HYDROLOGIC AND GEOCHEMICAL DATA FOR THE BIG BROWN LIGNITE MINE AREA, FREESTONE COUNTY, TEXAS

By Michael E. Dorsey

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CONVERSION FACTORS

For those readers who may prefer to use the International System (SI) of units rather than inch-pound units, the conversion factors for the terms used in this report are given below:

From	Multiply by	To obtain
foot (ft)	0.3048	meter
inch (in.)	25.40	millimeter
mile (mi)	1.609	kilometer
degree Fahrenheit (°F)	5/9 (°F-32)	degree Celsius

National Geodetic Vertical Datum of 1929 (NGVD 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 "mean sea level."

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ABSTRACT

Lignite mining in east and east-central Texas is increasing in response to increased energy needs throughout the State. Associated with the increase in mining activities is a greater need to know the effects of mining activities on the water quantity and quality of near-surface aquifers. The near-surface lignite beds mined at the Big Brown Lignite Mine are from the Calvert Bluff Formation of the Wilcox Group of Eocene age, which is a minor aquifer generally having water suitable for all uses, in eastern Freestone County, Texas. One of the potential hydrologic effects of surface-coal mining is a change in the quality of ground water associated with replacement of aquifer materials by mine spoils. The purpose of this report is to compile and categorize geologic, mineralogic, geochemical, and hydrologic data for the Big Brown Lignite Mine and surrounding area in east-central Texas. Included are results of paste-extract analyses, constituent concentrations in water from batch-mixing experiments, sulfur analyses, and minerals or mineral groups detected by X-ray diffraction in 12 spoil material samples collected from 3 locations at the mine site. Also, common-constituent and trace-constituent concentrations in water from eight selected wells, located updip and downdip from the mine, are presented. Dissolved-solids concentrations in water from batch-mixing experiments vary from 12 to 908 milligrams per liter. Water from selected wells contain dissolved-solids concentrations ranging from 75 to 510 milligrams per liter.

INTRODUCTION

Lignite mining activities in east and east-central Texas are increasing in response to increased energy needs throughout the State. Lignite in Texas occurs in three geologic units of Eocene age--the Wilcox Group, Jackson Group, and Yegua Formation (Kaiser and others, 1980). The near-surface lignite beds, which occur in the Calvert Bluff Formation of the Wilcox Group, are mined from the Big Brown Lignite Mine in eastern Freestone County (fig. 1). The coal seams usually are 2 to 10 ft thick, but may be as much as 16 ft thick (Kaiser and others, 1980). The Calvert Bluff Formation is a minor aquifer generally having water suitable for all uses. One of the potential hydrologic effects of surface-coal mining is a change in the quality of ground water associated with replacement of aquifer materials by mine spoils.

Purpose and Scope

The purpose of this report is to compile and categorize geologic, mineralogic, geochemical, and hydrologic data for the Big Brown Lignite Mine and surrounding area in east-central Texas (fig. 1). Similar reports are available for selected mine sites in Missouri, Montana, New Mexico, North Dakota, Oklahoma, Wyoming, and Colorado. The mine sites were chosen for various reasons:

1. Hydraulic connection exists between the undisturbed hydrogeologic system and the disturbed and replaced overburden (mine spoils).
2. A data base, which could be supplemented with minimal additional data collection, was available.
3. A general understanding of the hydrogeologic system existed.
4. A variety of geologic and hydrologic conditions were represented.

In addition to selected, previously available information, the data presented in this report include the results of X-ray diffraction analyses, paste-extract analyses, and sulphur analyses for the spoils material; chemical analyses of water from wells completed in the undisturbed system; and chemical analyses of water from batch-mixing experiments. Comparisons of the laboratory data with field conditions may enable future investigators to determine which factors would be primarily responsible for anticipated effects of mining in a given area.

Due to the limited scope of the study, existing well-inventory data were used for the selection of site locations for water-level and water-quality data collection. Areal coverage of data collection was limited to within a 1-mi radius of the mine area boundary.

Previous Studies

With a renewed interest in Texas lignite as an economical fuel source, there has been an increase in coal-hydrology related studies in recent years. Previous studies of Texas lignite generally have been concerning estimation of lignite resources. Recently, however, there has been more interest in the long- and short-term effects of lignite mining on the water quality and the hydraulic properties of ground-water systems (Dutton, 1982; Matthewson and others, 1982). William F. Guyton and Associates (1972) describe the ground-

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water conditions of a four-county area, which includes Freestone County; Kaiser (1974) and Kaiser and others (1980) list inventories of lignite resources in the east Texas region.

Acknowledgments

The author wishes to acknowledge the assistance and cooperation of John Alford and Joe White of Texas Utilities and residents and property owners in the Big Brown Lignite Mine vicinity.

Well-Numbering System

The Texas Department of Water Resources statewide well-numbering system is used in this report (fig. 2). Each 1-degree quadrangle in or overlapping into the State is given a two-digit number from 01 to 89. These are the first two digits of a well number. Each 1-degree quadrangle is further divided into sixty-four 7-1/2-minute quadrangles, which are assigned a two-digit number from 01 to 64. These two digits constitute the third and fourth digits of a well number. Each 7-1/2-minute quadrangle is subdivided into nine 2-1/2-minute quadrangles, which are numbered 1-9. This is the fifth digit of a well number. Finally, each well within the 2-1/2-minute quadrangles is assigned a two-digit number beginning with 01. These two digits constitute the sixth and seventh digits of a well number. Each seven-digit number has a two-letter prefix to identify the county in which the well is located. The prefix for Freestone County is KA.

Each well is also referenced to the identification system used by the U.S. Geological Survey. The identification number combines the latitude and longitude and adds a two-digit sequence number (table 1).

Physical and Climatic Setting

The study area is located in the rolling hills of east Texas. The mine area is drained by Cottonwood Creek on the west and Bear and Big Brown Creeks to the east. The three main creeks draining the mine area are tributaries to Tehuacana Creek, which is a tributary to the Trinity River (fig. 1). The streams generally are deep with wide alluvial flood plains and flow perennially. Altitudes in the study area range from 420 ft above NGVD of 1929 near the western side of the mine to 310 ft to the east.

East Texas has a humid subtropical climate. Average annual precipitation is 37.78 in. at Fairfield located on the southwestern edge of the study area. Precipitation is evenly distributed throughout the year with some increase during April and May. The average annual temperature at Fairfield is 66.3°F.

GEOLOGIC AND HYDROLOGIC SETTING

Geology

The Big Brown Lignite Mine area is directly underlain by the Calvert Bluff Formation of the Wilcox Group of Eocene age. The Calvert Bluff Formation con-

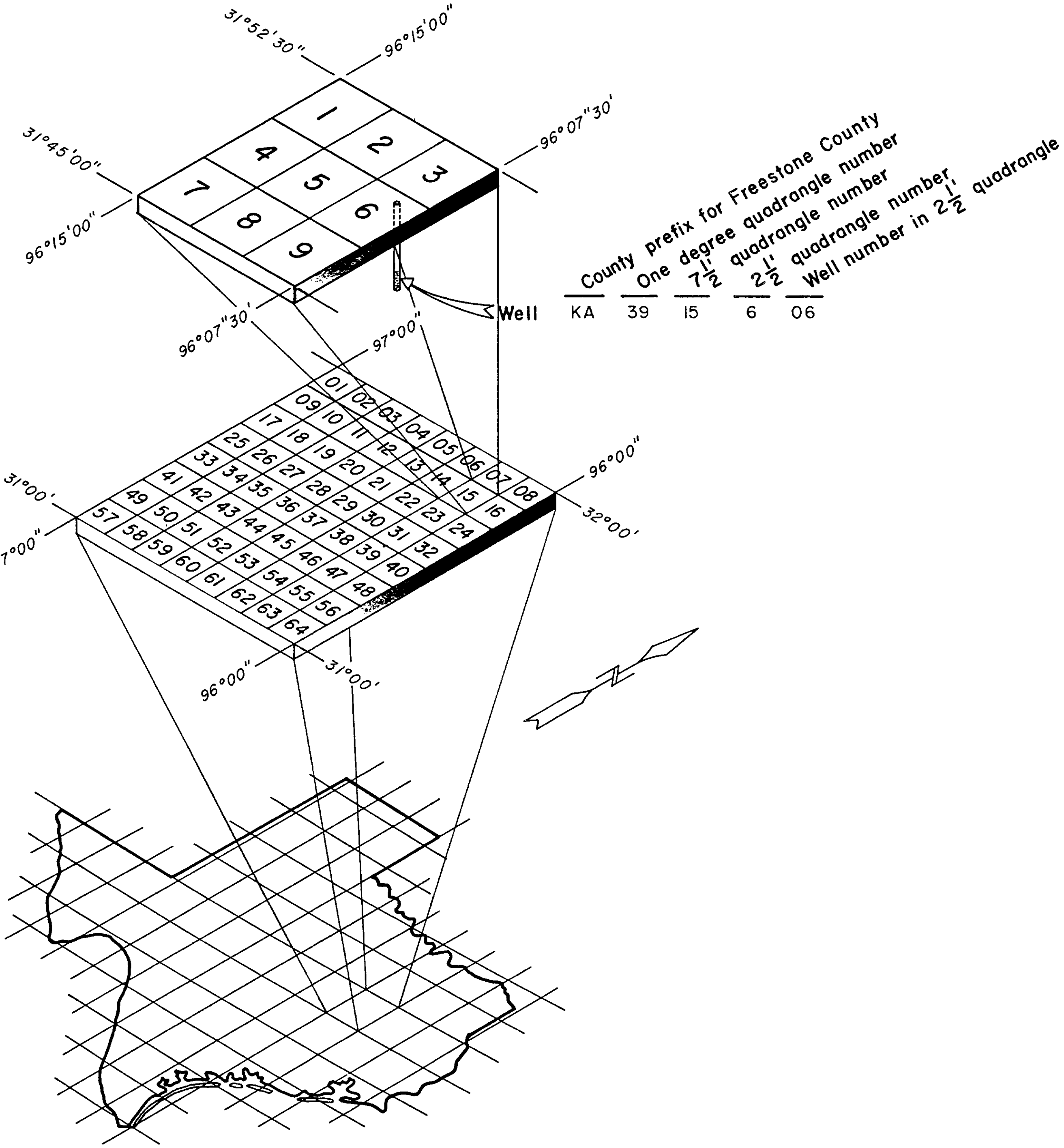

Figure 2.- Well-numbering system

Table 1.--State well numbers with corresponding U.S. Geological Survey identification numbers

State well number	U.S. Geological Survey identification number
KA-39-15-303	315135096073501
506	314935096100001
606	314929096080001
607	314940096082901
808	314540096122001
809	314702096115001
810	314622096122401
811	314535096110901
16-106	315055096050301
107	315002096051801
108	315207096064501
207	315033096045001
407	314952096052201
408	314939096052701
409	314900096054501
410	314851096053101
411	314751096062601
412	314839096055101
501	314905096043601
707	314718096063001
708	314528096072701
709	314608096070701
23-308	314438096094701
309	314454096081301

sists mainly of interbedded sand, silt, and clay. The sands typically are gray and most are relatively thin bedded, fine grained, and silty. Lignite occurs regularly in the lower part of the formation and irregularly in the upper part. The lignite beds occur in elongate concentrations between channel sand belts approximately along the dip of the formation, which is 2° to the southeast toward the Gulf of Mexico (Kaiser and others, 1980). The outcrop of the formation trends approximately northeast and is approximately perpendicular to the occurrence of lignite belts and the slope of the formation.

Ground Water

The Calvert Bluff Formation is a minor aquifer generally having water suitable for all uses. Water-well development generally is limited to old hand-dug wells or more recent augered wells. Wells range in depth from 20 to 60 ft with a few wells drilled to a depth of 100 to 150 ft. Wells that are drilled deeper than 150 ft begin to yield more mineralized water in lignite zones. Wells deeper than 150 ft generally are drilled to depths of 200 to 600 ft in order to penetrate the Simsboro Formation, which is known to be a prolific aquifer with water suitable for all uses.

Recharge to the Calvert Bluff Formation occurs through the infiltration of both precipitation falling on the outcrop area and, to some extent, streamflow over the outcrop area. Because the Calvert Bluff Formation contains clay, ground water moves slowly through the aquifer, and consequently, dewatering activities at the mine site have been very successful. Regional movement of water through the formation is downdip with some movement up through confining beds to be discharged through seeps in stream channels and evapotranspiration (fig. 3).

DATA COLLECTION

Spoils Material

A total of 12 spoils samples were collected at 3 sites within the mine (fig. 1). At each site, three samples were collected--one near the base of the spoils, one near the top of the spoils, and one midway between the base and the top. In addition, duplicate samples were collected at site TX1B to provide a basis for determining repeatability of laboratory analyses.

The first letter of the spoils-sample identification number pertains to the State, the next numeral is the arbitrary mine number, the next letter is the sampling-site designation, and the final numeral(s) relates to the vertical location at a site (1 is base, 2 is midway, and 3 is top). For duplicate samples, the final numeral is followed by the letter D.

Each sample was air dried and throughly mixed. The sample was then split and part sent to the U.S. Geological Survey Branch of Analytical Chemistry Laboratory in Lakewood, Colorado, for crushing and grinding. The crushed and ground samples were analyzed for sulfur content by the laboratory (table 2), for whole-rock and clay mineralogy using X-ray diffraction analysis by the North Dakaota Mining and Mineral Resources Research Institute in Grand Forks, North Dakota (table 3), and for paste-extract and other selected analyses by Minnesota Valley Testing Laboratories, Inc., in Bismarck, North Dakota (table 4).

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Table 2.--Results of sulfur analyses of spoils material

[Analyses by the U.S. Geological Survey Branch of Analytical Chemistry Laboratory, Lakewood, Colorado; results reported in percent by weight]

Constituent	Sample number											
	T1A1	T1A2	T1A3	T1B1	T1B2	T1B3	T1C1	T1C2	T1C3	T1B1D	T1B2D	T1B3D
Total sulfur	<0.01	0.05	0.02	0.41	0.16	0.18	0.07	0.02	0.09	0.24	0.16	0.16
Sulfate sulfur	.01	.01	.01	.04	.01	.03	.02	.02	.04	.03	.03	.03
Pyritic sulfur	<.01	<.01	<.01	.22	<.01	.02	<.01	<.01	<.01	.08	.01	<.01
Organic sulfur (calculated)	<.01	.03	<.01	.15	.14	.13	.04	<.01	.04	.13	.12	.12

Table 3.--Minerals or mineral groups detected by X-ray diffraction in spoils material

[Analyses by the North Dakota Mining and Mineral Resources Research Institute, Grand Forks, North Dakota; values reported in percent mineral present]

Sample number	Mixed layer clays	Smectite	Chlorite	Muscovite/ illite	Kaolinite	Gypsum	Quartz	Potassium feldspar	Plagioclase feldspar	Dolomite	Calcite	Total
T1A1	2	0	0	2	21	0	14	26	34	0	1	97
T1A2	1	1	1	1	3	0	58	19	9	0	0	93
T1A3	2	1	1	Trace	9	0	54	25	11	0	2	102
T1B1	2	1	3	1	10	0	47	24	4	0	0	92
T1B1D	2	1	2	1	6	0	63	20	4	0	0	99
T1B2	1	2	2	1	9	0	64	11	3	0	0	93
T1B2D	1	1	2	1	6	0	79	9	2	0	0	101
T1B3	1	Trace	1	1	4	0	69	11	8	0	1	96
T1B3D	1	1	1	1	6	0	75	14	2	0	0	101
T1C1	2	8	5	2	13	0	56	9	7	0	0	102
T1C2	3	5	3	1	5	0	66	11	8	1	2	105
T1C3	1	14	9	4	16	0	40	6	6	1	0	98

Table 4.--Results of paste-extract and other selected analyses of spoils material

[Analyses by Minnesota Valley Testing Laboratories, Inc., Bismark, North Dakota; Abbreviations: µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter]

Property or constituent	Sample number					
	T1A1	T1A2	T1A3	T1B1	T1B1D	T1B2
Specific conductance (µS/cm)	256	456	248	2,820	2,630	2,210
pH (units)	4.14	4.46	5.20	3.30	3.40	3.49
Calcium, dissolved (mg/L)	11	13	11	17	19	18
Magnesium, dissolved (mg/L)	4.2	5.3	4.6	9.8	10	10
Sodium, dissolved (mg/L)	2.7	2.6	2.1	2.1	2.2	2.0
Sulfate, dissolved (mg/L)	<.02	<.02	<.02	29	29	49
Sodium-adsorption ratio	.2	.2	.1	.1	.1	.1

Property or constituent	Sample number					
	T1B2D	T1B3	T1B3D	T1C1	T1C2	T1C3
Specific conductance (µS/cm)	2,170	2,830	2,640	2,140	2,200	2,360
pH (units)	3.50	3.26	3.31	7.17	7.83	7.03
Calcium, dissolved (mg/L)	21	16	18	67	95	73
Magnesium, dissolved (mg/L)	11	9.3	9.7	26	25	26
Sodium, dissolved (mg/L)	2.2	2.0	2.1	6.7	11	6.2
Sulfate, dissolved (mg/L)	49	52	52	21	26	46
Sodium-adsorption ratio	.1	.1	.1	.2	.3	.2

The spoils material that was not crushed and ground was used in batch-mixing experiments (Davis, 1984). In these experiments, distilled water and spoils material were combined in weight ratios of 2:1 and 5:1 (water:spoils material). The pH of this batch material was adjusted to the pH of precipitation in the area by adding concentrated hydrochloric acid before mixing to try to simulate the major source of recharge to the spoils (Turk, 1983). Mixing was accomplished by affixing the mixture bottles, which were filled to exclude oxygen, for 2 hours to a vertical wheel 3 ft in diameter and rotating at 3 revolutions per minute. The mixtures were then allowed to settle, and the water was filtered through 0.45- and 0.10-micrometer filters after a total contact time of about 24 hours. The filtrate was analyzed by the U.S. Geological Survey water-quality laboratory in Denver, Colorado (table 5).

Ground Water

To define the ground-water conditions in the mine area, the study relied on existing wells for sampling and measuring points. However, in the late 1960's, rural water-supply corporations began to form and distribute water throughout large areas of Texas. Thus, there are many private domestic and livestock wells that have been abandoned for 10 to 15 years, with many of these being destroyed. Consequently, the data-collection site network is not as dense as would be desired. Records of wells used for water-level and water-quality data collection in the study area are listed in table 6. Almost all of the wells selected for water-level measurements were old, hand-dug, shallow wells. Many of these wells are unused, which provided a good source for determining the water table in the aquifer. This is not the case for water-quality samples because lengthy periods of pumping are required in order to obtain representative water-quality samples. Thus, the wells used to dewater the overburden fields were considered to be very good points for water-quality data-collection because of representative aquifer samples and proximity to the mines (fig. 1) There are three principal dewatering fields downdip from the active mining area. Two wells from each of these fields were selected as water-quality data-collection sites, as well as two privately owned dug wells, which are still used, on the updip side of the mine.

Water samples were obtained by diverting water from the main discharge of the well via rubber surgical tubing. The samples were collected by filling a tall cylinder, 6 in. in diameter by 12 in. tall, from the bottom and allowing the water to overflow the top of the cylinder. The intake of a peristolic pump was placed near the bottom of the cylinder, and water was pumped through appropriate filters into sample bottles. This method was used in order to minimize contact with air and atmospheric contaminants. The water samples were analyzed at the well site for specific conductance, pH, temperature, and bicarbonate concentration. No hydrogen sulfide odor was detected in any of the wells sampled, thus the samples were analyzed at the well site only for dissolved-oxygen concentration. The samples also were analyzed by the U.S. Geological Survey water-quality laboratory for selected common and trace constituents. The water samples were filtered through a 0.45-micrometer filter (table 7). In addition, water analyzed for calcium, magnesium, sodium, silica, aluminum, iron, and manganese was filtered through a 0.10-micrometer filter (table 8).

Table 5.--Constituent concentrations in water from batch-mixing experiments using spoils material

[Constituents are dissolved and reported in milligrams per liter unless otherwise noted. Abbreviations: µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius; µg/L, micrograms per liter]

Sample number	Date	Source of water	Spoils sample number	Mixing ratio by weight (water: material)	Specific conductance (µS/cm)	Onsite pH (units)	Temperature (°C)	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Carbonate	Sulfate	Chloride	Fluoride	Silica	Dissolved solids (calculated)	Aluminum (µg/L)	Boron (µg/L)	Iron (µg/L)	Manganese (µg/L)	Strontium (µg/L)
T1A121	6-19-84	Distilled	T1A1	2:1	40	5.55	26.6	0.07	0.01	4.3	1.0	1.0	0	6.7	1.6	0.1	7.5	22	20	<10	5	<1	<0.5
T1A151	6-19-84	do.	T1A1	5:1	19	5.50	26.6	.07	.01	2.4	.4	<1	0	3.9	1.3	.2	3.3	12	30	<10	<3	<1	2
T1A221	6-21-84	do.	T1A2	2:1	73	5.00	26.4	.30	.10	8.4	1.9	2	0	17	2.8	.1	7.1	39	20	10	5	8	4
T1A251	6-21-84	do.	T1A2	5:1	35	5.51	26.2	.09	.05	4.1	.9	1	0	8.3	1.7	.1	4.0	20	20	<10	6	<1	2
T1A321	6-21-84	do.	T1A3	2:1	69	5.90	26.5	.30	.20	6.3	1.1	1	0	11	2.2	.1	5.4	27	10	10	3	9	7
T1A351	6-21-84	do.	T1A3	5:1	32	5.92	26.4	.10	.10	3.7	.6	1	0	7.1	1.4	.2	3.4	17	20	<10	<3	2	.9
T1B121	6-21-84	do.	T1B1	2:1	799	3.76	26.7	60	38	16	11	0	0	370	2.7	.3	7.6	506	830	30	720	830	900
T1B121D	6-21-84	do.	T1B1D	2:1	758	3.79	26.7	50	35	16	10	0	0	350	2.7	.3	7.2	471	740	30	500	730	790
T1B151	6-21-84	do.	T1B1	5:1	398	3.92	26.7	27	17	7.4	6.1	2	0	170	1.4	.2	3.5	234	310	10	250	350	390
T1B151D	6-21-84	do.	T1B1D	5:1	387	3.96	26.7	23	14	6.7	5.1	<1	0	150	1.4	.2	3.0	204	210	10	290	310	330
T1B221	6-26-84	do.	T1B2	2:1	820	3.58	26.1	58	38	15	11	0	0	380	2.5	.3	6.9	512	970	30	810	980	890
T1B221D	6-26-84	do.	T1B2D	2:1	813	3.58	26.2	59	39	15	11	0	0	390	2.5	.3	7.1	524	940	30	890	990	900
T1B251	6-26-84	do.	T1B2	5:1	410	3.75	26.2	25	15	6.0	5.3	0	0	160	1.4	.2	3.0	216	270	10	270	390	360
T1B251D	6-26-84	do.	T1B2D	5:1	405	3.75	26.1	26	16	6.3	5.8	0	0	160	1.4	.2	3.2	219	260	10	260	410	370
T1B321	6-26-84	do.	T1B3	2:1	904	3.39	26.2	71	40	16	10	0	0	420	2.6	.3	8.6	568	1,200	20	2,000	1,200	1,100
T1B321D	6-26-84	do.	T1B3D	2:1	915	3.39	26.1	69	38	15	10	0	0	420	2.6	.3	8.3	563	1,200	30	1,900	1,100	1,000
T1B351	6-26-84	do.	T1B3	5:1	465	3.60	26.2	31	16	6.1	5.0	0	0	190	1.4	.2	3.3	253	320	10	750	470	430
T1B351D	6-26-84	do.	T1B3D	5:1	462	3.58	26.1	29	15	6.2	4.9	0	0	180	1.4	.2	3.5	235	320	<10	770	450	410
T1C121	6-26-84	do.	T1C1	2:1	931	7.82	26.2	81	37	54	8.3	47	0	400	28	.8	5.5	638	20	300	7	1	2,000
T1C151	6-26-84	do.	T1C1	5:1	548	7.49	26.1	45	19	24	4.9	30	0	220	12	.5	4.1	344	20	190	6	<1	1
T1C221	6-26-84	do.	T1C2	2:1	784	8.32	26.2	50	19	80	2.0	62	<1	240	53	2.2	7.8	484	40	2,600	8	1	960
T1C251	6-26-84	do.	T1C2	5:1	373	8.48	26.3	22	7.5	34	1.1	54	<1	82	20	1.9	4.7	200	40	1,200	5	<1	380
T1C321	6-28-84	do.	T1C3	2:1	1,260	7.32	25.7	120	54	64	9.9	21	0	590	55	.6	4.4	908	20	340	3	2	2,700
BL221	6-28-84	do.	T1C3	2:1	1,260	7.32	25.7	120	54	63	10	21	0	590	54	.5	4.4	906	30	330	18	<1	2,700
T1C351	6-28-84	do.	T1C3	5:1	563	7.35	25.5	46	20	28	5.5	14	0	220	16	.5	3.2	346	30	190	8	<1	1,000
BL251	6-28-84	do.	T1C3	5:1	563	7.36	25.5	47	21	29	5.7	14	0	220	21	.5	3.3	354	30	180	6	2	1,100
TRW11	6-19-84	do.	TRW	--	5	4.94	26.5	.04	<.01	<.2	.1	<1	0	<.2	.5	.1	<.01	.74	20	<10	<3	<1	<.5
TRW12	6-21-84	do.	TRW	--	5	5.10	26.6	.02	<.01	<.2	<.1	<1	0	<.2	.5	.1	.02	.64	20	<10	5	<1	<.5
TRW21	6-26-84	do.	TRW	--	6	4.98	26.1	.08	.04	.2	<.1	<1	0	<.2	.5	.1	.03	.63	20	<10	5	<1	2
TRW31	6-28-84	do.	TRW	--	4	5.05	25.7	.10	.05	.2	<.1	<1	0	<.2	.4	.1	.02	.87	20	<10	5	<1	2

Table 6.--Record of well inventory

Method of lift: J, jet; N, none; S, submergible.
Use of water: D, domestic; Ind, industrial; N, none.

Well number	Owner	Date com-pleted	Depth of well (feet)	Casing		Water-yielding unit	Altitude of land surface (feet)	Water level		Method of lift	Use of Water	Remarks
				Diam-eter (inches)	Depth (feet)			Above (+) or below land surface (feet)	Date of measure-ment			
KA-39-15-303	Donald Pruitt	1969	27	34	--	Wilcox	320	3.9	4-12-84	N	N	--
506	- Lewis	1929	--	36	--	Wilcox	345	30.19	4-11-84	N	N	--
606	- Turner	1982	44	36	--	Wilcox	410	24.4	8- 2-84	J	D	Water-quality sample site.
607	- Bonner	1960	27	36	--	Wilcox	390	3.04	4-12-84	N	N	--
808	Thomas Cannon	1893	50	36	--	Wilcox	400	35.40	4-12-84	N	N	--
809	- Horton	--	13	36	--	Wilcox	425	Dry	4-11-84	N	N	--
810	--	--	37	36	--	Wilcox	370	30.70	4-11-84	N	N	--
811	Tate Estate	1935	62	36	--	Wilcox	400	42.10	4-12-84	N	N	--
16-106	Texas Utilities	--	90	6	90	Wilcox	355	45.6	8- 1-84	S	Ind	Water-quality sample site.
107	Texas Utilities	--	126	6	126	Wilcox	375	67.5	7-31-84	S	Ind	Do.
108	--	--	--	36	--	Wilcox	287	14.18	4-11-84	S	Ind	--
207	Texas Utilities	--	90	6	90	Wilcox	360	55.8	8- 1-84	S	Ind	Water-quality sample site
407	Texas Utilities	--	115	6	115	Wilcox	380	79.0	8- 1-84	S	Ind	do.
408	Texas Utilities	--	75	6	75	Wilcox	380	42.2	7-31-84	S	Ind	do.
409	Texas Utilities	--	92	6	92	Wilcox	430	55.3	7-31-84	S	Ind	do.
410	Mrs. Brady Gunter	--	--	34	--	Wilcox	405	17.55	4-11-84	--	--	--
411	Bethel Church	--	60	34	60	Wilcox	410	36.0	4-11-84	J	D	--
412	Texas Utilities	1968	35	34	35	Wilcox	460	31.2	4-11-84	N	N	--
501	Virgil Keaton	1969	110	6	--	Wilcox	380	33.5	4-11-84	S	D	--
707	H. A. Lee	--	34	36	34	Wilcox	460	33.2	4-11-84	N	N	--
708	--	--	24	36	24	Wilcox	452	20.0	4-11-84	N	N	--
709	--	--	--	36	--	Wilcox	441	5.5	4-11-84	N	N	--
23-308	- Glazener	--	25	36	25	Wilcox	443	19.6	4-11-84	J	D	--
309	Sim Gordon	1955	60	36	60	Wilcox	440	27.33	4-11-84	N	N	--

Table 7.--Common-constituent concentrations in water from selected wells

[Constituents are dissolved and concentrations are reported in milligrams per liter; Abbreviations: µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius]

Well number	Water-yielding unit	Date	Depth (feet)	Specific conductance (µS/cm)	Field pH (units)	Temperature (°C)	Dissolved oxygen	Calcium	Magnesium	Sodium	Potassium	Bicarbonate	Sulfate	Chloride	Fluoride	Silica	Dissolved solids (calculated)	Nitrite, as nitrogen	Nitrite, plus nitrate, as nitrogen	Ammonia, as nitrogen	Ammonia plus organic nitrogen, as nitrogen	Phosphorus	Orthophosphate, as phosphorus
KA-39-15-606	Wilcox	8- 2-84	44.0	286	7.8	21.7	7.6	34	3.2	15	1.4	91	11	19	<0.1	39	168	<0.01	5.5	0.05	0.4	0.01	0.01
16-106	Wilcox	8- 1-84	90.0	101	5.8	20.4	5.2	8.0	2.0	5.2	1.7	16	6.1	4.6	<.1	40	176	<.01	4.4	.03	2.3	<.01	<.01
107	Wilcox	7-31-84	126.0	305	5.9	20.6	.6	12	5.9	30	4.4	43	17	61	<.1	44	195	<.01	<.1	.04	<.2	<.01	<.01
207	Wilcox	8- 1-84	90.0	375	6.0	21.2	4.1	17	6.0	40	3.2	45	7.0	76	<.1	55	226	<.01	2.8	.05	<.2	.15	.11
407	Wilcox	8- 1-84	115.0	307	6.1	20.7	1.8	12	4.8	38	3.4	46	11	56	<.1	39	187	<.01	.33	.04	.4	.01	<.01
408	Wilcox	7-31-84	75.0	760	5.6	19.9	3.2	37	16	64	11	54	24	200	<.1	40	510	<.01	.64	.04	<.2	<.01	<.01
409	Wilcox	7-31-84	92.0	104	5.8	19.6	5.1	3.9	1.4	13	3.1	28	5.7	11	<.1	47	99	<.01	1.3	.05	.2	.02	.01
23-308	Wilcox	8- 2-84	25.0	660	6.9	21.6	4.8	50	7.2	53	3.9	205	39	51	.3	82	387	<.01	1.7	.05	.4	.02	.02

Table 8.--Trace-constituent concentrations in water from selected wells

[Constituents are dissolved and concentrations are reported in micrograms per liter]

Well number	Water-yielding unit	Date	Depth (feet)	Aluminum	Boron	Iron	Manganese	Molybdenum	Selenium	Strontium
KA-39-15-606	Wilcox	8- 2-84	44	10	20	6	<1	<1	<1	200
16-106	Wilcox	8- 1-84	90	<10	20	440	9	<1	<1	80
107	Wilcox	7-31-84	126	--	20	1,200	46	<1	<1	200
207	Wilcox	8- 1-84	90	<10	20	98	27	<1	<1	260
407	Wilcox	8- 1-84	115	<10	20	320	21	<1	Not determined	240
408	Wilcox	7-31-84	75	10	30	65	23	<1	<1	660
409	Wilcox	7-31-84	92	10	20	11	3	<1	1	90
23-308	Wilcox	8- 2-84	25	<10	<10	7	2	<1	<1	400

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