Draft Numerical Model Report: Minor Aquifers of the Llano Uplift Region of Texas (Marble Falls, Ellenburger-San Saba, and Hickory)

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February 16, 2016

This document is released for the purpose of interim review under the authority of Jianyou (Jerry) Shi, P.G. 11113, Radu Boghici, P.G. 482, and William Hutchison, P.E. 96287, P.G. 286, on January 31, 2016.
Materials and findings are subject to change and should not be applied for public use until the work is finalized.

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Executive Summary

The Texas Water Development Board (TWDB) has completed the construction and calibration of the numerical groundwater flow model for the minor aquifers in the Llano Uplift region. The minor aquifers defined by TWDB in the Llano Uplift region are (from oldest to youngest) the Hickory, Ellenburger-San Saba, and Marble Falls aquifers. These minor aquifers occur in nineteen counties: Blanco, Brown, Burnet, Coleman, Concho, Gillespie, Hays, Kendall, Kerr, Kimble, Lampasas, Llano, Mason, McCulloch, Menard, Mills, San Saba, Travis, and Williamson.

The completion of the groundwater availability model for the minor aquifers in the Llano Uplift region partially fulfills the mandate by the Texas State legislature that TWDB obtain or develop groundwater availability models for all major and minor aquifers in Texas. Groundwater availability models are the primary tools for stakeholders to evaluate and manage their groundwater resources in major and minor aquifers. These stakeholders include, but are not limited to, the regional water planning groups, groundwater conservation districts, other state/local government agencies, research institutions, private citizens, and private industries.

The development of a groundwater availability model involves two fundamental parts: a conceptual groundwater flow model and a numerical groundwater flow model. A conceptual model is a simplified version of the "real world" and lays the foundation for the development of a numerical model. The draft conceptual model report for the minor aquifers located in the Llano Uplift region was released by TWDB for comments in 2014. A numerical model uses information from the conceptual model to approximately reproduce the historic conditions and to predict potential future conditions, such as aquifer response under certain climatic or/and groundwater withdrawal conditions.

The computer code used to implement the numerical model is MODFLOW-USG. The model consists of eight layers corresponding to eight hydrogeologic units in the Llano Uplift region (from top to bottom): 1) the Cretaceous aquifers and younger units, 2) units below the Cretaceous aquifers but above the Marble Falls Aquifer, 3) the Marble Falls Aquifer, 4) units below Marble Falls Aquifer but above the Ellenburger-San Saba Aquifer, 5) the Ellenburger-San Saba Aquifer, 6) units below Ellenburger-San Saba Aquifer but above the Hickory Aquifer, 7) the Hickory Aquifer, and 8) parts of the Precambrian formations.

The numerical model is composed of uniform quarter-mile square grid cells and 31 stress periods. Stress Period 1 (steady state) represents a pseudo steady-state condition by the end of 1980, which provides initial heads for the following transient periods 2 through 31 that represent the time period 1981 through 2010. The numerical model was primarily calibrated to water levels measured in the minor aquifers between 1980 and 2010. The numerical model was also qualitatively compared with historical stream gain/loss data. The calibration results indicated that the numerical model reproduced the regional historical groundwater flow quite well.

For the Marble Falls Aquifer, major inflows were associated with recharge from precipitation entering through the outcrop area and cross-formational flow from younger units in the subcrop area. Most outflow from the aquifer was associated with leakage to reservoirs and streams, groundwater pumping, and cross-formational flow to older units.

Major inflow for the Ellenburger-San Saba Aquifer was associated with recharge from precipitation entering through the outcrop area. Groundwater flowed out of the aquifer mainly by leakage to reservoirs and streams, cross-formational flow to older units, and groundwater pumping.

Groundwater flows into the Hickory Aquifer from cross-formational flow from younger units and recharge due to precipitation entering through the outcrop area. The major outflow components included groundwater pumping, leakage to surface water bodies, and cross formational flow to the Ellenburger-San Saba Aquifer from the underlying Precambrian unit(s).

The amount of groundwater storage of aquifers fluctuated between 1981 and 2010 and, in general, declined slightly over the same time period. Groundwater discharge to surface water also showed a similar declining trend.

Results of sensitivity analysis indicate that the simulated water levels, groundwater leakage to surface water bodies, spring flow, and lateral flow between inside and outside of the modeled area are most sensitive to groundwater recharge due to infiltration of precipitation. Groundwater pumping and surface water also have moderate impacts on the lateral flow along the boundary of the modeled area.

Although this model is well calibrated to the measured water levels and compares well with the results of available stream gain/loss studies, there are always limitations. The main limitations of this model are associated with the uncertainty related to insufficient data for defining aquifer properties for the minor aquifers, delineating the downdip extent of the aquifers, and the complex heterogeneity associated with these aquifers. The uncertainty associated with the limitations of the model construction and calibration carries over into any predictive model simulations. In addition, each model grid represents an average condition of varied topography, geologic contacts, hydraulic, and hydrogeologic properties across the grid. As a result, modeled heads at valleys tend to be higher than measured heads, while modeled heads at ridges tend to be lower than measured heads. It is therefore recommended that results using this numerical flow model for predictive simulations should be used along with field monitoring and mainly for the evaluation of regional groundwater flow, as opposed to using the model for conducting localized, site-specific evaluations.

1.0 Introduction and Purpose of Model

1.1 Introduction

The Texas Water Development Board (TWDB) has designated nine major and twenty-one minor aquifers in Texas (Figures 1.0.1 and 1.0.2). Major aquifers supply large quantities of water over large areas and minor aquifer supply relatively small quantities of water over large areas or supply large quantities of water over small areas. The characteristics of these aquifers are discussed by George and others (2011).

Senate Bill 2 passed by the Texas Senate in 2001 mandated that the TWDB, in coordination with groundwater conservation districts and regional water planning groups, obtain or develop groundwater availability models for all major and minor aquifers in Texas. As a result, the TWDB has developed or adopted groundwater availability models for all the major aquifers and the majority of the minor aquifers in Texas. These groundwater availability models provide the most effective tools for stakeholders assessing groundwater availability and the effects of water management strategies during different climatic conditions.

Two major aquifers, the Edwards-Trinity (Plateau) and the Trinity, occur in the Llano Uplift region. The Llano Uplift region also has three minor aquifers: Hickory, Ellenburger-San Saba, and Marble Falls (Figure 1.0.3). These minor aquifers occur in nineteen counties: Blanco, Brown, Burnet, Coleman, Concho, Gillespie, Hays, Kendall, Kerr, Kimble, Lampasas, Llano, Mason, McCulloch, Menard, Mills, San Saba, Travis, and Williamson. According to the water use survey conducted by the TWDB in 2013, the major groundwater uses in the Llano Uplift region were for municipal, irrigation, mining, livestock, and manufacturing purposes. The 2012 State Water Plan indicated a total groundwater use of approximately 84,000-acre-feet per year, with approximately 343,000 acre-feet per year available from the three minor aquifers in the Llano Uplift region.

TWDB and its contractors have developed several models that cover the Edwards-Trinity (Plateau) and Trinity aquifers in the study area. The Hill Country portion of the Trinity Aquifer in the Llano Uplift region was included in the groundwater flow models by Mace and others (2000) and Jones and others (2009). The groundwater flow in Trinity Aquifer to the north and east of the Llano Uplift region was simulated in a groundwater availability model by INTERA and others (2014). The Edwards-Trinity (Plateau) Aquifer was covered in the groundwater flow models by Anaya and Jones (2009) and Hutchison and others (2011).

The development of a groundwater availability model involves two fundamental parts: a conceptual groundwater flow model and a numerical groundwater flow model. A conceptual model is a simplified version of the “real world” and lays the foundation for the development of a numerical model. The draft conceptual model report for the minor aquifers located in the Llano Uplift region was released by TWDB for comments in 2014. Through a computer code, a numerical model uses information from the conceptual model to approximately reproduce the historic conditions and can be used to predict potential future conditions, such as aquifer response under certain climatic or/and groundwater withdrawal conditions. Though the development of a groundwater availability model involves a conceptual model and a numerical model, the groundwater availability model refers to the numerical flow model when discussing its application for groundwater resources management. Thus, “groundwater availability model” and “numerical groundwater flow model” may be used interchangeably throughout this report.

This report documents the construction and calibration of the numerical groundwater flow model for the Hickory, Ellenburger-San Saba, and Marble Falls aquifers in the Llano Uplift region. Table 1.0.1 outlines the stratigraphy and hydrogeologic classification of the geologic units in the study area. The conceptual block diagrams of steady state and transient conditions from the conceptual model is provided as reference (Figure 1.0.4). Unlike the conceptual model report, this numerical model report is targeted primarily to those with experience constructing and/or using groundwater flow models.

1.2 Purpose of the Model

The Texas Water Code mandates that TWDB shall prepare, develop, formulate, and adopt a comprehensive State Water Plan that shall incorporate regional water plans and provides for the development, management, and conservation of water resources in preparation for and in response to drought conditions.

Numerical groundwater flow models help the citizens of Texas to evaluate the groundwater availability in an aquifer to ensure adequacy of supplies, or recognition of inadequacy of supplies, throughout a 50-year planning horizon. As a result, a groundwater availability model can assist groundwater conservation districts in managing their groundwater resources and can help the regional water planning groups to plan for future water supplies.

Specifically, this numerical groundwater flow model for the minor aquifers in the Llano-Uplift region will help:

- The groundwater conservation districts within a groundwater management area to determine modeled available groundwater based on desired future conditions, as required by House Bill 1763 (79^{th} Texas Legislative Session, 2005). The model may provide insight on how much groundwater is available from each of the minor aquifers under average, wet, or drought climatic conditions, assuming various pumping scenarios.
- A groundwater conservation district to quantify groundwater recharge, natural discharge, lateral flow, and cross-formation flow for each of the minor aquifers in their management plan, as required by Texas State Water Code, Section 36.1071, Subsection (h).
- The groundwater conservation districts within a groundwater management area to evaluate the total estimated recoverable storage for each of the minor aquifers, as required by Texas Water Code, § 36.108 (d).

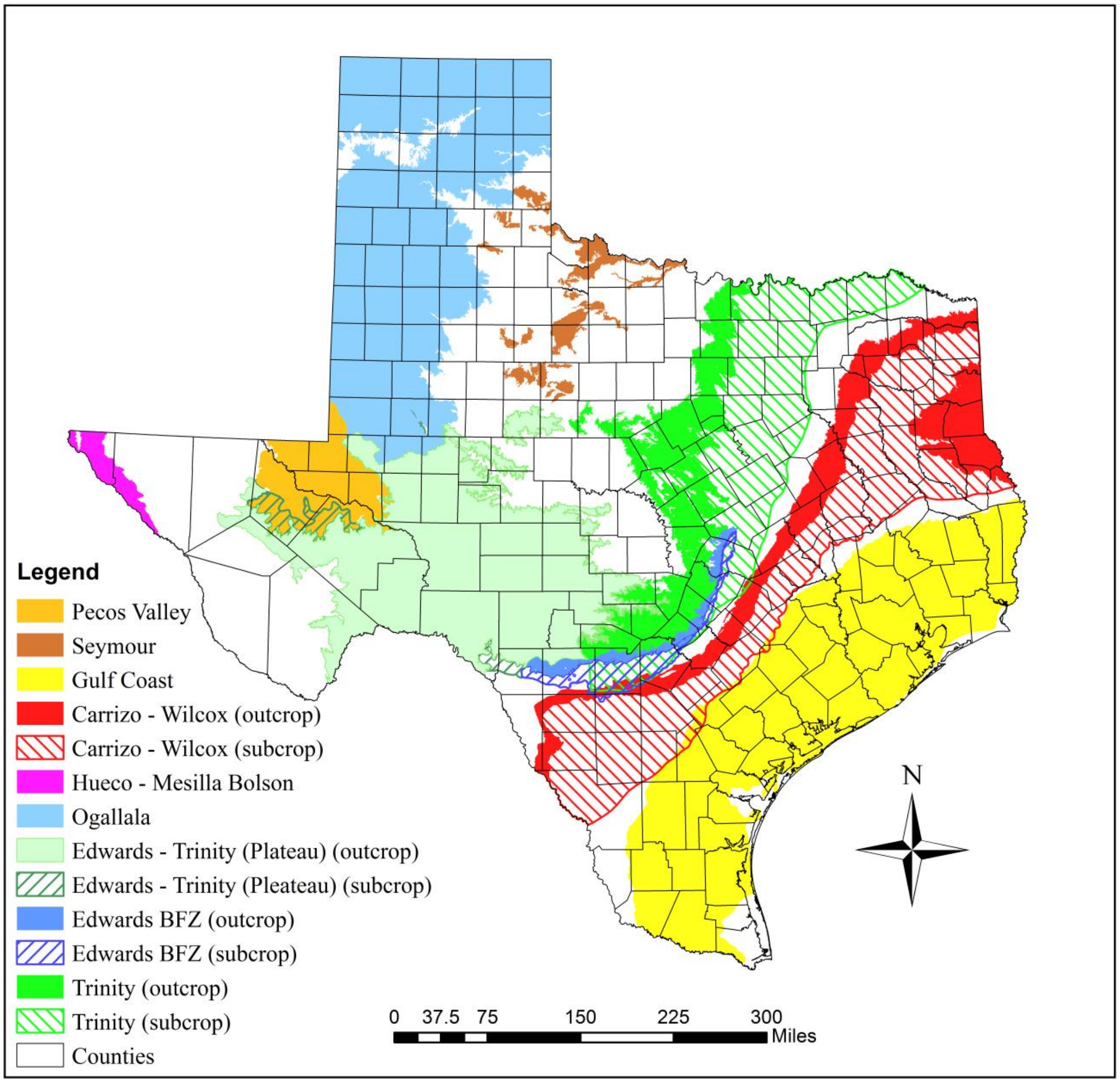

Figure 1.0.1 Location of major aquifers in Texas (revised from TWDB, 2016a).

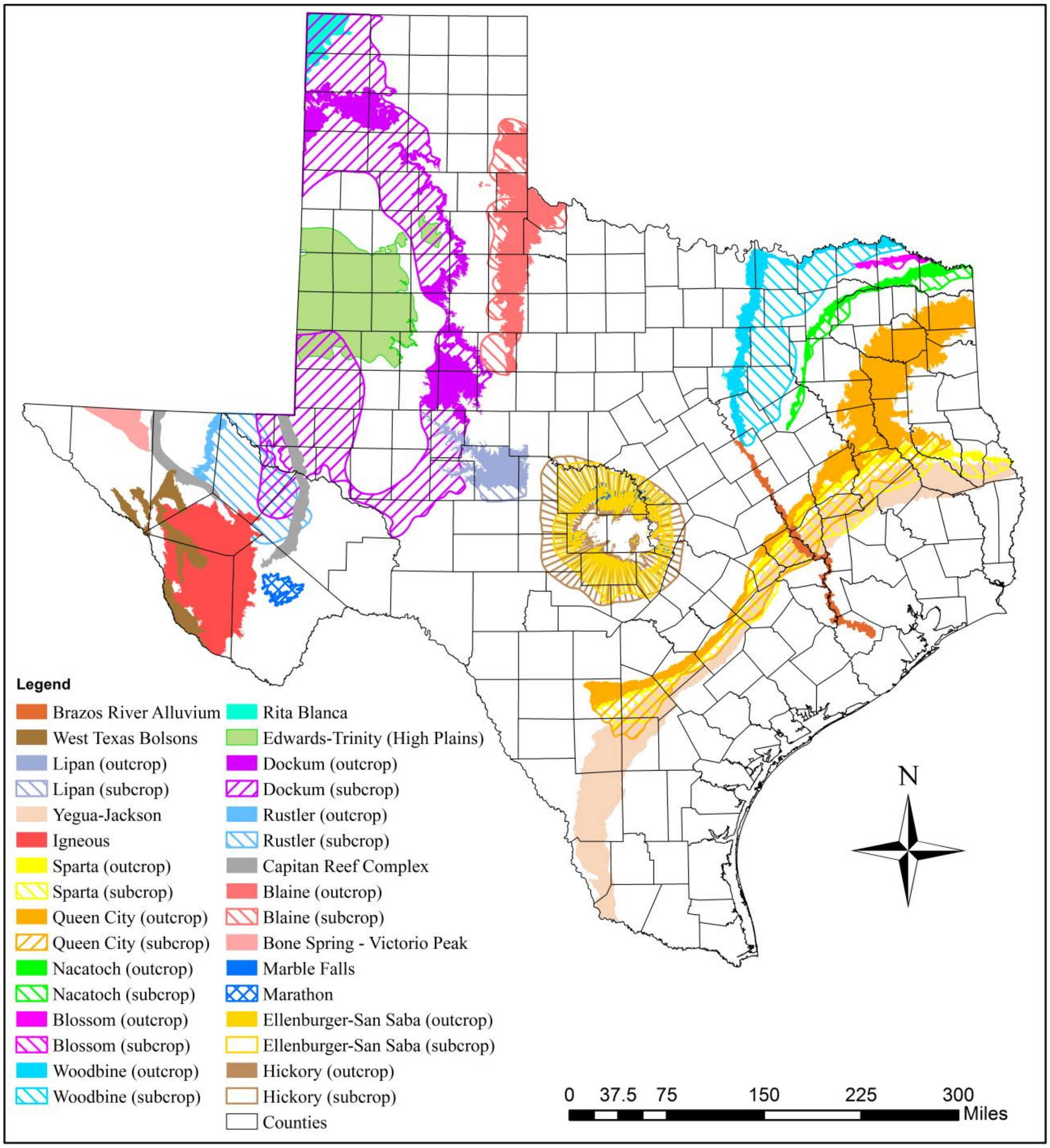

Figure 1.0.2 Location of minor aquifers in Texas (revised from TWDB, 2016b).

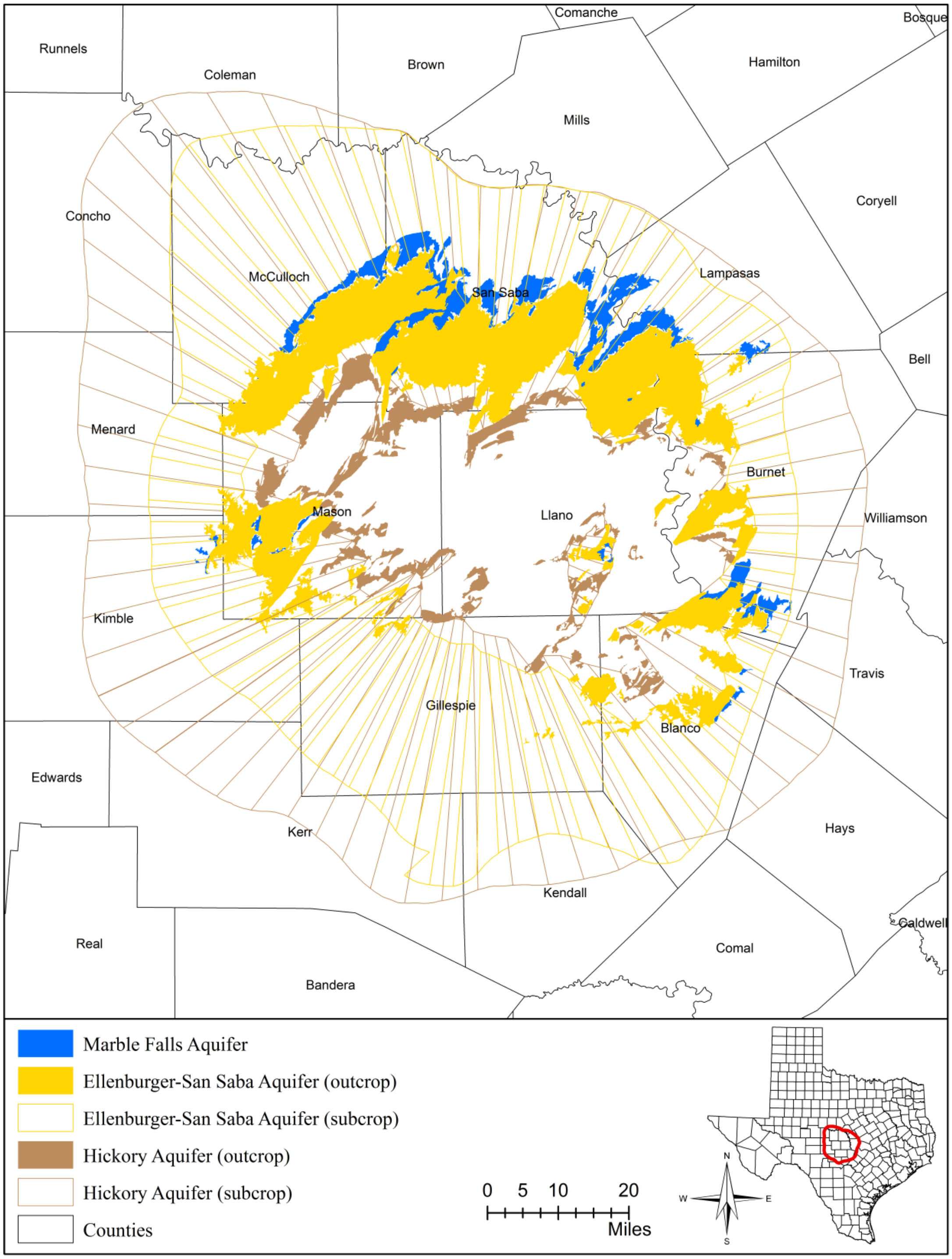

Figure 1.0.3 Location of minor aquifers in Llano Uplift region (based on TWDB (2016b)).

Table 1.0.1. Stratigraphy and hydrogeologic classification of geologic units in study area.

Geologic Units										Hydrogeologic Units
Era	System	North and East Study Area					South and West Study Area			
		Group	Formation			Member	Formation		Member	
Cenozoic	Quaternary	Loose sediments at river valley bottoms								
Mesozoic	Cretaceous	Washita	Buda, Del Rio							Cretaceous Aquifer
			Georgetown							
			Kiamichi				Segovia	Edwards Group		
		Fredericksburg	Edwards							
			Comanche Peak				Fort Terrett			
			Walnut							
		Trinity	Antlers	Paluxy			Paluxy			
				Glen Rose			Glen Rose			
				Travis Peak	Hensell		Travis Peak	Hensell		
					Cow Creek/Hammett			Cow Creek/Hammett		
					Sycamore/Hosston			Sycamore/Hosston		
	Jurassic	**Absent**								
	Triassic	**Absent**								
Paleozoic	Permian	Wichita Albany	Undivided				**Absent**			
		Cisco	Undivided				**Absent**			
	Pennsylvanian						Undivided			Confining Layer
		Canyon	Undivided				Undivided			
		Strawn	Undivided				Undivided			
		Bend	Smithwick			Undivided	Smithwick		Undivided	
			Marble Falls			Undivided	Marble Falls		Undivided	Marble Falls Aquifer
	Mississippian		Barnett				Barnett			Confining Layer
			Chappel				Chappel			
	Devonian	**Exists in collapses only**								
	Silurian	**Absent**								
	Ordovician	Burnam	**Exists in collapses only**							
		Ellenburger	Honeycut			Undivided	Honeycut		Undivided	Ellenburger-San Saba Aquifer
			Gorman			Undivided	Gorman		Undivided	
			Tanyard			Staendebach	Tanyard		Staendebach	
						Threadgill			Threadgill	
	Cambrian	Moore Hollow	Wilberns			San Saba	Wilberns		San Saba	
						Point Peak			Point Peak	Confining Layer
						Morgan Creek			Morgan Creek	
						Welge			Welge	Welge-Lion Mountain Aquifer
			Riley			Lion Mountain	Riley		Lion Mountain	
						Cap Mountain			Cap Mountain	Confining Layer
						Hickory			Hickory	Hickory Aquifer
Precambrian Formations										Confining/Buffer Layer

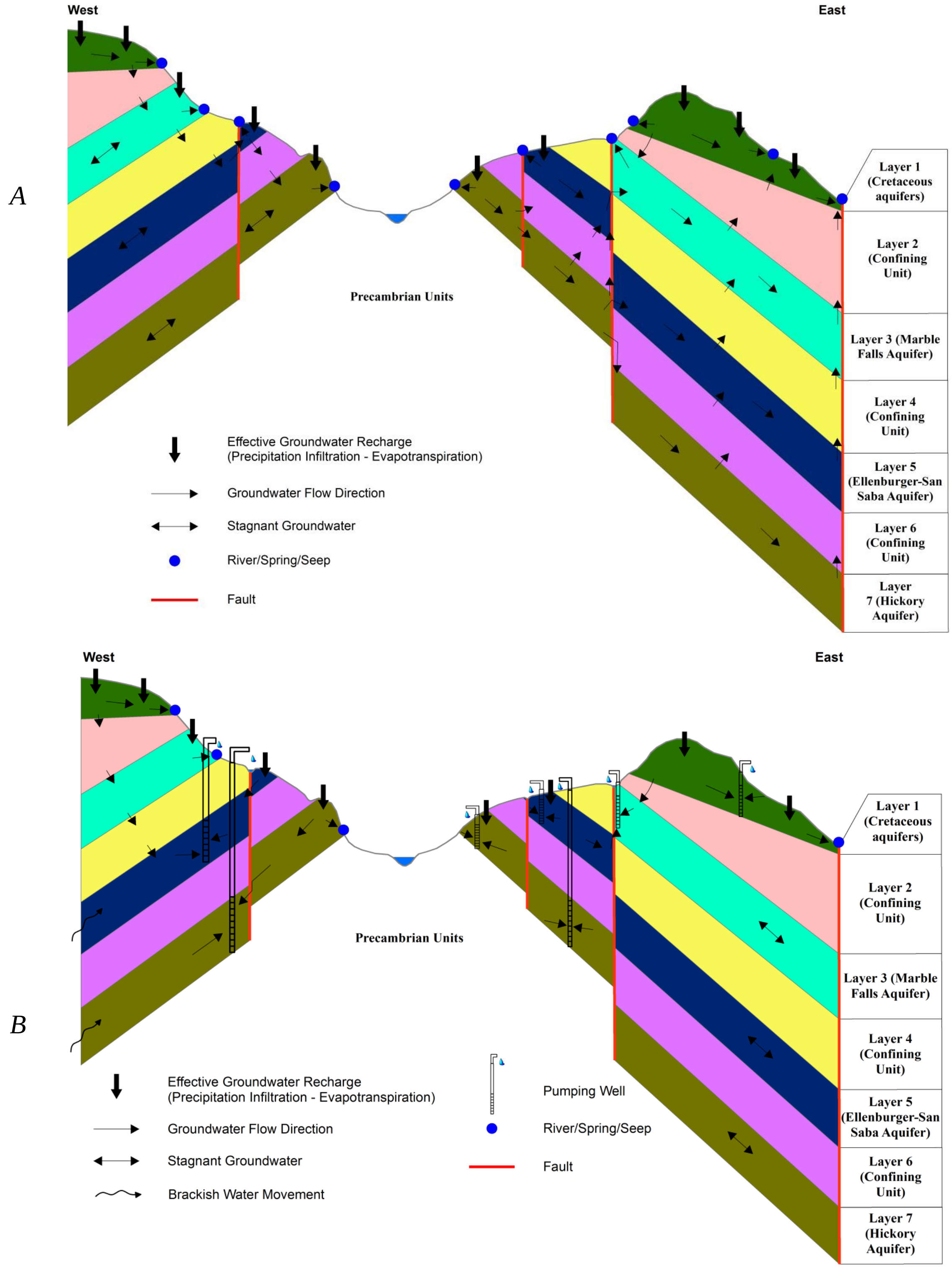

Figure 1.0.4. Block diagram of steady-state (A) and transient conditions (B) from conceptual model report by Shi and others (2014).

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2.0 Model Overview and Packages

The computer code selected for this numerical groundwater model is MODFLOW-USG (Panday and others, 2013), an enhanced version of previous MODFLOW codes, that supports both structured and unstructured grids. When the previous MODFLOW codes simulate an aquifer using a numerical layer, the lateral groundwater flow is expected within the numerical layer even if the aquifer may be totally disconnected, which is common in the Llano Uplift region due to faulting. MODFLOW-USG addresses this issue by connecting different hydrostratigraphic units which are actually in contact using an unstructured grid, so that groundwater flow can be correctly simulated within aquifers and between aquifers and confining units. MODFLOW-USG (Version 1.0) and other MODFLOW codes are available for public use from the U. S. Geological Survey (http://water.usgs.gov/ogw/modflow/).

A development or beta version MODFLOW-USG from the primary author, Dr. Sorab Panday, was used for the groundwater availability model for the minor aquifers in the Llano Uplift region. The beta version MODFLOW-USG executable code and all model input files are available to the public.

To help users view and edit model inputs, all model input packages have been incorporated into the Groundwater Vistas (Version 6.1), a commercial graphic user interface. The graphic user interface can also be used to extract model outputs. Because this numerical model was developed outside of the graphical user interface, TWDB does not guarantee the same results if a model run is performed from the graphic user interface. TWDB will deliver all the MODFLOW-USG input packages in a file that can be opened by the Groundwater Vistas (Version 6.1 or later) program. The input packages for this MODFLOW-USG model include the geometry and properties of the aquifers and confining units. They also contain the boundary conditions that influence the groundwater flow and a numerical solver to solve the flow equation. The input packages and their corresponding filenames are shown in Table 2.0.1. The output files written by MODFLOW-USG contain water budget (CBB), water levels (HDS), drawdown (DDN), and a listing of the characteristics of the run (LIST) (Table 2.0.2). MODFLOW-USG code initiates the model run by calling a name file, llano-uplift.nam, which includes the input packages and output files.

In this report, model grid, cell, and node are used interchangeably and each represents a finite difference volume of the simulated aquifer or confining units.

Table 2.0.1 Summary of model input packages and filenames.

File Type Abbreviation	File Type	Input File Name
BAS6	Basic Package	llano-uplift.bas
DISU	Unstructured Discretization File	llano-uplift.dis
DRN	Drain Package	llano-uplift.drn
GHB	General Head Package	llano-uplift.ghb
LPF	Layer-Property Flow Package	llano-uplift.lpf
OC	Output Control Option	llano-uplift.oc
RCH	Recharge Package	llano-uplift.rch
RIV	River Package	llano-uplift.riv
SMS	Sparse Matrix Solver Package	llano-uplift.sms
WEL	Well Package	llano-uplift.wel

Table 2.0.2 Summary of model output packages and filenames.

File Type	Output File Name
Binary flow file	llano-uplift.cbb
Binary drawdown file	llano-uplift.ddn
Binary head file	llano-uplift.hds
List file	llano-uplift.lst

2.1 Basic Package

The MODFLOW-USG basic package, llano-uplift.bas, specifies 1) which model cells are active or inactive, 2) the starting water levels at active model cells, and 3) a head value assigned to inactive cells.

The groundwater flow model contains eight numerical layers representing different hydrogeologic units ranging from current alluvium deposit to Precambrian rocks (Table 2.1.1). Please note that the aquifer layers (1, 3, 5 and 7) are colored blue in Table 2.1.1., and the aquitard layers are not colored.

In the IBOUND section of the Basic package, inactive model cells are assigned zero and active cells are represented by positive, two-digit integers. The first digit represents the model layer and the second digit represents whether the model cell is an outcrop (i.e., 1) or subcrop (i.e., 2). For example, a cell with an IBOUND value of 51 indicates that the cell is located in the outcrop area of the Ellenburger-San Saba Aquifer (Layer 5), while an integer 72 means that the model cell is in the subcrop area of the Hickory Aquifer (Layer 7). The model cells outside the study area but within the model domain were all designated as inactive. The active and inactive model cells for each model layer are shown in figures 2.1.1 through 2.1.8. To facilitate model convergence, some active model cells located along the edge or in isolated small islands were turned into inactive cells.

Table 2.1.1 Model stratigraphy and layering.

System	Group/Formation/Member	Aquifer/Confining Unit	Model Layer
Quaternary	Unclassified Alluvium	Alluvium Aquifer	1
Cretaceous	Edwards Group	Edwards – Trinity Aquifers	
	Trinity Group		
Permian and Pennsylvanian	Wichita Albany Group	Confining Units	2
	Cisco Group		
	Canyon Group		
	Strawn Group		
	Smithwick Formation		
	Marble Falls Formation	Marble Falls Aquifer	3
Mississippian	Barnett Formation	Confining Units	4
	Chappel Formation		
Ordovician	Ellenburger Group	Ellenburger-San Saba Aquifer	5
Cambrian	San Saba Member		
	Point Peak Member	Confining Units	6
	Morgan Creek Member		
	Welge Member		
	Lion Mountain		
	Cap Mountain		
	Hickory	Hickory Aquifer	7
Precambrian	Unclassified Rocks	Confining Units	8

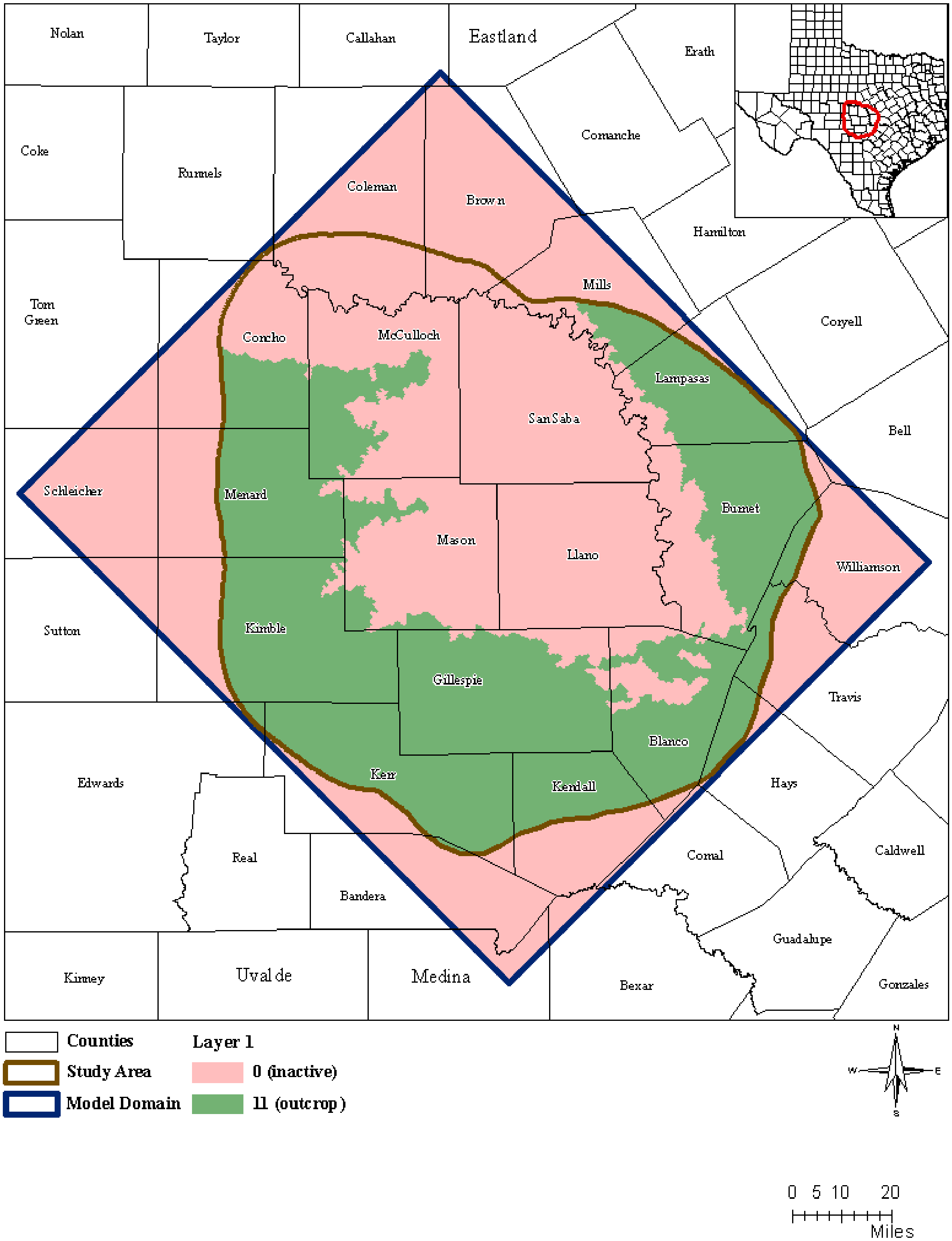

Figure 2.1.1 Layer 1 active and inactive model cells. Integers in legend are MODFLOW-USG IBOUND values.

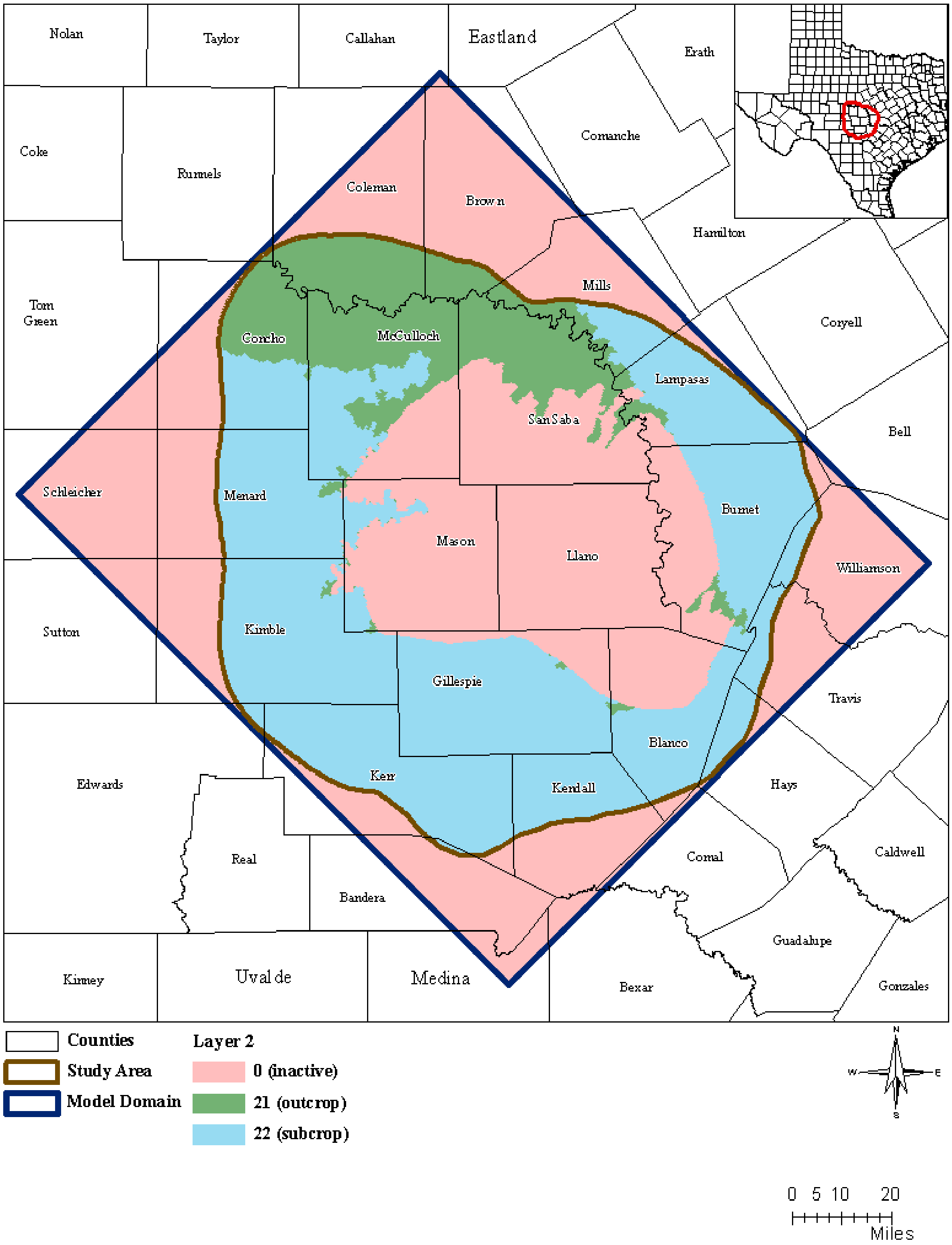

Figure 2.1.2 Layer 2 active and inactive model cells. Integers in legend are MODFLOW-USG IBOUND values.

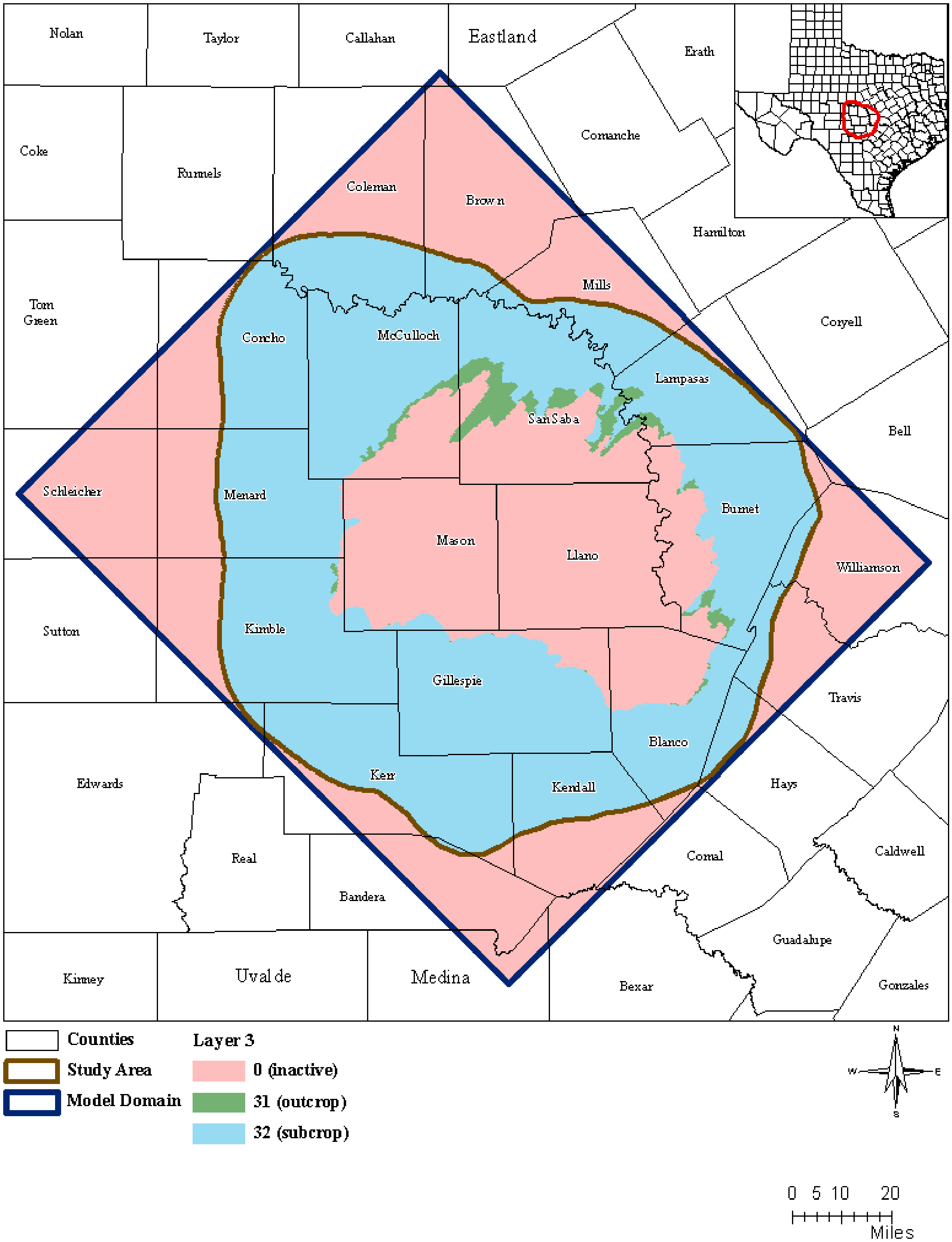

Figure 2.1.3 Layer 3 active and inactive model cells. Integers in legend are MODFLOW-USG IBOUND values.

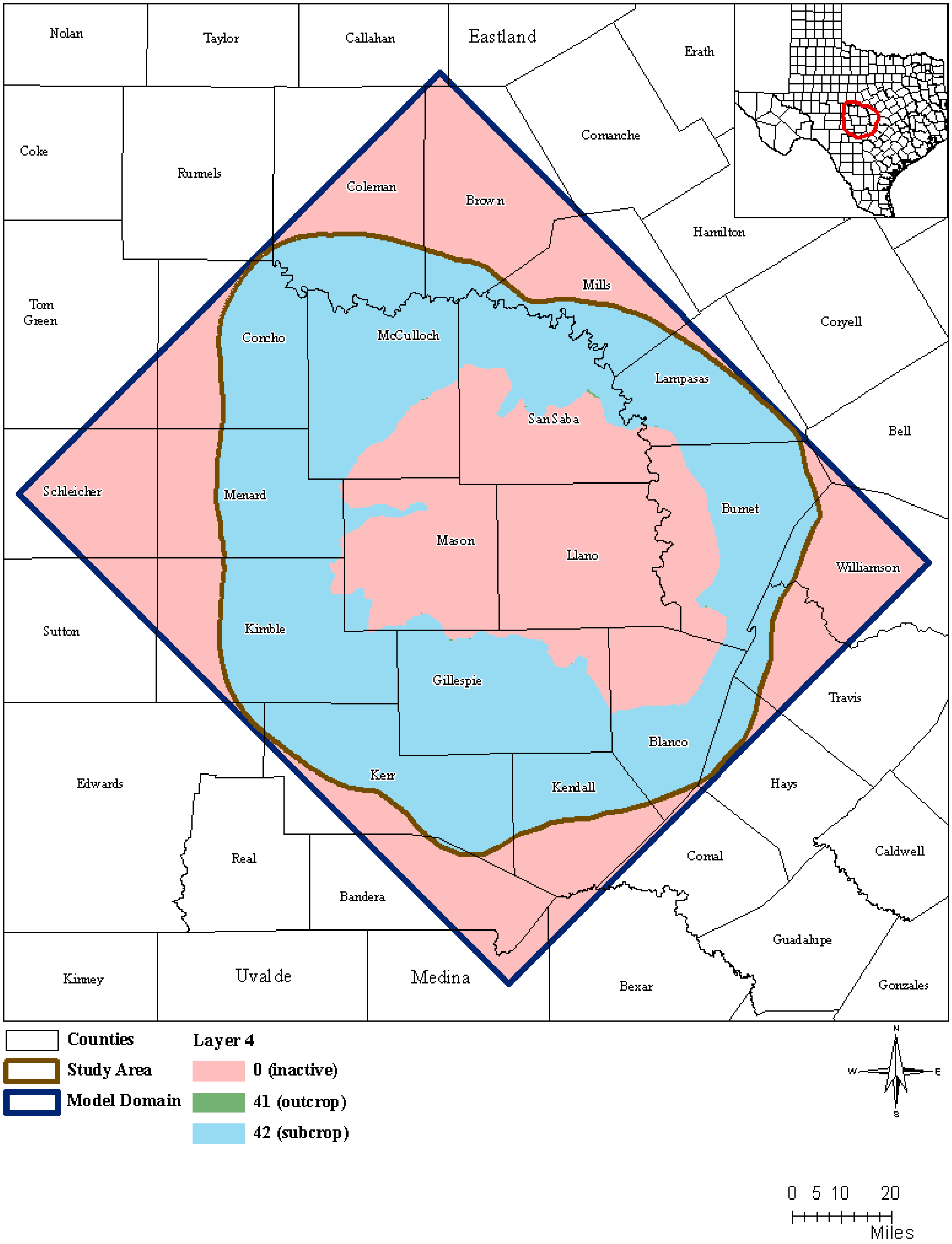

Figure 2.1.4 Layer 4 active and inactive model cells. Integers in legend are MODFLOW-USG IBOUND values.

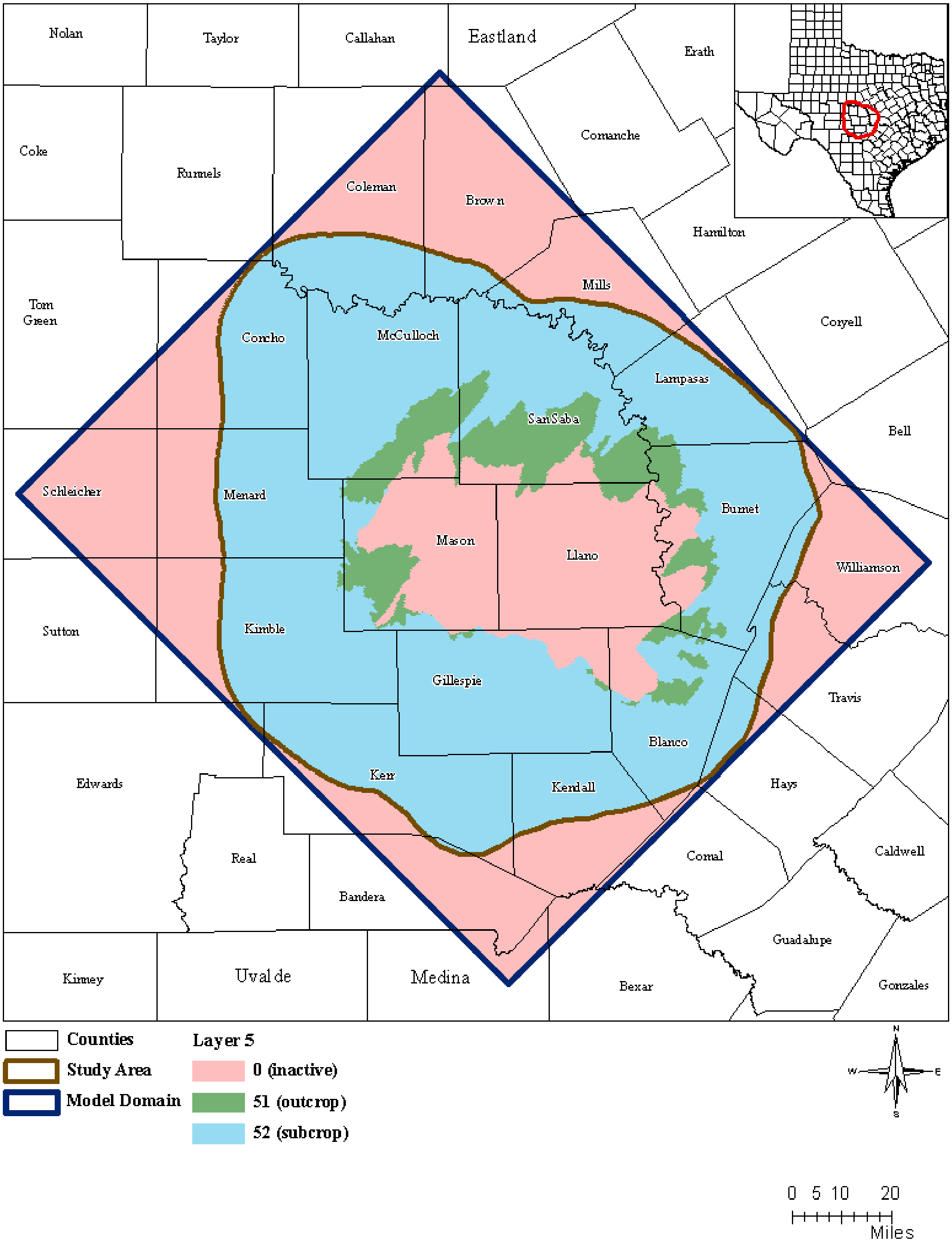

Figure 2.1.5 Layer 5 active and inactive model cells. Integers in legend are MODFLOW-USG IBOUND values.

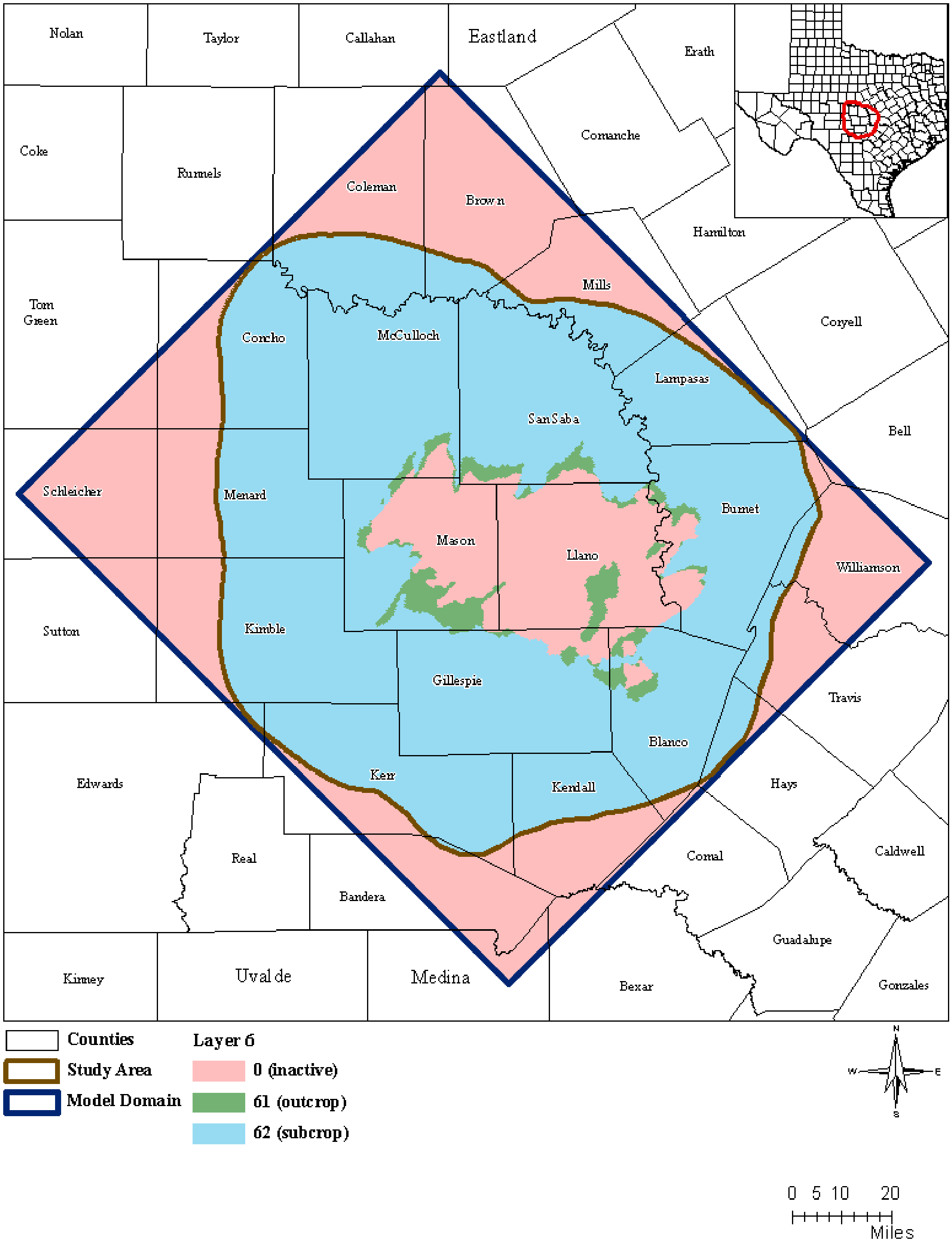

Figure 2.1.6 Layer 6 active and inactive model cells. Integers in legend are MODFLOW-USG IBOUND values.

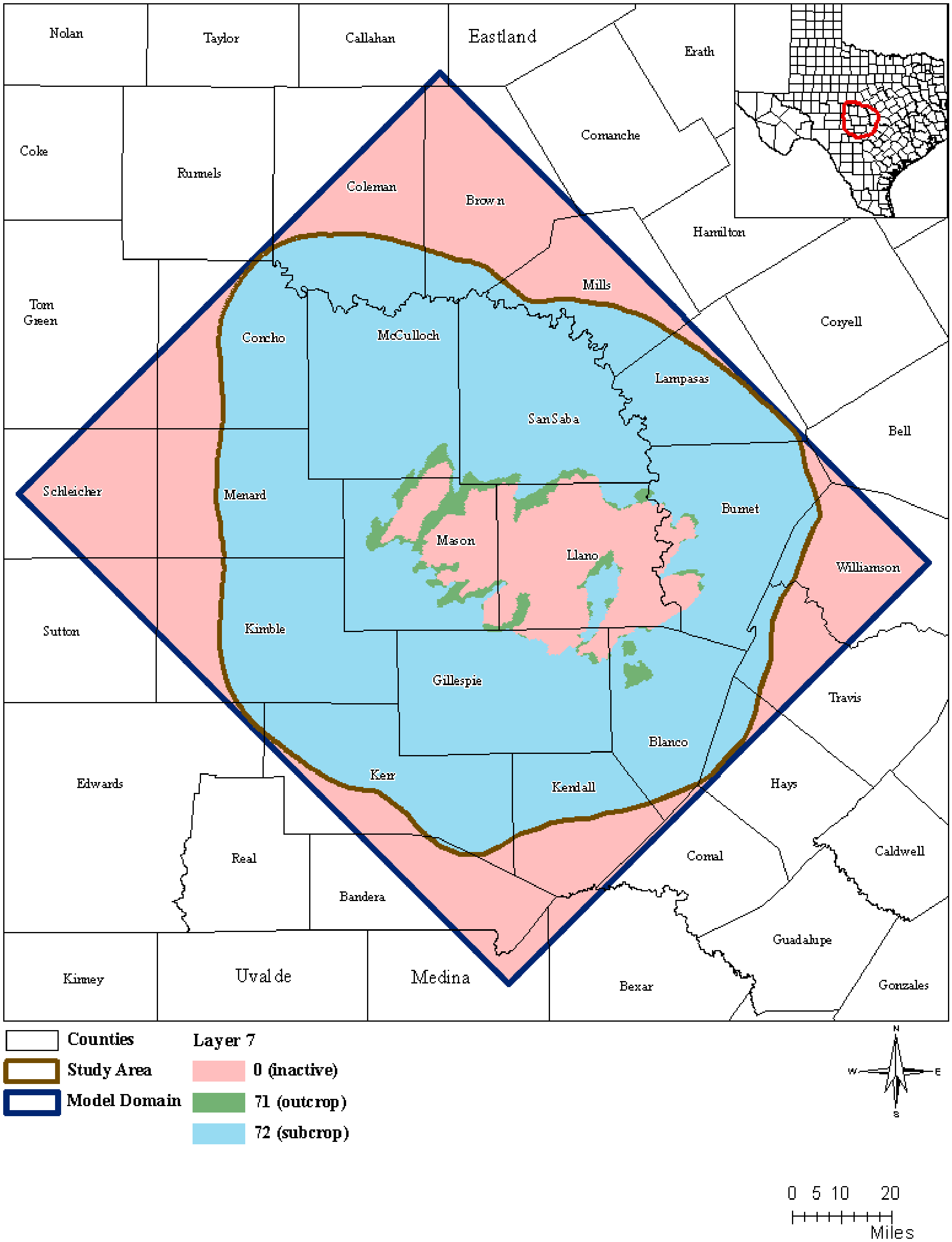

Figure 2.1.7 Layer 7 active and inactive model cells. Integers in legend are MODFLOW-USG IBOUND values.

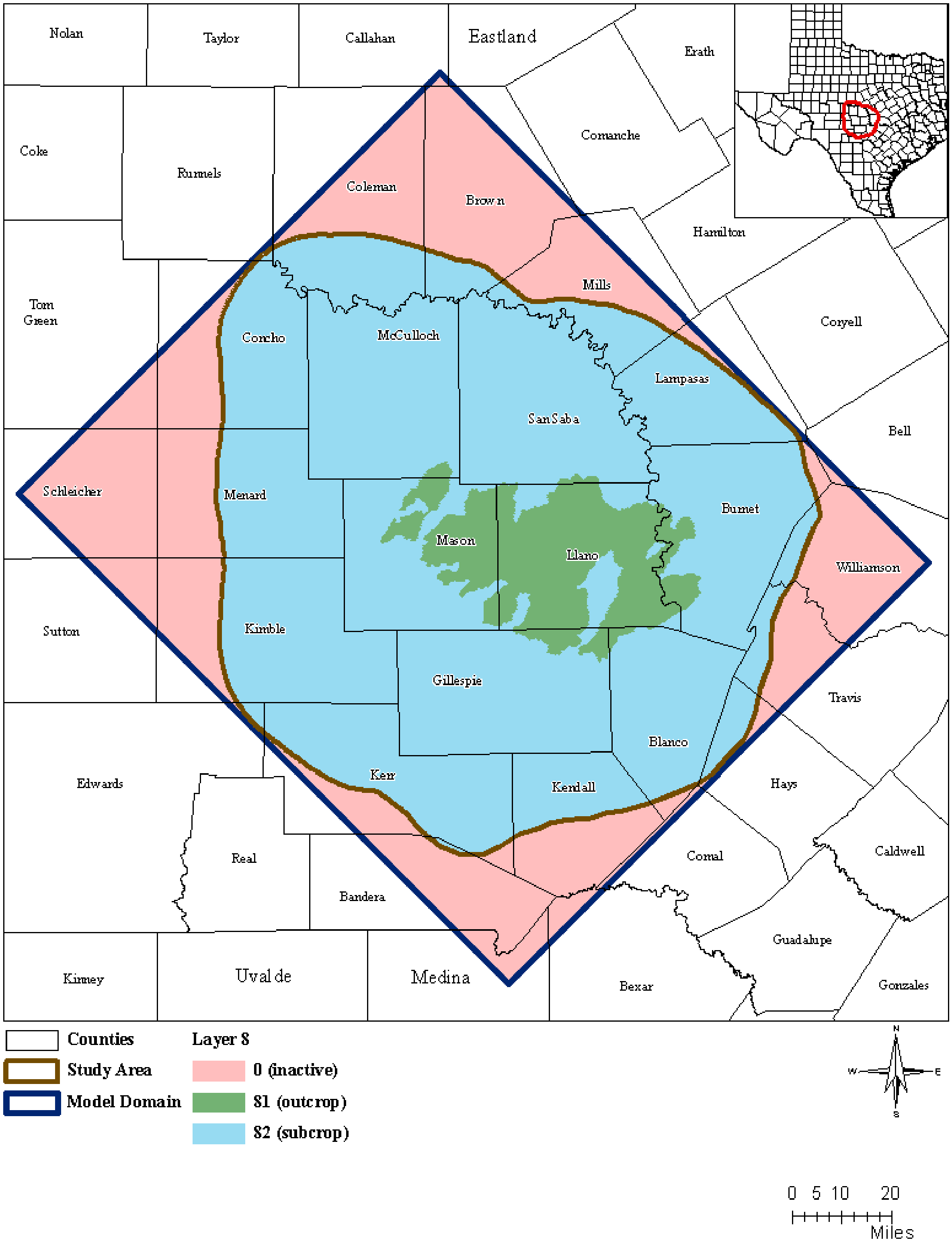

Figure 2.1.8 Layer 8 active and inactive model cells. Integers in legend are MODFLOW-USG IBOUND values.

2.2 Discretization Package

The MODFLOW-USG discretization package defines the model spatial and temporal resolution. The largest difference between MODFLOW-USG and previous MODFLOW codes lies in the discretization package. Unlike previous MODFLOW codes, MODFLOW-USG is not necessarily bound to the traditional layer concept and model cell coordinate system. In MODFLOW-USG, each model cell is represented by an integer or node number. To accommodate the unstructured grid, the MODFLOW-USG discretization package, llano-uplift.dis, defines model cell dimension and connection such as top elevation, bottom elevation, horizontal area, number of connection to other cells and itself, node number of a cell and node numbers of connected cells, connection direction, connection length, and connection interface.

Though MODFLOW-USG does not need a continuous numerical layer to simulate a discontinuous hydrogeological unit, a continuous layer concept was still used in this numerical model as in the previous MODFLOW codes. Each numerical layer contains 478 rows and 556 columns of uniform 1,320 feet by 1,320 feet cells. However, model cells located in areas where a geologic layer pinches out or is located outside the study area have been turned to inactive and assigned a thickness of zero. A minimum thickness of 50 feet was enforced for active model cells. In addition, model cells which belong to different numerical layers but in actual contact were connected using the unstructured concept in the discretization package.

The model grid was rotated 45 degrees clockwise to make the model columns parallel to the dominant faults oriented northeast to southwest. The model rows are thus parallel to northwest to southeast. Both row and column have a spacing of 1,320 feet. The coordinate of the lower left corner of the grid is at groundwater availability model coordinate system 4,738,600 feet easting and 19,556,600 feet northing. Because of the close spacing, only the grid orientation is presented in Figure 2.2.1. Figures 2.2.2 and 2.2.3 show representative cross sections of the model grid with their locations presented in Figure 2.2.1.

The MODFLOW-USG discretization package uses stress periods to define the temporal resolution at the end of the package. The model includes one steady-state stress period followed by 30 transient annual stress periods. The steady-state stress period represents pseudo steady-state conditions in 1980. The goal of this stress period is to produce a set of initial groundwater levels or hydraulic heads in the model cells that provide the transient simulation with reasonable starting conditions. Each transient stress period was 365 days long representing calendar years 1981 through 2010. Each stress period consists a single time step.

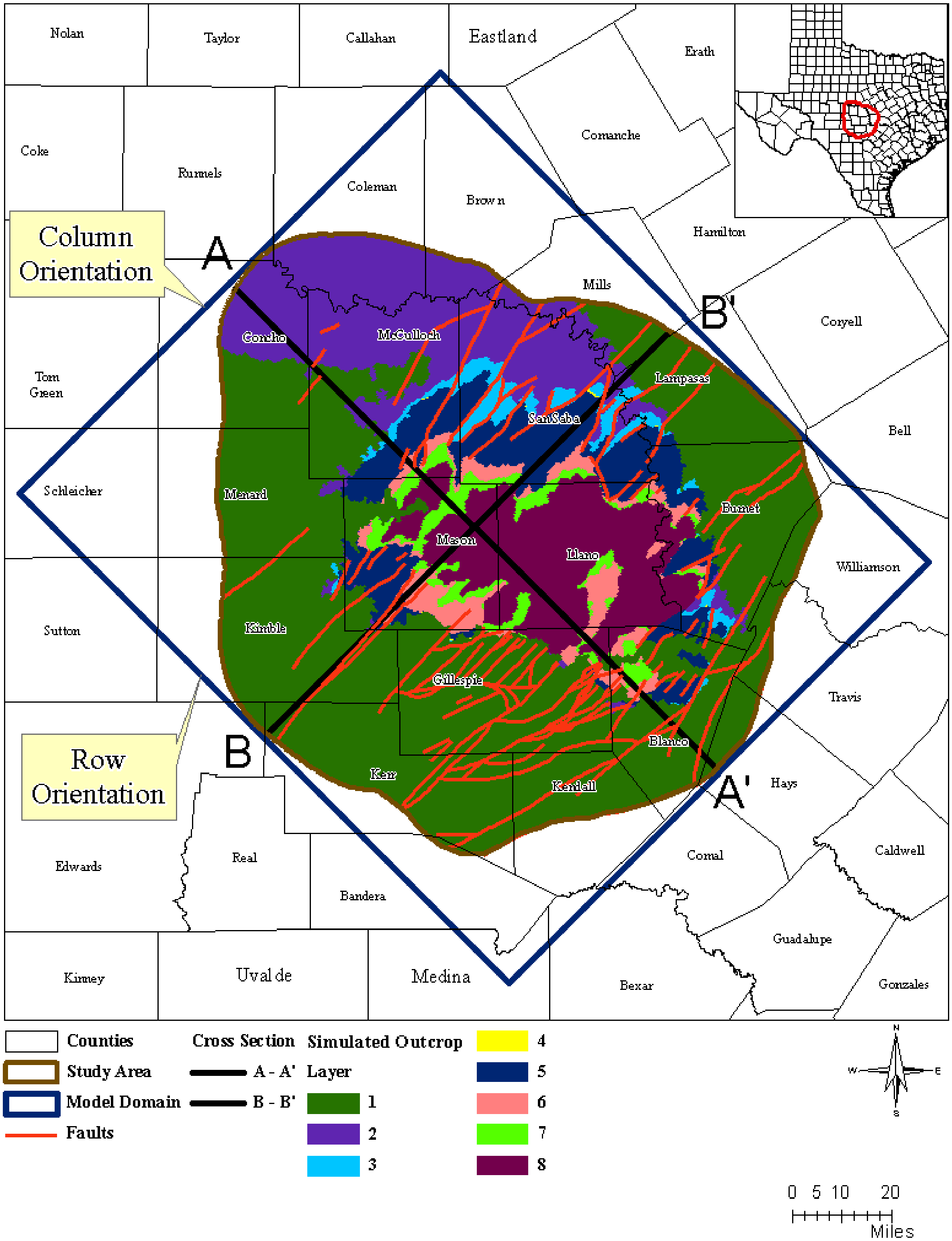

Figure 2.2.1 Orientation of model grid and locations of cross sections. Model rows are parallel to cross section A-A'. Model columns are parallel to cross section B-B'.

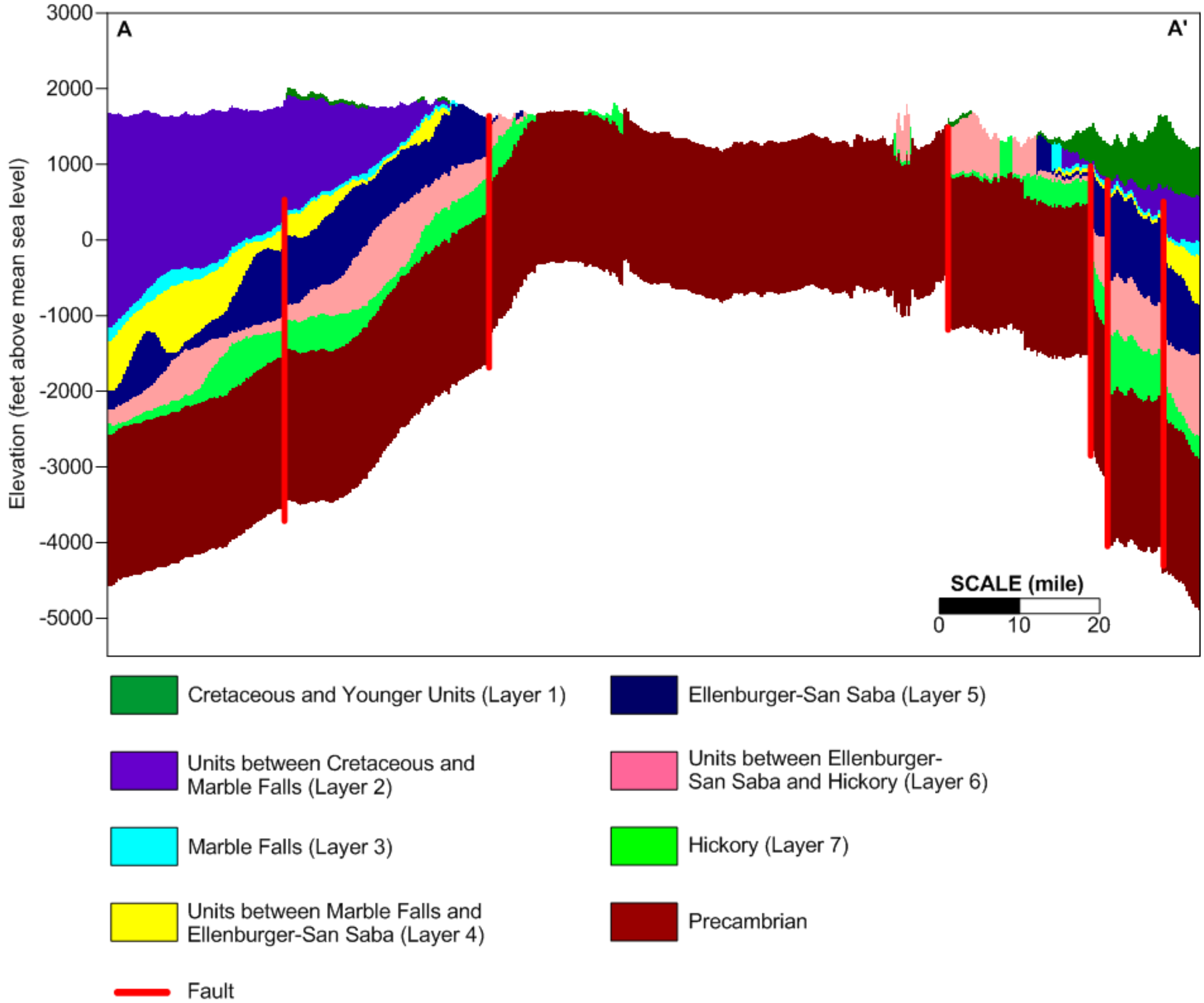

Figure 2.2.2 Northwest-southeast cross section A-A' along model row 239 (50x vertical exaggeration). Location of cross section is shown in Figure 2.2.1.

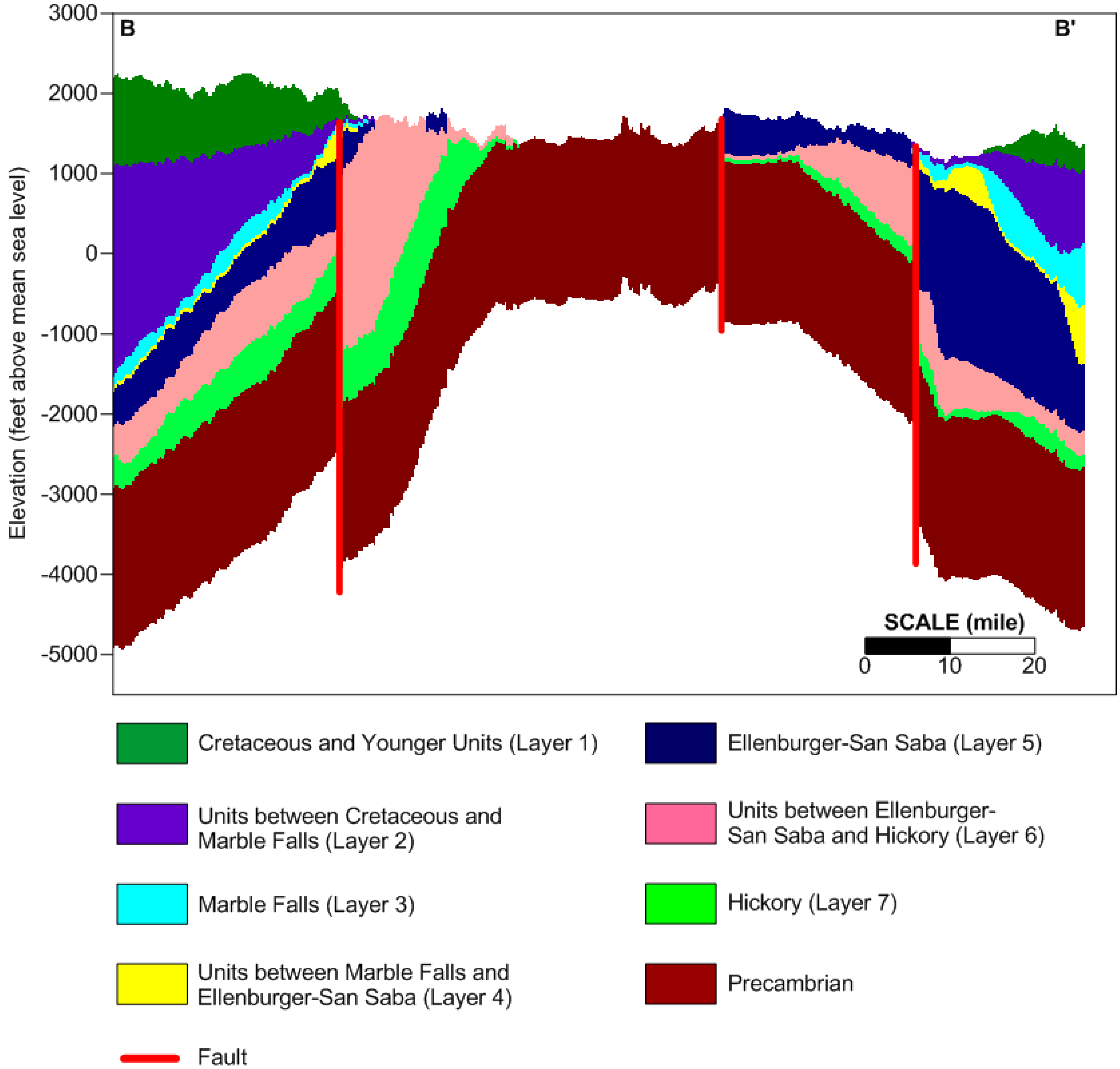

Figure 2.2.3 Southwest-northeast cross section B-B' along model column 278 (50x vertical exaggeration). Location of cross section is shown in Figure 2.2.1.

2.3 Layer-Property Flow Package

The Layer-Property Flow package, llano-uplift.lpf, defines the hydraulic properties of the model cells and how certain parameters are defined and simulated. In this package, all cell property values were assigned on a cell-by-cell basis. In addition, the storage coefficient (also known as storativity) instead of specific storage was used to define the storage properties of the model cells. To minimize numerical instability, the vertical conductance was calculated using cell thickness and the vertical flow correction under dewatered conditions was turned off.

Model layers 1 and 2 were simulated as convertible (Type 4) with transmissivity calculated using upstream water table depth to help model convergence. The rest of the model layers were treated as confined to improve numerical stability. In this numerical model, horizontal hydraulic conductivity values were assumed isotropic. However, the vertical hydraulic conductivity may be different from the horizontal conductivity and was calculated using vertical anisotropy which was also defined in the package.

During the model calibration, pilot points were used to adjust the hydraulic conductivity and storativity of the aquifers. The pilot points were placed at locations where estimated hydraulic conductivity values were available from hydraulic testing in the field as well as other key locations. Initially, the hydraulic conductivity values at these pilot point locations were constrained to vary within a factor of two from the tested values. The hydraulic conductivity values at pilot points in other key locations were constrained within the minimum and maximum of the tested values for that aquifer. However, during the calibration, it was found out that the interpolated hydraulic conductivity fields from the pilot points showed strong irregularity most likely due to the uneven distribution of the pilot points with tested hydraulic conductivity values and the dramatic change in these values. As a result, a Gaussian filter was used to smooth the values.

After several calibration trials, it was discovered that the use of pilot points did not significantly improve the model calibration. As a result, a traditional trial-and-error approach was applied to adjust the hydraulic property values (hydraulic conductivity, vertical anisotropy, storativity, and specific yield) of the aquifers and confining layers.

Figure 2.3.1 shows the horizontal hydraulic conductivity values for layer 1 ranging from 0.02 to 902 feet per day with a geometric mean of 1.03 feet per day. These values are consistent with the values presented in the conceptual model ranging from 0.02 to 885 feet per day with a geometric mean of 1.7 feet per day. The distribution of the vertical anisotropy (the ratio of horizontal to vertical hydraulic conductivity values) for layer 1 is presented in Figure 2.3.2. The range of the vertical anisotropy values range from approximately 10 to 100. These values reflect the presence of the shaly Glen Rose Formation which impedes vertical flow that often results in groundwater seepage along the top of the shale. The storativity and specific yield (required for a convertible layer) were assigned uniform values of 0.00002 and 0.02, respectively, for model layer 1. These values are also consistent with this type of limestone/shale depositional environment.

Figure 2.3.3 shows the horizontal hydraulic conductivity values for layer 2— ranging from 0.01 to 0.3 feet per day with a geometric mean of 0.08 feet per day. The distribution of vertical anisotropy for layer 2 is presented in Figure 2.3.4. The vertical anisotropy values range from approximately 19 to 1,000. These hydraulic conductivity and vertical anisotropy values are consistent with the abundance of shale and marl in the Permian rocks. The storativity and specific yield (required for a convertible layer) were assigned uniform values of 0.000002 and 0.002, respectively, for model layer 2. These values are also consistent with relatively low permeability rocks.

Figure 2.3.5 shows the horizontal hydraulic conductivity values for layer 3 ranging from 4.3 to 26.3 feet per day with a geometric mean of 6.2 feet per day. There are only two hydraulic conductivity values available from field test data, 6.29 and 197.2 feet per day, both from Burnet County. As discussed in the conceptual model report, the geometric mean of 35.2 feet per day based on these two values was likely overestimated. Thus, the geometric mean from the calibrated model appears more reasonable. The vertical anisotropy for layer 3 was assigned a uniform value of 12.9. The storativity of model layer 3 was assigned 0.03 at the outcrop area and 0.00002 at the subcrop area (Figure 2.3.6).

The model layer 4 was assigned a horizontal hydraulic conductivity of 0.25 feet per day and vertical anisotropy of 8.3. Figure 2.3.7 shows the storativity of model layer 4: 0.003 at the outcrop and 0.000002 at the subcrop.

Figure 2.3.8 shows the horizontal hydraulic conductivity values for layer 5 ranging from 0.3 to 132.6 feet per day with a geometric mean of 4.9 feet per day, which is higher than the geometric mean of 2.8 feet per day presented in the conceptual model report. The vertical anisotropy for model layer 5 was assigned a uniform value of 7.6. Figure 2.3.9 shows the storativity of model layer 4 with 0.03 at the outcrop and 0.00002 at the subcrop.

Uniform values of 0.3 feet per day and 10.3 were used to represent the horizontal hydraulic conductivity and vertical anisotropy of model layer 6, respectively. Figure 2.3.10 shows the storativity for the same layer with 0.005 at the outcrop and 0.000004 at the subcrop.

Figure 2.3.11 shows the horizontal hydraulic conductivity values for layer 7 ranging from 1.7 to 192.0 feet per day with a geometric mean of 5.6 feet per day. These values are higher than the values presented in the conceptual model, which ranged from 0.03 to 155.5 feet per day with a geometric mean of 3.1 feet per day. The vertical anisotropy for layer 7 was 10.4 except in a small outcrop area in Llano County where the anisotropy was assigned a value of 1.0 (Figure 2.3.12). This small area is coincident with densely distributed faults. The storativity for model layer 7 is shown in Figure 2.3.13 with lower values at subcrop area (0.00006 and 0.00012) and higher values at outcrop area (0.09 to 0.3).

The model layer 8 was assigned a uniform horizontal hydraulic conductivity of 0.1 feet per day. Due to the lack of layering, the Precambrian igneous and metamorphic rocks (model layer 8) were assigned a vertical anisotropy value of one. Figure 2.3.14 shows the storativity of the model layer with 0.001 at the outcrop and 0.000001 at the subcrop.

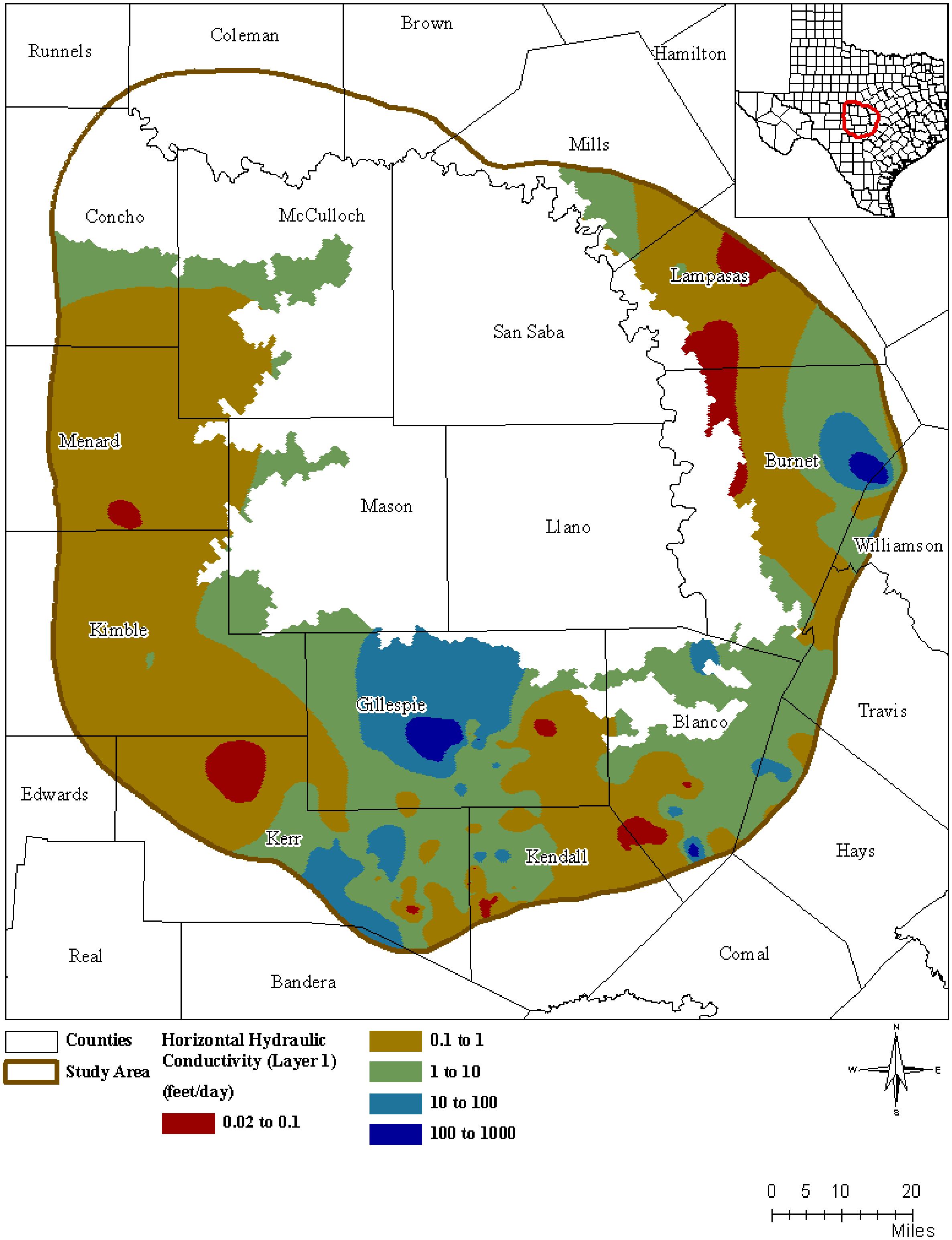

Figure 2.3.1 Horizontal hydraulic conductivity of model layer 1 (active cells only).

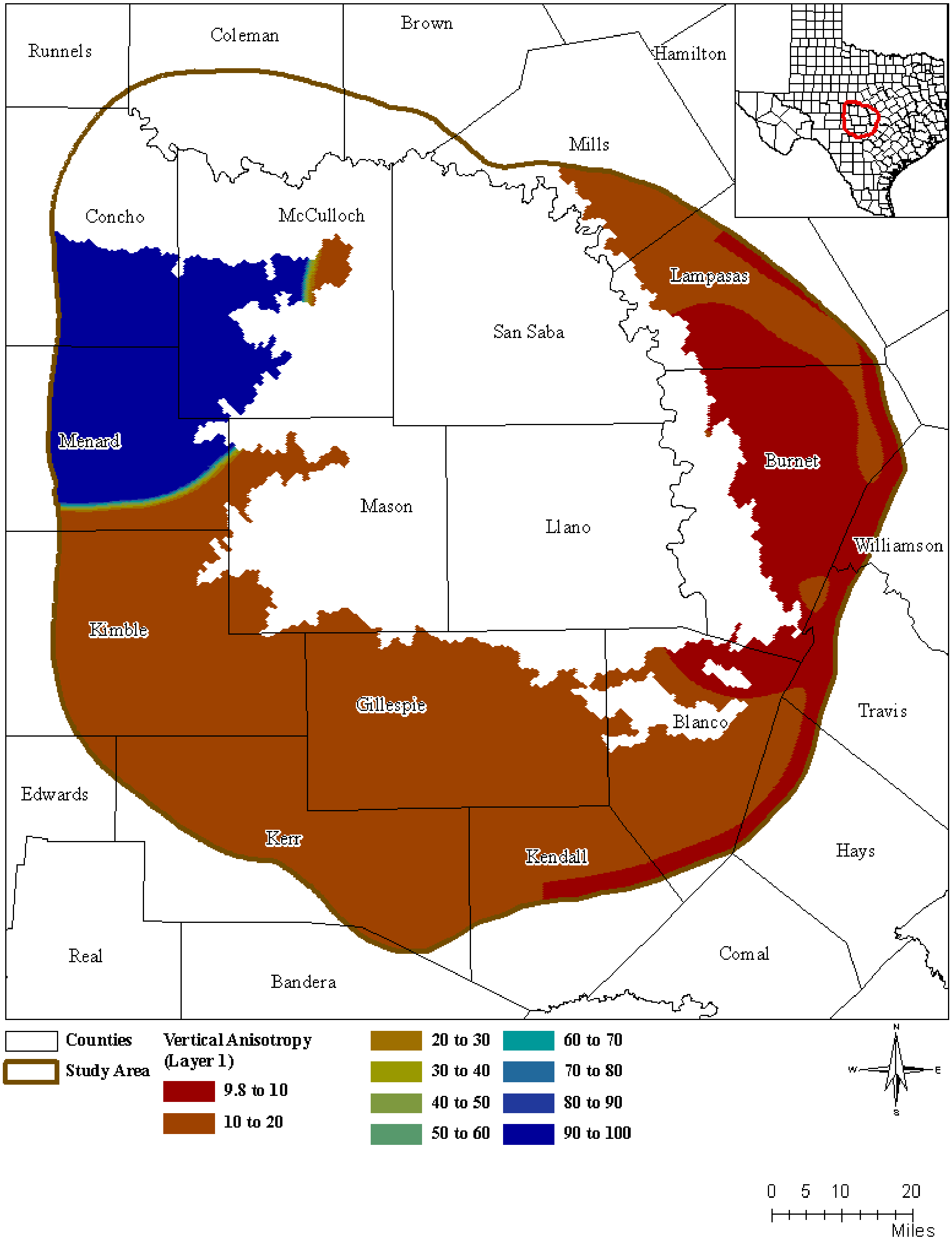

Figure 2.3.2 Vertical anisotropy of model layer 1 (active cells only).

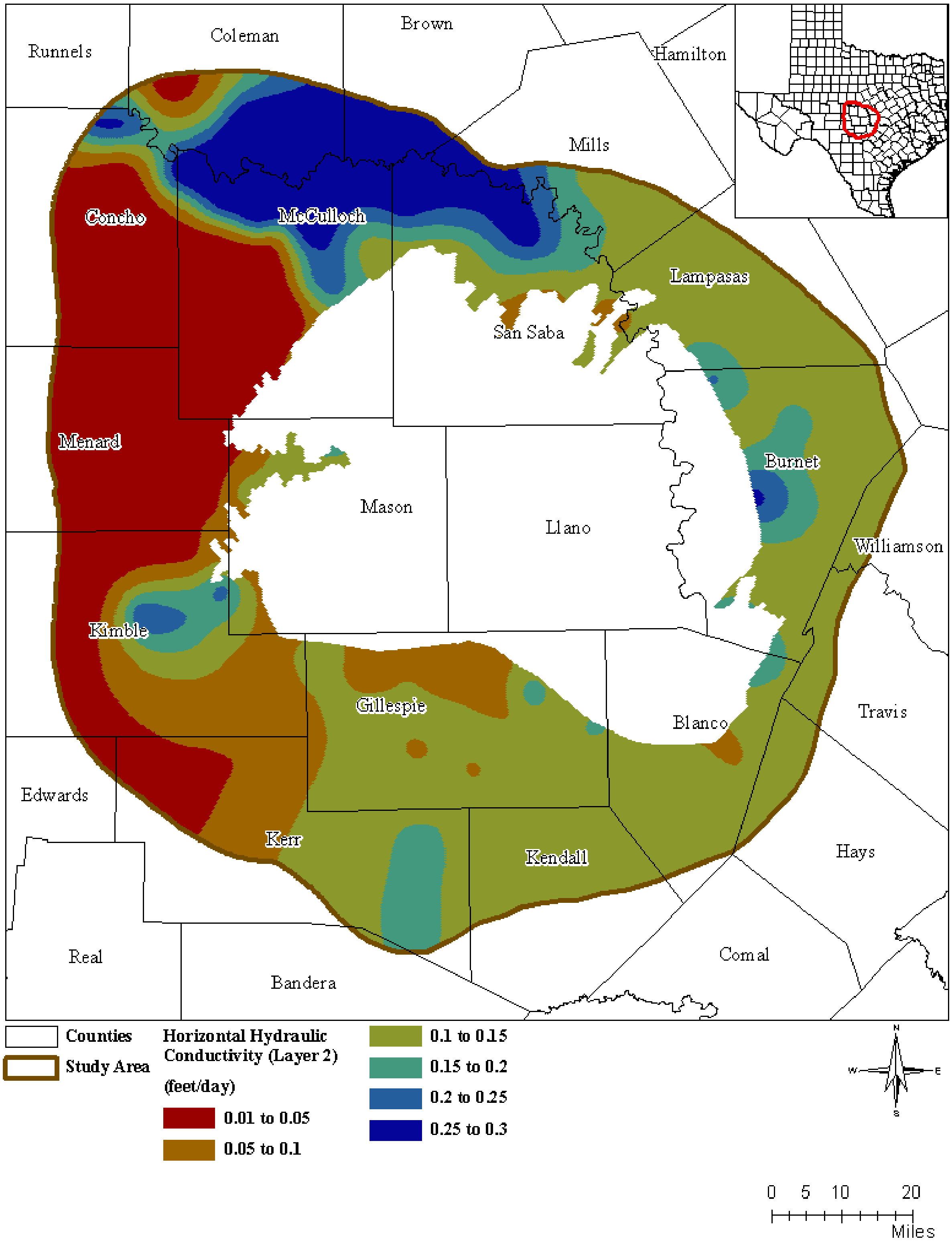

Figure 2.3.3 Horizontal hydraulic conductivity of model layer 2 (active cells only).

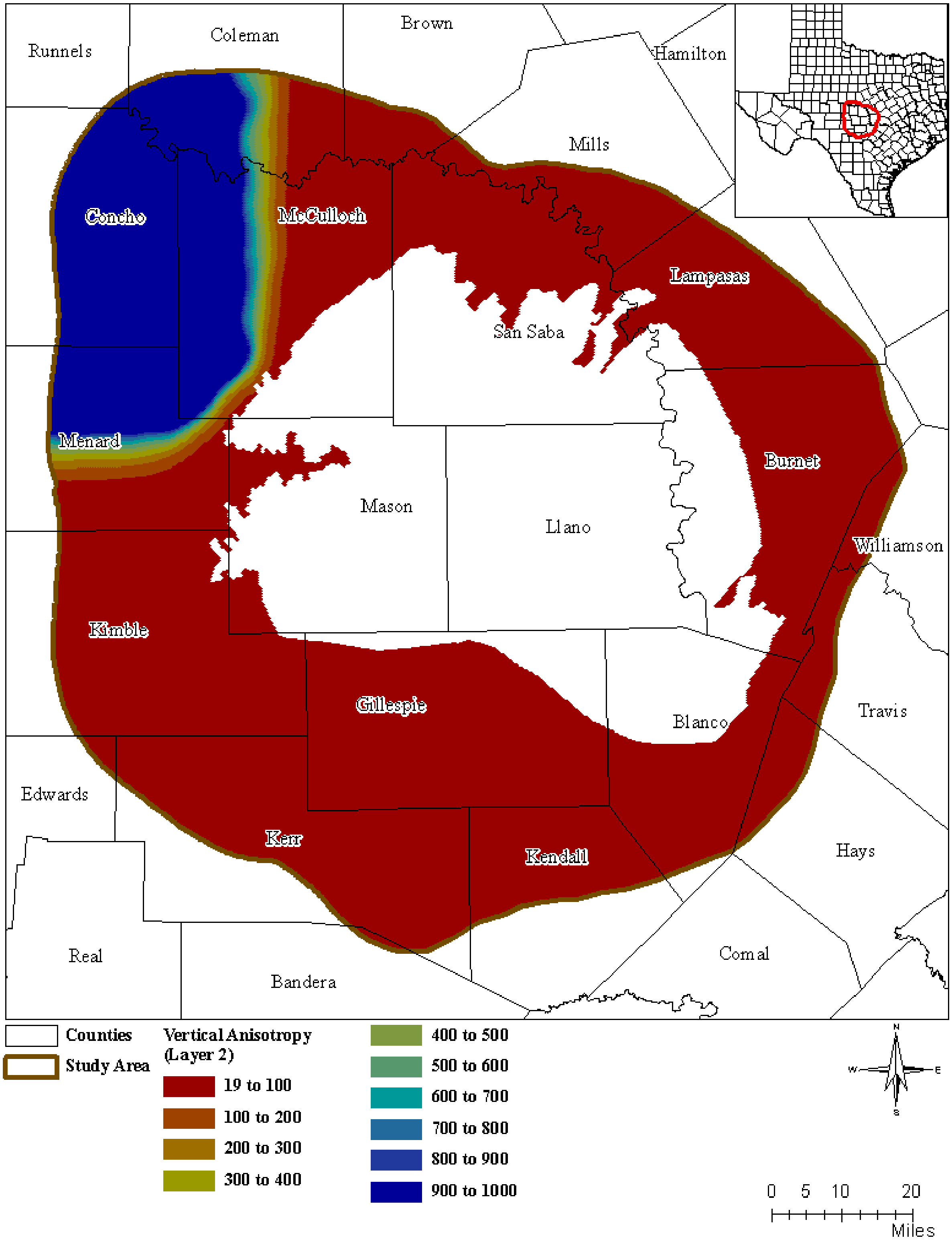

Figure 2.3.4 Vertical anisotropy of model layer 2 (active cells only).

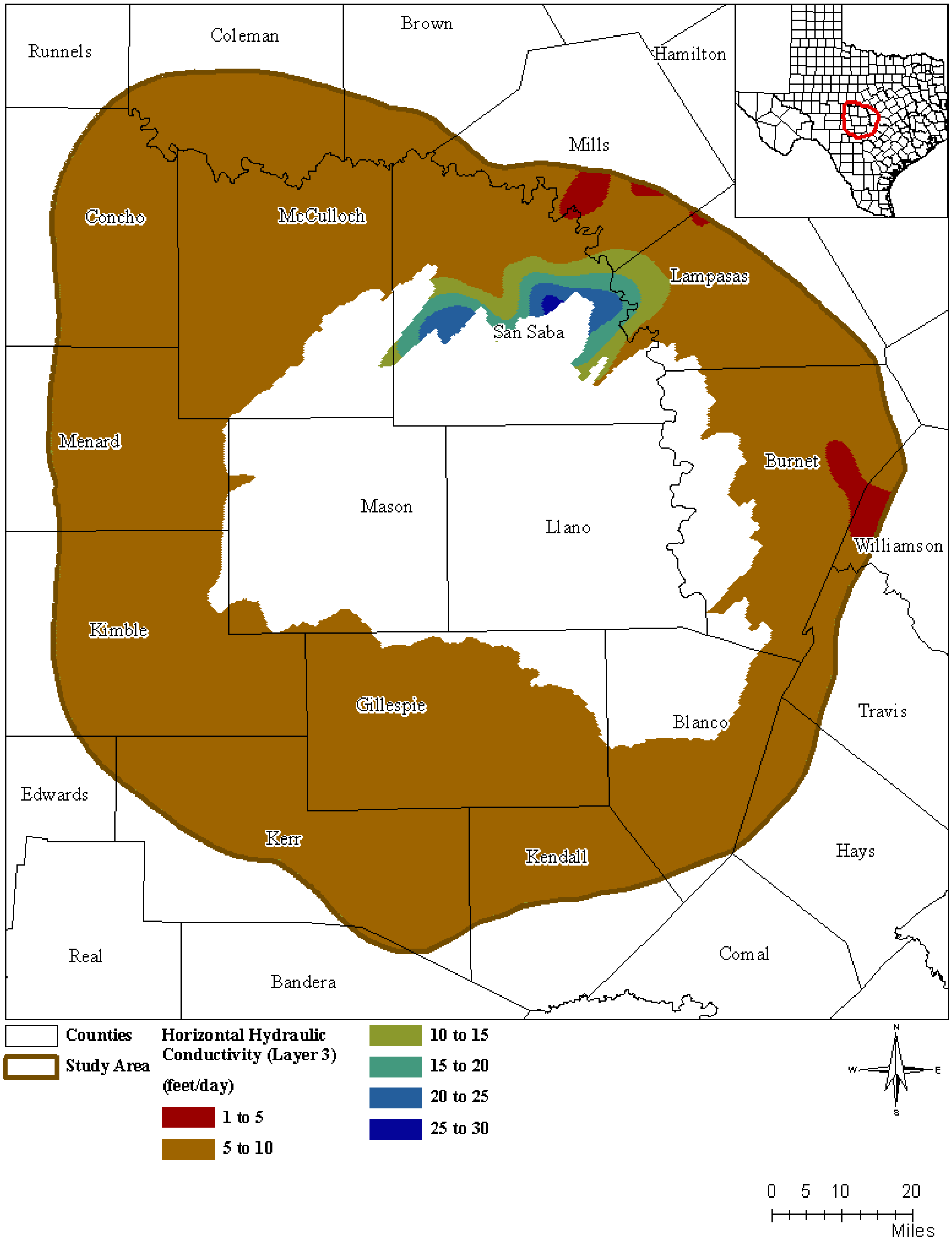

Figure 2.3.5 Horizontal hydraulic conductivity of model layer 3 (active cells only).

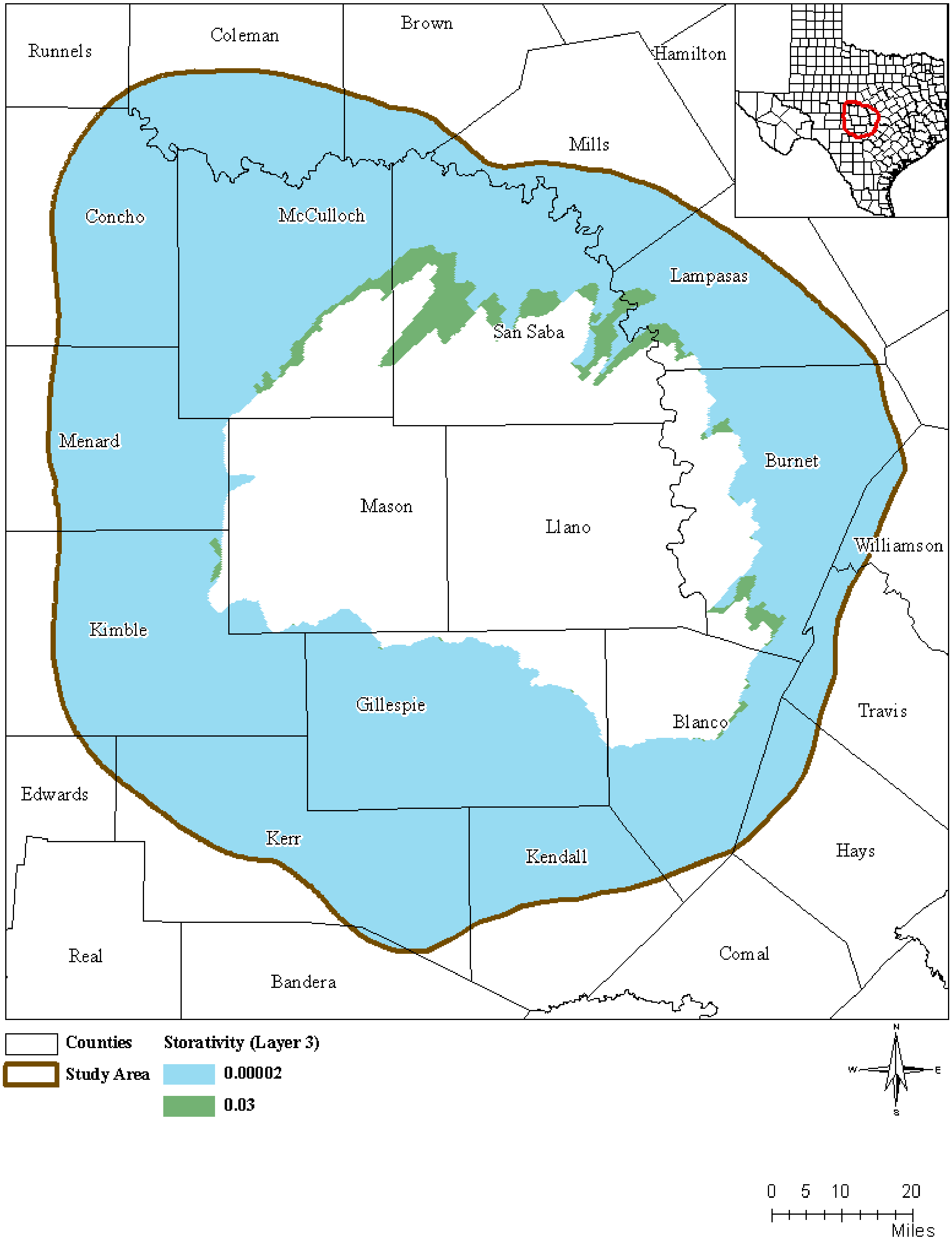

Figure 2.3.6 Storativity of model layer 3 (active cells only).

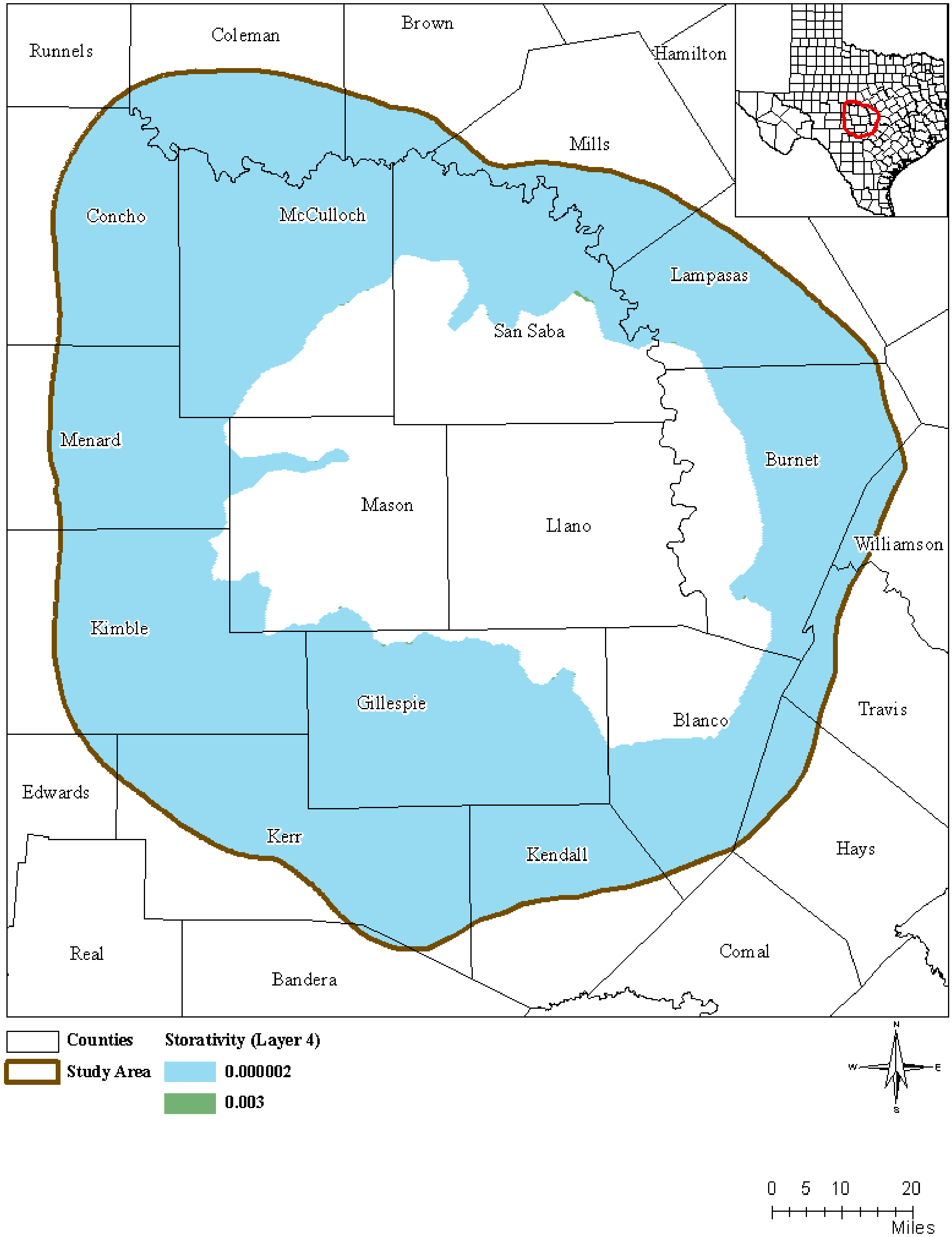

Figure 2.3.7 Storativity of model layer 4 (active cells only).

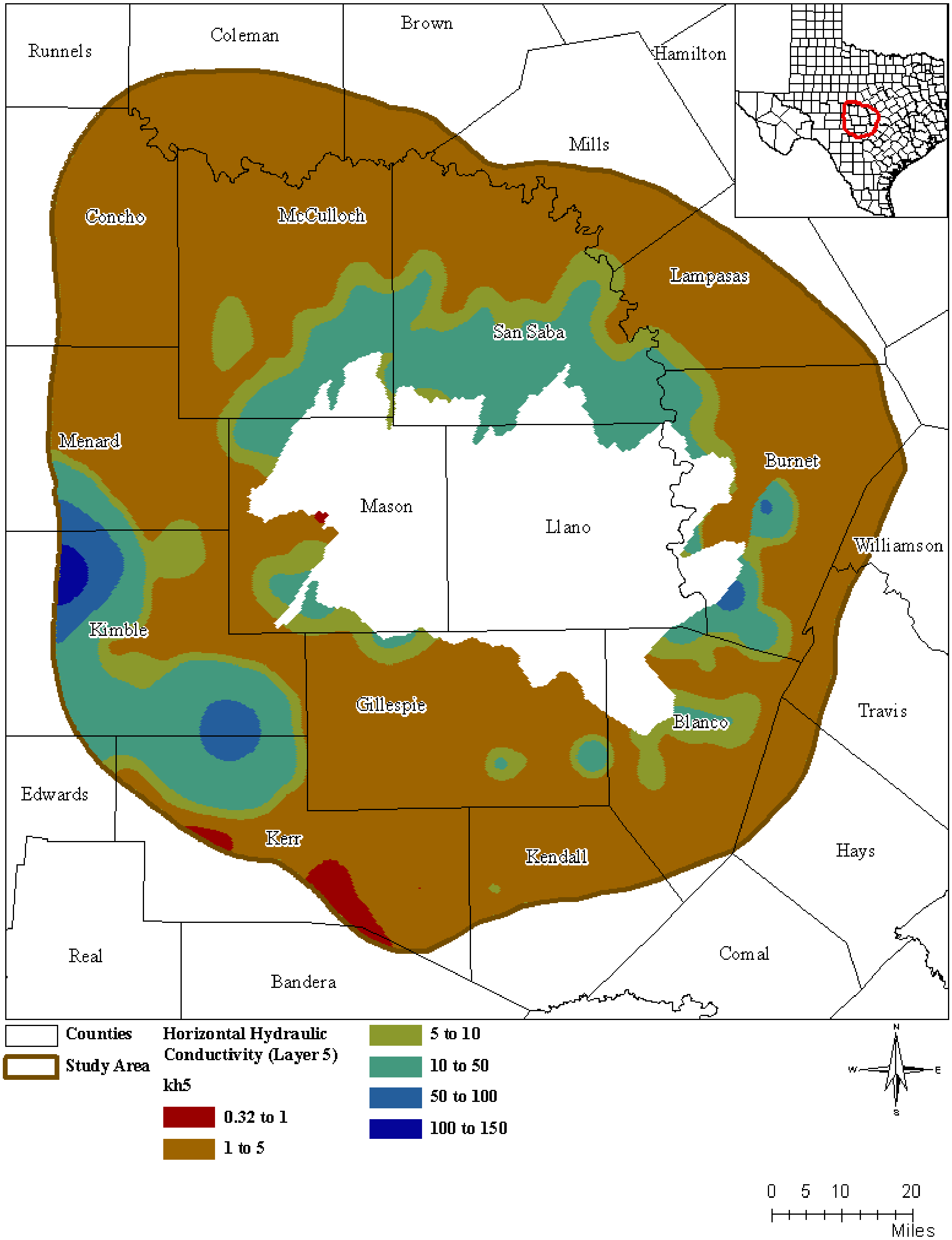

Figure 2.3.8 Horizontal hydraulic conductivity of model layer 5 (active cells only).

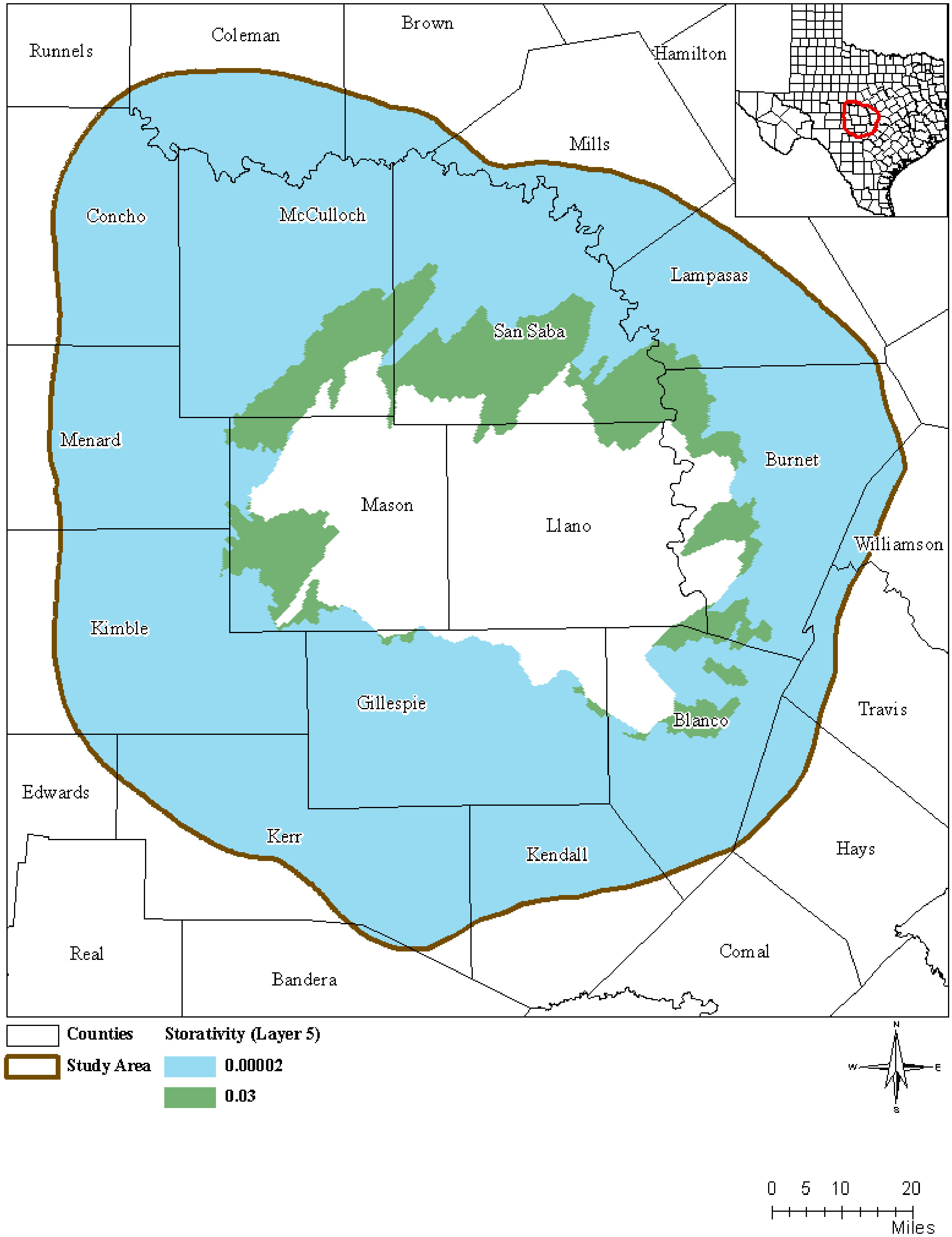

Figure 2.3.9 Storativity of model layer 5 (active cells only).

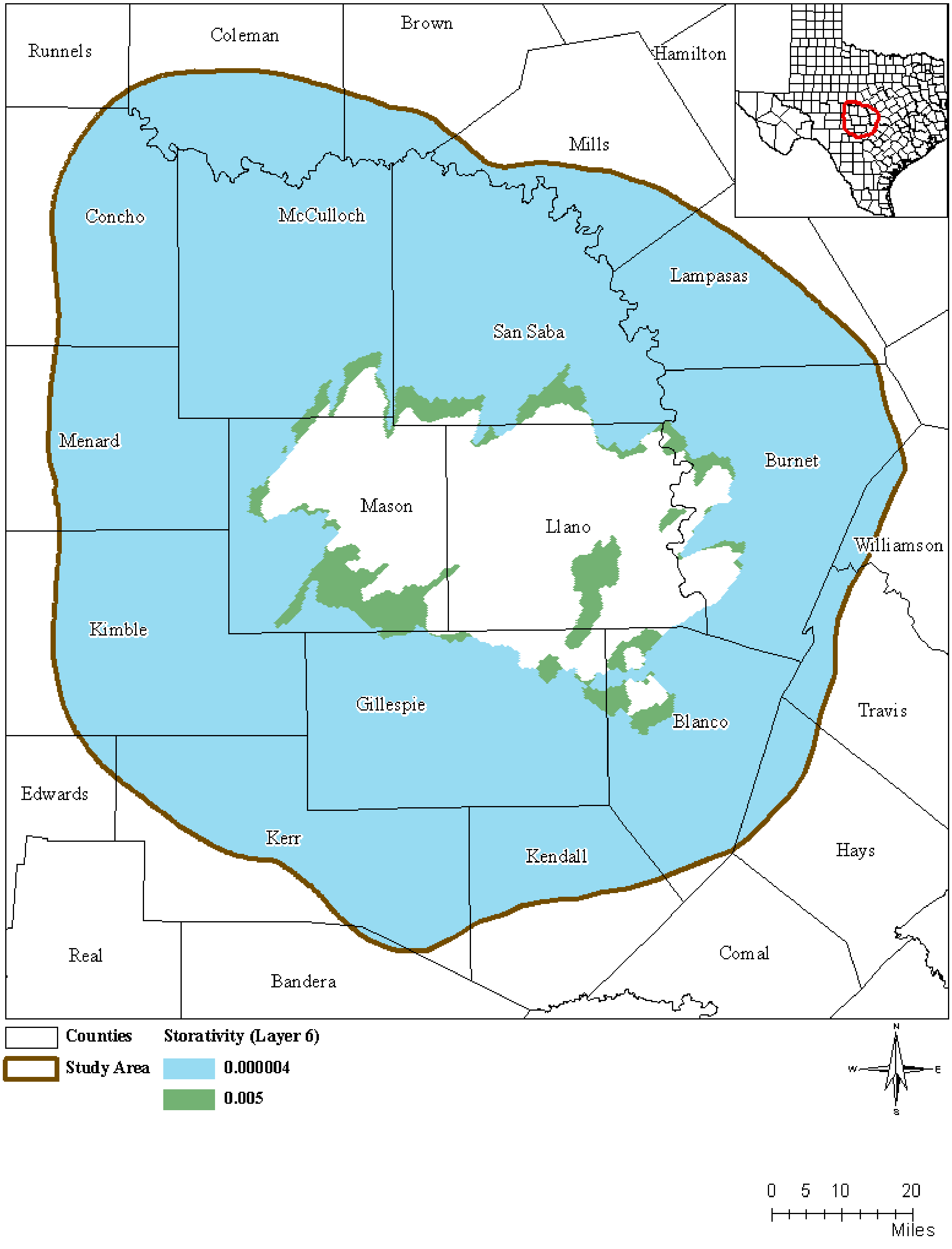

Figure 2.3.10 Storativity of model layer 6 (active cells only).

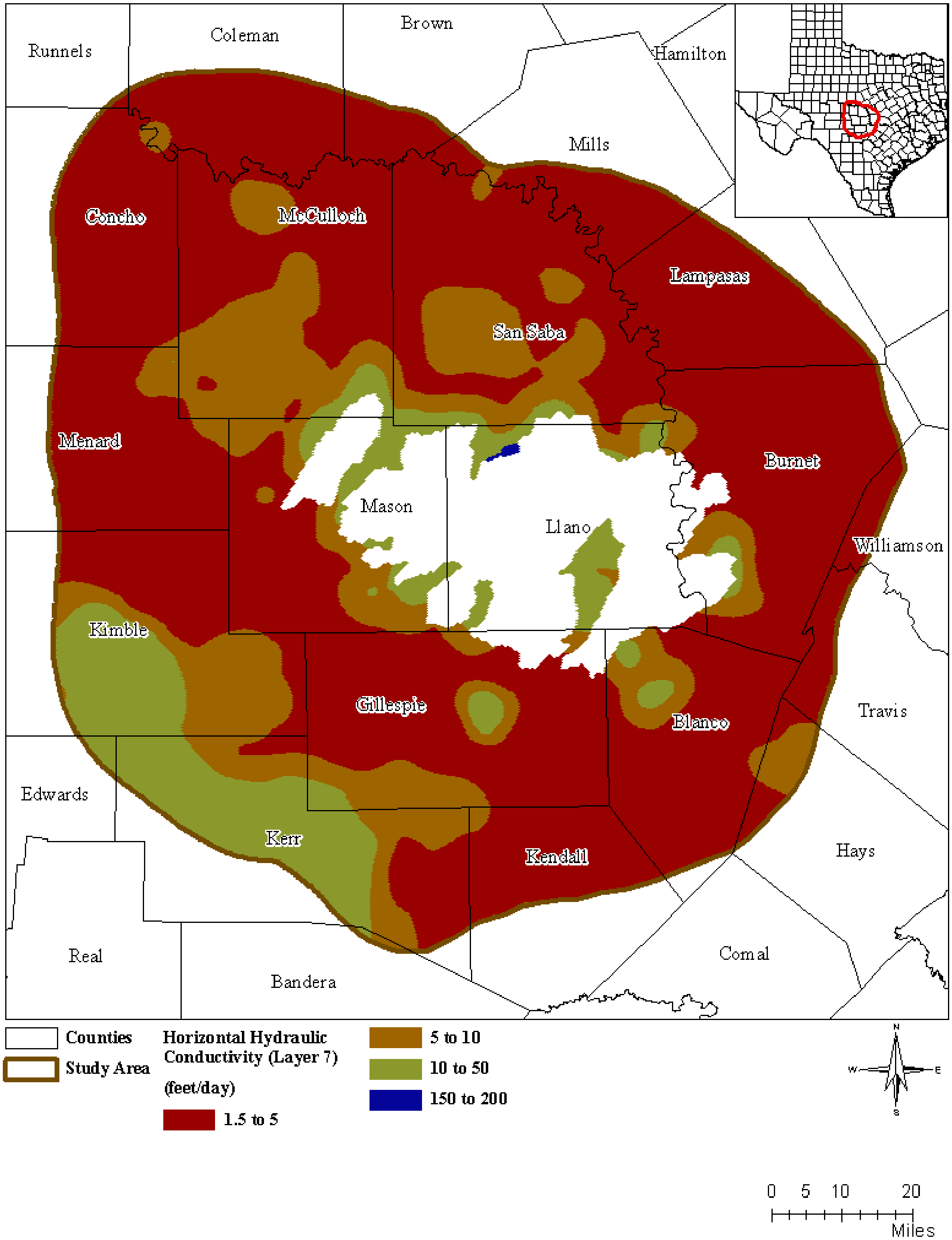

Figure 2.3.11 Horizontal hydraulic conductivity of model layer 7 (active cells only).

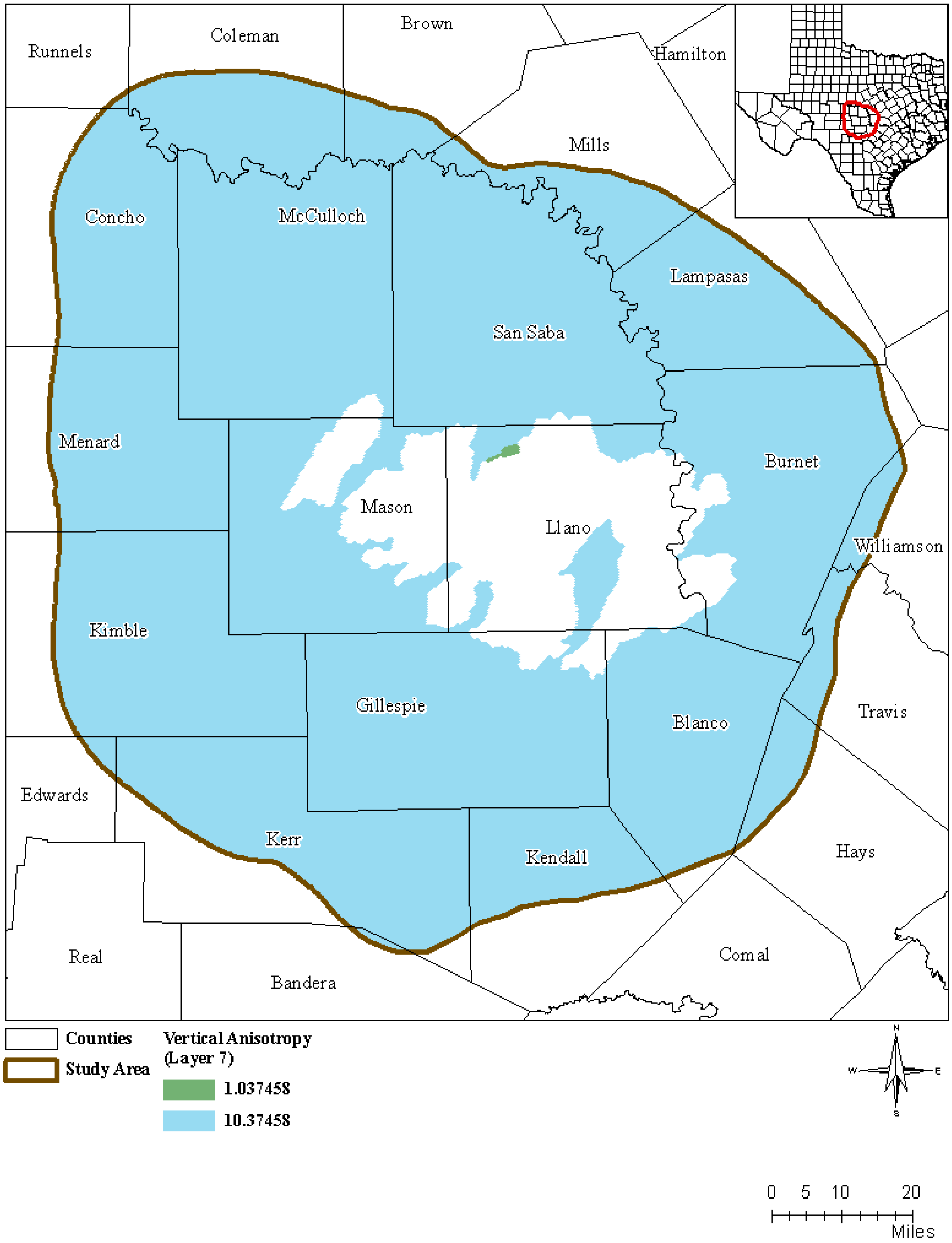

Figure 2.3.12 Vertical anisotropy of model layer 7 (active cells only).

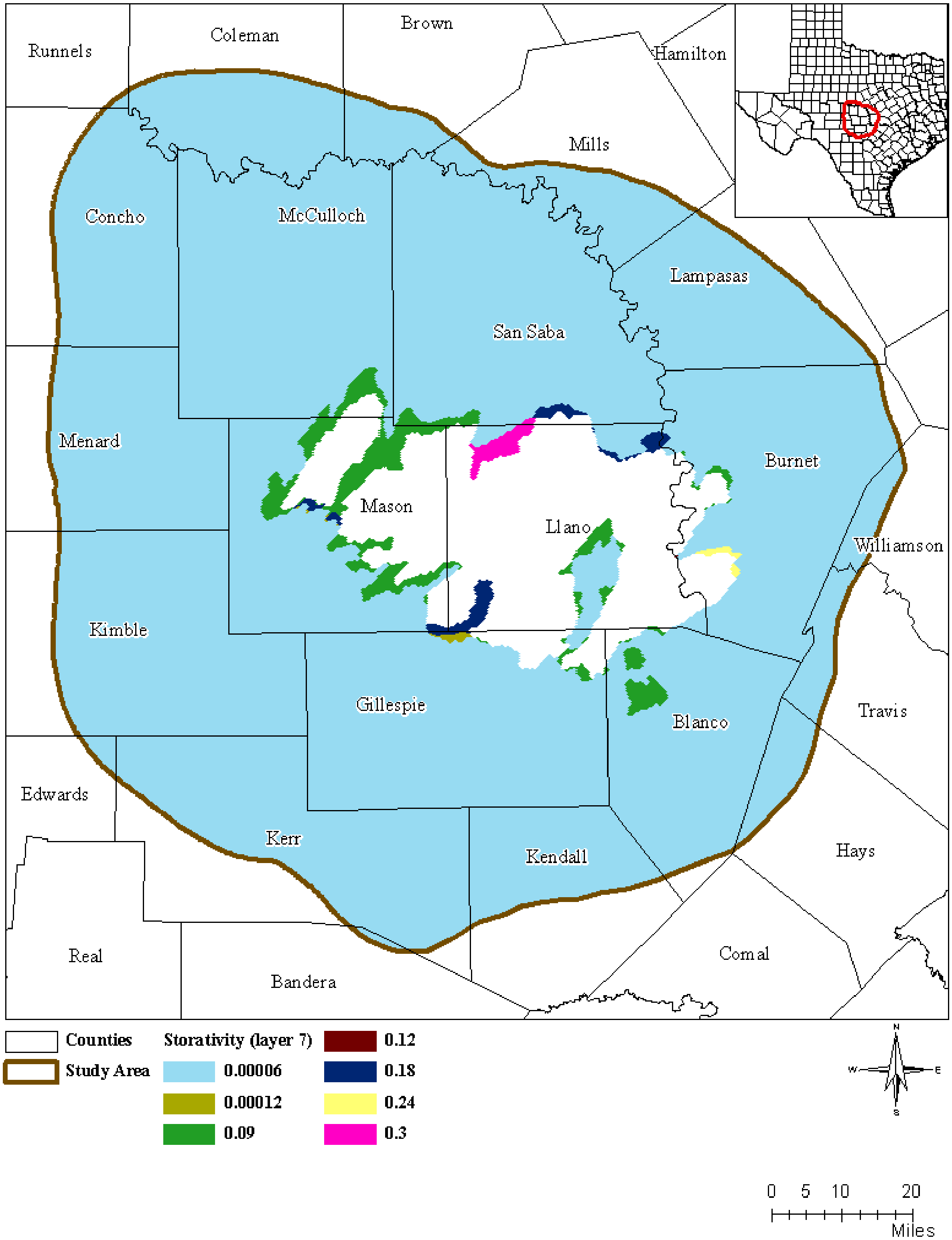

Figure 2.3.13 Storativity of model layer 7 (active cells only).

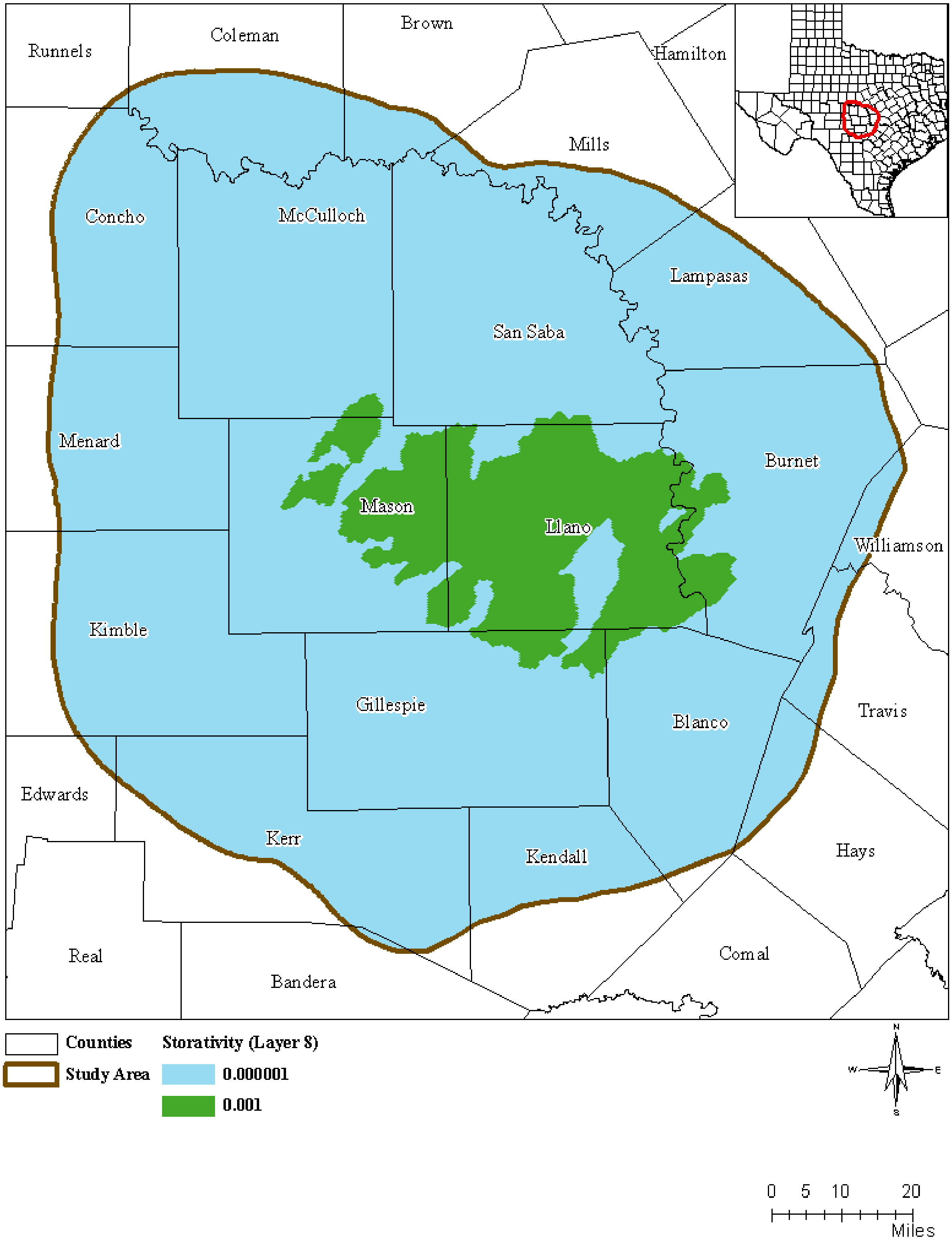

Figure 2.3.14 Storativity of model layer 8 (active cells only).

2.4 Well Package

The MODFLOW-USG well package, llano-uplift.wel, defines the groundwater withdrawal from model cells during the calibration period. The groundwater withdrawal information was mainly based on the annual historical water use survey by TWDB which includes six categories: municipal, manufacturing, steam-electric generation, irrigation, mining, and livestock.

Pumping locations and aquifer associations for the municipal and manufacturing groundwater uses were determined using the TWDB groundwater database and specific well locations. Distribution of mining and livestock pumping was based on land cover data from the National Land Cover Dataset (Fry and others, 2011). Distribution of irrigation pumping was based on the irrigation farmland distribution (U.S. Department of Agriculture, 2014) and the locations of specific irrigation wells. The distribution of mining, livestock, and irrigation to aquifers was based on well information from the TWDB groundwater database. We assumed the same ratio of well completion per aquifer per use category from the database. In addition, the irrigation pumping was only applied to areas more than 0.5 miles away from a river.

Domestic groundwater use is not included in the TWDB water use survey. The domestic groundwater use was estimated solely based on population in the rural areas where a public water system is not available. The census data were from four years: 1980, 1990, 2000, and 2010. Linear interpolation was used for years without census data. The groundwater consumption per person was assumed at around 100 gallons per day. The distribution of domestic use was based on assumed screen length of domestic wells (from 50 to 300 feet below ground surface). The pumping rate for each intercepted aquifer was linearly proportional to the screened aquifer thickness.

During model calibration, groundwater pumping was adjusted. The average pumping rates (1981 through 2010) for the Cretaceous (layer 1), Permian (layer 2), Marble Falls (layer 3), Ellenburger-San Saba (layer 5), Point Peak/Morgan Creek/Welge/Lion Mountain/Cap Mountain (layer 6), and Hickory units are shown in Figures 2.4.1, 2.4.2, 2.4.3, 2.4.4, 2.4.5, and 2.4.6, respectively. The pumping from model layer 1 was expected to be mainly from the Trinity and Edwards aquifers. Because the whole model layer 1 was an outcrop, the pumping was more evenly distributed (Figure 2.4.1). Note that only one pumping location existed in Concho County for the Permian unit (Figure 2.4.2). The pumping for model layer 6 was expected to be mainly from the Lion Mountain and Welge sandstones, but pumping wells were sparse and, generally, pumping rates were low (Figure 2.4.5). For the Marble Falls Aquifer (Figure 2.4.3), Ellenburger-San Saba Aquifer (Figure 2.4.4), and Hickory Aquifer (Figure 2.4.6), pumping occurred mainly in the outcrop area, but relatively high pumping was found in subcrop where public well fields or irrigation wells were located. The total simulated annual pumping (1980 through 2010) in the study area ranges from approximately 60,000 to 180,000 acre-feet per year (Figure 2.4.7).

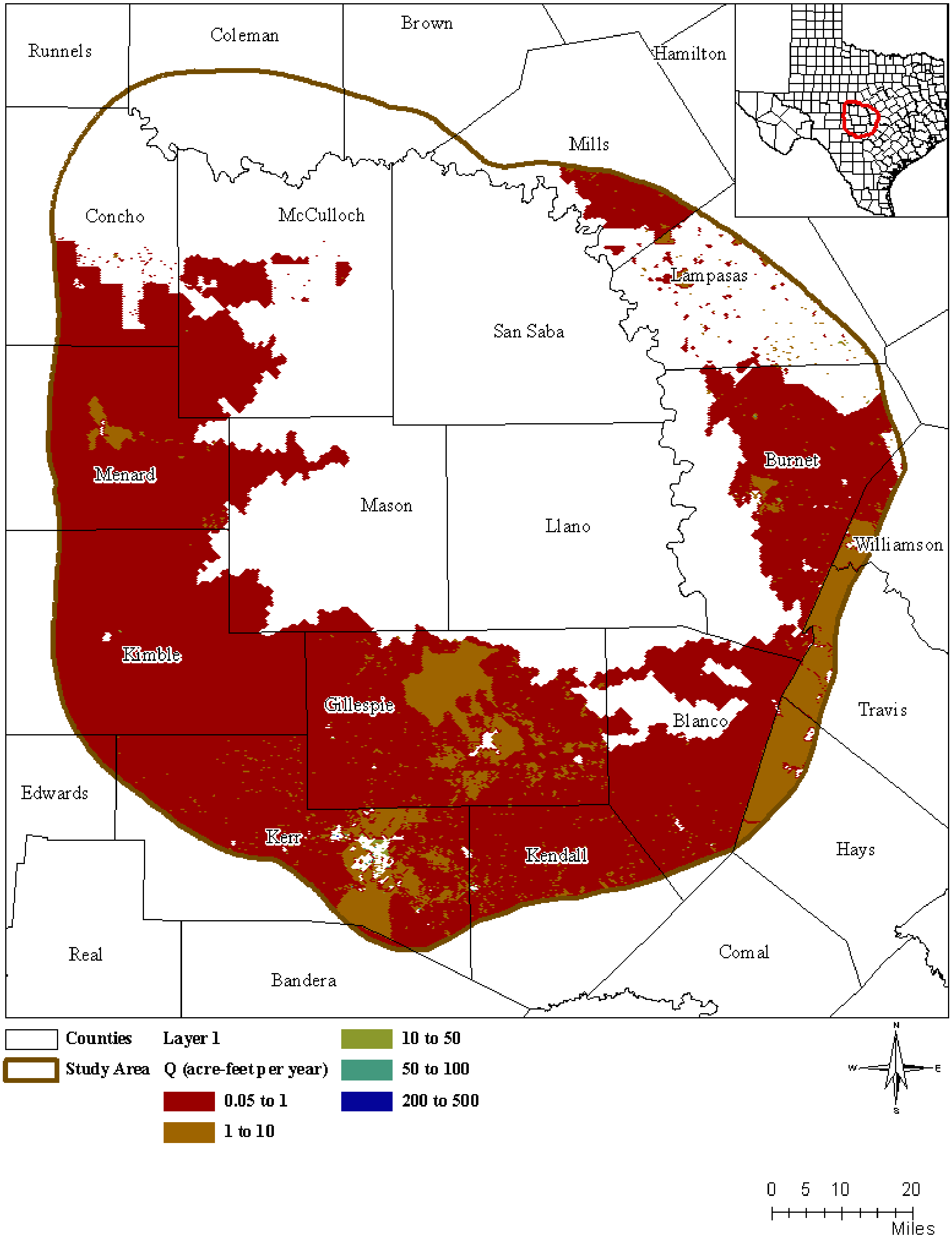

Figure 2.4.1 Simulated average pumping (1981 through 2010) for Cretaceous aquifers (layer 1).

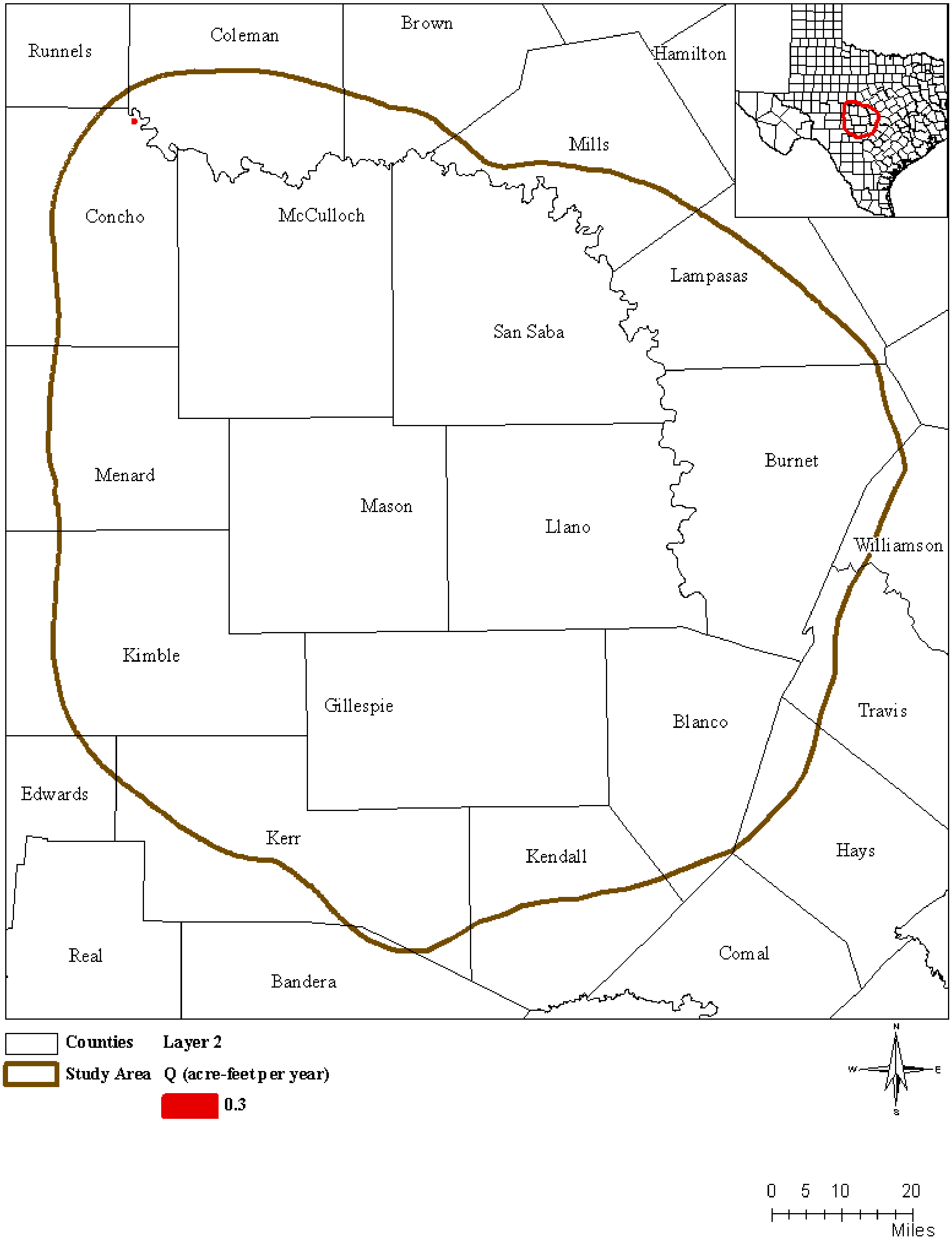

Figure 2.4.2 Simulated average pumping (1981 through 2010) for Permian unit (layer 2).

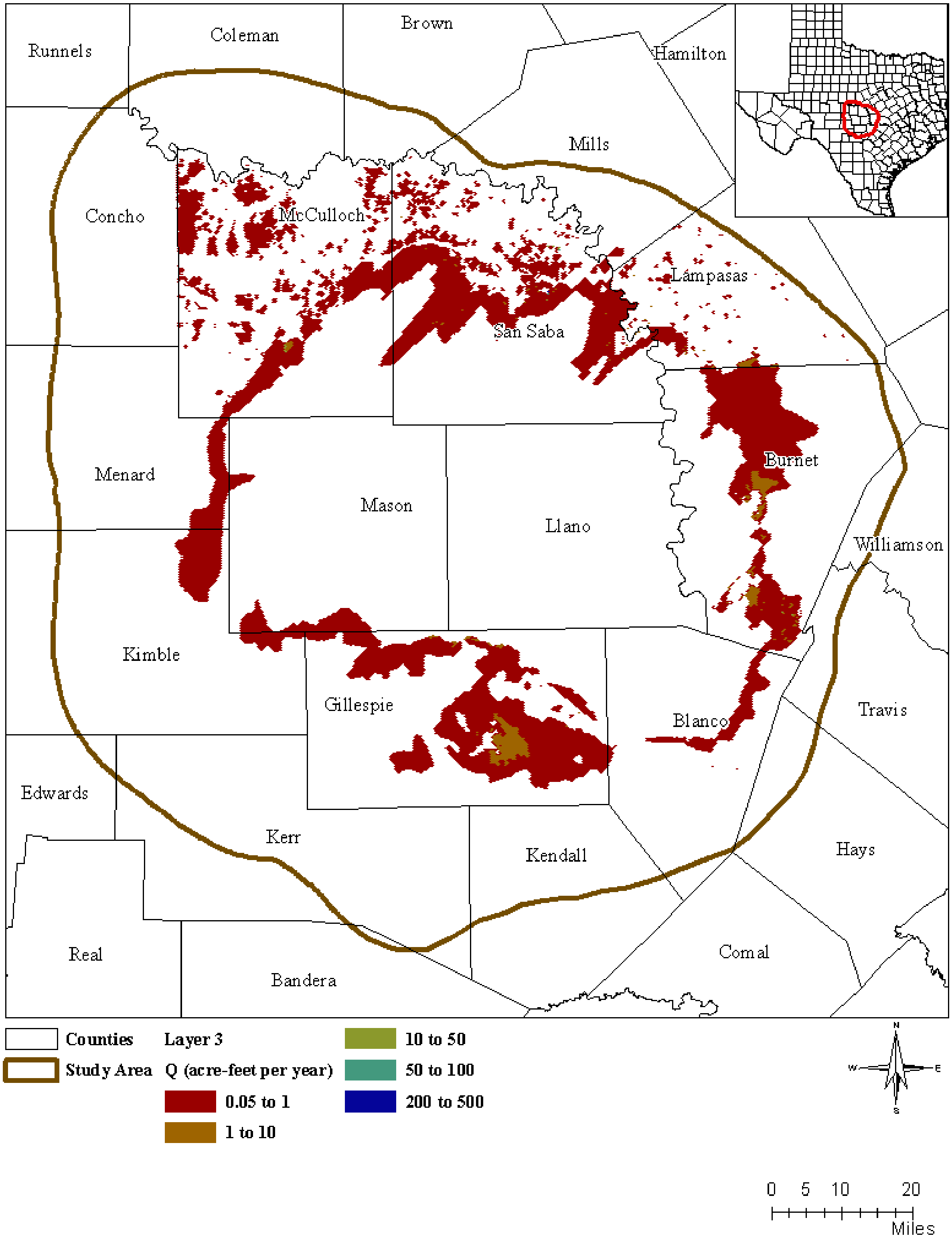

Figure 2.4.3 Simulated average pumping (1981 through 2010) for Marble Falls Aquifer (layer 3).

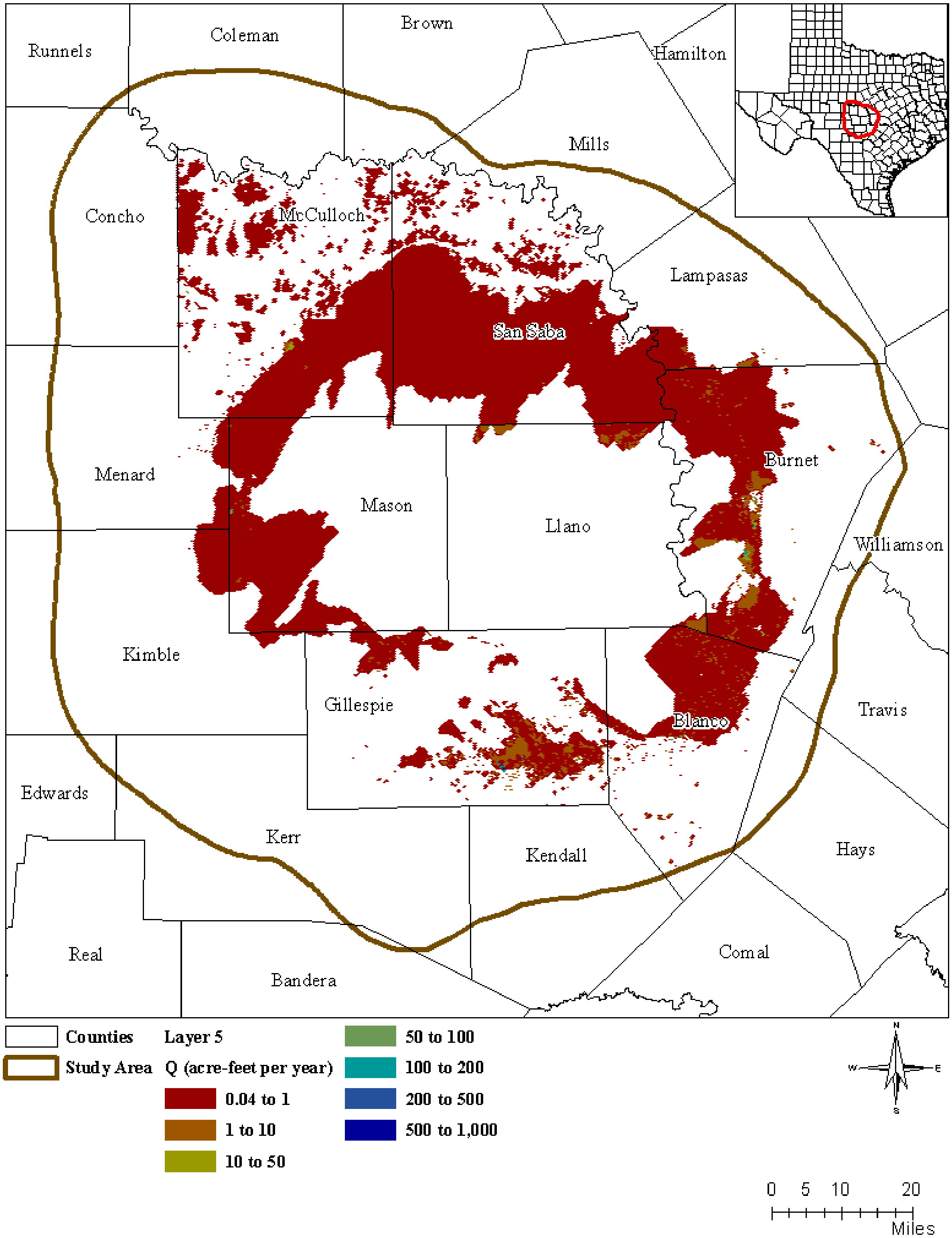

Figure 2.4.4 Simulated average pumping (1981 through 2010) for Ellenburger-San Saba Aquifer (layer 5).

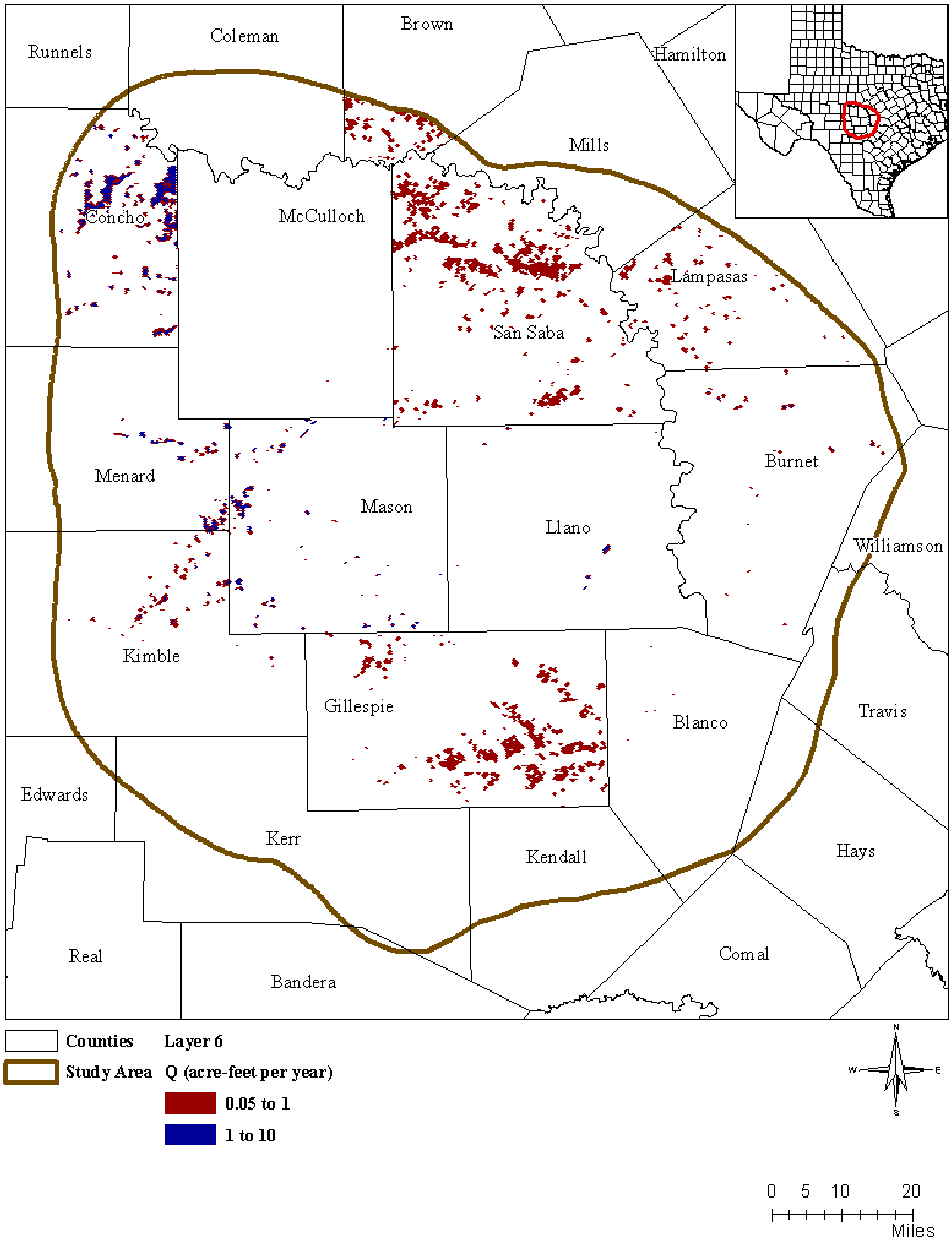

Figure 2.4.5 Simulated average pumping (1981 through 2010) for Point Peak/Morgan Creek/Welge/Lion Mountain/Cap Mountain units (layer 6).

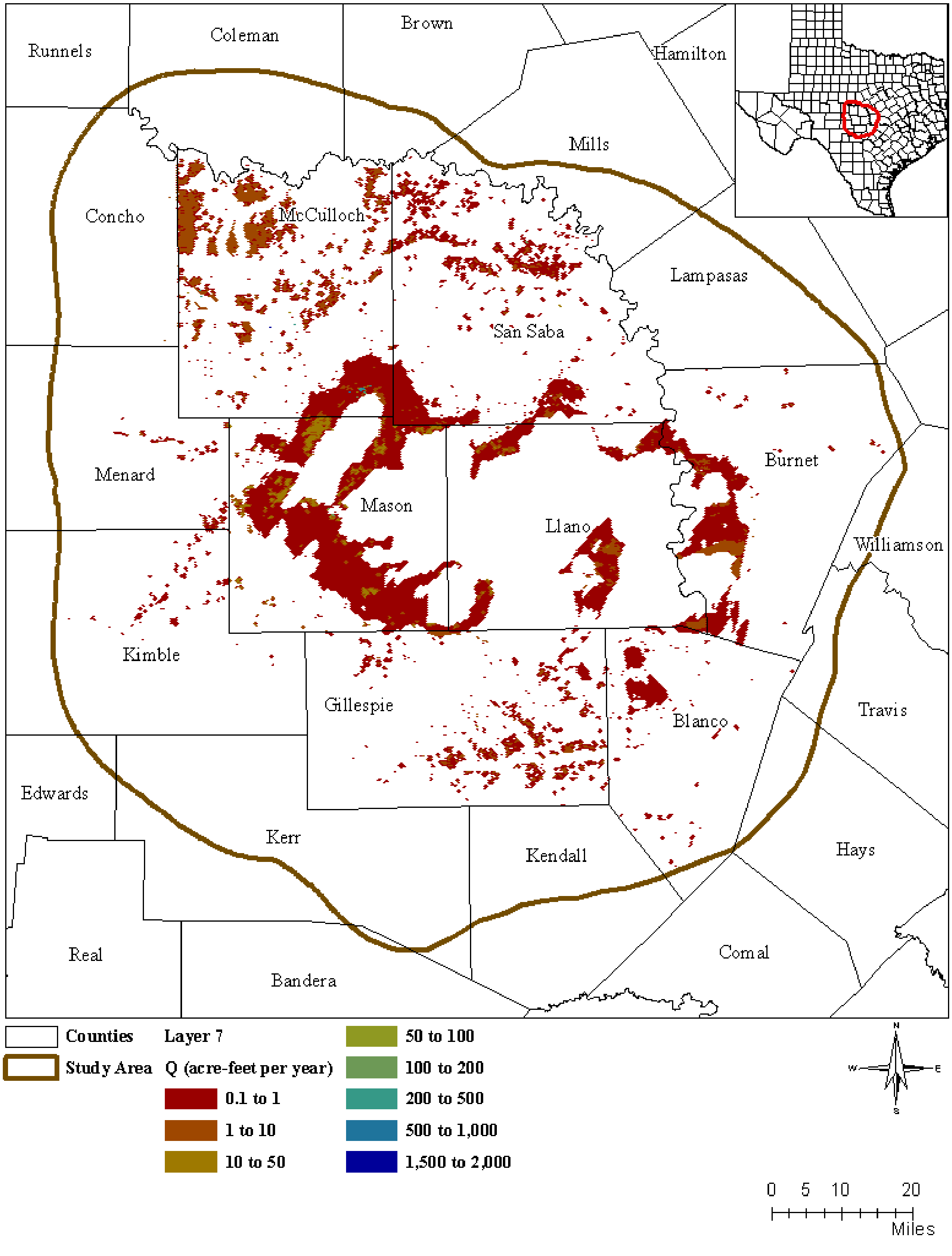

Figure 2.4.6 Simulated average pumping (1981 through 2010) for Hickory Aquifer (layer 7).

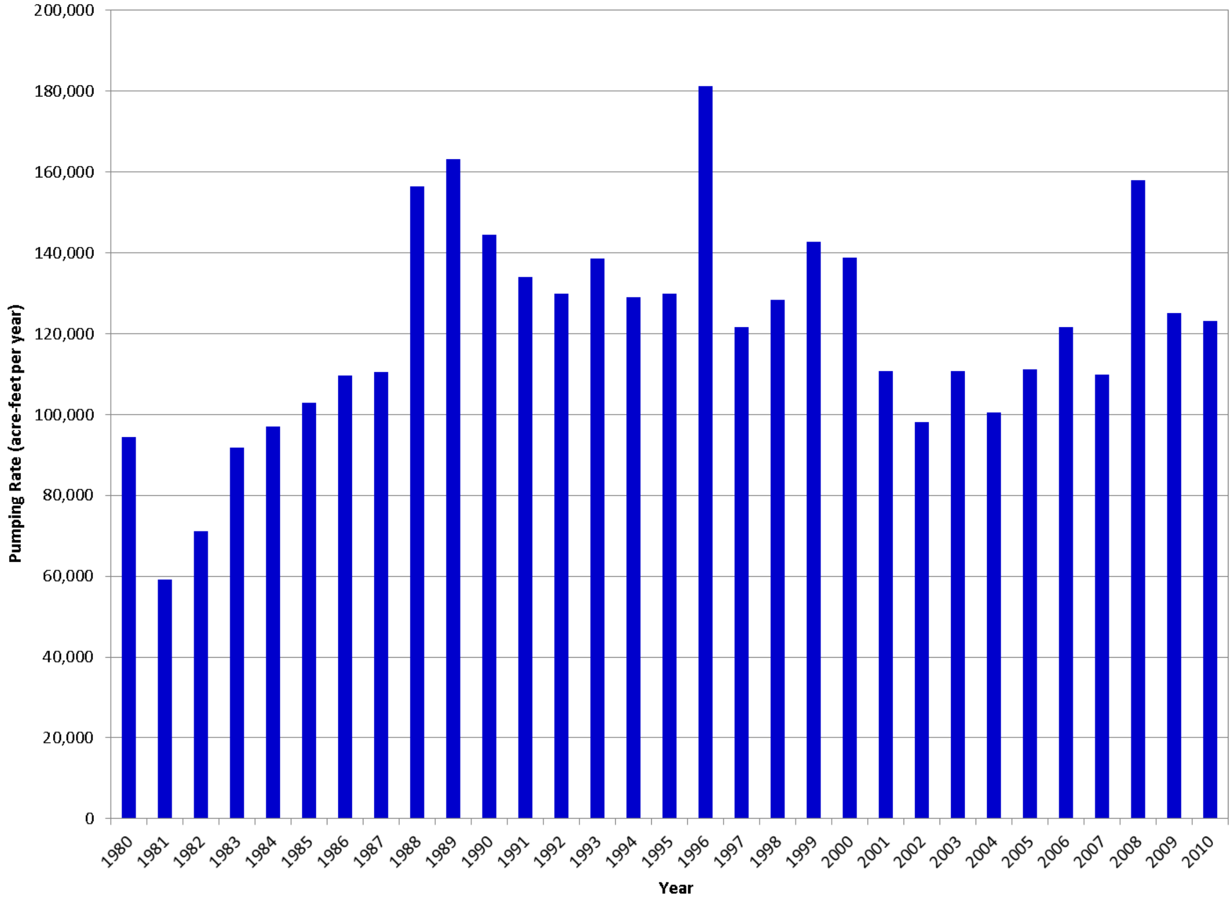

Figure 2.4.7 Simulated total pumping in study area between 1980 and 2010.

2.5 Drain Package

The MODFLOW-USG drain package, llano-uplift.drn, was used to simulate groundwater discharge to springs. A total of 287 springs were simulated in the model: 126 in model layer 1, 39 in model layer 3, 89 in model layer 5, and 33 in model layer 7. The spring location and aquifer association was taken from the TWDB groundwater database (TWDB, 2014a). The drain level at each spring was estimated from the U. S. Geological Survey's Digital Elevation Model. The drain conductance was initially estimated based on the horizontal hydraulic conductivity of the model cell where the drain was located. During the model calibration, the drain conductance was slightly adjusted because it did not impact the simulated water levels. The drain level and conductance for each spring were assumed to remain the same during the transient simulation period (1980 through 2010). In addition, because spring flux measurements were sparse and remained largely uncertain, using springs for calibration targets was not explored. The simulated spring locations are shown in Figures 2.5.1, 2.5.2, 2.5.3, and 2.5.4, respectively, for model layers 1, 3, 5, and 7.

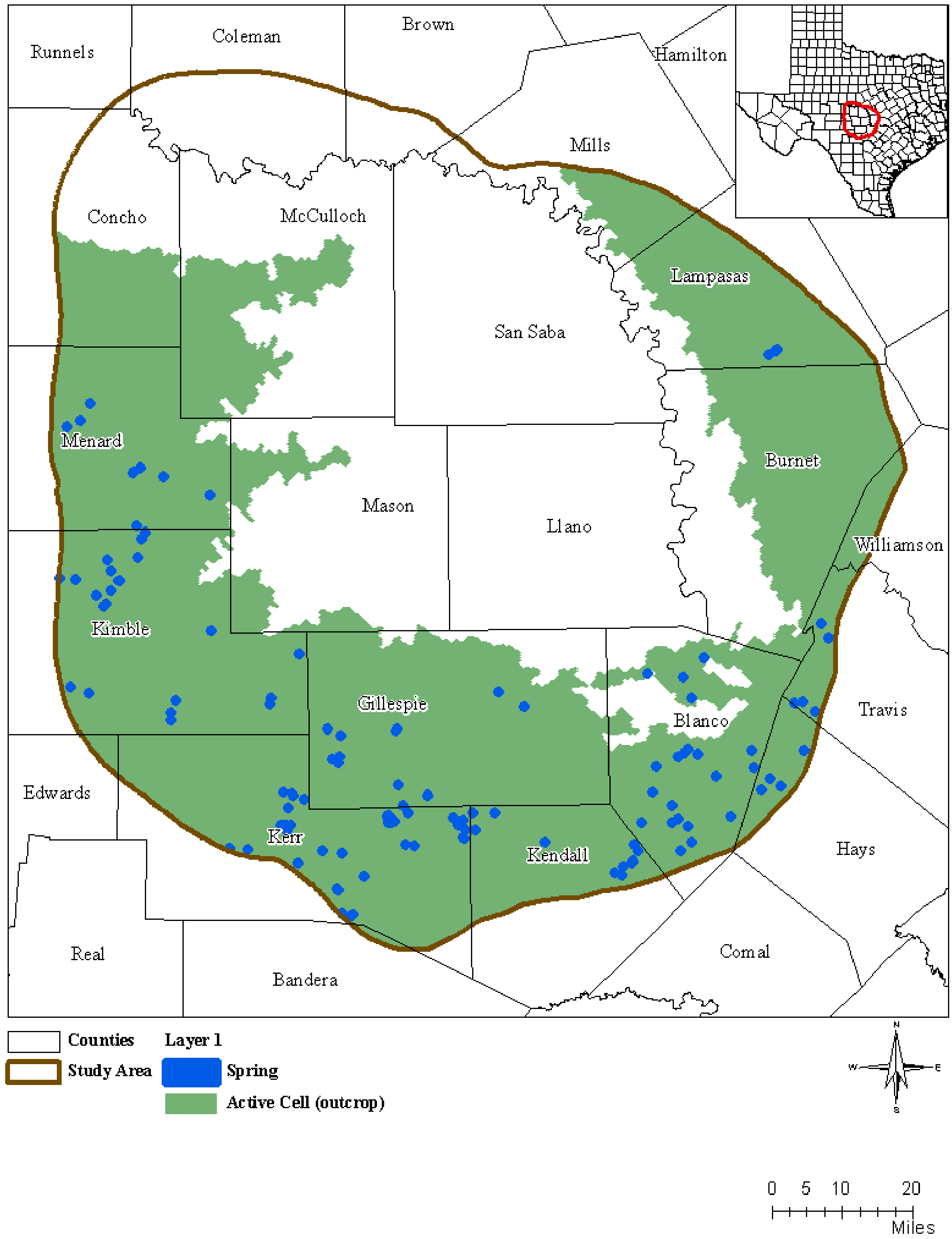

Figure 2.5.1 Location of simulated springs in model layer 1.

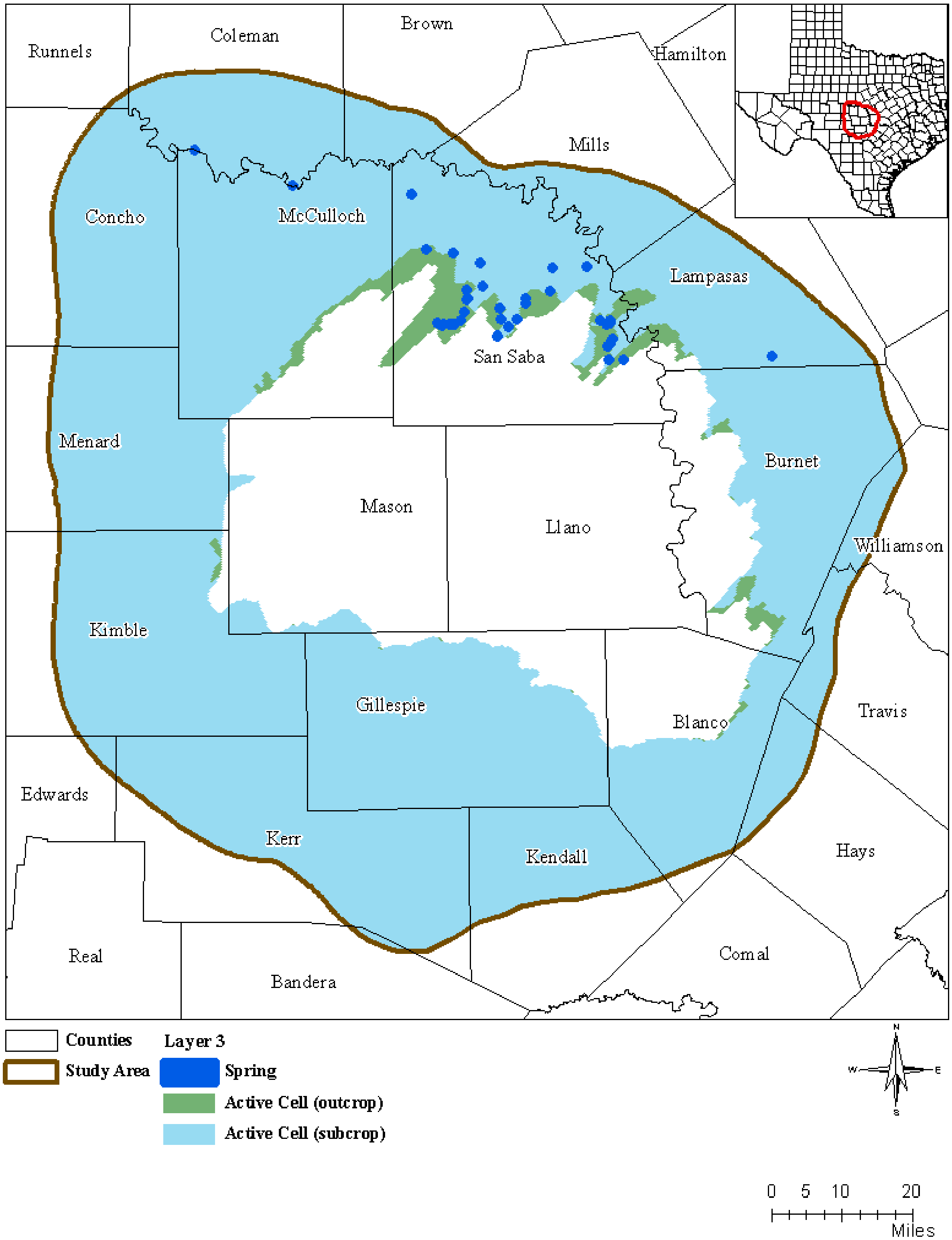

Figure 2.5.2 Location of simulated springs in model layer 3.

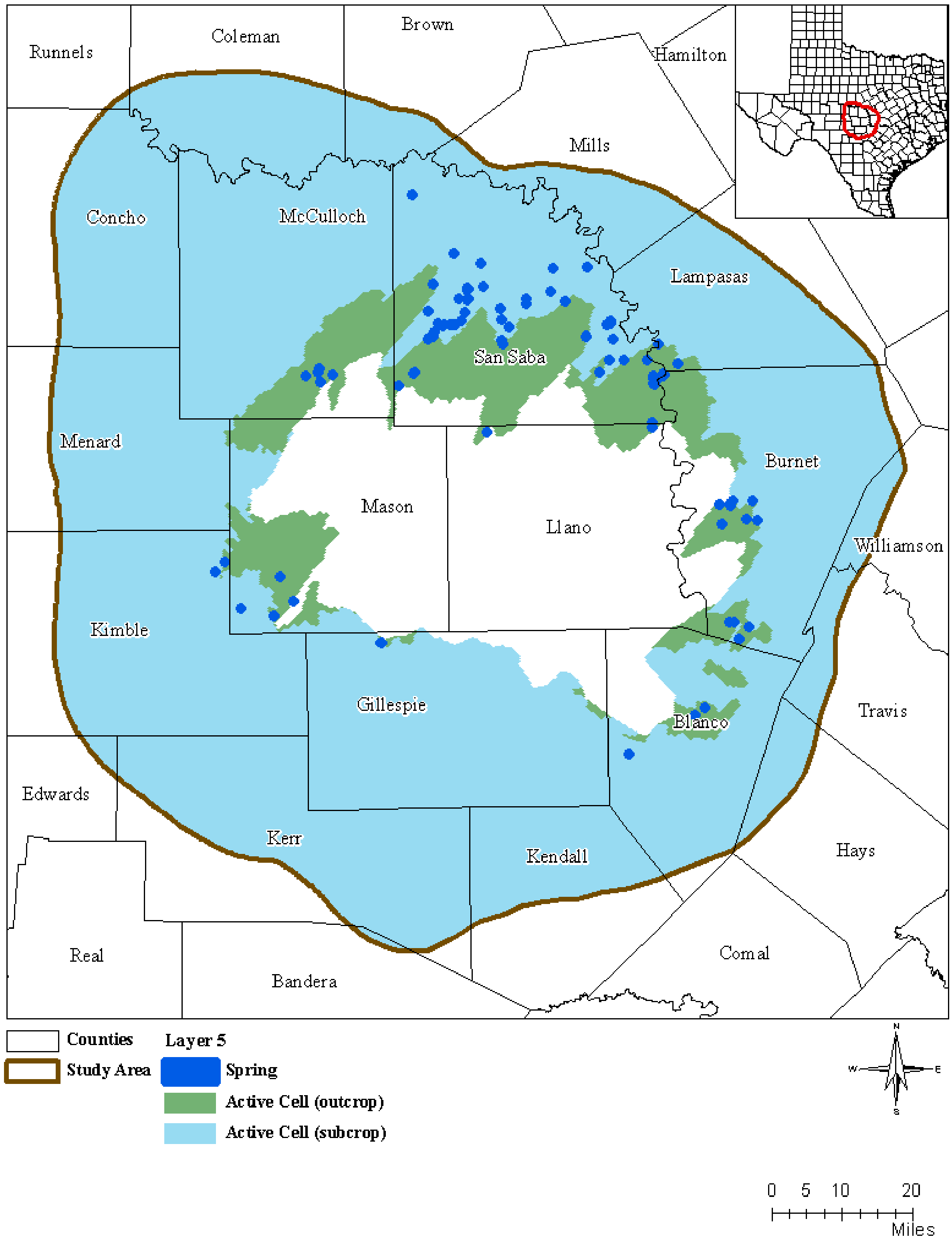

Figure 2.5.3 Location of simulated springs in model layer 5.

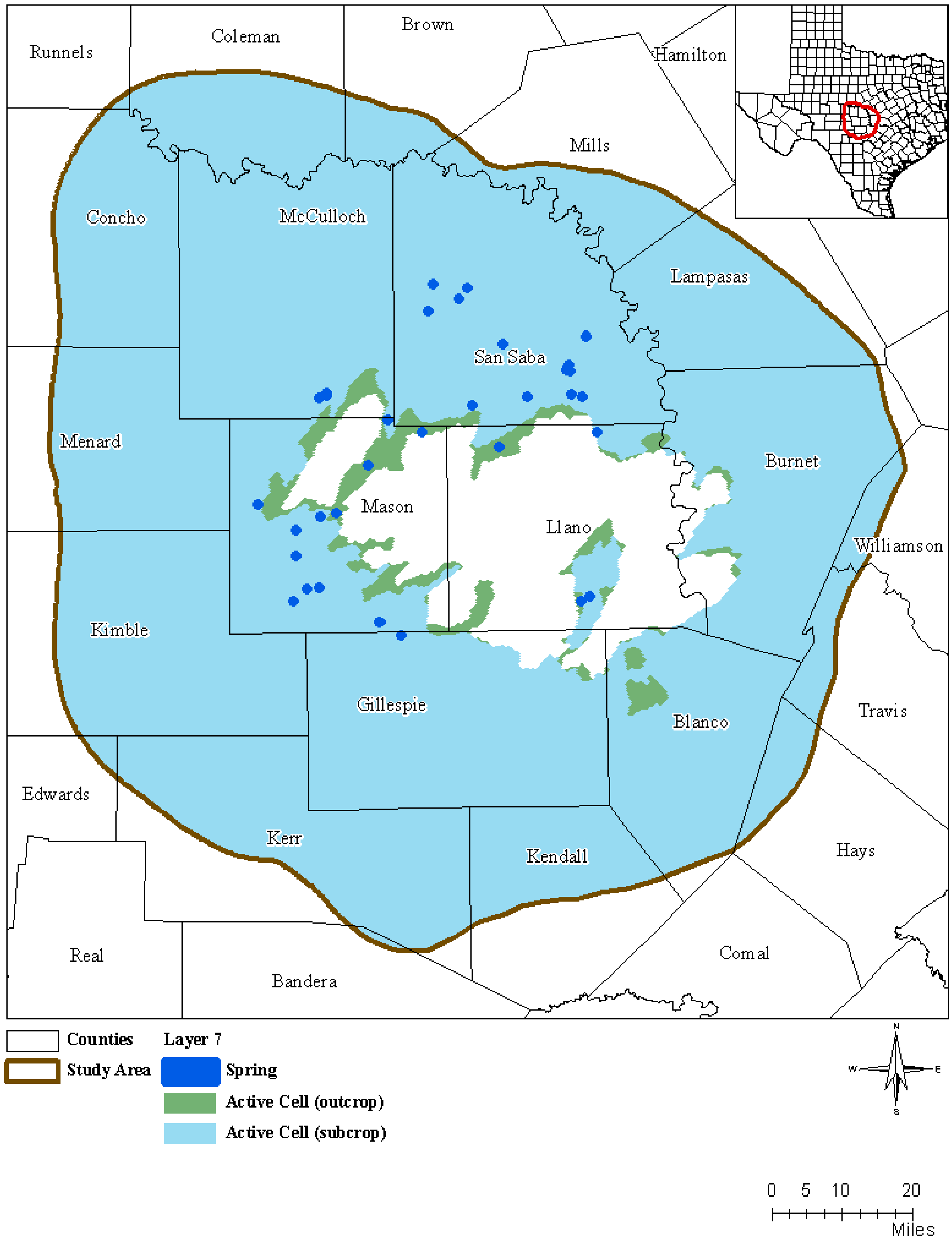

Figure 2.5.4 Location of simulated springs in model layer 7.

2.6 Recharge Package

The MODFLOW-USG recharge package, llano-uplift.rch, was used to simulate the effective groundwater recharge due to infiltration of precipitation in the whole study area. The initial recharge rates were estimated from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) precipitation raster data.

During the model calibration, the recharge rates were adjusted accordingly based on surficial geology. Table 2.6.1 shows the average calibrated recharge rates at outcrops for different years within the study area. Higher rates were used at the outcrop areas of aquifers (layers 1, 3, 5, and 7) and lower rates were assigned to the outcrop areas of confining units and the Precambrian rocks (layers 2, 4, 6, and 8). The average recharge rate for the entire study area was about 0.79 inches per year. Details of spatial variation of the calibrated groundwater recharge are also presented in Figures 2.6.1 and 2.6.2, respectively, for 1991and 2006. Though the minimum and maximum calibrated recharge rates were about the same between the two selected years, the average from 1991 (0.86 inches per year) was about 16 percent higher than 2006 (0.74 inches per year).

The total simulated recharge per year within the study area was approximately 2 to 5 percent of the total precipitation (Table 2.6.2), which is consistent with the conceptual model. The calibrated groundwater recharge was also positively related to the precipitation with a correlation coefficient of 0.74 (Figure 2.6.3).

Table 2.6.1 Simulated effective groundwater recharge rates at outcrop areas (inch per year).

Year	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6	Layer 7	Layer 8	Entire Study Area
1980	0.71	0.35	2.63	0.13	2.33	1.59	1.29	0.17	0.84
1981	0.61	0.21	2.13	0.25	3.18	0.89	1.00	0.20	0.80
1982	0.64	0.21	2.33	0.19	2.90	0.96	1.02	0.20	0.80
1983	0.67	0.21	2.34	0.19	2.59	0.71	2.01	0.20	0.80
1984	0.54	0.15	1.32	0.14	3.30	0.88	0.80	0.52	0.77
1985	0.60	0.15	0.94	0.13	3.30	0.45	0.69	0.53	0.78
1986	0.72	0.32	2.32	0.17	2.75	0.49	1.86	0.19	0.85
1987	0.76	0.23	0.93	0.19	3.01	0.44	0.90	0.13	0.81
1988	0.70	0.30	1.15	0.34	2.45	1.11	1.67	0.14	0.79
1989	0.53	0.24	0.94	0.13	3.47	0.87	1.26	0.13	0.76
1990	0.81	0.26	1.82	0.34	2.26	0.96	1.06	0.23	0.83
1991	0.90	0.29	1.28	0.14	2.37	0.46	1.30	0.15	0.86
1992	0.61	0.26	1.24	0.14	3.57	0.46	0.77	0.24	0.81
1993	0.54	0.29	0.25	0.07	3.35	0.07	1.27	0.21	0.73
1994	0.70	0.36	2.00	0.11	3.08	0.13	1.58	0.14	0.84
1995	0.53	0.27	1.48	0.45	3.26	1.04	0.69	0.12	0.75
1996	0.56	0.31	0.99	0.48	3.11	1.17	1.00	0.11	0.76
1997	0.76	0.40	1.44	0.32	2.95	1.32	1.04	0.14	0.89
1998	0.65	0.26	1.80	0.10	2.83	1.13	0.89	0.13	0.79
1999	0.36	0.24	2.50	0.11	3.42	0.65	0.73	0.13	0.68
2000	0.60	0.26	2.63	0.12	3.17	1.11	0.96	0.16	0.82
2001	0.64	0.28	1.60	0.10	2.84	1.16	1.05	0.12	0.78
2002	0.64	0.32	1.72	0.10	3.21	1.27	1.30	0.13	0.84
2003	0.44	0.24	1.32	0.09	3.56	0.81	0.74	0.11	0.71
2004	0.67	0.43	1.91	0.11	3.29	1.52	0.87	0.14	0.89
2005	0.41	0.24	1.04	0.35	3.60	0.66	0.63	0.10	0.68
2006	0.50	0.24	2.09	0.16	3.35	0.48	0.70	0.17	0.74
2007	0.59	0.29	2.55	0.38	3.56	0.50	0.74	0.20	0.83
2008	0.53	0.32	1.06	0.14	3.35	1.17	1.30	0.14	0.78
2009	0.70	0.30	0.99	0.14	2.91	1.12	1.18	0.14	0.82
2010	0.71	0.21	1.42	0.17	2.59	1.04	1.53	0.18	0.80
Minimum	0.36	0.15	0.25	0.07	2.26	0.07	0.63	0.10	0.68
Maximum	0.90	0.43	2.63	0.48	3.60	1.59	2.01	0.53	0.89
Average	0.62	0.27	1.62	0.19	3.06	0.86	1.09	0.18	0.79

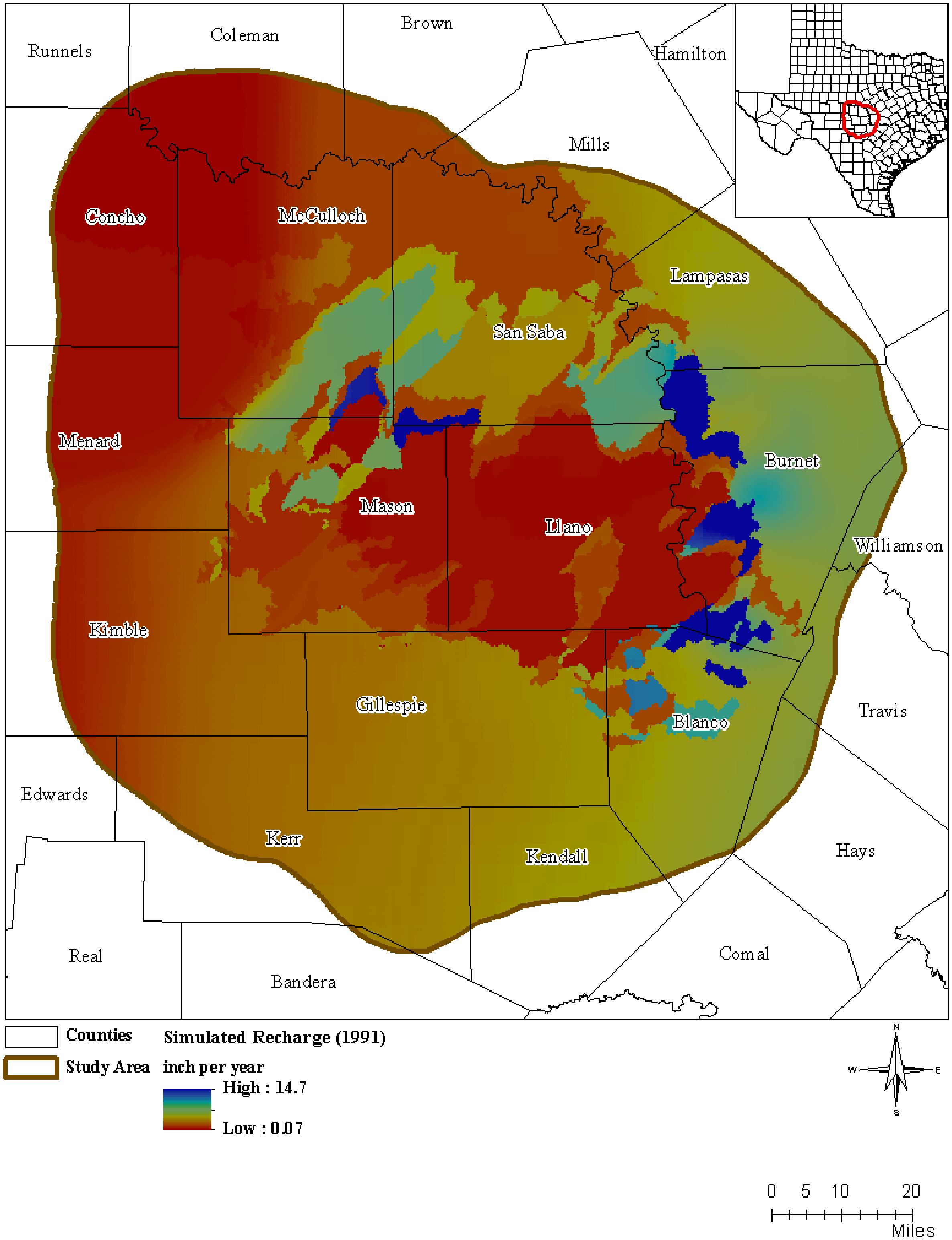

Figure 2.6.1 Calibrated groundwater recharge for 1991.

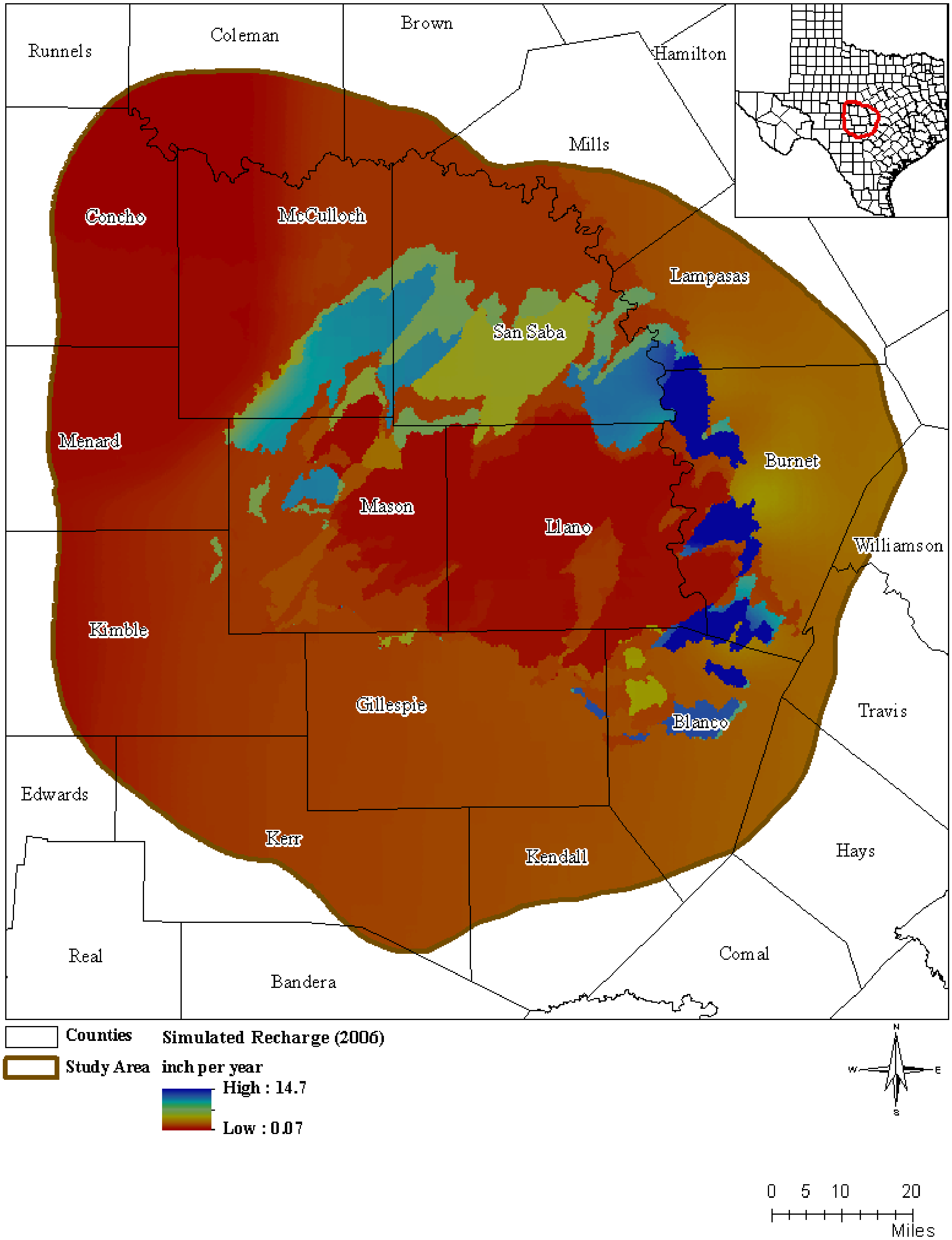

Figure 2.6.2 Calibrated groundwater recharge for 2006.

Table 2.6.2 Comparison between simulated groundwater recharge and precipitation from Parameter-elevation Regressions on Independent Slopes Model (PRISM).

Year	Precipitation (acre-feet per year)	Simulated Recharge (acre-feet per year)	Simulated Recharge/Precipitation
1980	16,405,510	509,286	3.10%
1981	20,089,799	485,899	2.42%
1982	14,924,638	485,382	3.25%
1983	14,744,818	486,999	3.30%
1984	15,319,961	470,286	3.07%
1985	17,059,871	474,678	2.78%
1986	22,001,038	515,473	2.34%
1987	19,372,919	493,455	2.55%
1988	12,135,603	480,758	3.96%
1989	14,339,071	460,942	3.21%
1990	19,537,220	504,792	2.58%
1991	23,797,579	521,994	2.19%
1992	22,455,263	489,595	2.18%
1993	15,135,064	441,900	2.92%
1994	18,975,801	510,644	2.69%
1995	16,931,936	456,432	2.70%
1996	16,347,538	461,297	2.82%
1997	22,761,041	538,351	2.37%
1998	19,576,095	479,286	2.45%
1999	11,565,835	411,552	3.56%
2000	18,940,906	497,886	2.63%
2001	18,295,443	476,609	2.61%
2002	20,572,832	512,355	2.49%
2003	14,749,432	431,453	2.93%
2004	23,818,098	540,361	2.27%
2005	13,113,603	415,723	3.17%
2006	12,932,961	446,881	3.46%
2007	25,702,359	503,528	1.96%
2008	9,578,060	472,730	4.94%
2009	18,827,923	497,793	2.64%
2010	16,522,835	486,727	2.95%
Minimum	9,578,060	411,552	1.96%
Maximum	25,702,359	540,361	4.94%
Average	17,670,851	482,614	2.85%

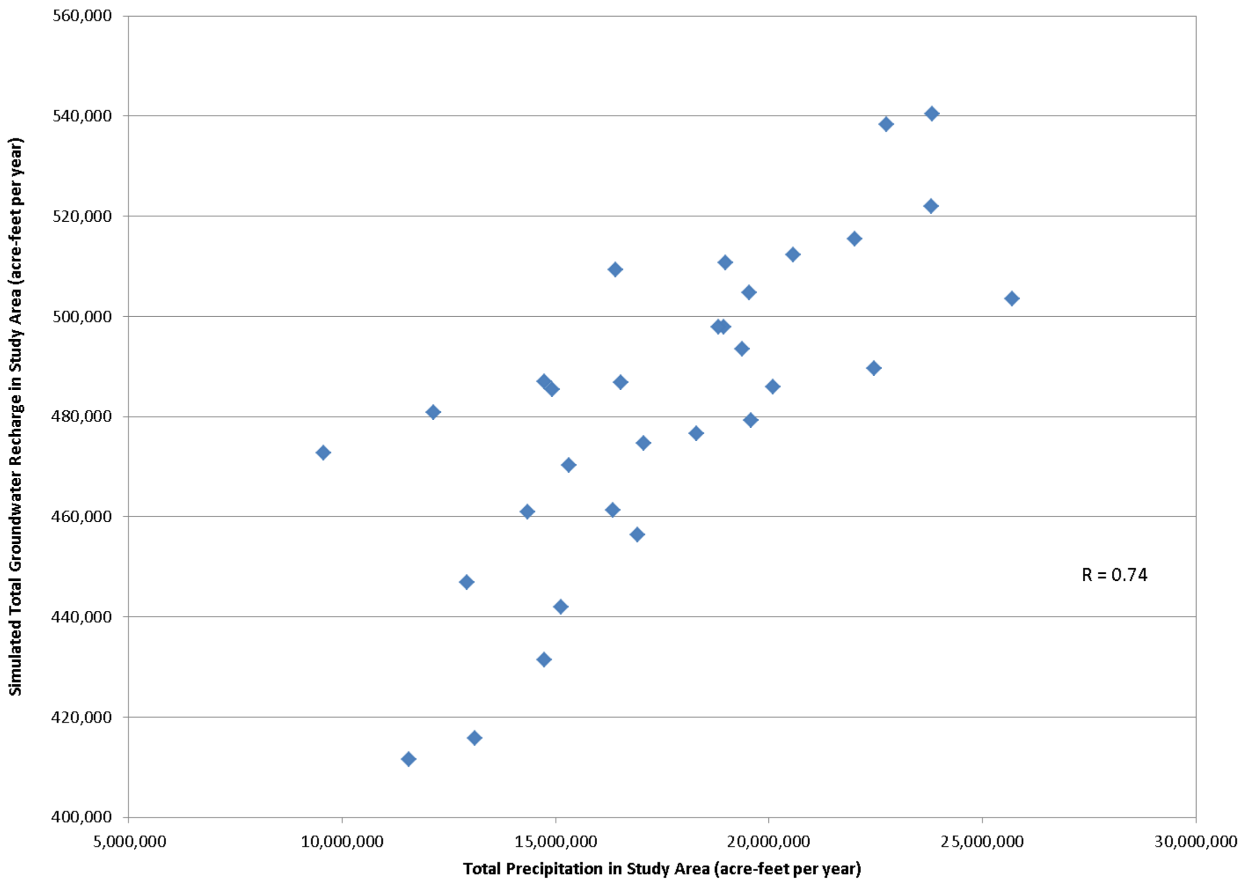

Figure 2.6.3 Correlation between simulated groundwater recharge and precipitation.

2.7 River Package

The MODFLOW-USG river package, llano-uplift.riv, was used to simulate the interaction of the aquifers with perennial streams and reservoirs in the study area.

All rivers were assumed under steady state with a width of 50 feet and water depth of three feet. The riverbed elevation was assigned the minimum digital elevation model value. The lake and reservoir levels were from field measurements or estimated from the U. S. Geological Survey's topographic map. Thus, the lakes and reservoirs with field measurements were under transient state. This transient state included variation of lake and reservoir levels and coverage. As a result, a lake/reservoir cell in the river package may not exist in certain stress periods. The lake bottom was estimated from lake levels and rating curves. If no rating curve was available, then the lake depth was calculated using conservation area, capacity, and pool elevation which were downloaded from https://www.tshaonline.org/handbook/online/articles/roogh. During the calculation a minimum lake depth of one foot was enforced.

The conductance of the river, lake, and reservoir cells were estimated from the assumed river width, lake coverage, and initial hydraulic conductivity value at the model cell. During the model calibration, the conductance was slightly adjusted since the model was not very sensitive to the change of conductance. Figure 2.7.1 shows the location of the simulated rivers and lakes and reservoirs with their respective layers colored.

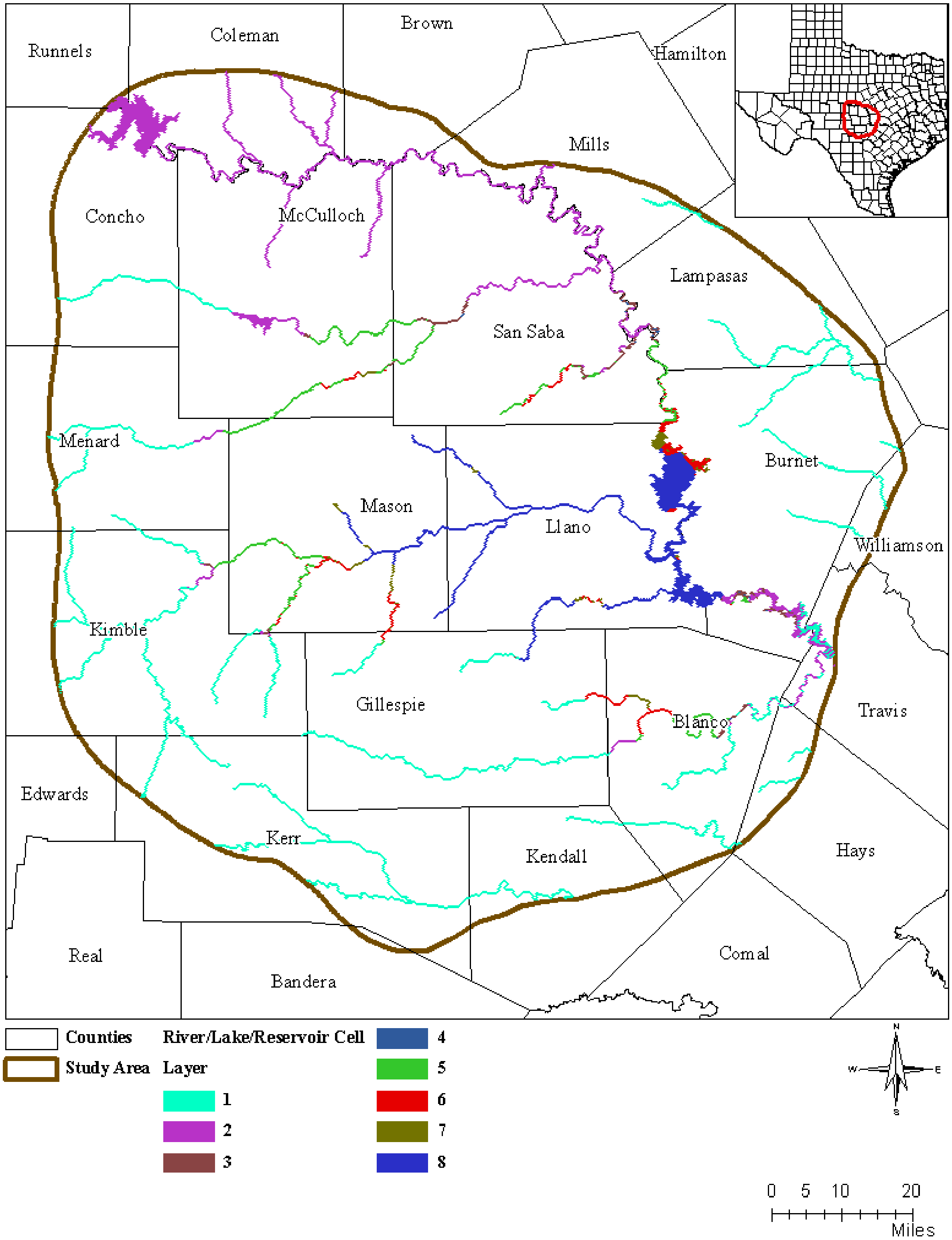

Figure 2.7.1 Location of simulated rivers, lakes, and reservoirs.

2.8 General Head Package

The MODFLOW-USG general head package, llano-uplift.ghb, was used to simulate groundwater flow in the Cretaceous or younger units (layer 1) across the study area boundary. The head value at each general head boundary cell was estimated from the average historical measured water levels. The initial conductance of the boundary was calculated from the initial horizontal hydraulic conductivity, saturated thickness, and a buffer distance of two miles. During the model calibration, conductance values were adjusted. The location of the general head boundary is shown in Figure 2.8.1.

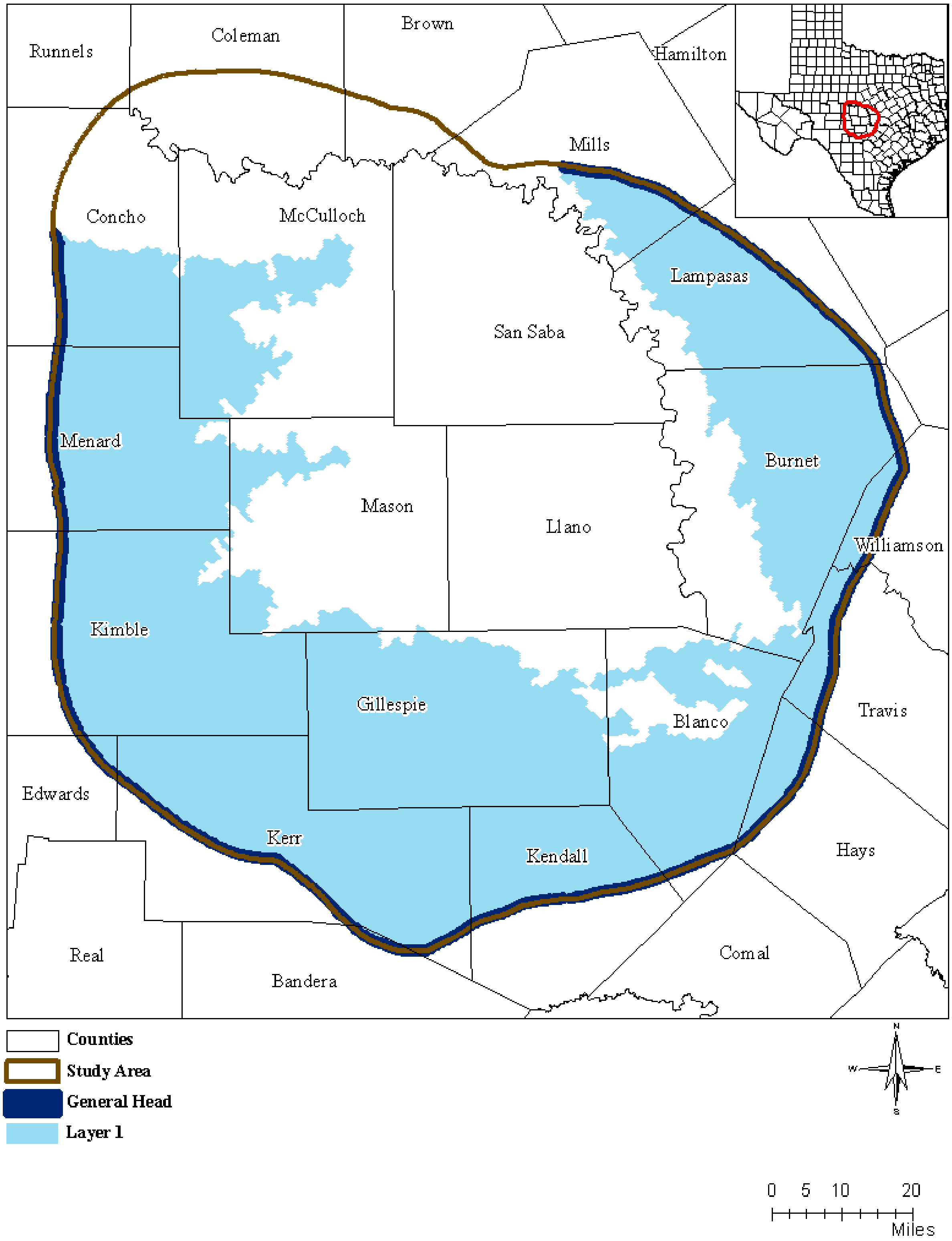

Figure 2.8.1 Location of general head boundary in model layer 1 (active cells only).

2.9 Sparse Matrix Solver Package

The MODFLOW-USG sparse matrix solver package, llano-uplift.sms, was used to solve the flow equation. This solver differs from previous MODFLOW solvers in that the new solver is able to solve an unsymmetrical matrix. To help model convergence, the χMD solver (Ibaraki, 2005) with the Newton-Raphson iteration and backtracking was chosen to solve the matrix. The maximum head convergence criteria of outer and inner iterations were set at one foot and 0.0001 feet, respectively. The errors for the volumetric flow balance for each stress period and accumulative volumetric flow balance were all far less than one percent.

2.10 Output Control File

The MODFLOW Output Control file specifies when, during the simulation, water level, drawdown, and water budget information are saved. The Output Control file was set up to save these results at the end of each stress period.

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3.0 Model Calibration and Results

Calibration of a groundwater flow model involves adjusting model input parameters, within a reasonable range, to match simulated values to measured or target values.

The primary targets for the calibration were water levels measured at wells (i.e. head targets). The calibration involved 2,250 head targets from 600 wells screened in the Marble Falls, Ellenburger-San Saba, and Hickory aquifers (Figure 3.0.1). The model was also qualitatively evaluated against a calculated river gain/loss value from Slade and others (2002). Since the original river gain/loss study by Slade and others (2002) was conducted on different sections of stream channels, the values were normalized by dividing the stream segment lengths. An average of the normalized values was used to calculate the total river gain/loss by multiplying the total stream length. Streams within the Colorado and Guadalupe river basins were included in the river gain/loss comparison (Figure 3.0.2). Due to higher uncertainty associated with low flow rates, the streams of the Brazos River basin in the study area were not selected.

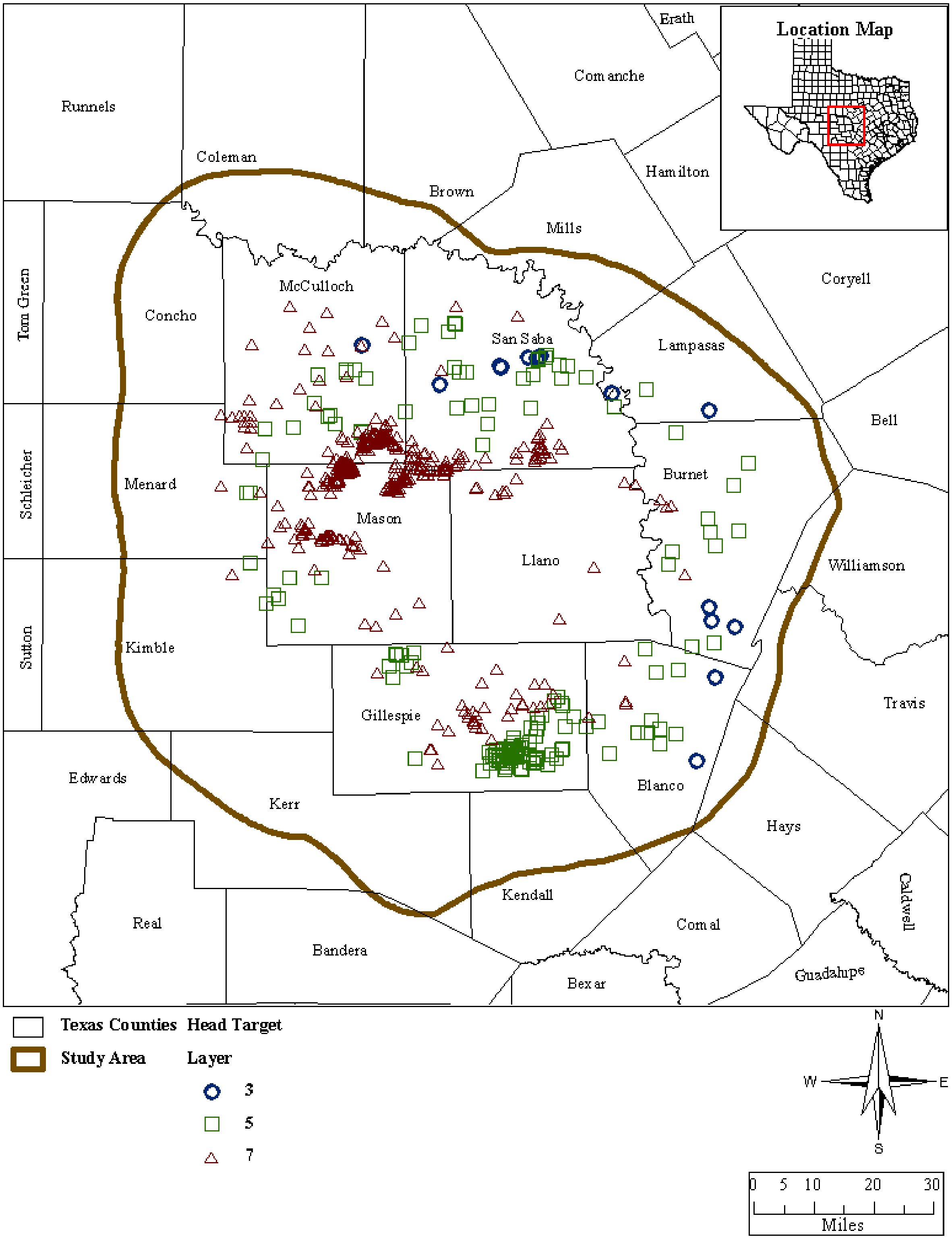

Figure 3.0.1 Location of hydraulic head targets in Marble Falls, Ellenburger-San Saba, and Hickory aquifers.

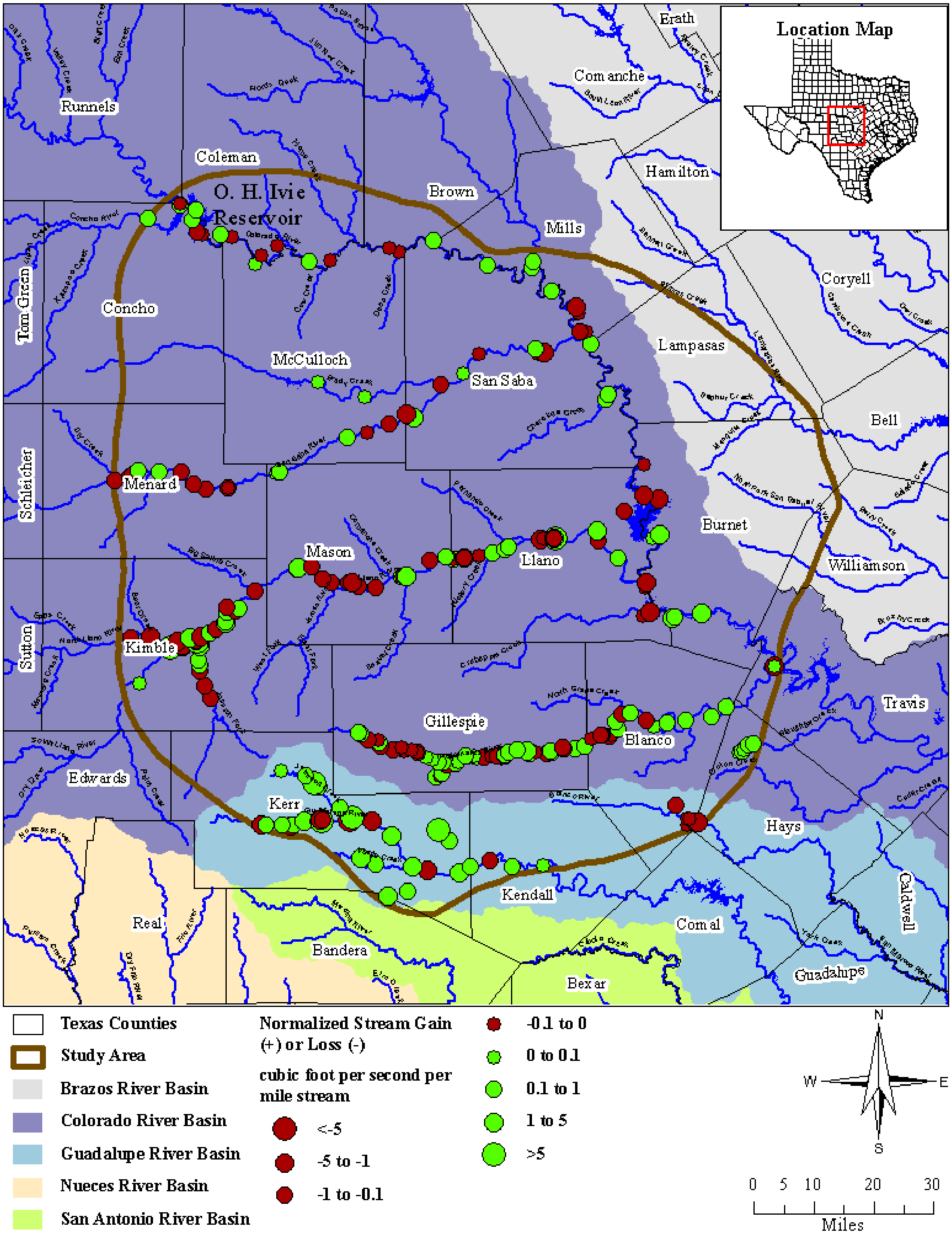

Figure 3.0.2 Normalized stream gain (+) or loss (-) of Colorado and Guadalupe river basins in study area (calculated from Slade and others (2002)).

3.1 Calibration Procedure

During the model calibration, the following parameters were adjusted: hydraulic properties (horizontal hydraulic conductivity, vertical anisotropy, specific yield, and storativity), drain conductance, conductance of river, lake, and reservoir, conductance of general head boundary, recharge, and pumping. The model was calibrated using a combination of parameter estimation program PEST (Watermark Numerical Computing, 2004) and trial-and-error.

To avoid non-uniqueness, a step-by-step approach was applied to ensure that the number of adjusted parameters were less than the number of targets. In addition, each parameter was adjusted within its reasonable range (based on available data and professional judgement). Details of the input parameters for the calibrated model can be found in the sections of layer-property flow package (hydraulic properties), drain package, river package, general head package, recharge package, and well package.

3.2 Model Simulated Versus Measured Heads

The overall head calibration for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers is shown in Figure 3.2.1. Figures 3.2.2, 3.2.3, and 3.2.4 show the head calibration for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers, respectively. The head residual (simulated head minus measured head) statistic summary indicates that the model is well calibrated to the measured head with head residual standard deviations over ranges of measured heads being less than 10 percent which is the TWDB groundwater flow model criterion. Details of measured and simulated heads are included in Table A1 of Appendix A.

Distribution of average head residuals (1980 through 2010) for each minor aquifer is presented in Figures 3.2.5 (Marble Falls), 3.2.6 (Ellenburger-San Saba), and 3.2.7 (Hickory), respectively. In general, positive and negative residuals for all three aquifers are evenly distributed across the study area except Burnet County where the simulated heads were lower than the measured heads in the subcrop area.

Simulated water levels for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers by the end of 2010 are presented in Figures 3.2.8, 3.2.9, and 3.2.10, respectively. As shown in the figures, the highest simulated water levels were from north-central Gillespie County southwest to Kerr County. This high water level area coincides with the Llano Arch (see Figure 2.2.3 in conceptual report). From there, the groundwater flows around the Llano Uplift and converges toward the Colorado River. The lowest simulated water levels were along the Colorado River in southern Burnet County. Locally, rivers influence the groundwater flow in or close to the outcrop area where the river channels cut into the formations, such as western Mason County, to form local head depressions or discharge points (Figures 3.2.9 and 3.2.10).

Comparison of the groundwater flow pattern in model layer 1 (predominantly Cretaceous aquifers) indicates that this numerical model produced similar flow patterns to previous models (Mace and others, 2000; Jones and others, 2009; Anaya and Jones, 2009; Hutchison and others, 2011; INTERA and others, 2014).

To show temporal calibration, hydrographs were produced at wells with more than 10 water level measurements for more than a 10-year span. Some counties have no wells that meet this criterion, while others may have multiple wells from the same aquifer. Some of the hydrographs are presented in this section with the well locations shown in Figure 3.2.11. The rest of the hydrographs are presented in Appendix B.

Figures 3.2.12 through 3.2.14 show the hydrographs at the selected wells in the Marble Falls Aquifer. The hydrographs at the selected wells in the Ellenburger-San Saba Aquifer are shown in Figures 3.2.15 through 3.2.21. The hydrographs at the selected wells in the Hickory Aquifer are shown in Figures 3.2.22 through 3.2.28. In general, the simulated water levels followed the measured values. Similar trends can also be observed in the hydrographs presented in Appendix B. Since each model grid represents an average condition of varied topography, geologic contacts, and hydrogeologic properties across the grid, the model heads tend to be higher than the measured heads in valleys and lower than measured values in ridges. As a result, the model may not accurately reproduce local sharp water level variations along valleys and ridges.

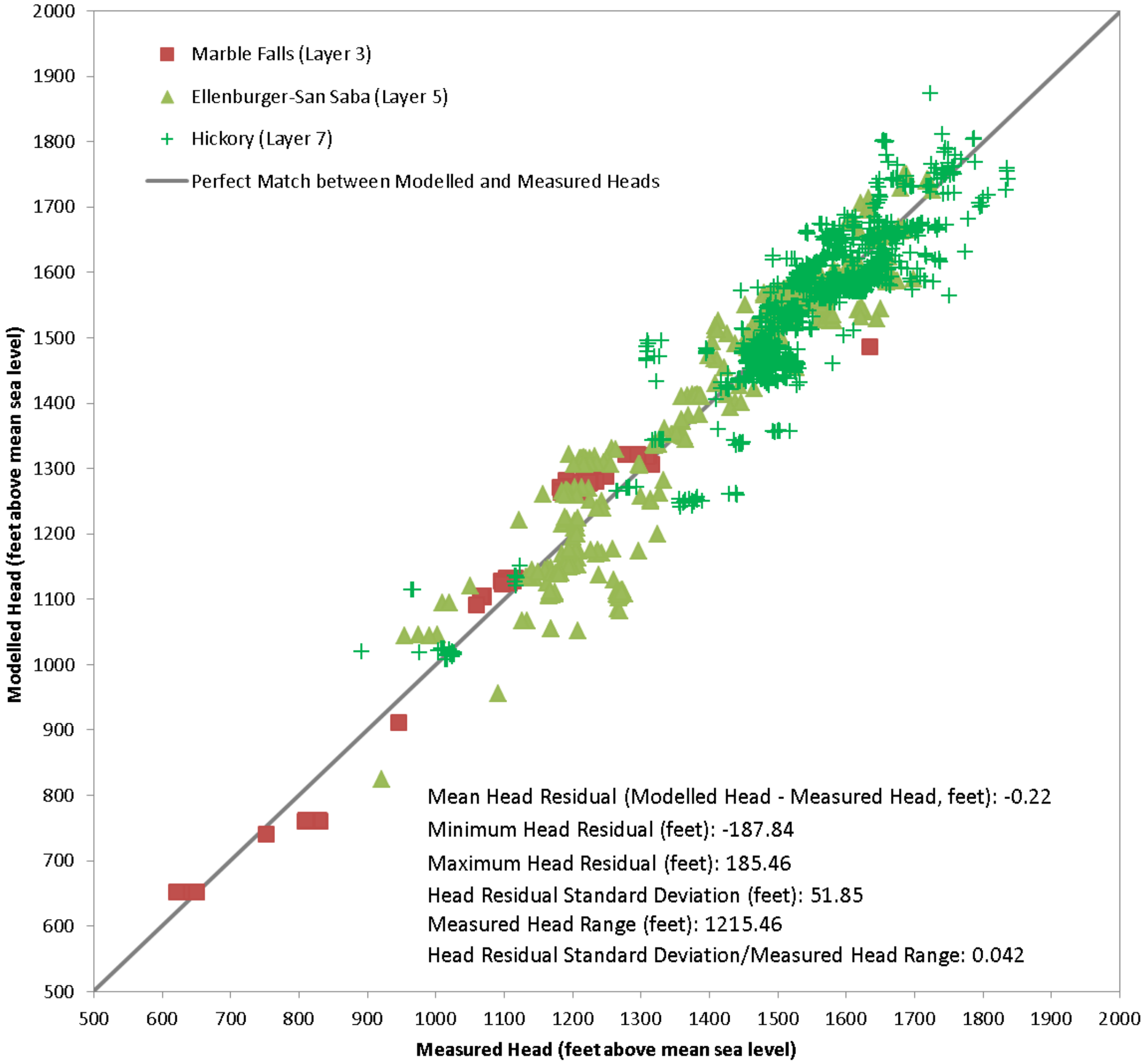

Figure 3.2.1 Simulated versus observed hydraulic head and statistic summary in Marble Falls (layer 3), Ellenburger-San Saba (layer 5), and Hickory (layer 7) aquifers.

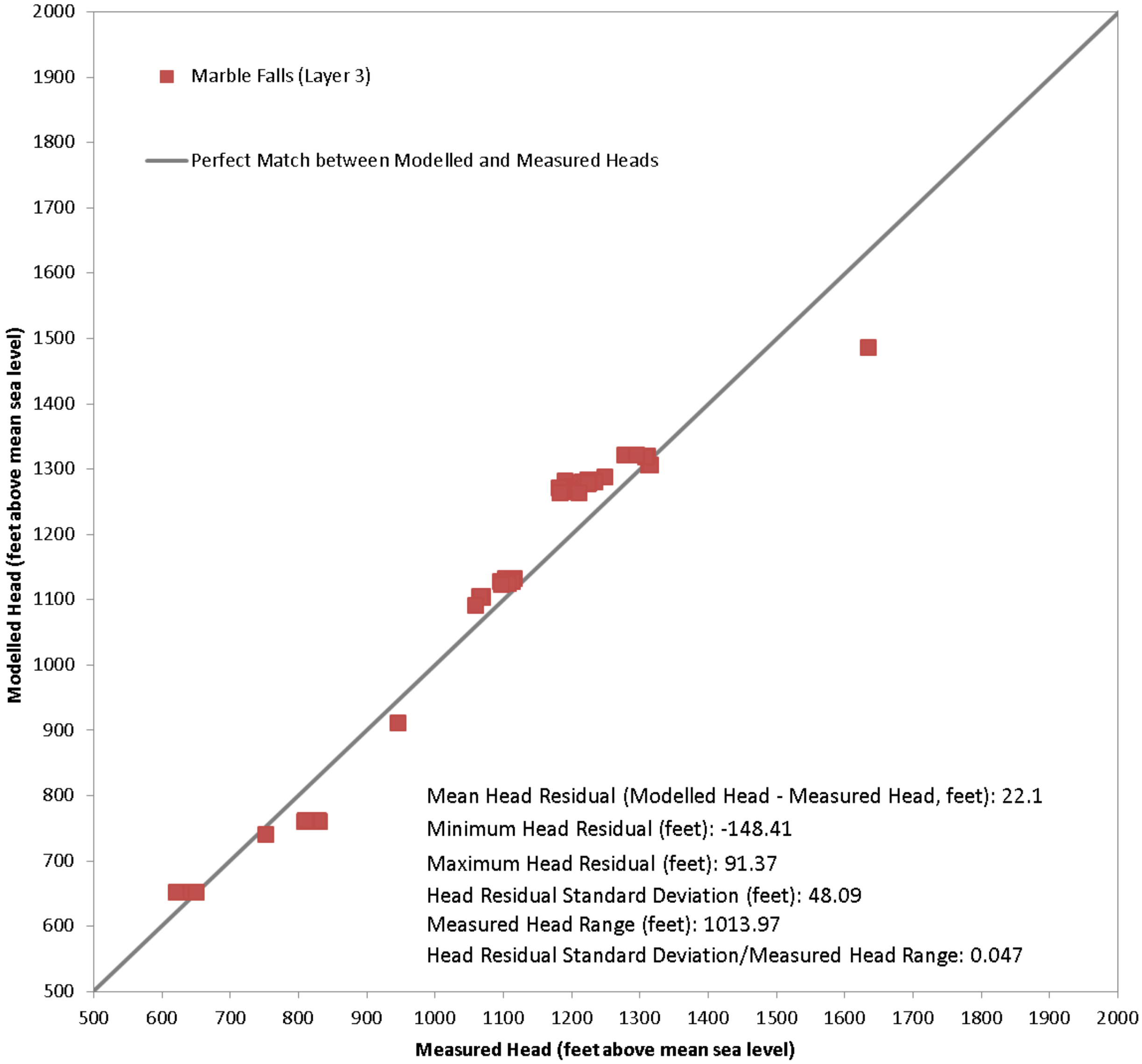

Figure 3.2.2 Simulated versus observed hydraulic head and statistic summary in Marble Falls Aquifer.

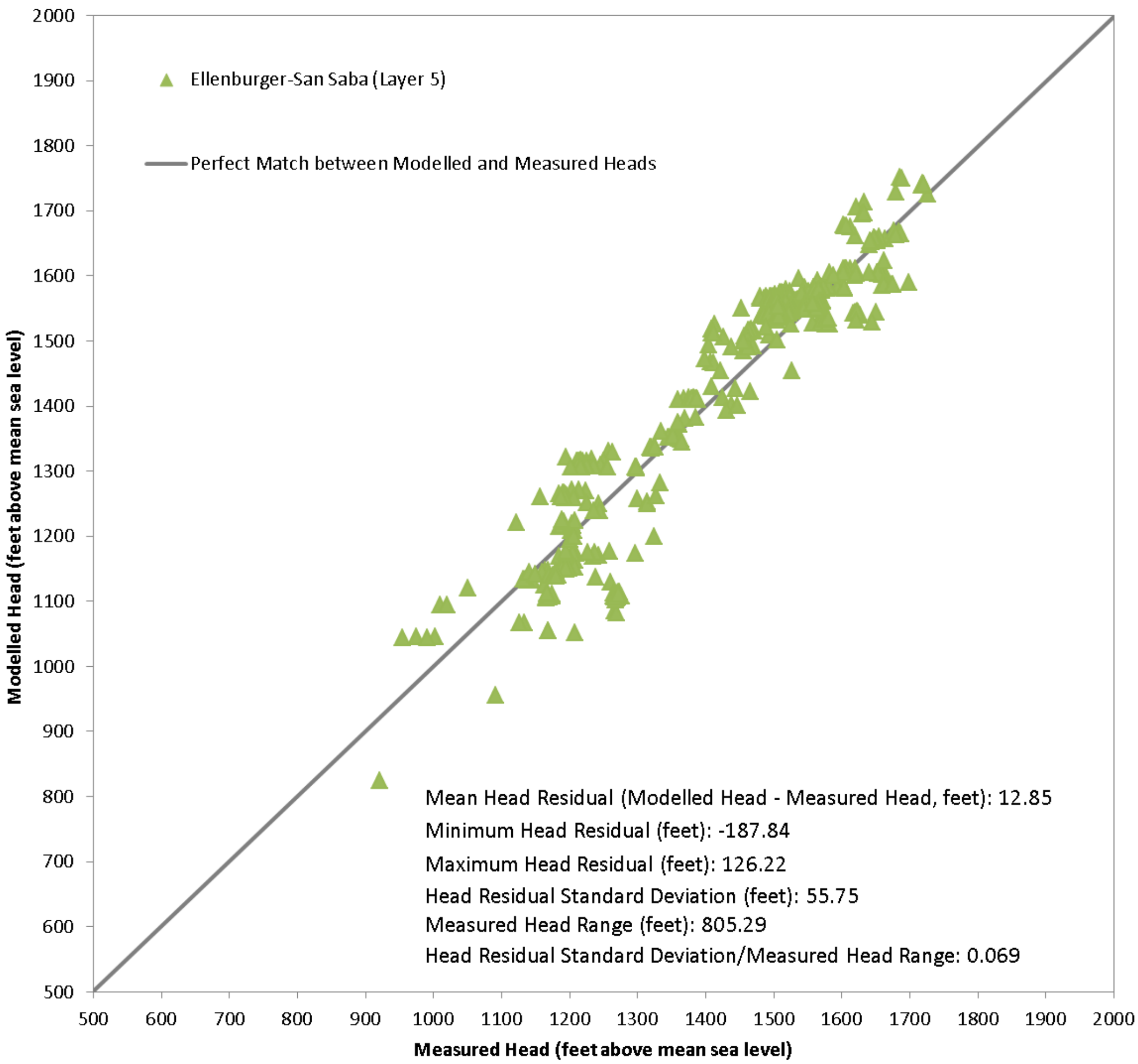

Figure 3.2.3 Simulated versus observed hydraulic head and statistic summary in Ellenburger-San Saba Aquifer.

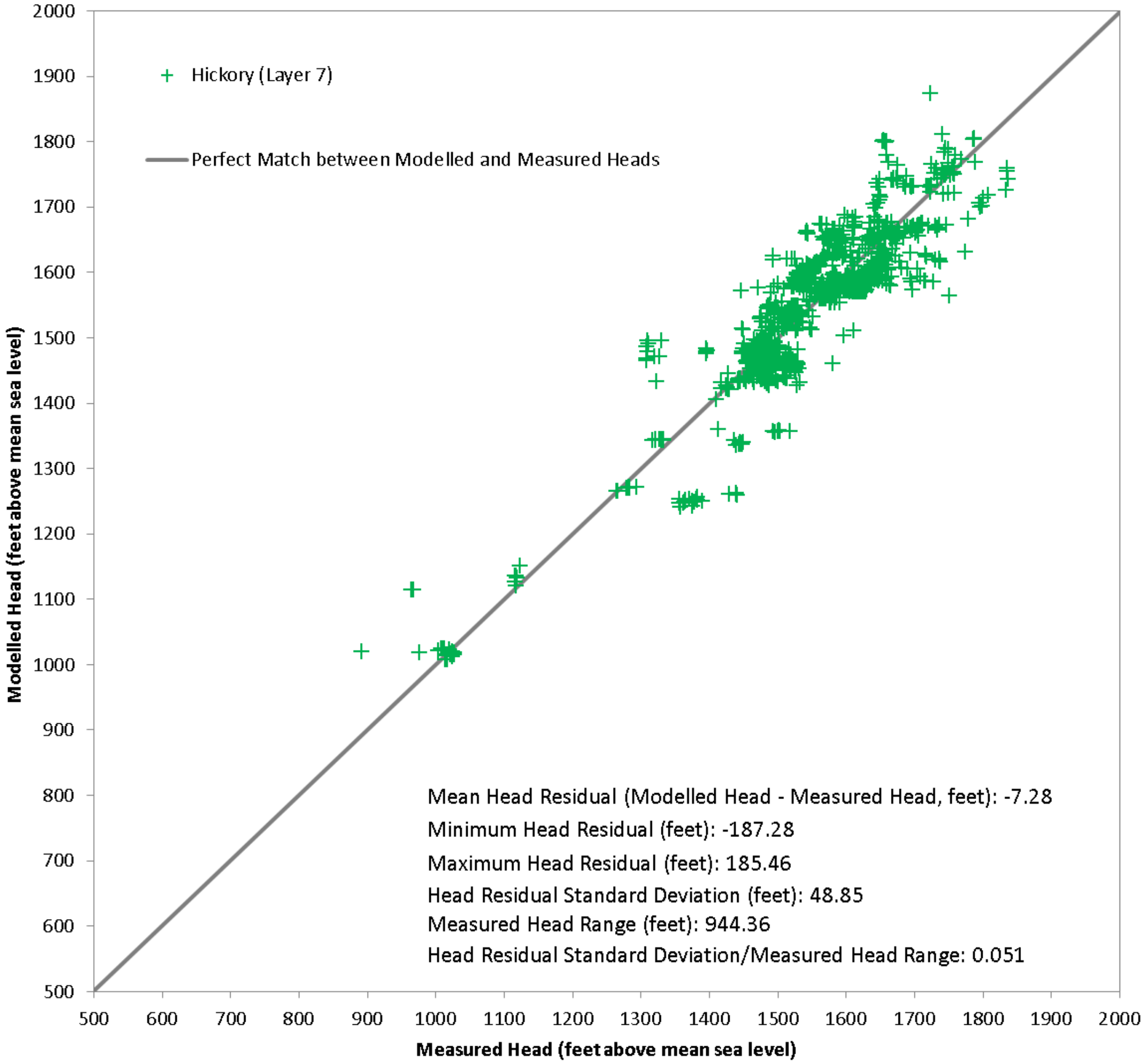

Figure 3.2.4 Simulated versus observed hydraulic head and statistic summary in Hickory Aquifer.

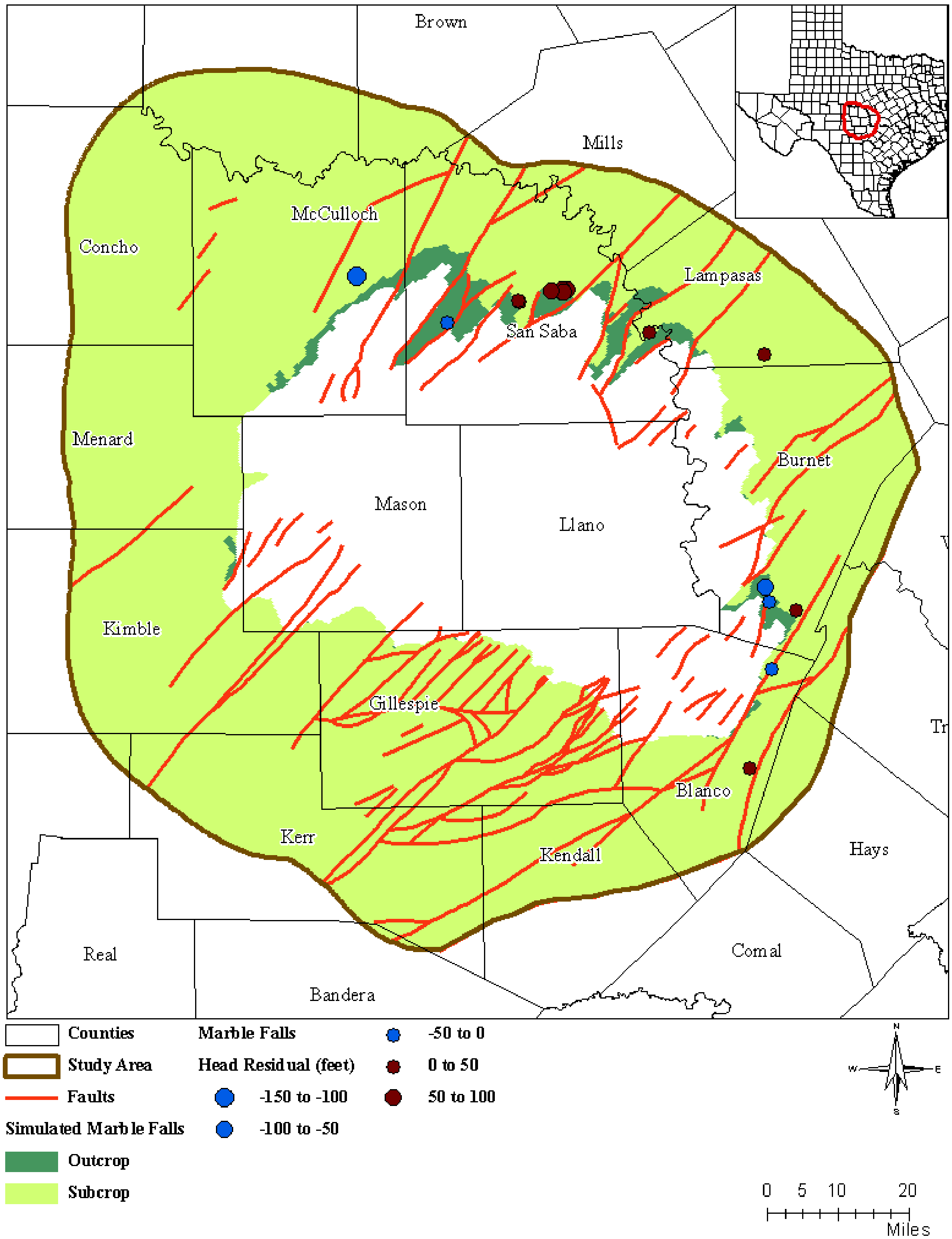

Figure 3.2.5 Distribution of average head residuals (simulated minus measured) in Marble Falls Aquifer.

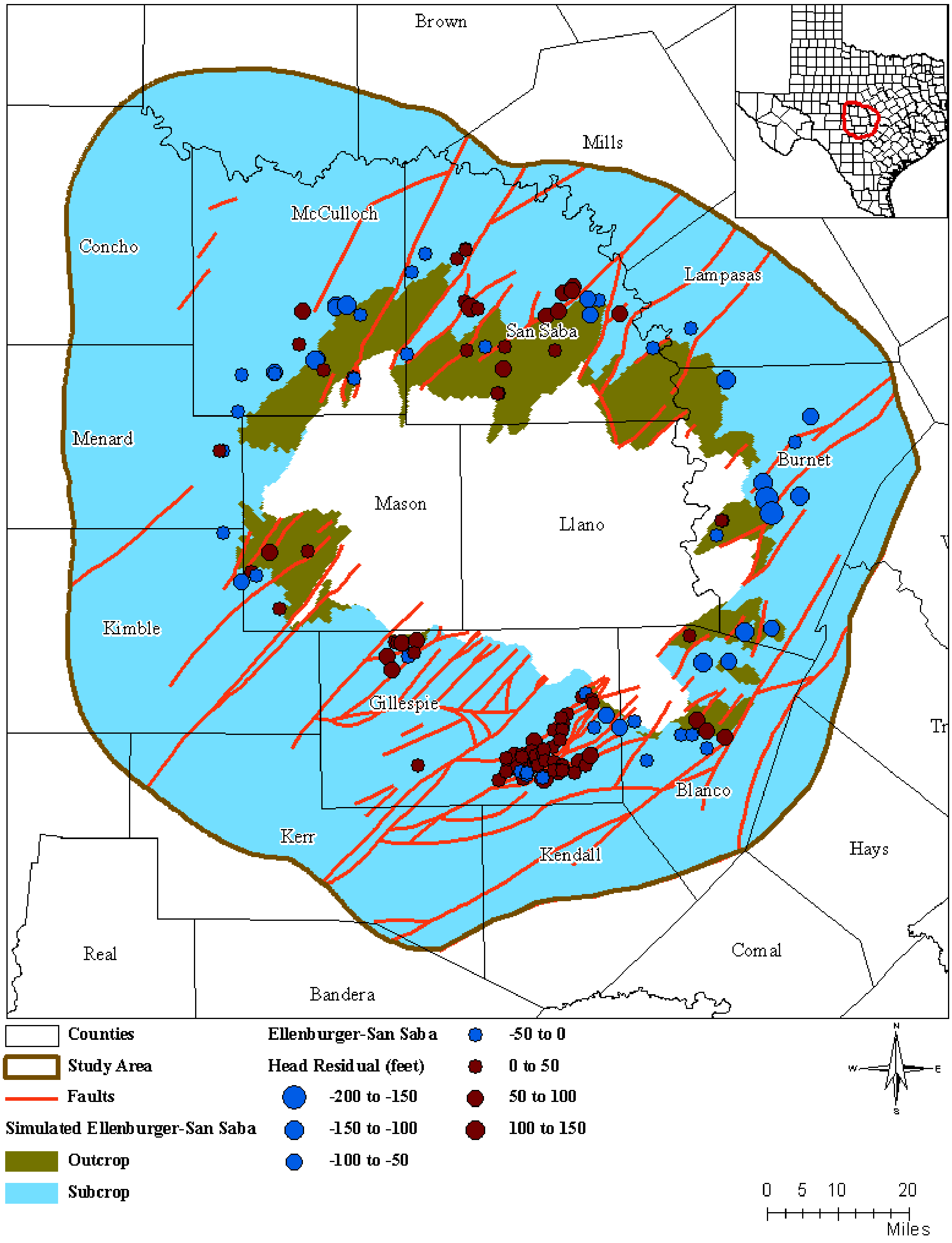

Figure 3.2.6 Distribution of average head residuals (simulated minus measured) in Ellenburger-San Saba Aquifer.

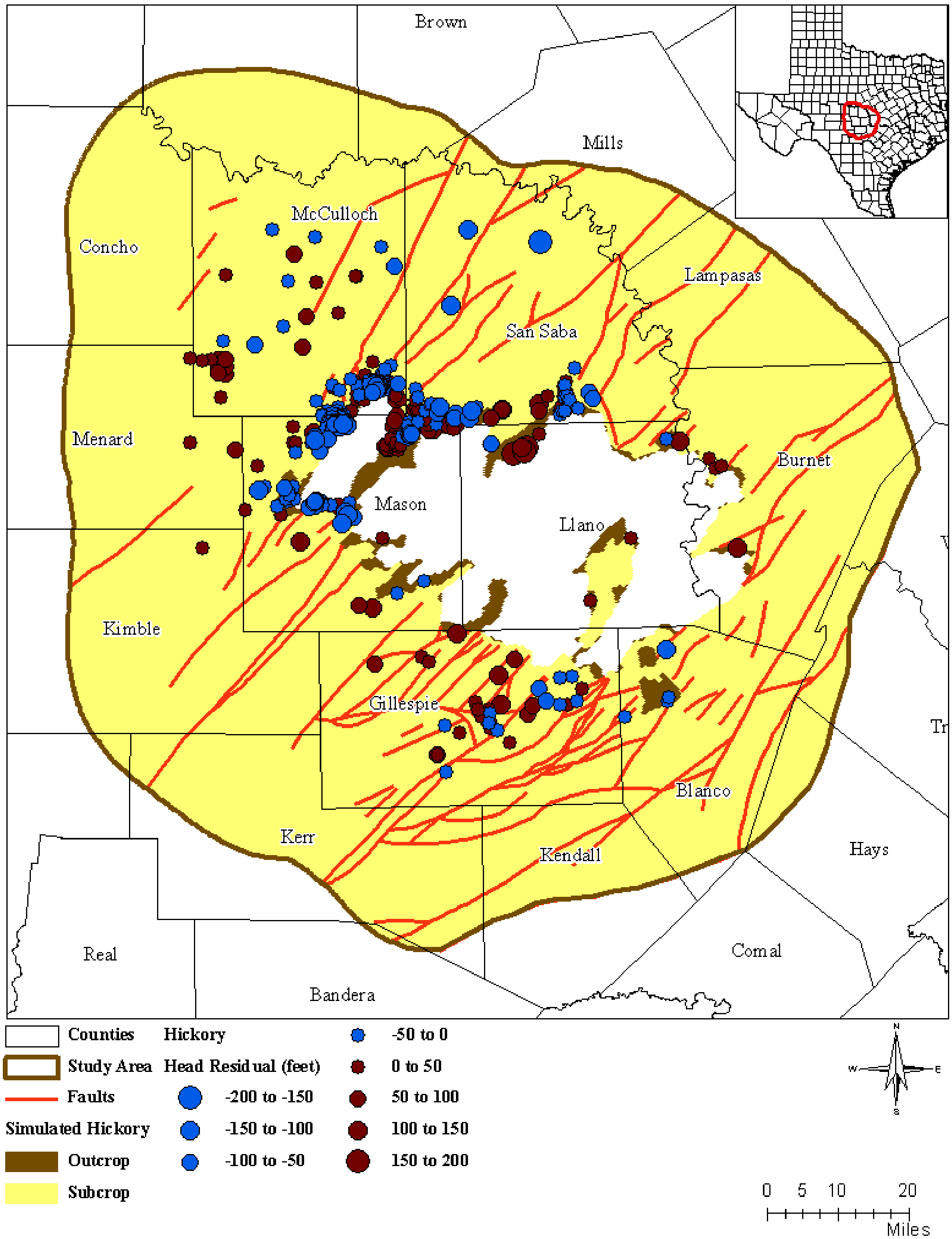

Figure 3.2.7 Distribution of average head residuals (simulated minus measured) in Hickory Aquifer.

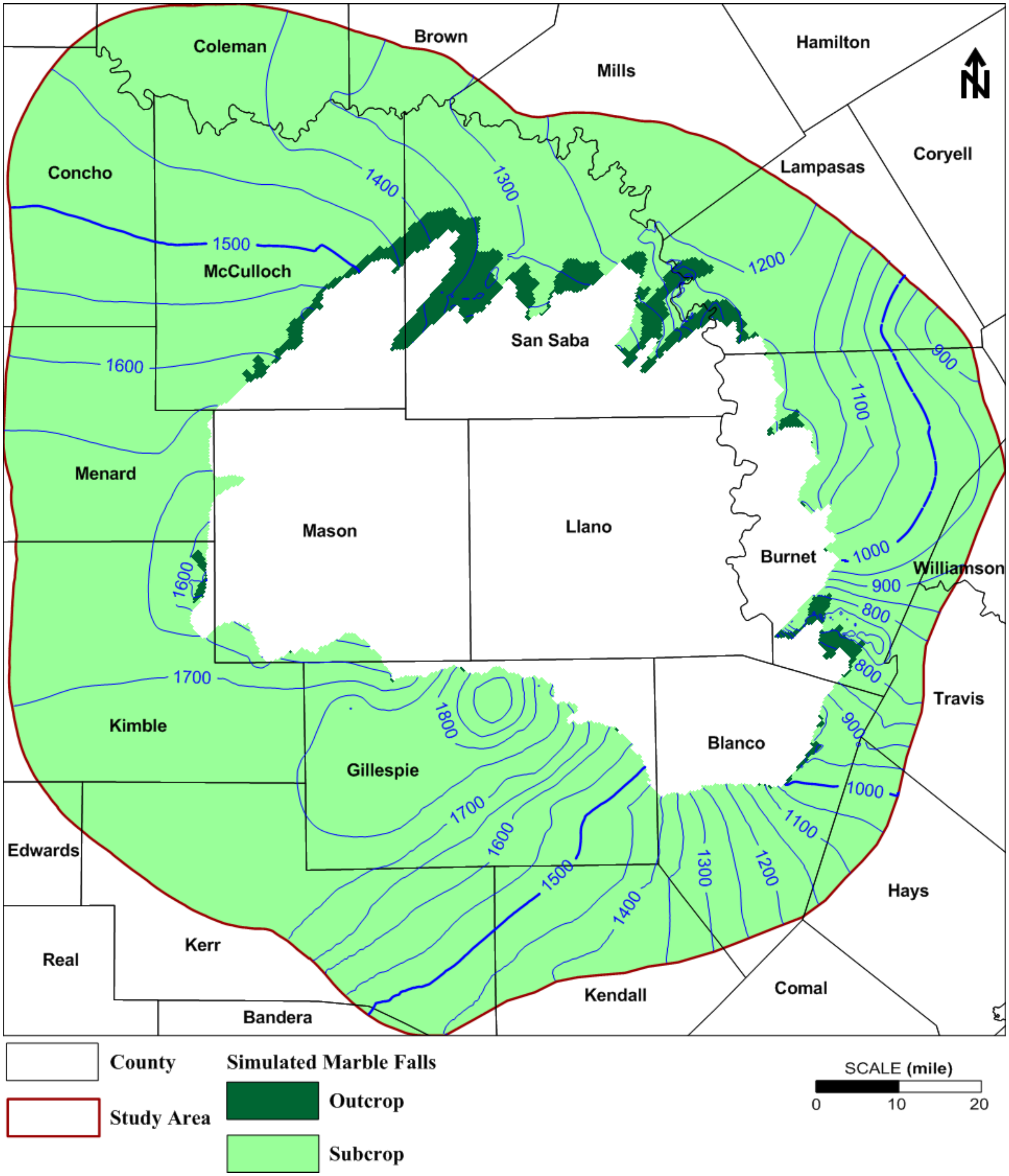

Figure 3.2.8 **Simulated water-level elevations (hydraulic heads) in feet above mean sea level by end of 2010 in Marble Falls Aquifer. Contour interval is 50 feet.**

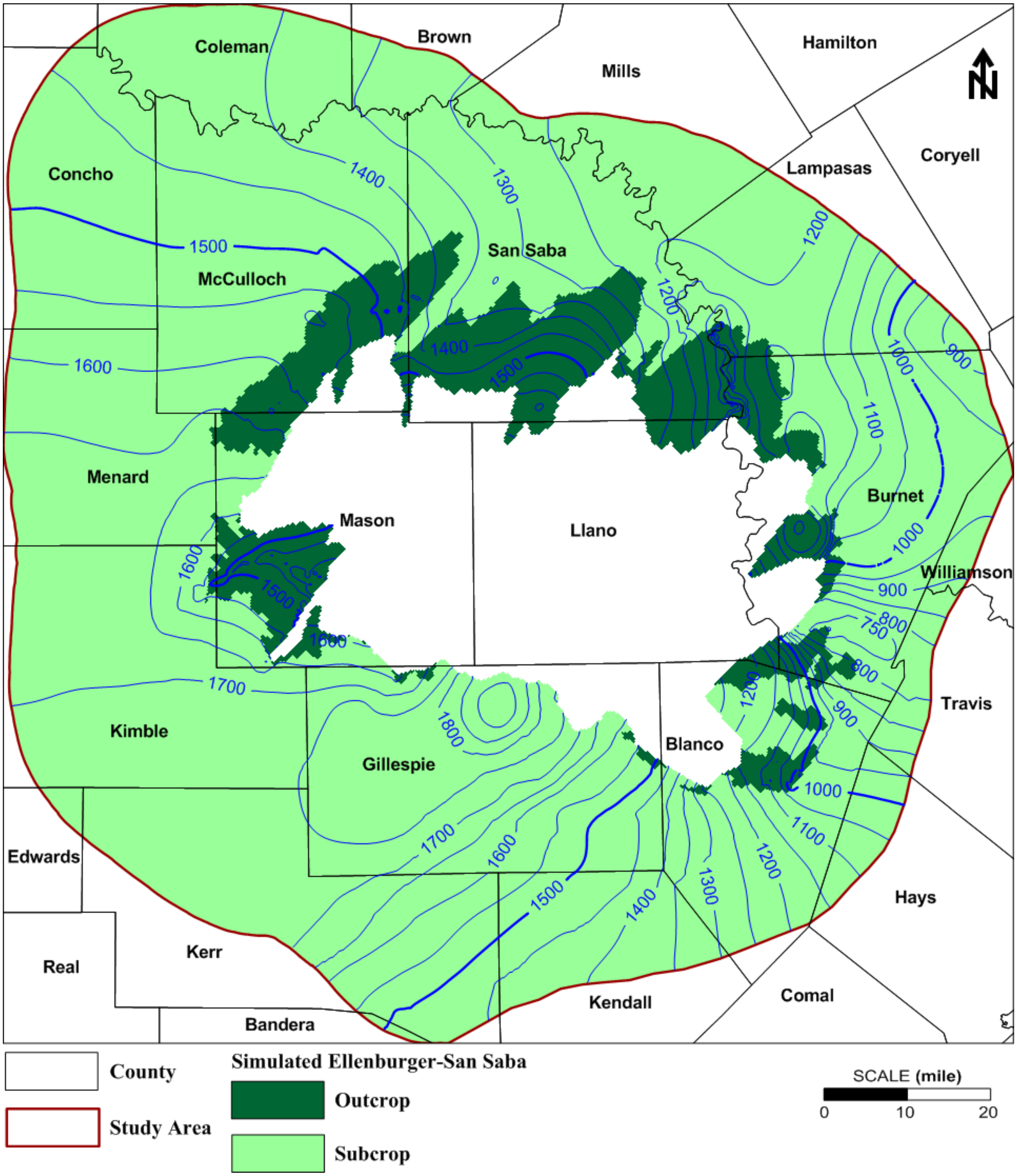

Figure 3.2.9 **Simulated water-level elevations (hydraulic heads) in feet above mean sea level by end of 2010 in Ellenburger-San Saba Aquifer. Contour interval is 50 feet.**

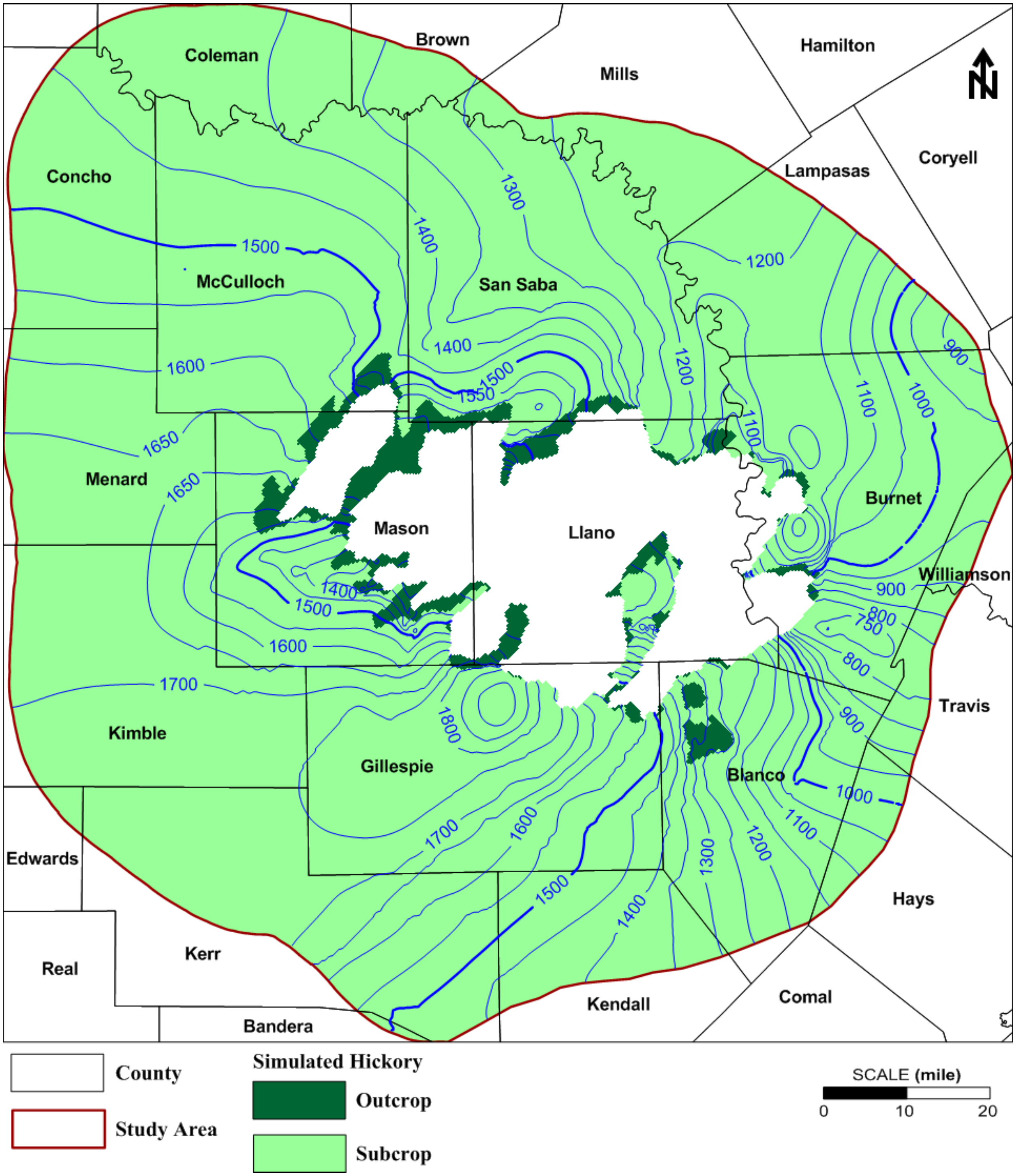

Figure 3.2.10 Simulated water-level elevations (hydraulic heads) in feet above mean sea level by end of 2010 in Hickory Aquifer. Contour interval is 50 feet.

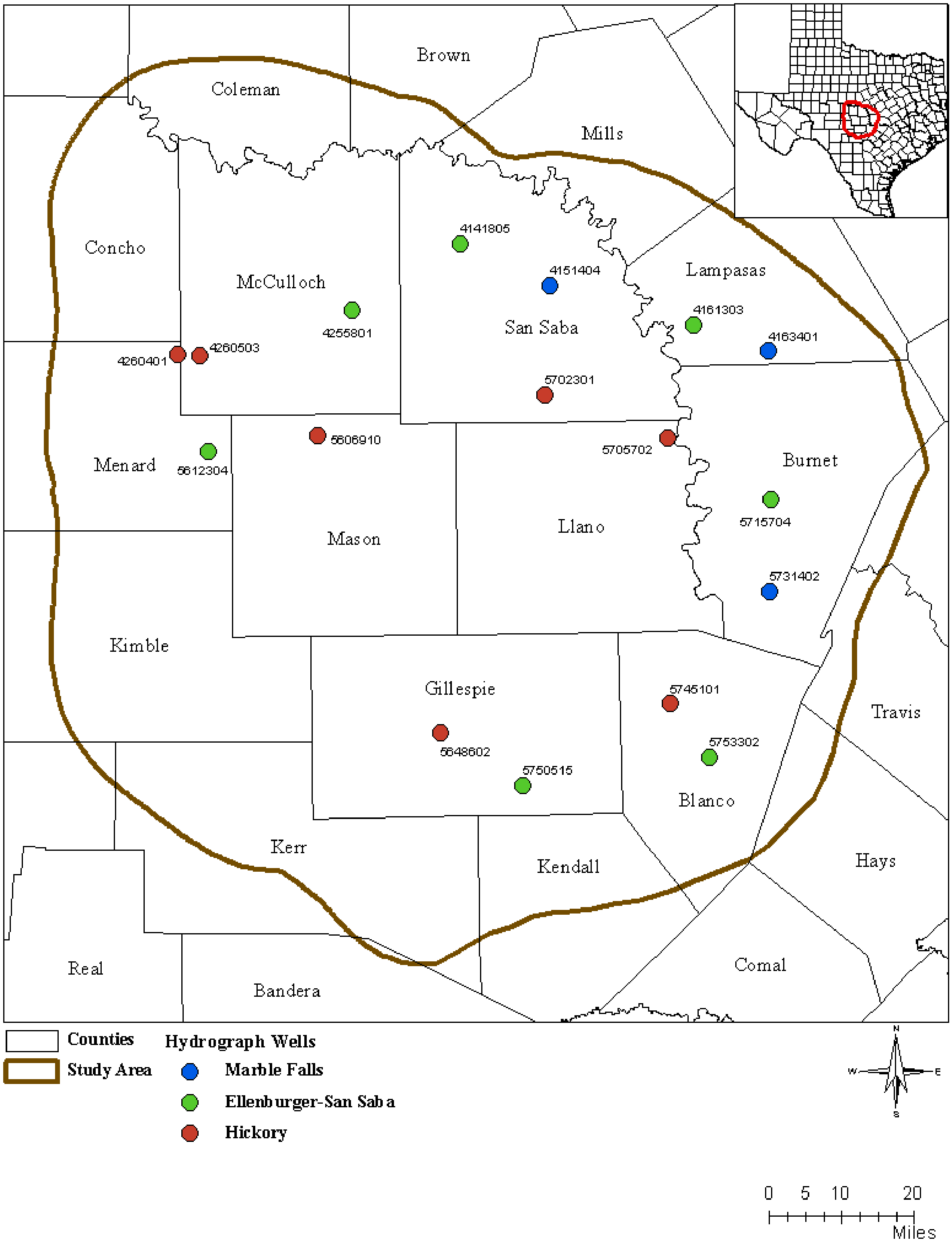

Figure 3.2.11 Wells selected with hydrograph in study area.

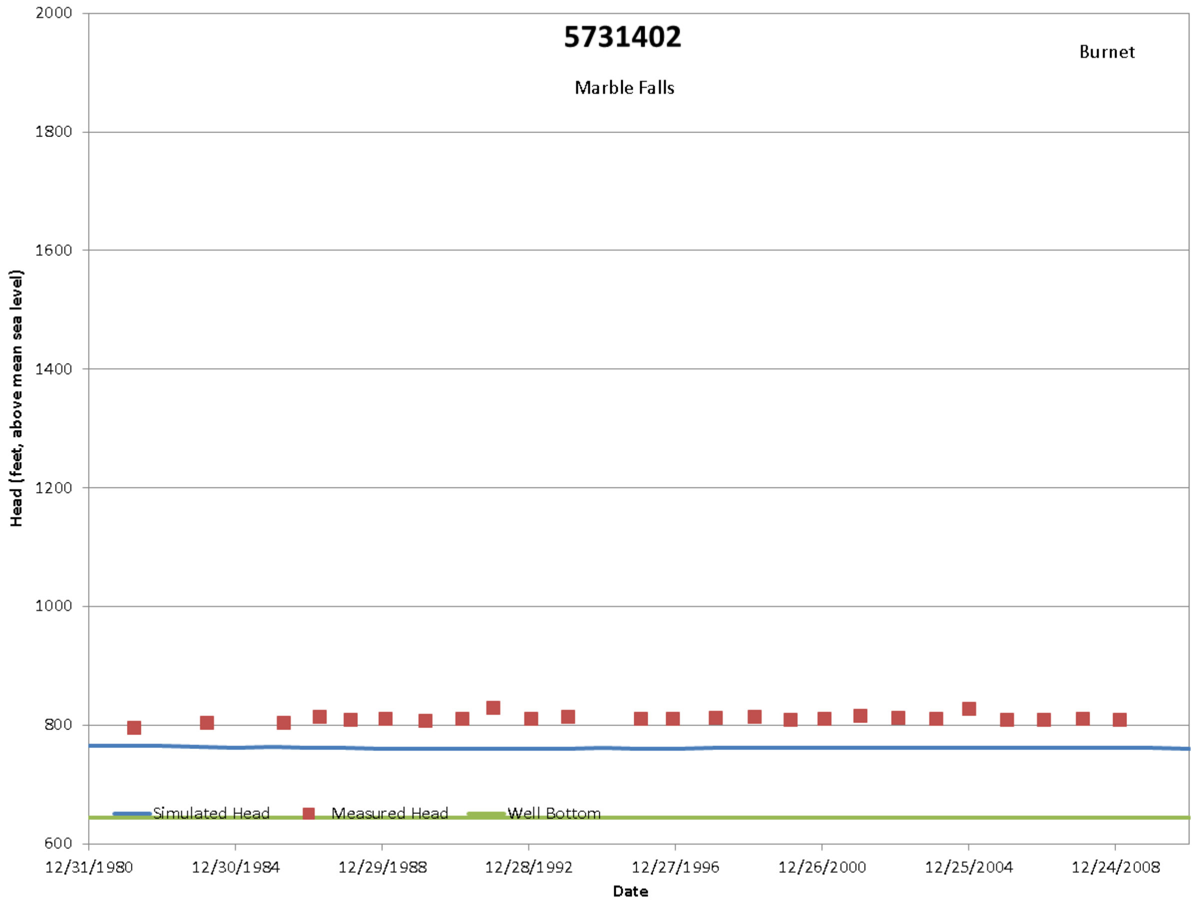

Figure 3.2.12 Hydrograph of water level at well 5731402 in Marble Falls Aquifer (Burnet County).

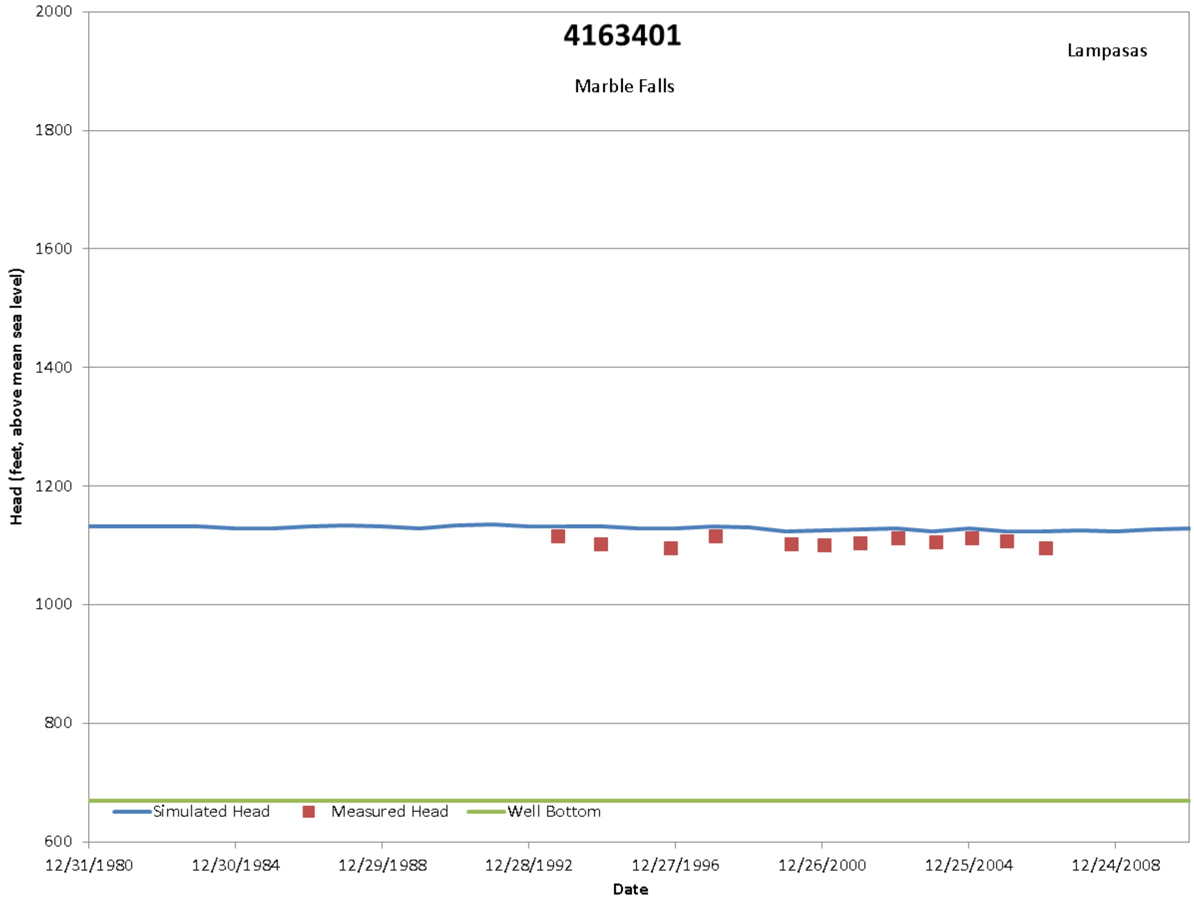

Figure 3.2.13 Hydrograph of water level at well 4163401 in Marble Falls Aquifer (Lampasas County).

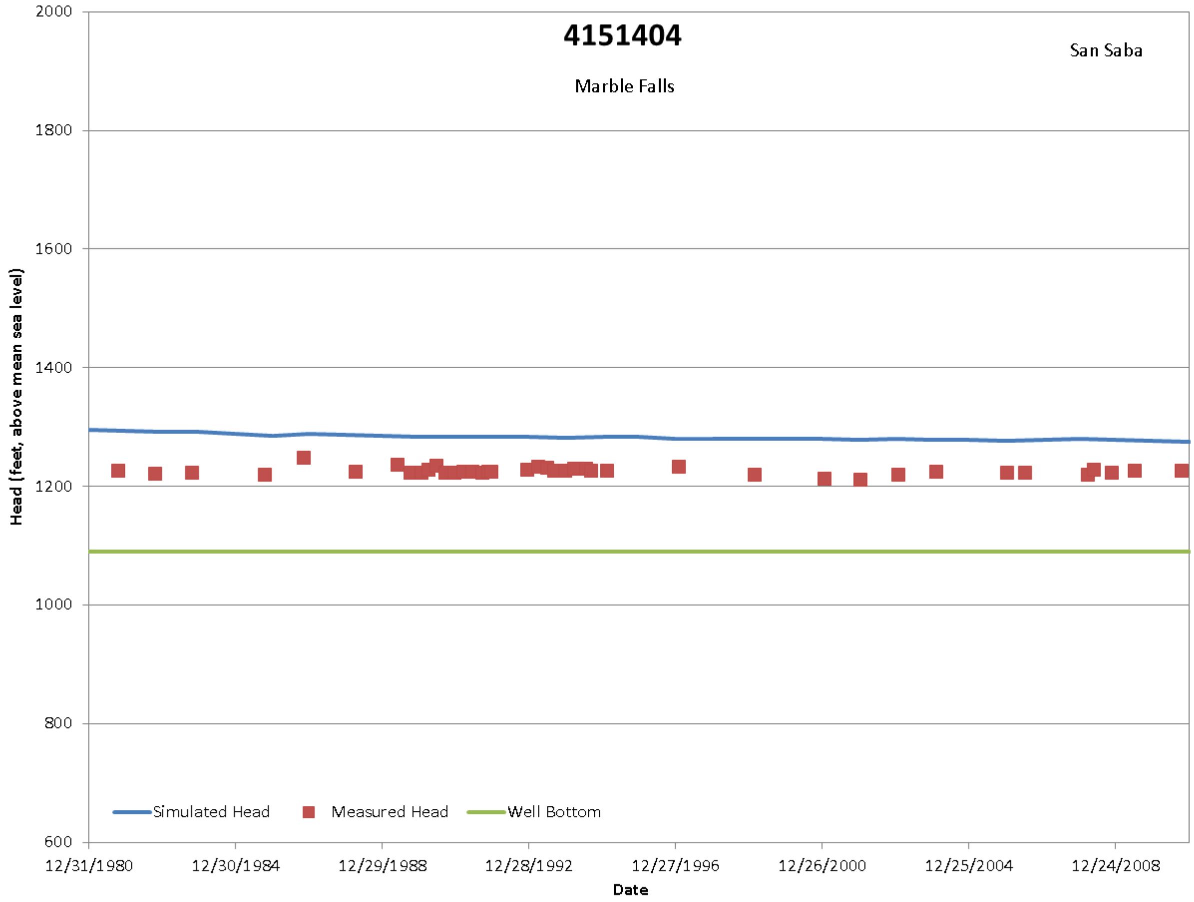

Figure 3.2.14 Hydrograph of water level at well 4151404 in Marble Falls Aquifer (San Saba County).

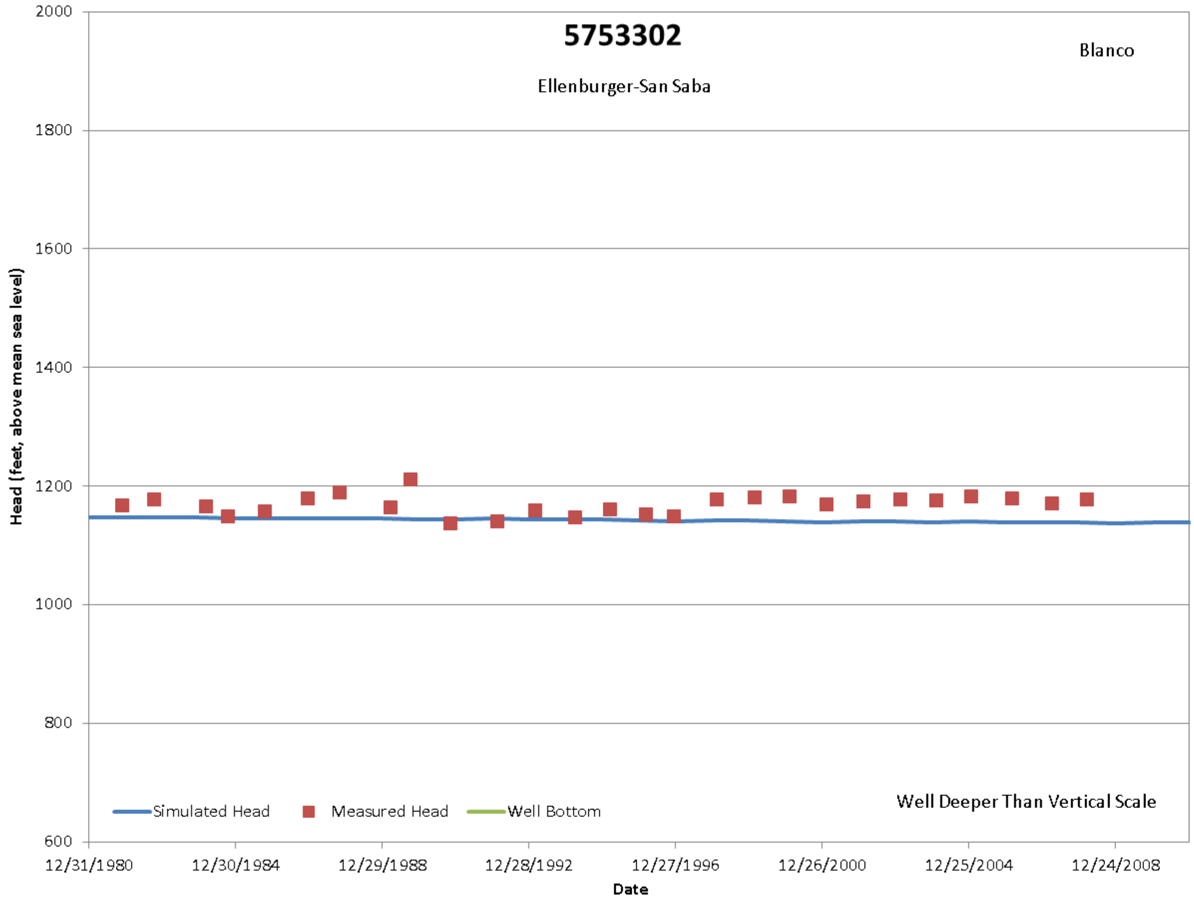

Figure 3.2.15 Hydrograph of water level at well 5753302 in Ellenburger-San Saba Aquifer (Blanco County).

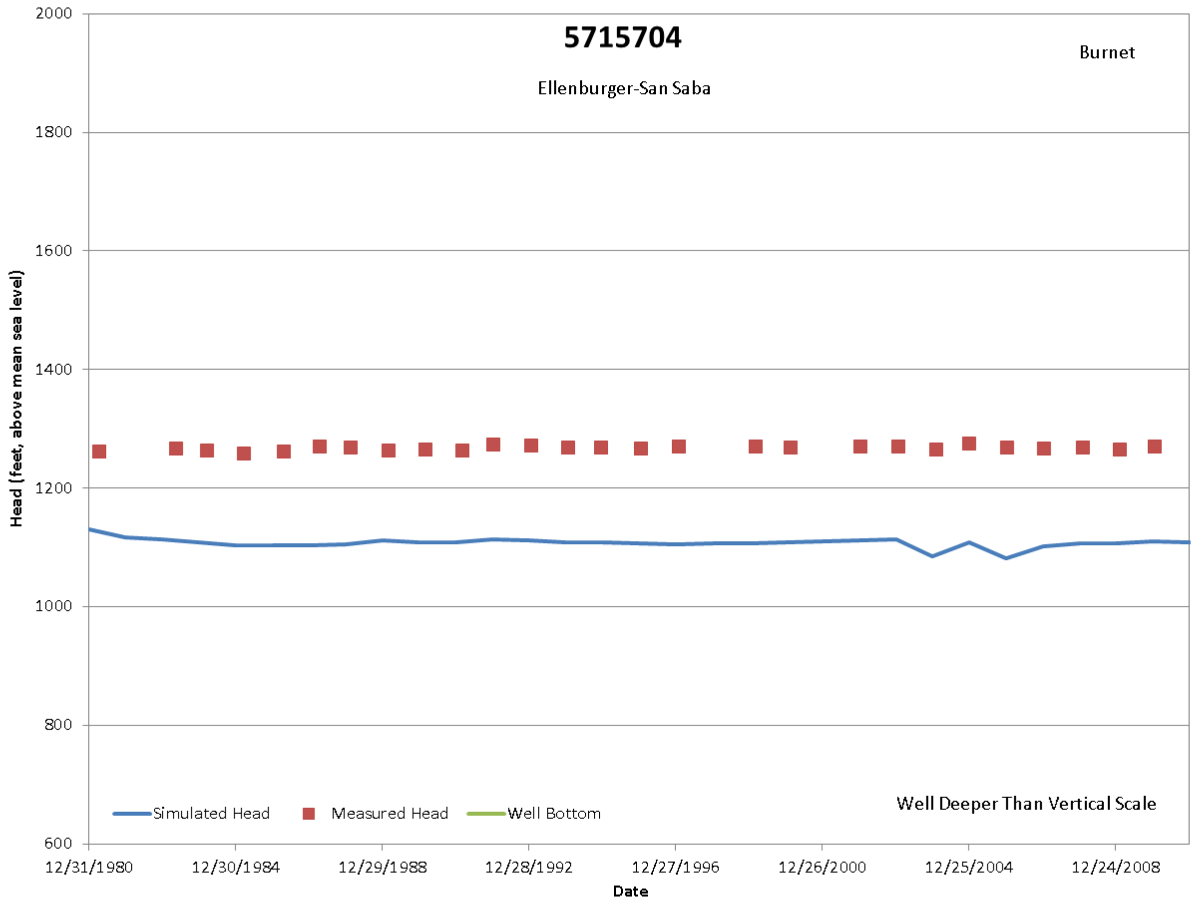

Figure 3.2.16 Hydrograph of water level at well 5715704 in Ellenburger-San Saba Aquifer (Burnet County).

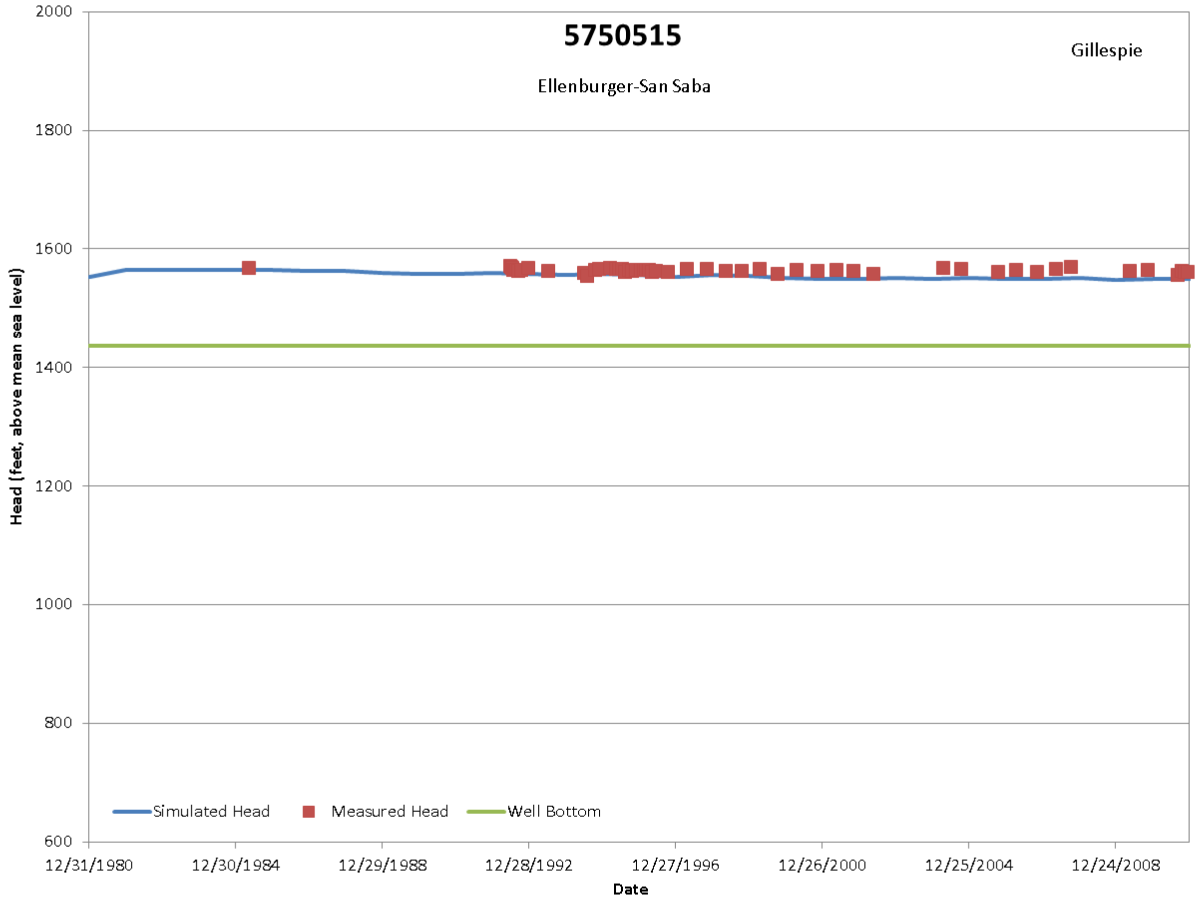

Figure 3.2.17 Hydrograph of water level at well 5750515 in Ellenburger-San Saba Aquifer (Gillespie County).

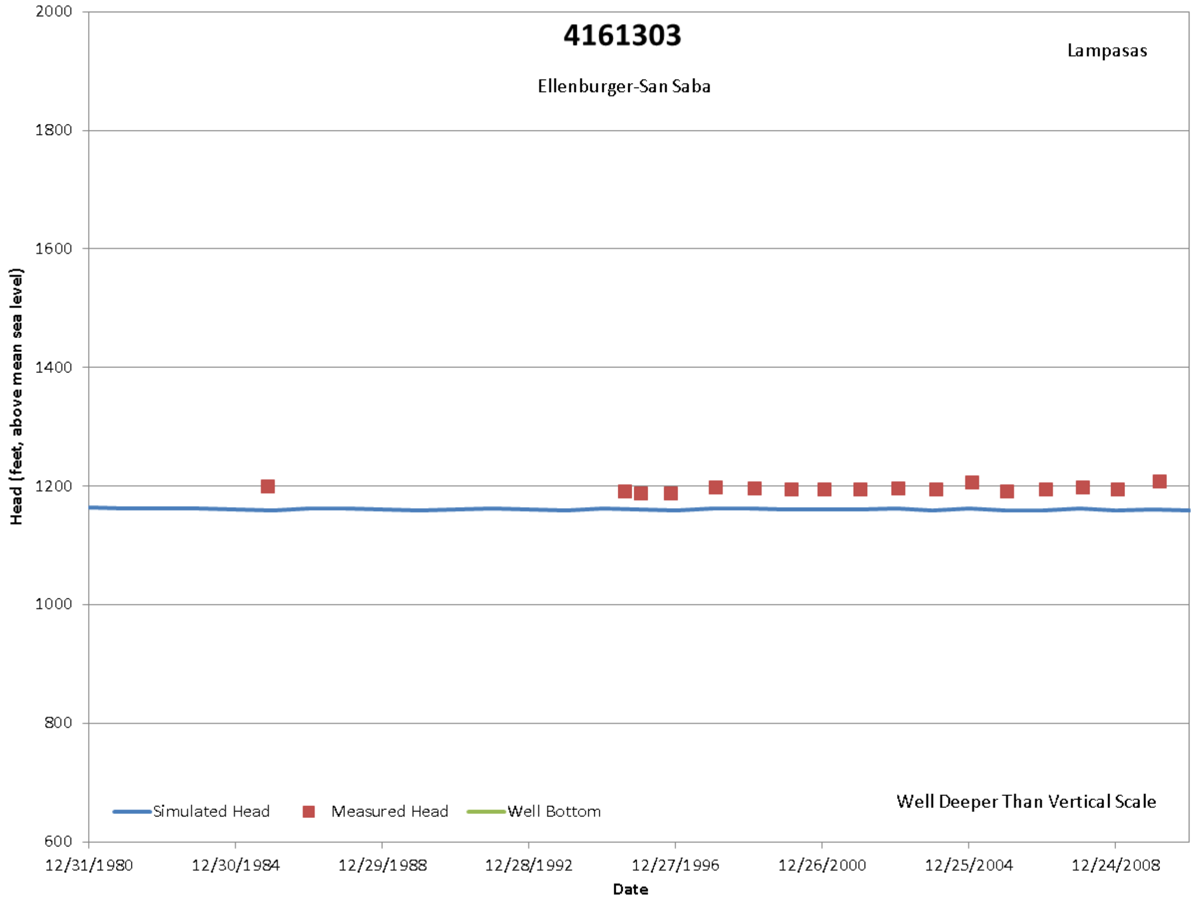

Figure 3.2.18 Hydrograph of water level at well 4161303 in Ellenburger-San Saba Aquifer (Lampasas County).

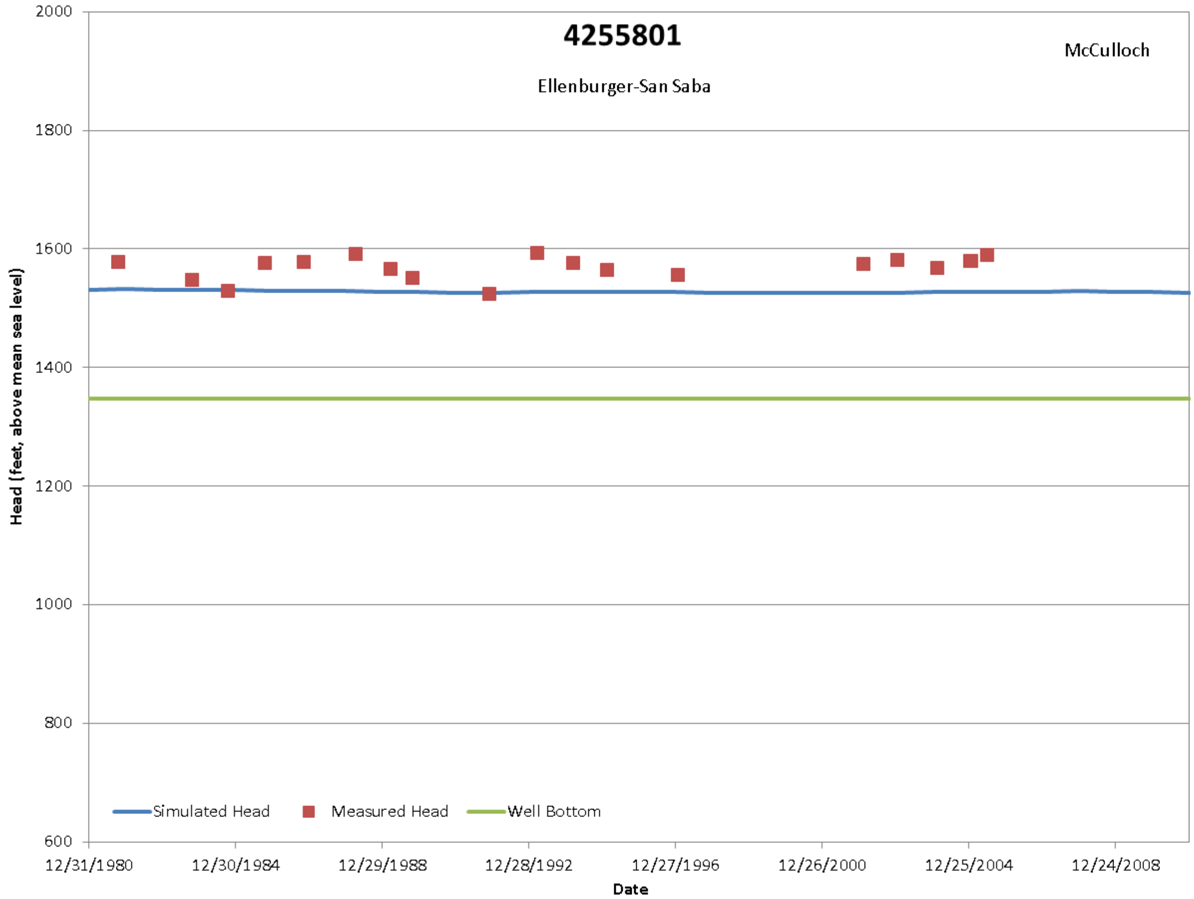

Figure 3.2.19 Hydrograph of water level at well 4255801 in Ellenburger-San Saba Aquifer (McCulloch County).

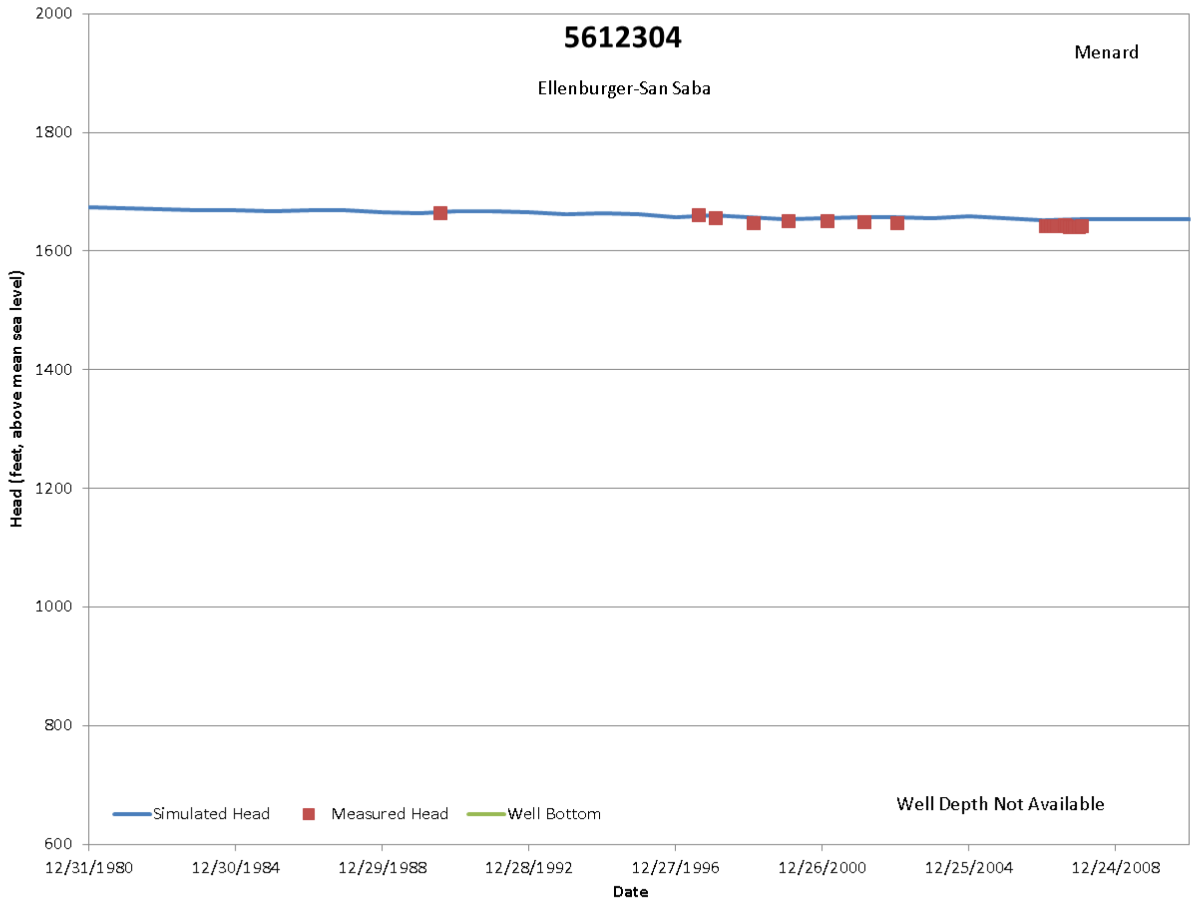

Figure 3.2.20 Hydrograph of water level at well 5612304 in Ellenburger-San Saba Aquifer (Menard County).

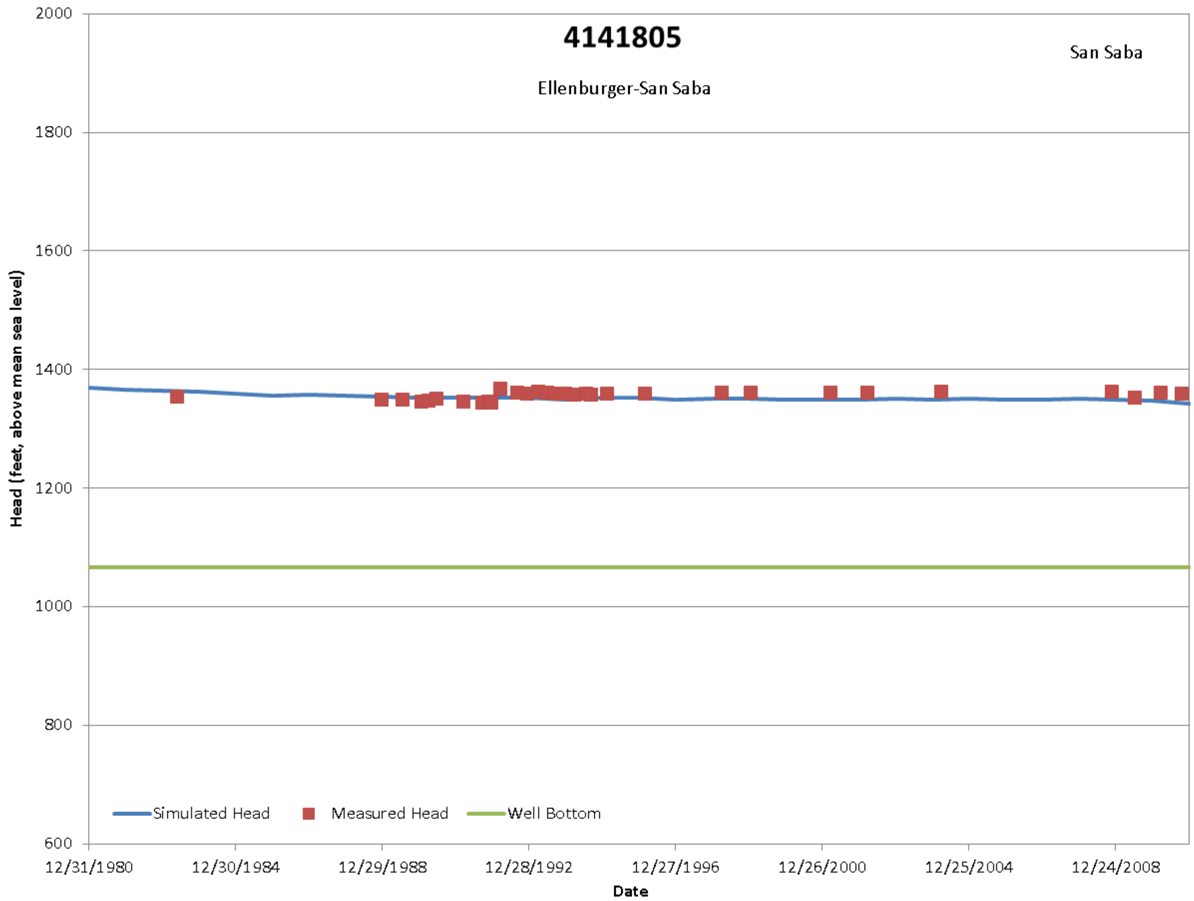

Figure 3.2.21 Hydrograph of water level at well 4141805 in Ellenburger-San Saba Aquifer (San Saba County).

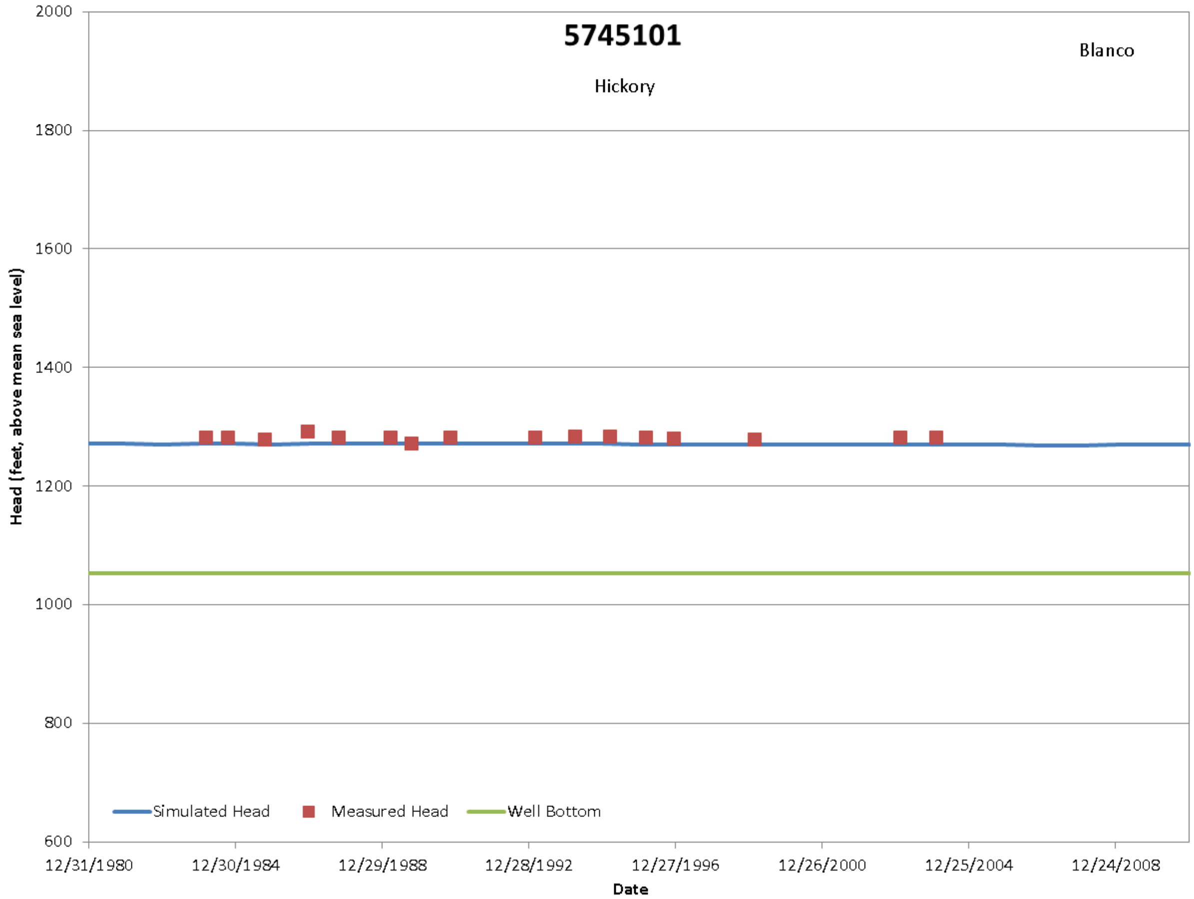

Figure 3.2.22 Hydrograph of water level at well 5745101 in Hickory Aquifer (Blanco County).

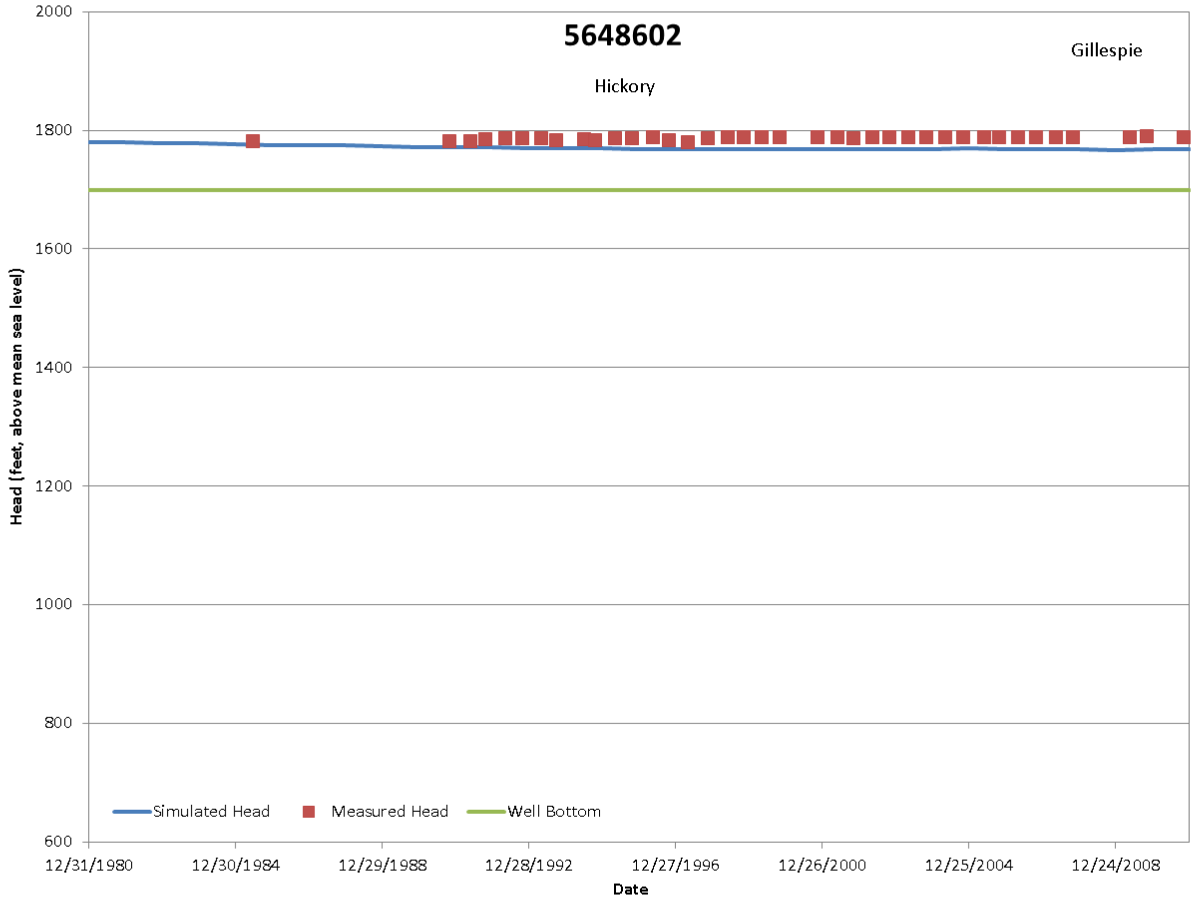

Figure 3.2.23 Hydrograph of water level at well 5648602 in Hickory Aquifer (Gillespie County).

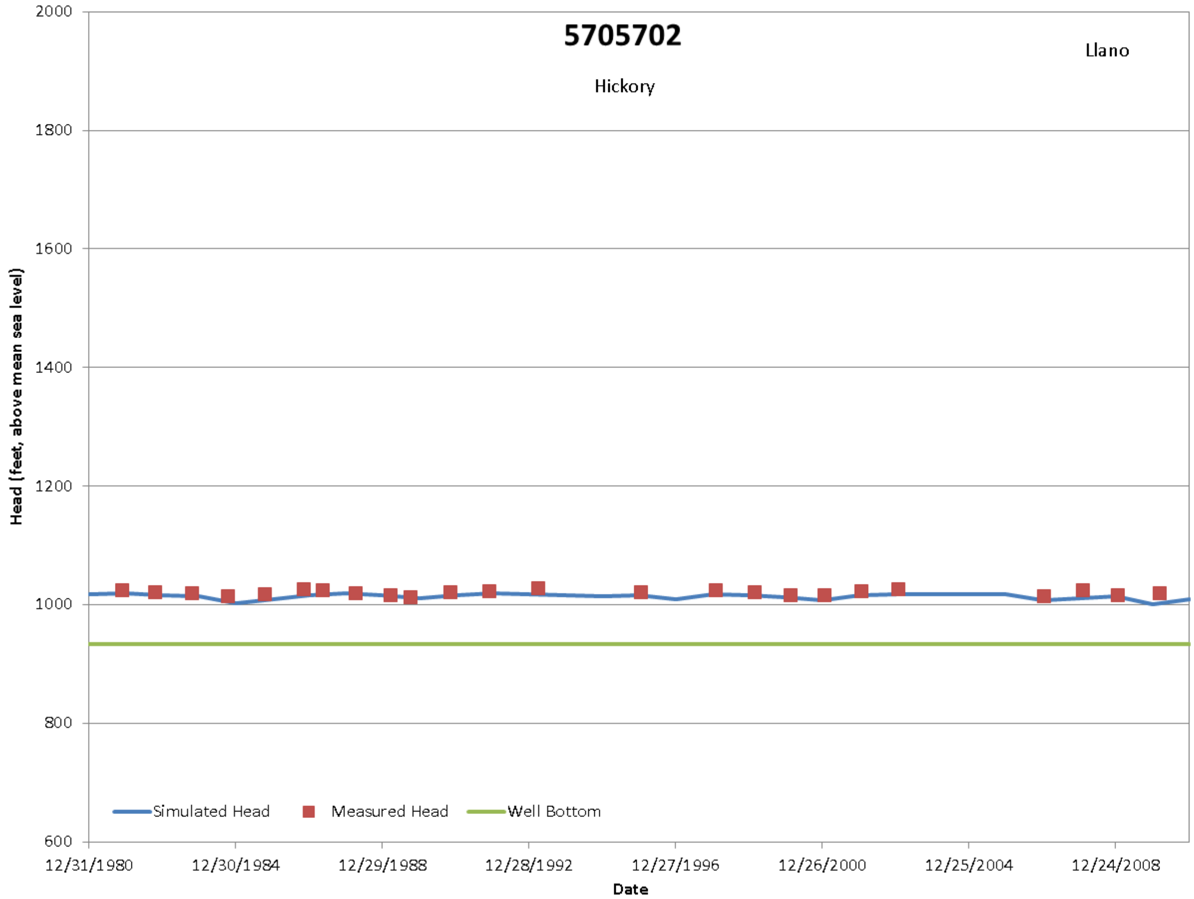

Figure 3.2.24 Hydrograph of water level at well 5705702 in Hickory Aquifer (Llano County).

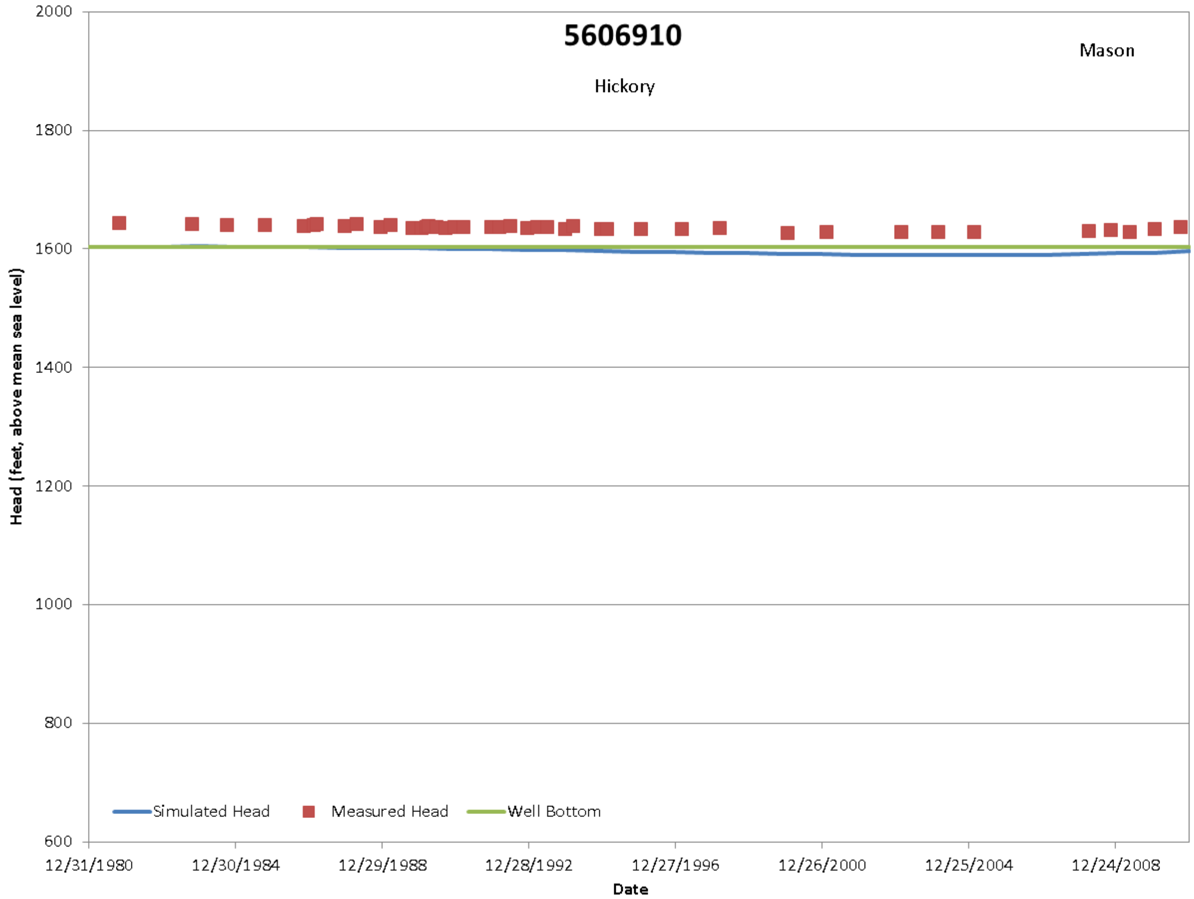

Figure 3.2.25 Hydrograph of water level at well 5606910 in Hickory Aquifer (Mason County).

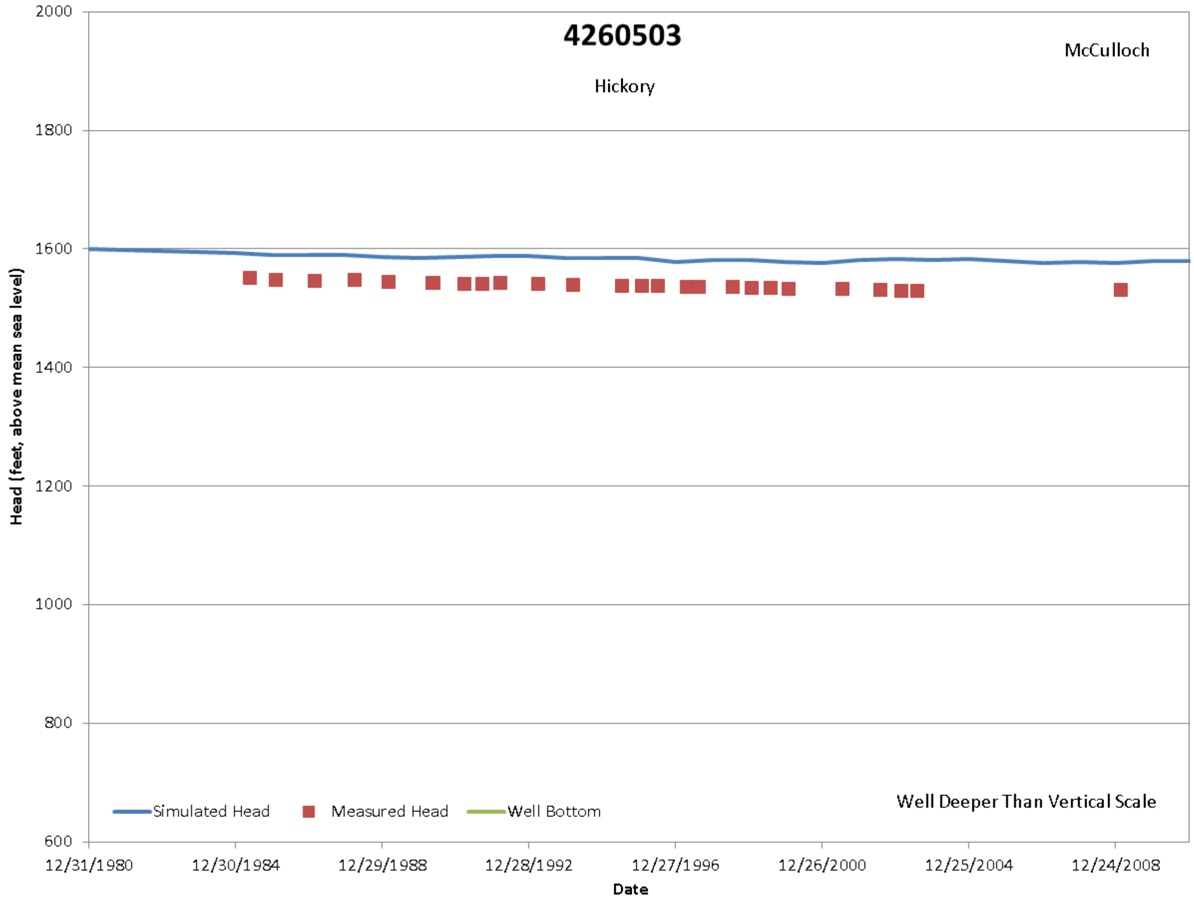

Figure 3.2.26 Hydrograph of water level at well 4260503 in Hickory Aquifer (McCulloch County).

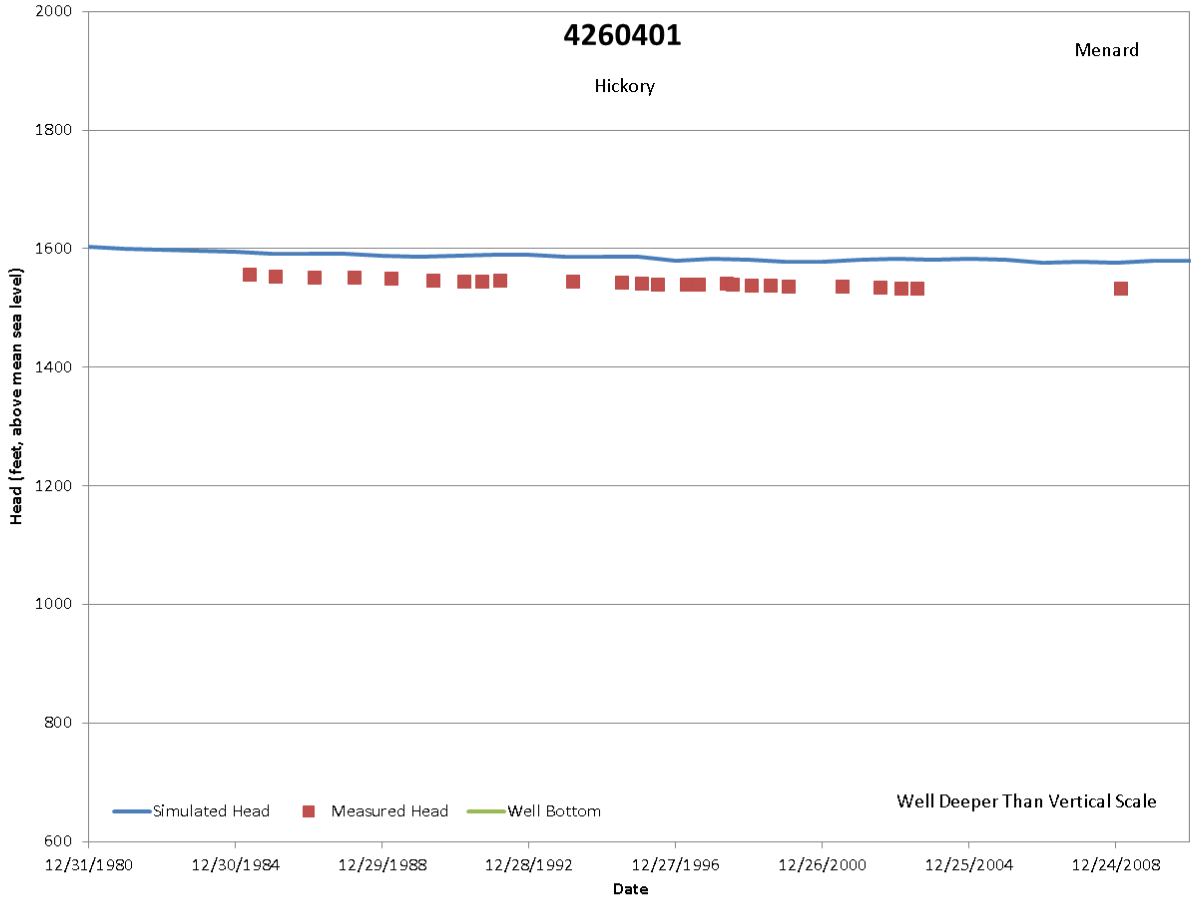

Figure 3.2.27 Hydrograph of water level at well 4260401 in Hickory Aquifer (Menard County).

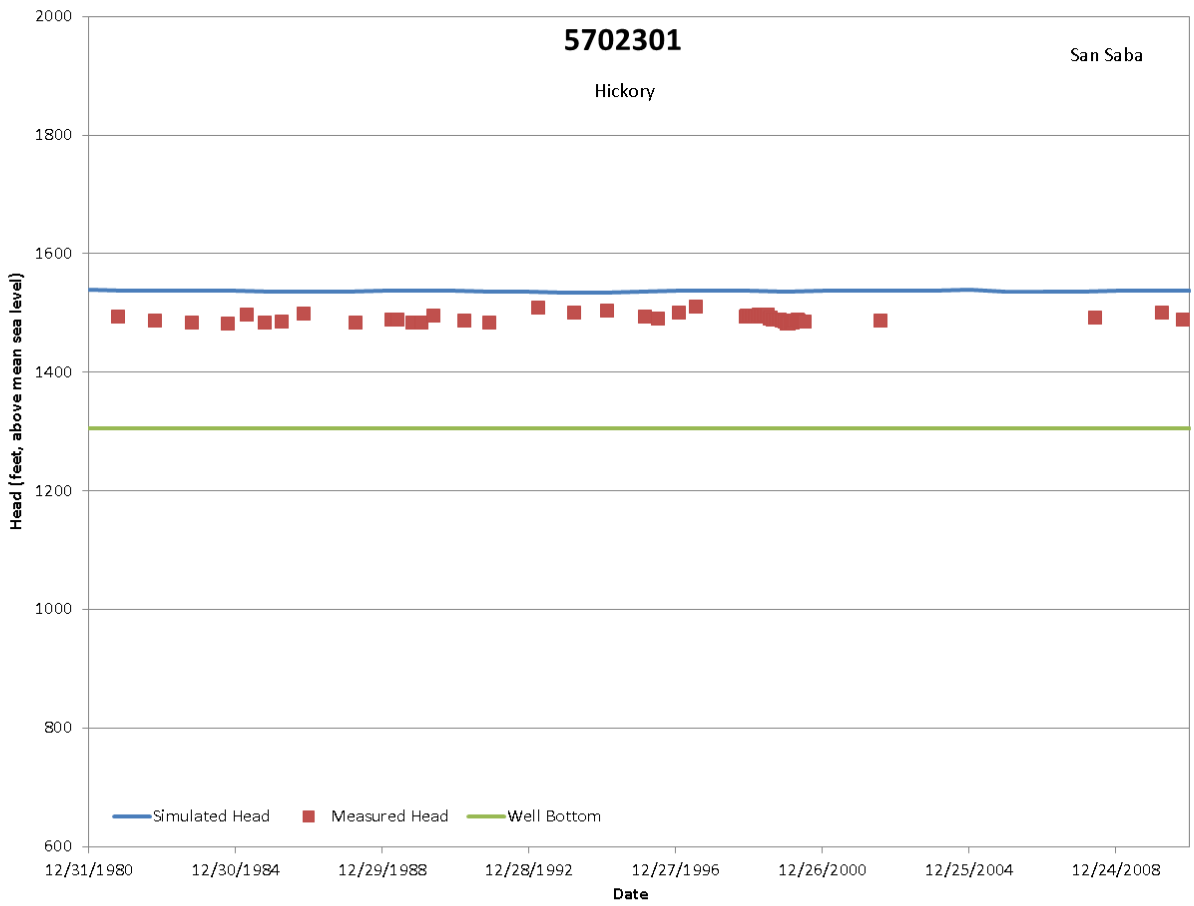

Figure 3.2.28 Hydrograph of water level at well 5702301 in Hickory Aquifer (San Saba County).

3.3 Model Simulated River Gain/Loss

Based on the stream gain/loss study by Slade and others (2002), the normalized gain/loss was calculated (Figure 3.0.2). Considering the total stream length in the Colorado and Guadalupe river basins (1187.5 miles) and the average normalized stream gain (0.52 cubic feet per second per mile), the total amount of water gained by streams from groundwater discharge was calculated as 5.4×10^7 cubic feet per day or 450,000 acre-feet per year. In comparison, the groundwater flow model simulated an average gain of 280,000 acre-feet per year for the same stream segments in the Colorado and Guadalupe river basins over the period 1981 – 2010. In general, the model also indicated a declining river gain from 1981 to 2010 (Figure 3.3.1). As discussed in the conceptual model report, the gain/loss data from Slade and others (2002) were collected prior to the construction of the reservoirs/lakes in the study area. In addition, groundwater withdrawal has significantly increased since the data were collected. Thus, the stream gain was expected to be lower for the simulation period (1981 through 2010) compared to the study period. The flow model results appear to reflect the change of the groundwater-surface water flow conditions.

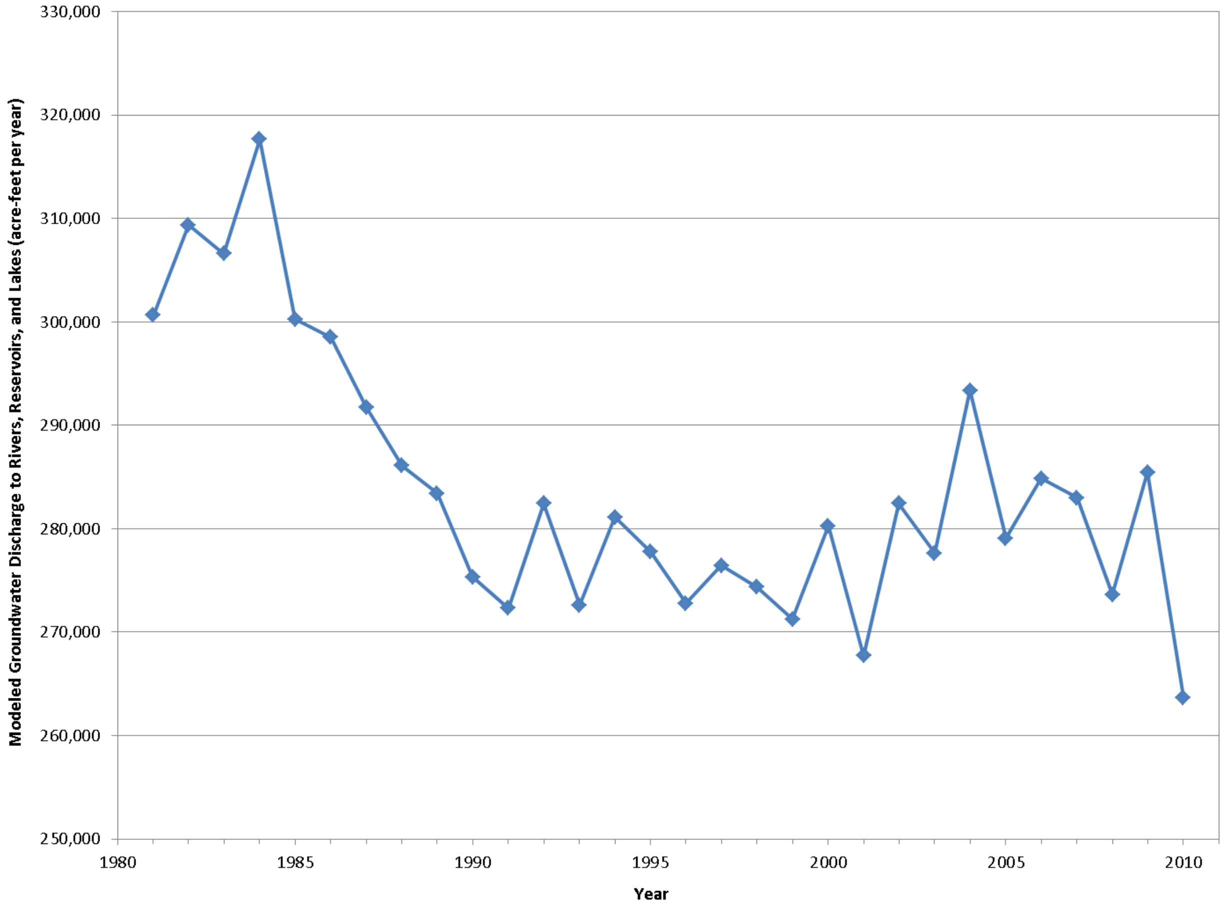

Figure 3.3.1 Modeled groundwater discharge to rivers, reservoirs, and lakes within Colorado and Guadalupe river basins.

3.4 Model Simulated Water Budgets

Evaluation of the simulated water budget further helps to verify if the model reproduces the regional groundwater flows consistent with the conceptual understanding of the regional geology, hydrogeology, surface water hydrology, and regional climate.

The overall water budget for this groundwater flow model includes the following components: rivers, lakes, reservoirs, general head, recharge, springs, pumpage, and storage change. Inflow and outflow components represent those contributing to the groundwater system or taking groundwater away from the system. As shown in Figure 3.4.1, the main influx to the groundwater system is recharge due to infiltration of precipitation. The outflow components are comprised of (in descending order of magnitude): leakage to rivers, lakes, and reservoirs, lateral flow through the Cretaceous and younger units to the surrounding (outside of model) area, groundwater withdrawal at wells, and discharge via springs. Over the simulation period, the flow model indicates declining groundwater recharge, leakage to rivers, lakes, and reservoirs, lateral flow to the surrounding area, and spring flow. Aquifers experience more storage loss (positive values) than gain (negative values) over the same period.

For the Marble Falls Aquifer, the main inflows are cross-formational flow from layer 1 (Cretaceous and younger units) and recharge (Figure 3.4.2). The main outflows are leakage to rivers, lakes, and reservoirs, pumping, and, to a lesser degree, cross-formational flow to layers 4 (confining unit between Marble Falls and Ellenburger-San Saba aquifers) and 5 (Ellenburger-San Saba Aquifer). Between 1981 and 2010, the storage loss for the Marble Falls Aquifer in the study area is estimated around 56,400 acre-feet.

For the Ellenburger-San Saba Aquifer, the main inflow is due to recharge from precipitation (Figure 3.4.3). Cross-formational flow from layers 7 (Hickory) and 1 (Cretaceous and younger units) contributes insignificant amounts of inflow. The main outflows are leakage to rivers, lakes, and reservoirs, cross-formational flow to layer 6 (units between Ellenburger-San Saba and Hickory aquifers), and pumping. Between 1981 and 2010, the storage loss for the Ellenburger-San Saba Aquifer in the study area is estimated around 22,700 acre-feet.

For the Hickory Aquifer, the main inflow component is cross-formational flow from layer 6 (units between Ellenburger-San Saba and Hickory aquifers) and recharge (Figure 3.4.4). The main outflows are pumping, and cross-formational flow to layers 5 (Ellenburger-San Saba

Aquifer) and 8 (Precambrian units). Between 1981 and 2010, the storage loss for the Hickory Aquifer in the study area is estimated around 35,700 acre-feet.

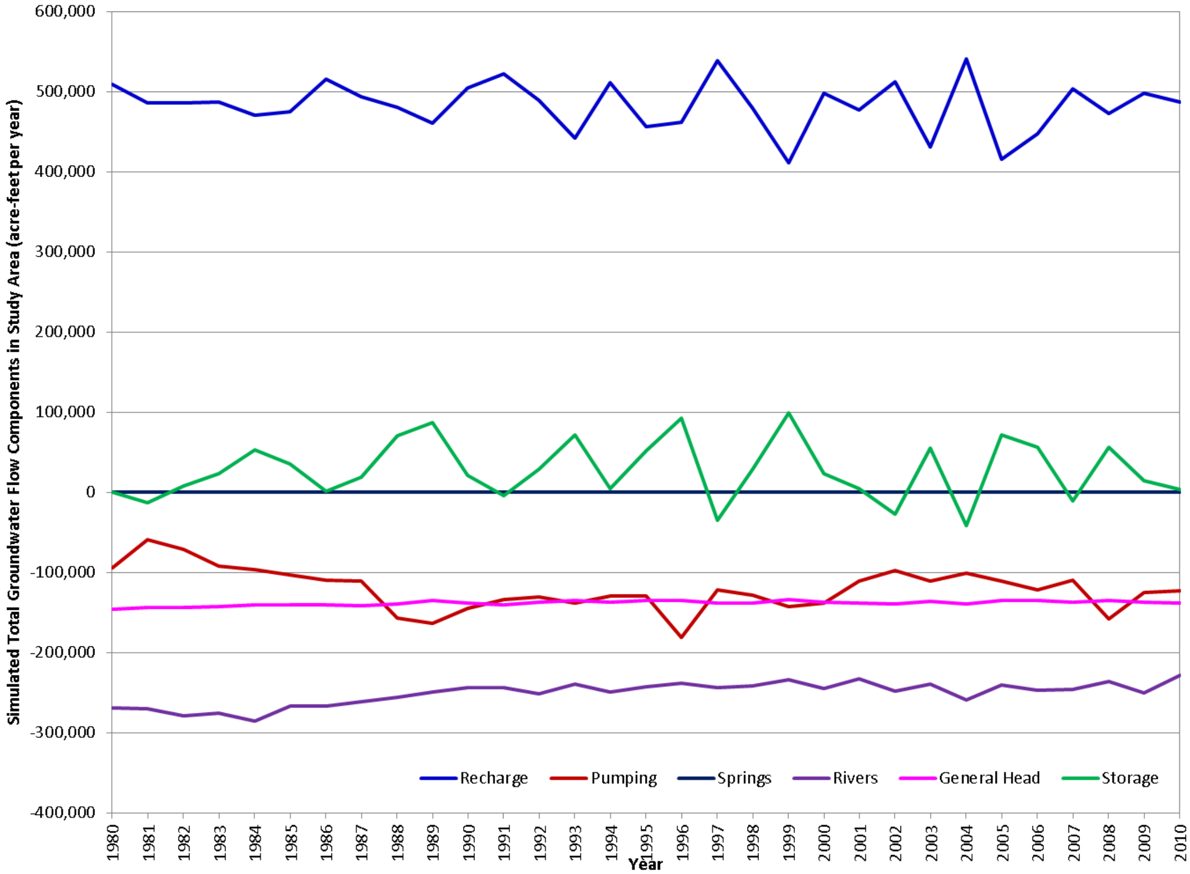

Figure 3.4.1 Overall modeled water budget in study area.

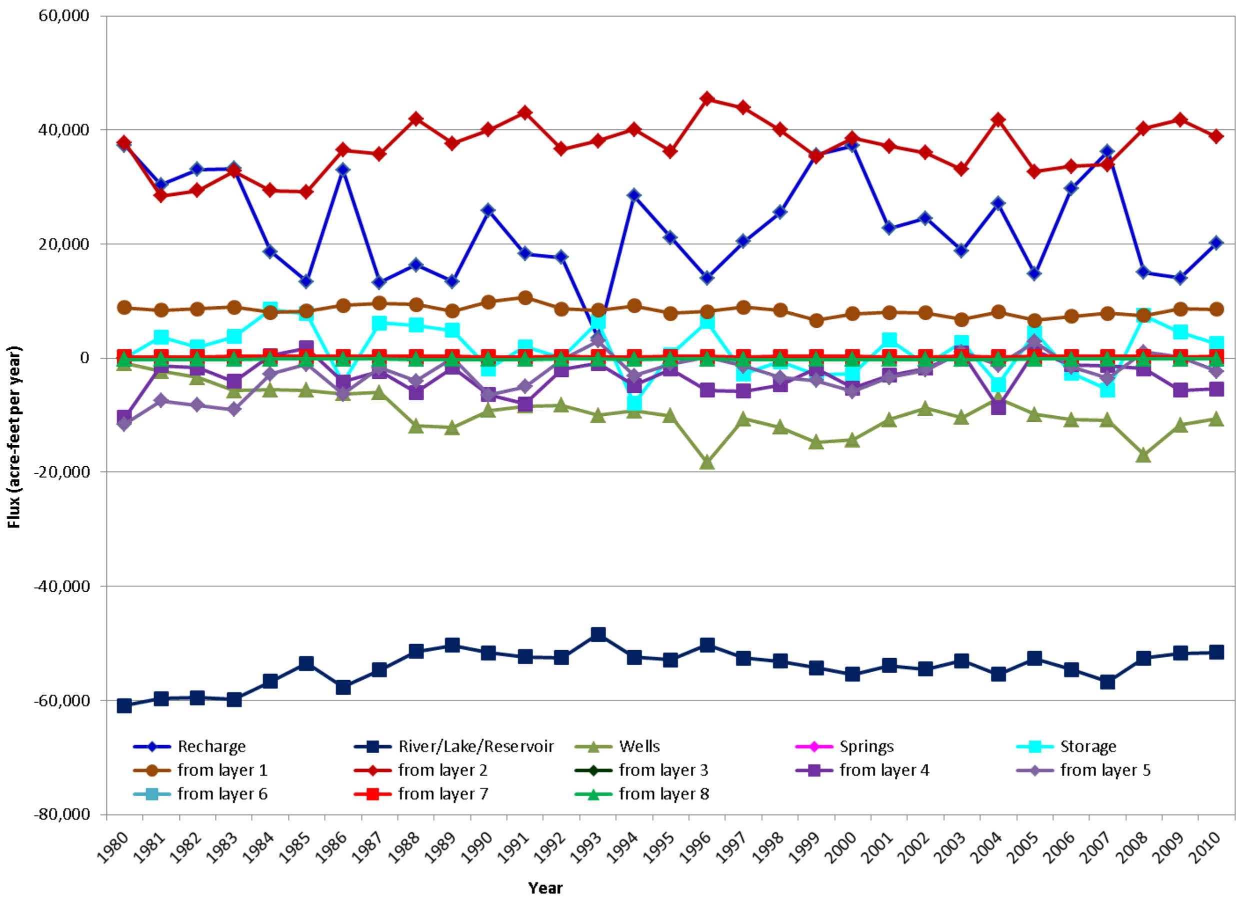

Figure 3.4.2 Modeled water budget for Marble Falls Aquifer in study area.

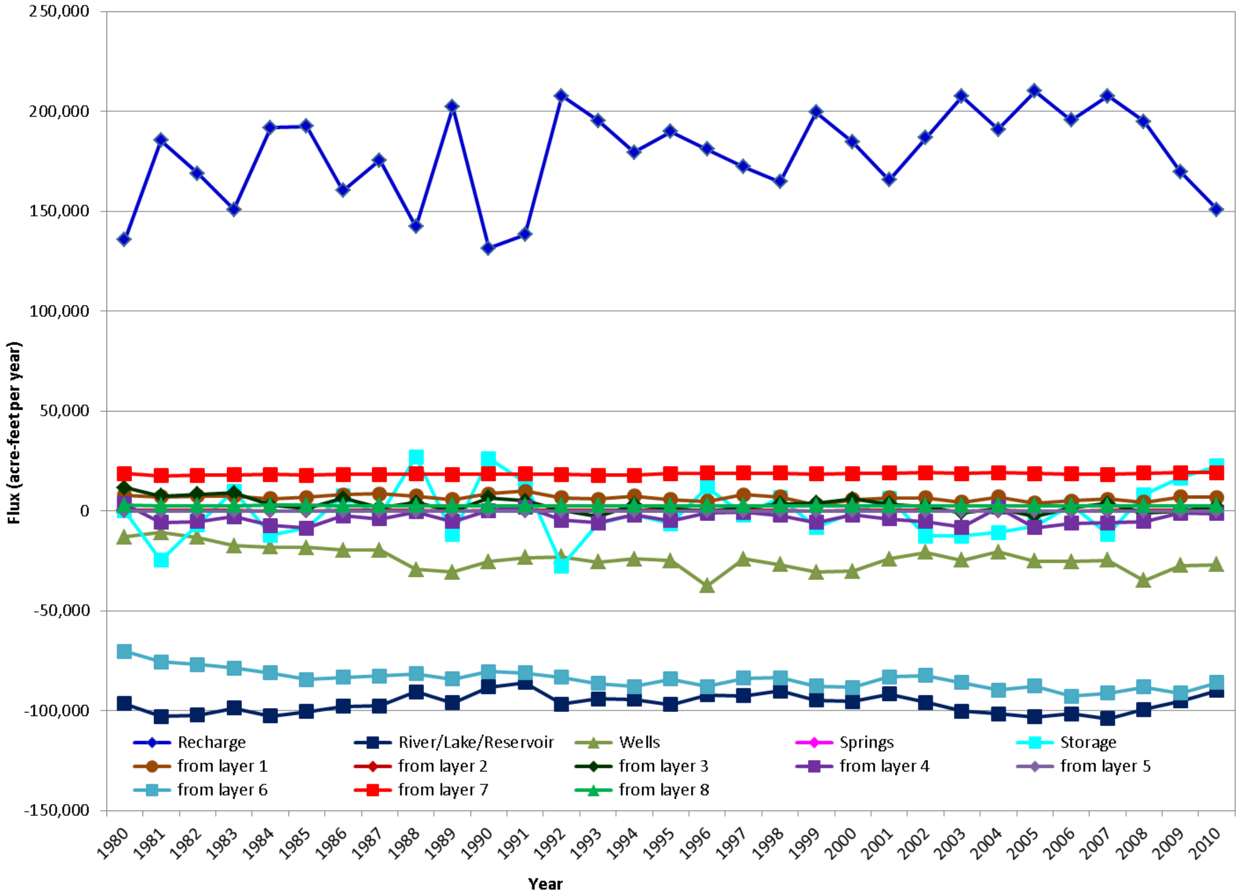

Figure 3.4.3 Modeled water budget for Ellenburger-San Saba Aquifer in study area.

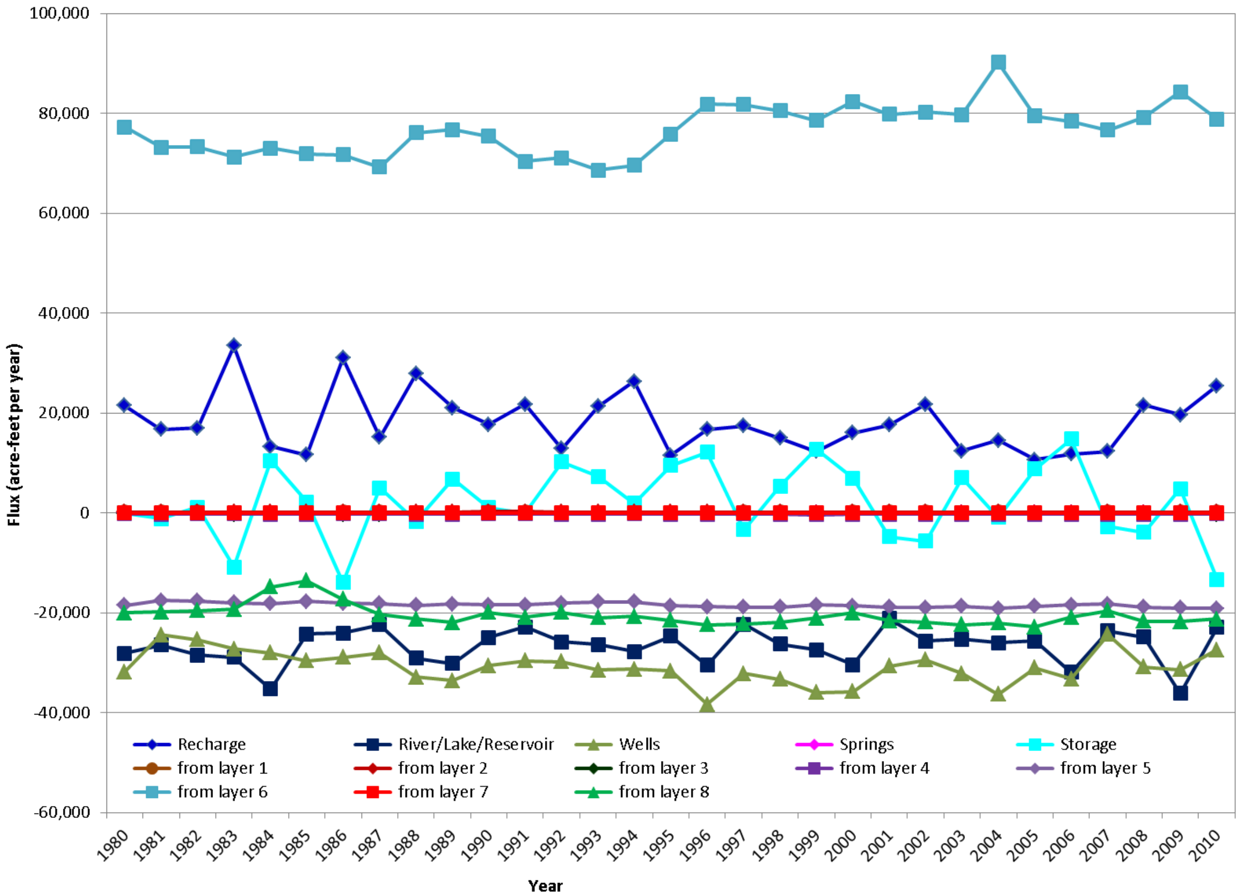

Figure 3.4.4 Modeled water budget for Hickory Aquifer in study area.

3.5 Correlation between Pumpage and Recharge

In general, pumpage is negatively correlated to precipitation, i.e. groundwater withdrawal at wells is usually higher in dry years than in wet years. Since groundwater recharge is positively related to precipitation, pumpage may then be negatively correlated to the groundwater recharge. To evaluate this, the simulated total pumping rates versus total groundwater recharge rates in the study area are plotted on Figure 3.5.1, which shows a weak negative correlation (-0.25).

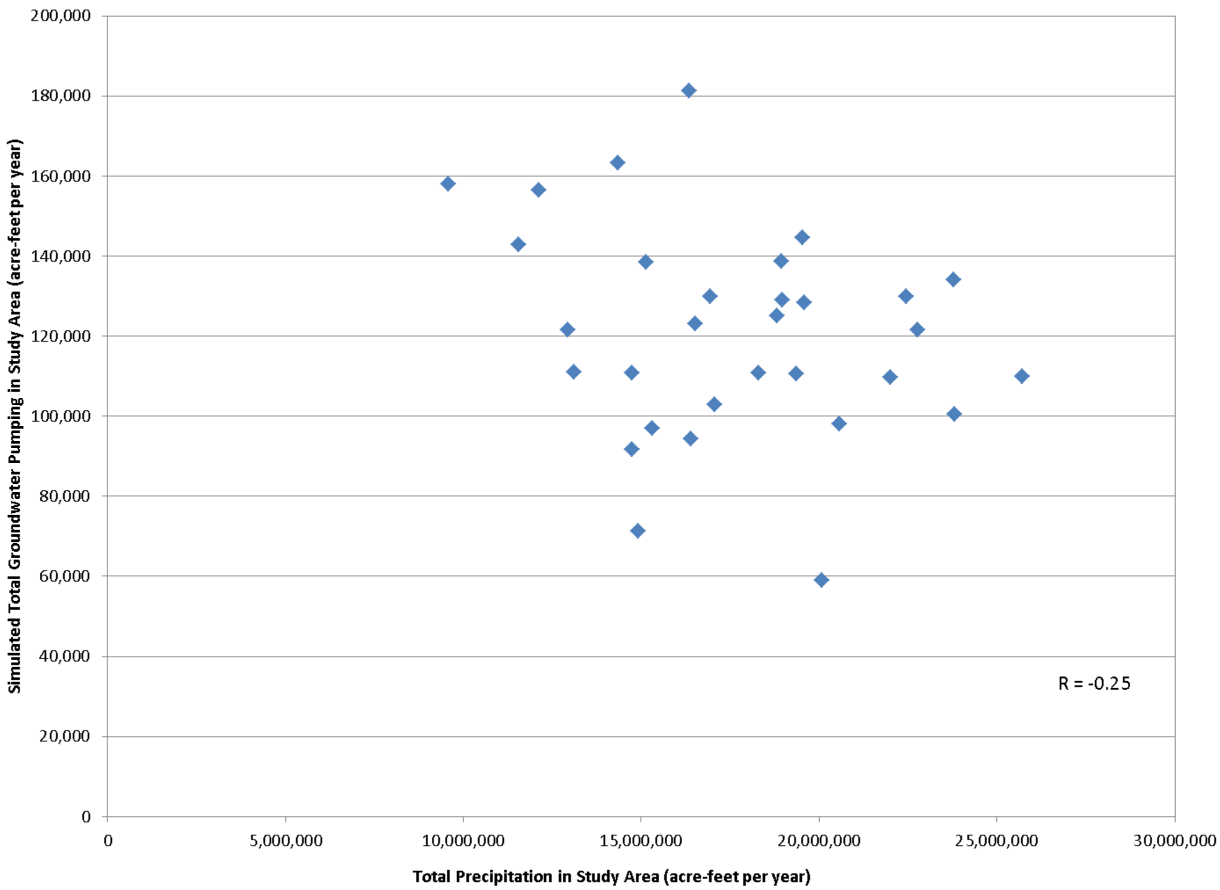

Figure 3.5.1 Correlation between groundwater withdrawal at wells and recharge from precipitation.

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4.0 Sensitivity Analysis

A sensitivity analysis is performed to analyze how sensitive the groundwater flow model is to certain input parameters. The most sensitive parameters are usually the targets of further refinement or investigation. In addition, special attention should be paid to the most sensitive parameters when a calibrated model is used for predictive simulations.

The following model input parameters were investigated for their sensitivity: drain conductance, general head conductance, conductance of river, lake, and reservoir, recharge, pumping, and hydraulic properties (horizontal hydraulic conductivity, vertical anisotropy, and storativity) of the Marble Falls, Ellenburger-San Saba, and Hickory aquifers. The sensitivity analysis involves independently decreasing and increasing these parameters by a factor of 0.5 and 1.5, respectively. After each model run, the simulated mean head residual based on head targets and flux for river leakage, spring flow, and general head were compared with the calibrated model using the following equations:

1) Head:

$$MHRD = MR_{sen} - MR_{cal} \tag{4.0.1}$$

where

MHRD = mean head residual difference

MR_{sen} = simulated mean head residual from sensitivity analysis

MR_{cal} = simulated mean head residual from calibrated model

2) Flux:

$$RMFC = MF_{sen}/MF_{cal} \tag{4.0.2}$$

where

RMFC = relative mean flux change for a flow component

MF_{sen} = mean flux (1981 to 2010) of a flow component from sensitivity analysis

MF_{cal} = mean flux (1981 to 2010) of a flow component from calibrated model

The relative mean flux change is used for the flux sensitivity analysis because of high flux values from the calibrated model.

4.1 Sensitivity Analysis Results

Figure 4.1.1 shows the sensitivity in hydraulic heads to changes of the input parameters described in Section 4.0. The simulated head is most sensitive to groundwater recharge and pumping. Increasing recharge or decreasing pumping results in higher simulated head. A moderate negative correlation can also be seen between the simulated groundwater level and the horizontal hydraulic conductivity of the Ellenburger-San Saba Aquifer or Hickory Aquifer. The model is not very sensitive to other parameters.

Groundwater leakage to river, lake, and reservoir is most sensitive and positively correlated to groundwater recharge (Figure 4.1.2). Variations of pumping or conductance of river, lake, and reservoir conductance may have some negative impacts on the groundwater leakage to the surface water bodies, but the impacts are expected to be insignificant. The negative impacts of the conductance of river, lake, and reservoir on the groundwater discharge to surface water are likely caused by the losing stream segments being more sensitive than gaining stream segments to the change of conductance. The groundwater leakage to surface water bodies is not sensitive to other model parameters.

Spring flow is highly correlated to recharge (Figure 4.1.3). Specifically, increasing recharge is expected to significantly increase spring flow. The horizontal hydraulic conductivity of the minor aquifers and pumping also have some impacts on the spring flow, but the negative correlation is not strong.

The general head boundary in the model simulated the lateral groundwater flow between inside and outside of the study area within the Cretaceous and younger units (layer 1). The sensitivity analysis indicates that the general head flux is sensitive to the conductance of river, lake, and reservoir and recharge (Figure 4.1.4). The correlation of general head flux with the conductance of river, lake, and reservoir conductance is likely due to closeness of these two boundary cells at some locations.

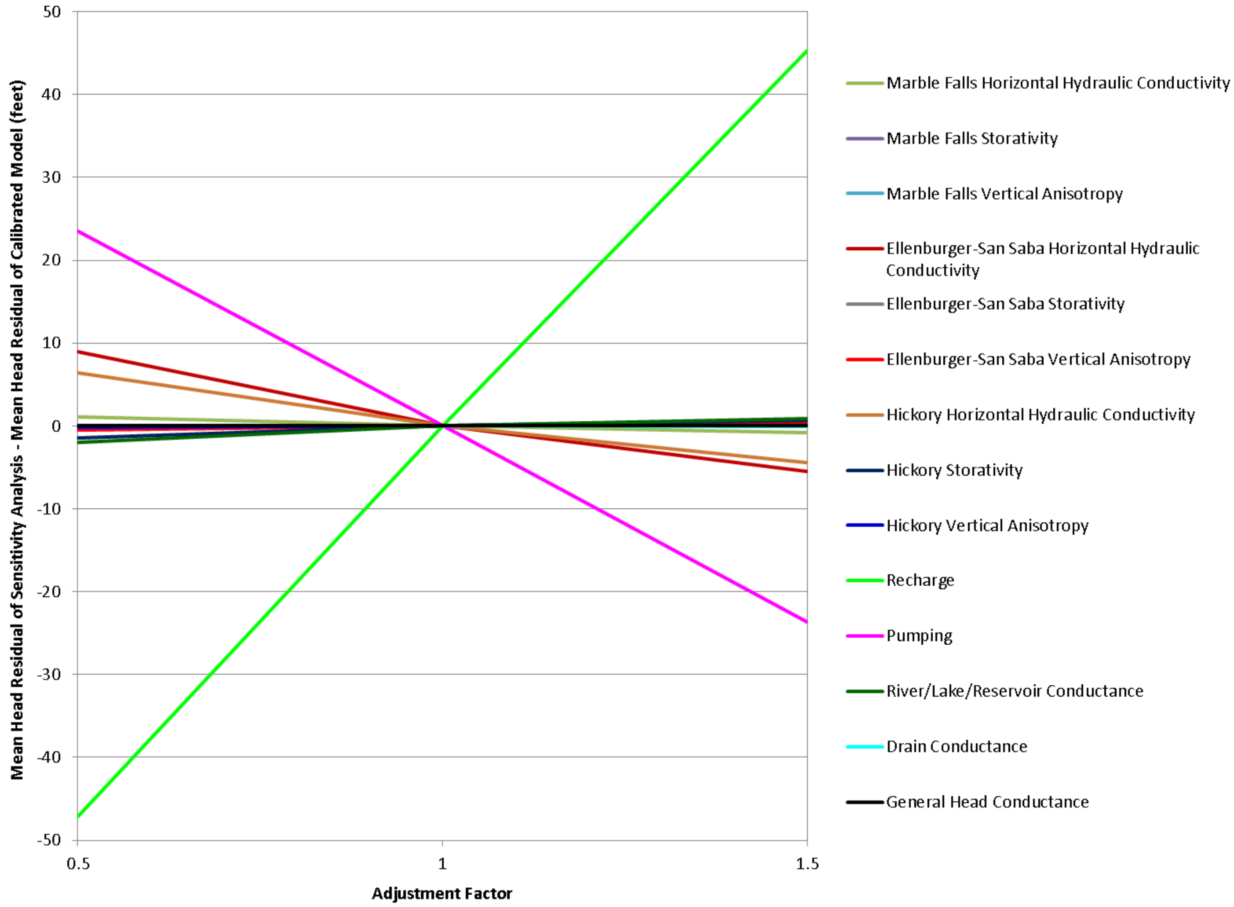

Figure 4.1.1 Sensitivity of hydraulic head to model input parameters.

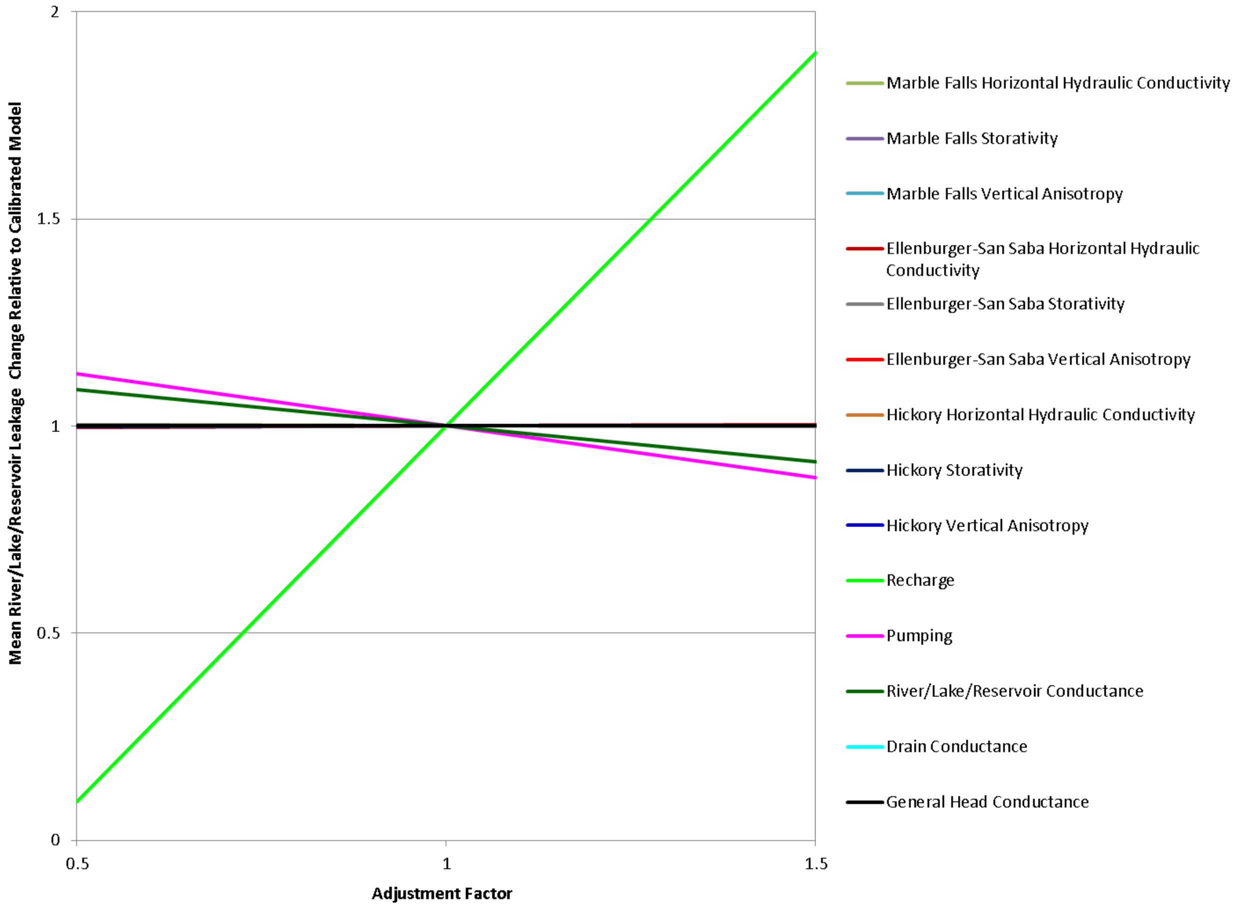

Figure 4.1.2 Sensitivity of groundwater leakage to rivers, lakes, and reservoirs to model input parameters.

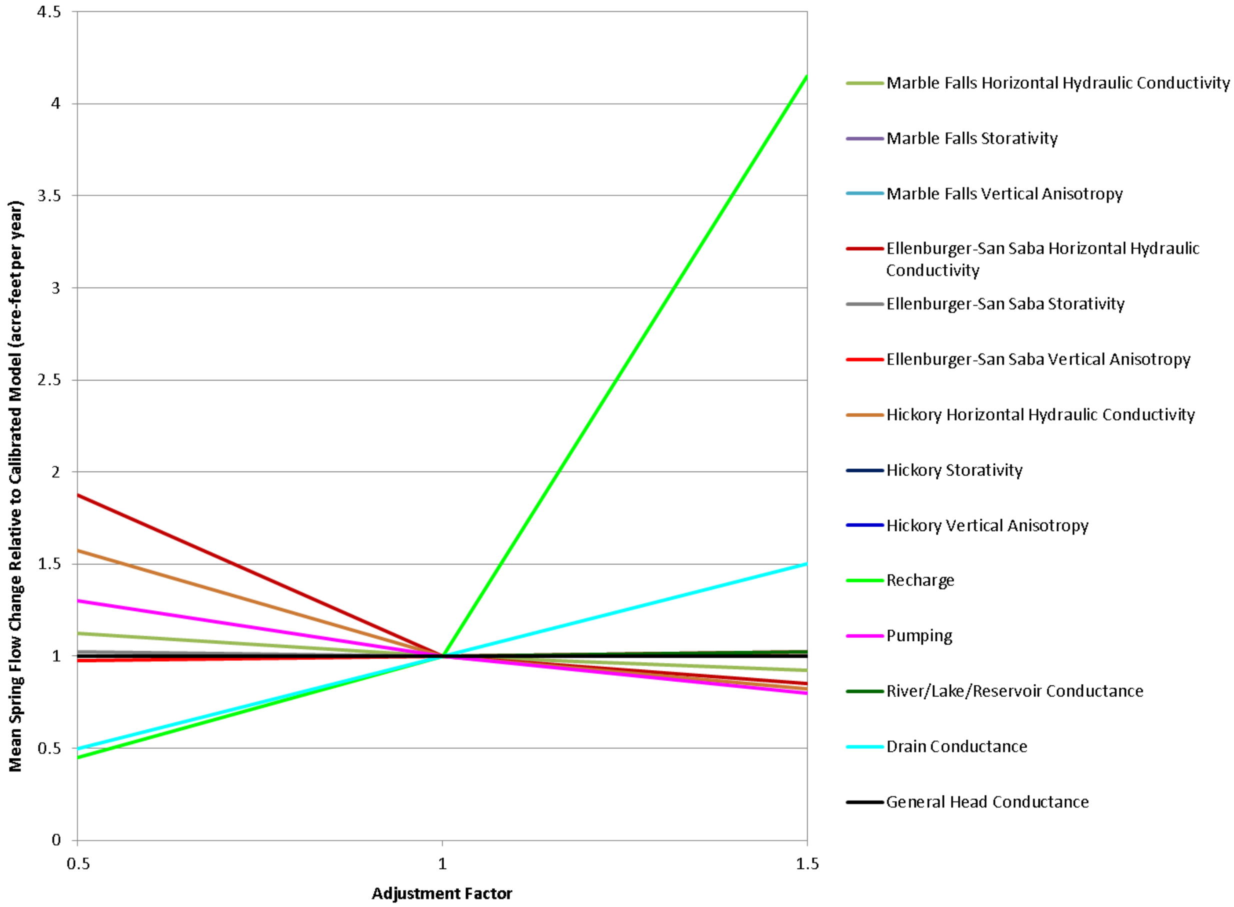

Figure 4.1.3 Sensitivity of spring flow to model input parameters.

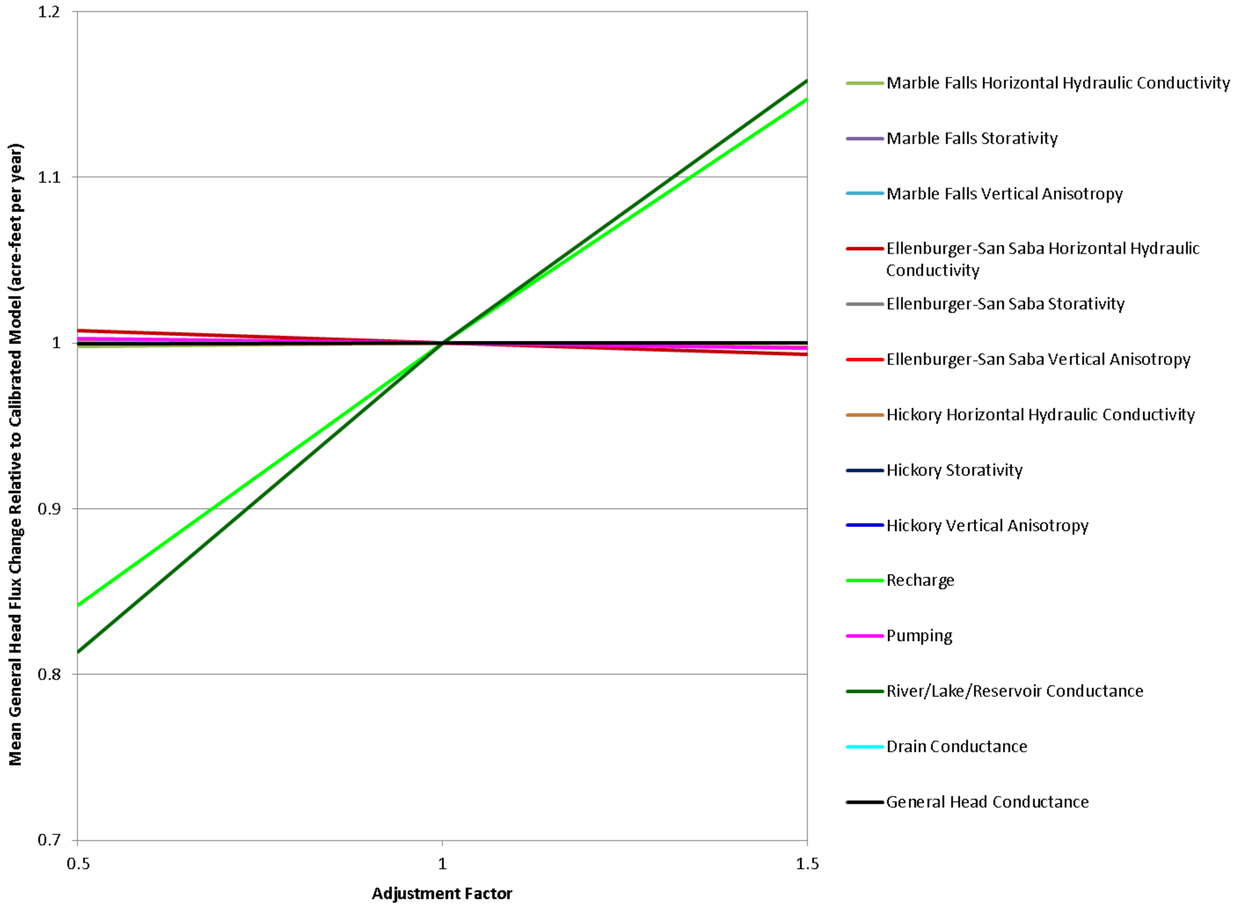

Figure 4.1.4 Sensitivity of general head flux to model input parameters.

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5.0 Model Limitations

Numerical groundwater flow models are approximations of aquifer systems (Anderson and Woessner, 2002). Numerical models require some assumptions and have some limitations. These limitations are usually associated with the purpose for the groundwater flow model, our extent of understanding the aquifer(s), the quantity and quality of data needed to constrain parameters in the groundwater flow model, and assumptions made during model development.

Several input parameters for the model are based on limited information. For example, there were no data regarding the hydraulic properties of the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in the far subcrop area. The distribution of the Marble Falls Aquifer in the subcrop area and the extent of the Ellenburger-San Saba and Hickory aquifers in the far subcrop area were interpolated based on very limited geophysical information. During the model calibration, special attention was paid to the validity of the model input parameters such as hydraulic conductivity, storativity, and recharge, among others, to ensure reasonable values were used to calibrate the model. However, uncertainty still exists regarding the quantity and distribution of the input parameters which, in turn, may introduce uncertainty of the model predictability.

For limestone aquifers such as Marble Falls and Ellenburger-San Saba aquifers, it is well known that aquifer properties could change dramatically over a relatively short distance. During the model construction and calibration, efforts were made to reflect these changes by using variable groundwater recharge and aquifer hydraulic properties. In addition, change of land topography could be significant between ridges and valleys. However, once the scale of aquifer heterogeneity, precipitation pattern, and land topography is smaller than a model grid, the model can only produce an average condition within the grid. As a result, TWDB does not recommend using this model for determining local scale concerns such as well spacing or the response of water levels in a single well.

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6.0 Summary and Conclusions

The TWDB has developed a MODFLOW-USG numerical groundwater flow model for the Marble Falls, Ellenburger-San Saba, and Hickory aquifers in Llano Uplift region. This groundwater flow model covers all or parts of nineteen counties: Blanco, Brown, Burnet, Coleman, Concho, Gillespie, Hays, Kendall, Kerr, Kimble, Lampasas, Llano, Mason, McCulloch, Menard, Mills, San Saba, Travis, and Williamson. The study area includes parts of Groundwater Management Areas 7, 8, and 9, and all or parts of thirteen groundwater conservation districts: Blanco-Pedernales Groundwater Conservation District, Bandera County River Authority & Ground Water District, Central Texas Groundwater Conservation District, Cow Creek Groundwater Conservation District, Hays Trinity Groundwater Conservation District, Headwaters Groundwater Conservation District, Hickory Underground Water Conservation District No. 1, Hill Country Underground Water Conservation District, Kimble County Groundwater Conservation District, Lipan-Kickapoo Water Conservation District, Menard County Underground Water District, Real-Edwards Conservation and Reclamation District, and Saratoga Underground Water Conservation District.

The Llano Uplift region is complex geologically, with a mixture of igneous, metamorphic, and sedimentary rocks that have been folded and faulted. To prepare the groundwater flow model, a conceptual groundwater model was developed to simplify the complex terrace suitable for numerical model construction (Shi and others, 2014). The Llano Uplift numerical groundwater flow model model consists of eight layers: 1) the Cretaceous-age limestones and younger units, 2) units below the Cretaceous but above the Marble Falls Aquifer, 3) the Marble Falls Aquifer, 4) units below Marble Falls Aquifer but above the Ellenburger-San Saba Aquifer, 5) the Ellenburger-San Saba Aquifer, 6) units below Ellenburger-San Saba Aquifer but above the Hickory Aquifer, 7) the Hickory Aquifer, and 8) parts of the Precambrian-age formations. The Precambrian layer was added during numerical model construction and calibration to alleviate the numerical instability at certain faulted aquifer blocks.

The numerical model is composed of uniform quarter-mile square nodes and 31 stress periods. Stress Period 1 (steady state) represents a pseudo steady-state condition by the end of 1980, which provides the initial heads for the transient periods 2 through 31 (time periods 1981 through 2010). The numerical model was primarily calibrated to measured water level data from the Marble Falls, Ellenburger-San Saba, and Hickory aquifers between 1980 and 2010. The numerical model was also qualitatively compared with historical stream gain/loss data. The calibration results indicate that the numerical model very well reproduced the regional groundwater flow pattern and was consistent with the long-term groundwater discharge to surface water bodies. The groundwater flow model meets the TWDB groundwater availability model standards.

For the Marble Falls Aquifer, recharge due to infiltration of precipitation at its outcrop area and cross- formational flow from the younger units in the subcrop area provide the major inflow. The major outflow is leakage to surface water bodies, groundwater pumping, and cross-formational flow to older units.

For the Ellenburger-San Saba Aquifer, the major inflow is recharge due to infiltration of precipitation at its outcrop area. Groundwater flows out of the aquifer mainly by leakage to surface water bodies, cross-formational flow to older units, and groundwater pumping.

For the Hickory Aquifer, the cross-formational flow from the younger units and recharge due to infiltration of precipitation at its outcrop area are the major inflow components. The major outflow is groundwater-pumping, leakage to surface water bodies, and cross-formational flow to the Ellenburger-San Saba Aquifer and the Precambrian unit.

Aquifer storage fluctuated between 1981 and 2010 and, in general, showed a slight declining trend attributable to variation of recharge and increasing groundwater withdrawal. Groundwater discharge to surface water bodies also showed a similar trend.

Sensitivity analysis indicated that the simulated water levels, groundwater leakage to surface water bodies, spring flow, and lateral flow between inside and outside of the study area are most sensitive to groundwater recharge due to precipitation. Groundwater pumping and surface water also have moderate impacts on the lateral flow between inside and outside of the study area.

Though this model was well calibrated to the measured water levels and compared well with the surface water gain/loss study, limitations still exist. The main limitation of this model is the uncertainty related to the lack of data in defining the aquifer properties, the downdip extent of the aquifers, and the complex heterogeneity of the limestone aquifers. The uncertainty of the model construction and calibration will be carried over to the model predictive simulations. As a result, this numerical flow model should be used with field monitoring and for regional groundwater flow evaluation.

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7.0 Acknowledgements

This model could not have been develped without the stakeholder participation. This is especially true during the conceptual model model development. Many stakeholders provided valuable suggestions and field data. These suggestions and data had been evaluated and incorporated into the conceptual model and numerical model. The Llano Uplift groundwater availability model team would like to thank all of the stakeholders for your contributions.

Special thanks go to Mr. Paul Tybor of the Hill Country Underground Water Conservation District, Mr. Ron Fieseler of the Blanco-Pedernales Groundwater Conservation District, and Mr. Charles Schell and Mr. Mitchell Sodek of the Central Texas Groundwater Conservation District, who provided all the help they could during the data collection phase of the project, hosted a field trip, and provided insight during model development. These data include water well logs, groundwater levels, and hydraulic test results, among others. In addition, we appreciate the cooperation and support from the Hickory Underground Water Conservation District No. 1 for providing funding for Dr. William Hutchison to participate directly with TWDB staff in the conceptualization and modeling phases of the project.

The study area provided one of the most challenging hydrogeological settings in Texas. Standen and Ruggiero (2007) provided the fundamental geologic framework, structure, and extent of the minor aquifers in the study area, which was the basis for further refinement during this project.

Mr. Roberto Anaya (TWDB) was very helpful with interpretating Cretaceous geology. The TWDB Groundwater Availability Model (GAM) group offered many valuable suggestions during technical review. Last but not least, we appreciate our groundwater availability modeling section manager, Ms. Cindy Ridgeway, for her leadership and continuous supports (both technically and administratively) throughout the whole process. Her advice on groundwater pumping was especially critical in developing the groundwater withdrawal package in the study area.

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8.0 References

Anaya, R., and Jones, I., 2009, Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas. Texas Water Development Board Report 373, 113 p.

Anderson, M.P. and Woessner, W.W., 2002, Applied groundwater modeling simulation of flow and advective transport, Academic Press, Inc., 381 p.

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011, Completion of the 2006 National Land Cover Database for the Conterminous United States, PE&RS, Vol. 77(9):858-864.

George, P.G., Mace, R.E., and Rima P., 2011, Aquifers of Texas. Texas Water Development Board Report 380, p. 172.

Hutchison, W.R., Jones, I.C., and Anaya, R., 2011, Update of the Groundwater Availability Model for the Edwards-Trinity (Plateau) and Pecos Valley Aquifers of Texas. Texas Water Development Board Report, 61 p.

Intera, Bureau of Economic Geology (The University of Texas at Austin), and LBG-Guyton Associates, 2014, Updated Groundwater Availability Model of the Northern Trinity and Woodbine Aquifers (FINAL MODEL REPORT), 990 p.

Jones, I.C., Anaya, R., and Wade, S.C., 2009, Groundwater Availability Model: Hill Country Portion of the Trinity Aquifer of Texas. Texas Water Development Board Report 377.

Larkin T.J., and Bomar, G.W., 1983, Climatic atlas of Texas. Texas Department of Water Resources Report LP-192.

Mace, R.E., Chowdhury, A.H., Anaya, R., and Way, S.C., 2000, Groundwater Availability of the Trinity Aquifer, Hill Country Area, Texas: Numerical Simulations through 2050. Texas Water Development Board Report 353

Panday, S., Langevin, C.D., Niswonger, R.G., Ibaraki, M., and Hughes, J.D., 2013, MODFLOW–USG version 1: An unstructured grid version of MODFLOW for simulating groundwater flow and tightly coupled processes using a control volume finite-difference formulation: U.S. Geological Survey Techniques and Methods, book 6, chap. A45, 66 p.

R.W. Harden & Associates, Inc., Freese & Nichols, Inc., HDR Engineering, Inc., L.B.G. Guyton Associates, U.S. Geological Survey, and Dr. Joe Yelderman, Jr., 2004. Northern Trinity / Woodbine Aquifer Groundwater Availability Model: Contract report to the Texas Water Development Board, 192 p.

Shi, J., Boghici, R., Kohlrenken, W., and Hutchison, W., 2014, Draft Conceptual Model Report: Minor Aquifers in Llano Uplift Region of Texas (November 2014).

Slade, Jr., R.M., Bentley, J.T., and Michaud, D., 2002, Results of Streamflow Gain-Loss Studies in Texas, with Emphasis on Gains from and Losses to Major and Minor Aquifers, Texas, 2000. U.S. Geological Survey, Open-File Report 02-068.

Standen, A. and Ruggiero, R., 2007, Llano Uplift Aquifers Structure and Stratigraphy, Prepared for Texas Water Development Board Contract Number 0604830614 (November 5, 2007), p. 78.

TWDB, 2016a, Maps & GIS data, GIS data, Major aquifers at http://www.twdb.texas.gov/mapping/gisdata.asp.

TWDB, 2016b, Maps & GIS data, GIS data, Minor aquifers at http://www.twdb.texas.gov/mapping/gisdata.asp.

TWDB, 2014a, Well Information/Groundwater Data at http://wiid.twdb.state.tx.us/ims/wwm_drl/viewer.htm, (accessed February 2014).

U.S. Department of Agriculture, 2014, National Agricultural Statistics Service, 2013 CropScape-Cropland Data Layer. http://nassgeodata.gmu.edu/CropScape/.

Watermark Numerical Computing, 2004, PEST Model-Independent Parameter Estimation User Manual: 5th Edition, variously p.

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Appendix A: Simulated versus Measured Heads

- Residual (feet) = Simulated Head (feet above mean sea level) – Measured Head (feet above mean sea level)
- Positive residuals indicate simulated heads higher than measured head
- Negative residuals indicate simulated heads lower than measured heads

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4149701	3	10	1,312.8	1,306.7	-6.1
4149701	3	12	1,312.6	1,306.7	-5.9
4149701	3	15	1,312.9	1,306.7	-6.1
4149701	3	17	1,313.0	1,306.7	-6.3
4149701	3	19	1,313.9	1,306.7	-7.2
4149701	3	23	1,315.3	1,306.7	-8.6
4150502	3	10	1,307.7	1,320.0	12.3
4150502	3	12	1,308.9	1,320.3	11.4
4150502	3	15	1,310.8	1,320.5	9.7
4150502	3	16	1,308.9	1,319.9	11.0
4150502	3	17	1,308.1	1,318.2	10.1
4150504	3	10	1,277.9	1,320.9	43.0
4150504	3	12	1,295.1	1,321.2	26.1
4151404	3	7	1,249.0	1,288.0	39.0
4151404	3	10	1,223.6	1,283.2	59.6
4151404	3	11	1,224.2	1,284.1	59.9
4151404	3	12	1,225.1	1,283.9	58.8
4151404	3	13	1,228.5	1,283.4	54.9
4151404	3	14	1,227.6	1,281.4	53.8
4151404	3	15	1,227.4	1,283.6	56.3
4151404	3	17	1,234.2	1,279.7	45.5
4151404	3	19	1,221.3	1,279.9	58.6
4151404	3	21	1,214.6	1,279.8	65.2
4151404	3	22	1,211.8	1,279.0	67.2
4151404	3	23	1,219.9	1,279.7	59.8
4151404	3	24	1,226.0	1,278.3	52.3
4151404	3	26	1,223.7	1,277.3	53.6
4151404	3	29	1,224.6	1,278.3	53.7
4151405	3	7	1,190.9	1,282.2	91.4
4151412	3	16	1,192.0	1,272.1	80.1
4151413	3	16	1,192.0	1,272.1	80.1
4151415	3	21	1,195.0	1,269.2	74.2
4151415	3	22	1,190.0	1,266.7	76.7
4151504	3	10	1,183.1	1,270.7	87.6
4151504	3	11	1,183.0	1,271.5	88.5
4151504	3	12	1,182.9	1,271.3	88.5
4151504	3	13	1,185.1	1,270.9	85.8
4151504	3	14	1,184.1	1,269.0	84.9

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4151504	3	15	1,182.1	1,271.2	89.1
4151504	3	17	1,184.4	1,265.6	81.2
4151504	3	19	1,183.4	1,265.6	82.1
4151504	3	20	1,183.4	1,265.3	81.9
4151504	3	21	1,184.0	1,265.0	80.9
4151504	3	22	1,183.5	1,264.4	80.9
4151504	3	23	1,183.5	1,265.4	81.9
4151504	3	24	1,183.1	1,264.1	81.0
4151504	3	25	1,186.3	1,264.8	78.6
4151504	3	26	1,183.4	1,263.5	80.1
4151504	3	29	1,210.2	1,263.9	53.7
4160303	3	10	1,067.3	1,104.6	37.4
4160303	3	12	1,068.9	1,105.0	36.2
4160303	3	15	1,068.0	1,105.3	37.3
4160303	3	16	1,066.5	1,105.0	38.5
4160303	3	17	1,068.0	1,104.8	36.8
4160303	3	18	1,066.8	1,105.4	38.6
4160303	3	19	1,067.4	1,105.1	37.7
4160303	3	20	1,066.3	1,105.2	38.9
4160303	3	21	1,068.0	1,104.7	36.7
4160303	3	22	1,068.8	1,104.6	35.8
4160303	3	23	1,068.8	1,104.6	35.8
4160303	3	24	1,069.0	1,104.1	35.1
4160303	3	25	1,069.7	1,105.0	35.3
4160303	3	26	1,065.9	1,104.1	38.2
4160303	3	27	1,064.9	1,104.8	39.9
4160303	3	28	1,068.2	1,105.4	37.2
4160303	3	29	1,066.3	1,105.0	38.6
4163401	3	15	1,102.4	1,132.5	30.1
4163401	3	17	1,096.1	1,128.5	32.4
4163401	3	18	1,116.9	1,131.8	15.0
4163401	3	20	1,102.5	1,124.5	22.0
4163401	3	21	1,100.8	1,125.3	24.5
4163401	3	22	1,104.9	1,127.5	22.5
4163401	3	23	1,112.9	1,128.7	15.9
4163401	3	24	1,106.0	1,124.6	18.7
4163401	3	25	1,113.7	1,128.6	14.9
4163401	3	26	1,108.1	1,124.4	16.4

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4163401	3	27	1,096.5	1,124.0	27.5
4255102	3	29	1,634.9	1,486.5	-148.4
5731402	3	8	810.8	761.8	-49.0
5731402	3	9	811.5	761.2	-50.3
5731402	3	10	809.2	761.1	-48.1
5731402	3	12	830.8	760.3	-70.5
5731402	3	13	811.5	760.5	-51.0
5731402	3	14	814.4	760.8	-53.6
5731402	3	16	811.7	760.4	-51.4
5731402	3	17	812.3	760.5	-51.8
5731402	3	18	814.2	761.4	-52.9
5731402	3	19	814.9	761.8	-53.1
5731402	3	20	810.9	762.1	-48.8
5731402	3	21	811.9	762.4	-49.5
5731402	3	22	817.4	762.2	-55.2
5731402	3	23	813.8	762.4	-51.4
5731402	3	24	811.2	761.8	-49.3
5731402	3	25	829.5	762.3	-67.2
5731402	3	26	810.8	761.6	-49.3
5731402	3	27	810.6	762.0	-48.5
5731402	3	28	811.4	762.7	-48.7
5731402	3	29	810.1	761.7	-48.4
5731405	3	11	752.0	740.9	-11.1
5731802	3	20	630.7	652.6	21.9
5731802	3	21	649.2	652.6	3.4
5731802	3	22	649.4	652.7	3.2
5731802	3	25	648.7	652.7	4.0
5731802	3	26	630.2	652.6	22.5
5731802	3	27	628.2	652.6	24.4
5731802	3	28	650.6	652.6	2.1
5731802	3	29	620.9	652.6	31.7
5739708	3	3	946.0	911.9	-34.1
5754608	3	3	1,059.0	1,091.7	32.7
4141703	5	8	1,360.7	1,371.4	10.7
4141805	5	9	1,350.3	1,354.2	3.9
4141805	5	10	1,346.8	1,352.0	5.2
4141805	5	12	1,345.3	1,352.5	7.2
4141805	5	13	1,359.4	1,351.9	-7.5

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4141805	5	14	1,360.1	1,350.0	-10.1
4141805	5	15	1,360.4	1,352.6	-7.8
4141805	5	16	1,360.7	1,351.9	-8.8
4141805	5	19	1,361.7	1,350.1	-11.6
4141805	5	29	1,363.6	1,349.5	-14.1
4141811	5	4	1,335.0	1,361.2	26.2
4141811	5	9	1,352.6	1,353.1	0.5
4149501	5	10	1,324.6	1,336.4	11.8
4149501	5	12	1,324.4	1,336.3	12.0
4149501	5	15	1,319.8	1,336.2	16.4
4149501	5	16	1,318.9	1,336.3	17.4
4149501	5	17	1,319.6	1,335.1	15.5
4149501	5	19	1,320.6	1,335.8	15.2
4149501	5	23	1,325.4	1,336.8	11.4
4149501	5	29	1,326.2	1,336.3	10.1
4149802	5	1	1,195.3	1,321.5	126.2
4149802	5	7	1,232.0	1,318.5	86.5
4149802	5	10	1,219.8	1,315.8	96.0
4149802	5	12	1,225.7	1,315.8	90.1
4149802	5	15	1,213.7	1,315.9	102.2
4149802	5	16	1,211.9	1,315.9	104.0
4149802	5	17	1,211.4	1,315.0	103.6
4149802	5	19	1,214.6	1,315.6	101.0
4149802	5	23	1,217.2	1,316.2	99.0
4149902	5	10	1,297.3	1,306.1	8.8
4149902	5	12	1,297.9	1,306.0	8.0
4149902	5	15	1,298.3	1,306.1	7.8
4149902	5	16	1,298.4	1,306.1	7.7
4149902	5	17	1,298.6	1,305.4	6.8
4149902	5	19	1,298.9	1,305.7	6.8
4150902	5	10	1,256.9	1,331.3	74.5
4150902	5	29	1,262.6	1,328.8	66.2
4151414	5	22	1,224.0	1,269.3	45.3
4151416	5	22	1,214.0	1,271.7	57.7
4151417	5	22	1,203.0	1,271.7	68.7
4151502	5	9	1,192.6	1,264.7	72.1
4151505	5	9	1,191.1	1,264.7	73.6
4151506	5	9	1,190.5	1,266.9	76.3

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4151506	5	10	1,184.3	1,265.2	80.9
4151506	5	12	1,191.3	1,266.0	74.7
4151506	5	17	1,196.1	1,261.4	65.4
4151506	5	18	1,194.8	1,263.0	68.1
4151506	5	19	1,193.9	1,261.6	67.6
4151506	5	20	1,190.8	1,260.9	70.2
4151506	5	21	1,187.5	1,260.9	73.4
4151506	5	22	1,194.3	1,260.7	66.4
4151506	5	23	1,189.9	1,261.7	71.8
4151506	5	24	1,156.6	1,260.2	103.6
4151506	5	25	1,206.1	1,259.7	53.7
4151506	5	26	1,193.1	1,259.6	66.6
4151506	5	29	1,187.6	1,260.2	72.6
4151602	5	1	1,300.0	1,257.9	-42.1
4151602	5	7	1,314.7	1,253.3	-61.4
4151602	5	10	1,243.2	1,250.3	7.2
4151602	5	15	1,314.9	1,249.4	-65.5
4151603	5	9	1,327.4	1,262.5	-64.9
4151701	5	7	1,250.2	1,314.7	64.5
4151701	5	10	1,213.5	1,310.4	96.9
4151701	5	11	1,214.0	1,310.4	96.4
4151701	5	12	1,211.7	1,309.7	98.0
4151701	5	13	1,245.5	1,309.5	64.0
4151701	5	14	1,226.1	1,307.9	81.9
4151701	5	15	1,227.5	1,309.4	81.9
4151701	5	17	1,229.6	1,307.5	77.9
4151701	5	18	1,228.0	1,307.5	79.6
4151701	5	19	1,224.9	1,307.4	82.5
4151701	5	20	1,234.9	1,308.0	73.1
4151701	5	21	1,225.0	1,308.0	83.0
4151701	5	22	1,221.2	1,307.1	85.9
4151701	5	23	1,224.8	1,307.2	82.4
4151701	5	24	1,217.4	1,306.5	89.1
4151701	5	25	1,255.5	1,307.0	51.5
4151701	5	26	1,216.3	1,306.2	90.0
4151701	5	29	1,201.6	1,306.7	105.1
4151901	5	10	1,332.7	1,282.2	-50.4
4152804	5	9	1,122.0	1,220.7	98.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4157504	5	10	1,370.0	1,381.3	11.3
4157602	5	1	1,386.0	1,383.0	-3.1
4158401	5	1	1,376.0	1,412.8	36.8
4158401	5	7	1,383.2	1,413.4	30.2
4158401	5	10	1,368.6	1,411.9	43.4
4158401	5	12	1,359.4	1,409.9	50.5
4158401	5	15	1,379.1	1,410.9	31.8
4158401	5	18	1,388.1	1,410.7	22.6
4158401	5	20	1,375.1	1,410.7	35.6
4158401	5	21	1,384.6	1,410.8	26.2
4158401	5	22	1,384.2	1,410.5	26.4
4158401	5	23	1,386.9	1,410.8	23.9
4158401	5	24	1,379.7	1,411.5	31.8
4158401	5	25	1,386.9	1,412.1	25.2
4158702	5	3	1,405.0	1,494.5	89.5
4159401	5	10	1,409.5	1,429.0	19.5
4161303	5	6	1,201.0	1,159.0	-42.0
4161303	5	16	1,189.3	1,160.2	-29.1
4161303	5	17	1,188.5	1,159.8	-28.8
4161303	5	18	1,198.0	1,162.3	-35.8
4161303	5	19	1,196.6	1,161.8	-34.8
4161303	5	20	1,195.3	1,160.1	-35.2
4161303	5	21	1,194.6	1,161.3	-33.3
4161303	5	22	1,195.5	1,161.6	-33.9
4161303	5	23	1,196.7	1,162.0	-34.7
4161303	5	24	1,195.4	1,159.2	-36.3
4161303	5	25	1,207.5	1,162.3	-45.2
4161303	5	26	1,192.0	1,158.8	-33.1
4161303	5	27	1,195.1	1,159.4	-35.7
4161303	5	28	1,199.1	1,161.8	-37.4
4161303	5	29	1,195.0	1,159.8	-35.2
4161402	5	15	1,139.3	1,132.0	-7.3
4161402	5	17	1,144.5	1,131.8	-12.6
4161402	5	20	1,138.1	1,133.0	-5.1
4161402	5	21	1,144.7	1,133.2	-11.5
4161402	5	24	1,138.2	1,132.9	-5.2
4161402	5	27	1,135.4	1,133.9	-1.5
4161402	5	29	1,131.9	1,134.0	2.1

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4162803	5	13	1,325.0	1,200.1	-124.9
4248801	5	1	1,425.5	1,413.1	-12.4
4248801	5	7	1,438.6	1,401.8	-36.8
4248801	5	29	1,430.5	1,393.3	-37.2
4254601	5	7	1,628.0	1,540.0	-88.0
4254704	5	5	1,452.0	1,550.1	98.1
4254901	5	12	1,623.1	1,544.2	-78.9
4254901	5	15	1,651.0	1,544.6	-106.4
4254901	5	16	1,624.9	1,544.3	-80.6
4254901	5	17	1,620.6	1,542.2	-78.4
4254901	5	20	1,617.1	1,542.1	-75.0
4254901	5	21	1,620.1	1,542.4	-77.7
4254901	5	23	1,620.3	1,543.9	-76.4
4254901	5	24	1,621.1	1,543.2	-77.9
4254901	5	25	1,622.8	1,545.4	-77.4
4255702	5	29	1,644.3	1,529.5	-114.8
4255801	5	1	1,577.0	1,531.4	-45.6
4255801	5	12	1,525.3	1,525.9	0.6
4255801	5	15	1,564.8	1,527.3	-37.5
4255801	5	17	1,557.5	1,527.0	-30.5
4255801	5	22	1,575.8	1,526.0	-49.8
4255801	5	23	1,582.8	1,526.3	-56.4
4255801	5	24	1,568.6	1,527.4	-41.2
4255801	5	25	1,580.7	1,527.9	-52.8
4256201	5	11	1,466.0	1,421.6	-44.4
4261701	5	29	1,618.1	1,599.8	-18.3
4261901	5	12	1,663.6	1,604.0	-59.6
4261901	5	15	1,659.8	1,604.0	-55.8
4261901	5	17	1,658.8	1,601.8	-57.0
4261901	5	22	1,657.4	1,603.3	-54.2
4261901	5	23	1,653.5	1,604.4	-49.1
4261901	5	24	1,653.2	1,604.2	-49.1
4261901	5	25	1,651.7	1,605.2	-46.5
4261901	5	26	1,653.7	1,604.5	-49.2
4261901	5	29	1,653.5	1,603.9	-49.6
4261904	5	29	1,640.4	1,605.2	-35.2
4262102	5	10	1,548.5	1,568.6	20.1
4262102	5	11	1,546.9	1,569.4	22.5

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4262102	5	12	1,548.4	1,570.8	22.4
4262503	5	12	1,660.0	1,585.9	-74.2
4262503	5	13	1,674.3	1,587.1	-87.1
4262503	5	15	1,662.4	1,587.4	-75.0
4262506	5	21	1,699.0	1,589.1	-109.9
4262909	5	11	1,603.7	1,581.1	-22.6
4262909	5	12	1,577.4	1,580.5	3.1
4262909	5	13	1,574.6	1,582.0	7.5
4262909	5	14	1,565.0	1,581.9	16.9
4262909	5	15	1,564.8	1,582.1	17.3
4262909	5	16	1,563.4	1,582.5	19.1
4262909	5	17	1,598.1	1,582.3	-15.8
4262909	5	21	1,603.9	1,582.7	-21.2
4262909	5	22	1,558.7	1,582.4	23.7
4262909	5	23	1,558.5	1,582.9	24.4
4262909	5	30	1,568.1	1,584.0	15.9
4262910	5	11	1,573.0	1,581.1	8.1
4262910	5	12	1,572.6	1,580.5	7.9
4262910	5	13	1,574.7	1,582.0	7.3
4262910	5	14	1,570.2	1,581.9	11.7
4262910	5	15	1,569.7	1,582.1	12.4
4262910	5	16	1,570.7	1,582.5	11.8
4262910	5	17	1,593.5	1,582.3	-11.2
4262910	5	20	1,604.7	1,582.3	-22.4
4262910	5	21	1,604.7	1,582.7	-22.0
4262910	5	22	1,569.0	1,582.4	13.4
4262910	5	23	1,570.2	1,582.9	12.7
4262910	5	24	1,569.4	1,584.1	14.7
4262910	5	30	1,581.4	1,584.0	2.6
4263708	5	7	1,493.2	1,509.0	15.8
4263709	5	7	1,505.2	1,500.7	-4.4
4264401	5	9	1,444.4	1,426.5	-17.9
5605403	5	1	1,664.0	1,656.3	-7.7
5605403	5	29	1,640.9	1,647.9	7.0
5612302	5	11	1,684.1	1,667.9	-16.2
5612302	5	12	1,677.1	1,668.9	-8.2
5612302	5	13	1,683.5	1,667.0	-16.5
5612302	5	15	1,686.7	1,664.9	-21.9

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5612302	5	16	1,679.5	1,663.2	-16.4
5612304	5	18	1,655.5	1,660.1	4.6
5612304	5	19	1,648.3	1,657.9	9.6
5612304	5	20	1,652.1	1,654.5	2.4
5612304	5	21	1,650.7	1,655.1	4.4
5612304	5	22	1,649.1	1,656.3	7.2
5612304	5	23	1,647.9	1,657.7	9.8
5612304	5	27	1,642.7	1,652.8	10.0
5612304	5	28	1,642.0	1,654.4	12.4
5620605	5	7	1,662.7	1,622.8	-39.9
5621801	5	5	1,426.3	1,505.4	79.2
5622802	5	5	1,359.2	1,375.1	16.0
5629104	5	1	1,549.0	1,560.7	11.7
5629105	5	2	1,675.0	1,587.4	-87.7
5629201	5	5	1,563.2	1,559.5	-3.6
5629602	5	5	1,581.8	1,604.9	23.2
5639602	5	5	1,633.3	1,713.4	80.1
5639603	5	12	1,685.0	1,751.1	66.1
5639603	5	13	1,688.7	1,750.1	61.5
5640104	5	10	1,606.0	1,610.7	4.7
5640104	5	18	1,605.4	1,610.7	5.3
5640104	5	19	1,613.2	1,610.7	-2.5
5640104	5	21	1,620.1	1,610.7	-9.5
5640104	5	30	1,606.2	1,610.7	4.4
5640104	5	31	1,602.9	1,610.7	7.8
5640105	5	10	1,620.6	1,661.6	40.9
5640106	5	18	1,602.4	1,677.5	75.2
5640106	5	19	1,604.4	1,677.3	72.9
5640106	5	30	1,612.6	1,675.6	63.0
5640106	5	31	1,606.8	1,676.0	69.3
5640201	5	8	1,621.0	1,706.0	85.0
5640201	5	18	1,631.4	1,696.9	65.5
5640201	5	30	1,630.8	1,695.5	64.7
5640201	5	31	1,632.8	1,696.1	63.3
5640402	5	5	1,726.2	1,725.5	-0.7
5640503	5	5	1,679.2	1,729.1	49.9
5656201	5	18	1,719.4	1,742.1	22.7
5656201	5	21	1,717.9	1,739.9	22.0

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5656201	5	27	1,719.7	1,740.3	20.6
5656201	5	30	1,719.8	1,740.1	20.3
5656201	5	31	1,720.1	1,740.5	20.4
5702101	5	10	1,572.2	1,561.8	-10.4
5702102	5	10	1,560.7	1,561.8	1.1
5708401	5	30	1,134.1	1,067.1	-67.0
5708401	5	31	1,126.0	1,067.5	-58.5
5715301	5	2	1,162.5	1,124.4	-38.1
5715402	5	5	1,239.0	1,136.8	-102.2
5715704	5	1	1,260.3	1,129.9	-130.4
5715704	5	8	1,269.1	1,104.6	-164.4
5715704	5	9	1,264.5	1,112.6	-151.9
5715704	5	10	1,265.4	1,107.9	-157.5
5715704	5	12	1,273.8	1,114.5	-159.3
5715704	5	13	1,272.0	1,112.4	-159.6
5715704	5	14	1,270.1	1,108.1	-162.1
5715704	5	15	1,268.9	1,109.1	-159.9
5715704	5	16	1,267.4	1,107.3	-160.1
5715704	5	17	1,270.3	1,105.9	-164.4
5715704	5	19	1,270.8	1,107.0	-163.7
5715704	5	20	1,268.9	1,108.6	-160.3
5715704	5	22	1,270.9	1,112.4	-158.4
5715704	5	23	1,271.9	1,113.9	-158.0
5715704	5	24	1,265.6	1,084.6	-181.0
5715704	5	25	1,275.7	1,108.2	-167.5
5715704	5	26	1,269.5	1,081.6	-187.8
5715704	5	27	1,267.5	1,101.5	-166.0
5715704	5	28	1,269.4	1,107.2	-162.2
5715704	5	29	1,266.0	1,106.4	-159.6
5715704	5	30	1,271.4	1,110.4	-161.0
5715902	5	30	1,168.9	1,054.7	-114.2
5715902	5	31	1,167.9	1,054.5	-113.5
5722103	5	15	1,225.0	1,250.8	25.8
5722104	5	15	1,245.0	1,238.4	-6.6
5722105	5	15	1,235.0	1,238.4	3.4
5722401	5	17	1,184.9	1,169.2	-15.7
5722401	5	18	1,234.4	1,169.8	-64.6
5722401	5	19	1,242.8	1,170.1	-72.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5722401	5	21	1,204.2	1,173.5	-30.7
5722401	5	22	1,208.7	1,173.5	-35.2
5722401	5	23	1,237.6	1,175.2	-62.5
5722401	5	24	1,207.6	1,174.5	-33.1
5722401	5	26	1,204.9	1,173.0	-31.9
5722401	5	27	1,195.9	1,173.4	-22.5
5722401	5	28	1,226.7	1,174.8	-51.9
5722401	5	29	1,194.8	1,176.3	-18.5
5722401	5	30	1,258.7	1,176.2	-82.5
5723112	5	24	1,208.2	1,051.8	-156.4
5737203	5	2	1,200.9	1,194.7	-6.2
5737203	5	7	1,201.9	1,208.6	6.6
5737203	5	12	1,206.8	1,209.1	2.3
5737203	5	17	1,184.4	1,214.1	29.7
5737203	5	18	1,203.4	1,216.2	12.8
5737203	5	19	1,203.5	1,216.8	13.3
5737203	5	20	1,188.9	1,216.7	27.8
5737203	5	21	1,204.9	1,216.8	11.9
5737203	5	22	1,203.3	1,216.4	13.1
5737203	5	23	1,204.0	1,220.1	16.1
5737203	5	24	1,192.1	1,222.4	30.3
5737203	5	25	1,208.0	1,223.9	15.9
5737203	5	26	1,189.1	1,226.0	36.9
5737607	5	23	1,297.0	1,174.2	-122.8
5738301	5	3	1,091.3	955.5	-135.7
5738512	5	18	1,168.5	1,107.0	-61.5
5738512	5	19	1,174.0	1,108.0	-66.0
5738512	5	20	1,166.0	1,105.1	-60.9
5738512	5	21	1,165.7	1,106.5	-59.2
5738512	5	22	1,169.3	1,106.7	-62.7
5738512	5	23	1,174.2	1,110.4	-63.8
5738512	5	24	1,167.4	1,110.4	-57.0
5738512	5	26	1,167.0	1,112.3	-54.7
5739103	5	26	920.9	824.8	-96.1
5742804	5	13	1,537.1	1,560.5	23.5
5742806	5	13	1,523.5	1,576.2	52.7
5742901	5	16	1,510.6	1,555.9	45.3
5742901	5	21	1,502.2	1,547.7	45.5

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5742901	5	22	1,509.9	1,548.0	38.1
5742901	5	27	1,504.9	1,545.2	40.4
5742901	5	30	1,504.8	1,544.0	39.2
5742901	5	31	1,511.6	1,544.7	33.1
5743206	5	13	1,602.0	1,605.8	3.8
5743207	5	13	1,621.7	1,603.5	-18.2
5743302	5	13	1,561.1	1,582.1	21.0
5743303	5	13	1,562.5	1,572.9	10.4
5743402	5	5	1,537.0	1,595.5	58.5
5743402	5	13	1,564.7	1,589.5	24.8
5743404	5	13	1,546.1	1,582.5	36.5
5743405	5	13	1,564.0	1,593.3	29.3
5743603	5	13	1,576.7	1,533.3	-43.4
5743702	5	16	1,544.8	1,575.0	30.2
5743702	5	21	1,547.0	1,564.9	17.9
5743702	5	22	1,547.3	1,564.9	17.7
5743702	5	27	1,547.5	1,560.7	13.2
5743702	5	30	1,546.8	1,559.2	12.3
5743702	5	31	1,548.3	1,560.0	11.7
5743703	5	13	1,551.9	1,576.3	24.4
5743704	5	13	1,544.0	1,568.7	24.7
5744405	5	13	1,526.7	1,453.7	-73.0
5744406	5	13	1,622.0	1,531.6	-90.4
5744512	5	19	1,447.0	1,400.2	-46.8
5745619	5	28	1,050.0	1,120.5	70.5
5745820	5	5	1,206.0	1,199.5	-6.5
5745822	5	25	1,207.6	1,151.8	-55.8
5745822	5	26	1,194.6	1,149.6	-44.9
5745822	5	27	1,187.1	1,149.7	-37.4
5745822	5	28	1,198.6	1,151.4	-47.2
5745822	5	29	1,186.0	1,149.4	-36.6
5745822	5	30	1,189.6	1,150.3	-39.3
5745822	5	31	1,194.8	1,150.3	-44.6
5745903	5	1	1,009.2	1,094.6	85.3
5745903	5	2	1,020.7	1,094.6	73.9
5746701	5	17	954.9	1,044.6	89.7
5746701	5	18	974.4	1,045.9	71.5
5746701	5	23	1,002.7	1,045.6	42.9

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5746701	5	26	990.5	1,044.6	54.1
5749601	5	5	1,587.5	1,600.9	13.4
5750101	5	1	1,505.0	1,531.3	26.3
5750101	5	14	1,497.9	1,566.0	68.1
5750102	5	4	1,512.0	1,574.0	62.0
5750102	5	13	1,505.5	1,567.4	61.9
5750102	5	15	1,480.6	1,568.6	88.0
5750102	5	16	1,496.8	1,567.7	71.0
5750102	5	21	1,485.6	1,565.0	79.4
5750102	5	22	1,508.7	1,565.6	56.8
5750102	5	27	1,507.7	1,565.6	57.9
5750102	5	30	1,501.2	1,565.3	64.1
5750102	5	31	1,506.8	1,565.9	59.1
5750106	5	12	1,498.8	1,567.7	69.0
5750106	5	13	1,489.3	1,567.4	78.1
5750106	5	15	1,489.3	1,568.6	79.3
5750106	5	16	1,495.1	1,567.7	72.6
5750106	5	21	1,488.9	1,565.0	76.1
5750106	5	22	1,511.6	1,565.6	53.9
5750106	5	27	1,488.3	1,565.6	77.4
5750106	5	30	1,480.1	1,565.3	85.3
5750106	5	31	1,490.1	1,565.9	75.8
5750107	5	16	1,502.7	1,562.5	59.8
5750107	5	21	1,497.7	1,559.5	61.8
5750107	5	22	1,509.9	1,560.0	50.1
5750107	5	27	1,507.9	1,560.0	52.2
5750107	5	30	1,502.7	1,559.7	57.0
5750107	5	31	1,508.9	1,560.2	51.3
5750108	5	10	1,502.0	1,562.7	60.7
5750108	5	11	1,509.6	1,563.2	53.6
5750108	5	12	1,510.8	1,564.4	53.7
5750108	5	13	1,520.2	1,563.9	43.7
5750108	5	14	1,512.9	1,564.1	51.2
5750108	5	15	1,512.2	1,565.2	53.0
5750108	5	16	1,511.2	1,564.3	53.1
5750108	5	17	1,512.6	1,561.6	49.0
5750108	5	18	1,520.8	1,564.2	43.5
5750108	5	19	1,520.6	1,562.1	41.5

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5750108	5	20	1,515.2	1,560.6	45.4
5750108	5	21	1,517.2	1,561.2	44.1
5750108	5	22	1,525.3	1,561.7	36.5
5750108	5	23	1,534.7	1,562.9	28.2
5750108	5	24	1,531.9	1,563.1	31.2
5750108	5	25	1,535.2	1,564.0	28.8
5750108	5	26	1,527.7	1,561.9	34.3
5750108	5	27	1,518.3	1,561.8	43.5
5750108	5	28	1,533.8	1,562.5	28.7
5750108	5	29	1,521.4	1,560.5	39.1
5750108	5	30	1,517.8	1,561.4	43.6
5750108	5	31	1,519.3	1,561.9	42.6
5750109	5	6	1,518.0	1,579.4	61.4
5750109	5	21	1,502.3	1,571.8	69.5
5750109	5	22	1,517.0	1,572.3	55.3
5750109	5	27	1,514.3	1,572.4	58.1
5750109	5	30	1,507.5	1,572.1	64.6
5750109	5	31	1,513.2	1,572.6	59.4
5750110	5	16	1,543.1	1,559.9	16.8
5750110	5	21	1,537.9	1,556.6	18.7
5750110	5	22	1,545.7	1,557.1	11.5
5750110	5	27	1,546.1	1,557.1	11.0
5750110	5	30	1,541.8	1,556.7	14.9
5750110	5	31	1,546.2	1,557.2	11.0
5750111	5	13	1,519.9	1,569.0	49.1
5750112	5	5	1,510.0	1,573.9	63.9
5750114	5	13	1,505.3	1,565.9	60.6
5750114	5	15	1,494.5	1,567.1	72.6
5750114	5	16	1,498.9	1,566.2	67.2
5750114	5	21	1,494.9	1,563.3	68.4
5750114	5	22	1,509.3	1,563.9	54.6
5750114	5	27	1,506.5	1,564.0	57.5
5750114	5	30	1,500.3	1,563.6	63.4
5750114	5	31	1,506.0	1,564.2	58.2
5750115	5	13	1,512.3	1,567.6	55.3
5750115	5	15	1,502.3	1,567.9	65.6
5750115	5	16	1,503.1	1,567.1	64.0
5750115	5	21	1,500.5	1,564.6	64.1

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5750115	5	22	1,511.4	1,565.2	53.9
5750115	5	27	1,509.4	1,565.3	55.9
5750115	5	30	1,503.6	1,565.0	61.4
5750115	5	31	1,511.9	1,565.6	53.7
5750118	5	22	1,562.0	1,577.6	15.7
5750118	5	27	1,571.2	1,577.8	6.6
5750118	5	30	1,567.3	1,577.5	10.2
5750118	5	31	1,570.3	1,578.1	7.8
5750202	5	5	1,515.0	1,564.7	49.7
5750205	5	21	1,505.6	1,554.2	48.6
5750205	5	22	1,517.3	1,554.8	37.4
5750205	5	27	1,515.6	1,554.7	39.1
5750205	5	30	1,510.6	1,554.4	43.8
5750205	5	31	1,516.3	1,554.9	38.6
5750209	5	16	1,514.3	1,557.2	42.9
5750209	5	21	1,509.0	1,554.2	45.2
5750209	5	22	1,519.9	1,554.8	34.9
5750209	5	27	1,509.5	1,554.7	45.2
5750209	5	30	1,515.2	1,554.4	39.2
5750209	5	31	1,520.7	1,554.9	34.2
5750215	5	5	1,517.1	1,567.1	50.0
5750218	5	5	1,525.0	1,568.1	43.1
5750221	5	16	1,509.6	1,557.2	47.6
5750221	5	22	1,515.7	1,554.8	39.0
5750221	5	27	1,515.2	1,554.7	39.6
5750221	5	30	1,510.9	1,554.4	43.4
5750221	5	31	1,516.5	1,554.9	38.4
5750222	5	16	1,510.8	1,557.2	46.4
5750224	5	6	1,524.0	1,567.0	43.0
5750227	5	15	1,516.1	1,554.4	38.3
5750227	5	16	1,514.7	1,553.3	38.6
5750227	5	21	1,507.7	1,548.6	40.9
5750227	5	22	1,515.9	1,549.1	33.1
5750227	5	27	1,512.0	1,548.8	36.7
5750227	5	30	1,510.7	1,548.3	37.6
5750227	5	31	1,514.6	1,548.8	34.2
5750230	5	2	1,541.0	1,572.6	31.6
5750231	5	14	1,507.2	1,557.4	50.3

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5750232	5	15	1,526.3	1,555.4	29.1
5750232	5	16	1,525.1	1,554.4	29.3
5750232	5	21	1,515.9	1,550.7	34.8
5750232	5	22	1,519.8	1,551.3	31.5
5750232	5	27	1,513.0	1,550.9	37.9
5750232	5	30	1,516.9	1,550.3	33.4
5750232	5	31	1,519.5	1,551.0	31.5
5750233	5	10	1,546.0	1,556.8	10.8
5750233	5	15	1,550.0	1,555.2	5.2
5750233	5	21	1,542.4	1,549.2	6.8
5750233	5	22	1,546.5	1,549.6	3.1
5750233	5	27	1,544.7	1,549.2	4.5
5750233	5	30	1,543.7	1,548.7	5.0
5750233	5	31	1,543.9	1,549.2	5.3
5750234	5	15	1,515.0	1,554.8	39.8
5750234	5	16	1,513.0	1,553.7	40.7
5750234	5	21	1,507.1	1,548.9	41.8
5750234	5	22	1,515.4	1,549.3	33.9
5750234	5	27	1,512.0	1,549.0	37.0
5750234	5	30	1,510.4	1,548.5	38.0
5750234	5	31	1,514.2	1,549.0	34.8
5750235	5	16	1,513.6	1,560.6	47.0
5750235	5	21	1,508.2	1,557.8	49.6
5750235	5	22	1,519.9	1,558.4	38.6
5750235	5	27	1,517.8	1,558.4	40.7
5750235	5	30	1,513.0	1,558.0	45.0
5750235	5	31	1,518.6	1,558.6	40.0
5750314	5	5	1,504.5	1,562.1	57.6
5750317	5	15	1,508.2	1,549.5	41.2
5750317	5	16	1,507.4	1,548.1	40.7
5750317	5	21	1,500.2	1,542.7	42.5
5750317	5	22	1,502.3	1,543.1	40.8
5750317	5	27	1,497.9	1,542.1	44.2
5750317	5	30	1,501.6	1,541.3	39.8
5750317	5	31	1,501.5	1,542.0	40.5
5750324	5	16	1,511.3	1,547.3	36.0
5750324	5	21	1,504.1	1,541.8	37.8
5750324	5	22	1,501.9	1,542.3	40.4

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5750324	5	23	1,504.0	1,543.4	39.3
5750324	5	24	1,499.2	1,543.1	44.0
5750324	5	25	1,496.6	1,544.2	47.7
5750324	5	26	1,504.5	1,541.8	37.3
5750324	5	27	1,499.3	1,541.8	42.4
5750324	5	28	1,507.6	1,542.7	35.1
5750324	5	29	1,482.4	1,540.1	57.7
5750324	5	30	1,501.6	1,541.1	39.5
5750324	5	31	1,491.1	1,541.7	50.6
5750325	5	16	1,510.6	1,544.5	33.9
5750325	5	21	1,500.4	1,539.1	38.7
5750325	5	22	1,486.3	1,539.6	53.3
5750325	5	27	1,490.2	1,539.0	48.9
5750325	5	30	1,493.5	1,538.4	44.9
5750325	5	31	1,489.4	1,539.0	49.6
5750326	5	16	1,511.1	1,544.5	33.4
5750326	5	21	1,500.9	1,539.1	38.2
5750326	5	22	1,486.2	1,539.6	53.4
5750326	5	27	1,489.6	1,539.0	49.4
5750326	5	30	1,493.8	1,538.4	44.7
5750326	5	31	1,490.3	1,539.0	48.8
5750327	5	16	1,506.1	1,544.5	38.4
5750327	5	21	1,495.6	1,539.1	43.5
5750327	5	22	1,485.8	1,539.6	53.7
5750327	5	27	1,482.1	1,539.0	56.9
5750327	5	30	1,489.5	1,538.4	48.9
5750327	5	31	1,487.1	1,539.0	51.9
5750328	5	16	1,505.5	1,544.5	39.0
5750328	5	21	1,495.1	1,539.1	44.0
5750328	5	22	1,485.1	1,539.6	54.5
5750328	5	27	1,482.7	1,539.0	56.3
5750328	5	30	1,488.3	1,538.4	50.1
5750328	5	31	1,485.6	1,539.0	53.4
5750329	5	16	1,511.7	1,548.0	36.3
5750329	5	21	1,501.9	1,543.1	41.3
5750329	5	22	1,493.7	1,543.6	50.0
5750329	5	27	1,493.2	1,543.0	49.9
5750330	5	15	1,512.3	1,551.7	39.4

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5750330	5	16	1,511.9	1,550.3	38.4
5750330	5	21	1,506.9	1,544.3	37.4
5750330	5	22	1,509.2	1,544.8	35.6
5750330	5	27	1,506.2	1,543.4	37.2
5750330	5	31	1,509.2	1,543.2	34.0
5750331	5	15	1,527.1	1,554.4	27.3
5750331	5	16	1,526.8	1,552.9	26.1
5750331	5	21	1,524.9	1,546.9	22.1
5750331	5	22	1,526.4	1,547.4	21.0
5750331	5	27	1,525.4	1,545.8	20.5
5750331	5	31	1,526.2	1,545.6	19.4
5750332	5	15	1,524.8	1,549.6	24.9
5750332	5	16	1,523.1	1,548.3	25.2
5750332	5	21	1,516.3	1,542.4	26.2
5750332	5	22	1,521.5	1,542.8	21.4
5750332	5	27	1,519.5	1,542.0	22.5
5750332	5	30	1,518.3	1,541.3	23.0
5750332	5	31	1,522.9	1,541.9	19.0
5750333	5	15	1,512.0	1,546.1	34.1
5750333	5	16	1,510.9	1,544.6	33.7
5750333	5	21	1,506.5	1,538.4	31.9
5750333	5	22	1,509.1	1,538.8	29.7
5750333	5	27	1,506.0	1,537.4	31.4
5750333	5	30	1,504.8	1,536.6	31.8
5750333	5	31	1,508.3	1,537.3	29.0
5750404	5	16	1,573.4	1,581.8	8.3
5750404	5	21	1,566.9	1,578.9	12.0
5750404	5	22	1,567.9	1,579.5	11.6
5750404	5	27	1,567.6	1,579.4	11.8
5750404	5	30	1,561.0	1,579.1	18.1
5750404	5	31	1,565.5	1,579.6	14.1
5750505	5	1	1,506.0	1,554.0	48.0
5750514	5	13	1,572.6	1,561.2	-11.4
5750514	5	15	1,567.7	1,561.5	-6.2
5750514	5	16	1,569.0	1,560.5	-8.5
5750514	5	21	1,564.6	1,556.6	-8.0
5750514	5	22	1,568.1	1,557.1	-11.1
5750514	5	27	1,569.3	1,556.9	-12.4

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5750514	5	30	1,567.8	1,556.5	-11.3
5750514	5	31	1,569.6	1,556.9	-12.7
5750515	5	13	1,569.3	1,558.2	-11.1
5750515	5	15	1,566.5	1,557.2	-9.2
5750515	5	16	1,566.0	1,556.1	-9.9
5750515	5	21	1,563.7	1,549.7	-14.0
5750515	5	22	1,564.3	1,549.9	-14.4
5750515	5	27	1,562.8	1,549.6	-13.2
5750515	5	30	1,564.9	1,549.0	-15.9
5750515	5	31	1,562.8	1,549.5	-13.3
5750516	5	18	1,558.0	1,557.2	-0.8
5750603	5	16	1,413.1	1,525.8	112.6
5750603	5	21	1,408.6	1,518.1	109.5
5750603	5	22	1,408.9	1,517.8	108.9
5750603	5	30	1,409.3	1,512.4	103.0
5750603	5	31	1,412.5	1,512.8	100.3
5750604	5	6	1,580.0	1,534.4	-45.6
5751101	5	5	1,462.6	1,513.8	51.2
5751107	5	5	1,466.0	1,516.7	50.7
5751109	5	19	1,489.0	1,521.7	32.7
5751111	5	6	1,472.0	1,515.2	43.2
5751201	5	5	1,437.9	1,490.4	52.4
5751215	5	6	1,455.0	1,484.1	29.1
5751305	5	18	1,407.6	1,467.5	59.9
5751305	5	19	1,411.6	1,466.6	55.0
5751305	5	30	1,422.4	1,454.9	32.5
5751307	5	10	1,398.0	1,472.7	74.7
5751402	5	5	1,466.9	1,518.0	51.1
5751404	5	16	1,463.0	1,516.5	53.6
5751404	5	21	1,456.7	1,507.8	51.1
5751404	5	22	1,461.3	1,507.5	46.2
5751404	5	27	1,458.4	1,503.8	45.4
5751404	5	30	1,456.5	1,502.1	45.6
5751404	5	31	1,461.4	1,502.4	41.0
5751407	5	28	1,470.3	1,493.0	22.7
5751407	5	29	1,459.3	1,490.1	30.8
5751407	5	30	1,461.2	1,490.7	29.6
5751407	5	31	1,462.2	1,491.1	28.8

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5751505	5	7	1,456.0	1,499.2	43.2
5752316	5	6	1,365.0	1,344.6	-20.4
5753302	5	1	1,163.7	1,147.8	-15.9
5753302	5	2	1,167.9	1,147.4	-20.4
5753302	5	7	1,180.7	1,145.8	-35.0
5753302	5	12	1,141.3	1,145.3	4.0
5753302	5	13	1,159.6	1,144.6	-15.0
5753302	5	17	1,149.3	1,140.9	-8.3
5753302	5	18	1,178.1	1,142.2	-35.8
5753302	5	19	1,182.0	1,142.3	-39.7
5753302	5	20	1,183.4	1,140.0	-43.4
5753302	5	21	1,170.1	1,139.7	-30.4
5753302	5	22	1,175.6	1,140.0	-35.6
5753302	5	23	1,179.3	1,140.5	-38.7
5753302	5	24	1,176.7	1,139.4	-37.4
5753302	5	25	1,183.8	1,140.2	-43.6
5753302	5	26	1,180.3	1,138.8	-41.5
4141501	7	9	1,449.5	1,339.6	-109.9
4141501	7	10	1,448.1	1,337.3	-110.9
4141501	7	11	1,447.3	1,338.0	-109.3
4141501	7	12	1,446.5	1,338.6	-107.9
4141501	7	13	1,446.9	1,337.9	-109.1
4141501	7	14	1,447.0	1,336.6	-110.3
4141501	7	15	1,446.0	1,339.5	-106.5
4141501	7	16	1,445.6	1,338.1	-107.5
4141501	7	19	1,443.8	1,336.1	-107.7
4141501	7	29	1,439.2	1,334.8	-104.4
4142601	7	10	1,441.4	1,259.4	-182.0
4142601	7	11	1,439.1	1,261.5	-177.6
4142601	7	12	1,438.9	1,260.3	-178.6
4142601	7	13	1,429.3	1,260.9	-168.4
4149704	7	16	1,494.0	1,356.7	-137.3
4149704	7	17	1,496.6	1,355.8	-140.8
4149704	7	19	1,500.4	1,356.1	-144.4
4149704	7	21	1,502.2	1,357.8	-144.4
4149704	7	23	1,503.2	1,357.0	-146.2
4149704	7	29	1,518.6	1,356.9	-161.7
4159702	7	9	1,453.4	1,463.4	10.0

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4159805	7	16	1,411.0	1,404.8	-6.2
4245601	7	1	1,512.5	1,477.3	-35.2
4245601	7	12	1,500.4	1,466.9	-33.5
4245601	7	15	1,495.5	1,463.3	-32.2
4245601	7	16	1,499.9	1,461.9	-37.9
4245601	7	17	1,491.3	1,452.3	-39.0
4245601	7	21	1,484.0	1,449.0	-35.0
4245601	7	23	1,482.0	1,460.3	-21.8
4245601	7	24	1,481.6	1,453.7	-27.9
4245601	7	25	1,482.0	1,458.8	-23.2
4246502	7	8	1,492.7	1,466.0	-26.7
4246502	7	17	1,485.7	1,457.0	-28.7
4246502	7	20	1,480.3	1,454.3	-26.0
4246502	7	21	1,471.7	1,453.2	-18.5
4246502	7	22	1,481.5	1,456.6	-24.9
4246502	7	23	1,479.4	1,459.4	-19.9
4246502	7	24	1,479.2	1,456.0	-23.2
4246502	7	25	1,480.1	1,461.0	-19.1
4246701	7	21	1,395.7	1,475.2	79.5
4246701	7	22	1,397.9	1,480.3	82.4
4246701	7	23	1,396.4	1,483.3	86.9
4246701	7	24	1,396.1	1,479.0	82.9
4246701	7	25	1,396.0	1,483.5	87.5
4247901	7	11	1,444.5	1,436.7	-7.9
4247901	7	16	1,442.4	1,436.4	-6.0
4247901	7	17	1,443.2	1,433.9	-9.3
4247901	7	21	1,441.8	1,432.0	-9.8
4247901	7	22	1,443.1	1,432.8	-10.3
4247901	7	23	1,443.3	1,434.5	-8.8
4247901	7	24	1,444.6	1,432.6	-12.0
4247901	7	25	1,445.7	1,437.1	-8.6
4252301	7	29	1,475.2	1,493.9	18.7
4254102	7	8	1,529.7	1,514.3	-15.4
4254102	7	16	1,502.6	1,508.5	5.9
4254202	7	3	1,491.0	1,523.4	32.4
4254802	7	21	1,486.0	1,547.1	61.1
4254903	7	17	1,495.8	1,541.8	46.0
4254903	7	21	1,494.7	1,541.9	47.2

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4254903	7	22	1,495.4	1,542.9	47.5
4254903	7	23	1,496.1	1,544.0	47.9
4254903	7	24	1,495.5	1,543.1	47.6
4254903	7	25	1,495.6	1,545.0	49.4
4255101	7	15	1,466.8	1,485.3	18.5
4255103	7	19	1,449.0	1,483.1	34.1
4255103	7	29	1,468.0	1,483.3	15.3
4256101	7	1	1,497.6	1,456.6	-41.0
4256101	7	11	1,482.6	1,442.6	-40.1
4256101	7	15	1,513.6	1,442.4	-71.1
4256101	7	16	1,508.3	1,442.0	-66.4
4260301	7	5	1,604.2	1,579.5	-24.7
4260401	7	6	1,552.9	1,591.1	38.2
4260401	7	7	1,551.7	1,591.1	39.4
4260401	7	16	1,542.4	1,586.2	43.8
4260401	7	19	1,538.8	1,581.9	43.1
4260401	7	20	1,536.9	1,578.8	41.9
4260401	7	23	1,533.7	1,583.6	49.9
4260401	7	29	1,533.1	1,576.2	43.2
4260502	7	7	1,551.7	1,591.2	39.5
4260503	7	6	1,548.0	1,589.1	41.1
4260503	7	7	1,547.4	1,589.2	41.8
4260503	7	9	1,545.6	1,586.3	40.7
4260503	7	16	1,538.4	1,584.6	46.2
4260503	7	19	1,534.9	1,580.6	45.7
4260503	7	20	1,532.8	1,577.8	45.0
4260503	7	23	1,530.3	1,582.8	52.5
4260503	7	29	1,532.5	1,576.6	44.2
4260601	7	6	1,541.9	1,595.7	53.8
4260601	7	7	1,542.1	1,595.7	53.6
4260601	7	15	1,531.6	1,592.0	60.4
4260601	7	16	1,533.0	1,591.5	58.5
4260601	7	19	1,529.5	1,587.9	58.4
4260601	7	20	1,526.9	1,585.4	58.5
4260601	7	23	1,525.6	1,590.0	64.4
4260601	7	29	1,530.2	1,584.9	54.7
4260602	7	6	1,540.2	1,590.1	49.9
4260602	7	7	1,541.9	1,590.1	48.2

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4260602	7	16	1,532.3	1,586.0	53.7
4260603	7	6	1,535.2	1,588.8	53.6
4260603	7	7	1,530.5	1,588.8	58.3
4260603	7	16	1,526.7	1,584.4	57.7
4260603	7	19	1,523.2	1,580.6	57.4
4260603	7	20	1,520.7	1,577.9	57.2
4260603	7	23	1,521.2	1,583.0	61.8
4260603	7	29	1,524.0	1,577.4	53.4
4260901	7	6	1,543.1	1,604.9	61.8
4260901	7	7	1,543.7	1,604.8	61.1
4260901	7	15	1,533.4	1,601.4	68.0
4260901	7	16	1,535.3	1,601.0	65.7
4260901	7	19	1,531.9	1,597.8	65.9
4260901	7	20	1,528.8	1,595.6	66.8
4260901	7	23	1,528.7	1,599.7	71.0
4260901	7	29	1,536.9	1,595.5	58.7
4260902	7	6	1,539.9	1,596.9	57.0
4260902	7	7	1,540.6	1,596.9	56.3
4260902	7	16	1,532.1	1,592.9	60.8
4260902	7	19	1,528.5	1,589.5	61.0
4260902	7	20	1,527.0	1,587.1	60.1
4260902	7	21	1,525.7	1,586.6	60.9
4260902	7	22	1,525.4	1,589.9	64.5
4260902	7	23	1,524.3	1,591.7	67.4
4260902	7	29	1,527.4	1,587.1	59.8
4260903	7	6	1,553.4	1,603.9	50.5
4260903	7	7	1,553.0	1,603.8	50.8
4260903	7	16	1,544.2	1,599.8	55.6
4260903	7	19	1,540.8	1,596.4	55.6
4260903	7	20	1,538.7	1,594.1	55.4
4260903	7	23	1,536.7	1,598.2	61.6
4260903	7	29	1,538.6	1,593.5	54.9
4261202	7	4	1,653.0	1,586.3	-66.7
4261303	7	29	1,529.9	1,482.0	-47.9
4262404	7	6	1,562.0	1,580.0	18.0
4262404	7	23	1,500.2	1,582.7	82.5
4262902	7	8	1,571.2	1,560.4	-10.9
4262902	7	9	1,567.1	1,560.1	-7.0

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4262902	7	10	1,567.7	1,560.4	-7.2
4262902	7	11	1,567.1	1,559.8	-7.4
4262902	7	12	1,567.1	1,559.1	-7.9
4262902	7	13	1,568.5	1,559.8	-8.7
4262902	7	14	1,567.5	1,559.4	-8.1
4262902	7	15	1,566.6	1,559.3	-7.3
4262902	7	16	1,563.3	1,560.1	-3.2
4262902	7	17	1,566.0	1,560.1	-5.9
4262902	7	18	1,566.7	1,560.0	-6.7
4262902	7	19	1,563.2	1,559.4	-3.8
4262902	7	20	1,562.2	1,559.5	-2.7
4262902	7	21	1,563.3	1,559.8	-3.5
4262902	7	22	1,563.8	1,559.7	-4.1
4262902	7	23	1,564.2	1,560.0	-4.2
4262902	7	24	1,563.7	1,560.3	-3.5
4262902	7	30	1,570.9	1,560.0	-10.9
4263501	7	6	1,482.3	1,495.8	13.5
4263501	7	7	1,484.8	1,495.5	10.7
4263501	7	8	1,485.6	1,495.3	9.7
4263501	7	9	1,483.3	1,495.8	12.5
4263501	7	16	1,469.4	1,496.0	26.6
4263501	7	17	1,475.5	1,496.4	20.9
4263501	7	18	1,480.0	1,496.7	16.7
4263501	7	19	1,480.2	1,495.8	15.6
4263501	7	20	1,477.8	1,495.3	17.5
4263501	7	21	1,478.6	1,496.1	17.5
4263501	7	22	1,478.2	1,496.3	18.1
4263501	7	25	1,478.4	1,497.9	19.5
4263501	7	30	1,481.9	1,496.8	14.9
4263706	7	7	1,547.7	1,515.7	-32.0
4263802	7	13	1,463.5	1,475.3	11.8
4263802	7	14	1,460.4	1,475.3	14.9
4263802	7	15	1,457.1	1,476.0	19.0
4263802	7	16	1,458.4	1,474.7	16.4
4263802	7	17	1,459.8	1,474.0	14.3
4263802	7	18	1,464.4	1,473.3	8.9
4263802	7	19	1,461.0	1,472.0	11.0
4263802	7	20	1,461.5	1,470.3	8.9

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4263802	7	22	1,463.1	1,468.6	5.5
4263802	7	23	1,469.4	1,468.6	-0.8
4263802	7	24	1,467.0	1,467.3	0.3
4263802	7	30	1,471.8	1,459.4	-12.5
4263803	7	17	1,482.7	1,470.3	-12.5
4263803	7	18	1,485.1	1,469.8	-15.3
4263803	7	19	1,483.3	1,468.9	-14.4
4263805	7	22	1,526.2	1,511.1	-15.1
4263807	7	7	1,520.2	1,474.0	-46.2
4263807	7	17	1,517.6	1,470.3	-47.3
4263807	7	18	1,516.8	1,469.5	-47.3
4263807	7	19	1,516.7	1,468.0	-48.7
4263808	7	7	1,478.2	1,471.8	-6.4
4263808	7	16	1,482.8	1,468.9	-13.9
4263808	7	17	1,471.0	1,468.3	-2.8
4263808	7	18	1,473.9	1,467.6	-6.3
4263808	7	19	1,474.6	1,466.4	-8.2
4263808	7	21	1,477.9	1,463.9	-14.0
4263808	7	22	1,478.8	1,463.2	-15.6
4263808	7	25	1,480.4	1,461.1	-19.3
4263808	7	30	1,481.8	1,454.9	-26.9
4263809	7	7	1,474.0	1,494.6	20.6
4263809	7	17	1,472.6	1,494.5	21.9
4263809	7	19	1,477.1	1,493.7	16.6
4263812	7	6	1,479.9	1,494.5	14.6
4263812	7	18	1,475.1	1,494.6	19.5
4263812	7	19	1,474.4	1,493.7	19.4
4263813	7	17	1,453.1	1,478.8	25.7
4263813	7	18	1,455.6	1,478.0	22.5
4263814	7	6	1,481.4	1,462.4	-19.0
4263814	7	9	1,481.5	1,462.8	-18.7
4263814	7	11	1,477.9	1,461.8	-16.1
4263814	7	17	1,476.8	1,459.4	-17.4
4263814	7	21	1,479.9	1,455.7	-24.2
4263814	7	25	1,481.4	1,453.4	-28.0
4263816	7	8	1,483.0	1,468.4	-14.6
4263816	7	16	1,467.6	1,466.8	-0.8
4263816	7	17	1,478.8	1,466.3	-12.5

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4263816	7	19	1,477.7	1,465.1	-12.6
4263816	7	21	1,479.6	1,463.4	-16.2
4263817	7	19	1,483.3	1,461.7	-21.6
4263819	7	17	1,508.0	1,463.1	-44.9
4263819	7	18	1,508.6	1,462.6	-46.0
4263821	7	29	1,477.0	1,486.7	9.7
4263908	7	1	1,482.1	1,460.6	-21.5
4263908	7	12	1,471.6	1,450.9	-20.7
4263908	7	15	1,472.8	1,450.3	-22.5
4263908	7	16	1,471.3	1,448.8	-22.5
4263908	7	21	1,473.2	1,444.0	-29.2
4263908	7	22	1,473.6	1,443.4	-30.2
4263908	7	25	1,474.9	1,441.3	-33.6
4263908	7	30	1,477.4	1,436.5	-41.0
4263909	7	16	1,473.7	1,471.0	-2.7
4263909	7	17	1,475.7	1,471.0	-4.7
4263909	7	18	1,477.1	1,471.0	-6.2
4263909	7	19	1,477.2	1,470.8	-6.4
4263909	7	20	1,477.6	1,470.7	-6.9
4263909	7	21	1,479.4	1,470.7	-8.7
4263909	7	22	1,479.8	1,470.7	-9.1
4263909	7	25	1,482.1	1,470.6	-11.5
4263909	7	30	1,482.7	1,470.5	-12.2
4263910	7	8	1,479.4	1,453.4	-26.0
4263910	7	9	1,477.9	1,453.4	-24.5
4263910	7	16	1,468.9	1,453.4	-15.5
4263910	7	17	1,472.4	1,453.4	-19.0
4263910	7	18	1,473.8	1,453.4	-20.4
4263910	7	19	1,471.2	1,453.4	-17.8
4263910	7	20	1,471.5	1,453.4	-18.1
4263910	7	21	1,473.6	1,453.4	-20.2
4263910	7	22	1,474.0	1,453.4	-20.6
4263910	7	25	1,475.4	1,453.4	-22.0
4263910	7	30	1,477.6	1,453.4	-24.2
4263915	7	9	1,473.1	1,456.2	-16.9
4263915	7	11	1,476.8	1,455.0	-21.8
4263915	7	16	1,460.4	1,452.6	-7.8
4263915	7	21	1,461.3	1,448.1	-13.2

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4263915	7	22	1,461.6	1,447.6	-14.0
4263915	7	25	1,461.6	1,445.6	-16.0
4263915	7	30	1,479.2	1,441.5	-37.7
4263916	7	11	1,487.6	1,453.4	-34.2
4263916	7	12	1,487.8	1,453.4	-34.4
4263916	7	13	1,487.0	1,453.4	-33.7
4263916	7	14	1,482.3	1,453.4	-28.9
4263916	7	16	1,482.0	1,453.4	-28.6
4263917	7	6	1,474.7	1,466.4	-8.3
4263918	7	8	1,483.5	1,457.3	-26.2
4263918	7	9	1,481.4	1,457.5	-23.9
4263918	7	16	1,476.9	1,457.5	-19.5
4263918	7	17	1,478.0	1,457.5	-20.5
4263918	7	18	1,478.2	1,457.7	-20.5
4263918	7	19	1,478.6	1,457.4	-21.3
4263918	7	20	1,476.7	1,457.2	-19.5
4263918	7	21	1,477.9	1,457.6	-20.3
4263918	7	22	1,479.6	1,457.6	-22.0
4263918	7	30	1,482.8	1,457.7	-25.2
4263925	7	6	1,472.0	1,466.4	-5.7
4263925	7	17	1,463.3	1,462.9	-0.4
4263925	7	18	1,467.1	1,462.4	-4.7
4263927	7	9	1,480.8	1,470.2	-10.6
4263928	7	11	1,483.6	1,471.2	-12.4
4263928	7	12	1,482.4	1,471.3	-11.2
4263928	7	14	1,484.0	1,471.1	-12.9
4263928	7	16	1,481.7	1,471.0	-10.7
4263928	7	18	1,482.9	1,471.0	-12.0
4263928	7	19	1,484.0	1,470.8	-13.2
4263928	7	20	1,484.2	1,470.7	-13.5
4263928	7	21	1,487.0	1,470.7	-16.3
4263928	7	25	1,487.1	1,470.6	-16.5
4263928	7	30	1,486.5	1,470.5	-16.0
4263930	7	17	1,468.0	1,467.8	-0.2
4263930	7	18	1,469.7	1,467.4	-2.3
4263931	7	17	1,474.5	1,467.8	-6.7
4263931	7	18	1,475.9	1,467.4	-8.6
4263931	7	19	1,474.9	1,466.5	-8.4

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
4263932	7	17	1,474.9	1,462.4	-12.5
4263932	7	18	1,477.5	1,461.9	-15.6
4263932	7	19	1,476.8	1,460.9	-15.8
4263933	7	17	1,474.7	1,439.9	-34.9
4263933	7	18	1,509.7	1,439.1	-70.6
4263933	7	19	1,513.4	1,437.8	-75.6
4263934	7	17	1,467.8	1,467.8	0.0
4263934	7	18	1,469.3	1,467.4	-2.0
4263934	7	19	1,468.5	1,466.5	-2.0
4263935	7	17	1,474.6	1,457.7	-16.9
4263935	7	18	1,475.4	1,457.0	-18.4
4263935	7	19	1,475.0	1,456.0	-19.0
4263935	7	30	1,480.4	1,448.1	-32.3
4263936	7	17	1,478.0	1,478.3	0.4
4263936	7	18	1,478.8	1,477.9	-0.9
4263936	7	19	1,478.5	1,477.0	-1.5
4263937	7	17	1,475.6	1,467.1	-8.5
4263937	7	18	1,477.7	1,466.7	-10.9
4263937	7	19	1,476.9	1,466.0	-11.0
4263938	7	17	1,473.0	1,475.8	2.9
4263938	7	18	1,473.9	1,475.5	1.7
4263938	7	19	1,473.2	1,474.7	1.6
4263939	7	17	1,477.2	1,452.4	-24.8
4263939	7	18	1,478.4	1,451.7	-26.7
4263939	7	19	1,478.3	1,450.6	-27.6
4264705	7	11	1,597.0	1,502.3	-94.7
5604302	7	15	1,582.0	1,627.9	45.9
5604707	7	11	1,640.9	1,656.5	15.6
5604707	7	12	1,638.4	1,657.5	19.2
5604707	7	13	1,639.0	1,656.5	17.5
5604707	7	14	1,634.9	1,654.2	19.3
5604707	7	16	1,631.9	1,653.1	21.3
5606202	7	16	1,600.1	1,593.9	-6.2
5606202	7	17	1,600.5	1,593.8	-6.7
5606202	7	18	1,647.7	1,593.7	-54.0
5606202	7	19	1,600.5	1,593.0	-7.5
5606202	7	21	1,644.2	1,593.4	-50.8
5606202	7	22	1,644.9	1,593.2	-51.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5606202	7	25	1,646.4	1,594.0	-52.4
5606202	7	29	1,600.2	1,594.1	-6.1
5606202	7	30	1,600.0	1,593.8	-6.2
5606308	7	8	1,576.3	1,553.7	-22.6
5606308	7	10	1,576.5	1,554.1	-22.3
5606308	7	11	1,577.3	1,553.6	-23.8
5606308	7	12	1,583.1	1,552.6	-30.5
5606329	7	21	1,543.0	1,558.3	15.3
5606404	7	11	1,634.6	1,648.7	14.1
5606404	7	23	1,640.6	1,646.5	5.9
5606404	7	24	1,641.1	1,647.3	6.2
5606404	7	25	1,641.6	1,647.4	5.8
5606507	7	7	1,628.9	1,593.1	-35.8
5606603	7	7	1,618.2	1,580.8	-37.4
5606604	7	7	1,615.1	1,583.2	-31.8
5606605	7	7	1,619.4	1,581.1	-38.3
5606606	7	7	1,610.3	1,579.6	-30.8
5606606	7	29	1,608.0	1,571.7	-36.3
5606606	7	30	1,610.3	1,572.1	-38.2
5606607	7	7	1,625.6	1,580.2	-45.5
5606609	7	1	1,605.9	1,582.2	-23.7
5606610	7	1	1,599.3	1,580.9	-18.4
5606610	7	12	1,592.2	1,575.4	-16.8
5606610	7	16	1,590.0	1,573.7	-16.3
5606610	7	29	1,592.7	1,571.1	-21.6
5606611	7	1	1,628.8	1,582.7	-46.1
5606611	7	7	1,625.9	1,579.5	-46.4
5606611	7	8	1,626.2	1,578.6	-47.6
5606611	7	9	1,621.8	1,578.5	-43.3
5606611	7	10	1,620.8	1,578.0	-42.8
5606611	7	11	1,627.6	1,577.3	-50.3
5606611	7	12	1,626.3	1,576.8	-49.5
5606611	7	13	1,627.1	1,575.8	-51.3
5606611	7	14	1,624.8	1,575.1	-49.7
5606611	7	15	1,624.5	1,574.8	-49.7
5606611	7	16	1,619.5	1,573.8	-45.7
5606611	7	17	1,621.3	1,573.2	-48.1
5606611	7	18	1,620.9	1,572.7	-48.2

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5606611	7	21	1,622.9	1,570.3	-52.6
5606611	7	23	1,623.2	1,570.1	-53.1
5606611	7	24	1,623.1	1,569.7	-53.4
5606611	7	25	1,624.9	1,569.5	-55.4
5606612	7	7	1,625.3	1,593.1	-32.2
5606613	7	7	1,611.2	1,579.8	-31.5
5606613	7	8	1,610.7	1,578.9	-31.7
5606613	7	10	1,605.2	1,578.4	-26.8
5606613	7	11	1,606.1	1,577.8	-28.3
5606613	7	12	1,605.6	1,577.2	-28.4
5606613	7	13	1,606.1	1,576.2	-29.9
5606613	7	14	1,604.6	1,575.5	-29.1
5606613	7	15	1,602.7	1,575.1	-27.6
5606613	7	16	1,602.3	1,574.4	-27.9
5606613	7	17	1,601.7	1,573.9	-27.8
5606613	7	18	1,602.7	1,573.6	-29.1
5606613	7	19	1,601.9	1,573.0	-28.9
5606613	7	20	1,597.4	1,571.9	-25.4
5606613	7	21	1,598.3	1,571.3	-27.0
5606613	7	22	1,599.4	1,571.2	-28.1
5606613	7	23	1,601.7	1,571.2	-30.5
5606613	7	24	1,600.3	1,570.9	-29.5
5606613	7	25	1,607.9	1,570.8	-37.1
5606613	7	26	1,605.6	1,570.8	-34.8
5606613	7	27	1,603.6	1,571.2	-32.4
5606613	7	28	1,610.1	1,573.1	-37.0
5606613	7	29	1,607.9	1,574.2	-33.7
5606613	7	30	1,608.7	1,574.6	-34.2
5606613	7	31	1,611.7	1,576.6	-35.2
5606614	7	1	1,616.9	1,591.5	-25.5
5606614	7	2	1,617.7	1,590.2	-27.5
5606614	7	3	1,614.9	1,589.6	-25.4
5606614	7	4	1,613.7	1,588.8	-24.9
5606614	7	5	1,612.7	1,588.7	-23.9
5606614	7	6	1,612.1	1,587.5	-24.6
5606614	7	7	1,612.7	1,587.1	-25.6
5606614	7	8	1,612.6	1,586.5	-26.1
5606614	7	9	1,609.7	1,587.0	-22.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5606614	7	10	1,607.8	1,586.8	-20.9
5606614	7	11	1,607.7	1,586.3	-21.4
5606614	7	12	1,607.6	1,585.0	-22.6
5606614	7	13	1,608.3	1,584.7	-23.6
5606614	7	14	1,606.2	1,583.5	-22.7
5606614	7	15	1,605.1	1,583.1	-22.0
5606614	7	16	1,603.8	1,584.3	-19.5
5606614	7	17	1,603.8	1,584.2	-19.6
5606614	7	18	1,604.0	1,584.4	-19.6
5606614	7	19	1,602.4	1,583.4	-19.1
5606614	7	20	1,599.8	1,582.2	-17.6
5606614	7	21	1,600.4	1,582.4	-18.0
5606614	7	22	1,600.4	1,582.5	-17.9
5606614	7	23	1,601.5	1,582.8	-18.7
5606614	7	24	1,599.6	1,582.3	-17.4
5606614	7	25	1,602.6	1,583.2	-19.4
5606614	7	26	1,602.6	1,582.3	-20.3
5606614	7	27	1,602.6	1,581.6	-21.0
5606614	7	28	1,606.7	1,582.3	-24.4
5606614	7	29	1,606.6	1,583.7	-22.8
5606614	7	30	1,606.9	1,583.9	-23.0
5606614	7	31	1,607.5	1,584.6	-22.9
5606615	7	7	1,600.1	1,580.2	-19.8
5606616	7	7	1,606.2	1,579.9	-26.3
5606616	7	16	1,606.1	1,575.3	-30.8
5606616	7	18	1,608.2	1,574.9	-33.4
5606616	7	29	1,610.5	1,573.2	-37.3
5606616	7	30	1,610.2	1,573.6	-36.6
5606617	7	7	1,628.0	1,579.2	-48.8
5606617	7	9	1,623.6	1,578.3	-45.3
5606617	7	16	1,622.5	1,573.7	-48.8
5606617	7	17	1,630.0	1,573.2	-56.8
5606617	7	18	1,619.6	1,572.8	-46.8
5606617	7	19	1,615.4	1,572.1	-43.3
5606617	7	21	1,618.2	1,570.5	-47.7
5606617	7	23	1,617.5	1,570.3	-47.2
5606617	7	24	1,609.4	1,570.0	-39.4
5606617	7	25	1,610.1	1,569.8	-40.3

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5606617	7	30	1,626.4	1,573.2	-53.2
5606618	7	7	1,622.2	1,581.8	-40.4
5606619	7	7	1,622.3	1,579.7	-42.5
5606620	7	7	1,636.9	1,579.9	-57.0
5606621	7	7	1,605.6	1,579.5	-26.1
5606623	7	7	1,621.4	1,581.7	-39.7
5606624	7	7	1,618.9	1,580.9	-38.0
5606625	7	7	1,619.3	1,581.0	-38.3
5606625	7	8	1,617.2	1,580.2	-37.1
5606625	7	9	1,613.6	1,580.2	-33.5
5606625	7	10	1,613.6	1,579.8	-33.8
5606625	7	11	1,610.9	1,579.2	-31.7
5606625	7	12	1,613.2	1,578.5	-34.7
5606625	7	13	1,613.6	1,577.6	-36.0
5606625	7	14	1,611.0	1,576.8	-34.2
5606625	7	15	1,610.0	1,576.3	-33.7
5606625	7	16	1,609.1	1,575.8	-33.3
5606625	7	17	1,609.3	1,575.4	-33.9
5606625	7	21	1,611.7	1,572.9	-38.8
5606625	7	23	1,612.1	1,572.8	-39.3
5606625	7	24	1,612.2	1,572.5	-39.7
5606625	7	25	1,612.3	1,572.5	-39.8
5606625	7	30	1,615.3	1,576.4	-38.9
5606626	7	7	1,622.0	1,580.4	-41.6
5606627	7	7	1,615.9	1,581.1	-34.8
5606627	7	9	1,612.3	1,580.0	-32.3
5606627	7	16	1,607.5	1,575.1	-32.4
5606627	7	17	1,610.8	1,574.5	-36.4
5606627	7	21	1,616.6	1,571.5	-45.1
5606627	7	23	1,615.9	1,571.2	-44.7
5606627	7	24	1,615.7	1,570.9	-44.8
5606627	7	25	1,615.8	1,570.7	-45.1
5606627	7	30	1,615.4	1,576.0	-39.4
5606628	7	7	1,627.9	1,580.2	-47.7
5606629	7	7	1,628.1	1,579.5	-48.6
5606629	7	9	1,624.6	1,578.5	-46.1
5606629	7	16	1,621.0	1,573.7	-47.3
5606629	7	17	1,622.2	1,573.1	-49.1

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5606629	7	20	1,617.3	1,570.9	-46.4
5606629	7	21	1,621.1	1,570.2	-50.9
5606629	7	23	1,622.2	1,569.9	-52.3
5606629	7	24	1,622.6	1,569.6	-53.0
5606629	7	25	1,623.1	1,569.4	-53.7
5606630	7	7	1,616.2	1,581.5	-34.7
5606631	7	7	1,627.3	1,579.9	-47.4
5606631	7	9	1,625.9	1,578.8	-47.1
5606631	7	16	1,624.3	1,574.0	-50.3
5606631	7	17	1,626.8	1,573.2	-53.6
5606631	7	21	1,627.2	1,570.2	-57.0
5606631	7	23	1,628.1	1,569.9	-58.2
5606631	7	24	1,628.3	1,569.6	-58.8
5606631	7	25	1,628.4	1,569.3	-59.1
5606631	7	30	1,627.8	1,573.1	-54.7
5606642	7	7	1,606.8	1,579.6	-27.2
5606643	7	7	1,610.2	1,579.7	-30.5
5606645	7	29	1,617.7	1,579.7	-38.0
5606645	7	30	1,617.9	1,580.1	-37.8
5606646	7	7	1,613.6	1,582.5	-31.1
5606647	7	7	1,622.2	1,579.5	-42.7
5606648	7	7	1,626.4	1,579.9	-46.5
5606648	7	8	1,627.5	1,579.0	-48.4
5606648	7	9	1,625.6	1,578.8	-46.8
5606648	7	10	1,623.7	1,578.2	-45.4
5606648	7	11	1,623.5	1,577.5	-46.0
5606648	7	12	1,623.9	1,577.0	-46.9
5606648	7	13	1,626.2	1,576.0	-50.2
5606648	7	14	1,625.5	1,575.3	-50.2
5606648	7	15	1,622.6	1,575.0	-47.6
5606649	7	7	1,631.5	1,579.9	-51.6
5606650	7	7	1,629.5	1,579.9	-49.6
5606651	7	7	1,614.3	1,579.5	-34.8
5606652	7	7	1,620.2	1,579.5	-40.7
5606653	7	7	1,618.7	1,580.7	-38.0
5606654	7	7	1,621.6	1,580.0	-41.6
5606655	7	7	1,606.7	1,579.6	-27.1
5606656	7	7	1,620.7	1,580.0	-40.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5606657	7	7	1,625.8	1,579.7	-46.1
5606658	7	7	1,665.0	1,579.5	-85.5
5606701	7	11	1,641.6	1,660.2	18.6
5606701	7	16	1,645.7	1,659.2	13.5
5606701	7	17	1,646.0	1,657.6	11.6
5606701	7	20	1,641.7	1,655.0	13.3
5606701	7	21	1,641.7	1,654.9	13.2
5606701	7	23	1,641.0	1,654.7	13.7
5606701	7	24	1,642.1	1,655.5	13.4
5606701	7	25	1,642.6	1,656.0	13.4
5606718	7	30	1,641.2	1,653.6	12.4
5606809	7	30	1,642.4	1,611.0	-31.4
5606811	7	8	1,647.4	1,622.9	-24.5
5606811	7	11	1,616.9	1,620.7	3.8
5606811	7	16	1,637.9	1,615.6	-22.3
5606811	7	21	1,647.2	1,610.0	-37.2
5606811	7	23	1,643.5	1,609.4	-34.1
5606811	7	25	1,645.2	1,608.4	-36.8
5606811	7	30	1,641.9	1,611.0	-31.0
5606813	7	17	1,737.0	1,620.6	-116.4
5606813	7	21	1,737.2	1,616.6	-120.6
5606813	7	23	1,737.5	1,616.3	-121.2
5606813	7	25	1,738.6	1,615.7	-123.0
5606815	7	30	1,678.5	1,616.4	-62.1
5606816	7	30	1,647.7	1,606.7	-41.0
5606835	7	9	1,650.0	1,635.4	-14.6
5606836	7	14	1,493.0	1,624.8	131.8
5606902	7	9	1,621.6	1,581.8	-39.8
5606902	7	17	1,616.1	1,576.1	-40.0
5606902	7	25	1,617.4	1,572.2	-45.2
5606903	7	7	1,637.4	1,602.8	-34.6
5606904	7	7	1,643.2	1,603.5	-39.6
5606905	7	11	1,631.8	1,608.4	-23.4
5606905	7	16	1,638.7	1,603.7	-35.0
5606905	7	17	1,639.7	1,602.6	-37.1
5606905	7	20	1,634.0	1,599.5	-34.5
5606905	7	21	1,638.7	1,598.5	-40.2
5606905	7	23	1,639.4	1,597.8	-41.6

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5606905	7	24	1,639.1	1,597.3	-41.8
5606905	7	25	1,639.5	1,596.9	-42.6
5606906	7	11	1,645.1	1,615.8	-29.3
5606906	7	16	1,638.1	1,610.8	-27.4
5606906	7	17	1,640.6	1,609.5	-31.1
5606906	7	20	1,634.9	1,606.1	-28.8
5606906	7	21	1,639.3	1,605.1	-34.2
5606906	7	23	1,640.1	1,604.3	-35.8
5606906	7	25	1,641.2	1,603.4	-37.8
5606906	7	30	1,648.0	1,606.7	-41.3
5606910	7	1	1,649.7	1,603.0	-46.6
5606910	7	7	1,641.4	1,602.8	-38.6
5606910	7	8	1,639.6	1,602.0	-37.6
5606910	7	9	1,638.3	1,601.6	-36.7
5606910	7	10	1,636.7	1,600.9	-35.8
5606910	7	11	1,637.9	1,600.1	-37.8
5606910	7	12	1,637.3	1,599.4	-37.9
5606910	7	13	1,636.6	1,598.4	-38.3
5606910	7	14	1,635.2	1,597.5	-37.7
5606910	7	15	1,634.0	1,596.9	-37.1
5606910	7	16	1,634.2	1,595.7	-38.5
5606910	7	17	1,634.1	1,594.7	-39.4
5606910	7	20	1,627.0	1,591.7	-35.3
5606910	7	21	1,628.7	1,590.7	-38.0
5606910	7	23	1,629.1	1,590.0	-39.1
5606910	7	24	1,629.4	1,589.6	-39.9
5606910	7	25	1,629.5	1,589.2	-40.3
5606910	7	30	1,633.7	1,593.6	-40.2
5606911	7	11	1,609.4	1,600.4	-9.1
5606911	7	16	1,603.0	1,596.0	-7.0
5606911	7	17	1,604.2	1,595.0	-9.2
5606911	7	20	1,619.9	1,592.2	-27.8
5606911	7	24	1,620.4	1,590.1	-30.3
5606911	7	25	1,620.9	1,589.8	-31.2
5606911	7	30	1,628.2	1,594.1	-34.1
5606912	7	7	1,637.2	1,588.3	-48.9
5606912	7	9	1,635.0	1,587.3	-47.7
5606913	7	9	1,616.3	1,579.1	-37.2

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5606913	7	11	1,606.4	1,577.9	-28.5
5606913	7	16	1,611.6	1,574.3	-37.3
5606913	7	17	1,611.9	1,573.6	-38.3
5606913	7	20	1,606.5	1,571.5	-35.0
5606913	7	21	1,613.4	1,570.7	-42.7
5606913	7	23	1,612.5	1,570.5	-42.0
5606913	7	24	1,604.8	1,570.2	-34.6
5606913	7	25	1,605.1	1,570.0	-35.1
5606913	7	30	1,618.8	1,574.9	-43.9
5606914	7	30	1,624.9	1,576.0	-48.9
5606919	7	23	1,618.5	1,577.8	-40.7
5606919	7	24	1,618.4	1,577.5	-40.9
5606919	7	25	1,618.7	1,577.3	-41.4
5606926	7	30	1,662.2	1,603.8	-58.4
5606935	7	30	1,626.0	1,575.6	-50.4
5606943	7	7	1,659.7	1,581.8	-77.8
5606944	7	7	1,632.1	1,598.3	-33.8
5606945	7	7	1,646.0	1,599.9	-46.2
5606946	7	7	1,681.1	1,606.3	-74.8
5606948	7	7	1,627.6	1,593.9	-33.7
5606949	7	7	1,645.5	1,595.7	-49.8
5606950	7	7	1,663.3	1,581.0	-82.3
5607107	7	1	1,546.2	1,541.1	-5.2
5607107	7	6	1,532.6	1,537.5	4.9
5607107	7	7	1,530.9	1,538.6	7.7
5607107	7	9	1,524.7	1,538.3	13.6
5607107	7	12	1,521.8	1,537.3	15.5
5607107	7	15	1,528.2	1,536.3	8.1
5607107	7	16	1,516.7	1,534.8	18.1
5607107	7	17	1,518.7	1,533.9	15.2
5607107	7	22	1,518.6	1,527.0	8.4
5607107	7	25	1,520.2	1,523.8	3.6
5607110	7	6	1,513.4	1,531.6	18.2
5607110	7	7	1,551.7	1,531.6	-20.1
5607110	7	9	1,511.3	1,532.4	21.1
5607110	7	11	1,511.0	1,532.1	21.1
5607110	7	16	1,502.4	1,531.0	28.6
5607110	7	17	1,515.8	1,530.6	14.8

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5607110	7	21	1,506.5	1,527.4	20.9
5607110	7	22	1,506.8	1,527.1	20.3
5607110	7	25	1,508.1	1,527.0	18.9
5607110	7	30	1,512.8	1,521.1	8.3
5607211	7	17	1,505.8	1,515.9	10.1
5607211	7	18	1,507.2	1,514.7	7.5
5607216	7	1	1,527.6	1,518.6	-9.0
5607216	7	6	1,491.6	1,514.8	23.2
5607216	7	7	1,500.5	1,515.1	14.6
5607216	7	9	1,494.2	1,516.1	21.9
5607216	7	11	1,489.2	1,516.0	26.8
5607216	7	12	1,483.8	1,515.0	31.2
5607216	7	15	1,494.0	1,513.9	19.9
5607216	7	16	1,489.0	1,515.0	26.0
5607216	7	17	1,492.6	1,514.4	21.8
5607216	7	20	1,476.7	1,511.0	34.3
5607216	7	21	1,487.6	1,511.0	23.4
5607216	7	22	1,488.1	1,510.7	22.6
5607216	7	25	1,489.1	1,510.4	21.3
5607218	7	1	1,478.7	1,472.5	-6.3
5607218	7	12	1,502.5	1,463.6	-38.9
5607218	7	15	1,516.1	1,462.9	-53.2
5607218	7	16	1,516.2	1,461.2	-55.0
5607218	7	17	1,517.4	1,460.1	-57.4
5607218	7	18	1,517.6	1,458.9	-58.7
5607218	7	21	1,517.7	1,453.4	-64.3
5607218	7	22	1,518.1	1,452.2	-65.9
5607218	7	25	1,520.2	1,448.8	-71.4
5607219	7	1	1,467.5	1,484.6	17.1
5607219	7	16	1,448.8	1,478.4	29.7
5607219	7	17	1,448.4	1,476.3	27.9
5607219	7	18	1,448.9	1,474.8	25.9
5607219	7	19	1,457.7	1,471.9	14.2
5607219	7	21	1,459.1	1,467.4	8.3
5607219	7	22	1,460.6	1,465.9	5.3
5607219	7	25	1,461.2	1,462.2	1.0
5607220	7	1	1,479.0	1,472.5	-6.5
5607220	7	15	1,526.8	1,462.9	-63.9

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5607220	7	16	1,528.4	1,461.2	-67.2
5607220	7	17	1,529.2	1,460.1	-69.2
5607220	7	18	1,529.7	1,458.9	-70.8
5607220	7	21	1,526.5	1,453.4	-73.1
5607220	7	22	1,526.9	1,452.2	-74.7
5607220	7	25	1,526.1	1,448.8	-77.3
5607223	7	7	1,495.8	1,515.4	19.6
5607234	7	17	1,504.8	1,460.1	-44.7
5607234	7	18	1,515.8	1,458.9	-56.9
5607234	7	19	1,515.2	1,457.1	-58.1
5607235	7	17	1,455.1	1,459.6	4.6
5607235	7	18	1,485.8	1,458.5	-27.3
5607236	7	7	1,550.1	1,512.1	-38.0
5607237	7	7	1,548.6	1,512.1	-36.5
5607238	7	7	1,514.2	1,515.4	1.2
5607240	7	6	1,486.9	1,480.6	-6.3
5607240	7	7	1,487.0	1,484.1	-2.9
5607240	7	9	1,478.3	1,485.2	6.9
5607240	7	16	1,516.1	1,481.3	-34.8
5607240	7	17	1,475.7	1,477.9	2.2
5607240	7	30	1,489.8	1,442.4	-47.4
5607241	7	7	1,508.8	1,513.0	4.2
5607242	7	17	1,489.7	1,440.1	-49.7
5607242	7	18	1,493.6	1,439.1	-54.6
5607242	7	19	1,492.8	1,437.5	-55.3
5607243	7	5	1,487.0	1,482.8	-4.2
5607243	7	6	1,486.3	1,481.2	-5.1
5607243	7	7	1,488.0	1,483.1	-4.9
5607243	7	11	1,473.8	1,483.0	9.2
5607243	7	16	1,455.0	1,480.1	25.1
5607243	7	17	1,466.2	1,478.1	12.0
5607243	7	18	1,473.3	1,476.6	3.3
5607243	7	19	1,474.7	1,473.9	-0.8
5607243	7	20	1,478.5	1,471.2	-7.3
5607243	7	21	1,480.1	1,469.3	-10.8
5607243	7	22	1,480.3	1,467.8	-12.5
5607243	7	25	1,481.4	1,463.9	-17.5
5607243	7	30	1,491.7	1,449.0	-42.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5607251	7	18	1,466.2	1,497.2	31.0
5607251	7	19	1,489.1	1,494.0	4.9
5607252	7	17	1,448.5	1,513.3	64.8
5607252	7	18	1,449.3	1,512.1	62.8
5607252	7	19	1,488.5	1,509.9	21.4
5607266	7	17	1,451.0	1,490.8	39.9
5607266	7	18	1,467.1	1,489.1	22.0
5607273	7	17	1,476.9	1,525.0	48.2
5607273	7	18	1,483.4	1,524.9	41.5
5607273	7	19	1,537.2	1,522.9	-14.3
5607301	7	9	1,481.9	1,444.7	-37.2
5607301	7	16	1,457.7	1,441.0	-16.8
5607301	7	19	1,512.6	1,437.6	-75.0
5607302	7	1	1,493.0	1,452.9	-40.1
5607302	7	12	1,485.6	1,439.5	-46.1
5607302	7	15	1,484.3	1,438.6	-45.7
5607302	7	16	1,483.1	1,437.0	-46.1
5607302	7	21	1,484.6	1,431.1	-53.6
5607302	7	22	1,485.1	1,430.2	-54.9
5607302	7	25	1,487.7	1,427.4	-60.3
5607305	7	1	1,483.4	1,465.2	-18.2
5607305	7	12	1,476.7	1,455.4	-21.3
5607305	7	15	1,474.3	1,454.6	-19.7
5607305	7	16	1,472.0	1,453.1	-18.9
5607305	7	17	1,474.1	1,452.4	-21.7
5607305	7	18	1,475.8	1,451.7	-24.1
5607305	7	19	1,475.8	1,450.6	-25.2
5607305	7	21	1,478.6	1,448.4	-30.3
5607305	7	22	1,479.3	1,447.8	-31.5
5607305	7	25	1,479.7	1,445.8	-34.0
5607309	7	17	1,474.6	1,470.1	-4.5
5607309	7	18	1,476.9	1,469.5	-7.4
5607309	7	19	1,476.6	1,468.5	-8.2
5607313	7	17	1,465.9	1,430.5	-35.3
5607315	7	17	1,478.8	1,470.1	-8.8
5607315	7	18	1,481.0	1,469.5	-11.5
5607315	7	19	1,478.9	1,468.5	-10.4
5607318	7	17	1,485.8	1,435.0	-50.8

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5607318	7	18	1,497.1	1,434.1	-63.0
5607318	7	19	1,500.2	1,432.7	-67.5
5607321	7	17	1,473.9	1,454.4	-19.4
5607321	7	18	1,473.7	1,453.7	-20.0
5607321	7	19	1,473.6	1,452.5	-21.1
5607322	7	17	1,479.8	1,448.7	-31.1
5607322	7	18	1,479.4	1,448.0	-31.4
5607322	7	19	1,479.6	1,446.8	-32.8
5607329	7	7	1,470.3	1,440.6	-29.8
5607329	7	16	1,463.9	1,436.3	-27.6
5607329	7	17	1,476.4	1,435.5	-40.9
5607331	7	17	1,450.8	1,435.5	-15.2
5607331	7	18	1,454.5	1,434.6	-19.9
5607331	7	19	1,453.7	1,433.3	-20.4
5607334	7	17	1,484.2	1,448.7	-35.5
5607334	7	18	1,485.0	1,448.0	-37.1
5607334	7	19	1,484.3	1,446.8	-37.5
5607335	7	17	1,481.2	1,433.0	-48.3
5607335	7	18	1,482.1	1,432.1	-49.9
5607335	7	19	1,484.4	1,430.8	-53.6
5607403	7	7	1,595.7	1,582.1	-13.5
5607403	7	23	1,589.6	1,571.6	-18.0
5607404	7	1	1,627.1	1,586.3	-40.7
5607404	7	7	1,609.2	1,584.6	-24.7
5607404	7	12	1,587.9	1,581.1	-6.8
5607404	7	16	1,577.8	1,577.8	0.0
5607404	7	17	1,588.0	1,576.9	-11.1
5607404	7	18	1,573.8	1,576.3	2.5
5607404	7	21	1,575.7	1,573.5	-2.2
5607404	7	23	1,575.8	1,573.3	-2.6
5607404	7	24	1,575.6	1,572.5	-3.1
5607404	7	25	1,577.1	1,572.1	-5.0
5607404	7	30	1,609.6	1,574.4	-35.2
5607406	7	6	1,581.4	1,578.8	-2.6
5607406	7	8	1,576.8	1,578.6	1.8
5607406	7	9	1,573.4	1,578.9	5.5
5607406	7	16	1,549.0	1,574.1	25.1
5607406	7	17	1,549.8	1,573.4	23.6

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5607406	7	18	1,550.4	1,572.9	22.5
5607406	7	19	1,550.7	1,571.9	21.2
5607406	7	21	1,554.1	1,569.9	15.8
5607406	7	25	1,555.6	1,568.1	12.5
5607407	7	9	1,571.5	1,578.9	7.4
5607407	7	16	1,562.8	1,574.1	11.3
5607407	7	17	1,562.8	1,573.4	10.6
5607407	7	18	1,563.2	1,572.9	9.7
5607407	7	19	1,563.6	1,571.9	8.3
5607407	7	21	1,557.1	1,569.9	12.8
5607407	7	22	1,558.3	1,569.5	11.2
5607407	7	25	1,559.0	1,568.1	9.1
5607407	7	30	1,562.7	1,566.5	3.8
5607409	7	7	1,609.1	1,580.1	-29.1
5607424	7	7	1,599.1	1,583.0	-16.1
5607424	7	17	1,574.9	1,576.0	1.1
5607424	7	18	1,563.4	1,575.5	12.1
5607424	7	23	1,573.0	1,572.6	-0.4
5607424	7	24	1,573.2	1,571.9	-1.3
5607424	7	25	1,573.6	1,571.5	-2.1
5607424	7	30	1,590.7	1,573.2	-17.5
5607425	7	7	1,585.3	1,582.0	-3.3
5607426	7	7	1,625.7	1,584.5	-41.2
5607426	7	29	1,608.3	1,573.8	-34.6
5607427	7	7	1,595.2	1,583.6	-11.6
5607428	7	7	1,593.6	1,581.2	-12.5
5607429	7	7	1,601.4	1,580.1	-21.4
5607430	7	7	1,594.4	1,581.7	-12.7
5607431	7	7	1,613.8	1,580.5	-33.2
5607432	7	7	1,614.9	1,580.1	-34.8
5607433	7	7	1,727.9	1,584.6	-143.3
5607434	7	7	1,582.1	1,580.9	-1.3
5607434	7	30	1,572.9	1,571.9	-1.0
5607436	7	7	1,611.4	1,580.6	-30.8
5607438	7	7	1,602.4	1,583.9	-18.5
5607439	7	7	1,608.9	1,583.9	-25.0
5607440	7	7	1,600.8	1,583.9	-16.9
5607441	7	7	1,714.7	1,586.8	-127.9

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5607442	7	7	1,716.4	1,586.8	-129.6
5607443	7	30	1,573.8	1,571.9	-1.9
5607901	7	1	1,636.7	1,666.0	29.3
5607902	7	20	1,562.2	1,674.3	112.1
5607902	7	23	1,564.6	1,673.1	108.5
5607902	7	25	1,565.2	1,671.8	106.6
5607902	7	29	1,571.8	1,671.5	99.7
5607902	7	30	1,591.6	1,671.2	79.6
5607903	7	9	1,612.3	1,676.2	64.0
5607904	7	20	1,609.8	1,683.0	73.2
5607906	7	9	1,642.4	1,685.0	42.6
5607907	7	9	1,612.8	1,676.2	63.5
5608104	7	9	1,506.1	1,554.2	48.1
5608104	7	11	1,498.4	1,553.0	54.6
5608104	7	16	1,489.2	1,549.6	60.4
5608104	7	17	1,485.9	1,549.1	63.2
5608104	7	21	1,485.1	1,545.6	60.5
5608104	7	22	1,500.6	1,545.2	44.6
5608104	7	25	1,487.7	1,544.3	56.6
5608104	7	30	1,514.5	1,542.1	27.6
5608105	7	30	1,547.9	1,554.0	6.1
5608106	7	9	1,522.6	1,548.4	25.8
5608106	7	11	1,520.3	1,547.1	26.8
5608106	7	16	1,496.7	1,543.6	46.9
5608106	7	17	1,516.6	1,542.9	26.3
5608106	7	21	1,518.0	1,539.2	21.2
5608106	7	25	1,518.7	1,537.5	18.8
5608106	7	30	1,535.2	1,535.3	0.1
5608109	7	6	1,526.7	1,548.3	21.6
5608109	7	9	1,520.3	1,548.4	28.1
5608109	7	11	1,520.5	1,547.1	26.6
5608109	7	16	1,518.7	1,543.6	24.9
5608109	7	17	1,517.8	1,542.9	25.1
5608109	7	21	1,523.7	1,539.2	15.5
5608109	7	22	1,525.6	1,538.8	13.2
5608109	7	25	1,526.6	1,537.5	10.9
5608109	7	30	1,530.6	1,535.3	4.7
5608110	7	6	1,530.1	1,548.3	18.2

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5608110	7	9	1,524.1	1,548.4	24.3
5608110	7	16	1,521.9	1,543.6	21.7
5608110	7	17	1,515.6	1,542.9	27.3
5608110	7	21	1,520.5	1,539.2	18.7
5608110	7	22	1,520.9	1,538.8	17.9
5608110	7	25	1,521.6	1,537.5	15.9
5608110	7	30	1,533.8	1,535.3	1.5
5608116	7	17	1,509.5	1,573.9	64.4
5608117	7	6	1,565.5	1,585.6	20.1
5608117	7	9	1,565.4	1,584.4	19.0
5608117	7	11	1,555.7	1,583.7	28.0
5608117	7	16	1,567.6	1,581.3	13.7
5608117	7	22	1,571.9	1,578.6	6.7
5608202	7	10	1,532.6	1,524.8	-7.8
5608205	7	10	1,582.7	1,598.9	16.2
5608205	7	12	1,580.3	1,595.9	15.7
5608205	7	15	1,584.6	1,592.6	8.0
5608205	7	16	1,584.8	1,595.7	10.9
5608205	7	29	1,587.0	1,592.9	5.9
5608206	7	7	1,581.6	1,570.5	-11.1
5608301	7	7	1,623.5	1,576.5	-47.0
5608302	7	7	1,622.2	1,585.5	-36.7
5608302	7	10	1,621.3	1,588.4	-32.9
5608302	7	11	1,605.6	1,588.9	-16.7
5608302	7	12	1,614.5	1,585.3	-29.2
5608302	7	16	1,605.2	1,584.0	-21.2
5608302	7	23	1,630.1	1,589.8	-40.3
5608302	7	29	1,628.7	1,583.6	-45.1
5608401	7	6	1,579.8	1,655.3	75.5
5608401	7	9	1,576.4	1,654.4	78.0
5608401	7	11	1,570.9	1,654.0	83.1
5608401	7	16	1,572.1	1,651.3	79.2
5608401	7	17	1,568.6	1,651.1	82.5
5608401	7	20	1,568.2	1,649.1	80.9
5608401	7	21	1,576.1	1,648.6	72.5
5608401	7	22	1,576.6	1,648.2	71.6
5608401	7	23	1,577.4	1,648.5	71.1
5608401	7	25	1,577.9	1,648.3	70.4

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5608403	7	1	1,583.3	1,652.2	68.9
5608403	7	12	1,574.0	1,655.9	81.9
5608403	7	15	1,576.7	1,654.5	77.7
5608403	7	16	1,565.9	1,653.9	88.1
5608403	7	17	1,576.9	1,653.6	76.7
5608403	7	20	1,577.1	1,651.7	74.6
5608403	7	21	1,578.9	1,651.1	72.2
5608403	7	22	1,578.7	1,650.7	72.0
5608403	7	25	1,579.2	1,650.6	71.4
5608403	7	29	1,588.2	1,648.2	60.0
5608403	7	30	1,591.7	1,647.9	56.2
5608409	7	9	1,696.6	1,664.2	-32.4
5608501	7	9	1,590.7	1,630.1	39.3
5608501	7	10	1,588.9	1,630.1	41.2
5608501	7	12	1,586.8	1,627.9	41.1
5608501	7	15	1,595.5	1,625.2	29.8
5608501	7	16	1,597.1	1,626.5	29.4
5608501	7	23	1,596.2	1,625.6	29.4
5608501	7	29	1,595.9	1,621.8	25.9
5608502	7	1	1,666.8	1,662.5	-4.3
5608502	7	7	1,664.6	1,661.4	-3.3
5608502	7	10	1,659.1	1,660.9	1.8
5608502	7	12	1,664.1	1,659.8	-4.3
5608502	7	16	1,667.4	1,657.4	-10.0
5608502	7	23	1,671.3	1,654.5	-16.8
5608502	7	29	1,665.3	1,650.6	-14.7
5608503	7	1	1,704.6	1,665.1	-39.5
5608503	7	12	1,703.5	1,662.4	-41.1
5608503	7	15	1,701.0	1,661.3	-39.7
5608503	7	16	1,701.4	1,659.6	-41.8
5608503	7	23	1,705.3	1,655.9	-49.4
5608503	7	29	1,683.7	1,651.6	-32.1
5608504	7	7	1,596.5	1,662.6	66.1
5608505	7	7	1,594.8	1,656.7	61.9
5608505	7	11	1,584.7	1,655.7	71.0
5608505	7	16	1,584.6	1,653.3	68.7
5608505	7	23	1,589.5	1,649.1	59.6
5608505	7	29	1,599.5	1,644.5	45.0

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5608508	7	9	1,658.7	1,660.8	2.2
5608509	7	7	1,668.8	1,661.1	-7.7
5608509	7	8	1,670.5	1,660.1	-10.5
5608509	7	11	1,669.8	1,660.1	-9.8
5608509	7	12	1,670.6	1,659.6	-11.1
5608509	7	13	1,678.5	1,658.5	-20.1
5608509	7	14	1,676.5	1,658.1	-18.5
5608509	7	15	1,670.8	1,658.2	-12.5
5608509	7	16	1,669.8	1,657.3	-12.5
5608509	7	17	1,668.3	1,657.1	-11.2
5608509	7	18	1,673.5	1,657.0	-16.5
5608509	7	19	1,668.2	1,656.1	-12.1
5608509	7	20	1,664.8	1,654.8	-10.0
5608509	7	21	1,666.7	1,654.3	-12.4
5608509	7	22	1,670.7	1,654.0	-16.7
5608509	7	23	1,675.3	1,654.5	-20.8
5608509	7	24	1,672.2	1,653.7	-18.5
5608509	7	25	1,674.1	1,653.6	-20.4
5608509	7	29	1,672.2	1,650.8	-21.4
5608511	7	7	1,638.1	1,650.4	12.3
5608512	7	7	1,633.4	1,647.4	14.1
5608512	7	29	1,629.2	1,636.3	7.1
5608513	7	9	1,594.2	1,638.5	44.4
5608514	7	9	1,624.5	1,641.3	16.9
5608515	7	8	1,594.0	1,652.3	58.3
5608516	7	8	1,611.4	1,649.1	37.7
5608517	7	7	1,648.2	1,643.2	-5.0
5608602	7	7	1,583.5	1,642.9	59.4
5608602	7	10	1,585.9	1,642.9	57.0
5608602	7	12	1,585.0	1,642.4	57.4
5608602	7	15	1,585.0	1,641.9	56.9
5608602	7	16	1,584.7	1,640.2	55.5
5608602	7	29	1,606.3	1,632.8	26.5
5608603	7	9	1,656.1	1,621.8	-34.2
5608604	7	9	1,554.5	1,613.7	59.2
5608605	7	10	1,697.6	1,573.1	-124.5
5608606	7	9	1,689.3	1,604.8	-84.5
5608607	7	11	1,600.0	1,625.8	25.8

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5608704	7	17	1,612.6	1,672.0	59.4
5608704	7	20	1,610.5	1,669.9	59.4
5608704	7	21	1,611.5	1,669.3	57.8
5608704	7	22	1,612.1	1,668.8	56.7
5608704	7	23	1,612.4	1,668.8	56.4
5608704	7	25	1,613.3	1,667.5	54.2
5608705	7	9	1,704.8	1,671.0	-33.8
5608706	7	9	1,634.0	1,674.7	40.7
5608708	7	17	1,697.6	1,669.8	-27.8
5608708	7	20	1,694.4	1,667.5	-26.9
5608708	7	21	1,695.6	1,666.9	-28.7
5608708	7	22	1,696.1	1,666.5	-29.6
5608708	7	23	1,696.3	1,666.7	-29.6
5608708	7	25	1,697.4	1,665.3	-32.1
5608715	7	17	1,580.2	1,665.5	85.3
5608717	7	9	1,705.6	1,672.1	-33.5
5608718	7	9	1,686.3	1,667.6	-18.7
5608719	7	9	1,689.3	1,669.6	-19.7
5608720	7	9	1,720.3	1,671.0	-49.3
5608721	7	9	1,699.3	1,670.6	-28.6
5608723	7	9	1,660.5	1,674.7	14.2
5608725	7	9	1,659.5	1,675.3	15.8
5608726	7	9	1,666.6	1,676.0	9.5
5608728	7	9	1,648.7	1,676.0	27.3
5608730	7	9	1,636.0	1,675.0	39.1
5608733	7	17	1,542.9	1,662.4	119.5
5608733	7	20	1,541.0	1,660.4	119.4
5608733	7	21	1,543.1	1,659.7	116.6
5608733	7	22	1,543.2	1,659.3	116.1
5608733	7	23	1,544.1	1,659.4	115.3
5608733	7	25	1,544.9	1,658.6	113.7
5608801	7	9	1,747.1	1,672.0	-75.1
5608802	7	9	1,736.1	1,671.4	-64.7
5608805	7	9	1,731.0	1,671.1	-59.9
5608805	7	17	1,733.8	1,667.6	-66.2
5608805	7	20	1,733.5	1,665.2	-68.4
5608902	7	9	1,576.5	1,629.4	52.9
5608903	7	9	1,575.1	1,629.4	54.3

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5608906	7	17	1,558.1	1,615.9	57.8
5608906	7	20	1,557.5	1,613.7	56.2
5608906	7	21	1,559.0	1,613.1	54.1
5608906	7	22	1,559.3	1,613.0	53.7
5608906	7	23	1,559.9	1,613.7	53.8
5608906	7	25	1,561.5	1,612.6	51.1
5608906	7	29	1,557.9	1,611.8	53.9
5608906	7	30	1,559.2	1,612.3	53.1
5613105	7	16	1,583.9	1,666.2	82.3
5613105	7	17	1,581.8	1,661.4	79.6
5613202	7	1	1,635.2	1,675.9	40.8
5613202	7	12	1,653.2	1,668.5	15.2
5613202	7	15	1,656.8	1,663.1	6.3
5613202	7	16	1,655.4	1,660.6	5.2
5613202	7	29	1,657.6	1,650.3	-7.3
5613502	7	16	1,633.1	1,635.1	2.0
5613502	7	21	1,646.7	1,628.6	-18.1
5613502	7	22	1,646.8	1,627.3	-19.5
5613502	7	23	1,646.7	1,628.4	-18.3
5613601	7	16	1,668.2	1,635.1	-33.1
5613601	7	21	1,716.2	1,627.8	-88.4
5613601	7	22	1,716.7	1,626.3	-90.4
5613601	7	23	1,717.0	1,625.2	-91.8
5613601	7	25	1,717.0	1,623.1	-94.0
5613804	7	16	1,774.6	1,630.4	-144.2
5613902	7	11	1,652.0	1,619.6	-32.4
5613902	7	16	1,647.8	1,612.4	-35.5
5613902	7	19	1,647.3	1,607.7	-39.6
5613902	7	20	1,645.7	1,606.4	-39.3
5613902	7	21	1,647.2	1,605.3	-41.9
5613902	7	22	1,647.2	1,604.3	-42.9
5613902	7	23	1,647.4	1,603.2	-44.2
5613902	7	25	1,650.6	1,601.1	-49.5
5613902	7	29	1,647.5	1,600.5	-47.1
5613904	7	12	1,655.8	1,635.5	-20.2
5613904	7	13	1,657.4	1,634.1	-23.3
5613904	7	15	1,648.4	1,630.7	-17.7
5613904	7	16	1,656.9	1,629.2	-27.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5613904	7	22	1,657.4	1,620.5	-36.9
5613904	7	23	1,657.1	1,619.4	-37.7
5613904	7	25	1,657.2	1,617.2	-40.0
5613904	7	26	1,609.5	1,616.2	6.7
5613916	7	22	1,624.4	1,596.1	-28.3
5613916	7	23	1,624.6	1,595.2	-29.4
5613916	7	25	1,625.2	1,593.3	-31.9
5613916	7	29	1,621.4	1,591.0	-30.4
5613917	7	29	1,622.6	1,594.8	-27.8
5614108	7	16	1,687.0	1,663.7	-23.3
5614108	7	29	1,634.6	1,655.5	20.9
5614203	7	29	1,694.5	1,629.5	-65.0
5614408	7	22	1,654.9	1,629.5	-25.4
5614408	7	23	1,656.4	1,628.5	-28.0
5614408	7	24	1,655.4	1,627.3	-28.1
5614716	7	11	1,659.3	1,626.6	-32.8
5614716	7	23	1,652.2	1,609.5	-42.7
5614716	7	25	1,652.4	1,607.4	-45.0
5614716	7	29	1,660.0	1,606.7	-53.3
5614717	7	11	1,652.3	1,631.7	-20.6
5614717	7	16	1,651.8	1,623.8	-28.0
5614717	7	19	1,653.4	1,618.9	-34.5
5614717	7	20	1,649.6	1,617.5	-32.1
5614717	7	22	1,649.7	1,615.4	-34.3
5614717	7	23	1,649.6	1,614.2	-35.4
5614717	7	25	1,650.0	1,612.1	-37.9
5614717	7	29	1,657.9	1,611.5	-46.4
5614720	7	29	1,652.5	1,611.5	-41.0
5614723	7	19	1,645.4	1,607.5	-37.9
5614723	7	20	1,643.5	1,606.8	-36.7
5614723	7	22	1,643.4	1,605.2	-38.2
5614723	7	23	1,643.6	1,603.9	-39.7
5614723	7	25	1,644.7	1,601.6	-43.1
5614801	7	7	1,622.3	1,597.9	-24.4
5614801	7	11	1,629.5	1,592.7	-36.8
5614801	7	16	1,626.6	1,588.2	-38.4
5614801	7	19	1,628.4	1,586.1	-42.3
5614801	7	20	1,628.7	1,586.9	-41.8

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5614801	7	22	1,629.0	1,588.4	-40.6
5614801	7	23	1,629.2	1,588.3	-40.9
5614801	7	25	1,630.2	1,587.5	-42.7
5614801	7	29	1,626.0	1,587.5	-38.5
5614802	7	1	1,591.5	1,553.4	-38.1
5614802	7	7	1,597.6	1,581.5	-16.1
5614802	7	12	1,591.5	1,584.7	-6.8
5614802	7	15	1,592.4	1,583.7	-8.7
5614802	7	16	1,593.6	1,583.9	-9.7
5614802	7	19	1,593.3	1,583.3	-10.0
5614802	7	20	1,590.1	1,584.1	-6.0
5614802	7	22	1,590.1	1,586.5	-3.6
5614802	7	23	1,590.4	1,587.0	-3.4
5614802	7	25	1,591.4	1,587.2	-4.2
5614803	7	7	1,635.5	1,591.7	-43.9
5614804	7	7	1,651.9	1,592.7	-59.3
5614804	7	19	1,647.2	1,587.5	-59.7
5614804	7	20	1,646.3	1,588.6	-57.7
5614804	7	22	1,647.4	1,590.8	-56.6
5614804	7	23	1,647.6	1,590.9	-56.7
5614804	7	25	1,647.9	1,590.5	-57.5
5614805	7	7	1,647.9	1,589.9	-57.9
5614806	7	7	1,659.8	1,589.9	-69.8
5614807	7	7	1,618.3	1,597.4	-20.9
5614808	7	7	1,635.2	1,581.4	-53.8
5614810	7	7	1,624.3	1,597.9	-26.4
5614811	7	7	1,626.9	1,576.0	-50.8
5614812	7	7	1,589.6	1,581.5	-8.1
5614812	7	19	1,591.0	1,583.3	-7.7
5614812	7	20	1,588.4	1,584.1	-4.3
5614812	7	22	1,589.0	1,586.5	-2.5
5614812	7	23	1,588.8	1,587.0	-1.8
5614812	7	29	1,577.7	1,589.7	12.0
5614814	7	7	1,649.6	1,589.9	-59.6
5614814	7	16	1,642.8	1,589.4	-53.5
5614814	7	19	1,645.8	1,588.4	-57.4
5614814	7	20	1,645.1	1,589.6	-55.5
5614814	7	22	1,645.2	1,592.3	-52.9

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5614814	7	23	1,645.4	1,592.6	-52.8
5614814	7	25	1,646.0	1,592.3	-53.7
5614815	7	19	1,608.1	1,587.2	-20.9
5614815	7	20	1,606.2	1,588.2	-18.0
5614815	7	22	1,606.1	1,591.0	-15.1
5614815	7	23	1,606.4	1,591.4	-15.0
5614815	7	25	1,607.5	1,591.4	-16.1
5614815	7	29	1,583.2	1,594.1	10.9
5614817	7	7	1,591.2	1,578.1	-13.1
5614817	7	19	1,585.5	1,579.0	-6.5
5614817	7	20	1,585.1	1,579.6	-5.5
5614817	7	22	1,585.2	1,581.6	-3.6
5614817	7	23	1,585.5	1,582.1	-3.4
5614817	7	25	1,586.0	1,582.4	-3.6
5614817	7	29	1,578.5	1,584.7	6.2
5614819	7	7	1,620.6	1,577.1	-43.5
5614901	7	16	1,473.7	1,528.7	55.0
5614901	7	20	1,475.1	1,528.3	53.2
5614901	7	22	1,475.0	1,530.3	55.3
5614901	7	23	1,474.7	1,530.3	55.6
5614901	7	25	1,476.4	1,531.2	54.8
5614906	7	19	1,586.2	1,560.3	-25.9
5614906	7	20	1,578.9	1,560.6	-18.3
5614906	7	22	1,578.6	1,561.9	-16.8
5614906	7	23	1,578.9	1,562.2	-16.7
5614906	7	25	1,579.0	1,562.4	-16.6
5614906	7	29	1,571.4	1,564.0	-7.5
5614907	7	11	1,584.5	1,567.3	-17.2
5614907	7	12	1,581.3	1,567.0	-14.3
5614907	7	16	1,575.7	1,565.1	-10.7
5614907	7	17	1,573.7	1,564.4	-9.3
5614907	7	18	1,572.6	1,564.0	-8.6
5614907	7	19	1,571.9	1,563.9	-8.0
5614907	7	20	1,567.8	1,564.2	-3.7
5614907	7	29	1,564.8	1,568.1	3.3
5615302	7	9	1,603.0	1,683.5	80.5
5615304	7	9	1,614.3	1,684.7	70.4
5615305	7	9	1,598.0	1,686.7	88.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5615702	7	1	1,536.3	1,532.0	-4.3
5615702	7	12	1,533.9	1,532.0	-2.0
5615702	7	15	1,534.7	1,532.0	-2.8
5615702	7	16	1,531.9	1,532.0	0.0
5615702	7	17	1,533.0	1,532.0	-1.1
5615702	7	18	1,535.0	1,532.0	-3.1
5615702	7	19	1,533.9	1,532.0	-1.9
5615702	7	20	1,532.3	1,532.0	-0.4
5615702	7	21	1,533.6	1,532.0	-1.6
5615702	7	23	1,534.4	1,532.0	-2.4
5615702	7	24	1,535.7	1,532.0	-3.8
5615702	7	25	1,536.7	1,532.0	-4.8
5616101	7	9	1,646.8	1,679.6	32.8
5620527	7	20	1,619.5	1,628.9	9.4
5621107	7	30	1,583.1	1,592.1	9.0
5621309	7	16	1,555.0	1,561.9	6.9
5622402	7	29	1,323.2	1,433.4	110.2
5623105	7	1	1,531.4	1,453.1	-78.3
5623105	7	12	1,527.2	1,456.8	-70.4
5623105	7	15	1,528.2	1,458.1	-70.1
5623105	7	18	1,527.5	1,458.9	-68.6
5623105	7	19	1,525.9	1,459.1	-66.8
5623105	7	20	1,523.2	1,459.2	-64.0
5623105	7	21	1,522.3	1,459.3	-63.0
5623105	7	22	1,522.5	1,459.4	-63.0
5623105	7	23	1,521.1	1,459.6	-61.5
5623105	7	24	1,519.4	1,459.6	-59.7
5623106	7	1	1,527.1	1,446.3	-80.8
5623106	7	12	1,497.9	1,476.3	-21.5
5623106	7	16	1,483.7	1,477.3	-6.5
5623106	7	17	1,478.1	1,476.9	-1.2
5623106	7	18	1,477.4	1,476.6	-0.8
5623106	7	19	1,484.9	1,476.0	-8.9
5623106	7	20	1,479.2	1,475.5	-3.7
5623106	7	21	1,477.0	1,475.3	-1.6
5623106	7	23	1,477.3	1,475.3	-2.1
5623106	7	24	1,471.2	1,475.5	4.3
5623107	7	5	1,580.7	1,460.2	-120.5

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5623114	7	5	1,532.0	1,430.9	-101.2
5623115	7	5	1,528.0	1,426.8	-101.2
5623603	7	1	1,317.4	1,343.0	25.6
5623603	7	12	1,328.2	1,344.8	16.7
5623603	7	15	1,322.2	1,344.8	22.6
5623603	7	16	1,327.8	1,344.5	16.7
5623603	7	17	1,331.4	1,344.1	12.7
5623603	7	18	1,327.3	1,343.9	16.6
5623603	7	19	1,333.5	1,343.7	10.2
5623603	7	20	1,332.4	1,343.3	10.9
5623603	7	21	1,333.4	1,343.1	9.7
5623603	7	22	1,330.2	1,342.9	12.7
5623603	7	23	1,333.3	1,342.9	9.6
5623603	7	24	1,321.9	1,342.7	20.8
5631503	7	29	1,447.1	1,571.3	124.2
5631504	7	18	1,495.0	1,577.5	82.5
5631504	7	29	1,490.9	1,568.6	77.7
5632202	7	1	1,418.0	1,431.9	13.9
5632202	7	12	1,424.3	1,426.5	2.2
5632202	7	15	1,426.8	1,423.9	-2.9
5632202	7	16	1,426.9	1,423.2	-3.8
5632202	7	17	1,425.3	1,422.6	-2.6
5632202	7	18	1,427.1	1,422.4	-4.7
5632202	7	19	1,417.7	1,422.0	4.4
5632202	7	21	1,427.5	1,420.9	-6.6
5632202	7	22	1,429.1	1,420.7	-8.5
5632202	7	23	1,428.6	1,420.6	-8.0
5632202	7	24	1,428.1	1,420.2	-8.0
5632401	7	1	1,476.0	1,455.9	-20.1
5632401	7	12	1,476.2	1,445.8	-30.4
5632401	7	16	1,479.4	1,444.4	-35.0
5632401	7	18	1,479.0	1,446.3	-32.7
5632401	7	19	1,463.8	1,445.5	-18.3
5632401	7	20	1,479.6	1,443.1	-36.5
5632401	7	22	1,479.7	1,444.8	-35.0
5632401	7	23	1,479.7	1,445.7	-34.0
5632401	7	24	1,479.6	1,443.9	-35.7
5632401	7	29	1,477.8	1,443.1	-34.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5639501	7	18	1,670.0	1,743.7	73.7
5639501	7	19	1,674.7	1,743.2	68.5
5639501	7	21	1,669.6	1,741.1	71.6
5639501	7	27	1,669.7	1,740.2	70.5
5639501	7	30	1,675.3	1,739.6	64.4
5639501	7	31	1,666.7	1,740.1	73.4
5640504	7	6	1,675.0	1,763.9	88.9
5640504	7	18	1,744.0	1,751.4	7.4
5640504	7	19	1,729.2	1,751.3	22.1
5640504	7	30	1,746.5	1,751.0	4.5
5640505	7	13	1,759.6	1,778.7	19.1
5648602	7	18	1,788.3	1,768.4	-19.9
5648602	7	19	1,788.6	1,768.5	-20.2
5648602	7	21	1,789.6	1,767.5	-22.1
5648602	7	31	1,789.6	1,768.3	-21.2
5656305	7	18	1,697.3	1,731.9	34.7
5656305	7	19	1,693.7	1,731.8	38.1
5656305	7	21	1,687.6	1,730.5	43.0
5656305	7	27	1,698.4	1,730.9	32.5
5656305	7	30	1,696.3	1,730.8	34.5
5656305	7	31	1,695.9	1,731.3	35.3
5656307	7	13	1,684.0	1,734.0	50.0
5656601	7	1	1,674.8	1,661.8	-13.0
5656601	7	7	1,677.1	1,662.6	-14.5
5656601	7	10	1,678.1	1,660.4	-17.7
5656601	7	18	1,670.5	1,659.1	-11.5
5656601	7	19	1,674.9	1,659.0	-15.9
5656601	7	21	1,670.5	1,657.9	-12.6
5656601	7	27	1,673.2	1,658.5	-14.7
5656601	7	30	1,674.0	1,658.4	-15.5
5656601	7	31	1,673.3	1,659.0	-14.3
5701202	7	9	1,750.7	1,563.4	-187.3
5701401	7	9	1,703.9	1,604.8	-99.1
5701402	7	9	1,560.0	1,608.6	48.6
5701402	7	10	1,554.7	1,609.5	54.8
5701402	7	12	1,552.5	1,610.6	58.1
5701404	7	9	1,550.9	1,608.6	57.7
5701405	7	9	1,550.5	1,606.3	55.8

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5701406	7	9	1,527.7	1,609.2	81.5
5701408	7	9	1,537.3	1,608.6	71.3
5701409	7	9	1,556.8	1,608.6	51.8
5701410	7	9	1,547.8	1,610.4	62.6
5701411	7	7	1,546.9	1,604.7	57.8
5701412	7	9	1,556.0	1,608.1	52.1
5701412	7	16	1,563.7	1,609.6	45.9
5701413	7	9	1,642.0	1,588.5	-53.5
5701413	7	10	1,647.4	1,589.4	-58.0
5701414	7	9	1,543.6	1,611.7	68.1
5701414	7	10	1,542.6	1,612.4	69.8
5701414	7	12	1,542.9	1,613.4	70.6
5701415	7	8	1,537.0	1,608.1	71.2
5701501	7	9	1,736.1	1,620.2	-116.0
5701501	7	16	1,730.1	1,619.1	-111.0
5701501	7	23	1,731.1	1,618.3	-112.8
5701502	7	9	1,667.2	1,592.5	-74.7
5701502	7	10	1,653.9	1,592.9	-61.0
5701502	7	12	1,657.3	1,590.2	-67.1
5701502	7	15	1,695.5	1,584.9	-110.6
5701502	7	16	1,694.6	1,589.9	-104.8
5701504	7	9	1,605.7	1,586.6	-19.1
5701505	7	9	1,580.8	1,619.4	38.6
5701506	7	16	1,708.7	1,593.5	-115.2
5701507	7	9	1,652.7	1,620.3	-32.4
5701602	7	1	1,567.1	1,624.3	57.2
5701602	7	10	1,567.5	1,623.6	56.1
5701602	7	12	1,566.9	1,623.1	56.3
5701602	7	15	1,568.9	1,623.6	54.7
5701602	7	16	1,570.1	1,622.4	52.3
5701703	7	1	1,537.9	1,570.5	32.6
5701903	7	9	1,610.6	1,510.7	-99.9
5701904	7	9	1,427.2	1,445.4	18.3
5702301	7	1	1,495.6	1,539.6	44.0
5702301	7	10	1,485.3	1,537.2	51.9
5702301	7	12	1,485.5	1,536.1	50.6
5702301	7	15	1,504.1	1,534.4	30.3
5702301	7	16	1,494.2	1,536.6	42.4

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5702301	7	17	1,501.7	1,537.4	35.7
5702301	7	19	1,495.9	1,537.8	41.9
5702301	7	20	1,486.5	1,536.4	50.0
5702303	7	9	1,471.7	1,575.6	103.9
5702401	7	3	1,493.0	1,619.2	126.2
5702401	7	17	1,513.3	1,620.2	106.9
5702401	7	19	1,513.5	1,620.1	106.6
5702402	7	16	1,524.9	1,620.1	95.2
5702402	7	17	1,520.8	1,620.2	99.4
5702402	7	19	1,521.7	1,620.1	98.4
5702601	7	9	1,509.6	1,575.1	65.5
5702901	7	1	1,526.3	1,541.4	15.2
5703103	7	1	1,483.9	1,485.2	1.3
5703103	7	8	1,484.6	1,476.7	-7.9
5703103	7	10	1,481.7	1,478.9	-2.8
5703103	7	12	1,481.4	1,477.0	-4.4
5703103	7	15	1,487.2	1,472.7	-14.5
5703103	7	16	1,488.6	1,476.7	-11.9
5703103	7	19	1,490.7	1,479.3	-11.5
5703105	7	3	1,464.0	1,486.6	22.6
5703107	7	9	1,468.9	1,468.7	-0.1
5703108	7	9	1,490.1	1,481.8	-8.2
5703109	7	8	1,469.0	1,472.7	3.7
5703202	7	8	1,458.3	1,462.0	3.7
5703202	7	10	1,455.5	1,464.6	9.1
5703202	7	12	1,456.2	1,462.4	6.2
5703202	7	19	1,462.4	1,465.8	3.4
5703204	7	9	1,491.1	1,474.0	-17.2
5703214	7	9	1,474.9	1,474.0	-0.9
5703220	7	9	1,488.8	1,469.5	-19.3
5703224	7	9	1,472.5	1,468.3	-4.2
5703224	7	10	1,471.7	1,468.1	-3.6
5703224	7	12	1,471.2	1,467.7	-3.5
5703224	7	15	1,474.1	1,466.4	-7.6
5703224	7	16	1,474.1	1,466.3	-7.8
5703231	7	9	1,476.2	1,471.8	-4.4
5703302	7	9	1,413.9	1,359.6	-54.3
5703311	7	19	1,437.0	1,343.2	-93.8

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5703401	7	8	1,482.6	1,490.7	8.1
5703401	7	16	1,484.6	1,488.8	4.2
5703401	7	19	1,487.7	1,488.6	0.9
5703402	7	8	1,496.9	1,494.3	-2.6
5703404	7	9	1,496.1	1,491.5	-4.6
5703405	7	9	1,491.4	1,495.9	4.5
5703410	7	8	1,502.1	1,487.4	-14.7
5703410	7	10	1,499.0	1,486.9	-12.1
5703410	7	12	1,497.7	1,486.6	-11.1
5703410	7	15	1,503.4	1,485.7	-17.7
5703410	7	16	1,503.9	1,485.3	-18.6
5703501	7	16	1,477.8	1,481.0	3.2
5703501	7	17	1,477.2	1,480.8	3.6
5703501	7	19	1,478.2	1,480.7	2.5
5703504	7	10	1,464.1	1,445.1	-18.9
5703504	7	12	1,463.6	1,444.8	-18.8
5703504	7	15	1,464.0	1,443.9	-20.1
5703504	7	16	1,464.2	1,443.6	-20.7
5705702	7	1	1,024.5	1,017.4	-7.2
5705702	7	2	1,025.8	1,018.8	-7.0
5705702	7	7	1,026.7	1,015.8	-10.9
5705702	7	11	1,021.3	1,015.4	-5.9
5705702	7	12	1,023.9	1,019.0	-4.9
5705702	7	16	1,021.7	1,016.5	-5.2
5705702	7	18	1,024.9	1,017.3	-7.6
5705702	7	19	1,021.8	1,016.6	-5.2
5705702	7	20	1,017.1	1,013.3	-3.9
5705702	7	21	1,017.6	1,007.1	-10.5
5705702	7	22	1,023.3	1,016.3	-7.0
5705702	7	23	1,026.7	1,017.6	-9.2
5705702	7	27	1,014.7	1,007.6	-7.1
5705702	7	28	1,025.0	1,011.8	-13.2
5705702	7	29	1,016.5	1,014.4	-2.1
5705804	7	19	892.0	1,020.3	128.3
5710103	7	1	1,308.4	1,464.4	156.0
5710103	7	2	1,308.7	1,467.6	158.9
5710103	7	7	1,310.4	1,479.0	168.6
5710103	7	12	1,308.9	1,486.6	177.7

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5710103	7	15	1,311.6	1,490.4	178.8
5710103	7	16	1,311.2	1,491.5	180.3
5710103	7	20	1,310.0	1,495.5	185.5
5710233	7	9	1,329.6	1,495.3	165.7
5710240	7	1	1,327.5	1,471.5	144.0
5710244	7	1	1,320.0	1,470.6	150.6
5714101	7	17	975.7	1,017.4	41.7
5714101	7	18	1,011.8	1,024.7	12.9
5714101	7	19	1,012.9	1,024.0	11.1
5714101	7	20	1,004.3	1,020.9	16.6
5714101	7	21	1,014.1	1,014.9	0.8
5714404	7	11	1,009.0	1,024.8	15.8
5714408	7	11	1,020.0	1,022.7	2.7
5720502	7	1	1,116.0	1,136.1	20.1
5720502	7	4	1,118.3	1,134.8	16.5
5720502	7	7	1,119.4	1,133.0	13.6
5720502	7	12	1,115.6	1,126.3	10.7
5720502	7	15	1,117.5	1,120.8	3.3
5722804	7	30	965.2	1,113.8	148.6
5722804	7	31	967.0	1,113.9	147.0
5727603	7	4	1,123.0	1,151.3	28.3
5733103	7	10	1,654.9	1,801.5	146.6
5733103	7	18	1,658.7	1,800.5	141.8
5733103	7	19	1,657.0	1,800.5	143.6
5733103	7	21	1,653.2	1,799.5	146.4
5733103	7	30	1,658.5	1,798.9	140.5
5733905	7	12	1,724.0	1,873.9	149.9
5734403	7	5	1,740.7	1,811.1	70.4
5735707	7	18	1,710.6	1,675.4	-35.1
5735707	7	19	1,711.4	1,675.0	-36.4
5735707	7	30	1,706.5	1,655.6	-50.9
5735805	7	9	1,672.0	1,655.0	-17.1
5735805	7	18	1,673.6	1,643.4	-30.2
5735805	7	19	1,673.3	1,643.0	-30.3
5735805	7	30	1,672.1	1,625.2	-46.9
5737402	7	1	1,357.3	1,240.6	-116.7
5737402	7	2	1,376.1	1,241.7	-134.4
5737402	7	7	1,377.9	1,248.0	-129.8

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5737402	7	12	1,390.0	1,250.3	-139.7
5737402	7	13	1,376.1	1,249.8	-126.3
5737402	7	17	1,357.1	1,247.1	-110.0
5737402	7	18	1,370.6	1,252.2	-118.4
5737402	7	19	1,383.0	1,251.9	-131.1
5737402	7	20	1,362.2	1,246.7	-115.5
5737402	7	21	1,363.6	1,248.9	-114.7
5737402	7	22	1,365.2	1,250.5	-114.7
5737402	7	23	1,380.5	1,253.5	-127.0
5737402	7	24	1,365.3	1,252.0	-113.3
5737402	7	25	1,383.0	1,256.1	-127.0
5737402	7	26	1,357.0	1,253.5	-103.5
5741205	7	10	1,787.5	1,802.9	15.3
5741205	7	18	1,786.1	1,802.8	16.7
5741205	7	19	1,787.6	1,802.8	15.2
5741205	7	30	1,787.7	1,804.8	17.1
5741206	7	18	1,768.9	1,772.9	4.0
5741301	7	1	1,745.0	1,789.2	44.2
5741301	7	2	1,750.0	1,787.7	37.7
5741301	7	4	1,744.0	1,784.0	40.0
5741301	7	10	1,724.6	1,765.5	41.0
5741502	7	10	1,750.3	1,767.4	17.1
5741502	7	19	1,755.5	1,761.2	5.6
5741502	7	30	1,758.0	1,761.5	3.5
5741503	7	10	1,741.5	1,756.5	15.1
5741503	7	18	1,744.5	1,748.7	4.2
5741503	7	19	1,744.9	1,749.0	4.2
5741503	7	30	1,753.0	1,749.1	-3.9
5741614	7	5	1,725.5	1,732.5	7.0
5741615	7	31	1,645.3	1,735.5	90.2
5741616	7	18	1,750.3	1,721.7	-28.6
5741616	7	21	1,741.8	1,719.4	-22.3
5741616	7	30	1,759.1	1,721.0	-38.2
5741618	7	13	1,756.8	1,753.4	-3.4
5741618	7	14	1,758.1	1,750.5	-7.6
5741618	7	15	1,757.1	1,750.7	-6.4
5741621	7	18	1,717.7	1,731.0	13.3
5741621	7	19	1,719.3	1,731.0	11.6

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5741621	7	30	1,723.0	1,730.4	7.4
5741621	7	31	1,721.7	1,731.2	9.5
5741702	7	1	1,732.0	1,758.8	26.8
5741702	7	18	1,740.1	1,743.6	3.5
5741702	7	19	1,739.6	1,743.6	4.1
5741702	7	21	1,733.9	1,742.3	8.4
5741908	7	5	1,723.3	1,722.3	-1.0
5742101	7	7	1,659.1	1,779.1	120.1
5742101	7	10	1,662.1	1,768.6	106.4
5742203	7	6	1,688.0	1,747.5	59.5
5742303	7	7	1,835.2	1,759.7	-75.5
5742303	7	10	1,835.2	1,754.5	-80.7
5742303	7	18	1,836.4	1,741.9	-94.5
5742303	7	30	1,834.4	1,726.2	-108.3
5742305	7	19	1,794.8	1,705.0	-89.7
5742306	7	7	1,807.5	1,718.2	-89.3
5742306	7	10	1,800.0	1,713.4	-86.6
5742306	7	18	1,798.9	1,700.4	-98.5
5742306	7	19	1,796.4	1,699.2	-97.3
5742306	7	30	1,778.2	1,681.8	-96.4
5742502	7	1	1,649.4	1,741.8	92.3
5742502	7	7	1,648.0	1,729.6	81.6
5742502	7	10	1,648.7	1,718.0	69.3
5742502	7	12	1,648.6	1,717.4	68.8
5742502	7	13	1,650.6	1,714.3	63.7
5742502	7	14	1,649.6	1,710.8	61.2
5742502	7	15	1,649.8	1,710.3	60.6
5742502	7	18	1,645.9	1,705.6	59.7
5742502	7	19	1,640.5	1,704.8	64.3
5742502	7	30	1,643.9	1,697.8	53.9
5742705	7	5	1,609.8	1,652.2	42.4
5743102	7	5	1,707.0	1,672.3	-34.7
5743103	7	18	1,573.1	1,627.9	54.7
5743103	7	19	1,581.4	1,626.9	45.5
5743103	7	30	1,581.1	1,609.6	28.5
5743201	7	5	1,606.6	1,621.6	15.0
5743203	7	13	1,613.0	1,610.3	-2.7
5744510	7	11	1,468.0	1,460.8	-7.2

Table A1 Simulated versus measured heads (water levels) at wells.

State Well Number	Model Layer	Stress Period	Measured Head (feet above mean sea level)	Simulated Head (feet above mean sea level)	Residual (feet)
5745101	7	7	1,293.6	1,271.8	-21.8
5745101	7	13	1,282.9	1,271.1	-11.8
5745101	7	17	1,281.7	1,270.3	-11.4
5745101	7	19	1,279.3	1,270.4	-8.9
5745101	7	23	1,283.5	1,270.7	-12.8
5745101	7	24	1,283.5	1,270.2	-13.3
5745111	7	1	1,264.1	1,264.7	0.6
5745111	7	2	1,266.8	1,264.4	-2.4

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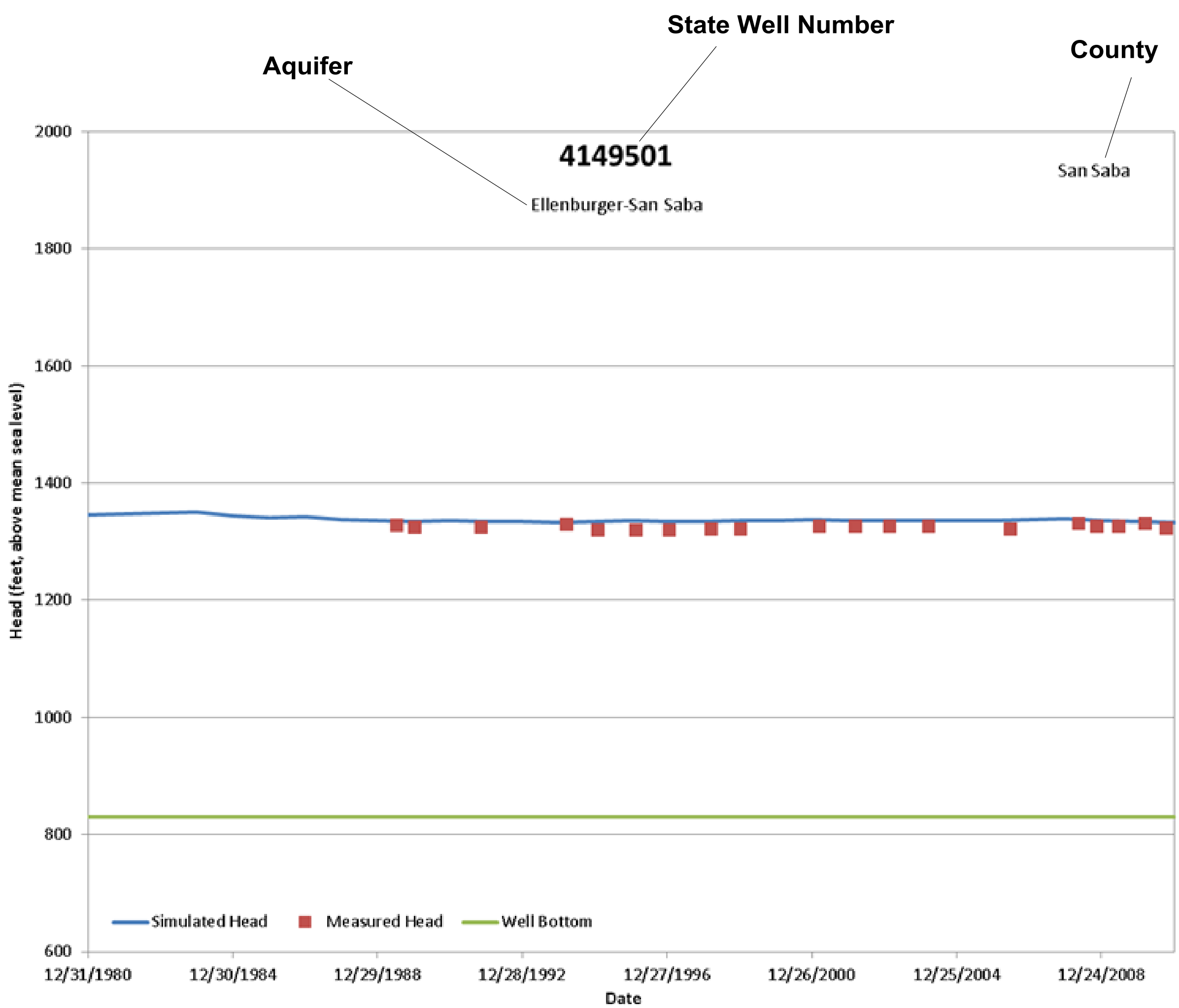
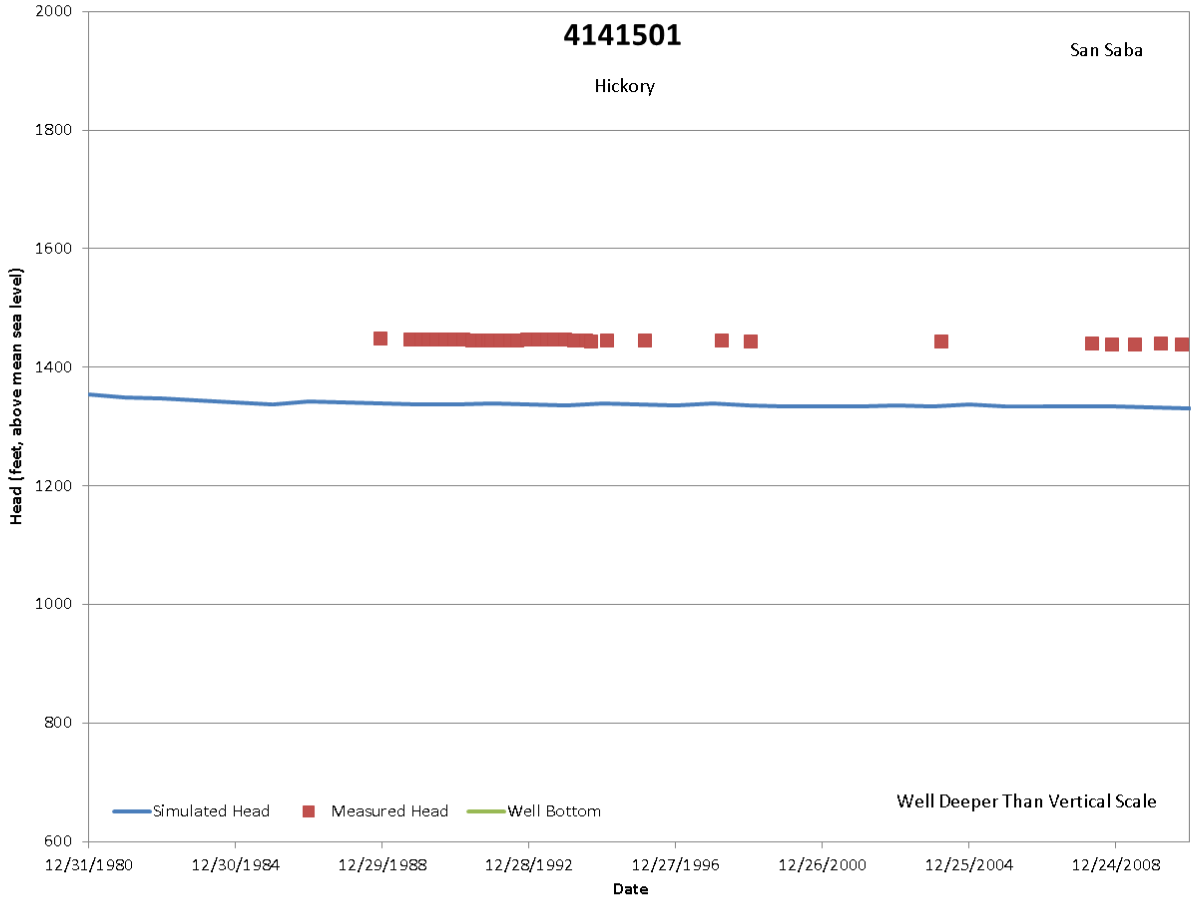
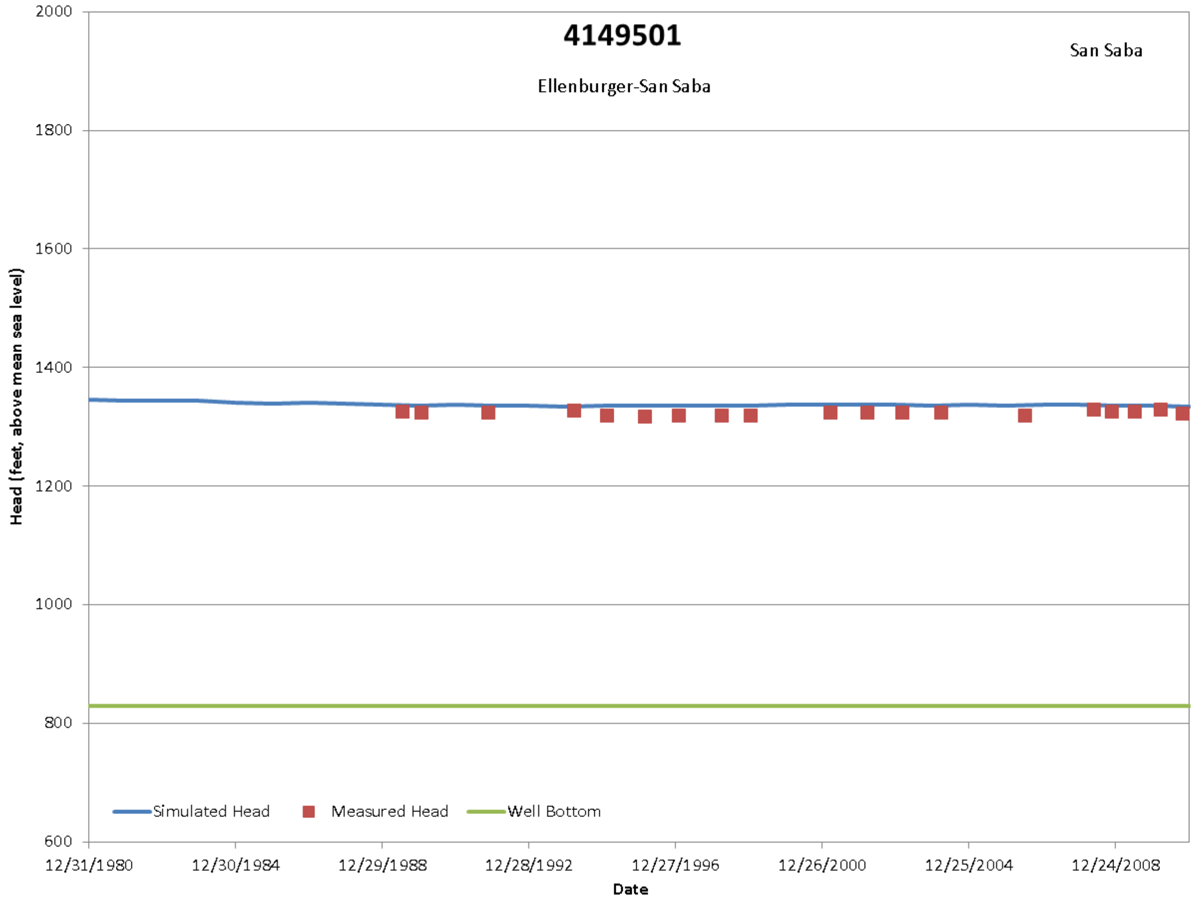
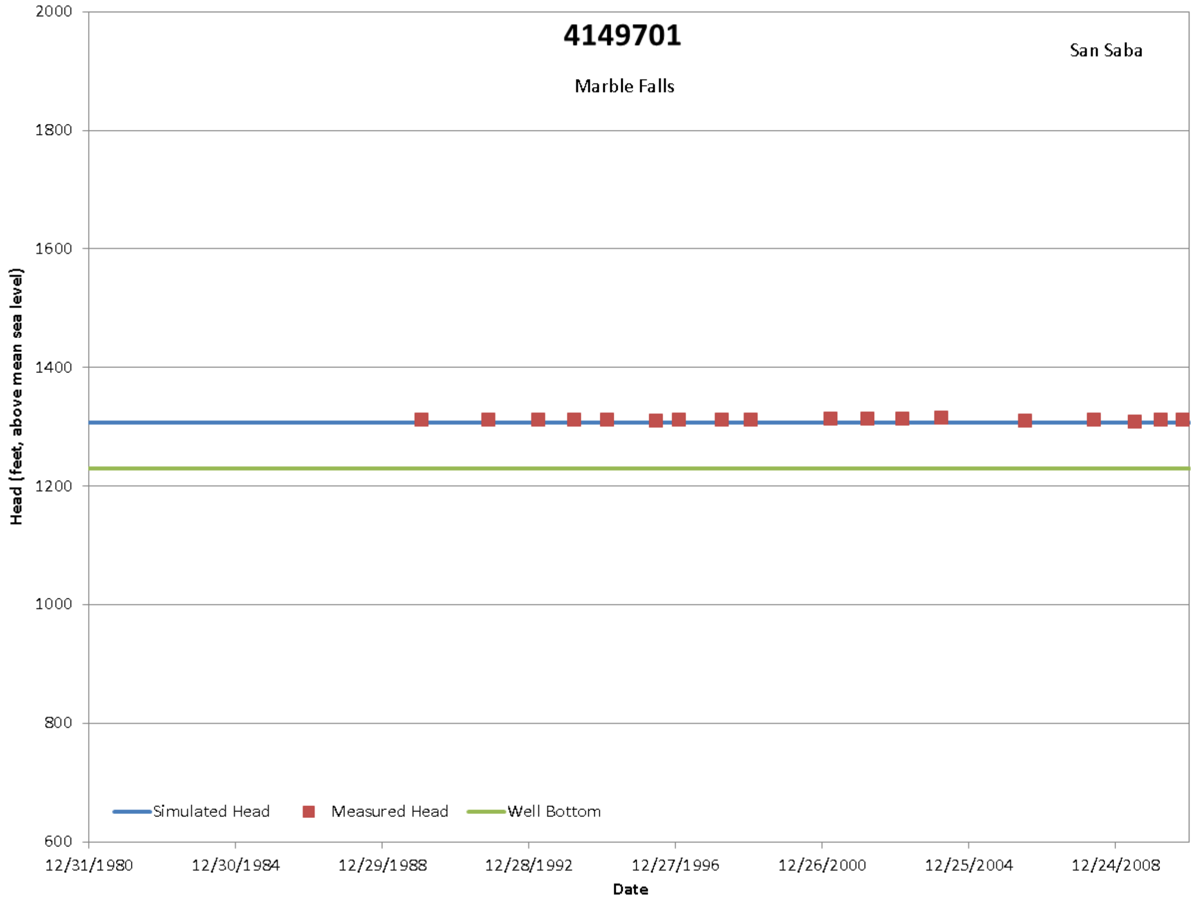
Appendix B: Head Hydrographs

- hydrographs are arranged based on state well number
- only wells with more than 10 measurements in more than 10 year span presented
- Following figure shows how to read a hydrograph




4141501
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4149501
San Saba
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4149701
Marble Falls
San Saba
Head (feet, above mean sea level)
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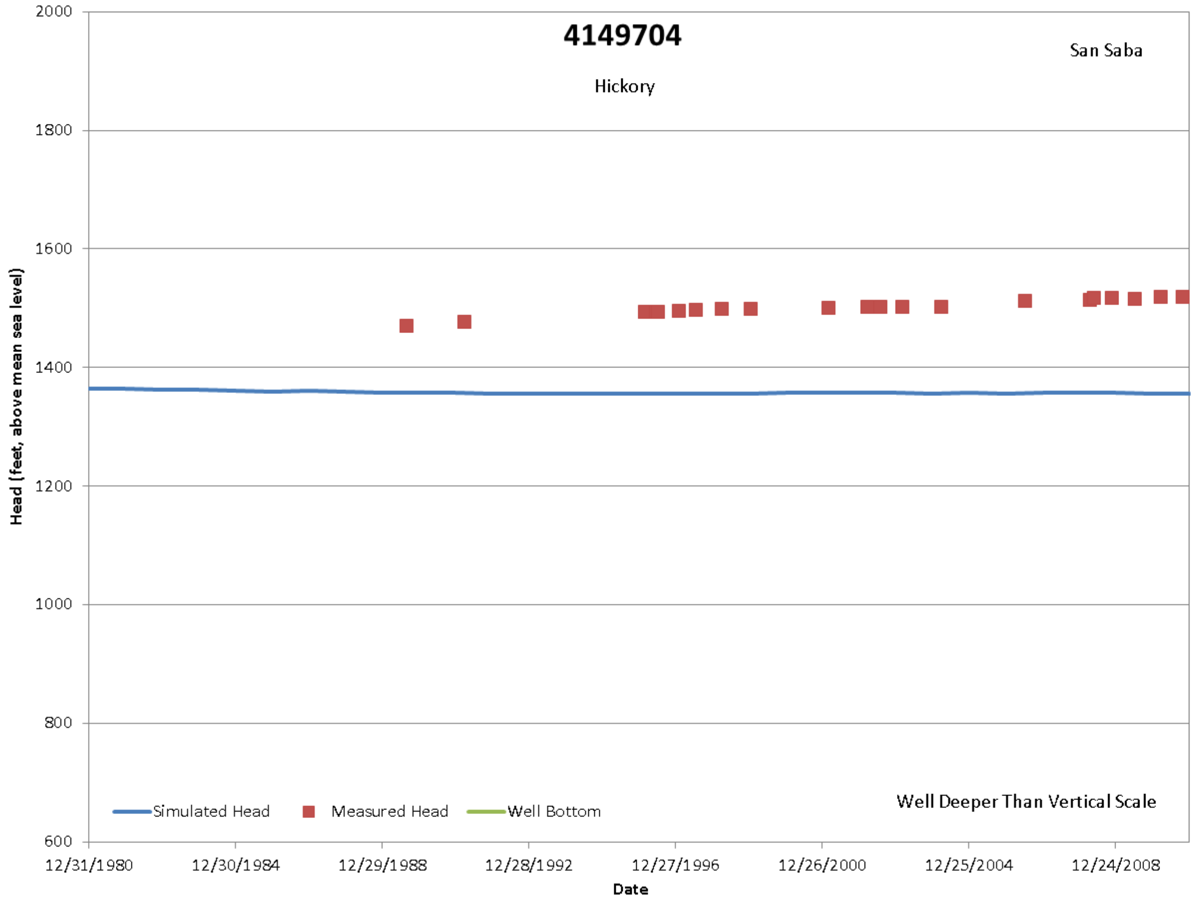
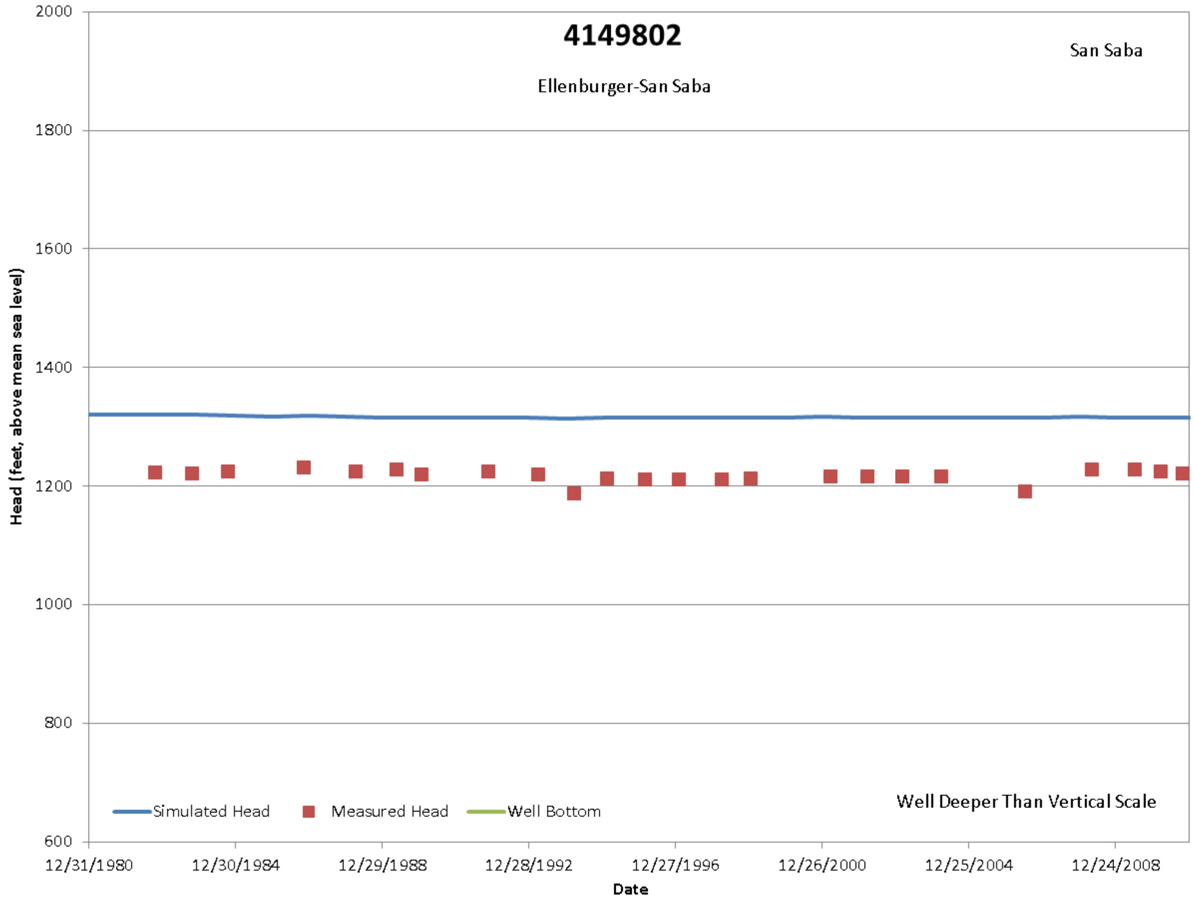
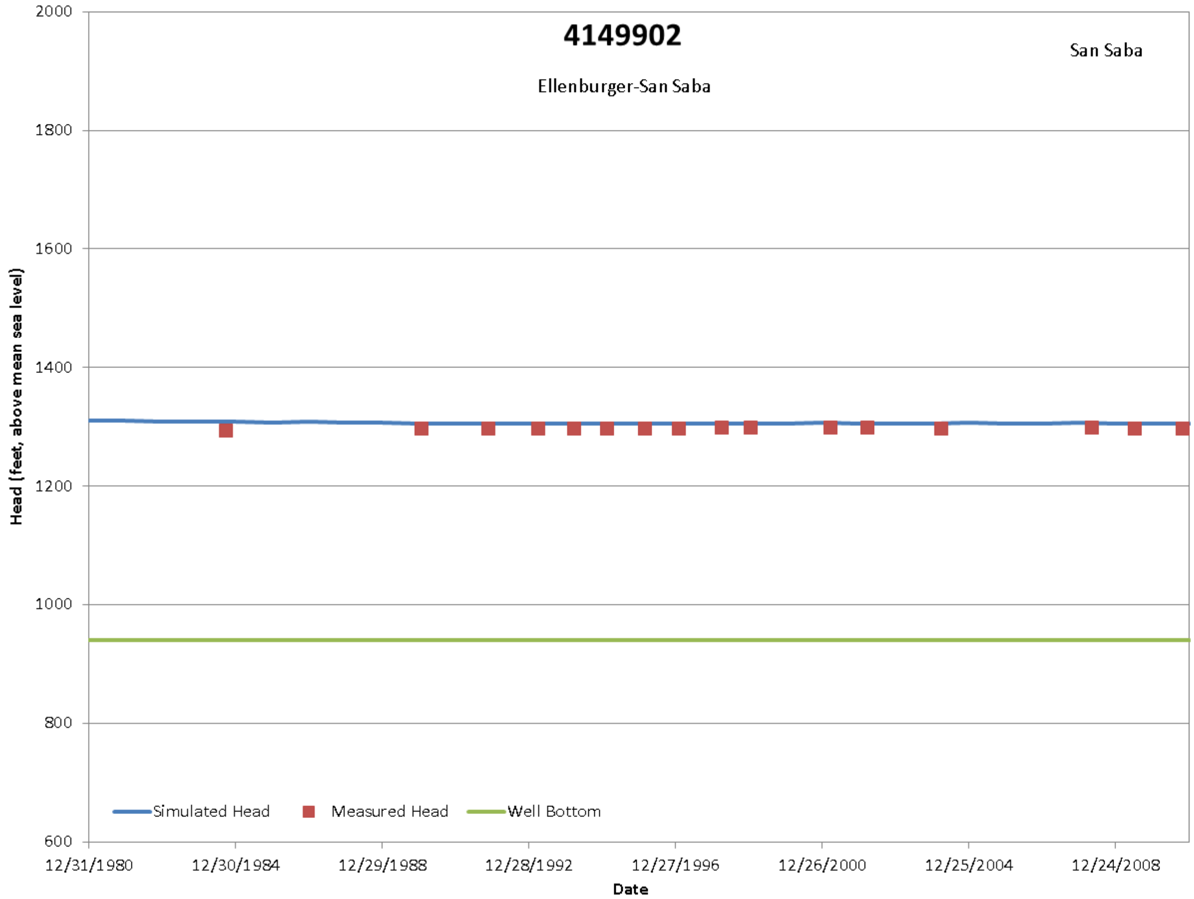
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4149704
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4149802
Ellenburger-San Saba
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale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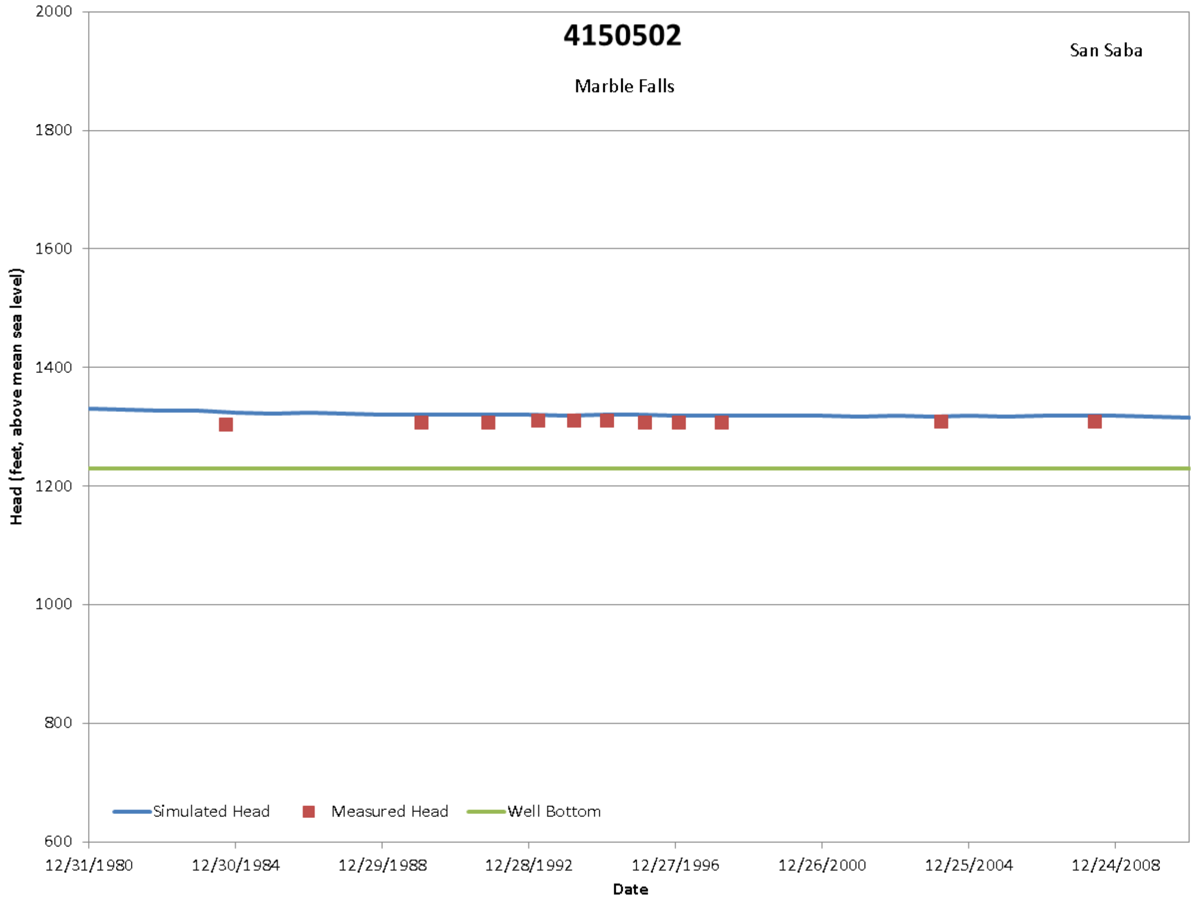
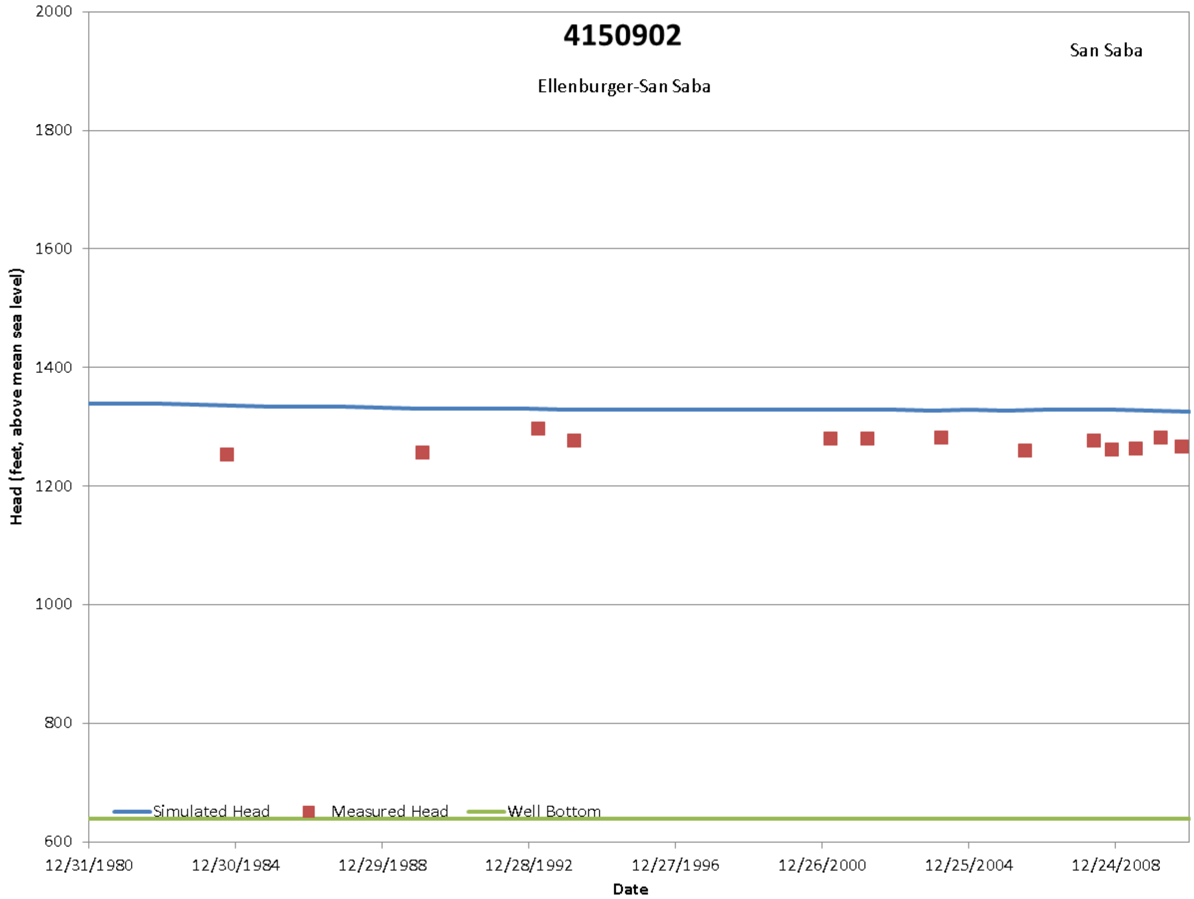
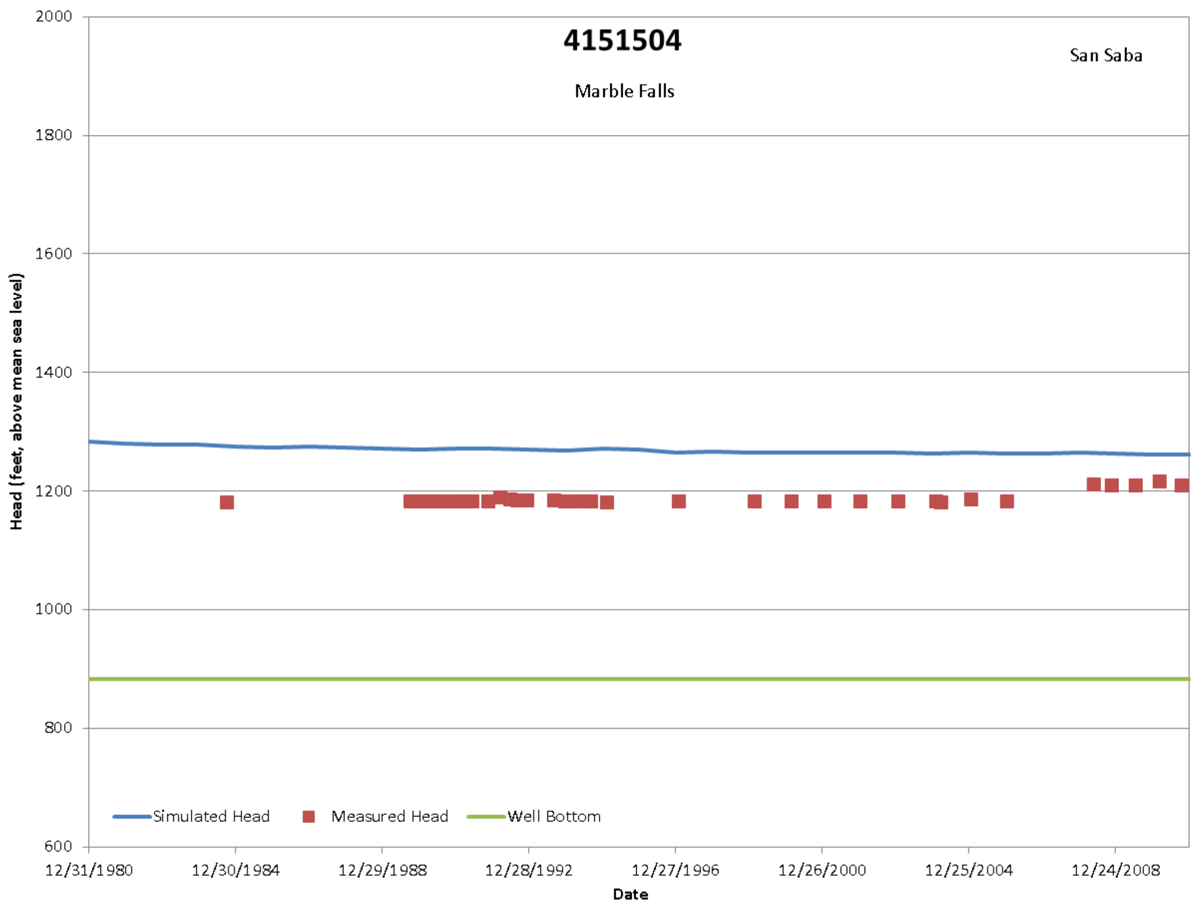
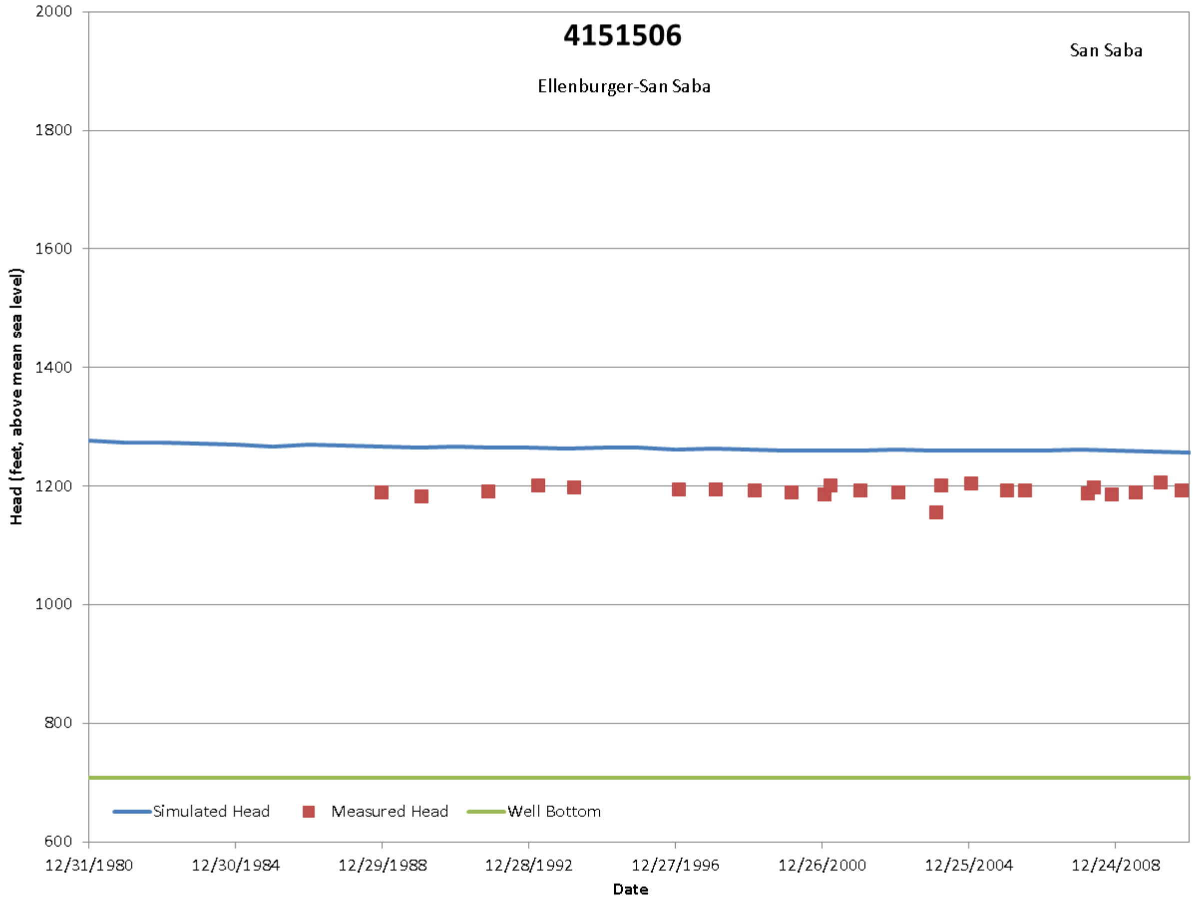
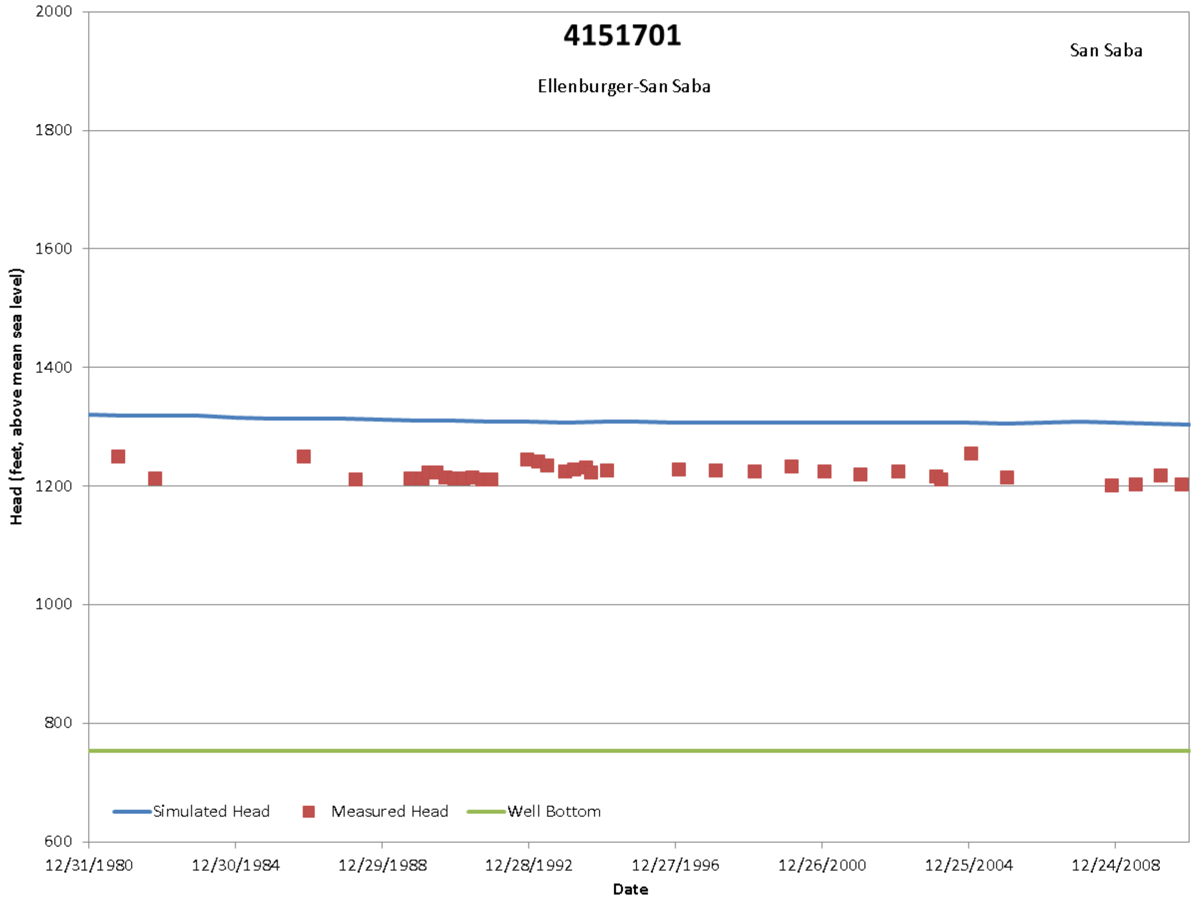
San Saba
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

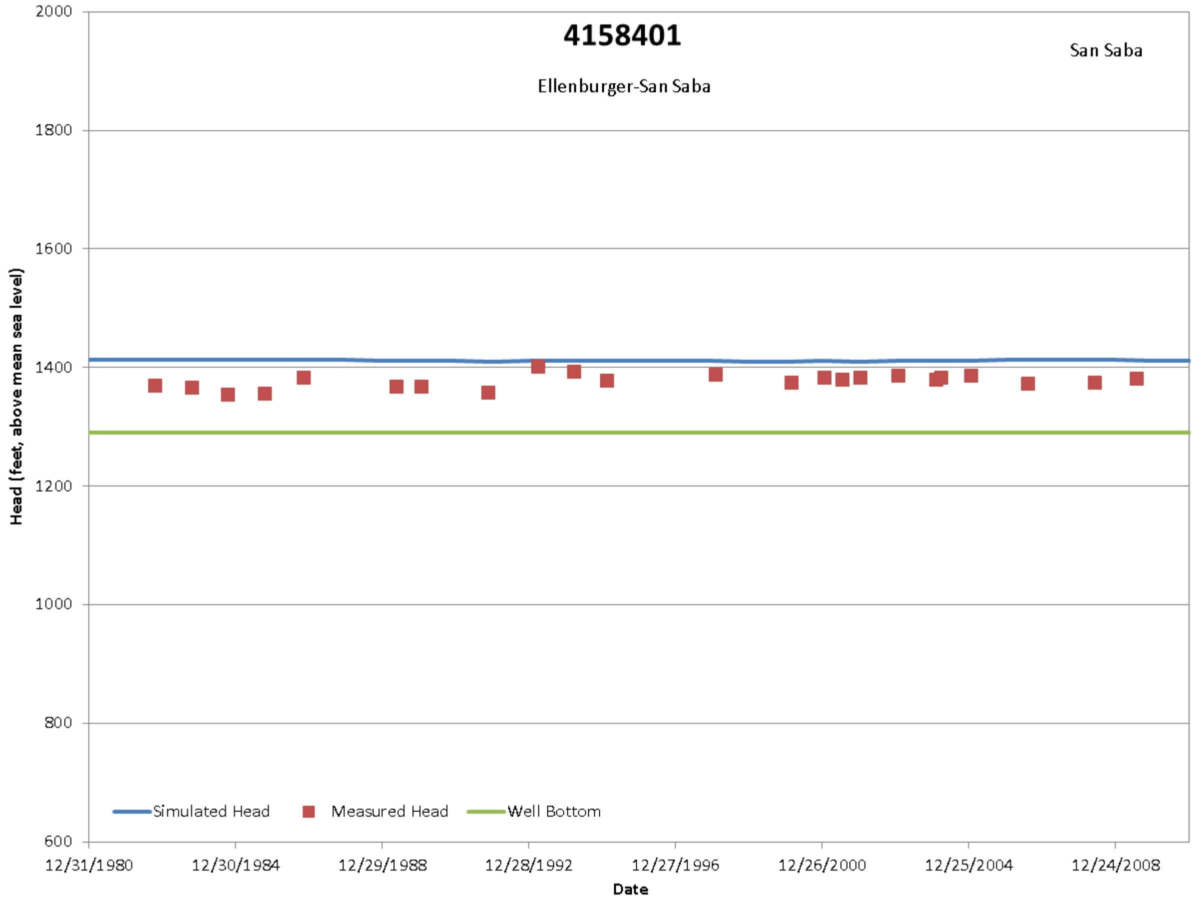

4150502
Marble Falls
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4150902
San Saba
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


4151504
Marble Falls
San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4151506
San Saba
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4151701
San Saba
Ellenburger-San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4158401
Ellenburger-San Saba
San Saba
Head (feet, above mean sea level)
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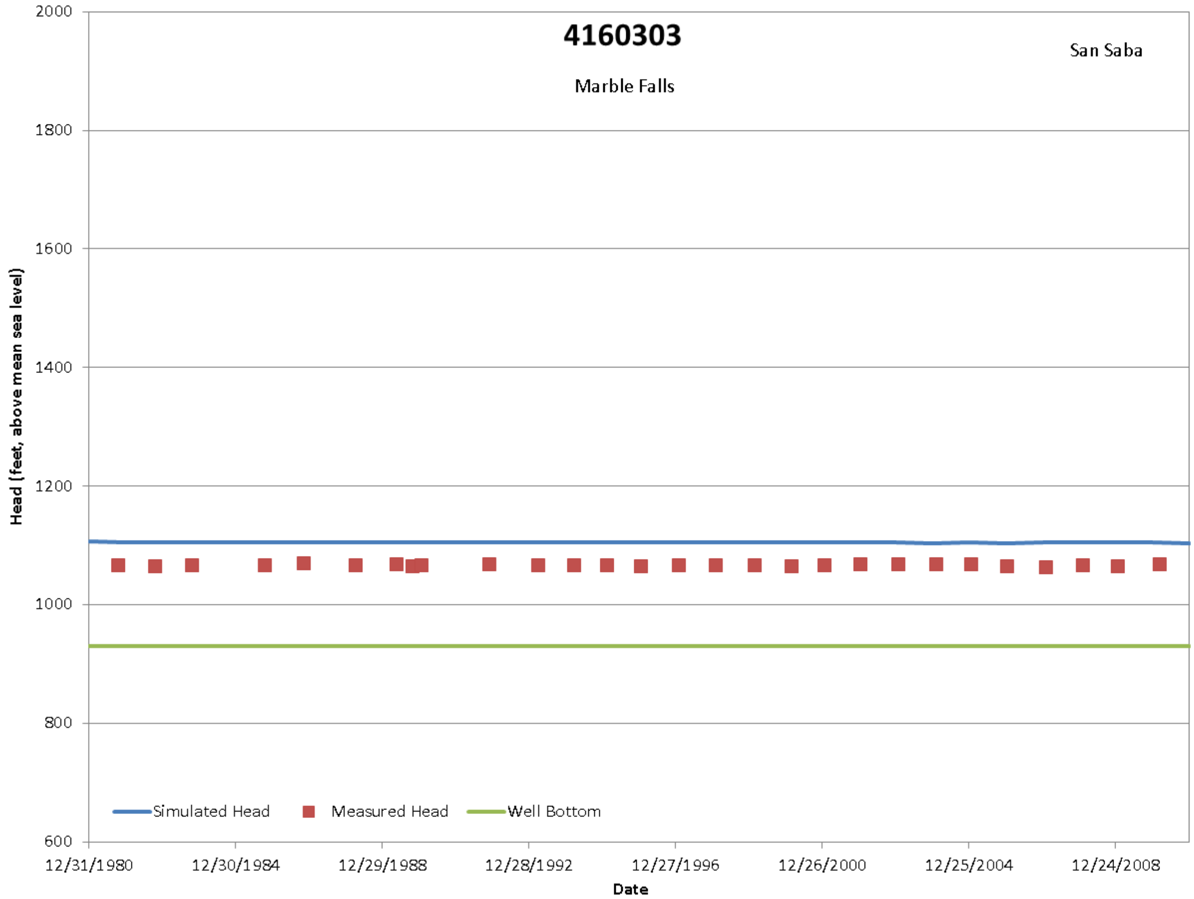
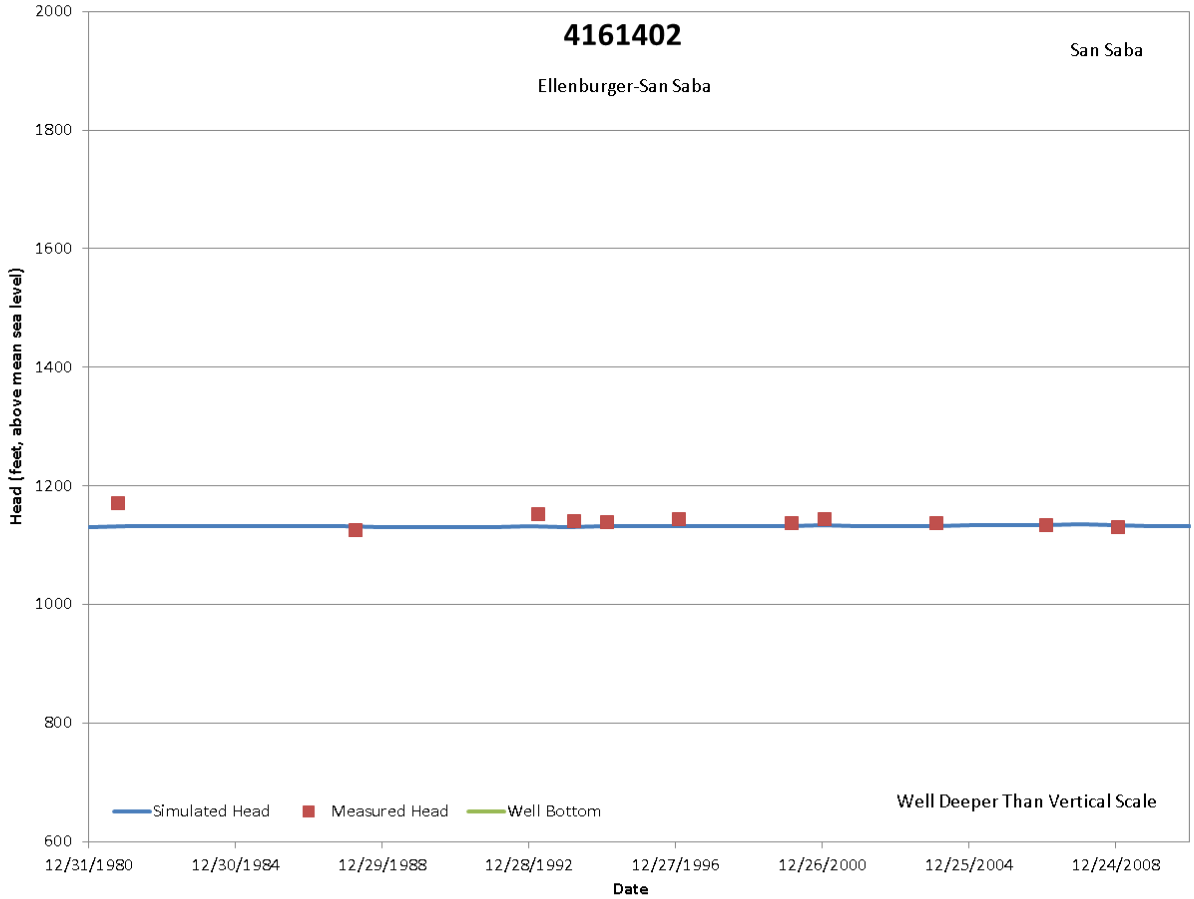
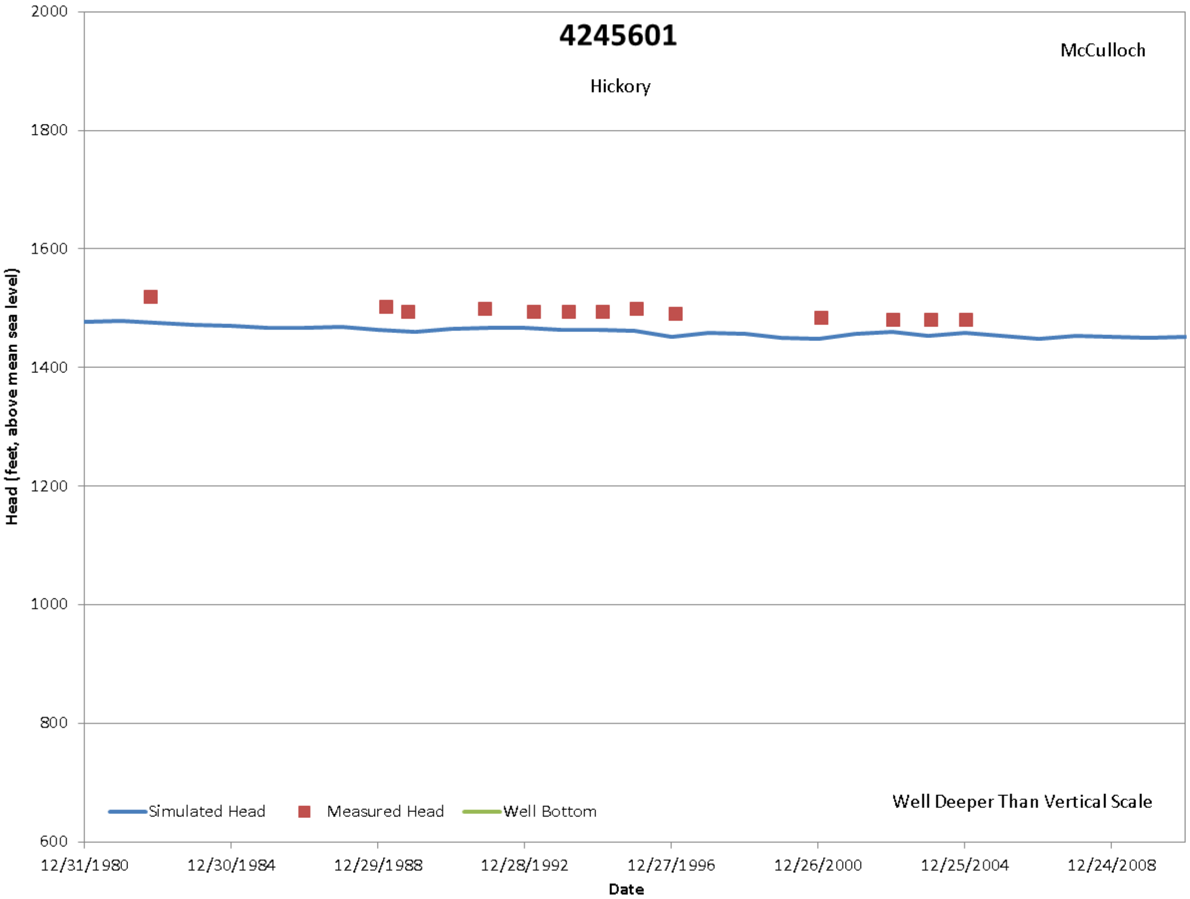
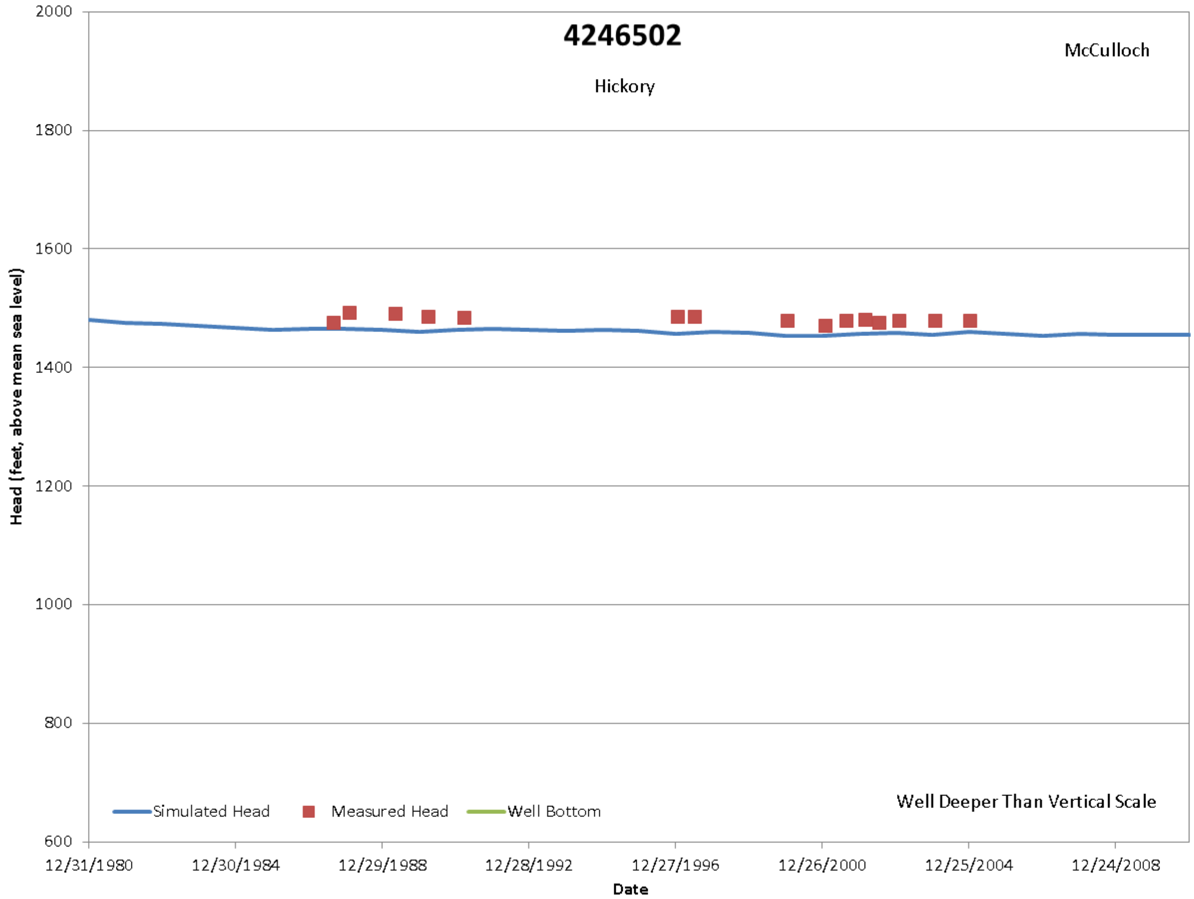
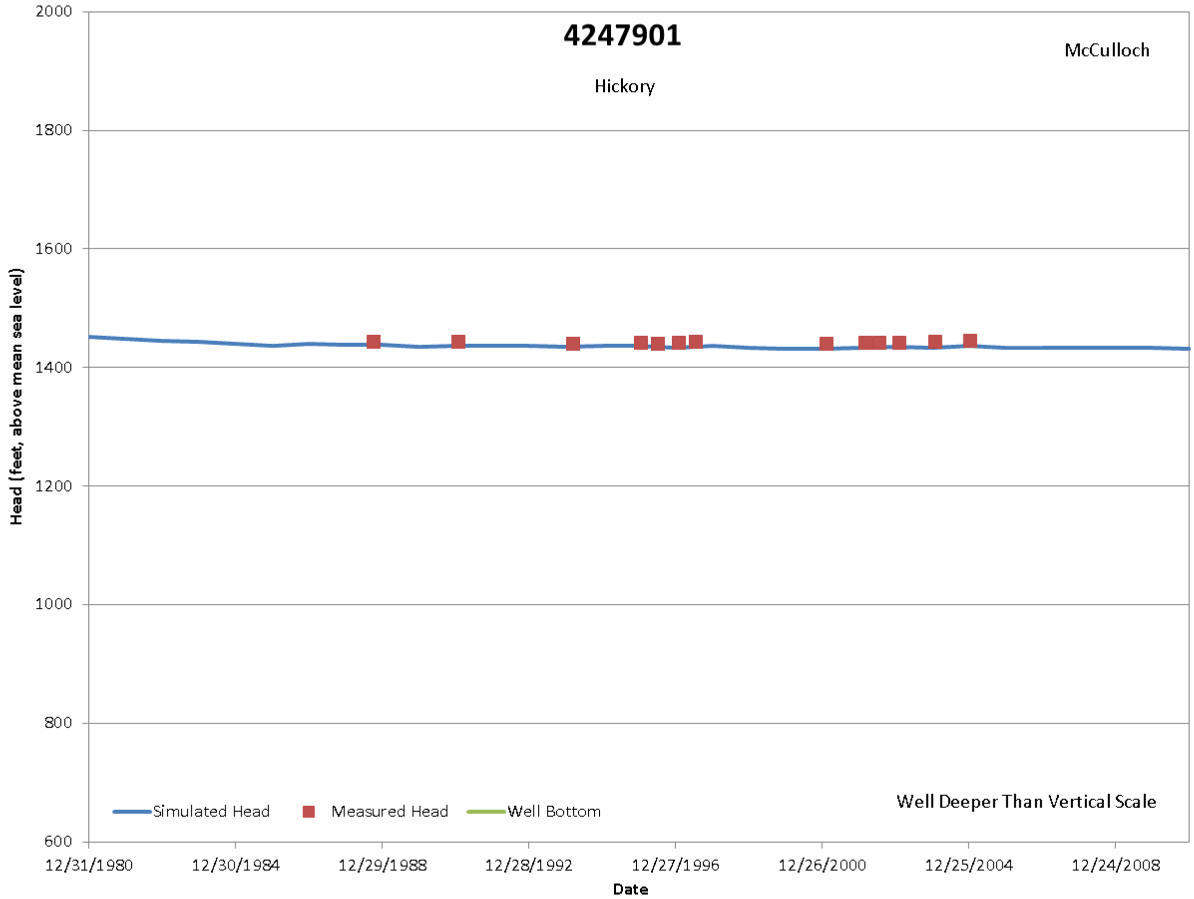
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

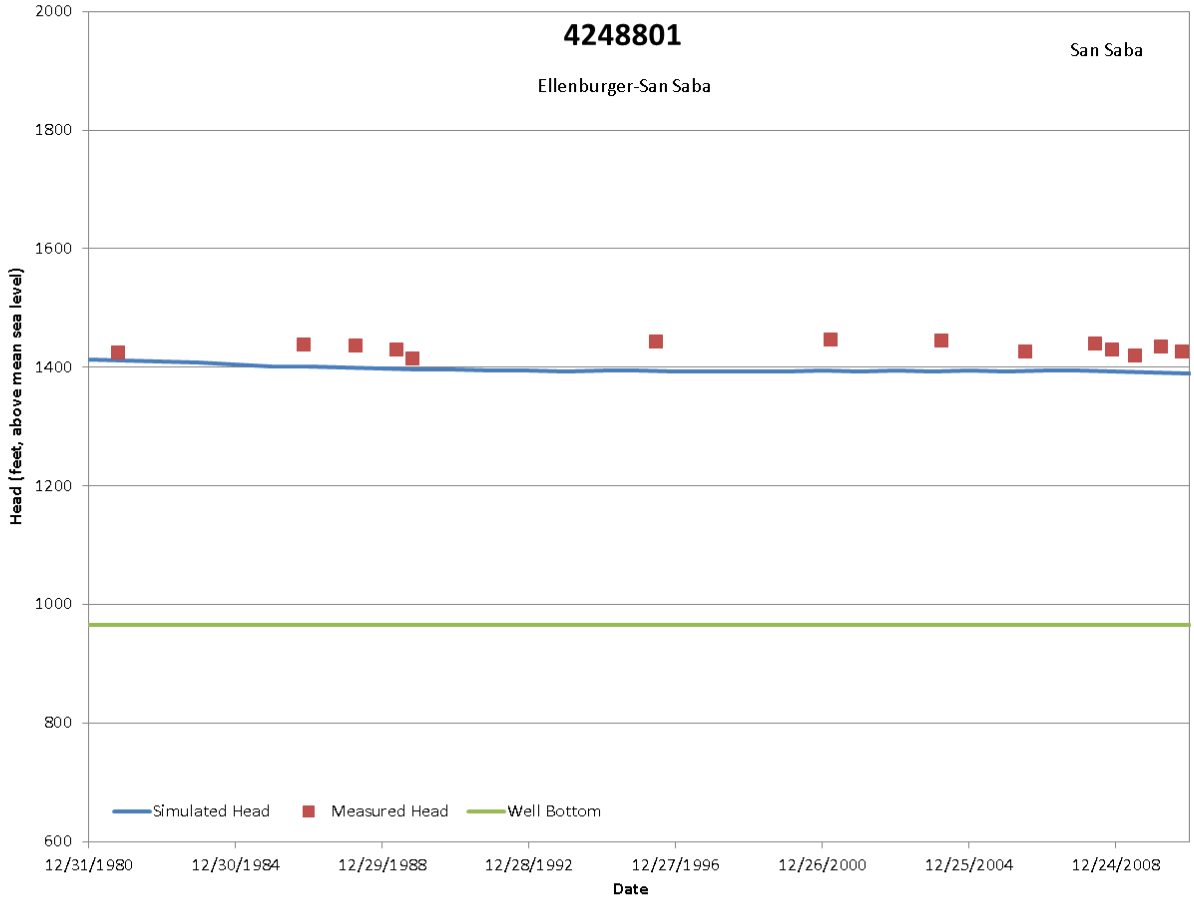

4160303
San Saba
Marble Falls
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

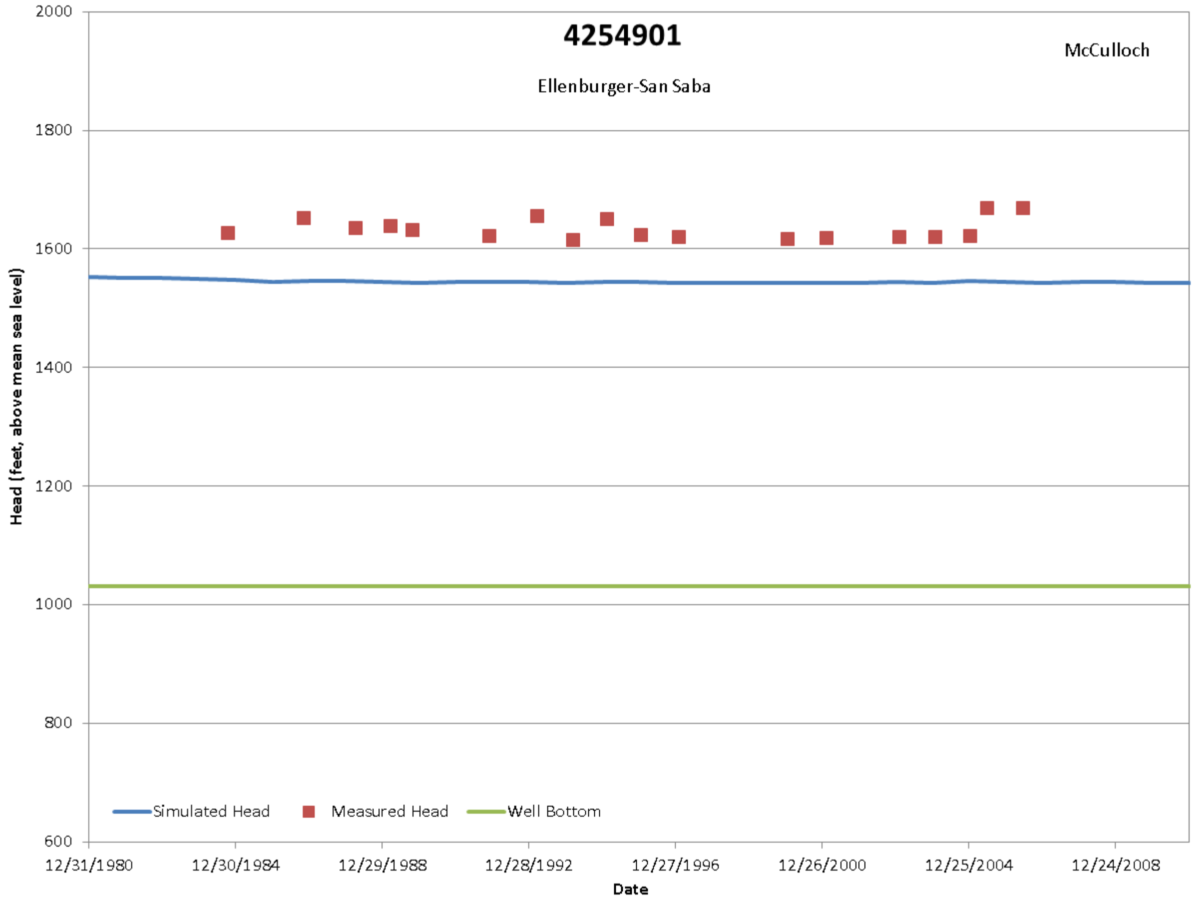

4161402
Ellenburger-San Saba
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

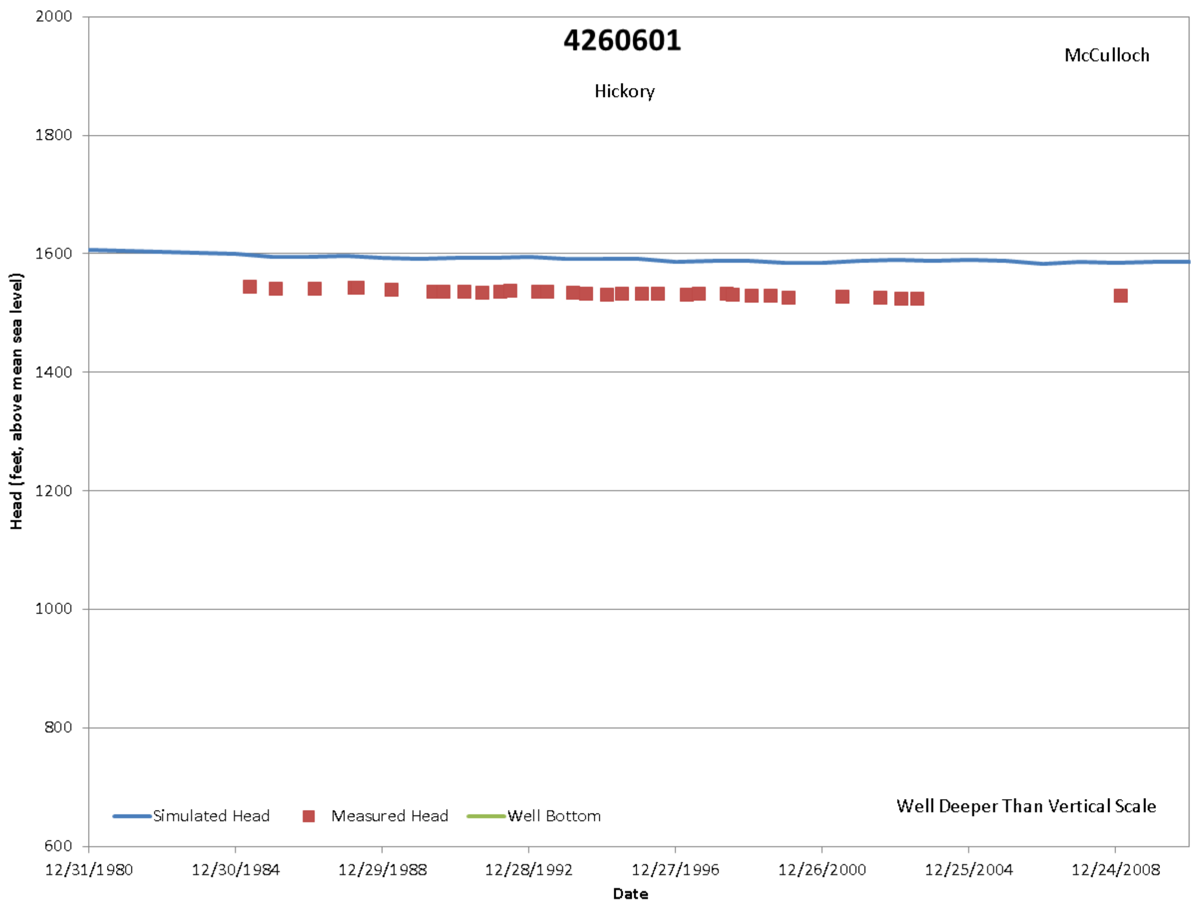

4245601
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

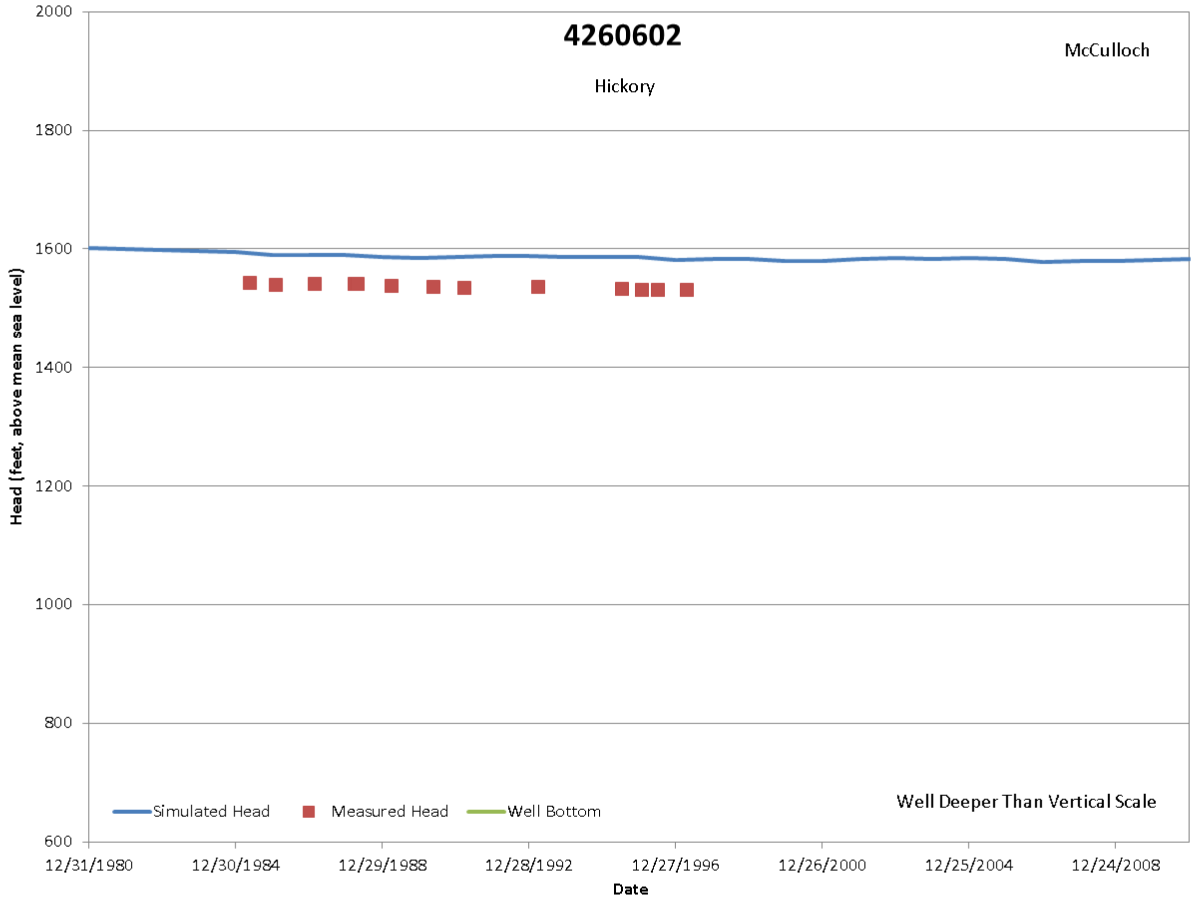

4246502
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

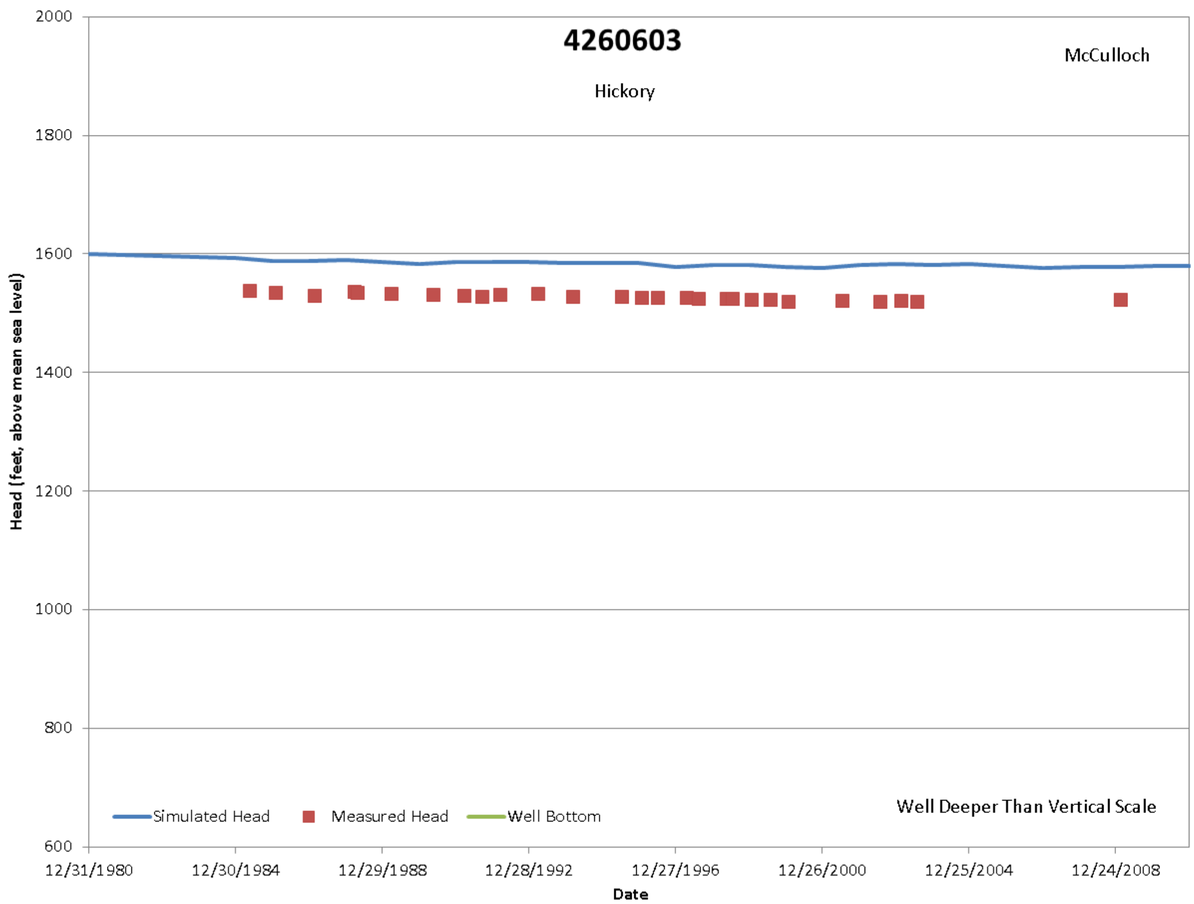

4247901
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

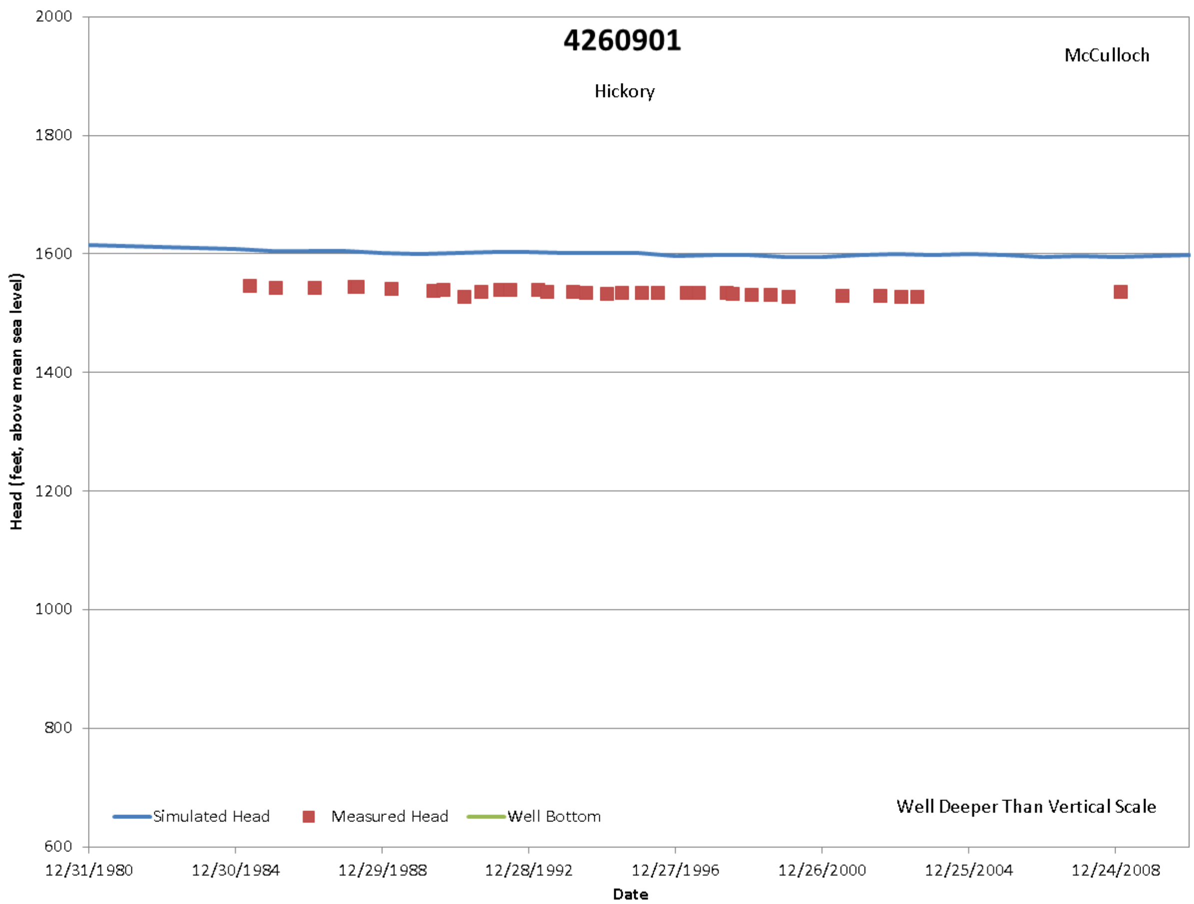

4248801
San Saba
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

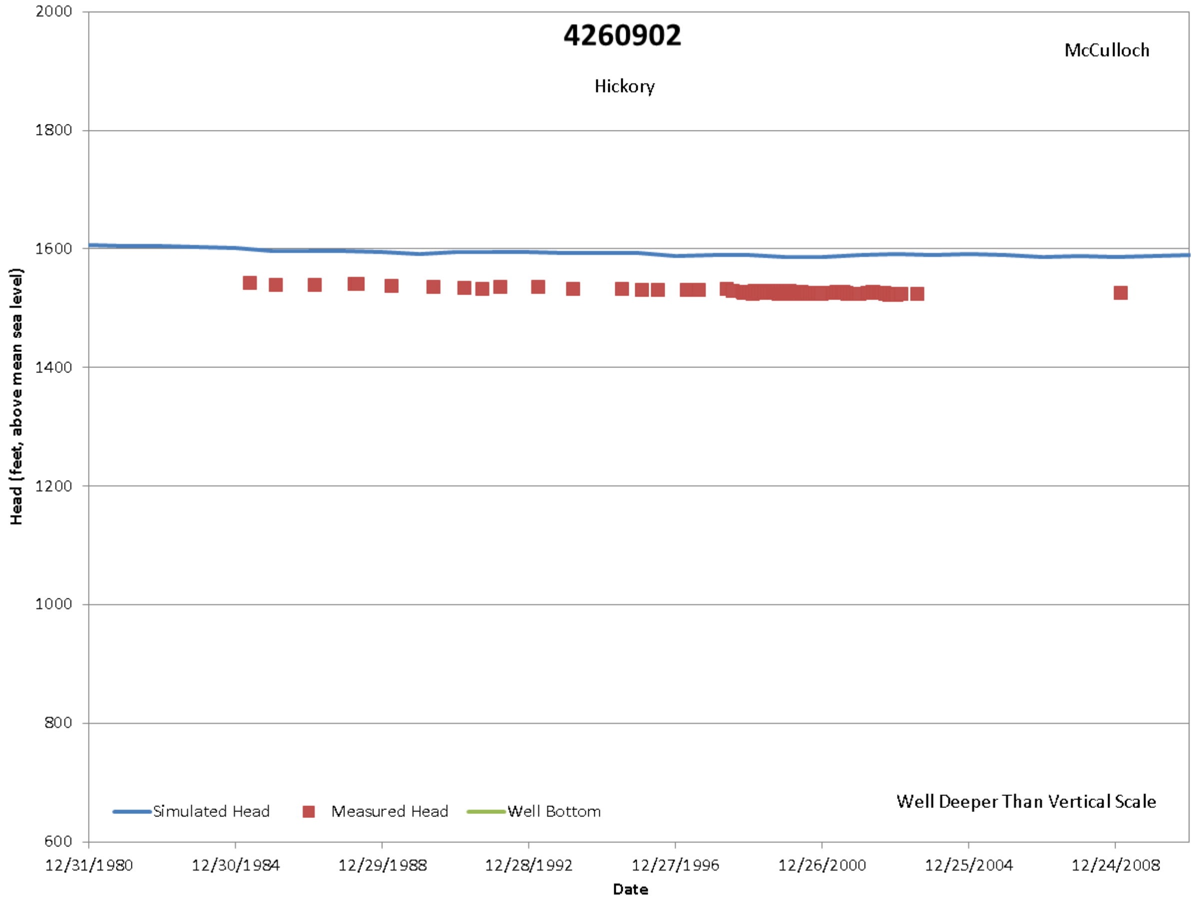

4254901
McCulloch
Ellenburger-San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

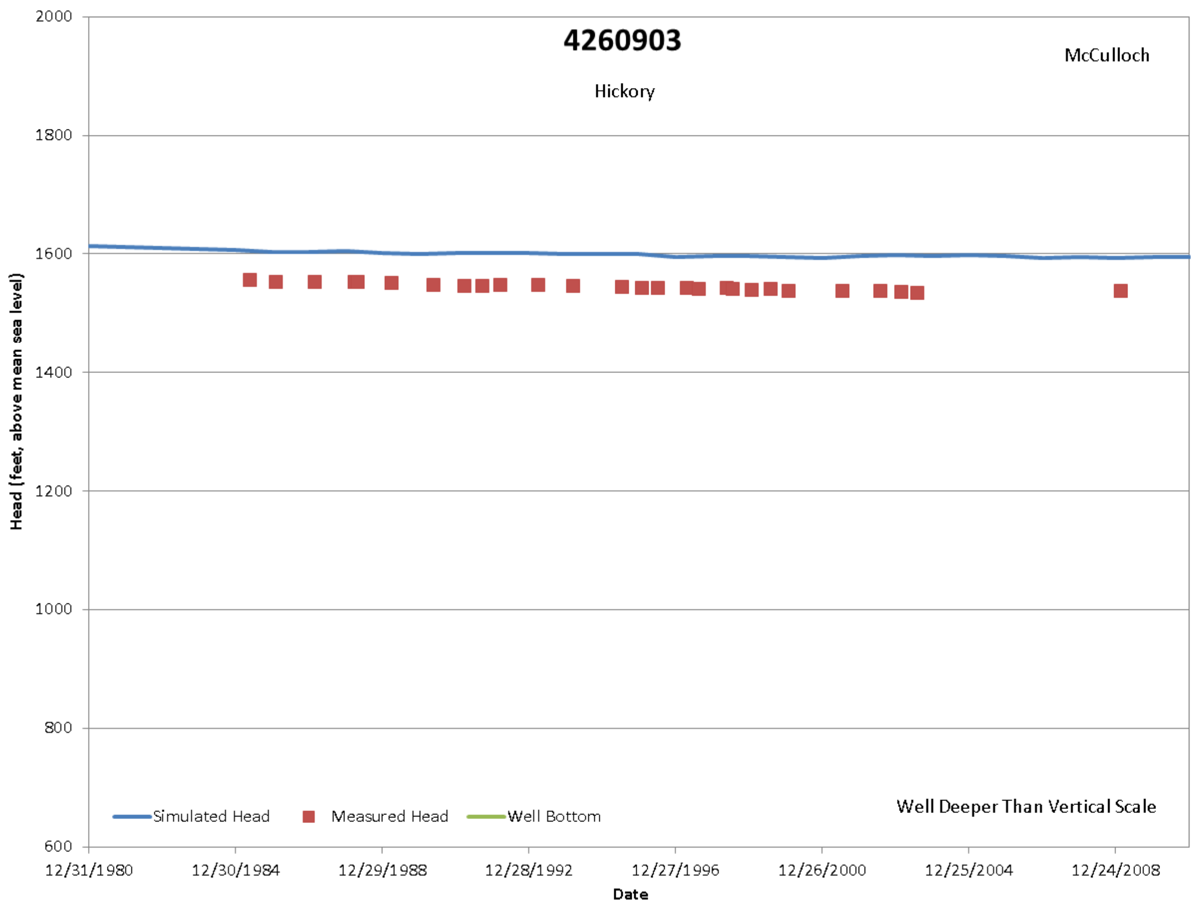

4260601
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

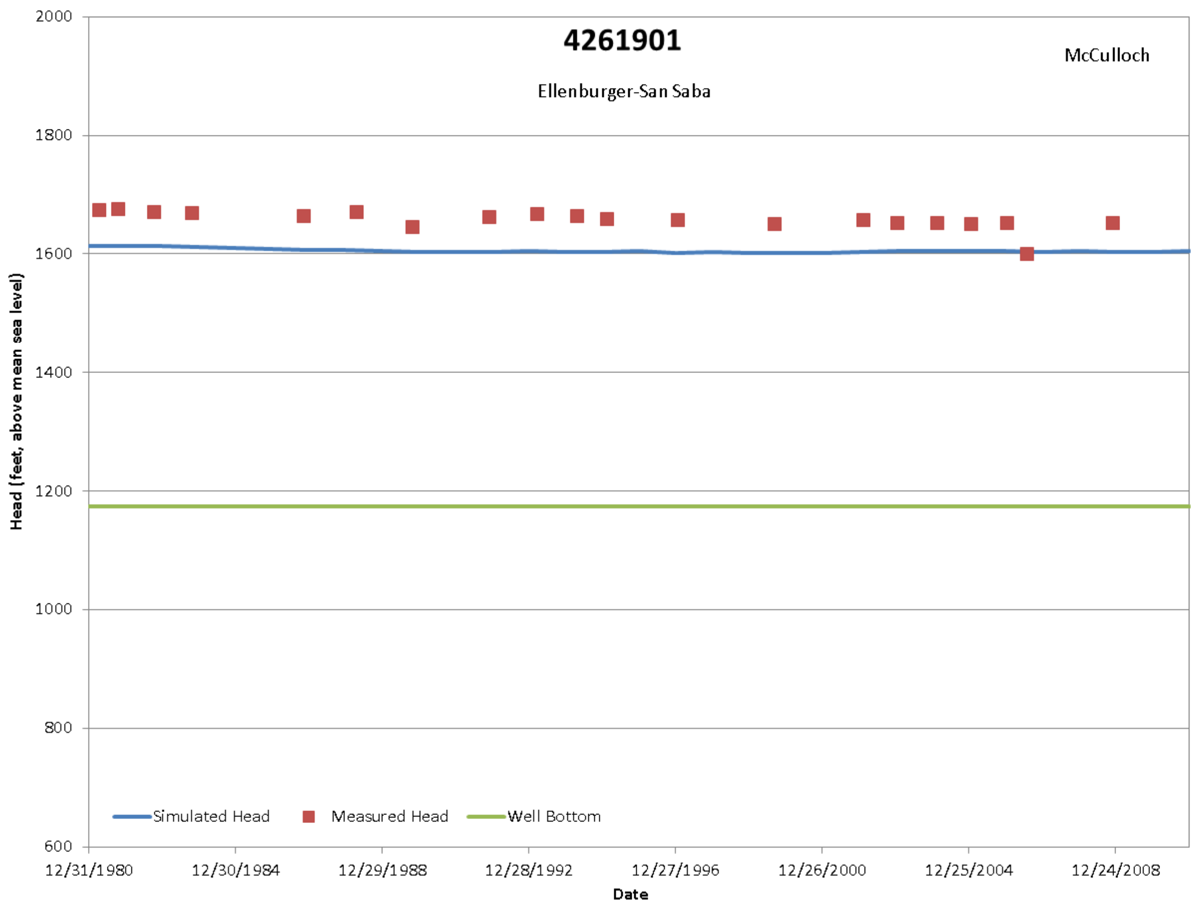

4260602
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

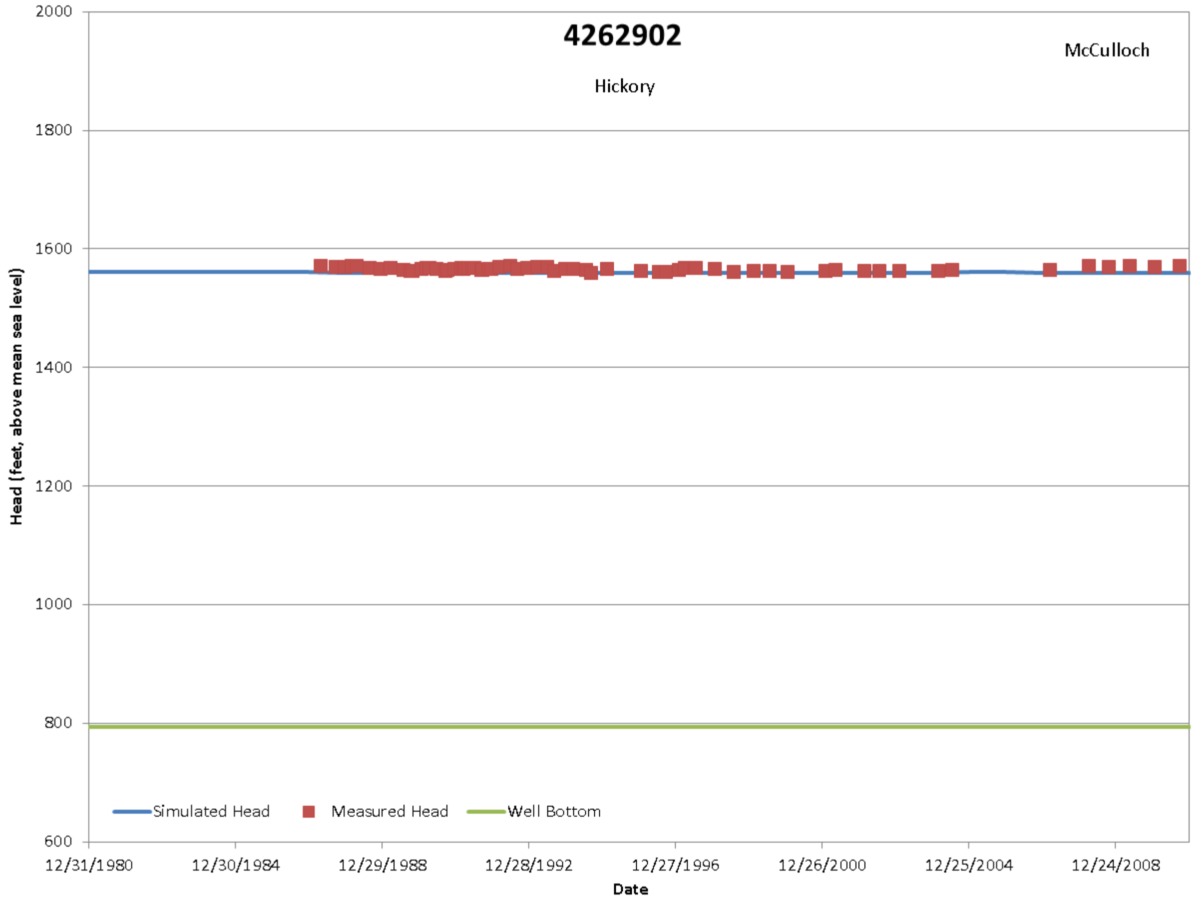

4260603
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

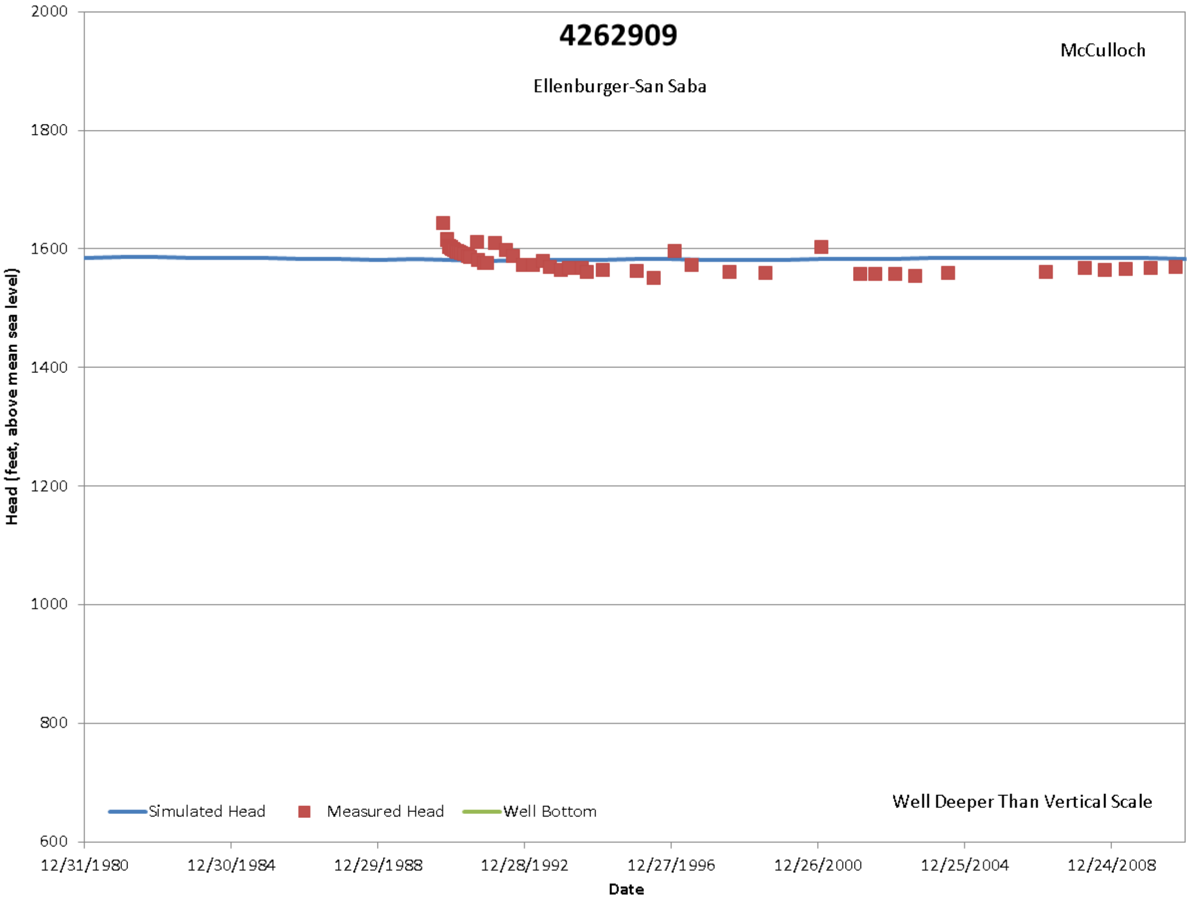

4260901
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

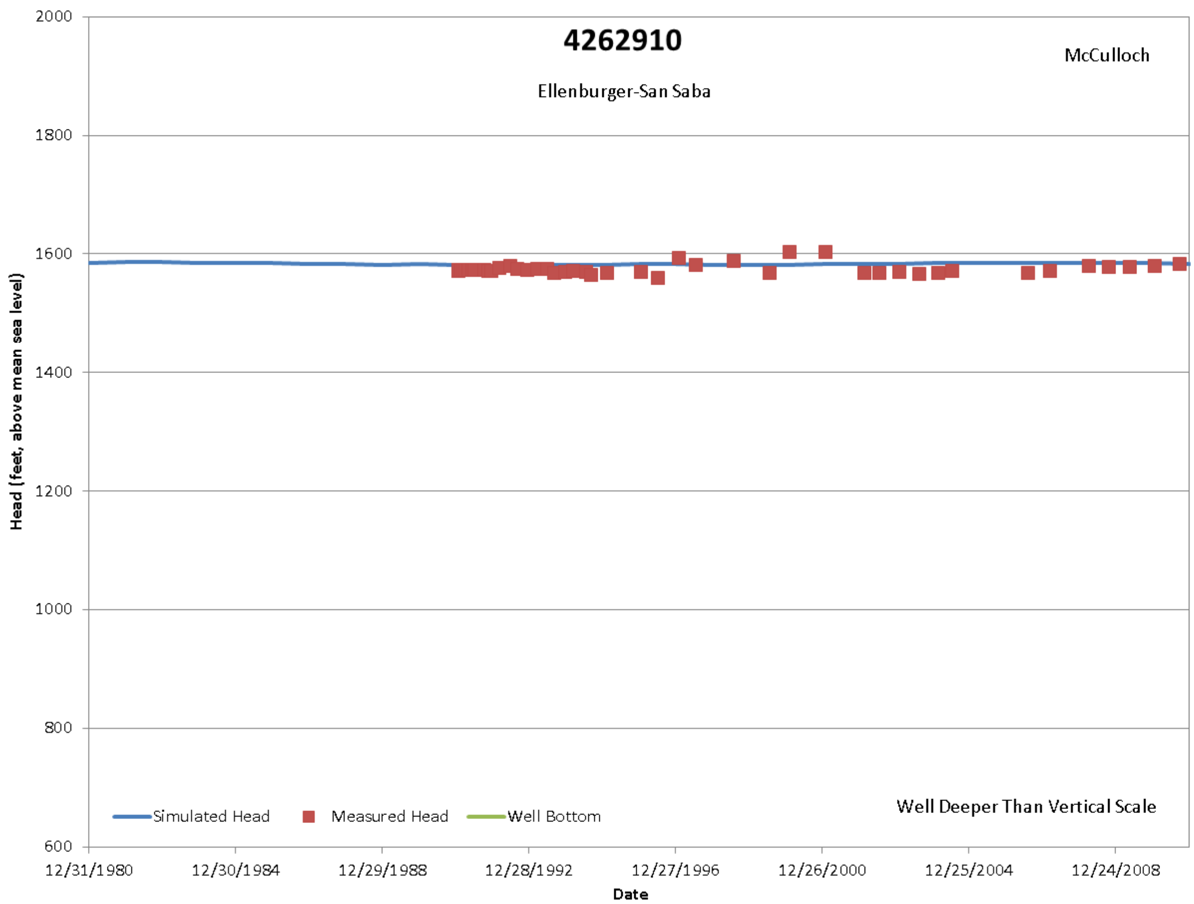

4260902
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

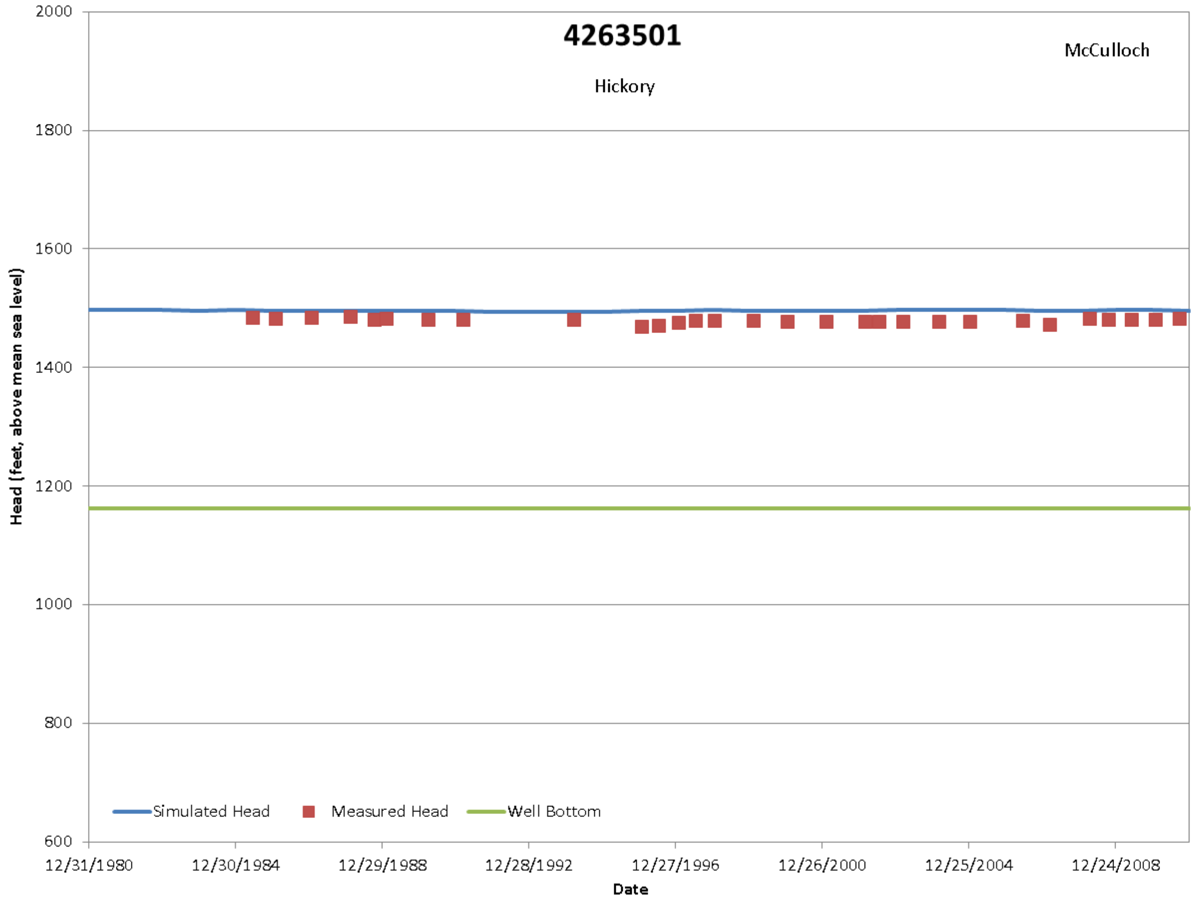

4260903
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

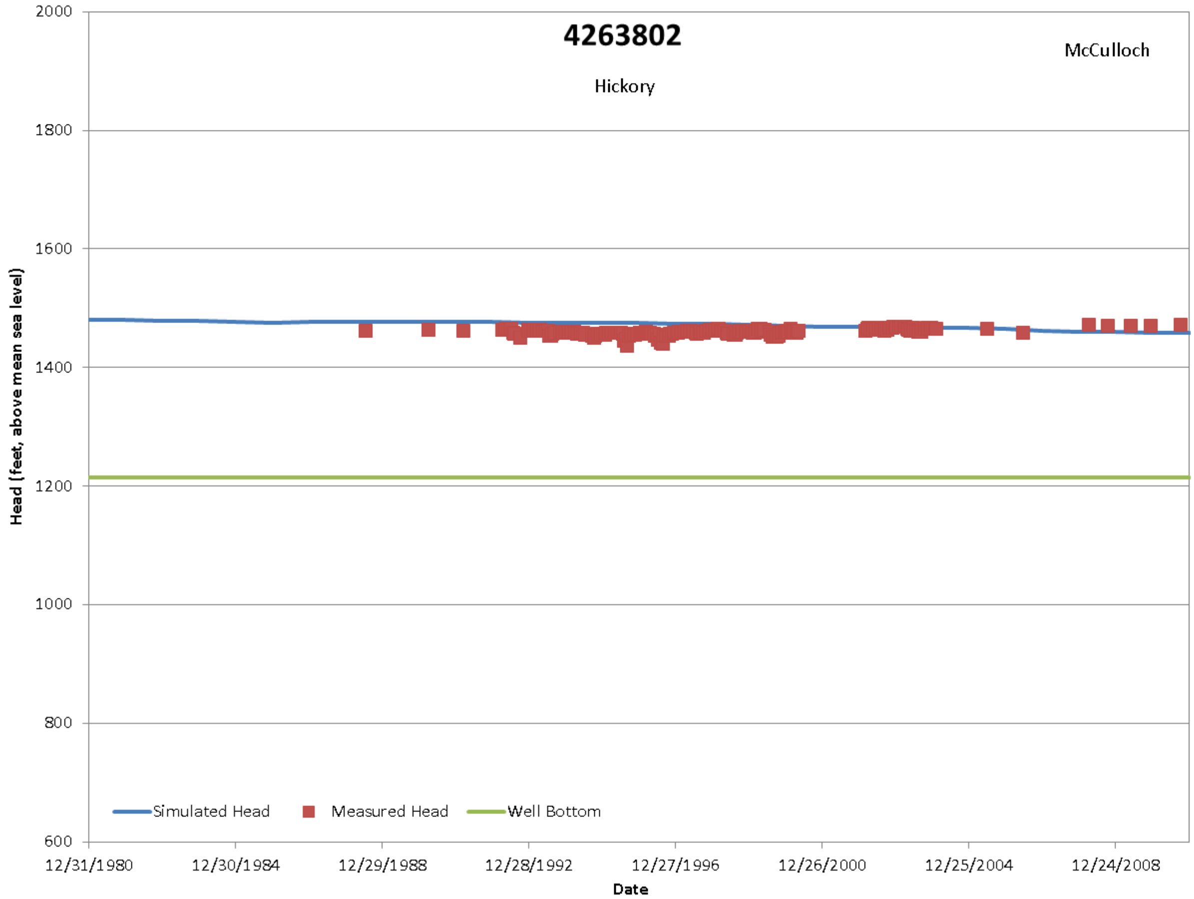

4261901
McCulloch
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

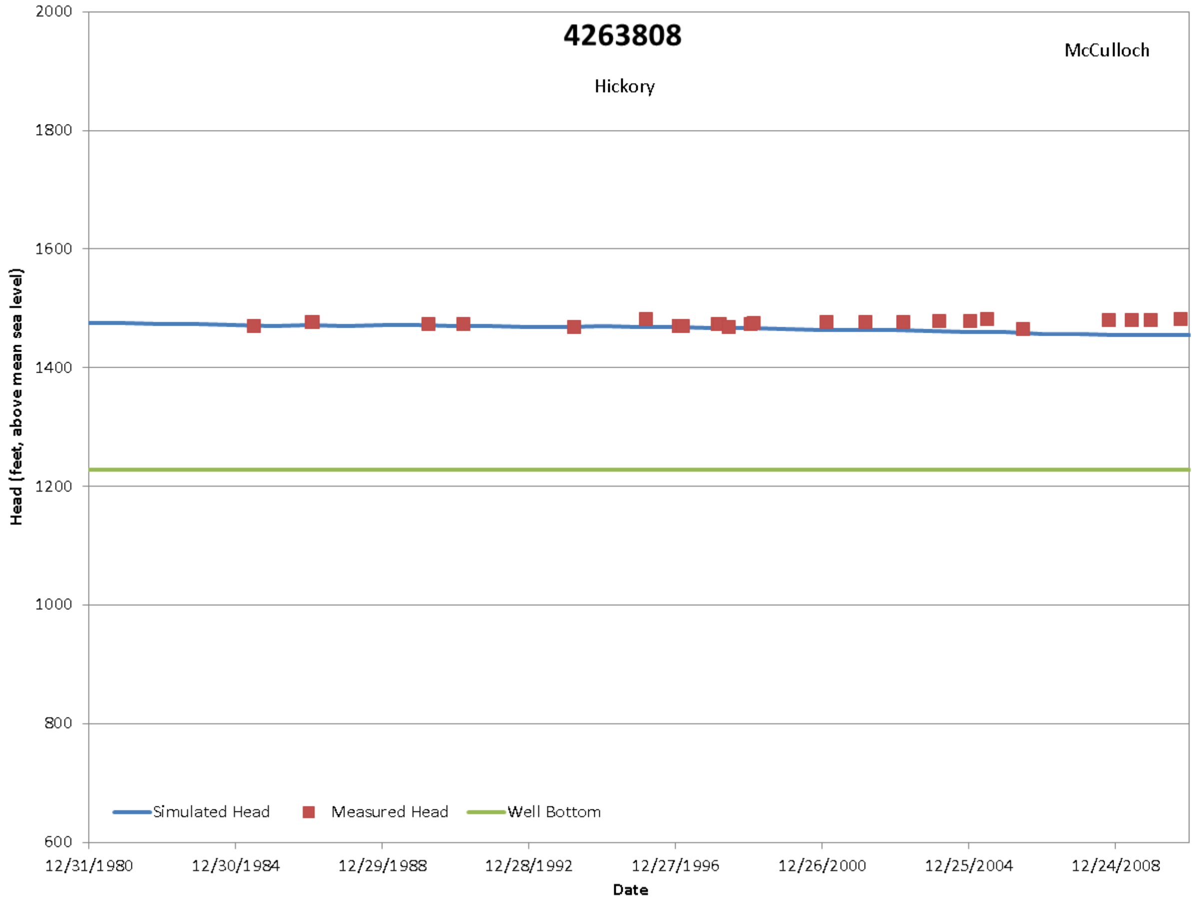

4262902
Hickory
McCulloch
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

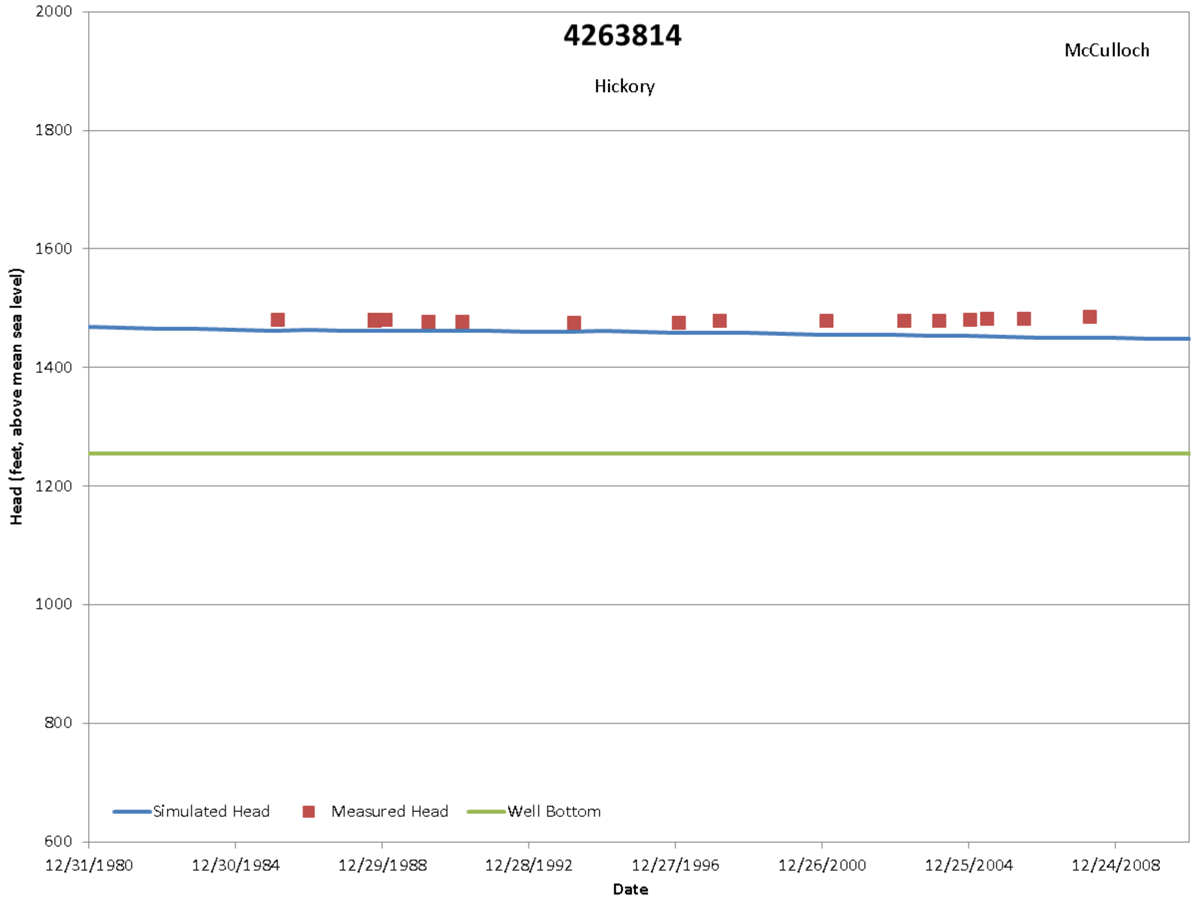

4262909
McCulloch
Ellenburger-San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

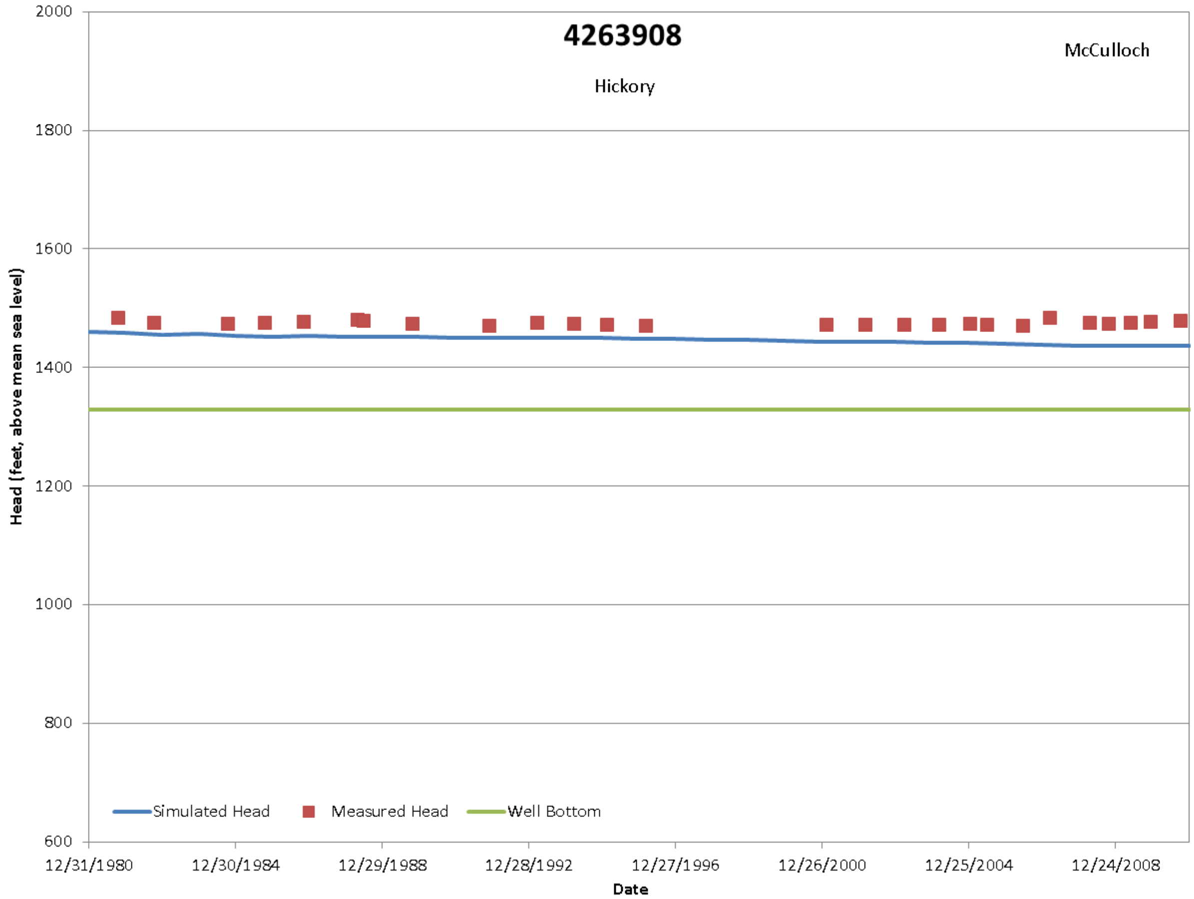

4262910
McCulloch
Ellenburger-San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
Well Deeper Than Vertical Scale
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

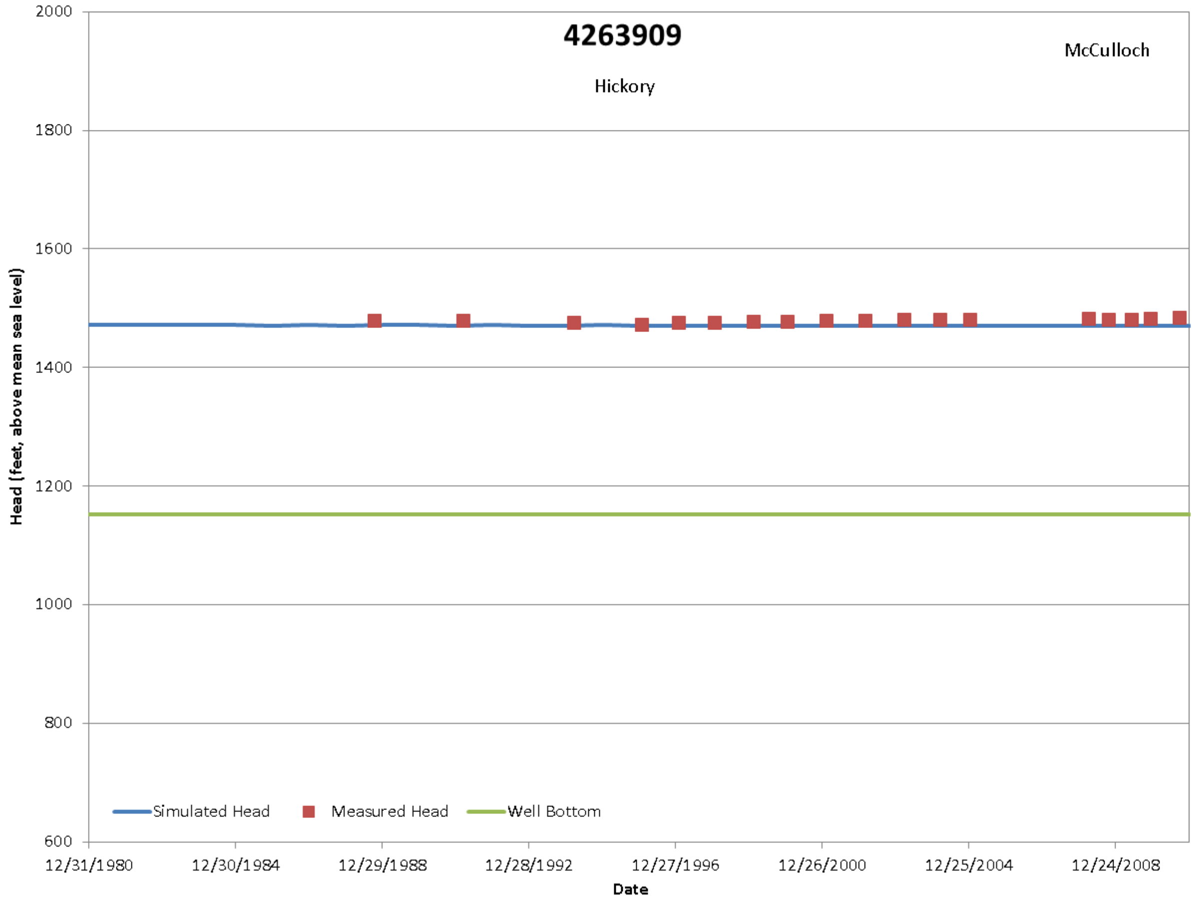

4263501
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

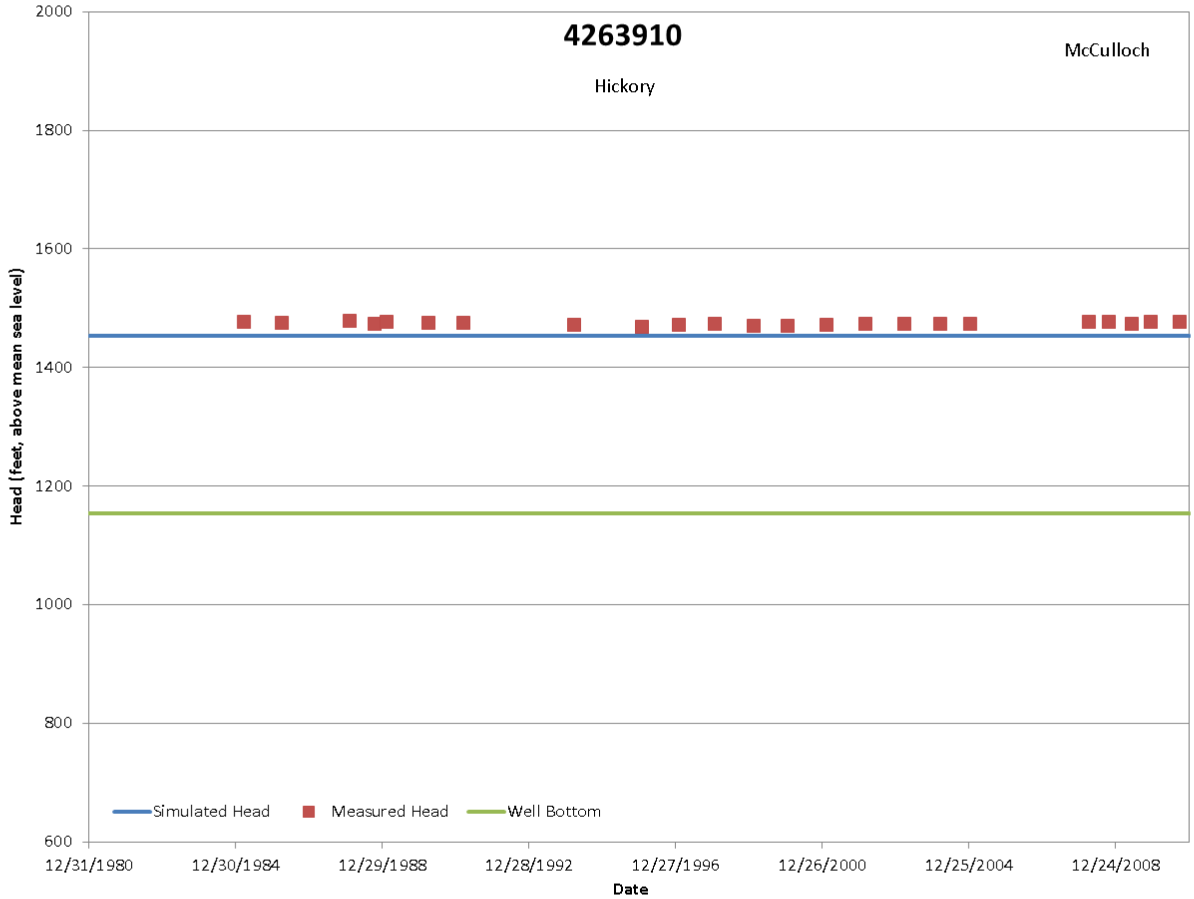

4263802
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

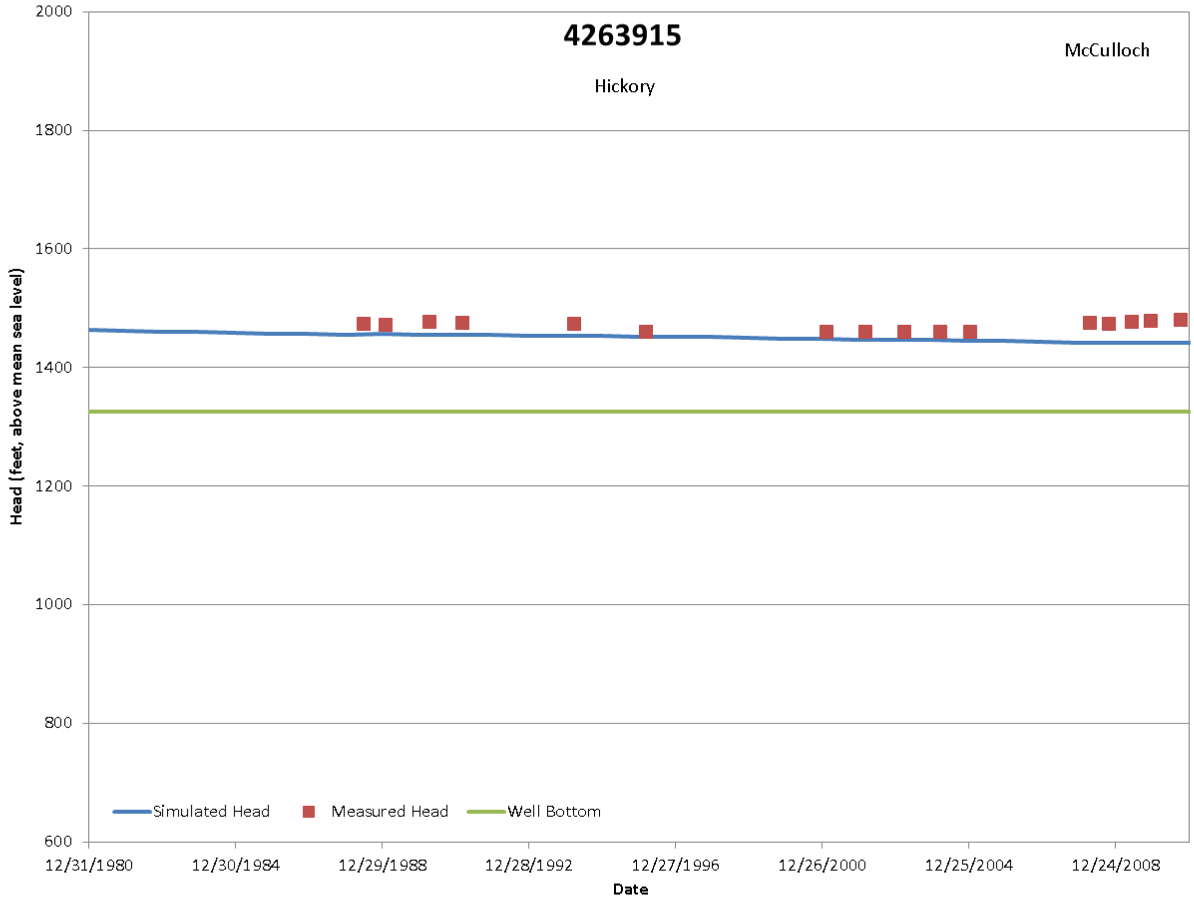

4263808
McCulloch
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

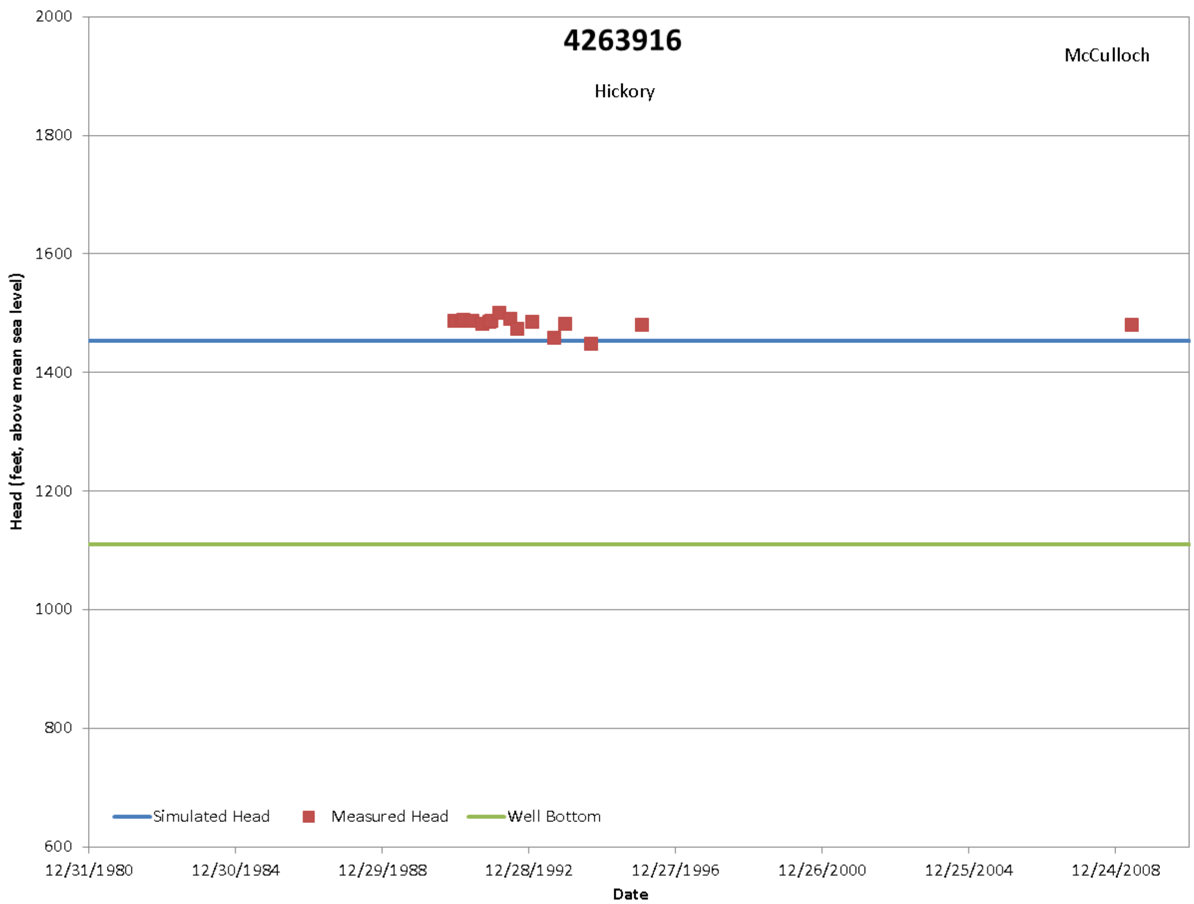

4263814
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

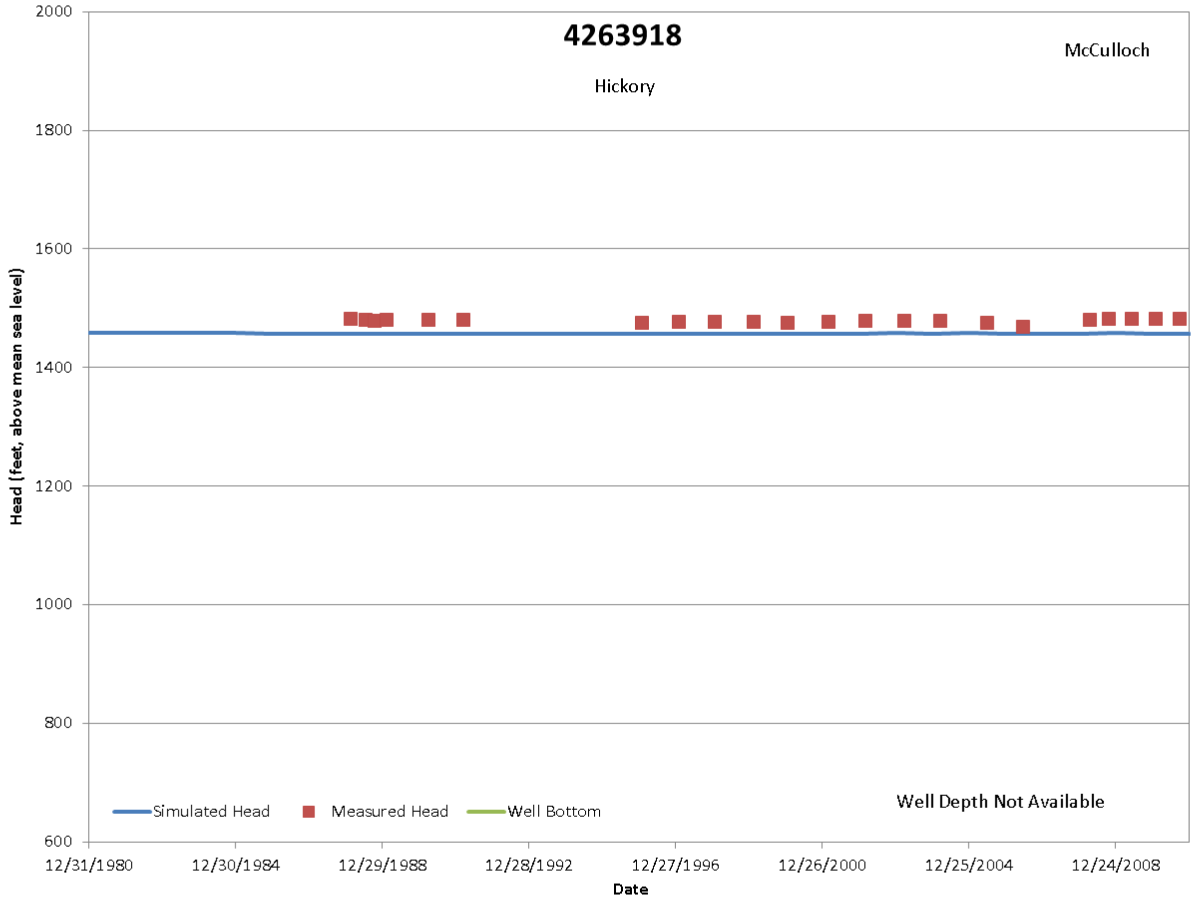

4263908
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

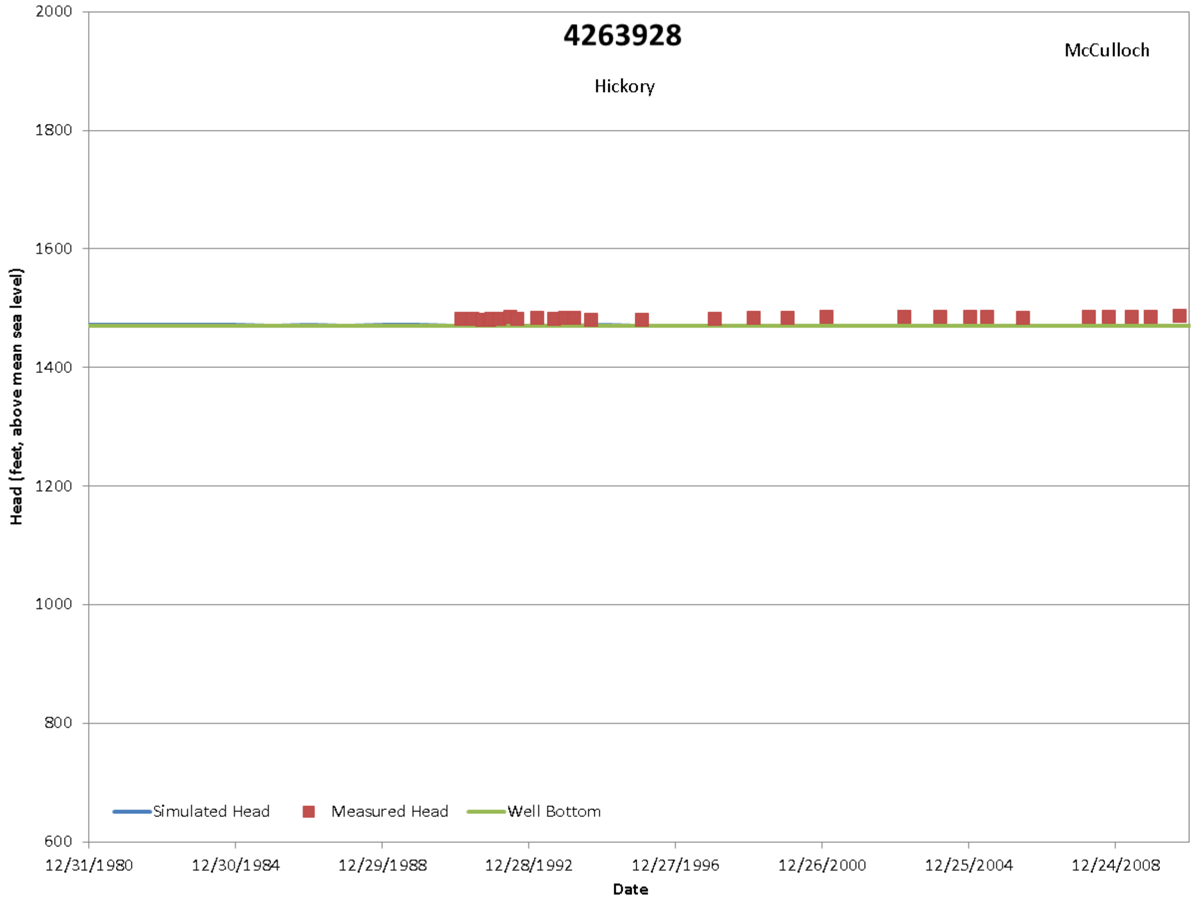

4263909
Hickory
McCulloch
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

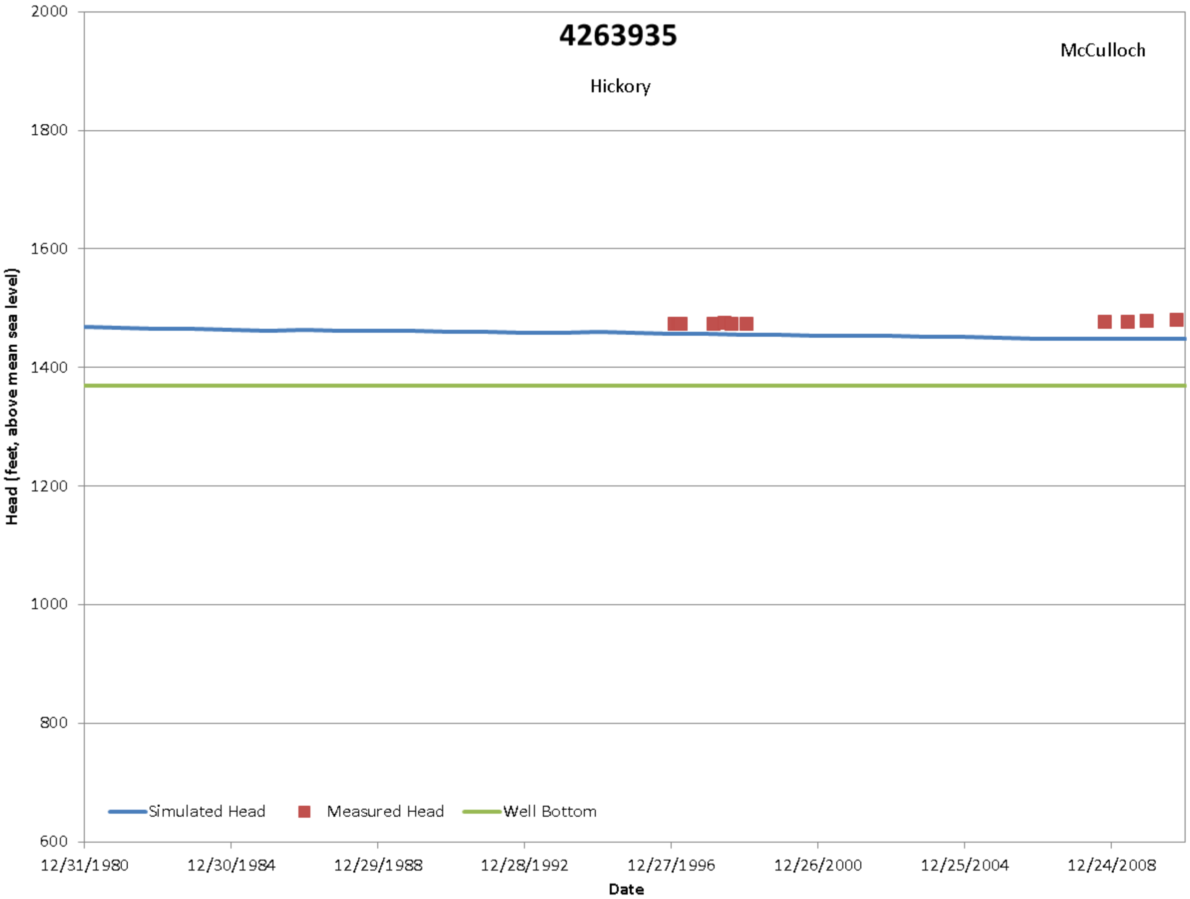

4263910
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom

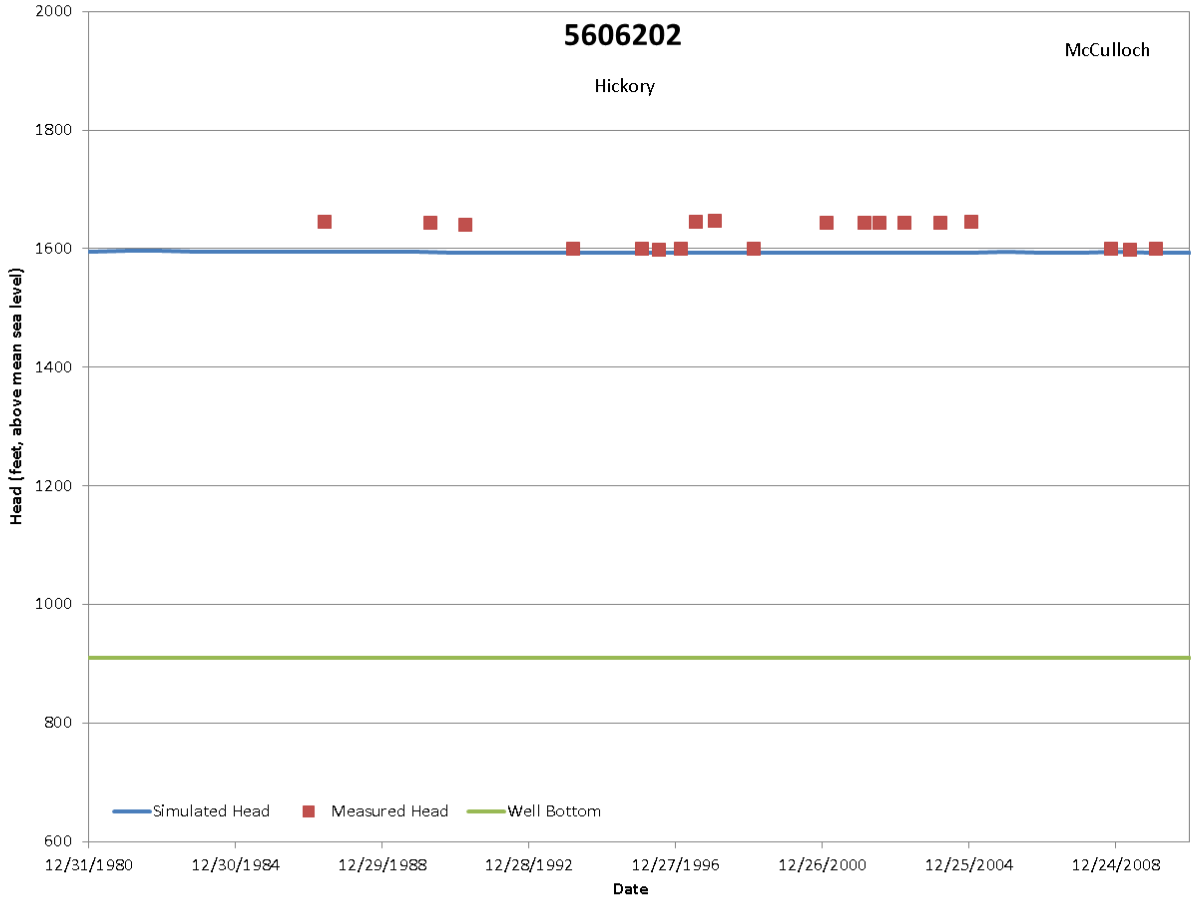

4263915
McCulloch
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

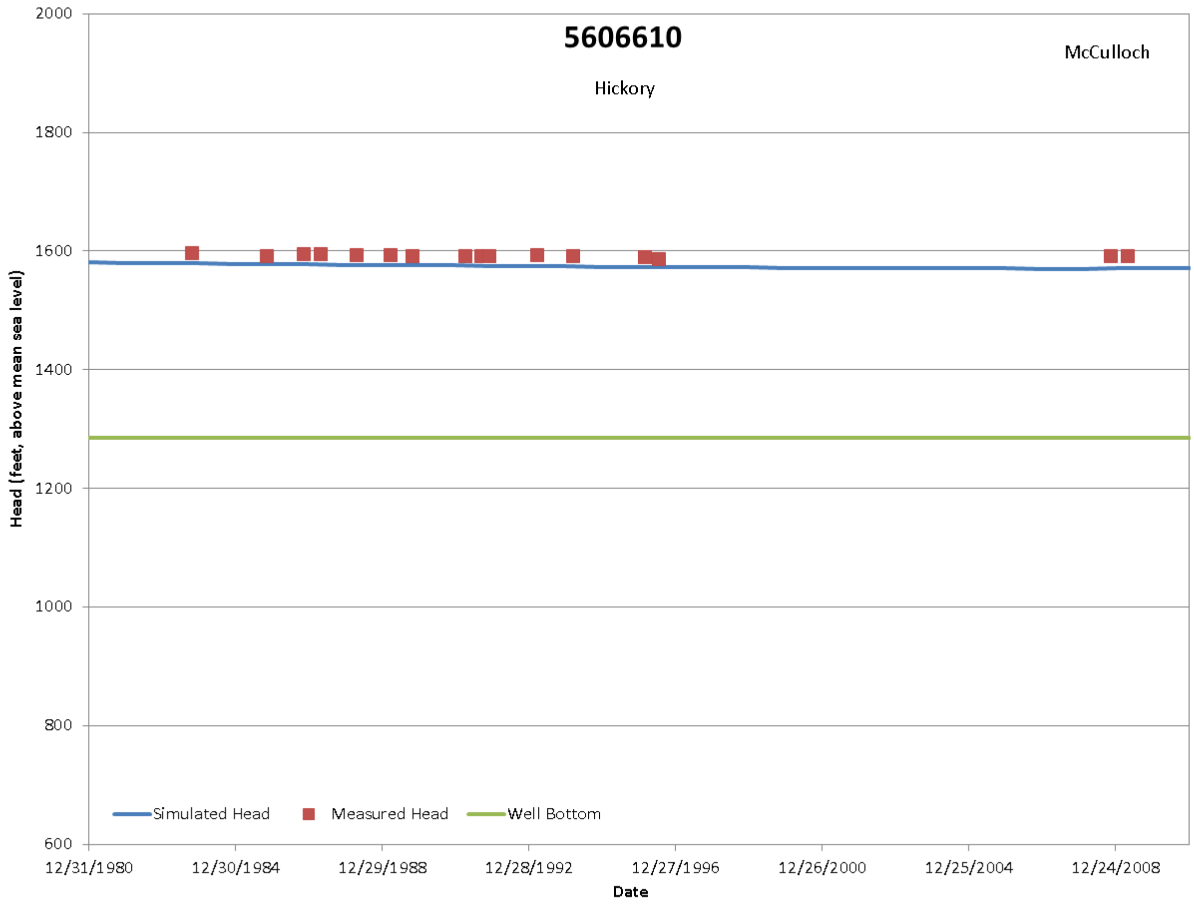

4263916
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


4263918
McCulloch
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
Well Depth Not Available
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

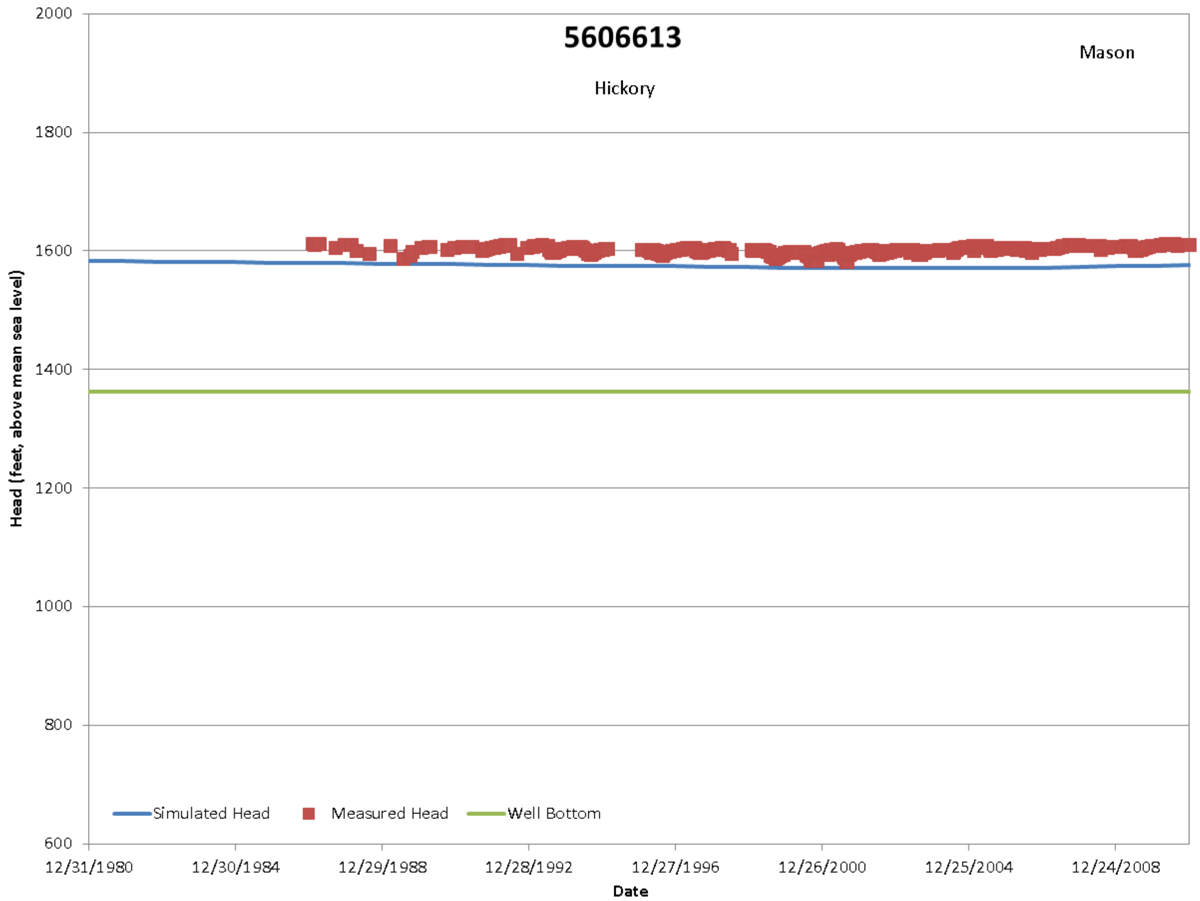

4263928
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

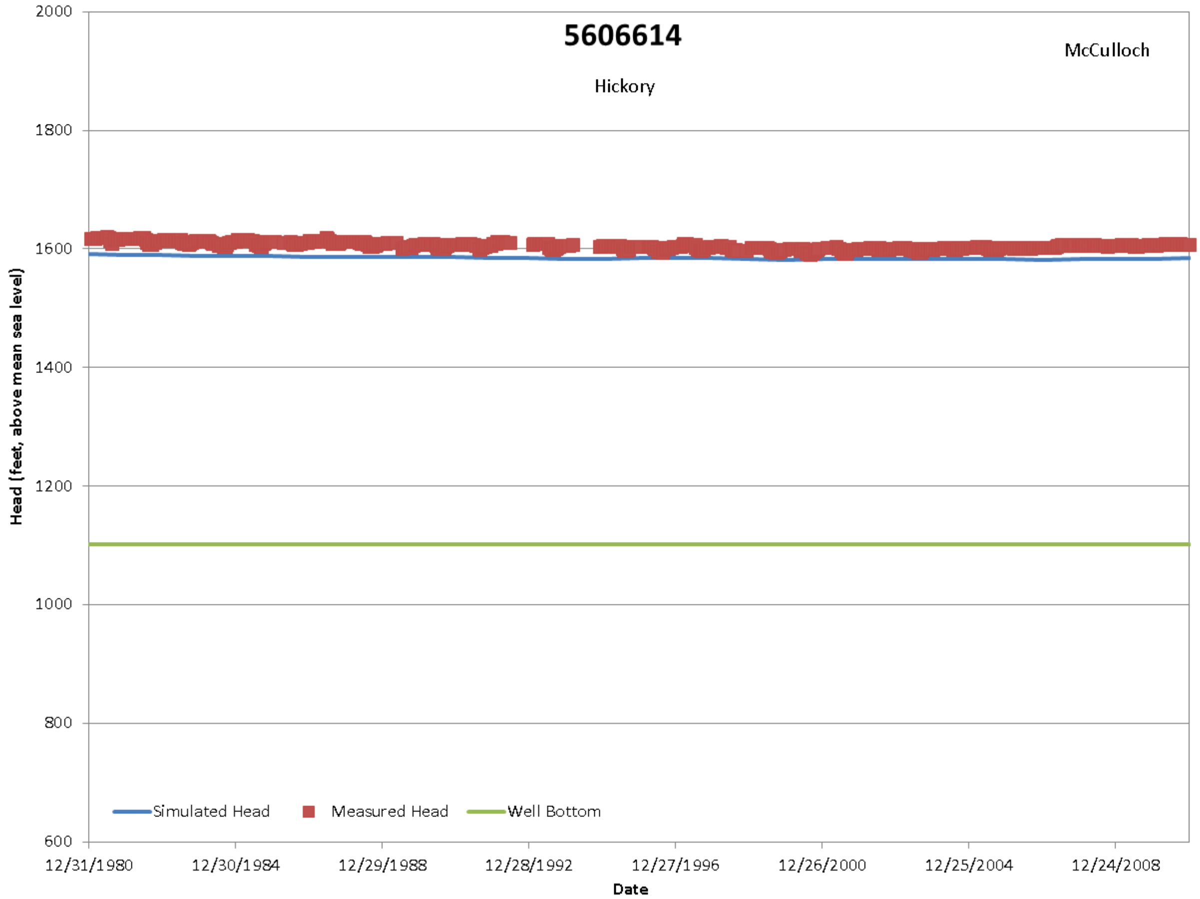

4263935
McCulloch
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

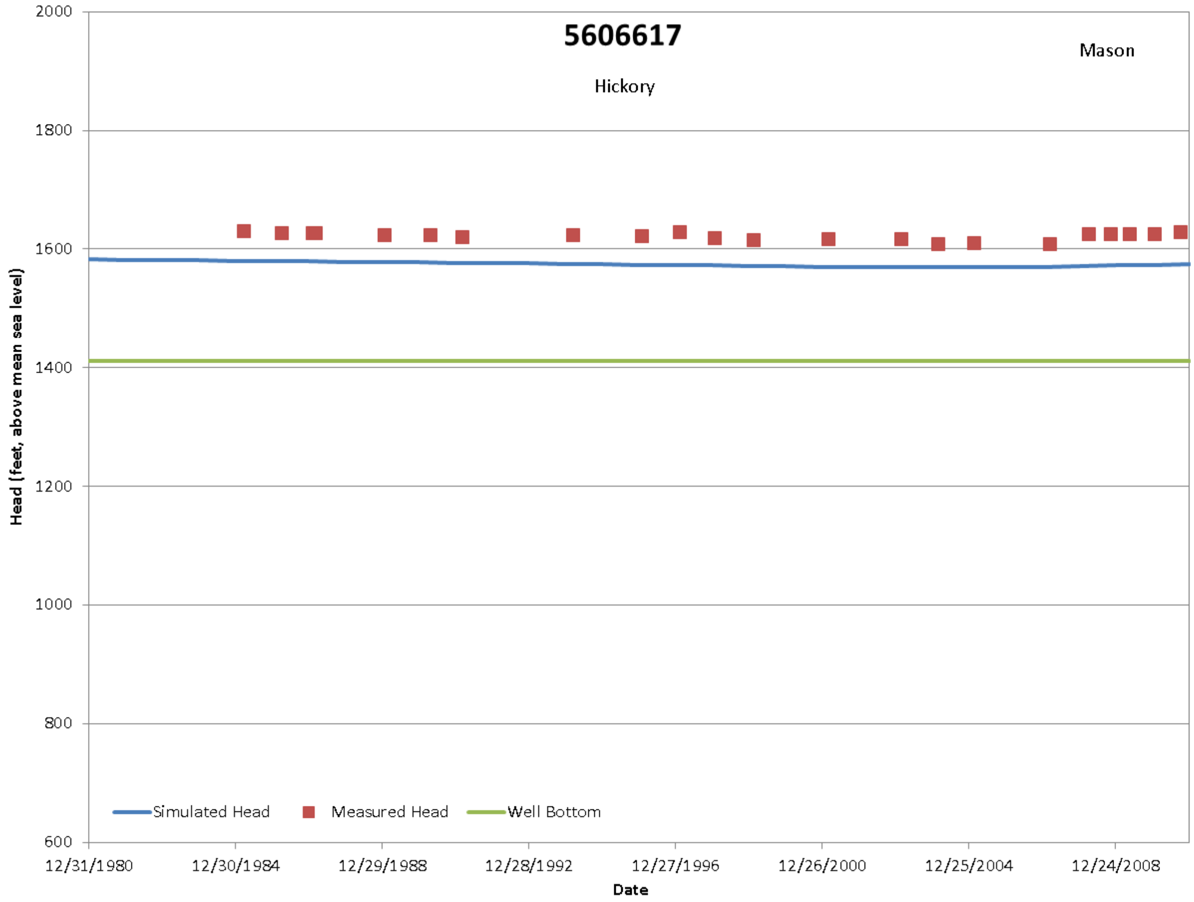

5606202
Hickory
McCulloch
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom

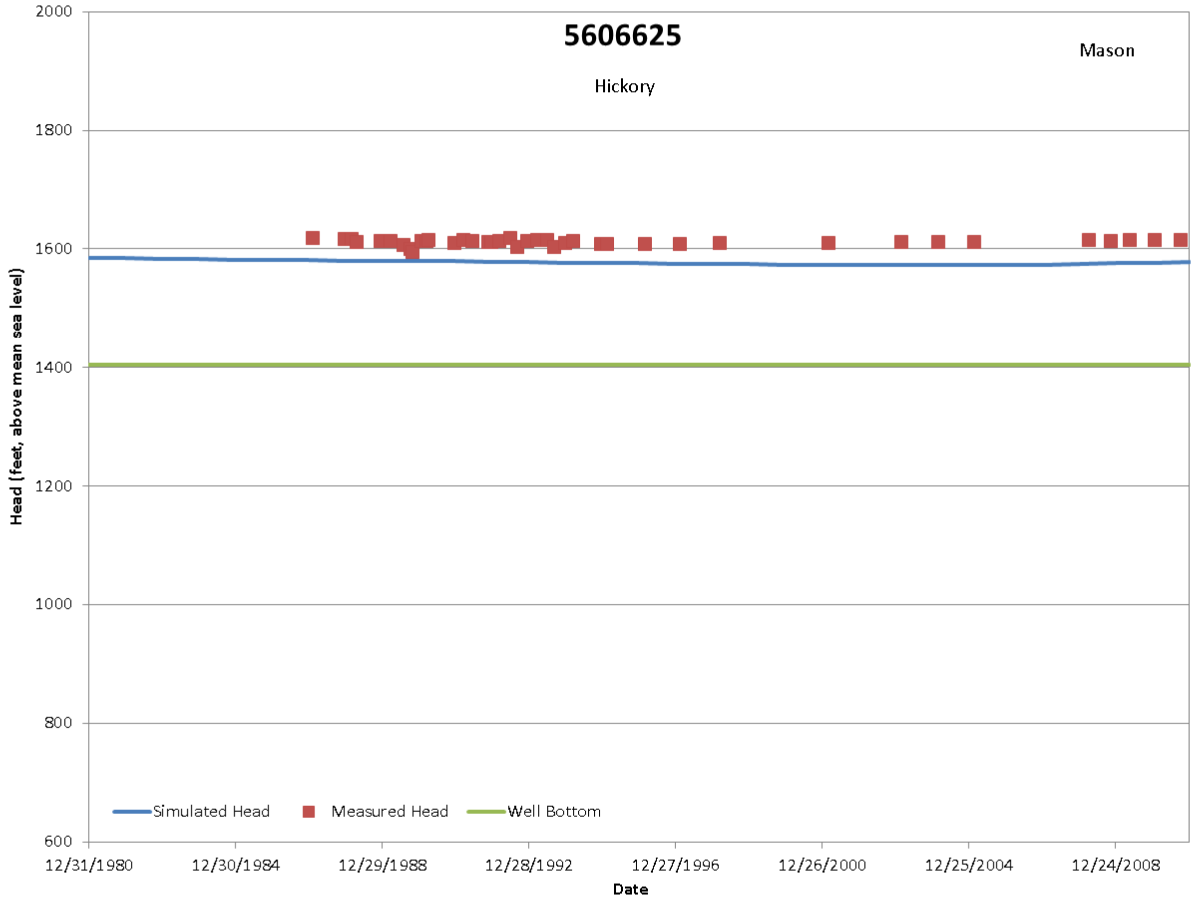

5606610
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

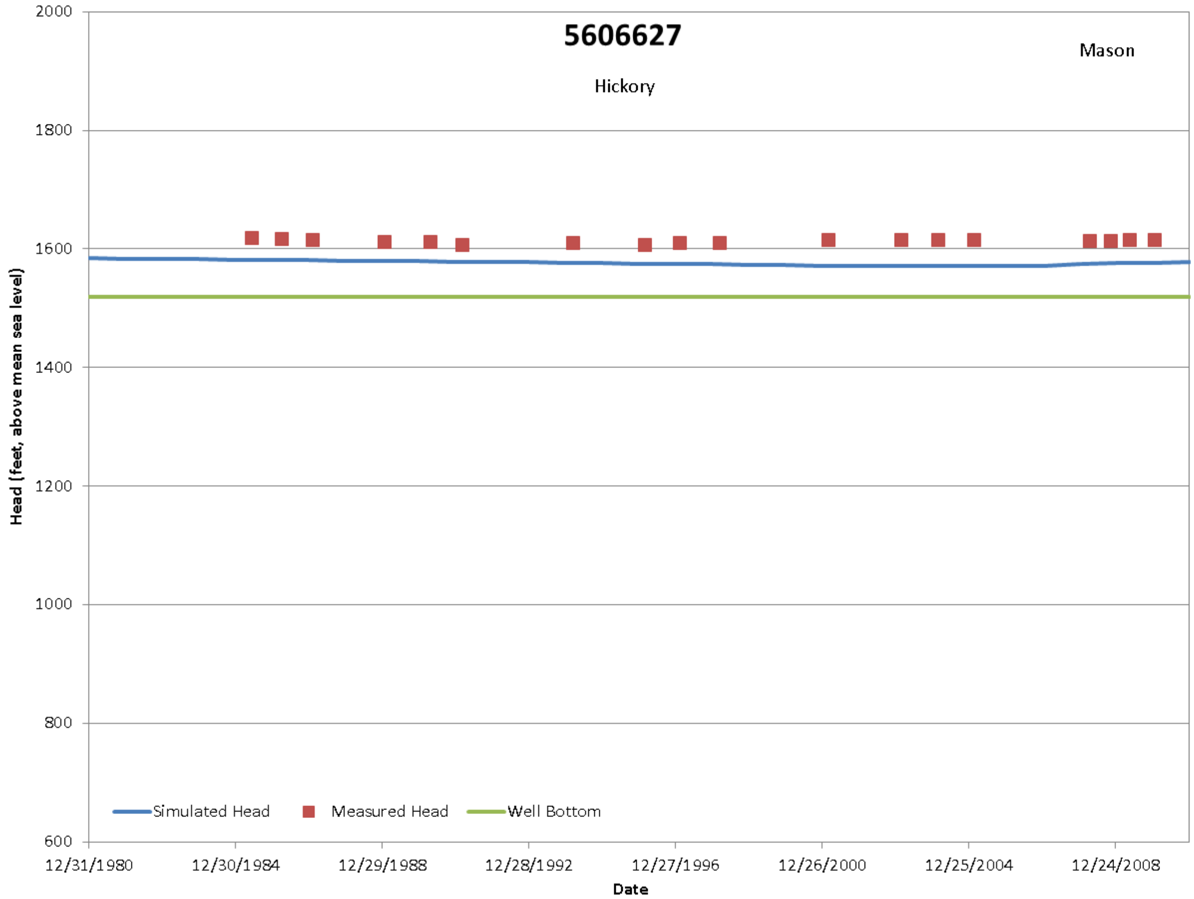

5606611
Mason
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

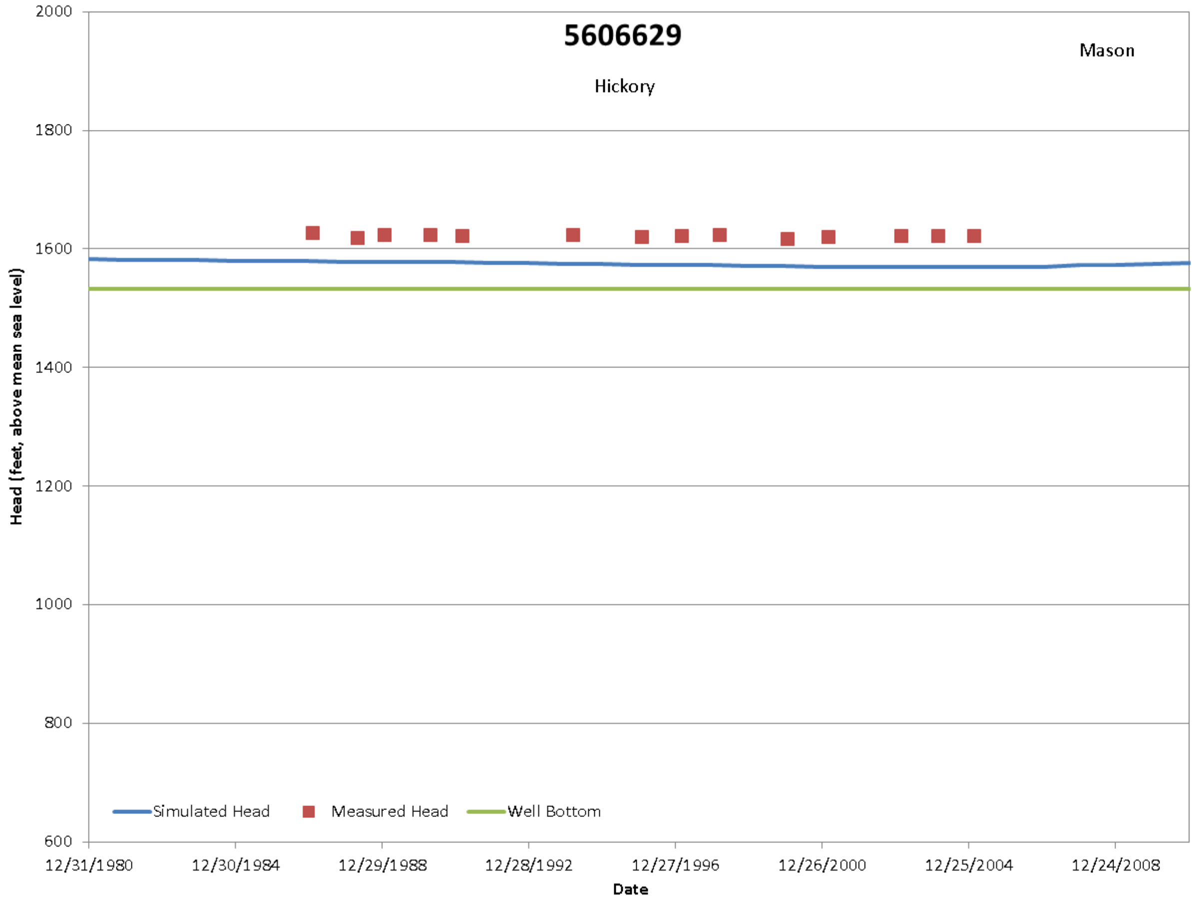

5606613
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

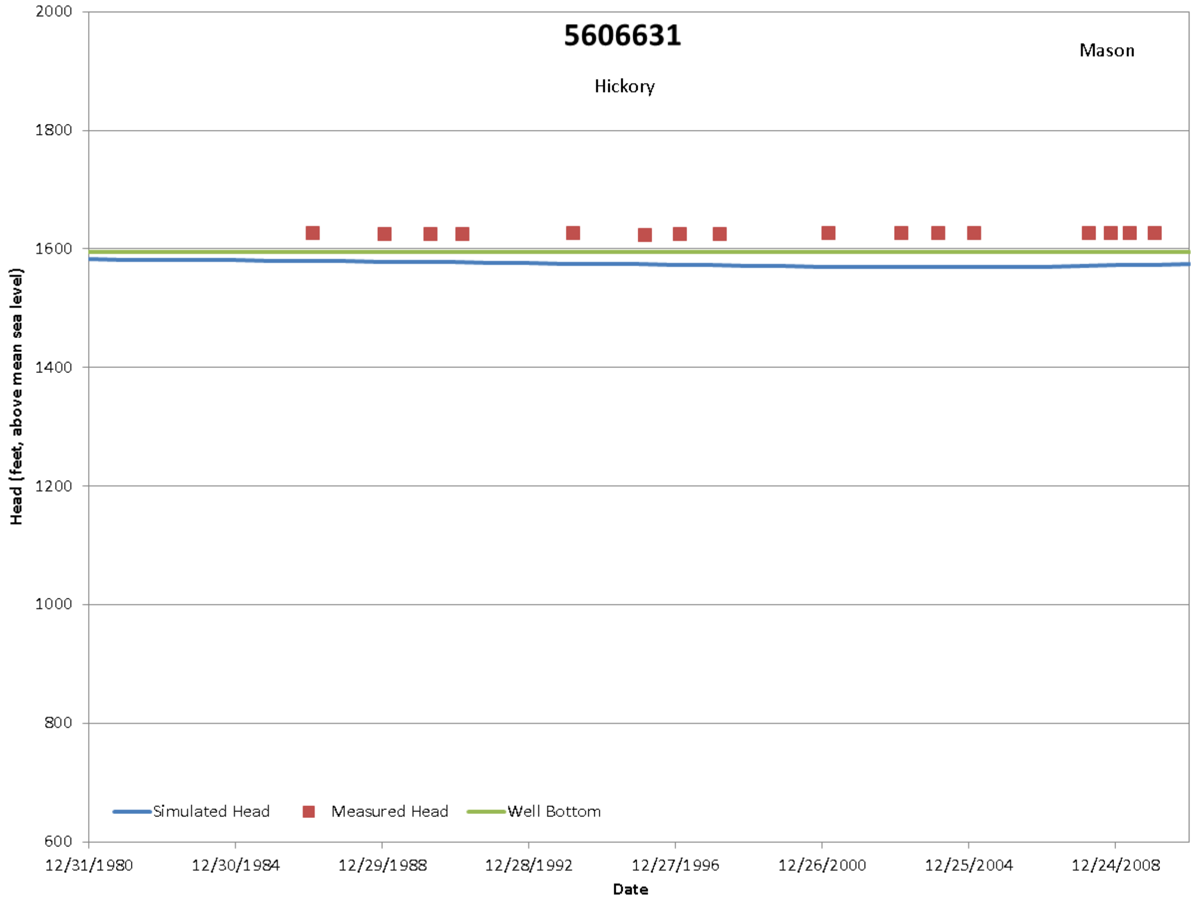

5606614
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

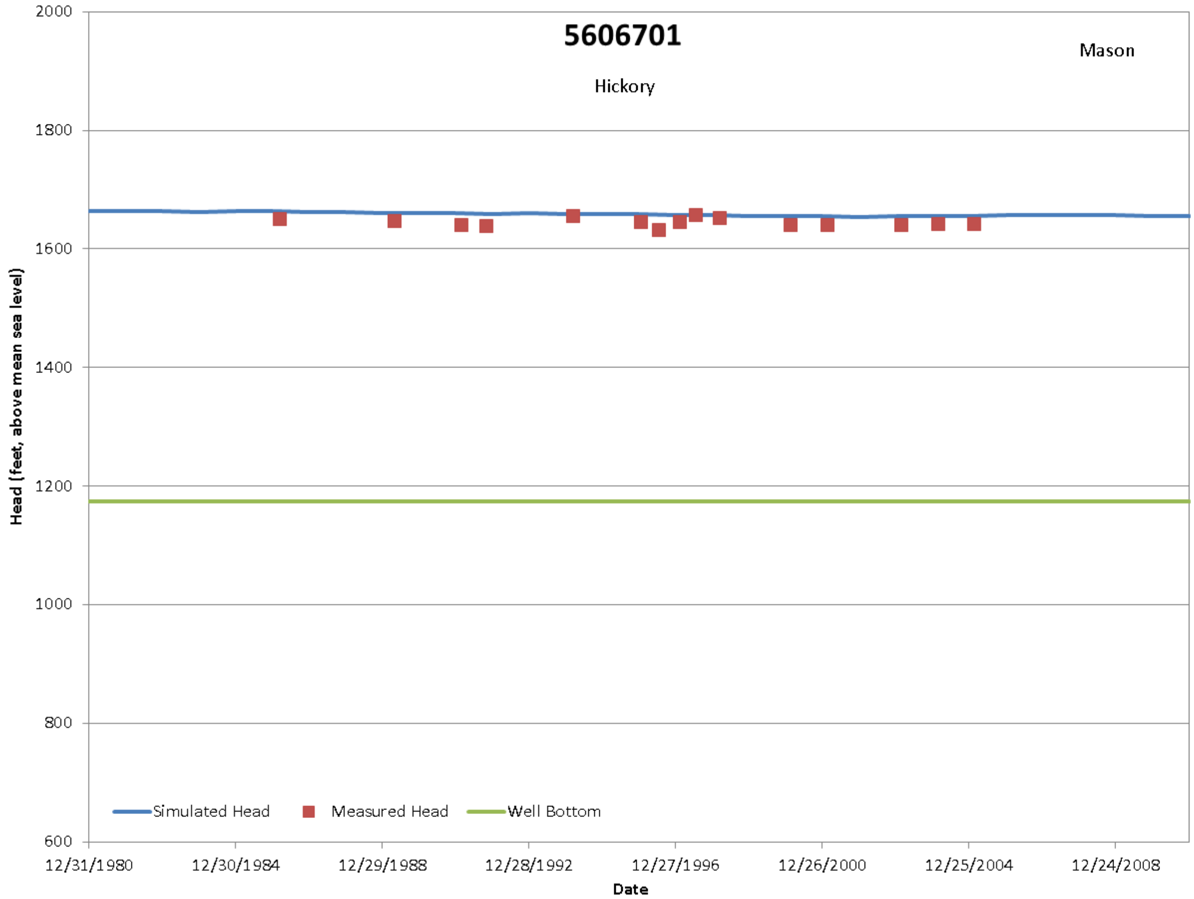

5606617
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

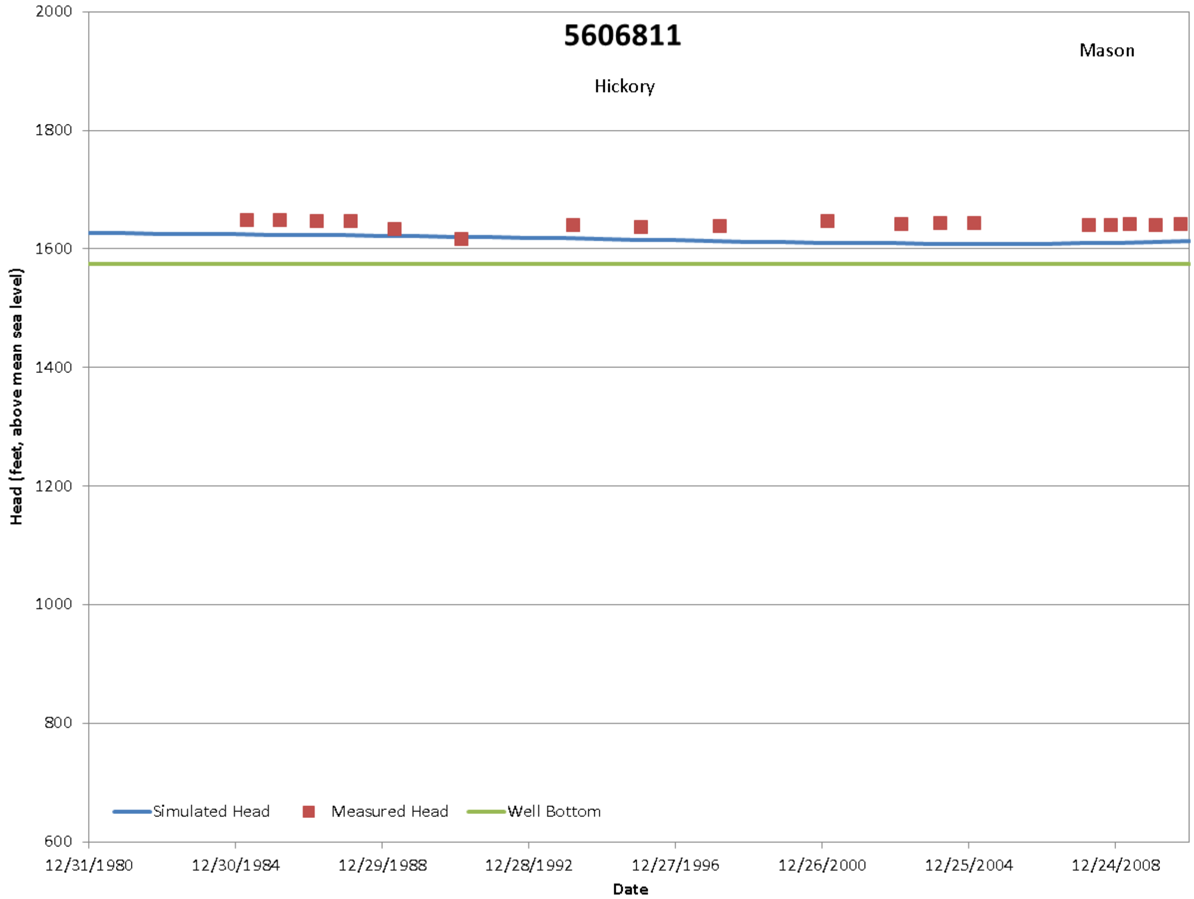

5606625
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom

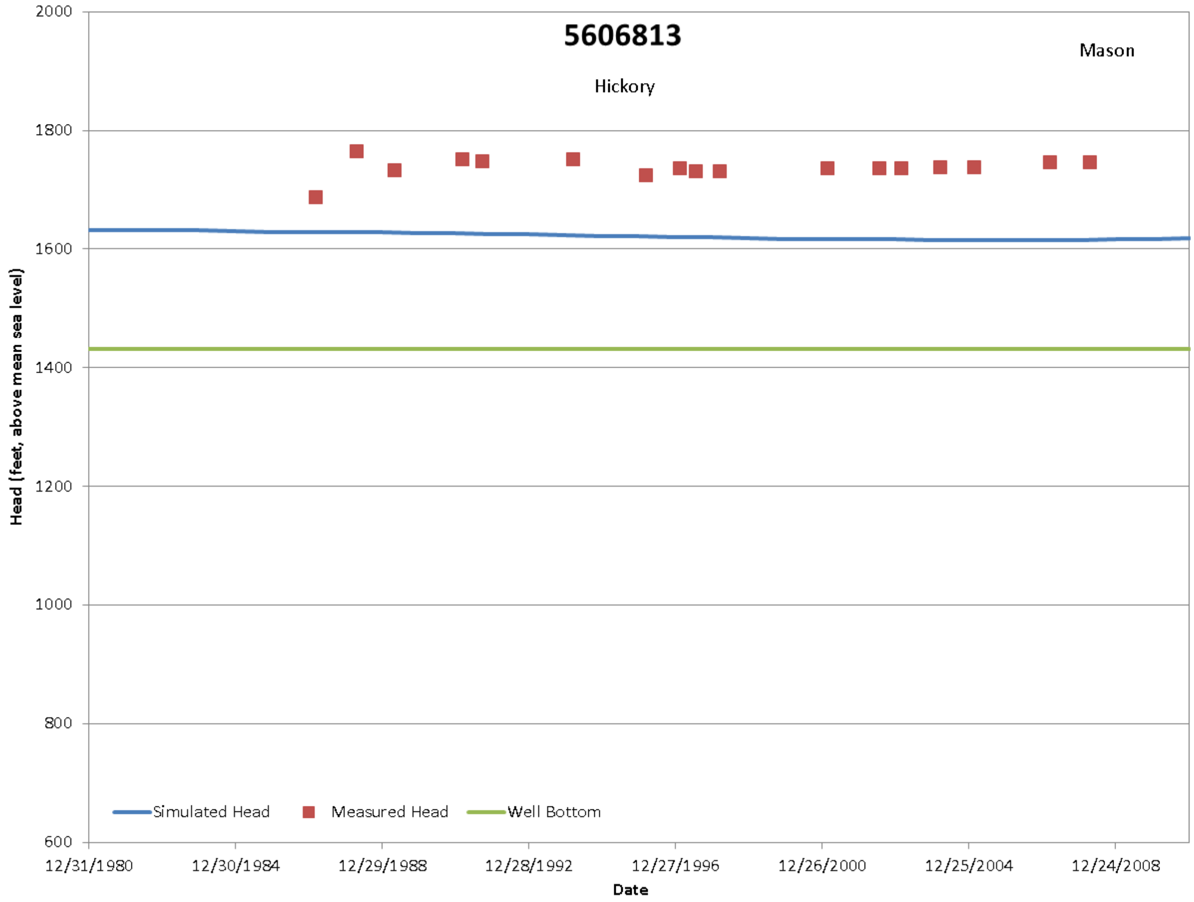

5606627
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

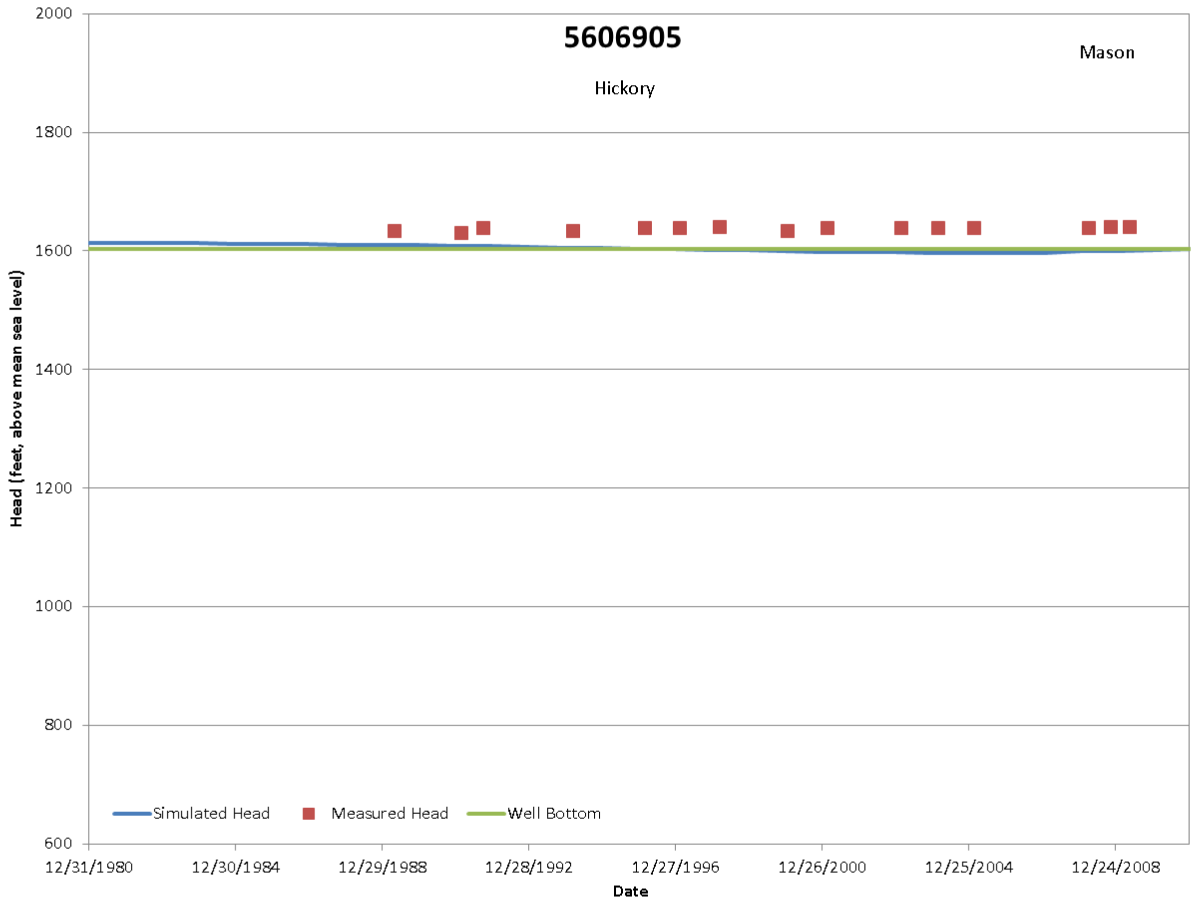

5606629
Mason
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

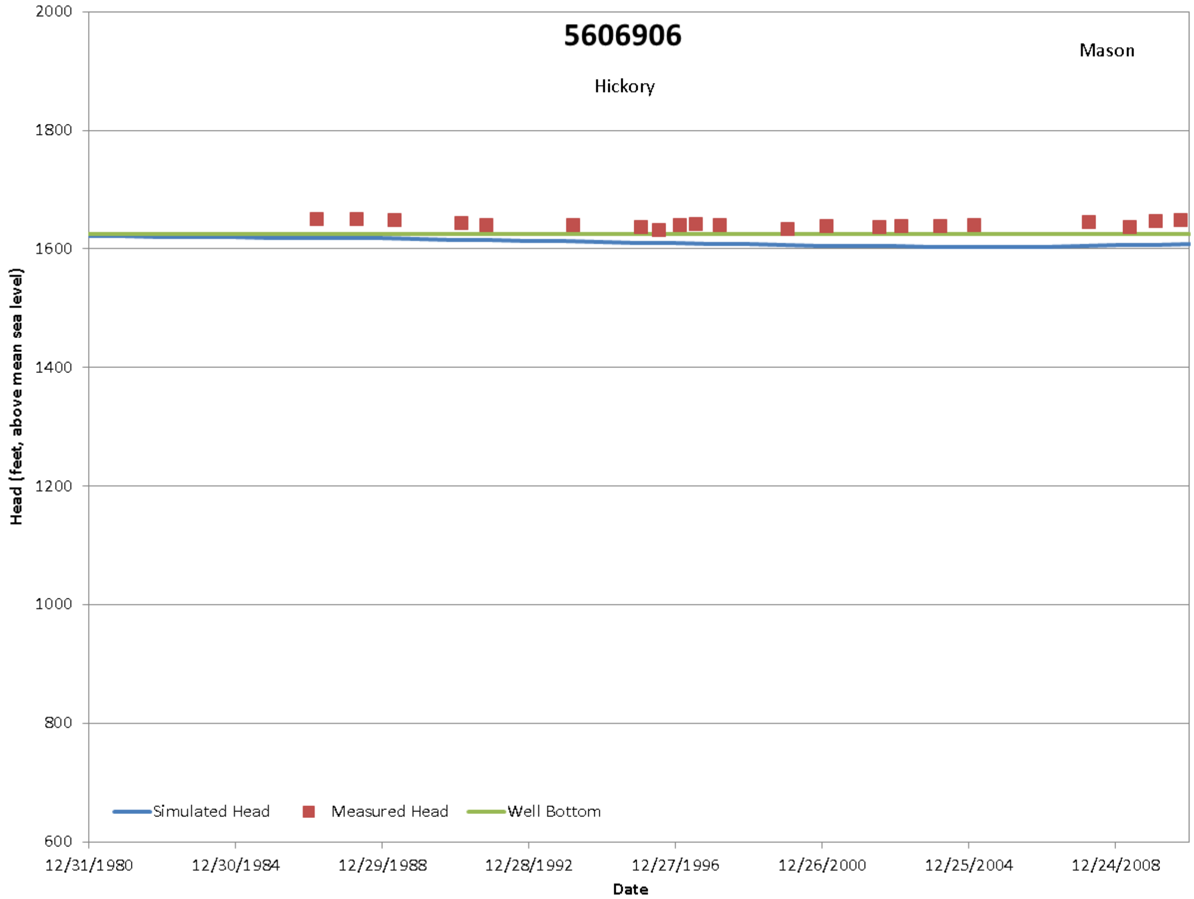

5606631
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

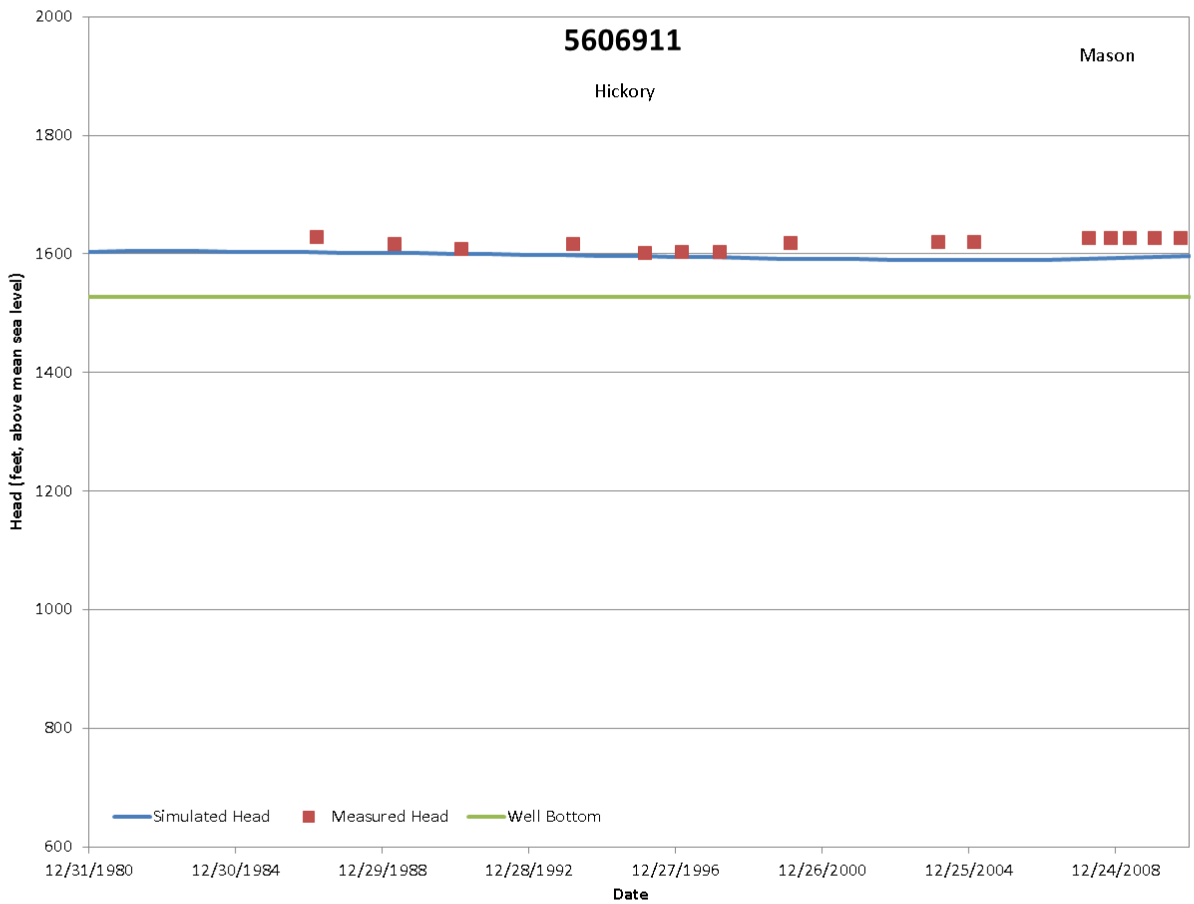

5606701
Mason
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

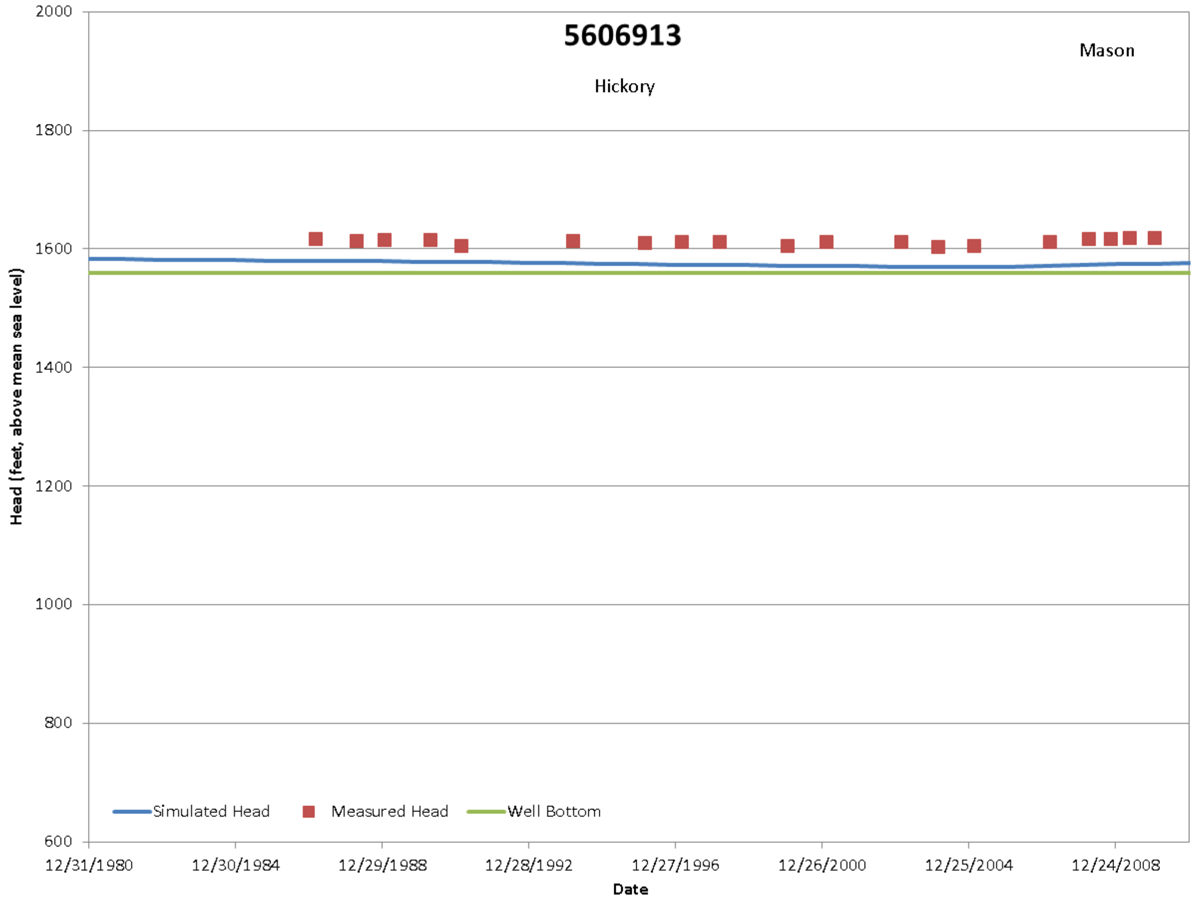

5606811
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

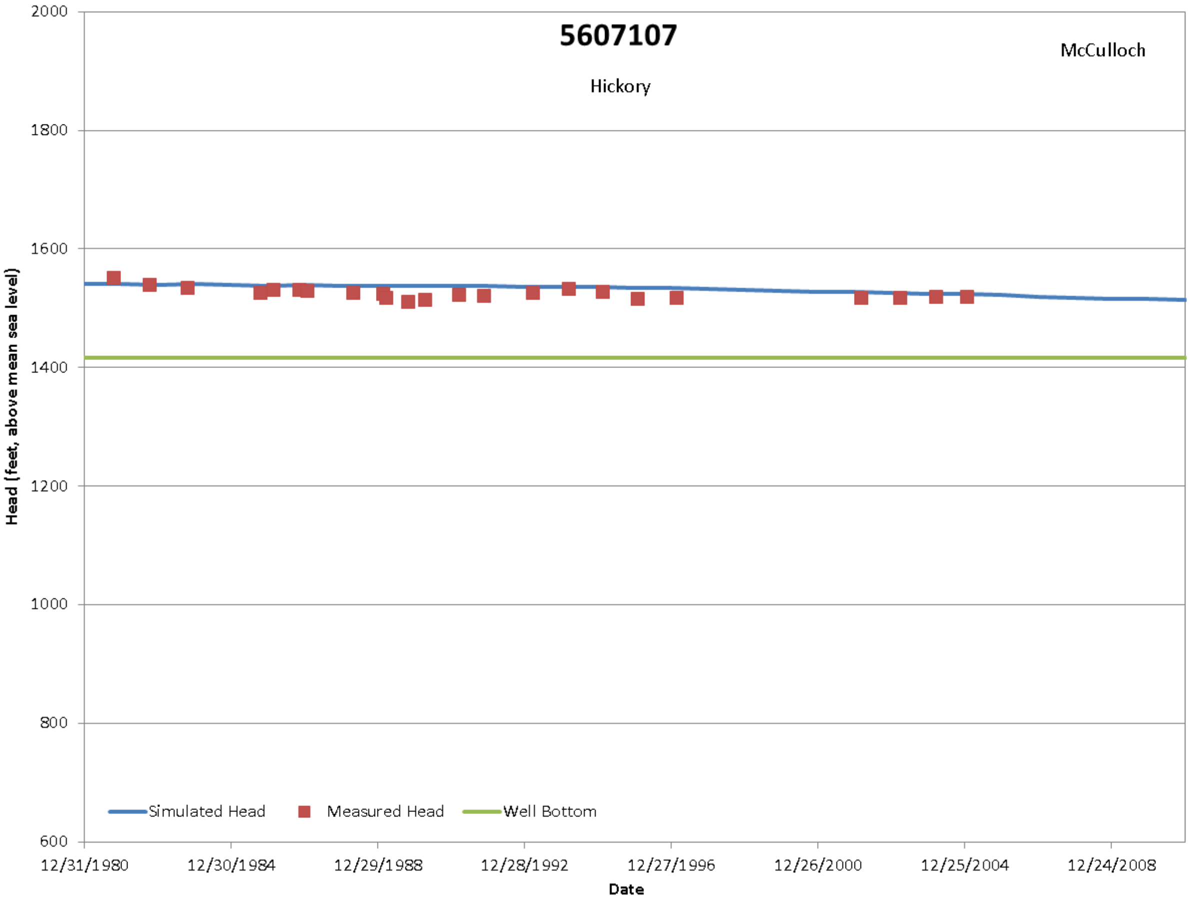

5606813
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

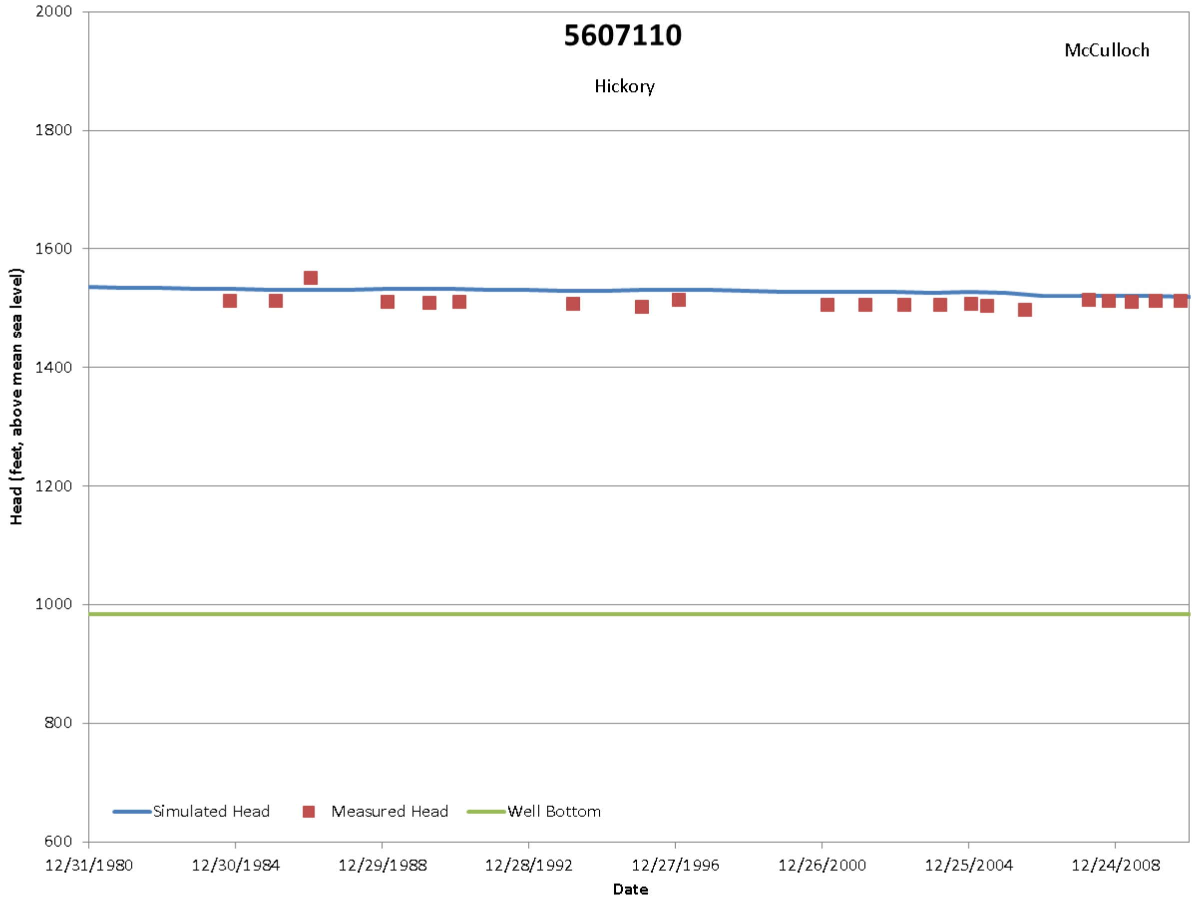

5606905
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

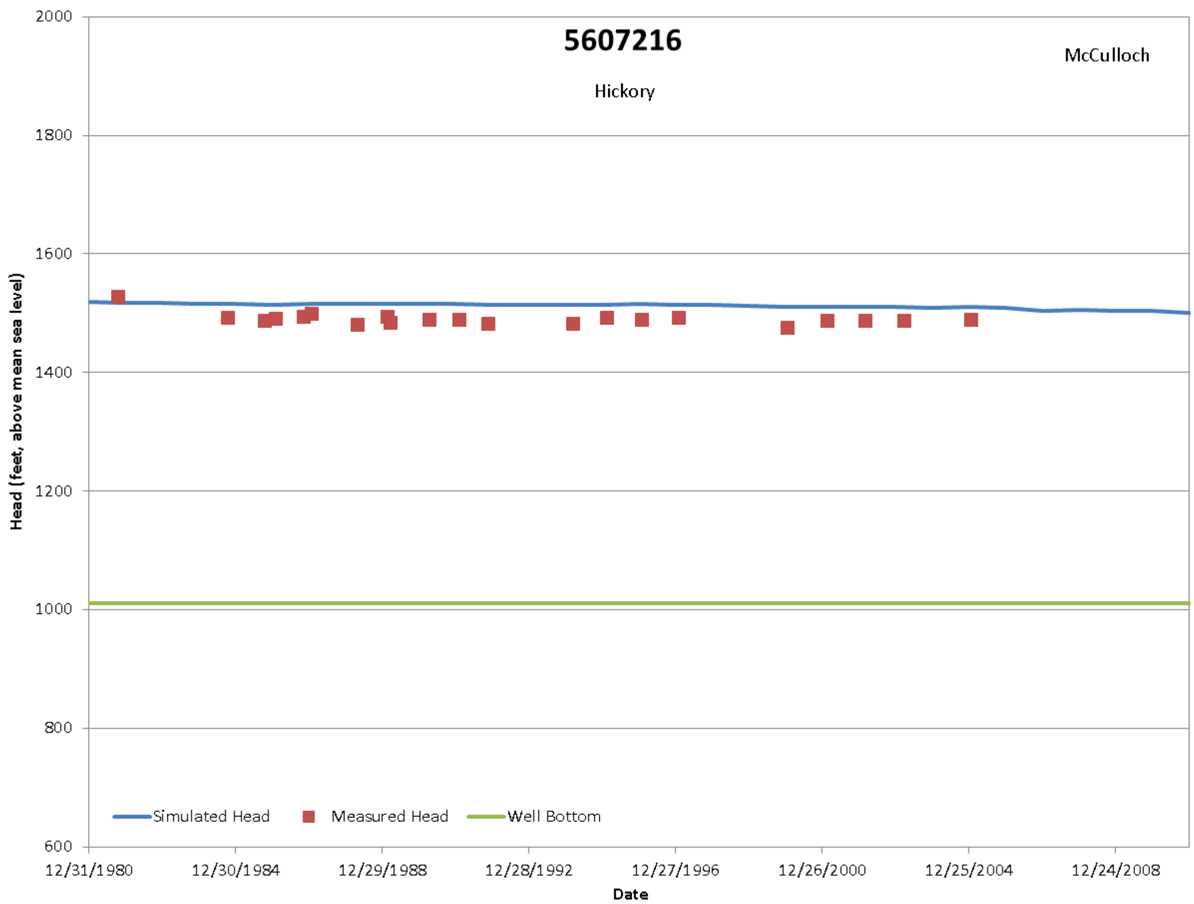

5606906
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

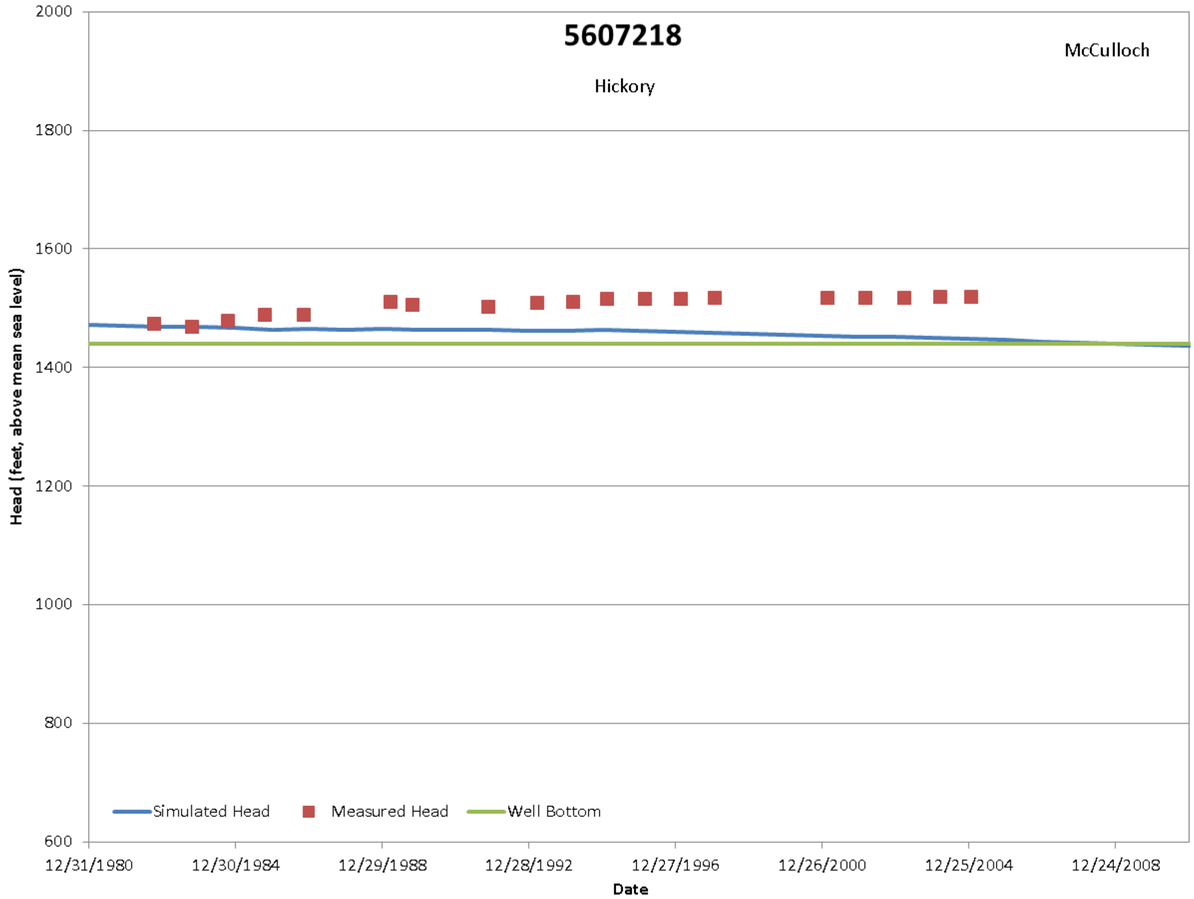

5606911
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

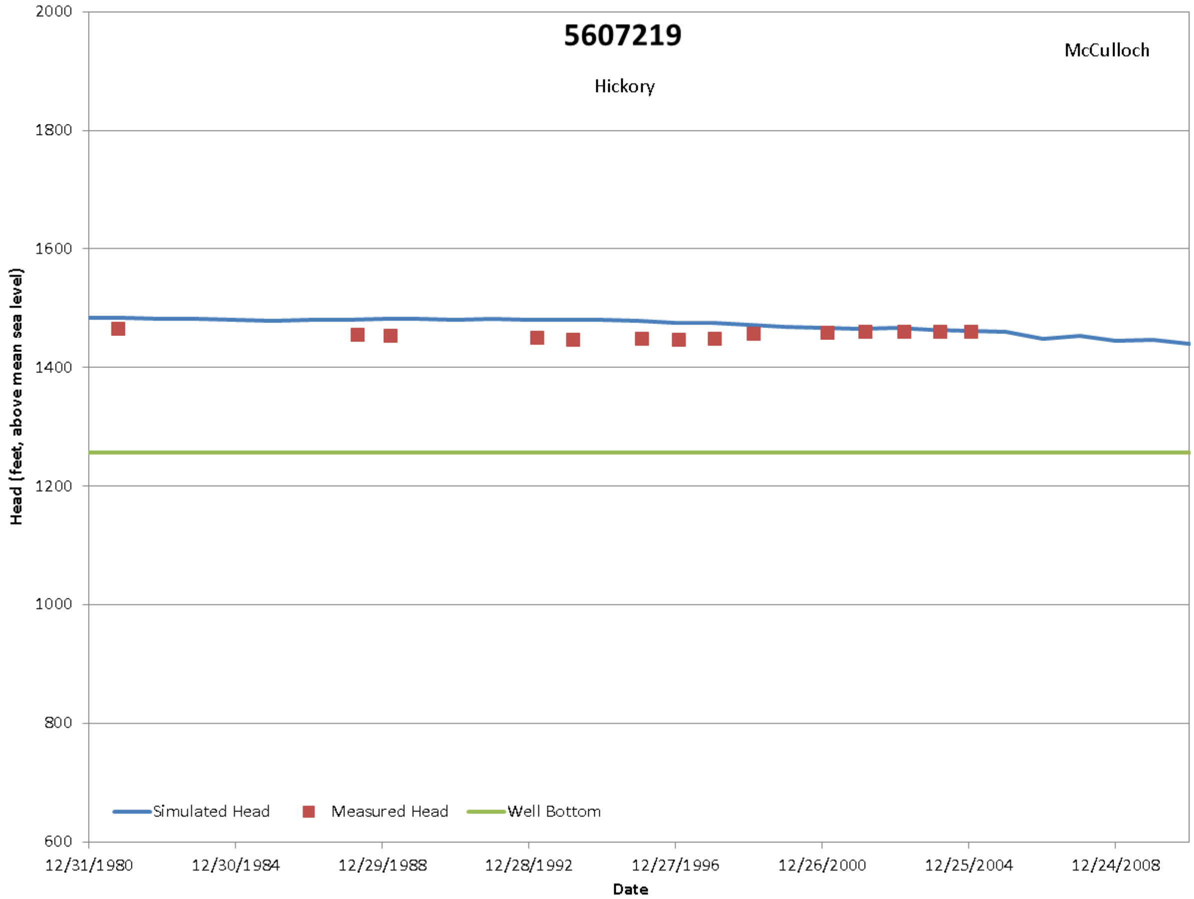

5606913
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

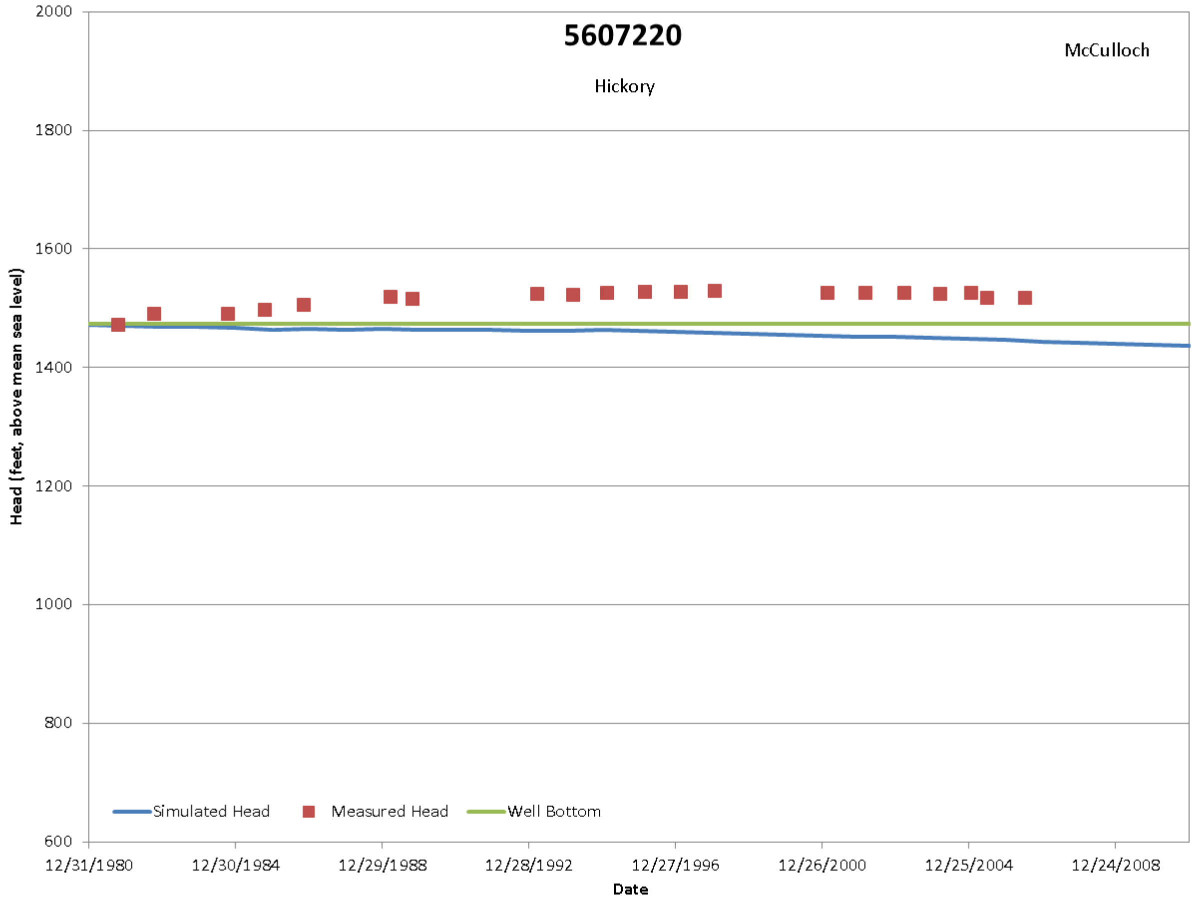

5607107
McCulloch
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

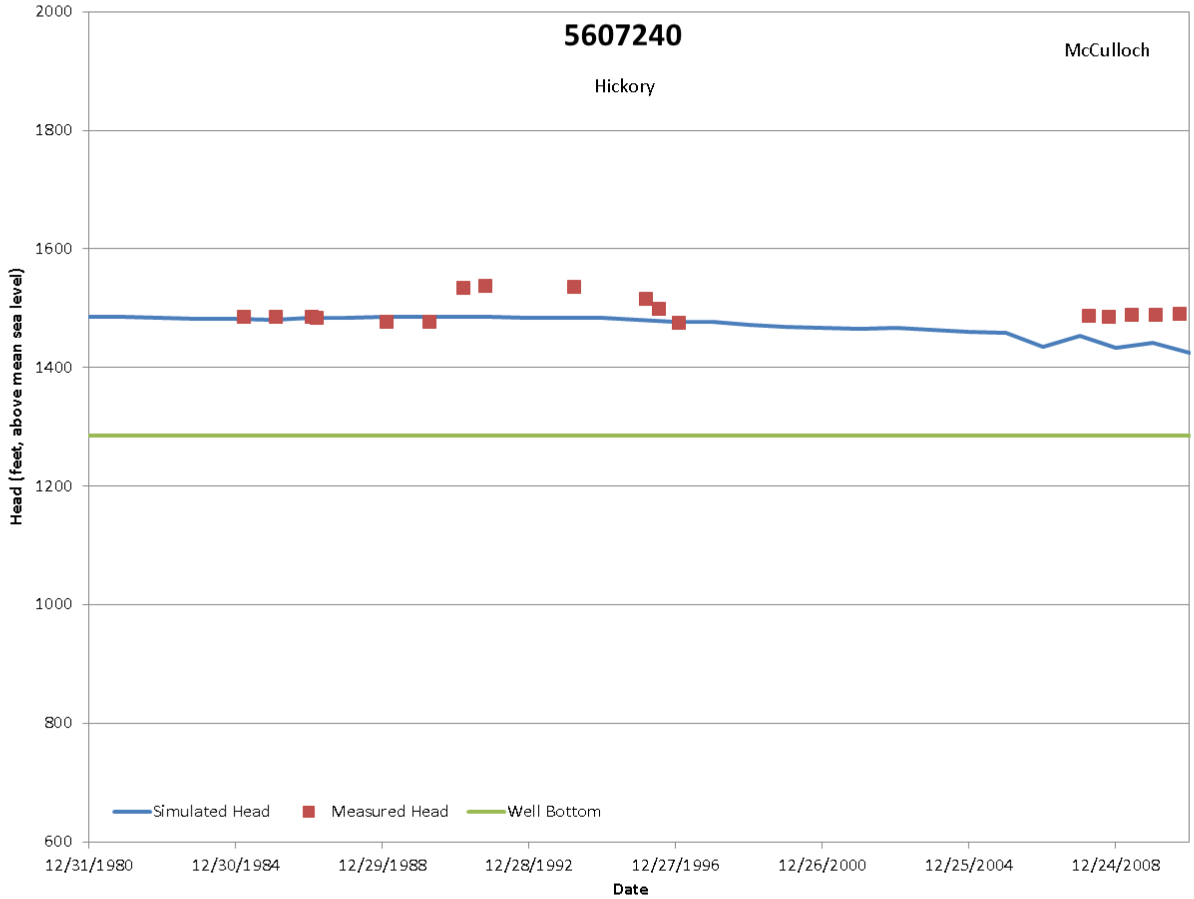

5607110
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

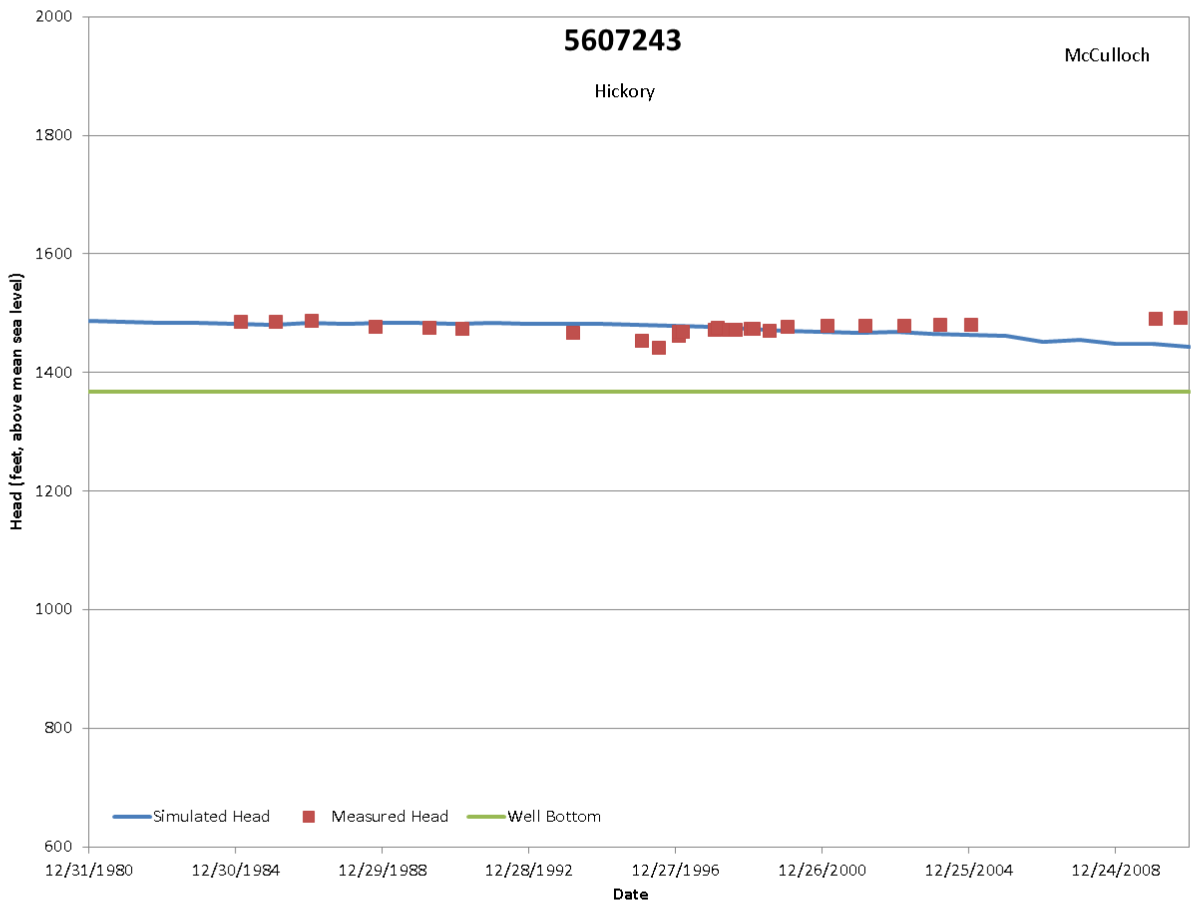

5607216
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom

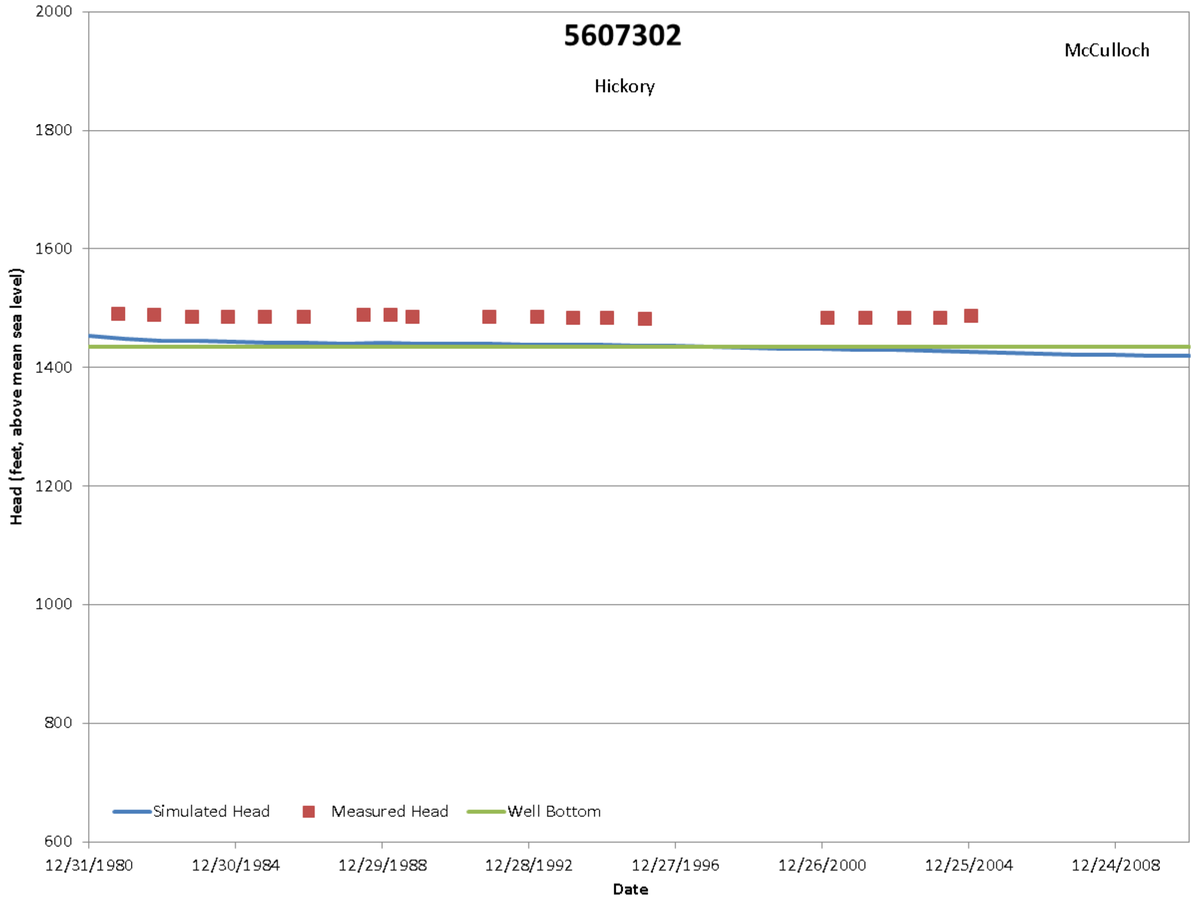

5607218
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

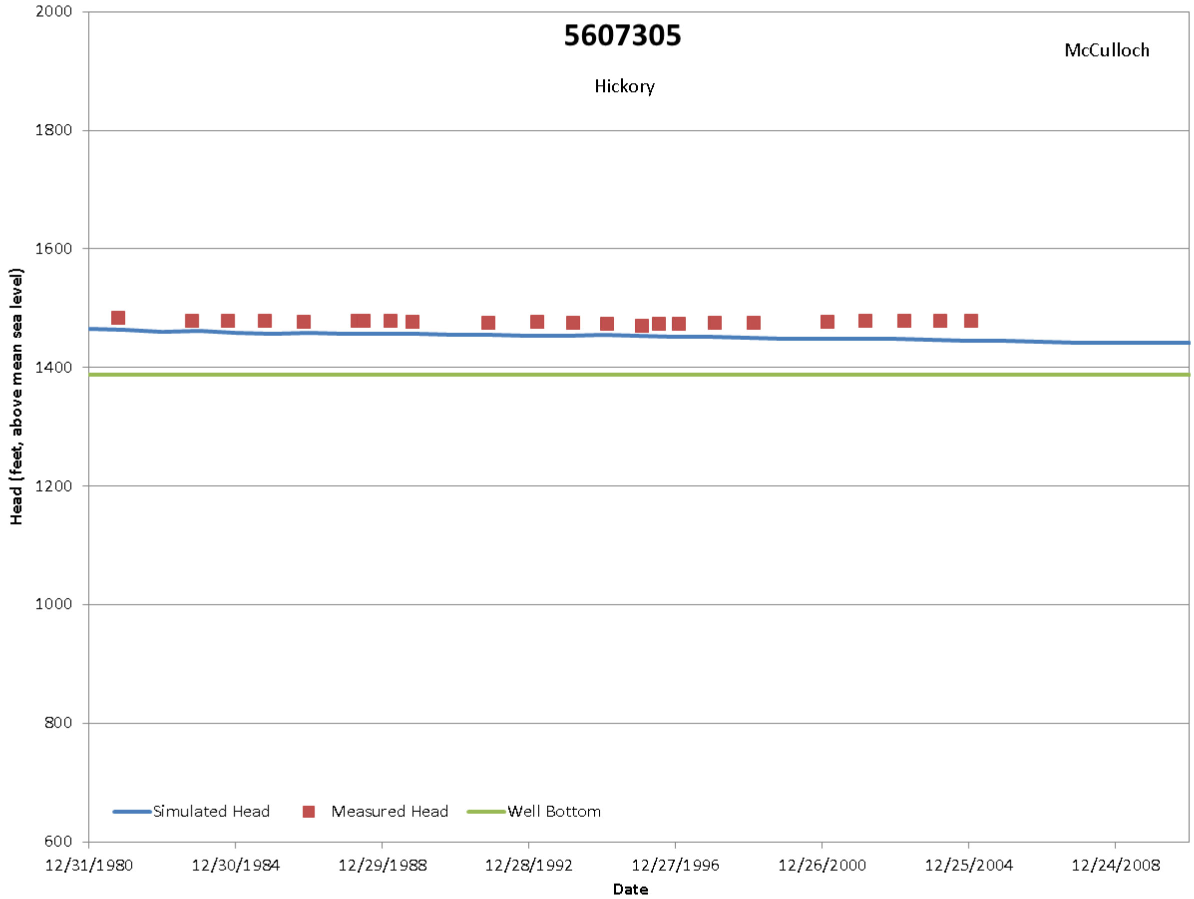

5607219
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

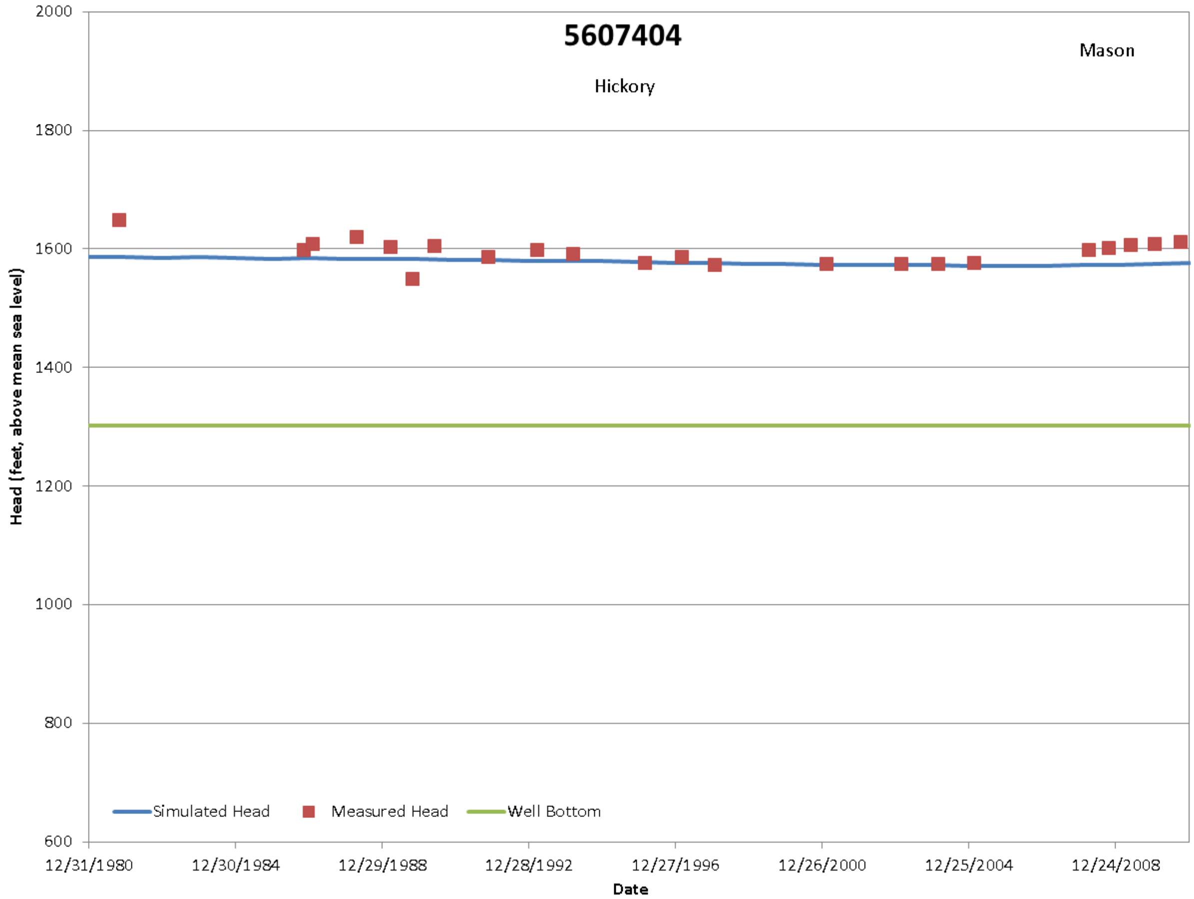

5607220
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

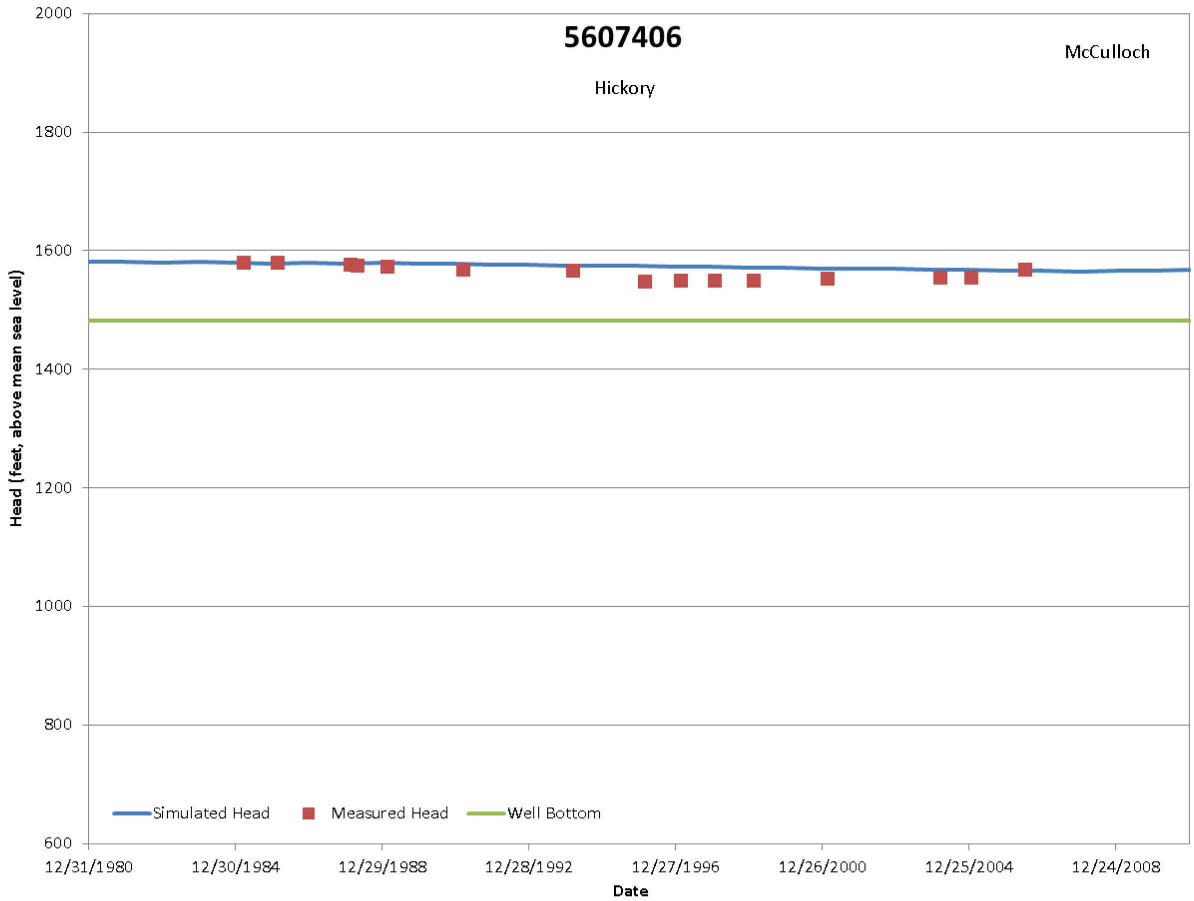

5607240
McCulloch
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

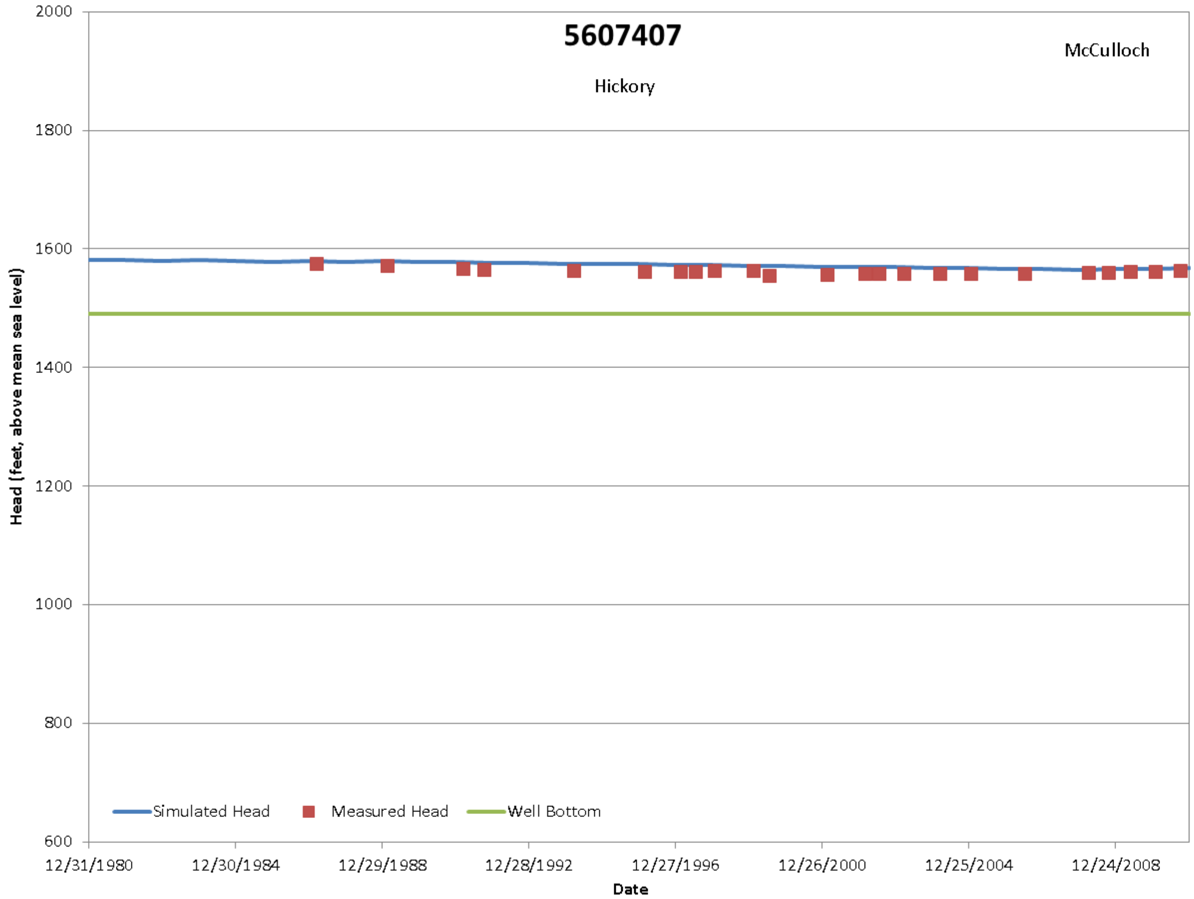

5607243
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom

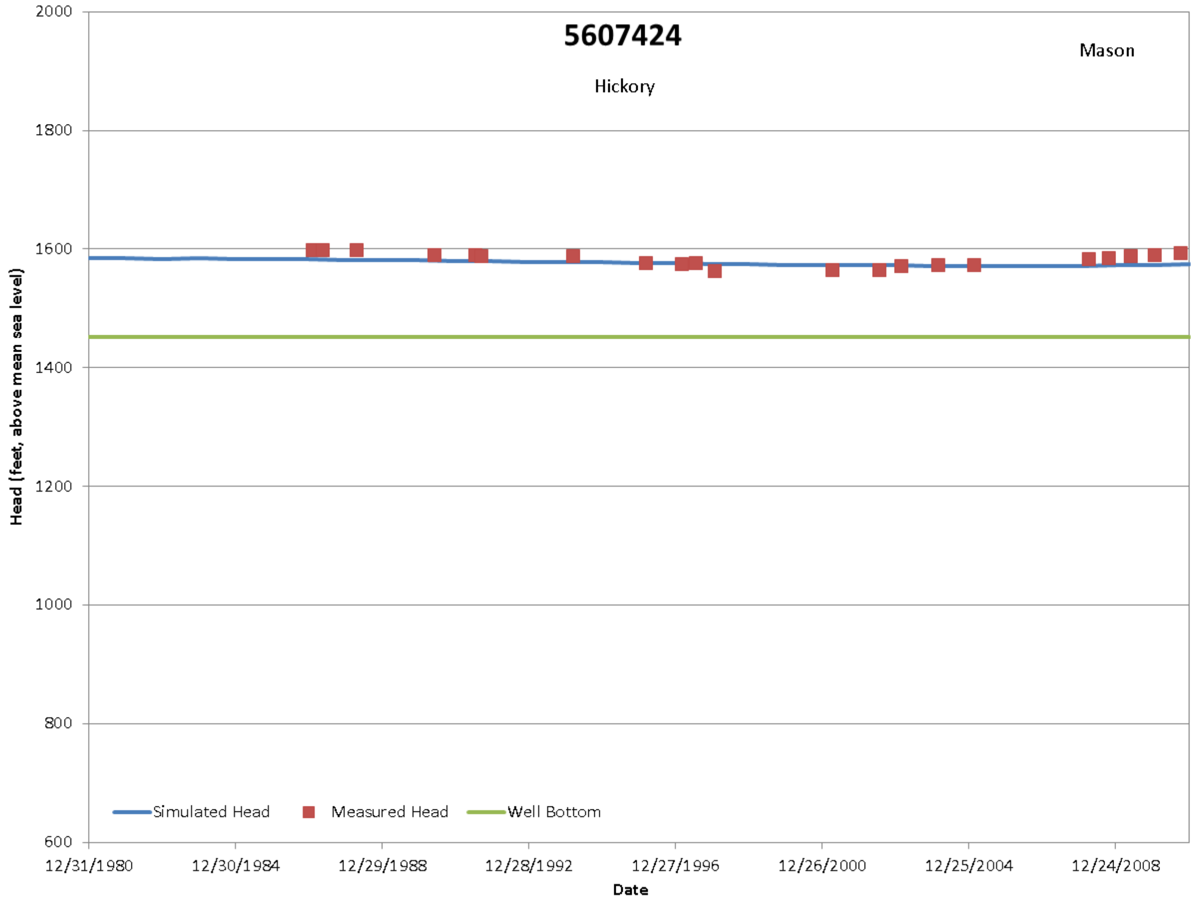

5607302
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

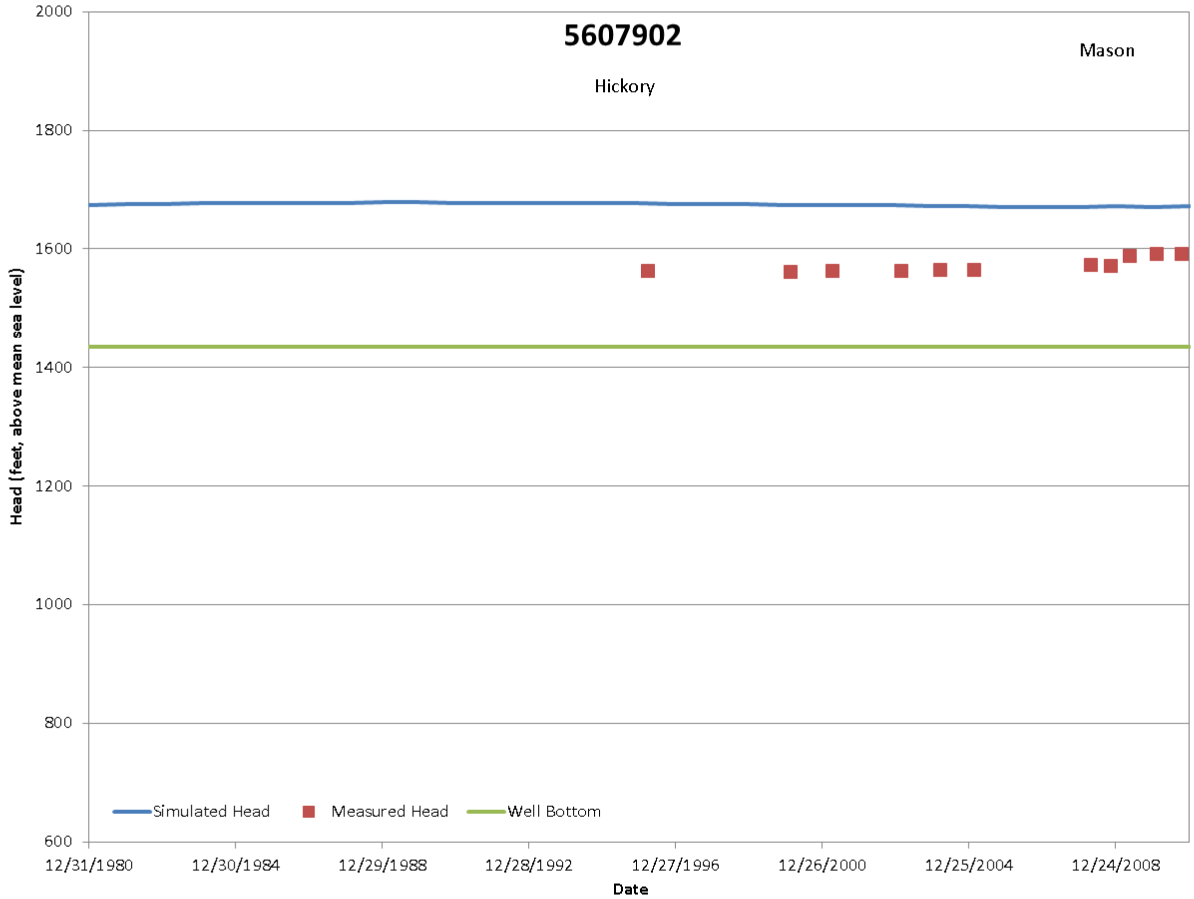

5607305
Hickory
McCulloch
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

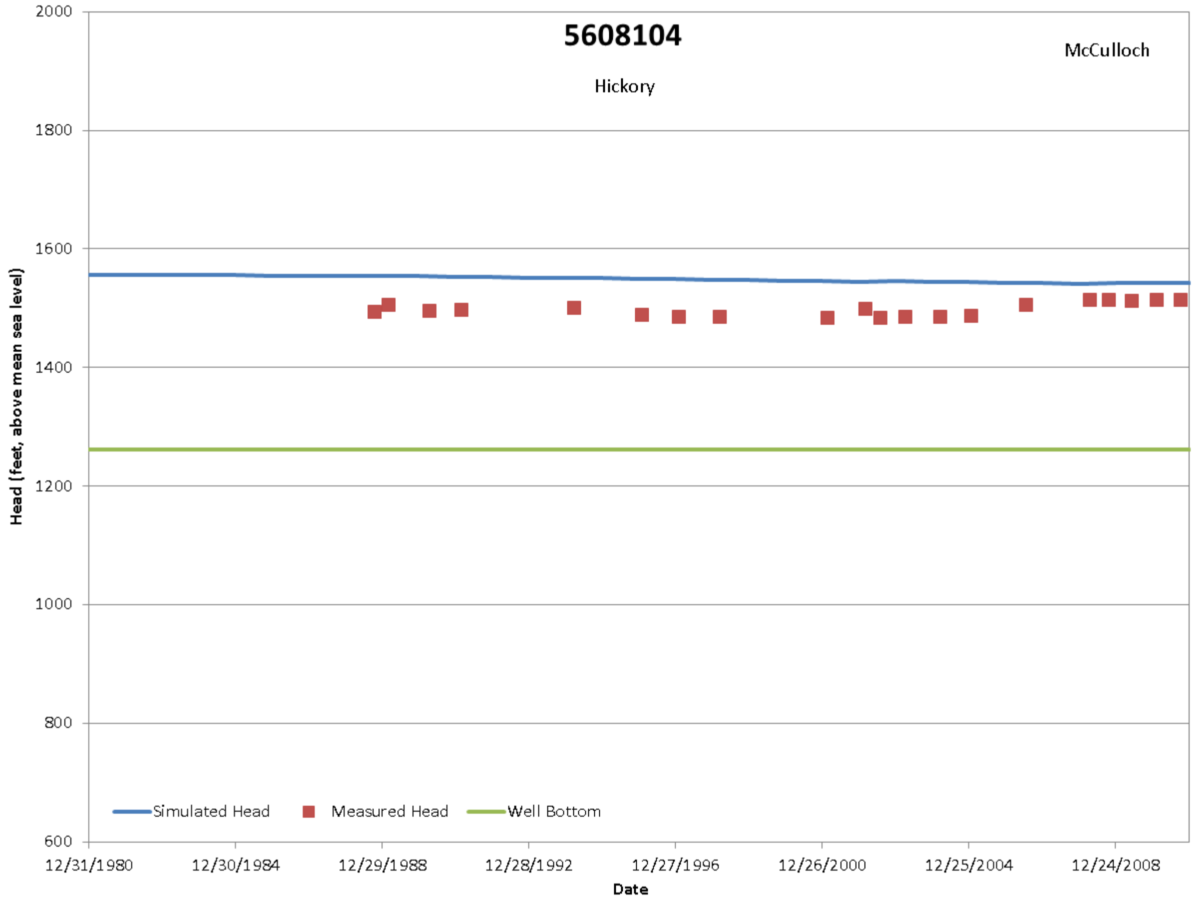

5607404
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

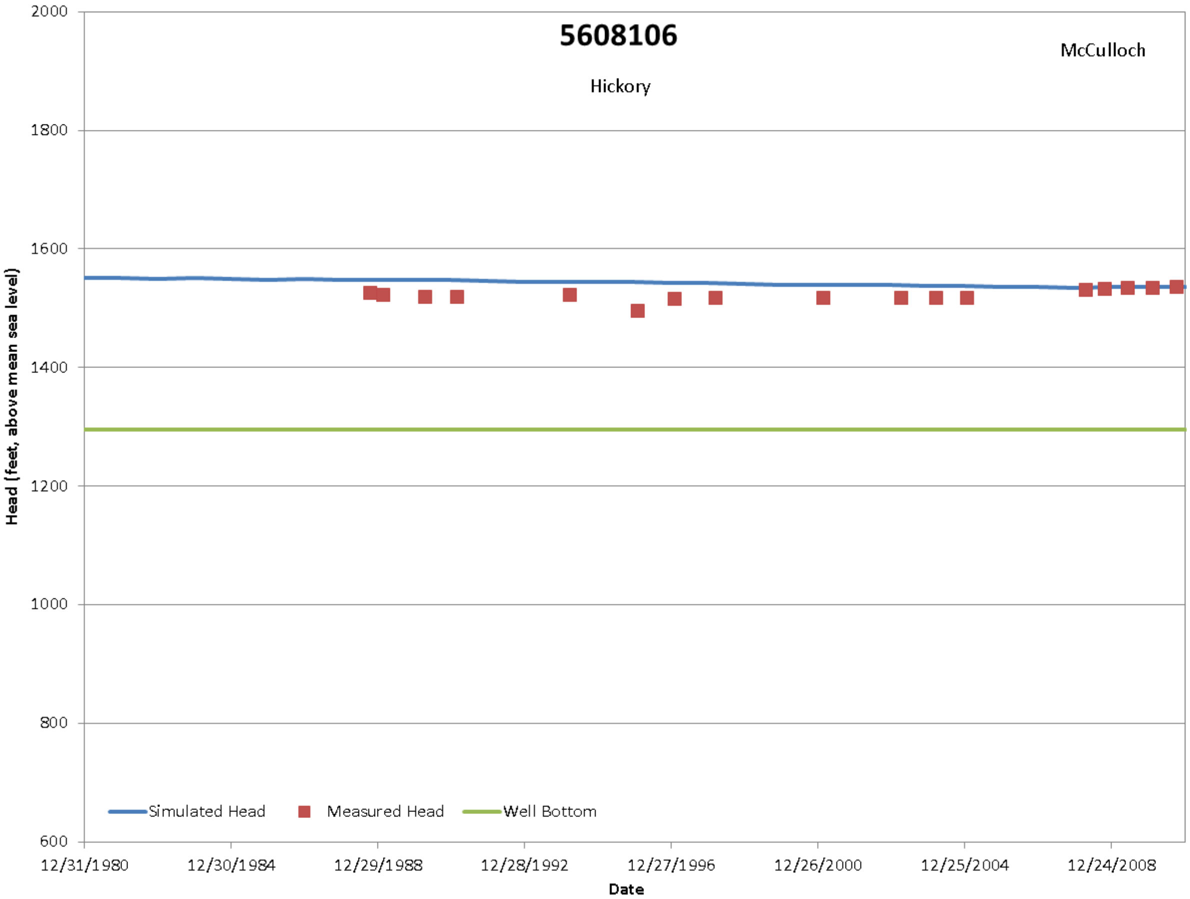

5607406
Hickory
McCulloch
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5607407
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

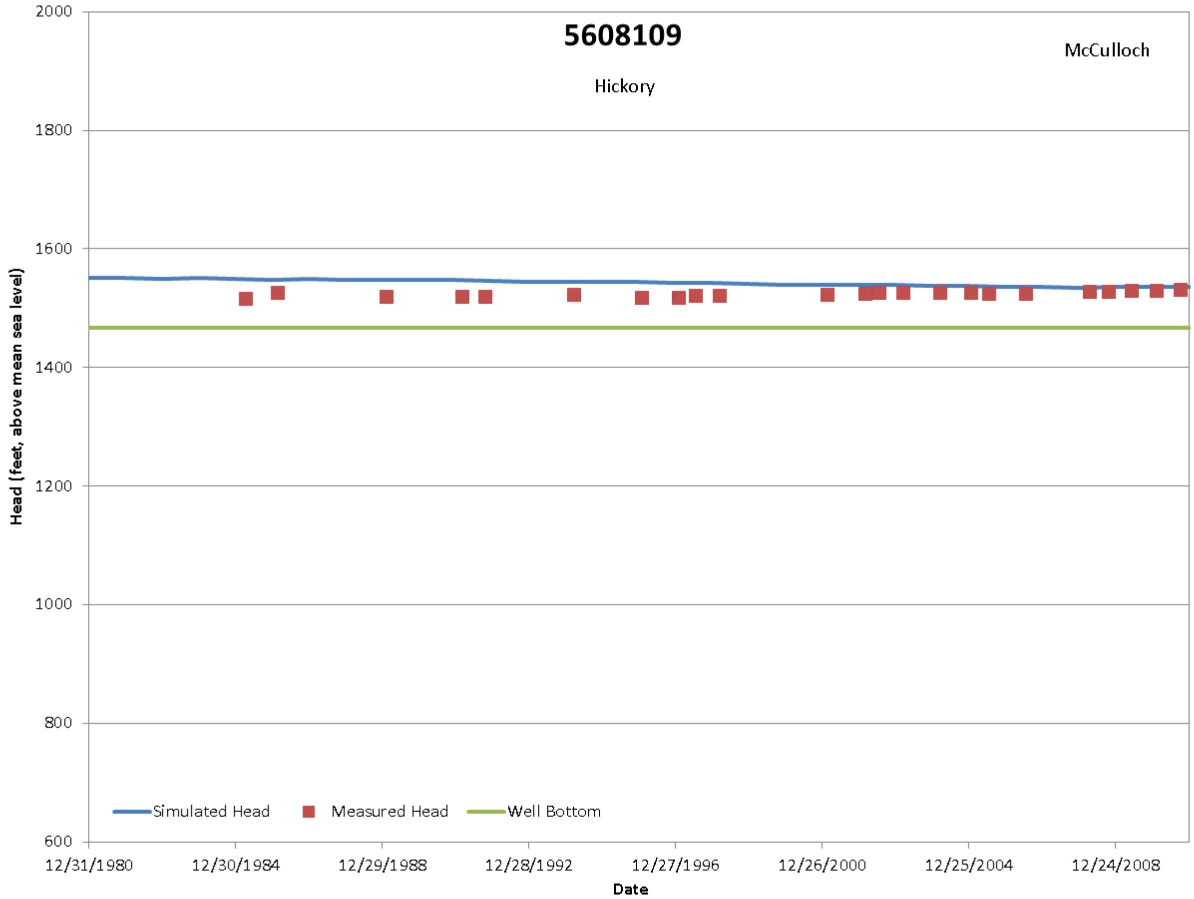

5607424
Mason
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

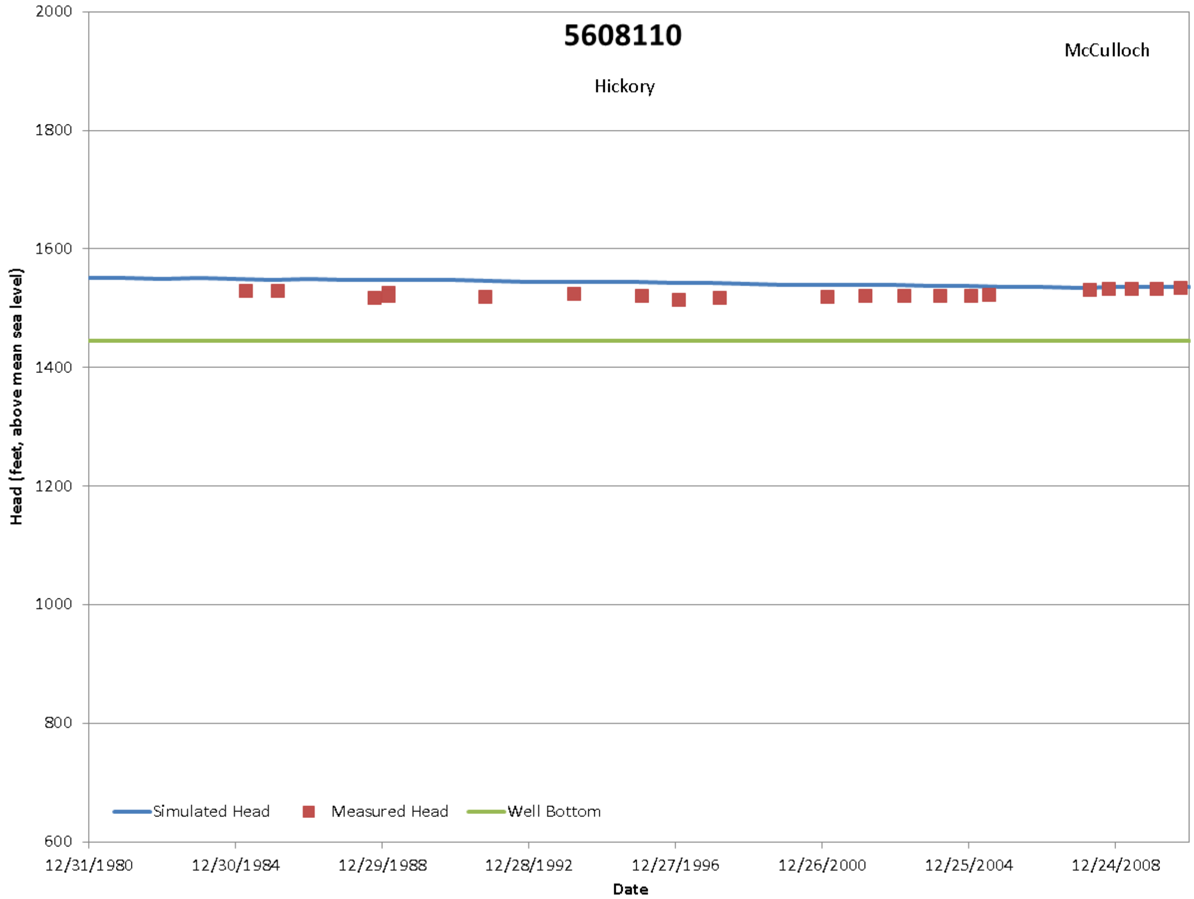

5607902
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

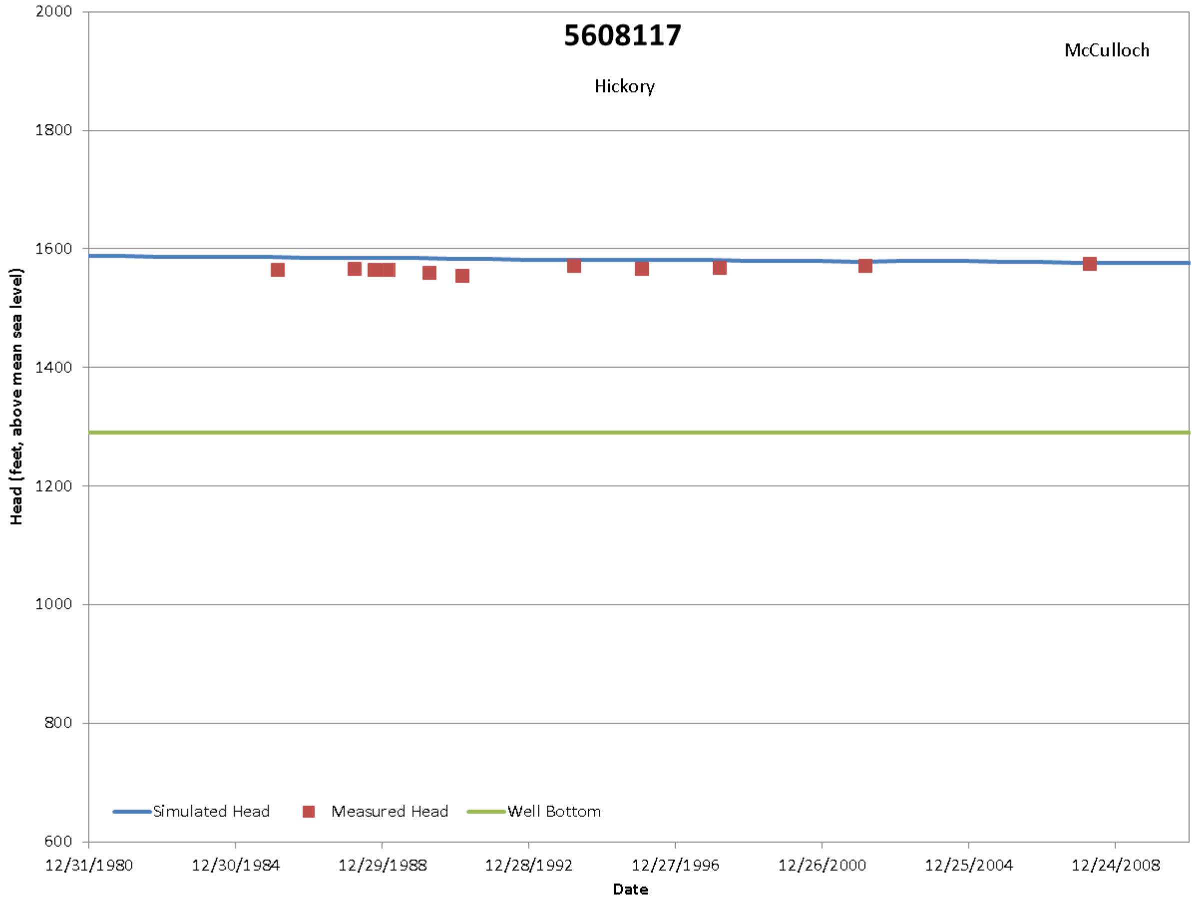

5608104
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom



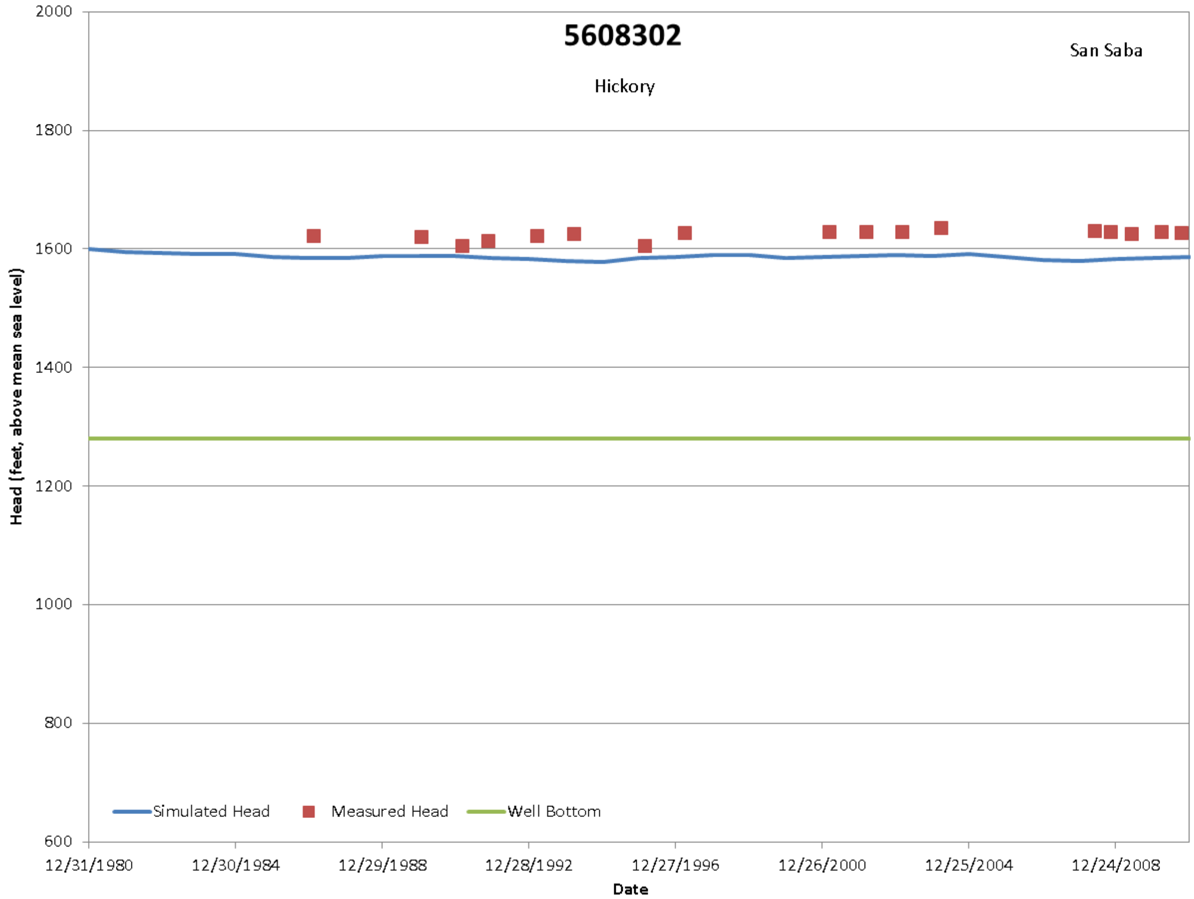
5608106
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

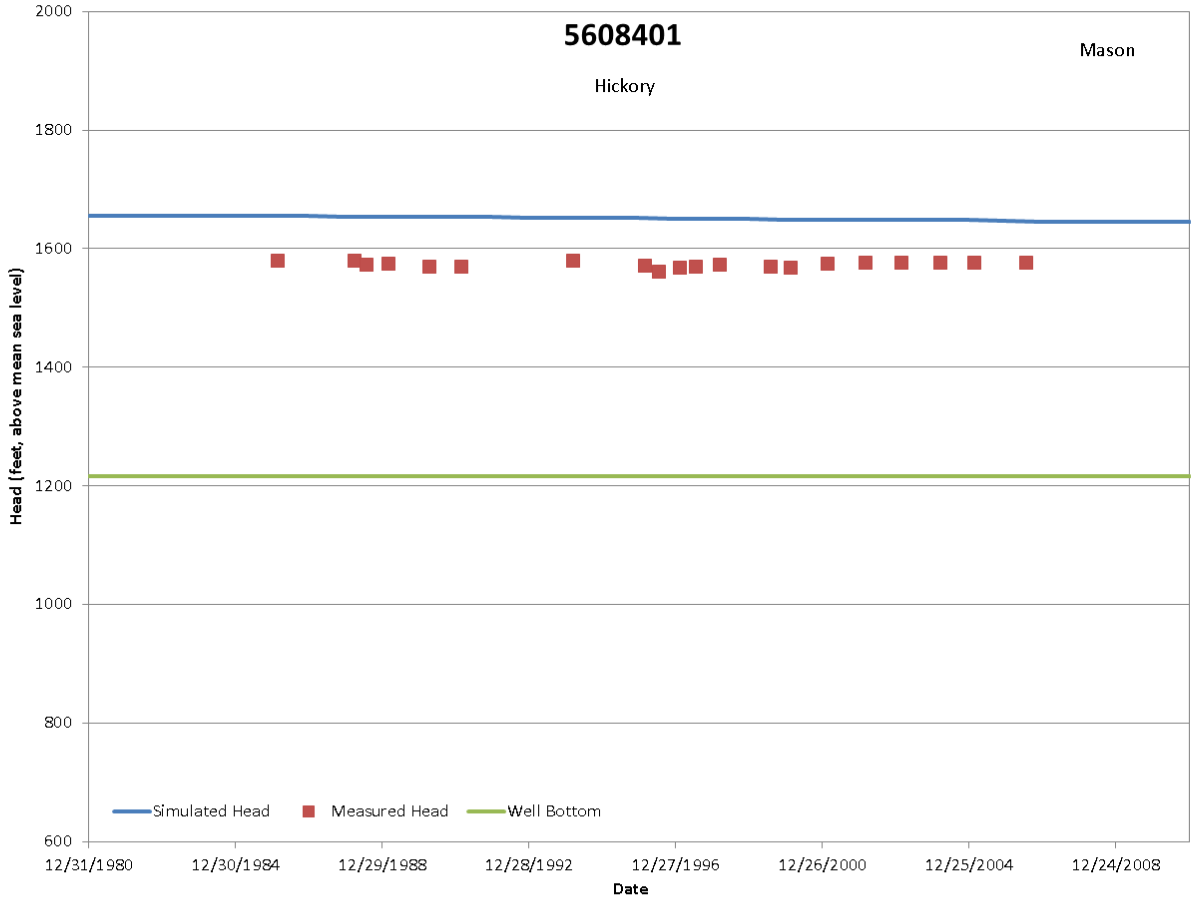

5608109
McCulloch
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

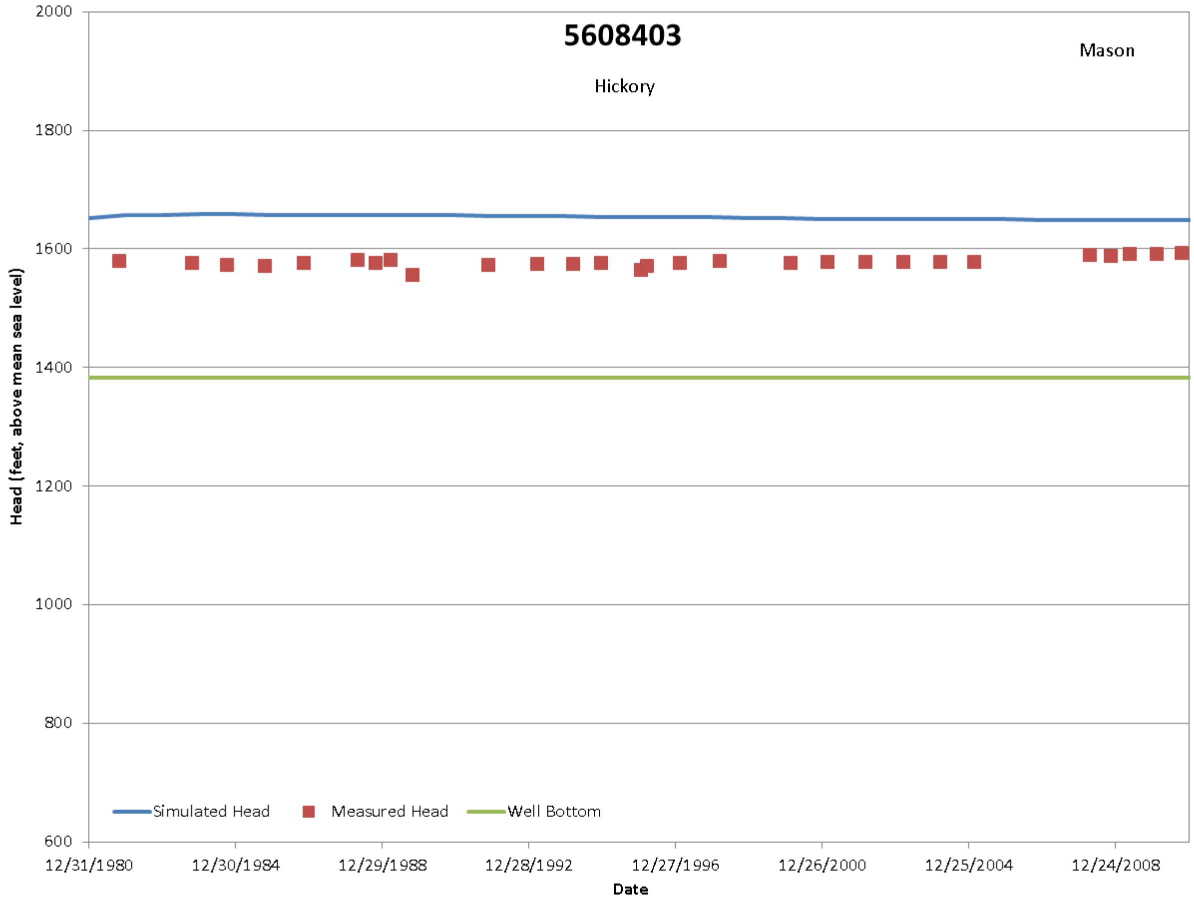

5608110
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

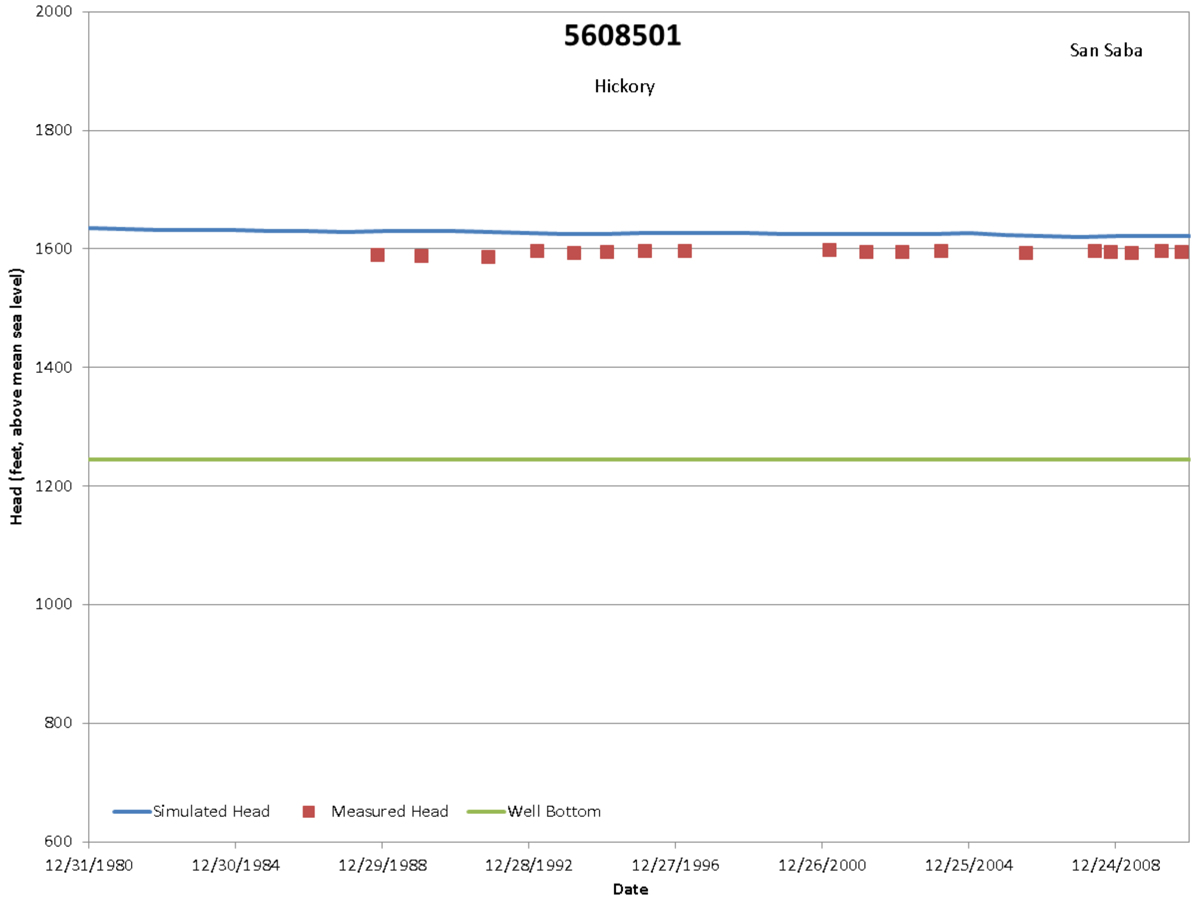

5608117
McCulloch
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

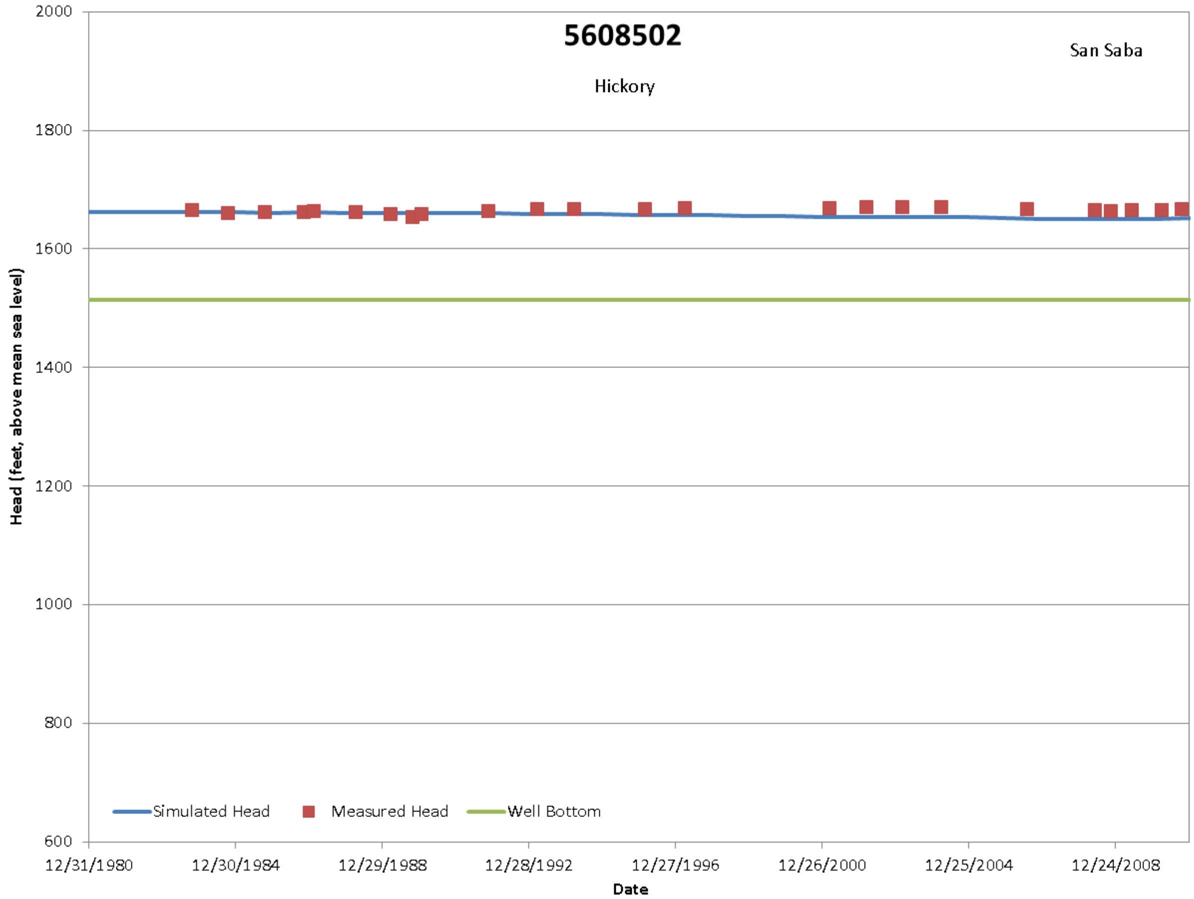

5608205
San Saba
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

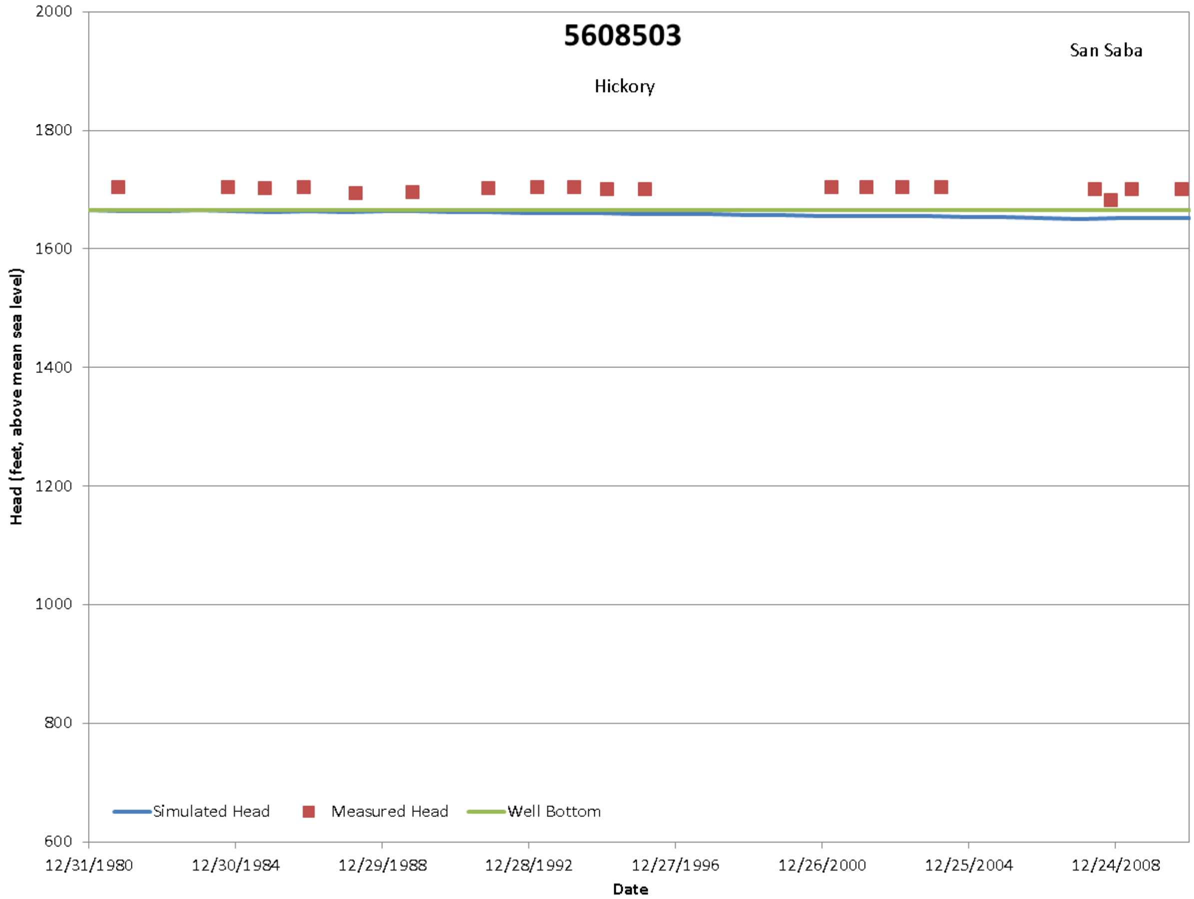

5608302
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5608401
Mason
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

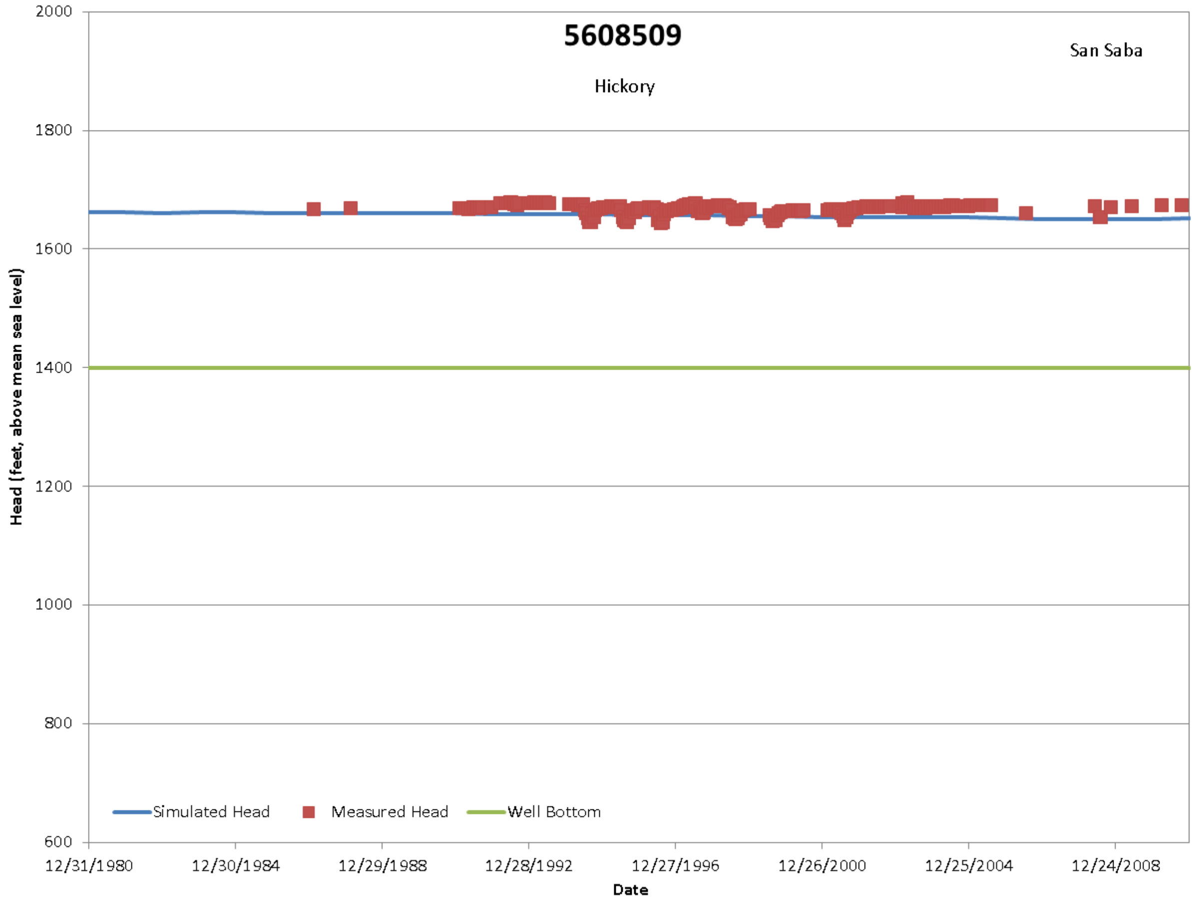

5608403
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5608501
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

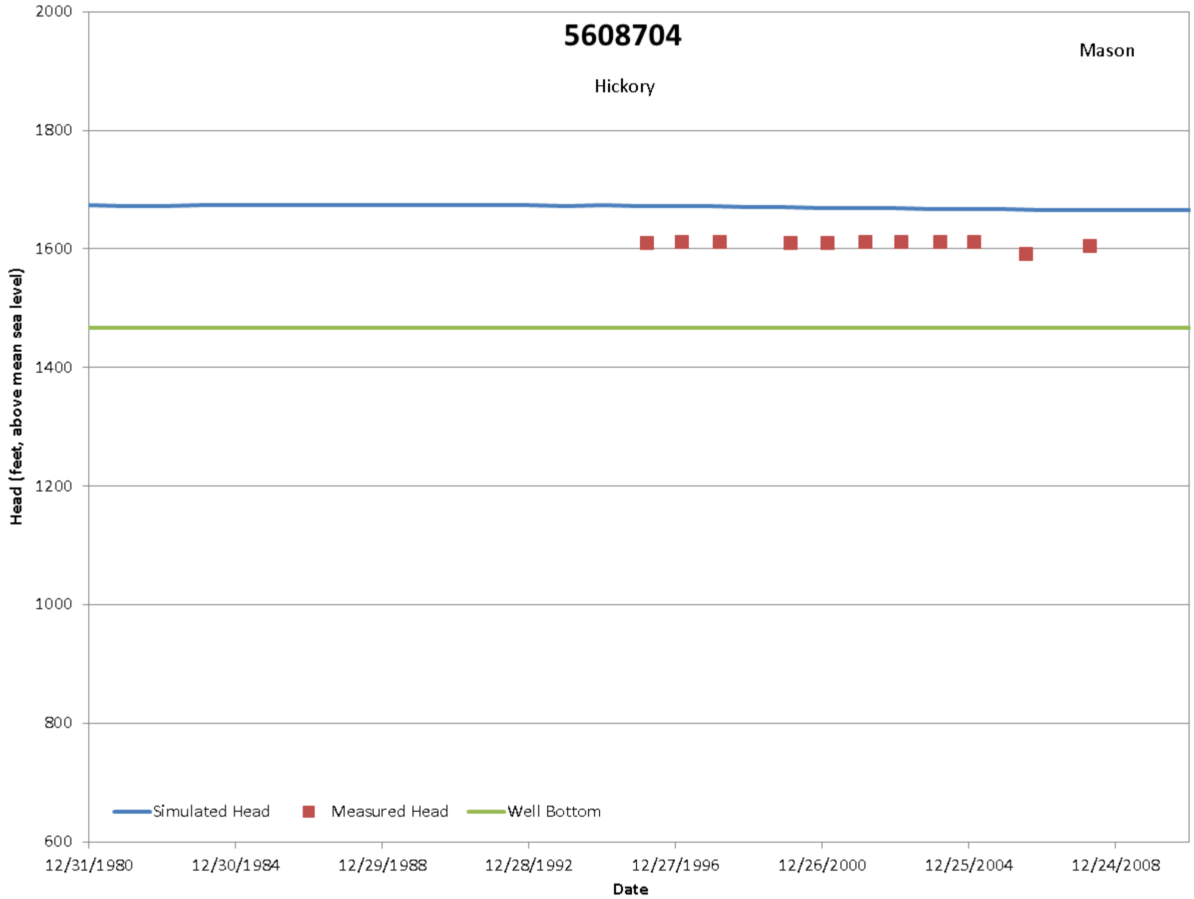

5608502
Hickory
San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5608503
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

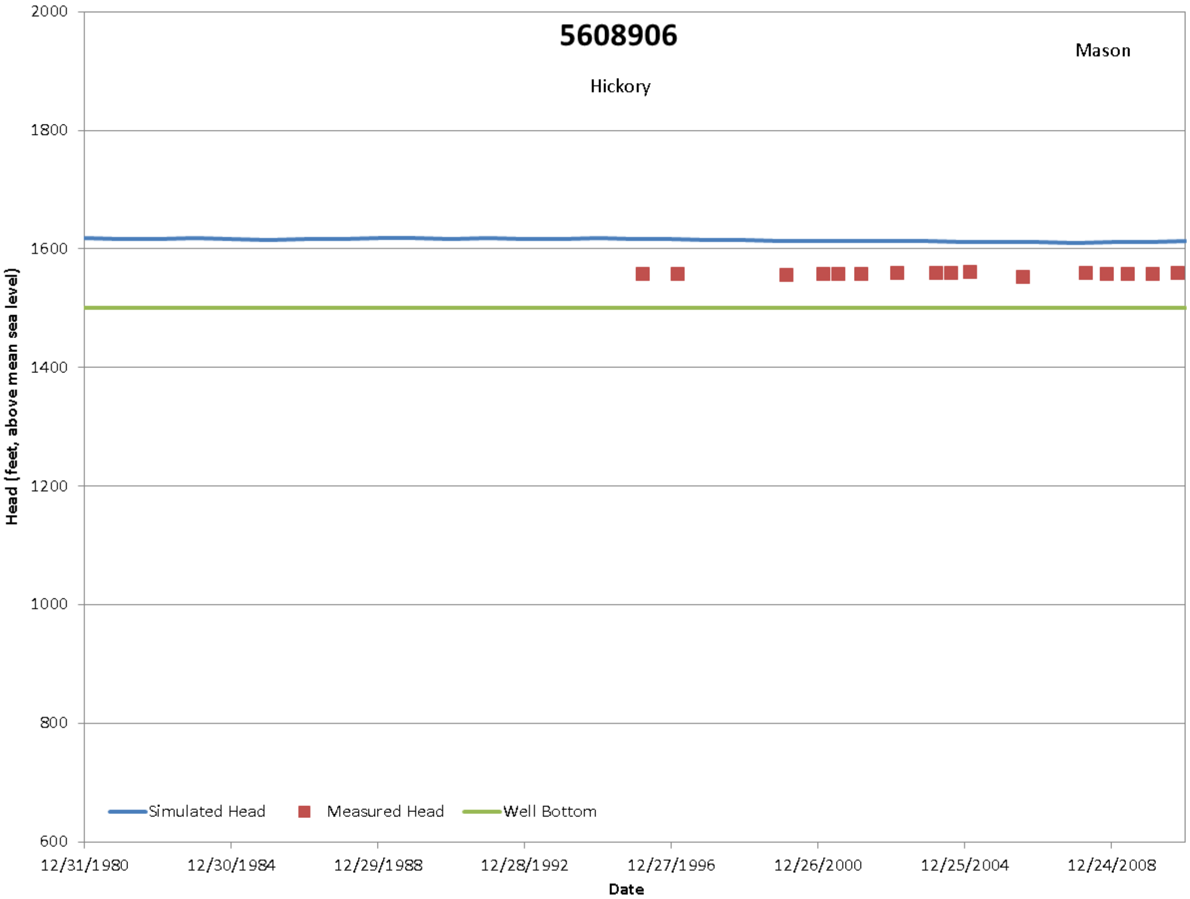

5608505
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

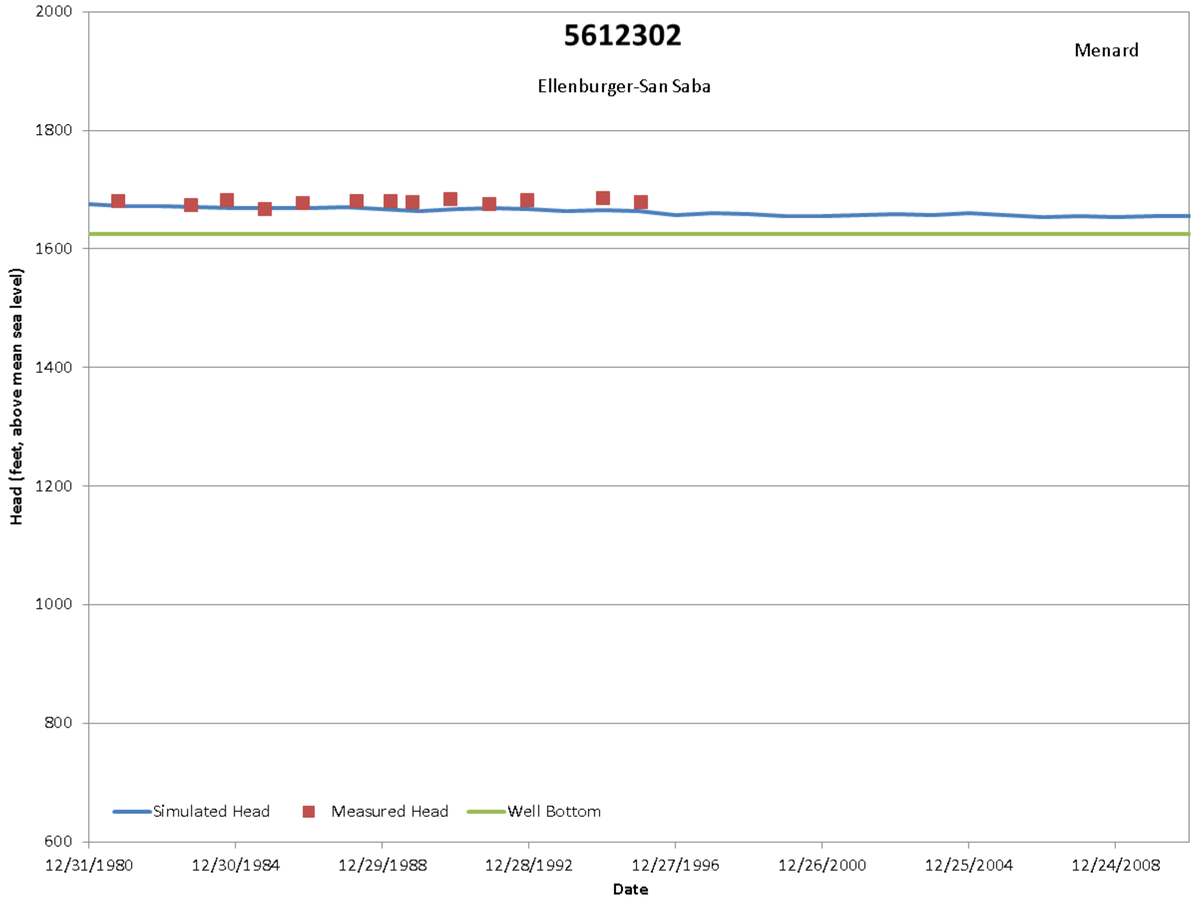

5608509
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom

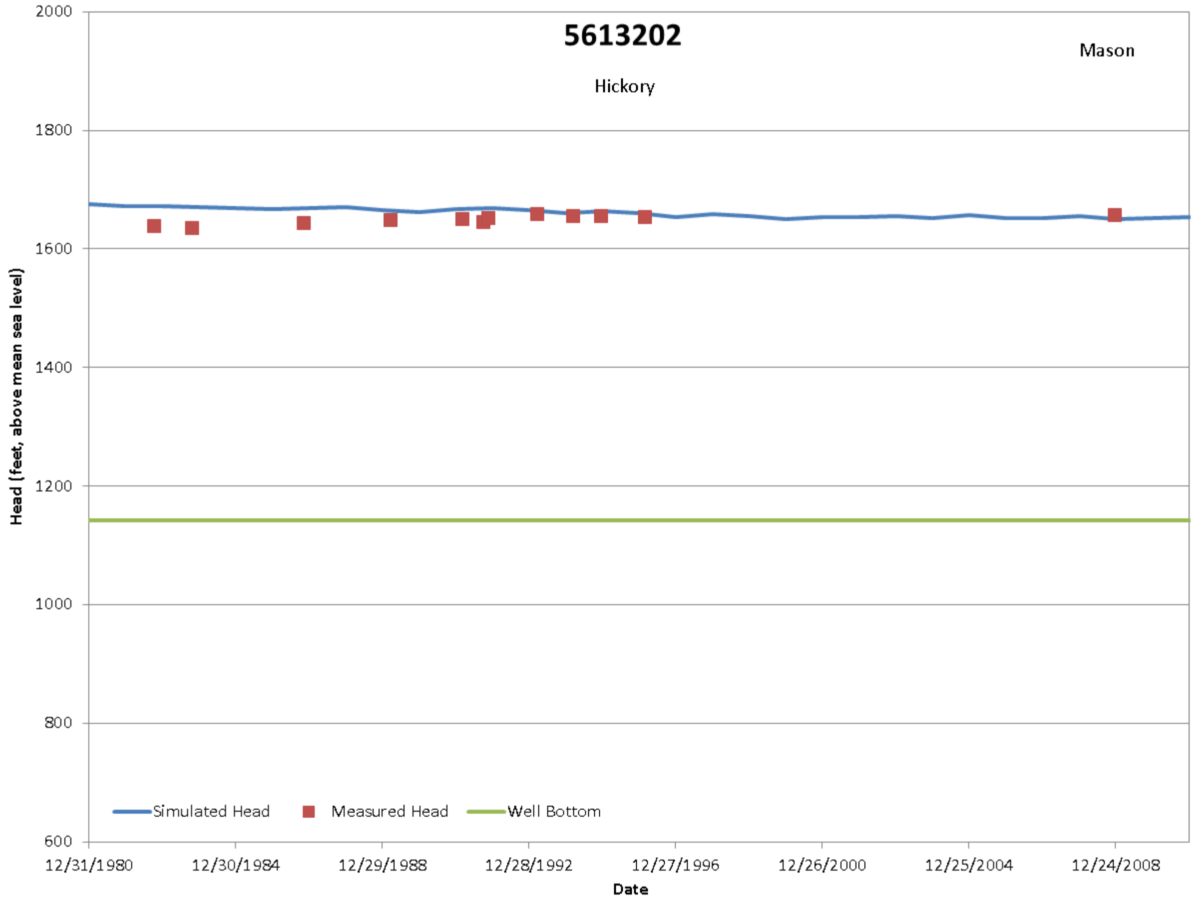

5608602
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

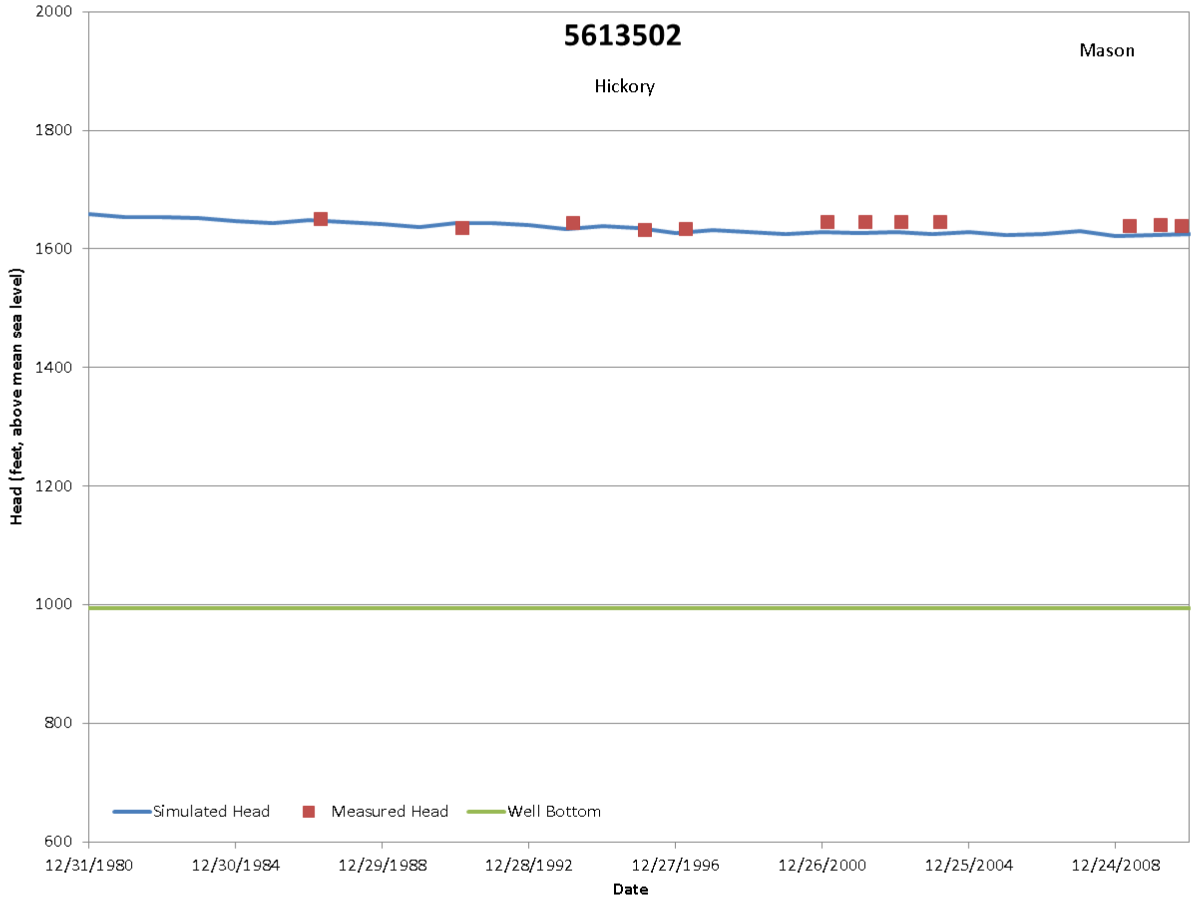


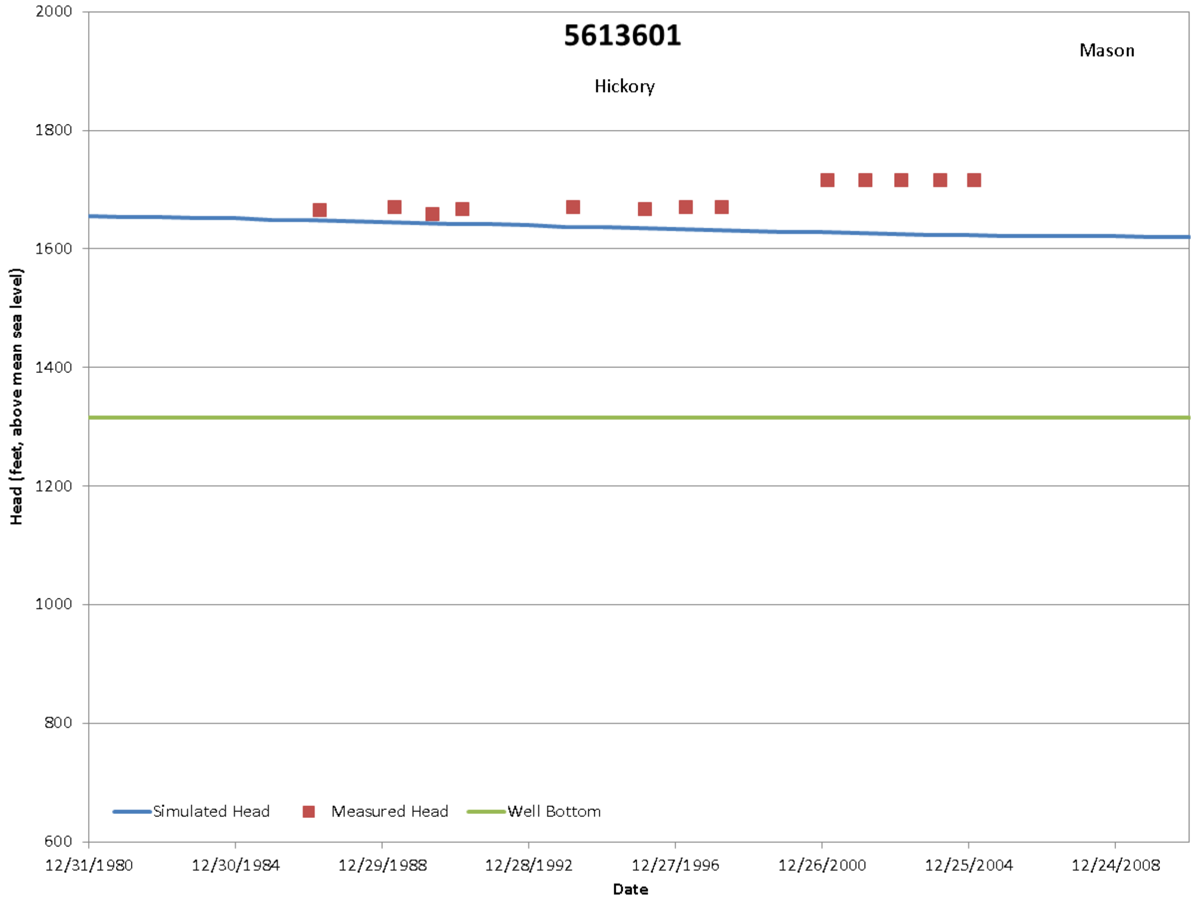
5608704
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

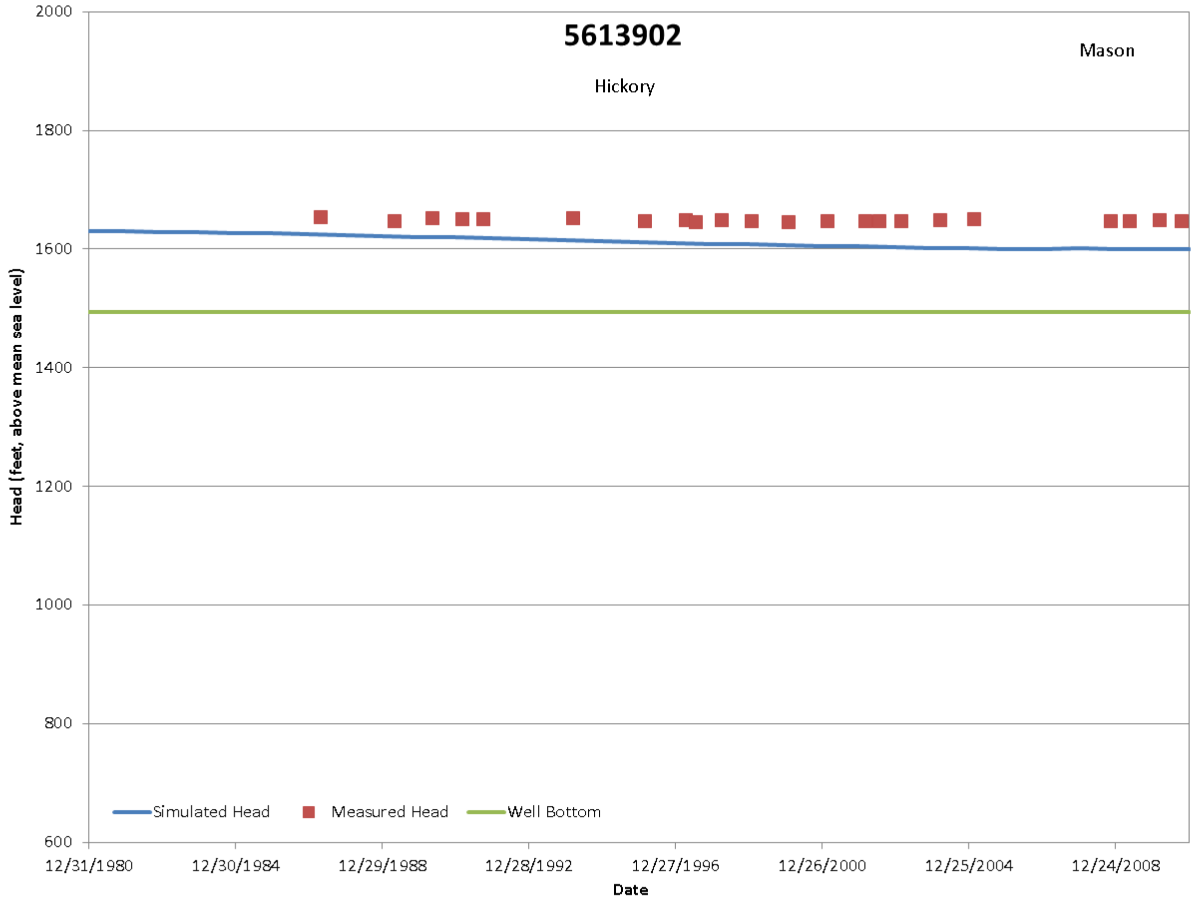

5608906
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

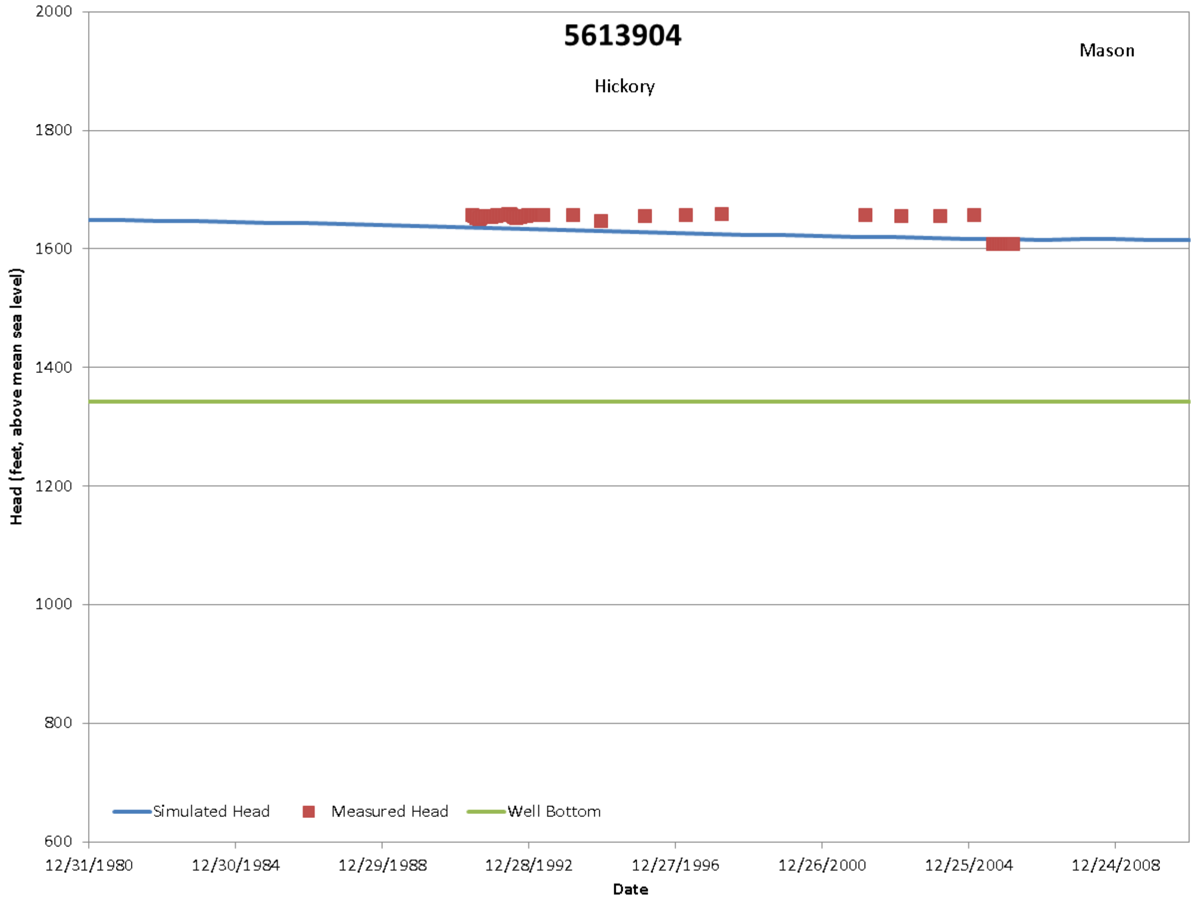

5612302
Menard
Ellenburger-San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

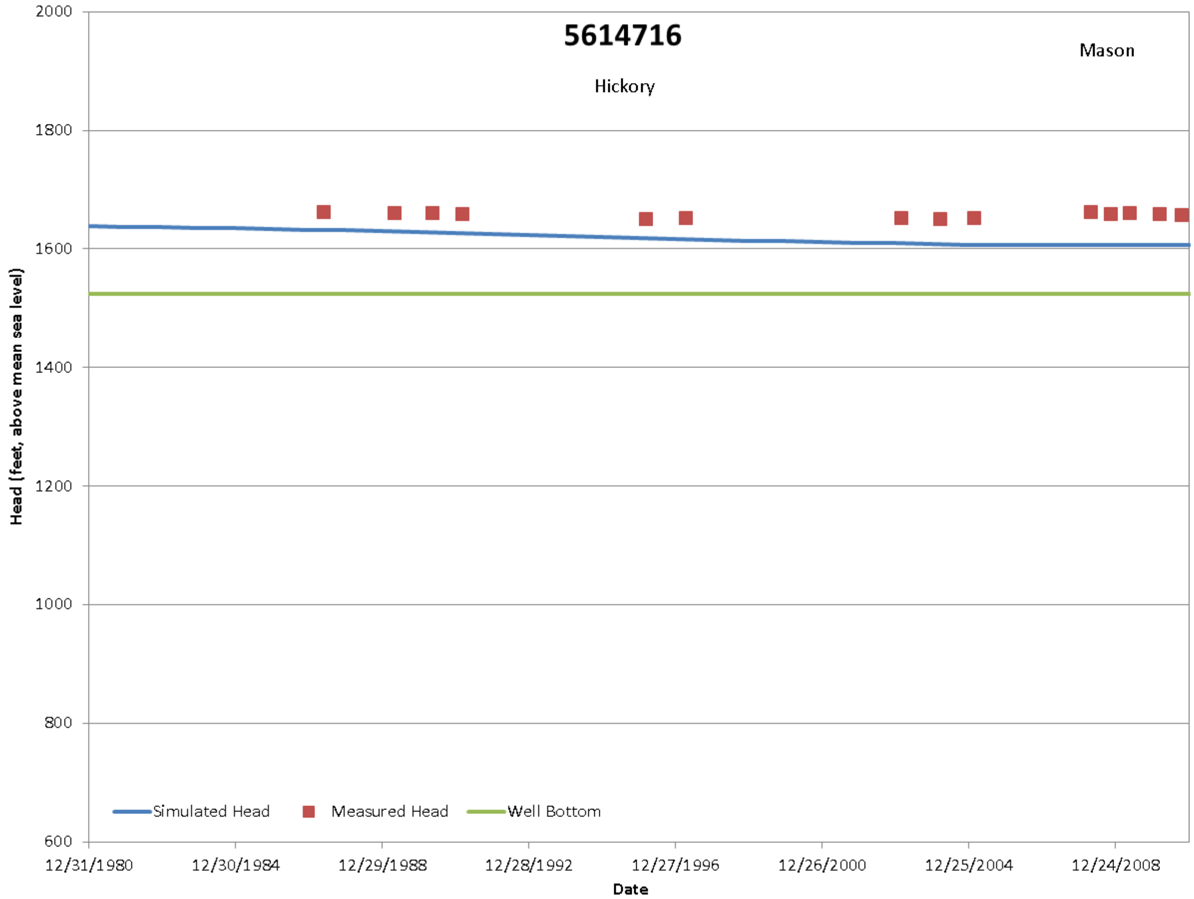

5613202
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

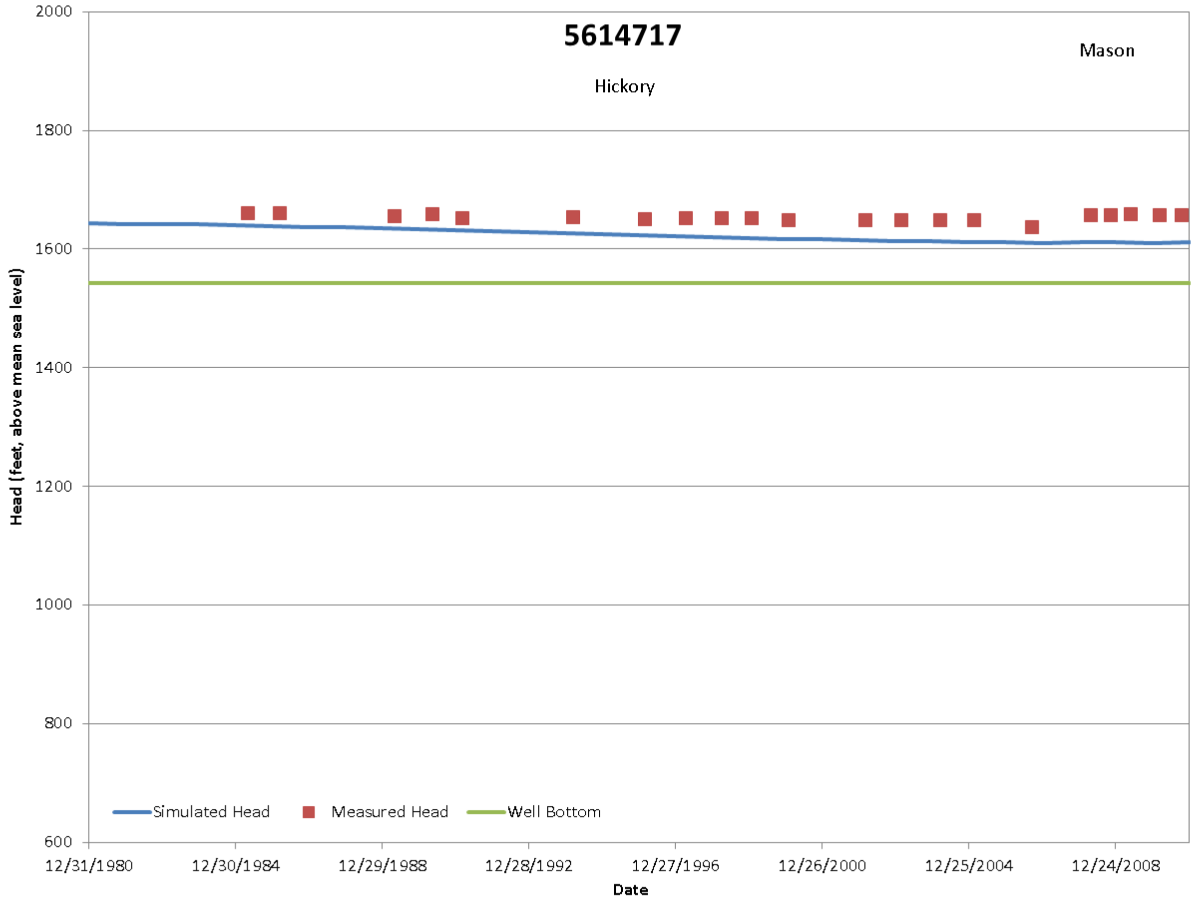

5613502
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

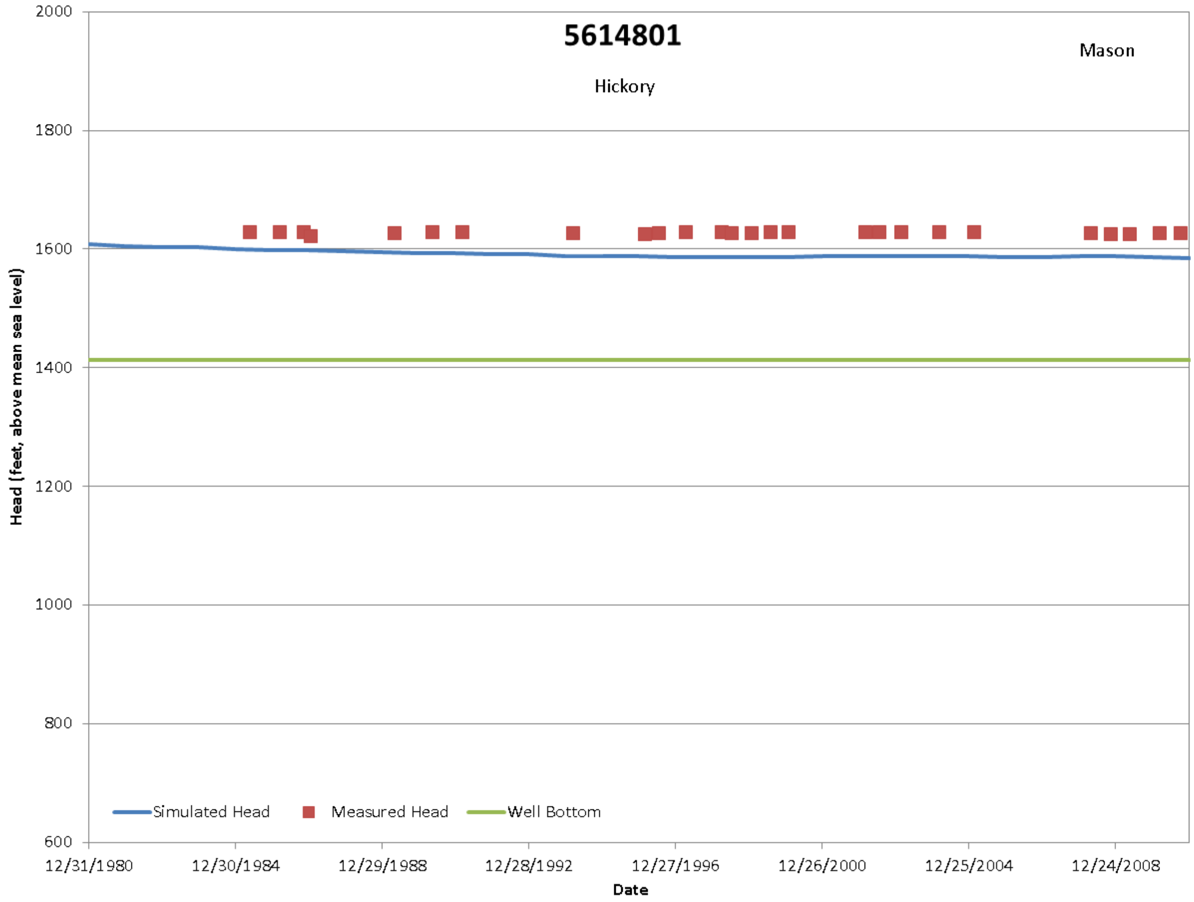

5613601
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom

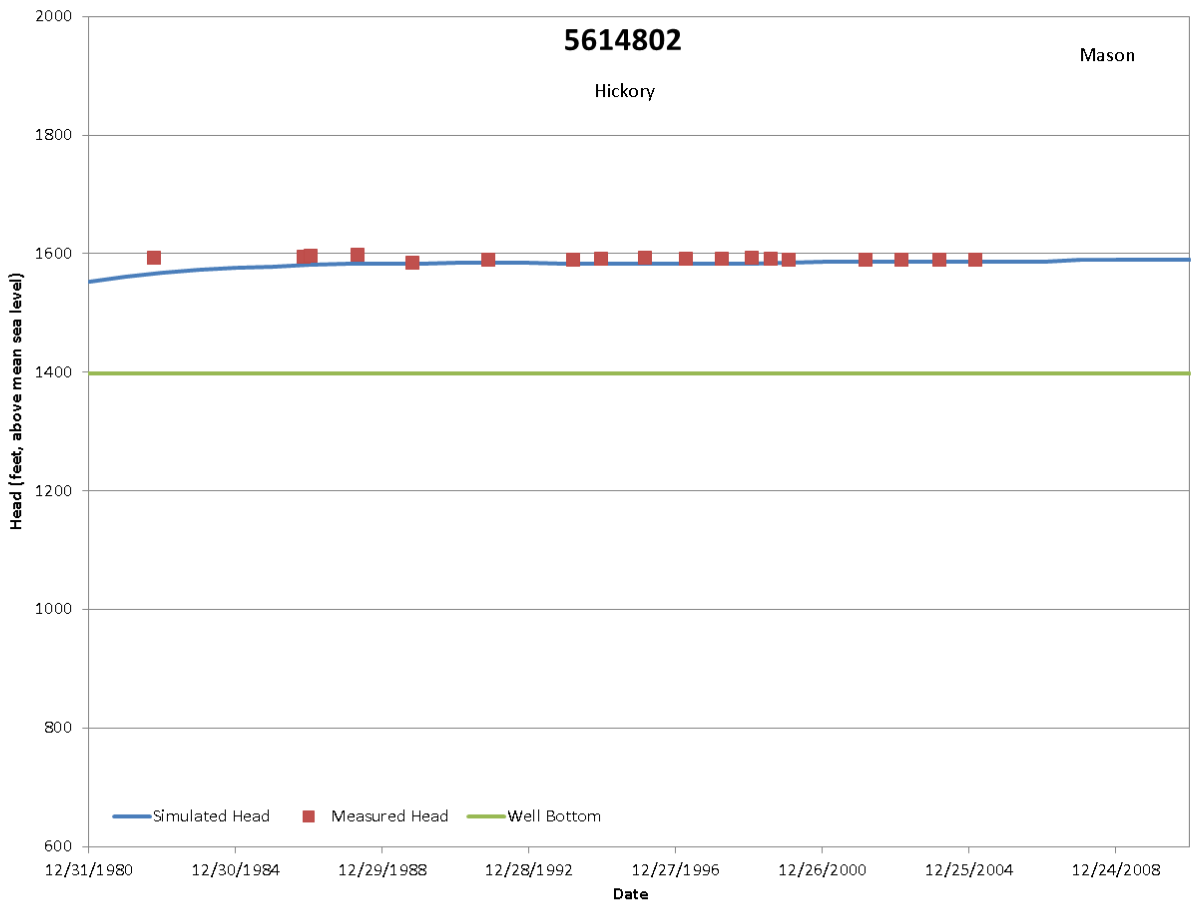

5613902
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom

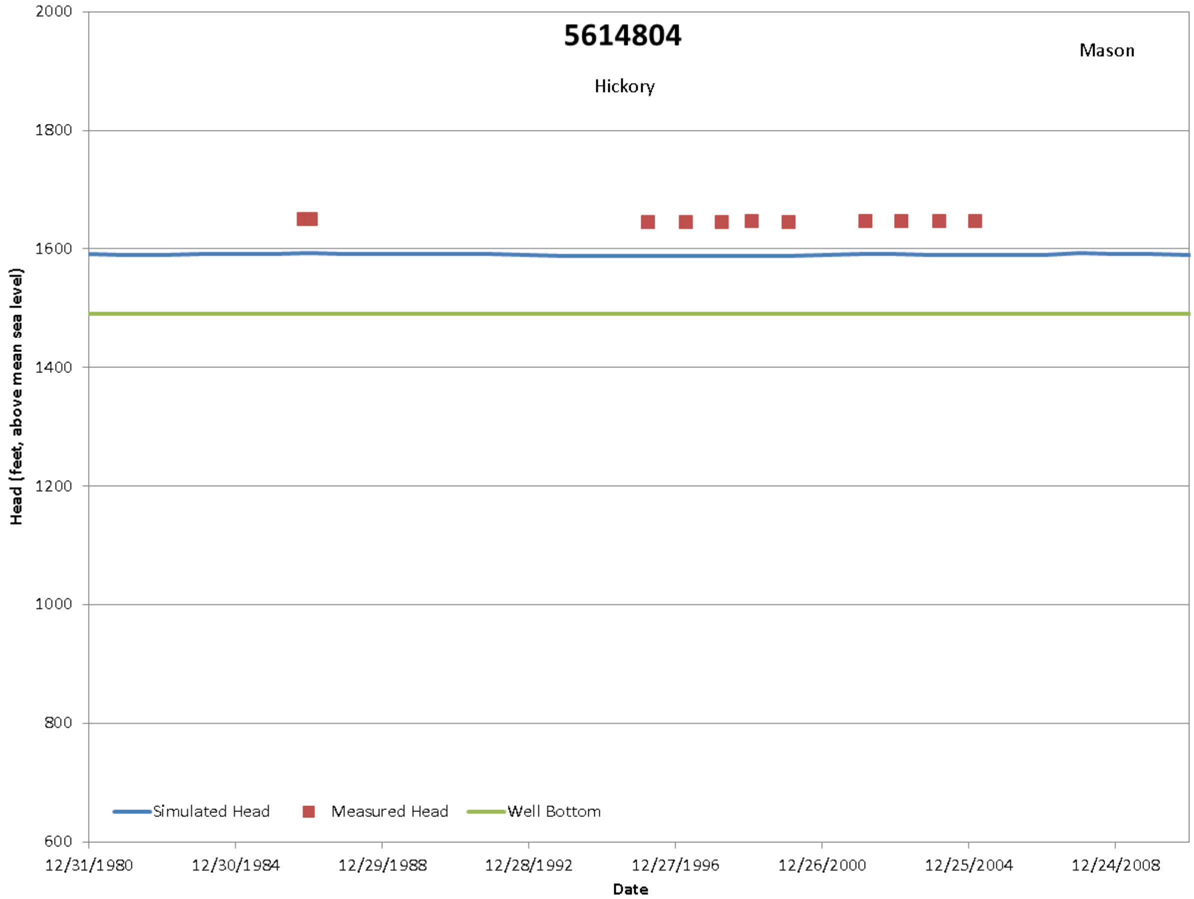

5613904
Hickory
Mason
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5614716
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

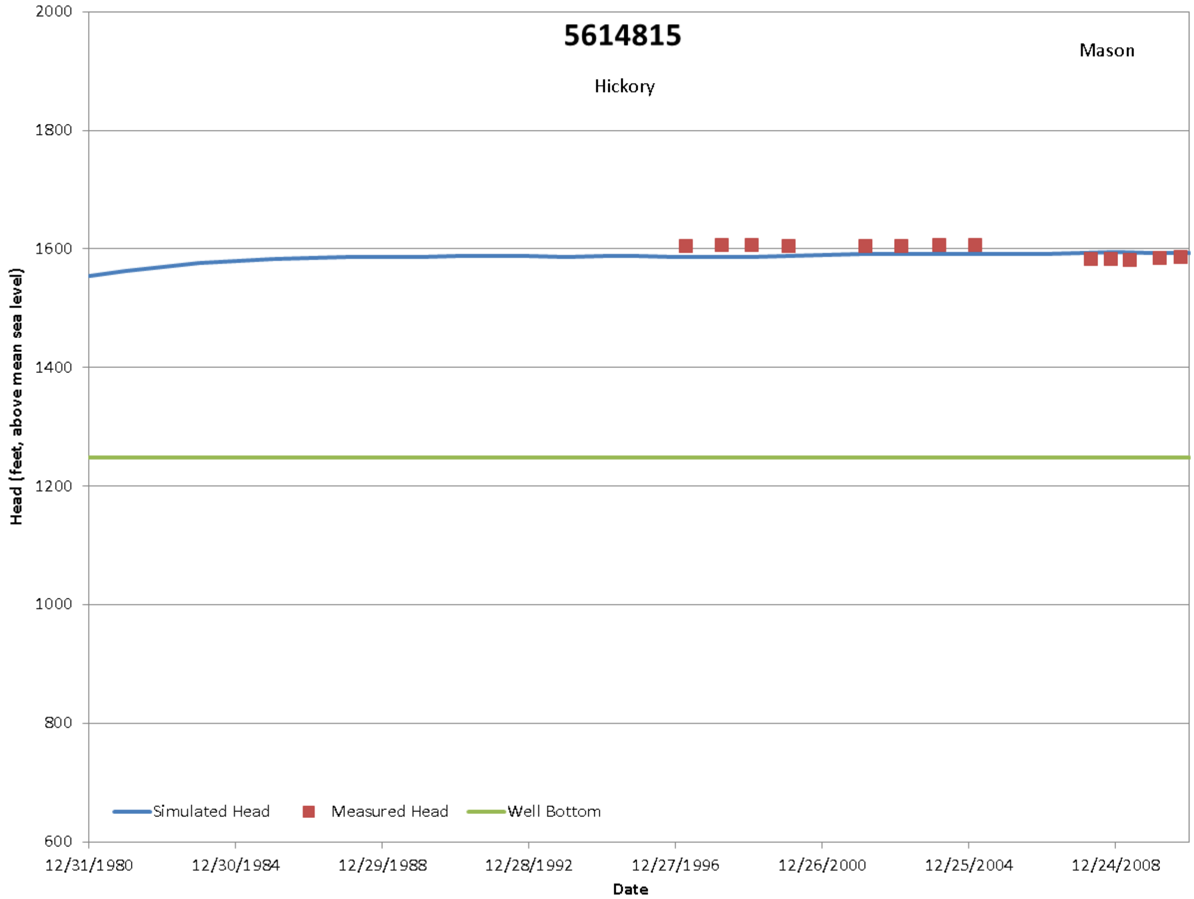

5614717
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5614801
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5614802
Hickory
Mason
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5614804
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5614812
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5614815
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
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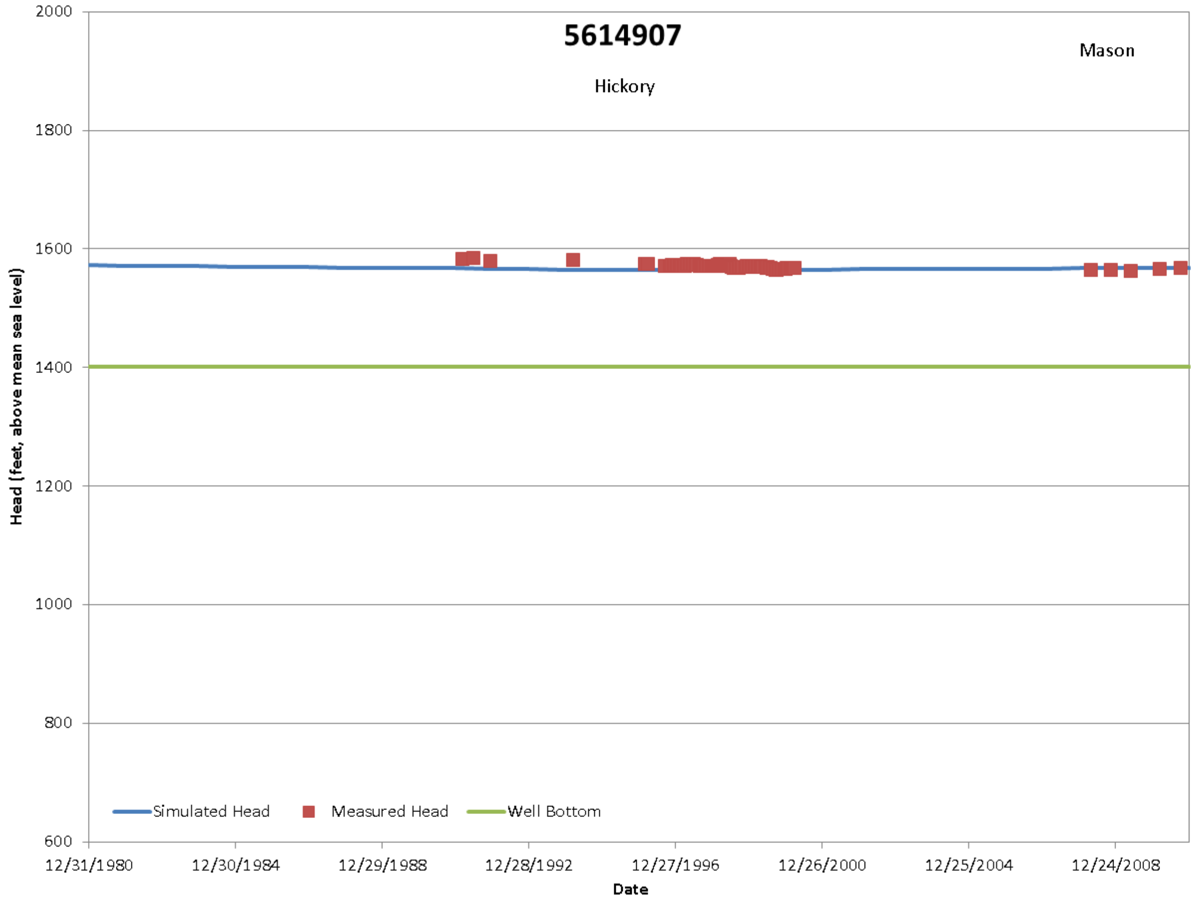
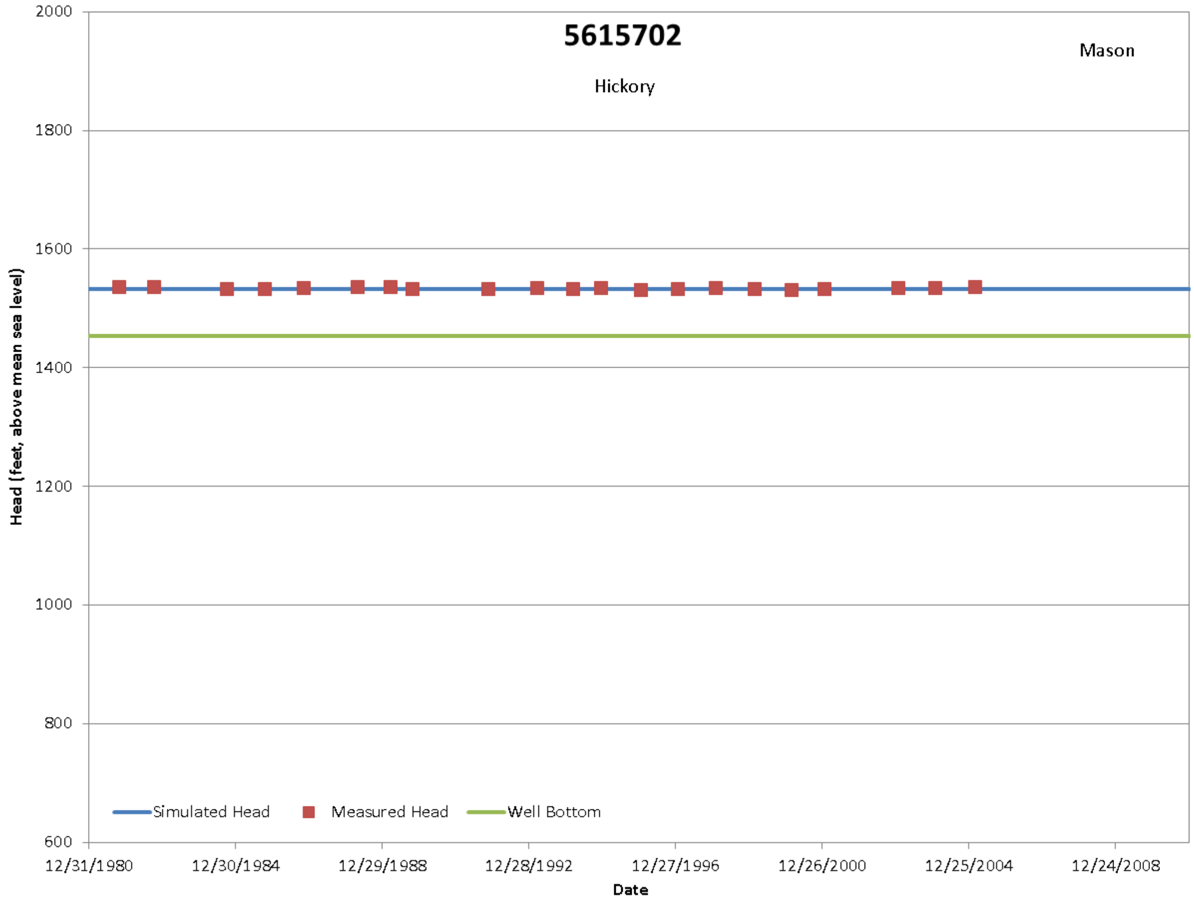
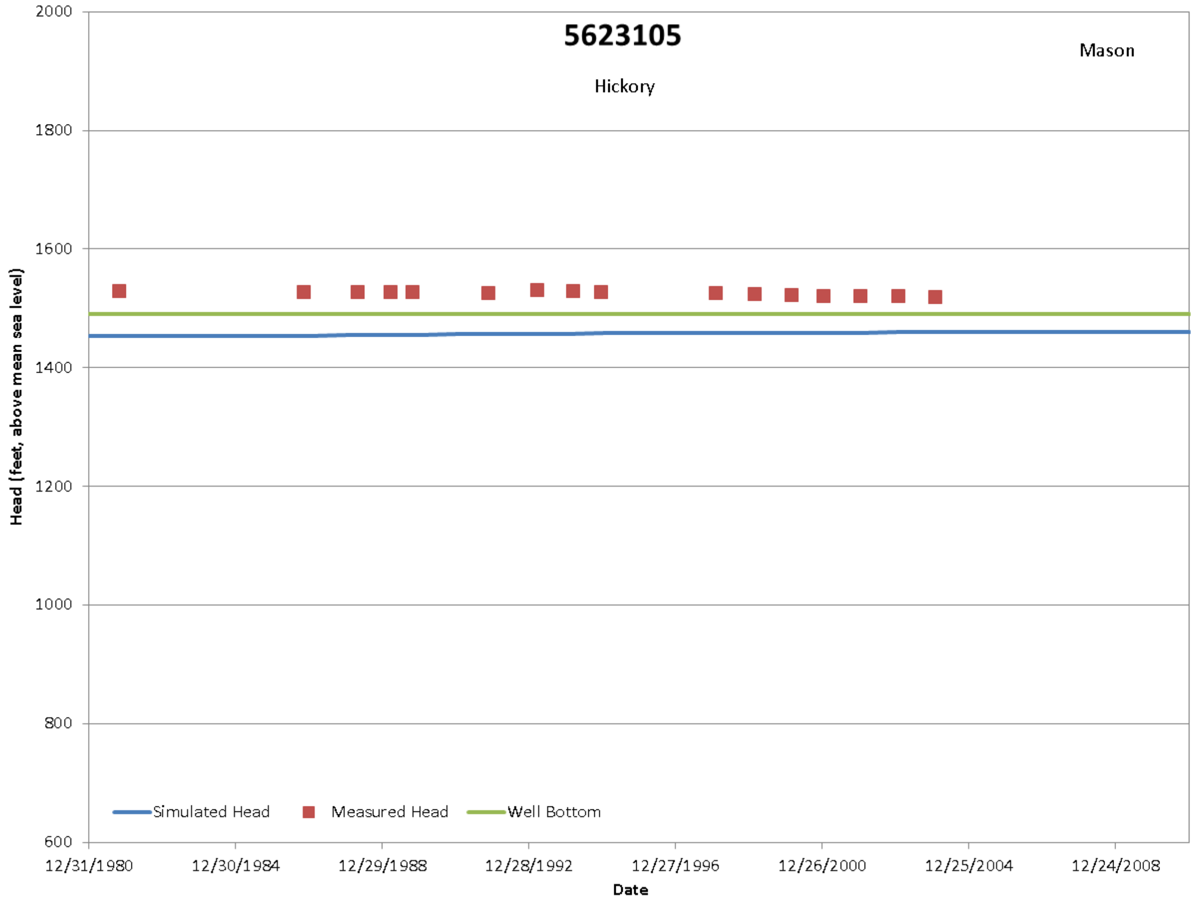
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

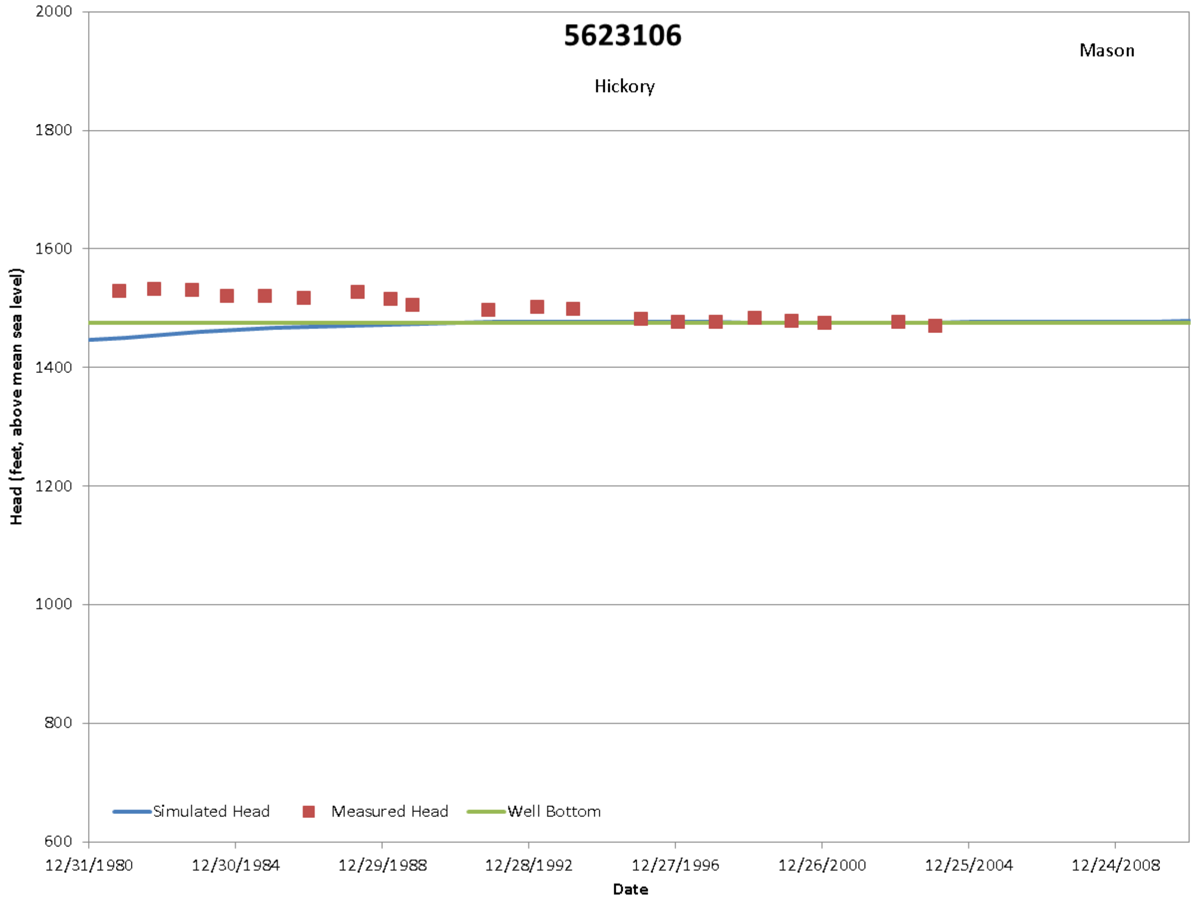

5614817
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date

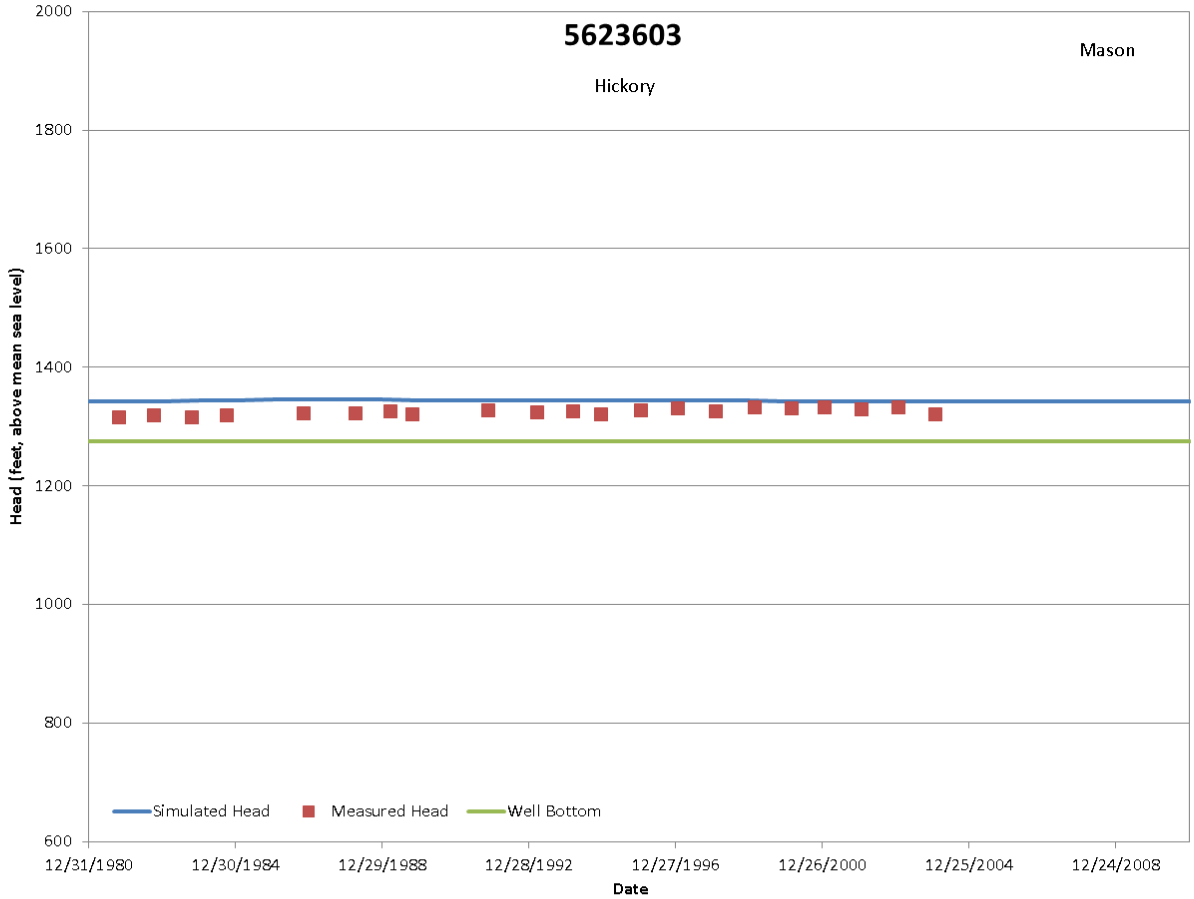

5614906
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5614907
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5615702
Hickory
Mason
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5623105
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5623106
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5623603
Mason
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
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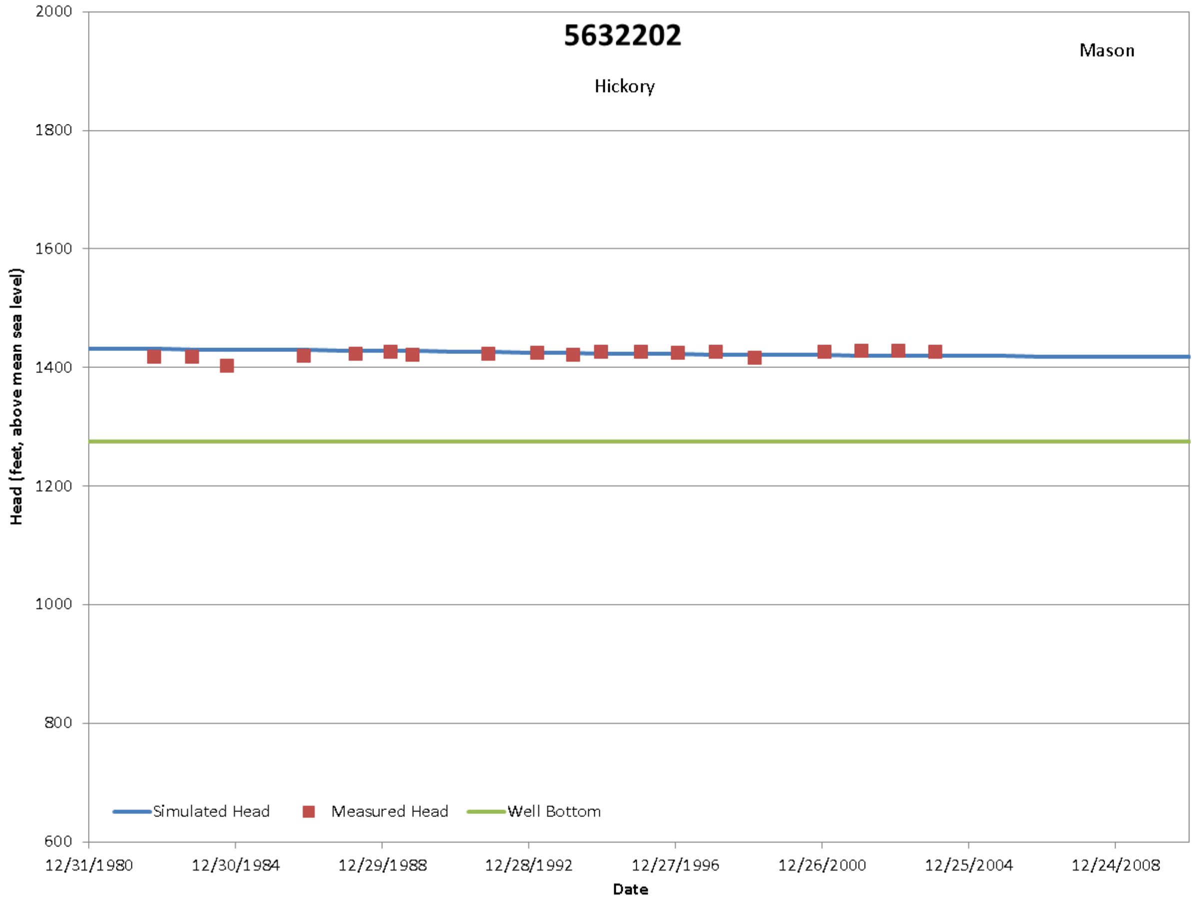
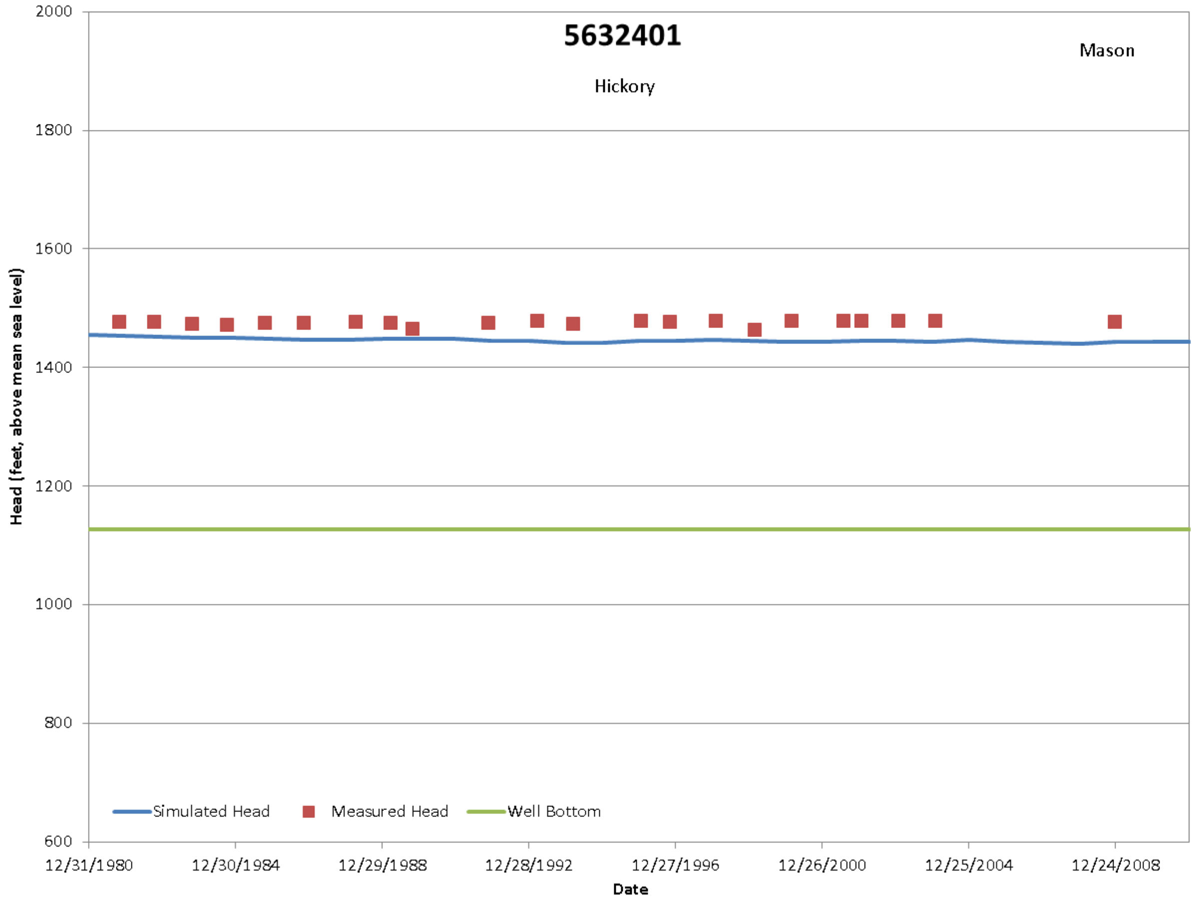
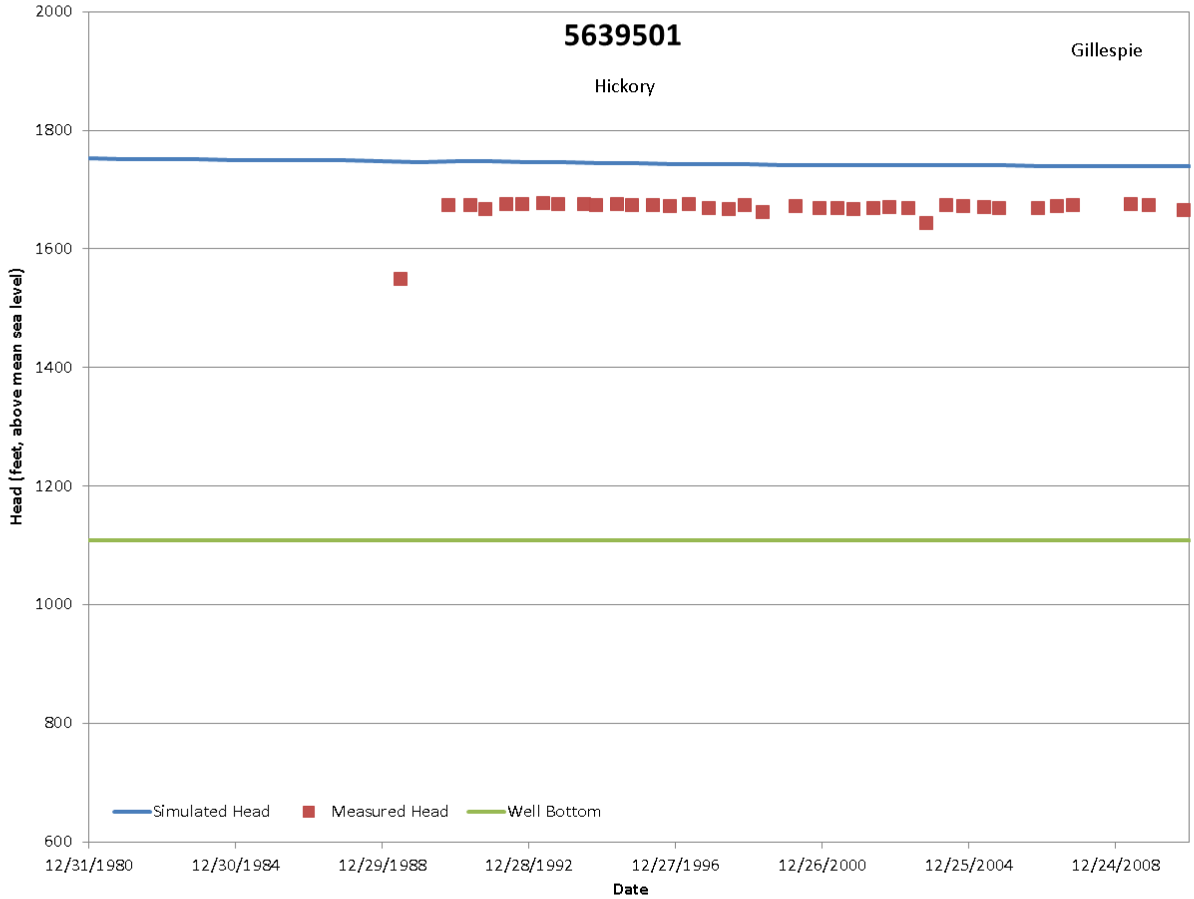
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5632202
Hickory
Mason
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5632401
Mason
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5639501
Hickory
Gillespie
Head (feet, above mean sea level)
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1800
1600
1400
1200
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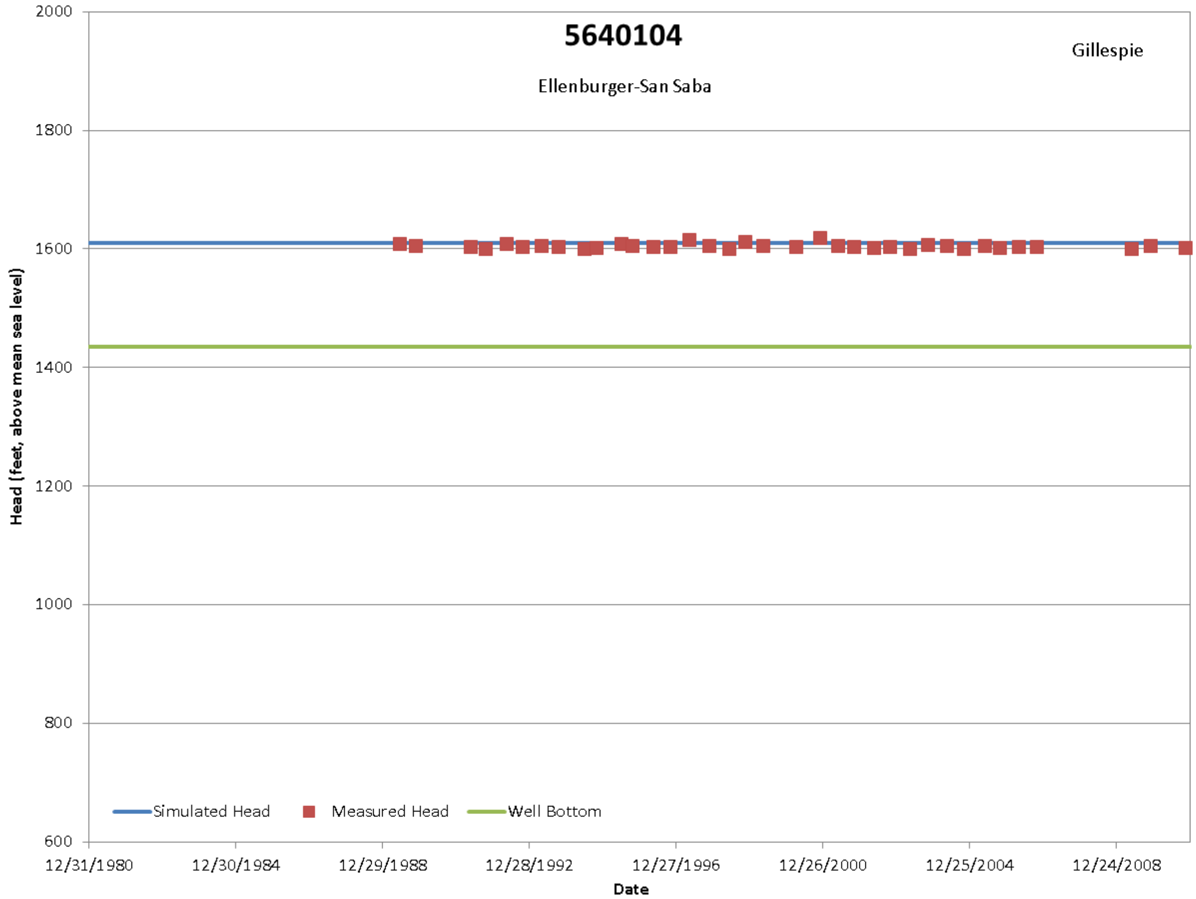
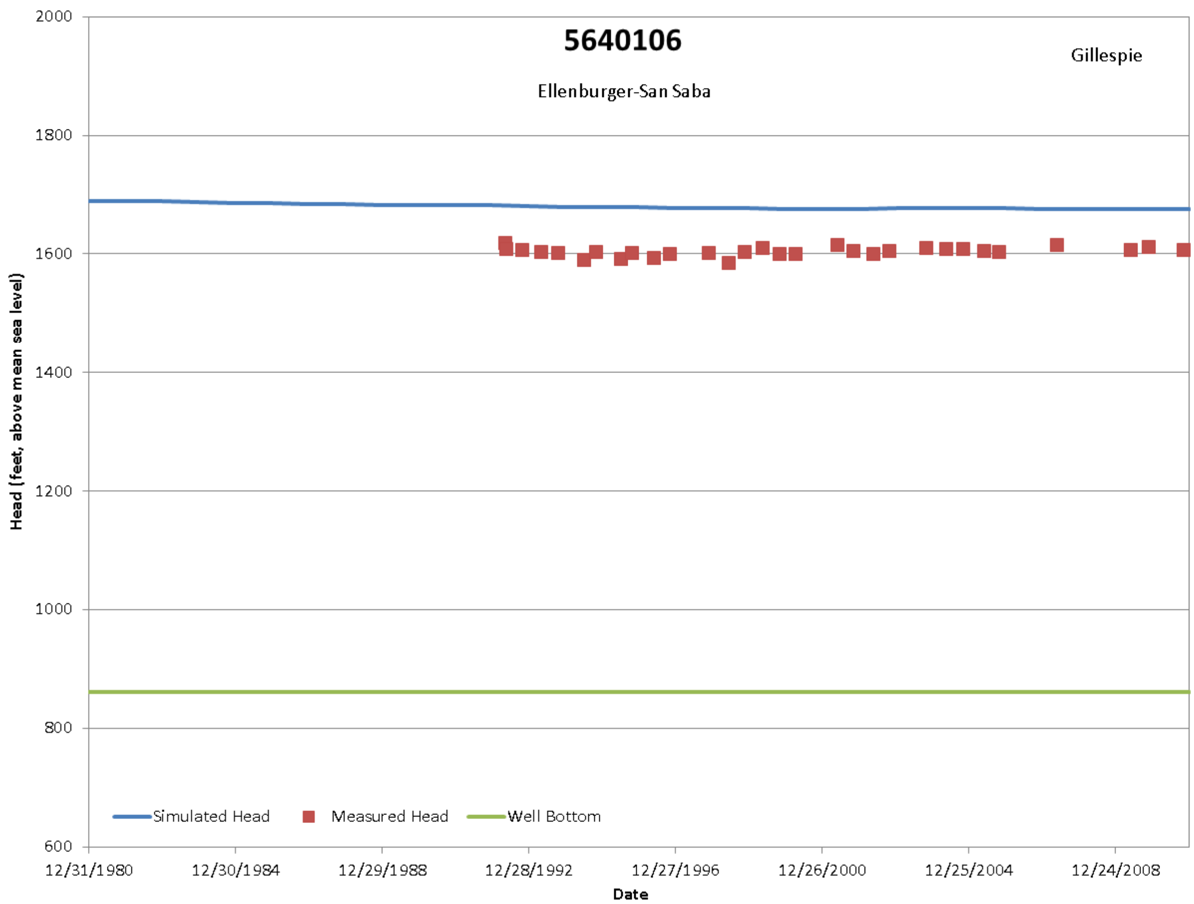
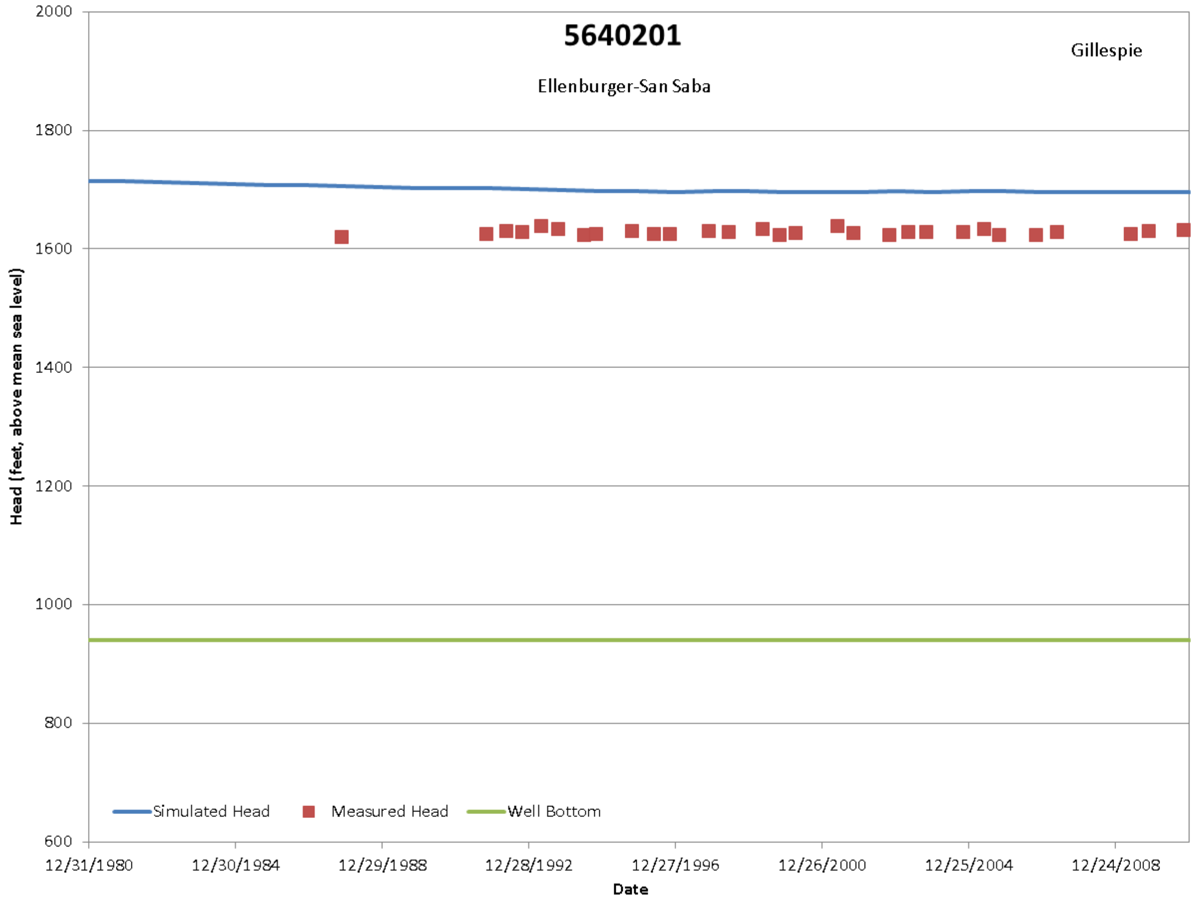
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5640104
Gillespie
Ellenburger-San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date



5640106
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5640201
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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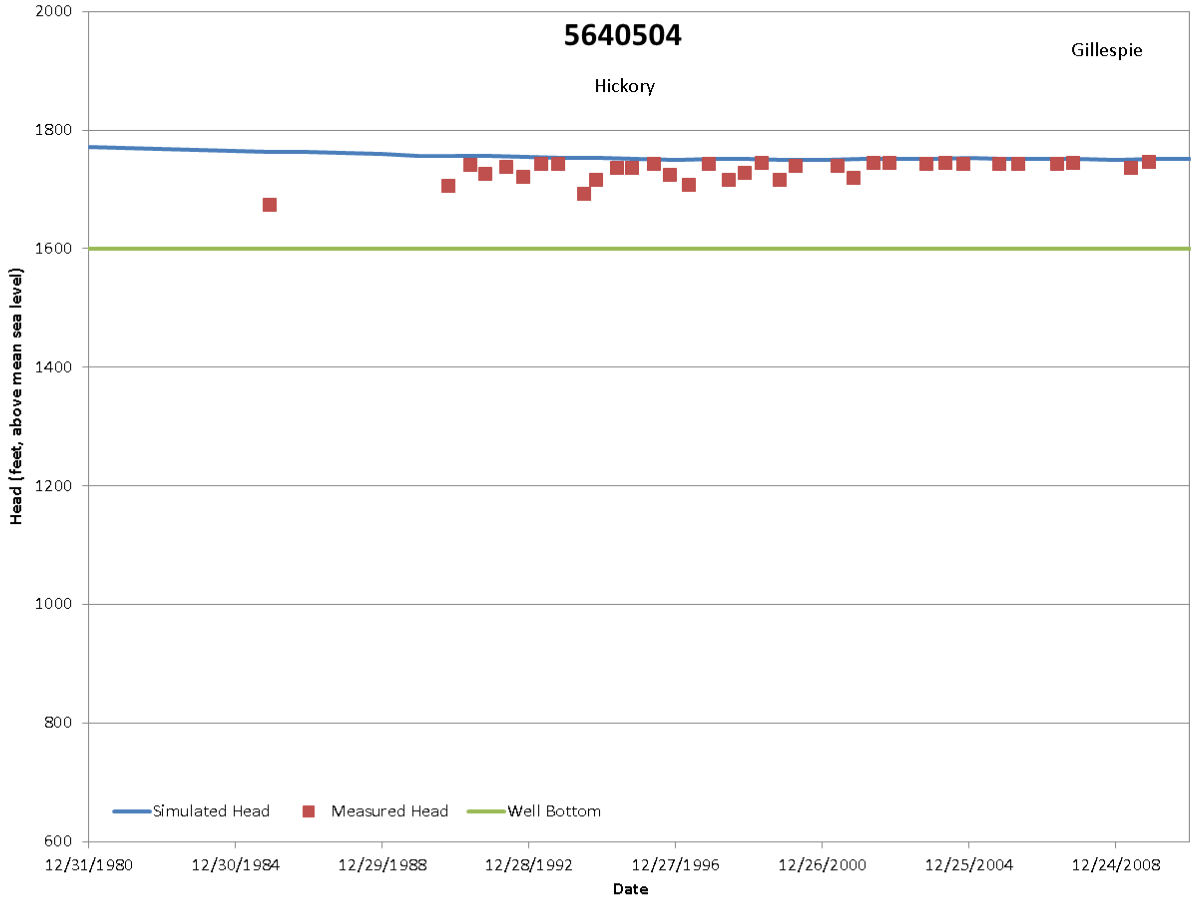
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5640504
Hickory
Gillespie
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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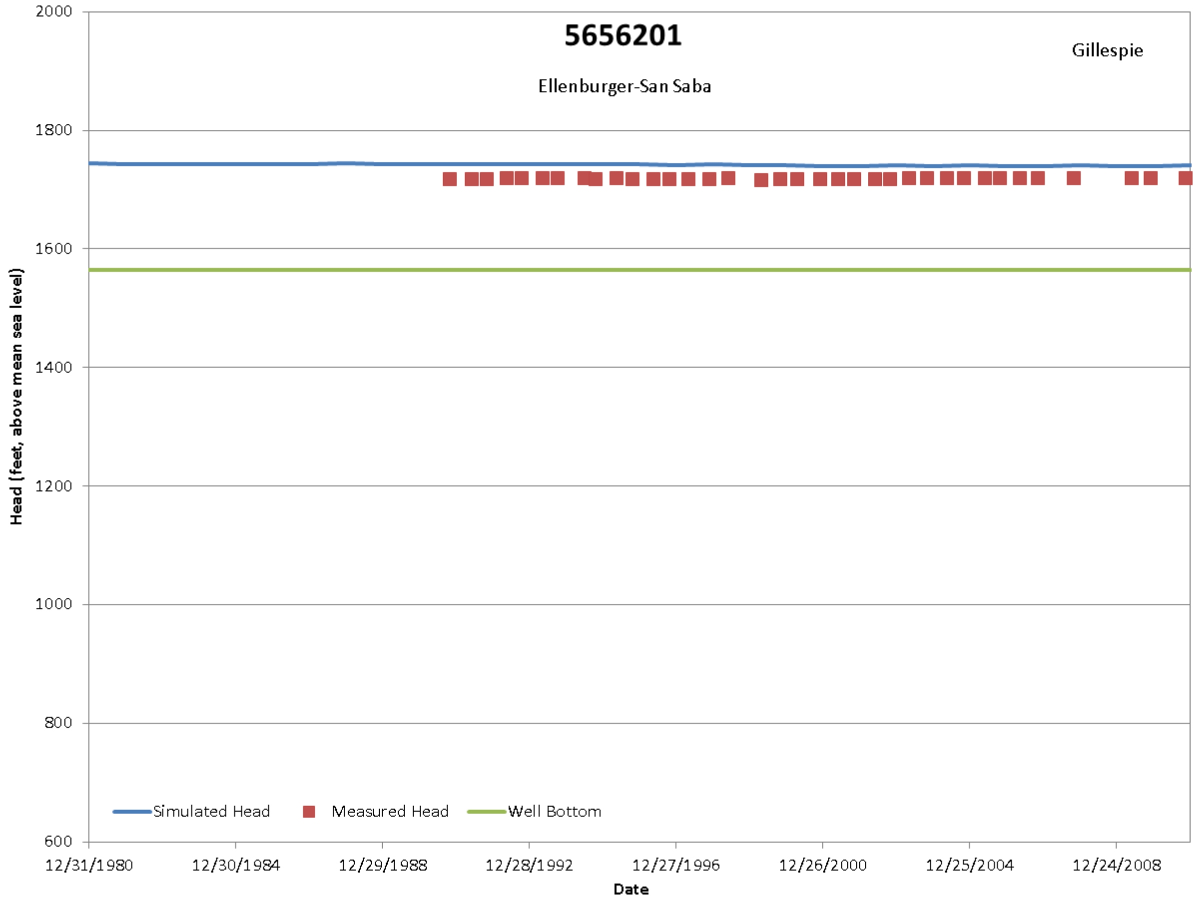
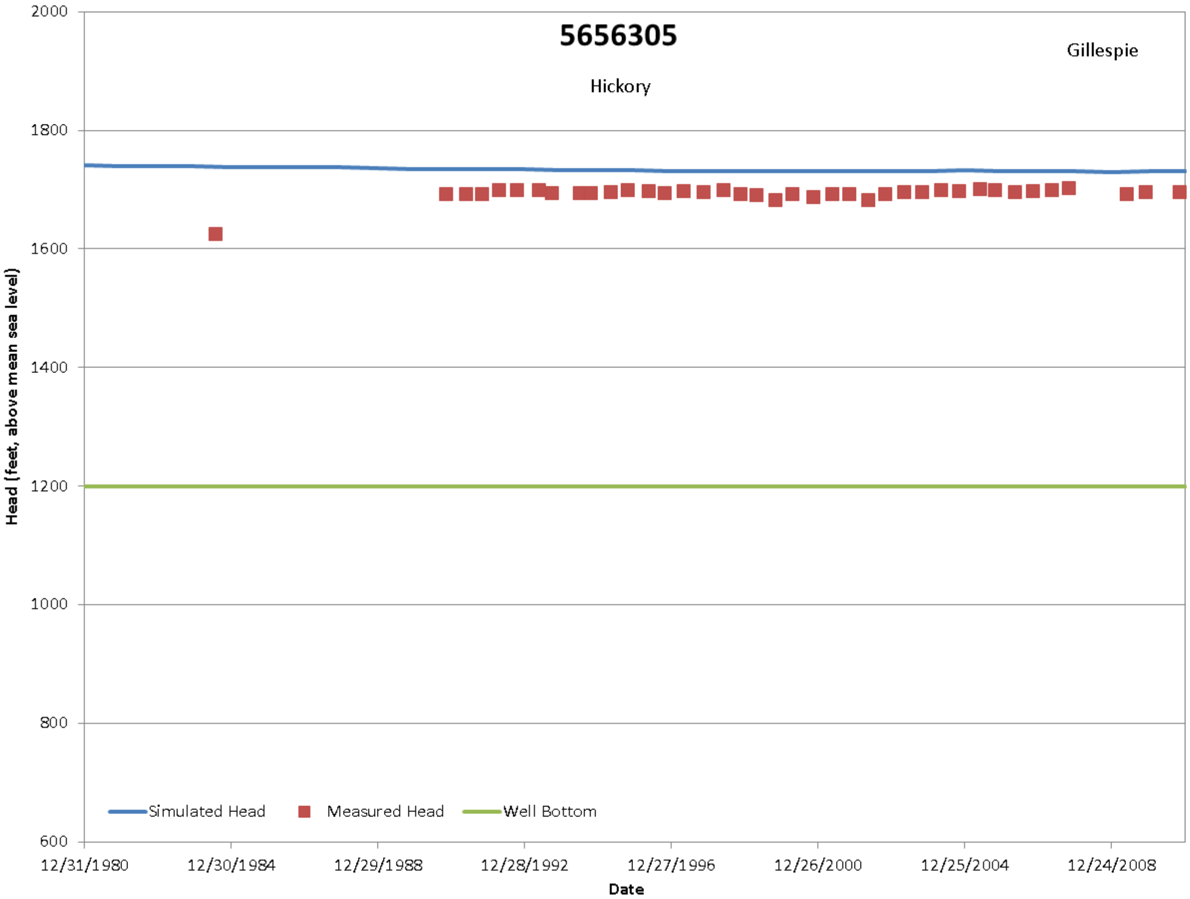
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5656201
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5656305
Hickory
Gillespie
Head (feet, above mean sea level)
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1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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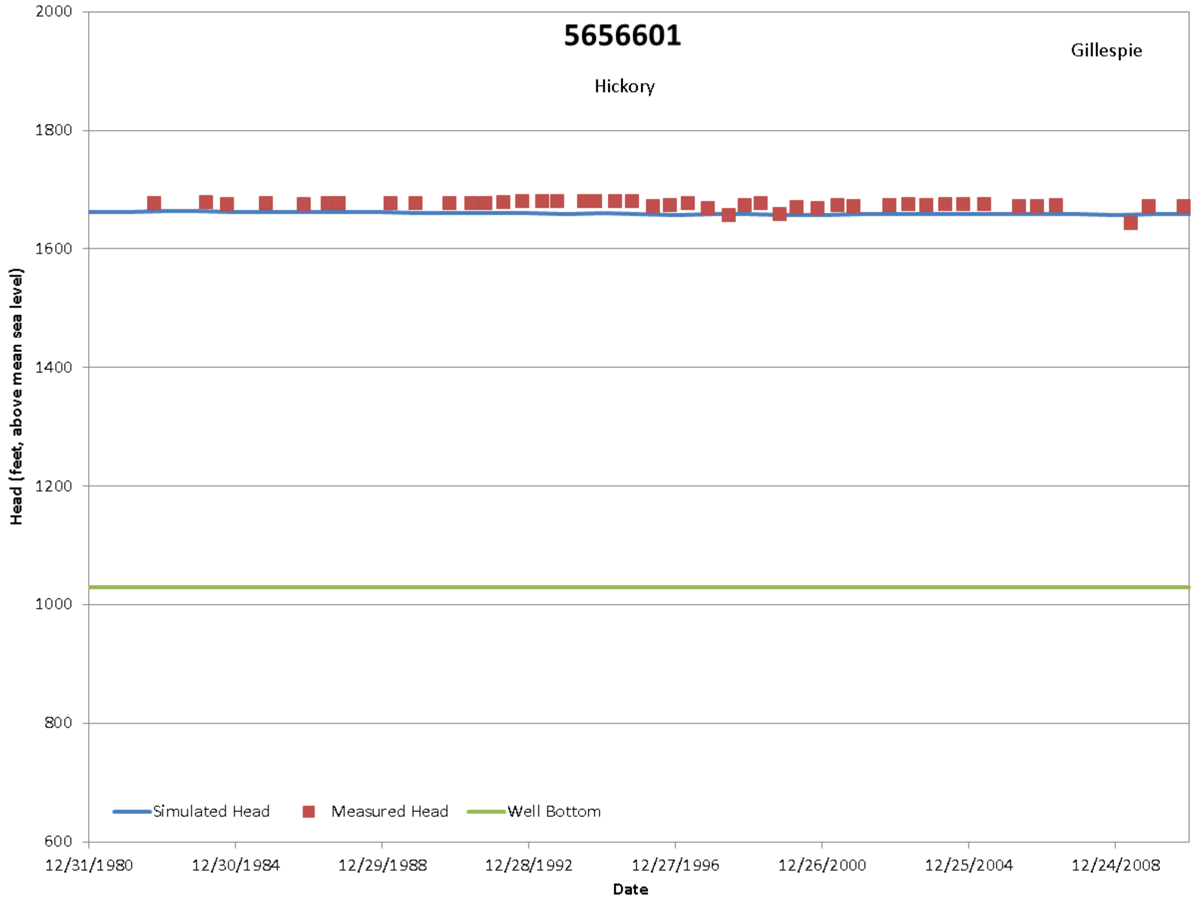
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5656601
Gillespie
Hickory
Head (feet, above mean sea level)
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1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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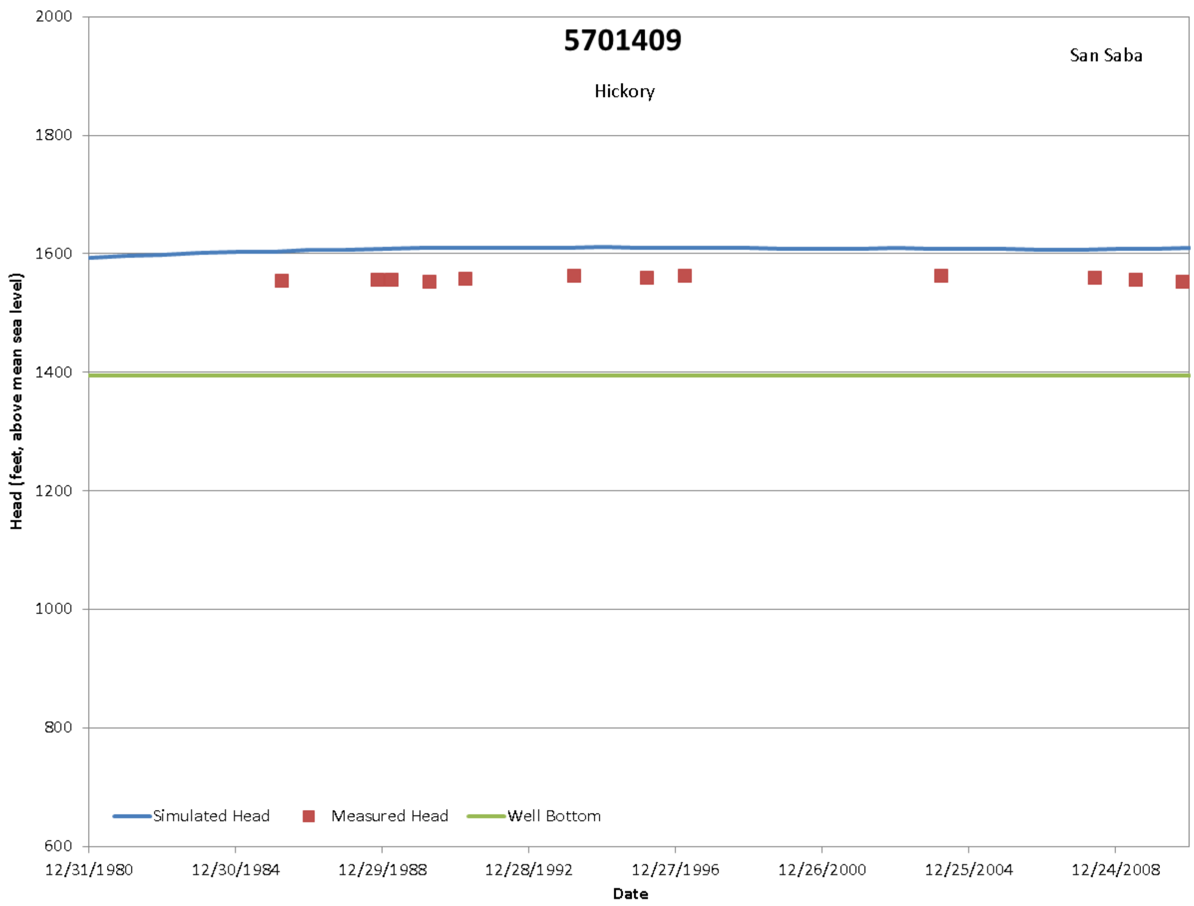
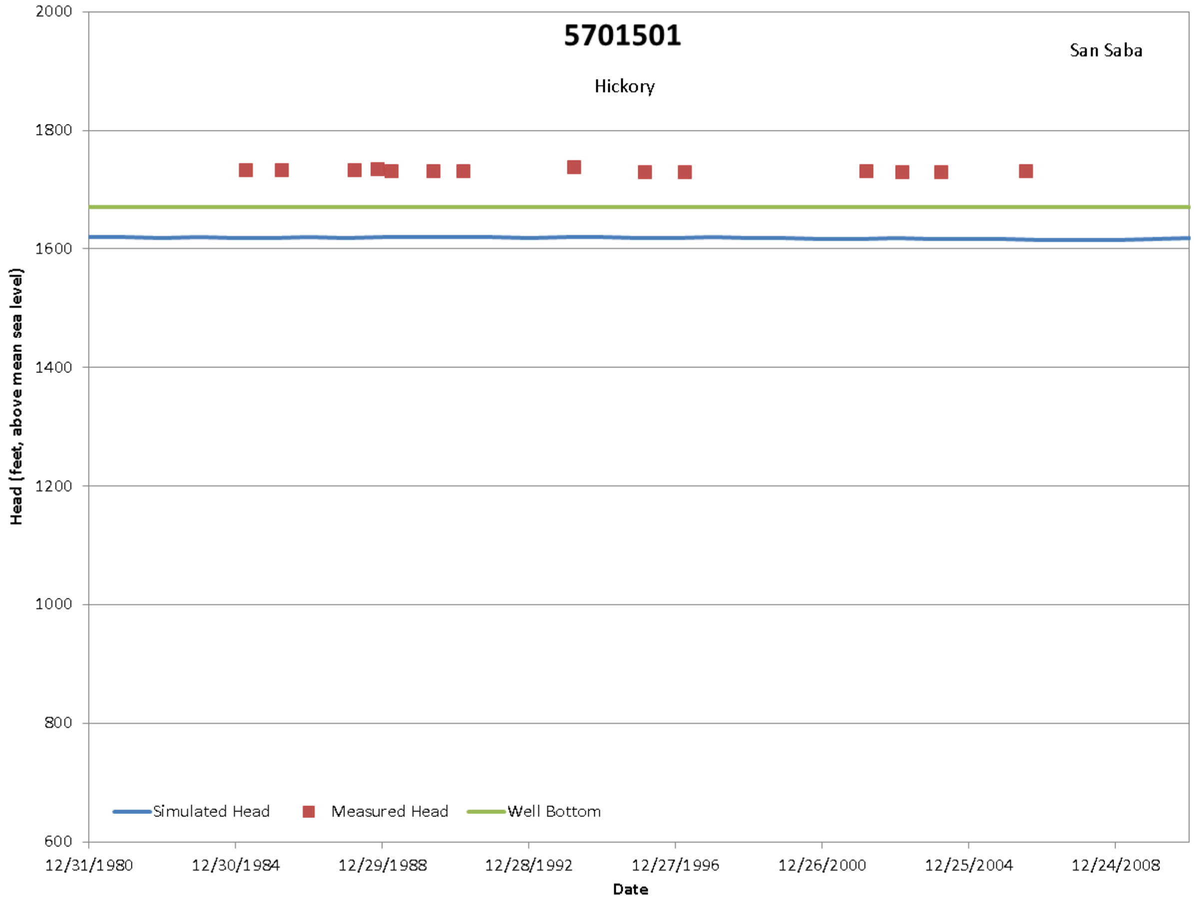
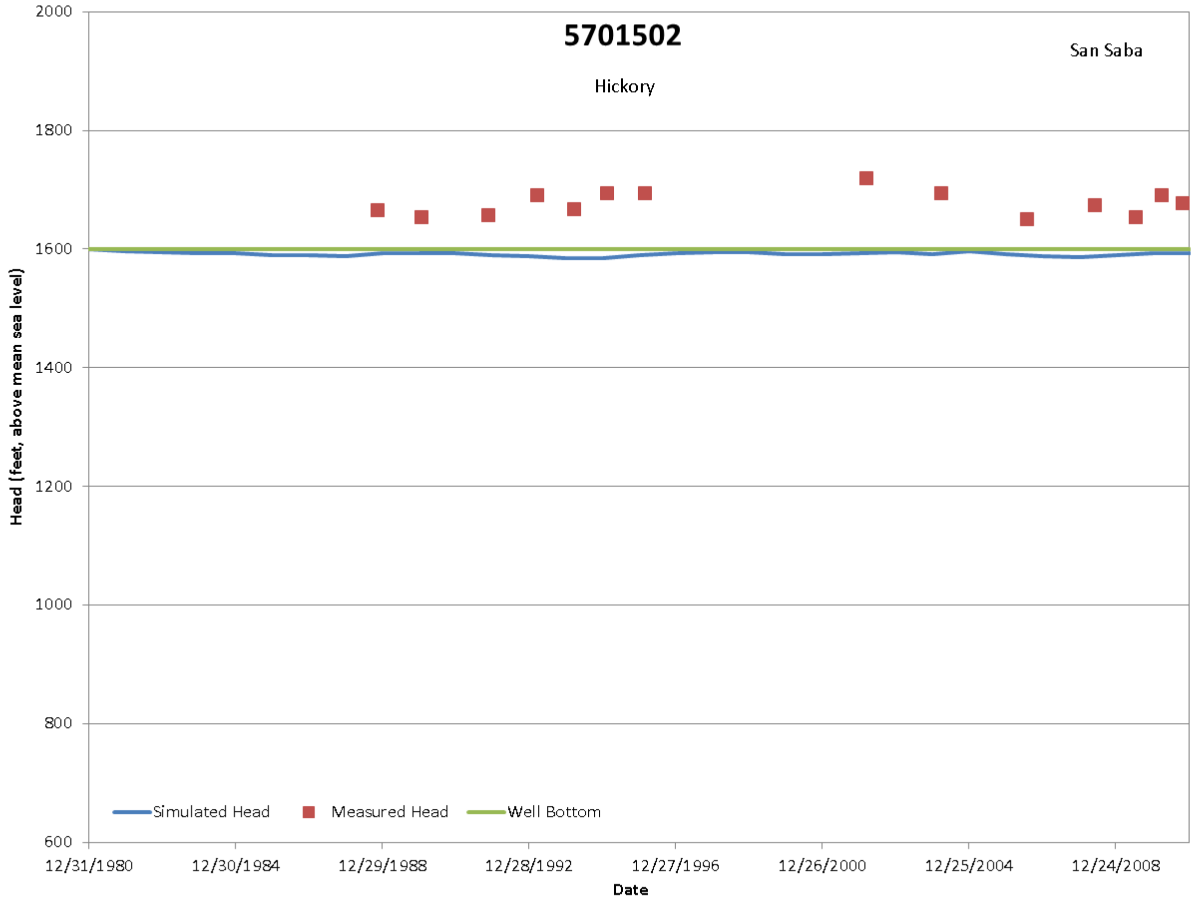
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5701409
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5701501
Hickory
San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5701502
Hickory
San Saba
Head (feet, above mean sea level)
2000
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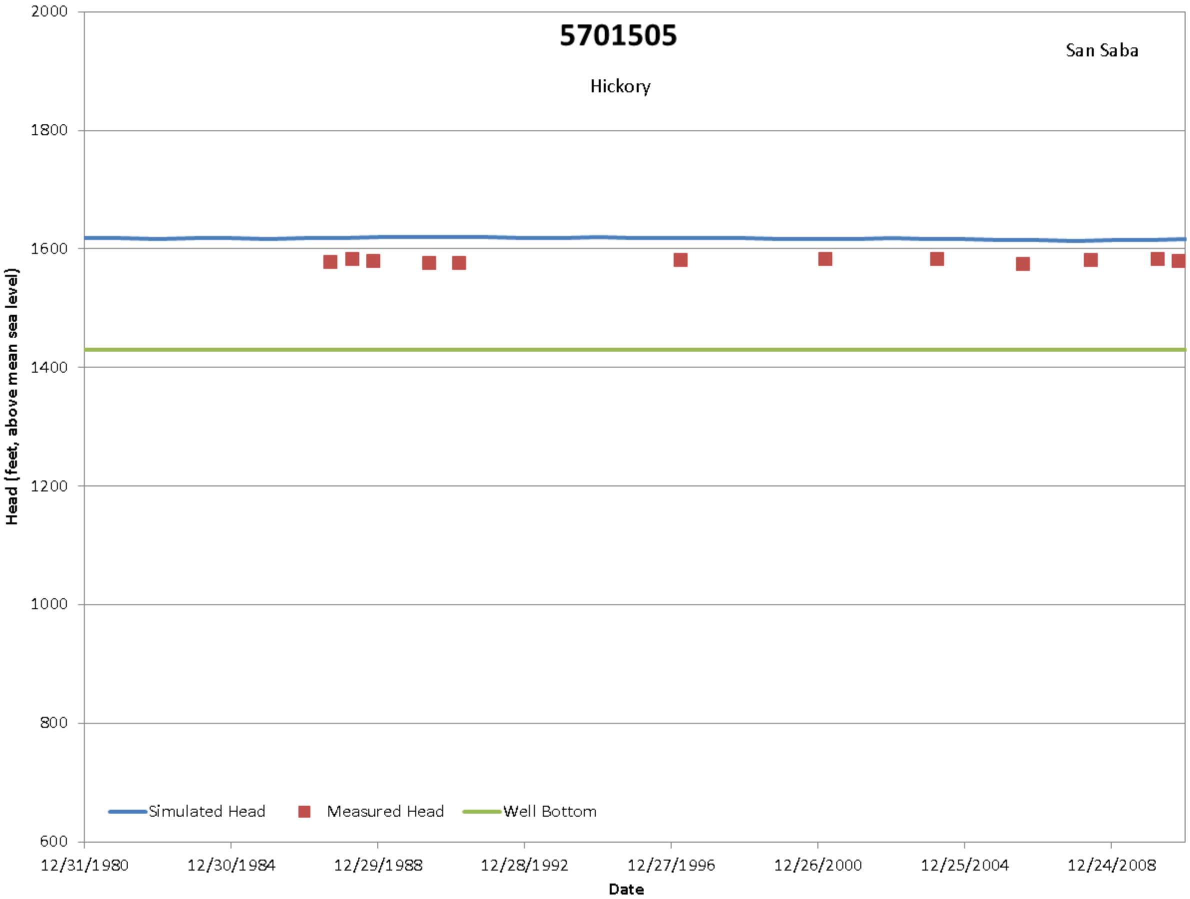
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5701505
Hickory
San Saba
Head (feet, above mean sea level)
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1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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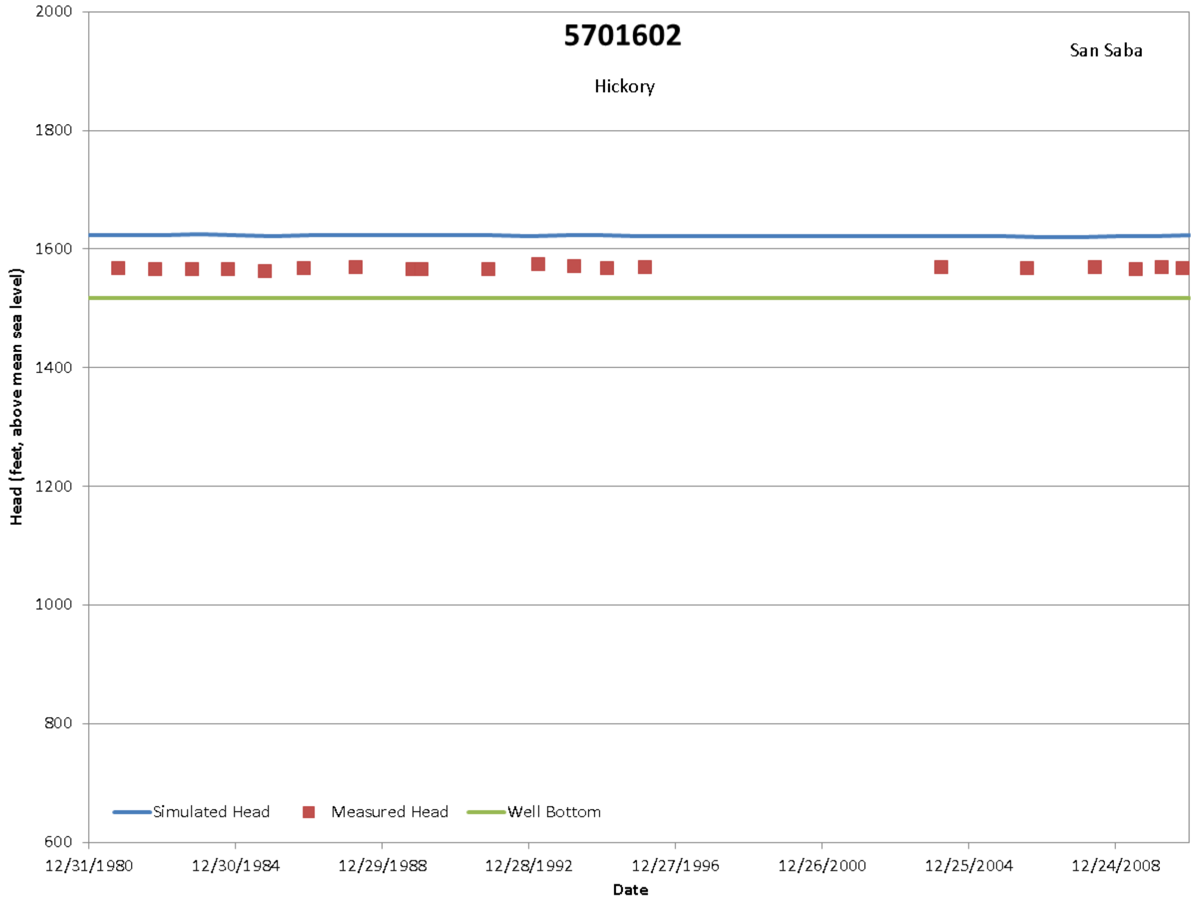
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5701602
Hickory
San Saba
Head (feet, above mean sea level)
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1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
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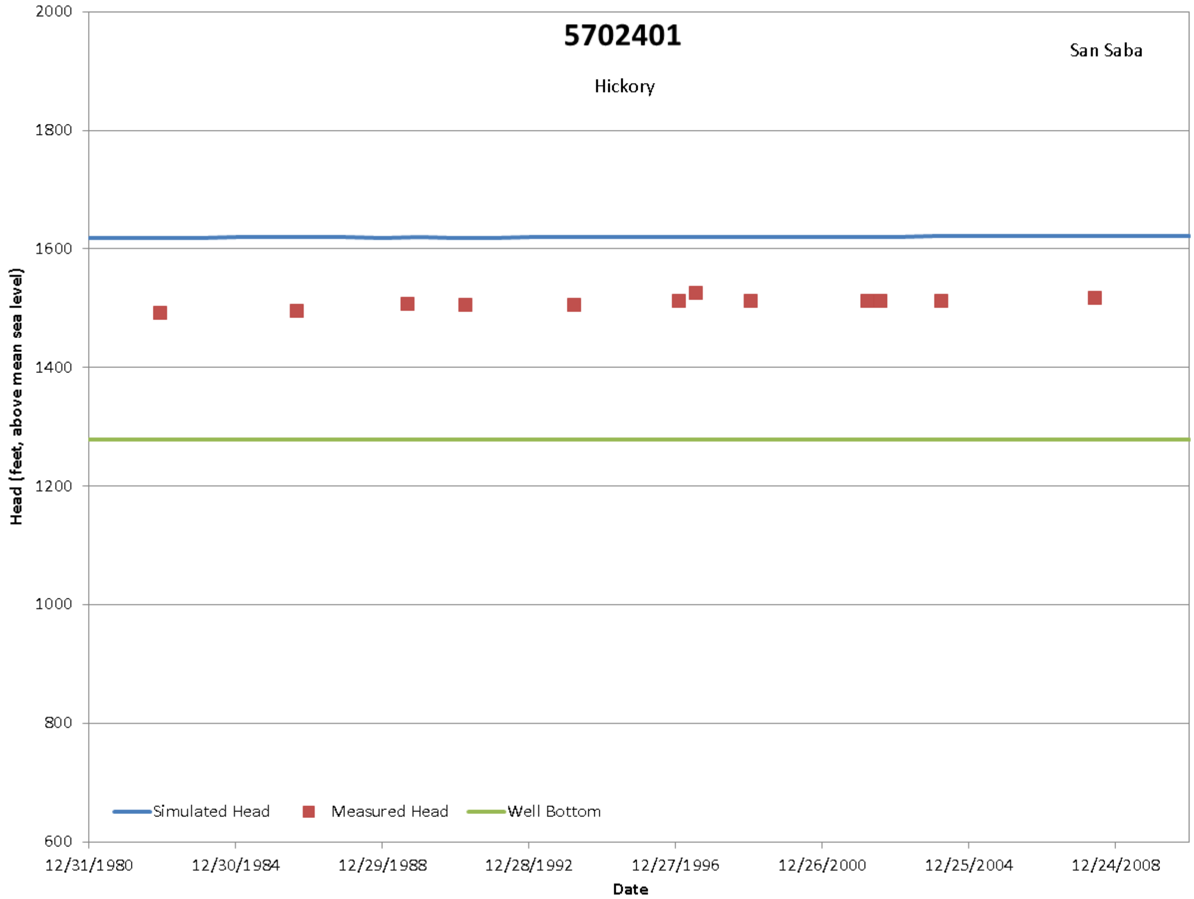
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5702401
Hickory
San Saba
Head (feet, above mean sea level)
2000
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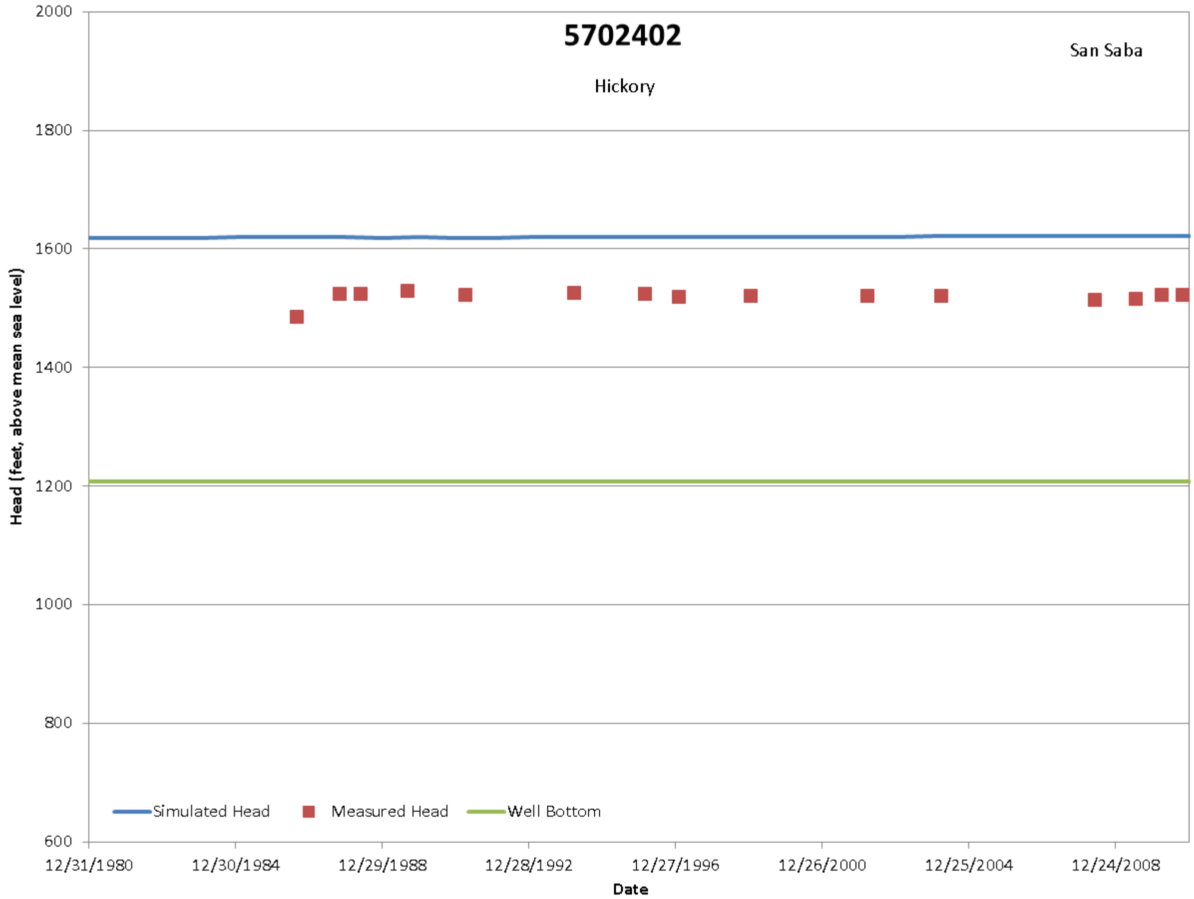
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5702402
Hickory
San Saba
Head (feet, above mean sea level)
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1400
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800
600
Simulated Head
Measured Head
Well Bottom
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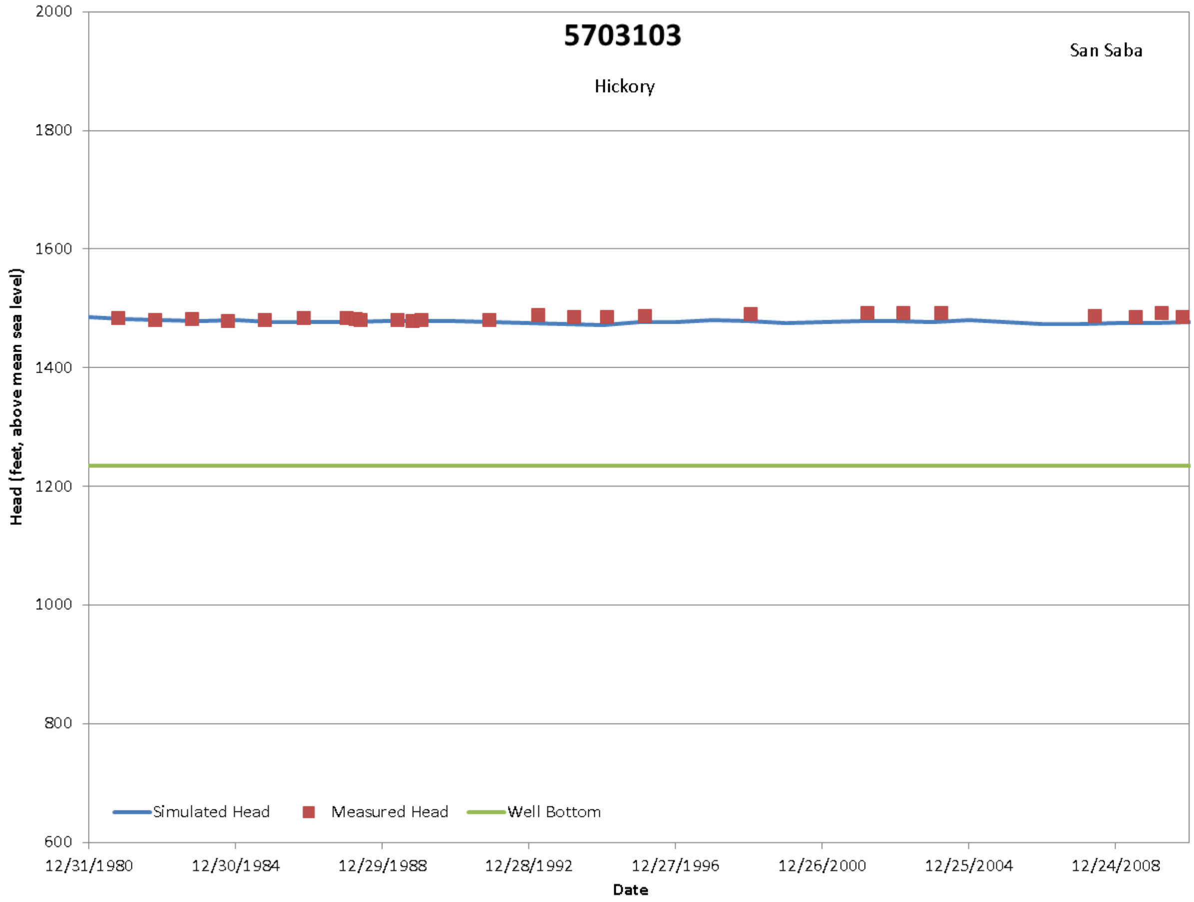
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5703103
Hickory
San Saba
Head (feet, above mean sea level)
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1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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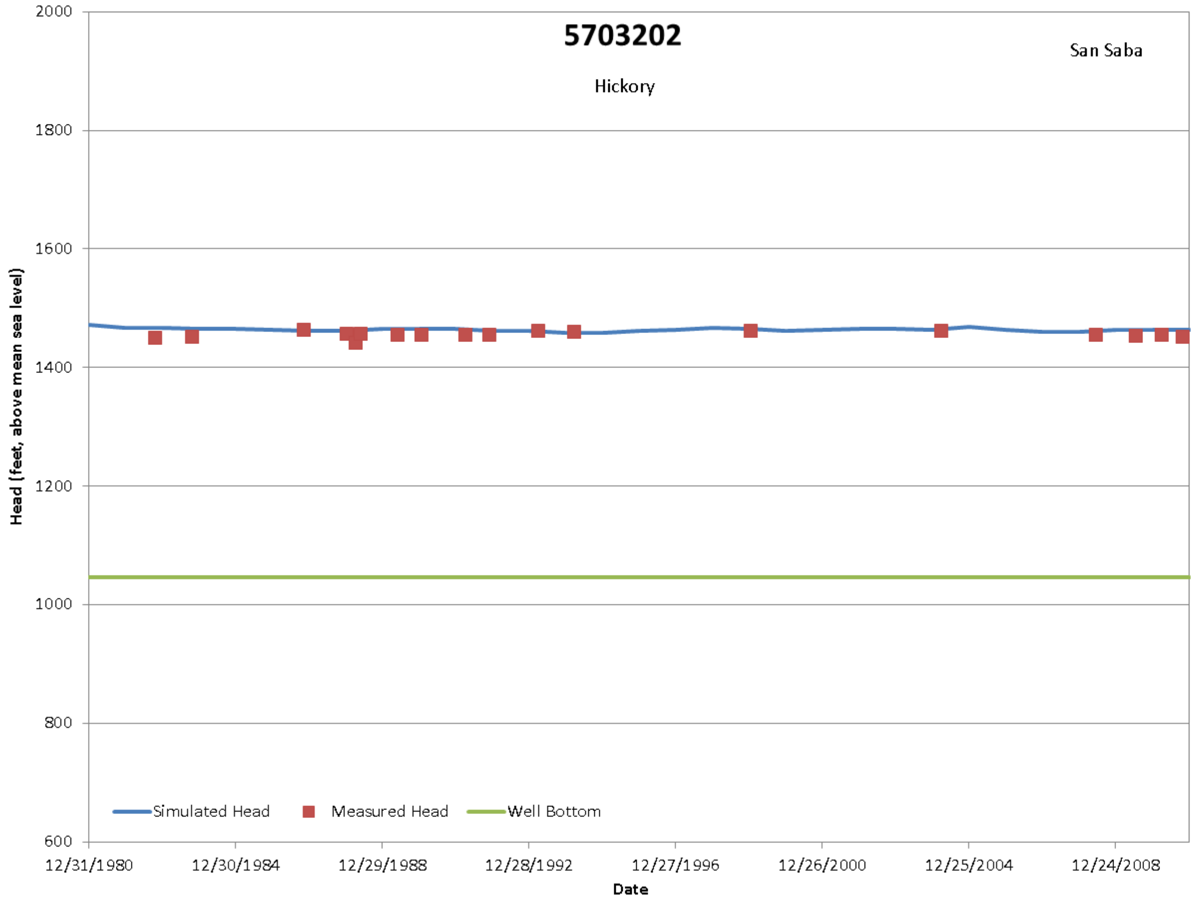
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5703202
Hickory
San Saba
Head (feet, above mean sea level)
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1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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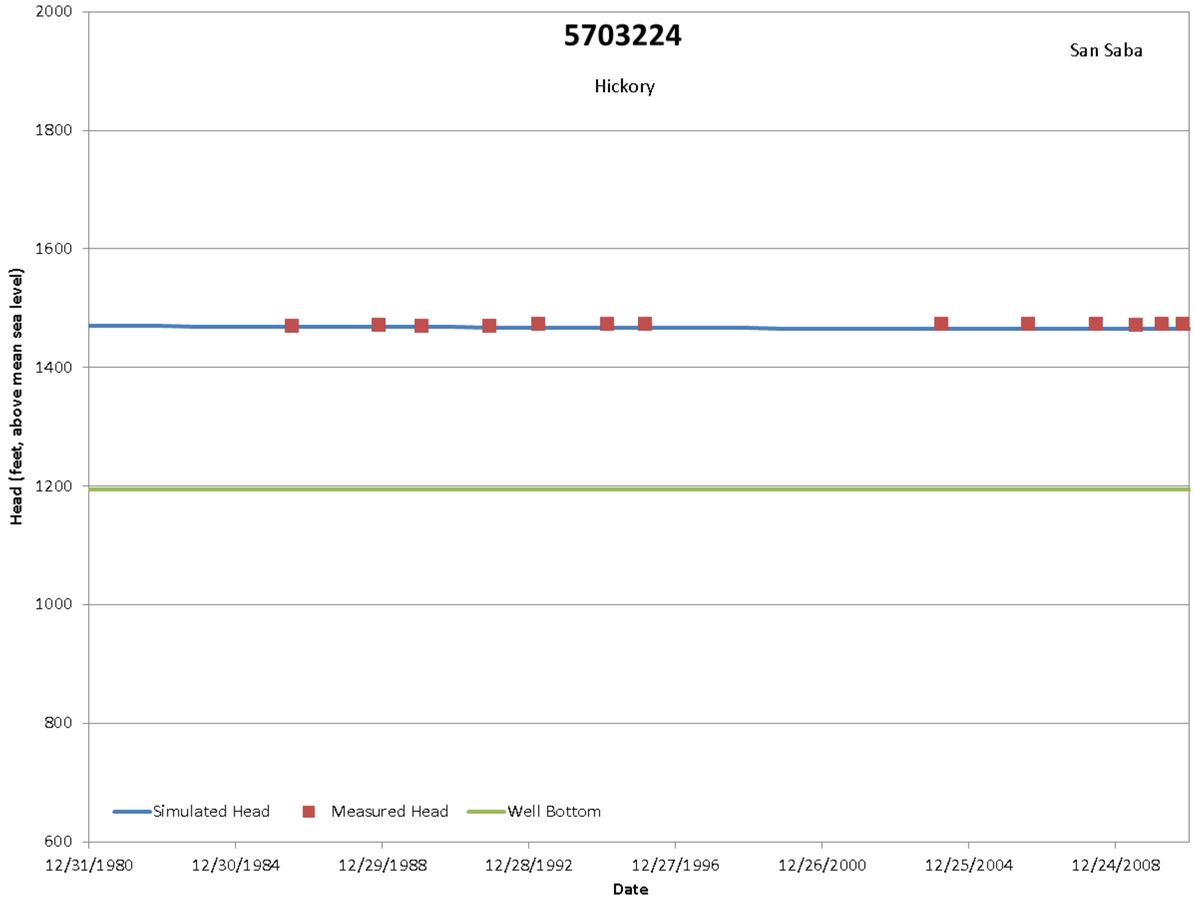
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5703224
Hickory
San Saba
Head (feet, above mean sea level)
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1600
1400
1200
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800
600
Simulated Head
Measured Head
Well Bottom
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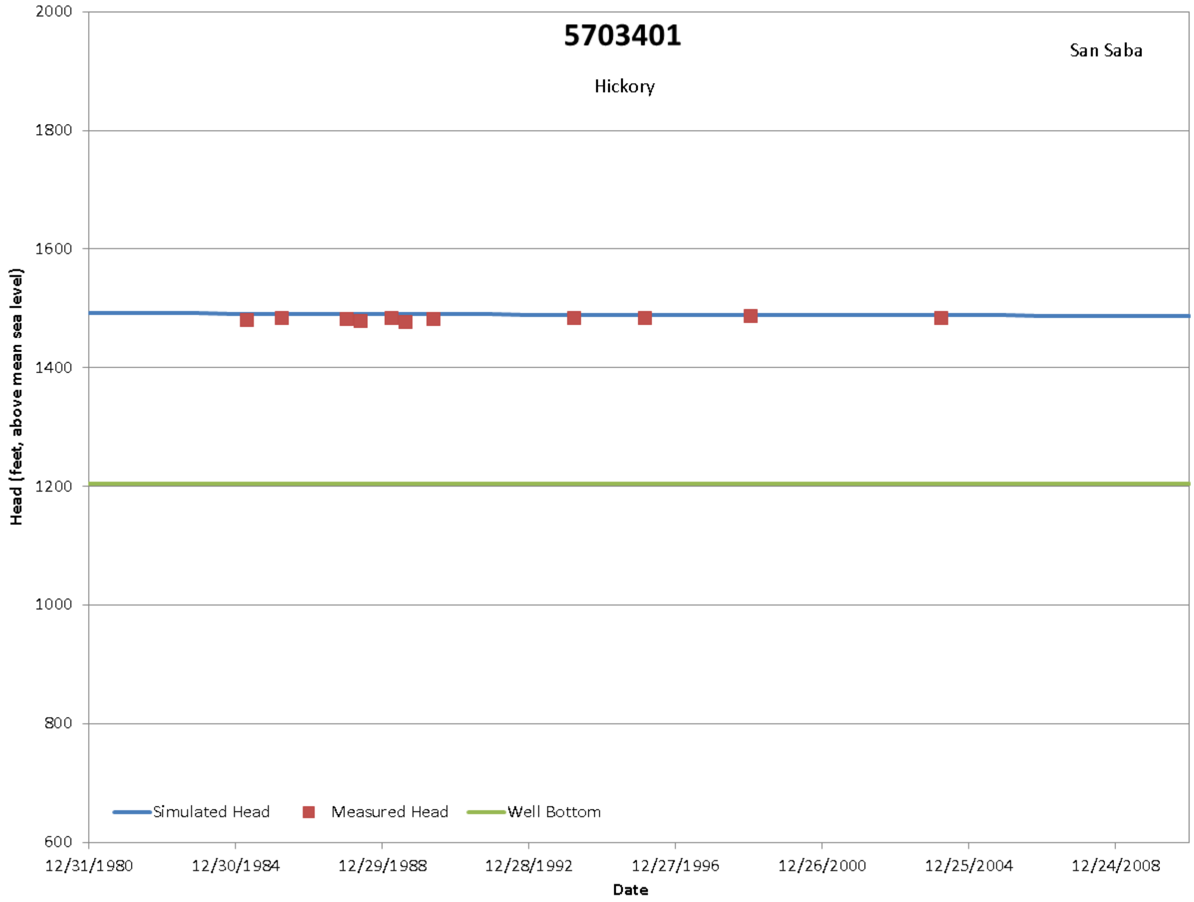
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5703401
Hickory
San Saba
Head (feet, above mean sea level)
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1400
1200
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800
600
Simulated Head
Measured Head
Well Bottom
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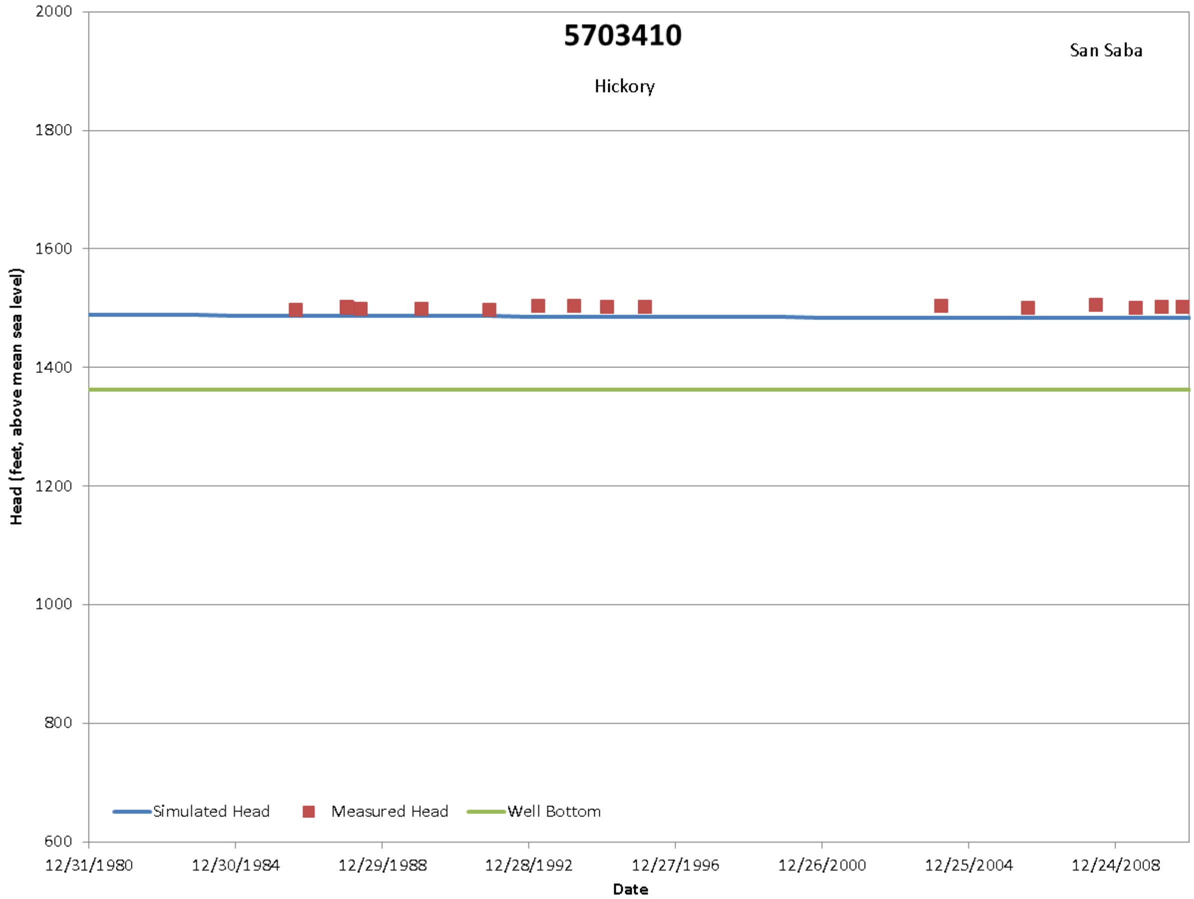
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5703410
Hickory
San Saba
Head (feet, above mean sea level)
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1400
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800
600
12/31/1980
12/30/1984
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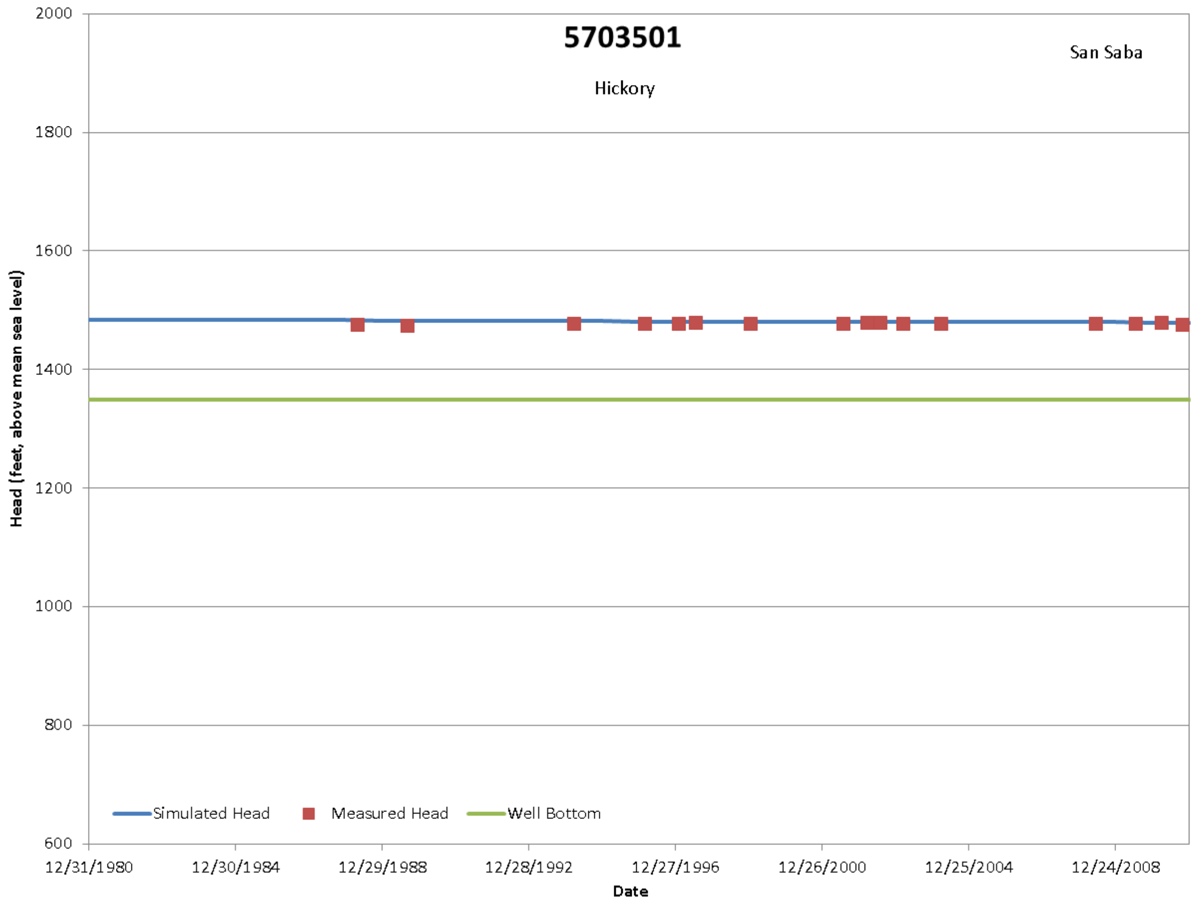
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5703501
Hickory
San Saba
Head (feet, above mean sea level)
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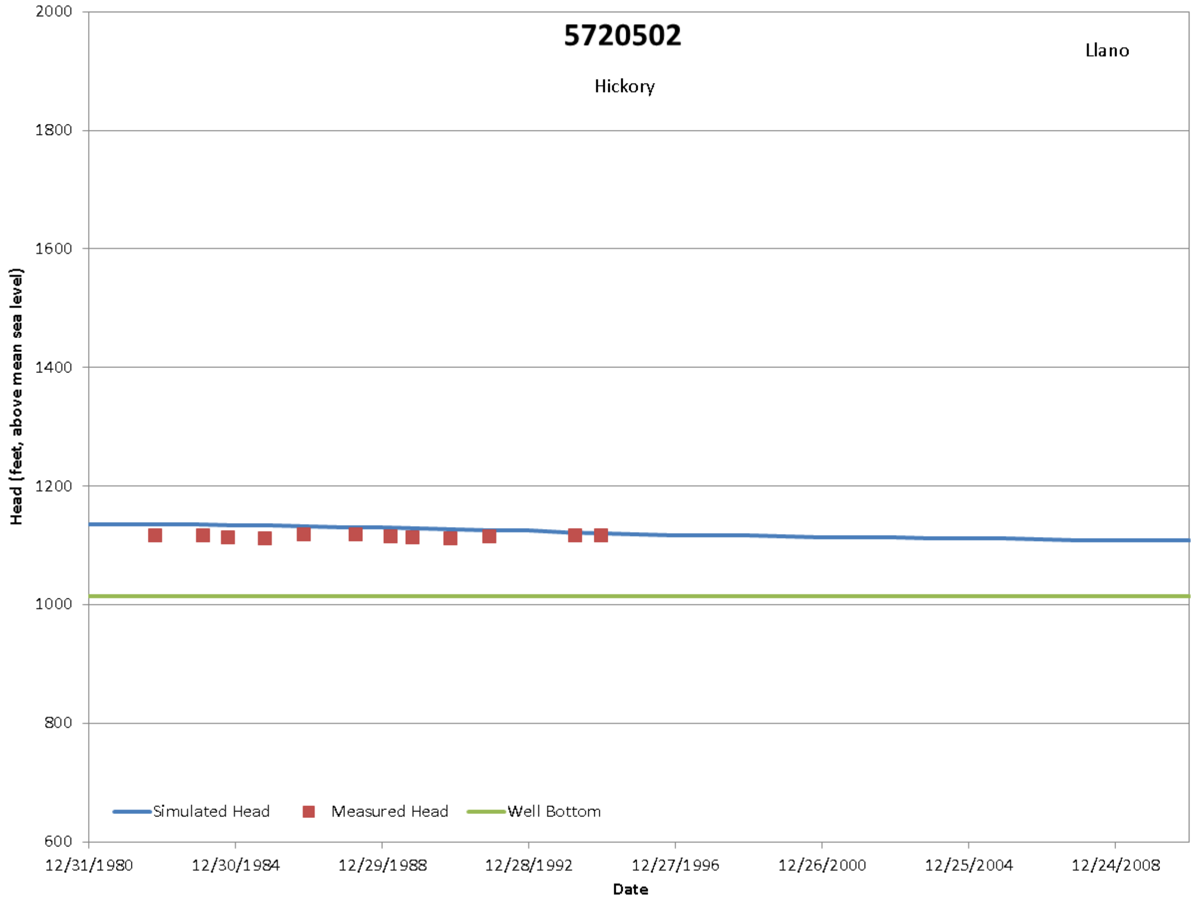
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5710103
Llano
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5720502
Llano
Hickory
Head (feet, above mean sea level)
2000
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1600
1400
1200
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800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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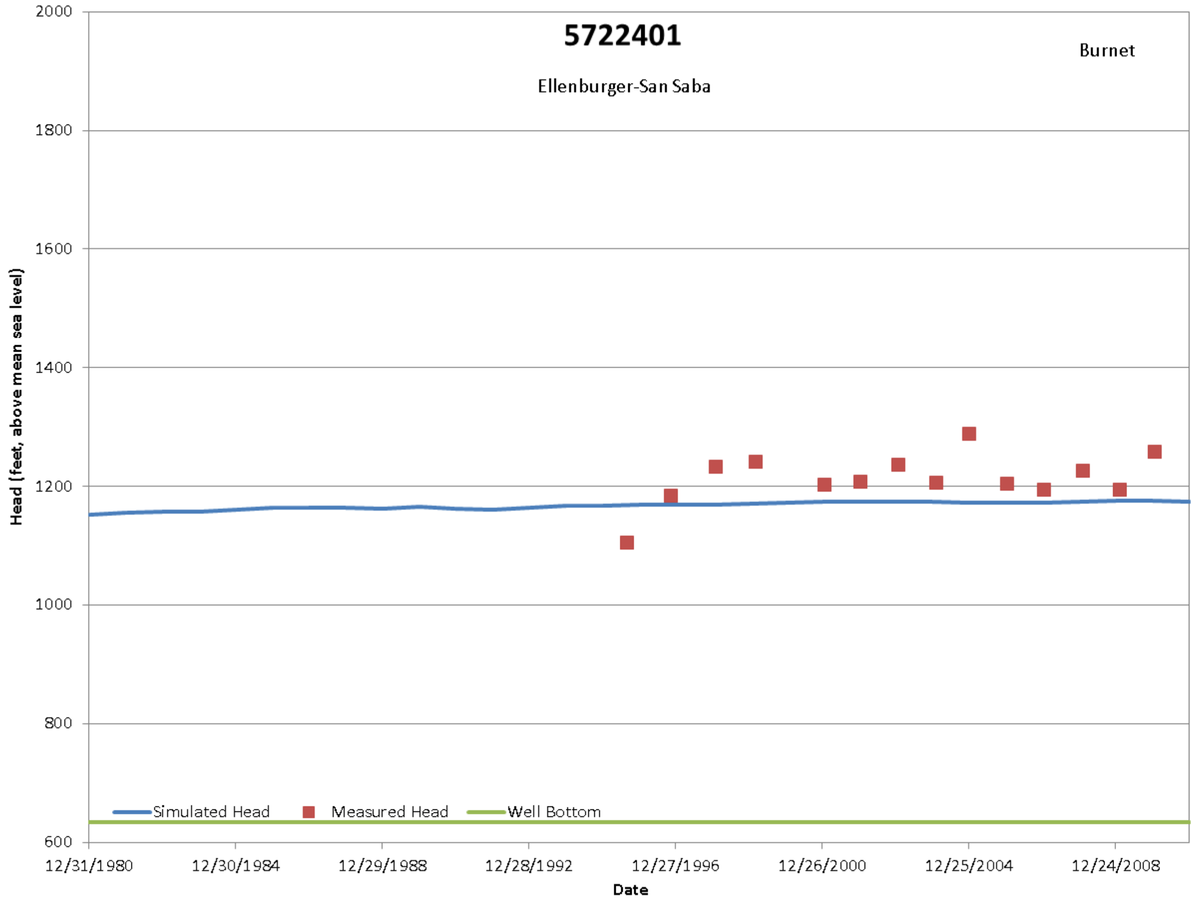
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5722401
Burnet
Ellenburger-San Saba
2000
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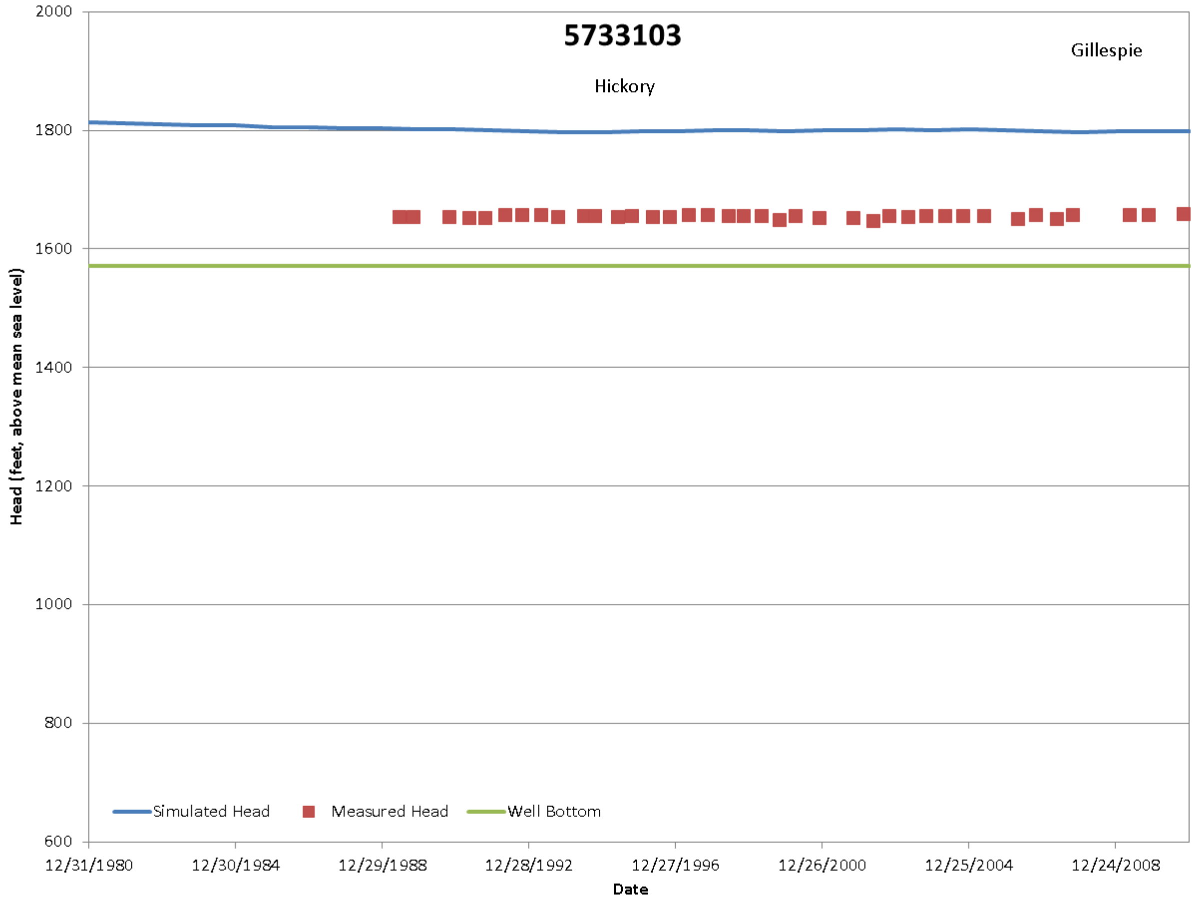
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5733103
Hickory
Gillespie
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
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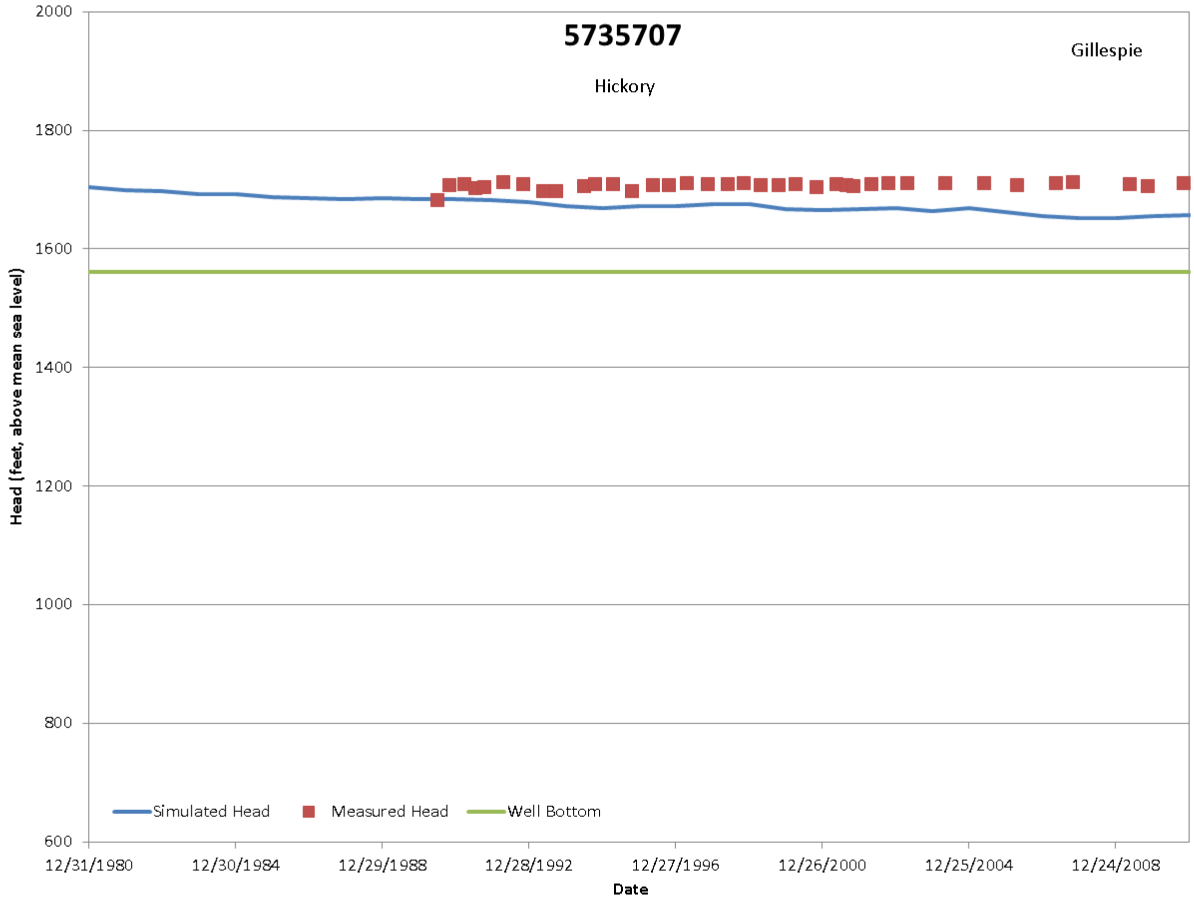
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5735707
Gillespie
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
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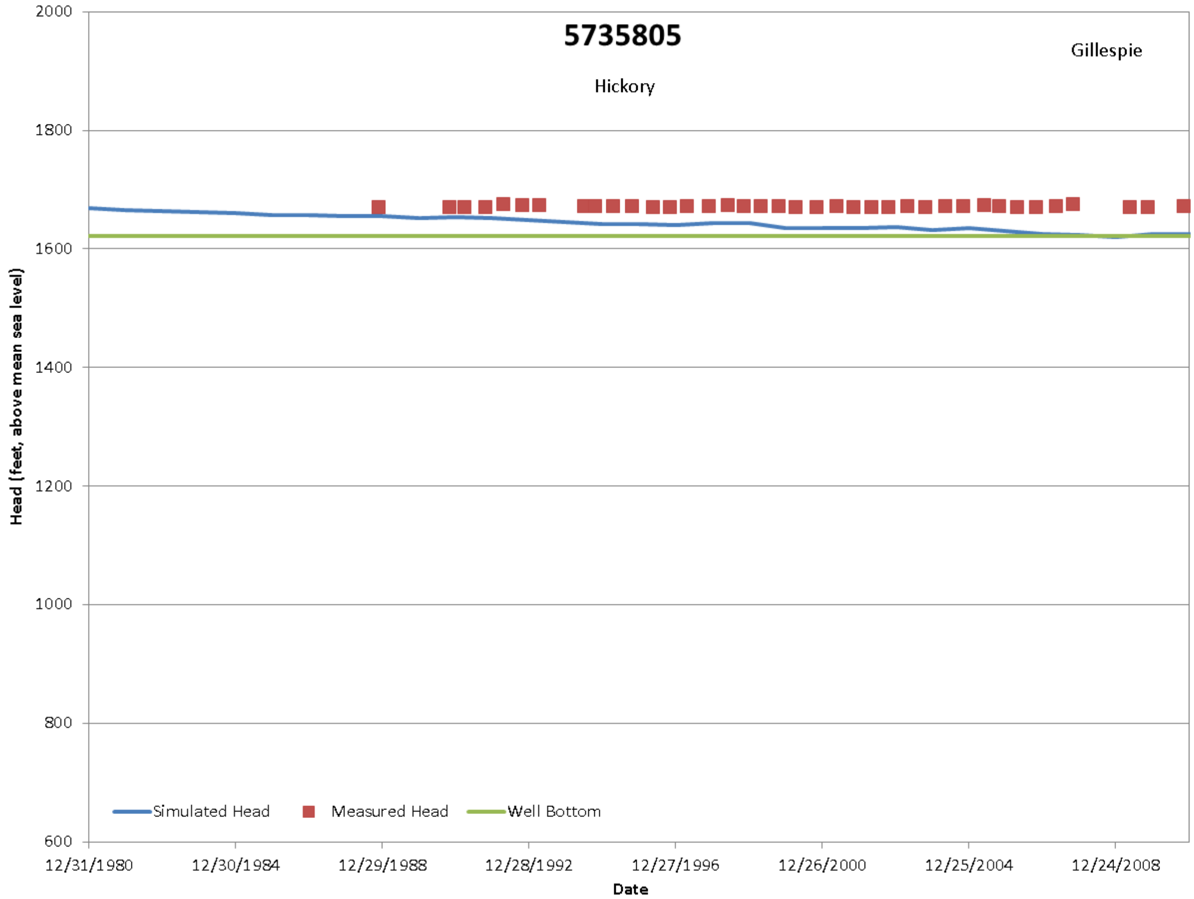
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5735805
Gillespie
Hickory
Head (feet, above mean sea level)
2000
1800
1600
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1200
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800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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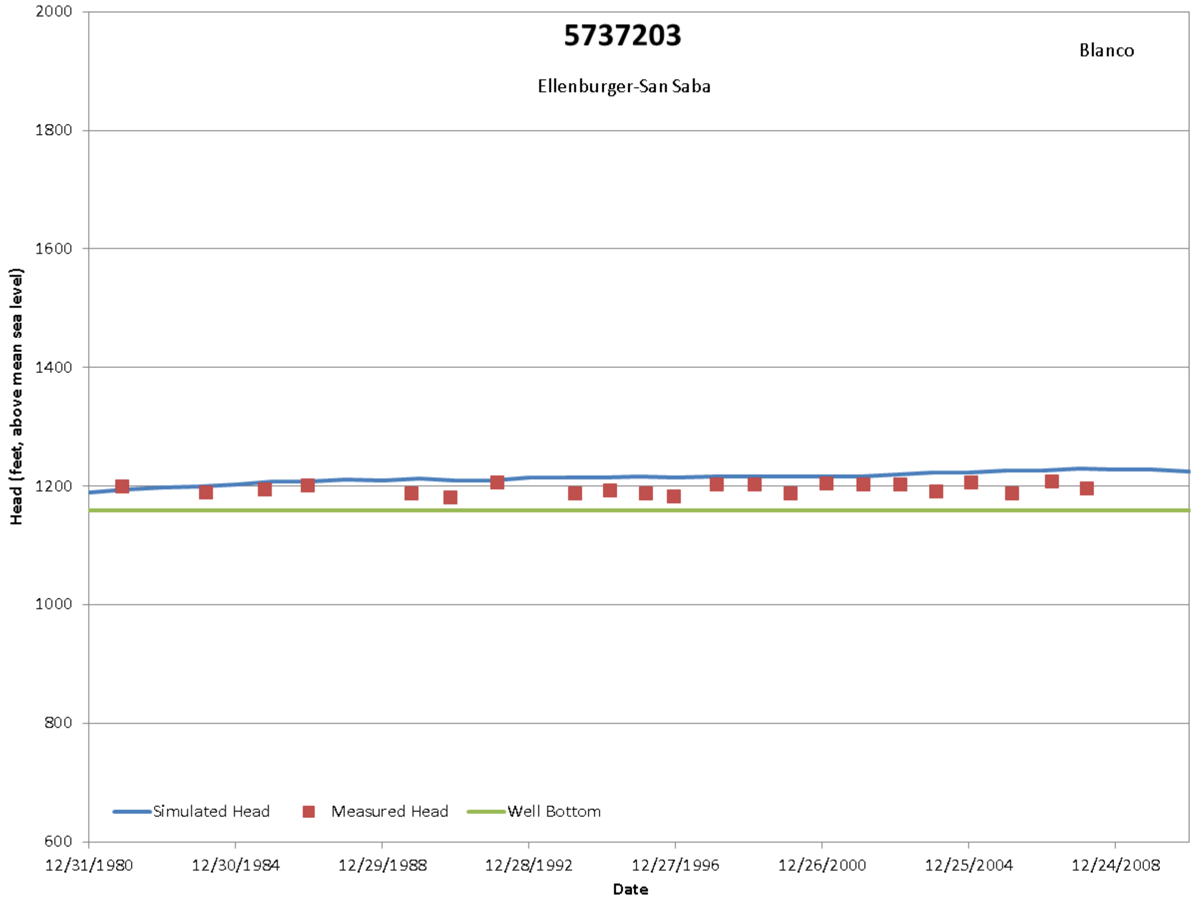
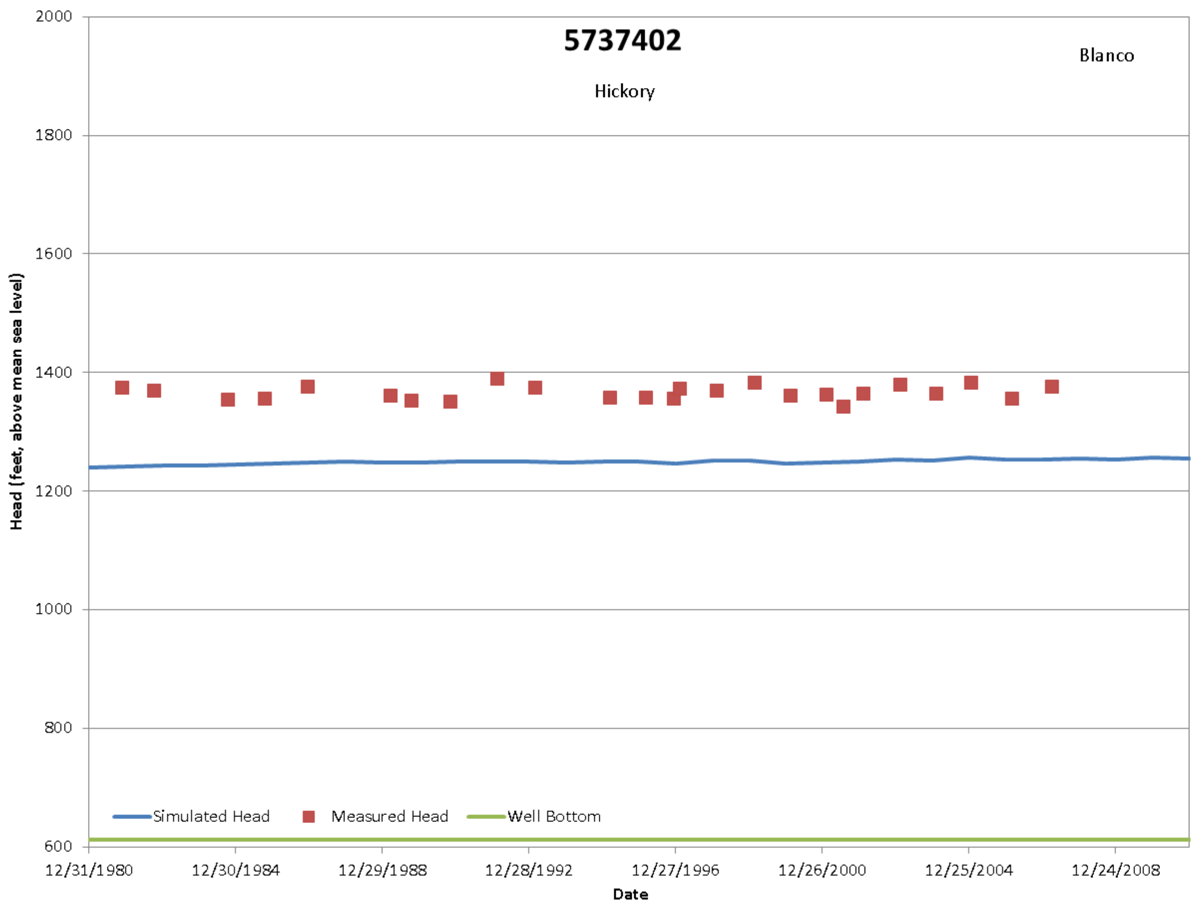
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5737203
Blanco
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5737402
Hickory
Blanco
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
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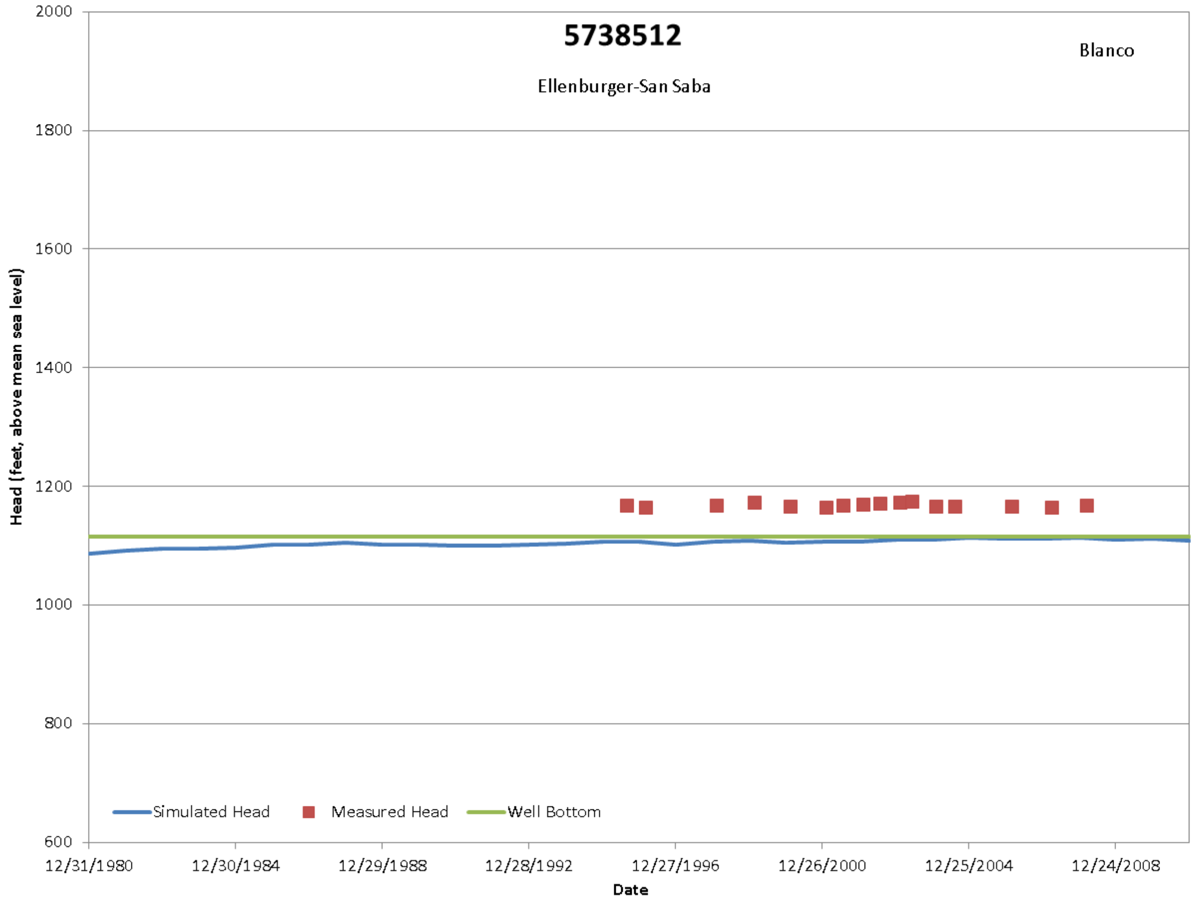
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5738512
Blanco
Ellenburger-San Saba
2000
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1600
1400
1200
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800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
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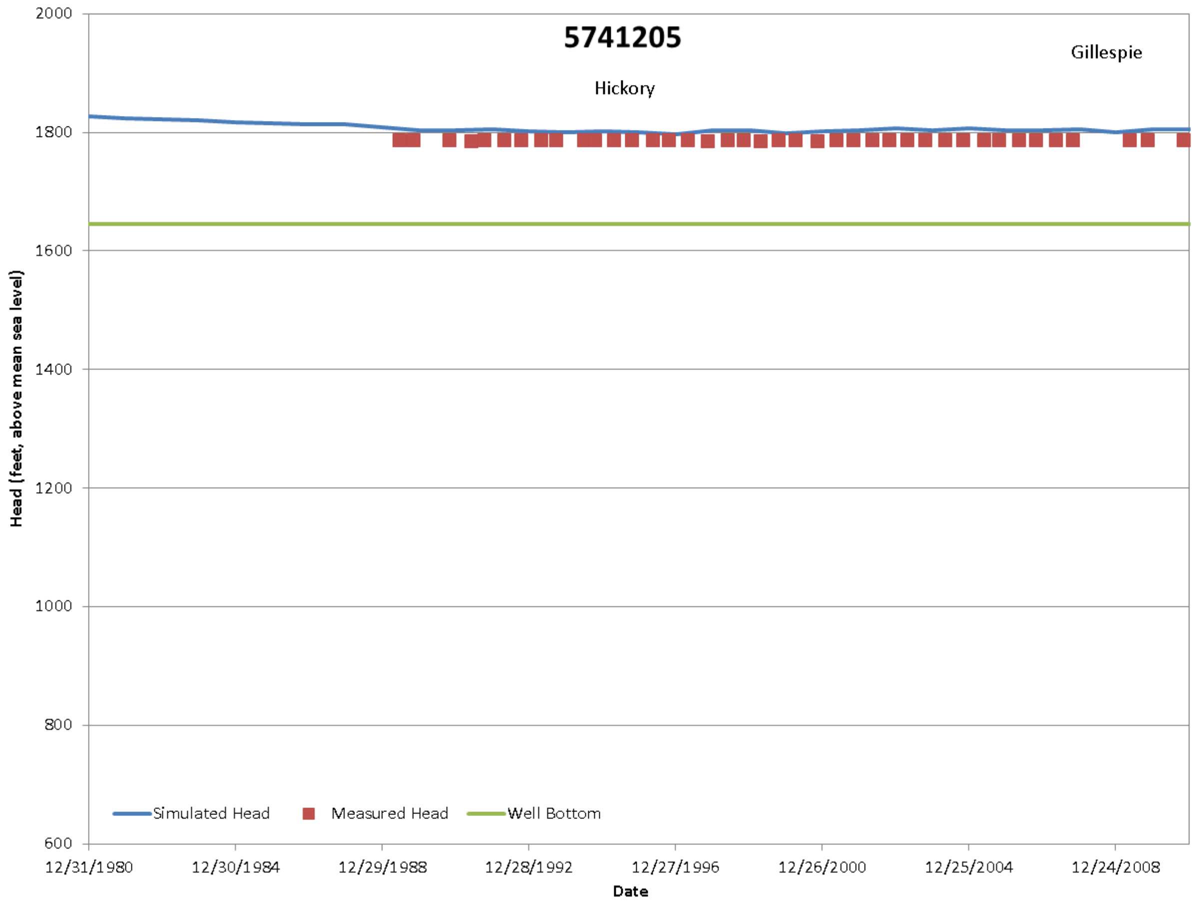
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5741205
Gillespie
Hickory
Head (feet, above mean sea level)
2000
1800
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1400
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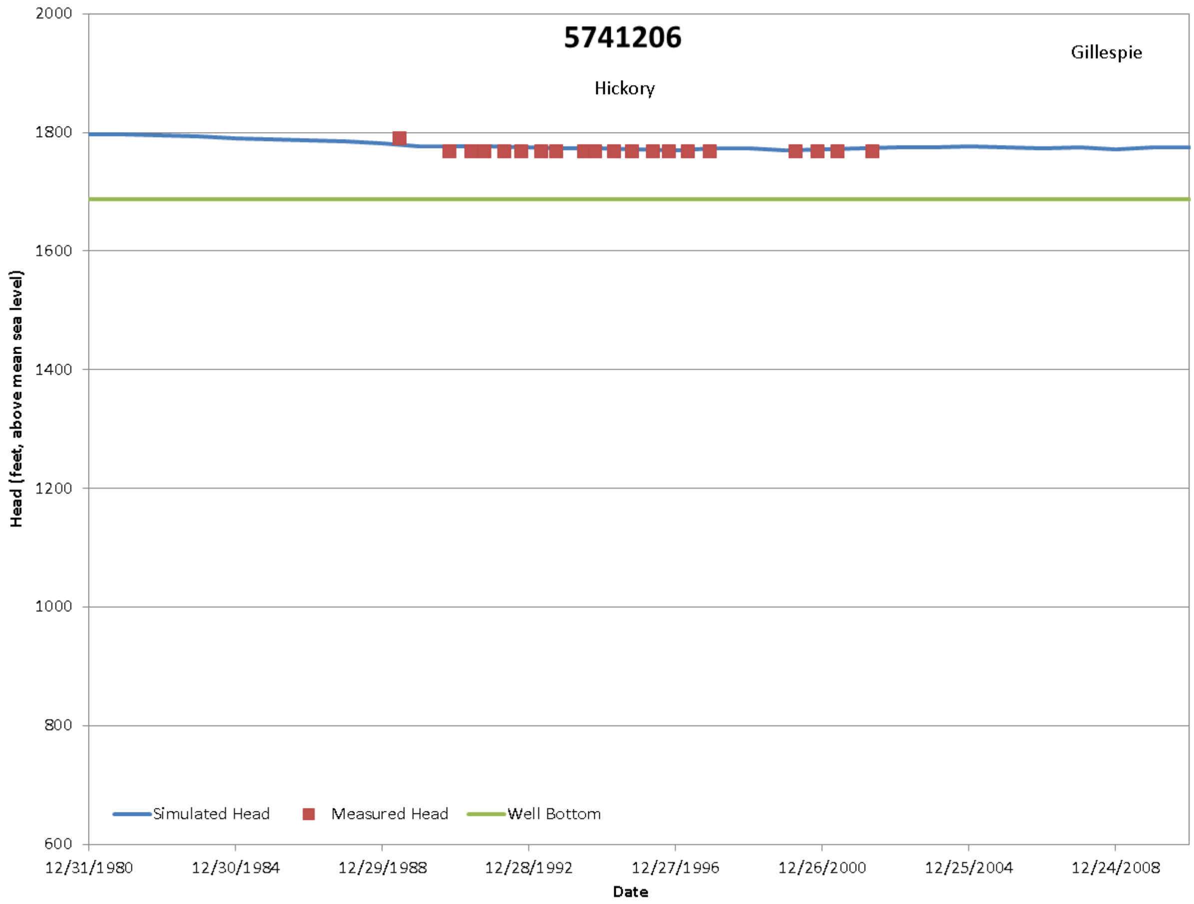
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5741206
Hickory
Gillespie
Head (feet, above mean sea level)
2000
1800
1600
1400
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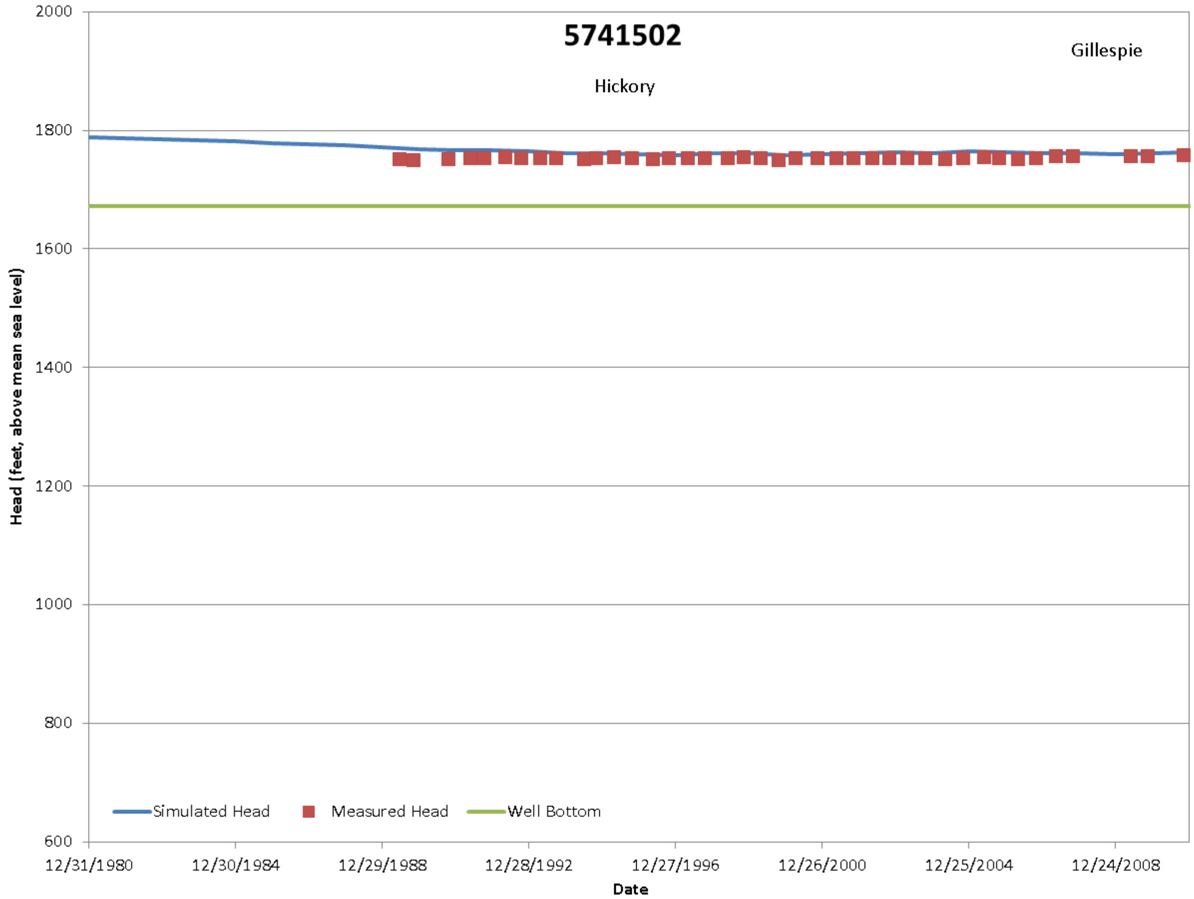
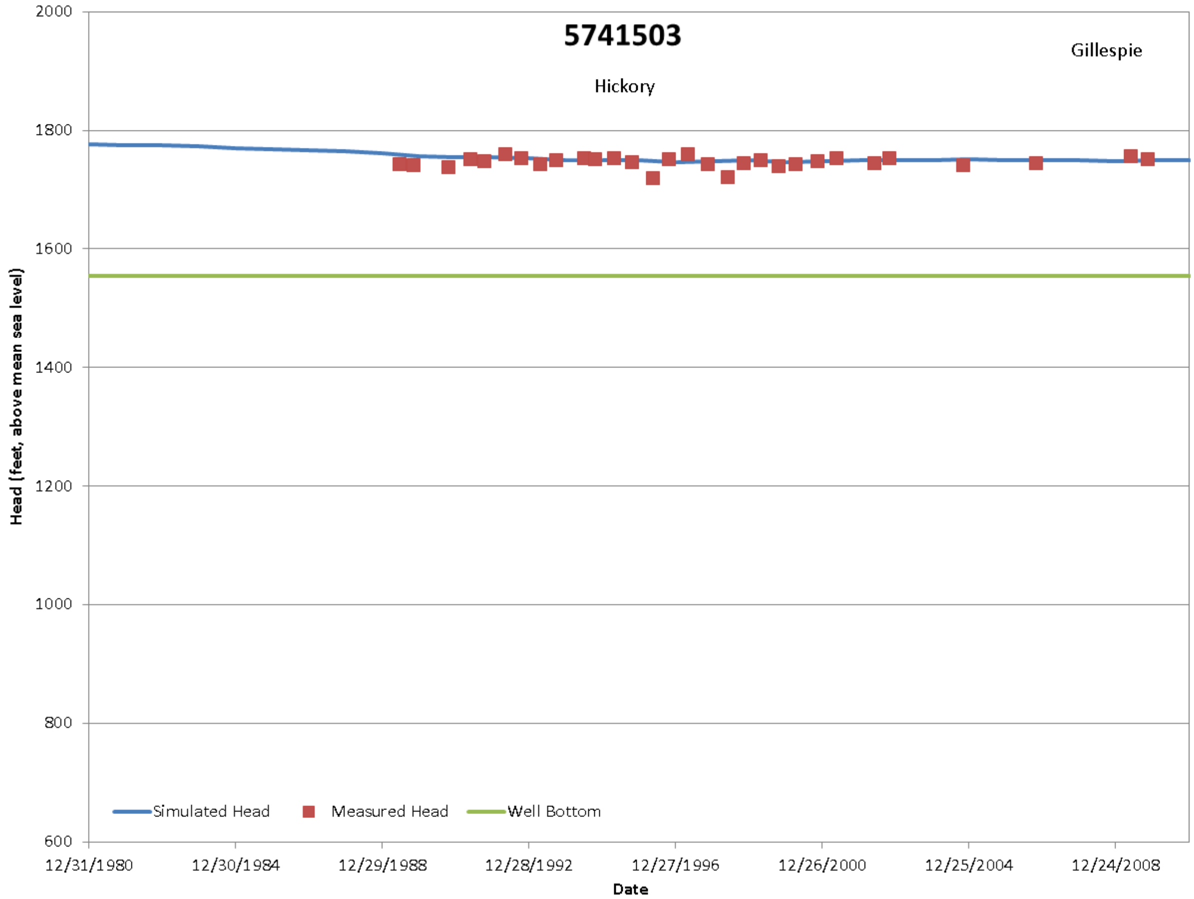
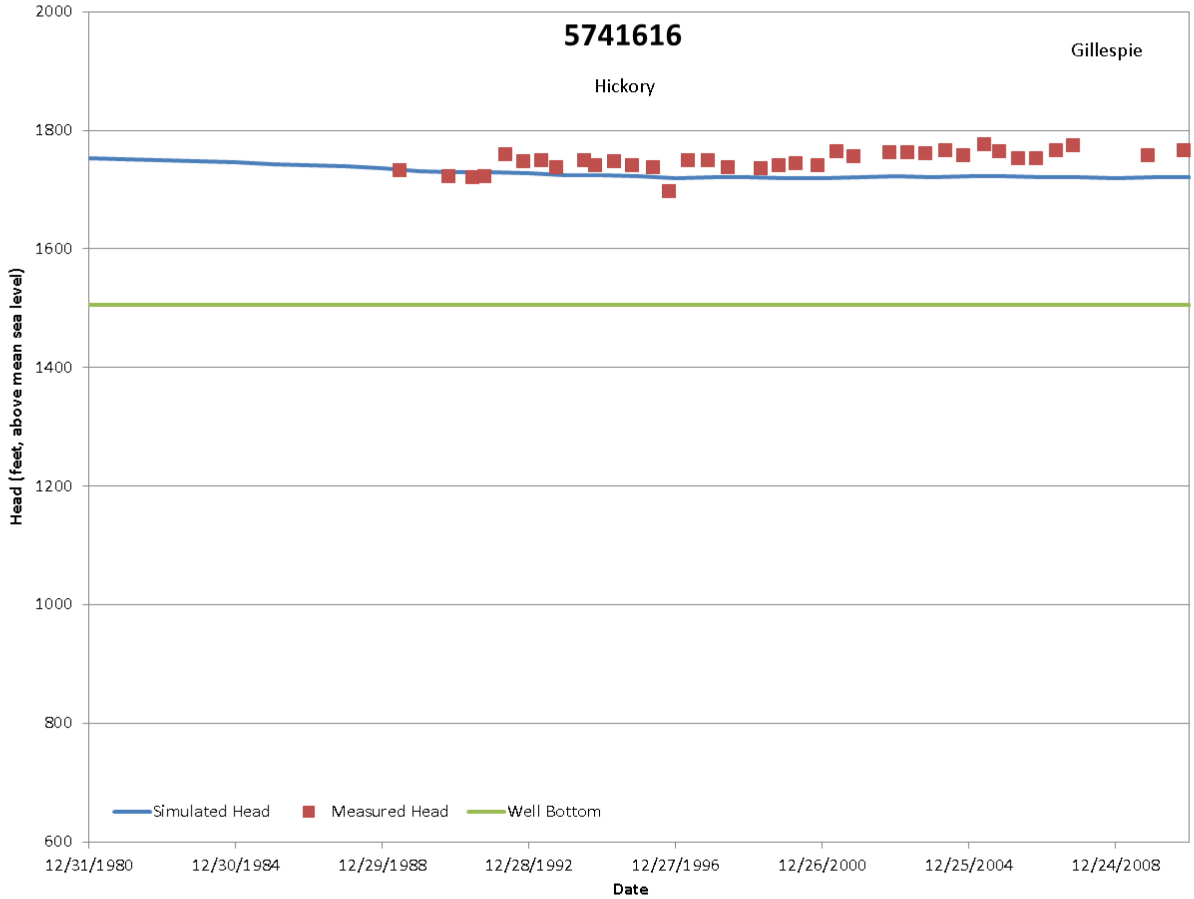
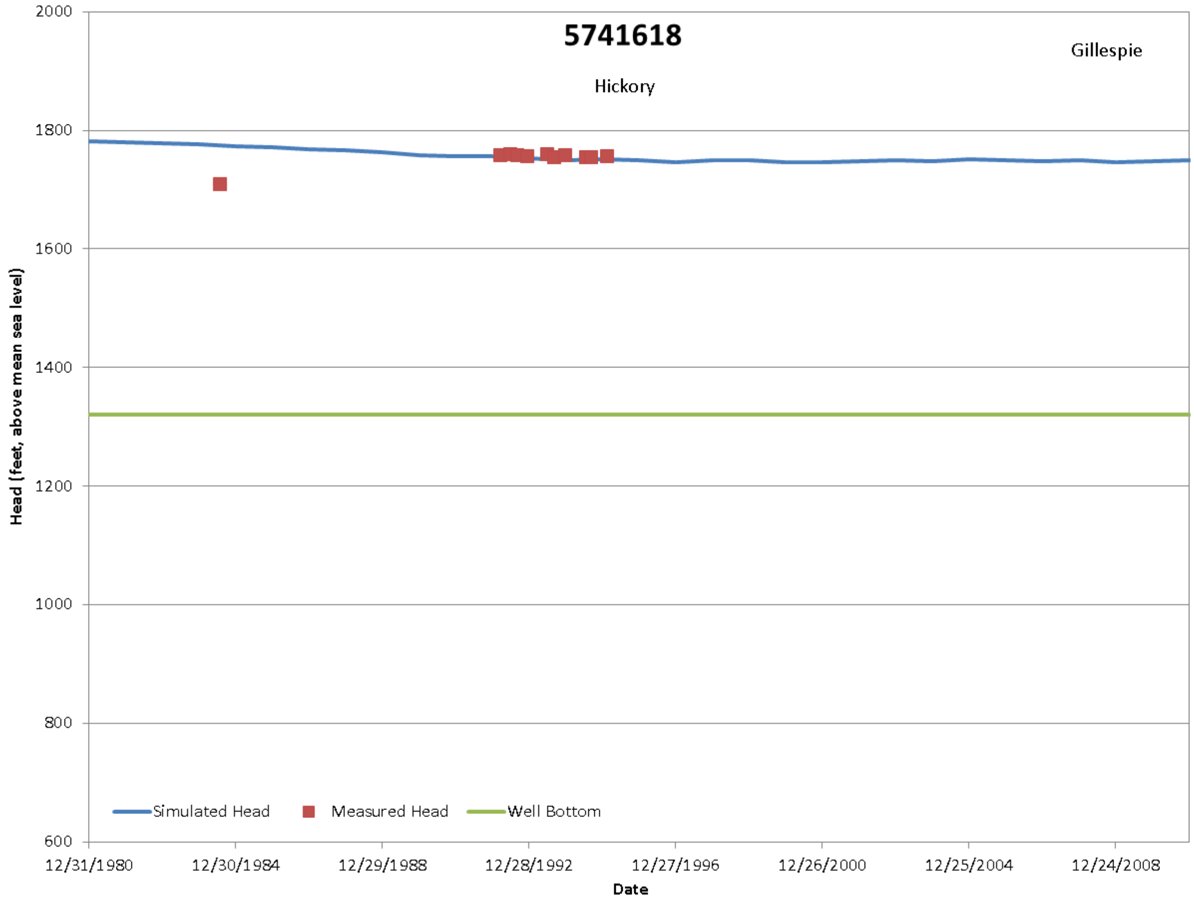
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5741502
Hickory
Gillespie
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5741503
Gillespie
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5741616
Gillespie
Hickory
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5741618
Gillespie
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
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800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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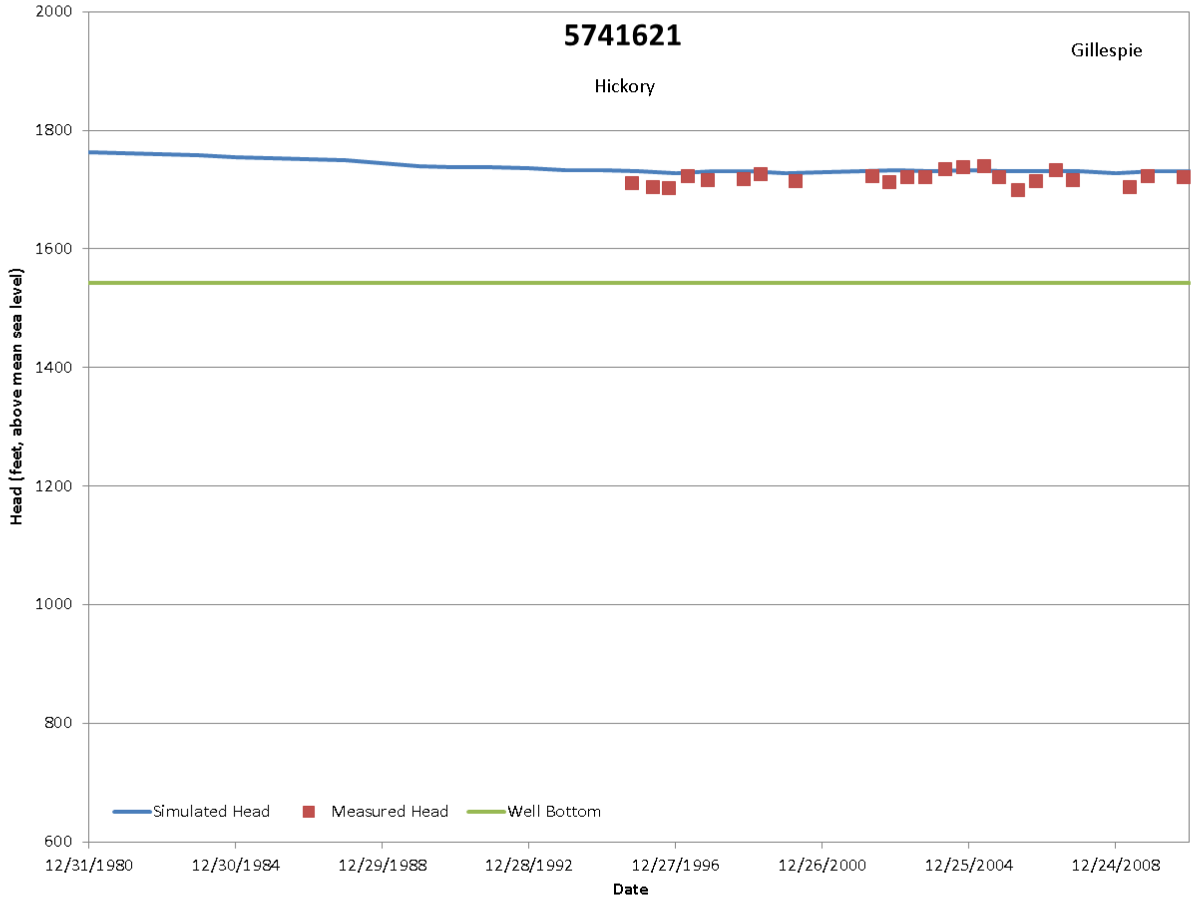
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5741621
Hickory
Gillespie
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
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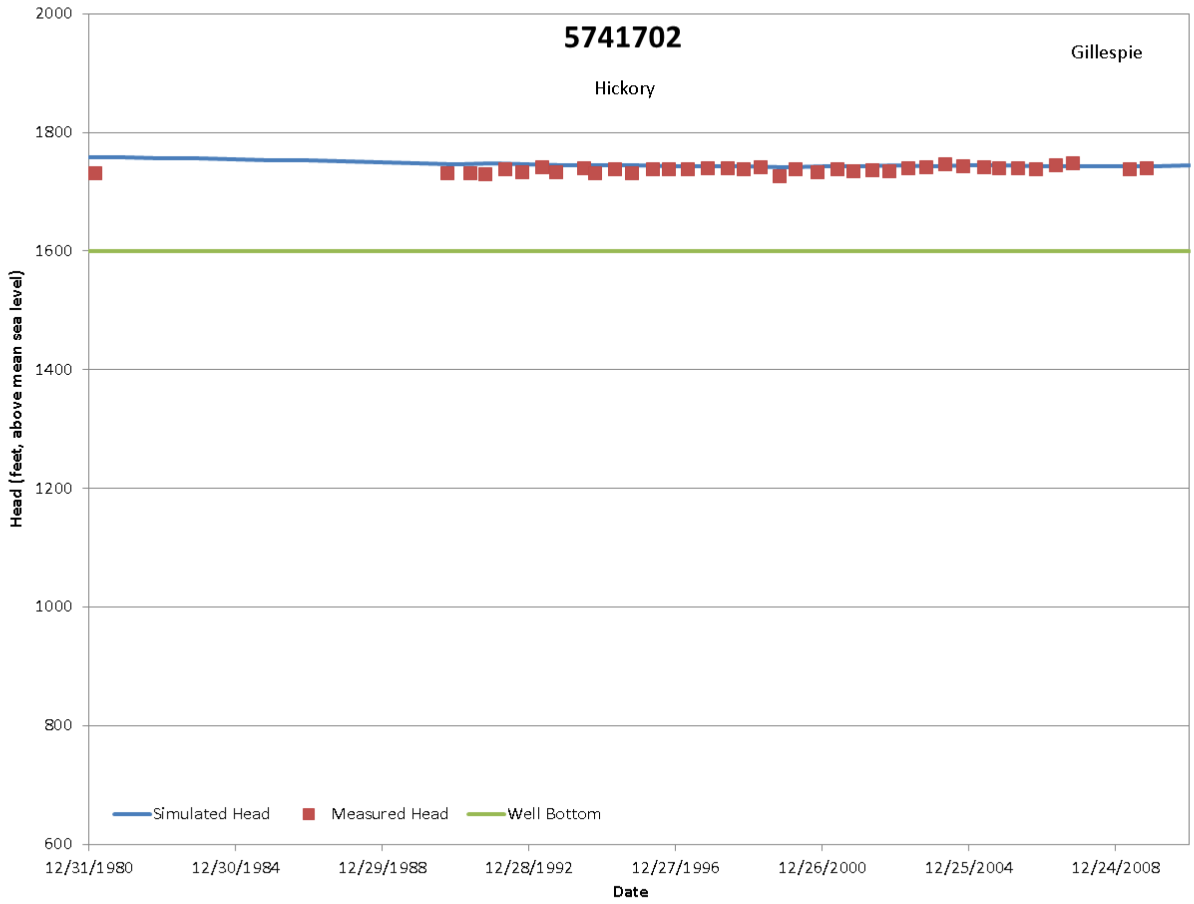
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5741702
Hickory
Gillespie
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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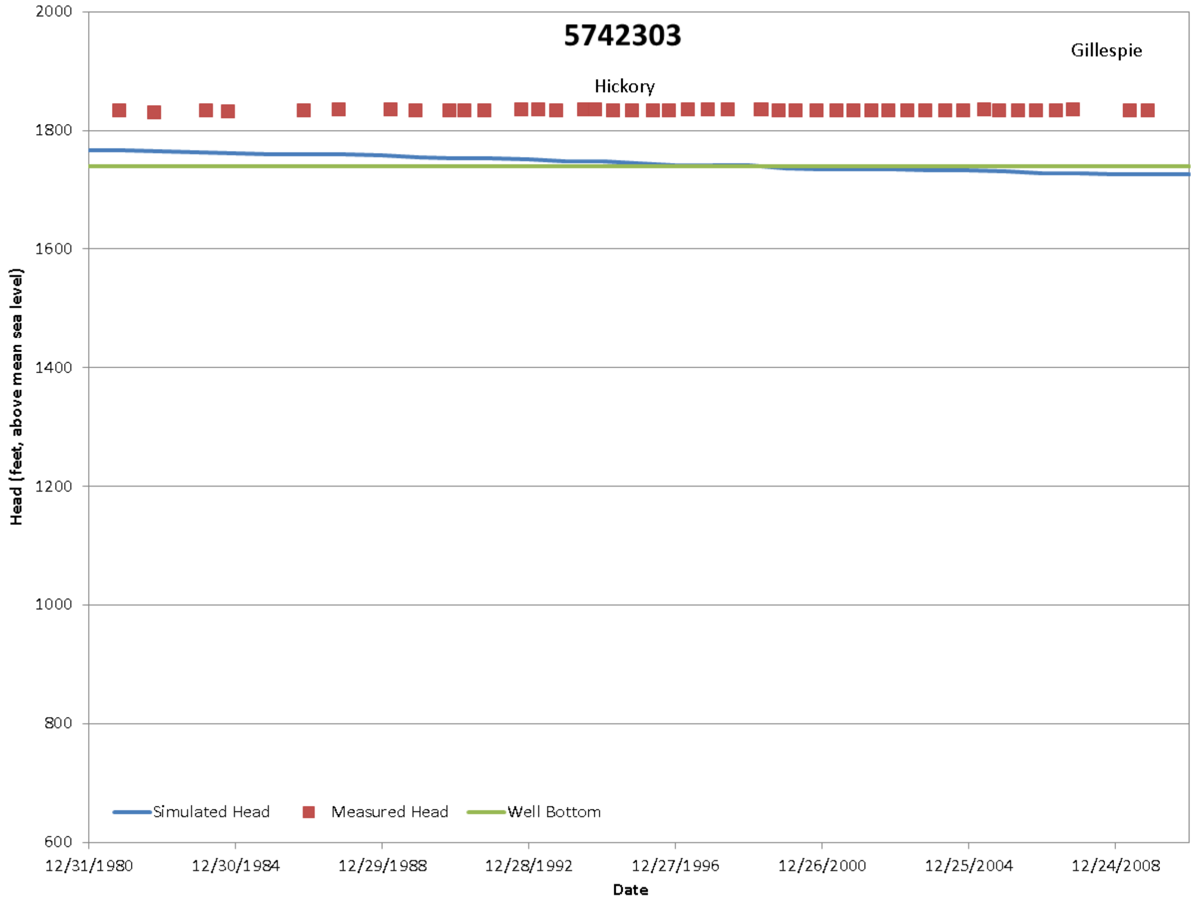
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5742303
Gillespie
Hickory
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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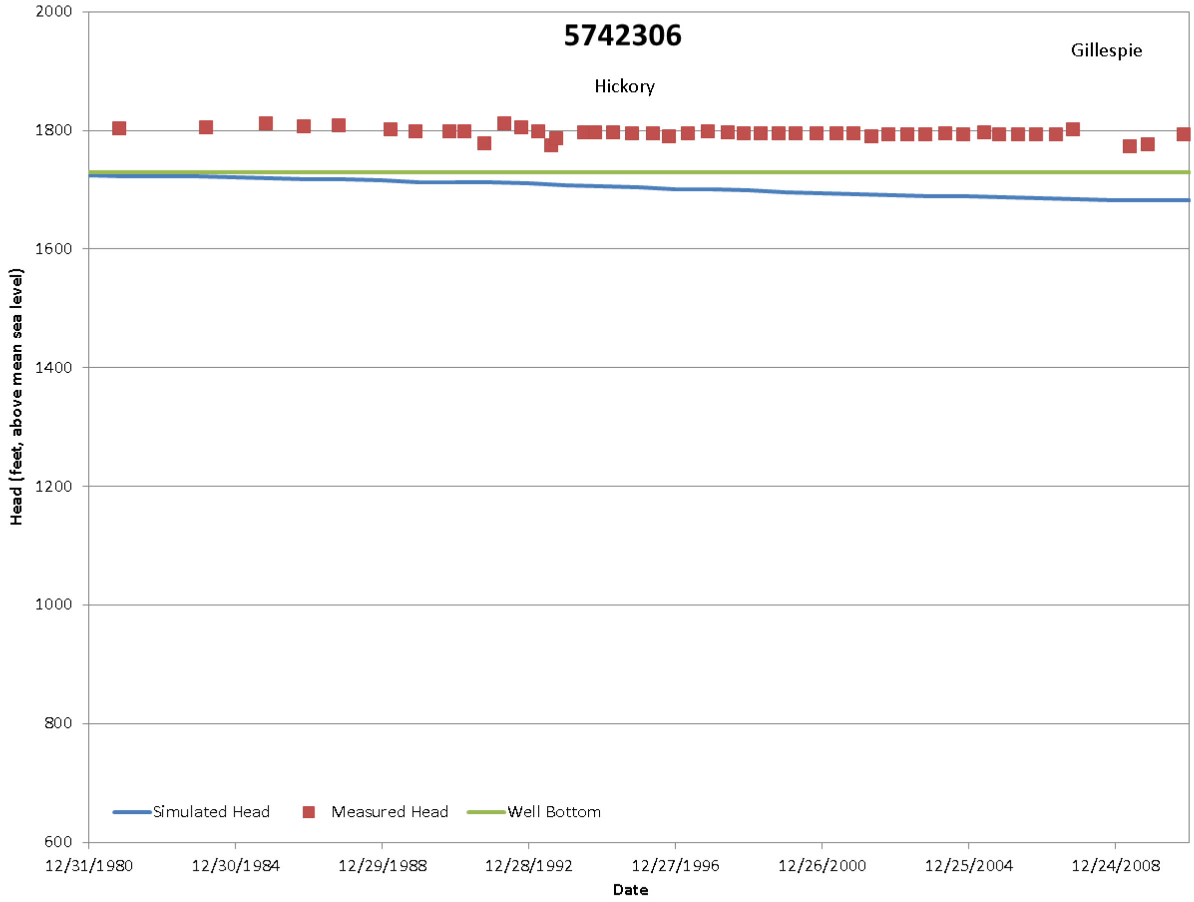
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5742306
Gillespie
Hickory
Head (feet, above mean sea level)
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1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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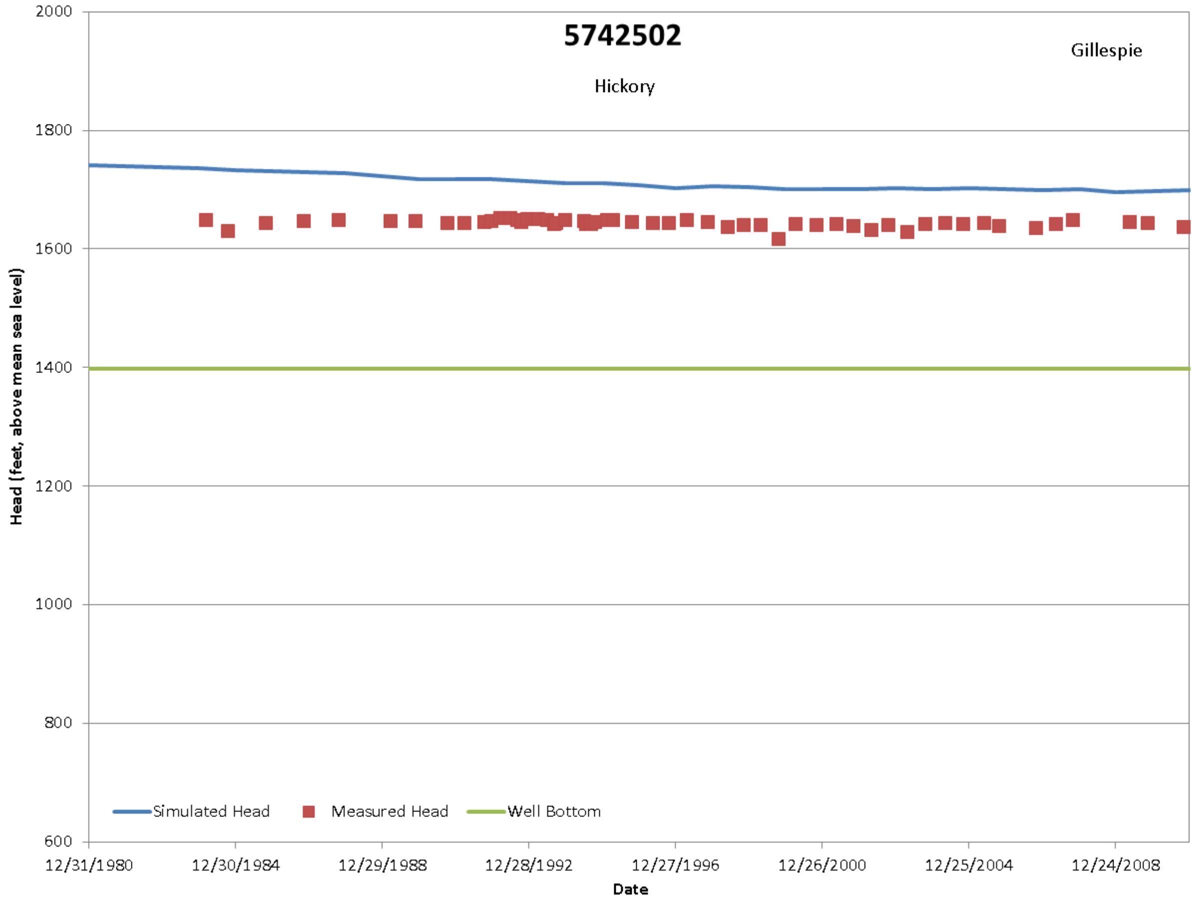
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5742502
Gillespie
Hickory
Head (feet, above mean sea level)
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1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
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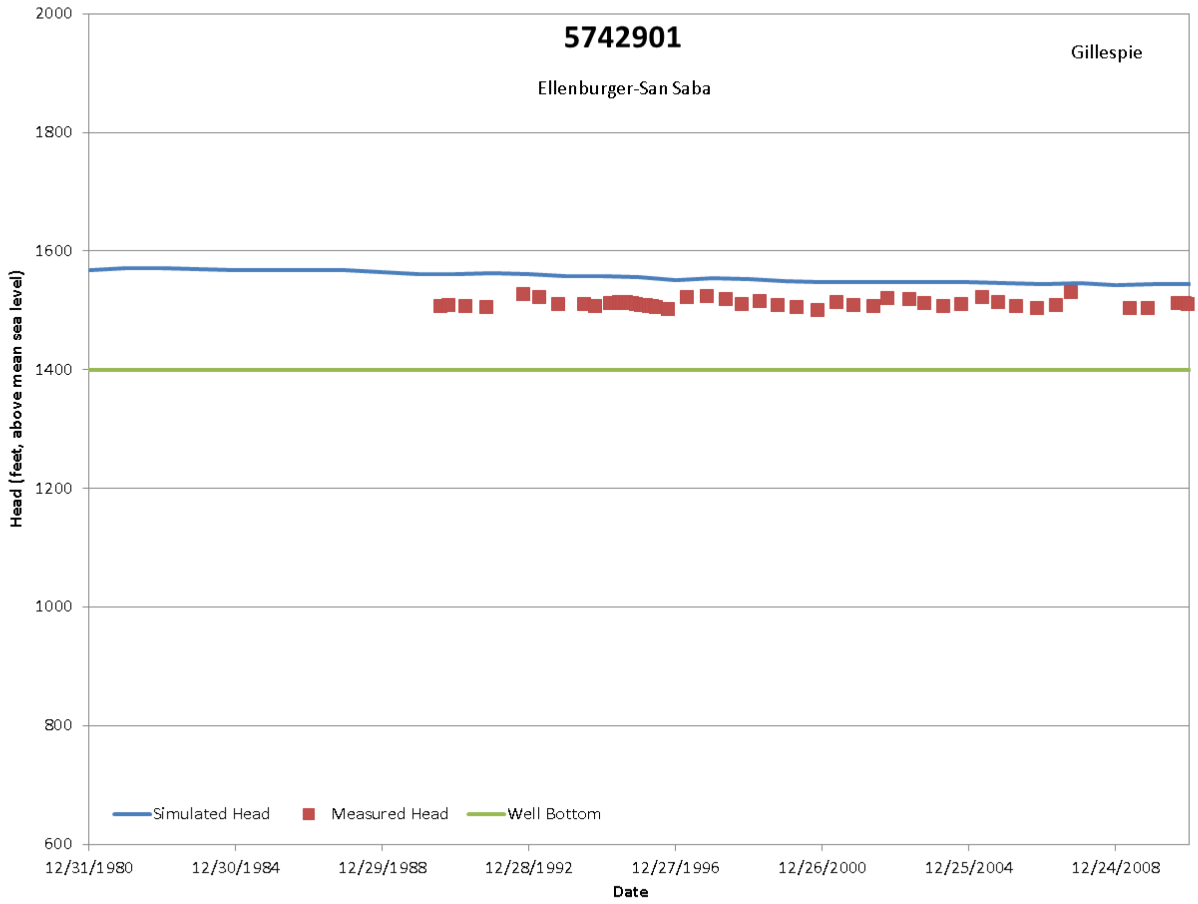
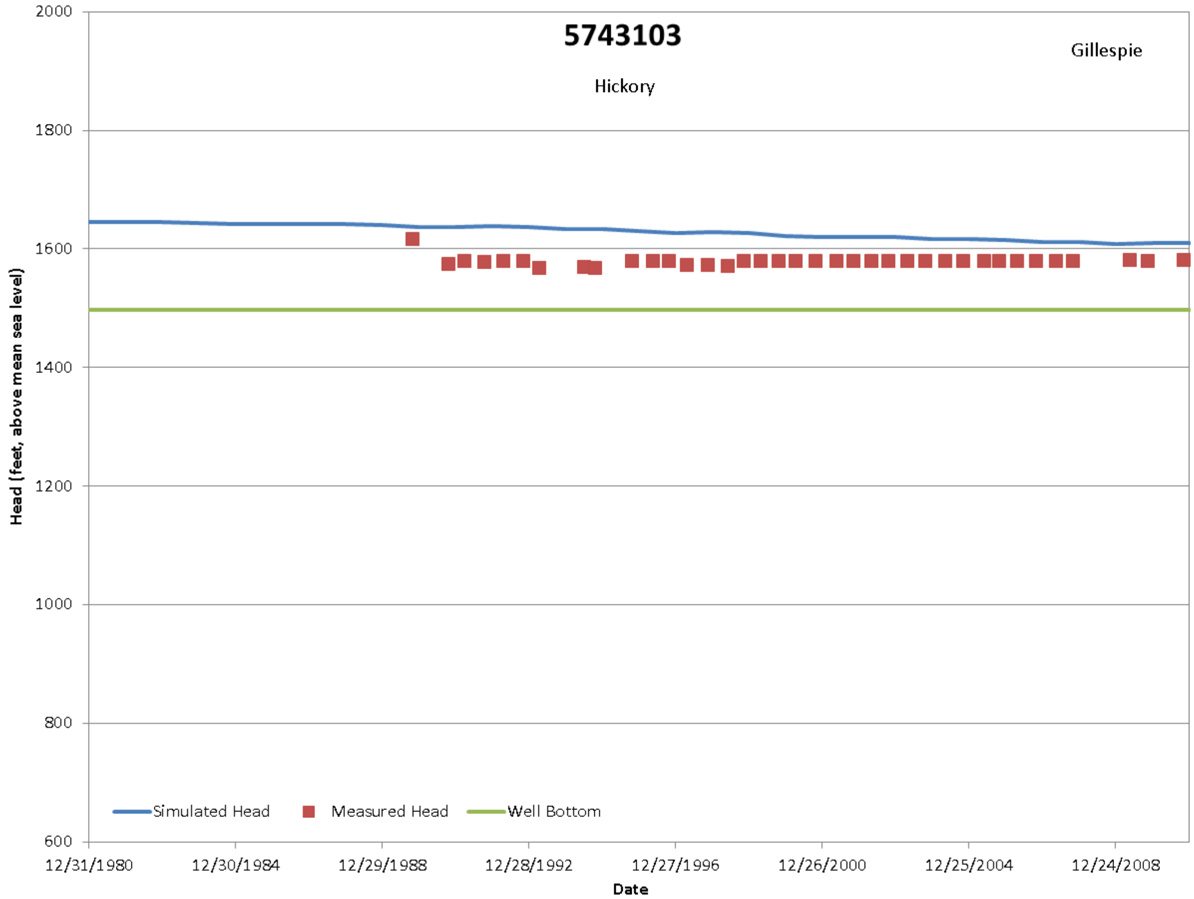
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5742901
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5743103
Hickory
Gillespie
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
12/31/1980
12/30/1984
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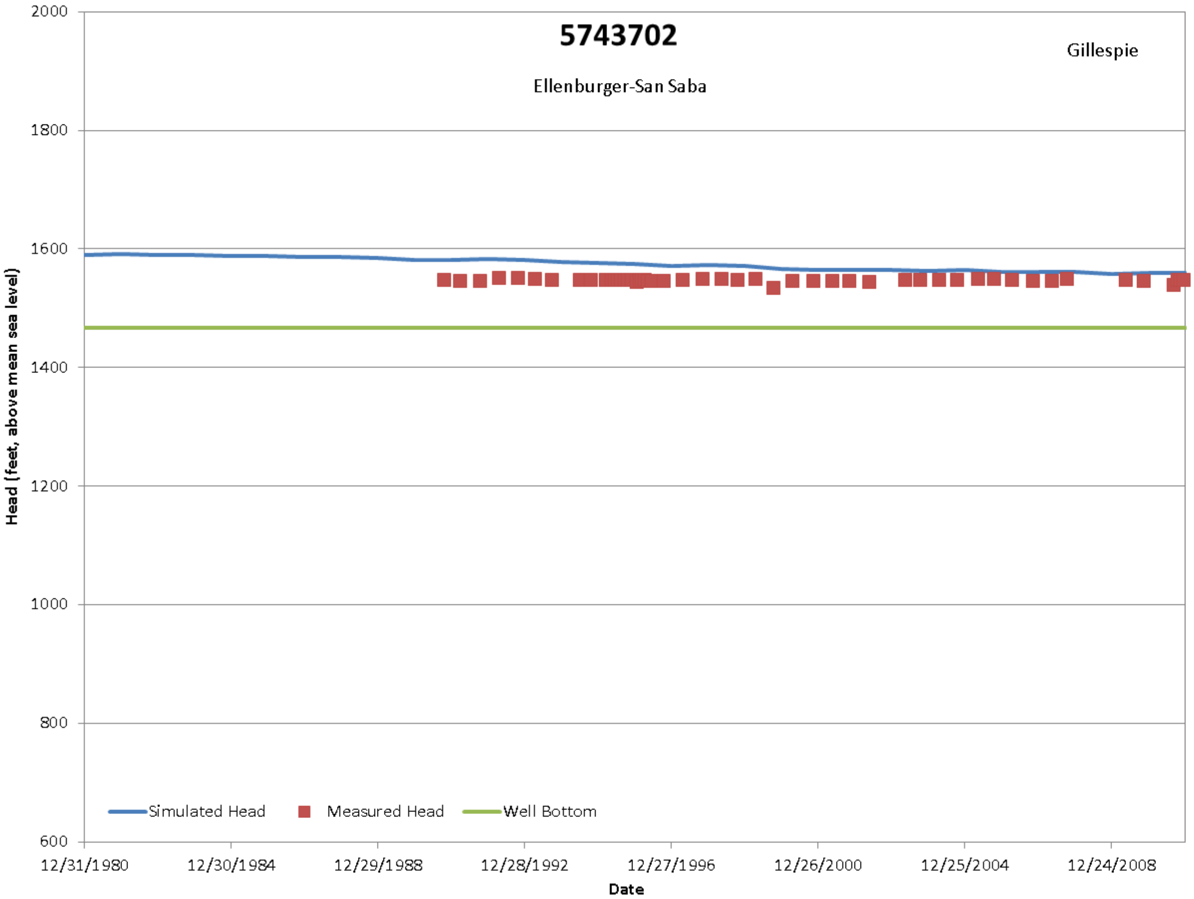
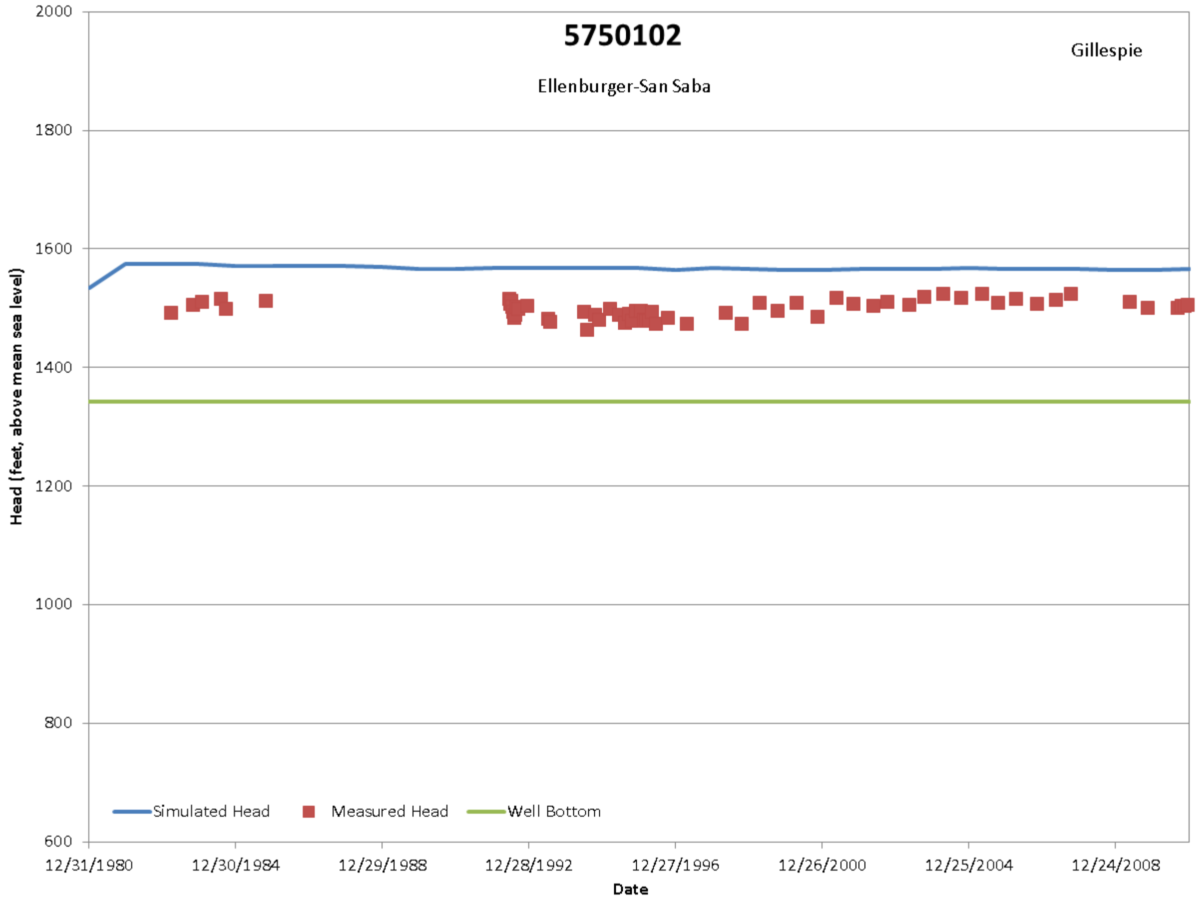
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date
Simulated Head
Measured Head
Well Bottom


5743702
Gillespie
Ellenburger-San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750102
Gillespie
Ellenburger-San Saba
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600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
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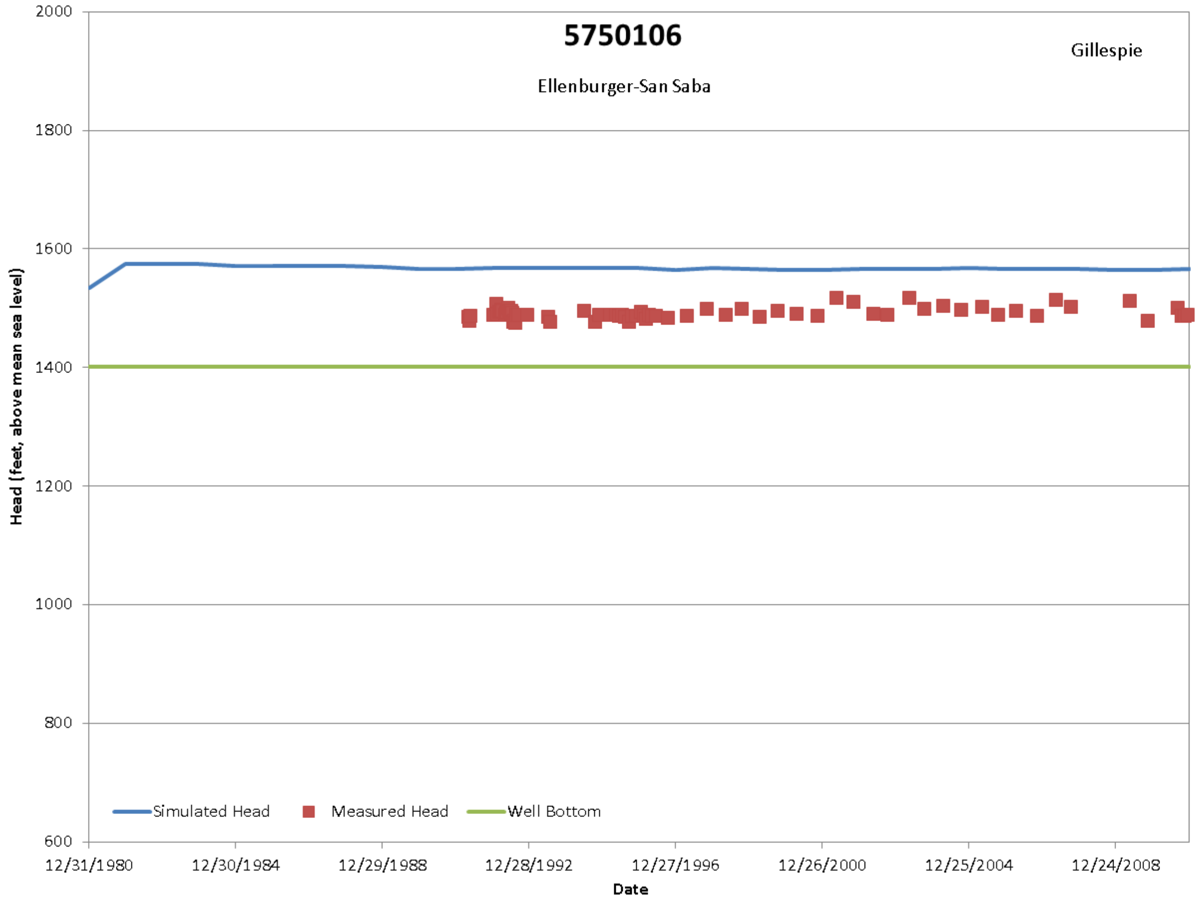
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750106
Gillespie
Ellenburger-San Saba
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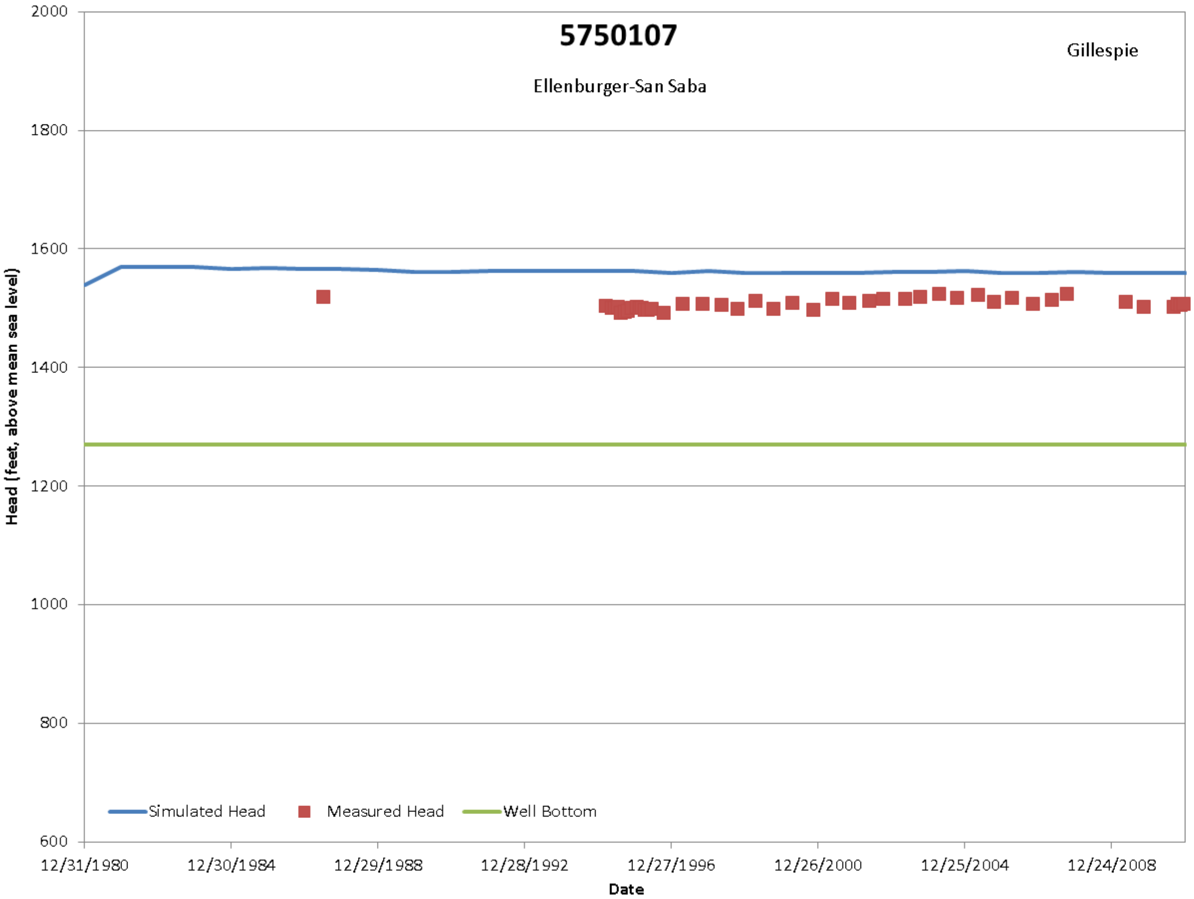
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750107
Gillespie
Ellenburger-San Saba
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1600
1400
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Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
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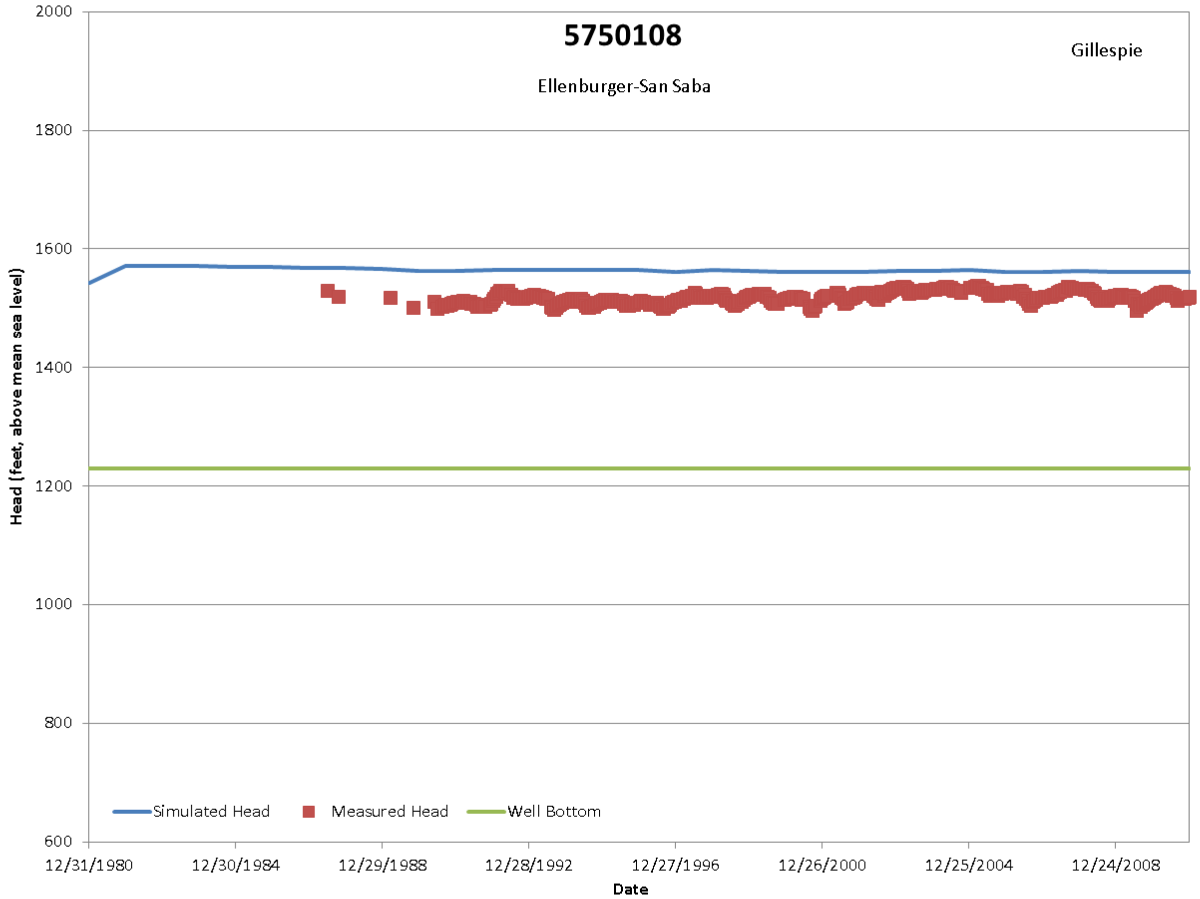
12/30/1984
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750108
Gillespie
Ellenburger-San Saba
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Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
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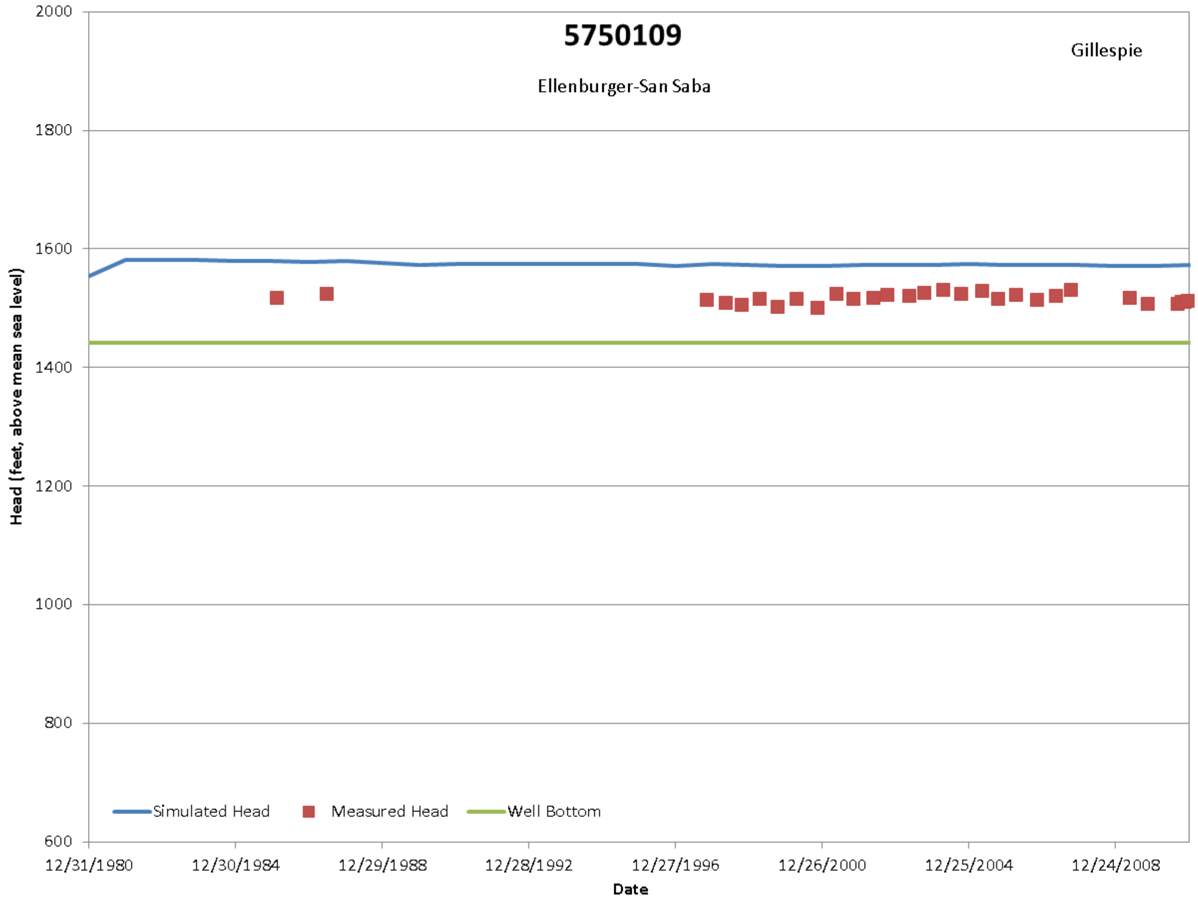
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750109
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
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1200
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800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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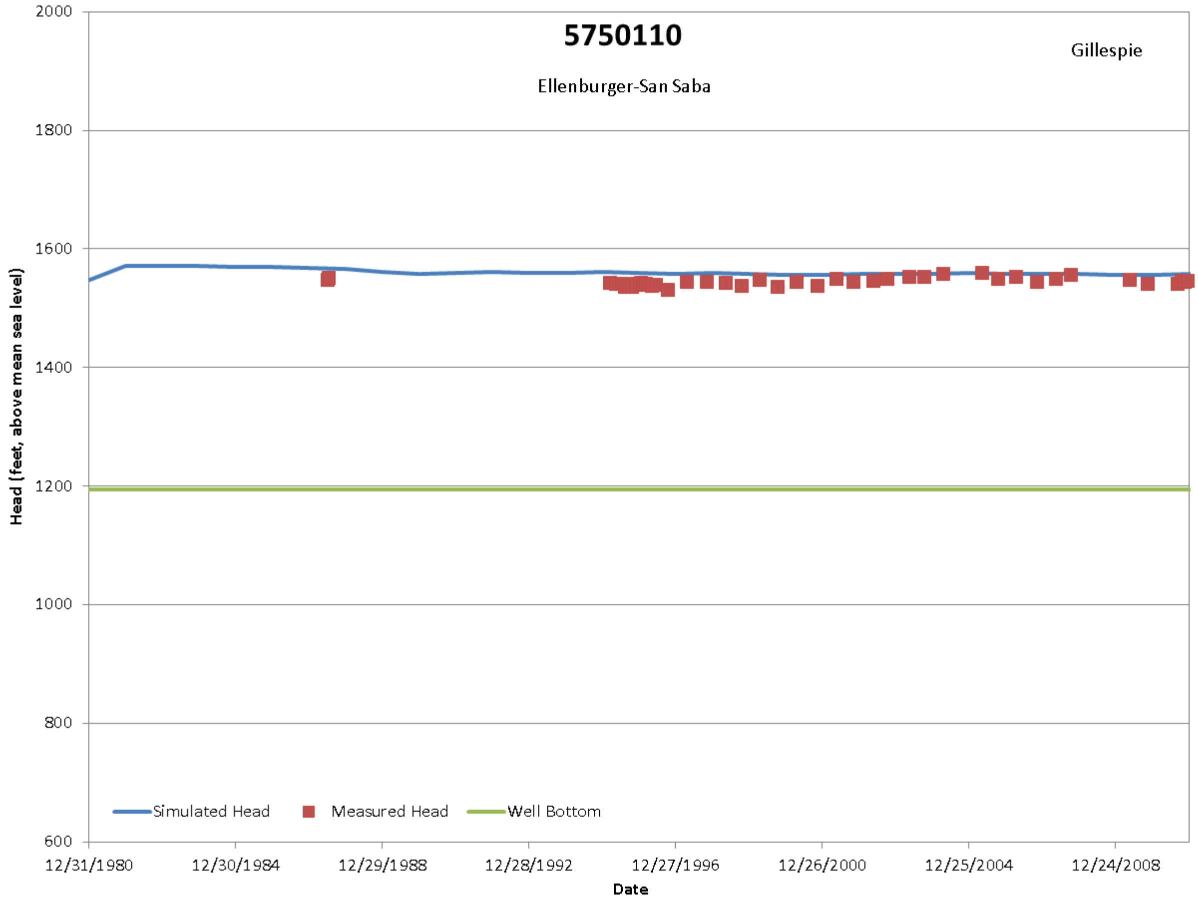
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750110
Gillespie
Ellenburger-San Saba
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1600
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Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
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12/29/1988
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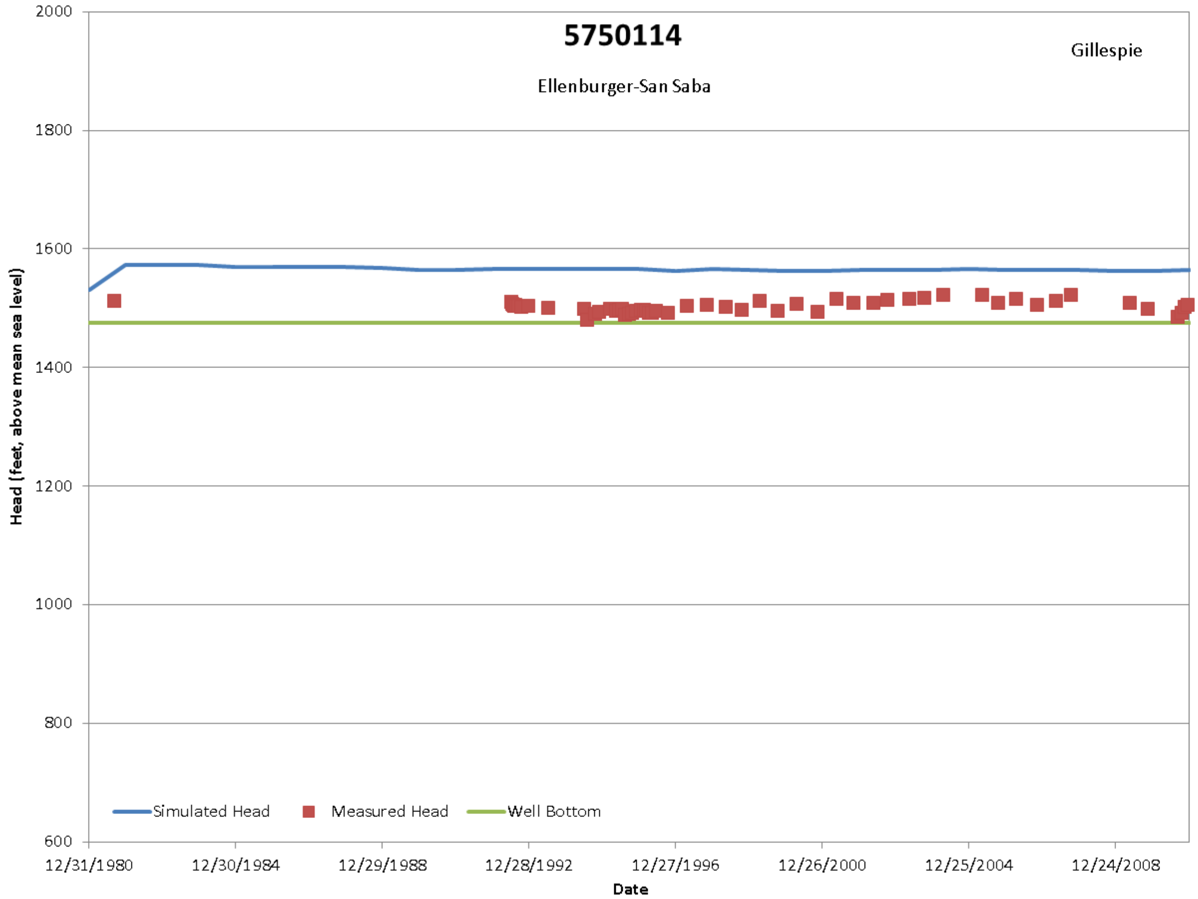
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750114
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
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Simulated Head
Measured Head
Well Bottom
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12/29/1988
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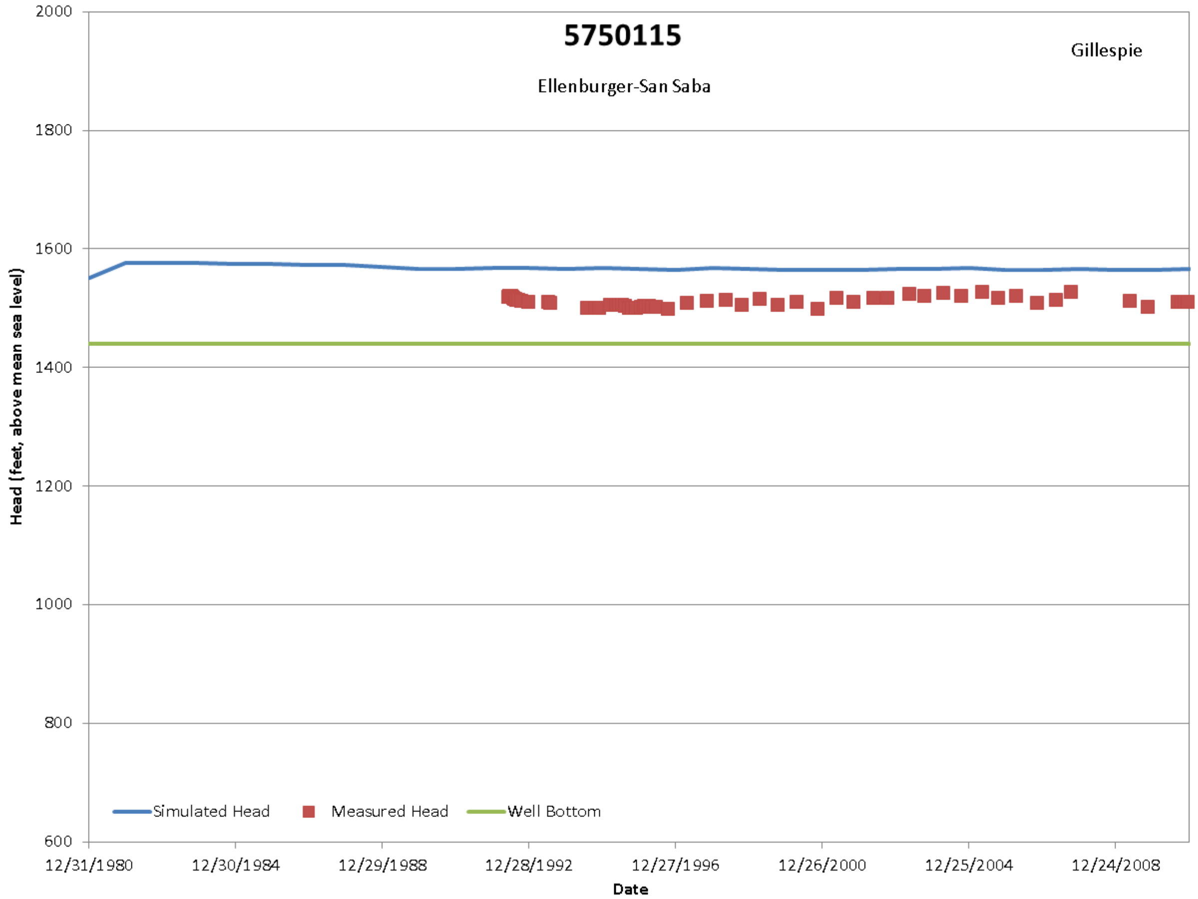
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750115
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
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1400
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800
600
Simulated Head
Measured Head
Well Bottom
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12/29/1988
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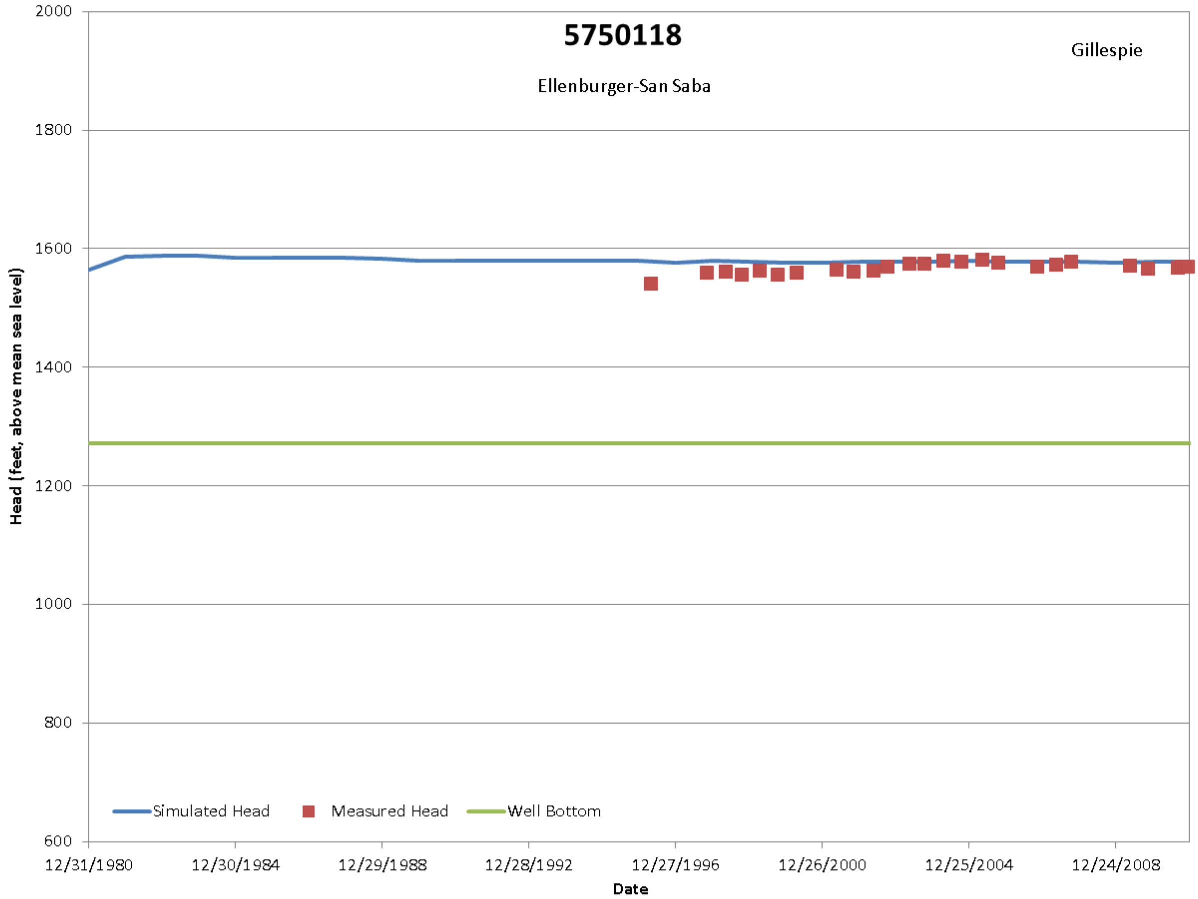
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750118
Gillespie
Ellenburger-San Saba
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1400
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600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
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12/29/1988
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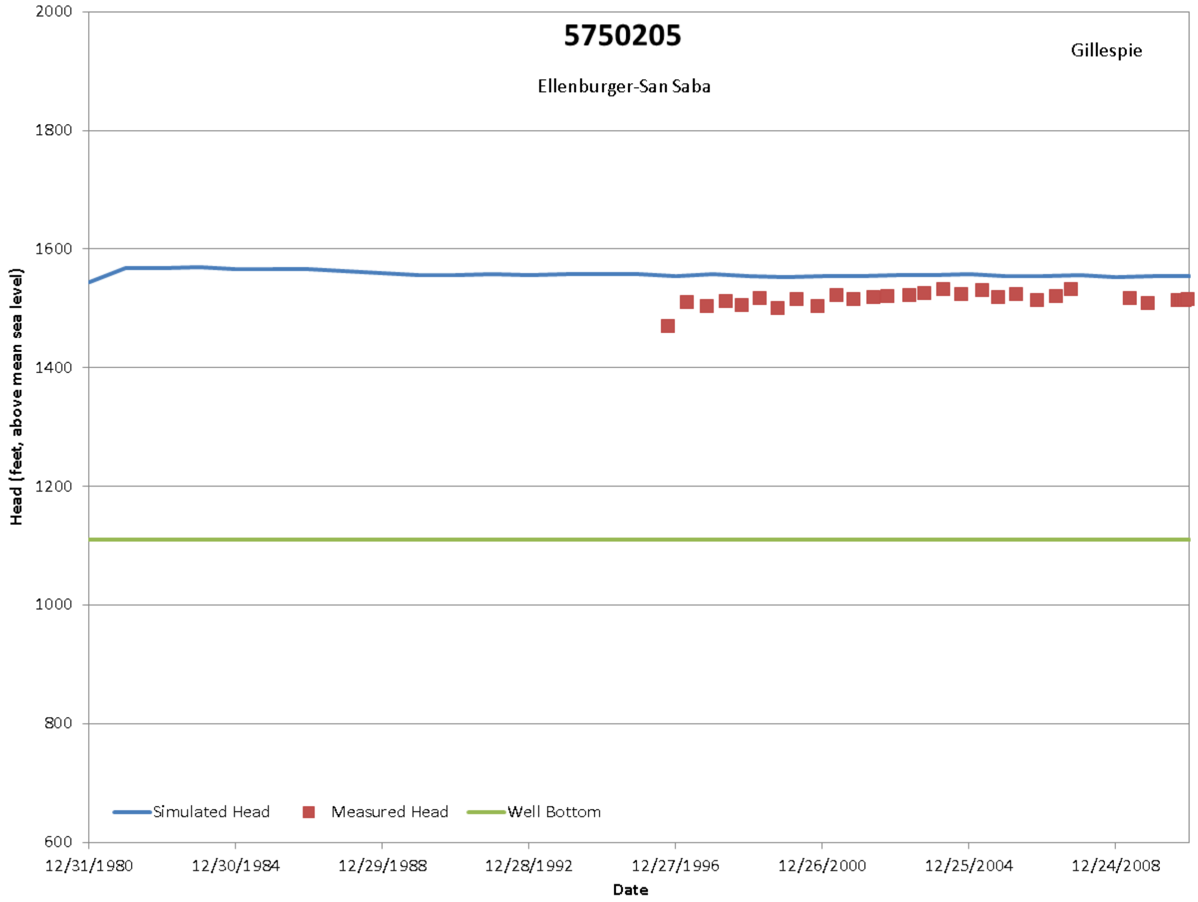
12/26/2000
12/25/2004
12/24/2008
Date


5750205
Gillespie
Ellenburger-San Saba
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800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
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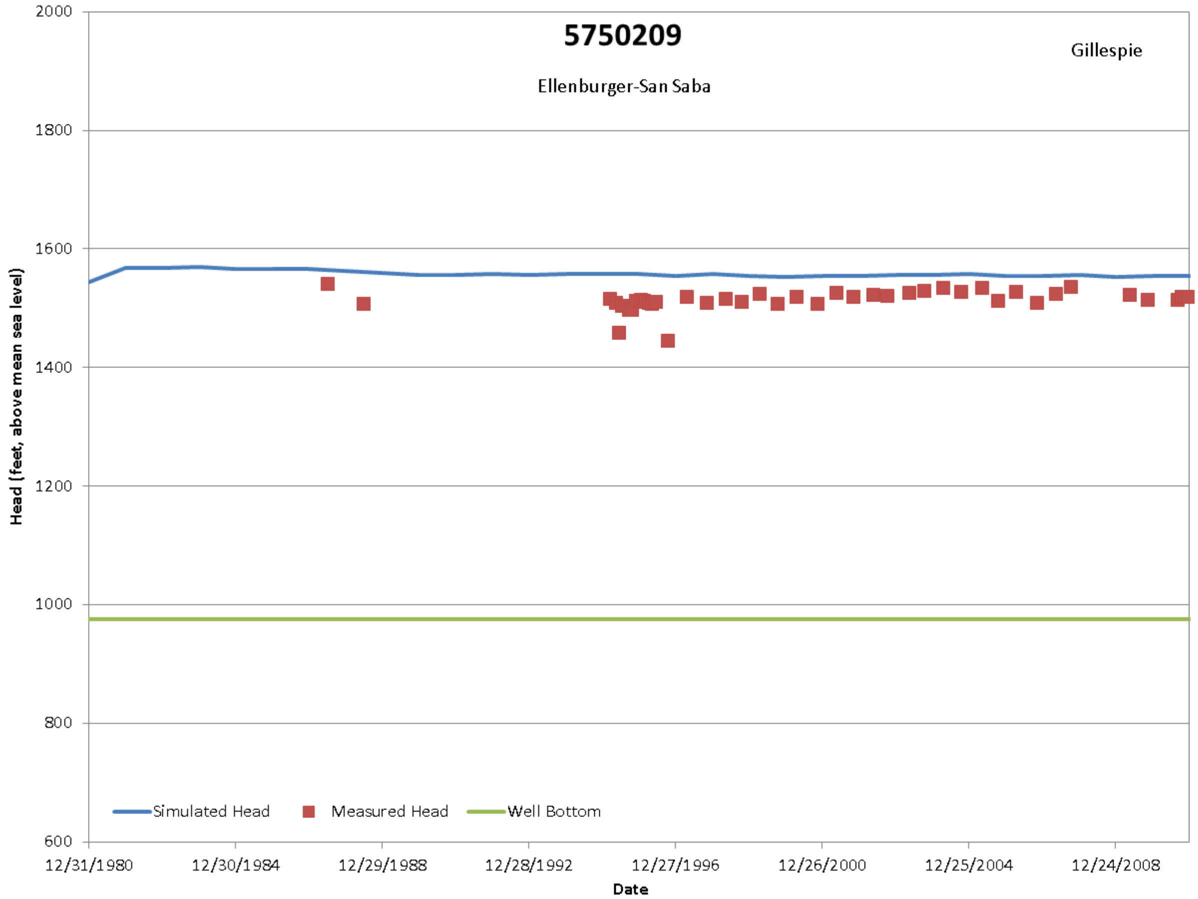
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750209
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
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1400
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800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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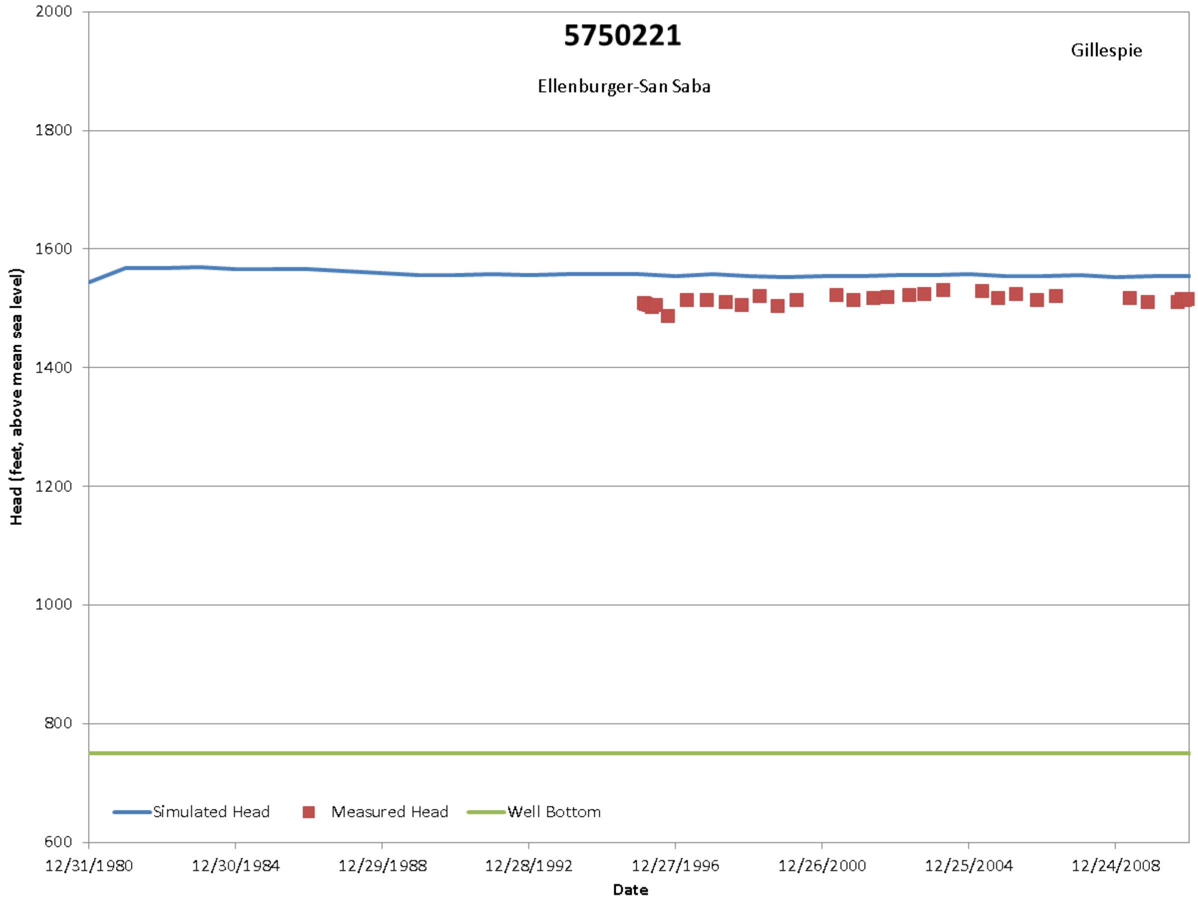
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750221
Gillespie
Ellenburger-San Saba
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Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
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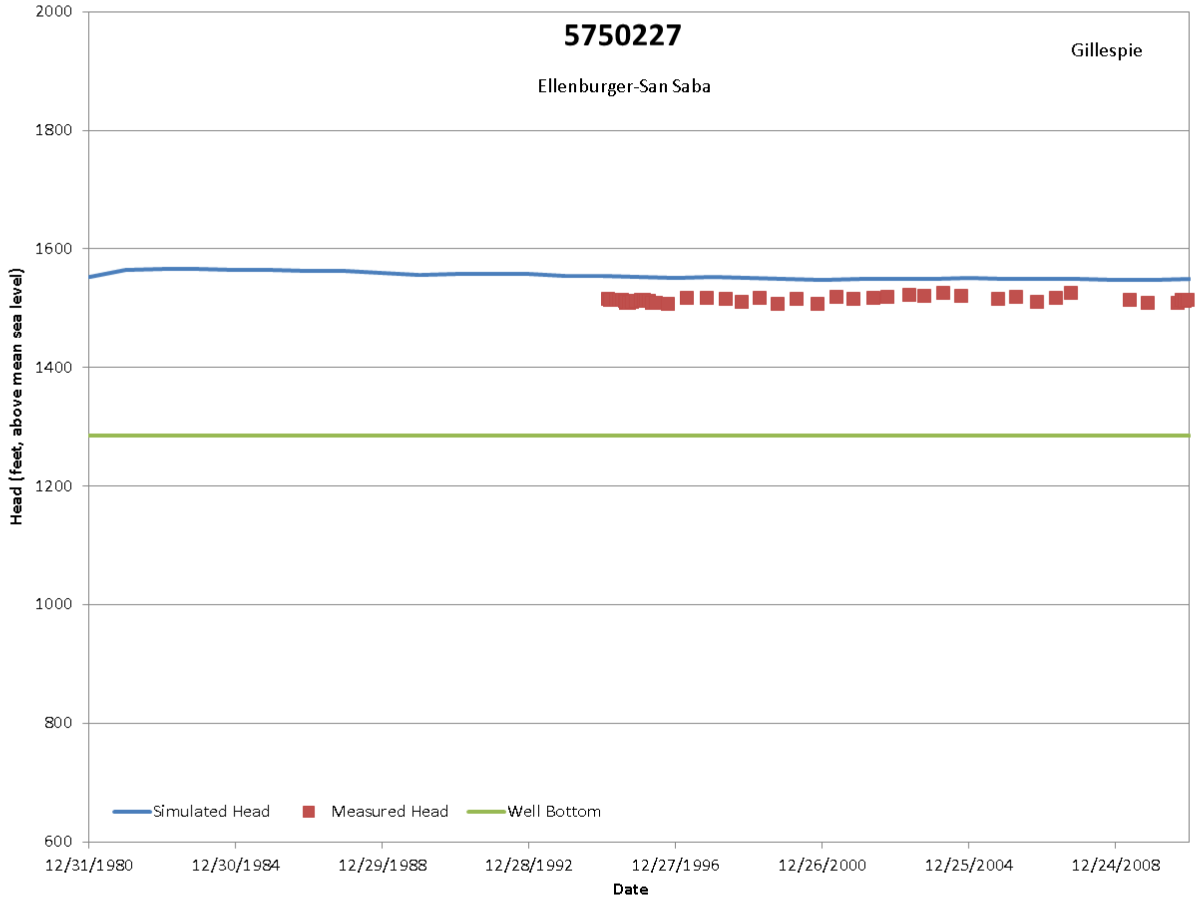
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750227
Gillespie
Ellenburger-San Saba
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Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
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12/29/1988
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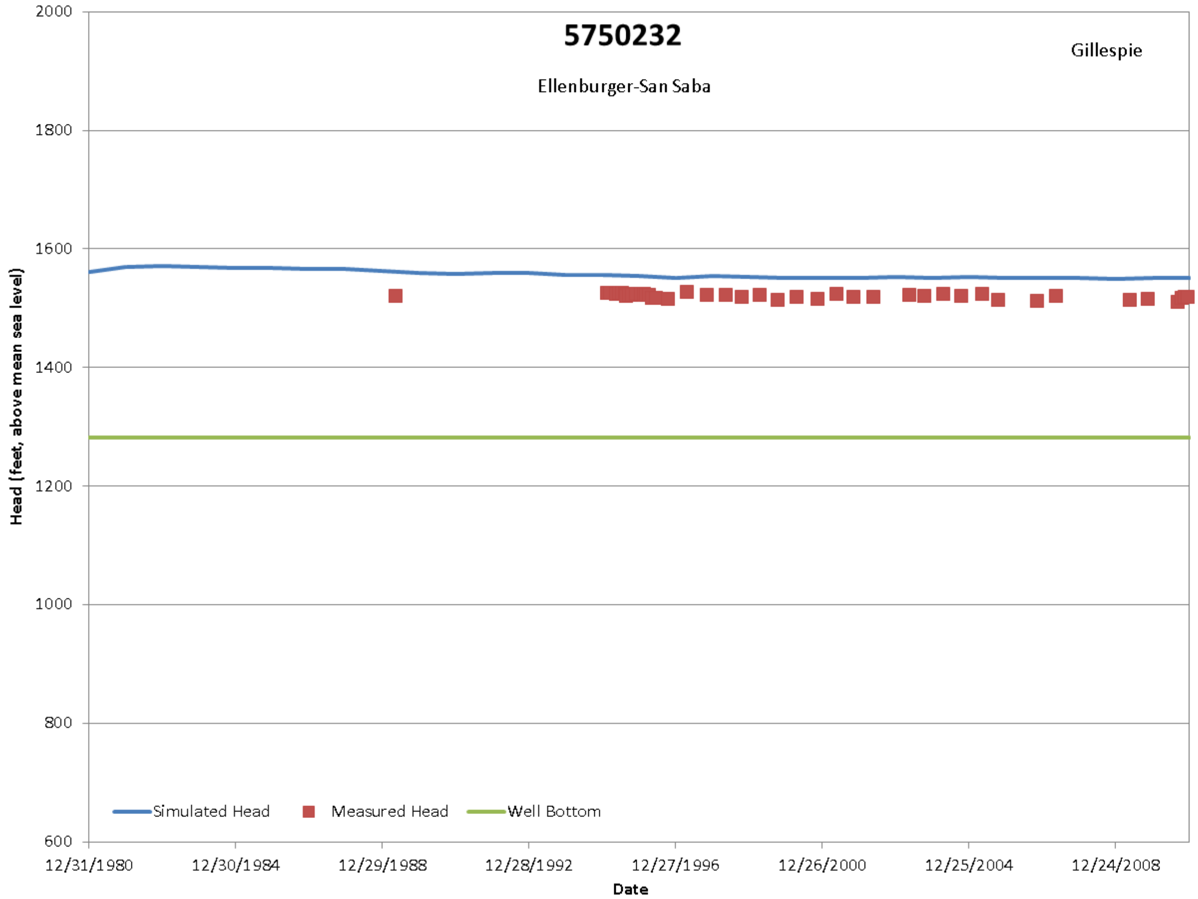
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750232
Gillespie
Ellenburger-San Saba
2000
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800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
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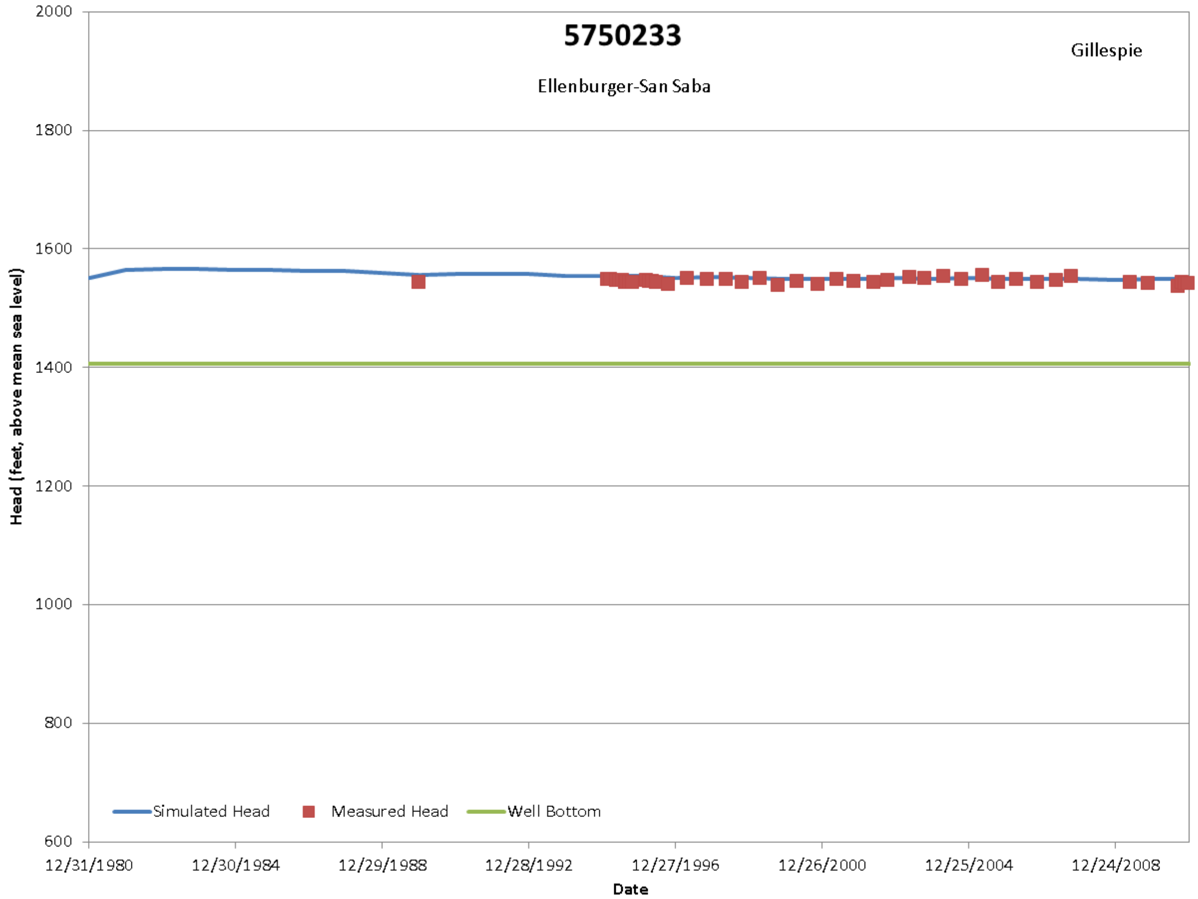
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750233
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
2000
1800
1600
1400
1200
1000
800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
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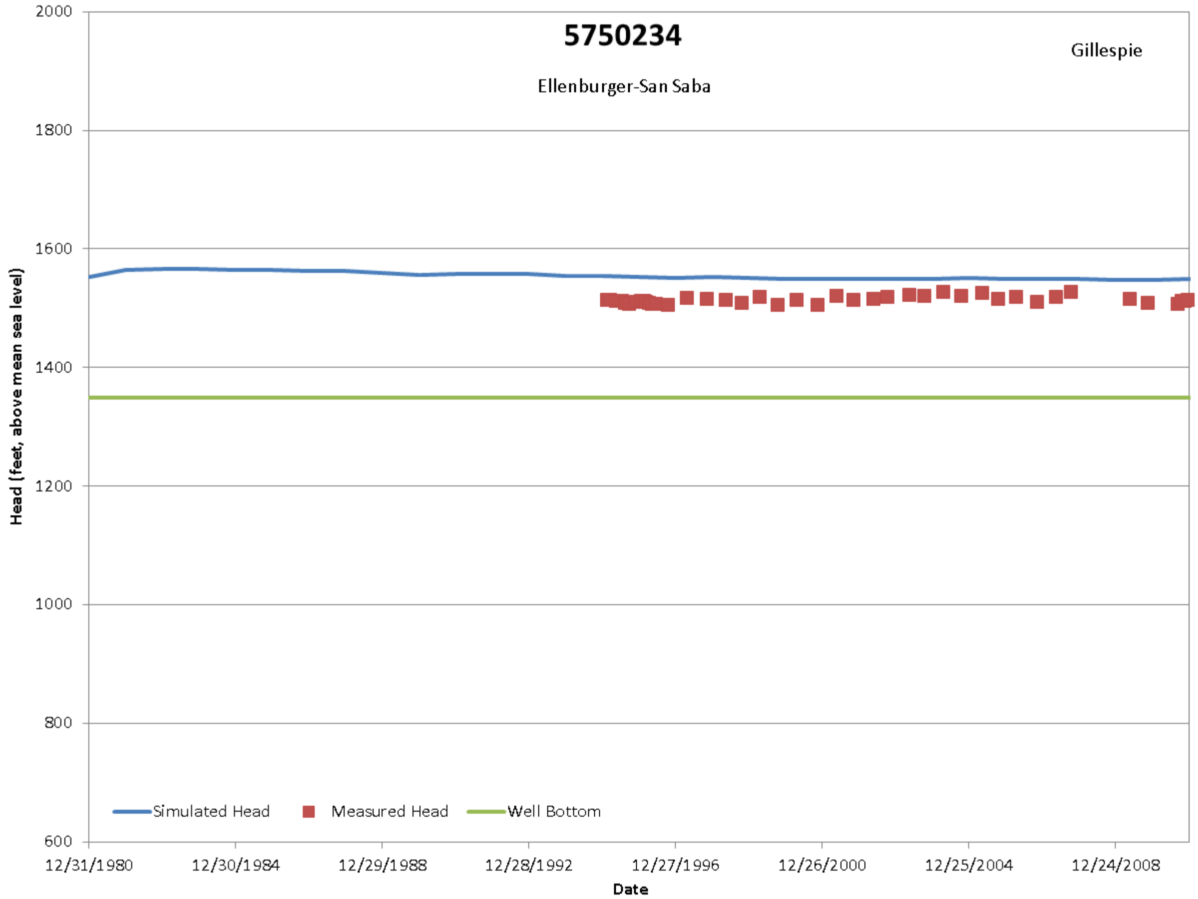
12/29/1988
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750234
Gillespie
Ellenburger-San Saba
2000
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1600
1400
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1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
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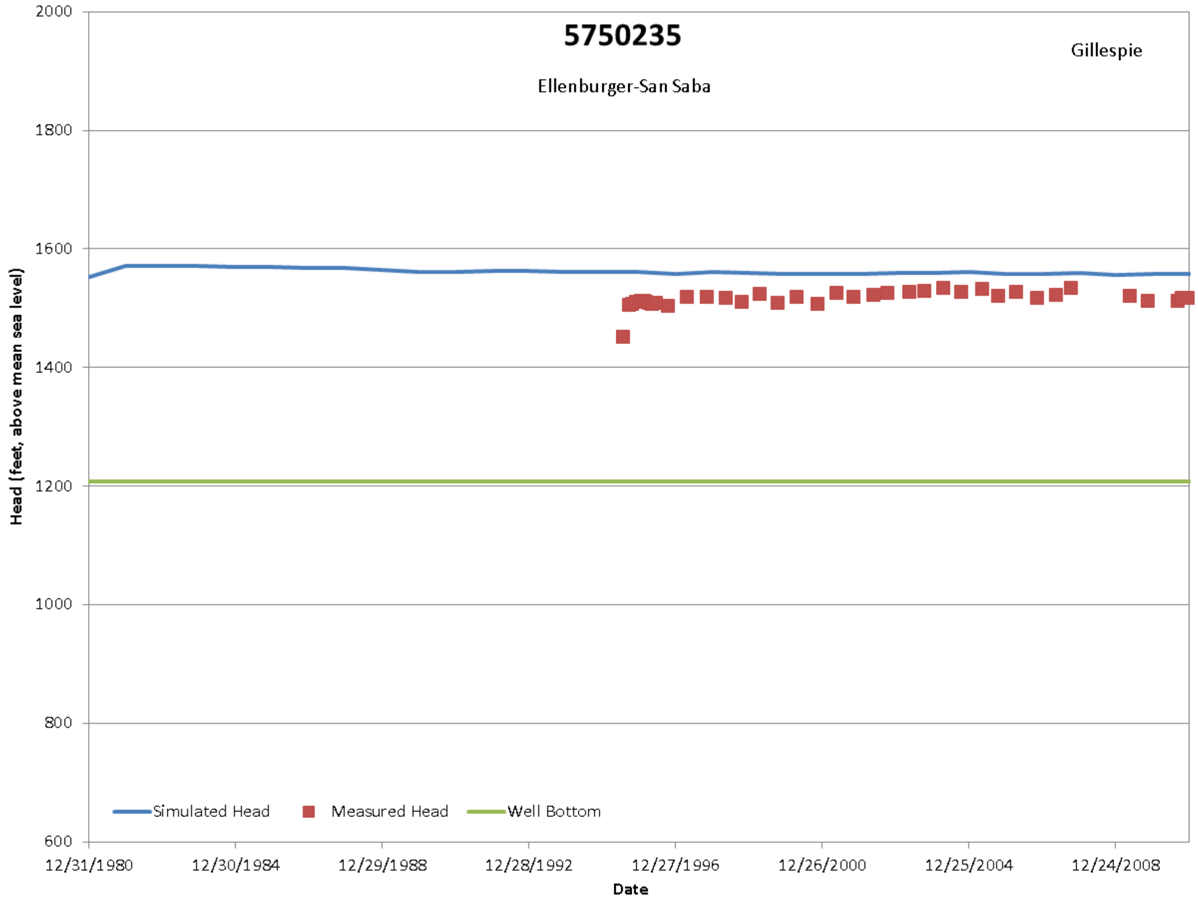
12/26/2000
12/25/2004
12/24/2008
Date


5750235
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
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Simulated Head
Measured Head
Well Bottom
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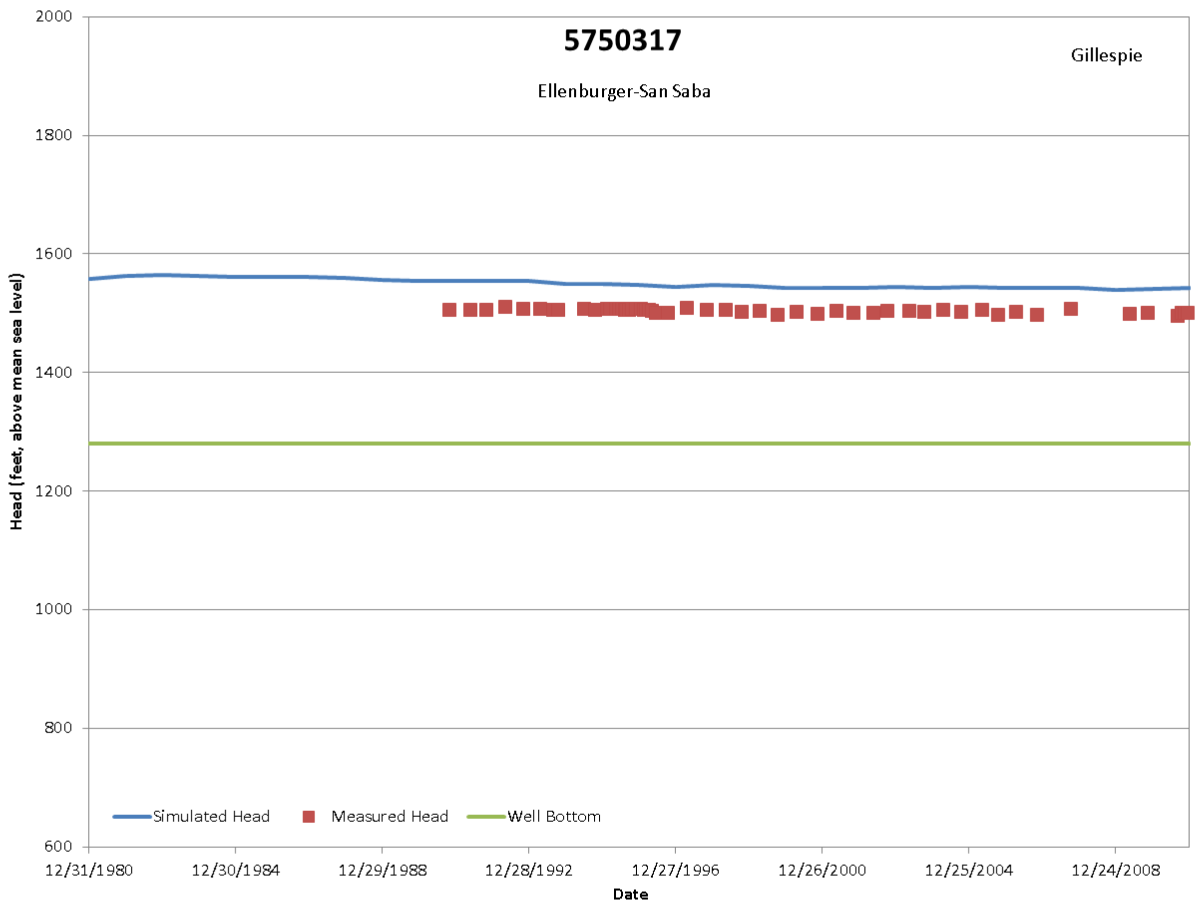
12/24/2008
Date


5750317
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
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Simulated Head
Measured Head
Well Bottom
12/31/1980
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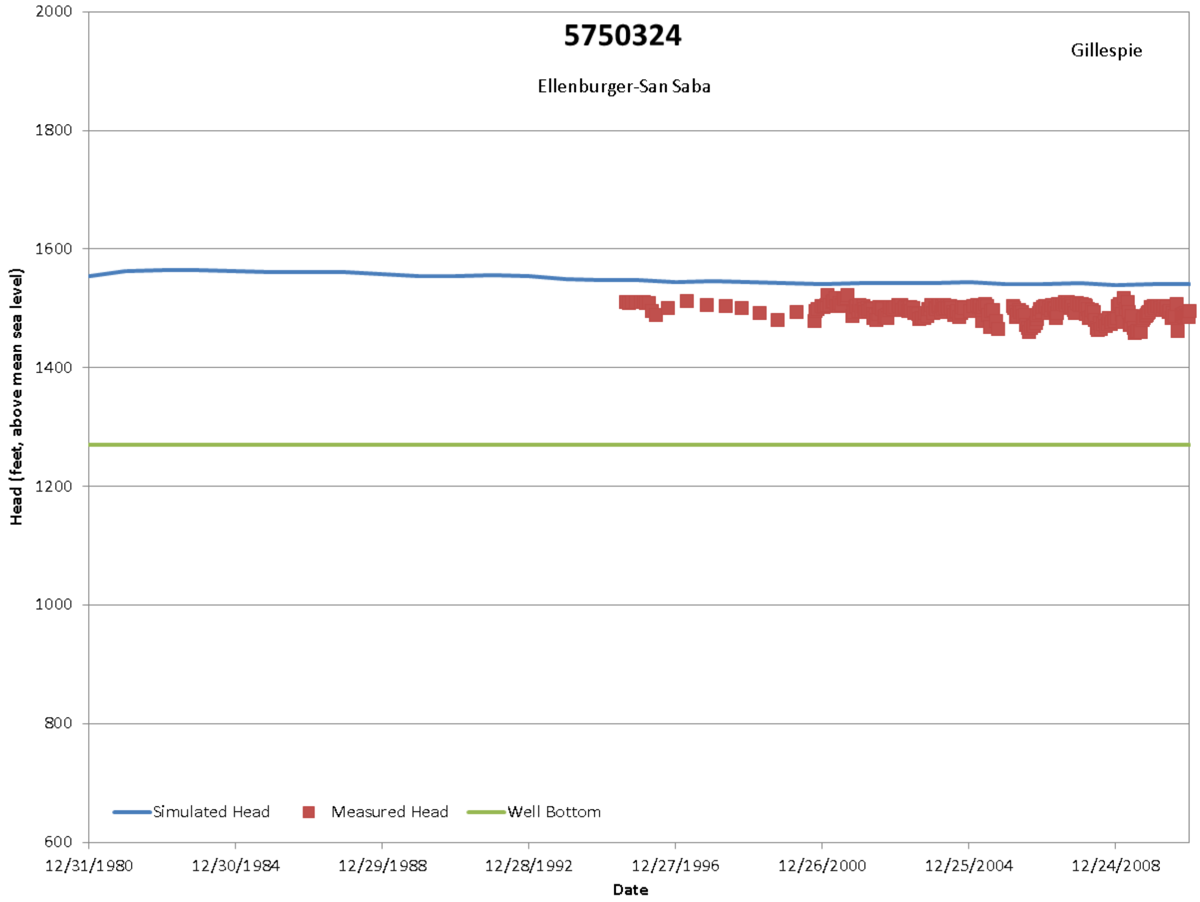
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750324
Gillespie
Ellenburger-San Saba
2000
1800
1600
1400
1200
1000
800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
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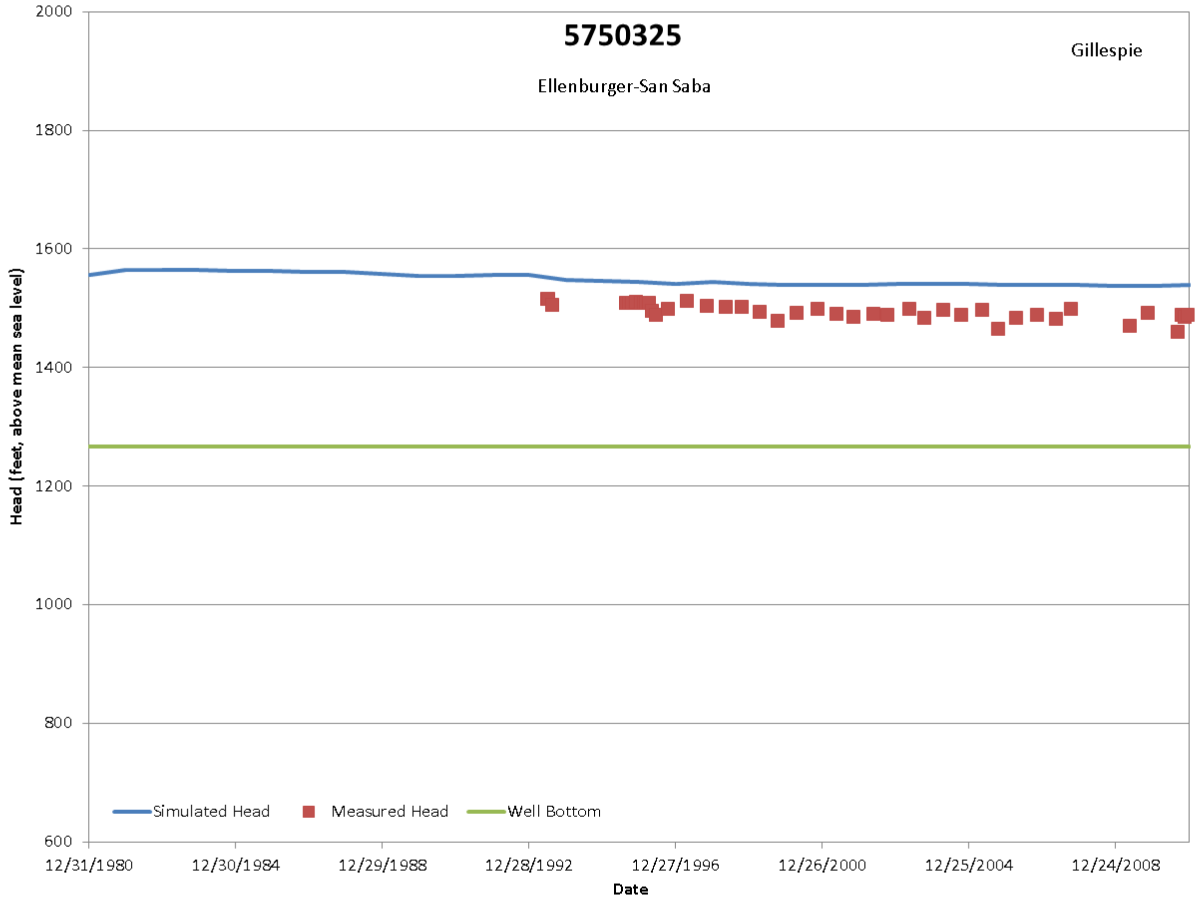
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750325
Gillespie
Ellenburger-San Saba
Head (feet, above mean sea level)
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1600
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1200
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800
600
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
12/29/1988
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12/27/1996
12/26/2000
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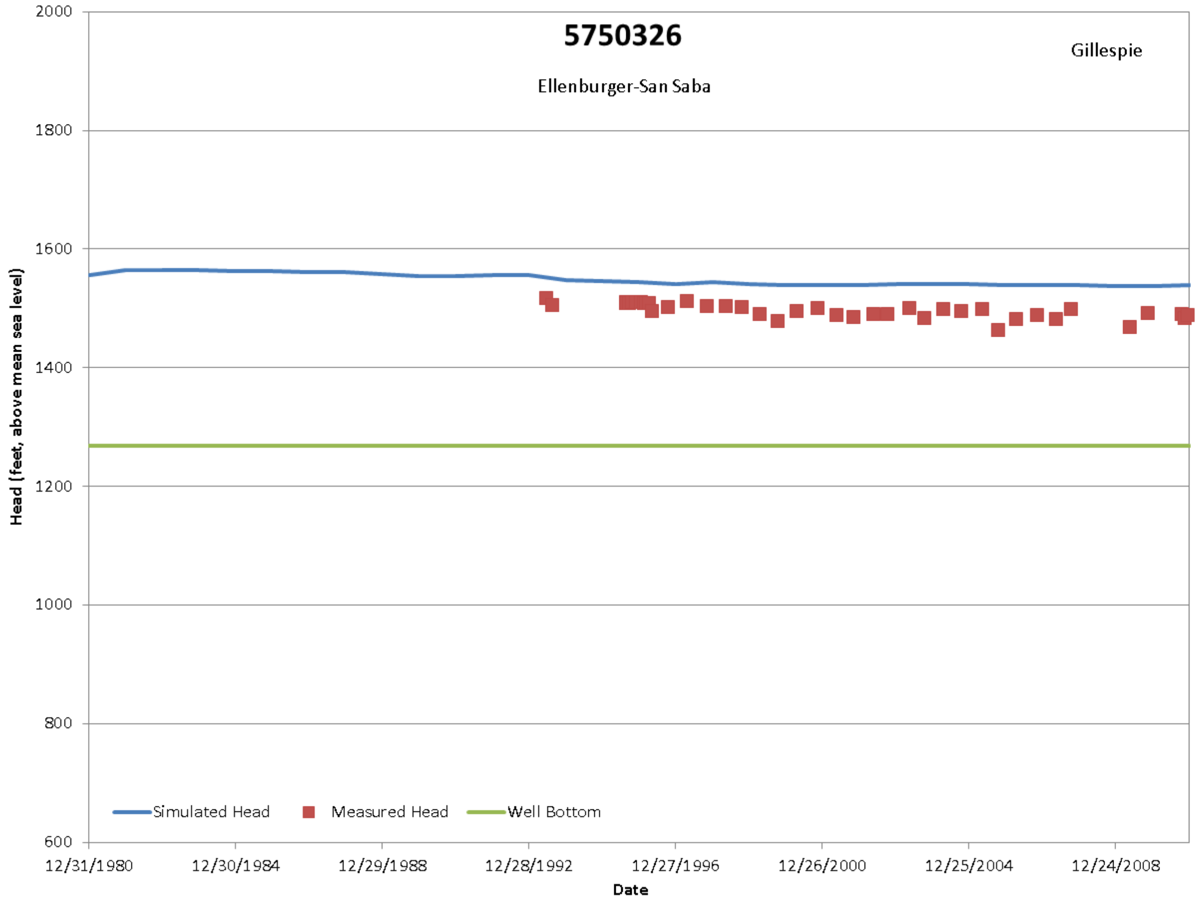
12/24/2008
Date


5750326
Gillespie
Ellenburger-San Saba
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1600
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1200
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800
600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
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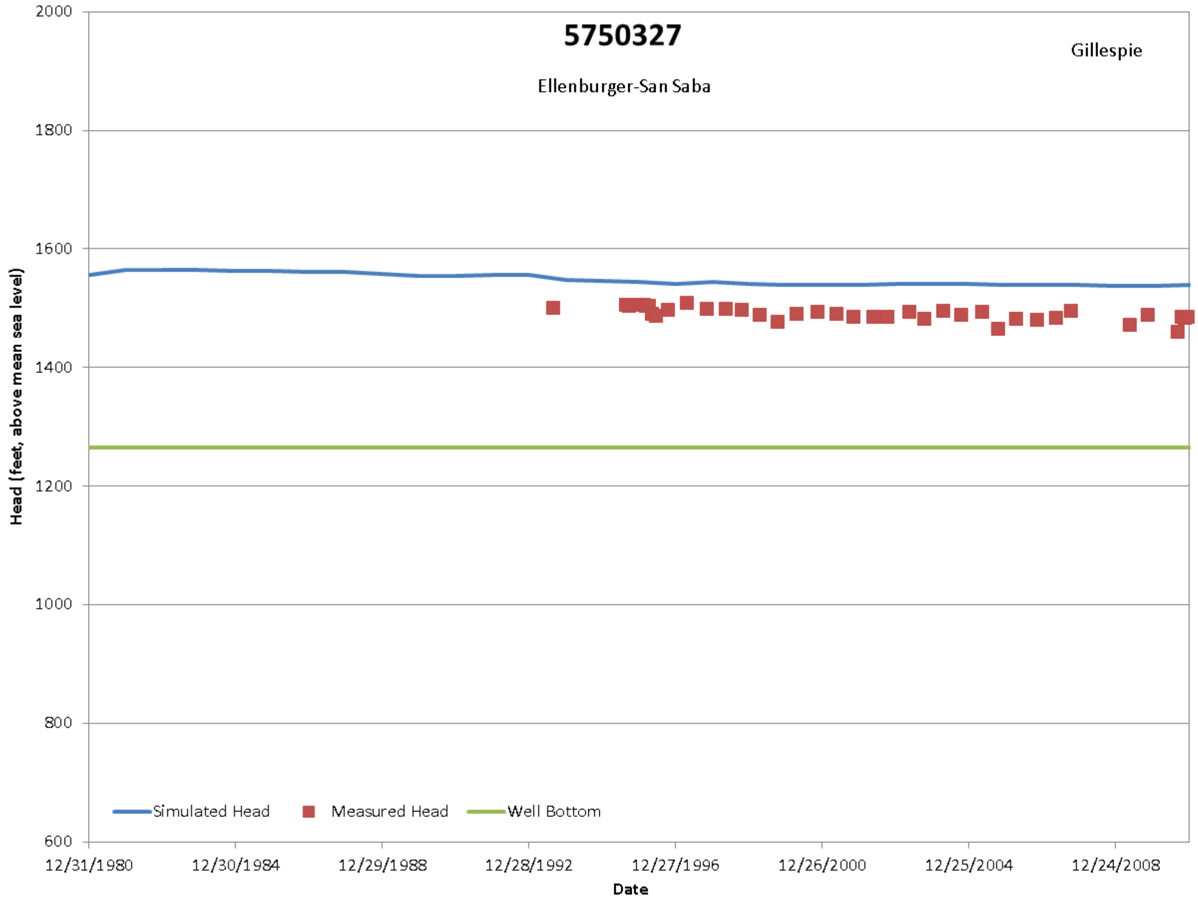
12/28/1992
12/27/1996
12/26/2000
12/25/2004
12/24/2008
Date


5750327
Gillespie
Ellenburger-San Saba
2000
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600
Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
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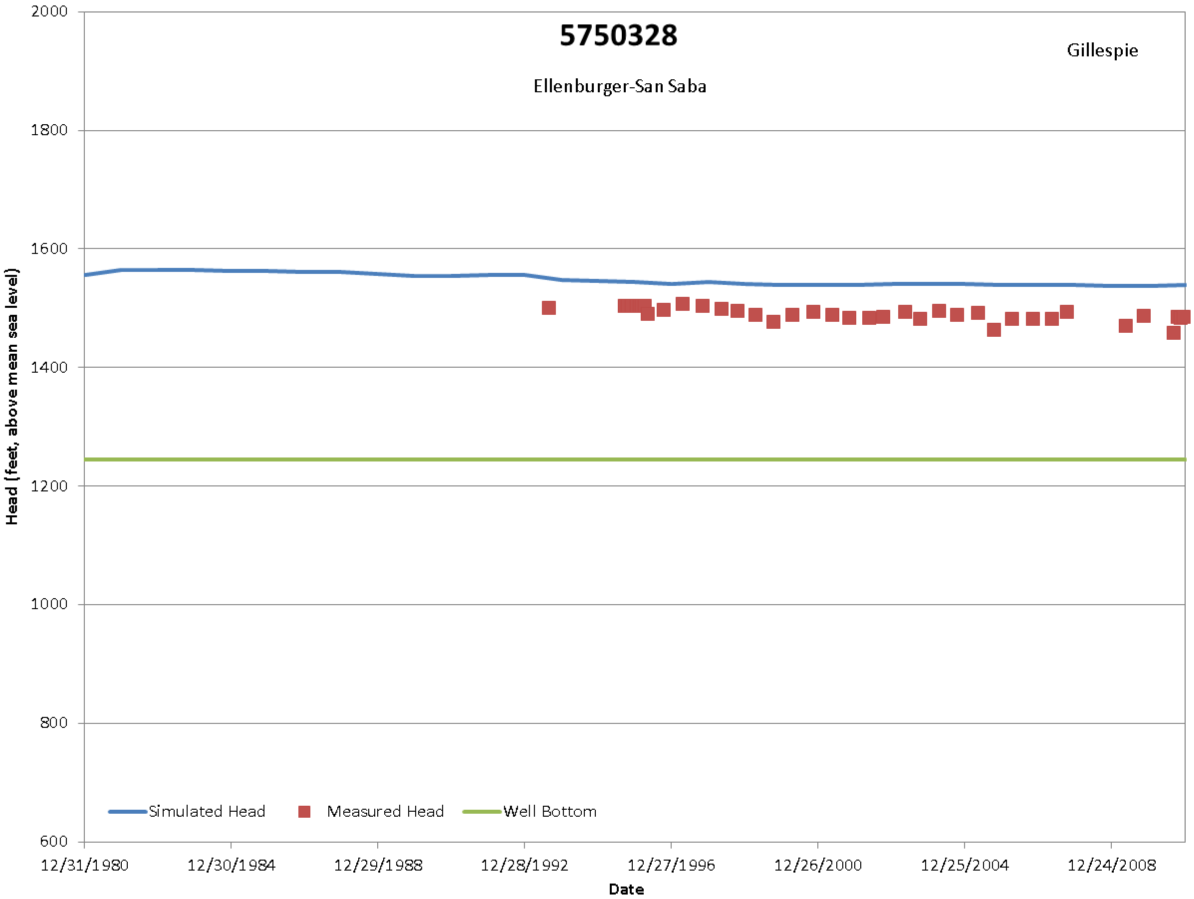
12/26/2000
12/25/2004
12/24/2008
Date


5750328
Gillespie
Ellenburger-San Saba
2000
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1600
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Head (feet, above mean sea level)
Simulated Head
Measured Head
Well Bottom
12/31/1980
12/30/1984
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12/26/2000
12/25/2004
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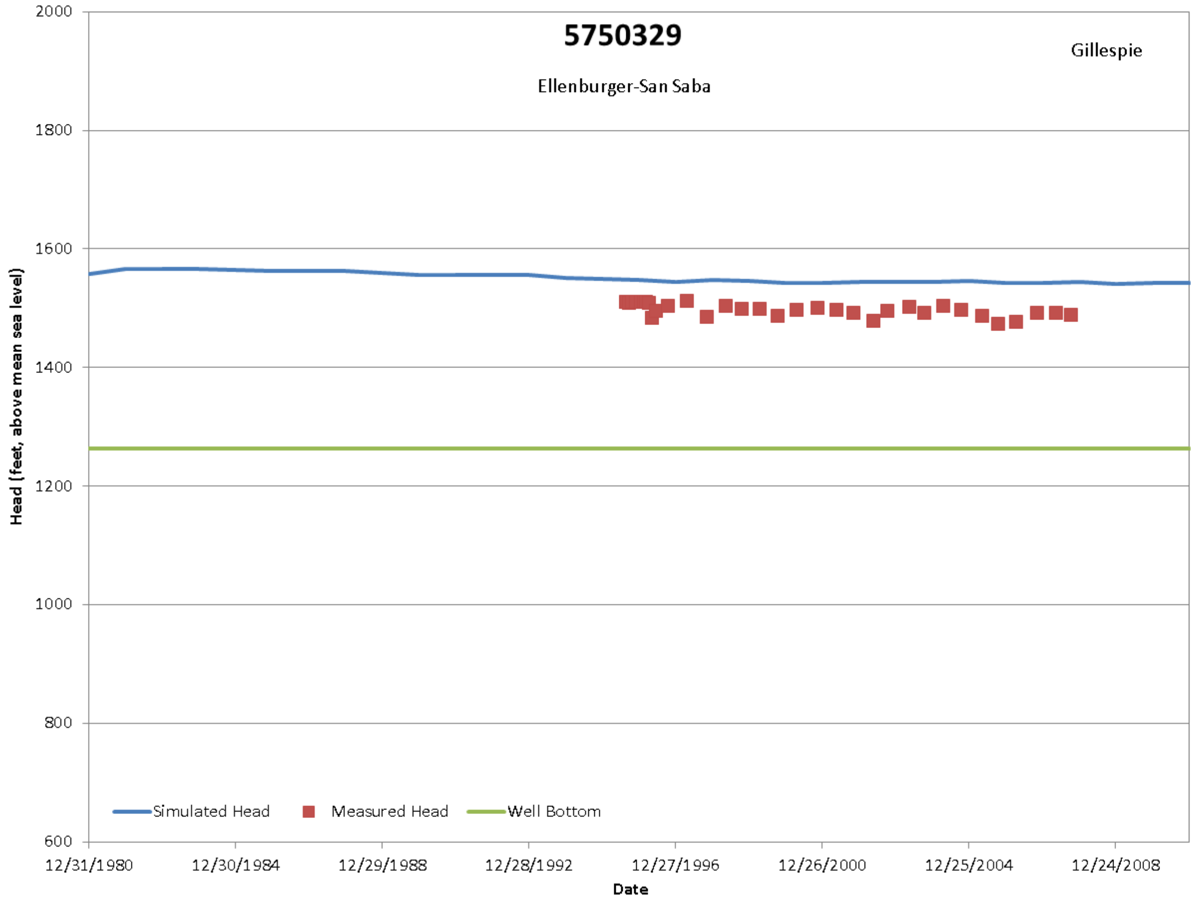
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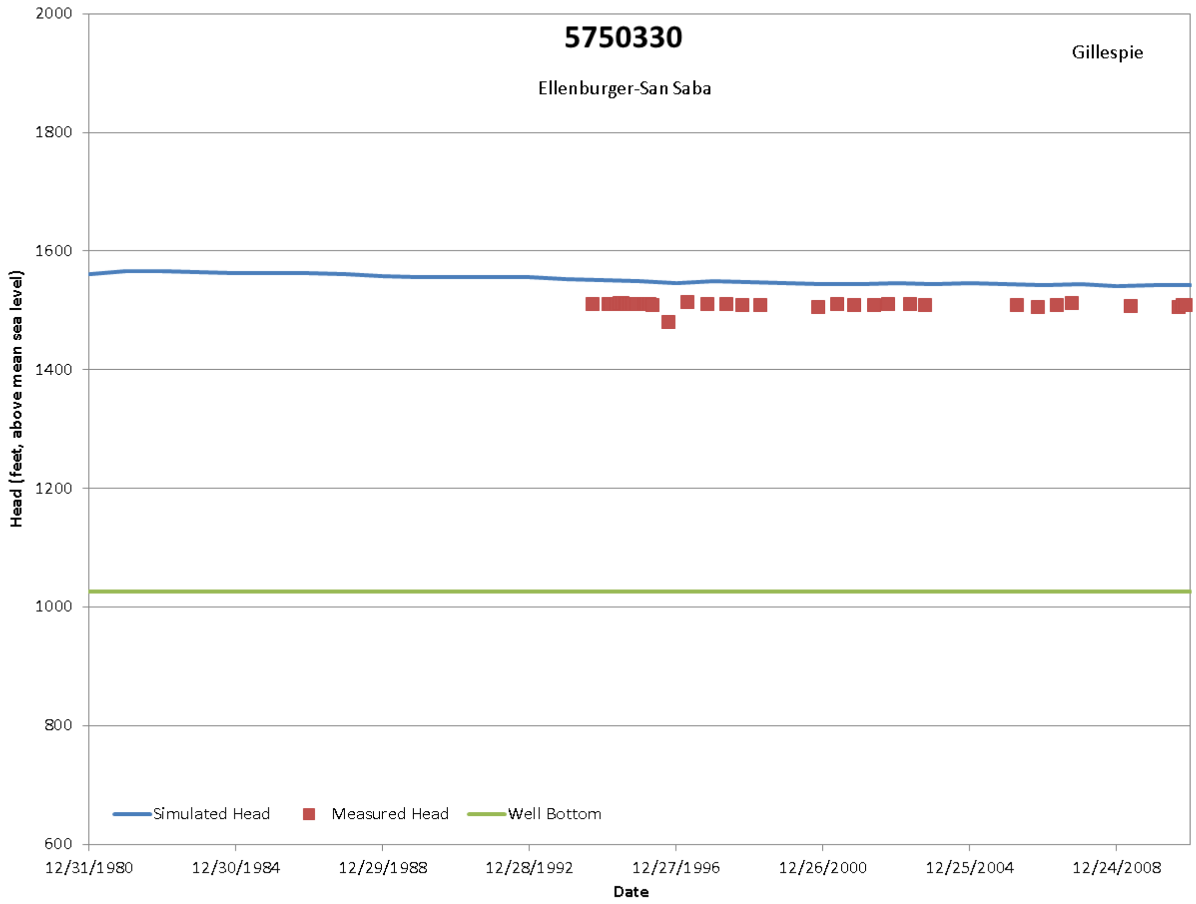
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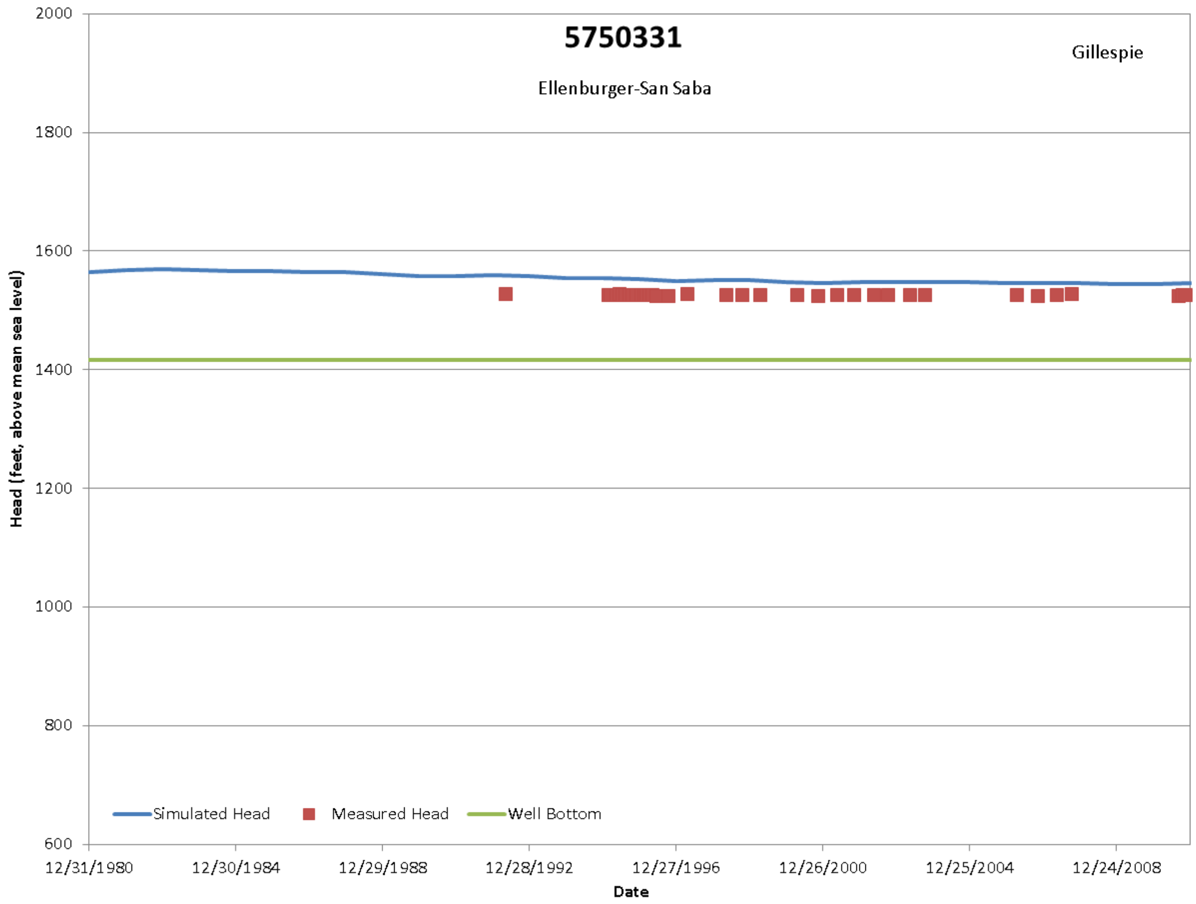
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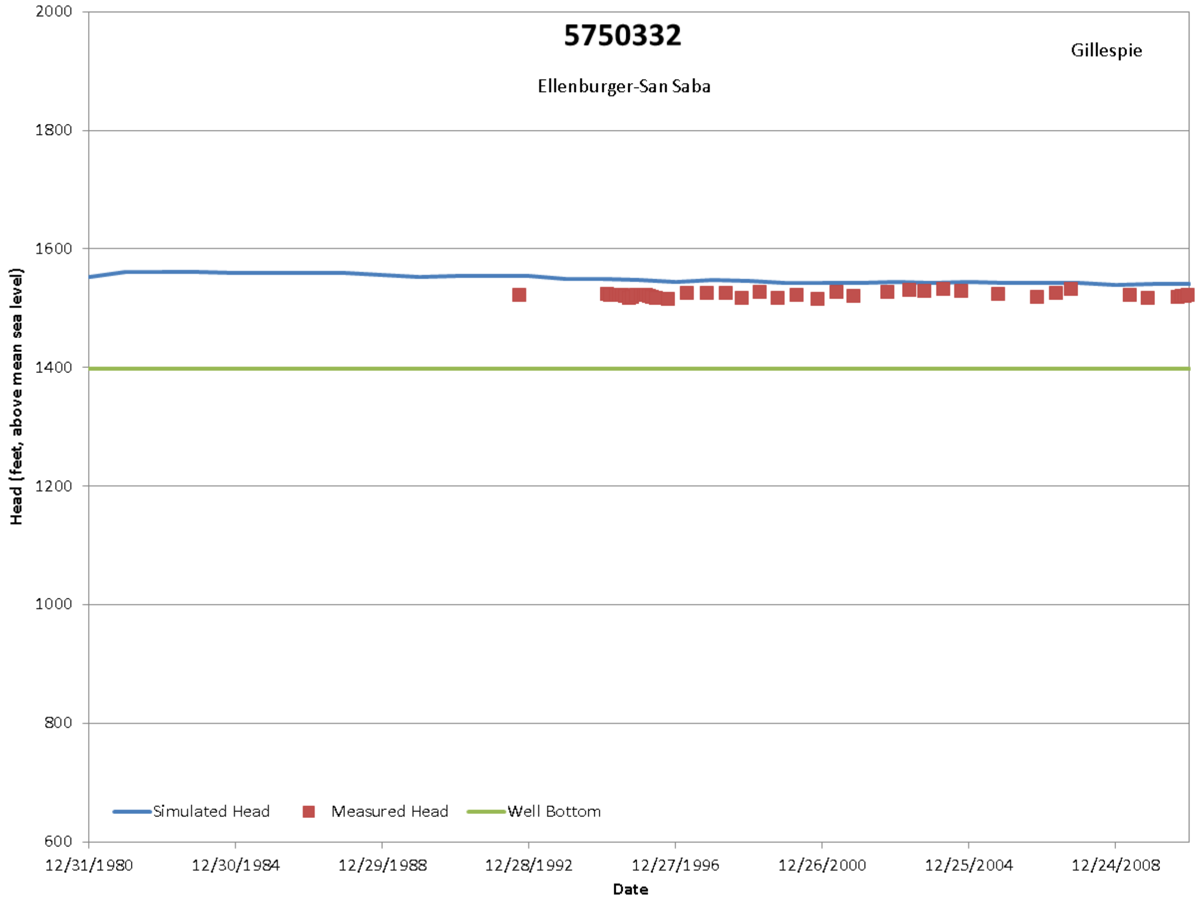
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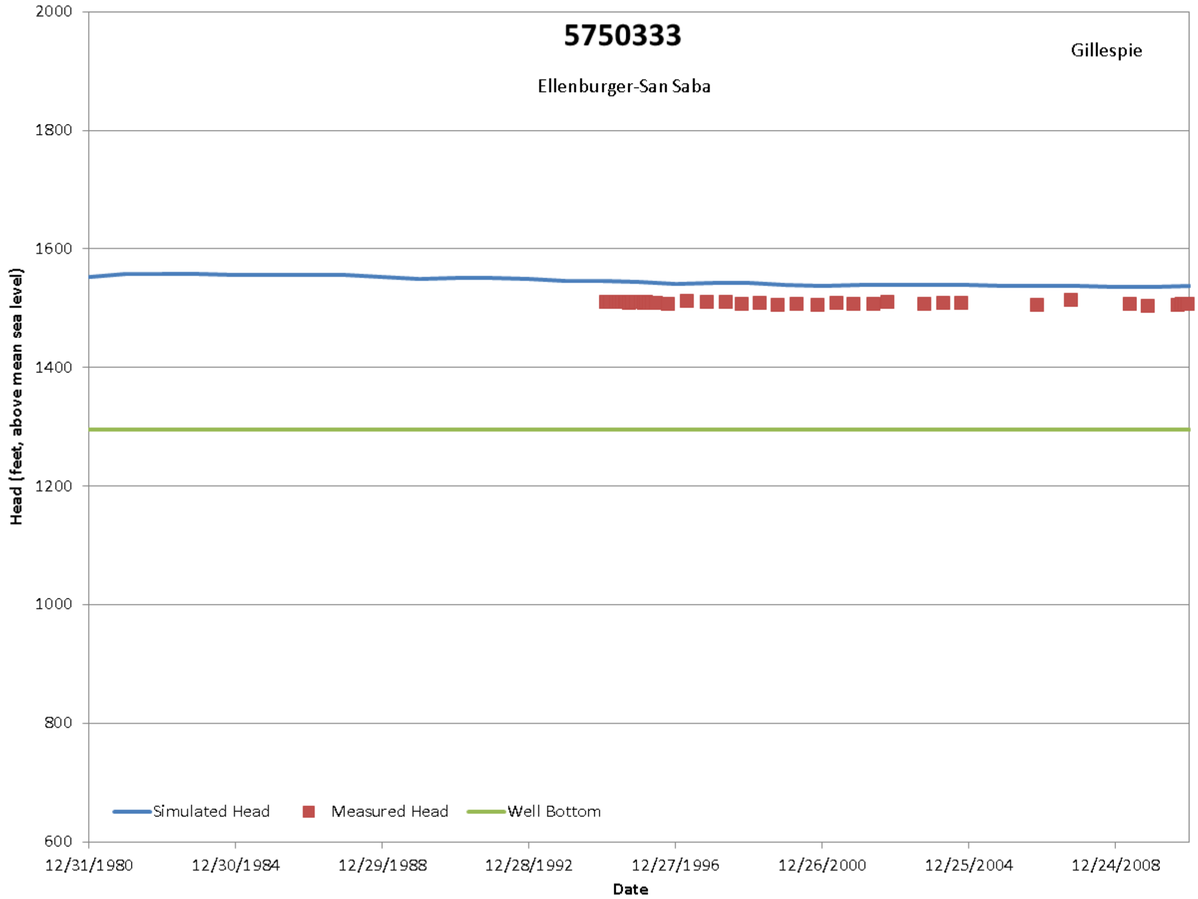
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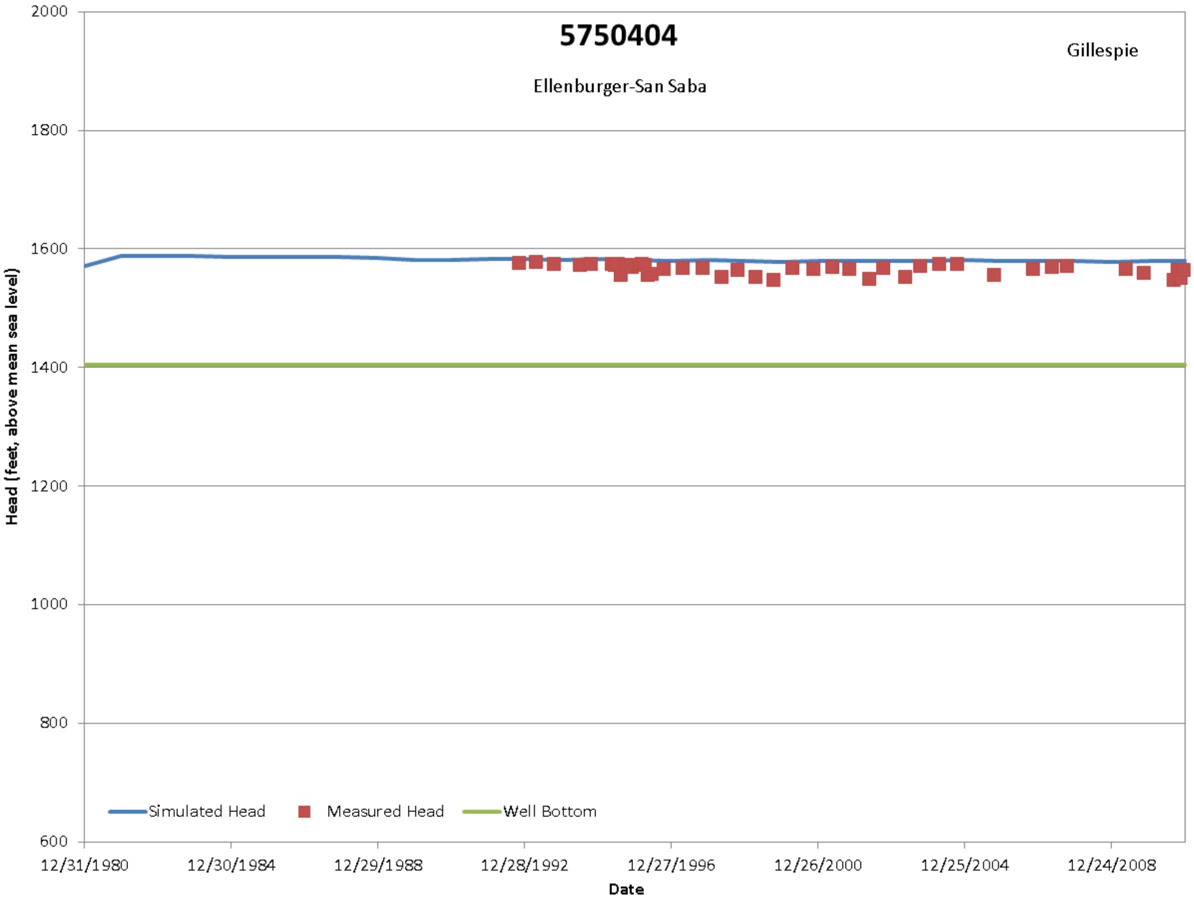
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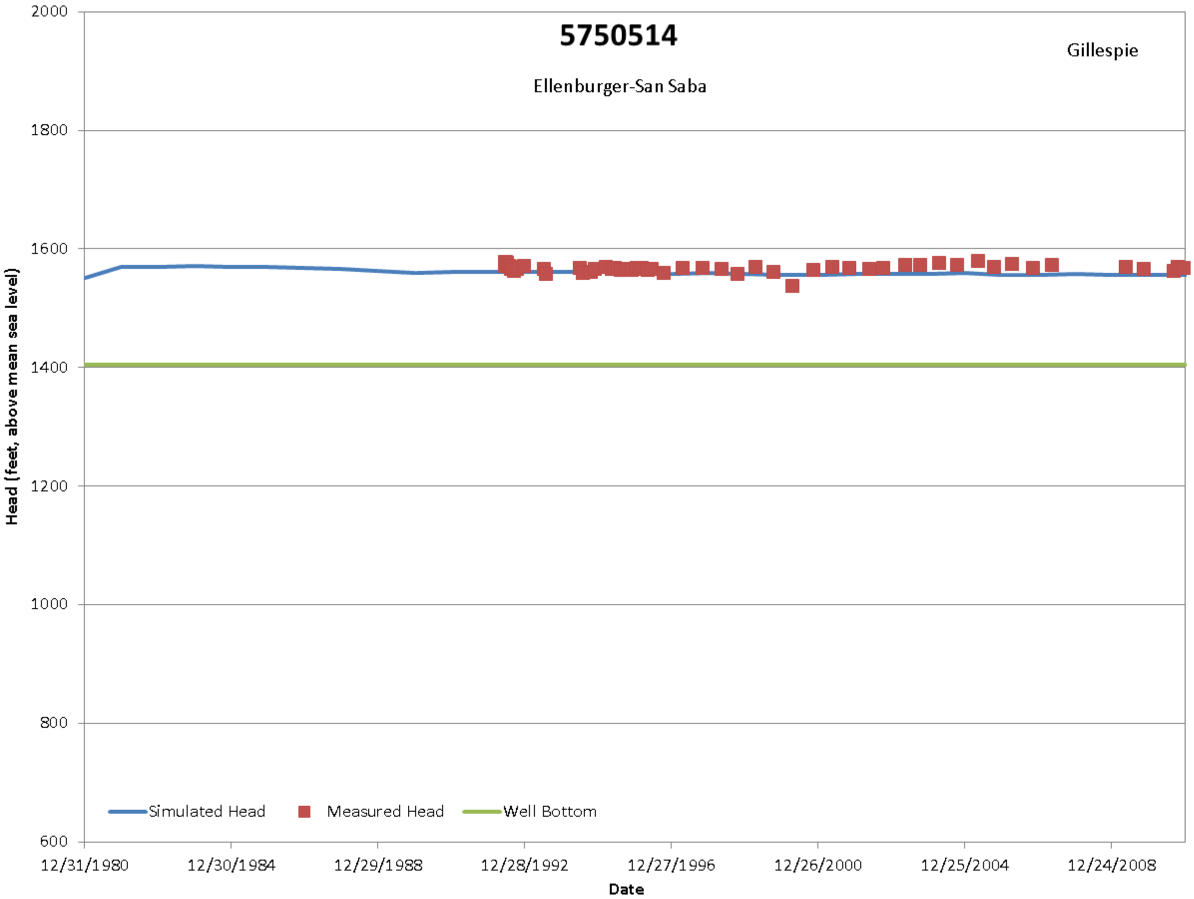
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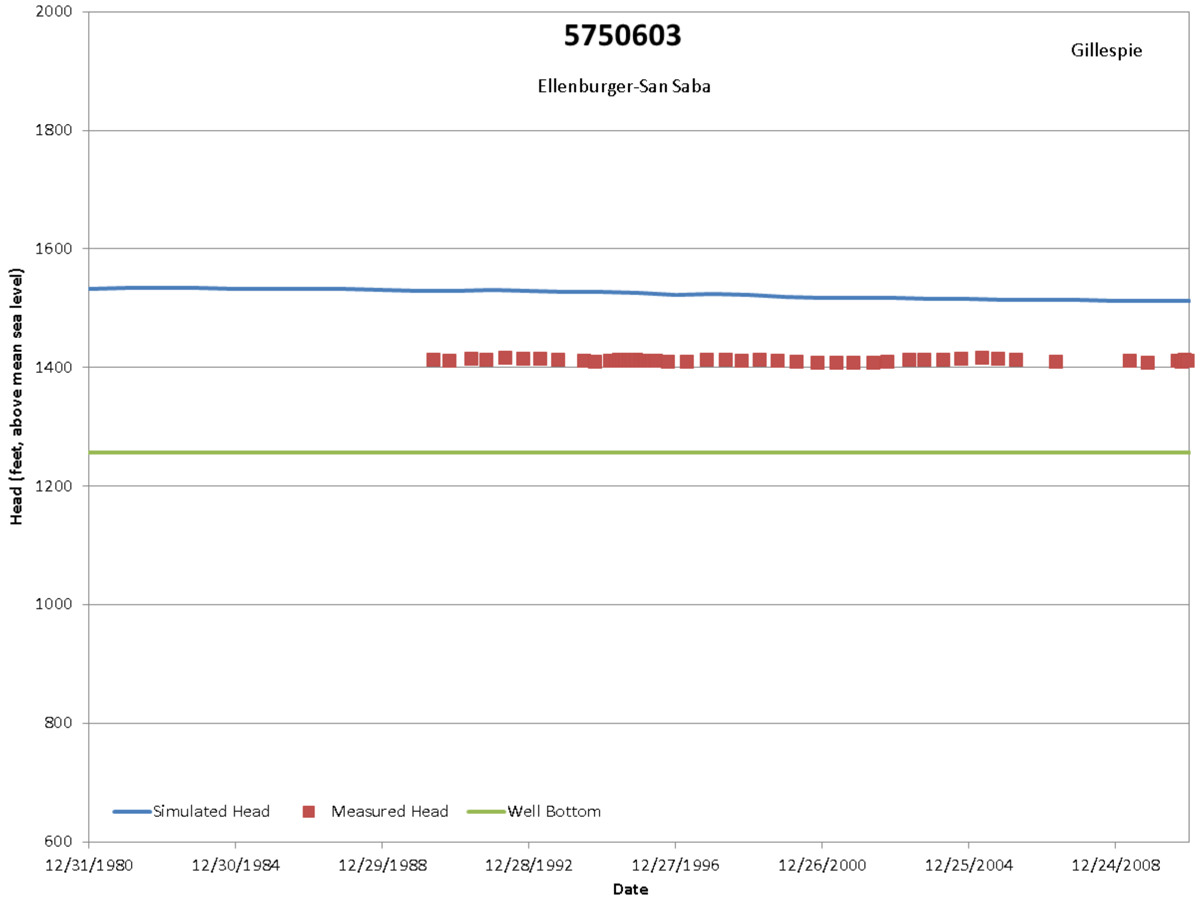
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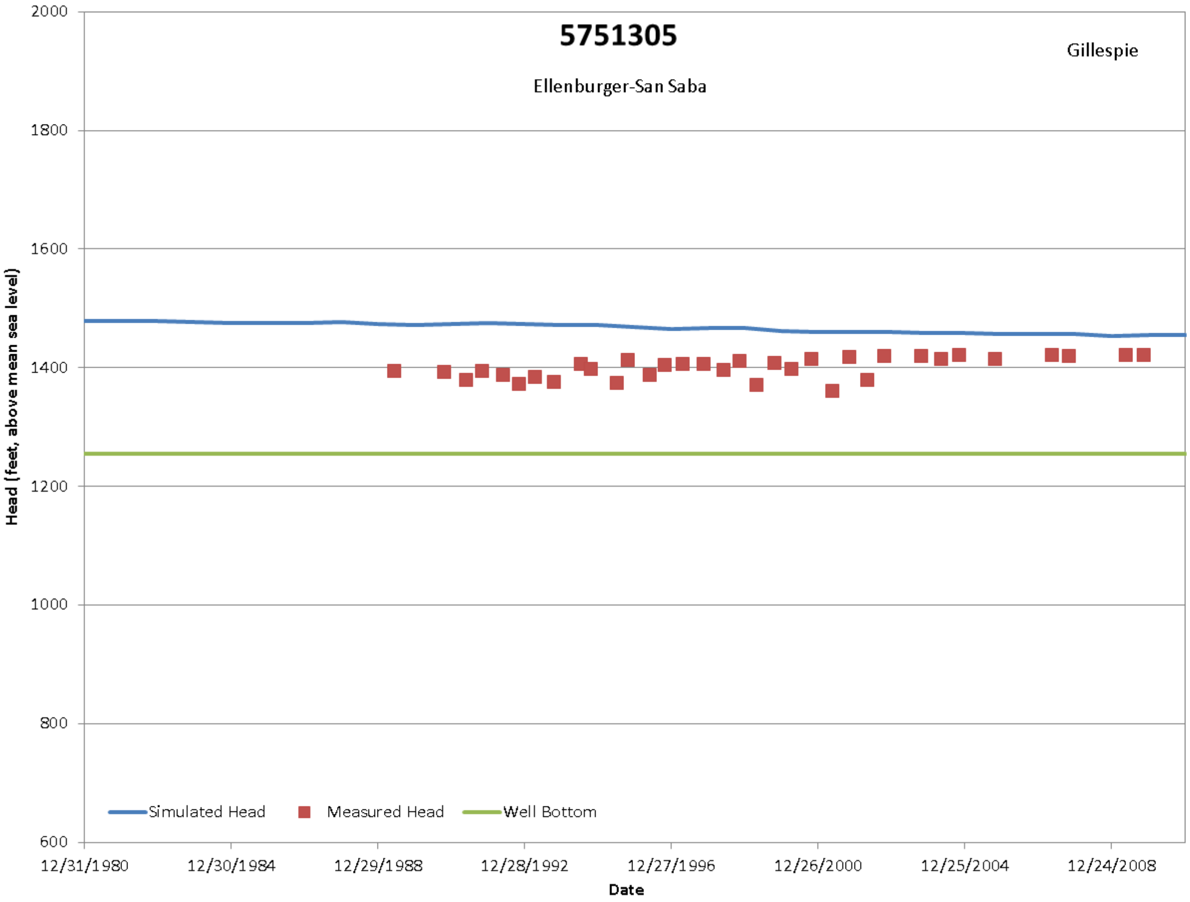
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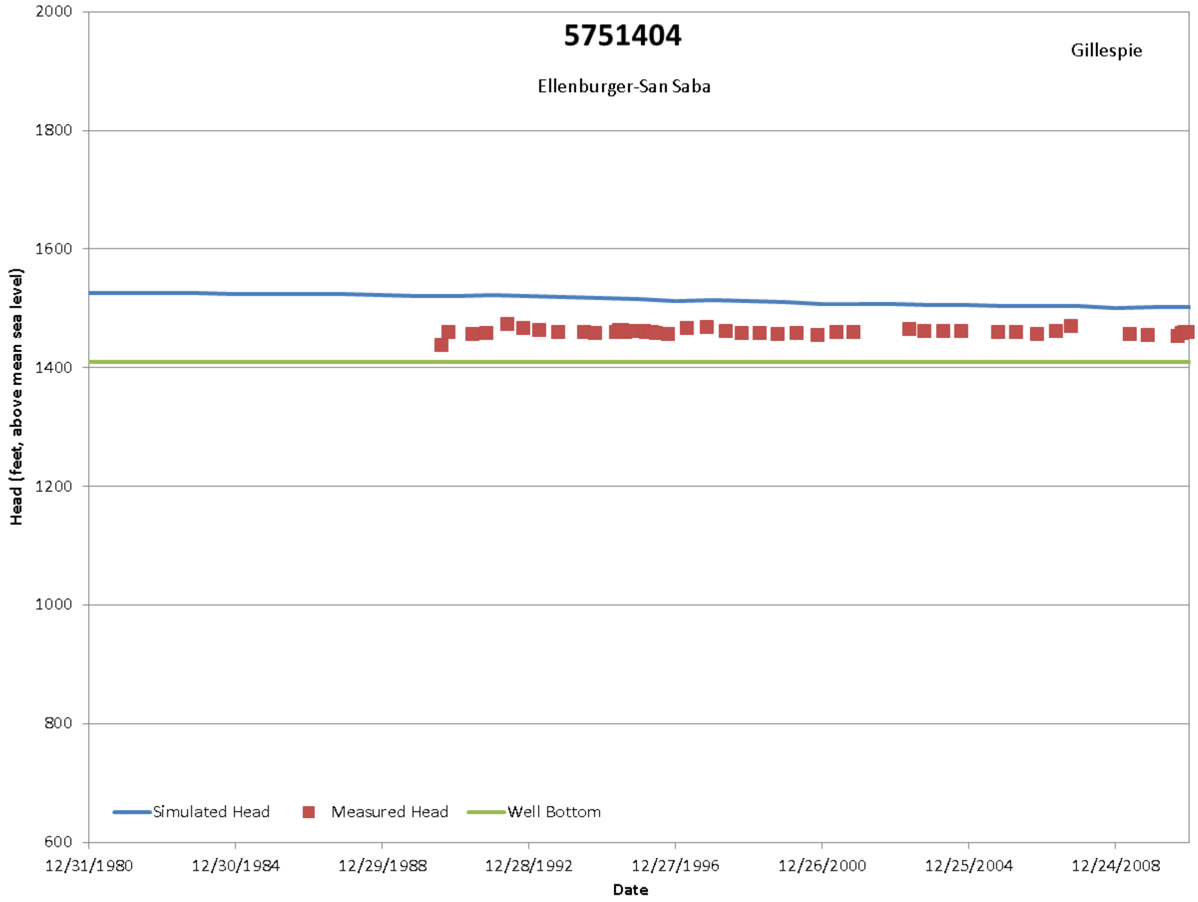
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Appendix C: Glossary List

acre-foot (ac-ft) - the volume of water required to cover 1 acre of land (43,560 square feet) to a depth of 1 foot. Equal to 325,851 gallons or 1,233 cubic meters.

anisotropy - the condition of having different values of hydraulic conductivity (in particular) in different directions in geologic materials. This is especially apparent in fractured bedrock or layered sediment.

aquifer - a geologic formation(s) that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses.

aquifer (confined) - soil or rock below the land surface that is saturated with water. There are layers of impermeable material both above and below it and it is under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer (not necessarily flowing well).

aquifer (unconfined) - an aquifer whose upper water surface (water table) is at atmospheric pressure, and thus is able to rise and fall.

base flow - sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced stream flows. Natural base flow is sustained largely by ground-water discharges.

boundary condition - a mathematical statement specifying the dependent variable at the boundaries of the modeled domain which contain the equations of the mathematical model. Examples are specified head, specified flux, or mixed boundaries.

calibrated model - a model for which all residuals between calibration targets and corresponding model outputs, or statistics computed from residuals, are less than pre-set acceptable values.

calibration - the process of refining the model representation of the hydrogeologic framework, hydraulic properties, and boundary conditions to achieve a desired degree of correspondence between the model simulations and observations of the groundwater flow system, which includes both measured hydraulic head and flux.

calibration target - measured, observed, calculated, or estimated hydraulic heads or groundwater flow rates that a model must reproduce, at lease approximately, to be considered calibrated.

cell - a distinct one-two-or three dimensional model unit representing a discrete portion of a physical system with uniform properties assigned to it.

code (computer program) - the assembly of numerical techniques, bookkeeping, and control language that represents the model from acceptance of input data and instructions to delivery of output. Examples: MODFLOW, BIOSCREEN, MT3d, etc.

conceptual model - an interpretation of the characteristics and dynamics of an aquifer system which is based on an examination of all available hydrogeological data for a modeled area. This includes the external configuration of the system, location and rates of recharge and discharge, location and hydraulic characteristics of natural boundaries, and the directions of groundwater flow throughout the aquifer system.

cone of depression - a depression of the potentiometric surface that develops around a well which is being pumped.

constant head boundary – a MODFLOW boundary condition used to simulate a hydraulic feature (such as lake or reservoir) where hydraulic head remains the same over the time period considered. Constant head boundary could receive from or discharge to groundwater.

cubic feet per second (cfs) - a rate of the flow, in streams and rivers, for example. It is equal to a volume of water one foot high and one foot wide flowing a distance of one foot in one second. One "cfs" is equal to 7.48 gallons of water flowing each second.

discharge - the volume of water that passes a given location within a given period of time. Usually expressed in cubic feet per second.

discretization - the process of subdividing the continuous model and/or time domain into discrete segments or cells. Algebraic equations which approximate the governing flow and/or transport equations are written for each segment or cell.

drain boundary - a MODFLOW boundary condition used to simulate a hydraulic feature (such as agriculture drain) which only receives groundwater.

drawdown - a lowering of the ground-water surface caused by pumping.

evaporation - the process of liquid water becoming water vapor, including vaporization from water surfaces, land surfaces, and snow fields, but not from leaf surfaces.

evapotranspiration - the sum of evaporation and transpiration.

finite difference method (FDM) - a discretization technique for solving a partial differential equation (PDE) by (1) replacing the continuous domain of interest by a finite number of regular-spaced mesh-or grid-points (i.e., nodes) representing volume-averaged sub-domain properties; and (2) by approximating the derivatives of the PDE for each of these points using finite differences; the resulting set of linear or nonlinear algebraic equations is solved using direct or interactive matrix solving techniques.

flux - the volume of fluid crossing a unit cross-sectional surface area per unit time.

general head boundary – a generic MODFLOW boundary condition used to simulate groundwater flow between model domain and a constant head hydraulic source outside the model domain.

groundwater - part of the subsurface water that is in the saturated zone.

groundwater recharge - inflow of water to a groundwater aquifer from the surface. Infiltration of precipitation and its movement to the water table is one form of natural recharge. Also, the volume of water added by this process.

groundwater basin - a groundwater system that has defined boundaries and may include more than one aquifer of permeable materials, which are capable of furnishing a significant water supply.

groundwater discharge - the water released from the zone of saturation; also the volume of water released.

groundwater flow - the movement of water in the zone of saturation.

groundwater flow model - an application of mathematical model to represent a regional or site-specific groundwater flow system.

groundwater modeling code - the computer code used in groundwater modeling to represent a non-unique, simplified mathematical description of the physical framework, geometry, active processes, and boundary conditions present in a reference subsurface hydrologic system.

hydraulic conductivity - a constant of proportionality which relates the rate of groundwater flow to the hydraulic head gradient. It is a property of the porous media (intrinsic permeability) and the density and viscosity of the water moving through the porous media. It is defined as the volume of water at the existing kinematic viscosity that will move in unit time under unit hydraulic gradient through a unit area measured at right angles to the direction of low. Estimated by, in order of preference, aquifer tests, slug tests, grain size analysis.

hydraulic gradient - the change in total hydraulic head per unit distance of flow at a given point and in the direction of groundwater flow.

hydraulic head - the height above a datum plane (such as sea level) of the column of water than can be supported by the hydraulic pressure at a given point in a groundwater system. For a well, the hydraulic head is equal to the distance between the water level in the well and the datum plane.

hydraulic properties - properties of sediment and rock that govern the entrance of water and the capacity to hold, transmit and deliver water, e.g. porosity, effective porosity, specific retention, permeability and direction of maximum and minimum permeability. Synonymous with hydrologic properties.

hydrogeologic unit - geologic strata that can be distinguished on the basis of capacity to yield and transmit fluids.

infiltration - flow of water from the land surface into the subsurface.

initial conditions - the specified values for the dependent variable (hydraulic head or solute concentration) at the beginning of the model simulation.

inverse method - a method of calibrating a groundwater flow model using a computer code to systematically vary inputs or input parameters to minimize residuals or residual statistics.

irrigation - the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall.

leakage - the flow of water from one hydrogeologic unit to another. The leakage may be natural, as through semi-impervious confining layer, or human made, as through an uncased tank.

model - an assembly of concepts in the form of mathematical equations that portray an understanding of a natural phenomenon.

model construction - the process of transforming the conceptual model into a parameterized mathematical form; as parameterization requires assumptions regarding spatial and temporal discretization, model construction requires a-priori selection of computer code.

modeling - the process of formulating a model of a system of process.

m**odel input** - the constitutive coefficients, system parameters, forcing terms, auxiliary conditions and program control parameters required to apply a computer code to a particular problem.

MODFLOW-88/96/2000/2005/NWT – finite difference computer codes developed by the U.S. Geological Survey to simulate groundwater flow.

MODFLOW-USG – an unstructured grid version of MODFLOW using a control volume finite-difference formulation to simulate groundwater flow.

no-flow boundary – a model boundary which is a specified flux boundary where the assigned flux is equal to zero.

numerical model - in subsurface fluid flow modeling, a mathematical model that uses numerical methods to solve the governing equations of the applicable problem.

numerical layer - a layer in a numerical model representing a hydrogeologic unit.

output - in subsurface fluid flow modeling, all information that is produced by the computer code.

parameter - any of a set of physical properties which determine the characteristics or behavior of a system.

peak flow - the maximum instantaneous discharge of a stream or river at a given location. It usually occurs at or near the time of maximum stage.

pre/post-processing - using computer programs to assist in preparing data sets for use with generic simulation codes; may include parameter allocation, control parameter selection, and data file formatting.

precipitation - rain, snow, hail, sleet, dew, and frost.

recharge - water added to an aquifer. For instance, rainfall that seeps into the ground.

reservoir - a pond, lake, or basin, either natural or artificial, for the storage, regulation, and control of water.

residual - the difference between the model-computed and field-measured values of a variable, such as hydraulic head or groundwater flow rate, at a specific time and location.

river - a natural stream of water of considerable volume, larger than a brook or creek.

river basin: the total area drained by a river and its tributaries.

river boundary - a MODFLOW boundary condition used to simulate the interaction between a hydraulic feature (such as river) and groundwater. The river boundary could gain water from or lose water to an aquifer.

runoff - part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or ground-water runoff.

sensitivity analysis - a procedure based on systematic variation of model input values (1) to identify those model input elements that cause the most significant variations in model output; and (2) to quantitatively evaluate the impact of uncertainty in model input on the degree of calibration and on the model's predictive capability.

simulation - in groundwater modeling, one complete execution of a groundwater modeling computer program, including input and output. Simulation is sometimes also used broadly to refer to the process of modeling in general.

specific storage - the volume of water released from or taken into storage per unit volume of the porous medium per unit change in head.

specific yield - the quantity of water released due to gravity drainage from unit volume of water table or unconfined aquifer.

specified flux boundary - a model boundary condition in which the groundwater flux or mass flux is specified; also called fixed or prescribed flux, or Neumann boundary condition.

spring - area where there is a concentrated discharge of ground water that flows at the ground surface.

steady state condition - a condition in which system inputs and outputs are in equilibrium so that there is no net change in the system with time.

storage coefficient - the volume of water an aquifer releases from or takes into storage per unit surface are of the aquifer per unit change in head. For a confined aquifer, the storage coefficient is equal to the product of the specific storage and aquifer thickness. For an unconfined aquifer, the storage coefficient is approximately equal to specific yield.

storativity - see storage coefficient.

transient condition - a condition in which system inputs and outputs are not in equilibrium so that there is a net change in the system with time.

transmissibility (groundwater) - the capacity of a rock or sediment to transmit water under pressure.

transpiration - the loss of water vapor from plants.

water budget (mass balance) - an inventory of the difference source and sinks of water in a hydrogeologic system. In a well-posed model, the sources and sinks should balance.

water table - the top of the water surface in the saturated part of an aquifer.