UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

HYDROGEOLOGIC DATA FOR THE BEAR CREEK SUBSURFACE-INJECTION TEST SITE, ST. PETERSBURG, FLORIDA

By J. J. Hickey and G. L. Barr

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Prepared in cooperation with the

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UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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CONVERSION FACTORS

Factors for converting U.S. inch-pound units to metric units are shown to four significant figures.

U.S. inch-pound units	Multiply by	To obtain metric units
inch (in)	2.540×10^{1}	millimeter (mm)
foot (ft)	3.048×10^{-1}	meter (m)
mile (mi)	1.609	kilometer (km)
gallon (gal)	3.785	liter (L)
	3.785×10^{-3}	cubic meter (m^3)
gallon per minute (gal/min)	6.309×10^{-1}	liter per second (L/s)
foot squared per day (ft^2/d)	9.290×10^{-2}	meter squared per day (m^2/d)
gallon per day per foot [(gal/d)/ft]	1.240×10^{-2}	meter squared per day (m^2/d)
pound per square inch (lb/in^2)	6.8948×10^{3}	Newtons per square meter (N/m^2)
pound per square foot (lb/ft^2)	4.788×10^{1}	Newtons per square meter (N/m^2)
foot per day (ft/d)	3.048×10^{-1}	meter per day (m/d)
gallon per minute per foot of drawdown [(gal/min)/ft]	2.070×10^{-1}	liter per second per meter [(L/s)/m]
microsecond per foot (ms/ft)	3.280	microsecond per meter (ms/m)

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ABSTRACT

Lithologic, hydraulic, geophysical, and water-quality data were collected at the Bear Creek subsurface-injection test site. The data will assist in evaluating the feasibility of subsurface injection of storm runoff.

An exploratory hole and five observation wells were constructed at this site between October 1974 and April 1976. The exploratory hole, drilled to 1,290 feet below land surface, was the second exploratory hole drilled at the test site. The first, 540 feet distant, was 3,504 feet deep. The observation wells constructed within the second exploratory hole ranged in depth between 340 to 1,267 feet.

The lithology of the upper 185 feet at the test site is predominantly sand and marl. From 185 to 3,504 feet, limestone and dolomite predominate. Below 1,290 feet, gypsum is also present.

Vertical intrinsic permeability of cores extracted during the drilling of the second exploratory hole ranges from 1.20×10^{-8} to 9.87×10^{-14} centimeters squared. Porosity of the cores ranges from 0.5 to 39.5 percent. Compressibility of the cores ranges from 1.2×10^{-5} to 1.5×10^{-7} square inches per pound.

A 73-hour withdrawal test was run in the test injection well. Water was pumped at a rate of 3,450 gallons per minute. At the site, chloride concentration in water from 192 to 340 feet ranged from 150 to 680 milligrams per liter, and from 500 to 1,267 feet ranged from 16,000 to 20,000 milligrams per liter. The chloride concentrations in water from 11 additional wells near the test site ranged from 72 to 1,100 milligrams per liter. The wells were 45 to 400 feet deep.

INTRODUCTION

The city of St. Petersburg, a municipality within Pinellas County, Florida, is experiencing a rapid population growth with increased water-supply demands. Limits have been placed on ground-water withdrawals from the city's well fields which has caused the city to investigate the potential for subsurface storage of storm runoff at the Bear Creek site (fig. 1). The city would like to create a potential water resource for future non-potable use.

The city of St. Petersburg and the State of Florida Department of Natural Resources drilled a test injection well at the Bear Creek site between October 1972 and April 1974 (Black, Crow and Eidsness, 1974). A stream intake structure for the test injection well was completed in 1976. At present (1978), long-term injection of storm runoff has not been performed.

Five observation wells, within 540 ft (feet) of the test injection well, were completed by the city in April 1976. Data collected during the construction of the observation wells and a subsequent withdrawal test on the injection well is the principal subject of this report.

The U.S. Geological Survey, in cooperation with the city of St. Petersburg, is investigating storage of storm runoff in permeable saline water zones within the carbonate rocks that underlie the Bear Creek test injection site (fig. 1). The U.S. Geological Survey's principal interest in this investigation is to understand and to document the hydrodynamic and chemical behavior of the stored water.

Purpose and Scope

This report presents the hydrogeologic data collected during the test drilling and withdrawal testing at the Bear Creek test site. The data, presented in tables and illustrations, include lithologic descriptions and laboratory analyses of drill cuttings and cores, results of a withdrawal test, hydrographs, geophysical logs, and chemical analyses.

The data were collected from the Bear Creek site to assist in the evaluation of the following objectives: (1) determine if there are transmissive zones which can accept large volumes of storm runoff; (2) determine the water-quality profile at the site; (3) evaluate effects of well injection on freshwater; and (4) design a long-term monitoring program. These and other determinations will be given in subsequent interpretive reports.

To achieve these objectives, an exploratory hole and five observation wells were constructed and a withdrawal test was run on a previously constructed injection test well. Water samples were collected from wells at the test site and also from selected wells near the site. These samples were analyzed for water quality.

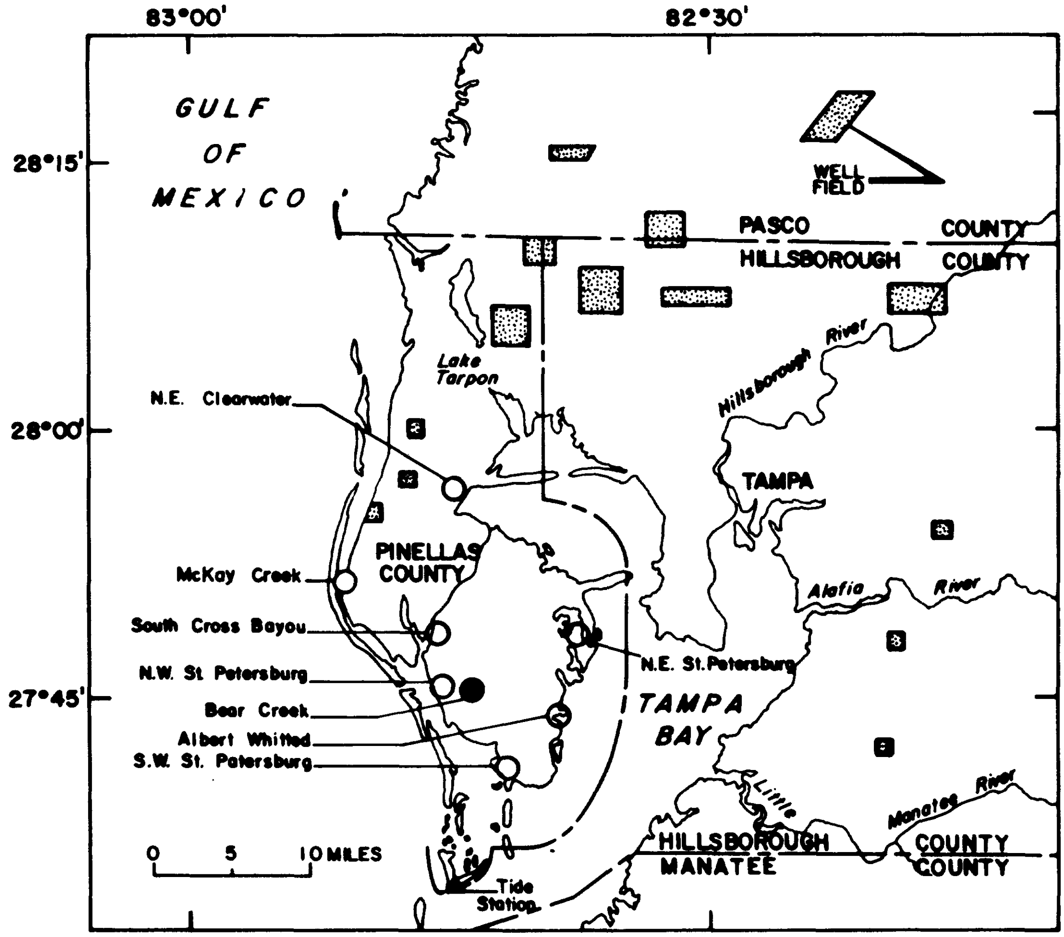

Figure 1.--Location of the Bear Creek injection test site, other proposed injection sites, and Tampa Bay area municipal well fields.

Previous Investigations

Various aspects of the geology and hydrology of Pinellas County have been the subject of several previous investigations. Chen (1965) described the lithologies penetrated from 500 to 5,000 ft below land surface by an oil test hole in Pinellas County as part of his regional stratigraphic analysis of the Paleocene and Eocene rocks of Florida. Hydrologic investigations by Heath and Smith (1954), Cherry, Stewart and Mann (1970), and Black, Crow and Eidsness (1970), evaluated the upper carbonate rock section to depths of about 400 ft, principally from a water-supply point of view. Greenleaf and Telesca (1975) described the construction of wells at the South Cross Bayou test injection site. Black, Crow and Eidsness (1974) investigated the potential for storing storm-water runoff and recovering it from saline zones within the carbonate rocks at the Bear Creek site for the city of St. Petersburg, Florida, and the State of Florida Department of Natural Resources. As part of their investigation, an exploratory hole was drilled to a depth of 3,504 ft. They concluded that most of the zones capable of accepting large volumes of storm-water runoff were above a depth of 1,270 ft. In addition to other tests, two injection tests, each lasting 1 day, were run on a zone between 1,180 and 1,270 ft. A transmissibility of 800,000 (gal/d)/ft (transmissivity of 107,000 ft^2/d) for the test injection zone was reported. Rosenshein and Hickey (1977) discussed the vertical distribution of permeable zones within the carbonate strata underlying the Pinellas peninsula and their potential use for the storage of treated sewage effluent and storm water. Hickey (1977) presented the hydrogeologic data collected at the McKay Creek injection test site (fig. 1).

Regional Hydrogeologic Setting

The Tampa Bay area, including the Bear Creek test site, is underlain by carbonate strata to a depth of about 10,000 ft below land surface (Applin, 1951), except for a thin surficial cover of sand, marl, and clay. The upper 1,300 ft of the carbonate strata is highly transmissive and constitutes one of the most productive aquifers in the world--the Floridan aquifer. The transmissivity of the aquifer, where it is tapped for water supplies, is estimated to range from 32,000 ft^2/d to more than 270,000 ft^2/d (Rosenshein and Hickey, 1977). The aquifer is thought to be made up of permeable zones separated by carbonate strata of low permeability (Rosenshein and Hickey, 1977). The aquifer contains potable water in its entire thickness east and north of Tampa Bay. In general, the flow of potable ground water in the aquifer is toward the Gulf of Mexico and Tampa Bay.

The upper part of the carbonate strata in the Tampa Bay area generally is overlain by less than 200 ft of sand, marl, and clay. The clay commonly forms the basal strata of these surficial deposits and, in northwest Hillsborough County, is in part a weathered residue of the underlying carbonate rock. There, according to Sinclair (1974, p. 24-26), the clay has a vertical hydraulic conductivity of less than 0.003 ft/d.

The surficial sand is generally less than 35 ft thick and during dry weather is generally saturated to within 5 to 10 ft of the land surface. During wet weather, the water table in the sand is at or near land surface. The sand in northwest Hillsborough County has a horizontal hydraulic conductivity of 13 ft/d and a vertical hydraulic conductivity in the range of 0.36 ft/d to 13 ft/d (Sinclair, 1974, p. 13).

Summary of Bear Creek Test Site Data

Depth of exploratory holes	3,504 ft 1,290 ft
Test injection well	Cased to 1,016 ft, open hole to 1,270 ft
Observation wells	1 within injection zone 5 above injection zone
Lithology	0 to 185 ft; sand, clay, shell and marl 185 to 3,504 ft; limestone, and dolomite, gypsum present below 1,290 ft
Cored intervals	720 to 741 ft 760 to 770 ft 900 to 903 ft 905 to 920 ft 930 to 950 ft 1,140 to 1,150 ft
Vertical intrinsic permeability of cores	1.2×10^{-8} to 9.87×10^{-14} cm^2
Porosity of cores	0.7 to 39.5 percent
Compressibility of cores	1.5 to 10^{-7} to 1.2×10^{-5} in^2/lb
Hydraulic tests	1 withdrawal test at 3,450 gal/min
Chloride concentration	192 to 250 ft, 150 mg/L; 192 to 340 ft, 680 mg/L; 500 to 1,267 ft, 16,000 to 20,000 mg/L

WELL CONSTRUCTION

Exploratory hole E2 and five observation wells, B1, B2, B3, B4, and B5 (table 1), were constructed at the test site between October 1974 and April 1976. Already in existence at the site were test injection well A1, observation well A2, and exploratory hole E1. Black, Crow and Eidsness (1974) describe these wells. Figure 2 shows the location of the exploratory holes and wells at the site.

Prior Construction at the Test Site

Exploratory hole E1, injection well A1, and observation well A2 (table 1), were constructed about 2 years before the observation wells discussed in this report were drilled. Exploratory hole E1 (fig. 3), was drilled to 3,504 ft below land surface. Test injection well A1 (fig. 3) has a 16-in (inch) casing set at 1,016 ft below land surface and is open hole to 1,270 ft. Well A2 (fig. 3) has a 2-in casing and is open between 550 and 570 ft in the annulus of A1. There is also a plugged well (fig. 3) in the annulus of A1 with a 1-1/4-in galvanized pipe which was to have been open to the interval between 800 and 870 ft. This plugged well has no value and is unnumbered in table 1.

Exploratory Hole

Exploratory hole E2 was drilled during this investigation to a depth of 1,290 ft for preliminary identification of a permeable and semi-confining strata at the Bear Creek test site. Location of this well and other wells at the site is shown on figure 2. The upper 500 ft of hole was drilled with cable tool. From 500 to 1,290 ft, the hole was drilled with air-reverse rotary. A 20-in casing was driven and set at 192 ft and a 14-in casing was set at 500 ft with its annulus cemented back to 340 ft. From land surface to 192 ft and 500 to 780 ft, freshwater was periodically added to the hole to aid drilling.

During drilling with the cable tool equipment, the bit dropped 2 ft between 318 and 320 ft below land surface, probably because of a cavity in the limestone.

Cores were taken in some strata during the drilling of well E2. Descriptions and laboratory analyses of these cores are presented later in this report.

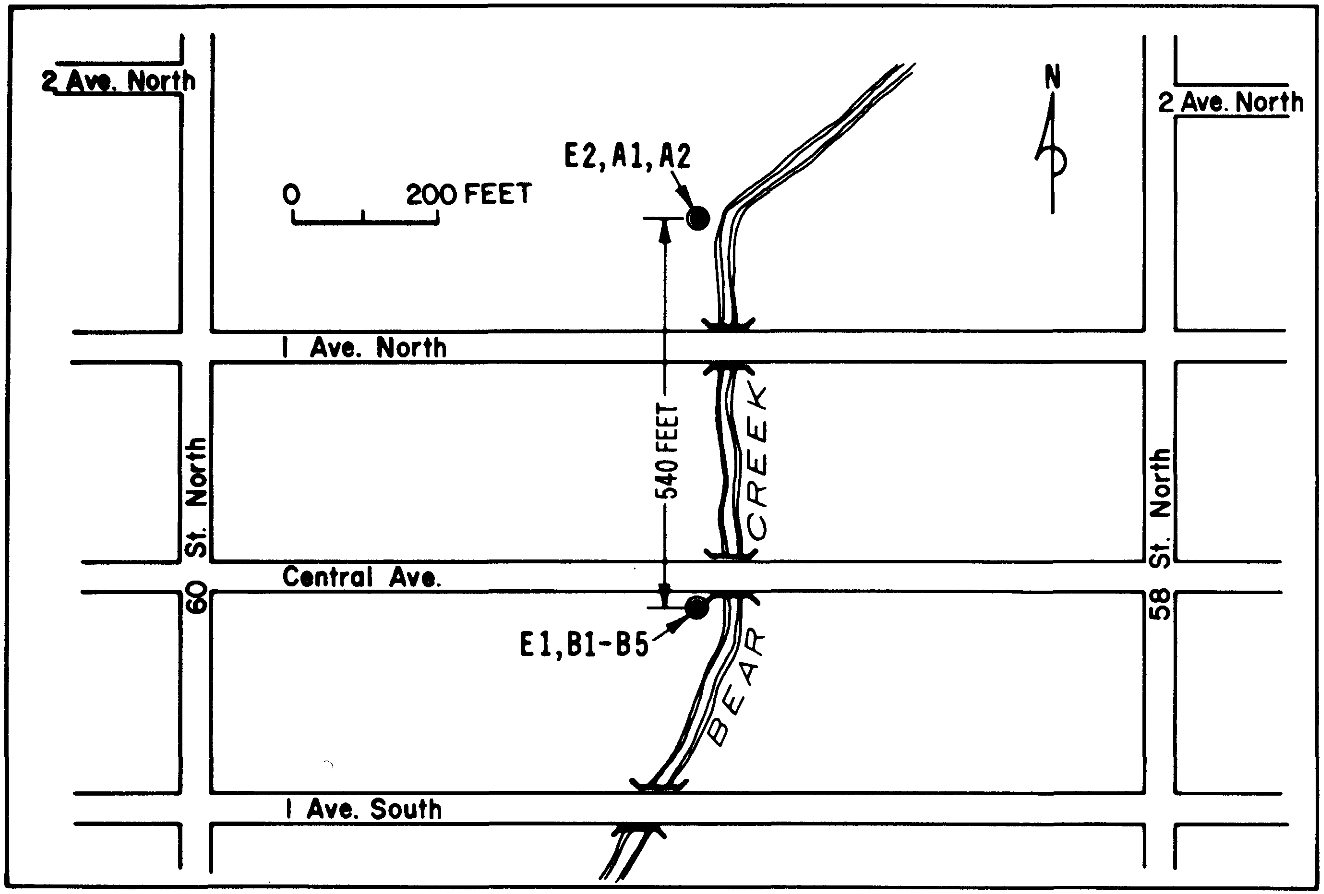

Figure 2.--Location of exploratory holes and wells at the test site.

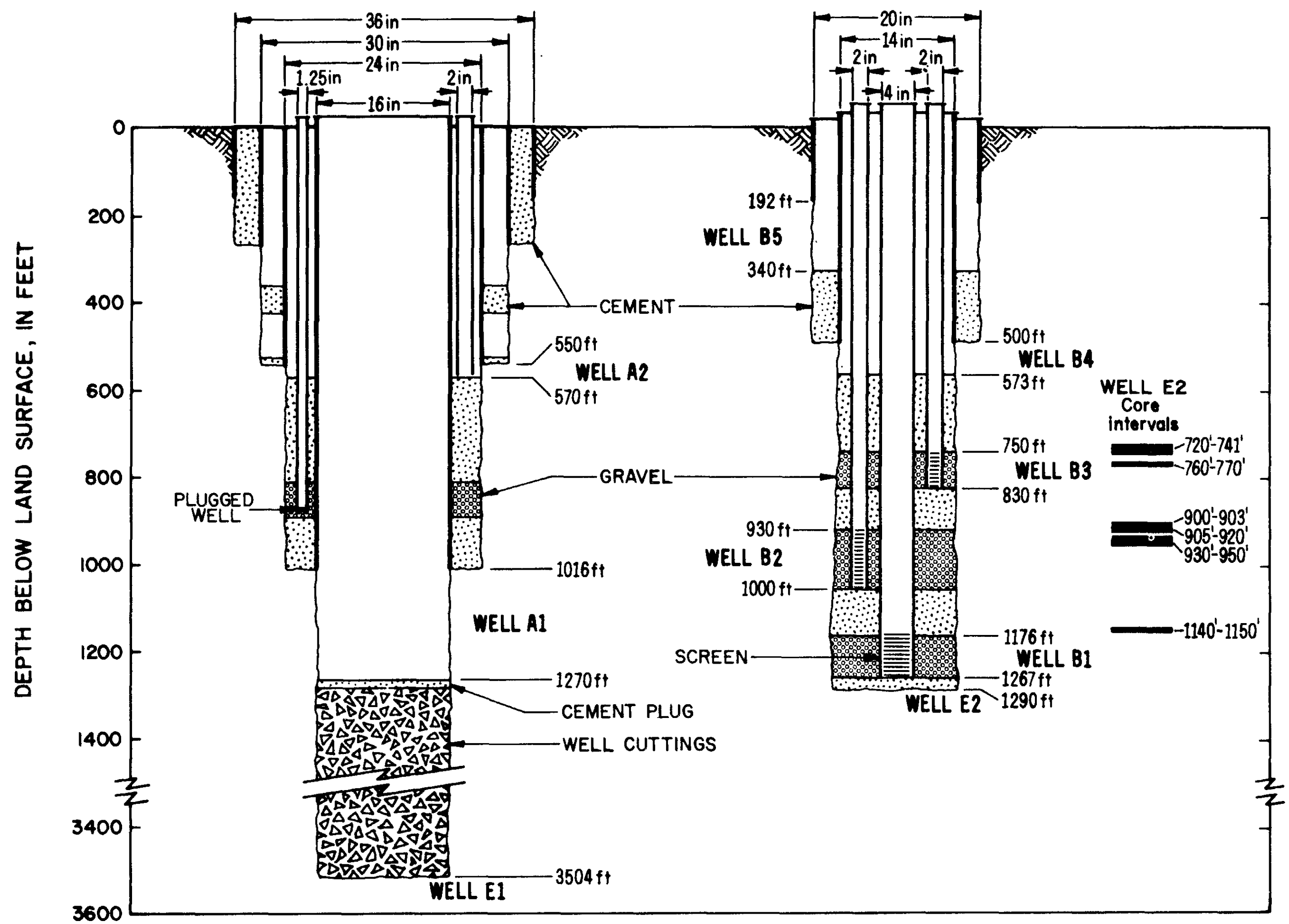

Figure 3.--Construction diagram of wells A1, A2, B1, B2, B3, B4, B5, E1 and E2.

Observation Wells

Five observation wells, B1, B2, B3, B4, and B5, were constructed in exploratory hole E2 from 192 ft to 1,267 ft below land surface (fig. 3). Exploratory hole E2, drilled to 1,290 ft, was plugged back to 1,267 ft with cement. Well B1 has a 4-in casing and monitors the depth interval between 1,170 and 1,267 ft. Well B2 has a 2-in casing and monitors the interval between 930 and 1,070 ft. Well B3 has a 2-in casing and monitors the interval between 750 and 830 ft. Well B4 has a 14-in casing and monitors the interval between 500 and 573 ft. Well B5 is the annular space between the 14-in and 20-in casings and monitors the interval between 192 and 340 ft. Wells B1, B2, and B3 have gravel packed intervals with stainless steel screens and wells B4 and B5 have open-hole intervals. The screen in well B2 became plugged after well construction and had to be perforated. All wells are separated by cement plugs between their screened or open-hole intervals. Wells B1, B2, B3, B4, and B5 are located 540 ft from test injection well A1 (fig. 2).

HYDROGEOLOGIC DATA

The data collected at the Bear Creek test injection site include lithologic descriptions of drill cuttings and cores, laboratory core analyses, specific capacity and withdrawal test results, water-level hydrographs, geophysical logs, and water analyses.

Drill Cuttings and Cores

Drill cuttings were collected every 5 ft from well E1 and every 10 ft from well E2. These cuttings have been forwarded, as required by state law, to the Florida State Bureau of Geology. The cuttings from well E1 are described in table 2, except for the interval between 50 to 130 ft which could not be identified. The drill cuttings from well E2 describe this interval as follows: 50 to 70 ft, sand; 70 to 110 ft, dark gray marl; 110 to 120 ft, dark gray clay; and from 120 to 130 ft, dark gray marl. A graphic lithologic log for well E1 and depth of cores from well E2 are shown in figure 4. A graphic lithologic log for well E2 is shown on the geophysical log illustrations discussed later in this report.

Cores of strata were taken during the drilling of well E2 for the following depth intervals: 720 to 741 ft (5 ft of core recovery), 760 to 770 ft (1 ft of core recovery), 900 to 950 ft (8.5 ft of core recovery), and 1,140 to 1,150 ft (3 ft of core recovery). Descriptions of these cores are given in table 3. Laboratory measurements of the cores

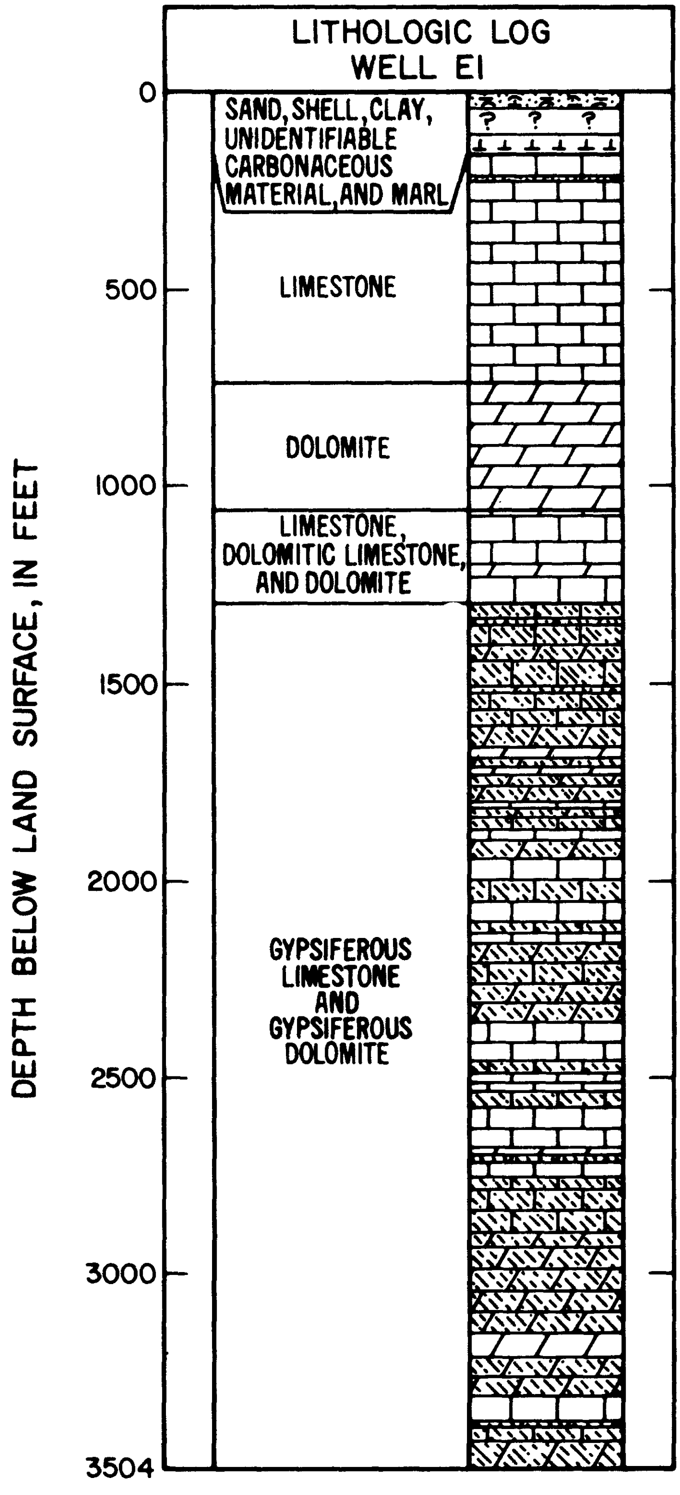

Figure 4.--Lithologic log of well E1.

included air and water vertical intrinsic permeability, porosity, interval transit time, and compressibility. The results of these measurements are presented in tables 4 through 6.

Specific Capacity Tests During Drilling of Well E2

Specific capacity tests were run on well E2 while it was being drilled. These data can be used to indicate major differences in permeability between intervals of drilled hole, from 192 to 1,290 ft below land surface. Table 7 lists the specific capacities in well E2.

Withdrawal Test

From May 18, 1976, to May 21, well A1 was pumped at a rate of 3,450 gal/min. During the 73-hour test, water levels were measured in wells A2, B1, B2, B3, B4, and B5. The measurements for A2 are shown in table 8 and for the remainder of the wells in table 9.

None of the water-level measurements obtained during the withdrawal test have been adjusted for natural fluctuations. These fluctuations, which have to be considered in preparing the data for hydraulic analysis, are caused by tidal changes in the Gulf of Mexico, periodic dilation of the rock column caused by earth tides, barometric pressure changes, and regional ground-water trends.

Hydrographs of wells A2, B1, and B2, which include the withdrawal test period, are shown on figure 5 and those of wells B3, B4, and B5 are shown on figure 6.

Geophysical Logs

Table 10 lists the geophysical logs run in well E2 and table 11 lists those run in well A1. Lithologic, caliper, and flowmeter logs for well A1 are shown on figure 7. For the upper part of well E2, lithologic, caliper, single point resistance, flowmeter, pumping temperature, and specific capacity logs are shown on figure 8, and for the lower part, lithologic, caliper, deep induction, static and pumping temperature, and specific capacity logs are shown on figure 9.

Chemical Analyses of Water from Selected Wells

Water samples from wells at the test site were collected and analyzed after all wells were constructed and again during the withdrawal test. Tables 12 through 14 show the results of these analyses.

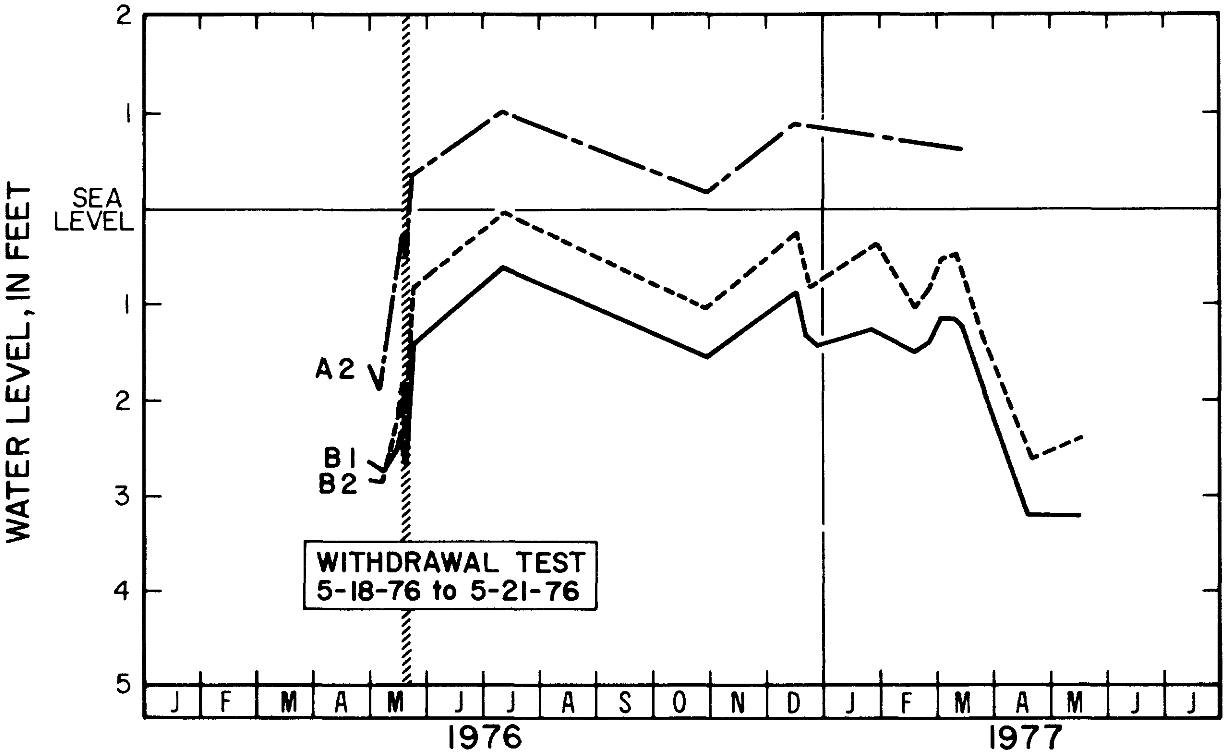

Figure 5.--Hydrographs of wells A2, B1, and B2, 1976-77.

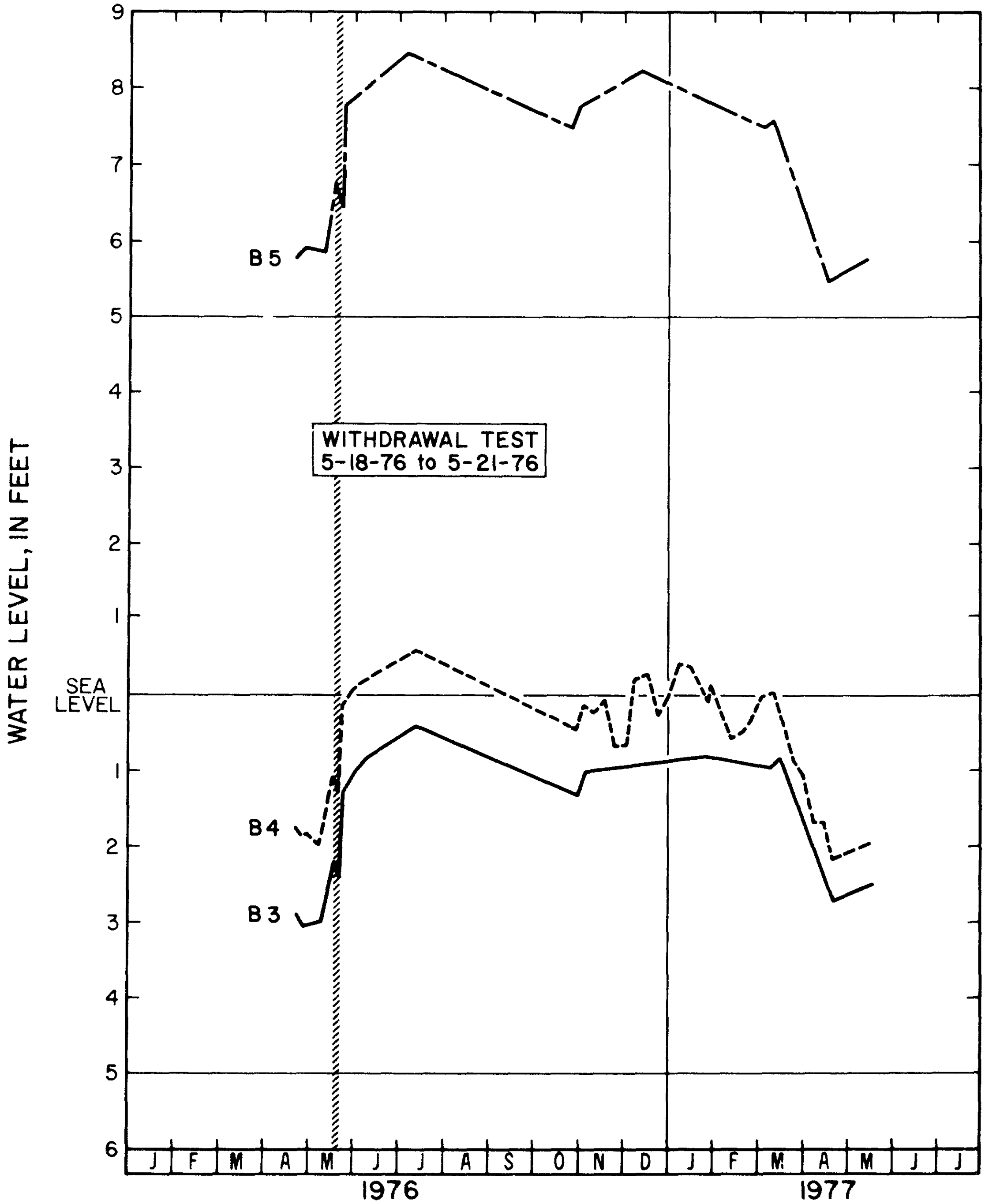

Figure 6.--Hydrographs of wells B3, B4, and B5, 1976-77.

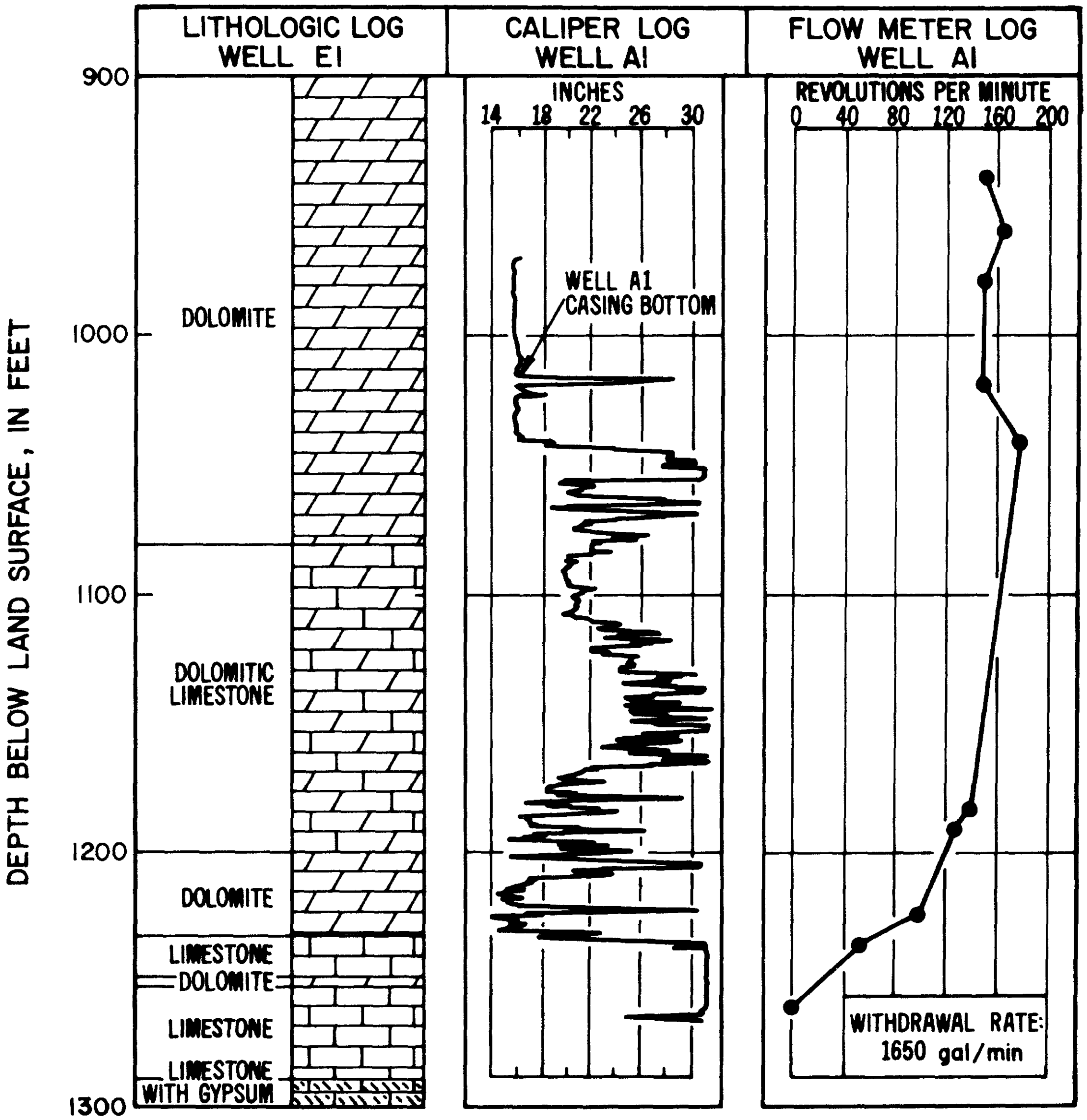

Figure 7.--Caliper and flowmeter logs of well A1.

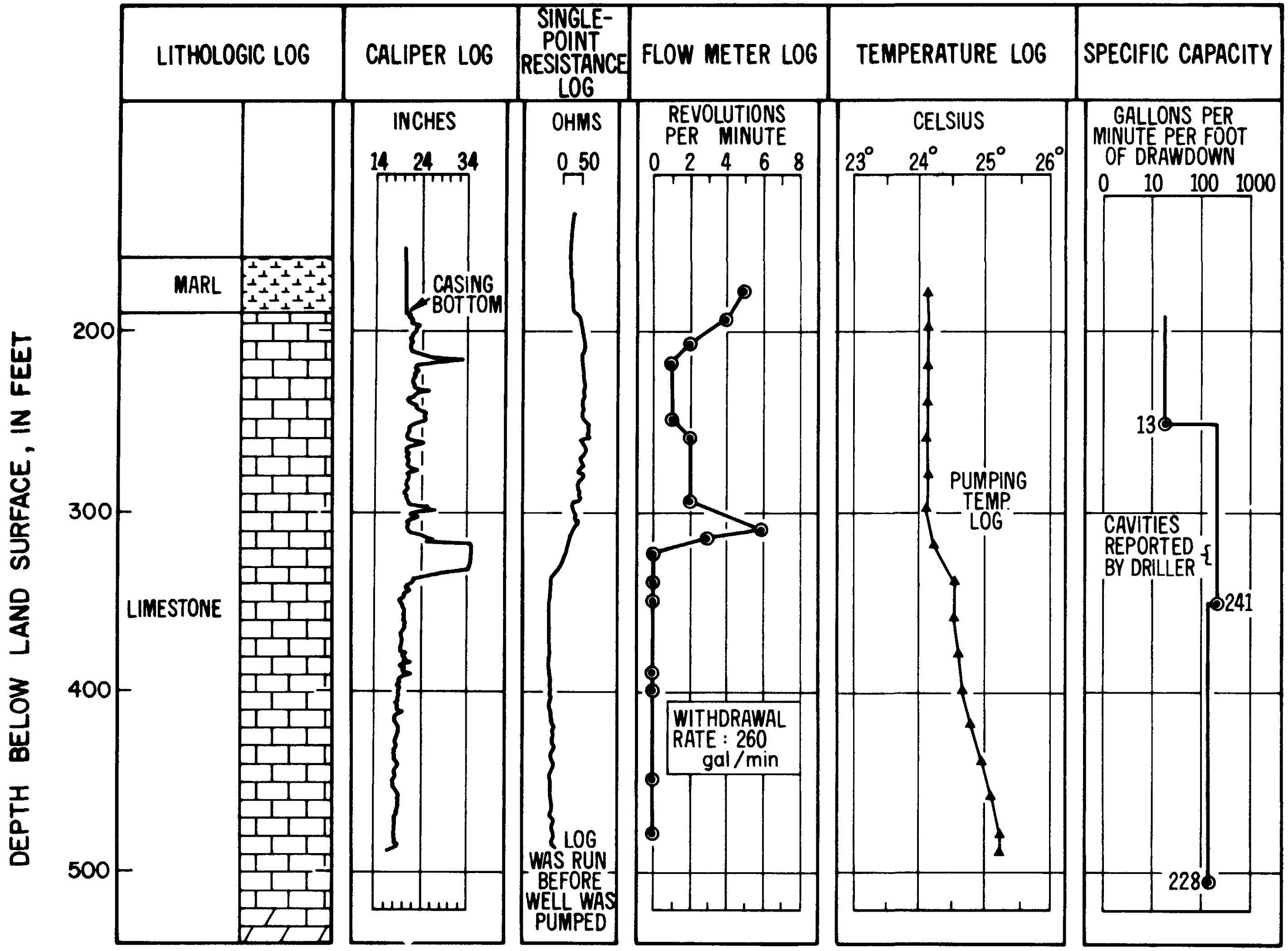

Figure 8.--Lithologic and geophysical logs of well E2, from 160 to 540 feet.

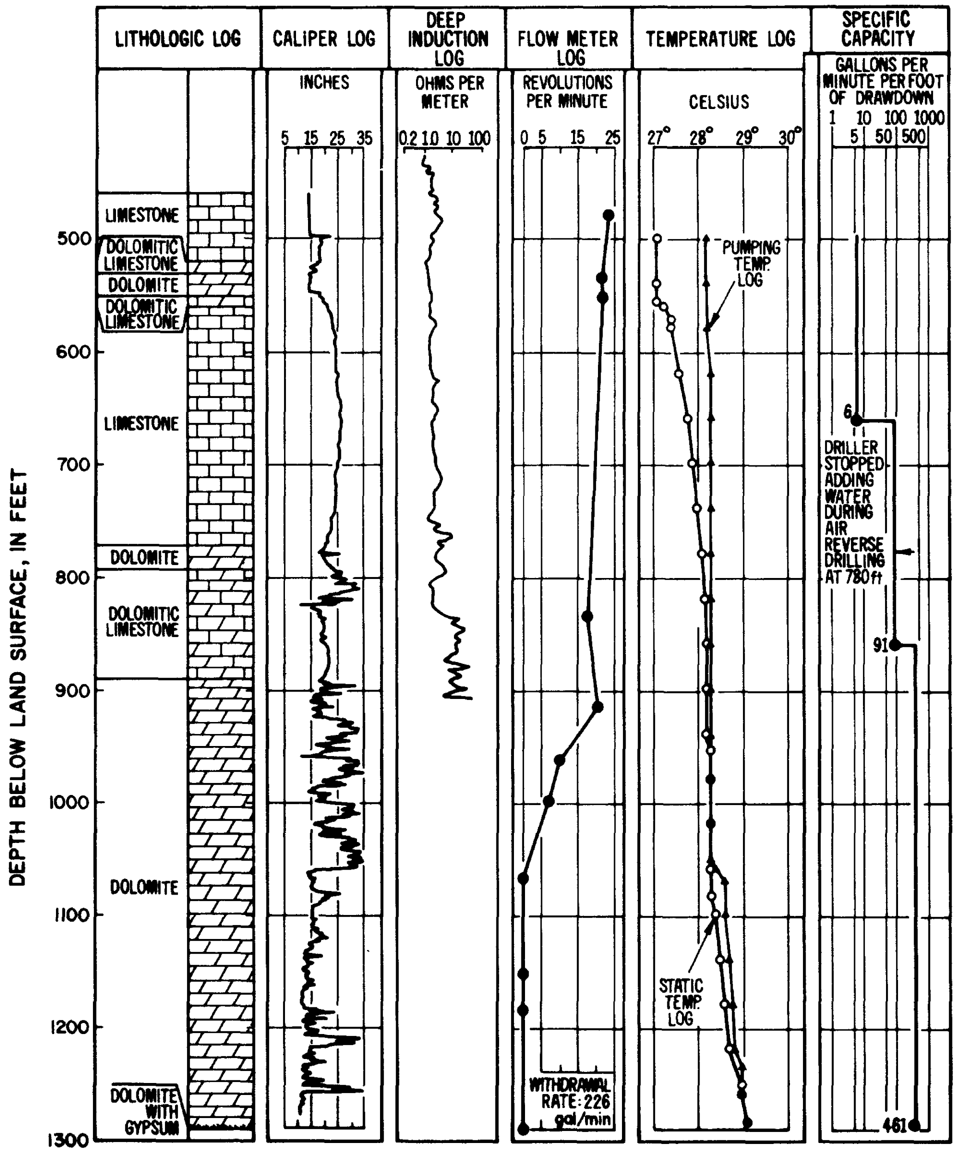

Figure 9.--Lithologic and geophysical logs of well E2, from 460 to 1,290 feet.

Concentration of chloride in water from wells at the site increase with depth. For example, from 192 to 340 ft the chloride concentration ranged from 150 to 680 mg/L (milligrams per liter), and from 500 to 1,267 ft it ranged from 16,000 to 20,000 mg/L.

The following water-quality sampling procedures were used at the wells. Each water sample was collected either with a centrifugal or a turbine pump. Before collecting the initial pumped water sample, the quantity of water equal to the total volume within the well was removed at least one time. Specific gravity, specific conductance, and temperature measurements of the discharging water were then made. Only after the specific gravity or specific conductance and temperature became constant during pumping were the initial water samples for chemical analysis collected. All subsequent samples were collected after the total volume of each well was removed.

Freshwater was introduced into the observation wells during drilling and construction. After placement of cement in wells B1 - B5, freshwater was used to wash cement from the work pipe. The disposition of this water and how it blended with the native saline water is unknown.

WATER QUALITY NEAR THE INJECTION TEST SITE

Water from 11 wells, other than those described earlier and ranging in depth from 45 to 400 ft near the test injection site, was collected and analyzed to provide background quality data prior to any long-term injection at the test site. Location of the wells is shown on figure 10 and construction details are given in table 15. Analyses of water from the wells are given in tables 16 and 17. Chloride concentration of water from these wells ranged from 72 to 1,100 mg/L.

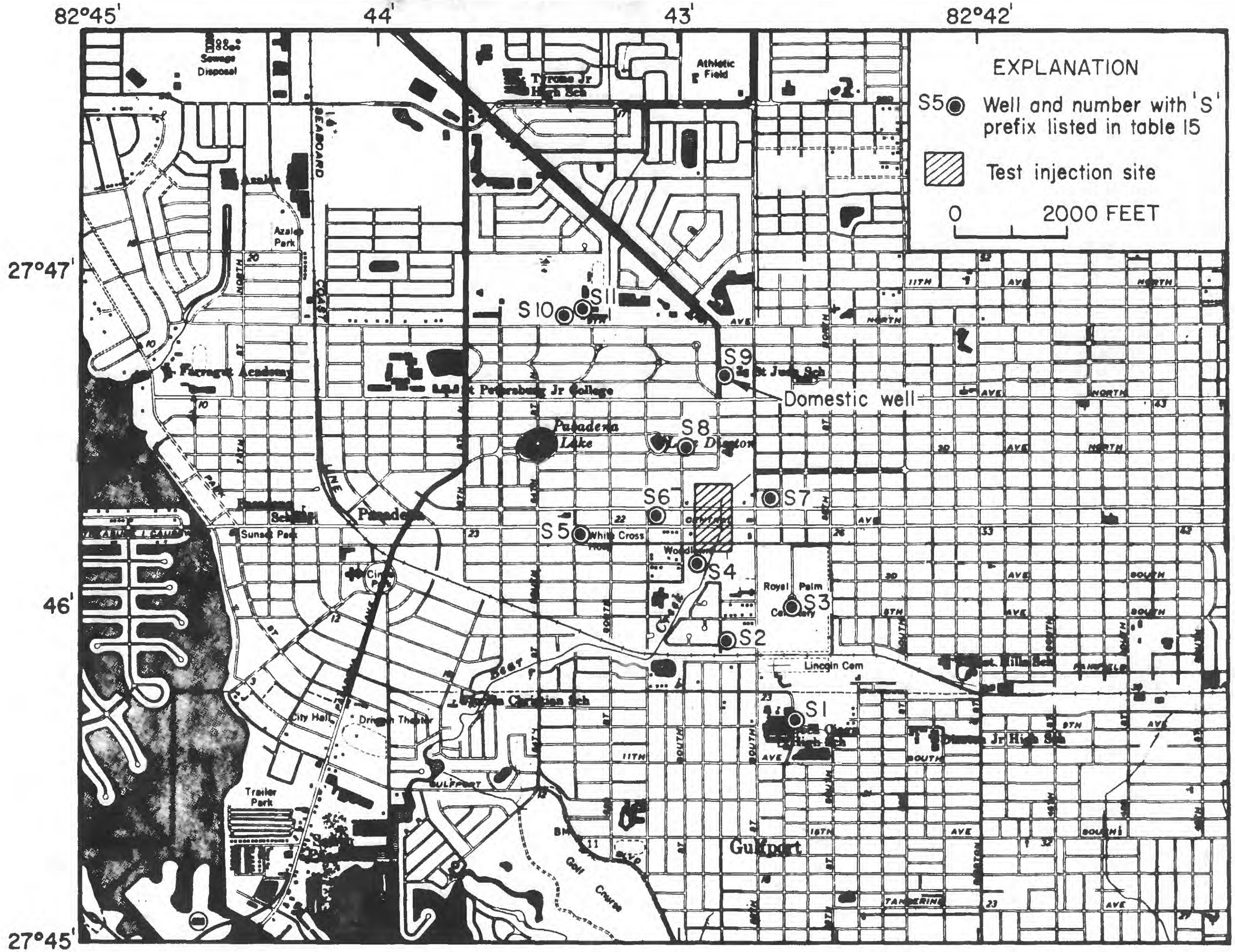

Figure 10.--Location of selected wells near the Bear Creek test site.

SELECTED REFERENCES

Applin, Paul L., 1951, Preliminary report on buried pre-Mesozoic rocks in Florida and adjacent states: U.S. Geological Survey Circular 91, p. 28.

Black, Crow and Eidsness, Inc., 1970, Water resources investigations for the Pinellas County water system, Pinellas County, Florida.

_____ 1974, Results of drilling and testing of the test storm water injection well for the City of St. Petersburg, Florida.

_____ 1978, Drilling and testing of the monitoring and injection wells at the Southwest Wastewater treatment plant for the City of St. Petersburg, Florida.

Briley, Wild and Associates, Inc., and Seaburn and Robertson, Inc., 1977, Effluent disposal well investigation, McKay Creek waste water treatment facility, Pinellas County, Florida.

Cherry, R. N., Stewart, J. W., and Mann, J. A., 1970, General hydrology of the Middle Gulf Area, Florida: Florida Geological Survey Report of Investigation 56, p. 96.

Chen, Chih Shan, 1965, The regional lithostratigraphic analysis of Palocene and Eocene rocks of Florida: Florida Geological Survey Bulletin 45, p. 105.

Greenleaf and Telesca, Inc., 1975, Construction of test wells, South Cross Bayou Pollution Control Facility, Pinellas County, Florida.

Hantush, M. S., 1964, Hydraulics of wells: in Advances of Hydroscience, vol. 1, edited by Ven Te Chow, Academic Press, New York and London, p. 280-432.

Heath, Ralph C., and Smith, Peter C., 1954, Ground-water resources of Pinellas County, Florida: Florida Geological Survey Report of Investigation 12, p. 139.

Hickey, J. J., 1977, Hydrogeologic data for the McKay Creek subsurface-injection test site, Pinellas County, Florida: U.S. Geological Survey Open-File Report 77-802, p. 62.

Jacob, C. E., 1947, Drawdown test to determine effective radius of artesian wells: American Society of Civil Engineers Transactions, v. 112, p. 1047-1070.

Kaufman, M. I., 1973, Subsurface waste water injection, Florida: American Society of Civil Engineers Proceedings, Journal of Irrigation and Drainage Division, v. 99, no. IT1, p. 53-70.

Klinkenberg, L. J., 1941, The permeability of porous media to liquids and gases: American Petroleum Institute Drilling Production Practices, p. 200-213.

Lohman, S. W. and others, 1972, Definitions of selected ground-water terms - revisions and conceptual refinements: U.S. Geological Survey Water-Supply Paper 1988, p. 21.

Puri, Harbans, S., Faulkner, Glen L., Winston, George O., 1973, Hydrogeology of subsurface liquid-waste storage in Florida, preprints of papers presented at the Second International Symposium on Underground Waste Management and Artificial Recharge, New Orleans, Louisiana, Sept. 26-30, vol. 2: American Association of Petroleum Geologists, Inc., Tulsa, Oklahoma, p. 825-841.

Rosenshein, J. S. and Hickey, J. J., 1977, Storage of treated sewage effluent and storm water in a saline aquifer, Pinellas Peninsula, Florida: Ground Water, vol. 15, no. 4, p. 289-293.

Sinclair, William C., 1974, Hydrogeologic characteristics of the surficial aquifer in northwest Hillsborough County, Florida: Florida Bureau of Geology Information Circular 86, p. 98.

Teeuw, D., 1971, Prediction of formation compaction from laboratory compressibility data: American Institute of Mining Metallurgists Petroleum Engineers Transactions, v. 251, p. 263-271.

Vernon, R. O., 1970, The beneficial use of zones of high transmissivities in Florida subsurface for water storage and waste disposal: Florida Bureau of Geology Information Circular 70, p. 39.

Table 1.--Record of wells at the Bear Creek test injection site

[Location of wells is shown on figure 2.]

Well number	Latitude Longitude	Bear Creek name	Land surface elevation (ft above mean sea level)	Total depth (ft below land surface)	Open interval (ft below land surface)	Casing diameter (in)	Distance from injection well A1 (ft)
A1	274619N0824252.01	Test injection well	16.45	1,270	1,016-1,270	16	0
A2	274619N0824252.02	570' annulus	16.45	570	550- 570	2	0.75
1/	274919N0824252.03	Annulus	16.45	870	800- 870 (plugged)	1-1/4	0.80
B1	274614N0824252.01	Injection monitor 1267'	19.10	1,267	1,170-1,267	4	540
B2	274614N0824252.02	Injection monitor 1070'	19.10	1,070	930-1,070	2	540
B3	274614N0824252.03	Injection monitor 830'	19.10	830	750- 830	2	540
B4	274614N0824252.04	Injection monitor 573'	19.10	573	500- 573	14	540
B5	274614N0824252.05	Injection monitor 340'	19.10	340	192- 340	Annulus 14"-20"	540
E2	274614N0824252.00	Exploratory hole	19.10	1,290	--	--	540
E1	274619N0824252.00	Exploratory hole	16.45	3,504	--	--	0

1/ Well is unnumbered because no data were obtained concerning hydrologic characteristics.

Table 2.--Lithologic log of well E1

	Thickness (ft)	Depth (ft)
No sample	5	5
Clay, brown; shell; some sand	5	10
Shell; some clay, brown; sand	5	15
Shell; some sand	10	25
Shell	5	30
No sample	5	35
Shell; some sand	5	40
No sample	5	45
Shell; sand; clay, brown	5	50
Unidentifiable, mostly black sooty, compact material that looks carbonaceous; clay, dark brown to black; shell; sand	80	130
Marl; clay, pale gray, some sand, coarse; shell	5	135
No sample	5	140
Marl; sand; shell; clay, pale gray	10	150
No sample	5	155
Dolomite, gray; marl; sand	10	165
Marl; clay, gray; sand	20	185
Limestone; marl; clay, gray; sand, coarse	20	205
Limestone, gray cream, fossiliferous; much chert	5	210
Limestone, gray cream; sand, coarse; chert	5	215
Limestone, cream, hard, fossiliferous; chert	20	235
Sand, clear, fine	5	240
No sample	5	245
Limestone, cream white, chalky; sand	10	255
Limestone, cream white, chalky, fossiliferous	5	260
Limestone, cream white; chert	20	280
No sample	30	310
Limestone, cream white, vugular, fossiliferous	15	325
No sample	10	335

	Thickness (ft)	Depth (ft)
Limestone, cream brown, chalky; chert, fossiliferous	5	340
Limestone, cream brown, chalky; some chert; clay, black	5	345
Limestone, cream, some vugs, fossiliferous; much chert	15	360
No sample	5	365
Limestone, cream, some vugs, fossiliferous; much chert	5	370
No sample	10	380
Limestone, cream, fossiliferous; chert	40	420
No sample	5	425
Limestone, cream, fossiliferous; sand, coarse; chert	10	435
Limestone, cream, fossiliferous (Dictyconus at 470 feet); chert	65	500
Limestone, cream; some dolomite, cream brown	15	515
No sample	35	550
Limestone, cream buff, vugular, granular, platy, fossiliferous, (Lepidocyclina at 590 feet, Camerina at 615 feet)	100	650
No sample	5	655
Limestone, cream buff, vugular, granular, platy	15	670
Limestone, cream white, vugular, coquinoid	45	715
Limestone, cream buff, granular; much calcite, fossiliferous	40	755
Dolomite, brown, vugular, sucrosic; chert	10	765
Dolomite, gray brown; some limestone, white, fossiliferous	10	775
Dolomite, gray brown, vugular, sucrosic; some limestone, white, very fossiliferous	75	850
Dolomite, yellow brown to dark brown, vugular	10	860
No sample	5	865
Dolomite, brown, vugular, coarsely crystalline	15	880

Table 2.--Lithologic log of well E1 - continued

	Thickness (ft)	Depth (ft)
Dolomite, brown black, vugular, coarsely crystalline; chert	90	970
Dolomite, brown black, vugular, coarsely crystalline; limestone, cream, fossiliferous	15	985
Dolomite, gray brown; chert	35	1,020
Dolomite, gray brown, crystalline; some limestone, cream, crystalline, some calcite crystals	50	1,070
Dolomite, brown, sucrosic; some limestone; some chert	10	1,080
Limestone, cream, vugular, sucrosic, dolomitic	50	1,130
Limestone, cream buff, vugular; dolomitic; chert	70	1,200
Dolomite, brown, vugular; some limestone	15	1,215
No sample	5	1,220
Dolomite, brown, vugular; some limestone	10	1,230
Limestone, brown, crystalline, fossiliferous; some dolomite	15	1,245
Dolomite, yellow brown, vugular, crystalline; chert	5	1,250
Limestone, dark brown, crystalline; some dolomite, little chert	40	1,290
Limestone, dark brown, crystalline; some gypsum or anhydrite	10	1,300
Limestone, cream buff, vugular, chalky; dolomitic; more gypsum	30	1,330
Dolomite, gray brown, platy; some limestone, cream brown, crystalline; chert; some gypsum	20	1,350
Limestone, cream, vugular, dolomitic, crystalline; dolomite, cream tan, vugular; chert; gypsum	40	1,390
Limestone, cream brown, crystalline, slightly fossiliferous; much gypsum	10	1,400
Dolomite, cream brown, vugular, some platy; some limestone; chert; gypsum	20	1,420
Limestone, cream brown, crystalline, fossiliferous, dolomitic; more gypsum	10	1,430

Table 2.--Lithologic log of well E1 - continued

	Thickness (ft)	Depth (ft)
Dolomite, cream brown; some limestone; chert; much gypsum	20	1,450
Limestone, brown, crystalline, vugular; some dolomite; gypsum	50	1,500
Limestone, brown, crystalline, slightly fossiliferous; much gypsum	15	1,515
Dolomite, cream tan, vugular; chert; some gypsum	10	1,525
Gypsum (100 percent)	5	1,530
Limestone, cream tan, some chalky; dolomite; gypsum	10	1,540
Limestone, cream tan, vugular, slightly fossiliferous; dolomite, cream tan, vugular; chert; gypsum	20	1,560
Limestone, cream tan to white, some vugs, chalky, slightly fossiliferous; gypsum	20	1,580
Limestone, cream tan, dense, brittle, dolomitic, fossiliferous; some clay, gray black; trace chert; gypsum	15	1,595
Dolomite, tan, crystalline, sucrosic	5	1,600
Dolomite, cream tan; limestone, much gypsum	5	1,605
Dolomite, tan, crystalline; chert	5	1,610
Limestone, cream, crystalline, dolomitic	5	1,615
Gypsum, 95 percent of sample	5	1,620
Dolomite, cream brown, finely crystalline; gypsum	45	1,665
Limestone, tan, crystalline, dolomitic; chert	10	1,675
Dolomite, dark tan, vugular; chert	5	1,680
Dolomite, dark brown, crystalline; much gypsum	20	1,700
Dolomite, dark brown, crystalline; considerable chert; much gypsum	30	1,730
Dolomite, cream tan, chalky	10	1,740
Dolomite, cream to buff, chalky; chert; gypsum	60	1,800
Limestone, cream, finely crystalline, platy, dolomitic	15	1,815

Table 2.--Lithologic log of well E1 - continued

	Thickness (ft)	Depth (ft)
Dolomite, cream to dark brown, crystalline; much chert; gypsum	20	1,835
Limestone, cream brown, vugular, chalky, dolomitic; chert; gypsum	15	1,850
Dolomite, cream brown; chert; gypsum	5	1,855
Limestone, cream brown, some chalky, platy, dolomitic; chert	35	1,890
Dolomite, cream to dark brown, vugular, coarsely crystalline; chert; gypsum	60	1,950
Limestone, gray brown to cream buff, crystalline, very fossiliferous	50	2,000
Limestone, cream buff, hard, fossiliferous, dolomitic; gypsum	40	2,040
Limestone, yellow brown, crystalline; some dolomite; chert; trace lignite?	25	2,065
Limestone, cream, oolitic, very fossiliferous	35	2,100
No sample	5	2,105
Limestone, brown, crystalline; some dolomite; chert; gypsum	15	2,120
Limestone, yellow to cream brown, very fossiliferous	30	2,150
Dolomite, yellow brown, crystalline; some limestone, cream, fossiliferous; gypsum	50	2,200
Limestone, cream, crystalline, very fossiliferous; trace gypsum	55	2,255
Dolomite, yellow brown, crystalline; limestone, crystalline, fossiliferous; some chert; gypsum	100	2,355
Limestone, yellow brown, crystalline, chalky; some dolomite, fossiliferous	90	2,445
Limestone, yellow to brown, crystalline; some dolomite, chert; gypsum	30	2,475
Limestone, cream, chalky, granular, fossiliferous; some dolomite	15	2,490
Limestone, cream, very fossiliferous; some dolomite; much chert	50	2,540

Table 2.--Lithologic log of well E1 - continued

	Thickness (ft)	Depth (ft)
Limestone, cream, very fossiliferous; much dolomite; some gypsum	30	2,570
Limestone, cream; some lignite?	35	2,605
Limestone, cream, chalky, granular, fossiliferous	30	2,635
Dolomite, buff brown, vugular; chert	5	2,640
Limestone, cream, chalky, granular, fossiliferous	30	2,670
Dolomite, gray grown, sucrosic, platy; chert	5	2,675
No sample	5	2,680
Dolomite, gray brown, sucrosic, platy	5	2,685
Limestone, cream, crystalline; some dolomite; some gypsum	20	2,705
Dolomite, tan to brown, vugular, crystalline	10	2,715
Limestone, cream, chalky	5	2,720
Limestone, cream; dolomite; gypsum	10	2,730
Limestone, cream, crystalline, chalky, platy, granular, dolomitic, fossiliferous	35	2,765
Limestone, cream, some coarsely crystalline, granular, very fossiliferous; some gypsum	60	2,825
No sample	5	2,830
Limestone, cream, coarsely crystalline, chalky, fossiliferous; some gypsum	70	2,900
Dolomite, yellow, brown, black, coarsely crystalline, platy; chert; some gypsum	85	2.985
Limestone, cream, vugular, chalky, fossiliferous	5	2,990
Dolomite, dark brown, vugular, coarsely crystalline, some platy; gypsum	40	3,030
Limestone, brown black, coarsely crystalline, some dolomitic	5	3,035
Dolomite, gray brown, crystalline, platy; gypsum	30	3,065
Dolomite, tan, brown, black, finely to coarsely crystalline; gypsum	75	3,140
Dolomite, gray	10	3,150

Table 2.--Lithologic log of well E1 - continued

	Thickness (ft)	Depth (ft)
Dolomite, cream brown, finely crystalline, some platy	70	3,220
Limestone, cream, chalky, dolomitic; gypsum	5	3,225
Dolomite, cream to gray buff, vugular, finely crystalline; some chert; some gypsum; some lignite	95	3,320
Limestone, cream to gray buff, chalky, granular or micro-oolitic, dolomitic; some lignite	50	3,370
Limestone, cream, fossiliferous; some dolomite, gray; chert; gypsum	10	3,380
Gypsum	5	3,385
Limestone, cream, fossiliferous; some dolomite, gray	10	3,395
Limestone, gray cream, granular, platy, dolomitic; some gypsum	25	3,420
Dolomite, cream to gray buff, vugular, crystalline, some platy, some mottled, black streaked; gypsum	40	3,460
Dolomite, cream to gray buff, vugular, crystalline, some platy, some mottled; some limestone, gray cream, chalky, dolomitic; gypsum	30	3,490
Dolomite, gray cream, some vugular, some crystalline; gypsum	14	3,504

Table 3.--Description of cores from well E2

Lithology	Core interval (ft below land surface)	Core recovery (ft)	Largest core segment (in)
Limestone, cream, granular, few vugs; few closed vertical fractures, fossil fragments, casts, molds, core very broken	720- 740	4	4
Limestone, cream, granular, some vugs; small black carbonaceous rods, fossil fragments, casts, molds	740- 741	1	3
Limestone, cream, vugular, some granular; fossiliferous	760- 770	1	3
Dolomite, gray brown, microcrystalline, very hard, some vugs; several closed and partially opened vertical, horizontal and oblique fractures	900- 903	1	3
Dolomite, gray brown, microcrystalline, very hard, some vugs, dolomite rhombs in vugs; no fractures observed	905- 920	3.0	4
Dolomite, gray brown, microcrystalline to coarse, very hard, some vugs; several closed horizontal, vertical and oblique fractures, dolomite rhombs on surface of several core fragments	930- 940	0.5	3
Dolomite, gray brown, microcrystalline, very hard, some vugs; no fractures	940- 950	4	4
Dolomite, tan, finely crystalline, many vugs; several closed and partially opened vertical fractures, fossil molds	1,140-1,150	3	8

Table 4.--Vertical intrinsic permeability of cores from well E2

[Analyses performed by Core Laboratories, Inc., Dallas, Texas. Nitrogen gas intrinsic permeabilities corrected for Klinkenberg effect (Klinkenberg, 1941) by Core Laboratories. Kinematic viscosity of the formation and distilled waters used in the tests were 0.960 centistokes and 0.955 centistokes, respectively. Kinematic viscosity of the nitrogen gas was 15.391 centistokes. Temperature of all of the fluids was 75°F. Intrinsic permeabilities may be converted to hydraulic conductivity as shown in Lohman and others (1972, p. 10).]

Core depth (ft)	Nitrogen gas intrinsic permeability (cm^2)	Water intrinsic permeability	
		Formation water (cm^2)	Distilled water (cm^2)
740-741	9.67×10^{-10}	5.5×10^{-10}	
760-761	1.20×10^{-8}	8.78×10^{-9}	8.46×10^{-9}
905-908	9.87×10^{-14}	---	---
940-944	9.87×10^{-14}	---	---

Table 5.--Porosity and interval transit time of cores from well E2

[Analyses performed by Core Laboratories, Inc., Dallas, Texas. Porosity determined at zero gage pressure. Interval transit time for 740-741 feet and 760-761 feet cores determined at 200 lb/in^2 and 750 lb/in^2 effective overburden pressure, respectively. Interval transit time for all other cores determined at 1,000 lb/in^2 effective overburden pressure. Effective overburden pressure is the external pressure minus internal pressure exerted on core.]

Core depth (ft)	Core porosity (percent)	Interval transit time (microseconds/ft, reciprocal of the velocity of a compressional sound wave)
740-741	39.5	123.8
760-761	35.9	115.8
905-908	0.5	44.2
940-944	4.9	48.5
940-944	0.7	

Table 6.--Compressibility of cores from well E2

[Analyses performed by Core Laboratories, Inc., Dallas, Texas. Core Laboratories calculated pore volume compressibility, which is change in pore volume divided by average pore volume divided by initial bulk volume divided by pressure change. Compressibility was calculated from the Core Laboratory results by multiplying pore volume compressibility by average pore volume divided by initial bulk volume. Average pore volume was calculated from values measured over a selected range of pressures. Initial bulk volume was measured at the first pressure in the selected pressure range.]

Depth of core (ft)	Average pore volume / Initial bulk volume (percent)	Pressure (lb/in^2)		Compressibility (in^2/lb)
		External	Internal	
	Uniaxial loading of core samples			
905-908	0.5	810	0	1.5×10^{-7}
940-944	0.6	850	0	5.2×10^{-7}
	Hydrostatic loading of core samples (Corrected to uniaxial loading by Core Laboratories, Inc.)			
740-741	19.8	2,000 2,000	1,800 1,319	1.2×10^{-5}
760-761	38.0	2,000 2,000	1,800 1,319	6.3×10^{-6}

Table 7.--Specific-capacity data for well E2

Date pumping began	Depth interval (ft)	Elapsed time (min)	Discharge (gal/min)	Specific capacity [(gal/min)/ft of drawdown]	Comments
11/ 6/74	192- 250	30	150	13	
11/14/74	192- 350	30	265	241	
11/18/74	192- 503	30	260	228	
12/13/74	500- 665	30	75	6	Drill rod and bit in hole at 665 feet
1/21/75	500- 865	30	145	91	Drill rod and bit in hole at 862 feet
8/29/75	500-1290	90	226	461	Drill rod and bit out of hole

Table 8.--Water levels in well A2 during well A1 withdrawal test

[Test began 5-18-76 at 1545 and ended 5-21-76 at 1630. Discharge of well A1 was 3,450 gallons per minute.]

Time (hr)	Water level (ft below mean sea level)	Time (hr)	Water level (ft below mean sea level)
5-18-76		1744	0.38
1305	0.48	1815	.35
1402	.46	1901	.17
1425	.45	1917	.15
1500	.44	1946	.17
1520	.43	2047	.17
1540	.41	2145	.20
1545	.41	2245	.30
1546	.33	2345	.38
1548	.37	5-19-76	
1549	.33	0045	.43
1550	.38	0144	.44
1551	.37	0345	.77
1552	---	0542	.72
1553	.38	0740	.70
1554	.36	0940	.72
1555	.37	1318	.72
1557	.37	1740	.60
1559	.37	2145	.64
1601	.36	5-20-76	
1603	.39	0057	.77
1605	.42	0500	.80
1610	.38	0845	.73
1615	.37	1245	.76
1620	.36	1645	.66
1625	.40	2045	.62
1635	.38	5-21-76	
1646	.37	0045	.69
1655	.36	0845	.65
1705	.36	1245	.56
1715	.37	1630	.49

Table 9.--Water levels in wells B1, B2, B3, B4, and B5 during well A1 withdrawal test

[Test began 5-18-76 at 1545 and ended 5-21-76 at 1630. Discharge of well A1 was 3,450 gal/min. Water levels are in feet below mean sea level.]

Date	Time (hr)	Well B1	Well B2	Well B3	Well B4	Well B5
5-18-76	1300	1.95	2.46	2.29	1.22	6.61
	1400	1.92	2.43	2.24	1.17	6.65
	1430	1.90	2.41	2.22	1.15	6.69
	1500	1.88	2.39	2.21	1.15	6.72
	1530	1.84	2.37	2.20	1.13	6.76
	1540	1.84	2.36	2.19	1.13	6.76
	1545	1.83	2.36	2.19	1.12	6.76
	1546	2.03	2.36	2.20	1.12	6.76
	1547	2.08	2.39	2.20	1.12	6.76
	1548	2.11	2.40	2.21	1.12	6.76
	1549	2.11	2.40	2.21	1.12	6.76
	1550	2.12	2.40	2.21	1.12	6.76
	1551	2.14	2.40	2.21	1.12	6.76
	1552	2.15	2.40	2.22	1.12	6.76
	1553	2.15	2.41	2.22	1.12	6.76
	1554	2.17	2.41	2.22	1.12	6.76
	1555	2.17	2.41	2.22	1.12	6.76
	1557	2.19	2.41	2.23	1.13	6.76
	1559	2.20	2.41	2.23	1.13	6.75
	1601	2.21	2.42	2.23	1.13	6.75
	1603	2.22	2.42	2.24	1.13	6.75
	1605	2.23	2.42	2.23	1.14	6.75
	1610	2.24	2.43	2.24	1.14	6.75
	1615	2.24	2.43	2.24	1.15	6.75
	1620	2.24	2.43	2.24	1.15	6.75
	1625	2.25	2.43	2.24	1.16	6.74
	1635	2.26	2.44	2.25	1.16	6.74
	1645	2.27	2.44	2.25	1.16	6.74
	1655	2.28	2.44	2.25	1.17	6.74
	1705	2.28	2.44	2.25	1.17	6.74
	1715	2.28	2.44	2.25	1.17	6.74
	1745	2.28	2.44	2.25	1.17	6.74
	1815	2.29	2.45	2.26	1.18	6.75
	1845	2.29	2.46	2.27	1.18	6.75
	1915	2.29	2.47	2.27	1.18	6.73
	1945	2.29	2.49	2.29	1.19	6.72
	2045	2.32	2.54	2.33	1.24	6.68
	2145	2.35	2.59	2.38	1.28	6.63
	2245	2.43	2.65	2.44	1.35	6.56
	2345	2.48	2.74	2.51	1.41	6.47

Table 9.--Water levels in wells B1, B2, B3, B4, and B5 during well A1 withdrawal test - continued

[Test began 5-18-76 at 1545 and ended 5-21-76 at 1630. Discharge of well A1 was 3,450 gal/min. Water levels are in feet below mean sea level.]

Date	Time (hr)	Well B1	Well B2	Well B3	Well B4	Well B5
5-19-76	0045	2.54	2.78	2.56	1.47	6.40
	0145	2.59	2.80	2.59	1.51	6.36
	0345	2.66	2.84	2.63	1.57	6.28
	0545	2.36	2.83	2.64	1.58	6.27
	0745	2.62	2.83	2.63	1.57	6.23
	0945	2.62	2.86	2.65	1.59	6.12
	1345	2.69	2.81	2.65	1.59	6.12
	1745	2.58	2.77	2.56	1.48	6.38
	2145	2.60	2.84	2.60	1.51	6.37
5-20-76	0045	2.72	2.96	2.72	1.63	6.22
	0445	2.79	3.01	2.78	1.70	6.05
	0845	2.78	2.96	2.74	1.67	6.17
	1245	2.73	2.92	2.71	1.64	6.13
	1645	2.66	2.82	2.61	1.55	6.28
	2045	2.60	2.73	2.56	1.49	6.40
5-21-76	0045	2.72	2.81	2.64	1.54	6.30
	0445	2.67	2.88	2.70	1.62	6.13
	0845	2.61	2.79	2.62	1.56	6.21
	1245	2.50	2.70	2.52	1.44	6.40
	1630	2.25	2.68	2.45	1.37	6.50

Table 10.--Summary of geophysical logs of well E2

[Logs are on file in the U.S. Geological Survey Southwest Florida Subdistrict office.]

Date	Log	Depth interval (ft)	Logged by
11/14/74	Temperature (static)	20- 204	U.S.G.S., Tampa
11/19/74	Acoustic velocity	150- 494	Welex
11/19/74	Caliper	140- 501	U.S.G.S., Tampa
11/19/74	Electric	90- 490	U.S.G.S., Tampa
11/19/74	Gamma-ray	4- 503	U.S.G.S., Tampa
11/19/74	Flowmeter	180- 480	U.S.G.S., Tampa
11/19/74	Temperature (pumping)	170- 490	U.S.G.S., Tampa
11/20/74	Micro-seismogram	150- 494	Welex
12/ 4/74	Temperature (static)	260- 500	U.S.G.S., Tampa
8/22/75	Caliper	460-1287	U.S.G.S., Tampa
8/22/75	Flowmeter	480-1290	U.S.G.S., Tampa
8/22/75	Temperature (pumping)	500-1290	U.S.G.S., Tampa
8/22/75	Temperature (static)	500-1285	U.S.G.S., Tampa
8/28/75	Compensated neutron - formation density	504- 922	Schlumberger
8/28/75	Dual induction laterolog	504- 990	Schlumberger

Table 11.--Summary of geophysical logs of well A1

[Logs are on file in the U.S. Geological Survey Southwest Florida Subdistrict office.]

Date	Log	Depth interval (ft)	Logged by
9/23/75	Flowmeter	940-1260	U.S.G.S., Tampa
9/23/75	Caliper	980-1274	U.S.G.S., Tampa
9/23/75	Temperature (static)	1000-1270	U.S.G.S., Tampa
9/23/75	Temperature (pumping)	980-1274	U.S.G.S., Tampa
4/30/76	Temperature (static)	112-1274	U.S.G.S., Tampa

Table 12.--Chemical analyses of water from selected wells at the test site

DATE	TIME	DEPTH TO TOP OF SAMPLE INTER-VAL (FT)	DEPTH TO BOT-TOM OF SAMPLE INTER-VAL (FT)	TEMPER-ATURE (DEG C)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH (UNITS)	ALKA-LINITY AS CACO3 (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)
WELL NUMBER A1		BEAR CR INJECTION WELL (LAT 27 46 19 LONG 082 42 52.01)									
MAR , 1975											
27...	1200	1016	1270	--	53000	--	--	--	--	20000	--
27...	1203	1016	1270	--	52500	--	--	--	--	20000	--
27...	1205	1016	1270	--	52000	--	--	--	--	20000	--
27...	1210	1016	1270	--	52000	--	--	--	--	20000	--
27...	1220	1016	1270	--	51000	--	--	--	--	20000	--
27...	1230	1016	1270	--	52500	--	--	--	--	19000	--
27...	1240	1016	1270	--	52500	--	--	--	--	20000	--
27...	1250	1016	1270	--	52000	--	--	--	--	20000	--
MAY , 1976											
18...	1655	1016	1270	28.9	52600	--	--	--	--	20000	4400
19...	0310	1016	1270	28.7	53000	--	--	--	--	21000	4400
19...	1255	1016	1270	28.7	53000	--	--	--	--	20000	4300
19...	1930	1016	1270	28.5	53000	--	--	--	--	20000	4600
20...	0930	1016	1270	28.8	53100	--	--	--	--	20000	4300
20...	1410	1016	1270	28.9	52900	--	--	--	--	20000	4200
21...	0755	1016	1270	28.5	53000	--	--	--	--	20000	4300
21...	1335	1016	1270	--	53300	--	--	--	--	20000	4300
WELL NUMBER A2		BEAR CR 570 ANNULUS (LAT 27 46 19 LONG 082 42 52.02)									
DEC , 1975											
17...	1456	550	570	25.9	43800	8.3	80	97	0	16000	2800

Table 12.--Chemical analyses of water from selected wells at the test site - continued

DATE	DIS-SOLVED FLUO-RIDE (F) (MG/L)	BROMIDE (BR) (MG/L)	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SILICA (SIO2) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L)	DENSITY (GM/ML AT 20 C)
WELL NUMBER A1		BEAR CR INJECTION WELL (LAT 27 46 19 LONG 082 42 52.01)								
MAR , 1975										
27...	--	--	--	--	--	--	--	--	--	1.026
27...	--	--	--	--	--	--	--	--	--	1.026
27...	--	--	--	--	--	--	--	--	--	1.025
27...	--	--	--	--	--	--	--	--	--	1.025
27...	--	--	--	--	--	--	--	--	--	1.025
27...	--	--	--	--	--	--	--	--	--	1.026
27...	--	--	--	--	--	--	--	--	--	1.025
27...	--	--	--	--	--	--	--	--	--	1.026
MAY , 1976										
18...	--	--	1500	--	--	--	--	--	--	--
19...	--	--	1400	970	--	--	--	--	--	--
19...	--	--	1400	970	--	--	--	--	--	--
19...	--	--	--	920	--	--	--	--	--	--
20...	--	--	1400	--	--	--	--	--	--	--
20...	--	--	1400	980	--	--	--	--	--	--
21...	--	--	1400	960	--	--	--	--	--	--
21...	--	--	1400	930	--	--	--	--	--	--
WELL NUMBER A2		BEAR CR 570 ANNULUS (LAT 27 46 19 LONG 082 42 52.02)								
DEC , 1975										
17...	.4	60	130	830	9400	250	5.0	30900	29600	1.018

Table 12.--Chemical analyses of water from selected wells at the test site - continued

DATE	TIME	DEPTH TO TOP OF SAMPLE INTER-VAL (FT)	DEPTH TO BOT-TOM OF SAMPLE INTER-VAL (FT)	TEMPER-ATURE (DEG C)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH (UNITS)	ALKA-LINITY AS CACO3 (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	TOTAL SUL-FIDE (S) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)
WELL NUMBER B1		BEAR CR INJ MONITOR 1267 (LAT 27 46 14 LONG 082 42 52.01)									
JAN , 1976 05...	1132	1170	1267	26.6	52900	7.0	147	179	0	--	20000
WELL NUMBER B2		BEAR CR INJ MONITOR 1070 (LAT 27 46 14 LONG 082 42 52.02)									
APR , 1976 19...	1300	930	1070	26.5	52200	7.2	153	186	0	.6	21000
WELL NUMBER B3		BEAR CR INJ MONITOR 800 (LAT 27 46 14 LONG 082 42 52.03)									
DEC , 1975 17...	1230	750	830	27.4	50800	7.3	38	46	0	--	19000
WELL NUMBER B4		BEAR CR INJ MONITOR 573 (LAT 27 46 14 LONG 082 42 52.04)									
JAN , 1976 06...	1337	500	573	25.8	43600	7.5	9	100	0	--	16000
WELL NUMBER B5		BEAR CR INJ MONITOR 300 (LAT 27 46 14 LONG 082 42 52.05)									
DEC , 1975 16...	1414	192	340	25.4	2490	7.4	203	248	0	--	680
WELL NUMBER E2		BEAR CR EXPLORATORY HOLE (LAT 27 46 14 LONG 082 42 52)									
NOV , 1974 06...	1515	192	250	24.8	840	--	186	227	--	--	150

Table 12.--Chemical analyses of water from selected wells at the test site - continued

DATE	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	BROMIDE (BR) (MG/L)	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SILICA (SIO2) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L)	DENSITY (GM/ML AT 20 C)
WELL NUMBER B1 BEAR CR INJ MONITOR 1267 (LAT 27 46 14 LONG 082 42 52.01)											
JAN , 1976 05...	4100	1.3	50	74	1100	12000	410	9.1	38600	37900	1.024
WELL NUMBER B2 BEAR CR INJ MONITOR 1070 (LAT 27 46 14 LONG 082 42 52.02)											
APR , 1976 19...	3100	.9	84	880	1200	11000	380	9.4	37900	37800	--
WELL NUMBER B3 BEAR CR INJ MONITOR 800 (LAT 27 46 14 LONG 082 42 52.03)											
DEC , 1975 17...	2500	.6	70	140	550	12000	430	2.9	35700	34800	1.021
WELL NUMBER B4 BEAR CR INJ MONITOR 573 (LAT 27 46 14 LONG 082 42 52.04)											
JAN , 1976 06...	2500	.5	76	120	730	9400	320	5.4	30400	29200	1.018
WELL NUMBER B5 BEAR CR INJ MONITOR 300 (LAT 27 46 14 LONG 082 42 52.05)											
DEC , 1975 16...	25	.2	3.0	230	30	230	3.6	30	1530	1360	0.997
- WELL NUMBER E2 BEAR CR EXPLORATORY HOLE (LAT 27 46 14 LONG 082 42 52											
NOV , 1974 06...	21	.3	--	110	16	39	2.0	36	566	487	--

Table 13.--Concentrations of trace elements in water from selected wells at the test site

DATE	TIME	DEPTH TO TOP OF SAMPLE INTERVAL (FT)	DEPTH TO BOTTOM OF SAMPLE INTERVAL (FT)	DIS-SOLVED ARSENIC (AS) (UG/L)	DIS-SOLVED BORON (B) (UG/L)	DIS-SOLVED CADMIUM (CD) (UG/L)	DIS-SOLVED CHROMIUM (CR) (UG/L)	HEXAVALENT CHROMIUM (CR6) (UG/L)	DIS-SOLVED COBALT (CO) (UG/L)	DIS-SOLVED COPPER (CU) (UG/L)	DIS-SOLVED IRON (FE) (UG/L)
WELL NUMBER A2	BEAR CR 570 ANNULUS (LAT 27 46 19 LONG 082 42 52.02)										
DEC • 1975 17...	1455	550	570	0	340	0	0	0	0	0	120
WELL NUMBER B1	BEAR CR INJ MONITOR 1267 (LAT 27 46 14 LONG 082 42 52.01)										
JAN • 1976 05...	1132	1170	1267	0	2500	1	0	0	0	0	12000
WELL NUMBER B2	BEAR CR INJ MONITOR 1070 (LAT 27 46 14 LONG 082 42 52.02)										
APR • 1976 19...	1300	930	1070	0	2500	0	0	0	0	0	2100
WELL NUMBER B3	BEAR CR INJ MONITOR 800 (LAT 27 46 14 LONG 082 42 52.03)										
DEC • 1975 17...	1230	750	830	0	1500	0	0	0	0	0	690
WELL NUMBER B5	BEAR CR INJ MONITOR 300 (LAT 27 46 14 LONG 082 42 52.05)										
DEC • 1975 16...	1414	192	340	0	70	0	0	0	0	0	570
WELL NUMBER E2	BEAR CR EXPLORATORY HOLE (LAT 27 46 14 LONG 082 42 52)										
NOV • 1974 06...	1515	192	250	1	60	0	0	0	0	0	0

Table 13.--Concentrations of trace elements in water from selected wells at the test site - continued

DATE	DIS-SOLVED LEAD (PB) (UG/L)	DIS-SOLVED MAN-GANESE (MN) (UG/L)	DIS-SOLVED MOLYB-DENUM (MO) (UG/L)	DIS-SOLVED NICKEL (NI) (UG/L)	DIS-SOLVED STRON-TIUM (SR) (UG/L)	DIS-SOLVED VANA-DIUM (V) (UG/L)	DIS-SOLVED ZINC (ZN) (UG/L)	DIS-SOLVED ALUM-INUM (AL) (UG/L)	DIS-SOLVED LITHIUM (LI) (UG/L)	DIS-SOLVED MERCURY (HG) (UG/L)
WELL NUMBER A2 — BEAR CR 570 ANNULUS (LAT 27 46 19 LONG 082 42 52.02)										
DEC , 1975 17...	0	130	0	0	45000	580	900	20	150	.1
WELL NUMBER B1 — BEAR CR INJ MONITOR 1267 (LAT 27 46 14 LONG 082 42 52.01)										
JAN , 1976 05...	0	1700	0	0	29000	850	3400	10	180	.1
WELL NUMBER B2 — BEAR CR INJ MONITOR 1070 (LAT 27 46 14 LONG 082 42 52.02)										
APR , 1976 19...	0	120	4	0	33000	84	10	10	170	.0
WELL NUMBER B3 — BEAR CR INJ MONITOR 600 (LAT 27 46 14 LONG 082 42 52.03)										
DEC , 1975 17...	0	160	0	0	93000	760	6600	0	210	.3
WELL NUMBER B5 — BEAR CR INJ MONITOR 300 (LAT 27 46 14 LONG 082 42 52.05)										
DEC , 1975 16...	0	100	0	0	<100	17	20	0	20	.1
WELL NUMBER E2 — BEAR CR EXPLORATORY HOLE (LAT 27 46 14 LONG 082 42 52)										
NOV , 1974 06...	0	12	2	3	1000	4.7	0	30	8	.0

Table 14.--Concentrations of nitrogen, phosphorus, coliform, and streptococci from selected wells at the test site

DATE	TIME	DEPTH TO TOP OF SAMPLE INTER-VAL (FT)	DEPTH TO BOT-TOM OF SAMPLE INTER-VAL (FT)	TOTAL NITRO-GEN (N) (MG/L)	TOTAL ORGANIC NITRO-GEN (N) (MG/L)	TOTAL AMMONIA NITRO-GEN (N) (MG/L)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)
WELL NUMBER B1			BEAR CR INJ MONITOR 1267 (LAT 27 46 14 LONG 082 42 52.01)					
JAN , 1976								
07...	1112	1170	1267	--	.09	--	--	--
WELL NUMBER B3			BEAR CR INJ MONITOR 800 (LAT 27 46 14 LONG 082 42 52.03)					
JAN , 1976								
07...	1140	750	830	.91	.24	.67	.00	.00
WELL NUMBER B4			BEAR CR INJ MONITOR 573 (LAT 27 46 14 LONG 082 42 52.04)					
JAN , 1976								
07...	1040	500	573	1.1	.18	1.0	.00	.00
WELL NUMBER B5			BEAR CR INJ MONITOR 300 (LAT 27 46 14 LONG 082 42 52.05)					
JAN , 1976								
07...	0945	192	340	.78	.11	.67	.00	.00
WELL NUMBER E2			BEAR CR EXPLORATORY HOLE (LAT 27 46 14 LONG 082 42 52)					
NOV , 1974								
06...	1515	192	250	.79	.12	.67	.00	.00

Table 14.--Concentrations of nitrogen, phosphorus, coliform, and streptococci from selected wells at the test site - continued

DATE	TOTAL PHOS-PHORUS (P) (MG/L)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L)	IMME-DIATE COLI-FORM (COL. PER 100 ML)	CON-FIRMED COLI-FORM (MPN)	FECAL COLI-FORM (EC BROTH) (MPN)	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)
WELL NUMBER B1	BEAR CR INJ MONITOR 1267 (LAT 27 46 14 LONG 082 42 52.01)						
JAN , 1976 07...	.03	--	--	<3	<3	--	--
WELL NUMBER B3	BEAR CR INJ MONITOR 800 (LAT 27 46 14 LONG 082 42 52.03)						
JAN , 1976 07...	.02	.01	<1	--	--	<1	80
WELL NUMBER B4	BEAR CR INJ MONITOR 573 (LAT 27 46 14 LONG 082 42 52.04)						
JAN , 1976 07...	.03	.02	--	<3	<3	--	--
WELL NUMBER B5	BEAR CR INJ MONITOR 300 (LAT 27 46 14 LONG 082 42 52.05)						
JAN , 1976 07...	.07	.05	<1	--	--	<1	<1
WELL NUMBER E2	BEAR CR EXPLORATORY HOLE (LAT 27 46 14 LONG 082 42 52)						
NOV , 1974 06...	.11	.10	--	--	--	--	--

Table 15.--Record of wells near the Bear Creek test site

[Location of wells is shown in figure 10.]

Well number	Latitude Longitude	Name or owner	Land surface elevation (ft above mean sea level)	Total depth (ft below land surface)	Open interval (ft below land surface)	Casing diameter (in)	Distance from injection well A1 (ft)
S1	274540N0824237.01	Boca Ciega High School	23	400	--	--	4,150
S2	274554N0824250.01	Floyd Shu	25	45	--	1-1/4	2,550
S3	274606N0824236.01	Royal Palm Corp.	24	285	185-285	10	1,950
S4	274607N0824253.01	Woodlawn Cemetary	20	153	92-153	3	1,100
S5	274613N0824318.01	White Cross Hospital	20	55	--	--	2,450
S6	274616N0824304.01	Second Church of Christ Scientist	20	270	--	2	1,100
S7	274620N0824238.01	D. Benton	22	163	--	1-1/4	1,200
S8	274628N0824256.01	Charley Davy	20	60	--	1-1/4	950
S9	274642N0824249.01	St. Judes School	20	380	--	6	2,250
S10	274652N0824322.01	Diocese of St. Petersburg	20	380	190-380	4	4,200
S11	274653N0824318.01	Bishop Barry High School	20	220	--	3	4,100

Table 16.--Chemical analyses of water from selected wells near the test site

DATE	TIME	TOTAL DEPTH OF WELL (FT)	TEMPER-ATURE (DEG C)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH (UNITS)	ALKA-LINITY AS CACO3 (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	TOTAL SUL-FIDE (S) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)
WELL NUMBER S1 — BOCA CIEGA HIGH SCHOOL (LAT 27 45 40 LONG 082 42 37.01)										
MAR , 1974 08...	1145	400	25.0	4010	7.0	181	221	0	1.3	1100
WELL NUMBER S2 — FLOYD SHU (LAT 27 45 54 LONG 082 42 50.01)										
MAR . 1974 07...	1145	45	24.0	287	4.8	0	0	0	1.9	72
WELL NUMBER S3 — ROYAL PALM CORP (LAT 27 46 06 LONG 082 42 36.01)										
MAR . 1974 07...	0900	285	21.0	1560	7.2	194	236	0	.7	310
WELL NUMBER S4 — WOODLAND CEMETARY (LAT 27 46 07 LONG 082 42 53.01)										
MAR , 1974 12...	0830	153	24.5	1000	7.2	201	245	0	7.1	180
WELL NUMBER S5 — WHITE CROSS HOSPITAL (LAT 27 46 13 LONG 082 43 18.01)										
MAR , 1974 08...	1025	55	23.0	1190	7.2	196	239	0	3.1	230
WELL NUMBER S6 — SECOND CHURCH OF CHRIST (LAT 27 46 16 LONG 082 43 04.01)										
MAR . 1974 07...	1300	270	24.0	1370	7.1	191	233	0	4.6	290

Table 16.--Chemical analyses of water from selected wells near the test site - continued

DATE	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED FLUO-RIDE (F) (MG/L)	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	DIS-SOLVED SILICA (SIO2) (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	DIS-SOLVED SOLIDS (SUM OF CONSTI-TUENTS) (MG/L)	DENSITY (GM/ML AT 20 C)
WELL NUMBER S1 BOCA CIEGA HIGH SCHOOL (LAT 27 45 40 LONG 082 42 37.01)										
MAR , 1974 08...	150	.2	240	54	460	14	28	2600	2160	.999
WELL NUMBER S2 FLOYD SHU (LAT 27 45 54 LONG 082 42 50.01)										
MAR , 1974 07...	9.7	.0	4.2	9.6	24	.4	6.9	138	127	.997
WELL NUMBER S3 ROYAL PALM CORP (LAT 27 46 06 LONG 082 42 36.01)										
MAR , 1974 07...	41	.2	150	27	89	4.7	34	1030	774	.998
WELL NUMBER S4 WOODLAND CEMETARY (LAT 27 46 07 LONG 082 42 53.01)										
MAR , 1974 12...	18	.3	120	19	45	3.5	37	760	545	.998
WELL NUMBER S5 WHITE CROSS HOSPITAL (LAT 27 46 13 LONG 082 43 18.01)										
MAR , 1974 08...	22	.2	130	22	57	4.4	37	784	622	.998
WELL NUMBER S6 SECOND CHURCH OF CHRIST (LAT 27 46 16 LONG 082 43 04.01)										
MAR , 1974 07...	29	.2	140	24	76	4.7	35	967	715	.997

Table 16.--Chemical analyses of water from selected wells near the test site - continued

DATE	TIME	TOTAL DEPTH OF WELL (FT)	TEMPER-ATURE (DEG C)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH (UNITS)	ALKA-LINITY AS CACO3 (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	TOTAL SUL-FIDE (S) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)
WELL NUMBER S7		D. BEATON (LAT 27 46 20 LONG 082 42 38.01)								
MAR , 1974 08...	0940	163	24.0	825	7.3	217	265	0	4.6	150
WELL NUMBER S8		CHARLEY DAVY (LAT 27 46 28 LONG 082 42 56.01)								
MAR , 1974 12...	1000	60	24.5	343	4.4	0	0	0	1.1	72
WELL NUMBER S9		ST. JUDES SCHOOL (LAT 27 46 42 LONG 082 42 49.01)								
MAR , 1974 12...	1130	380	25.0	2330	7.1	194	236	0	2.5	400
WELL NUMBER S10		DIOCESE OF ST PETERSBURG (LAT 27 46 52 LONG 082 43 22.01)								
SEP , 1975 18...	1115	380	24.6	900	--	--	--	--	--	140
WELL NUMBER S11		BISHOP BARRY HIGH SCHOOL (LAT 27 46 53 LONG 082 43 18.01)								
MAR , 1974 13...	1000	220	22.0	1020	7.2	230	280	0	6.7	180

Table 16.--Chemical analyses of water from selected wells near the test site - continued

DATE	TIME	SULFATE DIS-SOLVED (MG/L AS SO4)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	SILICA, DIS-SOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)	DENSITY (GM/ML AT 20 C)
WELL NUMBER S7		D. BEATON (LAT 27 46 20 LONG 082 42 38.01)									
MAR , 1974 08...	0940	17	.5	98	20	36	3.1	40	599	496	.998
WELL NUMBER S8		CHARLEY DAVY (LAT 27 46 28 LONG 082 42 56.01)									
MAR , 1974 12...	1000	39	.2	5.3	11	26	6.3	8.8	210	170	.997
WELL NUMBER S9		ST. JUDES SCHOOL (LAT 27 46 42 LONG 082 42 49.01)									
MAR , 1974 12...	1130	27	.3	150	26	140	4.6	35	1250	899	.998
WELL NUMBER S10		DIOCESE OF ST PETERSBURG (LAT 27 46 52 LONG 082 43 22.01)									
SEP , 1975 18...	1115	4.6	--	110	24	37	--	--	--	--	.999
WELL NUMBER S11		BISHOP BARRY HIGH SCHOOL (LAT 27 46 53 LONG 082 43 18.01)									
MAR , 1974 13...	1000	14	.3	120	21	47	4.9	40	664	566	.998

Table 17.--Concentrations of nitrogen and phosphorus in water from selected wells near the test site

DATE	TIME	TOTAL DEPTH OF WELL (FT)	TOTAL ORGANIC NITRO-GEN (N) (MG/L)	TOTAL AMMONIA NITRO-GEN (N) (MG/L)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L)
WELL NUMBER S1			ROCA CIEGA HIGH SCHOOL (LAT 27 45 40 LONG 082 42 37.01)					
MAR , 1974								
08...	1145	400	.38	1.6	--	.00	.11	.10
WELL NUMBER S2			FLOYD SHU (LAT 27 45 54 LONG 082 42 50.01)					
MAR , 1974								
07...	1145	45	.80	.07	.00	.00	.05	.00
WELL NUMBER S3			ROYAL PALM CORP (LAT 27 46 06 LONG 082 42 36.01)					
MAR , 1974								
07...	0900	285	.14	.83	.01	.08	.03	.01
WELL NUMBER S4			WOODLAND CEMETARY (LAT 27 46 07 LONG 082 42 53.01)					
MAR , 1974								
12...	0830	153	.09	.71	.00	.00	.02	.02
WELL NUMBER S5			WHITE CROSS HOSPITAL (LAT 27 46 13 LONG 082 43 18.01)					
MAR , 1974								
08...	1025	55	.16	.67	.01	.00	.05	.05
WELL NUMBER S6			SECOND CHURCH OF CHRIST (LAT 27 46 16 LONG 082 43 04.01)					
MAR , 1974								
07...	1300	270	.02	.73	.01	.00	.05	.04

Table 17.--Concentrations of nitrogen and phosphorus in water from selected wells near the test site - continued

DATE	TIME	TOTAL DEPTH OF WELL (FT)	TOTAL ORGANIC NITRO-GEN (N) (MG/L)	TOTAL AMMONIA NITRO-GEN (N) (MG/L)	TOTAL NITRITE (N) (MG/L)	TOTAL NITRATE (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)	TOTAL ORTHO PHOS-PHORUS (P) (MG/L)
WELL NUMBER S7			D. BEATON (LAT 27 46 20 LONG 082 42 38.01)					
MAR , 1974 08...	0940	163	.11	.62	.01	.00	.13	.13
WELL NUMBER S8			CHARLEY DAVY (LAT 27 46 28 LONG 082 42 56.01)					
MAR , 1974 12...	1000	60	.14	1.4	.00	.00	.01	.00
WELL NUMBER S9			ST. JUDES SCHOOL (LAT 27 46 42 LONG 082 42 49.01)					
MAR , 1974 12...	1130	380	.25	.79	.00	.00	.04	.03
WELL NUMBER S11			BISHOP BARRY HIGH SCHOOL (LAT 27 46 53 LONG 082 43 18.01)					
MAR , 1974 13...	1000	220	.17	.54	.00	.00	.01	.01

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