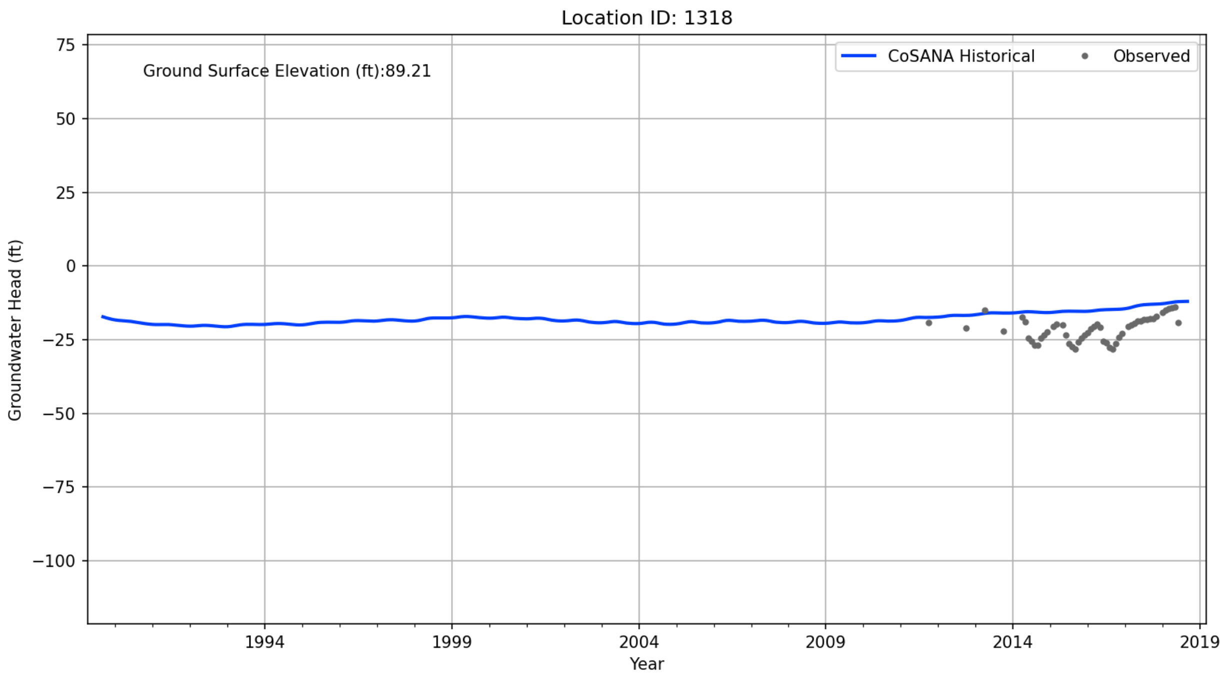
Location ID: 1312
Ground Surface Elevation (ft):176.42
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year

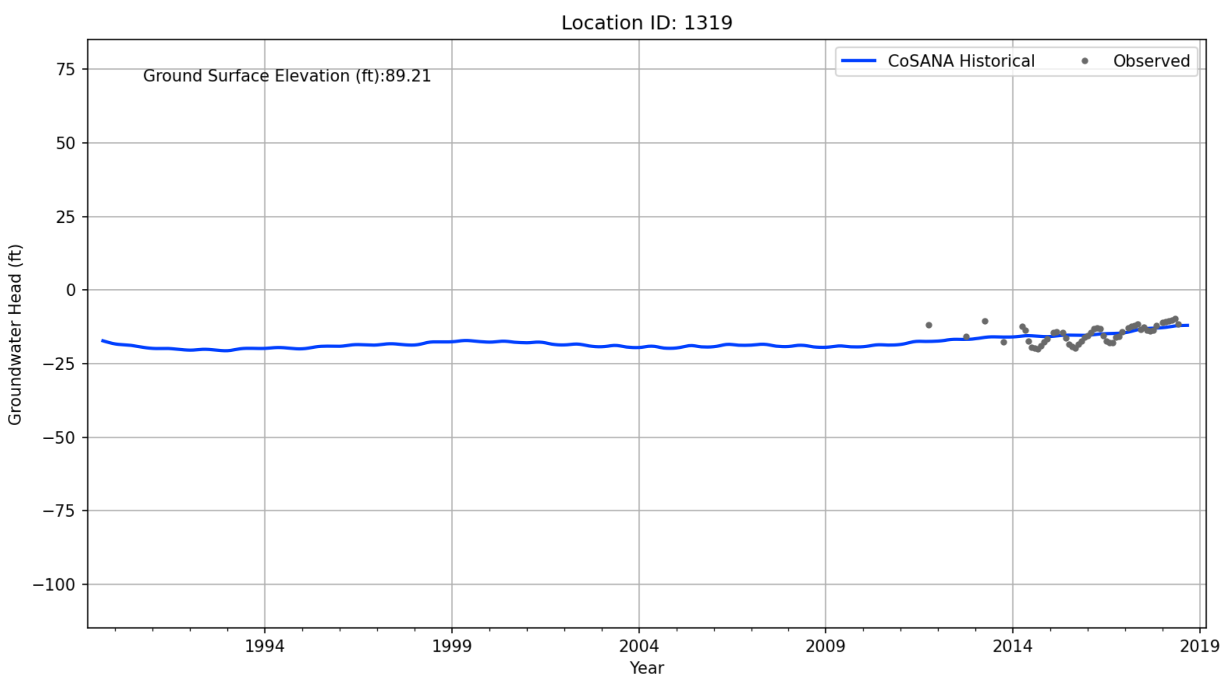

Location ID: 1313
Ground Surface Elevation (ft):176.42
CoSANA Historical
Observed
Groundwater Head (ft)
Year
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019

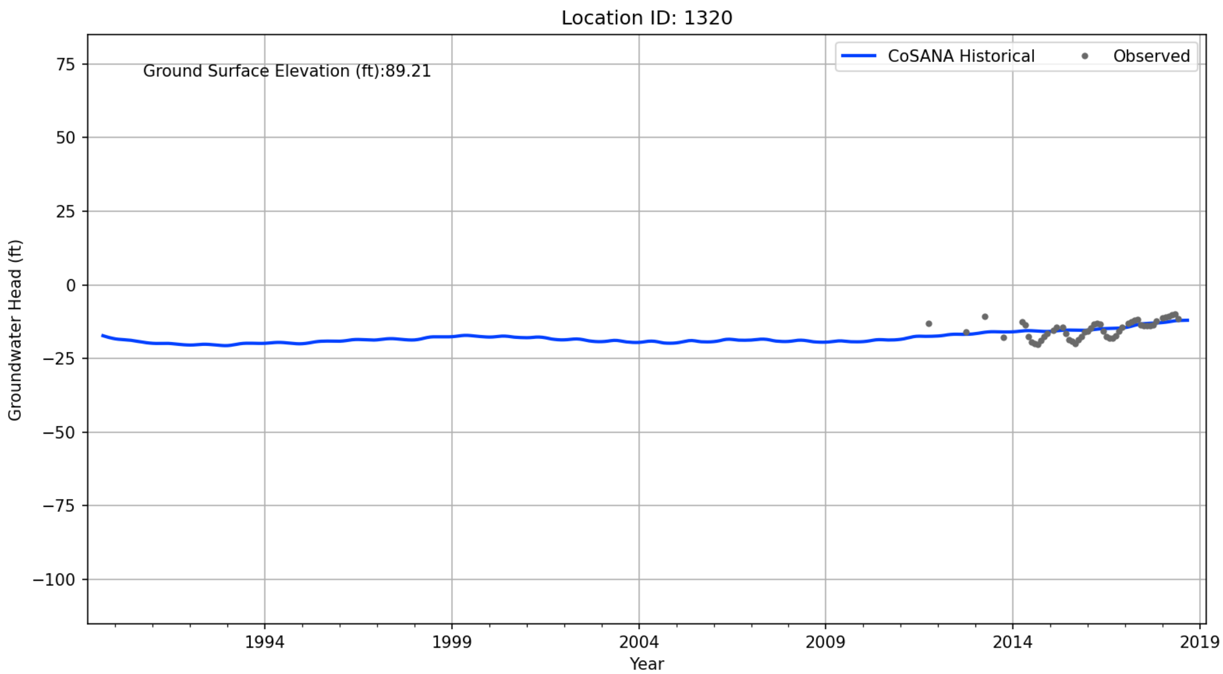

Location ID: 1315
Ground Surface Elevation (ft):119.04
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

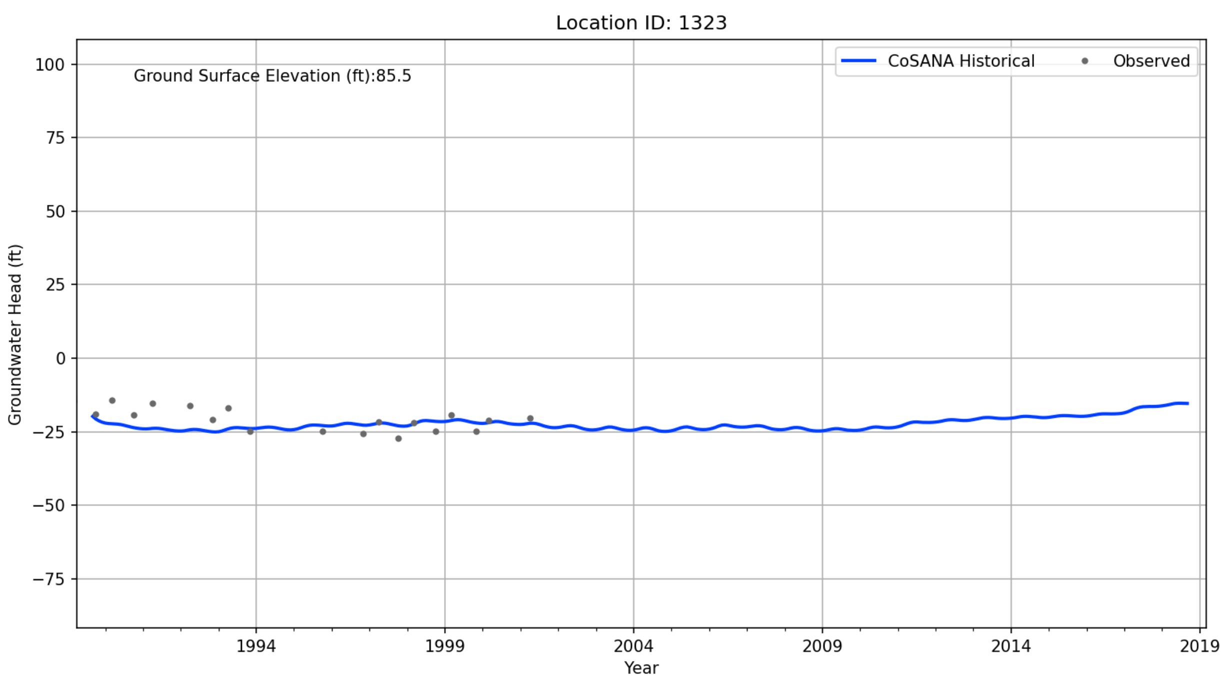

Location ID: 1316
CoSANA Historical
Observed
Ground Surface Elevation (ft):119.04
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

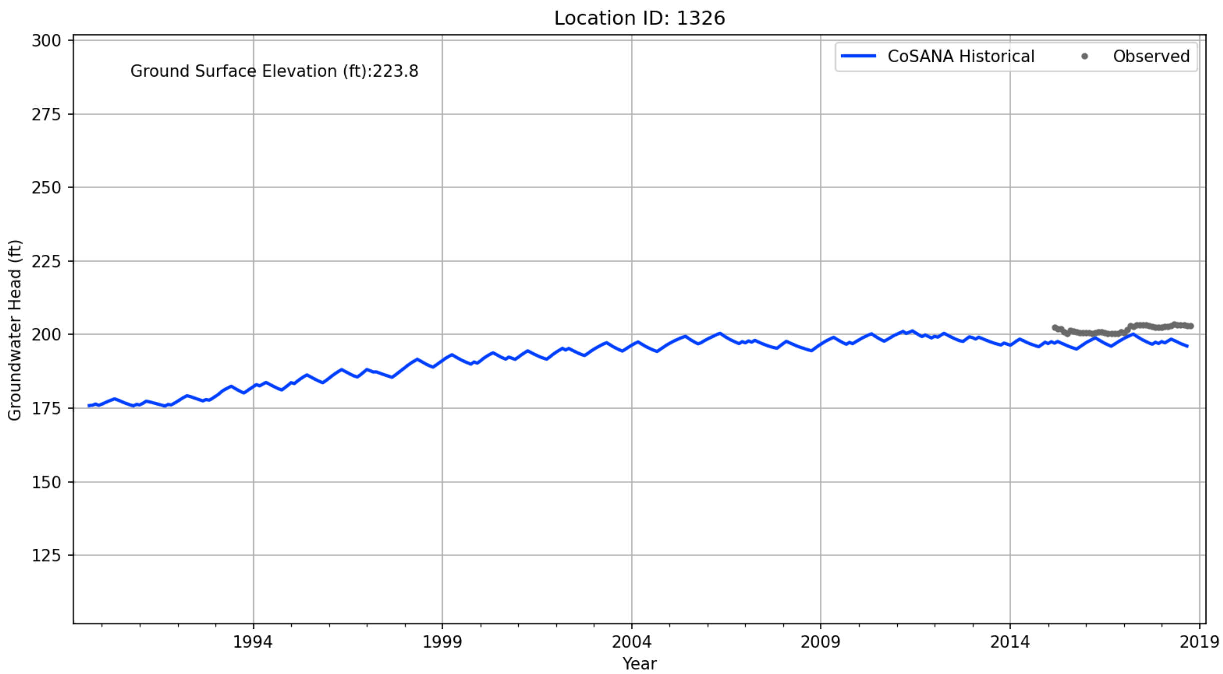

Location ID: 1317
CoSANA Historical
Observed
Ground Surface Elevation (ft):119.04
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 1318
CoSANA Historical
Observed
Ground Surface Elevation (ft):89.21
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

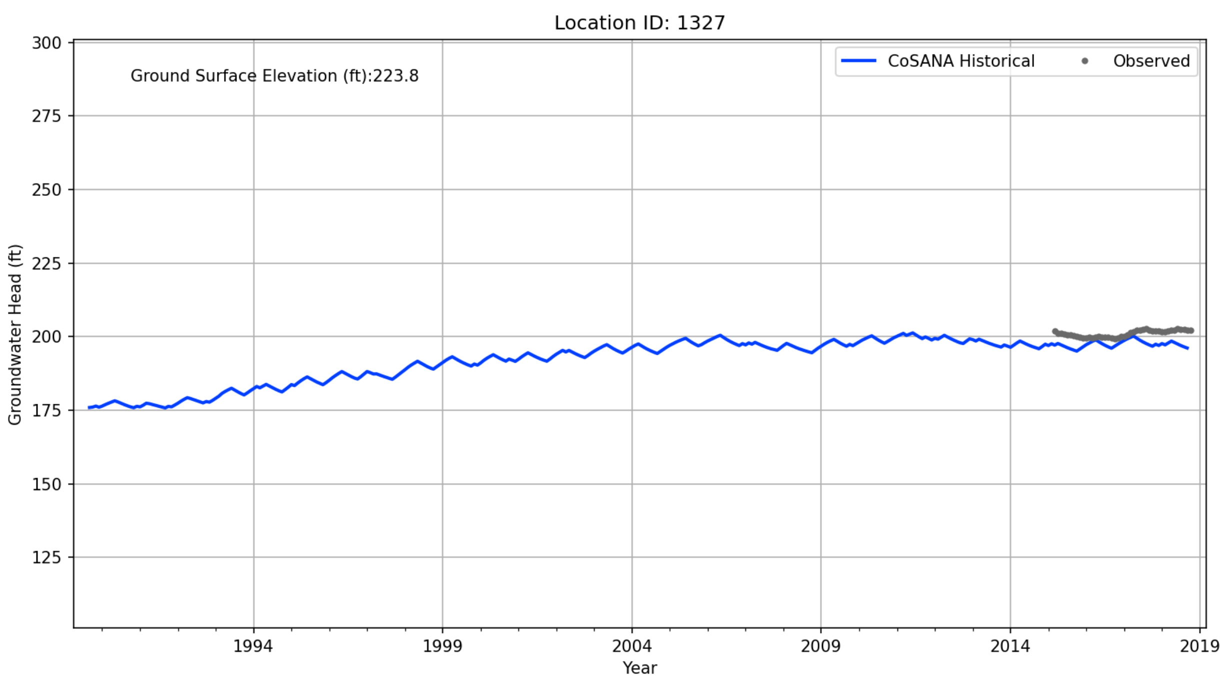

Location ID: 1319
CoSANA Historical
Observed
Ground Surface Elevation (ft):89.21
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 1320
Ground Surface Elevation (ft):89.21
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

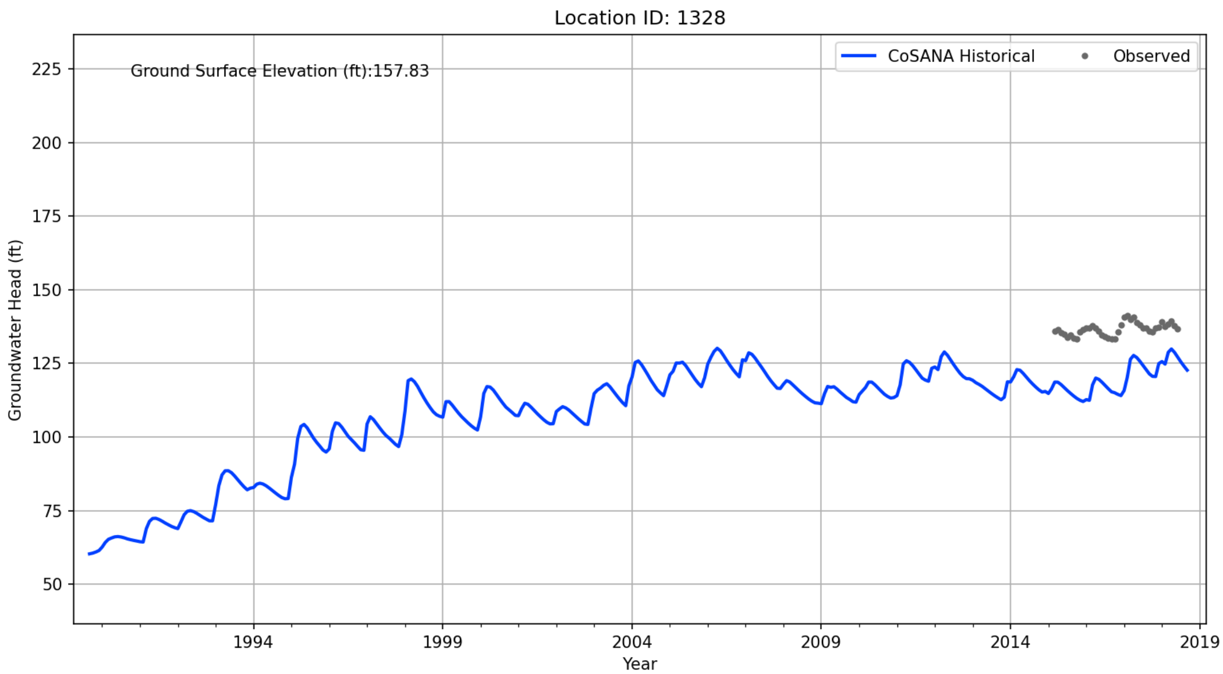

Location ID: 1323
Ground Surface Elevation (ft):85.5
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

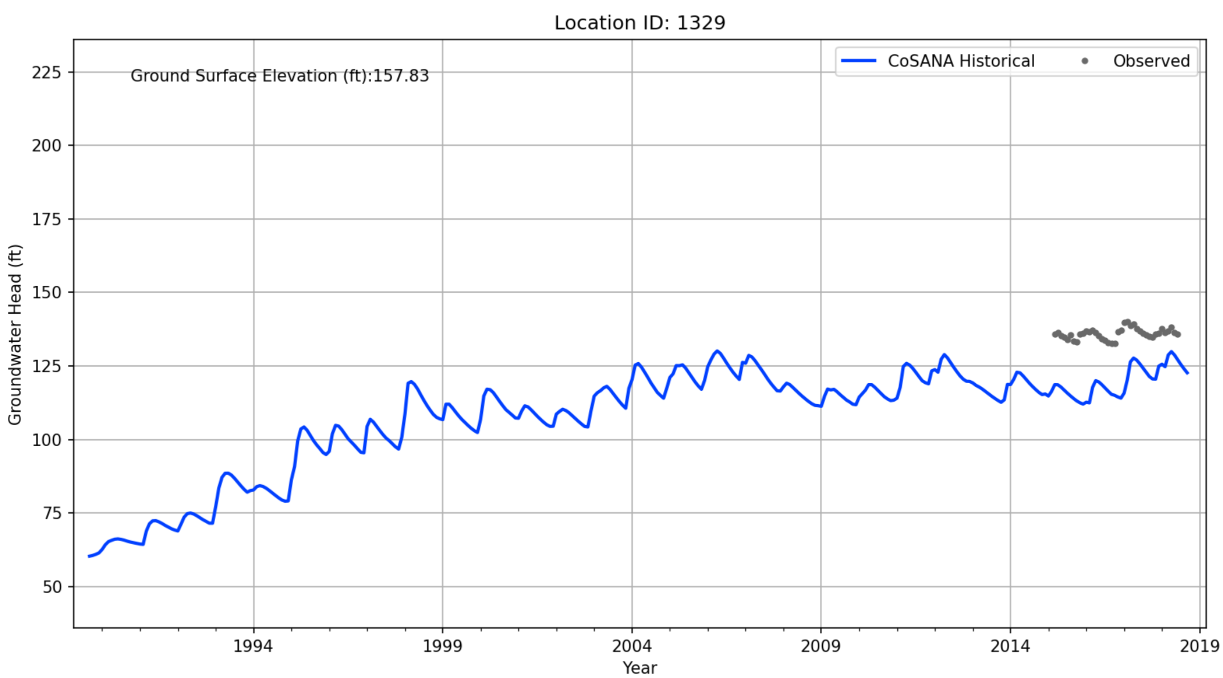


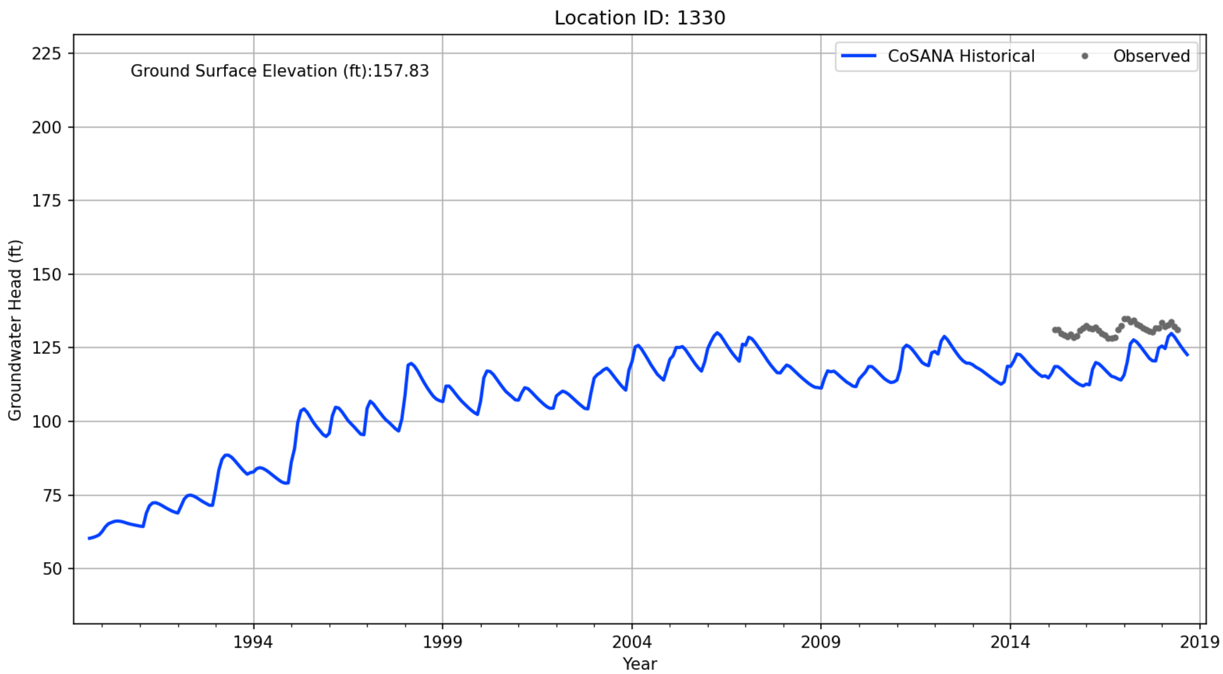
Location ID: 1326
Ground Surface Elevation (ft):223.8
CoSANA Historical
Observed
Groundwater Head (ft)
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019
Year

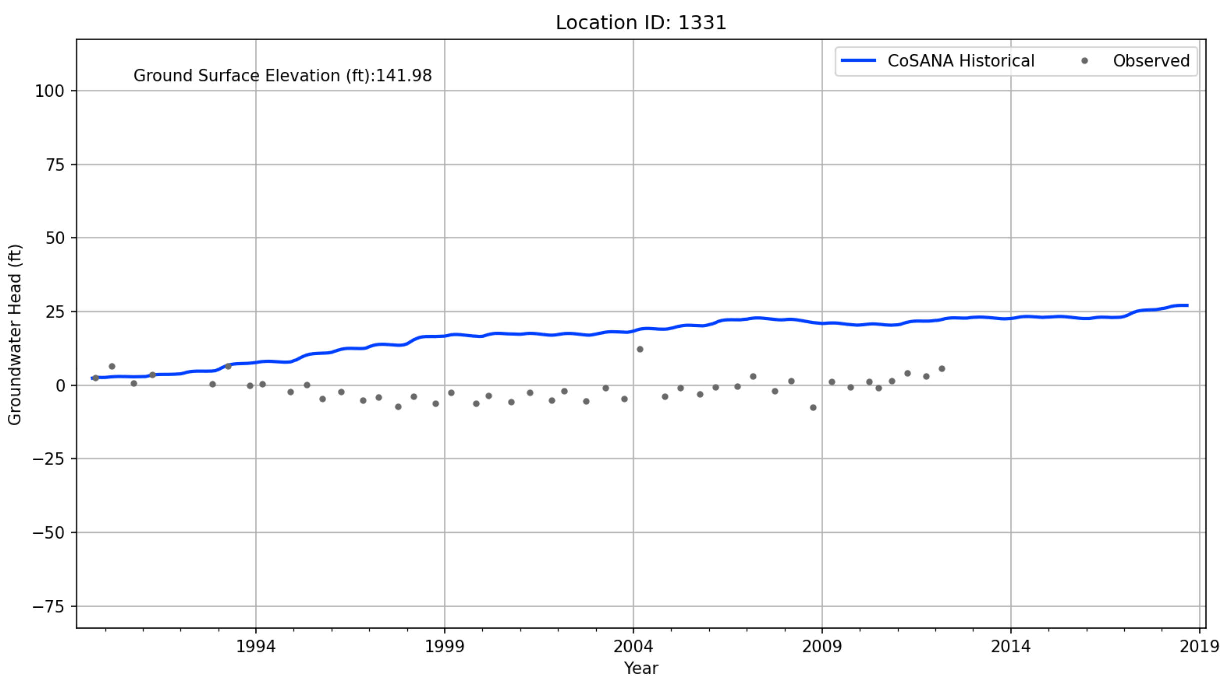


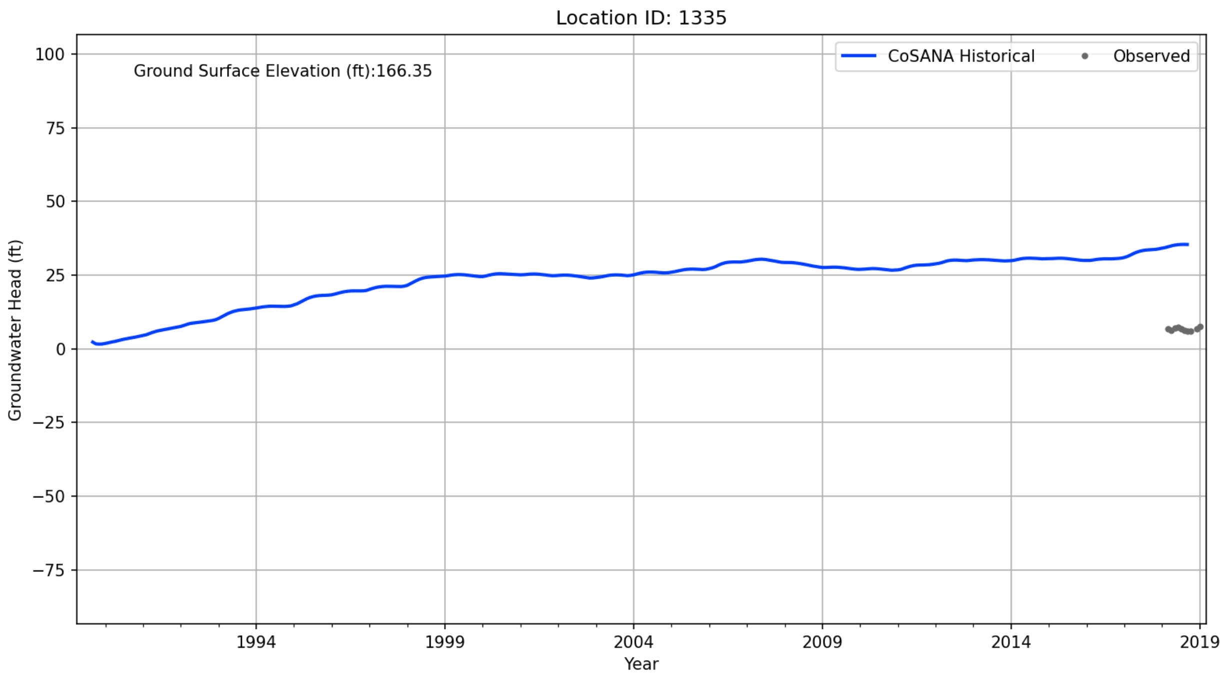
Location ID: 1327
Ground Surface Elevation (ft):223.8
CoSANA Historical
Observed
Groundwater Head (ft)
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019
Year

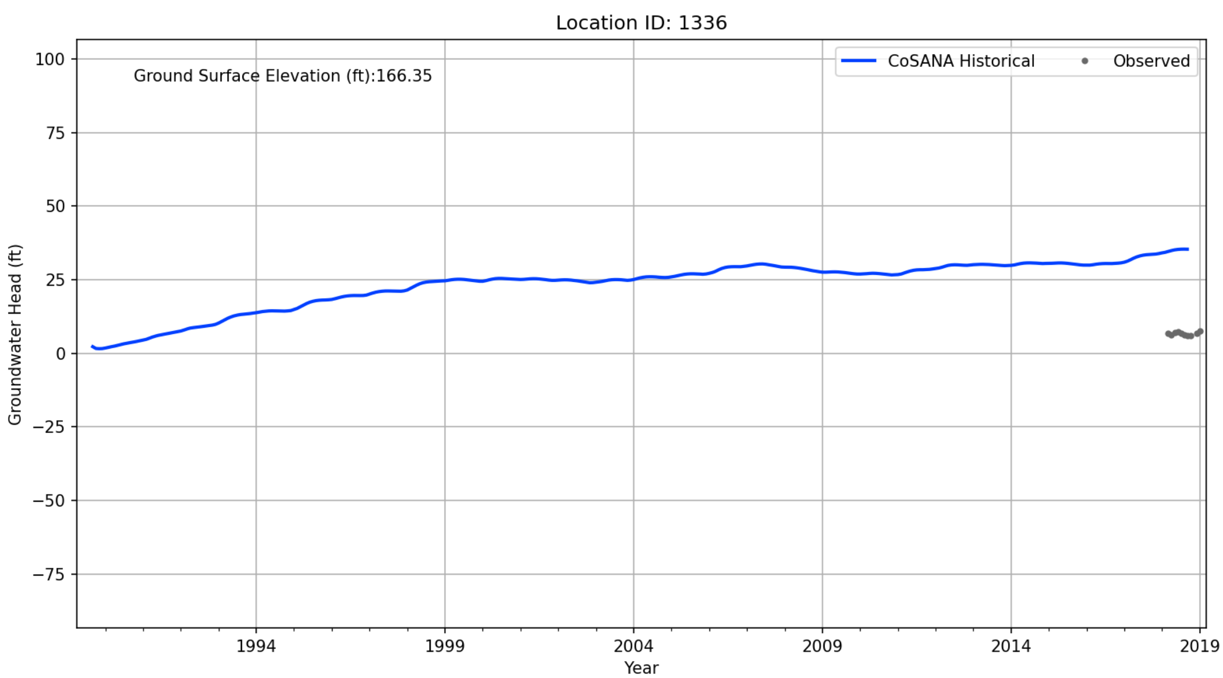

Location ID: 1328
Ground Surface Elevation (ft):157.83
CoSANA Historical
Observed
Groundwater Head (ft)
Year
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019

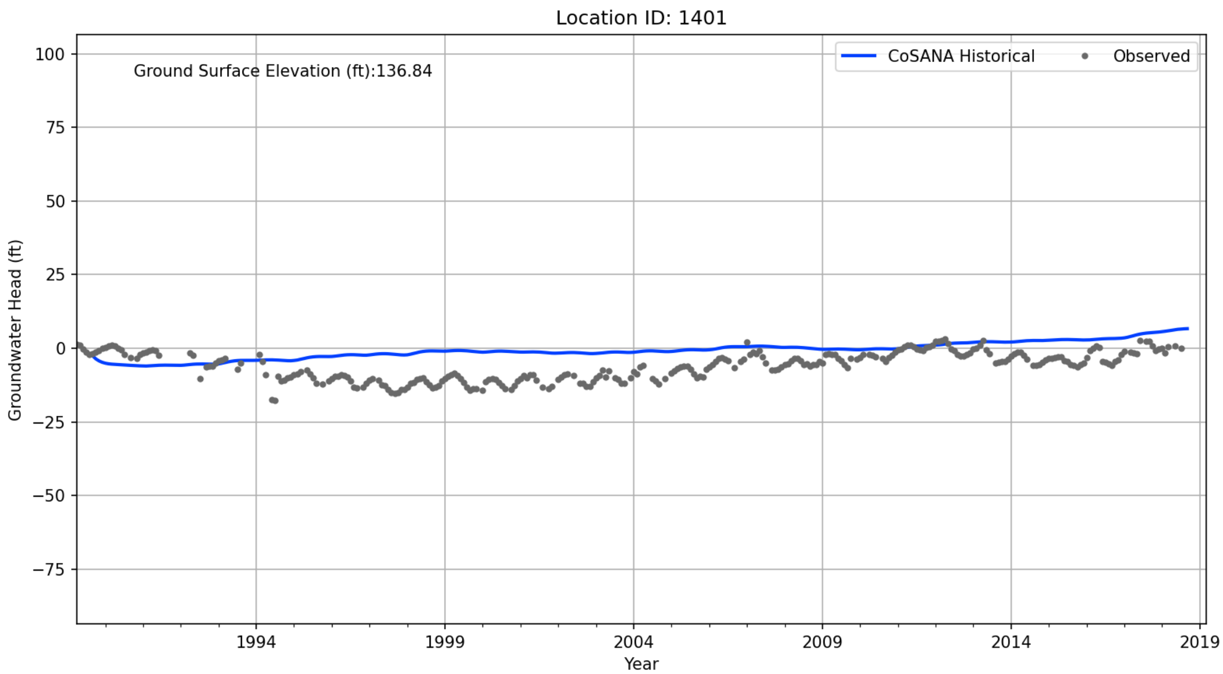

Location ID: 1329
Ground Surface Elevation (ft):157.83
CoSANA Historical
Observed
Groundwater Head (ft)
Year
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019

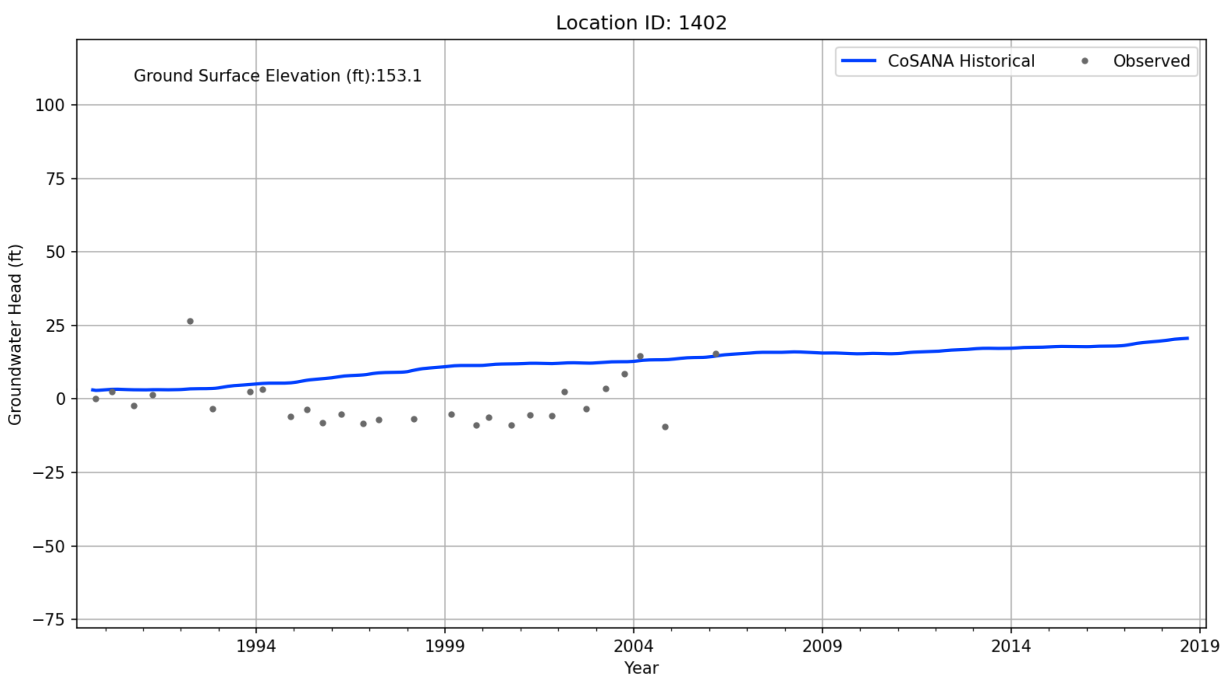

Location ID: 1330
Ground Surface Elevation (ft):157.83
CoSANA Historical
Observed
Groundwater Head (ft)
Year
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019

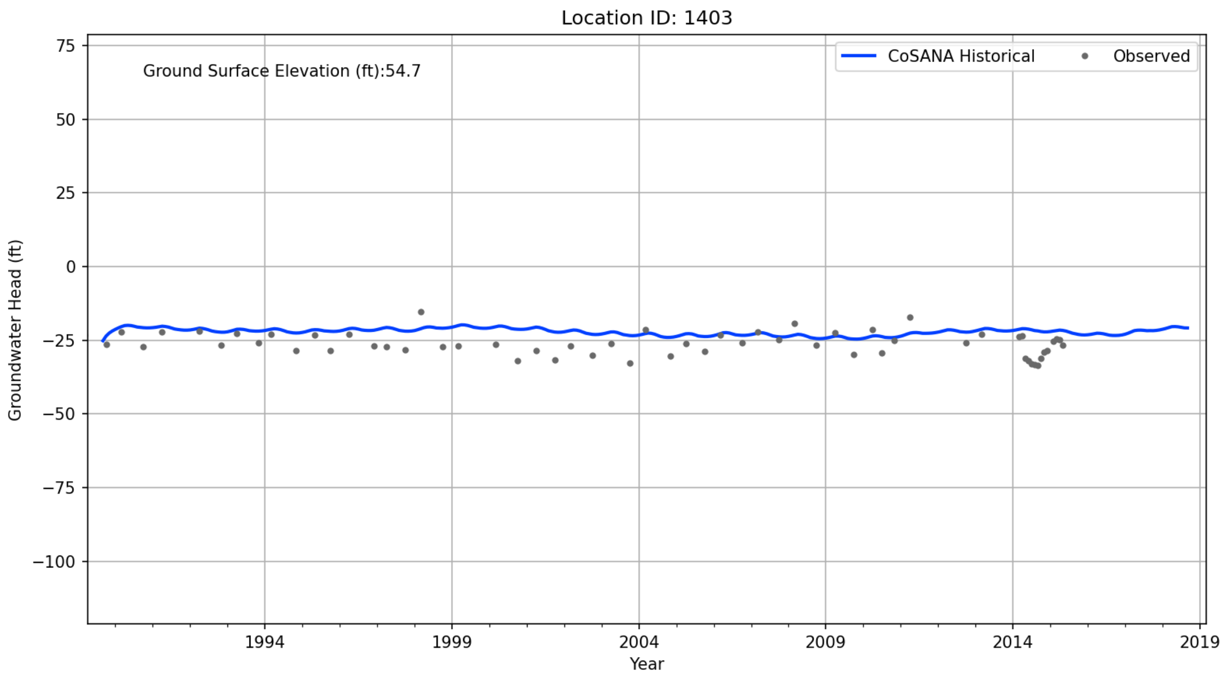

Location ID: 1331
Ground Surface Elevation (ft):141.98
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019


Location ID: 1335
CoSANA Historical
Observed
Ground Surface Elevation (ft):166.35
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

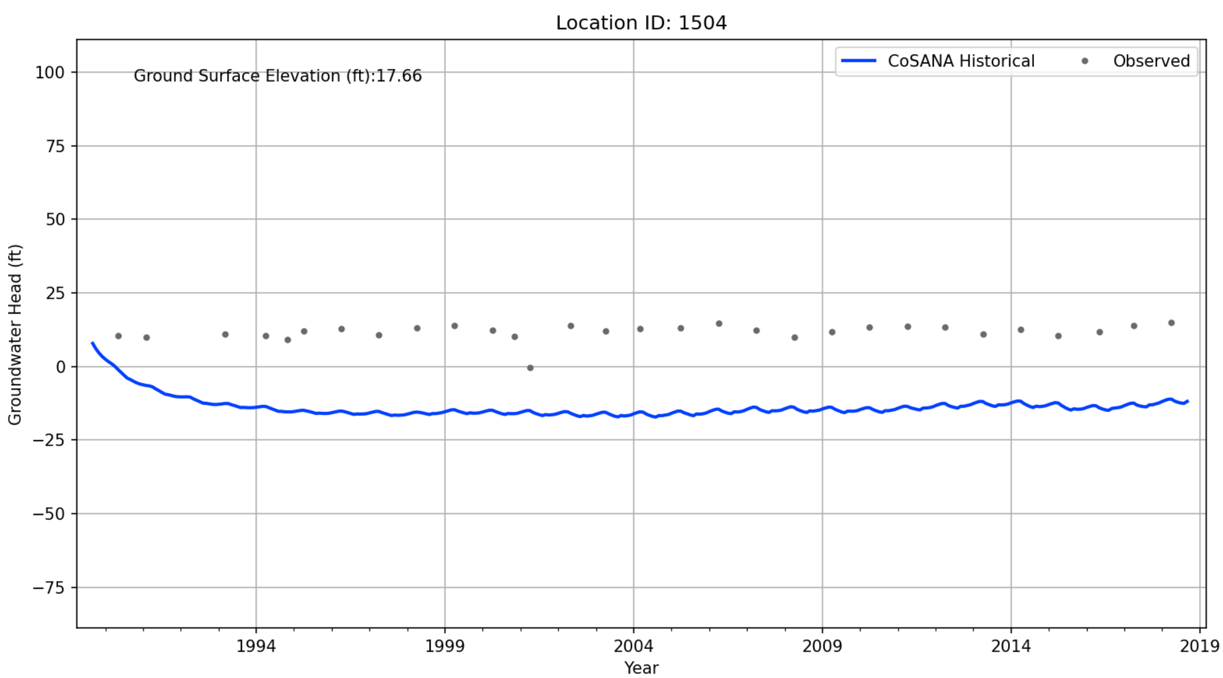

Location ID: 1336
CoSANA Historical
Observed
Ground Surface Elevation (ft):166.35
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 1401
Ground Surface Elevation (ft):136.84
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

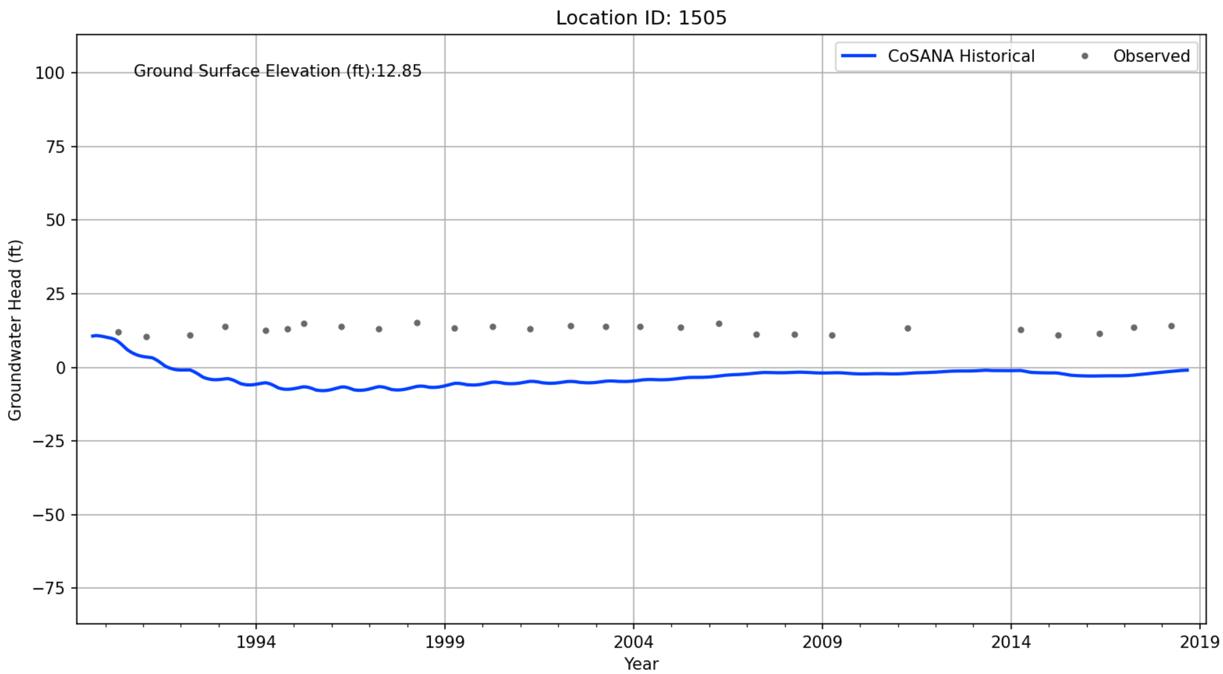

Location ID: 1402
Ground Surface Elevation (ft):153.1
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

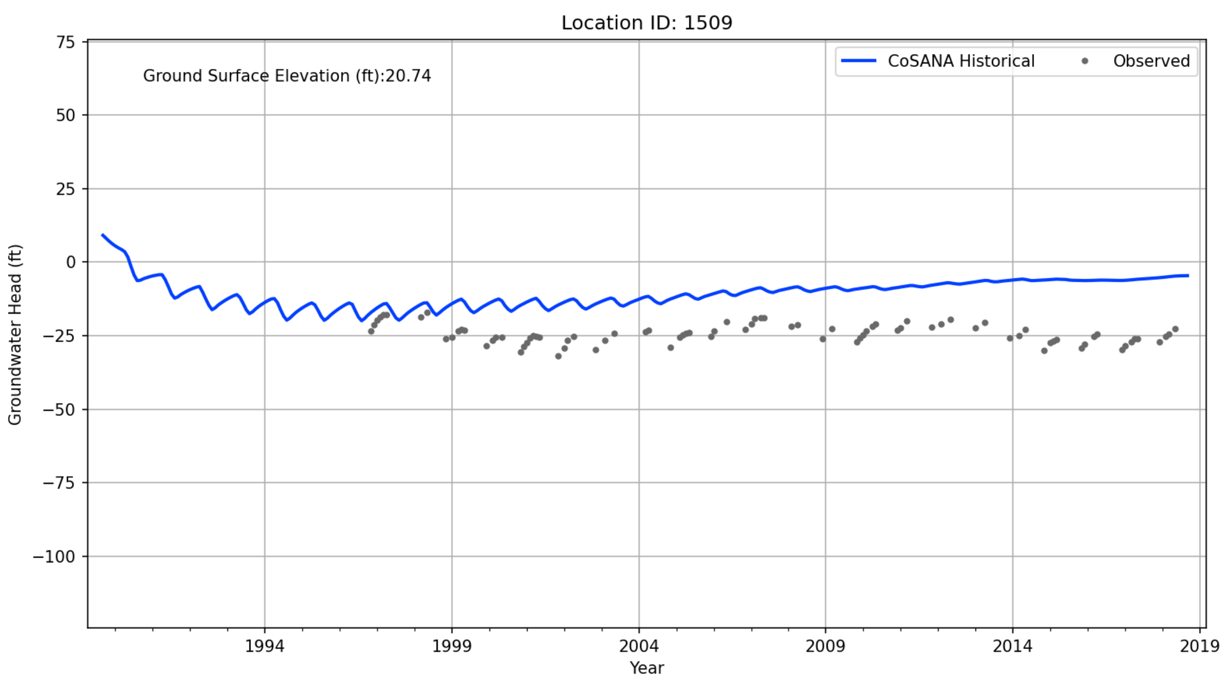


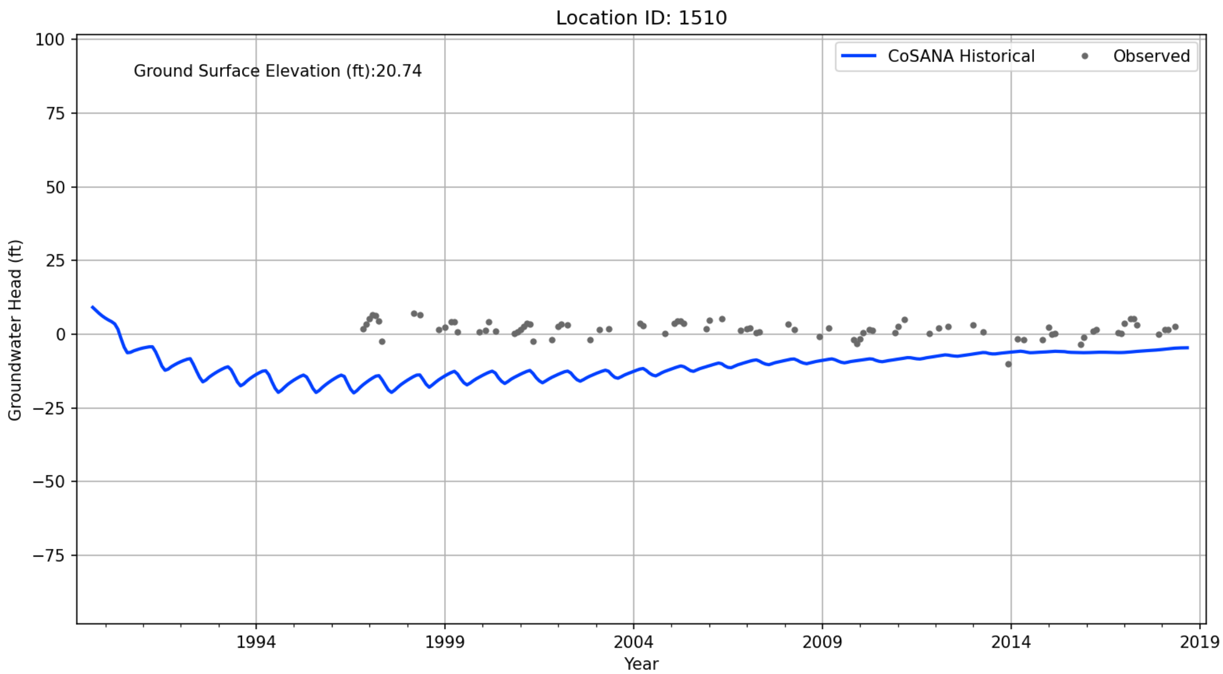
Location ID: 1403
CoSANA Historical
Observed
Ground Surface Elevation (ft):54.7
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



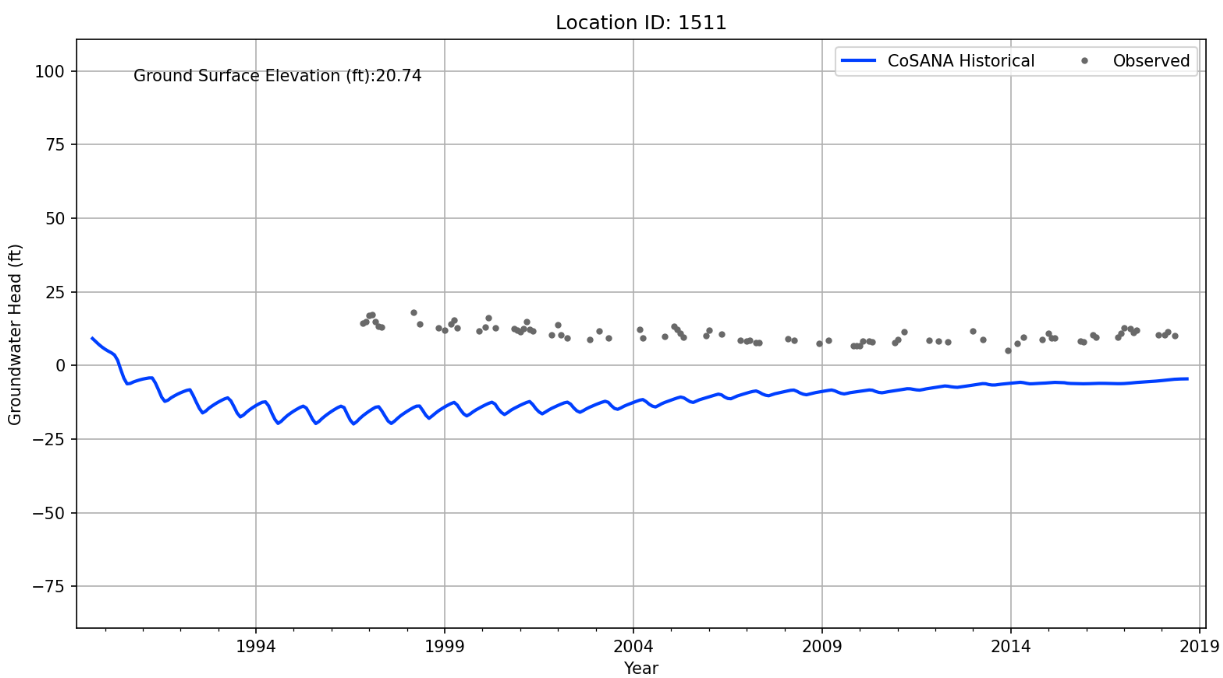
Location ID: 1504
CoSANA Historical
Observed
Ground Surface Elevation (ft):17.66
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 1505
Ground Surface Elevation (ft):12.85
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

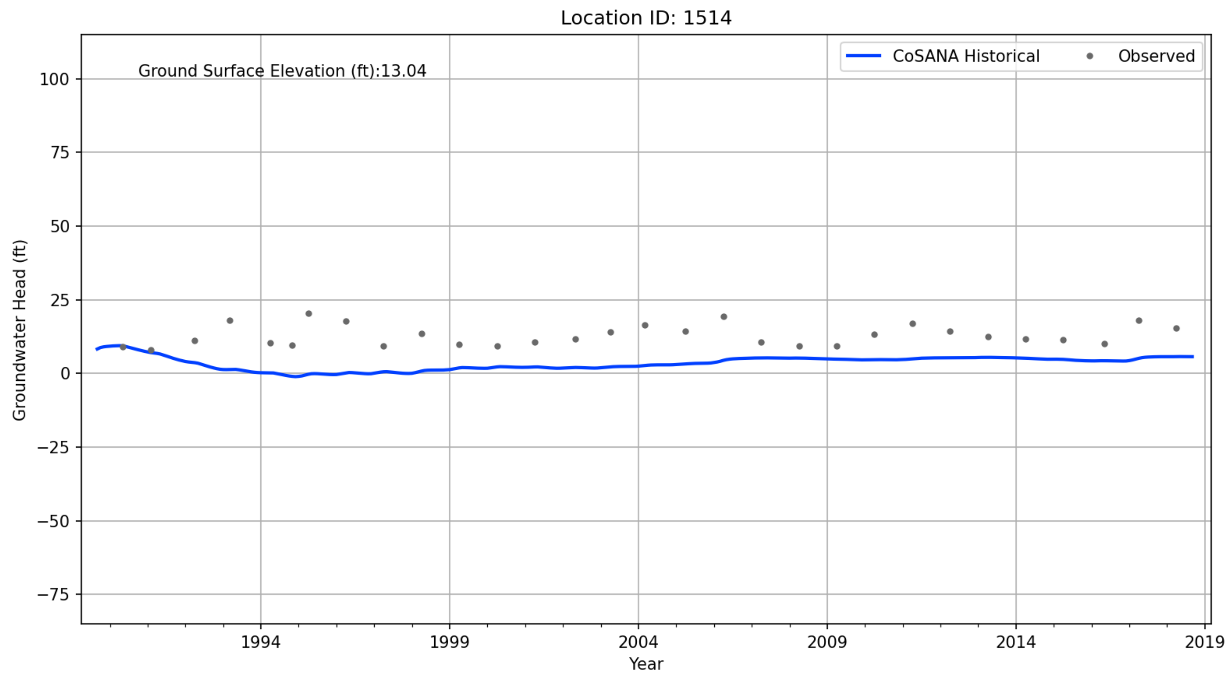

Location ID: 1509
Ground Surface Elevation (ft):20.74
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

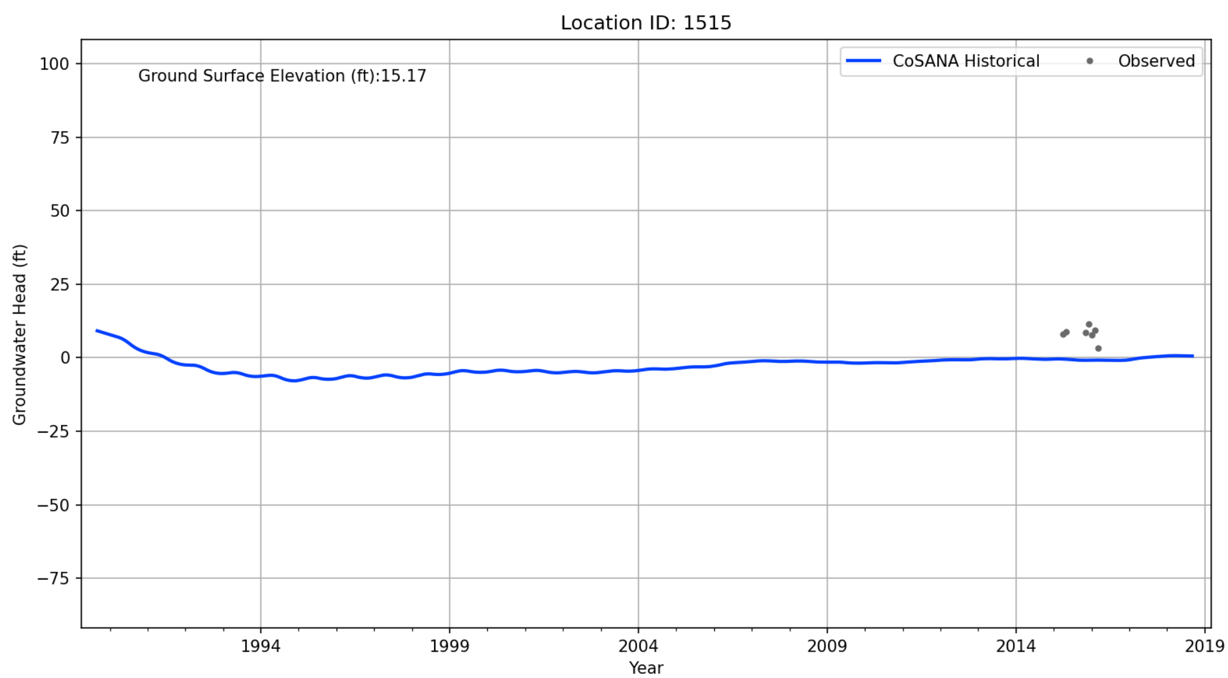


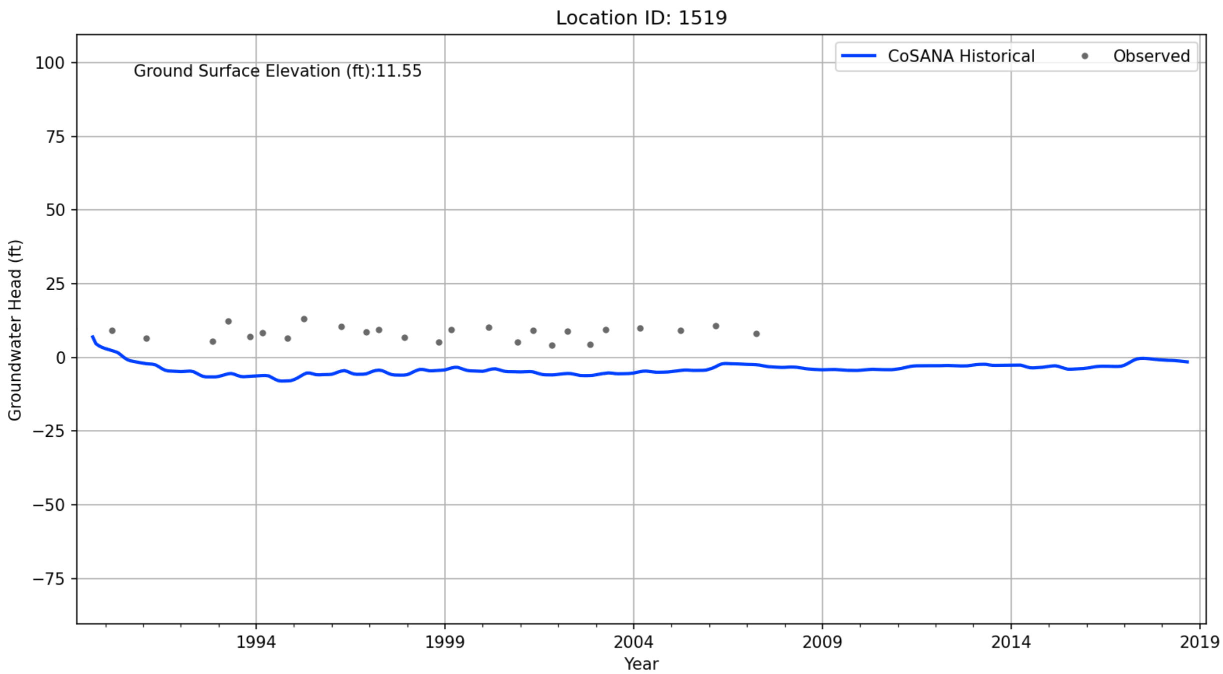
Location ID: 1510
Ground Surface Elevation (ft):20.74
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

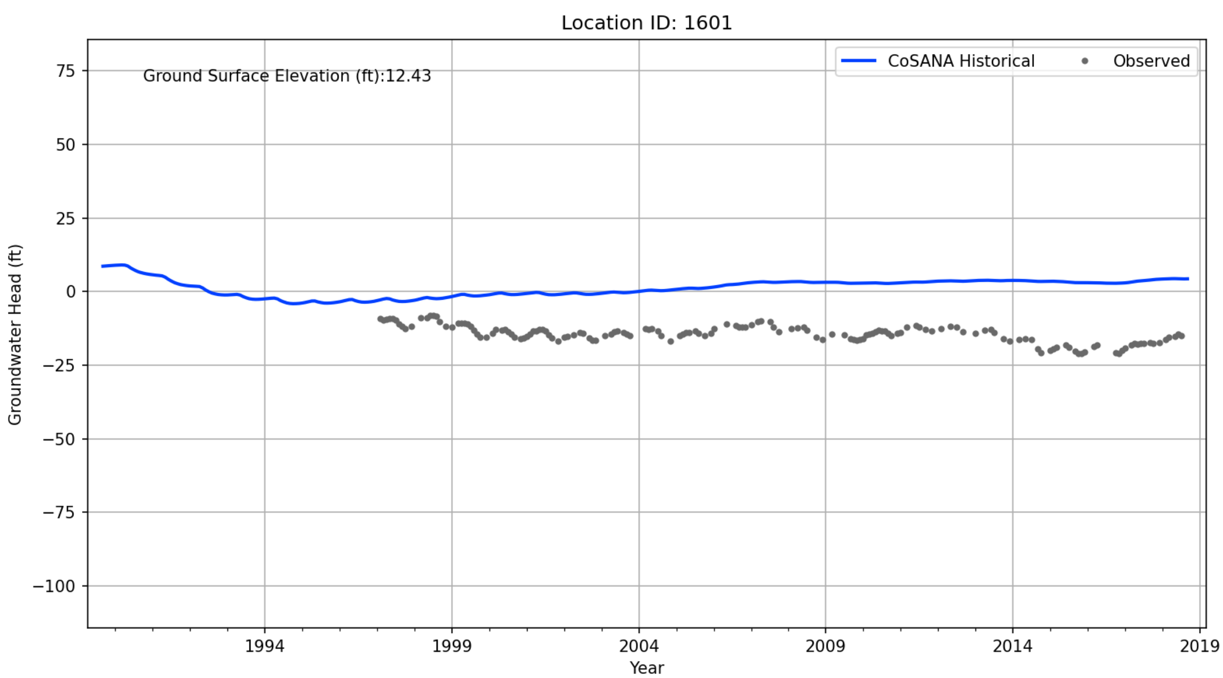


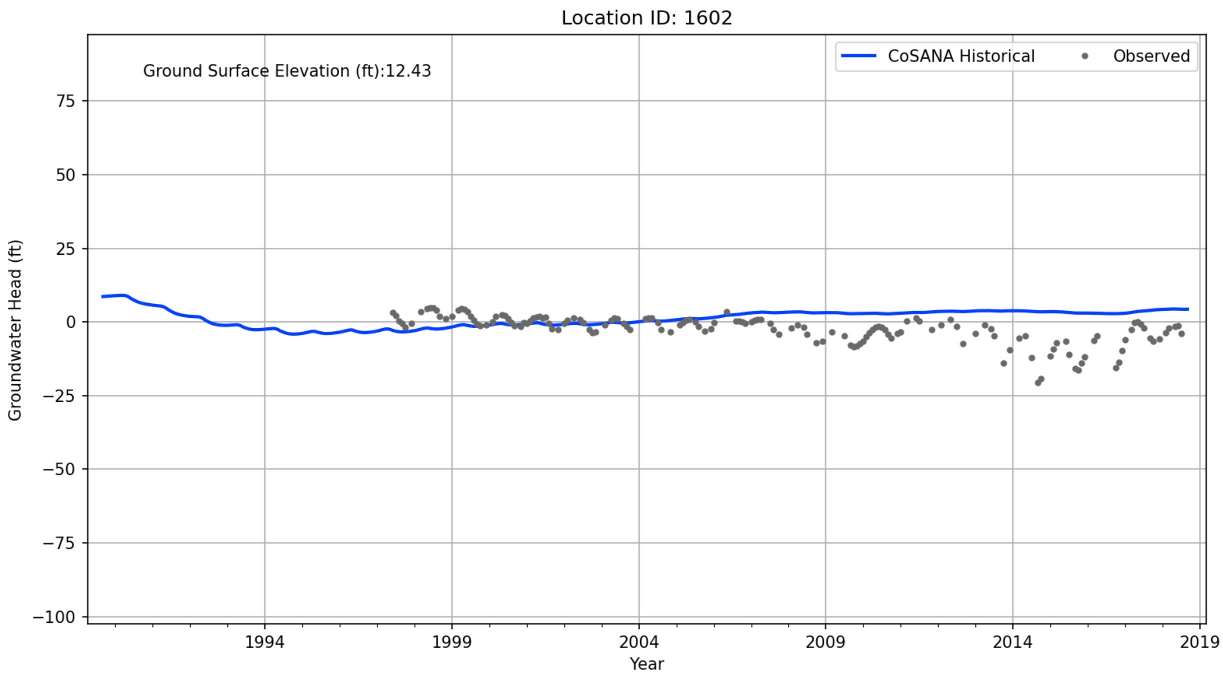
Location ID: 1511
Ground Surface Elevation (ft):20.74
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

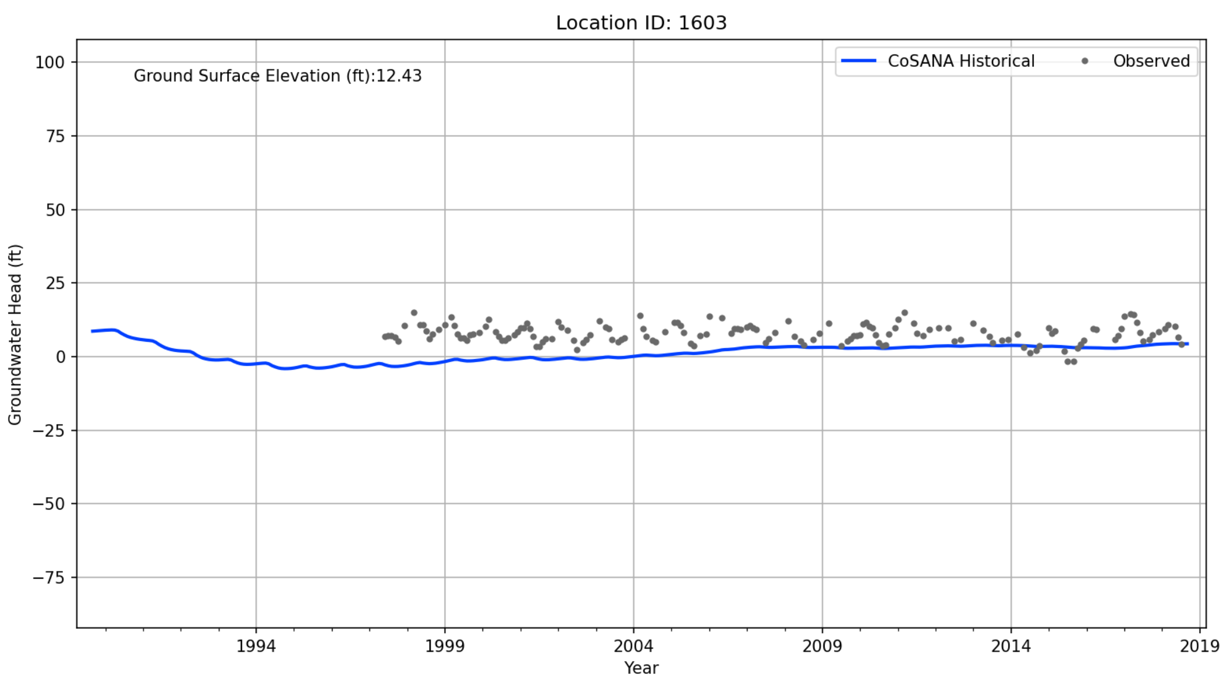

Location ID: 1514
CoSANA Historical
Observed
Ground Surface Elevation (ft):13.04
100
75
50
25
0
−25
−50
−75
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year

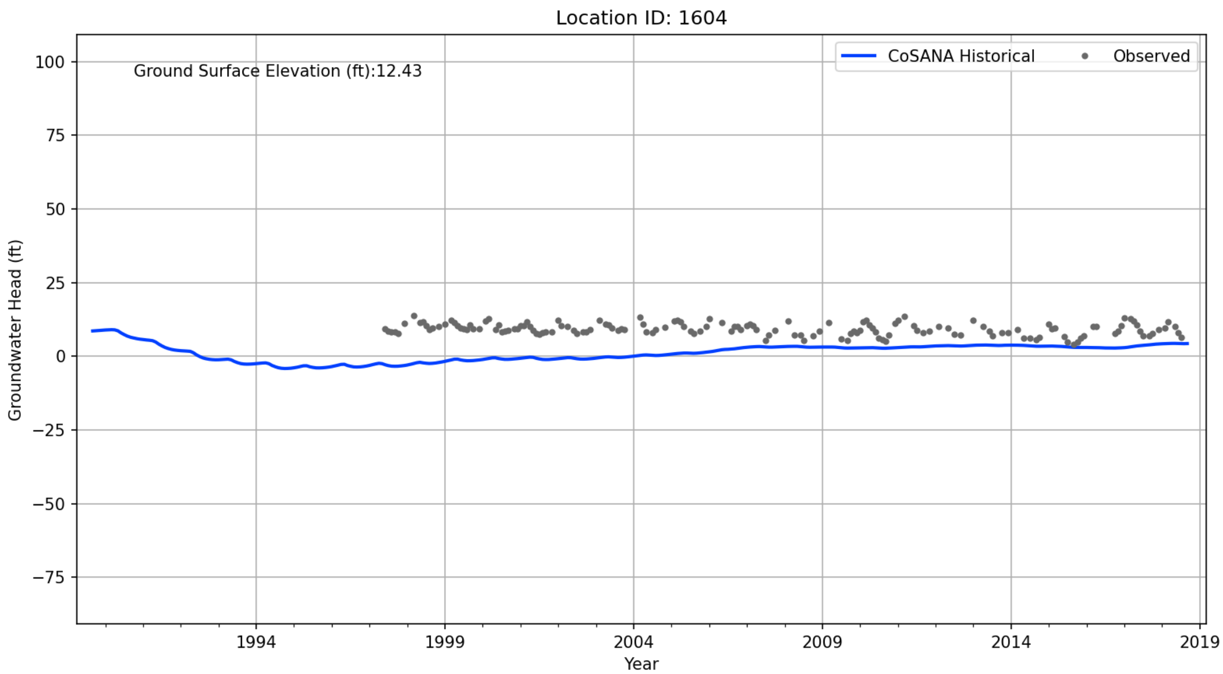

Location ID: 1515
CoSANA Historical
Observed
Ground Surface Elevation (ft):15.17
100
75
50
25
0
−25
−50
−75
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year

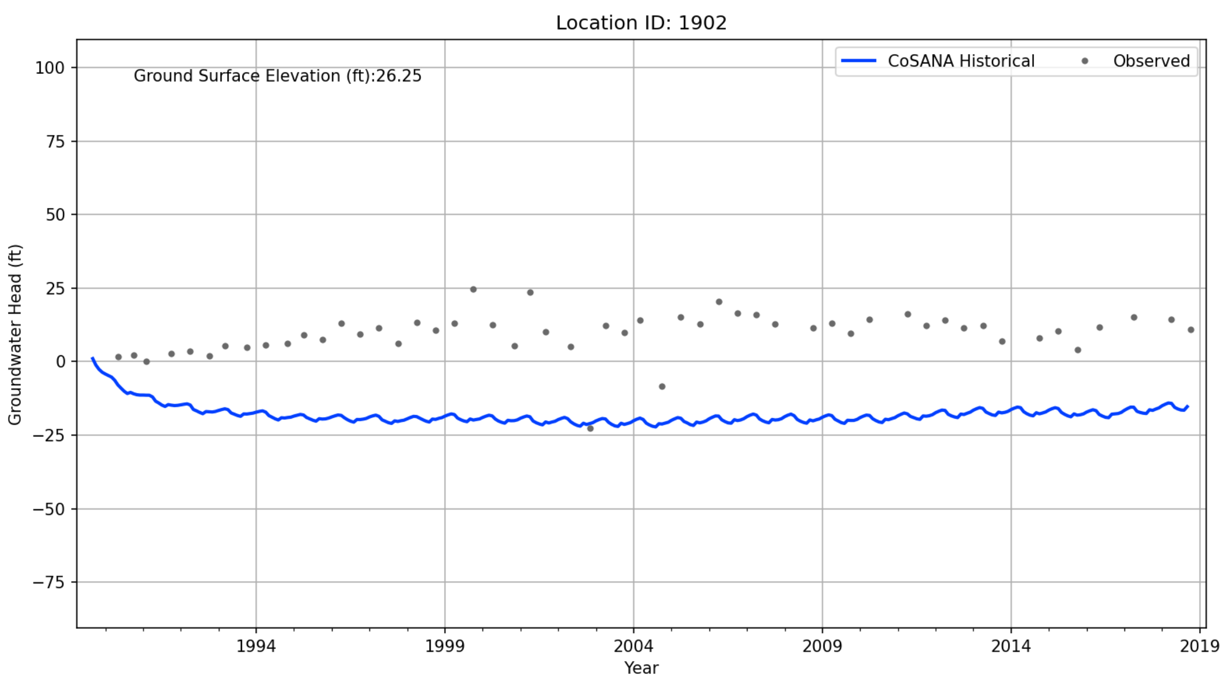

Location ID: 1519
CoSANA Historical
Observed
Ground Surface Elevation (ft):11.55
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

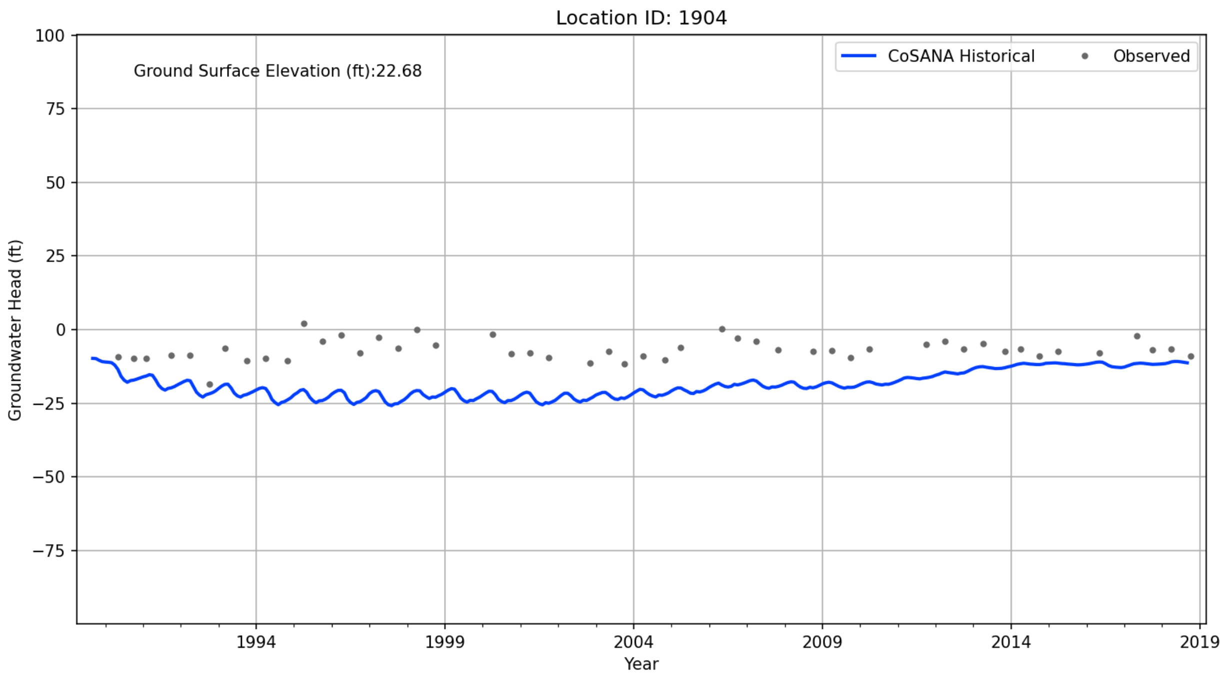

Location ID: 1601
CoSANA Historical
Observed
Ground Surface Elevation (ft):12.43
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 1602
Ground Surface Elevation (ft):12.43
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

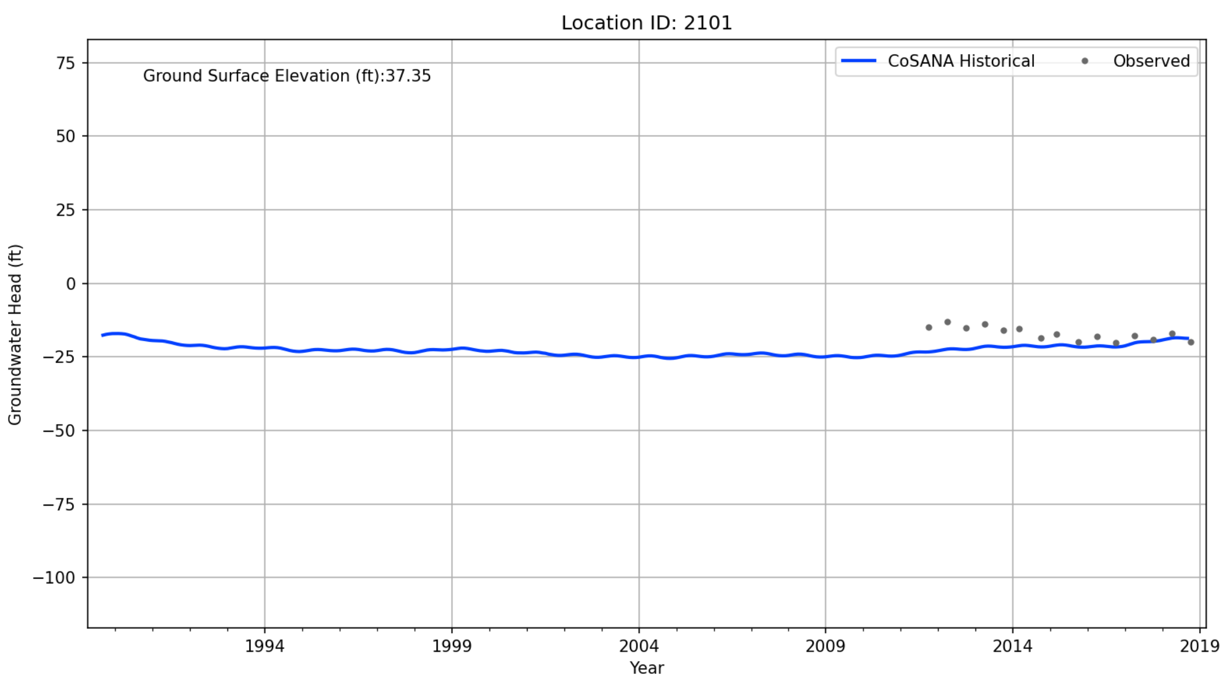

Location ID: 1603
Ground Surface Elevation (ft):12.43
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019


Location ID: 1604
CoSANA Historical
Observed
Ground Surface Elevation (ft):12.43
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

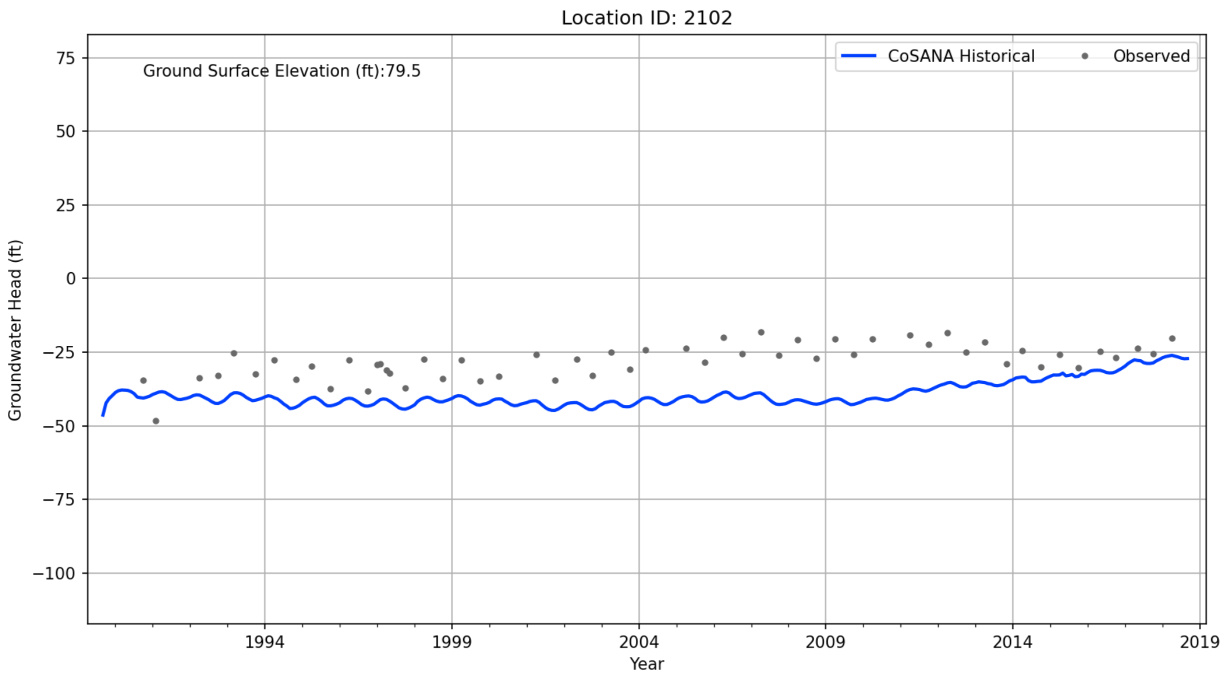

Location ID: 1902
CoSANA Historical
Observed
Ground Surface Elevation (ft):26.25
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019



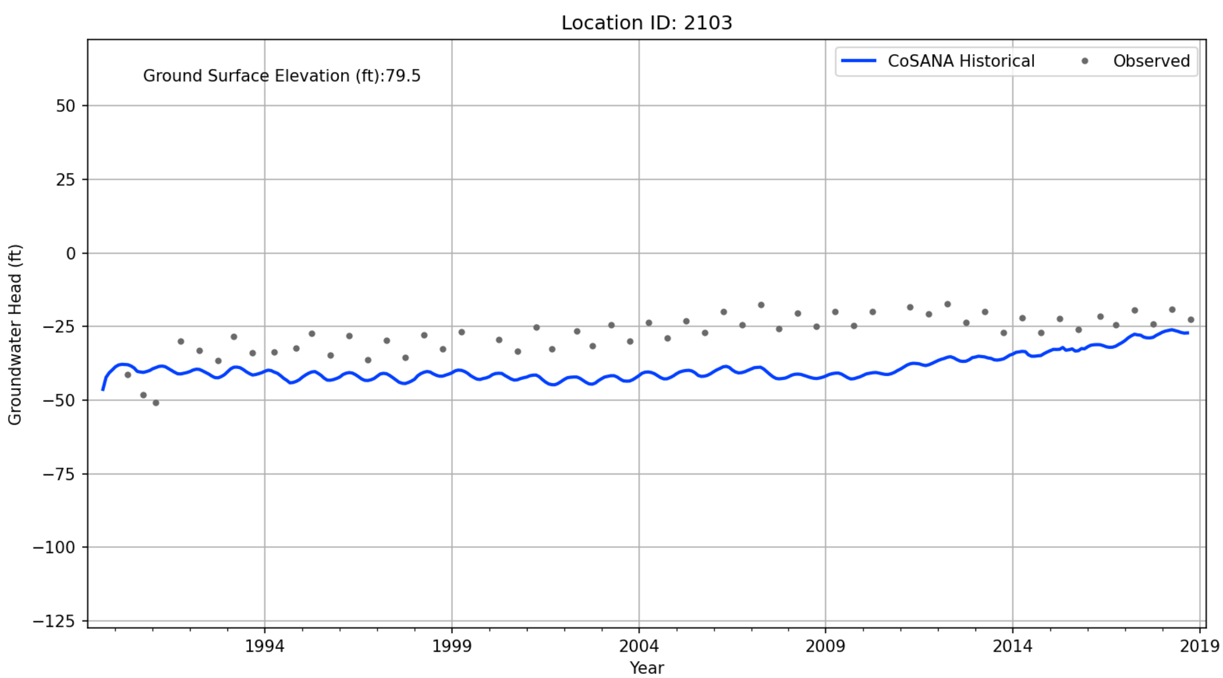
Location ID: 1904
Ground Surface Elevation (ft):22.68
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year



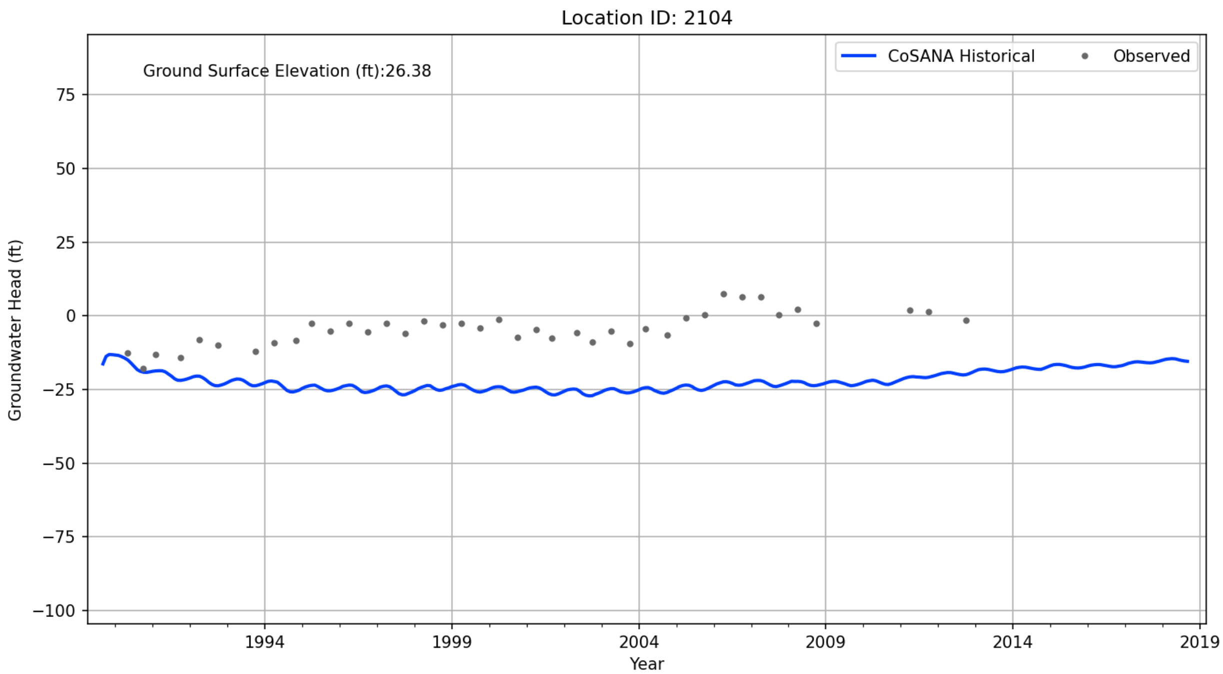
Location ID: 2101
Ground Surface Elevation (ft):37.35
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



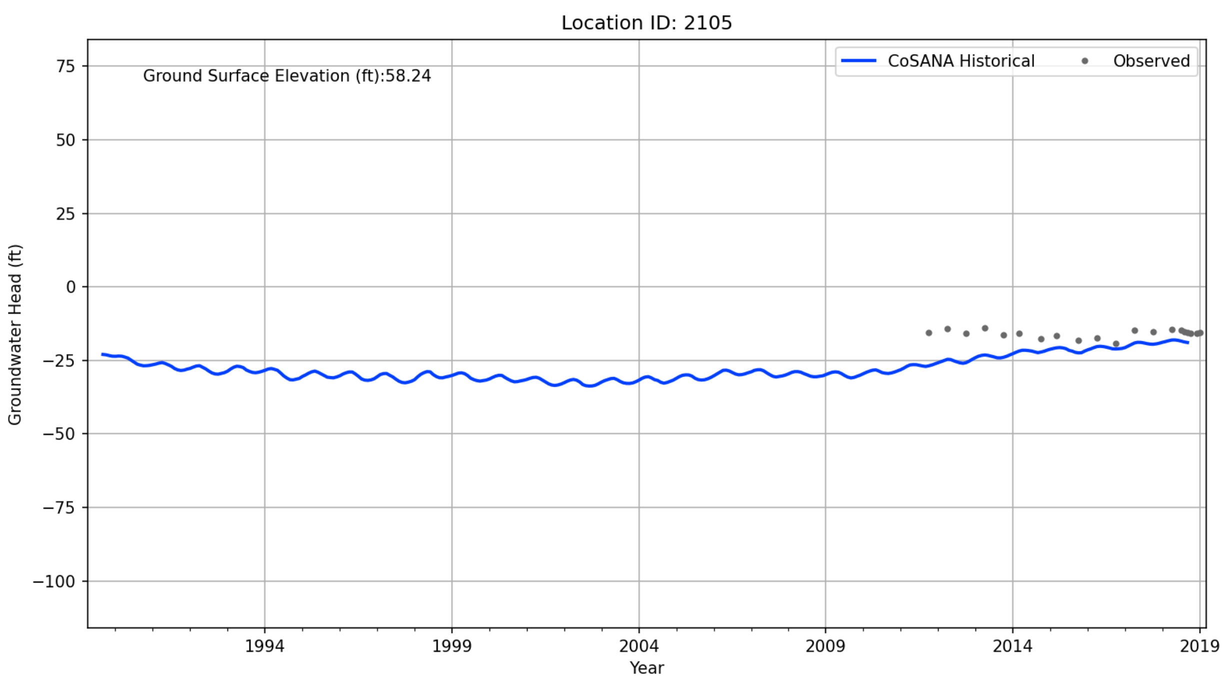
Location ID: 2102
CoSANA Historical
Observed
Ground Surface Elevation (ft):79.5
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



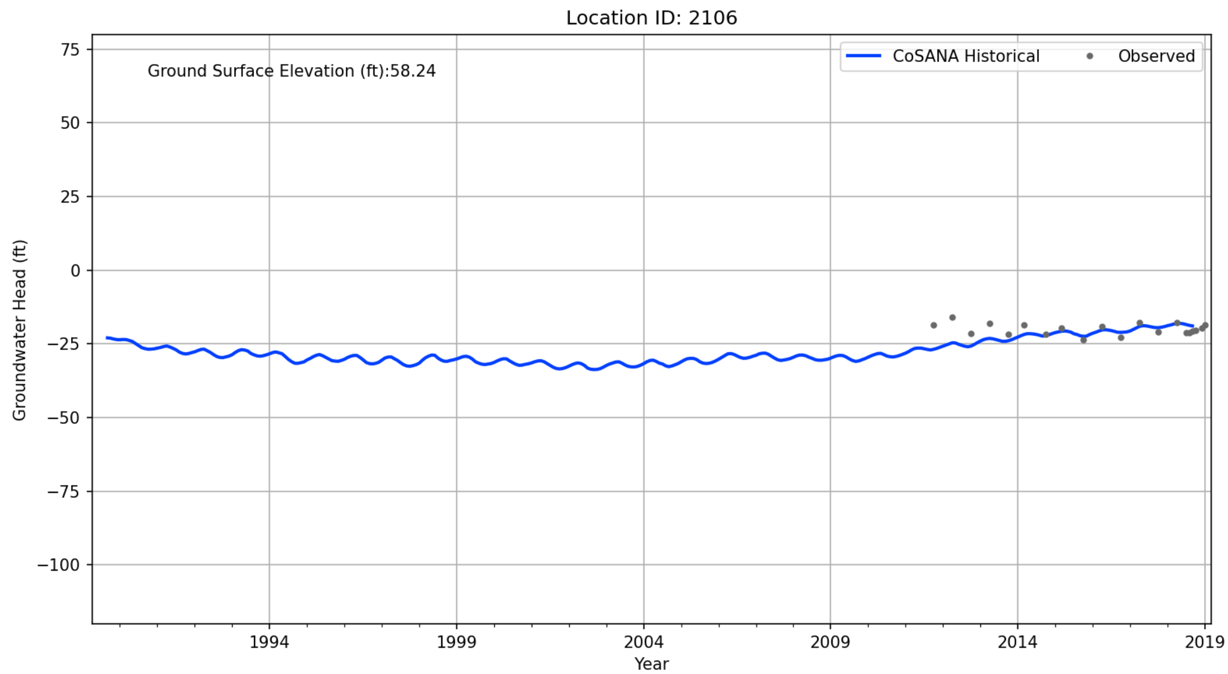
Location ID: 2103
CoSANA Historical
Observed
Ground Surface Elevation (ft):79.5
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

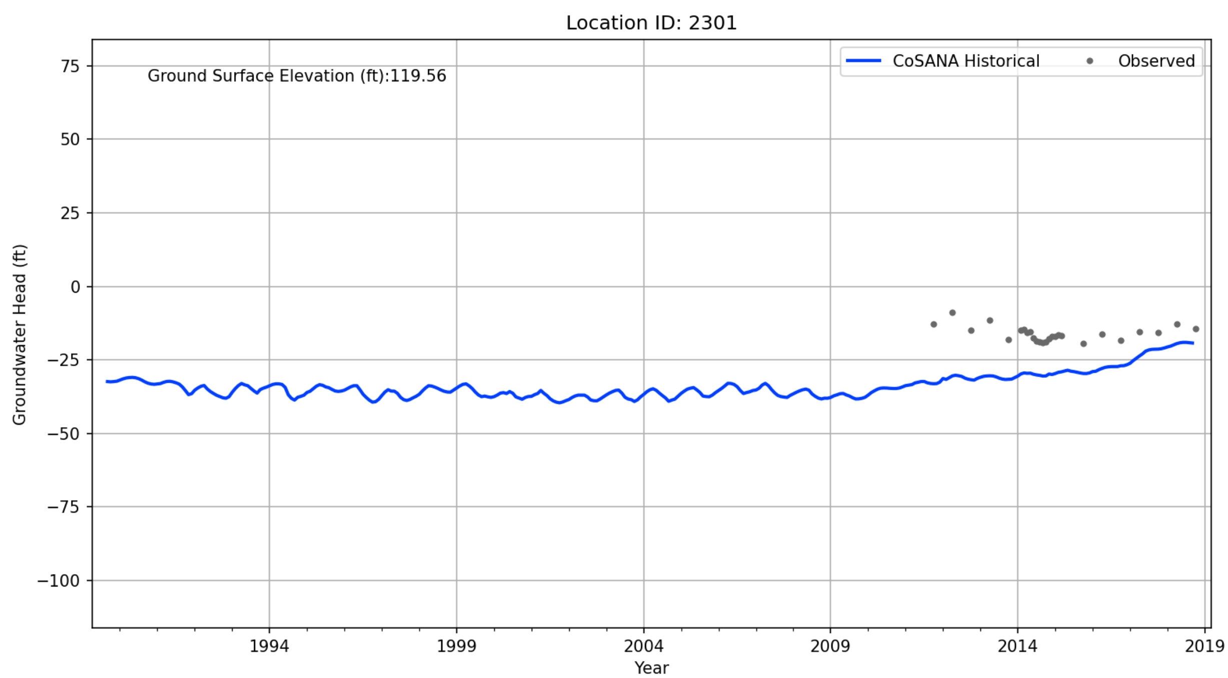


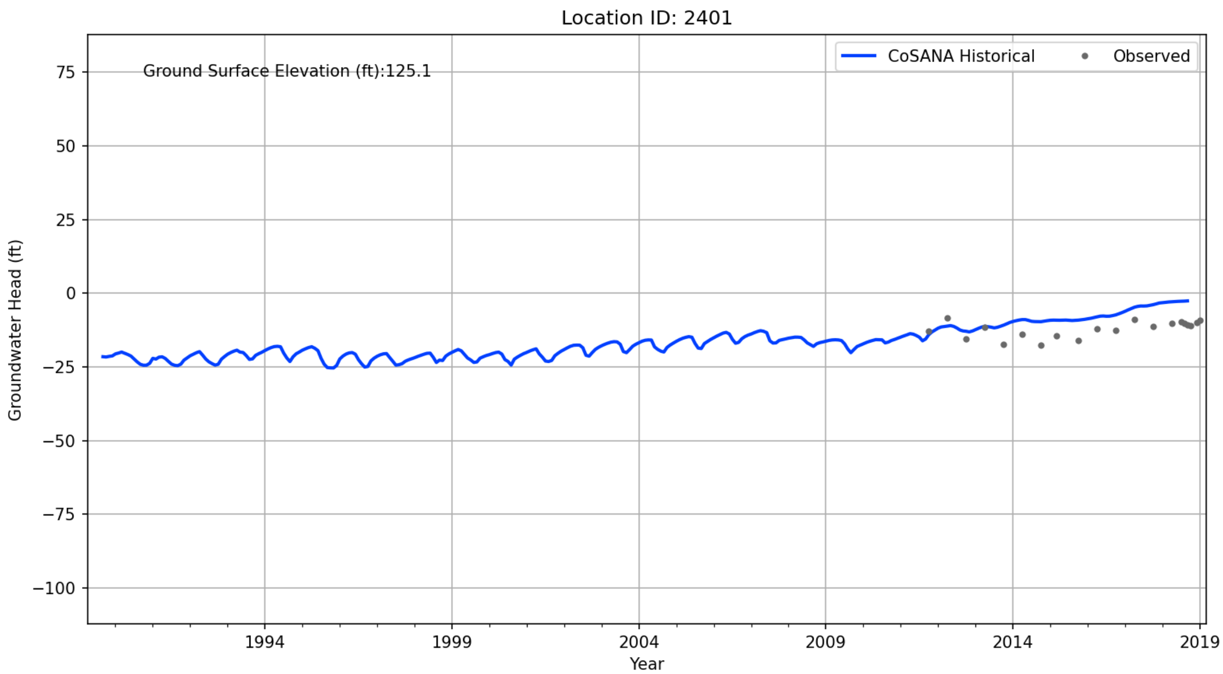
Location ID: 2104
CoSANA Historical
Observed
Ground Surface Elevation (ft):26.38
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

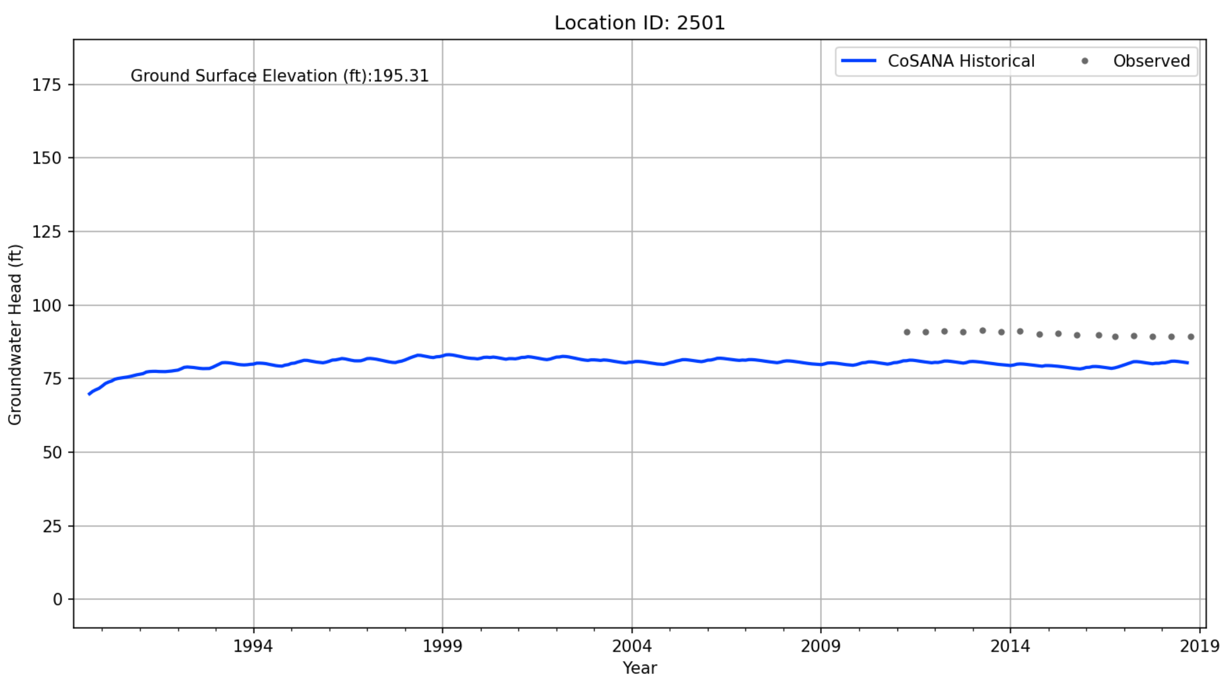


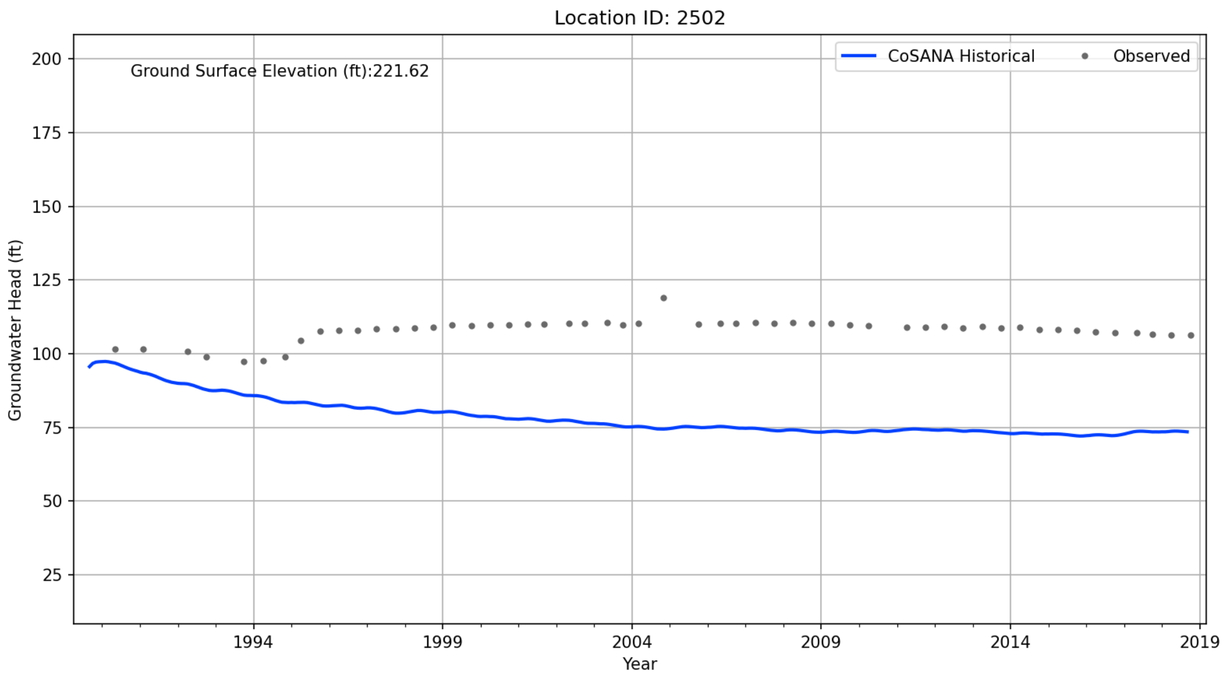
Location ID: 2105
CoSANA Historical
Observed
Ground Surface Elevation (ft):58.24
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 2106
CoSANA Historical
Observed
Ground Surface Elevation (ft):58.24
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

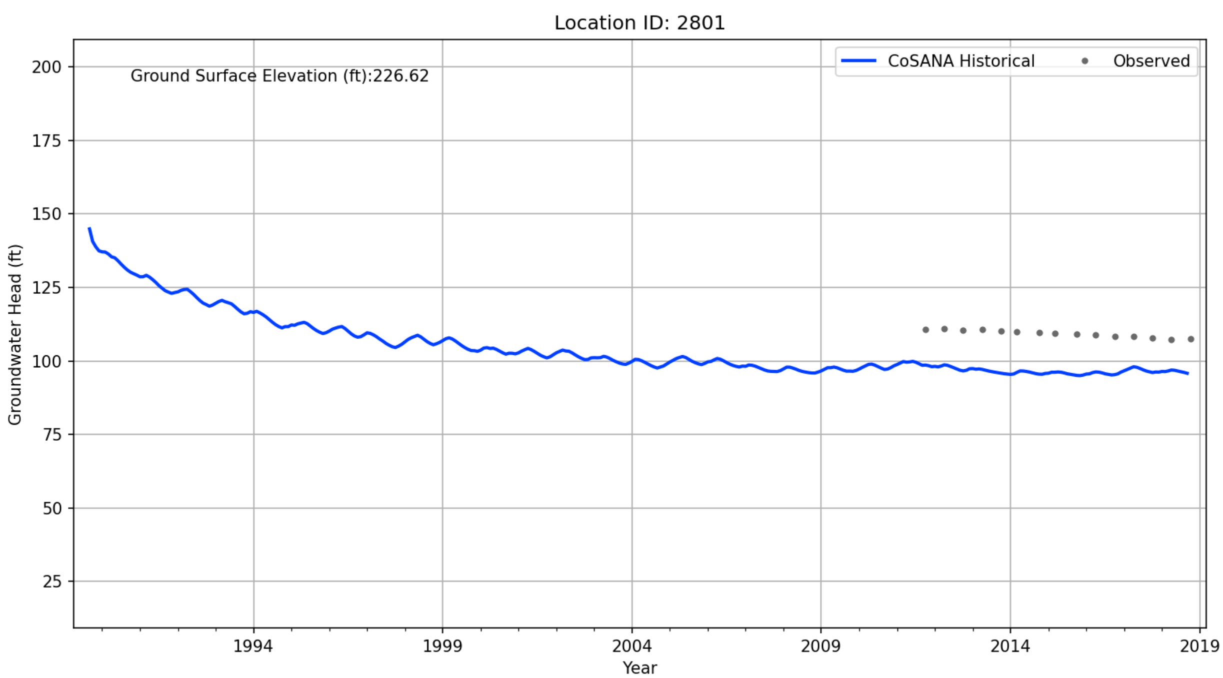

Location ID: 2301
CoSANA Historical
Observed
Ground Surface Elevation (ft):119.56
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 2401
CoSANA Historical
Observed
Ground Surface Elevation (ft):125.1
75
50
25
0
−25
−50
−75
−100
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year

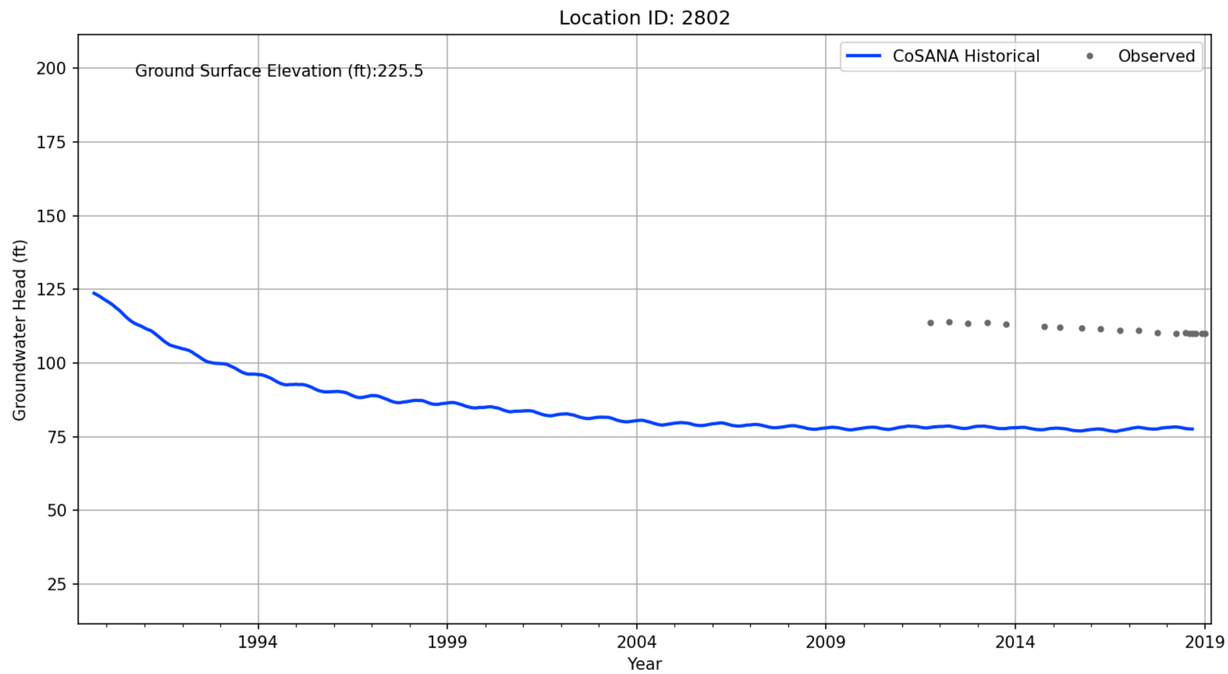

Location ID: 2501
CoSANA Historical
Observed
Ground Surface Elevation (ft):195.31
175
150
125
100
75
50
25
0
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year



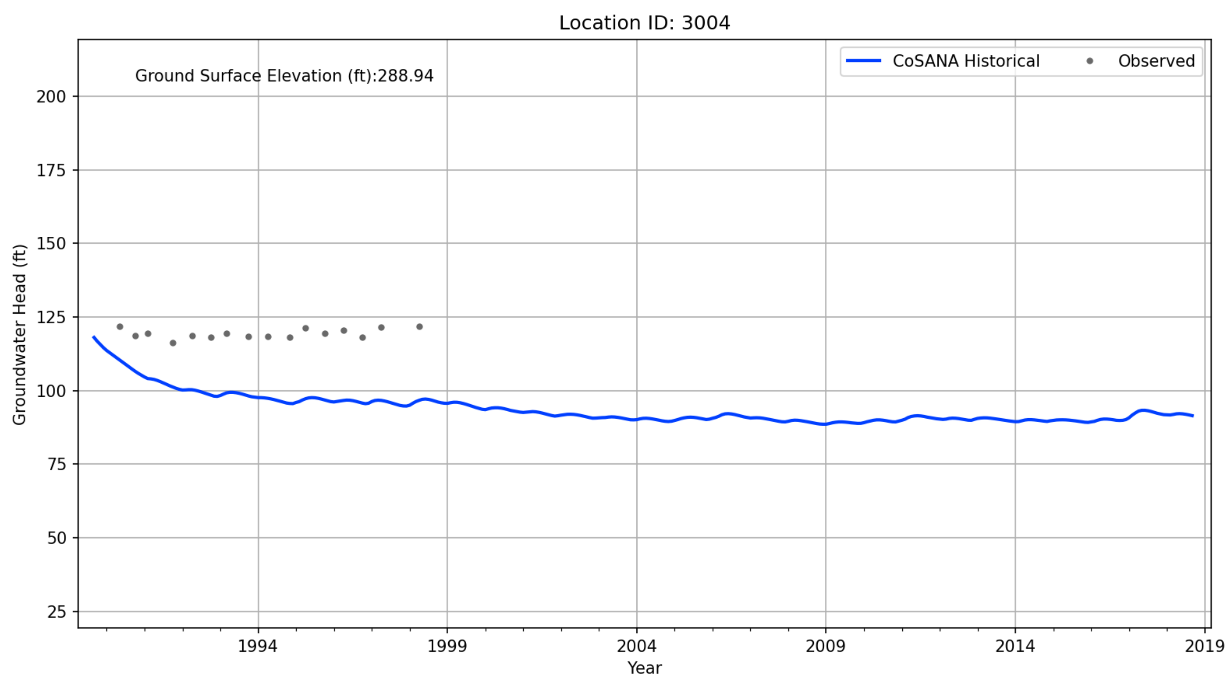
Location ID: 2502
CoSANA Historical
Observed
Ground Surface Elevation (ft):221.62
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year



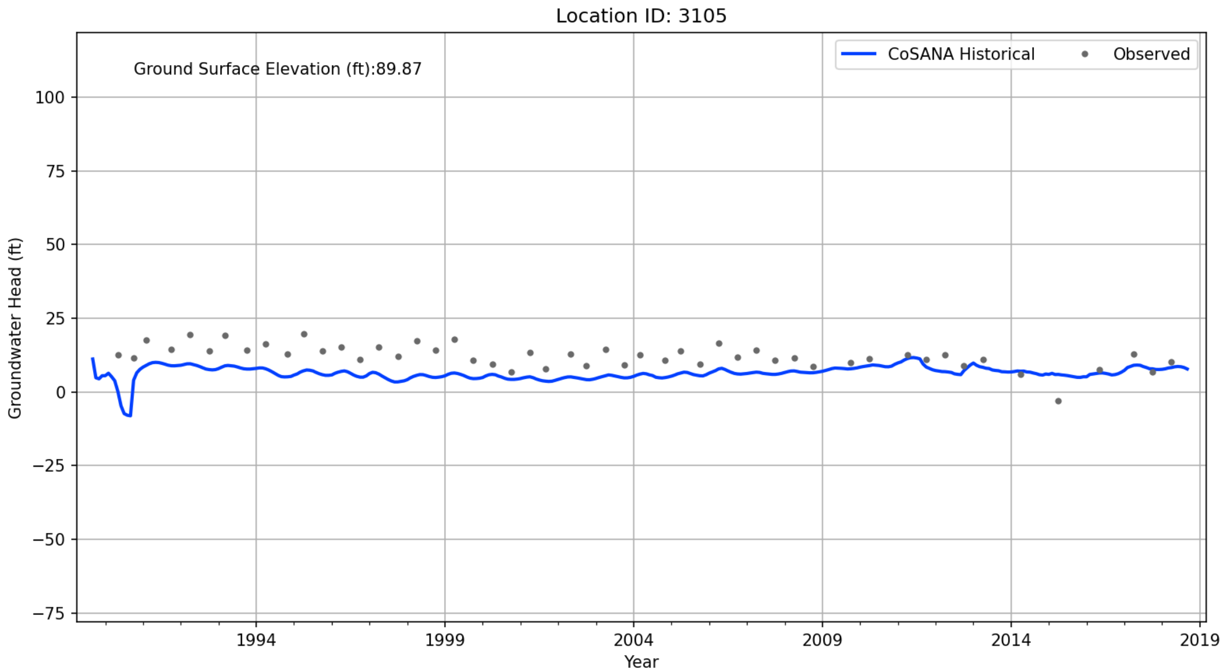
Location ID: 2801
CoSANA Historical
Observed
Ground Surface Elevation (ft):226.62
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year



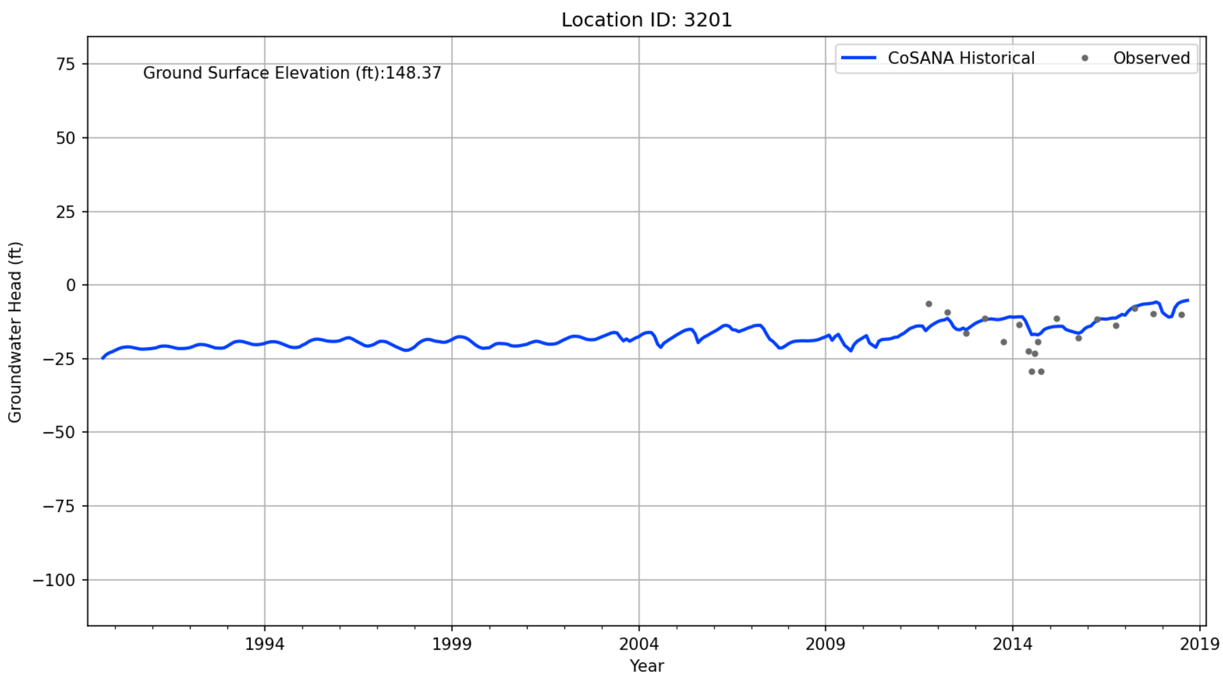
Location ID: 2802
Ground Surface Elevation (ft):225.5
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
50
75
100
125
150
175
200
1994
1999
2004
2009
2014
2019



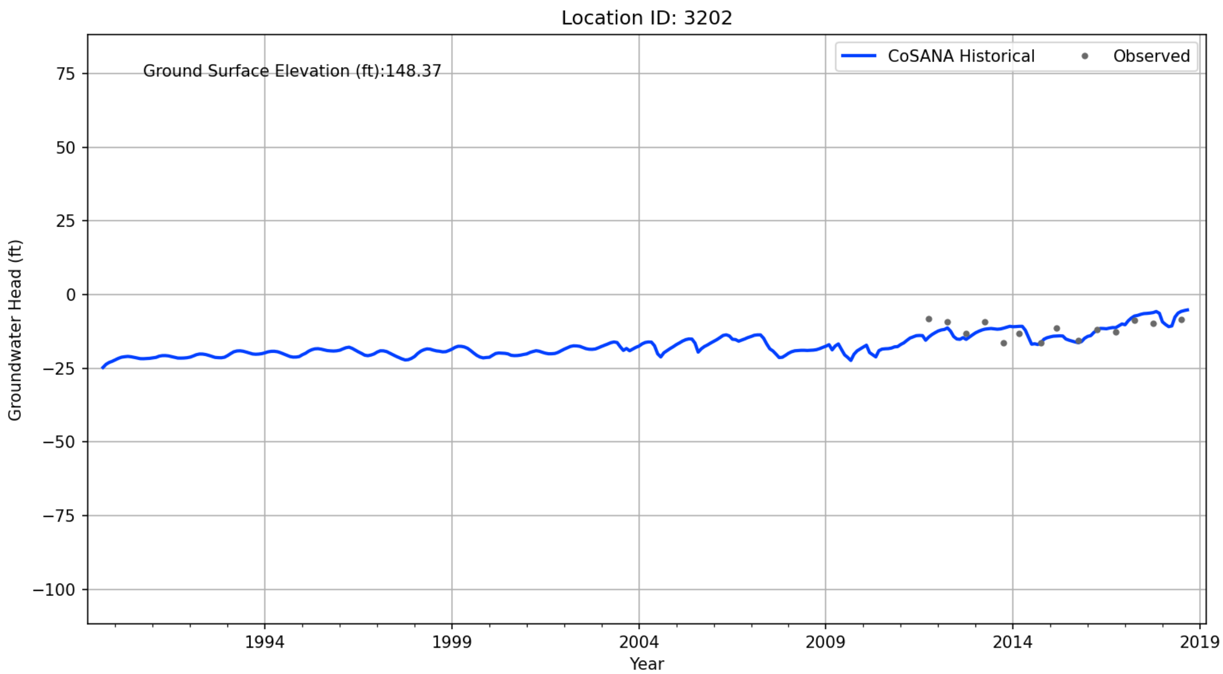
Location ID: 3004
Ground Surface Elevation (ft):288.94
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
50
75
100
125
150
175
200
1994
1999
2004
2009
2014
2019

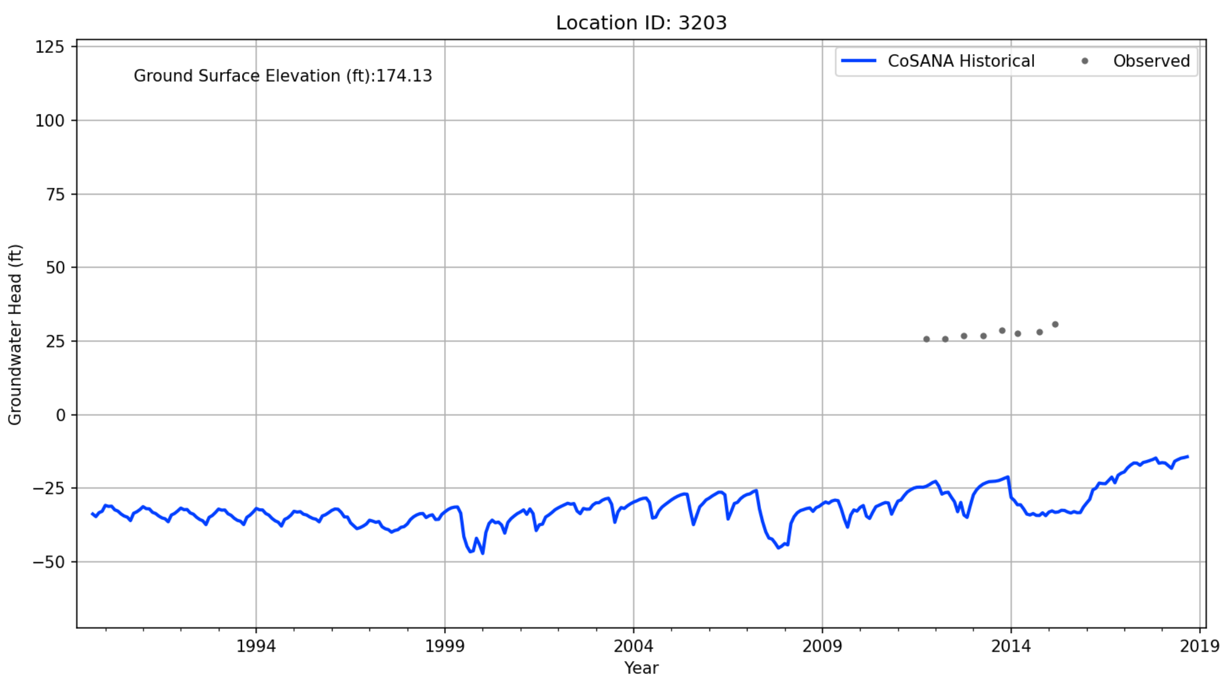


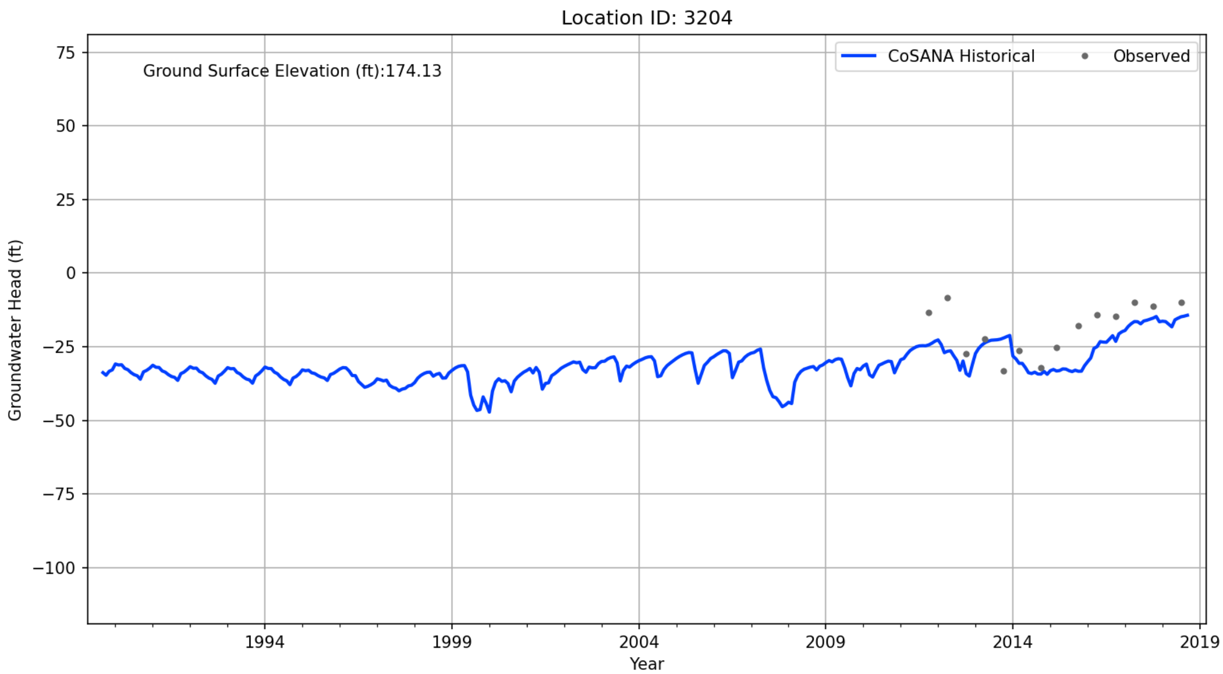
Location ID: 3105
Ground Surface Elevation (ft):89.87
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

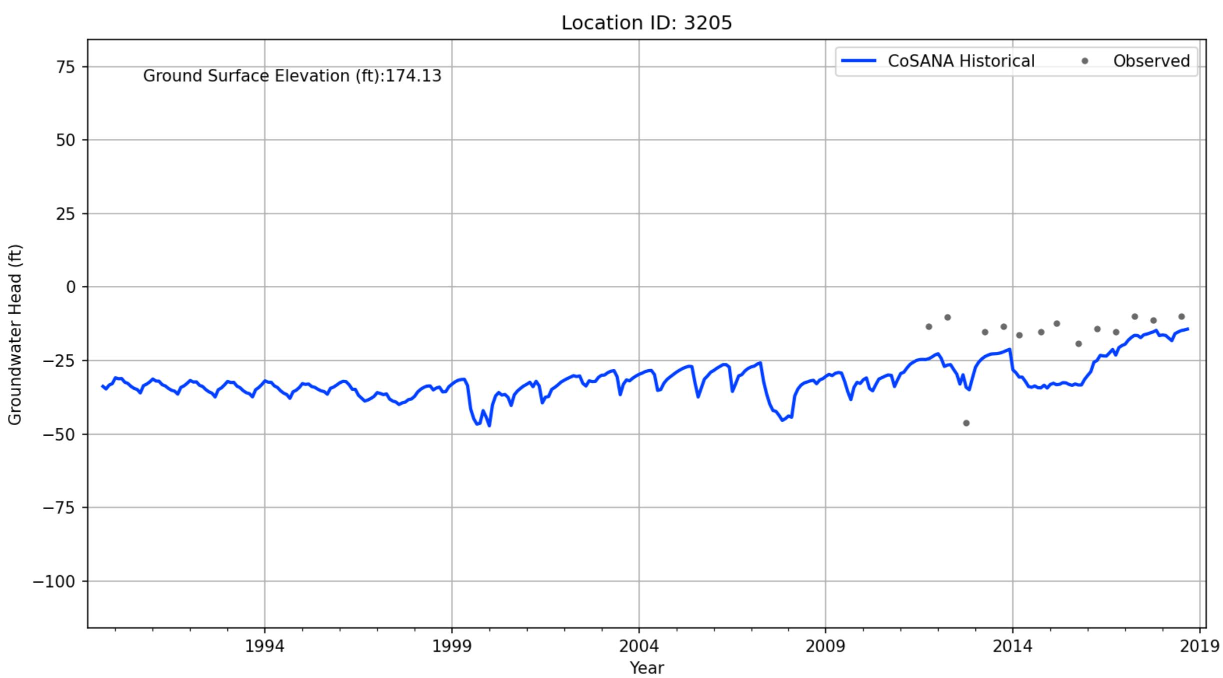


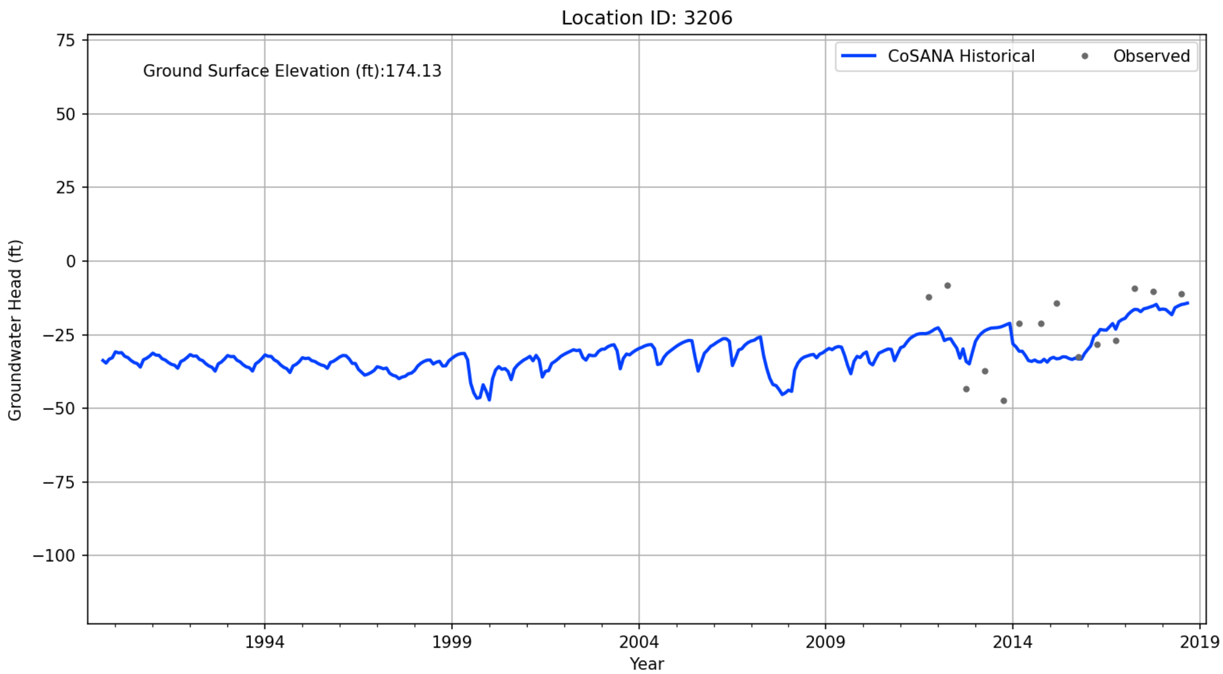
Location ID: 3201
Ground Surface Elevation (ft):148.37
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

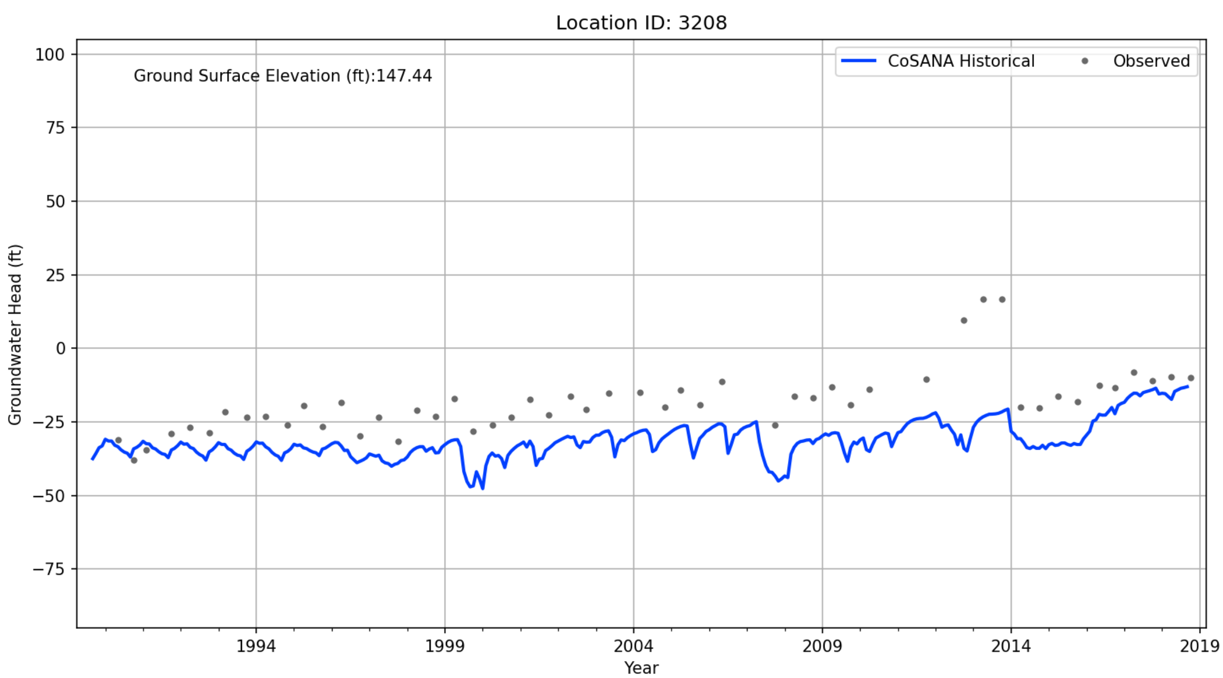

Location ID: 3202
Ground Surface Elevation (ft):148.37
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

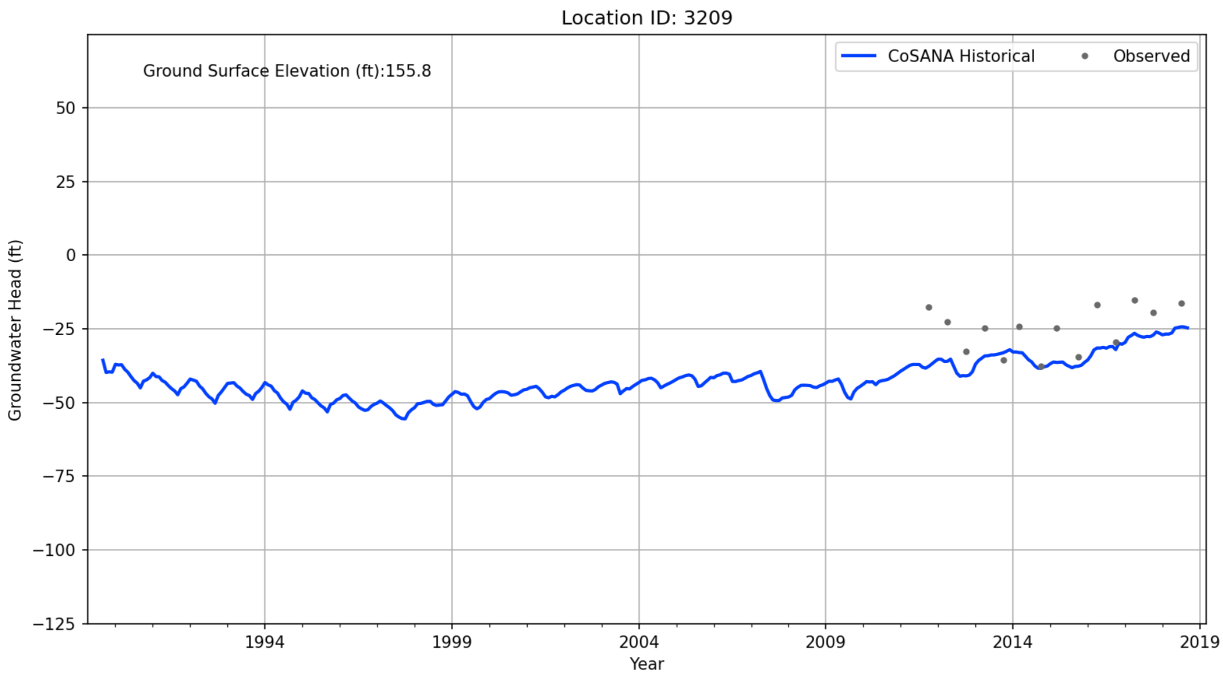

Location ID: 3203
Ground Surface Elevation (ft):174.13
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

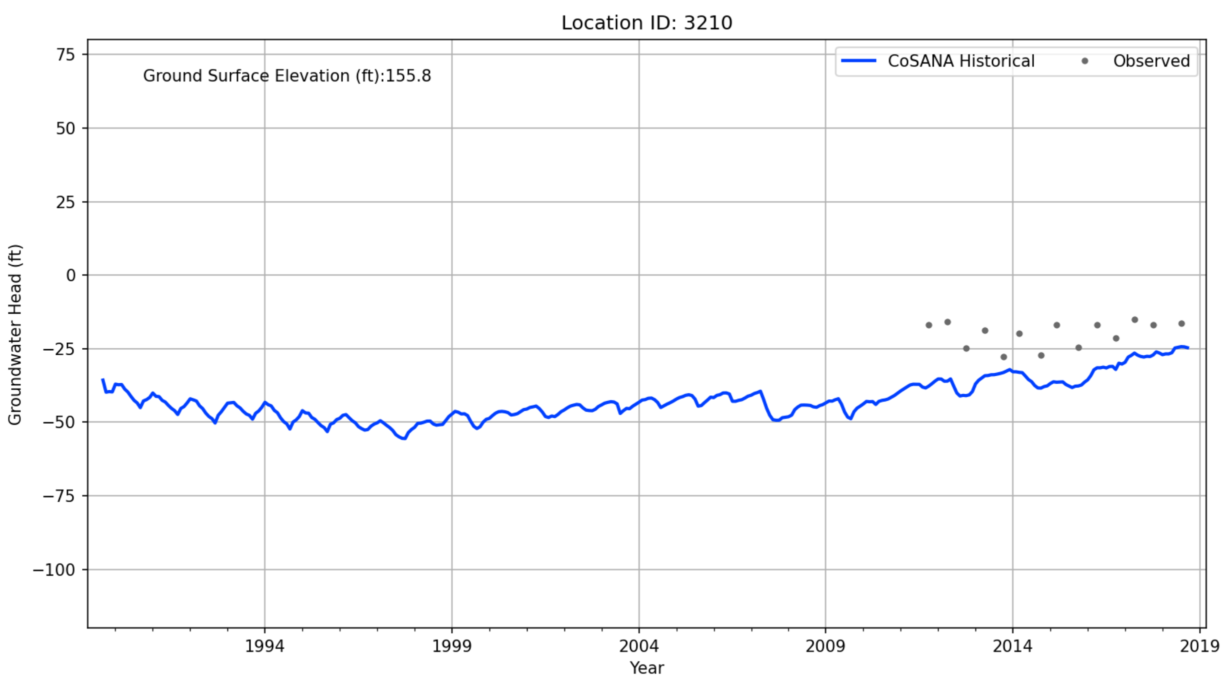

Location ID: 3204
Ground Surface Elevation (ft):174.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

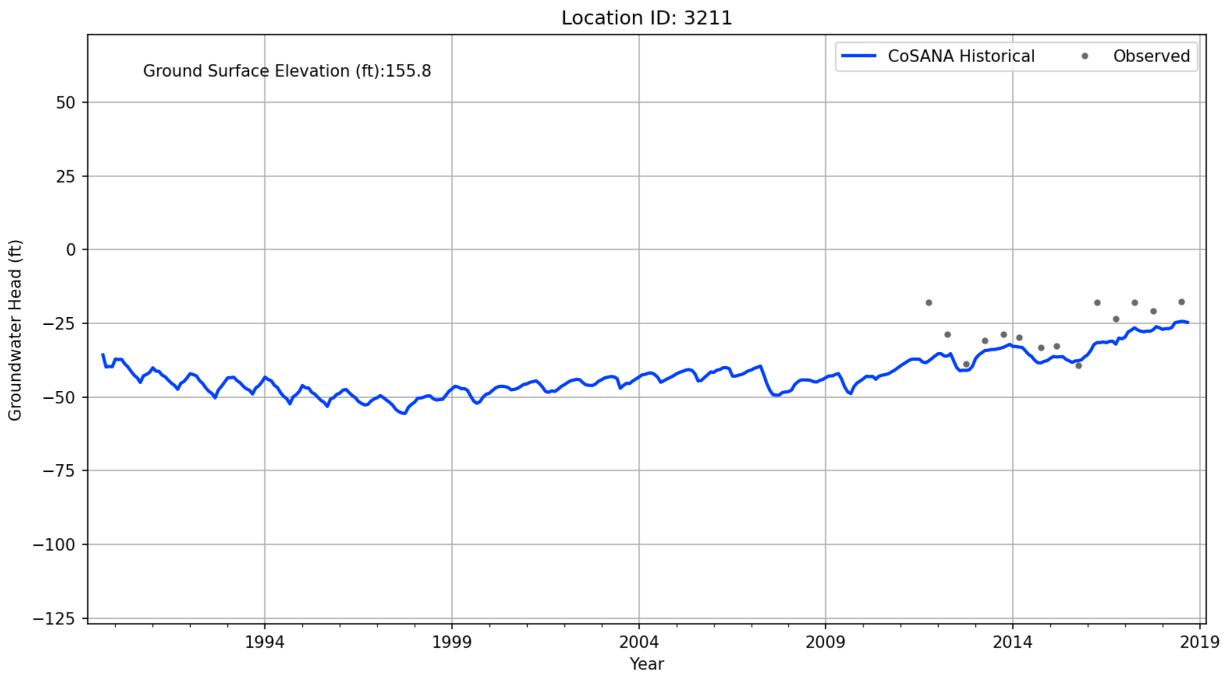

Location ID: 3205
Ground Surface Elevation (ft):174.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

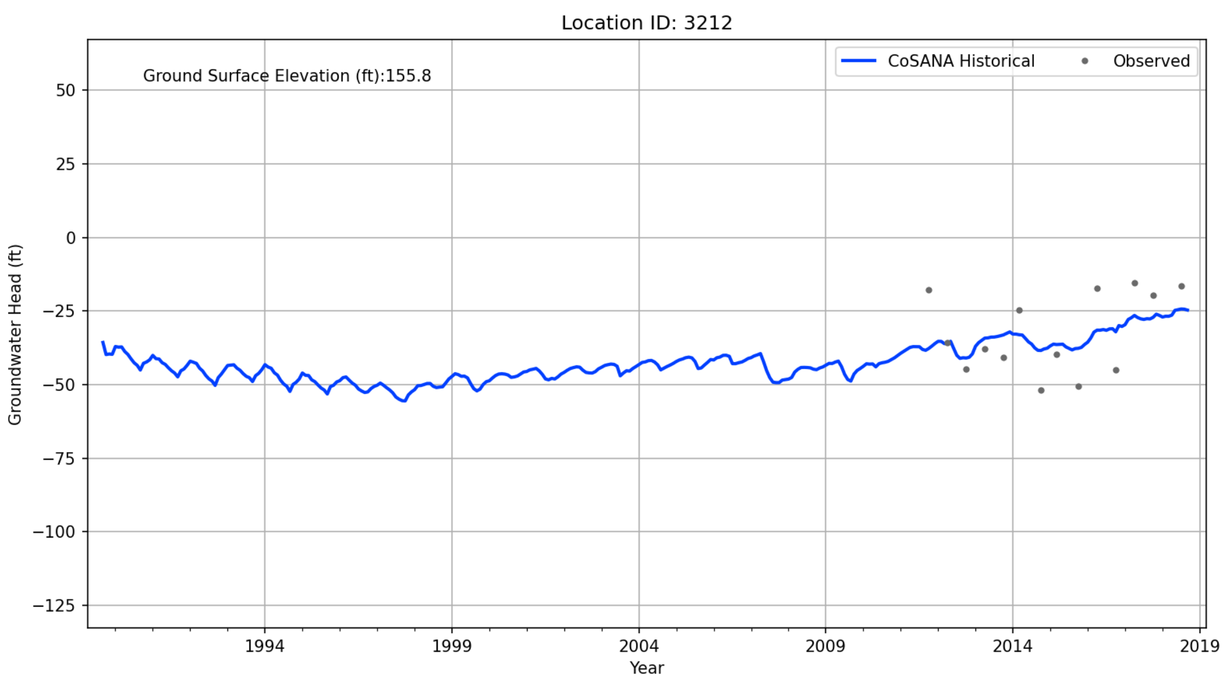

Location ID: 3206
Ground Surface Elevation (ft):174.13
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

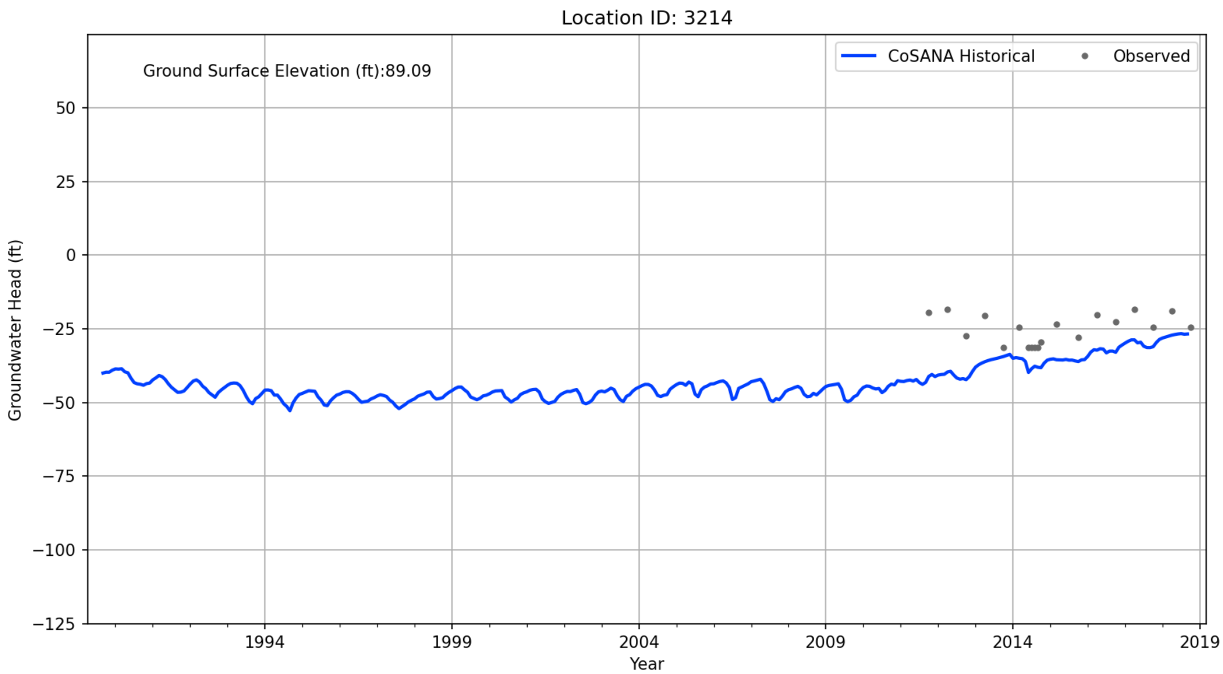

Location ID: 3208
Ground Surface Elevation (ft):147.44
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

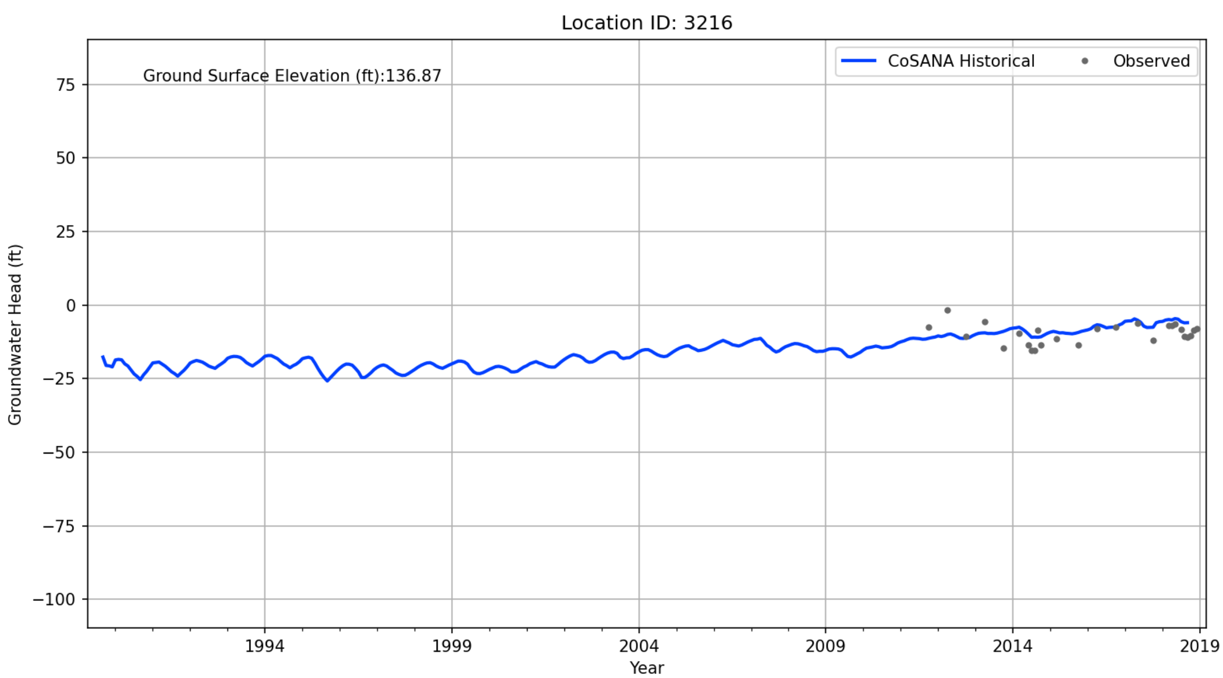

Location ID: 3209
Ground Surface Elevation (ft):155.8
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

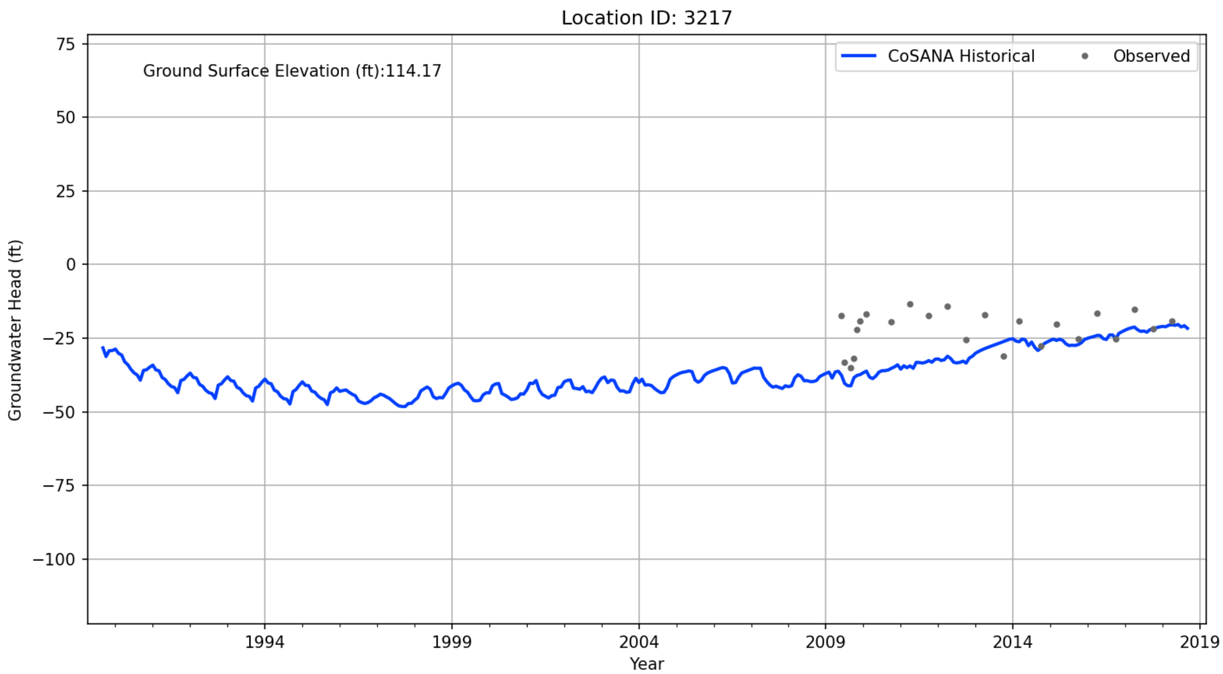

Location ID: 3210
Ground Surface Elevation (ft):155.8
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 3211
CoSANA Historical
Observed
Ground Surface Elevation (ft):155.8
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

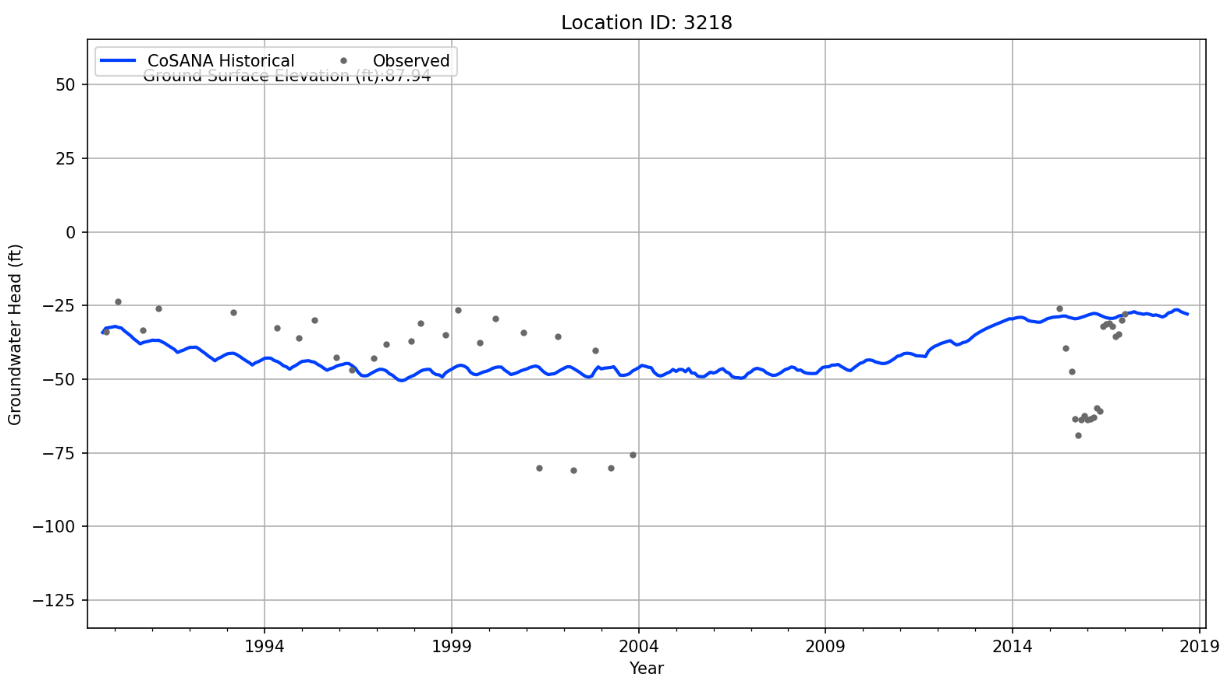

Location ID: 3212
CoSANA Historical
Observed
Ground Surface Elevation (ft):155.8
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 3214
Ground Surface Elevation (ft):89.09
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

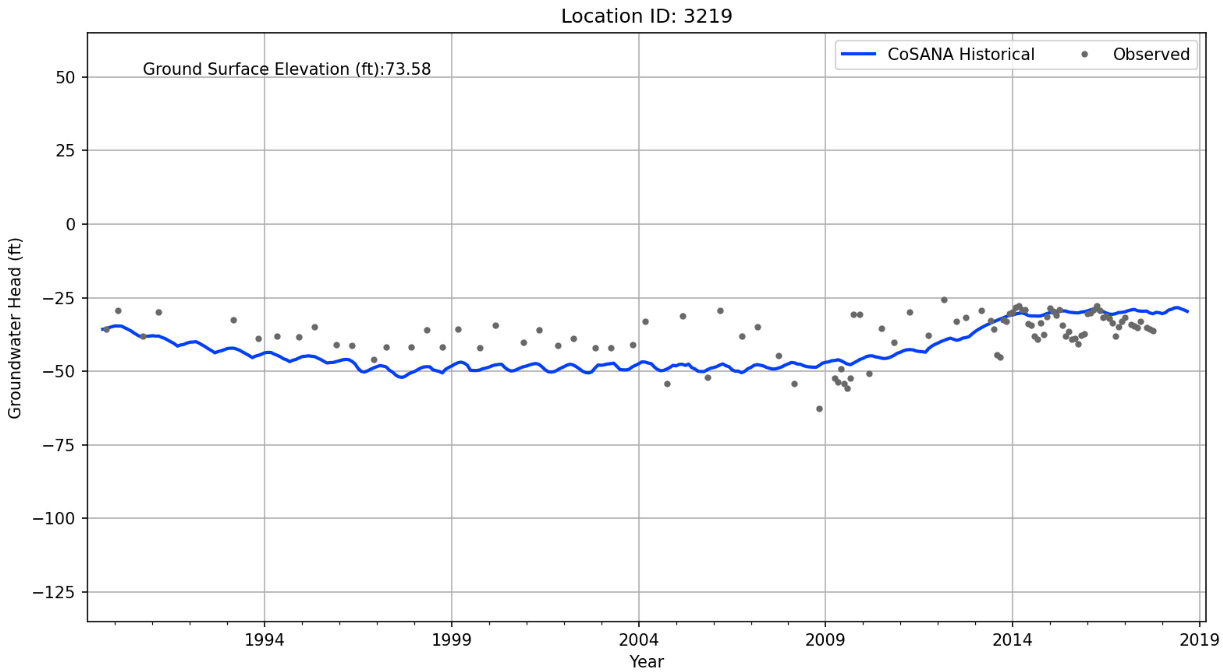

Location ID: 3216
Ground Surface Elevation (ft):136.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

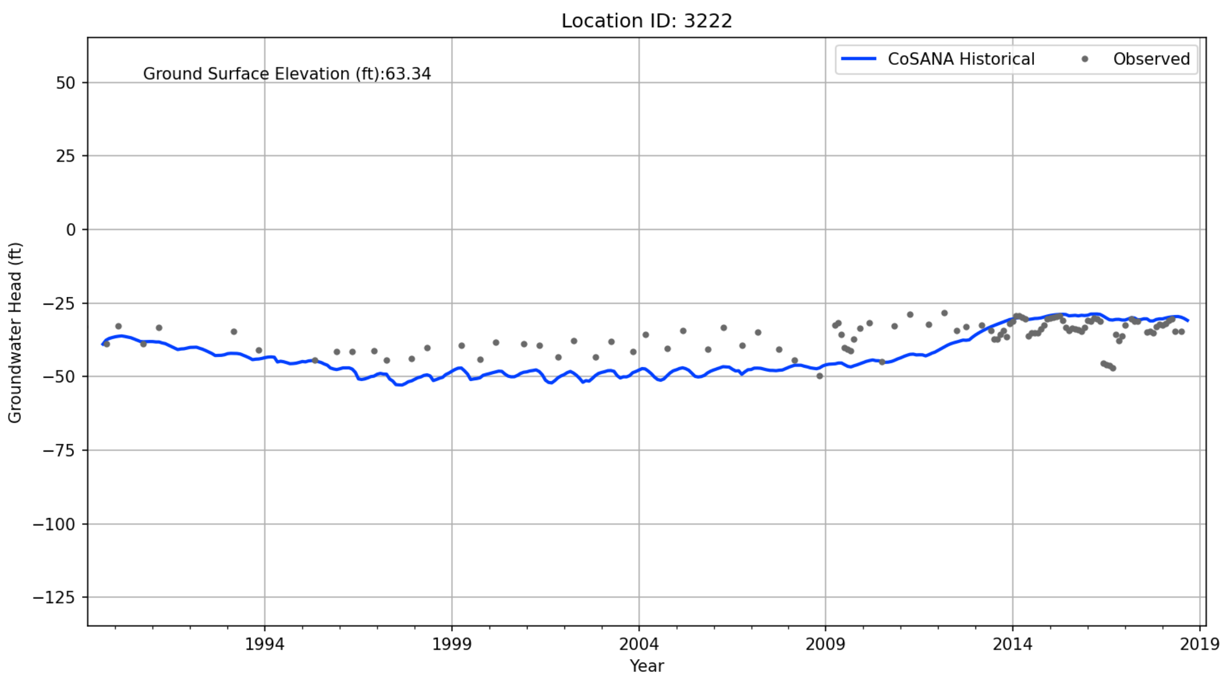


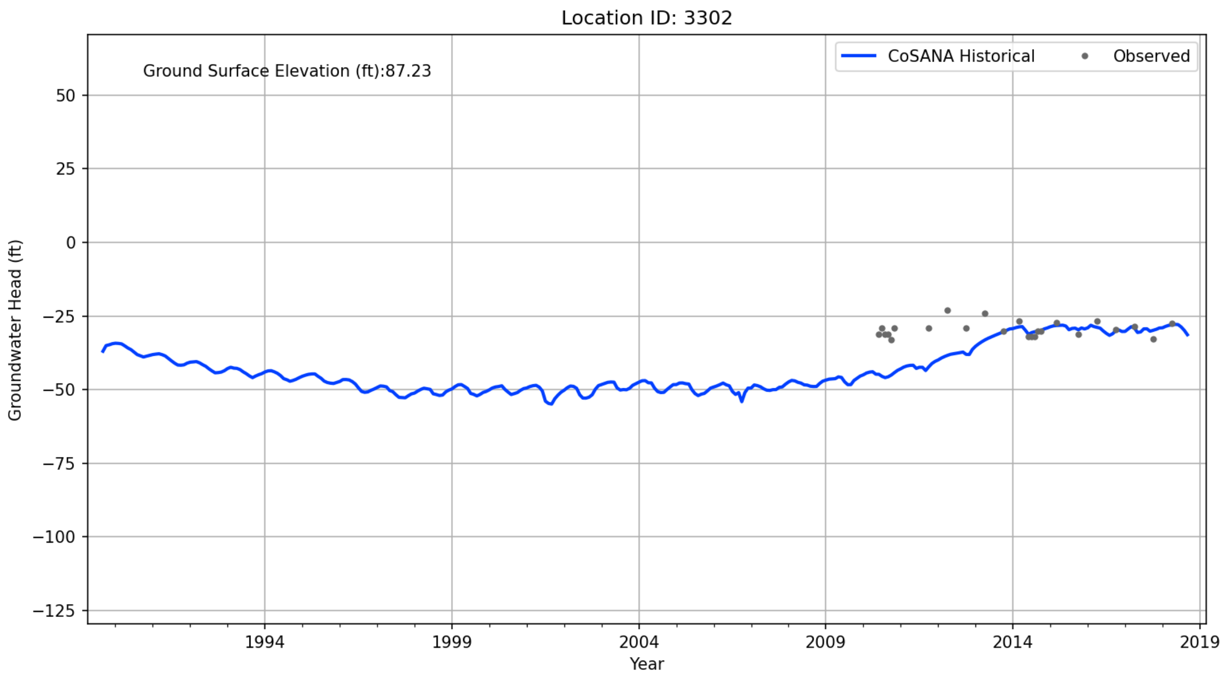
Location ID: 3217
CoSANA Historical
Observed
Ground Surface Elevation (ft):114.17
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

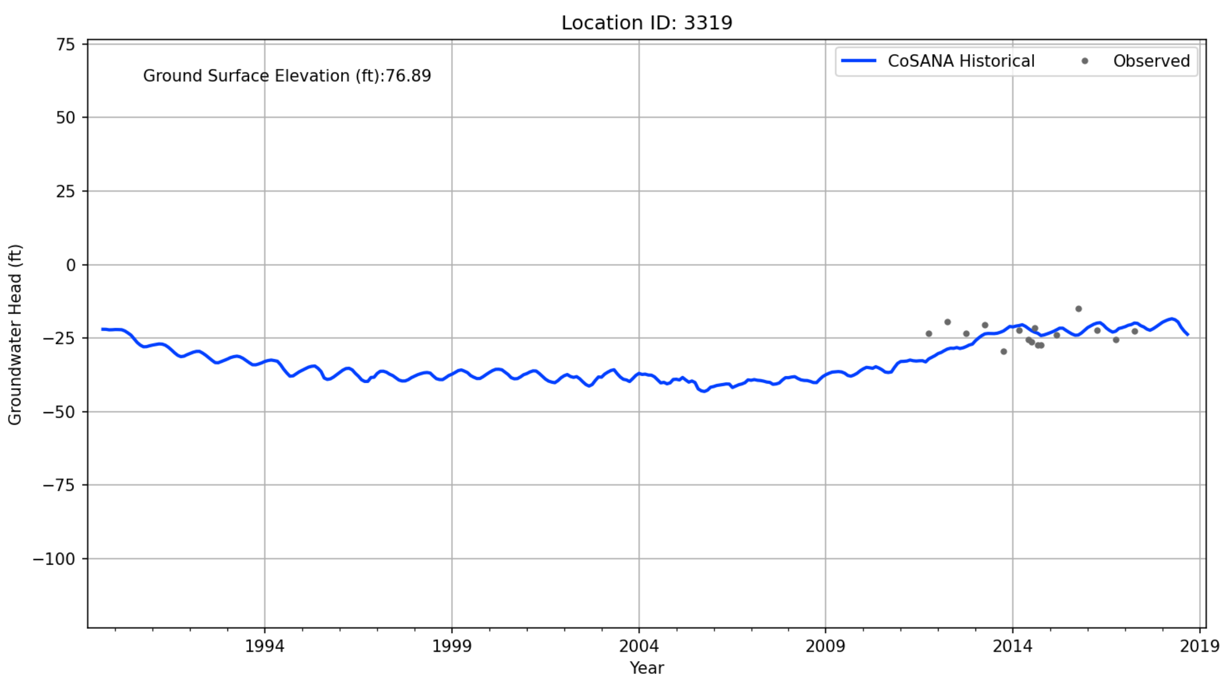


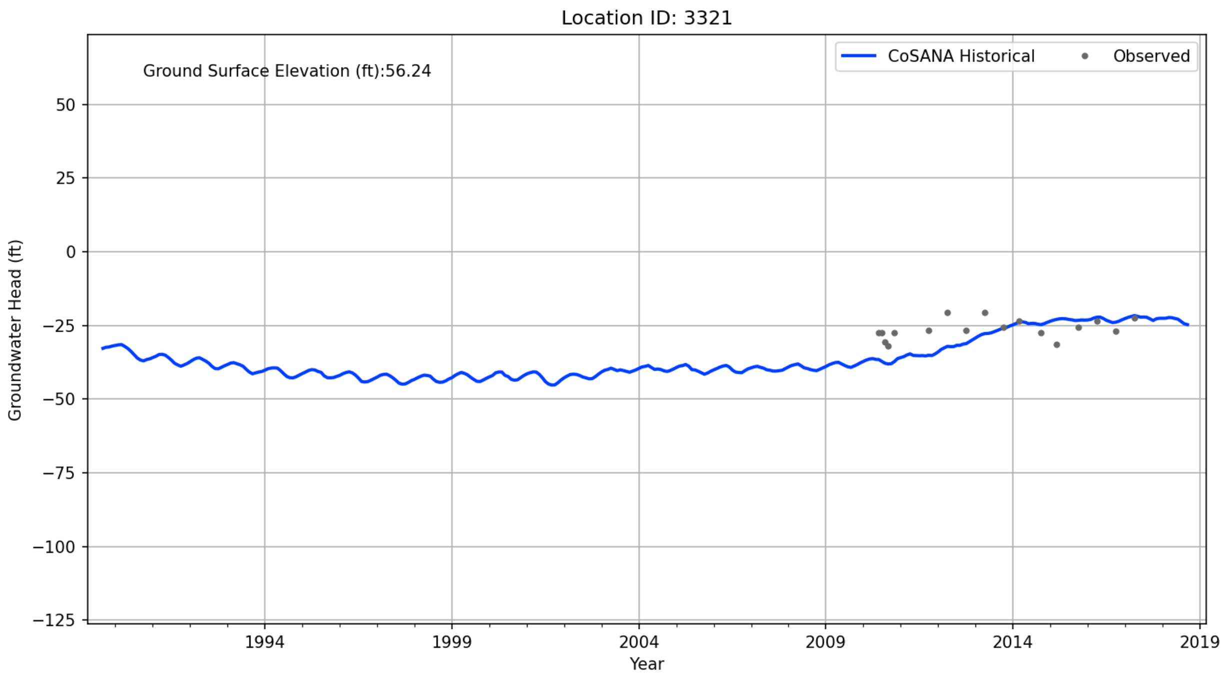
Location ID: 3218
CoSANA Historical
Observed
Ground Surface Elevation (ft):87.94
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019


Location ID: 3219
CoSANA Historical
Observed
Ground Surface Elevation (ft):73.58
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

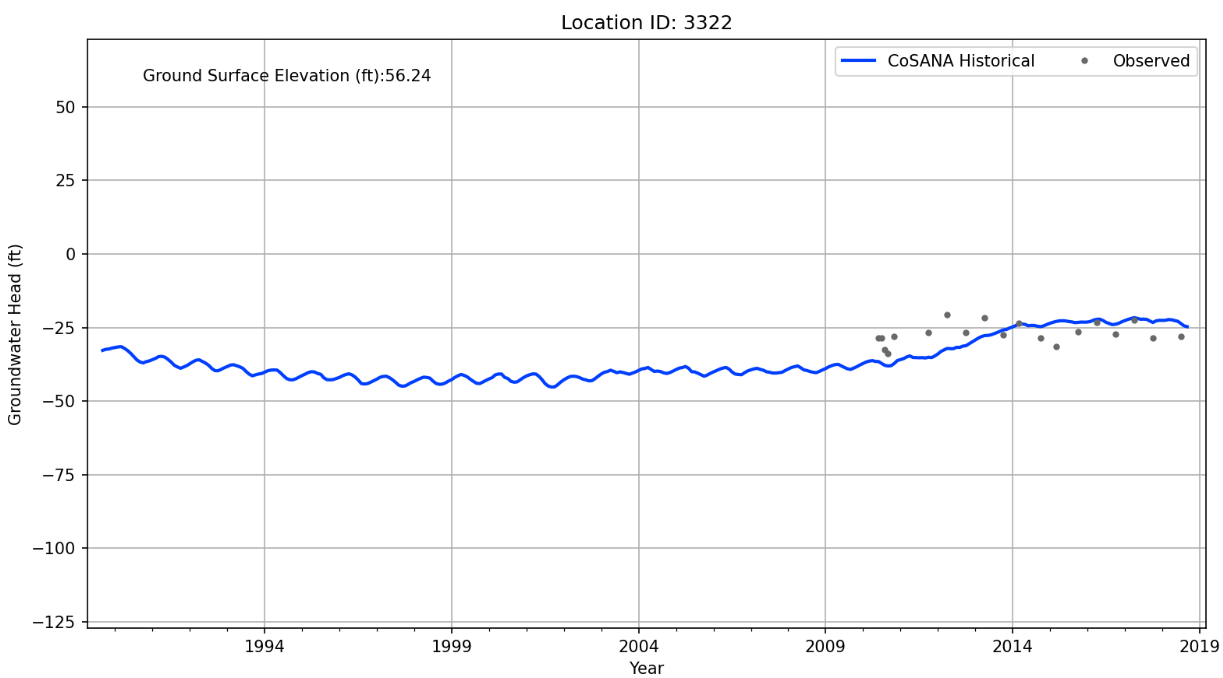

Location ID: 3222
CoSANA Historical
Observed
Ground Surface Elevation (ft):63.34
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 3302
CoSANA Historical
Observed
Ground Surface Elevation (ft):87.23
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

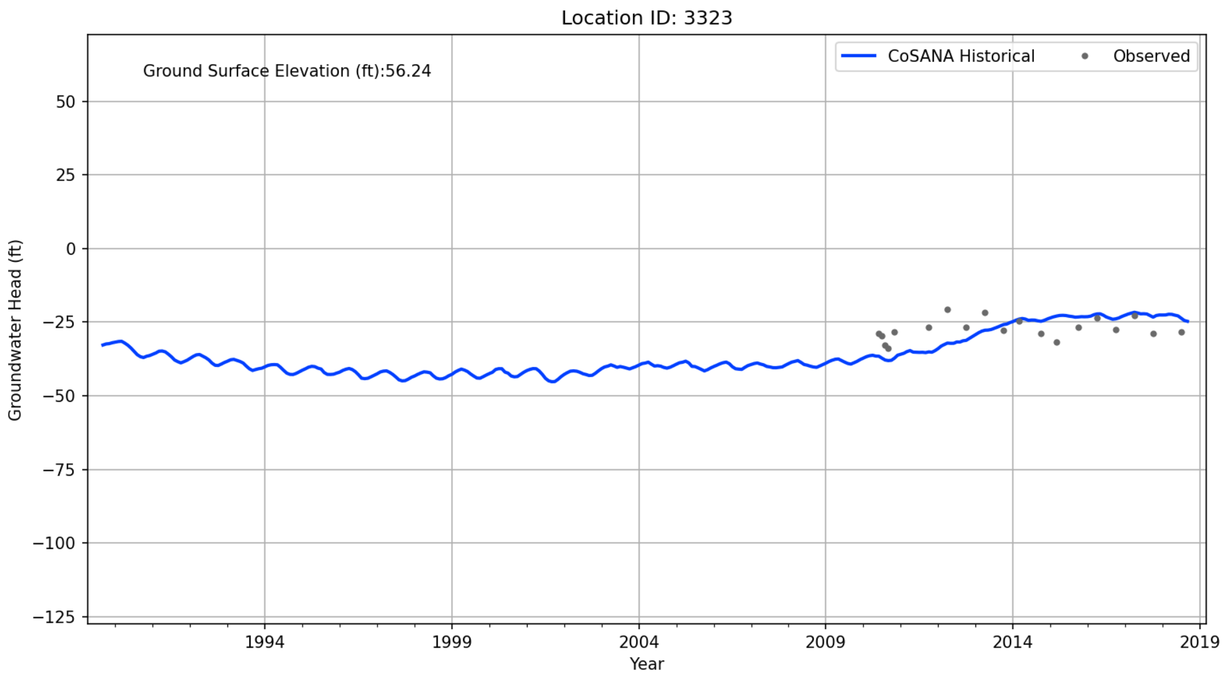

Location ID: 3319
CoSANA Historical
Observed
Ground Surface Elevation (ft):76.89
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

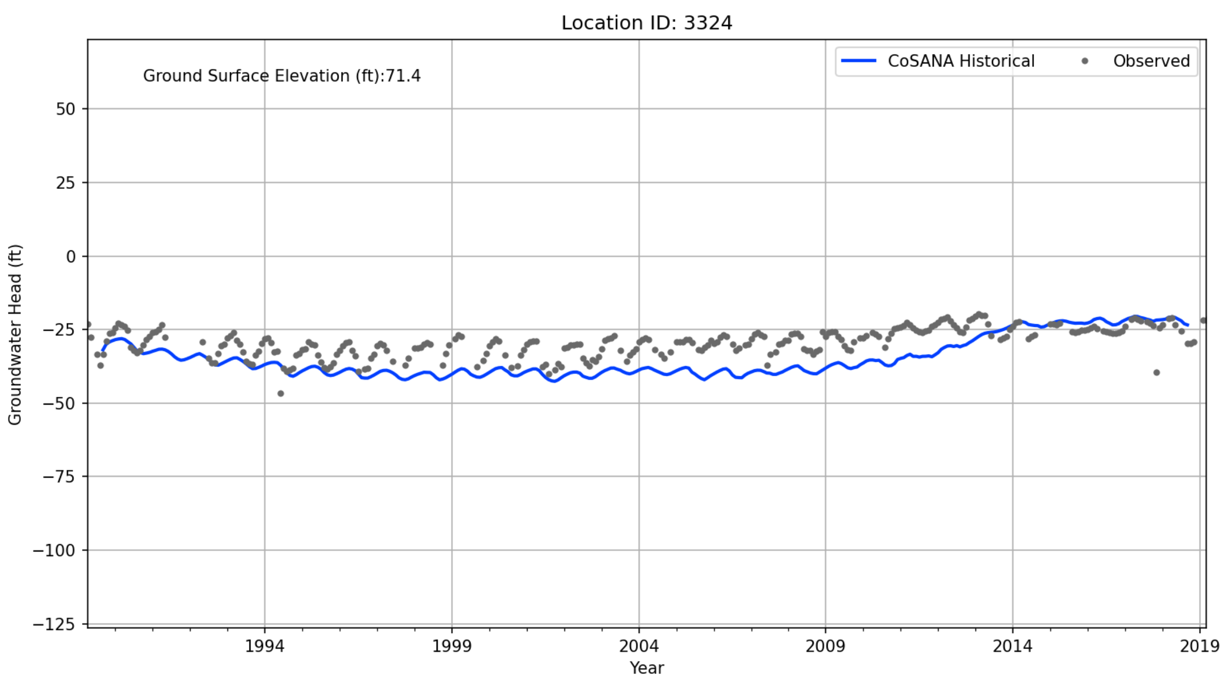


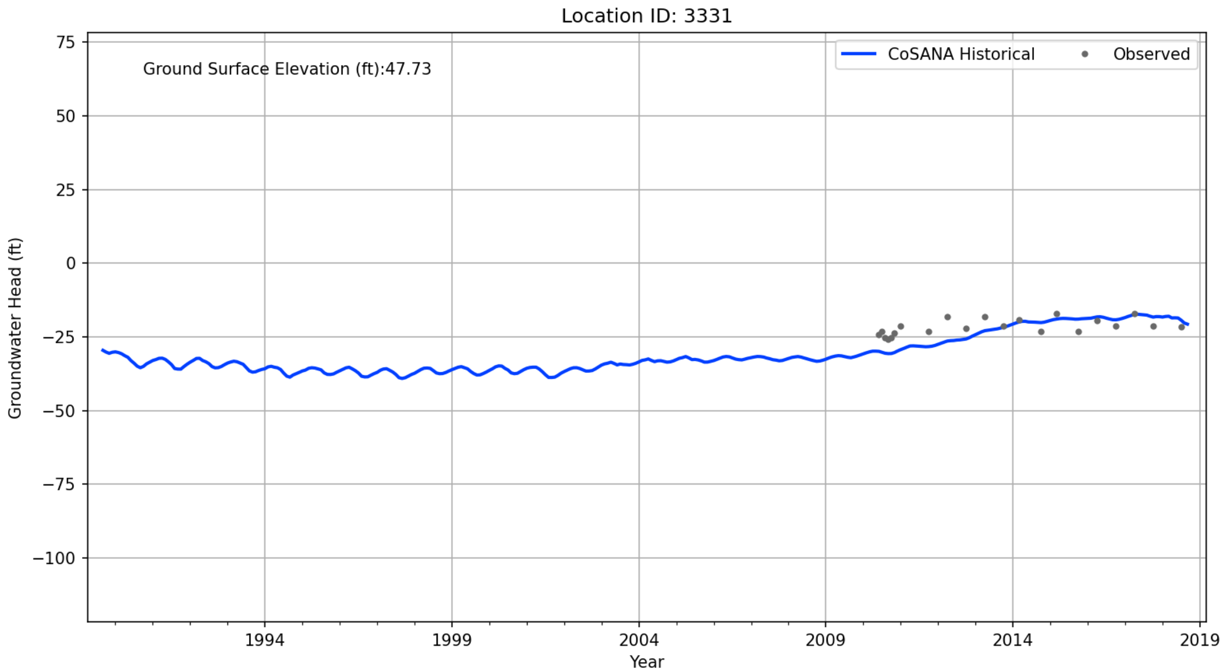
Location ID: 3321
Ground Surface Elevation (ft):56.24
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

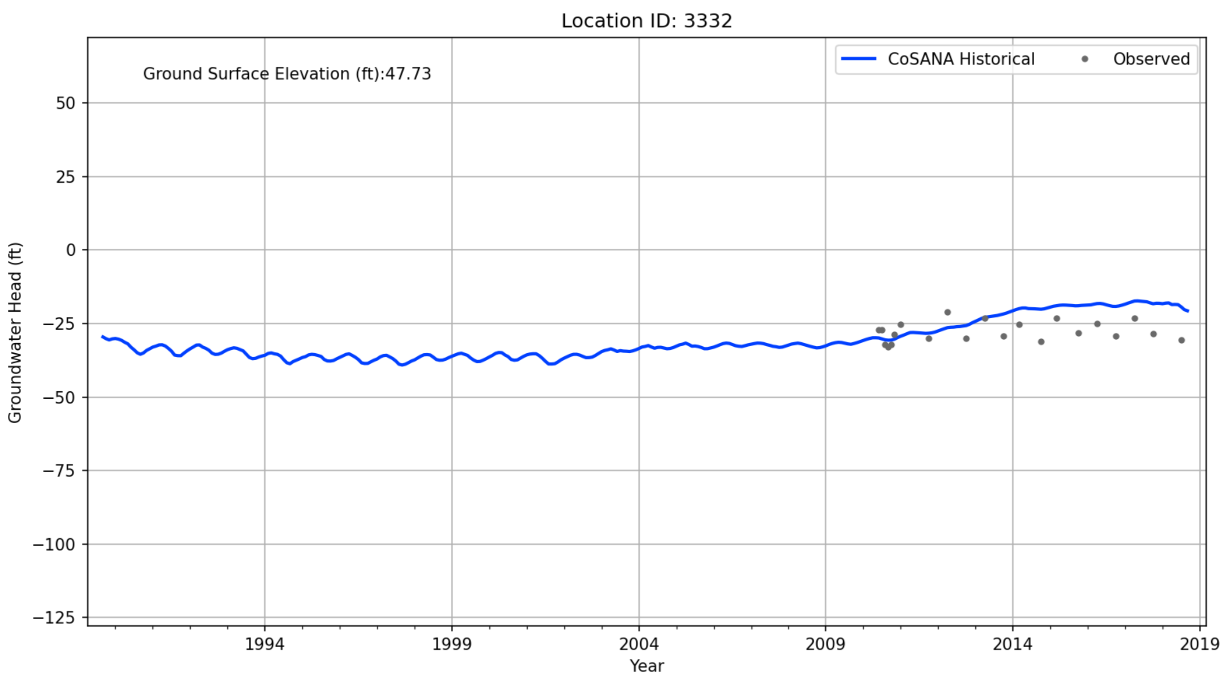


Location ID: 3322
Ground Surface Elevation (ft):56.24
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

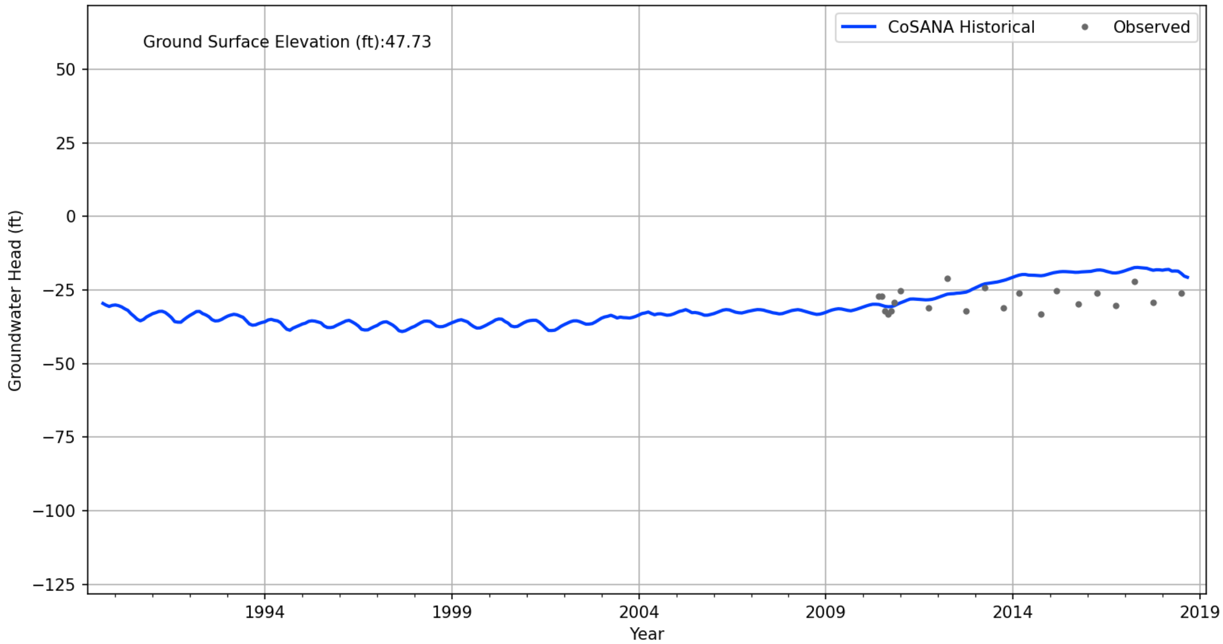

Location ID: 3323
Ground Surface Elevation (ft):56.24
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019


Location ID: 3324
Ground Surface Elevation (ft):71.4
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

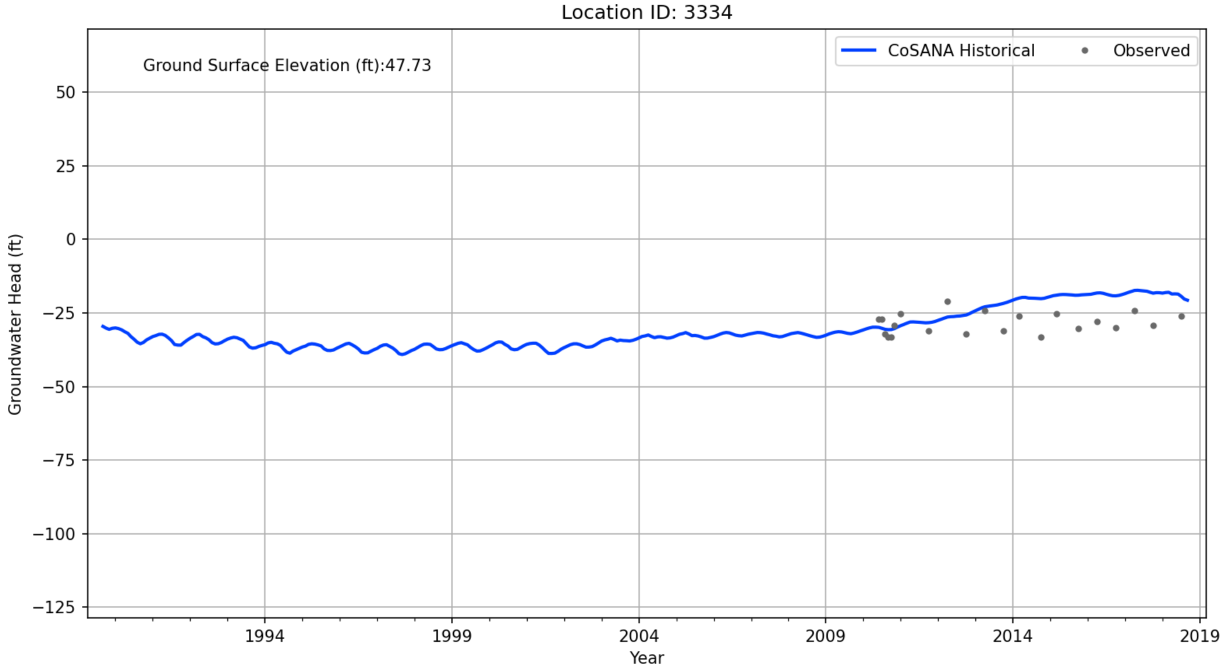

Location ID: 3331
Ground Surface Elevation (ft):47.73
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

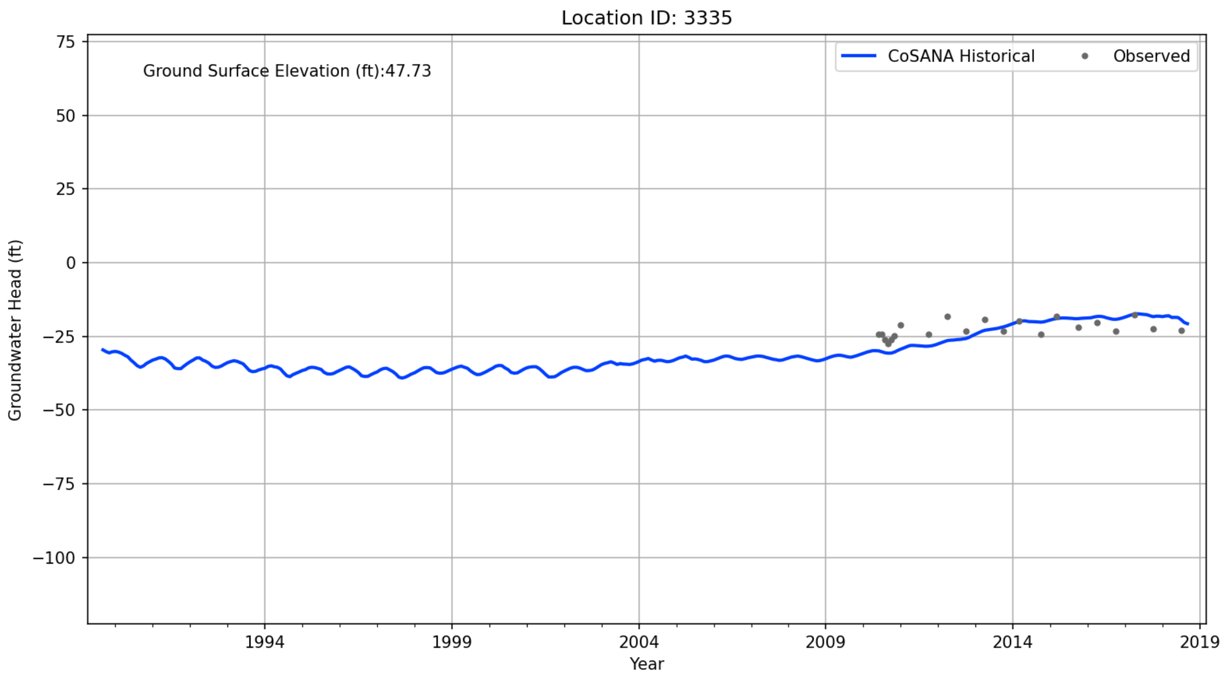

Location ID: 3332
Ground Surface Elevation (ft):47.73
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

Location ID: 3333

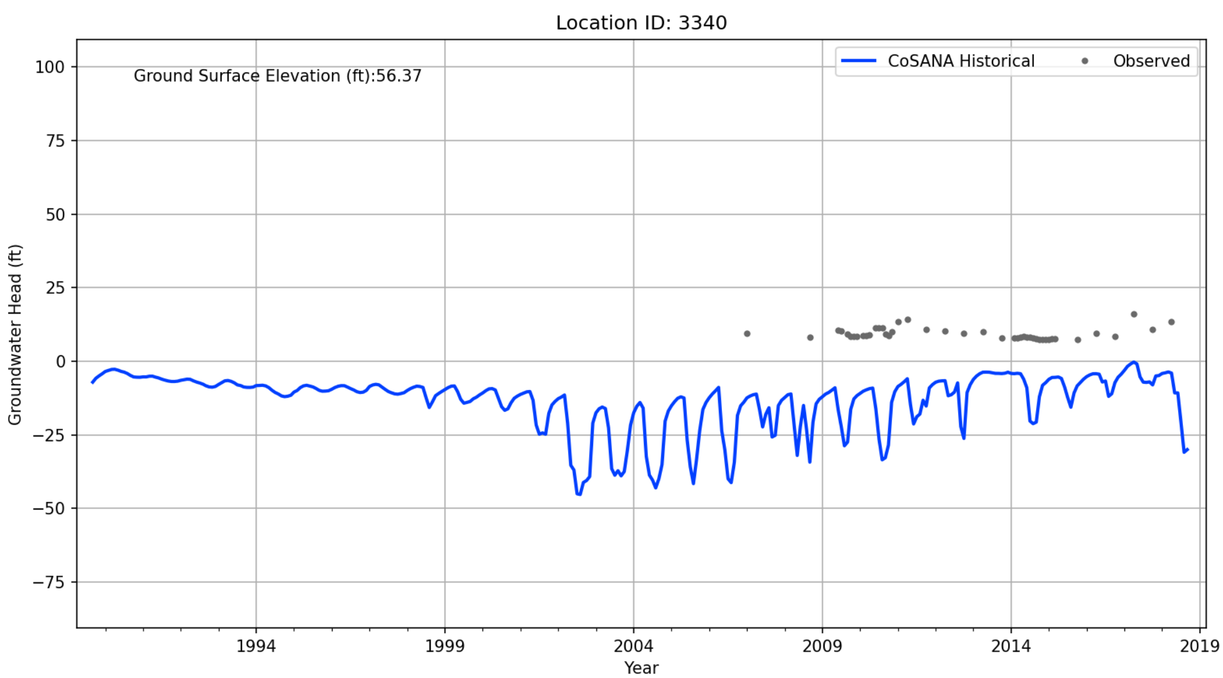


Location ID: 3334

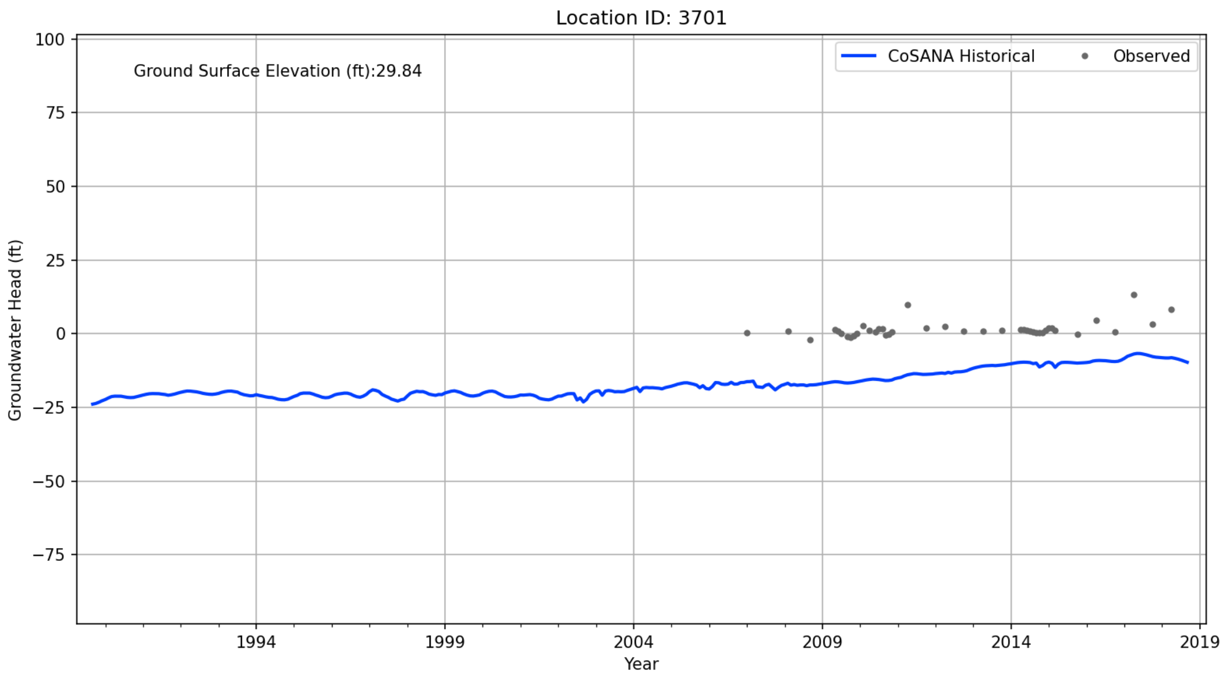


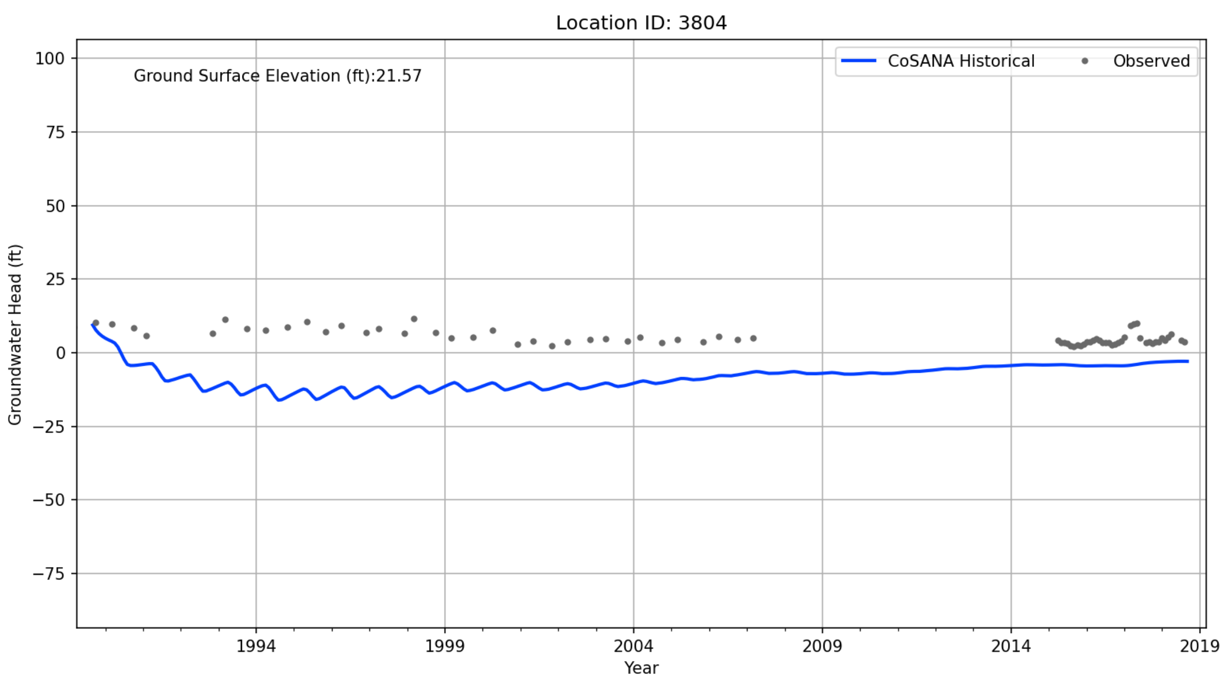


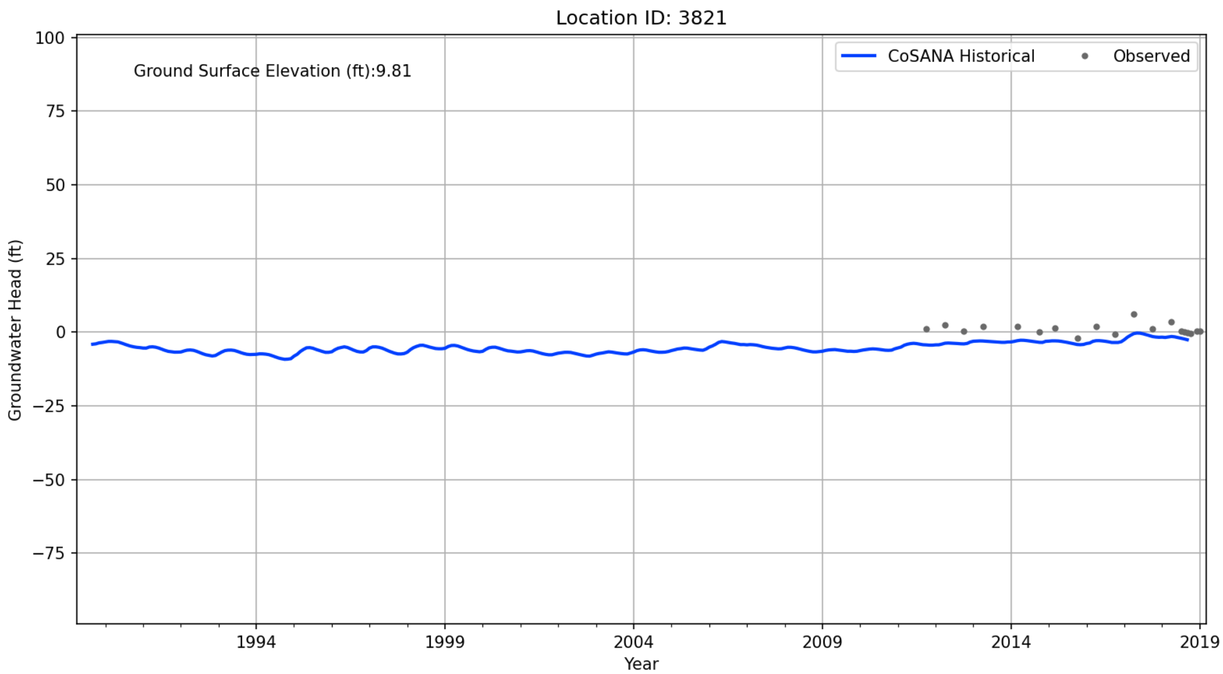
Location ID: 3335
Ground Surface Elevation (ft):47.73
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



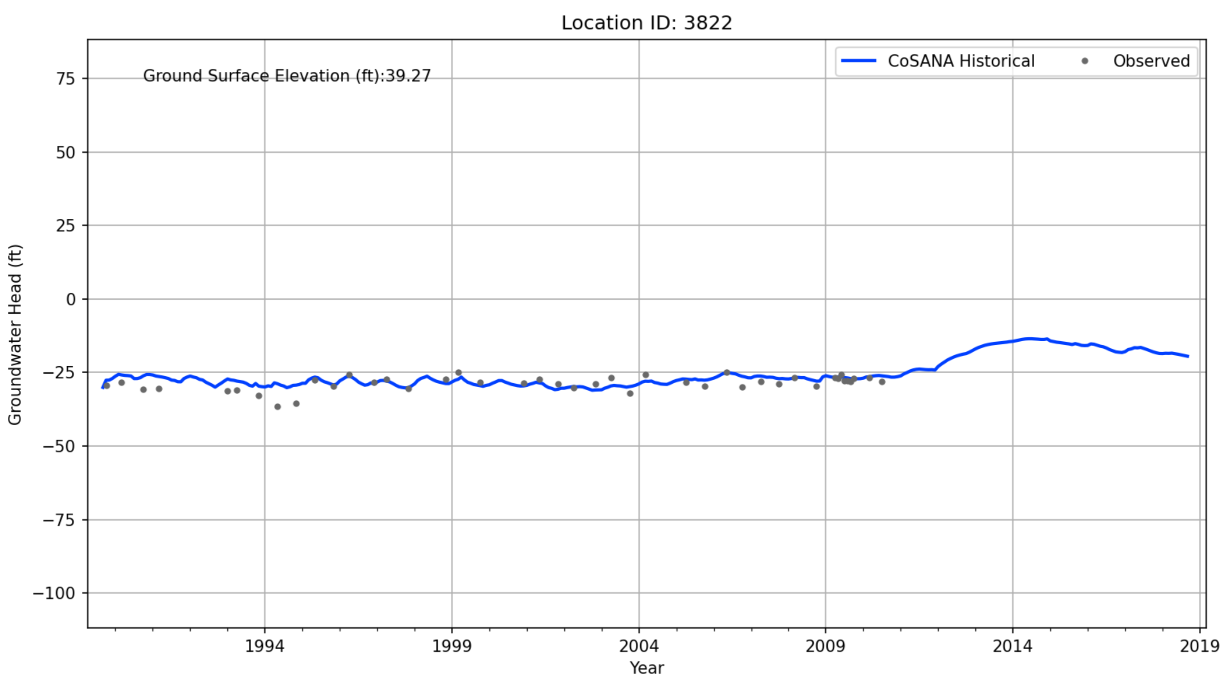
Location ID: 3340
Ground Surface Elevation (ft):56.37
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019


Location ID: 3701
Ground Surface Elevation (ft):29.84
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

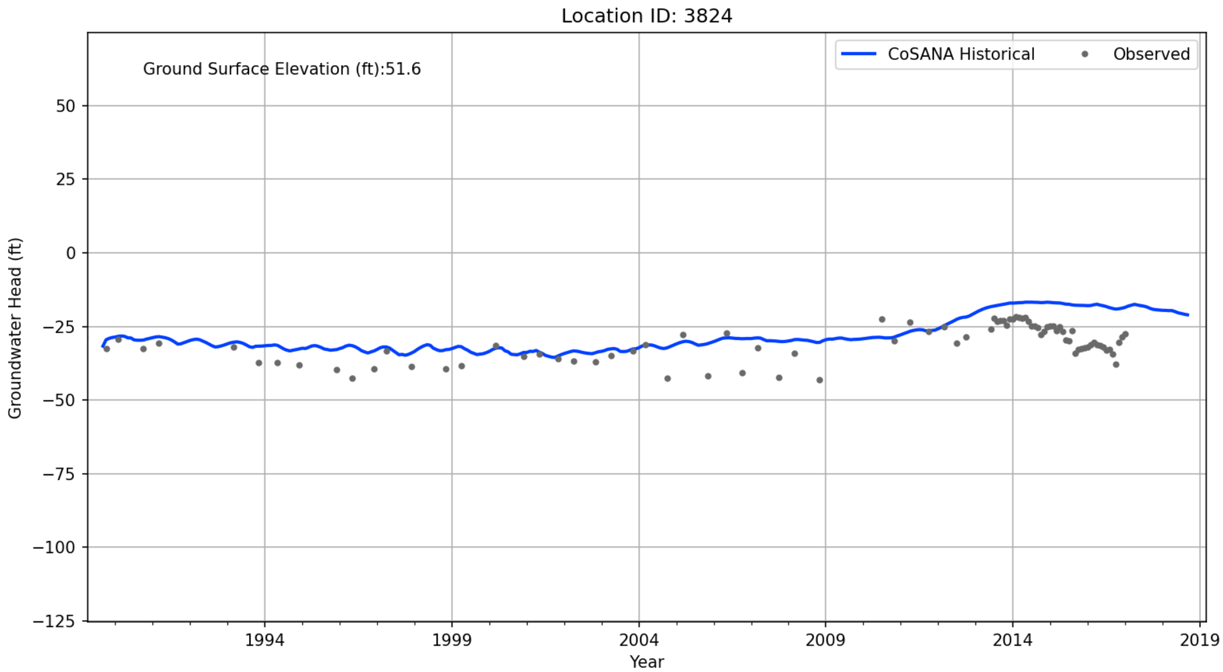

Location ID: 3804
Ground Surface Elevation (ft):21.57
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

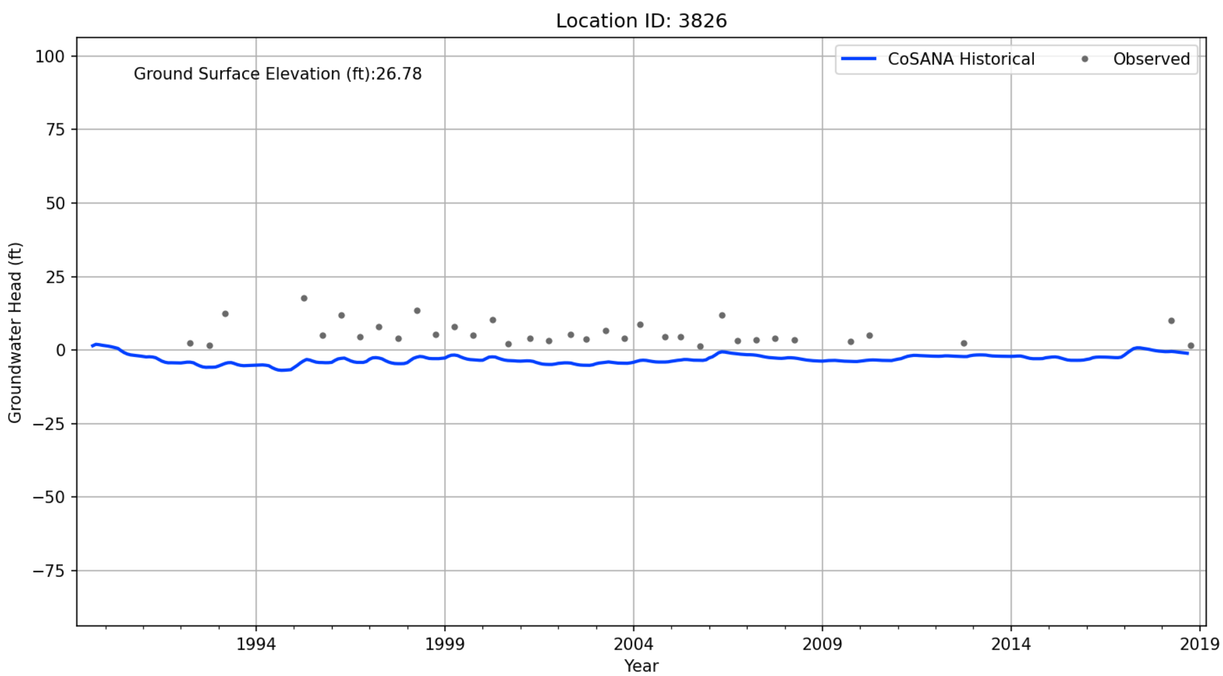


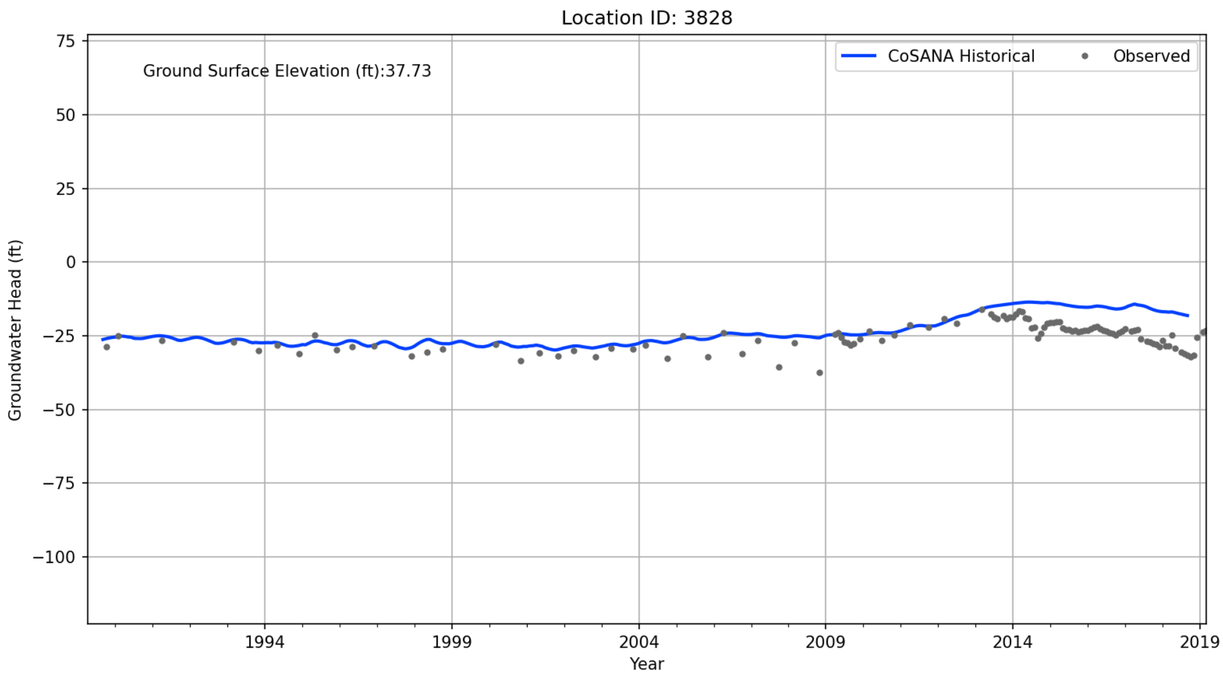
Location ID: 3821
Ground Surface Elevation (ft):9.81
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

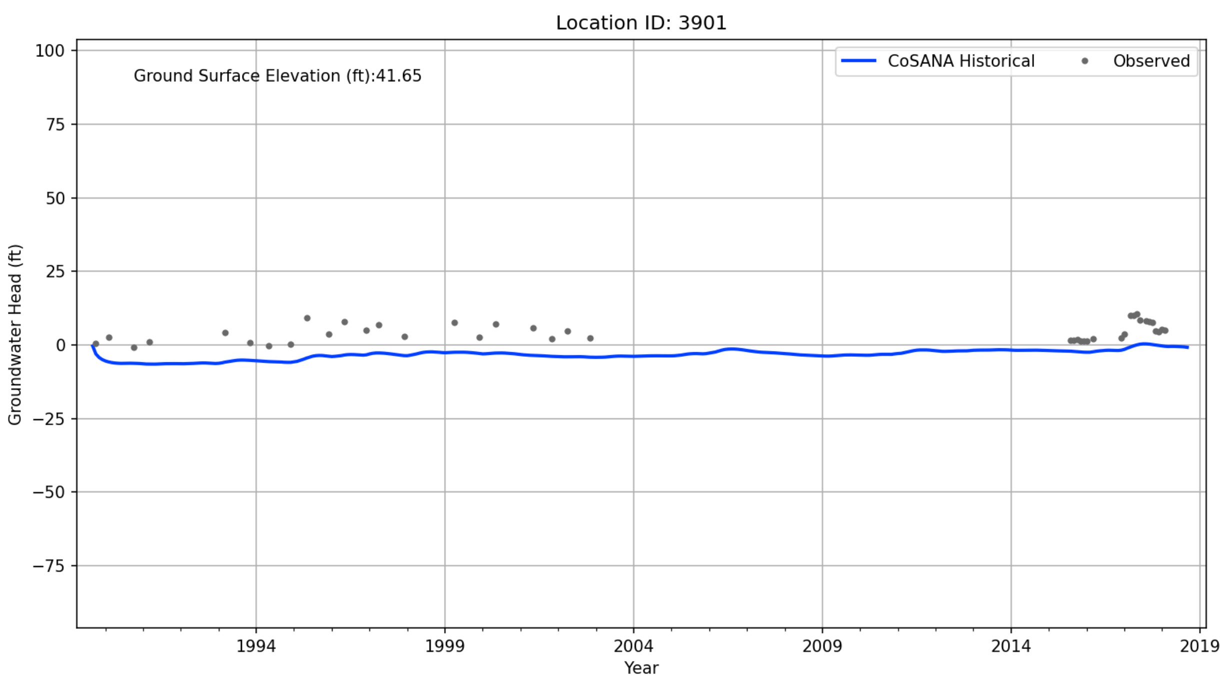


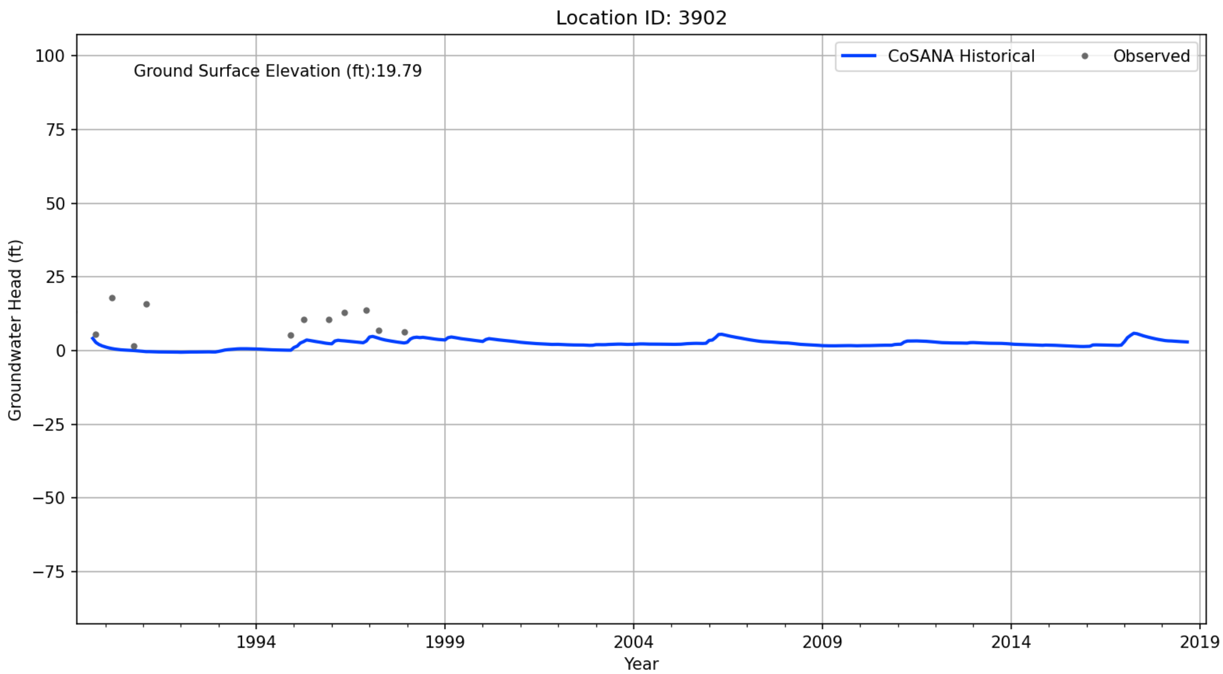
Location ID: 3822
Ground Surface Elevation (ft):39.27
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

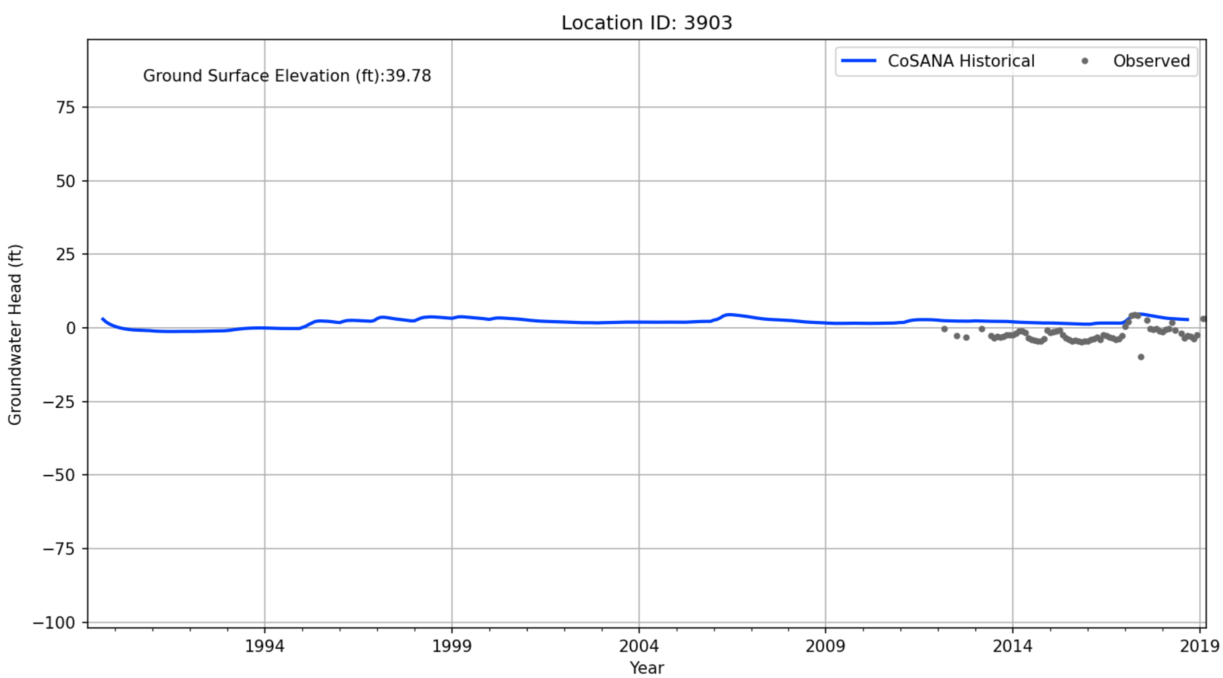

Location ID: 3824
Ground Surface Elevation (ft):51.6
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

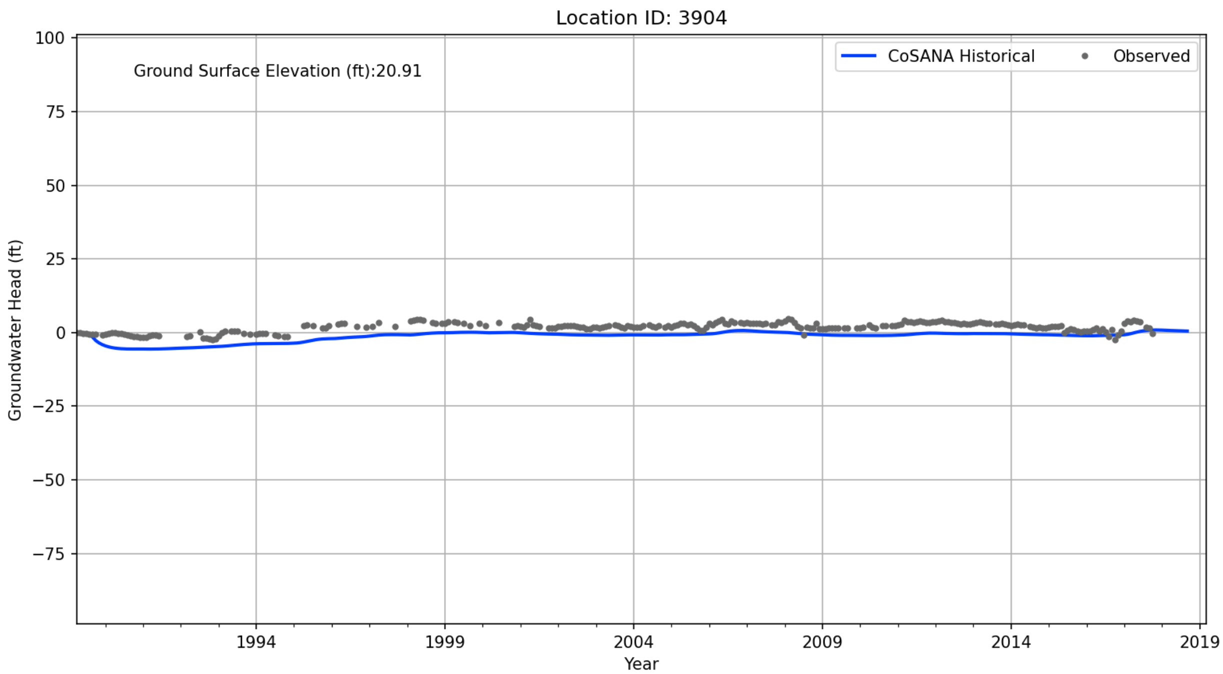

Location ID: 3826
Ground Surface Elevation (ft):26.78
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

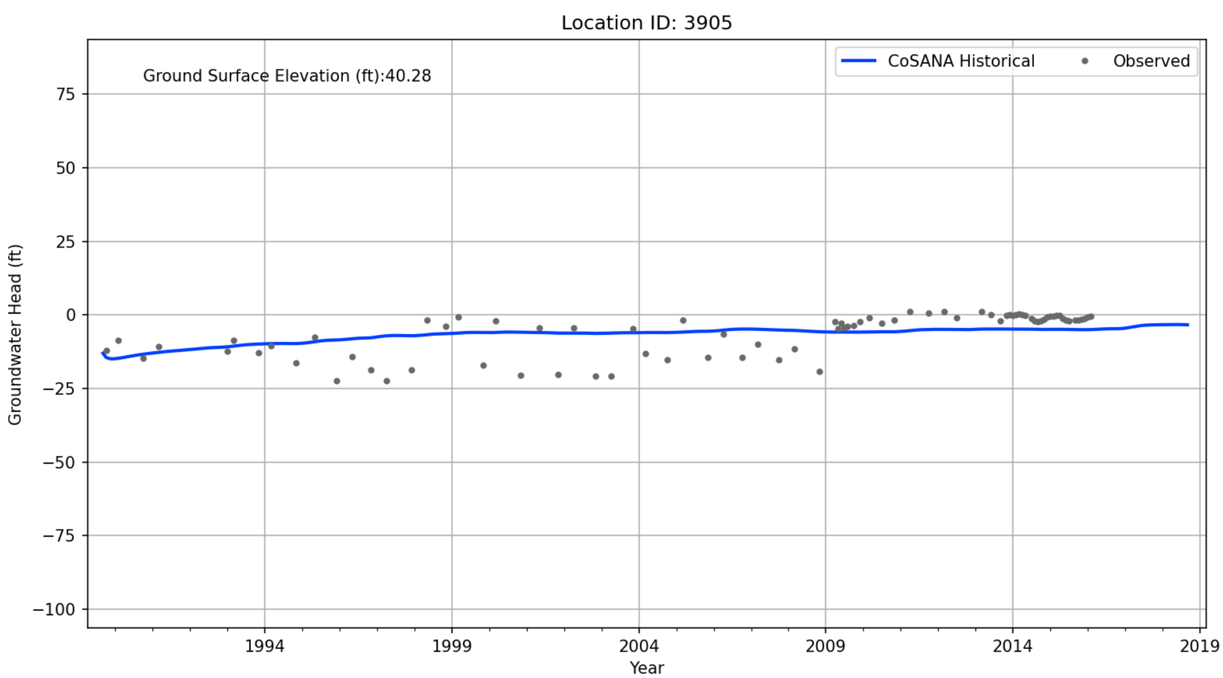

Location ID: 3828
Ground Surface Elevation (ft):37.73
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

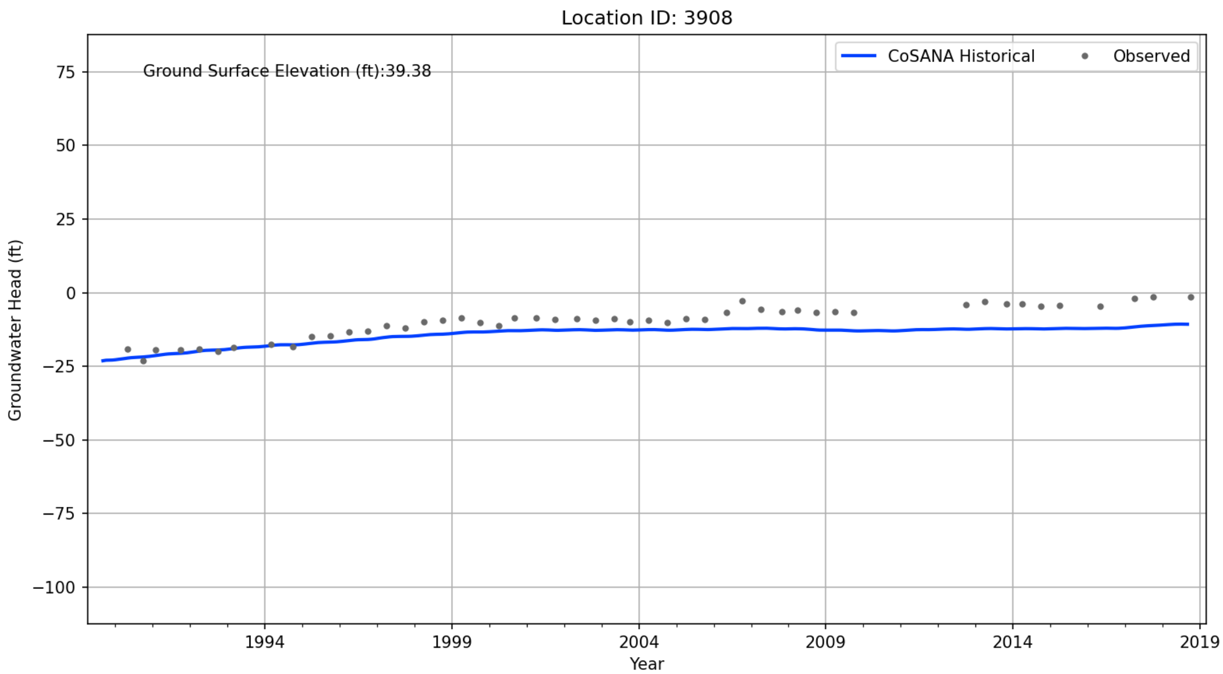

Location ID: 3901
Ground Surface Elevation (ft):41.65
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

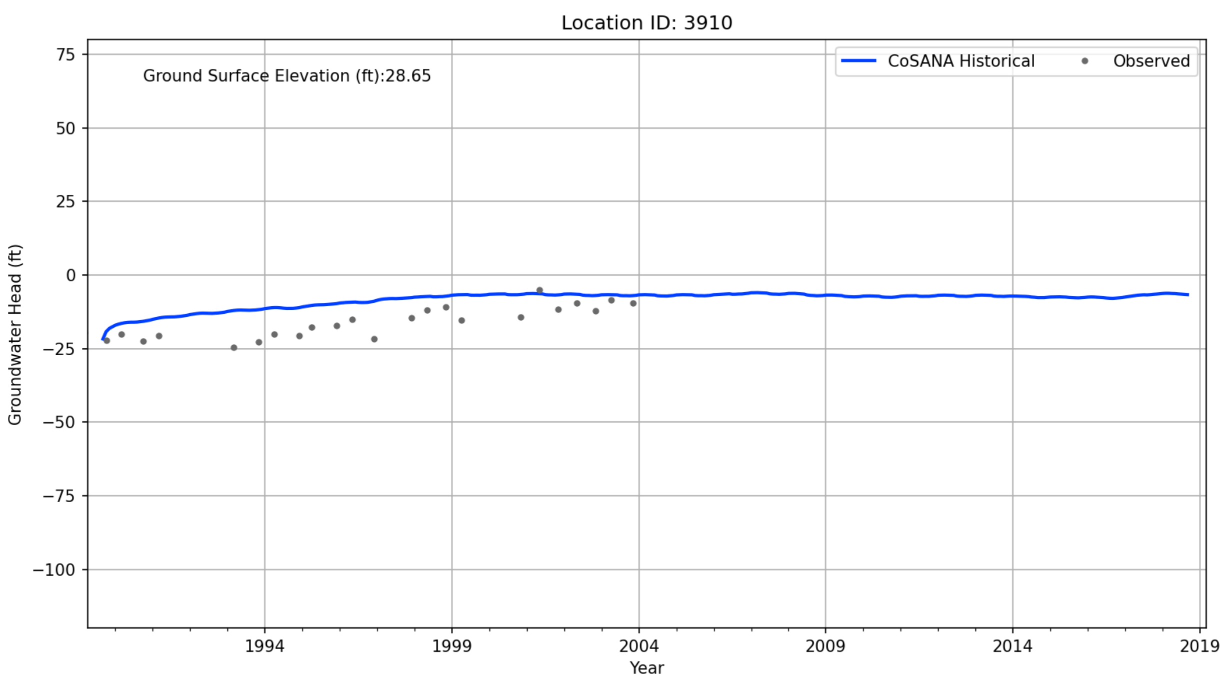

Location ID: 3902
Ground Surface Elevation (ft):19.79
CoSANA Historical
Observed
Groundwater Head (ft)
Year

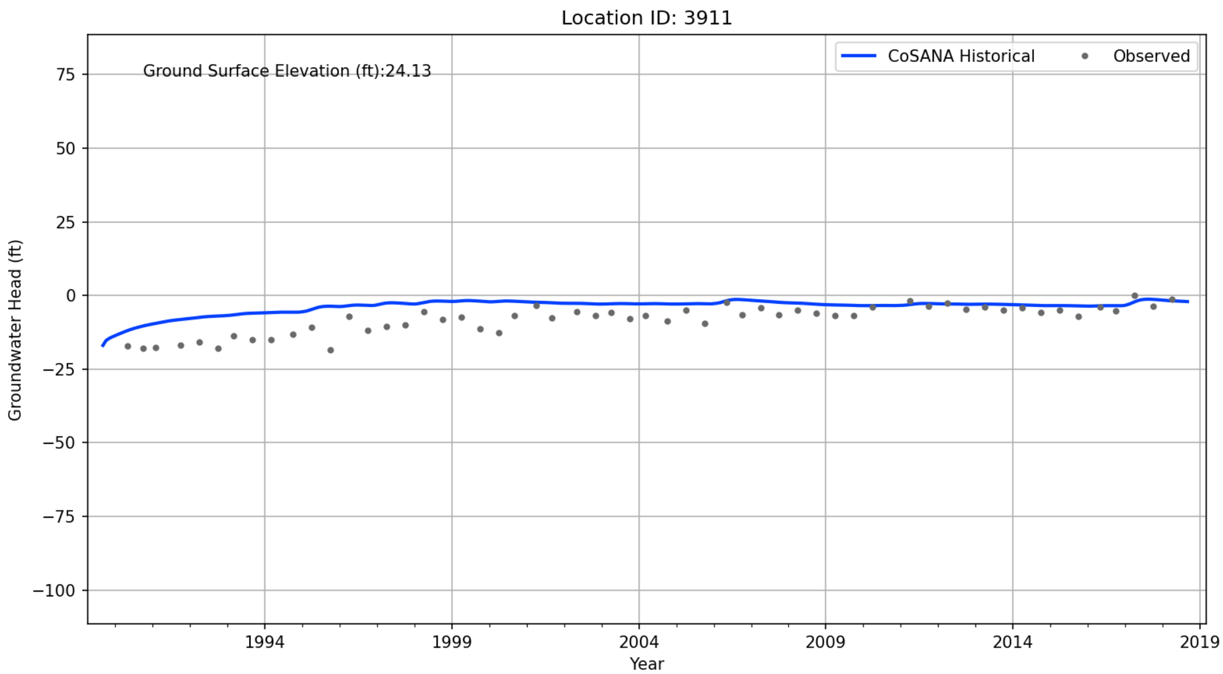

Location ID: 3903
Ground Surface Elevation (ft):39.78
CoSANA Historical
Observed
Groundwater Head (ft)
Year


Location ID: 3904
Ground Surface Elevation (ft):20.91
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

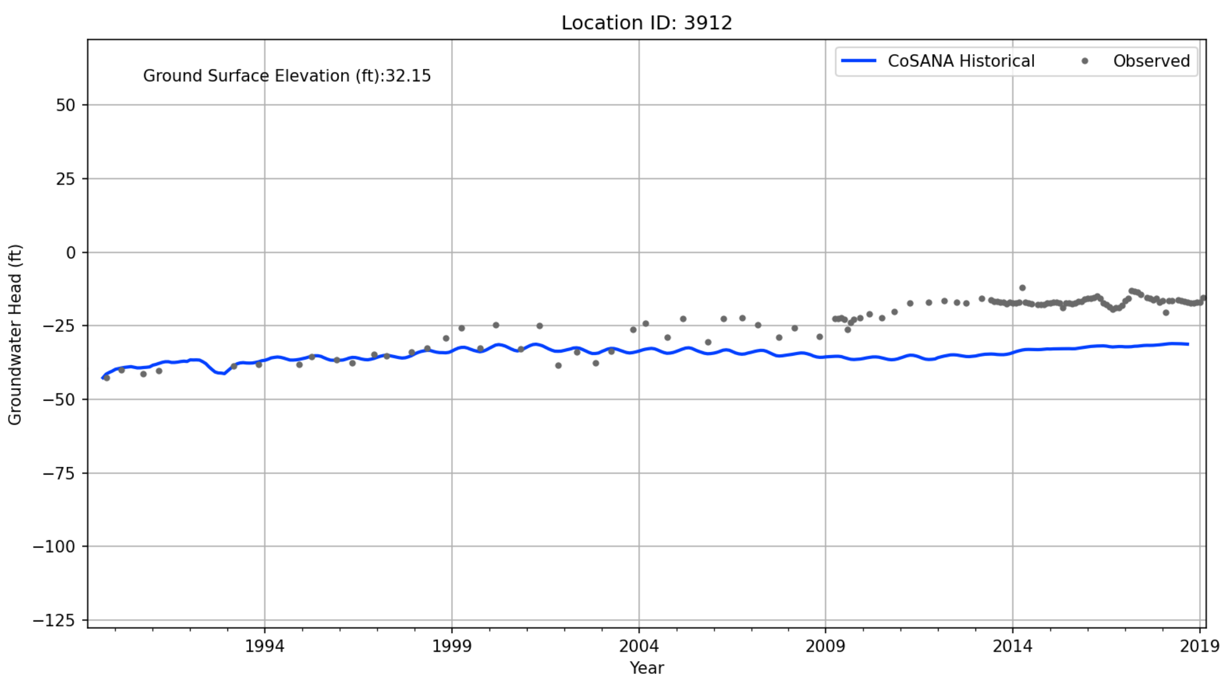

Location ID: 3905
Ground Surface Elevation (ft):40.28
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 3908
Ground Surface Elevation (ft):39.38
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

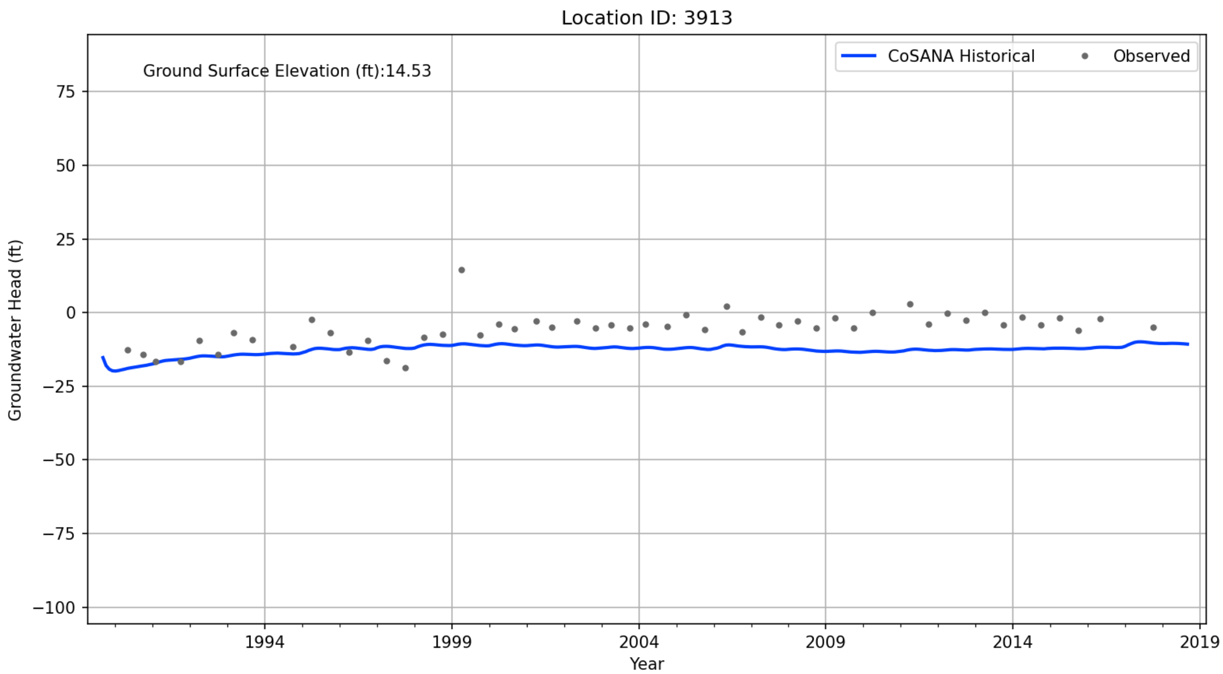

Location ID: 3910
Ground Surface Elevation (ft):28.65
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

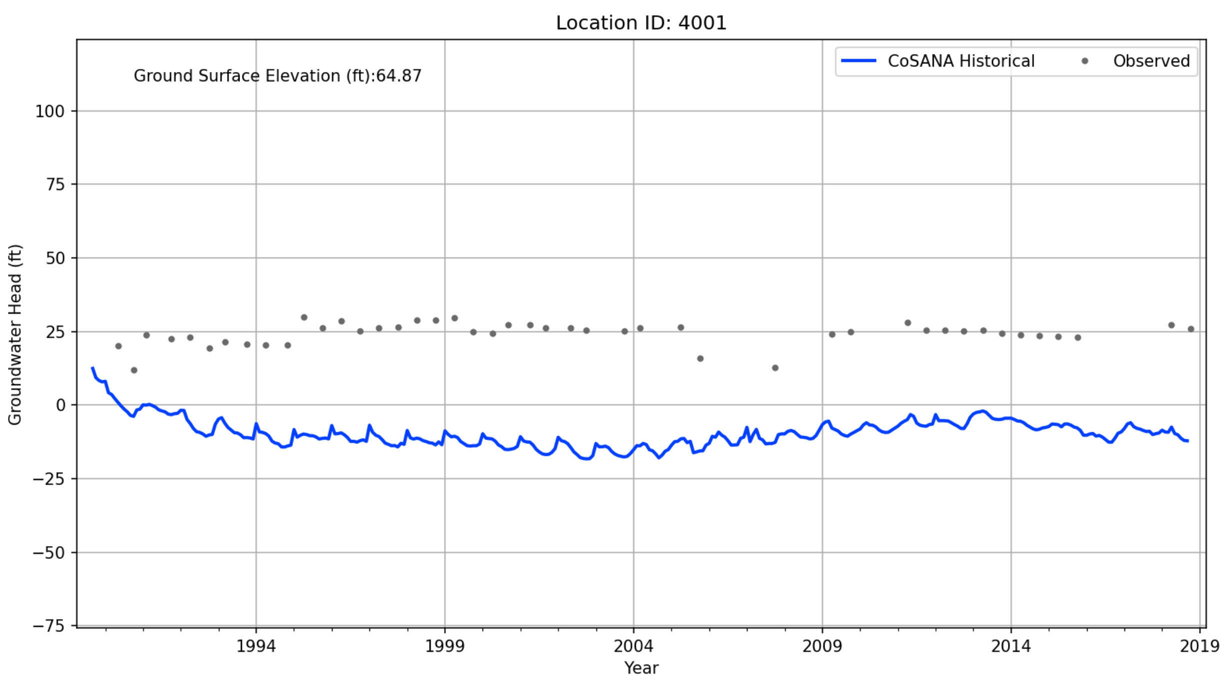


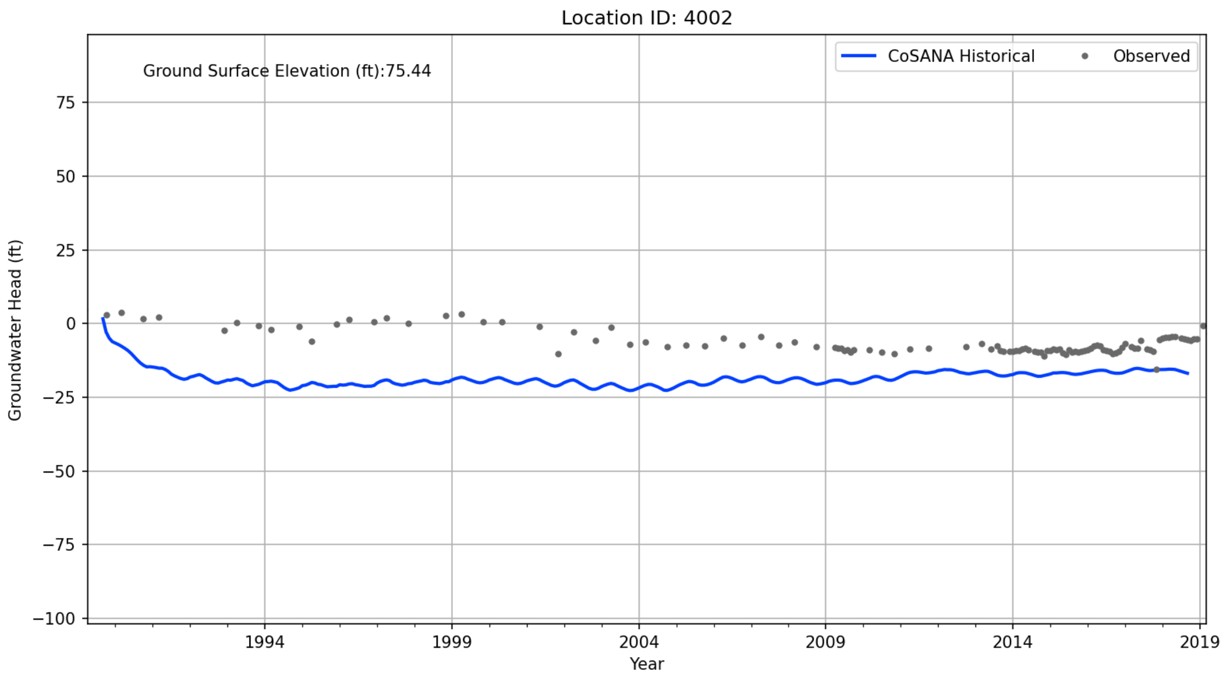
Location ID: 3911
Ground Surface Elevation (ft):24.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

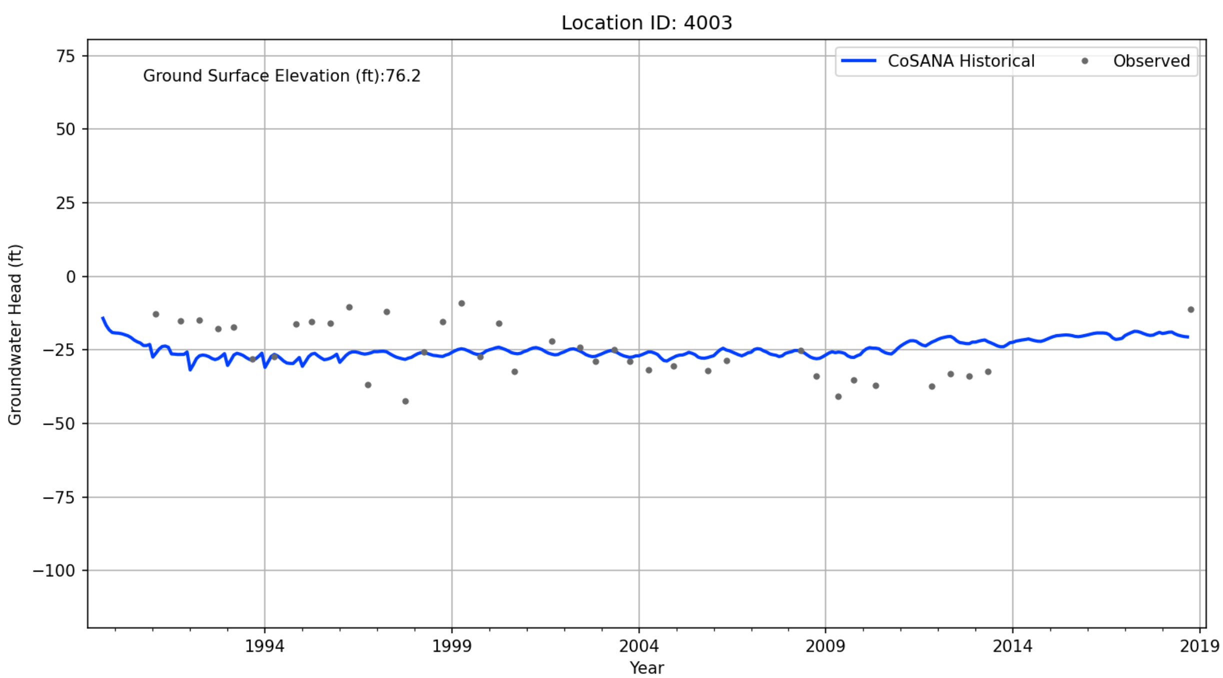


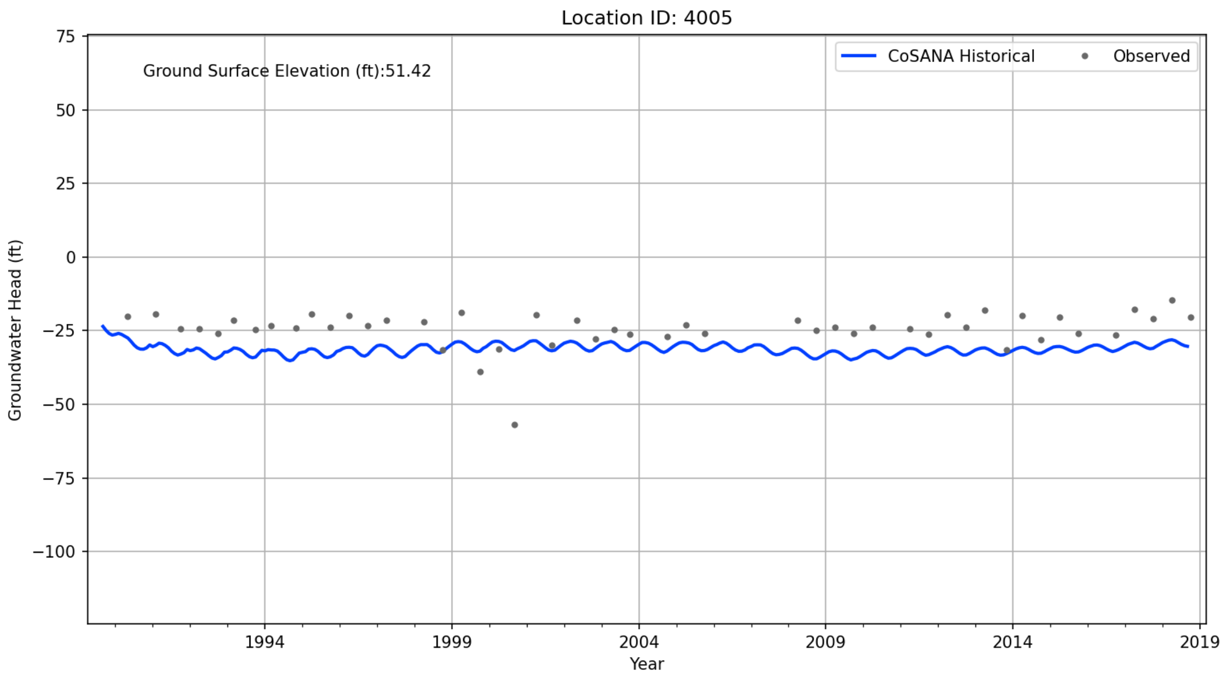
Location ID: 3912
Ground Surface Elevation (ft):32.15
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

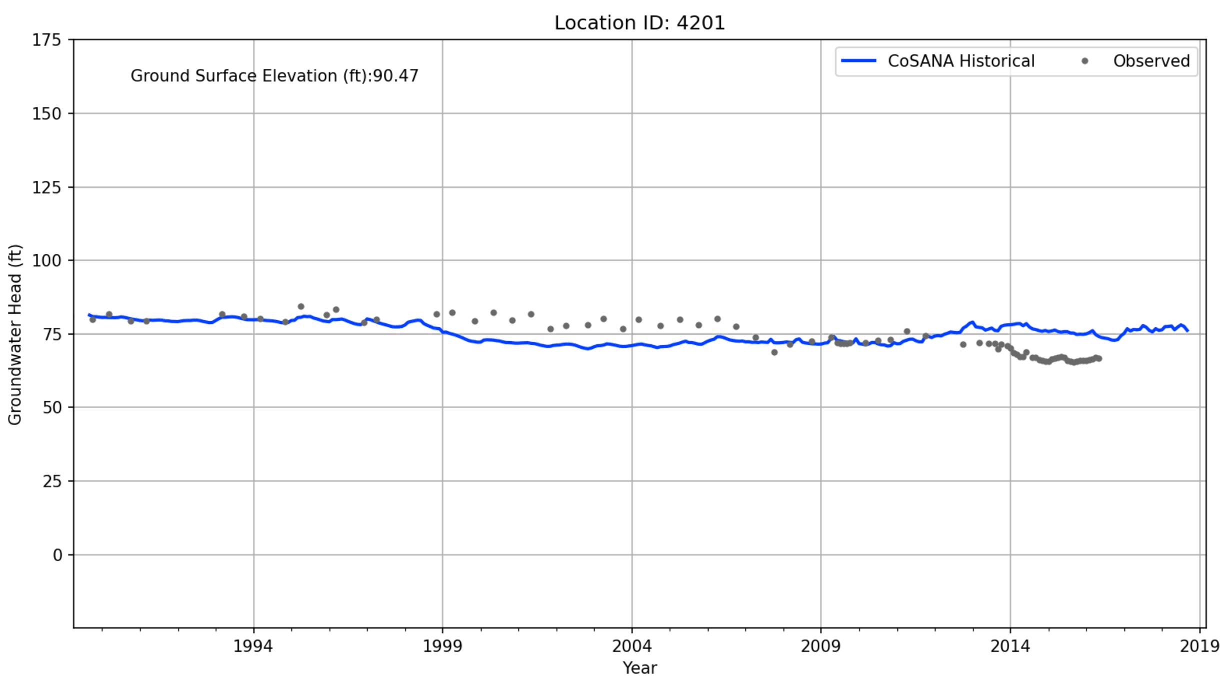

Location ID: 3913
Ground Surface Elevation (ft):14.53
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

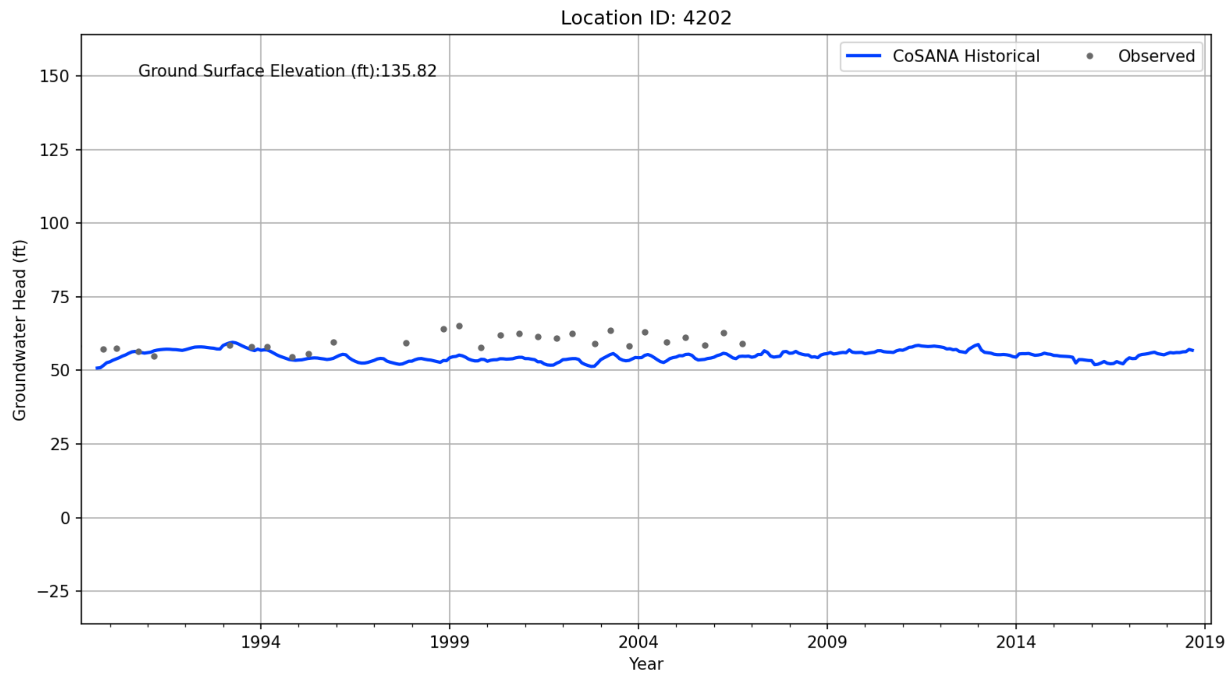

Location ID: 4001
Ground Surface Elevation (ft):64.87
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 4002
Ground Surface Elevation (ft):75.44
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

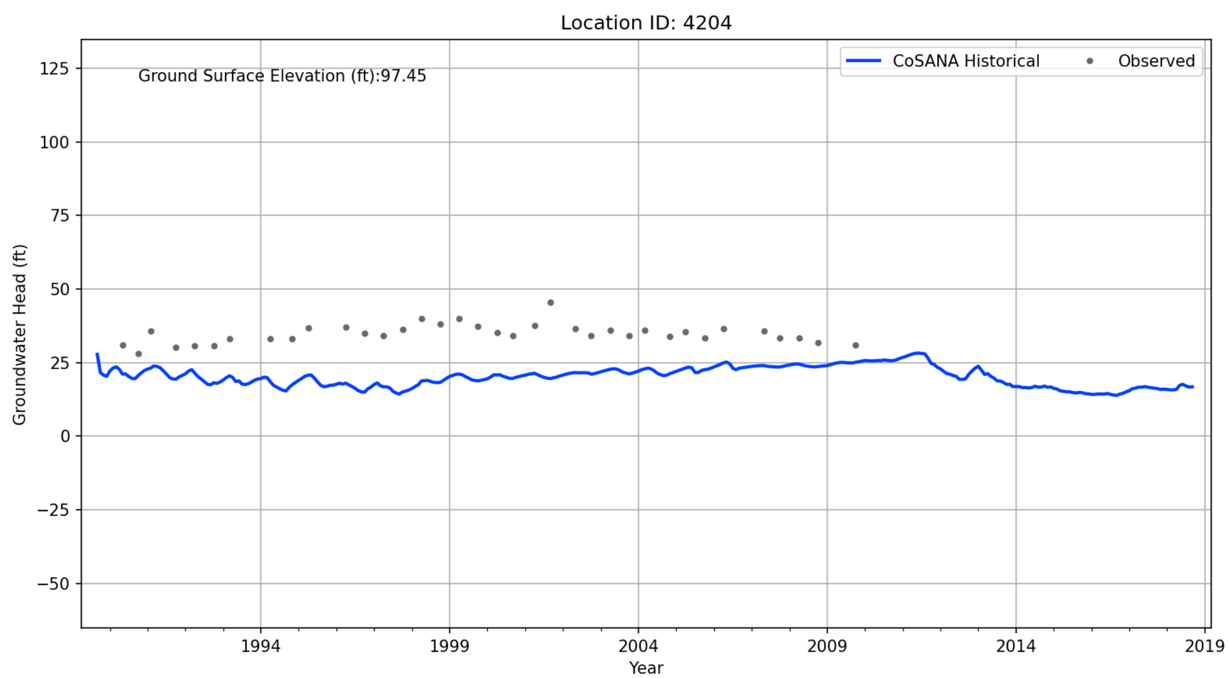

Location ID: 4003
Ground Surface Elevation (ft):76.2
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 4005
Ground Surface Elevation (ft):51.42
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

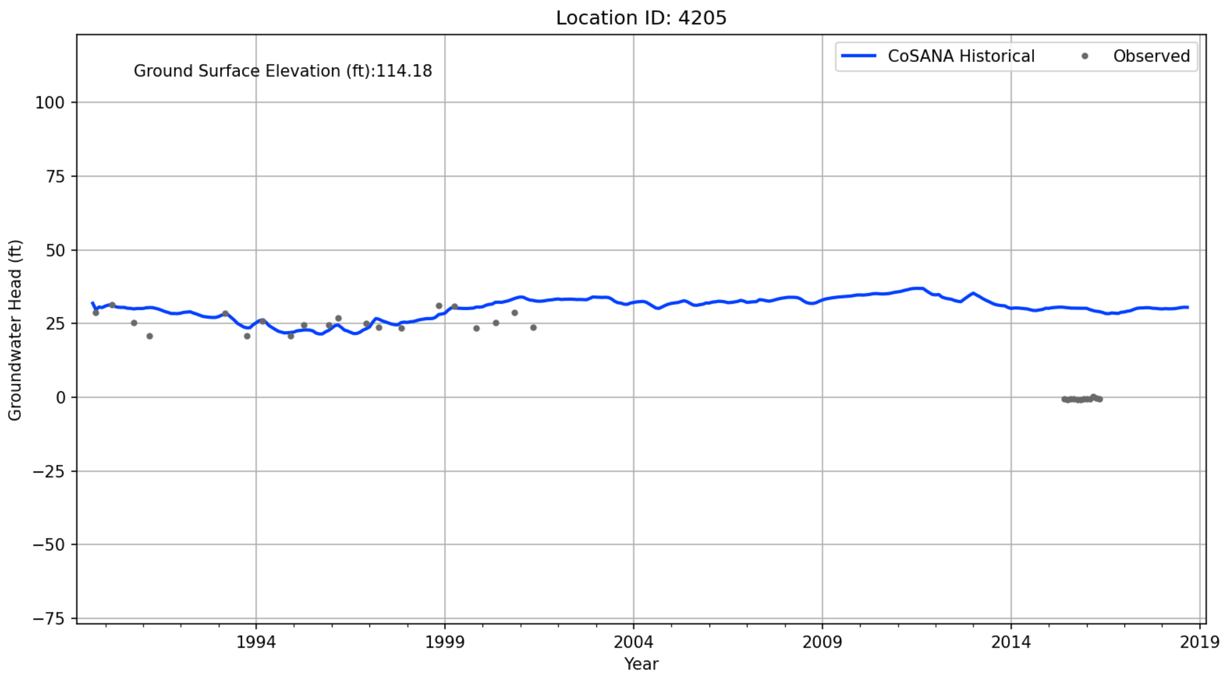

Location ID: 4201
Ground Surface Elevation (ft):90.47
CoSANA Historical
Observed
Groundwater Head (ft)
175
150
125
100
75
50
25
0
1994
1999
2004
2009
2014
2019
Year



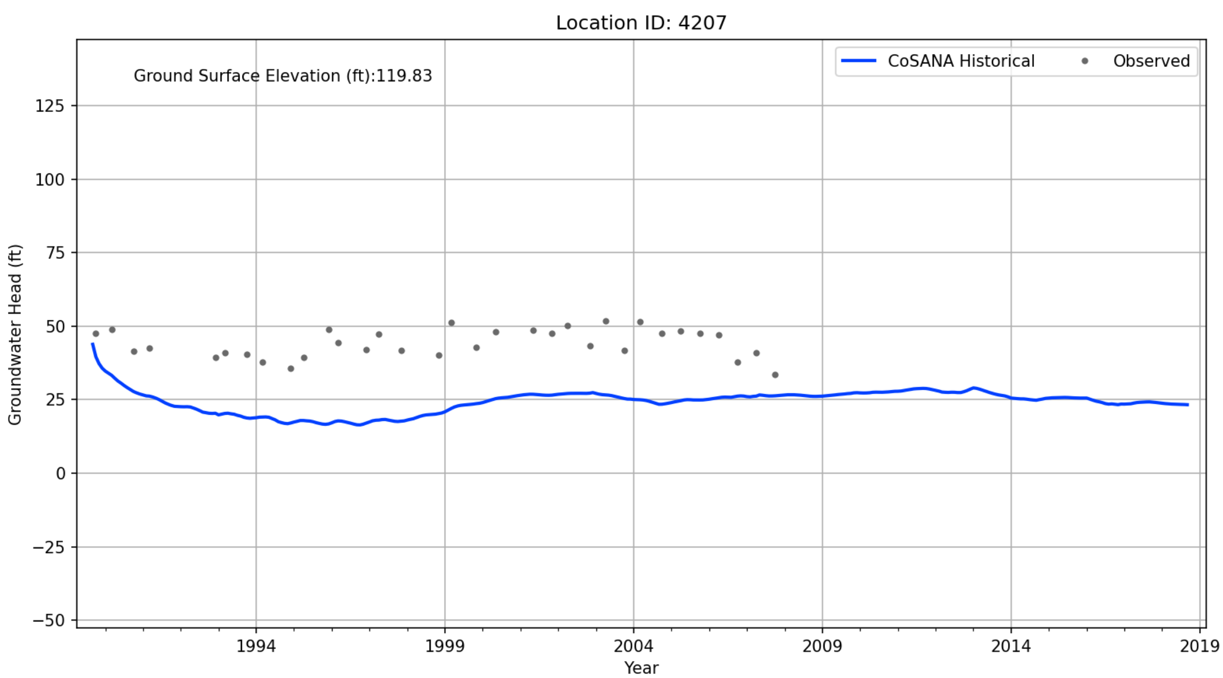
Location ID: 4202
CoSANA Historical
Observed
Ground Surface Elevation (ft):135.82
Groundwater Head (ft)
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019
Year



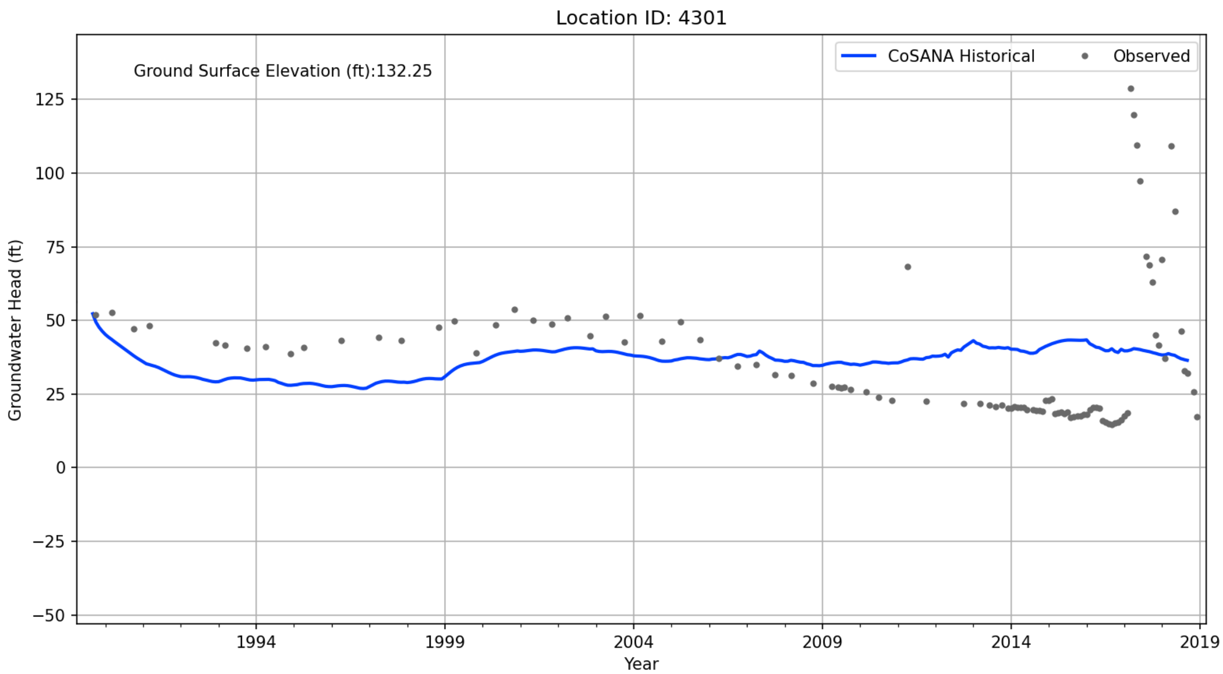
Location ID: 4204
CoSANA Historical
Observed
Ground Surface Elevation (ft):97.45
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

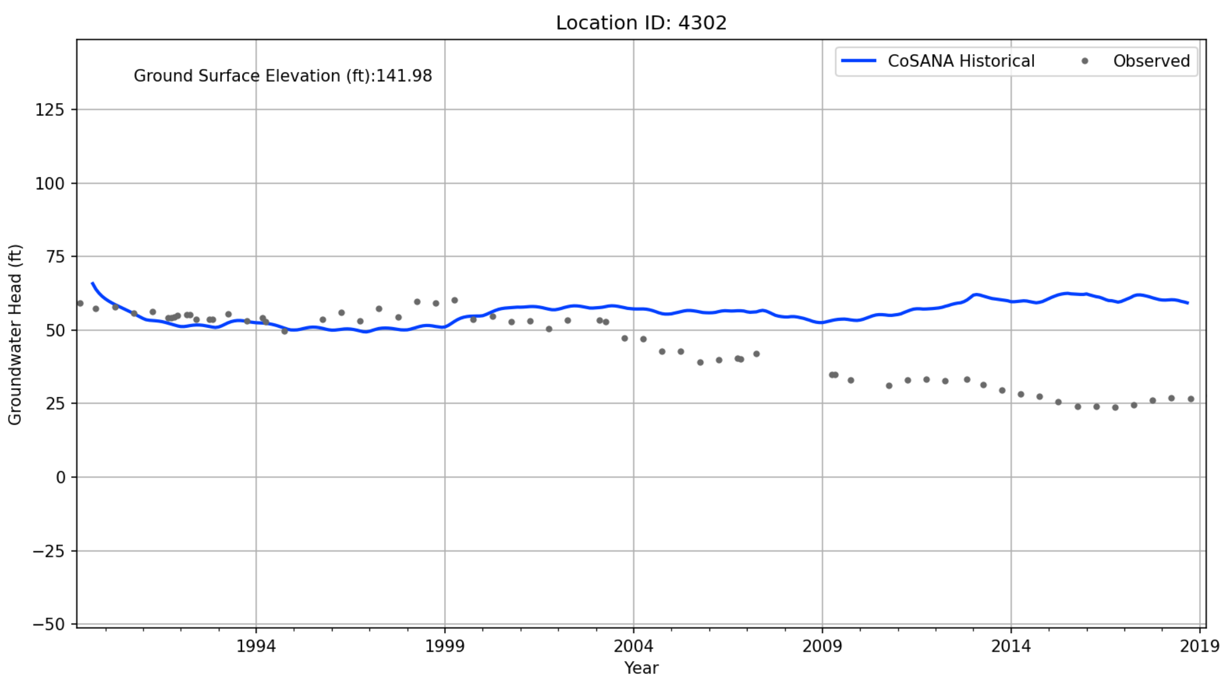


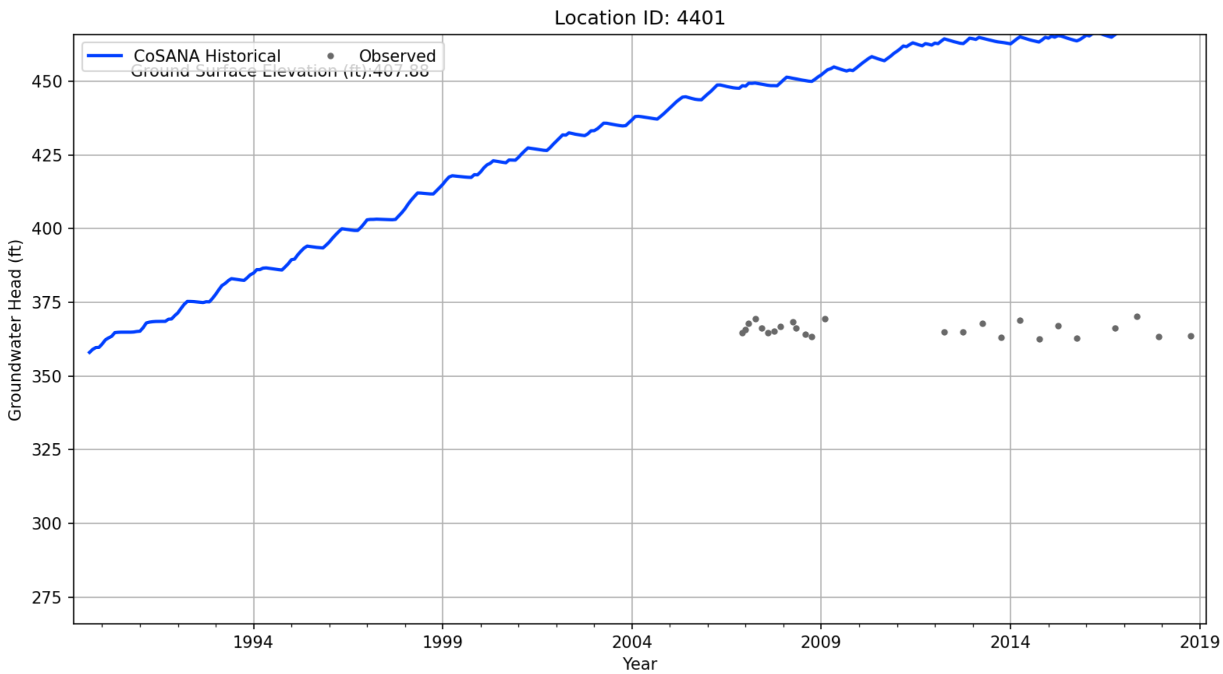
Location ID: 4205
Ground Surface Elevation (ft):114.18
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

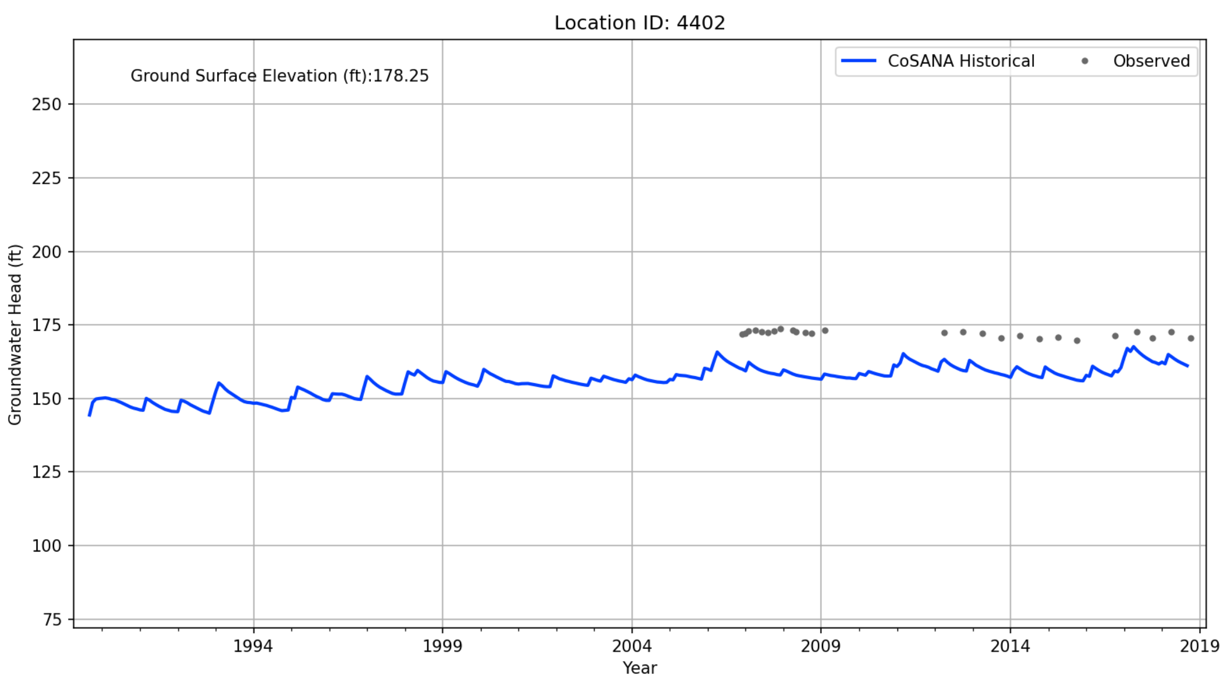


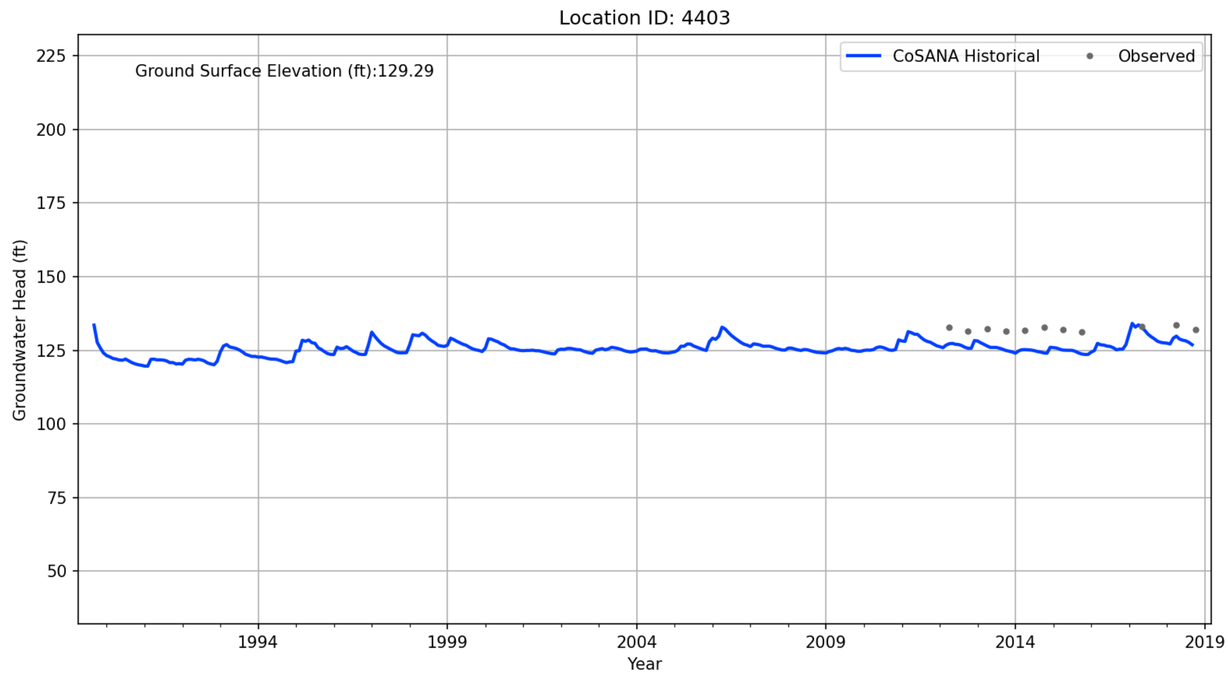
Location ID: 4207
Ground Surface Elevation (ft):119.83
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019


Location ID: 4301
Ground Surface Elevation (ft):132.25
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

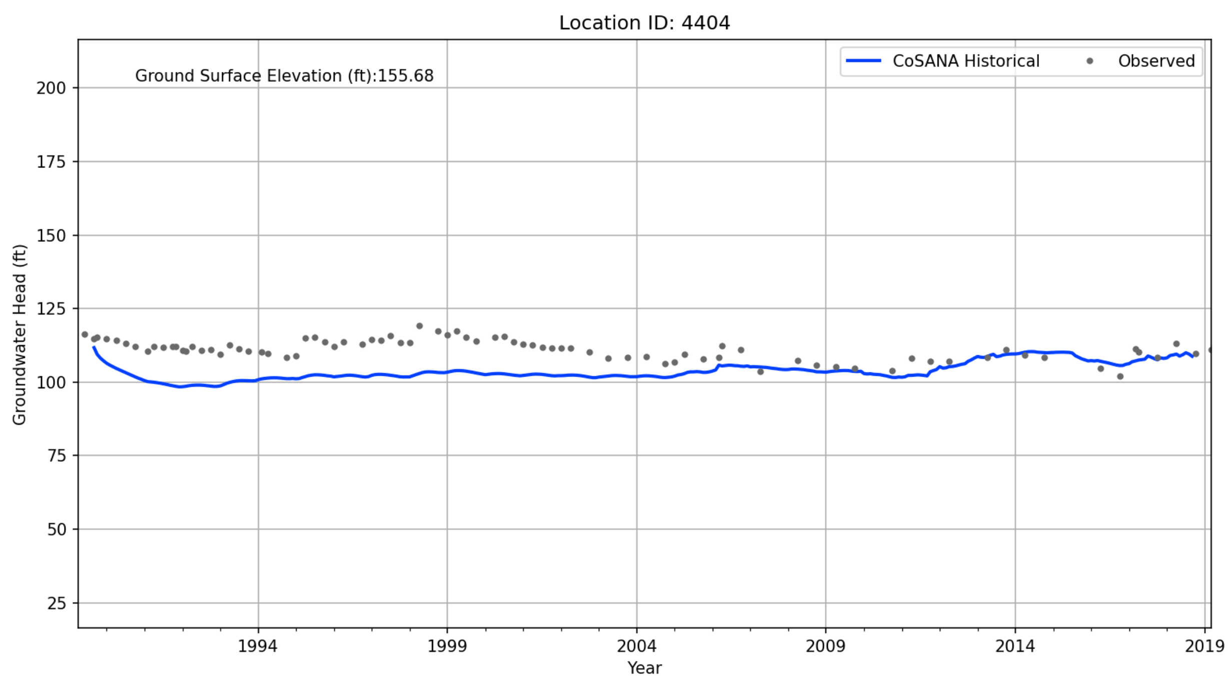

Location ID: 4302
Ground Surface Elevation (ft):141.98
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019


Location ID: 4401
CoSANA Historical
Observed
Ground Surface Elevation (ft):407.88
Groundwater Head (ft)
450
425
400
375
350
325
300
275
1994
1999
2004
2009
2014
2019
Year

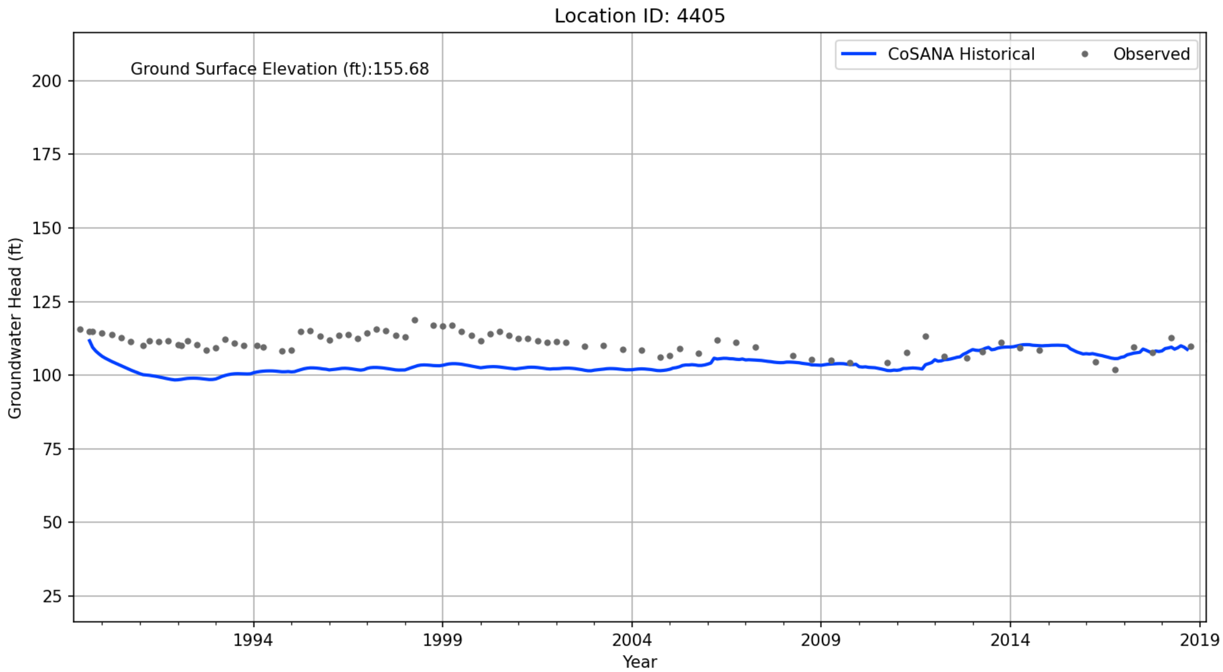

Location ID: 4402
Ground Surface Elevation (ft):178.25
CoSANA Historical
Observed
Groundwater Head (ft)
250
225
200
175
150
125
100
75
1994
1999
2004
2009
2014
2019
Year

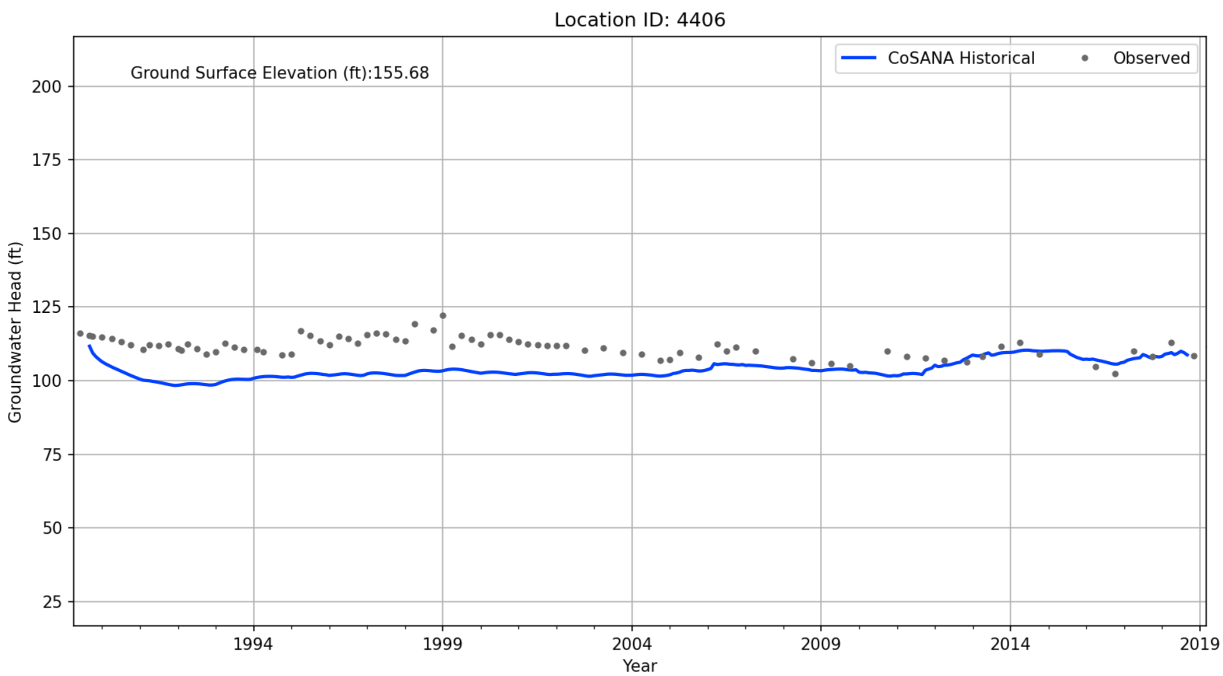


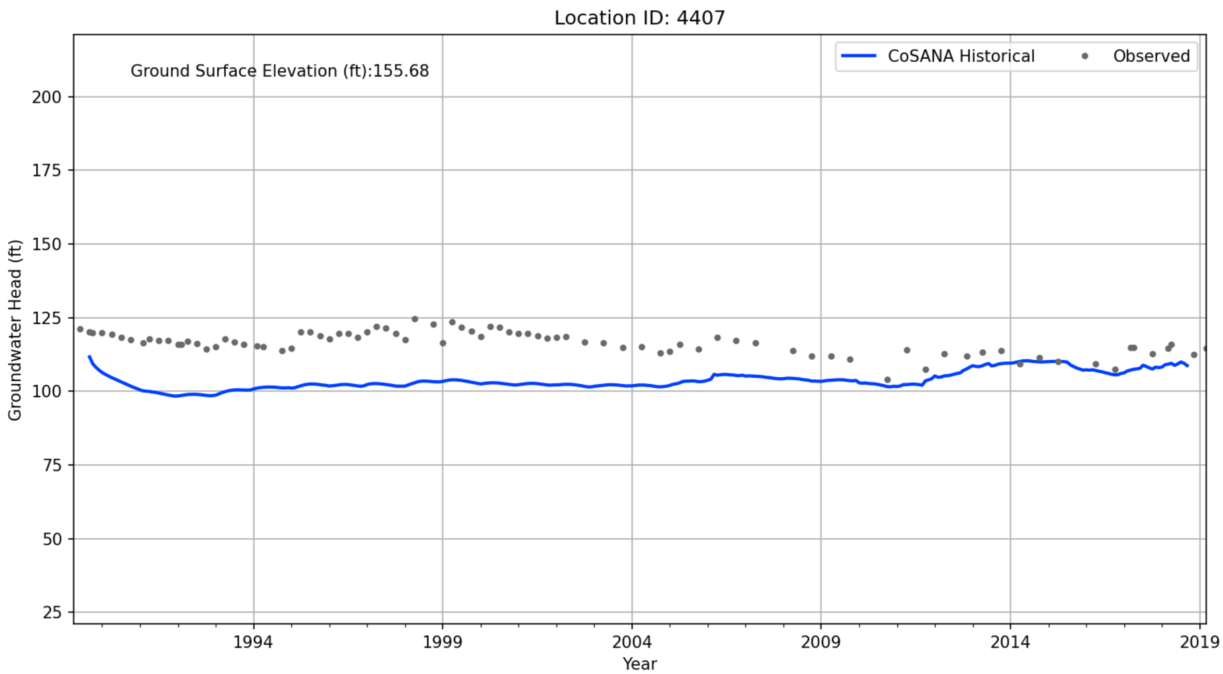
Location ID: 4403
Ground Surface Elevation (ft):129.29
CoSANA Historical
Observed
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

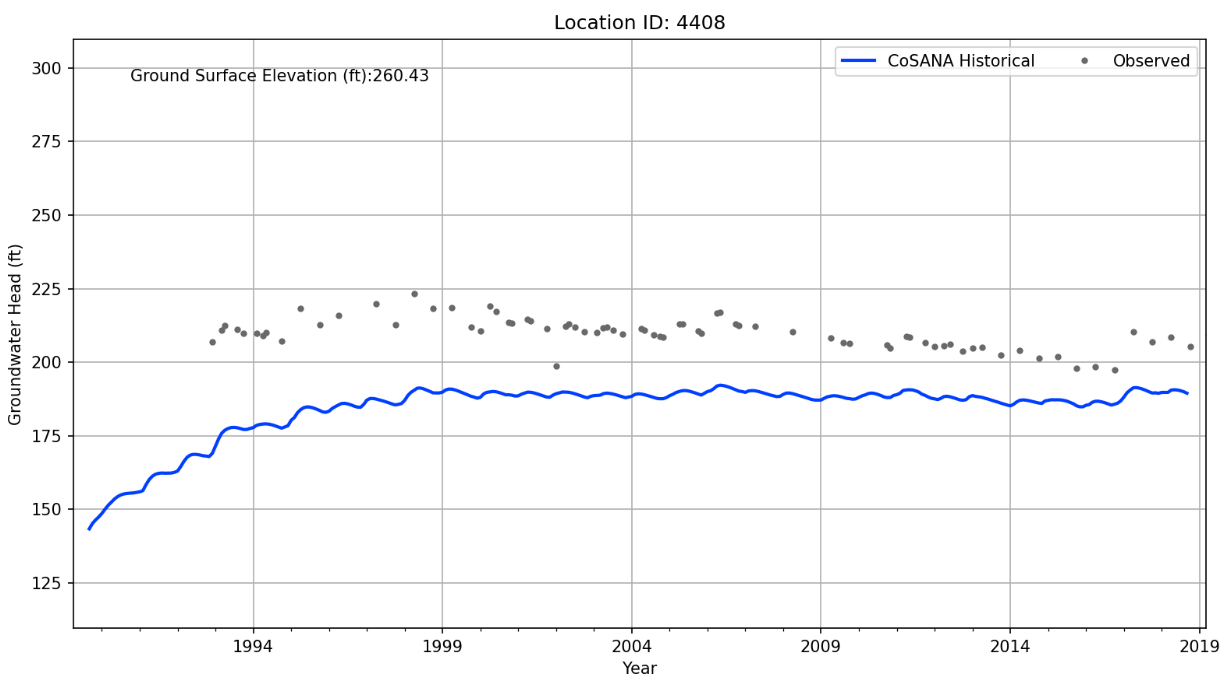


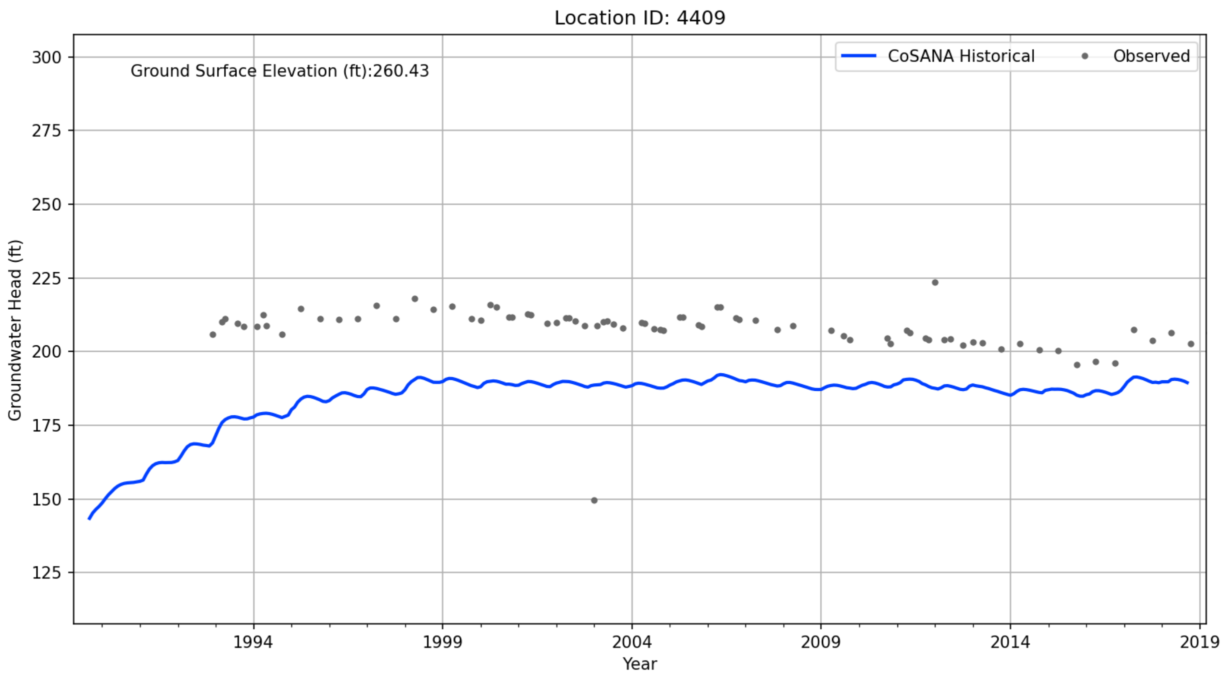
Location ID: 4404
Ground Surface Elevation (ft):155.68
CoSANA Historical
Observed
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year

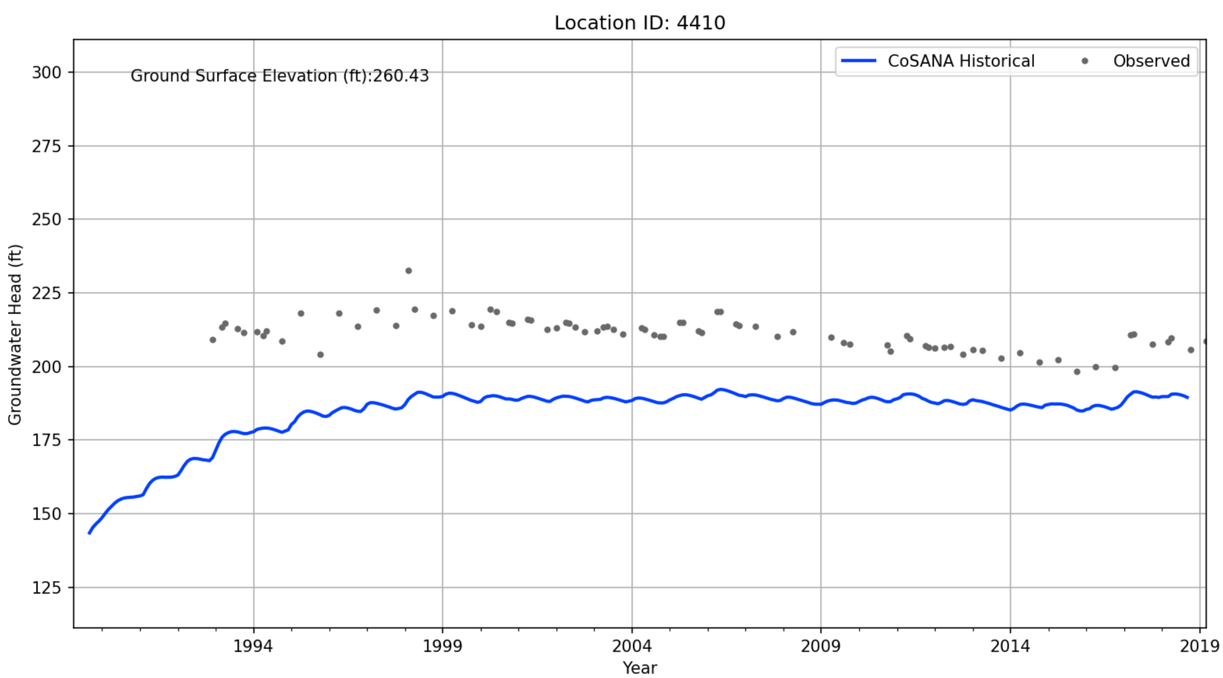

Location ID: 4405
Ground Surface Elevation (ft):155.68
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
50
75
100
125
150
175
200
1994
1999
2004
2009
2014
2019

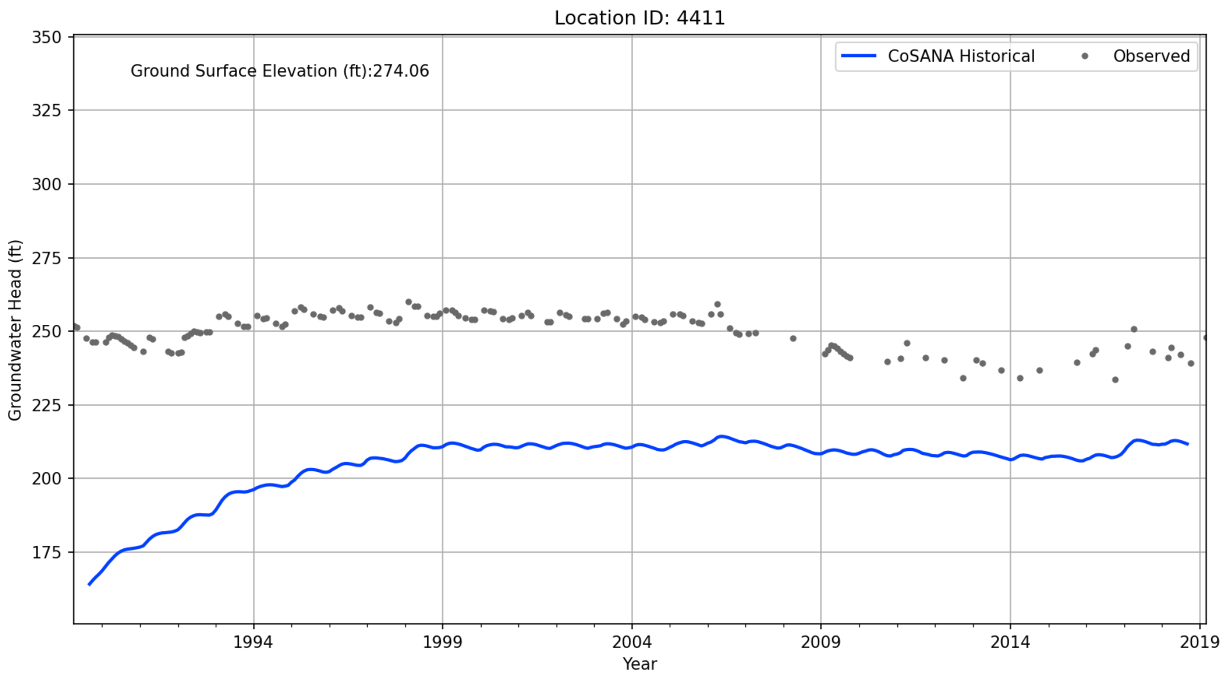

Location ID: 4406
Ground Surface Elevation (ft):155.68
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
50
75
100
125
150
175
200
1994
1999
2004
2009
2014
2019


Location ID: 4407
Ground Surface Elevation (ft):155.68
CoSANA Historical
Observed
Groundwater Head (ft)
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019
Year

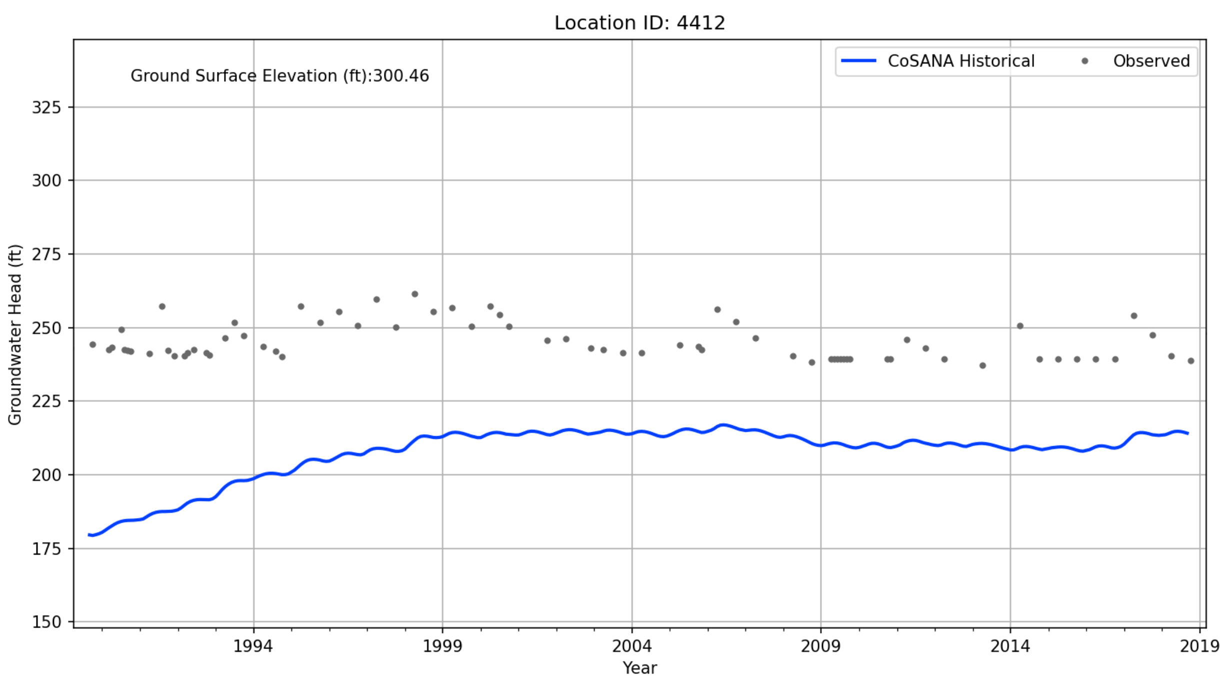

Location ID: 4408
Ground Surface Elevation (ft):260.43
CoSANA Historical
Observed
Groundwater Head (ft)
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019
Year


Location ID: 4409
CoSANA Historical
Observed
Ground Surface Elevation (ft):260.43
Groundwater Head (ft)
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019
Year

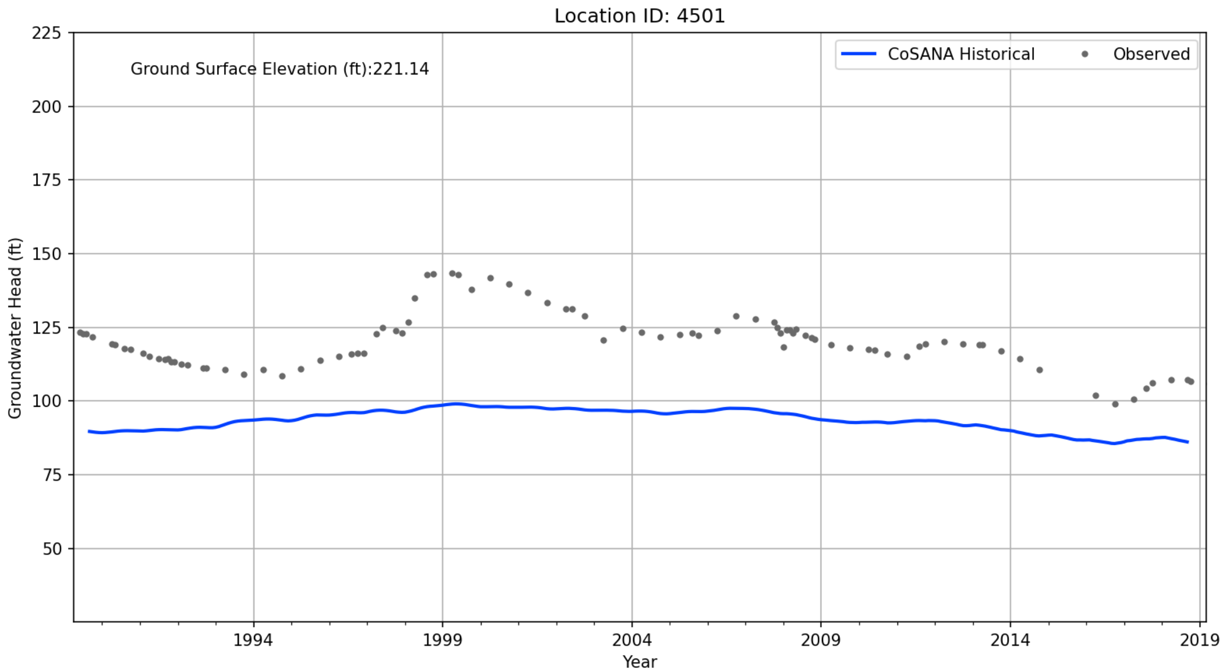

Location ID: 4410
CoSANA Historical
Observed
Ground Surface Elevation (ft):260.43
Groundwater Head (ft)
300
275
250
225
200
175
150
125
1994
1999
2004
2009
2014
2019
Year

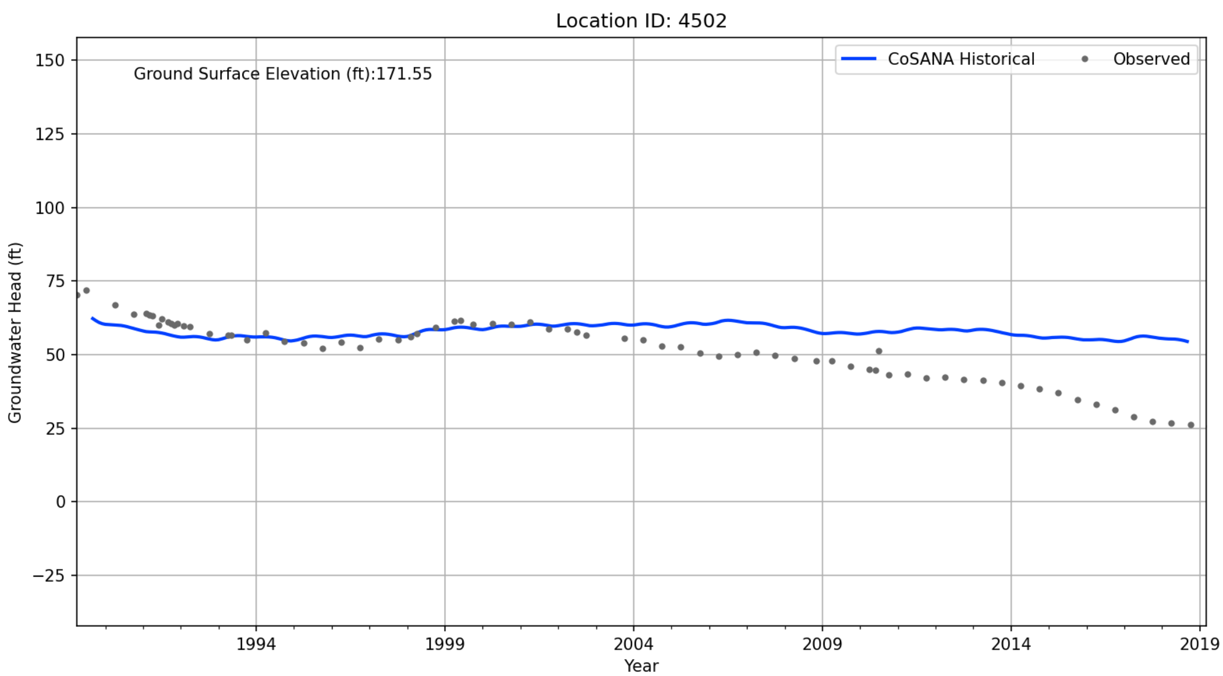


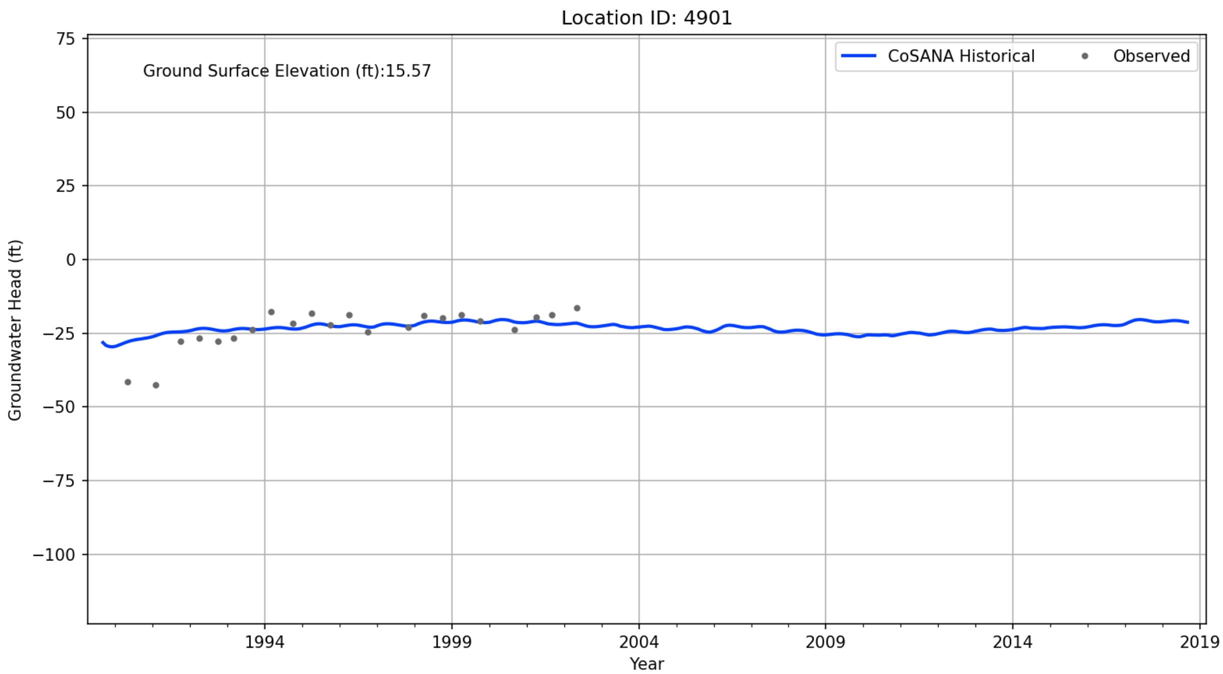
Location ID: 4411
Ground Surface Elevation (ft):274.06
CoSANA Historical
Observed
Groundwater Head (ft)
Year
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019

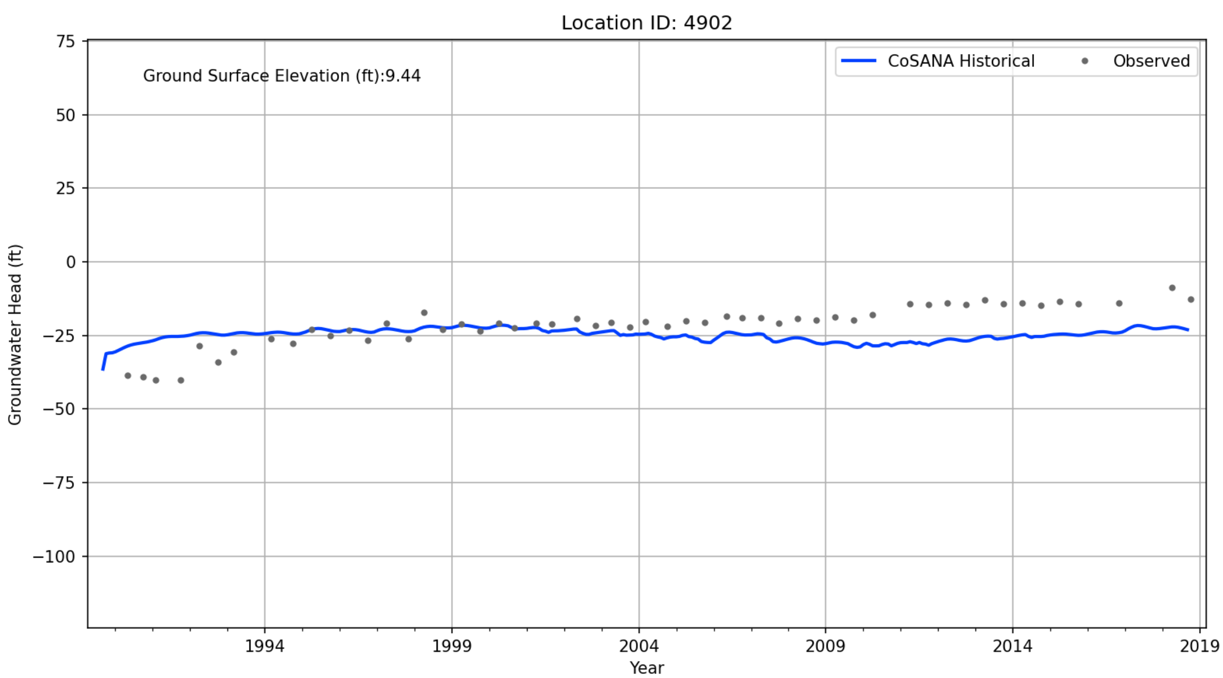


Location ID: 4412
Ground Surface Elevation (ft):300.46
CoSANA Historical
Observed
Groundwater Head (ft)
Year
325
300
275
250
225
200
175
150
1994
1999
2004
2009
2014
2019

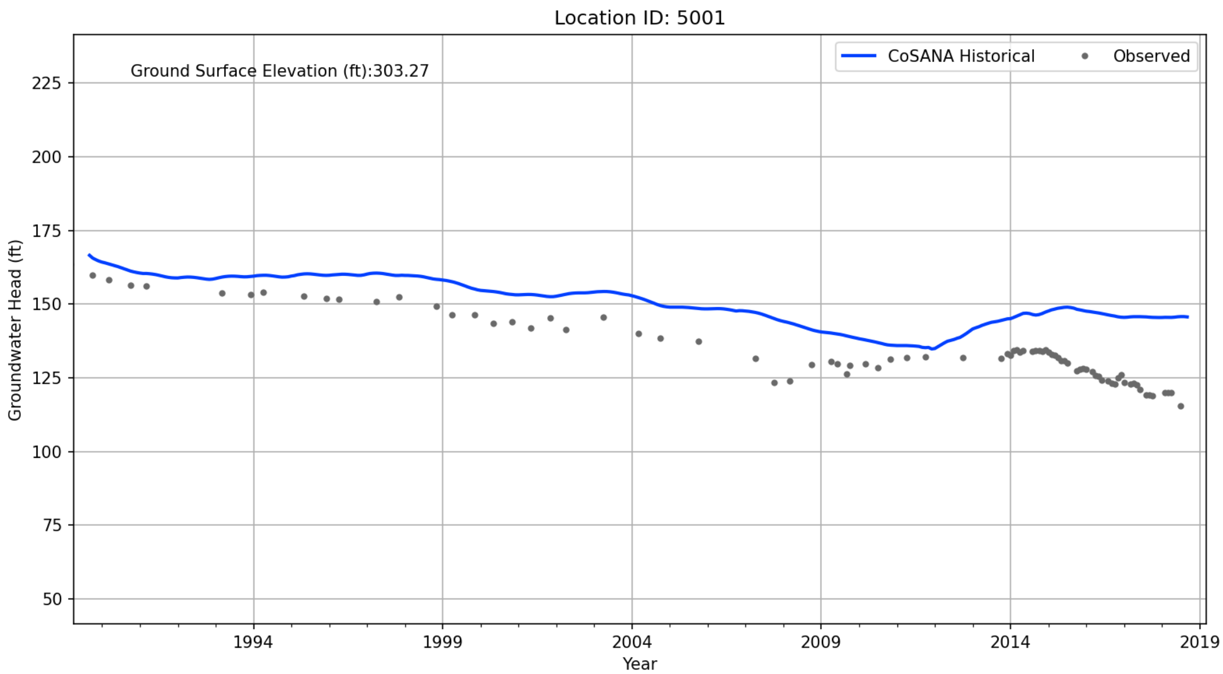

Location ID: 4501
Ground Surface Elevation (ft):221.14
CoSANA Historical
Observed
Groundwater Head (ft)
Year
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019


Location ID: 4502
Ground Surface Elevation (ft):171.55
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

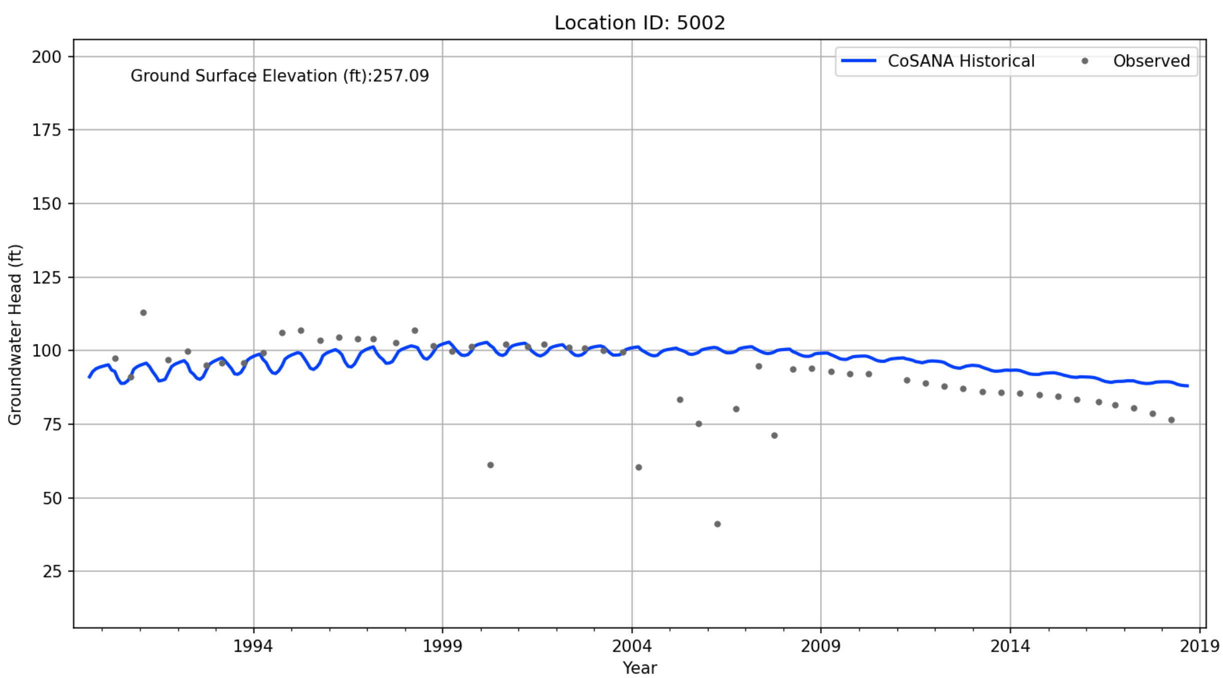

Location ID: 4901
Ground Surface Elevation (ft):15.57
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

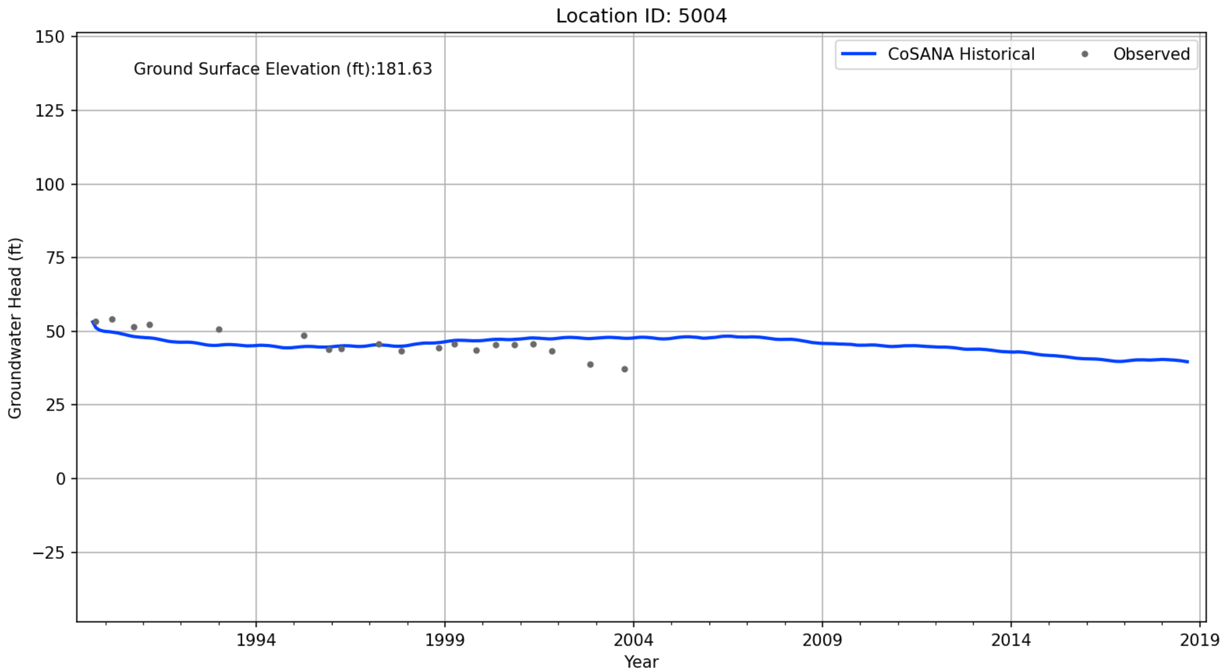

Location ID: 4902
Ground Surface Elevation (ft):9.44
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

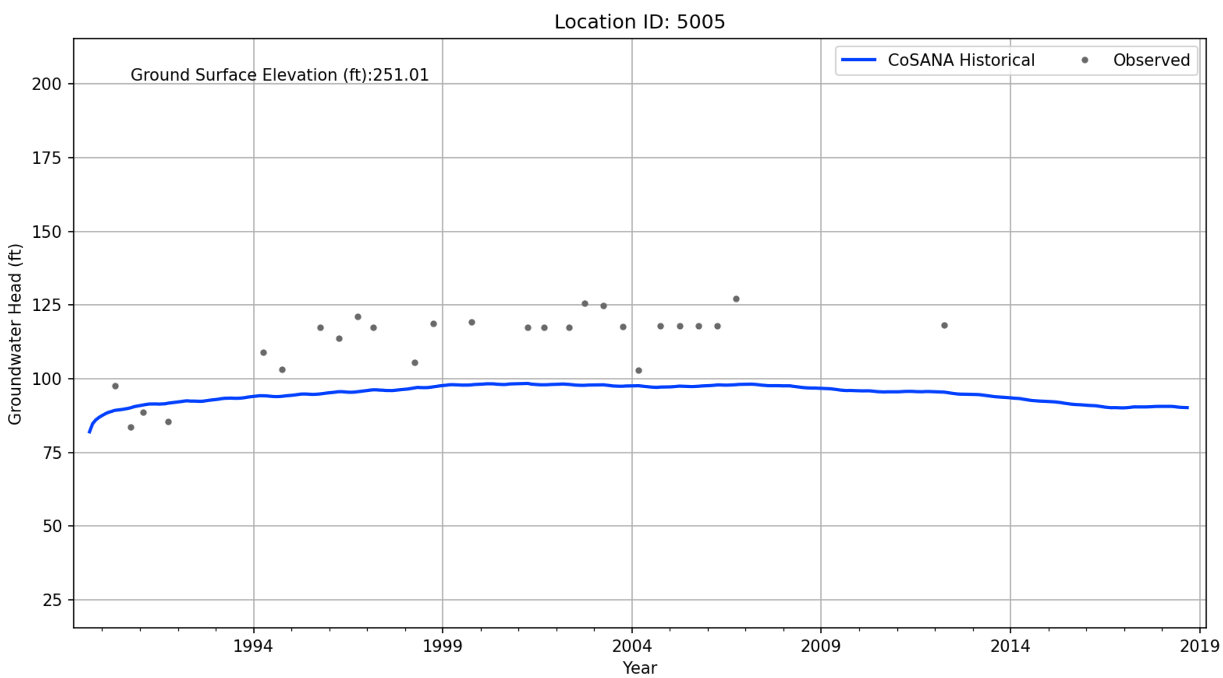
Location ID: 5001

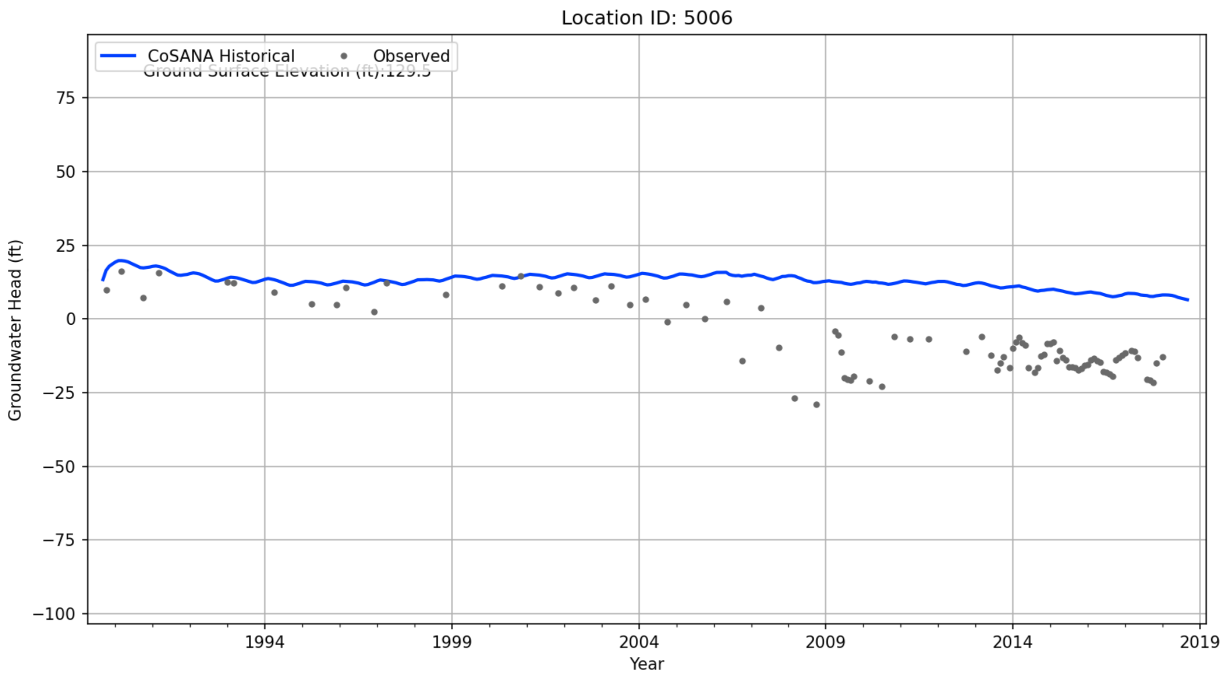


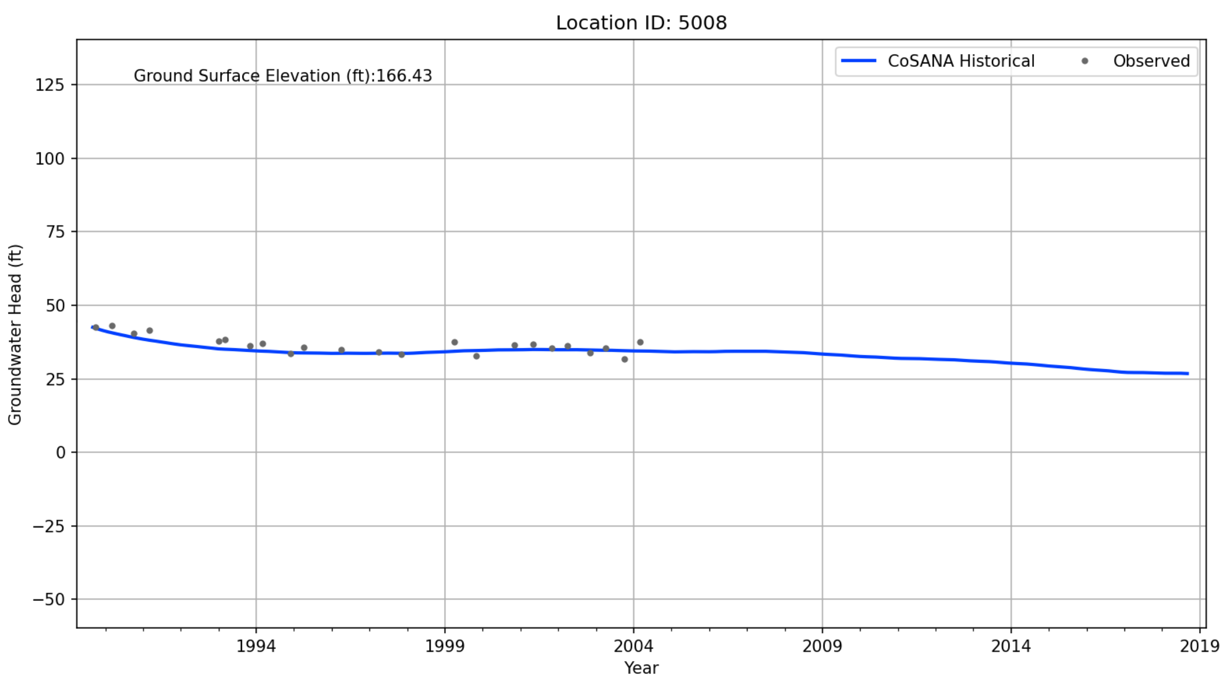
Location ID: 5002

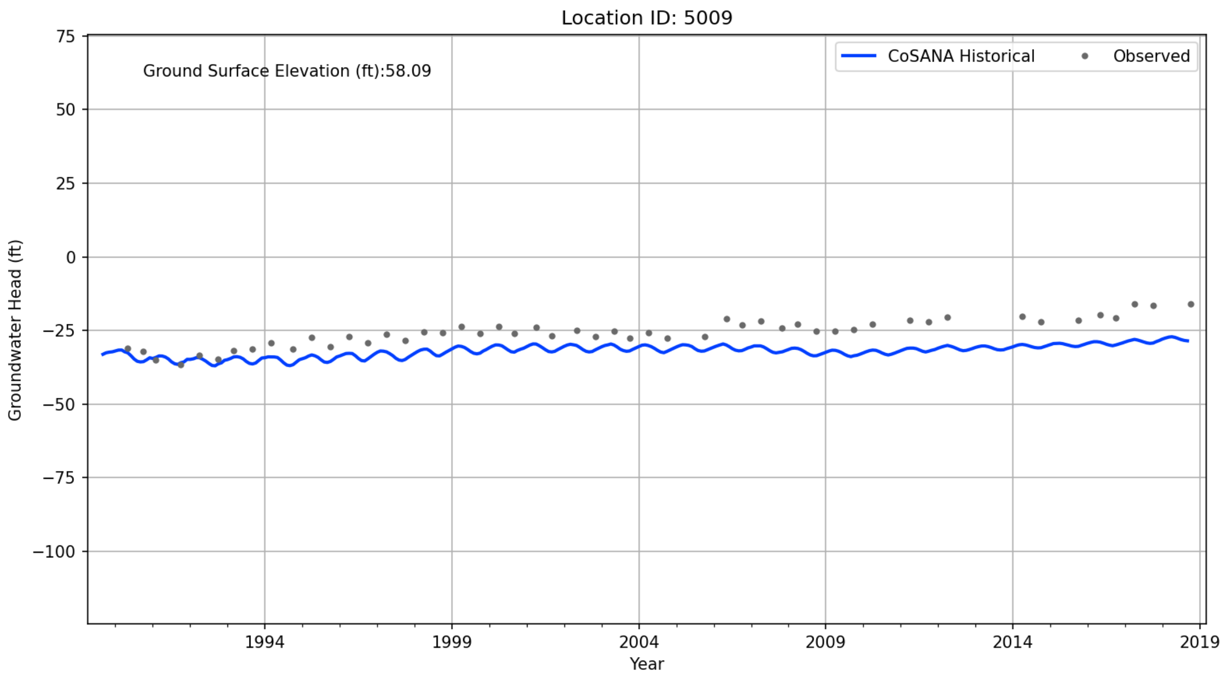


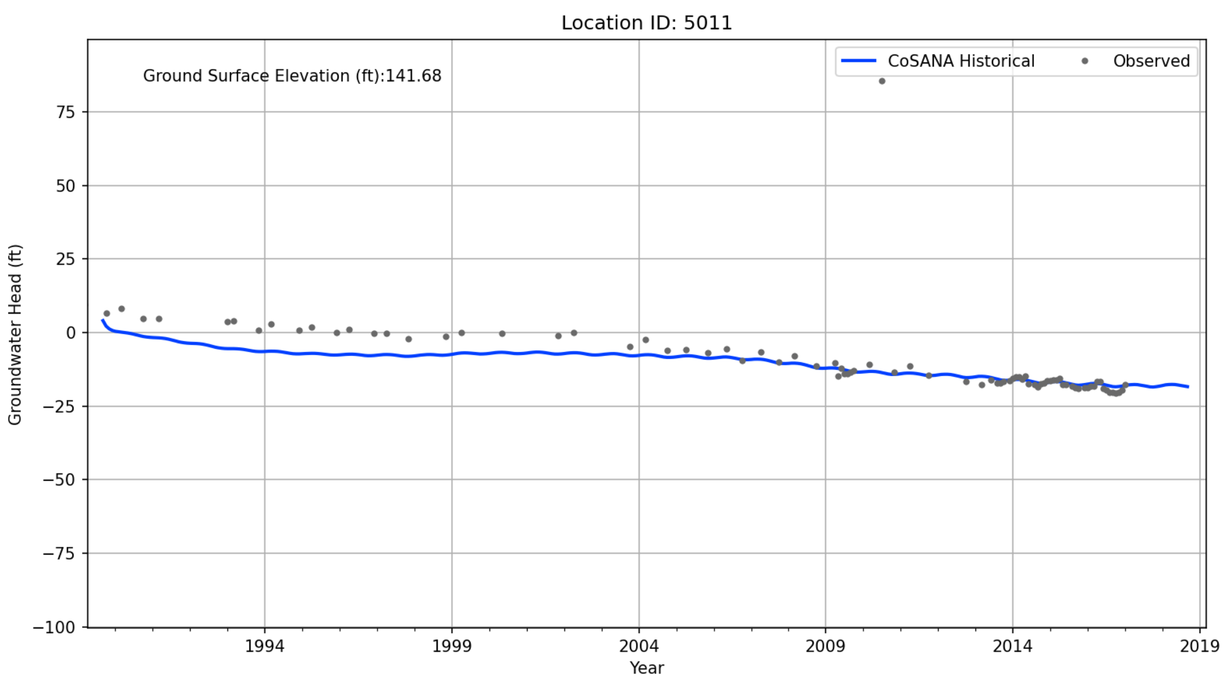

Location ID: 5004
Ground Surface Elevation (ft):181.63
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

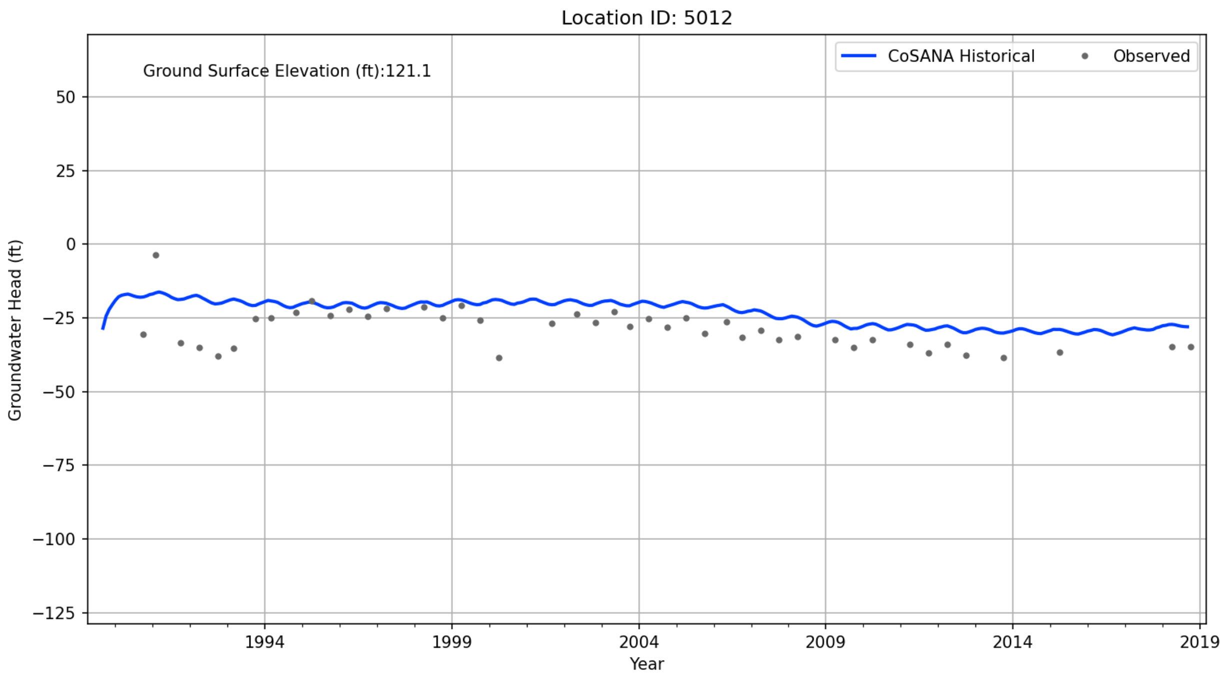

Location ID: 5005
Ground Surface Elevation (ft):251.01
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

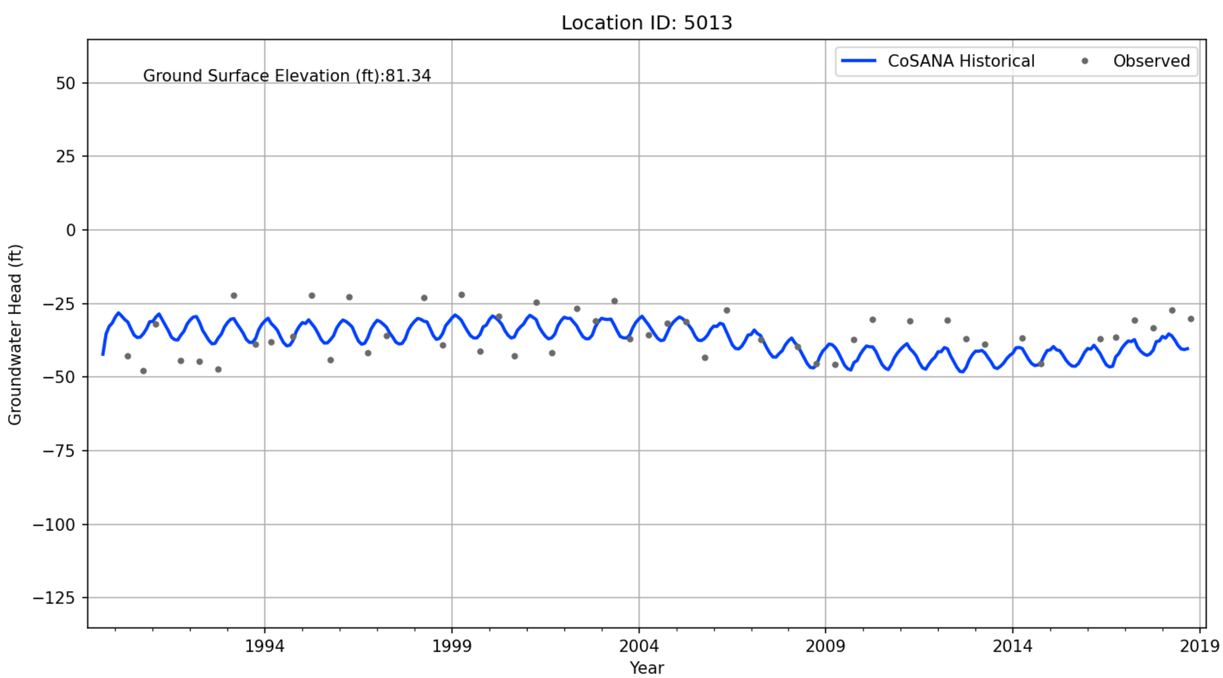

Location ID: 5006
CoSANA Historical
Observed
Ground Surface Elevation (ft):129.5
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

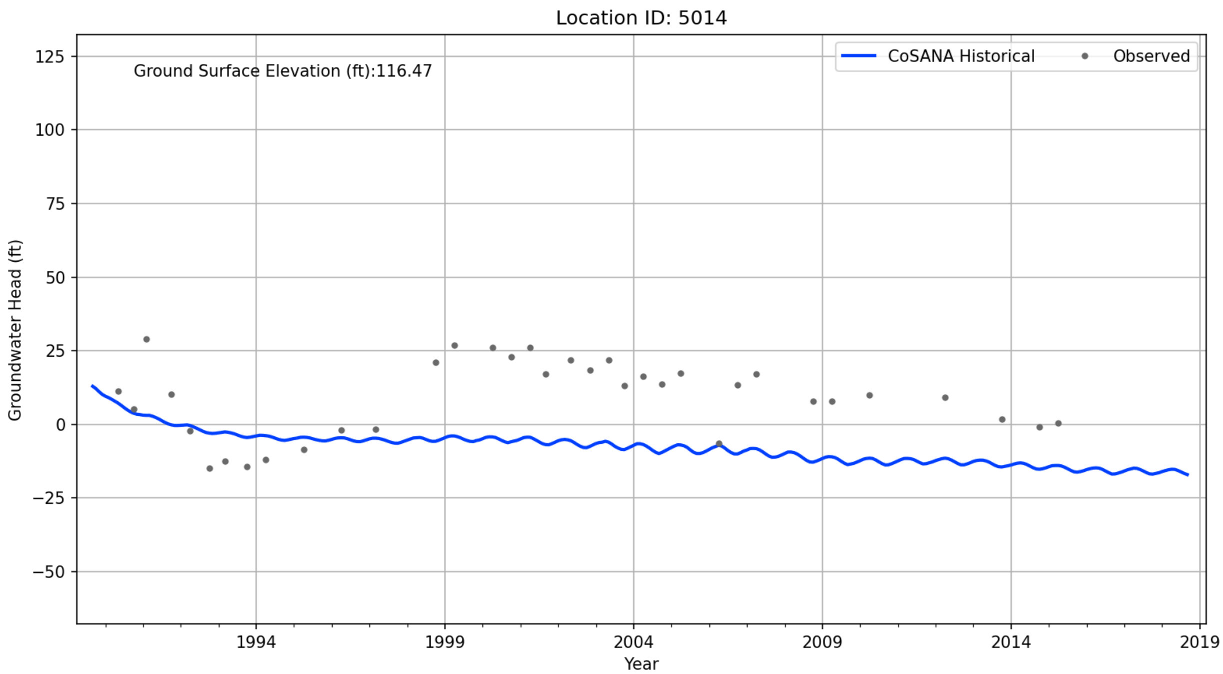

Location ID: 5008
CoSANA Historical
Observed
Ground Surface Elevation (ft):166.43
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

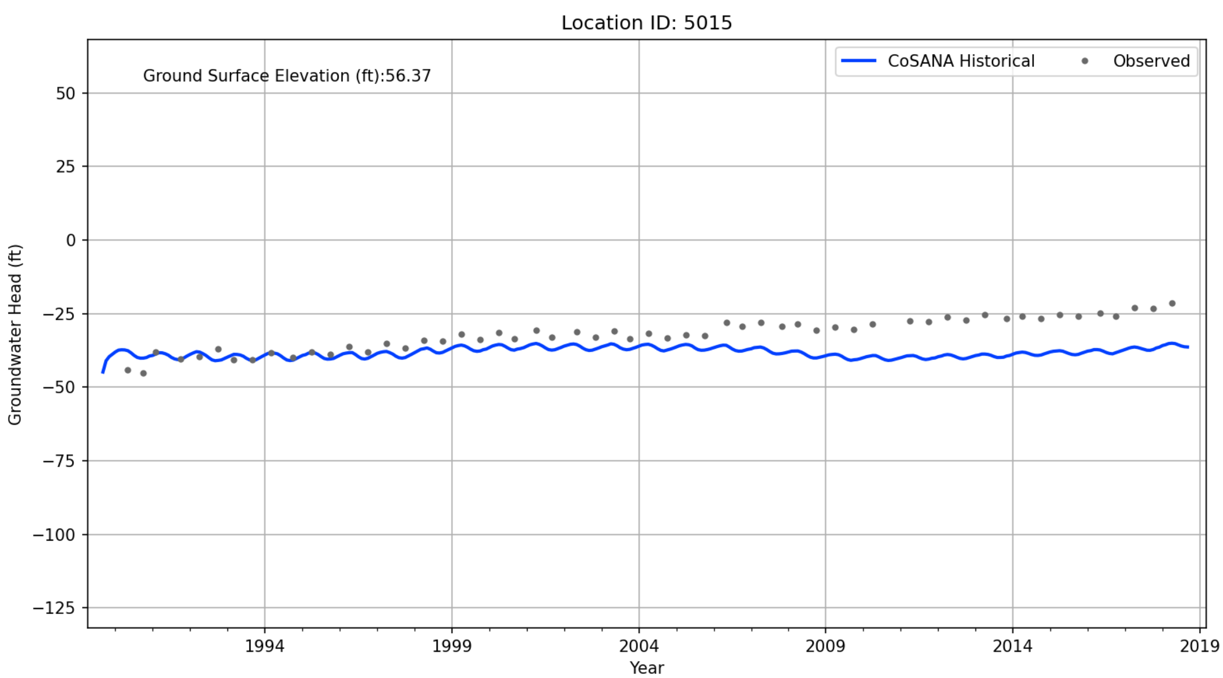

Location ID: 5009
CoSANA Historical
Observed
Ground Surface Elevation (ft):58.09
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

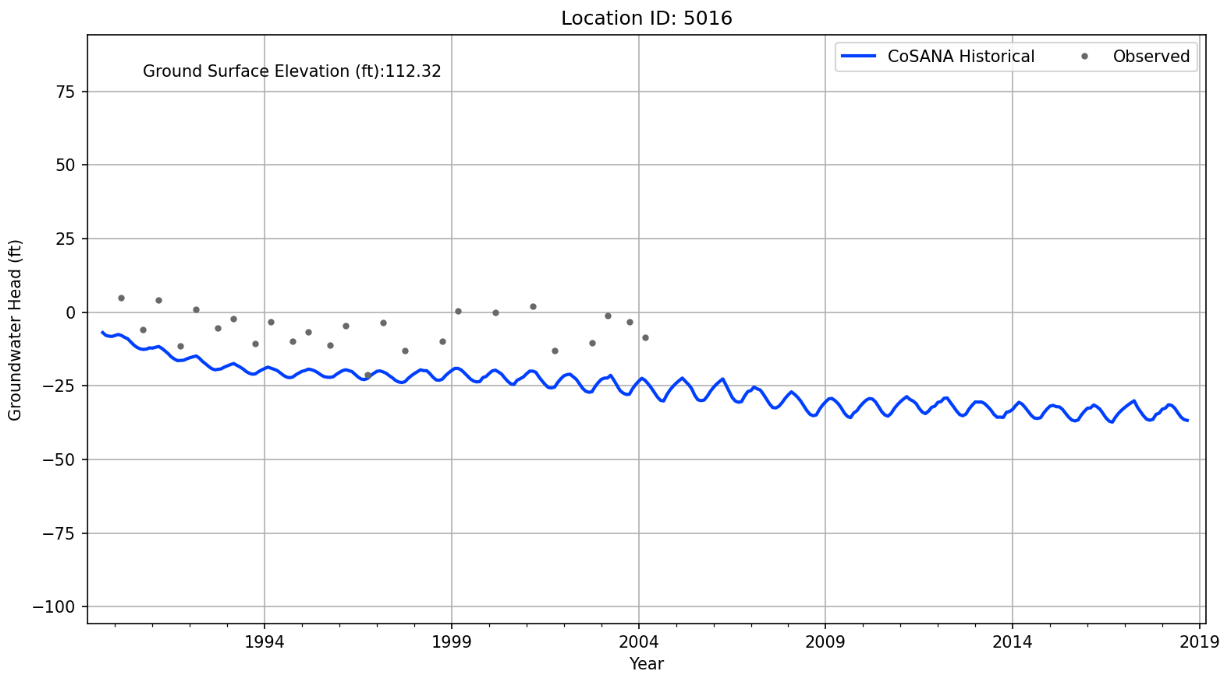

Location ID: 5011
CoSANA Historical
Observed
Ground Surface Elevation (ft):141.68
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

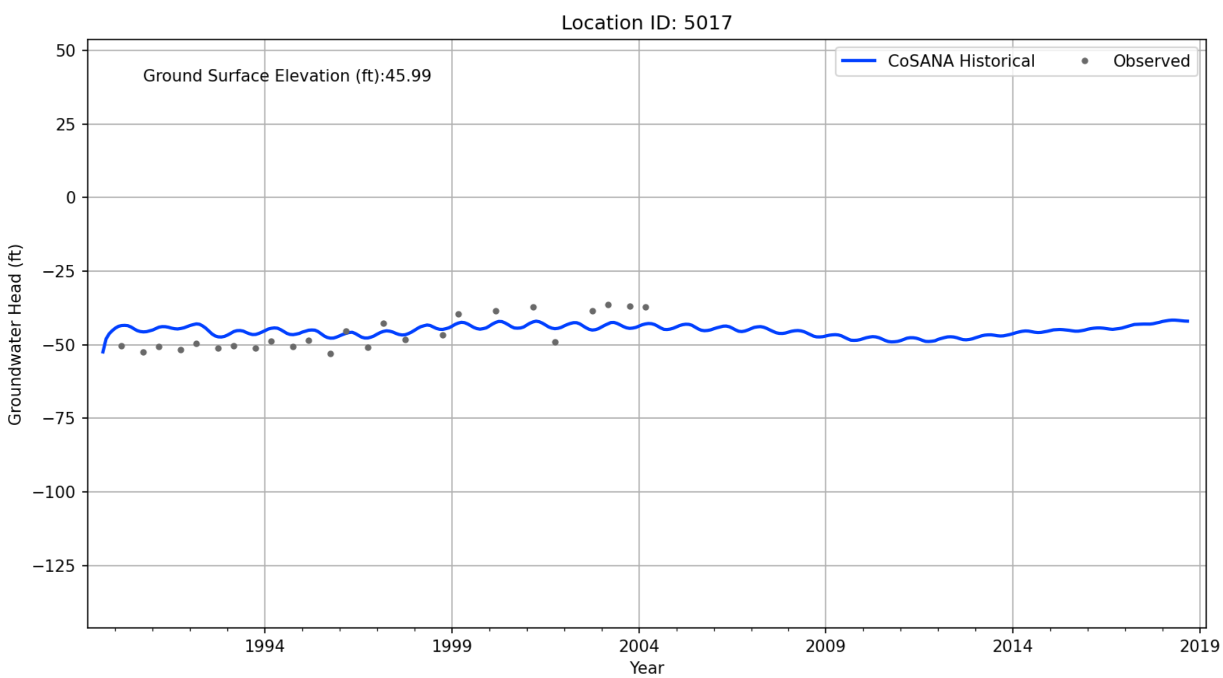

Location ID: 5012
Ground Surface Elevation (ft):121.1
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

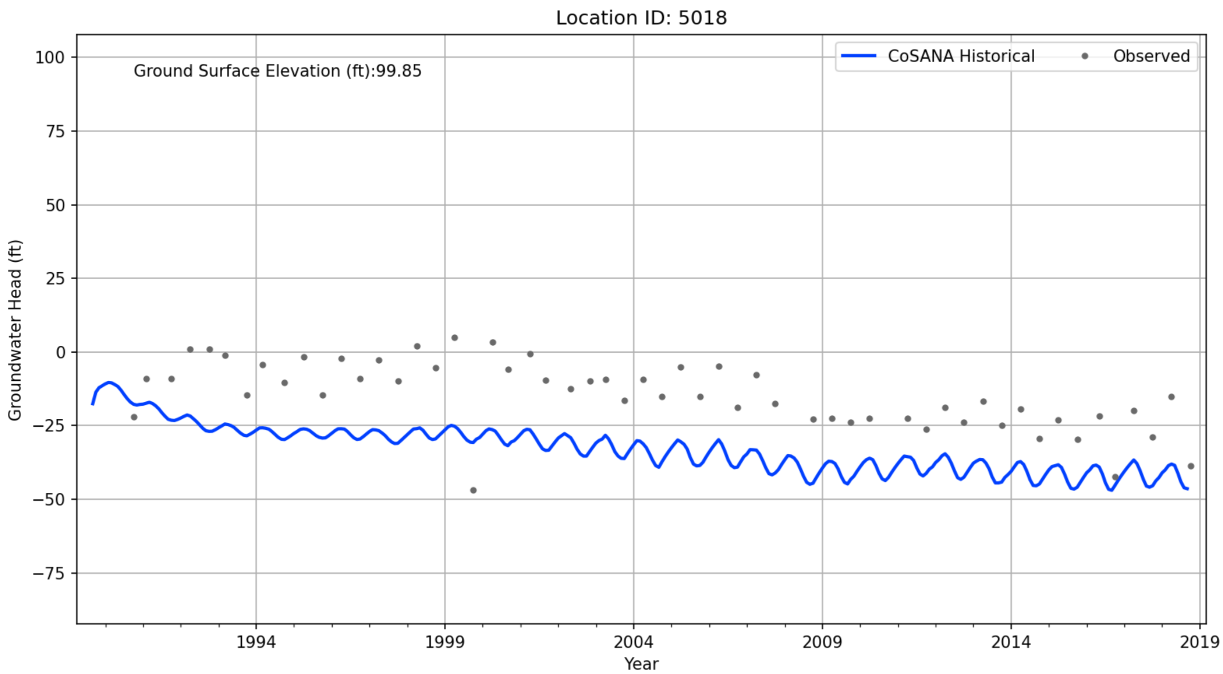

Location ID: 5013
Ground Surface Elevation (ft):81.34
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

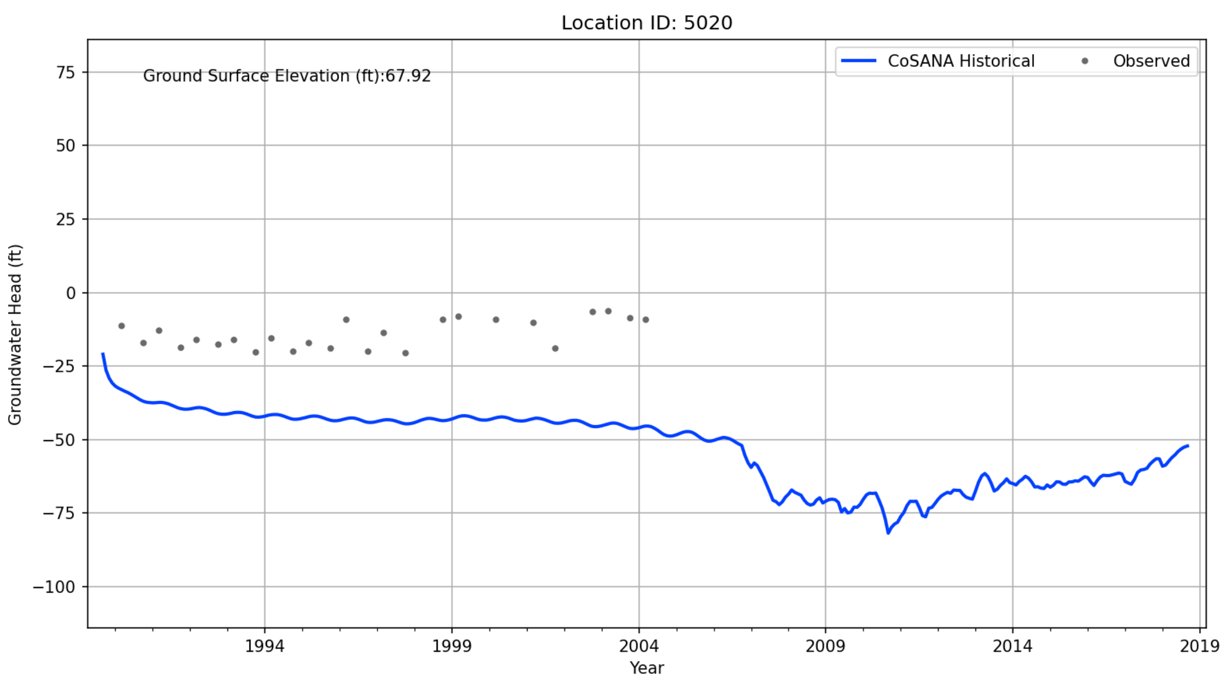

Location ID: 5014
Ground Surface Elevation (ft):116.47
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

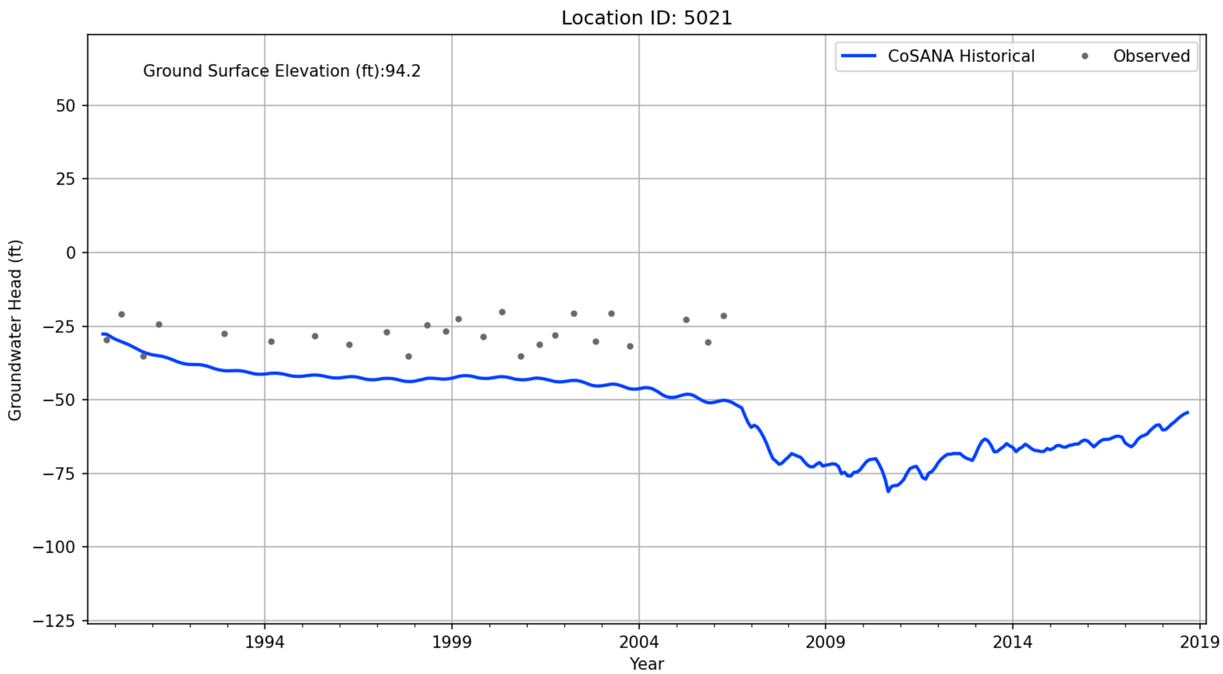

Location ID: 5015
Ground Surface Elevation (ft):56.37
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

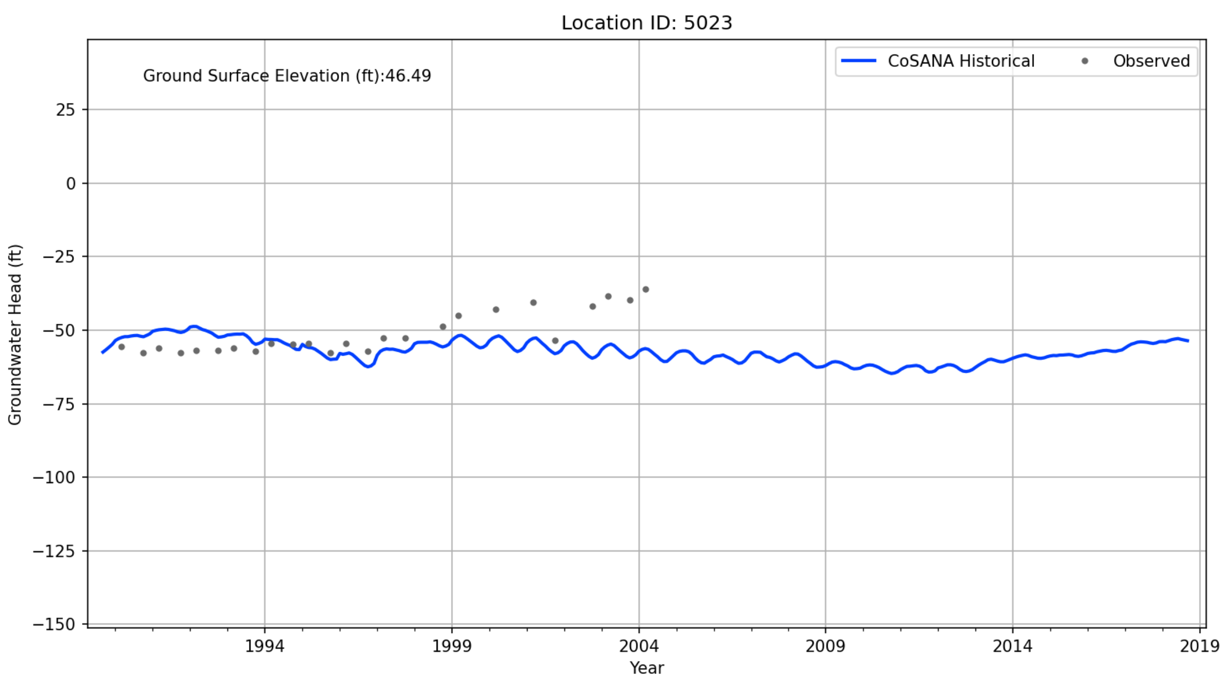

Location ID: 5016
Ground Surface Elevation (ft):112.32
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

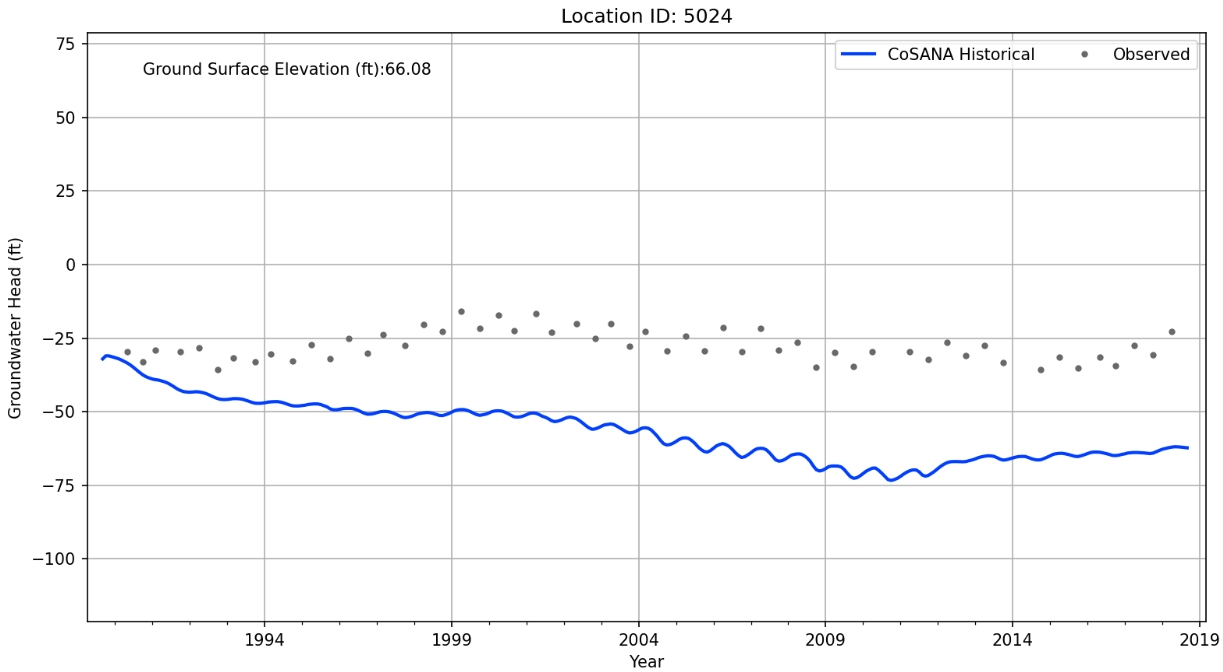

Location ID: 5017
Ground Surface Elevation (ft):45.99
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 5018
Ground Surface Elevation (ft):99.85
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

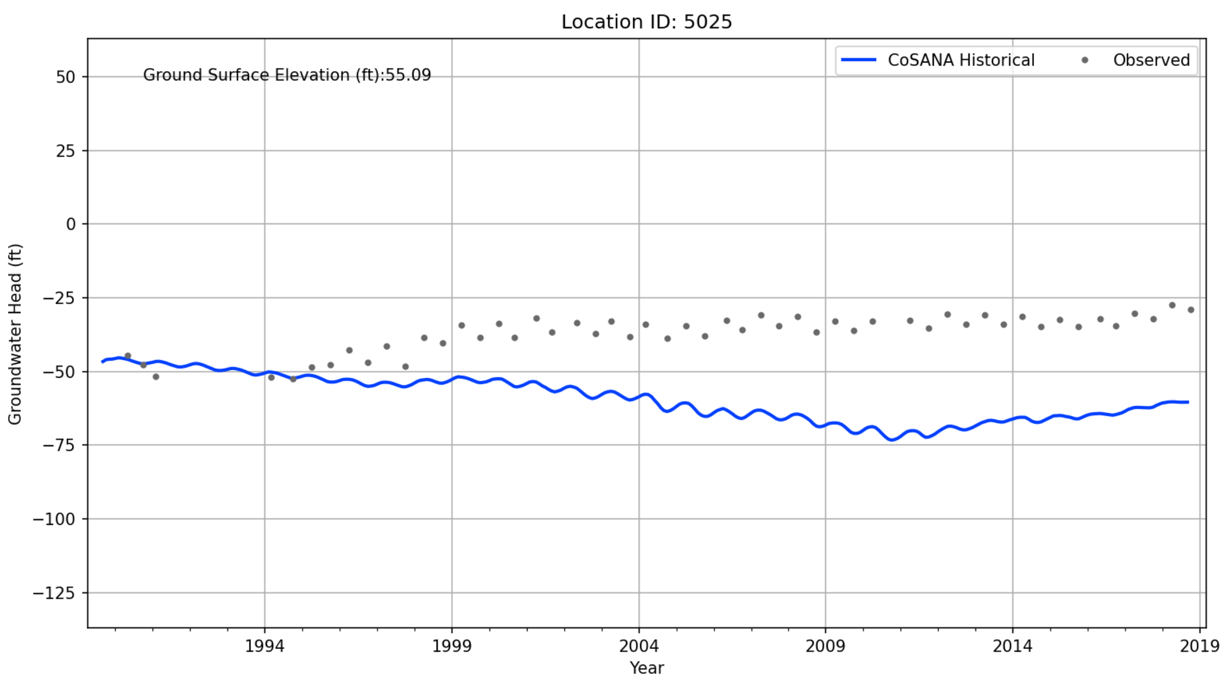

Location ID: 5020
Ground Surface Elevation (ft):67.92
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 5021
CoSANA Historical
Observed
Ground Surface Elevation (ft):94.2
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

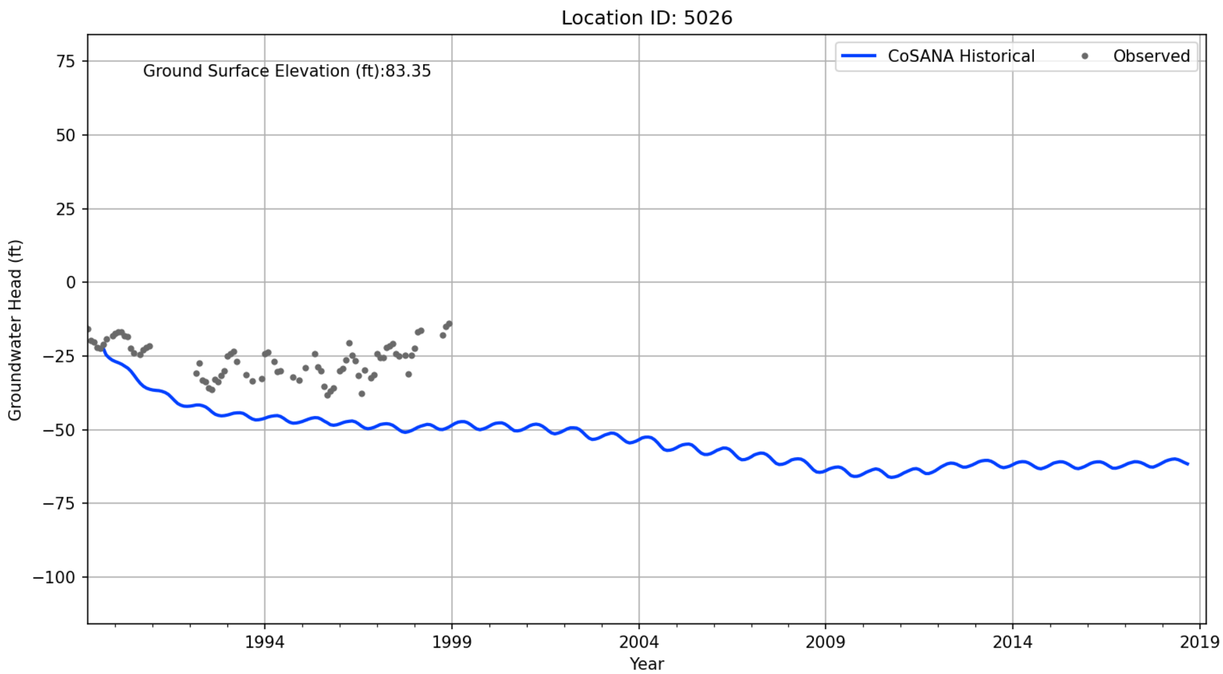

Location ID: 5023
CoSANA Historical
Observed
Ground Surface Elevation (ft):46.49
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019



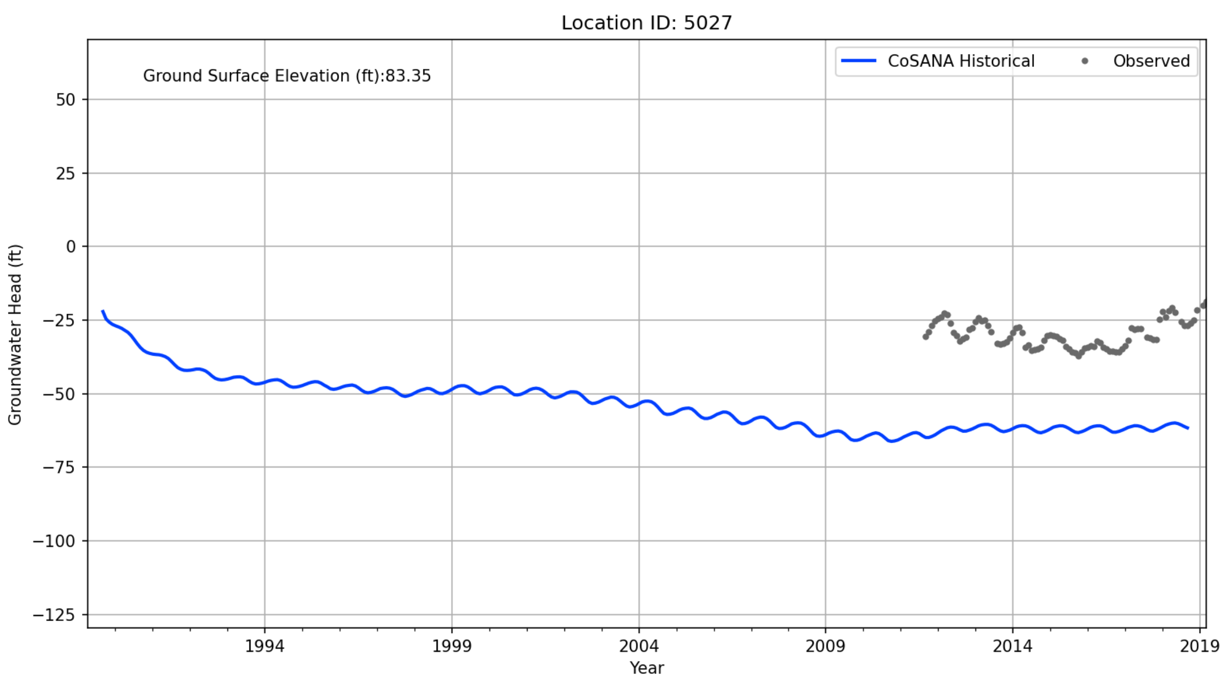
Location ID: 5024
Ground Surface Elevation (ft):66.08
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



Location ID: 5025
Ground Surface Elevation (ft):55.09
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year



Location ID: 5026
Ground Surface Elevation (ft):83.35
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



Location ID: 5027
Ground Surface Elevation (ft):83.35
CoSANA Historical
Observed
Groundwater Head (ft)
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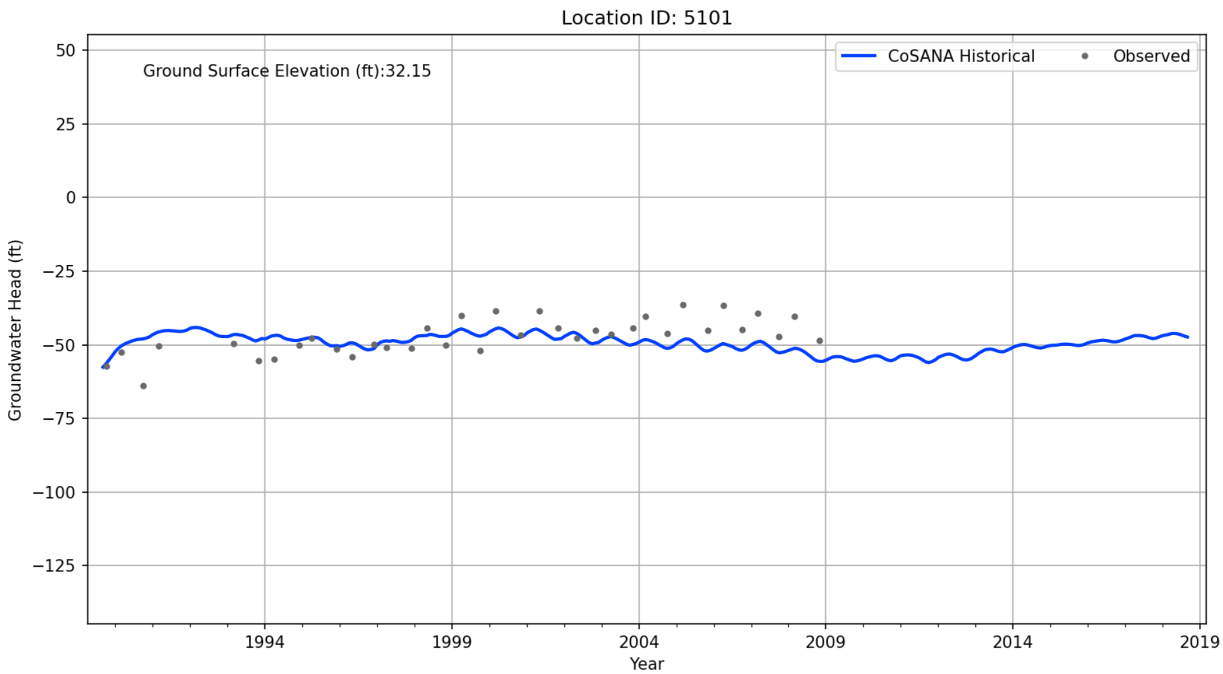
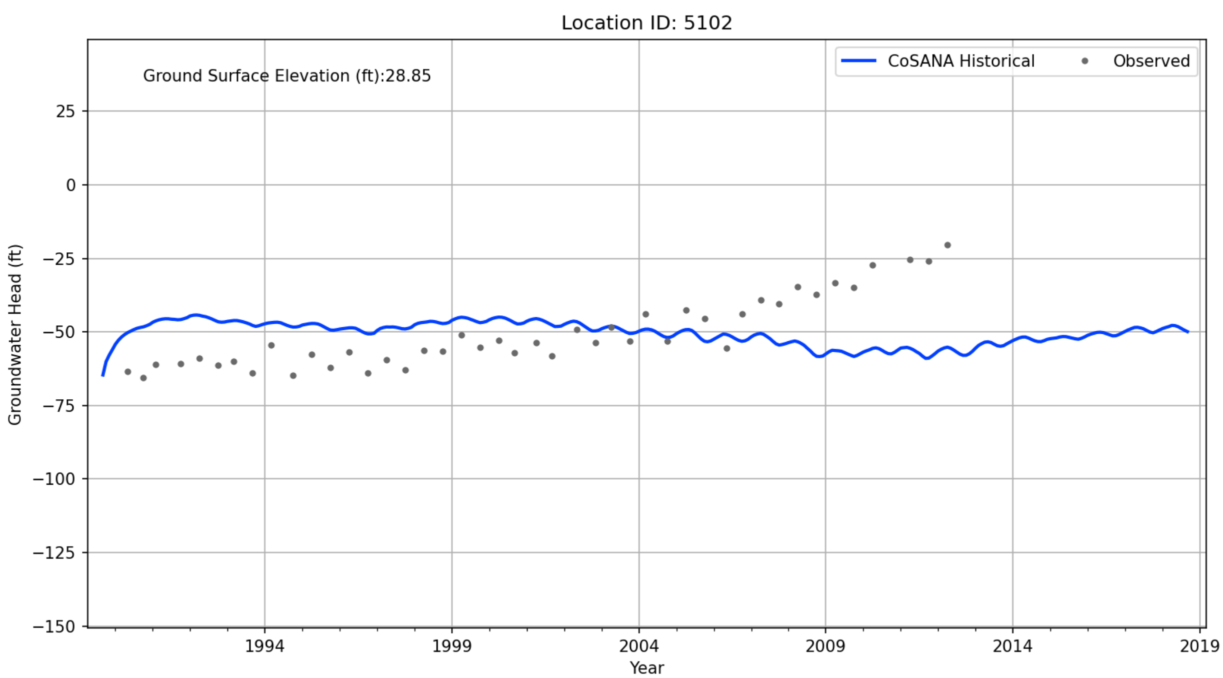
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 5101
Ground Surface Elevation (ft):32.15
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 5102
Ground Surface Elevation (ft):28.85
CoSANA Historical
Observed
Groundwater Head (ft)
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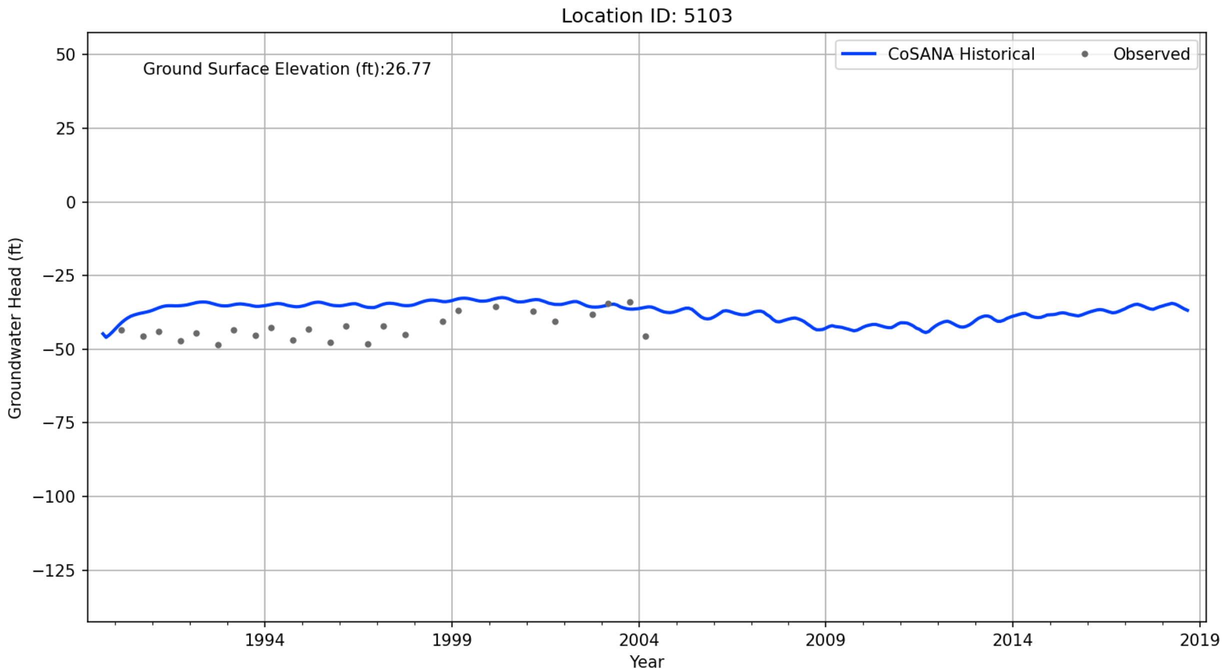
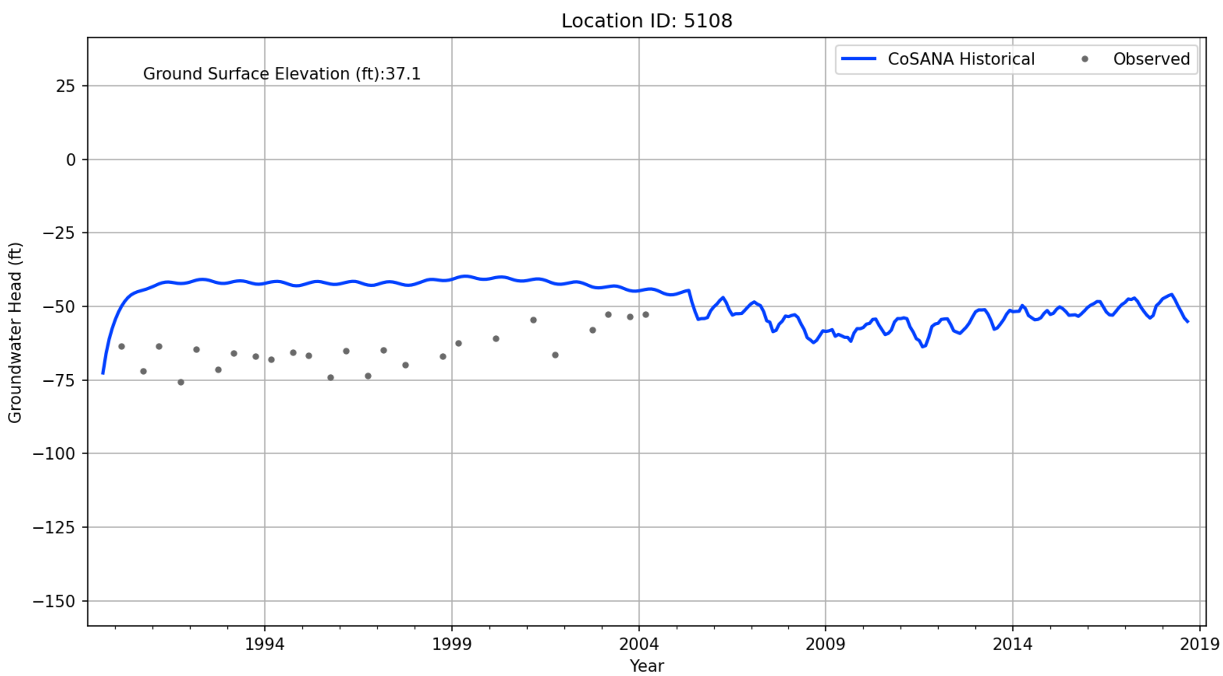
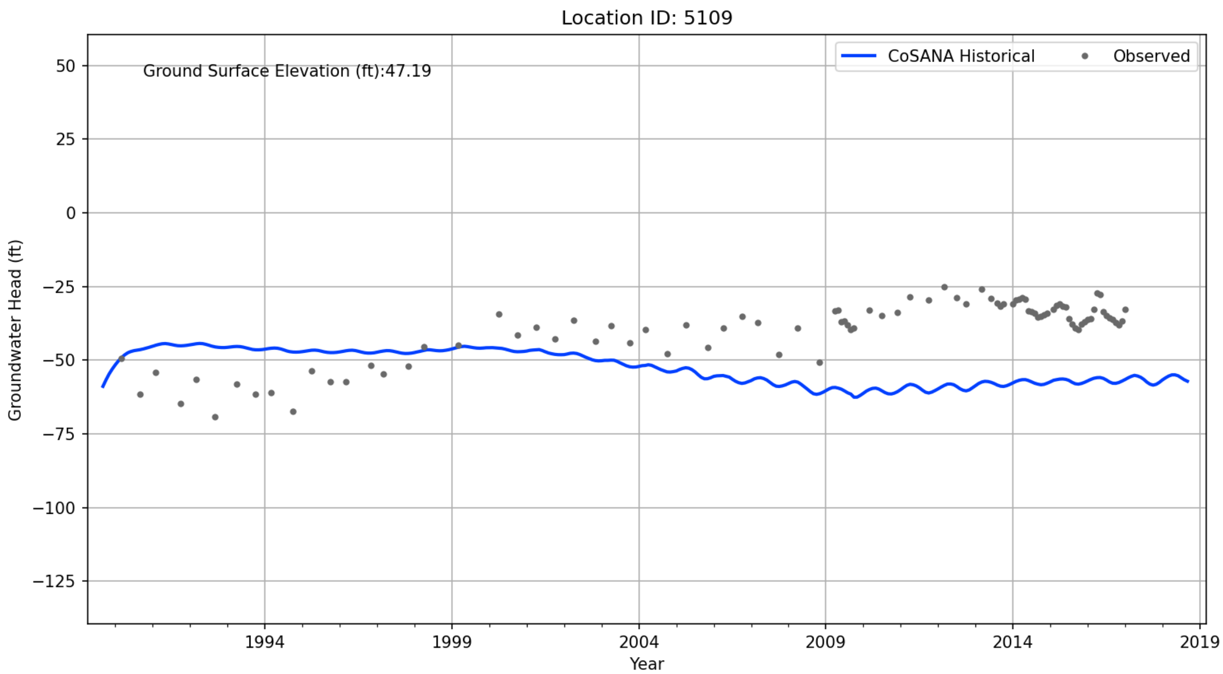
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

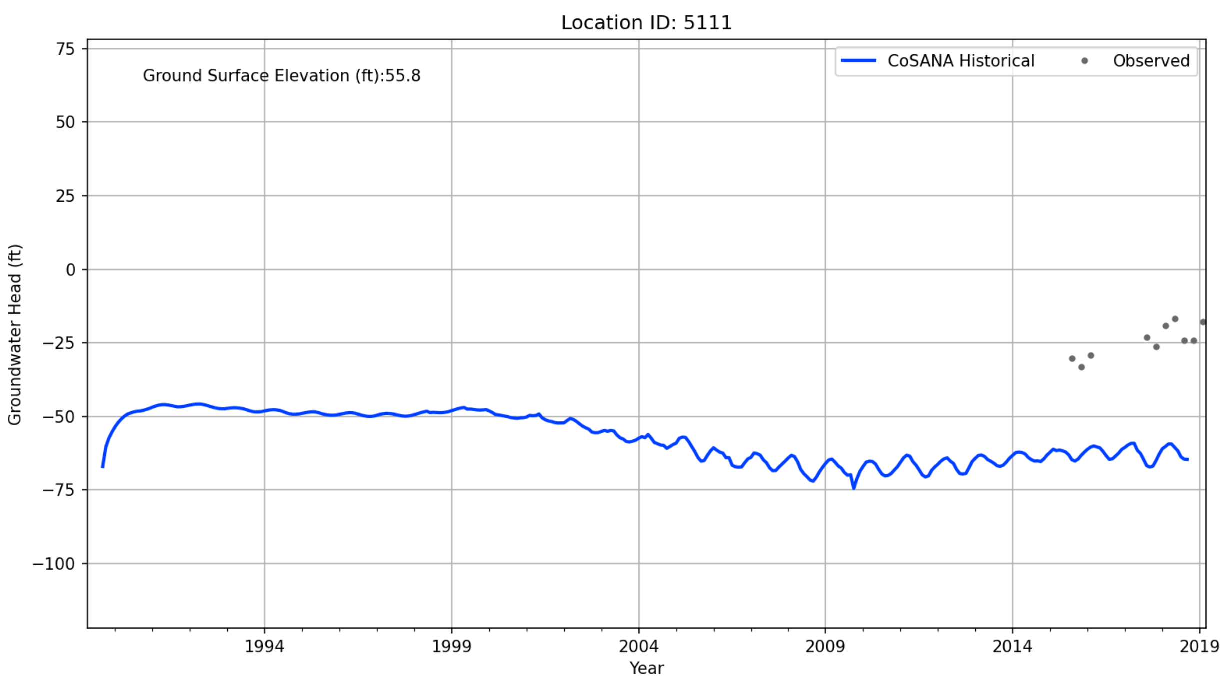


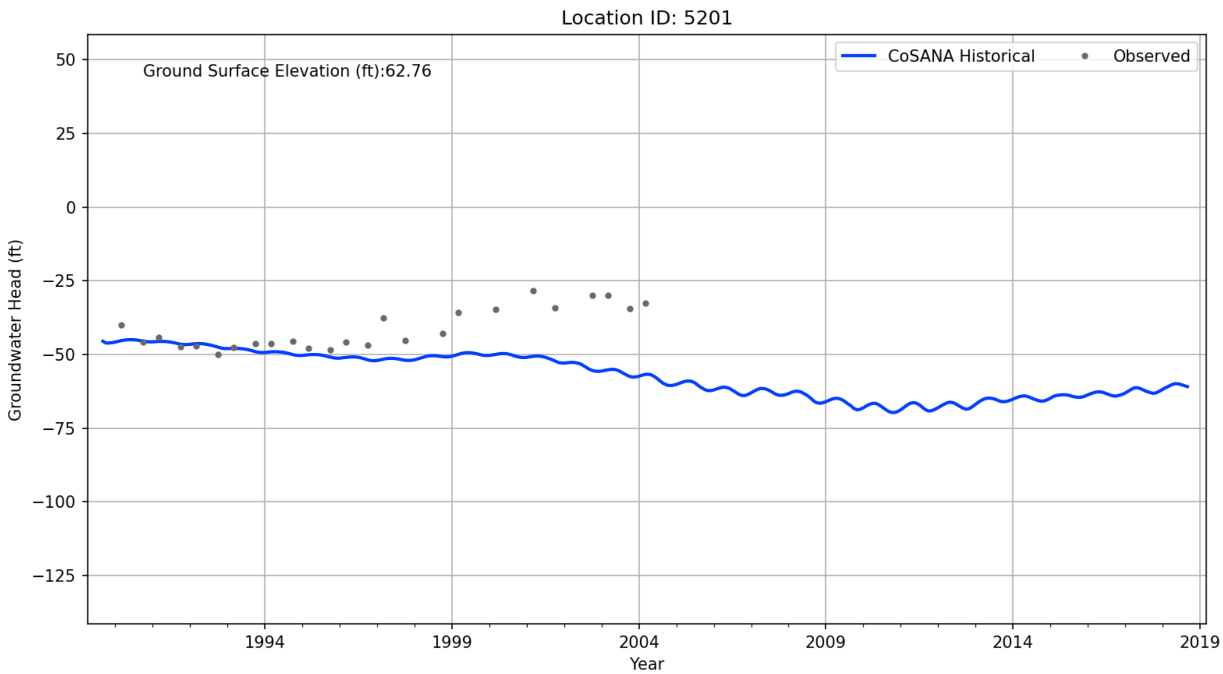
Location ID: 5103
Ground Surface Elevation (ft):26.77
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019



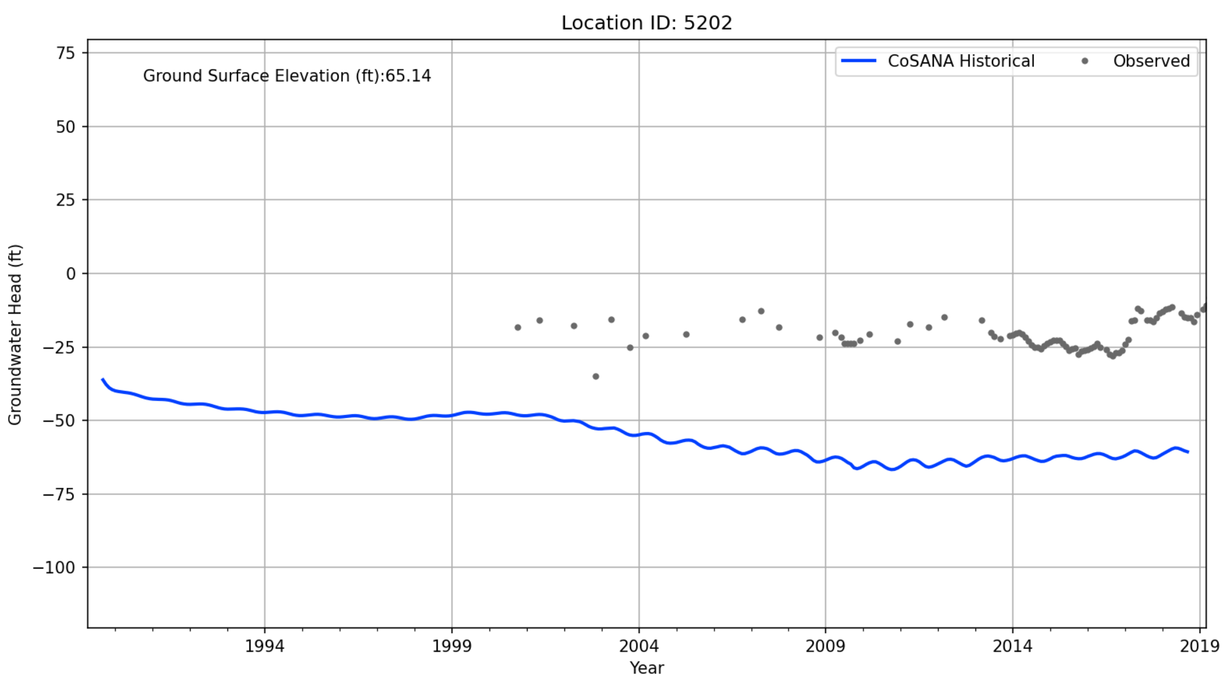
Location ID: 5108
Ground Surface Elevation (ft):37.1
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019


Location ID: 5109
Ground Surface Elevation (ft):47.19
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

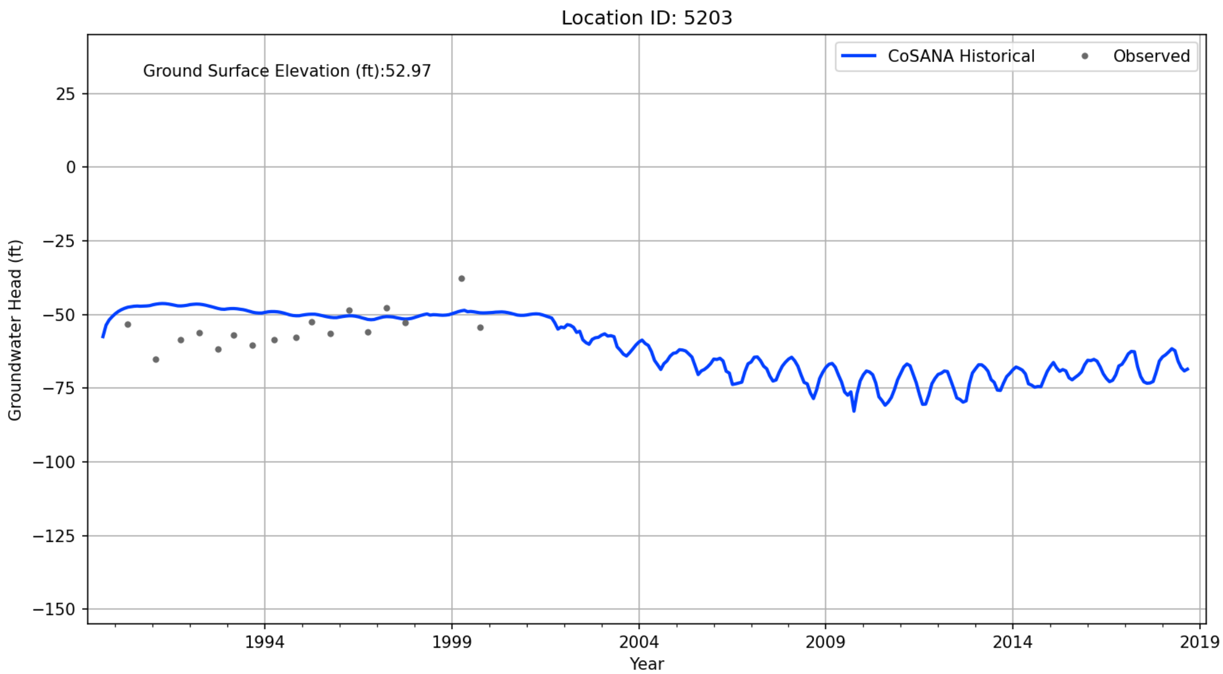

Location ID: 5111
Ground Surface Elevation (ft):55.8
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



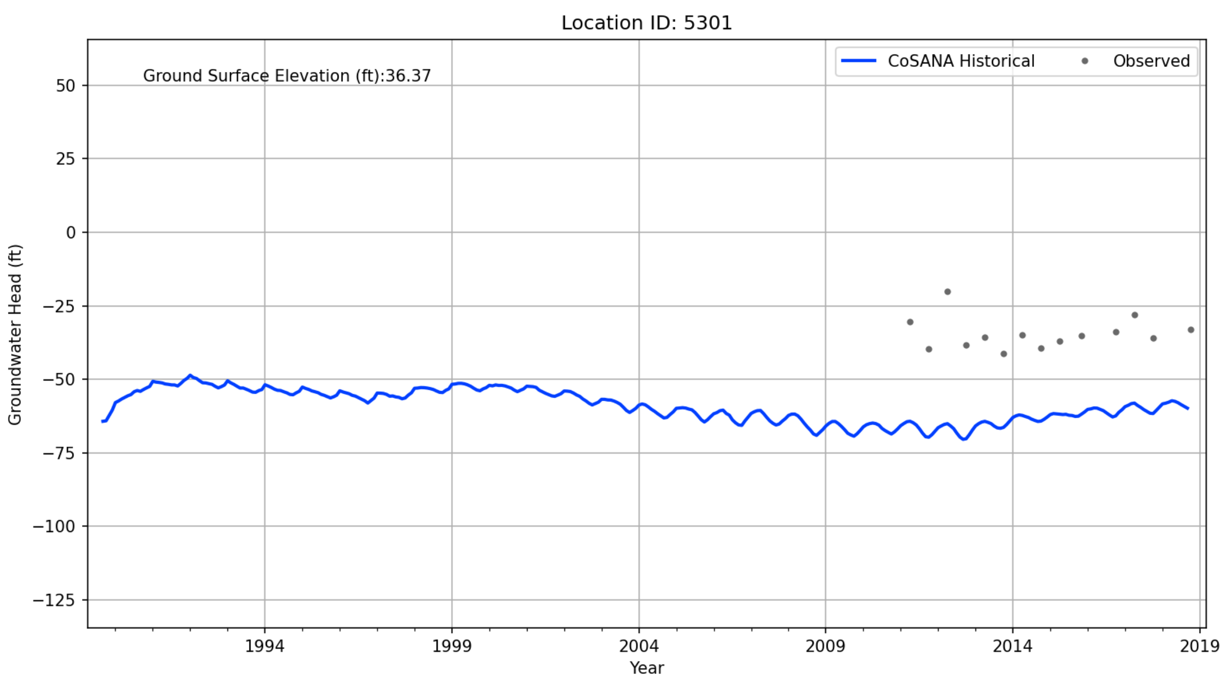
Location ID: 5201
Ground Surface Elevation (ft):62.76
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019



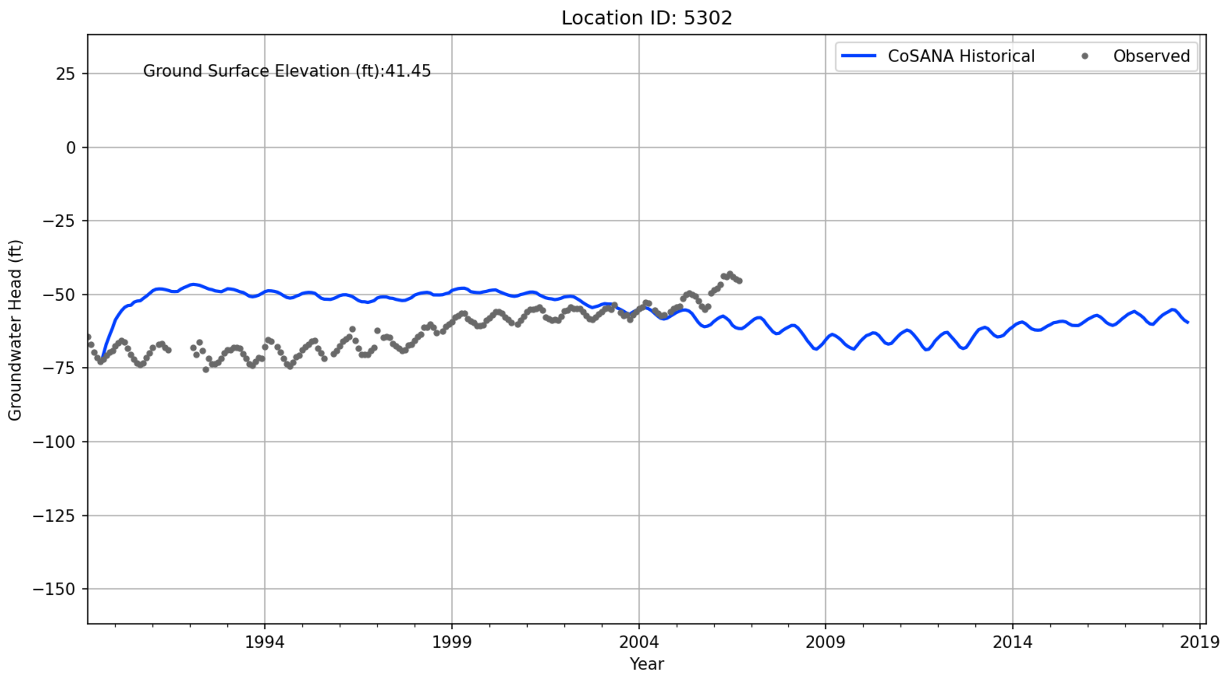
Location ID: 5202
Ground Surface Elevation (ft):65.14
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

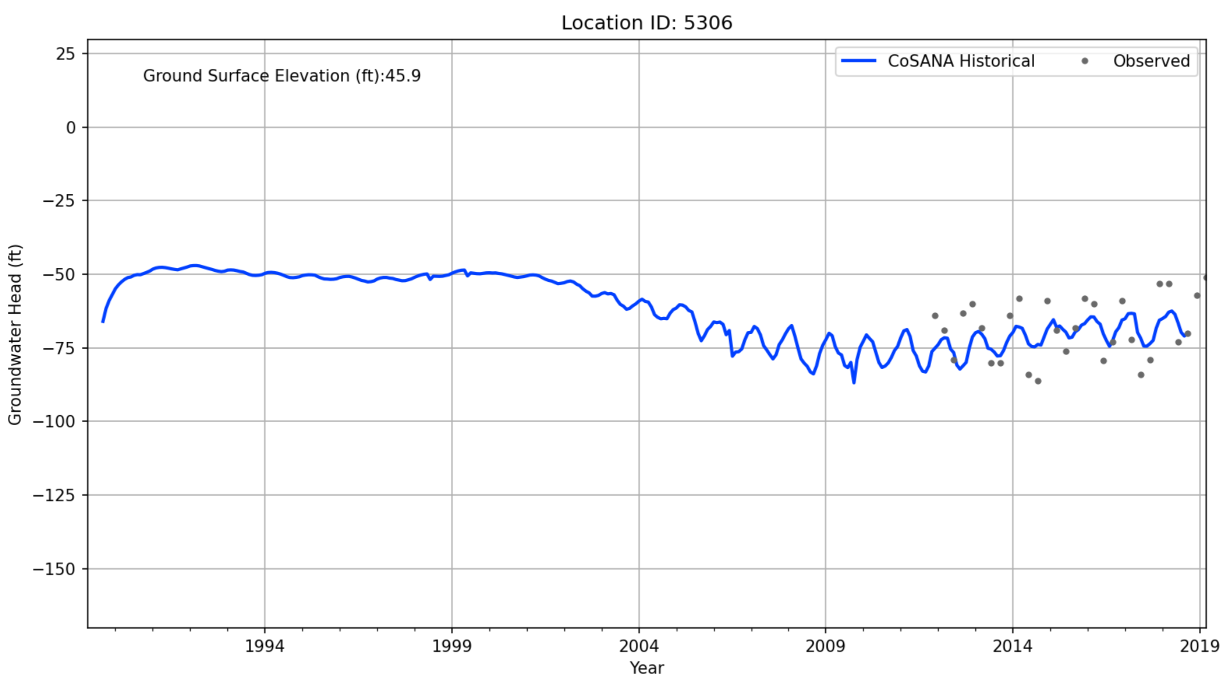


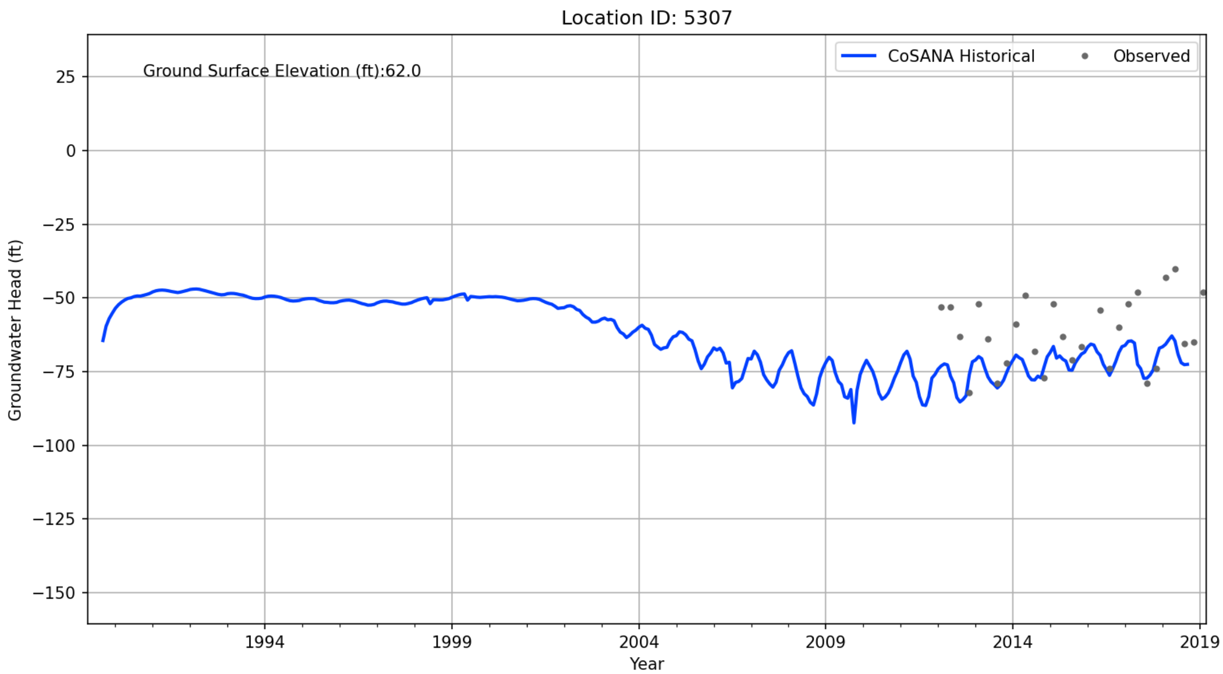
Location ID: 5203
Ground Surface Elevation (ft):52.97
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019

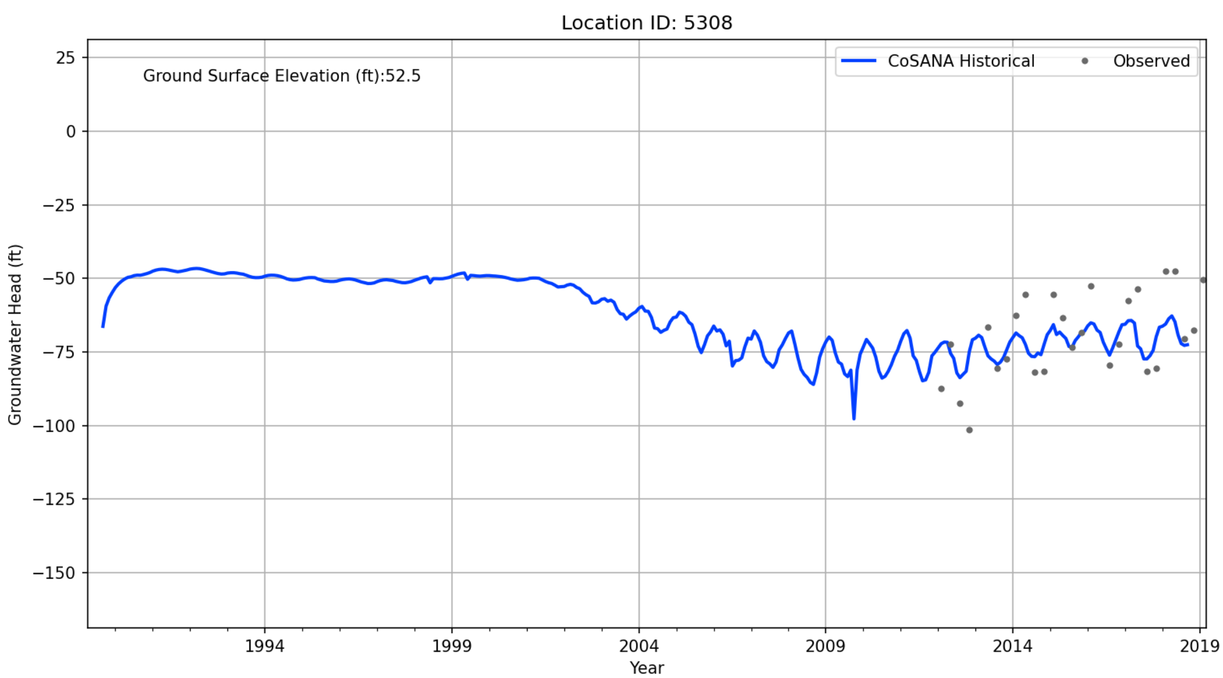


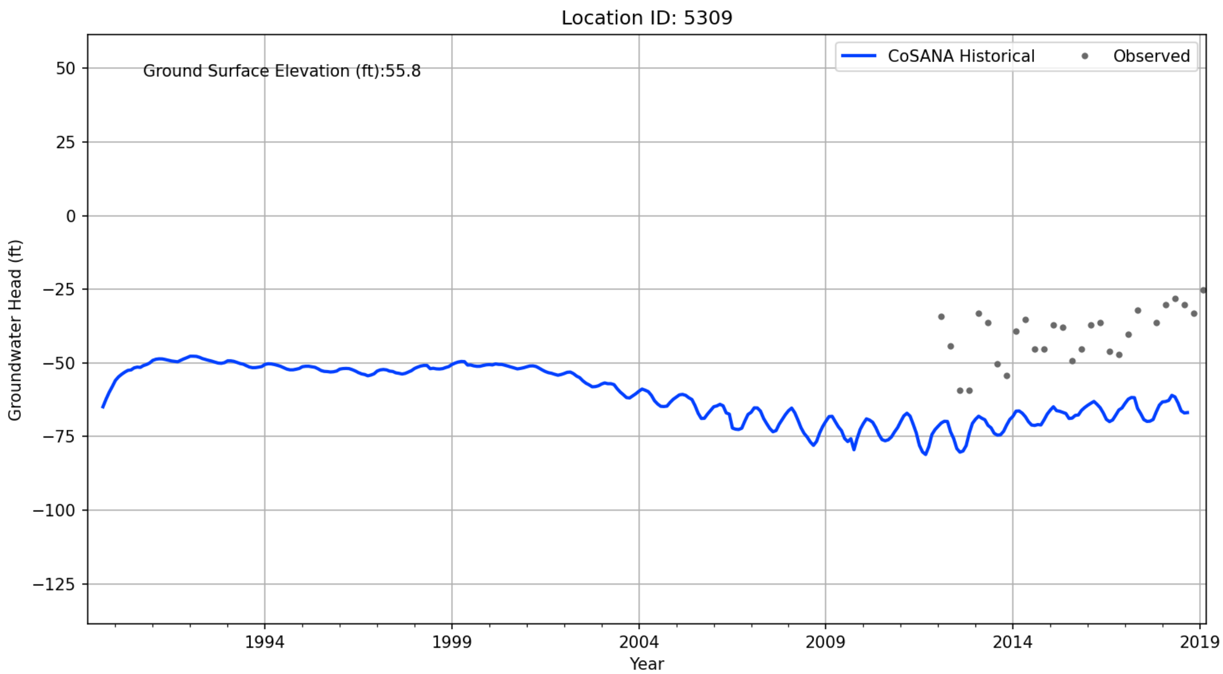
Location ID: 5301
Ground Surface Elevation (ft):36.37
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019


Location ID: 5302
Ground Surface Elevation (ft):41.45
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

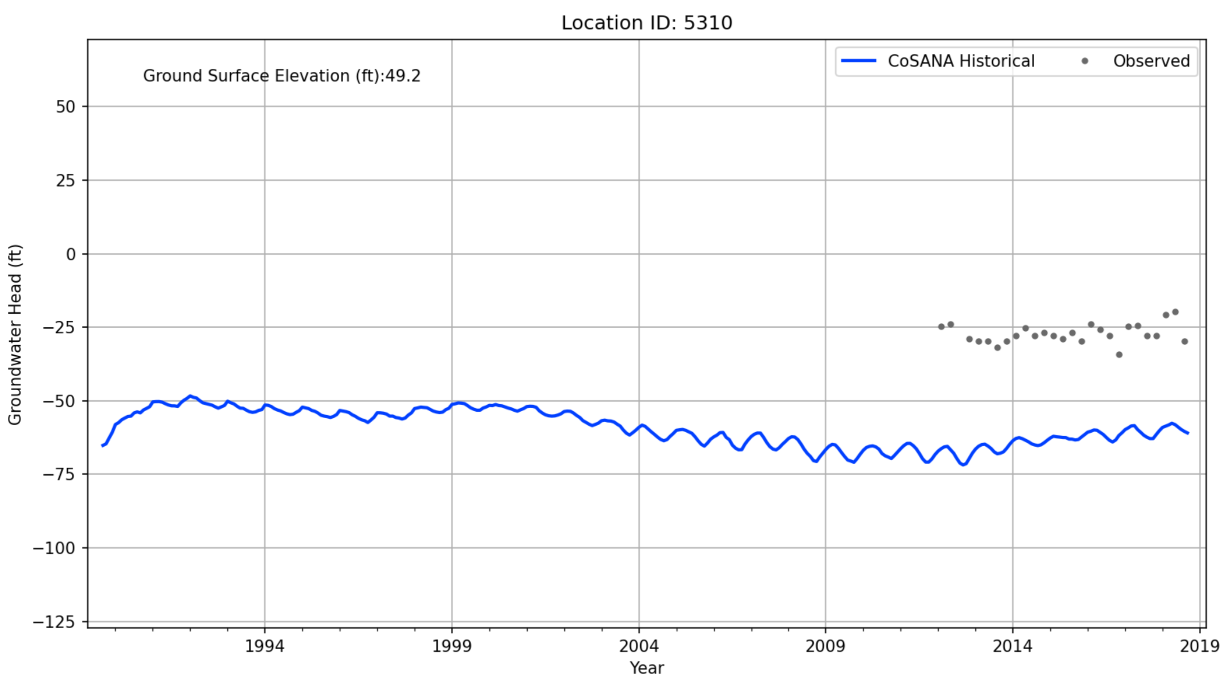

Location ID: 5306
Ground Surface Elevation (ft):45.9
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year


Location ID: 5307
Ground Surface Elevation (ft):62.0
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019

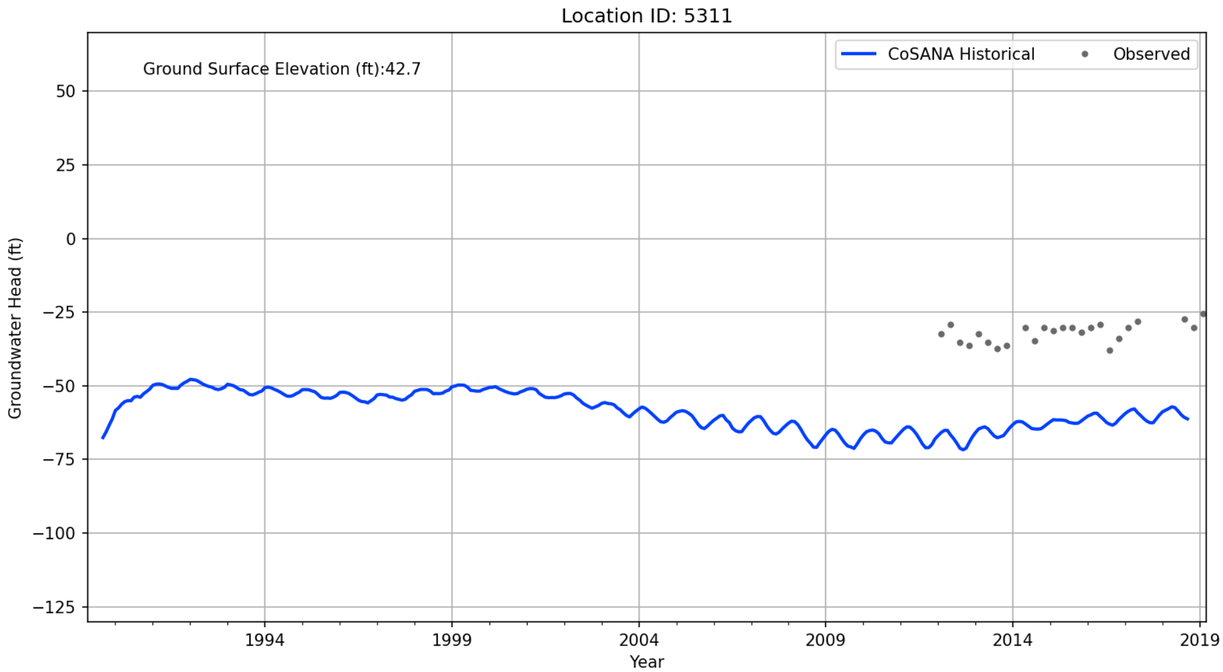

Location ID: 5308
Ground Surface Elevation (ft):52.5
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019



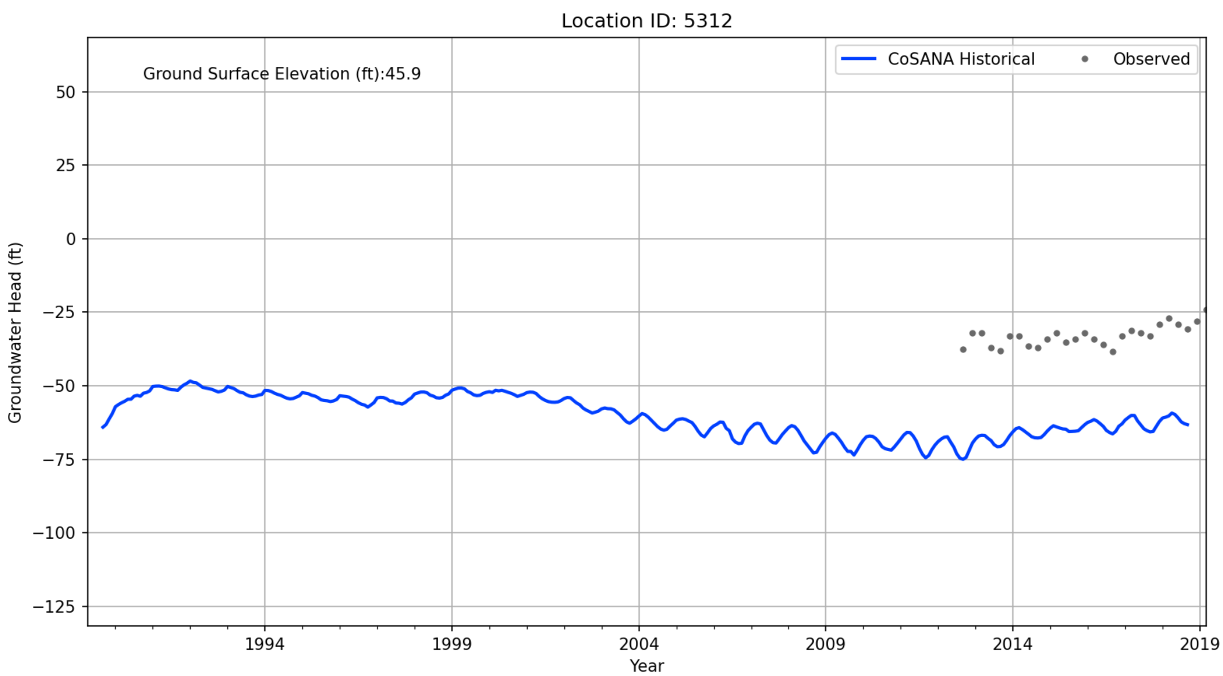
Location ID: 5309
CoSANA Historical
Observed
Ground Surface Elevation (ft):55.8
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year



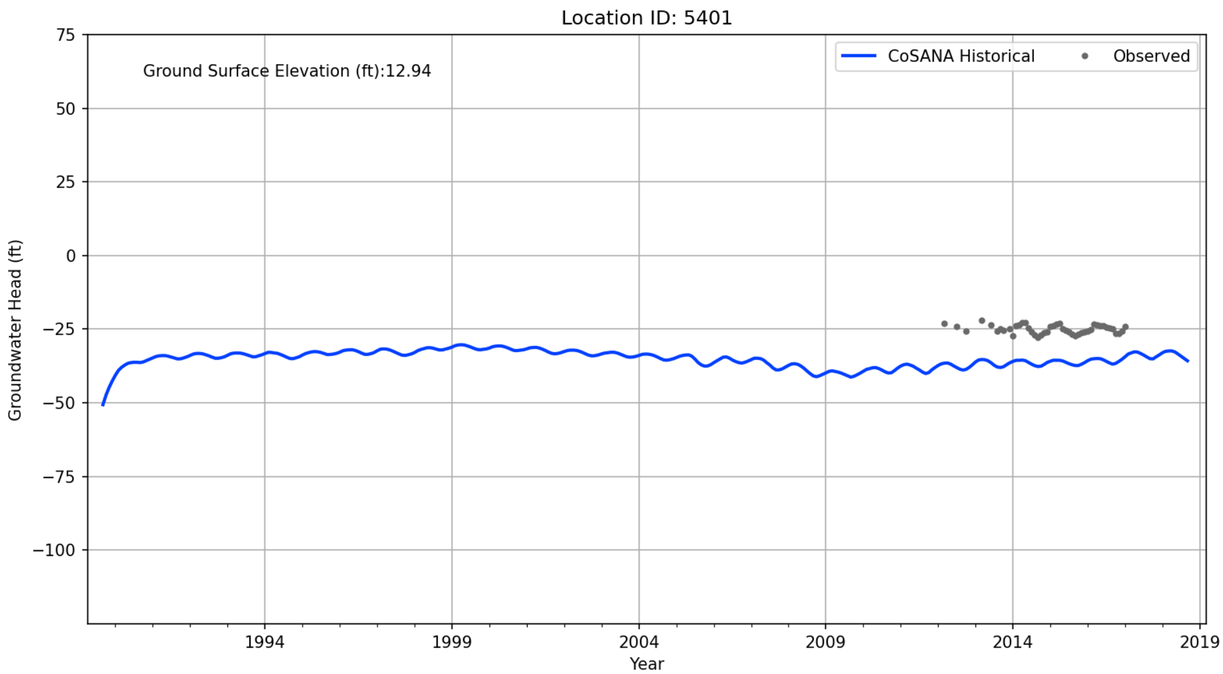
Location ID: 5310
CoSANA Historical
Observed
Ground Surface Elevation (ft):49.2
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

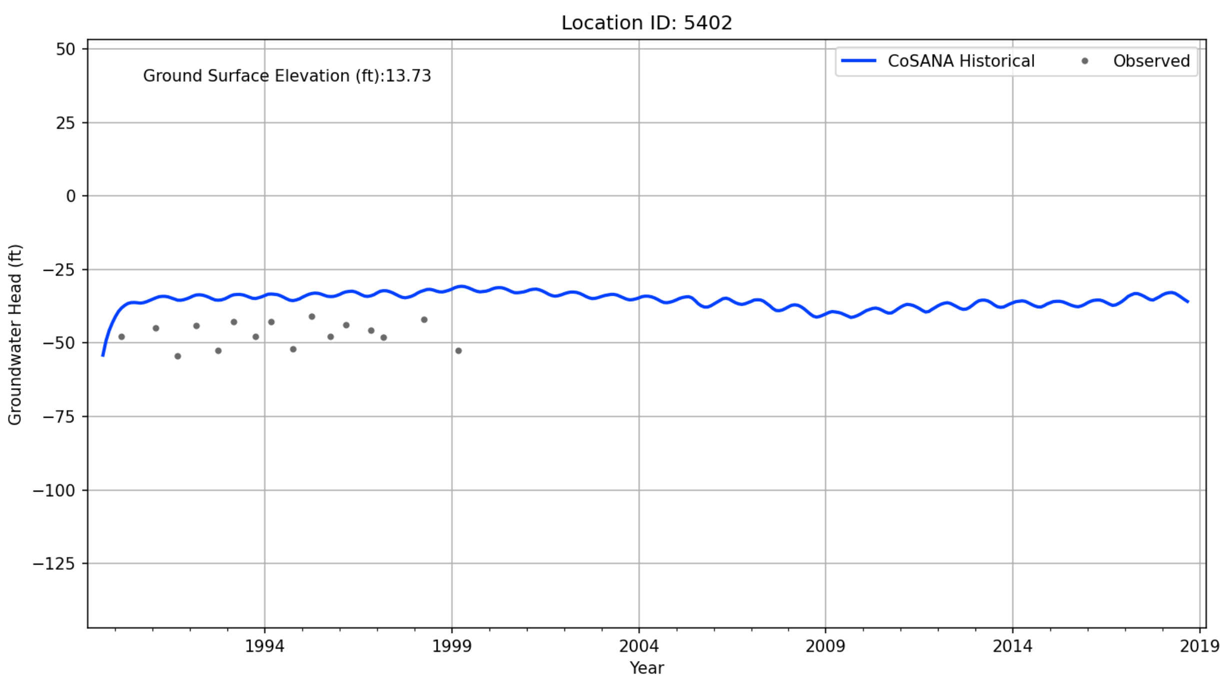


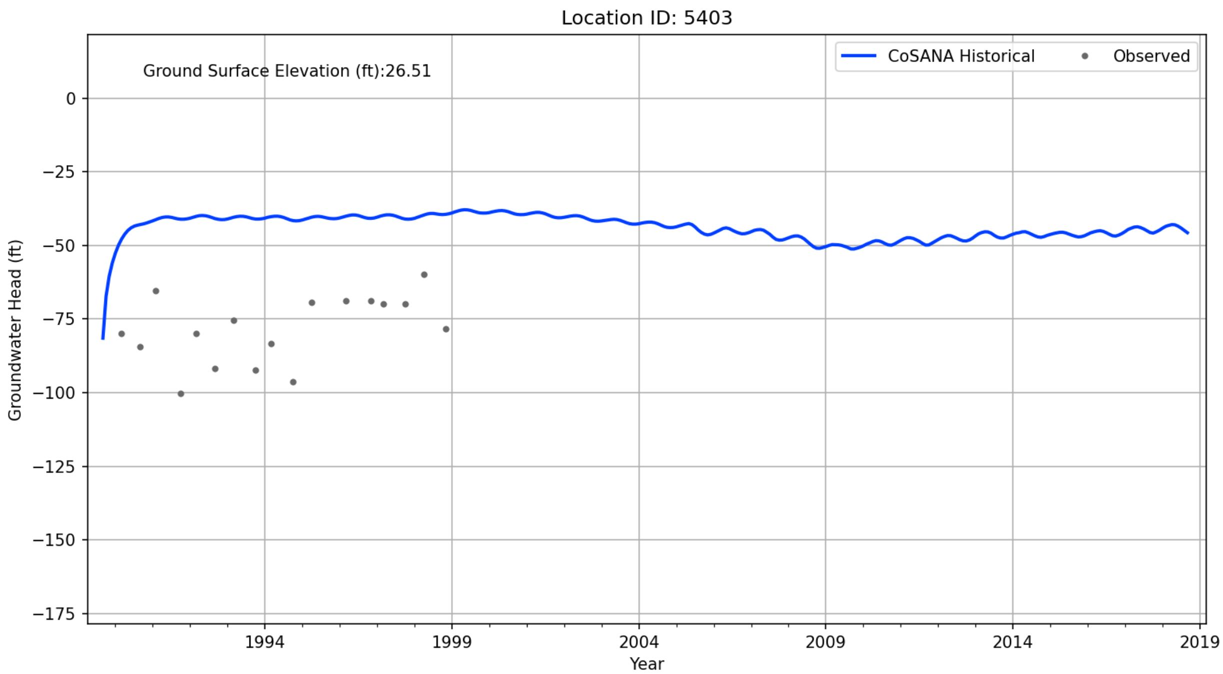
Location ID: 5311
Ground Surface Elevation (ft):42.7
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019



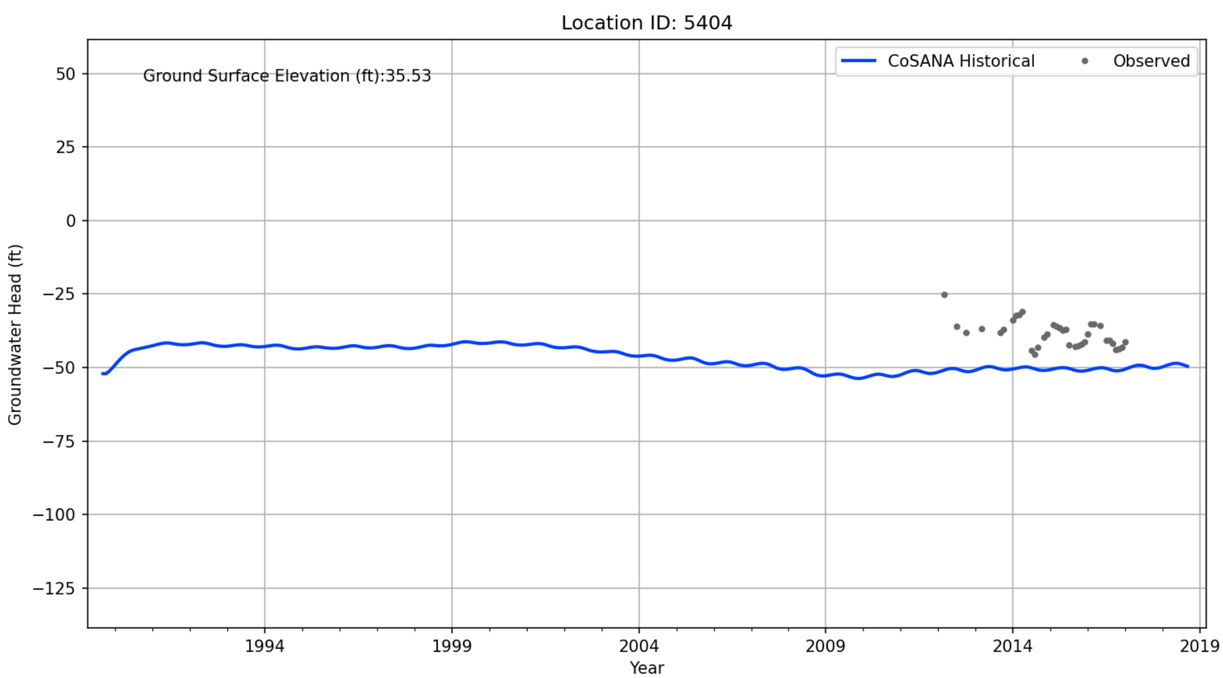
Location ID: 5312
Ground Surface Elevation (ft):45.9
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019


Location ID: 5401
Ground Surface Elevation (ft):12.94
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

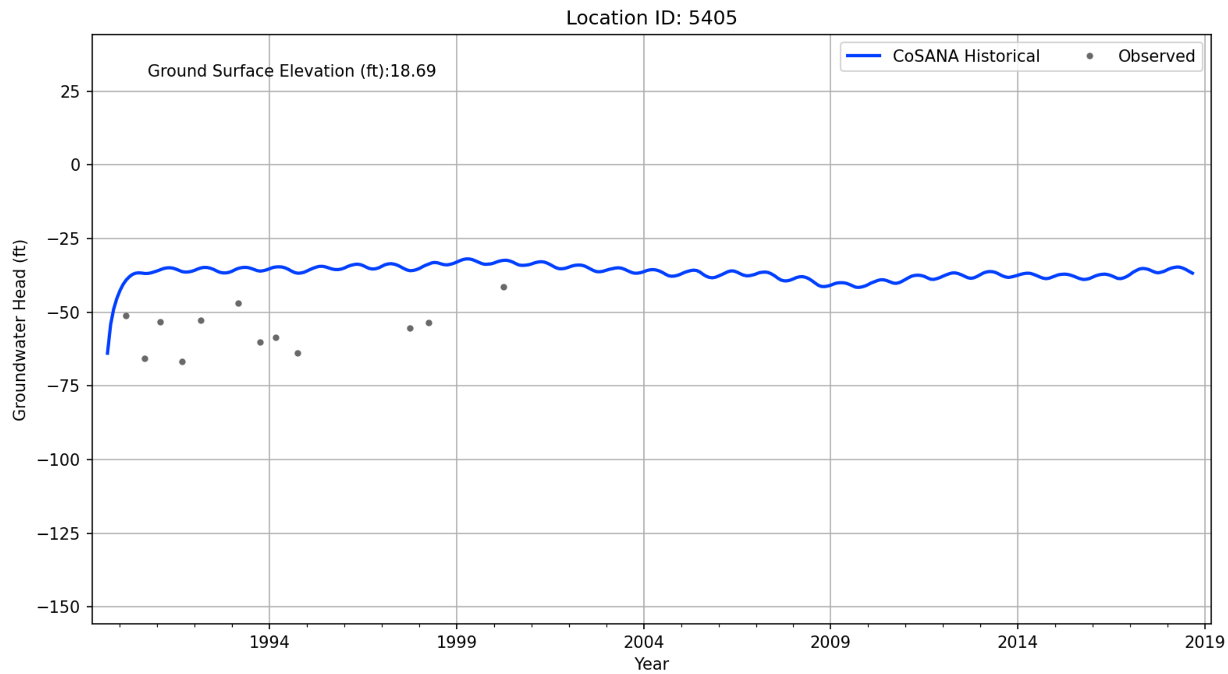

Location ID: 5402
Ground Surface Elevation (ft):13.73
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

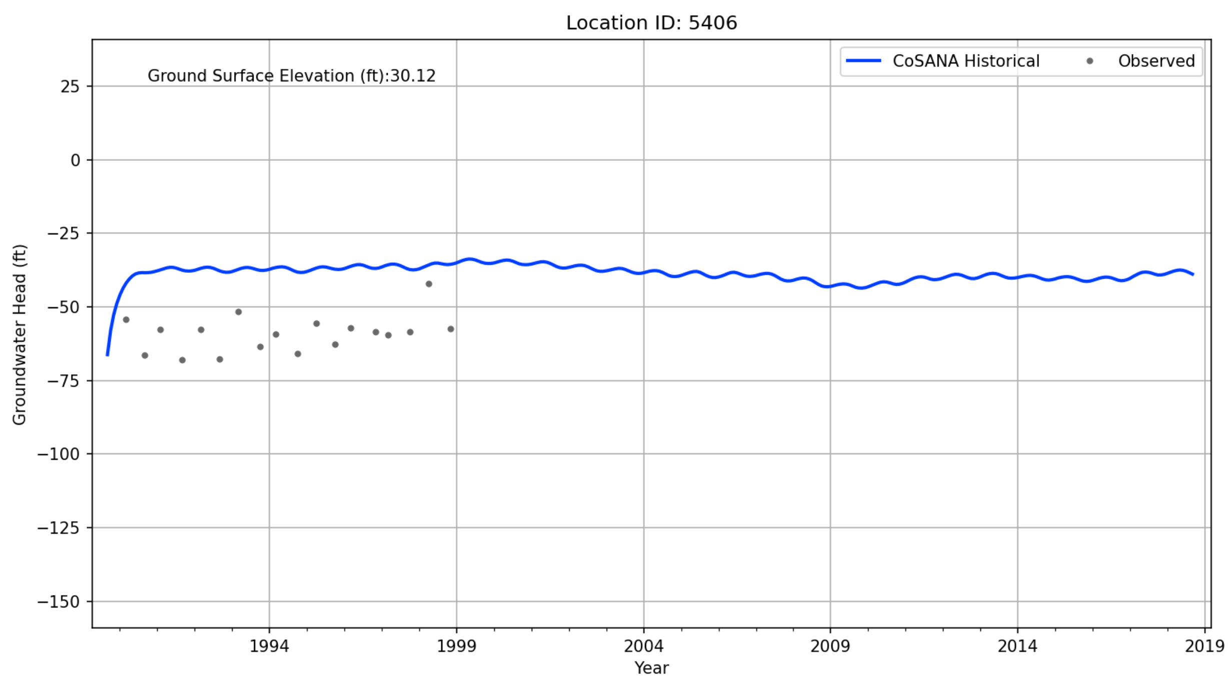


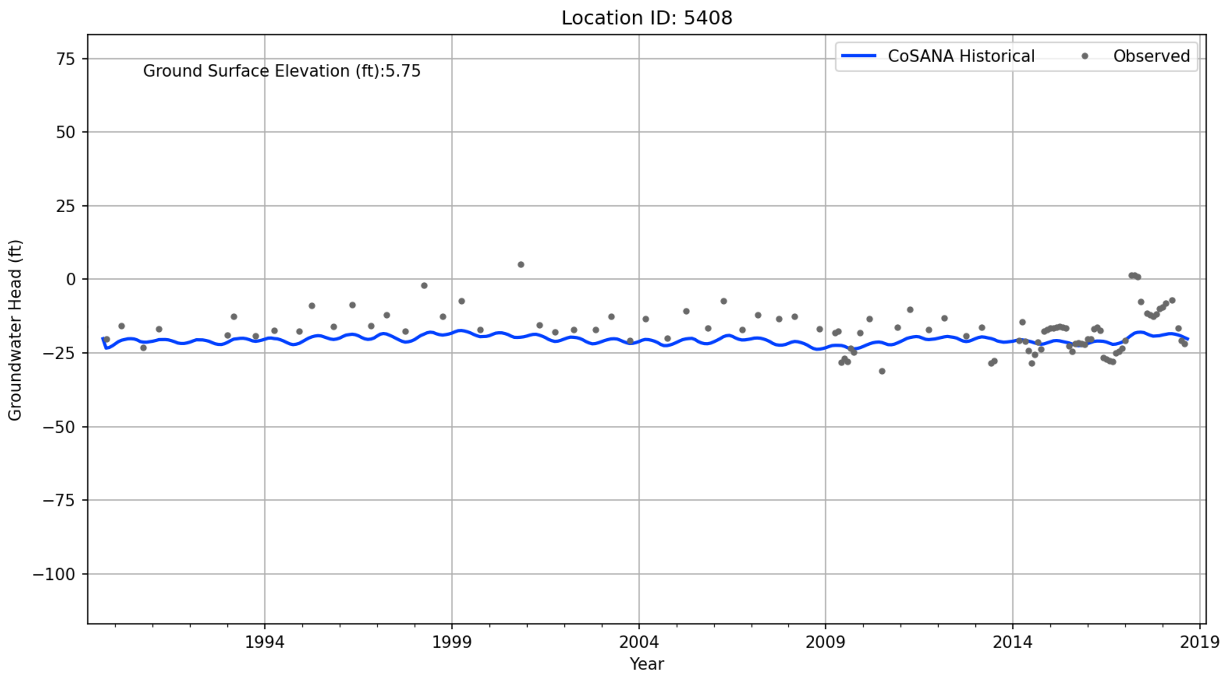
Location ID: 5403
CoSANA Historical
Observed
Ground Surface Elevation (ft):26.51
Groundwater Head (ft)
0
−25
−50
−75
−100
−125
−150
−175
1994
1999
2004
2009
2014
2019
Year

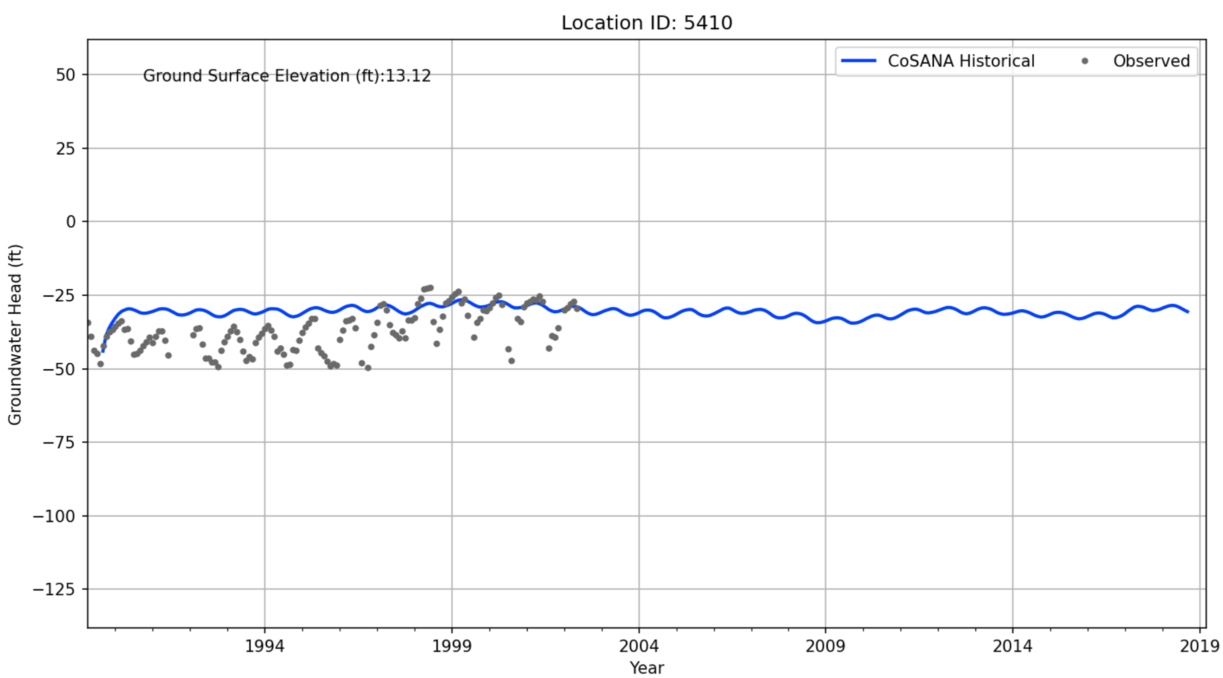


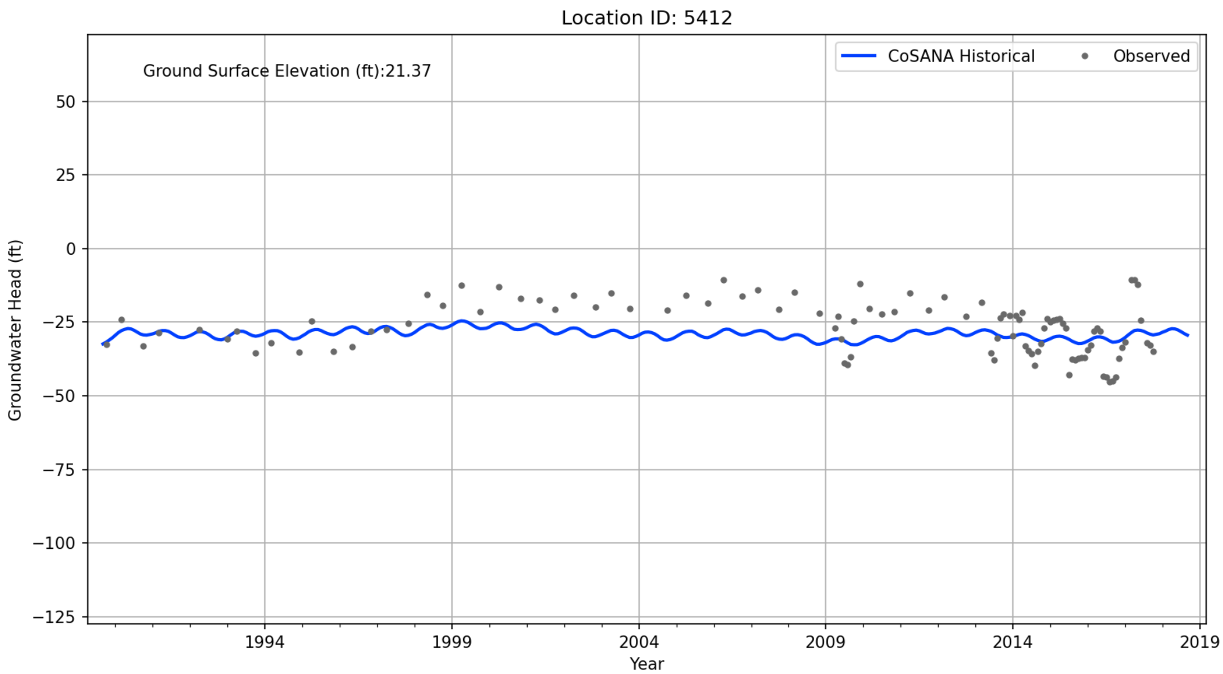
Location ID: 5404
CoSANA Historical
Observed
Ground Surface Elevation (ft):35.53
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 5405
Ground Surface Elevation (ft):18.69
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

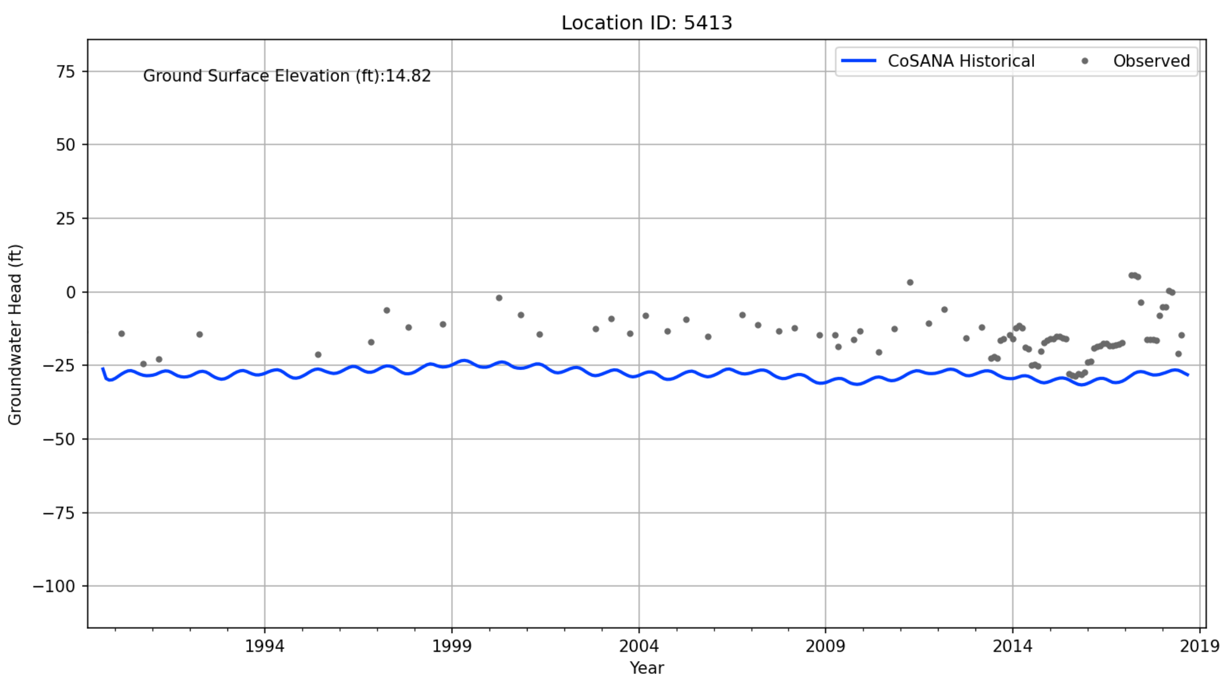

Location ID: 5406
Ground Surface Elevation (ft):30.12
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year


Location ID: 5408
CoSANA Historical
Observed
Ground Surface Elevation (ft):5.75
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

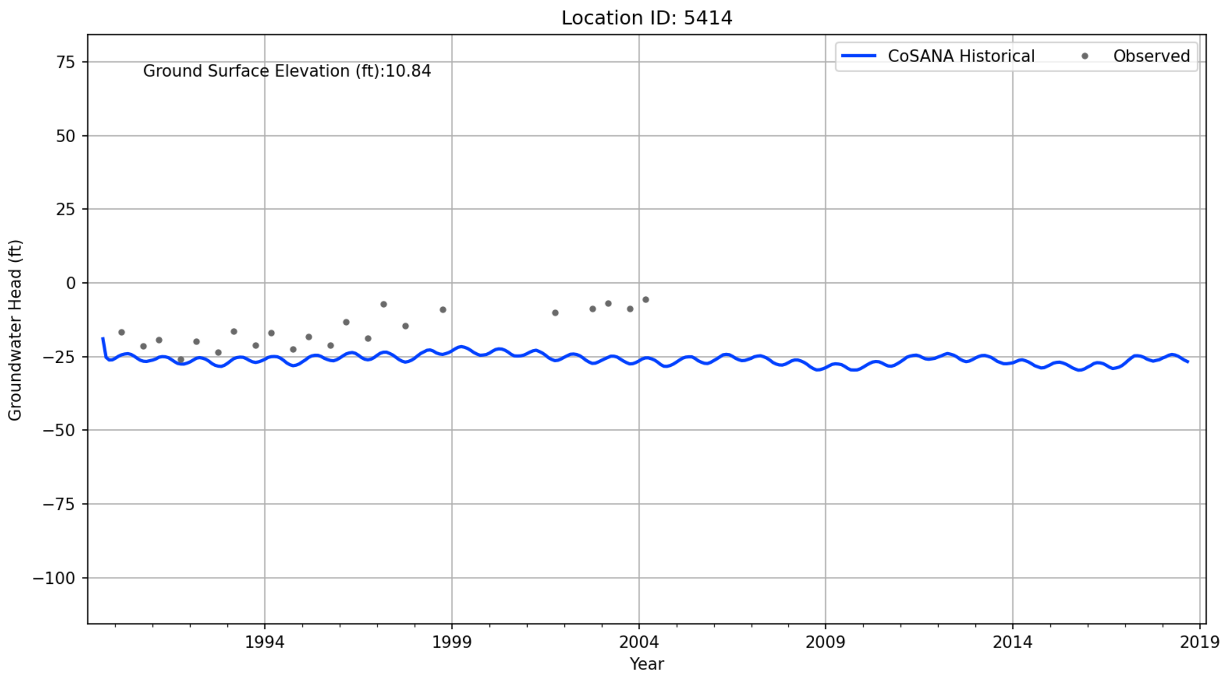

Location ID: 5410
CoSANA Historical
Observed
Ground Surface Elevation (ft):13.12
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year



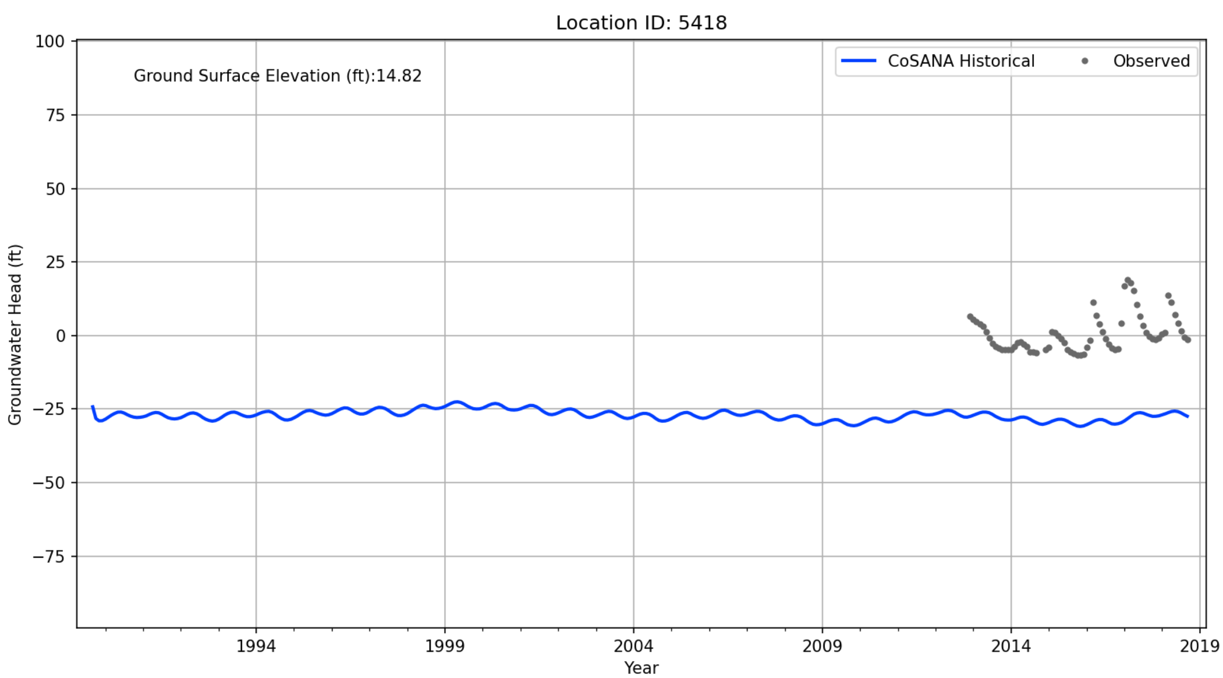
Location ID: 5412
Ground Surface Elevation (ft):21.37
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year



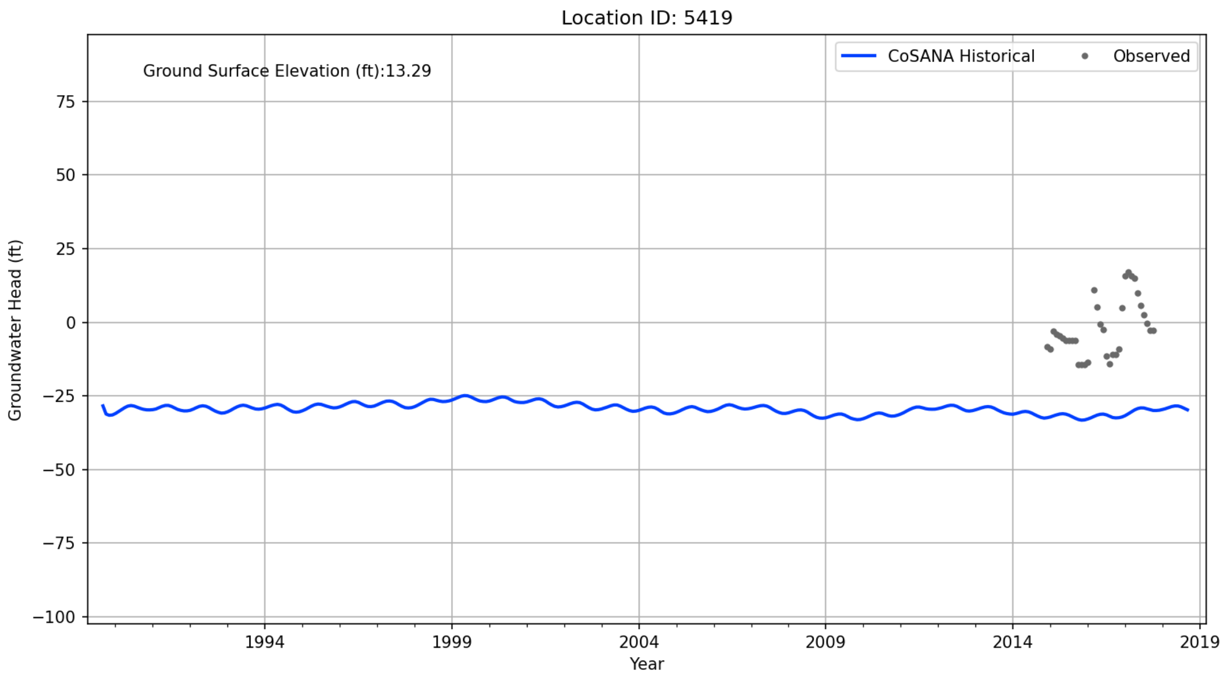
Location ID: 5413
Ground Surface Elevation (ft):14.82
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

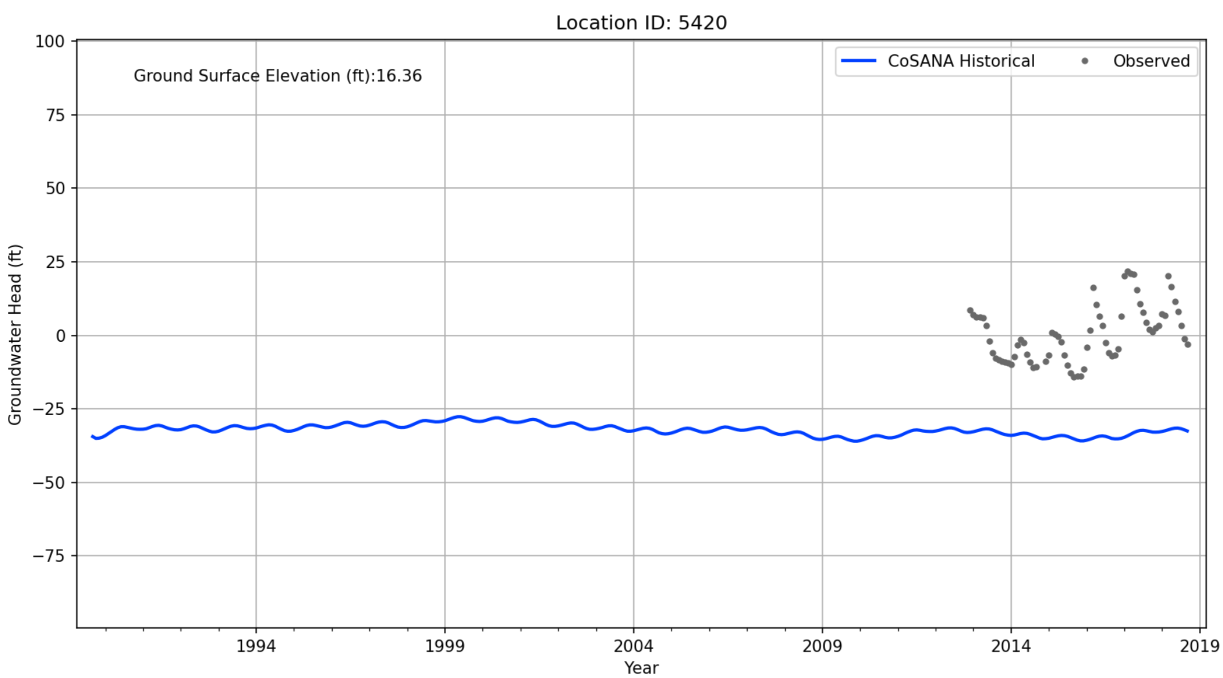


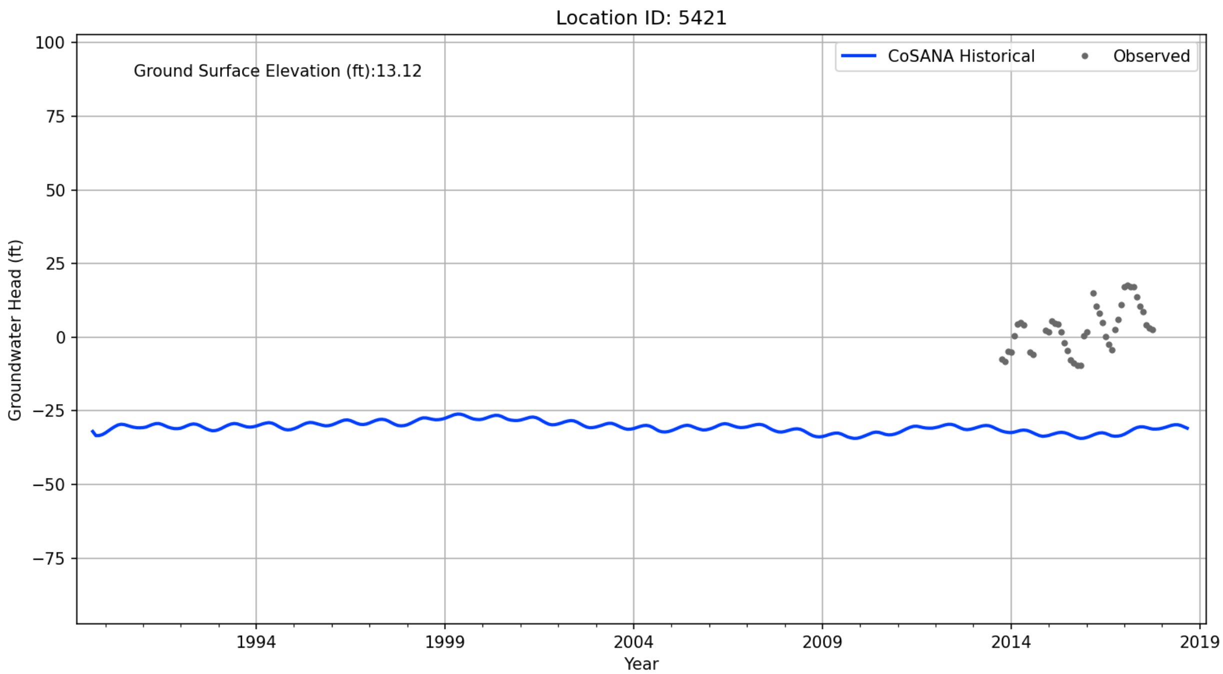
Location ID: 5414
CoSANA Historical
Observed
Ground Surface Elevation (ft):10.84
75
50
25
0
−25
−50
−75
−100
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year

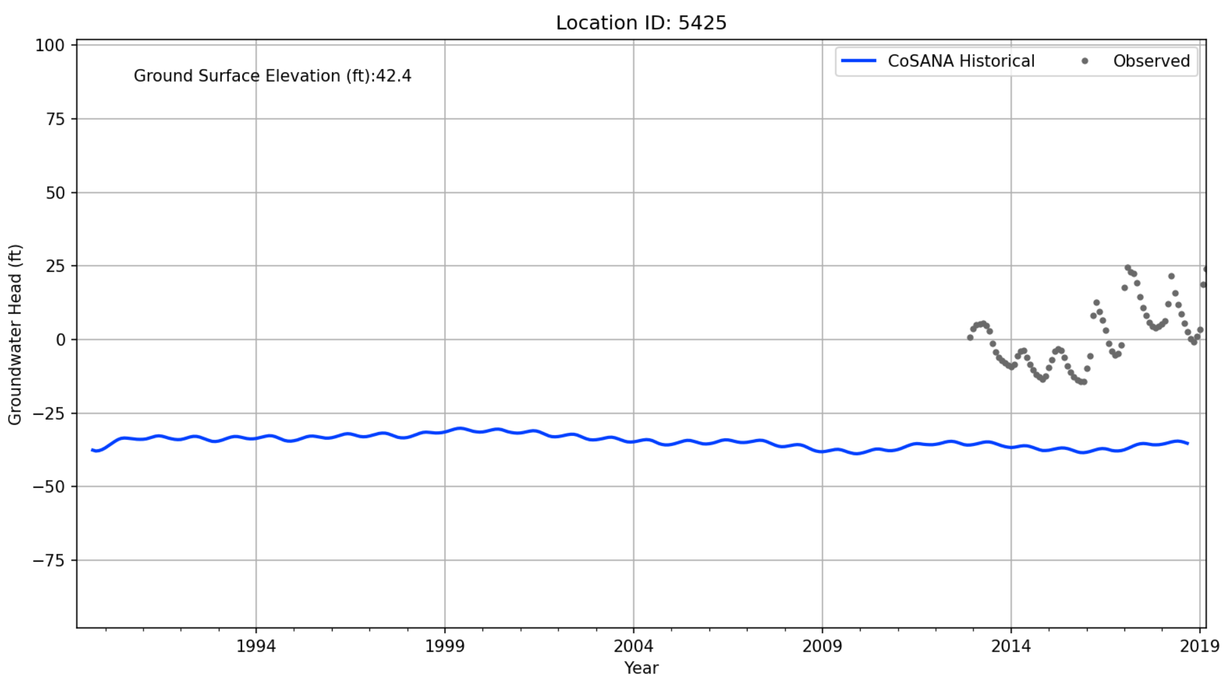


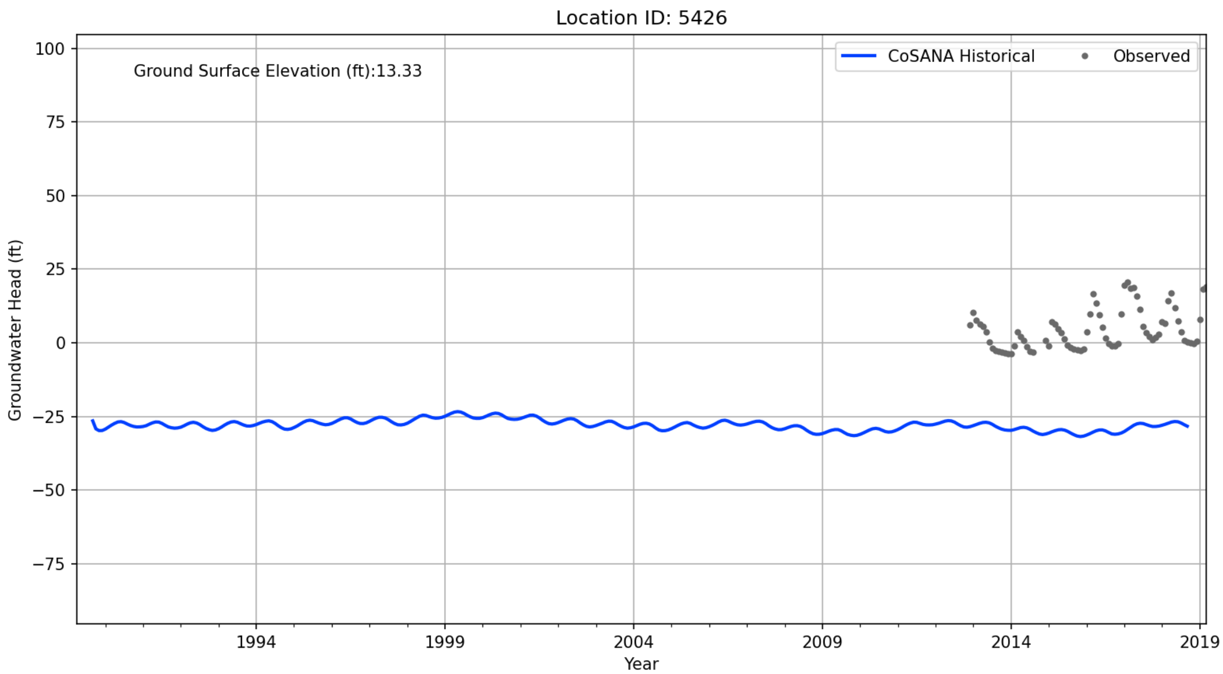
Location ID: 5418
CoSANA Historical
Observed
Ground Surface Elevation (ft):14.82
100
75
50
25
0
−25
−50
−75
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year

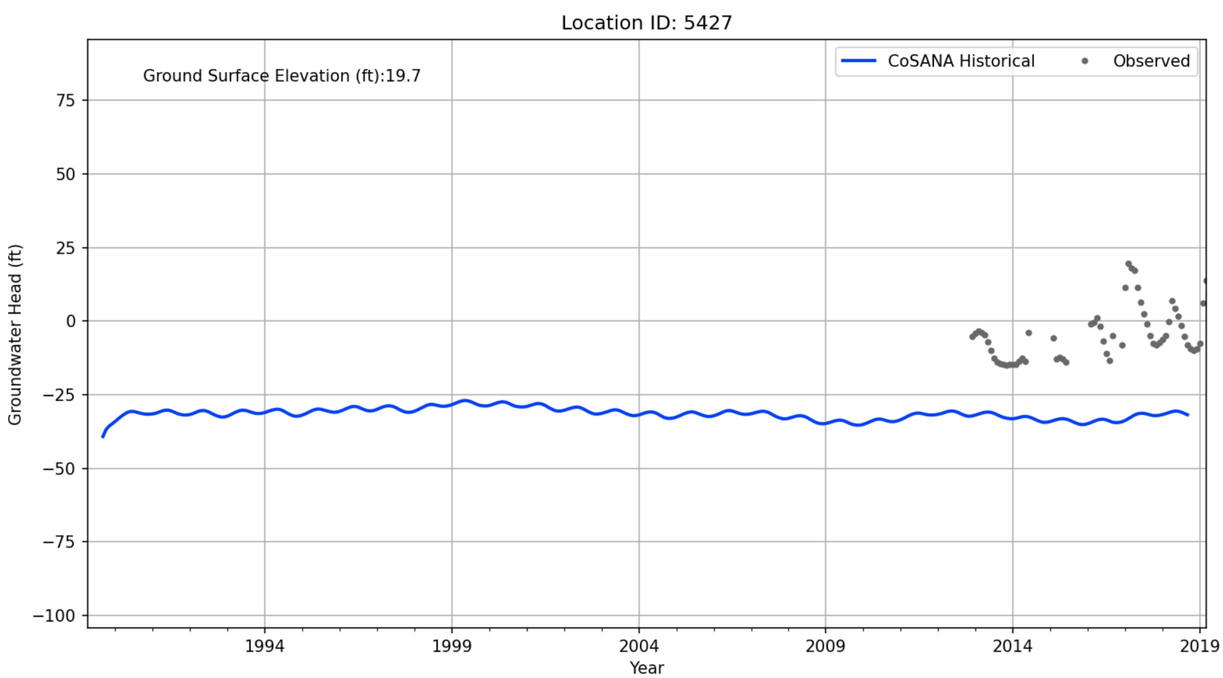

Location ID: 5419
Ground Surface Elevation (ft):13.29
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

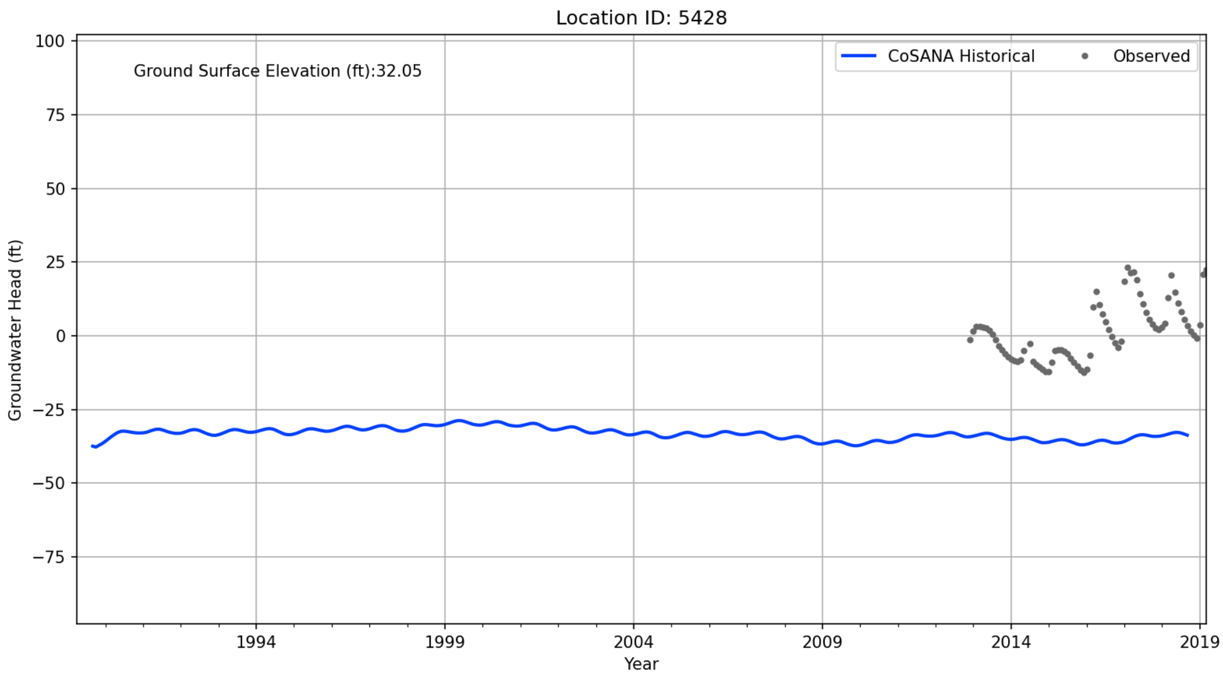

Location ID: 5420
Ground Surface Elevation (ft):16.36
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 5421
Ground Surface Elevation (ft):13.12
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

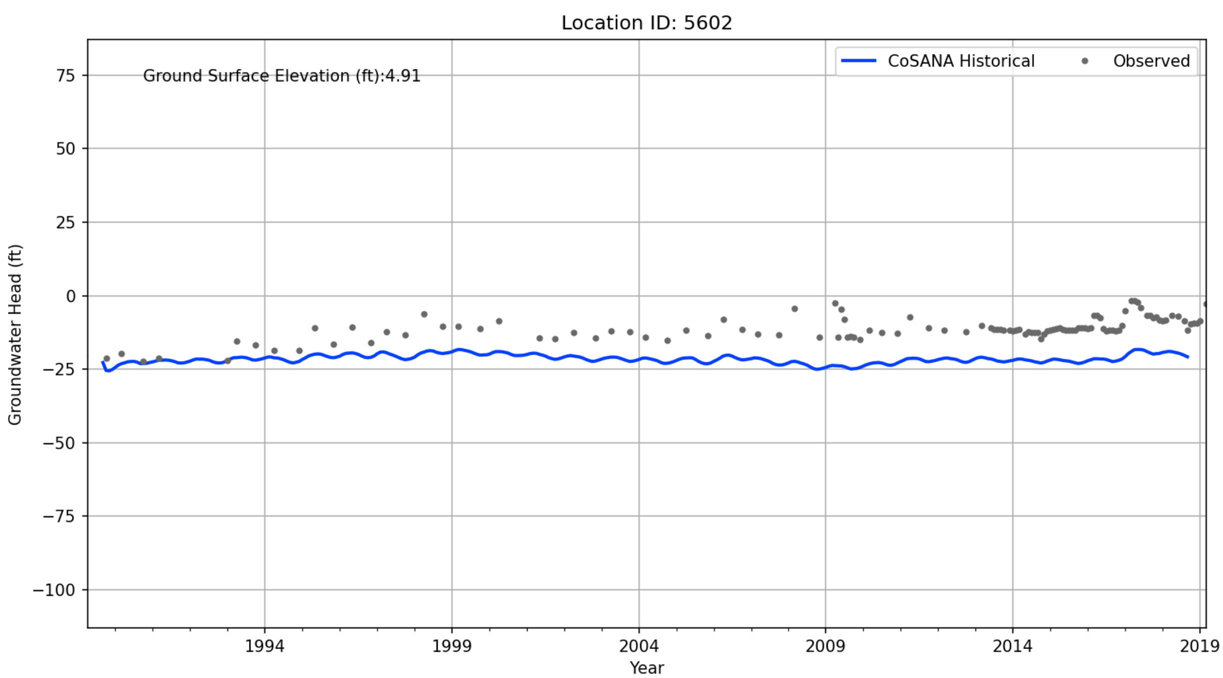

Location ID: 5425
Ground Surface Elevation (ft):42.4
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019


Location ID: 5426
Ground Surface Elevation (ft):13.33
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

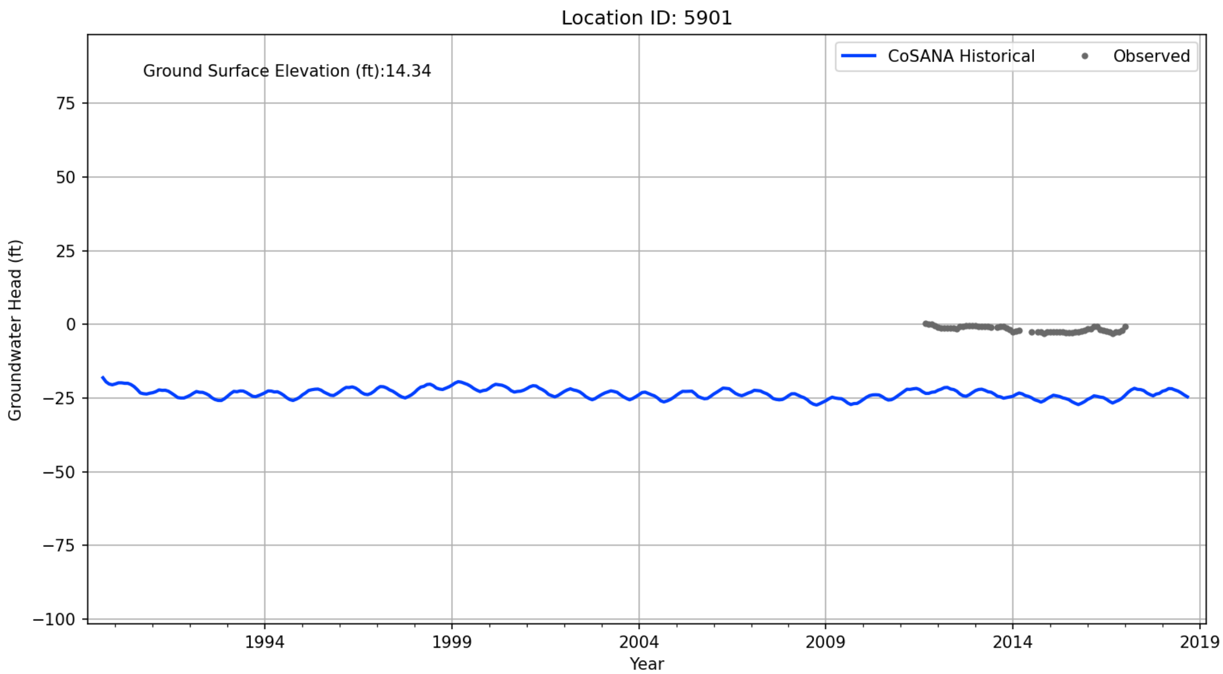

Location ID: 5427
Ground Surface Elevation (ft):19.7
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

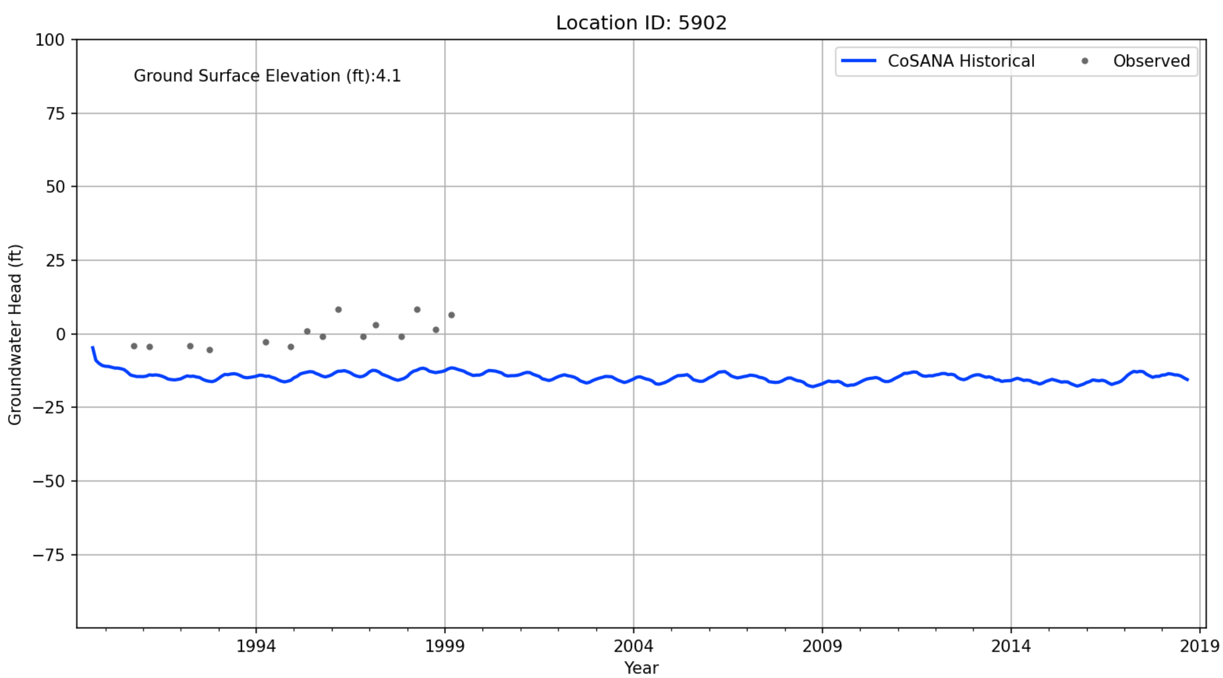


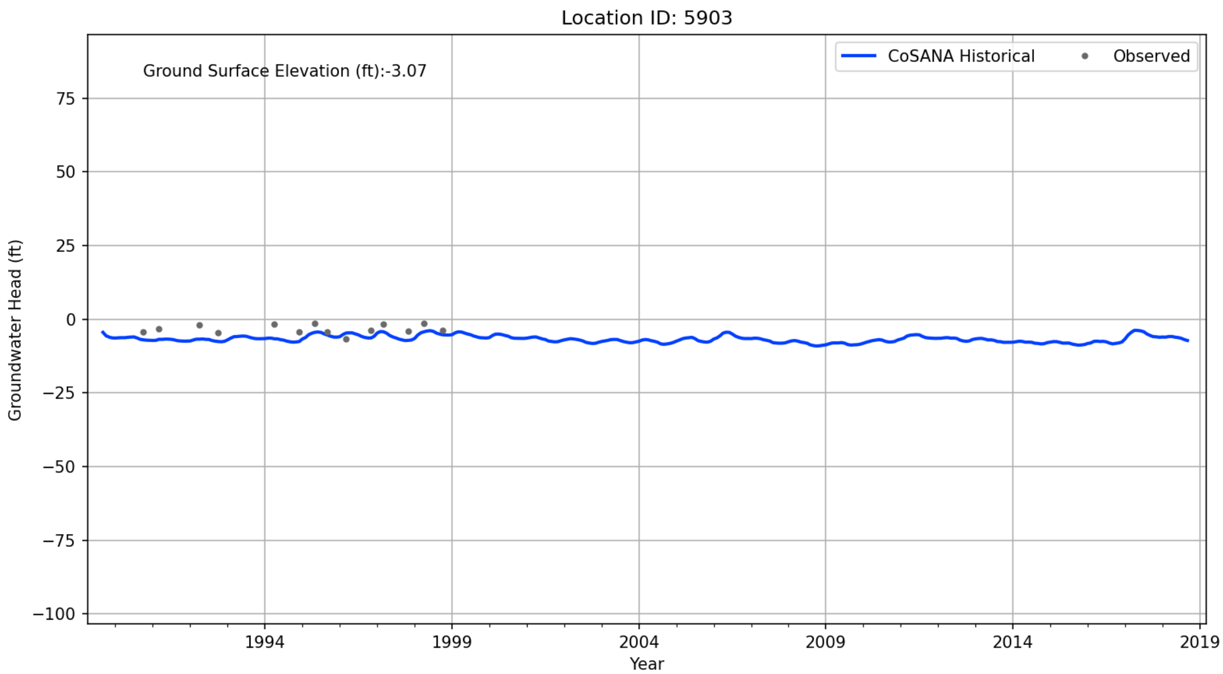
Location ID: 5428
Ground Surface Elevation (ft):32.05
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019



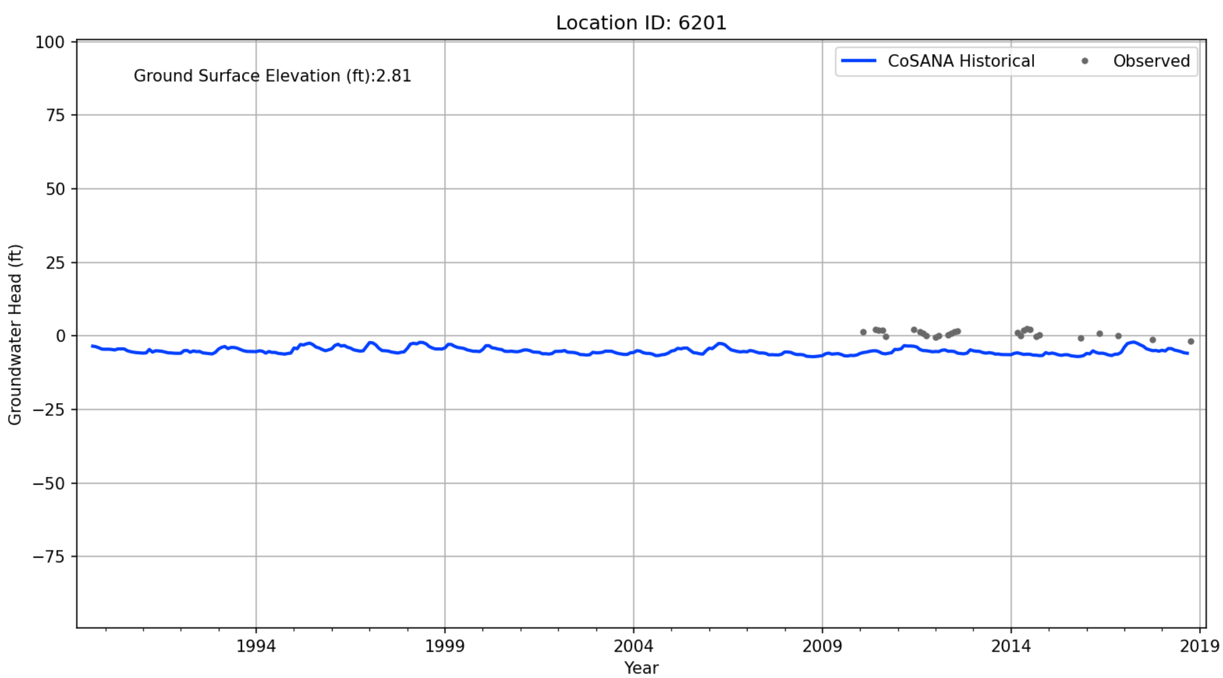
Location ID: 5602
Ground Surface Elevation (ft):4.91
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 5901
Ground Surface Elevation (ft):14.34
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

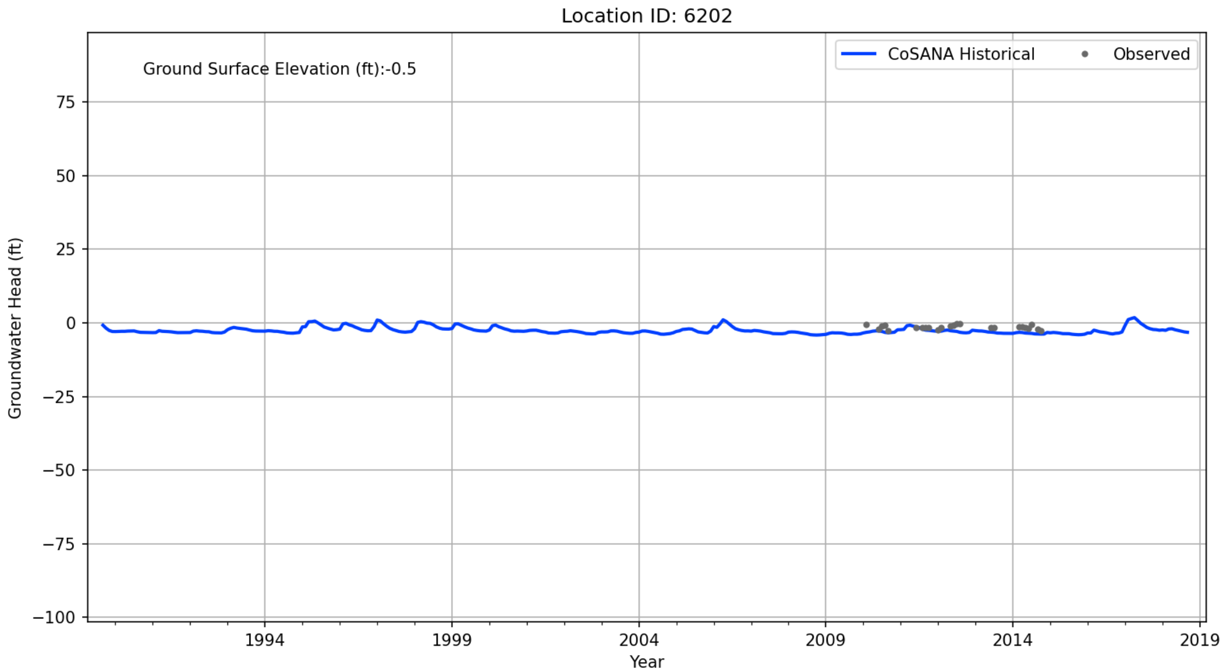

Location ID: 5902
Ground Surface Elevation (ft):4.1
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year



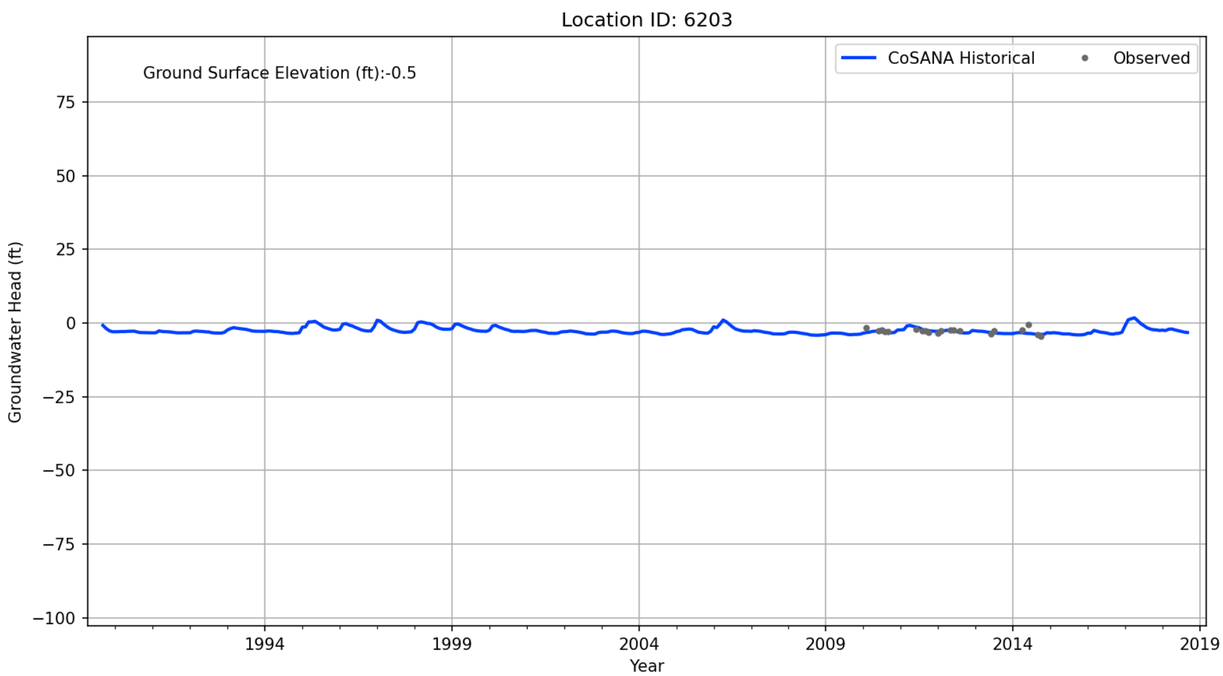
Location ID: 5903
CoSANA Historical
Observed
Ground Surface Elevation (ft):-3.07
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



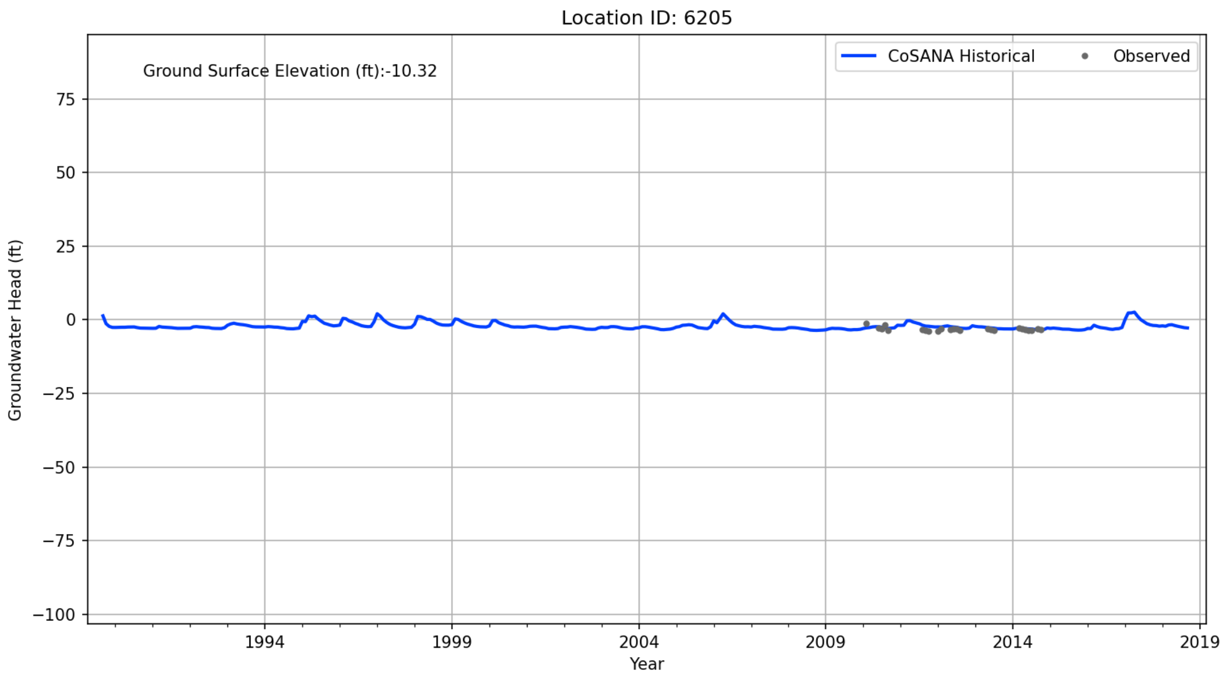
Location ID: 6201
CoSANA Historical
Observed
Ground Surface Elevation (ft):2.81
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year

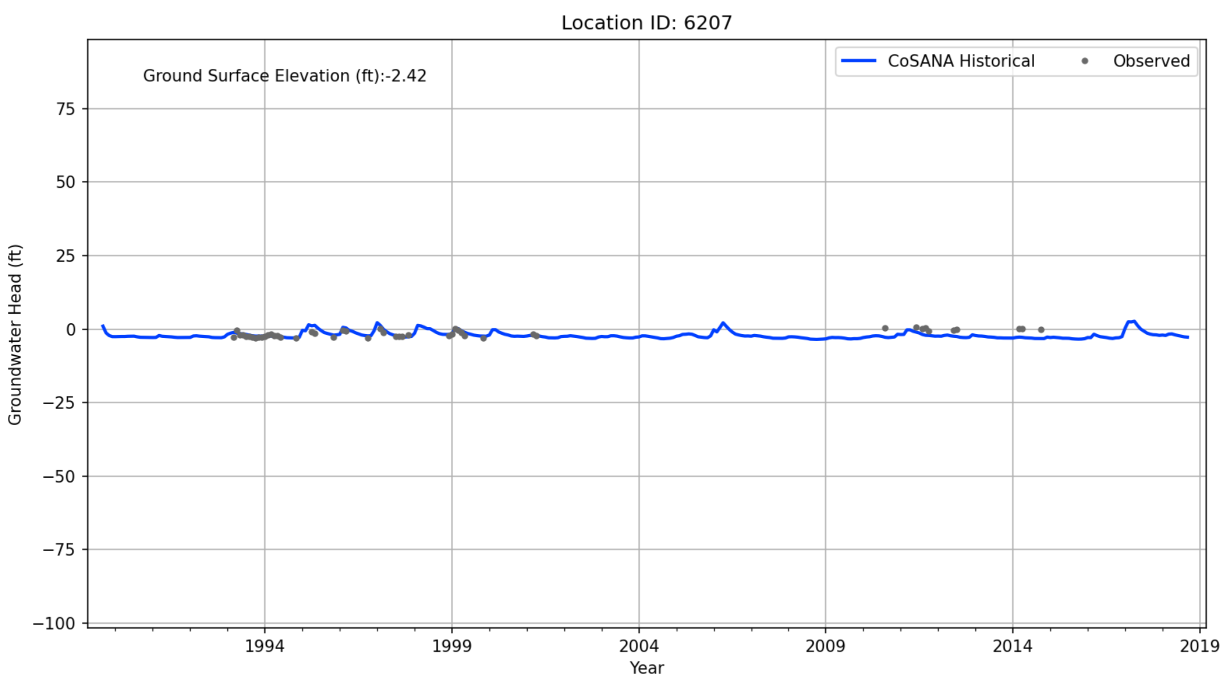


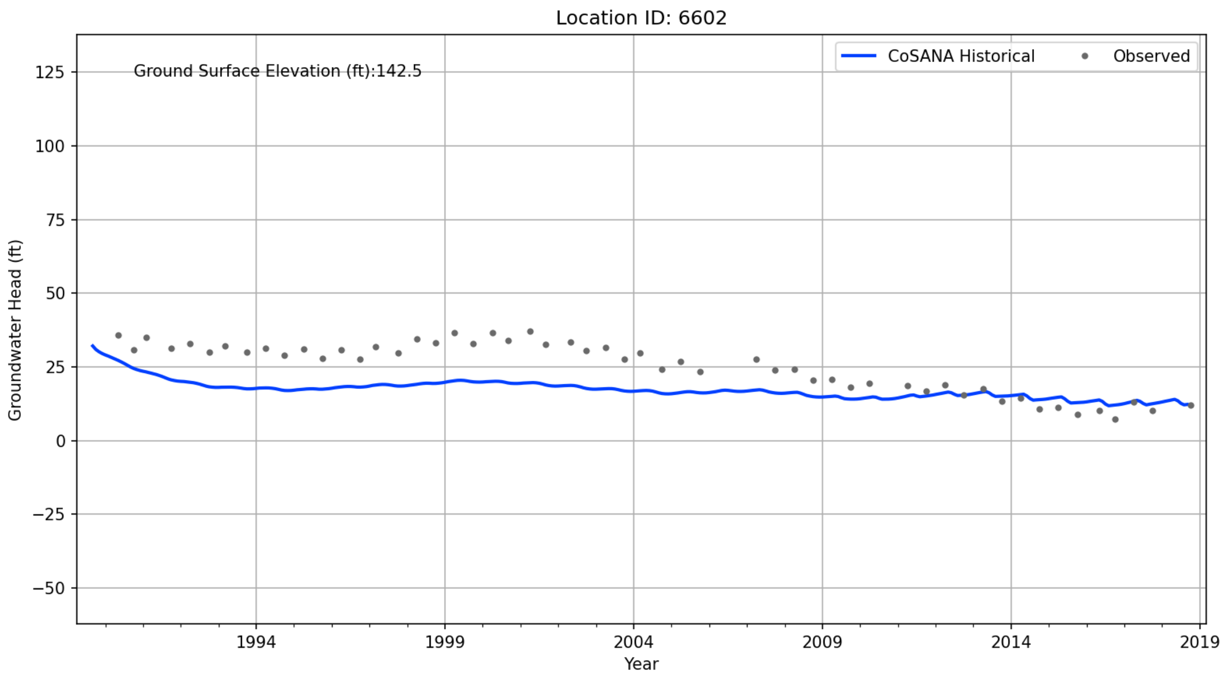
Location ID: 6202
CoSANA Historical
Observed
Ground Surface Elevation (ft):-0.5
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



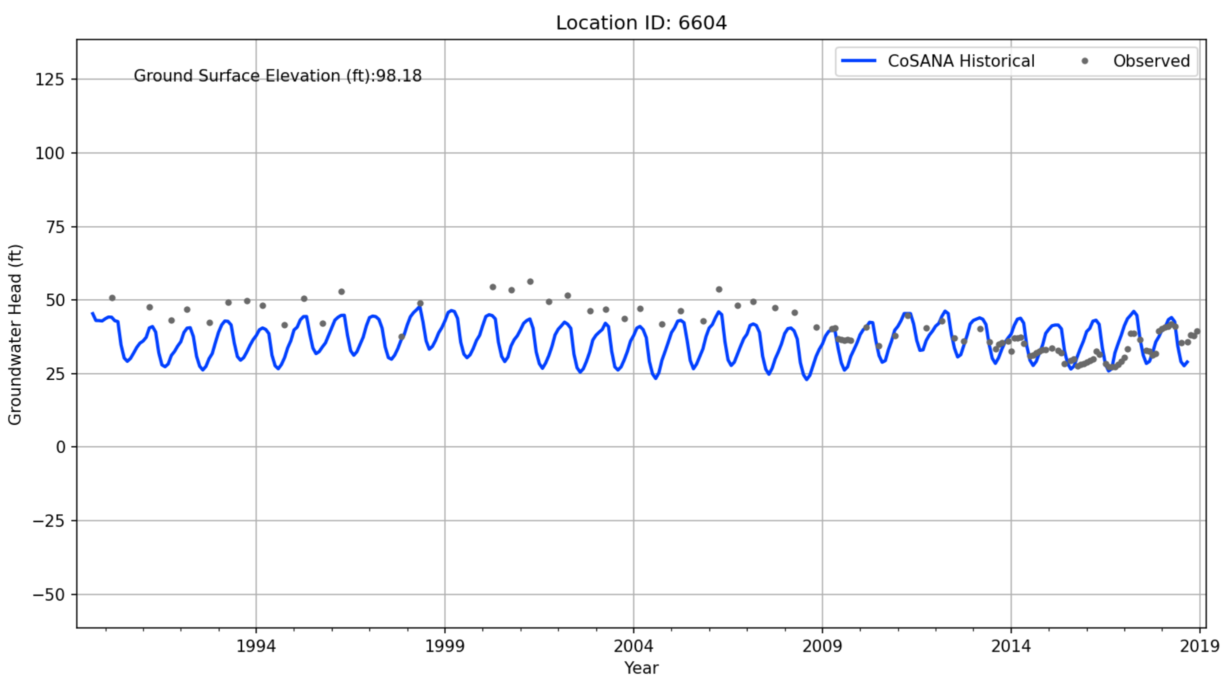
Location ID: 6203
CoSANA Historical
Observed
Ground Surface Elevation (ft):-0.5
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 6205
Ground Surface Elevation (ft):-10.32
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

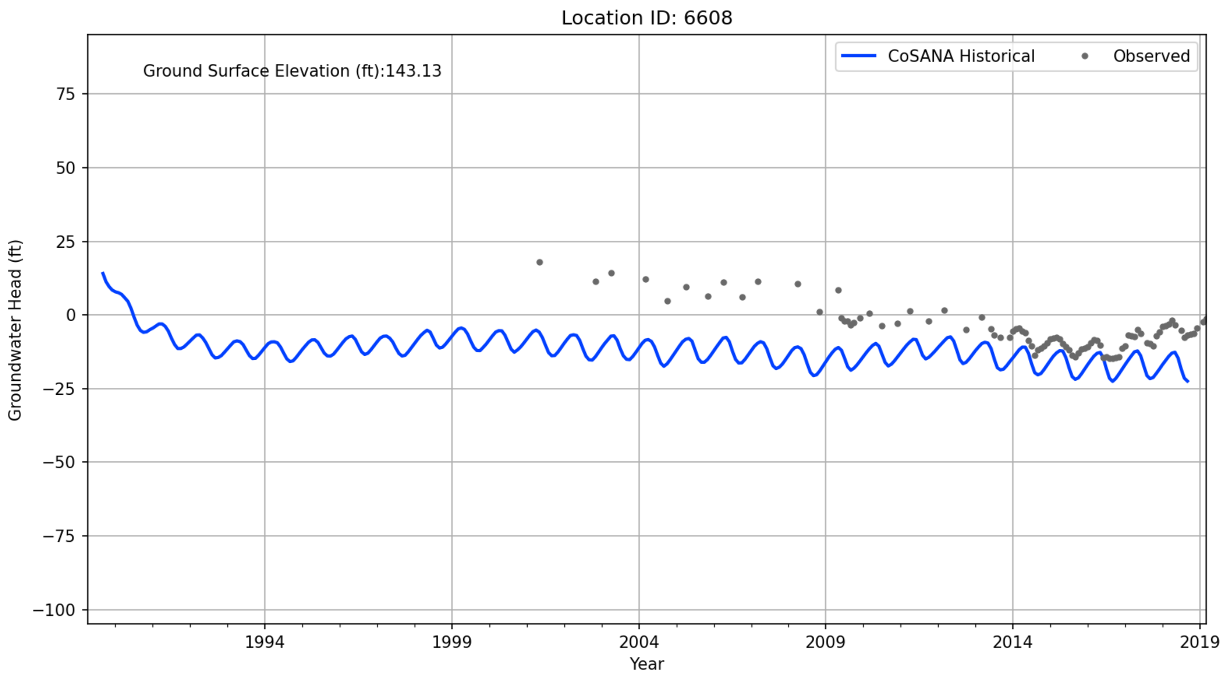

Location ID: 6207
Ground Surface Elevation (ft):-2.42
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

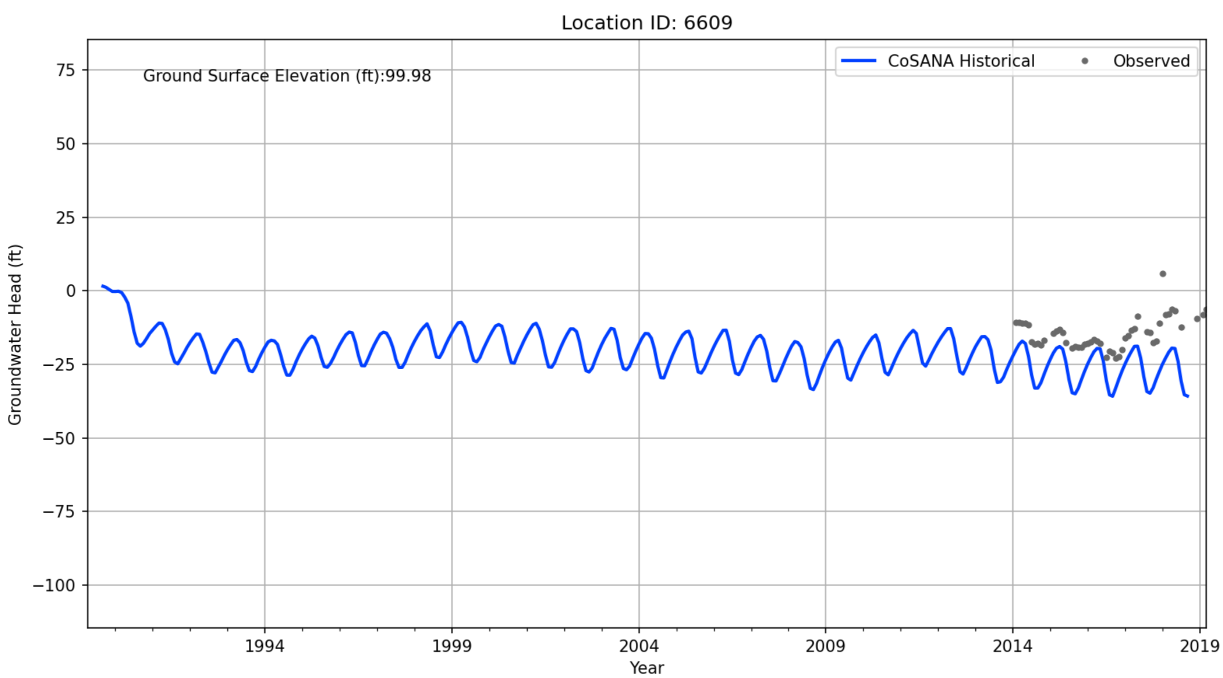


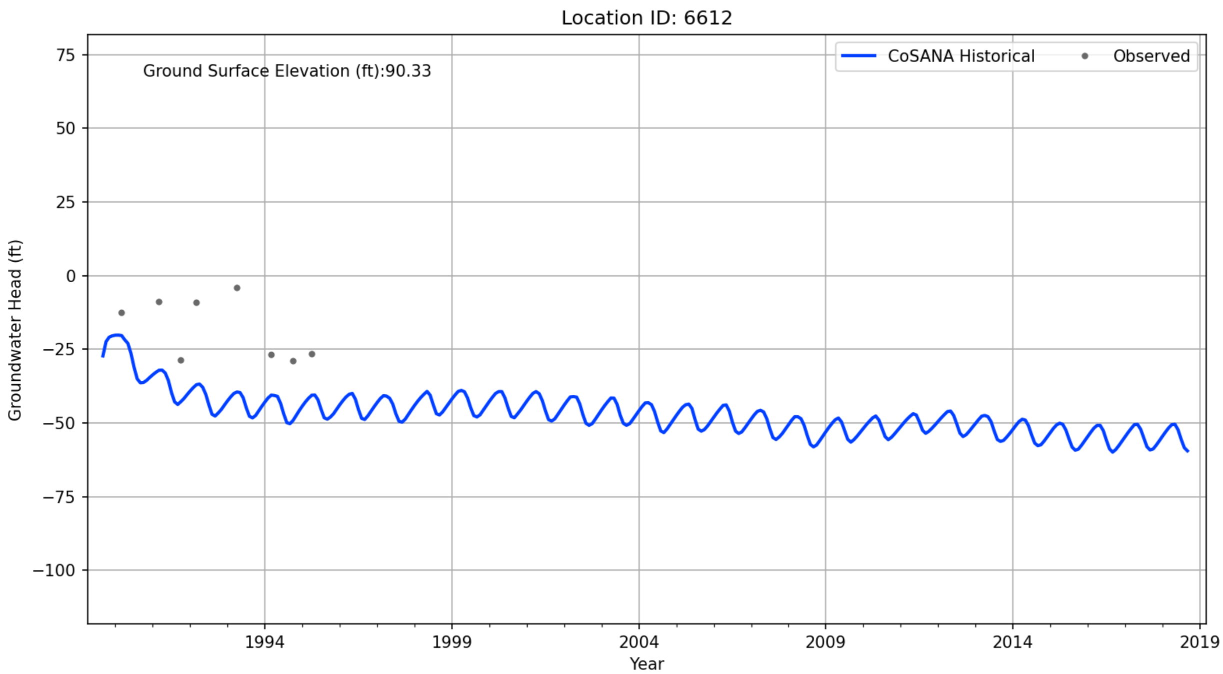
Location ID: 6602
Ground Surface Elevation (ft):142.5
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

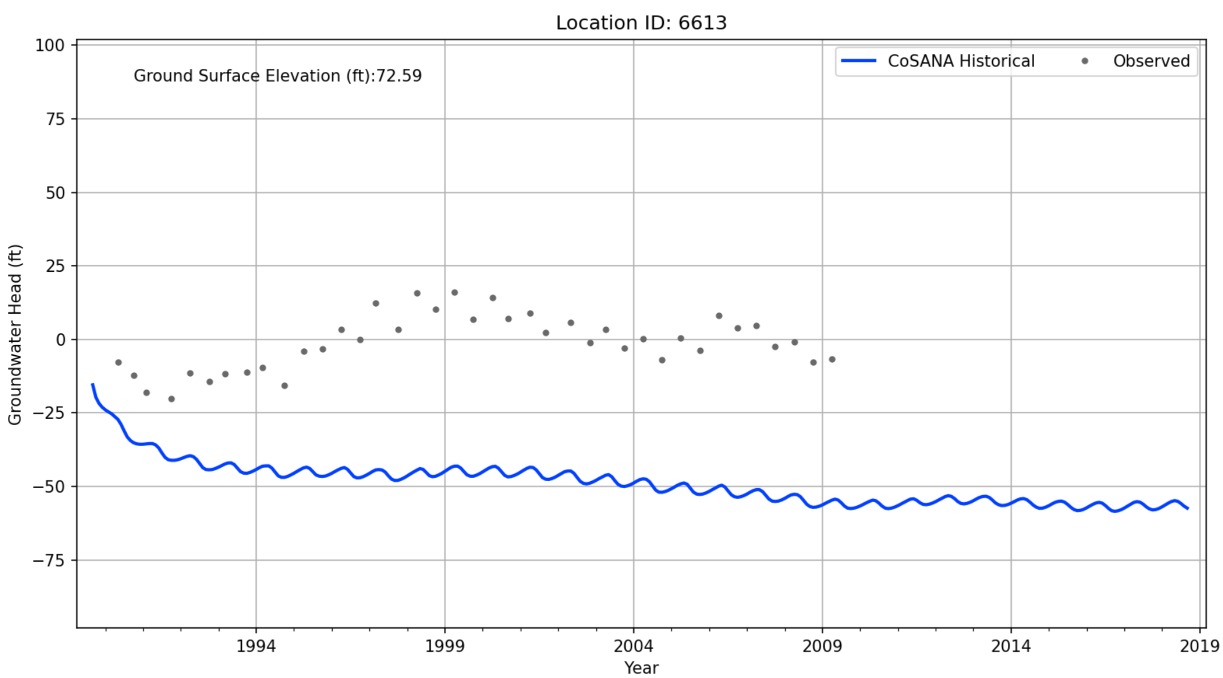


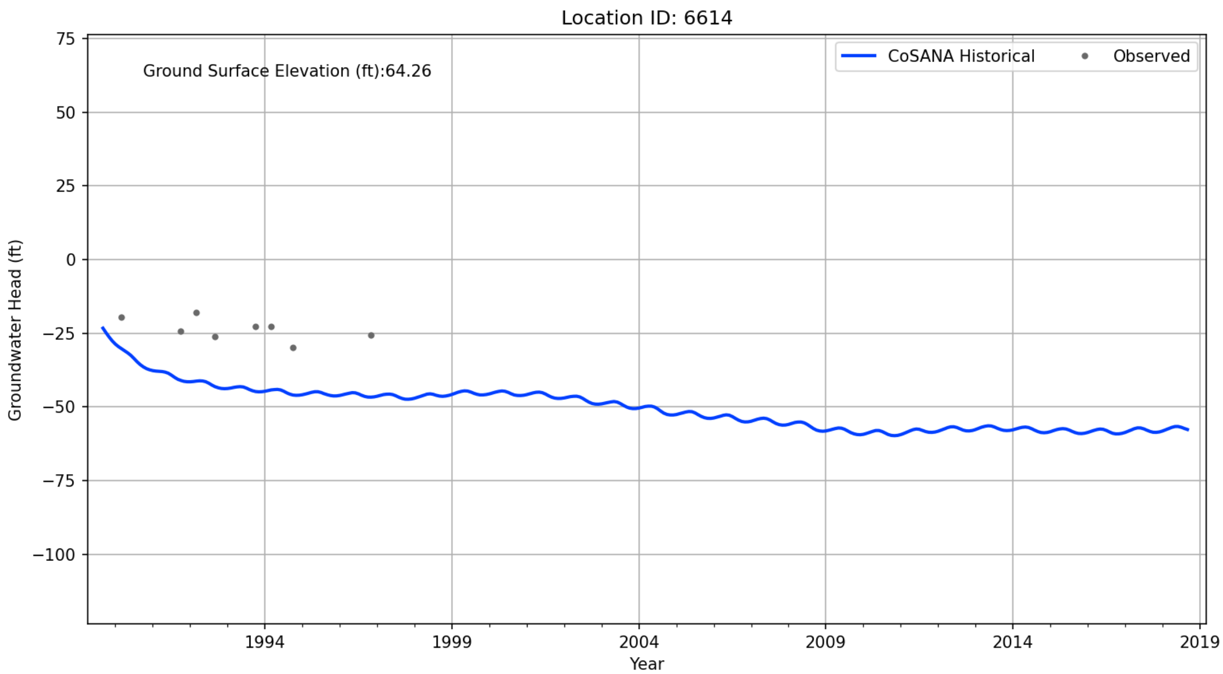
Location ID: 6604
Ground Surface Elevation (ft):98.18
CoSANA Historical
Observed
Groundwater Head (ft)
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019
Year

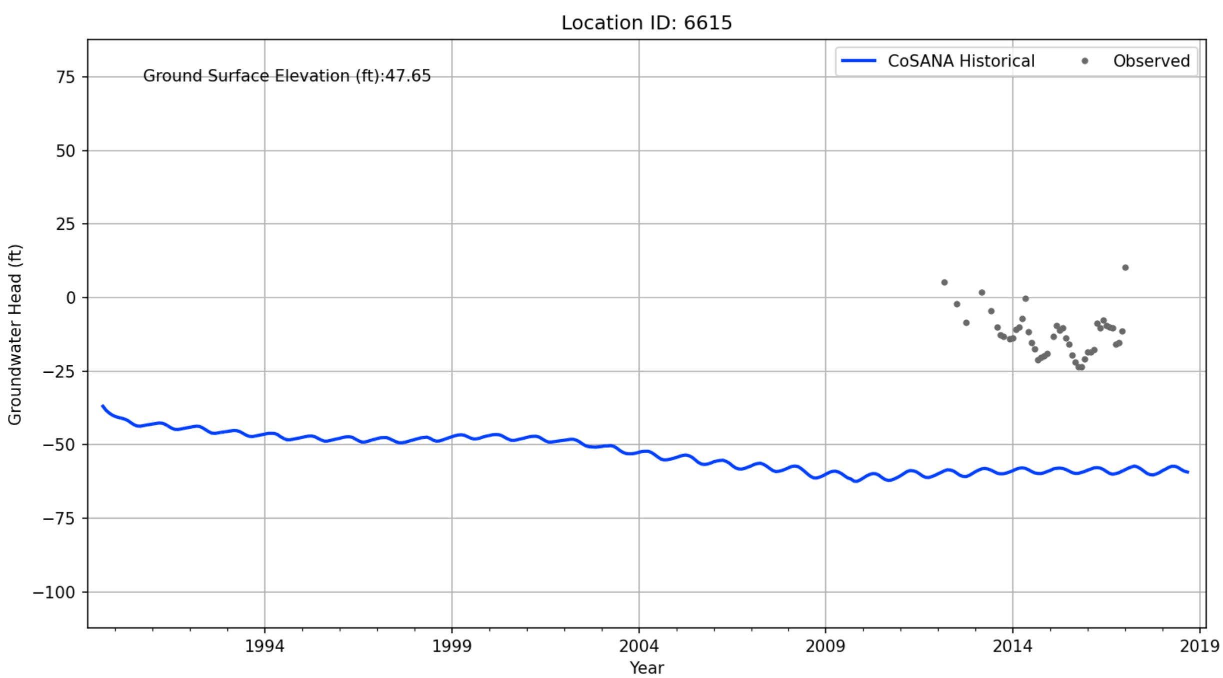

Location ID: 6608
Ground Surface Elevation (ft):143.13
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

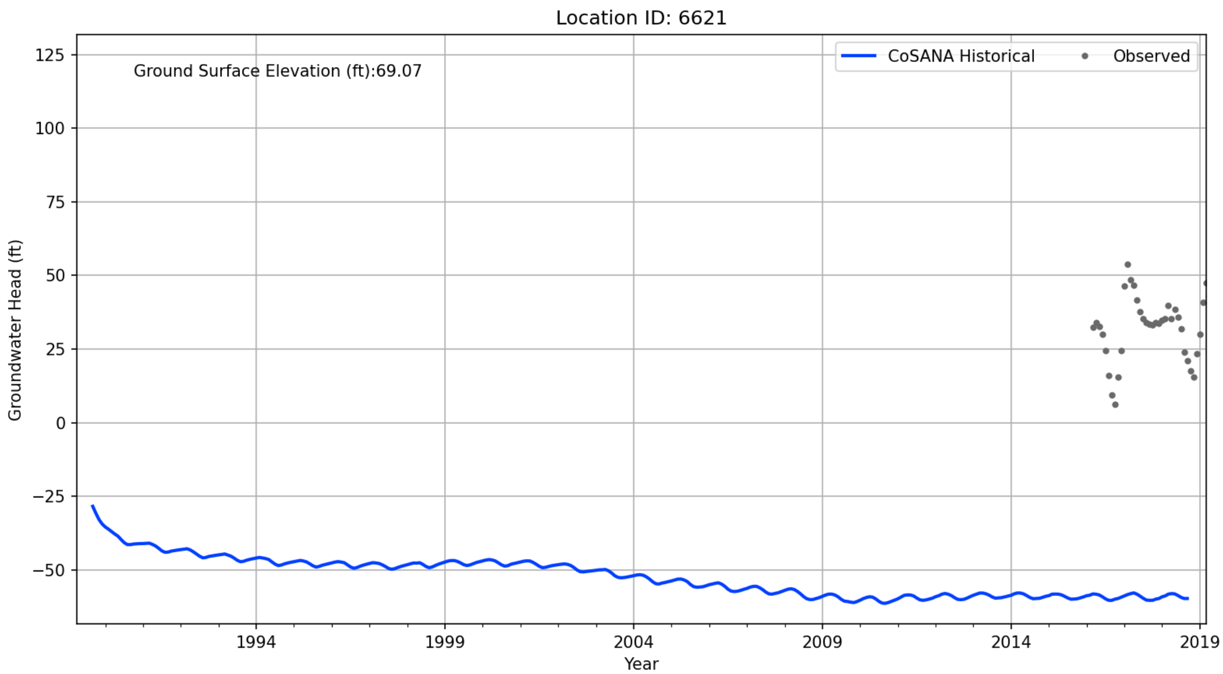

Location ID: 6609
Ground Surface Elevation (ft):99.98
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

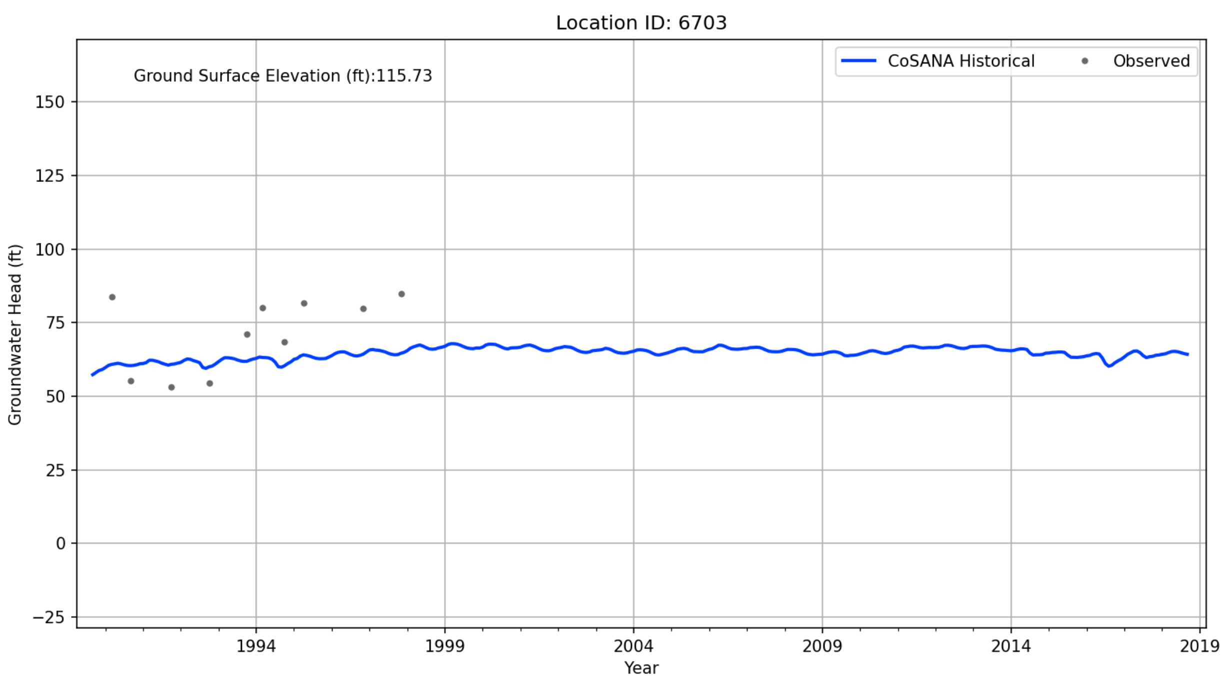

Location ID: 6612
Ground Surface Elevation (ft):90.33
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

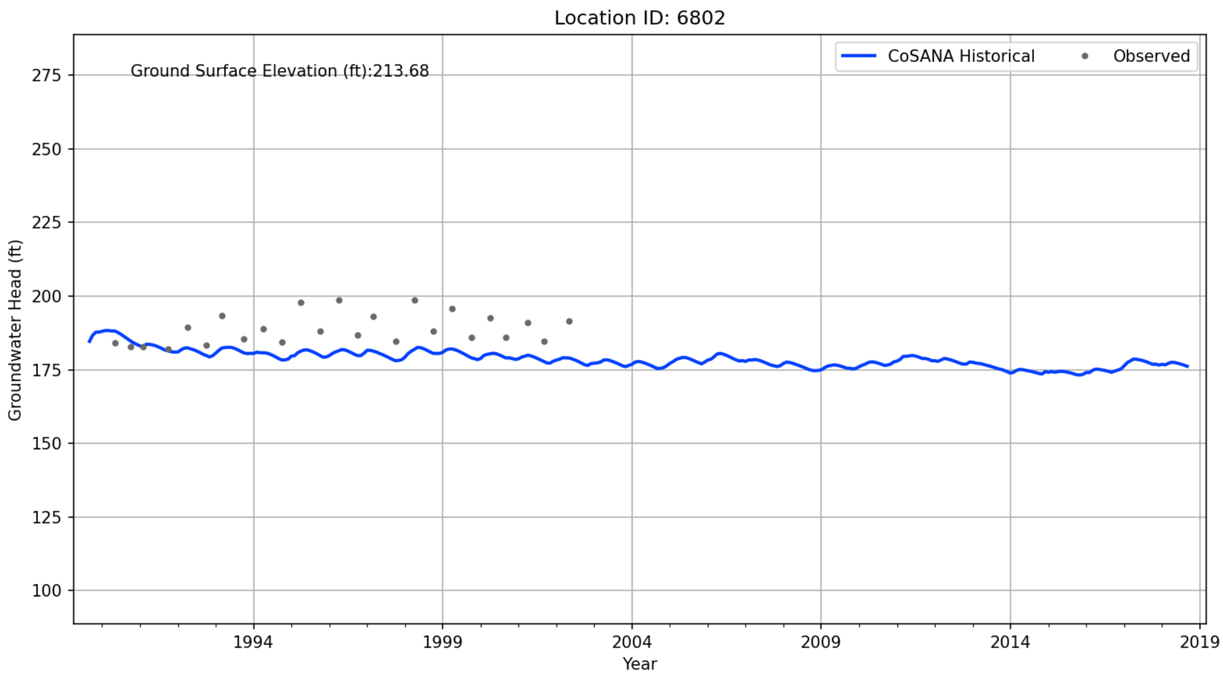

Location ID: 6613
Ground Surface Elevation (ft):72.59
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 6614
Ground Surface Elevation (ft):64.26
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

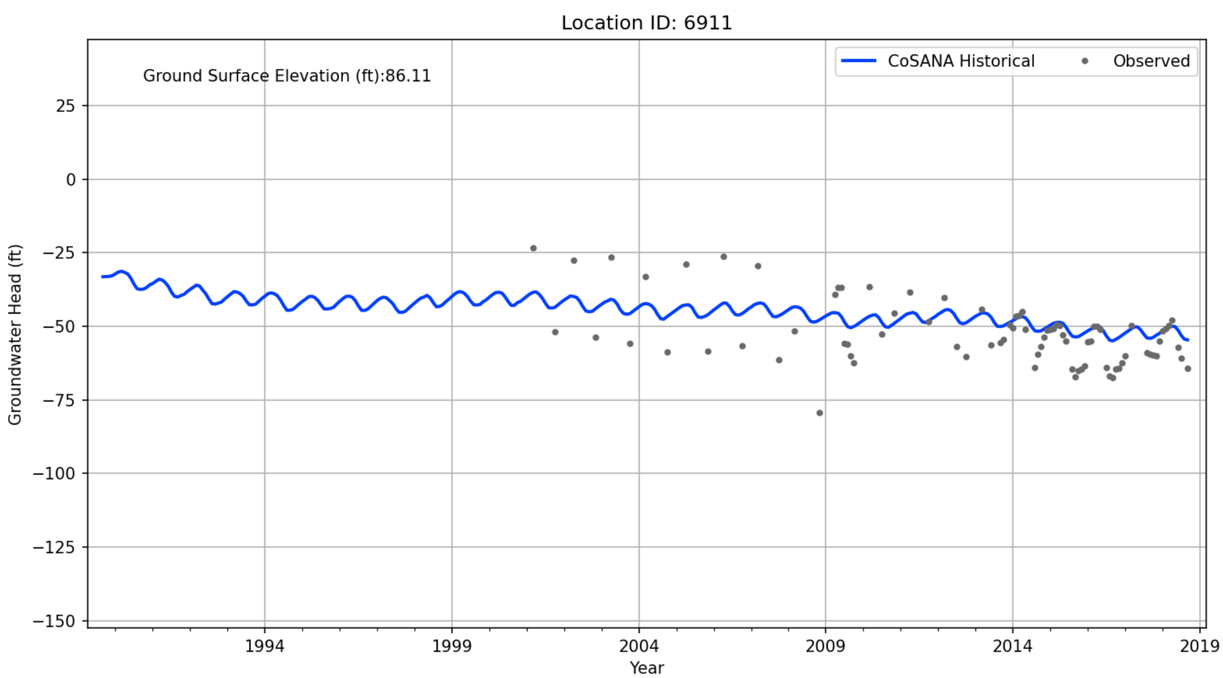

Location ID: 6615
Ground Surface Elevation (ft):47.65
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019


Location ID: 6621
Ground Surface Elevation (ft):69.07
CoSANA Historical
Observed
Groundwater Head (ft)
Year
125
100
75
50
25
0
−25
−50
1994
1999
2004
2009
2014
2019

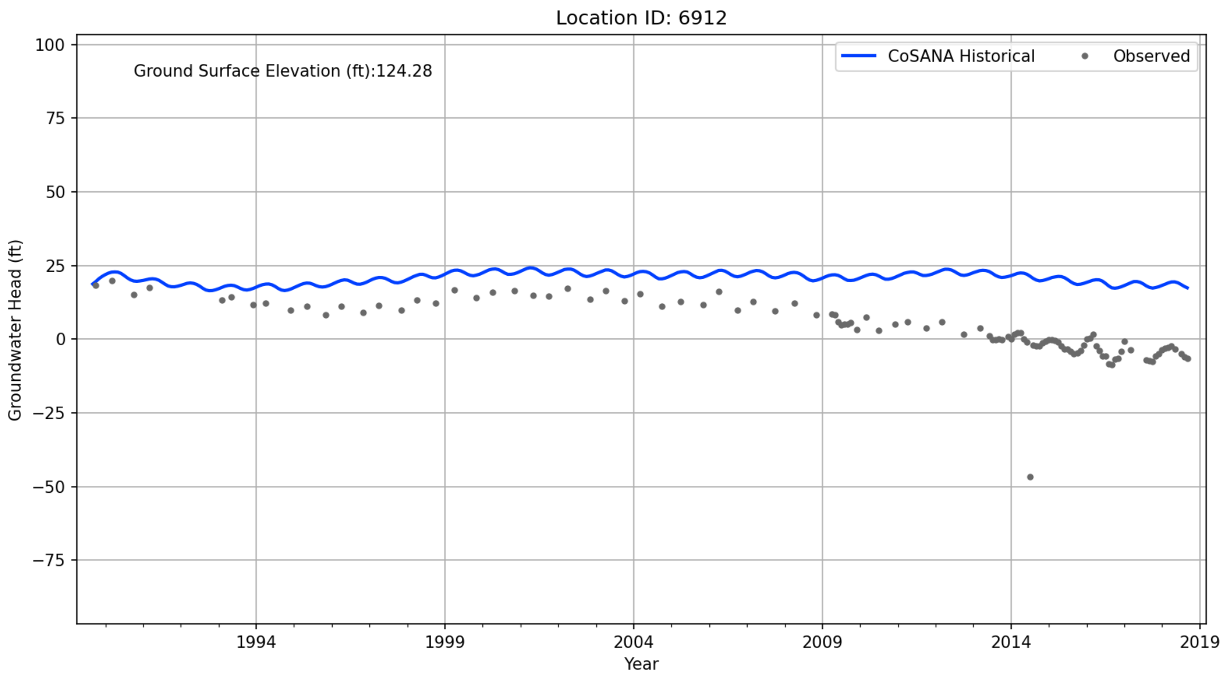

Location ID: 6703
Ground Surface Elevation (ft):115.73
CoSANA Historical
Observed
Groundwater Head (ft)
Year
150
125
100
75
50
25
0
−25
1994
1999
2004
2009
2014
2019

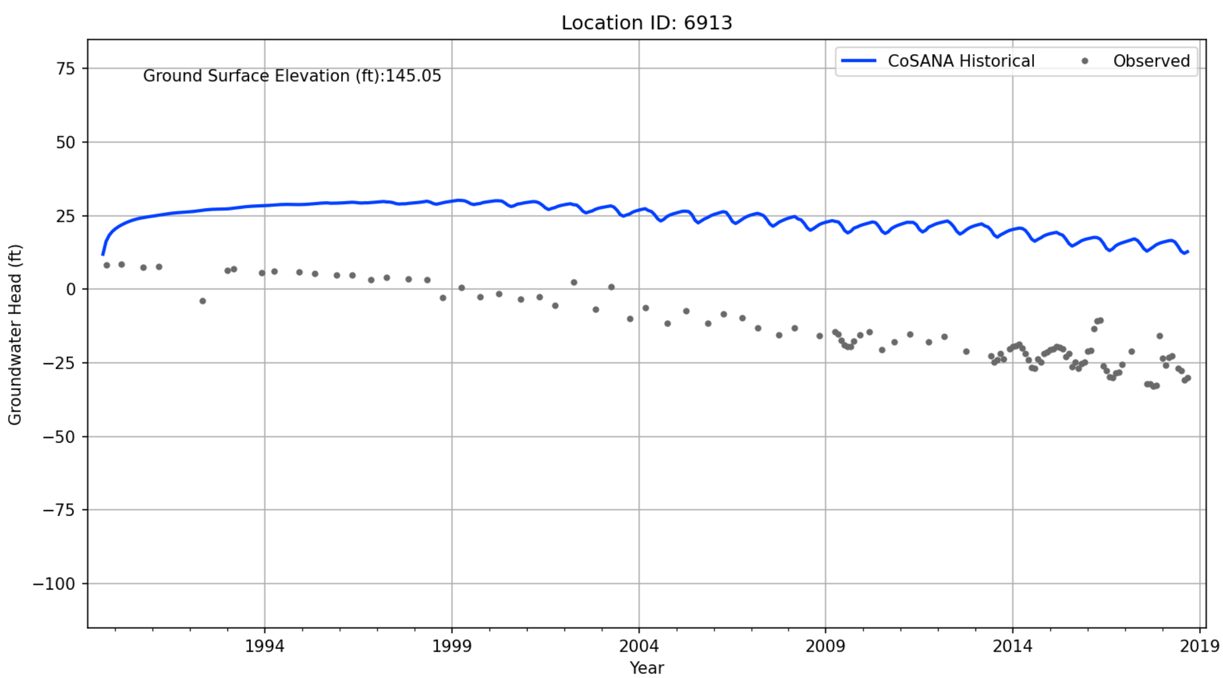


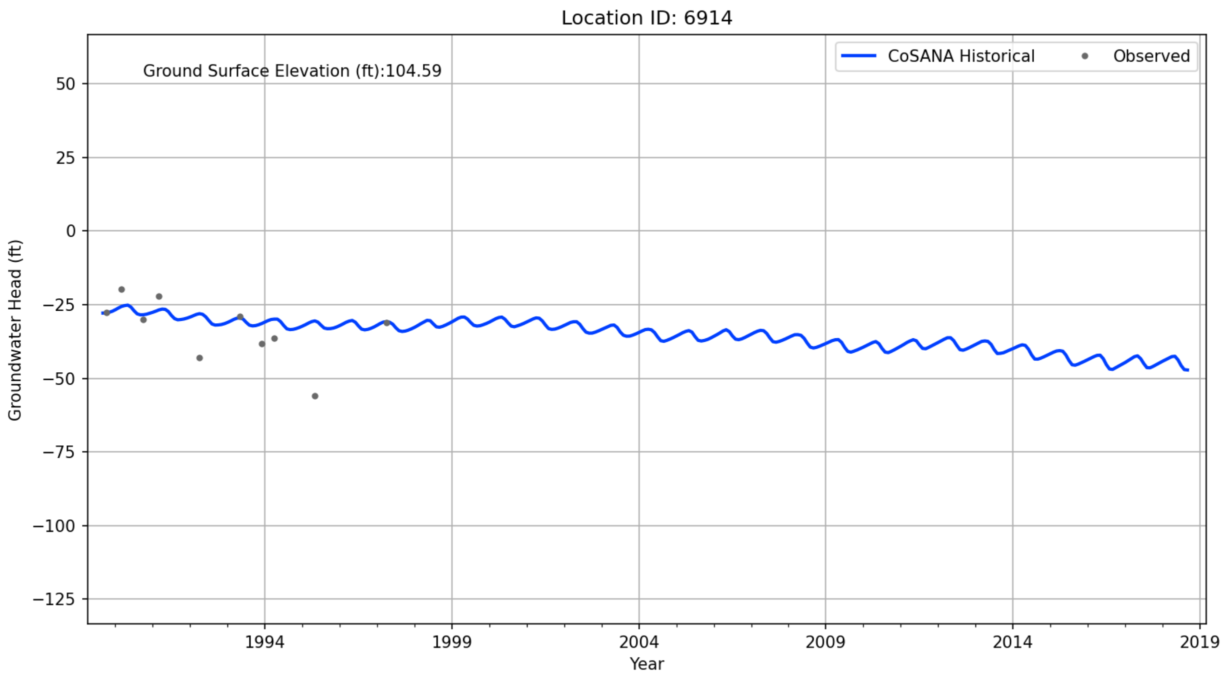
Location ID: 6802
CoSANA Historical
Observed
Ground Surface Elevation (ft):213.68
275
250
225
200
175
150
125
100
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year



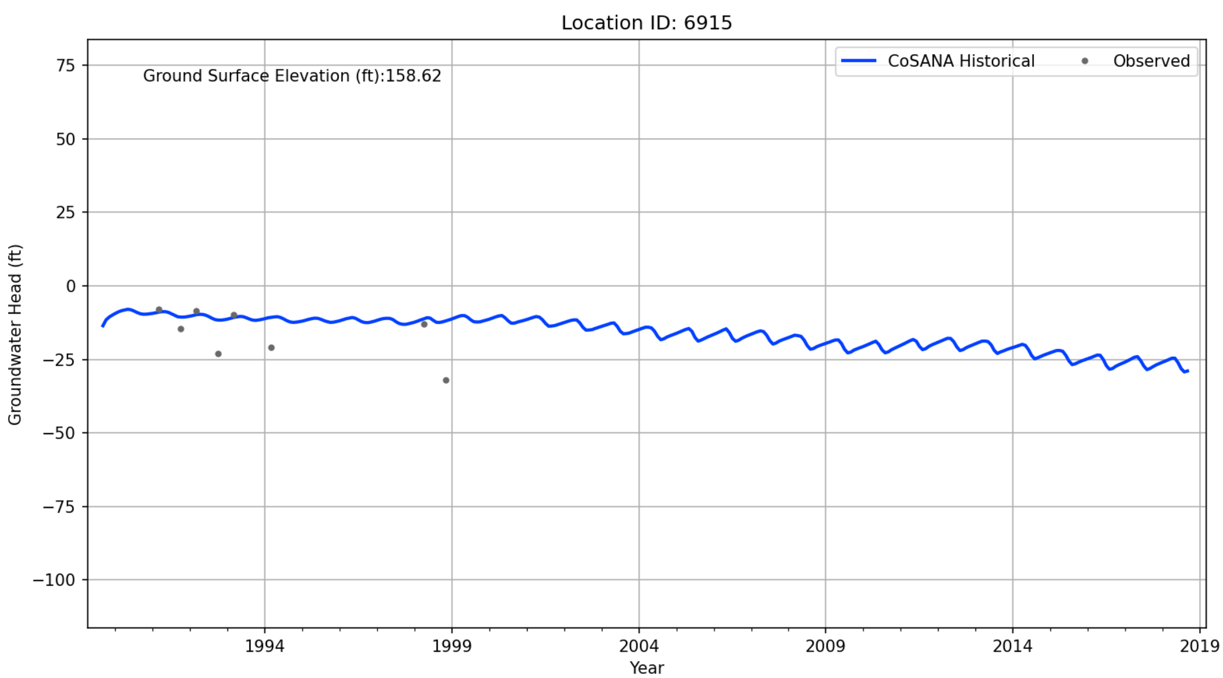
Location ID: 6911
CoSANA Historical
Observed
Ground Surface Elevation (ft):86.11
25
0
−25
−50
−75
−100
−125
−150
Groundwater Head (ft)
1994
1999
2004
2009
2014
2019
Year


Location ID: 6912
Ground Surface Elevation (ft):124.28
CoSANA Historical
Observed
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019

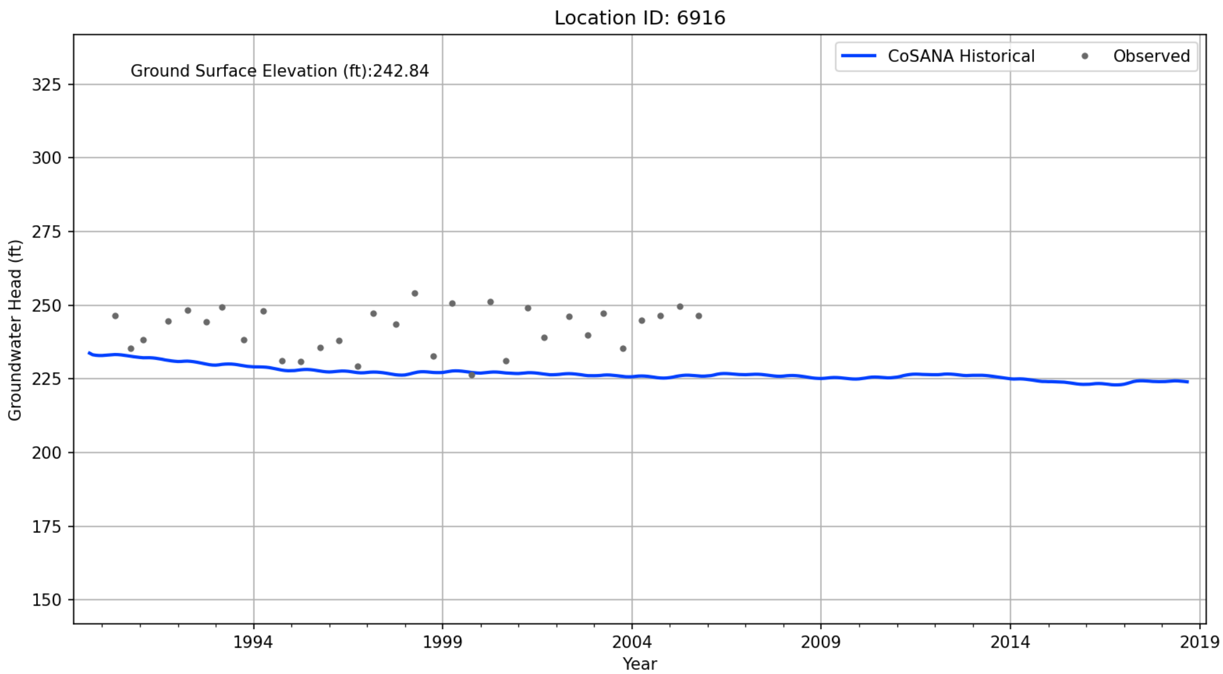

Location ID: 6913
Ground Surface Elevation (ft):145.05
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



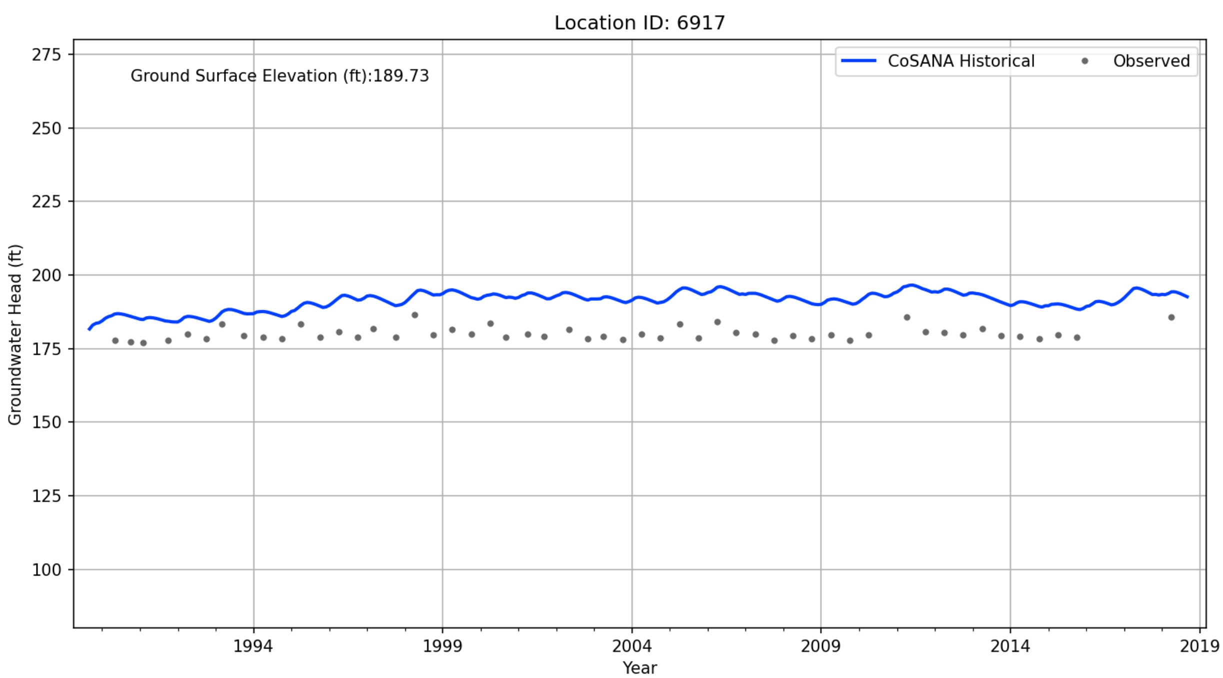
Location ID: 6914
Ground Surface Elevation (ft):104.59
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year



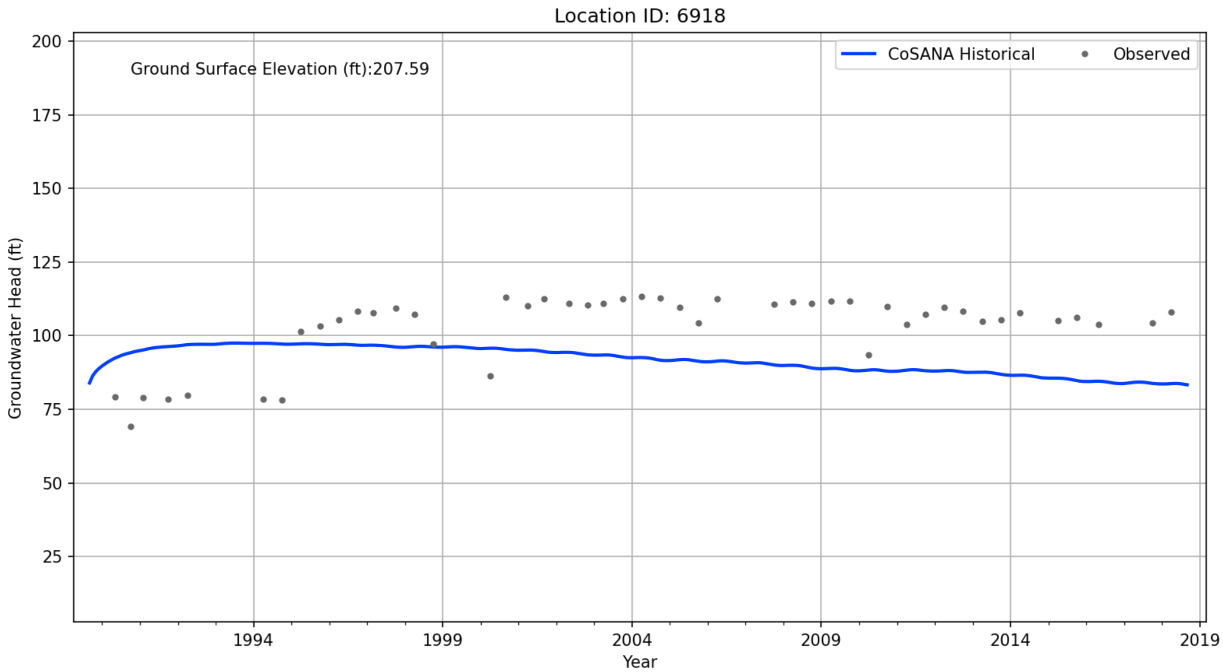
Location ID: 6915
Ground Surface Elevation (ft):158.62
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

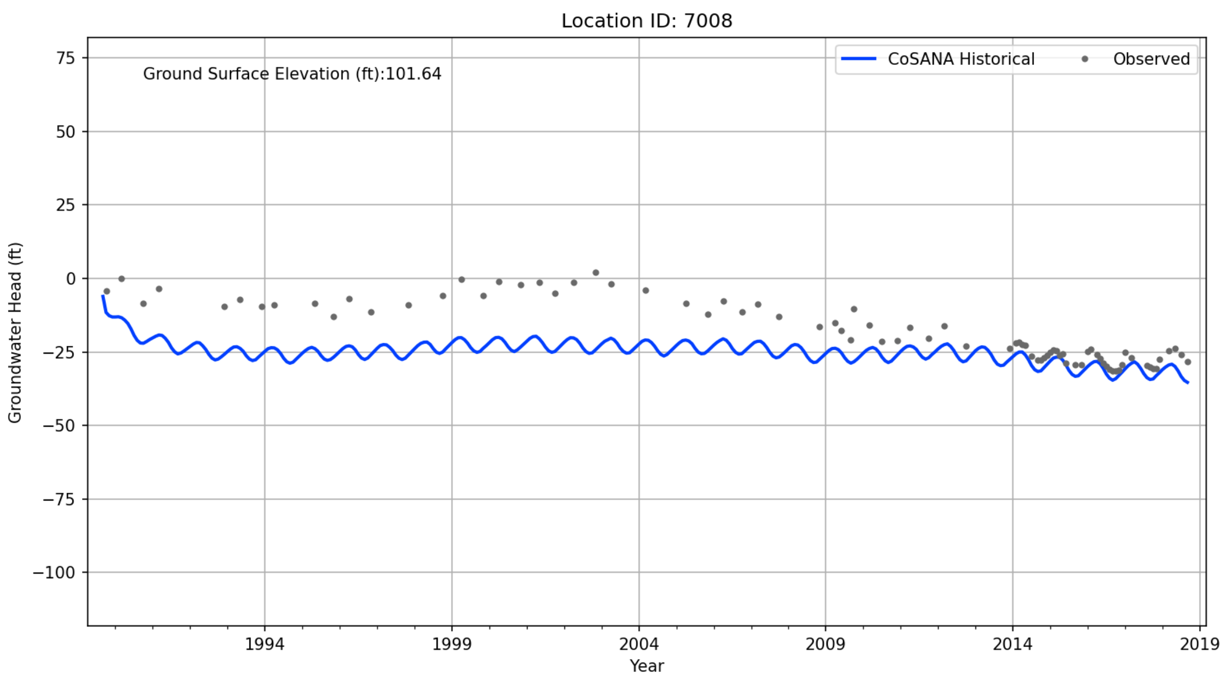


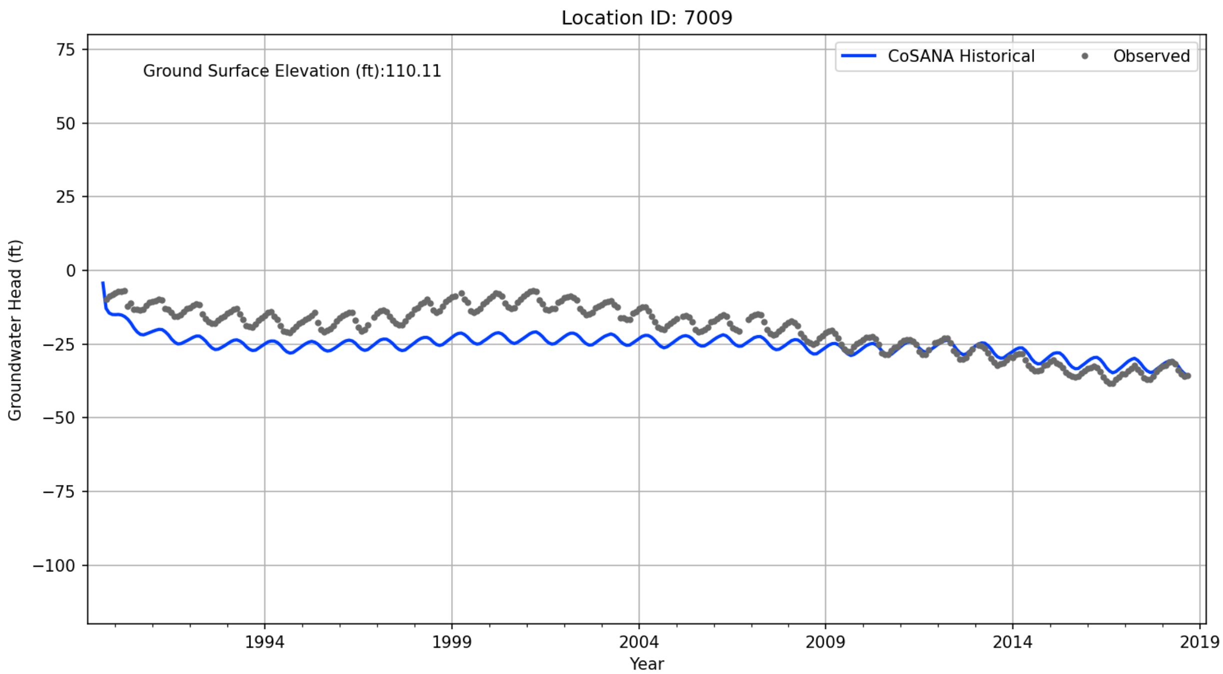
Location ID: 6916
Ground Surface Elevation (ft):242.84
CoSANA Historical
Observed
Groundwater Head (ft)
Year
325
300
275
250
225
200
175
150
1994
1999
2004
2009
2014
2019



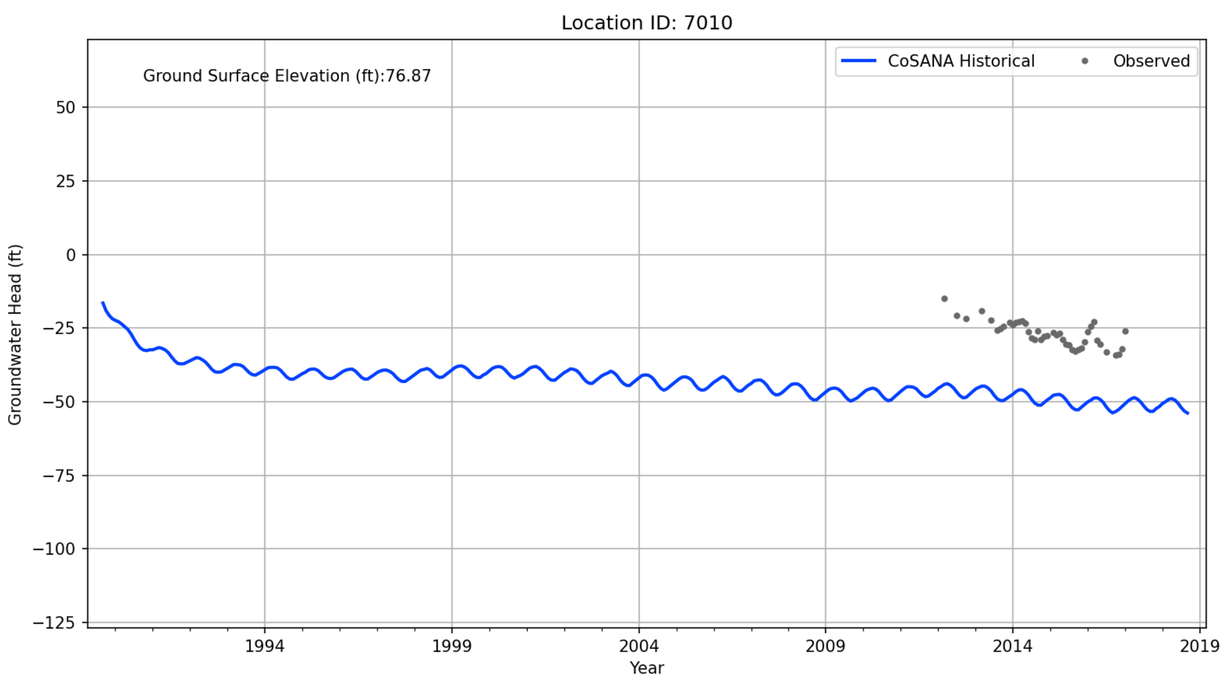
Location ID: 6917
Ground Surface Elevation (ft):189.73
CoSANA Historical
Observed
Groundwater Head (ft)
Year
275
250
225
200
175
150
125
100
1994
1999
2004
2009
2014
2019


Location ID: 6918
Ground Surface Elevation (ft):207.59
CoSANA Historical
Observed
Groundwater Head (ft)
Year
200
175
150
125
100
75
50
25
1994
1999
2004
2009
2014
2019

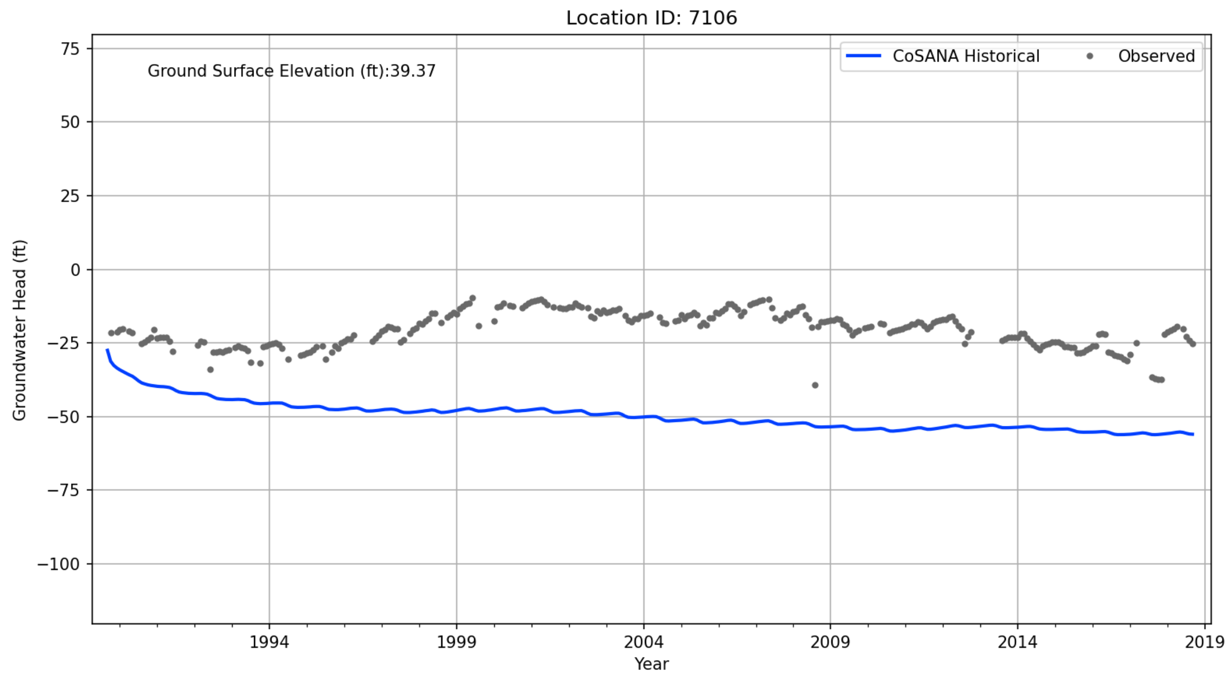

Location ID: 7008
Ground Surface Elevation (ft):101.64
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



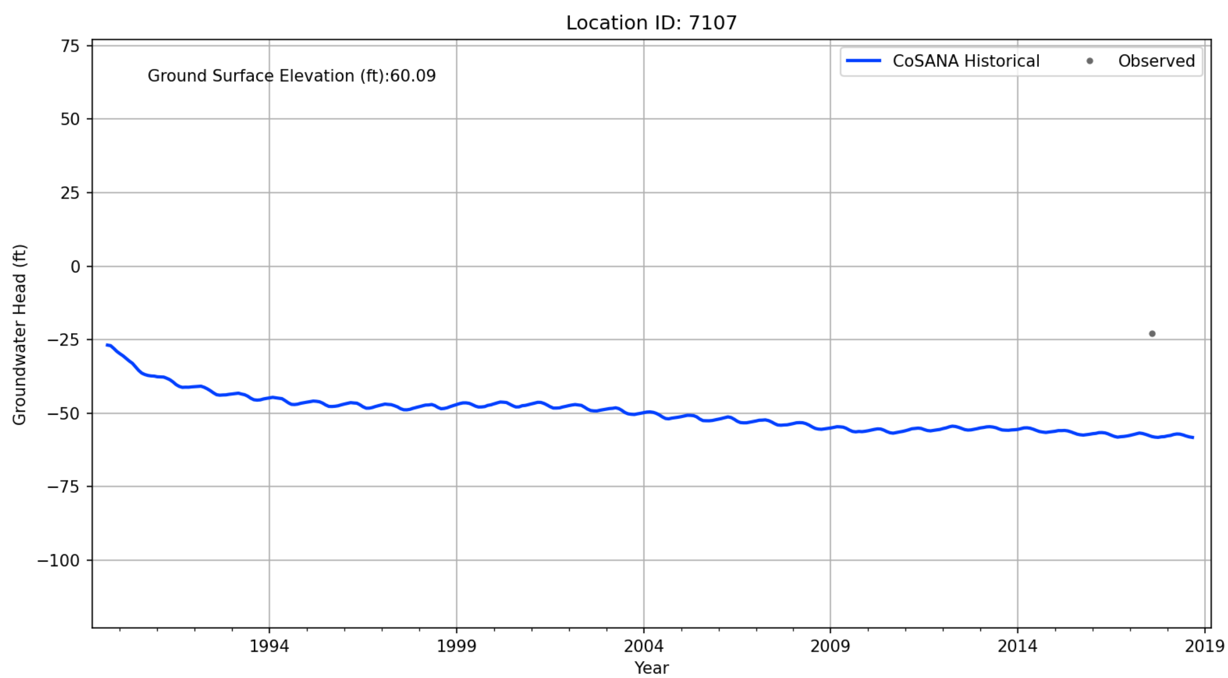
Location ID: 7009
CoSANA Historical
Observed
Ground Surface Elevation (ft):110.11
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



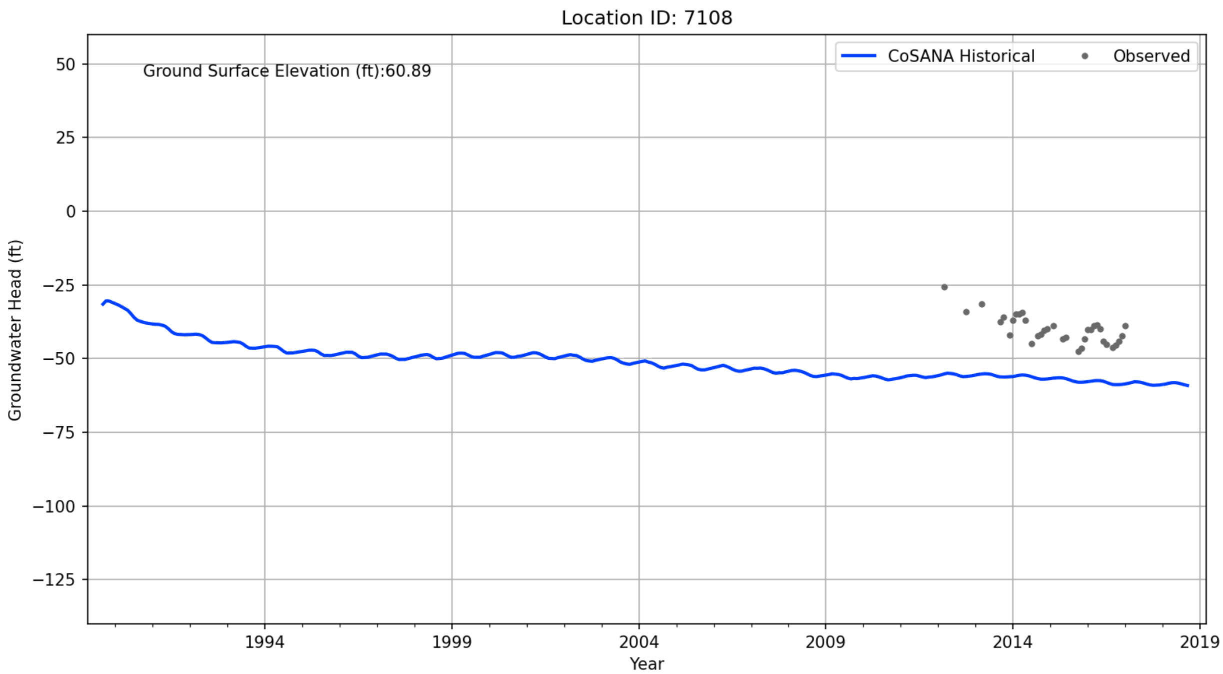
Location ID: 7010
CoSANA Historical
Observed
Ground Surface Elevation (ft):76.87
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year



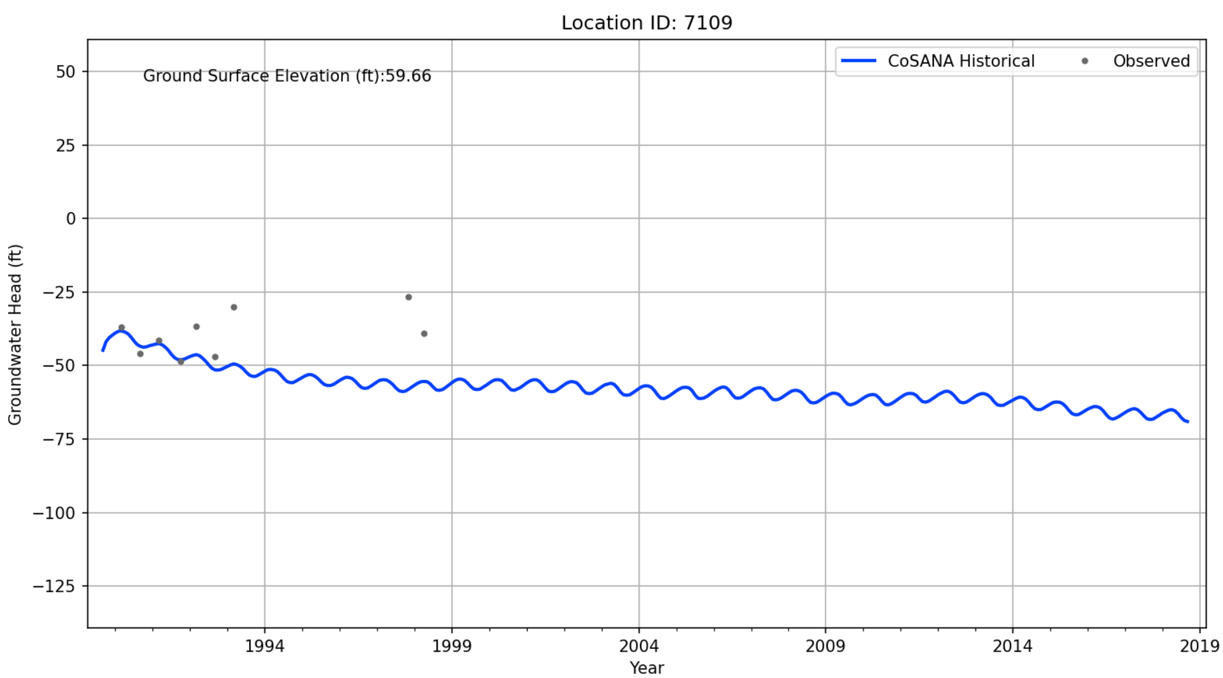
Location ID: 7106
Ground Surface Elevation (ft):39.37
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



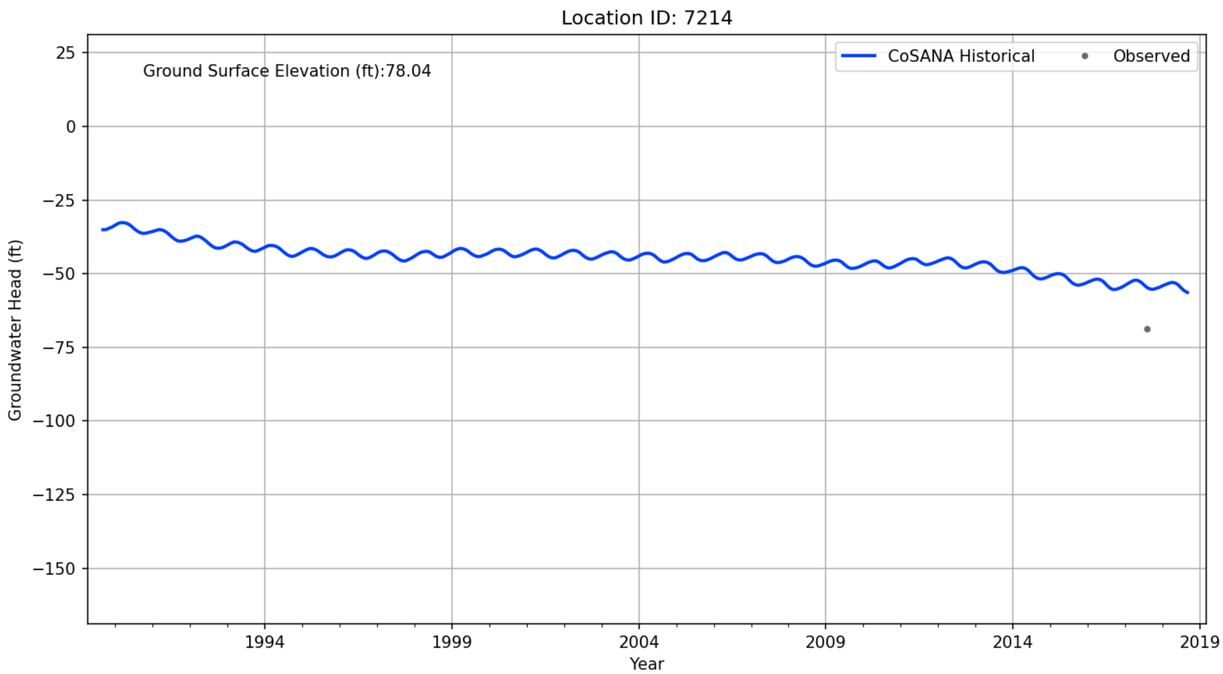
Location ID: 7107
Ground Surface Elevation (ft):60.09
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



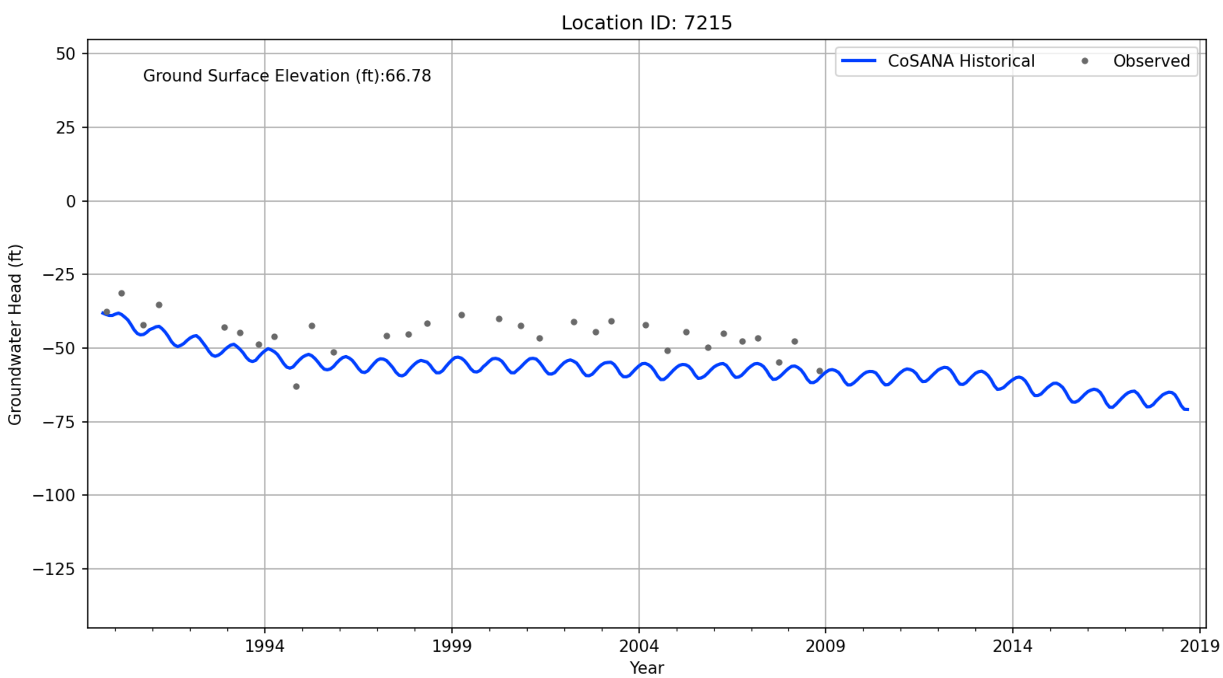
Location ID: 7108
CoSANA Historical
Observed
Ground Surface Elevation (ft):60.89
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year



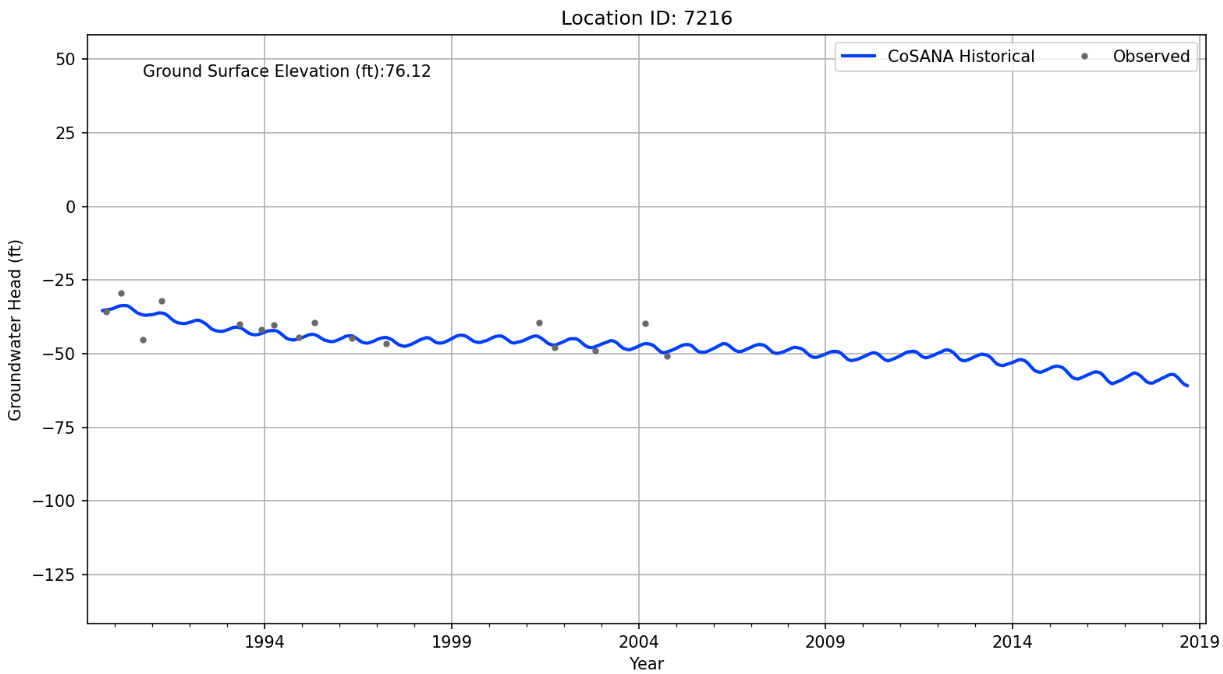
Location ID: 7109
CoSANA Historical
Observed
Ground Surface Elevation (ft):59.66
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

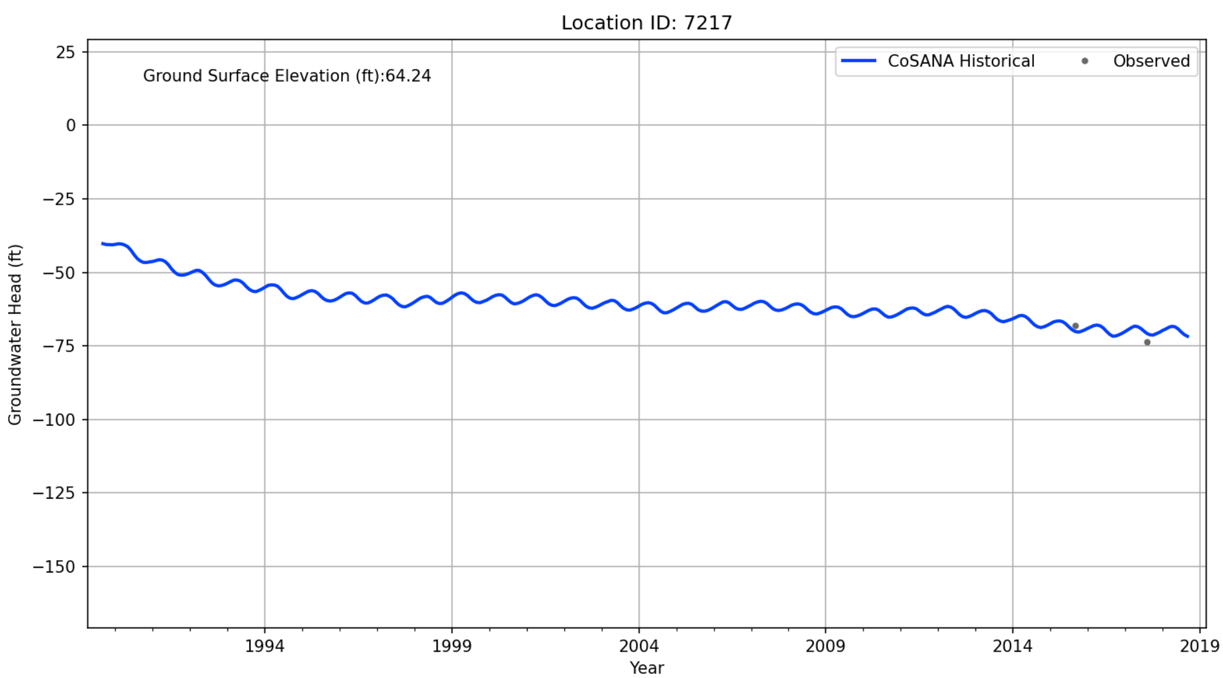


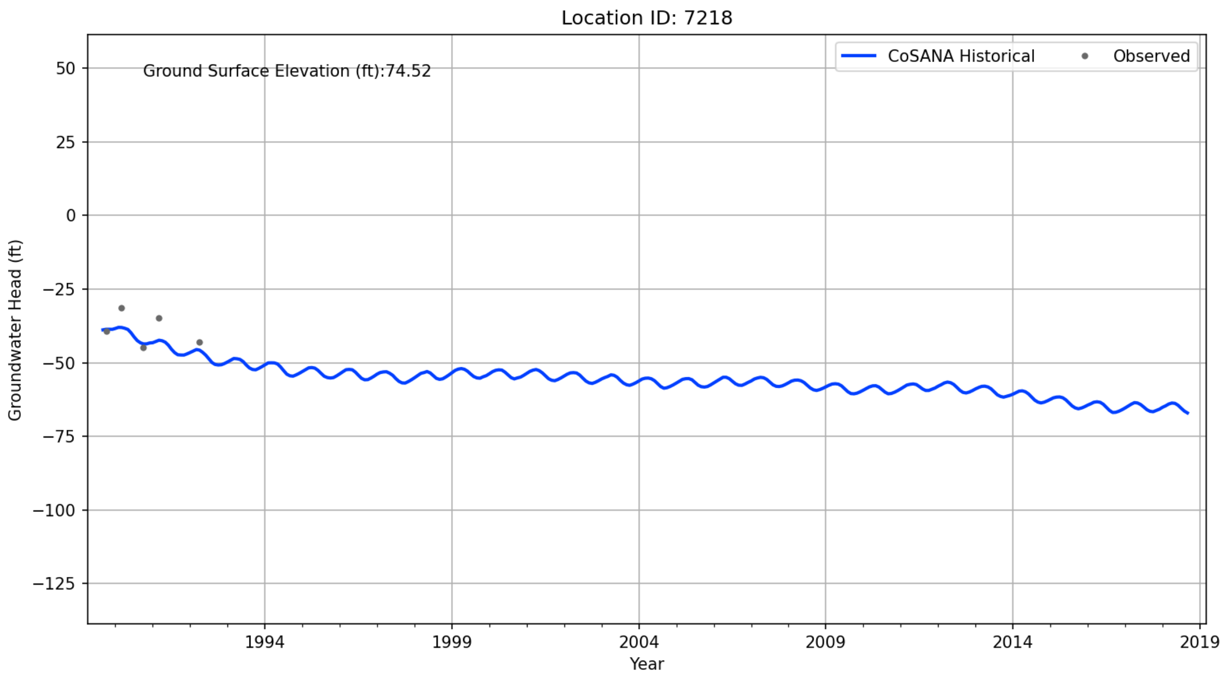
Location ID: 7214
CoSANA Historical
Observed
Ground Surface Elevation (ft):78.04
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

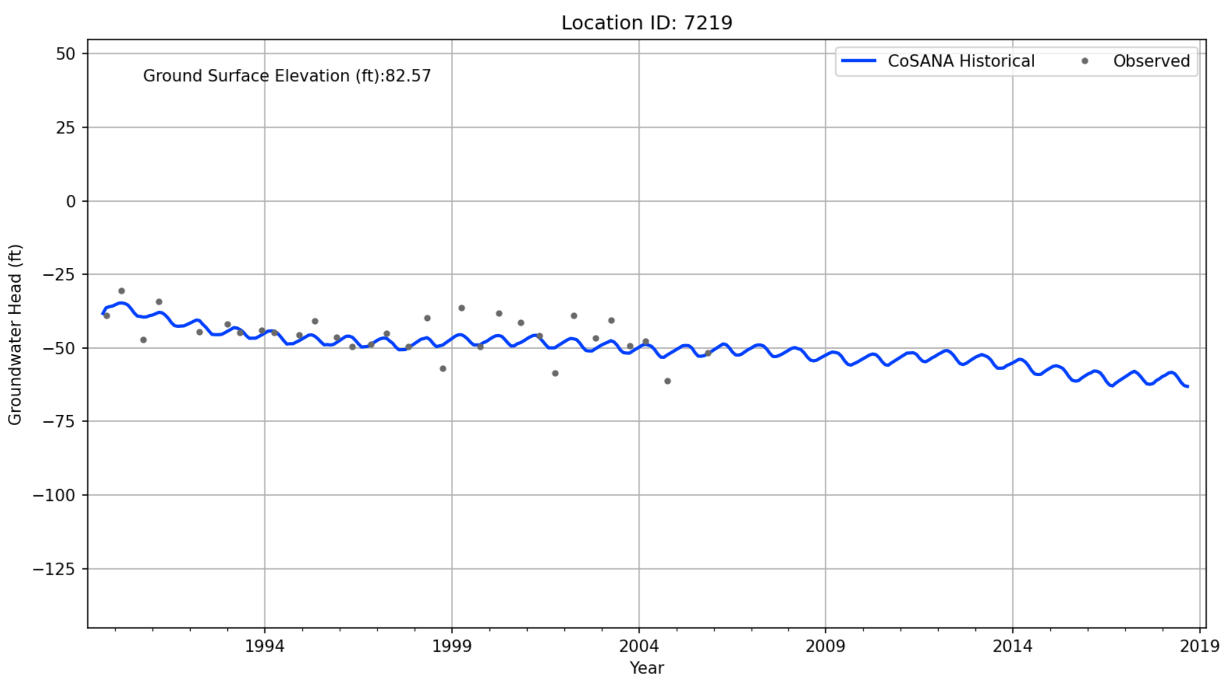


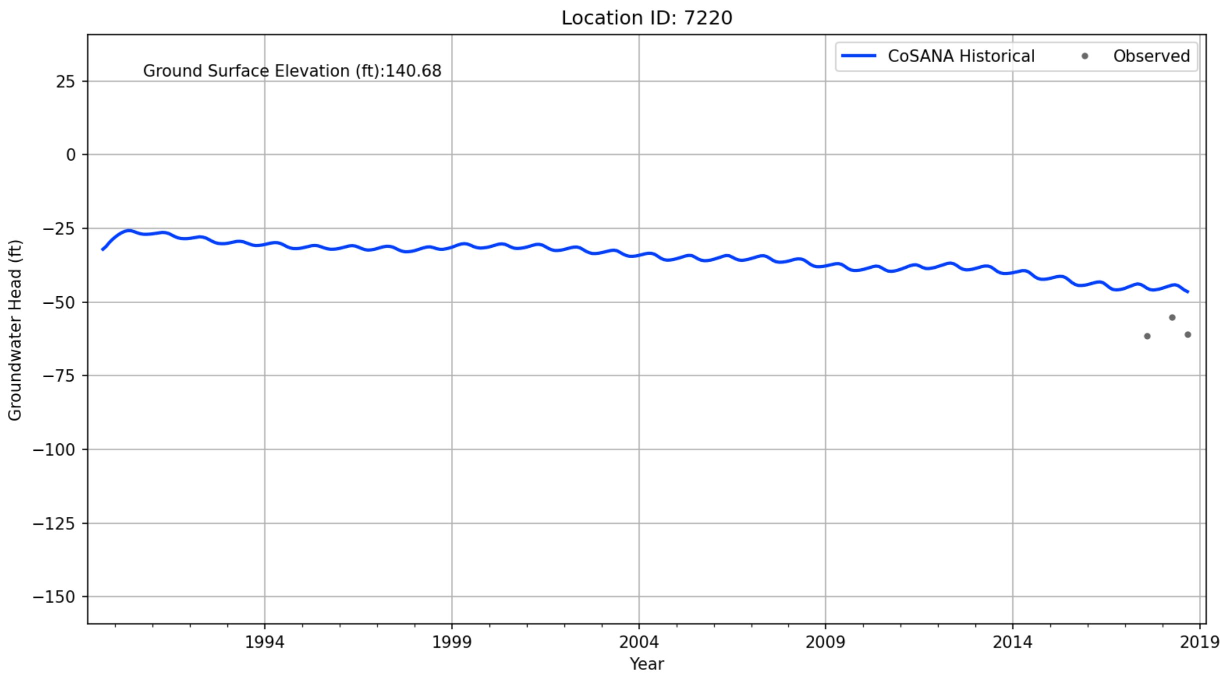
Location ID: 7215
CoSANA Historical
Observed
Ground Surface Elevation (ft):66.78
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

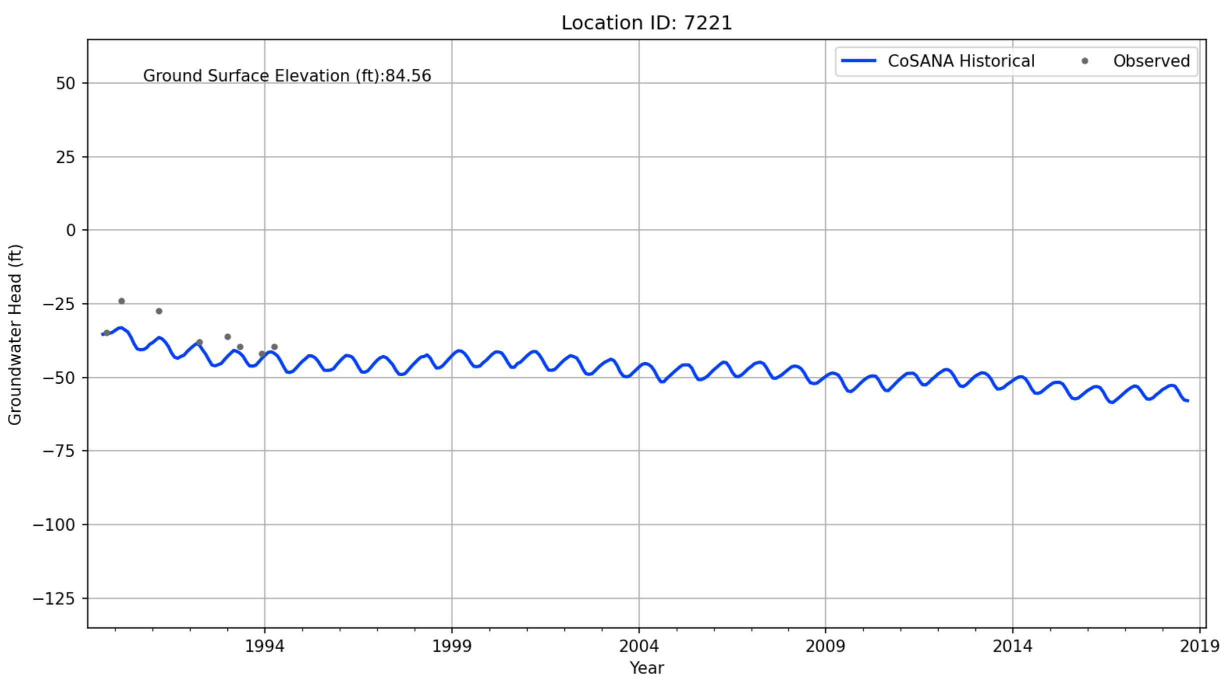

Location ID: 7216
CoSANA Historical
Observed
Ground Surface Elevation (ft):76.12
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

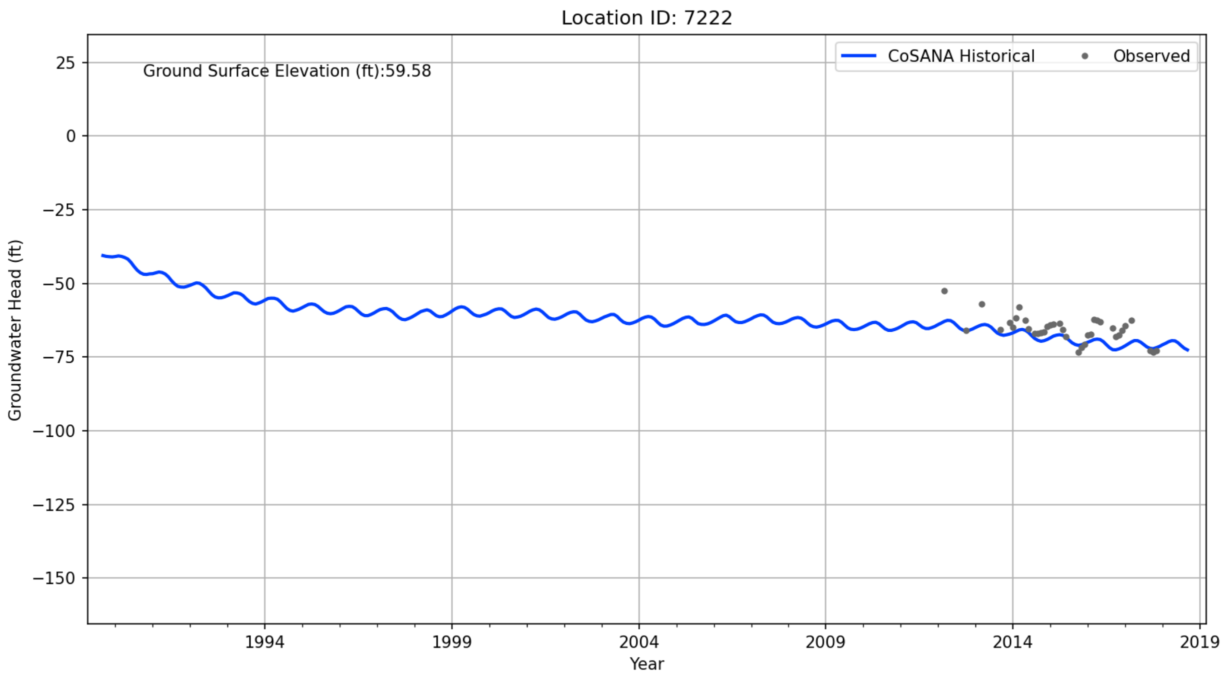

Location ID: 7217
CoSANA Historical
Observed
Ground Surface Elevation (ft):64.24
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019

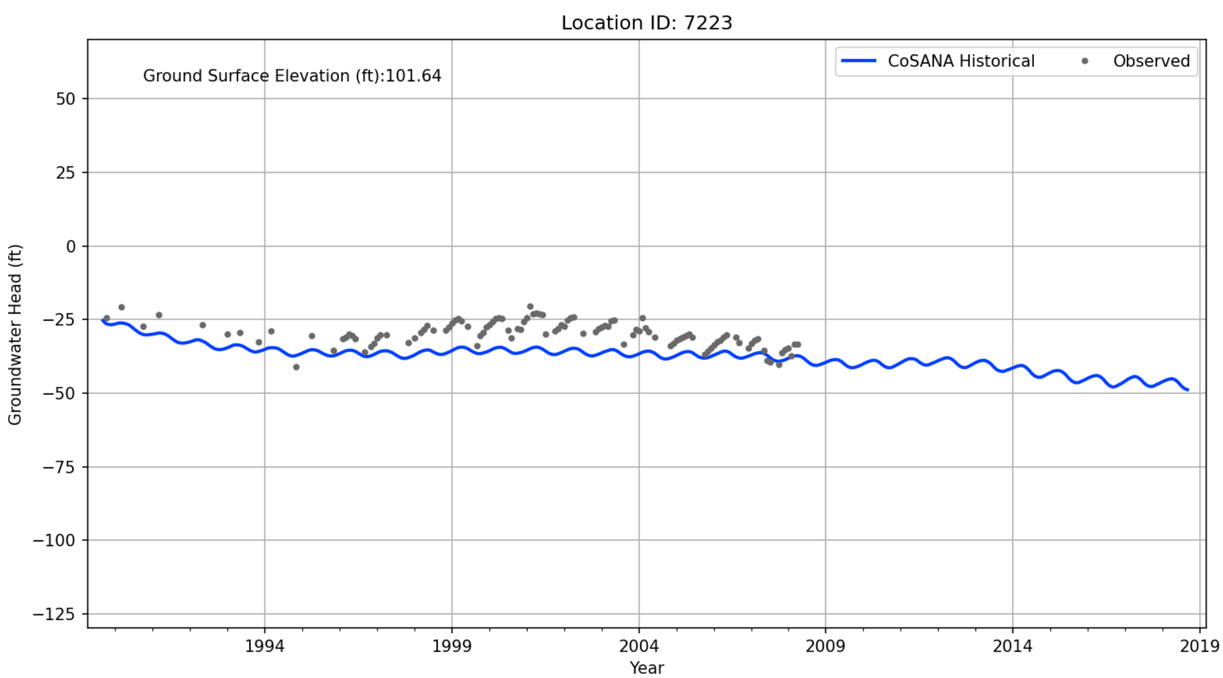

Location ID: 7218
Ground Surface Elevation (ft):74.52
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

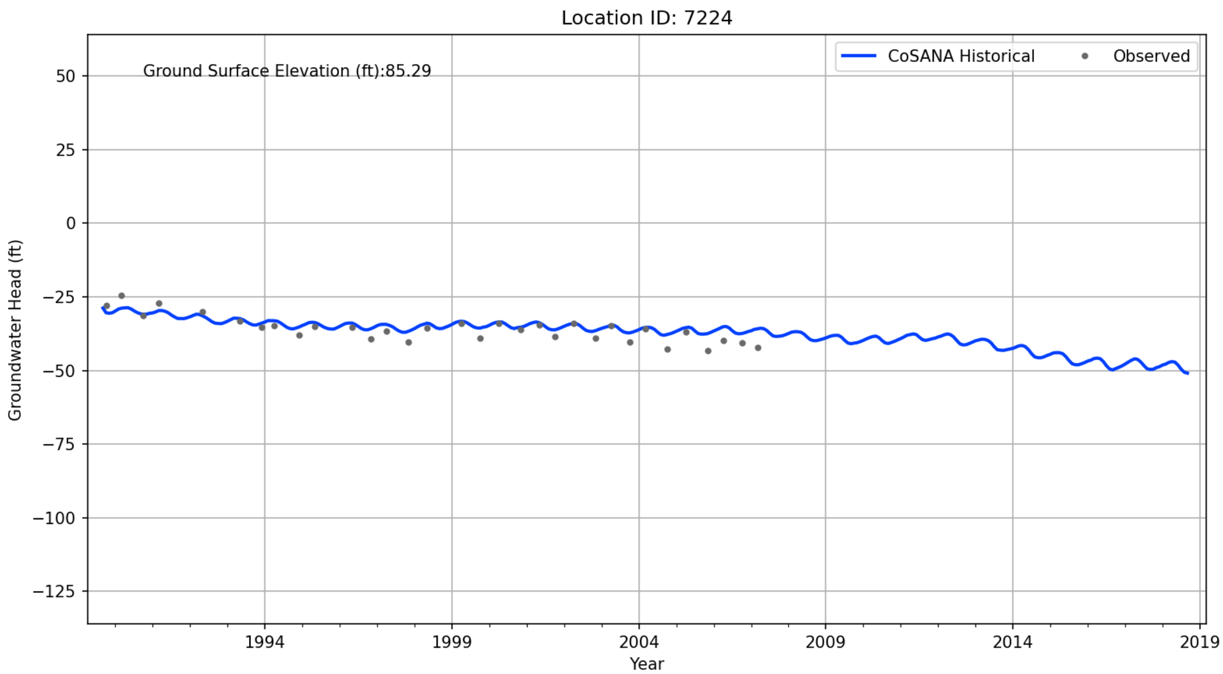

Location ID: 7219
Ground Surface Elevation (ft):82.57
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 7220
CoSANA Historical
Observed
Ground Surface Elevation (ft):140.68
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

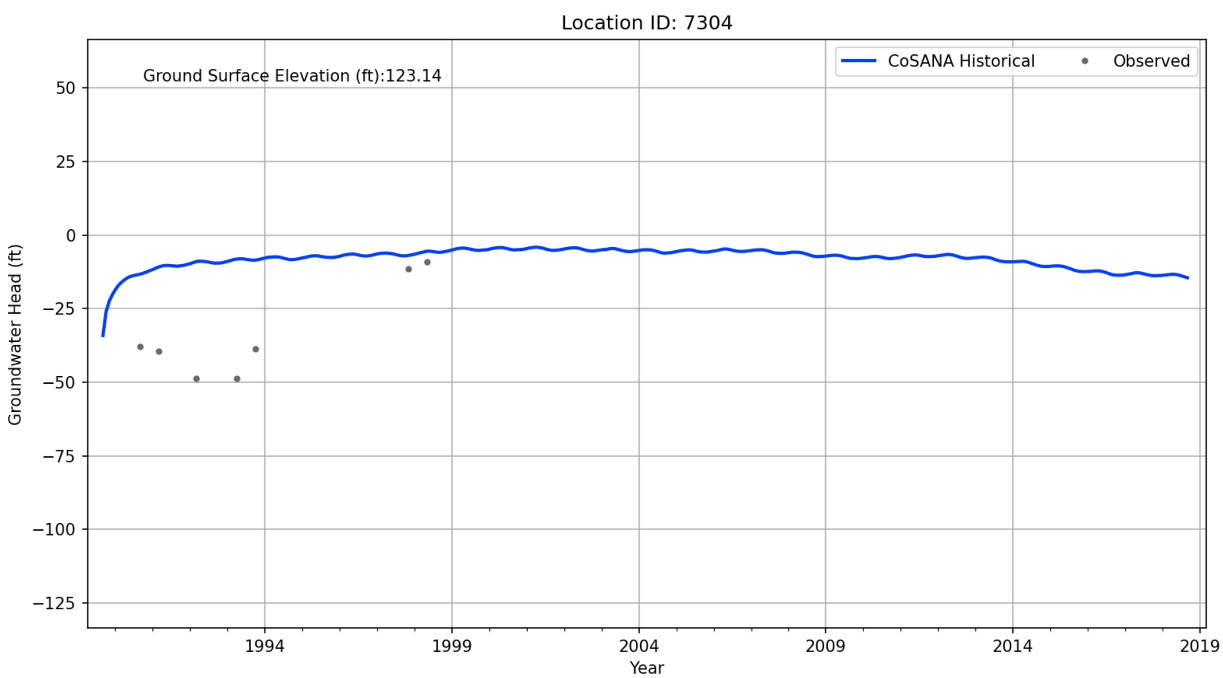

Location ID: 7221
CoSANA Historical
Observed
Ground Surface Elevation (ft):84.56
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 7222
CoSANA Historical
Observed
Ground Surface Elevation (ft):59.58
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019

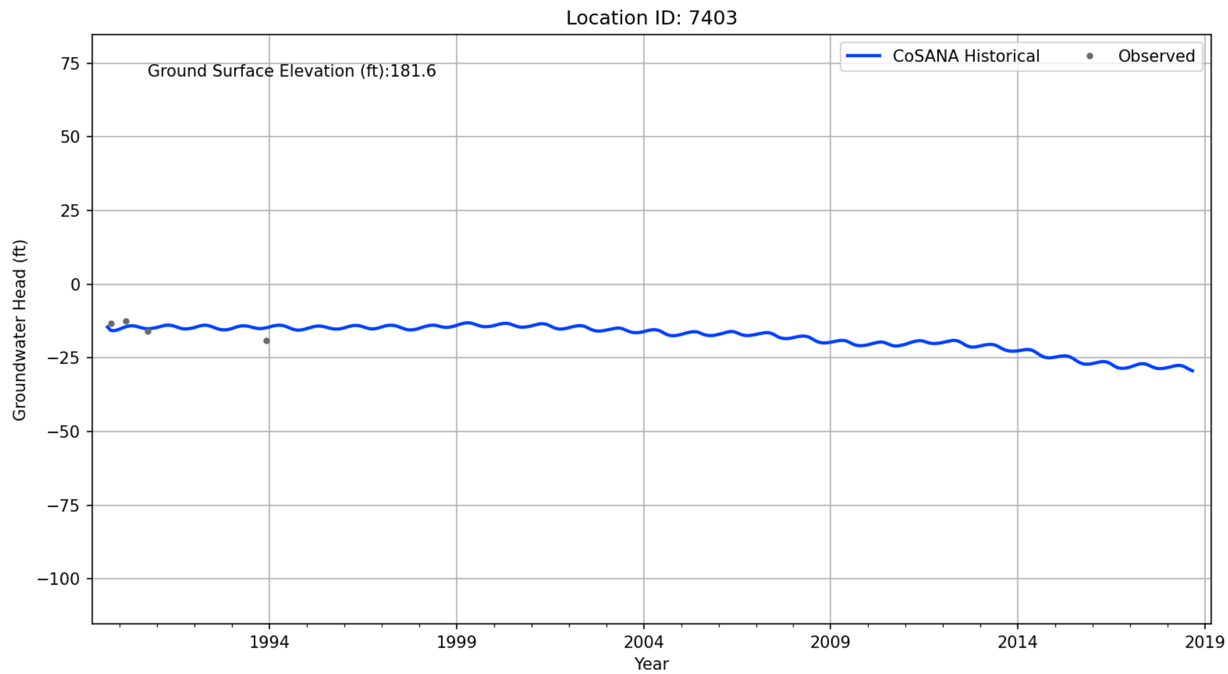

Location ID: 7223
CoSANA Historical
Observed
Ground Surface Elevation (ft):101.64
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

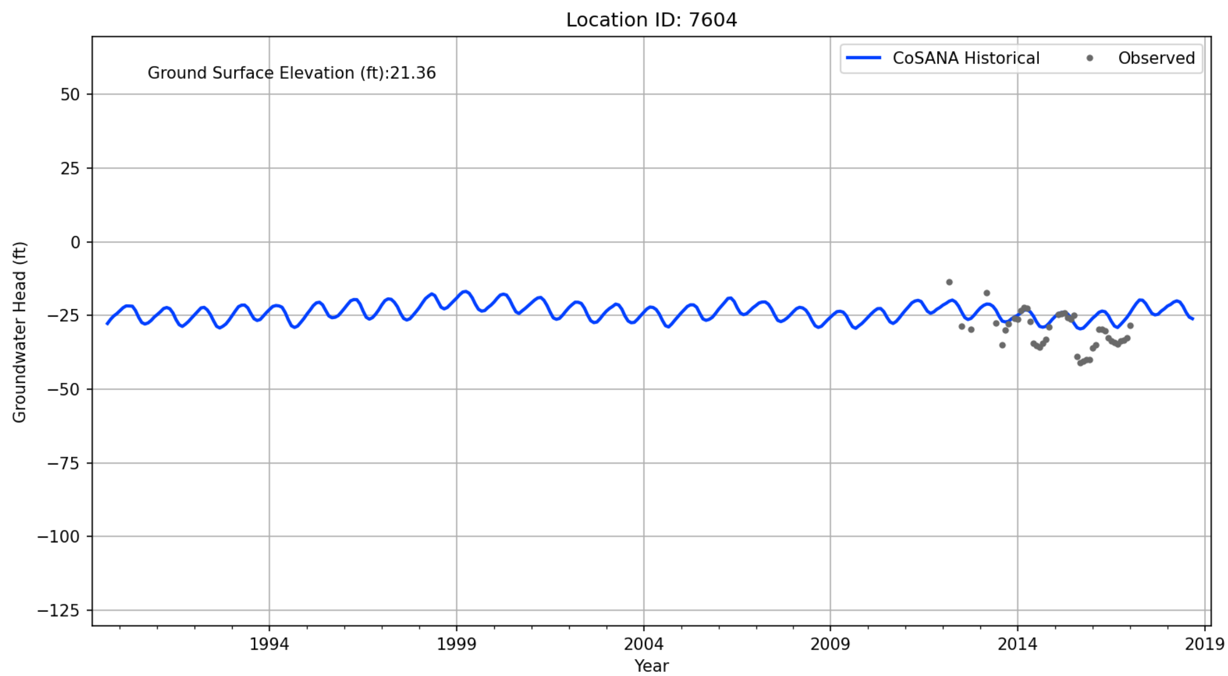


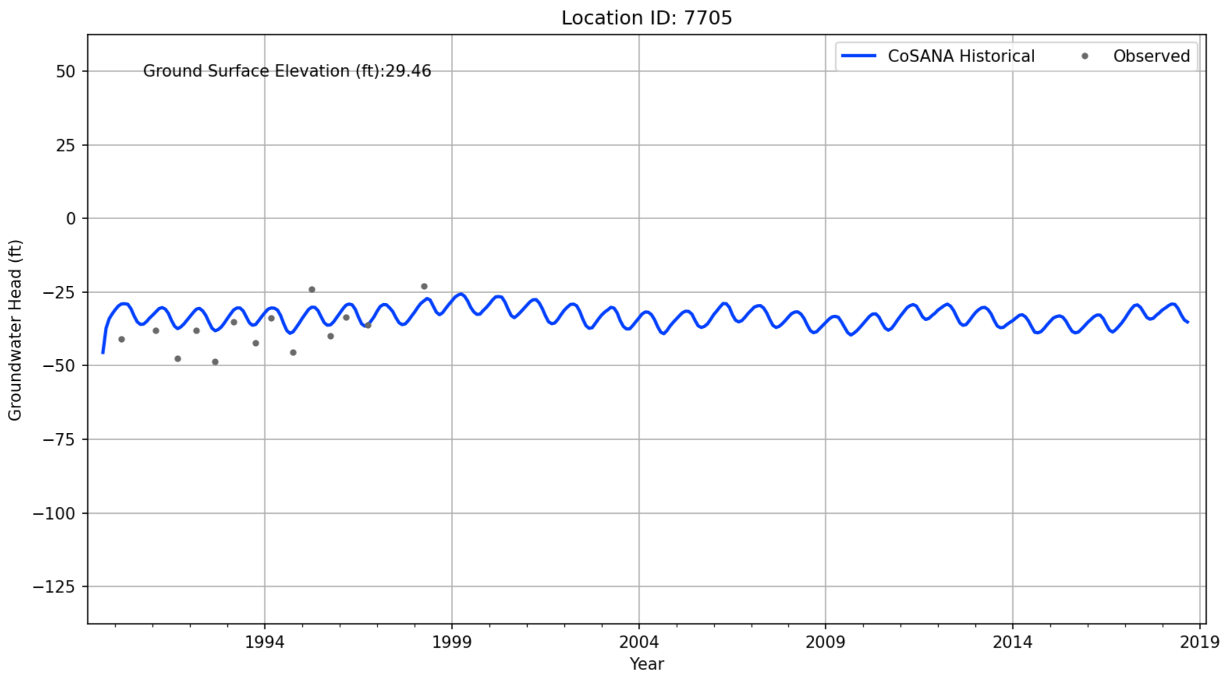
Location ID: 7224
Ground Surface Elevation (ft):85.29
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

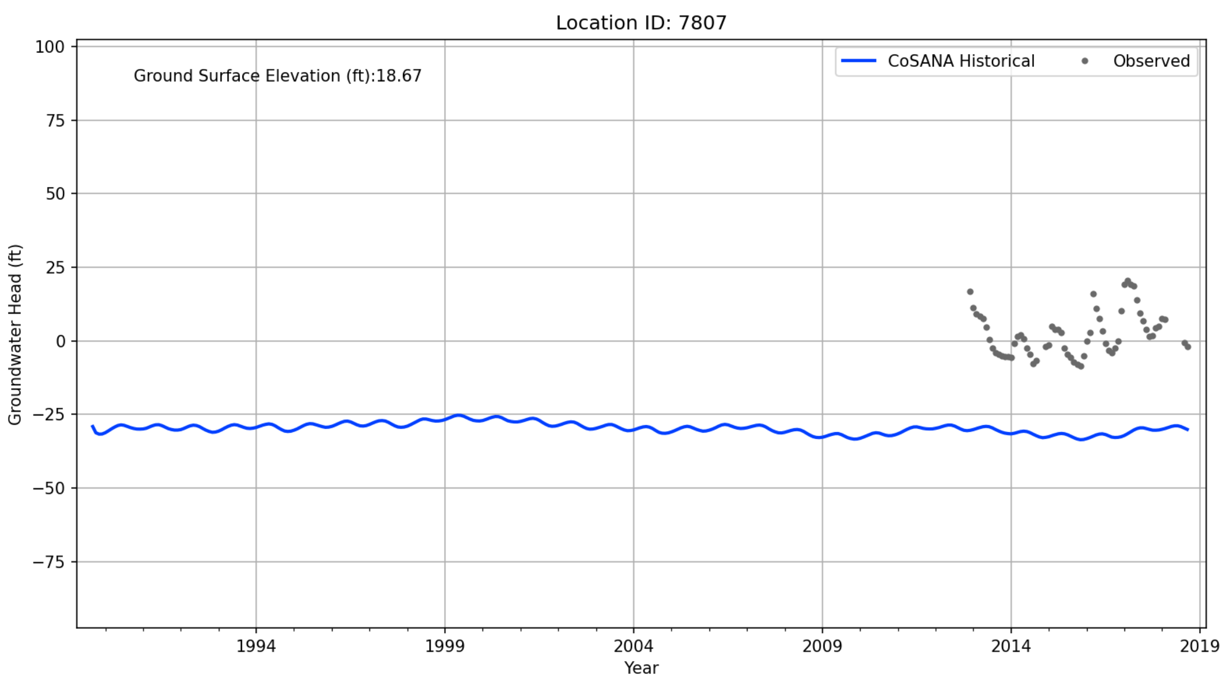


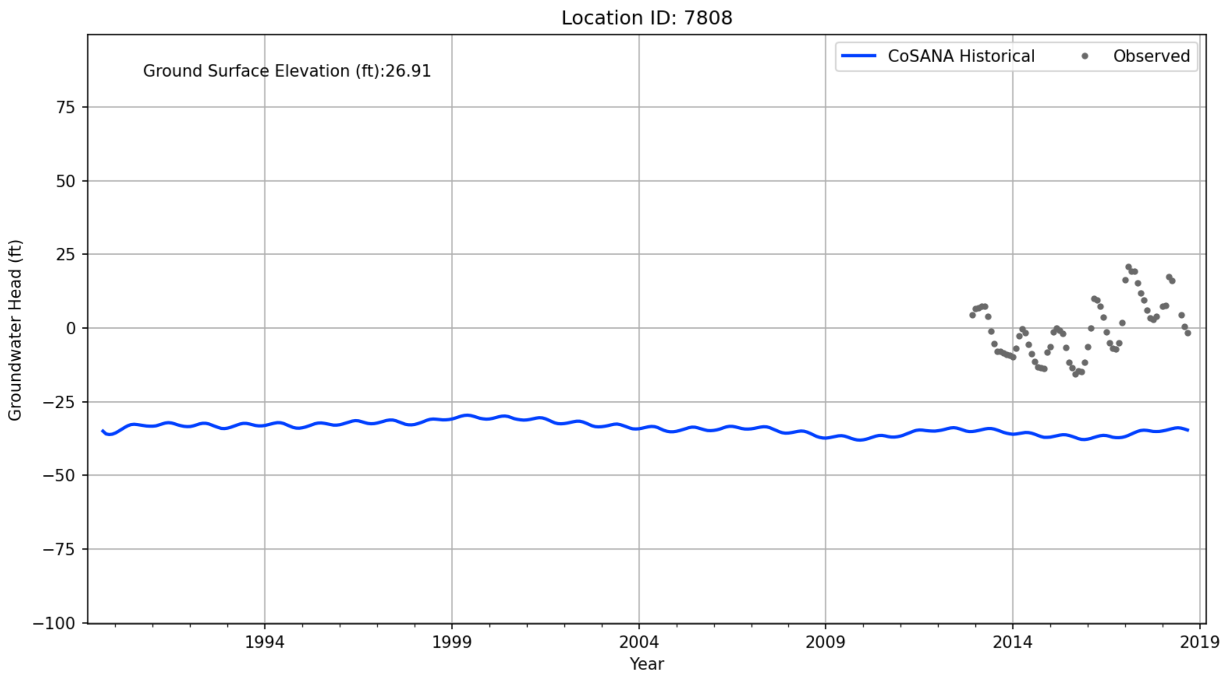
Location ID: 7304
Ground Surface Elevation (ft):123.14
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

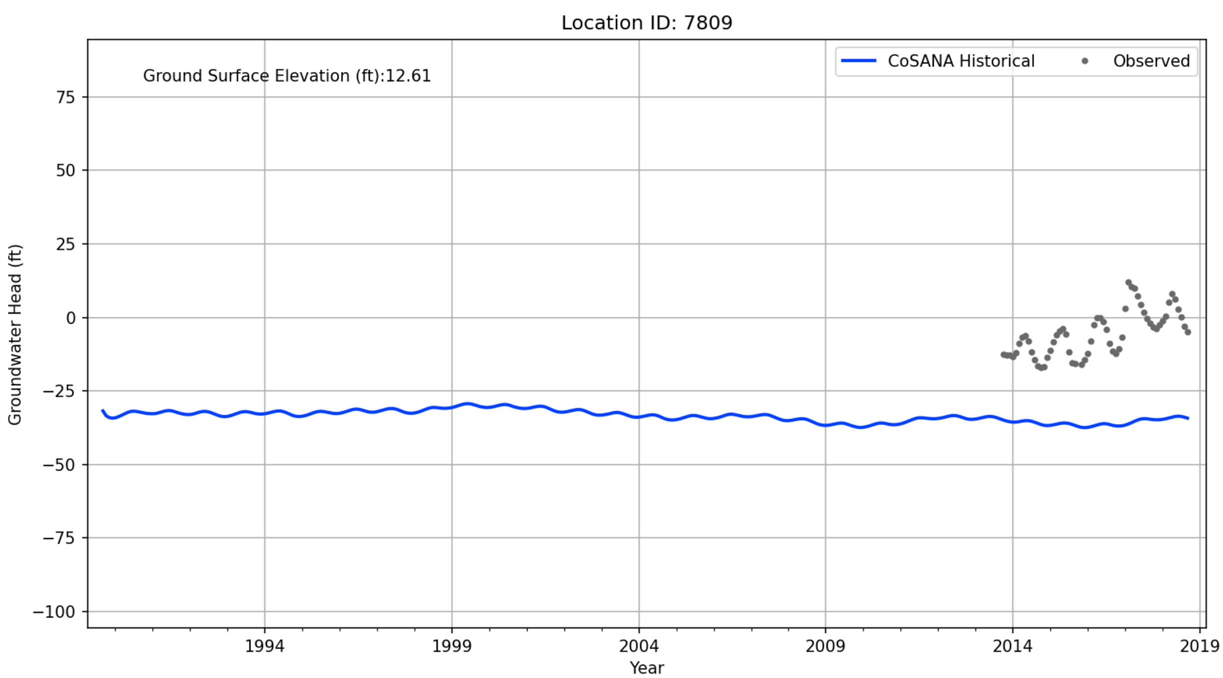

Location ID: 7403
CoSANA Historical
Observed
Ground Surface Elevation (ft):181.6
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

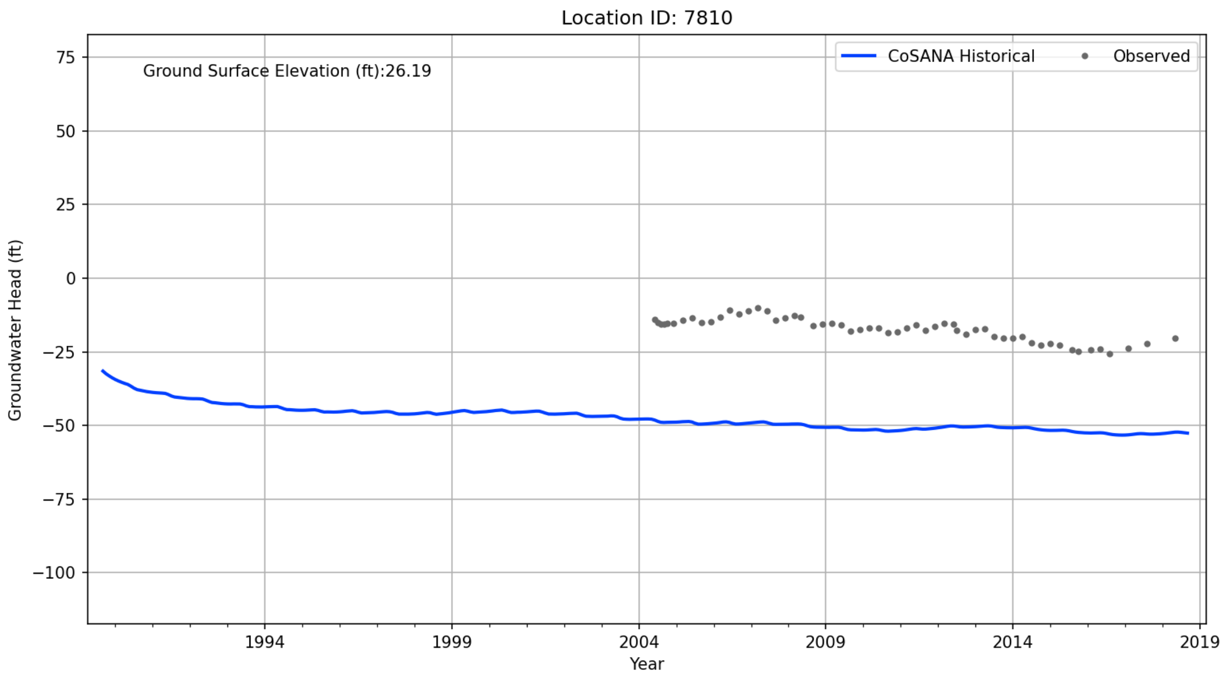

Location ID: 7604
CoSANA Historical
Observed
Ground Surface Elevation (ft):21.36
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019


Location ID: 7705
Ground Surface Elevation (ft):29.46
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

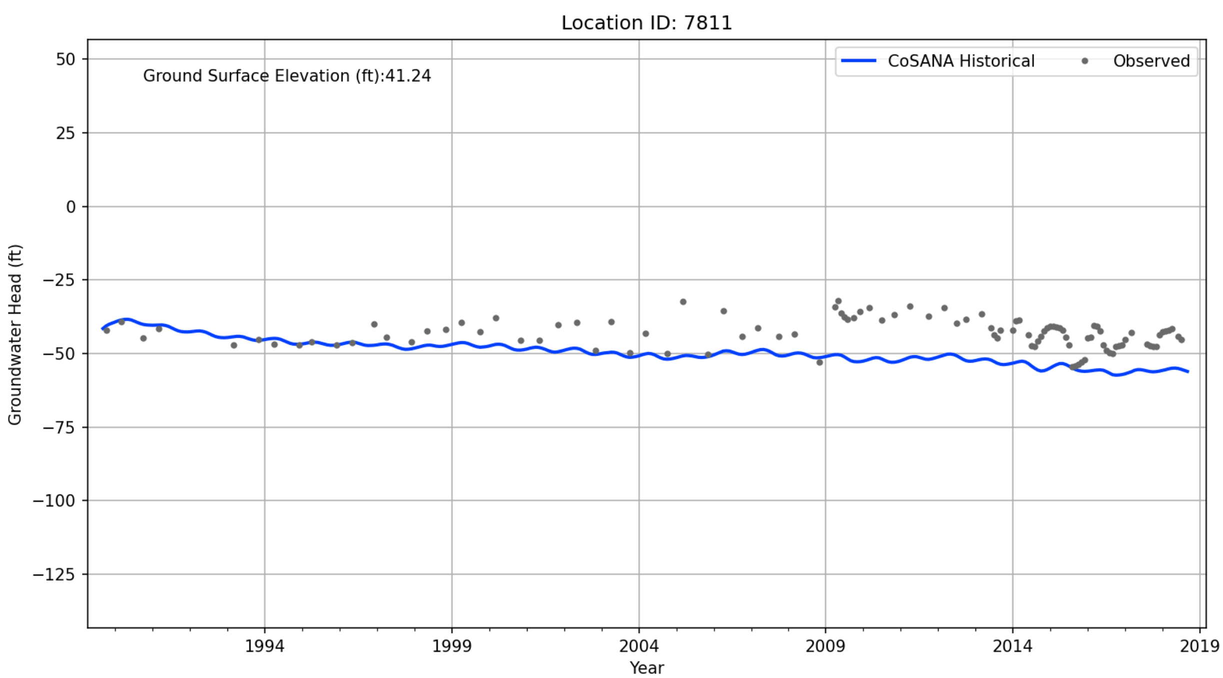

Location ID: 7807
Ground Surface Elevation (ft):18.67
CoSANA Historical
Observed
Groundwater Head (ft)
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019
Year


Location ID: 7808
Ground Surface Elevation (ft):26.91
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

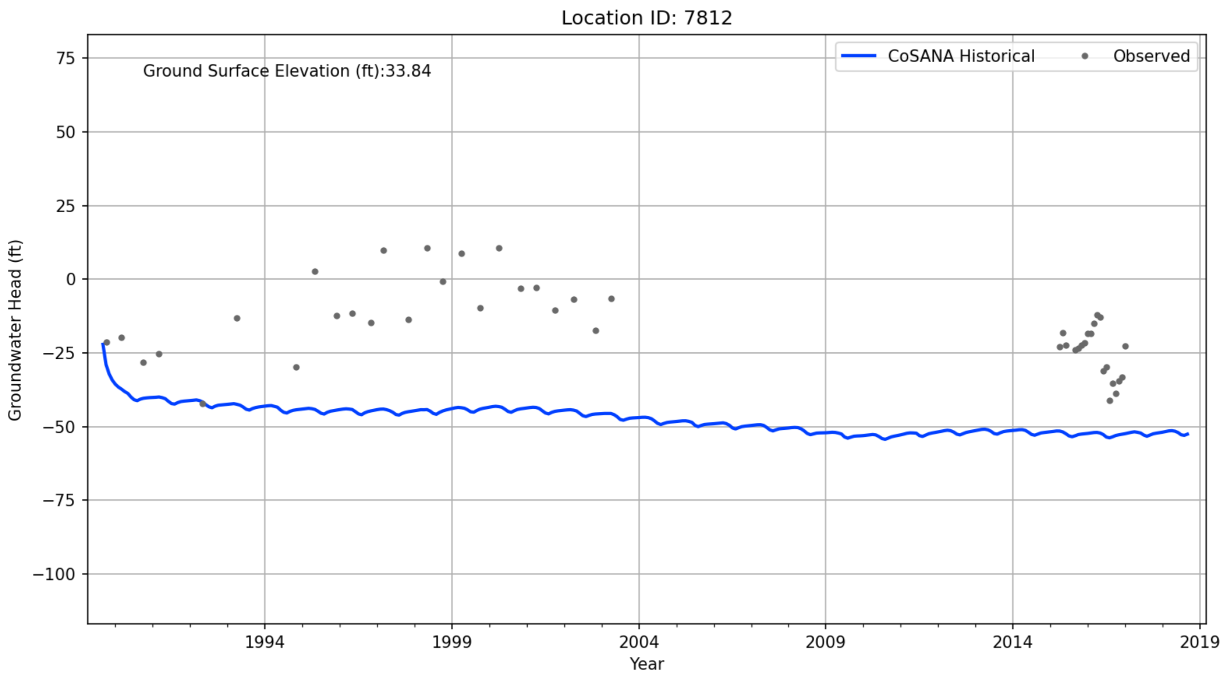

Location ID: 7809
Ground Surface Elevation (ft):12.61
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



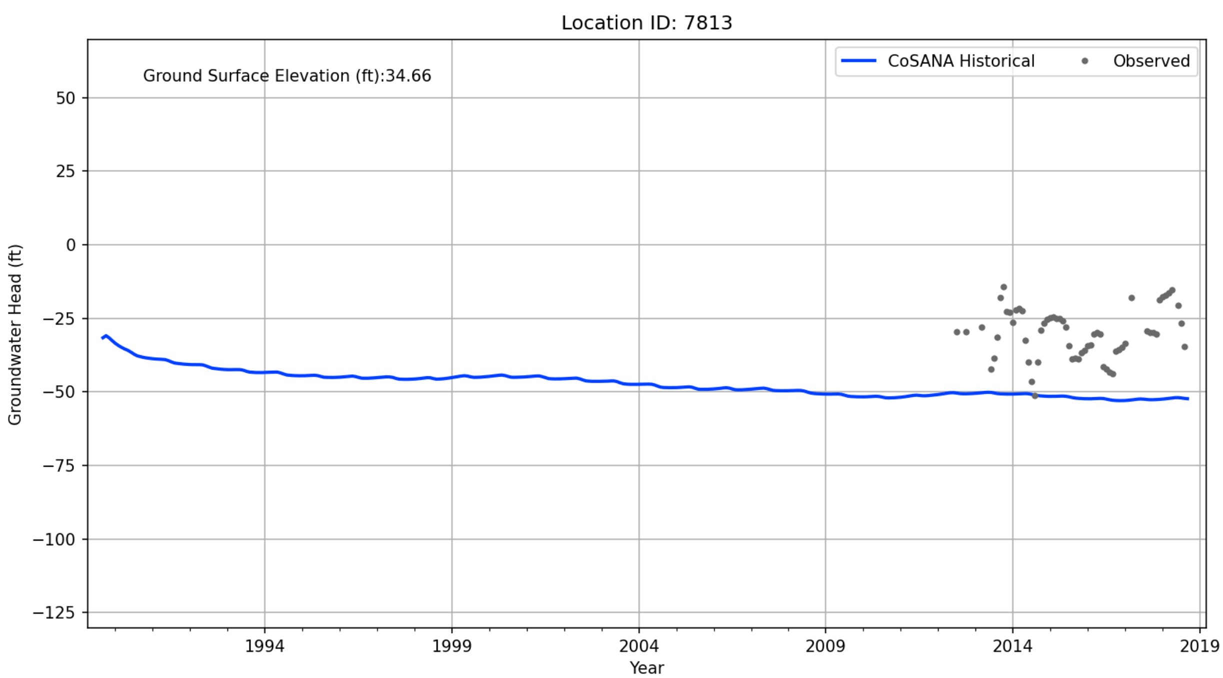
Location ID: 7810
Ground Surface Elevation (ft):26.19
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



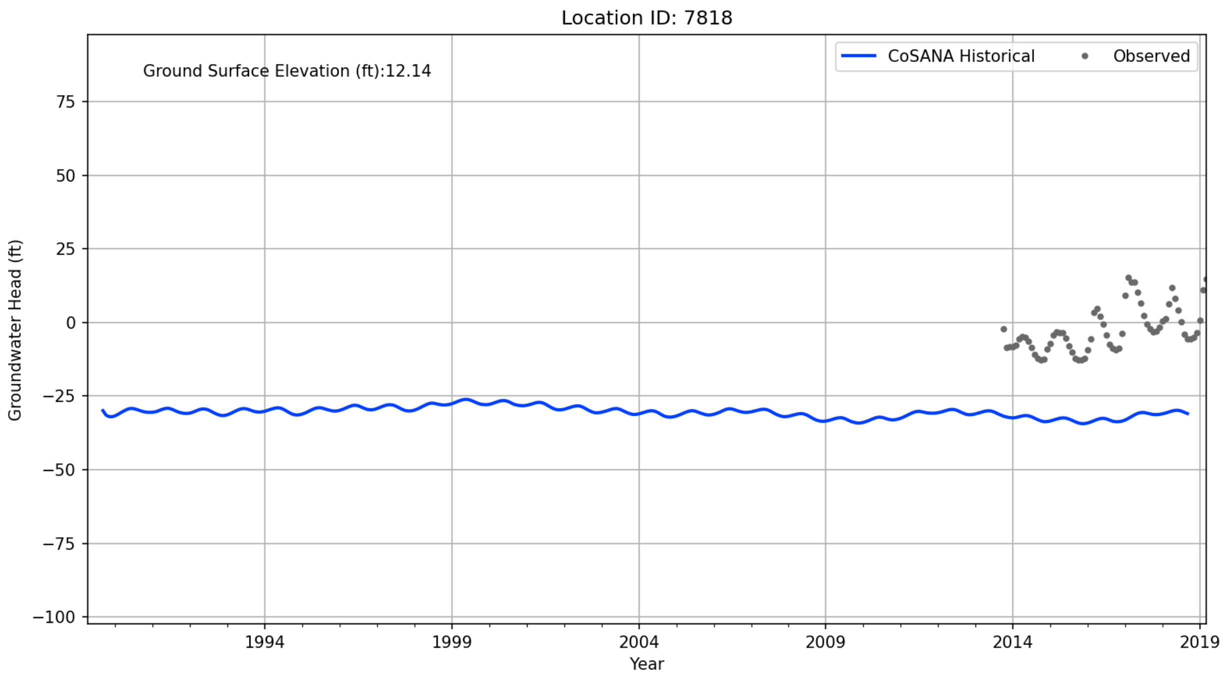
Location ID: 7811
Ground Surface Elevation (ft):41.24
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

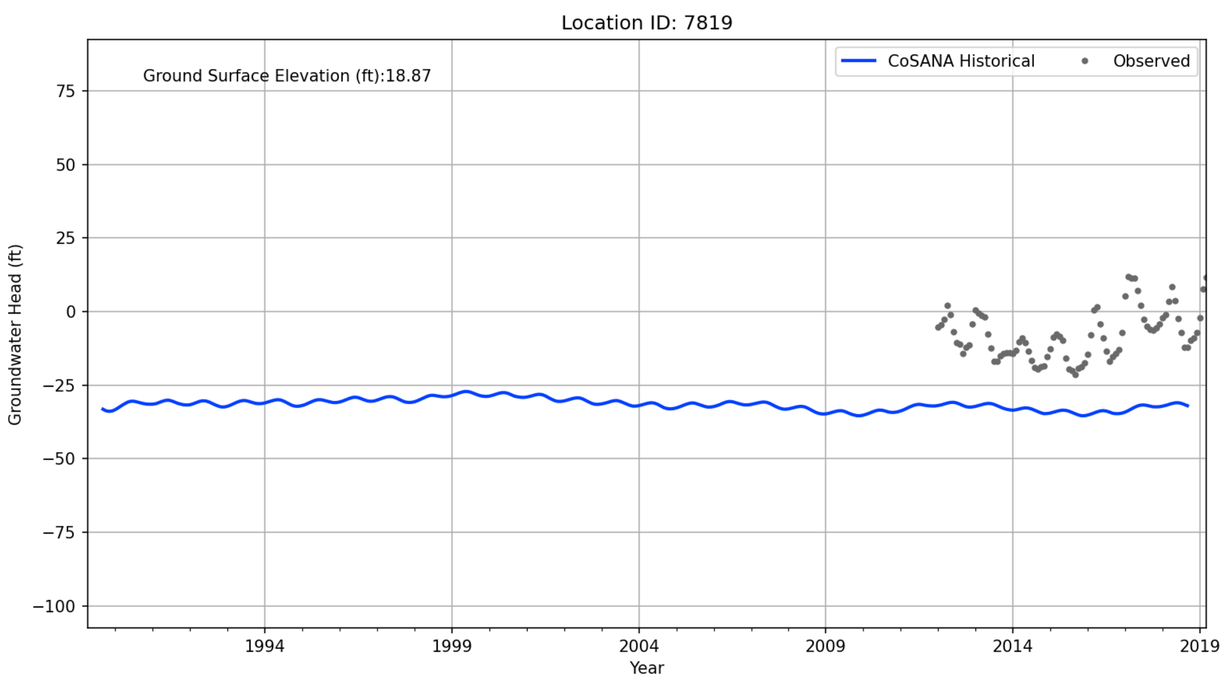


Location ID: 7812
Ground Surface Elevation (ft):33.84
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



Location ID: 7813
Ground Surface Elevation (ft):34.66
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year


Location ID: 7818
Ground Surface Elevation (ft):12.14
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 7819
Ground Surface Elevation (ft):18.87
CoSANA Historical
Observed
Groundwater Head (ft)
75
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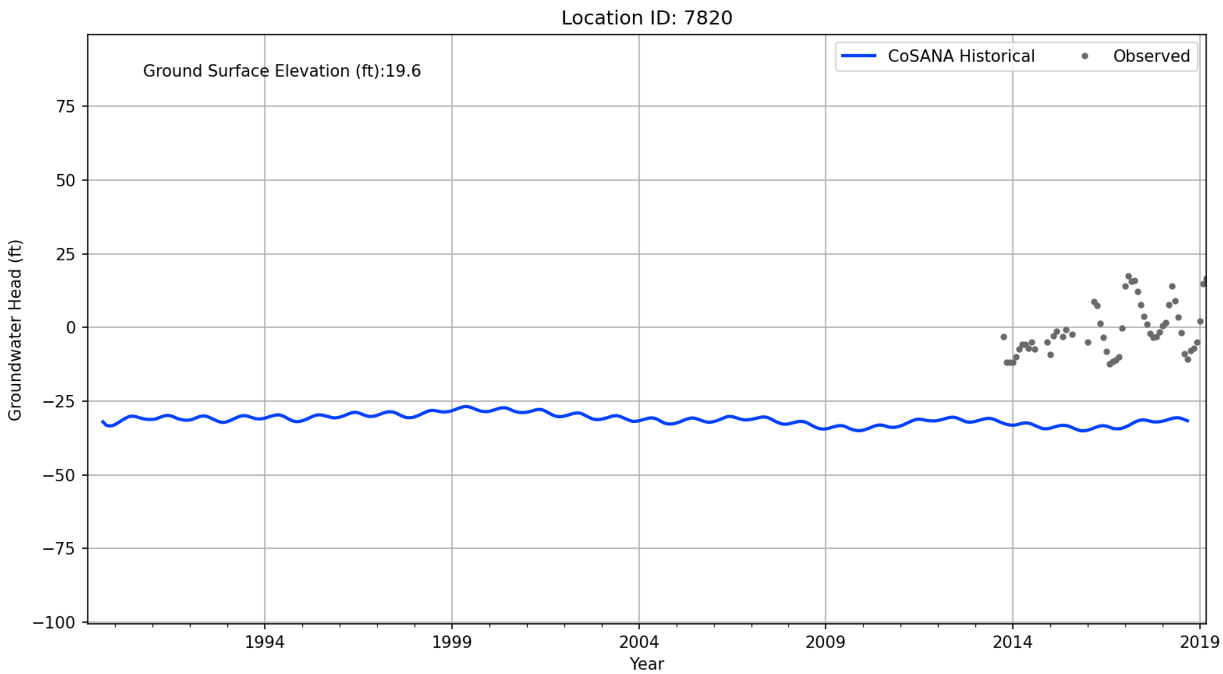
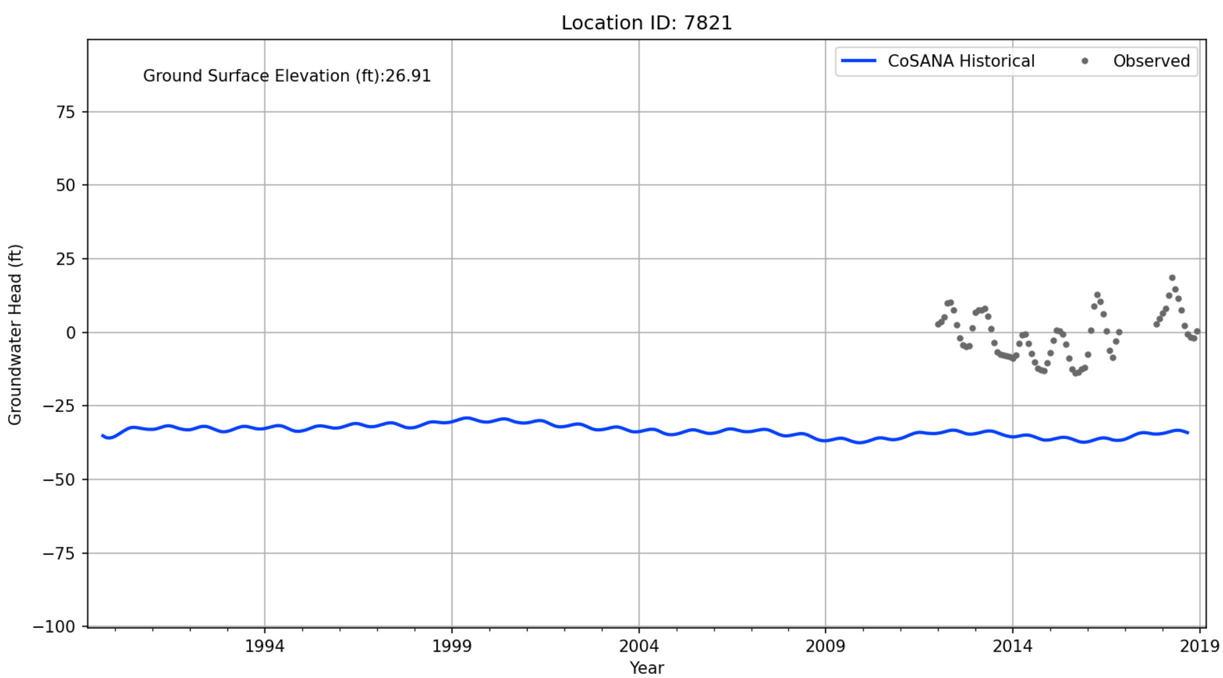
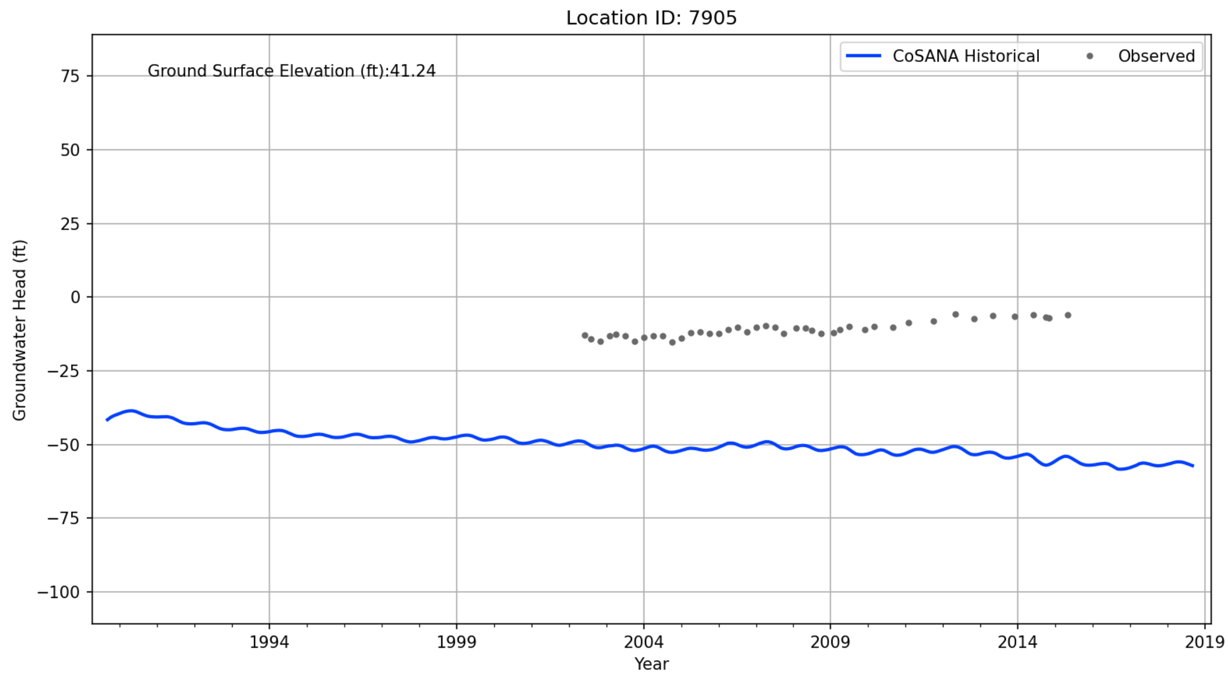
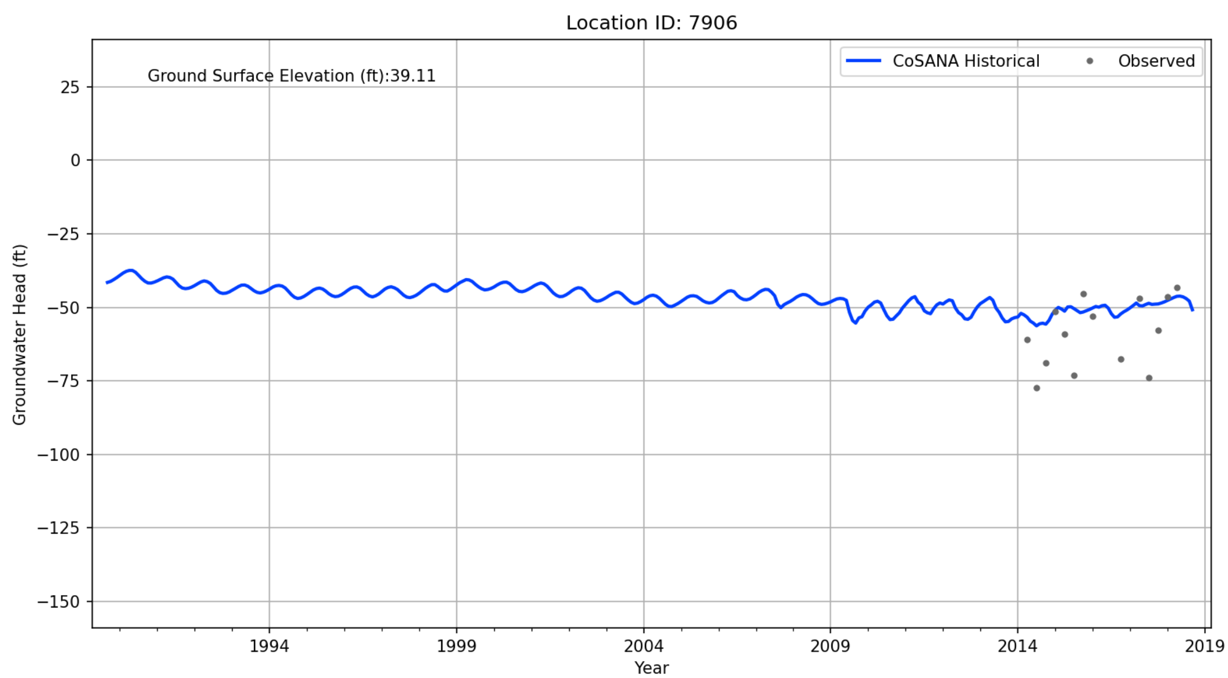
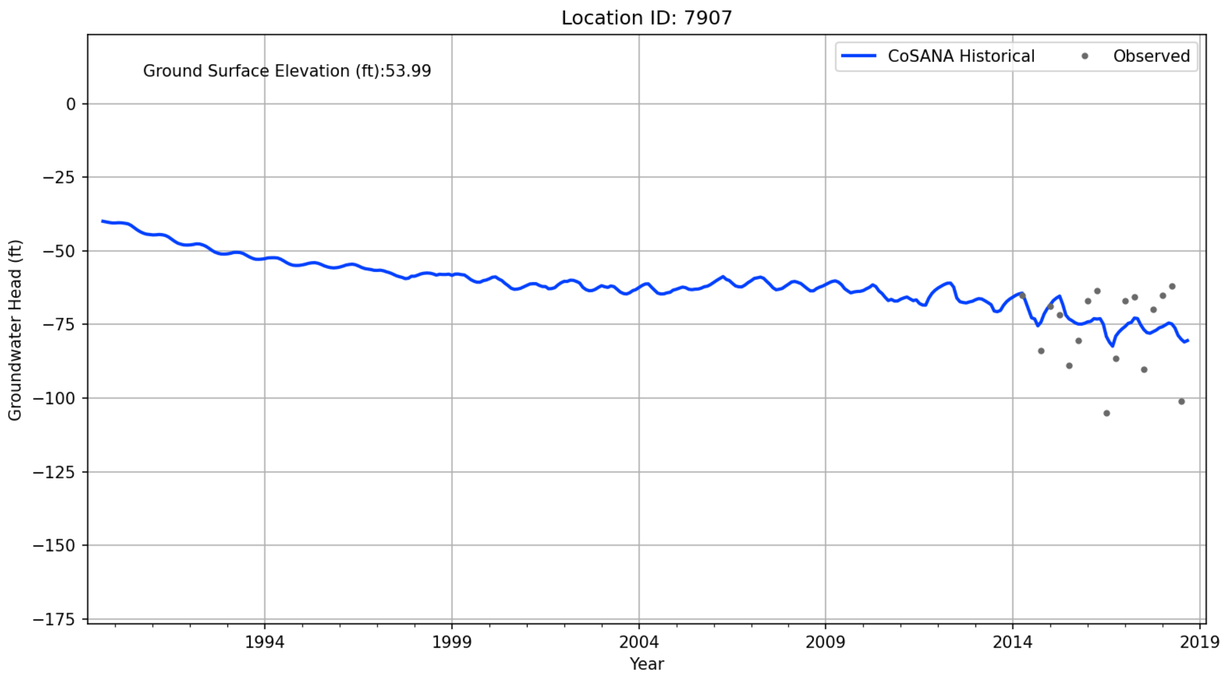
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

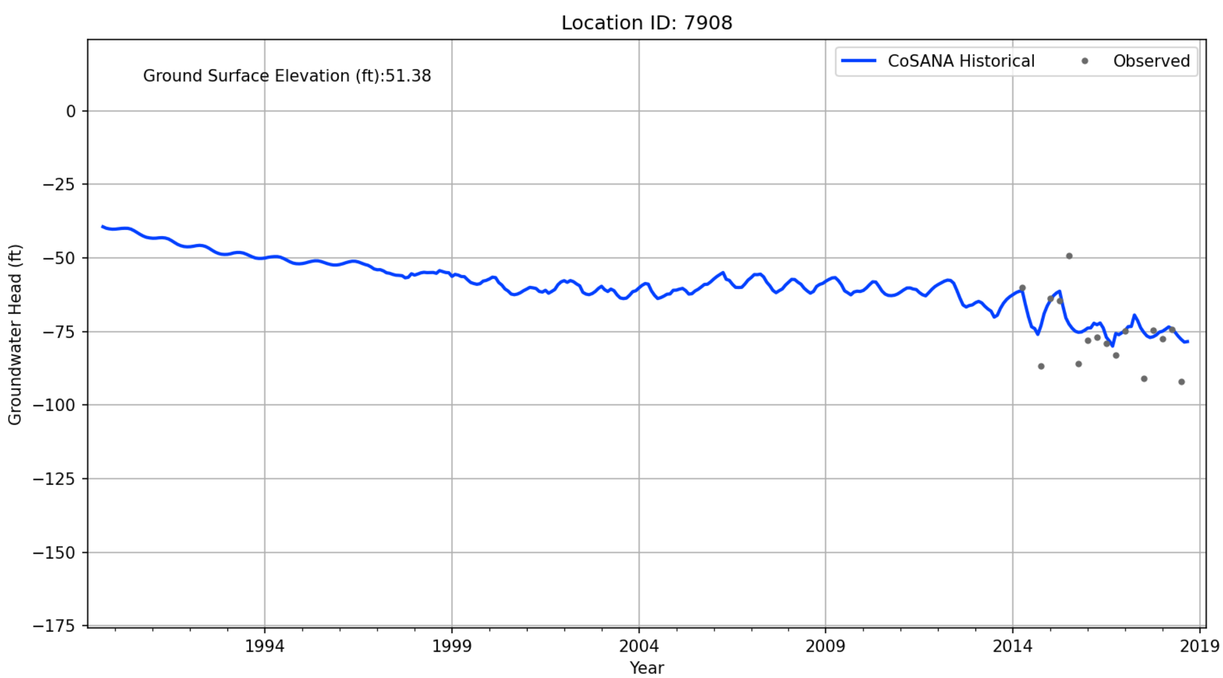

Location ID: 7820
CoSANA Historical
Observed
Ground Surface Elevation (ft):19.6
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

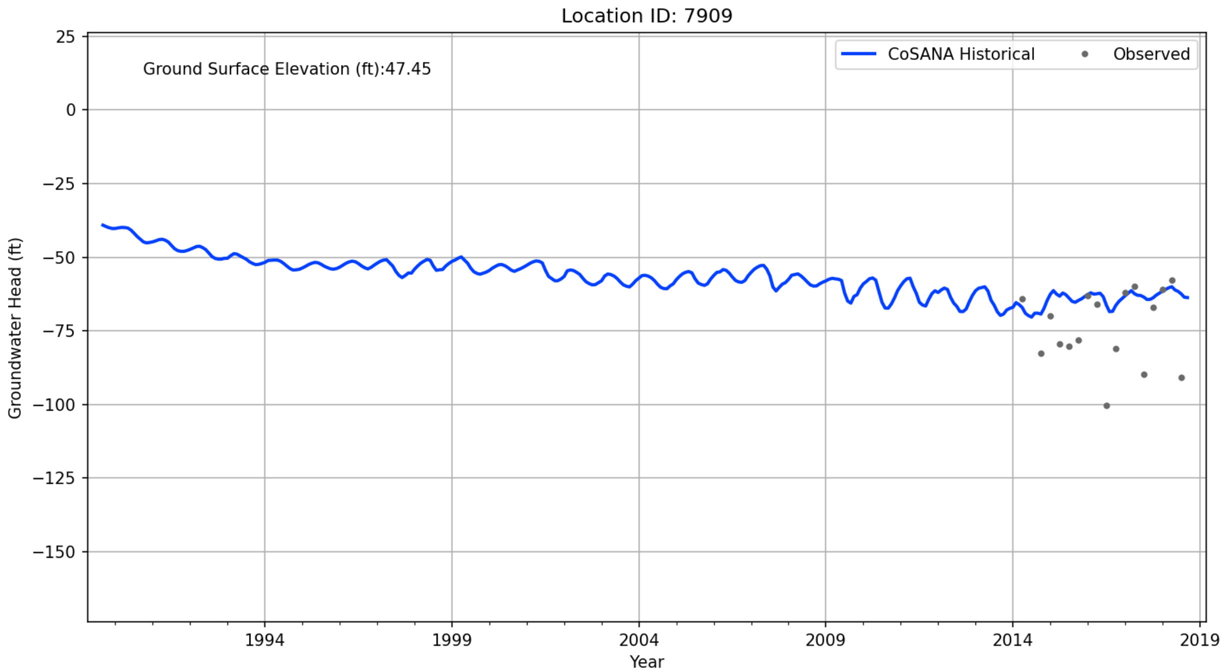

Location ID: 7821
CoSANA Historical
Observed
Ground Surface Elevation (ft):26.91
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

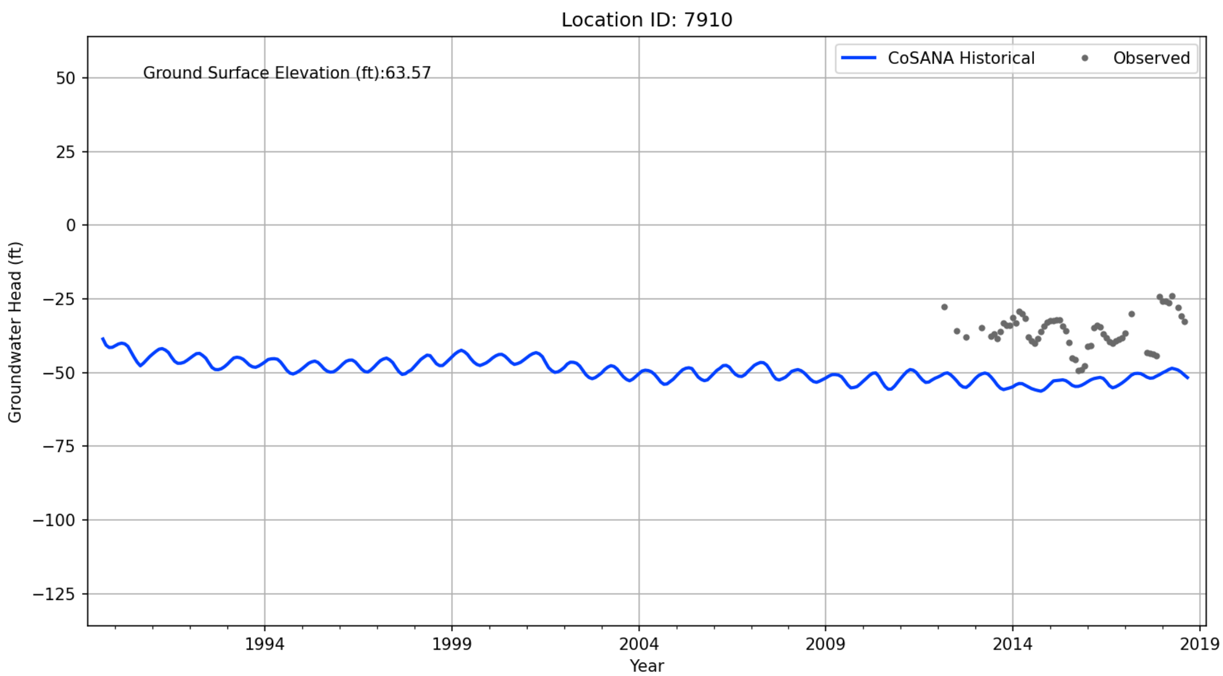

Location ID: 7905
CoSANA Historical
Observed
Ground Surface Elevation (ft):41.24
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

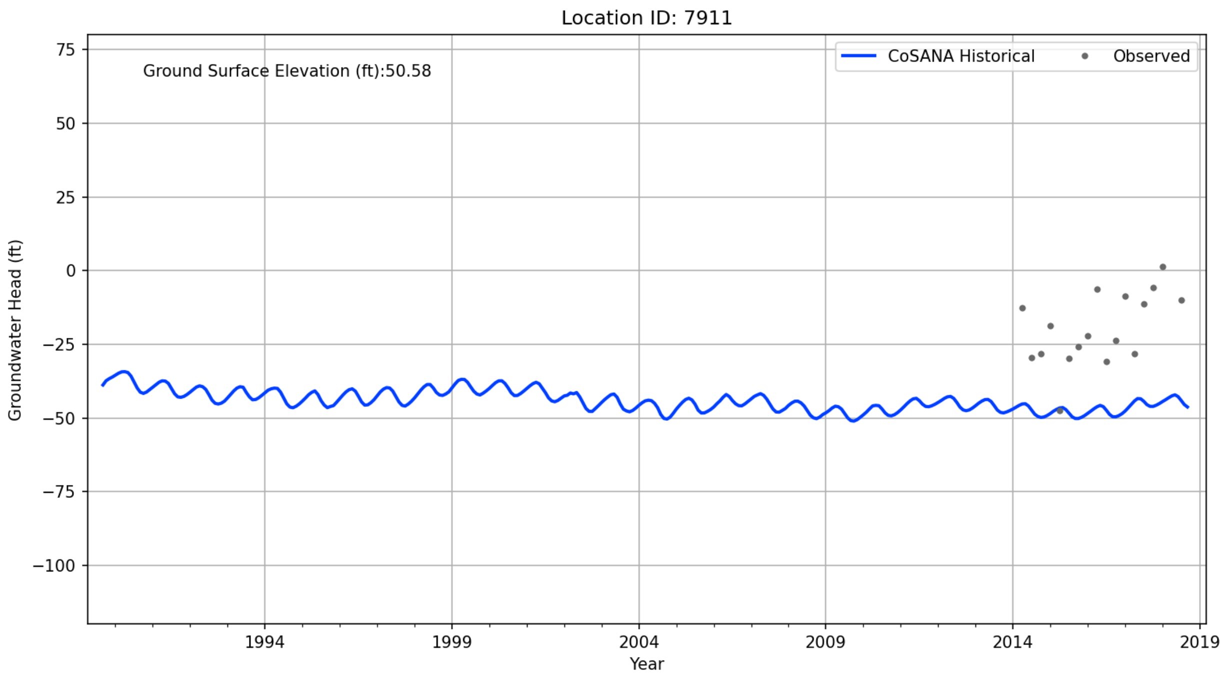

Location ID: 7906
CoSANA Historical
Observed
Ground Surface Elevation (ft):39.11
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019

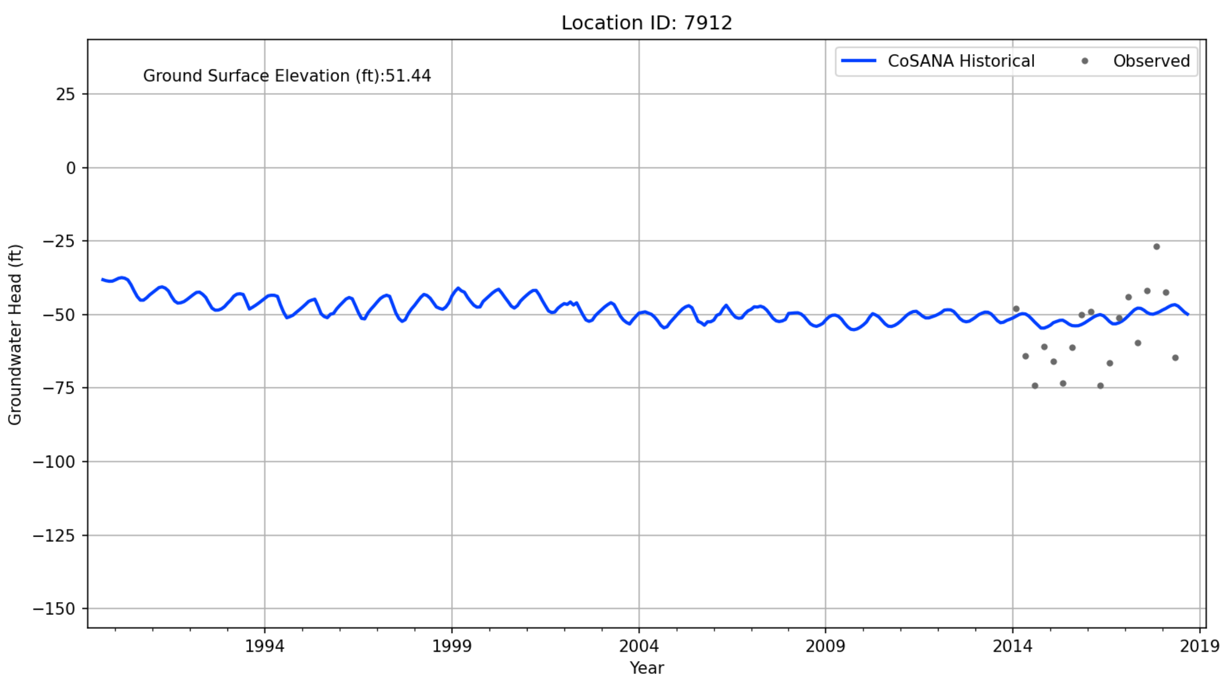

Location ID: 7907
Ground Surface Elevation (ft):53.99
CoSANA Historical
Observed
Groundwater Head (ft)
0
−25
−50
−75
−100
−125
−150
−175
1994
1999
2004
2009
2014
2019
Year

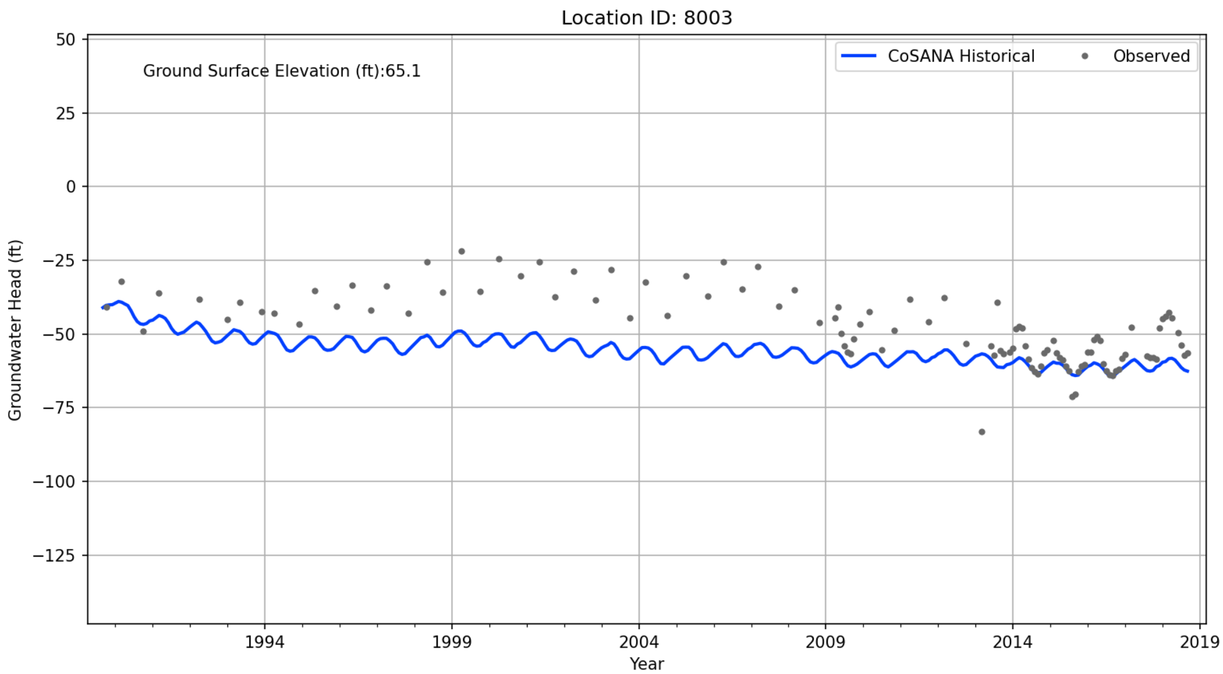

Location ID: 7908
Ground Surface Elevation (ft):51.38
CoSANA Historical
Observed
Groundwater Head (ft)
0
−25
−50
−75
−100
−125
−150
−175
1994
1999
2004
2009
2014
2019
Year

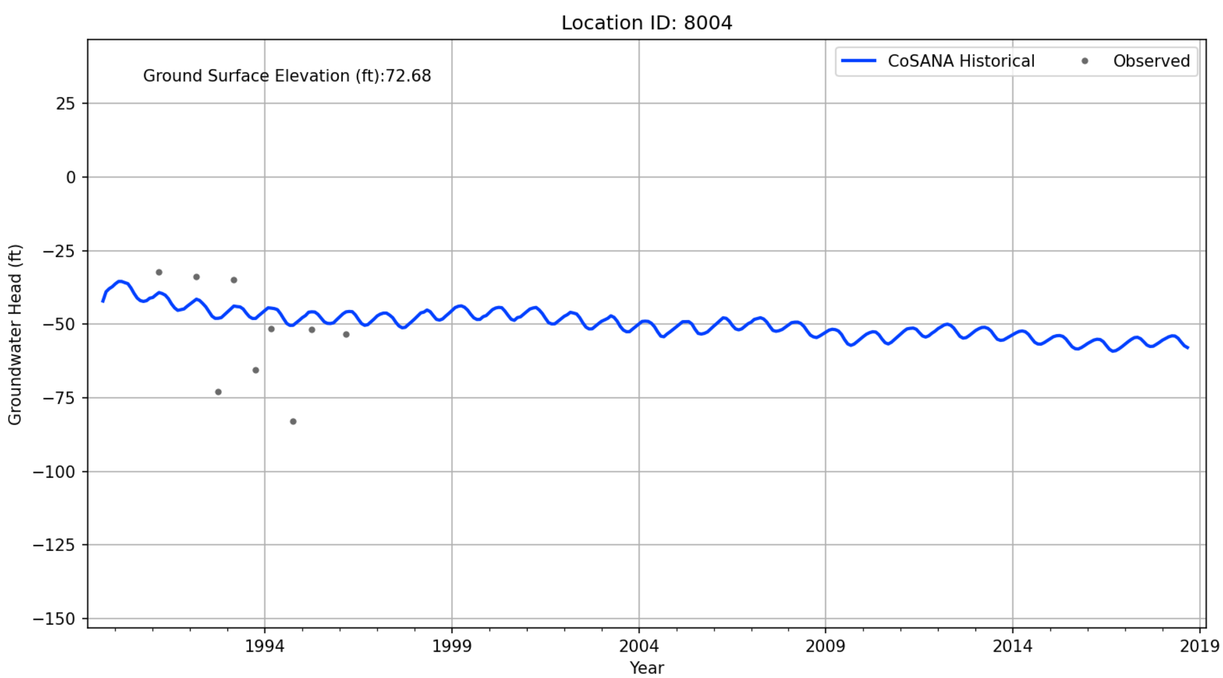

Location ID: 7909
Ground Surface Elevation (ft):47.45
CoSANA Historical
Observed
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

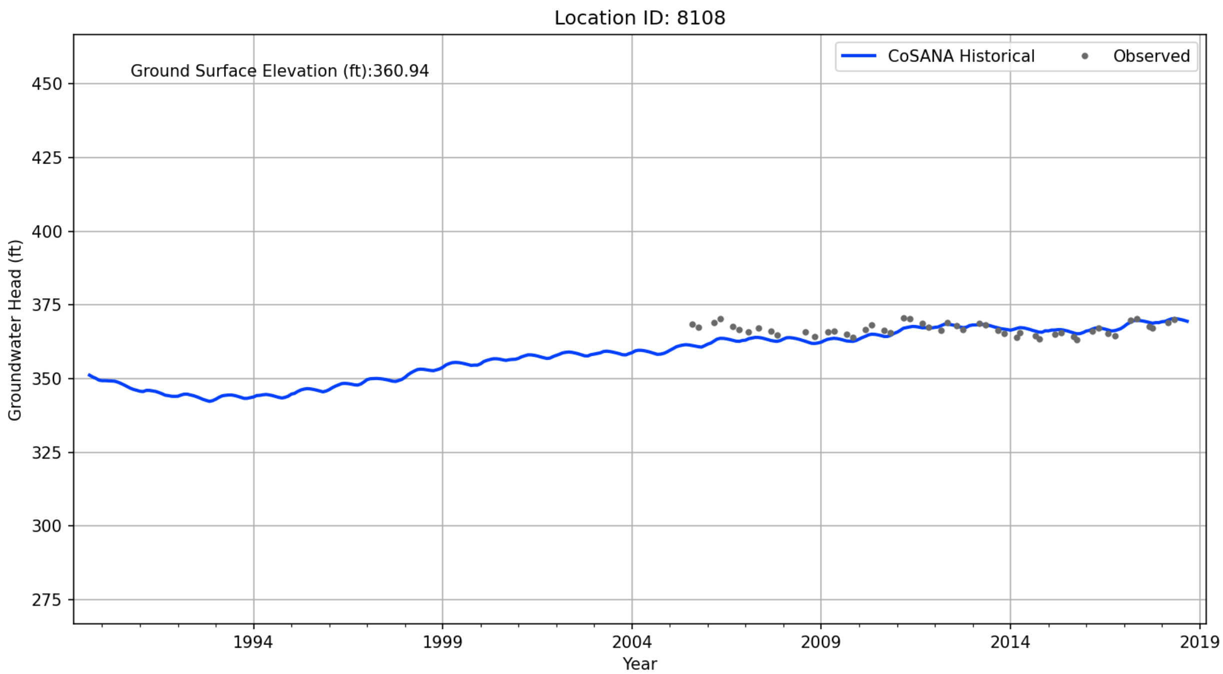

Location ID: 7910
Ground Surface Elevation (ft):63.57
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

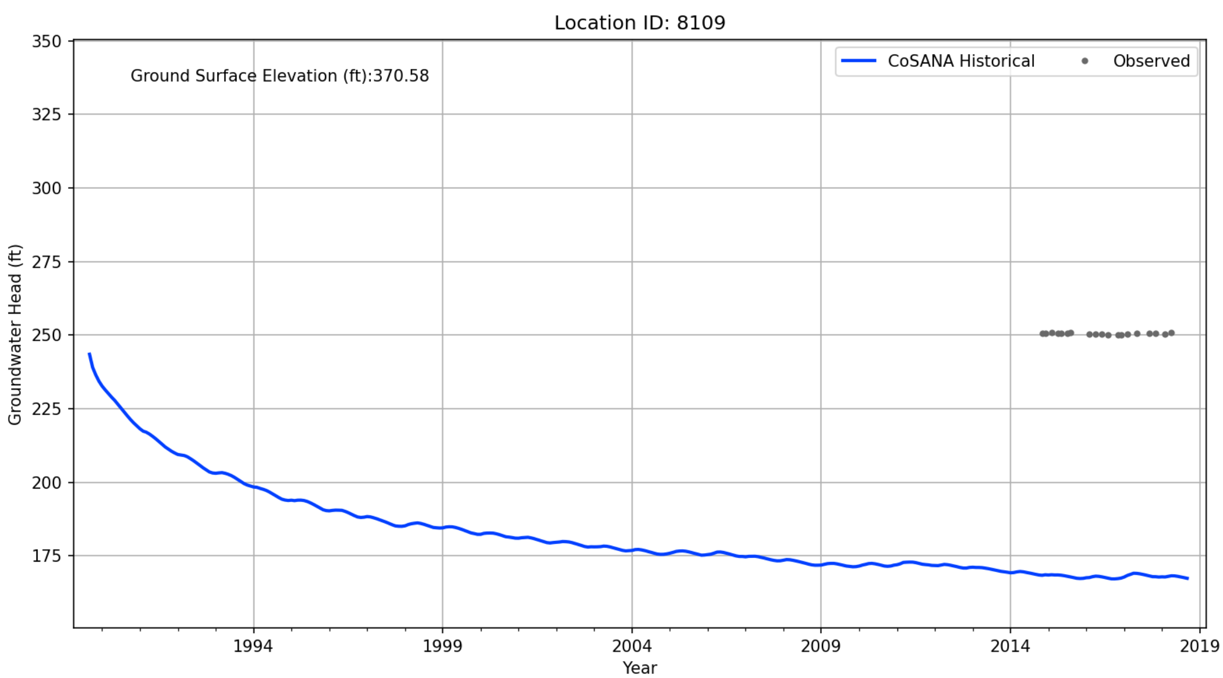

Location ID: 7911
CoSANA Historical
Observed
Ground Surface Elevation (ft):50.58
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

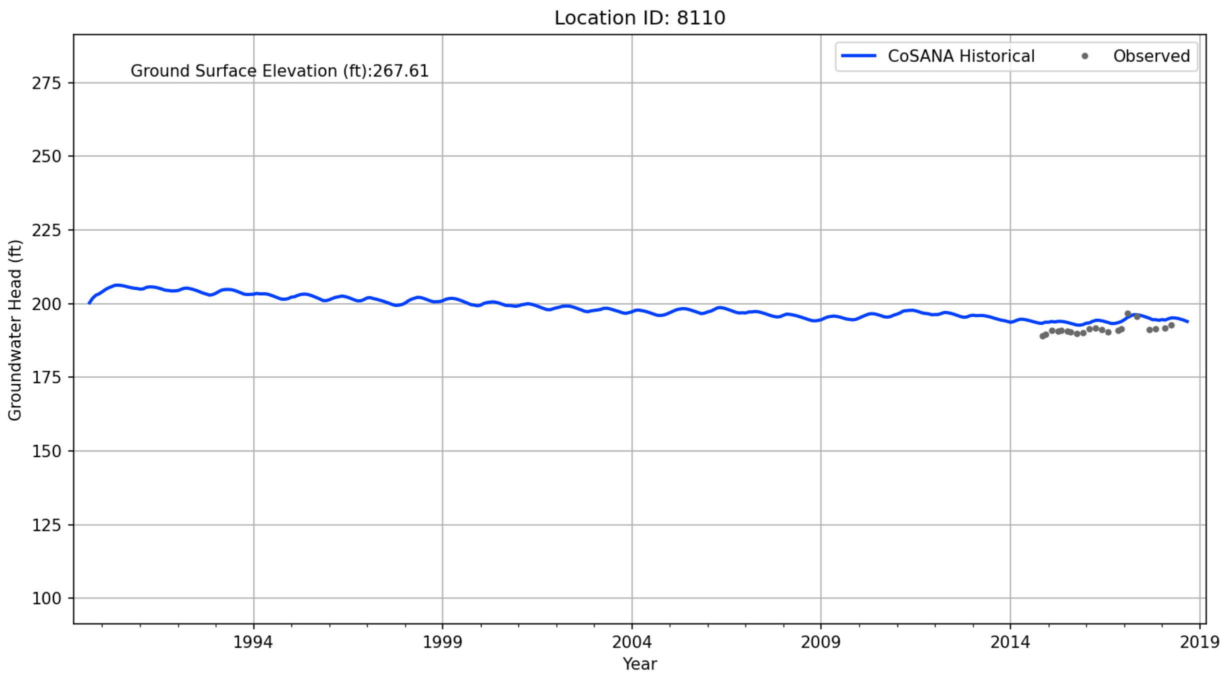

Location ID: 7912
CoSANA Historical
Observed
Ground Surface Elevation (ft):51.44
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

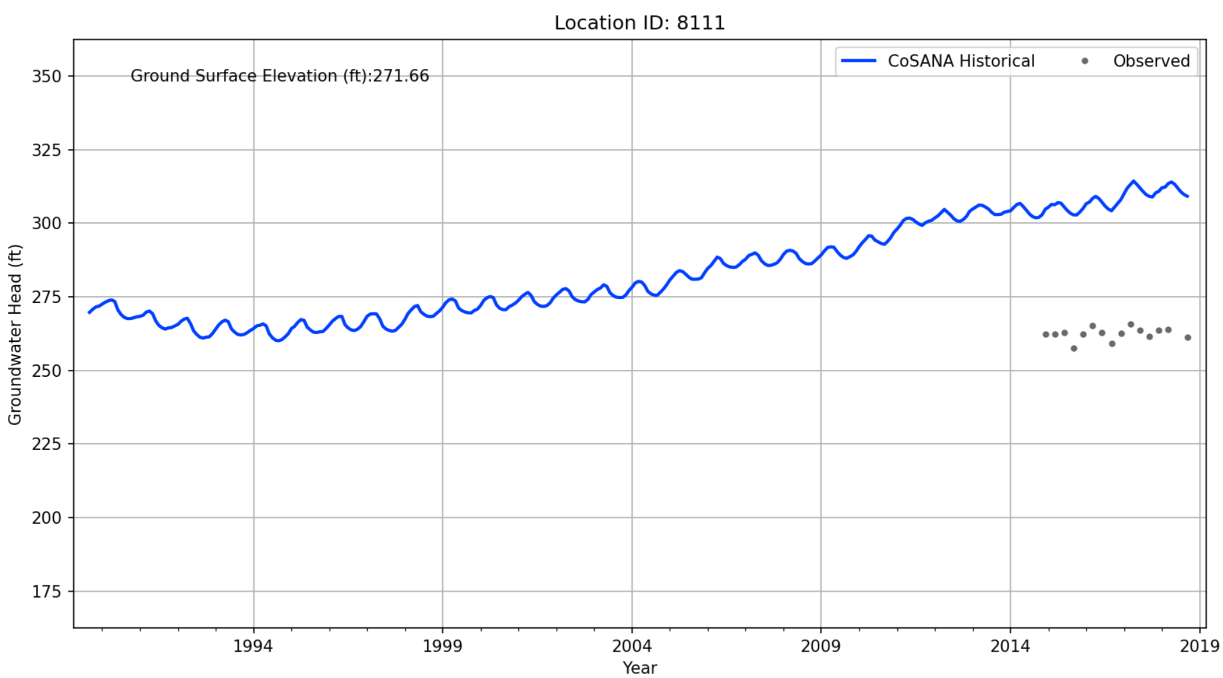

Location ID: 8003
Ground Surface Elevation (ft):65.1
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019

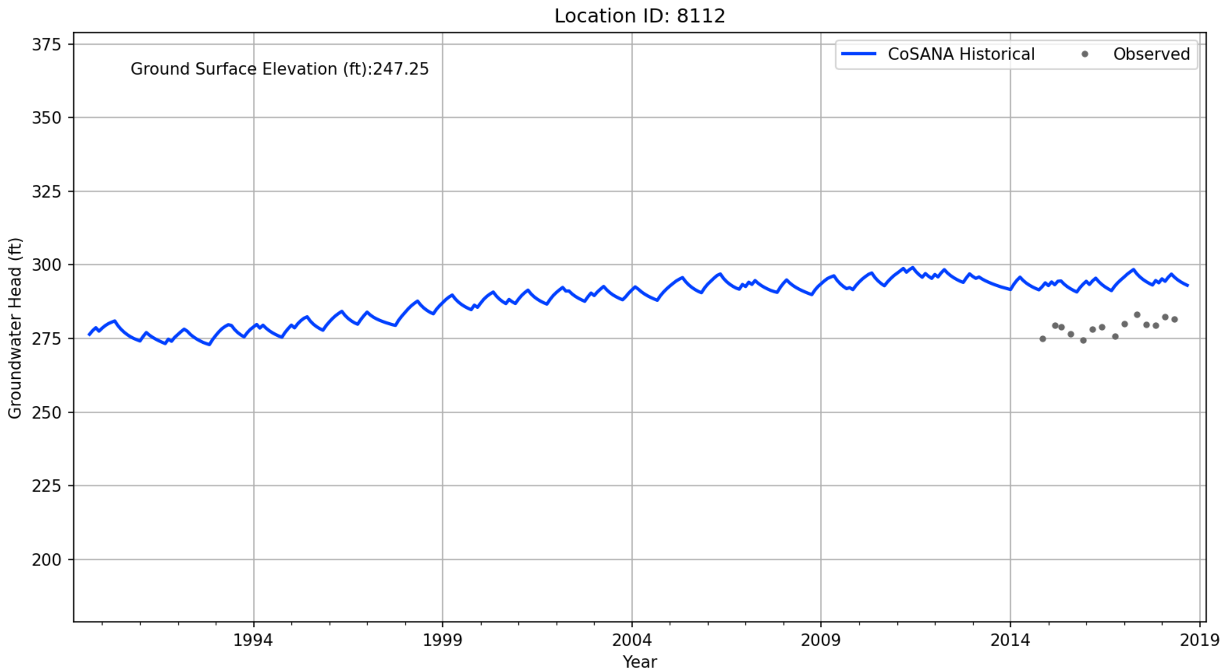

Location ID: 8004
Ground Surface Elevation (ft):72.68
CoSANA Historical
Observed
Groundwater Head (ft)
Year
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019

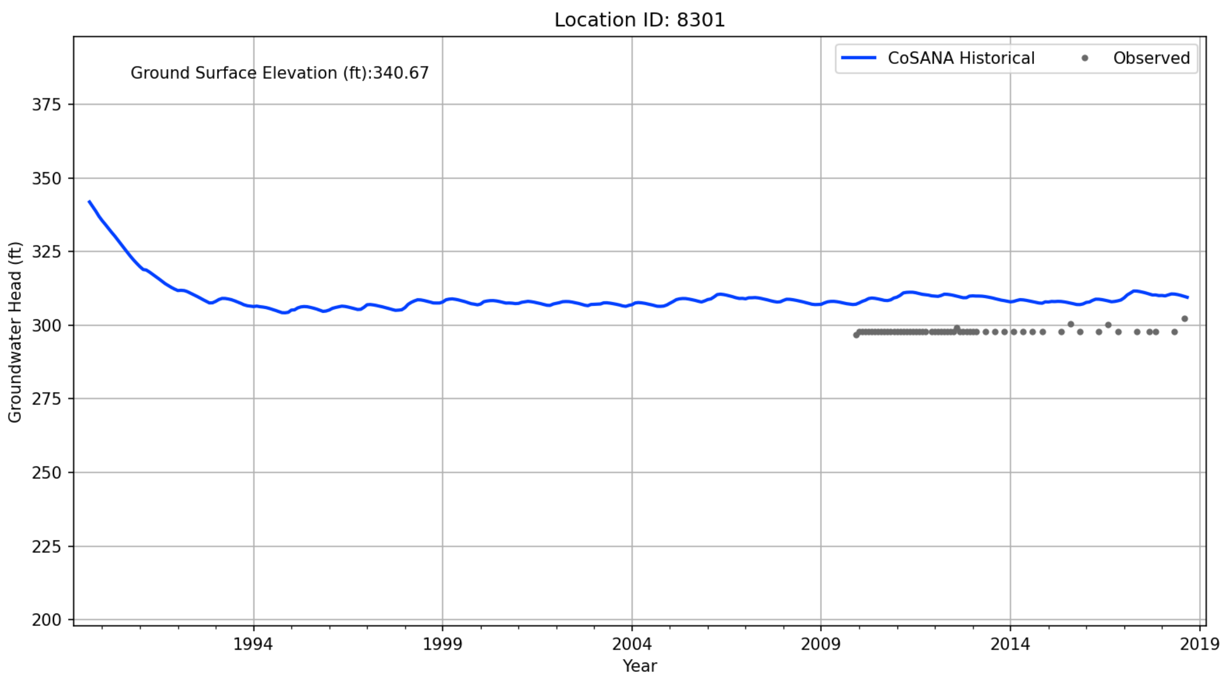

Location ID: 8108
Ground Surface Elevation (ft):360.94
CoSANA Historical
Observed
Groundwater Head (ft)
450
425
400
375
350
325
300
275
1994
1999
2004
2009
2014
2019
Year

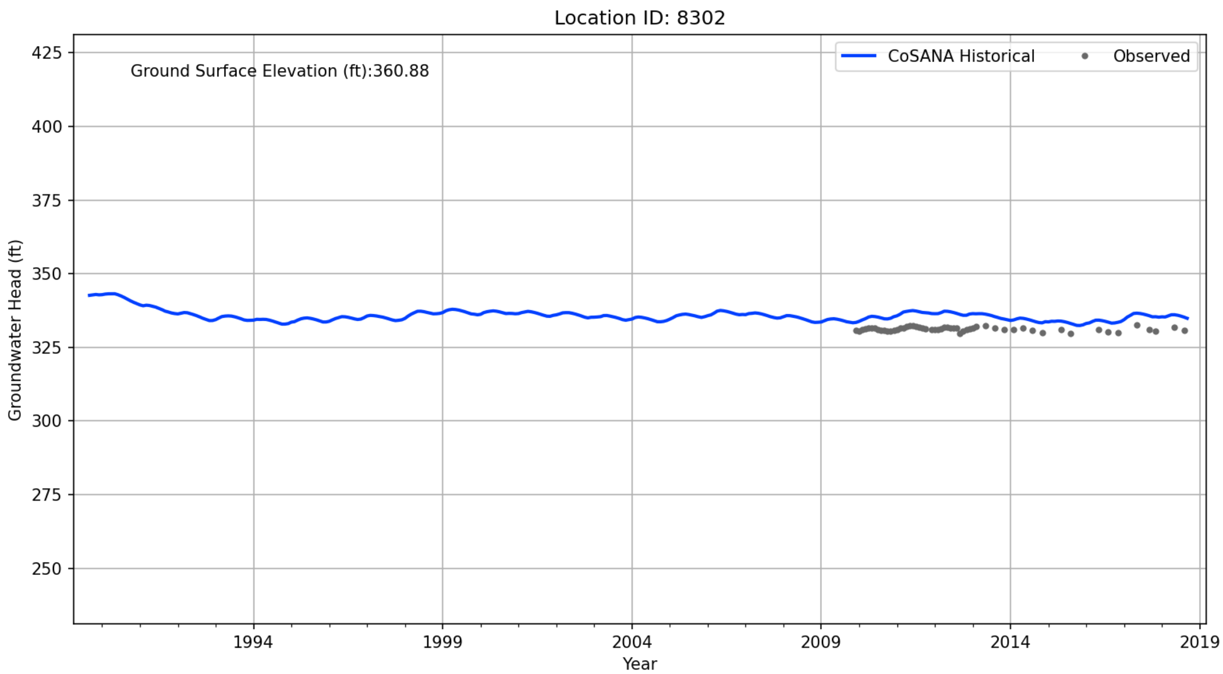

Location ID: 8109
Ground Surface Elevation (ft):370.58
CoSANA Historical
Observed
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year

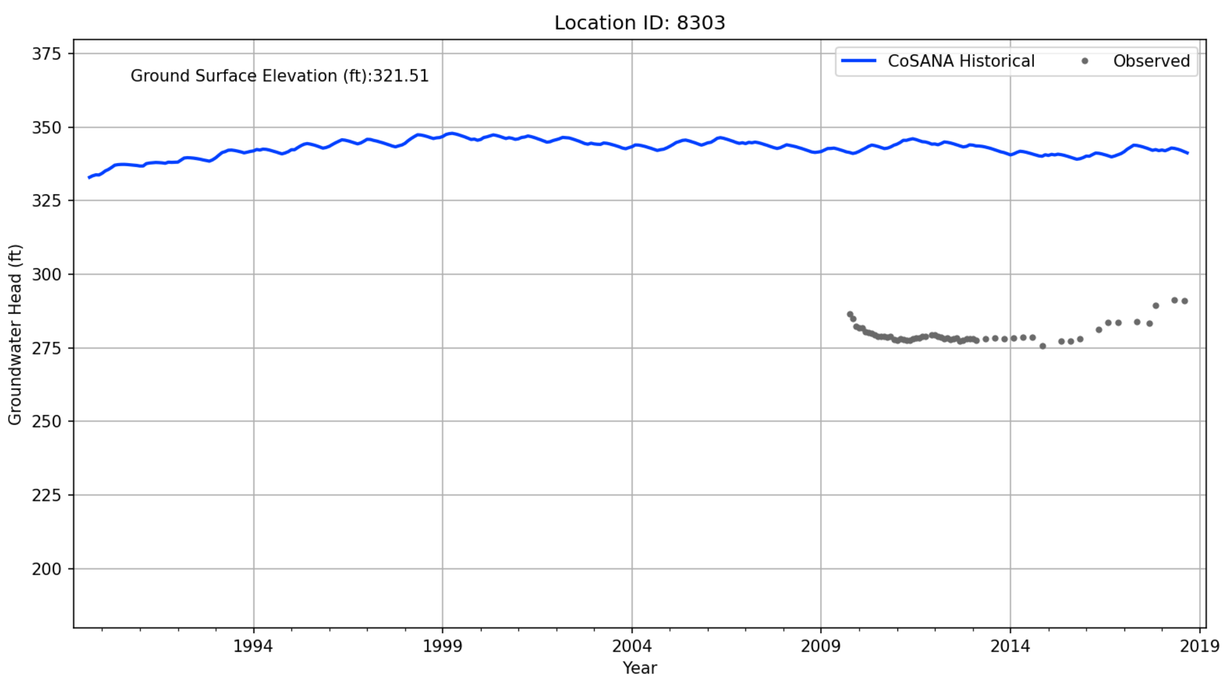

Location ID: 8110
CoSANA Historical
Observed
Ground Surface Elevation (ft):267.61
Groundwater Head (ft)
Year
275
250
225
200
175
150
125
100
1994
1999
2004
2009
2014
2019

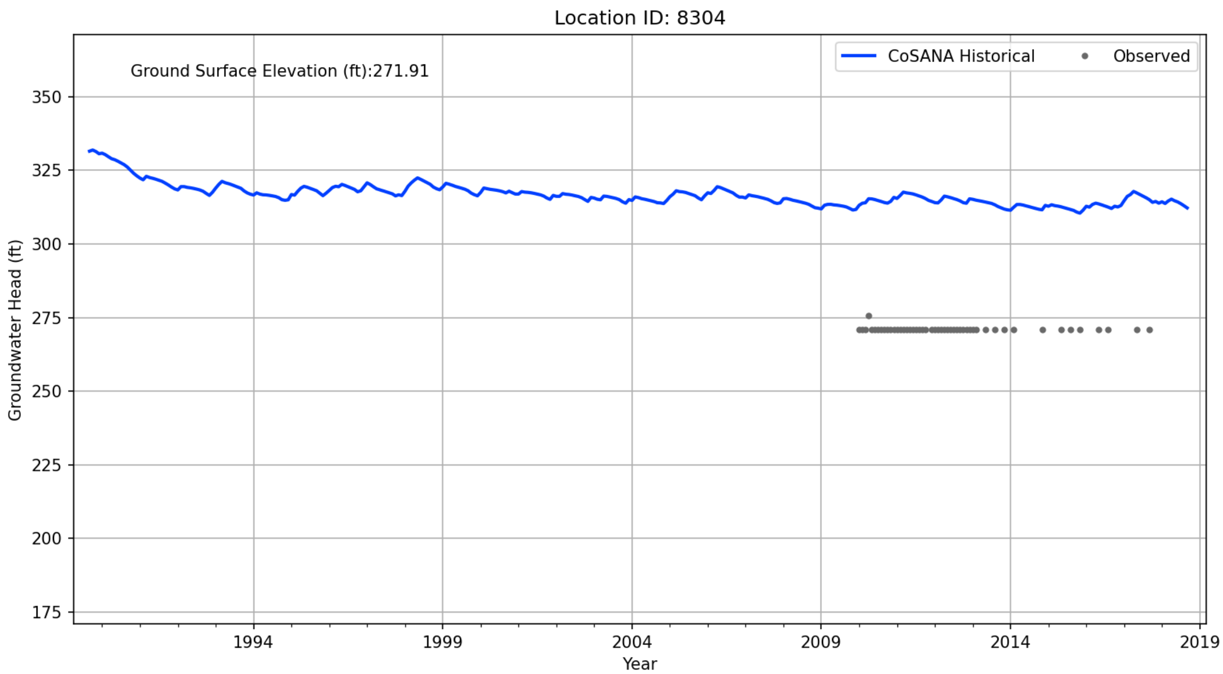

Location ID: 8111
CoSANA Historical
Observed
Ground Surface Elevation (ft):271.66
Groundwater Head (ft)
Year
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019


Location ID: 8112
Ground Surface Elevation (ft):247.25
CoSANA Historical
Observed
Groundwater Head (ft)
375
350
325
300
275
250
225
200
1994
1999
2004
2009
2014
2019
Year

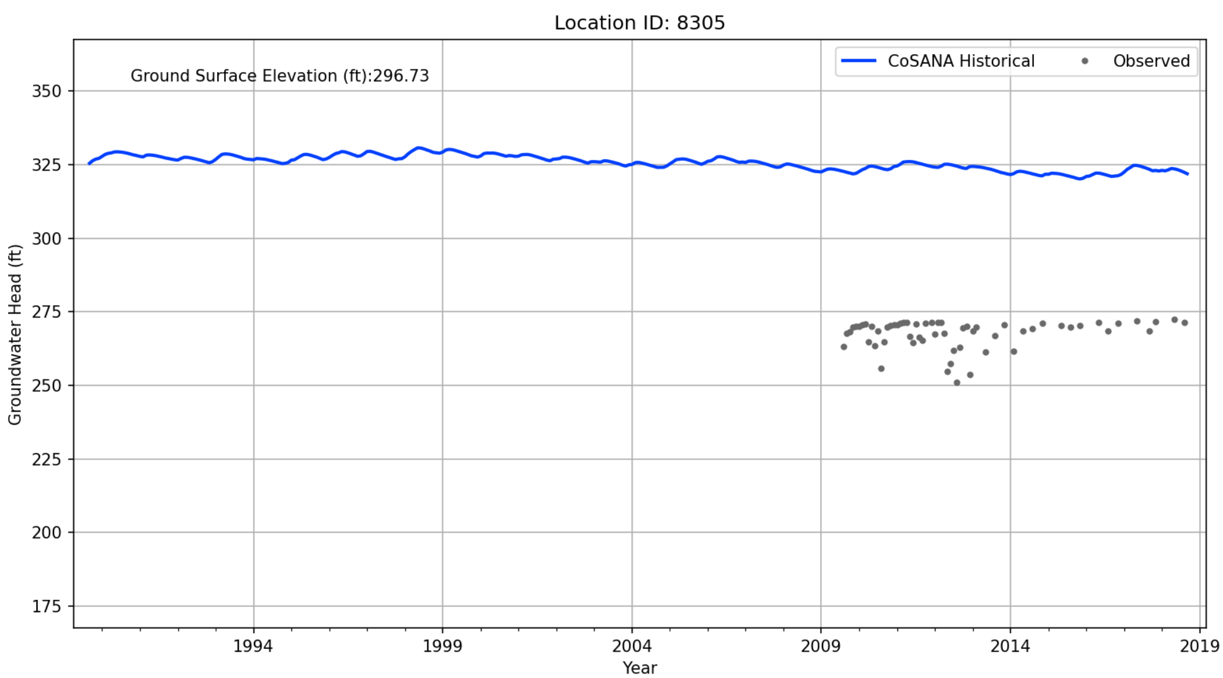

Location ID: 8301
Ground Surface Elevation (ft):340.67
CoSANA Historical
Observed
Groundwater Head (ft)
375
350
325
300
275
250
225
200
1994
1999
2004
2009
2014
2019
Year


Location ID: 8302
Ground Surface Elevation (ft):360.88
CoSANA Historical
Observed
Groundwater Head (ft)
425
400
375
350
325
300
275
250
1994
1999
2004
2009
2014
2019
Year

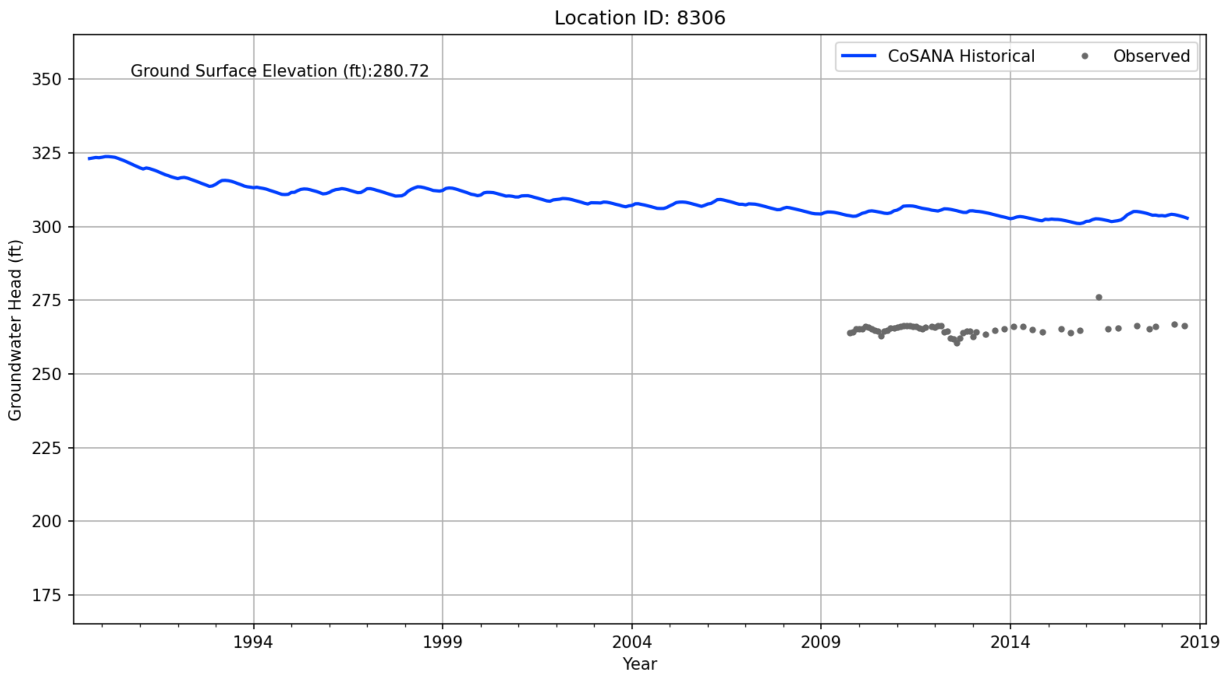

Location ID: 8303
Ground Surface Elevation (ft):321.51
CoSANA Historical
Observed
Groundwater Head (ft)
375
350
325
300
275
250
225
200
1994
1999
2004
2009
2014
2019
Year



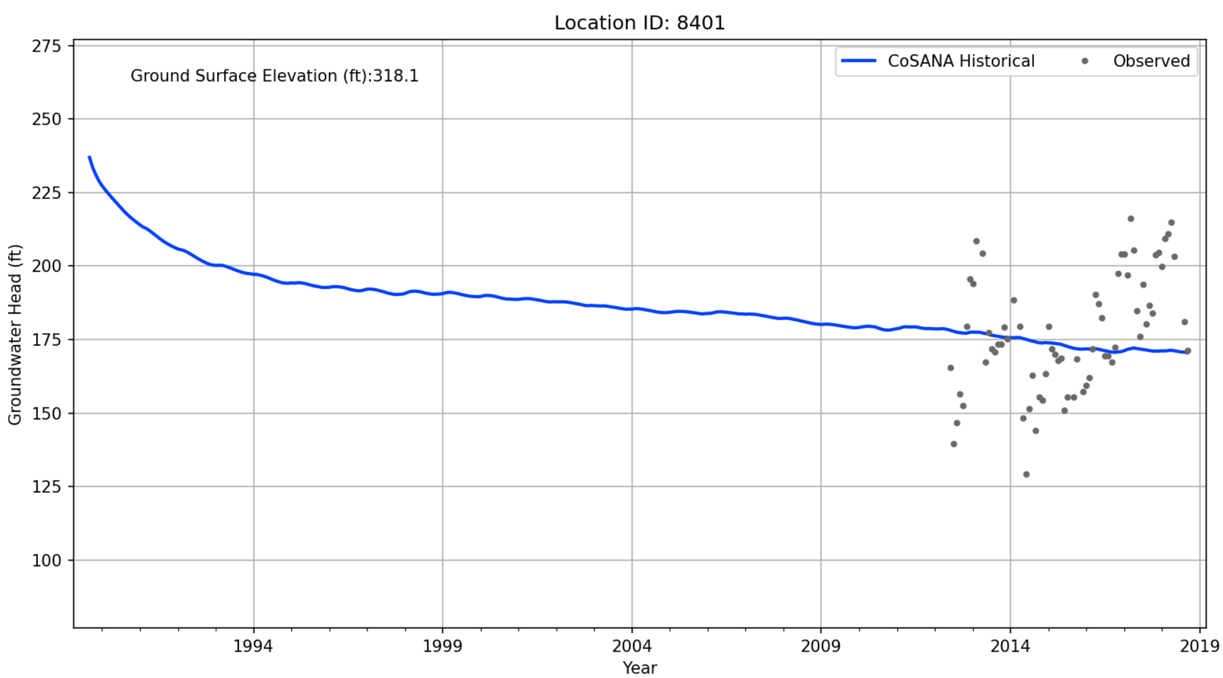
Location ID: 8304
Ground Surface Elevation (ft):271.91
CoSANA Historical
Observed
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year



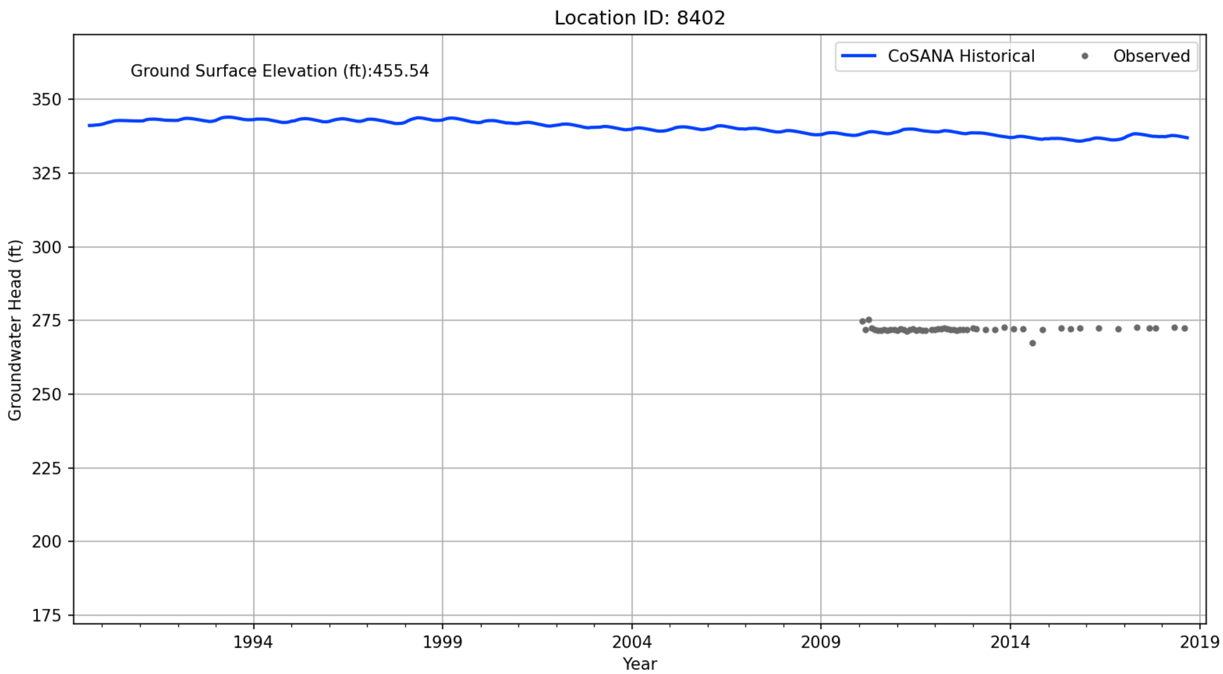
Location ID: 8305
Ground Surface Elevation (ft):296.73
CoSANA Historical
Observed
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year

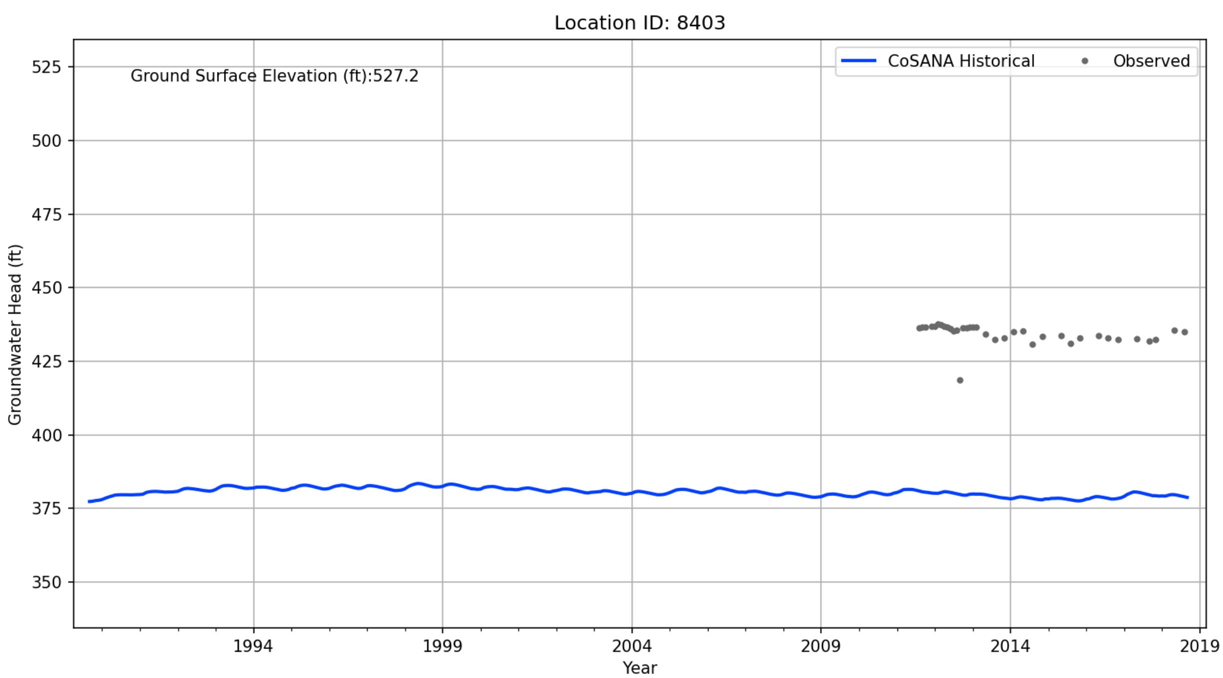


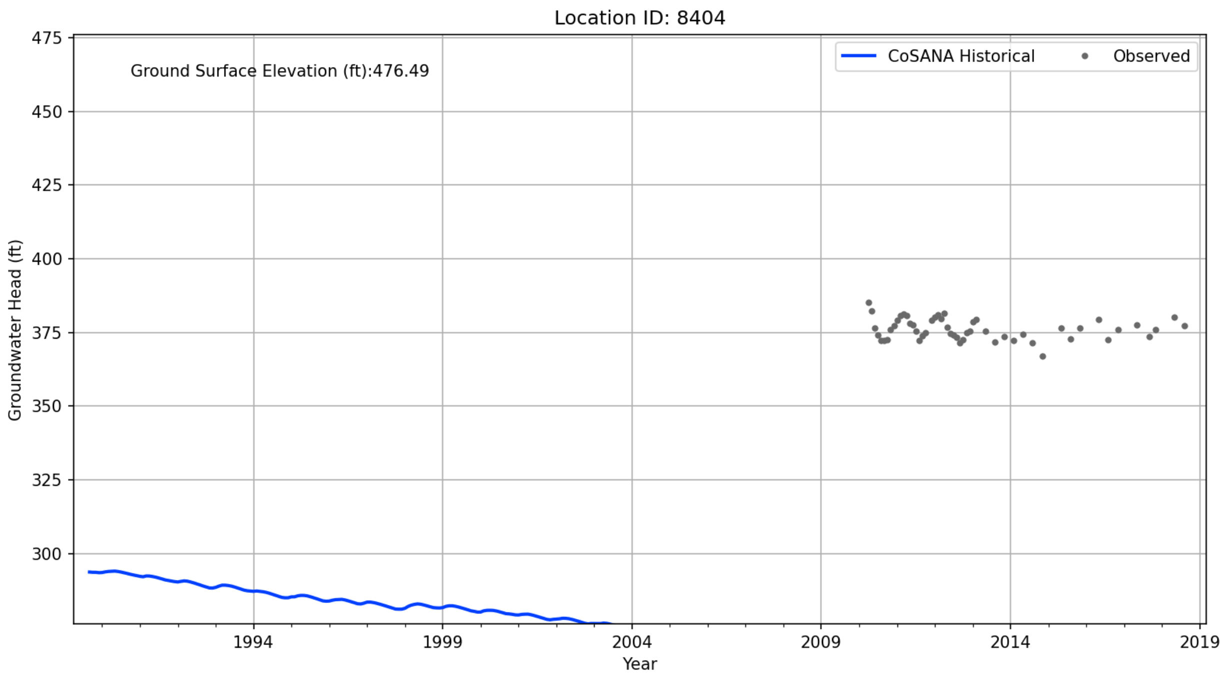
Location ID: 8306
CoSANA Historical
Observed
Ground Surface Elevation (ft):280.72
Groundwater Head (ft)
Year
175
200
225
250
275
300
325
350
1994
1999
2004
2009
2014
2019

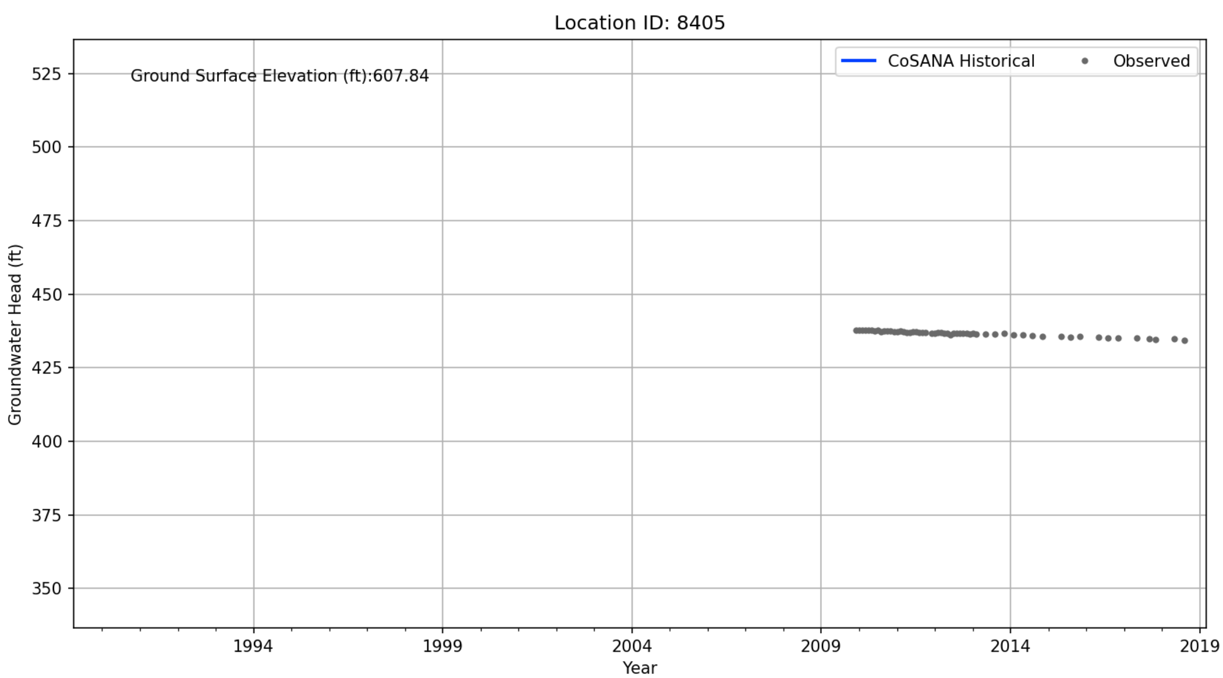


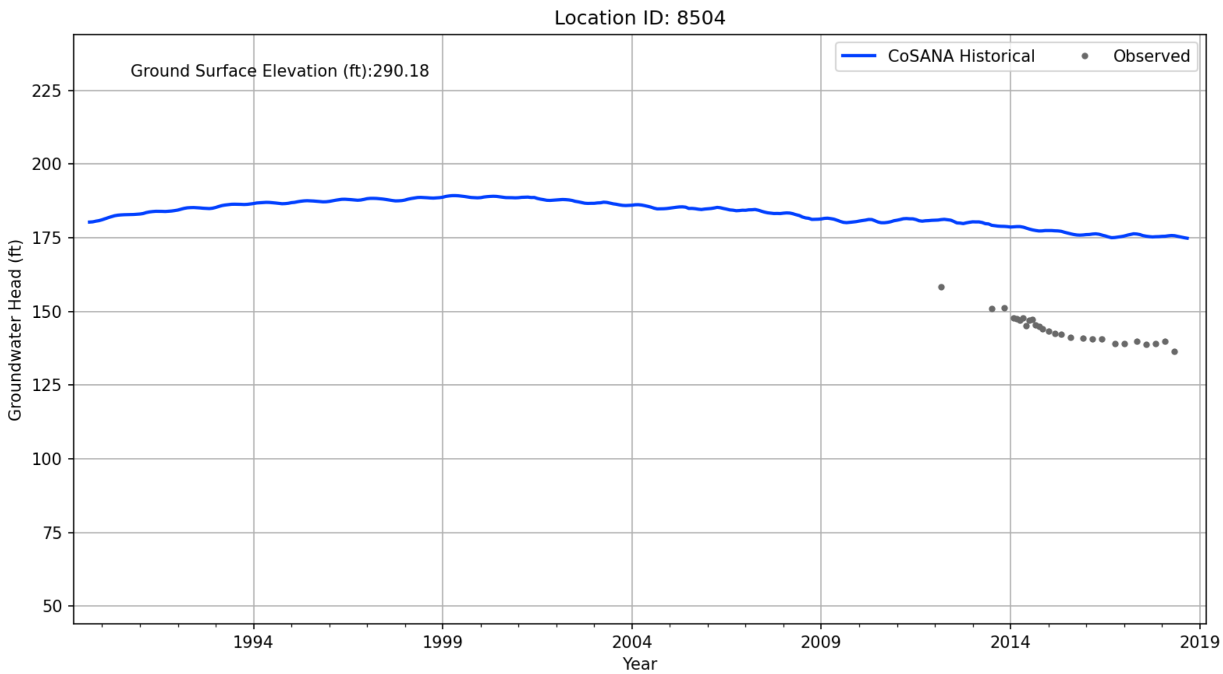
Location ID: 8401
CoSANA Historical
Observed
Ground Surface Elevation (ft):318.1
Groundwater Head (ft)
Year
100
125
150
175
200
225
250
275
1994
1999
2004
2009
2014
2019

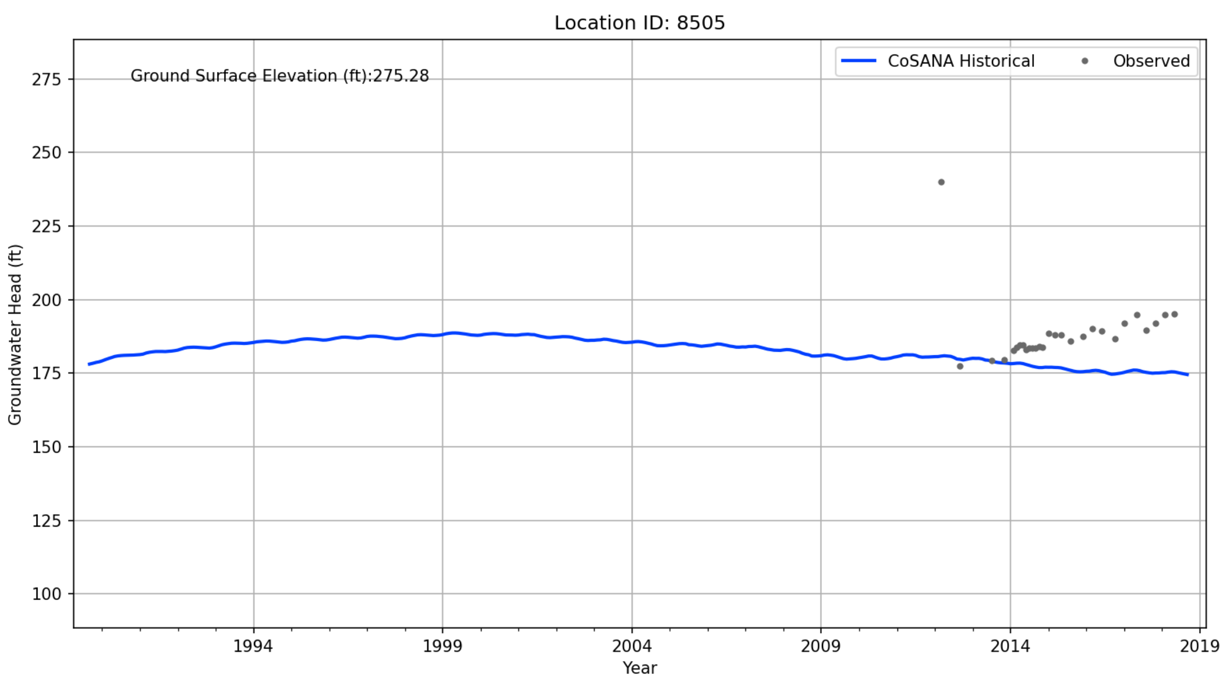

Location ID: 8402
CoSANA Historical
Observed
Ground Surface Elevation (ft):455.54
Groundwater Head (ft)
350
325
300
275
250
225
200
175
1994
1999
2004
2009
2014
2019
Year

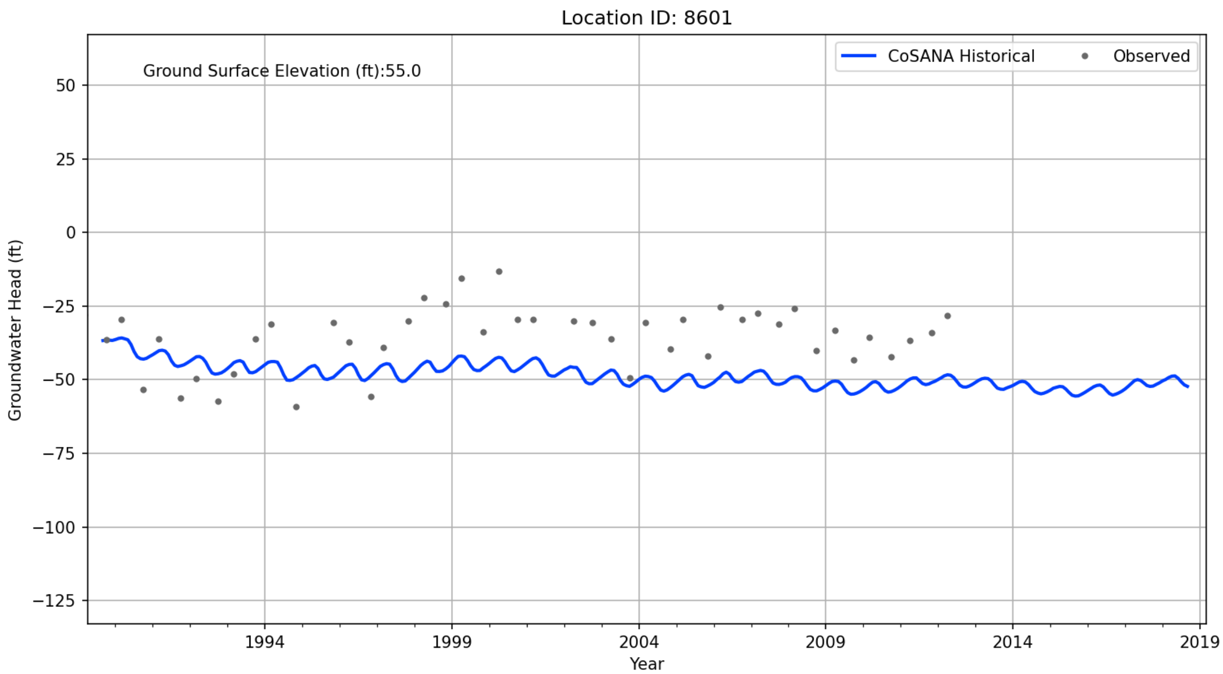

Location ID: 8403
CoSANA Historical
Observed
Ground Surface Elevation (ft):527.2
Groundwater Head (ft)
525
500
475
450
425
400
375
350
1994
1999
2004
2009
2014
2019
Year

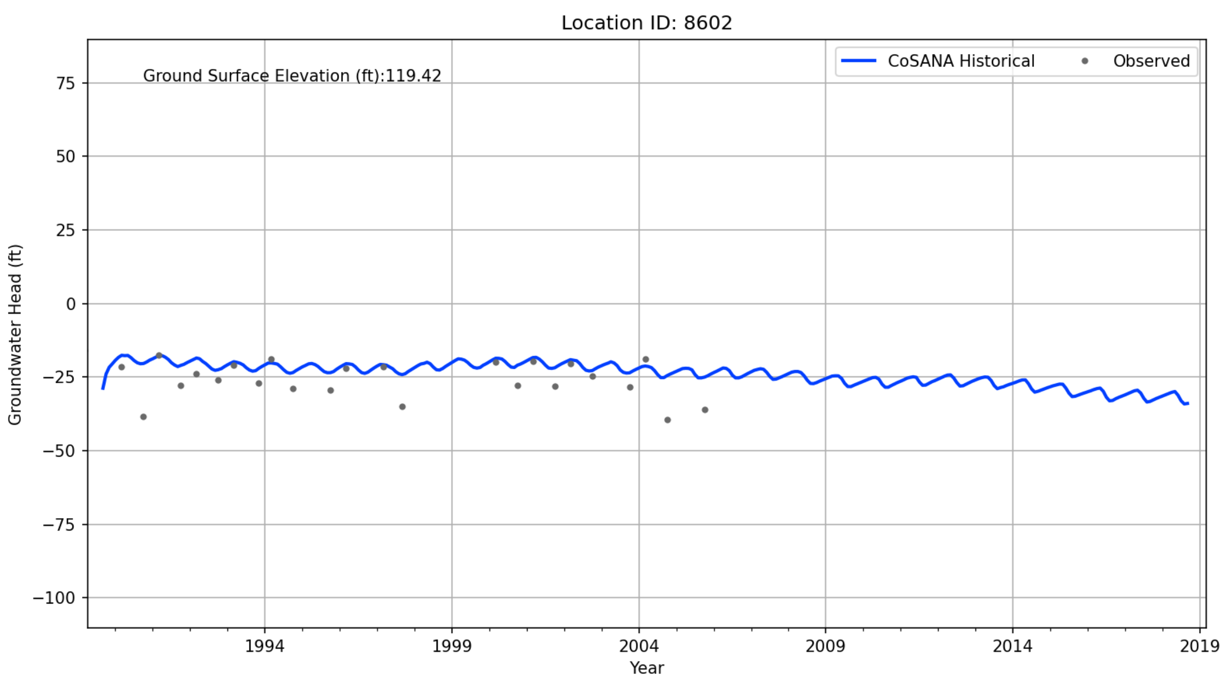

Location ID: 8404
Ground Surface Elevation (ft):476.49
CoSANA Historical
Observed
Groundwater Head (ft)
475
450
425
400
375
350
325
300
1994
1999
2004
2009
2014
2019
Year

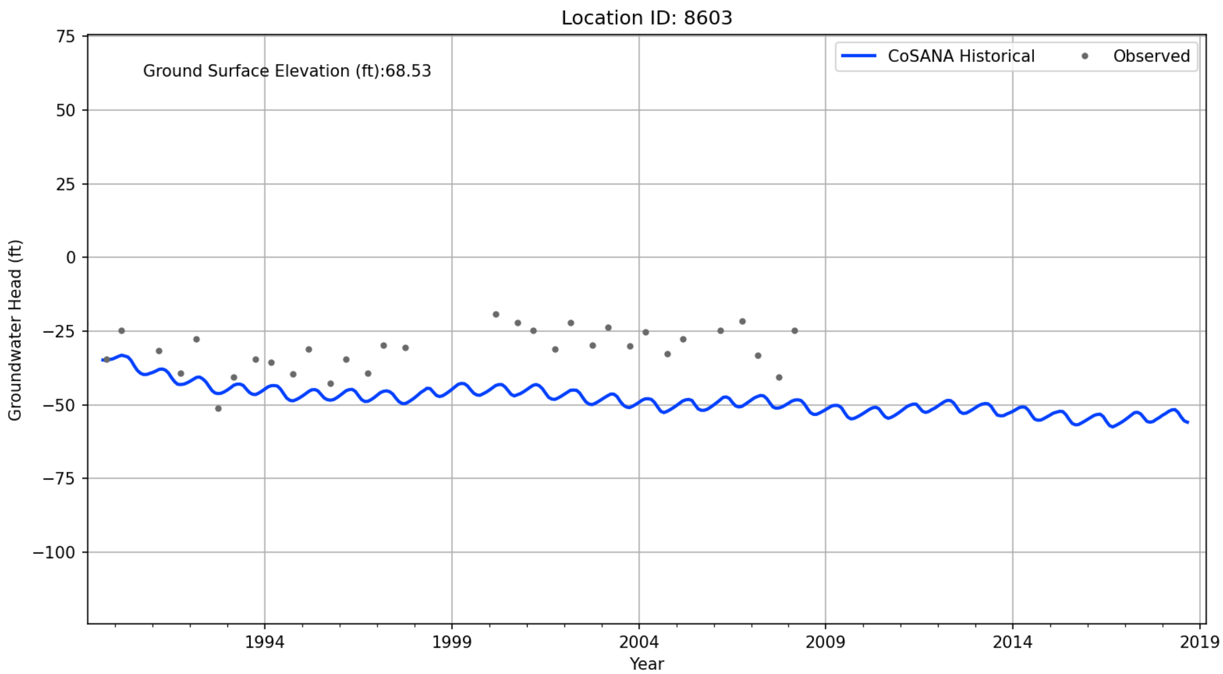

Location ID: 8405
Ground Surface Elevation (ft):607.84
CoSANA Historical
Observed
Groundwater Head (ft)
525
500
475
450
425
400
375
350
1994
1999
2004
2009
2014
2019
Year


Location ID: 8504
CoSANA Historical
Observed
Ground Surface Elevation (ft):290.18
Groundwater Head (ft)
225
200
175
150
125
100
75
50
1994
1999
2004
2009
2014
2019
Year

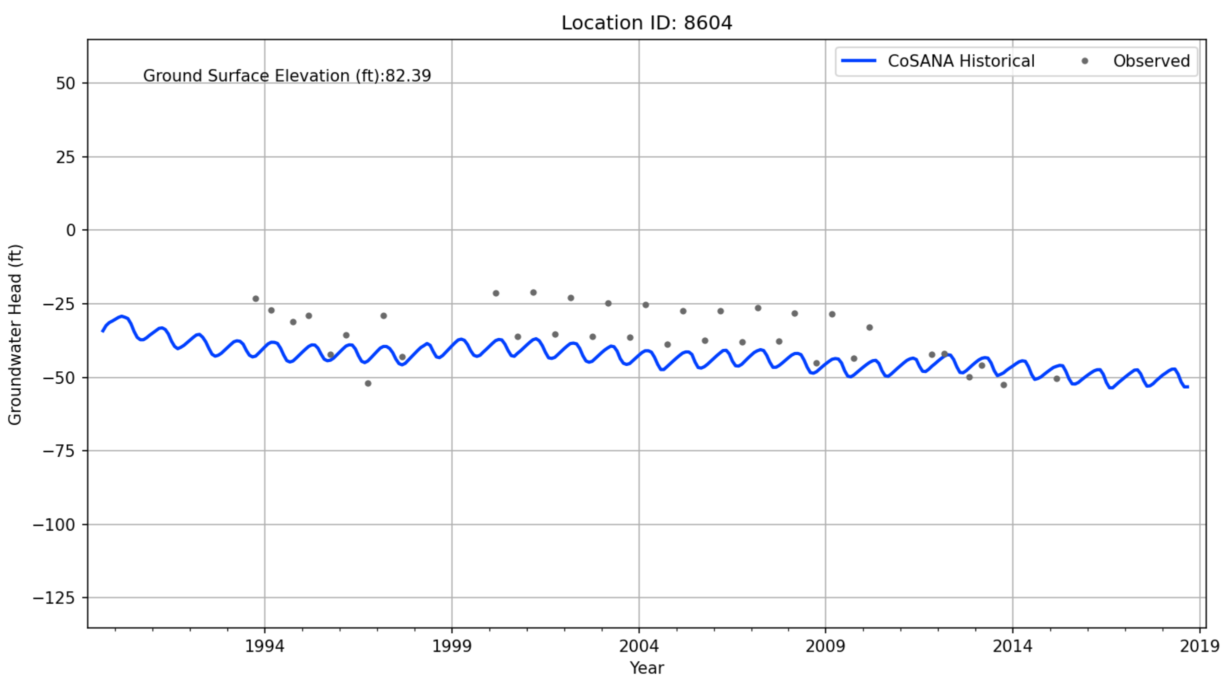

Location ID: 8505
CoSANA Historical
Observed
Ground Surface Elevation (ft):275.28
Groundwater Head (ft)
275
250
225
200
175
150
125
100
1994
1999
2004
2009
2014
2019
Year


Location ID: 8601
Ground Surface Elevation (ft):55.0
CoSANA Historical
Observed
Groundwater Head (ft)
Year

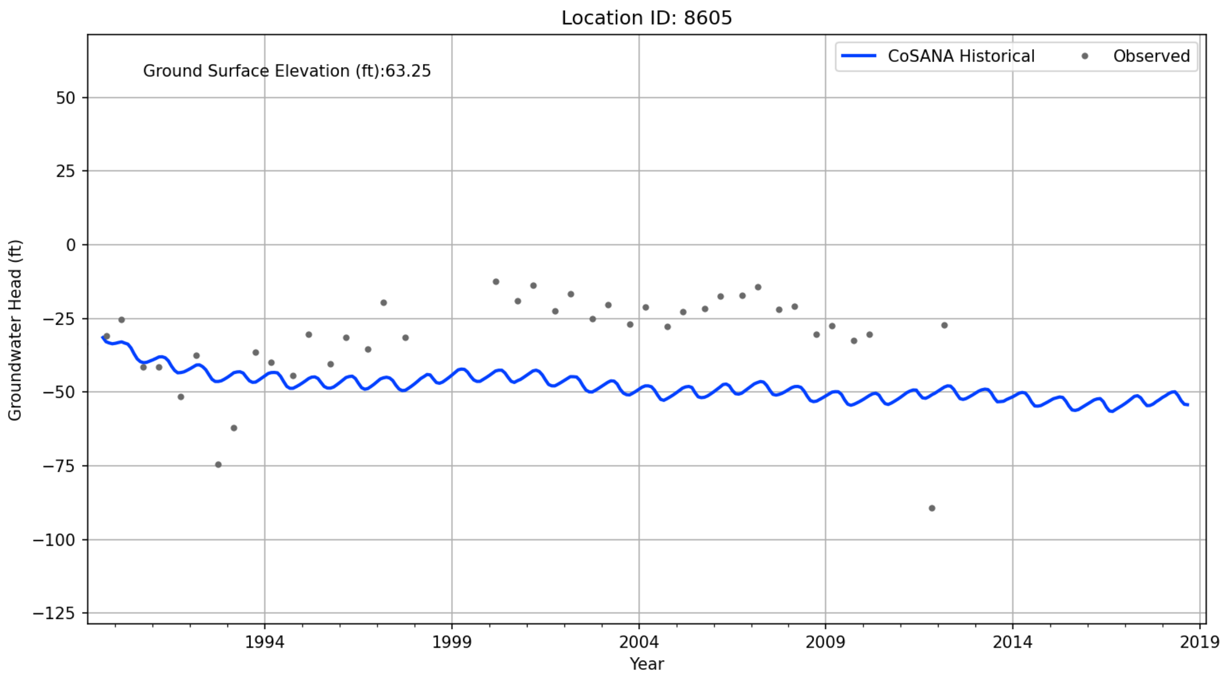

Location ID: 8602
Ground Surface Elevation (ft):119.42
CoSANA Historical
Observed
Groundwater Head (ft)
Year

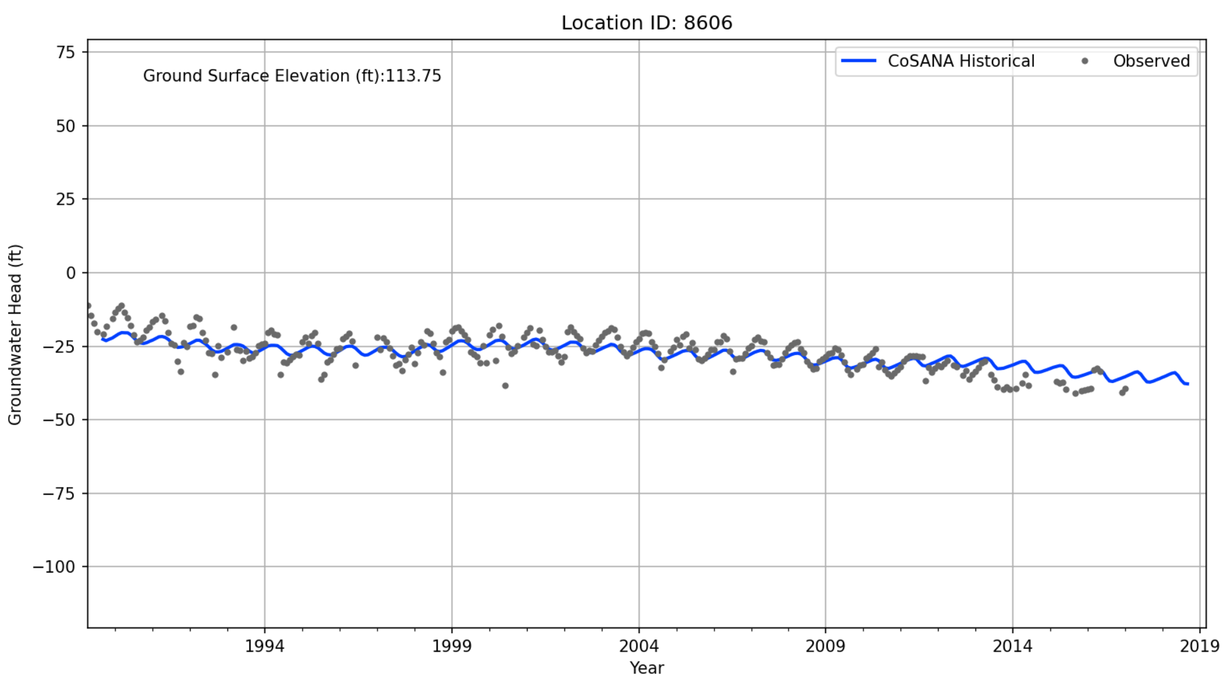


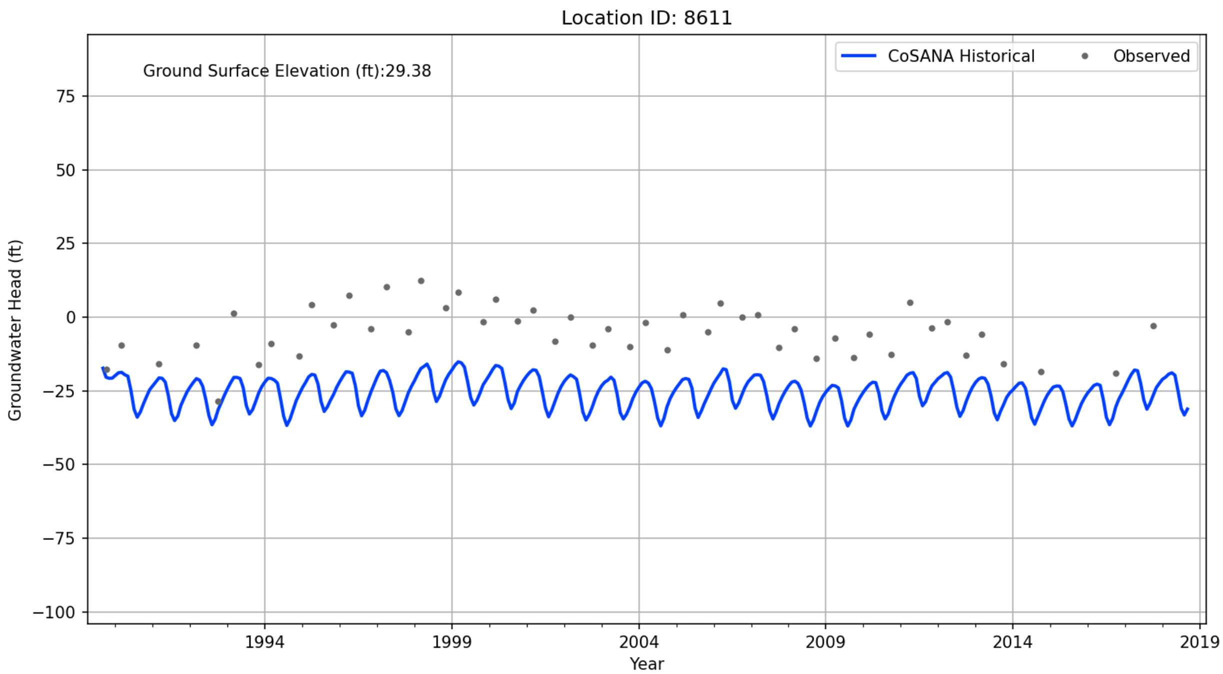
Location ID: 8603
Ground Surface Elevation (ft):68.53
CoSANA Historical
Observed
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



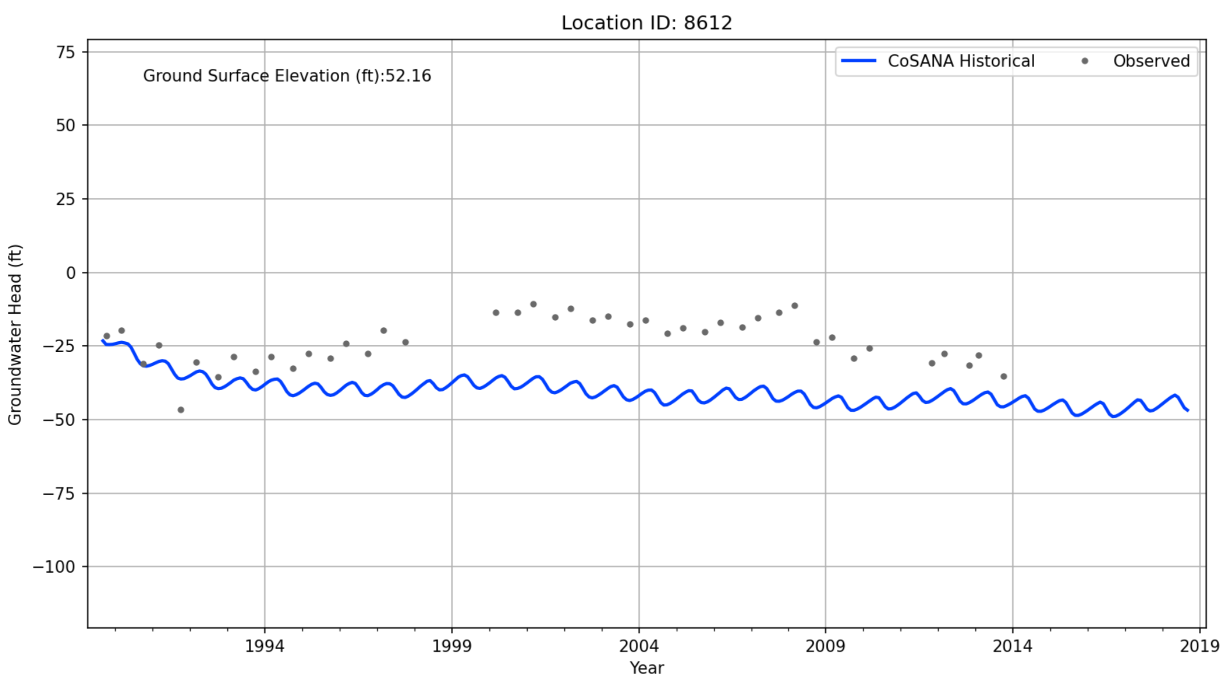
Location ID: 8604
Ground Surface Elevation (ft):82.39
CoSANA Historical
Observed
Groundwater Head (ft)
Year
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019


Location ID: 8605
Ground Surface Elevation (ft):63.25
CoSANA Historical
Observed
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year

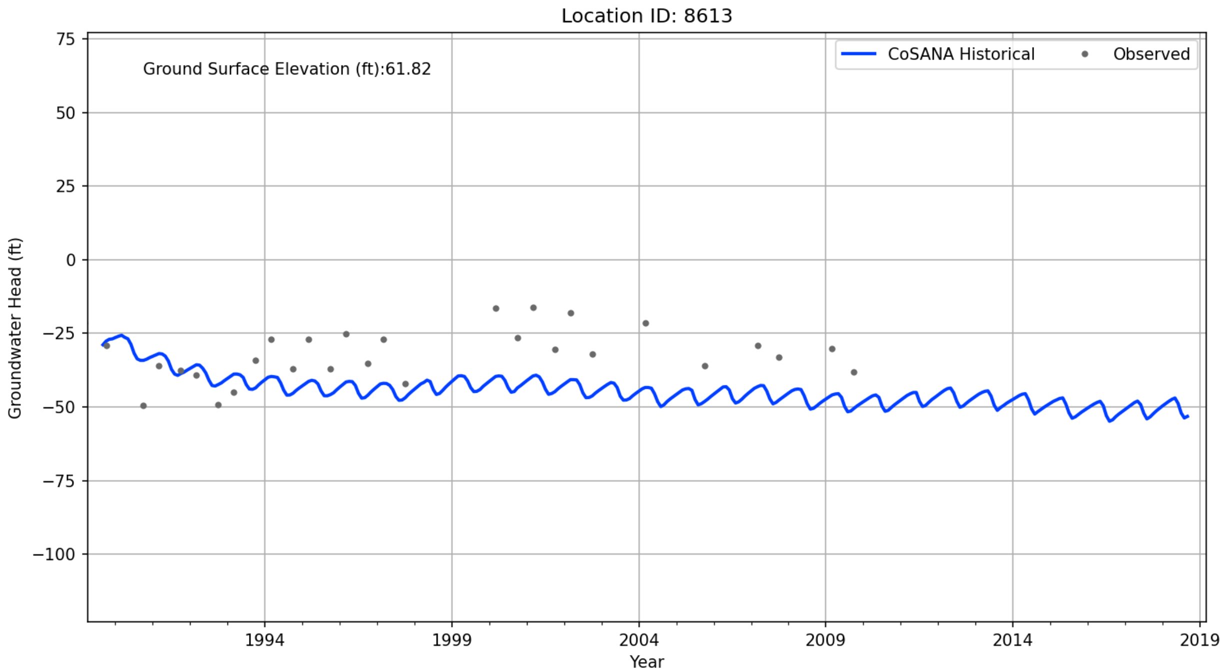

Location ID: 8606
Ground Surface Elevation (ft):113.75
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



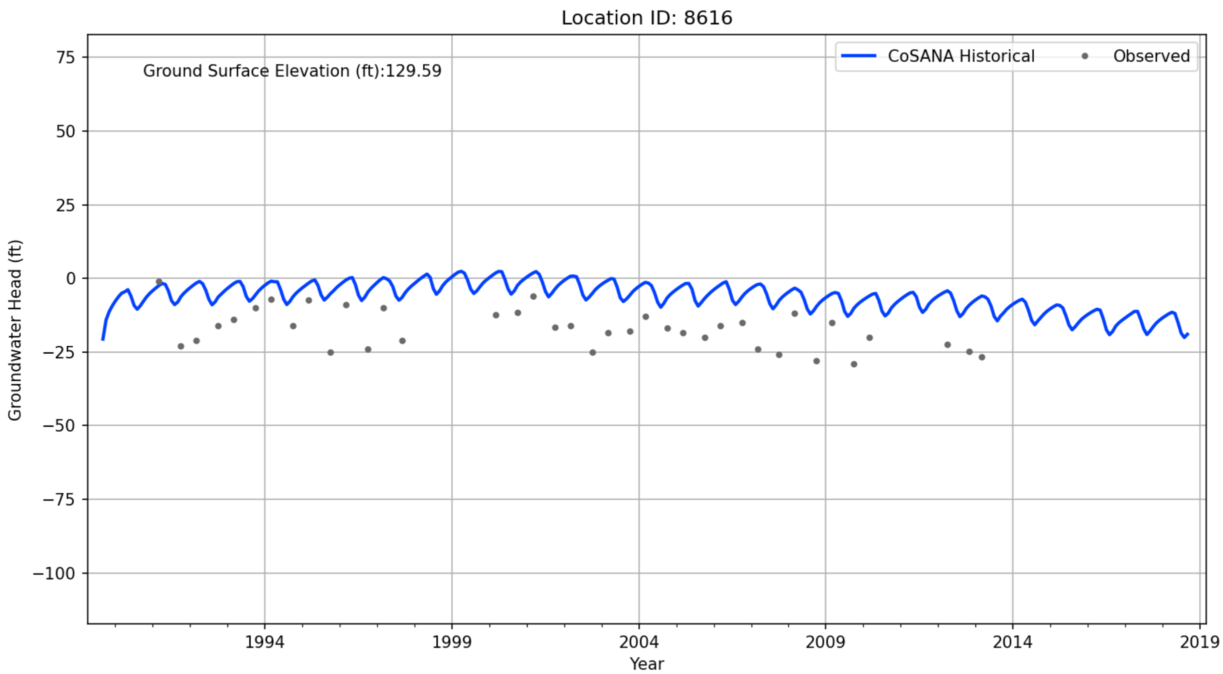
Location ID: 8611
Ground Surface Elevation (ft):29.38
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

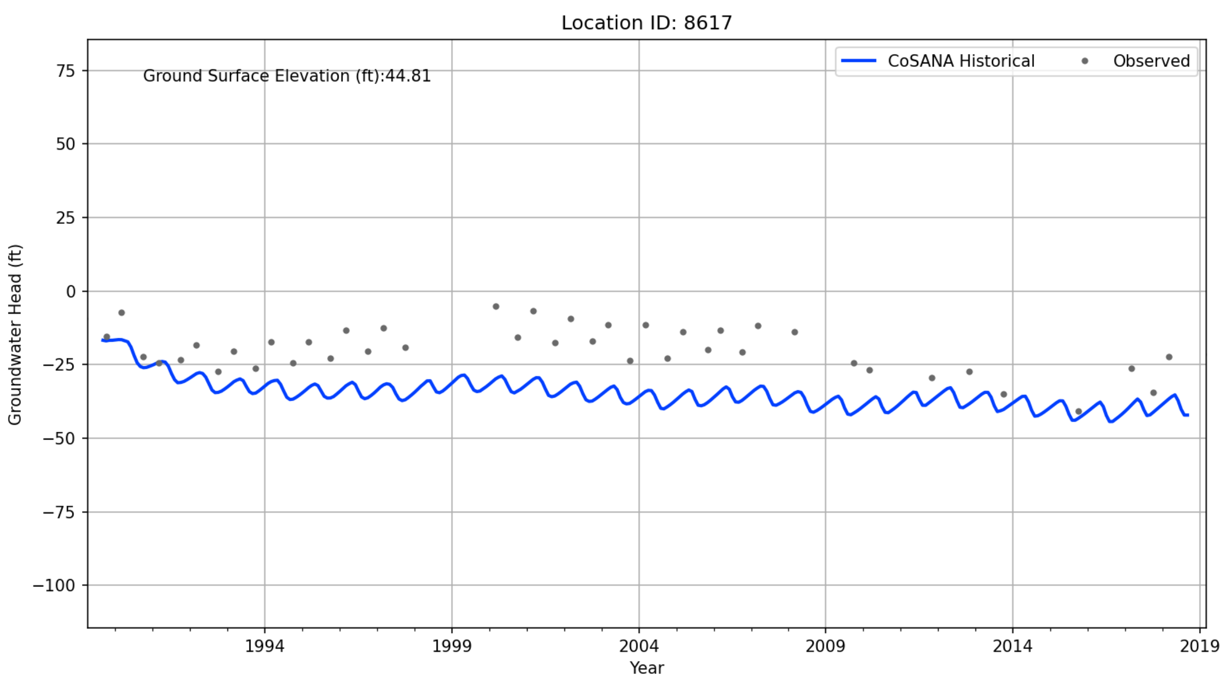


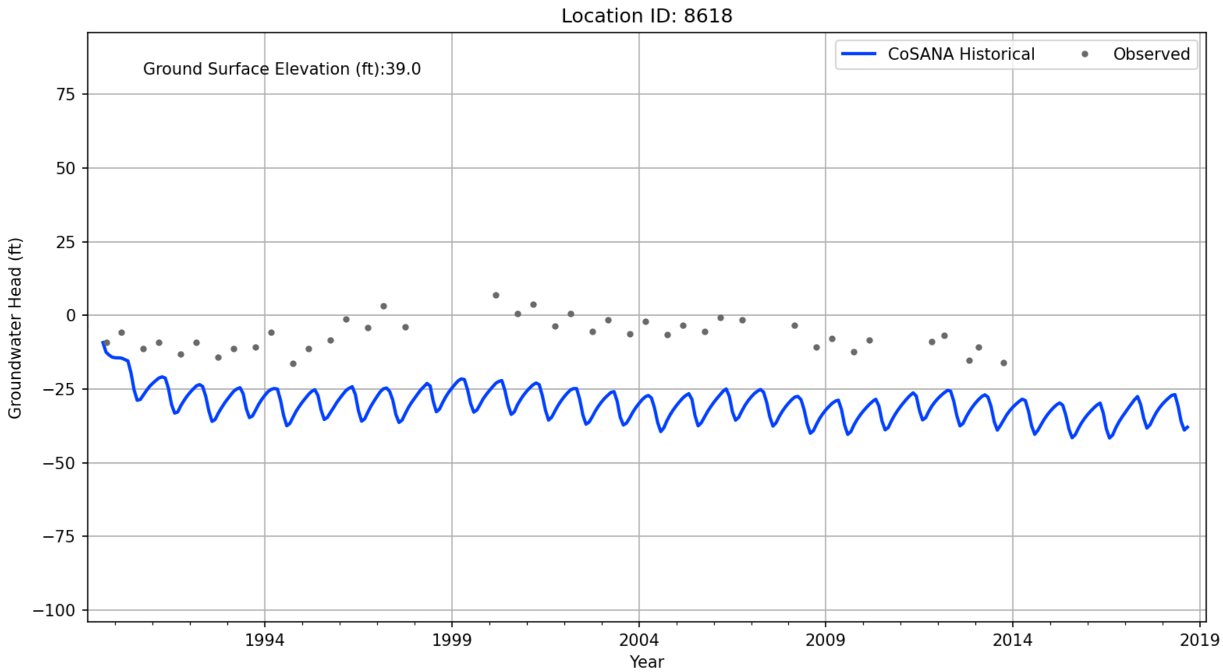
Location ID: 8612
Ground Surface Elevation (ft):52.16
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

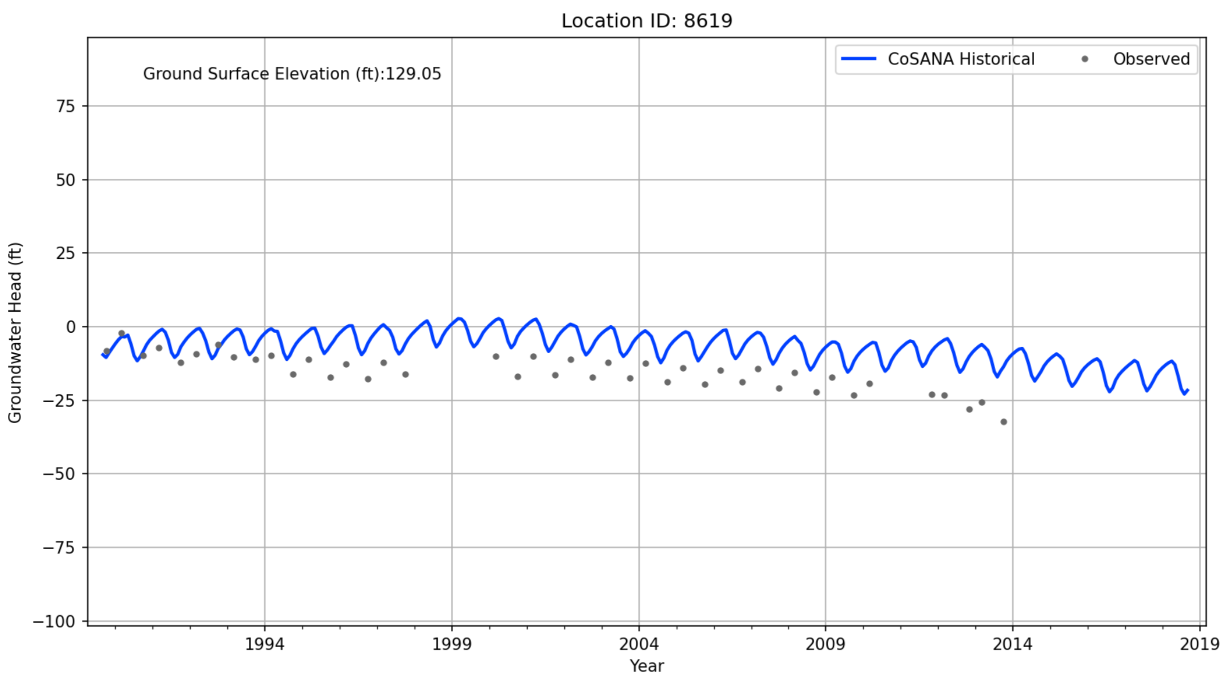


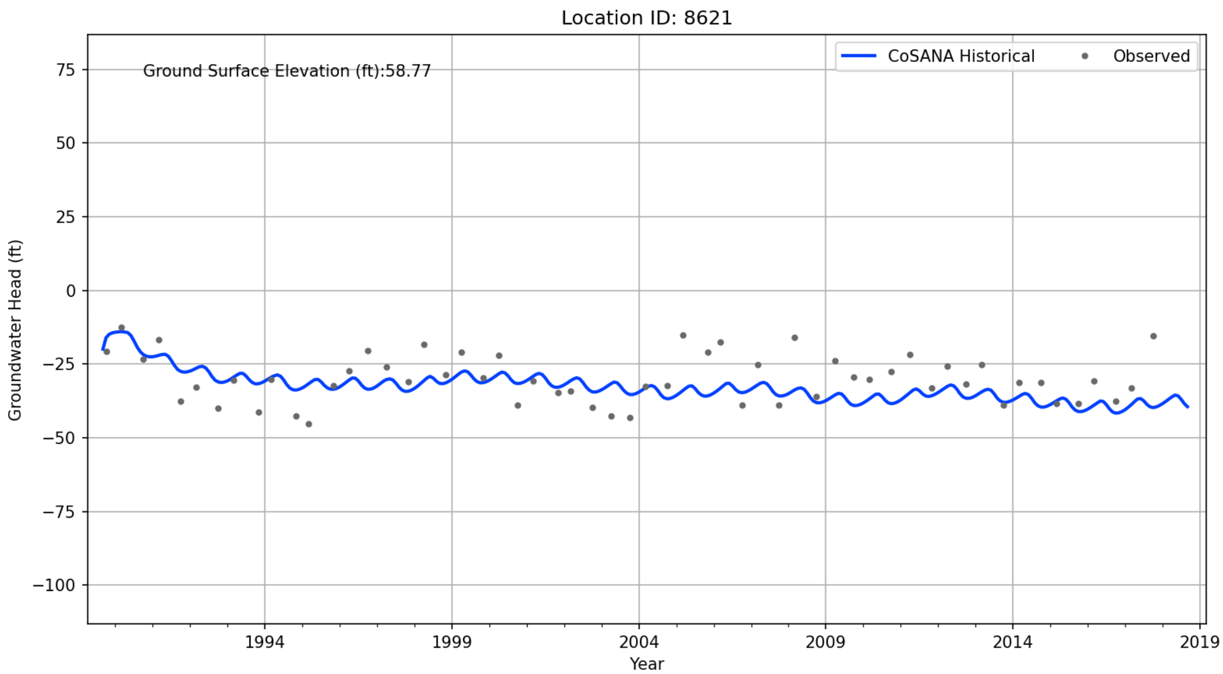
Location ID: 8613
Ground Surface Elevation (ft):61.82
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 8616
Ground Surface Elevation (ft):129.59
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

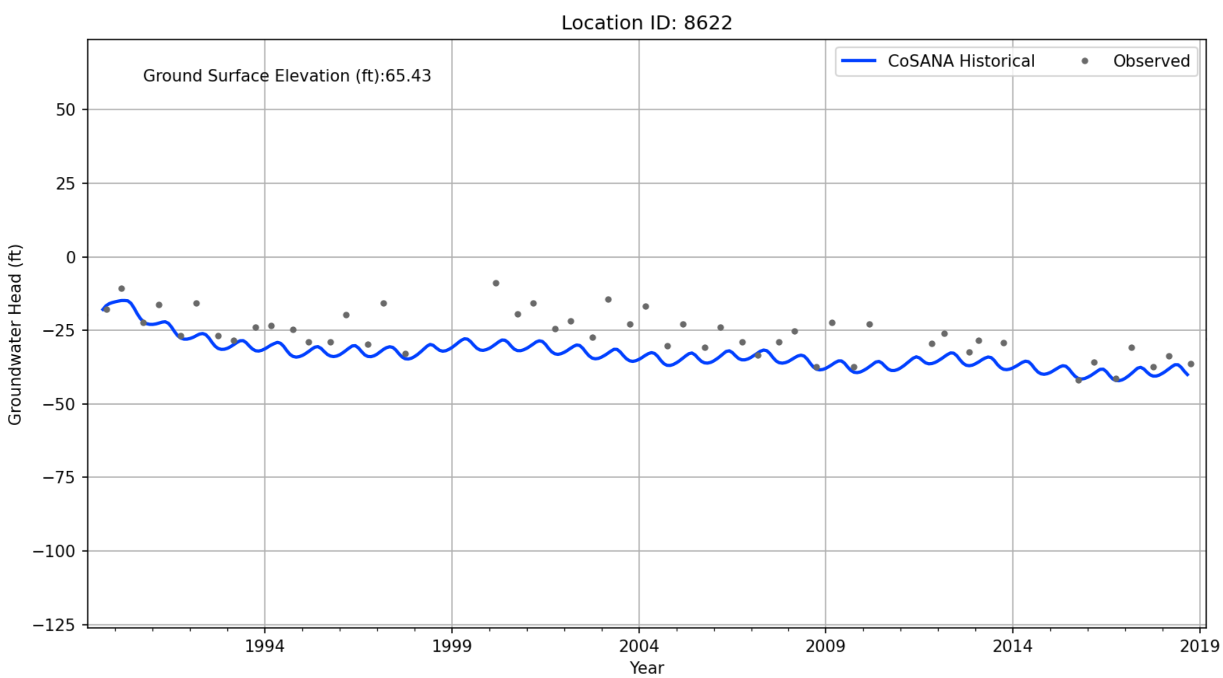

Location ID: 8617
Ground Surface Elevation (ft):44.81
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 8618
Ground Surface Elevation (ft):39.0
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year

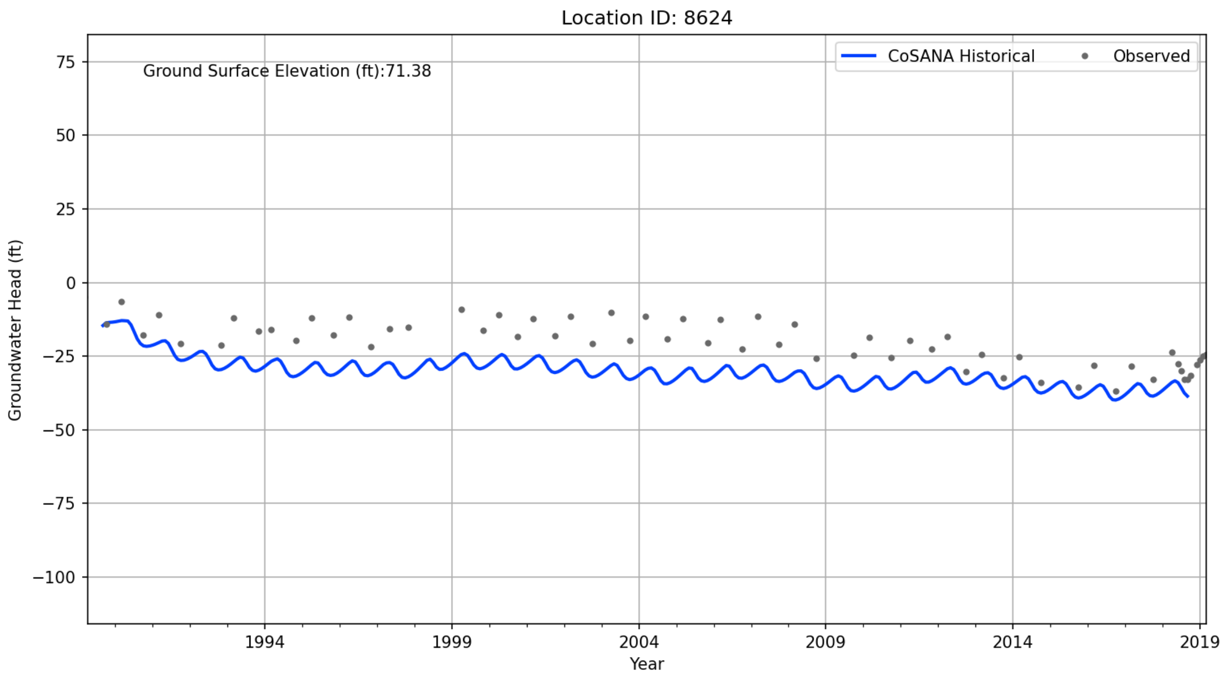

Location ID: 8619
Ground Surface Elevation (ft):129.05
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



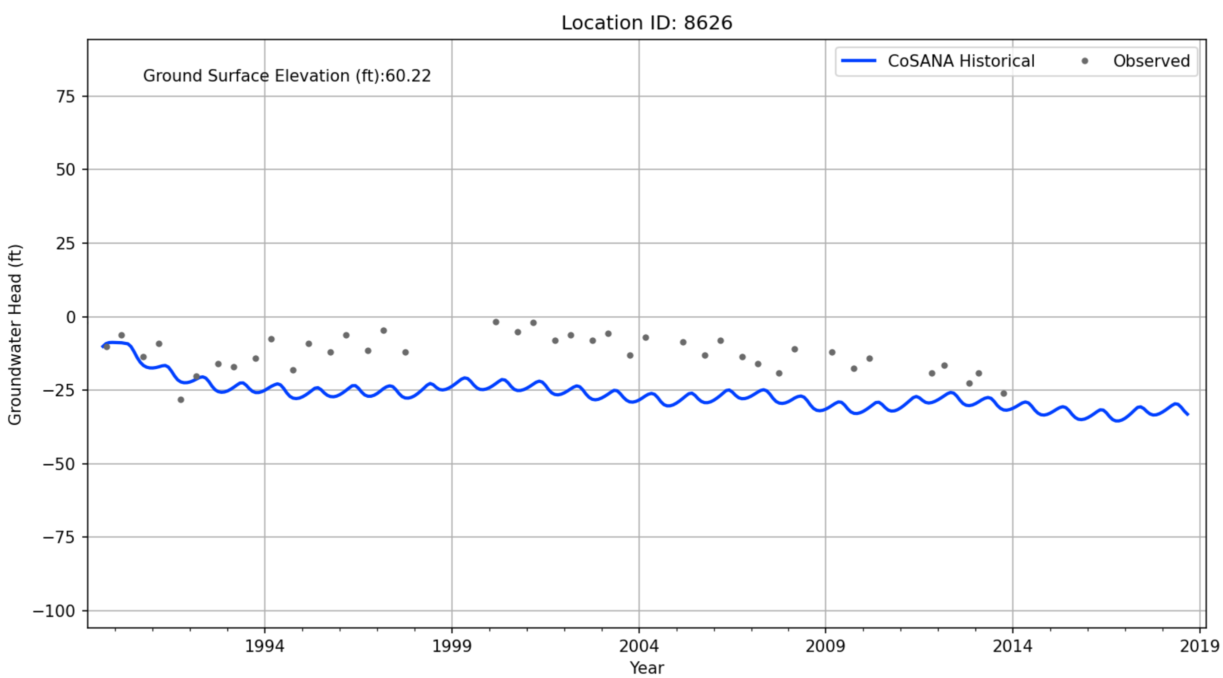
Location ID: 8621
CoSANA Historical
Observed
Ground Surface Elevation (ft):58.77
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



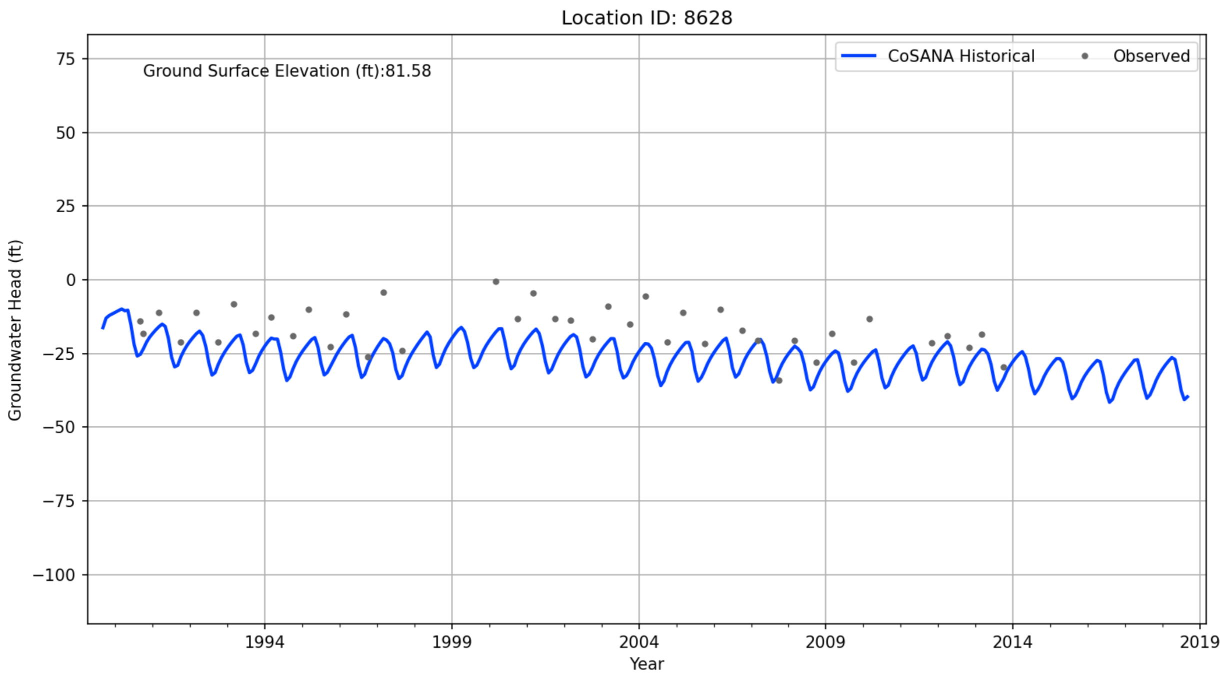
Location ID: 8622
CoSANA Historical
Observed
Ground Surface Elevation (ft):65.43
Groundwater Head (ft)
50
25
0
−25
−50
−75
−100
−125
1994
1999
2004
2009
2014
2019
Year



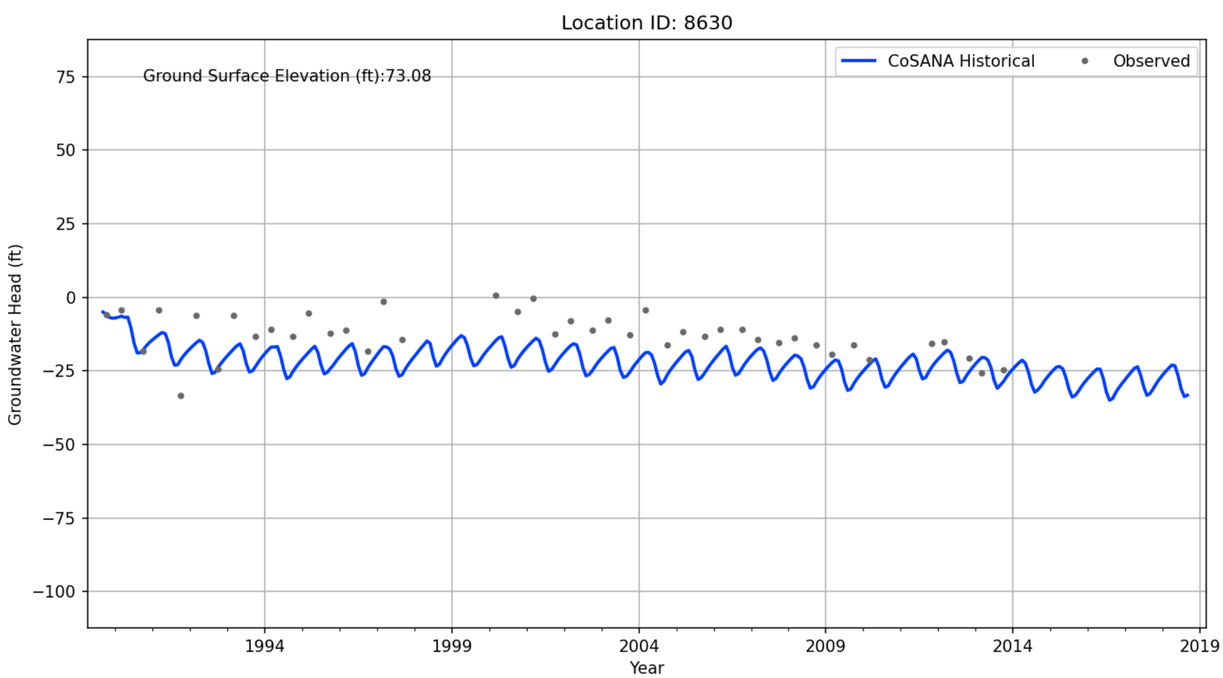
Location ID: 8624
CoSANA Historical
Observed
Ground Surface Elevation (ft):71.38
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



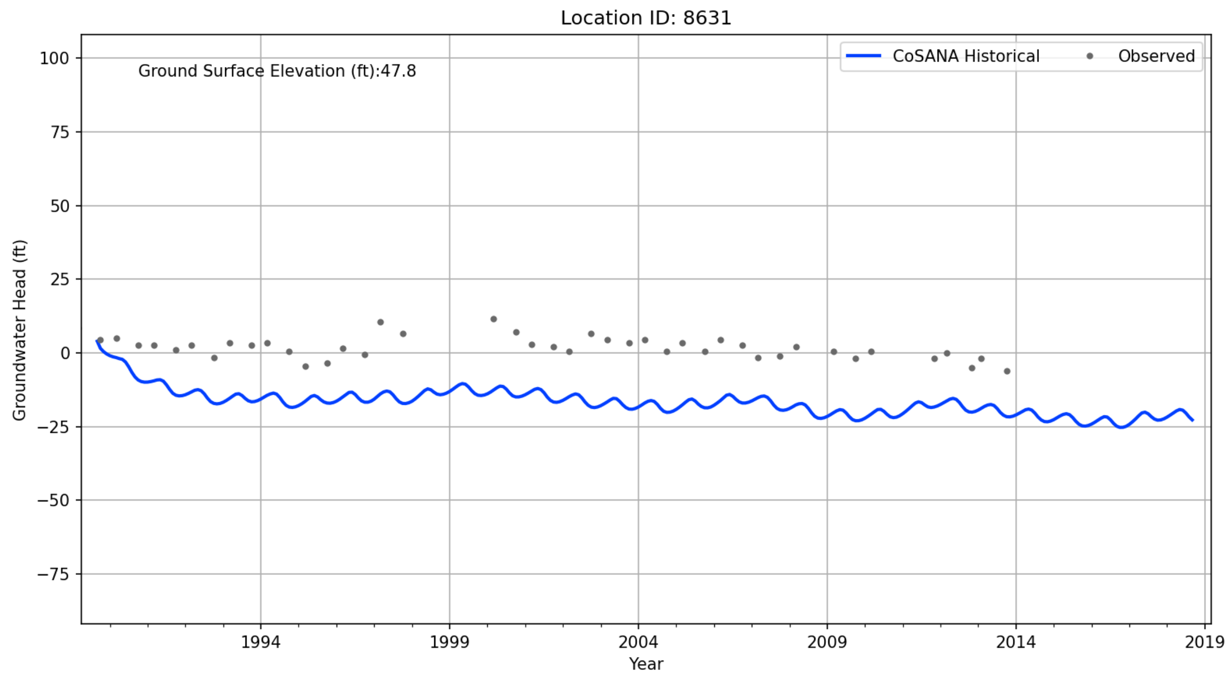
Location ID: 8626
CoSANA Historical
Observed
Ground Surface Elevation (ft):60.22
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019

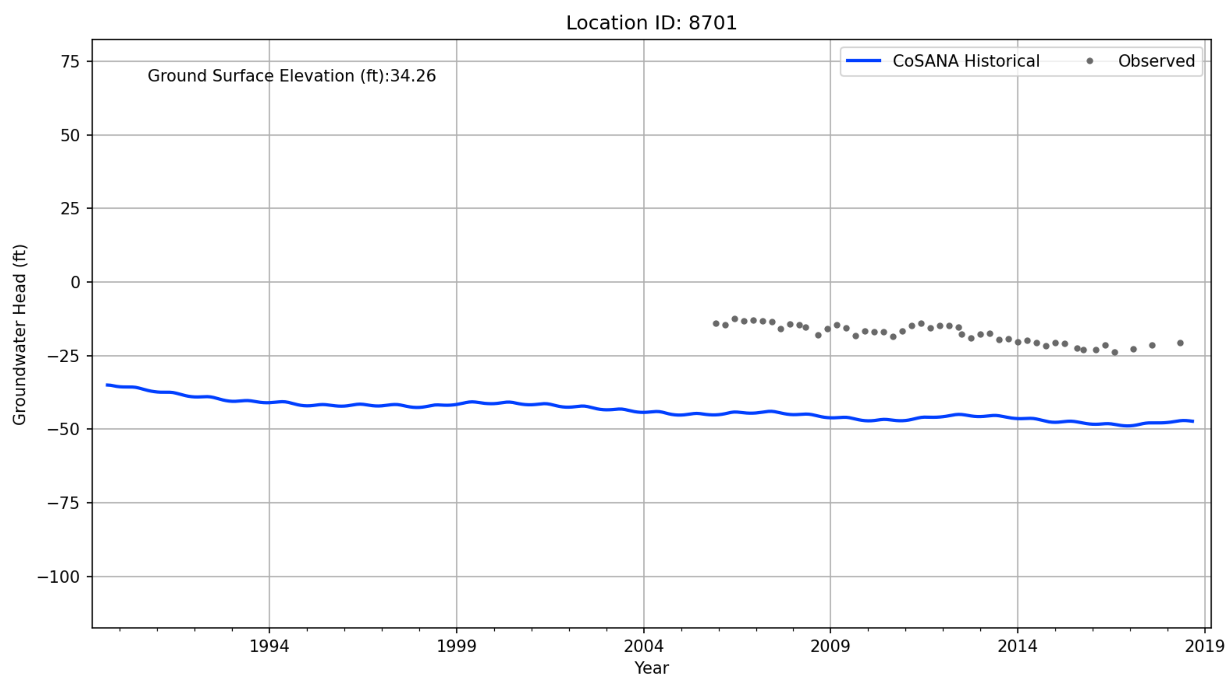


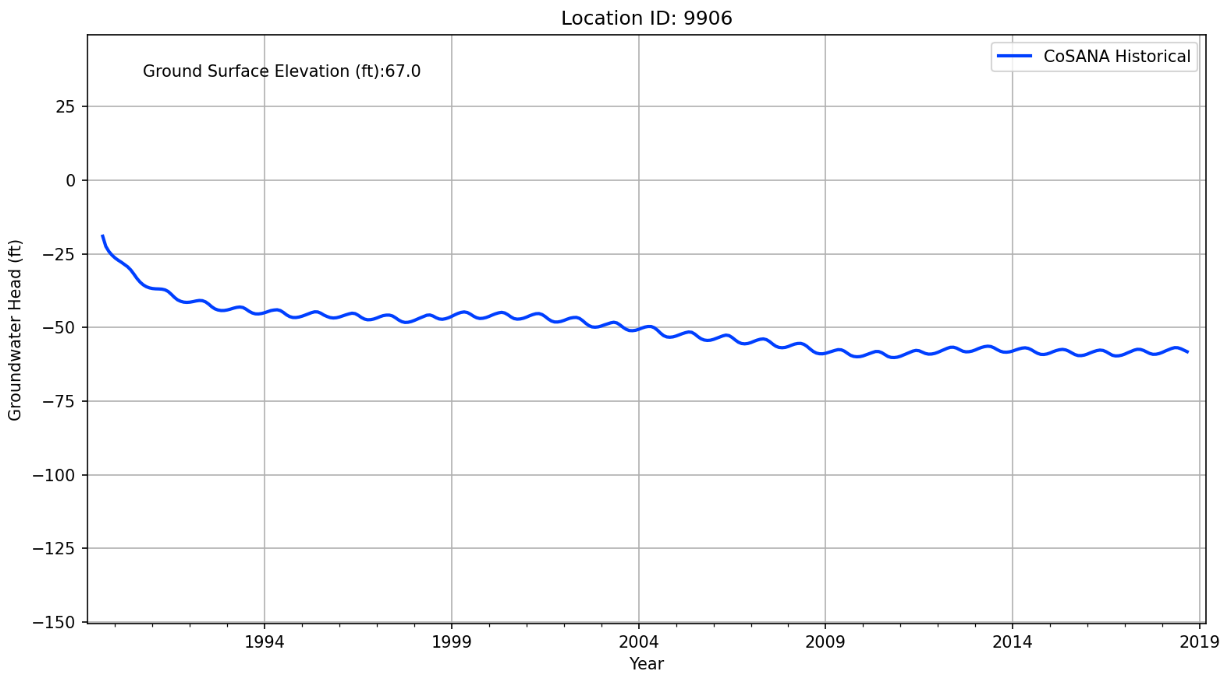
Location ID: 8628
Ground Surface Elevation (ft):81.58
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year



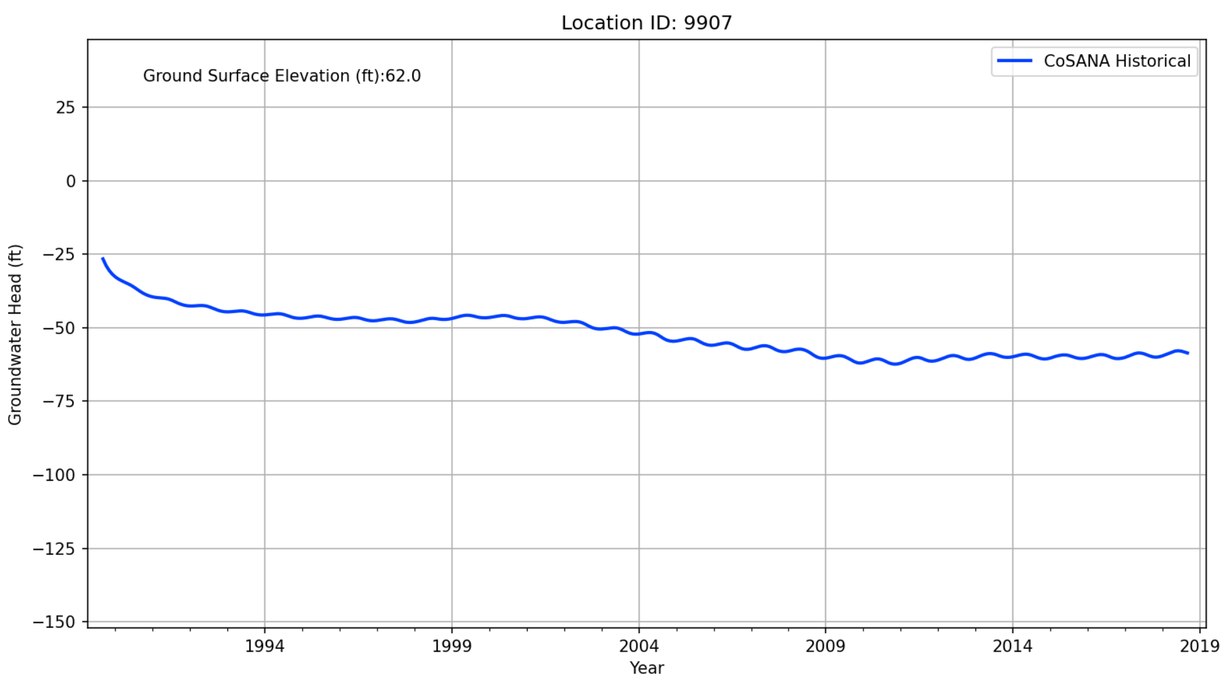
Location ID: 8630
Ground Surface Elevation (ft):73.08
CoSANA Historical
Observed
Groundwater Head (ft)
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019
Year


Location ID: 8631
CoSANA Historical
Observed
Ground Surface Elevation (ft):47.8
Groundwater Head (ft)
Year
100
75
50
25
0
−25
−50
−75
1994
1999
2004
2009
2014
2019


Location ID: 8701
CoSANA Historical
Observed
Ground Surface Elevation (ft):34.26
Groundwater Head (ft)
Year
75
50
25
0
−25
−50
−75
−100
1994
1999
2004
2009
2014
2019



Location ID: 9906
Ground Surface Elevation (ft):67.0
CoSANA Historical
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year



Location ID: 9907
Ground Surface Elevation (ft):62.0
CoSANA Historical
Groundwater Head (ft)
25
0
−25
−50
−75
−100
−125
−150
1994
1999
2004
2009
2014
2019
Year

APPENDIX G: BASELINE CONDITIONS DEMAND AND SUPPLY TABLES

CalAm Antelope

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,282	4,556	4,950	4,629	5,225	5,225	5,225	5,225
Groundwater	3,728	3,907	4,944	4,251	4,025	4,025	5,225	4,481
Surface Water	554	648	6	378	1,200	1,200	0	744
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	4,282	4,556	4,950	4,629	5,225	5,225	5,225	5,225

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Arden

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	1,421	1,459	1,509	1,467	1,606	1,606	1,606	1,606
Groundwater	1,408	1,459	1,509	1,464	1,123	1,123	1,123	1,123
Surface Water	13	0	0	4	483	483	483	483
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,421	1,459	1,509	1,467	1,606	1,606	1,606	1,606

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Fruitridge Vista

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,244	4,055	4,142	4,141	6,609	6,609	6,609	6,609
Groundwater	4,238	4,054	4,141	4,139	6,609	6,609	6,609	6,609
Surface Water	6	1	0	2	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	4,244	4,055	4,142	4,141	6,609	6,609	6,609	6,609

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Lincoln Oaks

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	6,826	6,395	7,770	7,038	6,213	6,213	6,213	6,213
Groundwater	6,131	5,504	7,766	6,539	5,413	5,413	6,213	5,717
Surface Water	695	891	4	499	800	800	0	496
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	6,826	6,395	7,770	7,038	6,213	6,213	6,213	6,213

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Parkway

Values shown in acre-feet/year

	Current *				**Projected ****			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	9,266	8,629	9,538	9,153	16,604	16,604	16,604	16,604
Groundwater	8,821	8,148	8,979	8,652	14,430	14,430	14,430	14,430
Surface Water	445	482	560	501	2,174	2,174	2,174	2,174
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	9,266	8,629	9,538	9,153	16,604	16,604	16,604	16,604

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Security Park

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	10	7	15	11	97	97	97	97
Groundwater	9	7	15	11	0	0	15	6
Surface Water	1	0	0	0	97	97	82	91
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	10	7	15	11	97	97	97	97

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm Suburban Rosemont

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	8,278	7,958	9,616	8,678	13,227	13,227	13,227	13,227
Groundwater	8,139	7,936	9,255	8,494	11,053	11,053	11,053	11,053
Surface Water	139	22	360	183	2,174	2,174	2,174	2,174
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	8,278	7,958	9,616	8,678	13,227	13,227	13,227	13,227

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

CalAm West Placer

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,059	1,011	1,042	1,036	6,819	6,819	6,819	6,819
Groundwater	0	0	0	0	0	0	0	0
Surface Water	1,059	1,011	1,042	1,036	6,819	6,819	6,819	6,819
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,059	1,011	1,042	1,036	6,819	6,819	6,819	6,819

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Camanche Village (ACWA)

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	293	296	286	292	1,415	1,415	1,483	1,441
Groundwater	293	296	286	292	420	420	420	420
Surface Water	0	0	0	0	681	681	749	707
Recycled Water/ Remediated Water	0	0	0	0	314	314	314	314
Total Supply	293	296	286	292	1,415	1,415	1,483	1,441

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Carmichael WD

Values shown in acre-feet/year

Year Type	Current *				Projected **			
	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	8,984	8,871	9,311	9,070	10,334	10,334	10,851	10,530
Groundwater	1,919	1,977	2,403	2,123	2,207	2,303	2,801	2,465
Surface Water	7,065	6,894	6,908	6,947	8,127	8,031	8,050	8,065
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	8,984	8,871	9,311	9,070	10,334	10,334	10,851	10,530

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Citrus Heights WD

Values shown in acre-feet/year

Year Type	Current * Normal	Current * Wet	Current * Dry	Current * 50-yr Average	Projected ** Normal	Projected ** Wet	Projected ** Dry	Projected ** 50-yr Average
Total Demand	12,370	12,130	13,083	12,559	18,210	18,210	15,478	17,172
Groundwater	1,179	748	1,126	1,012	900	900	900	900
Surface Water	11,191	11,382	11,957	11,547	17,310	17,310	14,578	16,272
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	12,370	12,130	13,083	12,559	18,210	18,210	15,478	17,172

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Del Paso Manor WD

Values shown in acre-feet/year

Year Type	Current *				Projected **			
	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	1,300	1,334	1,361	1,335	1,214	1,214	1,214	1,214
Groundwater	1,300	1,334	1,361	1,335	1,214	1,214	1,214	1,214
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,300	1,334	1,361	1,335	1,214	1,214	1,214	1,214

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Elk Grove Water District

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	9,080	8,744	9,388	9,083	8,081	8,081	8,323	8,173
Groundwater	4,305	4,158	4,625	4,376	4,598	4,598	4,736	4,650
Surface Water	4,775	4,586	4,764	4,707	3,483	3,483	3,587	3,523
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	9,080	8,744	9,388	9,083	8,081	8,081	8,323	8,173

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Elk Grove Water District surface water supply shown is from SCWA supplied intertie. These volumes may include a mix of sources (groundwater, surface water, and recycled water) that are unknown. For the purposes of this table, these volumes are all shown as surface water.

Fair Oaks WD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	10,518	10,322	10,676	10,511	12,726	12,726	12,726	12,726
Groundwater	1,983	2,222	1,416	1,849	2,399	2,399	1,688	2,129
Surface Water	8,535	8,100	9,260	8,663	10,327	10,327	11,038	10,597
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	10,518	10,322	10,676	10,511	12,726	12,726	12,726	12,726

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Florin County WD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645
Groundwater	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Folsom, City of

Values shown in acre-feet/year

Year Type	Current *				Projected **			
	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	21,235	21,329	20,445	20,967	29,923	29,923	30,819	30,263
Groundwater	0	0	0	0	0	0	0	0
Surface Water	21,235	21,329	20,445	20,967	29,923	29,923	30,819	30,263
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	21,235	21,329	20,445	20,967	29,923	29,923	30,819	30,263

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Galt, City of

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,841	4,286	5,452	4,884	8,266	8,266	8,266	8,266
Groundwater	4,841	4,286	5,452	4,884	7,663	7,663	7,663	7,663
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	603	603	603	603
Total Supply	4,841	4,286	5,452	4,884	8,266	8,266	8,266	8,266

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Grandpark

Values shown in acre-feet/year

Year Type	Current *				Projected **			
	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	0	0	0	0	12,030	12,030	12,030	12,030
Groundwater	0	0	0	0	2,407	2,407	3,007	2,635
Surface Water	0	0	0	0	9,623	9,623	9,023	9,395
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	0	0	0	0	8,021	8,021	8,021	8,021

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Golden State WC Arden

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	942	937	1,016	968	942	937	1,016	968
Groundwater	942	937	1,016	968	942	937	1,016	968
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	942	937	1,016	968	942	937	1,016	968

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Golden State WC Cordova

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	14,780	16,099	14,162	14,994	19,752	19,752	19,752	19,752
Groundwater	5,499	4,762	5,210	5,139	9,752	9,752	9,752	9,752
Surface Water	9,281	11,337	8,952	9,855	5,000	5,000	5,000	5,000
Recycled Water/ Remediated Water	0	0	0	0	5,000	5,000	5,000	5,000
Total Supply	14,780	16,099	14,162	14,994	19,752	19,752	19,752	19,752

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Projected remediated water includes groundwater previously pumped for remediation activities.

Ione, City of (ACWA)

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	2,434	2,448	2,256	2,371	11,744	11,744	11,676	11,718
Groundwater	0	0	0	0	0	0	0	0
Surface Water	2,434	2,448	2,256	2,371	10,794	10,794	10,726	10,768
Recycled Water/ Remediated Water	0	0	0	0	950	950	950	950
Total Supply	2,434	2,448	2,256	2,371	11,744	11,744	11,676	11,718

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Lincoln, City of

Values shown in acre-feet/year

Year Type	Current * Normal	Current * Wet	Current * Dry	Current * 50-yr Average	Projected ** Normal	Projected ** Wet	Projected ** Dry	Projected ** 50-yr Average
Total Demand	9,314	9,094	9,470	9,298	20,336	20,336	20,947	20,568
Groundwater	1,136	1,607	864	1,193	3,297	3,297	3,297	3,297
Surface Water	8,177	7,487	8,606	8,105	10,972	10,972	11,584	11,205
Recycled Water/ Remediated Water	0	0	0	0	6,063	6,063	6,063	6,063
Total Supply	9,314	9,094	9,470	9,298	20,332	20,332	20,944	20,565

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Orange Vale WC

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,075	3,905	4,217	4,071	4,981	4,981	4,234	4,697
Groundwater	0	0	0	0	0	0	0	0
Surface Water	4,075	3,905	4,217	4,071	4,981	4,981	4,234	4,697
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	4,075	3,905	4,217	4,071	4,981	4,981	4,234	4,697

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

PCWA (Regional Univ. and Placer Ranch)

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	0	0	0	0	6,805	6,805	6,805	6,805
Groundwater	0	0	0	0	0	0	0	0
Surface Water	0	0	0	0	6,805	6,805	6,805	6,805
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	0	0	0	0	6,805	6,805	6,805	6,805

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Placer County WA (Rocklin)

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	4,774	4,706	4,521	4,655	8,841	8,749	8,496	8,679
Groundwater	0	0	0	0	0	0	0	0
Surface Water	4,774	4,706	4,521	4,655	8,841	8,749	8,496	8,679
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	4,774	4,706	4,521	4,655	8,841	8,749	8,496	8,679

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Rancho Murietta CSD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,833	1,833	1,833	1,833	3,477	3,477	3,477	3,477
Groundwater	0	0	0	0	0	0	0	0
Surface Water	1,833	1,833	1,833	1,833	2,927	2,927	2,927	2,927
Recycled Water/ Remediated Water	0	0	0	0	550	550	550	550
Total Supply	1,833	1,833	1,833	1,833	3,477	3,477	3,477	3,477

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Rio Linda Elverta CWD

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	2,563	2,489	2,672	2,579	7,462	7,462	8,208	7,745
Groundwater	2,562	2,489	2,670	2,578	7,462	7,462	8,208	7,745
Surface Water	1	0	2	1	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	2,563	2,489	2,672	2,579	7,462	7,462	8,208	7,745

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Roseville, City of

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	28,834	28,177	30,779	29,349	65,615	65,615	52,666	60,694
Groundwater	9	2	7	6	25	25	4,734	1,814
Surface Water	28,826	28,174	30,771	29,344	59,632	59,632	41,974	52,922
Recycled Water/ Remediated Water	0	0	0	0	5,958	5,958	5,958	5,958
Total Supply	28,834	28,177	30,779	29,349	65,615	65,615	52,666	60,694

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Sacramento International Airport

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,138	1,133	1,133	1,134	1,144	1,144	1,144	1,144
Groundwater	763	785	877	814	673	673	673	673
Surface Water	376	348	255	320	471	471	471	471
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,138	1,133	1,133	1,134	1,144	1,144	1,144	1,144

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Sacramento, City of

Values shown in acre-feet/year

	Current *						Projected **					
Year Type	**Normal**	**Wet**	**Dry**	**Drier-Critical**	**Driest**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**Drier-Critical**	**Driest**	**50-yr Average**
Total Demand	104,096	98,465	89,879	100,782	100,782	96,779	162,029	162,029	162,029	162,029	162,029	162,029
Groundwater	14,942	8,750	22,287	48,952	53,726	15,628	35,864	24,302	47,690	81,290	81,290	36,427
Surface Water	89,154	89,715	67,592	51,830	47,056	81,151	125,165	136,727	113,339	79,739	79,739	124,602
Recycled Water/ Remediated Water	0	0	0	0	0	0	1,000	1,000	1,000	1,000	1,000	1,000
Total Supply	104,096	98,465	89,879	100,782	100,782	96,779	162,029	162,029	162,029	139,000	139,000	162,029

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

City of Sacramento has an estimated 2,200 AFY of additional pumping from irrigation wells that provide water to parks, schools, etc.

Sac Suburban

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	35,262	37,206	35,990	36,200	41,304	41,304	41,304	41,304
Groundwater	23,586	22,005	33,212	26,706	27,627	24,428	35,000	29,341
Surface Water	11,676	15,202	2,779	9,494	13,677	16,876	6,304	11,963
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	35,262	37,206	35,990	36,200	41,304	41,304	41,304	41,304

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

San Juan WD

Values shown in acre-feet/year

Year Type	Current *				Projected **			
	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	12,437	11,631	12,509	12,190	19,393	19,393	19,393	19,393
Groundwater	0	0	0	0	0	0	0	0
Surface Water	12,437	11,631	12,509	12,190	19,393	19,393	19,393	19,393
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	12,437	11,631	12,509	12,190	19,393	19,393	19,393	19,393

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA Arden

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	3,402	3,349	3,402	3,384	3,217	3,217	3,217	3,217
Groundwater	3,402	3,349	3,402	3,384	3,217	3,217	3,217	3,217
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	3,402	3,349	3,402	3,384	3,217	3,217	3,217	3,217

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA Hood

Values shown in acre-feet/year

Year Type	Current *				Projected **			
	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	82	75	82	79	31	31	31	31
Groundwater	82	75	82	79	31	31	31	31
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	82	75	82	79	31	31	31	31

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA Laguna Vineyard

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	24,331	24,734	24,343	24,473	68,900	68,900	68,900	68,900
Groundwater	13,910	13,315	13,910	13,707	20,200	20,200	51,900	32,246
Surface Water	9,569	10,556	9,580	9,909	36,500	36,500	4,800	24,454
Recycled Water/ Remediated Water	853	863	853	856	12,200	12,200	12,200	12,200
Total Supply	24,331	24,734	24,343	24,473	68,900	68,900	68,900	68,900

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA remediated water is assumed to be split 25% to Mather service area and 75% to Laguna Vineyard service area

SCWA Mather

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	5,363	5,624	5,363	5,452	34,900	34,900	34,900	34,900
Groundwater	1,742	1,673	1,742	1,719	0	0	1,100	418
Surface Water	3,621	3,951	3,621	3,733	34,900	34,900	33,800	34,482
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	5,363	5,624	5,363	5,452	34,900	34,900	34,900	34,900

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

SCWA remediated water is assumed to be split 25% to Mather service area and 75% to Laguna Vineyard service area

SCWA Northgate

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	**Normal**	**Wet**	**Dry**	**50-yr Average**	**Normal**	**Wet**	**Dry**	**50-yr Average**
Total Demand	1,423	1,205	1,423	1,349	1,365	1,365	1,365	1,365
Groundwater	1,423	1,205	1,423	1,349	1,365	1,365	1,365	1,365
Surface Water	0	0	0	0	0	0	0	0
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	1,423	1,205	1,423	1,349	1,365	1,365	1,365	1,365

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

Sutter Pointe

Values shown in acre-feet/year

	Current *				Projected **			
Year Type	Normal	Wet	Dry	50-yr Average	Normal	Wet	Dry	50-yr Average
Total Demand	0	0	0	0	15,786	15,786	15,786	15,786
Groundwater	0	0	0	0	10,919	10,919	10,919	10,919
Surface Water	0	0	0	0	4,867	4,867	4,867	4,867
Recycled Water/ Remediated Water	0	0	0	0	0	0	0	0
Total Supply	0	0	0	0	15,786	15,786	15,786	15,786

Notes:

* Current Condition Baseline information for each hydrologic year type was extracted based on the last 10 years of historical operations or the current use and facilities when available. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

** Projected Condition Baseline information is based on latest planning documents for each purveyor (2015 UWMPs, GWMPs, Water Supply Master Plans etc.). Projected demands are assumed to account for each entity's conservation targets. 50-year average projection reflects 50-year hydrologic projected conditions based on the water supplies and demands for each respective hydrologic year type.

APPENDIX H: BASELINE CONDITIONS LAND AND WATER USE BUDGETS

Current Conditions Baseline Water Use Budget Summary, Annual Average over 50-year Simulation																
Subregion	Description	Ag Area	Ag Demand	Ag Water Duty	Urban Area	Urban Demand	Urban Water Duty	Total Water Demand	Total Ag Water Supply (Acre-Feet/Year)		Total Urban Water Supply (Acre-Feet/Year)			Total Supply (Acre-Feet/Year)	Remediation Operations	
		(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acre-Feet)	GW Production	SW Deliveries	GW Use	SW Deliveries	Other Supply[2]		Extraction	Injection
1	Camp Far West ID	1,806	10,115	5.6	176	120	0.7	10,235	5,462	4,653	120	-	-	10,235	-	-
2	Sutter Co. 1	147	629	4.3	2	1	0.4	630	629	-	1	-	-	630	-	-
3	South Sutter WD GSA	51,339	183,798	3.6	2,094	2,044	1.0	185,842	109,495	76,260	2,044	-	-	187,799	-	-
4	Placer County WA[1]	10,653	29,617	2.8	9,186	11,101	1.2	40,718	23,214	6,415	6,446	4,655	-	40,730	-	-
5	Nevada ID	3,180	12,719	4.0	581	394	0.7	13,113	8,387	4,489	394	-	-	13,271	-	-
6	Lincoln[1]	372	91	0.2	6,577	9,298	1.4	9,390	91	-	1,193	8,106	-	9,390	-	-
7	RD1001 [1]	7,436	30,324	4.1	416	164	0.4	30,488	20,759	9,565	164	-	-	30,488	-	-
8	Pleasant Grove Verona MWC	6,667	23,324	3.5	101	40	0.4	23,364	12,521	11,216	40	-	-	23,777	-	-
9	Sutter Co. 2	904	3,238	3.6	88	35	0.4	3,272	2,063	1,175	35	-	-	3,272	-	-
10	Natomas MWC (Sutter Co.)	11,136	41,377	3.7	442	175	0.4	41,552	2,113	39,267	175	-	-	41,555	-	-
11	Sutter Co. 3	2,991	9,780	3.3	456	343	0.8	10,123	9,780	-	343	-	-	10,123	-	-
12	Roseville SOI	904	1,040	1.2	46	180	3.9	1,220	1,040	-	180	-	-	1,220	-	-
13	City of Roseville	512	202	0.4	20,005	29,349	1.5	29,551	202	-	6	29,344	-	29,552	-	-
14	Cal Am (West Placer)	2,211	4,122	1.9	2,514	1,037	0.4	5,158	4,122	-	-	1,037	-	5,158	-	-
15	Natomas MWC (Sacramento Co.)	11,732	37,038	3.2	1,882	3,562	1.9	40,600	2,168	34,874	3,562	-	-	40,604	-	-
16	Sacramento International Airport	526	130	0.2	1,669	1,134	0.7	1,264	130	-	814	321	-	1,264	-	-
17	Metro Air Park	1,578	-	0.0	71	-	0.0	-	-	-	-	-	-	-	-	-
18	Sac Co. 1	832	1,096	1.3	165	606	3.7	1,702	43	1,052	606	-	-	1,702	-	-
19	Sac Co. 2	803	2,086	2.6	194	21	0.1	2,107	2,086	-	21	-	-	2,107	-	-
20	Sac County WA (Northgate 880)	-	-	0.0	837	1,349	1.6	1,349	-	-	1,349	-	-	1,349	-	-
21	Rio Linda Elverta	515	801	1.6	6,094	8,590	1.4	9,391	801	-	8,589	1	-	9,391	-	-
22	Sac Co. 3	335	167	0.5	227	345	1.5	512	167	-	345	-	-	512	-	-
23	Cal Am (Antelope)	3	7	2.3	2,679	4,629	1.7	4,636	7	-	4,251	378	-	4,636	-	-
24	Cal Am (Lincoln Oaks)	9	20	2.3	4,285	7,038	1.6	7,058	20	-	6,539	499	-	7,058	-	-
25	Citrus Heights WD	12	50	4.3	7,744	12,559	1.6	12,609	50	-	1,012	11,547	-	12,610	-	-
26	San Juan WD (Placer Co.)	82	-	0.0	1,409	1,808	1.3	1,808	-	-	-	1,808	-	1,808	-	-
27	San Juan WD (Sacramento Co.)	47	89	1.9	2,106	2,702	1.3	2,792	89	-	-	2,702	-	2,792	-	-
28	Orange Vale WC	50	278	5.5	2,900	4,071	1.4	4,349	278	-	-	4,071	-	4,349	-	-
29	Lake Natoma/Mississippi Bar	3	97	35.9	140	-	0.0	97	97	-	-	-	-	97	-	-
30	Fair Oaks WD	75	240	3.2	6,204	10,511	1.7	10,751	240	-	1,849	8,663	-	10,751	1,229	-
31	Carmichael WD	-	-	0.0	5,264	9,070	1.7	9,070	-	-	2,123	6,947	-	9,070	1,876	-
32	Sacramento Suburban WD (North)	25	56	2.2	13,845	21,660	1.6	21,716	56	-	14,242	7,418	-	21,717	2,300	-
33	Sacramento Suburuban WD (South)	-	-	0.0	7,773	14,540	1.9	14,540	-	-	12,464	2,076	-	14,540	-	-
34	Del Paso Manor WD	-	-	0.0	614	1,335	2.2	1,335	-	-	1,335	-	-	1,335	-	-
35	Golden State WC Arden	-	-	0.0	496	968	2.0	968	-	-	968	-	-	968	-	-
36	Cal Am (Arden)	-	-	0.0	641	1,467	2.3	1,467	-	-	1,464	4	-	1,467	-	-
37	Sac County WA (Arden Park	-	-	0.0	1,350	3,384	2.5	3,384	-	-	3,384	-	-	3,384	-	-
38	City of Sacramento (North)	1,258	200	0.2	19,767	35,728	1.8	35,928	200	-	7,261	28,467	-	35,928	110	-
	Total NASb	118,141	392,731	109	131,039	201,360	51	594,091	206,311	188,966	83,319	118,044	-	596,640	5,515	-
39	City of Sacramento (South)	262	130	0.5	36,584	66,122	1.8	66,253	45	86	13,438	52,684	-	66,252	-	-
40	Cal Am (Suburban Rosemont)	211	575	2.7	7,563	8,677	1.1	9,252	575	-	8,494	205	-	9,274	508	-
41	Sac Co. 4	5	25	4.7	23	-	0.0	25	25	-	-	-	-	25	-	-
42	Golden State WC (Cordova)	8	27	3.3	6,459	14,994	2.3	15,021	27	-	5,139	9,855	-	15,021	10,981	-
43	Sac Co. 5	-	-	0.0	286	3	0.0	3	-	-	-	3	-	3	6,245	-
44	City of Folsom[1]	103	50	0.5	11,146	20,967	1.9	21,017	34	-	-	20,967	-	21,001	2,443	-
45	Cal Am (Security Park)	-	-	0.0	218	11	0.1	11	-	-	11	0	-	11	233	-
46	Fruitridge Vista WC	-	-	0.0	1,894	4,141	2.2	4,141	-	-	4,302	2	-	4,304	-	-
47	Florin County WD	2	10	4.0	1,380	2,645	1.9	2,655	10	-	2,645	-	-	2,655	-	-
48	Cal Am (Parkway)	7	3	0.4	5,162	9,153	1.8	9,156	3	-	8,652	501	-	9,157	-	-
49	Sac Co. 6	183	493	2.7	1,127	49	0.0	542	137	357	49	-	-	542	-	-
50	Sac County WA (North/Central)	3,581	8,940	2.5	17,404	21,456	1.2	30,395	8,940	-	14,039	7,065	330	30,374	8,733	207
51	Sac County WA (South)	2,225	3,237	1.5	10,542	15,858	1.5	19,095	3,237	-	7,450	7,943	465	19,095	-	-
52	Elk Grove WD (2 - Intertie Service Area)	676	1,470	2.2	3,225	4,852	1.5	6,322	1,470	-	2,279	2,430	142	6,322	-	-
53	Elk Grove WD (1 - GW Service Area)	18	1	0.0	3,074	4,376	1.4	4,377	1	-	4,376	-	-	4,377	-	-
54	Cosumnes River West	17,598	49,046	2.8	2,597	6,220	2.4	55,266	44,813	4,233	6,220	-	-	55,266	-	-
55	RD744	1,240	2,400	1.9	146	64	0.4	2,464	605	1,795	64	-	-	2,464	-	-
56	Franklin Drainage District	2,654	9,111	3.4	344	189	0.5	9,299	3,442	5,670	134	55	-	9,300	-	-
57	RD813	2,053	4,826	2.4	166	90	0.5	4,916	1,361	3,466	65	24	-	4,916	-	-
58	RD755	354	1,515	4.3	39	17	0.4	1,532	502	1,012	17	-	-	1,532	-	-
59	RD1002	4,060	9,611	2.4	423	222	0.5	9,833	2,483	7,129	222	-	-	9,834	-	-
60	RD551	7,767	21,698	2.8	683	301	0.4	21,999	5,464	16,236	301	-	-	22,001	-	-
61	RD369	92	376	4.1	39	17	0.4	393	121	255	17	-	-	393	-	-
62	RD2110	1,358	1,649	1.2	97	43	0.4	1,692	281	1,368	43	-	-	1,693	-	-
63	Sac Co. 7	254	635	2.5	98	105	1.1	740	151	483	105	-	-	740	-	-
64	Rancho Murieta (North)[1]	368	676	1.8	1,189	1,342	1.1	2,018	435	248	111	1,231	-	2,026	-	-
65	Sloughouse RCD (North)	722	1,633	2.3	903	574	0.6	2,207	1,594	39	545	29	-	2,208	-	-
66	OHWD (Sth American Subbasin)	10,099	24,772	2.5	3,345	1,985	0.6	26,757	22,821	2,431	1,420	588	-	27,261	621	-
	Total SASb	55,900	142,907	59	116,154	184,473	28	327,380	98,577	44,808	80,139	103,584	938	328,046	29,765	207
67	OHWD (Cosumnes Subbasin)	2,885	7,427	2.6	1,718	1,236	0.7	8,664	4,863	2,566	1,230	-	-	8,659	-	-
68	Rancho Murieta (South)	5	30	5.5	441	494	1.1	524	15	15	-	448	-	479	-	-
69	Sloughouse RCD (East)	9,647	22,821	2.4	1,872	1,383	0.7	24,204	21,177	1,644	122	124	-	23,068	-	-
70	Wilton	1,200	3,929	3.3	5,748	3,278	0.6	7,207	3,918	11	5,077	-	-	9,006	-	-
71	Sloughouse RCD (West)	4,261	9,306	2.2	490	256	0.5	9,562	9,182	125	6	-	-	9,312	-	-
72	Galt ID (East)	15,282	38,926	2.5	7,847	5,284	0.7	44,210	37,395	1,531	10,545	-	-	49,471	-	-
73	Clay WD	1,989	7,680	3.9	230	424	1.8	8,104	7,237	443	-	-	-	7,680	-	-
74	Clay	130	358	2.8	2,805	1,427	0.5	1,785	358	-	1,403	-	-	1,761	-	-
75	SMUD Rancho Seco	19	60	3.1	196	126	0.6	186	43	17	7	-	-	67	-	-
76	Cosumnes River South	4,231	10,943	2.6	329	465	1.4	11,408	8,293	2,651	-	-	-	10,944	-	-
77	Galt ID (West)	1,728	4,654	2.7	1,542	1,117	0.7	5,771	4,654	-	600	-	-	5,254	-	-
78	Sac Co. 8	2,693	5,929	2.2	697	799	1.1	6,728	5,410	518	131	-	-	6,059	-	-
79	City of Galt	197	216	1.1	3,206	4,777	1.5	4,993	216	-	3,413	-	-	3,629	-	-
80	Sloughouse RCD (South)	1,051	1,417	1.3	376	514	1.4	1,931	1,417	-	42	-	-	1,459	-	-
81	Amador Co. 1	1,900	2,863	1.5	1,832	2,418	1.3	5,282	858	2,003	0	-	-	2,861	-	-
82	Ione	147	14	0.1	1,128	2,371	2.1	2,385	14	0	-	1,911	-	1,925	-	-
83	Jackson ID	2,842	9,699	3.4	387	493	1.3	10,192	-	9,329	19	-	-	9,348	-	-
84	Camanche	81	-	0.0	325	240	0.7	240	-	-	87	-	-	87	-	-
85	Amador County WA	1	-	0.0	603	315	0.5	315	-	-	144	-	-	144	-	-
87	Galt WWTP	156	27	0.2	72	107	1.5	135	-	630	-	-	-	630	-	-
	Total CoSb	50,447	126,301	43	31,841	27,524	21	153,825	105,049	21,484	22,825	2,483	-	151,842	-	-
86	Mokelumne	35,660	75,590	2.1	3,287	4,606	1.4	80,196	75,590	-	4,606	-	-	80,196	-	
	Total Other	35,660	75,590	2.1	3,287	4,606	1.4	80,196	75,590	-	4,606	-	-	80,196	-	-
CoSANA Grand Total (NASb, SASb, CoSb)		224,487	661,939	212	279,035	413,358	100	1,075,297	409,937	255,259	186,284	224,111	938	1,076,528	35,279	207

Footnotes:
1. Subregion includes areas that fall outside of DWR B118 subbasin boundaries
2. Other Supply includes recycled water deliveries

Projected Conditions Baseline Water Use Budget Summary, Annual Average over 50-year Simulation

Subregion	Description	Ag Area	Ag Demand	Ag Water Duty	Urban Area	Urban Demand	Urban Water Duty	Total Water Demand	Total Ag Water Supply (Acre-Feet/Year)		Total Urban Water Supply (Acre-Feet/Year)			Total Supply (Acre-Feet/Year)	Remediation Operations	
		(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acre-Feet)	GW Production	SW Deliveries	GW Use	SW Deliveries	Other Supply[2]		Extraction	Injection
1	Camp Far West ID	1,807	10,113	5.6	177	101	0.6	10,214	5,459	4,653	101	-	-	10,214	-	-
2	Sutter Co. 1	147	629	4.3	2	1	0.4	629	629	-	1	-	-	629	-	-
3	South Sutter WD GSA	52,244	188,092	3.6	2,715	2,044	0.8	190,136	112,897	76,258	1,626	418	-	191,198	-	-
4	Placer County WA[1]	9,028	30,832	3.4	27,745	32,735	1.2	63,567	24,418	6,415	6,187	26,545	-	63,565	-	-
5	Nevada ID	1,481	6,536	4.4	4,231	3,433	0.8	9,969	2,243	4,489	765	2,667	-	10,164	-	-
6	Lincoln[1]	348	91	0.3	6,738	5,657	0.8	5,749	91	-	907	4,750	-	5,748	-	-
7	RD1001 [1]	7,436	30,319	4.1	416	167	0.4	30,486	20,754	9,565	167	-	-	30,486	-	-
8	Pleasant Grove Verona MWC	6,668	23,216	3.5	101	41	0.4	23,257	12,374	11,533	41	-	-	23,947	-	-
9	Sutter Co. 2	904	3,237	3.6	88	35	0.4	3,272	2,062	1,175	35	-	-	3,272	-	-
10	Natomas MWC (Sutter Co.)	6,336	23,929	3.8	5,699	11,492	2.0	35,421	3,662	20,320	7,979	3,512	-	35,473	-	-
11	Sutter Co. 3	1,424	4,445	3.1	2,344	4,577	2.0	9,021	4,445	-	3,222	1,355	-	9,021	-	-
12	Roseville SOI	1,104	2,081	1.9	1,056	2,530	2.4	4,612	2,081	-	188	2,342	-	4,612	-	-
13	City of Roseville	99	60	0.6	23,599	56,637	2.4	56,697	60	-	1,692	54,945	-	56,698	-	-
14	Cal Am (West Placer)	1,528	5,318	3.5	9,158	6,782	0.7	12,101	5,318	-	-	6,782	-	12,101	-	-
15	Natomas MWC (Sacramento Co.)	5,920	17,315	2.9	8,209	17,108	2.1	34,423	3,683	14,413	5,345	11,763	-	35,204	-	-
16	Sacramento International Airport	526	130	0.2	1,669	1,144	0.7	1,274	130	-	673	471	-	1,274	-	-
17	Metro Air Park	1,578	-	0.0	71	-	0.0	-	-	-	-	-	-	-	-	-
18	Sac Co. 1	832	1,096	1.3	165	568	3.5	1,664	43	1,052	568	-	-	1,664	-	-
19	Sac Co. 2	31	61	1.9	1,652	3,710	2.2	3,770	61	-	865	2,845	-	3,770	-	-
20	Sac County WA (Northgate 880)	-	-	0.0	837	1,365	1.6	1,365	-	-	1,365	-	-	1,365	-	-
21	Rio Linda Elverta	447	772	1.7	7,215	10,323	1.4	11,095	772	-	10,323	-	-	11,095	-	-
22	Sac Co. 3	36	129	3.5	652	1,064	1.6	1,193	129	-	1,064	-	-	1,193	-	-
23	Cal Am (Antelope)	3	5	2.0	2,706	5,225	1.9	5,230	5	-	4,481	744	-	5,230	-	-
24	Cal Am (Lincoln Oaks)	9	20	2.3	4,285	6,213	1.4	6,233	20	-	5,717	496	-	6,233	-	-
25	Citrus Heights WD	12	50	4.3	7,744	17,172	2.2	17,222	50	-	900	16,272	-	17,222	-	-
26	San Juan WD (Placer Co.)	82	-	0.0	1,409	2,876	2.0	2,876	-	-	-	2,876	-	2,876	-	-
27	San Juan WD (Sacramento Co.)	47	89	1.9	2,106	4,299	2.0	4,389	89	-	-	4,299	-	4,389	-	-
28	Orange Vale WC	50	277	5.5	2,899	4,697	1.6	4,975	277	-	-	4,697	-	4,975	-	-
29	Lake Natoma/Mississippi Bar	3	97	35.9	140	-	0.0	97	97	-	-	-	-	97	-	-
30	Fair Oaks WD	75	240	3.2	6,204	12,726	2.1	12,966	240	-	2,129	10,597	-	12,966	1,229	-
31	Carmichael WD	-	-	0.0	5,264	10,530	2.0	10,530	-	-	2,465	8,065	-	10,530	1,876	-
32	Sacramento Suburban WD (North)	25	56	2.2	13,846	24,848	1.8	24,904	56	-	15,597	9,251	-	24,904	2,300	-
33	Sacramento Suburuban WD (South)	-	-	0.0	7,773	16,456	2.1	16,456	-	-	13,744	2,712	-	16,456	-	-
34	Del Paso Manor WD	-	-	0.0	614	1,214	2.0	1,214	-	-	1,214	-	-	1,214	-	-
35	Golden State WC Arden	-	-	0.0	496	969	2.0	969	-	-	968	-	-	968	-	-
36	Cal Am (Arden)	-	-	0.0	641	1,606	2.5	1,606	-	-	1,123	483	-	1,606	-	-
37	Sac County WA (Arden Park	-	-	0.0	1,350	3,217	2.4	3,217	-	-	3,217	-	-	3,217	-	-
38	City of Sacramento (North)	806	191	0.2	20,363	55,977	2.7	56,168	191	-	13,955	42,022	-	56,168	110	-
	Total NASb	101,036	349,428	115	182,377	329,539	59	678,967	202,338	149,872	108,625	220,911	-	681,745	5,515	-
39	City of Sacramento (South)	122	24	0.2	36,875	101,356	2.7	101,381	24	1	25,256	76,100	-	101,381	-	-
40	Cal Am (Suburban Rosemont)	56	185	3.3	8,045	17,439	2.2	17,624	185	-	11,053	6,386	-	17,624	508	-
41	Sac Co. 4	5	25	4.7	23	-	0.0	25	25	-	-	-	-	25	-	-
42	Golden State WC (Cordova)	8	27	3.3	6,459	19,752	3.1	19,779	27	-	9,752	10,000	-	19,779	10,981	-
43	Sac Co. 5	-	-	0.0	1,815	2,863	1.6	2,863	-	-	-	2,863	-	2,863	6,245	-
44	City of Folsom[1]	75	50	0.7	15,728	27,405	1.7	27,455	34	-	-	27,405	-	27,439	2,443	-
45	Cal Am (Security Park)	-	-	0.0	1,770	3,408	1.9	3,408	-	-	6	3,402	-	3,408	233	-
46	Fruitridge Vista WC	-	-	0.0	1,894	4,957	2.6	4,957	-	-	2,642	2,478	-	5,120	-	-
47	Florin County WD	-	-	0.0	1,399	2,692	1.9	2,692	-	-	2,645	47	-	2,692	-	-
48	Cal Am (Parkway)	-	-	0.0	5,252	17,084	3.3	17,084	-	-	14,430	2,654	-	17,084	-	-
49	Sac Co. 6	183	493	2.7	1,141	60	0.1	553	136	357	60	-	-	553	-	-
50	Sac County WA (North/Central)	1,607	4,573	2.8	34,073	64,917	1.9	69,489	4,573	-	22,962	35,099	6,856	69,489	8,733	207
51	Sac County WA (South)	531	1,261	2.4	12,689	27,243	2.1	28,504	1,261	-	12,130	10,524	4,589	28,504	-	-
52	Elk Grove WD (2 - Intertie Service Area)	582	1,226	2.1	3,470	7,451	2.1	8,676	1,226	-	3,317	2,878	1,255	8,676	-	-
53	Elk Grove WD (1 - GW Service Area)	18	1	0.0	3,074	4,650	1.5	4,651	1	-	4,650	-	-	4,651	-	-
54	Cosumnes River West	17,599	49,045	2.8	2,597	4,968	1.9	54,013	44,805	4,240	4,968	-	-	54,014	-	-
55	RD744	1,240	2,400	1.9	146	78	0.5	2,478	601	1,799	78	-	-	2,479	-	-
56	Franklin Drainage District	2,654	9,111	3.4	344	185	0.5	9,295	3,431	5,680	163	21	-	9,296	-	-
57	RD813	2,053	4,826	2.4	166	89	0.5	4,915	1,354	3,473	80	10	-	4,916	-	-
58	RD755	354	1,514	4.3	39	21	0.5	1,535	500	1,014	21	-	-	1,535	-	-
59	RD1002	4,060	9,611	2.4	423	271	0.6	9,882	2,468	7,144	271	-	-	9,883	-	-
60	RD551	7,767	21,697	2.8	683	368	0.5	22,065	5,432	16,268	368	-	-	22,068	-	-
61	RD369	92	376	4.1	39	21	0.5	397	121	255	21	-	-	397	-	-
62	RD2110	1,358	1,649	1.2	97	52	0.5	1,702	278	1,371	52	-	-	1,702	-	-
63	Sac Co. 7	254	635	2.5	98	128	1.3	763	151	484	128	-	-	763	-	-
64	Rancho Murieta (North)[1]	367	675	1.8	1,945	2,837	1.5	3,512	433	249	182	2,655	-	3,519	-	-
65	Sloughouse RCD (North)	722	1,632	2.3	2,903	4,233	1.5	5,866	1,594	39	752	3,481	-	5,866	-	-
66	OHWD (Sth American Subbasin)	10,098	24,867	2.5	3,354	2,403	0.7	27,271	22,876	1,997	1,598	829	-	27,299	621	-
	Total SASb	51,804	135,904	57	146,542	316,931	40	452,836	91,537	44,372	117,584	186,834	12,700	453,027	29,765	207
67	OHWD (Cosumnes Subbasin)	2,885	7,427	2.6	1,718	1,234	0.7	8,661	4,861	2,568	1,321	-	-	8,750	-	-
68	Rancho Murieta (South)	5	30	5.5	441	633	1.4	663	15	15	-	583	-	614	-	-
69	Sloughouse RCD (East)	9,647	22,821	2.4	1,872	1,325	0.7	24,145	21,177	1,644	144	167	-	23,132	-	-
70	Wilton	1,200	3,929	3.3	5,748	3,631	0.6	7,560	3,918	11	5,574	-	-	9,503	-	-
71	Sloughouse RCD (West)	4,199	9,219	2.2	641	434	0.7	9,653	9,095	125	235	-	-	9,455	-	-
72	Galt ID (East)	14,125	35,219	2.5	9,175	6,681	0.7	41,900	33,688	1,531	12,889	-	-	48,108	-	-
73	Clay WD	1,990	7,680	3.9	230	301	1.3	7,981	7,237	443	-	-	-	7,680	-	-
74	Clay	130	358	2.8	2,805	1,673	0.6	2,031	358	-	1,653	-	-	2,011	-	-
75	SMUD Rancho Seco	19	60	3.1	196	105	0.5	165	43	17	7	-	-	67	-	-
76	Cosumnes River South	4,232	10,943	2.6	329	480	1.5	11,422	8,292	2,651	-	-	-	10,944	-	-
77	Galt ID (West)	1,562	4,294	2.7	1,753	1,480	0.8	5,774	4,294	-	1,139	-	-	5,433	-	-
78	Sac Co. 8	2,473	5,526	2.2	967	1,120	1.2	6,646	5,008	518	536	-	-	6,062	-	-
79	City of Galt	27	78	2.9	3,428	4,000	1.2	4,078	78	-	3,912	-	-	3,990	-	-
80	Sloughouse RCD (South)	822	964	1.2	677	784	1.2	1,748	964	-	546	-	-	1,510	-	-
81	Amador Co. 1	1,870	2,864	1.5	1,918	2,677	1.4	5,541	858	2,003	0	277	-	3,138	-	-
82	Ione	10	-	0.0	2,216	2,340	1.1	2,340	-	-	-	2,915	-	2,915	-	-
83	Jackson ID	2,842	9,699	3.4	400	549	1.4	10,247	-	9,329	17	-	-	9,346	-	-
84	Camanche	81	-	0.0	452	215	0.5	215	-	-	120	-	-	120	-	-
85	Amador County WA	0	-	0.0	1,184	429	0.4	429	-	-	353	-	-	353	-	-
87	Galt WWTP	156	27	0.2	72	84	1.2	111	-	630	-	-	-	630	-	-
	Total CoSb	48,275	121,140	45	36,220	30,173	19	151,314	99,886	21,487	28,445	3,943	-	153,761	-	-
86	Mokelumne	35,662	75,582	2.1	3,286	4,632	1.4	80,214	75,582	-	4,632	-	-	80,214	-	
	Total Other	35,662	75,582	2.1	3,286	4,632	1.4	80,214	75,582	-	4,632	-	-	80,214	-	-
	CoSANA Grand Total (NASb, SASb, CoSb)	201,115	606,472	216	365,138	676,644	118	1,283,116	393,760	215,731	254,654	411,687	12,700	1,288,532	35,279	207

Footnotes:
1. Subregion includes areas that fall outside of DWR B118 subbasin boundaries
2. Other Supply includes recycled water deliveries

Projected Conditions Baseline with Climate Change Water Use Budget Summary, Annual Average over 50-year Simulation																
Subregion	Description	Ag Area	Ag Demand	Ag Water Duty	Urban Area	Urban Demand	Urban Water Duty	Total Water Demand	Total Ag Water Supply (Acre-Feet/Year)		Total Urban Water Supply (Acre-Feet/Year)			Total Supply (Acre-Feet/Year)	Remediation Operations	
		(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acres)	(Acre-Feet)	(Acre-Feet/Acre)	(Acre-Feet)	GW Production	SW Deliveries	GW Use	SW Deliveries	Other Supply[2]		Extraction	Injection
1	Camp Far West ID	1,807	10,632	5.9	177	101	0.6	10,733	5,979	4,653	101	-	-	10,733	-	-
2	Sutter Co. 1	147	672	4.6	2	1	0.4	673	672	-	1	-	-	673	-	-
3	South Sutter WD GSA	52,244	200,075	3.8	2,715	2,044	0.8	202,119	124,690	76,246	1,626	418	-	202,980	-	-
4	Placer County WA[1]	9,028	33,233	3.7	27,745	32,735	1.2	65,967	26,818	6,415	6,187	26,545	-	65,965	-	-
5	Nevada ID	1,481	6,965	4.7	4,231	3,433	0.8	10,397	2,637	4,489	765	2,667	-	10,558	-	-
6	Lincoln[1]	348	98	0.3	6,738	5,657	0.8	5,755	98	-	907	4,750	-	5,754	-	-
7	RD1001 [1]	7,436	32,241	4.3	416	167	0.4	32,408	22,676	9,565	167	-	-	32,408	-	-
8	Pleasant Grove Verona MWC	6,668	24,847	3.7	101	41	0.4	24,887	13,800	11,533	41	-	-	25,373	-	-
9	Sutter Co. 2	904	3,469	3.8	88	35	0.4	3,504	2,286	1,183	35	-	-	3,504	-	-
10	Natomas MWC (Sutter Co.)	6,336	25,410	4.0	5,699	11,492	2.0	36,901	3,663	21,795	7,979	3,512	-	36,949	-	-
11	Sutter Co. 3	1,424	4,750	3.3	2,344	4,577	2.0	9,326	4,750	-	3,222	1,355	-	9,326	-	-
12	Roseville SOI	1,104	2,229	2.0	1,056	2,530	2.4	4,759	2,229	-	188	2,342	-	4,759	-	-
13	City of Roseville	99	63	0.6	23,599	56,637	2.4	56,700	63	-	1,692	54,945	-	56,700	-	-
14	Cal Am (West Placer)	1,528	5,790	3.8	9,158	6,782	0.7	12,572	5,790	-	-	6,782	-	12,572	-	-
15	Natomas MWC (Sacramento Co.)	5,920	18,453	3.1	8,209	17,108	2.1	35,561	3,691	15,528	5,345	11,763	-	36,327	-	-
16	Sacramento International Airport	526	139	0.3	1,669	1,144	0.7	1,283	139	-	673	471	-	1,283	-	-
17	Metro Air Park	1,578	-	0.0	71	-	0.0	-	-	-	-	-	-	-	-	-
18	Sac Co. 1	832	1,190	1.4	165	568	3.5	1,757	48	1,142	568	-	-	1,757	-	-
19	Sac Co. 2	31	64	2.0	1,652	3,710	2.2	3,774	64	-	865	2,845	-	3,774	-	-
20	Sac County WA (Northgate 880)	-	-	0.0	837	1,365	1.6	1,365	-	-	1,365	-	-	1,365	-	-
21	Rio Linda Elverta	447	842	1.9	7,215	10,323	1.4	11,166	842	-	10,323	-	-	11,166	-	-
22	Sac Co. 3	36	140	3.9	652	1,064	1.6	1,204	140	-	1,064	-	-	1,204	-	-
23	Cal Am (Antelope)	3	6	2.2	2,706	5,225	1.9	5,231	6	-	4,481	744	-	5,231	-	-
24	Cal Am (Lincoln Oaks)	9	22	2.5	4,285	6,213	1.4	6,235	22	-	5,717	496	-	6,235	-	-
25	Citrus Heights WD	12	54	4.7	7,744	17,172	2.2	17,226	54	-	900	16,272	-	17,226	-	-
26	San Juan WD (Placer Co.)	82	-	0.0	1,409	2,876	2.0	2,876	-	-	-	2,876	-	2,876	-	-
27	San Juan WD (Sacramento Co.)	47	97	2.1	2,106	4,299	2.0	4,396	97	-	-	4,299	-	4,396	-	-
28	Orange Vale WC	50	294	5.9	2,899	4,697	1.6	4,991	294	-	-	4,697	-	4,991	-	-
29	Lake Natoma/Mississippi Bar	3	98	36.2	140	-	0.0	98	98	-	-	-	-	98	-	-
30	Fair Oaks WD	75	257	3.4	6,204	12,726	2.1	12,984	257	-	2,129	10,597	-	12,983	1,229	-
31	Carmichael WD	-	-	0.0	5,264	10,530	2.0	10,530	-	-	2,465	8,065	-	10,530	1,876	-
32	Sacramento Suburban WD (North)	25	62	2.4	13,846	24,848	1.8	24,910	62	-	15,597	9,251	-	24,910	2,300	-
33	Sacramento Suburuban WD (South)	-	-	0.0	7,773	16,456	2.1	16,456	-	-	13,744	2,712	-	16,456	-	-
34	Del Paso Manor WD	-	-	0.0	614	1,214	2.0	1,214	-	-	1,214	-	-	1,214	-	-
35	Golden State WC Arden	-	-	0.0	496	969	2.0	969	-	-	968	-	-	968	-	-
36	Cal Am (Arden)	-	-	0.0	641	1,606	2.5	1,606	-	-	1,123	483	-	1,606	-	-
37	Sac County WA (Arden Park	-	-	0.0	1,350	3,217	2.4	3,217	-	-	3,217	-	-	3,217	-	-
38	City of Sacramento (North)	806	209	0.3	20,363	55,977	2.7	56,186	209	-	13,955	42,022	-	56,186	110	-
	Total NASb	101,036	372,398	121	182,377	329,539	59	701,937	222,172	152,548	108,625	220,911	-	704,255	5,515	-
39	City of Sacramento (South)	122	26	0.2	36,875	101,356	2.7	101,383	26	1	25,256	76,100	-	101,383	-	-
40	Cal Am (Suburban Rosemont)	56	196	3.5	8,045	17,439	2.2	17,635	196	-	11,053	6,386	-	17,635	508	-
41	Sac Co. 4	5	27	5.1	23	-	0.0	27	27	-	-	-	-	27	-	-
42	Golden State WC (Cordova)	8	29	3.5	6,459	19,752	3.1	19,781	29	-	9,752	10,000	-	19,781	10,981	-
43	Sac Co. 5	-	-	0.0	1,815	2,863	1.6	2,863	-	-	-	2,863	-	2,863	6,245	-
44	City of Folsom[1]	75	54	0.7	15,728	27,405	1.7	27,459	32	-	-	27,405	-	27,438	2,443	-
45	Cal Am (Security Park)	-	-	0.0	1,770	3,408	1.9	3,408	-	-	6	3,402	-	3,408	233	-
46	Fruitridge Vista WC	-	-	0.0	1,894	4,957	2.6	4,957	-	-	2,642	2,478	-	5,120	-	-
47	Florin County WD	-	-	0.0	1,399	2,692	1.9	2,692	-	-	2,645	47	-	2,692	-	-
48	Cal Am (Parkway)	-	-	0.0	5,252	17,084	3.3	17,084	-	-	14,430	2,654	-	17,084	-	-
49	Sac Co. 6	183	559	3.1	1,141	60	0.1	618	190	368	60	-	-	618	-	-
50	Sac County WA (North/Central)	1,607	4,981	3.1	34,073	64,917	1.9	69,897	4,981	-	22,962	35,099	6,856	69,897	8,733	207
51	Sac County WA (South)	531	1,377	2.6	12,689	27,243	2.1	28,620	1,377	-	12,130	10,524	4,589	28,620	-	-
52	Elk Grove WD (2 - Intertie Service Area)	582	1,333	2.3	3,470	7,451	2.1	8,784	1,333	-	3,317	2,878	1,255	8,784	-	-
53	Elk Grove WD (1 - GW Service Area)	18	1	0.1	3,074	4,650	1.5	4,651	1	-	4,650	-	-	4,651	-	-
54	Cosumnes River West	17,599	53,472	3.0	2,597	4,968	1.9	58,440	49,159	4,313	4,968	-	-	58,440	-	-
55	RD744	1,240	2,637	2.1	146	78	0.5	2,716	804	1,834	78	-	-	2,716	-	-
56	Franklin Drainage District	2,654	9,945	3.7	344	185	0.5	10,129	4,202	5,743	163	21	-	10,130	-	-
57	RD813	2,053	5,335	2.6	166	89	0.5	5,424	1,787	3,548	80	10	-	5,425	-	-
58	RD755	354	1,642	4.6	39	21	0.5	1,662	624	1,018	21	-	-	1,662	-	-
59	RD1002	4,060	10,637	2.6	423	271	0.6	10,908	3,281	7,356	271	-	-	10,908	-	-
60	RD551	7,767	23,766	3.1	683	368	0.5	24,134	7,291	16,477	368	-	-	24,135	-	-
61	RD369	92	409	4.4	39	21	0.5	430	152	257	21	-	-	430	-	-
62	RD2110	1,358	1,825	1.3	97	52	0.5	1,877	407	1,417	52	-	-	1,877	-	-
63	Sac Co. 7	254	704	2.8	98	128	1.3	832	207	497	128	-	-	832	-	-
64	Rancho Murieta (North)[1]	367	731	2.0	1,945	2,837	1.5	3,568	476	260	182	2,655	-	3,574	-	-
65	Sloughouse RCD (North)	722	1,760	2.4	2,903	4,233	1.5	5,993	1,721	39	752	3,481	-	5,993	-	-
66	OHWD (Sth American Subbasin)	10,098	27,030	2.7	3,354	2,403	0.7	29,434	24,981	2,053	1,598	829	-	29,461	621	-
	Total SASb	51,804	148,475	62	146,542	316,931	40	465,406	103,283	45,182	117,584	186,834	12,700	465,583	29,765	207
67	OHWD (Cosumnes Subbasin)	2,885	8,048	2.8	1,718	1,234	0.7	9,282	5,302	2,747	1,321	-	-	9,370	-	-
68	Rancho Murieta (South)	5	32	5.9	441	633	1.4	665	16	17	-	583	-	616	-	-
69	Sloughouse RCD (East)	9,647	24,790	2.6	1,872	1,325	0.7	26,115	23,102	1,689	144	167	-	25,102	-	-
70	Wilton	1,200	4,246	3.5	5,748	3,631	0.6	7,877	4,235	11	5,574	-	-	9,820	-	-
71	Sloughouse RCD (West)	4,199	10,057	2.4	641	434	0.7	10,491	9,932	125	235	-	-	10,293	-	-
72	Galt ID (East)	14,125	38,178	2.7	9,175	6,681	0.7	44,859	36,639	1,538	12,889	-	-	51,067	-	-
73	Clay WD	1,990	8,332	4.2	230	301	1.3	8,633	7,886	446	-	-	-	8,332	-	-
74	Clay	130	387	3.0	2,805	1,673	0.6	2,061	387	-	1,653	-	-	2,040	-	-
75	SMUD Rancho Seco	19	66	3.4	196	105	0.5	171	47	19	7	-	-	73	-	-
76	Cosumnes River South	4,232	11,994	2.8	329	480	1.5	12,473	9,084	2,924	-	-	-	12,008	-	-
77	Galt ID (West)	1,562	4,670	3.0	1,753	1,480	0.8	6,150	4,670	-	1,139	-	-	5,809	-	-
78	Sac Co. 8	2,473	5,969	2.4	967	1,120	1.2	7,089	5,433	536	536	-	-	6,505	-	-
79	City of Galt	27	83	3.1	3,428	4,000	1.2	4,082	83	-	3,912	-	-	3,995	-	-
80	Sloughouse RCD (South)	822	1,047	1.3	677	784	1.2	1,831	1,047	-	546	-	-	1,592	-	-
81	Amador Co. 1	1,870	3,126	1.7	1,918	2,677	1.4	5,804	968	2,155	0	277	-	3,400	-	-
82	Ione	10	-	0.0	2,216	2,340	1.1	2,340	-	-	-	2,915	-	2,915	-	-
83	Jackson ID	2,842	10,410	3.7	400	549	1.4	10,959	-	9,934	17	-	-	9,951	-	-
84	Camanche	81	-	0.0	452	215	0.5	215	-	-	120	-	-	120	-	-
85	Amador County WA	0	-	0.0	1,184	429	0.4	429	-	-	353	-	-	353	-	-
87	Galt WWTP	156	32	0.2	72	84	1.2	116	-	632	-	-	-	632	-	-
	Total CoSb	48,275	131,469	49	36,220	30,173	19	161,642	108,831	22,773	28,445	3,943	-	163,992	-	-
86	Mokelumne	35,662	83,220	2.3	3,286	4,632	1.4	87,852	83,220	-	4,632	-	-	87,852	-	
	Total Other	35,662	83,220	2.3	3,286	4,632	1.4	87,852	83,220	-	4,632	-	-	87,852	-	-
CoSANA Grand Total (NASb, SASb, CoSb)		201,115	652,342	231	365,138	676,644	118	1,328,986	434,286	220,503	254,654	411,687	12,700	1,333,830	35,279	207

Footnotes:
1. Subregion includes areas that fall outside of DWR B118 subbasin boundaries
2. Other Supply includes recycled water deliveries

APPENDIX I: BASELINE CONDITIONS GROUNDWATER BUDGETS

Current Conditions Baseline Groundwater Budget Summary, Annual Average over 50-year Simulation							
Subregion	**Description**	**Deep Percolation**	**Gain from Stream**	**Recharge (Recoverable Loss)**	**Boundary Inflow**	**Net Subsurface Inflow**	**Pumping**
		(Acre-Feet)	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*
	North American Subbasin						
1	Camp Far West ID	6,458	-4,879	651	2,526	834	5,582
2	Sutter Co. 1	312	23	0	1,232	-937	630
3	South Sutter WD GSA	54,557	26,635	10,625	4,478	16,746	111,539
4	Placer County WA	32,195	2,096	898	1,539	-3,198	29,899
5	Nevada ID	8,411	776	1,257	4,345	-6,277	8,782
6	Lincoln	5,464	640	0	504	-4,060	1,046
7	RD1001	16,678	6,067	1,148	-86	-2,764	20,923
8	Pleasant Grove Verona MWC	5,013	3,705	1,346	0	2,564	12,561
9	Sutter Co. 2	1,351	-2,512	141	945	2,150	2,098
10	Natomas MWC (Sutter Co.)	7,920	6,075	277	46	-8,615	5,586
11	Sutter Co. 3	3,461	917	0	0	5,931	10,123
12	Roseville SOI	1,059	1,146	0	0	-715	1,220
13	City of Roseville	5,082	5,202	210	2,758	-9,643	208
14	Cal Am (West Placer)	4,628	4,071	0	0	-3,453	4,130
15	Natomas MWC (Sacramento Co.)	9,916	-3,968	465	2,663	-3,906	5,140
16	Sacramento International Airport	736	0	0	0	161	944
17	Metro Air Park	477	0	0	0	-457	31
18	Sac Co. 1	733	-3,297	0	3,897	-709	649
19	Sac Co. 2	1,188	2,090	0	0	-344	2,849
20	Sac County WA (Northgate 880)	61	585	0	0	70	696
21	Rio Linda Elverta	2,194	5,392	0	0	2,387	9,390
22	Sac Co. 3	164	754	0	0	-344	512
23	Cal Am (Antelope)	567	629	0	0	2,949	3,903
24	Cal Am (Lincoln Oaks)	523	0	0	0	6,174	6,359
25	Citrus Heights WD	1,417	0	0	460	-176	1,263
26	San Juan WD (Placer Co.)	380	0	0	1,566	-2,057	0
27	San Juan WD (Sacramento Co.)	567	-589	0	825	-773	89
28	Orange Vale WC	1,187	0	0	0	-868	278
29	Lake Natoma/Mississippi Bar	1,590	-5,831	0	34	4,313	97
30	Fair Oaks WD	2,746	4,824	0	0	-4,113	3,317
31	Carmichael WD	1,032	5,622	0	0	-2,545	3,999
32	Sacramento Suburban WD (North)	2,691	50	0	0	11,769	13,785
33	Sacramento Suburuban WD (South)	866	6,342	0	0	5,791	12,843
34	Del Paso Manor WD	75	0	0	0	1,270	1,335
35	Golden State WC Arden	33	0	0	0	772	800
36	Cal Am (Arden)	92	0	0	0	1,382	1,464
37	Sac County WA (Arden Park	203	766	0	0	1,650	2,611
38	City of Sacramento (North)	3,252	14,463	0	727	-1,197	16,734
	Total NASb	185,281	77,793	17,017	28,461	9,761	303,413
	South American Subbasin						
39	City of Sacramento (South)	13,704	12,643	0	842	-21,062	5,940
40	Cal Am (Suburban Rosemont)	1,529	6,147	0	0	2,224	9,911
41	Sac Co. 4	286	2,527	0	0	-2,785	25
42	Golden State WC (Cordova)	6,482	12,851	0	0	-3,452	15,892
43	Sac Co. 5	1,947	0	0	0	4,280	6,245
44	City of Folsom	16,480	-3,463	0	2,155	-12,339	2,475
45	Cal Am (Security Park)	1,583	38	0	0	-1,424	244
46	Fruitridge Vista WC	299	278	0	0	2,982	3,550
47	Florin County WD	161	0	0	0	2,134	2,288
48	Cal Am (Parkway)	660	359	0	0	7,943	8,919
49	Sac Co. 6	969	3,022	0	254	-4,025	185
50	Sac County WA (North/Central)	16,795	4,020	209	0	15,652	37,013
51	Sac County WA (South)	3,686	213	0	0	11,379	15,038
52	Elk Grove WD (2 - Intertie Service Area)	1,302	1,192	0	0	1,805	4,229
53	Elk Grove WD (1 - GW Service Area)	390	668	0	0	5,823	6,835
54	Cosumnes River West	21,988	10,970	0	0	18,478	51,033
55	RD744	837	6,390	0	-773	-5,730	669
56	Franklin Drainage District	3,404	5,872	0	-252	-5,133	3,626
57	RD813	1,594	2,833	0	-134	-2,774	1,426
58	RD755	552	1,312	0	-283	-1,036	519
59	RD1002	3,060	0	0	0	-280	2,705
60	RD551	8,754	5,686	0	-1,517	-6,924	5,765
61	RD369	433	1,947	0	-216	-2,013	138
62	RD2110	746	-919	0	495	19	324
63	Sac Co. 7	358	1,221	0	26	-1,342	256
64	Rancho Murieta (North)	4,945	-2,429	0	0	-1,821	546
65	Sloughouse RCD (North)	5,139	-606	0	3,948	-6,007	2,140
66	OHWD (Sth American Subbasin)	11,901	15,290	26	64	-2,207	24,862
	Total SASb	129,985	88,059	235	4,610	-7,634	212,799
	Cosumnes Subbasin						
67	OHWD (Cosumnes Subbasin)	5,611	5,146	0	0	-4,615	6,093
68	Rancho Murieta (South)	1,081	-2,163	0	0	1,095	15
69	Sloughouse RCD (East)	23,460	3,256	0	1,183	-7,110	21,299
70	Wilton	4,917	48	0	0	3,963	8,995
71	Sloughouse RCD (West)	4,059	361	0	0	4,768	9,187
72	Galt ID (East)	20,225	1,975	0	0	25,568	47,940
73	Clay WD	3,489	1,189	0	0	2,464	7,237
74	Clay	1,074	3	0	0	618	1,761
75	SMUD Rancho Seco	490	0	0	0	-496	50
76	Cosumnes River South	4,753	9,282	0	-561	-5,145	8,293
77	Galt ID (West)	2,506	785	0	0	1,989	5,254
78	Sac Co. 8	4,149	7,799	0	0	-6,412	5,541
79	City of Galt	1,489	675	0	0	1,487	3,629
80	Sloughouse RCD (South)	964	997	0	0	-496	1,459
81	Amador Co. 1	13,631	-6,996	0	4,477	-9,734	858
82	Ione	1,367	0	0	0	-1,088	14
83	Jackson ID	8,808	-6,794	0	538	-2,476	0
84	Camanche	5,218	0	0	-4,190	-1,146	60
85	Amador County WA	1,457	0	0	6	-1,324	190
87	Galt WWTP	316	0	0	0	-317	0
	Total CoSb	109,064	15,562	0	1,453	1,591	127,874
	Other						
86	Mokelumne	30,689	51,058	0	1,834	-3,718	80,196
	Total Other	30,689	51,058	0	1,834	-3,718	80,196
CoSANA Total (NASb, SASb, CoSb)		424,331	181,414	17,252	34,525	3,718	644,087

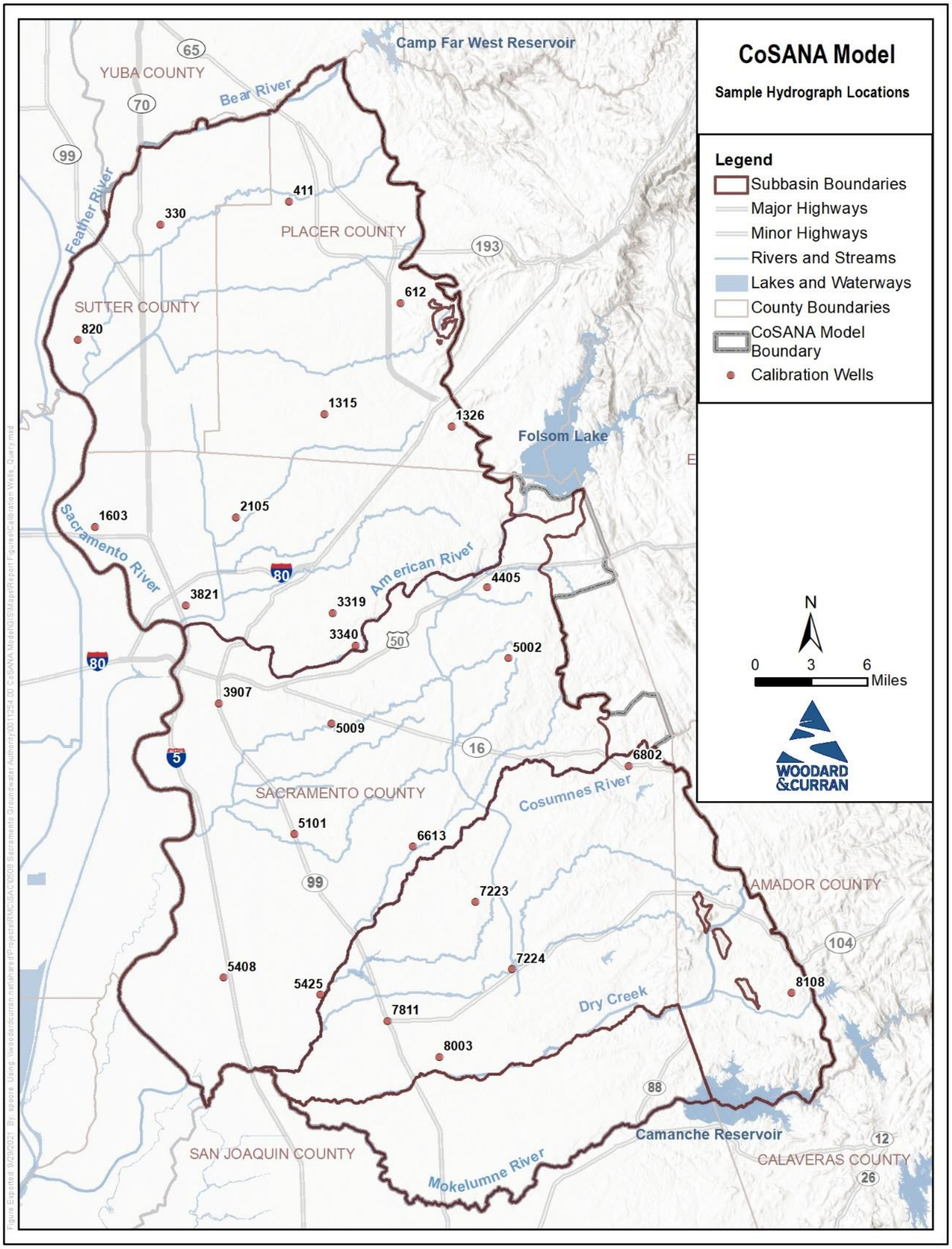
Projected Conditions Baseline Groundwater Budget Summary, Annual Average over 50-year Simulation

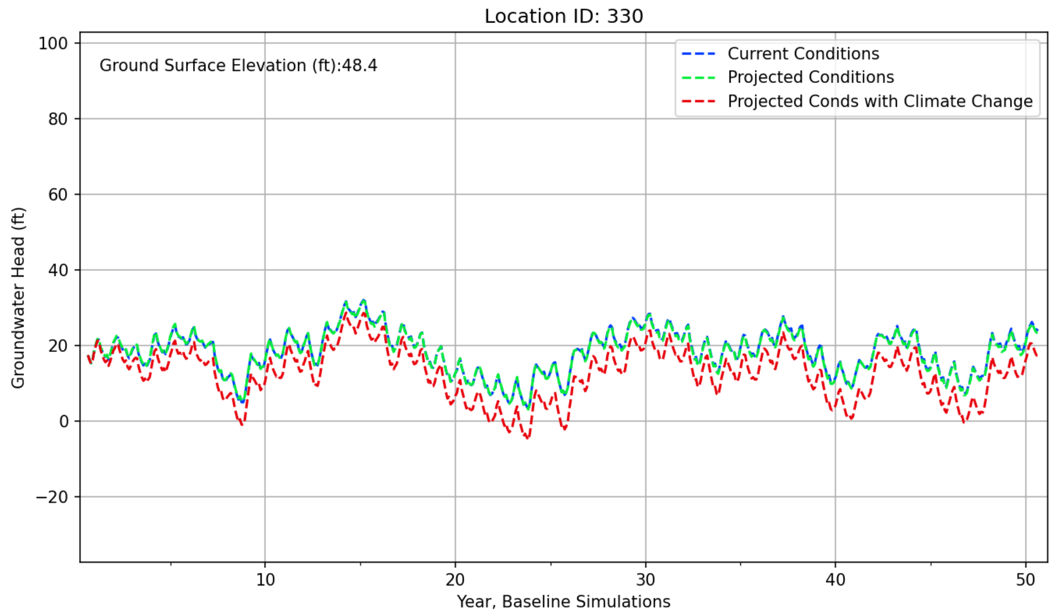
Subregion	Description	Deep Percolation	Gain from Stream	Recharge (Recoverable Loss)	Boundary Inflow	Net Subsurface Inflow	Pumping
		(Acre-Feet)	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*
			North American Subbasin				
1	Camp Far West ID	6,456	-4,691	651	2,549	603	5,560
2	Sutter Co. 1	312	63	0	1,246	-991	629
3	South Sutter WD GSA	54,699	31,313	10,625	4,579	13,738	114,443
4	Placer County WA	27,668	2,366	898	1,539	912	30,955
5	Nevada ID	6,315	702	1,257	4,345	-9,688	2,499
6	Lincoln	5,087	561	0	504	-3,418	1,187
7	RD1001	16,677	6,369	1,148	-40	-3,119	20,921
8	Pleasant Grove Verona MWC	5,152	5,551	1,384	0	376	12,414
9	Sutter Co. 2	1,351	116	141	1,340	-899	2,098
10	Natomas MWC (Sutter Co.)	4,579	8,640	130	70	1,220	15,205
11	Sutter Co. 3	1,690	1,136	0	0	4,552	7,667
12	Roseville SOI	1,244	1,143	0	0	-177	2,198
13	City of Roseville	5,939	5,388	2,108	2,758	-11,668	1,874
14	Cal Am (West Placer)	2,555	4,419	0	0	-1,515	5,327
15	Natomas MWC (Sacramento Co.)	6,500	-1,579	218	3,491	-2,793	6,635
16	Sacramento International Airport	737	0	0	0	-67	803
17	Metro Air Park	477	0	0	0	-525	52
18	Sac Co. 1	728	-2,650	0	4,361	-1,872	611
19	Sac Co. 2	113	2,768	0	0	-1,490	1,451
20	Sac County WA (Northgate 880)	61	656	0	0	877	1,614
21	Rio Linda Elverta	1,974	6,391	0	0	3,372	11,959
22	Sac Co. 3	95	818	0	0	-582	330
23	Cal Am (Antelope)	590	684	0	0	2,881	4,111
24	Cal Am (Lincoln Oaks)	490	0	0	0	5,224	5,562
25	Citrus Heights WD	1,712	0	0	460	-775	1,125
26	San Juan WD (Placer Co.)	461	0	0	1,566	-2,125	0
27	San Juan WD (Sacramento Co.)	662	-577	0	825	-879	89
28	Orange Vale WC	1,240	0	0	0	-946	277
29	Lake Natoma/Mississippi Bar	1,590	-5,522	0	34	4,002	97
30	Fair Oaks WD	2,921	6,048	0	0	-5,354	3,598
31	Carmichael WD	1,117	6,445	0	0	-3,261	4,342
32	Sacramento Suburban WD (North)	2,849	50	0	0	14,001	16,878
33	Sacramento Suburban WD (South)	919	7,507	0	0	7,330	15,864
34	Del Paso Manor WD	67	0	0	0	1,134	1,214
35	Golden State WC Arden	33	0	0	0	757	800
36	Cal Am (Arden)	75	0	0	0	1,042	1,123
37	Sac County WA (Arden Park	194	1,061	0	0	1,949	3,227
38	City of Sacramento (North)	3,884	19,364	0	861	-3,804	20,646
	Total NASb	169,212	104,540	18,560	30,488	8,023	325,385
			South American Subbasin				
39	City of Sacramento (South)	17,819	18,440	0	1,275	-17,061	21,111
40	Cal Am (Suburban Rosemont)	1,969	7,265	0	0	2,923	12,392
41	Sac Co. 4	286	2,902	0	0	-3,168	25
42	Golden State WC (Cordova)	7,385	14,630	0	0	-1,909	20,280
43	Sac Co. 5	1,519	0	0	0	4,664	6,245
44	City of Folsom	14,874	-2,446	0	2,155	-11,968	2,475
45	Cal Am (Security Park)	1,422	38	0	0	-1,297	239
46	Fruitridge Vista WC	358	278	0	0	1,519	2,191
47	Florin County WD	160	0	0	0	2,049	2,278
48	Cal Am (Parkway)	1,228	359	0	0	12,848	14,625
49	Sac Co. 6	969	4,316	0	279	-5,357	196
50	Sac County WA (North/Central)	13,944	4,021	209	0	9,034	28,197
51	Sac County WA (South)	3,114	213	0	0	14,449	17,670
52	Elk Grove WD (2 - Intertie Service Area)	1,318	1,192	0	0	2,960	5,497
53	Elk Grove WD (1 - GW Service Area)	404	668	0	0	5,579	6,664
54	Cosumnes River West	21,470	11,391	0	0	17,120	49,774
55	RD744	837	7,064	0	-709	-6,460	679
56	Franklin Drainage District	3,404	6,558	0	-180	-5,152	4,401
57	RD813	1,594	3,174	0	-82	-3,167	1,433
58	RD755	552	1,417	0	-252	-1,170	521
59	RD1002	3,061	0	0	0	-263	2,739
60	RD551	8,756	6,090	0	-1,426	-7,399	5,800
61	RD369	433	2,014	0	-205	-2,088	141
62	RD2110	746	-769	0	512	-143	331
63	Sac Co. 7	359	1,322	0	29	-1,427	279
64	Rancho Murieta (North)	4,871	-2,372	0	0	-1,756	615
65	Sloughouse RCD (North)	4,881	-339	0	3,948	-5,913	2,346
66	OHWD (Sth American Subbasin)	11,612	15,651	26	64	-2,214	25,095
	Total SASb	129,345	103,077	235	5,407	-4,767	234,238
			Cosumnes Subbasin				
67	OHWD (Cosumnes Subbasin)	5,622	5,276	0	0	-4,737	6,182
68	Rancho Murieta (South)	1,109	-2,126	0	0	1,030	15
69	Sloughouse RCD (East)	23,465	3,320	0	1,183	-7,361	21,321
70	Wilton	4,980	48	0	0	4,283	9,492
71	Sloughouse RCD (West)	4,052	371	0	0	4,557	9,096
72	Galt ID (East)	19,433	1,984	0	0	22,831	44,622
73	Clay WD	3,489	1,187	0	0	2,414	7,237
74	Clay	1,108	3	0	0	812	2,011
75	SMUD Rancho Seco	490	0	0	0	-509	50
76	Cosumnes River South	4,753	9,573	0	-546	-5,472	8,292
77	Galt ID (West)	2,440	791	0	0	1,627	4,854
78	Sac Co. 8	4,095	8,071	0	0	-7,133	5,092
79	City of Galt	1,448	680	0	0	5,597	7,737
80	Sloughouse RCD (South)	856	1,005	0	0	-871	983
81	Amador Co. 1	13,634	-6,968	0	4,477	-9,790	858
82	Ione	1,279	0	0	0	-1,040	0
83	Jackson ID	8,806	-6,733	0	538	-2,539	17
84	Camanche	5,208	0	0	-4,112	-1,224	94
85	Amador County WA	1,396	0	0	6	-1,094	379
87	Galt WWTP	316	0	0	0	-318	0
	Total CoSb	107,977	16,481	0	1,547	1,063	128,332
			Other				
86	Mokelumne	30,691	51,342	0	2,032	-4,319	80,214
	Total Other	30,691	51,342	0	2,032	-4,319	80,214
CoSANA Total (NASb, SASb, CoSb)		406,534	224,098	18,795	37,442	4,319	687,954

Projected Conditions Baseline with Climate Change Groundwater Budget Summary, Annual Average over 50-year Simulation							
Subregion	**Description**	**Deep Percolation**	**Gain from Stream**	**Recharge (Recoverable Loss)**	**Boundary Inflow**	**Net Subsurface Inflow**	**Pumping**
		(Acre-Feet)	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*	*(Acre-Feet)*
North American Subbasin							
1	Camp Far West ID	6,384	-3,554	651	2,802	-206	6,080
2	Sutter Co. 1	309	228	0	1,320	-1,184	673
3	South Sutter WD GSA	53,890	37,614	10,623	4,994	17,602	126,237
4	Placer County WA	26,028	2,902	898	1,483	2,003	33,355
5	Nevada ID	6,157	732	1,257	4,278	-9,411	2,892
6	Lincoln	4,928	664	0	483	-3,730	1,193
7	RD1001	16,409	7,802	1,148	1,380	-3,857	22,843
8	Pleasant Grove Verona MWC	5,050	8,165	1,384	0	-773	13,840
9	Sutter Co. 2	1,311	372	142	1,545	-1,108	2,321
10	Natomas MWC (Sutter Co.)	4,513	9,390	139	79	313	15,205
11	Sutter Co. 3	1,613	1,126	0	0	4,776	7,972
12	Roseville SOI	1,193	1,131	0	0	-155	2,345
13	City of Roseville	5,481	5,491	2,108	2,677	-12,114	1,877
14	Cal Am (West Placer)	2,330	4,464	0	0	-1,276	5,799
15	Natomas MWC (Sacramento Co.)	6,269	-1,584	234	3,962	-3,219	6,644
16	Sacramento International Airport	685	0	0	0	-33	812
17	Metro Air Park	426	0	0	0	-492	52
18	Sac Co. 1	671	-2,612	0	4,558	-2,055	616
19	Sac Co. 2	96	2,742	0	0	-1,480	1,455
20	Sac County WA (Northgate 880)	56	663	0	0	866	1,614
21	Rio Linda Elverta	1,708	6,397	0	0	3,469	12,029
22	Sac Co. 3	88	827	0	0	-595	341
23	Cal Am (Antelope)	520	691	0	0	2,870	4,111
24	Cal Am (Lincoln Oaks)	442	0	0	0	5,186	5,564
25	Citrus Heights WD	1,558	0	0	438	-737	1,130
26	San Juan WD (Placer Co.)	431	0	0	1,460	-2,016	0
27	San Juan WD (Sacramento Co.)	618	-548	0	772	-823	97
28	Orange Vale WC	1,193	0	0	0	-926	294
29	Lake Natoma/Mississippi Bar	1,600	-5,291	0	34	3,762	98
30	Fair Oaks WD	2,761	6,285	0	0	-5,475	3,615
31	Carmichael WD	1,024	6,582	0	0	-3,363	4,342
32	Sacramento Suburban WD (North)	2,480	50	0	0	14,128	16,883
33	Sacramento Suburuban WD (South)	797	7,717	0	0	7,148	15,864
34	Del Paso Manor WD	58	0	0	0	1,134	1,214
35	Golden State WC Arden	29	0	0	0	756	800
36	Cal Am (Arden)	66	0	0	0	1,045	1,123
37	Sac County WA (Arden Park	163	1,101	0	0	1,925	3,227
38	City of Sacramento (North)	3,413	19,844	0	990	-4,170	20,664
Total NASb		162,749	119,391	18,585	33,255	7,782	345,219
South American Subbasin							
39	City of Sacramento (South)	16,708	19,971	0	1,635	-18,250	21,113
40	Cal Am (Suburban Rosemont)	1,758	7,462	0	0	2,813	12,402
41	Sac Co. 4	266	2,940	0	0	-3,188	27
42	Golden State WC (Cordova)	7,090	14,997	0	0	-2,062	20,282
43	Sac Co. 5	1,478	0	0	0	4,683	6,245
44	City of Folsom	14,446	-2,148	0	2,013	-11,789	2,475
45	Cal Am (Security Park)	1,391	38	0	0	-1,303	239
46	Fruitridge Vista WC	311	278	0	0	1,542	2,191
47	Florin County WD	136	0	0	0	2,038	2,278
48	Cal Am (Parkway)	1,051	359	0	0	12,906	14,625
49	Sac Co. 6	913	5,011	0	302	-5,991	250
50	Sac County WA (North/Central)	13,021	4,022	209	0	9,027	28,605
51	Sac County WA (South)	2,803	213	0	0	14,509	17,786
52	Elk Grove WD (2 - Intertie Service Area)	1,193	1,192	0	0	2,963	5,605
53	Elk Grove WD (1 - GW Service Area)	352	668	0	0	5,513	6,664
54	Cosumnes River West	20,558	12,903	0	0	20,076	54,127
55	RD744	770	7,865	0	-605	-7,101	882
56	Franklin Drainage District	3,213	7,420	0	-49	-5,292	5,172
57	RD813	1,478	3,923	0	44	-3,524	1,867
58	RD755	522	1,961	0	-127	-1,689	644
59	RD1002	2,885	0	0	0	647	3,552
60	RD551	8,342	8,551	0	-968	-8,129	7,658
61	RD369	395	2,387	0	-141	-2,459	173
62	RD2110	667	-80	0	647	-765	460
63	Sac Co. 7	316	1,758	0	59	-1,807	334
64	Rancho Murieta (North)	4,788	-2,129	0	0	-1,887	658
65	Sloughouse RCD (North)	4,624	217	0	3,782	-6,084	2,473
66	OHWD (Sth American Subbasin)	11,032	15,967	26	60	-633	27,200
Total SASb		122,508	115,747	235	6,653	-5,232	245,986
Cosumnes Subbasin							
67	OHWD (Cosumnes Subbasin)	5,341	5,815	0	0	-4,966	6,623
68	Rancho Murieta (South)	1,095	-2,043	0	0	958	16
69	Sloughouse RCD (East)	21,910	3,688	0	1,094	-6,550	23,246
70	Wilton	4,623	45	0	0	4,353	9,809
71	Sloughouse RCD (West)	3,778	409	0	0	4,969	9,934
72	Galt ID (East)	18,352	1,928	0	0	24,803	47,573
73	Clay WD	3,368	1,112	0	0	2,873	7,886
74	Clay	977	3	0	0	744	2,040
75	SMUD Rancho Seco	448	0	0	0	-594	54
76	Cosumnes River South	4,481	11,014	0	-404	-6,143	9,084
77	Galt ID (West)	2,241	767	0	0	2,072	5,230
78	Sac Co. 8	3,795	8,781	0	0	-7,484	5,517
79	City of Galt	1,277	659	0	0	5,614	7,742
80	Sloughouse RCD (South)	777	974	0	0	-790	1,065
81	Amador Co. 1	13,068	-6,388	0	4,209	-9,703	968
82	Ione	1,194	0	0	0	-1,002	0
83	Jackson ID	8,289	-6,033	0	485	-2,765	17
84	Camanche	4,849	0	0	-3,840	-1,251	94
85	Amador County WA	1,316	0	0	7	-1,046	379
87	Galt WWTP	311	0	0	0	-330	0
Total CoSb		101,490	20,732	0	1,552	3,763	137,276
Other							
86	Mokelumne	27,801	53,146	0	9,567	-6,313	87,852
Total Other		27,801	53,146	0	9,567	-6,313	87,852
CoSANA Total (NASb, SASb, CoSb)		386,746	255,871	18,820	41,460	6,313	728,482

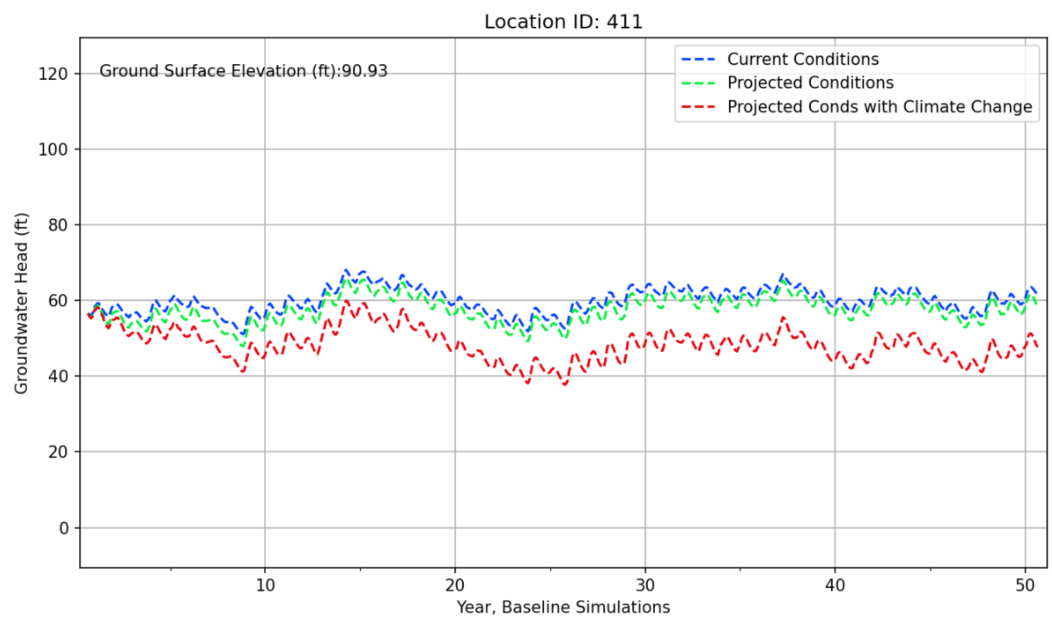
APPENDIX J: BASELINE CONDITIONS SAMPLE HYDROGRAPHS

Note: *Simulated values represent the layers screened at that well, except for 7223 and 7224 which do not have screen interval information.*

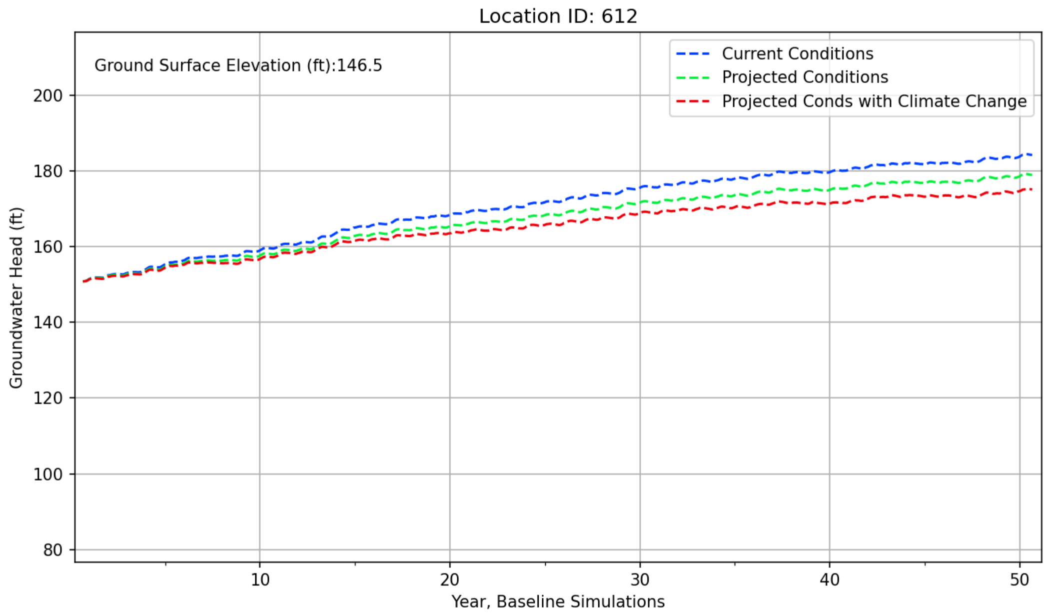


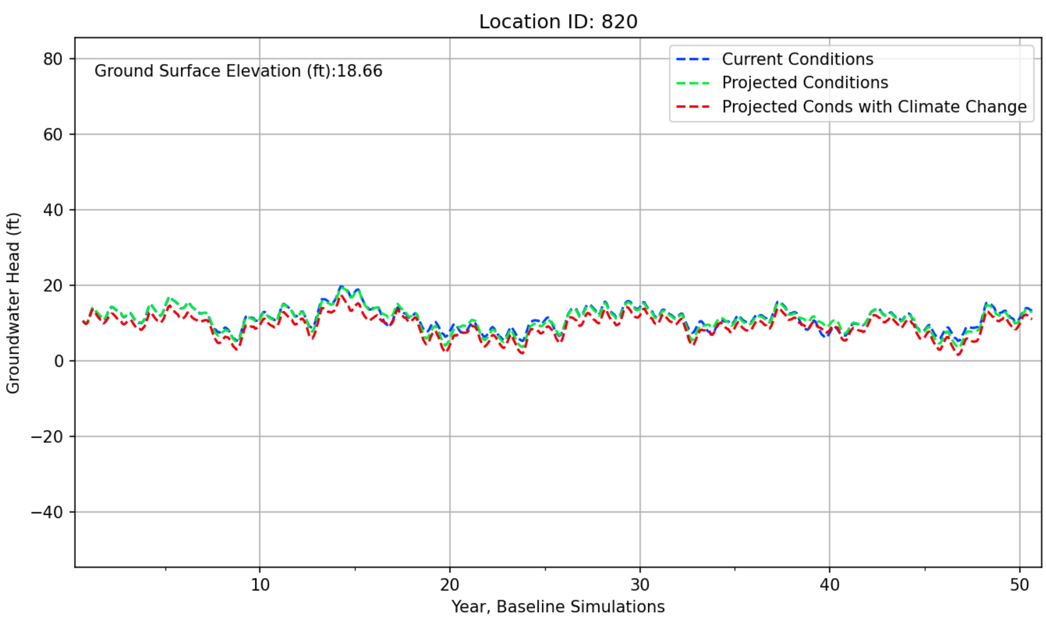


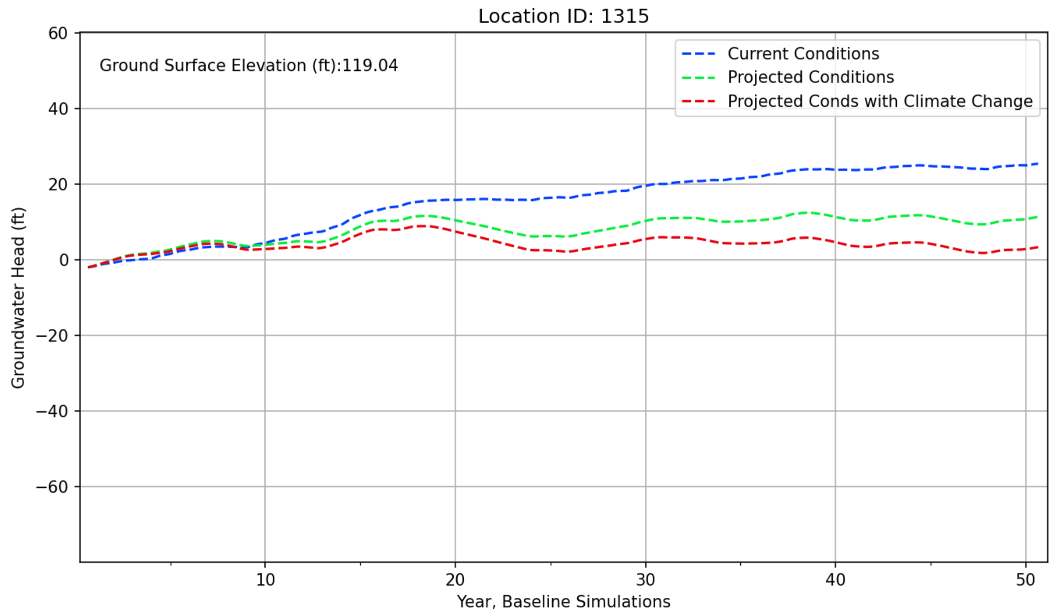
Location ID: 330
Ground Surface Elevation (ft):48.4
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations

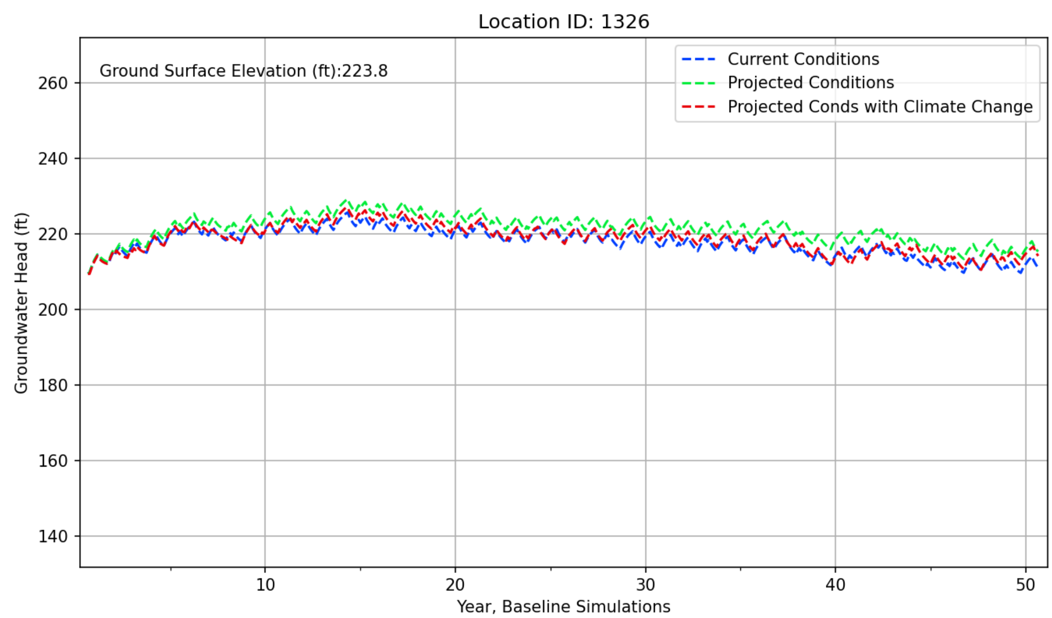


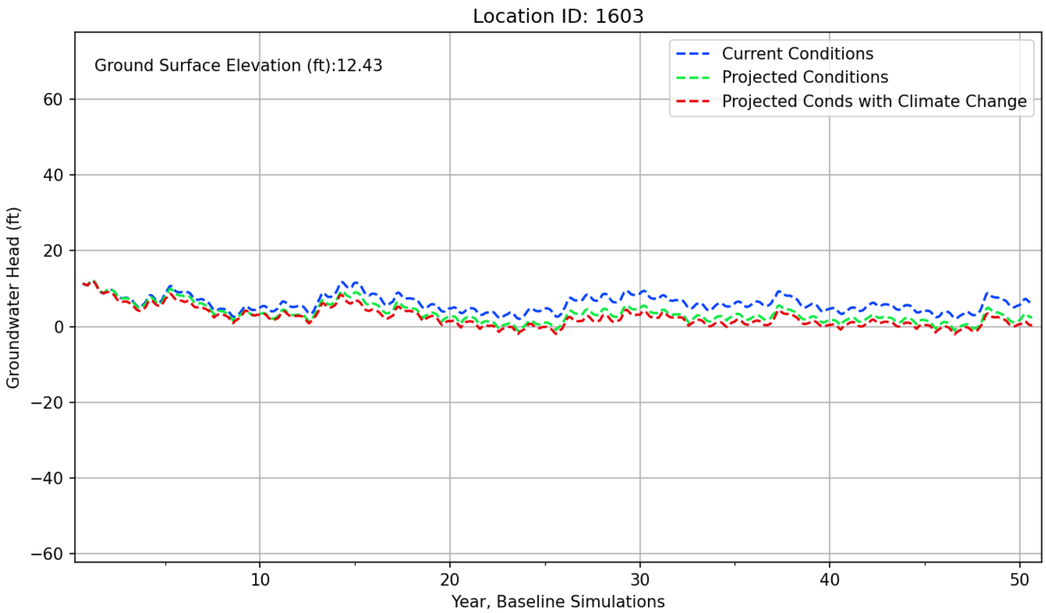
Location ID: 411
Ground Surface Elevation (ft):90.93
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations

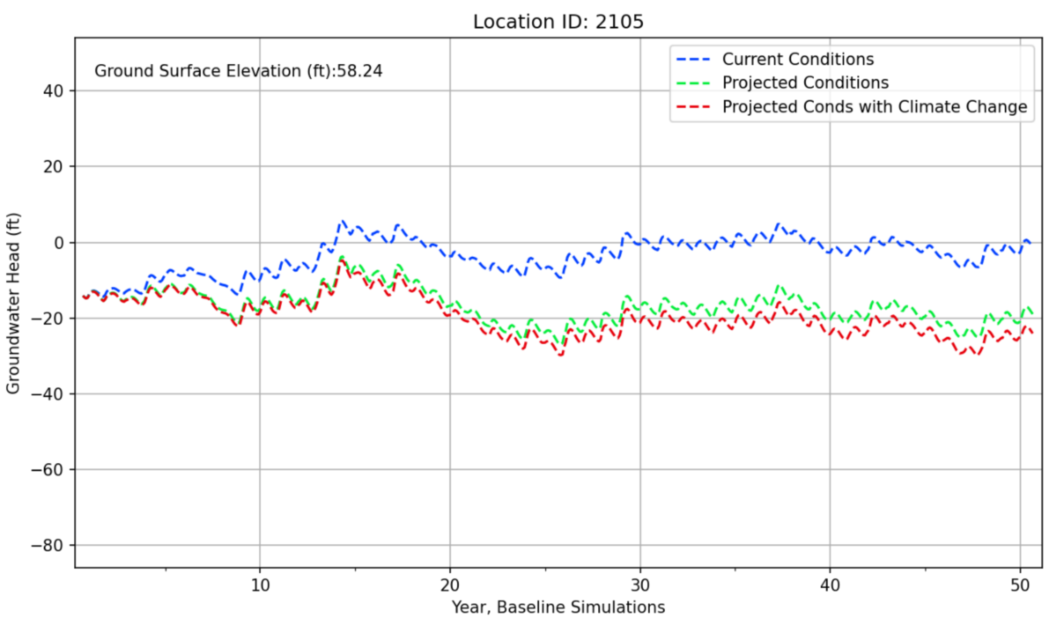

Location ID: 612
Ground Surface Elevation (ft):146.5
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations
200
180
160
140
120
100
80
10
20
30
40
50

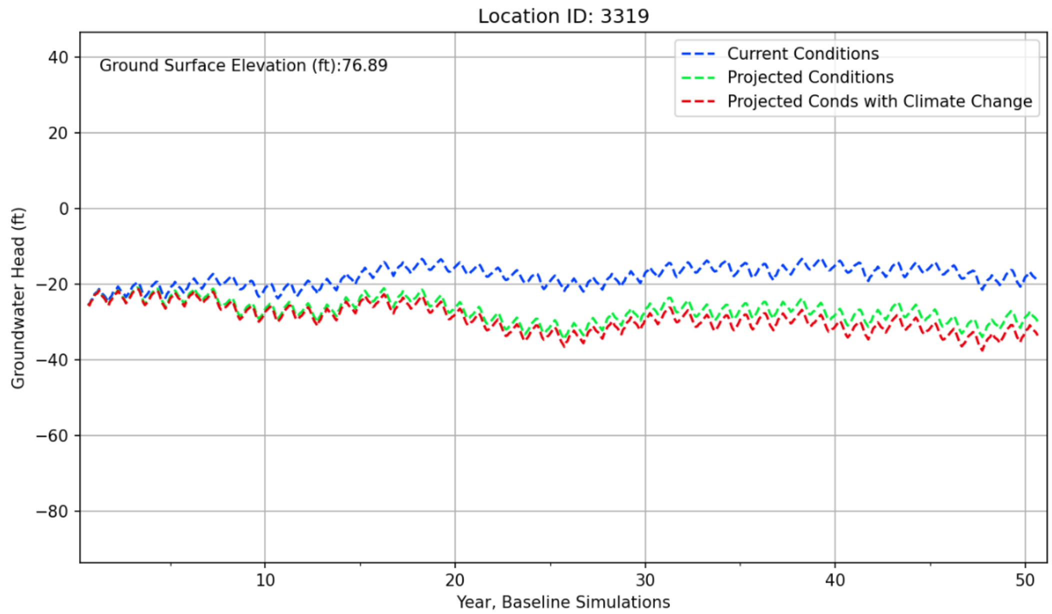

Location ID: 820
Ground Surface Elevation (ft):18.66
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations
80
60
40
20
0
−20
−40
10
20
30
40
50

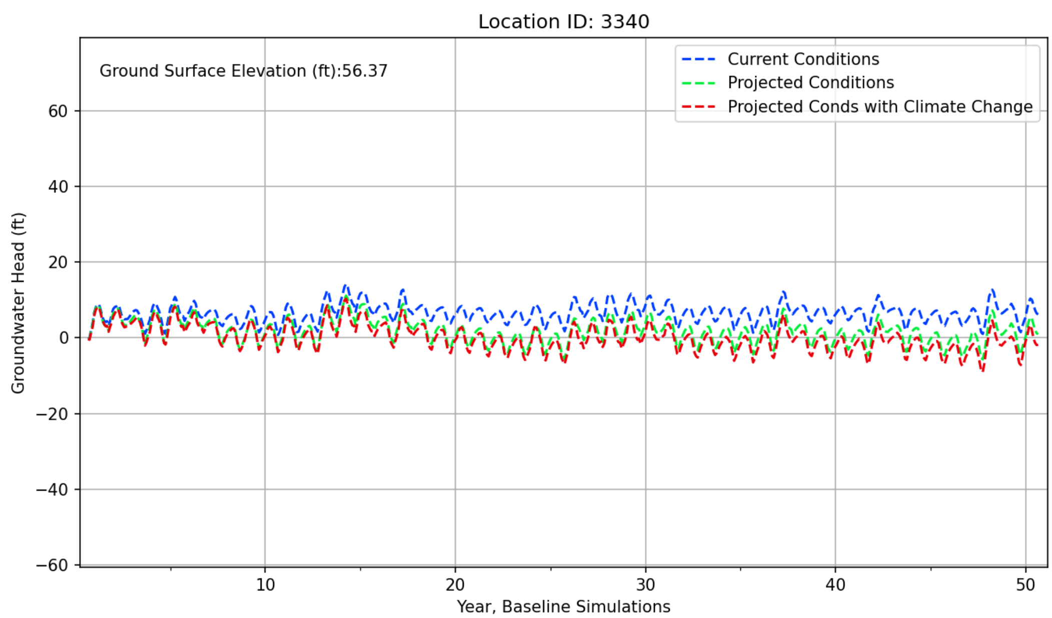

Location ID: 1315
Ground Surface Elevation (ft):119.04
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations

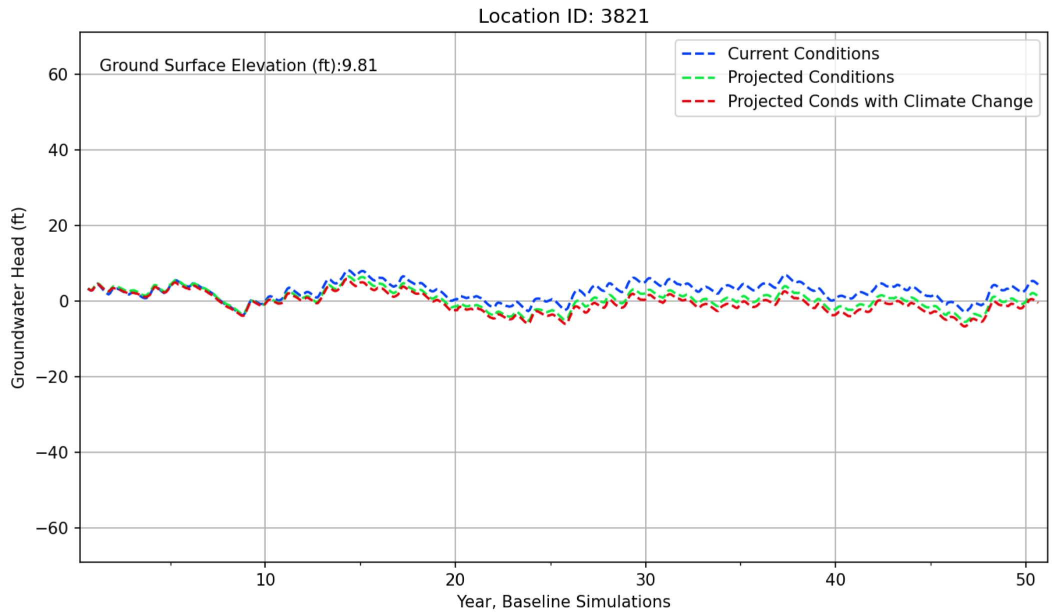

Location ID: 1326
Ground Surface Elevation (ft):223.8
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations


Location ID: 1603
Ground Surface Elevation (ft):12.43
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

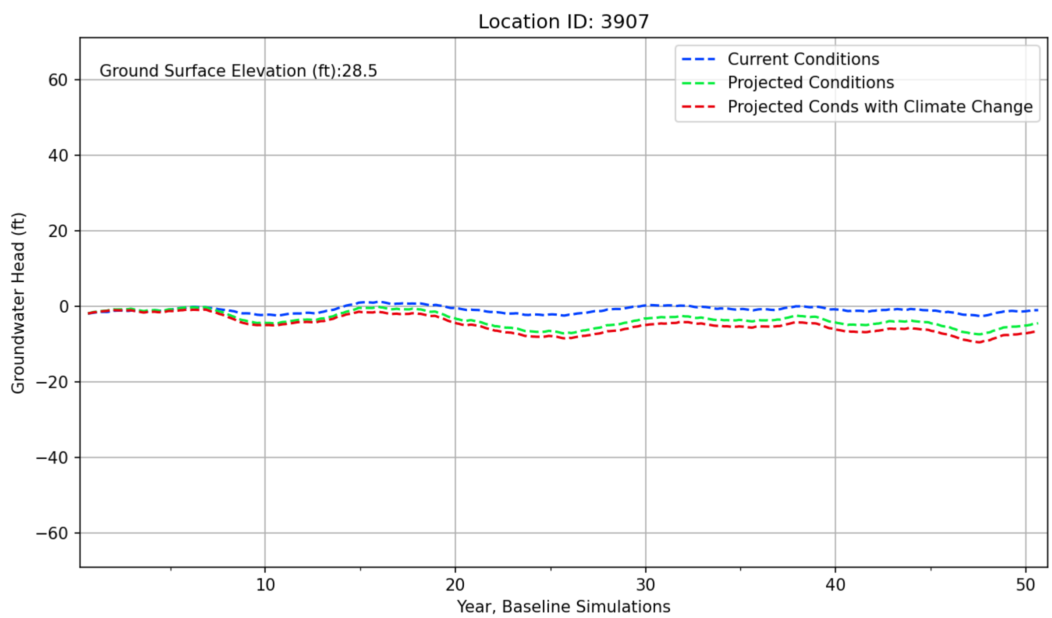

Location ID: 2105
Ground Surface Elevation (ft):58.24
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations


Location ID: 3319
Ground Surface Elevation (ft):76.89
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations

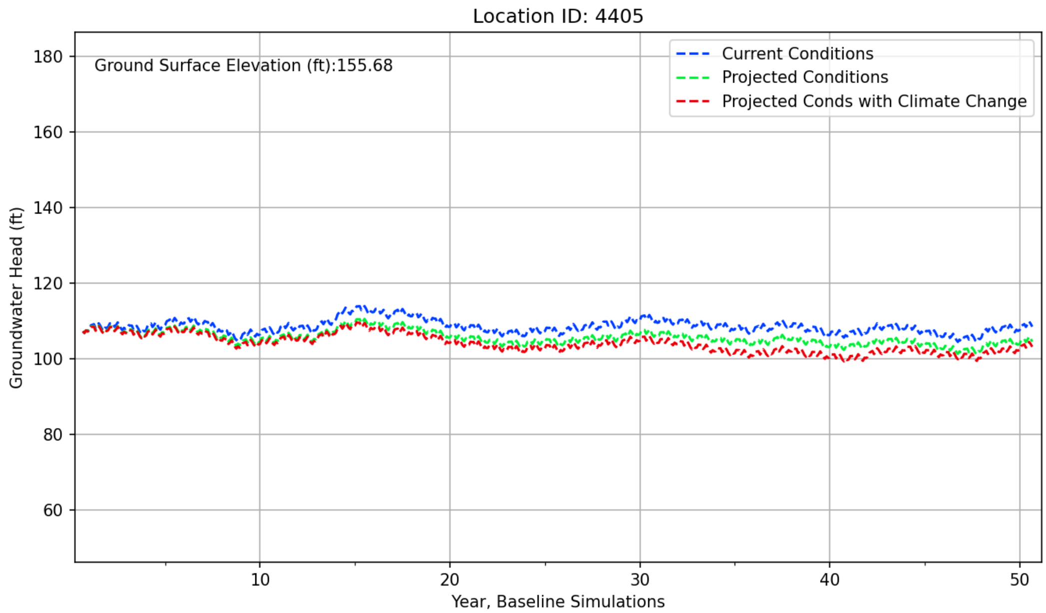

Location ID: 3340
Ground Surface Elevation (ft):56.37
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

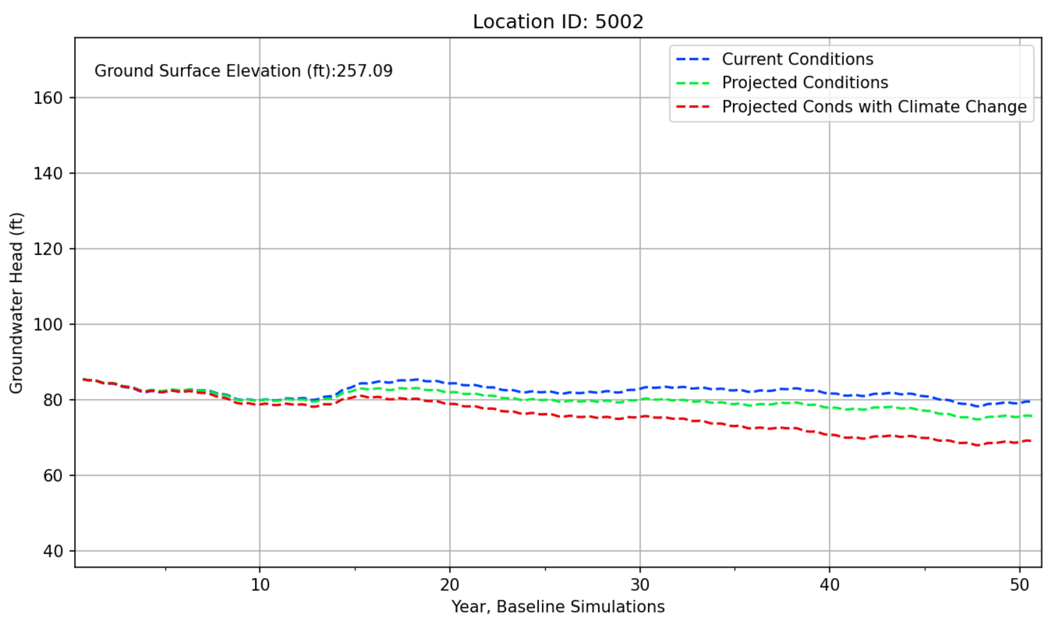


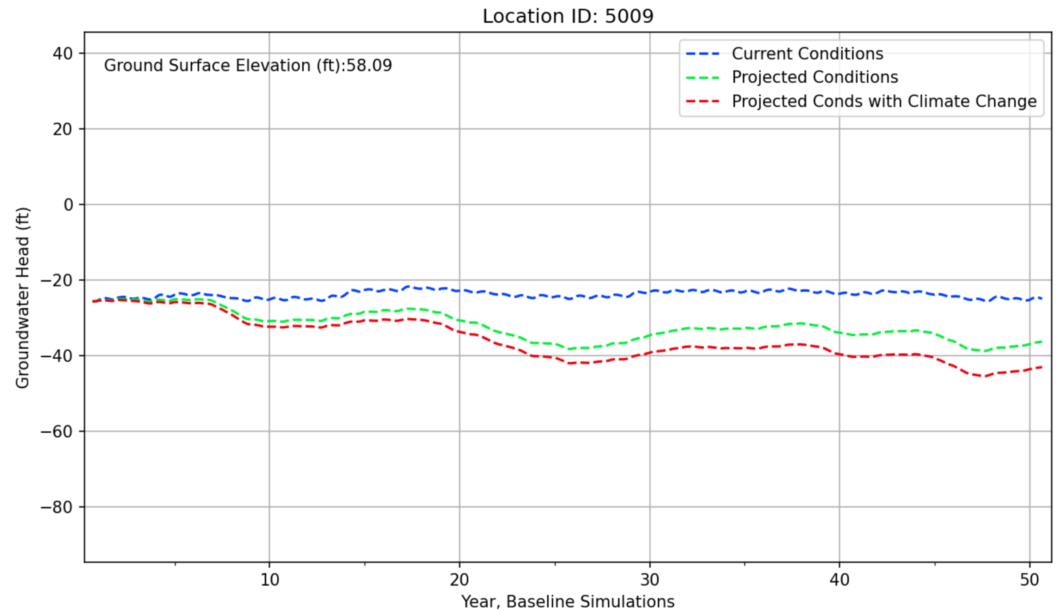
Location ID: 3821
Ground Surface Elevation (ft):9.81
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations



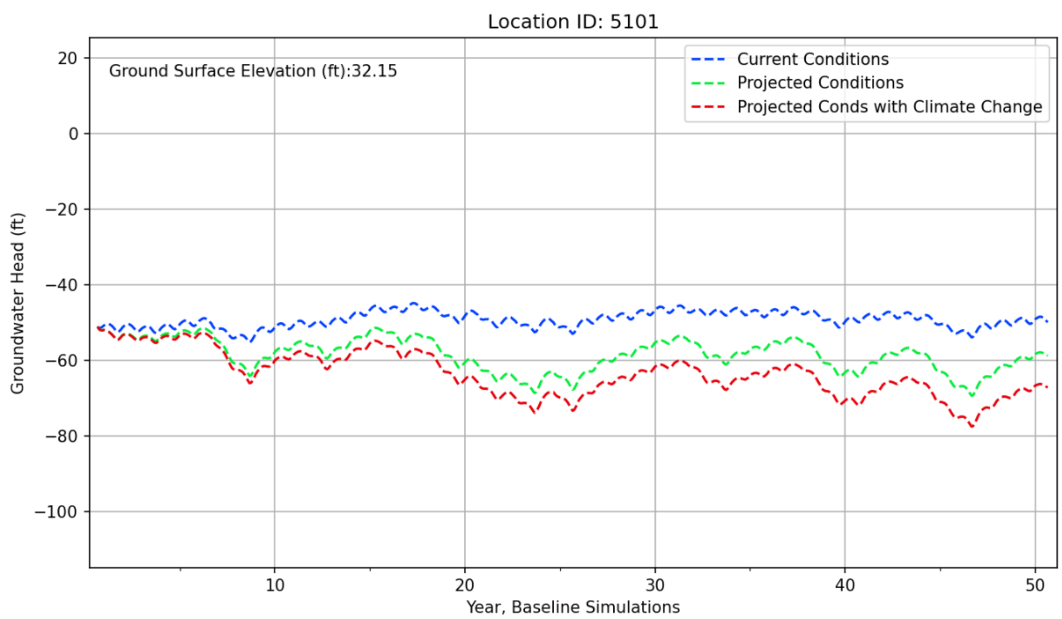
Location ID: 3907
Ground Surface Elevation (ft):28.5
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations


Location ID: 4405
Ground Surface Elevation (ft):155.68
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations

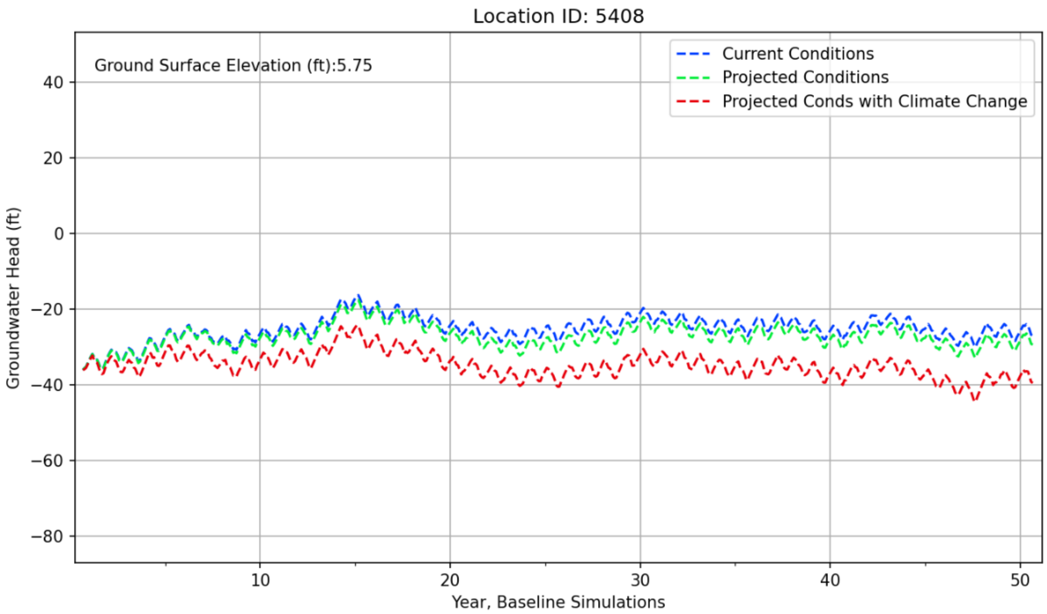

Location ID: 5002
Ground Surface Elevation (ft):257.09
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations



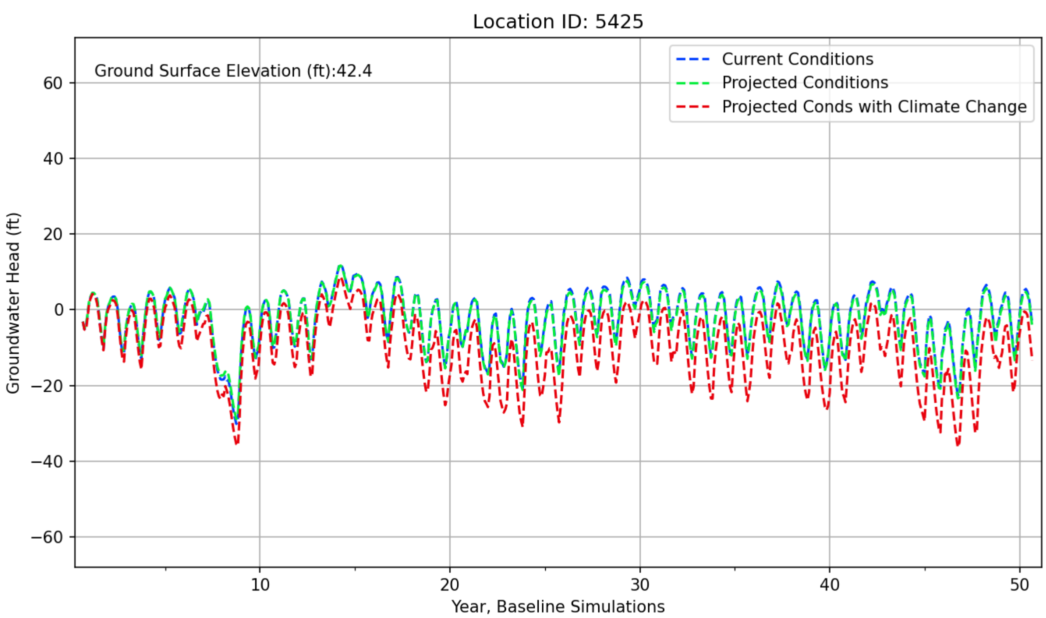
Location ID: 5009
Ground Surface Elevation (ft):58.09
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations



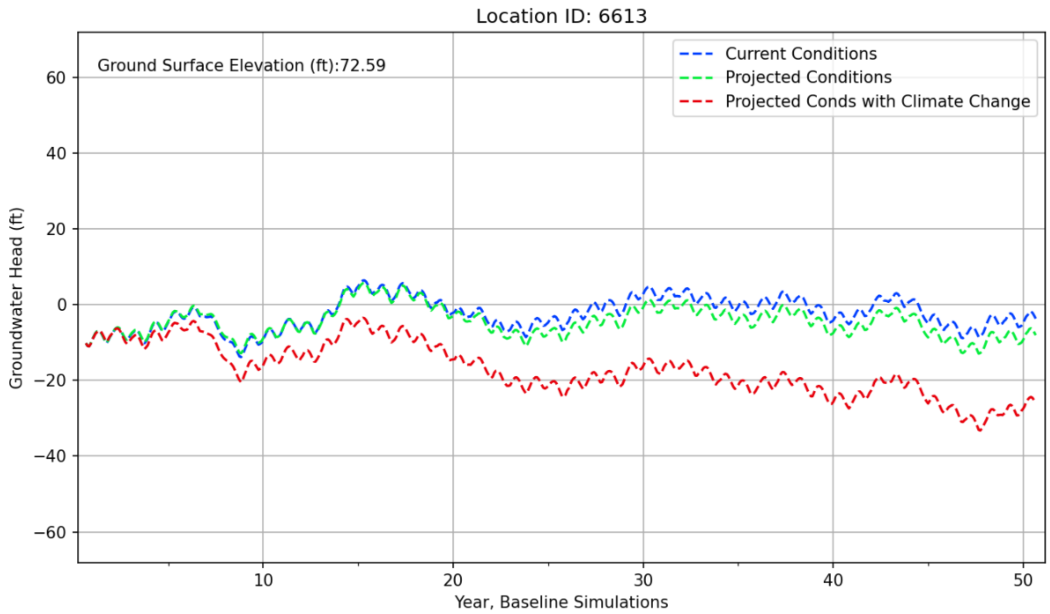
Location ID: 5101
Ground Surface Elevation (ft):32.15
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
20
0
−20
−40
−60
−80
−100
10
20
30
40
50
Year, Baseline Simulations



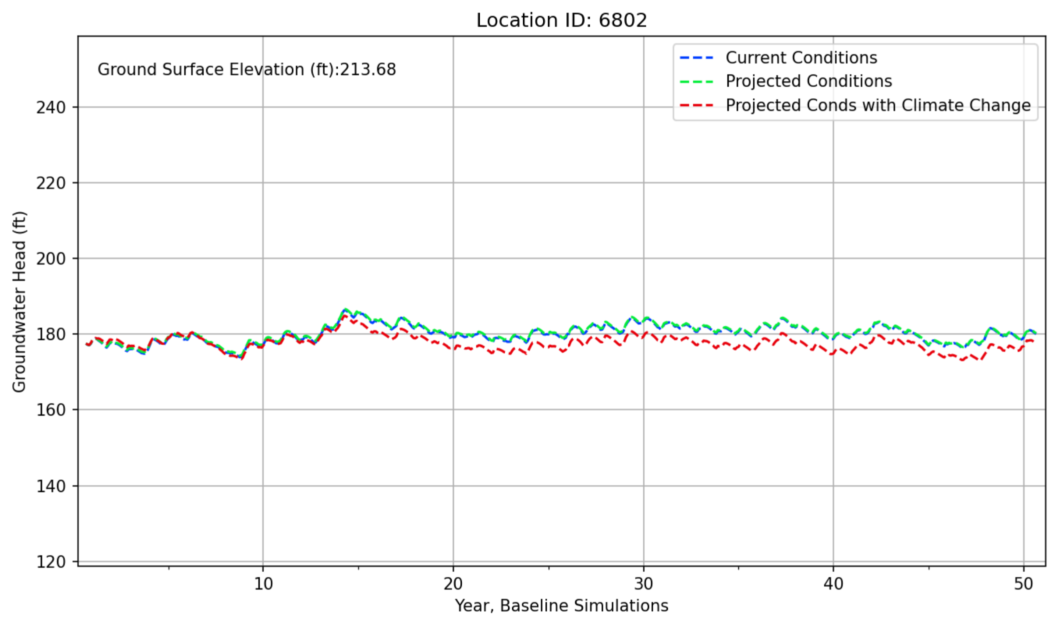
Location ID: 5408
Ground Surface Elevation (ft):5.75
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
40
20
0
−20
−40
−60
−80
10
20
30
40
50
Year, Baseline Simulations



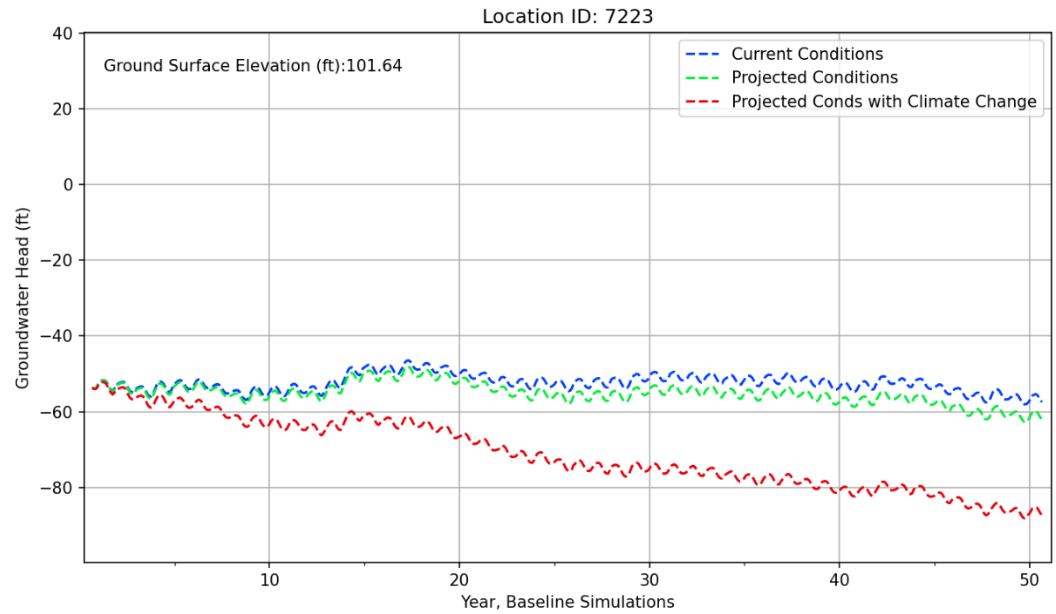
Location ID: 5425
Ground Surface Elevation (ft):42.4
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
60
40
20
0
−20
−40
−60
10
20
30
40
50
Year, Baseline Simulations

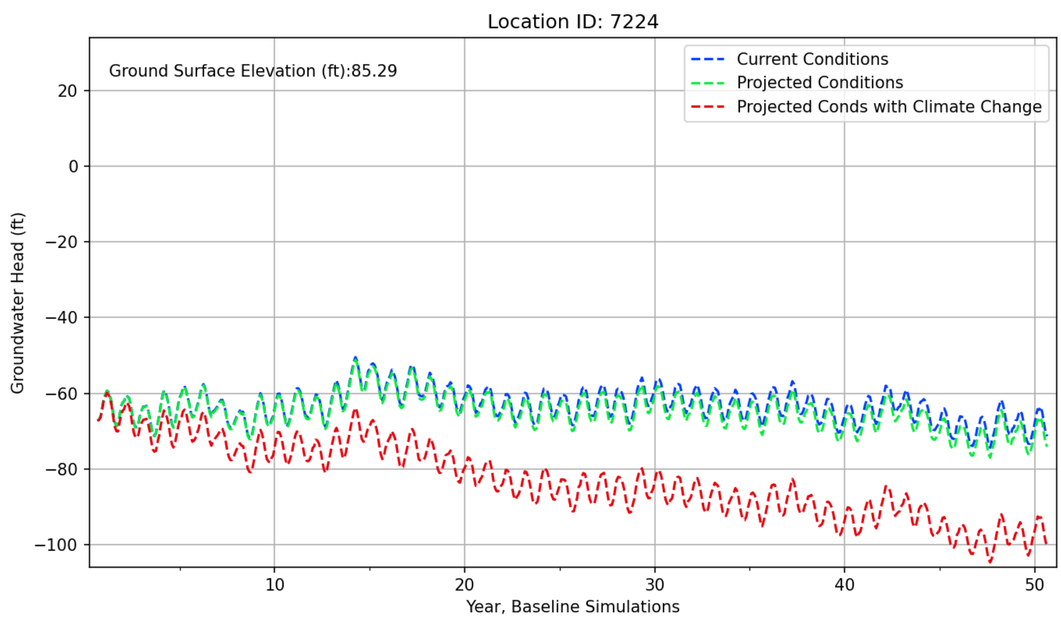


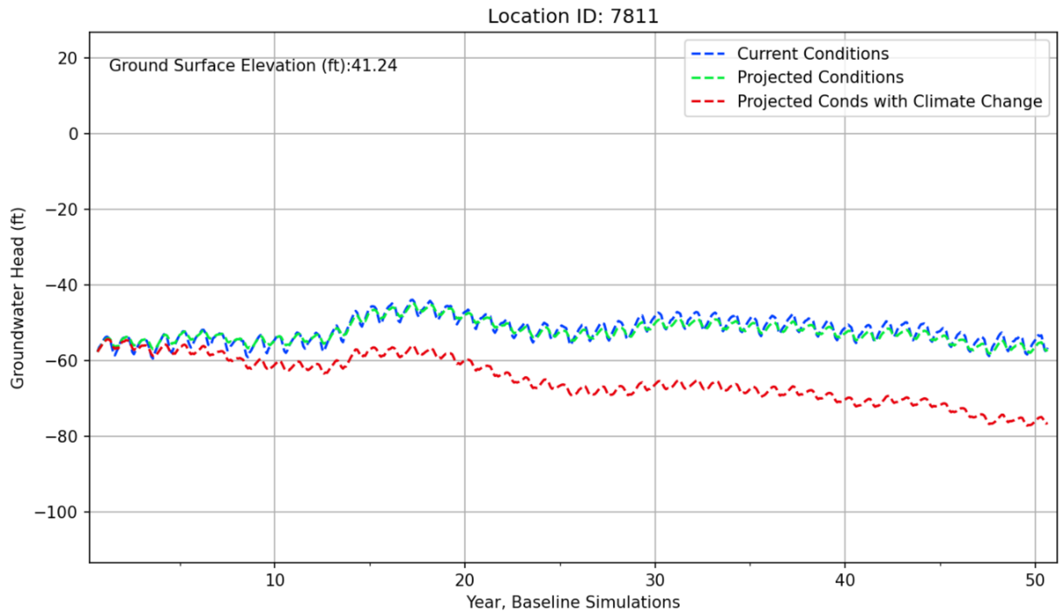
Location ID: 6613
Ground Surface Elevation (ft):72.59
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations



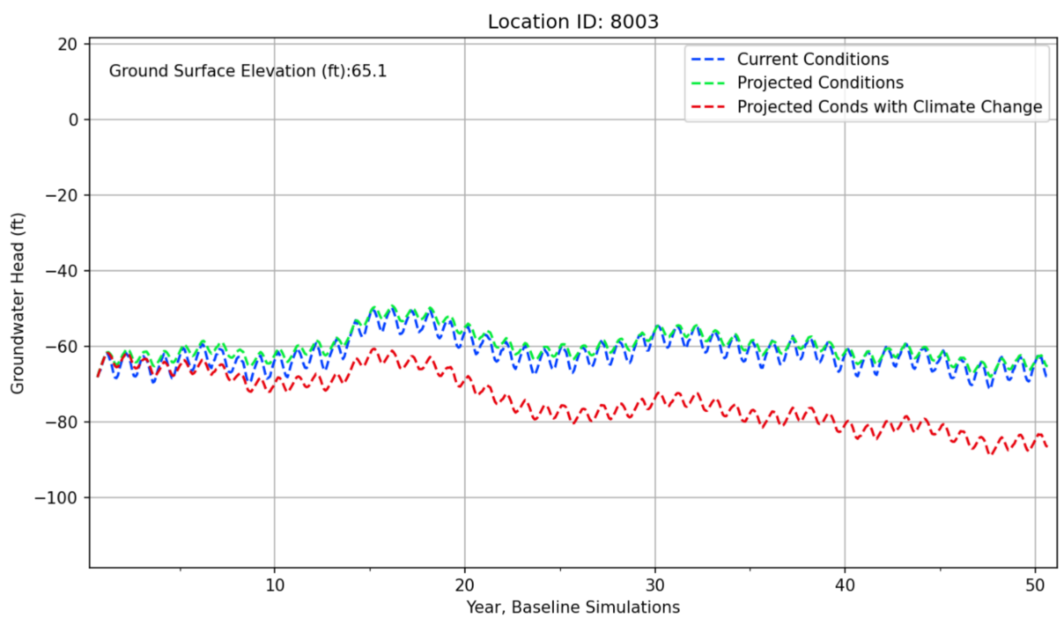
Location ID: 6802
Ground Surface Elevation (ft):213.68
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations


Location ID: 7223
Ground Surface Elevation (ft):101.64
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations
40
20
0
−20
−40
−60
−80
10
20
30
40
50

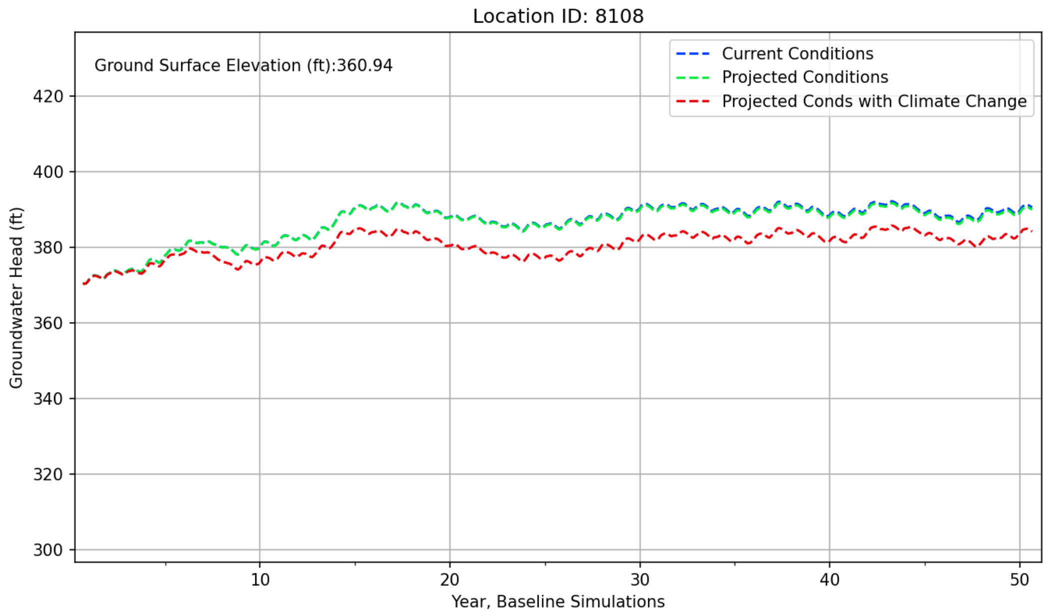

Location ID: 7224
Ground Surface Elevation (ft):85.29
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
Year, Baseline Simulations
20
0
−20
−40
−60
−80
−100
10
20
30
40
50



Location ID: 7811
Ground Surface Elevation (ft):41.24
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
20
0
−20
−40
−60
−80
−100
10
20
30
40
50
Year, Baseline Simulations



Location ID: 8003
Ground Surface Elevation (ft):65.1
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
20
0
−20
−40
−60
−80
−100
10
20
30
40
50
Year, Baseline Simulations



Location ID: 8108
Ground Surface Elevation (ft):360.94
Current Conditions
Projected Conditions
Projected Conds with Climate Change
Groundwater Head (ft)
300
320
340
360
380
400
420
10
20
30
40
50
Year, Baseline Simulations

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