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**A Revised Transient-Calibrated
Groundwater Flow Model for the
South Truckee Meadows,
Washoe County, Nevada**

By Richard A. Felling

Washoe County Department of Water Resources

May 2003



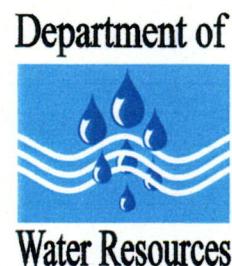
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Copies of this report can be obtained from:
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EXECUTIVE SUMMARY

Continued growth and demand for additional water in the South Truckee Meadows is placing increased demands on the regions' finite water resources. In order to maximize those resources and aquifer productivity, an up-to-date and accurate groundwater flow model is required. This report documents an updated numerical groundwater flow model, calibrated to both steady state and transient conditions, created to meet these needs.

The model is calibrated to match steady-state heads of 1985 by varying the properties of horizontal hydraulic conductivity and flow barrier conductance. The model adequately matches 1985 potentiometric head conditions. Model fit is better in layer 1 than layer 2, and interior areas within the model fit better than perimeter areas. The transient model, based on conditions from 1985 to 2001, was calibrated by varying the specific yield of layer 1. Model fit was adequate throughout all but a zone north of the Steamboat Hills. Poor calibration there is attributed to reduced aquifer recharge from the Steamboat Hills geothermal area that was not modeled.

A predictive simulation based on a likely future pumping rate predicts 5 to 30 feet of additional water level decline west of U.S. 395 by the year 2013, and 10 to 50 feet of decline by 2023. Utilizing a 3 million gallon per day surface water treatment facility on Galena Creek for 6 months of the year reduces water level decline by 10 to 30 feet in the upper Mt. Rose Fan by 2023. Surface water is both injected and sent directly to users, passively recharging the aquifer by replacing municipal well production.

Future groundwater flow modeling efforts in the South Truckee Meadows would benefit best through a better understanding and implementation of temporal variations in model sources and sinks. Incorporating historical precipitation data would lead to an improved transient calibration, better estimates of specific yield, and better predictive capabilities. Average annual precipitation of over 20 inches in the upper elevations of Mt. Rose Fan can directly recharge the aquifers; however, this surface recharge is not considered in this model. Leakage from streams and canals should also be incorporated into the model. Water levels and production data for the Steamboat Hills are neglected in the current model. Transient calibration appears to suffer in some model areas because of

water level decline in the Steamboat Hills. Including temporal changes in water levels in the Steamboat Hills may be critical in adequately calibrating these areas.

INTRODUCTION

Municipal water demand in the South Truckee Meadows (STM) is expected to triple in the next thirty years to approximately 15,500 acre-feet per year (Enloe, et. al., 2002). Washoe County's current annual groundwater production is approximately 5,000 acre-feet per year, excluding domestic wells. The estimated capacity of the municipal well system is 7,200 acre-feet per year, but previous models predict an unacceptable amount of water level decline at this production rate (Jamison and Ruefer, 1991, Bugenig, 2001). Domestic well owners may be faced with the prospect of deepening their wells, redrilling, or converting to municipal supply. Municipal wells may suffer decreased efficiency, reduced capacity, and increased pumping costs.

Washoe County and regional water planners are evaluating a number of plans designed to meet future needs. Current proposals call for the development of surface water resources to augment the existing groundwater supply. Plans include utilizing local surface water from Galena, Whites, and Thomas Creeks in addition to the Truckee River (Figure 1). Due to the seasonal nature of surface flows and the potential of drought, long-term water storage will provide water managers more options by alleviating groundwater decline due to pumping and meeting demand during periods of high use and/or low surface water availability. Subsurface storage of excess surface water could potentially recharge the aquifer, increase well field productivity, minimize the intrusion of geothermal waters into the fresh water aquifer, and stabilize water levels. A new transient-calibrated groundwater flow model is necessary to more accurately estimate groundwater levels for proposals that include new municipal wells, increased pumping rates, and the utilization of surface water resources.

This model is an update of an existing groundwater flow model, recalibrated to both steady state and transient conditions (Jamison and Ruefer, 1991, Bugenig, 2001). Steady state calibration is improved by simultaneous optimization of horizontal hydraulic conductivity and horizontal flow barrier conductance using the automated parameter optimizer PEST. Transient calibration is achieved through optimization of specific yield

using PEST. Predictive simulations estimate future water levels using an expected production schedule and models the effects of a groundwater injection scenario on the potentiometric surface of aquifers of the South Truckee Meadows.

PAST HYDROGEOLOGIC STUDIES

Past studies on the hydrogeology and hydrology of the South Truckee Meadows are included in Cohen and Loeltz (1964), Cooley et al. (1971), and Rush (1975). Widmer (1991) completed a two-dimensional groundwater model in the South Truckee Meadows from the Steamboat Hills to the Huffaker Hills. Jamison and Ruefer (1991) completed a three-dimensional groundwater flow and transport model of the South Truckee Meadows from Galena Creek in the south to the Huffaker Hills in the north.

The Jamison and Ruefer model was updated by Bugenig (2001) to improve calibration, incorporate revised hydraulic parameters, and expand the model area. Model coverage includes the South Truckee Meadows from the base of the Carson Range on the west to the base of the Virginia Range on the east, Pleasant Valley on the south, and the Huffaker Hills on the north (Figure 1). The model has two layers. Layer one is unconfined, and is defined as the top 200 feet of the saturated thickness of the aquifer. Layer two extends from the base of layer one to the maximum depth of wells across the study area. The 1991 model incorporated a third layer, composed almost entirely of bedrock, with a uniform thickness of 1,760 feet. Layer three was eliminated from the 2001 model, due in part to uncertainties with recharge and discharge in the layer.

Model recharge and sources and sinks are taken from the Bugenig (2001) model. Hydraulic parameters of transmissivity and hydraulic conductivity for the model were based on long-term pumping tests from municipal production wells, and initial estimates for the model were established by kriging. Mountain block recharge from the Carson Range was fixed at 16,100 acre-feet annually (AFA). Total recharge to the model area was fixed at 17,365 AFA. Specified flux boundary conditions were utilized for the west, south, and east sides of the model in both layers. The northern side of the model utilized a constant head boundary condition. The model has overall dimensions of 38,000 feet east-west by 49,000 feet north-south. Horizontal grid cell dimensions measure 1,000 by 1,000 feet.

GOALS AND OBJECTIVES

The principal goals of this study are:

- Improve the steady state calibration of the model.
- Calibrate the model on transient conditions to increase the accuracy of predictive simulations.
- Estimate future groundwater levels given expected municipal production rates.
- Simulate the effects of a 3 mgd surface water treatment facility that will replace municipal pumping and provide water for aquifer injection.
- Complete the model using the County standard preprocessor GMS, so that County hydrogeologists can simulate new scenarios quickly and accurately.

METHODOLOGY

Details of three recommended water supply scenarios and a recommended composite plan are outlined in a memorandum by ECO:LOGIC Engineering (Enloe, et al, 2002). Water supply and demand estimates from this memo, along with input from Washoe County hydrogeologists, dictate water extraction and injection for this simulation.

The finite difference groundwater flow model for the South Truckee Meadows (Jamison and Ruefer, 1991), recently updated by Bugenig (2001), was further modified for this study. Modifications include:

- Reexamine layer 2 with respect to the alluvium-bedrock contact and well depths.
- Reevaluate the Quaternary faults in the model.
- Review observation well coverage and incorporate a more representative selection to improve calibration.
- Add a section of the Steamboat Creek to allow for additional water discharge from the model using MODFLOW's river package.
- Recalibrate the steady-state model.
- Extend the model southward to parallel groundwater flow direction.
- Revise the northern no-flow boundary.
- Calibrate the model based on transient municipal pumping rates.

Refinements to the current groundwater flow model are considered important to improve the ability of the model to accurately estimate future water levels. The 1991 model has been shown to be relatively accurate in predicting transient water levels over much of the model area over the past ten years, but a few problem areas exist. By incorporating new information on the hydrogeology of the South Truckee Meadows, and by calibrating to transient conditions, significant improvements to model are expected.

HYDROGEOLOGIC SETTING

Regional Geology

The South Truckee Meadows is located on the western edge of the Great Basin in the Basin and Range province. North-south trending mountains and valleys that formed as a result of extensional tectonics and uplift characterize the Basin and Range Province. Tectonic activity began in the mid Tertiary and continues, to a lesser extent, to the present.

Local Geology

The geology of the area has been well studied, and is described in detail by White et al. (1964), Thompson and White (1964), Tabor and Ellen (1975), Silberman et al. (1979), Bonham and Rogers (1983), and Bonham and Bell (1993). The Carson Range borders the Truckee Meadows to the west. The core of the Carson Range consists of Cretaceous granodiorite of the Sierra Nevada batholith and Tertiary andesitic flows, breccias, and tuffs of the Kate Peak formation. East of the valley, the Virginia Range is composed primarily of Kate Peak andesitic volcanics and Cretaceous metavolcanic and metasedimentary rocks. To the south, low hills of granitic, volcanic, and metavolcanic rocks form a topographic and hydrologic boundary between the Truckee Meadows and Washoe Valley. The South Truckee Meadows is partially enclosed to the north by Windy Hill and the Huffaker Hills, where flow-dome complexes of the Kate Peak formation rise above the valley floor (Figure 2).

These same granitic, volcanic, and metasedimentary rocks form the bedrock basement of the valley. The Mt. Rose Fan is a pediment. Drill hole and geophysical evidence indicate that alluvial deposits are relatively thin and the bedrock basement slopes

roughly parallel to the land surface from the range front to the valley floor (Skalbeck, 2001). Sediments on the fan are high energy fluvial and glacial outwash deposits derived from the Carson Range. They consist of poorly sorted sand, gravel, and clay with common cobble to boulder-size clasts of andesitic and granitic rocks. Quaternary sediments attain a maximum thickness of over 800 feet just north of the Mt. Rose Highway, but are generally between 300 and 500 feet thick (Figure 3). On the east side of the valley, sediments derived from the Virginia Range are poorly sorted sand, gravel, and clay stream deposits with cobble to boulder-size clasts of andesitic composition. Floodplain deposits of sandy clay on the valley floor are underlain by the Tertiary Truckee formation, a weakly indurated sequence of sand and clay lacustrine and alluvial sediments. Quaternary sediments in the eastern and central portions of the valley are estimated to be less than 500 feet thick.

The Steamboat Hills lie in the south-central portion of the study area. Surface exposures are primarily Kate Peak andesitic flows. The formation overlies metavolcanic and granitic rocks, and is cut by rhyolite domes dated at 1.2 m.y. (Silberman et al., 1979). The Steamboat Hills are an active geothermal area, with several geothermal power plants currently in operation.

Geologic Structure

Faults related to Basin and Range extension dominate the structure of the area. North striking range-front faults occur at the base of both Carson and Virginia ranges. Numerous smaller structures associated with Basin and Range extension occur across the valley floor (Figure 4). Evidence of Quaternary movement can be seen on aerial photographs as linear scarps and vegetative changes in the alluvium. Many of these structures do not extend through bedrock, but are the result of alluvial subsidence and rotation near larger faults. Northeast-striking faults of Quaternary age can also be seen on aerial photographs. Two or more of these structures appear to control the location of Whites and Thomas Creeks on the fan. In the Steamboat Hills, mapped faults strike northerly, northeasterly, and northwesterly. The Quaternary rhyolite domes are aligned on northeast faults. Both north- and northeast-trending faults are believed to be conduits for upwelling thermal waters and subsequent recharge to the alluvial aquifers (White, 1968; White et al., 1964; Skalbeck, 2001).

Groundwater Occurrence and Movement

The hydrology of the South Truckee Meadows is similar to other valleys in the Basin and Range. Groundwater recharge is achieved primarily through mountain snowmelt underflow at the range front. Additional recharge is obtained through infiltration along streams, canals, and irrigated lands. Direct precipitation on the valley floor averages less than one foot, and provides little or no recharge to the aquifer. Potential evapotranspiration rates are on the order of 4 ft/yr. Water is lost from the aquifer by extraction wells, evapotranspiration, and discharge to Steamboat Creek.

Groundwater levels as of March 2002 are shown in Figure 5. Water-level contours show that groundwater flows generally northeasterly, and from the Carson and Virginia ranges toward the center of the valley. Numerous faults of Quaternary age are present in the alluvium, which to a greater or lesser extent will impede groundwater flow. North trending faults strike across the direction of flow, and are likely to have a more significant effect on flow than northeast trending faults. The Steamboat Hills act as a barrier to groundwater flow at shallow depths due to the lower hydraulic conductivity of crystalline rocks that make up the hills. The flat hydraulic gradient at the valley floor indicates that little groundwater is lost through underflow to the north, but rather is lost by discharge to Steamboat Creek and through evapotranspiration.

Sources and sinks

Groundwater recharge to the Mt. Rose Fan is estimated to average between 9,000 and 15,000 af/yr (Jamison and Ruefer, 1991). Three methods were used to estimate recharge: Maxey-Eakin (Maxey and Eakin, 1949), Arteaga-Durbin (Arteaga and Durbin, 1979), and a method based on cross-sectional area of creek canyon mouths. Irrigation application rate is estimated at 4.0 ft/yr for alfalfa and 2.5 ft/yr for pasture. Evapotranspiration (ET) was estimated at 0.0116 ft/d (4.2 ft/yr) with an extinction depth of six feet. The ET rate was modeled as varying linearly between zero and six feet. If water levels rise to the ground surface, ET will be 4.2 ft/yr. Water levels greater than or equal to six feet below ground surface will have an ET rate of zero ft/yr.

An undetermined amount of thermal water recharges the aquifer north and east of the Steamboat Hills. White (1964) estimated flux through the geothermal system at 1-2 cfs (725-1,450 af/yr) based on spring discharge and inflow to Steamboat Creek. Bugenig

(per. comm., 2002), estimated recharge to the aquifer at 250 af/yr. Thermal waters contain elevated concentrations of arsenic, boron, and TDS. However, modeling of the interaction between the fresh water and thermal water systems is beyond the scope of this paper.

Groundwater Monitoring

Detailed groundwater level studies in the South Truckee Meadows began in 1979 in a study by the U.S.G.S covering the southern portions of the Mt. Rose Fan. Washoe County increased the coverage to include wells from across the entire South Truckee Meadows in 1982. Since 1991, the Washoe County Department of Water Resources has conducted a regular monitoring program. Groundwater level changes have been documented by Kanbergs (1996) and Felling (2002). Currently, approximately 200 wells are measured three to four times per year.

On the upper Mt. Rose Fan, changes in the groundwater level of 20 feet due to variations in natural recharge have been documented. Water levels are also strongly influenced by both municipal and domestic well production. A potentiometric surface difference map (Figure 6) illustrates the extent of water level change from 1982 to 2002. Water levels have generally declined 10 to 20 feet west of South Virginia Street, with greater declines near municipal wells.

Surface Water

Several perennial streams exist in the South Truckee Meadows (Figure 1). Thomas, Whites, Galena, and Browns Creeks have headwaters in the Carson Range west of the Truckee Meadows and flow northeasterly across the study area. Steamboat Creek flows northerly from its source at Washoe Lake through the Truckee Meadows and enters the Truckee River near Vista. The Steamboat Ditch diverts water from the Truckee River and flows southeasterly across the Mt. Rose Fan, supplying water for surface irrigation along the eastern portions of the fan. Galena and Browns Creeks drain into Steamboat Creek at Pleasant Valley. Thomas and Whites Creeks enter Steamboat Creek further to the north in the meadows area on the valley floor. Steamboat Ditch empties into Steamboat Creek just east of the Steamboat Hills.

Widmer (2001) tabulated streamflow data for perennial streams in the STM and used regression analysis to generate long-term data for each stream. Average annual flow is listed below in Table 1.

Creek	Average annual flow (cfs)	Average annual flow (AFA)
Galena	12.8	9270
Whites	7.1	5140
Thomas	4.4	3190

Table 1. Average annual flow of perennial streams in the South Truckee Meadows
After Widmer (1991).

CONCEPTUAL MODEL

The South Truckee Meadows is a north-south elongate structural and topographic basin. Mountains bound the valley on the east, south, and west. It is mostly open to the north, but is partially closed by the Huffaker Hills. Both Quaternary and Tertiary alluvial deposits, and Tertiary volcaniclastic deposits and flows fill the basin. Quaternary deposits attain a maximum thickness of several hundred to perhaps a thousand feet, but average 300 to 500 feet on the Mt. Rose Fan. Combined Tertiary and Quaternary sediments are in excess of 1,000 feet thick in the center of the valley.

Groundwater recharge is derived primarily from the western margin of the basin from the Carson Range, but limited recharge also occurs along the southern and eastern borders. Groundwater flows toward the center of the valley and then to the north. Surficial recharge sources include irrigation, streams, ditches and canals, direct precipitation, and septic systems. Model discharge occurs by evapotranspiration, leakage to Steamboat Creek, and underflow to the north.

On the Mt. Rose Fan, groundwater flows through alluvial deposits on an irregular bedrock surface. The Steamboat Hills form a hydrologic barrier across the southern one third of the fan. Valley bedrock is composed of both volcanic and granitic rocks, but the upper portion of the volcanic sequence is composed of interbedded flows, sediments, and coarse volcaniclastic deposits. Numerous fault zones impede groundwater flow on the fan. North-striking faults are the most numerous and have the greatest effect on groundwater flow. A second prominent structural fabric is oriented northeasterly. These

structures have minimal effect on flow because they are roughly parallel to the hydraulic gradient.

Steep vertical gradients are known to exist throughout the Mt. Rose Fan. Evidence of vertical gradients is observed in water level measurements of closely spaced wells with different screened intervals.

The Steamboat Hills geothermal area occupies the south central part of the valley. The heat source lies beneath, or is fed from beneath, the central part of the Steamboat Hills. Extreme vertical hydraulic gradients exist in this area.

NUMERICAL MODEL

The U.S. Geological Survey's three-dimensional finite difference groundwater flow model MODFLOW (Harbaugh and McDonald, 1996, McDonald and Harbaugh, 1988) was used to simulate the basin flow system. Interface to the MODFLOW program and preprocessing was accomplished with GMS version 3.1. The model was calibrated in two stages, the first stage under steady-state conditions and the second under transient conditions.

As discussed above, the steady state model is an update of earlier models. The steady-state model was calibrated to 1985 conditions. Municipal pumping prior to 1985 was minimal, although approximately 1,000 domestic wells were in production at that time.

The transient model was calibrated using water level measurements and pumping data from 1985 to 2001. Mountain block and surficial recharge were considered constant for the calibration period. Predictive analyses were based on expected well production and were provided by the Washoe County Dept. of Water Resources.

Governing Equation

Transient three-dimensional flow in anisotropic porous medium can be evaluated by solving the following groundwater flow equation, given appropriate initial and boundary conditions:

$$\frac{\delta}{\delta x} \left(K_x \frac{\delta h}{\delta x} \right) + \frac{\delta}{\delta y} \left(K_y \frac{\delta h}{\delta y} \right) + \frac{\delta}{\delta z} \left(K_z \frac{\delta h}{\delta z} \right) - W = Ss \frac{\delta h}{\delta t}$$

where

h = hydraulic head;

K_x = horizontal hydraulic conductivity in the X-direction (L);

K_y = horizontal hydraulic conductivity in the Y-direction (L);

K_z = vertical hydraulic conductivity (L);

W = external sources and sinks (T^{-1});

Ss = specific storage (L^{-1}); and

t = time (T).

Discretization

Areally, the model grid is 38 columns by 49 rows with each model cell 1,000 feet on a side. The model has two layers. Layer 1 is unconfined and has a constant thickness of 200 feet. The top of layer 1 coincides approximately with the 1985 average potentiometric surface computed from all well measurement data, regardless of well depth. Layer 2 is confined/unconfined, has a minimum thickness of 200 feet, and extends to at least the bottom of screened intervals in production wells. The model uses the “true layer” approach, where the layers simulate hydrologic and geologic geometries.

Boundary Conditions

Specified flux boundary conditions are used for the eastern, southern, and western boundaries. The western half of the northern boundary is a no-flow boundary while the eastern half is a specified head boundary (Figure 7).

Boundary conditions are identical to the 2001 model with the exception of the northern boundary. Where the entire northern boundary was constant head, only the eastern half of the north end is now a constant head boundary. Based on potentiometric surface contour maps of the STM, the hydraulic gradient along the northwest boundary is almost due east (Felling, 2002). However, water flux into the model across the western constant head boundary was observed during the calibration procedure. Since the model boundary there approximates flow lines, the boundary condition was changed from specified head to no flow.

Sources and Sinks

Sources and sinks include domestic and municipal wells, boundary recharge, areal recharge due to precipitation and irrigation, streams and canals, evapotranspiration, and septic systems.

Approximately 1,200 domestic wells are currently active in the model area. Production is simulated by 259 wells assigned to model cells. Net discharge per domestic well, the sum of pumping outflow and septic inflow, is estimated to be 0.897 AFA (Widmer, pers. com., 2002). Twenty-eight municipal wells operated by Washoe County and the Truckee Meadows Water Authority are currently active. Washoe County plans to install four new wells within the next two years, and another four wells are planned for 2005 to 2008. Municipal wells produced 5,780 acre-feet of water in 2002. That amount is expected to increase to approximately 8,000 AFA by 2013.

Model boundary recharge is 17,365 AFA, of which 16,100 AFA is derived from the Carson Range. Recharge from thermal water is 250 AFA. Boundary and thermal recharge are simulated with injection wells. Areal recharge due to irrigation is assumed to be 25% of application rate (Guitjens, et.al., 1978). Recharge areas were defined by Widmer (1991) using aerial photographic interpretation. Irrigation for alfalfa is set at 4.0 ft./yr; the rate for pasture is 2.5 ft./yr. Recharge due to creek and canal leakage and direct precipitation is not accounted for in the model.

Steamboat Creek through Pleasant Valley and through its lower reaches in the meadows acts primarily as an internal sink and is modeled using the river package (McDonald and Harbaugh, 1988). A short stretch of Galena Creek just west of its confluence with Steamboat Creek is also modeled with the river package.

Potential evapotranspiration is estimated to be 4.2 ft./yr. The extinction depth is 6 feet, and evapotranspiration varies linearly between 0 and 6 feet.

STEADY STATE MODEL

Steady-state calibration of the flow model is required to establish aquifer hydraulic parameters, boundary flux, and source and sink flux. For modeling purposes, steady-state conditions are assumed to exist prior to municipal well production. Steady-state calibration used water levels as of January 1985. Seventy-six domestic and monitoring wells are used for calibration. Wells were selected for spatial distribution, well completion depth, reliability in the measurement, and continuity of measurement data. Most of the measurements were taken during monitoring programs in 1979 and 1982. Several of the measurements are artificial. Artificial data include municipal exploration and/or monitor wells drilled between 1985 and 1995. The use of post-1985 data for 1985 steady-state calibration is warranted by the distant location of the wells from any significant production. These data are needed to establish some control is areas where no other data is available. Regular monitoring of these wells supports the assumption that they are minimally affected by municipal pumping.

Domestic wells are all assigned to layer 1. Depending on their screened interval, monitor wells are assigned to either layer 1 or layer 2. A total of 56 observation wells are in layer 1, while 20 wells are screened in layer 2. Model observation wells are shown in Figure 8.

Calibration parameters are hydraulic conductivity in layer 1 and horizontal flow barrier (HFB) conductance in layers 1 and 2. Fixed parameters include hydraulic conductivity of layer 2 and internal sources and sinks. Mountain block recharge from the Carson range was calculated at 16,100 AFA by Bugenig (2001). This amount is slightly higher than the 9,000 to 15,000 AFA estimated by other methods. Due to these uncertainties in recharge, and to the scope of this project, recharge fluxes of the previous model are used with only minor modification. Changes consist of transferring some recharge water from layer 2 into layer 1 to improve calibration by reproducing vertical gradients observed in observation wells near the model boundary.

Layer 2 hydraulic conductivity is based on pump test data from municipal wells in layer 2. Calculated hydraulic conductivity values were kriged and assigned to model cells.

Vertical hydraulic conductivity in layer 2 is approximately 0.01 of horizontal hydraulic conductivity, and was not modified from the 2001 model.

Model calibration was accomplished with the automated parameter estimation module PEST (Doherty, Brebber, and Whyte, 1994). Horizontal hydraulic conductivity zones for layer 1 are delineated as polygons radially oriented from the head of the Mt. Rose alluvial fan (Figure 9). The Steamboat Hills is a separately defined zone due to its wholly crystalline rock lithology. A total of 15 hydraulic conductivity zones are defined.

Vertical hydraulic conductivity zones in layer 1 are identical to horizontal hydraulic conductivity zones. Vertical hydraulic conductivity is approximately 0.01 of horizontal hydraulic conductivity. Vertical hydraulic conductivity was not directly determined by PEST, as the method proved unstable when solving for both vertical and horizontal hydraulic conductivity simultaneously. Instead, vertical hydraulic conductivity was set at approximately 0.01 of horizontal hydraulic conductivity.

Numerous faults are simulated in the model. Published geologic maps (Bonham and Rogers, 1983; Szecsody, 1983) show several faults of Tertiary and Quaternary age in the STM. Unmapped faults are indicated by photolinears, topographic breaks, and abrupt changes in water levels over short lateral distance. Only faults having a noticeable effect on water levels were used in the model. Fault hydraulic conductivity was also determined with PEST, and was solved simultaneously with horizontal hydraulic conductivity. MODFLOW handles faults with the horizontal flow barrier (HFB) package (Hsieh and Freckleton, 1993). The branch conductance in the row direction between two cells can be determined as shown in McDonald and Harbaugh (1988):

$$\frac{1}{CR_{i,j+1/2,k}} = \frac{1}{\frac{TR_{i,j,k}DELC_i}{DELR_j}} + \frac{1}{\frac{TDW_{i,j+1/2,k}DELC_i}{DELR_{j+1}}} + \frac{1}{\frac{TR_{i,j,k}DELC_i}{DELR_{j+1}}}$$

where

$CR_{i,j+1/2,k}$ is the branch conductance in the row direction between nodes i,j,k and $i, j+1/2,k$;

$TR_{i,j,k}$ is the transmissivity in the row direction of cell i,j,k ;

$TR_{i,j+1/2,k}$ is the transmissivity in the row direction of cell $i,j+1/2,k$;
 $DELR_j$ is the grid width in the row direction of column j ;
 $DELR_{j+1/2}$ is the grid width in the row direction of column $j+1/2$;
 $DELC_i$ is the grid width in the column direction of row i ; and
 $TDW_{i,j+1/2,k}$ is the barrier transmissivity divided by the width of the barrier between cell i,j,k and cell $i,j+1/2,k$.

Combining the first and third terms and solving for $CR_{i,j+1/2,k}$ yields

$$CR_{i,j+1/2,k} = \frac{CR^*_{i,j+1/2,k} TDW_{i,j+1/2,k} DELC_i}{CR^*_{i,j+1/2,k} + TDW_{i,j+1/2,k} DELC_i}$$

where

$CR^*_{i,j+1/2}$ is the branch conductance if the barrier did not exist.

Applied to a condition where a flow barrier is located between two cells on the same column of a layer, the branch conductance in the column direction between the nodes i,j,k and $i+1,j,k$ is

$$CC_{i+1/2,j,k} = \frac{CC^*_{i+1/2,j,k} TDW_{i+1/2,j,k} DELR_j}{CC^*_{i+1/2,j,k} + TDW_{i+1/2,j,k} DELR_j}$$

where

$CC^*_{i+1/2,j,k}$ is the branch conductance if the barrier did not exist;

MODFLOW determines transmissivity from layer or saturated thickness and hydraulic conductivity. GMS uses a hydraulic characteristic term, which is equal to the hydraulic conductivity - or transmissivity - of the barrier divided by the barrier thickness. Faults and flow barriers used in the model are shown in Figure 10.

Calibration

Estimating model parameters using PEST requires the modeler to set initial, minimum, and maximum values for the parameter to be solved. Pumping tests of wells completed in alluvium yield hydraulic conductivities between 1 and 16 ft/d. While most of these wells are completed in layer 2, the values do serve to indicate the range of hydraulic conductivity expected in layer 1 alluvial deposits. In general, hydraulic conductivity is expected to increase from the range front toward the valley floor due to the more poorly sorted nature of alluvium near the range front and increased tortuosity. Minimum-

maximum limits for horizontal hydraulic conductivity were 1 to 30 ft/d, similar to the range determined from pumping tests of wells completed in deeper alluvium. Initial conditions were changed between calibration runs based on results of prior calibrations, generally starting at the solution from the previous run. Horizontal hydraulic conductivity in the Steamboat Hills was not optimized with PEST, but was fixed at 0.5 ft/d. Early attempts to estimate hydraulic conductivity in the Steamboat Hills with PEST were unsuccessful, and the method estimated hydraulic conductivity at the range maximum. This was probably due to the absence of observation wells in the Steamboat Hills. Conductance terms for HFBs were set between 0.01 and 1.0. Starting values were set at 0.5.

Final calibration was completed manually. Manual calibration resulted in a slightly higher total error than automated calibration, but was done to create better calibration in critical areas, such as neighborhoods with numerous domestic wells. Horizontal conductivities for the defined hydraulic conductivity zones in layer 1 are shown in Figure 9.

Results

Observation well calibration is shown in Figure 11. This GMS presentation displays a color bar whose size, color, and orientation represent calibrated minus observed head. A green bar indicates a fit within 20 feet. A yellow bar represents a fit between 20 and 40 feet. A red bar represents a fit greater than 40 feet. If the bar is above the center point, calibrated head exceeds observed head. Layer 1 and layer 2 heads are not differentiated. Measured versus observed heads are compared in Figure 12; residual versus observed heads are shown in Figure 13. A histogram of residuals (Figure 14) shows a normal distribution.

There are no model observation wells in the Steamboat Hills. Several wells exist, and are monitored by the two geothermal power companies currently producing there. The Steamboat Hills are made up crystalline rocks, and water flow occurs primarily in fractures. The geothermal heat source lies somewhere near the center of the Steamboat Hills, where hot water moves vertically upward then outward around the eastern perimeter. Detailed hydrology of the Steamboat Hills is poorly understood. Because of the geothermal systems' unique flow regime, structural complexity, and limited information, the Steamboat Hills area is excluded from calibration. The model

includes the Steamboat Hills, but water levels there are neglected. Hydraulic parameters for the Steamboat Hills are established to facilitate calibration in other areas of the model.

Sensitivity Analysis

Model sensitivity to horizontal and vertical hydraulic conductivity in layers 1 and 2 was determined by running the model using hydraulic conductivity multipliers of 0.1 to 5.0. The resulting graphs (Figures 15 and 16) show how variations in horizontal and vertical hydraulic conductivity in layers 1 and 2 affect model error. Model error is measured by mean error (ME), mean absolute error (MAE), and root mean squared error (RMSE). The ME is the mean difference between observed and simulated heads. MAE is mean of the absolute value of the differences in observed and simulated heads. RMSE is square root of the average of the squared differences in observed and simulated heads (Anderson and Woessner, 1992).

It is apparent from the sensitivity analysis that the model is quite sensitive to horizontal hydraulic conductivity, but is relatively insensitive to changes in vertical hydraulic conductivity. The model is most sensitive to changes in horizontal hydraulic conductivity in layer 1, followed by horizontal hydraulic conductivity in layer 2, vertical hydraulic conductivity in layer 2, and is least sensitive to vertical hydraulic conductivity in layer 1. Overall model error decreases with lower vertical hydraulic conductivity in layer 1, and is lowest at 10% of that used in the model. Model error also decreases with reduced vertical hydraulic conductivity in layer 2 to a minimum at 50% of that used. Total error is minimized with horizontal hydraulic conductivity at the calibrated level.

Discussion

Most of the layer 1 observations fit calibrated heads well. Poor calibration occurs along the western boundary of the model and around the Steamboat Hills. Most of the wells that calibrated poorly are municipal wells completed in layer 2. The northern and eastern portions of the model calibrate well and are relatively insensitive to hydraulic conductivity. Poor calibration results also occur in some of the wells adjacent to flow barriers.

Along the western boundary, poor calibration is probably a result of a combination of factors including complex geology, steep vertical gradients, and less than optimal hydraulic conductivity zone placement and size. More hydraulic conductivity zones would allow for more model flexibility in meeting highly variable heads along the range front. On the perimeter of the Steamboat Hills, complex geology and a poor understanding of the hydrology contribute to calibration errors. Much of the structural detail is not modeled due to the 1000-foot grid cell dimensions. Fault traces were digitized in their actual location, but MODFLOW fits the HFB between cells. The result is HFBs located up to 500 feet from their true location. Barriers create abrupt changes in potentiometric head, and a barrier displacement of a few hundred feet can be the difference between good calibration and poor calibration for a given observation point. Poor calibration near flow barriers is also due to steep vertical gradients caused by the barriers. Figure 17 is a west-east cross section through the center of the model. Closely spaced horizontal or subhorizontal equipotentials are indicative of high vertical hydraulic gradient.

An example of steep vertical gradients can be seen in municipal well STMGID 4 and domestic well Otten-Wycoff, located just north of the Steamboat Hills near intersecting northeast and north trending faults (Figures 8 and 17). STMGID 4 is screened in andesite from 700 to 830 feet. Otten-Wycoff is screened in alluvium just below the water table at 200 feet. The wells are 120 feet apart, yet there is up to 400 feet of difference in potentiometric head, a vertical gradient of approximately 0.8 ft/ft. It is possible to improve calibration by placing a flow barrier within 500 feet of the wells, but matching heads is not possible. The error associated with these wells represents approximately 10% of the total model error.

TRANSIENT MODEL

The transient calibration period is from January 1, 1985 to January 1, 2001. Stress periods of one year are divided into four time steps each. Initial head conditions were copied from the steady-state solution.

Water Level Data

Water level monitoring in the STM has been ongoing since 1979. Sixty wells, mostly in the southern part of the study area, were measured in 1979. In 1982, 158 wells, from the northern part of the study area were measured. Monthly monitoring near STMGID 1 and 2 began in the mid-1980's. A regular program of quarterly to semi-annual measurements began in 1991 and has been continuous since that time. Using all historical surveys, a set of 60 wells with good continuity of measurements over the period 1985 to 2001 was selected for transient calibration.

A transient observation file for drawdown was created from water level measurement data. The term drawdown is used in this report, although the measurement is actually areal water level decline. Measurements are collected when wells are not pumping. Water levels for 1985, where not directly measured, were generally assumed to be equal to 1979 or 1982 measured levels. This assumption is based on the absence of municipal well production prior to 1985. Drawdown on January 1, 1985 was set to 0 feet. Drawdown for each well was calculated by simply subtracting post-1985 potentiometric heads from 1985 heads. GMS then computes drawdown for all time steps through linear interpolation. Water level measurements for the years 1994 and 1995 were not used. As will be discussed later, model recharge was kept constant during model calibration, and the effects of prolonged drought resulted in significant regional water level decline in 1994 and 1995.

Recharge

Calibrated recharge from the 2001 steady-state model was used for the transient calibration. Confidence in actual mountain block recharge is not high, and the recharge computed in the 2001 model is at the upper end of the range calculated by other methods. Annual precipitation as a percentage of annual average for Reno, Glenbrook, and Stateline, NV is shown in Figure 18. These sites provide a good indication of precipitation in the STM recharge area. The data shows that the Carson Range and the STM received generally below average precipitation for the period 1984 to 1994. Hydrographs for domestic wells show significant effects of the drought in the mid-1990's. A good example is the First Aid Station well in the southwest portion of the study area (Figures 8 and 19). This well is located over one mile from the nearest municipal well producing during that period, and there are few domestic wells in the area. Water level

changes in this well are primarily the result of temporal variations in recharge. It is unclear what percentage of precipitation above or below norm actually recharges the aquifer. Because of these uncertainties and the scope of this project, it was decided to use constant recharge during calibration.

Wells

The number of domestic wells has not changed appreciably since 1985. New housing developments constructed after 1985 have used municipal or centralized water providers. New homes constructed outside of developments continue to develop new wells. However, many homes in and around housing developments have converted to municipal supply. As a result, domestic pumpage has stayed relatively constant over the last 20 years. Model water withdrawal from domestic wells in the transient calibration is identical to that of the steady-state model. Due to the difficulty in obtaining well logs for each of the 1,000+ domestic wells, all are assumed to pump from layer 1. This assumption is justified because very few domestic wells are screened more than 200 feet below the water table.

The number and pumped volume of municipal wells has increased steadily since 1985. Production schedules for all municipal and community wells are available, and that data was imported into GMS as a well pumping file. Production was input on an annual basis, so in a given one-year stress period, production is constant. The elevations of the screened intervals of all the municipal wells are known. GMS allows direct input of screen elevations and then automatically calculates discharge from the well based on the percentage of screen interval in a given layer.

Specific Storage

Specific storage values for layer 2 were assigned to model cells in a similar way as layer 2 hydraulic conductivity. Polygons were drawn around wells whose specific storage was calculated from long-term pumping tests. The polygons were assigned the value of specific storage of that well (Figure 20). Pumping tests generally report storativity rather than specific storage. Specific storage is easily calculated using the equation:

$$S=b \cdot S_s$$

where

S storativity (dimensionless);

- S_s is specific storage (L^{-1}), and
- b is length of the screened interval (L).

Specific Yield

Specific yield was the only parameter optimized during transient calibration. All of the pumping tests results available are from the deeper municipal wells. Most of these wells are screened in layer 2. As a result, there is an absence of useful information on specific yield in the STM. A set of specific yield zones was defined for layer 1. These zones are identical to those established for layer 1 hydraulic conductivity, with a single exception. An additional zone was created for the area just north of the eastern portion of the Steamboat Hills to assist in calibration (Figure 21).

Calibration

PEST was used to estimate the value of specific yield. Minimum values were set at 0.07; maximum values were 0.25. Layer 2 specific yield was fixed at 0.1 for the entire model. A specific yield of 0.05 was used for the Steamboat Hills. Values for specific yield are shown in Figure 21. Two of the zones are calculated to have a specific yield equal of 0.07, the minimum value allowed. Using the textural classification scheme of Johnson (1967) for specific yield, a clay content of approximately 20% is expected for these sediments. This is within the range reported in drill logs in the STM and reported by hydrogeologists who drilled the wells (Widmer, 2003, per. comm.)

Results

Error summaries for each stress period are shown in Figure 22. Model RMSE and MAE increase through 1992, level off from 1993 to 1996, and then increase gradually from 1997 until the end of the simulation. Model ME, or model bias, decreases from 1996 until the end of the simulation. Figure 23 is a plot of transient model bias and averaged annual precipitation for the three sites shown in Figure 18. In general, model bias appears to mimic precipitation, but with a two to three year delay. This evidence indicates that significant drawdown in the mid 1990's is a result of below average recharge.

Overall, the aquifer drawdown compares moderately well to the contoured water level difference maps for the twenty-year period ending in 2002 (Figure 24). Water level

decline in and around the Steamboat Hills is not duplicated in the model. The GMS presentation of observation well calibration for 1991 and 2001 (Figures 25 and 26) shows a good model fit for most areas of the model, other than the area just north of the Steamboat Hills.

Sensitivity Analysis

Model sensitivity to specific yield in layer 1 and to vertical hydraulic conductivity in both layers was determined by running the model with these fields multiplied by 0.1 to 10. Model error for stress periods ending in January of 1991, 1996, and 2001 were tabulated to examine error through the simulation. Error summaries for sensitivity analyses are shown in the Figures 27, 28, and 29. The model is moderately sensitive to specific yield and vertical hydraulic conductivity in layer 2. It is not sensitive to high values of vertical hydraulic conductivity in layer 1, but is quite sensitive to low vertical hydraulic conductivity in both layers. Model accuracy increases with lower specific yield in both 1991 and 1996, but in 2001, accuracy is highest at 50 to 75% of calibrated specific yield.

Discussion

The use of constant recharge for the transient calibration raises some questions. As discussed above and as shown in Figure 23, it seems clear that temporal recharge variations affect groundwater levels and calibration results. In addition, the correlation between precipitation and recharge is uncertain, other than to note that increased precipitation results more recharge and vice versa. After several dry years, an average year of precipitation will not result in average recharge due to increased plant uptake, recharge of the vadose zone, and recharge of bedrock aquifers outside of the model area. In order to minimize the effect of temporal variations in recharge, the transient calibration period was set to coincide with times with similar precipitation history (Figure 18). Water levels in the STM dropped several feet from 2001 to 2003 due to continued below average precipitation. Ending the transient model in 2003 would have resulted in increased model error and lower calculated specific yield.

Model error summaries, sensitivity analyses, and precipitation records clearly indicate that below-average recharge is responsible for an undetermined amount of groundwater decline between 1990 and 1997. PEST attempts to minimize total model error with a single value of specific yield for each zone. The resulting calculated values for specific

yield are then too high during dry periods and too low during wet periods. This scenario is clearly seen in the sensitivity analysis of specific yield for the years 1991 and 1996, where model error is reduced with lower values of specific yield. Some of the specific yield zones would have calculated specific yields less than 0.07 if allowed. For the year 2001, water levels are rising due to greater recharge and optimum specific yield values are higher. Model mean error for the simulation is –3.7 feet. As discussed below, most of the error is in the area north of the hot springs. With the exception of this area, model accuracy is good.

The area north of the eastern end of the Steamboat Hills, due north of the hot springs, has significantly greater observed drawdown than computed in the model. Although water level measurements in the Steamboat Hills are excluded from this model, other studies indicate a significant decline in potentiometric head in the Steamboat Hills over the last 20 years (Felling, 2002). Monitor wells in the Steamboat Hills are geothermal exploration holes, some of which are in excess of 1,000 feet deep. Potentiometric head decline in the Steamboat Hills may be due to a combination of increased consumption from the geothermal power plants, reduced natural recharge, a cooling geothermal reservoir, and increased pumping in adjacent alluvial aquifers that serve to recharge the Steamboat Hills. Skalbeck (2001) identified a structure termed the Mud Basin Volcano Fault that strikes north from the Steamboat Hills through this area. His evidence shows that the structure is an important conduit for conducting thermal water from the Steamboat Hills geothermal system into the alluvial aquifer. Furthermore, geothermal waters are present in several wells in this area. A significant reduction in head in the Steamboat Hills could reduce aquifer recharge along this structure, and may be responsible for drawdown greater than can be calculated in the model.

Model simulated drawdown near the municipal wells will be significantly less than actual drawdown at the wells due to the large grid size. A better estimate of drawdown near these wells could be accomplished with local grid refinement.

PREDICTIVE SIMULATION

A primary goal of this study was to estimate drawdown in the STM for 2013 and 2023 given an expected municipal pumping schedule. Several new municipal wells are

expected to initiate production in the next few years and several additional wells are planned for later this decade. Only one pumping schedule was evaluated. Under this scenario, total municipal pumping increased from 5,986 to 7,940 AFA between 2001 and 2012. Washoe County pumpage increased from 4,993 to 7,080 AFA over this period. In 2022 total municipal pumpage is 8,270, with Washoe County's share totaling 7,410 AFA. The pumping schedule is attached in the appendix.

Results

Estimated drawdown in layers 1 and 2 from 1985 to January 2013 and 2023 is shown in Figures 30 and 31. Drawdown in layers 1 and 2 from January 2003 to 2013 and 2023 is depicted in Figures 32 and 33. These results show a widespread decline in both layers across the western half of the STM. Greater drawdown occurs in the vicinity of the municipal wells, particularly wells STMGID 5 and STMGID 6.

Discussion

Water level drawdown estimated from this model is generally consistent with estimates from previous models. Drawdown in layer 1 due to pumping in both layer 1 and 2 is primarily a function of specific yield. During the period from 1984 to 1994, the STM and its recharge areas received below average precipitation, presumably resulting in significantly below average aquifer recharge. Variable water level decline across the STM is certain to have occurred due to this drought. Because the model uses constant recharge, PEST assumes all water level decline is due to pumping and calculates specific yield accordingly. If some of the water level decline is not due to pumping, the specific yield calculated by PEST may be lower than actual in order to match observed drawdown. Using a lower specific yield than actually exists will result in an overestimation of drawdown in the predictive scenarios. Based on precipitation data, there is a reasonable possibility that calculated specific yield for portions of the model are too low. In this case, predicted drawdown for the years 2013 and 2023 may be higher than will actually occur for the given pumping schedule. As discussed in the transient simulation section, most of the error occurs north of the hot springs.

Modeled drawdown for the southwestern edge of the model will have errors due to the nearby no-flow boundary. Pumping wells SJ1, SJ2, and SJ3 are within 1,500 feet of the southern boundary. Wells Callamont 1 and Callamont 2 are 4,000 and 7,000 feet from

the southern boundary, respectively. Pumping from these wells results in 30 feet of predicted drawdown in 2023. However, since the southern boundary does not allow flow across it, estimated drawdown here is probably greater than will actually occur under the given production schedule.

Predicted future drawdown along the western model boundary ranges from 20 feet in 2013 to 40 feet in 2023. Mountain front recharge for average precipitation years may actually increase as water levels decline due to increased hydraulic gradient. Increased average recharge would result in less drawdown than predicted by the model.

AQUIFER INJECTION

A three million gallon per day (3 mgd, 2,080 gpm) surface water treatment plant is proposed for the STM on Galena Creek. This water is available during the non-irrigation season from October through March, so that on an annual basis, available water is 1,040 gpm (1680 AFA). This water can be delivered directly to users, with a corresponding reduction in municipal well production, or injected directly into the aquifer. A single scenario, provided by Washoe County Department of Water Resources, was evaluated by this model. Two hypothetical injection wells (Figure 8) will each inject 130 gpm into layer 1. The remaining water will be sent directly to users. Municipal wells STMGID 5 and 6, AC 1 through 5, Mt. Rose 3, 5, and 6, Callamont 1 and 2, and SJ 1 through 3 will be effectively “turned off” for the winter, cumulatively saving 780 gpm on an annual basis. The facility is modeled to go into production in 2008 and operate continually from that time.

Results

The net impact of injection and decreased pumping due to the water treatment facility in the years 2013 and 2023 is shown in Figures 34 and 35. The simulation indicates significant reductions in future drawdown over most of the Mt. Rose Fan by 2023. In the Callahan Ranch subdivision, drawdown from 2003 to 2013 in layer 1 will be reduced from approximately 20 feet to 15 feet, and year 2023 drawdown will be reduced from 35 feet to 15 feet. Layer 1 heads appear to be stabilizing beyond 2013 west of the Steamboat Hills and south of the Mt. Rose highway. The effects of reduced pumping from municipal wells due to the water treatment facility will decrease future drawdown

over most of the upper Mt. Rose Fan by 15 to 20 feet in both layer 1 and layer 2 by 2023.

The injection wells are located close to the southern model boundary, where no-flow boundary conditions are assigned. It has the effect of blocking the injected water and creating an artificially high water mound between the injection wells and the model boundary.

SUMMARY AND CONCLUSIONS

A steady-state groundwater flow model, calibrated on the hydraulic properties of horizontal hydraulic conductivity and flow barrier conductance, adequately matched 1985 potentiometric head conditions. Model fit is better in layer 1 than layer 2, and interior areas within the model fit better than outer areas.

A transient model based on conditions from 1985 to 2001 was calibrated on specific yield of layer 1. Model fit was adequate throughout all but a zone north of the Steamboat Hills. Poor calibration there is tentatively attributed to reduced recharge from the Steamboat Hills geothermal area.

Much of the transient model error stems from the use of constant recharge during the calibration period. Model calibrated values of specific yield are based on the premise that all water level drawdown is a result of well pumping. Precipitation records and model analysis clearly indicate that variable water level decline in the mid-1990's is due to below average precipitation and recharge. In the case where aquifer drawdown is not the result of pumping, calculated values of specific yield will be lower than actual. Using specific yield values lower than actual in predictive analysis will lead to an overestimation of aquifer drawdown. The transient calibration from 1985 to 2001 was chosen to minimize the effects of variable recharge. With the exception of the area north of the eastern end of the Steamboat Hills, model calibration is acceptable.

MODEL LIMITATIONS

Users of this groundwater flow model or of model results described in this report should be aware of the model limitations. The model is a simulation of a simplified hydrologic and geologic system. Numerous assumptions and approximations are employed, any of which may affect the accuracy of the model. Many of these limitations are described in the previous chapters. A few of the limitations deserve further discussion.

Horizontal hydraulic conductivity and the conductance of the flow barriers were determined in the steady-state model. The assumption that steady-state conditions existed cannot be verified with the available data. If steady-state conditions were not in effect, then the calibrated hydraulic conductivity values would have greater error. That error would then increase the error of the transient simulations as well.

Confidence is not high in the amount of average recharge applied to the model from the mountain blocks. Mountain-block recharge was a calibration parameter in the earlier models, and the calibrated value is somewhat higher than recharge estimated by other methods. Steady-state calibration is non linear, that is, greater model recharge will result in higher calibrated horizontal hydraulic conductivity in layer 1 with little or no change in model error. If model average recharge and the corresponding calibrated horizontal hydraulic conductivity are too high, then future water level drawdown will be greater than estimated in the predictive simulations.

Transient simulations use a constant amount of recharge based on average annual recharge. Potential error is introduced in the calibration procedure, where reduced recharge due to drought was responsible for increased model error. In some areas the model did not match observed head decline, and consequently may have underestimated specific yield in layer 1. This would lead to an overestimation of drawdown in the predictive analyses. The use of average recharge in the predictive simulations does not take into account the variability of precipitation. It is clear from Figure 18 that “average” precipitation rarely occurs. Up to 20 feet of water level fluctuation is possible in the upper elevations of the Mt. Rose Fan due to long term variations in precipitation and recharge.

The use of 1,000-foot square grid cells leads to several approximations. The model simulates only a small fraction of the existing faults with flow barriers. Flow barriers cause high vertical and horizontal hydraulic gradients, and the model may not accurately estimate heads near these features. The large grid cell size will result in a significant underestimation of head near the municipal production wells. Additionally, the wells are modeled to pump at a constant rate throughout each one-year stress period. Municipal wells pump approximately 75% of their annual volume during the six-month irrigation season. This higher short-term pumping rate will lead to even greater, unmodeled, drawdown near the wells.

SUGGESTIONS FOR FUTURE WORK

Future groundwater flow modeling efforts in the South Truckee Meadows would benefit best through a better understanding and implementation of temporal variations in model sources and sinks. Incorporating historical precipitation data would lead to an improved transient calibration, better estimates of specific yield, and better predictive capabilities. It is suggested that this be done concurrently with a reevaluation of average recharge flux magnitude at the range front.

Surface recharge due to direct precipitation, particularly in the upper elevations, is not currently considered. Average annual precipitation of over 20 inches in the upper elevations of the STM certainly will directly recharge the aquifers and should be considered. Leakage from streams and canals should also be incorporated into the model.

Water level and production data for the Steamboat Hills are neglected in the current model, but transient calibration appears to suffer in some areas because of water level decline in the Steamboat Hills. Including temporal changes in water levels in the Steamboat Hills may be critical in adequately calibrating these areas.

Improving model discretization and/or local grid refinement may be required to satisfactorily calibrate the model in some areas. A smaller grid cell size would allow the use of more flow barriers, and a more accurate representation of existing fault structures. Flow barriers cause dramatic head changes over short distances and create

high vertical gradients. These conditions are observed in the observation wells, but depending on the scale of interest, may be unsatisfactorily reproduced in the model.

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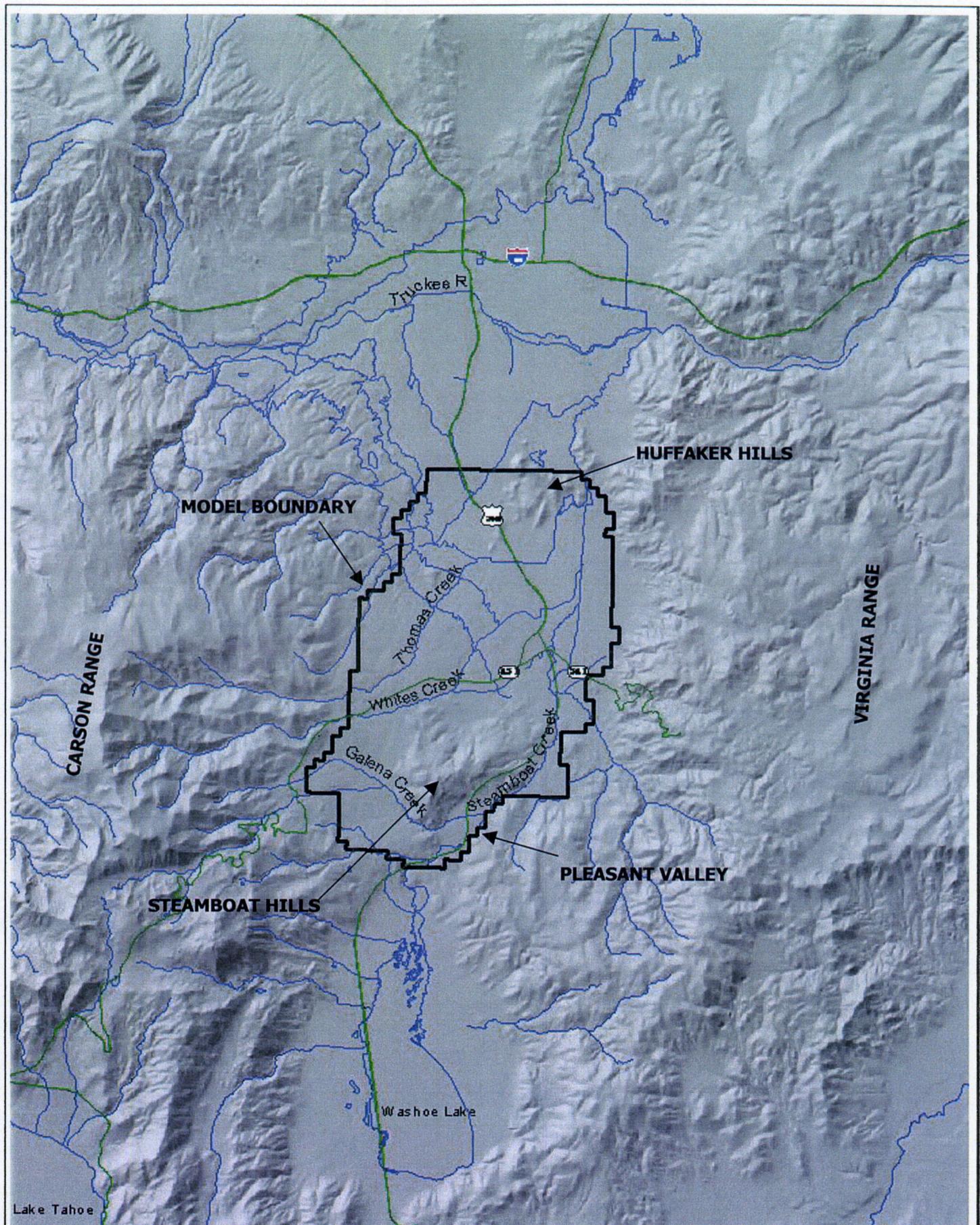
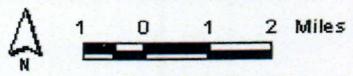


Figure 1 South Truckee Meadows model area location map



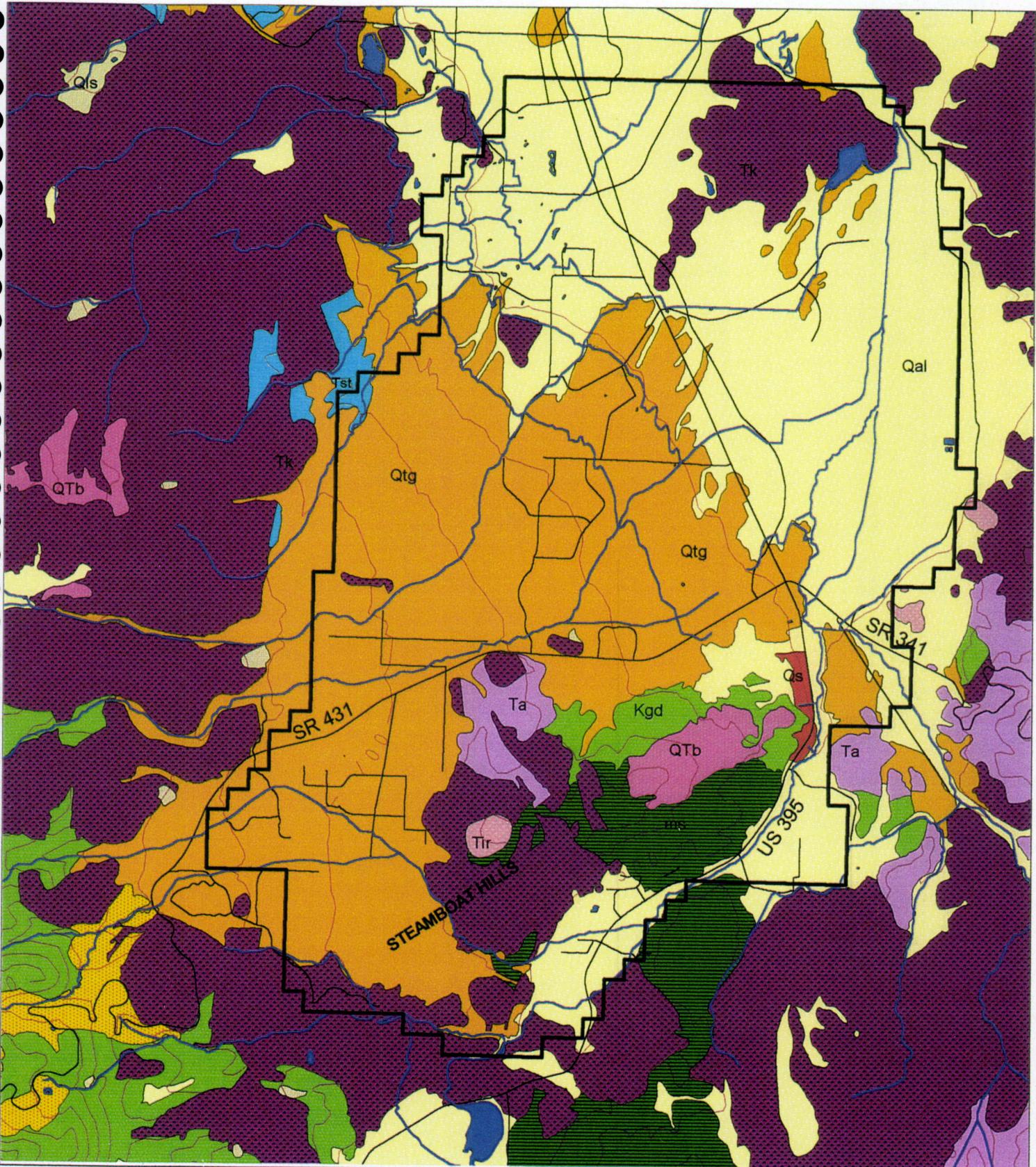


Figure 2. General geologic map of the South Truckee Meadows.
(Data from Bonham and Papke, 1969; Washoe County, 1994; Widmer, 2002)

Qsl - Alluvial deposits	Qba - Basalt and andesite
Qls - Land slide deposits	QTb - Basalt
Qal - Fluvial deposits	QTr - Rhyolite domes
QI - Lacustrine deposits	Tir - Rhyolite intrusives
Qg - Glacial deposits	Tab - Basalt
Qs - Hot spring sinter	Tst - Truckee Fm.
Qtg - Older alluvium	Tba - Basalt

Tk - Kate Peak Fm.	Groundwater model boundary
Tki - Kate Peak intrusives	
Tgd - Granodiorite stocks	
Ta - Alta Fm.	
Kgd - Granodiorite	
ms - Metamorphic rocks, undiff.	
water	

Scale 1:72,000
1000 0 1000 2000
Meters

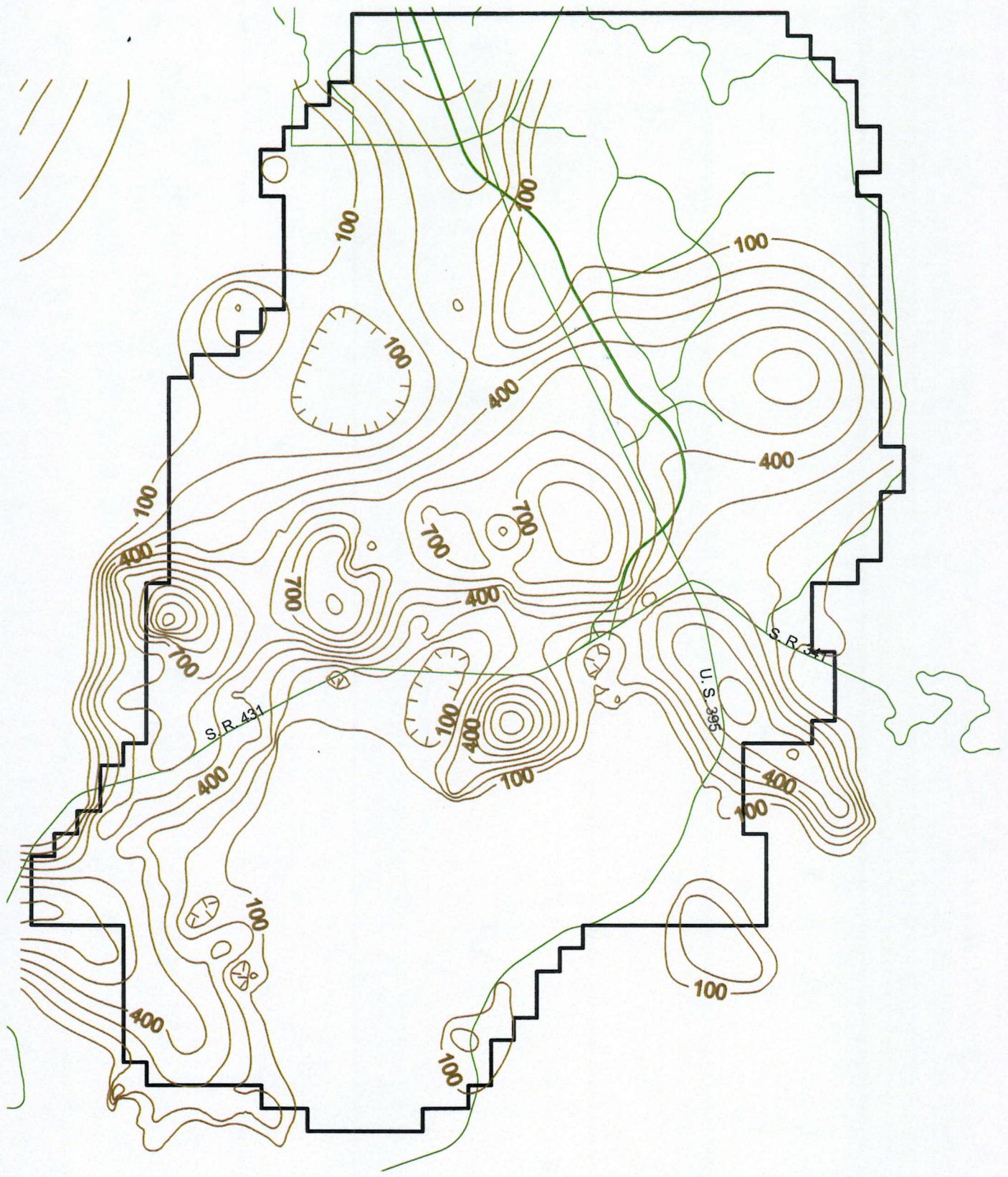


Figure 3. STM alluvial thickness contour map (modified from Skalbeck, 2001)

↗ Model boundary

Contour interval 100 feet

Scale 1:72,000

2000 0 2000 4000 6000 Feet

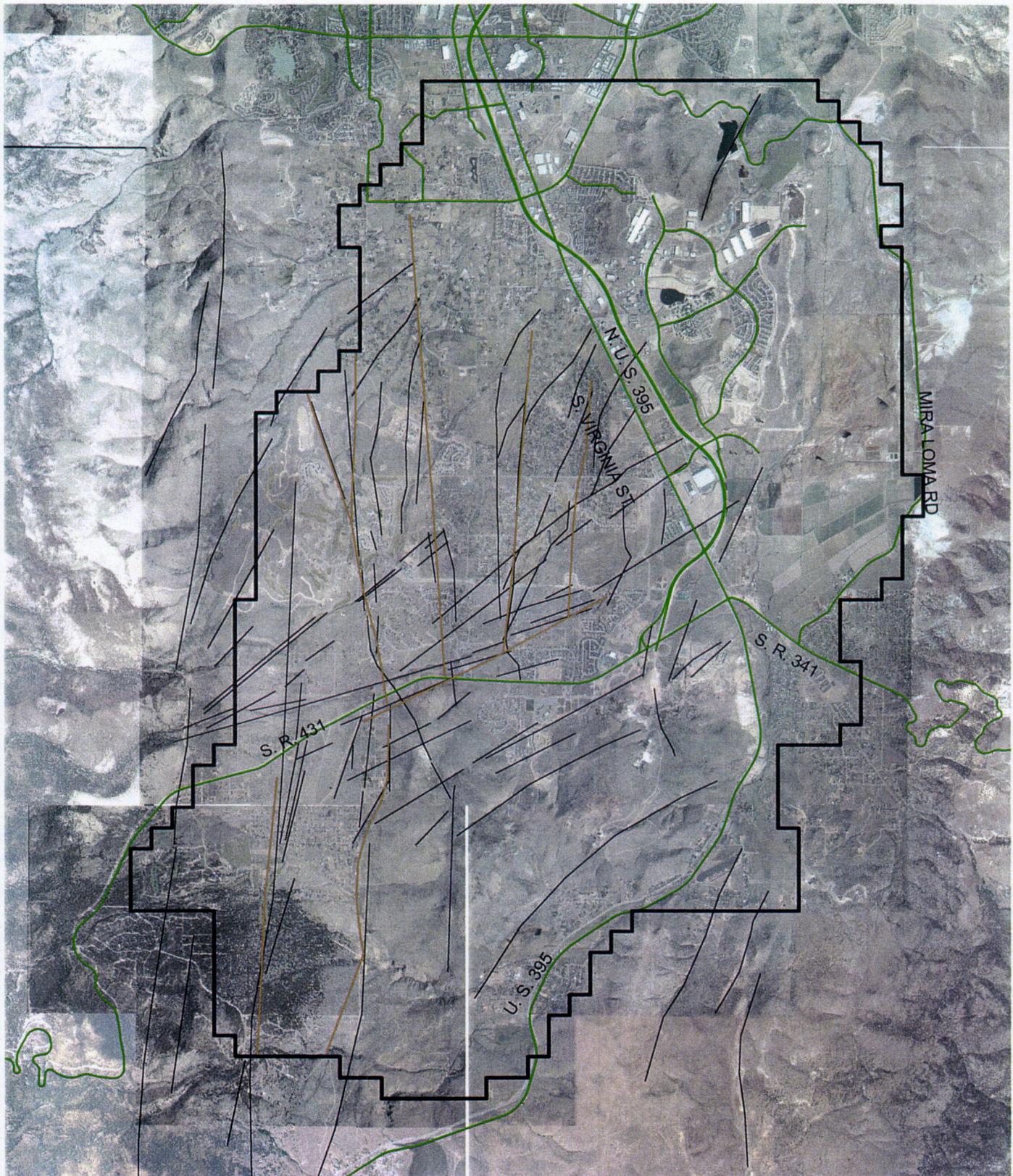


Figure 4. STM structure, showing mapped faults, photolinears, and model faults.
Modified after Bonham and Rogers, 1983; Bonham and Bell, 1983; and Tabor and Ellen, 1975

Model boundary
 Model faults
 Major roads
 Mapped faults and photolinears

0

2 Miles



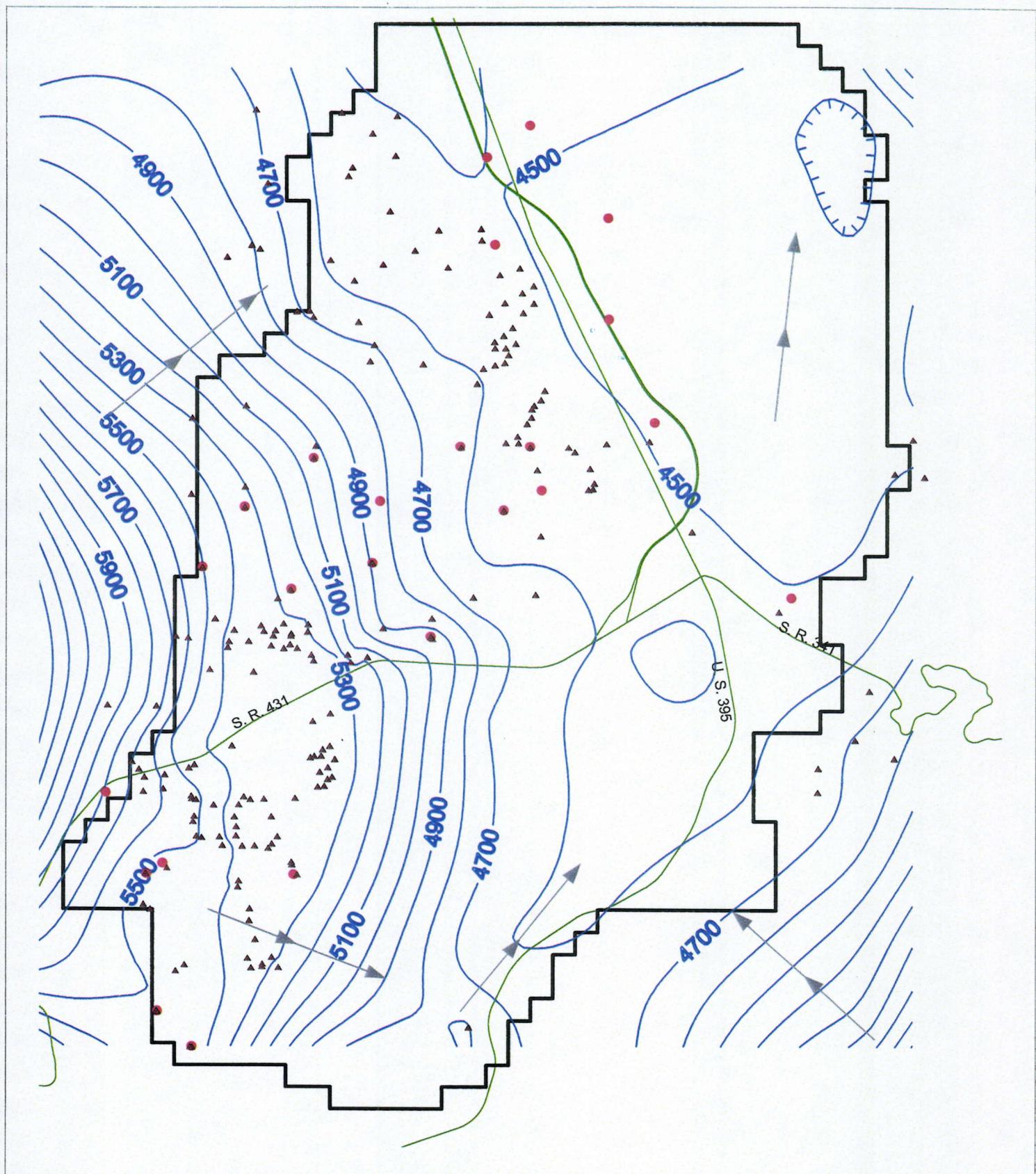


Figure 5. STM potentiometric surface contour map of 2002 (from Felling, 2002)

- Production well
- ▲ Measurement site used for this map
- Contour interval 100 feet

- ↗ Model boundary
- ↙ General groundwater flow direction

Scale 1:72,000

2000 0 2000 4000 6000 Feet



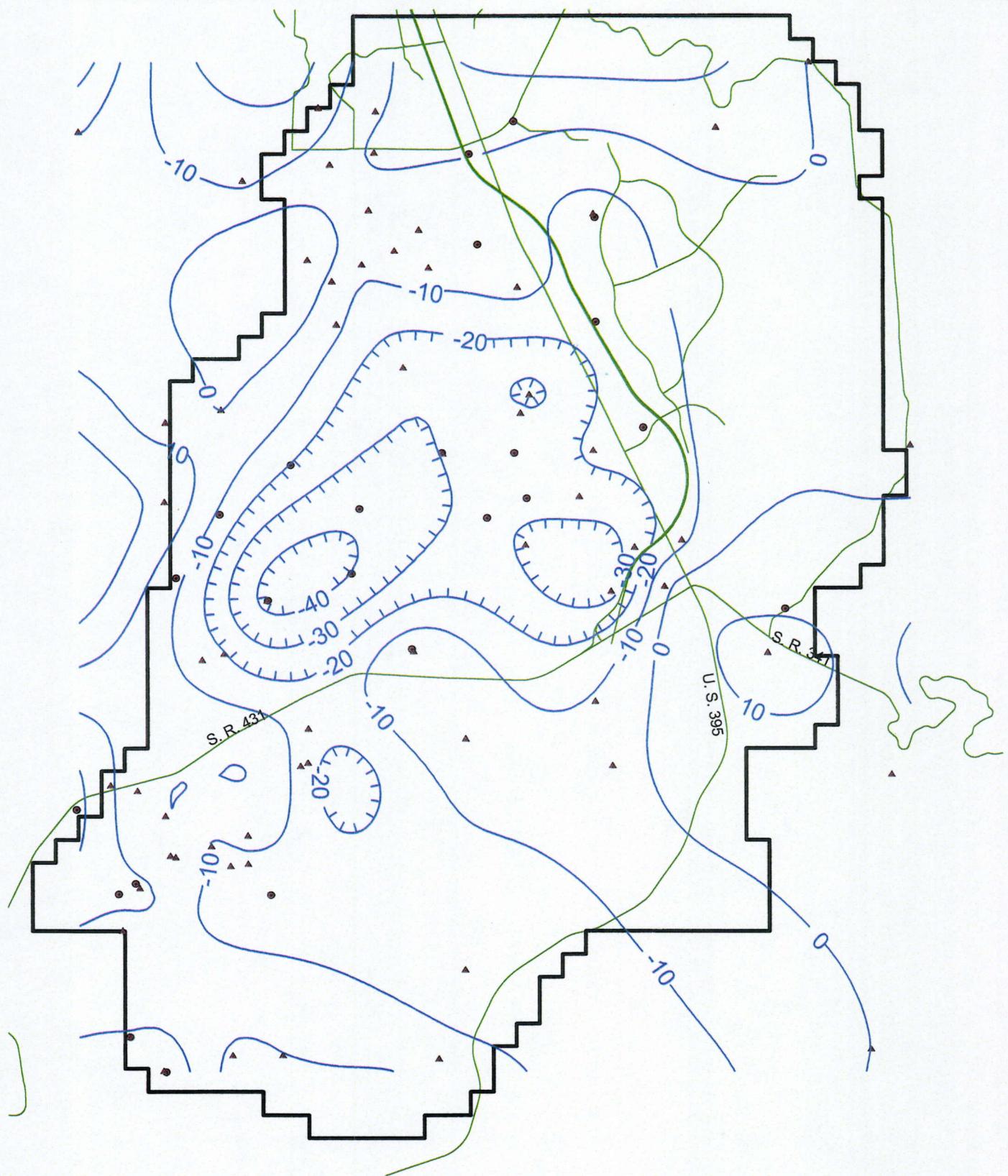


Figure 6. STM potentiometric surface difference from 1982 to 2002 (after Felling, 2002)

- Production well
- ▲ Measurement site used for this map
- Λ Model boundary
- Contour interval 10 feet

Scale 1:72,000
2000 0 2000 4000 6000 Feet

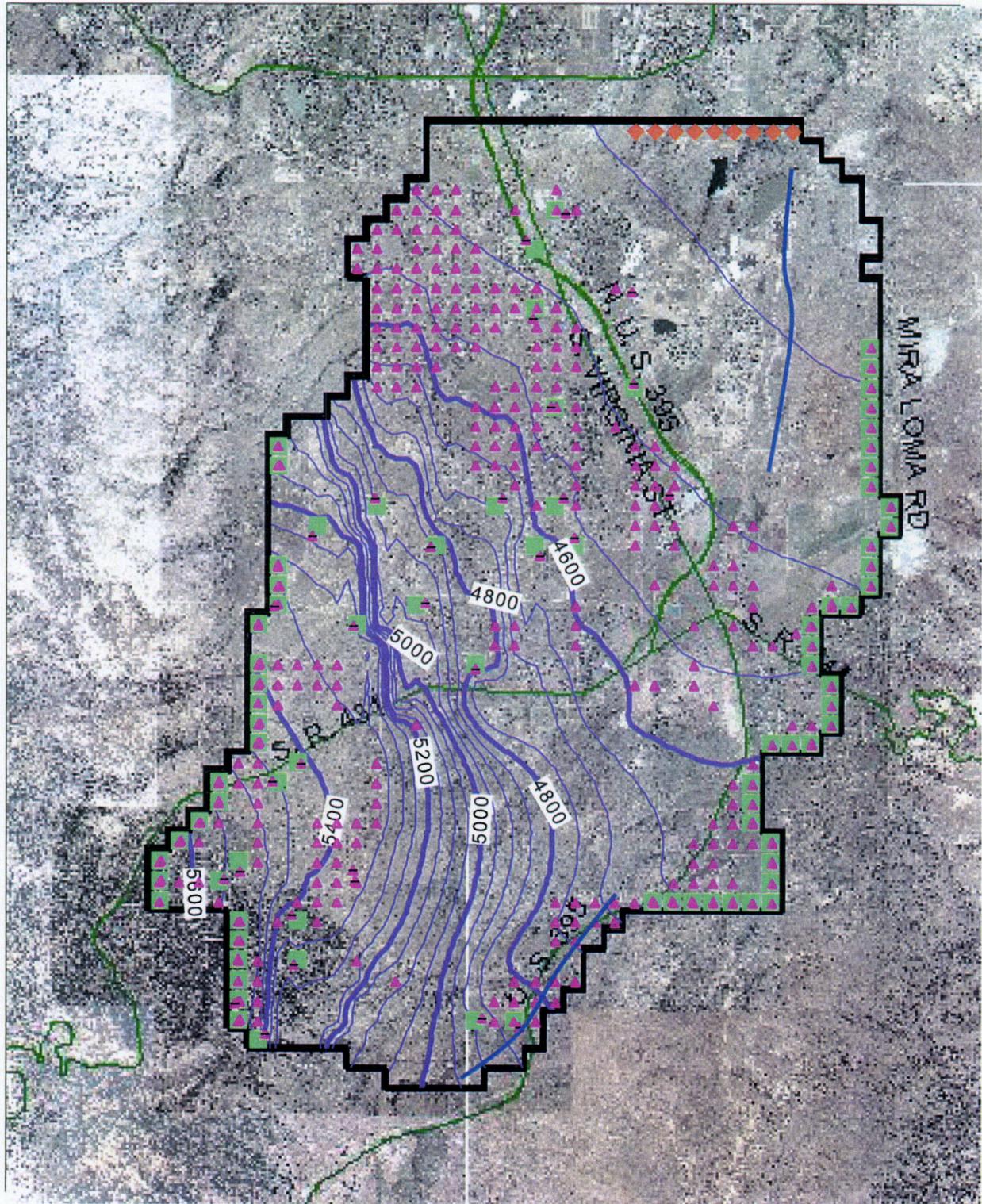


Figure 7. STM model boundary, sources and sinks, layer 2 calibrated heads.

■ Boundary simulated recharge
▲ Domestic wells
◆ Constant head

■ Municipal wells
└ No-flow boundary



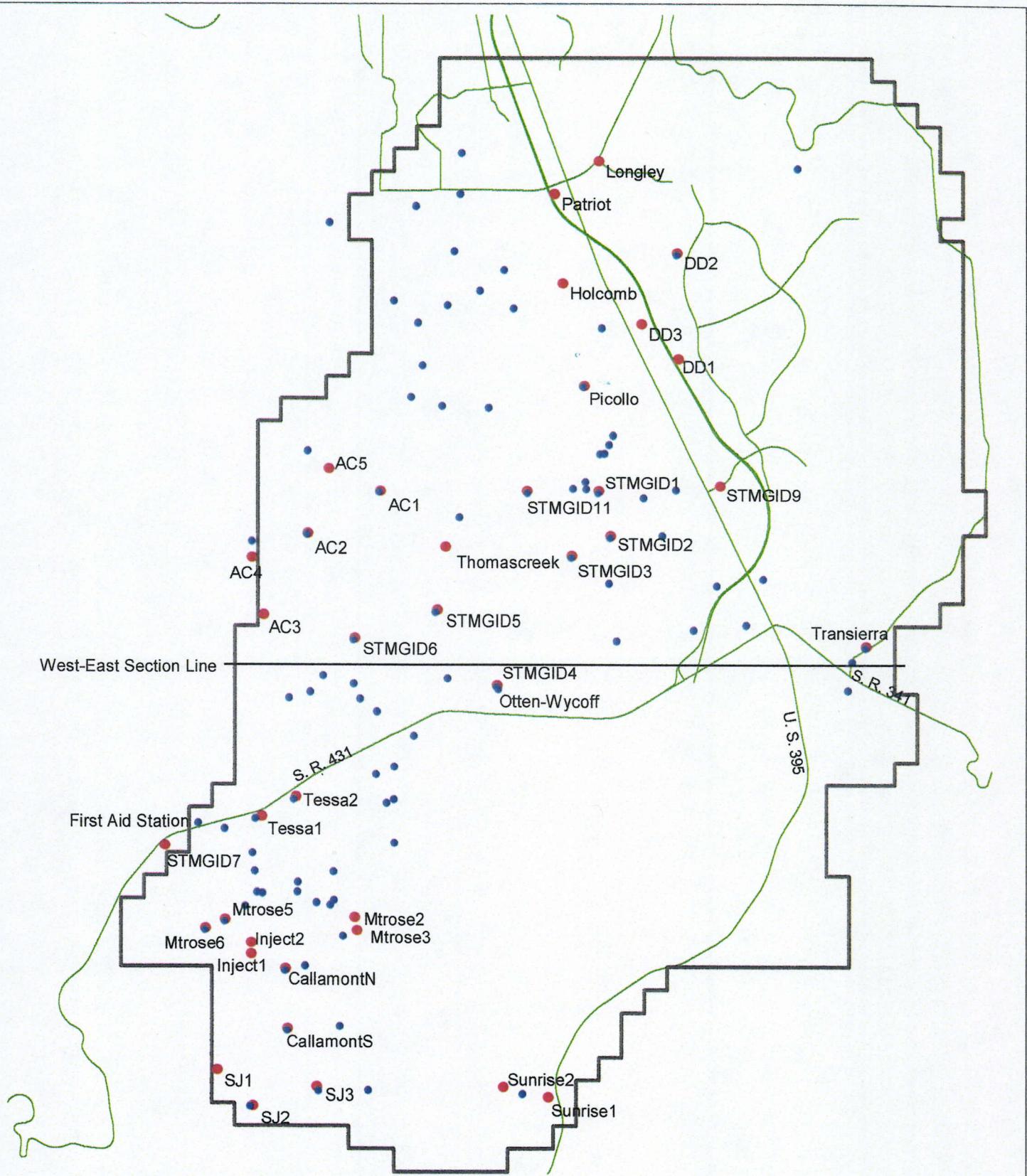


Figure 8. STM well locations

- Existing and proposed pumping and injection wells
- Observation wells

Scale 1:72,000
2000 0 2000 4000 6000 Feet

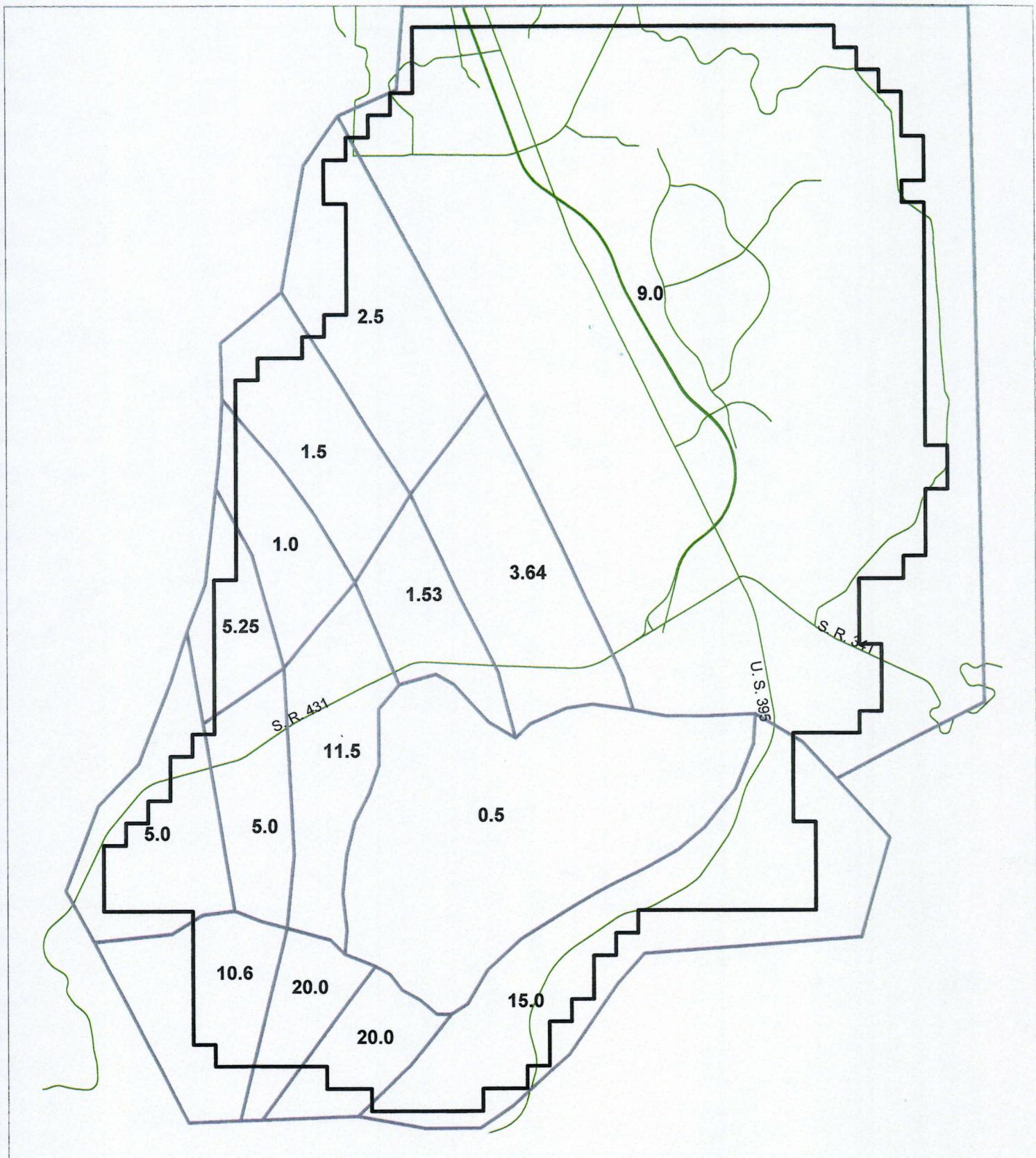


Figure 9. Horizontal conductivity for layer 1

Conductivity zone boundary

9.0 Conductivity (ft/d)

Scale 1:72,000

2000 0 2000 4000 6000 Feet



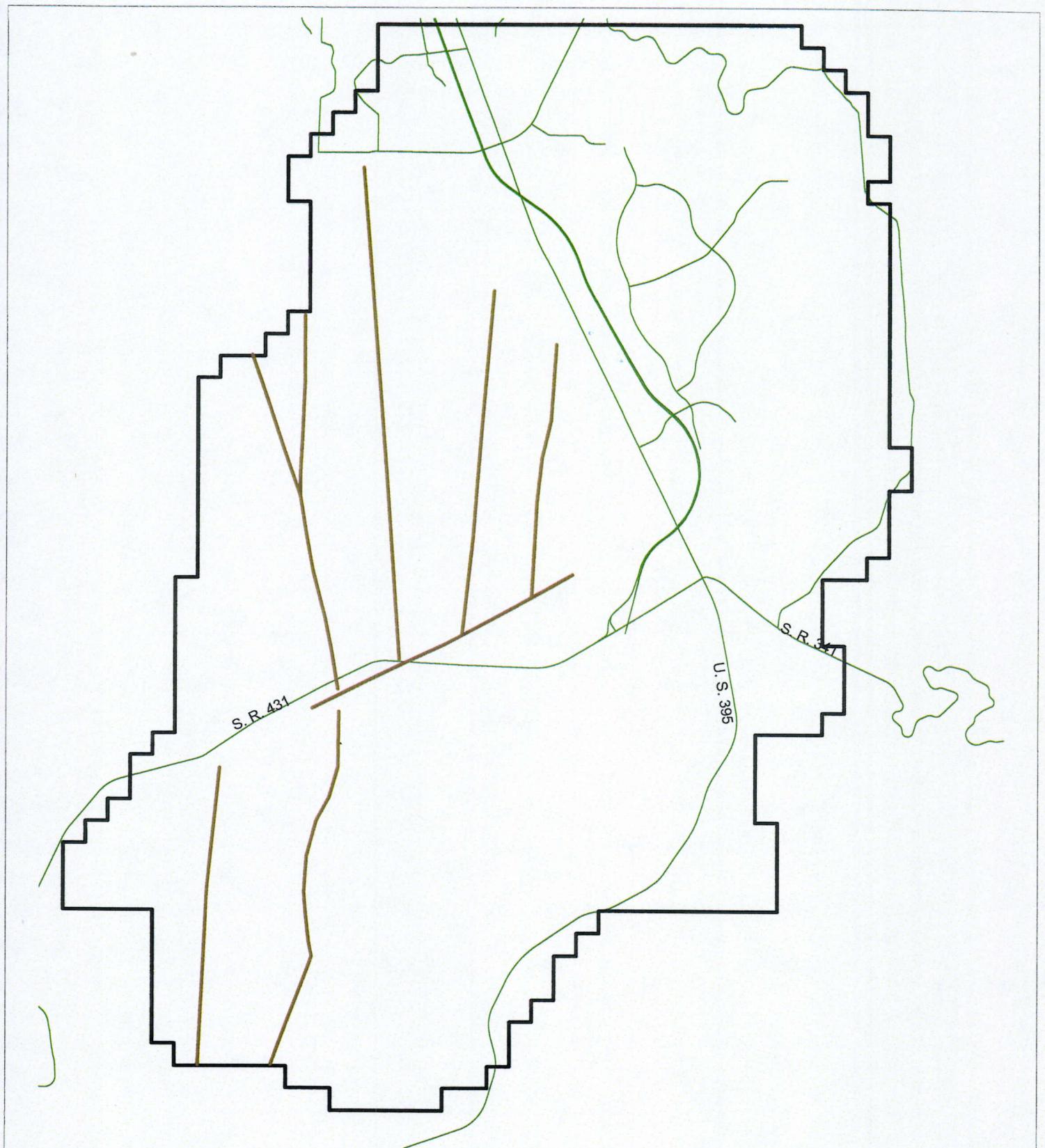


Figure 10. STM model faults used as horizontal flow barriers

Faults
 Model boundary

Scale 1:72,000
2000 0 2000 4000 6000 Feet

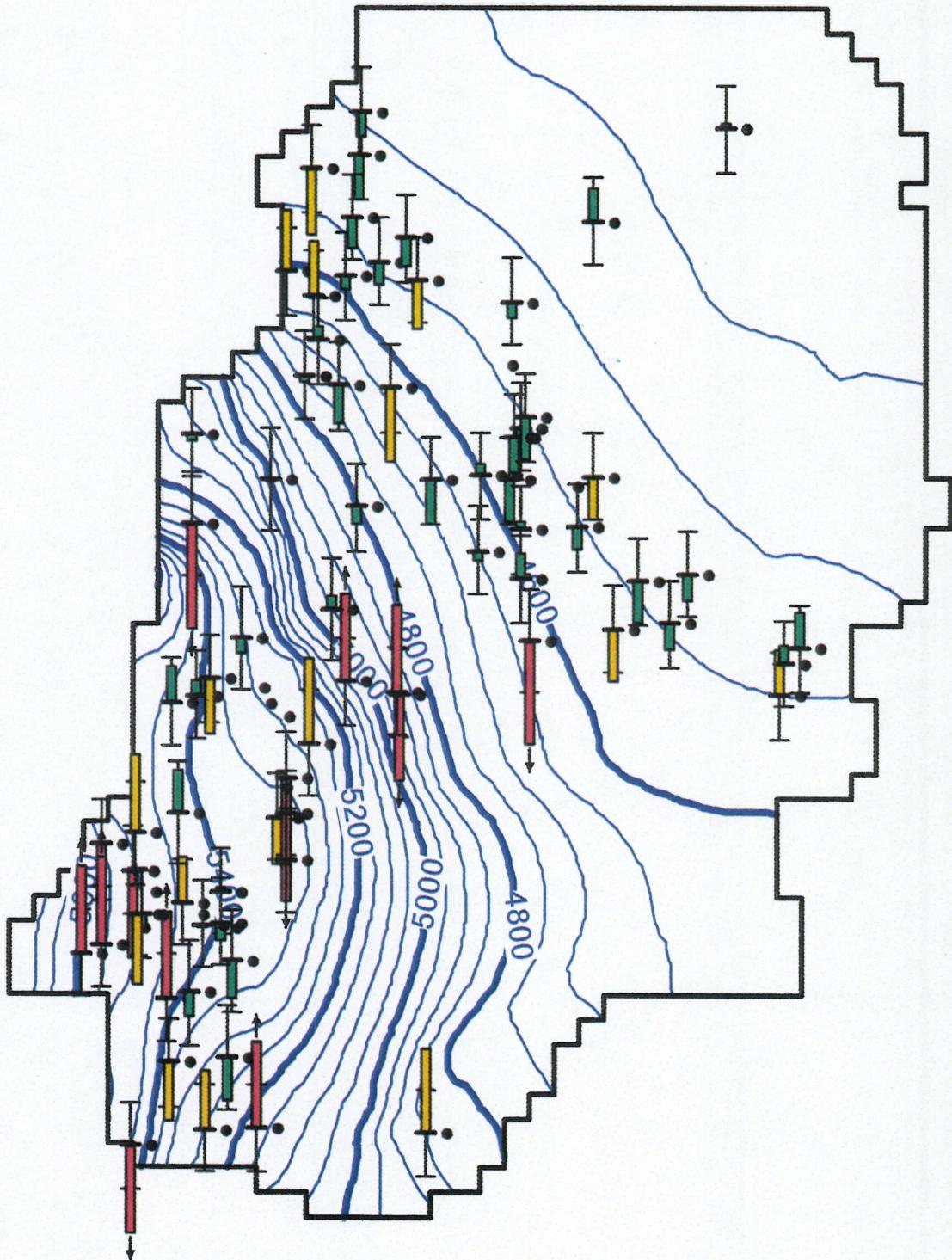


Figure 11. Observation well calibration and layer 1 calibrated heads. Green error bar indicates calculated head within 20 feet of observed head, yellow bars are within 40 feet, red bars are greater than 40 feet. Error bar above well point indicates calculated head exceeds observed head. Contour interval 50 feet.

Figure 12. Steady state computed versus observed head

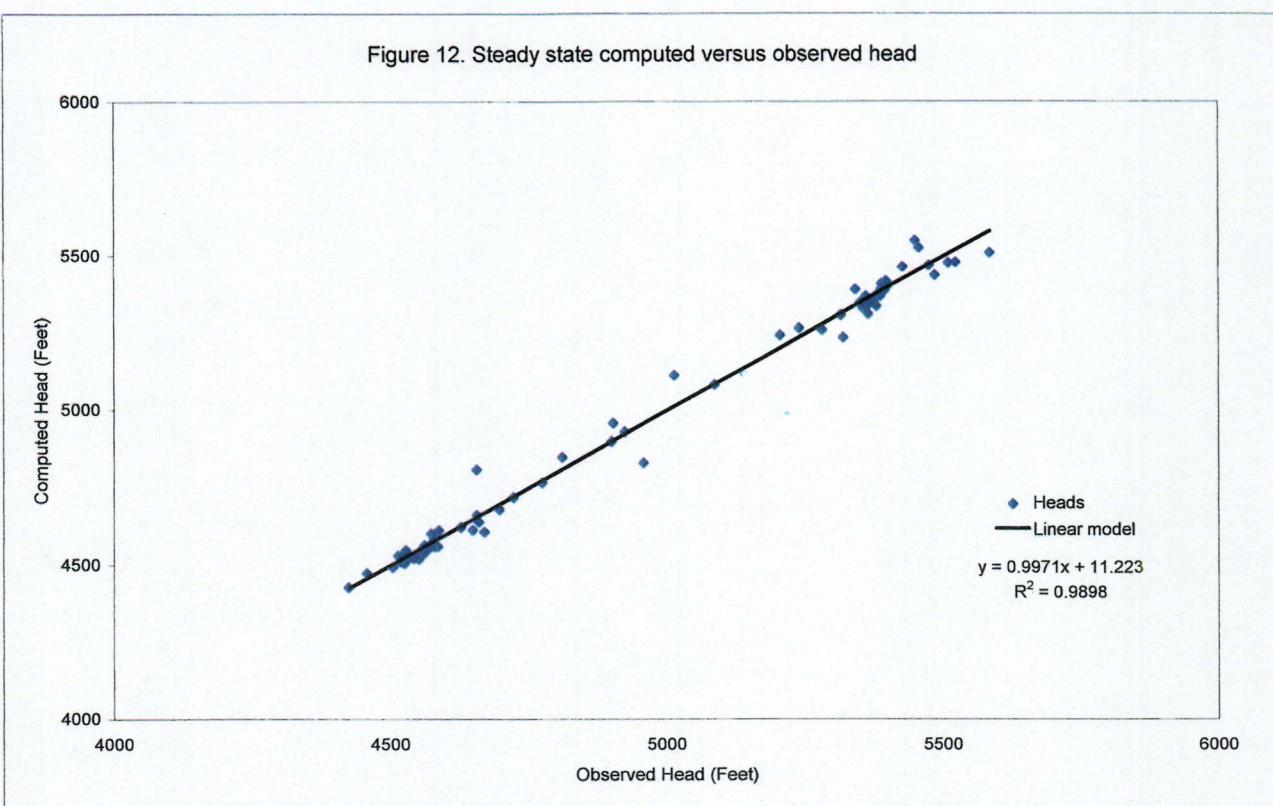
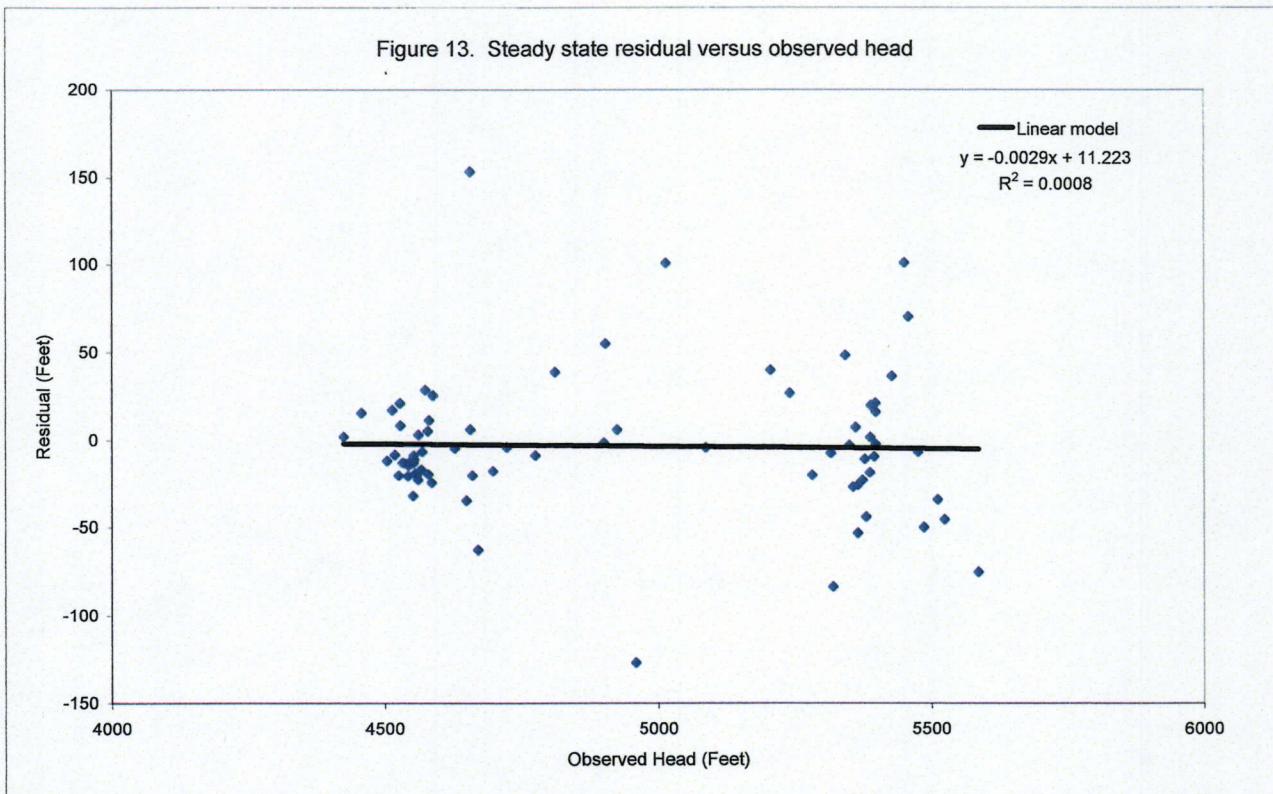


Figure 13. Steady state residual versus observed head



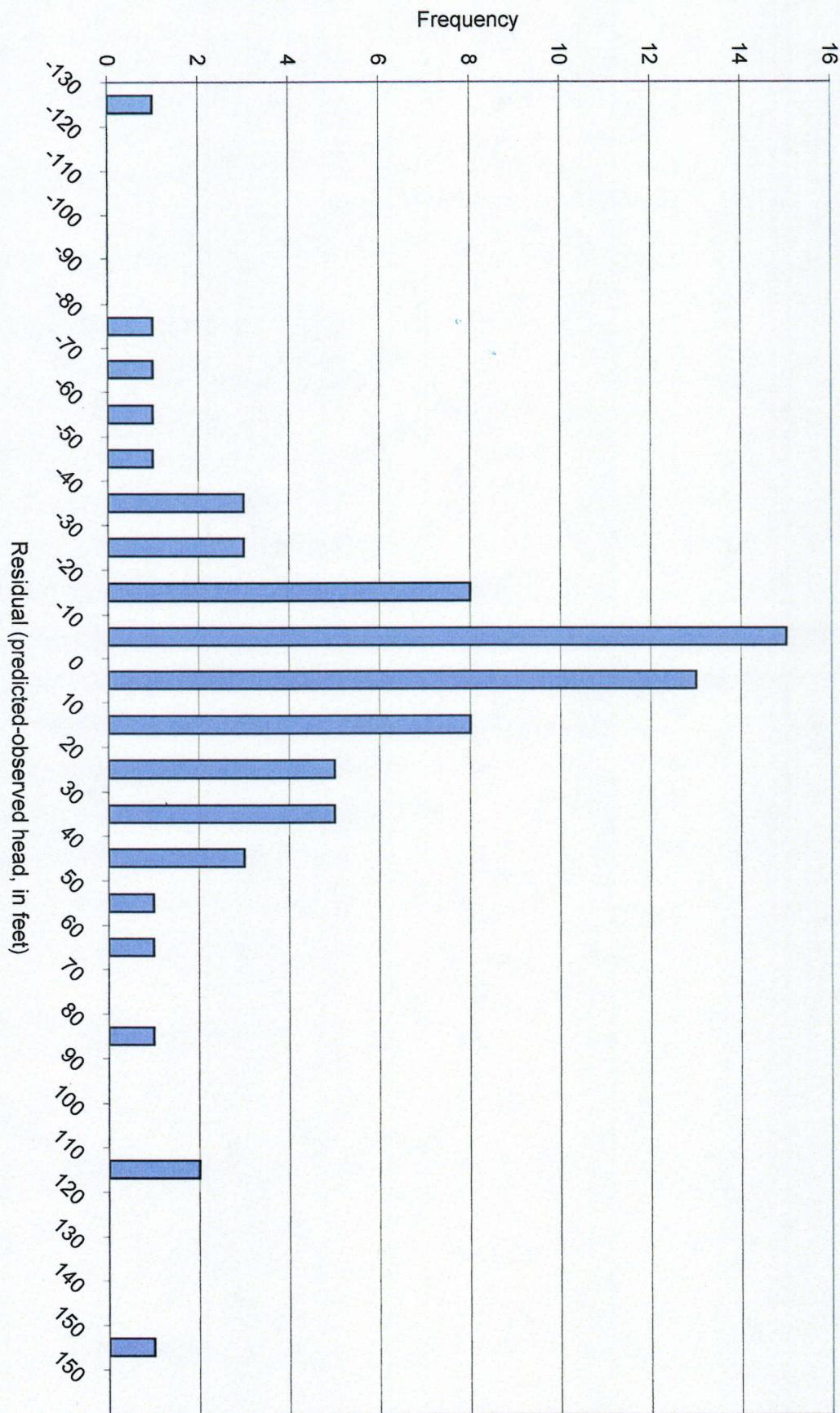


Figure 14. Steady state model histogram of residuals

Figure 15A. Steady state sensitivity to layer 1 horizontal conductivity

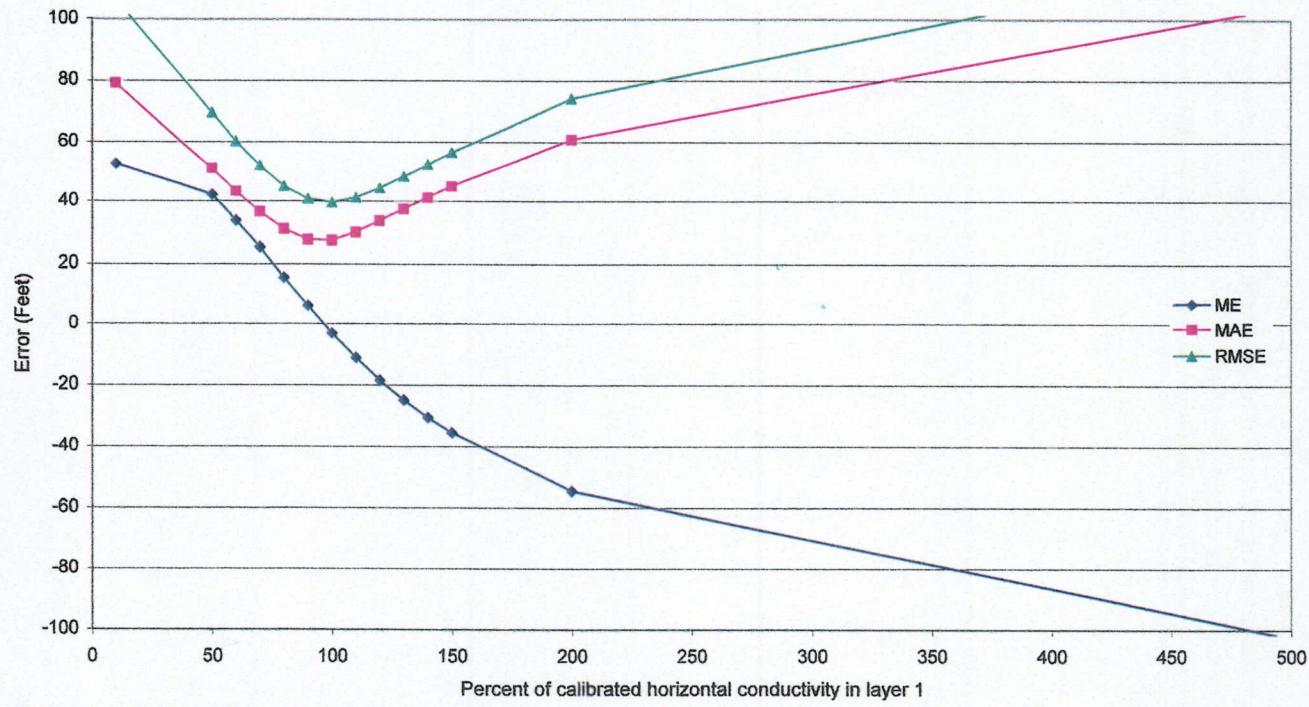


Figure 15B. Steady state sensitivity to layer 2 horizontal conductivity

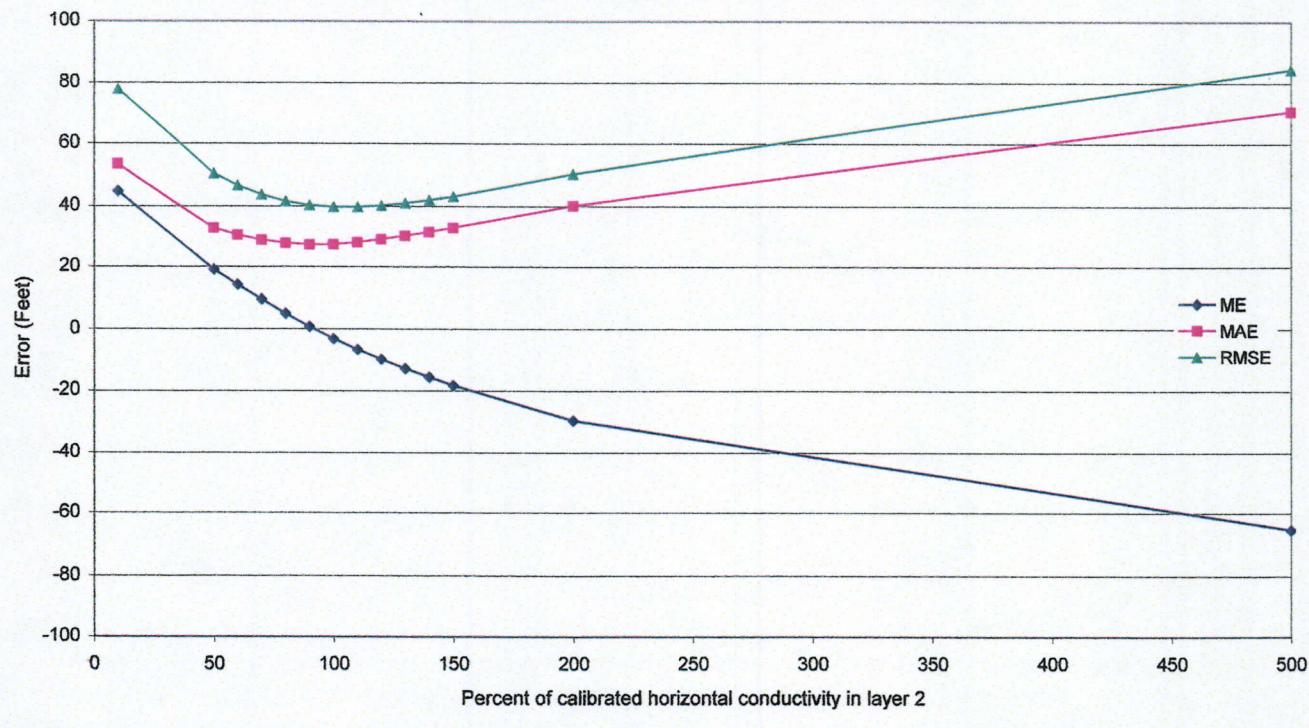


Figure 16A. Steady state sensitivity to layer 1 vertical conductivity

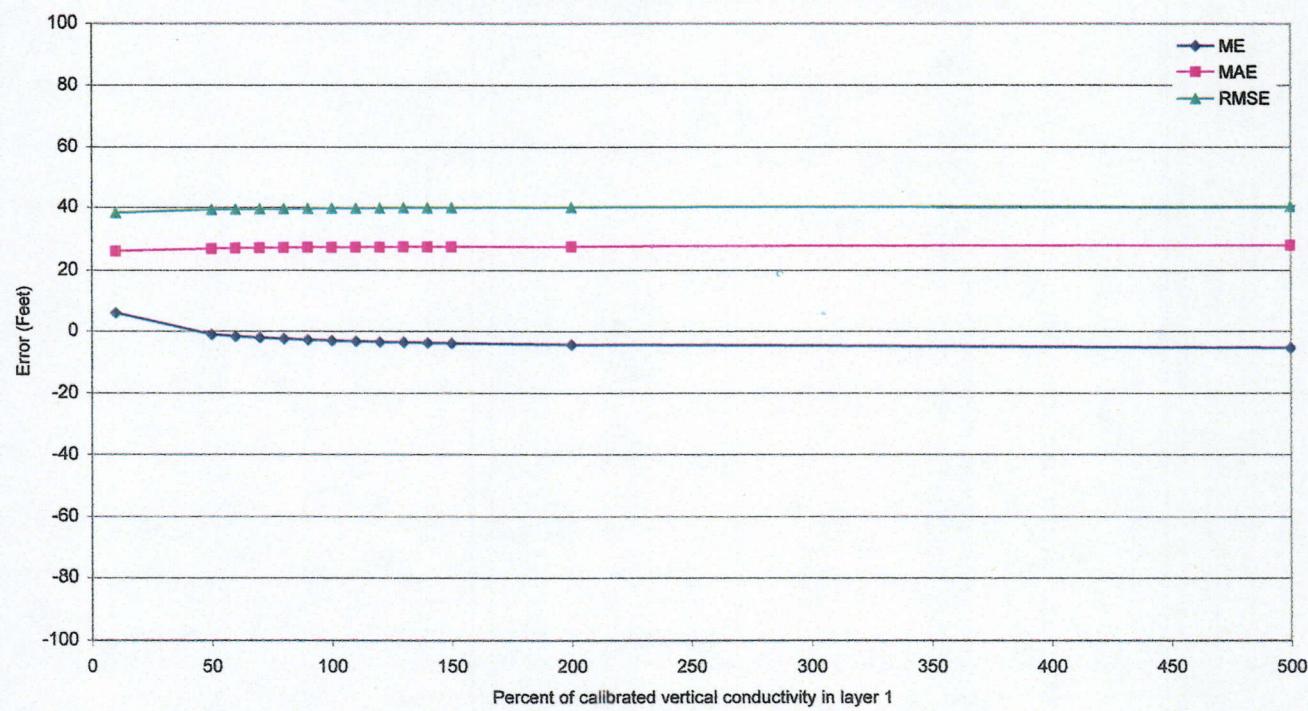
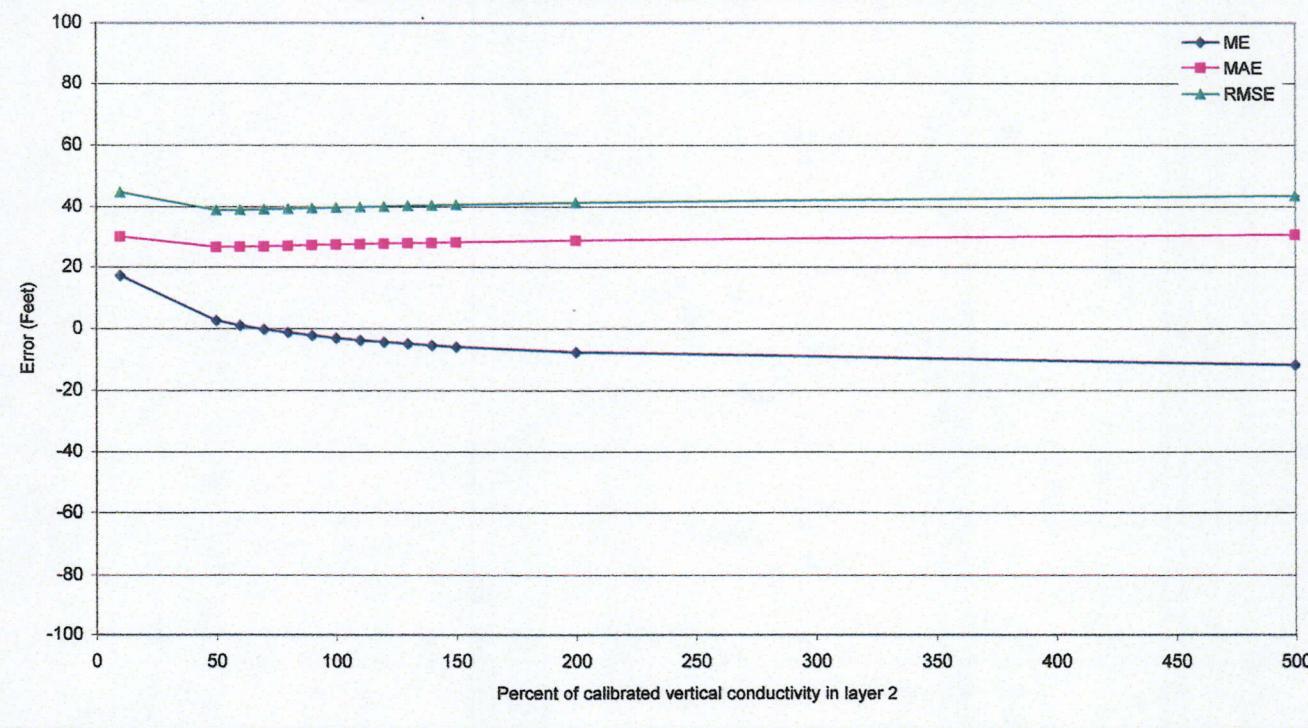


Figure 16B. Steady state sensitivity to layer 2 vertical conductivity



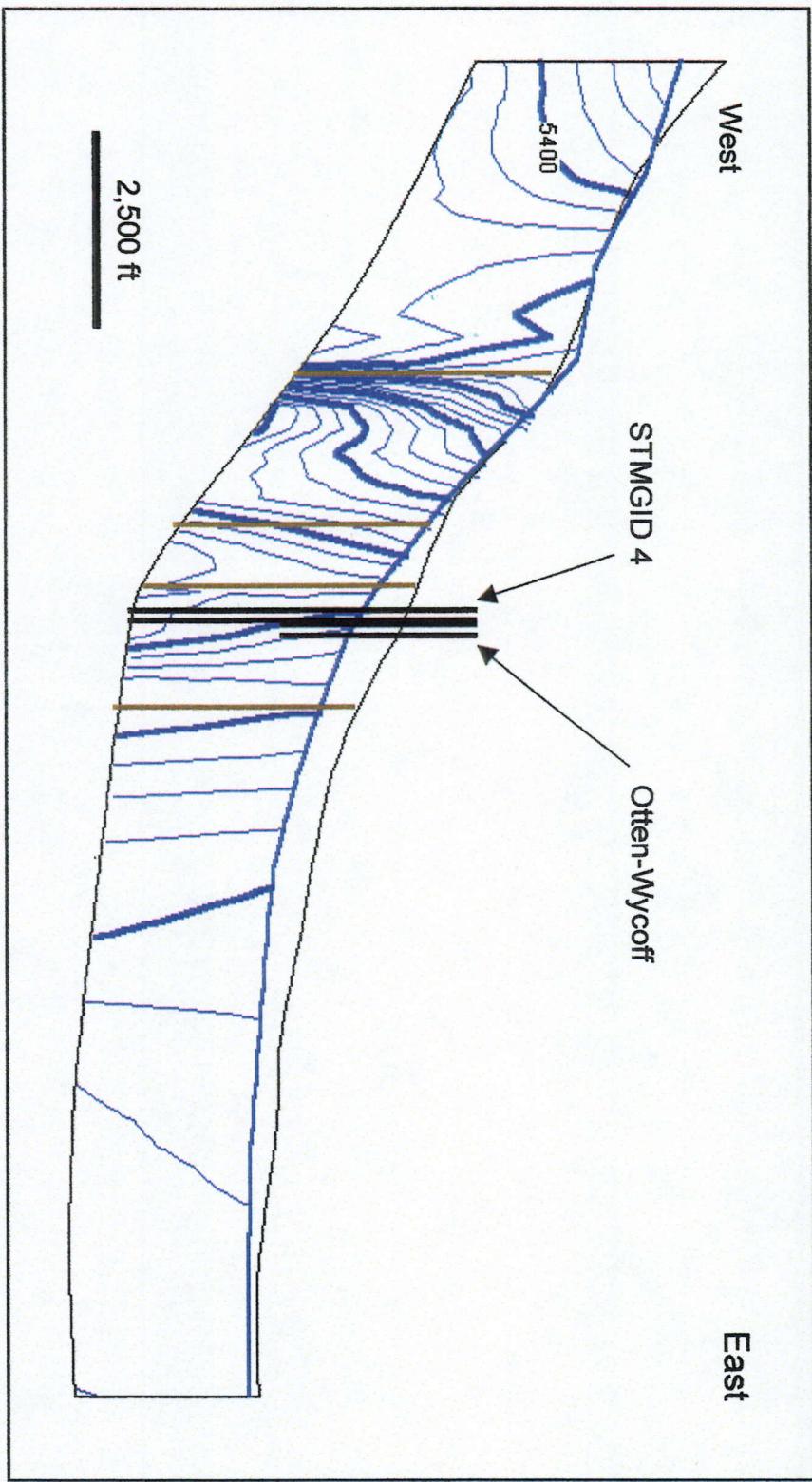


Figure 17. West-east cross section through STMGID 4 and Otten-Wycoff wells just north of the Steamboat Hills. Blue contours are equipotentials, vertical brown lines are modeled flow barriers. Subhorizontal equipotentials indicate vertical hydraulic gradients. Refer to Figure 8 for section location.

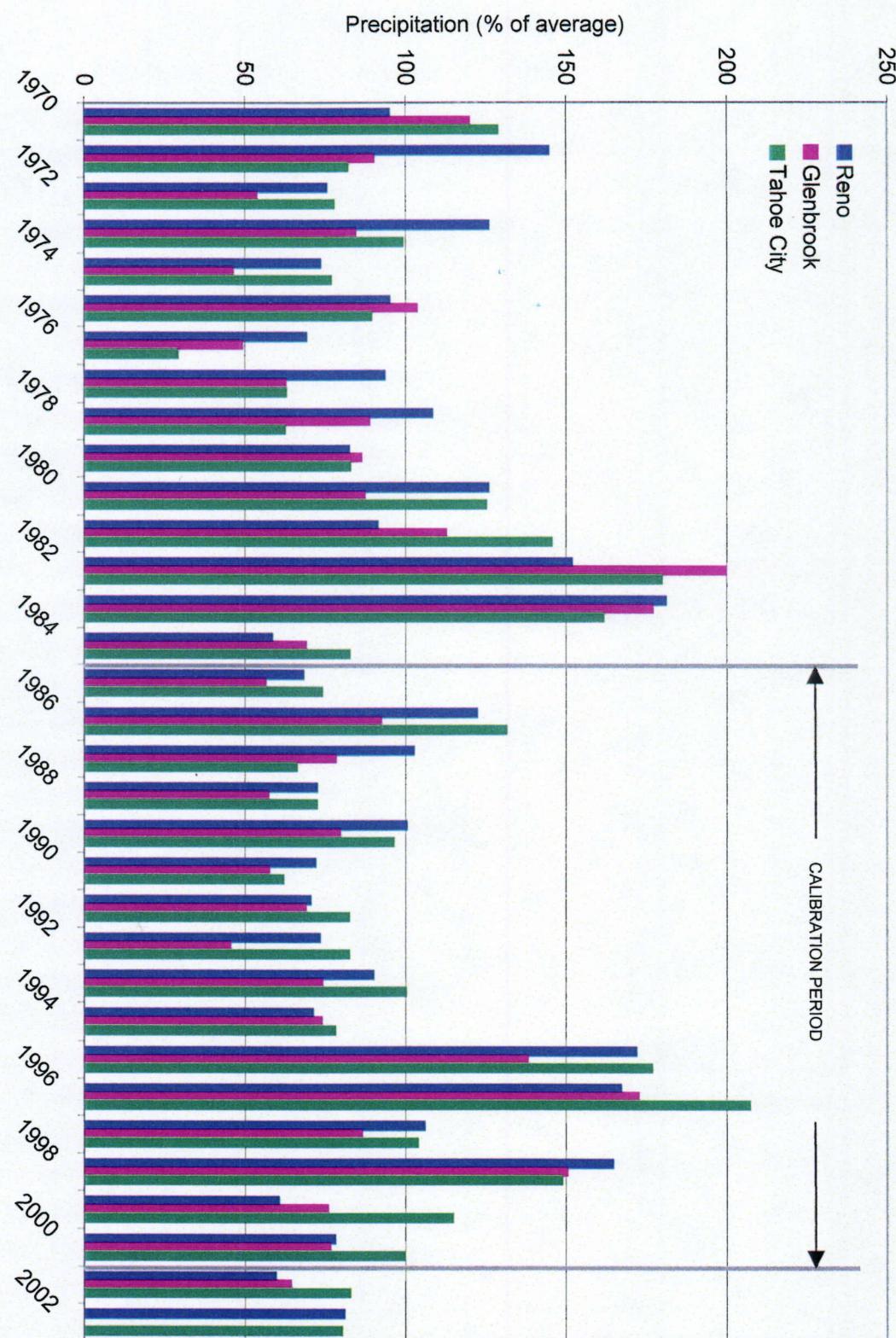


Figure 18. Annual precipitation relative to average for selected sites near the STM
(from www.wrcc.dri.edu/summary/climsmnv.html)

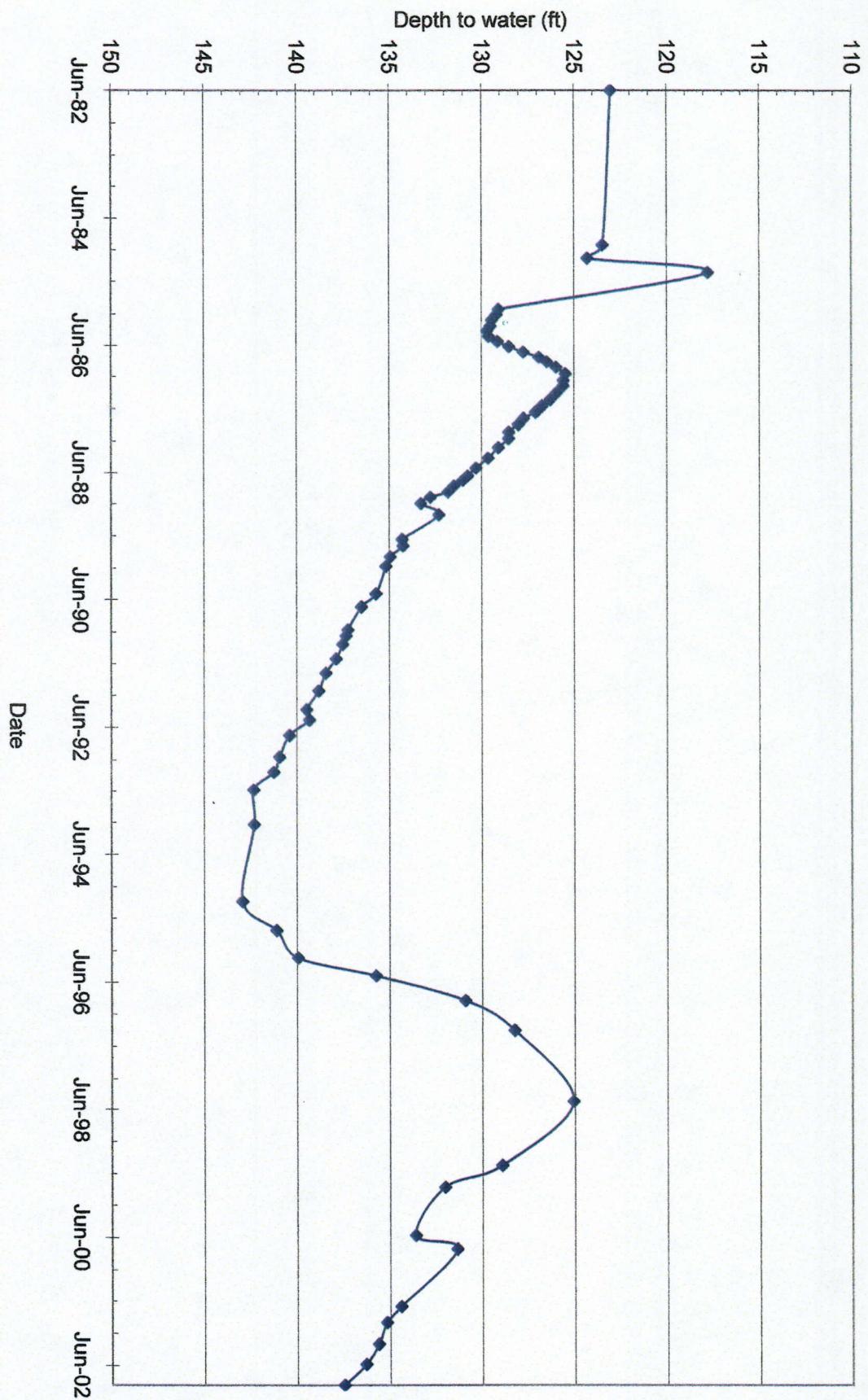
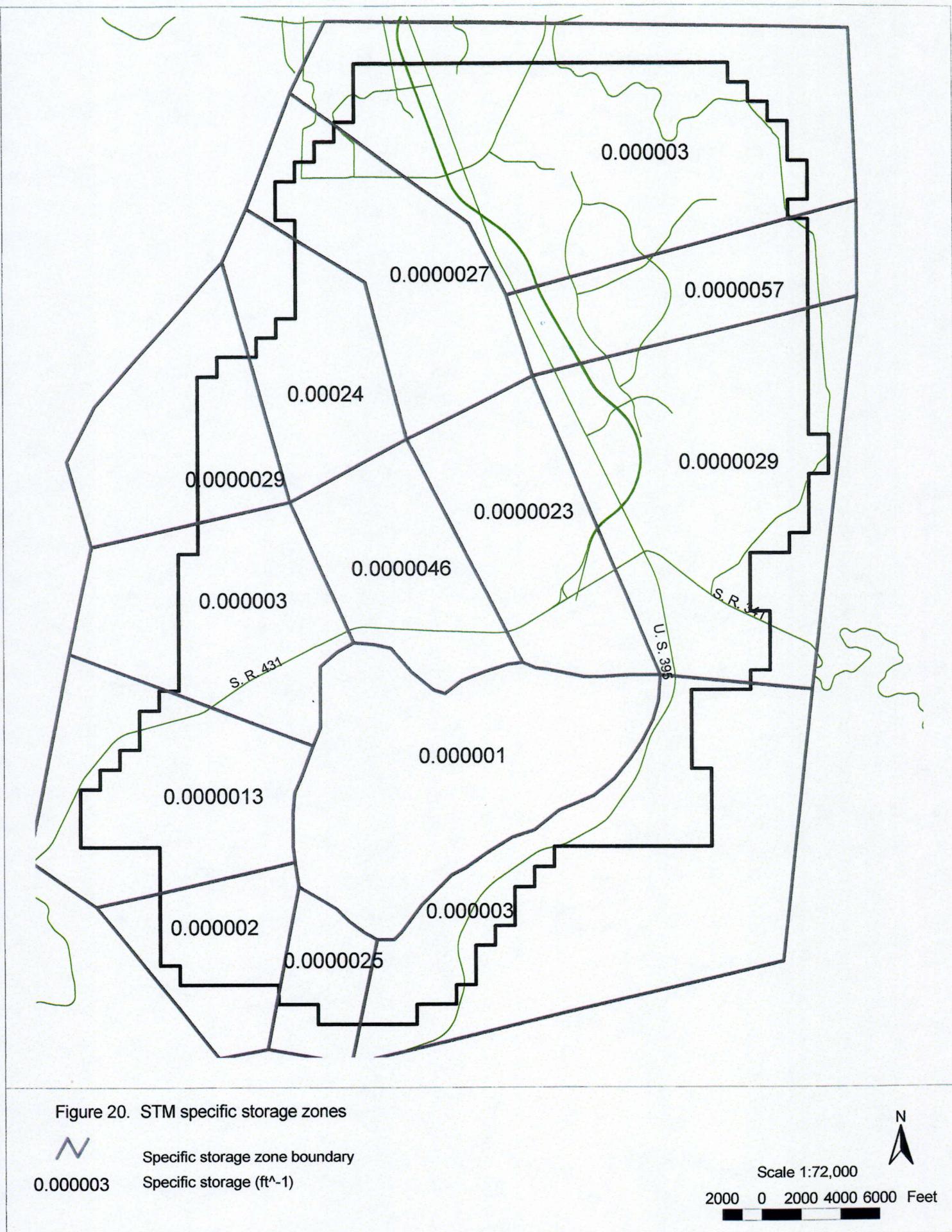


Figure 19. Hydrograph of the Mt. Rose First Aid Station well, Galena Area



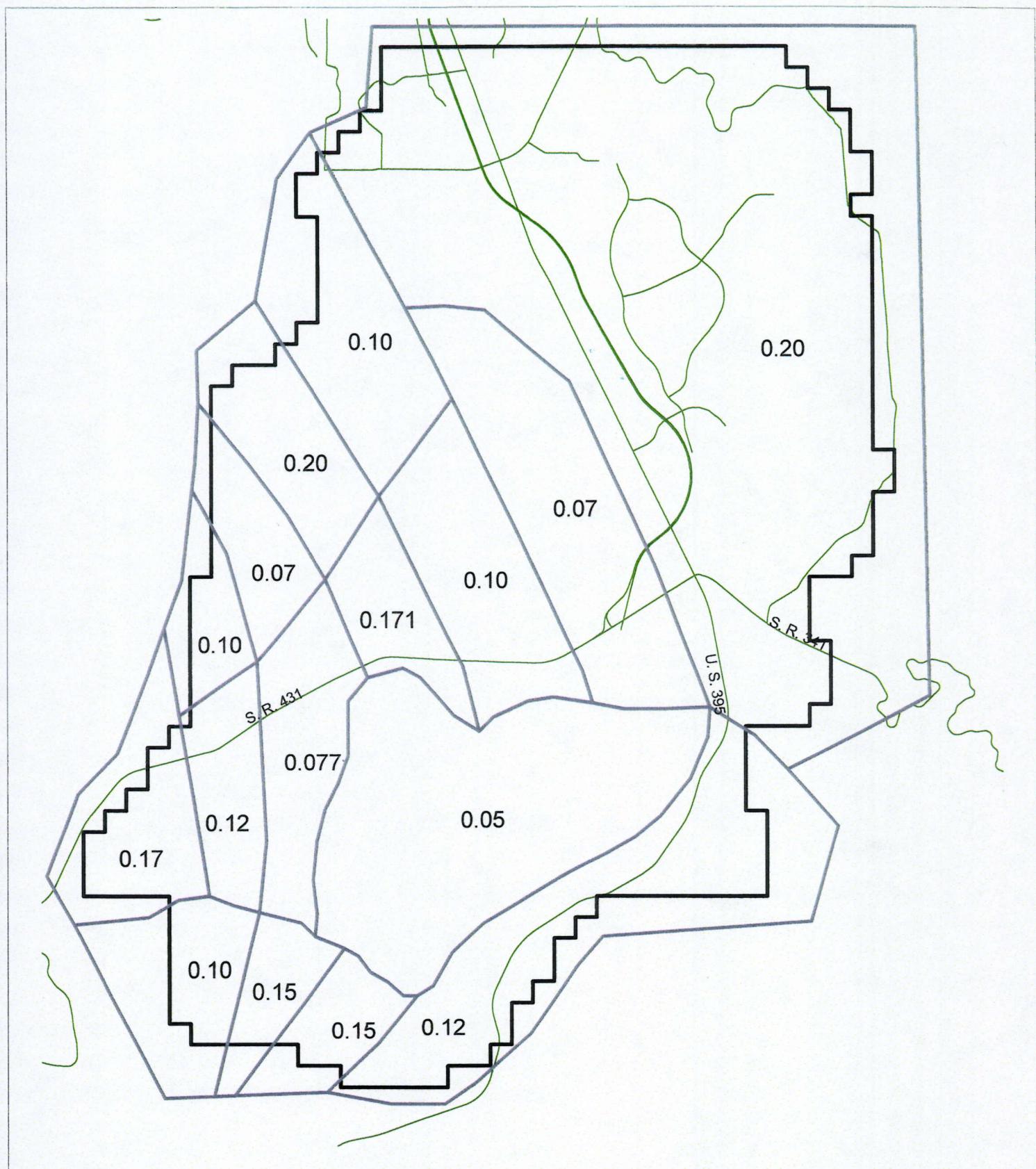


Figure 21. STM specific yield zones

W

Specific yield zone boundary

0.01

Specific yield

Scale 1:72,000

2000 0 2000 4000 6000 Feet

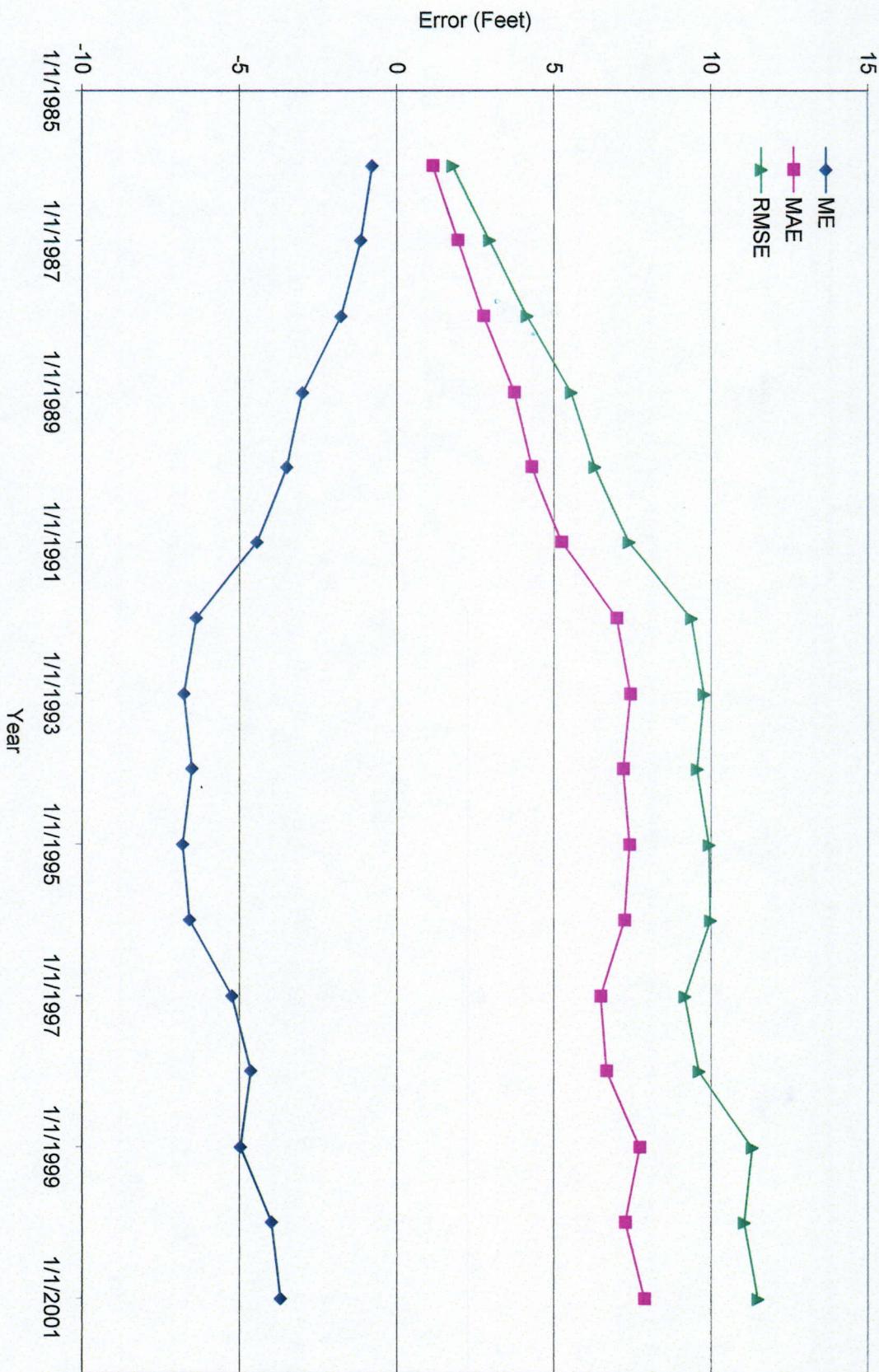


Figure 22. Transient error summary for individual stress periods.

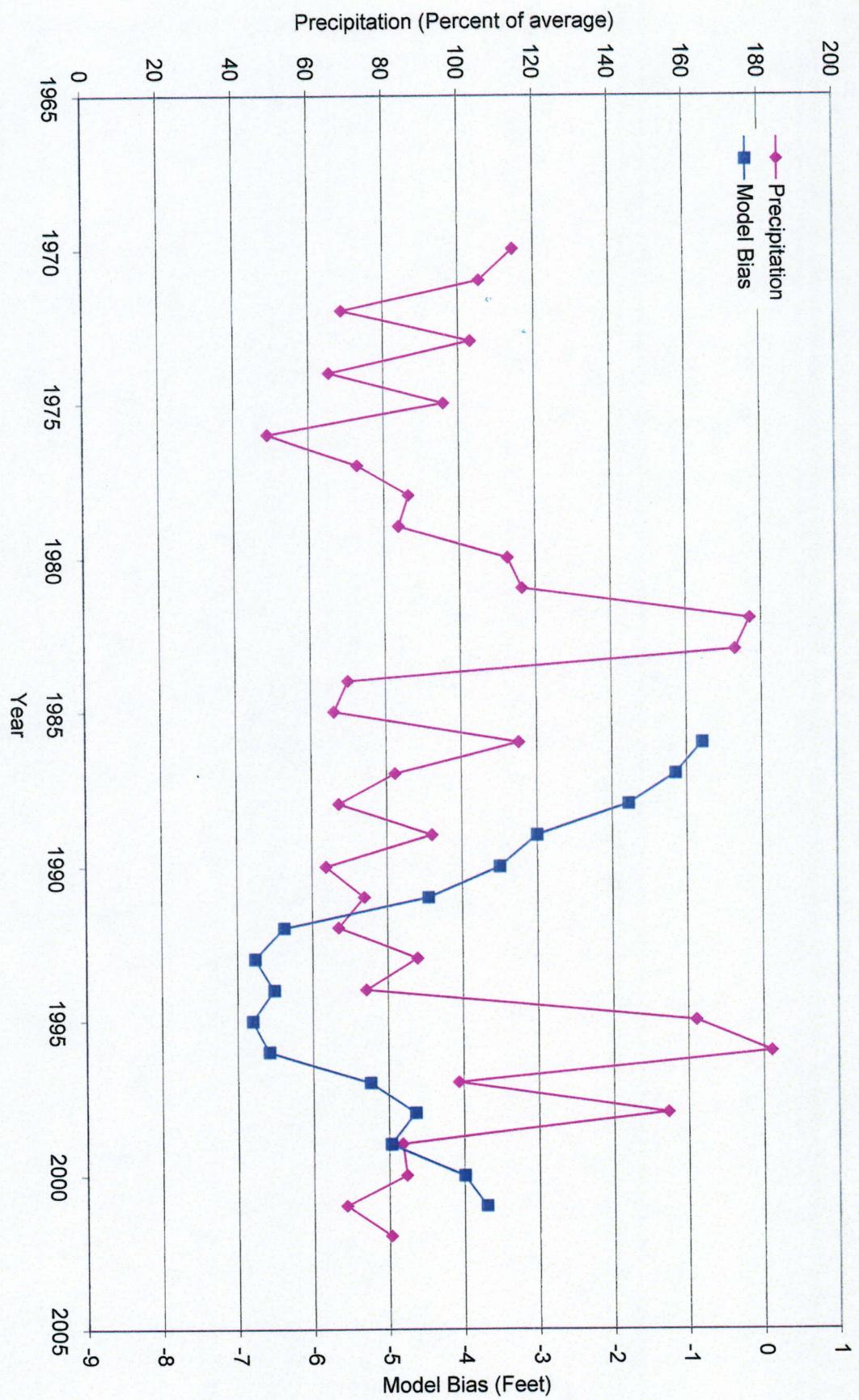


Figure 23. Transient model bias compared to average STM model area precipitation

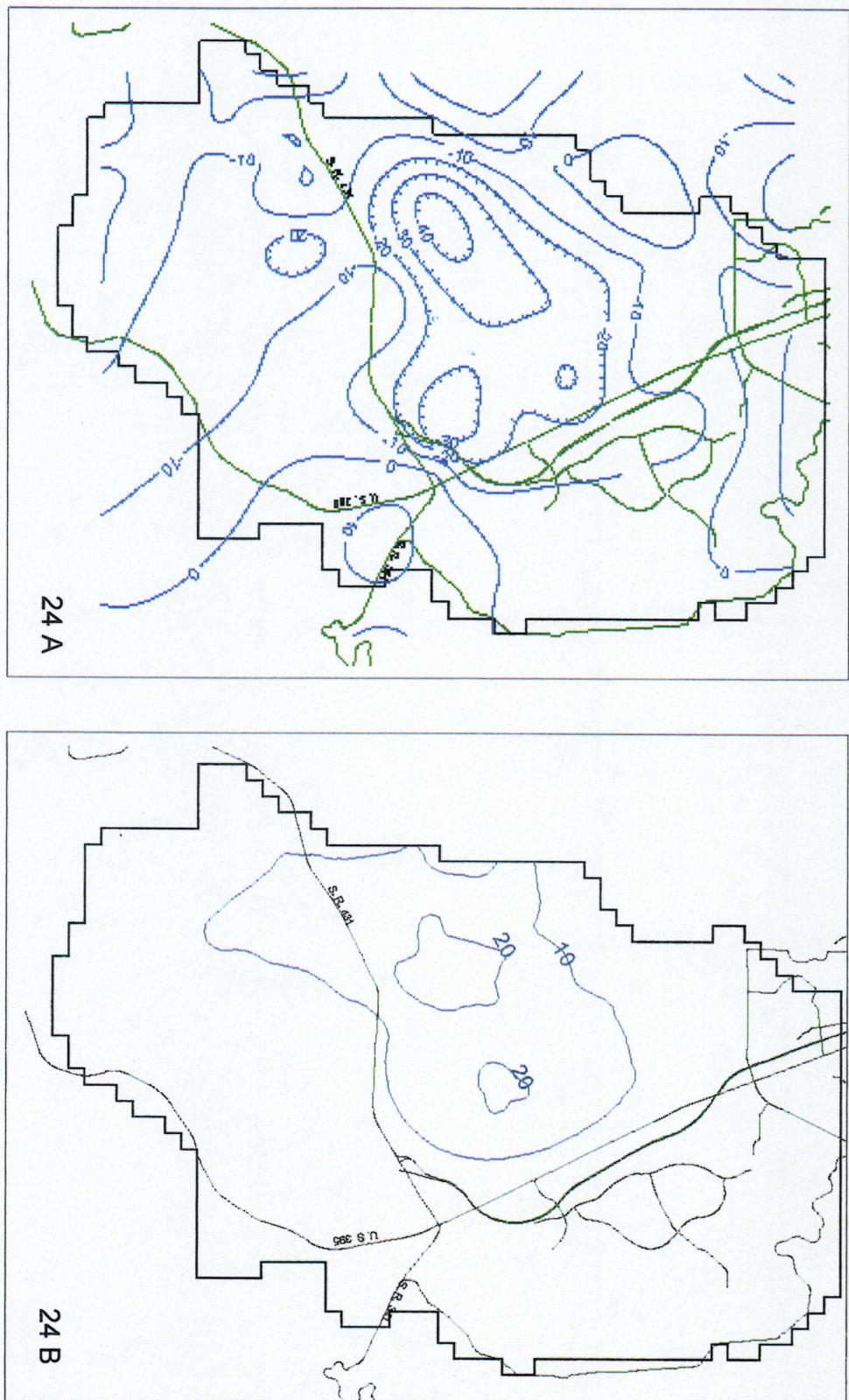


Figure 24. Contour maps of measured water level change. Fig. 24 A shows water level change from 1982 to 2002, negative values indicate decline (modified from Felling, 2002). Fig. 24 B shows computed drawdown in layer 1 from 1985 to 2001, positive values indicate decline. Contour interval 10 feet.

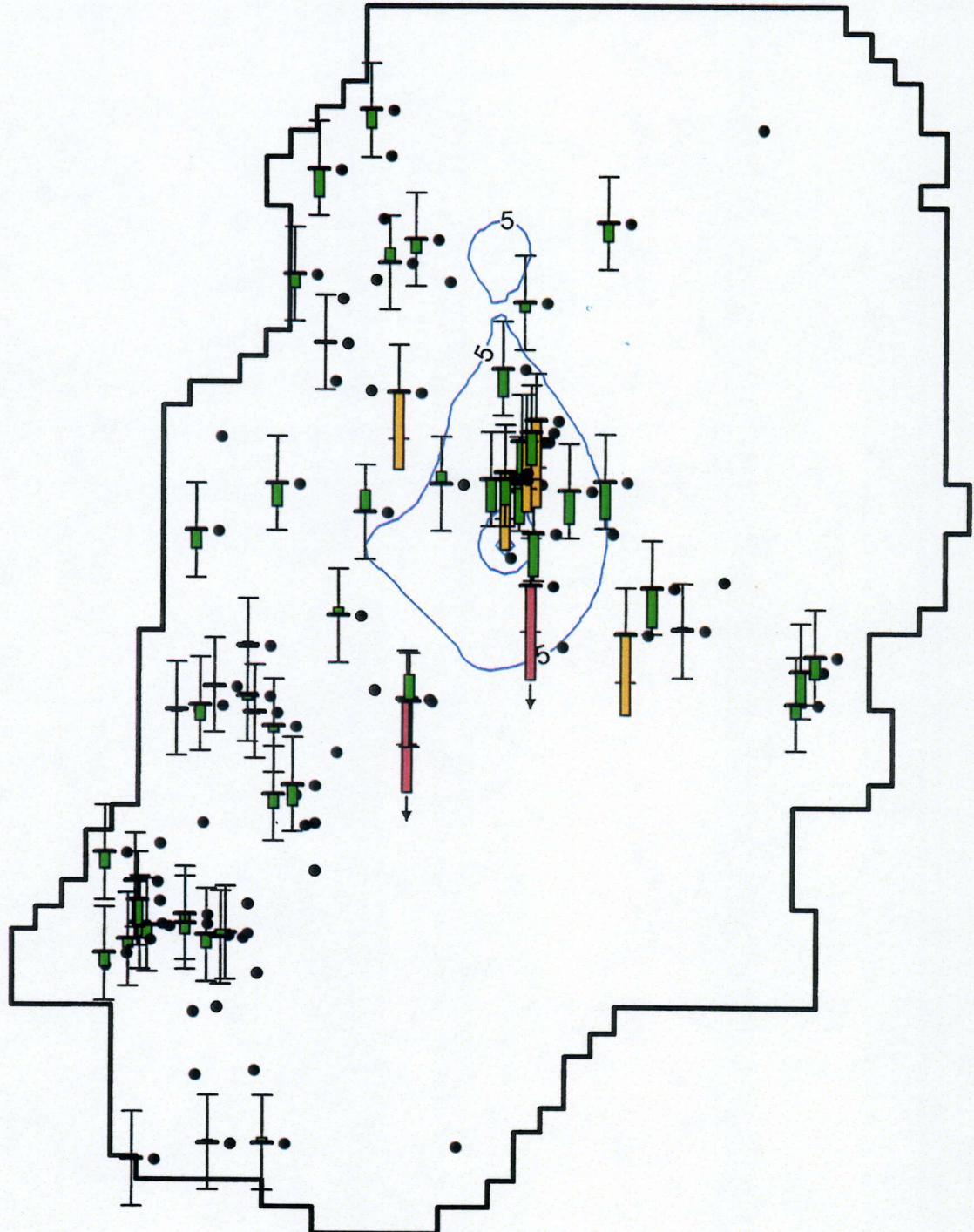


Figure 25. Transient observation well calibration of drawdown in layer 1 for January 1991. Green error bar indicates calculated drawdown within 10 feet of observed, yellow bars indicate fit within 20 feet, red bars indicate fit greater than 20 feet. Error bar above well point means calculated drawdown exceeds observed. Contour interval 5 feet.

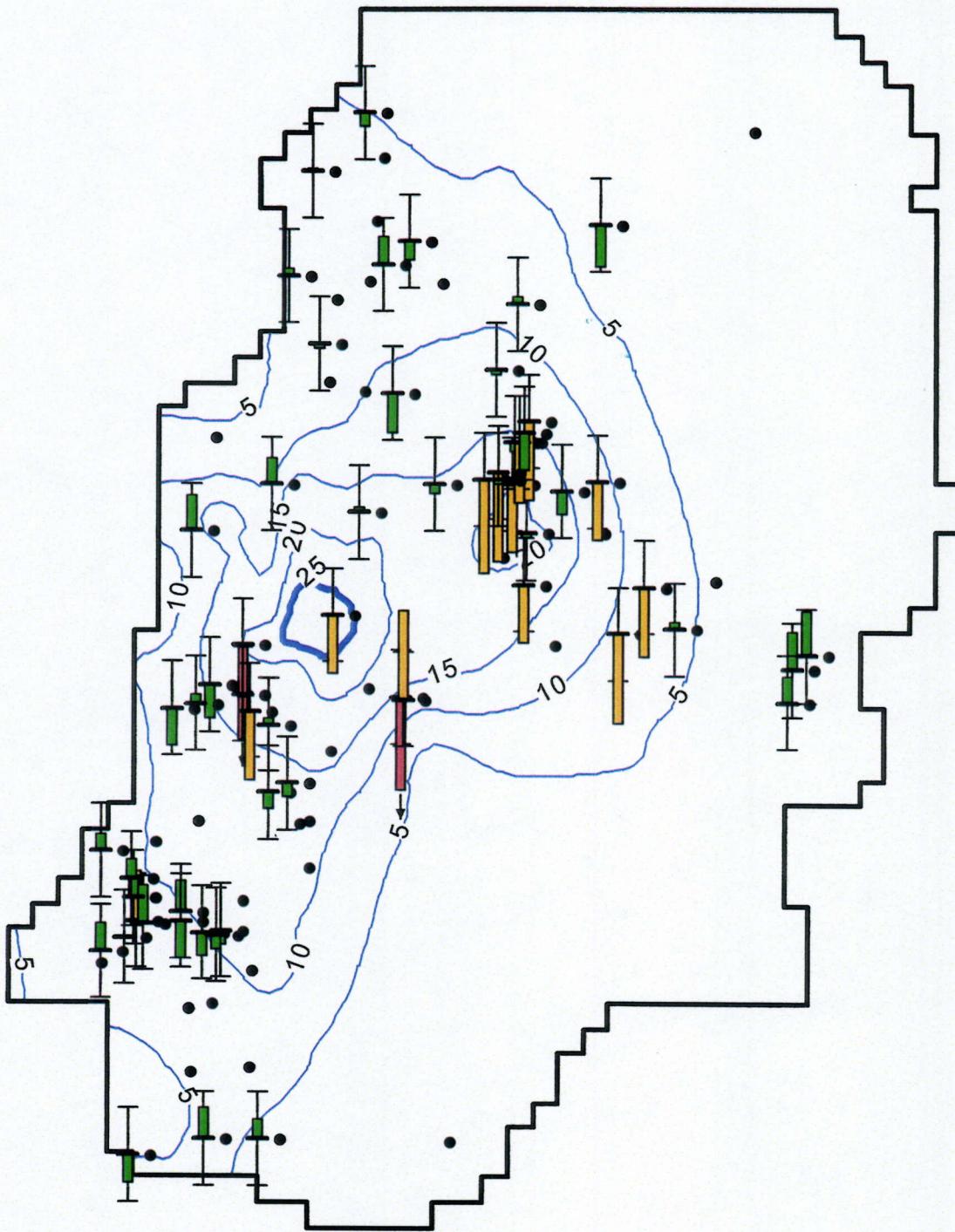


Figure 26. Transient observation well calibration of drawdown in layer 1 for January 2001. Green error bar indicates calculated drawdown within 10 feet of observed, yellow bars indicate fit within 20 feet, red bars indicate fit greater than 20 feet. Error bar above well point means calculated drawdown exceeds observed. Contour interval 5 feet.

Figure 27A. Transient model sensitivity to specific yield in layer 1. Error summary for January 1991

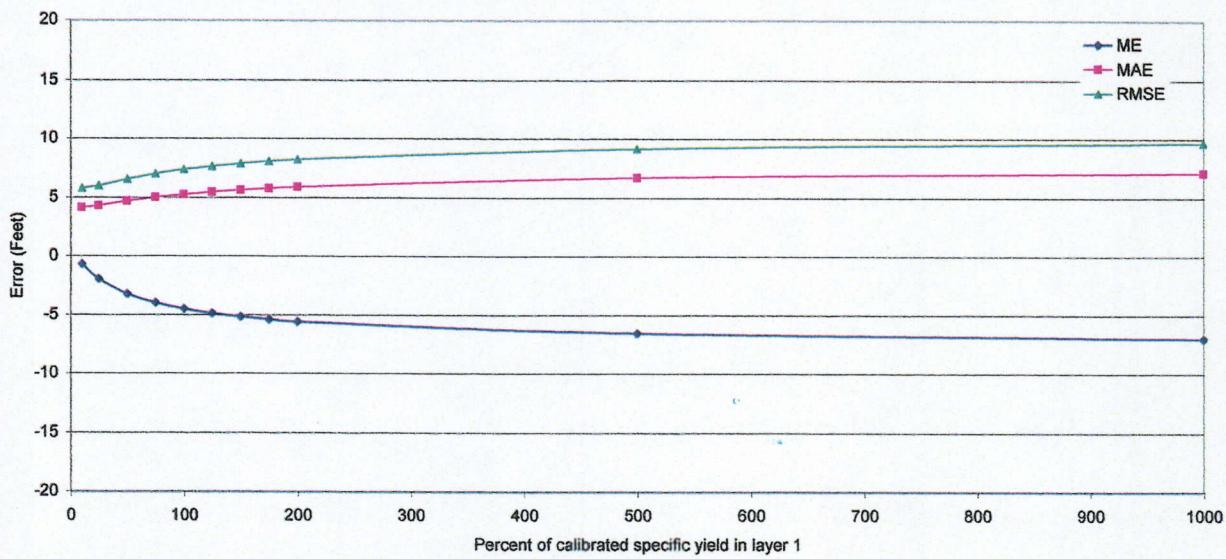


Figure 27B. Transient model sensitivity to specific yield in layer 1. Error summary for January 1996

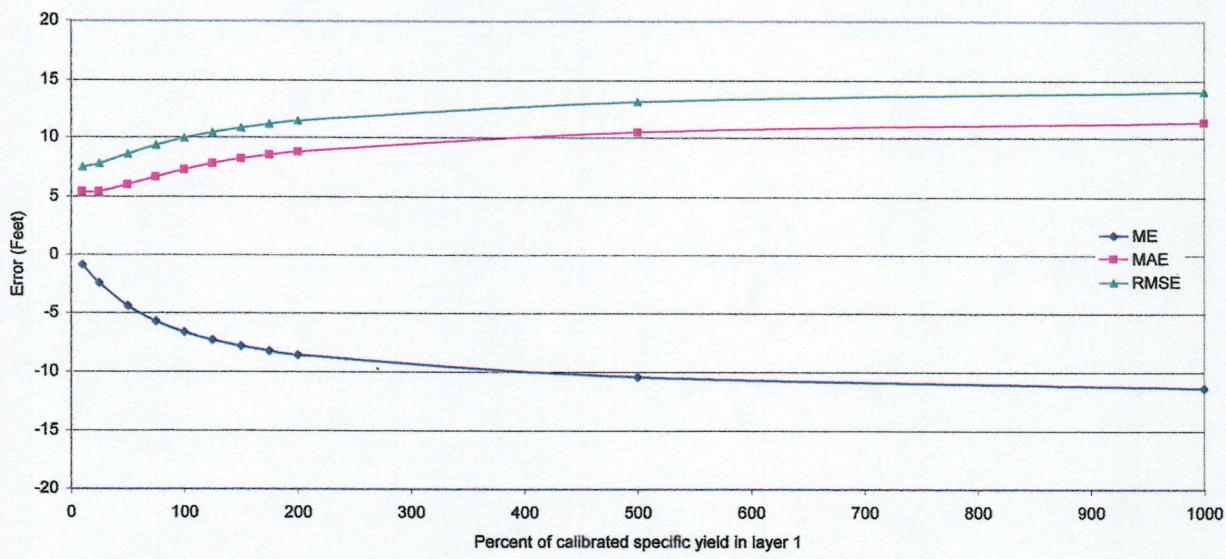


Figure 27C. Transient model sensitivity to specific yield in layer 1. Error summary for January 2001

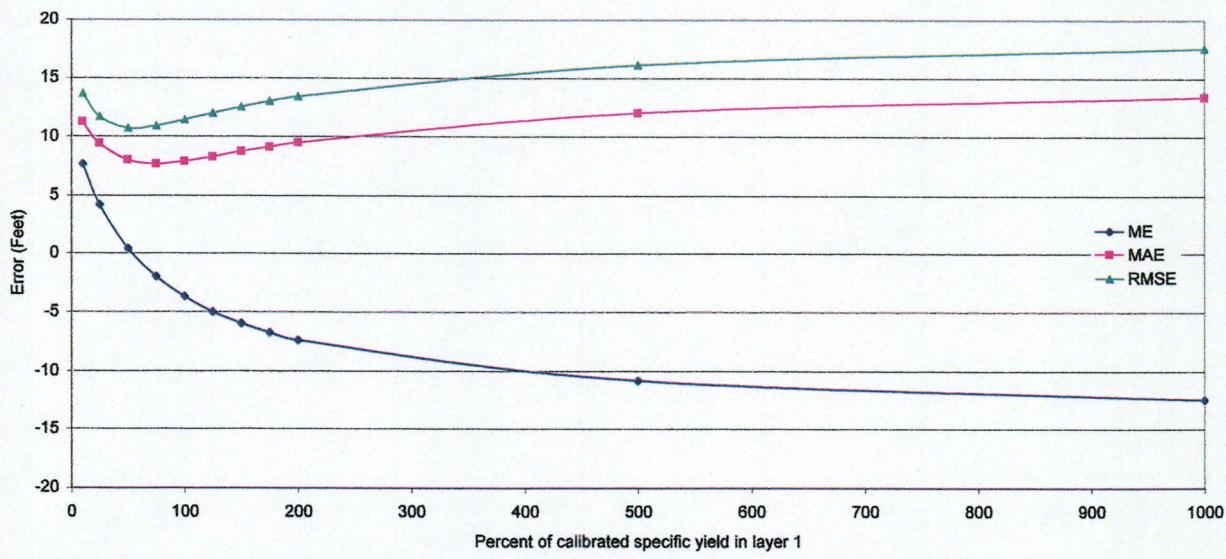


Figure 28A. Transient model sensitivity to vertical conductivity in layer 1. Error summary for January 1991

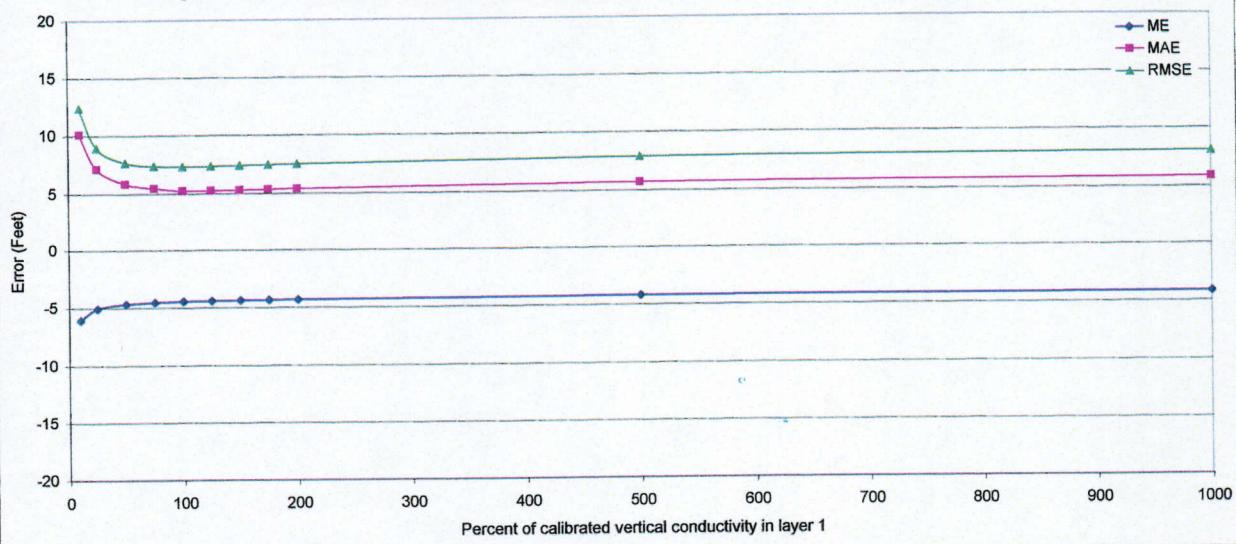


Figure 28B. Transient model sensitivity to vertical conductivity in layer 1. Error summary for January 1996

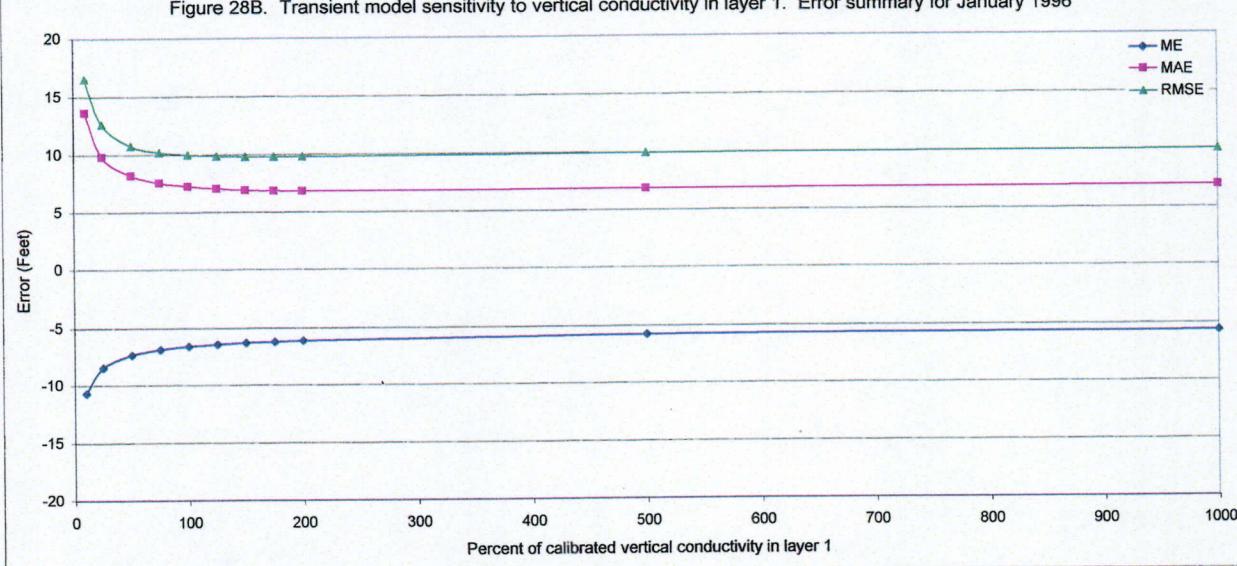


Figure 28C. Transient model sensitivity to vertical conductivity in layer 1. Error summary for January 2001

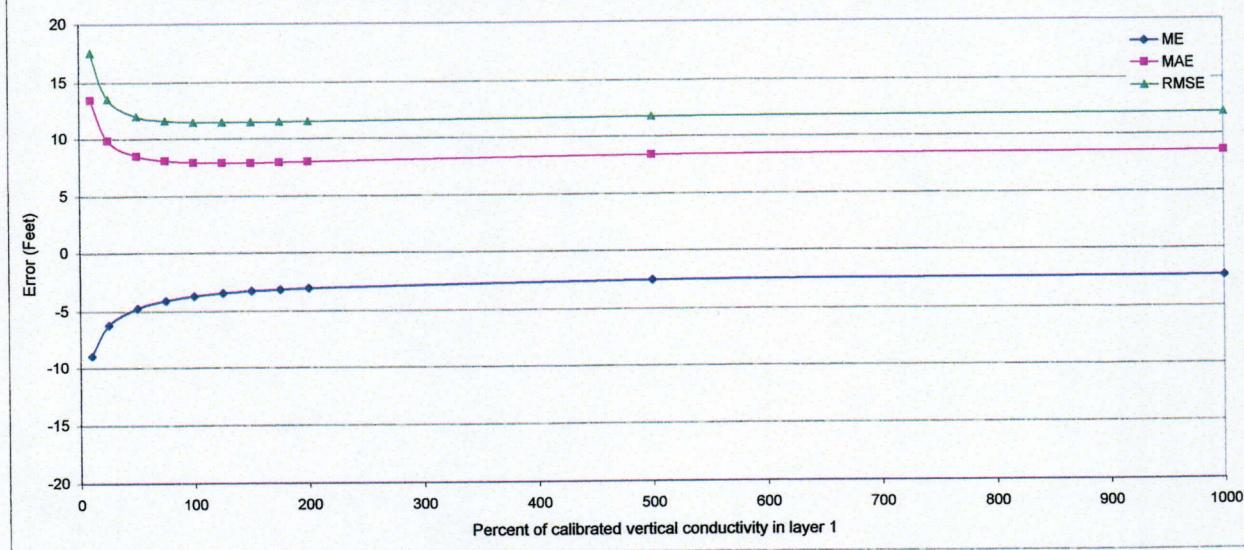


Figure 29A. Transient model sensitivity to vertical conductivity in layer 2. Error summary for January 1991

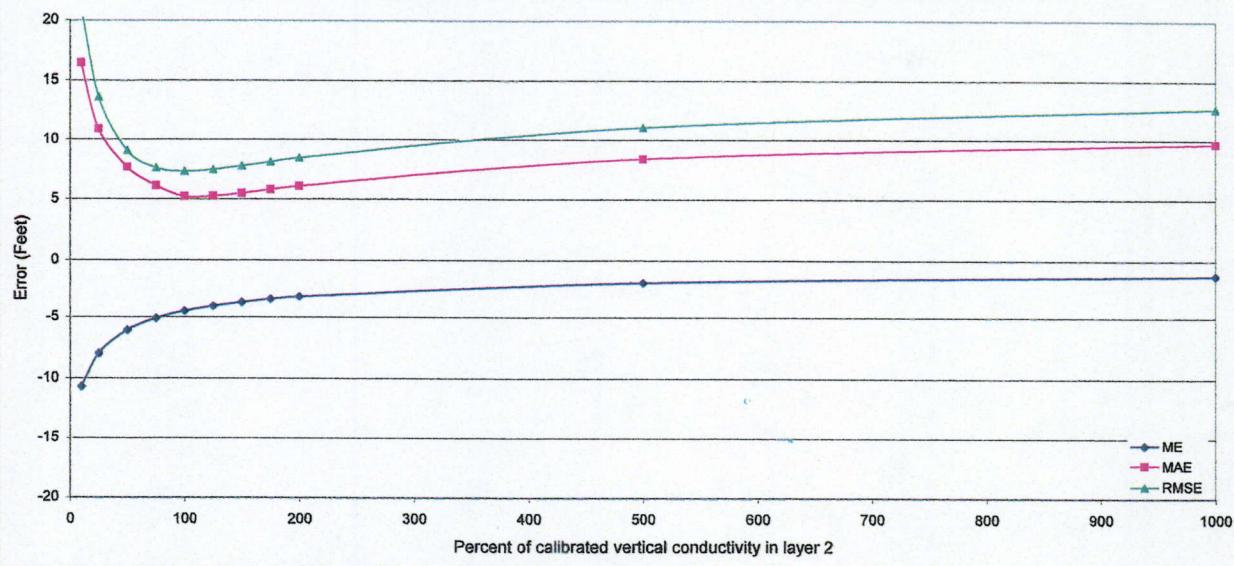


Figure 29B. Transient model sensitivity to vertical conductivity in layer 2. Error summary for January 1996

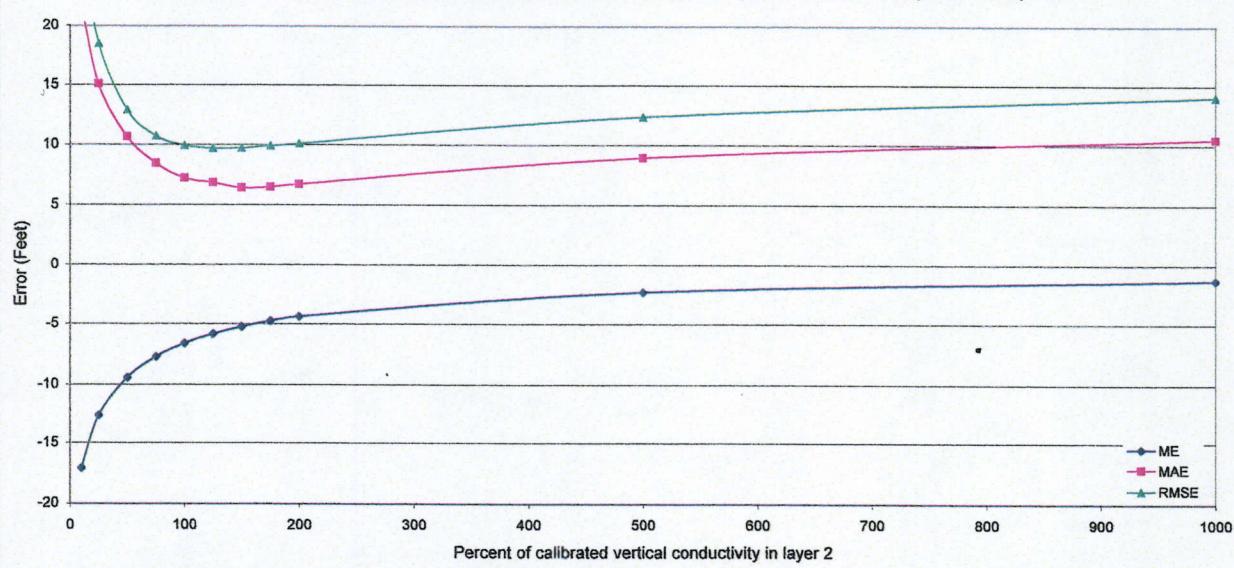
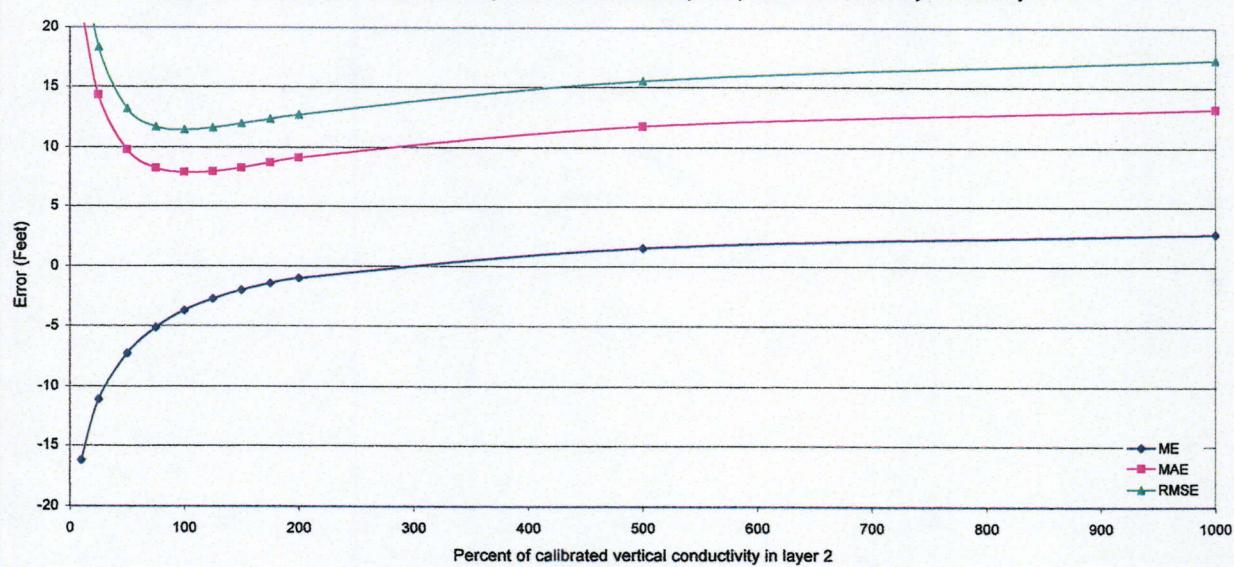


Figure 29C. Transient model sensitivity to vertical conductivity in layer 2. Error summary for January 2001



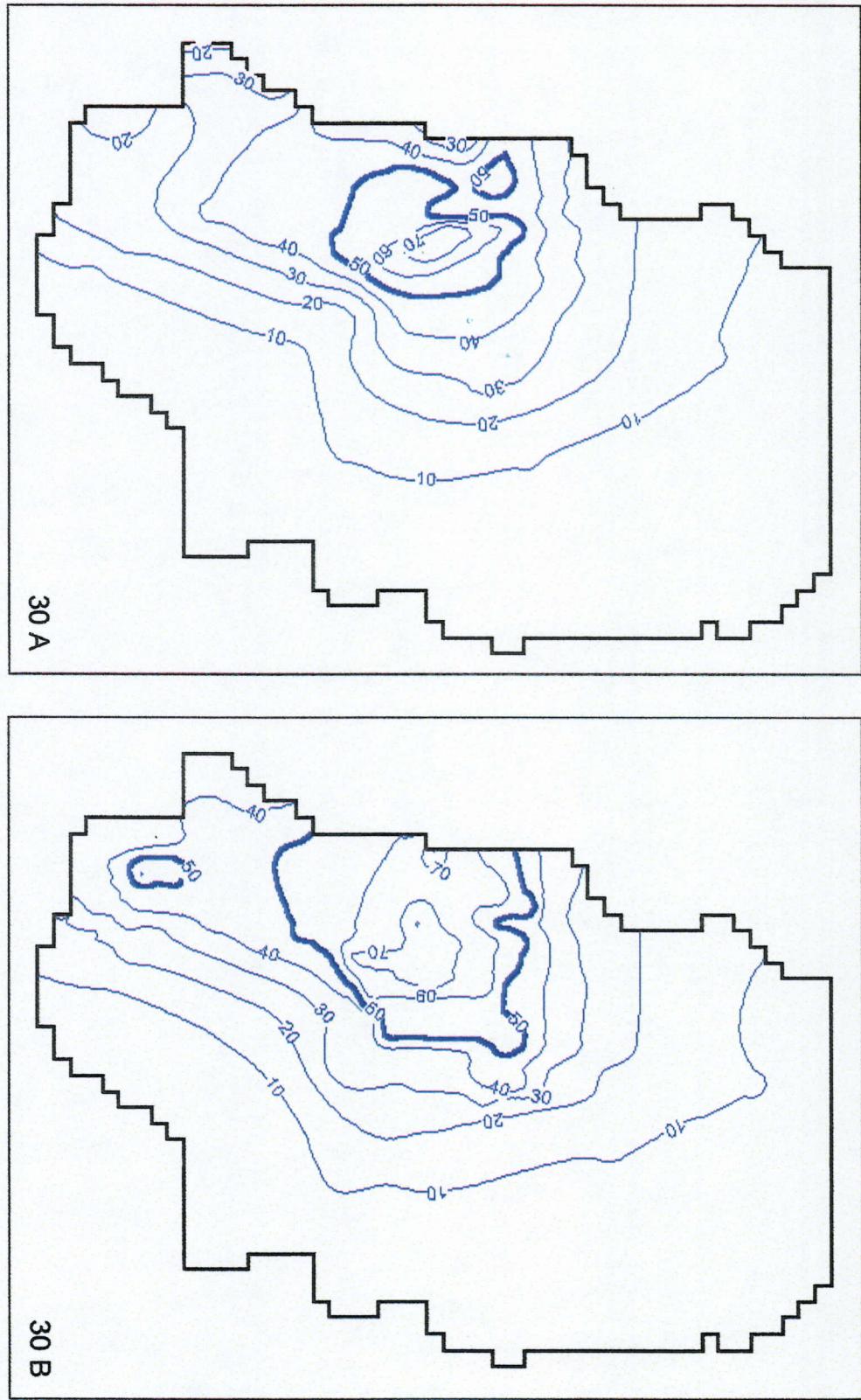


Figure 30. Predicted drawdown from 1985 to 2013 for layer 1 (fig. A) and layer 2 (fig. B). Contour interval 10 feet.

Figure 31. Predicted drawdown from 1985 to 2023 for layer 1 (fig. A) and layer 2 (fig. B). Contour interval 10 feet.

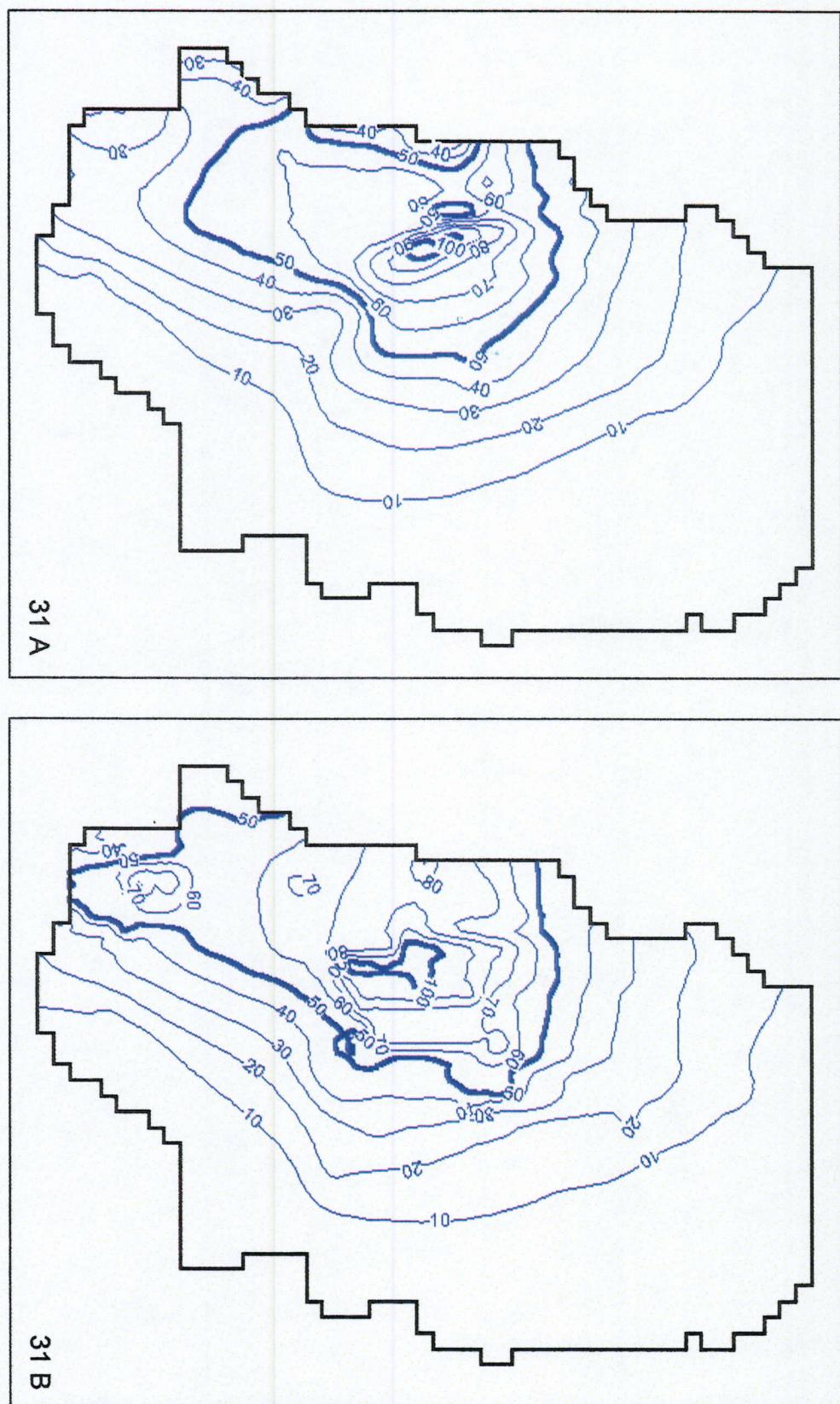


Figure 32. Predicted drawdown from 2003 to 2013 for layer 1 (fig. A) and layer 2 (fig. B). Contour interval 10 feet.

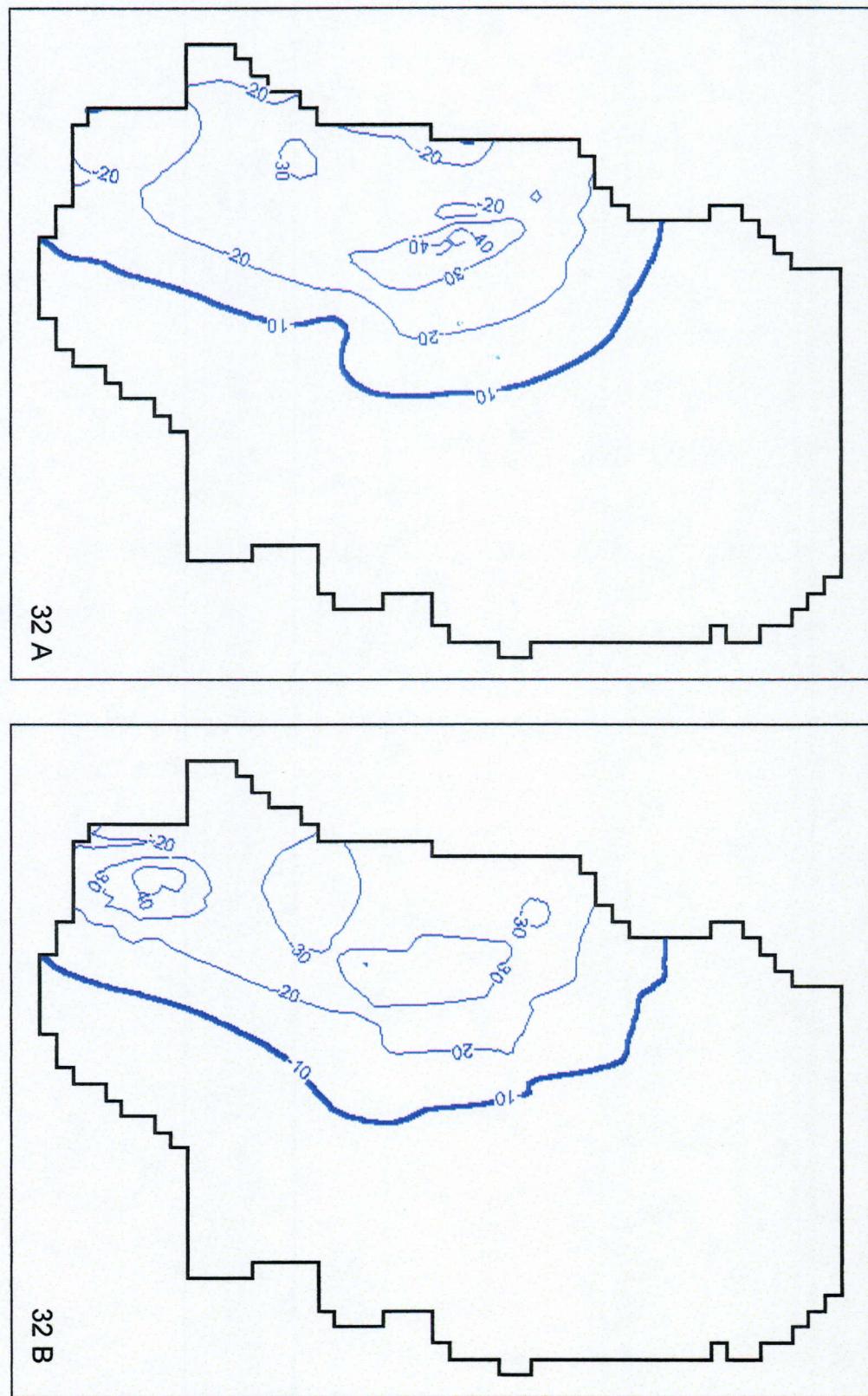
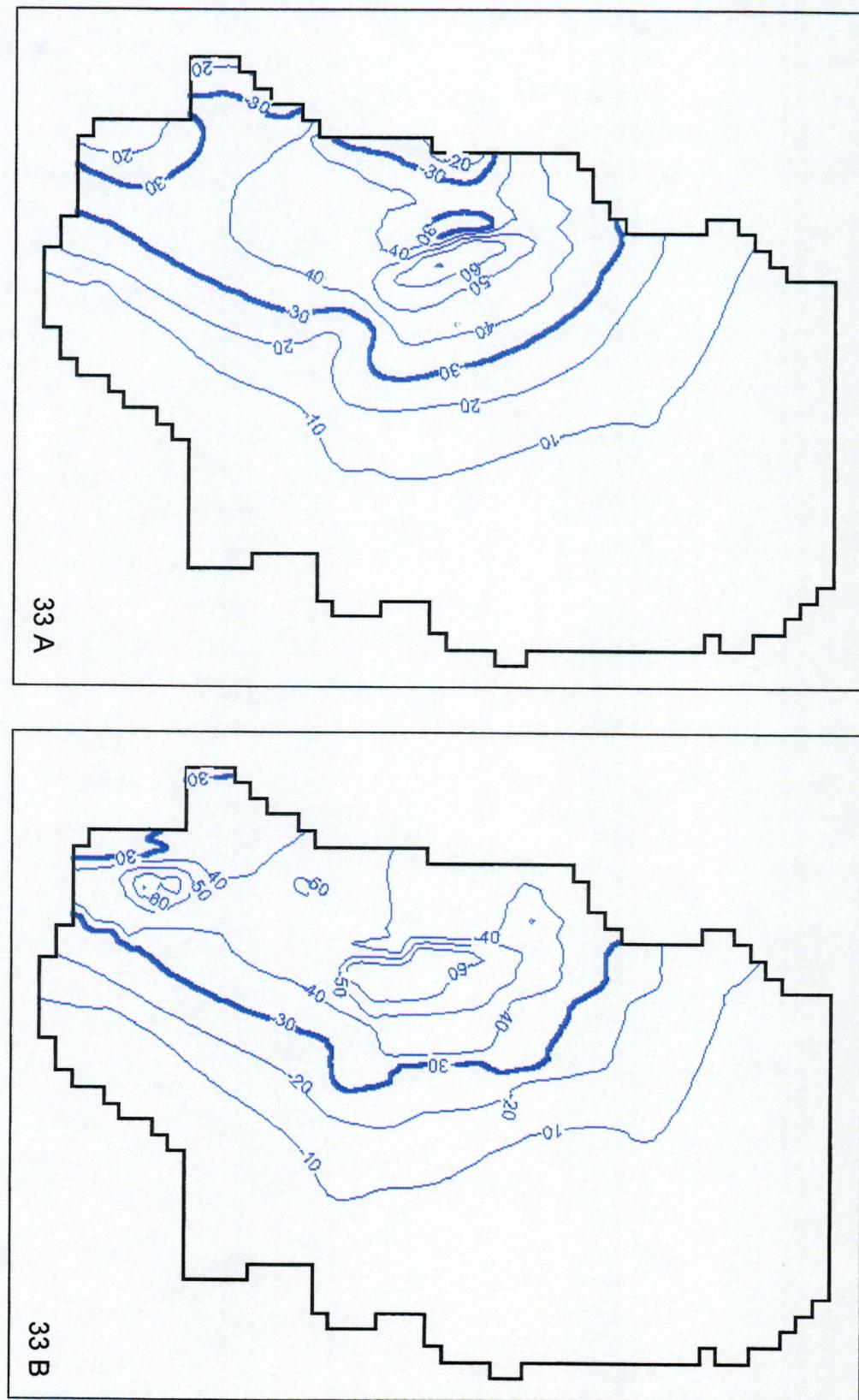


Figure 33. Predicted drawdown from 2003 to 2023 for layer 1 (fig. A) and layer 2 (fig. B). Contour interval 10 feet.



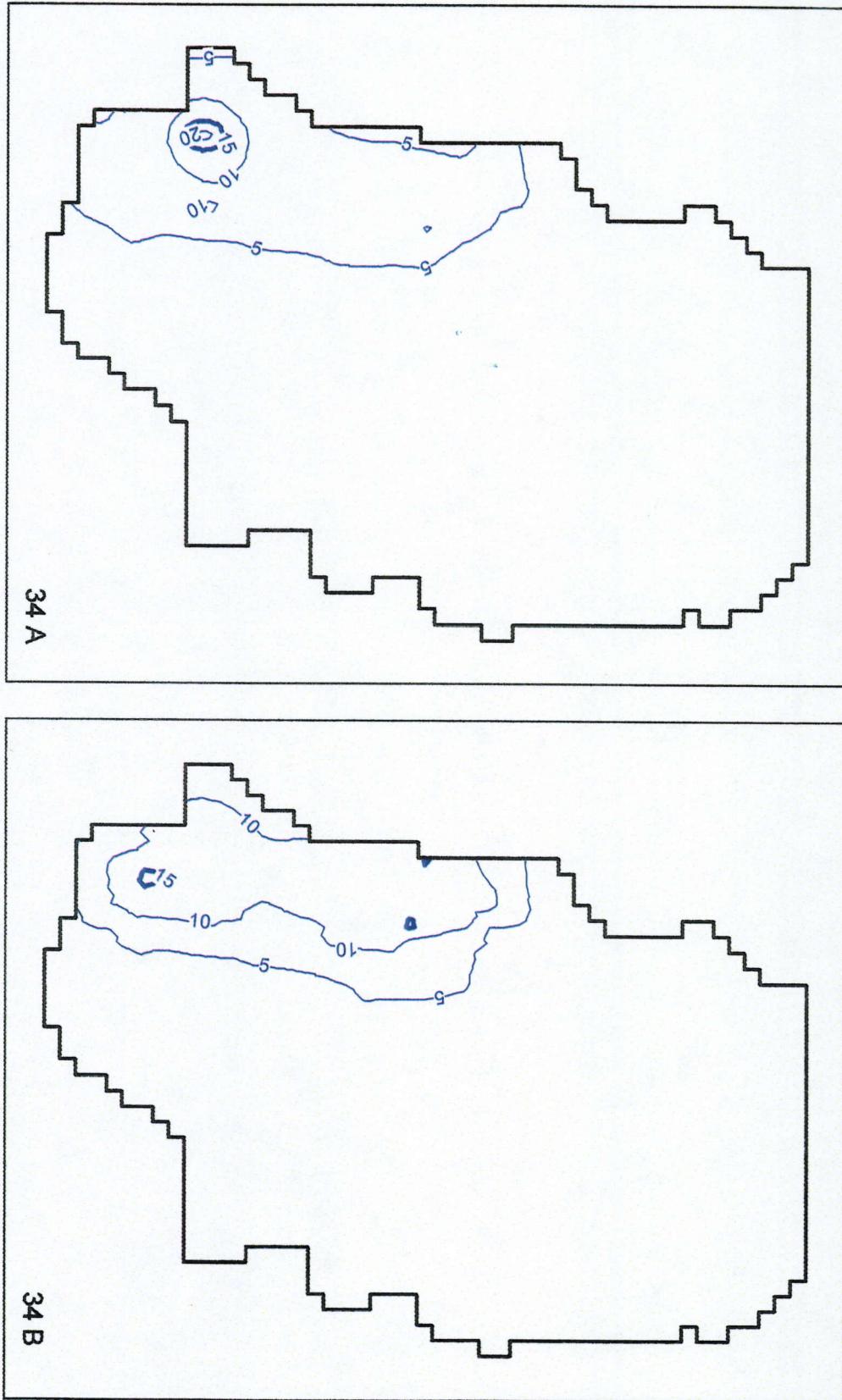


Figure 34. Aquifer injection impact for 2013 in layer 1 (fig. A) and layer 2 (fig. B). Contours represent reduction in drawdown in comparison to no-injection scenarios of Figure 26. Contour interval 5 feet.

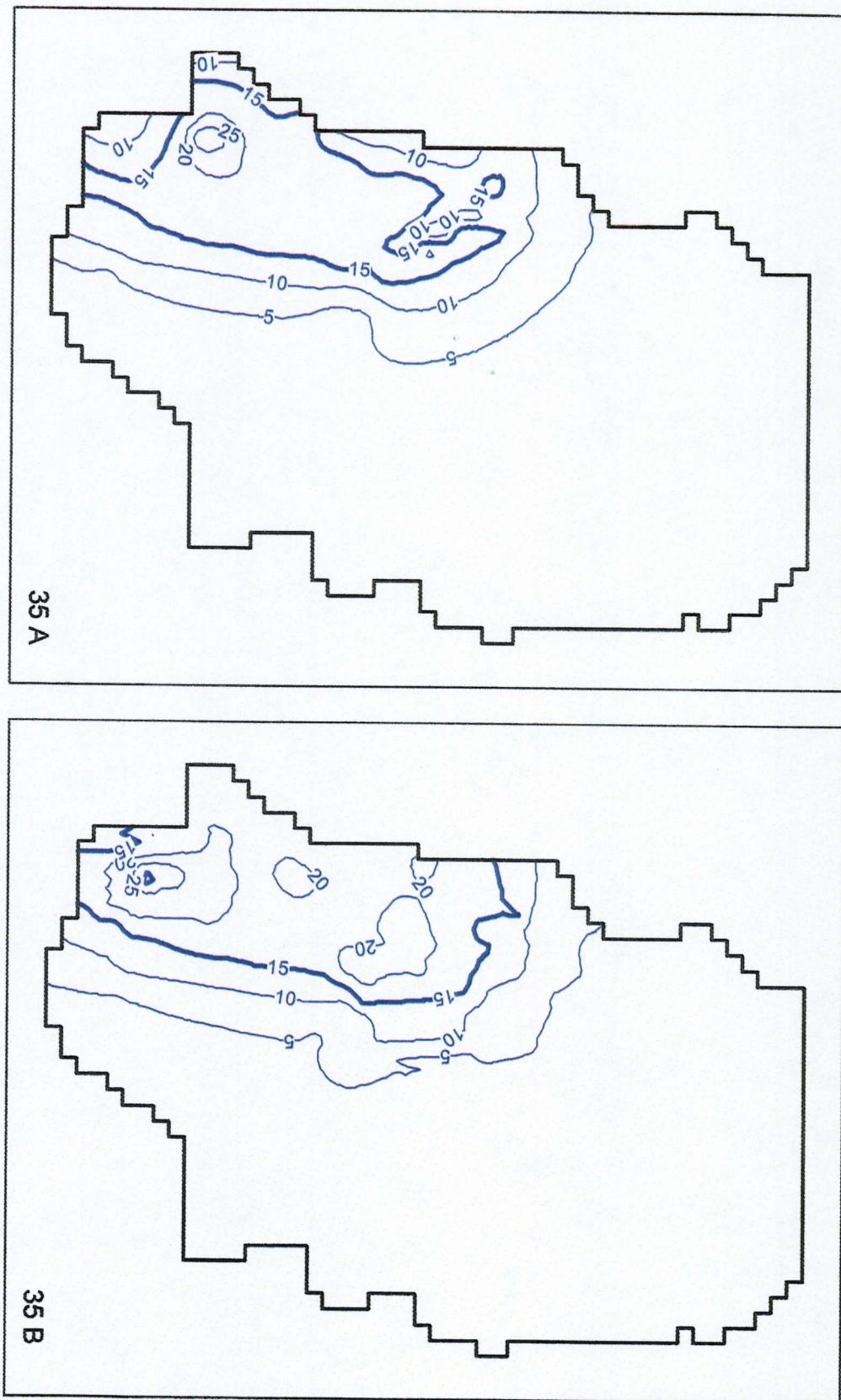


Figure 35. Aquifer injection impact for 2023 in layer 1 (fig. A) and layer 2 (fig. B). Contours represent reduction in drawdown in comparison to no-injection scenarios of Figure 27. Contour interval 5 feet.

APPENDIX

Model observation well drawdown file: drawdown.tof

name	date	time	drawdown
ACMW1(MW11)	4/3/1985	0:00:00	0
ACMW1(MW11)	3/13/1997	0:00:00	14.728
ACMW2	4/3/1985	0:00:00	0
ACMW2	1/11/1996	0:00:00	10.583
ACMW2	12/31/2000	0:00:00	15.5
ACMW4(MW9)	4/3/1985	0:00:00	0
ACMW4(MW9)	12/8/1993	0:00:00	4.365
ACMW4(MW9)	12/31/2000	0:00:00	4.665
ACMW5(MW12)	4/3/1985	0:00:00	0
ACMW5(MW12)	8/17/1992	0:00:00	0
ACMW5(MW12)	1/11/1996	0:00:00	0
ACMW5(MW12)	12/31/2000	0:00:00	0
Angotti	4/3/1985	0:00:00	0
Angotti	11/14/1990	0:00:00	12.87
Angotti	11/20/1992	0:00:00	18.84
Angotti	7/31/1997	0:00:00	18.59
Angotti	9/22/1998	0:00:00	18.67
Angotti	8/20/1999	0:00:00	19.97
Angotti	12/31/2000	0:00:00	22
Beckner	4/3/1985	0:00:00	0
Beckner	8/1/2000	0:00:00	13.68
Berry	4/3/1985	0:00:00	0
Berry	1/1/1992	0:00:00	0.7
Berry	12/31/2000	0:00:00	2.27
Blackburn	4/3/1985	0:00:00	0
Blackburn	9/1/1989	0:00:00	0.04
Blackburn	11/14/1990	0:00:00	3.9
Blackburn	9/27/1991	0:00:00	9.58
Blackburn	11/13/1992	0:00:00	14.57
Blackburn	8/1/1997	0:00:00	12.82
Blackburn	9/8/1998	0:00:00	12.96
Blackburn	12/31/2000	0:00:00	18
Brokaw	4/3/1985	0:00:00	0
Brokaw	11/15/1990	0:00:00	1.69
Brokaw	10/29/1991	0:00:00	4.29
Brokaw	11/17/1992	0:00:00	6.83
Brokaw	2/12/1996	0:00:00	15.33
Brokaw	3/7/1997	0:00:00	17.19
Brokaw	12/31/2000	0:00:00	24
Bush	4/3/1985	0:00:00	0
Bush	12/31/2000	0:00:00	16.57
Champelovier	4/3/1985	0:00:00	0
Champelovier	11/20/1989	0:00:00	0.55
Champelovier	11/16/1990	0:00:00	2.5
Champelovier	11/11/1991	0:00:00	4.69
Champelovier	11/16/1992	0:00:00	7.21
Champelovier	12/14/1993	0:00:00	8.84
Champelovier	10/27/1994	0:00:00	11.81
Champelovier	8/8/1995	0:00:00	12.7
Champelovier	12/30/1996	0:00:00	14.18
Champelovier	10/3/1997	0:00:00	14.87

Model observation well drawdown file: drawdown.tof

Champelovier	4/17/1998	0:00:00	14.4
Champelovier	8/19/1999	0:00:00	15.73
Champelovier	7/26/2000	0:00:00	32.05
DD2	4/3/1985	0:00:00	0
DD2	1/1/1991	0:00:00	5.9
DD2	12/31/2000	0:00:00	13
Dible	4/3/1985	0:00:00	0
Dible	11/13/1987	0:00:00	2.5
Dible	11/30/1988	0:00:00	7.08
Dible	11/20/1989	0:00:00	9.73
Dible	11/15/1990	0:00:00	13.35
Dible	10/30/1991	0:00:00	18.55
Dible	11/20/1992	0:00:00	20.64
Dible	12/17/1993	0:00:00	23.4
Dible	7/31/1997	0:00:00	23.56
Dible	9/22/1998	0:00:00	25.26
Dible	8/19/1999	0:00:00	22.09
Dible	12/31/2000	0:00:00	19.81
Dolan	4/3/1985	0:00:00	0
Dolan	12/31/1991	0:00:00	6
Dolan	12/31/2000	0:00:00	7.28
Dundas	4/3/1985	0:00:00	0
Dundas	11/19/1991	0:00:00	1.36
Dundas	5/26/1993	0:00:00	6.28
Espinosa	4/3/1985	0:00:00	0
Espinosa	12/22/1986	0:00:00	9.03
Espinosa	11/13/1987	0:00:00	14.22
Espinosa	1/7/1988	0:00:00	13.71
Espinosa	11/30/1988	0:00:00	18.07
Espinosa	11/20/1989	0:00:00	20.3
Espinosa	11/15/1990	0:00:00	24.42
Espinosa	10/30/1991	0:00:00	29.23
Espinosa	11/20/1992	0:00:00	31.8
Espinosa	9/22/1998	0:00:00	33.27
Espinosa	8/20/1999	0:00:00	34.06
Espinosa	4/11/2000	0:00:00	34.8
Espinosa	12/31/2000	0:00:00	37
Evart	4/3/1985	0:00:00	0
Evart	12/31/1991	0:00:00	2.25
Evart	12/31/2000	0:00:00	9.04
Frohlick	4/3/1985	0:00:00	0
Frohlick	11/20/1989	0:00:00	2.04
Frohlick	11/14/1990	0:00:00	5.83
Frohlick	9/27/1991	0:00:00	13.17
Frohlick	11/13/1992	0:00:00	14.98
Frohlick	8/1/1997	0:00:00	6.96
Frohlick	12/31/2000	0:00:00	5.64
Furchner	4/3/1985	0:00:00	0
Furchner	12/31/1991	0:00:00	5.57
Galantowicz	4/3/1985	0:00:00	0
Galantowicz	12/20/1996	0:00:00	9.03
Galantowicz	12/31/2000	0:00:00	5.72

Model observation well drawdown file: drawdown.tof

Gledhill	4/3/1985	0:00:00	0
Gledhill	9/27/1991	0:00:00	1.6
Gledhill	11/13/1992	0:00:00	9.67
Gledhill	12/14/1993	0:00:00	8.07
Gledhill	10/25/1994	0:00:00	12.72
Gledhill	8/2/1995	0:00:00	11.8
Gledhill	11/20/1996	0:00:00	11.29
Gledhill	8/1/1997	0:00:00	13.26
Gledhill	9/8/1998	0:00:00	5.8
Gledhill	8/18/1999	0:00:00	6.19
Gledhill	12/31/2000	0:00:00	13.96
Hallstrom	4/3/1985	0:00:00	0
Hallstrom	9/27/1991	0:00:00	2.98
Hallstrom	11/13/1992	0:00:00	8.23
Hallstrom	8/1/1997	0:00:00	7.41
Hallstrom	9/8/1998	0:00:00	7.38
Hallstrom	8/18/1999	0:00:00	6.5
Hallstrom	12/31/2000	0:00:00	13.98
Halvorson	4/3/1985	0:00:00	0
Halvorson	12/31/1991	0:00:00	8.71
Halvorson	12/31/2000	0:00:00	5.3
Hayes	4/3/1985	0:00:00	0
Hayes	12/31/1991	0:00:00	7.64
Hayes	12/31/2000	0:00:00	11.7
HerzDomestic	4/3/1985	0:00:00	0
HerzDomestic	12/31/1987	0:00:00	7.81
HerzDomestic	12/31/2000	0:00:00	22
HerzGeo	4/3/1985	0:00:00	0
HerzGeo	12/31/1987	0:00:00	-0.19
HerzGeo	12/31/1992	0:00:00	1.92
HerzGeo	12/31/1994	0:00:00	3.37
HerzGeo	12/31/2000	0:00:00	3.37
Heyer	4/3/1985	0:00:00	0
Heyer	12/31/1991	0:00:00	13.74
Heyer	12/31/2000	0:00:00	22
Hinton	4/3/1985	0:00:00	0
Hinton	11/30/1988	0:00:00	18.5
Hinton	11/20/1989	0:00:00	18.37
Hinton	11/14/1990	0:00:00	21.11
Hinton	10/30/1991	0:00:00	24.8
Hinton	7/31/1997	0:00:00	25.86
Hinton	9/22/1998	0:00:00	25.16
Hinton	8/20/1999	0:00:00	26.97
Hinton	4/4/2000	0:00:00	22.55
Hinton	12/31/2000	0:00:00	27.77
Homann	4/3/1985	0:00:00	0
Homann	12/31/1991	0:00:00	10.29
Homann	12/31/2000	0:00:00	10
Jenson	4/3/1985	0:00:00	0
Jenson	11/10/1987	0:00:00	15.39
Jenson	12/31/1987	0:00:00	14.42
Jenson	11/30/1988	0:00:00	21.65

Model observation well drawdown file: drawdown.tof

Jenson	11/20/1989	0:00:00	21.01
Jenson	12/17/1990	0:00:00	23.95
Jenson	10/30/1991	0:00:00	26.5
Jenson	11/20/1992	0:00:00	29.65
Jenson	7/31/1997	0:00:00	28.74
Jenson	9/22/1998	0:00:00	31.77
Jenson	8/20/1999	0:00:00	27.7
Jenson	12/31/2000	0:00:00	29.54
Kitchen	4/3/1985	0:00:00	0
Kitchen	11/20/1989	0:00:00	0.46
Kitchen	11/15/1990	0:00:00	1.19
Kitchen	11/6/1991	0:00:00	3.59
Kitchen	11/17/1992	0:00:00	6.1
Kitchen	12/14/1993	0:00:00	8.08
Kitchen	10/27/1994	0:00:00	10.52
Kitchen	2/12/1996	0:00:00	13.75
Kitchen	12/31/2000	0:00:00	21
Maitoza	4/3/1985	0:00:00	0
Maitoza	11/22/1986	0:00:00	1.72
Maitoza	11/10/1987	0:00:00	5.89
Maitoza	1/7/1988	0:00:00	5.87
Maitoza	11/30/1988	0:00:00	9.94
Maitoza	11/20/1989	0:00:00	11.07
Maitoza	11/15/1990	0:00:00	13.85
Maitoza	3/29/1991	0:00:00	13.86
Maitoza	7/31/1997	0:00:00	20.17
Maitoza	9/22/1998	0:00:00	21.15
Maitoza	8/20/1999	0:00:00	20.58
Maitoza	12/31/2000	0:00:00	16.81
Marlia	4/3/1985	0:00:00	0
Marlia	11/13/1987	0:00:00	2.03
Marlia	11/30/1988	0:00:00	7.78
Marlia	11/20/1989	0:00:00	7.85
Marlia	11/15/1990	0:00:00	12.63
Marlia	11/6/1991	0:00:00	13.54
Marlia	2/24/1992	0:00:00	18.4
Marlia	12/17/1993	0:00:00	13.22
Marlia	4/27/1994	0:00:00	14.93
Marlia	12/31/2000	0:00:00	18
Marshall	4/3/1985	0:00:00	0
Marshall	11/13/1992	0:00:00	5.74
Marshall	12/15/1993	0:00:00	7.66
Marshall	8/1/1997	0:00:00	4.81
Marshall	9/8/1998	0:00:00	5.44
Marshall	8/18/1999	0:00:00	10
Marshall	5/24/2000	0:00:00	3.87
Mayville	4/3/1985	0:00:00	0
Mayville	12/31/1991	0:00:00	0
Mayville	12/31/2000	0:00:00	15.43
Melarkey(govt)	4/3/1985	0:00:00	0
Melarkey(govt)	11/20/1989	0:00:00	0.4
Melarkey(govt)	11/15/1990	0:00:00	2.78

Model observation well drawdown file: drawdown.tof

Melarkey(govt)	10/29/1991	0:00:00	5.43
Melarkey(govt)	11/16/1992	0:00:00	10.66
Melarkey(govt)	12/14/1993	0:00:00	8.85
Melarkey(govt)	10/27/1994	0:00:00	13.08
Melarkey(govt)	8/7/1995	0:00:00	13.17
Melarkey(govt)	12/30/1996	0:00:00	13.93
Melarkey(govt)	10/3/1997	0:00:00	16.38
Melarkey(govt)	9/15/1998	0:00:00	16.51
Melarkey(govt)	8/27/1999	0:00:00	16.92
Melarkey(govt)	12/31/2000	0:00:00	18
MRSAMW1	4/3/1985	0:00:00	0
MRSAMW1	12/4/1991	0:00:00	3.87
MRSAMW1	11/13/1992	0:00:00	9.18
MRSAMW1	12/14/1993	0:00:00	11.54
MRSAMW1	3/3/1997	0:00:00	9.44
MtRose5(Cinder)	4/3/1985	0:00:00	0
MtRose5(Cinder)	9/14/1995	0:00:00	6.68
MtRose5(Cinder)	4/24/1996	0:00:00	7.11
MtRose5(Cinder)	12/31/2000	0:00:00	9.15
Northon	4/3/1985	0:00:00	0
Northon	11/19/1992	0:00:00	6.22
Northon	12/14/1993	0:00:00	6.9
Northon	11/22/1996	0:00:00	5.44
Northon	8/1/1997	0:00:00	7.92
Northon	9/8/1998	0:00:00	-0.31
Northon	12/31/2000	0:00:00	1.57
Olsen	4/3/1985	0:00:00	0
Olsen	11/20/1989	0:00:00	0
Olsen	11/14/1990	0:00:00	3.79
Olsen	9/27/1991	0:00:00	8.31
Olsen	9/8/1998	0:00:00	5.32
Olsen	8/18/1999	0:00:00	2.91
Olsen	5/23/2000	0:00:00	-1.02
Olsen	12/31/2000	0:00:00	0
OttenWycoff	4/3/1985	0:00:00	0
OttenWycoff	11/16/1992	0:00:00	-4.34
OttenWycoff	12/13/1993	0:00:00	-1.25
OttenWycoff	4/25/1994	0:00:00	-0.01
OttenWycoff	3/3/1997	0:00:00	5.1
OttenWycoff	4/14/1998	0:00:00	1.66
OttenWycoff	8/18/1999	0:00:00	-6.03
OttenWycoff	8/4/2000	0:00:00	-7.6
Pepple	4/3/1985	0:00:00	0
Pepple	11/13/1987	0:00:00	5.82
Pepple	11/30/1988	0:00:00	10.27
Pepple	11/20/1989	0:00:00	10.58
Pepple	11/15/1990	0:00:00	12.98
Pepple	10/30/1991	0:00:00	32
Pepple	11/20/1992	0:00:00	20.12
Pepple	12/17/1993	0:00:00	22.1
Pepple	3/14/1997	0:00:00	24.6
Pepple	9/22/1998	0:00:00	33.74

Model observation well drawdown file: drawdown.tof

Pepple	8/19/1999	0:00:00	38.27
Pepple	12/31/2000	0:00:00	38.47
PicolloMW	4/3/1985	0:00:00	0
PicolloMW	4/29/1991	0:00:00	12.23
PicolloMW	9/15/1992	0:00:00	15.22
PicolloMW	12/22/1993	0:00:00	11.11
PicolloMW	5/5/1994	0:00:00	13.44
PicolloMW	8/14/1995	0:00:00	12.63
PicolloMW	5/16/1996	0:00:00	9.88
PicolloMW	8/7/1997	0:00:00	7.33
PicolloMW	9/29/1998	0:00:00	6.27
PicolloMW	9/3/1999	0:00:00	10.42
PicolloMW	5/25/2000	0:00:00	10.87
PicolloMW	12/31/2000	0:00:00	12.5
PTR-2	4/3/1985	0:00:00	0
PTR-2	12/31/1987	0:00:00	9.69
PTR-2	12/31/1992	0:00:00	26.19
PTR-2	12/31/1994	0:00:00	30.34
PTR-2	12/31/1996	0:00:00	28.49
PTR-2	12/31/1998	0:00:00	22.57
PTR-2	12/31/2000	0:00:00	27
Ramsey	4/3/1985	0:00:00	0
Ramsey	12/31/1991	0:00:00	24
Ramsey	12/31/2000	0:00:00	20.05
Ronkos	4/3/1985	0:00:00	0
Ronkos	11/16/1990	0:00:00	3.68
Ronkos	10/29/1991	0:00:00	4.26
Ronkos	11/16/1992	0:00:00	7.06
Ronkos	12/14/1993	0:00:00	8.83
Ronkos	10/27/1994	0:00:00	11.55
Ronkos	8/7/1995	0:00:00	12.07
Ronkos	12/30/1996	0:00:00	13.57
Ronkos	10/3/1997	0:00:00	13.24
Ronkos	9/15/1998	0:00:00	13.4
Ronkos	8/19/1999	0:00:00	14.27
Ronkos	12/31/2000	0:00:00	14.93
SJMW1	4/3/1985	0:00:00	0
SJMW1	5/10/1994	0:00:00	0
SJMW1	8/7/1995	0:00:00	-0.29
SJMW1	9/20/1996	0:00:00	-0.3
SJMW1	3/6/1997	0:00:00	-1.34
SJMW1	9/15/1998	0:00:00	-0.2
SJMW1	8/19/1999	0:00:00	0.09
SJMW1	12/31/2000	0:00:00	0.41
SJMW2	4/3/1985	0:00:00	0
SJMW2	5/10/1994	0:00:00	0
SJMW2	8/7/1995	0:00:00	1.17
SJMW2	9/20/1996	0:00:00	1.32
SJMW2	3/6/1997	0:00:00	0.62
SJMW2	9/15/1998	0:00:00	-0.16
SJMW2	8/19/1999	0:00:00	-0.85
SJMW2	12/31/2000	0:00:00	-0.15

Model observation well drawdown file: drawdown.tof

SJMW3	4/3/1985	0:00:00	0
SJMW3	5/10/1994	0:00:00	0.28
SJMW3	8/7/1995	0:00:00	1.32
SJMW3	9/20/1996	0:00:00	9.67
SJMW3	3/6/1997	0:00:00	8.37
SJMW3	8/19/1999	0:00:00	15.74
SJMW3	5/18/2000	0:00:00	12.33
SJMW3	12/31/2000	0:00:00	14
Steinhardt	4/3/1985	0:00:00	0
Steinhardt	12/31/1987	0:00:00	3.72
Steinhardt	12/31/1992	0:00:00	3.72
Steinhardt	12/31/1994	0:00:00	3.82
Steinhardt	12/31/1996	0:00:00	-3.24
STMGID1MW	4/3/1985	0:00:00	0
STMGID1MW	11/13/1987	0:00:00	9.5
STMGID1MW	5/2/1988	0:00:00	14.93
STMGID1MW	11/28/1988	0:00:00	18.24
STMGID1MW	11/20/1989	0:00:00	17.08
STMGID1MW	11/15/1990	0:00:00	22.14
STMGID1MW	11/12/1991	0:00:00	25.65
STMGID1MW	11/20/1992	0:00:00	28.84
STMGID1MW	12/15/1993	0:00:00	29.81
STMGID1MW	2/28/1995	0:00:00	30.02
STMGID1MW	3/24/1998	0:00:00	42.77
STMGID2	4/3/1985	0:00:00	0
STMGID2	12/3/1985	0:00:00	1.18
STMGID2	12/22/1986	0:00:00	2.76
STMGID2	11/13/1987	0:00:00	7.56
STMGID2	11/30/1988	0:00:00	12.99
STMGID2	11/20/1989	0:00:00	15
STMGID2	12/20/1990	0:00:00	17.73
STMGID2	11/5/1991	0:00:00	21
STMGID2	11/20/1992	0:00:00	23.51
STMGID2	12/15/1993	0:00:00	23.34
STMGID2	4/26/1994	0:00:00	25.41
STMGID2	8/17/1995	0:00:00	31.55
STMGID2	5/17/1996	0:00:00	24.75
STMGID2	3/10/1997	0:00:00	13.37
STMGID2	9/22/1998	0:00:00	26.19
STMGID2	11/21/2000	0:00:00	24.92
STMGID4	4/3/1985	0:00:00	0
STMGID4	12/31/2000	0:00:00	75
STMGID5MW	4/3/1985	0:00:00	0
STMGID5MW	11/20/1989	0:00:00	0.21
STMGID5MW	11/20/1990	0:00:00	5.95
STMGID5MW	11/5/1991	0:00:00	6.3
STMGID5MW	11/16/1992	0:00:00	9.11
STMGID5MW	12/13/1993	0:00:00	8.86
STMGID5MW	4/26/1994	0:00:00	8.59
STMGID5MW	8/7/1995	0:00:00	16.36
STMGID5MW	5/20/1996	0:00:00	16.07
STMGID5MW	3/13/1997	0:00:00	18.82

Model observation well drawdown file: drawdown.tof

STMGID5MW	9/21/1998	0:00:00	19.67
STMGID5MW	12/17/1999	0:00:00	32.34
STMGID5MW	12/31/2000	0:00:00	45.76
STMGID6MW	4/3/1985	0:00:00	0
STMGID6MW	10/25/1988	0:00:00	0.2
STMGID6MW	11/20/1989	0:00:00	0.05
STMGID6MW	11/20/1990	0:00:00	3
STMGID6MW	11/5/1991	0:00:00	11.33
STMGID6MW	11/16/1992	0:00:00	7.38
STMGID6MW	12/13/1993	0:00:00	11.02
STMGID6MW	4/26/1994	0:00:00	12
STMGID6MW	8/7/1995	0:00:00	41.16
STMGID6MW	5/20/1996	0:00:00	35.72
STMGID6MW	3/13/1997	0:00:00	15.16
STMGID6MW	9/21/1998	0:00:00	44.97
STMGID6MW	9/3/1999	0:00:00	63.98
STMGID6MW	12/31/2000	0:00:00	64.12
STMGIDMW1	4/3/1985	0:00:00	0
STMGIDMW1	12/3/1985	0:00:00	1.33
STMGIDMW1	7/9/1986	0:00:00	-1
STMGIDMW1	11/30/1988	0:00:00	-1.74
STMGIDMW1	11/20/1989	0:00:00	1.25
STMGIDMW1	12/20/1990	0:00:00	-0.85
STMGIDMW1	11/6/1991	0:00:00	23.16
STMGIDMW1	11/20/1992	0:00:00	10.39
STMGIDMW1	12/15/1993	0:00:00	6.1
STMGIDMW1	4/27/1994	0:00:00	4.86
STMGIDMW1	2/28/1995	0:00:00	8.01
STMGIDMW1	5/20/1996	0:00:00	10.86
STMGIDMW1	9/22/1998	0:00:00	16.59
STMGIDMW2	4/3/1985	0:00:00	-0.001
STMGIDMW2	12/3/1985	0:00:00	0.919
STMGIDMW2	12/22/1986	0:00:00	-0.551
STMGIDMW2	11/13/1987	0:00:00	0.179
STMGIDMW2	11/30/1988	0:00:00	2.509
STMGIDMW2	11/20/1989	0:00:00	1.859
STMGIDMW2	12/20/1990	0:00:00	3.499
STMGIDMW2	3/29/1991	0:00:00	5.029
STMGIDMW2	11/5/1991	0:00:00	4.539
STMGIDMW2	11/20/1992	0:00:00	8.169
STMGIDMW2	12/15/1993	0:00:00	6.999
STMGIDMW2	4/26/1994	0:00:00	9.079
STMGIDMW2	9/21/1995	0:00:00	5.949
STMGIDMW2	5/20/1996	0:00:00	7.979
STMGIDMW2	7/31/1997	0:00:00	6.219
STMGIDMW2	9/22/1998	0:00:00	6.839
STMGIDMW2	8/31/1999	0:00:00	7.359
STMGIDMW2	12/31/2000	0:00:00	17.9
STMGIDMW3	4/3/1985	0:00:00	0
STMGIDMW3	12/3/1985	0:00:00	5.82
STMGIDMW3	12/22/1986	0:00:00	8.97
STMGIDMW3	11/13/1987	0:00:00	17.47

Model observation well drawdown file: drawdown.tof

STMGIDMW3	11/30/1988	0:00:00	21.19
STMGIDMW3	1/31/1989	0:00:00	22.09
STMGIDMW3	11/20/1989	0:00:00	26.06
STMGIDMW3	12/20/1990	0:00:00	27.79
STMGIDMW3	11/5/1991	0:00:00	30.17
STMGIDMW3	11/20/1992	0:00:00	34.2
STMGIDMW3	12/15/1993	0:00:00	31.55
STMGIDMW3	4/26/1994	0:00:00	30.6
STMGIDMW3	2/28/1995	0:00:00	36.46
STMGIDMW3	1/29/1996	0:00:00	29.05
STMGIDMW3	2/6/1997	0:00:00	18.4
STMGIDMW3	3/31/1999	0:00:00	25.8
STMGIDMW3	12/31/2000	0:00:00	28.8
STMWWTP	4/3/1985	0:00:00	0
STMWWTP	12/31/2000	0:00:00	0
Taylor	4/3/1985	0:00:00	0
Taylor	9/27/1991	0:00:00	5.82
Taylor	11/13/1992	0:00:00	9.65
Taylor	12/14/1993	0:00:00	12.38
Taylor	4/25/1994	0:00:00	13.05
Taylor	10/3/1997	0:00:00	15.07
Taylor	9/21/1998	0:00:00	17.02
Taylor	8/18/1999	0:00:00	17.23
Taylor	12/31/2000	0:00:00	17
TransSierra3	4/3/1985	0:00:00	0
TransSierra3	12/22/1986	0:00:00	-6.22
TransSierra3	11/13/1987	0:00:00	-3.88
TransSierra3	11/28/1988	0:00:00	2.2
TransSierra3	11/20/1989	0:00:00	2.38
TransSierra3	11/16/1990	0:00:00	6.38
TransSierra3	8/7/1991	0:00:00	3.46
TransSierra3	11/13/1992	0:00:00	12.43
TransSierra3	12/14/1993	0:00:00	6.01
TransSierra3	4/26/1994	0:00:00	9.84
TransSierra3	8/8/1995	0:00:00	3.81
TransSierra3	5/20/1996	0:00:00	0.35
TransSierra3	11/20/1997	0:00:00	-13.79
TransSierra3	9/15/1998	0:00:00	-20.68
TransSierra3	8/19/1999	0:00:00	-14.76
TransSierra3	8/4/2000	0:00:00	-5.97
UnequippedWell	4/3/1985	0:00:00	0
UnequippedWell	12/22/1986	0:00:00	-6.56
UnequippedWell	11/13/1987	0:00:00	-3.34
UnequippedWell	11/28/1988	0:00:00	2.62
UnequippedWell	11/20/1989	0:00:00	3.37
UnequippedWell	12/20/1990	0:00:00	8.24
UnequippedWell	3/29/1991	0:00:00	10.84
UnequippedWell	11/13/1992	0:00:00	12.72
UnequippedWell	12/14/1993	0:00:00	6.78
UnequippedWell	4/25/1994	0:00:00	9.85
UnequippedWell	8/8/1995	0:00:00	4.87
UnequippedWell	4/26/1996	0:00:00	1.87

Model observation well drawdown file: drawdown.tof

UnequippedWell	8/4/2000	0:00:00	-5.68
UnequippedWell	12/31/2000	0:00:00	0
Williams	4/3/1985	0:00:00	0
Williams	11/30/1990	0:00:00	5.81
Williams	11/15/1991	0:00:00	7.9
Williams	12/21/1992	0:00:00	10.52
Williams	12/29/1993	0:00:00	6.15
Williams	11/22/1994	0:00:00	9.98
Williams	8/9/1995	0:00:00	5.12
Williams	11/4/1996	0:00:00	3.6
Williams	10/17/1997	0:00:00	2.73
Williams	9/29/1998	0:00:00	3.27
Williams	5/24/1999	0:00:00	5.12
Williams	5/25/2000	0:00:00	5.3
Williams	12/31/2000	0:00:00	6

Model observation wells: obs.tob

NODATA	-999							
name	x	y	z	layer	head	int	conf	
ACMW1(MW11)	2278826	14825280	5111	2	4900	20	90	
ACMW2	2275662	14823400	5418	2	5320	20	90	
ACMW4(MW9)	2273241	14823081	5581.795	2	-999	20	95	
ACMW5(MW12)	2275707	14827096	5235	1	5087	20	95	
Angotti	2288920	14827354	4632	1	4553	20	95	
Beckner	2275826	14816444	5626	1	5361	20	95	
Berry	2283259	14834110	4561	1	4551	20	95	
Blackburn	2275266	14807654	5498	1	-999	20	95	
Brokaw	2276375	14817151	5567	1	5372.13	20	95	
Bush	2279489	14813184	5460	1	5365	20	95	
CallamontN(CP2)	2274700	14804200	5492	2	5342	20	95	
CallamontS(CP1)	2274800	14801600	5502	2	5356	20	95	
Champelovier	2277989	14816138	5472	1	-999	20	95	
Creps	2277119	14801774	5377	1	5282	20	90	
DD2	2291884	14835723	4464	2	4458	20	95	
Delongchamps	2275603	14804392	5470	1	5378	20	90	
Dible	2287909	14825403	4713	1	-999	20	95	
Dolan	2282462	14840182	4534	1	4505	20	95	
Dundas	2273273	14809363	5685	1	5524	20	95	
Espinosa	2287876	14825711	4707	1	4583.8	20	95	
Evart	2280735	14830864	4718	1	4656	20	95	
Frohlick	2273385	14808552	5640	1	-999	20	95	
Furchner	2279481	14833676	4689	1	4574	20	95	
Galantowicz	2272051	14810449	5771	1	5586	20	95	
Gillenwater	2295699	14821425	4541	1	4533	20	95	
Gledhill	2276700	14807107	5438	1	-999	20	95	
Glover	2280540	14832719	4651	1	4588	20	95	
Gonzales	2281603	14829041	4756	1	4698	20	95	
Gregg	2276846	14808533	5460	1	5388	20	95	
Hale	2277262	14805719	5400	1	5387	20	90	
Hallstrom	2276862	14807294	5437	1	5395	20	95	
Halvorson	2280458	14837873	4586	1	4552	20	95	
Hayes	2284325	14835028	4541	1	4537	20	95	
HerzDomestic	2293655	14821116	4580	1	4556	20	95	
HerzGeo	2294953	14819423	4603	1	4553	20	95	
Heyer	2291856	14825363	4562	1	4543	20	95	
Hinton	2288706	14826971	4648	1	4567	20	95	
Homann	2276663	14837157	4772	1	4712	20	95	
Hunt	2279151	14811557	5476	1	5374	20	95	
Jenson	2289091	14827763	4617	1	4559	20	95	
Kitchen	2274885	14816174	5691	1	5398	20	95	
Lemaire	2279474	14811709	5472	1	5380	20	95	
Mailander	2284737	14833340	4569	1	4561	20	95	
Maitoza	2288513	14826956	4648	1	-999	20	95	
Marlia	2290439	14824995	4610	1	-999	20	95	
Marshall	2275275	14808072	5510	1	5397	20	95	
May	2281835	14833478	4577	1	4569	20	95	
Mayville	2276096	14807203	5456	1	5398	20	95	
Mealshear	2280236	14829444	4797	1	4723	20	95	
Melarkey	2282394	14838398	4537	1	4526	20	95	

Model observation wells: obs.tob

Melarkey(govt)	2277720	14816793	5489	1	-999	20	95
Moehl	2282139	14835877	4553	1	4544	20	95
MRSAMW1	2272959	14807034	5621	1	-999	20	95
MtRose5(Cinder)	2272064	14806386	5688	2	5457	20	95
MtRose6	2271195	14805998	5757	2	5450	20	95
Northon	2273712	14807590	5576	1	5475	20	95
Olsen	2273478	14807648	5590	1	5511	20	95
OttenWycoff	2284059	14816564	5148	1	4958	20	95
Pepple	2287341	14825409	4741	1	4579	20	95
PicolloMW	2287785	14829891	4604.58	1	-999	20	95
Powell	2291252	14823324	4612	1	4554	20	95
PTR-2	2292630	14819200	4648	1	4586	20	95
Ramsey	2283629	14828958	4705	1	4649	20	95
Ronkos	2278734	14815588	5449	1	-999	20	95
Scott	2280351	14814564	5385	1	5205	20	90
SJMW1	2278348	14798938	5418	2	5014	20	95
SJMW2	2276183	14798927	5514	2	5240	20	95
SJMW3	2273177	14798242	5720	2	5486	20	95
Solaro	2279502	14809822	5465	1	5350	20	90
SRP-2(EastPz)	2285133	14798785	4833	2	4811	20	95
Steinhardt	2299433	14816514	4604	1	4528	20	95
STMGID10	2281843	14817045	5268	2	4903	20	95
STMGID1MW	2288445	14825213	4677	2	4580	20	95
STMGID2	2288965	14823233	4692	2	4562	20	95
STMGID3	2287250	14822370	4788	2	4628	20	95
STMGID4	2283985	14816650	5151	2	4656	20	95
STMGID5MW	2281302	14819984	5204	2	4924	20	90
STMGID6MW	2277705	14818776	5419	2	5316	20	90
STMGIDMW1	2282348	14824139	4981	1	4775	20	95
STMGIDMW2	2285343	14825218	4825	1	4660	20	95
STMGIDMW3	2288924	14821223	4761	1	4581	20	95
STMWWTP	2297220	14839489	4440	1	4425	20	95
Taylor	2278702	14812834	5482	1	-999	20	95
Tessa1MW(W)	2273396	14810888	5722	2	5427	20	90
Tessa2MW(E)	2275084	14811718	5625	2	5389	20	90
TransSierra3	2300189	14818420	4573	1	4514	20	95
UnequippedWell	2299617	14817803	4587.54	1	4529	20	95
Williams	2288593	14832470	4530	1	4519	20	95
Woods	2289265	14818722	4790	1	4670	20	90

Model wells: wells.wdf

name	x	y	Q
AC1	2278859	14825228	0
AC2	2275680	14823348	0
AC3	2273744	14819772	0
Callamont ^b	2274700	14804200	0
Callamont ^c	2274800	14801600	0
DD1	2291929	14831058	0
DD2	2291884	14835723	0
Holcomb	2286859	14834362	0
Patriot	2286498	14838314	0
Longley	2288442	14839730	0
Mtrose2	2277739	14806480	0
Mtrose3	2277839	14805900	0
Mtrose5	2272064	14806386	0
Mtrose6	2271195	14805998	0
Picollo	2287786	14829851	0
SJ1	2271721	14799748	0
SJ2	2273278	14798177	0
STMGID11	2285301	14825240	0
STMGID2	2288965	14823233	0
STMGID3	2287250	14822370	0
STMGID5	2281353	14820006	0
STMGID7	2269406	14809620	0
STMGID9	2293776	14825457	0
STMGID1	2288439	14825230	0
STMGID4	2283985	14816650	0
STMGID6	2277728	14818783	0
Sunrise1	2286231	14798560	0
Sunrise2	2284263	14799000	0
Tessa1	2273648	14810901	0
Tessa2	2275167	14811760	0
Thomascre	2281711	14822770	0
Transierra	2300189	14818420	0
D259	2276986	14808843	-2247
D258	2276986	14807843	-2033
D257	2275986	14807843	-1819
D256	2287986	14799843	-1819
D255	2278986	14830843	-1712
D254	2276986	14806843	-1605
D253	2286986	14828843	-1605
D252	2287986	14800843	-1605
D251	2277986	14830843	-1498
D250	2288986	14800843	-1498
D249	2291986	14825843	-1498
D248	2275986	14808843	-1391
D247	2286986	14799843	-1391
D246	2286986	14833843	-1284
D245	2288986	14803843	-1284
D244	2288986	14826843	-1284
D243	2289986	14803843	-1284
D242	2290986	14804843	-1284
D241	2275986	14806843	-1177

Model wells: wells.wdf

D240	2285986	14799843	-1177
D239	2286986	14800843	-1177
D238	2291986	14824843	-1177
D237	2287986	14802843	-1097
D236	2272986	14809843	-1070
D235	2286986	14830843	-1070
D234	2286986	14832843	-1070
D233	2287986	14829843	-1070
D232	2287986	14830843	-1070
D231	2287986	14832843	-1070
D230	2294986	14806843	-1070
D229	2277986	14808843	-963
D228	2278986	14810843	-963
D227	2278986	14831843	-963
D226	2279986	14830843	-963
D225	2285986	14800843	-963
D224	2286986	14829843	-963
D223	2286986	14831843	-963
D222	2287986	14803843	-963
D221	2288986	14802843	-963
D220	2295986	14804843	-963
D219	2279986	14831843	-856
D218	2280986	14830843	-856
D217	2280986	14837843	-856
D216	2281986	14839843	-856
D215	2284986	14799843	-856
D214	2284986	14826843	-856
D213	2284986	14827843	-856
D212	2285986	14798843	-856
D211	2285986	14826843	-856
D210	2285986	14827843	-856
D209	2286986	14798843	-856
D208	2287986	14831843	-856
D207	2287986	14833843	-856
D206	2294986	14805843	-856
D205	2296986	14804843	-856
D204	2280986	14832843	-776
D203	2296986	14808843	-776
D202	2277986	14836843	-749
D201	2277986	14837843	-749
D200	2278986	14809843	-749
D199	2278986	14835843	-749
D198	2278986	14836843	-749
D197	2279986	14832843	-749
D196	2279986	14835843	-749
D195	2279986	14838843	-749
D194	2279986	14839843	-749
D193	2280986	14840843	-749
D192	2282986	14833843	-749
D191	2283986	14827843	-749
D190	2284986	14830843	-749
D189	2286986	14834843	-749

Model wells: wells.wdf

D188	2288986	14804843	-749
D187	2288986	14831843	-749
D186	2292986	14827843	-749
D185	2295986	14820843	-749
D184	2293986	14804843	-669
D183	2275986	14804843	-642
D182	2278986	14838843	-642
D181	2280986	14831843	-642
D180	2280986	14838843	-642
D179	2283986	14828843	-642
D178	2290986	14803843	-642
D177	2291986	14804843	-642
D176	2294986	14804843	-642
D175	2296986	14805843	-642
D174	2281986	14840843	-562
D173	2282986	14832843	-562
D172	2275986	14815843	-535
D171	2277986	14801843	-535
D170	2280986	14839843	-535
D169	2281986	14832843	-535
D168	2281986	14837843	-535
D167	2283986	14832843	-535
D166	2283986	14833843	-535
D165	2284986	14828843	-535
D164	2285986	14834843	-535
D163	2289986	14804843	-535
D162	2292986	14824843	-535
D161	2294986	14807843	-535
D160	2295986	14807843	-535
D159	2295986	14821843	-535
D158	2285986	14835843	-509
D157	2284986	14834843	-482
D156	2283986	14837843	-455
D155	2292986	14825843	-455
D154	2270986	14808843	-428
D153	2272986	14801843	-428
D152	2275986	14803843	-428
D151	2276986	14804843	-428
D150	2278986	14811843	-428
D149	2278986	14832843	-428
D148	2280986	14836843	-428
D147	2281986	14834843	-428
D146	2281986	14836843	-428
D145	2282986	14835843	-428
D144	2282986	14836843	-428
D143	2282986	14840843	-428
D142	2286986	14827843	-428
D141	2288986	14832843	-428
D140	2296986	14807843	-428
D139	2300986	14812843	-428
D138	2297986	14808843	-375
D137	2281986	14831843	-348

Model wells: wells.wdf

D136	2293986	14822843	-348
D135	2271986	14810843	-321
D134	2272986	14800843	-321
D133	2272986	14807843	-321
D132	2273986	14816843	-321
D131	2276986	14805843	-321
D130	2276986	14816843	-321
D129	2278986	14808843	-321
D128	2278986	14834843	-321
D127	2278986	14837843	-321
D126	2279986	14834843	-321
D125	2279986	14836843	-321
D124	2280986	14835843	-321
D123	2281986	14835843	-321
D122	2281986	14838843	-321
D121	2282986	14838843	-321
D120	2283986	14826843	-321
D119	2283986	14834843	-321
D118	2283986	14835843	-321
D117	2284986	14829843	-321
D116	2284986	14833843	-321
D115	2285986	14817843	-321
D114	2285986	14818843	-321
D113	2286986	14835843	-321
D112	2287986	14804843	-321
D111	2291986	14823843	-321
D110	2292986	14826843	-321
D109	2296986	14821843	-321
D108	2297986	14807843	-321
D107	2298986	14807843	-321
D106	2284986	14835843	-241
D105	2296986	14809843	-241
D104	2297986	14822843	-241
D99	2272986	14813843	-214
D98	2272986	14812843	-214
D97	2272986	14808843	-214
D96	2272986	14810843	-214
D95	2274986	14815843	-214
D94	2274986	14816843	-214
D93	2275986	14816843	-214
D92	2276986	14814843	-214
D91	2276986	14815843	-214
D90	2279986	14833843	-214
D89	2280986	14833843	-214
D88	2280986	14834843	-214
D87	2281986	14833843	-214
D86	2282986	14834843	-214
D85	2282986	14839843	-214
D84	2283986	14829843	-214
D83	2284986	14798843	-214
D82	2284986	14818843	-214
D81	2285986	14828843	-214

Model wells: wells.wdf

D80	2287986	14839843	-214
D79	2288986	14817843	-214
D78	2288986	14818843	-214
D77	2288986	14827843	-214
D76	2288986	14833843	-214
D75	2290986	14828843	-214
D74	2291986	14822843	-214
D73	2291986	14827843	-214
D72	2292986	14823843	-214
D71	2293986	14823843	-214
D70	2293986	14826843	-214
D69	2295986	14805843	-214
D68	2295986	14806843	-214
D67	2297986	14819843	-214
D103	2271986	14801843	-214
D102	2272986	14816843	-214
D101	2272986	14815843	-214
D100	2272986	14814843	-214
D66	2292986	14803843	-142
D65	2288986	14824843	-134
D64	2297986	14811843	-134
D9	2297986	14823843	-107
D8	2298986	14806843	-107
D7	2298986	14817843	-107
D63	2268986	14805843	-107
D62	2269986	14805843	-107
D61	2269986	14807843	-107
D60	2270986	14804843	-107
D6	2299986	14813843	-107
D59	2270986	14810843	-107
D58	2271986	14811843	-107
D57	2272986	14798843	-107
D56	2272986	14799843	-107
D55	2272986	14806843	-107
D54	2272986	14811843	-107
D53	2273986	14803843	-107
D52	2273986	14814843	-107
D51	2273986	14815843	-107
D50	2274986	14804843	-107
D5	2300986	14813843	-107
D49	2275986	14805843	-107
D48	2277986	14805843	-107
D47	2277986	14807843	-107
D46	2278986	14833843	-107
D45	2279986	14800843	-107
D44	2280986	14813843	-107
D43	2282986	14837843	-107
D42	2283986	14835843	-107
D41	2283986	14836843	-107
D40	2284986	14817843	-107
D4	2300986	14818843	-107
D39	2285986	14825843	-107

Model wells: wells.wdf

D38	2285986	14829843	-107
D37	2285986	14830843	-107
D36	2285986	14839843	-107
D35	2286986	14824843	-107
D34	2287986	14834843	-107
D33	2287986	14840843	-107
D32	2288986	14819843	-107
D31	2288986	14825843	-107
D30	2288986	14828843	-107
D3	2300986	14819843	-107
D29	2288986	14829843	-107
D28	2288986	14839843	-107
D27	2290986	14835843	-107
D26	2291986	14815843	-107
D25	2291986	14826843	-107
D24	2292986	14804843	-107
D23	2292986	14820843	-107
D22	2293986	14805843	-107
D21	2293986	14825843	-107
D20	2294986	14815843	-107
D2	2301986	14819843	-107
D19	2294986	14816843	-107
D18	2294986	14818843	-107
D17	2295986	14808843	-107
D16	2295986	14814843	-107
D15	2296986	14810843	-107
D14	2296986	14818843	-107
D13	2296986	14820843	-107
D12	2296986	14823843	-107
D11	2297986	14817843	-107
D10	2297986	14820843	-107
D1	2301986	14820843	-107
R116	2301986	14819843	1000
R115	2303986	14832843	1000
R114	2303986	14831843	1000
R113	2303986	14830843	1000
R112	2303986	14829843	1000
R111	2303986	14828843	1000
R110	2303986	14827843	1000
R109	2303986	14826843	1000
R108	2303986	14825843	1000
R107	2303986	14822843	1000
R106	2303986	14821843	1000
R105	2303986	14820843	1000
R104	2304986	14824843	1000
R103	2304986	14823843	1000
R99	2294986	14804843	4000
R98	2295986	14804843	4000
R97	2296986	14804843	4000
R96	2297986	14807843	4000
R95	2297986	14810843	4000
R94	2297986	14809843	4000

Model wells: wells.wdf

R93	2297986	14808843	4000
R92	2297986	14804843	4000
R91	2298986	14807843	4000
R90	2298986	14806843	4000
R89	2298986	14805843	4000
R88	2298986	14804843	4000
R101	2292986	14804843	4000
R100	2293986	14804843	4000
R38	2270986	14810843	5000
R86	2298986	14812843	6000
R85	2299986	14812843	6000
R84	2300986	14818843	6000
R83	2300986	14817843	6000
R82	2300986	14816843	6000
R81	2300986	14812843	6000
R80	2301986	14815843	6000
R79	2301986	14814843	6000
R78	2301986	14813843	6000
R77	2302986	14819843	6000
R36	2273986	14827843	8000
R35	2273986	14826843	8000
R76	2273986	14827843	10000
R75	2273986	14826843	10000
R29	2272986	14816843	20000
R28	2272986	14815843	20000
R27	2272986	14814843	20000
R26	2272986	14813843	20000
R25	2272986	14812843	20000
R68	2271986	14803843	25000
R67	2271986	14802843	25000
R66	2271986	14801843	25000
R23	2271986	14803843	25000
R22	2271986	14802843	25000
R21	2271986	14801843	25000
R65	2270986	14810843	30000
R64	2272986	14812843	30000
R63	2272986	14813843	30000
R62	2272986	14814843	30000
R61	2272986	14815843	30000
R60	2272986	14816843	30000
R59	2292986	14815843	30000
R58	2270986	14809843	40000
R57	2271986	14798843	40000
R56	2271986	14800843	40000
R55	2271986	14799843	40000
R54	2273986	14819843	40000
R53	2273986	14819843	40000
R52	2273986	14820843	40000
R51	2273986	14820843	40000
R50	2273986	14821843	40000
R18	2270986	14809843	40000
R17	2271986	14800843	40000

Model wells: wells.wdf

R16	2271986	14800843	40000
R15	2271986	14799843	40000
R14	2271986	14798843	40000
R13	2273986	14820843	40000
R12	2273986	14819843	40000
R49	2272986	14818843	45000
R10	2272986	14818843	45000
R47	2267986	14805843	50000
R46	2267986	14804843	50000
R45	2267986	14806843	50000
R9	2273986	14821843	60000
R44	2268986	14807843	65000
R43	2269986	14808843	65000
R8	2267986	14804843	70000
R7	2267986	14805843	70000
R6	2267986	14806843	70000
R4	2268986	14807843	80000
R3	2269986	14808843	80000
Inject1	2273200	14804845	0
Inject2	2273200	14805345	0
DD3	2290324	14832572	0
AC4	2273208	14822305	0
AC5	2276606	14826229	0
SJ3	2276069	14799021	0

Simulation well pumping file: wells_asr.wpf

name	date	time	Q
STMGID1	1/1/1985	0:00:00	-5527
STMGID1	1/1/1986	0:00:00	-15154
STMGID1	1/1/1987	0:00:00	-34407
STMGID1	1/1/1988	0:00:00	-29575
STMGID1	1/1/1989	0:00:00	-26061
STMGID1	1/1/1990	0:00:00	-33089
STMGID1	1/1/1991	0:00:00	-40409
STMGID1	1/1/1992	0:00:00	-39128
STMGID1	1/1/1993	0:00:00	-50805
STMGID1	1/1/1994	0:00:00	-54319
STMGID1	1/1/1995	0:00:00	-59333
STMGID1	1/1/1996	0:00:00	-53989
STMGID1	1/1/1997	0:00:00	-45644
STMGID1	1/1/1998	0:00:00	-18924
STMGID1	1/1/1999	0:00:00	-63359
STMGID1	1/1/2000	0:00:00	-62005
STMGID1	1/1/2001	0:00:00	-63030
STMGID1	1/1/2002	0:00:00	-52190
STMGID1	1/1/2003	0:00:00	-52945
STMGID1	1/1/2004	0:00:00	-52945
STMGID1	1/1/2005	0:00:00	-52945
STMGID1	1/1/2006	0:00:00	-52945
STMGID1	1/1/2007	0:00:00	-52945
STMGID1	1/1/2008	0:00:00	-52945
STMGID1	1/1/2009	0:00:00	-52945
STMGID1	1/1/2010	0:00:00	-52945
STMGID1	1/1/2011	0:00:00	-52945
STMGID1	1/1/2012	0:00:00	-52945
STMGID1	1/1/2013	0:00:00	-52945
STMGID1	1/1/2014	0:00:00	-52945
STMGID1	1/1/2015	0:00:00	-52945
STMGID1	1/1/2016	0:00:00	-52945
STMGID1	1/1/2017	0:00:00	-52945
STMGID1	1/1/2018	0:00:00	-52945
STMGID1	1/1/2019	0:00:00	-52945
STMGID1	1/1/2020	0:00:00	-52945
STMGID1	1/1/2021	0:00:00	-52945
STMGID1	1/1/2022	0:00:00	-52945
STMGID2	1/1/1985	0:00:00	0
STMGID2	1/1/1997	0:00:00	-24890
STMGID2	1/1/1998	0:00:00	-21962
STMGID2	1/1/1999	0:00:00	-30417
STMGID2	1/1/2000	0:00:00	-26757
STMGID2	1/1/2001	0:00:00	-22328
STMGID2	1/1/2002	0:00:00	-24114
STMGID2	1/1/2003	0:00:00	-24066
STMGID2	1/1/2004	0:00:00	-24066
STMGID2	1/1/2005	0:00:00	-24066
STMGID2	1/1/2006	0:00:00	-24066
STMGID2	1/1/2007	0:00:00	-24066
STMGID2	1/1/2008	0:00:00	-24066

Simulation well pumping file: wells_asr.wpf

STMGID2	1/1/2009	0:00:00	-24066
STMGID2	1/1/2010	0:00:00	-24066
STMGID2	1/1/2011	0:00:00	-24066
STMGID2	1/1/2012	0:00:00	-24066
STMGID2	1/1/2013	0:00:00	-24066
STMGID2	1/1/2014	0:00:00	-24066
STMGID2	1/1/2015	0:00:00	-24066
STMGID2	1/1/2016	0:00:00	-24066
STMGID2	1/1/2017	0:00:00	-24066
STMGID2	1/1/2018	0:00:00	-24066
STMGID2	1/1/2019	0:00:00	-24066
STMGID2	1/1/2020	0:00:00	-24066
STMGID2	1/1/2021	0:00:00	-24066
STMGID2	1/1/2022	0:00:00	-24066
STMGID3	1/1/1985	0:00:00	-8821
STMGID3	1/1/1986	0:00:00	-40922
STMGID3	1/1/1987	0:00:00	-41434
STMGID3	1/1/1988	0:00:00	-54977
STMGID3	1/1/1989	0:00:00	-53037
STMGID3	1/1/1990	0:00:00	-57320
STMGID3	1/1/1991	0:00:00	-54941
STMGID3	1/1/1992	0:00:00	-52598
STMGID3	1/1/1993	0:00:00	-42349
STMGID3	1/1/1994	0:00:00	-31844
STMGID3	1/1/1995	0:00:00	-33784
STMGID3	1/1/1996	0:00:00	-37445
STMGID3	1/1/1997	0:00:00	-41691
STMGID3	1/1/1998	0:00:00	-37042
STMGID3	1/1/1999	0:00:00	-38030
STMGID3	1/1/2000	0:00:00	-41508
STMGID3	1/1/2001	0:00:00	-41947
STMGID3	1/1/2002	0:00:00	-28325
STMGID3	1/1/2003	0:00:00	-28879
STMGID3	1/1/2004	0:00:00	-28879
STMGID3	1/1/2005	0:00:00	-28879
STMGID3	1/1/2006	0:00:00	-28879
STMGID3	1/1/2007	0:00:00	-28879
STMGID3	1/1/2008	0:00:00	-28879
STMGID3	1/1/2009	0:00:00	-28879
STMGID3	1/1/2010	0:00:00	-28879
STMGID3	1/1/2011	0:00:00	-28879
STMGID3	1/1/2012	0:00:00	-28879
STMGID3	1/1/2013	0:00:00	-28879
STMGID3	1/1/2014	0:00:00	-28879
STMGID3	1/1/2015	0:00:00	-28879
STMGID3	1/1/2016	0:00:00	-28879
STMGID3	1/1/2017	0:00:00	-28879
STMGID3	1/1/2018	0:00:00	-28879
STMGID3	1/1/2019	0:00:00	-28879
STMGID3	1/1/2020	0:00:00	-28879
STMGID3	1/1/2021	0:00:00	-28879
STMGID3	1/1/2022	0:00:00	-28879

Simulation well pumping file: wells_asr.wpf

STMGID4	1/1/1985	0:00:00	0
STMGID4	1/1/1986	0:00:00	-1940
STMGID4	1/1/1987	0:00:00	-5893
STMGID4	1/1/1988	0:00:00	-4466
STMGID4	1/1/1989	0:00:00	-3880
STMGID4	1/1/1990	0:00:00	-5088
STMGID4	1/1/1991	0:00:00	-4356
STMGID4	1/1/1992	0:00:00	-3880
STMGID4	1/1/1993	0:00:00	-7687
STMGID4	1/1/1994	0:00:00	-14312
STMGID4	1/1/1995	0:00:00	-18960
STMGID4	1/1/1996	0:00:00	-17130
STMGID4	1/1/1997	0:00:00	-14824
STMGID4	1/1/1998	0:00:00	-14348
STMGID4	1/1/1999	0:00:00	-8638
STMGID4	1/1/2000	0:00:00	-6955
STMGID4	1/1/2001	0:00:00	-2782
STMGID4	1/1/2002	0:00:00	-3130
STMGID4	1/1/2003	0:00:00	-2888
STMGID4	1/1/2004	0:00:00	-2888
STMGID4	1/1/2005	0:00:00	-2888
STMGID4	1/1/2006	0:00:00	-2888
STMGID4	1/1/2007	0:00:00	-2888
STMGID4	1/1/2008	0:00:00	-2888
STMGID4	1/1/2009	0:00:00	-2888
STMGID4	1/1/2010	0:00:00	-2888
STMGID4	1/1/2011	0:00:00	-2888
STMGID4	1/1/2012	0:00:00	-2888
STMGID4	1/1/2013	0:00:00	-2888
STMGID4	1/1/2014	0:00:00	-2888
STMGID4	1/1/2015	0:00:00	-2888
STMGID4	1/1/2016	0:00:00	-2888
STMGID4	1/1/2017	0:00:00	-2888
STMGID4	1/1/2018	0:00:00	-2888
STMGID4	1/1/2019	0:00:00	-2888
STMGID4	1/1/2020	0:00:00	-2888
STMGID4	1/1/2021	0:00:00	-2888
STMGID4	1/1/2022	0:00:00	-2888
STMGID5	1/1/1985	0:00:00	0
STMGID5	1/1/1989	0:00:00	-549
STMGID5	1/1/1990	0:00:00	-14348
STMGID5	1/1/1991	0:00:00	-9407
STMGID5	1/1/1992	0:00:00	-15373
STMGID5	1/1/1993	0:00:00	-8968
STMGID5	1/1/1994	0:00:00	-23828
STMGID5	1/1/1995	0:00:00	-15044
STMGID5	1/1/1996	0:00:00	-26500
STMGID5	1/1/1997	0:00:00	-26171
STMGID5	1/1/1998	0:00:00	-27818
STMGID5	1/1/1999	0:00:00	-41142
STMGID5	1/1/2000	0:00:00	-53696
STMGID5	1/1/2001	0:00:00	-48609

Simulation well pumping file: wells_asr.wpf

STMGID5	1/1/2002	0:00:00	-45834
STMGID5	1/1/2003	0:00:00	-48132
STMGID5	1/1/2004	0:00:00	-48132
STMGID5	1/1/2005	0:00:00	-48132
STMGID5	1/1/2006	0:00:00	-48132
STMGID5	1/1/2007	0:00:00	-48132
STMGID5	1/1/2008	0:00:00	-48132
STMGID5	1/1/2009	0:00:00	-48132
STMGID5	1/1/2010	0:00:00	-48132
STMGID5	1/1/2011	0:00:00	-48132
STMGID5	1/1/2012	0:00:00	-48132
STMGID5	1/1/2013	0:00:00	-48132
STMGID5	1/1/2014	0:00:00	-48132
STMGID5	1/1/2015	0:00:00	-48132
STMGID5	1/1/2016	0:00:00	-48132
STMGID5	1/1/2017	0:00:00	-48132
STMGID5	1/1/2018	0:00:00	-48132
STMGID5	1/1/2019	0:00:00	-48132
STMGID5	1/1/2020	0:00:00	-48132
STMGID5	1/1/2021	0:00:00	-48132
STMGID5	1/1/2022	0:00:00	-48132
STMGID6	1/1/1985	0:00:00	0
STMGID6	1/1/1989	0:00:00	-586
STMGID6	1/1/1990	0:00:00	-13909
STMGID6	1/1/1991	0:00:00	-5856
STMGID6	1/1/1992	0:00:00	-27525
STMGID6	1/1/1993	0:00:00	-18301
STMGID6	1/1/1994	0:00:00	-53367
STMGID6	1/1/1995	0:00:00	-35541
STMGID6	1/1/1996	0:00:00	-63762
STMGID6	1/1/1997	0:00:00	-74121
STMGID6	1/1/1998	0:00:00	-65519
STMGID6	1/1/1999	0:00:00	-93703
STMGID6	1/1/2000	0:00:00	-99889
STMGID6	1/1/2001	0:00:00	-129025
STMGID6	1/1/2002	0:00:00	-117920
STMGID6	1/1/2003	0:00:00	-119367
STMGID6	1/1/2004	0:00:00	-119367
STMGID6	1/1/2005	0:00:00	-119367
STMGID6	1/1/2006	0:00:00	-119367
STMGID6	1/1/2007	0:00:00	-119367
STMGID6	1/1/2008	0:00:00	-119367
STMGID6	1/1/2009	0:00:00	-119367
STMGID6	1/1/2010	0:00:00	-119367
STMGID6	1/1/2011	0:00:00	-119367
STMGID6	1/1/2012	0:00:00	-119367
STMGID6	1/1/2013	0:00:00	-119367
STMGID6	1/1/2014	0:00:00	-119367
STMGID6	1/1/2015	0:00:00	-119367
STMGID6	1/1/2016	0:00:00	-119367
STMGID6	1/1/2017	0:00:00	-119367
STMGID6	1/1/2018	0:00:00	-119367

Simulation well pumping file: wells_asr.wpf

STMGID6	1/1/2019	0:00:00	-119367
STMGID6	1/1/2020	0:00:00	-119367
STMGID6	1/1/2021	0:00:00	-119367
STMGID6	1/1/2022	0:00:00	-119367
STMGID7	1/1/1985	0:00:00	0
STMGID7	1/1/1990	0:00:00	-878
STMGID7	1/1/1991	0:00:00	-512
STMGID7	1/1/1992	0:00:00	-732
STMGID7	1/1/1993	0:00:00	-732
STMGID7	1/1/1994	0:00:00	-915
STMGID7	1/1/1995	0:00:00	-1208
STMGID7	1/1/1996	0:00:00	-2160
STMGID7	1/1/1997	0:00:00	-3916
STMGID7	1/1/1998	0:00:00	-3258
STMGID7	1/1/1999	0:00:00	-2745
STMGID7	1/1/2000	0:00:00	-4575
STMGID7	1/1/2001	0:00:00	-1354
STMGID7	1/1/2002	0:00:00	-2264
STMGID7	1/1/2003	0:00:00	-2287
STMGID7	1/1/2004	0:00:00	-1925
STMGID7	1/1/2005	0:00:00	-1925
STMGID7	1/1/2006	0:00:00	-1925
STMGID7	1/1/2007	0:00:00	-1925
STMGID7	1/1/2008	0:00:00	-1925
STMGID7	1/1/2009	0:00:00	-1925
STMGID7	1/1/2010	0:00:00	-1925
STMGID7	1/1/2011	0:00:00	-1925
STMGID7	1/1/2012	0:00:00	-1925
STMGID7	1/1/2013	0:00:00	-1925
STMGID7	1/1/2014	0:00:00	-1925
STMGID7	1/1/2015	0:00:00	-1925
STMGID7	1/1/2016	0:00:00	-1925
STMGID7	1/1/2017	0:00:00	-1925
STMGID7	1/1/2018	0:00:00	-1925
STMGID7	1/1/2019	0:00:00	-1925
STMGID7	1/1/2020	0:00:00	-1925
STMGID7	1/1/2021	0:00:00	-1925
STMGID7	1/1/2022	0:00:00	-1925
STMGID9	1/1/1985	0:00:00	0
STMGID9	1/1/1998	0:00:00	-12006
STMGID9	1/1/1999	0:00:00	-3843
STMGID9	1/1/2000	0:00:00	0
STMGID9	1/1/2001	0:00:00	-2050
STMGID9	1/1/2002	0:00:00	-8047
STMGID9	1/1/2003	0:00:00	-8127
STMGID9	1/1/2004	0:00:00	-8209
STMGID9	1/1/2005	0:00:00	-7701
STMGID9	1/1/2006	0:00:00	-7701
STMGID9	1/1/2007	0:00:00	-7701
STMGID9	1/1/2008	0:00:00	-7701
STMGID9	1/1/2009	0:00:00	-7701
STMGID9	1/1/2010	0:00:00	-7701

Simulation well pumping file: wells_asr.wpf

STMGID9	1/1/2011	0:00:00	-7701
STMGID9	1/1/2012	0:00:00	-7701
STMGID9	1/1/2013	0:00:00	-7701
STMGID9	1/1/2014	0:00:00	-7701
STMGID9	1/1/2015	0:00:00	-7701
STMGID9	1/1/2016	0:00:00	-7701
STMGID9	1/1/2017	0:00:00	-7701
STMGID9	1/1/2018	0:00:00	-7701
STMGID9	1/1/2019	0:00:00	-7701
STMGID9	1/1/2020	0:00:00	-7701
STMGID9	1/1/2021	0:00:00	-7701
STMGID9	1/1/2022	0:00:00	-7701
STMGID11	1/1/1985	0:00:00	0
STMGID11	1/1/2001	0:00:00	-11457
STMGID11	1/1/2002	0:00:00	-37959
STMGID11	1/1/2003	0:00:00	-38506
STMGID11	1/1/2004	0:00:00	-38506
STMGID11	1/1/2005	0:00:00	-38506
STMGID11	1/1/2006	0:00:00	-38506
STMGID11	1/1/2007	0:00:00	-38506
STMGID11	1/1/2008	0:00:00	-38506
STMGID11	1/1/2009	0:00:00	-38506
STMGID11	1/1/2010	0:00:00	-38506
STMGID11	1/1/2011	0:00:00	-38506
STMGID11	1/1/2012	0:00:00	-38506
STMGID11	1/1/2013	0:00:00	-38506
STMGID11	1/1/2014	0:00:00	-38506
STMGID11	1/1/2015	0:00:00	-38506
STMGID11	1/1/2016	0:00:00	-38506
STMGID11	1/1/2017	0:00:00	-38506
STMGID11	1/1/2018	0:00:00	-38506
STMGID11	1/1/2019	0:00:00	-38506
STMGID11	1/1/2020	0:00:00	-38506
STMGID11	1/1/2021	0:00:00	-38506
STMGID11	1/1/2022	0:00:00	-38506
Transierra	1/1/1985	0:00:00	-4905
Transierra	1/1/1986	0:00:00	-878
Transierra	1/1/1987	0:00:00	-7943
Transierra	1/1/1988	0:00:00	-3441
Transierra	1/1/1989	0:00:00	-2416
Transierra	1/1/1990	0:00:00	-5527
Transierra	1/1/1991	0:00:00	-2928
Transierra	1/1/1992	0:00:00	-3111
Transierra	1/1/1993	0:00:00	-3477
Transierra	1/1/1994	0:00:00	-5161
Transierra	1/1/1995	0:00:00	-5015
Transierra	1/1/1996	0:00:00	-3624
Transierra	1/1/1997	0:00:00	-2123
Transierra	1/1/1998	0:00:00	-1867
Transierra	1/1/1999	0:00:00	-13104
Transierra	1/1/2000	0:00:00	-6405
Transierra	1/1/2001	0:00:00	-3550

Simulation well pumping file: wells_asr.wpf

Transierra	1/1/2002	0:00:00	-3550
Transierra	1/1/2003	0:00:00	-3550
Transierra	1/1/2004	0:00:00	-3550
Transierra	1/1/2005	0:00:00	-3550
Transierra	1/1/2006	0:00:00	-3550
Transierra	1/1/2007	0:00:00	-3550
Transierra	1/1/2008	0:00:00	-3550
Transierra	1/1/2009	0:00:00	-3550
Transierra	1/1/2010	0:00:00	-3550
Transierra	1/1/2011	0:00:00	-3550
Transierra	1/1/2012	0:00:00	-3550
Transierra	1/1/2013	0:00:00	-3550
Transierra	1/1/2014	0:00:00	-3550
Transierra	1/1/2015	0:00:00	-3550
Transierra	1/1/2016	0:00:00	-3550
Transierra	1/1/2017	0:00:00	-3550
Transierra	1/1/2018	0:00:00	-3550
Transierra	1/1/2019	0:00:00	-3550
Transierra	1/1/2020	0:00:00	-3550
Transierra	1/1/2021	0:00:00	-3550
Transierra	1/1/2022	0:00:00	-3550
Thomascreek	1/1/1985	0:00:00	-3733
Thomascreek	1/1/1986	0:00:00	-8053
Thomascreek	1/1/1987	0:00:00	-17496
Thomascreek	1/1/1988	0:00:00	-15263
Thomascreek	1/1/1989	0:00:00	-17569
Thomascreek	1/1/1990	0:00:00	-12921
Thomascreek	1/1/1991	0:00:00	-17386
Thomascreek	1/1/1992	0:00:00	-29502
Thomascreek	1/1/1993	0:00:00	-19363
Thomascreek	1/1/1994	0:00:00	0
Thomascreek	1/1/1995	0:00:00	-16252
Thomascreek	1/1/1996	0:00:00	-24377
Thomascreek	1/1/1997	0:00:00	-20315
Thomascreek	1/1/1998	0:00:00	-25476
Thomascreek	1/1/1999	0:00:00	-22547
Thomascreek	1/1/2000	0:00:00	-26281
Thomascreek	1/1/2001	0:00:00	-27891
Thomascreek	1/1/2002	0:00:00	-28567
Thomascreek	1/1/2003	0:00:00	-28879
Thomascreek	1/1/2004	0:00:00	-28879
Thomascreek	1/1/2005	0:00:00	-28879
Thomascreek	1/1/2006	0:00:00	-28879
Thomascreek	1/1/2007	0:00:00	-28879
Thomascreek	1/1/2008	0:00:00	-28879
Thomascreek	1/1/2009	0:00:00	-28879
Thomascreek	1/1/2010	0:00:00	-28879
Thomascreek	1/1/2011	0:00:00	-28879
Thomascreek	1/1/2012	0:00:00	-28879
Thomascreek	1/1/2013	0:00:00	-28879
Thomascreek	1/1/2014	0:00:00	-28879
Thomascreek	1/1/2015	0:00:00	-28879

Simulation well pumping file: wells_asr.wpf

Thomascreek	1/1/2016	0:00:00	-28879
Thomascreek	1/1/2017	0:00:00	-28879
Thomascreek	1/1/2018	0:00:00	-28879
Thomascreek	1/1/2019	0:00:00	-28879
Thomascreek	1/1/2020	0:00:00	-28879
Thomascreek	1/1/2021	0:00:00	-28879
Thomascreek	1/1/2022	0:00:00	-28879
AC1	1/1/1985	0:00:00	0
AC1	1/1/1998	0:00:00	-1135
AC1	1/1/1999	0:00:00	-5966
AC1	1/1/2000	0:00:00	-20937
AC1	1/1/2001	0:00:00	-22145
AC1	1/1/2002	0:00:00	-13276
AC1	1/1/2003	0:00:00	-13409
AC1	1/1/2004	0:00:00	-13543
AC1	1/1/2005	0:00:00	-11552
AC1	1/1/2006	0:00:00	-11552
AC1	1/1/2007	0:00:00	-11552
AC1	1/1/2008	0:00:00	-11552
AC1	1/1/2009	0:00:00	-11552
AC1	1/1/2010	0:00:00	-11552
AC1	1/1/2011	0:00:00	-11552
AC1	1/1/2012	0:00:00	-11552
AC1	1/1/2013	0:00:00	-11552
AC1	1/1/2014	0:00:00	-11552
AC1	1/1/2015	0:00:00	-11552
AC1	1/1/2016	0:00:00	-11552
AC1	1/1/2017	0:00:00	-11552
AC1	1/1/2018	0:00:00	-11552
AC1	1/1/2019	0:00:00	-11552
AC1	1/1/2020	0:00:00	-11552
AC1	1/1/2021	0:00:00	-11552
AC1	1/1/2022	0:00:00	-11552
AC2	1/1/1985	0:00:00	0
AC2	1/1/1998	0:00:00	-293
AC2	1/1/1999	0:00:00	-10102
AC2	1/1/2000	0:00:00	-26647
AC2	1/1/2001	0:00:00	-27013
AC2	1/1/2002	0:00:00	-34988
AC2	1/1/2003	0:00:00	-35618
AC2	1/1/2004	0:00:00	-35618
AC2	1/1/2005	0:00:00	-35618
AC2	1/1/2006	0:00:00	-35618
AC2	1/1/2007	0:00:00	-35618
AC2	1/1/2008	0:00:00	-35618
AC2	1/1/2009	0:00:00	-35618
AC2	1/1/2010	0:00:00	-35618
AC2	1/1/2011	0:00:00	-35618
AC2	1/1/2012	0:00:00	-35618
AC2	1/1/2013	0:00:00	-35618
AC2	1/1/2014	0:00:00	-35618
AC2	1/1/2015	0:00:00	-35618

Simulation well pumping file: wells_asr.wpf

AC2	1/1/2016	0:00:00	-35618
AC2	1/1/2017	0:00:00	-35618
AC2	1/1/2018	0:00:00	-35618
AC2	1/1/2019	0:00:00	-35618
AC2	1/1/2020	0:00:00	-35618
AC2	1/1/2021	0:00:00	-35618
AC2	1/1/2022	0:00:00	-35618
AC3	1/1/1985	0:00:00	0
AC3	1/1/2001	0:00:00	-24414
AC3	1/1/2002	0:00:00	-40162
AC3	1/1/2003	0:00:00	-40564
AC3	1/1/2004	0:00:00	-40969
AC3	1/1/2005	0:00:00	-38506
AC3	1/1/2006	0:00:00	-38506
AC3	1/1/2007	0:00:00	-38506
AC3	1/1/2008	0:00:00	-38506
AC3	1/1/2009	0:00:00	-38506
AC3	1/1/2010	0:00:00	-38506
AC3	1/1/2011	0:00:00	-38506
AC3	1/1/2012	0:00:00	-38506
AC3	1/1/2013	0:00:00	-38506
AC3	1/1/2014	0:00:00	-38506
AC3	1/1/2015	0:00:00	-38506
AC3	1/1/2016	0:00:00	-38506
AC3	1/1/2017	0:00:00	-38506
AC3	1/1/2018	0:00:00	-38506
AC3	1/1/2019	0:00:00	-38506
AC3	1/1/2020	0:00:00	-38506
AC3	1/1/2021	0:00:00	-38506
AC3	1/1/2022	0:00:00	-38506
DD1	1/1/1985	0:00:00	0
DD1	1/1/1993	0:00:00	-29
DD1	1/1/1994	0:00:00	-27049
DD1	1/1/1995	0:00:00	-22181
DD1	1/1/1996	0:00:00	-17203
DD1	1/1/1997	0:00:00	-36969
DD1	1/1/1998	0:00:00	-33235
DD1	1/1/1999	0:00:00	-44326
DD1	1/1/2000	0:00:00	-43008
DD1	1/1/2001	0:00:00	-44472
DD1	1/1/2002	0:00:00	-33239
DD1	1/1/2003	0:00:00	-33571
DD1	1/1/2004	0:00:00	-33907
DD1	1/1/2005	0:00:00	-34246
DD1	1/1/2006	0:00:00	-34589
DD1	1/1/2007	0:00:00	-34890
DD1	1/1/2008	0:00:00	-32730
DD1	1/1/2009	0:00:00	-32730
DD1	1/1/2010	0:00:00	-32730
DD1	1/1/2011	0:00:00	-32730
DD1	1/1/2012	0:00:00	-32730
DD1	1/1/2013	0:00:00	-32730

Simulation well pumping file: wells_asr.wpf

DD1	1/1/2014	0:00:00	-32730
DD1	1/1/2015	0:00:00	-32730
DD1	1/1/2016	0:00:00	-32730
DD1	1/1/2017	0:00:00	-32730
DD1	1/1/2018	0:00:00	-32730
DD1	1/1/2019	0:00:00	-32730
DD1	1/1/2020	0:00:00	-32730
DD1	1/1/2021	0:00:00	-32730
DD1	1/1/2022	0:00:00	-32730
DD2	1/1/1985	0:00:00	0
DD2	1/1/1997	0:00:00	-2855
DD2	1/1/1998	0:00:00	-25329
DD2	1/1/1999	0:00:00	-33748
DD2	1/1/2000	0:00:00	-23792
DD2	1/1/2001	0:00:00	-30380
DD2	1/1/2002	0:00:00	-26112
DD2	1/1/2003	0:00:00	-26373
DD2	1/1/2004	0:00:00	-26637
DD2	1/1/2005	0:00:00	-26903
DD2	1/1/2006	0:00:00	-27172
DD2	1/1/2007	0:00:00	-27444
DD2	1/1/2008	0:00:00	-26954
DD2	1/1/2009	0:00:00	-26954
DD2	1/1/2010	0:00:00	-26954
DD2	1/1/2011	0:00:00	-26954
DD2	1/1/2012	0:00:00	-26954
DD2	1/1/2013	0:00:00	-26954
DD2	1/1/2014	0:00:00	-26954
DD2	1/1/2015	0:00:00	-26954
DD2	1/1/2016	0:00:00	-26954
DD2	1/1/2017	0:00:00	-26954
DD2	1/1/2018	0:00:00	-26954
DD2	1/1/2019	0:00:00	-26954
DD2	1/1/2020	0:00:00	-26954
DD2	1/1/2021	0:00:00	-26954
DD2	1/1/2022	0:00:00	-26954
Sunrise1	1/1/1985	0:00:00	-476
Sunrise1	1/1/1986	0:00:00	-1025
Sunrise1	1/1/1987	0:00:00	-1061
Sunrise1	1/1/1988	0:00:00	-1611
Sunrise1	1/1/1989	0:00:00	-3331
Sunrise1	1/1/1990	0:00:00	-2635
Sunrise1	1/1/1991	0:00:00	-4685
Sunrise1	1/1/1992	0:00:00	-5710
Sunrise1	1/1/1993	0:00:00	-6003
Sunrise1	1/1/1994	0:00:00	-6259
Sunrise1	1/1/1995	0:00:00	-5051
Sunrise1	1/1/1996	0:00:00	-6222
Sunrise1	1/1/1997	0:00:00	-5710
Sunrise1	1/1/1998	0:00:00	-6113
Sunrise1	1/1/1999	0:00:00	-8053
Sunrise1	1/1/2000	0:00:00	-7540

Simulation well pumping file: wells_asr.wpf

Sunrise1	1/1/2001	0:00:00	-7723
Sunrise1	1/1/2002	0:00:00	-8053
Sunrise1	1/1/2003	0:00:00	-8053
Sunrise1	1/1/2004	0:00:00	-8053
Sunrise1	1/1/2005	0:00:00	-8053
Sunrise1	1/1/2006	0:00:00	-8053
Sunrise1	1/1/2007	0:00:00	-8053
Sunrise1	1/1/2008	0:00:00	-8053
Sunrise1	1/1/2009	0:00:00	-8053
Sunrise1	1/1/2010	0:00:00	-8053
Sunrise1	1/1/2011	0:00:00	-8053
Sunrise1	1/1/2012	0:00:00	-8053
Sunrise1	1/1/2013	0:00:00	-8053
Sunrise1	1/1/2014	0:00:00	-8053
Sunrise1	1/1/2015	0:00:00	-8053
Sunrise1	1/1/2016	0:00:00	-8053
Sunrise1	1/1/2017	0:00:00	-8053
Sunrise1	1/1/2018	0:00:00	-8053
Sunrise1	1/1/2019	0:00:00	-8053
Sunrise1	1/1/2020	0:00:00	-8053
Sunrise1	1/1/2021	0:00:00	-8053
Sunrise1	1/1/2022	0:00:00	-8053
Sunrise2	1/1/1985	0:00:00	0
Sunrise2	1/1/2001	0:00:00	-83
Sunrise2	1/1/2002	0:00:00	-87
Sunrise2	1/1/2003	0:00:00	-88
Sunrise2	1/1/2004	0:00:00	-89
Sunrise2	1/1/2005	0:00:00	-90
Sunrise2	1/1/2006	0:00:00	-91
Sunrise2	1/1/2007	0:00:00	-91
Sunrise2	1/1/2008	0:00:00	-92
Sunrise2	1/1/2009	0:00:00	-93
Sunrise2	1/1/2010	0:00:00	-94
Sunrise2	1/1/2011	0:00:00	-95
Sunrise2	1/1/2012	0:00:00	-96
Sunrise2	1/1/2013	0:00:00	-97
Sunrise2	1/1/2014	0:00:00	-98
Sunrise2	1/1/2015	0:00:00	-99
Sunrise2	1/1/2016	0:00:00	-100
Sunrise2	1/1/2017	0:00:00	-101
Sunrise2	1/1/2018	0:00:00	-102
Sunrise2	1/1/2019	0:00:00	-103
Sunrise2	1/1/2020	0:00:00	-104
Sunrise2	1/1/2021	0:00:00	-105
Sunrise2	1/1/2022	0:00:00	-106
Mtrose3	1/1/1985	0:00:00	-6222
Mtrose3	1/1/1986	0:00:00	-6589
Mtrose3	1/1/1987	0:00:00	-6955
Mtrose3	1/1/1988	0:00:00	-7321
Mtrose3	1/1/1989	0:00:00	-7687
Mtrose3	1/1/1990	0:00:00	-8053
Mtrose3	1/1/1991	0:00:00	-8748

Simulation well pumping file: wells_asr.wpf

Mtrose3	1/1/1992	0:00:00	-13872
Mtrose3	1/1/1993	0:00:00	-15154
Mtrose3	1/1/1994	0:00:00	-21376
Mtrose3	1/1/1995	0:00:00	-20132
Mtrose3	1/1/1996	0:00:00	-29538
Mtrose3	1/1/1997	0:00:00	-24304
Mtrose3	1/1/1998	0:00:00	-8675
Mtrose3	1/1/1999	0:00:00	-12591
Mtrose3	1/1/2000	0:00:00	-17203
Mtrose3	1/1/2001	0:00:00	-16691
Mtrose3	1/1/2002	0:00:00	-16769
Mtrose3	1/1/2003	0:00:00	-17328
Mtrose3	1/1/2004	0:00:00	-17328
Mtrose3	1/1/2005	0:00:00	-17328
Mtrose3	1/1/2006	0:00:00	-17328
Mtrose3	1/1/2007	0:00:00	-17328
Mtrose3	1/1/2008	0:00:00	-17328
Mtrose3	1/1/2009	0:00:00	-17328
Mtrose3	1/1/2010	0:00:00	-17328
Mtrose3	1/1/2011	0:00:00	-17328
Mtrose3	1/1/2012	0:00:00	-17328
Mtrose3	1/1/2013	0:00:00	-17328
Mtrose3	1/1/2014	0:00:00	-17328
Mtrose3	1/1/2015	0:00:00	-17328
Mtrose3	1/1/2016	0:00:00	-17328
Mtrose3	1/1/2017	0:00:00	-17328
Mtrose3	1/1/2018	0:00:00	-17328
Mtrose3	1/1/2019	0:00:00	-17328
Mtrose3	1/1/2020	0:00:00	-17328
Mtrose3	1/1/2021	0:00:00	-17328
Mtrose3	1/1/2022	0:00:00	-17328
Mtrose5	1/1/1985	0:00:00	0
Mtrose5	1/1/1997	0:00:00	-9773
Mtrose5	1/1/1998	0:00:00	-24707
Mtrose5	1/1/1999	0:00:00	-36603
Mtrose5	1/1/2000	0:00:00	-46229
Mtrose5	1/1/2001	0:00:00	-59370
Mtrose5	1/1/2002	0:00:00	-29192
Mtrose5	1/1/2003	0:00:00	-29264
Mtrose5	1/1/2004	0:00:00	-30727
Mtrose5	1/1/2005	0:00:00	-32264
Mtrose5	1/1/2006	0:00:00	-33877
Mtrose5	1/1/2007	0:00:00	-35570
Mtrose5	1/1/2008	0:00:00	-37350
Mtrose5	1/1/2009	0:00:00	-38506
Mtrose5	1/1/2010	0:00:00	-38506
Mtrose5	1/1/2011	0:00:00	-38506
Mtrose5	1/1/2012	0:00:00	-38506
Mtrose5	1/1/2013	0:00:00	-38506
Mtrose5	1/1/2014	0:00:00	-38506
Mtrose5	1/1/2015	0:00:00	-38506
Mtrose5	1/1/2016	0:00:00	-38506

Simulation well pumping file: wells_asr.wpf

Mtrose5	1/1/2017	0:00:00	-38506
Mtrose5	1/1/2018	0:00:00	-38506
Mtrose5	1/1/2019	0:00:00	-38506
Mtrose5	1/1/2020	0:00:00	-38506
Mtrose5	1/1/2021	0:00:00	-38506
Mtrose5	1/1/2022	0:00:00	-38506
Mtrose6	1/1/1985	0:00:00	0
Mtrose6	1/1/2002	0:00:00	-26405
Mtrose6	1/1/2003	0:00:00	-26415
Mtrose6	1/1/2004	0:00:00	-27735
Mtrose6	1/1/2005	0:00:00	-28879
Mtrose6	1/1/2006	0:00:00	-28879
Mtrose6	1/1/2007	0:00:00	-28879
Mtrose6	1/1/2008	0:00:00	-28879
Mtrose6	1/1/2009	0:00:00	-28879
Mtrose6	1/1/2010	0:00:00	-28879
Mtrose6	1/1/2011	0:00:00	-28879
Mtrose6	1/1/2012	0:00:00	-28879
Mtrose6	1/1/2013	0:00:00	-28879
Mtrose6	1/1/2014	0:00:00	-28879
Mtrose6	1/1/2015	0:00:00	-28879
Mtrose6	1/1/2016	0:00:00	-28879
Mtrose6	1/1/2017	0:00:00	-28879
Mtrose6	1/1/2018	0:00:00	-28879
Mtrose6	1/1/2019	0:00:00	-28879
Mtrose6	1/1/2020	0:00:00	-28879
Mtrose6	1/1/2021	0:00:00	-28879
Mtrose6	1/1/2022	0:00:00	-28879
SJ1	1/1/1985	0:00:00	0
SJ1	1/1/1998	0:00:00	-476
SJ1	1/1/1999	0:00:00	-4429
SJ1	1/1/2000	0:00:00	-3660
SJ1	1/1/2001	0:00:00	-3624
SJ1	1/1/2002	0:00:00	-5531
SJ1	1/1/2003	0:00:00	-6141
SJ1	1/1/2004	0:00:00	-6755
SJ1	1/1/2005	0:00:00	-7430
SJ1	1/1/2006	0:00:00	-8174
SJ1	1/1/2007	0:00:00	-8991
SJ1	1/1/2008	0:00:00	-9890
SJ1	1/1/2009	0:00:00	-10879
SJ1	1/1/2010	0:00:00	-11967
SJ1	1/1/2011	0:00:00	-13164
SJ1	1/1/2012	0:00:00	-14440
SJ1	1/1/2013	0:00:00	-14440
SJ1	1/1/2014	0:00:00	-14440
SJ1	1/1/2015	0:00:00	-14440
SJ1	1/1/2016	0:00:00	-14440
SJ1	1/1/2017	0:00:00	-14440
SJ1	1/1/2018	0:00:00	-14440
SJ1	1/1/2019	0:00:00	-14440
SJ1	1/1/2020	0:00:00	-14440

Simulation well pumping file: wells_asr.wpf

SJ1	1/1/2021	0:00:00	-14440
SJ1	1/1/2022	0:00:00	-14440
SJ2	1/1/1985	0:00:00	0
SJ2	1/1/1997	0:00:00	-3514
SJ2	1/1/1998	0:00:00	-6186
SJ2	1/1/1999	0:00:00	-5564
SJ2	1/1/2000	0:00:00	-2965
SJ2	1/1/2001	0:00:00	-5490
SJ2	1/1/2002	0:00:00	-7222
SJ2	1/1/2003	0:00:00	-7944
SJ2	1/1/2004	0:00:00	-8738
SJ2	1/1/2005	0:00:00	-9612
SJ2	1/1/2006	0:00:00	-10573
SJ2	1/1/2007	0:00:00	-11630
SJ2	1/1/2008	0:00:00	-12794
SJ2	1/1/2009	0:00:00	-14073
SJ2	1/1/2010	0:00:00	-14440
SJ2	1/1/2011	0:00:00	-14440
SJ2	1/1/2012	0:00:00	-14440
SJ2	1/1/2013	0:00:00	-14440
SJ2	1/1/2014	0:00:00	-14440
SJ2	1/1/2015	0:00:00	-14440
SJ2	1/1/2016	0:00:00	-14440
SJ2	1/1/2017	0:00:00	-14440
SJ2	1/1/2018	0:00:00	-14440
SJ2	1/1/2019	0:00:00	-14440
SJ2	1/1/2020	0:00:00	-14440
SJ2	1/1/2021	0:00:00	-14440
SJ2	1/1/2022	0:00:00	-14440
Tessa1	1/1/1985	0:00:00	0
Tessa1	1/1/2002	0:00:00	0
Tessa1	1/1/2003	0:00:00	-18771
Tessa1	1/1/2004	0:00:00	-20648
Tessa1	1/1/2005	0:00:00	-22715
Tessa1	1/1/2006	0:00:00	-24984
Tessa1	1/1/2007	0:00:00	-27483
Tessa1	1/1/2008	0:00:00	-28879
Tessa1	1/1/2009	0:00:00	-28879
Tessa1	1/1/2010	0:00:00	-28879
Tessa1	1/1/2011	0:00:00	-28879
Tessa1	1/1/2012	0:00:00	-28879
Tessa1	1/1/2013	0:00:00	-28879
Tessa1	1/1/2014	0:00:00	-28879
Tessa1	1/1/2015	0:00:00	-28879
Tessa1	1/1/2016	0:00:00	-28879
Tessa1	1/1/2017	0:00:00	-28879
Tessa1	1/1/2018	0:00:00	-28879
Tessa1	1/1/2019	0:00:00	-28879
Tessa1	1/1/2020	0:00:00	-28879
Tessa1	1/1/2021	0:00:00	-28879
Tessa1	1/1/2022	0:00:00	-28879
Tessa2	1/1/1985	0:00:00	0

Simulation well pumping file: wells_asr.wpf

Tessa2	1/1/2002	0:00:00	0
Tessa2	1/1/2003	0:00:00	-24547
Tessa2	1/1/2004	0:00:00	-27000
Tessa2	1/1/2005	0:00:00	-29702
Tessa2	1/1/2006	0:00:00	-32670
Tessa2	1/1/2007	0:00:00	-35939
Tessa2	1/1/2008	0:00:00	-38506
Tessa2	1/1/2009	0:00:00	-38506
Tessa2	1/1/2010	0:00:00	-38506
Tessa2	1/1/2011	0:00:00	-38506
Tessa2	1/1/2012	0:00:00	-38506
Tessa2	1/1/2013	0:00:00	-38506
Tessa2	1/1/2014	0:00:00	-38506
Tessa2	1/1/2015	0:00:00	-38506
Tessa2	1/1/2016	0:00:00	-38506
Tessa2	1/1/2017	0:00:00	-38506
Tessa2	1/1/2018	0:00:00	-38506
Tessa2	1/1/2019	0:00:00	-38506
Tessa2	1/1/2020	0:00:00	-38506
Tessa2	1/1/2021	0:00:00	-38506
Tessa2	1/1/2022	0:00:00	-38506
Picollo	1/1/1985	0:00:00	0
Holcomb	1/1/1985	0:00:00	0
Holcomb	1/1/1988	0:00:00	-3339
Holcomb	1/1/1989	0:00:00	-87179
Holcomb	1/1/1990	0:00:00	-57960
Holcomb	1/1/1991	0:00:00	-74419
Holcomb	1/1/1992	0:00:00	-17889
Holcomb	1/1/1993	0:00:00	-2743
Holcomb	1/1/1994	0:00:00	-23852
Holcomb	1/1/1995	0:00:00	-13238
Holcomb	1/1/1996	0:00:00	-20155
Holcomb	1/1/1997	0:00:00	-23017
Holcomb	1/1/1998	0:00:00	-50686
Holcomb	1/1/1999	0:00:00	-21944
Holcomb	1/1/2000	0:00:00	-2504
Holcomb	1/1/2001	0:00:00	-16350
Holcomb	1/1/2002	0:00:00	-19096
Holcomb	1/1/2003	0:00:00	-19096
Holcomb	1/1/2004	0:00:00	-19096
Holcomb	1/1/2005	0:00:00	-19096
Holcomb	1/1/2006	0:00:00	-19096
Holcomb	1/1/2007	0:00:00	-19096
Holcomb	1/1/2008	0:00:00	-19096
Holcomb	1/1/2009	0:00:00	-19096
Holcomb	1/1/2010	0:00:00	-19096
Holcomb	1/1/2011	0:00:00	-19096
Holcomb	1/1/2012	0:00:00	-19096
Holcomb	1/1/2013	0:00:00	-19096
Holcomb	1/1/2014	0:00:00	-19096
Holcomb	1/1/2015	0:00:00	-19096
Holcomb	1/1/2016	0:00:00	-19096

Simulation well pumping file: wells_asr.wpf

Holcomb	1/1/2017	0:00:00	-19096
Holcomb	1/1/2018	0:00:00	-19096
Holcomb	1/1/2019	0:00:00	-19096
Holcomb	1/1/2020	0:00:00	-19096
Holcomb	1/1/2021	0:00:00	-19096
Holcomb	1/1/2022	0:00:00	-19096
Patriot	1/1/1985	0:00:00	0
Patriot	1/1/1990	0:00:00	-2862
Patriot	1/1/1991	0:00:00	-63327
Patriot	1/1/1992	0:00:00	-117471
Patriot	1/1/1993	0:00:00	-101013
Patriot	1/1/1994	0:00:00	-101729
Patriot	1/1/1995	0:00:00	-80978
Patriot	1/1/1996	0:00:00	-65951
Patriot	1/1/1997	0:00:00	-38521
Patriot	1/1/1998	0:00:00	-34824
Patriot	1/1/1999	0:00:00	-48658
Patriot	1/1/2000	0:00:00	-23494
Patriot	1/1/2001	0:00:00	-33494
Patriot	1/1/2002	0:00:00	-35805
Patriot	1/1/2003	0:00:00	-35805
Patriot	1/1/2004	0:00:00	-35805
Patriot	1/1/2005	0:00:00	-35805
Patriot	1/1/2006	0:00:00	-35805
Patriot	1/1/2007	0:00:00	-35805
Patriot	1/1/2008	0:00:00	-35805
Patriot	1/1/2009	0:00:00	-35805
Patriot	1/1/2010	0:00:00	-35805
Patriot	1/1/2011	0:00:00	-35805
Patriot	1/1/2012	0:00:00	-35805
Patriot	1/1/2013	0:00:00	-35805
Patriot	1/1/2014	0:00:00	-35805
Patriot	1/1/2015	0:00:00	-35805
Patriot	1/1/2016	0:00:00	-35805
Patriot	1/1/2017	0:00:00	-35805
Patriot	1/1/2018	0:00:00	-35805
Patriot	1/1/2019	0:00:00	-35805
Patriot	1/1/2020	0:00:00	-35805
Patriot	1/1/2021	0:00:00	-35805
Patriot	1/1/2022	0:00:00	-35805
Longley	1/1/1985	0:00:00	0
Longley	1/1/2000	0:00:00	-25402
Longley	1/1/2001	0:00:00	-44756
Longley	1/1/2002	0:00:00	-41772
Longley	1/1/2003	0:00:00	-47750
Longley	1/1/2004	0:00:00	-47750
Longley	1/1/2005	0:00:00	-47750
Longley	1/1/2006	0:00:00	-47750
Longley	1/1/2007	0:00:00	-47750
Longley	1/1/2008	0:00:00	-47750
Longley	1/1/2009	0:00:00	-47750
Longley	1/1/2010	0:00:00	-47750

Simulation well pumping file: wells_asr.wpf

Longley	1/1/2011	0:00:00	-47750
Longley	1/1/2012	0:00:00	-47750
Longley	1/1/2013	0:00:00	-47750
Longley	1/1/2014	0:00:00	-47750
Longley	1/1/2015	0:00:00	-47750
Longley	1/1/2016	0:00:00	-47750
Longley	1/1/2017	0:00:00	-47750
Longley	1/1/2018	0:00:00	-47750
Longley	1/1/2019	0:00:00	-47750
Longley	1/1/2020	0:00:00	-47750
Longley	1/1/2021	0:00:00	-47750
Longley	1/1/2022	0:00:00	-47750
CallamontN	1/1/1985	0:00:00	0
CallamontN	1/1/2003	0:00:00	0
CallamontN	1/1/2004	0:00:00	0
CallamontN	1/1/2005	0:00:00	-21177
CallamontN	1/1/2006	0:00:00	-23296
CallamontN	1/1/2007	0:00:00	-25625
CallamontN	1/1/2008	0:00:00	-28188
CallamontN	1/1/2009	0:00:00	-31006
CallamontN	1/1/2010	0:00:00	-34108
CallamontN	1/1/2011	0:00:00	-37520
CallamontN	1/1/2012	0:00:00	-41270
CallamontN	1/1/2013	0:00:00	-45397
CallamontN	1/1/2014	0:00:00	-49936
CallamontN	1/1/2015	0:00:00	-54929
CallamontN	1/1/2016	0:00:00	-57758
CallamontN	1/1/2017	0:00:00	-57758
CallamontN	1/1/2018	0:00:00	-57758
CallamontN	1/1/2019	0:00:00	-57758
CallamontN	1/1/2020	0:00:00	-57758
CallamontN	1/1/2021	0:00:00	-57758
CallamontN	1/1/2022	0:00:00	-57758
CallamontS	1/1/1985	0:00:00	0
CallamontS	1/1/2003	0:00:00	0
CallamontS	1/1/2004	0:00:00	-19252
CallamontS	1/1/2005	0:00:00	-21178
CallamontS	1/1/2006	0:00:00	-23296
CallamontS	1/1/2007	0:00:00	-25625
CallamontS	1/1/2008	0:00:00	-28188
CallamontS	1/1/2009	0:00:00	-31006
CallamontS	1/1/2010	0:00:00	-34108
CallamontS	1/1/2011	0:00:00	-37520
CallamontS	1/1/2012	0:00:00	-41270
CallamontS	1/1/2013	0:00:00	-45397
CallamontS	1/1/2014	0:00:00	-49936
CallamontS	1/1/2015	0:00:00	-52945
CallamontS	1/1/2016	0:00:00	-52945
CallamontS	1/1/2017	0:00:00	-52945
CallamontS	1/1/2018	0:00:00	-52945
CallamontS	1/1/2019	0:00:00	-52945
CallamontS	1/1/2020	0:00:00	-52945

Simulation well pumping file: wells_asr.wpf

CallamontS	1/1/2021	0:00:00	-52945
CallamontS	1/1/2022	0:00:00	-52945
DD3	1/1/1985	0:00:00	0
DD3	1/1/2003	0:00:00	0
DD3	1/1/2004	0:00:00	0
DD3	1/1/2005	0:00:00	0
DD3	1/1/2006	0:00:00	0
DD3	1/1/2007	0:00:00	-19253
DD3	1/1/2008	0:00:00	-20215
DD3	1/1/2009	0:00:00	-21226
DD3	1/1/2010	0:00:00	-22288
DD3	1/1/2011	0:00:00	-23402
DD3	1/1/2012	0:00:00	-24572
DD3	1/1/2013	0:00:00	-25800
DD3	1/1/2014	0:00:00	-27090
DD3	1/1/2015	0:00:00	-28879
DD3	1/1/2016	0:00:00	-28879
DD3	1/1/2017	0:00:00	-28879
DD3	1/1/2018	0:00:00	-28879
DD3	1/1/2019	0:00:00	-28879
DD3	1/1/2020	0:00:00	-28879
DD3	1/1/2021	0:00:00	-28879
DD3	1/1/2022	0:00:00	-28879
AC4	1/1/1985	0:00:00	0
AC4	1/1/2003	0:00:00	0
AC4	1/1/2004	0:00:00	0
AC4	1/1/2005	0:00:00	-10000
AC4	1/1/2006	0:00:00	-15000
AC4	1/1/2007	0:00:00	-19253
AC4	1/1/2008	0:00:00	-19253
AC4	1/1/2009	0:00:00	-19253
AC4	1/1/2010	0:00:00	-19253
AC4	1/1/2011	0:00:00	-19253
AC4	1/1/2012	0:00:00	-19253
AC4	1/1/2013	0:00:00	-19253
AC4	1/1/2014	0:00:00	-19253
AC4	1/1/2015	0:00:00	-19253
AC4	1/1/2016	0:00:00	-19253
AC4	1/1/2017	0:00:00	-19253
AC4	1/1/2018	0:00:00	-19253
AC4	1/1/2019	0:00:00	-19253
AC4	1/1/2020	0:00:00	-19253
AC4	1/1/2021	0:00:00	-19253
AC4	1/1/2022	0:00:00	-19253
AC5	1/1/1985	0:00:00	0
AC5	1/1/2003	0:00:00	0
AC5	1/1/2004	0:00:00	0
AC5	1/1/2005	0:00:00	0
AC5	1/1/2006	0:00:00	-10000
AC5	1/1/2007	0:00:00	-15000
AC5	1/1/2008	0:00:00	-19253
AC5	1/1/2009	0:00:00	-19253

Simulation well pumping file: wells_asr.wpf

AC5	1/1/2010	0:00:00	-19253
AC5	1/1/2011	0:00:00	-19253
AC5	1/1/2012	0:00:00	-19253
AC5	1/1/2013	0:00:00	-19253
AC5	1/1/2014	0:00:00	-19253
AC5	1/1/2015	0:00:00	-19253
AC5	1/1/2016	0:00:00	-19253
AC5	1/1/2017	0:00:00	-19253
AC5	1/1/2018	0:00:00	-19253
AC5	1/1/2019	0:00:00	-19253
AC5	1/1/2020	0:00:00	-19253
AC5	1/1/2021	0:00:00	-19253
AC5	1/1/2022	0:00:00	-19253
SJ3	1/1/1985	0:00:00	0
SJ3	1/1/2003	0:00:00	0
SJ3	1/1/2004	0:00:00	0
SJ3	1/1/2005	0:00:00	0
SJ3	1/1/2006	0:00:00	0
SJ3	1/1/2007	0:00:00	0
SJ3	1/1/2008	0:00:00	-5000
SJ3	1/1/2009	0:00:00	-5500
SJ3	1/1/2010	0:00:00	-6050
SJ3	1/1/2011	0:00:00	-6655
SJ3	1/1/2012	0:00:00	-7320
SJ3	1/1/2013	0:00:00	-8052
SJ3	1/1/2014	0:00:00	-8857
SJ3	1/1/2015	0:00:00	-9744
SJ3	1/1/2016	0:00:00	-10718
SJ3	1/1/2017	0:00:00	-11790
SJ3	1/1/2018	0:00:00	-12968
SJ3	1/1/2019	0:00:00	-14440
SJ3	1/1/2020	0:00:00	-14440
SJ3	1/1/2021	0:00:00	-14440
SJ3	1/1/2022	0:00:00	-14440
Inject1	1/1/1985	0:00:00	0
Inject1	10/1/2003	0:00:00	96250
Inject1	4/1/2004	0:00:00	0
Inject1	10/1/2004	0:00:00	96250
Inject1	4/1/2005	0:00:00	0
Inject1	10/1/2005	0:00:00	96250
Inject1	4/1/2006	0:00:00	0
Inject1	10/1/2006	0:00:00	96250
Inject1	4/1/2007	0:00:00	0
Inject1	10/1/2007	0:00:00	96250
Inject1	4/1/2008	0:00:00	0
Inject1	10/1/2008	0:00:00	96250
Inject1	4/1/2009	0:00:00	0
Inject1	10/1/2009	0:00:00	96250
Inject1	4/1/2010	0:00:00	0
Inject1	10/1/2010	0:00:00	96250
Inject1	4/1/2011	0:00:00	0
Inject1	10/1/2011	0:00:00	96250

Simulation well pumping file: wells_asr.wpf

Inject1	4/1/2012	0:00:00	0
Inject1	10/1/2012	0:00:00	96250
Inject1	4/1/2013	0:00:00	0
Inject1	10/1/2013	0:00:00	96250
Inject1	4/1/2014	0:00:00	0
Inject1	10/1/2014	0:00:00	96250
Inject1	4/1/2015	0:00:00	0
Inject1	10/1/2015	0:00:00	96250
Inject1	4/1/2016	0:00:00	0
Inject1	10/1/2016	0:00:00	96250
Inject1	4/1/2017	0:00:00	0
Inject1	10/1/2017	0:00:00	96250
Inject1	4/1/2018	0:00:00	0
Inject1	10/1/2018	0:00:00	96250
Inject1	4/1/2019	0:00:00	0
Inject1	10/1/2019	0:00:00	96250
Inject1	4/1/2020	0:00:00	0
Inject1	10/1/2020	0:00:00	96250
Inject1	4/1/2021	0:00:00	0
Inject1	10/1/2021	0:00:00	96250
Inject1	4/1/2022	0:00:00	0
Inject1	10/1/2022	0:00:00	96250
Inject2	1/1/1985	0:00:00	0
Inject2	10/1/2003	0:00:00	96250
Inject2	4/1/2004	0:00:00	0
Inject2	10/1/2004	0:00:00	96250
Inject2	4/1/2005	0:00:00	0
Inject2	10/1/2005	0:00:00	96250
Inject2	4/1/2006	0:00:00	0
Inject2	10/1/2006	0:00:00	96250
Inject2	4/1/2007	0:00:00	0
Inject2	10/1/2007	0:00:00	96250
Inject2	4/1/2008	0:00:00	0
Inject2	10/1/2008	0:00:00	96250
Inject2	4/1/2009	0:00:00	0
Inject2	10/1/2009	0:00:00	96250
Inject2	4/1/2010	0:00:00	0
Inject2	10/1/2010	0:00:00	96250
Inject2	4/1/2011	0:00:00	0
Inject2	10/1/2011	0:00:00	96250
Inject2	4/1/2012	0:00:00	0
Inject2	10/1/2012	0:00:00	96250
Inject2	4/1/2013	0:00:00	0
Inject2	10/1/2013	0:00:00	96250
Inject2	4/1/2014	0:00:00	0
Inject2	10/1/2014	0:00:00	96250
Inject2	4/1/2015	0:00:00	0
Inject2	10/1/2015	0:00:00	96250
Inject2	4/1/2016	0:00:00	0
Inject2	10/1/2016	0:00:00	96250
Inject2	4/1/2017	0:00:00	0
Inject2	10/1/2017	0:00:00	96250

Simulation well pumping file: wells_asr.wpf

Inject2	4/1/2018	0:00:00	0
Inject2	10/1/2018	0:00:00	96250
Inject2	4/1/2019	0:00:00	0
Inject2	10/1/2019	0:00:00	96250
Inject2	4/1/2020	0:00:00	0
Inject2	10/1/2020	0:00:00	96250
Inject2	4/1/2021	0:00:00	0
Inject2	10/1/2021	0:00:00	96250
Inject2	4/1/2022	0:00:00	0
Inject2	10/1/2022	0:00:00	96250

VOLUMETRIC BUDGET FOR THE ENTIRE MODEL AT THE END OF TIME STEP 1 IN STRESS PERIOD 1

RATES FOR THIS TIME STEP L*3

IN:

CONSTANT HEAD	=	682.4919
WELLS	=	2071000
RIVER LEAKAGE	=	457.1176
ET	=	0
RECHARGE	=	219450
TOTAL IN	=	2291589.5

OUT:

CONSTANT HEAD	=	93390.9688
WELLS	=	108248.4219
RIVER LEAKAGE	=	1016284.125
ET	=	1072850.875
RECHARGE	=	0
TOTAL OUT	=	2290774.5
IN-OUT	=	815
PERCENT DISCREPANCY	=	0.04

VOLUMETRIC BUDGET FOR THE ENTIRE MODEL AT THE END OF TIME STEP 4 IN STRESS PERIOD 38

CUMULATIVE VOLUMES L*3

RATES FOR THIS TIME STEP L*3

IN:

STORAGE	=	3868075264	STORAGE	=	233619.94
CONSTANT HEAD	=	14997674	CONSTANT HEAD	=	1704.7577
WELLS	=	28744448000	WELLS	=	2071000
RIVER LEAKAGE	=	149898896	RIVER LEAKAGE	=	29131.387
ET	=	0	ET	=	0
RECHARGE	=	3045861888	RECHARGE	=	219450
TOTAL IN	=	35823284224	TOTAL IN	=	2554906

OUT:

STORAGE	=	25804534	STORAGE	=	0
CONSTANT HEAD	=	1190929792	CONSTANT HEAD	=	79086.25
WELLS	=	10409761792	WELLS	=	1062781.3
RIVER LEAKAGE	=	12640006144	RIVER LEAKAGE	=	754368.31
ET	=	11557513216	ET	=	658901
RECHARGE	=	0	RECHARGE	=	0
TOTAL OUT	=	35824017408	TOTAL OUT	=	2555136.8
IN-OUT	=	-733184	IN-OUT	=	-230.75
PERCENT DISCREPANCY	=	0	PERCENT DISCREPANCY	=	-0.01