HYDROGEOLOGY AND ANALYSIS OF GROUND-WATER WITHDRAWAL FROM THE CATAHOULA AQUIFER SYSTEM IN THE NATCHEZ AREA, ADAMS COUNTY, MISSISSIPPI

By Eric W. Strom, David E. Burt Jr., and William T. Oakley

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot	0.3048	meter
foot per mile	0.1894	meter per kilometer
inch	25.4	millimeter
mile	1.609	kilometer
million gallons per day	0.04381	cubic meter per second
cubic foot per second	0.02832	cubic meter per second
million cubic feet per day	0.3278	cubic meter per second
square mile	2.590	square kilometer
foot squared per day	0.0929	meter squared per day

Temperature in degrees Fahrenheit (^{o}F) can be converted to degrees Celsius (^{o}C) as follows: $^{o}C = (^{o}F-32)/1.8$.

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 --a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

The standard unit for transmissivity is cubic foot per day per square foot times foot of aquifer thickness. In this report, the mathematically reduced form, foot squared per day, is used for convenience.

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ABSTRACT

The city of Natchez, located in Adams County, Mississippi, relies on ground water for public supply and industrial needs. Most public supply and industrial wells are developed in Catahoula Formation sands of Miocene age. In 1991, an investigation began to describe the hydrogeology, analyze the effects of ground-water withdrawal from currently pumped wells, and project the possible effects of increased ground-water withdrawals on water levels in the Catahoula aquifer system within the Natchez area.

The study area covers about 80 square miles in Adams County, southwestern Mississippi. The study area contains several aquifers; however, the most important aquifers in terms of water supply are the Mississippi River alluvial aquifer and the Catahoula aquifer system. In the Natchez area, the Catahoula aquifer system consists of three main sand intervals that form the upper, middle, and lower Catahoula aquifers.

Ground-water withdrawal from the Catahoula aquifer system in the study area currently (March 1995) is from 24 wells screened in the three aquifers. The current daily rate of withdrawal is about 9.2 million gallons of water per day. Analysis of the effect of ground-water withdrawal from these wells was made using the Theis nonequilibrium equation and applying the principle of superposition. The calculated drawdown surfaces under current conditions indicate cones of depression surrounding the principal wells. In the upper Catahoula sand, most of the drawdown is concentrated about 1 mile east of the downtown Natchez area, where a maximum drawdown of 95 feet was calculated. Most of the drawdown in the middle Catahoula sand occurred in the same general vicinity as in the upper sand, with a maximum calculated drawdown of about 113 feet. Drawdown in the lower Catahoula sand was concentrated about 4 miles northeast of downtown Natchez, with a maximum calculated drawdown of about 31 feet.

Drawdown-surface maps were made using calculations based on current pumping rates for 10 years and 20 years beyond March 1995. Planned changes in the pumping configuration were incorporated into these analyses. The drawdown surface calculated for 10 years beyond March 1995 indicates an average total increase in drawdown of

about 7.3 feet for the upper Catahoula sand, with a maximum increase of about 28 feet. An average total increase in drawdown of only 1.2 feet was calculated for the middle Catahoula sand due to the planned discontinued pumping of many of the wells. An average total increase in drawdown of about 19 feet was calculated for the lower Catahoula sand, with a maximum increase of about 41 feet. The drawdown surface calculated for 20 years beyond March 1995 indicates an average total additional increase in drawdown over the 10 year drawdown surface of about 1.9, 0.6, and 2.7 feet for the upper, middle, and lower Catahoula sands, respectively.

INTRODUCTION

The city of Natchez, located in Adams County, Mississippi, relies on ground water for public supply and industrial needs. Most public supply and industrial wells are developed in Catahoula Formation sands of Miocene age. In 1982, about 7.4 million gallons of water per day was withdrawn from the Catahoula aquifer system in Adams County (Boswell and Bednar, 1985). Currently (March 1995), more than 9 million gallons of water per day is withdrawn from the Catahoula aquifer system in the Natchez area alone. Increased ground-water withdrawals from a growing population and the development of new industries may increase water-level declines and affect water quality. In 1991, the U.S. Geological Survey, in cooperation with the Mississippi Department of Environmental Quality, Office of Land and Water Resources (OLWR), began an investigation to describe the hydrogeology, to analyze the effects of ground-water withdrawal from currently pumped wells, and to project the possible effects of increased ground-water withdrawals on water levels in the Catahoula aquifer system within the Natchez area. This report presents the results of that study.

General Setting of the Study Area

The study area covers about 80 square miles in Adams County, southwestern Mississippi (fig. 1). The area is located in the Mississippi Alluvial Plain and the Bluff Hills of the Gulf Coastal Plain physiographic province (Fenneman, 1938). Most of the study area is hilly due to the erosion of loess deposits; however, a broad flat alluvial plain formed by the Mississippi River is located in the western part of the study area. The mean annual temperature at Natchez is about 64.4 degrees Fahrenheit; annual precipitation is about 53.4 inches (National Weather Service, oral commun., 1995).

Previous Investigations

Previous investigations that include all or part of the study area have been published by Stephenson and others, (1928); Vestal (1942); Callahan and others (1963, 1964); Childress and others (1976); Boswell and Bednar (1985); and Martin and Whiteman (1989).

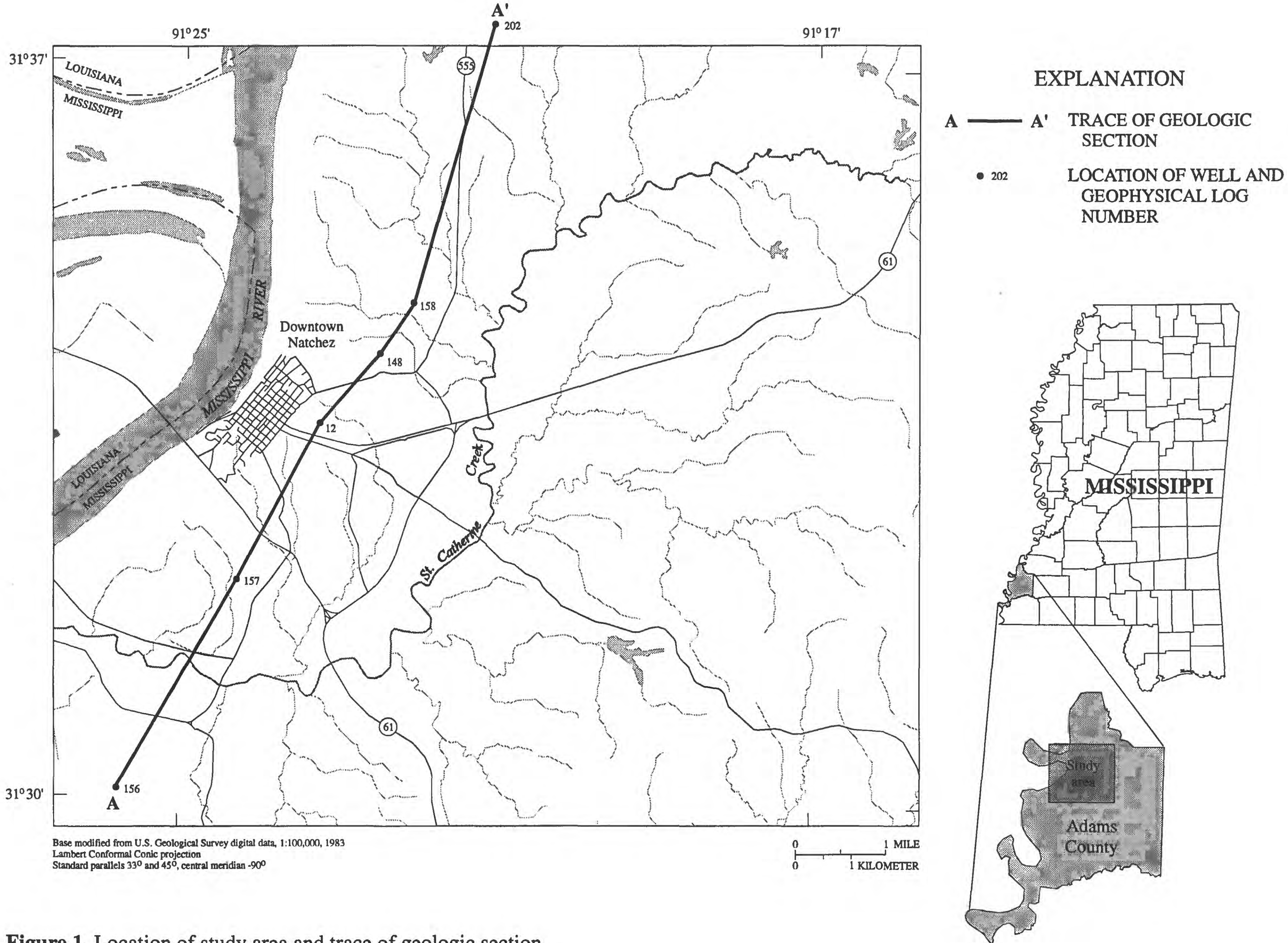


Figure 1. Location of study area and trace of geologic section.

HYDROGEOLOGY

The study area contains several aquifers; however, the most important aquifers in terms of water supply are the Mississippi River alluvial aquifer and the Catahoula aquifer system (fig. 2). The Catahoula aquifer system consists of three main sand intervals in the study area, although some of the uppermost sand may belong to the Hattiesburg Formation in parts of the study area (E.H. Boswell, OLWR, oral commun., 1995). The Catahoula aquifer system is the focus of this investigation.

The Catahoula Aquifer System

The Catahoula Formation is described by May and Marble (1976) as being fluvial to marginal-deltaic in depositional origin, with sediments probably representing a regressive, offlap sequence. The formation mainly consists of deltaic silt and clay deposited in a low energy environment, and intervals of sand deposited in a high energy environment. In the Natchez area, the Catahoula Formation contains three main sand intervals that are referred to as the 400-foot, 600-foot, and 1,000-foot sands (Callahan and others, 1963; Boswell and Bednar, 1985) and correspond to the upper, middle, and lower Catahoula Formation sands, respectively. These three sand intervals comprise the Catahoula aquifer system in the Natchez area (fig. 3). Because the sand intervals are southward dipping, depths are variable, and assignment of a sand bed into a particular sand interval is determined by the interval's altitude above the Glendon Limestone: the upper, middle, and lower sand intervals average 1,100 feet, 900 feet, and 650 feet above the limestone, respectively (Boswell and Bednar, 1985).

The Catahoula aquifers are described by Boswell and Bednar (1985) as being under confined conditions in the study area. The base of freshwater ranges from about 500 feet below sea level in the northern part of the study area, to about 800 feet below sea level in the southern part. Recharge probably occurs in outcrop areas northeast of Natchez. Locally, ground-water movement is toward pumping wells; regionally, ground-water movement generally is westward. Analysis of the flow system indicates regional discharge is upward into the central and western parts of the Mississippi River valley in southern Louisiana (Martin and Whiteman, 1989). The Miocene aquifers are highly permeable; however, aquifer thickness and transmissivity are highly variable within the study area. Transmissivities from aquifer tests range from 2,000 to 16,000 feet squared per day.

Ground-Water Withdrawal

Ground-water withdrawal from the Catahoula aquifer system in the study area currently (March 1995) is from 24 wells screened in the upper, middle, and lower sands of the Catahoula Formation. Information regarding each well is listed in table 1. Values of transmissivity listed are either from an aquifer test at the well site or are estimated using the value of transmissivity from the nearest test site. Test values (mostly single-borehole tests) come from currently pumping wells (table 1) and from wells that are no longer in use. Pumpage for the wells represents an average steady pumping rate, or the rate at which the wells would be pumped if the pumps ran continuously throughout the

Erathem	System	Series	Group	Geologic unit	Hydrogeologic properties
Cenozoic	Quaternary	Holocene		Alluvial deposits	Alluvial aquifer. Water-table aquifer yielding very large amounts of water.
		Pleistocene and Pliocene (?)		Loess deposits	Unimportant as an aquifer.
	Tertiary			Natchez Formation and terrace deposits	Natchez aquifer. Not commonly used by larger wells.
		Miocene		Hattiesburg Formation and Catahoula Formation (undifferentiated)	Catahoula aquifer system. Confined aquifers yielding large amounts of water. Most public and industrial wells screened in one of three main sand intervals of the Catahoula Formation
		Oligocene	Vicksburg	Bucatunna Formation	Not an aquifer.
				Byram Formation	Not an aquifer.
				Glendon Limestone	Unimportant as an aquifer.
				Marianna Limestone	Unimportant as an aquifer.
				Forest Hill Formation	Unimportant as an aquifer.

Figure 2. Geologic units and principal aquifers in the study area (modified from Boswell and Bednar, 1985).

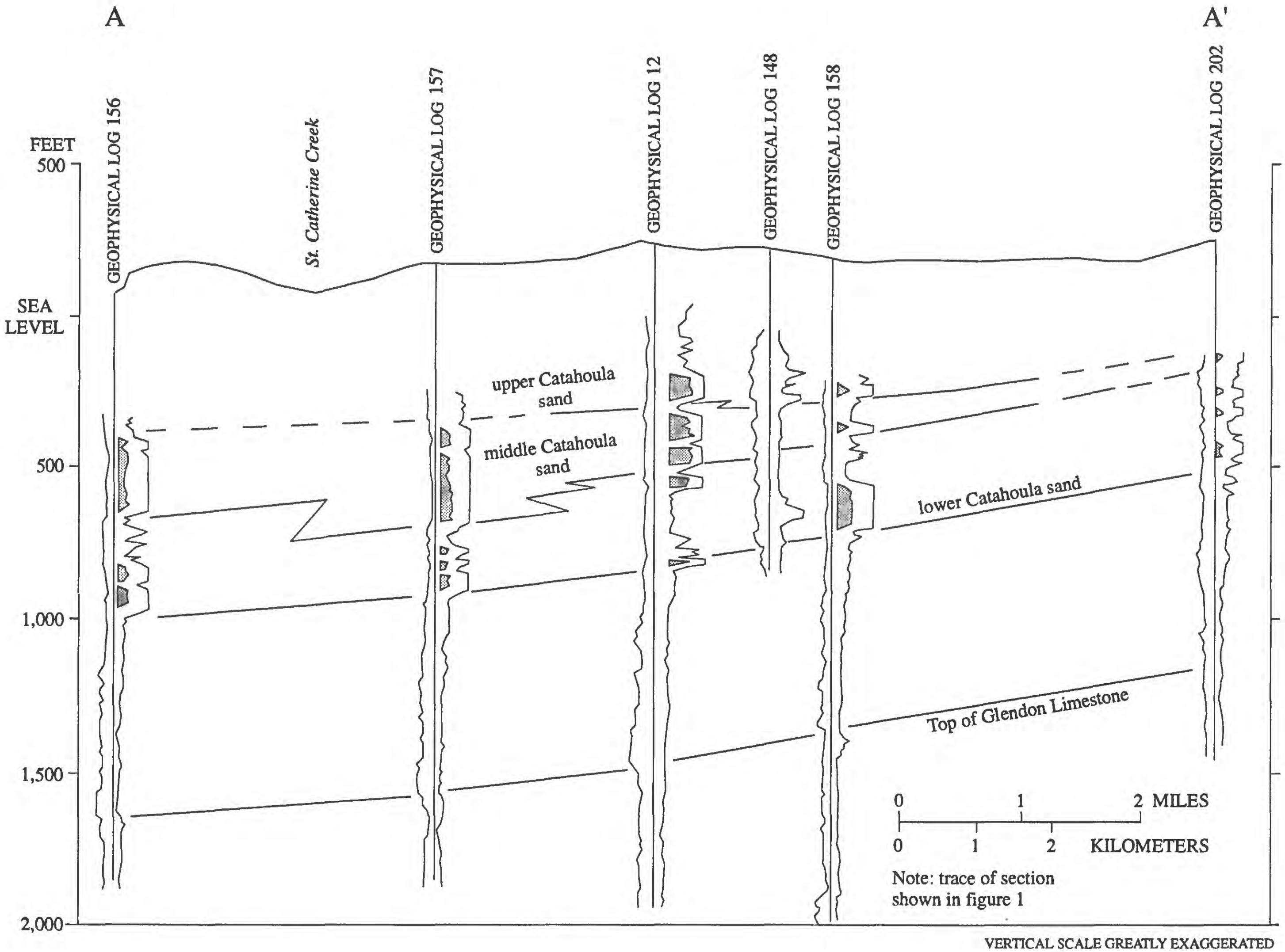


Figure 3. Geologic section showing the north to south dip and relation of geologic units in the Natchez area, Adams County, Mississippi (modified from Boswell and Bednar, 1985).

Table 1. Current wells in the Natchez, Mississippi, area and data used in the investigation

Well number	Latitude	Longitude	Land surface altitude (feet)	Screen interval (feet below land surface)	Sand interval	Months pumped	Pumpage (million gallons per day)	Transmissivity (feet squared per day)
C003	313339	912326	232	399-444	upper	670	0.288	8,400
C005	313336	912321	212	371-421	upper	551	0.384	[a]8,400
C007	313338	912316	210	553-613	middle	501	0.384	4,000
C015	313341	912238	209	532-592	upper	614	0.624	[a]5,000
C016	313343	912244	207	405-455	upper	578	0.464	[a]5,000
C018	313337	912252	203	417-467	upper	466	0.484	[a]5,000
C031	313359	912311	210	382-442	upper	369	0.288	[a]8,400
C032	313400	912311	210	515-575	middle	368	0.288	4,700
C034	313134	912537	90	580-674	middle	363	0.231	2,000
C035	313140	912557	90	639-679	middle	362	0.231	2,000
C037	313136	912543	90	489-560	upper	298	0.231	[a]5,500
C048	313409	912242	183	517-578	middle	181	0.480	2,100
C063	313213	912158	119	539-599	upper	440	0.154	[a]2,000
C064	313337	912321	205	600-650	middle	136	0.720	6,700
C069	313156	912158	119	537-597	upper	450	0.154	9,600
C073	313340	912326	230	555-595 630-652	middle	139	0.720	11,100
C102	313335	912244	200	365-380 395-437 448-471	upper	8	0.324	7,200
D040	313359	911704	293	1,000-1,030	lower	203	0.042	[a]16,000
D046	313456	911713	275	898-958	lower	188	0.231	[a]16,000
D061	313457	911712	275	910-971	lower	183	0.224	[a]16,000
D073	313407	911657	325	1,022-1,051	lower	122	0.336	[a]16,000
D080	313518	911932	248	800-841 857-928	lower	93	0.936	[a]14,700
D081	313524	911958	220	768-788 798-858	lower	93	0.936	13,800
F075	313050	912230	190	780-800	middle	261	0.024	[a]2,000

[a] Estimated value.

year. The current daily rate of withdrawal is about 9.2 million gallons of water per day. The total time the wells have been pumped (table 1) is calculated through March 1995.

ANALYSIS OF GROUND-WATER WITHDRAWAL

Analysis of the effect of ground-water withdrawal from the 24 wells listed in table 1 was made by applying the Theis nonequilibrium equation to each of the three Catahoula sand intervals in the study area to calculate drawdown. This method is applicable because pumping tests and water-level data indicate that the aquifers are confined and generally non-leaky in the study area. The Theis nonequilibrium equation computes drawdown in a confined aquifer for a given time at a specified distance from a pumping well. To perform the analysis, pumpage from the well, the length of time pumping occurred, and the transmissivity and storage coefficient of the aquifer must be known. The equation given by Theis (1935) is of the form:

$$h_o - h = s = \frac{Q}{4\pi T} \int_{\frac{r^2 S}{4Tt}}^{\infty} \frac{e^{-z}}{z} dz$$

where

- h_0 is the initial head (length) at some distance r (length) from the well,
- h is the head (length) at some time t (time),
- s is the resulting drawdown (length),
- Q is the pumping rate (length cubed per time),
- T is the transmissivity (length squared per time), and
- S is the storage coefficient (dimensionless).

The Theis nonequilibrium equation is a solution to the radial form of the diffusion equation for a given set of initial and boundary conditions. Because the diffusion equation is linear, the principle of superposition can be applied to determine the total drawdown caused by multiple wells being pumped simultaneously by summing the drawdown determined for each individual well.

The study area was discretized into three equally spaced grids representing the upper, middle, and lower Catahoula Formation sand intervals. Each grid cell was 500 feet on a side for a total of 9,000 cells in each grid (figs. 4-6). This discretization provided the resolution necessary to delineate the drawdown surface caused by pumpage from multiple wells, and to position each well in the center of a cell. The Theis nonequilibrium equation was applied at the center of each cell for each well in a particular layer using numerical approximations. Drawdown for each well in each cell was summed and plotted on a map (figs. 7-9). Drawdown was calculated using a well radius of 1 foot in cells that contained a well. The calculated drawdown does not account for drawdown caused by other factors, such as turbulent flow, regional water-level declines, or previously existing wells. A storage coefficient of 0.0002 was used for each well in the analysis.

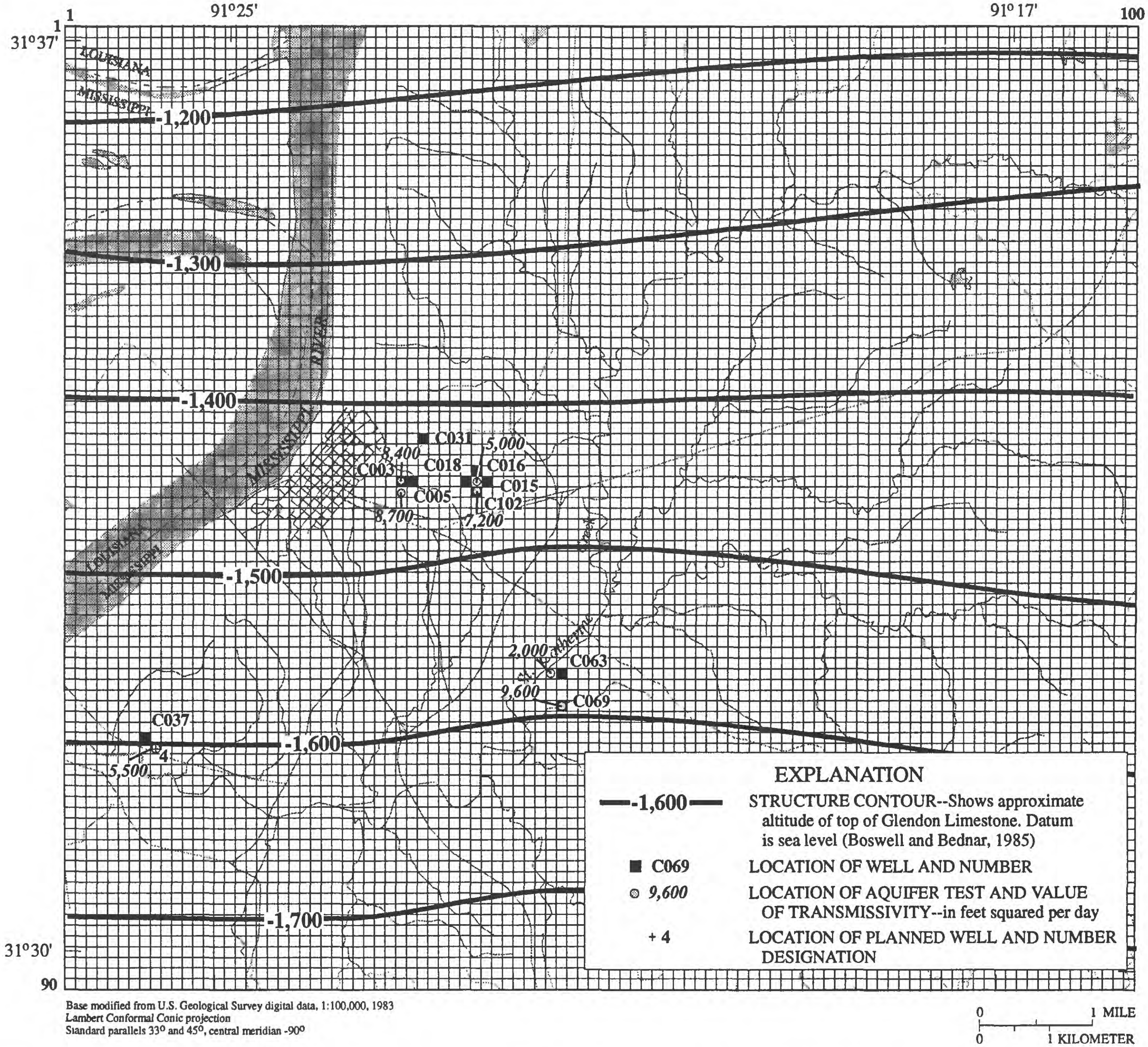
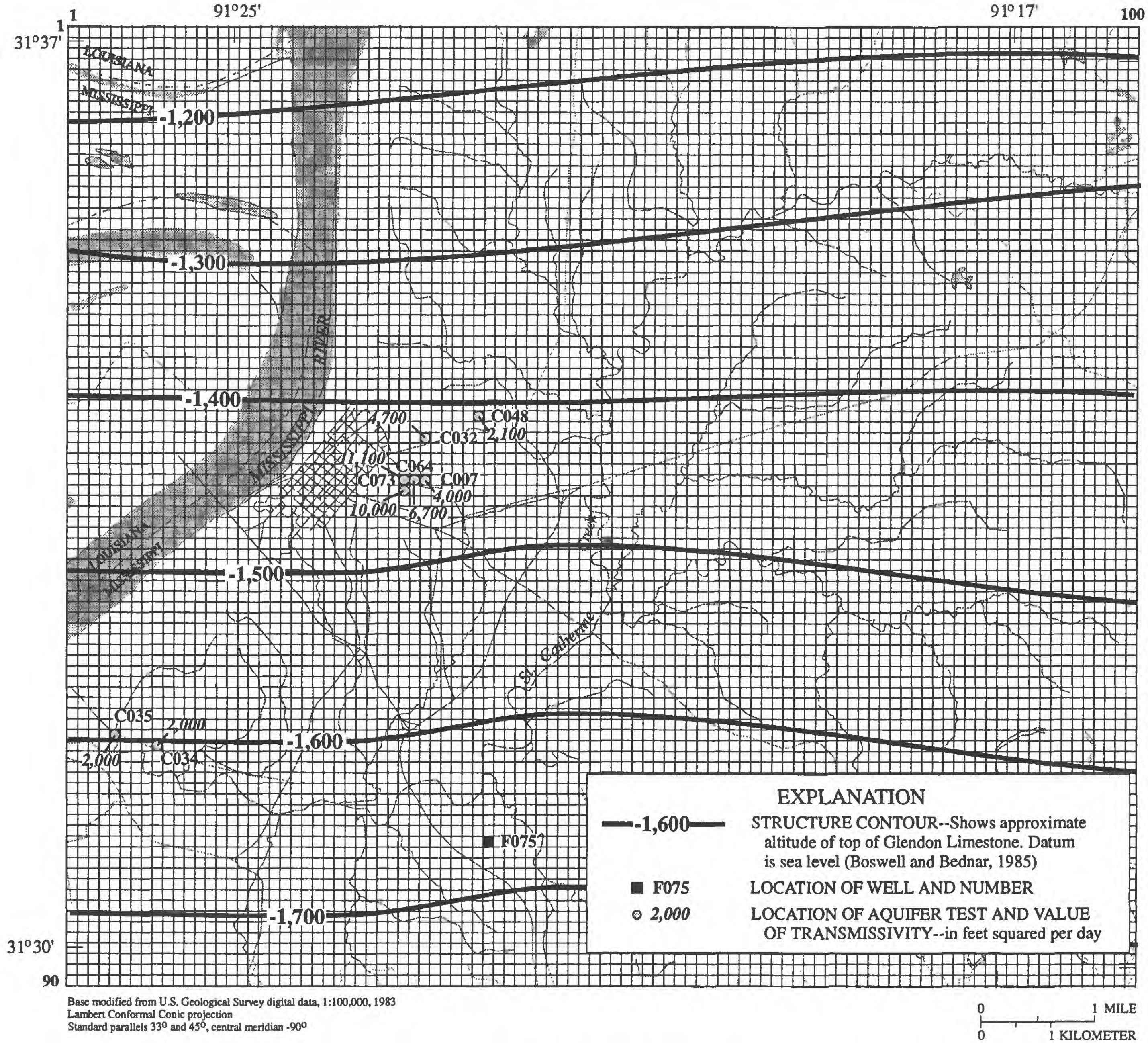


Figure 4. Grid cells, well locations for the upper Catahoula sand, and top of Glendon Limestone used in drawdown calculations.



Base modified from U.S. Geological Survey digital data, 1:100,000, 1983
Lambert Conformal Conic projection
Standard parallels 33° and 45°, central meridian -90°

Figure 5. Grid cells, well locations for the middle Catahoula sand, and top of Glendon Limestone used in drawdown calculations.

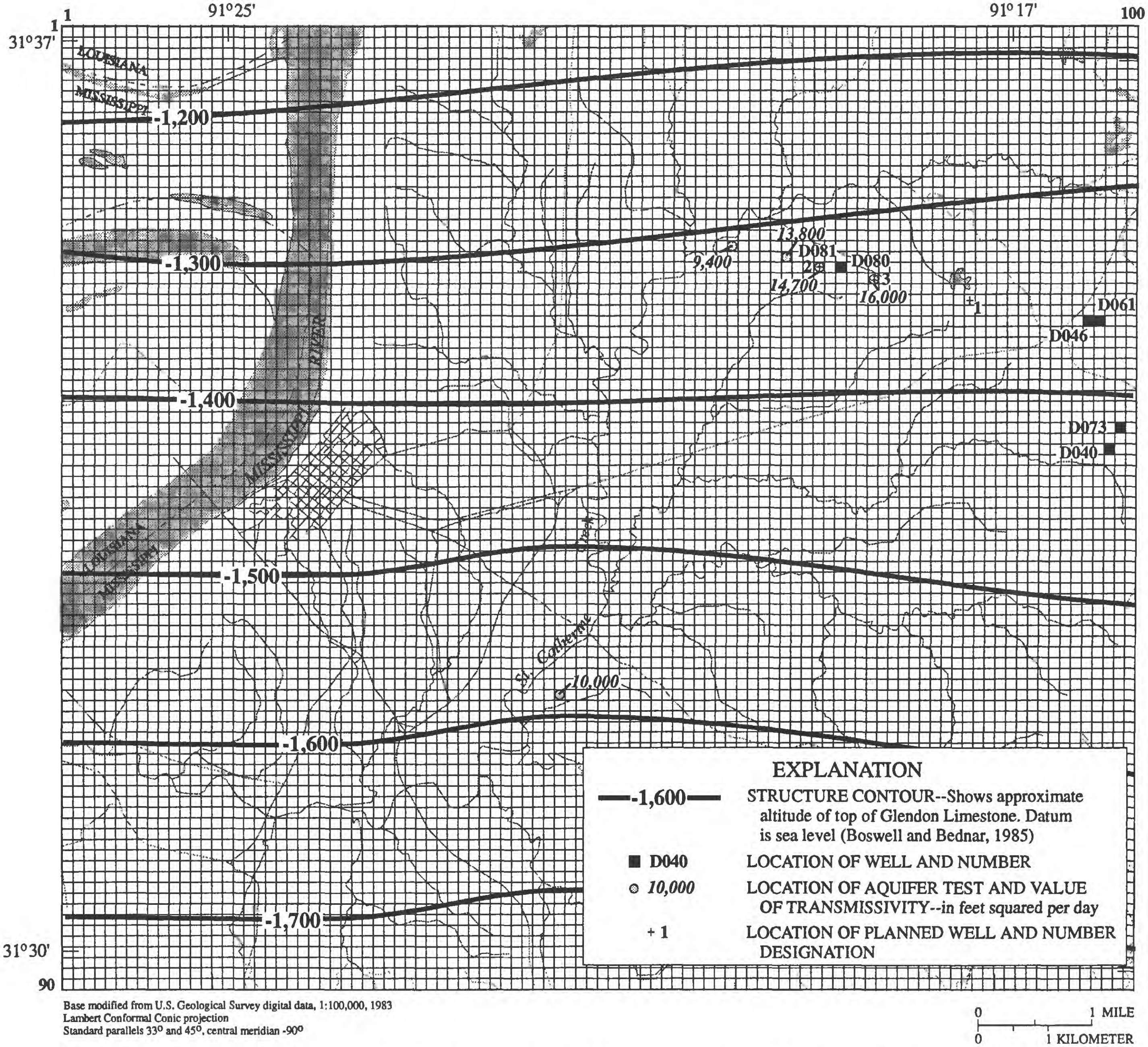


Figure 6. Grid cells, well locations for the lower Catahoula sand, and top of Glendon Limestone used in drawdown calculations.

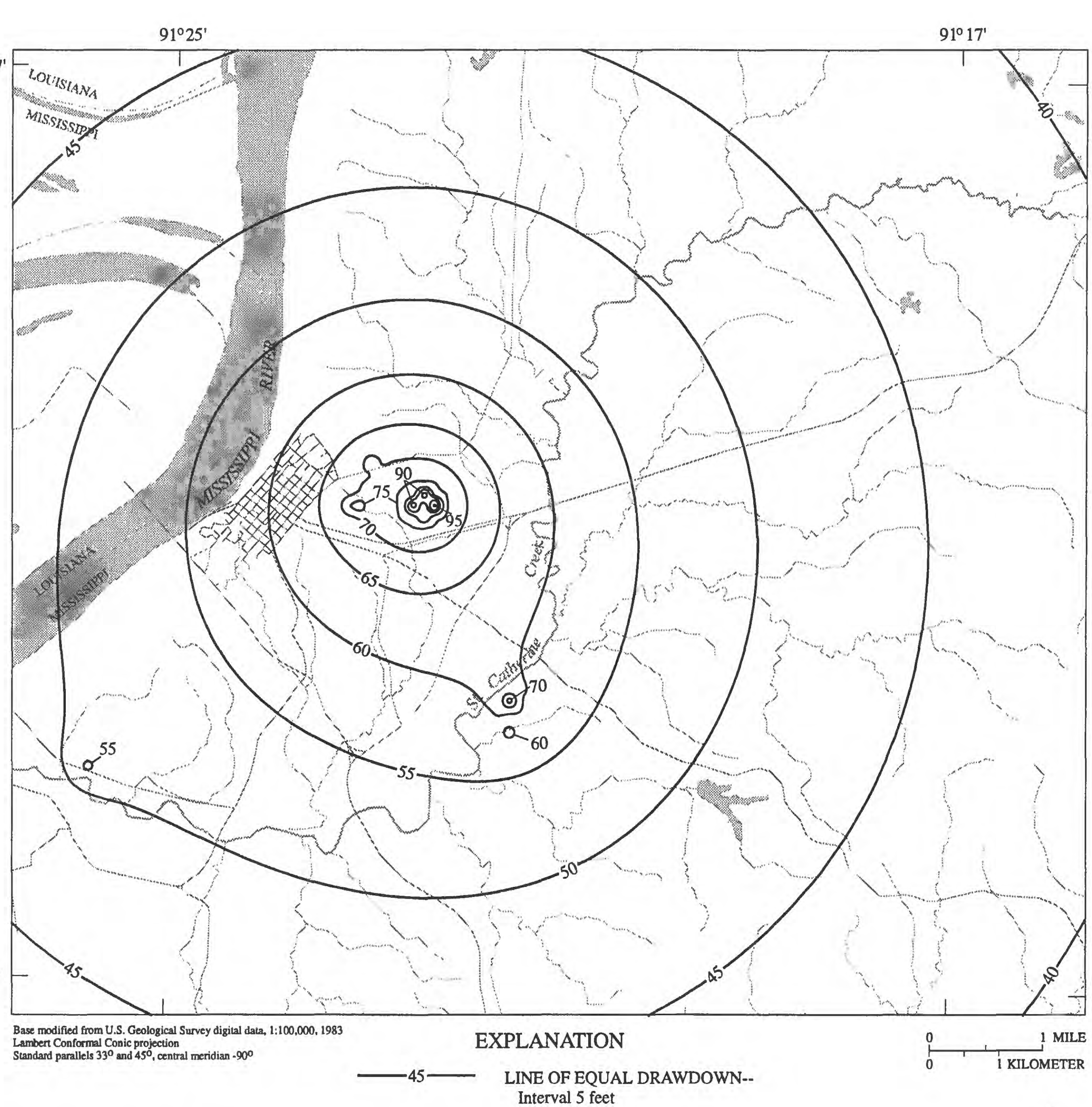


Figure 7. Calculated drawdown of water levels in the upper Catahoula sand interval for currently (March 1995) pumping wells.

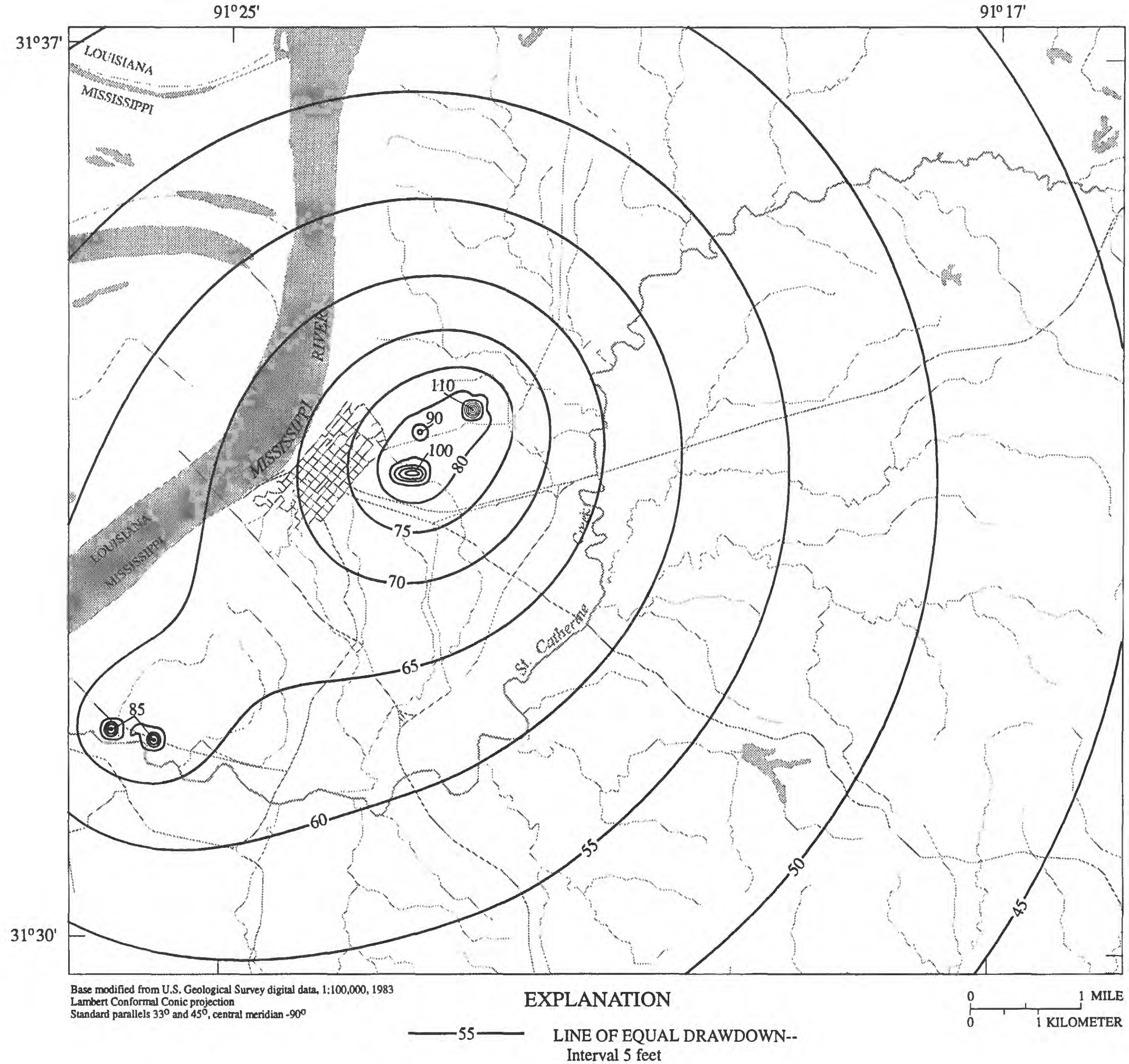


Figure 8. Calculated drawdown of water levels in the middle Catahoula sand interval for currently (March 1995) pumping wells.

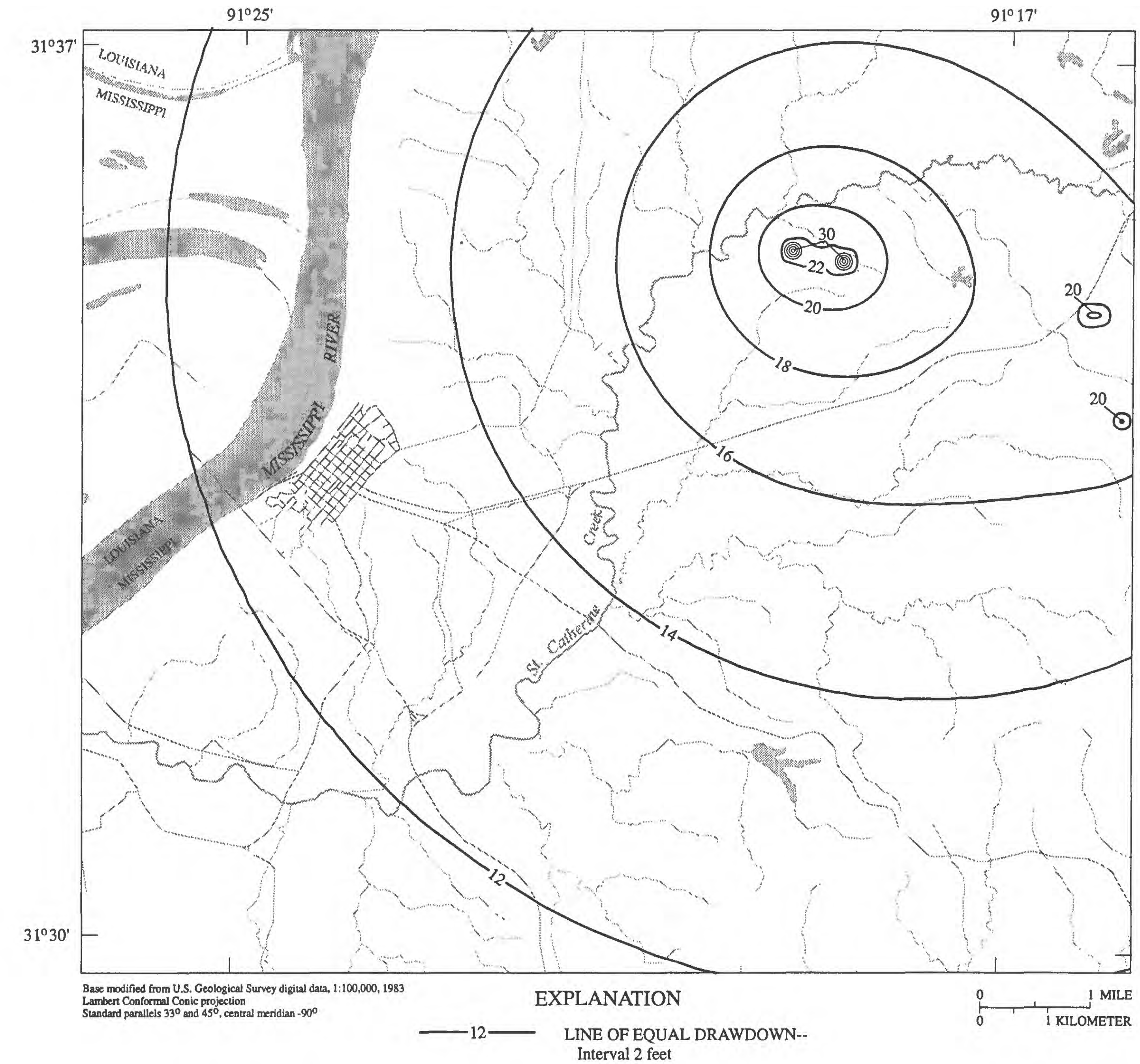


Figure 9. Calculated drawdown of water levels in the lower Catahoula sand interval for currently (March 1995) pumping wells.

Analysis of Current Conditions

Drawdown analysis for current conditions was made using the Theis nonequilibrium equation with pumpage through March 1995 and information listed in table 1. The calculated drawdown surfaces indicate cones of depression surrounding the principal wells. In the upper Catahoula sand (fig. 7) most of the drawdown is concentrated about 1 mile east of the downtown Natchez area, where a maximum drawdown of 95 feet was calculated. Most of the drawdown in the middle Catahoula sand (fig. 8) occurred in the same general vicinity as the upper sand, with a maximum calculated drawdown of about 113 feet. Significant drawdown also occurred in the middle sand about 3 miles southwest of downtown Natchez due to relatively low transmissivity values in the area. Drawdown in the lower Catahoula sand (fig. 9) was concentrated about 4 miles northeast of downtown Natchez, with a maximum calculated drawdown of about 31 feet. Water-level measurements in the Natchez area indicate that the potentiometric surfaces of the upper, middle, and lower Catahoula aquifers are greater than 100, 200, and 600 feet, repectively, above the top of the water-bearing sands. A generalized view of drawdown in all three sands is shown in figure 10.

Sensitivity Analyses

The Theis nonequilibrium equation was applied using the value of transmissivity determined from an aquifer test or estimated for each individual well. An alternative method would be to assume a single average value of transmissivity for all of the wells; however, error likely is reduced by using site-specific values of transmissivity for each individual well (Strom and Oakley, 1995) because calculated drawdown is greatest at the center of a well and decreases exponentially with distance from the well. However, because the Theis nonequilibrium equation is based on the assumption of a homogeneous aquifer, and because site-specific values of transmissivity were used for each individual well, sensitivity analyses were performed using the geometric mean of the test-determined values of transmissivity for each sand interval.

A geometric mean transmissivity of 6,000 feet squared per day for the upper Catahoula sand resulted in an average calculated drawdown about 3 feet less than the drawdown values calculated using site-specific values of transmissivity. A maximum difference of about 13 feet less than the drawdown values calculated using site-specific values of transmissivity occurred at well C063 (fig. 4) due to the relatively large difference between the test-determined and geometric mean value of transmissivity. Differences up to about 9 feet less than the drawdown values calculated using site-specific values of transmissivity also occurred in the vicinity of wells C015 and C016. A geometric mean transmissivity of 4,300 feet squared per day for the middle Catahoula sand resulted in an average calculated drawdown about 4 feet less than the drawdown values calculated using site-specific values of transmissivity. Maximum differences from about 18 to 23 feet less than the drawdown values calculated using site-specific values of transmissivity occurred at wells C034, C35, and C48, and about 18 feet more than the drawdown values calculated using site-specific values of transmissivity occurred at well C073 (fig. 5) due to the relatively large differences between the test-determined and geometric mean value of transmissivity. A geometric mean transmissivity of 12,500 feet

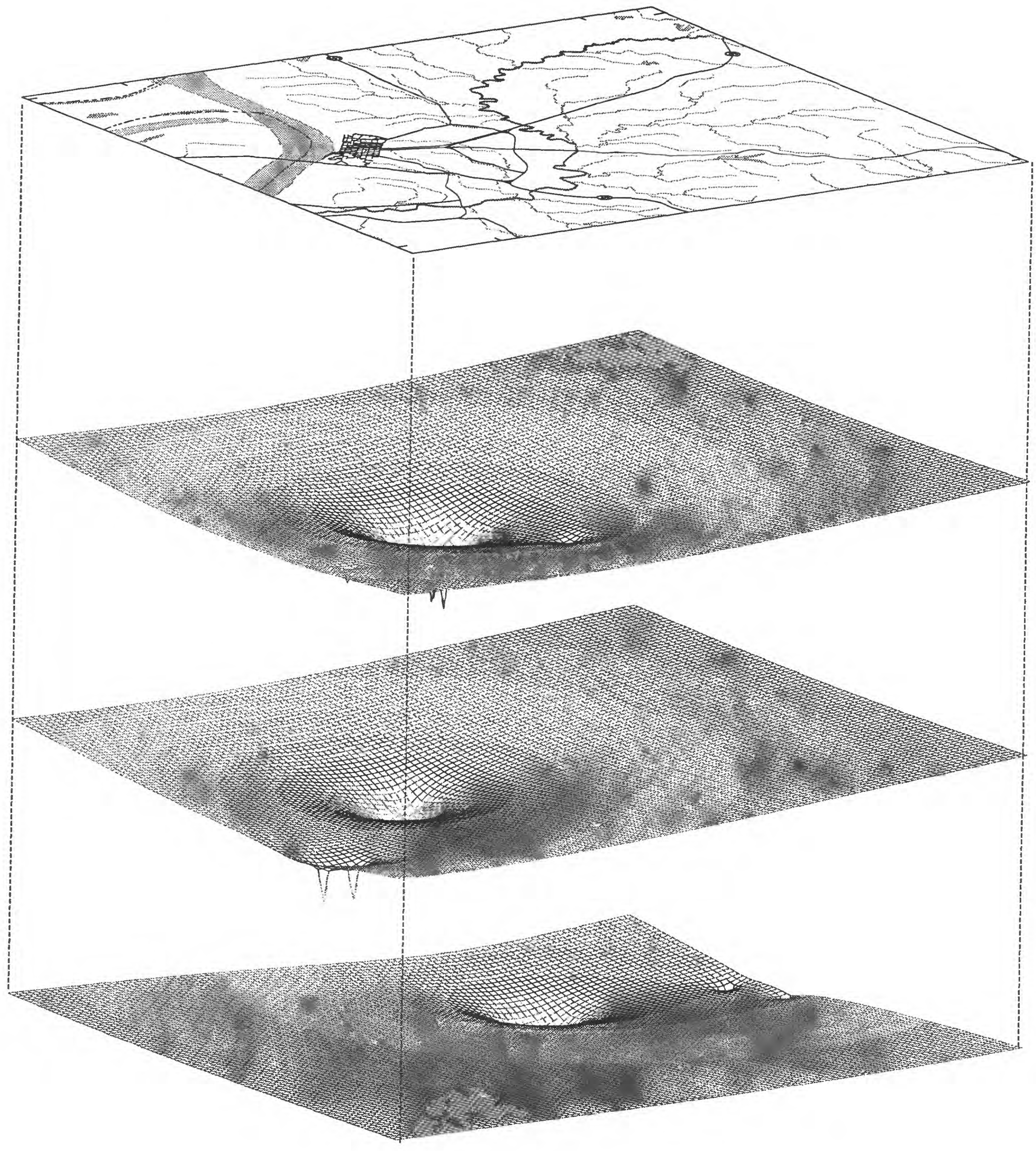


Figure 10. Generalized drawdown surfaces viewed from southwest of the Natchez, Mississippi, area for the upper, middle, and lower Catahoula sand intervals calculated from currently (March 1995) pumping wells.

squared per day for the lower Catahoula sand resulted in an average calculated drawdown about 2 feet greater than the drawdown values calculated using site-specific values of transmissivity. The maximum difference of about 5 feet greater than the drawdown values calculated using site-specific values of transmissivity occurred at all of the pumping wells except D040, which had a maximum difference of about 3 feet (fig. 6).

Because storage coefficient data were limited, a sensitivity analysis of the change in the storage coefficient was made. Decreasing the storage coefficient from 0.0002 to 0.0001 resulted in an increase in drawdown of about 4.5, 5.9, and 1.4 feet for current conditions for the upper, middle, and lower Catahoula sands, respectively. Increasing the storage coefficient from 0.0002 to 0.0003 resulted in a decrease in drawdown of about 2.6, 3.4, and 0.8 feet for current conditions for the upper, middle, and lower Catahoula sands, respectively.

Projected Effects of Ground-Water Withdrawals

Projected drawdown-surface maps based on current pumping rates were made for 10 years and 20 years beyond March 1995. Several major changes in the pumping configuration are planned by the city of Natchez in the near future; table 2 lists relevant information regarding the planned addition of several new wells. Planned locations for the new wells are shown on figure 4 and figure 6. In addition, wells C3, C5, C7, C31, C32, C48, C73, and C64 are expected to discontinue production in May 1996. These changes in the pumping configuration were incorporated into the projection analyses. The projection analyses determined the total drawdown caused by pumping the existing and planned wells 10 and 20 years beyond March 1995; however, water-level recoveries are to be expected for the upper and middle Catahoula sands where wells are planned to be taken out of production.

Table 2. Estimated data used in projection analyses for planned wells in the Natchez area

Well number	Latitude	Longitude	Sand interval	Date pumping to begin	Pumpage (million gallons per day)	Transmissivity (feet squared per day)
1	313506	911819	lower	May 1996	1.184	16,000
2	313520	911942	lower	May 1996	1.184	14,700
3	313516	911910	lower	May 1996	1.184	16,000
4	313133	912535	upper	April 1995	0.528	5,500

The drawdown surface calculated for 10 years beyond March 1995 indicates an average total increase in drawdown of about 7.3 feet for the upper Catahoula sand (fig. 11), with a maximum increase of about 28 feet at the planned location of well 4 (fig. 4 and table 2). An average total increase in drawdown of only 1.2 feet was calculated for the middle Catahoula sand (fig. 12) due to the planned discontinued pumping of many

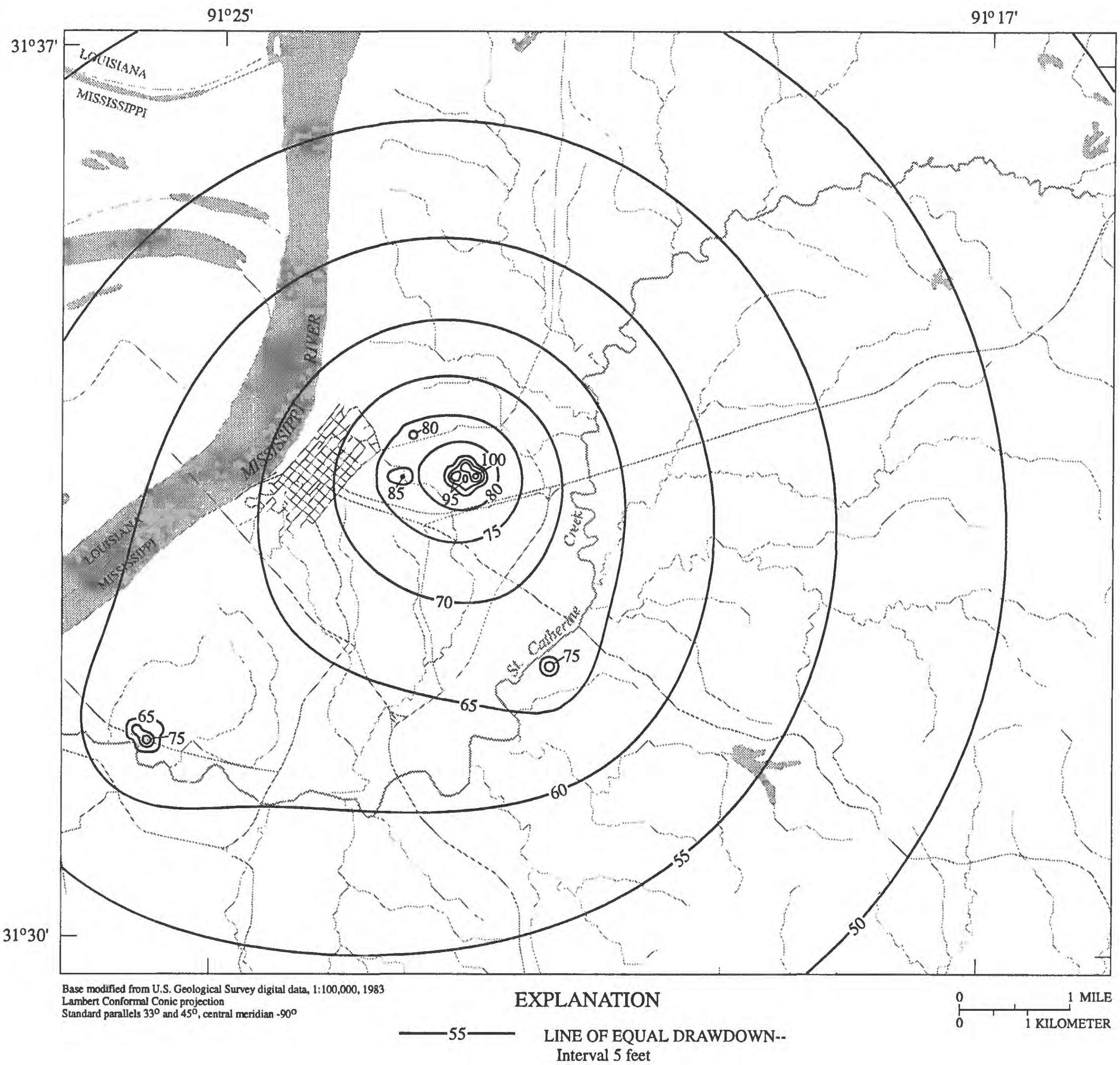


Figure 11. Projected drawdown map based on current pumping rates in the upper Catahoula sand 10 years beyond March 1995.

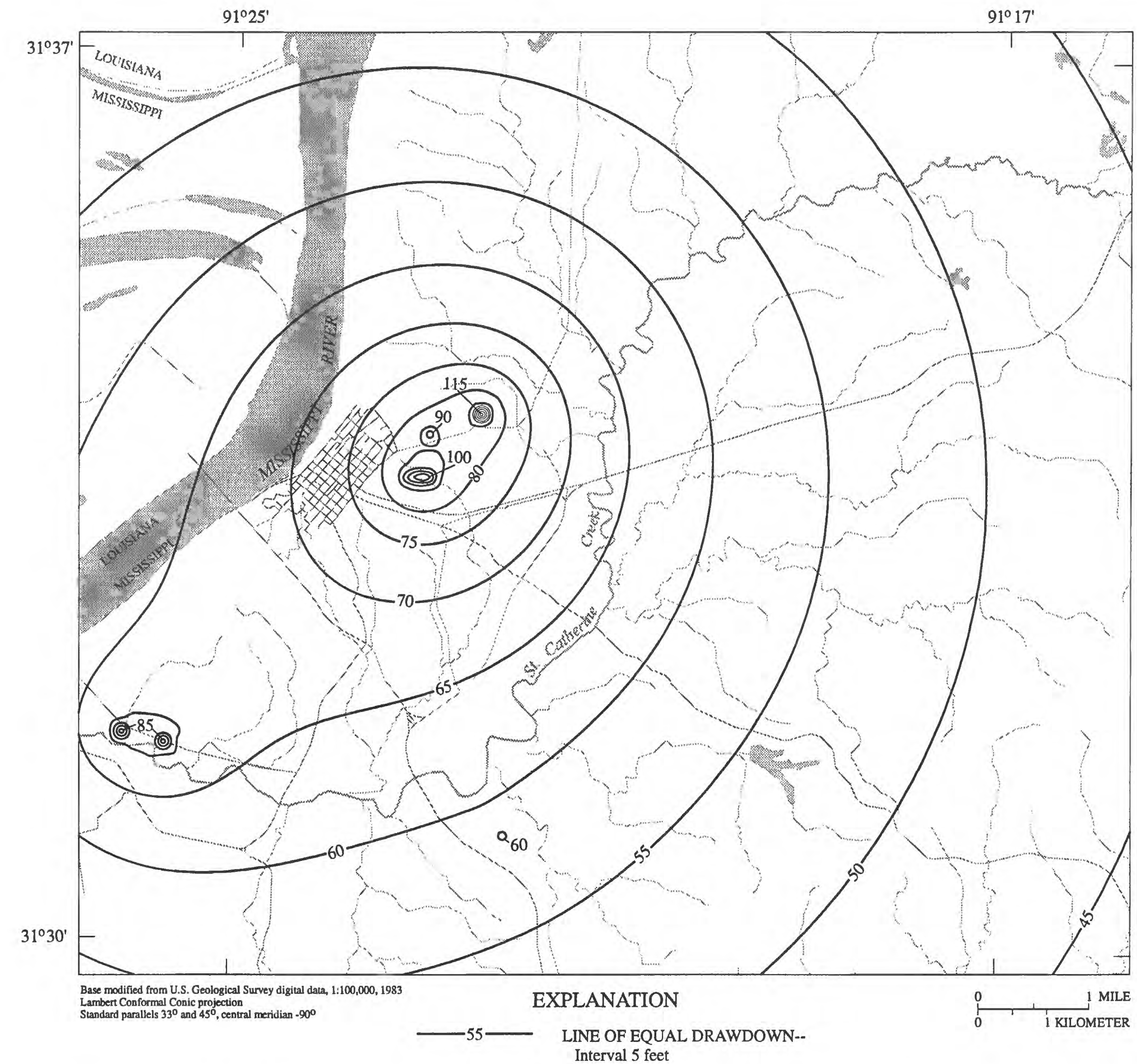


Figure 12. Projected drawdown map based on current pumping rates in the middle Catahoula sand 10 years beyond March 1995.

of the wells. An average total increase in drawdown of about 19 feet was calculated for the lower Catahoula sand (fig. 13), with a maximum increase of about 41 feet at the planned locations of wells 1, 2, and 3 (fig. 6 and table 2). The drawdown surface calculated for 20 years beyond March 1995 (figs. 14-16) indicates an average total additional increase in drawdown over the 10-year estimates of about 1.9, 0.6, and 2.7 feet for the upper, middle, and lower Catahoula sands, respectively.

Projection analyses are based on the assumption that the planned new wells will have properties similar to those listed in table 2. However, if the completion date of the planned wells is as much as 1 year later than anticipated, the drawdown surfaces calculated for 10 years beyond current conditions would be less than 0.3 foot different than the values calculated above.

Because drawdown and pumpage have a linear relation in the Theis nonequilibrium equation, the projection maps may be used for extrapolation or interpolation of drawdown for other pumping rates. For example, the calculated drawdown for current conditions at well C063 (fig. 4) is about 71 feet (fig. 7). After 10 years of pumpage beyond March 1995, the calculated drawdown is about 79 feet (fig. 11); therefore, total additional drawdown is 8 feet. If pumpage were increased by 50 percent for all of the wells for the 10-year period, the total additional drawdown at well C063 would be 1.5 times 8, or 12 feet, resulting in a total drawdown of about 91 feet.

Limitations of the Analysis

To correctly apply the Theis nonequilibrium equation in the drawdown analyses, several assumptions were made: (1) the upper, middle, and lower sand intervals of the Catahoula Formation are confined and infinite in extent, (2) wells are of infinitesimal diameter and fully penetrate the aquifer, (3) water is released instantaneously from the aquifer with decline in head, (4) the aquifer is homogeneous and isotropic, and (5) there are no contributions of water from overlying or underlying aquifers. The first assumption is valid if the extent of the aquifer is large compared to the extent of the drawdown cones of the pumping wells. If impermeable geologic boundaries are reached by the drawdown cones, however, computed drawdown will be less than actual drawdown. Nearby sources of recharge would cause computed drawdown to be greater than actual drawdown. The second assumption ignores any storage in the well, which is a reasonable assumption for long-term analyses in which the total water pumped is large relative to wellbore storage. Wells in the study area generally were screened the entire thickness of the sand interval. The third assumption is valid for the confined case, but would be invalid if water-table conditions were encountered. The fourth assumption was made for the analysis of each individual well; however, aquifer tests indicated variations in transmissivity. Because site-specific aquifer properties were used at each individual well, the drawdown calculated near each well probably is a better approximation than if a constant value of transmissivity were applied to all wells. According to the fifth assumption, the clay and silt confining layers are impermeable. The calculated drawdown will be greater than the actual drawdown if water moves through the confining layers into the aquifers.

The drawdowns calculated herein do not necessarily represent precise drawdowns observed in the field. Calculated drawdown is for the currently pumping wells and does

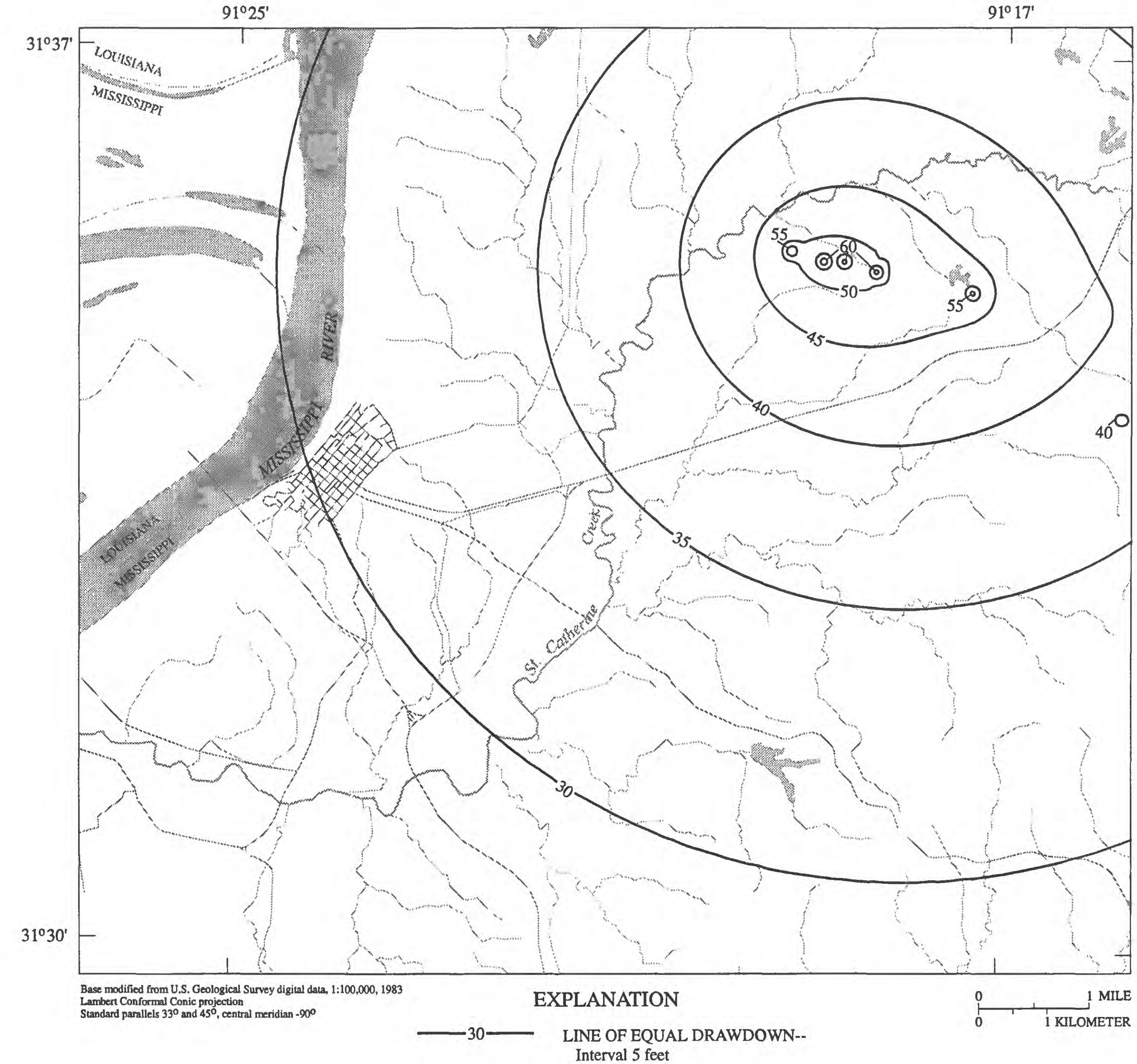


Figure 13. Projected drawdown map based on current pumping rates in the lower Catahoula sand 10 years beyond March 1995.

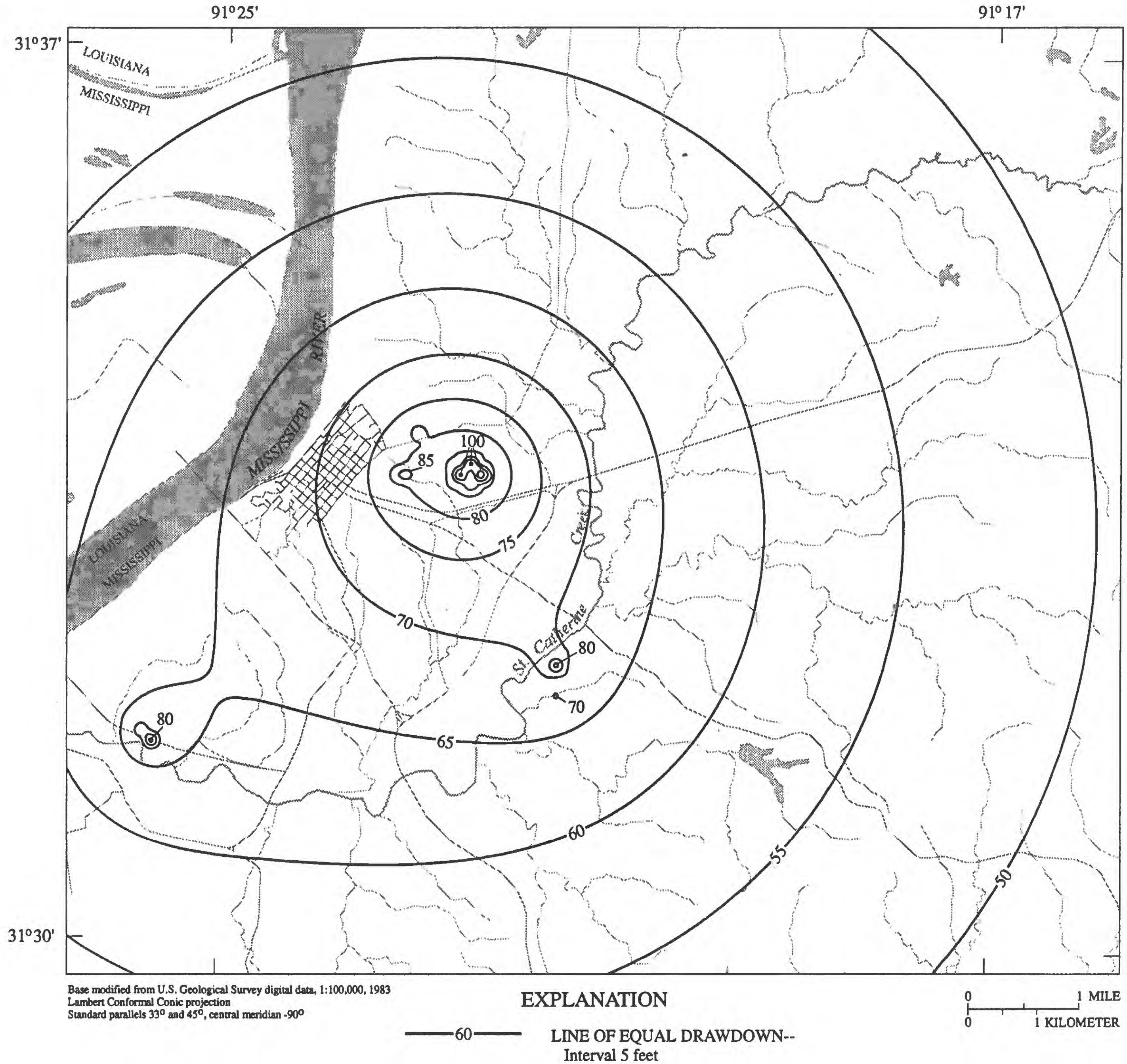


Figure 14. Projected drawdown map based on current pumping rates in the upper Catahoula sand 20 years beyond March 1995.

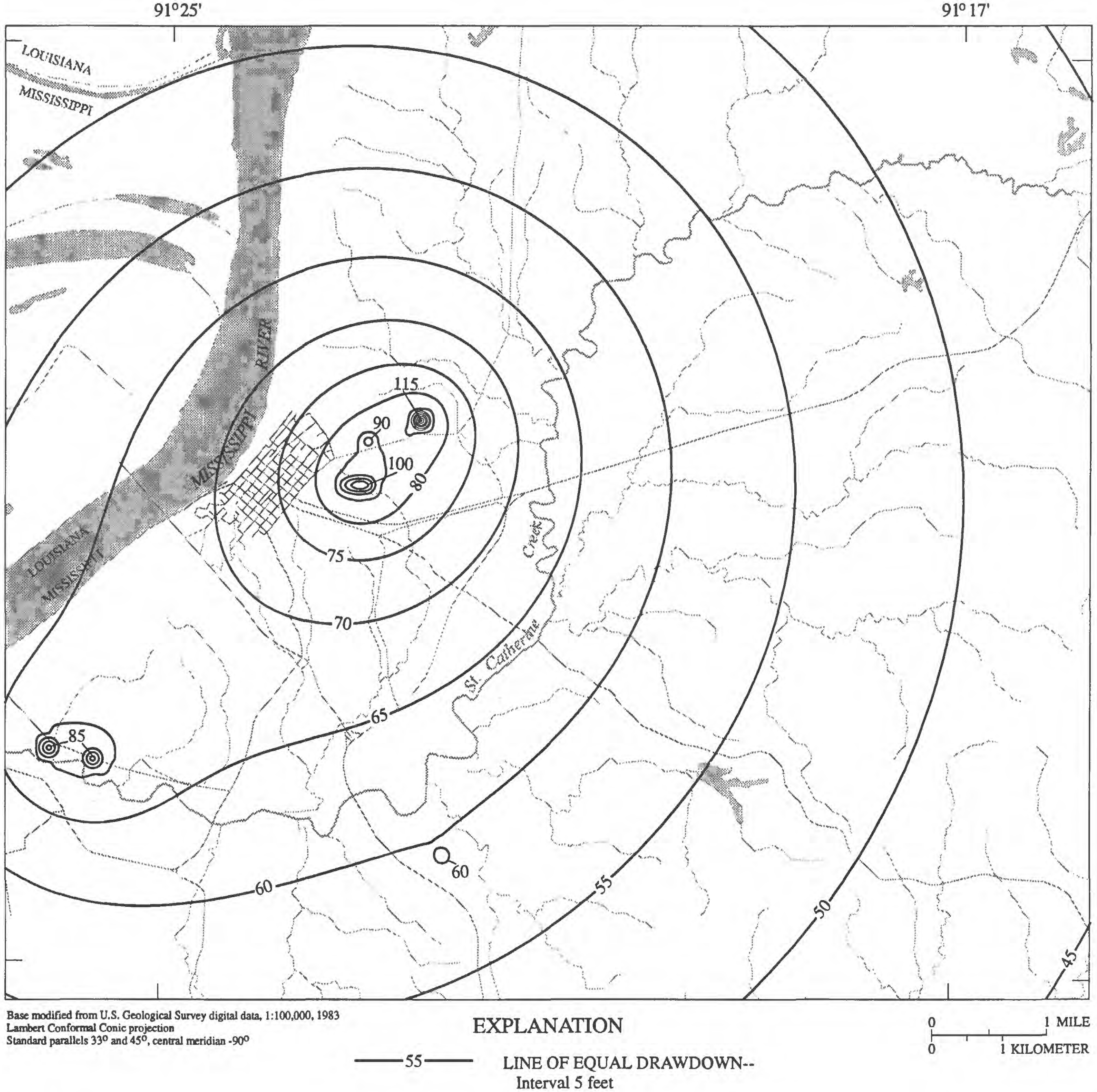


Figure 15. Projected drawdown map based on current pumping rates in the middle Catahoula sand 20 years beyond March 1995.

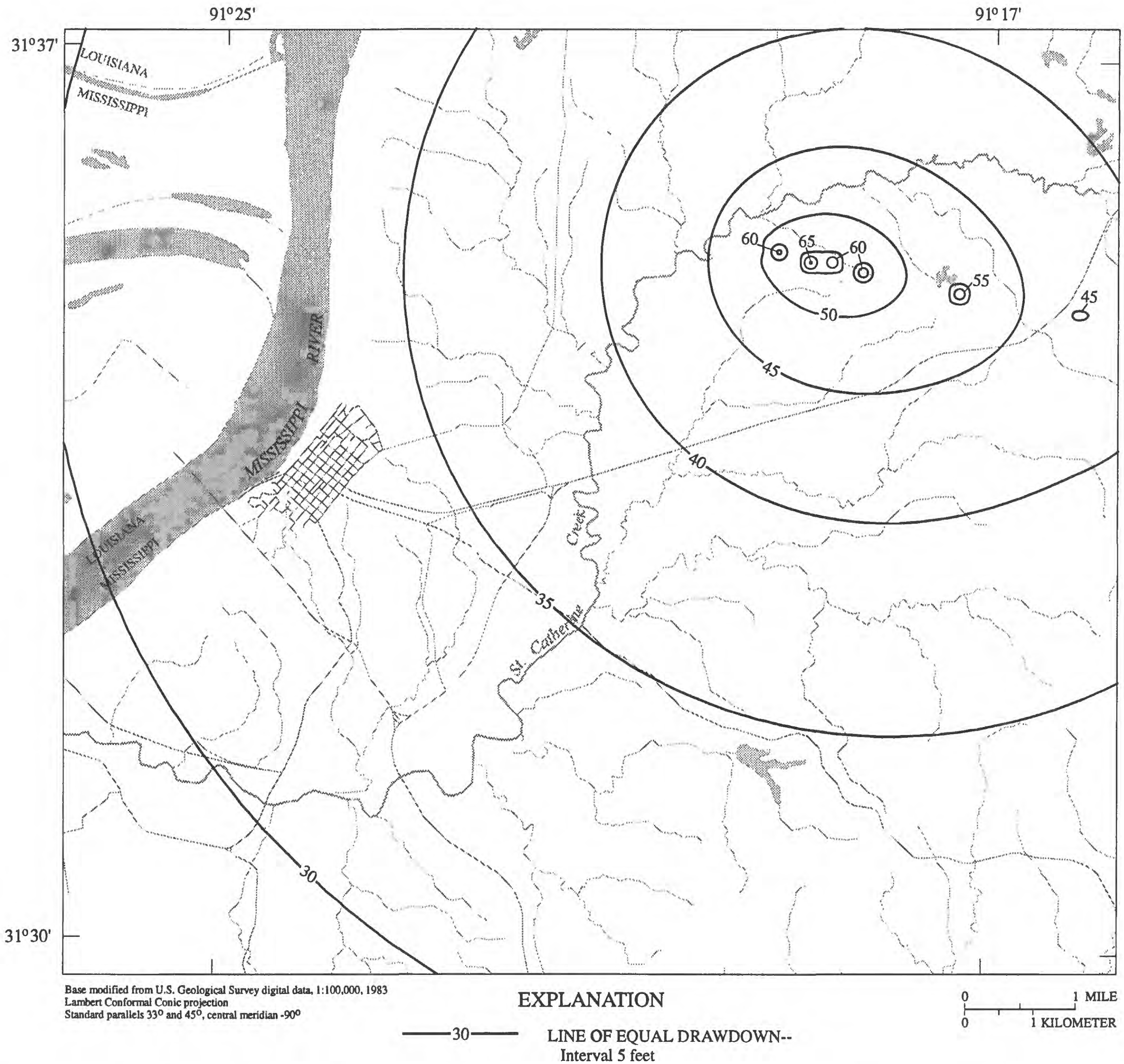


Figure 16. Projected drawdown map based on current pumping rates in the lower Catahoula sand 20 years beyond March 1995.

not account for drawdown caused by previously existing wells or regional water-level declines; however, the calculated drawdowns provide a guide for estimating drawdown trends that may occur in the future. Water-level recoveries are to be expected for the upper and middle Catahoula sand intervals if numerous wells discontinue pumping. Projection analyses are based on the assumption that the planned new wells will have properties similar to those listed in table 2.

SUMMARY

The city of Natchez, located in Adams County, Mississippi, relies on ground water for public supply and industrial needs. Most public-supply and industrial wells are developed in Catahoula Formation sands of Miocene age. The U.S. Geological Survey, in cooperation with the Mississippi Department of Environmental Quality, Office of Land and Water Resources, began an investigation to describe the hydrogeology, analyze the effects of ground-water withdrawal from currently pumped wells, and project the possible effects of increased ground-water withdrawals on water levels in the Catahoula aquifer system within the Natchez area.

The study area covers about 80 square miles in Adams County, southwestern Mississippi. The study area contains several aquifers; however, the most important aquifers in terms of water supply are the Mississippi River alluvial aquifer and the Catahoula aquifer system. In the Natchez area, the Catahoula Formation contains three principal sand intervals that are referred to as the 400-foot, 600-foot, and 1,000-foot sands and correspond to the upper, middle, and lower Catahoula Formation, respectively.

Ground-water withdrawal from the Catahoula aquifer system in the study area currently (March 1995) is from 24 wells screened in the upper, middle, and lower sands of the Catahoula Formation. The current daily rate of withdrawal is about 9.2 million gallons of water per day. Analysis of the effect of ground-water withdrawal from the wells was made using the Theis nonequilibrium equation and applying the principle of superposition. The study area was discretized into three equally spaced grids, and drawdown was calculated at the center of each cell. Analysis of current conditions was based on the pumpage through March 1995 and the aquifer properties determined for each well. The calculated drawdown surfaces indicate cones of depression surrounding the principal wells. In the upper Catahoula sand most of the drawdown is concentrated about 1 mile east of the downtown Natchez area, where a maximum drawdown of 95 feet was calculated. Most of the drawdown in the middle Catahoula sand occurred in the same general vicinity as in the upper sand, with a maximum calculated drawdown of about 113 feet. Drawdown in the lower Catahoula sand was centered about 4 miles northeast of downtown Natchez, with a maximum calculated drawdown of about 31 feet.

Drawdown-surface maps were made using calculations based on current pumping rates for 10 years and 20 years beyond March 1995. Planned changes in the pumping configuration were incorporated into these analyses. The drawdown surface calculated for 10 years beyond March 1995 indicates an average total increase in drawdown of about 7.3 feet for the upper Catahoula sand, with a maximum increase of about 28 feet. An average total increase in drawdown of only 1.2 feet was calculated for the middle

Catahoula sand due to the planned discontinued pumping of many of the wells. An average total increase in drawdown of about 19 feet was calculated for the lower Catahoula sand, with a maximum increase of about 41 feet. The drawdown surface calculated for 20 years beyond March 1995 indicates an average total additional increase in drawdown over the 10-year calculations of about 1.9, 0.6, and 2.7 feet for the upper, middle, and lower Catahoula sands, respectively.

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