HYDROGEOLOGIC DATA FROM A STUDY OF THE FRESHWATER ZONE/SALINEWATER ZONE INTERFACE IN THE EDWARDS AQUIFER, SAN ANTONIO REGION, TEXAS

By Dianne Pavlicek, Ted A. Small, and Paul L. Rettman

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the EDWARDS UNDERGROUND WATER DISTRICT,
and the TEXAS WATER DEVELOPMENT BOARD

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METRIC CONVERSIONS

The inch-pound units of measurement used in this report may be converted to metric units (International System) by the following factors:

Multiply inch-pound unit	By	To obtain metric units
foot (ft)	0.3048	meter
gallon per minute (gal/min)	0.06308	liter per second
gallon per minute per foot [(gal/min)/ft]	0.2070	liter per second per meter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer

Sea level: In this report "sea level" refers to the 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 of 1929."

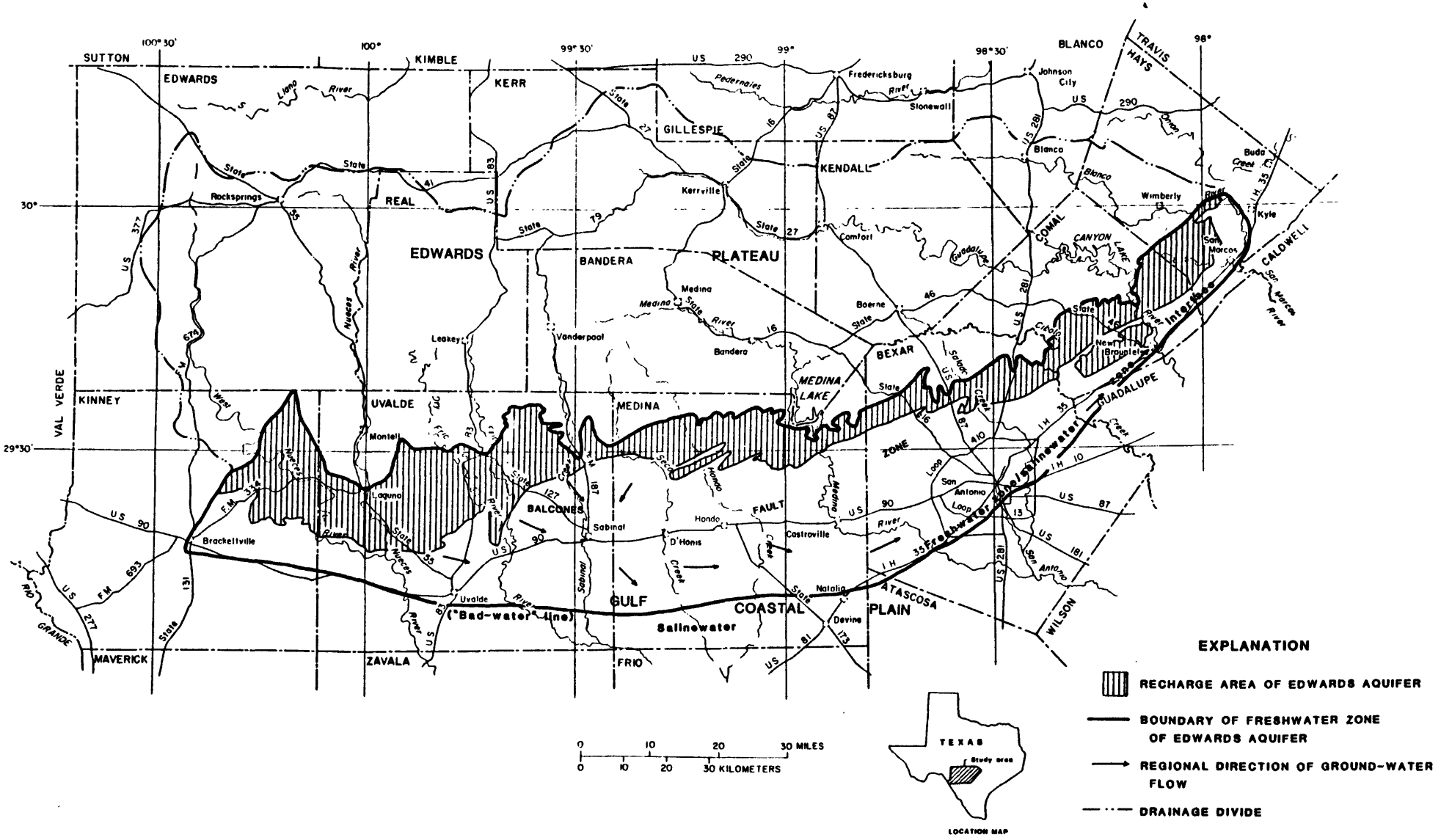

Figure 1.--Location of freshwater zone of the Edwards aquifer, San Antonio region.

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INTRODUCTION

The highly productive freshwater zone of the Edwards aquifer in the San Antonio region (fig. 1) is the sole-source water supply for more than 1 million people. A transitional interface exists between the freshwater zone and the downdip, salinewater zone. A 1,000 mg/L (milligrams per liter) dissolved-solids-concentration contour defines an arbitrary boundary between the freshwater zone and the salinewater zone. Locally, the 1,000 mg/L dissolved-solids-concentration contour is referred to as the "bad-water" line. Salinewater intrusion into the freshwater zone is hydraulically possible. Lower-than-average water levels in the Edwards aquifer could reverse hydraulic gradients and cause intrusion. Drought conditions, lower-than-average recharge, and increased ground-water withdrawals are factors which lower ground-water levels.

The purpose of this study is to assess the potential for salinewater intrusion into the freshwater zone. The purpose of this report is to present hydrogeologic data collected during the test drilling and initial testing phase of the study. Information regarding flow tests, water quality, geophysical logs, and lithology are provided in this report. The study was conducted by the U.S. Geological Survey in cooperation with the San Antonio City Water Board, the Edwards Underground Water District, and the Texas Water Development Board.

Regional Hydrogeologic Setting

In the San Antonio region, the 180-mi expanse of the Edwards aquifer includes parts of Kinney, Uvalde, Medina, Bexar, Comal, and Hays Counties (fig. 1). A major geologic feature of the region is the east-northeast trending Balcones fault zone. This system of en echelon, high-angle, predominantly down-to-the-coast, normal faults displaces the Edwards aquifer throughout the region. Horsts and grabens are formed locally. Varying in width from 5 to 40 mi, the highly productive freshwater zone of the Edwards aquifer is bounded on the north by the faulted outcrop of the aquifer, on the east and west by ground-water divides in Hays County and Kinney County, respectively, and on the south by the transitional interface of the freshwater zone and the salinewater zone.

Lower Cretaceous carbonate rocks of the Georgetown Limestone and underlying Edwards Group of Rose (1972) or stratigraphic equivalents comprise the

Edwards aquifer in this report. The Del Rio Clay is the upper confining unit and the Glen Rose Formation is the lower confining unit. Subdivisions of the Edwards aquifer are shown in figure 2. In this study, the San Marcos platform depositional province subdivisions of Rose (1972) apply. The leached and collapsed member (III), the Kirschberg evaporite (VI), and the dolomitic member (VII) are the most consistently porous and permeable subdivisions in the freshwater zone based on test-hole core and geophysical logs. High porosity and permeability in these subdivisions are associated with leached dolomite, collapse breccias (formed by the early dissolution of evaporites), and preferentially leached burrow infill resulting in honeycomb porosity. Fractures serve to interconnect cavernous zones (Maclay and Small, 1976, 1984). Marked diagenetic and mineralogic differences occur in the carbonate rocks comprising the Edwards aquifer as a result of varying interstitial water chemistry (Maclay and Small, 1976; Mench-Ellis, 1985).

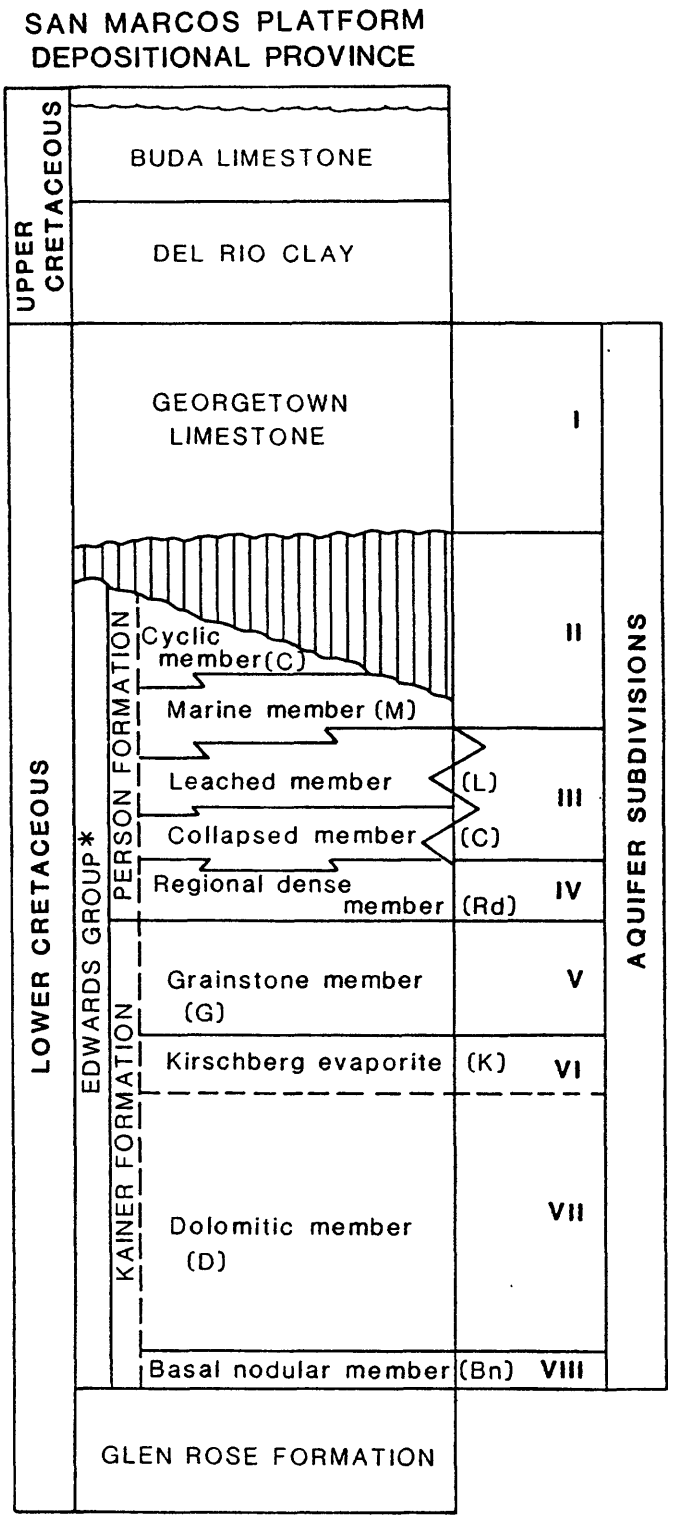
The freshwater zone contains an oxidizing calcium bicarbonate water that is saturated with respect to calcite and undersaturated with respect to dolomite, gypsum, celestite, strontianite, and fluorite. Dissolved-solids concentrations generally range from 250 to 300 mg/L. The salinewater zone contains a calcium sulfate water that is saturated with respect to calcite, dolomite, gypsum, and often celestite, strontianite, and fluorite. The dissolved-solids concentration generally increases rapidly near the "bad-water" line from 1,000 to about 9,000 mg/L (Maclay, Rettman, and Small, 1980; Pearson, 1973; Pearson and Rettman, 1976).

Recharge to the Edwards aquifer occurs where the Georgetown Limestone and Edwards Group (Rose, 1972) or stratigraphic equivalents are exposed in the Balcones fault zone. Streams draining the Edwards Plateau lose most of or all their base flow and much of their storm runoff by infiltration through fractured and porous limestone exposed in the stream channels. Springflow and well withdrawals account for most of the discharge from the Edwards aquifer.

On a regional scale, water moves through permeable strata from the major recharge areas in the north and northwest to major pumping centers in Bexar County and to Comal and San Marcos Springs in the northeast. The ground-water-flow pattern is controlled primarily by the continuity of permeable carbonate strata and by the occurrence of faults within the Balcones fault zone. Segments of faults, where the vertical displacements are sufficient to juxtapose permeable strata opposite relatively impermeable strata across the fault plane, cause major restrictions or barriers to lateral ground-water flow (Holt, 1959; Maclay, Land, and Woodward, 1985; Maclay and Small, 1983).

Location of Study Area

The study area is located in southeast San Antonio. The test sites were located along a section normal to the "bad-water" line in the vicinity of a city pump station which would provide representative pumping conditions. Site A is located within the salinewater zone; site C is considered to be in the transition zone; and site D, located next to the City Water Board Artesia pump station, is considered to be in the freshwater zone (fig. 3). A hydrogeologic cross section through sites A, C, D, and the Artesia pump station is shown in figure 4.



* The Edwards Limestone was raised to a stratigraphic group by Rose (1972) and divided into his Person and Kainer Formations and their informal members

Hydrogeology from Maclay and Small, 1984

Figure 2.--Stratigraphic column showing subdivisions of the Edwards aquifer.

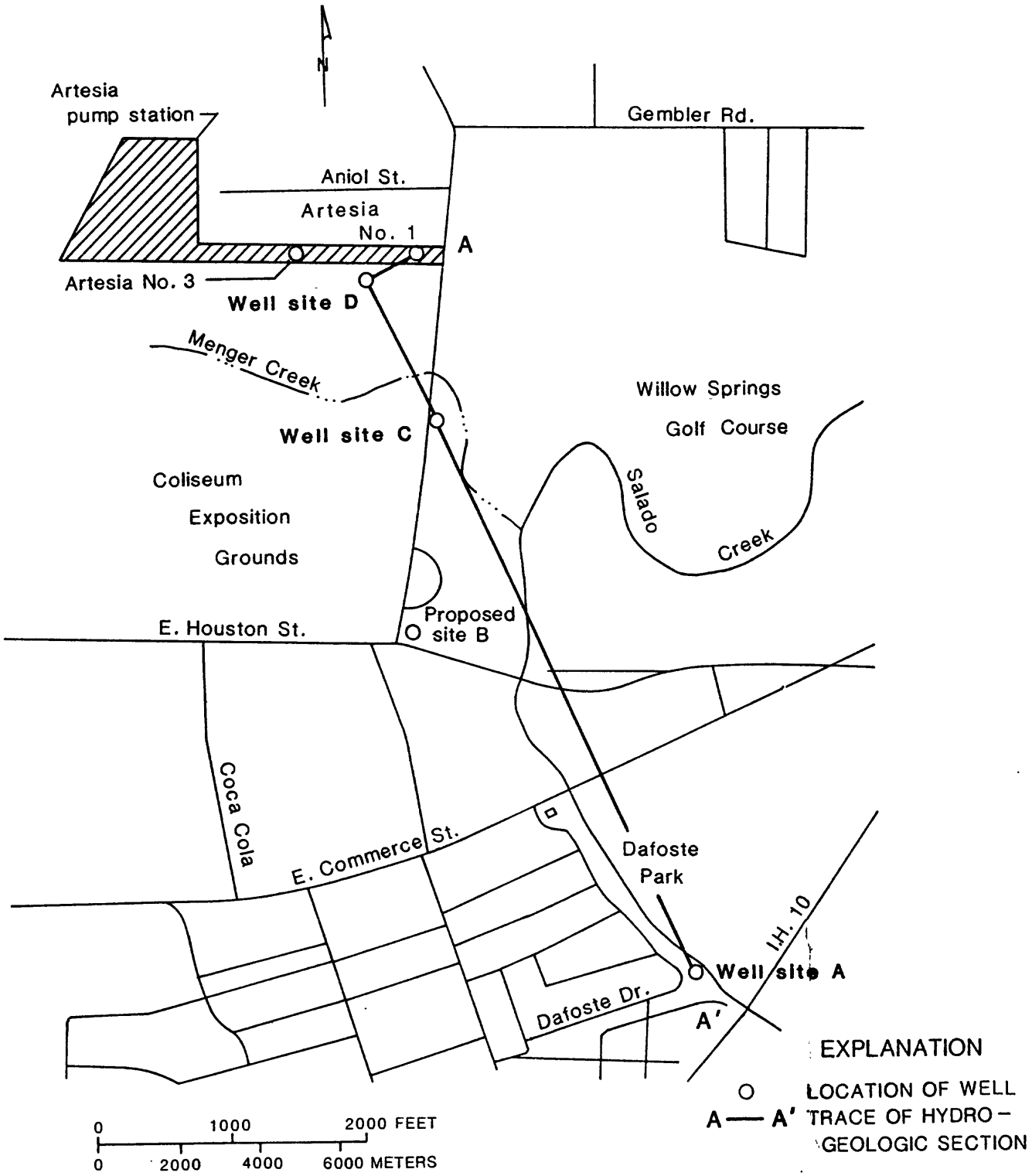


Figure 3.—Location of well sites in study area.

page 9 follows

APPROACH

A total of seven monitor wells were completed during the test drilling. Three monitor wells were completed at site A, two at site C, and two at site D (fig. 5). At each site, the first well (A-1, C-1, and D-1) was drilled through or nearly through the entire thickness of the Edwards aquifer. The second wells at sites A, C, and D, and third well at site A were drilled to selected depths within the Edwards aquifer. Site B, at Willow Springs Golf Course, was omitted because information indicated it might be located in the salinewater zone instead of the targeted transition zone. Site A wells were drilled, tested, and completed first, site C second, site D last.

Wells were drilled using two drilling methods. The mud rotary method was used to drill from the land surface to the top of the Georgetown Limestone using a 7-7/8-in. diameter bit for all wells except D-2. Next, the borehole was reamed to a 14-in. diameter, and 9-5/8-in. steel casing was set and cemented. Well D-2 was drilled using the mud rotary method with a 12-in. diameter bit so that reaming was not necessary, and 7-5/8-in. steel casing was set and cemented. The air-assist reverse circulation method was used to drill through the Georgetown Limestone and Edwards Group (Rose, 1972), which comprise the Edwards aquifer, by using a 7-7/8-in. modified bit. This method was used to avoid lost circulation problems if cavernous intervals were encountered and to provide rock cuttings.

Drill cuttings were collected at 10-ft intervals and were examined at the well site. Cuttings provided lithologic information for determining stratigraphic units and formation depths during drilling. Cuttings from the Georgetown Limestone and Edwards Group were later described using a 10X magnification binocular microscope. Texture classification terminology of Dunham (1962) and porosity classification of Choquette and Pray (1970) were used (tables 1 and 2). A sucrosic texture and slight or no effervescence with 10-percent hydrochloric acid application were the basis for classification of dolomitic limestone in hand specimen.

Lithologic columns, constructed from drill-cutting descriptions of the Georgetown Limestone and Edwards Group were made for wells A-1, C-1, and D-1. The circulation of oxidizing waters in the freshwater zone has resulted in late freshwater diagenesis of Edwards carbonates. Recrystalization, dedolomitization, and late sparry calcite cementation are characteristic of the freshwater zone (Mench-Ellis, 1985). The salinewater zone has not experienced this late freshwater diagenetic event and has a higher percentage of dolomite. Study of petrographic thin sections of drill cuttings is necessary to better document these diagenetic characteristics which can be used to define the interface of the freshwater zone and salinewater zone.

Geophysical logs were run by the Edwards Underground Water District or the Texas Water Development Board logger on the stratigraphic units above the Edwards aquifer for each test hole, and including the Edwards aquifer for test holes A-2, A-3, C-2, and D-2. A suite of logs was run on the Edwards aquifer in test holes A-1, C-1, and D-1 by the U.S. Geological Survey Borehole Geophysical Services Unit logger. Schlumberger Well Surveying Corporation[1] ran

[1] Use of firm names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

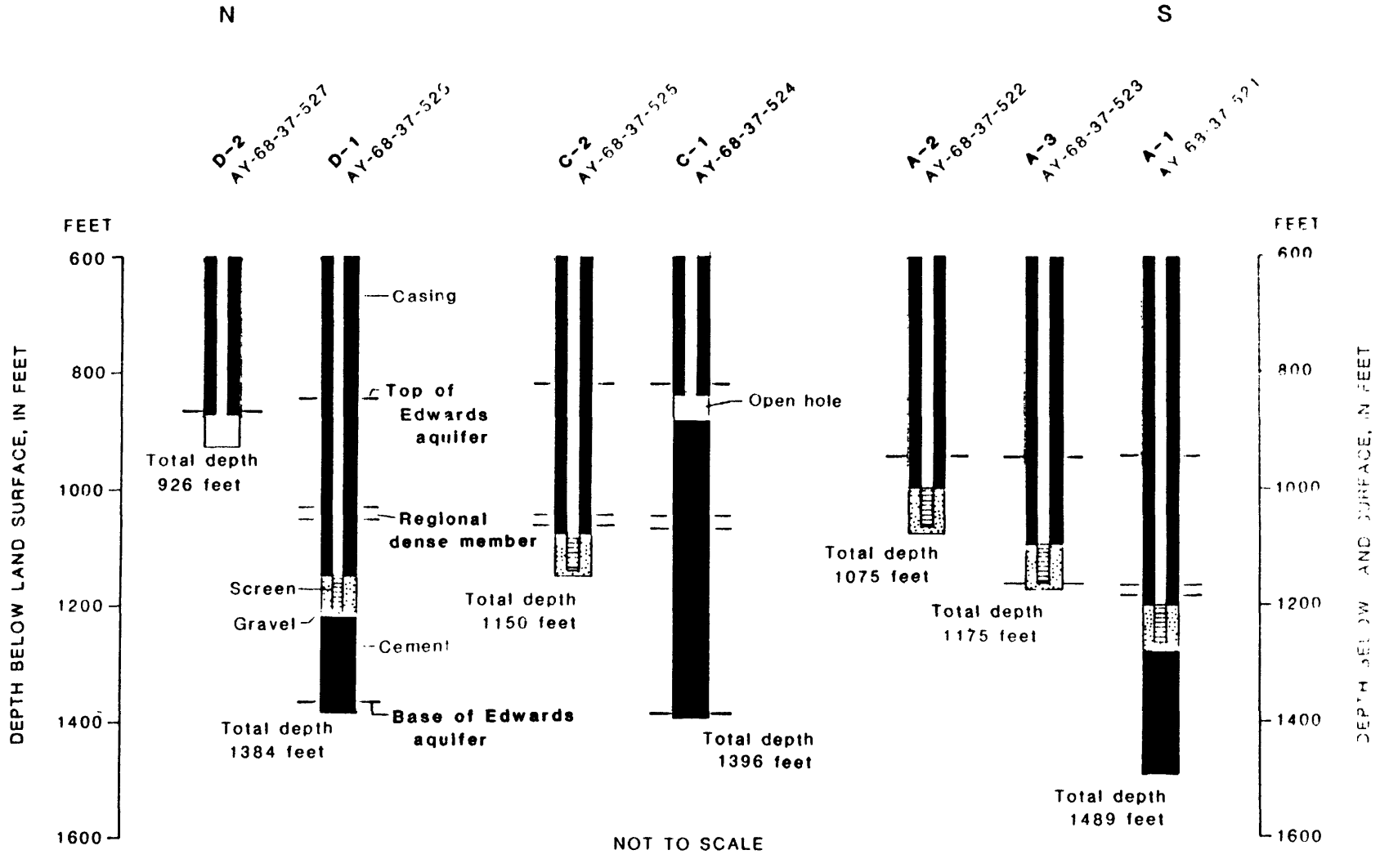
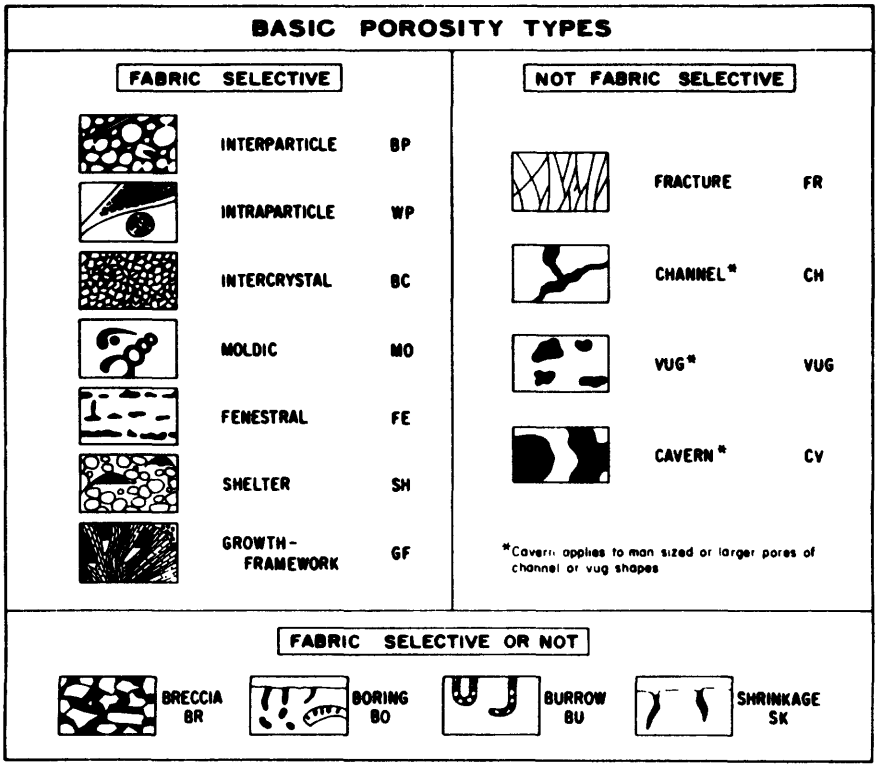


Figure 5.--Diagram showing well completions.

Table 1.--Carbonate-rock classification system of Dunham (1962)

Depositional texture recognizable					Depositional texture not recognizable
Original components not bound together during deposition				Original components were bound together during deposition... as shown by intergrown skeletal matter, lamination contrary to gravity, or sediment-floored cavities that are roofed over by organic or questionably organic matter and are too large to be interstices.	Crystalline carbonate (Subdivide according to classifications designed to bear on physical texture or diagenesis.)
Contains mud (particles of clay and fine silt size)		Grain-supported	Lacks mud and is grain-supported		
Mud-supported					
Less than 10 percent grains	More than 10 percent grains				
Mudstone	Wackestone	Packstone	Grainstone	Boundstone	

Table 2.--Porosity classification system of Choquette and Pray (1970)



logs on well A-1 and C-1. Types of borehole geophysical logs run on each well are listed in table 3. Some of the hydrogeologic information that can be derived from the logs is listed in table 4. A radioactive source tool, necessary for the neutron and density logs, was not run for safety reasons on well D-1 due to the irregularity and jaggedness of the hole from 850 to approximately 1,129 ft as shown on the downhole television survey. Well Services of Texas conducted downhole television surveys which were recorded on videocassette tapes on wells A-1, C-1, and D-1 to obtain an in situ view of carbonates comprising the Edwards aquifer. Marked variations in percentage and width of fractures and vugs and cavernous porosity are exhibited among the wells.

Cumulative-depth flow tests of the Edwards aquifer were conducted each time another 50 ft of the aquifer was penetrated during drilling, in order to monitor water quality and production in the aquifer. The test results are listed as "Cumulative-Depth Flow Tests" in the "Hydrogeologic Data" section, and the detailed field measurements are presented in table 5 (Supplemental Information). Testing was conducted with the drill column remaining in the borehole. This caused production characteristics to be affected to an unknown degree. All wells flowed to the land surface under artesian pressure, thus pumps were not necessary to conduct these tests.

Drawdown tests were conducted on wells C-1 and D-1 where the test wells functioned as production wells and nearby wells served as observation wells. The detailed field measurements for drawdown tests are presented in table 6 (Supplemental Information). Wells C-2 and Artesia #1 served as observation wells while well C-1 was allowed to flow (see Drawdown test, well C-1). Similarly, wells Artesia #1 and Artesia #3 served as observation wells while well D-1 was allowed to flow (see Drawdown test, well D-1).

To determine the aquifer's production and water-quality characteristics, interval flow tests were conducted on the entire aquifer thickness and zones starting or stopping at the top and bottom of the aquifer at wells A-1, C-1, and D-1. The tests for the entire thickness was conducted with the drill column in the well. The zones were tested by using a single packer mounted at the bottom of the drill column having an outside diameter of 4-1/2 in. and an inside diameter of 3-1/2 in. When testing zones between the packer and the bottom of the test hole, water was allowed to flow inside the drill column. When testing zones between the top of the aquifer and the packer, water was allowed to flow between the well casing and the drill column. Additional interval flow tests include the measurements for all seven completed monitor wells. The results are referred to as "Interval Flow Tests" in this report. The detailed field measurements for these tests are presented in table 7 (Supplemental Information).

Water-level fluctuations due to regional pumping are minor, $\pm$0.5 ft during a given day, and have not been introduced into any recorded water-level data or specific-capacity calculations for cumulative-depth flow tests, drawdown tests, or interval flow tests.

Water quality and production characteristics of specific intervals within the Edwards aquifer were conducted on wells A-1, C-1, C-2, and D-1 after the geophysical logs and downhole television surveys were run. An inflatable packer was set at various intervals to test isolated sections of the Edwards

Table 3.--Listing of geophysical logs run for each well

Well number	Type of geophysical logs
Well A-1:	Spontaneous potential Resistivity Natural gamma Caliper Focused resistivity Acoustic velocity Neutron Density (gamma-gamma) Spinner survey Borehole (fluid) temperature and resistivity Continuous acoustic televiewer Downhole television survey Dual induction spherically focused electric log[1/] Density - compensated neutron - gamma ray[1/] Borehole compensated sonic - caliper - gamma ray[1/]
Well A-2:	Spontaneous potential Resistivity Natural gamma Caliper
Well A-3:	Spontaneous potential Resistivity Natural gamma Caliper
Well C-1:	Spontaneous potential Resistivity Natural gamma Caliper Focused resistivity Acoustic velocity Neutron Density (gamma-gamma) Spinner survey Borehole (fluid) temperature and resistivity Continuous acoustic televiewer Downhole television survey Dual induction spherically focused electric log[1/] Density - compensated neutron - gamma ray[1/] Borehole compensated sonic - caliper - gamma ray[1/]
Well C-2:	Spontaneous potential Resistivity Natural gamma Caliper Casing collar
Well D-1:	Spontaneous potential Resistivity Natural gamma Caliper Focused resistivity Acoustic velocity Spinner survey Borehole (fluid) temperature and resistivity Continuous acoustic televiewer Downhole television survey
Well D-2:	Spontaneous potential Resistivity Natural gamma Caliper

1/ Logs run by Schlumberger Well Surveying Corporation.

Table 4.--Hydrogeologic information derived from logs

Type of geophysical log	Application/information derived
Caliper	Borehole diameter, location and size of solution openings
Natural gamma	Stratigraphic correlation of clay/argillaceous units (example - Del Rio Clay)
Resistivity Focused resistivity Dual induction Spontaneous potential (electric logs)	Stratigraphic correlation, lithology, porosity
Neutron Density Acoustic velocity (sonic) Continuous acoustic televiewer	Stratigraphic correlation, porosity, lithology - mineralogy (indirectly)
Spinner survey	Determine vertical movement of water within borehole; determine yields of major water-producing zones
Borehole temperature	Determine temperature of formation fluid; temperature gradients; locate water producing zones
Borehole resistivity	Determine resistivity of formation fluid
Downhole television survey	Obtain in situ view of fractures, solution openings, nodular chert, etc., in carbonate rocks making up the Edwards aquifer; observe deviation of borehole diameter

NOTE: Refer to Maclay, Small, and Rettman (1981) and MacCary (1978) for further detailed discussion.

aquifer. The downhole television surveys complemented the caliper logs in determining the depth location for placement of the inflatable packer. Data from these tests also are referred to as "Interval Flow Tests" in this report. These tests revealed the variations in production characteristics and particularly water quality that were not detectable during cumulative-depth flow tests or from water-quality samples taken during interval flow tests of the entire section of the Edwards aquifer.

Well C-1 most clearly demonstrates the importance of interval flow tests of isolated intervals in determining the stratification of water quality and production characteristics. At this well, specific-conductance values over the 832 to 1,352-ft interval generally increased with depth and ranged from 652 to 736 µS/cm (microsiemens per centimeter at 25 °C) as gathered from cumulative-depth flow tests (see Cumulative-depth flow tests, well C-1). During the 832 to 1,396-ft interval flow test (entire section of Edwards aquifer), the specific conductance was 842 µS/cm (490 mg/L dissolved solids) (see Interval flow tests, well C-1 and Water-quality data, well C-1). The interval flow tests of isolated intervals revealed marked water-quality variations with depth. The cumulative-depth flow tests and 832 to 1,396-ft interval flow tests were masked by the influx of "fresher" water from a productive cavernous interval at approximately 841 to 847 ft in the uppermost part of the Edwards aquifer. Water samples from the 832 to 859-ft interval flow test had a specific conductance of 772 µS/cm (470 mg/L dissolved solids); the 859 to 1,396-ft interval had 3,860 µS/cm (2,900 mg/L dissolved solids); the 1,056 to 1,396-ft interval had 5,860 µS/cm (4,400 mg/L dissolved solids); and the 1,240 to 1,396-ft interval had 5,870 µS/cm (4,600 mg/L dissolved solids). Water samples from the 832 to 1,056-ft interval flow test had a specific conductance of 784 µS/cm (470 mg/L dissolved solids), and the 832 to 1,246-ft interval had 826 µS/cm (470 mg/L dissolved solids). These values are the result of mixing of water from different stratigraphic intervals within the Edwards aquifer during the test. Site C is considered a transition zone between the saline-water zone and freshwater zone of the Edwards aquifer based on the variation of water quality with depth revealed by the interval flow tests. Note also, that well C-2, located 100 ft north of well C-1, did not encounter any cavernous intervals, and the smallest recorded specific-conductance values were 1,636 to 2,650 µS/cm (see Cumulative-depth flow tests, well C-2). Interestingly, interval flow tests of isolated intervals in well D-1, considered to be located in the freshwater zone, revealed specific-conductance values increasing with depth with a specific conductance of 6,380 µS/cm (4,800 mg/L dissolved solids) from the 1,225 to 1,384-ft interval flow test (top of Edwards aquifer, 844 ft and base, 1,362 ft; top of Glen Rose Formation--the lower confining unit--1,362 ft; total depth of well, 1,384 ft).

Some wells were screened completions and some were open-hole completions (fig. 5). Wells A-1, A-2, A-3, C-2, and D-1 were completed with screens for monitoring. Stainless steel, wire-wrapped, 2-3/8-in. diameter screens, 50 ft in length with a 0.045-in. slot size were set in these wells. Gravel was placed in the well bore from approximately 10 ft below to 10 ft above each screen. Wells C-1 and D-2 were open-hole completions for monitoring. Well C-1 was completed in a cavernous zone and well D-2 was completed in the uppermost 50 ft of the Edwards aquifer. Cathodic protection was installed on each well to prevent corrosion of piping.

Water samples were collected during each cumulative-depth flow test and interval flow test. Water-quality data collected include the field determination of pH, temperature, alkalinity, and specific conductance. Laboratory analyses include determination of inorganic concentrations of the major cations and anions. Results of laboratory analysis for the cumulative-depth flow tests and interval flow tests for wells A-1, C-1, and D-1, and from all seven completed monitor wells taken in March and July 1986, are listed in tables by well in the "Hydrogeologic Data" section of this report.

With the completion of drilling, testing, and monitor-well construction, a long-term (50 years) monitoring program is now in effect. Continuous water-level recorders have been installed on each well to establish a record of water-level fluctuations. Water-quality samples are being collected monthly for chemical analysis to establish a record of any variations in water quality.

HYDROGEOLOGIC DATA

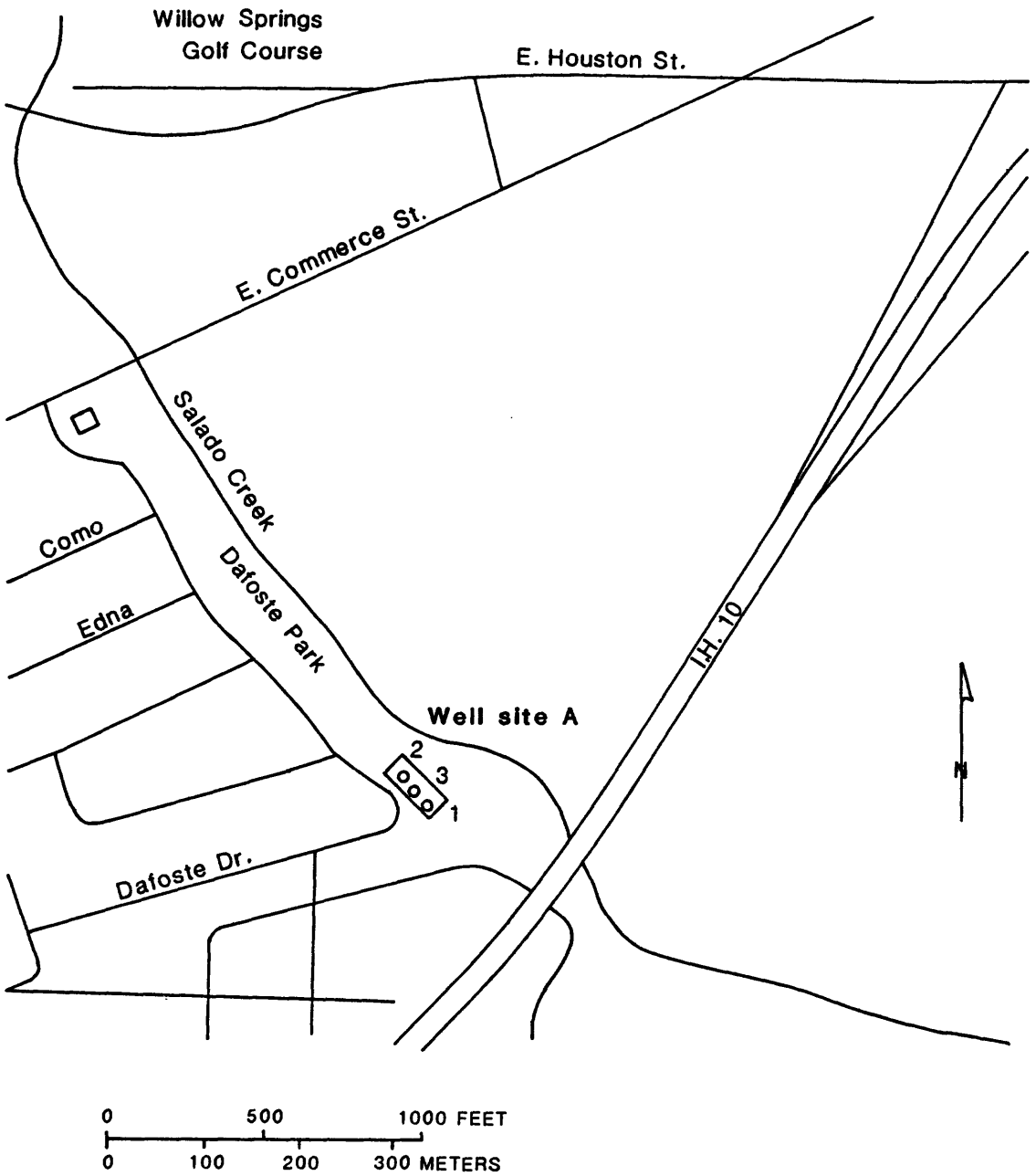
Hydrogeologic data collected from this study are presented by site locations A, C, and D in a summarized format. Information presented includes the following:

1. A detailed site location map;
2. A well summary for each well listing the types of data available;
3. A lithologic column of the Georgetown Limestone and Edwards Group (Rose, 1972) for wells A-1, C-1, and D-1;
4. General drill-cutting descriptions of the Georgetown Limestone and Edwards Group for wells A-1, C-1, and D-1;
5. A selection of geophysical logs and borehole surveys for wells A-1, C-1, and D-1;
6. Cumulative-depth flow-test data for all wells, except well D-2 (see Interval flow test for well D-2);
7. Drawdown-test data for wells C-1 and D-1;
8. Interval flow-test data for all wells; and
9. Water-quality data for all wells.

Detailed data listings of flow tests and drawdown tests are included in the "Supplemental Information" section of this report. Data are organized by test type in the following order: Cumulative-depth flow tests (table 5), drawdown tests (table 6), and interval flow tests (table 7).

HYDROGEOLOGIC DATA

Site A

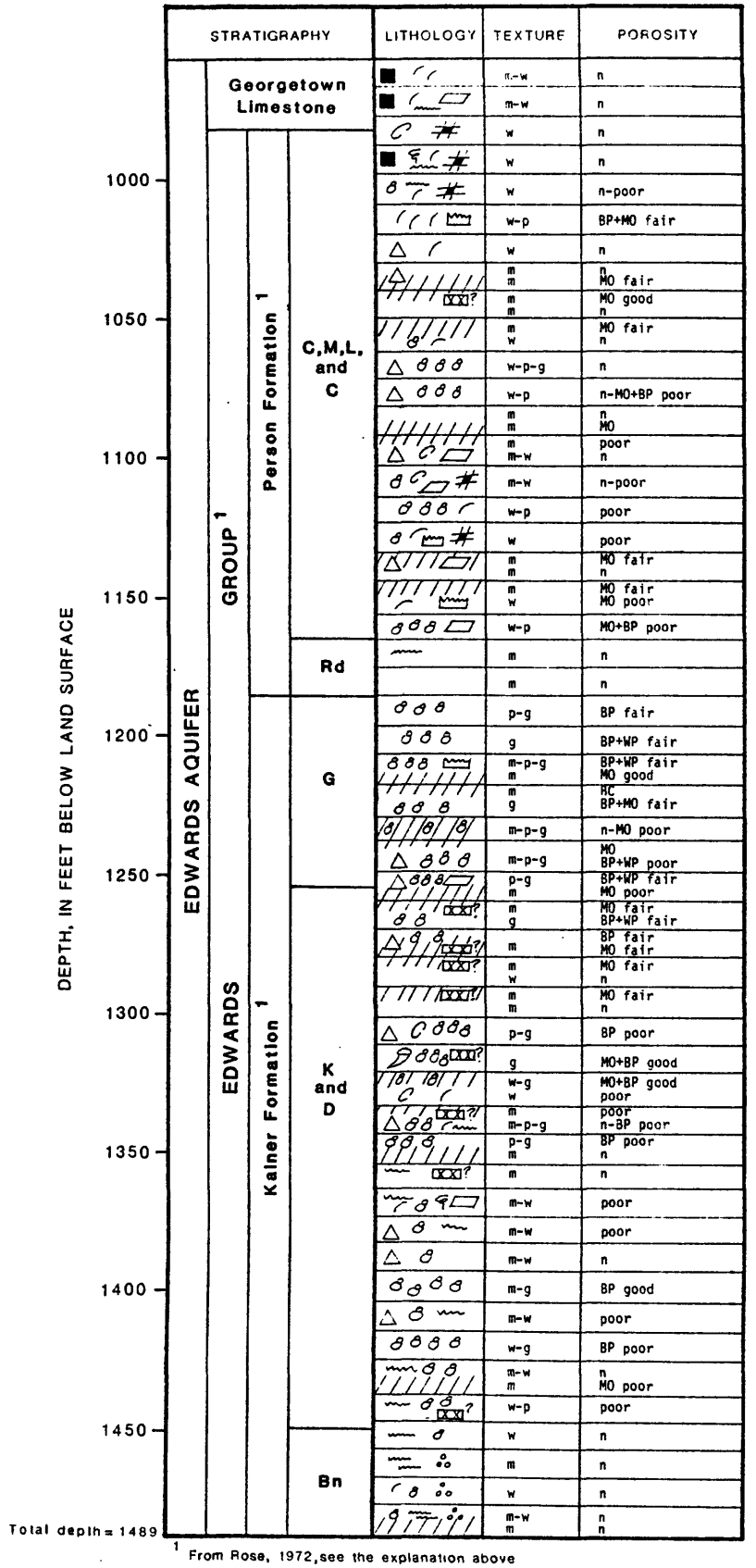


Location map of well site A

Well summary, well A-1

AY-68-37-521

Owner:	San Antonio City Water Board
Drilling started:	6-28-85
Well completed:	8-15-85
Location:	188 Dafoste Park, San Antonio, Texas
Altitude of land surface:	620 feet above sea level
Total test depth:	1,489 feet
Casing depth:	9-5/8 inch casing to 965 feet 2-3/8 inch casing to 1,215 feet
Depth to formation tops:	Navarro Group and Taylor Marl, undivided------ surface Anacacho Limestone---------- 546 feet Austin Group---------- 700 feet Eagle Ford Group---------- 812 feet Buda Limestone---------- 842 feet Del Rio Clay---------- 902 feet Georgetown Limestone-------- 952 feet Edwards Group (Rose, 1972)-- 982 feet
Geophysical logs:	Natural gamma Caliper Spontaneous potential Resistivity Focused resistivity Acoustic velocity Neutron Density
Borehole surveys:	Spinner survey Fluid temperature Fluid resistivity Continuous acoustic televiewer Downhole television survey
Flow tests:	Cumulative-depth Interval
Monitored depth interval:	1,200-1,275 feet - Gravel pack 1,215-1,265 feet - Screen
Water-quality data:	Field measurements and selected inorganic constituents



[1] From Rose, 1972, see the explanation above

EXPLANATION

STRATIGRAPHY

Members from Rose, 1972 (see fig. 2)

C, M, L, and C = cyclic, marine, leacned, and collapsed members, undivided

Rd = regional dense member

G = grainstone member

K and D = Kirschberg evaporite and dolomitic member, undivided

Bn = basal nodular member

LITHOLOGY

Fossil allochems

- miliolid foraminifera
- caprinid rudistid
- Toucasia rudistid
- gastropod
- other mollusc fragments

Mineral constituents

- //// dolomitic (otherwise calcitic)
- chert
- pyrite
- single crystal calcite or aggregate
- calcite crystal druse
- celestite?
- pyrite replaced allochems, "BRBs" - black rotund bodies

Sedimentary structures

- pressure solution boundaries and/or clay seams
- algal laminations
- burrow

Tectonic structures

- filled microfracture

TEXTURES

m = mudstone
w = wackestone
p = packstone
g = grainstone
(Dunham, 1962)

DIAGENETIC FEATURES

F = iron stains
A = altered (associated with late freshwater diagenesis)
D? = dedolomite?
CE? = calcitized evaporites

POROSITY

BP = interparticle
WP = intraparticle
BC = intercrystal
MO = moldic
(Choquette and Pray, 1970)
n = negligible
poor, fair, and good are qualitative modifiers

NOTE: Cuttings collected at approximately 10-foot intervals.

General descriptions of drill cuttings, well A-1

Munsell (1967) color chart notation: Hue value/chroma (example, 10YR 7/1)
[ft, feet; mm, millimeter]

Depth (ft)	
956-968	LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/1 -mollusc fragments present -fine-grained fossil fragments present -chalky appearance -disseminated pyrite present; fine-grained opaque specks present - probable allochems replaced by pyrite -5-mm mollusc fragment with part of shell material replaced by pyrite (circular area) observed -noted a cutting with concentration of pyrite with quartz concentrated in central part of area affected by pyrite replacement -porosity negligible
968-978	LIMESTONE: WACKESTONE -10YR 7/1 -mollusc fragments rare -fine-grained, dark gray, unidentifiable allochems with pyrite replacement evident are common -dark gray calcareous worm tubes observed; noted one cutting with pyrite replacing the tubes -chalky appearance -pressure solution boundaries and/or clay seams present -pyrite common -6-mm cutting - aggregate of pyrite crystals -two 5-mm calcite crystals - indication of vugs with calcite druses -porosity negligible
978-989	LIMESTONE: WACKESTONE -10YR 8/1 -mollusc fragments present; replaced by sparry calcite -Toucasia mollusc fragments present; single large fragment with part of shell replaced by sparry calcite observed -dense micrite matrix -sparry calcite patches present -calcite filled microfractures present -porosity negligible
989-999	LIMESTONE: WACKESTONE -10YR 8/1 -mollusc fragments present -small gastropods rare -fine-grained, round, sparry specks present - probable replaced allochems -pyrite present -pressure solution boundaries and/or clay seams rare -calcite filled microfractures present; microbreccia observed -dense micrite matrix -porosity negligible
999-1,009	LIMESTONE: WACKESTONE Ls: wackestone (60 percent) (same as 989-999 ft) -10YR 8/1 -probable fossil allochems replaced by calcite observed; fine-grained, round geometry -dense, micrite matrix -calcite filled microfractures present -porosity negligible Ls: wackestone (40 percent) -10YR 7/1 -miliolid foraminifera rare -white mollusc fragments present; commonly loose, detached from matrix -mollusc fragments present; replaced by sparry calcite -pressure solution boundaries and/or clay seams common -porosity poor

General descriptions of drill cuttings, well A-1--Continued

Depth (ft)	
1,009-1,021	LIMESTONE: PACKSTONE - WACKESTONE -10YR 7/2 -white mollusc fragments common -small cavities lined with calcite druse observed -interparticle and moldic porosity fair
1,021-1,031	LIMESTONE: WACKESTONE -10YR 7/1 -white mollusc fragments present -noted sparry areas within micrite matrix -noted cutting with microstylolites - pressure solution boundaries -brown chert present -porosity negligible - few micropores
1,032-1,042	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE Dolomitic ls: mudstone (50 percent) -10YR 7/2 -sucrosic texture -moldic porosity (after foraminifera) Ls: mudstone (50 percent) -10YR 6/2 -mollusc fragments rare -micropores present 5-mm dogtooth spar crystal Dark brown-black chert present
1,042-1,052	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE Dolomitic ls: mudstone (70 percent) -10YR 6/2 -sucrosic texture -pressure solution boundaries and/or clay seams present -clear crystal aggregates present - calcite and/or celestite -moldic porosity well developed (after foraminifera) Ls: mudstone (30 percent) -may be slightly dolomitic -porosity negligible
1,052-1,062	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE Dolomitic ls: mudstone (90 percent) -10YR 5/2 -sucrosic texture -pressure solution boundaries and/or clay seams present -moldic porosity (after foraminifera) - not as well developed as 1,042-1,052 ft section Ls: wackestone (10 percent) -miliolid foraminifera present -mollusc fragments present; replaced by sparry calcite -porosity negligible
1,062-1,072	LIMESTONE: WACKESTONE - PACKSTONE - GRAINSTONE -10YR 7/1; 6/2 -miliolid foraminifera present to abundant -micrite matrix; possible sparry cement matrix also -brown chert common -porosity negligible

General descriptions of drill cuttings, well A-1--Continued

Depth (ft)	
1,072-1,082	LIMESTONE: WACKESTONE - PACKSTONE -10YR 6/1 -miliolid foraminifera common -predominantly dense micrite matrix; rare cuttings of miliolid packstone with sparry matrix (cement) observed -dark brown - black chert common -porosity negligible - poor; rare moldic and interparticle porosity
1,082-1,093	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE Dolomitic ls: mudstone (50 percent) -10YR 6/2 -sucrosic texture -pressure solution boundaries and/or clay seams present -moldic porosity (after foraminifera) -calcite druses and crystal aggregates observed (rare) Ls: mudstone (50 percent) -10YR 5/1 -miliolid foraminifera present -porosity negligible
1,093-1,103	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE Dolomitic Ls: mudstone (70 percent) -10YR 7/1 -calcite crystal aggregates present -porosity poor; probable intercrystalline porosity Ls: mudstone - wackestone (30 percent) -Toucasia mollusc fragments present -porosity negligible Brown chert with allochem ghosts present Grayish chert present
1,103-1,113	LIMESTONE: WACKESTONE - MUDSTONE -10YR 7/1 -miliolid foraminifera present -Toucasia mollusc fragments present -calcite filled hairline fractures present -2-4 mm long blocky calcite crystals observed -observed a few cuttings with sparry calcite patches associated with disseminated, fine-grained pyrite(?) -porosity poor to negligible
1,113-1,124	LIMESTONE: WACKESTONE - PACKSTONE -10YR 6/2 -miliolid foraminifera common -mollusc fragments present -dense micrite matrix -porosity poor
1,124-1,134	LIMESTONE: WACKESTONE -10YR 5/2 -mollusc fragments present -miliolid foraminifera present -dense, micrite matrix -calcite filled hairline fractures observed -pressure solution boundaries and/or clay seams present -cuttings with calcite druses observed -porosity poor

Depth (ft)	
1,134-1,144	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE Dolomitic ls: mudstone (50 percent) -sucrosic texture -aggregates of quartz crystals present - void infill and duses -calcite crystal aggregates observed -porosity - micropores abundant; probably moldic porosity (after foraminifera); probable intercrystalline porosity Ls: mudstone (50 percent) -dense micrite -porosity negligible Dark brown chert present
1,144-1,155	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE Dolomitic ls: mudstone (50 percent) -10YR 7/1 -miliolid foraminifera present -moldic porosity; variation in degree of secondary porosity development Ls: wackestone (50 percent) -10YR 6/2 -mollusc fragments present -miliolid foraminifera present -sparry areas in matrix present -calcite druses and void infill observed -minor moldic porosity development
1,155-1,165	LIMESTONE: WACKESTONE - PACKSTONE -10YR 7/1 -miliolid foraminifera common to abundant -worm tubes observed -fossil allochems replaced by sparry calcite present -fossil allochems replaced by pyrite present -aggregates of calcite crystals observed -pore-filling sparry cement observed between miliolids, but not ubiquitous -moldic and interparticle porosity poor; rare intraparticle porosity
1,165-1,175	LIMESTONE: MUDSTONE -10YR 6/1 -chalky appearance -microstylolites observed - pressure solution boundaries -porosity negligible
1,175-1,185	LIMESTONE: MUDSTONE - PACKSTONE - GRAINSTONE Ls: mudstone (95 percent) -dense micrite -porosity negligible Ls: grainstone - packstone (5 percent) -sparry cement detectable -chalky-altered appearance -interparticle porosity fair
1,185-1,195	LIMESTONE: PACKSTONE - GRAINSTONE -10YR 7/1 -miliolid foraminifera abundant -intraclast noted -areas with coarse spar present - replacement of allochems -sparry matrix cement and micrite matrix -interparticle porosity

General descriptions of drill cuttings, well A-1--Continued

Depth (ft)	
1,195-1,206	LIMESTONE: GRAINSTONE - MUDSTONE Ls: grainstone (95 percent) -10YR 7/1 -miliolid foraminifera abundant -sparry calcite cement -intraparticle and interparticle porosity Ls: mudstone (5 percent) -dense micrite -stylolite observed -porosity negligible
1,206-1,218	LIMESTONE - DOLOMITIC LIMESTONE: GRAINSTONE - PACKSTONE - MUDSTONE Ls: grainstone - packstone (75 percent) -10YR 7/1 -miliolid foraminifera abundant -intraparticle and interparticle porosity; variation in degree of secondary porosity development Dolomitic ls: mudstone (20 percent) -sucrosic texture -excellent moldic porosity Ls: mudstone -dense micrite -porosity negligible Calcite druses present Aggregate of quartz crystals observed
1,218-1,228	LIMESTONE - DOLOMITIC LIMESTONE: GRAINSTONE - MUDSTONE Ls: grainstone (50 percent) -10YR 7/2 -miliolid foraminifera abundant -sparry cement matrix -interparticle and moldic porosity; variation in degree of secondary porosity development Dolomitic ls: mudstone (50 percent) -very fine sucrosic texture -probable intercrystalline porosity
1,228-1,238	DOLOMITIC LIMESTONE: MUDSTONE - PACKSTONE - GRAINSTONE Dolomitic ls: mudstone (60 percent) -10YR 7/3 -very fine-grained sucrosic texture -porosity negligible Dolomitic ls: packstone - grainstone (40 percent) -10YR 7/2 -miliolid foraminifera common: leached appearance -pressure solution boundaries and/or clay seams present -moldic porosity poor
1,238-1,249	LIMESTONE - DOLOMITIC LIMESTONE: GRAINSTONE - WACKESTONE - MUDSTONE Ls: grainstone (30 percent) -10YR 7/1 -miliolid foraminifera abundant -tightly (calcite) cemented calcite cuttings contain opaque, irregularly shaped specks -intraparticle and interparticle porosity in some cuttings

General descriptions of drill cuttings, well A-1--Continued

Depth (ft)	
1,238-1,249 --continued	Ls: packstone - grainstone (40 percent) -10YR 4/2 -allochems are very fine-grained, round, unidentifiable fossils; probable foraminifera - much smaller than typical miliolid foraminifera -brown, sparry cement matrix - allochems floating in matrix Dolomitic ls: mudstone (30 percent) -sucrosic texture -moldic and probable intercrystaline porosity Brown chert common
1,249-1,259	LIMESTONE - DOLOMITIC LIMESTONE: GRAINSTONE - PACKSTONE Ls: grainstone - packstone (60 percent) -miliolid foraminifera abundant -sparry calcite cement and/or micrite matrix -intraparticle and interparticle porosity; variation in degree of porosity development Dolomitic ls: mudstone (40 percent) -sucrosic texture -moldic porosity poorly developed; probable intercrystalline porosity Brown chert present Botryoidal chalcedony - single cutting 4-mm dogtooth spar crystal
1,259-1,269	DOLOMITIC LIMESTONE - LIMESTONE: GRAINSTONE - MUDSTONE Dolomitic ls: mudstone (60 percent) -sucrosic texture -probable dolomitized packstone - grainstone - wackestone -moldic porosity (after foraminifera) and probable intercrystalline porosity -3-mm celestite(?) crystal Ls: grainstone (30 percent) -miliolid foraminifera abundant -caprinid rudistid fragments present -mollusc fragments present -interparticle and intraparticle porosity; variation in degree of development Ls: mudstone (5 percent) -miliolid foraminifera rare -mudstone is probable reflection of micrite stringers within miliolid grainstone -porosity negligible Ls: wackestone (5 percent) -10YR 5/1 -very fine-grained, round allochems - foraminifera(?) -brown micrite matrix Brown chert rare
1,269-1,280	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE Dolomitic ls: mudstone - wackestone (80 percent) -10YR 7/2 -sucrosic texture -microstylolites present (pressure solution boundaries and/or algal laminations -rare crystal aggregates; clear, vitreous luster - celestite(?) -variation in degree of porosity development; moldic porosity -probable intercrystalline porosity

General description of drill cuttings, well A-1--Continued

Depth (ft)	
1,269-1,280 --continued	Ls: packstone - grainstone (15 percent) -miliolid foraminifera common -mollusc fragments present -interparticle porosity poor to fair Ls: mudstone (5 percent) -dense micrite -porosity negligible Brown chert present
1,280-1,290	LIMESTONE - DOLOMITIC LIMESTONE: WACKESTONE - MUDSTONE Ls: wackestone (80 percent) -10YR 7/1 -single echinoderm fragment observed -dense -porosity negligible Dolomitic ls: mudstone (20 percent) -celestite(?) common -moldic and probable intercrystalline porosity -pressure solution boundaries and/or clay seams present
1,290-1,300	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE Ls: mudstone (70 percent) -10YR 7/1 -dense, negligible porosity Dolomitic ls: mudstone (30 percent) -10YR 6/2 -celestite(?) present -moldic porosity
1,300-1,311	LIMESTONE: PACKSTONE - GRAINSTONE -10YR 8/2 -miliolid foraminifera abundant -Toucasia fragments present -brown - gray chert present -interparticle porosity poor
1,311 -1,321	LIMESTONE: GRAINSTONE -10YR 7/2 -miliolid foraminifera abundant -caprinid rudistid fragments present; part of internal micrite cast of caprinid observed -celestite (?) present -moldic and interparticle porosity good
1,321-1,331	CALCITIC DOLOMITE - LIMESTONE: GRAINSTONE - WACKESTONE Calcitic dolomite: grainstone - wackestone (50 percent) -10YR 6/3 -miliolid foraminiferra abundant -sucrosic dolomite coating allochems -interparticle and moldic porosity excellent Ls: wackestone (50 percent) -10YR 7/1 -Toucasia fragments present -other mollusc fragments present -porosity poor

General descriptions of drill cuttings, well A-1--Continued

Depth (ft)	
1,437-1,447	LIMESTONE: WACKESTONE - PACKSTONE -10YR 7/1 -predominantly wackestone -miliolid foraminifera present to common -stylolites observed; other pressure solution boundaries and/or clay seams present -celestite(?) and calcite druses present -porosity poor
1,447-1,457	LIMESTONE: WACKESTONE -10YR 7/1 -miliolid foraminifera present -pressure solution boundaries and/or clay seams common -calcite-filled mirofracture observed -porosity negligible
1,457-1,468	LIMESTONE: MUDSTONE -10YR 7/1 -BRB's - ("black rotund bodies") present - probable pyrite replaced fossil allochems and fecal pellets; refer to Mench-Ellis (1985, p. 152) for extensive explanation of pyrite in basal nodular member -dense micrite -pressure solution boundaries and/or clay seams common -porosity negligible
1,468-1,478	LIMESTONE: WACKESTONE -10YR 7/1 -miliolid foraminifera present to common -mollusc fragments present; replaced by sparry calcite -BRB's present to common -pressure solution boundaries and/or clay seams common -porosity negligible
1,479-1,489	LIMESTONE - DOLOMITIC LIMESTONE: WACKESTONE - MUDSTONE Ls: wackestone - mudstone (95 percent) -10YR 7/1; 4/1 -miliolid foraminifera present -BRB's common -pressure solution boundaries and/or clay seams common (10YR 4/1) -porosity negligible Dolomitic ls: mudstone (5 percent) -10YR 8/1 -non-sucrosic -dense, dolomitized micrite

General descriptions of drill cuttings, well A-1--Continued

Depth (ft)	
1,374-1,384	LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/1 -miliolid foraminifera present -probable algal laminations in mudstone; 10YR 5/2; very large cutting -stylolites and other pressure solution boundary evidence and/or clay seams present -brown chert common (very large cuttings) -porosity poor
1,384-1,394	LIMESTONE: WACKESTONE - MUDSTONE -10YR 6/2 -miliolid forminifera present -chalky appearance -brown chert present -porosity negligible
1,394-1,405	LIMESTONE: GRAINSTONE - MUDSTONE Ls: grainstone (85 percent) -10YR 8/1 -foraminifera abundant - miliolid and probable other species -leached appearance -interparticle porosity good Ls: mudstone (15 percent) -dense micrite -laminations present -porosity negligible
1,405-1,415	LIMESTONE: WACKESTONE - MUDSTONE -10YR 7/1 -miliolid foraminifera present -chalky appearance -pressure solution boundaries and/or clay seams present -brown chert rare -porosity poor
1,415-1,425	LIMESTONE: GRAINSTONE - WACKESTONE Ls: grainstone (85 percent) -miliolid foraminifera abundant -mollusc fragments present to rare -interparticle porosity poor Ls: wackestone (15 percent) -miliolid foraminifera present -porosity poor
1,425-1,437	LIMESTONE - DOLOMITIC LIMESTONE: WACKESTONE - MUDSTONE Ls: wackestone - mudstone (90 percent) 10YR 8/1 -miliolid foraminifera present -chalky appearance -pressure solution boundaries and/or clay seams present -porosity negligible Dolomitic ls: mudstone (10 percent) -sucrosic texture -moldic porosity poor (after miliolid foraminifera)

Depth (ft)	
1,331-1,343	DOLOMITIC LIMESTONE - CALCITIC DOLOMITE: GRAINSTONE - PACKSTONE - MUDSTONE Ls: grainstone - packstone (33 percent) -10YR 7/2 -miliolid foraminifera abundant -mollusc fragments present -pressure solution boundaries and/or clay seams present -interparticle porosity poor; many dense, tightly cemented cuttings Dolomitic ls - calcitic dolomite: mudstone (33 percent) -probable dolomitized packstone: -sucrosic texture -moldic (after miliolid foraminifera) and probable intercrystalline porosity -dolomitized mudstone: -fine sucrosic texture -brownish algal laminations present in some cuttings -celestite(?) present -porosity poor Ls: mudstone (33 percent) -may be slightly dolomitic -pressure solution boundaries present; stylolite observed -porosity negligible Dark brown - blackish gray chert present; allochem ghosts observed
1,343-1,353	DOLOMITE - LIMESTONE: MUDSTONE - GRAINSTONE - PACKSTONE Dolomite: mudstone (50 percent) -10YR 5/2 -dense -noted that some cuttings have a single 0.5-mm thick surface with miliolid foraminifera molds (foraminifera laminae) Ls: grainstone - packstone (50 percent) -10YR 7/1 -miliolid foraminifera abundant -intraparticle porosity poor
1,353-1,363	LIMESTONE: MUDSTONE -10YR 7/1 -stylolites present -chalky appearance -pinacoid celestite or calcite(?) druses present (indecisive hydrochloric acid test due to interference with calcite matrix) -brown-gray chert rare -porosity negligible
1,363-1,374	LIMESTONE - DOLOMITIC LIMESTONE: WACKESTONE - MUDSTONE Ls: wackestone - mudstone (95 percent) -10YR 8/1 -mollusc fragments present; commonly replaced by sparry calcite -gastropods rare -milliolid foraminifera rare -pressure solution boundaries and/or clay seams rare -2-mm calcite crystals present; crystal aggregates also -porosity poor Dolomitic ls: mudstone (5 percent) -10YR 6/1 -slightly sucrosic texture -moldic porosity (after miliolid foraminifera)

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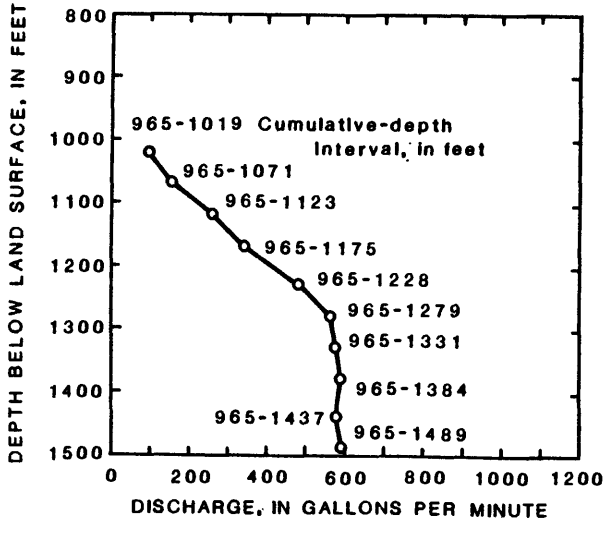
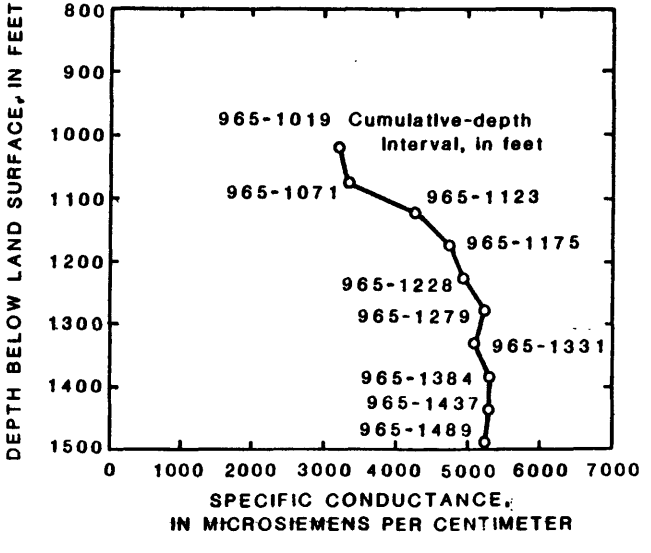
Cumulative-depth flow tests, well A-1

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/2/	Water level, flowing (ft) 3/	Water level, recovery (ft) 3/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)	Temperature (°C)
1	965-1,019	96	--	+39.96	--	--	3,198	31.0
2	965-1,071	151	--	+37.65	--	--	3,324	32.0
3	965-1,123	257	--	+37.08	--	--	4,260	32.5
4	965-1,175	341	--	+36.61	--	--	4,740	33.0
5	965-1,228	481	+3.46	+35.23	31.77	15.14	4,940	33.0
6	965-1,279	564	+2.94	+35.34	32.40	17.41	5,220	33.0
7	965-1,331	575	+3.45	+34.07	30.62	18.78	5,080	33.0
8	965-1,384	588	+3.47	+32.92	29.45	19.97	5,300	33.0
9	965-1,437	576	+2.38	+32.69	30.31	19.00	5,280	33.0
10	965-1,489	590	+3.23	+32.34	29.11	20.27	5,230	33.0

1/ Duration of flow, 1 hour; duration of recovery, 1 hour.
2/ Average discharge determined volumetrically.
3/ Water levels determined by pressure transducer.



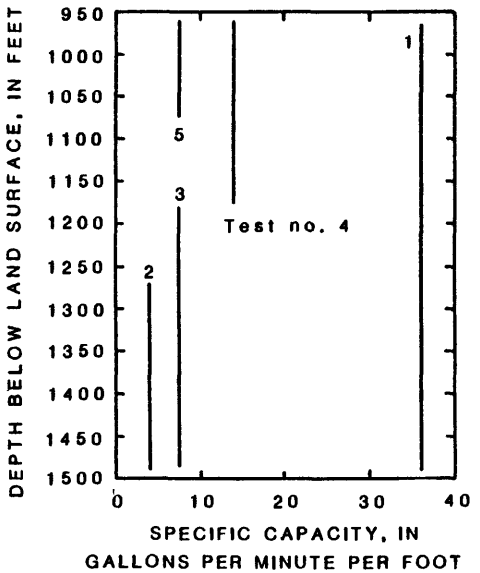


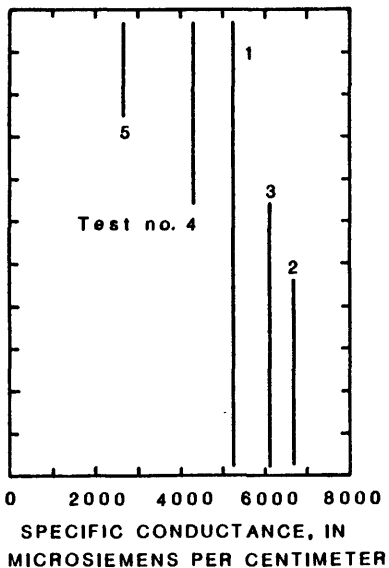
Interval flow tests, well A-1

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/	Water level, static (ft) 2/	Water level, flowing (ft) 2/	Water level, end flow (ft) 2/	Water level, recovery (ft) 2/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)
1	965-1,489	3/378	--	--	4/+19.40	4/+29.88	10.48	36.07	5,230
2	1,276-1,489	5/33	+27.77	+19.78	--	--	7.99	4.10	6,650
3	1,180-1,489	6/44	+29.17	+23.37	--	--	5.80	7.51	6,060
4	965-1,180	7/238	--	+11.08	--	+28.00	16.92	14.07	4,360
5	965-1,075	6/128	+28.88	+12.02	--	--	16.86	7.66	2,680
6	8/1,200-1,275	5/9/23	--	--	9/+24.77	--	--	--	--

1/ Duration of flow, 4 hours; duration of recovery, 2 hours.
2/ Water levels determined by direct readings.
3/ Discharge determined by manometer with 10-inch pipe X 8-inch orifice.
4/ Water levels determined by pressure transducer.
5/ Discharge determined volumetrically.
6/ Discharge determined by manometer with 4-inch pipe X 2.5-inch orifice.
7/ Discharge determined by 8-inch pipe X 5-inch orifice.
8/ Completed monitor well.
9/ End of 1-hour flow.





Water-quality data, well A-1

[ft, feet; °C, degree Celsius; µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter]

Date	Depth to top of water-bearing zone (ft)	Depth to bottom of water-bearing zone (ft)	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Alkalinity, wh wat total field (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Specific conductance, lab (µS/cm)
July 1985																
22...	965	1019	31.0	3200	6.40	215	320	100	250	16	440	920	2.2	17	2200	3120
23...	965	1071	32.0	3320	6.11	215	270	110	250	15	470	960	2.3	16	2200	3280
24...	965	1123	32.5	4260	6.60	231	460	140	340	20	670	1300	2.5	18	3090	4200
25...	965	1175	32.5	4260	6.60	231	360	140	340	20	700	1300	2.5	18	3000	4200
25...	965	1228	33.0	4940	6.70	235	420	170	400	23	880	1500	2.7	18	3600	4880
26...	965	1279	33.0	5220	6.70	233	420	170	380	24	810	1500	2.7	17	3500	5020
29...	965	1331	33.0	5080	6.80	237	430	180	380	28	750	1400	2.6	18	3300	5130
29...	965	1384	33.0	5300	6.70	239	430	180	390	26	890	1500	2.7	18	3600	5160
30...	965	1437	33.0	5280	6.50	231	420	170	440	25	810	1300	2.8	18	3300	5170
Aug.																
02...	965	1489	33.0	5230	6.60	232	510	180	400	25	840	1500	2.7	18	3600	5080
06...	1276	1489	33.0	6650	6.60	249	600	230	550	33	1200	2000	3.0	20	4800	6450
07...	1180	1489	33.0	6060	6.50	240	590	210	480	29	1000	1800	2.9	19	4300	5850
07...	965	1180	32.5	4360	6.61	224	390	140	320	21	670	1200	2.5	17	2900	4040
08...	965	1075	32.0	2680	6.90	212	260	89	200	13	380	780	2.0	16	1900	2730
Mar. 1986																
13...	1200	1275	32.5	5840	6.70	241	600	210	460	28	930	1800	2.8	21	4200	5610
July																
14...	1200	1275	--	5740	--	235	540	200	--	--	920	1800	--	--	--	5420
Sept.																
18...	1200	1275	--	5780	--	246	510	190	--	--	980	1900	--	--	--	5390

Well summary, well A-2

AY-68-37-522

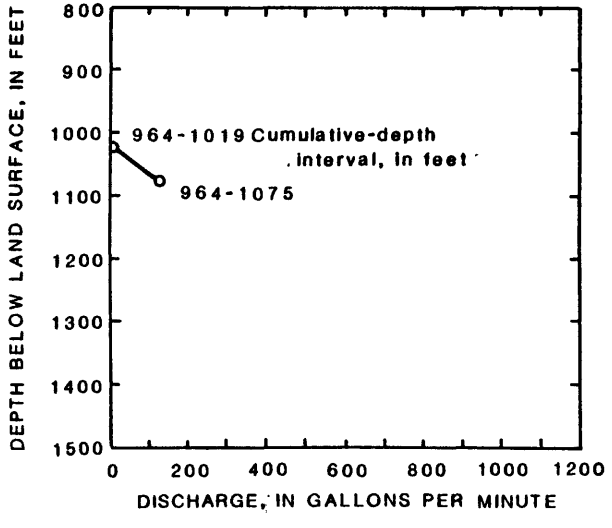
Owner:	San Antonio City Water Board
Drilling started:	8-26-85
Well completed:	9-20-85
Location:	188 Dafoste Park, San Antonio, Texas
Altitude of land surface:	620 feet above sea level
Total test depth:	1,075 feet
Casing depth:	9-5/8 inch casing to 964 feet 2-3/8 inch casing to 1,013 feet
Depth to formation tops:	Navarro Group and Taylor Marl, undivided------ surface Anacacho Limestone---------- 546 feet Austin Group---------- 686 feet Eagle Ford Group---------- 810 feet Buda Limestone---------- 840 feet Del Rio Clay---------- 900 feet Georgetown Limestone-------- 952 feet Edwards Group (Rose, 1972)-- 980 feet
Geophysical logs:	Natural gamma Caliper Spontaneous potential Resistivity
Borehole surveys:	None
Flow tests:	Cumulative-depth Interval
Monitored depth interval:	1,001-1,075 feet - Gravel pack 1,013-1,067 feet - Screen
Water-quality data:	Field measurements and selected inorganic constituents

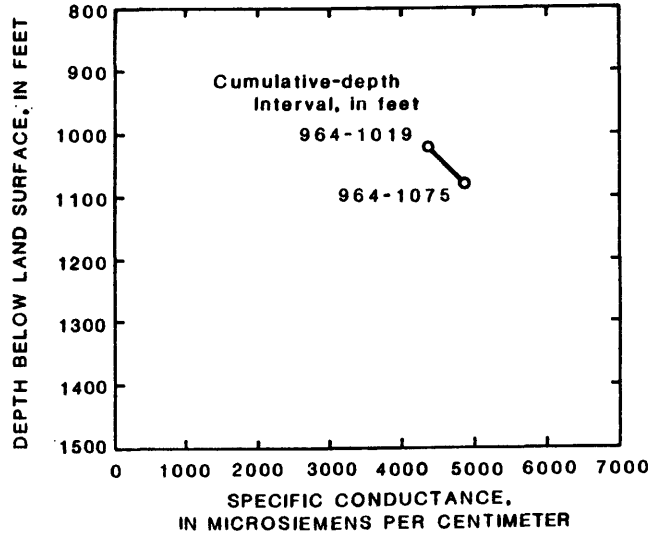
Cumulative-depth flow tests, well A-2

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/	Water level, flowing (ft) 2/	Water level, recovery (ft) 2/	Draw-down (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)	Temper-ature (°C)
1	964-1,019	3/9.1	+2.22	+18.53	16.31	0.56	4,370	32.5
2	964-1,075	4/127.5	+2.11	+25.81	23.70	5.38	4,860	--

1/ Discharge determined volumetrically.
2/ Water levels determined by pressure transducer.
3/ Duration of flow, 40 minutes; duration of recovery, 20 minutes.
4/ Duration of flow, 1 hour; duration of recovery, 1 hour.





Interval flow test, well A-2

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/	Water level, static (ft) 2/	Water level, flowing (ft) 2/	Water level, end flow (ft) 2/	Water level, recovery (ft) 2/	Drawdown (ft)	Specific capacity [(gal/min)ft]	Specific conductance (µS/cm)
1	3/1,001-1,075	4/23.64	+30.02	--	4/+15.43	--	14.59	1.62	--

1/ Discharge determined volumetrically.
2/ Water levels determined by direct readings.
3/ Completed monitor well.
4/ End of 1-hour flow.

Water-quality data, well A-2

[ft, feet; °C, degree Celsius; µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter]

Date	Depth to top of water-bearing zone (ft)	Depth to bottom of water-bearing zone (ft)	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Alkalinity, wh wat total field (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Specific conductance lab (µS/cm)
March 1986																
13...	1001	1075	31.5	4700	6.70	225	490	170	370	23	730	1400	2.8	19	3300	4570
July																
14...	1001	1075	--	4710	--	220	440	160	--	--	730	1400	--	--	--	4470
Aug.																
15...	1001	1075	--	4750	--	225	610	220	--	2.2	--	--	--	--	--	--
Sept.																
18...	1001	1075	--	4550	--	223	410	150	--	--	790	1400	--	--	--	4410

Well summary, well A-3

AY-68-37-523

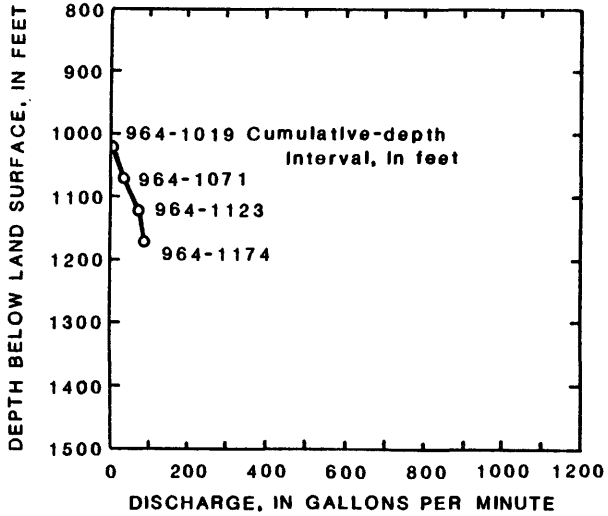
Owner:	San Antonio City Water Board
Drilling started:	9-26-85
Well completed:	10-21-85
Location:	188 Dafoste Park, San Antonio, Texas
Altitude of land surface:	620 feet above sea level
Total test depth:	1,175 feet
Casing depth:	9-5/8 inch casing to 964 feet 2-3/8 inch casing to 1,112 feet
Depth to formation tops:	Navarro Group and Taylor Marl, undivided------ surface Anacacho Limestone---------- 546 feet Austin Group---------- 690 feet Eagle Ford Group---------- 812 feet Buda Limestone---------- 842 feet Del Rio Clay---------- 900 feet Georgetown Limestone-------- 954 feet Edwards Group (Rose, 1972)-- 980 feet
Geophysical logs:	Natural gamma Caliper Spontaneous potential Resistivity
Borehole surveys:	None
Flow tests:	Cumulative-depth Interval
Monitored depth interval:	1,099-1,175 ft - Gravel pack 1,112-1,164 ft - Screen
Water-quality data:	Field measurements and selected inorganic constituents

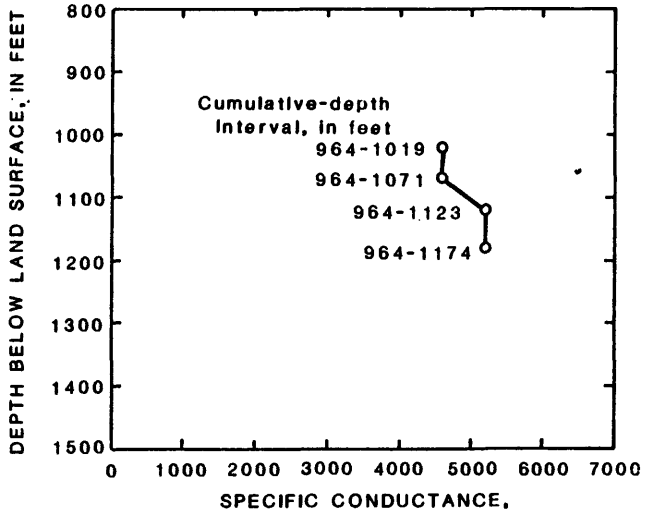
Cumulative-depth flow tests, well A-3

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/	Water level, flowing (ft) 2/	Water level, recovery (ft) 2/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)	Temperature (°C)
1	964-1,019	3/ 5.48	+3.73	+35.93	32.20	0.17	4,600	32.0
2	964-1,071	4/ 34.38	+3.84	+34.86	31.02	1.11	4,590	--
3	964-1,123	3/ 73.00	+3.18	+34.87	31.69	2.30	5,200	32.0
4	964-1,174	3/ 87.00	+4.02	+33.39	29.37	2.96	5,200	32.0

1/ Discharge determined volumetrically.
2/ Water levels determined by direct readings.
3/ Duration of flow, 1 hour; duration of recovery, 1 hour.
4/ Duration of flow, 1 hour, 30 minutes; duration of recovery, 20 minutes.





Interval flow test, well A-3

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/	Water level, static (ft) 2/	Water level, flowing (ft) 2/	Water level, end flow (ft) 2/	Water level, recovery (ft) 2/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)
1	3/1,099-1,175	4/36.95	--	--	4/-114.32	+39.69	154.01	0.24	--

1/ Discharge determined volumetrically.
2/ Water levels determined by direct readings.
3/ Completed monitor well.
4/ End of 8-hour flow.

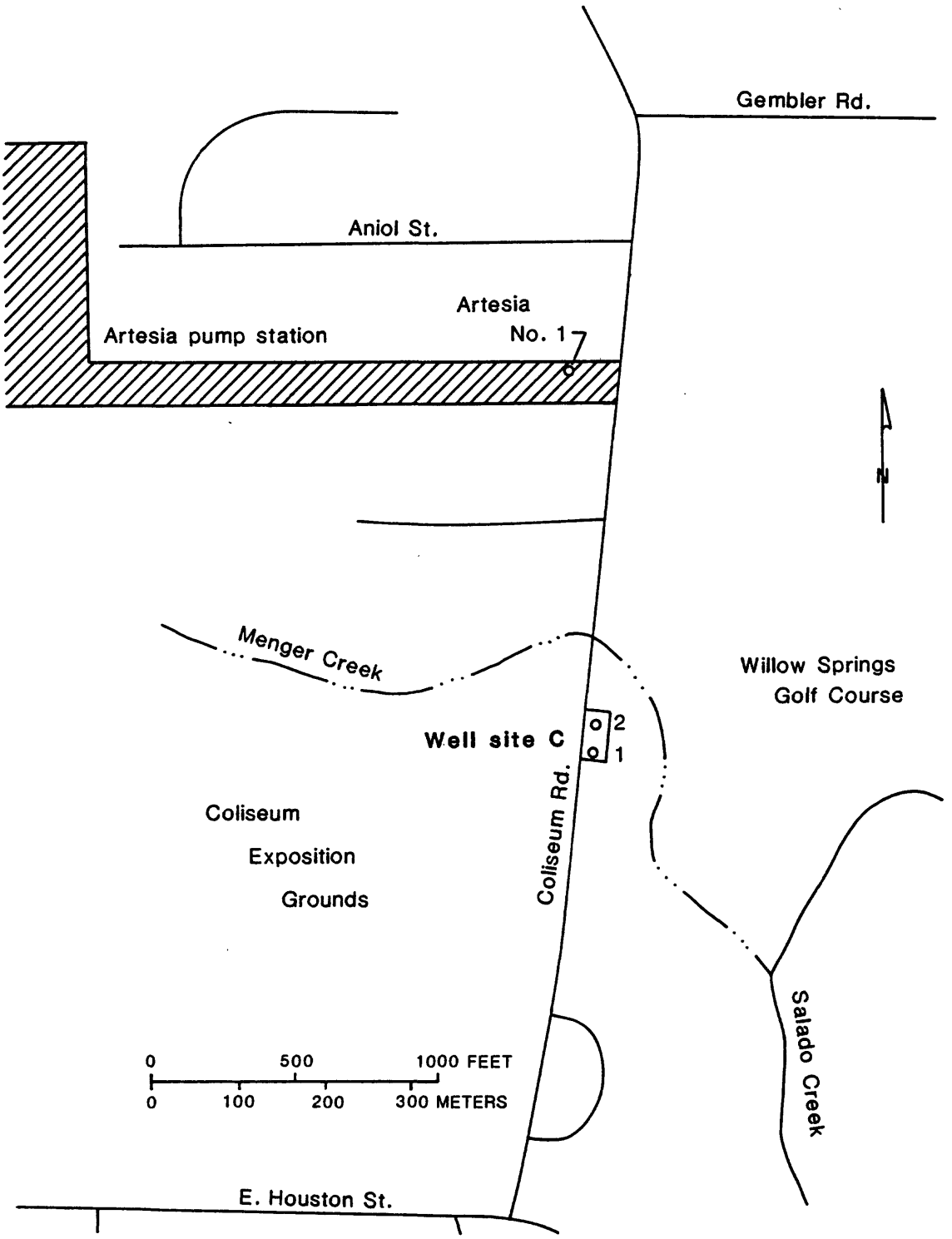
Water-quality data, well A-3

[ft, feet; °C, degree Celsius; µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter]

Date	Depth to top of water-bearing zone (ft)	Depth to bottom of water-bearing zone (ft)	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Alkalinity, wh wat total field (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (MG/L)	Specific conductance lab (µS/cm)
March 1986																
13...	1099	1175	31.0	5900	6.70	241	580	220	510	29	940	1800	3.1	21	4200	5690
July																
14...	1099	1175	--	5860	--	235	520	210	--	--	1100	1900	--	--	--	5520
Aug.																
15...	1099	1175	--	6040	--	242	590	230	--	--	980	1900	--	--	--	6060
Sept.																
18...	1099	1175	--	5440	--	253	500	210	--	--	1000	1900	--	--	--	5550

H Y D R O G E O L O G I C D A T A

Site C

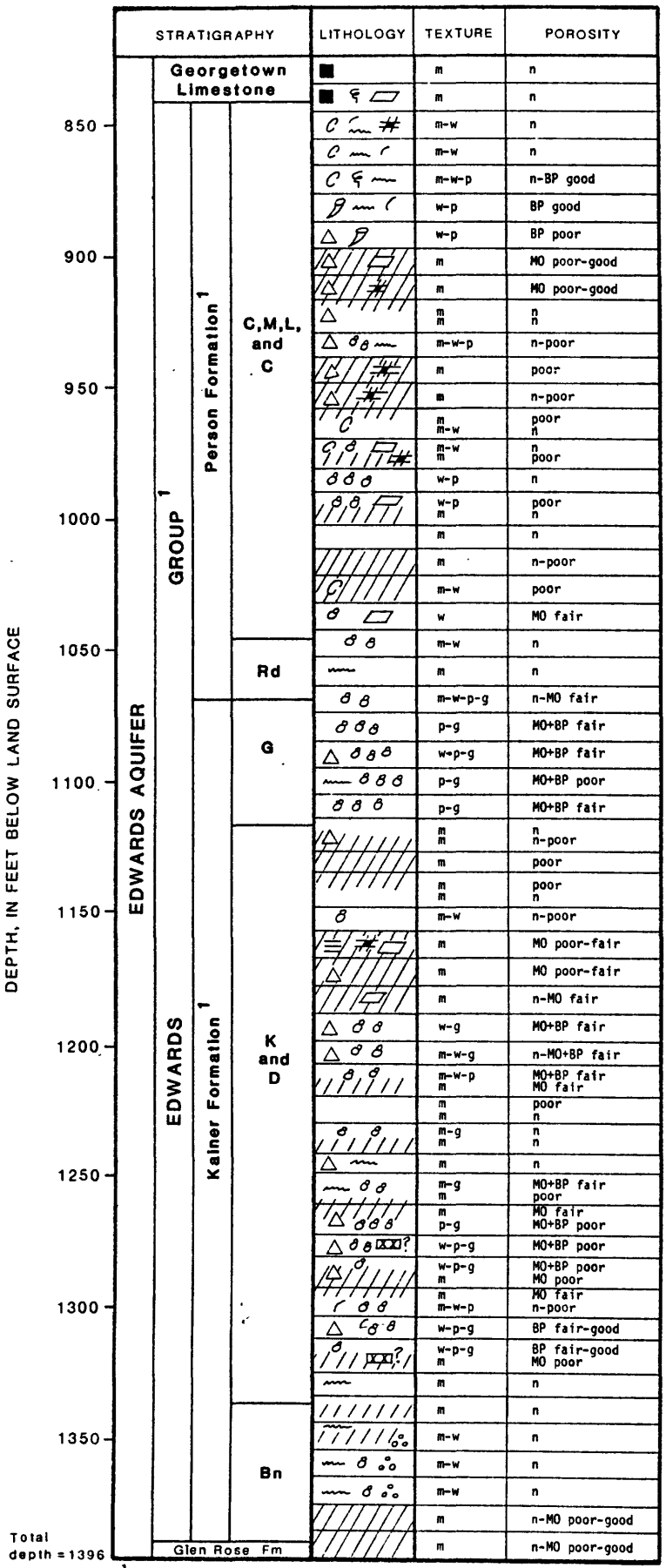


Location map of well site C

Well summary, well C-1

AY-68-37-524

Owner:	San Antonio City Water Board
Drilling started:	10-31-85
Well completed:	1-31-86
Location:	350 Coliseum Road, Willow Springs Golf Course, San Antonio, Texas
Altitude of land surface:	626 feet above sea level
Total test depth:	1,396 feet
Casing depth:	9-5/8 inch casing to 832 feet 2-3/8 inch casing to 840 feet
Depth to formation tops:	Navarro Group and Taylor Marl, undivided------ surface Anacacho Limestone---------- 404 feet Austin Group---------- 552 feet Eagle Ford Group---------- 670 feet Buda Limestone---------- 702 feet Del Rio Clay---------- 760 feet Georgetown Limestone-------- 820 feet Edwards Group (Rose, 1972)-- 840 feet Glen Rose Formation--------- 1,390 feet
Geophysical logs:	Natural gamma Caliper Spontaneous potential Resistivity Focused resistivity Acoustic velocity Neutron Density
Borehole surveys:	Spinner survey Fluid temperature Fluid resistivity Continuous acoustic televiewer Downhole television survey
Flow tests:	Cumulative-depth Drawdown test Interval depth
Monitored depth interval:	840-881 feet, open hole
Water-quality data:	Field measurements and selected inorganic constituents



EXPLANATION

STRATIGRAPHY

Members from Rose, 1972 (see fig. 2)

C, M, L, and C = cyclic, marine, leached, and collapsed members, undivided

Rd = regional dense member

G = grainstone member

K and D = Kirschberg evaporite and dolomitic member, undivided

Bn = basal nodular member

LITHOLOGY

Fossil allochems

- miliolid foraminifera
- caprinid rudistid
- Toucasia rudistid
- gastropod
- other mollusc fragments

Mineral constituents

- //// dolomitic (otherwise calcitic)
- chert
- pyrite
- single crystal calcite or aggregate
- calcite crystal druse
- celestite?
- pyrite replaced allochems, "BRBs" - black rotund bodies

Sedimentary structures

- pressure solution boundaries and/or clay seams
- algal laminations
- burrow

Tectonic structures

- filled microfracture

TEXTURES

m = mudstone
w = wackestone
p = packstone
g = grainstone
(Dunham, 1962)

DIAGENETIC FEATURES

F = iron stains
A = altered (associated with late freshwater diagenesis)
D? = dedolomite?
CE? = calcitized evaporites

POROSITY

BP = interparticle
WP = intraparticle
BC = intercrystal
MO = moldic
(Choquette and Pray, 1970)
n = negligible
poor, fair, and good are qualitative modifiers

NOTE: Cuttings collected at approximately 10-foot intervals.

General descriptions of drill cuttings, well C-1

Munsell (1967) color chart notation: Hue value/chroma (example, 10YR 7/1)
[ft, feet; mm, millimeter]

Depth (ft)	
824-834	LIMESTONE: MUDSTONE -10YR 7/1 -pyrite present -porosity negligible
834-845	LIMESTONE: MUDSTONE Ls: mudstone (20 percent) -10YR 6/1 -pyrite present -porosity negligible Ls: mudstone (80 percent) -10YR 8/2 -gastropods rare (replaced by sparry calcite) -calcite crystal aggregates present -porosity negligible
845-855	LIMESTONE: MUDSTONE - WACKESTONE -10YR 8/2 -dense -Toucasia fragments present -pelecypod (other bivalves) fragments rare -filled microfractures common -pressure solution boundaries and/or clay seams present -porosity negligible
855-865	LIMESTONE: MUDSTONE - WACKESTONE -10YR 8/2; 7/1 -Toucasia fragments present -pelecypod fragments present -recrystalized areas(?) observed (5 percent of cuttings) -pressure solution boundaries and/or clay seams present -porosity negligible
865-877	LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE -10YR 7/1 -turritelid gastropods rare -Toucasia fragments rare -pressure solution boundaries and/or clay seams present -poorly sorted, fossil fragment wackestone - packstone with good interparticle porosity -porosity negligible except in above mentioned wackestone - packstone
877-887	LIMESTONE: WACKESTONE - PACKSTONE -10YR 7/1 -poorly sorted, fine to medium-grained, fossil fragment packstone -caprinid fragments present -pressure solution boundaries and/or clay seams present -interparticle (and possibly moldic) porosity good
887-897	LIMESTONE: WACKESTONE - PACKSTONE -10YR 7/1 -fine to medium-grained, fossil fragment wackestone - packstone -caprinid fragments rare -dark brown chert common -interparticle porosity poorly developed

General descriptions of drill cuttings, well C-1--Continued

Depth (ft)	
897-908	DOLOMITIC LIMESTONE: MUDSTONE -sucrosic texture -calcite crystal aggregates rare -dark brown chert present (from uphole?) -poor to good moldic porosity - variation in degree of porosity development
908-918	DOLOMITIC LIMESTONE: MUDSTONE -10YR 6/2 -sucrosic texture -calcite filled fractures present -pressure solution boundaries and/or clay seams present -dark brown chert rare -moldic porosity poor to good; micropores (not necessarily moldic porosity)
918-928	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE Dolomitic ls: mudstone (50 percent) -10YR 6/2 -sucrosic texture -porosity negligible Ls: mudstone (50 percent) -10YR 6/2 -dense -porosity negligible Dark brown chert rare
928-939	LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE Ls: mudstone (40 percent) -10YR 6/1 -dense -porosity negligible Ls: wackestone - packstone (60 percent) -10YR 7/1 -miliolid foraminifera present to abundant -pressure solution boundaries and/or clay seams present -dark brown chert present -porosity poor
939-949	DOLOMITIC LIMESTONE: MUDSTONE -10YR 5/2 -sucrosic texture -filled, hairline fractures present -brown chert present -porosity poor
949-959	DOLOMITIC LIMESTONE - DOLOMITE: MUDSTONE Dolomite: altered mudstone (40 percent) -very dense -sucrosic texture -porosity negligible Dolomitic ls: mudstone (60 percent) -10YR 6/2 -sucrosic texture -filled hairline fractures present -brown chert rare -porosity poor

General descriptions of drill cuttings, well C-1--Continued

Depth (ft)	
959-971	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE Ls: mudstone - wackestone (50 percent) -10YR 7/1 -recrystalized(?) -Toucasia fragments rare -sparry areas common -porosity negligible Dolomitic ls: mudstone (50 percent) -10YR 6/2 -sucrosic texture -porosity poor -possibility of dedolomite - cuttings which look like leached dolomitic limestone - whiter coloration
971-981	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE Ls: mudstone - wackestone (50 percent) -10YR 7/1 -Toucasia fragments rare -miliolid foraminifera rare to present -allochems replaced by sparry calcite present -single, brownish dogtooth spar crystal 6 mm in length observed -sparry areas present - recrystalized? -pressure solution boundaries and/or clay seams present -porosity negligible Dolomitic ls: mudstone (50 percent) -10YR 7/2 -sucrosic texture -filled hairline fractures rare -porosity poor - micropores present
981-991	LIMESTONE: WACKESTONE - PACKSTONE -10YR 7/1 -miliolid foraminifera common; leached, "chalky" appearance -porosity negligible
991-1,001	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE Dolomitic ls: mudstone (50 percent) -10YR 6/2 -slightly dolomitic -very fine-grained sucrosic texture -pressure solution boundaries and/or clay seams present -porosity negligible Ls: wackestone - packstone (50 percent) -10YR 7/1 -miliolid foraminifera common; leached, "chalky" appearance -calcite crystal aggregate observed -porosity poor
1,001-1,011	LIMESTONE: MUDSTONE -10YR 7/2; 6/2 -darker mudstone (6/2) may be slightly dolomitic -porosity negligible
1,011-1,021	DOLOMITIC LIMESTONE: MUDSTONE -10YR 6/2 -sucrosic texture -dolomite content greatly varies -porosity negligible to poor

General descriptions of drill cuttings, well C-1--Continued

Depth (ft)	
1,251-1,261	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE - GRAINSTONE Ls: mudstone - grainstone (90 percent) -10YR 7/1 -leached -pressure solution boundaries and/or clay seams present -variation in degree of porosity development; grainstone and packstone have moldic and interparticle porosity Dolomitic ls: mudstone (10 percent) -10YR 6/2 -dense -sucrosic texture -micropores present - porosity poor
1,261-1,271	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - PACKSTONE GRAINSTONE Dolomitic ls: mudstone (90 percent) -10YR 6/3 -sucrosic texture -some cuttings are dense -variation in degree of porosity development; some moldic porosity -observed foraminifera mold with elongate, ellipsoidal geometry; not a "typical" miliolid Ls: packstone - grainstone (10 percent) -10YR 7/1 -miliolid, fossil fragment packstone - grainstone -leached -porosity poor; some moldic and interparticle Grayish brown chert present
1,271-1,282	LIMESTONE: WACKESTONE - PACKSTONE - GRAINSTONE -10YR 7/1 -leached; "chalky" appearance -miliolid foraminifera common to abundant; leached appearance -fossil fragments present to common -clear, tabular twinned crystals observed - celestite(?) -grayish brown chert abundant -porosity poor - moldic and interparticle
1,282-1,292	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE - GRAINSTONE Ls: wackestone - packstone - grainstone (15 percent) -same as 1,271-1,282 ft with pressure solution boundaries and/or clay seams present Dolomitic ls: mudstone (85 percent) -10YR 6/2 -sucrosic texture -pressure solution boundaries and/or clay seams present -variation in degree of porosity development; some moldic Grayish brown chert present

General descriptions of drill cuttings, well C-1--Continued

Depth (ft)	
1,189-1,199	LIMESTONE: WACKESTONE - GRAINSTONE -10YR 7/1 -miliolid foraminifera present to abundant -calcite cemented grainstone has leached appearance -brown chert abundant -moldic and interparticle porosity fair in grainstone
1,199-1,209	LIMESTONE: MUDSTONE - WACKESTONE - GRAINSTONE -10YR 7/1 -leached, "chalky" appearance -miliolid foraminifera present to abundant; leached appearance -brown chert abundant -approximately 20 percent of sample is miliolid grainstone with moldic and interparticle porosity (better developed interparticle) -porosity of wackestone negligible
1,209-1,219	LIMESTONE - DOLOMITIC LIMESTONE - DOLOMITE: MUDSTONE - WACKESTONE - GRAINSTONE Ls: mudstone - wackestone - packstone (70 percent) -10YR 7/1 -miliolid foraminifera present to common -leached appearance -variation in degree of porosity development - moldic and interparticle Dolomitic ls - dolomite: mudstone and grainstone (30 percent) -sucrosic texture -mudstone - moldic porosity (after miliolids foraminifera) -dolomitized grainstone with interparticle porosity
1,219-1,229	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE Ls: mudstone (90 percent) -10YR 7/1 -"chalky" appearance -porosity negligible Dolomitic ls: mudstone (10 percent) -10YR 6/2 -sucrosic texture -micropores present - porosity poor Grayish brown chert present
1,229-1,239	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - GRAINSTONE Dolomitic ls: mudstone (60 percent) -10YR 6/2 -dense -very fine-grained sucrosic texture -porosity negligible Ls: mudstone - grainstone (40 percent) -10YR 7/2 -"chalky" appearance -part of cuttings are dense calcite cemented miliolid grainstone with negligible porosity
1,239-1,251	LIMESTONE: MUDSTONE -10YR 7/1 -"chalky" appearance -pressure solution boundaries and/or clay seams present -brown chert rare -a few dolomitic mudstone cuttings present - from uphole? -porosity negligible

General descriptions of drill cuttings, well C-1--continued

Depth (ft)	
1,105-1,115	LIMESTONE: PACKSTONE - GRAINSTONE -10YR 7/2 -miliolid formaminifera common to abundant -leached appearance -moldic and interparticle porosity; better developed than 1,095-1,105 ft
1,115-1,127	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE Ls: mudstone (30 percent) -10YR 7/2 -dense -porosity negligible Dolomitic ls: mudstone (70 percent) -sucrosic texture -leached appearance -possible evaporites -brown chert present
1,127-1,137	DOLOMITIC LIMESTONE: MUDSTONE -10YR 7/2 -sucrosic texture -very fine-grained black, opaque specks present -micropores present - porosity poor
1,137-1,147	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE -10YR 7/2 Ls: mudstone (30 percent) -dense -porosity negligible Dolomitic ls: mudstone (70 percent) -sucrosic texture -micropores present
1,147-1,157	LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/1 -miliolid foraminifera rare to present -leached appearance -porosity negligible to poor
1,157-1,167	DOLOMITIC LIMESTONE: MUDSTONE -10YR 7/2 -sucrosic texture -rare algal laminations(?); could be pressure solution boundaries, but are uniformly parallel and horizontal -calcite crystals present -calcite filled hairline fractures rare -variation in degree of porosity development; micropores rare to common; moldic porosity
1,167-1,177	DOLOMITIC LIMESTONE: MUDSTONE -10YR 6/2 -sucrosic texture -brown chert present -variation in degree of porosity development; some moldic porosity; micropores present
1,177-1,189	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE -10YR 7/1 -very leached - "chalky" appearance -calcite crystal aggregates present -porosity negligible to fair; some moldic porosity in dolomitic limestone which has leached appearance

General descriptions of drill cuttings, well C-1--Continued

Depth (ft)	
1,021-1,032	DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/2 -slightly dolomitic -leached -Toucasia fragments present in recrystalized (?) matrix (calcitic) -micropores present - porosity poor
1,032-1,042	LIMESTONE: WACKESTONE -10YR 7/1 -leached appearance -calcite crystal aggregates present -moldic porosity fair
1,042-1,052	LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/1 -dense -miliolid foraminifera present; leached appearance -pressure solution boundaries and/or clay seams present -porosity negligible
1,052-1,064	LIMESTONE: MUDSTONE -10YR 6/2 -dense -pressure solution boundaries and/or clay seams present -porosity negligible
1,064-1,074	LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE - GRAINSTONE Ls: mudstone (80 percent) -10YR 7/1 -dense -porosity negligible Ls: wackestone - packstone - grainstone (20 percent) -leached appearance -grainstone has moldic porosity; variation in degree of porosity development
1,074-1,084	LIMESTONE: PACKSTONE - GRAINSTONE -10YR 7/1 -miliolid foraminifera common to abundant -leached appearance -moldic and interparticle porosity
1,084-1,095	LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE - GRAINSTONE Ls: mudstone (5 percent) -dense micrite: observed single cutting with apparent miliolid grainstone contact -rare dolomitic cuttings; sucrosic texture Ls: wackestone - packstone - grainstone (95 percent) -miliolid foraminifera present to abundant -leached appearance -grainstone has moldic and interparticle porosity Brown chert rare
1,095-1,105	LIMESTONE: PACKSTONE - GRAINSTONE -10YR 7/2 -miliolid foraminifera common to abundant -leached appearance -pressure solution boundaries and/or clay seams present -moldic and interparticle porosity poor

General descriptions of drill cuttings, well C-1--Continued

Depth (ft)	
1,292-1,302	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE Dolomitic ls: mudstone (50 percent) -10YR 6/2 -sucrosic texture -moldic (after foraminifera) porosity fair Ls: mudstone - wackestone - packstone (50 percent) -10YR 7/1 -leached appearance -miliolid foraminifera rare to common -fossil fragments present (in wackestone - packstone) -porosity negligible to poor
1,302-1,313	LIMESTONE: WACKESTONE - PACKSTONE - GRAINSTONE -10YR 7/1 -leached appearance -fossil fragments present -miliolid foraminifera common to abundant -grayish brown chert rare -interparticle porosity fair to good (in packstone - grainstone) -rare dolomitic mudstone cuttings
1,313-1,323	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE Dolomitic ls: mudstone (60 percent) -10YR 6/2 -sucrosic texture -pressure solution boundaries and/or clay seams present -celestite(?) rare -moldic porosity poor Ls: mudstone - wackestone - packstone (40 percent) -same as 1,302-1,313 ft
1,323-1,333	LIMESTONE: MUDSTONE -10YR 7/1 -pressure solution boundaries and/or clay seams present -porosity negligible
1,333-1,345	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE -10YR 6/2 -dense -dolomitic cuttings have very fine-grained sucrosic texture -pressure solution boundaries and/or clay seams present -porosity negligible
1,345-1,355	DOLOMITIC LIMESTONE - LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/1 -slightly dolomitic to calcitic -BRB's ("black rotund bodies") present to common - probable pyrite replaced fossil allochems and fecal pellets; refer to Mench-Ellis (1985, p. 152) for extensive explanation of pyrite in basal nodular member -pressure solution boundaries and/or clay seams present -porosity negligible
1,355-1,365	LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/1 -miliolid foraminifera present -BRB's present to rare -pressure solution boundaries and/or clay seams present -porosity negligible

General descriptions of drill cuttings, well C-1--Continued

Depth (ft)	
1,365-1,376	LIMESTONE: MUDSTONE - WACKESTONE -same as 1,355-1,365 ft
1,376-1,386	DOLOMITIC LIMESTONE: MUDSTONE 10YR 6/2 -sucrosic texture -moldic porosity poor to good; variation in degree of porosity development
1,386-1,396	DOLOMITIC LIMESTONE: MUDSTONE -10YR 7/1 -color much lighter than 1,376-1,386 ft -majority of cuttings have very fine-grained sucrosic texture -approximately 30 percent of cuttings exhibit moldic porosity like 1,376-1,386 ft, in remainder, porosity is negligible

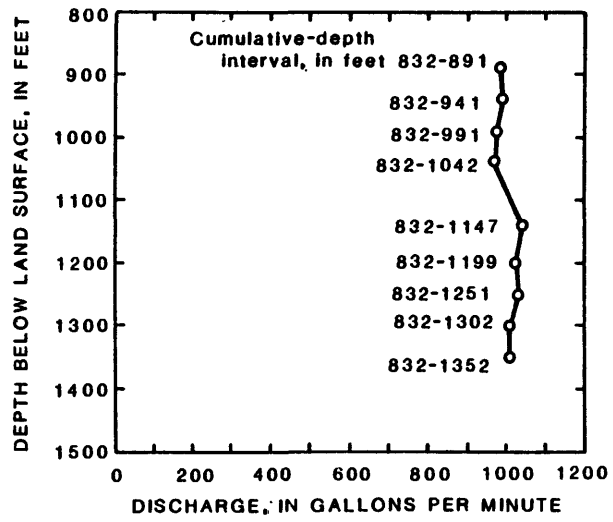
page 59 follows

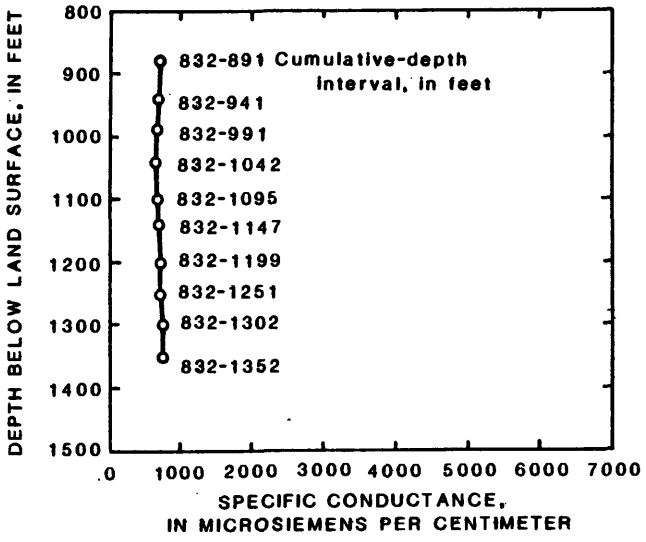
Cumulative-depth flow tests, well C-1

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/2/	Water level, flowing (ft) 3/	Water level, recovery (ft) 3/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)	Temperature (°C)
1	832- 891	985	+7.03	+43.23	36.20	27.20	712	28.5
2	832- 941	992	+7.14	+41.88	34.74	28.55	696	28.5
3	832- 991	977	+7.00	+43.15	36.15	27.02	672	28.5
4	832-1,042	971	+7.20	+43.05	35.85	27.08	652	28.5
5	832-1,095	4/745	+5.60	+43.13	37.53	19.85	673	28.5
6	832-1,147	1,024	+7.37	+42.19	34.82	29.92	680	28.5
7	832-1,199	1,026	+7.15	+43.09	35.94	28.54	720	28.5
8	832-1,251	1,035	+7.00	+42.88	35.88	28.84	712	28.5
9	832-1,302	1,011	+6.84	+42.60	35.76	28.27	732	28.5
10	832-1,352	1,013	+7.40	+43.04	35.64	28.42	736	28.5

1/ Discharge determined with Hoff meter from full 10-inch pipe.
2/ Duration of flow, 1 hour; duration of recovery, 1 hour.
3/ Water levels determined by direct readings.
4/ Mud ball restricted flow during test.



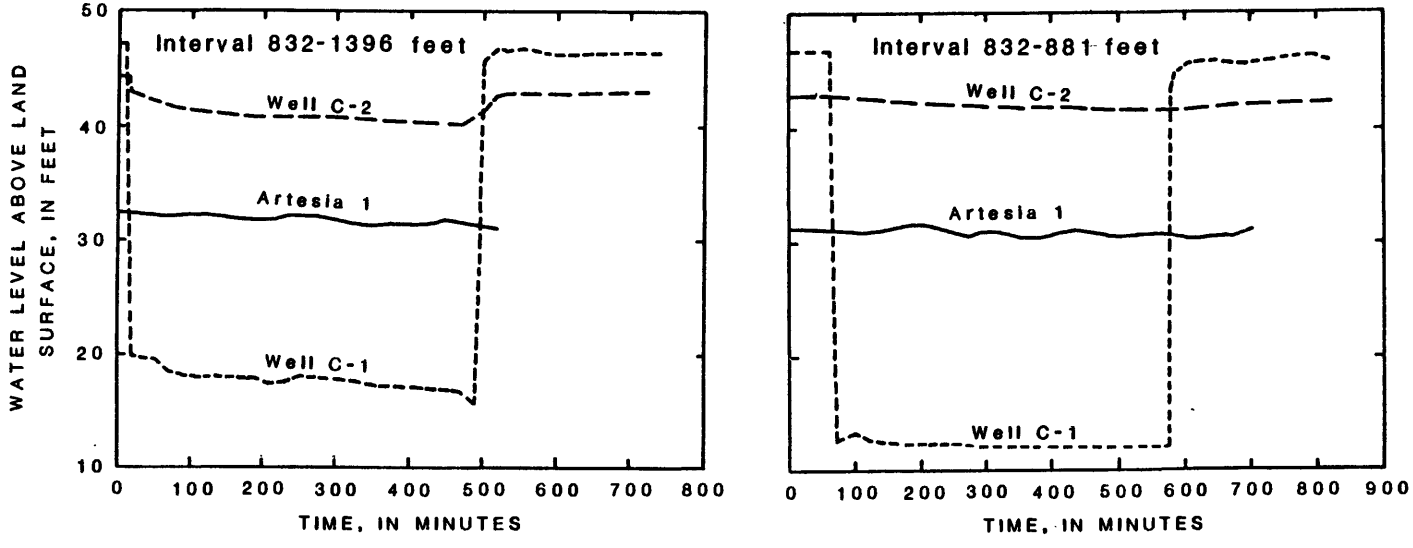


Drawdown test, well C-1

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot]

Well number	Interval (ft)	Average discharge (gal/min) 1/2/	Water level, static (ft) 3/	Water level, end flow (ft) 3/	Drawdown (ft)	Specific capacity [(gal/min)/ft]
C-1	832-1,396	1,978	+47.10	+16.86	30.24	65.41
C-2	1,072-1,150	--	+44.28	+40.06	4.22	--
Artesia no. 1	863- 977	--	+32.34	4/+32.11	5/.23	--
C-1	832- 881	1,960	+46.60	+12.01	34.59	56.66
C-2	1,072-1,150	--	+42.83	+41.56	1.27	--
Artesia no. 1	863- 977	--	+31.07	+30.49	5/.58	--

1/ Discharge determined by manometer with 10-inch pipe X 8-inch orifice.
2/ Duration of flow of well C-1 was 8 hours; duration of recovery, 4 hours.
3/ Water levels determined by direct readings.
4/ Water levels determined by pressure transducer.
5/ Water-level fluctuations at Artesian #1 reflect water-level changes due to regional pumping. Typical daily water-level changes in this area are about ±0.5 ft.

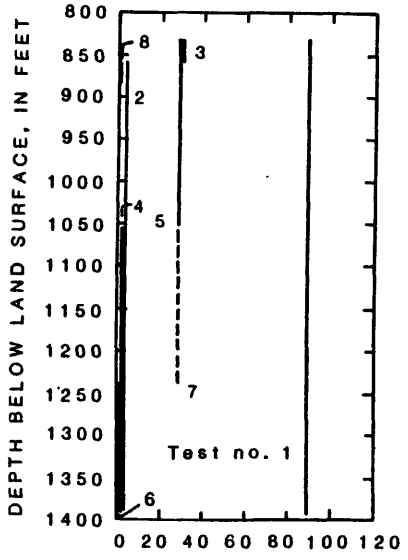


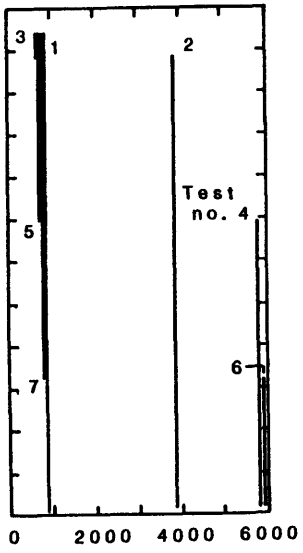
Interval flow tests, well C-1

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/	Water level, static (ft) 2/	Water level, flowing (ft) 2/	Water level, end flow (ft) 2/	Water level, recovery (ft) 2/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)
1	832-1,396	3/1,413	--	--	+29.04	+44.95	5.91	88.81	842
2	859-1,396	4/5/95	+44.38	+14.72	--	--	29 66	3.25	3,860
3	832- 859	4/1,128	+48.15	+12.12	--	--	36.03	31.30	772
4	1,056-1,396	4/5/76	+42.21	+15.39	--	--	26 82	2.83	5,860
5	832-1,056	6/1,147	+48.80	+11.12	--	--	37.68	30.44	784
6	1,240-1,396	4/5/27	+41.90	+11.20	--	--	30.70	.88	5,870
7	832-1,240	7/1,167	+48.52	+10.11	--	--	38.41	30.38	826
8	8/840- 881	5/9/42	--	--	9/+14.54	+46.66	32.12	76	--

1/ Discharge determined by manometer with 10-inch pipe X 8-inch orifice.
2/ Water levels determined by direct readings.
3/ Duration of flow, 6 hours; duration of recovery, 2 hours.
4/ Duration of flow, 4 hours; duration of recovery, 2 hours.
5/ Discharge determined by manometer with 4-inch pipe X 2-inch orifice.
6/ Duration of flow, 3 hours; duration of recovery, 1 hour.
7/ Duration of flow, 2 hours; duration of recovery, 1 hour.
8/ Completed monitor well.
9/ End of 1 hour flow.





Water-quality data, well C-1

[ft, feet; °C, degree Celsius; µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter]

Date	Depth to top of water-bearing zone (ft)	Depth to bottom of water-bearing zone (ft)	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Alkalinity, wh wat total field (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Specific conductance lab (µS/cm)
Nov. 1985																
18...	832	885	28.5	712	7.00	199	80	24	27	2.7	48	87	0.8	13	400	691
19...	832	938	28.5	696	6.90	198	82	25	28	2.8	50	92	0.8	13	410	705
19...	832	991	28.5	672	6.80	198	79	24	26	2.7	48	86	0.7	13	400	683
20...	832	1040	28.5	652	6.80	200	80	24	25	2.5	45	77	0.7	13	390	674
20...	832	1100	28.5	673	6.90	198	78	23	25	2.6	42	80	0.7	13	380	670
21...	832	1150	28.5	680	7.10	197	79	23	25	2.5	44	80	0.7	13	390	666
21...	832	1200	28.5	720	6.90	197	81	25	28	2.8	49	93	0.7	13	410	706
22...	832	1250	28.5	7120	7.20	197	83	25	30	2.8	51	97	0.8	13	420	725
22...	832	1300	28.5	732	7.10	199	82	26	31	3.1	54	110	0.8	13	440	746
23...	832	1360	28.5	736	7.20	199	83	26	33	3.2	56	110	0.8	13	440	757
27...	832	1400	28.5	842	7.10	197	90	29	38	3.4	66	130	0.9	14	490	829
Dec.																
02...	859	1396	29.0	3860	6.60	220	390	170	340	21	650	1200	2.3	16	2900	4180
02...	832	859	28.5	772	6.80	187	87	28	35	3.4	60	130	0.9	14	470	793
03...	1056	1396	29.0	5860	6.70	246	560	250	540	29	1100	1800	2.7	17	4400	5760
03...	832	1056	28.5	784	6.90	197	88	28	35	3.3	59	120	0.9	14	470	790
04...	1240	1396	29.0	5870	6.50	246	560	250	550	31	1100	1900	2.8	17	4600	5790
04...	832	1240	--	826	7.00	197	87	27	35	3.2	61	120	0.9	14	470	794
Mar. 1986																
13...	840	881	28.5	769	6.90	195	81	25	31	3.2	52	120	0.9	13	440	754
July																
15...	840	881	--	740	--	199	80	20	--	--	51	110	--	--	--	714
Aug.																
15...	840	881	--	682	--	209	78	25	--	--	52	110	--	--	--	762
Sept.																
18...	840	881	--	668	--	205	79	21	--	--	50	120	--	--	--	713

Well summary, well C-2

AY-68-37-525

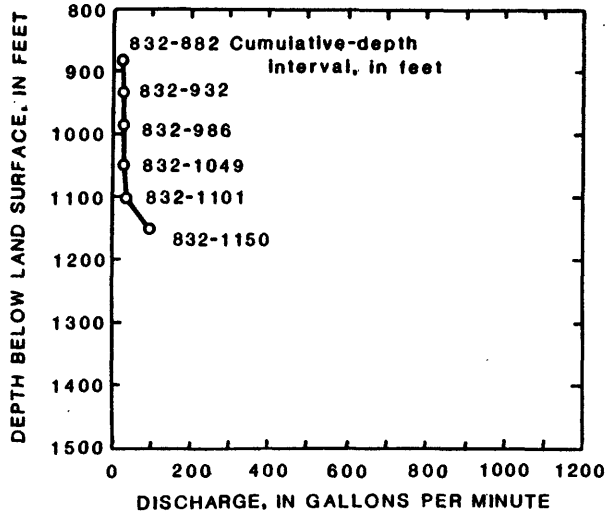
Owner:	San Antonio City Water Board
Drilling started:	12-12-85
Well completed:	1-22-86
Location:	350 Coliseum Road, Willow Springs Golf Course, San Antonio, Texas
Altitude of land surface:	624 feet above sea level
Total test depth:	1,150 feet
Casing depth:	9-5/8 inch casing to 832 feet 2-3/8 inch casing to 1,089 feet
Depth to formation tops:	Navarro Group and Taylor Marl, undivided------ surface Anacacho Limestone---------- 404 feet Austin Group---------- 550 feet Eagle Ford Group---------- 668 feet Buda Limestone---------- 700 feet Del Rio Clay---------- 756 feet Georgetown Limestone-------- 820 feet Edwards Group (Rose, 1972)-- 841 feet
Geophysical logs:	Natural gamma Caliper Spontaneous potential Resistivity
Borehole surveys:	None
Flow tests:	Cumulative-depth Interval
Monitored depth interval:	1,072-1,150 feet - Gravel pack 1,089-1,140 feet - Screen
Water-quality data:	Field measurements and selected inorganic constituents

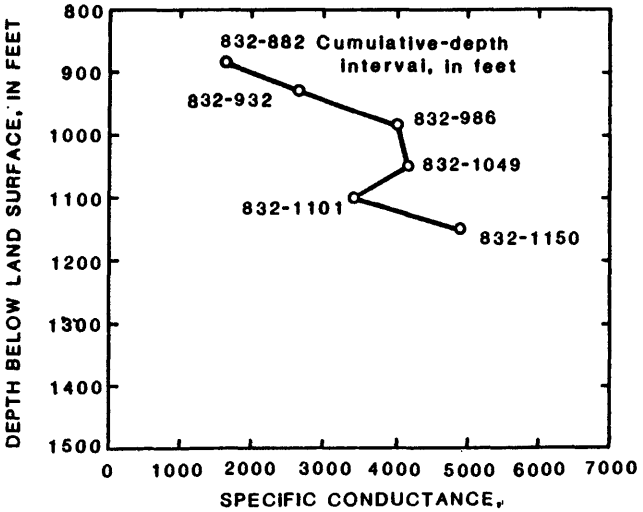
Cumulative-depth flow tests, well C-2

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/2/	Water level, flowing (ft) 3/	Water level, recovery (ft) 3/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)	Temperature (°C)
1	832- 882	23.8	+3.18	+46.70	43.52	0.55	4/1,636	--
2	832- 932	26.9	+3.20	+45.86	42.66	.63	2,650	--
3	832- 986	28.10	+3.22	+46.40	43.18	.65	4,000	--
4	832-1,049	30.60	+3.24	+46.91	43.67	.70	4,150	--
5	832-1,101	37.40	+3.24	+47.09	43.85	.85	3,410	--
5/6	832-1,150	6/96.00	+3.71	+45.88	42.17	2.28	4,880	30.0

1/ Discharge determined volumetrically.
2/ Duration of flow, 1 hour; duration of recovery, 1 hour.
3/ Water levels determined by direct readings.
4/ Water quality was affected by the addition of city water used in drilling, since the aquifer was not producing enough water to keep circulation going.
5/ Drill column not in hole during test.
6/ Duration of flow, 1 hour, 25 minutes; duration of recovery, 1 hour.





Interval flow tests, well C-2

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot, µS/cm, microsiemens per centimeter at 25° Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/2/	Water level, static (ft) 3/	Water level, flowing (ft) 3/	Water level, end flow (ft) 3/	Water level, recovery (ft) 3/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)
1	1,049-1,150	40	+46.37	+22.94	--	--	23.16	1.73	5,740
2	4/ 1,072-1,150	28.1	--	--	5/ +16.25	+46 16	29.91	.95	--

1/ Discharge determined by manometer with 4-inch pipe X 2-inch orifice.
2/ Duration of flow, 4 hours; duration of recovery, 2 hours.
3/ Water levels determined by direct readings.
4/ Completed monitor well.
5/ End of 1 hour flow.

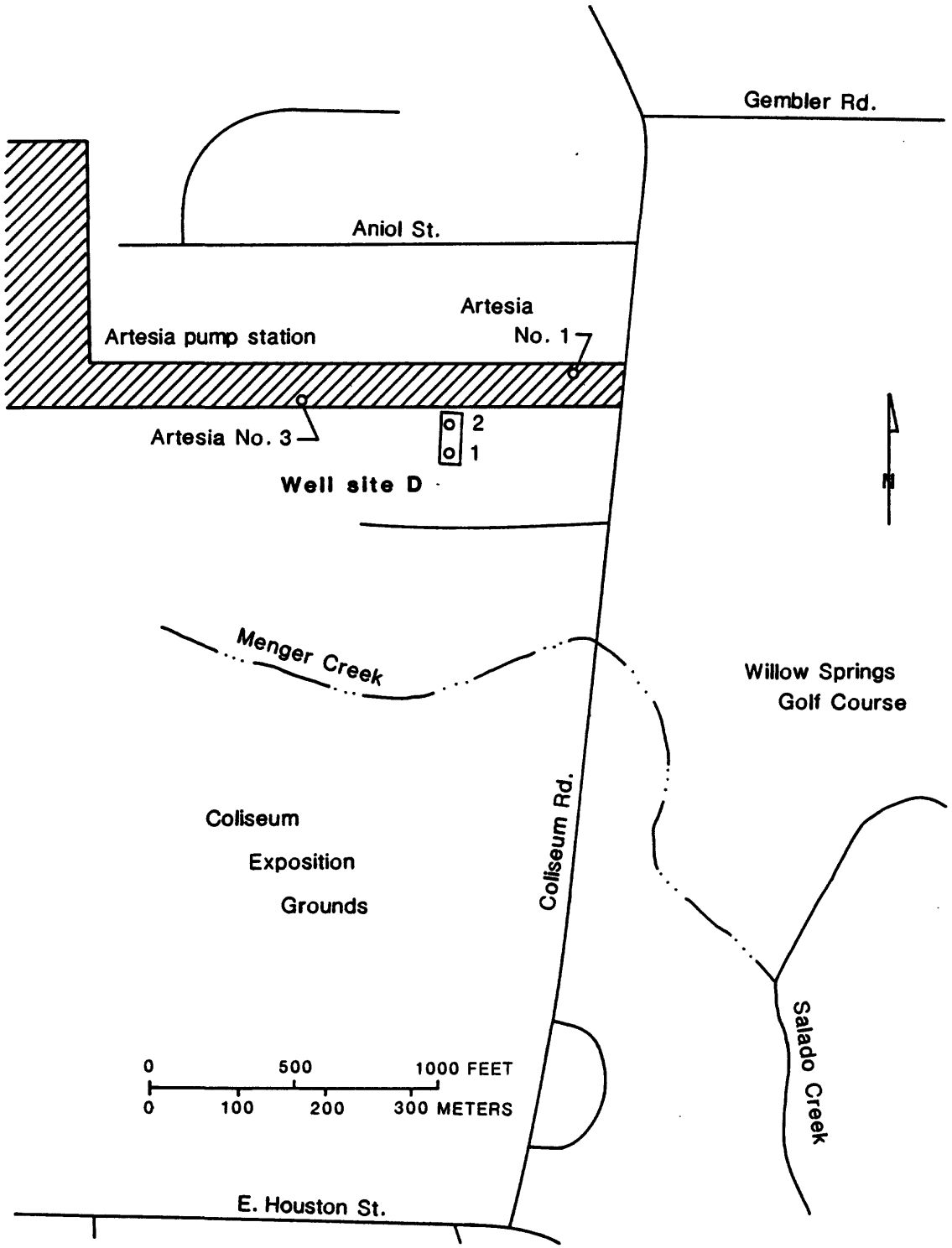
Water-quality data, well C-2

[ft, feet; °C, degree Celsius; µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter]

Date	Depth to top of water-bearing zone (ft)	Depth to bottom of water-bearing zone (ft)	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Alkalinity, wh wat total field (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Specific conductance lab (µS/cm)
March 1986																
13...	1072	1150	30.0	5940	6.60	250	590	250	600	29	1000	1900	2.9	19	4500	5710
July																
15...	1072	1150	--	6000	--	243	510	220	--	--	1000	1900	--	--	--	5660
Sept.																
18...	1072	1150	--	5730	--	259	510	220	--	--	1100	1900	--	--	--	5660

HYDROGEOLOGIC DATA

Site D

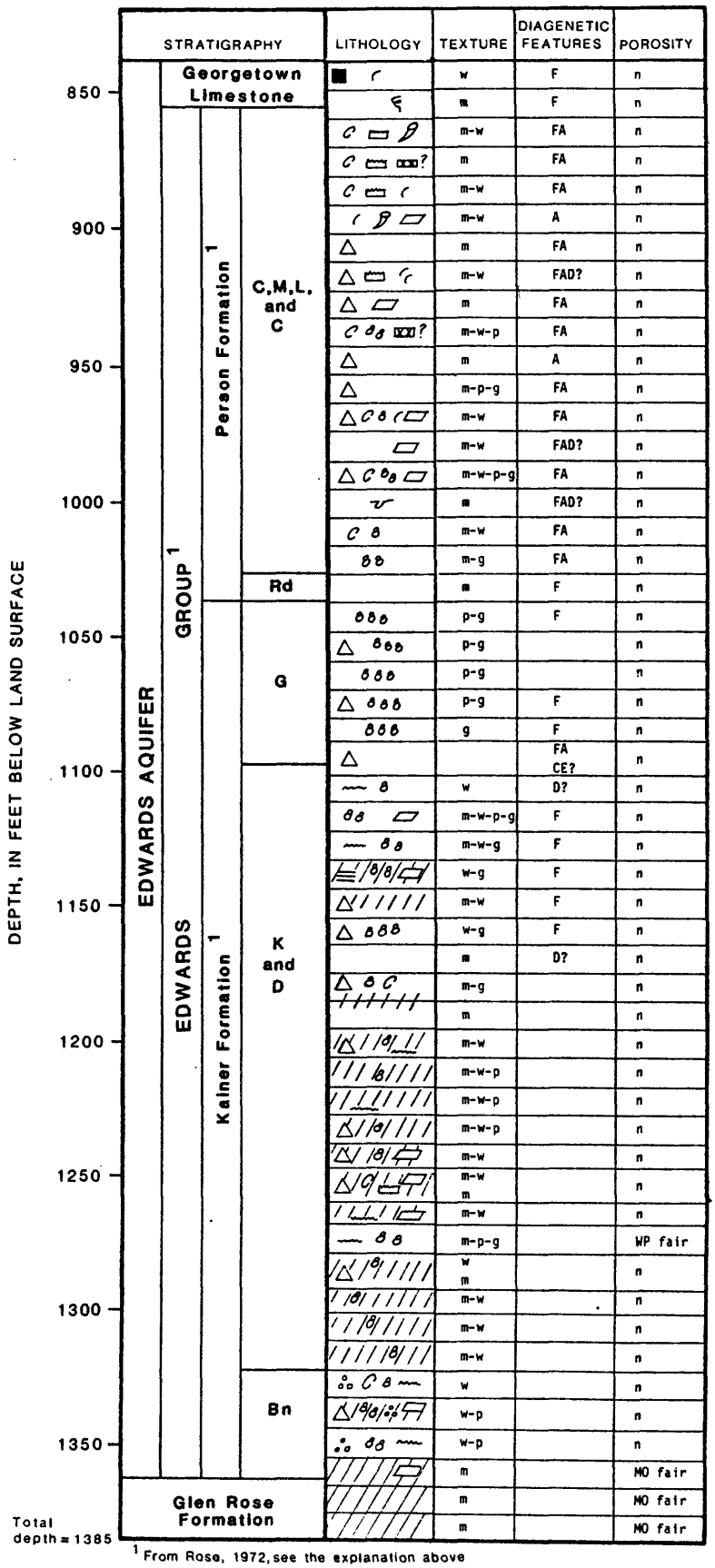


Location map of well site D

Well summary, well D-1

AY-68-37-526

Owner:	San Antonio City Water Board
Drilling started:	2-17-86
Well completed:	4-16-86
Location:	339 Coliseum Road, San Antonio, Texas (adjacent to Artesia pump station)
Altitude of land surface:	641 feet above sea level
Total test depth:	1,385 ft
Casing depth:	9-5/8 inch casing to 854 feet 2-3/8 inch casing to 1,156 feet
Depth to formation tops:	Navarro Group and Taylor Marl, undivided------ surface Anacacho Limestone---------- 440 feet Austin Group---------- 580 feet Eagle Ford Group---------- 710 feet Buda Limestone---------- 742 feet Del Rio Clay---------- 798 feet Georgetown Limestone-------- 844 feet Edwards Group (Rose, 1972)-- 856 feet Glen Rose Formation--------- 1,362 feet
Geophysical logs:	Natural gamma Caliper Spontaneous potential Resistivity Focused resistivity Acoustic velocity
Borehole surveys:	Spinner survey Fluid temperature Fluid resistivity Continuous acoustic televiewer Downhole television survey
Flow tests:	Cumulative-depth Drawdown test Interval
Monitored depth interval:	1,148-1,223 feet - Gravel pack 1,156-1,209 feet - Screen
Water-quality data:	Field measurements and selected inorganic constituents



EXPLANATION

STRATIGRAPHY

Members from Rose, 1972 (see fig. 2)

C, M, L, and C = cyclic, marine, leached, and collapsed members, undivided

Rd = regional dense member

G = grainstone member

K and D = Kirschberg evaporite and dolomitic member, undivided

Bn = basal nodular member

LITHOLOGY

Fossil allochems

- miliolid foraminifera
- caprinid rudistid
- Toucasia rudistid
- gastropod
- other mollusc fragments

Mineral constituents

- dolomitic (otherwise calcitic)
- chert
- pyrite
- single crystal calcite or aggregate
- calcite crystal druse
- celestite?
- pyrite replaced allochems, "BRBs" - black rotund bodies

Sedimentary structures

- pressure solution boundaries and/or clay seams
- algal laminations
- burrow

Tectonic structures

- filled microfracture

TEXTURES

m = mudstone
w = wackestone
p = packstone
g = grainstone
(Dunham, 1962)

DIAGENETIC FEATURES

F = iron stains
A = altered (associated with late freshwater diagenesis)
D? = dedolomite?
CE? = calcitized evaporites

POROSITY

BP = interparticle
WP = intraparticle
BC = intercrystal
MO = moldic
(Choquette and Pray, 1970)
n = negligible
poor, fair, and good are qualitative modifiers

NOTE: Cuttings collected at approximately 10-foot intervals.

General descriptions of drill cuttings, well D-1

Munsell (1967) color chart notation: Hue value/chroma (example, 10YR 7/1)
[ft, feet; mm, millimeter, cm, centimeter]

Depth (ft)	
842-852	LIMESTONE: WACKESTONE -10YR 6/1 -mollusc fragments present -disseminated pyrite common -10 percent of cuttings are iron-stained and altered
852-862	LIMESTONE: MUDSTONE -10YR 8/1 -dense -iron stains present -calcite replaced gastropods rare -calcite replaced fine- to medium-grained unidentifiable fossil allochems rare -porosity negligible
862-874	LIMESTONE - ALTERED LIMESTONE[1/]: MUDSTONE - WACKESTONE -10YR 8/2 -Toucasia fragments present -internal cast of caprinid rudist noted -sparry calcite areas common - replaced allochems -calcite druses common -iron stains common -recrystallized limestone present -porosity negligible
874-884	LIMESTONE - ALTERED LIMESTONE: MUDSTONE -10YR 8/2 -Toucasia fragments rare -calcite druses common -iron stains common -recrystallized limestone present -tabular crystal aggregates (length, 1 cm) - calcite - this crystal habit not observed before -porosity negligible
884-894	LIMESTONE - ALTERED LIMESTONE: MUDSTONE - WACKESTONE -10YR 8/2; 8/4 Ls: wackestone (50 percent) -dense, not as altered as mudstone -Toucasia and mollusc fragments rare -porosity negligible Ls: mudstone (50 percent) -yellow tinged (from oxidized iron) -calcite crystal aggregates present -chalcedony, some botryoidal, present; probable source is fossil allochems that were replaced by chalcedony (microcrystalline quartz) -recrystallization apparent -porosity negligible
894-905	LIMESTONE - ALTERED LIMESTONE: MUDSTONE - WACKESTONE -10YR 8/2 -mollusc fragments present -caprinid rudistid fragments rare -calcite crystal aggregates present -chalcedony, some botryoidal, present -note that cuttings are only coarse sand size

1/ Altered limestone is here defined as alteration due to late freshwater diagenesis. Examination of petrographic thin sections of rock cuttings is necessary to further positively identify, for example, recrystallized limestone or dedolomite.

General descriptions of drill cuttings, well D-1--Continued

Depth (ft)	
905-915	ALTERED LIMESTONE: MUDSTONE -leached appearance -recrystallized -iron stains present -brown-gray chert present -porosity negligible
915-925	LIMESTONE - ALTERED LIMESTONE - DEDOLOMITE -10YR 7/1 Ls - Altered ls: mudstone - wackestone (90 percent) -dense -white mollusc fragments present (Chondrodonta?) -iron stains common -porosity negligible Dedolomite(?) (10 percent) -sucrosic dolomite texture, but reacts profusely with hydrochloric acid -porosity negligible Dark brown chert common Calcite crystal aggregates present
925-937	LIMESTONE - ALTERED LIMESTONE: MUDSTONE -10YR 7/1: 7/4 Ls: mudstone (70 percent) -dense micrite -miliolid foraminifera rare -porosity negligible Altered limestone (30 percent) -iron stains common -leached appearance Calcite crystal aggregates and parts of single crystals present Botryoidal chalcedony rare Brown chert rare (from uphole?)
937-947	LIMESTONE - ALTERED LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE Ls - Altered ls: wackestone - packstone (60 percent) -leached -miliolid foraminifera present to common -calcite cemented packstone -iron stains present -porosity negligible Ls - Altered ls: mudstone (40 percent) -dense micrite -observed part of a caprinid rudistid micrite cast -Toucasia fragments rare -iron stains present Observed single cutting of celestite(?) crystal aggregate
947-957	LIMESTONE - ALTERED LIMESTONE: MUDSTONE -10YR 7/1 -dense micrite -probable recrystallization -light brown chert rare -porosity negligible

General descriptions of drill cuttings, well D-1--Continued

Depth (ft)	
957-968	LIMESTONE - ALTERED LIMESTONE: MUDSTONE - PACKSTONE - GRAINSTONE -10YR 7/1 Ls: mudstone (90 percent) -dense -some cuttings have chalky appearance -iron stains present -porosity negligible Ls: packstone - grainstone (10 percent) -calcite cemented -iron stains present -porosity negligible Light gray-brown chert present
968-978	LIMESTONE - ALTERED LIMESTONE: MUDSTONE - WACKESTONE -10YR 8/2 -some cuttings have leached appearance -Toucasia fragments present to rare -miliolid foraminifera present to rare -dense micrite cuttings present -single calcite crystal pieces and aggregates rare -observed mollusc shell fragment partially replaced by chalcedony -iron stains present -dark gray chert rare -porosity negligible
978-988	LIMESTONE - ALTERED LIMESTONE - DEDOLOMITE(?): MUDSTONE - WACKESTONE -10YR 8/1 -dense micrite cuttings present -a few large cuttings which have altered sucrosic texture with sparry areas - probable dedolomite -dark, ferrous precipitate present on severely altered cuttings -calcite crystals present; noted large aggregates of etched calcite crystals coated with iron oxide precipitate
988-1,000	LIMESTONE - ALTERED LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE - GRAINSTONE Ls - Altered ls: mudstone - wackestone (90 percent) -Toucasia fragments rare -iron-stained highly altered limestone cuttings common with iron oxide precipitates Ls: packstone - grainstone (10 percent) -miliolid foraminifera common to abundant -calcite cemented -porosity negligible -calcite crystal aggregates and pieces of single crystals present -light brown - gray chert present
1,000-1,010	LIMESTONE - ALTERED LIMESTONE - DEDOLOMITE(?): MUDSTONE Ls: mudstone (50 percent) -10YR 7/1 -dense -porosity negligible Altered ls - Dedolomite(?) (50 percent) -iron-stained yellowish -recrystallization common -possible dedolomite -observed large cutting which exhibits leaching of preferentially dolomitized burrow infill; burrow infill is altered and yellow tinged

General descriptions of drill cuttings, well D-1--Continued

Depth (ft)	
1,010-1,020	LIMESTONE - ALTERED LIMESTONE: MUDSTONE - WACKESTONE -10YR 8/1 Ls: mudstone - wackestone (80 percent) -dense -Toucasia fragments rare to present -miliolid foraminifera present -porosity negligible Altered ls (20 percent) -iron-stained yellow -iron oxide precipitate present -sparry calcite areas -porosity negligible
1,020-1,031	LIMESTONE - ALTERED LIMESTONE: MUDSTONE - GRAINSTONE -10YR 8/1 -miliolid foraminifera rare to common -calcite cemented grainstone -iron stains present -porosity negligible
1,031-1,041	LIMESTONE: MUDSTONE -regional dense member -10YR 7/3 -dense -iron stain tinge common -slightly argillaceous -porosity negligible
1,041-1,051	LIMESTONE: PACKSTONE - GRAINSTONE -grainstone member -10YR 8/1 -calcite cemented -miliolid foraminifera common to abundant -iron stains present -porosity negligible
1,050-1,063	LIMESTONE: PACKSTONE - GRAINSTONE -same as 1,041-1,051 ft -light brown chert rare
1,063-1,073	LIMESTONE: PACKSTONE - GRAINSTONE -10YR 8/1 -calcite cemented -miliolid foraminifera abundant; other larger "miliolid like" foraminifera also present -porosity negligible
1,073-1,083	LIMESTONE: PACKSTONE - GRAINSTONE -10YR 8/1 -calcite cemented -miliolid foraminifera common to abundant -mollusc fragments rare -iron stains rare -light gray chert rare -porosity negligible

General descriptions of drill cuttings, well D-1--Continued

Depth (ft)	
1,083-1,094	LIMESTONE: PACKSTONE - GRAINSTONE -10YR 8/1 -miliolid foraminifera common to abundant -calcite cemented -few dense micrite cuttings observed -iron stains common to present -porosity negligible
1,094-1,104	CALCITIZED EVAPORITES? -10YR 8/4 -iron tinged yellow -sparry calcite cuttings with rare micrite matrix -uphole gray chert present -see photographs of brecciated evaporite in which evaporites have been replaced by coarsely crystalline calcitic spar in core from TD-69-39-504 (Medina Co.), as reported by Mench-Ellis (1985, p. 251, 253)
1,104-1,114	LIMESTONE - DEDOLOMITE - CALCITIZED EVAPORITES: WACKESTONE -10YR 7/1 Dedolomite(?) (45 percent) -sucrosic texture -reacts profusely with hydrochloric acid -pressure solution boundaries and/or clay seams present Ls: wackestone (45 percent) -miliolid foraminifera common -porosity negligible Calcitized evaporites(?) (10 percent) -same as 1,094-1,104 ft
1,114-1,126	LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE - GRAINSTONE -10YR 8/1 -calcite cemented miliolid, fossil fragment grainstone with negligible porosity -miliolid foraminifera present to common in other textures -iron stains present -calcite crystals present; doubly terminated scalenohedron noted; twinned scalenohedra noted - these samples kept separate -porosity negligible
1,126-1,136	LIMESTONE: MUDSTONE - GRAINSTONE Ls: mudstone - grainstone (40 percent) -10YR 8/1 -dense micrite -minor amount of calcite cemented miliolid grainstone -iron stains present -porosity negligible Ls: mudstone - wackstone (60 percent) -10YR 6/1 -may be dolomitic -miliolid foraminifera and mollusc fragments rare -pressure solution boundary and/or clay seams present -porosity negligible

General descriptions of drill cuttings, well D-1--Continued

Depth (ft)	
1,136-1,146	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE - GRAINSTONE Dolomitic ls: mudstone (90 percent) -10YR 7/1 -sucrosic texture -calcite - blocky spar present -single cutting with probable algal laminations -possible celestite(?) rare -porosity not interconnected -micropores common Ls: wackestone - grainstone (10 percent) -10YR 8/1 -calcite cemented miliolid grainstone -iron stains present -porosity negligible
1,146-1,157	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -Note - majority of cuttings are very fine and difficult to examine -dolomitic limestone with sucrosic texture -limestone - miliolid foraminifera present and minor amount of calcite cemented miliolid grainstone -iron stains present in limestone cuttings -celestite(?) rare -brown chert present
1,157-1,167	LIMESTONE - DOLOMITIC LIMESTONE: WACKESTONE - GRAINSTONE -10YR 8/2 -Note - majority of cuttings are very fine and difficult to examine Ls: wackestone - grainstone (90 percent) -calcite cemented miliolid grainstone -Toucasia fragments present to rare -porosity negligible Dolomitic ls: mudstone (10 percent) -sucrosic texture -iron stains present -dark brown chert common
1,167-1,177	DOLOMITIC LIMESTONE - DEDOLOMITE(?): MUDSTONE -10YR 7/1 Dedolomite? (80 percent) -altered grainstone - moldic porosity resulting from dissolved miliolid foraminifera in matrix with remnant sucrosic texture -poorly interconnected moldic porosity Dolomitic ls: mudstone (20 percent) -sucrosic texture -porosity negligible Noted few iron-stained limestone cuttings - uphole?
1,177-1,189	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - GRAINSTONE Ls: mudstone - grainstone (90 percent) -miliolid grainstone has leached appearance -Toucasia fragments present -predominantly mudstone Dolomitic ls: mudstone (10 percent) -sucrosic texture -porosity negligible Dark brown chert common

General descriptions of drill cuttings, well D-1--Continued

Depth (ft)	
1,189-1,199	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE -10YR 7/2 Ls: mudstone (60 percent) -dense -slightly argillaceous micrite -porosity negligible Dolomitic ls: mudstone (40 percent) -sucrosic texture -porosity very poor
1,199-1,209	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -10YR 6/2 -pressure solution boundaries and/or clay seams present -miliolid foraminifera present to rare -dark brown chert common -porosity negligible
1,209-1,220	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE -Note - cuttings are powdery and difficult to examine -10YR 7/1 -miliolid foraminifera common to present -unidentified fossil fragments present -porosity poor to negligible
1,220-1,230	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE -Note - cuttings powdery and difficult to examine -10YR 7/1 -dense calcitic mudstone -slightly dolomitic miliolid, fossil fragment wackestone - packstone -pressure solution boundaries and/or clay seams rare -porosity poor to negligible
1,230-1,240	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE - PACKSTONE -Note - cuttings are powdery and difficult to examine -10YR 7/1 -predominantly mudstone - wackestone -miliolid foraminifera present -dark brown chert present -porosity negligible
1,240-1,251	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -Note - cuttings are powdery -10YR 7/1 -miliolid foraminifera present -iron stains present associated with calcite crystal aggregates -dark brown gray chert present -porosity negligible
1,251-1,261	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE Dolomitic ls: mudstone (80 percent) -10YR 6/3 -sucrosic texture -calcite crystal aggregates and druses present -dark brown-black chert present -porosity poor Ls: wackestone (20 percent) -10YR 8/1 -Toucasia fragments present -sparry areas common - calcite replaced fossil fragments -porosity negligible

General descriptions of drill cuttings, well D-1--Continued

Depth (ft)	
1,261-1,271	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/1 -miliolid foraminifera present -calcite crystal aggregates present; penetration twins noted -pressure solution boundaries and/or clay seams present -porosity negligible
1,271-1,281	LIMESTONE: MUDSTONE AND PACKSTONE - GRAINSTONE -10YR 7/1 -pressure solution boundaries and/or clay seams present -miliolid, fossil fragment grainstone has fair intraparticle porosity
1,281-1,291	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -Note - cuttings are powdery and difficult to examine Ls: wackestone (60 percent) -10YR 7/1 -miliolid foraminifera present -porosity negligible Dolomitic ls: mudstone (40 percent) -sucrosic texture -celestite(?) Brown chert rare
1,291-1,301	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -Note - cuttings are powdery and sand size; difficult to examine; probable "contaminated" sample -iron stained, sand size cuttings common -coarse sand size calcite crystal pieces common -calcite cemented grainstone present -brown chert present
1,301-1,312	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -Note - cuttings are powdery and difficult to examine; probable "contaminated" sample -iron stained, sand size cuttings common -coarse sand size calcite crystal pieces common -calcite cemented grainstone present -brown chert present
1,301-1,312	LIMESTONE - DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -Note - cuttings are powdery and difficult to examine -10YR 7/1 -miliolid foraminifera present -some cuttings have dolomitic sucrosic texture -porosity negligible
1,312-1,322	LIMESTONE DOLOMITIC LIMESTONE: MUDSTONE - WACKESTONE -10YR 7/1 -same as 1,301-1,312 ft
1,322-1,332	LIMESTONE: WACKESTONE -10YR 7/1 -miliolid foraminifera present to common -mollusc fragments present -BRB's ("black rotund bodies") common - probable pyrite replaced fossil allochems and fecal pellets; refer to Mench-Ellis (1985, p. 152) for extensive explanation of pyrite in the basal nodular member -pressure solution boundaries and/or clay seams common -porosity negligible

General descriptions of drill cuttings, well D-1--Continued

Depth (ft)	
1,332-1,344	LIMESTONE - DOLOMITIC LIMESTONE: WACKESTONE - PACKSTONE -miliolid foraminifera common -BRB's present to common -large mudstone cutting with fine pyrite crystals observed -few calcite crystals observed -light gray chert common -porosity negligible
1,344-1,354	LIMESTONE - DOLOMITIC LIMESTONE: WACKESTONE - PACKSTONE -miliolid foraminifera common to present -BRB's common to present -pressure solution boundaries and/or clay seams present -porosity negligible
1,354-1,364	DOLOMITIC LIMESTONE: MUDSTONE -10YR 7/1 Dolomitic ls: mudstone (50 percent) -sucrosic texture -moldic porosity (after foraminifera) fair Dolomitic ls: mudstone (50 percent) -dense -very fine sucrosic texture -porosity negligible Calcite crystals present
1,364-1,375	DOLOMITIC LIMESTONE: MUDSTONE -same as 1,354-1,364 ft
1,375-1,385	DOLOMITIC LIMESTONE: MUDSTONE -10YR 6/1 -sucrosic texture -variation in percent of moldic porosity

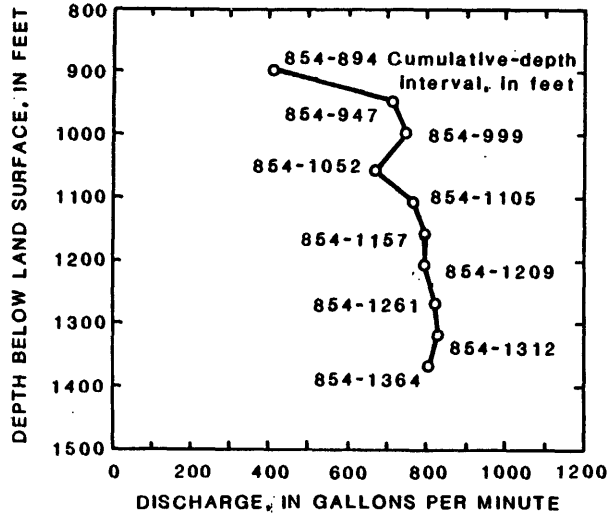
page 81 follows

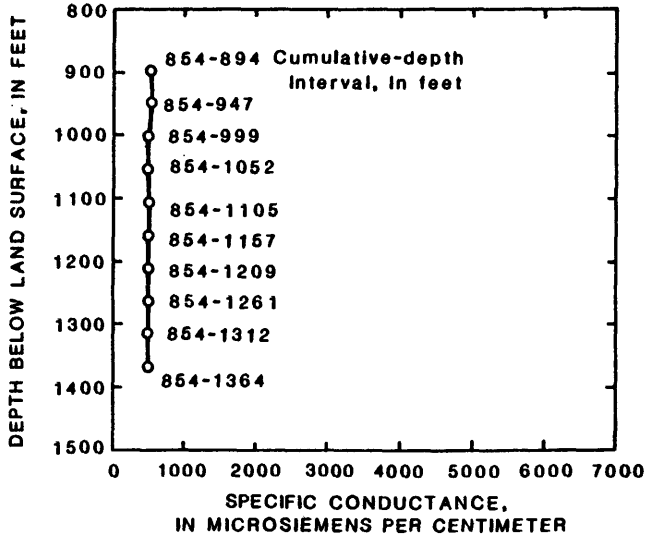
Cumulative-depth flow tests, well D-1

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µs/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/2/	Water level, flowing (ft) 3/	Water level, recovery (ft) 3/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)	Temperature (°C)
1	854- 894	4/5/412	17.04	25.58	8.54	48.24	511	25.0
2	854- 947	5/713	5.13	25.51	20.38	34.98	520	26.5
3	854- 999	748	6.68	25.23	18.55	40.32	480	26.5
4	854-1,052	6/671	6.11	25.12	19.01	38.82	475	26.5
5	854-1,105	768	6.06	24.49	18.43	41.67	495	26.5
6	854-1,157	797	5.06	24.92	19.86	40.13	482	26.5
7	854-1,209	797	5.26	24.33	19.07	41.79	495	26.5
8	854-1,261	825	4.40	24.59	20.19	40.86	495	26.5
9	854-1,312	833	4.19	24.53	20.34	41.20	482	26.5
10	854-1,364	809	4.16	23.61	19.45	41.59	490	26.5

1/ Discharge determined by manometer with 10-inch pipe X 8-inch orifice.
2/ Duration of flow, 1 hour; duration of recovery, 1 hour.
3/ Water levels determined by direct readings.
4/ Duration of flow, 1 hour; duration of recovery, 1 hour, 45 minutes.
5/ Discharge determined volumetrically.
6/ Duration of flow, 1 hour, 20 minutes; duration of recovery, 40 minutes.



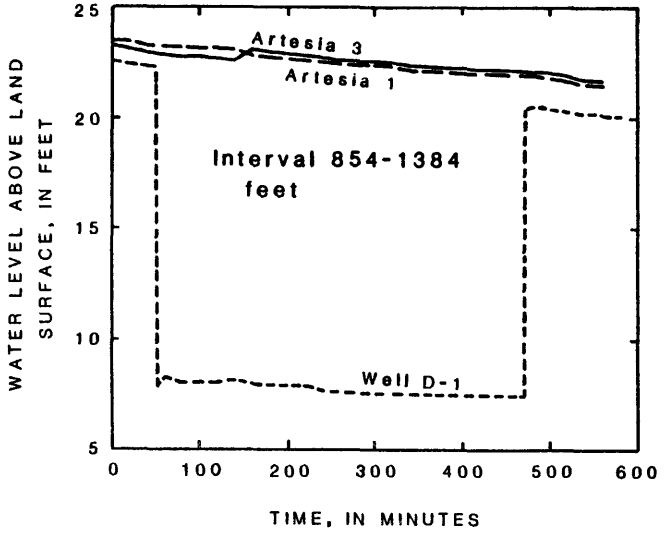


Drawdown test, well D-1

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius]

Well number	Interval (ft)	Average discharge (gal/min) 1/2/	Water level, static (ft) 3/	Water level, end flow (ft) 3/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)
D-1	854-1,384	1,335	4/+22.27	4/+7.43	14.84	89.99	490
Artesia no. 1	863- 977	--	+23.25	+21.98	1.27	--	--
Artesia no. 3	860-1,108	--	+22.97	+22.04	.95	--	--

1/ Discharge determined by manometer with 10-inch pipe X 8-inch orifice.
2/ Duration of flow of well D-1 was 7 hours; duration of recovery, 2 hours, 30 minutes.
3/ Water levels determined by pressure transducer.
4/ Water levels determined by direct readings.

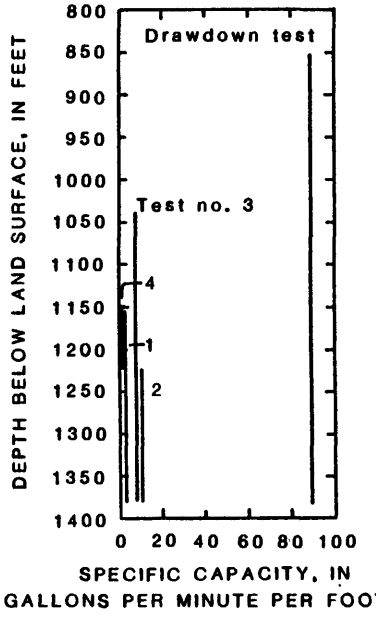


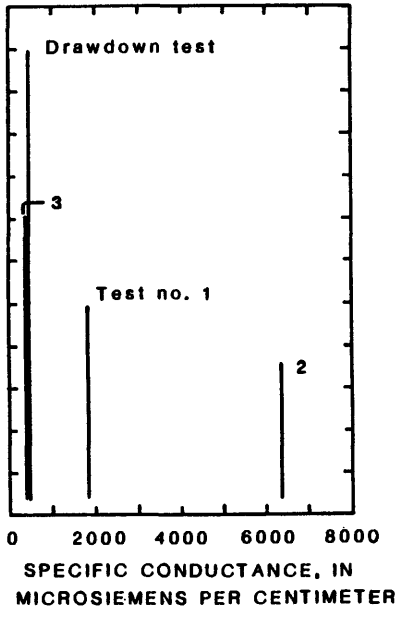
Interval flow tests, well D-1

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/	Water level, static (ft) 2/	Water level, flowing (ft) 2/	Water level, end flow (ft) 2/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)
1	1,158-1,384	3/32.4	+21.67	+12.19	--	9.48	3.42	1,862
2	1,225-1,384	4/114.0	+20.50	+10.44	--	10.06	11.33	6,380
3	1,040-1,384	5/64.0	+21.15	+13.20	--	7.95	8.05	474
4	6/1,148-1,223	7/8/7.56	+17.30	--	8/+14.53	2.77	2.73	--

1/ Discharge determined by manometer with 4-inch pipe X 2-inch orifice.
2/ Water levels determined by direct readings.
3/ Duration of flow, 7 hours; duration of recovery, 1 hour.
4/ Duration of flow, 8 hours, 40 minutes; duration of recovery, 1 hour.
5/ Duration of flow, 8 hours, 10 minutes; duration of recovery, 1 hour.
6/ Completed monitor well.
7/ Discharge determined volumetrically.
8/ End of 1 hour flow.





Water-quality data, well D-1

[ft, feet; °C, degree Celsius; µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter]

Date	Depth to top of water-bearing zone (ft)	Depth to bottom of water-bearing zone (ft)	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Alkalinity, wh wat total field (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (MG/L)	Specific conductance lab (µS/cm)
March 1986																
04...	854	894	25.0	511	6.90	197	63	17	10	1.4	16	23	0.3	12	260	485
05...	854	947	26.5	520	6.80	198	64	17	10	1.3	17	24	0.3	12	260	487
06...	854	999	26.5	--	6.80	--	64	17	10	1.3	16	27	0.3	12	--	453
07...	854	1052	26.5	475	6.90	200	65	17	10	1.3	17	17	0.3	12	260	471
12...	854	1105	26.5	495	6.80	198	64	17	10	1.3	17	17	0.3	11	260	455
14...	854	1157	26.5	482	6.80	--	64	17	10	1.3	17	16	0.3	12	--	488
17...	854	1209	26.5	495	6.90	192	64	17	10	1.3	17	24	0.3	12	260	489
18...	854	1261	26.5	495	6.70	190	64	17	10	1.2	17	23	0.3	11	260	490
19...	854	1364	26.5	482	6.90	198	63	16	9.7	1.2	16	18	0.3	11	250	472
24...	854	1384	26.5	490	7.00	188	63	16	9.8	1.3	17	23	0.4	11	250	491
25...	1158	1384	26.5	1862	6.90	204	170	69	120	7.8	220	470	1.2	13	1200	1950
26...	1225	1384	--	6380	--	255	630	280	600	33	1100	2000	3.3	20	4800	6310
27...	1040	1384	26.5	474	6.90	198	64	16	9.9	1.2	17	16	0.3	12	260	487
July																
18...	1148	1223	--	1040	--	206	110	37	52	3.9	100	200	0.8	13	640	1010
Aug.																
15...	1148	1223	--	860	--	205	100	33	--	--	79	150	--	--	--	926
Sept.																
18...	1148	1223	--	881	--	202	97	35	--	--	99	190	--	--	--	976

Well summary, well-D-2

AY-68-37-527

Owner:	San Antonio City Water Board
Drilling started:	4-23-86
Well completed:	5-07-86
Location:	339 Coliseum Road, San Antonio, Texas (adjacent to Artesia pump station)
Altitude of land surface:	641 feet above sea level
Total test depth:	926 feet
Casing depth:	7-5/8 inch casing to 873 feet 2-3/8 inch casing to 874 feet
Depth to formation tops:	Navarro Group and Taylor Marl, undivided------ surface Anacacho Limestone---------- 444 feet Austin Group---------- 595 feet Eagle Ford Group---------- 715 feet Buda Limestone---------- 746 feet Del Rio Clay---------- 804 feet Georgetown Limestone-------- 864 feet Edwards Group (Rose, 1972)-- 875 feet
Geophysical logs:	Natural gamma Caliper Spontaneous potential Resistivity
Borehole surveys:	None
Flow tests:	Interval flow test
Monitored depth interval:	874-926 feet - Open hole
Water-quality data:	Field measurements and selected inorganic constituents

Interval flow test, well D-2

[ft, feet; gal/min, gallons per minute; (gal/min)/ft, gallons per minute per foot; µS/cm, microsiemens per centimeter at 25° Celsius]

Test number	Interval (ft)	Average discharge (gal/min) 1/	Water level, static (ft) 2/	Water level, end flow (ft) 2/	Drawdown (ft)	Specific capacity [(gal/min)/ft]	Specific conductance (µS/cm)
1	873-926	3/350.18	+13.20	+7.32	5.88	59.55	490

1/ Discharge determined by manometer with 6-inch pipe X 4-inch orifice.
2/ Water levels determined by direct readings.
3/ Duration of flow, 7 hours; duration of recovery, 1 hour.

Water-quality data, well D-2

[ft, feet; °C, degree Celsius; µS/cm, microsiemens per centimeter at 25° Celsius; mg/L, milligrams per liter]

Date	Depth to top of water-bearing zone (ft)	Depth to bottom of water-bearing zone (ft)	Temperature (°C)	Specific conductance (µS/cm)	pH (standard units)	Alkalinity, wh wat total field (mg/L as $CaCO_3$)	Calcium, dissolved (mg/L as Ca)	Magnesium, dissolved (mg/L as Mg)	Sodium, dissolved (mg/L as Na)	Potassium, dissolved (mg/L as K)	Chloride, dissolved (mg/L as Cl)	Sulfate, dissolved (mg/L as SO_4)	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, sum of constituents, dissolved (mg/L)	Specific conductance lab (µS/cm)
July 1986 18...	874	926	--	474	--	199	66	17	9.7	1.3	19	24	0.3	12	270	483
Aug. 15...	874	926	--	410	--	197	68	16	--	3.4	--	--	--	--	--	469
Sept. 18...	874	926	--	427	--	197	61	16	--	--	18	25	--	--	--	482

REFERENCES CITED

Choquette, P.W., and Pray, L.C., 1970, Geologic nomenclature and classification of porosity in sedimentary rocks: American Association of Petroleum Geologists Bulletin, v. 54, p. 207-250.

Dunham, R.J., 1962, Classification of carbonate rocks according to depositional texture, in Ham, W.E., ed., Classification of carbonate rocks: American Association of Petroleum Geologists Memoir 1, p. 108-121.

Holt, C.L.R., Jr., 1959, Geology and ground-water resources of Medina County, Texas: U.S. Geological Survey Water-Supply Paper 1422, 213 p.

MacCary, L.M., 1978, Interpretation of well logs in a carbonate aquifer: U.S. Geological Survey Water-Resources Investigations Report 78-88, 30 p.

Maclay, R.W., Land, L.F., and Woodward, D.G., 1985, Influence of barrier faults on ground-water flow in the Edwards aquifer, San Antonio region, Texas, in Proceedings of the Association of Ground Water Scientists and Engineers, Southern Regional Ground Water Conference, San Antonio, Texas, Sept. 18-19, 1985: Worthington, Ohio, National Water Well Association, p. 1-13.

Maclay, R.W., Rettman, P.L., and Small, T.A., 1980, Hydrochemical data for the Edwards aquifer in the San Antonio area, Texas: Texas Department of Water Resources LP-131, 38 p.

Maclay, R.W., and Small, T.A., 1976, Progress report on geology of the Edwards aquifer, San Antonio area, Texas, and preliminary interpretation of borehole geophysical and laboratory data on carbonate rocks: U.S. Geological Survey Open-File Report 76-627, 65 p.

----- 1983, Hydrostratigraphic subdivisions and fault barriers of the Edwards aquifer, south-central Texas, USA, in Back, W., and LaMoreaux, P.E., eds., V.T. Stringfield Symposium, Processes in Karst Hydrology: Journal of Hydrology, v. 61, p. 127-146.

----- 1984, Carbonate geology and hydrology of the Edwards aquifer in the San Antonio area, Texas: U.S. Geological Survey Open-File Report 83-537, 72 p.

Maclay, R.W., Small, T.A., and Rettman, P.L., 1981, Application and analysis of borehole data for the Edwards aquifer in the San Antonio area, Texas: Texas Department of Water Resources LP-139, 88 p.

Mench-Ellis, Patricia, 1985, Diagenesis of the Lower Cretaceous Edwards Group in the Balcones fault zone area, south-central Texas: Austin, University of Texas, unpub. Ph.D. dissertation, 326 p.

Munsell, A.H., 1967, A color notation--an illustrated system defining all colors and their relations by measured scales of hue, value, and chroma: Baltimore, Maryland, Munsell Color Co., Inc.

Pearson, F.J., Jr., 1973, The evaluation and application of C^{14} dating of ground water: Durham, North Carolina, Final report, Project CRDARD-L, P-5830-EN, U.S. Army Research Office, 70 p.

Pearson, F.J., Jr., and Rettman, P.L., 1976, Geochemical and isotopic analyses of waters associated with the Edwards Limestone aquifer, central Texas: Edwards Underground Water District report, 35 p.

Rose, P.R., 1972, Edwards Group, surface and subsurface, central Texas: Austin, University of Texas Bureau of Economic Geology, Report of Investigations 74, 198 p.

SUPPLEMENTAL INFORMATION

Table 5.--Field data for cumulative-depth flow tests

[ft, feet; gal/min; gallons per minute]

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Remarks
Well: AY-68-37-521 (A-1)			
Interval: 965-1,019 feet			
Test number: 1			
July 22, 1985			
1445	-	96	Start of flow. 3/
1500	-	96	
1515	-	96	
1527	-	96	
1535	-	96	
1545	-		End of flow, begin recovery.
1545:30	21.94		
1546	35.11		
1547	39.38		
1548	39.27		
1549	39.73		
1550	39.73		
1554	39.84		
1557	39.84		
1600	39.84		
1605	39.96		
1610	39.96		
1615	39.96		
1620	39.96		
1630	39.96		
1645	39.96		End of test.
Interval: 965-1,071 feet			
Test number: 2			
July 23, 1985			
2015	-	151	Start of flow. 3/
2030	-	151	
2035	-	151	
2045	-	151	
2100	-	151	
2107	-	151	
2110	-	151	
2115	-		End of flow, begin recovery.
2115:30	27.72		
2116	35.46		
2117	37.08		
2118	37.42		
2119	37.54		
2120	37.65		
2125	37.65		
2130	37.65		
2135	37.65		
2140	37.65		
2145	37.65		
2150	37.65		
2155	37.65		
2200	37.65		
2215	37.65		End of test.
Interval: 965-1,123 feet			
Test number: 3			
July 24, 1985			
1345	-	257	Start of flow. 3/
1400	-	257	
1415	-	257	
1430	-	257	
1440	-	257	
1445	-		End of flow, begin recovery.
1445:30	32.22		
1446	34.88		
1447	35.69		
1448	36.15		
1449	36.38		
1450	36.61		

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Remarks
Well: AY-68-37-521 (A-1)--Continued			
Test number: 3--Continued			
July 24, 1985--Continued			
1455	36.96		
1500	37.08		
1505	37.08		
1510	37.08		
1515	37.19		
1520	37.19		
1525	37.19		
1530	37.08		
1535	37.08		
1540	37.08		
1545	37.08		End of test.
Interval: 965-1,175 feet			
Test number: 4			
July 25, 1985			
0927	-	341	Start of flow. 3/
0942	-	341	
0957	-	341	
1012	-	341	
1022	-	341	
1027	-		End of flow, begin recovery.
1027:30	31.76		
1028	32.69		
1029	34.19		
1030	35.00		
1031	35.57		
1032	35.92		
1033	36.04		
1034	36.15		
1035	36.27		
1036	36.38		
1037	36.38		
1042	36.50		
1047	36.61		
1052	36.61		
1057	36.61		
1112	36.61		
1127	36.61		End of test.
Interval: 965-1,228 feet			
Test number: 5			
July 25, 1985			
1840	-	481	Start of flow. 3/
1855	-	481	
1910	-	481	
1925	-	481	
1935	-	481	
1939	3.46	481	
1940	-		End of flow, begin recovery.
1940:30	31.07		
1941	33.38		
1942	33.84		
1943	34.19		
1945	34.77		
1950	35.11		
1955	35.23		
2000	35.34		
2005	35.34		
2010	35.34		
2015	35.34		
2020	35.34		
2025	35.34		
2030	35.23		
2035	35.23		
2040	35.23		End of test.

See footnotes at end of table.

Table 5.--Field data for cumulative-depth flow tests--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Remarks
Well: AY-68-37-521 (A-1)--Continued			
Interval: 965-1,279 feet Test number: 6			
July 26, 1985			
1105	-	-	Start of flow. 3/
1120	-	-	
1135	-	-	
1143	-	-	
1200	2.65	564	
1205	-		End of flow, begin
1205:30	28.75		recovery.
1206	32.91		
1207	33.37		
1208	33.84		
1209	34.07		
1210	34.31		
1215	34.76		
1220	34.99		
1225	35.11		
1230	35.22		
1240	35.22		
1250	35.34		
1300	35.34		
1305	35.34		End of test.
Interval: 965-1,331 feet Test number: 7			
July 29, 1985			
0805	-	-	Start of flow. 3/
0820	-	-	
0835	-	-	
0836	-	-	
0850	-	-	
0900	3.45	575	
0920	3.45	-	
0905	3.35		End of flow, begin
0905:30	27.49		recovery.
0906	31.18		
0907	32.34		
0908	32.80		
0909	33.03		
0910	33.26		
0915	33.73		
0920	33.84		
0925	33.96		
0930	33.96		
0935	34.07		
0940	34.07		
0950	34.07		
1000	34.07		
1005	34.07		End of test.
Interval: 965-1,384 feet Test number: 8			
July 29, 1985			
1650	-	-	Start of flow. 3/
1705	-	-	
1720	-	-	
1735	-	-	
1745	3.47	588	
1750	3.47		End of flow, begin
1750:30	26.57		recovery.
1751	30.61		
1752	31.07		
1753	31.42		
1754	31.76		
1755	31.88		
1756	32.11		

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Remarks
Well: AY-68-37-521 (A-1)--Continued			
Test number: 8--Continued			
July 29, 1985--Continued			
1757	32.22		
1758	32.22		
1759	32.34		
1800	32.34		
1805	32.46		
1810	32.57		
1815	32.69		
1820	32.80		
1825	32.80		
1830	32.80		
1840	32.92		
1850	32.92		End of test.
Interval: 965-1,437 feet Test number: 9			
July 30, 1985			
1015	-	-	Start of flow. 3/
1030	-	-	
1045	-	-	
1100	-	-	
1110	-	576	
1115	3.35		End of flow, begin
1115:30	25.29		recovery.
1116	29.91		
1112	31.07		
1118	31.28		
1119	31.76		
1120	31.99		
1125	32.34		
1130	32.46		
1135	32.57		
1140	32.57		
1145	32.57		
1150	32.57		
1200	32.11		
1210	32.69		
1215	32.69		End of test.
Interval: 965-1,489 feet Test number: 10			
July 31, 1985			
0742	-	-	Start of flow. 3/
0757	-	-	
0812	-	-	
0827	-	-	
0837	3.23	590	
0842	3.23		End of flow, begin
0842:30	24.95		recovery.
0843	29.34		
0844	30.61		
0845	30.61		
0846	30.95		
0847	31.42		
0848	31.53		
0849	31.65		
0850	31.76		
0855	31.99		
0900	32.11		
0905	32.22		
0810	32.34		
0920	32.34		
0930	32.34		
0935	32.34		
0942	32.34		End of test.

See footnotes at end of table.

Table 5.--Field data for cumulative-depth flow tests--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Remarks
Well: AY-68-37-522 (A-2)			
Interval: 964-1,019 feet			
Test number: 1			
September 13, 1985			
0655	18.69	-	
0700	-	-	Start of flow. 3/
0708	2.26	9.9	
0715	-	9.6	
0730	2.22	-	
0738	2.22	9.2	
0740	-		End of flow, begin
0740:15	9.47		recovery.
0740:30	11.52		
0741	14.90		
0742	17.09		
0743	17.90		
0744	18.17		
0745	18.24		
0750	18.53		
0755	18.64		
0800	18.55		
0802	18.53		End of test.
Interval: 964-1,075 feet			
Test number: 2			
September 13, 1985			
1400	2.15	-	Start of flow. 3/
1415	2.13	-	
1430	-	-	
1445	2.11	127	
1500	2.11		End of flow, begin
1500:15	3.64		recovery.
1500:30	4.94		
1501	13.17		
1502	19.80		
1503	22.57		
1505	24.14		
1506	24.49		
1507	24.83		
1508	25.06		
1510	25.29		
1515	25.53		
1520	25.64		
1525	25.76		
1530	25.76		
1540	25.81		
1550	25.81		
1600	25.81		End of test.
Well: AY-68-37-523 (A-3)			
Interval: 964-1,019 feet			
Test number: 1			
October 10, 1985			
1930	-	5.8	Start of flow. 3/
1947	4/3.72	-	
1952	-	5.4	
2002	-	-	
2010	4/3.74	5.4	
2025	-	5.3	
2030	4/3.73		End of flow, begin
2032	4/21.00		recovery.
2033	4/26.50		
2034	4/29.05		
2035	4/31.70		
2036	4/33.40		
2040	4/35.50		
2053	35.80		
2105	35.86		

Date and time	Water level 4/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Remarks
Well: AY-68-37-523 (A-3)--Continued			
Test number: 1--Continued			
October 10, 1985--Continued			
2120	35.91		
2130	35.93		End of test.
Interval: 964-1,071 feet			
Test number: 2			
October 11, 1985			
1110	-	-	Start of flow. 3/
1113	-	36.2	
1116	3.84	-	
1122	-	33.3	
1130	3.86	-	
1135	-	36.6	
1145	3.84	-	
1150	-	33.4	
1200	3.85	33.4	
1220	3.84	33.4	
1225	-	34.5	
1235	-	-	
1239	3.84	-	
1240	-		End of flow, begin
1241	28.40		recovery.
1242	32.45		
1243	34.44		
1244	34.69		
1245	34.74		
1255	34.84		
1310	34.86		End of test.
Interval: 964-1,123 feet			
Test number: 3			
October 14, 1985			
0735	3.15	-	Start of flow. 3/
0745	-	-	
0755	3.17	-	
0805	-	-	
0815	3.18	-	
0825	-	73	
0835	3.18	-	End of flow, begin
0836	33.50		recovery.
0837	34.15		
0838	34.44		
0839	34.59		
0840	34.66		
0845	34.85		
0850	34.92		
0855	34.94		
0900	34.95		
0910	34.96		
0920	34.95		
0930	34.90		
0935	34.87		End of test.
Interval: 964-1,174 feet			
Test number: 4			
October 15, 1985			
0545	34.12	-	
0630	4.20	-	Start of flow. 3/
0640	4.18	-	
0650	-	-	
0700	4.02	-	
0710	-	87	
0720	-		End of flow, begin
0730	4.02		recovery

See footnotes at end of table.

Table 5.--Field data for cumulative-depth flow tests--Continued

Date and time	Water level 4/ above land-surface datum (ft)	Discharge 5/ (gal/min)	Remarks
Well: AY-68-37-523 (A-3)--Continued			
Interval: 964-1,174 feet			
Test number: 4--Continued			
October 15, 1985--Continued			
0731	32.50		
0732	32.80		
0734	33.24		
0735	33.35		
0741	33.55		
0747	33.55		
0755	33.51		
0805	33.46		
0815	33.42		
0830	33.39		End of test.
Well: AY-68-37-524 (C-1)			
Interval: 832-891 feet			
Test number: 1			
November 18, 1985			
1110	-	-	Start of flow. 3/
1112	7.00	991	
1120	6.97	1,000	
1130	7.05	976	
1140	7.04	981	
1150	7.08	976	
1200	7.02	985	
1205	7.03	981	
1210	-		End of flow, begin recovery.
1210:30	42.09		
1211	42.28		
1312	42.57		
1213	42.72		
1214	42.82		
1215	42.89		
1216	42.95		
1217	42.98		
1220	43.02		
1225	43.08		
1230	43.11		
1235	43.13		
1240	43.17		
1250	43.20		
1300	43.20		
1310	43.23		End of test.
Interval: 832-941 feet			
Test number: 2			
November 18, 1985			
0800	-	-	Start of flow. 3/
0801	7.15	972	
0810	7.10	987	
0820	7.15	1,000	
0830	7.20	964	
0840	7.15	1,020	
0850	7.11	1,000	
0855	7.14	1,000	
0900	-		End of flow, begin recovery.
0912	30.10		
0915	32.10		
0920	35.10		
0925	37.16		
0930	38.62		
0940	40.39		
0950	41.34		
1000	41.88		End of test.

Date and time	Water level 4/ above land-surface datum (ft)	Discharge 5/ (gal/min)	Remarks
Well: AY-68-37-524 (C-1)--Continued			
Interval: 832-991 feet			
Test number: 3			
November 19, 1985			
1700	-	-	Start of flow. 3/
1701	7.08	991	
1710	6.98	981	
1720	6.96	966	
1730	6.93	976	
1740	6.95	985	
1750	6.98	968	
1755	7.00	975	
1800	-		End of flow, begin recovery test.
1800:30	41.20		
1801	41.65		
1802	41.90		
1803	42.14		
1804	42.25		
1805	42.34		
1806	42.42		
1807	42.49		
1808	42.55		
1810	42.62		
1815	42.73		
1820	42.80		
1825	42.85		
1830	42.87		
1840	43.03		
1850	43.11		
1900	43.15		End of test.
Interval: 832-1,042 feet			
Test number: 4			
November 20, 1985			
0915	-	-	Start of flow. 3/
0917	6.96	981	
0927	7.32	991	
0937	7.20	964	
0947	7.05	985	
0957	7.02	964	
1007	7.05	955	
1013	7.20	955	
1015	-		End of flow, begin recovery.
1015:30	36.40		
1016	40.55		
1017	42.04		
1018	42.25		
1019	42.36		
1020	42.44		
1021	42.51		
1022	42.56		
1023	42.60		
1025	42.67		
1030	42.86		
1035	42.96		
1040	43.00		
1045	43.00		
1050	42.99		
1100	43.02		
1110	43.04		
1115	43.05		End of test.

See footnotes at end of table.

Table 5.--Field data for cumulative-depth flow tests--Continued

Date and time	Water level 4/ above land-surface datum (ft)	Discharge 5/ (gal/min)	Remarks
Well: AY-68-37-524 (C-1)--Continued			
Interval: 832-1,095 feet			
Test number: 5			
November 20, 1985			
1705	-	-	Start of flow. 3/
1710	-	6/715	
1720	5.10	6/736	
1730	5.21	6/750	
1740	5.30	6/790	
1750	5.50	6/839	
1800	5.60	6/819	
1805	-		End of flow, begin
1805:30	-		recovery.
1806	42.45		
1807	42.55		
1808	42.59		
1809	42.61		
1810	42.68		
1811	42.73		
1812	42.76		
1815	42.84		
1820	42.90		
1825	42.94		
1830	42.97		
1840	42.97		
1850	42.97		
1900	43.09		
1905	43.13		End of test.
Interval: 832-1,147 feet			
Test number: 6			
November 21, 1985			
0830	-	-	Start of flow. 3/
0831	7.35	1,060	
0840	7.40	1,050	
0850	7.42	1,010	
0900	7.38	1,000	
0910	7.32	1,000	
0920	7.41	1,020	
0925	7.37	1,020	
0930	-		End of flow, begin
0930:30	42.00		recovery.
0931	42.25		
0932	42.49		
0933	42.67		
0934	42.80		
0935	42.88		
0936	42.94		
0937	42.98		
0940	43.04		
0945	43.02		
0950	42.94		
0955	42.87		
1000	42.83		
1010	42.77		
1020	42.72		
1030	42.91		End of test.
Interval: 832-1,199 feet			
Test number: 7			
November 21, 1985			
1635	-	-	Start of flow. 3/
1637	7.25	1,070	
1647	7.22	1,020	
1657	7.15	1,000	
1707	7.10	1,050	
1717	7.13	972	

Date and time	Water level 4/ above land-surface datum	Discharge 5/ (gal/min)	Remarks
Well: AY-68-37-524 (C-1)--Continued			
Interval: 832-1,199 feet			
Test number: 7--Continued			
November 21, 1985--Continued			
1727	7.12	1,020	
1733	7.15	1,050	
1735	-		End of flow, begin
1735:30	41.35		recovery.
1736	41.58		
1737	41.88		
1738	42.06		
1739	42.17		
1740	42.27		
1742	42.38		
1745	42.46		
1750	42.49		
1755	42.51		
1800	42.54		
1805	42.61		
1815	42.69		
1825	42.90		
1835	43.09		End of test.
Interval: 832-1,251 feet			
Test number: 8			
November 22, 1985			
0550	43.77	-	
0855	-	-	Start of flow. 3/
0857	7.00	1,030	
0907	6.98	1,020	
0917	6.85	1,030	
0927	6.90	992	
0937	7.10	1,050	
0947	7.05	1,030	
0953	7.00	964	
0955	-		End of flow, begin
0955:30	41.40		recovery.
0956	41.55		
0957	41.85		
0958	42.05		
0959	42.09		
1000:30	42.34		
1001	42.37		
1002	42.45		
1003	42.48		
1005	42.55		
1010	42.63		
1015	42.67		
1020	42.68		
1025	42.66		
1035	42.62		
1045	42.76		
1055	42.88		End of test.
Interval: 832-1,302 feet			
Test number: 9			
November 22, 1985			
1600	-	-	Start of flow. 3/
1602	6.95	985	
1612	6.85	966	
1622	6.88	1,070	
1632	6.90	1,010	
1642	-	1,050	
1652	6.88	945	
1657	6.84	1,050	

See footnotes at end of table.

Table 5.--Field data for cumulative-depth flow tests--Continued

Date and time	Water level 4/ above land-surface datum (ft)	Discharge 5/ (gal/min)	Remarks
Well: AY-68-37-524 (C-1)--Continued			
Interval: 832-1,302 feet			
Test number: 9--Continued			
November 22, 1985--Continued			
1700	-		End of flow, begin
1700:30	-		recovery.
1701	41.08		
1702	41.99		
1703	42.18		
1704	42.40		
1705	-		
1706	42.52		
1708	42.56		
1710	42.61		
1715	42.68		
1720	42.70		
1730	42.71		
1740	42.69		
1750	42.67		
1800	42.60		End of test.
Interval: 832-1,352 feet			
Test number: 10			
November 23, 1985			
0942	-	-	Start of flow. 3/
0944	7.4	1,000	
0954	7.3	1,000	
1004	7.28	1,040	
1014	7.30	1,000	
1024	7.26	962	
1034	7.30	992	
1040	7.40	1,050	
1042	-		End of flow, begin
1042:30	-		recovery.
1044	42.67		
1045	42.77		
1046	42.84		
1047	42.93		
1048	43.04		
1049	43.11		
1050	43.12		
1052	43.25		
1057	43.36		
1100	43.41		
1105	43.43		
1110	43.43		
1115	43.43		
1120	43.43		
1130	43.21		
1140	43.06		
1142	43.04		End of test.

NOTE: Discharge determined with Hoff meter from full 10-inch pipe.

Well: AY-68-37-525 (C-2)

Date and time	Water level 4/ above land-surface datum	Discharge 2/ (gal/min)	Remarks
Interval: 832-882 feet			
Test number: 1			
January 14, 1986			
1640	-	-	Start of flow. 3/
1650	3.10	2/23.1	
1700	3.05	2/23.6	
1710	3.20	2/24.0	
1720	3.19	2/23.8	
1730	3.16	2/24.0	
1740	3.18	24.4	End of flow, begin
1742	36.80		recovery.

Well: AY-68-37-525 (C-2)--Continued

Date and time	Water level 4/ above land-surface datum	Discharge 2/ (gal/min)	Remarks
Interval: 832-882 feet			
Test number: 1--Continued			
January 14, 1986--Continued			
1743	39.60		
1744	41.85		
1745	43.26		
1746	44.25		
1747	44.75		
1750	45.72		
1755	45.85		
1800	45.97		
1805	46.04		
1810	46.06		
1820	46.11		
1830	46.15		
1840	46.17		End of test.
Interval: 832-932 feet			
Test number: 2			
January 15, 1986			
0900	-	-	Start of flow. 3/
0910	3.17	27.2	
0920	3.18	26.8	
0930	3.18	26.8	
0940	3.18	26.5	
0950	3.20	27.1	
1000	3.20	26.8	End of flow, begin
1001	34.50		recovery.
1002	40.55		
1003	43.85		
1004	45.22		
1005	45.60		
1006	45.72		
1007	45.78		
1010	45.82		
1015	45.89		
1020	45.97		
1025	45.99		
1030	46.00		
1040	45.96		
1050	45.89		
1100	45.86		End of test.
Interval: 832-986 feet			
Test number: 3			
January 15, 1986			
1740	-	-	Start of flow. 3/
1745	3.24	28.5	
1755	3.22	28.1	
1805	3.22	27.8	
1815	3.22	27.8	
1825	3.23	27.8	
1835	3.22	28.5	
1840	-		End of flow, begin
1845	45.72		recovery.
1846	45.98		
1847	46.10		
1850	46.17		
1855	46.25		
1900	46.30		
1905	46.34		
1910	46.38		
1920	46.39		
1930	46.41		
1940	46.40		End of test.

See footnotes at end of table.

Table 5.--Field data for cumulative-depth flow tests--Continued

Date and time	Water level 4/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Remarks
Well: AY-68-37-525 (C-2)--Continued			
Interval: 832-1,049 feet			
Test number: 4			
January 16, 1986			
1025	-	-	Start of flow. 3/
1030	3.21	30.6	
1040	3.21	30.6	
1050	3.23	30.6	
1100	3.22	30.6	
1110	3.24	30.6	
1120	3.24	30.6	
1125	-		End of flow, begin
1126	37.20		recovery.
1127	44.55		
1128	45.97		
1129	46.32		
1130	46.42		
1131	46.40		
1132	46.44		
1135	46.56		
1140	46.66		
1145	46.75		
1150	46.78		
1155	46.82		
1205	46.83		
1215	46.88		
1225	46.91		End of test.
Interval: 832-1,101 feet			
Test number: 5			
January 17, 1986			
0900	-	-	Start of flow. 3/
0905	3.24	37.5	
0915	3.23	37.0	
0925	3.24	37.5	
0935	3.24	37.5	
0945	3.24	37.0	
0955	3.24	37.0	
1000	-		End of flow, begin
1001	41.00		recovery.
1002	45.05		
1003	46.30		
1004	46.57		
1005	46.73		
1006	46.81		
1007	46.86		
1010	46.97		
1015	47.05		
1020	47.10		
1025	47.09		
1030	47.08		
1040	47.12		
1050	47.09		
1100	47.09		End of test.
Interval: 832-1,150 feet			
Test number: 6			
January 17, 1986			
1900	3.69	-	Start of flow. 7/
1915	3.69	96	
1930	3.70	-	
1945	3.70	95	
2000	3.69	-	
2015	3.69	94	
2030	3.72	-	
2045	3.69	98	
2100	3.69	-	
2115	3.68	98	
2125	3.71		End of flow, begin
2126	40.10		recovery.
2127	41.60		
2128	42.50		
2129	43.03		
2130	43.30		
2131	43.55		
2132	43.84		
2135	44.36		
2140	44.81		
2145	45.08		
2150	45.27		
2155	45.44		
2205	45.64		
2210	45.77		
2225	45.88		End of test.
Well: AY-68-37-525 (C-2)--Continued			
Interval: 832-1,150 feet			
Test number: 6--Continued			
January 17, 1986--Continued			
Well: AY-68-37-526 (D-1)			
Interval: 854-894 feet			
Test number: 1			
March 4, 1986			
1715	-	-	Start of flow. 3/
1725	4.18	-	
1730	15.90	-	
1735	16.18	-	
1745	16.57	-	
1755	16.65	-	
1805	16.68	-	
1815	16.69	-	
1825	16.69	412	
1830	17.04		End of flow, begin
1832	25.58		recovery.
1834	25.58		
1836	25.58		
1838	25.58		
1840	25.59		
1845	25.59		
1850	25.55		
1855	25.49		
1900	25.46		
1905	25.44		
1910	25.53		
1915	25.58		End of test.
Interval: 854-947 feet			
Test number: 2			
March 5, 1986			
1230	4.60	-	Start of flow. 3/
1240	4.65	-	
1250	5.10	-	
1300	5.14	-	
1310	5.14	-	
1320	5.10	713	
1330	5.13		End of flow, begin
1331	23.40		recovery.
1332	25.00		
1334	24.94		
1336	24.86		
1338	24.86		
1340	24.88		
1345	24.89		
1350	25.62		
1400	25.57		

See footnotes at end of table.

Table 5.--Field data for cumulative-depth flow tests--Continued

Time	Water level 4/ above land-surface datum (ft)	Discharge 8/ (gal/min)	Remarks
Well: AY-68-37-526 (D-1)--Continued			
Interval: 854-947 feet			
Test number: 2--Continued			
March 5, 1986--Continued			
1410	25.52		
1420	25.49		
1430	25.51		End of test.
Interval: 854-999 feet			
Test number: 3			
March 6, 1986			
1130	6.27	748	Start of flow. 3/
1140	6.05	748	
1150	5.85	748	
1200	5.83	748	
1210	5.80	748	
1220	6.70	748	
1230	6.68	748	End of flow, begin recovery.
1231	25.50		
1232	25.50		
1234	25.50		
1236	25.49		
1238	25.49		
1240	25.48		
1245	25.48		
1250	25.47		
1255	25.47		
1300	25.47		
1305	25.35		
1310	25.30		
1315	25.29		
1320	25.25		
1325	25.24		
1330	25.23		End of test.
Interval: 854-1,052 feet			
Test number: 4			
March 7, 1986			
1315	-	-	Start of flow. 3/
1316	18.40	5/371	
1325	18.54	-	
1326	13.98	5/436	
1335	13.96	-	
1336	6.01	738	
1340	6.05	738	
1350	5.60	738	
1400	6.25	738	
1410	6.30	738	
1420	6.21	738	
1430	6.17	738	
1435	6.11	738	End of flow, begin recovery.
1436	24.95		
1438	24.95		
1440	24.88		
1442	24.89		
1444	24.90		
1446	24.92		
1450	24.97		
1455	25.02		
1500	25.05		
1505	25.08		
1510	25.10		
1515	25.12		End of test.

Date and time	Water level 4/ above land-surface datum (ft)	Discharge 8/ (gal/min)	Remarks
Well: AY-68-37-526 (D-1)--Continued			
Interval: 854-1,105 feet			
Test number: 5			
March 12, 1986			
1940	-	-	Start of flow. 3/
1945	6.01	768	
1950	6.02	768	
2000	6.05	768	
2010	6.04	768	
2020	6.10	768	
2030	6.08	768	
2040	6.06	768	End of flow, begin recovery.
2041	24.78		
2042	24.78		
2044	24.65		
2046	24.64		
2048	24.60		
2050	24.58		
2055	24.53		
2100	24.50		
2105	24.48		
2110	24.48		
2115	24.49		
2120	24.49		
2125	24.49		
2130	24.49		
2135	24.49		
2140	24.49		End of test.
Interval: 854-1,157 feet			
Test number: 6			
March 14, 1986			
0600	-	-	Start of flow. 3/
0605	4.38	797	
0610	4.40	797	
0620	4.65	797	
0630	4.65	797	
0640	4.95	797	
0650	5.02	797	
0700	5.06	797	End of flow, begin recovery.
0701	25.29		
0702	25.33		
0704	25.33		
0706	25.32		
0708	25.31		
0710	25.30		
0715	25.28		
0720	25.25		
0725	25.21		
0730	25.21		
0735	25.19		
0740	25.09		
0745	25.03		
0750	24.98		
0755	24.95		
0800	24.92		End of test.
Interval: 854-1,209 feet			
Test number: 7			
March 17, 1986			
0850	-	-	Start of flow. 3/
0855	5.28	797	
0900	5.24	797	

See footnotes at end of table.

Table 5.--Field data for cumulative-depth flow tests--Continued

Date and time	Water level above land-surface datum (ft) 4/	Discharge (gal/min) 8/	Remarks
Well: AY-68-37-526 (D-1)--Continued			
Interval: 854-1,209 feet			
Test number: 7--Continued			
March 17, 1986--Continued			
0910	5.20	797	
0920	5.22	797	
0930	5.22	797	
0940	5.23	797	
0950	5.26	797	End of flow, begin
0951	24.70		recovery.
0952	24.65		
0954	24.68		
0956	24.67		
0958	24.67		
1000	24.66		
1005	24.65		
1010	24.64		
1015	24.64		
1020	24.63		
1025	24.50		
1030	24.45		
1035	24.42		
1040	24.39		
1045	24.39		
1050	24.33		End of test.
Interval: 854-1,261 feet			
Test number: 8			
March 18, 1986			
0710	4.45	825	Start of flow. 3/
0720	4.42	825	
0730	4.45	825	
0740	4.52	825	
0750	4.40	825	
0800	4.35	825	
0810	4.40	825	End of flow, begin
0811	24.50		recovery.
0812	24.60		
0814	24.51		
0816	24.51		
0818	24.51		
0820	24.48		
0825	24.48		
0830	24.45		
0835	24.45		
0840	24.43		
0845	24.54		
0850	24.56		
0855	24.58		
0900	24.59		
0910	24.59		End of test.
Interval: 854-1,312 feet			
Test number: 9			
March 19, 1986			
0715	4.25	825	Start of flow. 3/
0720	4.24	825	
0725	4.23	838	
0735	4.25	825	
0745	4.18	838	
0755	4.20	838	
0805	4.19	838	
0815	-	838	End of flow, begin
0817	24.40		recovery.
0818	24.50		
0819	24.50		
0820	24.50		
0821	24.52		
0822	24.51		
0823	24.52		
0824	24.52		
0825	24.53		
0827	24.53		
0830	24.52		
0835	24.54		
0840	24.54		
0845	24.54		
0850	24.54		
0855	24.54		
0900	24.54		
0905	24.53		
0910	24.53		
0915	24.53		End of test.
Interval: 854-1,364 feet			
Test number 10			
March 20, 1986			
0600	25.11	809	Start of flow. 3/
0650	4.20	809	
0700	4.20	809	
0710	4.15	809	
0720	4.18	809	
0730	4.12	809	
0740	4.12	809	
0750	4.16	809	End of flow, begin
0751	24.40		recovery.
0752	24.00		
0754	24.00		
0756	23.99		
0758	23.98		
0800	23.97		
0805	23.95		
0810	23.94		
0815	23.93		
0820	23.91		
0825	23.89		
0830	23.87		
0835	23.80		
0840	23.70		
0845	23.65		
0850	23.61		End of test.

1/ Water levels determined by pressure transducer.
2/ Discharge determined volumetrically.
3/ Drill column in hole during test.
4/ Water levels determined by direct readings.
5/ Discharge determined with Hoff meter from full 10-inch pipe.
6/ Mud ball in hole restricted flow during test.
7/ Drill column not in hole during test.
8/ Discharge determined by manometer with 10-inch pipe x 8-inch orifice.

Table 6.--Field data for drawdown tests

[ft, feet; gal/min, gallons per minute; µS/cm, microsiemens per centimeter at 25° Celsius]

Time	Water level 1/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Specific conductance (µS/cm)	Remarks	Time	Water level 1/ above land-surface datum (ft)	Time	Water level 3/ above land-surface datum (ft)
				January 28, 1986				
	Well: AY-68-37-524 (C-1) Open interval: 832-1,389 ft				Observation wells and open intervals (): C-2 (1,072-1,150 ft)		Artesia 1 (863-977 ft)	
0950	47.10	-	-		0950	44.28	0940	32.34
1000	47.06	-	-	Start flow	1000	44.15	1025	32.11
1010	19.65	1,980	-		1010	42.81	1040	31.99
1020	19.60	1,980	-		1020	42.47	1050	31.99
1040	19.40	1,980	746		1040	42.00	1100	31.99
1100	18.45	1,980	-		1100	41.55	1115	32.11
1120	18.04	1,980	-		1120	41.34	1130	31.99
1140	18.07	1,980	710		1140	41.08	1145	31.99
1200	18.02	1,980	-		1200	41.02	1200	31.99
1220	18.00	1,980	-		1220	40.87	1215	31.76
1240	17.90	1,980	711		1240	40.74	1230	31.65
1300	17.89	1,964	-		1300	40.64	1245	31.65
1320	17.32	1,987	-		1320	40.55	1300	31.65
1340	17.65	1,980	714		1340	40.55	1315	31.65
1400	18.01	1,980	-		1400	40.59	1330	31.99
1420	17.91	1,978	-		1420	40.60	1345	31.99
1440	17.78	1,980	723		1440	40.55	1400	31.99
1500	17.65	1,980	-		1500	40.46	1415	31.99
1520	17.54	1,980	-		1520	40.45	1430	31.65
1540	17.23	1,980	724		1540	40.30	1445	31.42
1600	17.16	1,980	-		1600	40.27	1500	31.30
1620	17.13	1,980	-		1620	40.24	1515	31.19
1640	17.09	1,980	727		1640	40.21	1530	31.19
1700	16.96	1,980	-		1700	40.17	1545	31.30
1720	16.90	1,980	-		1720	40.11	1600	31.30
1740	16.86	1,980	736		1740	40.06	1615	31.30
1800	-			End of flow,	1800	-	1630	31.30
1803	-			begin recovery.	1803	-	1645	31.65
1804	27.52				1804	40.52	1700	31.07
1805	-				1805	40.98	1715	30.95
1806	-				1806	41.06		
1807	44.97				1807	41.32		
1810	45.37				1810	41.50		
1815	45.84				1815	41.90		
1820	46.06				1820	42.15		
1830	46.80				1830	42.49		
1840	46.44				1840	42.70		
1850	46.54				1850	42.85		
1900	46.55				1900	42.92		
1920	46.25				1920	42.85		
1940	46.12				1940	42.81		
2000	46.09				2000	42.79		
2020	46.20				2020	42.87		
2040	46.24				2040	42.90		
2100	46.27				2100	42.93		
2120	46.35				2120	42.99		
2140	46.35				2140	42.99		
2200	46.38			End of test.	2200	43.00		

See footnotes at end of table.

Table 6.--Field data for drawdown tests--Continued

Time	Water level 1/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Specific conductance (µS/cm)	Remarks	Water level 1/ above land-surface datum (ft)	Time	Water level 1/ above land-surface datum (ft)
				January 30, 1986			
	Well: AY-68-37-524 (C-1) Open interval: 832-881 ft				Observation wells and open intervals (): C-2 (1,072-1,150 ft)	Artesia 1 (863-977 ft)	
0735	46.77	-	-		42.75	0615	31.53
0835	46.60	-	-		42.83	0640	31.53
0840	-	1,964	-		-	0740	31.30
0845	12.5+	-	-		42.82	0840	31.07
0915	13.30	1,941	-	Start flow	42.65	0920	30.84
0940	12.70	1,918	-		42.50	1010	30.95
1000	12.46	1,918	734		42.42	1030	30.95
1020	12.35	1,918	-		42.28	1045	31.19
1040	12.30	1,918	-		42.20	1100	31.30
1100	12.27	1,918	770		42.12	1115	31.53
1120	12.30	1,918	-		42.05	1130	31.53
1140	12.32	1,918	-		42.02	1145	31.53
1200	12.28	1,918	783		41.98	1200	31.19
1220	12.17	1,912	-		41.93	1215	30.95
1240	12.08	1,912	-		41.89	1230	30.84
1300	12.04	1,906	780		41.85	1245	30.46
1320	12.07	1,906	-		41.80	1300	30.84
1340	12.08	1,906	-		41.78	1315	30.95
1400	12.03	1,906	777		41.74	1330	30.95
1420	12.02	1,906	-		41.71	1345	30.84
1440	12.02	1,906	-		41.67	1430	30.49
1500	12.00	1,906	782		41.63	1445	30.49
1520	12.03	1,906	-		41.61	1500	30.38
1540	12.05	1,906	-		41.48	1515	30.46
1600	12.05	1,906	784		41.55	1530	30.84
1620	12.03	1,906	-		41.54	1545	30.95
1640	12.02	1,906	-		41.52	1600	31.07
1700	12.00	1,906	799		41.51	1615	30.95
1715	12.01	1,906	-	End of flow,	41.56	1630	30.84
1716	33.70			begin recovery.	41.49	1645	30.61
1717	42.83				41.48	1700	30.49
1718	43.40				41.48	1715	30.49
1719	43.80				41.48	1730	30.49
1720	44.09				41.48	1745	30.61
1721	44.33				41.48	1800	30.61
1722	44.50				41.48	1815	30.61
1723	44.54				41.48	1830	30.61
1725	44.86				41.48	1845	30.38
1730	45.15				41.50	1900	30.26
1735	45.34				41.53	1915	30.38
1740	45.51				41.57	1930	30.49
1750	45.64				41.64	1945	30.61
1800	45.71				41.70	2000	30.46
1810	45.75				41.77	2015	30.84
1820	45.77				41.80	2030	31.07
1830	45.79				41.87		
1840	45.67				41.91		
1850	45.64				41.93		
1900	45.60				41.96		
1920	45.68				42.01		
1940	45.78				42.05		
2000	45.98				42.09		
2020	46.11				42.14		
2040	46.29				42.21		
2100	46.18				42.24		
2115	45.94			End of test.	42.27		

See footnotes at end of table.

Table 6.--Field data for drawdown tests--Continued

Time	Water level 1/ above land-surface datum (ft)	Discharge 2/ (gal/min)	Specific conductance (µS/cm)	Water level 3/ above land-surface datum (ft)	Water level 3/ above land-surface datum (ft)	Remarks
			March 24, 1986			
Wells:	AY-68-37-526 (D-1)			Artesia 1	Artesia 3	
Open intervals:	854-1,384 ft			863-977 ft	860-1,108 ft	
0740	22.55	-	-	23.49	23.35	
0800	22.40	-	-	23.37	23.12	
0820	22.27	-	-	23.25	22.97	
0830	22.24	-	-	23.23	22.93	Start of test.
0832	7.80	1,364	-	-	-	
0840	8.20	1,348	497	23.19	22.88	
0900	7.98	1,348	488	23.11	22.73	
0920	8.05	1,348	492	23.17	22.75	
0940	8.04	1,348	490	23.18	22.68	
1000	8.15	1,348	492	23.10	22.61	
1020	7.95	1,348	491	22.96	23.07	
1040	7.89	1,339	488	22.80	22.90	
1100	7.89	1,339	486	22.75	22.86	
1120	7.89	1,331	486	22.62	22.76	
1140	7.65	1,339	486	22.55	22.66	
1200	7.60	1,339	484	22.44	22.51	
1220	7.56	1,331	487	22.33	22.53	
1240	7.54	1,331	480	22.38	22.50	
1300	7.52	1,331	487	22.28	22.44	
1320	7.53	1,331	488	22.16	22.26	
1340	7.46	1,322	490	22.14	22.23	
1400	7.50	1,322	493	22.11	22.23	
1420	7.44	1,322	487	22.08	22.17	
1440	7.45	1,322	489	22.01	22.11	
1500	7.43	1,322	488	22.01	22.07	
1520	7.42	1,322	490	21.98	22.02	
1530	7.43	1,322	490	21.98	22.04	End of flow, begin recovery.
1531	20.40			-	-	
1532	13.70			-	-	
1534	20.31			-	-	
1536	20.60			-	-	
1538	20.50			-	-	
1540	20.50			-	-	
1545	20.50			21.91	21.99	
1550	20.50			-	-	
1555	20.46			-	-	
1600	20.44			21.84	21.92	
1610	20.40			21.78	21.91	
1620	20.30			21.69	21.79	
1630	20.22			21.58	21.68	
1640	20.15			21.52	21.61	
1650	20.20			21.48	21.56	
1700	20.12			-	-	
1720	20.10			-	-	End of test.

1/ Water levels determined by direct readings.
2/ Discharge determined by manometer with 10-inch pipe x 8-inch orifice.
3/ Water levels determined by pressure transducer.

Table 7.--Field data for interval flow tests

[ft, feet; gal/min, gallons per minute; µS/cm, microsiemens per centimeter at 25° Celsius]

Well: AY-68-37-521 (A-1)

Open interval depth: 964 to 1,490 feet
Test number: 1

Date and time	Water level 2/ above land-surface datum (ft)	Discharge 3/ (gal/min)	Specific conductance (µS/cm)	Remarks
August 2, 1985				
1514	30.03	-		
1515	-	-		Start of flow.
1516	23.22	-		
1517	18.25	-		
1518	20.21	378		
1519	20.21	-		
1520	20.10	378		
1521	20.07	-		
1522	20.03	-		
1523	20.04	-		
1524	19.98	-		
1525	19.87	378		
1530	19.40	378		
1535	19.52	378		
1540	19.52	-		
1545	19.52	-		
1555	19.52	-		
1605	19.64	-		
1615	19.66	-		
1630	19.85	-		
1645	19.68	-		
1700	20.47	378		
1715	20.66	-		
1730	20.65	-		
1745	20.66	-		
1800	20.69	-		
1815	20.62	-		
1830	20.66	-		
1845	20.58	-		
1900	20.66	-		
1915	20.68	-		End of flow,
1916	-	0		begin recovery.
1917	-			
1918	-			
1919	-			
1920	29.84			
1921	-			
1922	-			
1923	-			
1924	-			
1925	30.12			
1930	30.09			
1935	30.24			
1940	30.25			
1945	30.26			
1955	30.27			
2005	30.31			
2015	30.33			
2030	30.35			
2045	30.39			
2100	30.41			
2115	30.42			End of test.

Open interval depth: 1,276 to 1,489 feet
Test number: 2

Date and time	Water level 2/ above land-surface datum (ft)	Discharge 3/ (gal/min)	Specific conductance (µS/cm)	Remarks
August 6, 1985				
1330	1/27.83			
1358	I/27.77			
1400:10	-	-		Start of flow.
1404	-	4/30.0		
1405	1/22.05	-		
1415	I/20.20	4/33.3		
1420	I/19.91	4/33.3		
1425	I/20.05	4/33.3		
1430	I/20.10	4/33.3		
1440	I/20.00	4/33.3		
1450	I/20.00	4/33.3		
1500	I/20.00	4/33.3		
1515	I/20.00	-		
1530	I/19.92	-	6,750	
1545	I/20.00	4/33.3	-	
1600	I/19.92	4/33.3	-	

See footnotes at end of table.

Well: AY-68-37-521 (A-1)--Continued

Open interval depth: 1,276 to 1,489 feet
Test number: 2--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 4/ (gal/min)	Specific conductance (µS/cm)	Remarks
August 6, 1985--Continued				
1615	19.91	33.3	-	
1630	19.89	33.3	-	
1645	19.89	33.3	-	
1700	19.88	33.3	-	
1715	19.87	33.3	-	
1730	19.84	33.3	-	
1745	19.79		6,650	
1800	19.78			End of flow,
1801	27.02			begin recovery.
1802	27.25			
1803	27.33			
1804	27.35			
1805	27.39			
1806	27.40			
1807	27.43			
1808	27.43			
1809	27.46			
1810	27.46			
1812	-			
1814	-			
1815	27.49			
1816	-			
1818	-			
1820	27.50			
1825	27.50			
1830	27.51			
1840	27.49			
1850	27.46			
1900	27.44			
1915	27.42			
1930	27.36			
1945	27.30			
2000	27.25			End of test.

Open interval depth: 1,180 to 1,489 feet
Test number: 3

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 4/ (gal/min)	Specific conductance (µS/cm)	Remarks
August 7, 1985				
0917	29.09			
0922	-			
0930	29.15			
0945	29.17			
1000	29.18			Start of flow.
1001	-			
1002	25.90			
1003	-			
1004	24.05			
1005	24.12	5/44.4		
1006	24.10	-		
1007	24.20	-		
1008	24.18	-		
1009	24.02	-		
1010	23.93	-		
1012	23.74	-		
1015	23.15	-		
1020	23.78	5/42.7		
1025	24.02	-		
1030	23.88	-		
1040	23.64	-		
1050	23.82	-		
1100	23.68	-		
1115	23.73	-		
1130	23.72	-	6,090	
1145	23.60	-		
1200	23.64	-		
1215	23.58	-		
1230	23.52	-		
1245	23.50	5/44.4		
1300	23.48	-		
1315	23.48	-		
1330	23.45	5/42.7		
1345	23.41			
1400	23.37			End of flow,
				begin recovery.

Table 7.--Field data for interval flow tests--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 5/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-521 (A-1)--Continued				
Open interval depth: 1,180 to 1,489 feet Test number: 3--Continued				
August 7, 1985--Continued				
1400:30	-			
1401	27.20			
1402	27.55			
1403	27.58			
1404	27.59			
1405	27.60			
1406	27.60			
1407	27.60			
1408	27.61			
1409	27.61			
1410	27.61			
1412	27.61			
1415	27.59			
1420	27.59			
1425	27.56			
1430	27.54			
1440	27.50			
1450	27.47			
1500	27.47			
1515	27.40			
1530	-			
1545	-			
1600	-			End of flow, 1,180-1,849 ft.
Open interval depth: 965 to 1,180 feet Test number: 4				
August 7, 1985				
1600	29.30			Start flow.
1601	13.40			
1602	12.85			
1603	12.05			
1604	-			
1605	11.85	6/238		
1606	11.78	-		
1607	11.85	6/238		
1608	11.65	-		
1609	11.59	-		
1610	11.52	-		
1612	11.43	-		
1615	11.38	-		
1620	11.34	-		
1625	11.32	-		
1630	11.33	-	4,130	
1640	11.29	-	-	
1650	11.31	-	-	
1700	11.38	-	-	
1715	11.40	-	-	
1730	11.39	-	-	
1745	11.39	-	4,350	
1800	11.37	-	-	
1815	11.36	-	-	
1830	11.35	-	-	
1845	11.33	-	-	
1900	11.28	-	-	
1915	11.27	-	-	
1930	11.25	6/238	-	
1945	11.11		4,360	
2000	11.08			End of flow, begin recovery.
2000:30	20.00			
2001	22.80			
2002	26.40			
2003	27.22			
2004	27.48			
2005	27.70			
2006	-			
2007	27.88			
2008	27.92			
2009	27.98			
2010	28.00			
2012	28.05			
2015	28.09			
2020	28.13			

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 5/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-521 (A-1)--Continued				
Open interval depth: 965 to 1,180 feet Test number: 4--Continued				
August 7, 1985--Continued				
2025	28.13			
2030	28.14			
2040	28.14			
2050	28.14			
2100	28.11			
2115	28.07			
2130	28.03			
2145	28.02			
2200	28.00			End of test.
Open interval depth: 965 to 1,075 feet Test number: 5				
August 8, 1985				
1250	28.82			
1255	28.82			
1311	28.86			
1313	-			
1318	28.88			
1324	28.88			
1330	28.89			Start of flow
1331	17.00	130		
1332	12.40	-		
1333	12.44	-		
1334	12.42	-		
1335	12.43	-		
1336	12.40	-		
1337	12.41	-		
1338	12.41	127.8		
1339	12.41	-		
1340	12.41	-		
1342	12.40	-		
1345	12.41	-		
1350	12.43	127.5		
1355	12.43	-		
1400	12.44	-	3,010	
1410	12.44	-	-	
1420	12.44	127	-	
1430	12.42		-	
1445	12.36		2,960	
1500	12.34		-	
1515	12.28		-	
1530	12.28		-	
1545	12.27		-	
1600	12.27		-	
1615	12.21		-	
1630	12.21		-	
1645	12.21		-	
1700	12.14		2,940	
1715	12.13		2,910	
1730	12.02			End of flow, begin recovery
1730:30	17.38			
1731	22.65			
1732	27.72			
1733	28.39			
1734	28.48			
1735	28.54			
1736	28.58			
1737	28.61			
1738	28.62			
1739	28.63			
1740	28.64			
1742	28.66			
1745	28.68			
1750	28.68			
1755	28.69			
1800	28.69			
1810	28.69			
1820	28.68			
1830	28.67			
1845	28.62			
1900	28.59			
1915	28.54			
1930	28.50			End of test.

See footnotes at end of table.

Table 7.--Field data for interval flow tests--Continued

Date and time	Water level above land-surface datum (ft)	Discharge 4/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-521 (A-1)				
Open interval depth: 1,200-1,275 feet below land surface.				
Test number: 6				
August 14, 1985				
1250	-	-		Start of flow.
1252	-	23		7/
1338	-	22.2		
1350	-			End of flow,
1351:30	23.70			begin recovery.
1352	23.83			
1353	23.79			
1354	23.81			
1355	23.79			
1356	23.79			
1357	23.78			
1358	23.77			
1359	23.75			
1400	23.74			
1402	23.72			
1405	23.70			
1410	23.68			
1415	23.63			
1420	23.61			
1425	23.58			
1431	23.61			
1500	23.74			
1530	23.77			
1600	23.77			
1700	23.74			
1815	23.81			
1912	24.04			
2125	23.78			
August 15, 1985				
0230	24.77			End of test
Well: AY-68-37-522 (A-2)				
Open interval depth: 1,001-1,075 feet below land surface.				
Test number: 1				
September 17, 1985				
0751	30.02	-		
0753	30.02	-		
0755	30.02	-		
0757	30.02	-		
0759	30.02	-		
0800	-	-		Start of flow.
0800:30	-	-		8/
0801	16.02	22.6		
0802	16.03	-		
0803	16.00	23.5		
0804	15.98	-		
0805	15.97	23.7		
0806	15.95	-		
0807	15.94	-		
0808	15.94	-		
0909	15.94	-		
0810	15.94	23.8		
0812	15.94	-		
0815	15.94	23.9		
0820	15.94	-		
0825	15.94	-		
0830	15.05	23.7		
0840	15.34	-		
0850	15.40	24.2		
0900	15.43			End of flow,
0900:30	29.20			begin recovery.
0901	29.40			
0902	29.57			
0903	29.66			
0904	29.70			
0905	29.72			
0906	29.74			
0907	29.75			
0908	29.77			

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 4/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-522 (A-2)--Continued				
Open interval depth: 1,001-1,075 feet below land surface.				
Test number: 1--Continued				
September 17, 1985--Continued				
0909	29.80			
0910	29.80			
0912	29.81			
0915	29.81			
0920	29.80			
0930	29.78			
0945	29.77			
1000	29.77			End of test
Well: AY-68-37-523 (A-3)				
Open interval depth: 1,099-1,175 feet below land surface.				
Test number: 1				
October 21, 1985				
0600	39.66	-		
0615	39.66	-		
0630	39.72	-		
0640	39.70	-		
0650	39.69	-		
0655	39.69	-		
0700	39.68	-		Start of flow.
0701	-	-		9/
0702	-	-		
0703	116	-		
0704	116	-		
0705	-	-		
0707	116.55	-		
0710	116.82	-		
0715	116.10	40.5		
0720	116.92	-		
0725	115.95	-		
0730	115.66	-		
0740	116.99	-		
0750	116.40	-		
0800	116.46	37.5		
0815	115.46	-		
0830	116.50	-		
0845	116.60	-		
0900	116.86	-		
0915	115.85	-		
0930	116.08	-		
0945	116.20	-		
1000	115.90	-		
1015	115.88	-		
1030	115.78	-		
1045	115.78	38.4		
1100	115.70	-		
1115	114.90	-		
1130	114.50	-		
1145	115.10	-		
1200	115.30	-		
1215	115.28	35		
1230	115.20	-		
1245	115.23	-		
1300	114.90	-		
1315	115.30	34.9		
1330	115.10	-		
1345	114.23	-		
1400	114.91	-		
1415	114.94	-		
1430	114.88	35.4		
1445	114.32	-		
1500	-			End flow,
1501	-			begin recovery
1502	38.50			
1503	39.55			
1504	39.66			
1505	39.77			
1507	39.90			
1510	39.98			
1515	40.08			

See footnotes at end of table.

Table 7.--Field data for interval flow tests--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 3/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-523 (A-3)--Continued				
Open interval depth: 1,099-1,175 feet below land surface.				
Test number: 1--Continued				
October 21, 1985--Continued				
1520	40.18			
1525	40.18			
1530	40.29			
1545	40.25			
1600	40.28			
1615	40.29			
1630	40.27			
1645	40.29			
1700	40.22			
1715	40.20			
1730	40.20			
1745	40.14			
1800	40.14			
1830	40.15			End of test.
Well: AY-68-37-544 (C-1)				
Open interval depth: 832-1,396 feet				
Test number: 1				
November 27, 1985				
0600	45.0	-	-	
0615	44.95	-	-	
0630	44.92	-	-	Start of flow.
0635	30.90	1,413	-	
0640	30.70	1,413	-	
0645	30.45	1,413	805	
0700	30.25	1,413	-	
0730	29.65	1,413	-	
0800	29.85	1,413	834	
0830	29.95	1,413	828	
0900	29.83	1,413	835	
0930	29.68	1,413	830	
1000	29.68	1,413	840	
1030	29.67	1,413	824	
1100	29.68	1,413	841	
1130	29.44	1,413	835	
1200	29.28	1,413	841	
1230	29.04	1,413	842	End of flow,
1231	44.30			begin recovery.
1232	44.68		-	
1233	44.90			
1234	45.05			
1235	45.15			
1236	45.23			
1237	45.28			
1238	45.34			
1240	45.42			
1245	45.56			
1250	45.66			
1255	45.73			
1300	45.77			
1310	45.84			
1320	45.89			
1330	45.81			
1340	45.74			
1350	45.74			
1400	45.70			
1410	45.70			
1420	45.64			
1430	45.57			End of test.
Well: AY-68-37-524 (C-1)				
Open interval depth: 859-1,396 feet				
Test number: 2				
December 2, 1985				
1030	-	-	-	Start of flow.
1033	-	-	1,300	
1040	-	10/about 100	1,670	

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 10/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-524 (C-1)--Continued				
Open interval depth: 859-1,396 feet				
Test number: 2--Continued				
December 2, 1985--Continued				
1050	-	-	1,980	
1105	-	-	2,310	
1125	14.95	97.9	2,700	
1145	14.96	97.9	2,790	
1200	14.90	97.3	2,930	
1215	15.05	95.5	3,230	
1230	15.00	95.5	3,200	
1300	14.90	95.5	3,530	
1330	14.75	94.9	3,750	
1400	14.70	94.9	3,680	
1430	14.72	94.9	3,860	End of flow,
1431	39.75	-	-	begin recovery.
1432	40.70	-	-	
1433	40.70	-	-	
1434	40.95	-	-	
1435	41.25	-	-	
1436	41.47	-	-	
1437	41.72	-	-	
1438	41.90	-	-	
1440	42.10	-	-	
1445	42.60	-	-	
1450	42.94	-	-	
1455	43.20	-	-	
1500	43.46	-	-	
1510	43.84	-	-	
1520	44.14	-	-	
1530	44.38	-	-	
1540	44.56	-	-	
1550	44.69	-	-	
1600	44.84	-	-	
1610	44.95	-	-	
1620	45.09	-	-	
Open interval depth: 832-859 feet				
Test number: 3				
December 2, 1985				
1630	45.19	-	-	Start of flow.
1635	13.90	3/1,140	798	
1640	13.05	3/1,130	775	
1645	13.05	3/1,130	-	
1650	12.99	3/1,130	772	
1700	12.97	3/1,130	758	
1730	12.67	3/1,130	775	
1800	12.55	3/1,130	802	
1830	12.53	3/1,130	793	
1900	12.11	3/1,130	787	
1930	12.10	3/1,130	770	
2000	12.11	3/1,130	775	
2030	12.12	3/1,130	772	End of flow,
2031	47.50			begin recovery.
2032	47.76			
2033	47.90			
2034	47.99			
2035	48.04			
2036	48.08			
2037	48.10			
2038	48.14			
2040	48.16			
2045	48.22			
2050	48.25			
2055	48.27			
2102	48.27			
2110	48.20			
2120	48.14			
2130	48.08			
2140	48.03			
2150	48.00			
2200	47.95			
2210	47.95			
2220	48.02			
2230	48.15			End of test.

See footnotes at end of table.

Table 7.--Field data for interval flow tests--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 10/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-524 (C-1)--Continued				
Open interval depth: 1,056-1,396 feet				
Test number: 4				
December 3, 1985				
0915	44.80	-	-	Start of flow.
0918	-	86.8	472	11/
0927	-	86.8	-	
0930	15.15	84.1	3,230	
0940	16.25	78.5	5,140	
0950	15.92	78.5	5,000	
1000	15.44	78.5	5,080	
1015	14.75	78.5	5,220	
1030	16.88	72.4	5,390	
1045	16.85	72.4	5,380	
1100	16.55	72.4	5,440	
1115	16.47	72.4	5,400	
1130	16.25	72.4	5,570	
1145	16.12	72.4	5,680	
1200	15.88	72.4	5,640	
1215	15.84	72.4	5,700	
1230	15.82	72.4	5,810	
1245	15.82	72.4	5,810	
1300	15.45	72.4	5,900	
1315	15.39	72.4	5,860	End of flow,
1316	37.15	-	-	begin recovery.
1317	37.88	-	-	
1318	37.18	-	-	
1319	38.69	-	-	
1320	38.85	-	-	
1321	39.15	-	-	
1322	39.30	-	-	
1323	39.39	-	-	
1325	39.69	-	-	
1330	40.29	-	-	
1335	40.68	-	-	
1340	41.02	-	-	
1345	41.26	-	-	
1355	41.69	-	-	
1405	41.97	-	-	
1415	42.21	-	-	
1430	42.44	-	-	
1445	42.69	-	-	
1500	42.82	-	-	End of test.
Open interval depth: 832-1,056 feet				
Test number: 5				
December 3, 1985				
1515	42.96	-	-	Start of flow.
1520	11.80	3/1,150	794	
1525	11.50	3/1,150	791	
1530	11.50	3/1,150	-	
1540	11.48	3/1,150	790	
1550	11.46	3/1,150	-	
1600	11.46	3/1,150	782	
1615	11.44	3/1,150	785	
1630	11.27	3/1,150	787	
1645	11.24	3/1,150	787	
1700	11.28	3/1,150	786	
1715	11.24	3/1,150	787	
1730	11.27	3/1,150	787	
1745	11.27	3/1,150	784	
1800	11.15	3/1,150	777	
1815	11.12	3/1,150	784	End of flow,
1816	-			begin recovery.
1817	47.66			
1818	47.80			
1819	47.90			
1820	48.02			
1821	48.10			
1822	48.14			
1823	48.19			
1825	48.27			
1830	48.42			
1835	48.50			

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 10/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-524 (C-1)				
Open interval depth: 832-1,056 feet				
Test number: 5--Continued				
December 3, 1985--Continued				
1840	48.54			
1845	48.57			
1855	48.58			
1905	48.68			
1915	48.80			End of test
Open interval depth: 1,240-1,396 feet				
Test number: 6				
December 4, 1985				
0830	-	-	-	Start of flow.
0835	11.2	33.3	505	
0840	11.2	-	-	
0845	11.2	29.7	488	
0850	11.2	28.6	2,070	
0900	11.2	28.0	5,000	
0910	11.2	-	5,240	
0920	11.2	25.9	5,510	
0930	11.2	26.5	5,560	
0945	11.2	27.3	5,670	
1000	11.2	27.8	5,710	
1015	11.2	27.8	5,740	
1030	11.2	27.3	5,870	
1045	11.2	28.0	5,860	
1100	11.2	25.4	5,920	
1115	11.2	24.8	5,990	
1130	11.2	26.8	5,840	
1145	11.2	25.0	5,890	
1200	11.2	23.1	5,840	
1215	11.2	24.6	5,890	
1230	11.2	-	5,870	End of flow,
1231	37.0	-	-	begin recovery.
1232	38.23	-	-	
1233	38.85	-	-	
1234	39.15	-	-	
1235	39.35	-	-	
1236	39.65	-	-	
1237	39.75	-	-	
1238	39.90	-	-	
1240	40.20	-	-	
1245	40.72	-	-	
1250	41.04	-	-	
1300	41.35	-	-	
1310	41.65	-	-	
1320	41.80	-	-	
1330	41.90	-	-	
1340	42.02	-	-	
1350	42.08	-	-	
1400	42.13	-	-	
1410	42.20	-	-	
1420	42.27	-	-	
1430	42.31	-	-	End of test
Open interval depth: 832-1,240 feet				
Test number: 7				
December 4, 1985				
1435	11.46	3/1,170	820	Start of flow.
1440	11.44	3/1,170	822	
1445	11.23	3/1,170	817	
1450	11.23	3/1,170	820	
1455	10.91	3/1,170	823	
1500	10.85	3/1,170	825	
1510	10.78	3/1,170	822	
1520	10.87	3/1,170	824	
1530	10.77	3/1,170	826	
1540	10.63	3/1,170	826	
1550	10.48	3/1,170	828	
1600	10.51	3/1,170	830	
1610	10.47	3/1,170	831	

See footnotes at end of table.

Table 7.--Field data for interval flow tests--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 10/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-524 (C-1)--Continued				
Open interval depth: 832-1,240 feet				
Test number: 7--Continued				
December 4, 1985--Continued				
1620	10.40	3/1,170	831	
1630	10.11	3/1,170	826	End of flow,
1631	47.40			begin recovery.
1632	47.69			
1633	47.86			
1634	48.00			
1635	48.12			
1636	48.23			
1637	48.25			
1638	48.29			
1640	48.34			
1645	48.50			
1650	48.57			
1655	48.66			
1700	48.70			
1710	48.74			
1720	48.76			
1730	48.52			End of test.
Well: AY-68-37-524 (C-1)				
Open interval depth: 840-882 feet				
Test number: 8				
January 31, 1986				
1724	45.54	-		
1727	45.50	-		
1729	45.50	-		
1730	-	-		Start of flow.
1731	14.52	-		13/
1732	14.51	-		
1733	14.52	-		
1734	14.51	42.1		
1735	14.51	-		
1736	14.52	-		
1737	14.52	-		
1738	14.52	42.1		
1739	14.51	-		
1740	14.52	42.1		
1742	14.53	-		
1745	14.54	-		
1750	14.54	42.1		
1755	14.54	-		
1800	14.53	42.4		
1810	14.53	42.4		
1820	14.53			
1830	14.54			End of flow,
1831	45.62			begin recovery.
1832	45.64			
1833	45.70			
1834	45.75			
1835	45.80			
1836	45.83			
1837	45.86			
1838	45.89			
1839	45.91			
1840	45.94			
1842	46.00			
1845	46.10			
1900	46.42			
1915	46.66			End of test.
Well: AY-68-37-525 (C-2)				
Open Interval depth: 1,049-1,150 feet				
Test number: 1				
January 20, 1986				
1030	46.24	-	-	
1033	46.37	-	-	Start of flow.
1035	24.90	39	5,100	
1040	24.25	40	5,720	
1050	23.20	40	5,790	
1100	23.27	40	5.650	

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 4/ (gal/min)	Specific conductance (µS/cm	Remarks
Well: AY-68-37-525 (C-2)--Continued				
Open Interval depth: 1,049-1,150 feet				
Test number: 1--Continued				
January 20, 1986--Continued				
1110	23.23	40	5,780	
1120	23.23	40	5,710	
1130	23.22	40	5,710	
1140	23.26	40	5,680	
1200	23.22	40	5,750	
1230	23.28	40	5,750	
1300	23.18	40	5,680	
1330	22.97	40	5,720	
1400	22.94	40	5,720	
1430	22.94	40	5,140	
1435	-			End of flow,
1436	43.07			begin recove
1437	43.81			
1438	44.35			
1439	44.46			
1440	44.79			
1441	44.96			
1445	45.37			
1450	45.65			
1455	45.79			
1500	45.89			
1510	45.99			
1520	46.03			
1530	46.04			
1540	46.05			
1550	46.04			
1600	46.08			
1615	46.10			
1625	46.09			
1635	46.10			End of test.
Open interval depth: 1,072-1,150 feet				
Test number: 2				
January 22, 1986				
1315	46.64	-		
1321	46.67	-		
1323	46.68	-		
1324:30	46.69	-		
1325	-	-		Start of flo
1326	16.25	-		12/
1327	16.88	-		
1328	17.05	-		
1329	17.07	-		
1330	-	-		
1331	17.09	28.6		
1332	17.12	-		
1333	17.11	-		
1334	17.09	27.3		
1335	17.12	-		
1337	17.11	27.9		
1340	17.09	27.9		
1345	17.09	27.9		
1350	17.09	27.9		
1355	17.07	28.6		
1400	17.07	-		
1405	17.07	-		
1415	17.02	28.6		
1425	17.03			End of flow,
1426	44.70			begin recove
1427	45.09			
1428	45.42			
1429	45.57			
1430	45.67			
1431	45.77			
1432	45.84			
1433	45.88			
1434	45.94			
1435	45.98			
1437	46.02			
1440	46.08			
1445	46.13			
1450	46.15			
1455	46.16			End of test.

See footnotes at end of table.

Table 7.--Field data for interval flow tests--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 10/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-526 (D-1)				
Open interval depth: 1,158-1,384 feet Test number: 1				
March 25, 1986				
0900	22.30	-	-	
0905	21.67	-	-	
0910	-	-	-	Start of flow.
0912	12.41	37.7	-	
0915	12.41	37.7	-	
0920	12.45	37.7	480	
0940	12.44	33.8	1,480	
1000	12.33	33.8	1,593	
1020	12.29	33.8	1,732	
1040	12.27	33.0	1,779	
1100	12.26	33.0	1,798	
1120	12.26	33.0	1,853	
1140	12.22	32.2	1,867	
1200	12.20	32.2	1,901	
1220	12.20	31.4	1,900	
1240	12.20	31.4	1,916	
1300	12.18	31.4	1,905	
1320	12.19	30.6	1,903	
1340	12.18	30.6	1,884	
1400	12.19	30.6	1,883	
1420	12.18	30.6	1,855	
1440	12.17	30.6	1,877	
1500	12.17	30.6	1,876	
1520	12.17	30.6	1,873	
1540	12.19	30.6	1,875	
1600	12.18	30.6	1,862	
1610	12.19	30.6	1,862	End of flow,
1611	18.85			begin recovery.
1612	18.89			
1614	18.90			
1616	18.90			
1618	18.91			
1620	18.91			
1625	18.91			
1630	18.92			
1635	18.91			
1640	18.92			
1645	18.90			
1650	18.89			
1655	18.88			
1700	18.88			
1705	18.89			
1710	18.89			End of test.
Open interval depth: 1,225-1,384 feet Test number: 2				
March 26, 1986				
0718	20.50	-	-	
0720	11.88	-	-	Start of flow.
0740	11.12	5.9	-	
0800	11.19	5.6	482	
0820	11.15	5.0	473	
0840	11.06	4.8	480	
0900	11.00	4.4	452	
0920	10.88	4.0	590	
0940	10.82	3.6	3,840	
1000	10.80	3.4	6,100	
1020	10.77	3.3	6,230	
1040	10.75	3.3	6,220	
1100	10.73	3.2	6,250	
1130	10.72	3.1	6,250	
1200	10.70	3.1	6,300	
1230	10.67	3.0	6,310	
1300	10.68	3.0	6,330	

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 10/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-526 (D-1)--Continued				
Open interval depth: 1,225-1,384 feet Test number: 2--Continued				
March 26, 1986--Continued				
1330	10.66	2.8	6,300	
1400	10.65	2.8	6,370	
1430	10.64	2.8	6,290	
1500	10.64	2.7	6,370	
1530	10.63	2.8	6,400	
1600	10.44	2.6	6,380	End of flow,
1601	13.48			begin recovery.
1602	13.69			
1604	13.80			
1606	13.90			
1608	13.98			
1610	14.03			
1615	14.09			
1620	14.11			
1625	14.13			
1630	14.17			
1635	14.18			
1640	14.19			
1645	14.19			
1650	14.20			
1655	14.20			
1700	14.20			End of test
Open interval depth: 1,040-1,384 feet Test number: 3				
March 27, 1986				
0644	21.15	-	-	
0650	21.11	-	-	Start of flow.
0652	13.98	60	-	
0700	14.56	60	467	
0720	14.50	60	450	
0740	15.00	60	487	
0800	15.60	60	476	
0805	13.90	71	-	
0830	13.93	71	482	
0900	13.91	71	482	
0930	13.60	71	479	
1000	13.56	70	479	
1030	13.52	69	480	
1100	13.45	68	478	
1130	13.4	67	472	
1200	13.5	66	470	
1230	13.4	65	468	
1300	13.3	65	478	
1330	13.28	65	478	
1400	13.26	64	472	
1430	13.25	64	471	
1500	13.20	64	474	End of flow,
1501	18.58			begin recovery
1502	18.57			
1504	18.56			
1506	18.56			
1508	18.55			
1510	18.54			
1515	18.53			
1520	18.53			
1525	18.52			
1530	18.53			
1535	18.51			
1540	18.51			
1545	18.51			
1550	18.51			
1555	18.50			
1600	18.49			End of test.

See footnotes at end of table.

Table 7.--Field data for interval flow tests--Continued

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 4/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-526 (D-1)				
Open interval depth: 1,148-1,223 feet				
Test number: 4				
April 1, 1986				
2100	17.29	-		Start of flow.
2102	14.38	7.5		15/16/
2103	14.39	-		
2104	14.40	-		
2105	14.40	-		
2107	14.41	7.5		
2110	14.43	7.7		
2115	14.46	7.5		
2120	14.50	7.7		
2125	14.51	-		
2130	14.53	7.5		
2131	14.53			
2132	-			End of flow,
2133	17.45			begin recovery.
2134	17.45			
2135	17.45			
2137	17.46			
2140	17.46			
2145	17.36			
2150	17.33			
2155	17.32			
2200	17.31			End of test.
Well: AY-68-37-527 (D-2)				
Open interval depth: 873-926 feet				
Test number:				
May 5, 1986				
1730	12.43	-	-	
May 6, 1986				
0510	-	-	-	
0520	13.00	-	-	
0525	-	-	-	
0540	13.11	-	-	
0550	-	-	-	
0600	13.20	-	-	Start of test.
0605	8.38	351		

Date and time	Water level 1/ above land-surface datum (ft)	Discharge 14/ (gal/min)	Specific conductance (µS/cm)	Remarks
Well: AY-68-37-527 (D-2)--Continued				
Open interval depth: 873-926 feet				
Test number: 1				
May 6, 1986--Continued				
0620	8.46	351	484	
0640	8.29	351	492	
0700	8.36	351	491	
0720	8.10	351	493	
0740	7.98	351	493	
0800	7.90	351	493	
0820	7.82	351	493	
0840	7.79	351	493	
0900	7.79	351	492	
0920	7.79	351	492	
0940	7.58	351	493	
1000	7.54	351	490	
1020	7.45	351	492	
1040	7.42	351	493	
1100	7.47	351	493	
1120	7.48	351	493	
1140	7.44	351	493	
1200	7.38	345	492	
1220	7.38	345	493	
1240	7.35	345	493	
1300	7.32	345	490	End of flow,
1301	12.00			begin recovery
1302	12.10			
1304	11.80			
1306	11.70			
1308	11.75			
1310	11.75			
1315	11.74			
1320	11.73			
1325	11.80			
1330	11.80			
1335	11.80			
1340	11.81			
1400	11.80			
1420	11.79			
1440	11.63			
1500	11.55			
1520	11.53			
1540	11.50			
1600	11.46			End of test.

1/ Water levels determined by direct readings.
2/ Water levels determined by pressure transducer.
3/ Discharge determined by manometer with 10-inch pipe x 8-inch orifice.
4/ Discharge determined volumetrically.
5/ Discharge determined by manometer with 4-inch pipe x 2.5 inch orifice.
6/ Discharge determined by manometer with 8-inch pipe x 5-inch orifice.
7/ Well A-1 completed with gravel packed, screened interval (screen at 1,215-1,265 feet.
8/ Well A-2 completed with gravel packed, screened interval (screen at 1,013-1,067 feet.
9/ Well A-3 completed with gravel packed, screened interval (screen at 1,112-1,164 feet).
10/ Discharge determined by manometer with 4-inch pipe x 2-inch orifice.
11/ 832-1,056 feet leaking approximately 50 gal/min during test.
12/ Well C-2 completed with gravel packed screened interval (screen at 1,089-1,140 feet).
13/ Well C-1 completed with nonscreened, open interval.
14/ Discharge determined by manometer with 6-inch pipe x 4-inch orifice.
15/ Well D-1 completed with gravel packed, screened interval (screen at 1,156 -1,209 feet).
16/ Test run from 1921 to 2121 hours; flowing water levels were inaccurate from 1921 to 2100 hours.

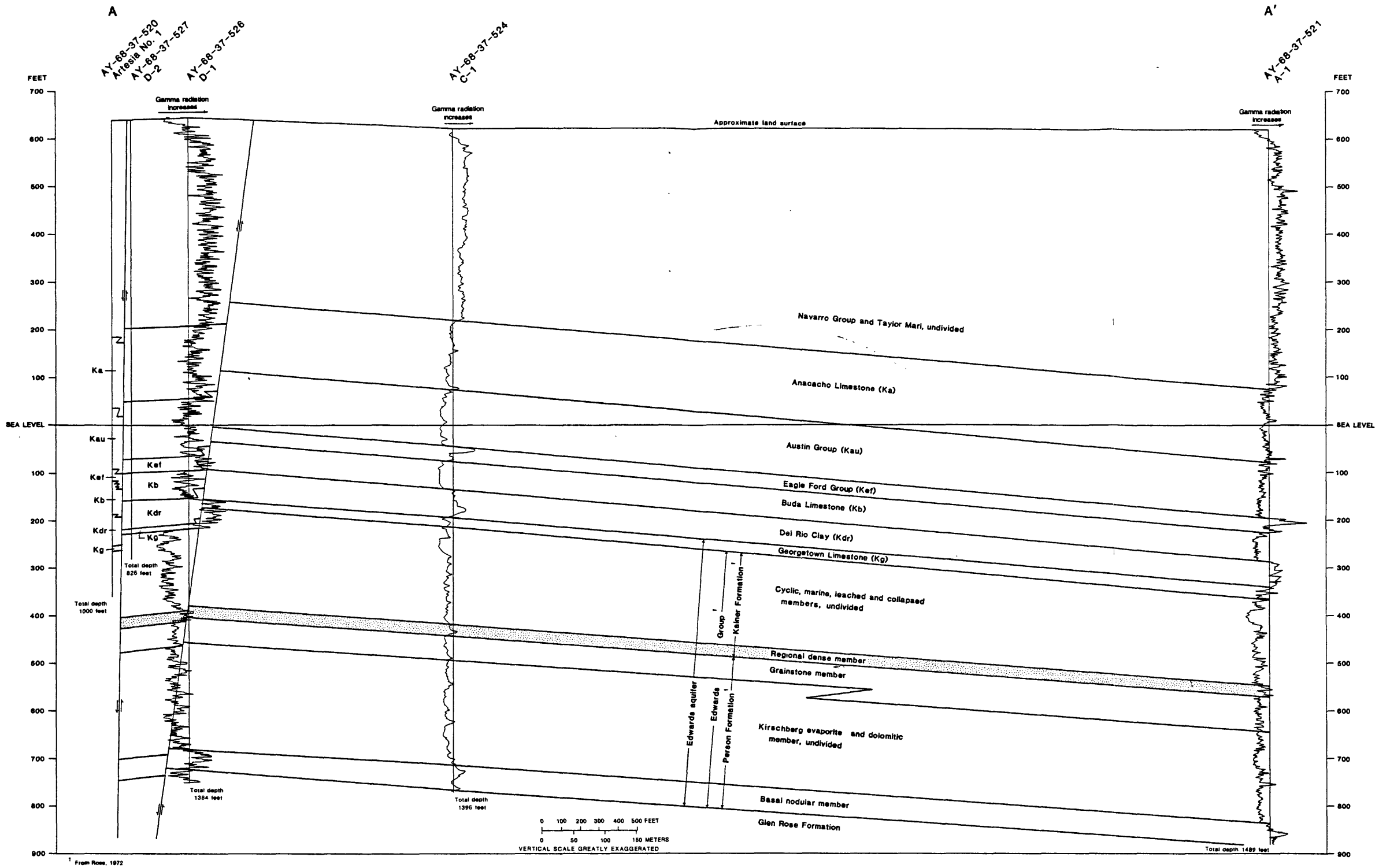
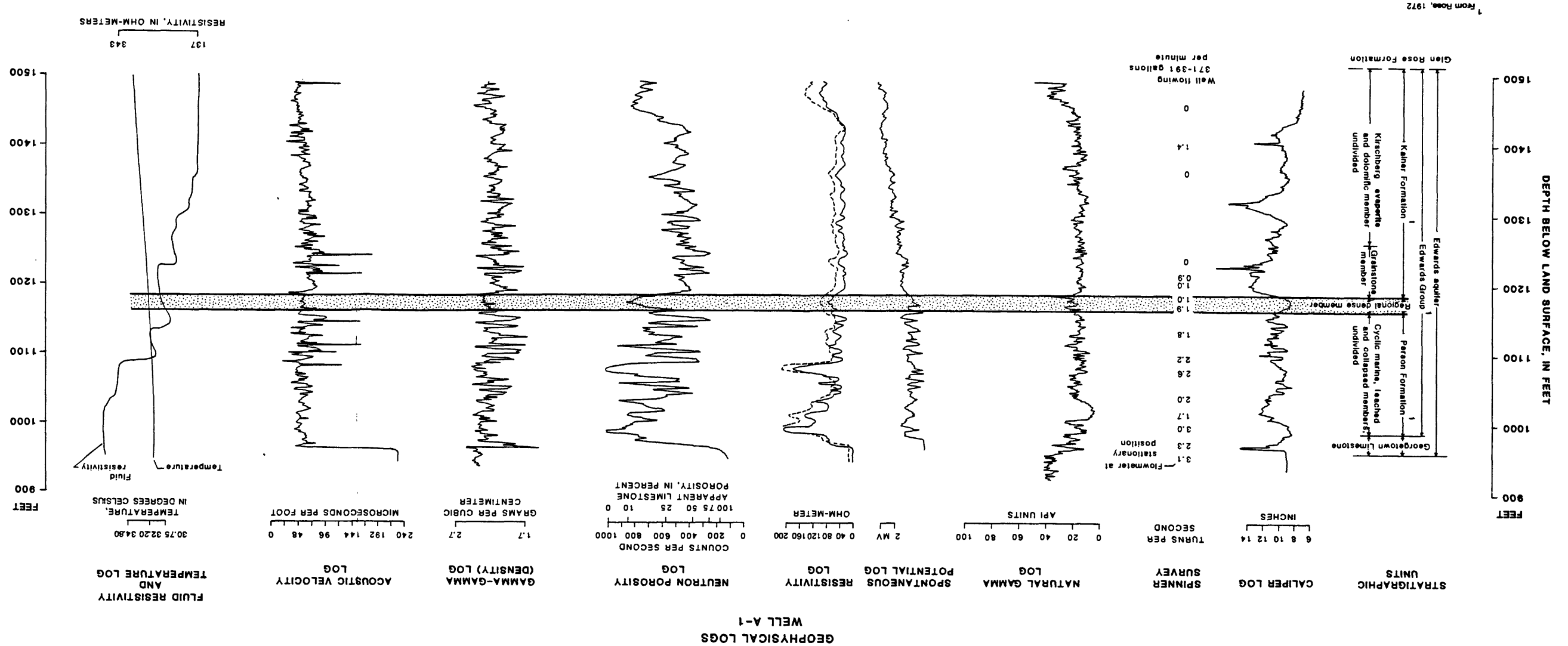


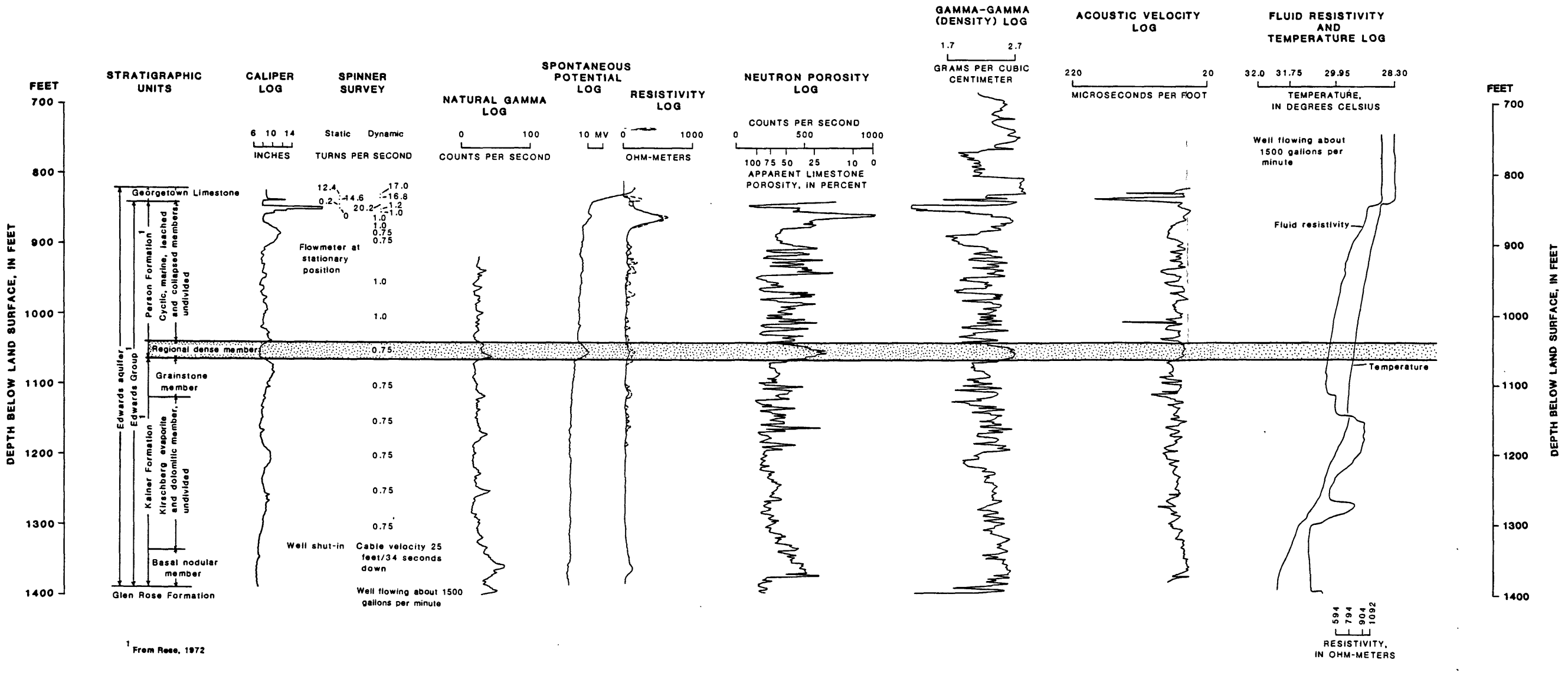
Figure 4.--Hydrogeologic section through well sites.



GEOPHYSICAL LOGS
WELL A-1

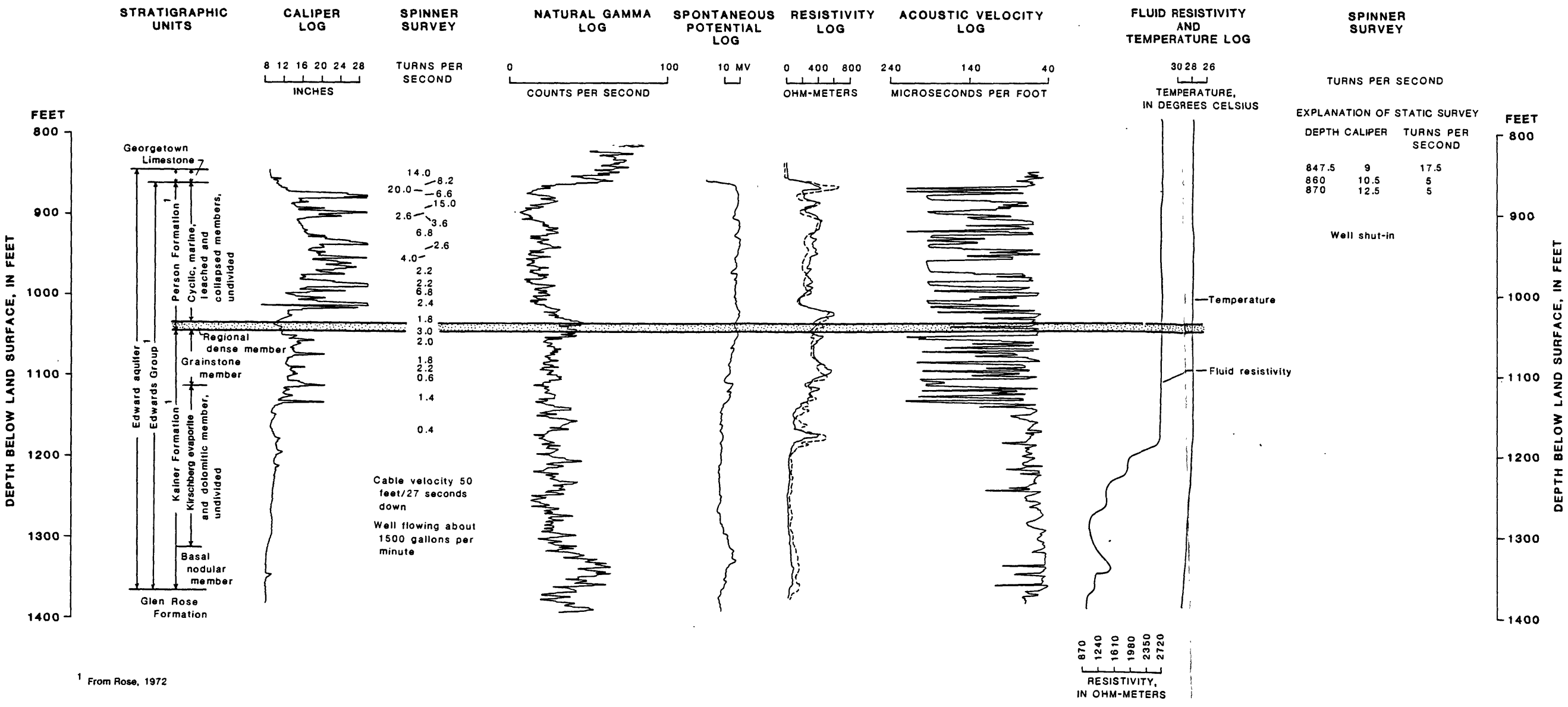
[1] From Rose, 1972

GEOPHYSICAL LOGS
WELL C-1



[1] From Reese, 1972

GEOPHYSICAL LOGS
WELL D-1



[1] From Rose, 1972