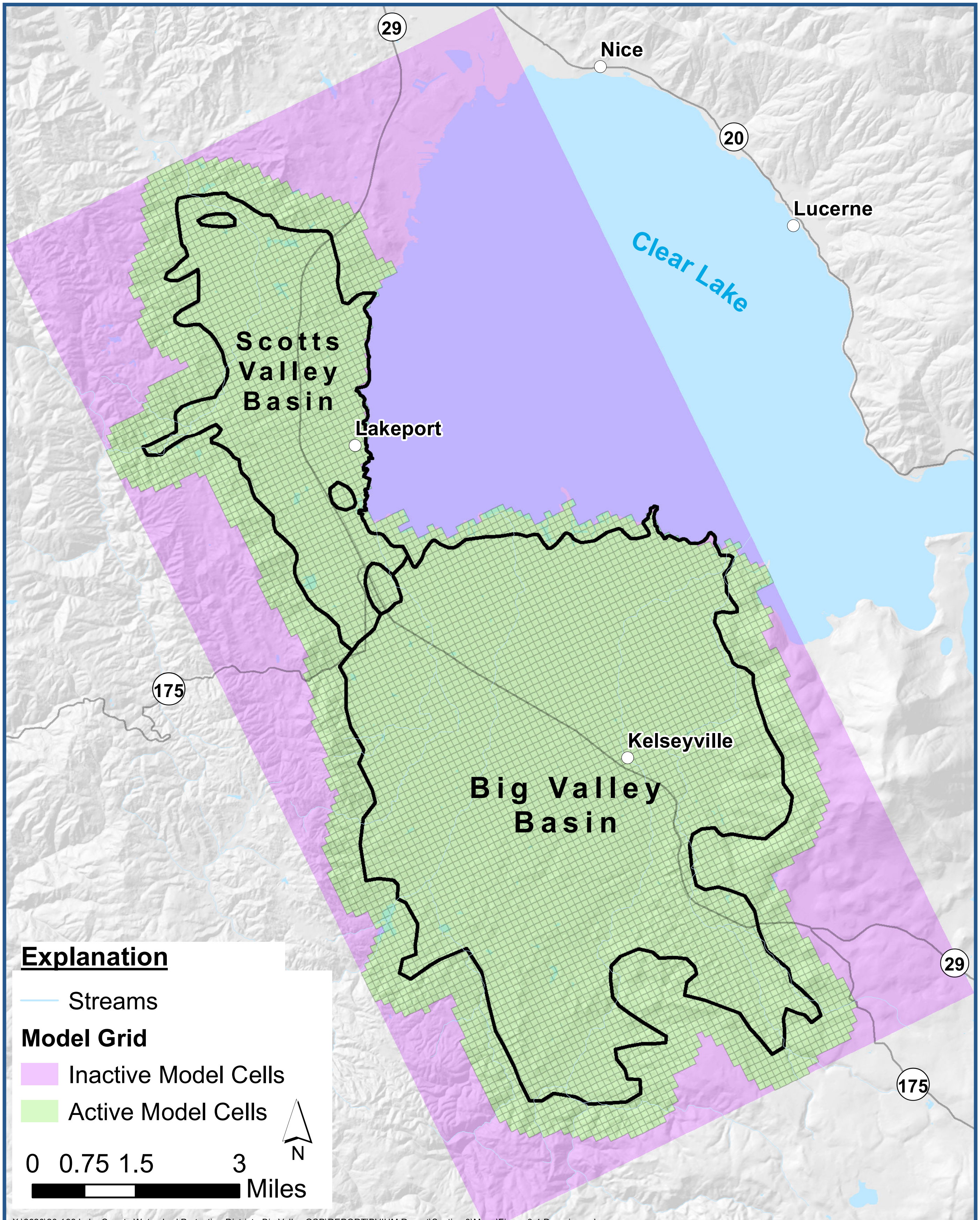

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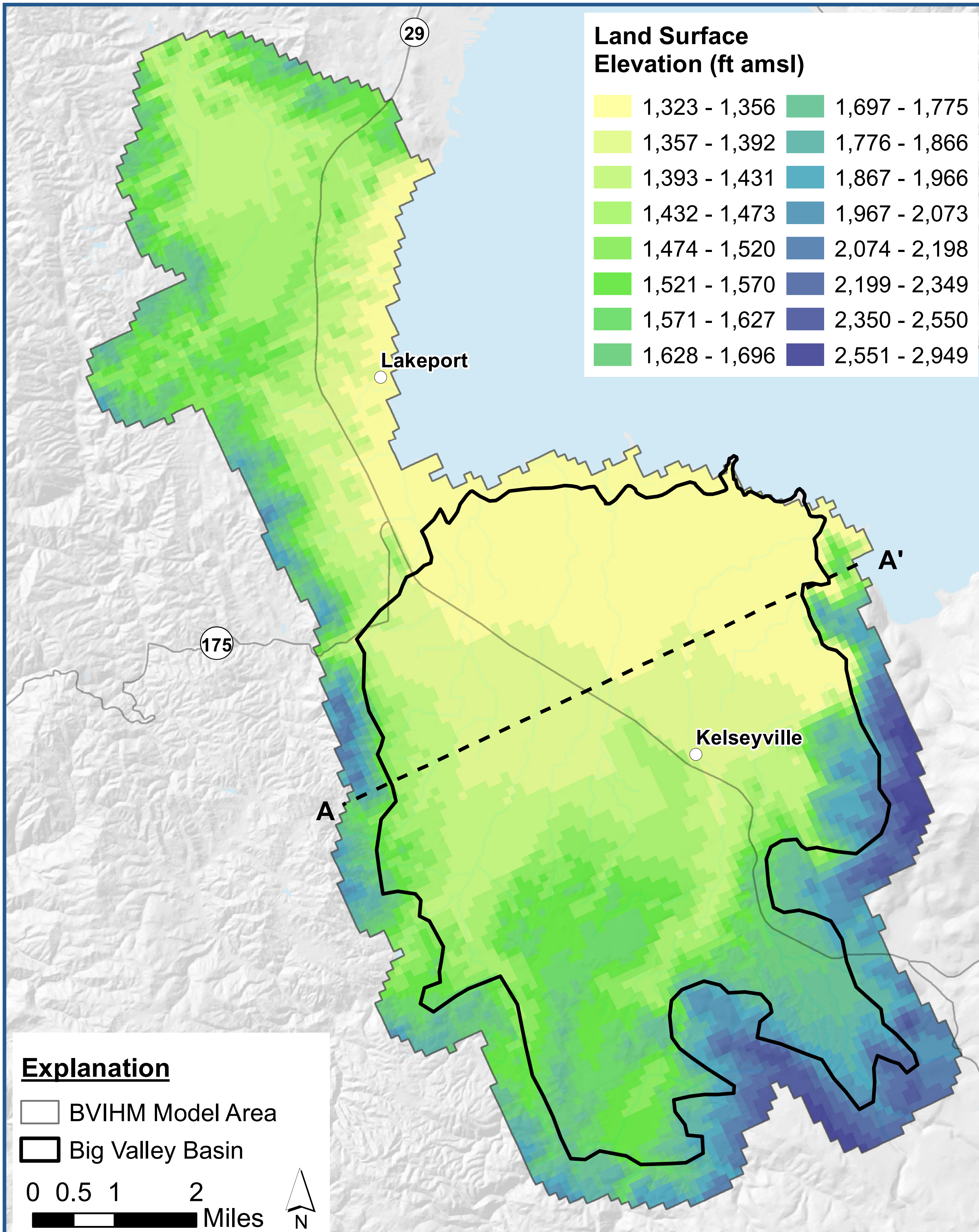
BVIHM Model Grid and Active Model Domain

Figure 3-1

Big Valley Groundwater Sustainability Plan
Lake County, California



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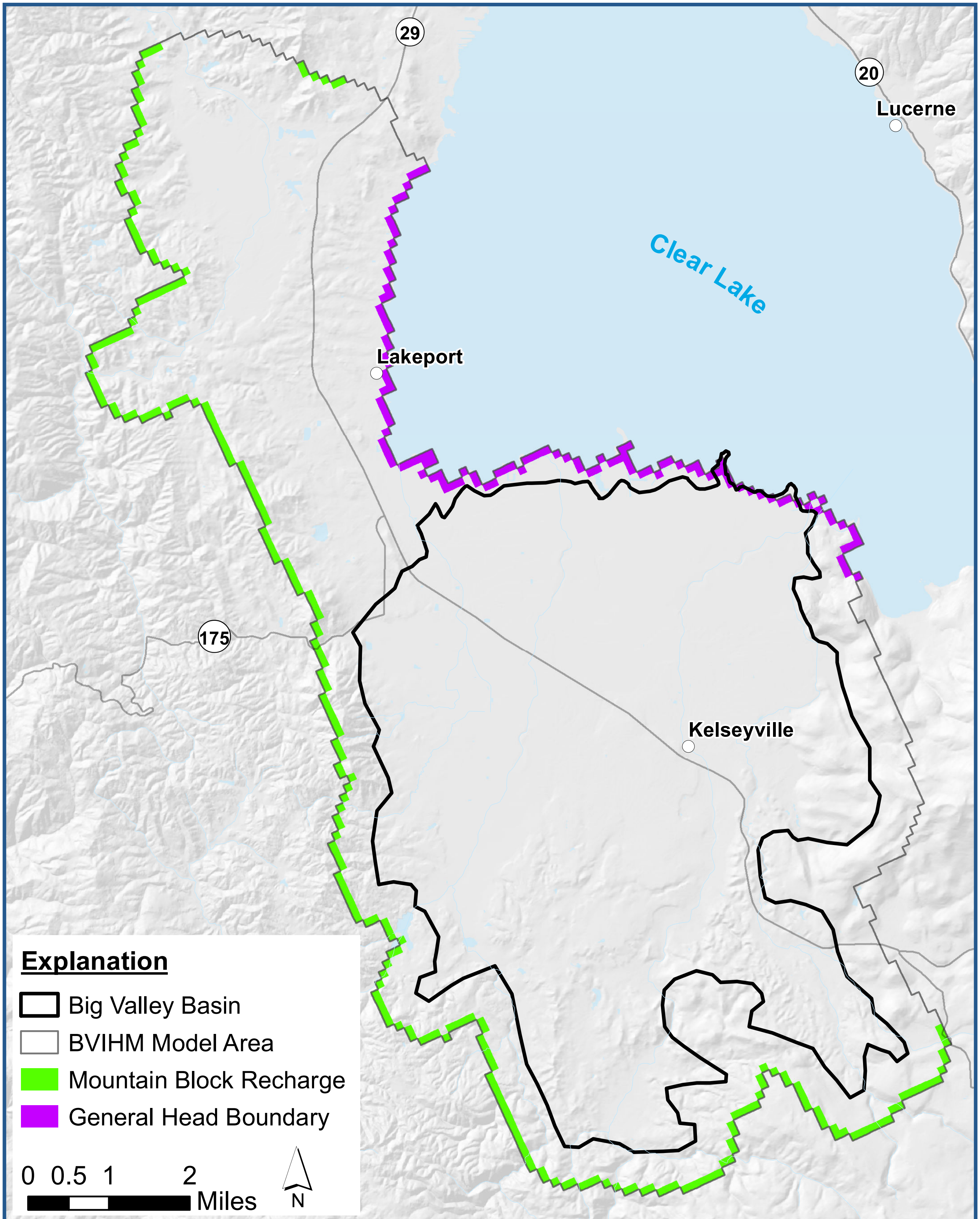
BVIHM Specified Land Surface Elevation

Figure 3-2

Big Valley Groundwater Sustainability Plan
Lake County, California



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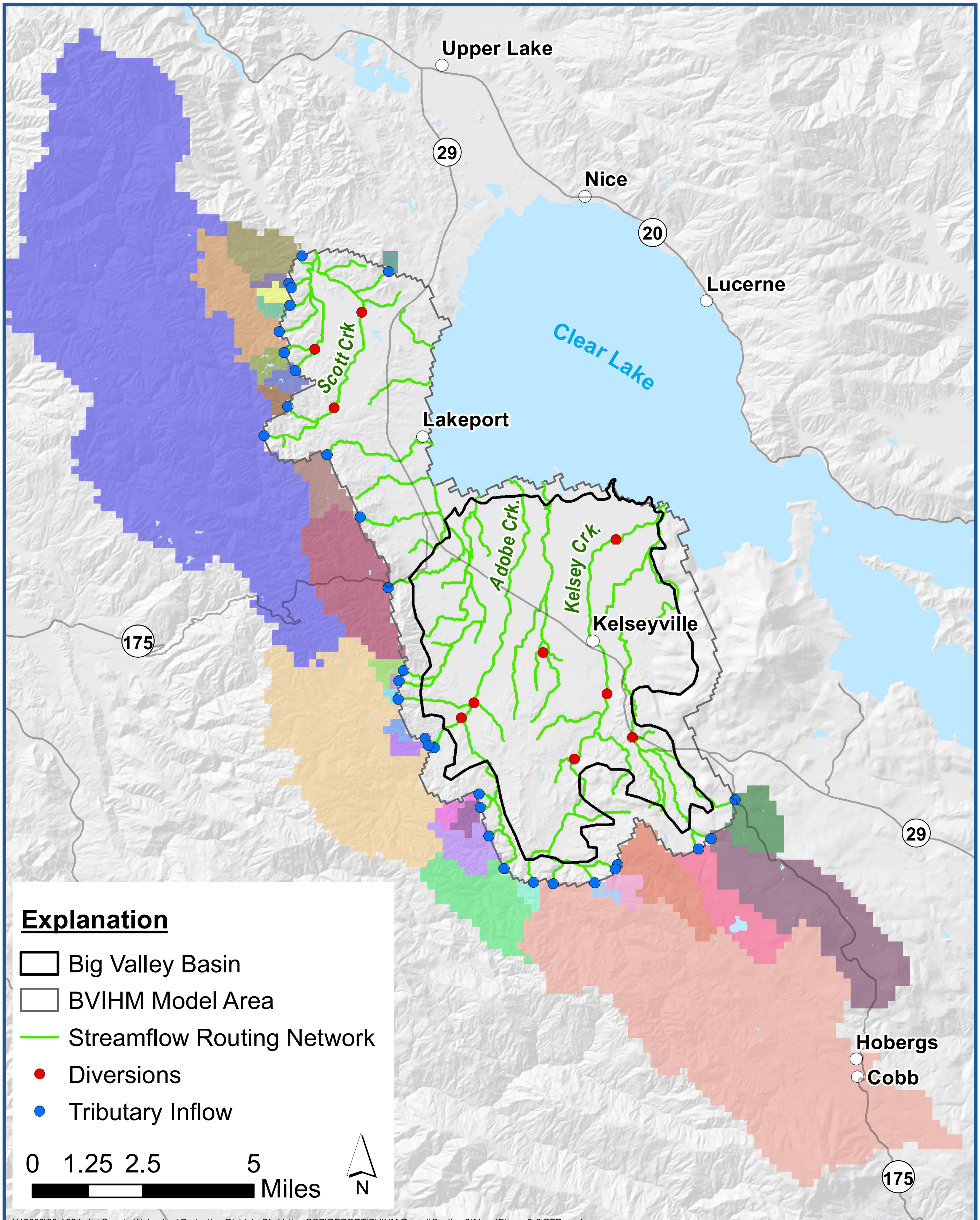
BVIHM General Head Boundary and Mountain Block Recharge

Figure 3-4

Big Valley Groundwater Sustainability Plan
Lake County, California



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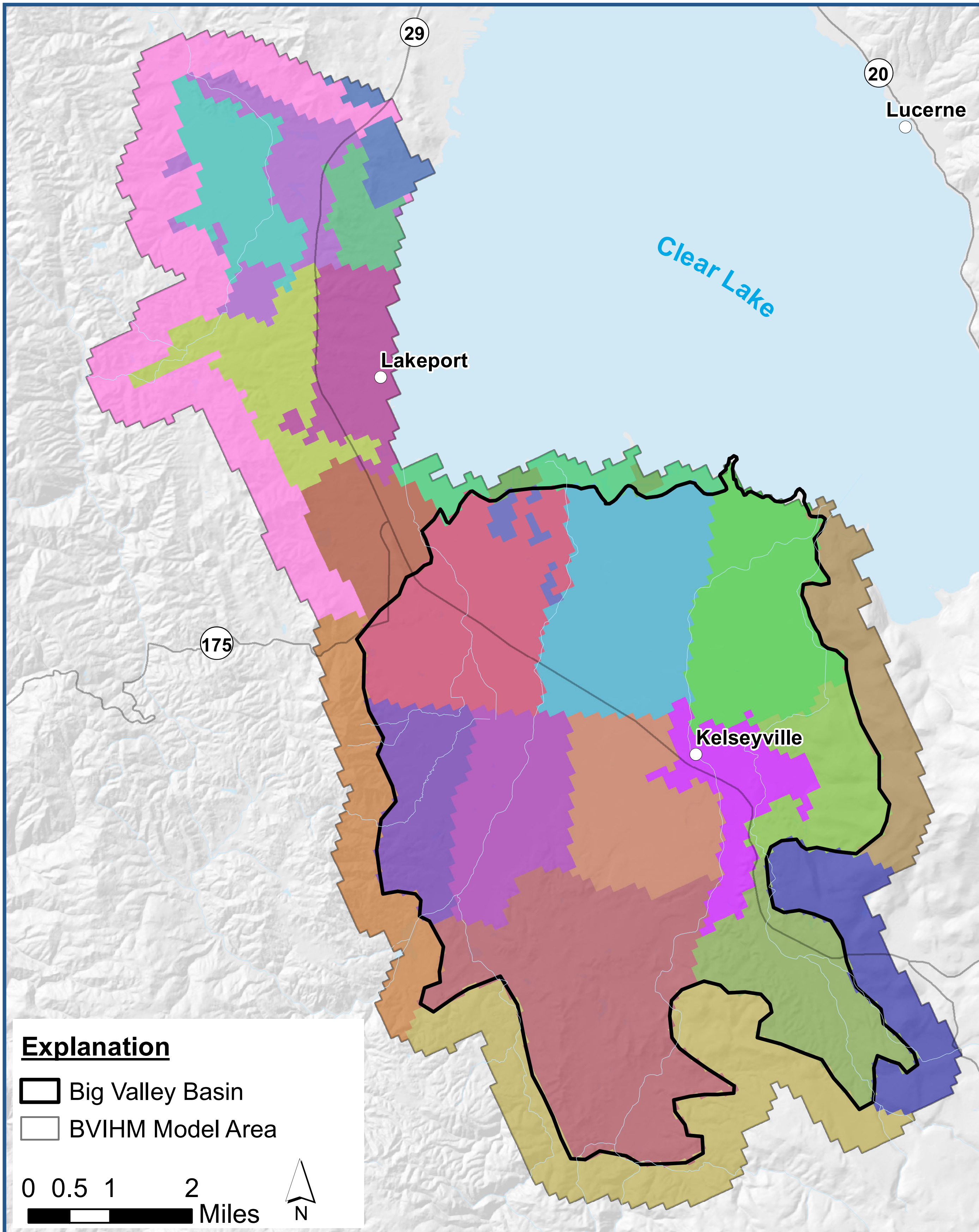
BVIHM Streamflow Routing (SFR) Package Network
Inflows, Diversions and Contributing Tributary Watersheds

Figure 3-6

Big Valley Groundwater Sustainability Plan
Lake County, California



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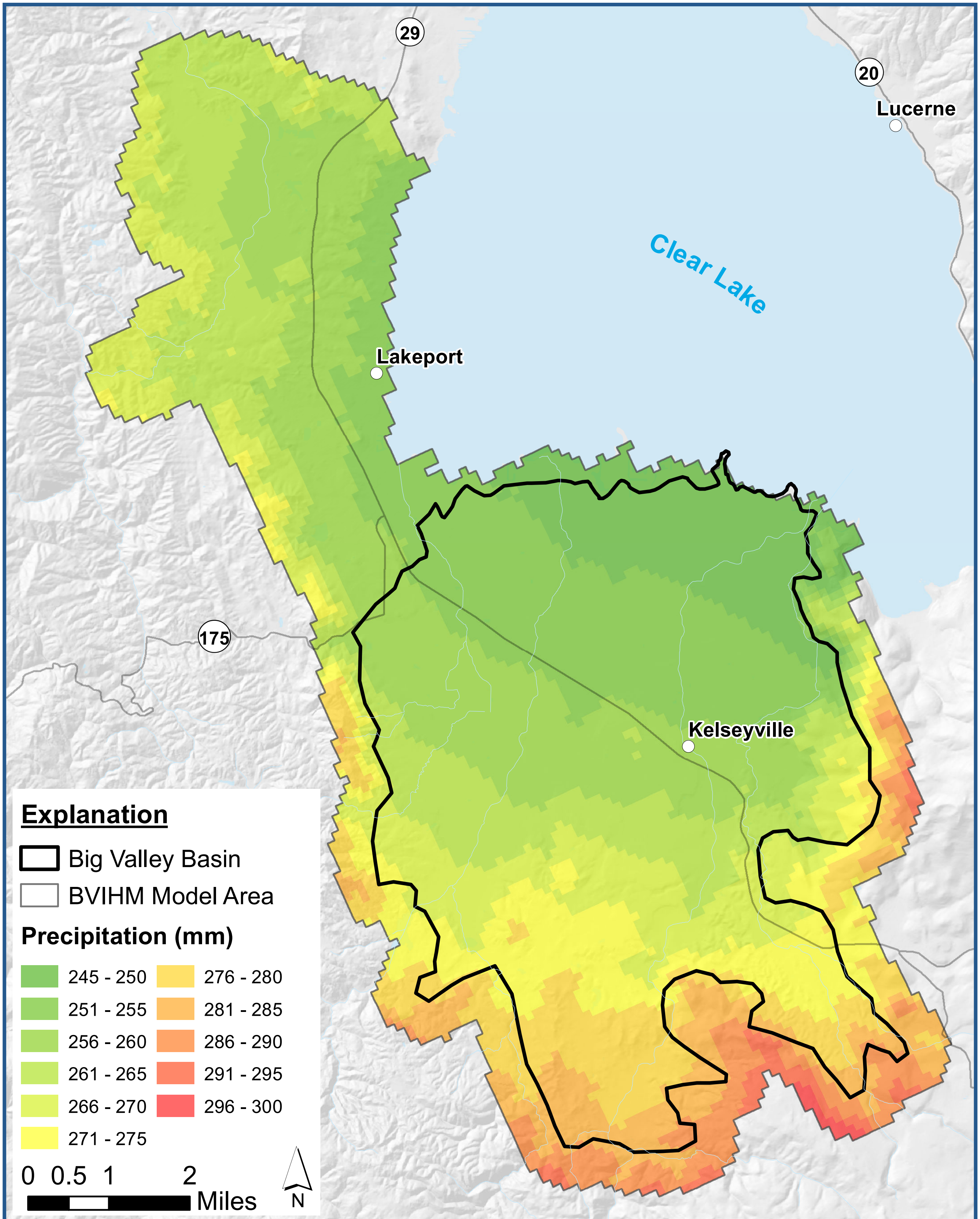
BVIHM Farm Process
Water Balance Subregions

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 3-8



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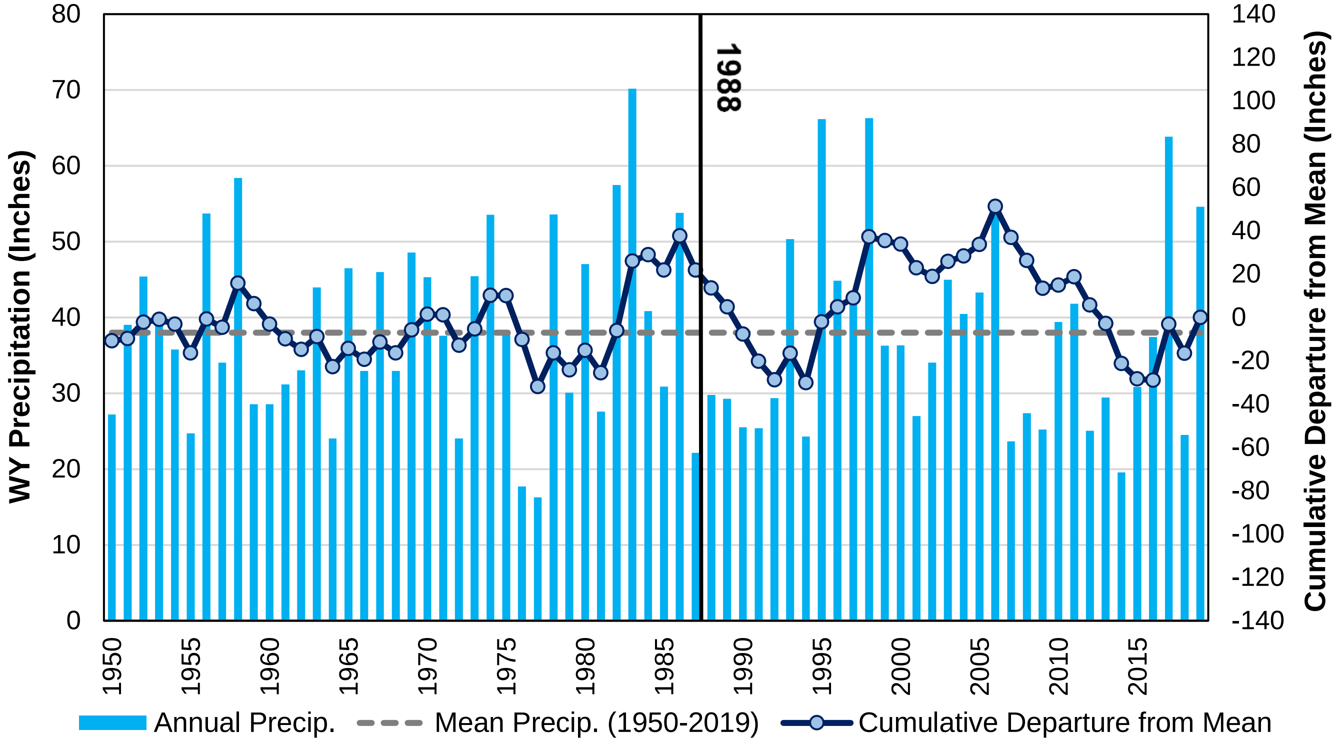
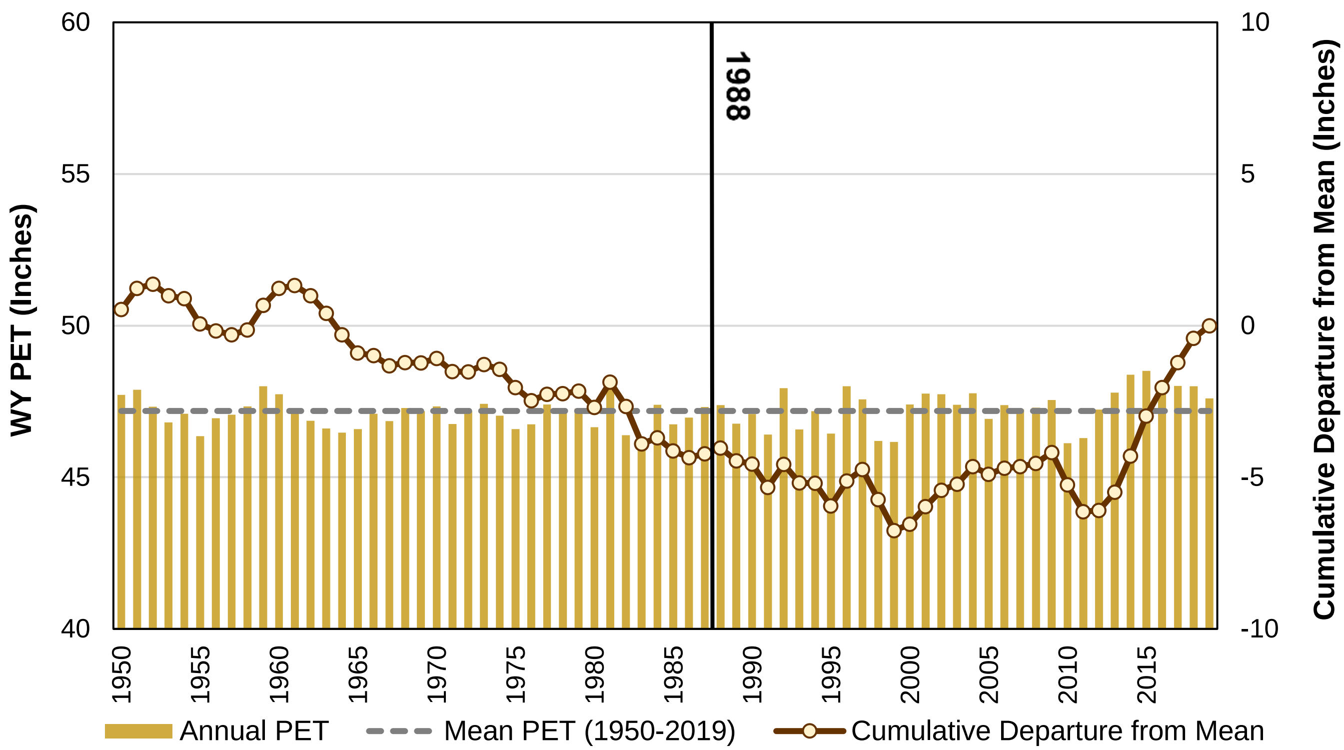
BVIHM Precipitation Distribution
January 2019

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 3-9





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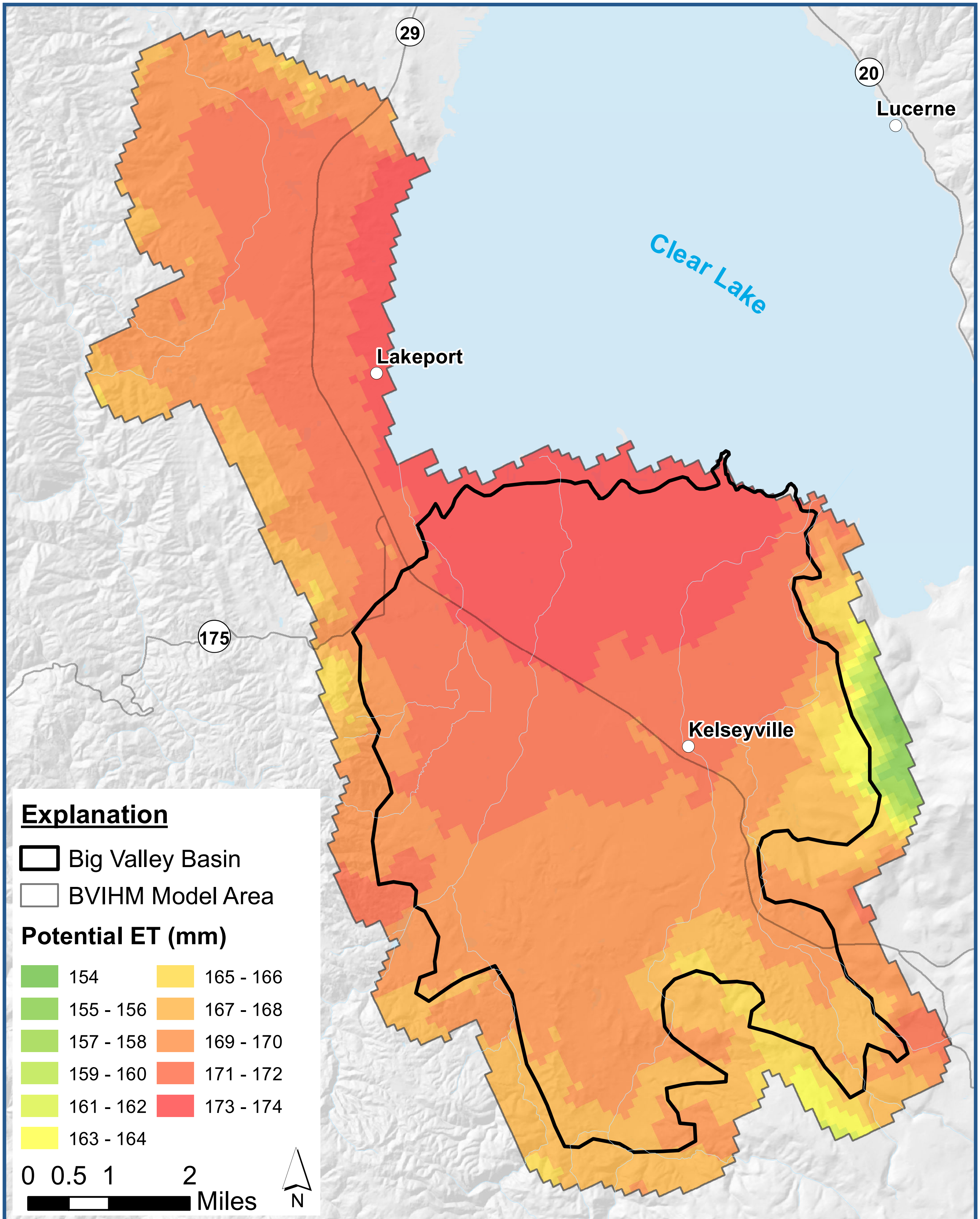
Historical Precipitation and PET at Kesleyville
Basin Characterization Model (1950-2019)

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 3-10



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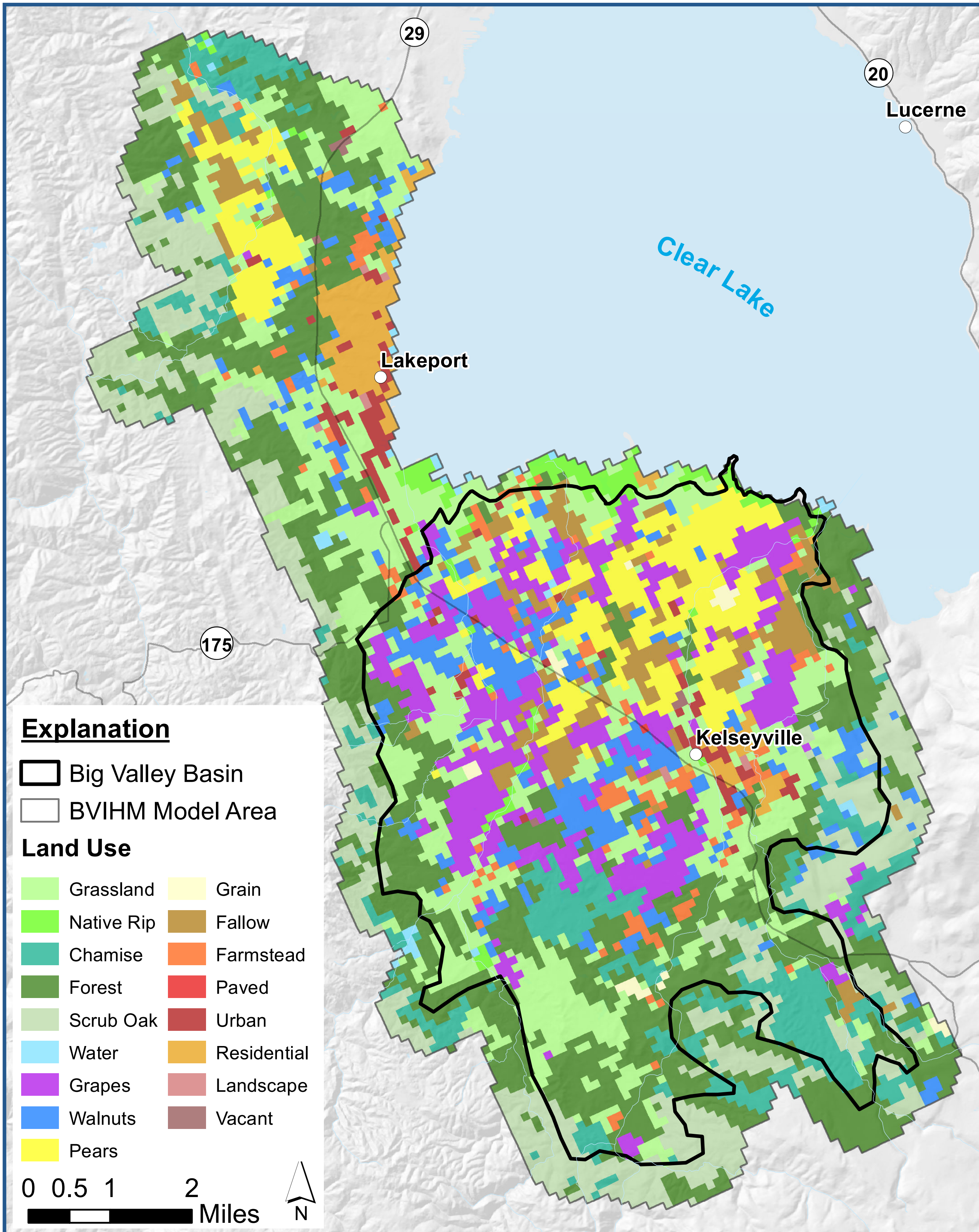
BVIHM Potential Evapotranspiration Distribution
August 2019

Figure 3-11

Big Valley Groundwater Sustainability Plan
Lake County, California



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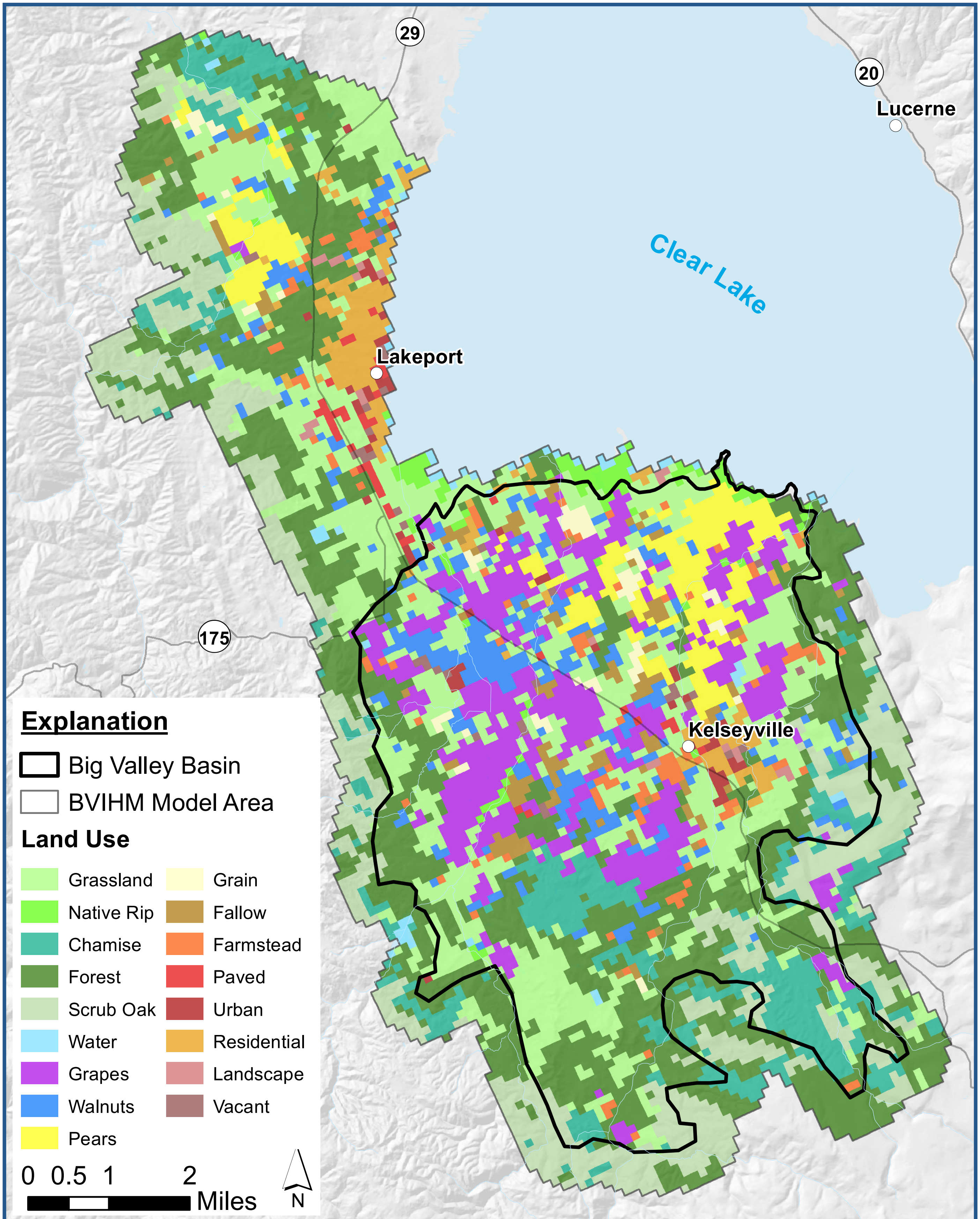
BVIHM Specified Land Use Classes
2001

Figure 3-12

Big Valley Groundwater Sustainability Plan
Lake County, California



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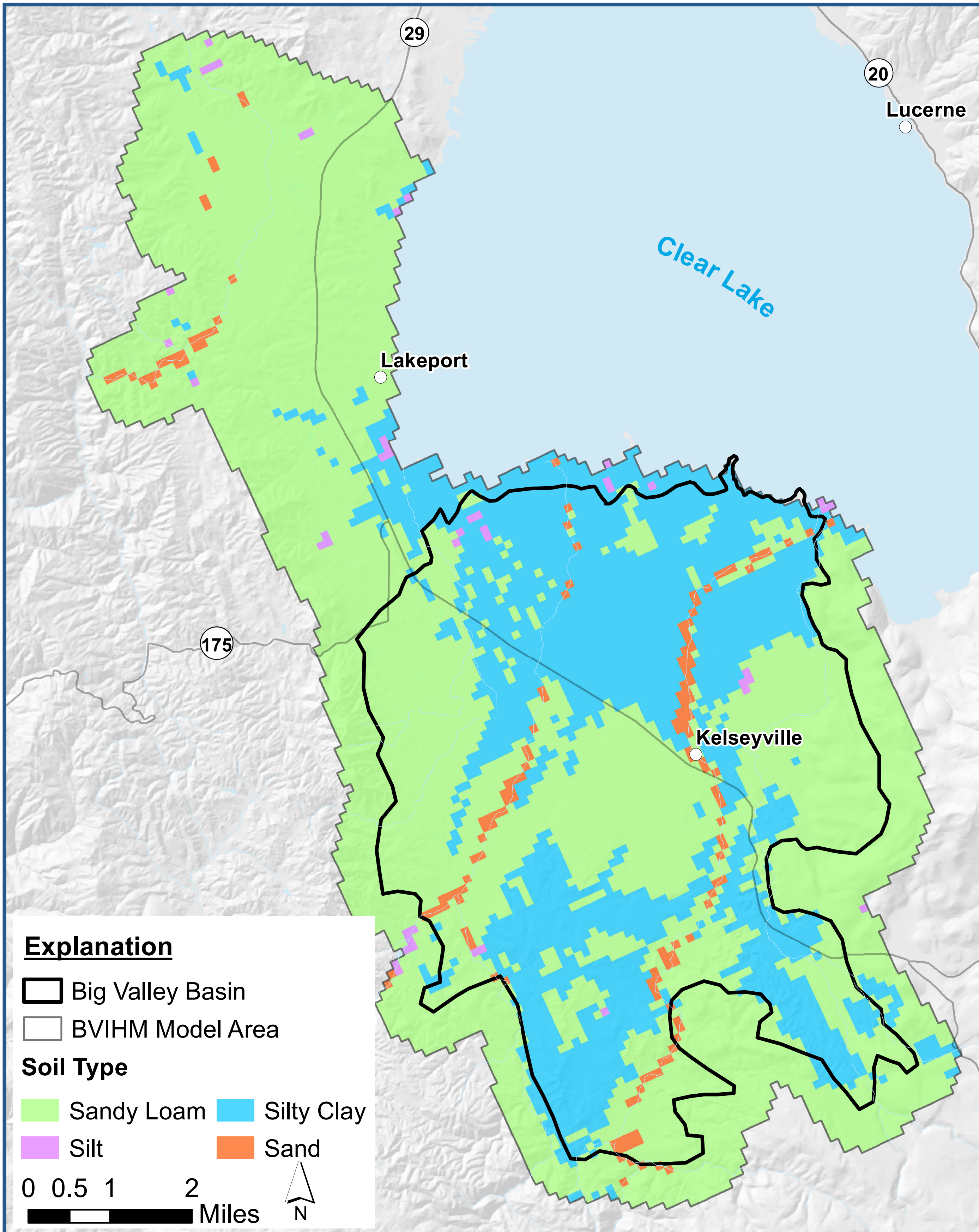
BVIHM Specified Land Use Classes 2018

Figure 3-13

Big Valley Groundwater Sustainability Plan
Lake County, California



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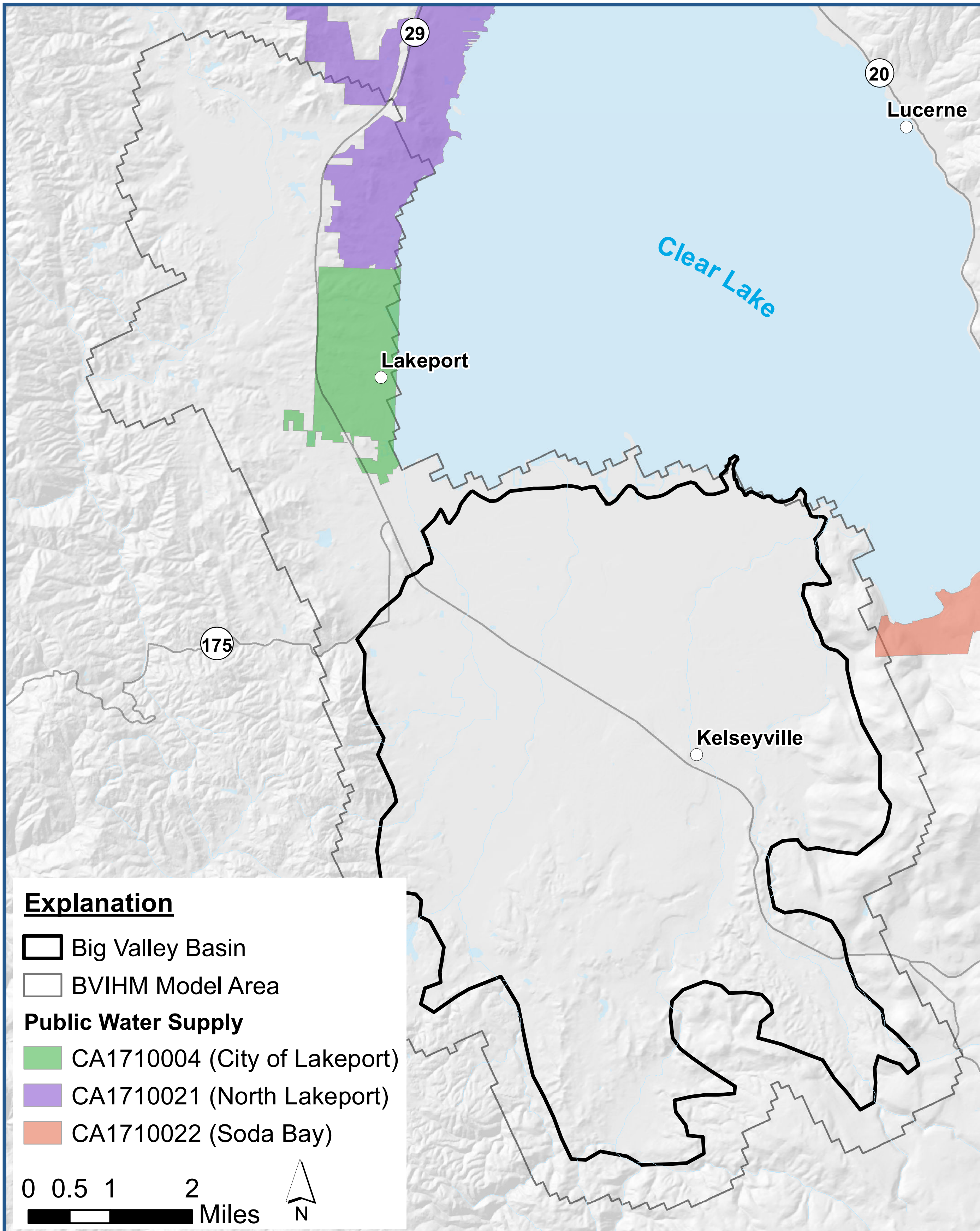
BVIHM Specified Soil Type from SSURGO

Figure 3-14

Big Valley Groundwater Sustainability Plan
Lake County, California



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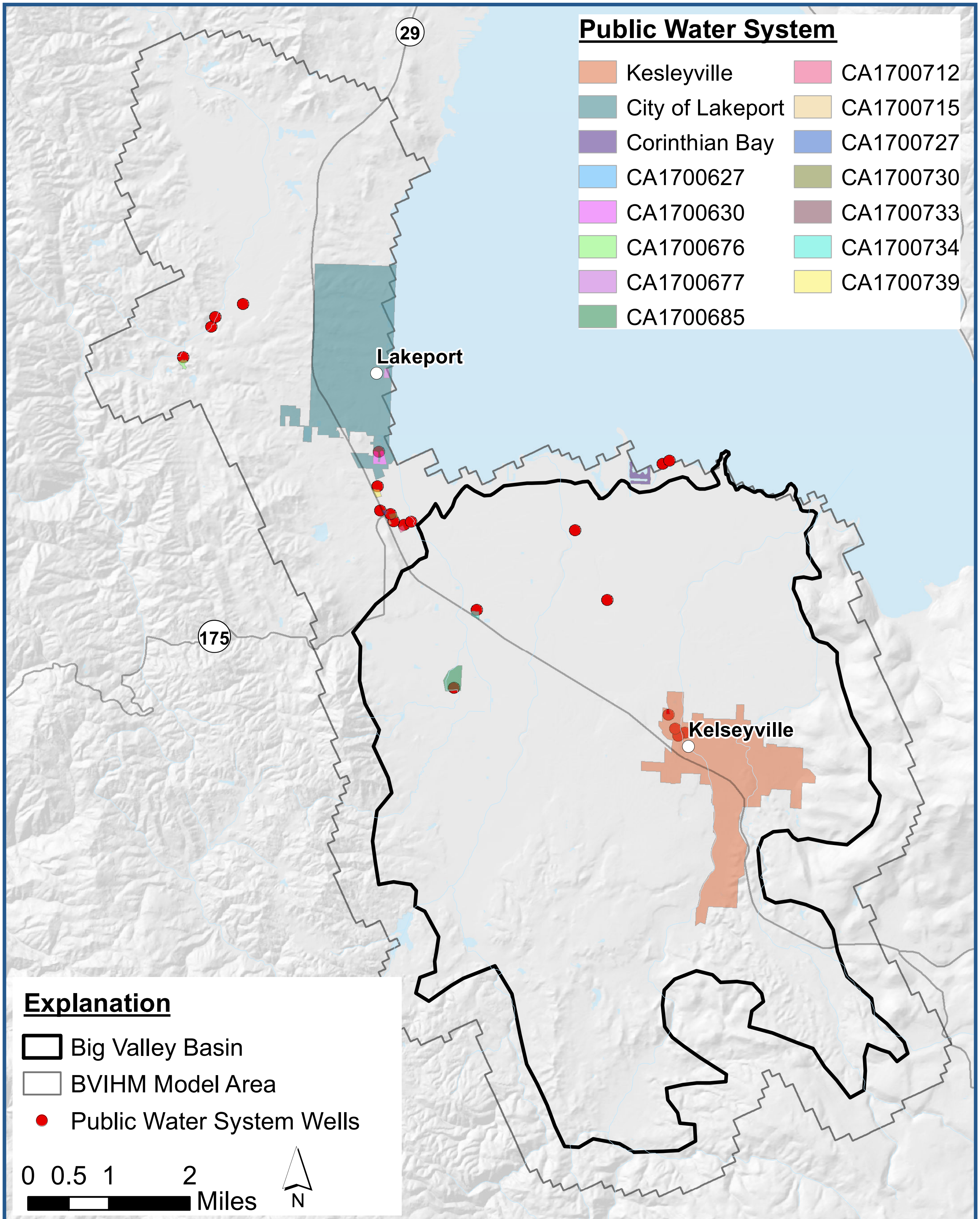
Public Water Systems Receiving Treated Surface Water

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 3-15



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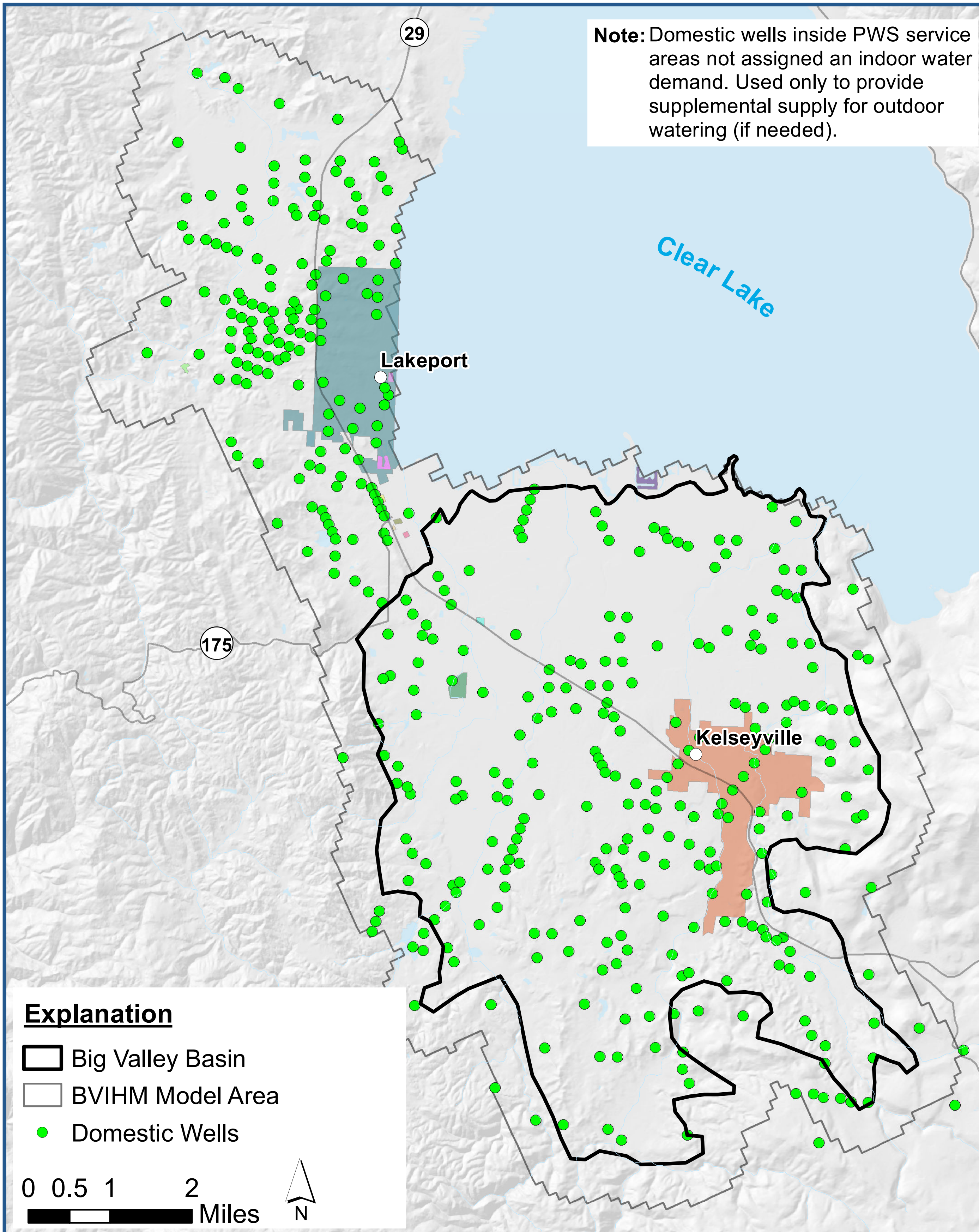
Public Water Sytems Reliant on Groundwater and Public Supply Wells

Figure 3-18

Big Valley Groundwater Sustainability Plan
Lake County, California



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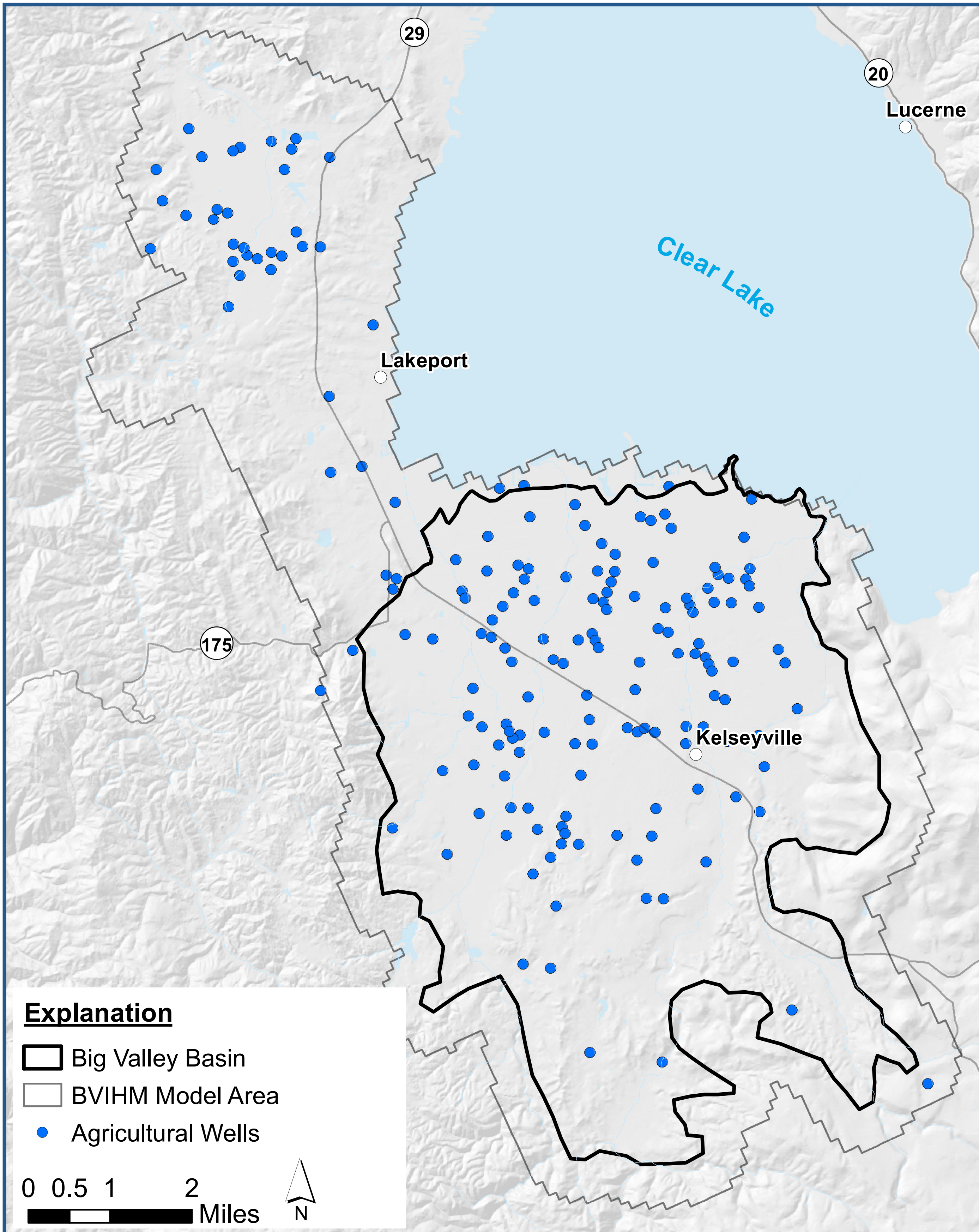
Location of Domestic Wells

Figure 3-20

Big Valley Groundwater Sustainability Plan
Lake County, California



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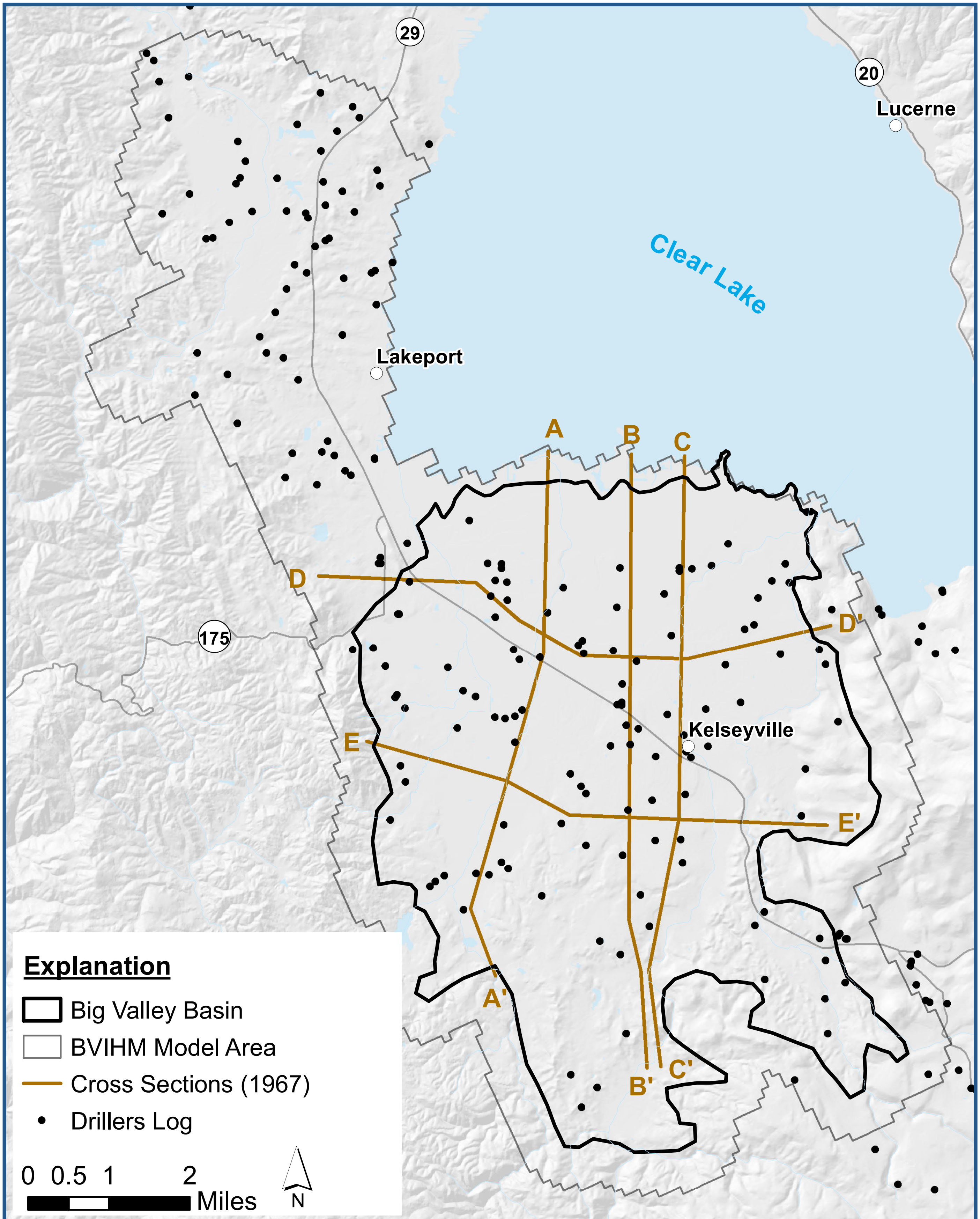
Location of Agricultural Wells

Figure 3-22

Big Valley Groundwater Sustainability Plan
Lake County, California



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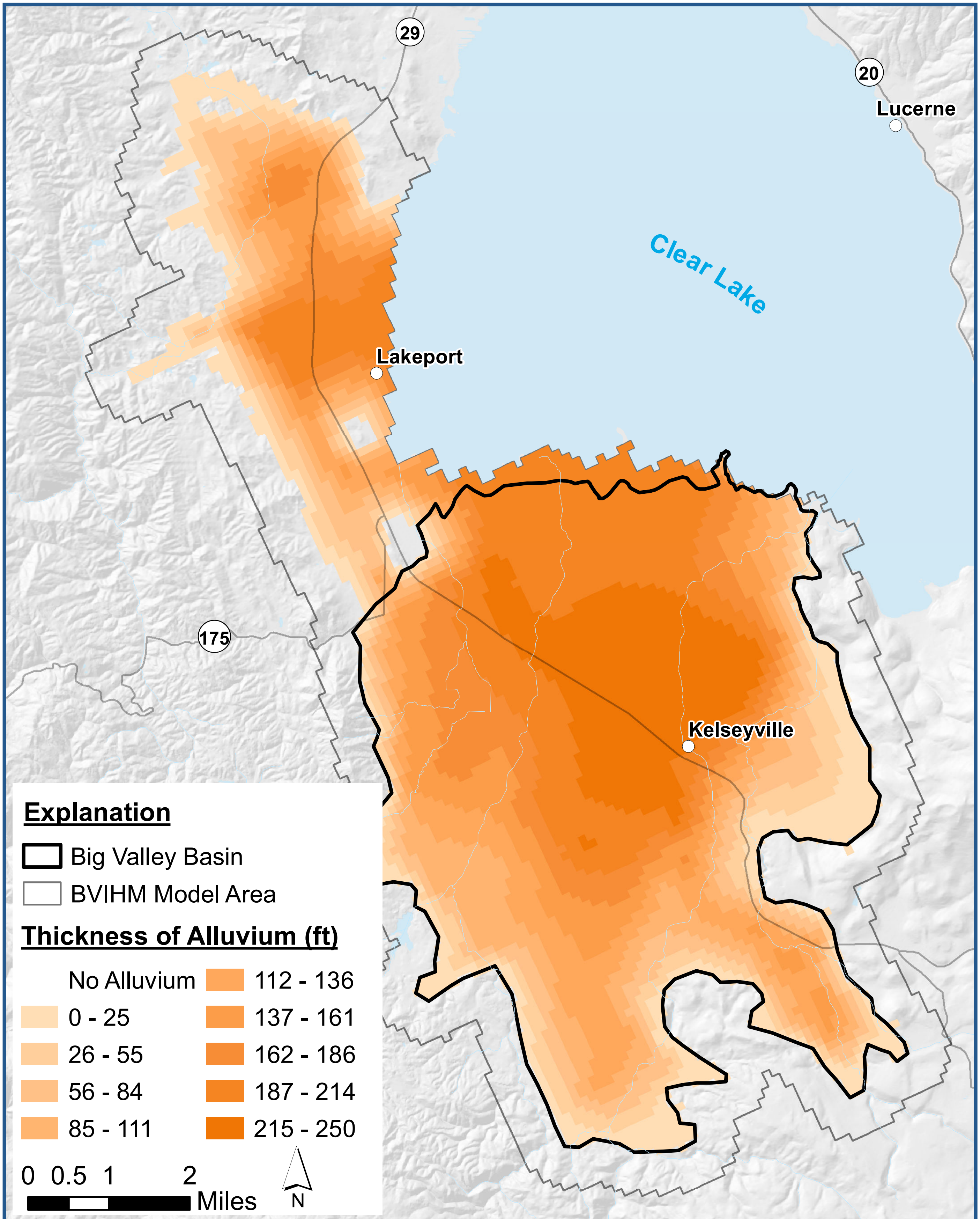
Location of Digtized Well Completion Reports and Geologic Cross Sections

Figure 3-23

Big Valley Groundwater Sustainability Plan
Lake County, California



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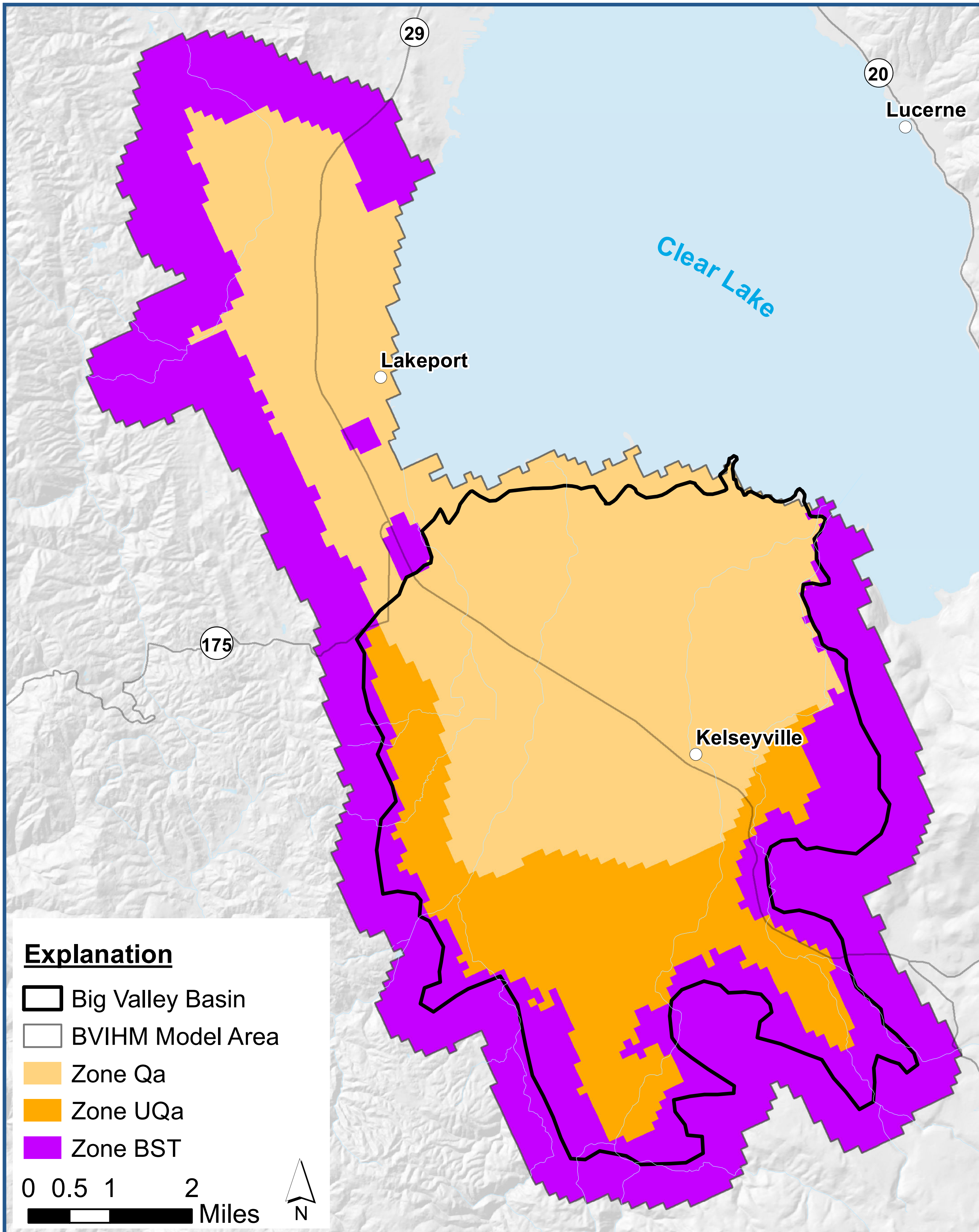
Thickness of Quaternary Alluvial and Ash Deposits

Figure 3-24

Big Valley Groundwater Sustainability Plan
Lake County, California



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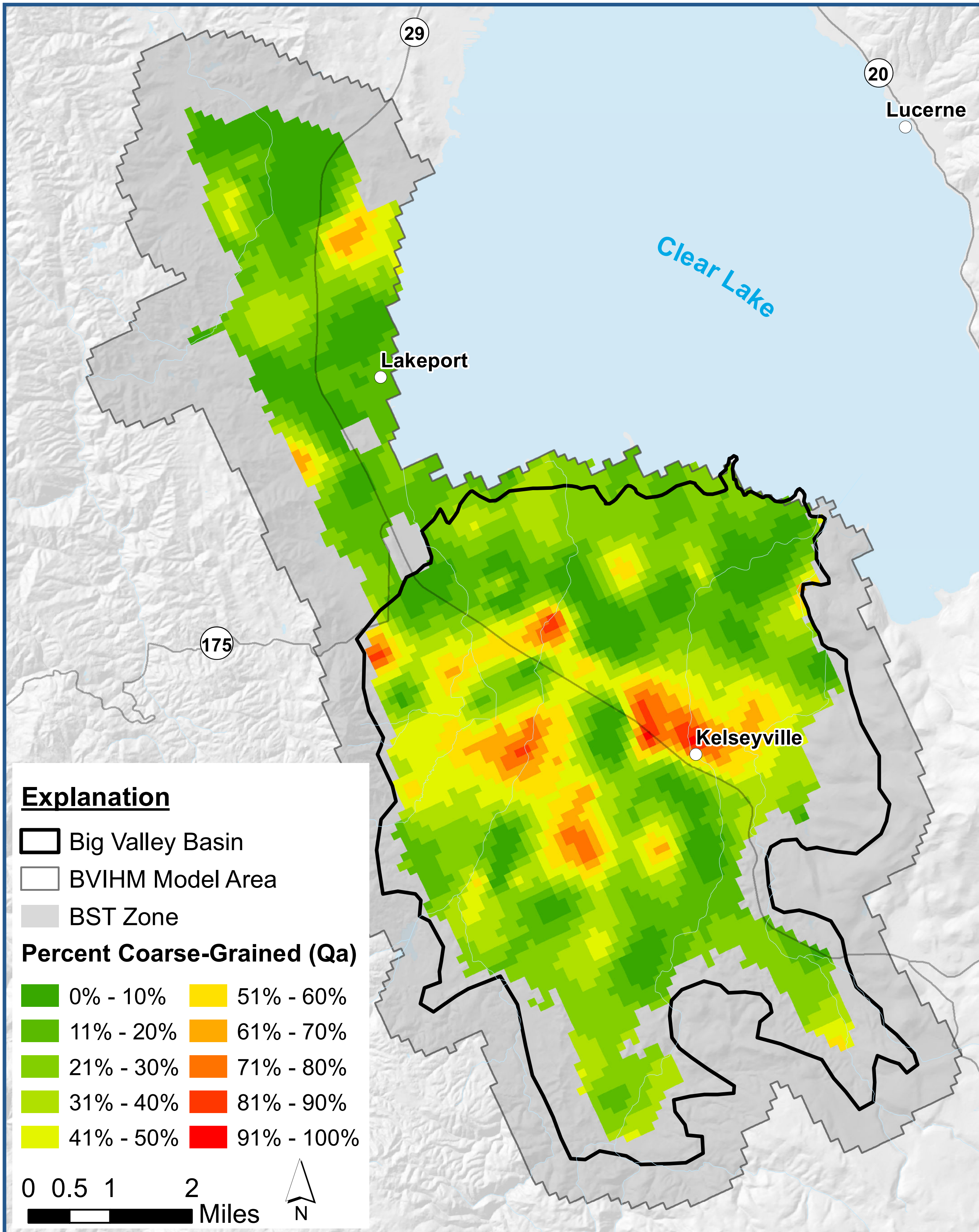
BVIHM Model Zones in Model Layer 1

Figure 3-25

Big Valley Groundwater Sustainability Plan
Lake County, California



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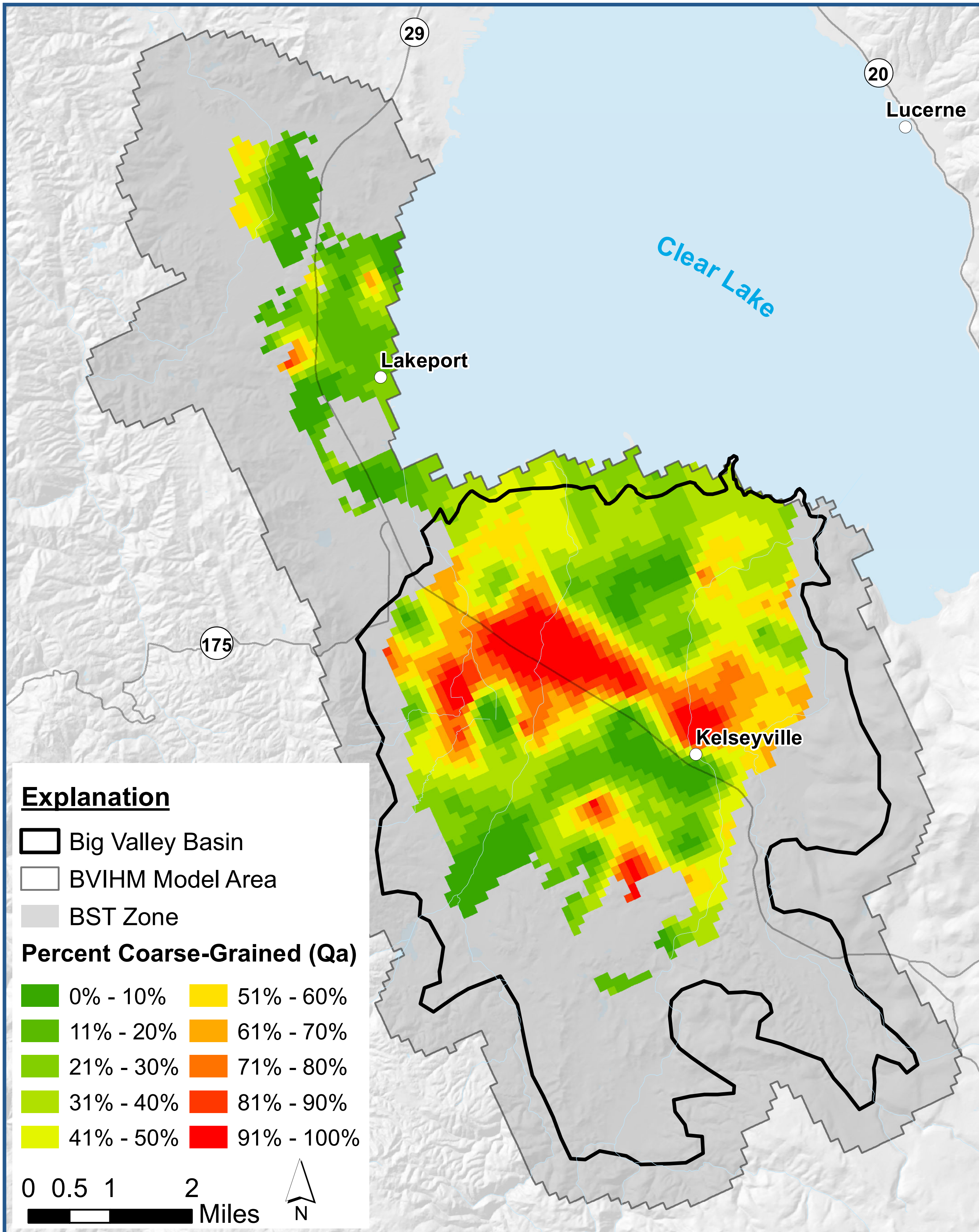
Zone Qa and UQa Percentage Coarse-Grained in Model Layer 1

Figure 3-26

Big Valley Groundwater Sustainability Plan
Lake County, California



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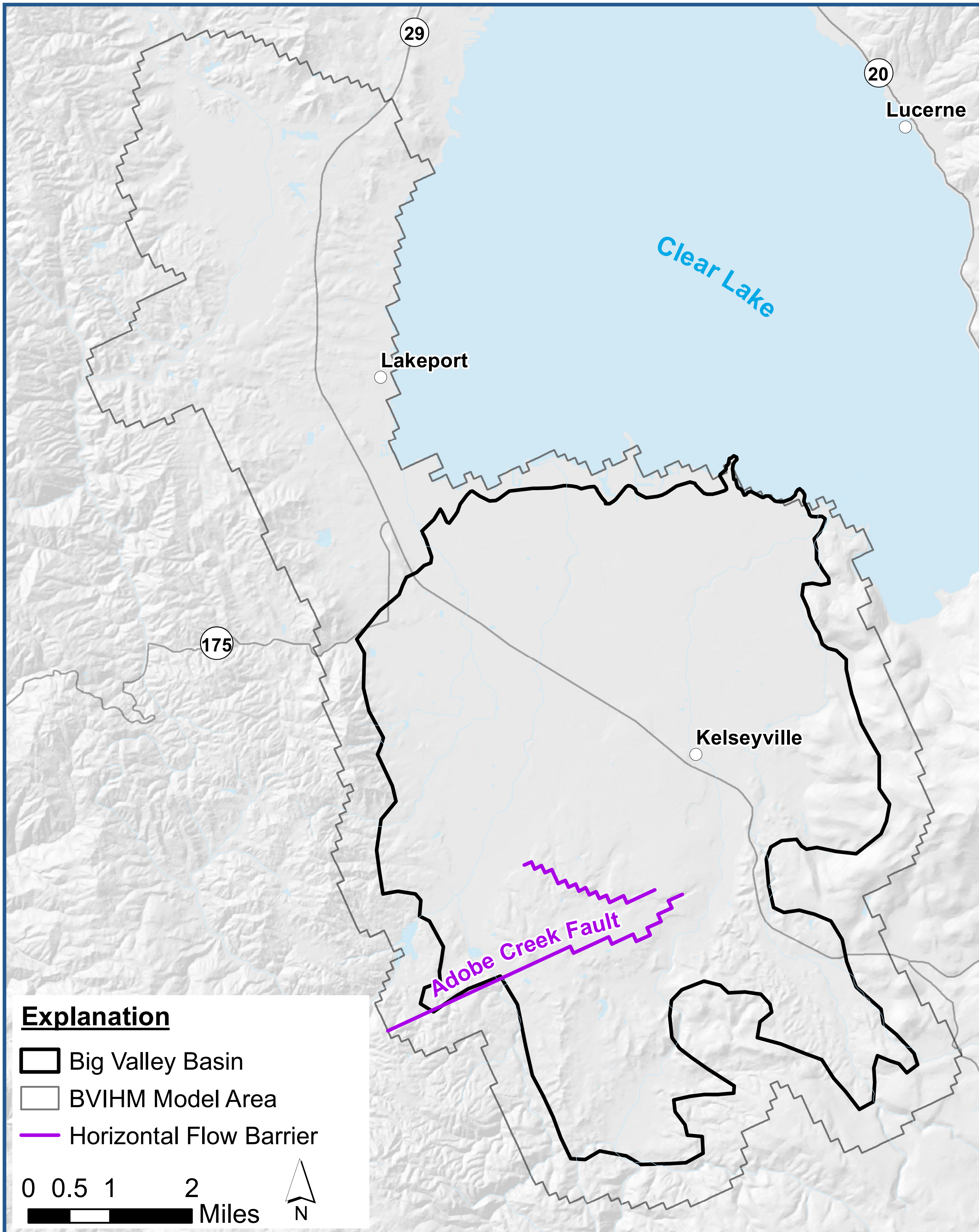
Zone Qa and UQa Percentage Coarse-Grained in Model Layer 3

Figure 3-27

Big Valley Groundwater Sustainability Plan
Lake County, California



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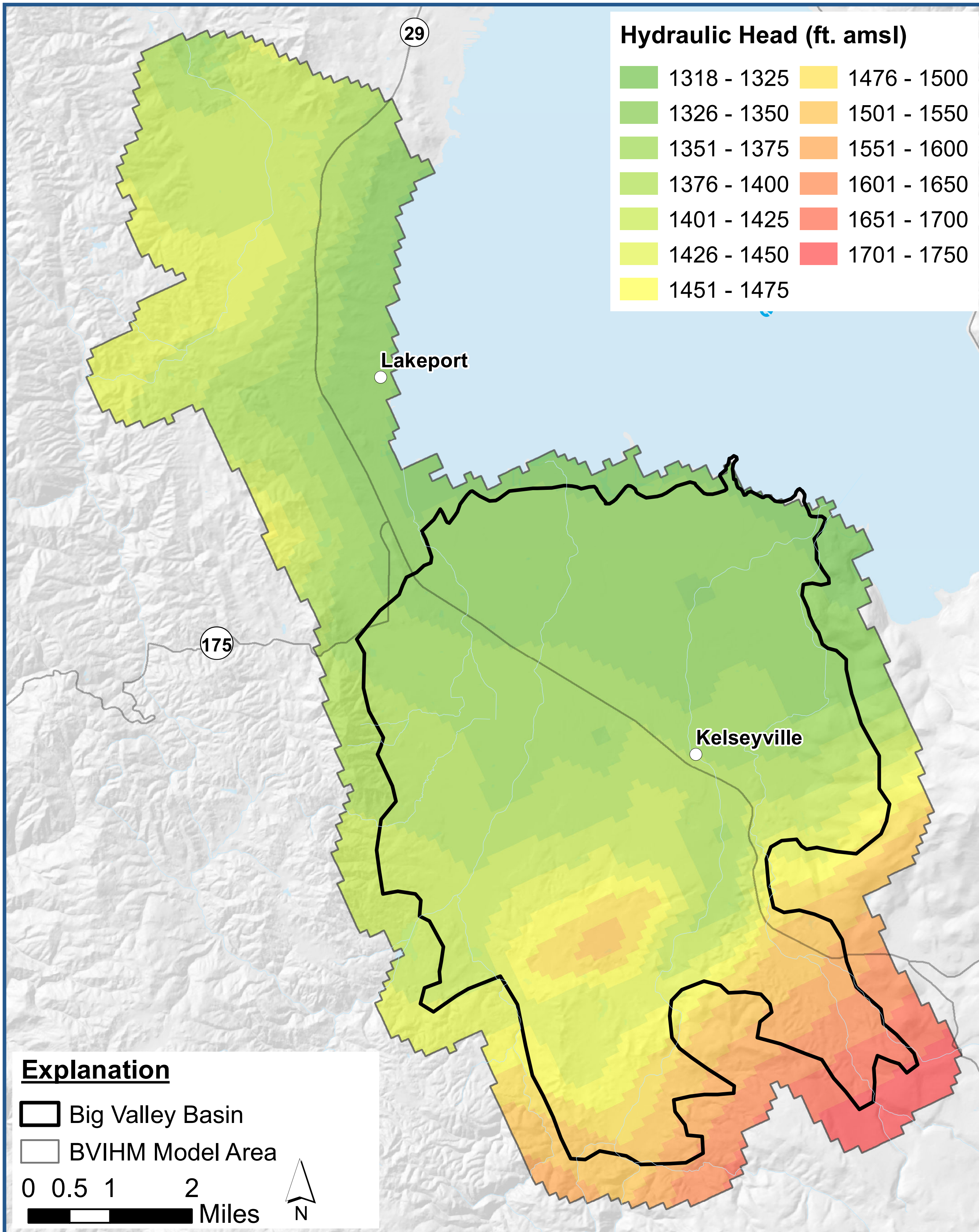
BVIHM Horizontal Flow Barriers

Figure 3-28

Big Valley Groundwater Sustainability Plan
Lake County, California



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BVIHM Initial Conditions

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 3-29

4. MODEL RESULTS

The model was calibrated through both trial and error and automated procedures. PEST Version 17.1 was used to evaluate model sensitivity and estimate parameters (Doherty, 2018). The calibration process involves adjusting model parameter values to improve the model fit to observed data (Anderson and Woessner, 2002; Hill and Tiedman, 2007).

4.1. Model Observations

Observations used to constrain parameter values included 3,742 water level observations from 39 wells (**Figure 4-1**). Wells used for calibration were selected based on reliability of measured data, period of record and availability of well construction information. These observations were supplemented by 1,218 measurements of stream discharge at the USGS Gage in Kelsey Creek at Kelseyville (11448500) and the DWR gages on Kelsey Creek (KCK) and Scotts Creek (SCS) (USGS, 2021; DWR, 2021).

4.2. Statistical Measures of Model Fit

Model calibration was evaluated through five common residual error statistics used to characterize model fit. These include the mean of residual error (ME), mean of absolute residual error (MAE), root mean of squared residual error ($RMSE$), Normalized RMSE ($NRMSE$), and coefficient of determination (R^2). The residual error was calculated by subtracting the observed value from the modeled value at a specific physical location and time.

The mean of residual error (ME) is a measure of the general model tendency to overestimate (+) or underestimate (-) measured values. In general, it is a quantification of the model bias given by:

$$ME = \frac{1}{N}\sum_{i=1}^{N}(y_i - \hat{y}_i)$$ (**Equation 4-1**)

Where: N is the total number of observations
y_i is the i^th observed value
$\hat{y}_i$ is the i^th simulated value of a model dependent variable

The mean absolute residual errors (MAE) is a more robust statistic used to represent the goodness of fit since it avoids the cancelation of individual errors that is part of the ME estimation. The MAE estimates the average magnitude of the error between modeled and observed values and is defined as:

$$MAE = \frac{1}{N}\sum_{i=1}^{N}|(y_i - \hat{y}_i)|$$ (**Equation 4-2**)

The root mean of squared residual error ($RMSE$) is defined as the square root of the second moment of the differences between observed and simulated error. Since the error between each observed and simulated value is squared, larger errors tend to have a greater impact on the value of the $RMSE$, therefore RMSE is generally more sensitive to outliers than the MAE.

$$RMSE = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(y_i - \hat{y}_i)^{2}} \quad \textbf{(Equation 4-3)}$$

The normalized root mean squared error ($NRMSE$) is calculated to account for the scale dependency of the $RMSE$ and is a measure of the $RMSE$ divided by the range of observations (Anderson and Woessner, 2002).

The coefficient of determination (R^2) is a measure of the proportion of variation in model residuals that can be determined by the variation in the observed data. In simplified terms, R^2 is a measure of how close the measured values and simulated equivalents fit a regression line:

$$R^2 = 1 - \sum_{i=1}^{N}\frac{\sum_{i=1}^{N}(y_i-\hat{y}_i)^2}{\sum_{i=1}^{N}(y_i-\bar{y})^2} \quad \textbf{(Equation 4-4)}$$

Where: $\bar{y}$ is the mean of the observed values

The value of R^2 lies between 1 (perfect linear correlation) and 0 (no correlation). Usually, simulated and observed quantity is plotted in a scatter diagram to represent the model calibration results graphically with associated coefficient of determination (R^2).

4.3. Calibrated Model Parameters

Model parameters relating to aquifer and stream hydraulics and landscape processes were adjusted from initial estimates to fit simulated results to observed data. A description of fitted parameter values is below.

4.3.1. Hydraulic Parameters

Calibrated aquifer parameters include the horizontal (Kh) and vertical (Kv) hydraulic conductivity, specific storage (Ss) and specific yield (Sy). Prior estimates of hydraulic parameters are limited to well testing conducted during well construction in some cases. These tests are short term and generally considered unreliable. As a result, hydraulic parameter estimates were derived primarily through calibration to observed water levels in groundwater wells and measured streamflow.

Horizontal hydraulic conductivity (Kh) in the primary alluvium (Qa) ranges from 0.09 ft/d in the fine-grained material to 79 ft/d in the coarse-grained material (**Table 4-1**). Kh in upland alluvium (UQa) required a multiplier of 0.5. Kh in the basement rock (BST) is 3.7 ft/d. The calibrated distribution of horizontal hydraulic conductivity in model layer 1 is shown in **Figure 4-2.**

Vertical conductivity in the alluvium is between 18 times lower than horizontal hydraulic conductivity in fine-grained material to 80 times lower in the coarse-grained material (**Table 4-1**). A power applied to the generalized mean equation of -0.30 in the calculation of vertical hydraulic conductivity produced the best model fit to observed groundwater levels. The multiplier for vertical hydraulic conductivity in the UQa is 0.10. Calibrated vertical hydraulic conductivity in basement rocks (BST) is 0.90 ft/d.

Calibrated specific storage in the alluvium ranges from $5 \text{x} 10^{-6}$ per foot in fine-grained material to $5 \text{x} 10^{-5}$ per foot in coarse-grained material in both the Qa and UQa. In consolidated materials, which are less elastic specific storage was 7.7x10-7. Specific yield ranges from between 0.015 and 0.15 in Qa and UQa zones and is 0.026 in the consolidated basement rocks (BST) (**Table 4-1**).

Table 4-1. Calibrated Aquifer Hydraulic Parameters

Zone	Kh (ft/d)	Kv (ft/d)	Ss (ft^{-1})	Sy (--)
Qa (Coarse-Grained)	79	0.94	5.00E-06	0.15
Qa (Fine-Grained)	0.09	0.005	5.00E-05	0.03
UQa Multiplier[1]	0.50	0.10	1.00	0.50
BST	3.70	0.90	7.73E-07	0.026
Power[2]	1.00	-0.30	1.00	1.00

[1] Multiplier applied to upland portions of Qa to yield the hydraulic parameter for UQa

[2] Weighting factor applied in generalized mean equation for Qa

Other calibrated hydraulic parameters are summarized in **Table 4-2**. These include fault characteristics, streambed vertical hydraulic conductivity, GHB conductance factors and scale factors for mountain block recharge calculated by the BCM.

Table 4-2. Other Calibrated Hydraulic Parameters

Parameter	Value	Units
Adobe Creek Fault[1]	1.00E-05	d^{-1}
Upper Big Valley Stream Kv[2]	0.10	ft/d
Middle Big Valley Stream Kv[2]	1.10	ft/d
Lower Big Valley Stream Kv[2]	2.43	ft/d
Upper Scotts Creek Kv[2]	5.00	ft/d
Lower Scotts Creek Kv[2]	0.92	ft/d
Diversion Kv[2]	0.00	ft/d
GHB Conductance Factor[3]	0.05	none
Mountain Block Recharge Factor[4]	0.50	none

[1] Hydraulic characteristic of fault (Fault Kh / Cell Width)

[2] Streambed hydraulic conductivity

[3] Factor applied to calculated model conductance

4.3.2. Crop Parameters

Key crop parameters are shown in **Table 4-3**. These include runoff fractions for precipitation, irrigation efficiency and transpiration and evaporation from irrigation fractions.

4.4. Model Fit

The model fit to observed data is evaluated with respect to groundwater levels (hydraulic head) and streamflow using the quantitative metrics described in **Section 4.2**.

4.4.1. Hydraulic Head (Groundwater Levels)

Simulated and observed groundwater elevations used to generate model fit statistics used to inform model calibration over the 1984 through 2019 calibration period (**Figure 4-3**). The calculated coefficient of determination (R^2=0.93) shows a satisfactory fit of the modeled results to observed values. The correlation coefficient (R=0.97) is also greater than the threshold value of 0.90 used to evaluate quality of model fit (Hill and Tiedemann, 2007). The calculated *RMSE* is 11.67 ft, and the *MAE* is 7.36 ft. These values are small compared to the range of observed groundwater levels in the model domain (*NRMSE* = 4.82%). The calculated *ME* indicates that the model tends to simulate lower groundwater levels than observed (under-predict) by an average of 3.4 ft, which is within the reasonable range of the measurement error. Analysis of the frequency of residual error shows that 55% of simulated groundwater levels fall within five feet of observed values, 77% fall within ten feet of observed values and 95% fall within 25 feet of observed values. Groundwater hydrographs of observed and simulated groundwater levels from wells used in model calibration are shown in **Appendix A**.

The spatial distribution of mean residual error between simulated and observed groundwater levels in wells used for model calibration can be used to assess spatial bias in the model results and are shown **in Figure 4-4**. Values in red depict where simulated hydraulic head is higher than observed, while blue represents where observed hydraulic head is lower than simulated values. Maps of the average residuals at the calibration wells show that the model tends to underpredict groundwater levels near the in the Scotts Valley Basin, but otherwise does not show bias in the spatial distribution of residuals.

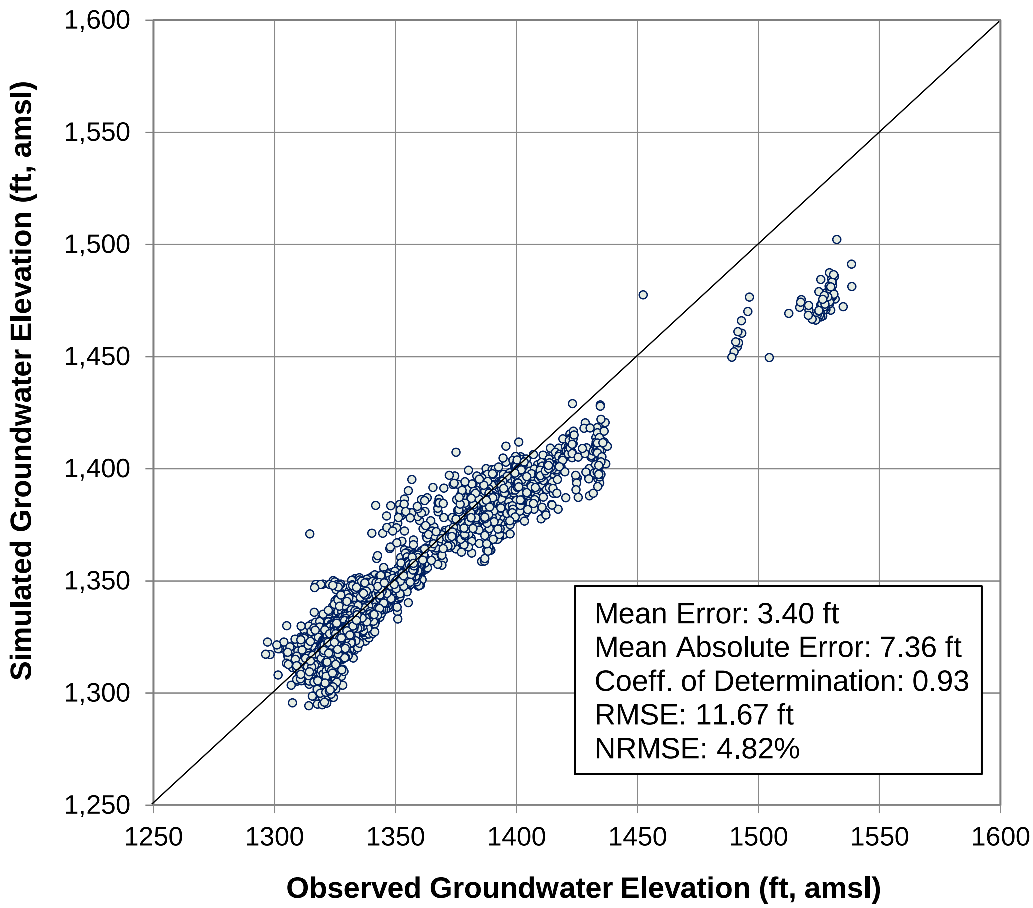


Figure 4-3. BVIHM Observed and Simulated Groundwater Levels and Model Fit Statistics

4.4.2. Streamflow

Simulated and observed streamflow were compared over the 1984 through 2019 calibration period. Calibration observations are monthly measured stream discharge in the Kesley Creek at the USGS gage near Kesleyville (1149500), discharge in the downstream DWR in Kesley Creek near Kesleyville (KCK) and discharge in the DWR gage in Scotts Creek (SCS). The primary quantitative statistic to evaluate model fit is the coefficient of determination (R^2), which shows a good fit at all gages (**Figure 4-5**). Calculated R^2 values in Kesley Creek are 0.88 and 0.99 at the upstream USGS gage and downstream DWR gage, respectively. R^2 in Scotts Creek is 0.91.

Observed as simulated discharge from each of the gages was also qualitatively compared to evaluate model performance. This includes analysis of discharge hydrographs, mean monthly flow and flow duration (**Figures 4-6** through **4-8**). Flow duration curves are a method of evaluating the cumulative frequency which streamflow is equaled or exceeded during the model period (Searcy, 1959). Results suggest that the model can capture the magnitude and timing of observed streamflow relatively well. Analysis of mean monthly flows and flow duration shows that the model can capture low flows, baseflow recession and the general characteristic of flow well at the USGS gage at the upstream site on Kelsey Creek and the DWR gage at Scotts Creek. The model performance with respect to both low flows and baseflow recession are adequate, but not as well captured at the DWR gage at the lower site on Kelsey Creek. This may be a function of measurement error at the CDEC gage, incorrect or missing diversion data, or need for model refinement to enhance the simulation of stream-aquifer interaction.

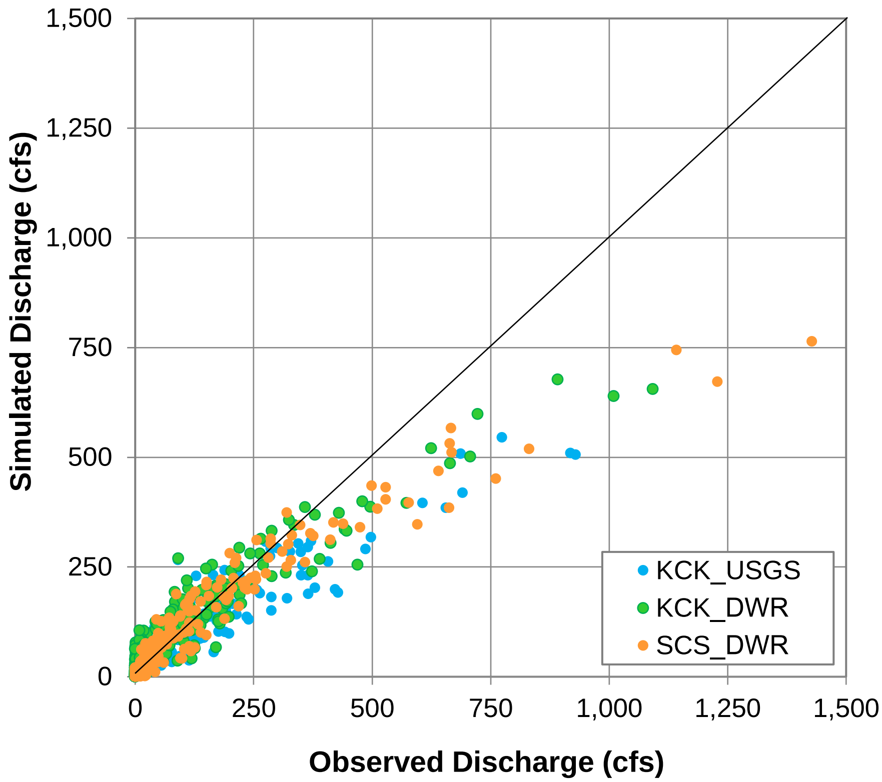


Figure 4-5. BVIHM Observed and Simulated Streamflow

4.5. Model Sensitivity

A sensitivity analysis was conducted to evaluate which model parameters have the largest effect on simulated equivalents. Results from the sensitivity analysis are summarized as a composite scaled sensitivity (*CSS*) described in **Section 2.3**. Results are presented in terms of the ratio of each parameter *CSS* to the maximum *CSS* from all parameters **(Figure 4-9)**. The *CSS* is useful in determining which parameters influence the simulated model equivalents the most, which can inform future refinements in parameter estimates and model structure.

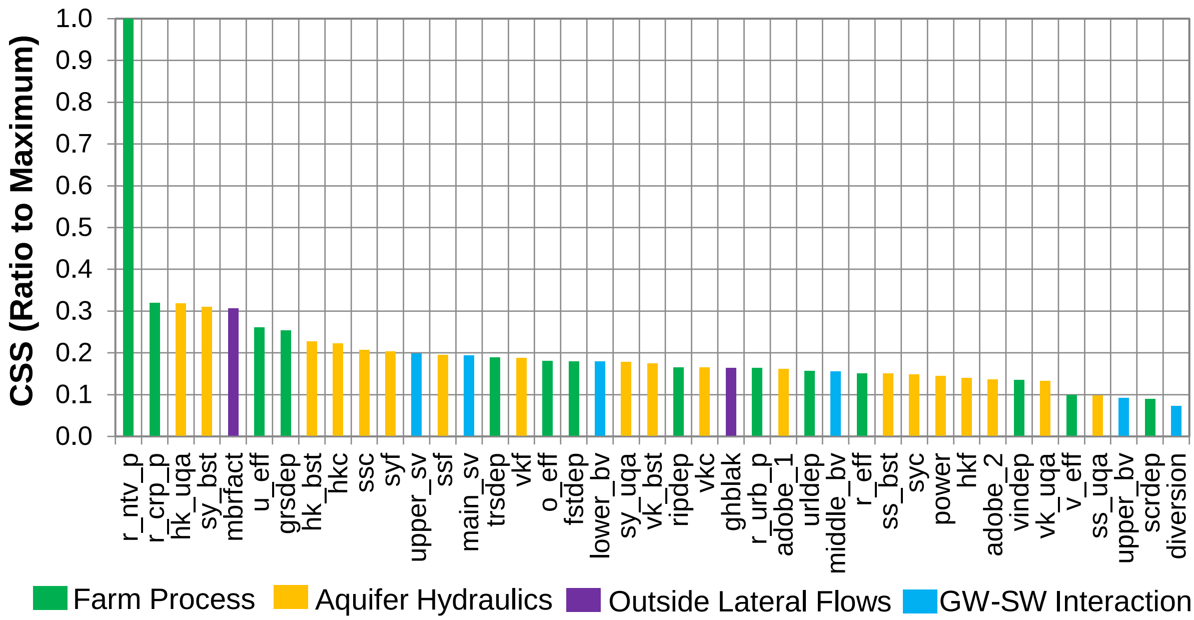


Figure 4-9. Composite Scaled Sensitivity

4.6. Hydrologic Flow Analysis

4.6.1. Groundwater

Color floods of water table elevation are shown for the fall of 2015 and spring 2017 in **Figure 4-10** and **Figure 4-11**. The principal direction of horizontal groundwater flow is from the upper portion of the Big Valley and Scotts Valley Basins toward Clear Lake. Simulated water table elevations range from over 1,675 ft above mean sea level near tributaries of Kesley Creek to about 1,300 ft above mean sea level near Clear Lake.

Groundwater levels fluctuate within each year in response to groundwater recharge due largely to precipitation and stream loss which occurs in the winter and spring and groundwater discharge due to groundwater pumping and stream gain in the summer and fall (**Appendix A**). Intra-annual variations in groundwater levels are generally greater in the deeper (semi-confined) portions of the aquifer system or in consolidated units and are less pronounced in the shallow (unconfined, water table) portion of the aquifer system (**Appendix A**).

Groundwater levels in the Basin are relatively stable throughout the 1988-2019 historical period (**Appendix A**). Between years, simulated groundwater levels respond to climate variability. During prolonged dry periods with lower precipitation, groundwater levels tend to decrease. However, water levels recover during wetter periods (**Appendix A**).

4.6.2. Water Budgets

Water budget results are summarized for the Big Valley Basin with respect to the land surface system, surface water system and groundwater system in accordance with GSP guidelines outlined by DWR (DWR, 2016). Water budgets for each respective hydrologic system are summarized in **Section 3** of the GSP.

4.6.3. Interconnected Surface Water

The numerical model was used to evaluate the frequency of streamflow and stream-aquifer interaction in creeks within the model domain.

The frequency of streamflow is a measure of the amount of time where there is streamflow in a given reach and was compared during the 2015 (dry) and 2017 (wet) calendar years (**Figure 4-12** and **4-13**). In general, the model suggests that streamflow occurs for a greater portion of the year during wet years than dry years. In the Scotts Basin, flows occur with greater frequency in higher order reaches while in the Big Valley Basin streams tend to flow more in tributary reaches and become more intermittent nearer to Clear Lake. In the Big Valley Basin, flows are generally more intermittent in the western portion of the Basin (Thompson and Adobe Creeks) and maintain flow for more of the year in the eastern portion of the Basin (Kelsey and Cole Creeks).

Stream-aquifer interaction in creeks within the model domain are highlighted for the spring and summer of 2019 in **Figure 4-14** and **4-15**. The model suggests that exchange of surface water and groundwater is dynamic and variable between months within any year and also between years. In general, stream reaches in the upland portion of the model domain tend to be consistently losing and act as a source of recharge to the aquifer system. In the lower portion of the Big Valley Basin stream-aquifer interaction varies depending on season and water year. In this case, streams can be losing or gaining depending on stream inflows and aquifer conditions in the winter and spring. In the later portion of the spring and into the summer, lower reaches of creeks tend to be consistently losing and act as a source of recharge until they run dry and become disconnected from the aquifer system. Dry stream segments are not shown in the figures.

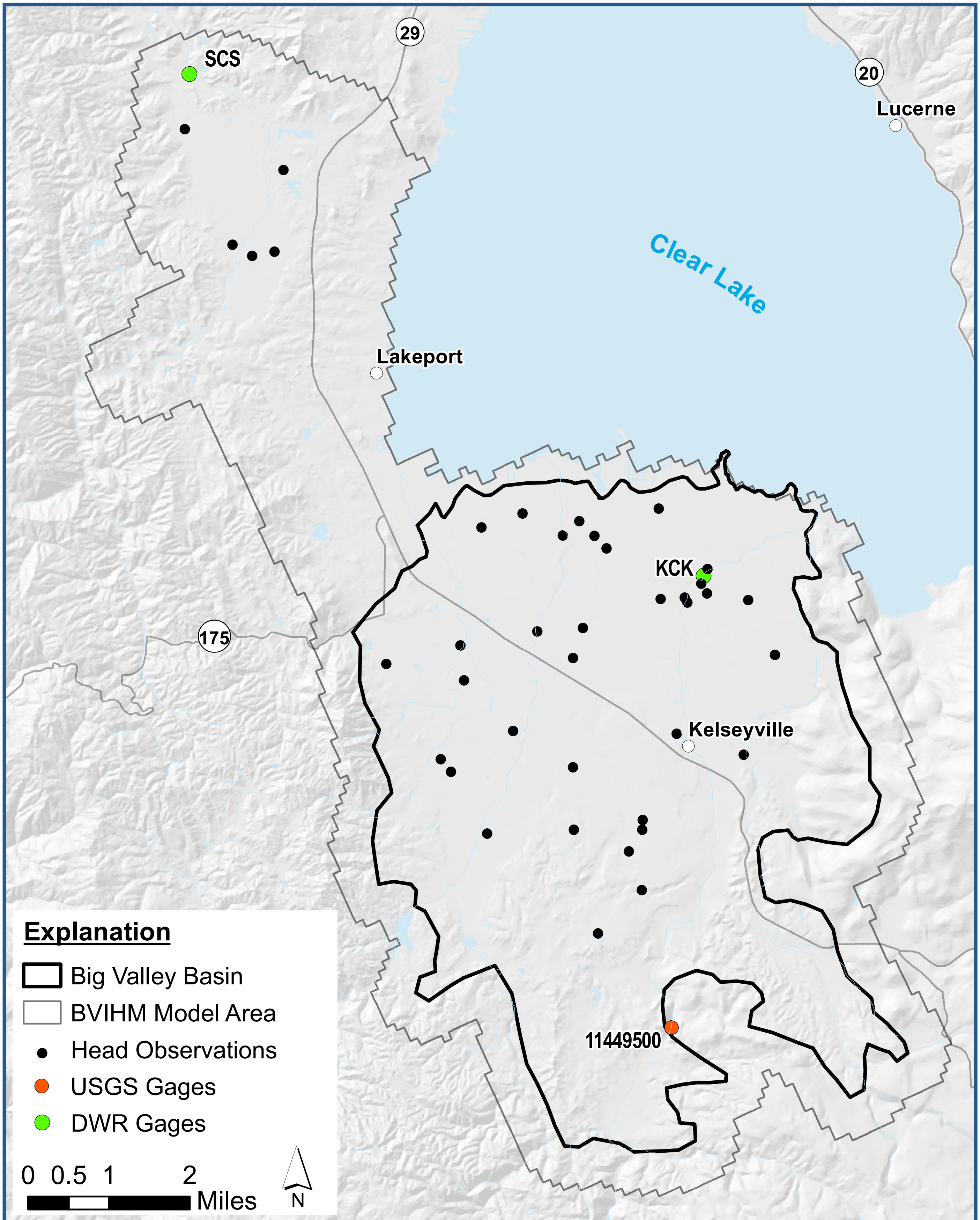
4.6.4. Stream Depletion

The numerical model was used to evaluate depletion of interconnected surface water due to groundwater pumping for irrigation. The approach used to quantify stream depletion involves comparing streamflow during the WY 1988-2019 base period included in the calibrated model (which includes pumping for irrigation) to a hypothetical scenario where all groundwater pumping for irrigation of agriculture and residential landscaping is ceased. Through this comparison, stream depletion due groundwater pumping from irrigation can be estimated by the difference in simulated streamflow between the model runs at locations along Adobe and Kelsey Creeks. These streams are particularly significant as spring flows support spawning for Clear Lake hitch. These points are located near each creek's terminus in Clear Lake to capture the total depletion due to groundwater pumping for irrigation (**Figure 4-16**).

Estimated historical stream depletion due to groundwater pumping in Adobe and Kelsey Creeks is summarized in **Figure 4-17** and **4-18**. These graphics show a timeseries of streamflow in the baseline (calibrated) model and the synthetic (no-irrigation) model and highlight the streamflow and stream depletion in April during hitch spawning. Stream depletion in Adobe and Kelsey Creek ranges from 0 to 10 cfs and 0 to 7 cfs, respectively. The greatest volumetric amount of stream depletion occurs when there is greater streamflow and fewer stream reaches are dry. When reaches go dry, groundwater pumping leads to a reduction in groundwater storage since there are no streams to deplete. When streamflow occurs the storage deficit is replenished by streams leading to stream depletion. The greatest relative stream depletion occurs during low flows as volumetric reductions in flow are large compared to the amount of streamflow occurring.

Stream depletion during the hitch spawn (April shown) ranges from about 1 to 4 cfs in Adobe Creek and 1.5 to 3 cfs in Kelsey Creek (**Figure 417** and **4-18**). Stream depletion in Kelsey Creek is relatively consistent while stream depletion in Adobe Creek is more variable depending on climate which influences groundwater pumping and stream drying. Since April streamflow in Adobe Creek is often very low or does not occur, the relative reduction in flow due to pumping can be very high (up to 90%) relative to the synthetic model run. Since there is generally higher flow in Kesley Creek, the relative reduction in April flow is much smaller (less than 20%) in all years. Notably, the extent which this may impact stream habitat is beyond the scope of this study and not assessed.

Table 4-3. Calibrated Farm Process Parameters															
Land Use	OFE	Runoff	Depth (ft)	Monthly Fraction of Transpiration											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grassland	-	0.87	10.00	0.85	0.85	0.80	0.75	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.75
Native Riparian	-	0.87	15.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Chamise	-	0.87	20.00	0.85	0.85	0.80	0.75	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.75
Forest	-	0.87	20.00	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Scrub Oak	-	0.87	20.00	0.66	0.66	0.66	0.64	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Water	-	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grapes	0.90	0.73	4.00	0.00	0.50	0.53	0.78	0.90	0.93	0.93	0.93	0.93	0.93	0.81	0.00
Walnuts	0.80	0.73	15.00	0.15	0.75	0.81	0.88	0.93	0.95	0.95	0.95	0.95	0.94	0.00	0.00
Pears	0.80	0.73	15.00	0.36	0.75	0.81	0.88	0.93	0.95	0.95	0.95	0.95	0.94	0.00	0.00
Grain	-	0.73	10.00	0.79	0.93	0.95	0.95	0.92	0.59	0.00	0.00	0.00	0.00	0.00	0.51
Fallow	-	0.73	10.00	0.00	0.46	0.50	0.68	0.87	0.93	0.93	0.93	0.93	0.93	0.93	0.90
Farmstead	0.80	0.75	2.80	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Paved	-	0.75	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Urban	0.84	0.75	2.80	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Residential	0.80	0.75	2.80	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Landscape	0.80	0.75	2.80	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Vacant	-	0.75	2.80	0.66	0.66	0.66	0.64	0.59	0.58	0.58	0.58	0.58	0.58	0.58	0.58



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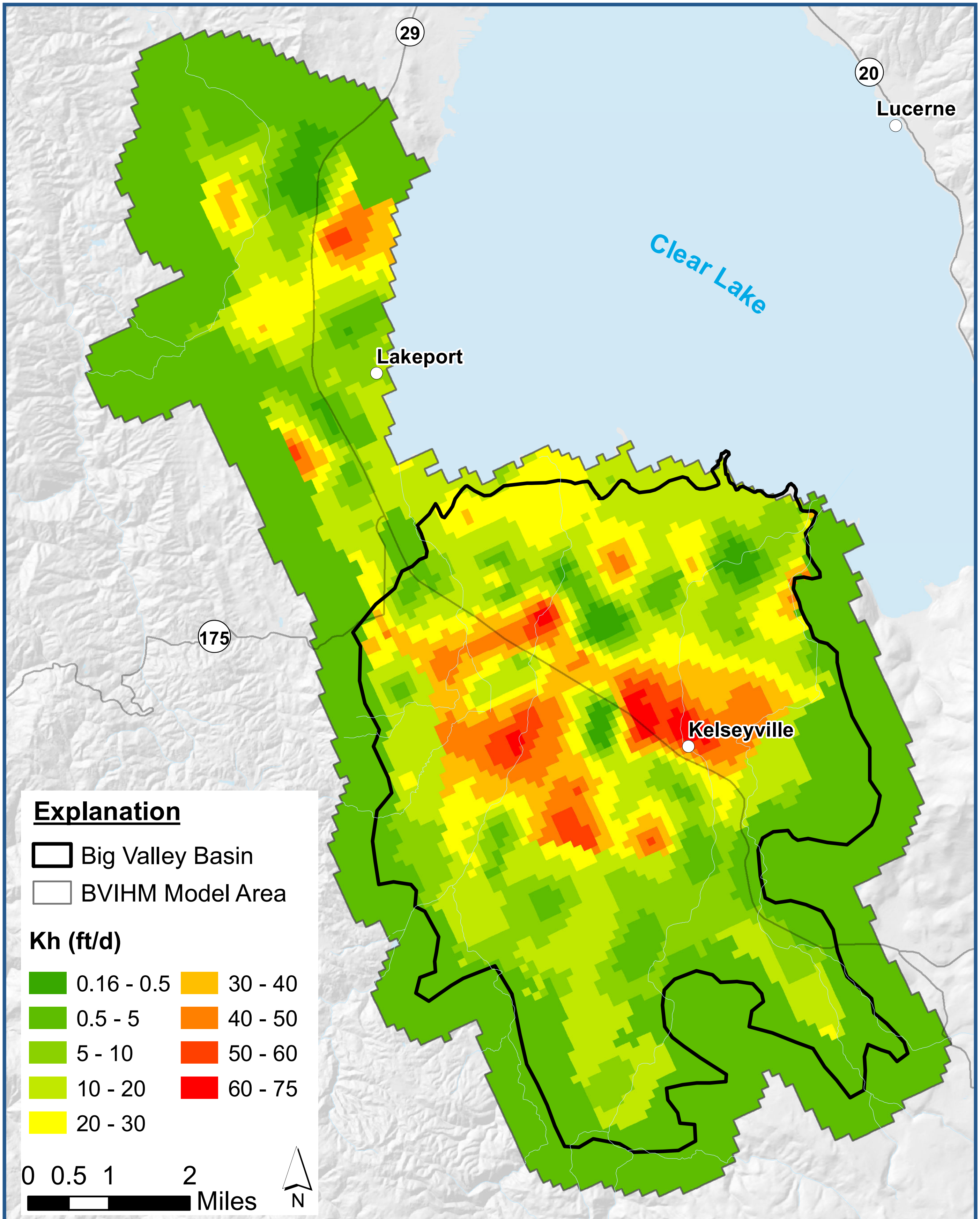
Location of Hydraulic Head and Streamflow Measurements Used in BVIHM Calibration

Figure 4-1

Big Valley Groundwater Sustainability Plan
Lake County, California



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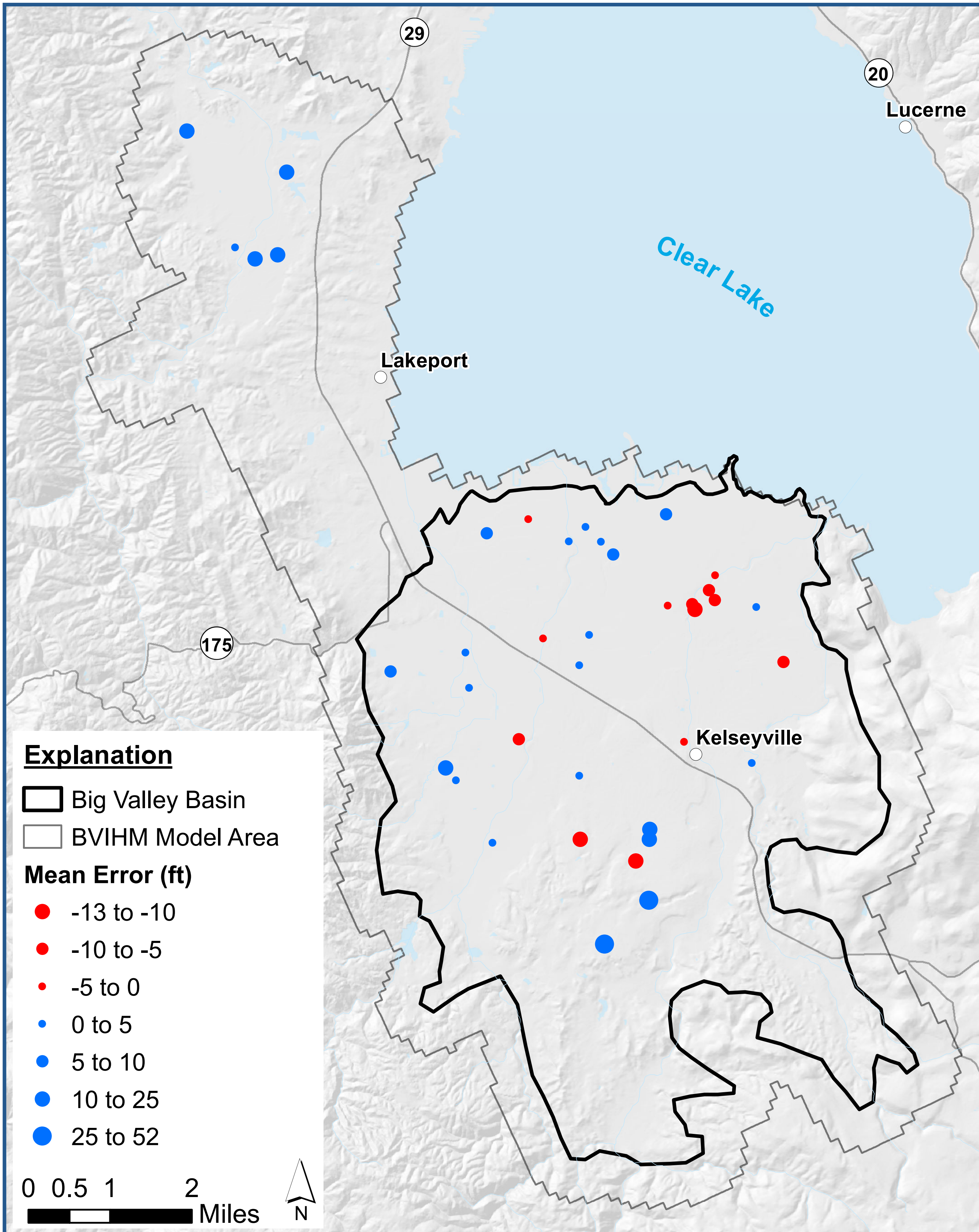
Calibrated Horizontal Hydraulic Conductivity in Model Layer 1

Figure 4-2

Big Valley Groundwater Sustainability Plan
Lake County, California



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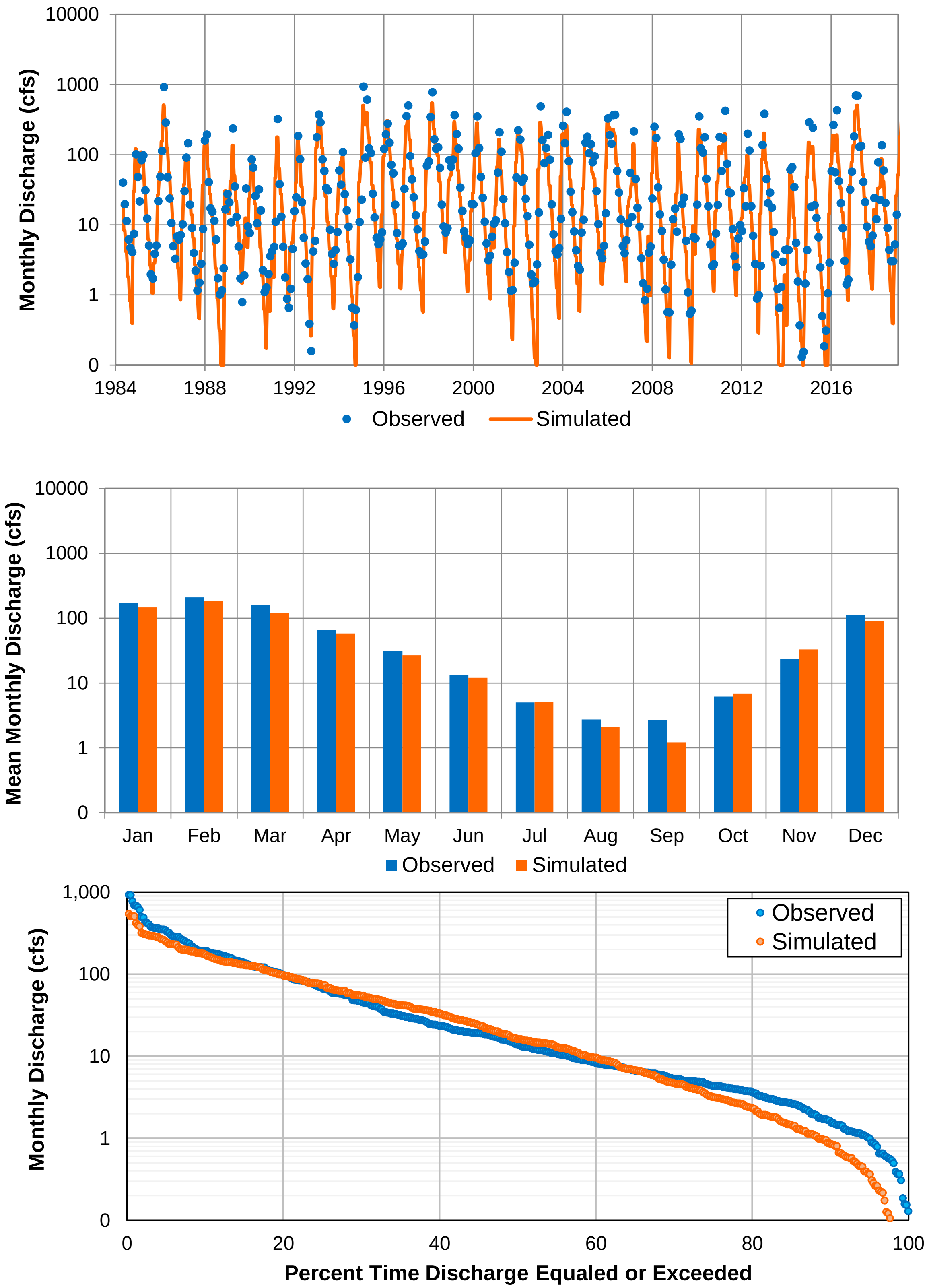
Spatial Distribution of Mean Error in Groundwater Level Observation Wells

Figure 4-4

Big Valley Groundwater Sustainability Plan
Lake County, California



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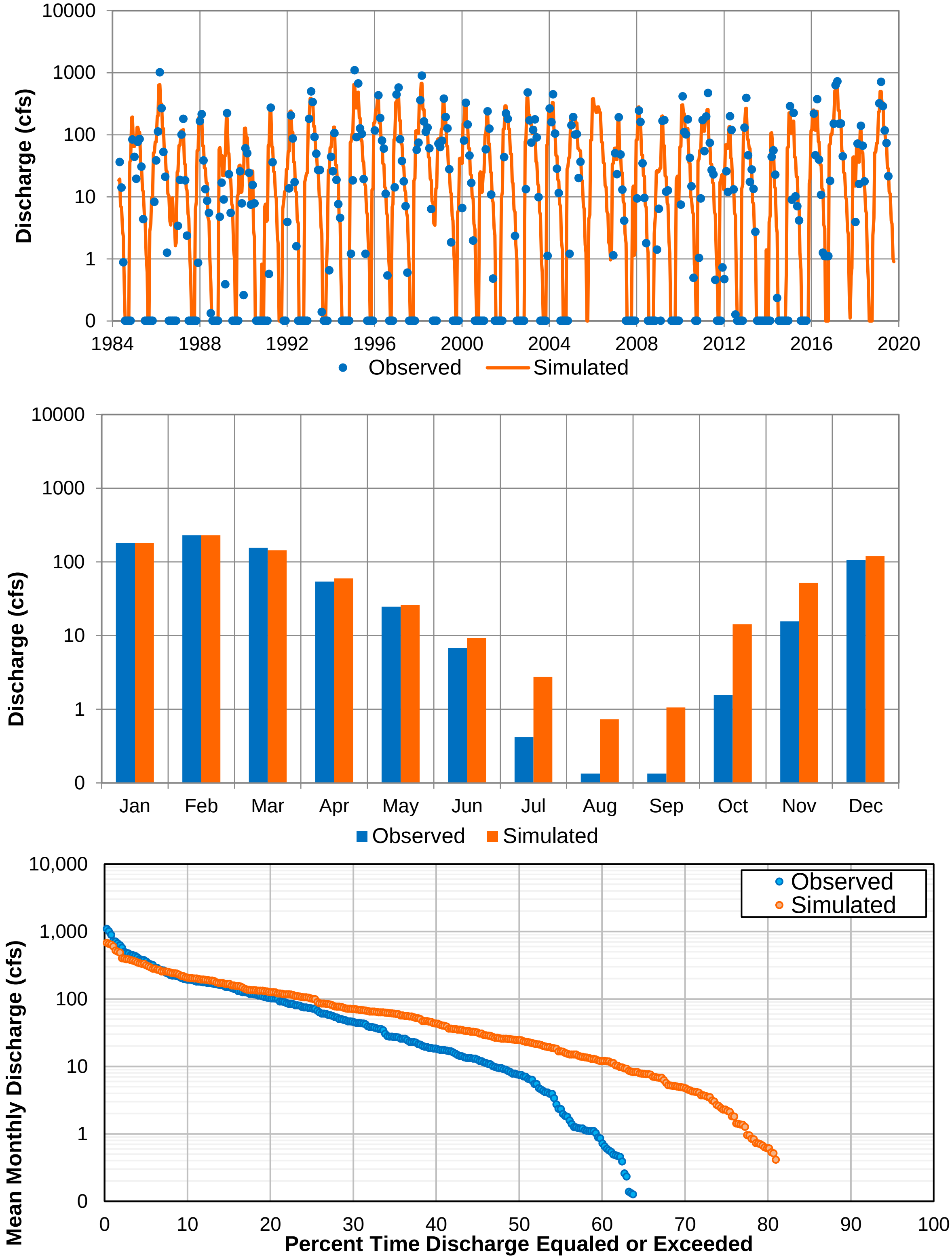
Observed and Simulated Hydrograph, Mean Monthly Flow, and Flow Duration in the USGS Gage at Kelsey Creek

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 4-6



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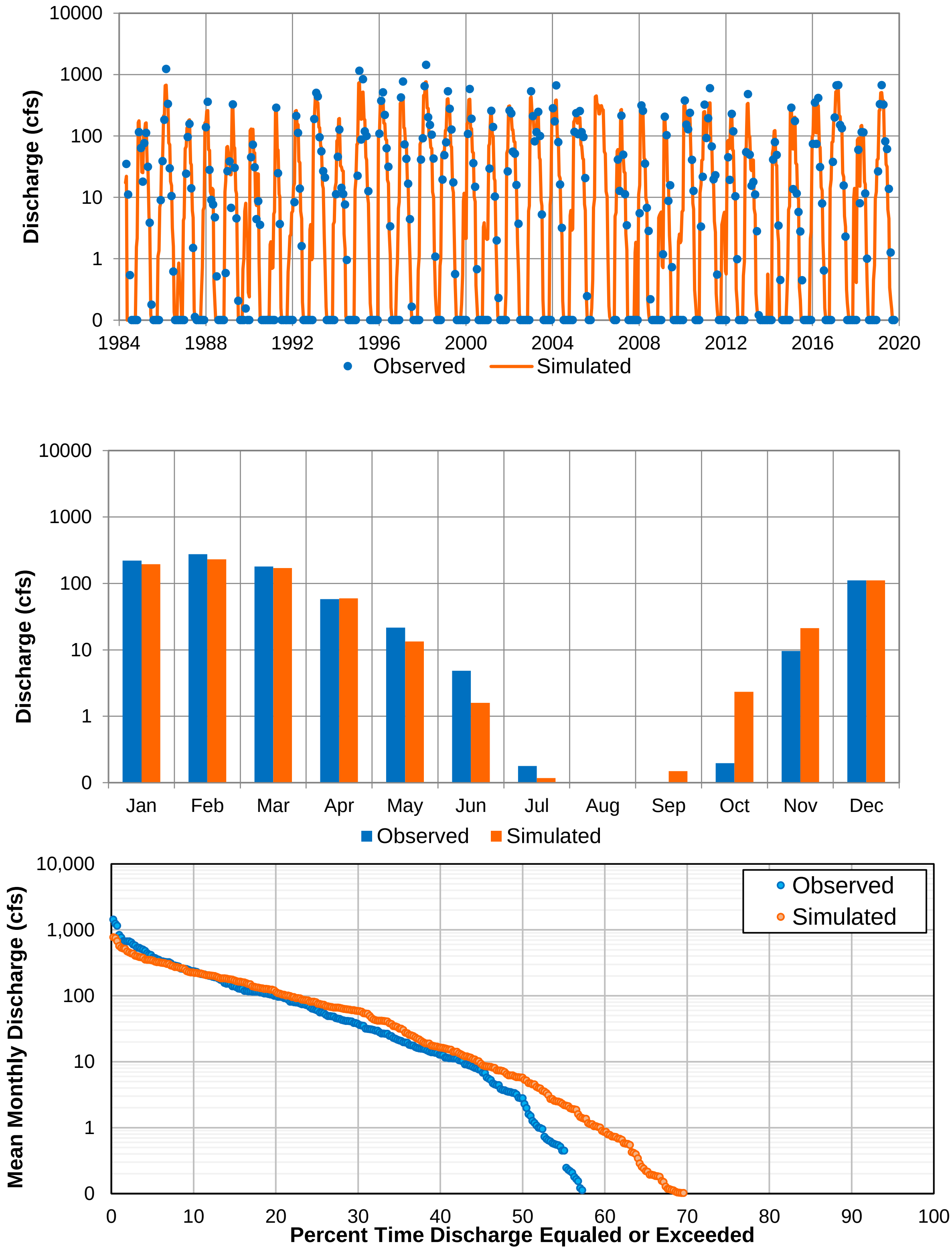
Observed and Simulated Hydrograph, Mean Monthly Flow, and Flow Duration in the DWR Gage at Kelsey Creek

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 4-7



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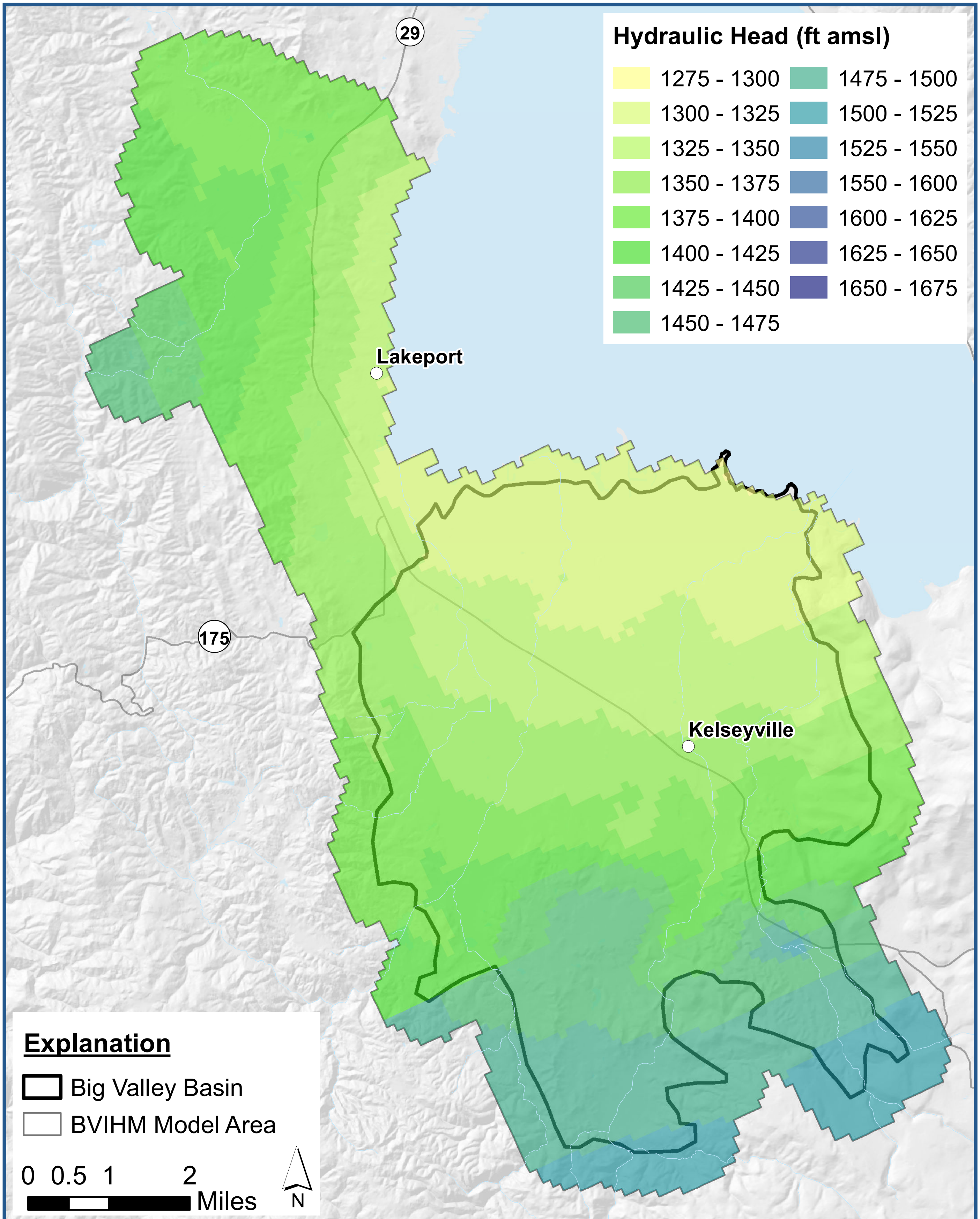
Observed and Simulated Hydrograph, Mean Monthly Flow, and Flow Duration in the DWR Gage at Scotts Creek

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 4-8



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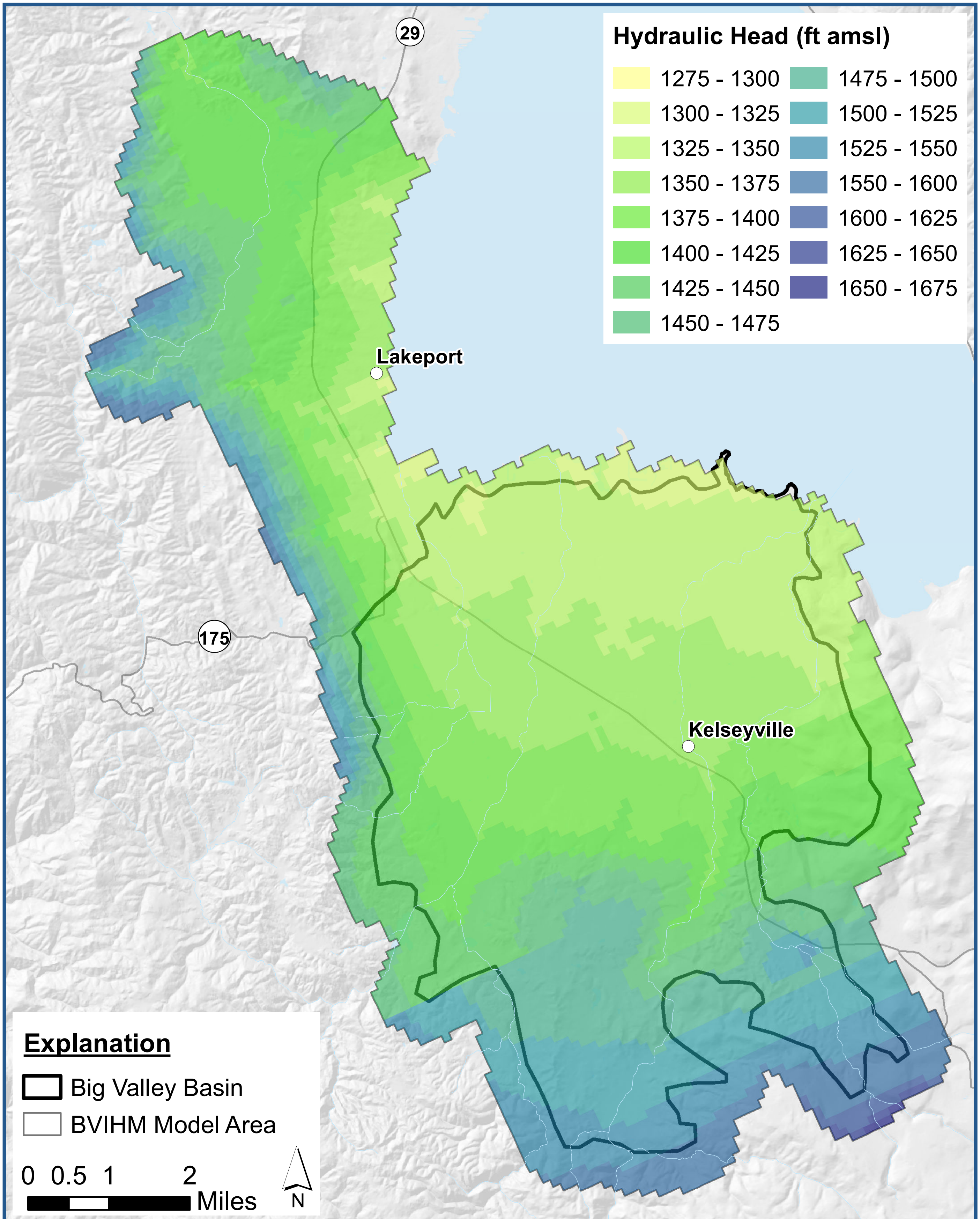
Simulated Water Table Elevation
September 2015

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 4-10



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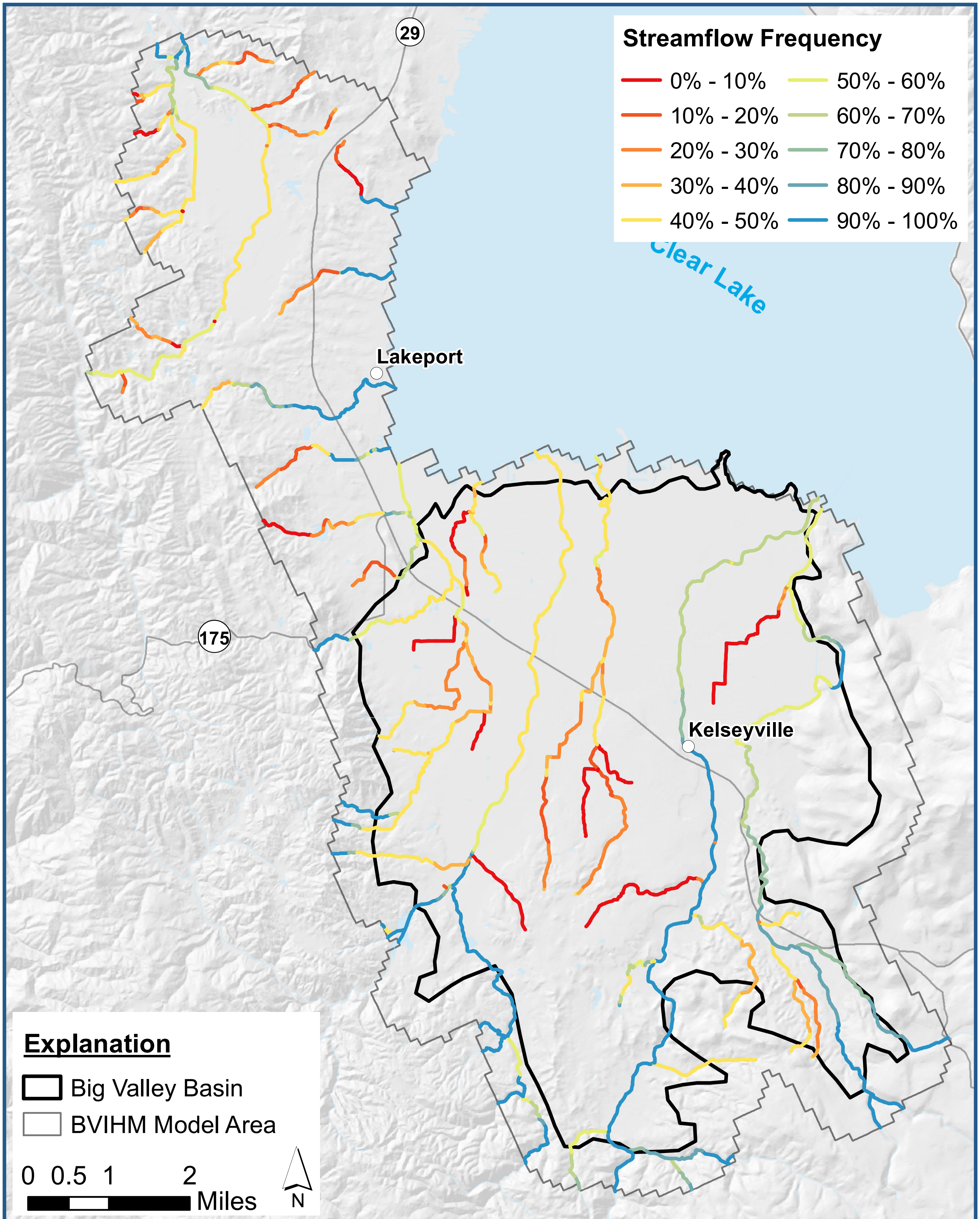
Simulated Water Table Elevation
March 2017

Figure 4-11

Big Valley Groundwater Sustainability Plan
Lake County, California



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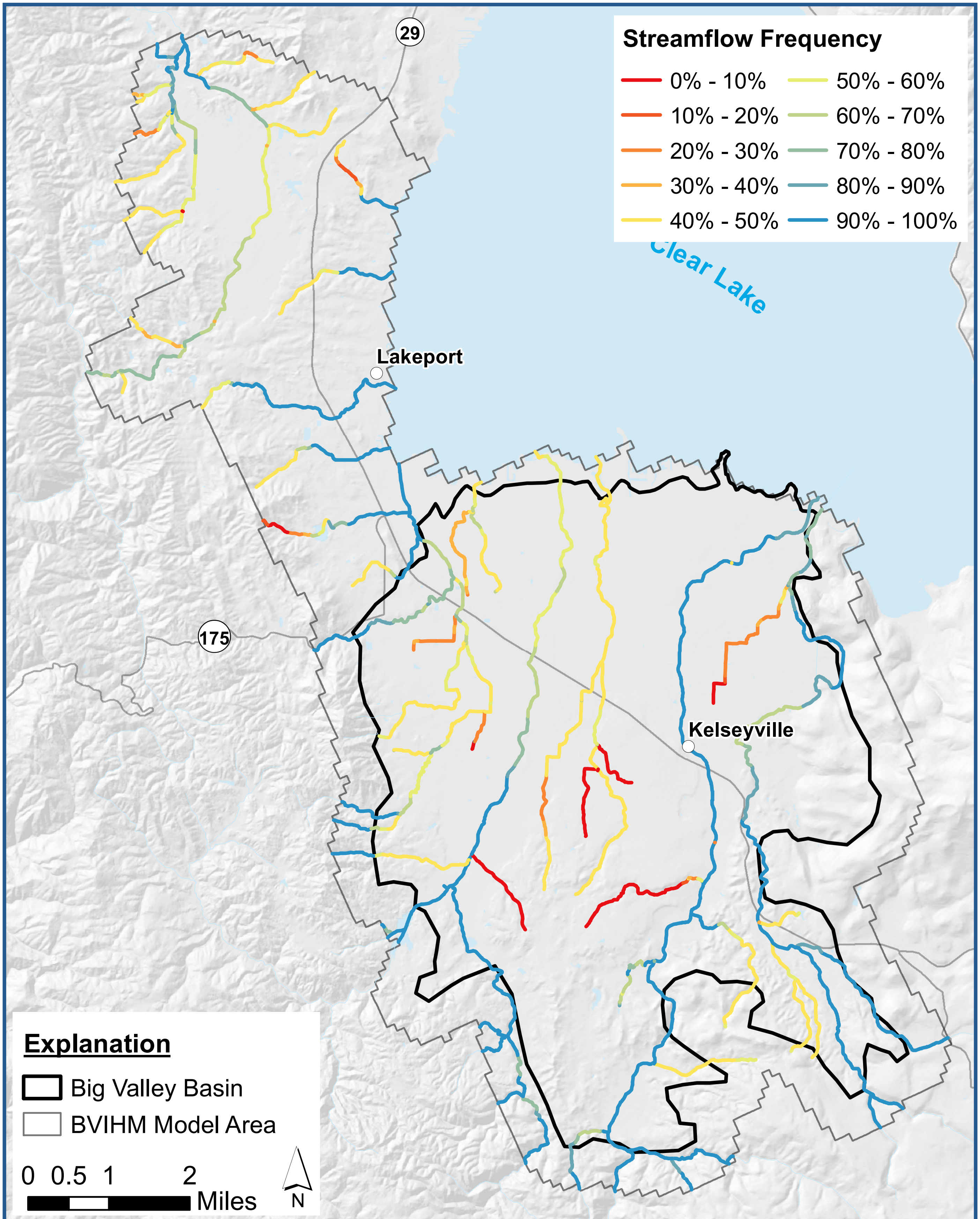
Simulated Streamflow Frequency in the 2015 Calendar Year

Figure 4-12

Big Valley Groundwater Sustainability Plan
Lake County, California



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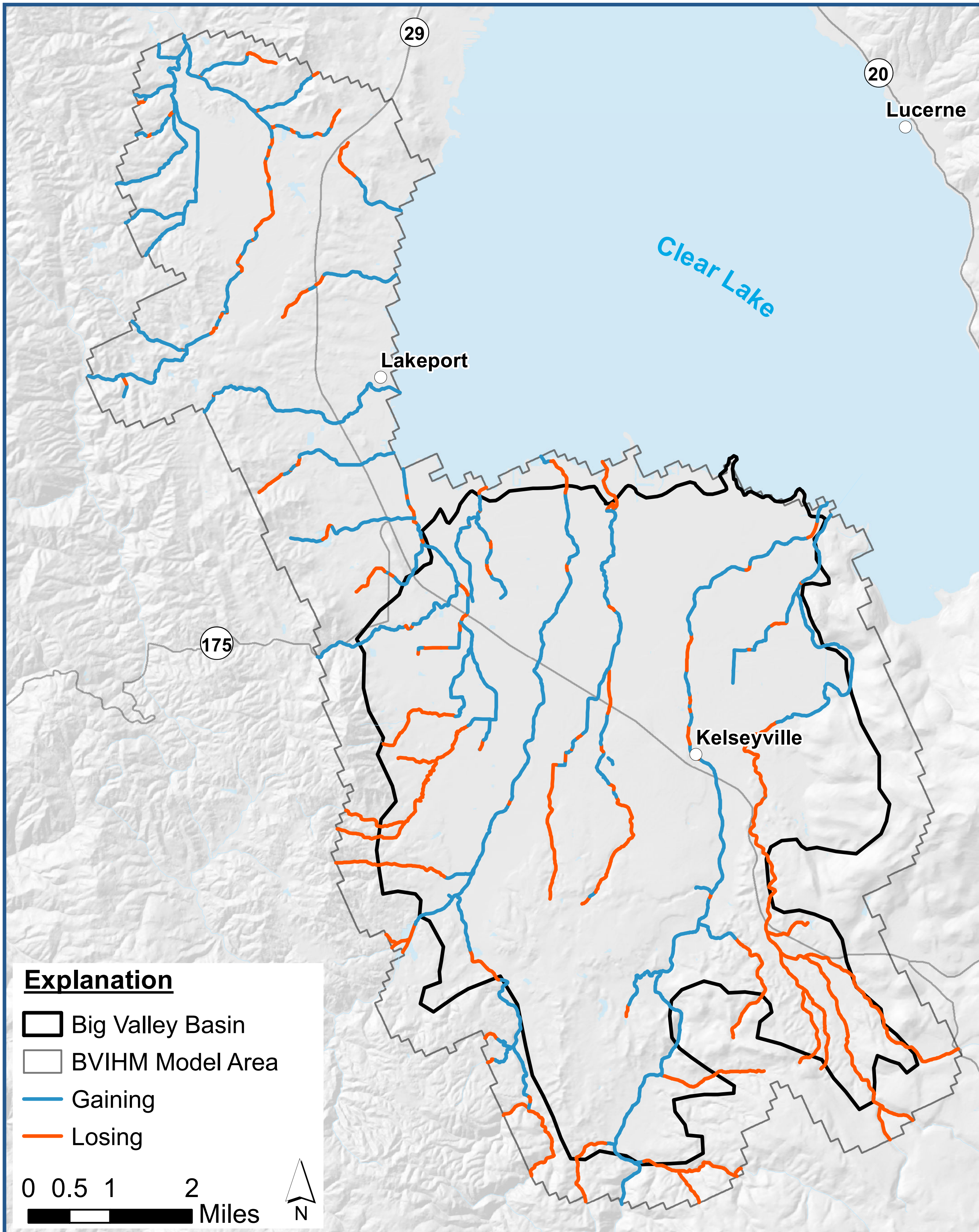
Simulated Streamflow Frequency in the 2017 Calendar Year

Figure 4-13

Big Valley Groundwater Sustainability Plan
Lake County, California



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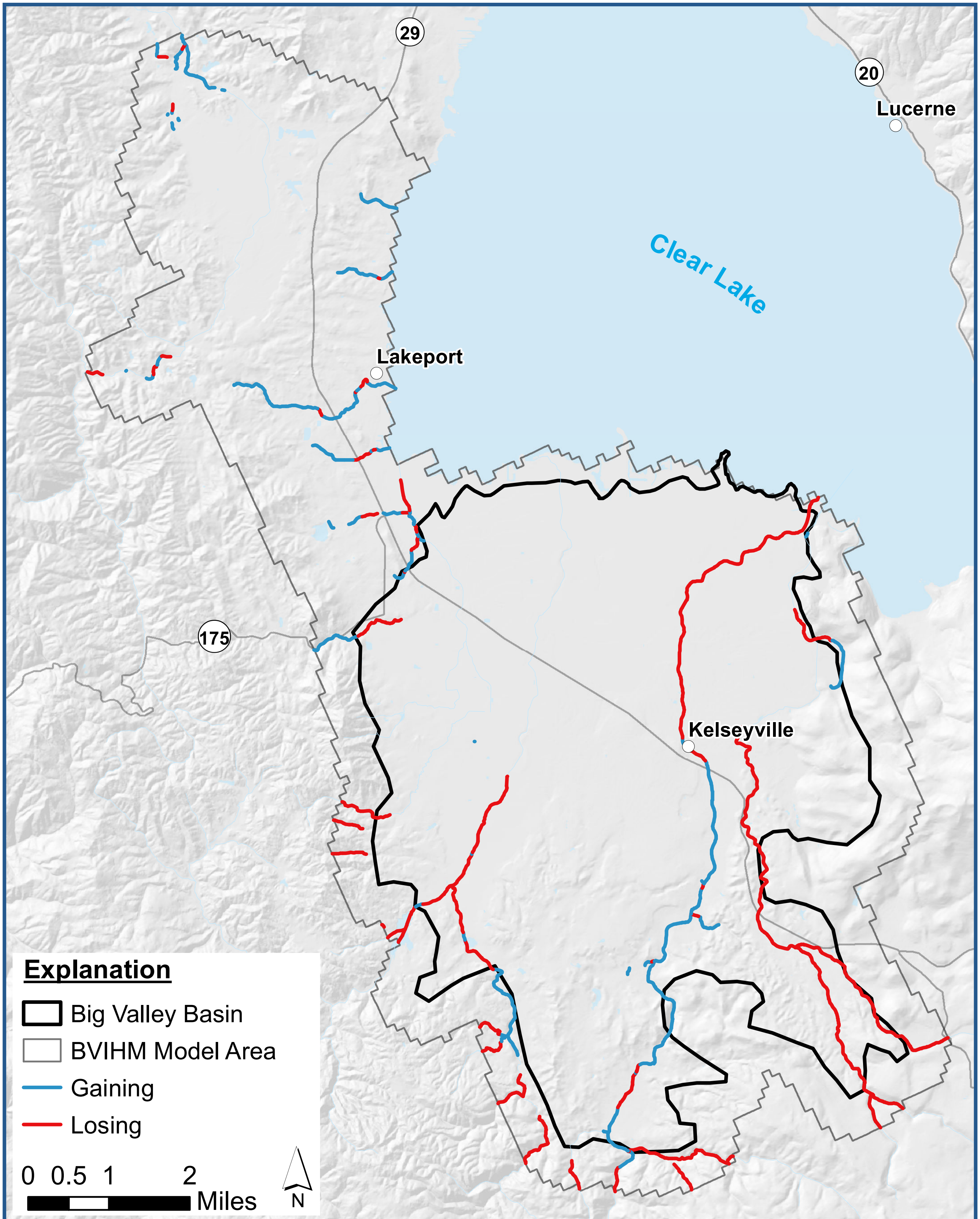
Gaining and Losing Reaches
March 2019

Figure 4-14

Big Valley Groundwater Sustainability Plan
Lake County, California



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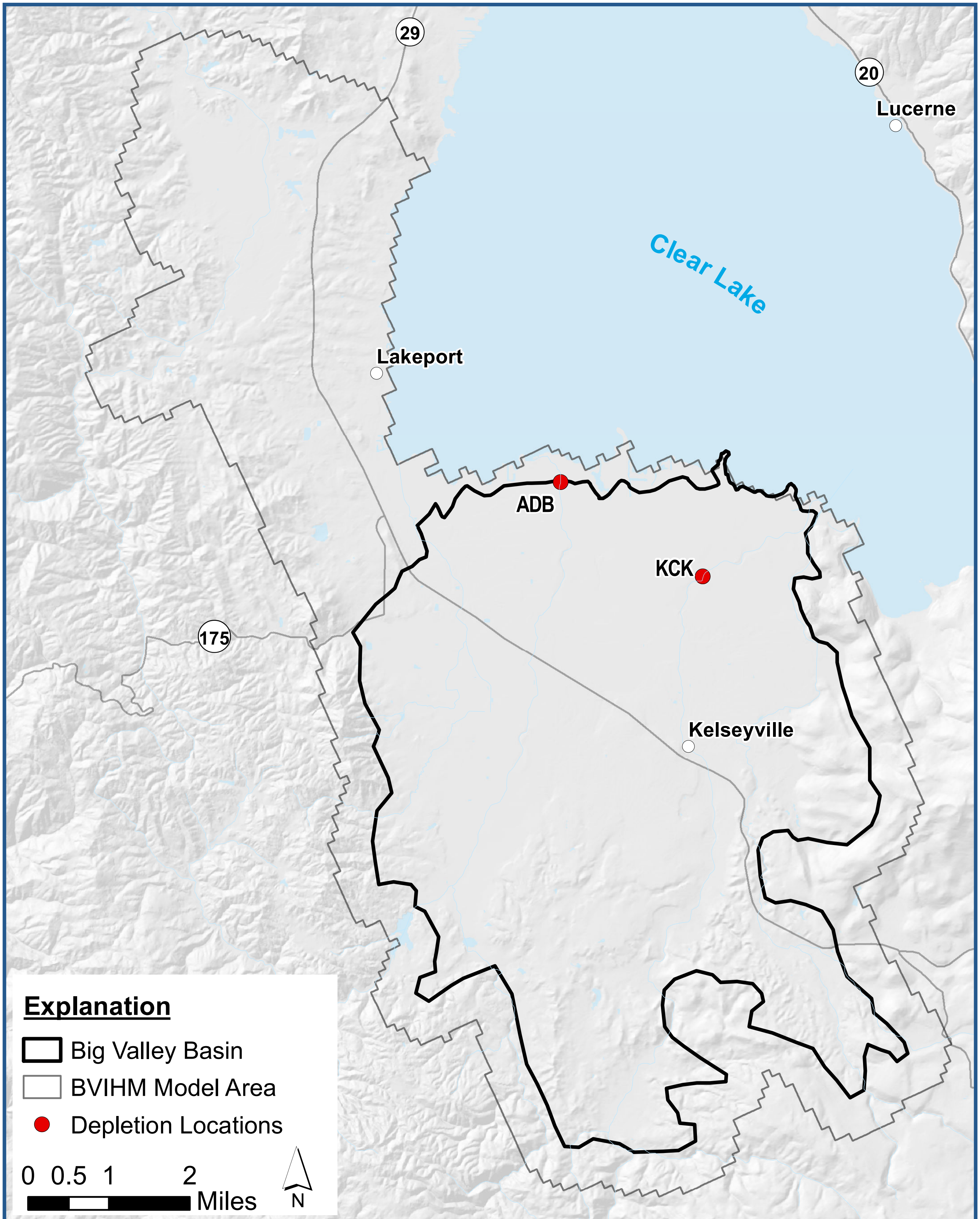
Gaining and Losing Reaches
August 2019

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 4-15



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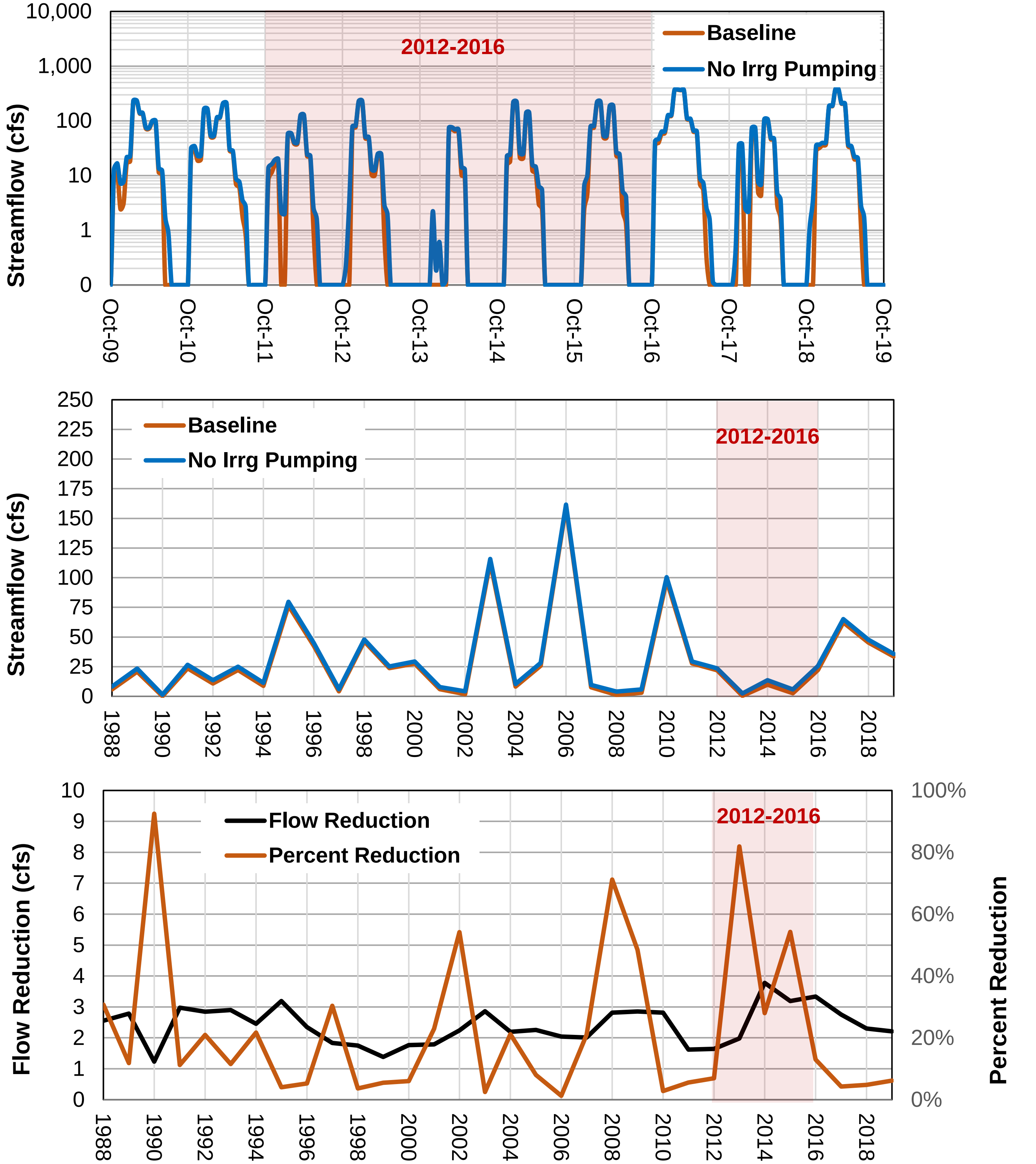
Location of Stream Depletion Analysis Locations

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 4-16



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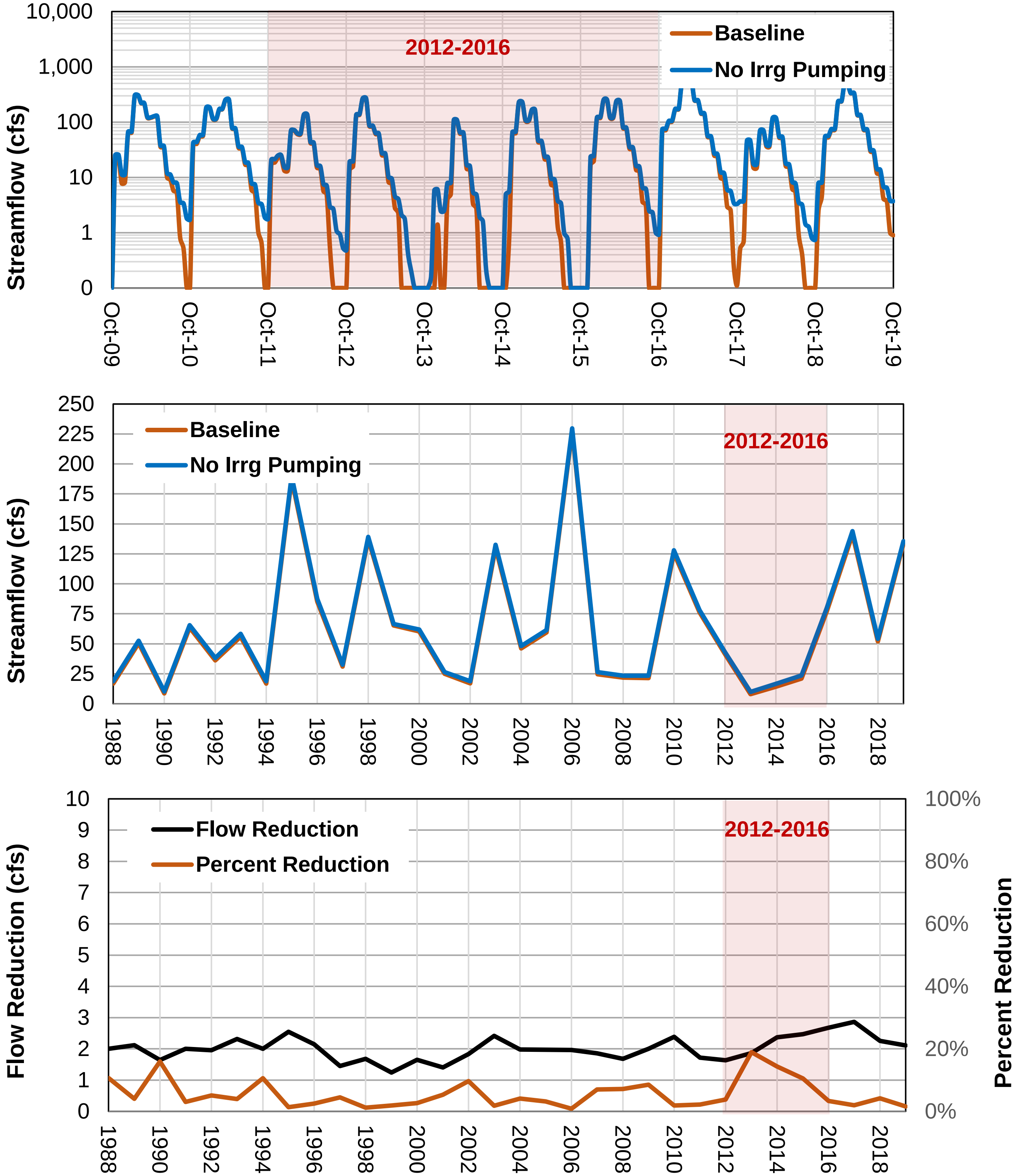
Baseline and No Irrigation Pumping Hydrograph, April Flow, and April Flow Reduction in Adobe Creek

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 4-17



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Baseline and No Irrigation Pumping Hydrograph, April Flow, and April Flow Reduction in Kelsey Creek

Figure 4-18

Big Valley Groundwater Sustainability Plan
Lake County, California

5. MODEL PROJECTIONS

The numerical model was used to simulate projected groundwater conditions over the 50-year planning horizon used for GSP development. Predictive scenarios were developed to conduct the projected water budget assessment which is reported in **Section 3** of the GSP. Accordingly, predictive model scenarios were developed using guidelines outlined in the DWR Modeling BMP (DWR, 2016).

Model scenarios represents a forward in time projection of hydrologic conditions based on results from the calibrated model. As a result, projected model setup utilizes the hydrogeologic framework, structure and parameter values described earlier in the technical memorandum. The model period selected for the predictive scenario spans from the end of the calibrated model period (WY 2019) through the 50-year GSP planning horizon ending in the 2070 water year. The 51-year period (WY 2020 through WY 2070) was discretized into 612 monthly stress periods with each stress period subdivided equally into two timesteps. Initial conditions for projected models were extracted from the calibrated model results from the end of the 2019 water year.

5.1. Baseline Projection (Scenario A)

A baseline model was developed to serve as a comparative benchmark for predictive scenarios and analysis of climate change. Scenario A relies on historic hydrologic data from a 50-year period as outlined in Water Code §354.18(c)(3)(A):

"Projected hydrology shall utilize 50 years of historical precipitation, evapotranspiration, and streamflow information as the baseline condition for estimating future hydrology. The projected hydrology information shall also be applied as the baseline condition used to evaluate future scenarios of hydrologic uncertainty associated with projections of climate change and sea level rise."

Accordingly, Scenario A relies on hydrologic and water supply data from a 50-year historic period spanning from WY 1969 through WY 2019 (WY 2020 through WY 2070). This time frame includes a combination of wet and dry periods used to evaluate the basin water budget response to variable hydrologic stresses. During periods where no historic data is available (dependent on data source), values were assigned from surrogate water years using similar hydrologic year types determined from annual precipitation measured at the Kelseyville.

5.1.1. Climate

Monthly precipitation and potential evapotranspiration data were derived from historical data developed by the PRISM Climate Group and included in the BCM data release (Flint et al., 2021; http://prism.oregonstate.edu). The model utilized climate data from the 1969 through 2019 water years (corresponding to projected WY 2020 through WY 2070). Projected annual precipitation and PET are shown in **Figure 5-1**. With respect to precipitation, the projection includes three notable dry periods corresponding to droughts in 1976-1977, 1986-1994 and 2012-2016. PET is more stable and doesn't show any notable trends in cooling or warming. The climate response in assigned lake levels in Clear Lake are shown in **Figure 5-2**.

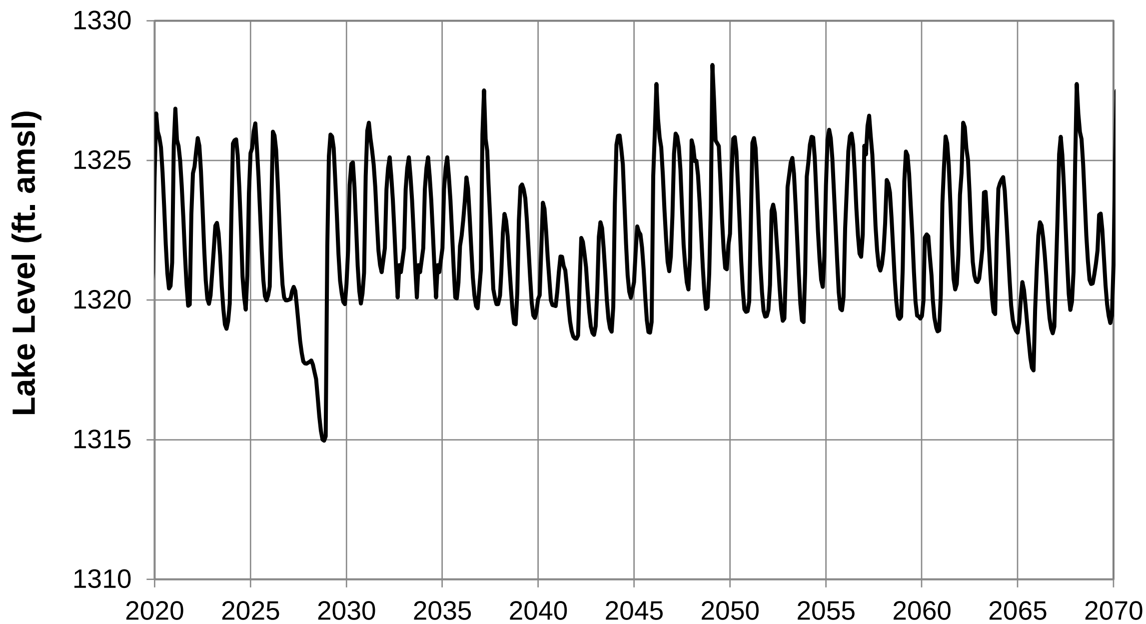


Figure 5-2. Projected Lake Levels (WY 2020-2070)

5.1.2. Land Use

Projected land use was derived from the most recent land use dataset specified in the calibrated model from 2018 shown in **Figure 3-13**. Section §354.18(c)(3)(B) of the water code states that:

"Projected water demand shall utilize the most recent land use, evapotranspiration, and crop coefficient information as the baseline condition for estimating future water demand. The projected water demand information shall also be applied as the baseline condition used to evaluate future scenarios of water demand uncertainty associated with projected changes in local land use planning, population growth, and climate."

Consultation with the Lake County Farm Bureau as well as past population trends were also considered in developing the projected dataset to evaluate the impacts of expected land use changes within the Basin. Based on input from the Farm Bureau, it was determined that agriculture is likely to decline to some extent in the future but is largely uncertain. In order to provide a conservative assessment, it was assumed that croplands would not decline during the SGMA planning and implementation period. A similar rationale was taken for establishing population trends and urban footprint which influences indoor self-supplied water demand and the landscaping footprint.

5.1.3. Water Supply

Section §354.18(c)(3)(C) of the water code states that:

"Projected surface water supply shall utilize the most recent water supply information as the baseline condition for estimating future surface water supply. The projected surface water supply shall also be applied as the baseline condition used to evaluate future scenarios of surface water supply availability and reliability as a function of the historical surface water supply identified in Section 354.18(c)(2)(A), and the projected changes in local land use planning, population growth, and climate."

Projected PWS water supply from groundwater and surface water from Clear Lake was projected using wet and dry year mean-monthly averages from the water supply data reported to the EAR system from 2013-2019. In-stream diversions were projected using the monthly mean of the available data from eWRIMS database. Notably, projected in-stream diversions in dry years will be curtailed based on the available streamflow in diversion reaches. Projected Clear Lake water levels are shown in **Figure 5-2**.

5.2. Climate Change

Uncertainty due to climate change was evaluated in accordance with Section 354.18(c)(3) of the GSP regulations and rely on downscaled outputs from global circulation models (GCM) recognized by the California Fourth Climate Change Assessment (Pierce et al., 2018). Selection of climate models used to develop model inputs was informed by discussion and coordination with the DWR, USGS and Pepperwood Preserve. Based on discussion, it was determined that locally downscaled results from two GCMs are the most suitable for evaluating the anticipated range in future climate in the Big Valley Basin. These include:

- CNRM-CM5–RCP45 (CNRM). This model was developed by the Centre National de Reserches Meteorologiques (CNRM) and Centre Europeen de Reserches et de Formation Avancee en Calcul Scientifique (CERFACS) which simulates cool and wet future conditions.
- HadGEM2-ES-RCP85 (HadGEM). This model was developed by the Met Office Hadley Center and simulates warm and dry future conditions.

These models align with the "Wet and Moderate Warming" (WMW) and "Dry with Extreme Warming" (DEW) model scenarios provided in the climate change guidance document prepared by DWR for developing climate change related inputs for GSP development (DWR, 2018). They are also included in a suite of models developed by the USGS using the BCM, which were readily available for GSP preparation. These models were used to develop future projections of climate (precipitation and PET), tributary inflow and surface water supply.

5.2.1. CNRM-CM5–RCP45 Wet with Moderate Warming (Scenario B)

5.2.1.1. Climate

Monthly precipitation and potential evapotranspiration were derived from the 270-meter CNRM climate projection developed by the USGS for the BCM (Flint et al., 2021). As the raw CNRM data lack the resolution for modeling on the watershed scale, data were downscaled, and bias corrected using local correction factors derived from the historical mean and variance of climate parameters (Flint and Flint, 2013). The 270-meter resolution data were then further downscaled onto the 500-foot resolution BVIHM grid via bilinear interpolation.

The CNRM data show consistently wetter projected conditions than historical **(Figure 5-3**). Projected precipitation for WY2020-2040 averages 50 inches per year and for 2041-2070 averages 47 inches per year compared to the historical 1950-2019 average of 38 inches per year in Kesleyville.

The CNRM scenario also shows warming conditions resulting an increase in projected PET (**Figure 5-3**). Projected PET for WY2020-2040 averages 48 inches per year and for 2041-2070 averages 49 inches per year compared to the historical 1950-2019 average of 47 inches per year at Kelseyville.

5.2.1.2. Tributary Inflow and Mountain Block Recharge

Projected inflow from tributary streams and mountain block recharge were developed using simulated recharge and runoff from the BCM projection which incorporated climate inputs derived from the CNRM GCM.

5.2.2. HadGEM2-ES-RCP85 – Dry with Extreme Warming (Scenario C)

5.2.2.1. Climate

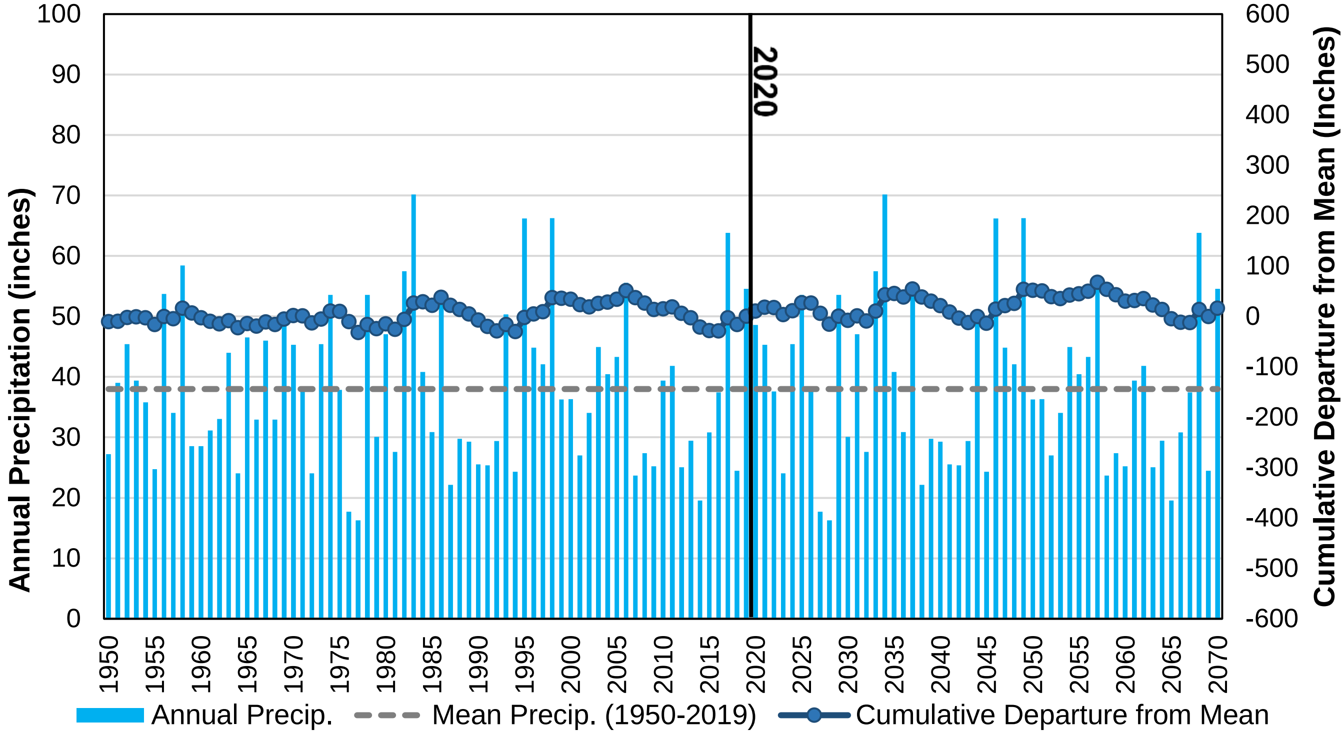
Monthly precipitation and potential evapotranspiration were derived from the 270-meter HadGEM climate projection developed by the USGS for the BCM (Flint et al., 2021). These data were also downscaled from the original coarser-resolution 270-meter BCM output to the BVIHM grid.

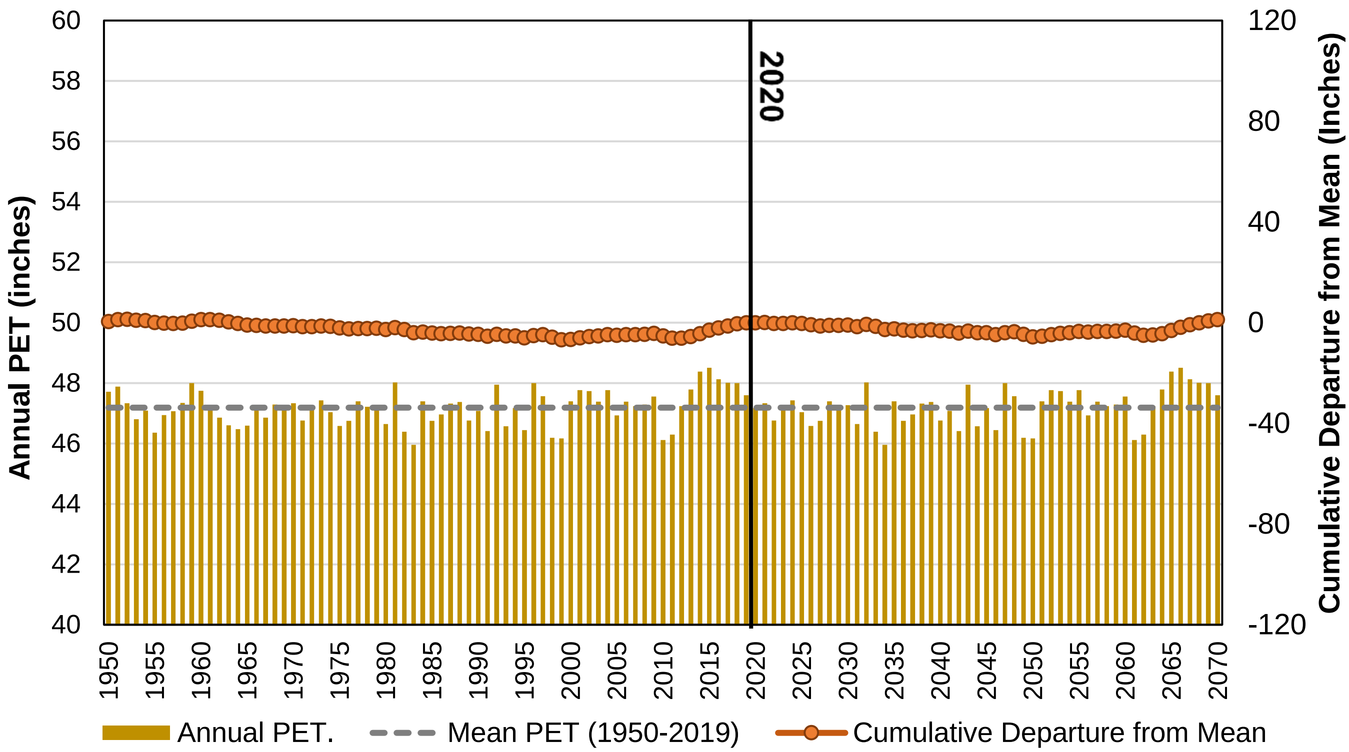
Projected precipitation in the HadGEM scenario is higher than historical throughout much of the projection period (**Figure 5-4**). Projected precipitation for WY2020-2040 averages 41 inches per year and for 2041-2070 averages 35 inches per year compared to the historical 1950-2019 average of 38 inches per year in Kelseyville. However, the HadGEM scenario does show considerably drier than historical precipitation through a prolonged drought period WY2053-2070 (31 inches). Coordination with DWR revealed that this also occurs in the coastal Northern California region in the DEW scenario provided for GSP climate change analysis (also based on the HadGEM GCM).

The HadGEM scenario also shows warming conditions resulting an increase in projected PET (**Figure 5-4**). Projected PET for WY2020-2040 averages 48 inches per year and for 2041-2070 averages 50 inches per year compared to the historical 1950-2019 average of 47 inches per year in Kelseyville.

5.2.2.2. Tributary Inflow and Mountain Block Recharge

Projected inflow from tributary streams and mountain block recharge were developed using simulated recharge and runoff from the BCM projection which incorporated climate inputs derived from the HadGEM GCM.





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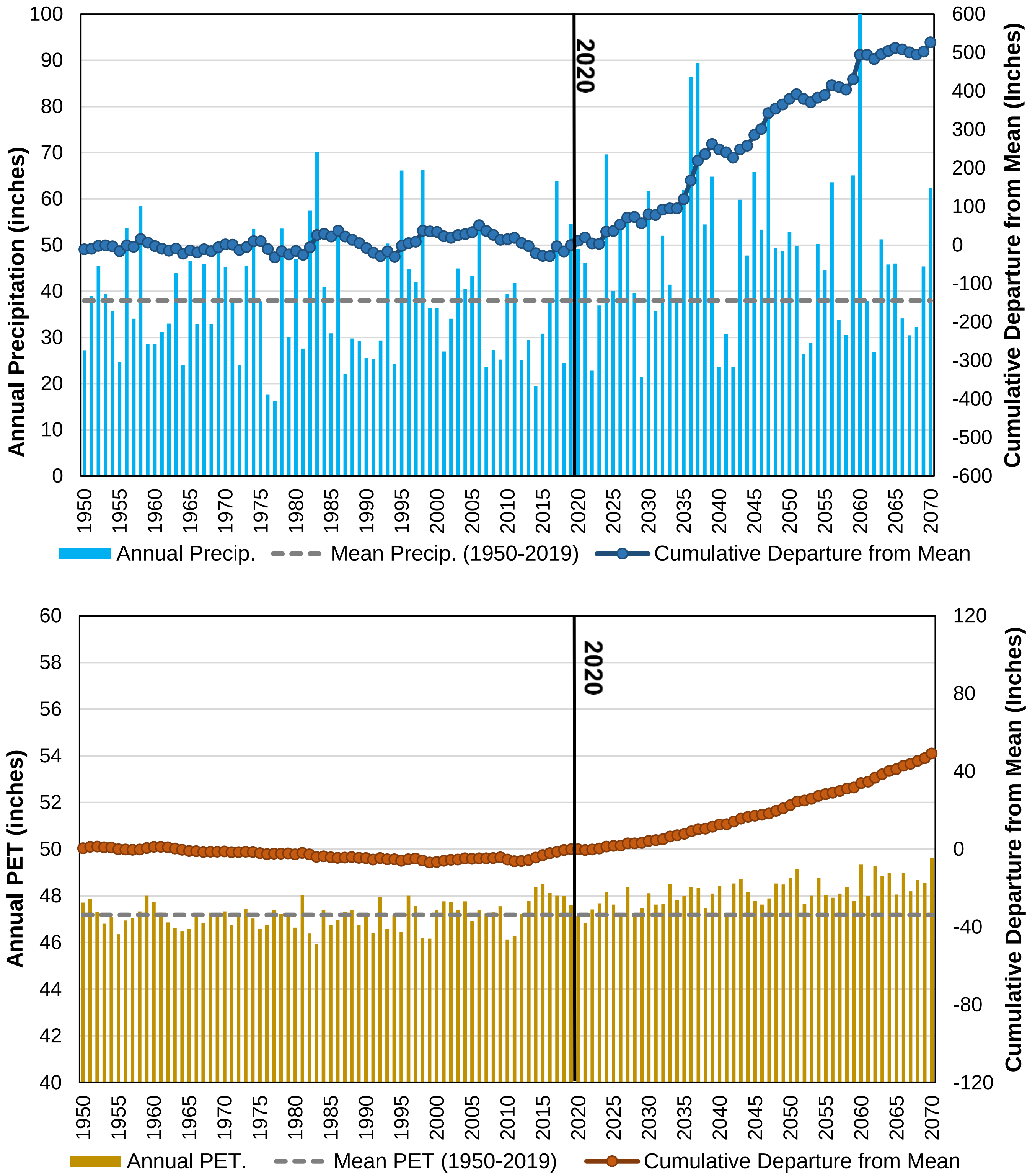
Historical and Projected Precipitation and PET at Kesleyville
Basin Characterization Model (1950-2070)

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 5-1



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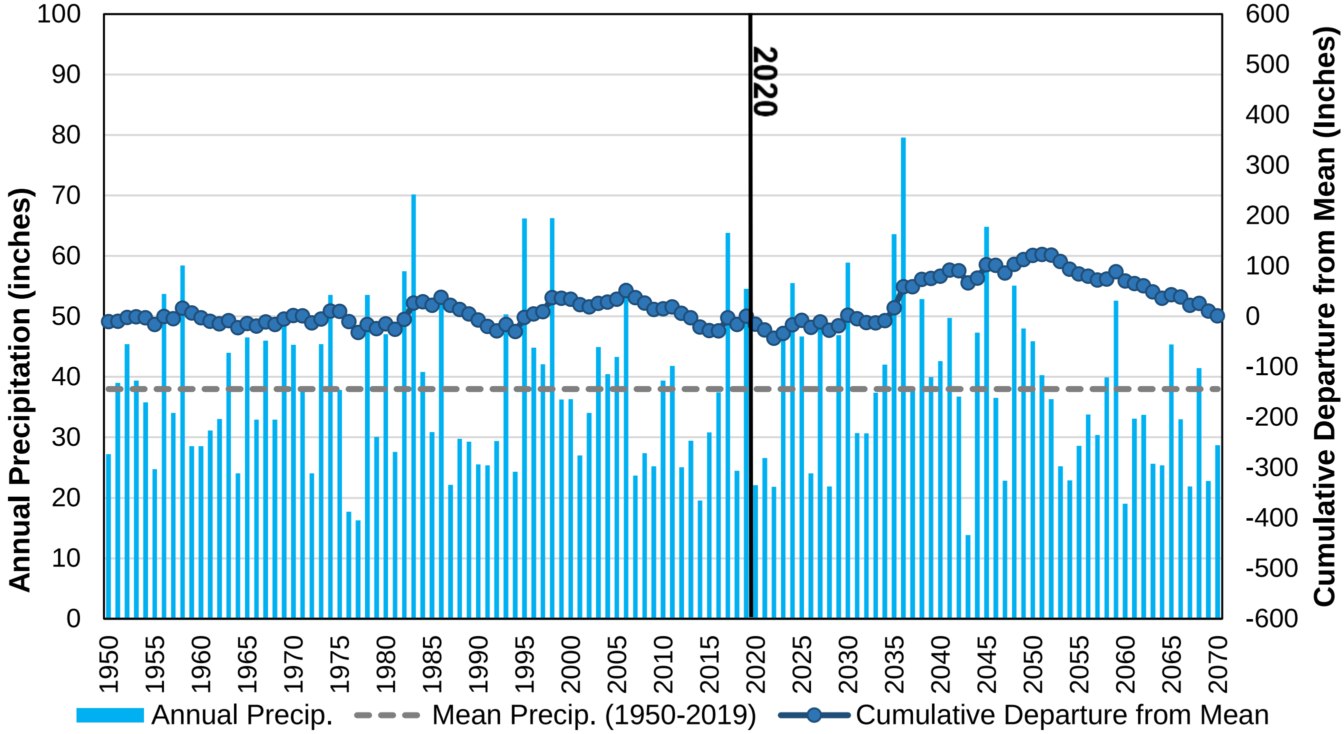
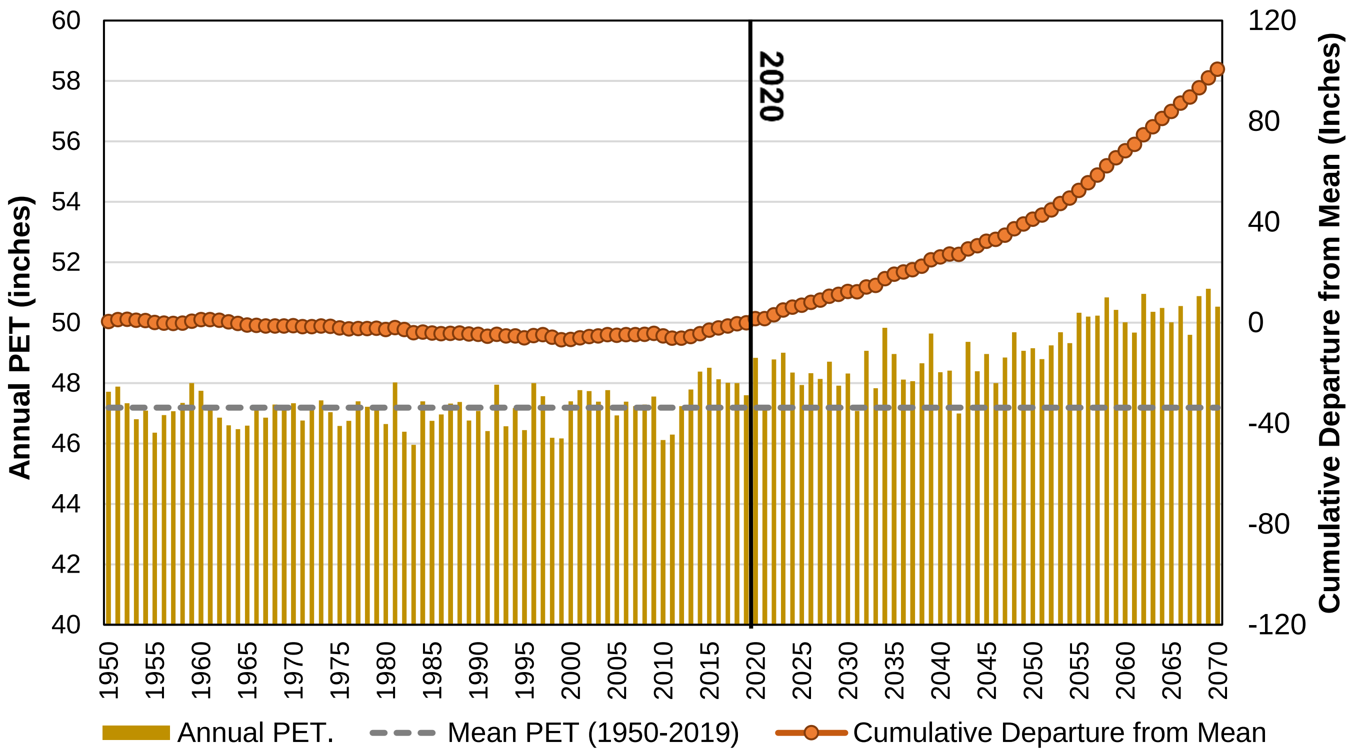
Historical and CNRM Precipitation and PET at Kesleyville Basin Characterization Model (1950-2070)

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 5-3





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Historical and HadGEM Precipitation and PET at Kesleyville
Basin Characterization Model (1950-2070)

Big Valley Groundwater Sustainability Plan
Lake County, California

Figure 5-4

6. MODEL LIMITATIONS AND RECOMMENDATIONS

A summary of model limitations and recommendations for improving the numerical model are presented below.

6.1. Model Limitations

Numerical groundwater models are created based on simplified assumptions used to replicate complex natural systems. Consequently, results are generally subject to errors and limitations due to conceptual misunderstandings of the hydrologic system and uncertainties in estimating model inputs. These uncertainties are often due to both spatial and temporal limitations in observation data and the types of observation data available. Key limitations identified during model development include:

- Groundwater extraction rates are not well constrained. Groundwater pumping was estimated based on the residual water demand for irrigation within the landscape system derived from best estimates of crop coefficients PET modeled on statewide scale. Several factors including rooting depths and changes in soil moisture could also influence crop water demand leading to even larger errors (likely about 15-20%).
- The model was constructed using the end-member approach for alluvium on the regional scale and relatively large hydrologic zones to represent volcanic and undifferentiated basement units. As a result, the model may not reproduce local scale conditions.
- Estimates of hydraulic parameters are informed through fitting the model to observed water levels and streamflow through the process of model calibration. As a result, aquifer parameter estimates are informed by the model calibration process and not constrained by field measurements.
- The zonation of hydrogeologic units in the model is coarse and based on limited data. This could lead to some errors in simulated groundwater gradients and associated water budgets.

6.2. Recommendations for Model Updates and Refinement

A key advantage of numerical modeling is that through the integration of data and hydrologic processes it enables scientists and managers to identify key data gaps and limitations in the hydrogeologic conceptualization. Recommendations for data collection and model updates and refinement are described below:

- Estimates of measured pumping and irrigation could substantially improve the calculation of water budget components and help better constrain estimates of sustainable yield. Groundwater pumping is the largest outflow component of the groundwater budget and (if measured) could be used to substantially reduce uncertainty in the water budget.

Measured fluxes can also substantially reduce parameter uncertainty and model non-uniqueness as opposed to relying solely on groundwater levels and streamflow observations.

- Enhancement of the streamflow monitoring network can be used to better estimate model parameters and help constrain stream-aquifer interaction and estimates of stream depletion. This should be coupled with refinements to stream properties within the model with respect to streambed elevation and stage dependent channel geometry.
- Aquifer test data would provide additional information to better constrain aquifer parameters and could be readily acquired and incorporated into the model. These data can be directly incorporated into the parameter estimation routine through the process of regularization to increase model certainty and reduce non-uniqueness. These measurements may also inform further refinements in the hydrogeologic conceptualization and delineation of hydrostratigraphic zones.
- Local estimates of crop coefficients based on measured or remotely sensed Evapotranspiration and local measurements of PET to bias correct PET arrays will improve the simulation of landscape processes and help limit uncertainty in resulting budgets.
- Refinement to the SFR package to implement either 8-point channel cross sections (iCalc = 2) or flow-depth-width relationship (iCalc = 4) will improve the simulation of stream-aquifer interaction. These options will enable streambed conductance to vary with stage which could influence the volumetric rate of exchange between the aquifer and streams.

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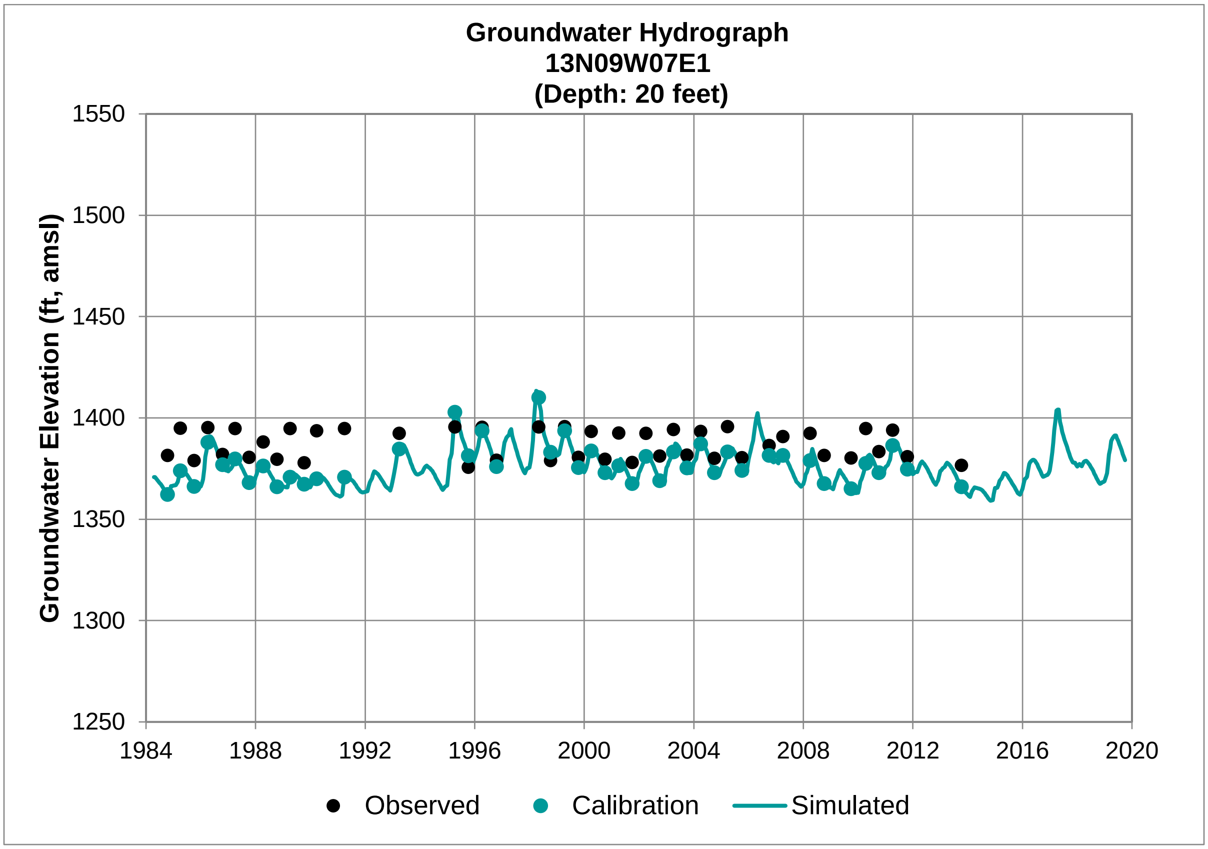
APPENDIX A

GROUNDWATER HYDROGRAPHS

1 BIG VALLEY BASIN


Groundwater Hydrograph
13N09W07E1
(Depth: 20 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
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1300
1250
1984
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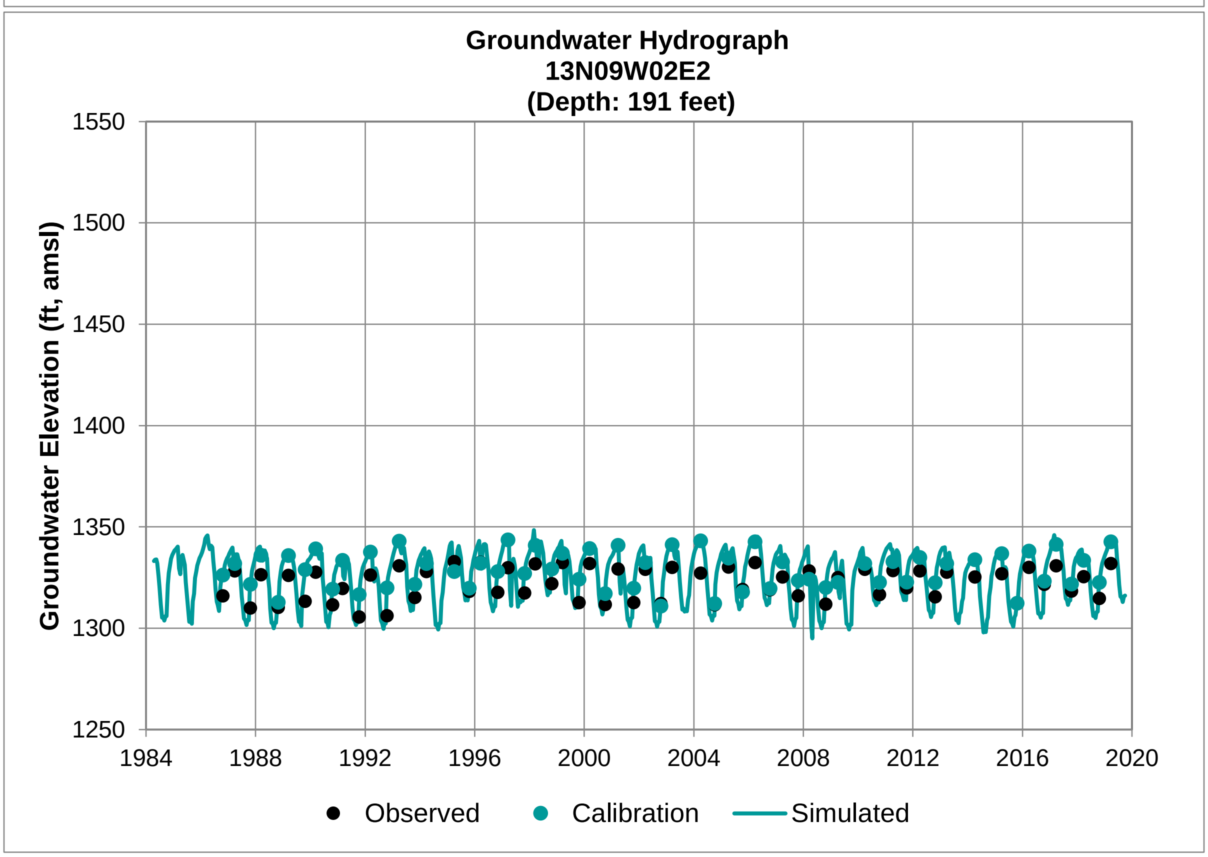
2016
2020
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W02E2
(Depth: 191 feet)
Groundwater Elevation (ft, amsl)
1550
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1450
1400
1350
1300
1250
1984
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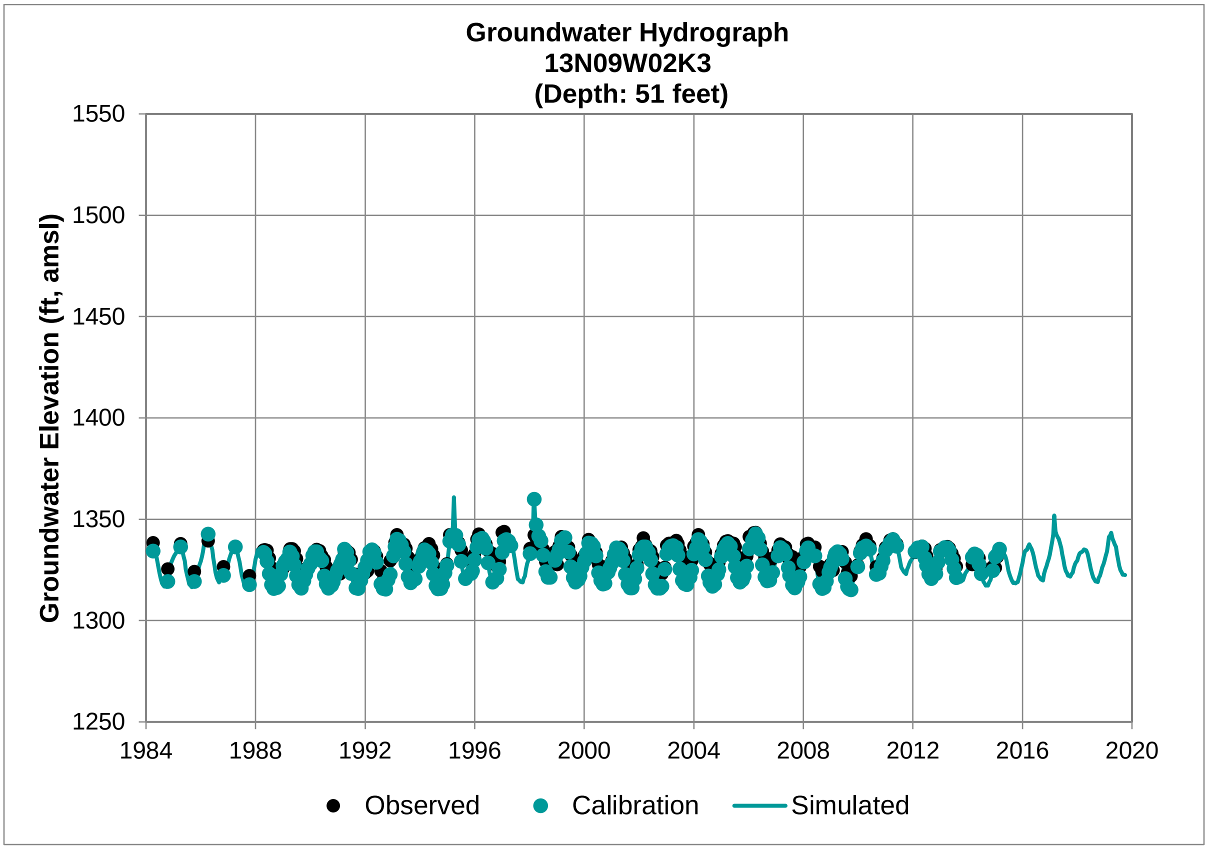
2020
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W02K3
(Depth: 51 feet)
Groundwater Elevation (ft, amsl)
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1450
1400
1350
1300
1250
1984
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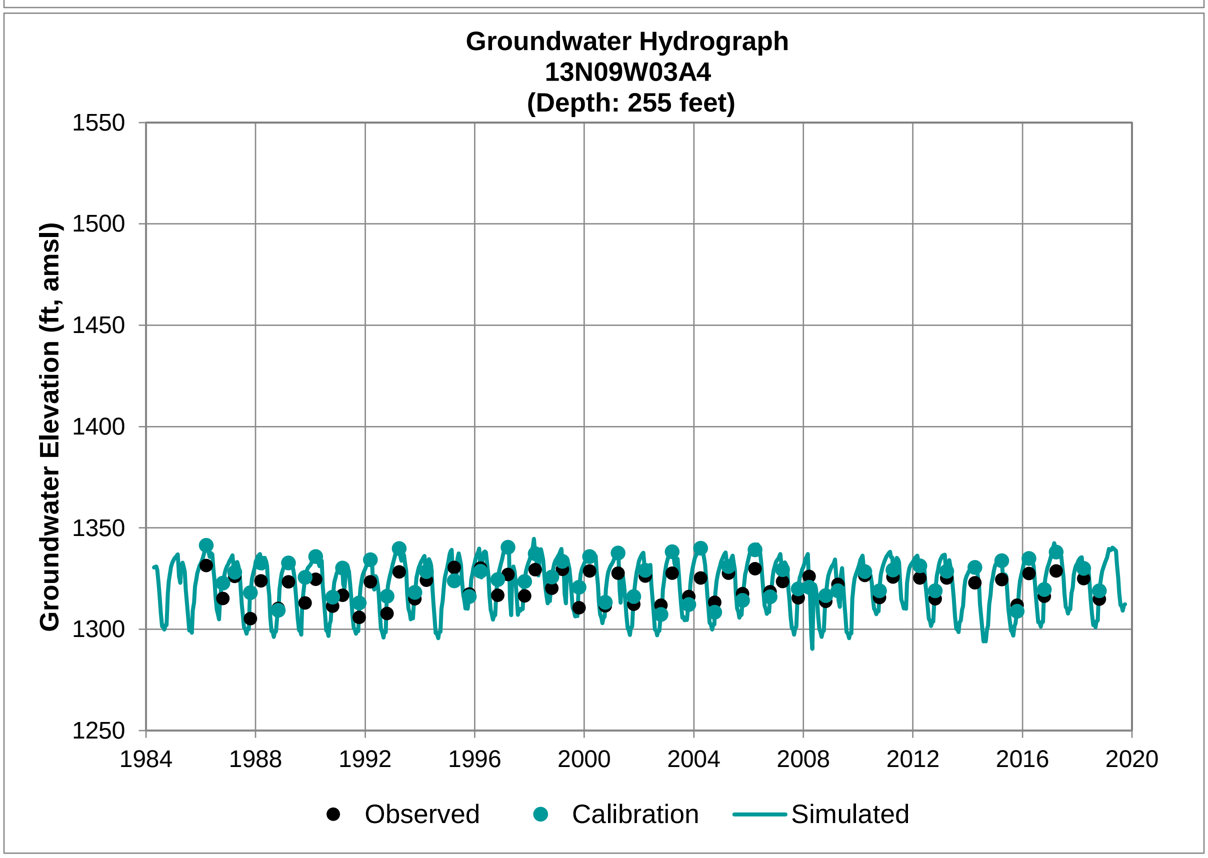
2020
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W03A4
(Depth: 255 feet)
Groundwater Elevation (ft, amsl)
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1450
1400
1350
1300
1250
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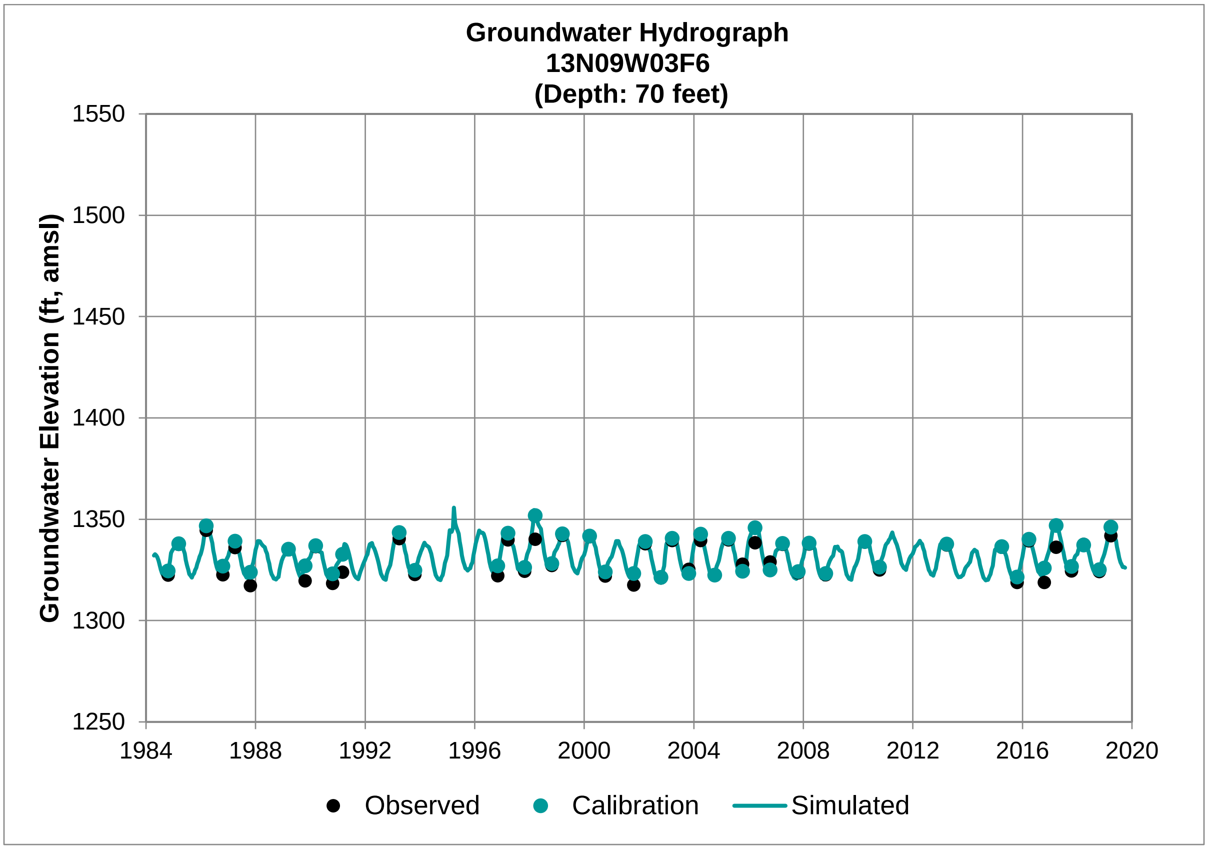
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W03F6
(Depth: 70 feet)
Groundwater Elevation (ft, amsl)
1550
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1450
1400
1350
1300
1250
1984
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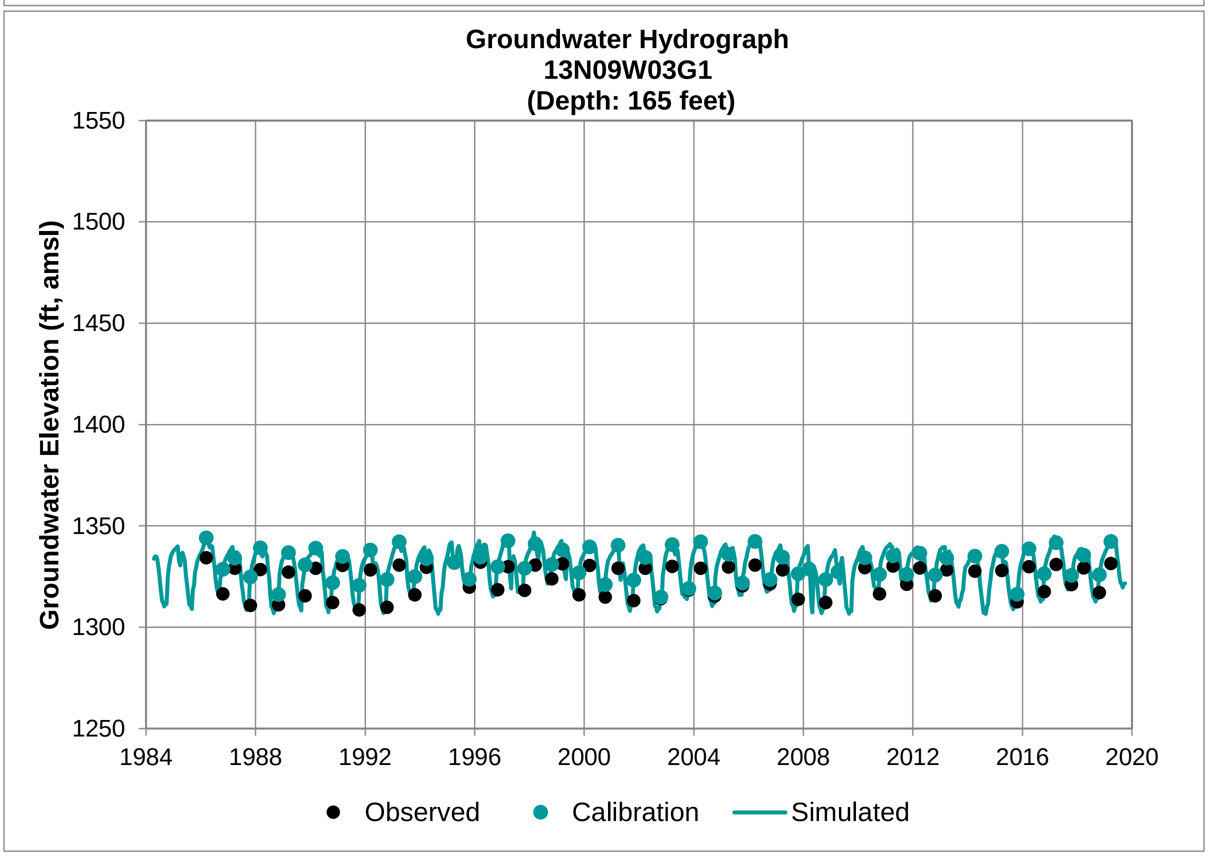
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W03G1
(Depth: 165 feet)
Groundwater Elevation (ft, amsl)
1550
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1450
1400
1350
1300
1250
1984
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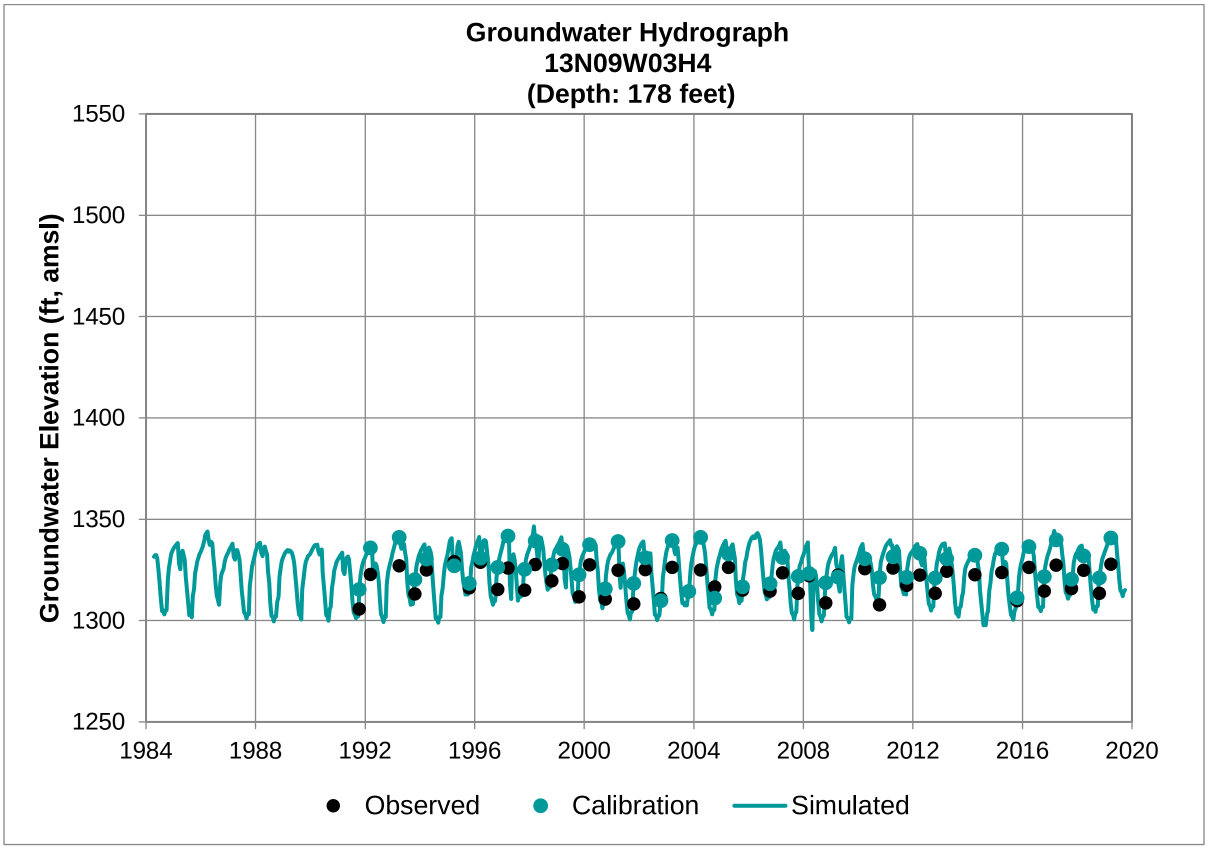
Observed
Calibration
Simulated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13N09W03H4
(Depth: 178 feet)
Groundwater Elevation (ft, amsl)
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1500
1450
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1300
1250
1984
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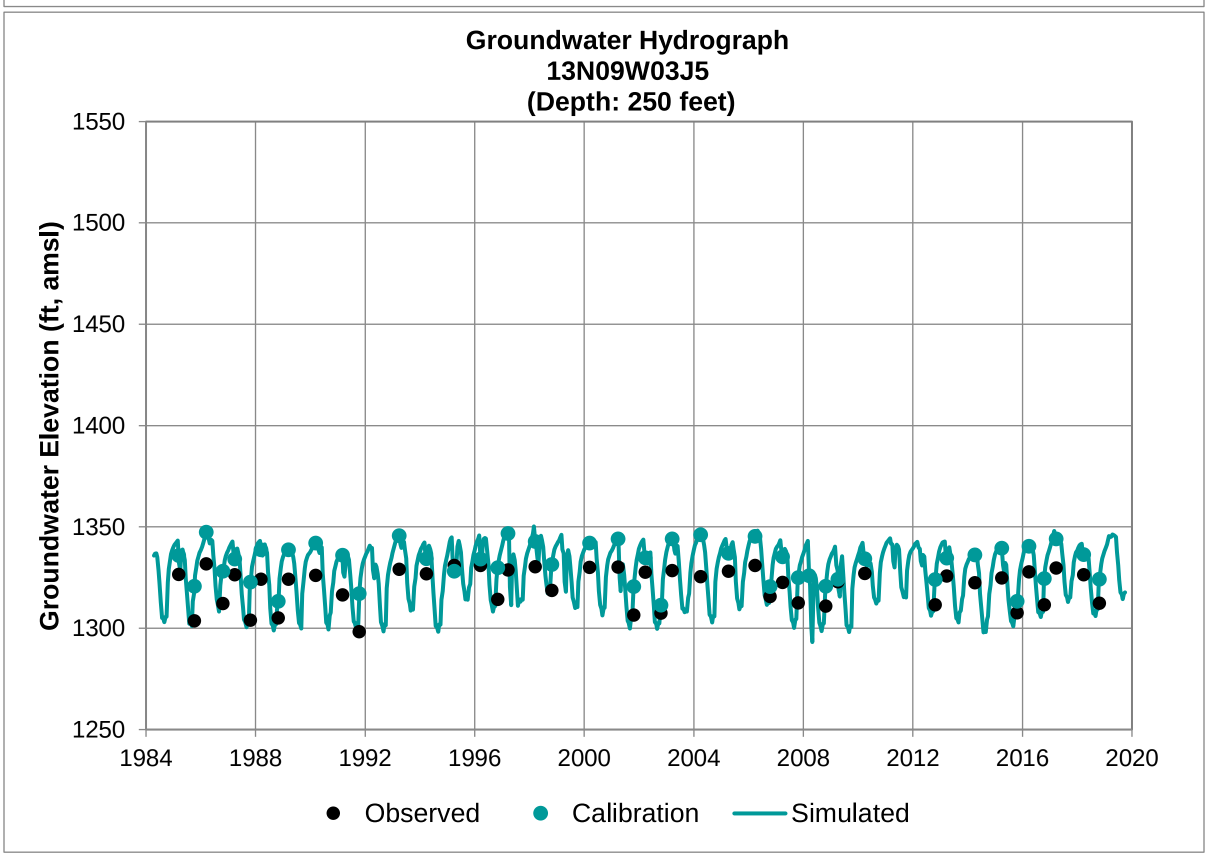
2020
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W03J5
(Depth: 250 feet)
Groundwater Elevation (ft, amsl)
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1500
1450
1400
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1300
1250
1984
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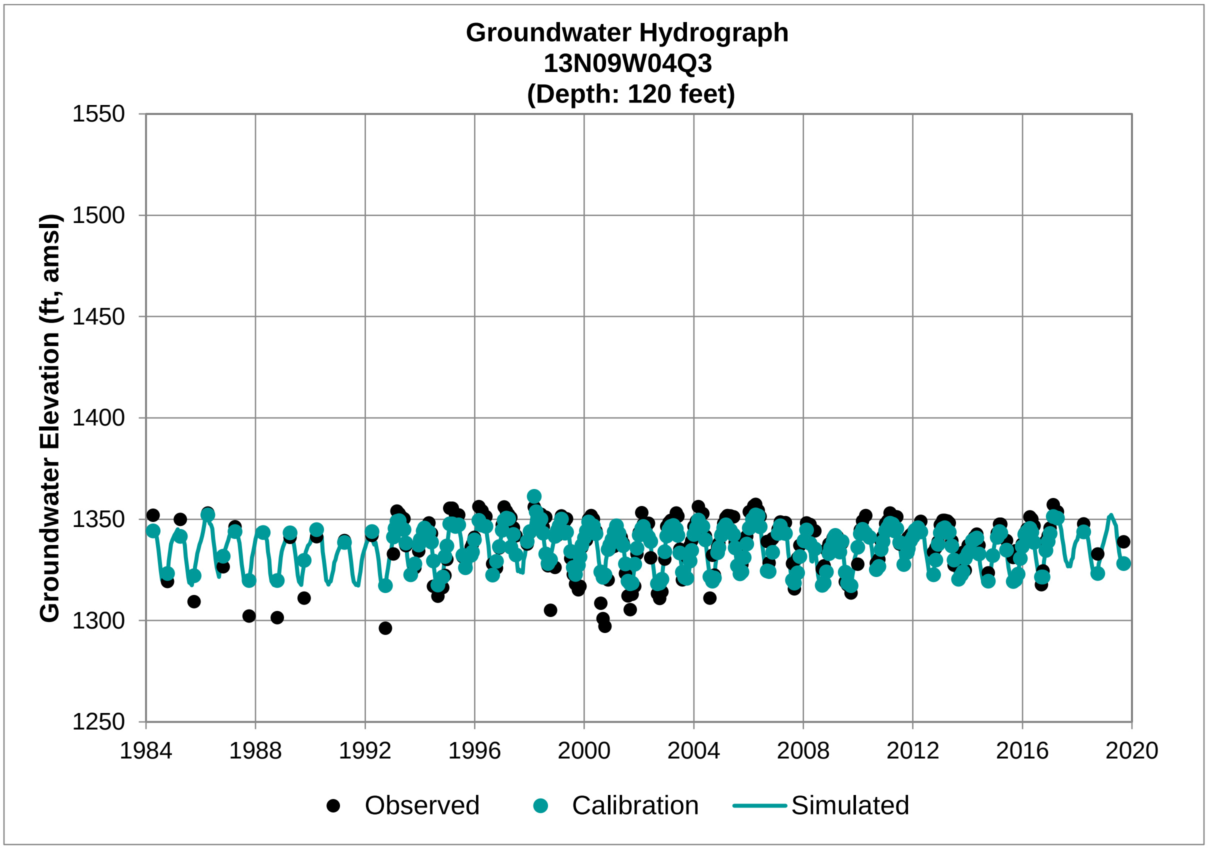
2020
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W04Q3
(Depth: 120 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
1400
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1300
1250
1984
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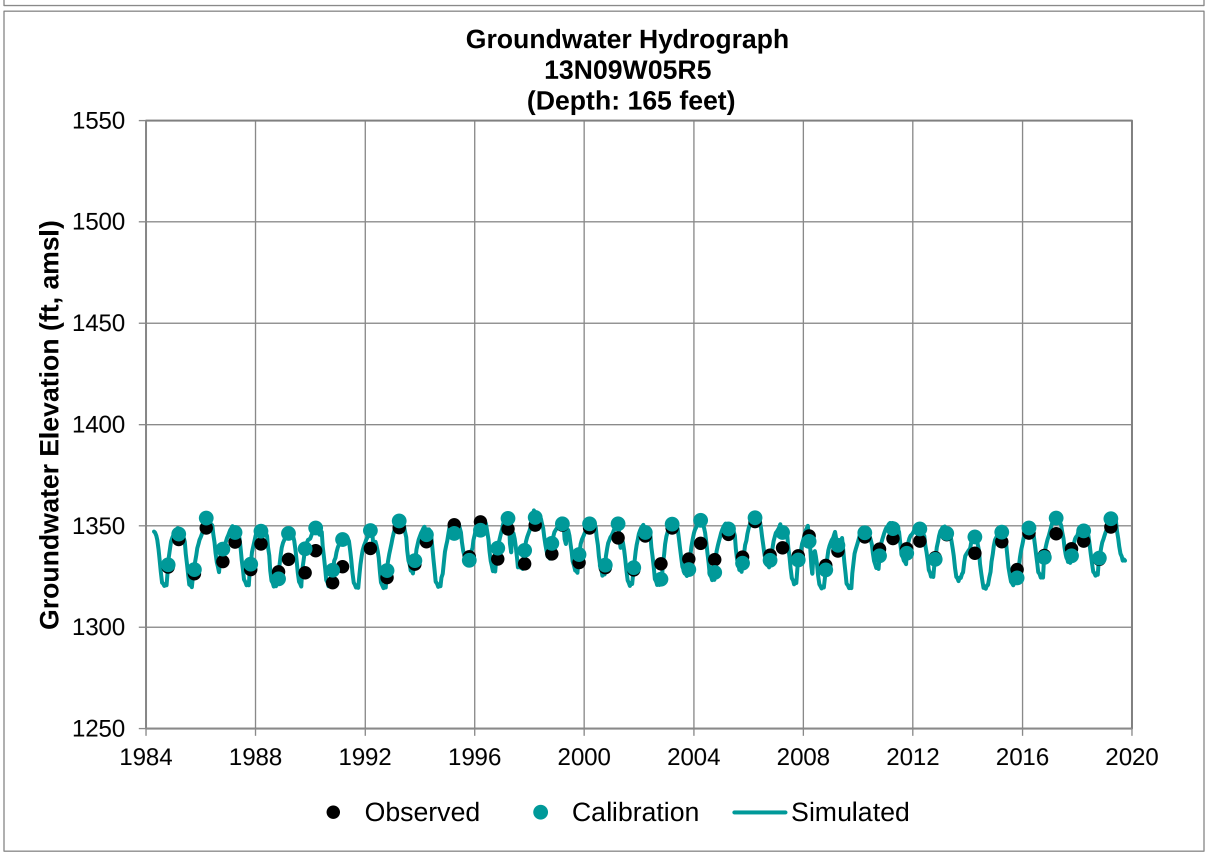
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W05R5
(Depth: 165 feet)
Groundwater Elevation (ft, amsl)
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1500
1450
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1350
1300
1250
1984
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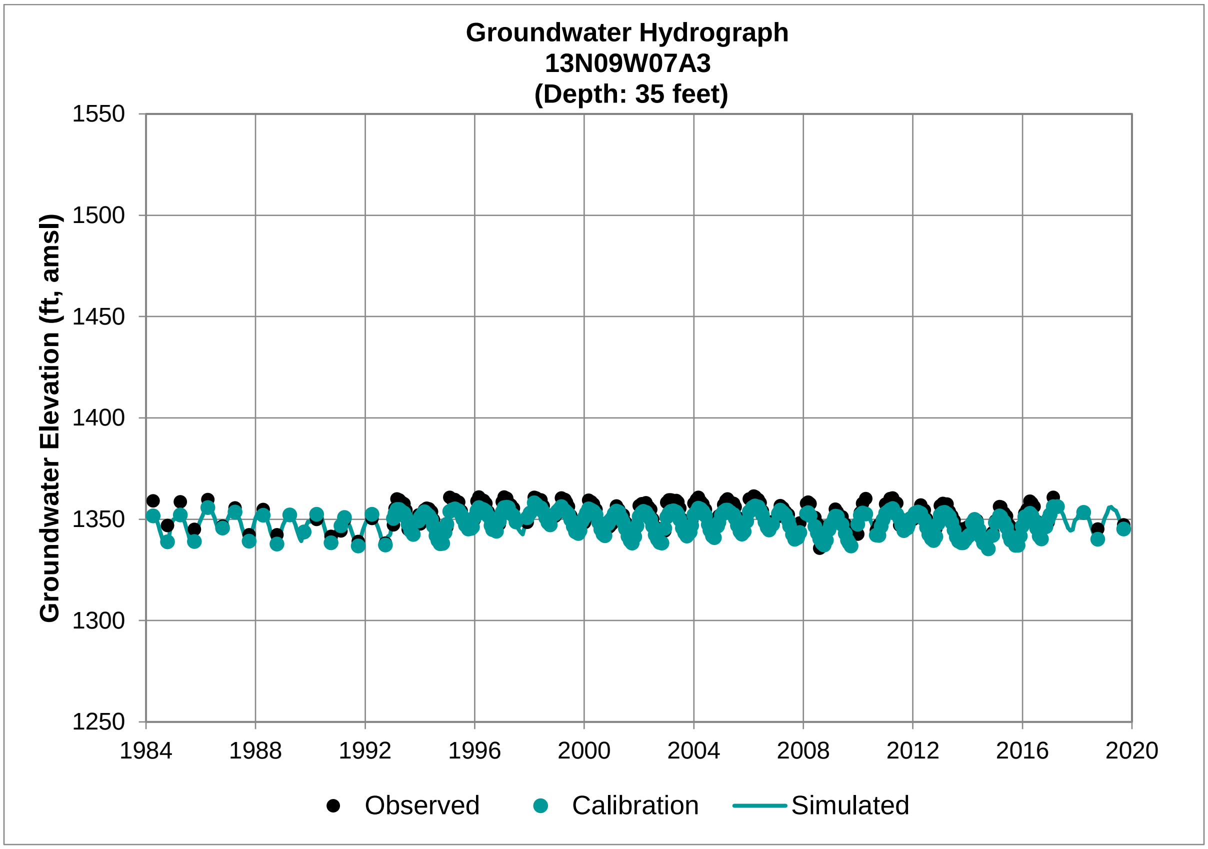
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W07A3
(Depth: 35 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
1400
1350
1300
1250
1984
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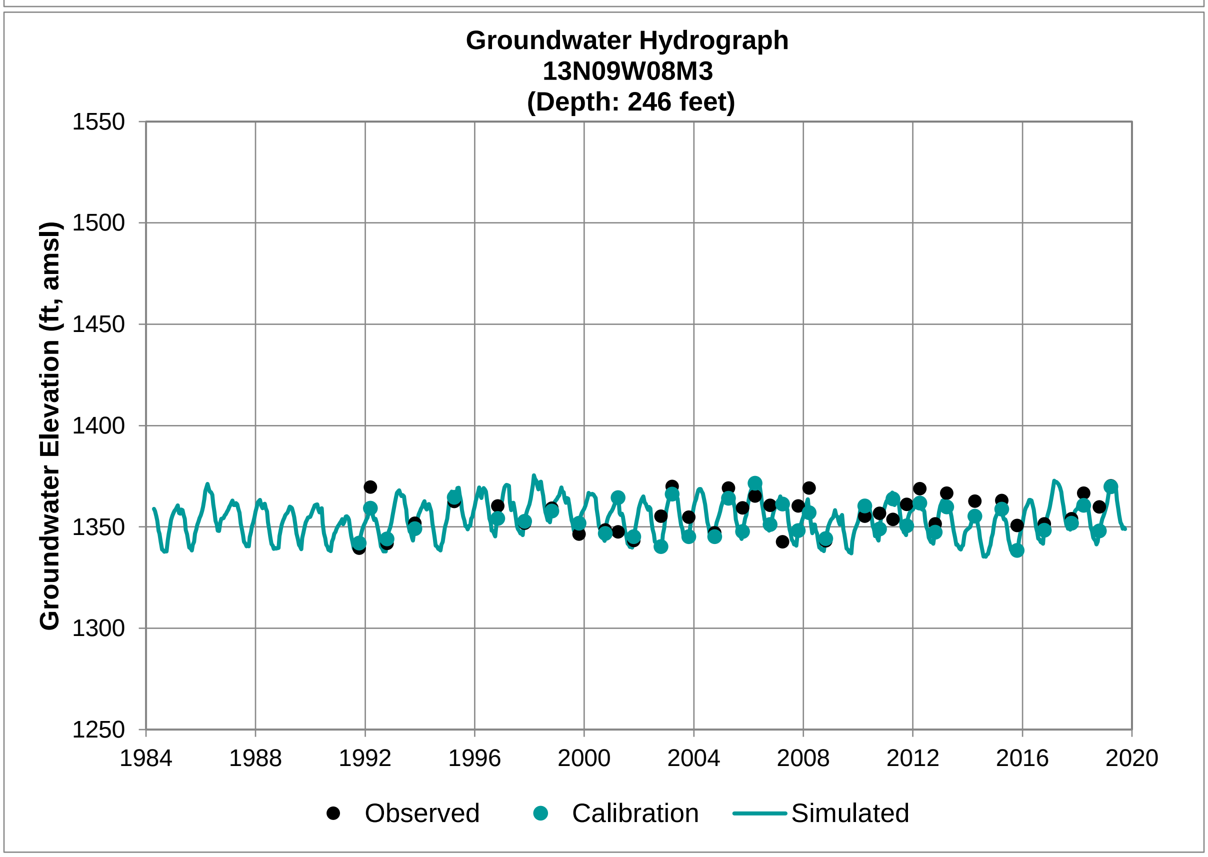
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W08M3
(Depth: 246 feet)
Groundwater Elevation (ft, amsl)
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1500
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1250
1984
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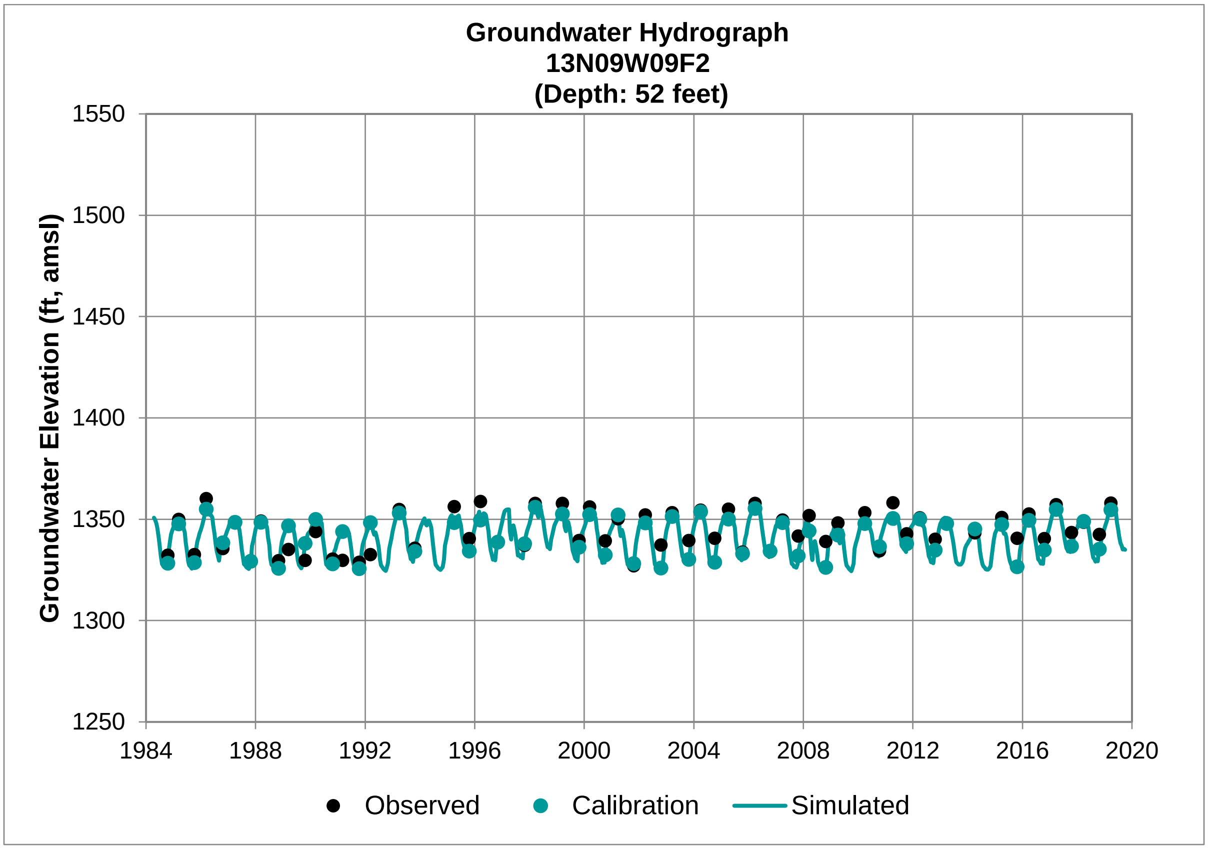
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W09F2
(Depth: 52 feet)
Groundwater Elevation (ft, amsl)
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1500
1450
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1300
1250
1984
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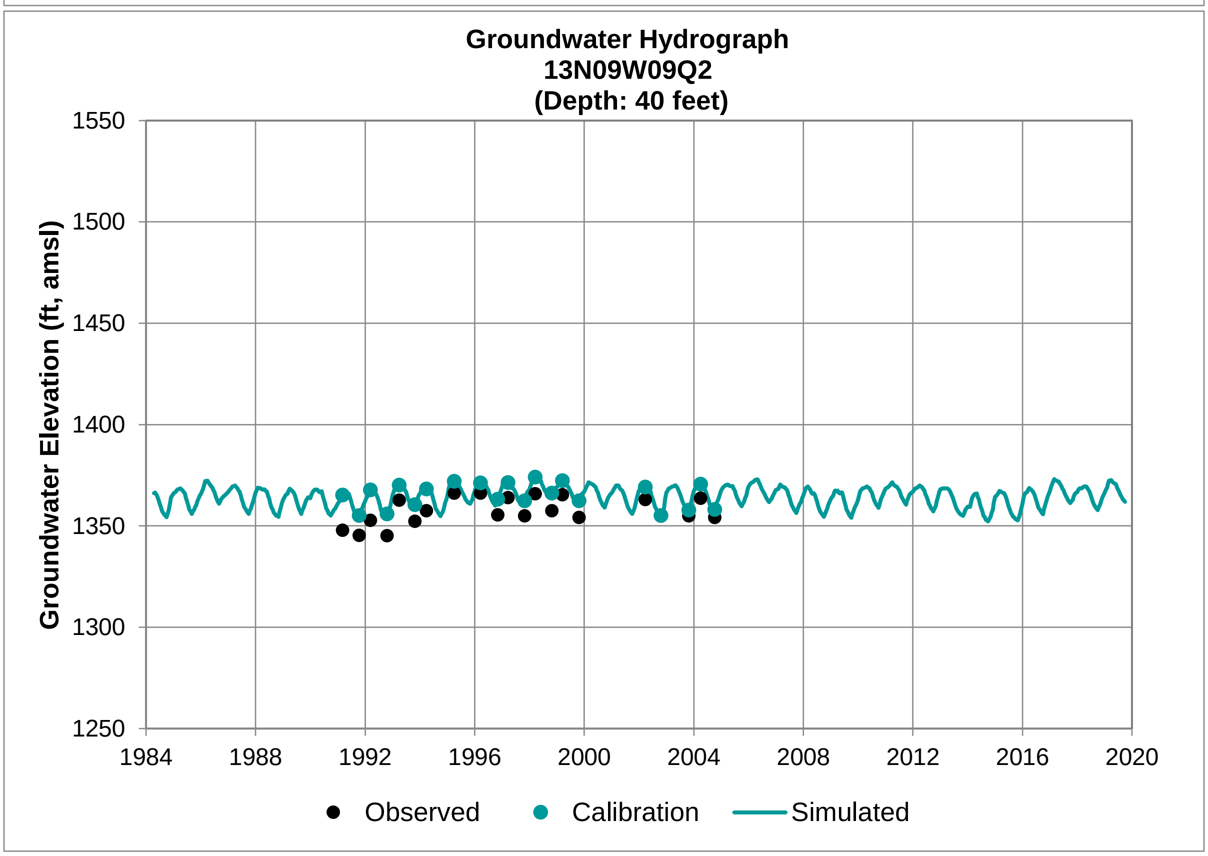
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W09Q2
(Depth: 40 feet)
Groundwater Elevation (ft, amsl)
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1450
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1250
1984
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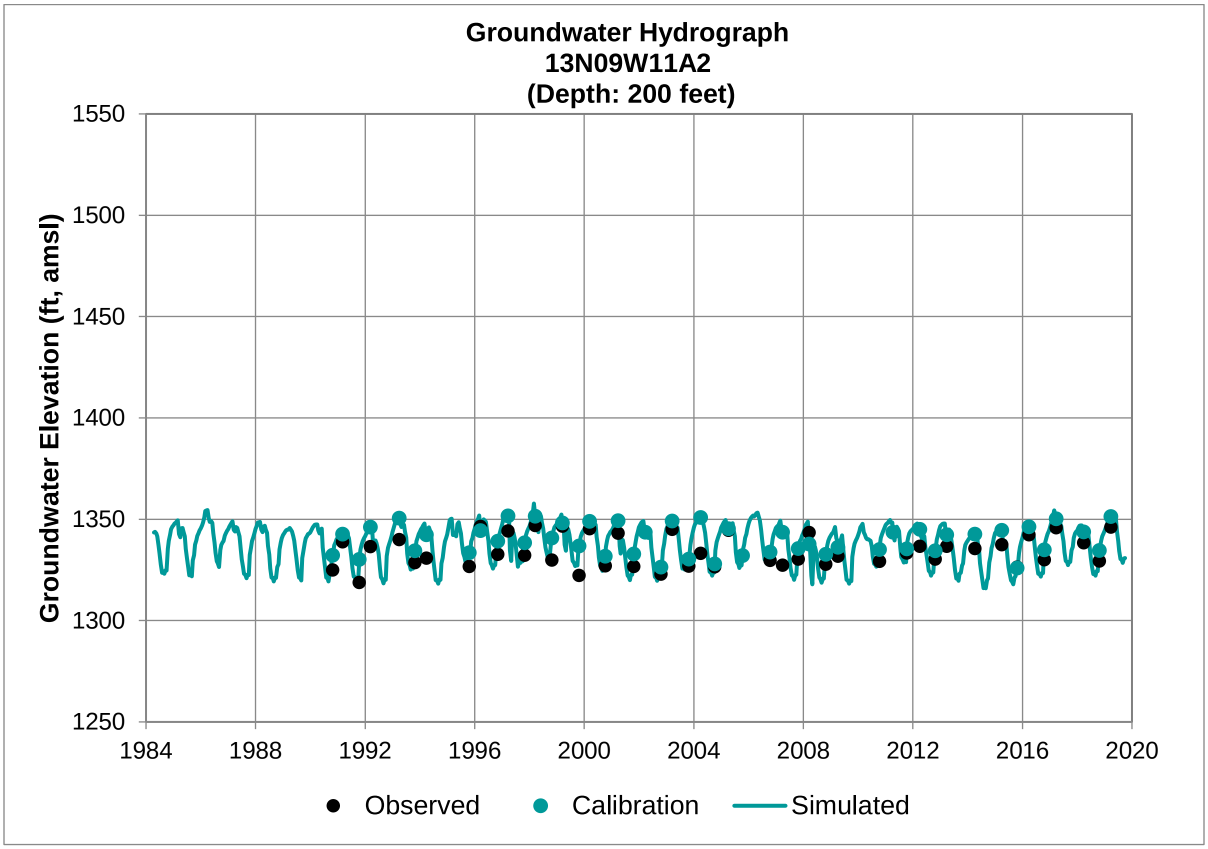
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W11A2
(Depth: 200 feet)
Groundwater Elevation (ft, amsl)
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1450
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1250
1984
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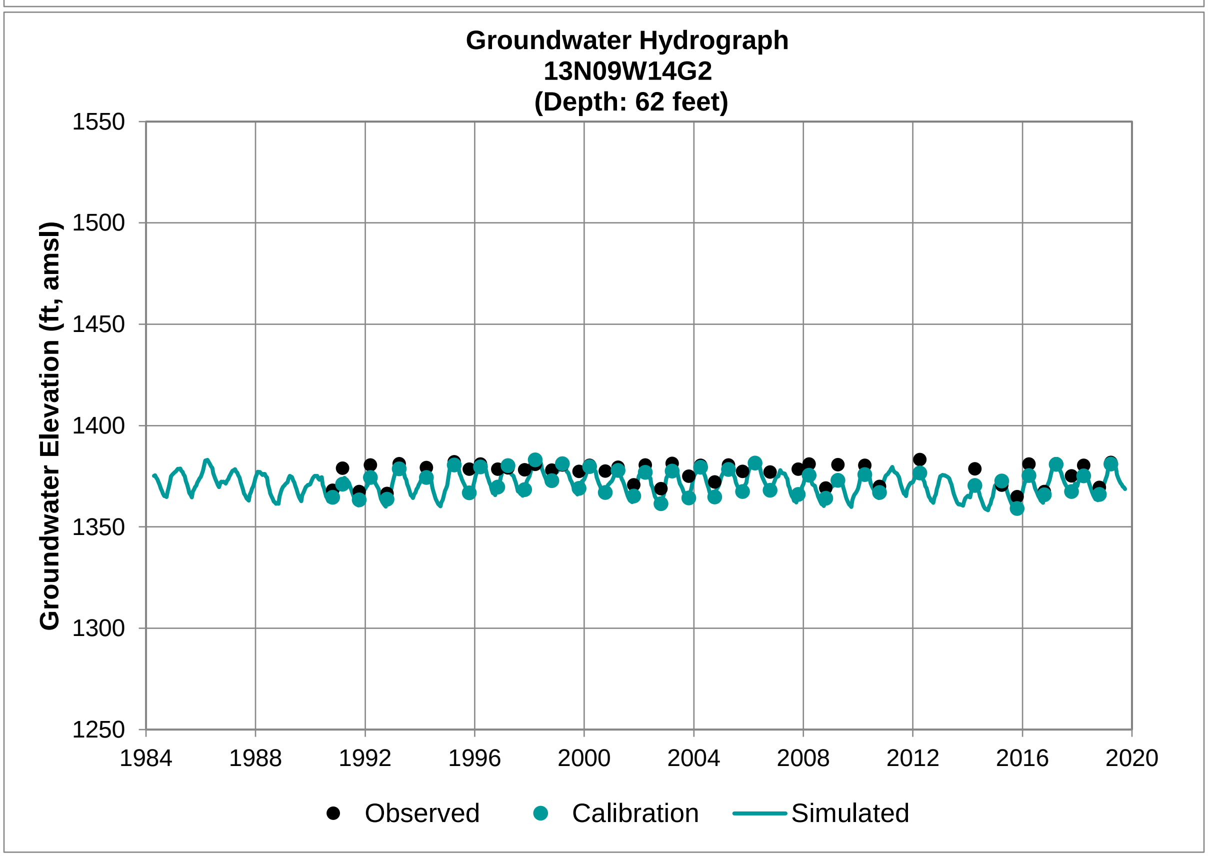
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W14G2
(Depth: 62 feet)
Groundwater Elevation (ft, amsl)
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1450
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1250
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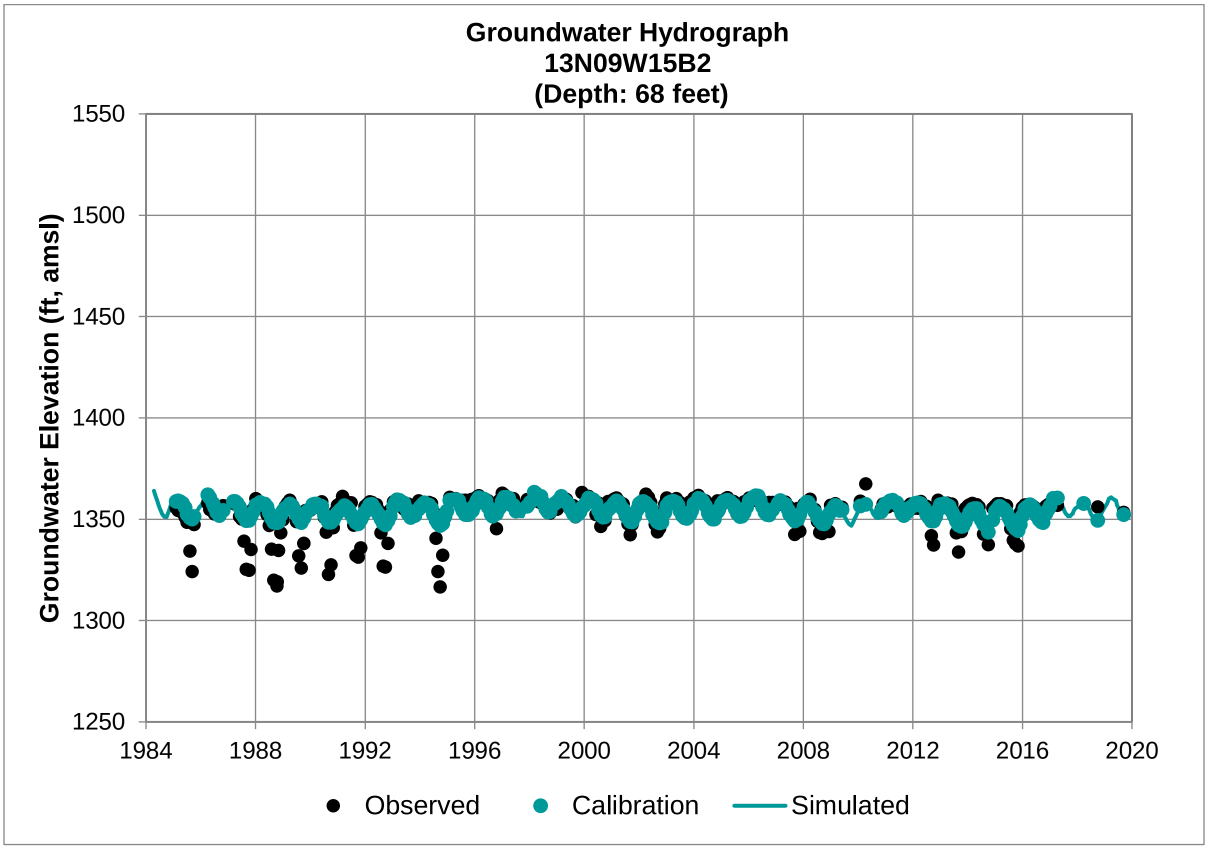
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W15B2
(Depth: 68 feet)
Groundwater Elevation (ft, amsl)
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1250
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Observed
Calibration
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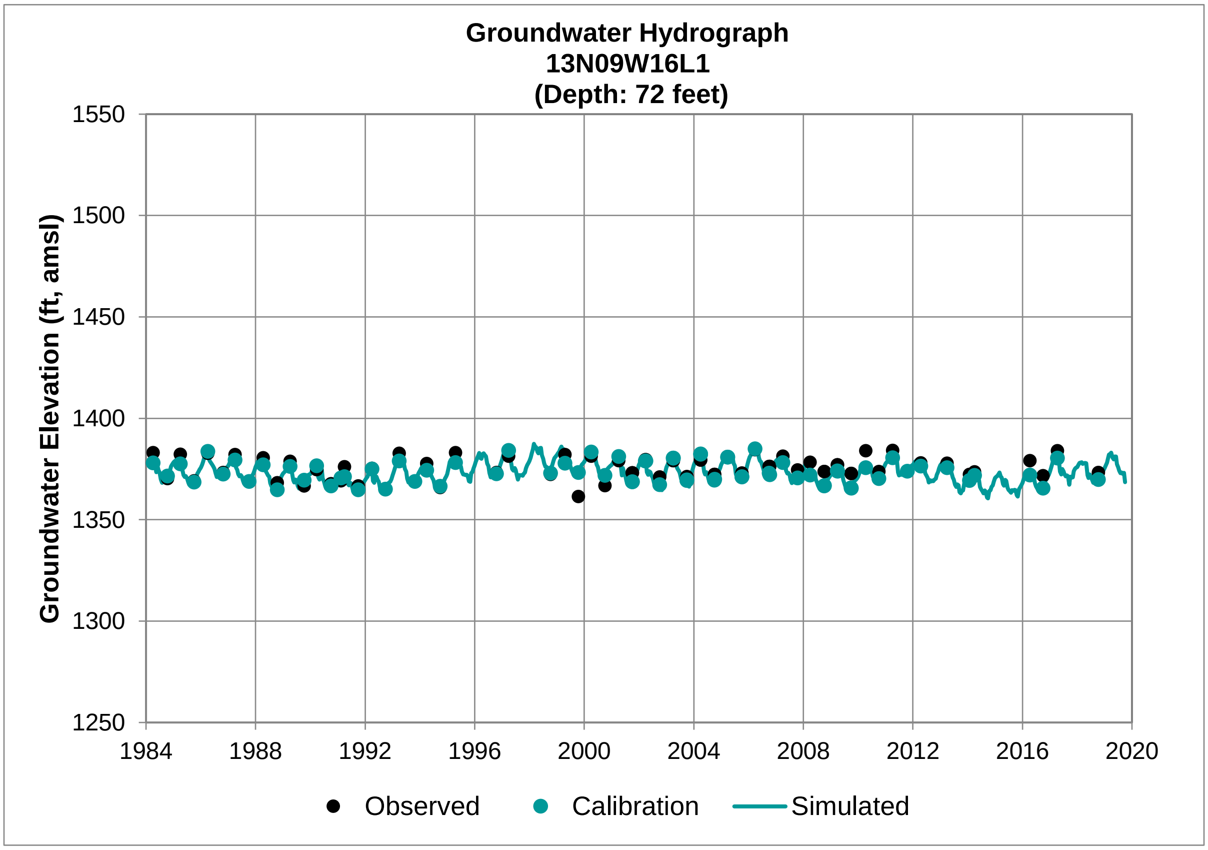
Groundwater Hydrograph
13N09W16L1
(Depth: 72 feet)
Groundwater Elevation (ft, amsl)
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Observed
Calibration
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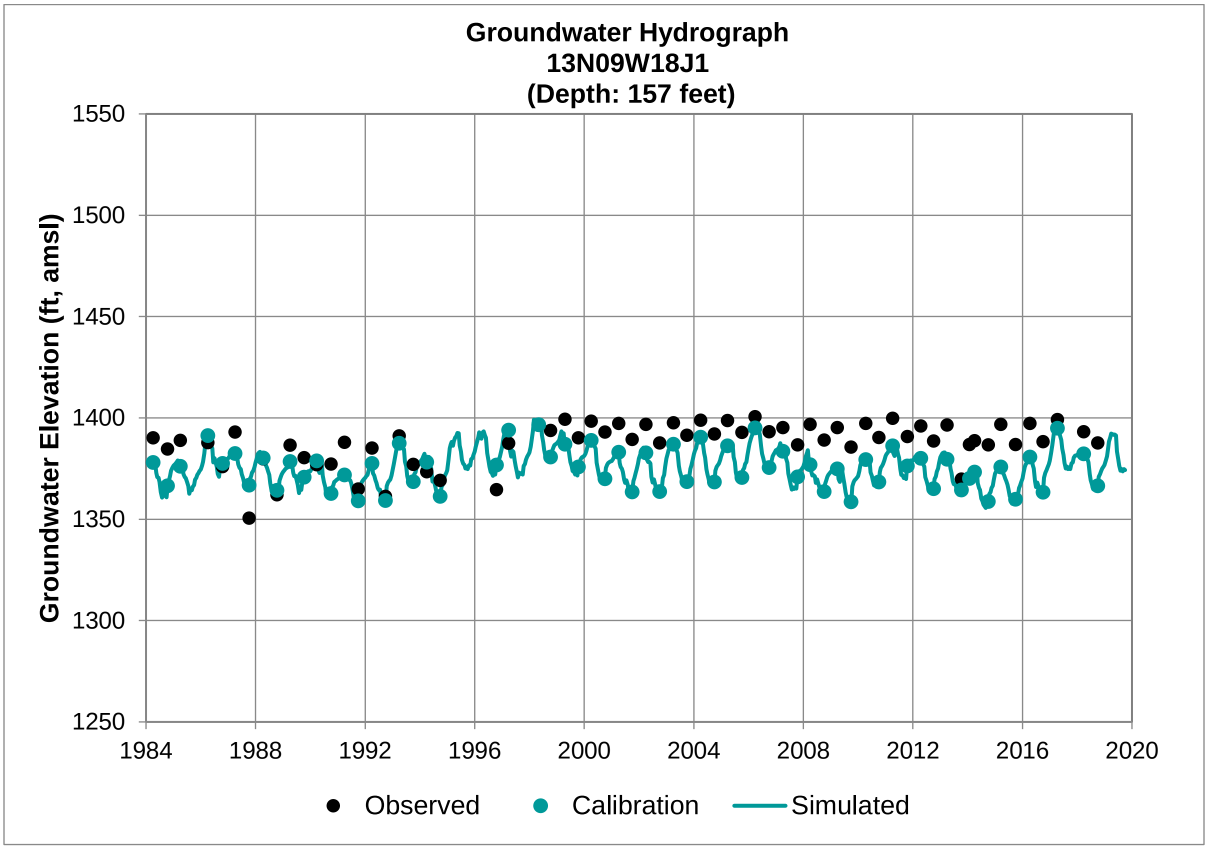
Groundwater Hydrograph
13N09W18J1
(Depth: 157 feet)
Groundwater Elevation (ft, amsl)
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1250
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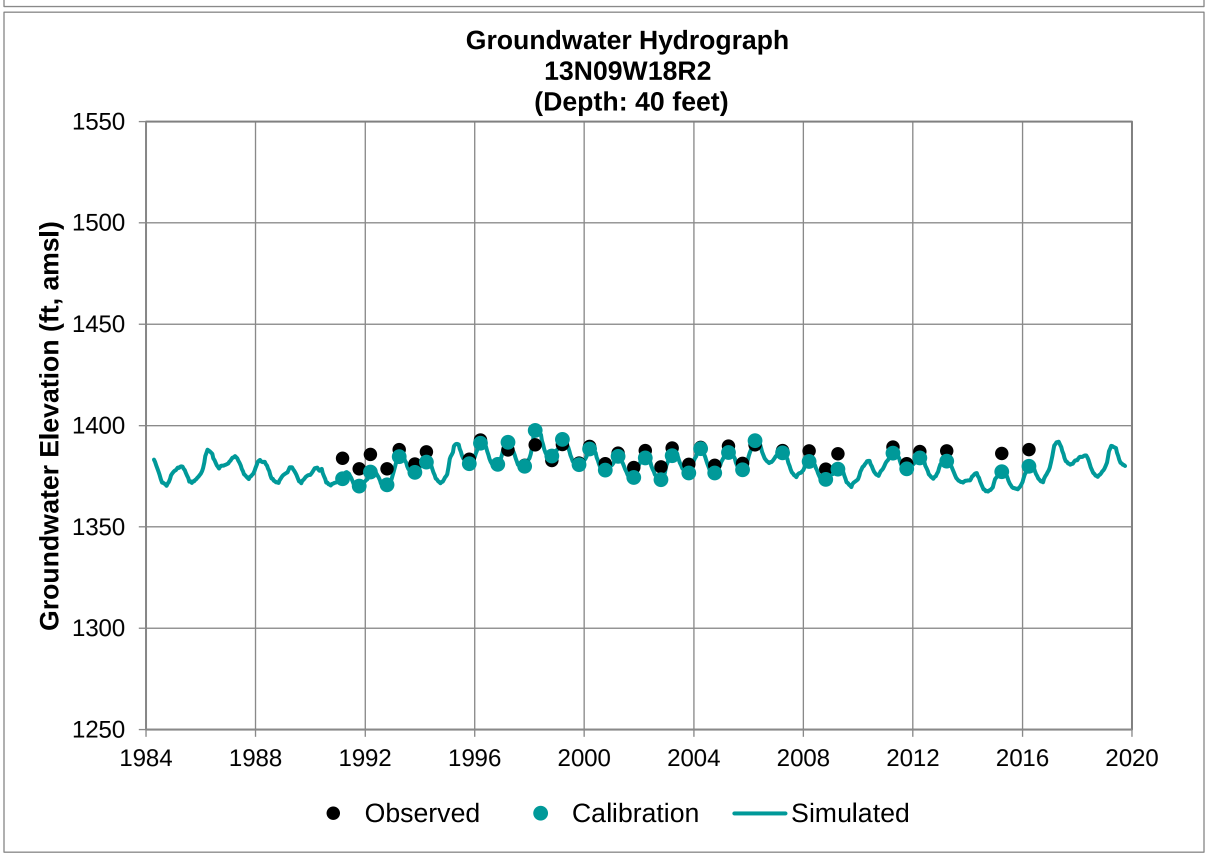
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W18R2
(Depth: 40 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
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1250
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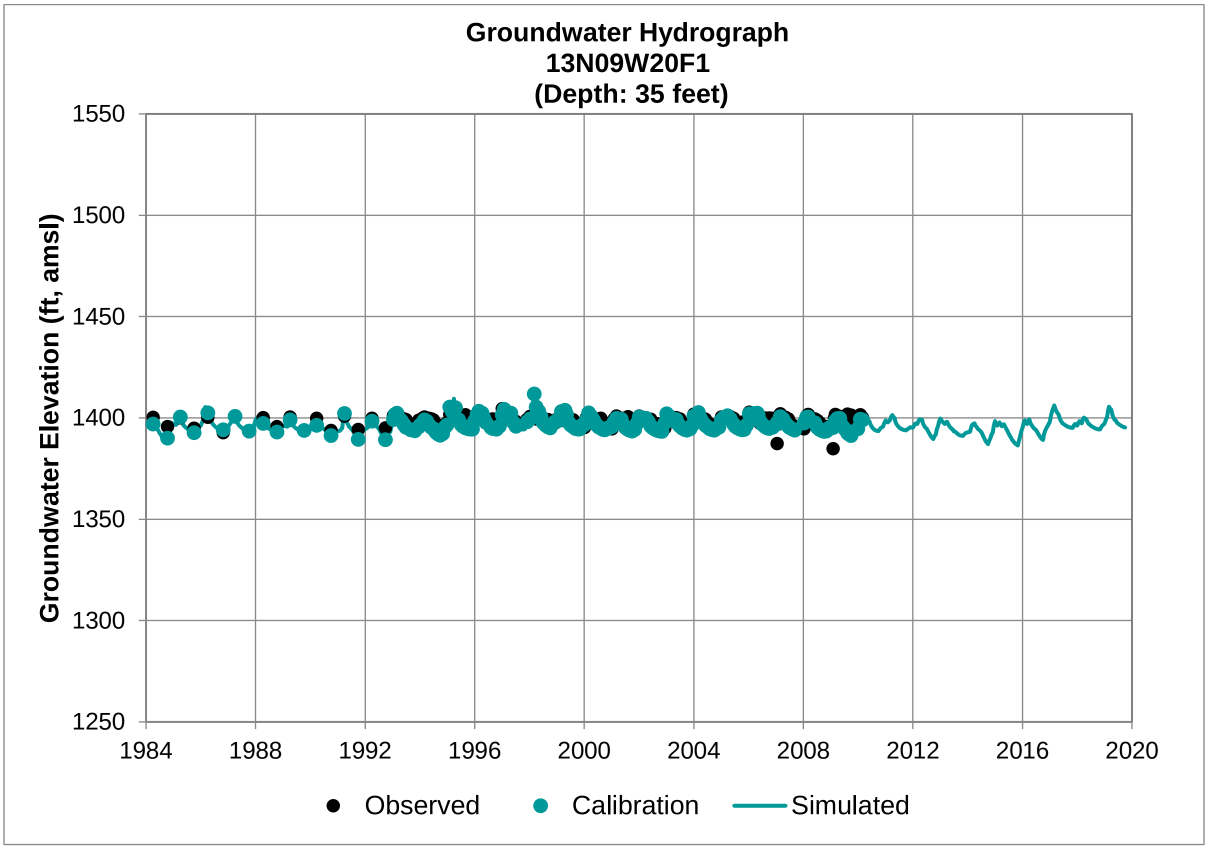
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W20F1
(Depth: 35 feet)
Groundwater Elevation (ft, amsl)
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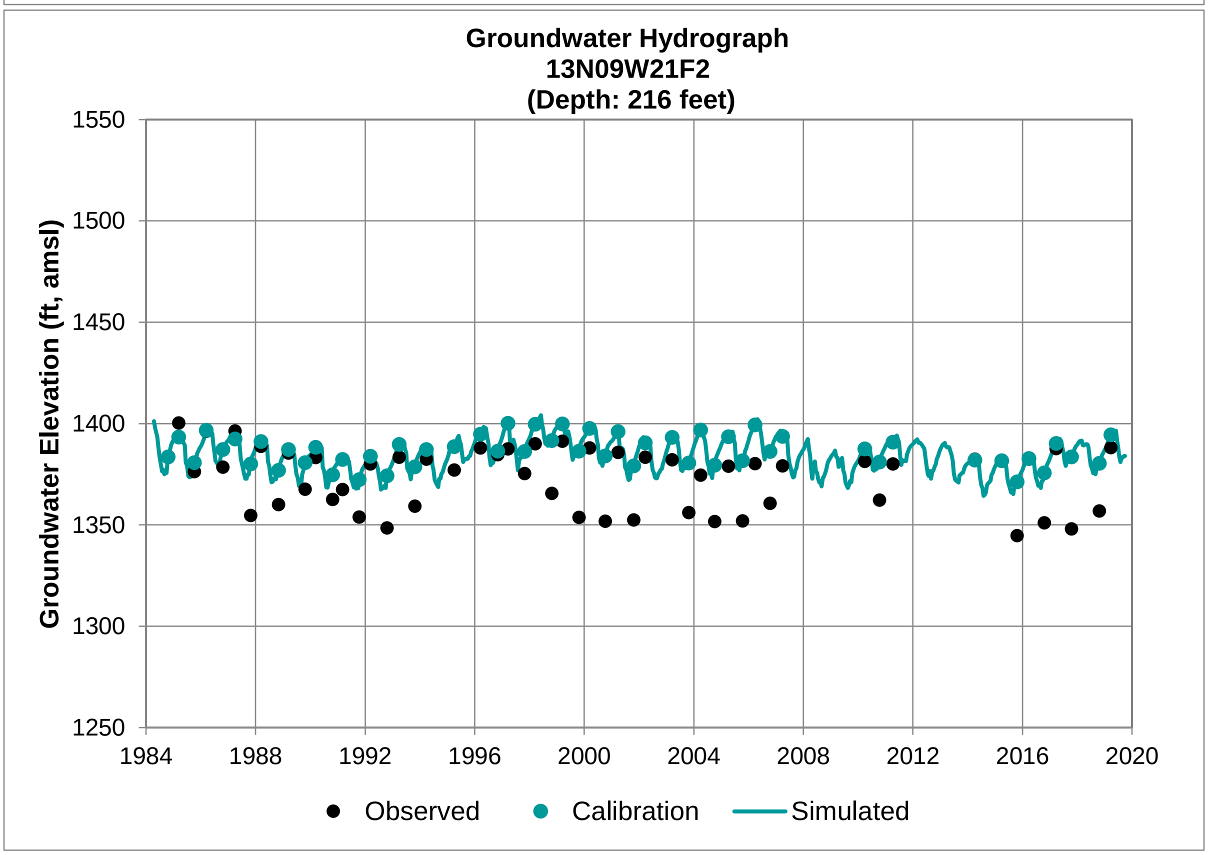
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W21F2
(Depth: 216 feet)
Groundwater Elevation (ft, amsl)
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1250
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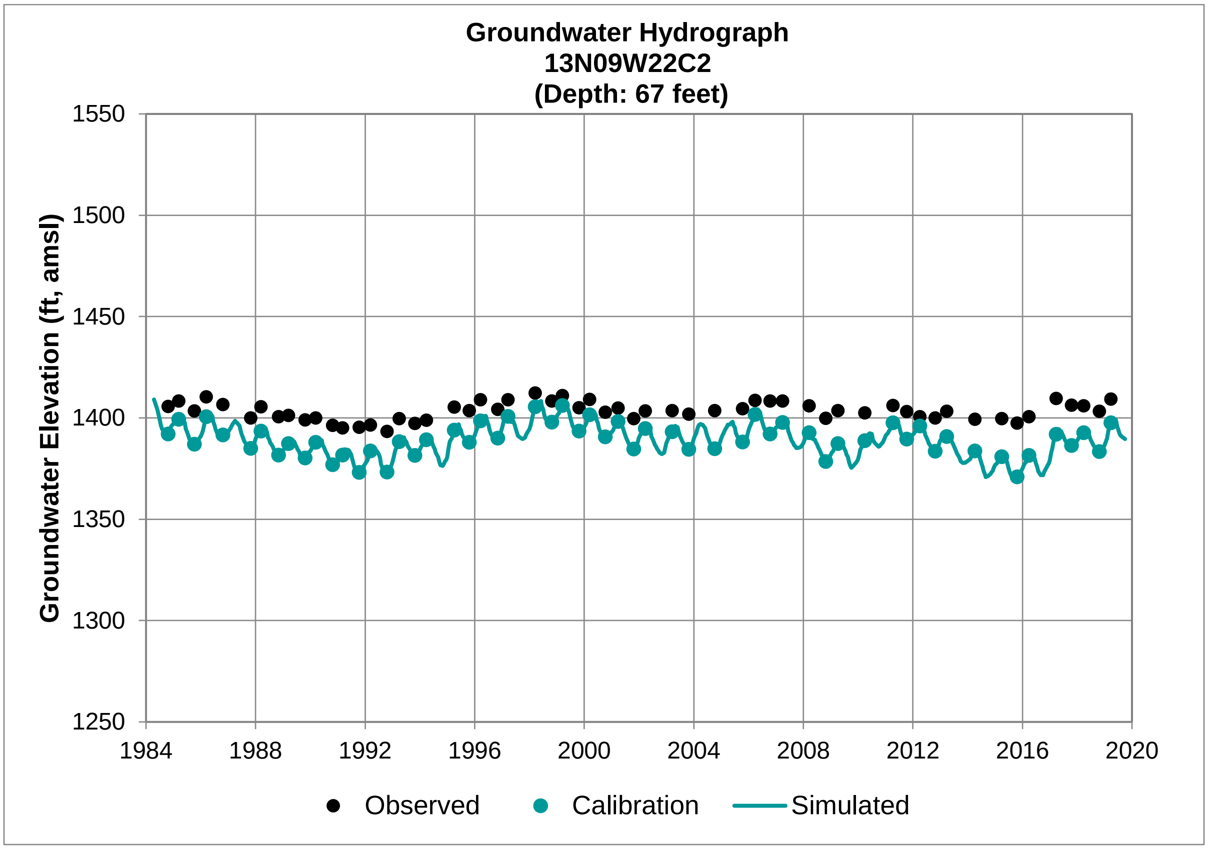
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W22C2
(Depth: 67 feet)
Groundwater Elevation (ft, amsl)
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1500
1450
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1250
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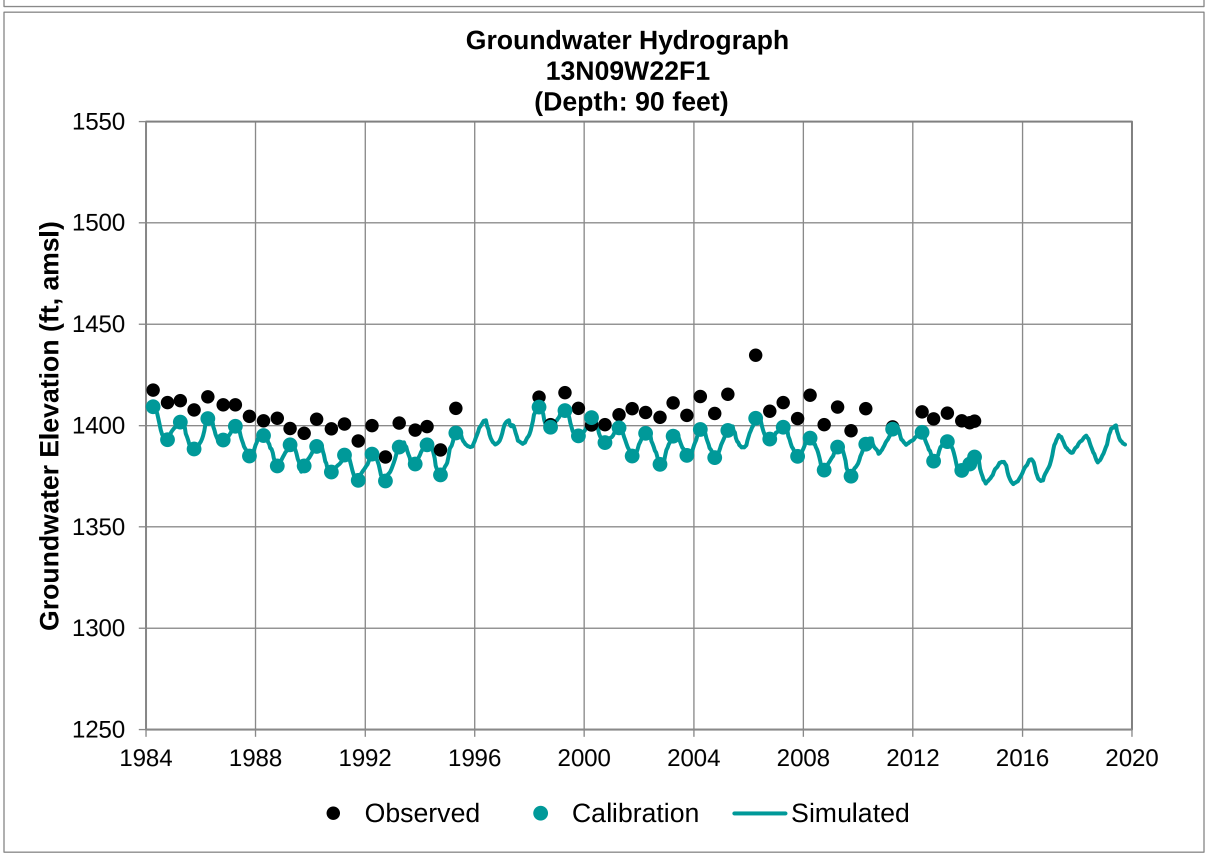
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W22F1
(Depth: 90 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
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1250
1984
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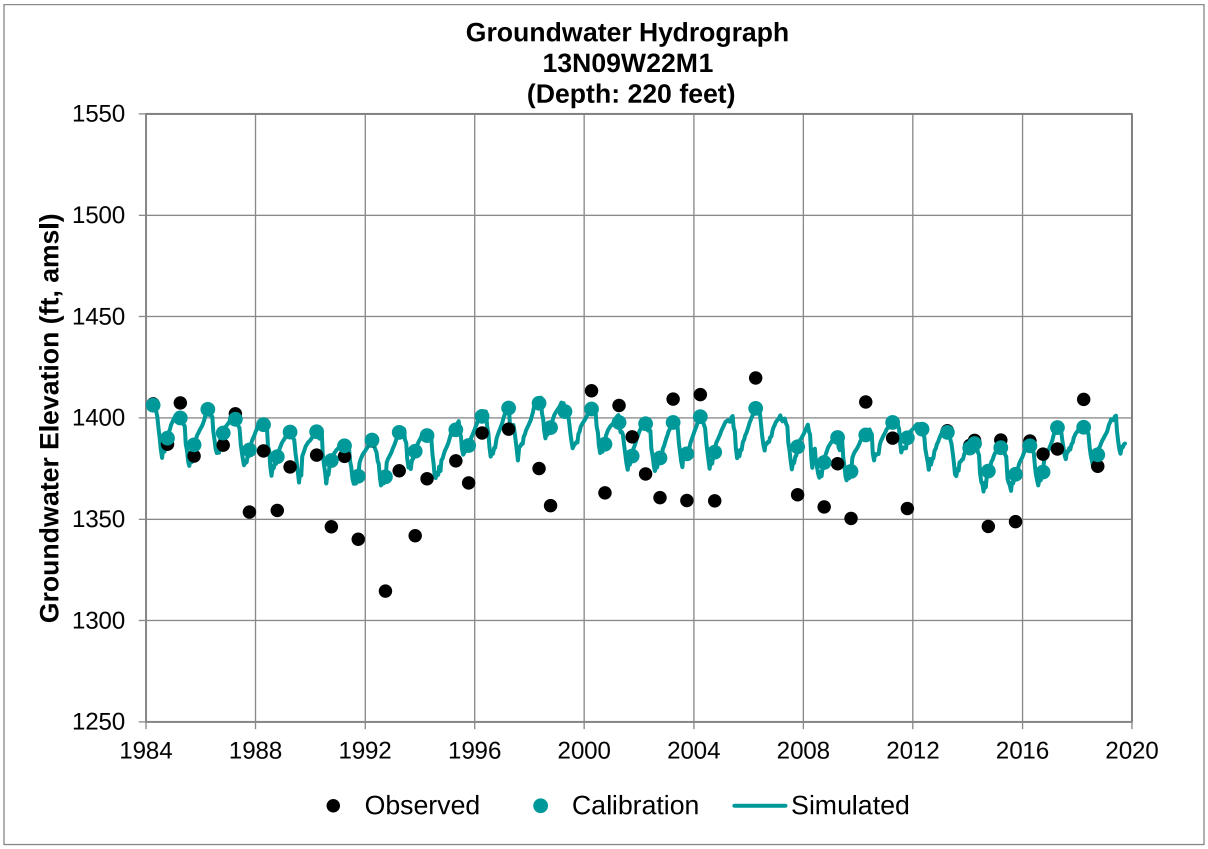
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W22M1
(Depth: 220 feet)
Groundwater Elevation (ft, amsl)
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1500
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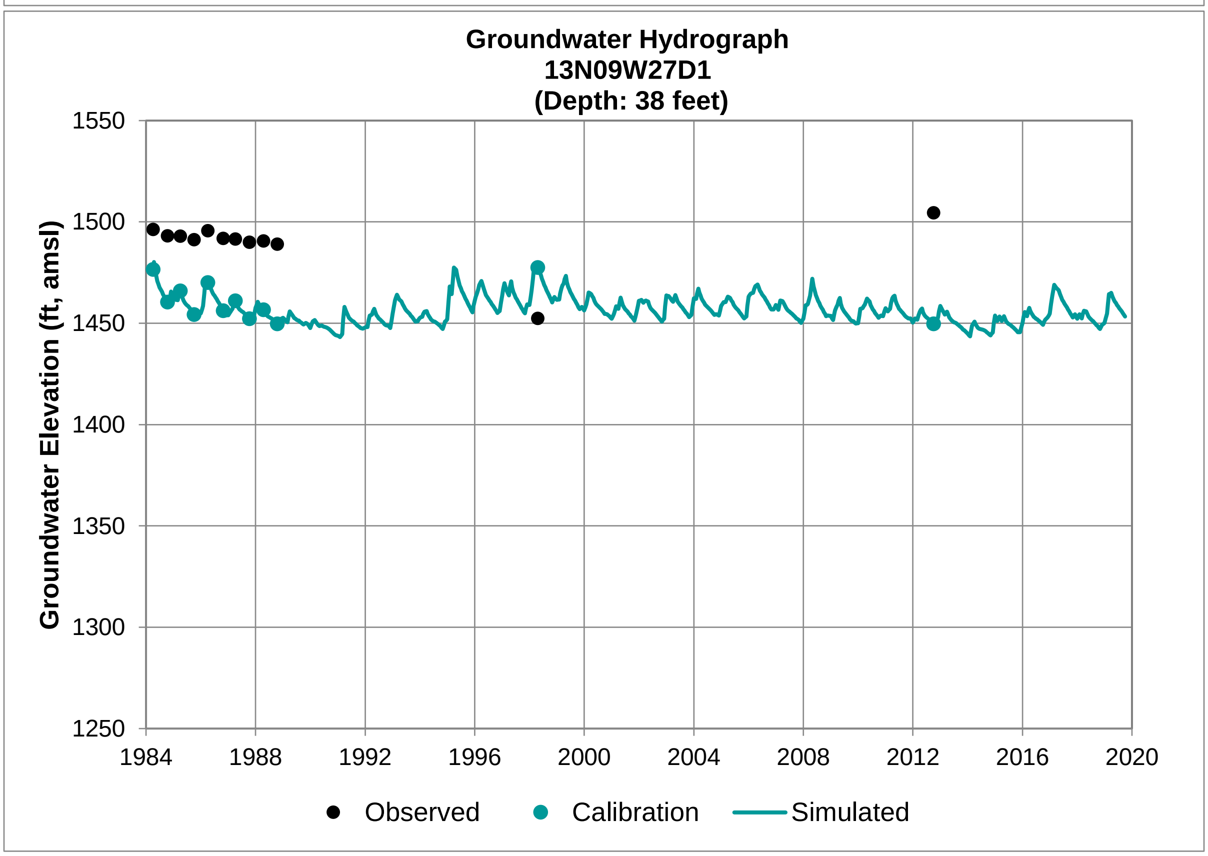
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W27D1
(Depth: 38 feet)
Groundwater Elevation (ft, amsl)
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1500
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1250
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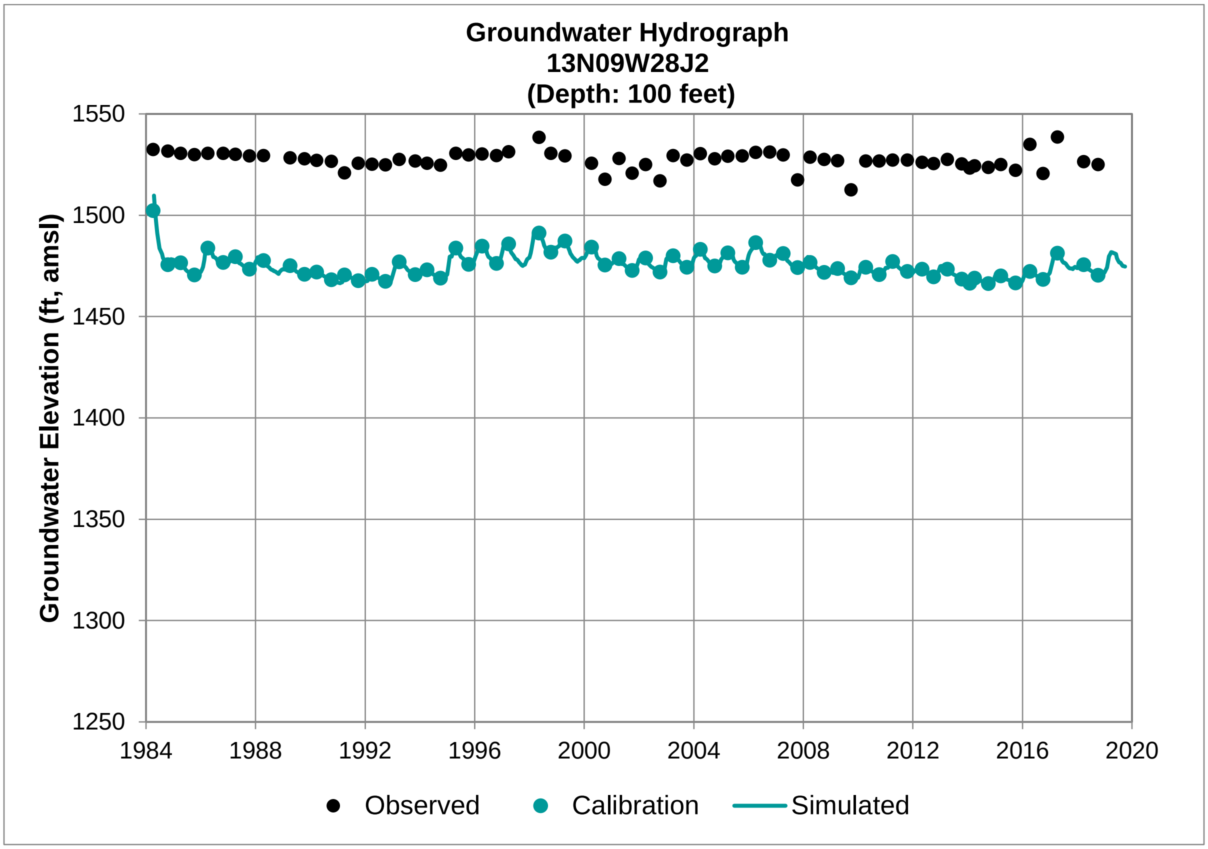
Observed
Calibration
Simulated


Groundwater Hydrograph
13N09W28J2
(Depth: 100 feet)
Groundwater Elevation (ft, amsl)
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1250
1984
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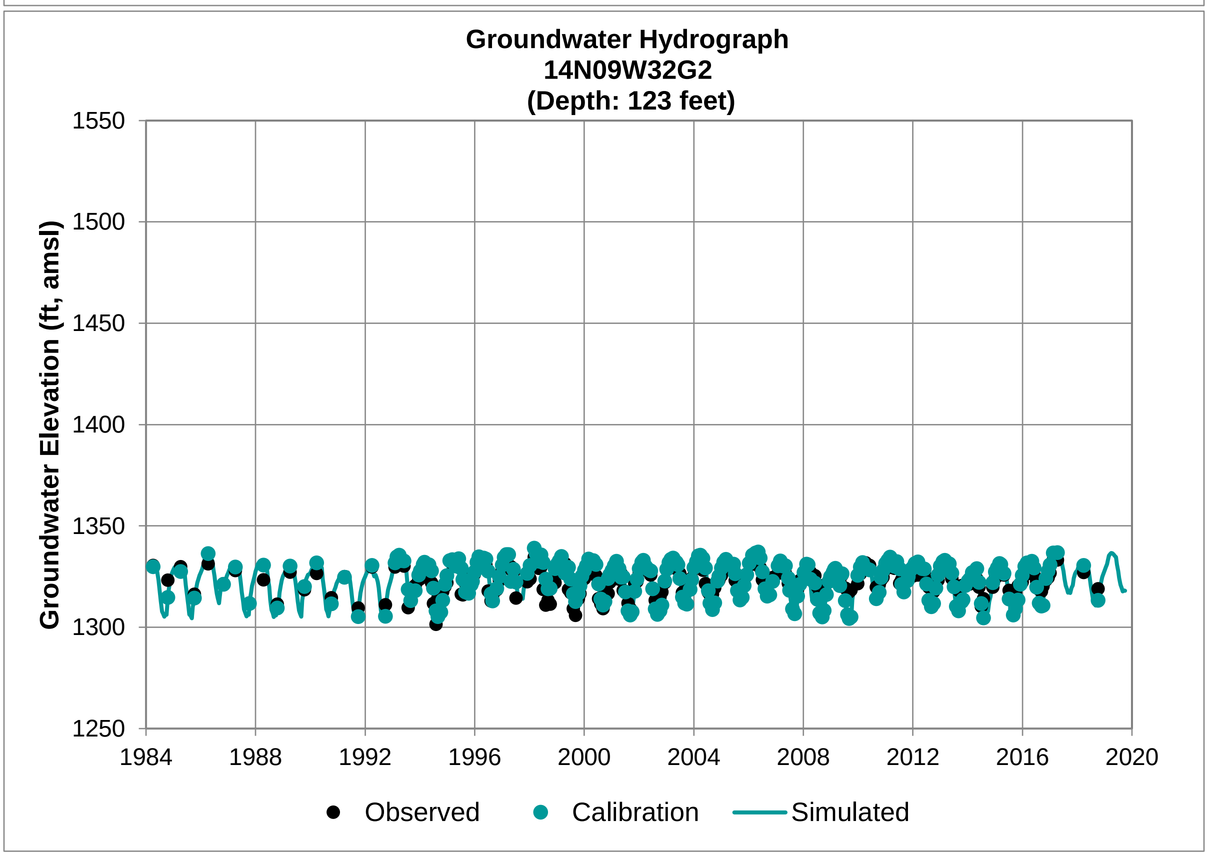
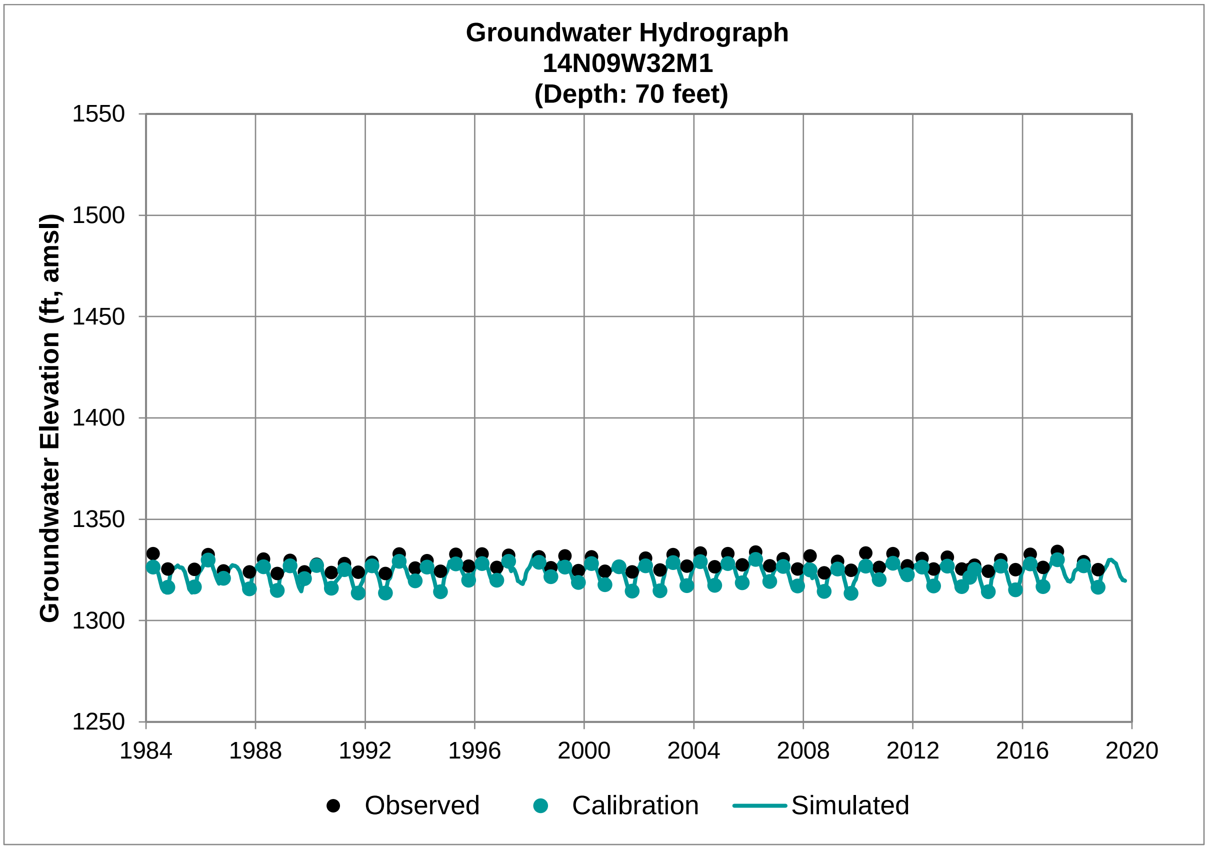
Observed
Calibration
Simulated


Groundwater Hydrograph
14N09W32G2
(Depth: 123 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
1400
1350
1300
1250
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Observed
Calibration
Simulated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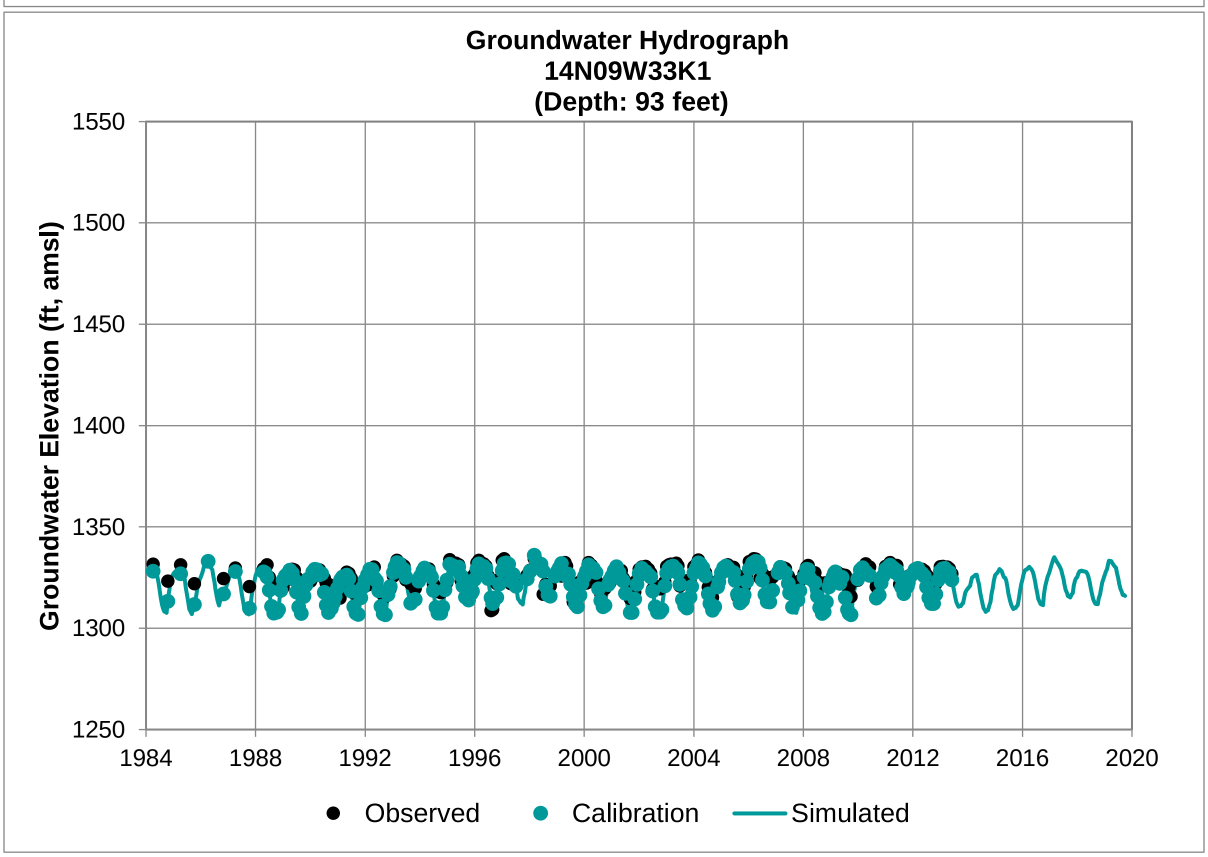
14N09W32M1
(Depth: 70 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
1400
1350
1300
1250
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Observed
Calibration
Simulated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(Depth: 93 feet)
Groundwater Elevation (ft, amsl)
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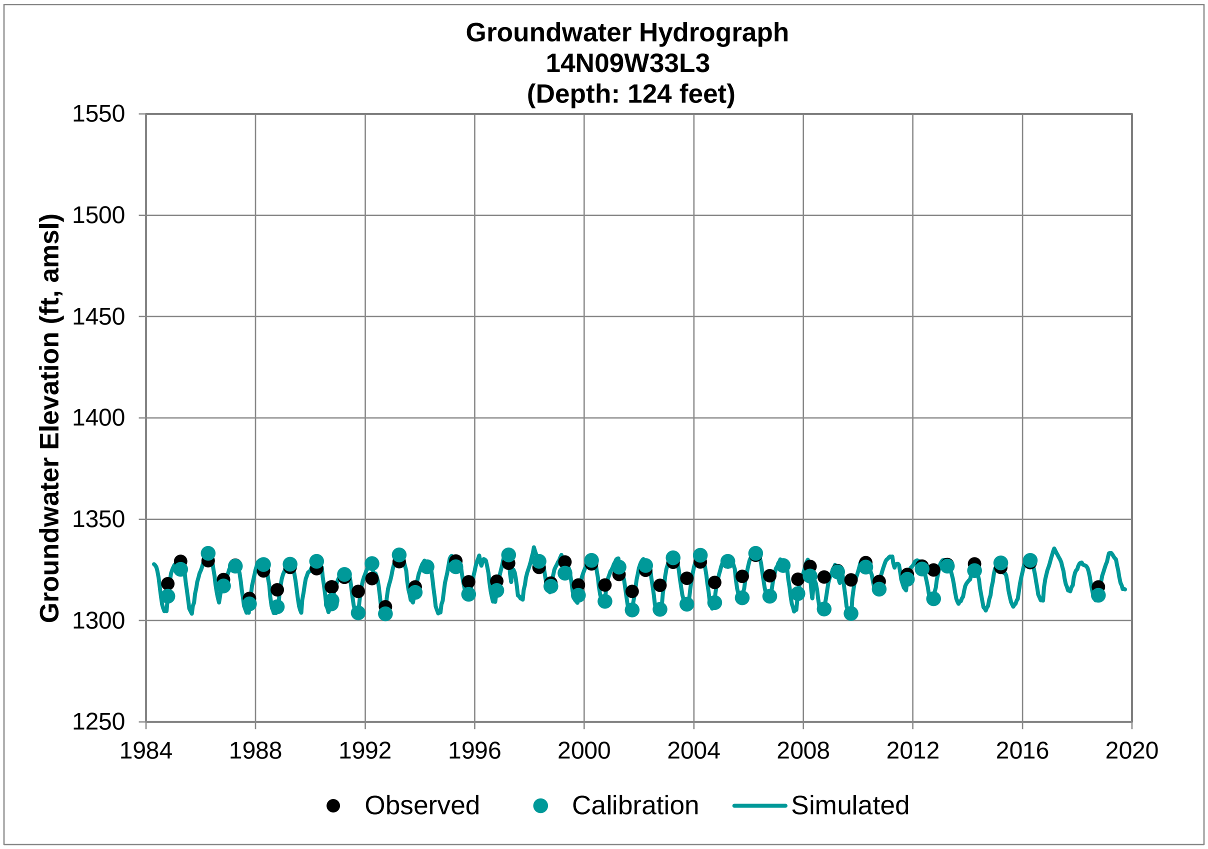
1500
1450
1400
1350
1300
1250
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Observed
Calibration
Simulated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14N09W33L3
(Depth: 124 feet)
Groundwater Elevation (ft, amsl)
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1500
1450
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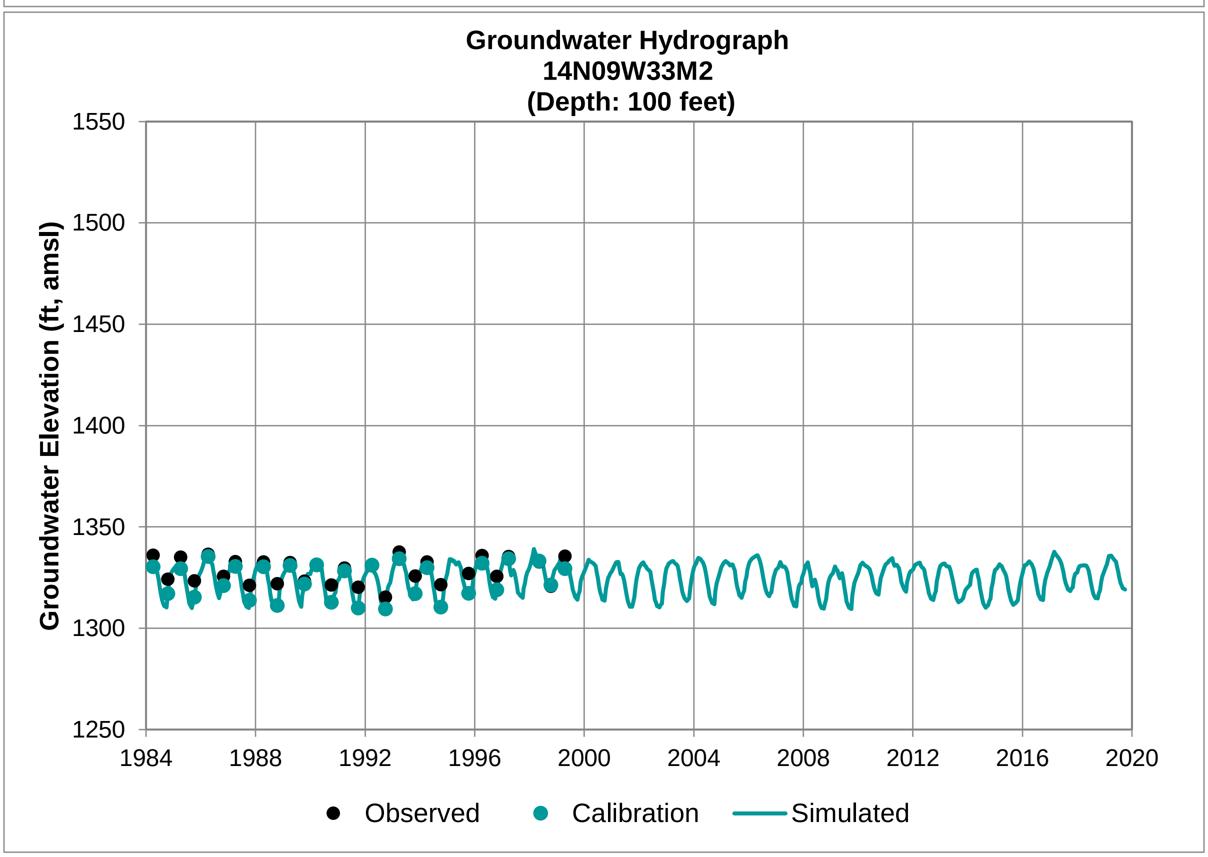
1350
1300
1250
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Observed
Calibration
Simulated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14N09W33M2
(Depth: 100 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
1400
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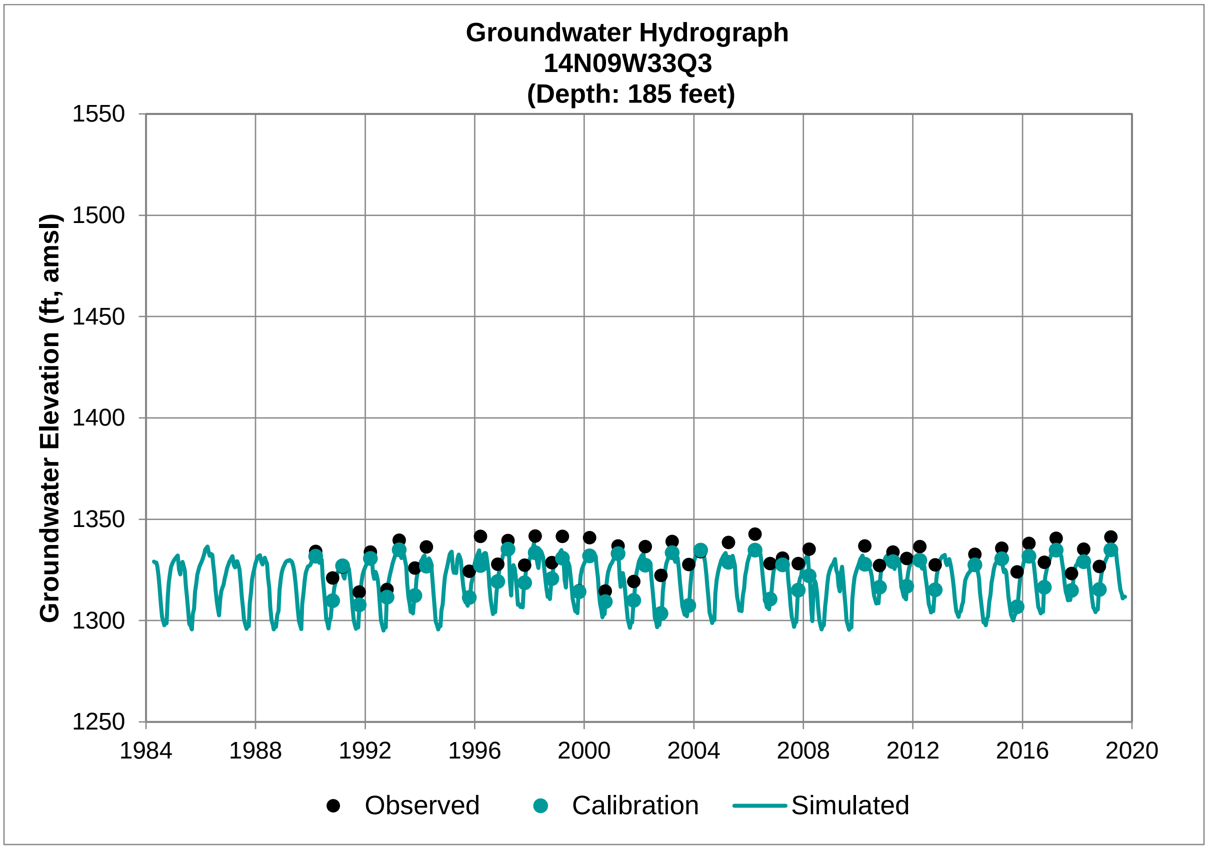
1300
1250
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Observed
Calibration
Simulated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(Depth: 185 feet)
Groundwater Elevation (ft, amsl)
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1450
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1300
1250
1984
1988
1992
1996
2000
2004
2008
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2016
2020
Observed
Calibration
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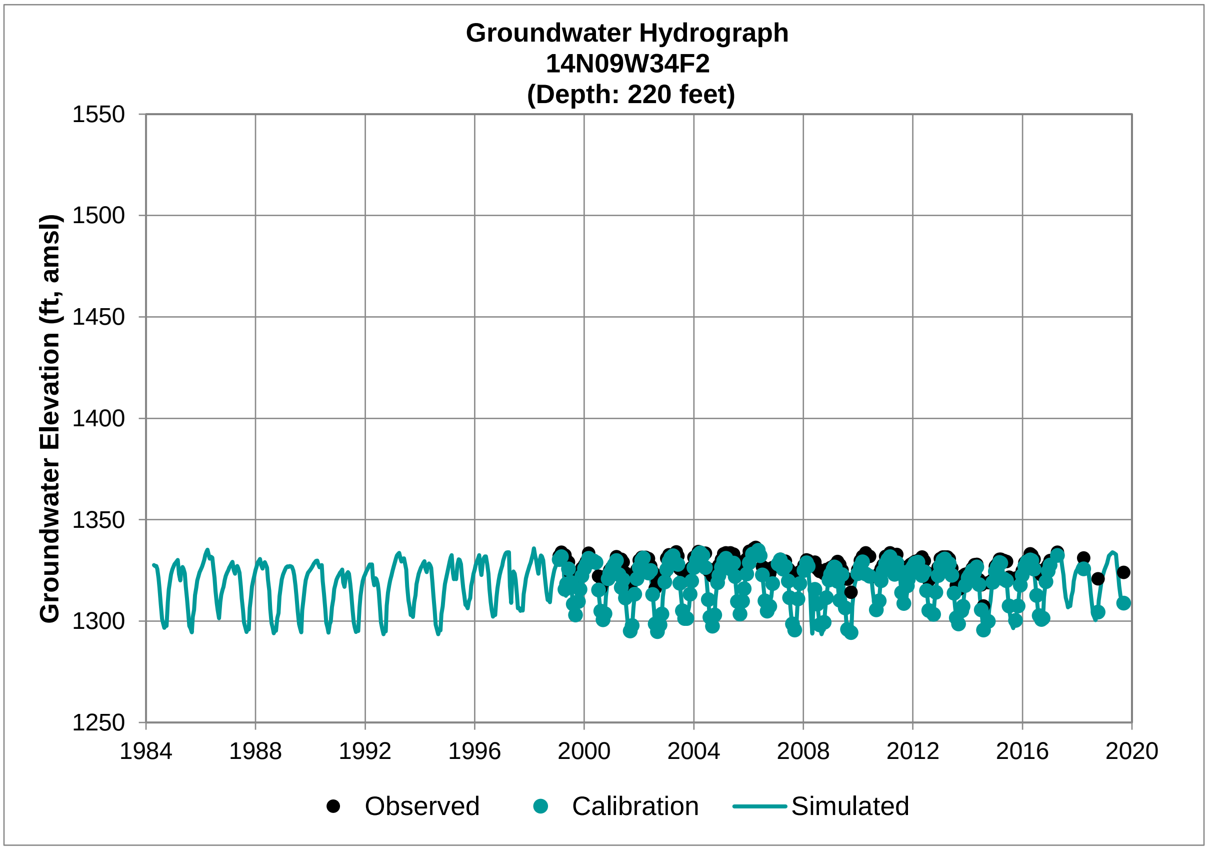
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14N09W34F2
(Depth: 220 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
1400
1350
1300
1250
1984
1988
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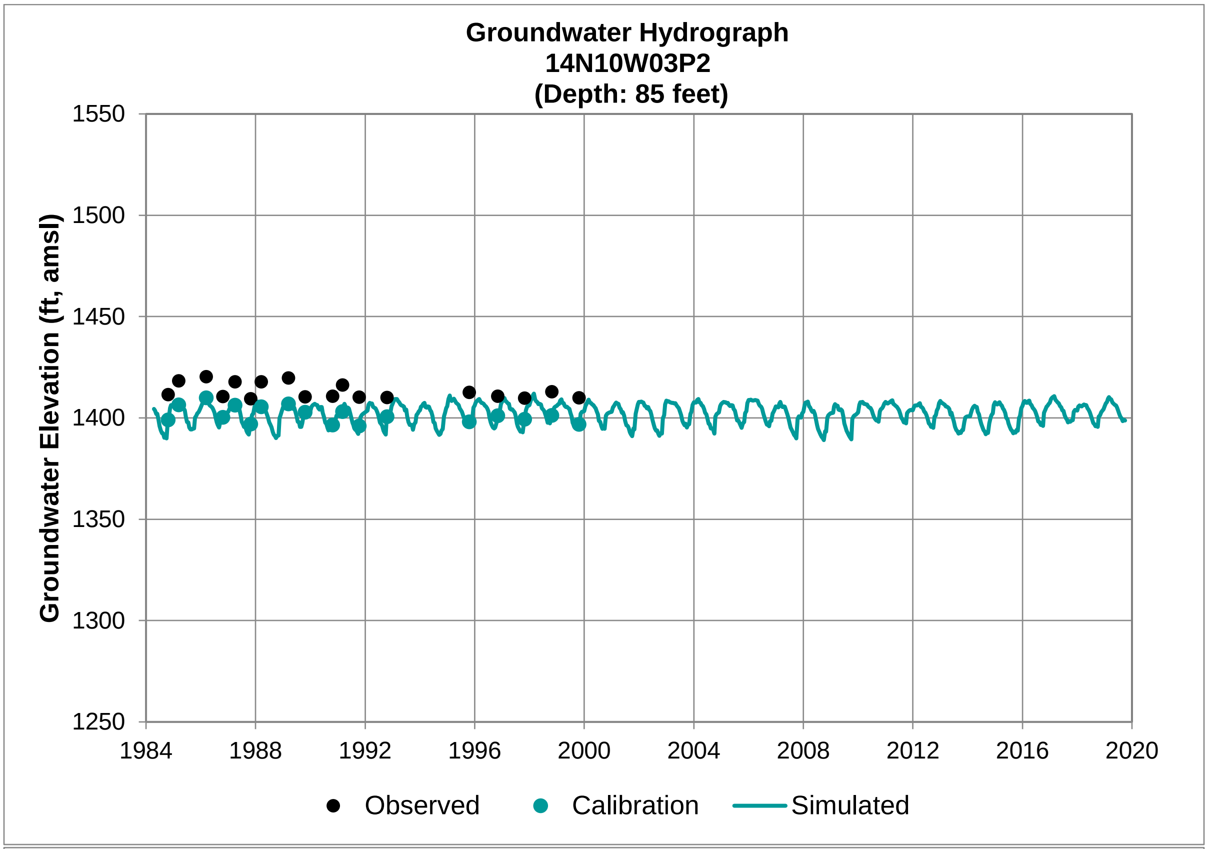
2012
2016
2020
Observed
Calibration
Simulated

2 SCOTT VALLEY BASIN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14N10W03P2
(Depth: 85 feet)
Groundwater Elevation (ft, amsl)
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1250
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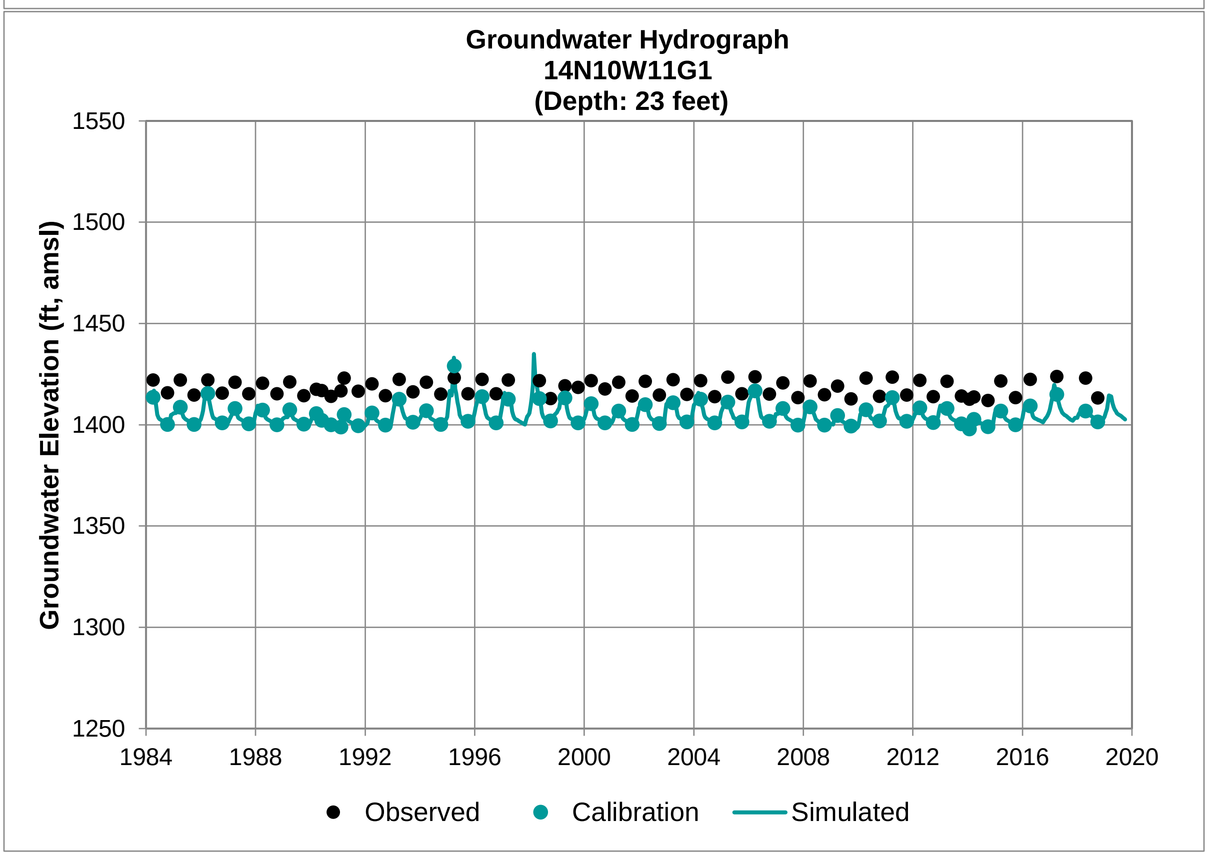
2016
2020
Observed
Calibration
Simulated


Groundwater Hydrograph
14N10W11G1
(Depth: 23 feet)
Groundwater Elevation (ft, amsl)
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1500
1450
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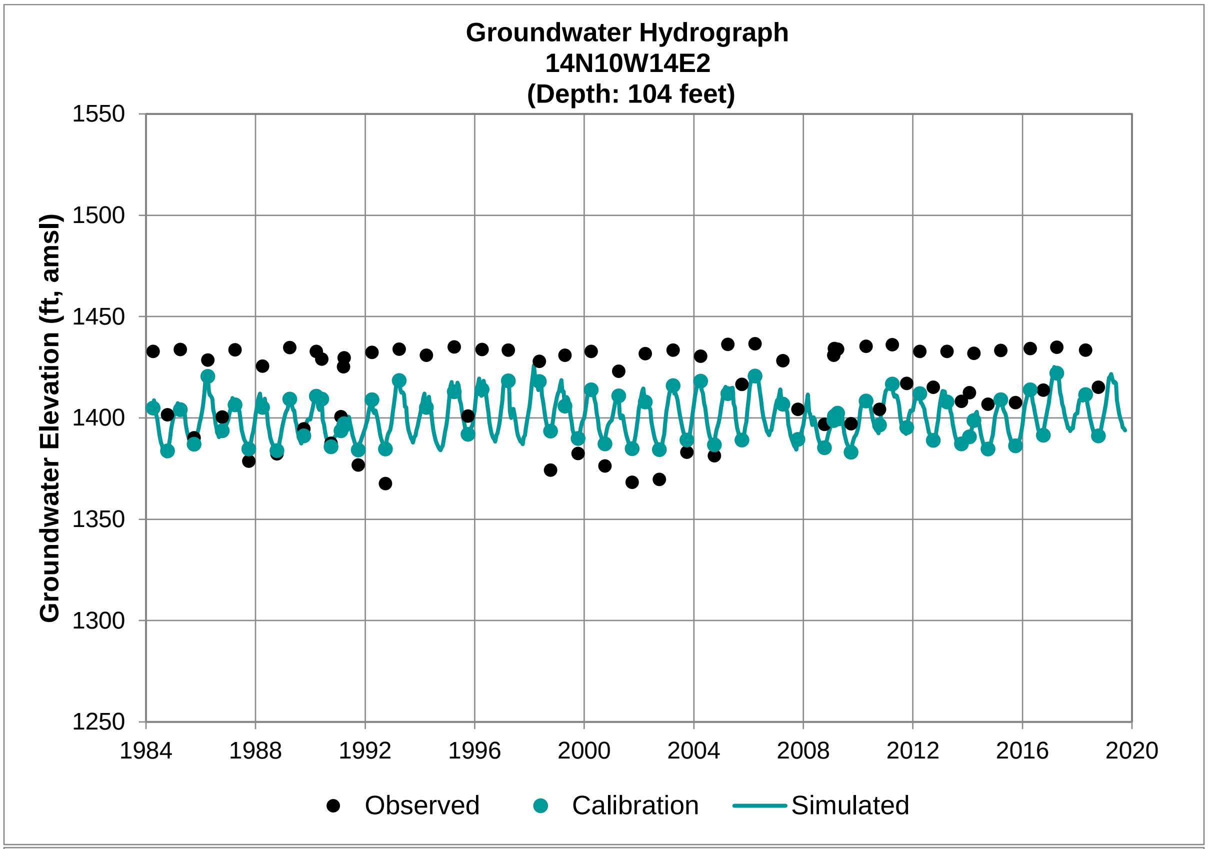
1350
1300
1250
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Observed
Calibration
Simulated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14N10W14E2
(Depth: 104 feet)
Groundwater Elevation (ft, amsl)
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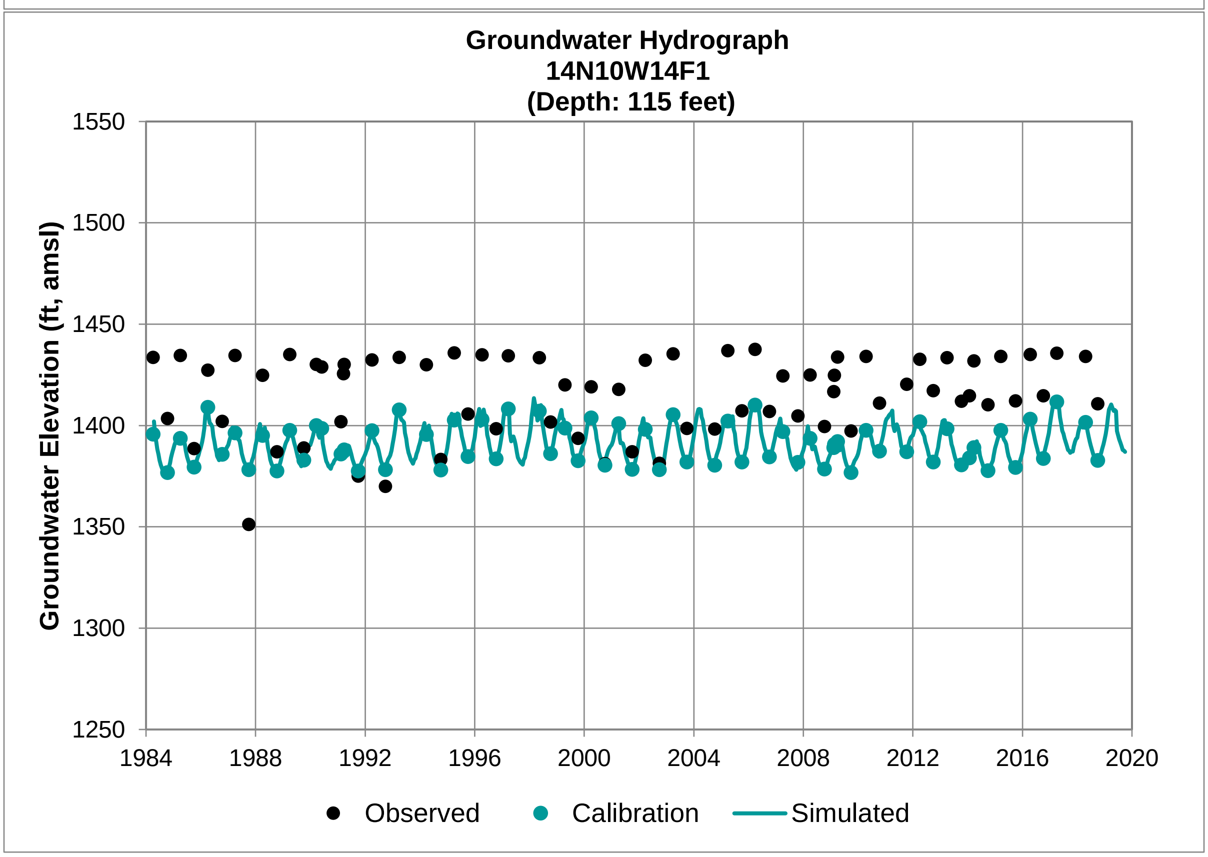
1500
1450
1400
1350
1300
1250
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Observed
Calibration
Simulated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14N10W14F1
(Depth: 115 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
1400
1350
1300
1250
1984
1988
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1996
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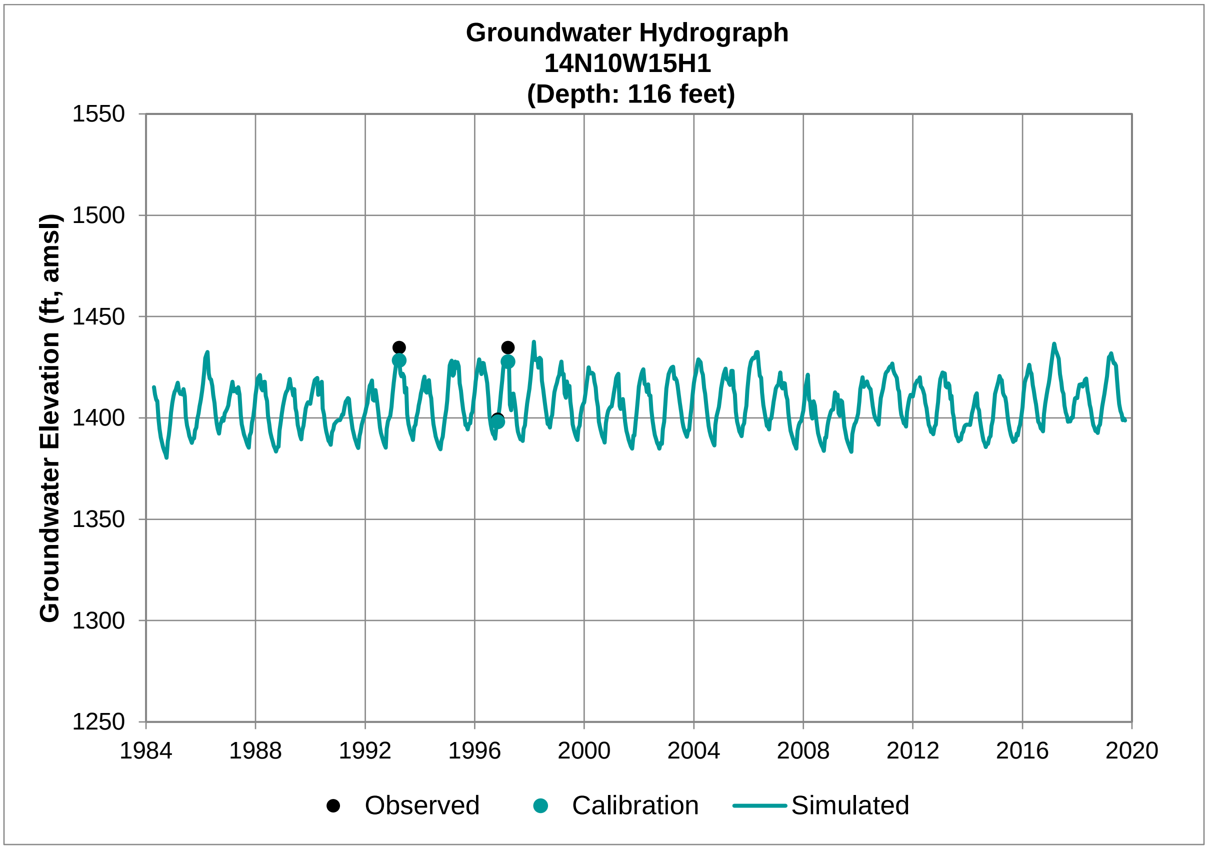
2004
2008
2012
2016
2020
Observed
Calibration
Simulated


Groundwater Hydrograph
14N10W15H1
(Depth: 116 feet)
Groundwater Elevation (ft, amsl)
1550
1500
1450
1400
1350
1300
1250
1984
1988
1992
1996
2000
2004
2008
2012
2016
2020
Observed
Calibration
Simulated

APPENDIX 3A

Standard Operating Procedure for Manual Water Level Measurements and Water Quality Sampling

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List of Tables

Abbreviations and Acronyms

°C	degrees Celsius
μS/cm	microSiemens per centimeter
COC	chain of custody
DO	dissolved oxygen
HDPE	high-density polyethylene
mg/L	milligrams per liter
mL	milliliter
MP	measuring point
NTU	Nephelometric Turbidity Unit
ORP	oxygen- reduction potential

1. SCOPE AND APPLICATION

This guideline is a general reference for the proper equipment and techniques for (1) the determination of the depth to water in a water production well or a monitoring well, and (2) groundwater sampling. The purpose of these procedures is to enable the user to collect representative and defensible groundwater samples and to facilitate planning of the field sampling effort. These techniques should be followed whenever applicable, although site specific conditions or project specific plans may require adjustments in methodology. In all instances, the actual procedures employed will be documented and described on the field form.

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2. PRE-FIELD ACTIVITIES

This section provides checklists and procedures to be completed prior to mobilizing to the field.

2.1 Equipment List

The sampling team members should obtain the equipment and supplies listed below.

- Submersible pump (Grundfos® or equivalent) and a bladder pump (QED Sample Pro ® pump or equivalent), unless well is equipped with an existing pump:
  - Submersible pump – supplemental equipment needed:
    - Generator – at least 2,000 watts for the 2-inch-diameter, 110-volt pump and 4,000 watts for the 4-inch-diameter 220 volt pump. Fill the tank with gasoline. Do not touch any other sampling supplies before thoroughly washing hands to prevent cross-contamination.
    - Converter box.
    - Extension cord – 50 feet.
    - Discharge tubing – tubing diameter depending on pump model selected. Length should be 5 feet greater than the depth of the deepest monitoring well to be sampled.
    - 5-gallon bucket for decontamination. Submersible pumps are generally not dedicated for specific wells and, therefore, must be decontaminated with distilled water and soap (see below) between each sample location.
  - Bladder pump – supplemental equipment needed:
    - Bladder pump power pack or 12-volt car battery.
    - Bladder pump controller.
    - Portable compressor or nitrogen cylinders.
    - Teflon® or high-density polyethylene (HDPE) tubing - typically ¼-inch outside diameter. Length should be 5 feet greater than the depth of the deepest monitoring well to be sampled.
    - Silicon tubing – typically 3/8-inch outside diameter. Length should be approximately 20 feet per sampling event.
    - 5-gallon bucket for decontamination if the equipment is not dedicated in a well.

- Water level sounder (Solinst® Model 101 or 122, or similar instrument) or steel tape and chalk. Length of cable or steel tape equal to the deepest well based on well construction details, if available.
- Multi-parameter meter (Horiba, YSI or similar) to measure temperature, pH, specific conductivity, oxygen- reduction potential (ORP), dissolved oxygen (DO), and turbidity, if possible. Purchase or rent models such as Horiba U-20®, YSI 556 MPS, YSI Professional Plus, YSI 600 XL®, YSI 6920®, or YSI 6820®.
  - Calibration solutions and/or blank standards:
    - pH standards of 4, 7, and 10.
    - Conductivity standards.
    - ORP standards.
    - Turbidity standards (if sonde includes a turbidity probe. Distilled water is an acceptable zero standard).
    - Calibration cup or other vessel to hold calibration standards.
    - Stand to hold meter upright during calibration.
- Flow-through cell to temporarily store purge water to allow the multi-parameter meter probes to stabilize. Use clear flow-through cells to check for particle buildup.
- Turbidimeter to measure turbidity, if not possible with the multi-parameter meter. Purchase or rent models such as the Hach 2100P®, Lamotte 2020®, or HF Scientific DRT-15CE® and a three-way valve for use with turbidimeter.
- 500-milliliter (mL) graduated cylinder to measure the groundwater purge rate (mL/minute).
- 0.45-micron filters (at least one for each sample collected for dissolved metal analyses).
- Decontamination supplies (e.g., Liquinox® or Alconox® soap, distilled water, scrubbing brush and uncoated paper towels.
- Health and safety supplies per approved Health and Safety Plan (e.g., nitrile gloves, steel-toed boots, long sleeve shirt, pants, hard hat and safety glasses).
- Record keeping items (e.g., Chain of Custody forms, groundwater sampling sheets, field notebook, waterproof pens).
- Keys to unlock monitoring wells and/or access gates.
- Tool kit (e.g., wrenches, screwdrivers, cutting tool, etc.).

- Stopwatch and calculator (or a smartphone).
- Packing tape and shipping supplies.
- Camera and camera charger (or a smartphone).

2.2 Equipment Calibration

The equipment listed above that should be calibrated and/or tested prior to use are listed below.

2.2.1 Multi-parameter Meter

The following procedures describe calibration of a commonly used multi-parameter meter (YSI 6-Series i.e., YSI 600 XL®, YSI 6920®, or YSI 6820®.). Specific calibration instructions may differ for other makes/models.

2.2.1.1 Specific Conductivity Calibration

1. Rinse probes with distilled water.
2. Immerse sonde in the conductivity calibration solution.
3. Select “Calibrate” from the main menu.
4. Select “Conductivity.”
5. Select “spCond.”
6. Enter the standard concentration in microSiemens per centimeter (µS/cm) and press “enter.”
7. Allow the specific conductivity reading to stabilize, then press “enter.” Wait for the message “Calibrated” to appear.
8. Rinse the probe with distilled water and re-insert the probe into the standard. The reading should stabilize to within 5% of the standard.

2.2.1.2 pH Calibration

1. Rinse probes with distilled water.
2. Submerge the probes into the pH 7 solution.
3. Select “Calibrate” and press “enter.”
4. Select “pH” and press “enter.”
5. Select “3-point” and press “enter.”
6. Input the pH of the solution (7) and press “enter.”

7. Wait for the pH reading to stabilize and press “enter.”

8. When the display reads “calibrated,” remove the probe and rinse with distilled water.

9. Repeat steps 2 through 8 with the low (pH = 4) and high (pH = 10) calibration solutions. Press “enter” again to return to the calibration menu.

10. To check the calibration, submerge the probe in the pH 7 solution and check the reading. If the reading does not stabilize at 7 +/- 0.3, repeat the calibration.

2.2.1.3 Dissolved Oxygen Calibration

1. Inspect the membrane on the DO probe for damage. The membrane should be in place on the probe for 12 hours prior to calibration. If the membrane is damaged, request a new meter from the equipment rental company or purchase new membrane from the manufacturer.

2. Rinse probe with distilled water.

3. Place 1/8th inch of water in the calibration cup. Screw the cup loosely onto the end of the probe and wait 10 minutes for the air in the cup to become saturated. Ensure that the membrane is completely dry and that the meter is not in direct sunlight.

4. Select “Calibrate” and press “enter.”

5. Select “Dissolved Oxy” and press “enter.”

6. Select “DO%” and press “enter” (Note: this will also calibrate DO in milligrams per liter [mg/L] mode).

7. Wait for the DO reading to equilibrate and press “enter.” Press “enter” again to return to the calibration menu.

8. To perform a zero DO calibration check, exit calibration mode and enter “Run” mode. Submerge the probe in a sodium sulfite solution, after allowing the solution to sit for one hour. The DO reading should be below 0.5 mg/L. If the reading exceeds 0.5 mg/L, ensure that no water droplets are on the probe membrane and verify that the barometric pressure is accurately measured on the device. If the DO reading still exceeds 0.5 mg/L, recalibrate DO by following Steps 2 through 7. Be sure to thoroughly rinse the probe with distilled water to remove all sodium sulfite.

9. To check the saturated DO calibration, repeat Step 3 while in “Run” mode. The reading should be +/- 0.5 mg/L of the saturated value.

2.2.1.4 Oxidation-Reduction Potential ORP Calibration

1. Rinse probe with distilled water.

2. Select “Calibrate” and press “enter.”

3. Select “ORP” and press “enter.”

4. Rinse the ORP sensor with a small amount of ORP calibration solution (Zobell solution).

5. Completely submerge the probe in the solution. Ensure that there are no bubbles on the sensor.

6. Screw the calibration cup onto the meter and tighten.

7. Enter the correct value for the solution based on the ambient temperature (see table in manual). Press "enter."

8. Allow the ORP reading to stabilize and press "enter." Press "enter" again to return to the calibration menu.

9. To check the calibration, submerge the probe into the ORP solution and check the reading. If the reading does not stabilize at +/- 10% of the standard, repeat the calibration.

2.2.1.5 Turbidity Probe Calibration

The following procedures describe calibration of a sonde-mounted turbidity probe (e.g., YSI 6136 probe). For calibration of a separate turbidimeter instrument, see the section below.

1. Rinse probe with distilled water.

2. Select "Calibrate" and press "enter."

3. Select "Turbidity" and press "enter."

4. Completely submerge the probe in the zero Nephelometric Turbidity Unit (NTU) calibration solution. Distilled water is an acceptable substitute for a zero calibration solution.

5. Screw the calibration cup onto the meter and tighten.

6. Enter the correct value for the solution. Press "enter."

7. Allow the turbidity reading to stabilize and press "enter." Press "enter" again to return to the calibration menu.

8. Repeat steps 4-7 for the high-level turbidity solution (typically 123 NTU).

9. If the reading does not stabilize at +/- 10% of the standard, repeat the calibration.

2.2.2 Turbidimeter

The following procedures describe calibration of a commonly used turbidimeter (e.g., LaMotte® model 2020). Specific calibration instructions may differ for other makes/models.

1. Turn the unit on.

2. Select "Measure."

3. A zero NTU blank standard is typically provided with rental equipment. Clean the blank standard thoroughly with a lint free cloth or lab wipe.

4. Open the lid of the meter and insert the blank standard so that the index notch aligns with the arrow on the meter.

5. Select "scan blank."

6. Ensure that the meter reads "0.00." Remove the blank standard.

7. A standard with a higher turbidity is typically provided with rental equipment. Clean the standard thoroughly with a lint free cloth or lab wipe.

8. Open the lid of the meter and insert the standard so that the index notch aligns with the arrow on the meter.

9. Press "OK" to scan sample.

10. Press the down arrow and select "calibrate."

11. If necessary, use the up and down arrows to change the highlighted digits so that they match the turbidity of the standard.

12. When the value displayed matched the standard, press "OK" to select "Set."

13. Press "OK" to proceed to turbidity analysis.

2.2.3 Water Level Sounder

1. Turn the unit on.

2. Press the battery test button, should hear a beep.

3. If no beep is heard, replace battery in unit.

4. Wet probe with distilled water, should hear a beep.

5. If no beep is heard, replace sounder or use steel tape and chalk method.

2.3 Calibration checks

A calibration check for all instruments should be conducted at the end of each day. Checks against standards should conform to the following:

1. Specific Conductance: +/- 5% of known conductivity standard or +/- 10 µs/cm (whichever is greater).

2. pH: +/- 0.3 pH unit with pH 7 buffer.

3. DO: +/- 0.5 mg/L of saturated value; <0.5 mg/L for the 0 mg/L solution, but not a negative value.

4. ORP: +/- 10% of known ORP standard.

5. Turbidity: +/- 5% of known standard.

If observed values do not conform to the above specifications, note the deviations in the field book. Data should be qualified as “estimated” with the direction of bias noted. If the pH calibration check grossly exceeds the criteria (i.e., +/- 1.0), a determination should need to be made as to whether to reject the data or re-test.

2.4 Contacting Landowners or Lessees

Communication with landowners is vital to the success of the monitoring program. For some wells, the landowner has requested County personnel contact them before sampling. Check the index sheet and/or contact notes in the field book to identify those wells. Contact at least 24 hours prior to scheduled sampling event, unless otherwise noted in the field book.

If the well to be sampled is an irrigation well, request that the landowner discontinue pumping at least 12 hours prior to sampling event. Note in the field book if landowner turned off the well and, if yes, the approximate time the well was turned off.

If the well is located near a residence or business, knock on the door to attempt to notify the landowner before sampling. Landowners in the YWA monitoring program graciously allow staff to enter their property for data collection. Courtesy and respect are required when interacting with landowners.

2.5 Sample Containers, Methods and Hold Times

Approximately one week before the sampling event, select a California Environmental Laboratory Accreditation Program certified laboratory and inform them of the planned sampling event. Inform the laboratory of how many water samples are to be collected and the constituents for analysis. Request the laboratory to deliver or ship the required sample containers to YWA before the sampling event. Request an extra set of sample containers in case a bottle is broken or damaged.

Before departure, fill out the chain of custody (COC) to the extent possible and ensure sample bottles are labeled properly. Table 1 lists the analysis parameters, laboratory methods, types of sample containers, sample preservatives, and sample hold times provided by California Laboratory Services. Verify hold times with the specific laboratory being used when informing the lab ahead of the sampling event.

Table 1. Analytical Laboratory Programs

Parameter	Method	Required ContainerType	Preservation	Hold Time (on ice)
Metals	EPA 200.8	1 Plastic/Glass Pint	HNO_3	6 months
Boron, Magnesium, Potassium, Sodium	EPA 200.7	1 Plastic/Glass Pint	HNO_3	6 months
Bromide, Nitrate (as N), Sulfate	EPA 300.0	1 Plastic/Glass Pint	N/A	48 hours
Chromium-6	SM 3500 Cr B	1 Plastic/Glass Pint	N/A	24 hours
pH	SM 2320B	1 Plastic/Glass Pint	N/A	15 minutes[1]
Total Alkalinity	SM 2320B	1 Plastic/Glass Pint	N/A	14 days
Bicarbonate Hydroxide	SM 2320B	1 Plastic/Glass Pint	N/A	14 days
Hardness	SM 2340 B	1 Plastic Glass Pint	HNO_3	180 days
Total Dissolved Solids	SM 2540 C	1 Plastic/Glass Pint	N/A	7 days
Specific Conductance	SM 2510 B	1 Plastic/Glass Pint	N/A	28 days
Fecal coliform	SM 9221 E	1 Plastic Pint	$Na_2S_2O_3$	24 hours

Note:
[1] The laboratory will analyze pH outside of hold time. pH value measured during well sampling can be used.

Key:
HNO_3 = nitric acid
N/A = Not applicable
$Na_2S_2O_3$ = Sodium thiosulfate

2.6 Directions

Confirm directions and access to all well locations.

3. MONITORING AND SAMPLING PROCEDURES

The purpose of each well visit is to record depth to water and to collect water-quality samples for analysis.

Upon arrival at the well site, and before exiting the vehicle, ensure conditions are safe (no vicious animals or other dangerous conditions). If the well is near a residence or business, knock on the door. Make sure the field book contains current well owner information and explain to the well owner or representative that you will be sampling the well.

Inspect the well and note any issues (e.g., missing locks or damage) in the field book. Note relevant information regarding the physical condition of the well, the surrounding ground surface, weather, and any condition that may interfere with obtaining representative analytical results. Attempt to fix the situation, if possible, before sampling. Follow the site-specific health and safety plan and all YWA safety procedures at all times.

3.1 Depth Measurements

Measure depth-to-water in each well. A total depth measurement should be taken at least once per year per well. The presence of oil in the water, odors, or any other notable conditions should be recorded in the field book. Depth to water measurements may be made using either a depth-to-water indicator (sounder) or using a steel tape with chalk. Total well depth should be measured using a steel tape, as steel tape is less prone to catching on down well materials or obstructions (such as a pump).

3.1.1 Measure Depth of Well

Depth of well should be measured to the nearest hundredth of a foot and should be properly recorded in the field book. The measurement should be made with weighted steel tape.

How to measure:

1. Reference previous measurement in field book to approximate expected depth.
2. Approach the measuring point (MP), which should be demarcated with a notch in the well casing or "MP."
3. written on the casing and unlock the reel.
4. Slowly feed the tape down well, while wiping with a cloth soaked in a dilute chlorine solution as it enters the well.
5. If tape hits obstruction at depth not expected, slowly attempt to dislodge end of tape and continue lowering.
6. Without letting the steel tape hit bottom hard, record depth in field book to the nearest hundredth foot. Do so by placing the tape against side of well at the MP. This location should be used for all depth recordings.

7. Reel in steel tape.

8. Record total depth in field notebook.

9. Decontaminate with Liquinox or Alconox, disinfect with dilute chlorine solution, and triple rinse with distilled water.

10. Dry off tape.

3.1.2 Measure Depth to Water

Depth to water measurements can be made using a water level sounder or a steel tape and chalk. For domestic/irrigation wells, sampler should request that the well owner or representative discontinue pumping water from the well for 12 to 24 hours prior to sampler's arrival in order to get an accurate measurement of the depth to static groundwater levels. If the well contains more than a foot of oil, the measured depth to water needs to be adjusted for the amount of oil present. Water level adjustments can be ignored if the well contains less than a foot of oil.

3.1.2.1 Water Level Sounder

Depth to water should be measured to the nearest hundredth of a foot and recorded on the well sampling form. Lower the probe slowly to avoid damage.

How to measure:

1. Approach the MP, which should be demarcated with a notch in the well casing or "MP" written on the casing.

2. Turn on the unit and unlock the reel.

3. Slowly lower the probe down well at the MP, while wiping with a cloth soaked in a dilute chlorine solution as it enters the well.

4. Maneuver the probe past any obstructions encountered (e.g., well casing joint).

5. At the top of the water surface in the well casing, the unit should beep.

6. Reel probe up until unit is no longer beeping.

7. Slowly lower the probe back down until beep is heard.

8. Record the depth to water from the MP to 0.01 foot on the well sampling form.

9. Reel the probe up the well at a slow and steady pace. Maneuver the probe past any obstructions encountered.

10. Record depth to water in field notebook.

11. Decontaminate probe and reel with Liquinox or Alconox, disinfect with dilute chlorine solution, and triple rinse with distilled water.

12. Dry off sounder

3.1.2.2 Steel Tape and Chalk

Depth to water should be measured to the nearest hundredth of a foot when using steel tape and chalk and should be properly recorded.

How to measure:

1. Reference the most recent measurement.

2. Put on protective gloves, then completely chalk at least the first five feet of the graduated steel tape.

3. Insert the graduated steel tape at the MP referenced in the field book.

4. Slowly feed the tape down hole, wiping with a cloth soaked in a dilute chlorine solution as it enters the well. Insert the graduated steel tape approximately 3 – 5 feet deeper than most recent measurement, adjusting where needed to reflect anticipated change in depth to groundwater since the most recent measurement.

5. Once the desired depth is reached (the HOLD mark), place the graduated line at the MP and hold for 3 to 5 seconds. Make sure the tape does not go in the well past the HOLD mark. Record this value in field book.

6. Begin reeling the tape up the well at a rapid pace so the wetted mark does not dry before reaching the surface.

7. Watch for the wetted mark (the CUT) on the chalked end of the tape.

8. Read the graduation to the nearest hundredth of a foot of the CUT mark on the tape. If the mark is not at a graduated line, an engineer's measuring tape is used to obtain the measurement to the hundredths of a foot.

9. Record depth in field book.

10. Decontaminate tape with Liquinox or Alconox, disinfect with dilute chlorine solution, and triple rinse with distilled water.

11. Dry off tape.

3.1.2.3 Floating Oil Adjustment Procedure

The following procedure should be implemented, where possible, to "correct" the measured depth to water where the oil thickness in a well is greater than 1 foot.

1. Measure the depth to water and oil using a water using an oil/water interface meter.

2. Calculate the thickness of the oil column.

3. A more accurate estimate of the actual water level is made by adding the thickness of the oil layer times the oils density to the measured oil-water interface depth. If the density of oil is unknown it can be estimated as 0.87 (the average density of various grades of Phillips 66 Turbine Oils).

   Corrected Depth to Water (feet) = Measured Depth to Oil/Water Interface (feet) + 0.87 x Oil Layer Thickness (feet).

3.2 Collect Groundwater Samples

Procedures are provided in this section for purging and sampling dedicated monitoring wells and active domestic and irrigation wells.

3.2.1 Purging and Sampling Monitoring Wells

- Place purging and sampling equipment and supplies downwind of the monitoring well. Sampling equipment should be decontaminated with Liquinox or Alconox, disinfect with dilute chlorine solution, and triple rinse with distilled water prior to entering the well.

- Lower the bladder or submersible pump into the well to the middle of the screen, if known, or at least five feet below the water table if not known.

- Connect the pump to the controller, power pack or generator, and compressor, as needed.

- Turn on the pump beginning with a slow speed setting. In a graduated cylinder measure the amount of water extracted from the well and discharged in one minute. A good starting purge rate is 100 to 200 mL/minute. In no case should the purge rate exceed 500 mL/min. A purge rate below 50 mL/minute indicates potential well construction problems. The target purge rate range should be 100 to 500 mL/minute.

- Record the purge rate and use to calculate the amount of water purged from the well over time.

- After the pump has been turned on, monitor the water level in the well. The target drawdown level is for no more than 0.3 feet; however, in some wells the level may exceed this amount before equilibrium is reached.

- If the water level draws down despite the lowest purge rate that the pump is capable of, continue to purge groundwater from the well. Do not allow the water level to fall within the screened interval of the well, as this will cause cascading within the well screen and oxygenate. Record the water level when purging is discontinued. Allow the water level in the well to sufficiently recharge prior to the commencement of purging and/or sampling.

- Measure and record readings of pH, temperature, specific conductivity, turbidity (if applicable), DO, and ORP from the multi-parameter meter and turbidity from a turbidimeter every five minutes until three consecutive readings have met stabilization criteria (Table 2).

- When using a Flow Cell: The pump's flow rate must be able to "turn-over" at least one volume of the flow through cell between measurements. The turbidity measurement should be made using an aliquot collected in a clean cuvette from the bypass valve to avoid fine particles that have accumulated in the flow cell and that slowly bleed off in the discharge water.
- No Flow Cell: Collect field parameters from the discharge line or sample port directly. Care should be taken to avoid agitating samples to limit gas exchange. Sample readings should be taken immediately after being placed in the meter.

- When three consecutive readings for each parameter have been recorded within the limits specified in Table 2, purging is complete and sample collection can begin.

Table 2. Stabilization Criteria Before Sampling

Indicator Parameter	Stabilization
Temperature	+/- 3% degrees Celsius (C°)
Dissolved Oxygen	+/- 10% for values greater than 0.5 milligram per liter (mg/L). If three consecutive DO readings are less than 0.5 mg/L, the parameter is stable.
Specific Conductance	+/- 3% µS/cm)
pH	+/- 0.1 units
Oxidation-Reduction Potential	+/- 10 millivolts (mV)
Turbidity	+/- 10% for values greater than 5 Nephelometric Turbidity Units (NTU). If three consecutive turbidity readings are less than 5 NTU, the parameter is stability.

Source: Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samplesfrom Monitoring Wells (EPA, July 30, 2017, rev. 4).

The stabilization goals may not be achievable in all geological formations. A reasonable effort should be made to achieve stabilization of field parameters. However, if stabilization is not achieved within 10 casing volumes, note it in the field notebook or on the field sheet, and samples should be collected.

If the turbidly measurement is greater than 20 NTUs at the time of sample collection, a filtered and unfiltered sample should be collected for metals.

- The last measurements taken prior to sampling should be considered the final measurements and are those that should be reported.
- Disconnect the pump head tubing from the flow cell and three-way bypass valve prior to the beginning of sample collection.
- Fill each bottle to the top, without letting any sample spill out. Be sure to provide sufficient sample volume by completely filling all containers. A small amount of headspace in the sample bottle is acceptable.
- If dissolved metals analysis is to be conducted, the groundwater should be filtered with a 0.45-micron filter in the field prior to the sample being collected. Connect the pump head tubing to the filter intake, allow the water to run through the filter and collect the outflow directly into the sample bottle.
- Label samples and record any notes regarding the sample in the field notebook.
- During sampling, the sample bottles should be shielded from wind, airborne dust and rain. Samples should not be exposed to sunlight after collection.
- Immediately place all labeled sample containers in a cooler with ice.
- Fill out the COC form.
- If tubing is not dedicated, remove the tubing from the well and properly discard.

3.2.2 Domestic/Irrigation Well Sampling Procedure

- Turn on the well pump, if not already running, and allow to run for 15 to 30 minutes to purge standing water from the well. Ideally, at least three casing volumes should be removed from the well, if construction details are known. If the well pump has been running within the last 24 hours, you can skip this step and continue to sample collection
- If the resident has a water filter or conditioner, the sample should be collected prior to entry into this apparatus, if possible; also, aerators on spigots or faucets should be removed. If the resident has a water or pressure tank, samples should be collected before entering the tank, if possible.
- Turn on the faucet of spigot at approximately one-half to three quarters flow.
- Complete and attach the sample labels to the sampling bottles.
- Fill each bottle to the top, without letting any sample spill out. Be sure to provide sufficient sample volume by completely filling all containers. A small amount of headspace in the sample bottle is acceptable.
- If dissolved metals analysis is to be conducted, the groundwater should be filtered with a 0.45-micron filter in the field prior to the sample being collected. It is recommended that

the groundwater to be sampled be transferred to a clean, secondary container (such as a clean 5-gallon bucket) and the pump used to push the water through the filter. The sample should be collected from the secondary container by connecting the pump head tubing to the filter intake, allowing the water to run through the filter and collecting the outflow directly into the sample bottle.

- Record any notes regarding the sample in the field notebook.
- During sampling, the sample bottles should be shielded from wind, airborne dust and rain. Samples should not be exposed to sunlight after collection, to the extent possible.
- Immediately place all labeled sample containers in a cooler with ice.
- Fill out a chain of custody form.

3.3 Decontamination

Decontamination for all non-dedicated groundwater sampling equipment should be performed prior to and between sampling locations.

Decontamination should include, at a minimum, a scrub or wash with laboratory-grade detergent (Liquinox® or Alconox® soap) and potable water solution. Following the detergent wash, the equipment should disinfected with a dilute chlorine solution and triple rinsed with distilled water and dried with clean, uncoated paper towels.

For decontamination of submersible pumps (if used), the procedure is as follows:

- Flush in a clean 5-gallon bucket with laboratory-grade detergent (Liquinox® or Alconox® soap) and potable water solution.
- Flush in a clean 5-gallon bucket with potable or distilled/deionized water to remove all of the detergent solution.
- Flush in a clean 5-gallon bucket with potable or distilled/deionized water containing a dilute chlorine solution. A dilute chlorine solution can be made by adding 1 fluid ounce of non-scented household bleach to 4 gallons of water.
- Flush in a clean 5-gallon bucket with distilled/deionized water.

3.4 Field Documentation

3.4.1 Sample Labeling

A sample label should be affixed to all sample containers. At a minimum, the label should identify each sample by the sample ID, sampler's initials, sample location, date and time, and any preservatives, if present. It is recommended that samples are labelled using a waterproof ink and attached to the sample container prior to sample collection.

3.4.2 Field Notebook and Sampling Forms

The field notebook and/or groundwater sampling sheets should be updated for each well during the sampling event. During sampling, all groundwater sampling activities should be recorded on a groundwater sampling sheet and/or in the field notebook. At a minimum the following items should be documented during field activities:

- Site name, municipality, state.
- Well number/identifier.
- Measuring point description.
- Well depth.
- Well screen interval/length.
- Description of all sampling/monitoring equipment used, including product names, model number, instrument identification number, etc.
- Pump intake depth.
- Depth to water.
- Pumping rate, total drawdown, final field parameters values, total volume pumped, time of each set of measurements.
- Type of tubing used and length.
- Time of start and end of purging and sampling activity.
- Types of sample containers used and sample identification numbers.
- Parameters requested for analyses.
- Preservatives used.
- Filtered status for dissolved metals.
- Name of sample collectors.
- Weather conditions, including approximate ambient air temperature.
- Calibration data for field instruments.
- Field observations during sampling event.
- Any problems encountered.

Any deviations from the established procedures should be described in detail in the sampling notebook. A determination should be on whether the sampling will meet the data quality objectives for the sampling event.

3.4.3 Chain-of-Custody

A COC form must be filled out, signed, and submitted to the laboratory with all water samples. Laboratories have in- house formats, but information provided is standard for all laboratories. A standard COC and Groundwater Sampling Form is attached.

Notes when filling out the COC:

- Ensure date, time and page numbers are filled out properly.
- Ensure the number of sample bottles are counted correctly for each sample and that preservatives are noted.
- Ensure the correct analytes and analysis methods are listed. For dissolved metals, indicate whether they were filtered in the field or need filtering in the laboratory in the notes section.
- If all sample containers are filled in succession, use time at start of sampling as the sample collection time.
- Ensure contact information is complete, including an email address, physical address and phone number.
- Sign and date the COC in the “Relinquished By” box before relinquishing to any other party and ensure the person you are relinquishing the samples to signs and dates the “Received By” box, including the laboratory or lab courier. When shipping samples, sign and date the “Received By” box for the commercial shipping company as their employees may not agree to sign the COC.
- Take a photograph of the completed COC.

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4. SAMPLE HANDLING AND SHIPPING

Samples should be stored in a sample cooler with regular ice after collection and during shipment. The samples should be stored upright in an appropriately sized cooler (typically provided by the laboratory) above a layer of packing material, such as bubble wrap, and a layer of ice. Each sample should be double bagged in an individual bubble wrap bag (typically provided by the lab) and a Ziplock bag. They should be packed so that they are not directly touching one another, with the space between sample containers filled in with ice. Once samples have been placed and tightly packed, ice should be carefully placed above the samples followed by packaging material, so that they are completely encapsulated. Any additional cooler space should be filled with packing material. It is recommended that additional ice be added or that ice be replaced shortly before shipping the sample cooler(s) to ensure samples stay cold during transport.

4.1 Shipping Samples

Samples can be delivered to the laboratory following sampling, picked up by a lab courier, or shipped overnight to the laboratory.

If samples are not to be delivered or picked up by a lab courier, they should be shipped overnight to the laboratory using a reliable commercial shipping service. Temperature range should be a maximum of 4 degrees Celsius (°C) +/- 2°C upon laboratory receipt of samples. Guidelines for sample shipment:

- Call the laboratory to notify them the samples should arrive on the following day. If sampling on a Friday, ensure they can receive samples on Saturday before shipping the samples.
- Place the completed COC in Ziploc bag and seal.
- Tape the sealed bag with the COC to the top of the inside of the cooler.
- Tape cooler shut with at least three wraps of packing tape.
- Place a custody seal (provided by the lab) on the cooler lid to ensure the cooler was not opened or tampered with during shipment.

4.2 Results

The laboratory should e-mail results to the YWA representative along with a copy of the COC. If results have not been sent one week after sampling event, call the laboratory to inquire.

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5. REFERENCES

U.S. Environmental Protection Agency Region 1, 2017, *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction (ORP), and turbidity)*, dated June 3, 1998, revised March 23.

U.S. Environmental Protection Agency, 2017, *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*, dated July 30, 1996, revised September 19.

USGS, 2011, *Groundwater Technical Procedures of the U.S Geological Survey, Techniques and Methods 1-A1*.

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APPENDIX 6A

Data Management System Summary

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List of Tables

Abbreviations and Acronyms

CCR	California Code of Regulations
DDW	Division of Drinking Water
DMS	data management system
DWR	California Department of Water Resources
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
JPL	Jet Propulsion Laboratory
NOAA	National Oceanic and Atmospheric Administration
SWN	State Well Number
SWRCB	State Water Resources Control Board
USGS	U.S. Geological Survey

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1. INTRODUCTION

Through the development of this Groundwater Sustainability Plan (GSP), the Groundwater Sustainability Agency (GSA) created a data management system (DMS). The DMS was created to manage data related to monitoring, analysis, and reporting on groundwater conditions and related information and meet the requirements of the GSP Regulations, including California Code of Regulations (CCR) Title 23 § 352.4, § 352.6, and § 354.4.

The DMS has four key attributes:

1. Flexibility for importing data from various software platforms and systems,
2. Sufficient capacity to store existing historical data and additional future data,
3. Ability to export data to numerous software formats (i.e., ESRI, Tableau), and
4. Capability to grow and evolve in the future.

This DMS consists of a Microsoft Access database that incorporates data storage and an interface to manipulate, query, and manage data. Microsoft Access also has the capability to sync with web components to allow for online viewing of data in the form of maps and graphs. The DMS also has functionality to enable importing/exporting data to other commercially available software programs for data visualization and/or allow for multiple users.

1.1 Data Types and GSP Indicators

Public agencies collect and maintain data applicable to GSP development and implementation, including California Department of Water Resources (DWR), United States Geological Survey (USGS), State Water Resources Control Board (SWRCB) comprising data from GeoTracker, Groundwater Ambient Monitoring and Assessment Program (GAMA), and Division of Drinking Water (DDW), National Aeronautics and Space Administration Jet Propulsion Laboratory (JPL), and National Oceanic and Atmospheric Administration (NOAA). The Lake County Water Resources Department also conducts groundwater monitoring. These monitoring programs and available data are continually evolving to expand and merge to create a more useful and powerful network of information. Data collection methods and sources will likely change in the future. The DMS contains a variety of data types, including well location and construction details, groundwater level and quality, and stream flow.

1.2 DMS Database Structure

The database has a similar structure to common datasets developed by the USGS, SWRCB, and DWR. All data in the DMS are identified by data source. Each site or station is uniquely identified by a Site ID depending on the data source the Site ID could be the State Well Number (SWN), Station ID, or site-specific name. To ensure user flexibility, the DMS was designed using the Microsoft Access 2007-2016 software platform and the .accdb database format. There are three main tables, several smaller tables, and many “lookup tables.” The three main tables are:

- T_Well = well information

- T_WL = water level information related to wells
- T_WQ = water level information related to wells

1.3 Database Schema and Data Fields

Proper creation of tables and table relationships, also known as schema, will avoid errors in query results and improve database efficiency. All tables in the DMS have a unique primary key (a special key (field) used to uniquely identify records) that serves as the common link between tables. The primary key maintains structural integrity of the relational database, prohibits duplicate entries in a field that requires unique information, and it is a useful field for linking tables with a defined relationship. Tables may also have foreign keys (a field used to establish a relationship between two tables) to help association with other tables and their fields. The process of creating proper table construction and relationship definitions makes inconsistent data more obvious and helps with quality control. All tables are normalized to at least the 3rd normal form. Normalization is a database design technique, to modify existing tables and their schema to minimize data redundancy and dependency.

Data standardization is important to avoid mixing definitions, units or other references that make data non-equivalent. Examples include elevation data that is referenced by a datum. There are generally two different vertical datums commonly used in reporting elevations: NGVD29 and NAVD88. NGVD29 is the older vertical datum that is referenced on USGS Quadrangles, and in California it is basically equivalent to mean sea level. Equating the NAVD88 datum to the NGVD29 datum varies by location. The datum in this DMS is all NAVD88. Water quality parameters are also standardized for example nitrate as nitrogen versus nitrate as nitrate, and should have consistent concentration units (e.g., mg/l, µg/l).

Use of List of Values tables. These can help in data standardization and keep track of the allowable values for each table filed (column). These can be referenced by other data tables. For example, T_LOV_WQ_AN which contains list of analytes. These are “lookup tables.”

Table 1. Lookup Table Example

T_CD_DATUM		
CD_DATUM	**DATUM_DESC**	**DATUM_TYPE**
NA	Not Applicable	--
NAD27	North American Datum 1927	Horizontal
NAD83	North American Datum 1983	Horizontal
NAVD88	North American Vertical Datum 1988	Vertical
NGVD29	National Geodetic Vertical Datum 1929	Vertical
UNK	Unknown Vertial Datum	Vertical

Key: CD_Datum = Creation Date Datum; DATUM_DESC = Datum Description; T_CD_DATUM = Type Creation Date Datum

The well site is uniquely identified by a “Well ID,” usually corresponding to the DWR-assigned SWN, USGS Site ID, or local Source Name. It is important to ensure this field is unique as State Well Numbers are not the unique identification that they were intended to be.

1.4 Quality Assurance and Quality Control

The DMS users should follow quality assurance and quality control processes to identify inconsistencies with data and common problems that occur through data entry. The most important component of quality control in the DMS is the preparation and review of data before entry in the DMS. These data are technical and should be scrutinized for inconsistencies and completely described before data entry. Tools have been established in the DMS for troubleshooting and error checking and should be used by a technical person with a conceptual understanding of the data to identify any questionable data or functional problems of the DMS (should they arise).

Additional quality assurance and quality control queries have been established to identify conflicting or inconsistent records or information (e.g., inconsistent units of measure for a water quality parameter, multiple reference point elevations for a well or groundwater pumping during water level collection). Despite efforts to minimize inaccurate data in the DMS inaccurate data does exists and is corrected on an ongoing basis.

It is important to remove redundancy in data. This can occur when two sources of information provide identical or similar data for the same well. The well records with redundant data need to be identified and flagged. Then the duplicated data (water level/quality entry) need to be examined and appropriate steps taken to remove the redundancy. One well ID should be used for each physical well. Nested wells (multiple wells within the same casing) should be uniquely identified.

Groundwater level data may contain measuring point discrepancies and/or changes over time. These differences may arise when a well gets modified, re-surveyed or the measuring point changes. There might also be errors in the reference point elevations, in which case the reporting agency should be notified to resolve the error. Other differences in reference point elevations should be considered when making interpretations of water level changes and should, therefore, be rectified. Differences in elevation datum (between the older NGVD29 and more recent NAVD88) should be carefully observed and considered in order to interpret groundwater elevations. Lastly, significant subsidence over time may make the reference point elevation no longer representative.

Numeric entries, such as *Depth to Water* field and *water quality value* fields should contain only numeric values. No text, spacing, or punctuation is allowed in numeric data. Data in fields should be consistent and logical. The use of numerical flags, like 999 or -9999 should be avoided as a separate field can perform this function. Also, these comment type numbers can bias mathematical functions, like mean or median.

1.5 Reporting

1.5.1 DWR Submittals

Data submittals to DWR, as part of regular reporting, will include data contained in the DMS and be contained in forms (Excel files) provided by DWR through the SGMA Portal.[1] The DMS has

[1] https://sgma.water.ca.gov/portal/

the capability to conduct queries for extracting the appropriate reporting data in a format compatible for submittal in accordance with DWR reporting requirements.

1.5.2 Annual CASGEM Reporting

After the submittal of the GSP, the GSA will no longer need to update the CASGEM site with data and will instead report groundwater level monitoring data for Representative Monitoring Sites through uploads to the SGMA Monitoring Network Module.[2]

1.5.3 GSP Annual Report

GSP Regulation §356.2 requires GSAs to submit GSP annual reports covering the previous water year (October 1 to September 30) every April 1 after submitting the GSP. GSP Regulations require that GSP annual reports include the following content:

- Executive Summary and location map §356.2(a).
- Groundwater elevation data, including groundwater contours and hydrographs for each principal aquifer §356.2(b).
- Total water use including groundwater extraction (general location and volume) for the preceding water year and surface water supply used or available for use (including the volume and sources) for the preceding water year §356.2(b).
- Change in groundwater storage for each principal aquifer §356.2(b).
- A graph illustrating cumulative change in groundwater storage, water year type, annual change in groundwater storage §356.2(b).
- Progress on Plan Implementation including achieving interim milestones, and implementation of projects and management actions §356.2(c).

There is no required template for GSP annual reports, although DWR provides a spreadsheet-based template, that it refers to as an elements guide, intended to accompany each annual report and provide a cross-reference between the content required by the GSP Regulations and the location of the required content in that annual report. Additionally, DWR has released spreadsheet-based templates to use for submitting and uploading data on groundwater extraction, groundwater extraction methods, surface water supply, and total water use required as part of GSP annual reports.

[2] https://sgma.water.ca.gov/SgmaWell/

APPENDIX 7A

Big Valley Basin Communication and Engagement Plan

PREPARED FOR:

Big Valley Groundwater Sustainability Agency (BVGSA)
Lake County, California

PREPARED BY:

Stantec Consulting Services Inc.

January 2022

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Executive Summary

The Big Valley Basin Communication and Engagement Plan (C&E Plan) provides a high-level overview of potential near- and long-term outreach strategies, tactics, and tools that support public and stakeholder communication actions, as required by the Sustainable Groundwater Management Act of 2014 (SGMA) and for consideration by Big Valley Groundwater Sustainability Agency (BVGSA).

This C&E Plan recognizes that communication evolves, and so it broadly describes potential actions in categories. These actions may be implemented by the BVGSA to inform and engage stakeholders about the development of the Groundwater Sustainability Plan (GSP), the delivery of clear and consistent messaging about SGMA, and to comply with the SGMA outreach requirements. The potential outreach tools and activities identified in this document were informed by a Stakeholder Assessment conducted in the Summer and Fall of 2020, input from members of the Groundwater Sustainability Plan Advisory Committee (GSPAC), and information gathered from public meetings. Both the Stakeholder Assessment and this C&E Plan were funded through a Facilitation Support Services grant from the California Department of Water Resources (DWR).

Outreach Tools

This Plan identifies several potential tools to support communication and engagement activities with stakeholders in the Lake County's Big Valley Basin. For the purposes of this C&E Plan, stakeholders are defined as beneficial users of groundwater in the basin or individuals or organizations with an interest or stake in the management of groundwater resources in the region. Identified tools include the following:

- Project Website: The BVGSA has updated its webpages (http://www.lakecountyca.gov/Government/Directory/WaterResources/Programs___Projects/Big_Valley_GSP.htm) to provide information about SGMA and to house BVGSA meeting and outreach materials.

- Interested Parties Database: Pursuant to the requirements of SGMA, the BVGSA has developed and will maintain an Interested Party Database. Opting-in to the database will be a simple process via a Stay Connected online form, with the ability to request inclusion, should someone not have access to the form. The Database will be used to notify stakeholders of pending meetings and workshops, opportunities for public comment, and notices of other GSA outreach actions.

- Informational Materials: The BVGSA will develop template outreach materials during the GSP process. These materials may include informational fact sheets, template presentation slides, notices, and new releases. Materials may be translated, as needed, into Spanish or other languages.

Outreach Activities

This Plan identifies a variety of potential outreach activities to provide opportunities for interested parties and stakeholders to stay informed and engaged in the development of the

GSP. These potential outreach activities seek to build and expand public awareness of the BVGSA, groundwater in the Big Valley Basin, and SGMA and to actively engage key stakeholder groups to coordinate and collaborate on technical issues important for GSP development and implementation. Below is a summary of existing and potential additional outreach opportunities.

- Groundwater Sustainability Plan Development Meetings: The ongoing way for members of the public to provide input on development of the GSP is by attending and providing public comment at regular GSPAC monthly meetings, or to attend any one of the series of technical subcommittee meetings that are publicly noticed and open for anyone to join.

- Board of Directors Briefings: BVGSA representatives or technical consulting staff may conduct periodic presentations to the Lake County Board of Supervisors, as the sitting Board of Directors for the agency. These presentations are intended to provide updates on GSP progress and next steps and to respond to questions.

- Public Meetings and Workshops: In support of plan development, the BVGSA will periodically host public meetings or workshops aimed at educating members of the public about key GSP topics, and to solicit input on technical content and draft GSP sections and chapters. It is anticipated that up to seven workshops will be held between Spring 2021 and Winter 2022.

- Community Presentations: The BVGSA may provide brief, high-level overviews of the GSP process and status at meetings hosted by various civic, nonprofit, and community groups in the Big Valley Basin.

- Partnerships with Local Organizations: The BVGSA may establish partnerships with trusted organizations in the basin to broaden the dissemination of SGMA information and to connect with specific stakeholder groups. This may include sending these organizations notices and informational materials for distribution to their stakeholders, cohosting events or workshops, and/or holding briefings with partners' leadership.

- In-Person Outreach at Community Events: The BVGSA may also conduct targeted outreach to specific stakeholder groups during community events. These gatherings would provide an opportunity to distribute informational materials while allowing an agency representative to talk to people about SGMA, groundwater in Big Valley Basin, and the GSP process.

Groundwater Sustainability Plan Comment Process and Adoption Outreach

The BVGSA will release draft GSP sections and chapters for public review and comment as content is developed. Interested parties will be able to view draft chapters on the BVGSA webpages and to submit comments remotely via email or in-person during any of the GSPAC meetings, related subcommittee meetings, or in public meetings. The draft chapters may be revised according to comments received during the respective comment periods.

It is currently envisioned that a complete Public Draft GSP will be released for public review in late Fall 2021, for a public comment period. A summary of the comments received during this period will be attached to the Final GSP and posted on the BVGSA webpages. The Final GSP will be adopted at a public hearing and then submitted to DWR no later than January 31, 2022.

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Abbreviations and Acronyms

BVGSA	Big Valley Groundwater Sustainability Agency
CASGEM	California Statewide Groundwater Elevation Monitoring
C&E Plan	Communication and Engagement Plan
District	Lake County Watershed Protection District
DWR	California Department of Water Resources
FSS	Facilitation Support Services
GDE	groundwater dependent ecosystem
GSA	Groundwater Sustainability Agency
GSPAC	Groundwater Sustainability Plan Advisory Committee
GSP	Groundwater Sustainability Plan
MHI	median household income
SGMA	Sustainable Groundwater Management Act of 2014

1. INTRODUCTION

1.1 About the Sustainable Groundwater Management Act of 2014

The Sustainable Groundwater Management Act of 2014 (SGMA) was signed into law by Governor Jerry Brown on September 16, 2014—three years after the start of California's historic drought. The legislation requires local public agencies and newly formed Groundwater Sustainability Agencies (GSA) in high- and medium-priority subbasins to meet certain requirements for the long-term sustainable management of California's groundwater resources. These requirements include the following:

- June 30, 2017: Establish GSAs (or equivalent) for all high- and medium-priority basins. Water Code § 10724(b)
- July 1, 2017: County must affirm or disaffirm responsibility as GSA if no GSA has been established. Water Code § 10724(b)
- Jan. 31, 2022: All non-critically overdrafted high- and medium-priority basins must be managed under a Groundwater Sustainability Plan (GSP). Water Code § 10720.7(a)(1)
- On April 1, following GSP adoption and annually thereafter, GSAs will provide reports on progress towards sustainability to the California Department of Water Resources (DWR). Water Code § 10728

Oversight of these requirements is provided by DWR with potential intervention by the State Water Resources Control Board if management activities are determined to be inadequate.

1.1.1 Groundwater Sustainability Plan Emergency Regulations

Following the passage of SGMA, DWR embarked on a series of public and agency meetings to develop the GSP Emergency Regulations. These regulations were released in July 2016 and are chaptered under the California Code of Regulations Title 23. Waters (§350-§358.4). In conjunction with the release of these regulations, DWR published the Groundwater Sustainability Plan Emergency Regulations Guide. This guide summarizes and defines the processes and requirements for GSA formation found in Title 23, the development and implementation of GSPs, the responsibilities of DWR—and by extension the State Water Resources Control Board (State Water Board)—and inter-basin coordination (§357.2).

The Big Valley Basin Communication and Engagement Plan (C&E Plan) describes methods, tools, and activities available to the BVGSA as it undertakes communication and engagement activities identified in the GSP Emergency Regulations and chaptered in California Code of Regulations Section 354.10:

Each plan shall include a summary of information relating to notification and communication by the agency with other agencies and interested parties including the following:

> *(a) A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of*

groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.

(b) A list of public meetings at which the plan was discussed or considered by the agency.

(c) Comments regarding the plan received by the agency and a summary of any responses by the agency.

(d) A communication section of the plan that includes the following:

(1) An explanation of the agency's decision-making process.

(2) Identification of opportunities for public engagement and a discussion of how public input and response will be used.

(3) A description of how the agency encourages the active involvement of diverse social, cultural and economic elements of the population within the basin.

1.2 About the Big Valley Basin

There are a total of 515 groundwater basins and subbasins in the State of California. The Big Valley Basin (DWR Bulletin 118 Basin Number 5-015) is located entirely within Lake County. It is one of two DWR-designated basins in Lake County, with the other being Scotts Valley Basin that has a low-priority designation. Big Valley Basin is one of the 94 basins and subbasins that have been designated as high or medium priority by DWR's California Statewide Groundwater Elevation Monitoring (CASGEM) program. With CASGEM data and analysis, DWR has classified the Big Valley Basin as a medium-priority basin. This classification requires the GSA in the basin to submit a GSP to DWR no later than January 31, 2022.

1.3 Previous Groundwater Efforts in Big Valley Basin

The Lake County Watershed Protection District (District) initiated the original well monitoring network in the Big Valley groundwater basin in the late 1940s, and it has provided routine monthly well monitoring in the basin since the early 1990s. In the early 2000s, the District established a Groundwater Database for tracking well measurements for both the monthly well collection and the bi-annual well collection. The District also participates in the DWR CASGEM program, where seasonal and long-term groundwater elevation trends are tracked for certain wells. This historical monitoring has aided in planning efforts throughout the basin, such as the development of the following documents: 1967 Big Valley Groundwater Report, 1999 Big Valley Groundwater Management Plan, 2003 Big Valley Recharge Investigation, 2006 Lake County Groundwater Management Plan, and the 2019 Annual Big Valley Report. These reports can be found on the BVGSA webpages at http://www.lakecountyca.gov/Government/Directory/WaterResources/Programs___Projects/Big_Valley_GSP/Advisory_Committee_Documents.htm.

1.4 About the Big Valley Basin Groundwater Sustainability Agency

The Big Valley Groundwater Sustainability Agency (BVGSA) has formed in response to the regulations set forth by SGMA. A 2019 resolution by the Lake County Board of Supervisors formally established the BVGSA and tasked it with managing SGMA-related activities in basin. The BVGSA is working to develop a single GSP for the Big Valley Basin, conduct general and targeted outreach communication and engagement activities, and working toward GSP implementation with the intent to achieve groundwater sustainability in the Big Valley Basin.

1.5 About the Big Valley Basin Communication and Engagement Plan

This C&E Plan was developed by Stantec in coordination with the BVGSA, with funding provided by DWR's SGMA Facilitation Support Services (FSS) program. The Plan provides a structure for potential communication and engagement activities that will support the development, adoption, and implementation of a GSP for Big Valley Basin. The purpose of the Plan is to provide options that may aid the BVGSA and technical teams as they work to: (1) meet the regulatory requirements of SGMA, (2) support the GSP development processes (technical, policy, and others, as applicable), and (3) accomplish the communication and engagement objectives specific to the members of the BVGSA.

Every chapter of this C&E Plan begins with the California Water Code or California Code of Regulations section(s) identifying the applicable requirements for public outreach and engagement under SGMA. Introduction of these requirements serve as a reminder of the applicable regulatory and statutory requirements of SGMA, and they establish content development for inclusion in the BVGSA GSP.

2. DECISION-MAKING PROCESS

2.1 Legal Requirements

> **§354.10 (d)** A communication section of the Plan that includes the following:
>
> An explanation of the Agency's decision-making process.

The BVGSA has been tasked with overseeing development of a GSP for the Big Valley Basin, and it serves as the administrative body for public outreach and all phases of the GSP under SGMA. The five members of the Lake County Board of Supervisors serve as the Board of Directors for the Lake County Watershed Protection District, and they thereby act as the BVGSA. Big Valley Basin includes territory under the Lake County Board of Supervisors District 4 and District 5 regions.

Through a chartered process, the BVGSA Board of Directors created the Big Valley Basin Groundwater Sustainability Plan Advisory Committee (GSPAC), a group of stakeholder representatives that reflect local beneficial uses and users of groundwater. The eleven-member GSPAC is coordinating on all basin-wide outreach and implementation efforts and activities. The GSPAC members and the entities they represent are also consulting and coordinating, both individually and collectively as a group, with community organizations and nonprofits to support or implement outreach efforts and activities.

Pursuant to SGMA regulation §354.10 (d), the Big Valley Basin GSP will contain a description of the GSA's decision-making process, which will include their governance structure. Consistent with the GSPAC charter, administrative and plan-development activities of BVGSA have been delegated to GSPAC members by the BVGSA Board of Directors. These GSPAC representatives will be utilized to solicit input, help guide public outreach activities, provide guidance on GSP elements, and to achieve adoption of the GSP.

3. BENEFICIAL USES AND USERS

3.1 Legal Requirements

> **§354.10** Each plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:
>
> (1) A description of the beneficial uses and users of groundwater in the basin, including the land uses and property interests potentially affected by the use of groundwater in the basin, the types of parties representing those interests, and the nature of consultation with those parties.

SGMA requires that each GSP include a description of beneficial uses and users of groundwater in the basin, and to describe the nature of consultation with those parties. California Water Code §10723.2 identifies beneficial user types, including:

- Agricultural well owners
- Domestic well owners
- Municipal well operators
- Public water systems
- Local land-use planning agencies
- Environmental users of groundwater
- Surface water users
- Federal government
- California Native American Tribes
- Disadvantaged communities (DAC)
- Groundwater elevation monitoring entities

As part of its initial GSA formation notification, the BVGSA provided a preliminary list of beneficial users within Big Valley Basin. These actions centered around leveraging existing relationships with stakeholders in the basin and initially connecting with participants who had knowledge of water-related issues in the region. Stakeholders identified in the initial notification included:

- Agricultural water users, including small individual landowners that rely on groundwater for agriculture

- California Native American Tribes
- DACs
- Domestic well owners
- Environmental uses and users
- Improvement districts and other special districts that own or maintain water infrastructure
- Land-use planning agencies or organizations

This C&E Plan identifies proposed tools and activities to engage and consult with each of these beneficial users in development of the GSP for the Big Valley Basin. In some cases, these beneficial users will be consulted through the general public and stakeholder outreach activities identified in **Section 4.3**. In other cases, targeted outreach activities may be needed, and targeted stakeholder outreach activities are described in **Section 4.4**.

4. COMMUNICATION AND ENGAGEMENT

4.1 Legal Requirements

§354.10 (d)

(1) Identification of opportunities for public engagement and a discussion of how public input and response will be used.

(2) A description of how the Agency encourages the active involvement of diverse social, cultural, and economic elements of population within the basin.

(3) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.

Consistent with SGMA, the BVGSA intends to develop and implement their GSP in close coordination with the public and stakeholders through various outreach tools and activities. It is important to note that these tools and activities can, and should, evolve and adapt as new stakeholders are identified and as new outreach needs arise. Thoughtful communication planning provides a foundation for consistent and progressive engagement with diverse social, cultural, and economic stakeholder communities within the jurisdictional boundaries of the Big Valley Basin.

Communication and engagement activities described in this section include tools, activities, and strategies tailored to the unique needs of the stakeholders within the Big Valley Basin. These tools and activities have either already been completed, are currently in progress, or may be scheduled to be initiated or completed on an as-needed basis. They draw from results of the Big Valley Basin Stakeholder Assessment, further described below, and establish and maintain stakeholders' awareness and understanding of SGMA, the BVGSA, and the GSP development process.

4.2 Stakeholder Assessment

The Big Valley Basin Stakeholder Assessment (Stakeholder Assessment) was conducted by Stantec (outreach consultant) in Summer and Fall 2020 on behalf of the BVGSA. The purpose of the Stakeholder Assessment was to evaluate stakeholders' initial knowledge of SGMA and groundwater management practices in the Big Valley Basin, and to establish goals and strategies for public outreach, communication, and engagement to achieve SGMA compliance. Stantec conducted the Stakeholder Assessment in three parts: a pre-interview stakeholder survey, individual one-on-one interviews, and follow-up stakeholder sessions to review findings and to solicit additional input. This section describes each of these parts and summarizes the key Stakeholder Assessment findings.

4.2.1 Stakeholder Pre-Survey

The first part of the Stakeholder Assessment was a stakeholder pre-survey to assess an identified group of stakeholders' understanding and perspectives on key SGMA topics and groundwater conditions in Big Valley Basin. The surveys were sent in Summer and Fall 2020, prior to individual one-hour interview sessions with each of the identified stakeholders.

4.2.2 Stakeholder Assessment Interviews

The second part of the Stakeholder Assessment was a series of one-on-one interviews with stakeholders that were identified by the BVGSA as beneficial users in the Big Valley Basin. The purpose of the interviews was to gauge community knowledge of SGMA, local groundwater efforts, and to gather information on preferred methods for public outreach in the Big Valley Basin. At the onset, BVGSA identified 10 beneficial user stakeholders as candidates to participate in the interviews. As facilitators of the Stakeholder Assessment, Stantec conducted interviews with 9 stakeholders representing the following beneficial user groups: agricultural water users, improvement districts/other special districts, land use agencies, private users-schools, and Native American Tribes. Two additional categories of beneficial users were identified as high priority and sought out during the Stakeholder Assessment—representatives for disadvantaged communities and domestic well owners—but initial interviewee candidates did not complete the process or were not located. Both of these beneficial user groups remained a high priority as the GSPAC was being developed and in long-range planning; both categories have identified representation positions on the GPSAC.

Prior to each Stakeholder Assessment interview, the participants were asked to fill out a pre-meeting questionnaire about their background, experience with groundwater issues, and general knowledge of SGMA. Stantec compared the pre-survey and interview responses from each participant to that of other interviewees, as well as to those of other survey participants. The results of this analysis was a discussion topic during the interviews, to gauge both individual knowledge of groundwater issues and each participant's assessment of community knowledge of groundwater efforts and activities. The other discussion topics included expectations for and barriers to the GSP development process, priorities for water use in the basin, and activities and communication channels for stakeholder outreach. The feedback and input received from each stakeholder interview was compared and contrasted with the other responses, then aggregated to create a set of stakeholder findings.

4.2.3 Stakeholder Assessment Findings

Stantec staff collated and analyzed the results of the interviews to identify common trends and deviations between interviewees and perceptions of community needs and knowledge. The results of this analysis were summarized in a series of presentation slides. Stantec staff presented the Stakeholder Assessment findings summary to all interview participants in two stakeholder sharing sessions in Spring 2021, to provide additional opportunities for their input and direction at the onset of GSP efforts. Key findings from the Big Valley Basin Stakeholder Assessment include the following:

- Big Valley Basin groundwater is in good stead, with no critical issues to address other than potential effects from drought.
- Of the interviews conducted, there was an average time of 37 years spent living in the basin among the stakeholders interviewed.

- Stakeholders are most concerned about the costs and potential financial burden of implementing SGMA.
- There is an interest in continuing with stakeholder and community engagement and outreach as it relates to Big Valley GSP development and implementation.
- Members of the general public do not have a strong understanding of the roles and responsibility of the District and groundwater management, historical groundwater efforts, and the overall SGMA process.

The Stakeholder Assessment findings served as the basis for many of the selected outreach tools and activities recommended in this C&E Plan. It is important to note that the Stakeholder Assessment was based on a statistically small sample size and some results may not represent the opinion of the majority of stakeholders in the basin. This C&E Plan reflects both the findings from the Stakeholder Assessment as well as discussions with the GSAs representatives and best practices for stakeholder engagement in groundwater sustainability planning. It is vital to note that what is reflected in this current C&E Plan is an initial effort to communicate with both stakeholders and the public, and the tools, methods, and activities for outreach and engagement should be constantly evaluated and updated as the GSP process moves from development and adoption into implementation.

4.3 Outreach Tools

This section describes the collection of tools the BVGSA has developed, plans to develop, or may develop to disseminate information to the public and engage stakeholders in support of the GSP. The BVGSA intends to, on an as-needed basis, translate materials in Spanish or other languages to reach non-English-language communities. Each tool is evaluated to see how it can work most effectively with other tools and resources—and a premium is put on materials that are easy to access and that provide information for varied levels of knowledge on groundwater issues.

4.3.1 Website

The BVGSA has developed websites to keep stakeholders and other interested parties informed of GSP development, adoption, and future implementation activities. The BVGSA web pages are housed under the Lake County Water Resources Department (http://www.lakecountyca.gov/Government/Directory/WaterResources/Programs___Projects/Big_Valley_GSP.htm) website. The site includes copies of informational, background, technical, and planning documents; GSPAC meeting agendas and materials; and information on the Big Valley Basin. The site includes a simple Stay Connected form for gathering contact information for the Big Valley GSP Interested Parties Database. In addition, the BVGSA site has been the location of public postings of draft GSP sections to solicit public review and input. As the GSP is submitted in January 2022 and the move is made toward implementation, the webpages for the BVGSA will be streamlined, an archive of all materials will be available, and the site will become a hub for notifications, GSP updated information, and guidance on getting involved in Big Valley Basin groundwater issues.

4.3.2 Interested Parties Databases

California Water Code §10723.8 requires a GSA to “establish and maintain a list of persons interested in receiving notices regarding plan preparation, meeting announcements, and availability of draft plans, maps, and other relevant documents.” Pursuant to this requirement, the BVGSA has developed an Interested Parties Database—a list of individuals, organizations, or agencies that have expressed interest in being informed about BVGSA activities and efforts related to the GSP. The BVGSA uses the contacts in its Interested Parties Databases for notifications related to public meetings, GSPAC meetings, workshops, and announcements related to SGMA implementation in the Big Valley Basin. Interested parties can self-select to be added to the Interested Parties Databases by filling out the simple form on the BVGSA webpage or by contacting a GSA representative in the Lake County Water Resources Department or on the GSPAC.

4.3.3 Informational Materials

The BVGSA intends to develop a suite of informational materials aimed at educating members of the public and stakeholders about key SGMA topics, and for keeping interested parties informed about GSP development and implementation. These materials can be used to bridge information gaps that may exist related to SGMA and groundwater conditions in the Big Valley Basin. As needs arise, the BVGSA intends to offer and adapt materials over time as the GSP is completed, adopted, and implemented. As needed, the BVGSA may have materials translated into non-English languages, to reach specific-language communities. As such, these documents are fit-for-purpose outreach tools that include the following:

4.3.3.1 Fact Sheets

The BVGSA may develop a set of informational fact sheets aimed at educating members of the public about SGMA and key topics identified in the GSP. The purpose of the fact sheets is to prepare interested parties to provide meaningful input on GSP-related elements and to encourage engagement at public meetings and workshops. Fact sheet topics may include the following:

- SGMA 101: Aimed at a general audience, this fact sheet provides an introductory-level overview of SGMA, the Big Valley Basin, and the GSP process and implementation.
- Groundwater Conditions: This fact sheet educates stakeholders about historical and current groundwater conditions in the Big Valley Basin, including groundwater supply, storage, and quality.
- Water Budget: This fact sheet explains a water budget, water budget inputs/outputs, and how the water budget will be used as part of the GSP.
- Sustainable Management Criteria: This fact sheet defines key terms related to sustainable management criteria, including minimum thresholds and measurable objectives, and describe how the sustainable management criteria will be used to manage groundwater conditions in the basin.

- Overview of the BVGSA GSP: This fact sheet provides an overview and explanation of each chapter of the GSP, and then describes the GSP process and opportunities to get involved.

The fact sheets can be distributed through postings on websites, via electronic distribution, or offered in hard-copy format in easy-to-access public areas or through GSPAC members' existing communication channels.

4.3.3.2 Presentation Slides

The BVGSA has developed various presentation slides aimed at educating members of the general public about SGMA, the Big Valley Basin, groundwater in Lake County, and the BVGSA's governance structure. These slides may be adapted for use at public meetings, workshops, and presentations to community groups or agency decision-making bodies (e.g., Board of Supervisors meetings or existing associations meetings). These slides help educate, provide a basis for engaging in meaningful discussions, and ensure consistent messaging and that helps unify materials across the basin.

4.3.3.3 Notices

The BVGSA may develop fliers, email copy, social media posts, and other types of notices to promote public meetings, workshops, and other opportunities for public involvement. The BVGSA will distribute these notices to the Interested Parties Databases, customers and constituents of the member agencies, and other community stakeholders. The materials may be distributed via email, by posting on websites and social media accounts, and/or delivered as hard-copy materials for physical posting on community bulletin boards or at events.

The BVGSA may also periodically develop template email, social media posts, and/or website text to promote public comment periods and educate members of the public on key SGMA topics. To the extent possible, these posts will be scheduled to align with other public outreach events (e.g., National Groundwater Awareness Week, Public Works Week).

4.3.3.4 Calendar Notices and News Releases

The BVGSA may develop news releases aimed at informing the media about GSP development milestones, including the release of public documents and the opening of public comment periods or calls for suggestions and input. The BVGSA may also use calendar notices to distribute details for upcoming public events or community events where groundwater educational materials are being distributed.

4.4 Outreach Activities

The BVGSA may conduct and monitor a variety of public outreach activities to inform, engage, and respond to stakeholders and other interested parties during GSP development, adoption, and later, implementation. These activities serve to engage and interact with the public and stakeholders during GSP development, and to assist GSA staff and leadership in collecting information important to groundwater sustainability planning. This engagement and interaction will occur through six primary activities: regular GSP development meetings, Board of Directors briefings, public meetings and workshops, community presentations, partnerships with local organizations in the basin, and in-person outreach at community events. Each of these activities are further described below.

Most of these activities will be promoted through similar outreach tactics, including webpage promotion, sending an email to the Interested Parties Database, posting on the BVGSA webpages, and providing social media alerts. In addition, some activities may require other tactics to target specific stakeholder groups. The activities identified in this section are assumed to be promoted by these standard tactics, unless otherwise noted in the activity description.

In response to social-distancing and local health ordinances resulting from the COVID-19 pandemic, the BVGSA is prepared to adapt these activities to virtual, hybrid, or other distance-engagement formats. The BVGSA will utilize online collaboration platforms and implement best practices for virtual engagement. In addition, the BVGSA may relay information and materials through trusted organizations and existing communication channels in the basin, to keep stakeholders—who may not have access to the technical equipment required to engage—virtually informed.

4.4.1 Groundwater Sustainability Plan Development Meetings

The primary way for members of the public to provide input on development of the GSP is by attending and providing public comment at standing public meetings of the GSPAC or during a topic-specific subcommittee or ad hoc meeting. The GSPAC holds monthly meetings and frequent technical subcommittee and ad hoc meetings that are publicly noticed, that include public comment periods, and that are recorded and archived for on-demand viewing at any time. The meetings are additionally noticed by email alerts to the Interested Parties Database. All of these meetings include GSP development updates and discussions and are open for the public to attend and provide comment. All meetings' calendar details and associated materials are available on the BVGSA webpages.

4.4.2 Board of Directors Briefings

Representatives of the BVGSA, or the GSP technical consultant staff, will regularly brief the Lake County Board of Supervisors—as the standing Board of Directors for the GSA—on the status of GSP development, implementation, and any upcoming outreach activities. These briefings are conducted during regularly held and publicly noticed meetings, which also include opportunities for public comment. The primary purpose of these briefings is to update the governing body on GSP progress and next steps, and to respond to questions from the Board of Directors. These presentations also provide opportunities to share progress and describe how elements of the GSP apply to the Big Valley Basin, outreach partners, or members of the public. The frequency of member agency briefings varies by need and the status of the GSP development and implementation process.

In addition to regular briefings throughout development of the GSP, the BVGSA may also brief the Board of Directors during the public review and comment process for the Public Draft GSP in late Fall 2021. This public comment process is further described in Section 6.0, below.

4.4.3 Public Meetings and Workshops

Public meetings and workshops are another venue to educate the public about SGMA, collect feedback on results of technical analyses, and to solicit input on content that will become part of the draft GSP chapters. Table 1, below, identifies the anticipated schedule, topics, and desired outcomes for the GSP development workshops for the Subbasin.

Table 1. Big Valley Basin Groundwater Sustainability Plan Public Meetings and Workshops

Projected Timing	Topics	Desired Outcome(s)
March 2021	• Introduction to SGMA • Big Valley Basin Overview • GSP Development Process	• Educate the public about SGMA and Big Valley Basin. • Identify how interested parties can engage in the GSP development process.
August 2021	• Update on GSP Development • Domestic Wells in Big Valley Basin • Communication and Outreach Planning	• Increase public knowledge of GSP process, developments, and next steps. • Educate stakeholders on domestic wells and monitoring in Big Valley Basin. • Detail SGMA Communication and Engagement requirements and solicit public input for elements of the draft Communications and Engagement Plan.
November 2021	• Public Draft GSP	• Provide a forum for stakeholders and interested parties to discuss comments on the Public Draft GSP.
December 2021	• Public Draft GSP Comments and Update • Adoption Process for Big Valley Basin GSP	• Receive feedback and comments on the Public Draft GSP. • Increase understanding of the GSP adoption process.
March 2022	• GSP Implementation	• Review SGMA implementation timeline and key milestones. • Overview of GSPAC activity and rechartering process. • Highlight communication and outreach planning and needs.

Key:
GSPAC = Groundwater Sustainability Plan Advisory Committee
GSP = Groundwater Sustainability Plan
SGMA = Sustainable Groundwater Management Act

The format of each public meeting or workshop will be adapted according to content, feedback from stakeholders, and changing needs and conditions in the basin. During periods when state and local ordinances limit or prohibit in-person gatherings, meetings and workshops may be held using the Zoom virtual collaboration platform, as it was identified as the most prevalent virtual engagement tool during the Stakeholder Assessment. Every public meeting and workshop held by the BVGSA will be and posted on the BVGSA webpages for on-demand public viewing. This tactic allows those who are unable to attend—due to scheduling conflicts or health and safety concerns—to have the ability to stay informed about GSP development and implementation.

4.4.4 Community Presentations

The BVGSA may conduct presentations to existing civic, nonprofit, and other community organizations to build and maintain awareness about SGMA, encourage participation at public meetings and workshops, and to solicit self-selection into the Interested Parties Database. Representatives from the BVGSA will conduct the presentations. Presenters will be encouraged to use the template presentation slides and other informational materials to ensure consistent messaging across all communication. Presentations may be provided upon request by organizations or stakeholder groups, and then scheduled as time allows for all involved. Any presentations given will be tracked in the Communications Plan Database, described in Section 5.0.

4.4.5 Partnerships with Local Organizations

The BVGSA realizes the value and increased outreach that comes from cultivating and maintaining relationships with local community and industry organizations. These partnerships allow for more effective communication and opportunities to broaden the dissemination of SGMA information while connecting with additional stakeholder groups. Participants in the Stakeholder Assessment identified the following active organizations in the basin:

- Lake County Farm Bureau
- Lake County Land Trust

The BVGSA may identify additional potential partner organizations during GSP development and throughout implementation. The BVGSA already maintains relationships with many of these organizations and intends to keep them informed throughout GSP development and implementation via personal communications, informal briefings, or one-on-one meetings. The BVGSA may also ask partner agencies to distribute notices and materials to their stakeholders and offer opportunities to host events, workshops, and speakers related to SGMA, the GSP, and local groundwater issues.

4.4.6 In-Person Outreach at Community Events

The Big Valley Basin is representative of Lake County as whole, in that a good portion of information sharing and communication is done when out in the community. The BVGSA will create an ongoing list of community events where an agency representative can provide in-person distribution of materials to the public, while offering a chance to engage people in conversations about groundwater and GSP elements.

4.5 Targeted Stakeholder Outreach Tools and Activities

In addition to general public outreach, the BVGSA may also conduct outreach to targeted stakeholder groups that may be underrepresented in public-involvement activities or that benefit from specific messaging or engagement.

4.5.1 Tribes

Lake County is the ancestral homeland for a number of Tribal Nations that have lived on the land in Big Valley Basin since time immemorial. The BVGSA filled a Sacred Lands File and Native American Contacts List Request with the Native American Heritage Commission (NAHC) to identify all Tribes that have indicated sacred land or traditional and/or cultural resources interests within the Big Valley Basin. The BVGSA received initial NAHC notification from eight Tribes with stated interests in the Big Valley Basin, including:

- Big Valley Band of Pomo Indians
- Elem Indian Colony Pomo Tribe
- Guidville Indian Rancheria
- Koi Nation of Northern California
- Middletown Rancheria of Pomo Indians
- Mishewal-Wappo Tribe of Alexander Valley
- Pinoleville Pomo Nation
- Scotts Valley Band of Pomo

After consulting with representatives from the Big Valley Band of Pomo Indians and the Scotts Valley Band of Pomo Indians, two additional Tribes were identified to include in Tribal outreach:

- Robinson Rancheria Pomo Indians of California
- Habematolel of Upper Lake

The BVGSA will consult with all 10 of these tribes to learn about and consider their interests, and to ask for their guidance and leadership in the best ways to engage the Tribes—individually and collectively—in all aspects of GSP development and implementation.

4.5.2 Agricultural Water Users

Agriculture plays a vital role in both the economy and the community in the Big Valley Basin, and groundwater resources are essential to maintaining this industry. Engaging agricultural water users will be key to the success of the GSP. In addition to representation on the GSPAC, the BVGSA may conduct targeted outreach to agricultural water users in the Big Valley Basin with the intent to understand the range of needs as they differ between crop types and their respective groundwater needs.

4.5.3 Urban Water Users

To encourage engagement with domestic water users, the BVGSA may conduct targeted outreach in the two unincorporated communities in the Big Valley Basin—Finley and Kelseyville.

These activities may include developing fact sheets on groundwater use and conditions in the Big Valley Basin and distributing these materials through existing communication channels and community gathering locations (e.g., a library, community center, schools, or civic centers); providing presentations on SGMA to local civic and community organizations; and inviting community leaders to informal briefings on groundwater issues and GSP elements. These activities are further described in Section 4.3. In addition, the GSAs may develop key messages on the importance of groundwater to the local economy and environment, and to incorporate these messages in all informational materials and talking points.

4.5.4 Disadvantaged Communities

California Code of Regulations §79505.5(a) defines a disadvantaged community as a "community with an annual median household income (MHI) that is less than 80 percent of the statewide annual median household income." The American Community Survey of the U.S. Census Bureau provides a dataset than can be used as a source to estimate a community's MHI. According to 2012–2016 American Community Survey 5-Year Estimates, California's statewide MHI is $63,783. Thus, a community with an MHI less than or equal to $51,026 is considered disadvantaged.

The BVGSA boundary includes one census-designated place considered disadvantaged by the state: Kelseyville. This community is identified in DWR's DAC Mapping Tool. The MHI for this area is identified in Table 2 below.

Table 2. Communities Designated as Disadvantaged in the Big Valley Basin

Census-Designated Place	Median Household Income[1]
Kelseyville	$41,680

Notes:
[1] Median Household Income determined by California Department of Water Resources DAC Mapping Tool available at https://gis.water.ca.gov/app/dacs/

The overall Big Valley Basin population living in a disadvantaged area—defined by DWR's SGM Grant Program 2019 Guidelines as "a collective group of severely disadvantaged communities, disadvantaged communities, and economically distressed area"—is more than 96 percent.

Individuals living in communities that are state-designated disadvantaged face unique challenges when it comes to participating in public planning processes. This may include physical and/or linguistic barriers which may impede their ability to provide input on plans or regulations that impact them. The BVGSA intends to use best practices to help address barriers these communities may face in participating in the GSP development and implementation processes. These practices may include translating materials and fliers into multiple languages, offering interpreting services at public workshops and meetings, holding workshops and meetings at familiar and trusted locations (e.g., schools, community centers, churches), and ensuring workshops/meetings are held at times accessible by a wide range of people. (Note that due to social-distancing and local health ordinances resulting from the COVID-19 pandemic, many of the basin's outreach activities have been using virtual engagement formats.)

The BVGSA may also partner with local community advocates or organizations to educate community members about SGMA and local groundwater developments, and to encourage further involvement in public events. Often leveraging the communication channels of these trusted messengers is a more effective means of reaching DACs than traditional communication methods.

A key component of outreach to this community is finding an individual to sit on the GSPAC to represent disadvantaged communities in the Big Valley Basin. That person will be critical to helping develop a meaningful and focused outreach plan that considers how best to engage with these stakeholders.

4.5.5 Watershed Stewardship Organizations

GSAs are obligated to consider the potential impact of sustainable groundwater management activities on groundwater dependent ecosystems (GDE). These considerations may range from monitoring activities to steps to preserve and expand these natural resources. Stewardship of these resources has primarily been led through a combination of government, regulatory, and nonprofit organizations. In the Big Valley Basin, the Lake County Watershed Protection District—the official designation of the Lake County Water Resources Department—is actively involved in water-management planning activities. The Big Valley Band of Pomo Indians has been instrumental in ecosystem stewardship activities in Big Valley Basin and throughout Lake County. The Lake County Land Trust has been successful in preserving land in Big Valley Basin and in partnering with organizations at a local, regional, statewide, and national level. Both the Big Valley Band of Pomo Indians and the Lake County Land Trust are represented on the Big Valley Basin's GSPAC.

Other partner organizations may include The Nature Conservancy, Redbud Audubon Society, and other local entities focused on the protection and restoration of land in Big Valley Basin. These organizations represent sources of valuable input on the subject matter of groundwater dependent ecosystems that are being considered during GSP development and implementation. The BVGSA may engage leadership from these groups throughout the groundwater sustainability planning process, for discussion of environmental water needs and groundwater dependent ecosystems. In addition, interested stewardship and environmental-focused organizations may also request briefings with the BVGSA and are invited to participate in the outreach activities described in **Section 4.3**.

4.5.6 Government and Land-Use Agencies

The BVGSA may engage local and regional governmental and land-use agencies throughout the GSP development and implementation process. This may include presentations or meetings with local planning commissions or local agency formation commissions. In addition, local cities and counties will receive notice at least 90 days prior to adoption of the Final GSP, as described in **Section 6.2**.

5. SUMMARY OF ENGAGEMENT

5.1 Legal Requirements

§354.10 Each plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:

- A list of public meetings at which the Plan was discussed or considered by the Agency.

SGMA requires that GSAs include a list of public meetings at which the GSP was discussed or considered by an agency. To fulfill this requirement, and to follow best practices for outreach and communication, each GSA should develop a tool or database to track all SGMA-related outreach conducted by the agency. As an initial step, all public engagement activities have been collected on the BVGSA webpages under the Lake County Water Resources Department (http://www.lakecountyca.gov/Government/Directory/WaterResources/Programs___Projects/Big_Valley_GSP.htm). On this site anyone can access agendas, companion materials, presentation slides, and full recordings of all meetings that have occurred since the BVGSA convened the GSPAC to undertake the development of the Big Valley Basin GSP.

BVGSA will develop a Meeting Inventory Table to track all SGMA public and stakeholder engagement activities in list form, along with brief notes on the topics for each meeting or event. A copy of the Meeting Inventory Table will be included in the Final GSP to demonstrate the BVGSA's efforts to involve members of the public in GSP development and to comply with California Code of Regulations §354.10.

It is the intention of the BVGSA to continue to offer a full archive of all GSP proceedings beyond the January 2022 GSP submission date, and to make that archive easily accessible by the public. This archive allows anyone an opportunity to view every meeting that has been held for GSP development and implementation.

6. PUBLIC ENGAGMENT IN GROUNDWATER SUSTAINABILITY PLAN ADOPTION

6.1 Legal Requirements

> **§354.10** Each plan shall include a summary of information relating to notification and communication by the Agency with other agencies and interested parties including the following:
>
> (c) Comments regarding the Plan received by the Agency and a summary of any responses by the Agency.
>
> **§10728.4**
>
> (2) A groundwater sustainability agency may adopt or amend a groundwater sustainability plan after a public hearing, held at least 90 days after providing notice to a city or county within the area of the proposed plan or amendment. The groundwater sustainability agency shall review and consider comments from any city or county that receives notice pursuant to this section and shall consult with a city or county that requests consultation within 30 days of receipt of the notice.

This chapter describes requirements and approaches for collecting and summarizing comments on the Draft GSP and required steps necessary, prior to GSP adoption.

6.2 Public Comment Process

California Code of Regulations §354.10 states that each GSP must include a summary of comments received regarding the GSP and a summary of any responses that resulted from the GSA. However, the SGMA regulations do not provide a prescriptive public review process or comment period for the Public Draft GSP. After the Final GSP is submitted to DWR, the agency will post the GSP to its website and hold a public comment period. Pursuant to California Code of Regulations §353.8(b), the minimum period for public comment is 60 days. However, DWR intends to open the comment period for 75 days or more.

The BVGSA intends to release draft GSP sections and/or chapters for public review and comment as the chapters are developed. Sections and chapters will be released individually or in groups in a phased or serial review process. The BVGSA intends to post the drafts on the BVGSA webpages for review and to collect comments through a designated project email address, direct mail, at public workshops, and publicly noticed meetings. Interested parties will have a designated time (e.g., 14 days or 21 days) to review the draft chapters and to submit comments. Comments received during the comment period will be reviewed by the BVGSA and consultant staff.

Once all the draft sections and chapters have been released and revised, the BVGSA intends to issue a complete Public Draft GSP for further public review and comment. The Public Draft GSP will be released for a specified public comment period in late Fall 2021. Public comments will be collected via email, postal mail, or accepted as drop-off at the Water Resources Department.

The BVGSA intends to summarize comments received during the Public Draft GSP comment period and to present them in a GSP Public Comment Summary incorporated into the Final GSP. The GSP Public Comment Summary will describe the public comment process, summarize the major themes or topics that individuals submitted comments on, and will include copies of received written comments. In addition, any comments that raise substantive technical or policy issues may be addressed in the Final GSP text, as noted in a public comment matrix.

6.3 Notice to Cities and Counties

California Water Code §10728.4 states that a GSA must provide notice to any cities or counties within the GSP area at least 90-days prior to adopting or amending a GSP at a public meeting. The cities and counties have 30 days upon receipt of the notice to request consultation on the plan. Pursuant to these requirements, the BVGSA will develop and distribute a notice to cities and counties within the basin prior to the Public Draft GSP public comment period, and no later than 90 days before the first scheduled GSP adoption hearing.

The notice will provide an overview of SGMA and the GSA; identify where the Public Draft GSP can be viewed, or copies can be obtained; identify the 90-day notice period; and describe the method for agencies to submit consultation requests. A single point of contact will be identified in the notice. Cities and counties will have 30 days to respond to the notice.

6.4 Final Groundwater Sustainability Plan Adoption Process

Following the 30-day consultation request period, if no cities or counties have requested consultation, the Final GSP will be adopted at a designated public hearing. The BVGSA will adopt the Final GSP at a public hearing held by the Lake County Board of Supervisors. This hearing may be held as part of a Board of Supervisors' standing public meeting, or at a special meeting of the governing body. Notices for the public hearings will follow all applicable local, state, and federal regulations regarding meeting noticing practices that apply.

At this time, it is not anticipated that fees would be adopted with the Final GSP. However, if fees are associated with adoption of the Final GSP, then additional public meeting notices will be required pursuant to Government Code §6066.

7. PUBLIC ENGAGEMENT IN GROUNDWATER SUSTAINBILITY PLAN IMPLEMENTATION

7.1 Legal Requirements

> **§354.10 (d)**
>
> (2) The method the Agency shall follow to inform the public about progress implementing the Plan, including the status of projects and actions.

As part of its GSP, the BVGSA must describe how it plans to inform the public about progress in implementing the GSP. GSP implementation outreach activities should build upon activities conducted during GSP development—but they should also include new and targeted outreach as the need arises and to cultivate more diverse engagement. Successful and established activities should be continued throughout GSP implementation and then updated to include new stakeholder groups and emerging issues.

The primary methods to inform the public about progress of the GSP include posting on the BVGSA website; sending out progress information to the Interested Parties Database; leveraging the GSPAC proceedings and members' organizations to distribute updates, and by holding regular public meetings focused on GSP implementation.

In addition, the BVGSA may choose to continue other general public outreach activities, such as GSP-related educational events and open houses, community presentations and Board updates, and engaging the public in conversations at community events. Informational materials and website content will be updated at key implementation milestones (e.g., annual reporting periods, Five-Year Updates) to reflect the status of the GSP and Big Valley Basin current conditions. Additionally, new materials will be developed to help the public understand next steps, how they can stay engaged in GSP implementation, and how to participate in call-to-action activities in the basin.

8. INTER-BASIN COORDINATION

8.1 Legal Requirements

> **§ 357.2.** Inter-basin Agreements
>
> Two or more Agencies may enter into an agreement to establish compatible sustainability goals and understanding regarding fundamental elements of the Plans of each Agency as they relate to sustainable groundwater management.

The Big Valley Basin is adjacent to the second CASGEM-designated basin in Lake County: the low-priority labeled Scotts Valley Basin. Under SGMA, low-priority basins are not required to submit a GSP. The City of Lakeport elected to form a GSA for their jurisdiction of the Scotts Valley Basin in June of 2017. There are a number of entities working on groundwater issues in the Scotts Valley Basin, including the Scotts Valley Band of Pomo Indians and the Scotts Valley Groundwater Protection Subcommittee. The Big Valley Basin GSP recognizes the regional proximity of the Scotts Valley Basin, current groundwater activities underway in both basins, and the importance of regional efforts to achieve sustainable groundwater management.

Recognizing the value of shared data and knowledge, the BVGSA is open to ongoing discussion and coordination with representatives of the Scotts Valley Basin as it relates to regional sustainable groundwater management.

The BVGSA has interest in coordinating efforts with any future Scotts Valley Basin GSA activities through periodic meetings focused on discussing inter-basin boundary flows and other regional groundwater issues. These meetings can also serve to share lessons learned from the GSP development and implementation process between the medium-priority Big Valley Basin and the low-priority Scotts Valley Basin.

APPENDIX 7B

Big Valley Groundwater Sustainability Agency Interested Parties List

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Table 1. Organizations Represented in the Big Valley GSA Interested Parties Database

Organization (Number of People Represented)	Identified User Type/Primary Beneficial Use (If Any)
Lake County Watershed Protection District	Big Valley Basin GSA and GSA/Surface water and Groundwater Manager
Lake County Special Districts	Improvement Districts/Special Districts
California Department of Water Resources (5)	State Agency/All Uses/CASGEM Program
Big Valley Band of Pomo Indians	California Native American Tribe/All Uses
Scotts Valley Band of Pomo Indians	California Native American Tribe/All Uses
Lake County Agricultural Commissioner	Local Government/Agriculture
Aqua Oso	Agriculture
Bella Vista Farming Company	Agriculture
Wine Grower	Agriculture
Clean Water Action	NGO/Disadvantaged Community
Lake County Climate Action Network	NGO/Environmental User
Lake County Land Trust	NGO/Environmental User
The Nature Conservancy	NGO/Environmental User
Community Member (9)	All Uses
Larry Walker Associates	Consultant
Geo-Logic Associates	Consultant
Stantec	Consultant
FlowWest	Consultant
GEI Consultants	Consultant

Key:
CASGEM = California Statewide Groundwater Elevation Monitoring
GSA = Groundwater Sustainability Agency
NGO = Non-governmental organization

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SUMMARY OF PUBLIC COMMENTS ON DRAFT BIG VALLEY GROUNDWATER SUSTAINABILITY PLAN

The Big Valley Groundwater Sustainability Agency (GSA) in the Big Valley Basin held a 21-day public comment period for the Draft Big Valley Groundwater Sustainability Plan (GSP) from November 12–December 3, 2021. This memo describes the process the GSA used to solicit public and stakeholder comments on the Draft GSP and summarizes comments received during the public comment period.

Public Comment Process

The Big Valley Basin GSA released the draft GSP chapters to the Groundwater Sustainability Plan Advisory Committee (GSPAC) for initial feedback, prior to public review. With GSPAC feedback incorporated, the GSA then posted full GSP chapters for an initial public review and comments as they were developed. Draft chapters were posted on the Lake County Water Resources' website for a varying public review periods that ranged from 12- to 56-days, depending on how much time was needed for finalizing each chapter. The GSA sent emails to the Interested Parties Database to notify stakeholders as chapters were released, as well as posting notifications and using social media channels to alert the community to public review periods. Comments were collected using a dedicated Lake County Watershed Protection District email address that was used for all GSP-related communication, to make it easier for the public to engage. Members of the public could also provide comments at monthly GSPAC meetings, technical subcommittee meetings, and at the public open houses that were held during the open comment periods. All comments received were reviewed by the planning team and comments that raised substantive technical or policy issues resulted in changes to the Draft GSP.

The GSA released a complete draft of the GSP for a 21-day public comment period on Friday, November 12, 2021. The public comment period closed at midnight on Friday, December 3, 2021. A copy of the Draft GSP was posted on the GSA website for download and review. Public comments on the Draft GSP were accepted via email, postal mail, or in-person drop-off.

The GSA also held an informational public open house on November 18 to inform interested parties about the content of the Draft GSP, to explain the public comment process, and to answer any questions about the plan. Additional outreach was conducted to promote the workshop, including targeted outreach to individuals and organizations representing beneficial users of groundwater in the Basin.

SUMMARY OF COMMENTS RECEIVED

The GSA received five comment letters from four commenters during the Draft GSP public comment period. The list of comment letters received is provided in **Table 1.**

Table 1. Comment Letters Received During Public Comment Period

Name of Author	Agency/Organization	Date Received
Laura Hall	Lake County Community Development Department, Planning Division	11/29/2021
Joan Moss*	Member of the Public	12/03/2021
Melissa M. Rohde Ngodoo Atume Samantha Arthur E.J. Remson J. Pablo Ortiz-Partida Danielle V. Dolan	The Nature Conservancy Clean Water Action/Clean Water Fund Audubon California The Nature Conservancy Union of Concerned Scientists Local Government Commission	12/03/2021
Sarah Ryan	Big Valley Band of Pomo Indians	12/10/2021

*Joan Moss submitted two separate public comment letters.

Summary of Public Comments

The following provides a summary of the comment letters' main topics and themes.

Updating the Basin Characterization

Public commenters requested additional information and clarification regarding the Basin characterization, Section 2.1 and 2.2. This included corrected and expanded information on cannabis production and permitting, correction of the extent of Big Valley Band of Pomo Indians lands, inclusion of the Kelseyville Area Plan, a request for interconnected surface water maps, and water quality concerns.

Groundwater Dependent Ecosystem Identification

One public commenter provided feedback regarding Groundwater Dependent Ecosystem identification.

Monitoring Network

Two public commenters provided feedback on the monitoring wells. There was concern over spatial density, particularly for the interconnected surface water monitoring network.

Sustainable Management Criteria

Two public commenters provided input on the sustainable management criteria (SMC). One commenter requested additional information be included regarding impacts to domestic well owners, disadvantaged communities (DAC), tribes, and environmental users. Both commentors were concerned with where the minimum thersholds (MTs) were set, especially for chronic lowering of groundwater levels and for depletion of interconnected surface water. For the depletion of interconnected surface water, one commentor had concerns with the underlying model and its results.

Projects and Management Actions

Two public commenters requested additional information be included on the projects and management actions. There was particular interest in an expanded discussion on the domestic well mitigation program and inventory. One commentor requested that climate change projections and water quality impacts be included in all projects and management actions.

Attachments:

Attachment A: Public Comment Matrix with Responses

Attachment B: Sarah Ryan Excel Matrix

Attachment C: Melissa Rhode et al. Comment Letter

Attachment D: Laura Hall Comment Letter

Attachment E: Joan Moss Comment Letter 1

Attachment F: Joan Moss Comment Letter 2

Public Draft GSP Comment Matrix and Response

Commenter Name	Commenter Organization	Date Received	Related Chapter	Section Number	Line, Figure, or Table #s	Comment	Response to Comment Received	Submission Type
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	EC	Executive Summary	Table ES-1	Depletion MT and MO. It was my understanding that the GSPAC agreed to select the MT based on one or two standard deviations from the mean and not the lowest historical spring groundwater elevations. Since BVHIM results indicate depletions are leading to undesirable effects to interconnected surface waters (i.e. impacting the survival and success of the Clear Lake Hitch), the Tribe does not agree that the lowest ever recorded spring value + 20% should set the MT. Setting the MTs at based on this criteria assumes undesirable results are not occurring, a premise unsupported by the best available information. Setting the MTs at this level would ensure that any undesirable results would continue to occur and potentially increase in severity.	MTs were selected based on the minimum observed historical spring groundwater elevation, after removing outliers. Here, outliers refers to data outside 2 standard deviations. A similar approach was followed to select MOs based on the maximum observed historical groundwater elevation. Presentation of the model results in terms of percent depletion in Appendix 2D seems to have been misleading in that the spikes in depletion occur when the creeks are almost dried and there is zero or close to zero flowrate in the creek (please see middle plot in Figure 4-17). Therefore, it is implied that there will be up to 90% depletion (during drought condition) which will have undesirable results on the beneficial uses and users of groundwater including hitch, while it simply is equal to 90% of no flow (0.1 cfs). It is also worth noting that these drought conditions happened in July.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	EC	Executive Summary	Table ES-2	Most of the wells selected for monitoring depletions of interconnected surface waters are too far away from streams and gages and collected too infrequently to adequately monitor for undesirable results. Many existing monitoring locations closer to the streams would be a better fit, but ultimately, the timeline to create this GSP was too fast for thoughtful review and negotiations. Additionally, not enough time was granted to determine the extent of depletions and review analyses that were conducted as part of this GSP (e.g., the BVIHM) and other studies. Based on preliminary review of the BVIHM results, we do not believe the wells selected along Adobe creek are suitable for evaluating and preventing undesirable results related to depletions. For example, the BVIHM results show large relative flow depletions (50% to 90% of Adobe Creek flow) during years where the recorded spring groundwater elevations in the selected Adobe Creek wells are higher than the MTs and approaching or greater than the MOs (see years 1990, 2002, 2008, 2013, and 2015). This means that undesirable results are potentially occurring during times when both the MTs and MOs would be achieved. Therefore, the set of wells used to monitor for depletions will need to be revised in the future, likely requiring new well drilling since the wells selected based on the current network are not likely to protect against undesirable results.	Comment noted. The distance from the monitoring wells to the streams and gauges has been included in Table 3-7. Most of the wells are under a quarter mile from a creek and all are under a third of a mile from a creek. Additionally, the GSA Is currently working on a DWR Technical Support Services application that will include the installation of monitoring wells. The location of these wells is to be determined, but the intent is for these wells to better characterize interconnected surface water and the aquifer and will likely be placed along Kelsey and Adobe Creek. The GSA plans to work with technical experts and the GSPAC to determine monitoring well locations in early 2022. With the data collected from these wells, the GSA will determine if modifications to the MOs and MTs are necessary.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	3	3.5	Table 3-7	We provided previous comments that requested distances of each well from the selected gages be added to the table, but they have not. Please add distances in miles.	Table 3-7 has been edited to include the distance from each well to the creek and nearest gauge.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	3	3.5	Table 3-7	Please change footnote "BVR = Rancheria" to "BVR = Big Valley Rancheria"	The table key has been updated to say Big Valley Rancheria.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	3	3.5.4	335	Please indicate use of DWR BMPs in determining spatial coverage at the end of the last sentence. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-2-Monitoring-Networks-and-Identification-of-Data-Gaps_ay_19.pdf	The text has been revised to state that the monitoring network will be revised in the future using DWR's BMP, to determine its spatial coverage adequacy.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	3	3.5.5	333	I'm having trouble with the language here, specifically the use of "should be". Is the monitoring frequency going to be what it "should be" or something else? Please distinguish between what the actual monitoring frequency will be along with what it "should be" here.	The text has been updated for clarity. It now reads, "Streamflow/stream stage are monitored continuously with a sample interval of 15 minutes. Groundwater monitoring should also be continuous using pressure transducers, with a 1-hour sample interval for depletion analysis. The monitoring wells are currently monitored bi-annually, however, the Lake County Watershed Protection District plans to monitor them monthly, and as funding becomes available, data loggers may be installed to allow for continuous monitoring."	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	3	3.5.6	337	Please add sentence to the beginning something like, "Significant data gaps exist within the existing groundwater-surface water monitoring network that prohibit clear determination of undesirable results related to depletions of interconnected surface waters. Future efforts to improve the monitoring network will consider DWR's best management practices related to interconnected surface water, and will likely include installation of multi-completion wells closer to the Kelsey and Adobe Creek stream gage stations."	Thank you for your comment. Section 3.5.6 Data Gaps does recognize that there are both spatial and temporal gaps in the monitoring network. The subsequent section, 3.5.7, mentions the work the GSA is doing with DWR to install new shallow monitoring wells along Kelsey and Adobe Creek	Email with attachments

Public Draft GSP Comment Matrix and Response

Commenter Name	Commenter Organization	Date Received	Related Chapter	Section Number	Line, Figure, or Table #s	Comment	Response to Comment Received	Submission Type
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021		Appendix 2D	4.6.4	Model results show stream depletions in Adobe Creek up to 90% of total stream flow in the month of April (during hitch spawning and migration). This is a clear indication of potential undesirable results related to groundwater extraction during a critical time for the Clear Lake Hitch. If time permitted, we would request more analyses to identify where data could be refined or used to inform the MTs for depletions. However, the development of this GSP was too accelerated to allow thorough review and thought, and these model results were only presented at the release of this draft GSP--after all other chapters were reviewed. Future studies should focus on refining the model and exploring relative depletions, but in the mean time (at the very least), MTs need to be adjusted up to account for this new information. However, we also do not believe the monitoring wells selected along Adobe Creek will be useful in protecting against undesirable results related to depletions since large depletions were estimated during times when these wells reported spring ground water elevations above the MTs and near the MOs. Questions like this could be explored through future model runs, but time has not permitted such things.	Comment noted. Model refinement and recalibration, data gap reconciliation, and improving the Basin characterization are the primary objectives of proposed PMAs (please see Section 5). All inconclusive discussions and associated conclusions will be revisited after data gaps are reconciled following the GSP implementation. Presentation of the model results in terms of percent depletion in Appendix 2D seems to have been misleading in that the spikes in depletion occur when the creeks are almost dried and there is zero or close to zero flowrate in the creek (please see middle plot in Figure 4-17). Therefore, it is implied that there will be up to 90% depletion (during drought condition) which will have undesirable results on the beneficial uses and users of groundwater including hitch, while it simply is equal to 90% of no flow (0.1 cfs). It is also worth noting that even these drought conditions happened in July which is outside the hitch spawning and migration window.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021		Appendix 2D	General	Please confirm that KCK data was collected from the DWR Water Data Library (WDL) and not the California Data Exchange Center (CDEC). The tech memo says the data is from CDEC, but that data is not QA/QC'd. We have made this comment before on multiple occasions. Please rectify. And if the analysis was done on Kelsey Creek using cdec data, please update using WDL data. We can provide that data if needed.	We can confirm that the KCK data was collected from the DWR Water Data Library. We thank you for bringing this issue up earlier and have since incorporated the new data. Appendix 2D was incorrect in citing the CDEC data source and has now been updated.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	4	4.9	17	Long-term annual average depletion obscures seasonal trends and is insufficient to determine undesirable results related to Clear Lake Hitch migration and spawning. To be fully transparent in the summary of potential depletions from groundwater extraction on Kelsey Creek, please include the range of relative (%) flow depletions (maximum and minimum monthly for all months over all records), and highlight April and May trends.	Comment noted. Figures 2-65, 2-66, and 2-67 show the potential depletion at Kelsey Creek and Adobe Creek based on the monthly average depletion not the annual average. Accordingly, the discussions use the same figures (monthly average) to draw conclusions.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	4	4.9	25	Again, highlighting a long-term annual average depletion on Adobe Creek obscures seasonal trends that show extremely large relative (%) depletions. Looking at the model results, depletions in April could be up to 90% and often at or above 50% (see years 1990, 2002, 2008, 2013, and 2015 in appendix 2D). Those are very large percentages during a critical time for the hitch migration and spawning. This happens when flows are already low, therefore stranding is a big concern and has been observed many times in the basin, resulting in large population losses and significant reductions in spawning success of the endangered Clear Lake Hitch. Summarizing the depletions on an annual basis (as has been done here) minimizes and hides potential significant impacts of groundwater pumping on surface water flows in Adobe Creek, by giving it a value of merely 5.5% of streamflow (a potentially insignificant amount). Please add the range of monthly depletions as an average of stream flow (maximum and minimum monthly for all months over all records) and talk about the large depletions in April and reference the BVIHM report appendix.	Analysis of monthly-average modeled water depletion at Adobe Creek and Kelsey Creek shows the range of monthly depletion varies from 0 to the maximum of 5.5% at Adobe Creek and 3.5% at Kelsey Creek during Hitch migration period (Please see Section 2.3.3.3). The 90% and other high depletions presented in Figure 4-7 is related to drought condition during summer months when there is little to no base flow in the creeks. That is why the depletion percentage seems to high, while it is in fact calculated compared to non-flow (0.1 cfs) condition. As you suggested, using annual average for this type of analysis results in such confusion. Please refer to Section 2.3.3.3 for more information regarding surface water depletion analysis.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	4	4.9.1.4	4	Given the findings of the BVIHM, we adamantly disagree with the statement that the "relative magnitude of observed and estimated depletions (3-5 percent) during this period show that depletions will have no material effect on stream flows". And the conclusion that "current evidence suggests the observed historical depletions have no negative impacts on Clear Lake Hitch." This section needs to be revised significantly to bring in the information summarized in the BVIHM report. The model includes estimations for frost protection which can be up to 30% of total agricultural water use, a significant amount. This is contradictory to the statement that "Modeling results show that this limited pumping has no measurable effect on depletions." The model results indicate clearly significant depletions in Adobe Creek and the potential for significant and extremely negative impacts on Clear Lake Hitch during a critical time for migration and spawning. This paragraph does not align with the conclusions of the BVIHM, the best available data we have to quantify depletions of interconnected surface waters.	Thank you for bringing up this issue. The range of 3 -5 cfs stream depletion was found in the model by taking into account the effect of pumping and overal impact of frost protection. So, there is definitely pumping happening in the basin. However, the way frost protection water use is reported in the table (up to 30% of total agricultural water use) seems to have been misleading. This amount of frost protection does not directly translate into stream depletion amount. The total pumping is already included in the stream depletion estimation in Section 4 analysis. In that analysis, the baseline shows no pumping (except for M&I, and indoor use for public health and safety) and the other modeled scenario includes agricultural pumping, frost protection pumping, and landscape irrigation pumping. Therefore, the amount discussed in the report (3 -5 sfc) is the depletion that has already taken into consideration the effect of all these pumping scenrios. The conclusion that the frost protection would significantly impact the stream is due to overlooking the fact that all the water use for frost protection does not directly translate into stream depletion. One justification is that if it is cold enough to produce frost, there is likely very limited ET. As a result, a substantial amount of the water applied for frost protection likely percolates through the soil zone to the water table. This means that the amount pumped does not directly translate to a stream impact. However, some individual wells close to the creek that are shallow may have localized impact on the sream as it has been discussed in the document. At this point in time, we do not have specific monitoring data at those wells to conclude the exact frost protection impacts even on localized levels. Hopefully the implemenattion of the GSP project an dmanagement actions would help fill in those data gaps to understand the actual dynamics in the basin.	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021		4.9.1.4	24-25	I'm confused by these two last sentences. It's my understanding that the data outside of 2 standard deviations were not used to determine the MTs or MOs. However, the last two sentences seem to indicate a comparison was made and then doesn't say what was done after that. Please clarify the process for removing outliers and setting the MTs.	As you noted, the data outside 2 standard deviations were removed from the dataset. Then, the remaining data was used to assign MTs and MOs. To make sure that the identified outliers using the 2 standard deviation approach were not due to a drought condition across the Basin, the comparison to other close by wells was performed. It is worth noting that after the comparison, all the identified outliers following the 2 standard deviation approach still remained in the list of outliers in the analysis.	Email with attachments

Public Draft GSP Comment Matrix and Response

Commenter Name	Commenter Organization	Date Received	Related Chapter	Section Number	Line, Figure, or Table #s	Comment	Response to Comment Received	Submission Type
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	4	4.9.2.1	general	Given the new information provided in Appendix 2D, we do not agree with setting the MT based on the lowest historical spring measurement plus 20% lower. As stated in this section, this value was set based on the premise that there are no indications of undesirable results related to depletions of interconnected surface waters--a conclusion that is not supported by best available existing information. The BVIHM clearly shows indications of undesirable results for the Clear Lake Hitch during a critical migration and spawning period, specifically with up to 90% of the flow being depleted in Adobe Creek during April. Other, ungaged creeks, have not been included in the analysis due to lack of information, so Adobe Creek might be considered as a proxy for potential effects in other locations throughout the basin. Instead of adjusting the MT down, we want the MT adjusted up by some amount such that the minimum threshold is above the minimum spring measurement. The MT needs to be higher than the minimum historical values to attempt to avoid the undesirable effects currently happening. Again, however, it is unfortunate that the selected wells along Adobe Creek do not appear to be useful in preventing undesirable results related to depletions of interconnected surface waters, as summarized in previous comments.	Presentation of the model results in terms of percent depletion in Appendix 2D seems to have been misleading in that the spikes in depletion occur when the creeks are almost dried and there is zero or close to zero flowrate in the creek (please see middle plot in Figure 4-17). Therefore, it is implied that there will be up to 90% depletion (during drought condition) which will have undesirable results on the beneficial uses and users of groundwater including hitch, while it simply is equal to 90% of no flow (0.1 cfs). It is also worth noting that these drought conditions happened in July, which is outside the hitch spawning and migration period. Analysis of monthly-average modeled water depletion at Adobe Creek and Kelsey Creek shows the range of monthly depletion varies from 0 to the maximum of 5.5% at Adobe Creek and 3.5% at Kelsey Creek during Hitch migration period (Please see Section 2.3.3.3 and refer to the GDEs health analysis).	Email with attachments
Bethany Hackenjos on behalf of Big Valley Band of Pomo Indians	Big Valley Band of Pomo Indians	12/10/2021	4	4.9.2.1	general	We have reviewed the results of the BVIHM and cross-referenced the years that show at least 50% flow depletions in Adobe Creek (see years 1990, 2002, 2008, 2013, and 2015) with the MTs and the historical spring groundwater elevation measurements. Taken together, these data indicate that the selected monitoring wells will not likely be useful for avoiding undesirable results related to depletions of interconnected surface waters, specifically near Adobe Creek. This is because the selected wells do not consistently show low spring elevations during the times when the model reports very high relative depletions. In fact, many of the large depletions occur during years when the spring levels were closer to the MO at these selected wells. Given the fact that this model has been calibrated based on best available information, this seems to indicate that groundwater elevations at these wells are not a good proxy for determining whether undesirable results related to depletion of interconnected surface waters are occurring, and therefore not a good proxy for avoiding these undesirable results. If this GSP process were not so rushed, we would likely have more time to give more thought to effects of depletions on the Clear Lake Hitch, RMS well selection, and process for setting MTs and MOs--whether that be based on groundwater elevations or some other measure. However, at this time, we do not believe the RMS wells, MTs, and MOs selected for depletion of interconnected surface water will protect against undesirable results.	Comment noted. Model refinement and recalibration, data gap reconciliation, and improving the Basin characterization are the primary objectives of proposed PMAs (please see Section 5). The SMCs and other conclusions will be revisited following the proposed timeline after GSP implementation.	Email with attachments
Joan Moss	Member of the Public	12/3/2021	2	2.1.5.3	352	"Groundwater quality monitoring was discontinued after 2007." This page is confusing since on line 343 it states 24 wells that were monitored by Lake County or DWR under CASGEM program. Then on page 2-21 on line 393 it states the State and Federal Entities Groundwater Ambient Monitoring and Assessment Program, established in 20002 has been monitoring under various agencies. I believe these varied reports and statements need clarification and consistency.	The referenced language has now been removed. The discontinued groundwater quality monitoring program was from the California Department Resources, but they have monitored groundwater in Big Valley Basin (August 2021) since this portion of the document was initially written (April 2021). However, groundwater quality monitoring is different from groundwater elevation monitoring which is done through the California Statewide Groundwater Elevation Monitoring Program (CASGEM).	Email with attachments
Joan Moss	Member of the Public	12/3/2021	N/A	N/A	N/A	I would like to see proof by our engineer presenter that groundwater in Big Valley is going up. [Concern about dry creeks and the hitch]	Thank you for this feedback, Joan. In future public meetings, consultants and GSA staff will work to make the language easier to understand.	Email with attachments
Joan Moss	Member of the Public	12/3/2021	N/A	N/A	N/A	I am concerned about geothermal water and how many times it is mentioned in the 2006 Groundwater Management Plan.	Thank you, Joan, for the feedback. The 2006 Groundwater Management Plan is for all of Lake County, not just Big Valley Basin. Issues surrounding geothermal water intrusion are not as problematic in Big Valley as they are in other basins. Geothermal water quality concerns are addressed in the GSP in a few ways. The GSP states in Section 2.2.2.3 "However, Lake County (1999 and 2003) stated that local concerns exist associated with increasing nitrate concentrations in groundwater, occurrence of boron at concentrations undesirable for some crops, and potential groundwater quality degradation due to intrusion of geothermal water. Widespread presence of contaminants at undesirable levels (concentrations that exceed applicable regulatory limits) has not been reported in groundwater samples in the Basin. " DWR also did water quality sampling in August 2021 (see Appendix 2C-2) which did not indicate signs of geothermal water intrusion. Additionally, we also state that the Geysers Geothermal Field is five miles south of the basin and there is no active geothermal fluid extraction wells in the Basin (Section 2.2.2.4 Land Subsidence). The GSA plans to monitor groundwater quality which will alert the GSA to any groundwater intrusion (see section 4.7). The GSA has also established sustainable management criteria for water quality; if the monitoring indicates an undesirable result, the GSA will address it.	Email with attachments
Joan Moss	Member of the Public	12/3/2021	N/A	N/A	N/A	I want to say here that the public needs to be more involved in the process. I am willing to help with this.	Thank you for the offer to participate in this process, Joan. We definitely welcome and appreciate public contribution.	Email with attachments
Joan Moss	Member of the Public	12/3/2021	N/A	N/A	N/A	I still have questions about the press release by Like County Public Health Nov 19 that concerns private wells and "Filters may be contaminated with algal (cyanobacterial) matter that can release toxins"	The GSA acknowledges that cyanobacteria in Clear Lake is an issue. Currently, there are no known cases of cyanobacteria that has traveled from the lake to the groundwater. To protect groundwater quality, the GSA plans to install three shallow monitoring wells. Additionally, the Big Valley Band of Pomo Indians is also sampling wells for cyanobacteria. The GSA plans to coordinate with them on this effort.	Email with attachments

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Commenter Name	Commenter Organization	Date Received	Related Chapter	Section Number	Line, Figure, or Table #s	Comment	Response to Comment Received	Submission Type
Laura Hall	Lake County Community Development Department.	11/29/2021	2	2.1	114, 130-137	The statement, "As of 2021, no reliable information on cannabis irrigation or projections exist for Lake County" is not an accurate statement. They provided several resources--RWQCB permitting and a link to a UC-joint study. They do note that this is for legal cannabis and that illegal cultivation of cannabis has no data except for arial imagery. They also mention that they are in the process of building a database that will geo-reference all cannabis projects throughout Lake County. They recommend referencing this database.	Thank you, Laura, for the additional information. We have revised the text to include the reference to the Community Development Department's forthcoming database as well as the UC studies.	Email with attachments
Laura Hall	Lake County Community Development Department.	11/29/2021	2	N/A	N/A	It is confusing to the reader to have two sections named "2. Plan Area and Basin Setting"	Comment acknowledged. We will revisit and revise our naming convention when we finalize the draft. If we keep the GSP in multiple sections, we will have to follow DWR's naming convention will make things easier to follow.	Email with attachments
Laura Hall	Lake County Community Development Department.	11/29/2021	2	2.1	861-875, 959-965	If groundwater wells in these areas [near interconnected streams] can be defined as subterranean, then there should be a discussion on State Water Board requirements for cannabis cultivates as it relates to water diverted from subterranean streams flowing through a known and definite channel.	Comment acknowledged. The GSA is installing shallow monitoring wells to better understand and characterize groundwater-surface water interaction.	Email with attachments
Laura Hall	Lake County Community Development Department.	11/29/2021	2		115-158	Due to the ongoing high cost of drinking water that the disadvantaged community of Lucerne and other communities throughout Lake County continue to face, it seems this would be an important topic that should be addressed.	Thank you for bringing up issues surrounding affordability, Laura. While the GSA is not responsible for setting drinking water rates, the GSA is responsible for ensuring access to the groundwater supply. Groundwater is a more affordable water source when compared to alternatives (imported water, bottled water, treated surface water) therefore helping the cost of drinking water. The GSA will also keep affordability in mind when setting any fees or rates for GSP implementation.	Email with attachments
Laura Hall	Lake County Community Development Department.	11/29/2021	2	2.1	N/A	The GSP should include a summary of the Kelseyville Area Plan and how the GSP affects the goals, objectives, and polices included in the plan.	Thank you for bringing the Kelseyville Area Plan to our attention. We have revised the text to include the Area Plan and the relevant objectives/polices that connect to the GSP.	Email with attachments
NGOs	Multiple	12/3/2021	4	N/A	N/A	Describe direct and indirect impacts on DACs, domestic well owners, and tribes when describing undesirable results and defining minimum thresholds for chronic lowering of groundwater levels. Include information on the impacts during prolonged period or below average water years.	Additional text has been added in regards to the impacts to DACs, domestic well owners, and tribes (see Section 4.4.2.4 Protection of Beneficial Uses). The purpose of this section is to describe the impacts to domestic well users under various scenarios (increase in demand and extreme climate change) and reiterate that the MTs for chronic lowering of groundwater levels, in combination with the projects and management actions, are protective of beneficial uses.	Email with attachments
NGOs	Multiple	12/3/2021	4	N/A	N/A	Clarify what the 5%, 10%, and 20% lines represent and how they were developed.	Additional text has been added to the a new section, 4.4.2.4 Protection of Beneficial Users, to explain what these percentages mean and where they came from. In addition, a note has been added under each figure. The number of wells, along with their depth, in each grid monitoring section was obtained from DWR's Online System of Well Completion Reports. The 5, 10, and 15% lines on the graph represent the depth percentages of the wells in each grid. For example, in the North grid, 5 percent of the wells are 29.6 feet below ground surface.	Email with attachments
NGOs	Multiple	12/3/2021	4	N/A	N/A	Describe direct and indirect impacts on DACs, domestic well owners, and tribes when describing undesirable results and defining minimum thresholds for degraded water quality.	The text has been modified to more clearly indicate the impacts on domestic well owners, DACs, and the tribe.	Email with attachments
NGOs	Multiple	12/3/2021	4	N/A	N/A	Evaluate the cumulative or indirect impacts of proposed MTs for degraded water quality on DACs, drinking water users, and tribes	The text has been modified to more clearly indicate the impacts on domestic well owners, DACs, and the tribe.	Email with attachments
NGOs	Multiple	12/3/2021	3	N/A	N/A	Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, tribes, and GDEs to clearly identify monitored areas. Include a shallow well in the southeast grid of the basin to monitor impacts to beneficial users.---Specifically Figure 3-2 doesn't include depth information	Two figures were updated to show the spatial relationship between the representative monitoring wells and beneficial users. Figure 3-2 now includes Kelseyville, a severely disadvantaged community, and the Big Valley Band of Pomo Indians. Figure 3-3 now includes the groundwater dependent ecosystems.	Email with attachments
NGOs	Multiple	12/3/2021	5	N/A	N/A	For DACs and domestic well owners, further describe specific plans for implementation of the drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.	Additional text has been added to the Domestic Well Mitigation Program to explain that it can be triggered either by an undesirable result or through the adaptive management approach (see Section 5.6). The adaptive management approach looks at both short-term triggers such as a drought and long-term triggers such as a negative trend in a sustainability indicator. Additional text has also been added to Section 5.6 that a negative trend towards (or an exceedance of) an MT will include analysis of potential impacts to beneficial uses and users of groundwater, including those reliant on groundwater for their drinking water source.	Email with attachments
NGOs	Multiple	12/3/2021	2	2.1	Figure 2-1	Clearly label the community of Kelseyville as a SDAC. State the data used to map the community (i.e., DAC places, tracks or block)	The map has been updated with the data source (census place). However, the community of Kelseyville was not labeled as an SDAC. This map is intended to show jurisdictions, not disadvantaged communities. If looking at disadvantaged communities, we would need to show additional areas are disadvantaged within the Basin at the census tract or block group level. By labeling only Kelseyville as an SDAC on this map, it gives the impression that it is the only economically stressed area within the Basin which is inaccurate. Additional text has been added to explain that there are more DACs within Big Valley Basin when using the census tract or block group.	Email with attachments

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NGOs	Multiple	12/3/2021	2	2.2.2.5	N/A	Provide a map showing all of the stream reaches in the basin, with reaches clearly labeled as interconnected (gaining/losing) or disconnected. Consider any segments with data gaps as potential ISWs and clearly make them as such on maps provided in the GSP	Two figures have been added to Section 2.2.2.5, Interconnected Surface Water Systems, which show the simulated average monthly interconnection of surface water bodies in a wet and dry year.	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.3	N/A	Use seasonal data over multiple water year types to capture the variability in environmental conditions inherent in California's climate, when mapping ISWs. We recommend the 10-year pre-SGMA period of 2005 to 2015	Comment noted. The GSA agrees with the need to capture hydrologic variability. The Big Valley Integrated Hydrological Model used a period of 30 years to capture hydrological variability from 1984 - 2015.	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.3	N/A	Overlay the basin's stream reaches on depth-to-groundwater contour map to illustrate groundwater depths and the groundwater gradient near the stream reaches. Show the location of the groundwater wells used in the analysis	Section 2.2.2.5 includes charts showing the depth to groundwater relative to creek beds along the length of Kelsey and Adobe Creeks for dry and wet conditions. Depth to groundwater are based on contour maps in Section 2.2.2.2. Section 4.4.9 also includes charts showing the depth to groundwater relative to creek beds for Kelsey and Adobe Creeks compared to 3 wells along each creek. The comparison include the entire historical record at each of the wells.	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.3	N/A	For the depth-to-groundwater contour maps, use the best practices presented in Attachment C. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this lower from land surface elevations from a DEM to estimate depth-to-groundwater contours across the landscape. This will provide accurate contours of depth to groundwater along streams and other land surface depressions where GDEs are commonly found.	Please see Section 2.2.2 for groundwater elevation contours in the Basin and groundwater elevation hydrographs of representative wells. These contours were developed using US Geological Survey and DWR guidelines. In addition, hydrographs along Adobe Creek and Kelsey Creek are presented in Section 2.2.2.	Email with attachments
NGOs	Multiple	12/3/2021	3		N/A	Reconcile ISW data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/cluster wells) along surface water features in the Monitoring Network section of the GSP	Comment noted. Section 5 provides Project and Management Actions to fill the data gaps discussed in Sections 2, 3, and 4. Reconciling ISW with future measurements will help develop a clear understanding on the relationship between surface water and groundwater across the Basin.	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.3	N/A	Re-evaluate the NC dataset polygons that are adjacent to irrigated fields or surface water supplies. Refer to Attachment C of this letter for best practices for using local groundwater data to verify whether polygons in the NC dataset are supported by groundwater in an aquifer	Managed habitat receiving supplemental irrigation supplies, such as irrigated refuges and managed wetlands, are not considered GDEs (see Section 2.2.3.1). It is believed that what TNC has identified as wetlands seem to rely on surface waters, and it was noticed during a recent field investigation that there wasn't any evidence of those wetlands. Rather mixed riparian habitat was observed along the creeks. Therefore, to be consistent with the observations, the wetlands designation is changed to "riparian habitats" that are stream-fed for most of the year. However, because there are uncertainties regarding the level of dependency of these habitats on groundwater sources, these habitats are also considered as potential GDEs (see Section 2.2.3.1 Identification of GDEs).	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.3	N/A	Refer to Attachment B for more information on TNC's plant rooting depth database. Deeper thresholds are necessary for plants that have reported maximum root depths that exceed the averaged 30-ft threshold, such as Valley Oak. We recommend that reported max rooting depth for these deeper-rooted plants be used if these species are present in the basin. For example, a depth-to-groundwater threshold of 80 feet should be used instead of the 30-ft threshold, when verifying whether Valley Oak polygons are connected to groundwater	The NCCAG dataset was used to identify potential GDEs. No depth to water criteria were applied in identifying likely GDEs. As a result, no GDEs were removed based on depth to groundwater conditions. In fact, potential GDEs, in addition to the NCCAG dataset, were added to the list of identified Big Valley GDEs. Also, as it is currently known, the 80 ft requirement for Valley Oak only applies to fractured bedrock, which is a very specific condition and most likely not applicable to the entire Basin.	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.3	N/A	If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as "Potential GDEs" in the GSP until data gaps are reconciled in the monitoring network.	As noted in Section 2.2.3.1, "TNC advises that if sufficient data are not available in time for the 2020/2022 plan, questionable polygons from the NCCAG dataset be included in the GSP until data gaps are reconciled in the monitoring network." Following TNC advice, not only the NCCAG polygons were considered as potential GDEs, new GDEs are identified through communication with public and field visits which are added to the list of potential GDEs (see Figure 2.58).	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.4	N/A	Quantify an represent all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including native vegetation	Please see Table 2-14 in Section 2.2.4. The water budget table includes an individual line item for each water sector use.	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.3	N/A	State whether or not there are managed wetlands in the basin. If there are, ensure that their groundwater demands are included as separate line items in the historical, current, and projected water budgets.	A statement has been added to Section 2.2.3 Groundwater Dependent Ecosystems regarding managed wetlands. It reads, "There are no federal or state wildlife refuge areas within the Basin. However, the Lake County Land Trust owns two properties close to the Basin, Melo Wetland Preserve and Wright Property. Both of these areas are wetland preserves and a part of the CDFW-approved Big Valley Wetlands Conceptual Area Protection Plan."	Email with attachments
NGOs	Multiple	12/3/2021	7	N/A	N/A	Provide clear documentation of how stakeholder input was incorporated into the GSP development process	Section 7.1 has been updated to further describe the multi-step process by which GSPAC members provided feedback on the GSP, and this process is outlined in detail in Section 7.5. This text details the GSPAC review process and affrms that every component of the GSP was reviewed by GSPAC members individually and then discussed openly in GSPAC meetings.	Email with attachments
NGOs	Multiple	12/3/2021	7	N/A	N/A	Clarify the role of the GSP Advisory Committee in the GSP implementation phase	Additional information has been added to Section 7.1 to explain the GSPAC recharting that will occur in February 2022 (this is also detailed in Section 7.7). The role that the rechartered GSPAC will have in implementation will be decided by the designated GSPAC members themseleves, and that role will be reflected in the new GSPAC charter document.	Email with attachments
NGOs	Multiple	12/3/2021	7	N/A	N/A	Utilize DWR tribal engagement guidance to comprehensively identify, involve, and address all tribes and tribal interests that may be present in the basin	The GSA is working with local Tribes for guidance on tribal engagement as implementation of the GSP gets underway. From the onset of GSP development, the GSA has sought to properly identify all possible Tribes to engage in the process, and GSPAC member Sarah Ryan, of the Big Valley Band of Pomo Indians, and Terre Logsdon, of the Scotts Valley Tribe of Pomo Indians have been instrumental in assisting in these efforts.	Email with attachments
NGOs	Multiple	12/3/2021	4	N/A	N/A	Consider minimum threshold exceedances for single RMS wells when defining the groundwater level undesirable result across the basin, instead of exceedances at two of the six RMS wells	Thank you for your comment. The MTs for chronic groundwater levels were set using best available science and have been approved both by the GSPAC and the Board of Supervisors. The MTs also take into consideration the GSAs technical and financial capabilities.	Email with attachments

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NGOs	Multiple	12/3/2021	4	N/A	N/A	Set MTs and Mos for all water quality constituents within the basin that are impacted or exacerbated by groundwater use and/or management.	Thank you for your comment. Currently, MTs and MOs have been set for Total Dissolved Solids which act as a proxy for other water quality constituents. Additionally, the GSA has plans for a more thorough groundwater quality monitoring program as described in Section 5.3.	Email with attachments
NGOs	Multiple	12/3/2021	4	N/A	N/A	Evaluate impacts on GDEs when establishing SMC for chronic lowering of groundwater levels. When defining undesirable results, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results in the basin. Defining undesirable results is the crucial first step before the minimum thresholds can be determined	As discussed in Section 2.3.3 (GDE identification) and later in Sections 4.2, 4.3.1, and 4.9, multiple health indices were used to analyze GDEs health response to various groundwater elevation over 35 years. Accordingly, potential impact on beneficial uses and users of groundwater was considered when determining the SMCs and undesirable conditions in the Basin. A full discussion concerning the potential impacts of groundwater fluctuations on beneficial uses and users of groundwater and assigning MTs may be found in Section 4.9.	Email with attachments
NGOs	Multiple	12/3/2021	4	N/A	N/A	When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when minimum thresholds in the basin are reached.15 The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts on environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law.	GSP analyses indicate the Basin is currently sustainable and has not experience any significant and unreasonable impacts to beneficial users over the historical base period since 1985 (please refer to Section 2). Additionally, the model suggest the Basin will be able to maintain sustainability over the projected period, including under climate change conditions. MTs were defined to prevent the occurrence of undesirable conditions outside the range of those experienced in the historical base period, thereby avoiding significant and unreasonable adverse impacts on beneficial users. Additional planned monitoring sites will improve understanding of ISW in the Basin and inform ongoing groundwater management, including periodic review of conditions as part of the Five-Year GSP Update as laid out in the GSP.	Email with attachments
NGOs	Multiple	12/3/2021	4	N/A	N/A	When establishing SMC for the basin, consider that the SGMA statute [Water Code §10727.4(l)] specifically calls out that GSPs shall include "impacts on groundwater dependent ecosystems."	Section 4 identifies how the MTs are set to be protective of all beneficial users, including GDEs, in the Basin. SMCs specific to GDEs are discussed in Sections 4.4 and 4.9.	Email with attachments
NGOs	Multiple	12/3/2021	2	2.2.4	N/A	Include imported water, which is currently included in the "Non-Routed Delivery" column, as its own line item in the water budget tables.	There is no imported water into Big Valley Basin. "Non-Routed Deliveries" in this Basin is used to represent water supplied to Kelseyville and two other small public water systems. All of these water systems are supplied by groundwater.	Email with attachments
NGOs	Multiple	12/3/2021	5	N/A	N/A	Incorporate climate change scenarios into projects and management actions.	The text in the adaptive management section (5.6) has been augmented. It now specifically call out how uncertainties related climate change will be incorporated.	Email with attachments
NGOs	Multiple	12/3/2021	3	N/A	N/A	Increase the number of RMSs in the shallow aquifer across the basin as needed to map ISWs and adequately monitor all groundwater condition indicators across the basin and at appropriate depths for all beneficial users. Prioritize proximity to DACs, domestic wells, tribes, GDEs, and ISWs when identifying new RMSs. --Specifically talking about the southeast grid because many domestic wells and potential GDEs	The existing RMS network in the Basin is believed to adequately monitor the different sustainability indicators. The density of the RMS network is consistent with the well density guidelines outlined in DWR's BMPs. The sufficiency of the RMS network to adequately monitor basin conditions and sustainability will be reviewed on an ongoing basis throughout GSP implementation. Moreover, adding multiple completion monitoring well with one or more shallow screen interval, or a separate shallow monitoring well, is part of the Technical Support Service application grant that will help improve the understanding of stream aquifer interaction and Interbasin flows and the impacts on beneficial uses and users of groundwater. No RMS well was selected for the southeast grid, as this grid lies primarily in upland areas. The wells in this grid are generally shallow and are located near surface water sources. This decision was discussed and supported in GSPAC meetings.	Email with attachments
NGOs	Multiple	12/3/2021	3	N/A	N/A	Ensure groundwater elevation and water quality RMSs are monitoring groundwater conditions spatially and at the correct depth for all beneficial users - especially DACs, domestic wells, tribes, and GDEs.	Comment noted. The density of the RMS network is consistent with the well density guidelines outlined in DWR's BMPs. The sufficiency of the RMS network to adequately monitor basin conditions and sustainability will be reviewed on an ongoing basis throughout GSP implementation. To consider the RMS spatial distribution and representative area, Big Valley Basin was subdivided into seven grids (size and geometry varies based on proximity to the basin boundary), each containing approximately six Public Land Survey System (PLSS) Sections, and with an overall area of approximately four to six square miles (see Figure 3-2). Specific considerations to take measurements are discussed in Section 3.2.2. Please also see revised Figures 3-2 and 3-3 which show the proxmity of the RMS wells to DACs, the tribe, and GDEs.	Email with attachments
NGOs	Multiple	12/3/2021	3	N/A	N/A	Describe biological monitoring that can be used to assess the potential for significant and unreasonable impacts to GDEs or ISWs due to groundwater conditions in the basin.	Project and Management Actions include items that involves coordination with the Big Valley Band of Pomo Indians and CDFW to incorporate updated data and understanding of hitch passage and spawning into GSP updates and share groundwater level and streamflow data as useful. Please refer to Section 5 for more information on PMAs addressing ISW and GDEs.	Email with attachments
NGOs	Multiple	12/3/2021	5	N/A	N/A	For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSA plans to mitigate such impacts.	The Tier 1B projects and management actions are those that relate to filling data gaps and performing outreach. As such, they do not have any impacts to water quality. There are two Tier 2 projects and management actions, which may be implemented if resources are available, that could impact groundwater quality-- the Adobe Creek Conjunctive Use Project and the Investigate Recharge Locations and Benefits. The text has been augmented to include an investigation of potential groundwater quality impacts.	Email with attachments
NGOs	Multiple	12/3/2021	5	N/A	N/A	Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.	There are no water deliveries in Big Valley Basin. However, additional text has been added to the adaptive management section (5.6) to include uncertainties related to climate change.	Email with attachments

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Sarah Ryan	Big Valley Band of Pomo Indians	12/10/2021	4		Table 4-4	The Tribe does not believe that it is acceptable to set MTs that will lead to dry wells. Many people in this community do not have funding to drill their wells deeper, and setting action levels that formalize the acceptance of any percentage of wells should not be considered sustainable use of groundwater, or good management of our water resources.	Thank you for raising this issue. The GSA is committed to sustainable groundwater management for all users, including domestic users. A new section has been added, 4.4.2.4 Protection of Beneficial Uses, which dives into the impacts to domestic wells. In the North, Northeast, and Southwest grid sections, all domestic wells are deeper than the MT. In the Northwest, West-Central, and East-Central grid sections, the number of domestic wells that are shallower than the MT are estimated to be 13 (15%), 4 (7%), and 9 (16%), respectively. The analysis shows that even under climate change and forecasted demand increase scenarios, the spring groundwater elevations would not exceed any MT. However, the GSA is aware that wells have gone dry in the Basin. To that end, the GSA has a management action, Develop Domestic Well Management Program, to safeguard domestic well owners. It proposes a domestic well inventory which will help identify well location, construction, and use. Additionally, the GSA's Domestic Well Mitigation Program intends to work with well owners on both short-term and long-term solutions to dry wells. The GSA also has adaptive management measures that respond to changing conditions such as drought, climate change, and negative trends in groundwater levels which will help guide action before an MT is reached. These actions, when paired with monitoring for the MT, will help mitigate impacts to drinking water supplies.	Email with attachments
Sarah Ryan	Big Valley Band of Pomo Indians	12/10/2021	EC	executive summary	84	Big Valley Rancheria also operates two Public Water Systems that are groundwater fed.	Thank you for pointing this out--an omission on our part. We called out the Public Water Systems in Section 2.1, but did not bring that information into the executive summary. The text has now been amended to include the information.	Email with attachments
Sarah Ryan	Big Valley Band of Pomo Indians	12/10/2021	EC	executive summary	Figure ES-2	The Tribal land portion identifying Big Valley Rancheria is incorrect. I'm attaching a map.	Thank you for helping us correctly identify tribal lands. It appears the database we used is outdated. A new, correct map has replaced the incorrect map in both the executive summary and Section 2.1	Email with attachments
Sarah Ryan	Big Valley Band of Pomo Indians	12/10/2021	3		Table 3-7	Please correct the wells information for Big Valley. They are continuous monitoring, 2 at Kelsey Creek and 3 at Adobe Creek. I don't believe we've shared the geocoordinates, only 1 is located at the stream gage - Bell Hill.	The well information has been corrected. The table incorrectly listed three wells monitored by the Big Valley Rancheria. The table now accurately lists the wells as monitored by the District. The coordinates for these wells and their location were checked and are accurate.	Email with attachments
Sarah Ryan	Big Valley Band of Pomo Indians	12/10/2021	3		Figure 3.3	Please adjust wells as appropriate, based on Table 3-7 updates.	The wells were not adjusted in Figure 3-3 since the well locations were correct. Figure 3-3 was augmented, however, by adding the groundwater dependent ecosystems.	Email with attachments

Big Valley Basin Groundwater Sustainability Plan
Comment Tracking Table 2021

Commenter Name	Commenter Organization	Section Number	Line #s or Figure #	Comment
SR	Big Valley Band of Pomo Indians	executive summary	84	Big Valley Rancheria also operates two Public Water Systems that are groundwater fed.
SR	Big Valley Band of Pomo Indians	executive summary	Figure ES-2	The Tribal land portion identifying Big Valley Rancheria is incorrect. I'm attaching a map.
BHJ - FW	Big Valley Band of Pomo Indians	executive summary	Table ES-1	Depletion MT and MO. It was my understanding that the GSPAC agreed to select the MT based on one or two standard deviations from the mean and not the lowest historical spring groundwater elevations. Since BVHIM results indicate depletions are leading to undesirable effects to interconnected surface waters (i.e. impacting the survival and success of the Clear Lake Hitch), the Tribe does not agree that the lowest ever recorded spring value + 20% should set the MT. Setting the MTs at based on this criteria assumes undesirable results are not occurring, a premise unsupported by the best available information. Setting the MTs at this level would ensure that any undesirable results would continue to occur and potentially increase in severity.
BHJ - FW	Big Valley Band of Pomo Indians	executive summary	Table ES-2	Most of the wells selected for monitoring depletions of interconnected surface waters are too far away from streams and gages and collected too infrequently to adequately monitor for undesirable results. Many existing monitoring locations closer to the streams would be a better fit, but ultimately, the timeline to create this GSP was too fast for thoughtful review and negotiations. Additionally, not enough time was granted to determine the extent of depletions and review analyses that were conducted as part of this GSP (e.g., the BVIHM) and other studies. Based on preliminary review of the BVIHM results, we do not believe the wells selected along Adobe creek are suitable for evaluating and preventing undesirable results related to depletions. For example, the BVIHM results show large relative flow depletions (50% to 90% of Adobe Creek flow) during years where the recorded spring groundwater elevations in the selected Adobe Creek wells are higher than the MTs and approaching or greater than the MOs (see years 1990, 2002, 2008, 2013, and 2015). This means that undesirable results are potentially occurring during times when both the MTs and MOs would be achieved. Therefore, the set of wells used to monitor for depletions will need to be revised in the future, likely requiring new well drilling since the wells selected based on the current network are not likely to protect against undesirable results.
BHJ - FW	Big Valley Band of Pomo Indians	3.5	Table 3-7	We provided previous comments that requested distances of each well from the selected gages be added to the table, but they have not. Please add distances in miles.
SR	Big Valley Band of Pomo Indians		Table 3-7	Please correct the wells information for Big Valley. They are continuous monitoring, 2 at Kelsey Creek and 3 at Adobe Creek. I don't believe we've shared the geocoordinates, only 1 is located at the stream gage - Bell Hill.
SR	Big Valley Band of Pomo Indians		Figure 3.3	Please adjust wells as appropriate, based on Table 3-7 updates.

Big Valley Basin Groundwater Sustainability Plan
Comment Tracking Table 2021

Commenter Name	Commenter Organization	Section Number	Line #s or Figure #	Comment
BHJ - FW	Big Valley Band of Pomo Indians	3.5	Table 3-7	Please change footnote "BVR = Rancheria" to "BVR = Big Valley Rancheria"
BHJ - FW	Big Valley Band of Pomo Indians	3.5.4	335	Please indicate use of DWR BMPs in determining spatial coverage at the end of the last sentence. https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/BMP-2-Monitoring-Networks-and-Identification-of-Data-Gaps_ay_19.pdf
BHJ - FW	Big Valley Band of Pomo Indians	3.5.5	333	I'm having trouble with the language here, specifically the use of "should be". Is the monitoring frequency going to be what it "should be" or something else? Please distinguish between what the actual monitoring frequency will be along with what it "should be" here.
BHJ - FW	Big Valley Band of Pomo Indians	3.5.6	337	Please add sentence to the beginning something like, "Significant data gaps exist within the existing groundwater-surface water monitoring network that prohibit clear determination of undesirable results related to depletions of interconnected surface waters. Future efforts to improve the monitoring network will consider DWR's best management practices related to interconnected surface water, and will likely include installation of multi-completion wells closer to the Kelsey and Adobe Creek stream gage stations."
SR	Big Valley Band of Pomo Indians		Table 4-4	The Tribe does not believe that it is acceptable to set MTs that will lead to dry wells. Many people in this community do not have funding to drill their wells deeper, and setting action levels that formalize the acceptance of any percentage of wells should not be considered sustainable use of groundwater, or good management of our water resources.
BHJ - FW	Big Valley Band of Pomo Indians	Appendix 2D	4.6.4	Model results show stream depletions in Adobe Creek up to 90% of total stream flow in the month of April (during hitch spawning and migration). This is a clear indication of potential undesirable results related to groundwater extraction during a critical time for the Clear Lake Hitch. If time permitted, we would request more analyses to identify where data could be refined or used to inform the MTs for depletions. However, the development of this GSP was too accelerated to allow thorough review and thought, and these model results were only presented at the release of this draft GSP--after all other chapters were reviewed. Future studies should focus on refining the model and exploring relative depletions, but in the mean time (at the very least), MTs need to be adjusted up to account for this new information. However, we also do not believe the monitoring wells selected along Adobe Creek will be useful in protecting against undesirable results related to depletions since large depletions were estimated during times when these wells reported spring ground water elevations above the MTs and near the MOs. Questions like this could be explored through future model runs, but time has not permitted such things.

Big Valley Basin Groundwater Sustainability Plan
Comment Tracking Table 2021

Commenter Name	Commenter Organization	Section Number	Line #s or Figure #	Comment
BHJ - FW	Big Valley Band of Pomo Indians	Appendix 2D	General	Please confirm that KCK data was collected from the DWR Water Data Library (WDL) and not the California Data Exchange Center (CDEC). The tech memo says the data is from CDEC, but that data is not QA/QC'd. We have made this comment before on multiple occasions. Please rectify. And if the analysis was done on Kelsey Creek using cdec data, please update using WDL data. We can provide that data if needed.
BHJ - FW	Big Valley Band of Pomo Indians	4.9	17	Long-term annual average depletion obscures seasonal trends and is insufficient to determine undesirable results related to Clear Lake Hitch migration and spawning. To be fully transparent in the summary of potential depletions from groundwater extraction on Kelsey Creek, please include the range of relative (%) flow depletions (maximum and minimum monthly for all months over all records), and highlight April and May trends.
BHJ - FW	Big Valley Band of Pomo Indians	4.9	25	Again, highlighting a long-term annual average depletion on Adobe Creek obscures seasonal trends that show extremely large relative (%) depletions. Looking at the model results, depletions in April could be up to 90% and often at or above 50% (see years 1990, 2002, 2008, 2013, and 2015 in appendix 2D). Those are very large percentages during a critical time for the hitch migration and spawning. This happens when flows are already low, therefore stranding is a big concern and has been observed many times in the basin, resulting in large population losses and significant reductions in spawning success of the endangered Clear Lake Hitch. Summarizing the depletions on an annual basis (as has been done here) minimizes and hides potential significant impacts of groundwater pumping on surface water flows in Adobe Creek, by giving it a value of merely 5.5% of streamflow (a potentially insignificant amount). Please add the range of monthly depletions as an average of stream flow (maximum and minimum monthly for all months over all records) and talk about the large depletions in April and reference the BVIHM report appendix.
BHJ - FW	Big Valley Band of Pomo Indians	4.9.1.4	4	Given the findings of the BVIHM, we adamantly disagree with the statement that the "relative magnitude of observed and estimated depletions (3-5 percent) during this period show that depletions will have no material effect on stream flows". And the conclusion that "current evidence suggests the observed historical depletions have no negative impacts on Clear Lake Hitch." This section needs to be revised significantly to bring in the information summarized in the BVIHM report. The model includes estimations for frost protection which can be up to 30% of total agricultural water use, a significant amount. This is contradictory to the statement that "Modeling results show that this limited pumping has no measurable effect on depletions." The model results indicate clearly significant depletions in Adobe Creek and the potential for significant and extremely negative impacts on Clear Lake Hitch during a critical time for migration and spawning. This paragraph does not align with the conclusions of the BVIHM, the best available data we have to quantify depletions of interconnected surface waters.

Big Valley Basin Groundwater Sustainability Plan
Comment Tracking Table 2021

Commenter Name	Commenter Organization	Section Number	Line #s or Figure #	Comment
BHJ - FW	Big Valley Band of Pomo Indians	4.9.1.4	24-25	I'm confused by these two last sentences. It's my understanding that the data outside of 2 standard deviations were not used to determine the MTs or MOs. However, the last two sentences seem to indicate a comparison was made and then doesn't say what was done after that. Please clarify the process for removing outliers and setting the MTs.
BHJ - FW	Big Valley Band of Pomo Indians	4.9.2.1	general	Given the new information provided in Appendix 2D, we do not agree with setting the MT based on the lowest historical spring measurement plus 20% lower. As stated in this section, this value was set based on the premise that there are no indications of undesirable results related to depletions of interconnected surface waters--a conclusion that is not supported by best available existing information. The BVIHM clearly shows indications of undesirable results for the Clear Lake Hitch during a critical migration and spawning period, specifically with up to 90% of the flow being depleted in Adobe Creek during April. Other, ungaged creeks, have not been included in the analysis due to lack of information, so Adobe Creek might be considered as a proxy for potential effects in other locations throughout the basin. Instead of adjusting the MT down, we want the MT adjusted up by some amount such that the minimum threshold is above the minimum spring measurement. The MT needs to be higher than the minimum historical values to attempt to avoid the undesirable effects currently happening. Again, however, it is unfortunate that the selected wells along Adobe Creek do not appear to be useful in preventing undesirable results related to depletions of interconnected surface waters, as summarized in previous comments.

Big Valley Basin Groundwater Sustainability Plan
Comment Tracking Table 2021

Commenter Name	Commenter Organization	Section Number	Line #s or Figure #	Comment
BHJ - FW	Big Valley Band of Pomo Indians	4.9.2.1	general	We have reviewed the results of the BVHIM and cross-referenced the years that show at least 50% flow depletions in Adobe Creek (see years 1990, 2002, 2008, 2013, and 2015) with the MTs and the historical spring groundwater elevation measurements. Taken together, these data indicate that the selected monitoring wells will not likely be useful for avoiding undesirable results related to depletions of interconnected surface waters, specifically near Adobe Creek. This is because the selected wells do not consistently show low spring elevations during the times when the model reports very high relative depletions. In fact, many of the large depletions occur during years when the spring levels were closer to the MO at these selected wells. Given the fact that this model has been calibrated based on best available information, this seems to indicate that groundwater elevations at these wells are not a good proxy for determining whether undesirable results related to depletion of interconnected surface waters are occurring, and therefore not a good proxy for avoiding these undesirable results. If this GSP process were not so rushed, we would likely have more time to give more thought to effects of depletions on the Clear Lake Hitch, RMS well selection, and process for setting MTs and MOs--whether that be based on groundwater elevations or some other measure. However, at this time, we do not believe the RMS wells, MTs, and MOs selected for depletion of interconnected surface water will protect against undesirable results.

December 3, 2021

Big Valley Groundwater Sustainability Agency
255 N. Forbes Street, Room 309
Lakeport, CA 95453

Submitted via email: water.resources@lakecountyca.gov

Re: Public Comment Letter for Big Valley Basin Draft GSP

Dear Scott De Leon,

On behalf of the above-listed organizations, we appreciate the opportunity to comment on the Draft Groundwater Sustainability Plan (GSP) for the Big Valley Basin being prepared under the Sustainable Groundwater Management Act (SGMA). Our organizations are deeply engaged in and committed to the successful implementation of SGMA because we understand that groundwater is critical for the resilience of California's water portfolio, particularly in light of changing climate. Under the requirements of SGMA, Groundwater Sustainability Agencies (GSAs) must consider the interests of all beneficial uses and users of groundwater, such as domestic well owners, environmental users, surface water users, federal government, California Native American tribes and disadvantaged communities (Water Code 10723.2).

As stakeholder representatives for beneficial users of groundwater, our GSP review focuses on how well disadvantaged communities, drinking water users, tribes, climate change, and the environment were addressed in the GSP. While we appreciate that some basins have consulted us directly via focus groups, workshops, and working groups, we are providing public comment letters to all GSAs as a means to engage in the development of 2022 GSPs across the state. Recognizing that GSPs are complicated and resource intensive to develop, the intention of this letter is to provide constructive stakeholder feedback that can improve the GSP prior to submission to the State.

Based on our review, we have significant concerns regarding the treatment of key beneficial users in the Draft GSP and consider the GSP to be **insufficient** under SGMA. We highlight the following findings:

1. Beneficial uses and users **are not sufficiently** considered in GSP development.
    a. Human Right to Water considerations **are not sufficiently** incorporated.
    b. Public trust resources **are not sufficiently** considered.
    c. Impacts of Minimum Thresholds, Measurable Objectives and Undesirable Results on beneficial uses and users **are not sufficiently** analyzed.
2. Climate change **is sufficiently** considered.

3. Data gaps **are not sufficiently** identified and the GSP **needs additional plans** to eliminate them.
4. Projects and Management Actions **do not sufficiently consider** potential impacts or benefits to beneficial uses and users.

Our specific comments related to the deficiencies of the Big Valley Basin Draft GSP along with recommendations on how to reconcile them, are provided in detail in **Attachment A.**

Please refer to the enclosed list of attachments for additional technical recommendations:

Attachment A	GSP Specific Comments
Attachment B	SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users
Attachment C	The Nature Conservancy's "Identifying GDEs under SGMA: Best Practices for using the NC Dataset"
Attachment D	Maps of representative monitoring sites in relation to key beneficial users

Thank you for fully considering our comments as you finalize your GSP.

Best Regards,

Ngodoo Atume
Water Policy Analyst
Clean Water Action/Clean Water Fund

J. Pablo Ortiz-Partida, Ph.D.
Western States Climate and Water Scientist
Union of Concerned Scientists

Samantha Arthur
Working Lands Program Director
Audubon California

Danielle V. Dolan
Water Program Director
Local Government Commission

E.J. Remson
Senior Project Director, California Water Program
The Nature Conservancy

Melissa M. Rohde
Groundwater Scientist
The Nature Conservancy

Attachment A

Specific Comments on the Big Valley Basin Draft Groundwater Sustainability Plan

1. Consideration of Beneficial Uses and Users in GSP development

Consideration of beneficial uses and users in GSP development is contingent upon adequate identification and engagement of the appropriate stakeholders. The (A) identification, (B) engagement, and (C) consideration of disadvantaged communities, drinking water users, tribes,[1] groundwater dependent ecosystems, streams, wetlands, and freshwater species are essential for ensuring the GSP integrates existing state policies on the Human Right to Water and the Public Trust Doctrine.

A. Identification of Key Beneficial Uses and Users

Disadvantaged Communities, Drinking Water Users, and Tribes

The identification of Disadvantaged Communities (DACs), drinking water users, and tribes is **insufficient**, due to lack of a map labeling the community of Kelseyville as a severely disadvantaged community (SDAC). Figure 2-1 (Big Valley Basin Boundaries, Communities, and Public Lands) shows Kelseyville, but it is not clearly labeled as an SDAC nor is the source of data provided (i.e., DAC places, tracks, or block data). We recommend that this missing element be included to provide a complete description of DACs in the basin.

Despite this omission, we commend the GSA for clearly identifying Kelseyville as a SDAC in the GSP text, providing its population, and identifying that it is dependent on groundwater as its source of drinking water in the basin. Additionally, the GSP maps tribal lands of the Big Valley Band of Pomo Indians of the Big Valley Rancheria on Figure 2-1. The GSP also provides a density map of domestic wells in the basin (Figure 2-5), which shows the average domestic well depth within each grid cell.

RECOMMENDATIONS
• Clearly label the community of Kelseyville as an SDAC. State the data used to map the community (i.e., DAC places, tracks, or block data).

Interconnected Surface Waters

The identification of Interconnected Surface Waters (ISWs) is **insufficient**, due to lack of supporting information provided for the ISW analysis. The GSP discusses available stream gauge data in the basin, and compares the profile of channels (Kelsey Creek and Adobe Creek) with the groundwater elevations along the creek channels for representative wet and dry conditions (Fall 2015 and Spring 2019). However, the GSP does not provide a map of stream reaches in the basin to illustrate the conclusions of the ISW analysis and show which reaches are connected to groundwater.

[1] Our letter provides a review of the identification and consideration of federally recognized tribes (Data source: SGMA Data viewer) within the GSP from non-tribal members and NGOs. Based on the likely incomplete information available to our organizations for this review, we recommend that the GSA utilize the California Department of Water Resources' "Engagement with Tribal Governments" Guidance Document (https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents) to comprehensively address these important beneficial users in their GSP.

The GSP recognizes that most available groundwater elevation data in the basin are from deep wells which may not be representative of the shallow aquifer. The GSP states: (p. 3-18): *"The interconnected surface water monitoring network could be improved through the installation of multi-completion wells closer to the Kelsey and Adobe Creek stream gage stations. Also surface water monitoring (stage and flow) on Kelsey Creek near the Main Street bridge should be conducted in the future. Opportunities to fill data gaps for depletions will also benefit the understanding of GDEs located downstream of the KCK stream gage. In addition, stream flow monitoring of McGaugh Slough could also be considered. The District will coordinate with Big Valley Rancheria regarding stream gage monitoring protocols so that data collection efforts and quality are consistent with the GSP."* We recommend that any segments with data gaps are considered potential ISWs and clearly marked as such on maps provided in the GSP.

RECOMMENDATIONS

- Provide a map showing all the stream reaches in the basin, with reaches clearly labeled as interconnected (gaining/losing) or disconnected. Consider any segments with data gaps as potential ISWs and clearly mark them as such on maps provided in the GSP.
- Use seasonal data over multiple water year types to capture the variability in environmental conditions inherent in California's climate, when mapping ISWs. We recommend the 10-year pre-SGMA baseline period of 2005 to 2015.
- Overlay the basin's stream reaches on depth-to-groundwater contour maps to illustrate groundwater depths and the groundwater gradient near the stream reaches. Show the location of groundwater wells used in the analysis.
- For the depth-to-groundwater contour maps, use the best practices presented in Attachment C. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a Digital Elevation Model (DEM) to estimate depth-to-groundwater contours across the landscape. This will provide accurate contours of depth to groundwater along streams and other land surface depressions where GDEs are commonly found.
- Reconcile ISW data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP.

Groundwater Dependent Ecosystems

The identification of Groundwater Dependent Ecosystems (GDEs) is **incomplete**. The GSP took initial steps to identify and map GDEs using the Natural Communities Commonly Associated with Groundwater dataset (NC dataset). The GSP uses depth-to-groundwater data from 1985 to 2019 to characterize groundwater conditions in the basin's GDEs. However, we found that some mapped features in the NC dataset were improperly disregarded. NC dataset polygons were incorrectly removed in areas adjacent to irrigated fields or due to the presence of surface water supplies. However, this removal criteria is flawed since GDEs, in addition to groundwater, can rely on multiple water sources – including shallow groundwater receiving inputs from irrigation return flow from nearby irrigated fields – simultaneously and at different temporal/spatial scales. NC dataset polygons adjacent to irrigated land or surface water supplies can still potentially be reliant on shallow groundwater aquifers, and therefore should not be removed solely based on their proximity to irrigated fields or surface water supplies.

The GSP states (p. 2-92): *"Oak trees are considered amongst the most common plants and also the deepest-rooted species in the region, with a maximum root zone of roughly 30 feet."* If Valley Oaks exist in the basin, we recommend instead that an 80-foot depth-to-groundwater threshold be used when inferring whether Valley Oak polygons in the NC Dataset GDE map are likely reliant on groundwater. This recommendation is based on a recent correction in TNC's rooting depth database,[2] after finding a typo in the max rooting depth units for Valley Oak. This resulted in a specific change in the max rooting depth of Valley Oak from 24 feet to 24 meters (80 feet). For all other phreatophytes, we continue to recommend that a 30-foot depth-to-groundwater threshold be used when inferring whether all other vegetation polygons are likely reliant on groundwater.

RECOMMENDATIONS

- Re-evaluate the NC dataset polygons that are adjacent to irrigated fields or surface water supplies. Refer to Attachment C of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.
- Refer to Attachment B for more information on TNC's plant rooting depth database. Deeper thresholds are necessary for plants that have reported maximum root depths that exceed the averaged 30-ft threshold, such as Valley Oak (*Quercus lobata*). We recommend that the reported max rooting depth for these deeper-rooted plants be used if these species are present in the basin. For example, a depth-to-groundwater threshold of 80 feet should be used instead of the 30-ft threshold, when verifying whether Valley Oak polygons are connected to groundwater.
- If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as "Potential GDEs" in the GSP until data gaps are reconciled in the monitoring network.

Native Vegetation and Managed Wetlands

Native vegetation and managed wetlands are water use sectors that are required to be included in the water budget.[3,4] The integration of native vegetation into the water budget is **insufficient**. The GSP text discusses evapotranspiration from native vegetation as a separate water use sector, but native vegetation appears to be grouped into a category with all evapotranspiration in the water budget tables. The omission of explicit water demands for native vegetation is problematic because key environmental uses of groundwater are not being accounted for as water supply decisions are made using this budget, nor will they likely be considered in project

[2] TNC. 2021. Plant Rooting Depth Database. Available at: https://groundwaterresourcehub.org/sgma-tools/gde-rooting-depths-database-for-gdes/

[3] "'Water use sector' refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation." [23 CCR §351(al)]

[4] "The water budget shall quantify the following, either through direct measurements or estimates based on data: (3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow." [23 CCR §354.18]

and management actions. Managed wetlands are not mentioned in the GSP, so it is not known whether or not they are present in the basin.

RECOMMENDATIONS

- Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including native vegetation.
- State whether or not there are managed wetlands in the basin. If there are, ensure that their groundwater demands are included as separate line items in the historical, current, and projected water budgets.

B. Engaging Stakeholders

Stakeholder Engagement During GSP Development

Stakeholder engagement during GSP development is **incomplete**. SGMA's requirement for public notice and engagement of stakeholders is not fully met by the description in the Communication and Engagement Plan (Appendix 7A).[5]

The GSP documents explicit involvement of beneficial users through the GSP Advisory Committee, which includes designated seats for DAC, tribal, and environmental representation. However, we note the following deficiencies with the overall stakeholder engagement process:

- The GSP documents opportunities for public involvement and engagement as the following: GSP development meetings, Board of Directors briefings, public meetings and workshops, community presentations, partnerships with local organizations, and in-person outreach at community events. However, the plan does not include documentation on how stakeholder input from the above mentioned outreach and engagement was considered and incorporated into the GSP development process.
- Page 7-1 of the Communication and Engagement Plan states that the GSA will continue to hold regular public meetings during the GSP implementation phase. However, the plan does not include strategies to improve outreach and engagement during GSP implementation. It is also unclear whether the GSP Advisory Committee will continue to be actively involved in the GSP implementation process.

RECOMMENDATIONS

- Provide clear documentation on how stakeholder input was incorporated into the GSP development process.

[5] "A communication section of the Plan shall include a requirement that the GSP identify how it encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin." [23 CCR §354.10(d)(3)]

- Clarify the role of the GSP Advisory Committee in the GSP implementation phase.

- Utilize DWR's tribal engagement guidance to comprehensively identify, involve, and address all tribes and tribal interests that may be present in the basin.[6]

C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users

The consideration of beneficial uses and users when establishing sustainable management criteria (SMC) is **insufficient**. The consideration of potential impacts on all beneficial users of groundwater in the basin are required when defining undesirable results and establishing minimum thresholds.[7,8,9]

Disadvantaged Communities and Drinking Water Users

For chronic lowering of groundwater levels, minimum thresholds were set to the lowest historical spring groundwater elevation, plus an operational flexibility margin, at each representative monitoring site (RMS). Hydrographs for each of the six RMS show horizontal lines representing groundwater elevations for 5%, 10%, and 20% of domestic wells (Figures 4-1 to 4-6). The GSP text does not provide justification or explain how these lines were developed or what exactly they represent (e.g., total well depth or top of screen depth). At the six RMS, minimum thresholds range from groundwater elevations above the 5% of domestic well line to groundwater elevations between the 10% and 20% lines. Besides the lack of justification or explanation of the lines shown on the hydrographs, the GSP does not sufficiently describe whether minimum thresholds will avoid significant and unreasonable loss of drinking water to domestic well users. In addition, the GSP does not sufficiently describe or analyze direct or indirect impacts on DACs, drinking water users, or tribes when defining undesirable results, nor does it describe how the groundwater level minimum thresholds are consistent with the Human Right to Water policy.[10]

The GSP states (p. 4-6): *"Undesirable results would occur when 33 percent (two of six wells) of RMS used to monitor groundwater levels fall below their MTs for two consecutive years at the same sites."* The requirement that 33% of monitoring wells exceed the minimum threshold before triggering an undesirable result and the limited RMS wells means that areas with high concentrations of domestic wells may experience impacts significantly greater than the established minimum threshold.

For degraded water quality, the GSP establishes SMC for TDS, and states that TDS is monitored as an overall indicator of groundwater quality within the basin. The minimum threshold for TDS is

[6] Engagement with Tribal Governments Guidance Document. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Guidance-Doc-for-SGM-Engagement-with-Tribal-Govt_ay_19.pdf

[7] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results." [23 CCR §354.26(b)(3)]

[8] "The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[9] "The description of minimum thresholds shall include [...] how state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the agency shall explain the nature of and the basis for the difference." [23 CCR §354.28(b)(5)]

[10] California Water Code §106.3. Available at: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=WAT&sectionNum=106.3

750 milligrams per liter (mg/L). This is the only constituent of concern (COC) for which SMC are established. The GSP states (p. 4-13): *"There are other water quality concerns within the Big Valley Basin that are outside the purview of the GSA and are covered by other regulatory programs and are without a causal nexus to groundwater pumping, including: Naturally occurring constituents such as iron, manganese, boron, and arsenic; Constituents from human activities (urban, agricultural, and industrial) that are not managed under SGMA. These constituents may include nitrate, salts, pesticides, and herbicides from agricultural and urban uses, which are managed by other programs such as Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS), Irrigated Lands Regulatory Program, and Department of Pesticide Regulation."* Significantly, nitrate is an acute contaminant which, at levels above the maximum contaminant level, can affect public health. This is a particular concern for domestic wells, as nitrate exceedances do not affect the taste or smell of the water. All COCs in the basin that may be impacted or exacerbated by groundwater use and/or management should be included in the SMC, in addition to coordinating with water quality regulatory programs.

RECOMMENDATIONS

Chronic Lowering of Groundwater Levels

- Describe direct and indirect impacts on DACs, domestic well owners, and tribes when describing undesirable results and defining minimum thresholds for chronic lowering of groundwater levels. Include information on the impacts during prolonged periods of below average water years.

- Consider minimum threshold exceedances for single RMS wells when defining the groundwater level undesirable result across the basin, instead of exceedances at two out of six RMS wells.

Degraded Water Quality

- Describe direct and indirect impacts on DACs, drinking water users, and tribes when defining undesirable results for degraded water quality.[11] For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act."[12]

- Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on DACs, drinking water users, and tribes.

- Set minimum thresholds and measurable objectives for all water quality constituents within the basin that are impacted or exacerbated by groundwater use and/or management.

Groundwater Dependent Ecosystems and Interconnected Surface Waters

Sustainable management criteria for chronic lowering of groundwater levels provided in the GSP do not consider potential impacts to environmental beneficial users. The GSP neither describes nor analyzes direct or indirect impacts on environmental users of groundwater when defining

[11] "Degraded Water Quality [...] collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues." [23 CCR §354.34(c)(4)]

[12] Guide to Protecting Water Quality under the Sustainable Groundwater Management Act https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

undesirable results. This is problematic because without identifying potential impacts on GDEs, minimum thresholds may compromise, or even destroy, these environmental beneficial users. Since GDEs are present in the basin, they must be considered when developing SMC for chronic lowering of groundwater levels.

Sustainable management criteria for depletion of interconnected surface water are established by proxy using groundwater levels. The GSP notes the data gap for shallow groundwater elevations, which make the use of groundwater elevations suitable for use by proxy. In the interim, the GSP uses groundwater levels from available deep monitoring wells in the proximity of surface water gages as proxy for groundwater depletions. At these RMS, lowest historical spring (April or March) groundwater level was identified as the minimum threshold, and capped to not exceed a depth of 30 feet below ground surface (bgs). All minimum thresholds are less than 30 feet bgs, and range from 14.9 ft bgs to 29.7ft bgs. While ensuring that the minimum thresholds do not exceed 30 feet bgs is a good first step, we recommend that the GSP include analysis or discussion to further describe how the SMC will affect GDEs, and the impact of these minimum thresholds on GDEs in the subbasin. We also recommend that the GSP evaluate how the proposed minimum thresholds and measurable objectives will avoid significant and unreasonable effects on surface water beneficial users in the basin, such as increased mortality and inability to perform key life processes (e.g., reproduction, migration).

RECOMMENDATIONS

- Evaluate impacts on GDEs when establishing SMC for chronic lowering of groundwater levels. When defining undesirable results, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when ‘significant and unreasonable’ effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results in the basin.[13] Defining undesirable results is the crucial first step before the minimum thresholds can be determined.[14]

- When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when minimum thresholds in the basin are reached.[15] The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts on environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected

[13] “The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results”. [23 CCR §354.26(b)(3)]
[14] The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests.” [23 CCR §354.28(b)(4)]
[15] “The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results.” [23 CCR §354.28(c)(6)]

by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law.[8,16]

- When establishing SMC for the basin, consider that the SGMA statute [Water Code §10727.4(l)] specifically calls out that GSPs shall include "impacts on groundwater dependent ecosystems."

2. Climate Change

The SGMA statute identifies climate change as a significant threat to groundwater resources and one that must be examined and incorporated in the GSPs. The GSP Regulations require integration of climate change into the projected water budget to ensure that projects and management actions sufficiently account for the range of potential climate futures.[17] The effects of climate change will intensify the impacts of water stress on GDEs, making available shallow groundwater resources especially critical to their survival. Condon *et al.* (2020) shows that GDEs are more likely to succumb to water stress and rely more on groundwater during times of drought.[18] When shallow groundwater is unavailable, riparian forests can die off and key life processes (e.g., migration and spawning) for aquatic organisms, such as steelhead, can be impeded.

The integration of climate change into the projected water budget is **sufficient**. We commend the GSA for its comprehensive inclusion of the impacts of climate change into the GSP. The GSP incorporates climate change into the projected water budget using two different global climate models (CNRM-CM5 RCP4.5 and HadGEM2-ES RCP8.5). Under the HadGEM2-ES model, the GSP incorporated a more extreme climate scenario using RCP 8.5 in the projected water budget. While extreme scenarios may have a lower likelihood of occurring, their consequences could be significant, and thus we commend the GSA for including extreme scenarios in the basin's approach to groundwater management.

The GSP integrates climate change into key inputs (e.g., changes in precipitation, evapotranspiration, and surface water flow) of the projected water budget. We recommend that imported water, which is currently included in the "Non-Routed Delivery" column, be included as its own line item in the water budget tables to clearly communicate and quantify the changes in this input to the different water budgets.

RECOMMENDATIONS

- Include imported water, which is currently included in the "Non-Routed Delivery" column, as its own line item in the water budget tables.
- Incorporate climate change scenarios into projects and management actions.

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[16] Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/Critical_Species_LookBook_91819.pdf

[17] "Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow." [23 CCR §354.18(e)]

[18] Condon et al. 2020. Evapotranspiration depletes groundwater under warming over the contiguous United States. Nature Communications. Available at: https://www.nature.com/articles/s41467-020-14688-0

3. Data Gaps

The consideration of beneficial users when establishing monitoring networks is **insufficient**, due to lack of specific plans to increase the Representative Monitoring Sites (RMSs) in the monitoring network that represent water quality conditions and shallow groundwater elevations around DACs, domestic wells, tribes, GDEs, and ISWs in the basin. These beneficial users may remain unprotected by the GSP without adequate monitoring and identification of data gaps in the shallow aquifer. The Plan therefore fails to meet SGMA's requirements for the monitoring network.[19]

Figure 3-2 (Representative Monitoring Networks) shows insufficient representation of drinking water users and GDEs for the groundwater elevation and water quality monitoring network. Figure 3-2 shows sufficient spatial representation of DACs and tribes for the monitoring network, however depth representation cannot be determined from the information provided in the GSP. Refer to Attachment D for maps of these monitoring sites in relation to key beneficial users of groundwater.

The GSP states (p. 3-6): *"No RMS well was selected for the southeast grid, as this grid lies primarily in upland areas with available wells generally shallow and located near surface water sources."* We note that the southeast grid is one of the areas of the basin with the highest concentration of domestic wells (see our maps in Attachment D). There are also potential GDEs in this area. We recommend inclusion of one or more shallow wells in this grid quadrant into the RMS network.

The GSP provides discussion of data gaps for GDEs and ISWs in the Monitoring Network section of the GSP. The GSP (p. 3-18) states: "*Opportunities to fill data gaps for depletions will also benefit the understanding of GDEs located downstream of the KCK stream gage. In addition, stream flow monitoring of McGaugh Slough could also be considered*." However, the GSP proposes filling data gaps based on funding availability and level of need. The plan does not provide specific plans, such as locations or a timeline, to fill the data gaps.

RECOMMENDATIONS

- Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, tribes, and GDEs to clearly identify monitored areas. Include a shallow well in the southeast grid of the basin to monitor impacts to beneficial users.

- Increase the number of RMSs in the shallow aquifer across the basin as needed to map ISWs and adequately monitor all groundwater condition indicators across the basin and at appropriate depths for *all* beneficial users. Prioritize proximity to DACs, domestic wells, tribes, GDEs, and ISWs when identifying new RMSs.

- Ensure groundwater elevation and water quality RMSs are monitoring groundwater conditions spatially and at the correct depth for *all* beneficial users - especially DACs, domestic wells, tribes, and GDEs.

[19] "The monitoring network objectives shall be implemented to accomplish the following: [...] (2) Monitor impacts to the beneficial uses or users of groundwater." [23 CCR §354.34(b)(2)]

- Describe biological monitoring that can be used to assess the potential for significant and unreasonable impacts to GDEs or ISWs due to groundwater conditions in the basin.

4. Addressing Beneficial Users in Projects and Management Actions

The consideration of beneficial users when developing projects and management actions is **insufficient**, due to the failure to completely identify benefits or impacts of identified projects and management actions, including water quality impacts, to key beneficial users of groundwater such as GDEs, aquatic habitats, surface water users, DACs, tribes, and drinking water users. Therefore, potential project and management actions may not protect these beneficial users. Groundwater sustainability under SGMA is defined not just by sustainable yield, but by the avoidance of undesirable results for *all* beneficial users.

While the plan describes investigations for locating potential recharge projects within the basin, there are no concrete plans for groundwater recharge currently in place during the GSP planning horizon. Moreover, the GSP fails to describe this or other projects' explicit benefits or impacts to other beneficial users such as DACs.

We note that the plan includes a domestic well mitigation program (Section 5.3.5.4) that will be implemented upon adoption of the GSP. We recommend that the GSP further describes the well mitigation program's benefits to DACs within the basin.

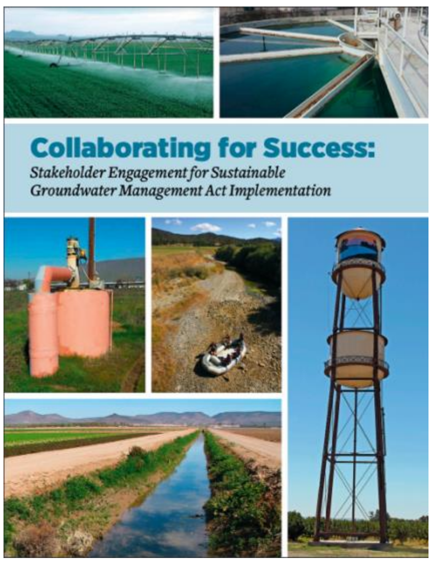
RECOMMENDATIONS

- For DACs and domestic well owners, further describe specific plans for implementation of the drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.
- For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSA plans to mitigate such impacts.
- Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.

Attachment B

SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users

Stakeholder Engagement and Outreach



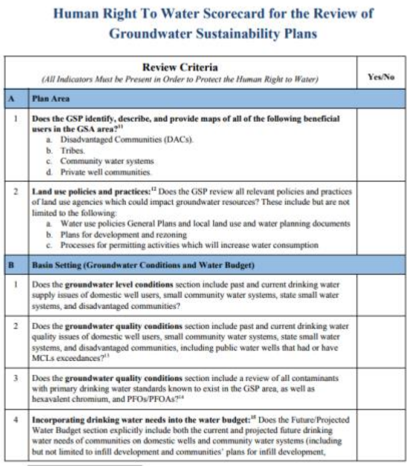
Clean Water Action, Community Water Center and Union of Concerned Scientists developed a guidance document called Collaborating for success: Stakeholder engagement for Sustainable Groundwater Management Act Implementation. It provides details on how to conduct targeted and broad outreach and engagement during Groundwater Sustainability Plan (GSP) development and implementation. Conducting a targeted outreach involves:

- Developing a robust Stakeholder Communication and Engagement plan that includes outreach at frequented locations (schools, farmers markets, religious settings, events) across the plan area to increase the involvement and participation of disadvantaged communities, drinking water users and the environmental stakeholders.

- Providing translation services during meetings and technical assistance to enable easy participation for non-English speaking stakeholders.

- GSP should adequately describe the process for requesting input from beneficial users and provide details on how input is incorporated into the GSP.

The Human Right to Water

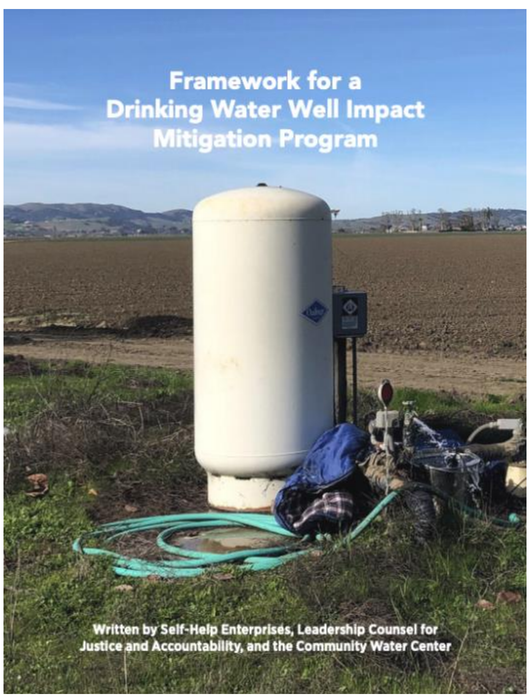


Human Right To Water Scorecard for the Review of Groundwater Sustainability Plans

	Review Criteria *(All Indicators Must be Present in Order to Protect the Human Right to Water)*	Yes/No
A	**Plan Area**	
1	**Does the GSP identify, describe, and provide maps of all of the following beneficial users in the GSA area?**[11] a. Disadvantaged Communities (DACs). b. Tribes. c. Community water systems d. Private well communities.	
2	**Land use policies and practices:**[12] Does the GSP review all relevant policies and practices of land use agencies which could impact groundwater resources? These include but are not limited to the following: a. Water use policies General Plans and local land use and water planning documents b. Plans for development and rezoning c. Processes for permitting activities which will increase water consumption	
B	**Basin Setting (Groundwater Conditions and Water Budget)**	
1	Does the **groundwater level conditions** section include past and current drinking water supply issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities?	
2	Does the **groundwater quality conditions** section include past and current drinking water quality issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities, including public water wells that had or have MCLs exceedances?[13]	
3	Does the **groundwater quality conditions** section include a review of all contaminants with primary drinking water standards known to exist in the GSP area, as well as hexavalent chromium, and PFOs/PFOAs?[14]	
4	**Incorporating drinking water needs into the water budget:**[15] Does the Future/Projected Water Budget section explicitly include both the current and projected future drinking water needs of communities on domestic wells and community water systems (including but not limited to infill development and communities' plans for infill development,	

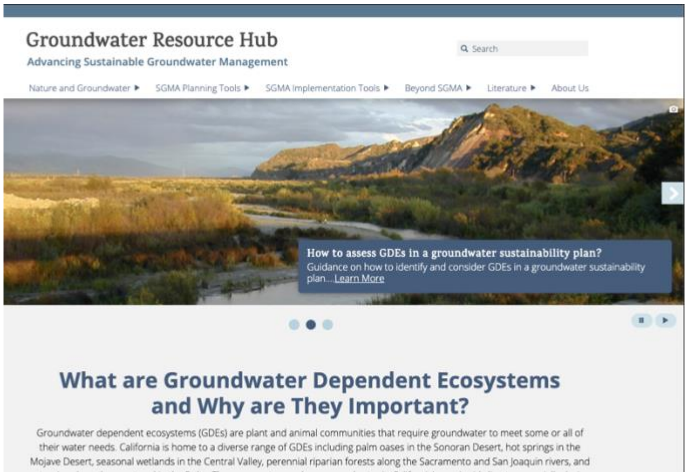
The Human Right to Water Scorecard was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid Groundwater Sustainability Agencies (GSAs) in prioritizing drinking water needs in SGMA. The scorecard identifies elements that must exist in GSPs to adequately protect the Human Right to Drinking water.

Drinking Water Well Impact Mitigation Framework



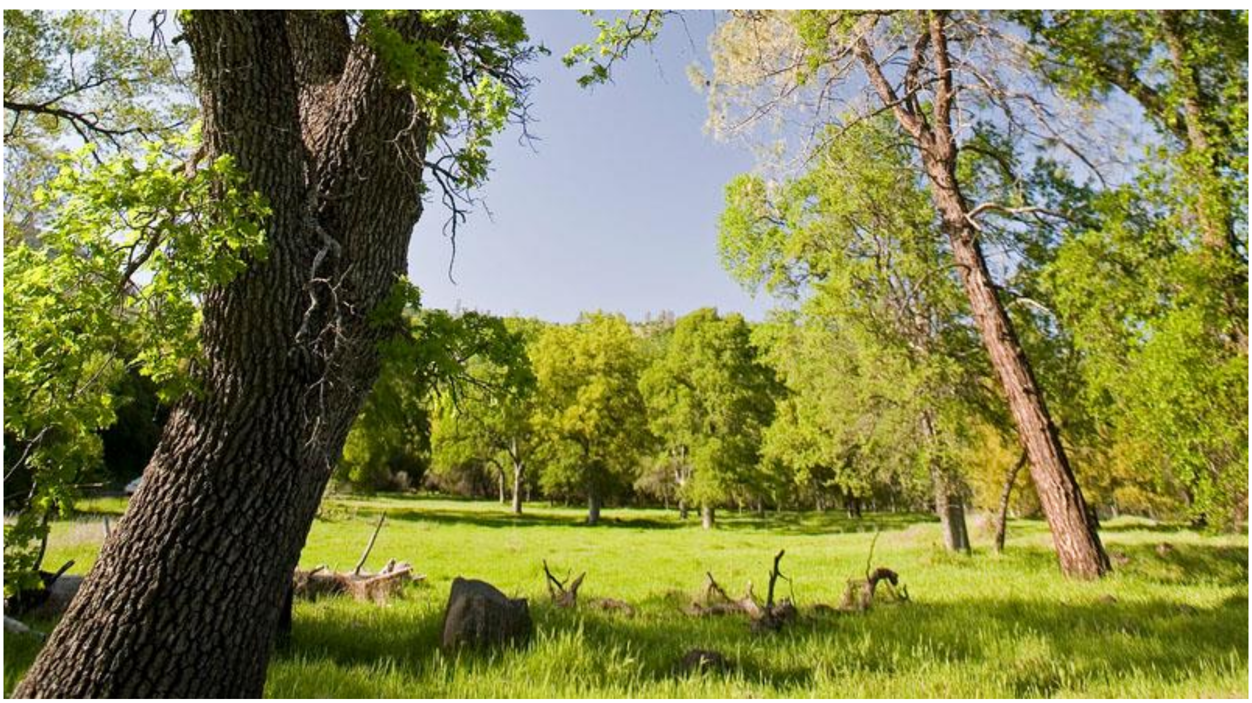
The Drinking Water Well Impact Mitigation Framework was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid GSAs in the development and implementation of their GSPs. The framework provides a clear roadmap for how a GSA can best structure its data gathering, monitoring network and management actions to proactively monitor and protect drinking water wells and mitigate impacts should they occur.

Groundwater Resource Hub



The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Rooting Depth Database



The Plant Rooting Depth Database provides information that can help assess whether groundwater-dependent vegetation are accessing groundwater. Actual rooting depths will depend on the plant species and site-specific conditions, such as soil type and availability of other water sources. Site-specific knowledge of depth to groundwater combined with rooting depths will help provide an understanding of the potential groundwater levels are needed to sustain GDEs.

How to use the database

The maximum rooting depth information in the Plant Rooting Depth Database is useful when verifying whether vegetation in the Natural Communities Commonly Associated with Groundwater (NC Dataset) are connected to groundwater. A 30 ft depth-to-groundwater threshold, which is based on averaged global rooting depth data for phreatophytes[1], is relevant for most plants identified in the NC Dataset since most plants have a max rooting depth of less than 30 feet. However, it is important to note that deeper thresholds are necessary for other plants that have reported maximum root depths that exceed the averaged 30 feet threshold, such as valley oak (*Quercus lobata*), Euphrates poplar (*Populus euphratica*), salt cedar (*Tamarix spp.*), and shadescale (*Atriplex confertifolia*). The Nature Conservancy advises that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to groundwater threshold of 80 feet should be used instead of the 30 ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

The Plant Rooting Depth Database is an Excel workbook composed of four worksheets:

1. California phreatophyte rooting depth data (included in the NC Dataset)
2. Global phreatophyte rooting depth data
3. Metadata
4. References

How the database was compiled

The Plant Rooting Depth Database is a compilation of rooting depth information for the groundwater-dependent plant species identified in the NC Dataset. Rooting depth data were compiled from published scientific literature and expert opinion through a crowdsourcing campaign. As more information becomes available, the database of rooting depths will be updated. Please Contact Us if you have additional rooting depth data for California phreatophytes.

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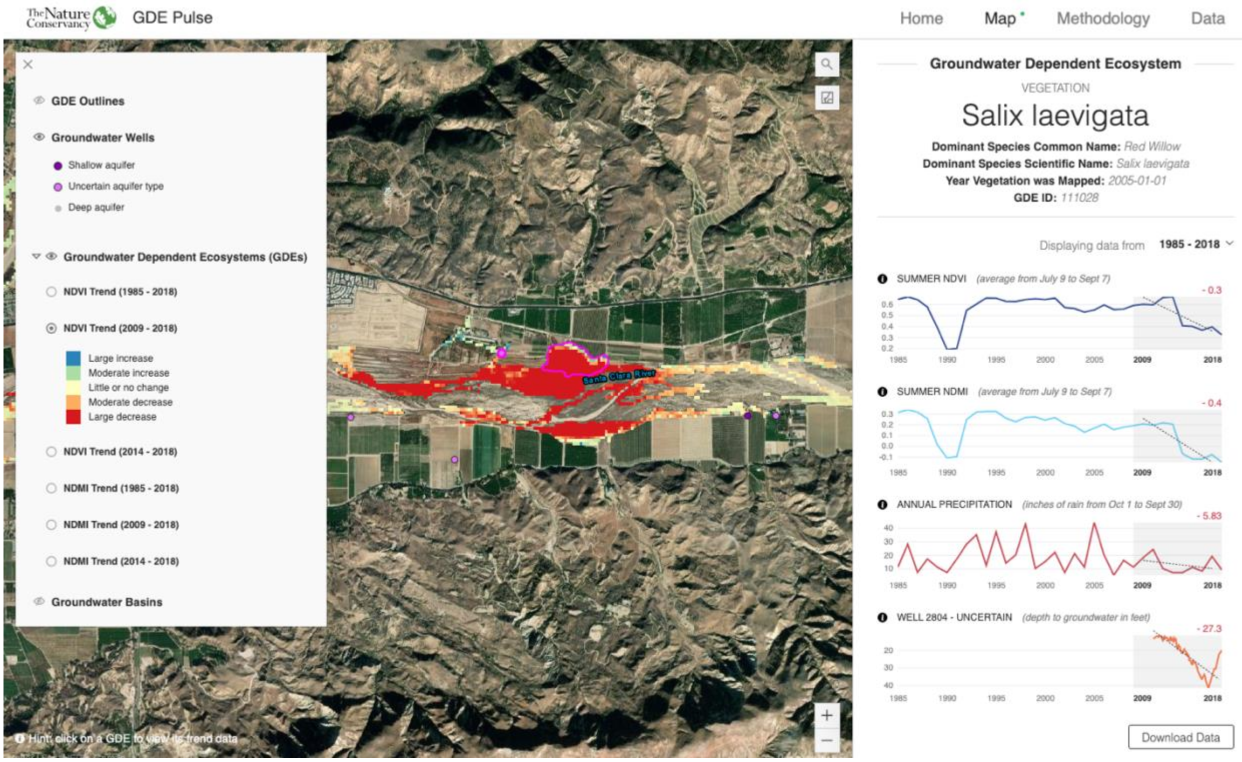
[1] Canadell, J., Jackson, R.B., Ehleringer, J.B. et al. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia 108, 583–595. https://doi.org/10.1007/BF00329030

GDE Pulse



GDE Pulse is a free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data. Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset. The following datasets are available for downloading:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

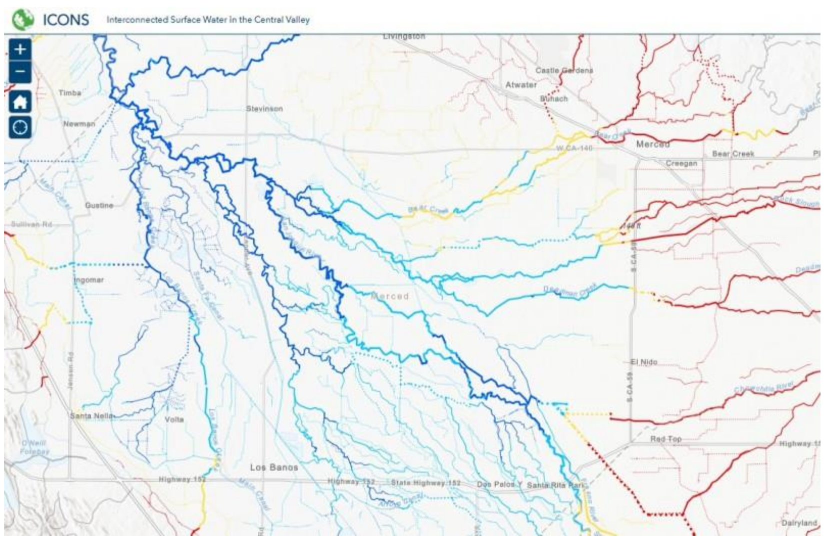
Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

ICONOS Mapper

Interconnected Surface Water in the Central Valley



[ICONS](#) maps the likely presence of interconnected surface water (ISW) in the Central Valley using depth to groundwater data. Using data from 2011-2018, the ISW dataset represents the likely connection between surface water and groundwater for rivers and streams in California's Central Valley. It includes information on the mean, maximum, and minimum depth to groundwater for each stream segment over the years with available data, as well as the likely presence of ISW based on the minimum depth to groundwater. The Nature Conservancy developed this database, with guidance and input from expert academics, consultants, and state agencies.

We developed this dataset using groundwater elevation data available online from the California Department of Water Resources (DWR). DWR only provides this data for the Central Valley. For GSAs outside of the valley, who have groundwater well measurements, we recommend following our methods to determine likely ISW in your region. The Nature Conservancy's ISW dataset should be used as a first step in reviewing ISW and should be supplemented with local or more recent groundwater depth data.

Attachment C

The Nature Conservancy

July 2019

IDENTIFYING GDEs UNDER SGMA

Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[1] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[2]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.

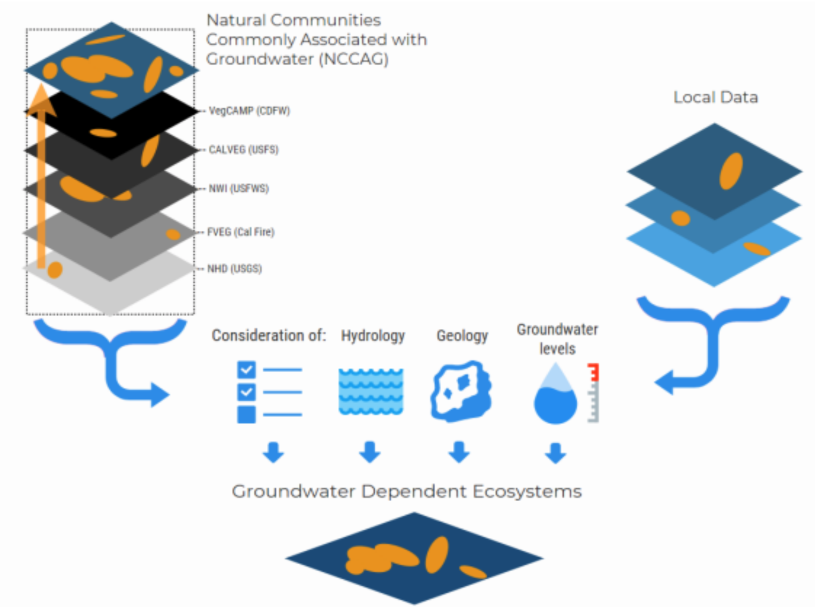


Figure 1. Considerations for GDE identification.
Source: DWR[2]

[1] NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/
[2] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf