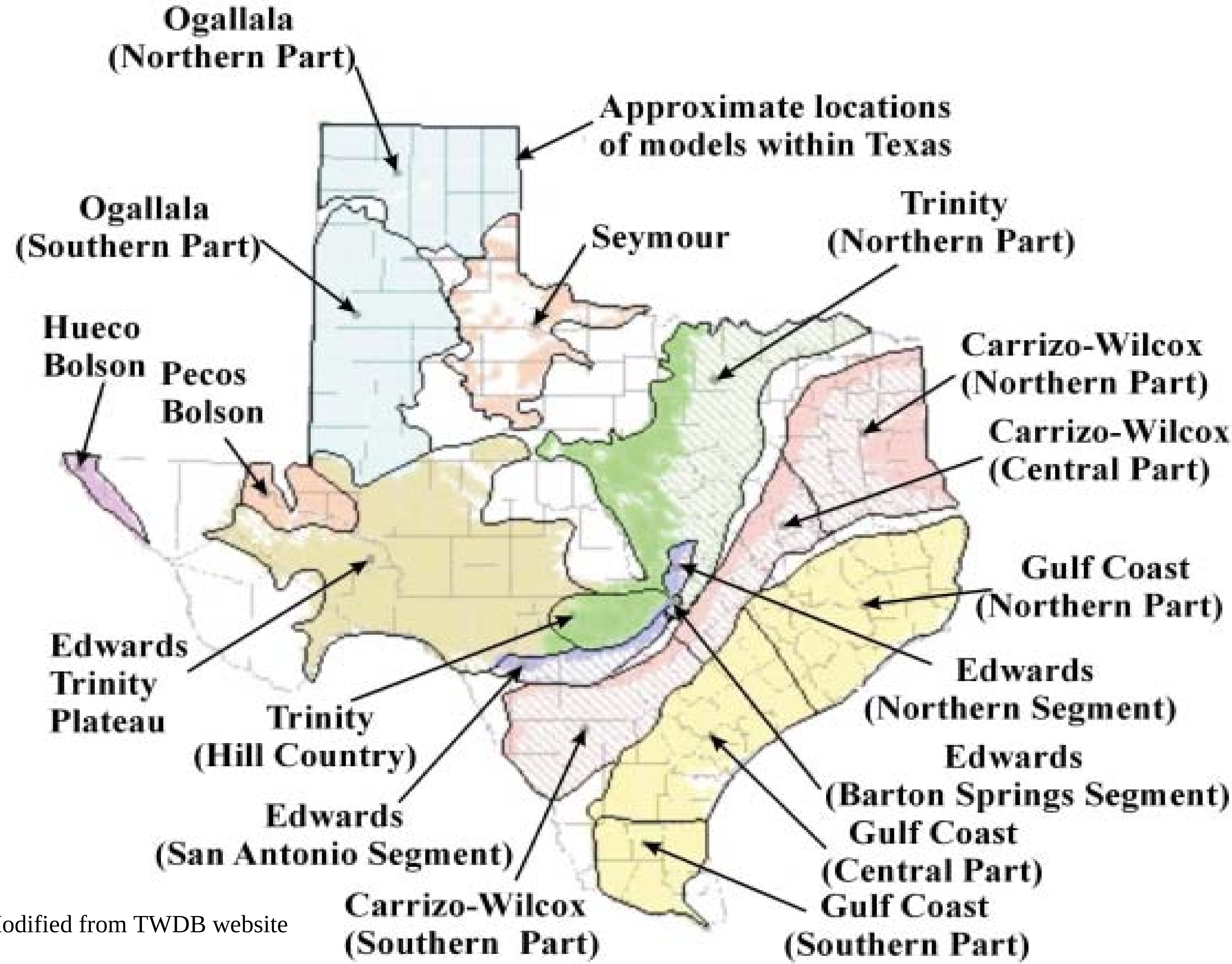
Hydrogeology, Simulation of Ground-Water Flow, and Land-Surface Subsidence in the Chicot, Evangeline, and Jasper Aquifers, Houston Area, Texas

By Mark C. Kasmarek, James L. Robinson, and Eric W. Strom

In Cooperation with the Texas Water Development Board and the Harris-Galveston Coastal Subsidence District

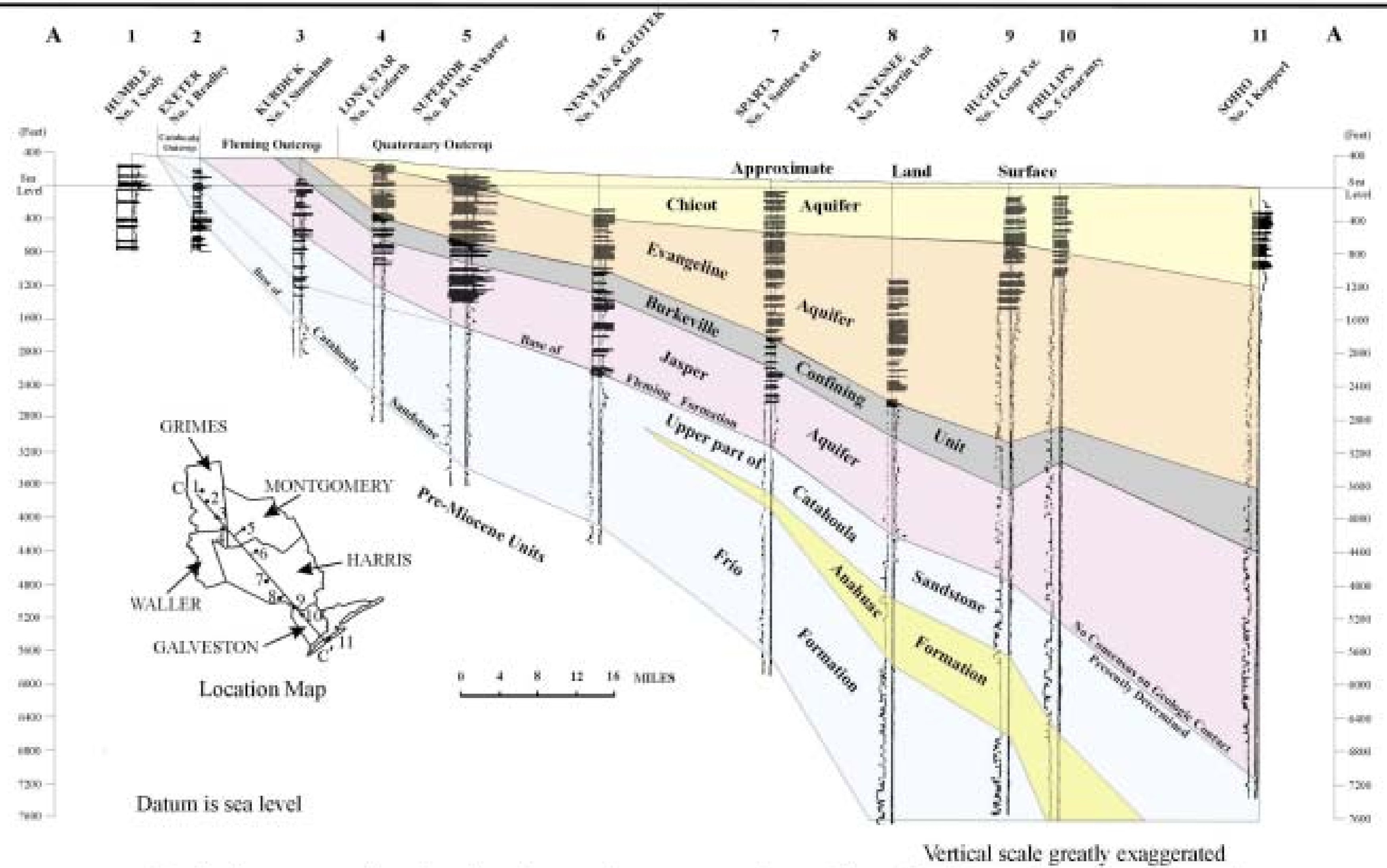
TWDB Ground-Water Availability Models in Texas



Modified from TWDB website

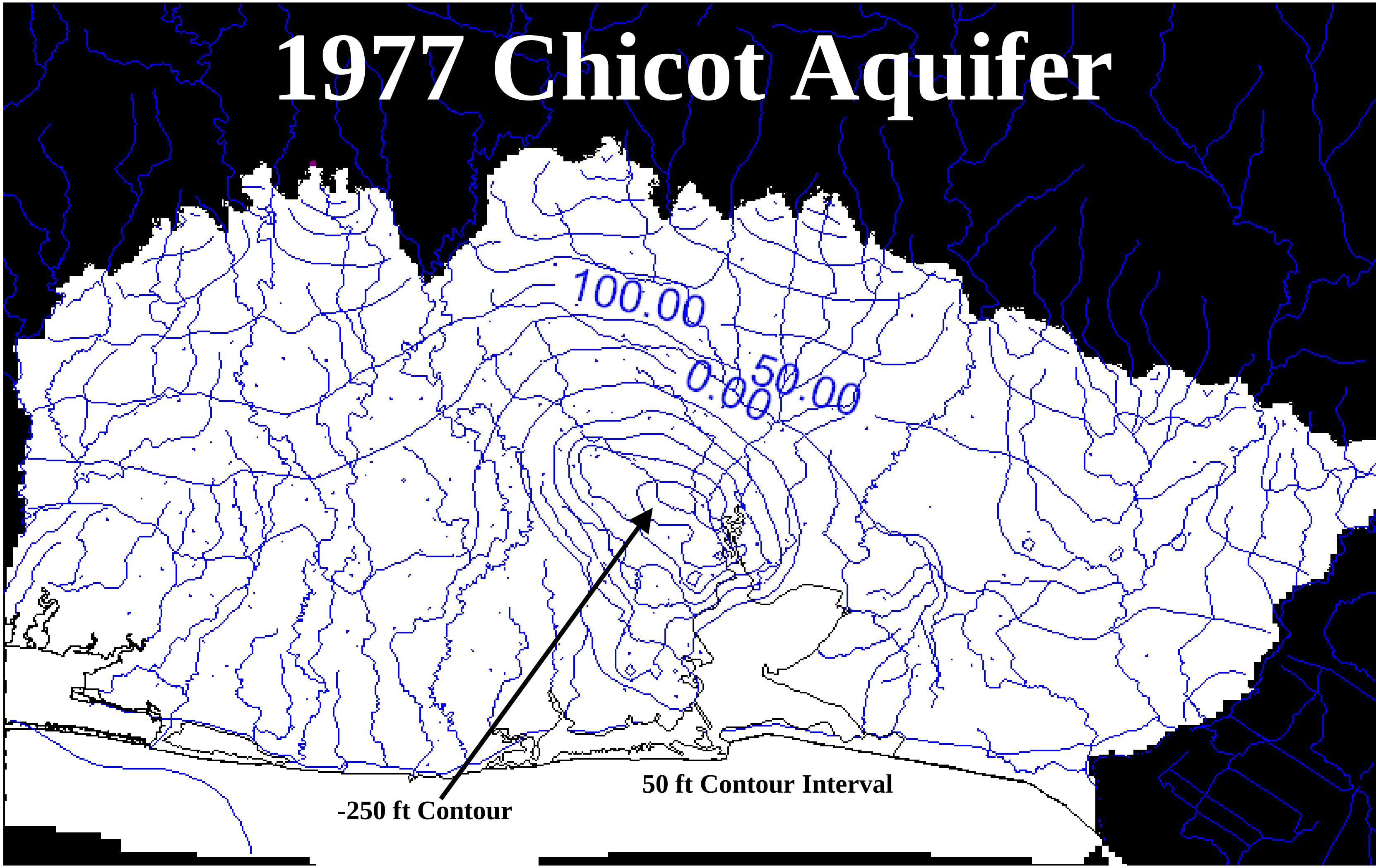
GAM Upper Gulf Coast Aquifer Outcrops

Stratigraphic and Hydrologic Sections



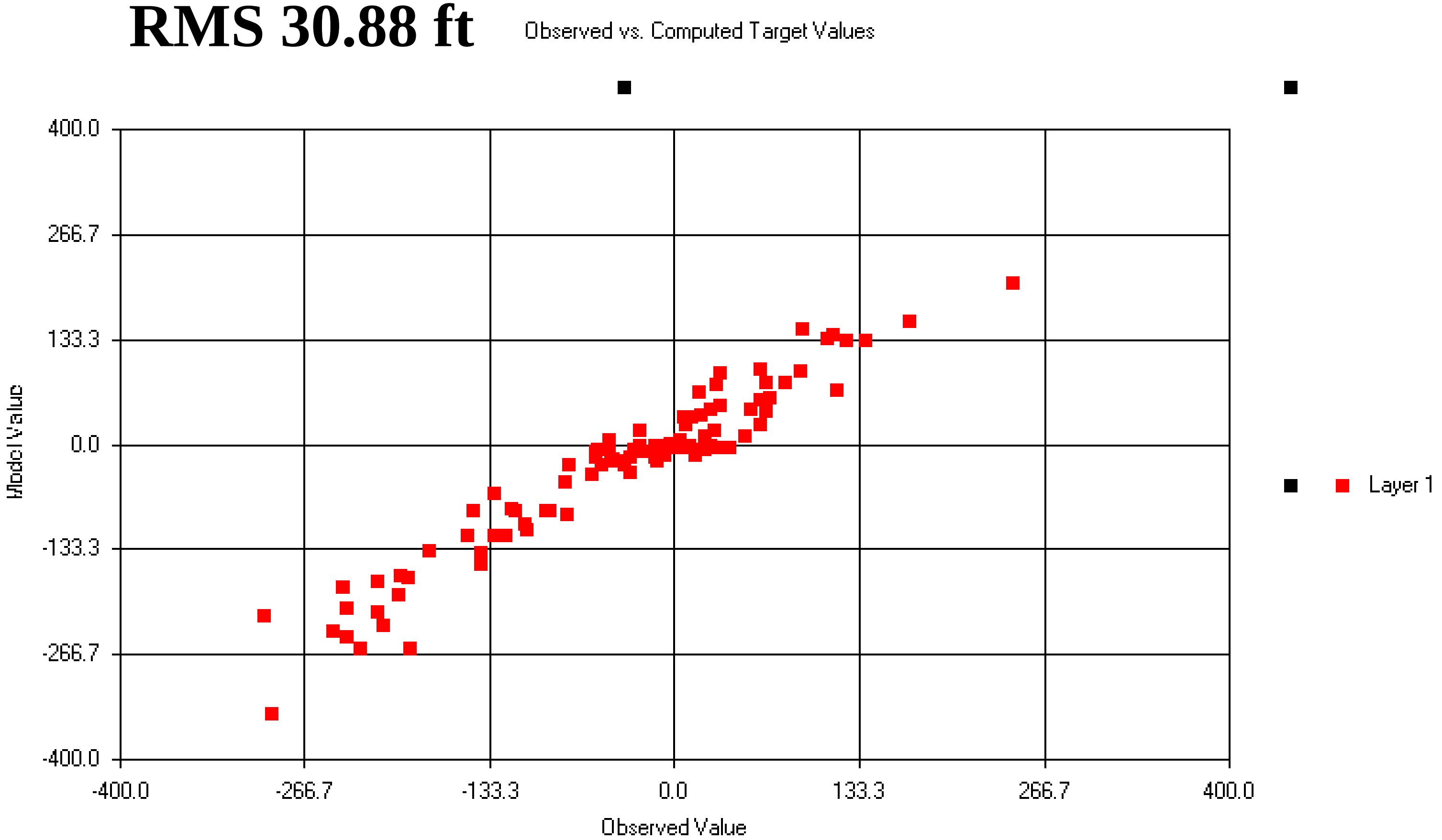
Geologic cross section showing the northwest to southeast dip and relation of stratigraphic and hydrologic units (modified from Baker, 1986).

1977 Chicot Aquifer

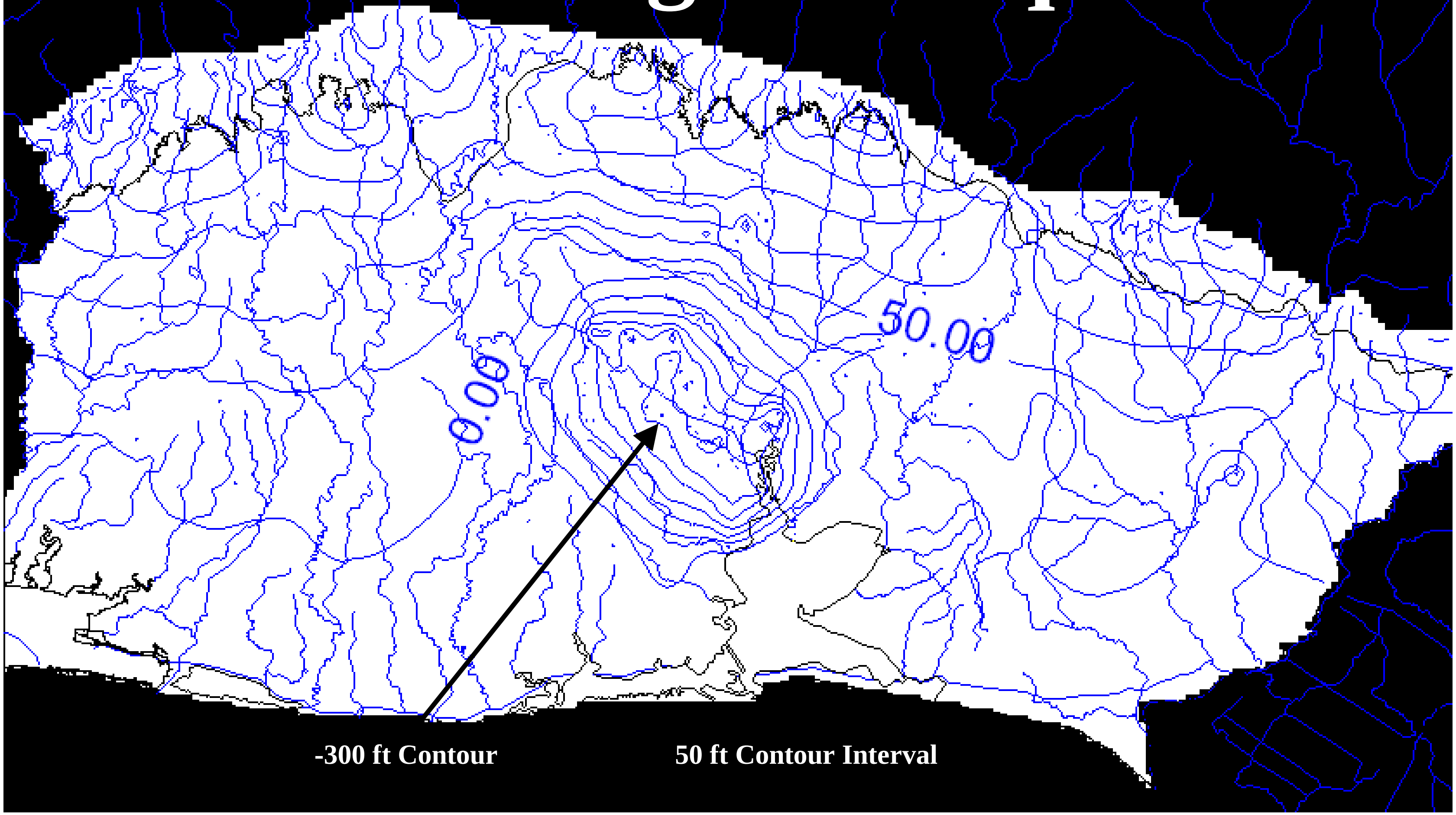


1977 Chicot Aquifer RMS

RMS 30.88 ft

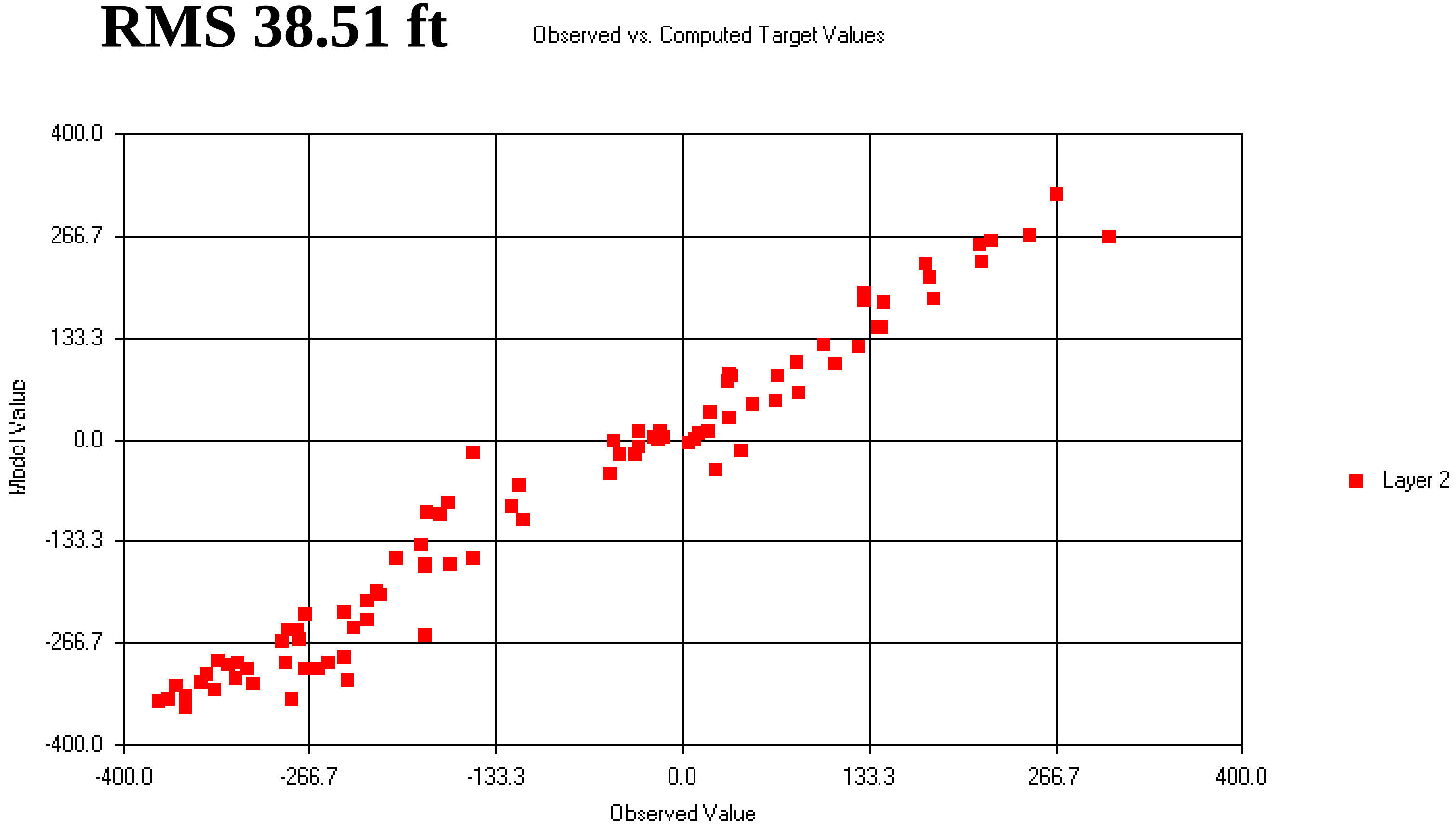


1977 Evangeline Aquifer



1977 Evangeline Aquifer RMS

RMS 38.51 ft



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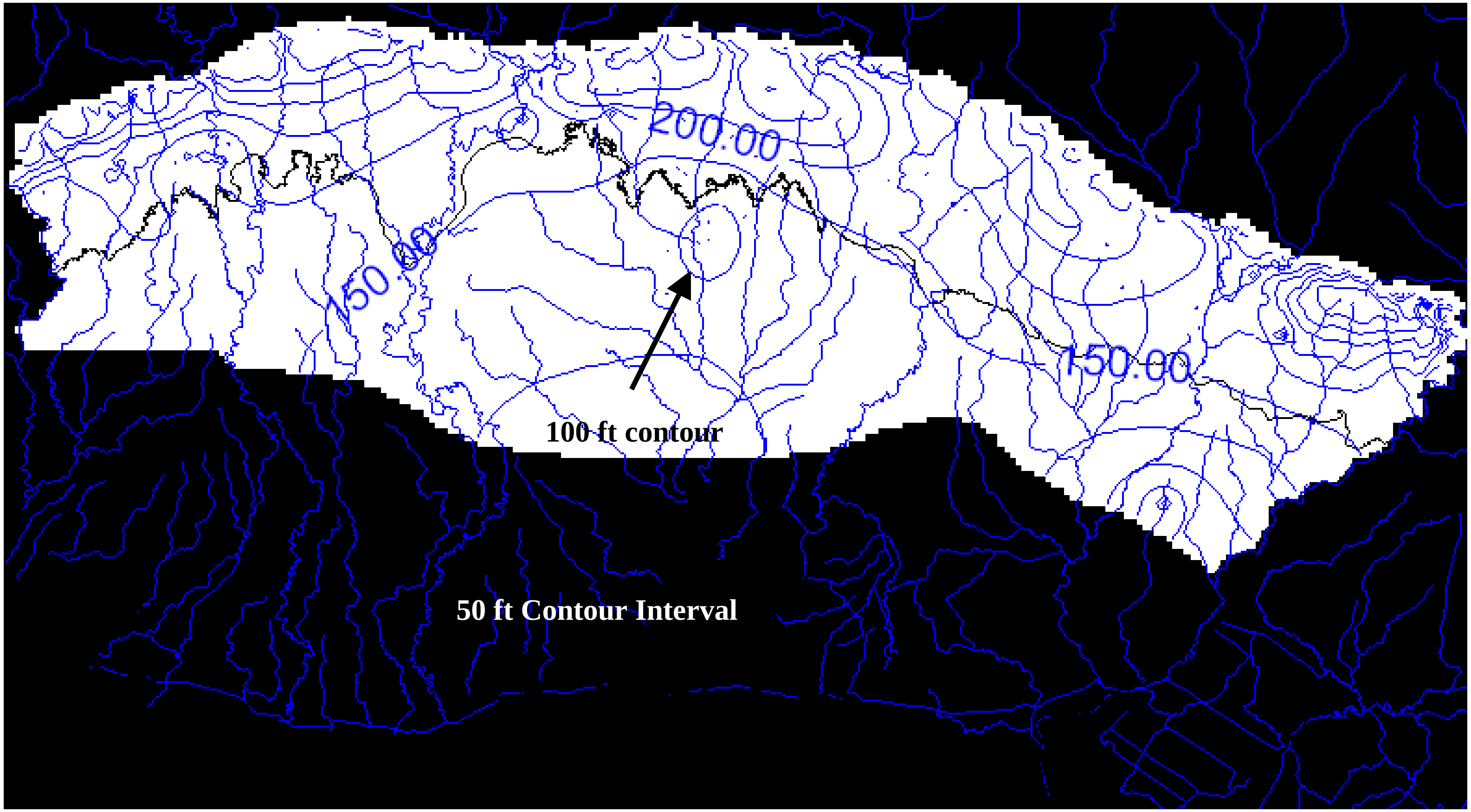
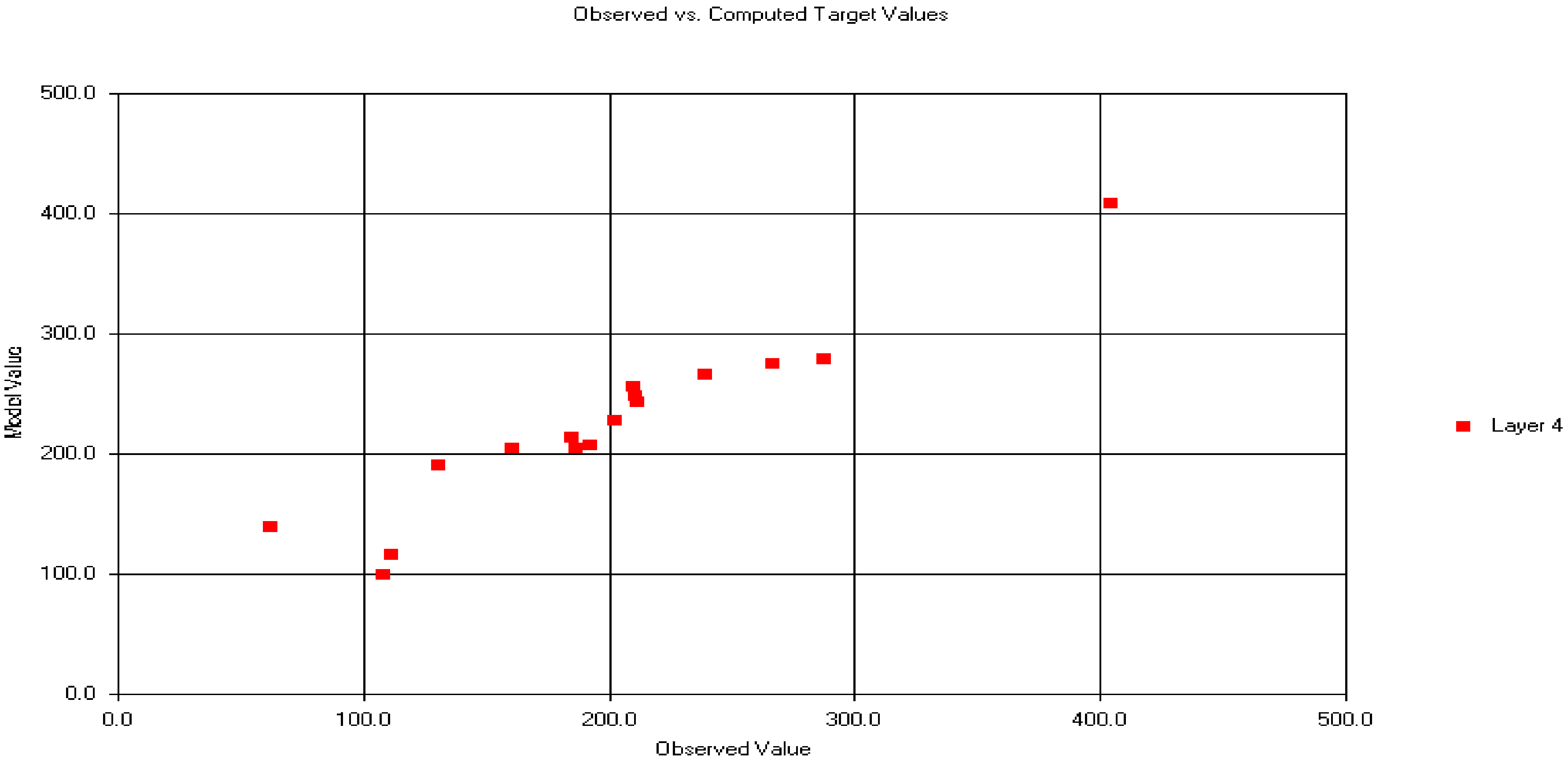
1977 Jasper Aquifer

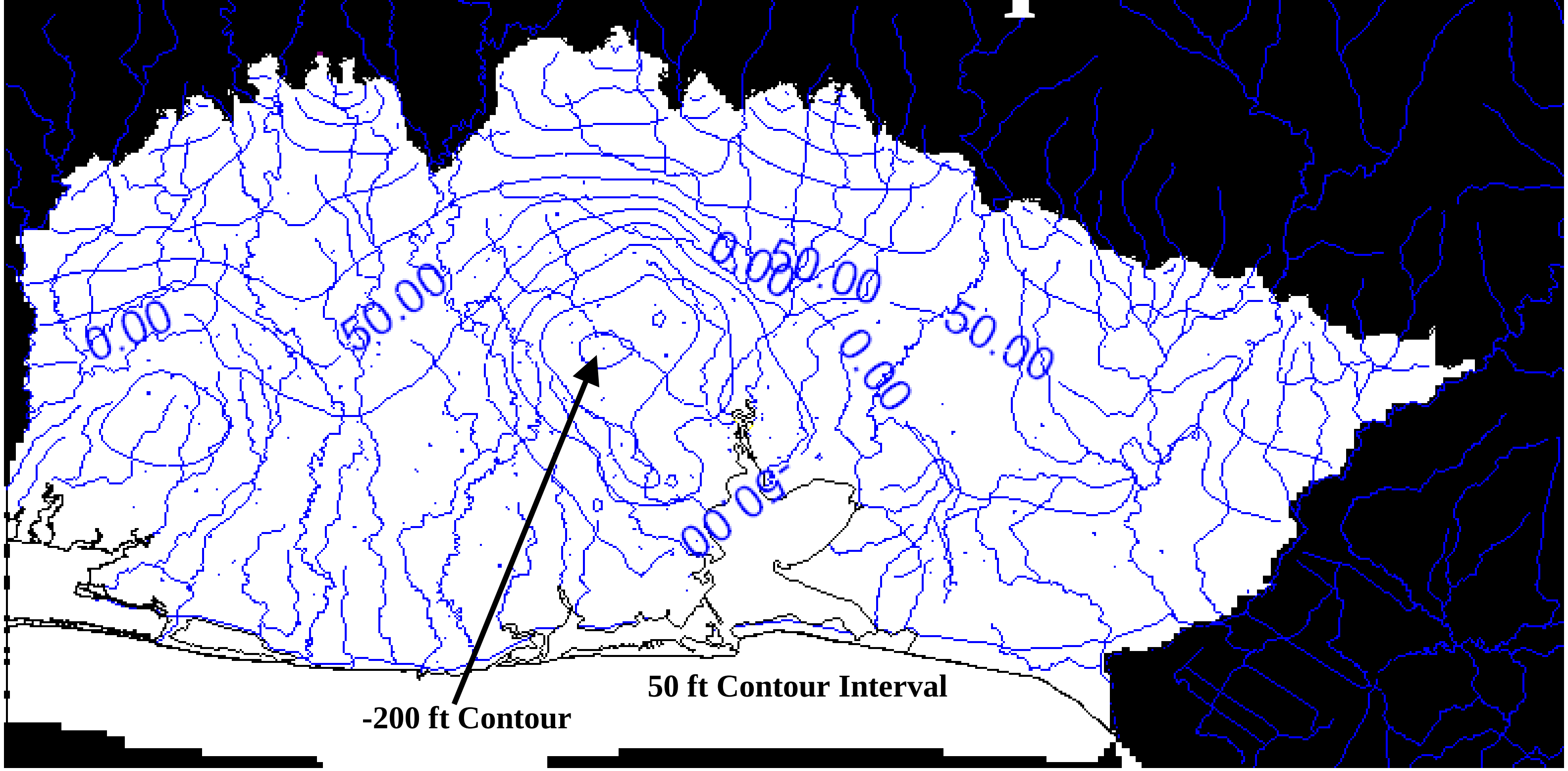


1977 Jasper Aquifer RMS

RMS 35.14

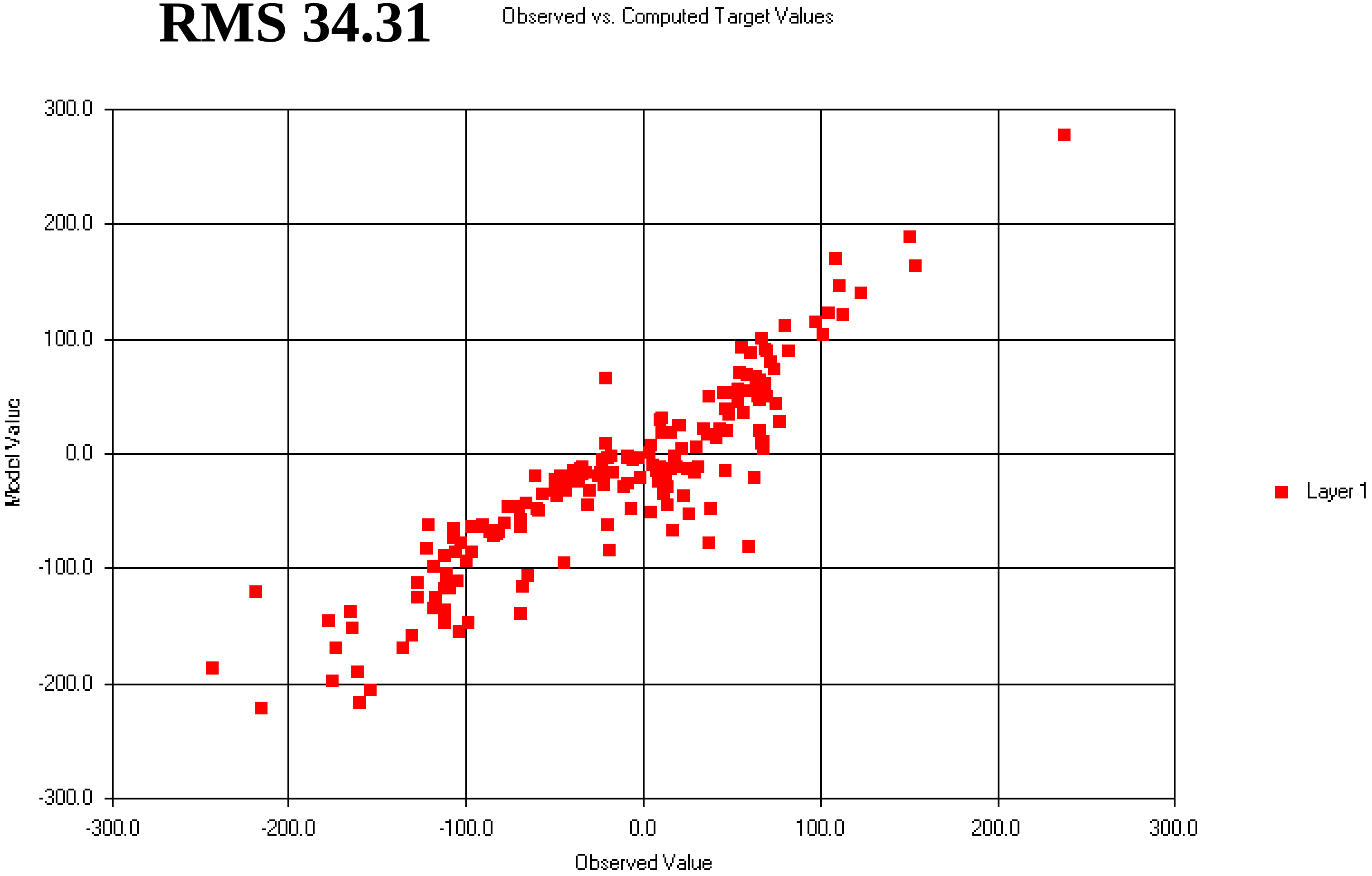


1997 Chicot Aquifer

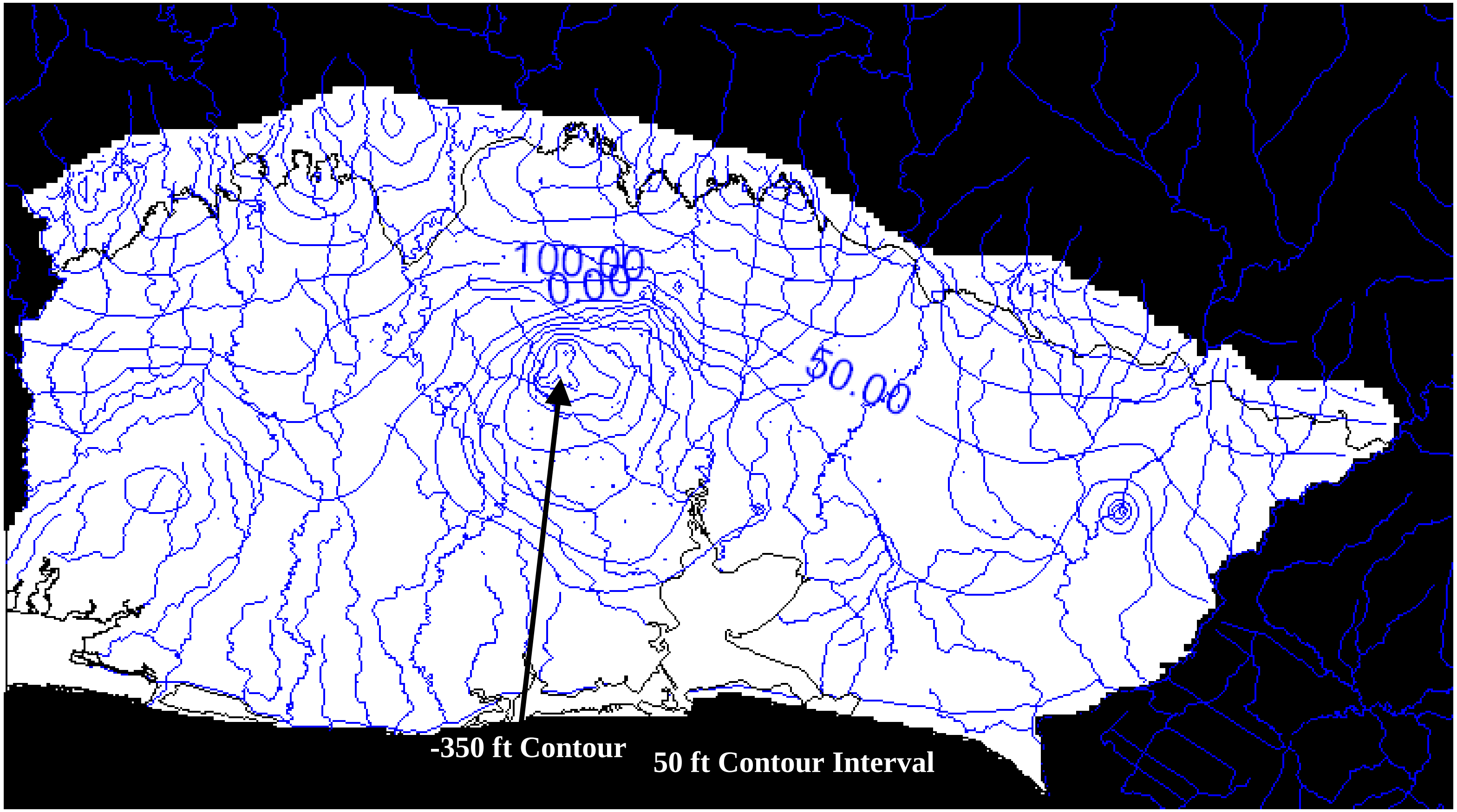


1997 Chicot Aquifer RMS

RMS 34.31

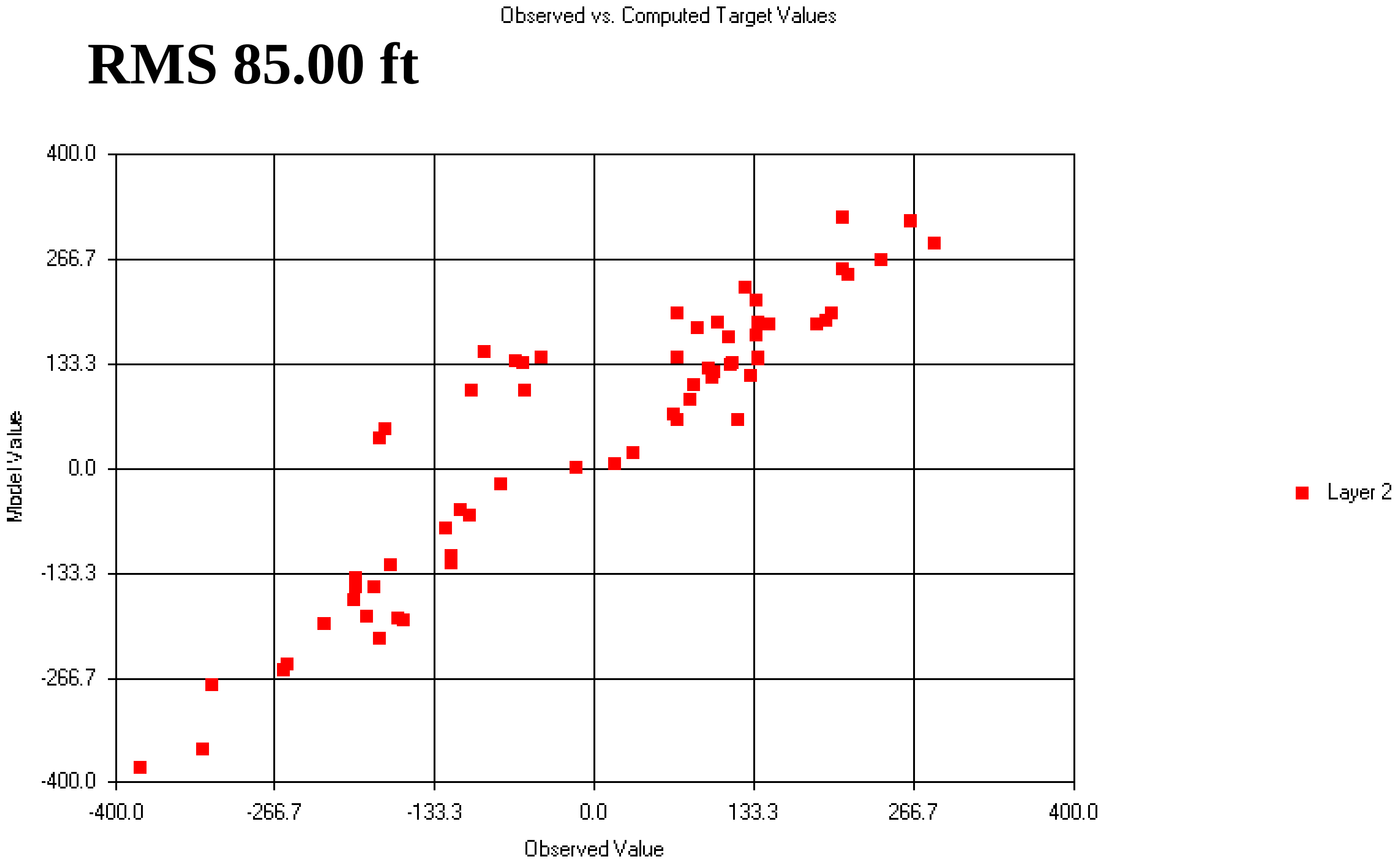


1997 Evangeline Aquifer

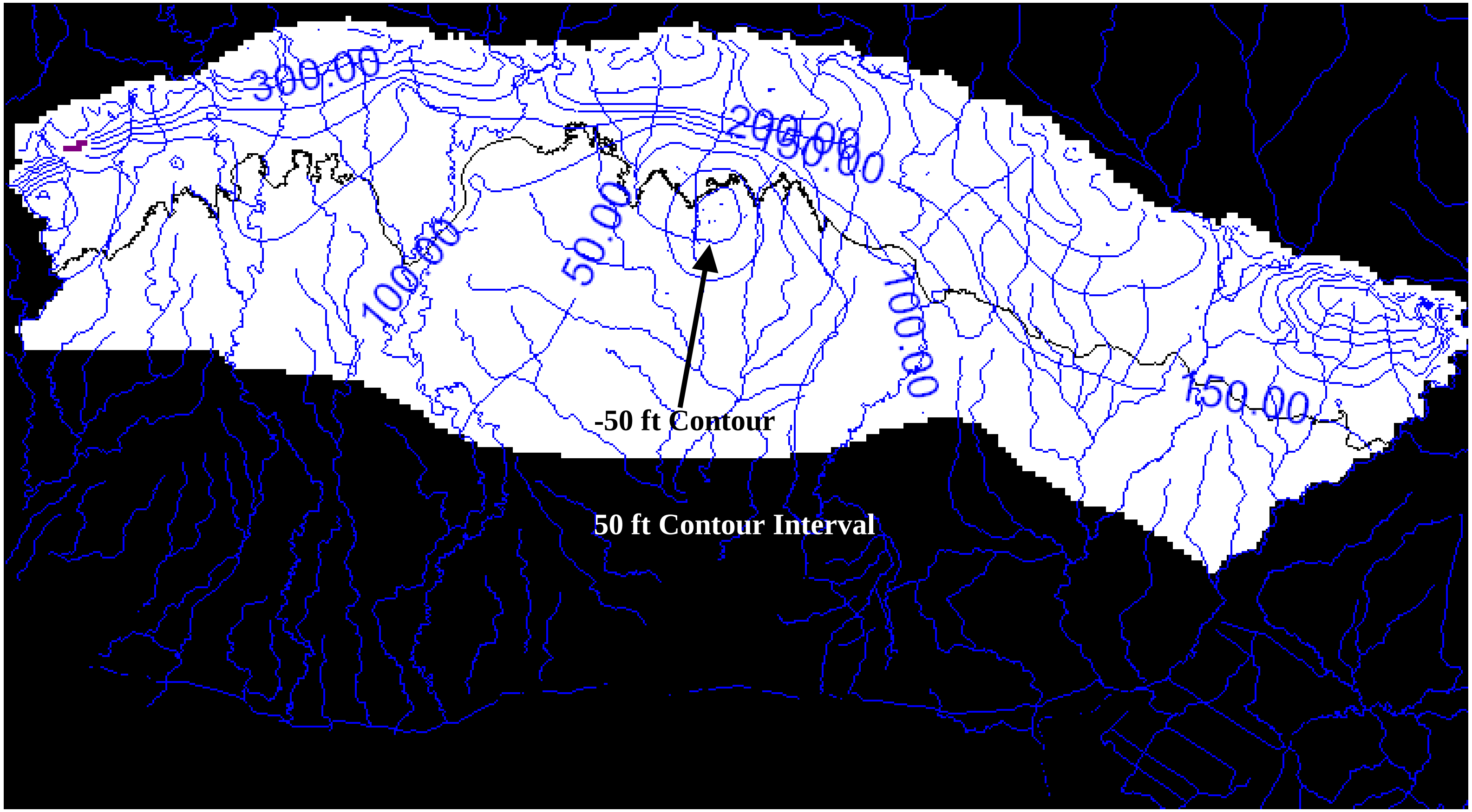


1997 Evangeline Aquifer RMS

RMS 85.00 ft

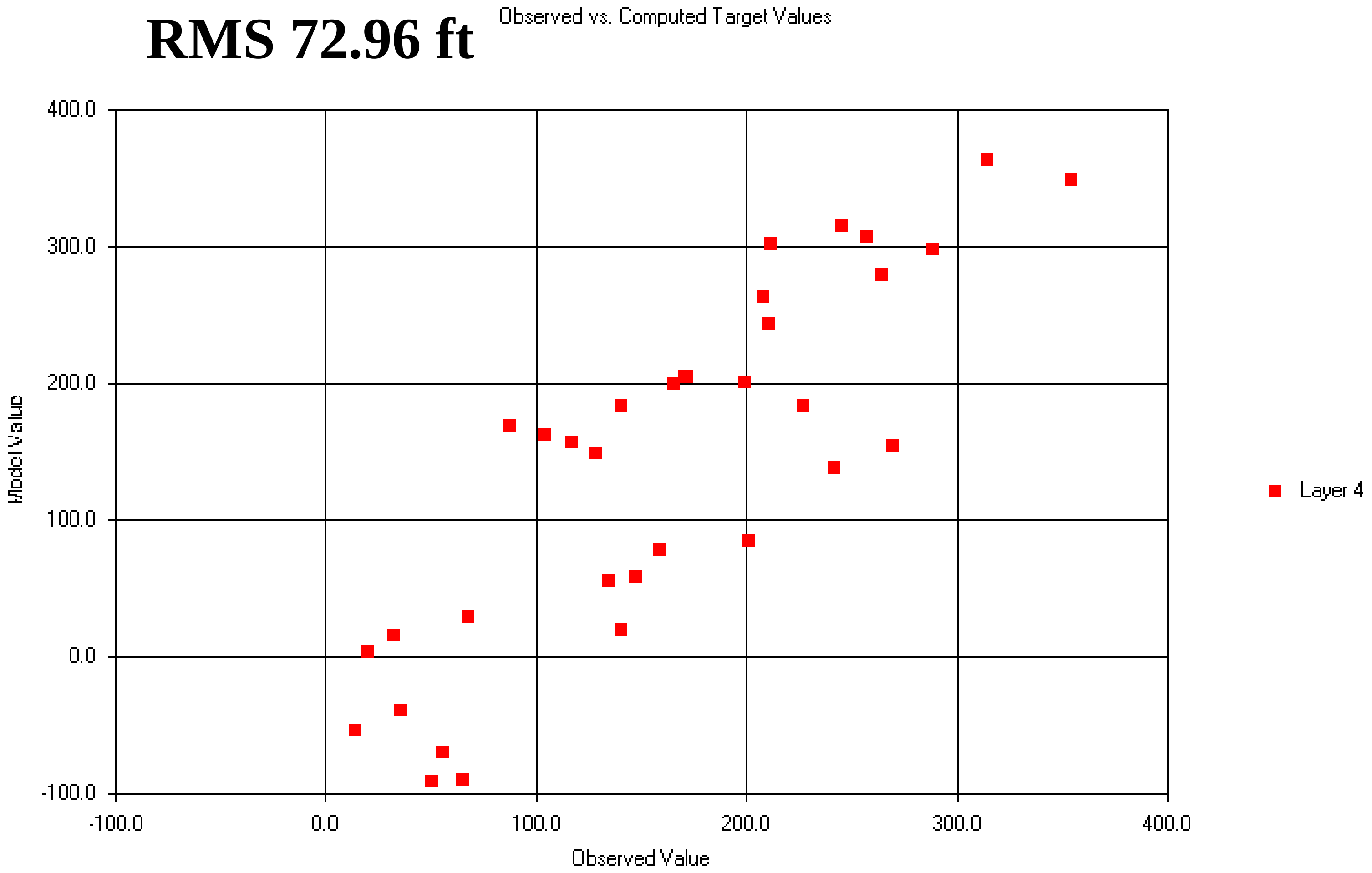


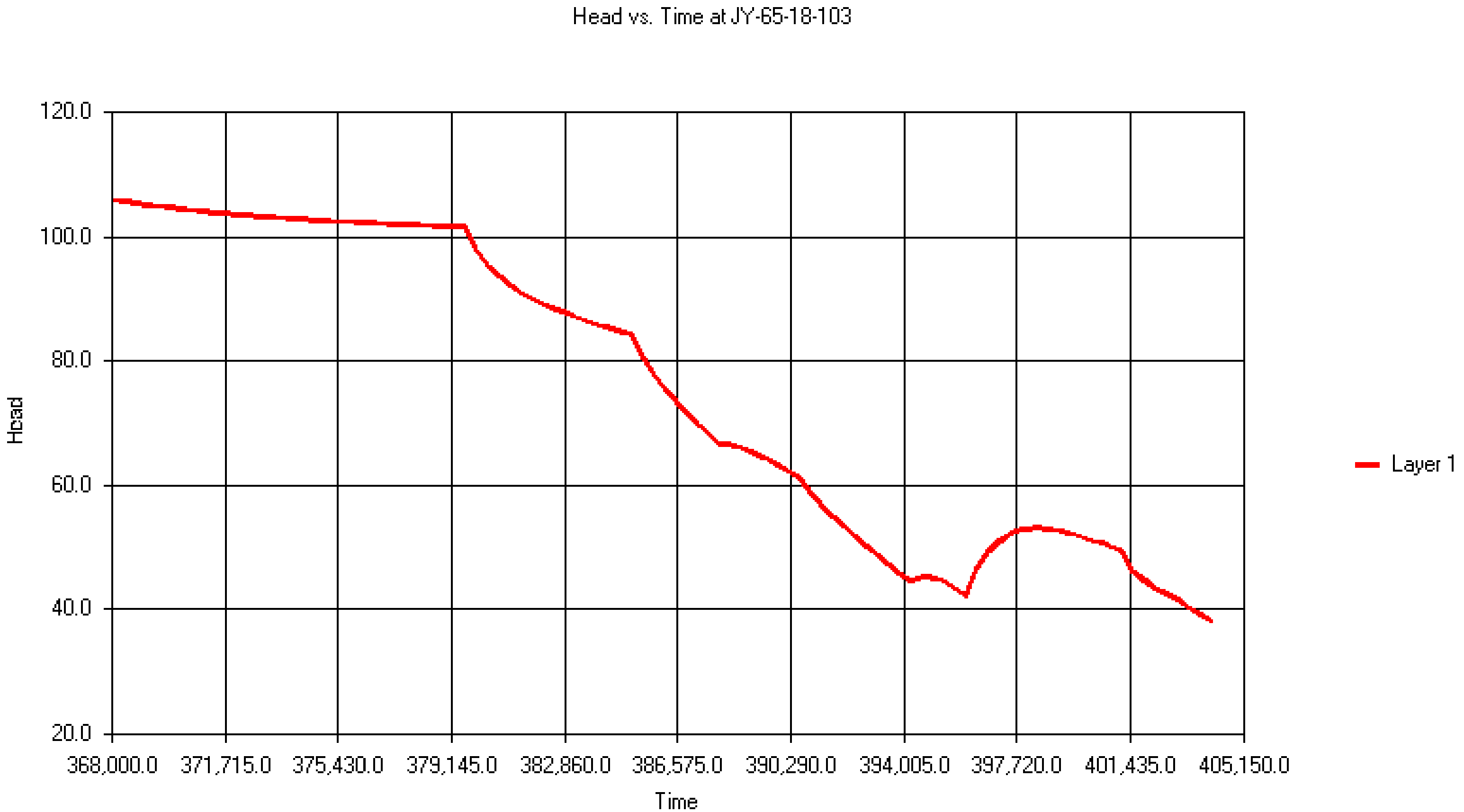
1997 Jasper Aquifer



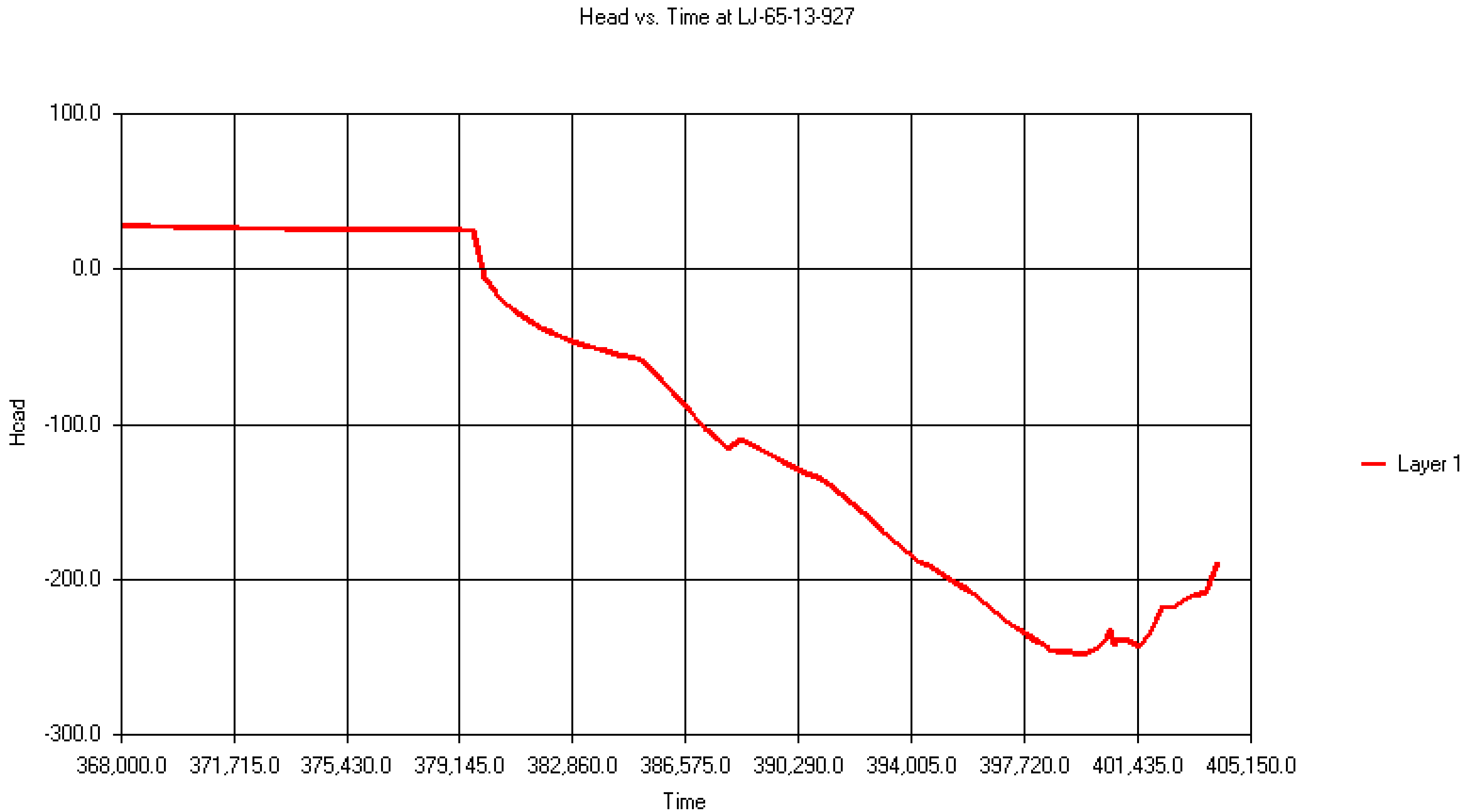
1997 Jasper Aquifer RMS

RMS 72.96 ft

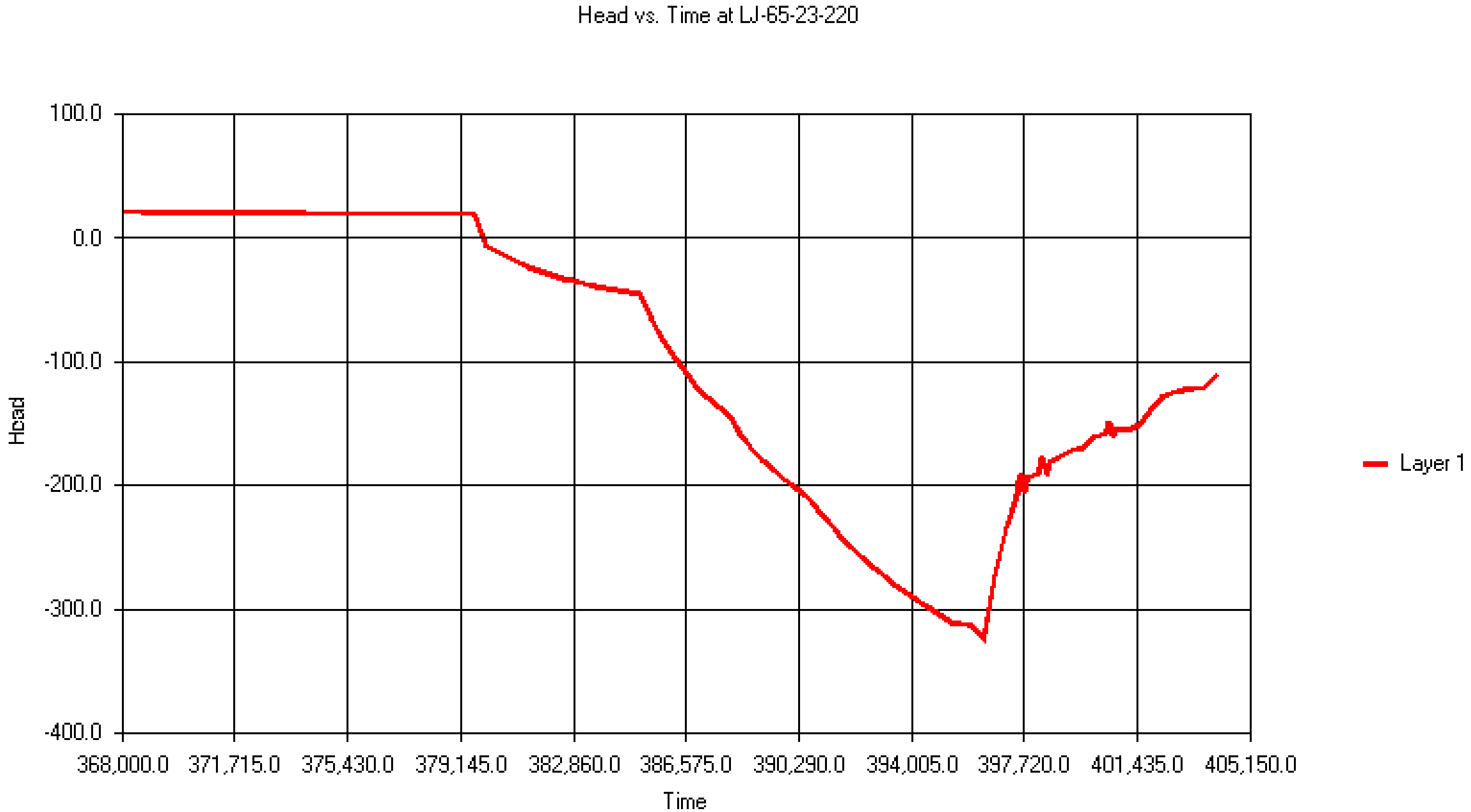




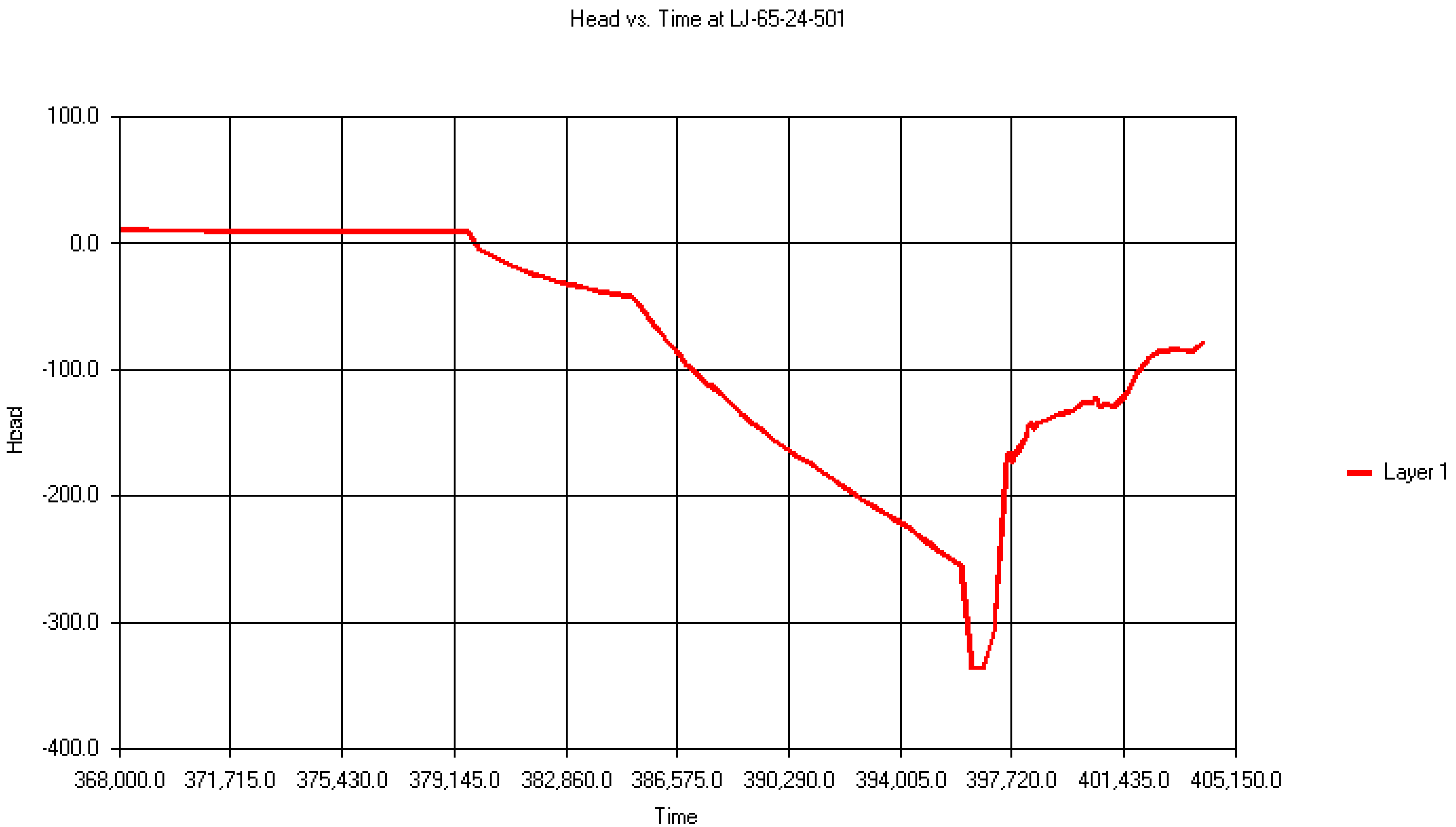
Well JY-65-18-103



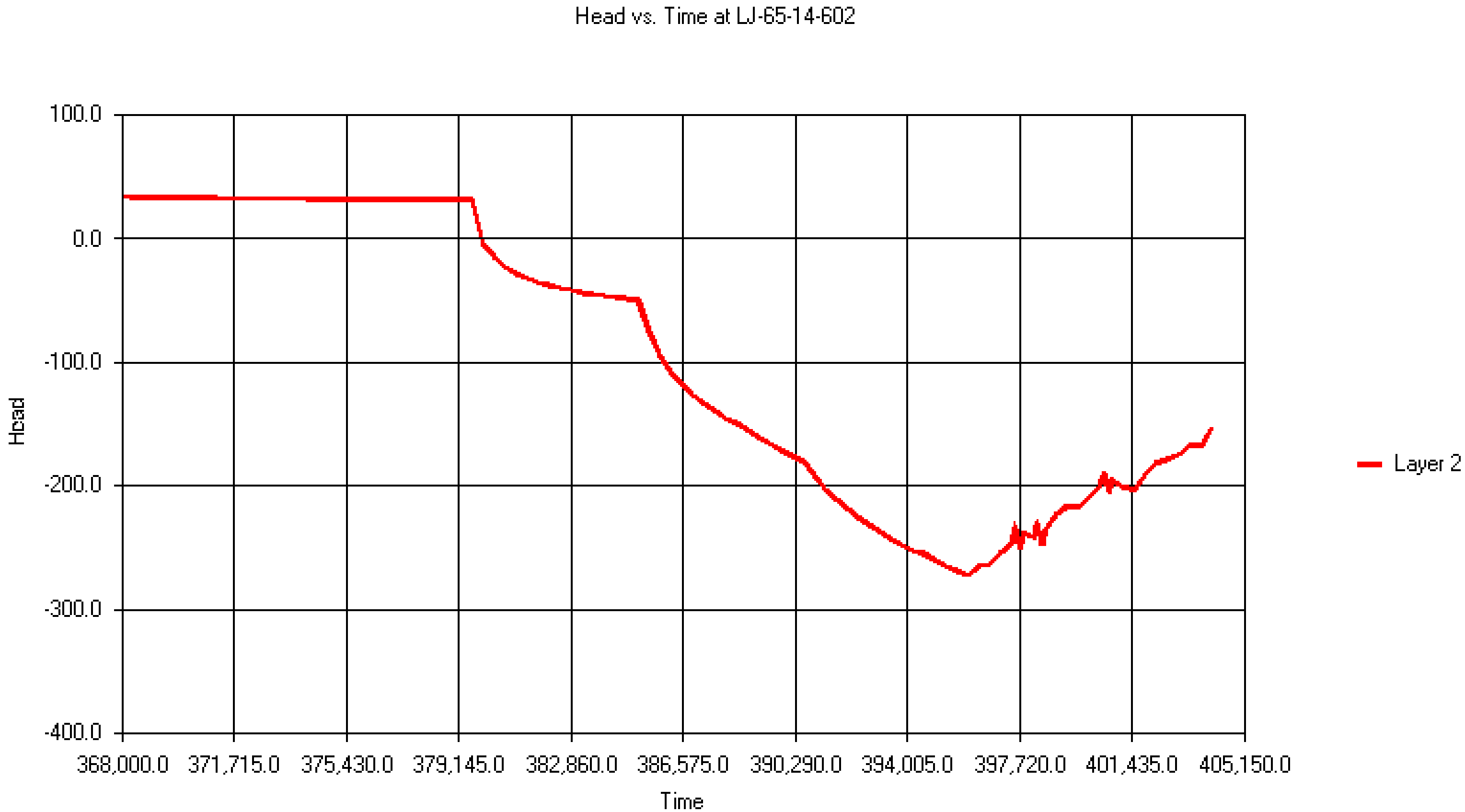
Well LJ-65-13-927



Well LJ-65-23-220



Well LJ-65-24-501



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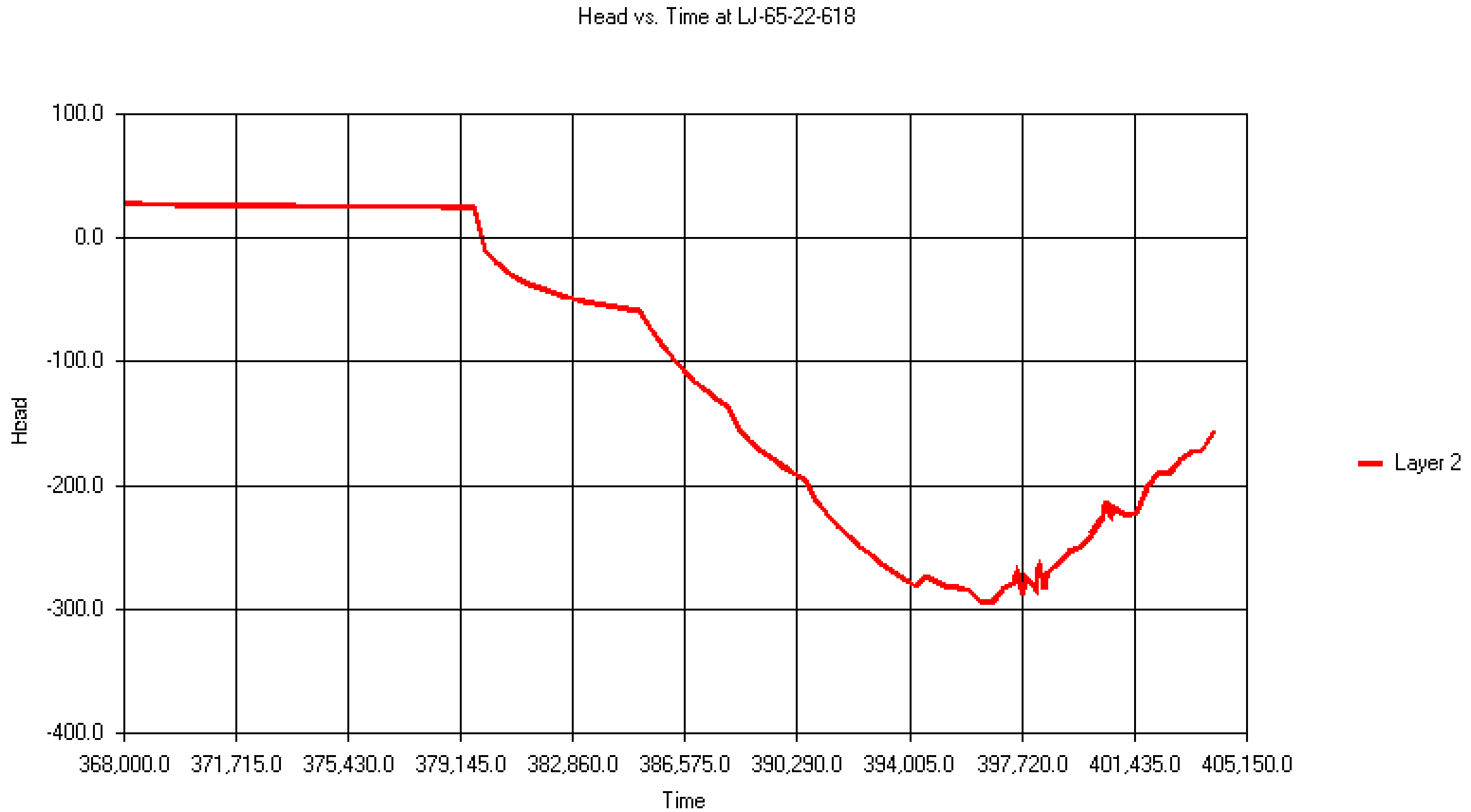
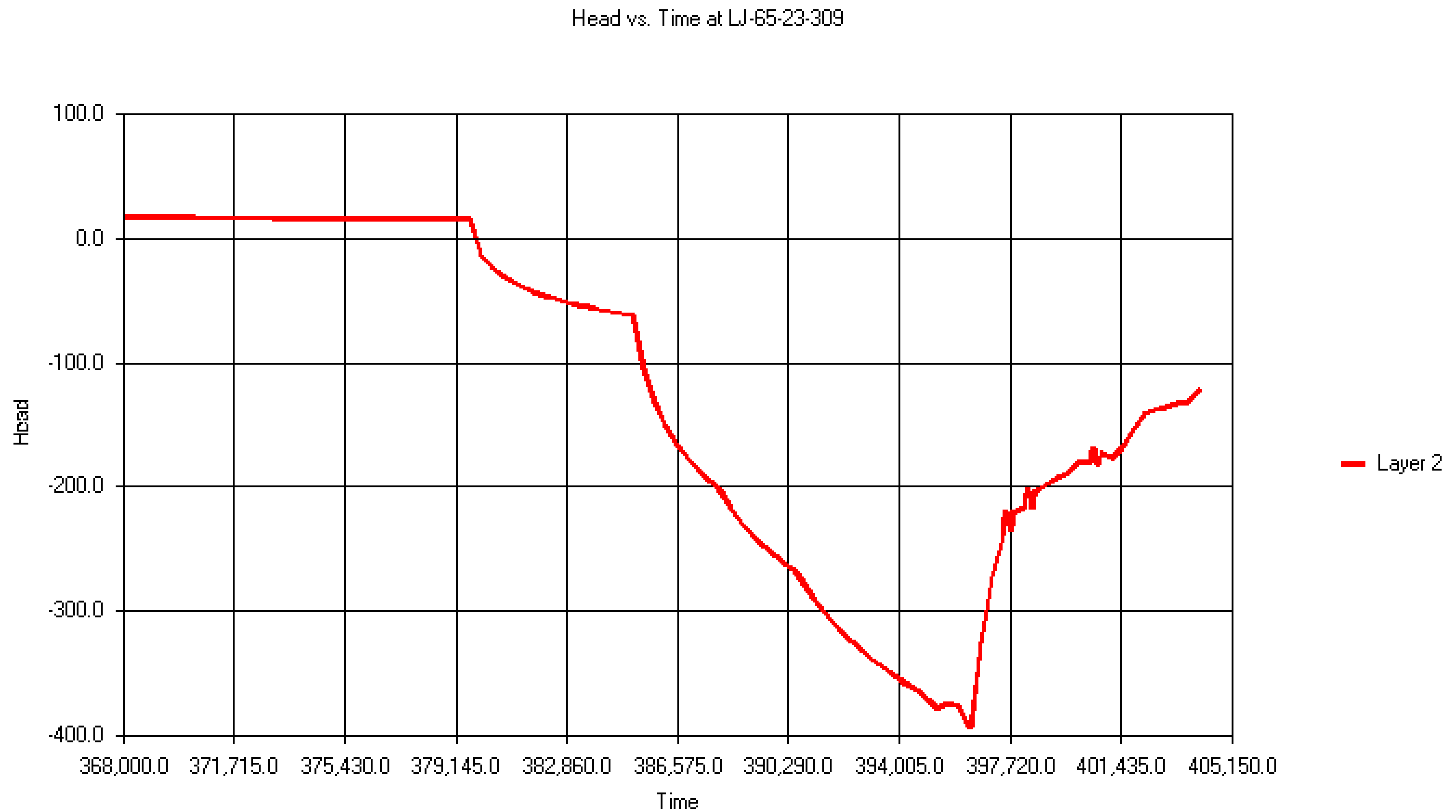
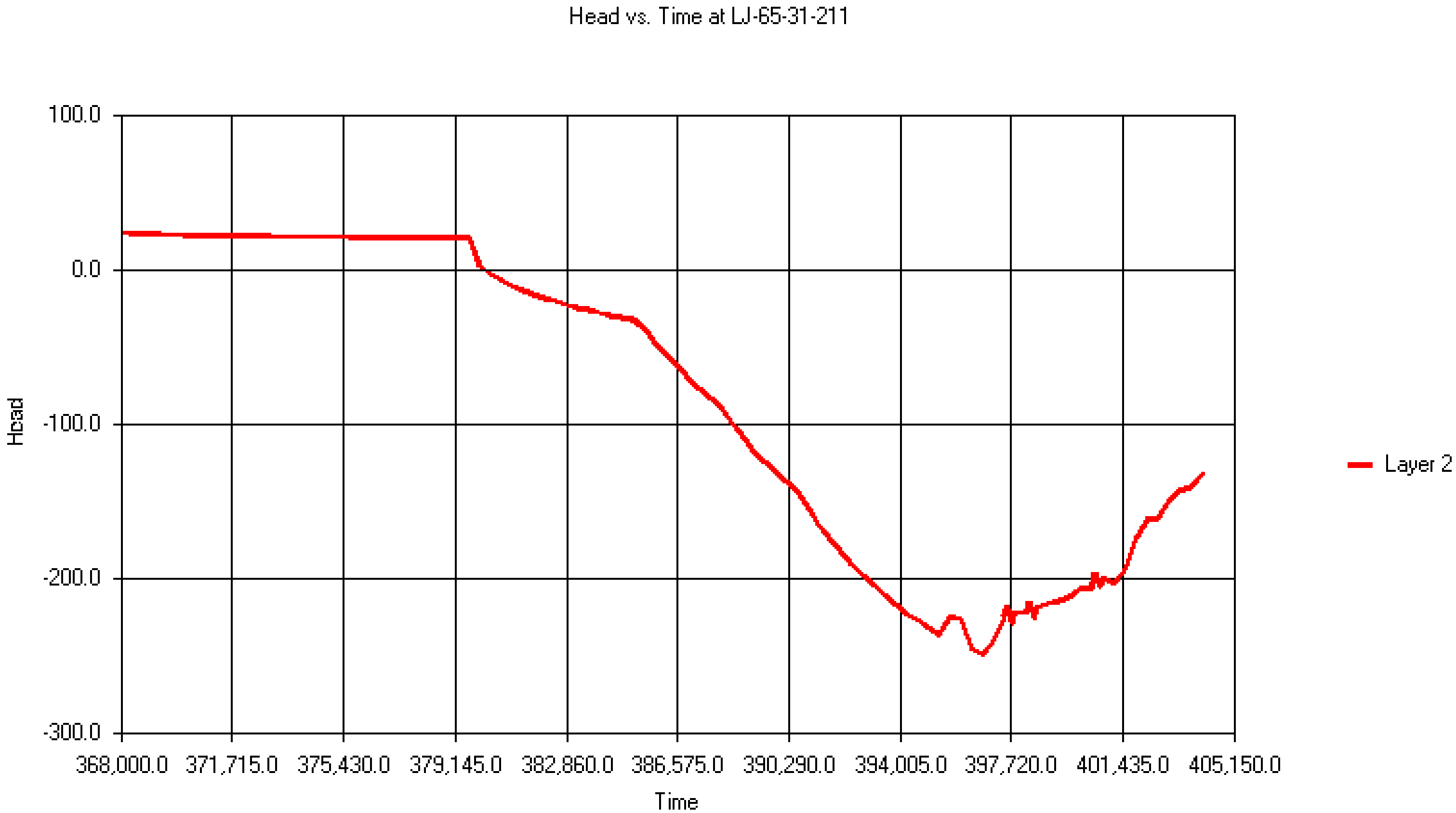


Well LJ-65-22-618

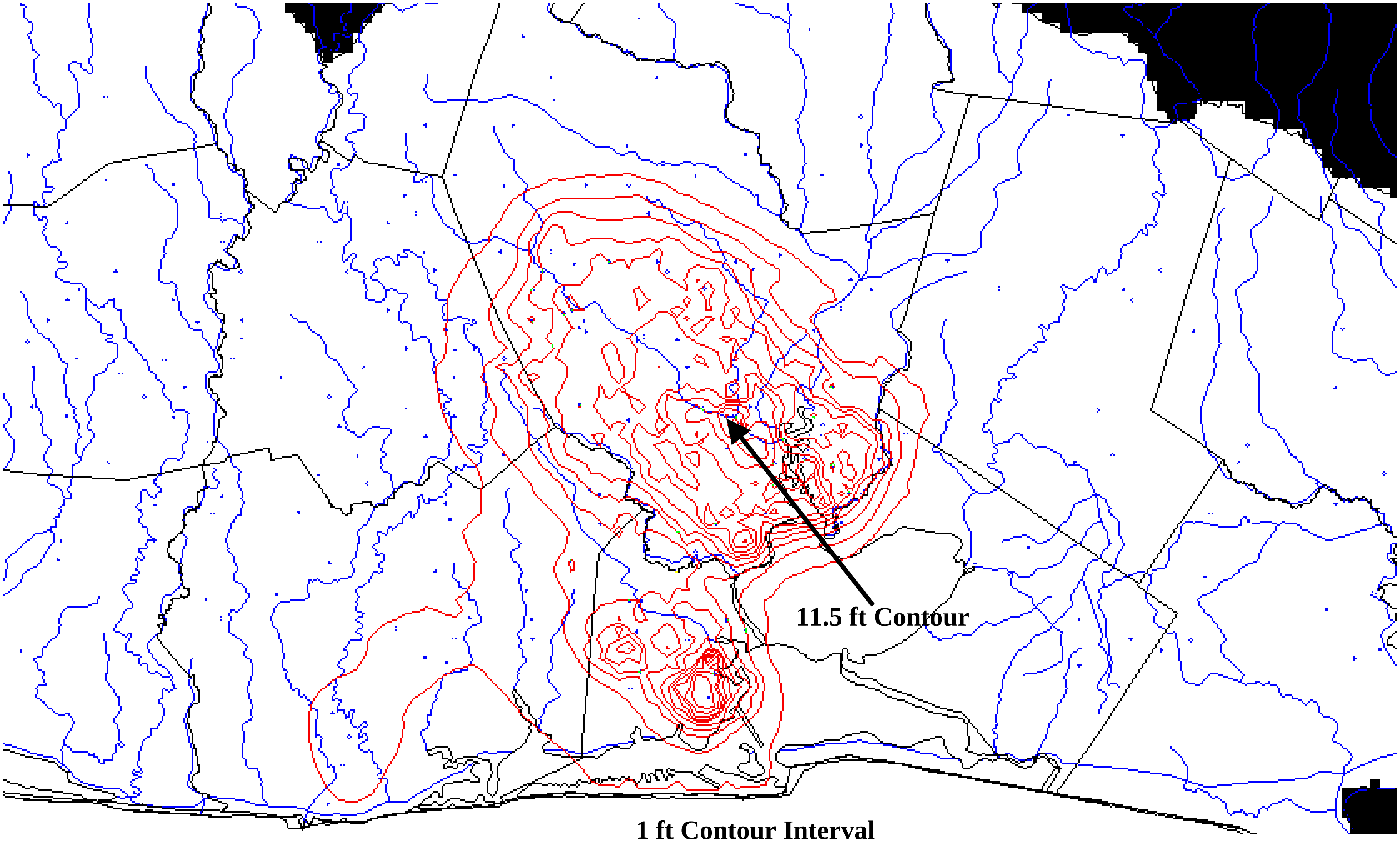


Well LJ-65-23-309

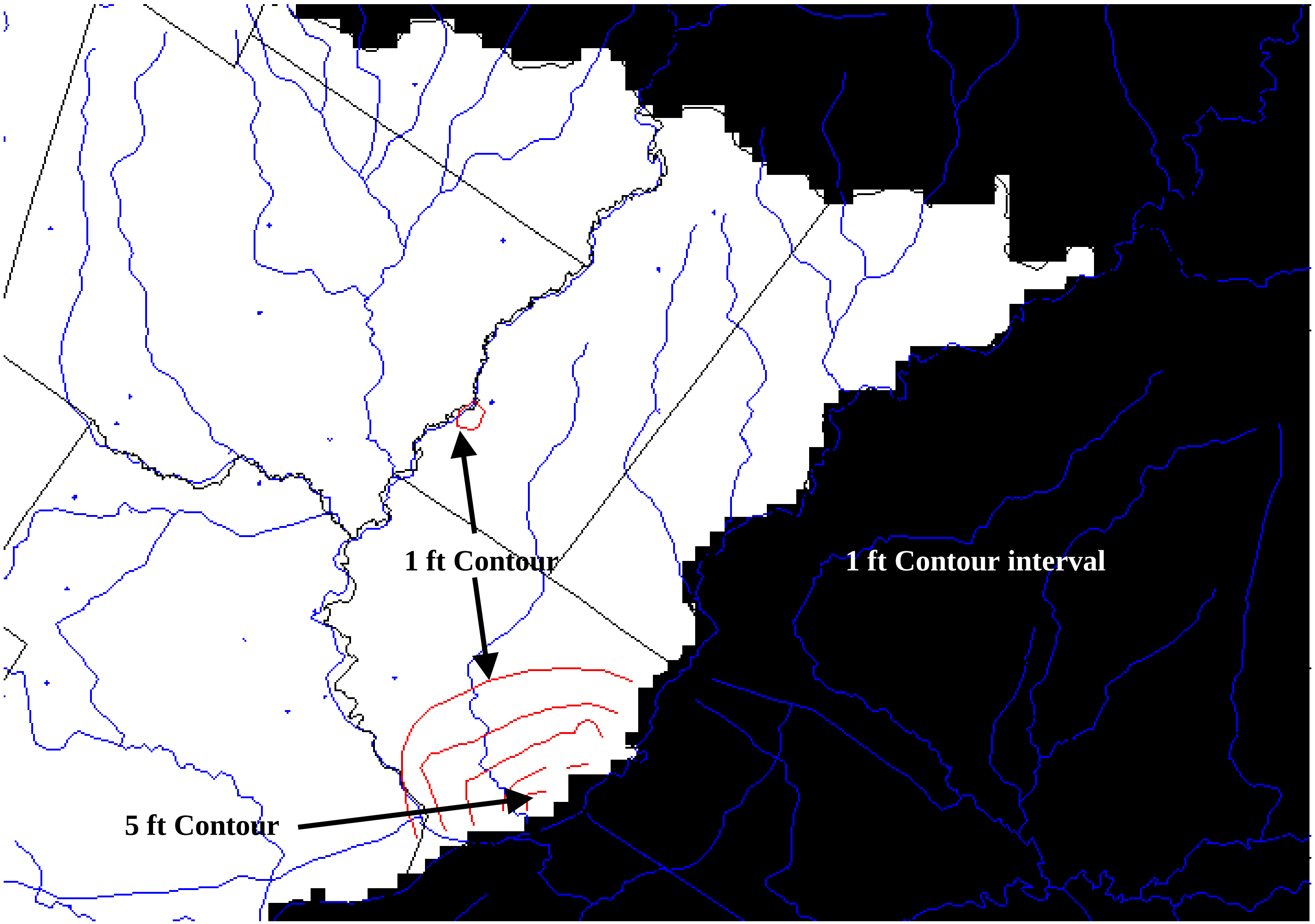


Well LJ-65-31-211

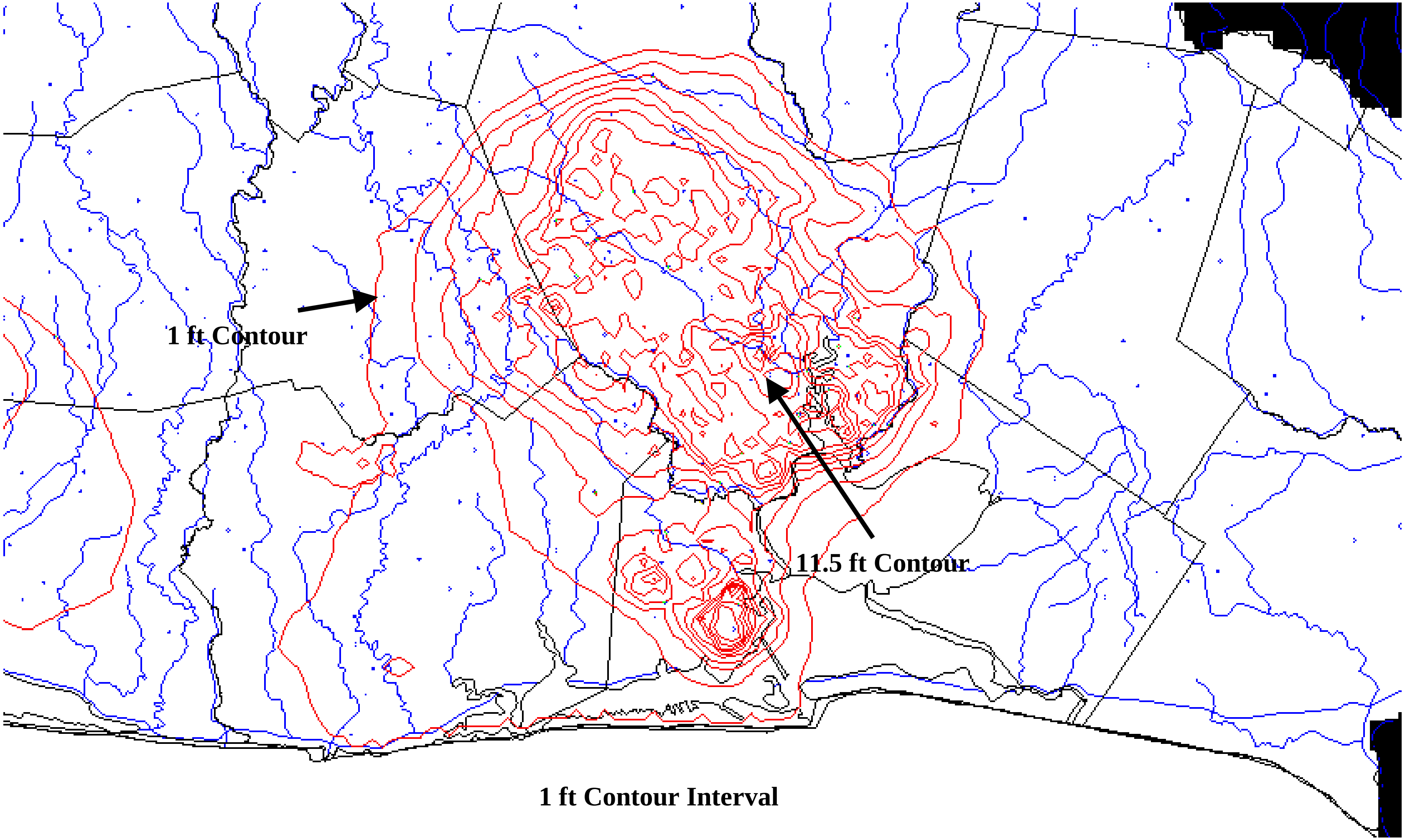
1977 Land-Surface Subsidence



1977 Land-Surface Subsidence

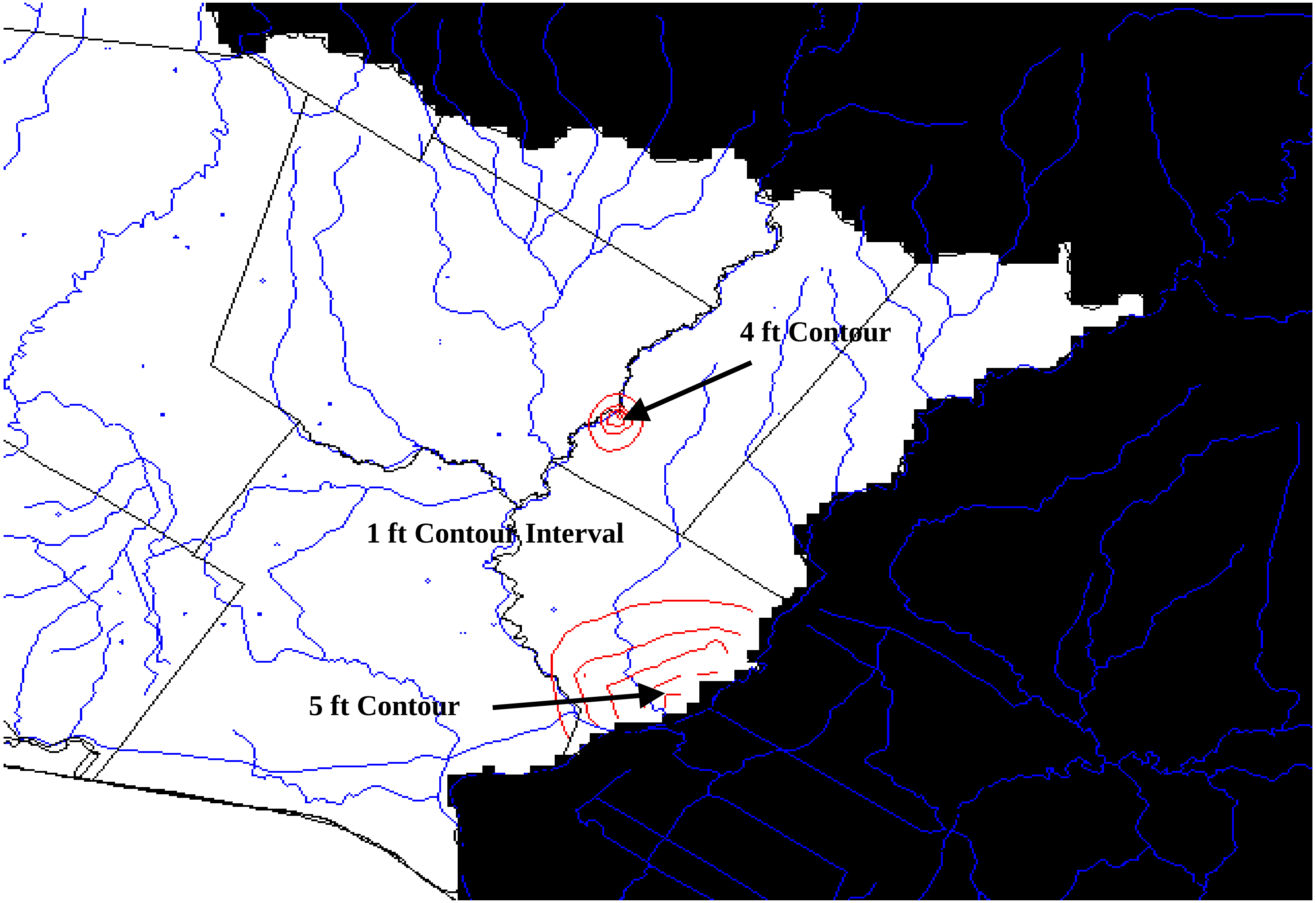


1997 Land-Surface Subsidence



1 ft Contour Interval

1997 Land-Surface Subsidence



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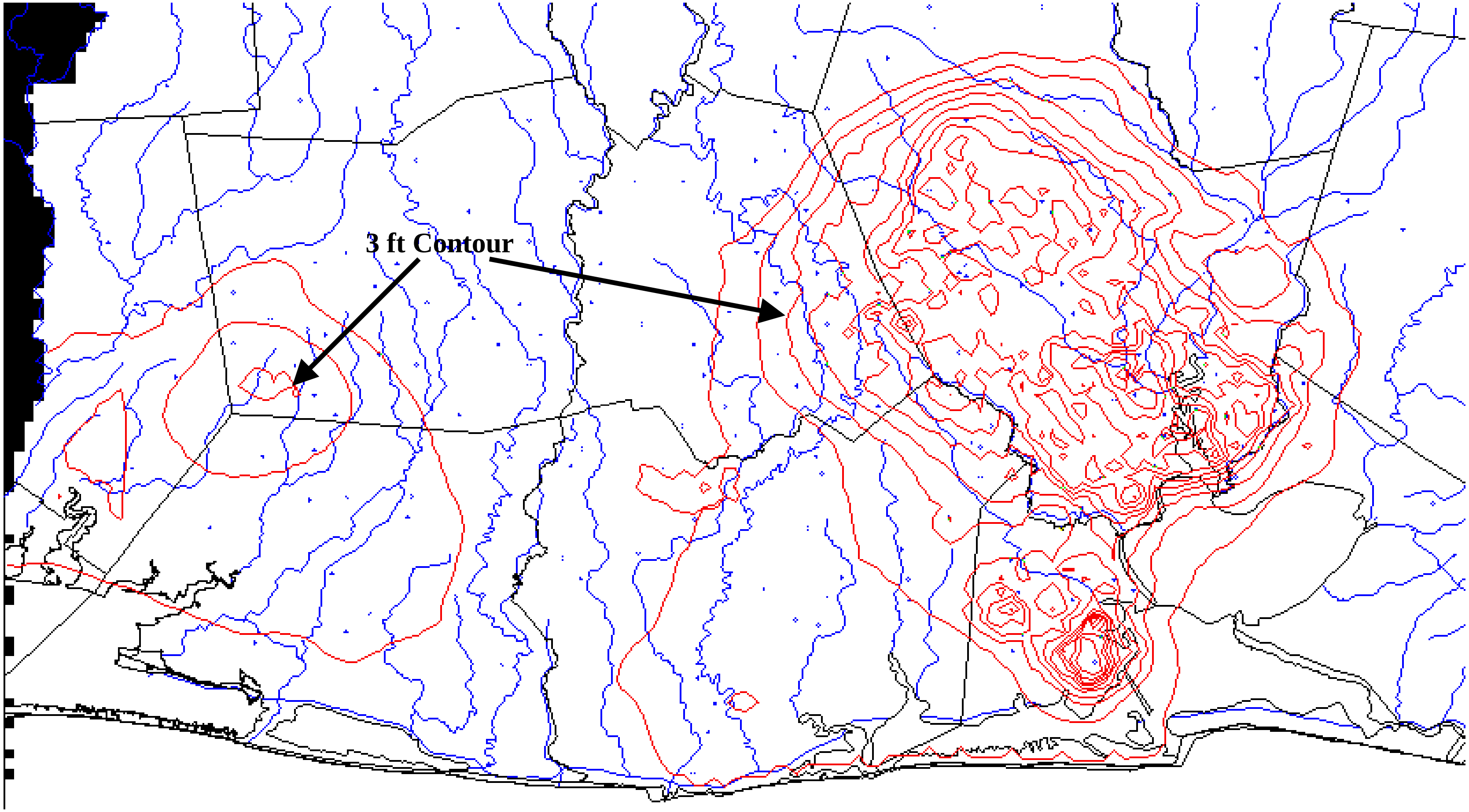
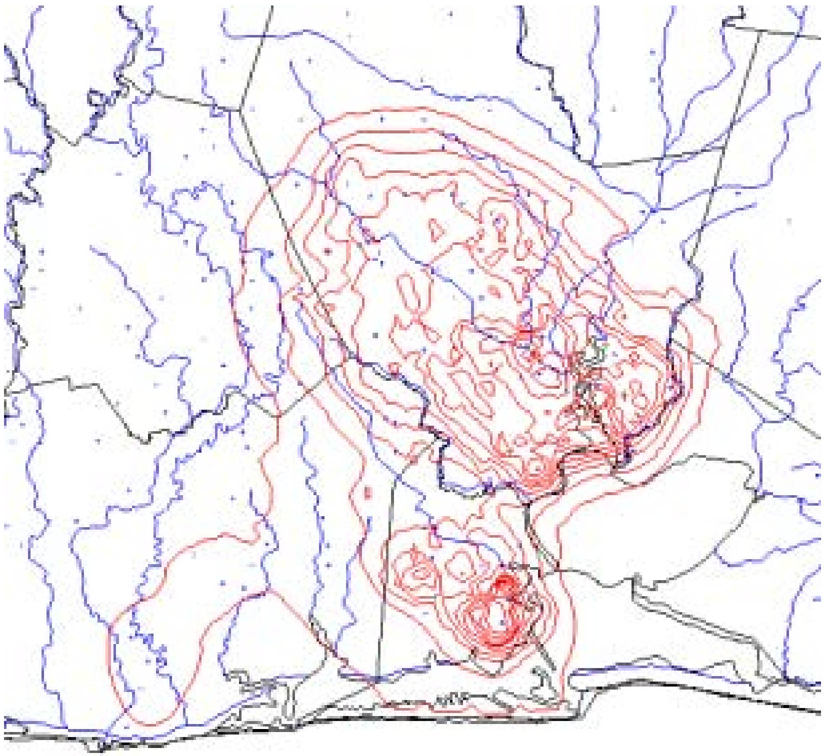
1997 Land-Surface Subsidence

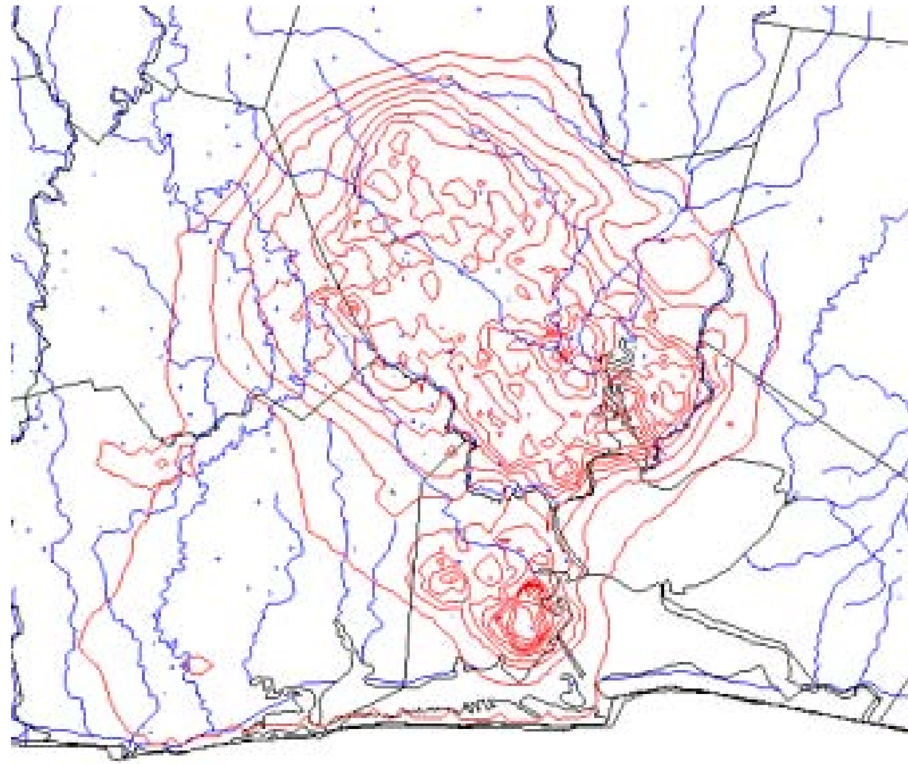


1 ft Contour Interval

Land-Surface Subsidence Comparison



1977



1997

1 ft Contour Interval

1997 Volumetric Budget

VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 1 IN STRESS PERIOD 66

CUMULATIVE VOLUMES L**3	RATES FOR THIS TIME STEP L**3/T
IN:	IN:
STORAGE = 0.72691E+12	STORAGE = 0.31168E+08
CONSTANT HEAD = 0.0000	CONSTANT HEAD = 0.0000
WELLS = 0.0000	WELLS = 0.0000
HEAD DEP BOUNDS = 0.17626E+14	HEAD DEP BOUNDS = 0.94316E+08
INTERBED STORAGE = 0.49467E+12	INTERBED STORAGE = 0.10994E+08
TOTAL IN = 0.18847E+14	TOTAL IN = 0.13648E+09
OUT:	OUT:
STORAGE = 0.80851E+11	STORAGE = 0.38993E+07
CONSTANT HEAD = 0.0000	CONSTANT HEAD = 0.0000
WELLS = 0.21098E+13	WELLS = 0.10671E+09
HEAD DEP BOUNDS = 0.16654E+14	HEAD DEP BOUNDS = 0.25418E+08
INTERBED STORAGE = 0.31366E+10	INTERBED STORAGE = 0.47707E+06
TOTAL OUT = 0.18848E+14	TOTAL OUT = 0.13651E+09
IN - OUT = -0.56623E+09	IN - OUT = -30736.
PERCENT DISCREPANCY = 0.00	PERCENT DISCREPANCY = -0.02

Approximate Average Recharge for Entire Model is 1.09 inches/year

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Attendance list at the Stakeholder Advisory Forum for the northern
Gulf Coast aquifer Groundwater Availability Model, April 24, 2003

Names	Affliation
Ali Chowdhury	Texas Water Development Board
Mark Lowry	Turner, Collie and Braden
John Nelson	LBG-Guyton and Associates
Michael Baugher	Turner, Collie and Braden
Haskel Simon	Coastal Plains GCD
Richard Howe	Charterwood MUD
Eric Strom	US Geological Survey
John Nelson	LBG-Guyton Associates
Mark C. Kasmarek	US Geological Survey
Robert K. Gabrysch	Consultant Hydrogeologist
Phil Savoy	Murfee Engineering
Tom Michel	Harris-Galveston CSD
Joe Broadus	USGS
James Robinson	USGS
Jimmie Schindewolf	North Harris County Water Authority
Michael Klaus	Resident of Pearland
Ron Graham	North Harris County Water Authority
Phil Savoy	Murfee Engineering

Q: Did the model take into account sand/shale distributions using all oil and gas wells in the area?

A: It did include all wells in the model area and sand/shale distributions were considered in developing the structure surfaces and hydraulic conductivity.

Q: Does the RMS for simulated vs. measured water levels meet the GAM RFP?

A: For most of the aquifers, the RMS values through 1980s and 1990s meet the GAM RFP. However, USGS will try to bring down the errors particularly that in the Jasper aquifer.

Q: Some of the transient hydrographs show a decline in water levels to 400 feet and then a progressive rise to 150 feet. Is there a recovery in compaction /subsidence of the land surface when the water levels considerably rise?

A: Minimal recovery in subsidence with the rise of the water level. Increased groundwater pumping is causing more subsidence in northwest portion of Harris County.

Q: How does the recharge differ throughout the three Gulf Coast GAM models?

A: Average recharge for the northern Gulf Coast is 1.09 in/yr, for the central gulf coast is about 1 in/yr and for the southern gulf coast is about 0.14 in/yr. Previous groundwater modeling studies for the Gulf Coast aquifer also found highly variable recharge rates due to differences in rainfall intensity, hydraulic conductivity and model grid sizes.

Q: Can the model be used for well permitting?

A: It is a regional model with 1 mile by 1 mile grid sizes that better estimates groundwater availability at the county levels. When a wellfield is put in certain parts of the aquifer, the model will be able to determine the effects of pumping on the water levels. Well permitting can better be investigated using analytical equations.

Q: Where do we go from here?

A: Transient model will be finalized soon. After that USGS will make the predictive runs from 2000 through 2050 using the demand numbers provided by the RWPG's.

Q: When will the model be completed?

A: November 30th , 2003 when the USGS submits a draft report to the TWDB for review.

Q: Could a training session be arranged after the model completion although we understand that it is not in the contract? All other GAM contractors are providing a training session at the end of the model completion.

A: USGS may undertake a training session at the end of model completion. The session however will likely be geared towards people who are familiar with hydrogeology and better if, groundwater modeling.