Prepared in cooperation with the
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 82-90

INTRODUCTION

Ground-water withdrawals in southwest Florida are increasing because of urban growth, industrial expansion, and increased agricultural irrigation. As a result, the potentiometric surface of the Floridan aquifer has been lowered in some areas, allowing seawater to encroach into the aquifer and threaten the freshwater resources of the area. Effective management of ground water is needed to control this encroachment and protect the freshwater aquifer.

Because of increased interest in the occurrence and changes of chloride concentration in ground water along the coast, the U.S. Geological Survey, in cooperation with the Southwest Florida Water Management District, began a program in 1977 to study the saltwater-freshwater transition zone along coastal southwest Florida from Levy County southward to Charlotte County (fig. 1). The continuing program includes evaluation of various methods used for locating the saltwater-freshwater transition zone and selection of monitor sites to determine location and movement of the transition zone.

All elevations in this report are referenced to NGVD of 1929 (National Geodetic Vertical Datum of 1929), a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "mean sea level." NGVD of 1929 is referred to as sea level in this report.

The purpose of this report is to show the general location of the 250-milligram-per-liter (mg/L) line of chloride concentration in that part of the Floridan aquifer tapped by the majority of wells along the coast. This zone, referred to as the upper producing zone of the Floridan aquifer, produces most of the water used in coastal southwest Florida. The zone occurs near the top of the Floridan aquifer and increases in depth and thickness from north to south. The 250-mg/L line of equal chloride concentration in 1979 (fig. 1) is used in this report to represent the transition from saltwater to freshwater in the upper part of the Floridan aquifer.

The line was mapped from results of previous investigations and interpretation of chloride concentration data in the files of the U.S. Geological Survey. The 250-mg/L line is used because the U.S. Environmental Protection Agency (1977) recommends that chloride concentrations not exceed 250 mg/L in public water supplies in areas where more suitable supplies are available.

HYDROGEOLOGY

Southwest Florida is underlain by a thick sequence of sedimentary rocks that are generally grouped into four hydrogeologic units (fig. 2): (1) surficial aquifer, (2) upper confining bed for the Floridan aquifer, (3) Floridan aquifer, and (4) lower confining bed for the Floridan aquifer.

The surficial aquifer is composed predominantly of fine sand and clayey sand with extensive areas of shell beds, marl, and limestone. Along the coast, the aquifer ranges in thickness from zero in the north to 50 feet in the south. Water in the aquifer is generally unconfined. The surficial aquifer is usually a minor source of freshwater for private domestic or small irrigation wells. However, in the southern part of the study area, the aquifer is a major source of water because in many places the water is more readily available and less mineralized than water from the Floridan aquifer.

The upper confining bed for the Floridan aquifer consists of relatively impermeable, interbedded limestone, dolomite, sand, and clay. The upper confining bed is absent in much of the northern part of the study area where the surficial and Floridan aquifers are hydraulically continuous. Thickness of the confining bed increases from less than 25 feet in Pasco County to about 650 feet in Charlotte County (Buono and others, 1979). The major and lowermost unit of the upper confining bed is the Hawthorn Formation, which contains limestone and sand stringers that locally yield water to wells. In areas where the confining bed is present, hydraulic connection between the surficial aquifer and the Floridan aquifer occurs where sinkholes have breached the confining bed or where wells are open to multiple zones.

The Floridan aquifer, the most productive and widely used aquifer in southwest Florida, was originally defined by Parker and others (1955) to include, in descending order, the permeable zones of the Hawthon Formation of middle Miocene age that are in hydraulic connection with the underlying formation, the Tampa Limestone of early Miocene age, the Suwannee Limestone of Oligocene age, the Ocala Limestone of late Eocene age, and all or parts of the Avon Park and Lake City Limestones of middle Eocene age. The Floridan aquifer extends downward from the top of the persistent limestone sequence to the top of the persistent evaporite. It consists of a thick sequence of limestone and dolomite that dips and thickens southward (fig. 3). The aquifer yields water from permeable zones in the carbonates. The top of the Floridan aquifer ranges in elevation from sea level in the northern part of the study area to 700 feet below sea level in the southeast (fig. 4).

The Tampa Limestone, generally considered the uppermost formation within the Floridan aquifer, crops out in northwest Hillsborough, southwest Pasco, and northern Pinellas Counties (Stringfield, 1966). The top of the unit reaches a depth of about 700 feet below sea level in Charlotte County. Numerous solution openings in the Tampa Limestone have formed zones of high permeability that are capable of yielding large quantities of water to wells.

The Suwannee Limestone underlies the Tampa Limestone and the top of the unit ranges in depth from near sea level in northern Hernando County (P. McGill, written commun., 1976) to about 800 feet below sea level in Charlotte County (Joyner and Sutcliffe, 1976). In the central part of the study area, permeable zones of the Suwannee Limestone yield water to many domestic and commercial wells and constitute the major source of water for wells in coastal Pasco County.

The Ocala Limestone underlies the Suwannee Limestone and is exposed in parts of Citrus, Hernando, and Pasco Counties (Vernon, 1951) where it is one of the major water-producing units. The top of the Ocala Limestone is near sea level in parts of Citrus County and dips to more than 1,000 feet below sea level in Charlotte County.

The Avon Park Limestone underlies the Ocala Limestone. This unit is a widely used source of water both in the northern coastal counties, where it lies near land surface, and in inland areas throughout the study area.

The Lake City Limestone underlies the Avon Park Limestone. The lower confining bed for the Floridan aquifer generally occurs within the Lake City Limestone. A persistent zone on intergranular anhydrite or gypsum, which reduces pore space and thus restricts the flow of water, defines the top of the lower confining bed. The confining bed varies in depth from less than 600 feet below sea level in northern counties to greater than 2,500 feet below sea level in the southern counties (Wolansky and others, 1979).

FRESHWATER-SALTWATER RELATION

Freshwater in the Floridan aquifer is underlain by saltwater throughout the peninsula of Florida. In coastal parts of the aquifer, chloride concentrations grade from less than 25 mg/L to 19,000 mg/L, forming a zone of transition between the freshwater and saltwater as opposed to a sharp contact between the two fluids. The size and shape of this zone of transition is influenced by variations in thickness and permeability of stratified beds forming the aquifer and by the hydraulic gradient. The transition zone typically slopes landward with the result that saltwater wedges beneath freshwater and extends farther landward with increasing depth.

Seawater moving inland from the sea floor introduces salt ions into the overlying freshwater system. Upon losing these ions, the seawater becomes less dense and rises. The flow of freshwater carries salts back to the sea. This process limits the extent to which saltwater can infiltrate the aquifer (Cooper and others, 1964).

Both convection and molecular diffusion are important parts of this dispersion process. Convection is the mechanical process responsible for transferring one fluid into the other as a result of ocean tides and the rise and fall of the potentiometric surface. Blending of the two fluids is then completed by molecular diffusion.

The potentiometric map of the Floridan aquifer can be used to indicate the general direction of flow within the aquifer. Freshwater in the aquifer moves from areas of high potential where recharge occurs through percolation, sinks, and streambeds to areas of low potential where discharge occurs through wells, springs, seeps, and direct flow to the sea. In southwest Florida, this movement is generally westward toward the coast where the potentiometric surface approaches sea level.

The likelihood of seawater intrusion is greatest in the dry season when water levels are low and puming rates are high. High pumping rates often reverse the hydraulic gradient. The potentiometric surface in May (fig. 5) generally depicts aquifer conditions near the end of the dry season when the aquifer is under maximum stress. Overdevelopment of coastal aquifers by pumping water in excess of recharge reduces the freshwater head and induces inland migration of seawater.

POSITION OF THE 250-MILLIGRAM-PER-LITER LINE OF EQUAL CHLORIDE CONCENTRATION

The transition zone between freshwater and saltwater in the upper part of the Floridan aquifer is bounded on the coastal side by chloride concentrations of 19,000 mg/L and on the landward side by chloride concentrations of 25 mg/L (fig. 6). The zone is depicted in this report as the approximate position of the 250-mg/L line of equal chloride concentration. The surface delineation of the 250-mg/L line is intended to depict the position of the line where it intersects the base of the upper producing zone of the Floridan aquifer. In this report, the upper producing zone is described as being that upper part of the aquifer which contains most of the production wells (fig. 3). Thus, the bottom of the zone is defined by use, in the form of production well depth, and not by descriptive hydrogeologic characteristics.

The position of the 250-mg/L line of equal chloride concentration (fig. 1) was determined by the interpretation of chloride concentration data for wells (table 1) open within the upper producing zone of the Floridan aquifer (fig. 2). In areas where data were minimal, the position of the line was interpolated on the basis of available hydrogeologic data for the aquifer. In previous studies where the chloride concentration line has been determined, these interpretations were used as a basis for determining the present position, using current data to adjust the position of the line.

Chloride concentration values for wells were assumed to represent water from the base of the well unless data specified that samples were taken from some other point in the well. Wells that terminated within or near the upper producing zone or wells that were sampled within or near that zone were plotted on a 1:24,000 scale map. A line of equal concentration was drawn between points and weighted toward the deeper wells or deeper sampling points, with heavier emphasis being placed on more recent values. Data from the northern counties is generally of better quality because of a better knowledge of the sampling zone and more current data that in the south. The 250-mg/L chloride concentration line was then transferred to the 1:500,000 scale map.

Areally, the 250-mg/L line is located less than 3 miles inland along most of coastal southwest Florida. It lies off the coast in parts of southern Hillsborough, Manatee, and Sarasota Counties. In northern Pinellas County, the line turns southeastward into Hillsborough County; a closed line shows that freshwater exists in the upper part of the Floridan aquifer in southern Pinellas County. In Hillsborough County, the line extends northward along the tidal part of the Hillsborough River. In southern Sarasota County, the line turns eastward and extends inland through Charlotte and De Soto Counties.

The top of the Floridan aquifer lies near land surface in coastal areas of Levy, Citrus, Hernando, and Pasco Counties. In these counties, the location of the 250-mg/L line of equal chloride concentration for the upper producing zone of the aquifer was determined by interpolating chloride concentration data collected in 1978 (table 1) from wells having depths ranging from 30 to 525 feet below sea level. Data were sparse in some areas and the position of the line was partially based on Mills and Ryder (1977) for Citrus and Hernando Counties and on Reichenbaugh (1972) for Pasco County. The depth represented by the 250-mg/L line in Levy and Citrus Counties is approximately 100 feet below sea level, which places it in the Avon Park Limestone or Ocala Limestone (fig. 3). In Hernando and Pasco Counties, the line ranges from near 100 feet below sea level in the north to greater than 200 feet below sea level in the south, which places it predominantly in the Suwannee Limestone.

The upper producing zone of the Floridan aquifer in Hillsborough and Pinellas Counties falls predominantly within the Tampa Limestone, although part of the underlying Suwannee Limestone may be in this zone (J.J. Hickey, written commun., 1979). The top of the zone lies near land surface in the northern part of the counties and extends to a depth of 200 feet below sea level in southern Hillsborough County. Chloride concentration data collected in the mid-1970's at wells open within the upper 250 feet of the Floridan aquifer were used to define the position of the 250-mg/L line of equal chloride concentration. The depth below sea level represented by the line is approximately 250 feet in northern Pinellas and Hillsborough Counties and increases to approximately 400 feet in southern Hillsborough County.

The upper producing zone of the Floridan aquifer in Manatee, Sarasota, Charlotte, and De Soto Counties consists of the Tampa Limestone and the lower part of the Hawthorn Formation. The top of the producing zone lies about 200 feet below sea level in northern Manatee County, 400 feet below sea level in northern Sarasota County, rises to 300 feet below sea level in southern Sarasota County, and dips to 700 feet below sea level along the Charlotte-De Soto County line. Chloride concentration data used to define the position of the 250-mg/L line were collected during 1954-78 from wells open to the Tampa Linestone, or the lower part of the Hawthorn Formation, or both. In some cases, the only well-construction information available was well depth. Hence, some samples may represent water from shallower zones as well as the upper Floridan aquifer (D.P. Brown, written commun., 1979). The depth represented by the 250-mg/L line is considered to be related to the deepest part of the aquifer to which the well is open, based on the assumption that most yield to the wells originates from the deepest zones penetrated. The depths below sea level at which the 250-mg/L line of equal chloride concentration occurs are approximately 400 to 600 feet in Manatee County, 600 feet in Sarasota County, and 600 to 900 feet in Charlotte County.

SUMMARY

The U.S. Geological Survey began a program in 1977 in cooperation with the Southwest Florida Water Management District to determine the location of the transition zone between freshwater and saltwater.

The approximate position of the 250-mg/L line of equal chloride concentration within the upper 200 feet of the Floridan aquifer is used in this report to show the general location of the zone of transition. The position of the line is based on currently available chloride concentration data and results of previous Geological Survey investigations. Segments of the line were interpolated from nearby data because of sparse information in many areas. Chloride data for the line were taken at wells having known depths, but many wells are probably open to more than one producing zone. This would tend to give a chloride concentration value that is slightly lower than a value obtained from a representative sample from the base of the well.

In the northern counties, the 250-mg/L line is 100 to 200 feet below sea level in the Ocala Limestone and Avon Park Limestone, the major producing units of the area. The line is within the Suwannee Limestone in Pasco County. In Hillsborough and Pinellas Counties, the line is in the upper 200 feet of the Floridan aquifer where the upper producing zone falls predominantly within the Tampa Limestone. In the southern counties, the line is in the Tampa Limestone or the lower part of the Hawthorn Formation.

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______ 1980, Configuration of the top of the highly permeable dolomite zone of the Floridan aquifer, Southwest Florida Water Management District: U.S. Geological Survey Water-Resources Investigations 80-433.

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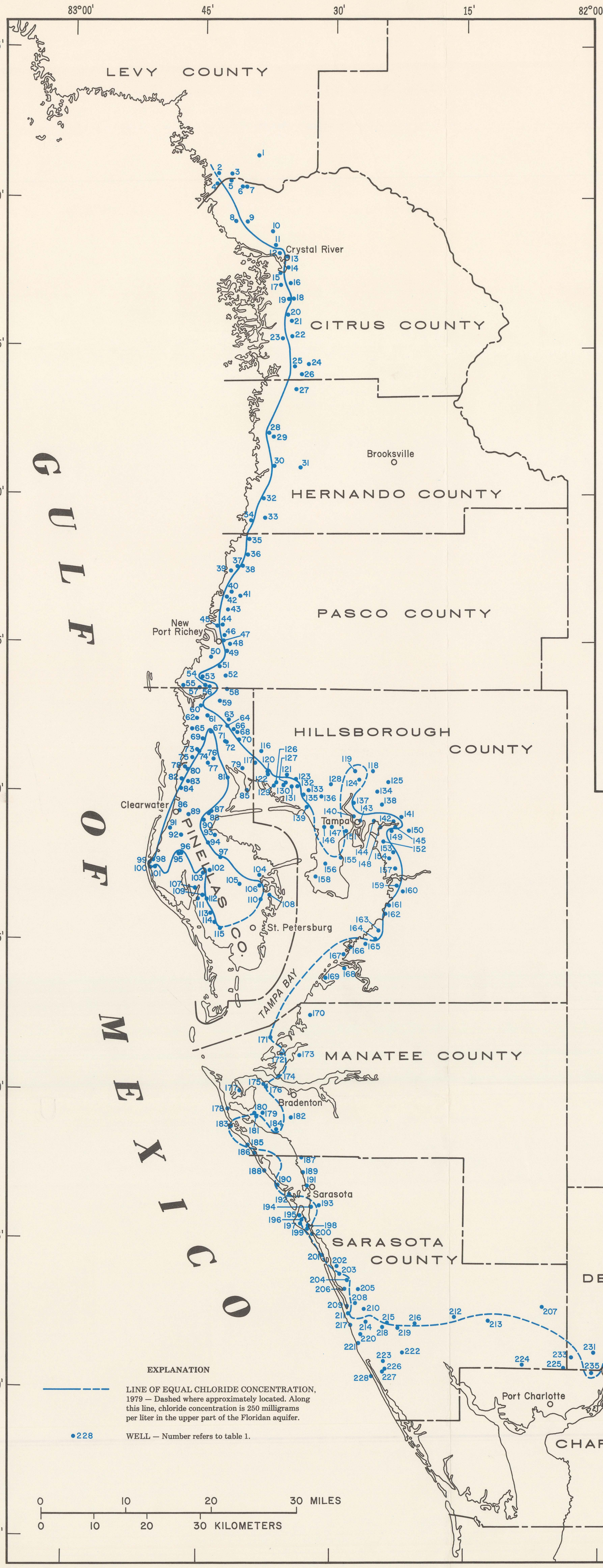

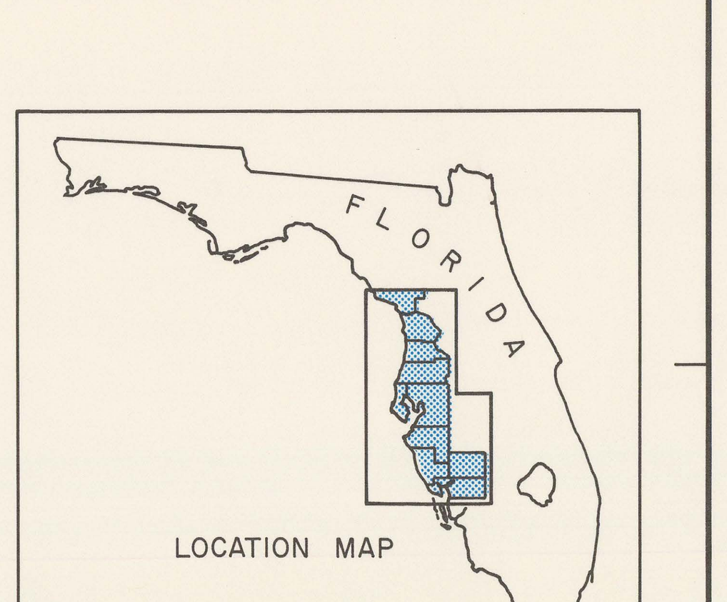

Base from U.S. Geological Survey
State of Florida map, 1967

Figure 1.—Position of 250-milligram-per-liter line of equal chloride concentration in the upper part of the Floridan aquifer along the southwest coast of Florida.

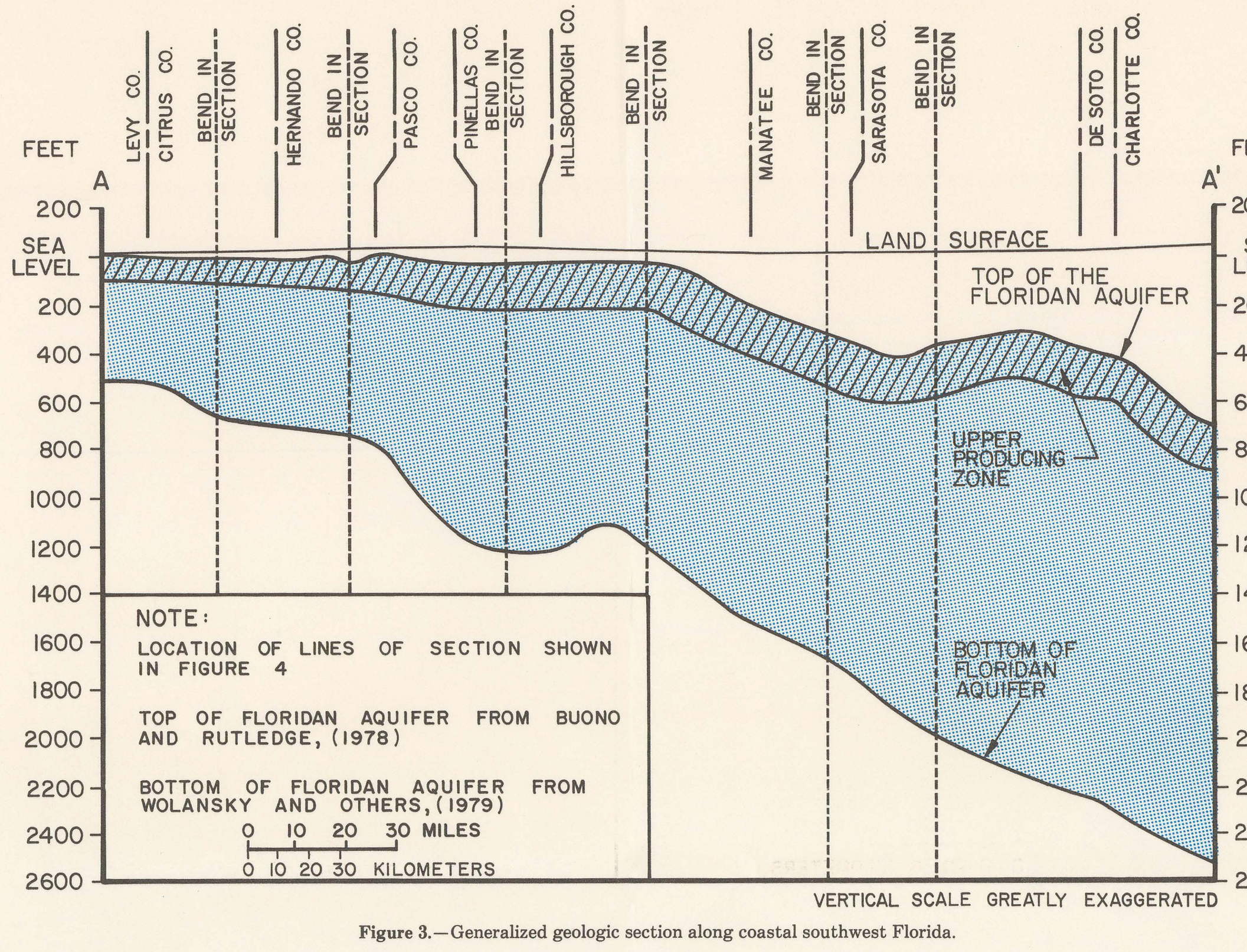

Figure 3.—Generalized geologic section along coastal southwest Florida.

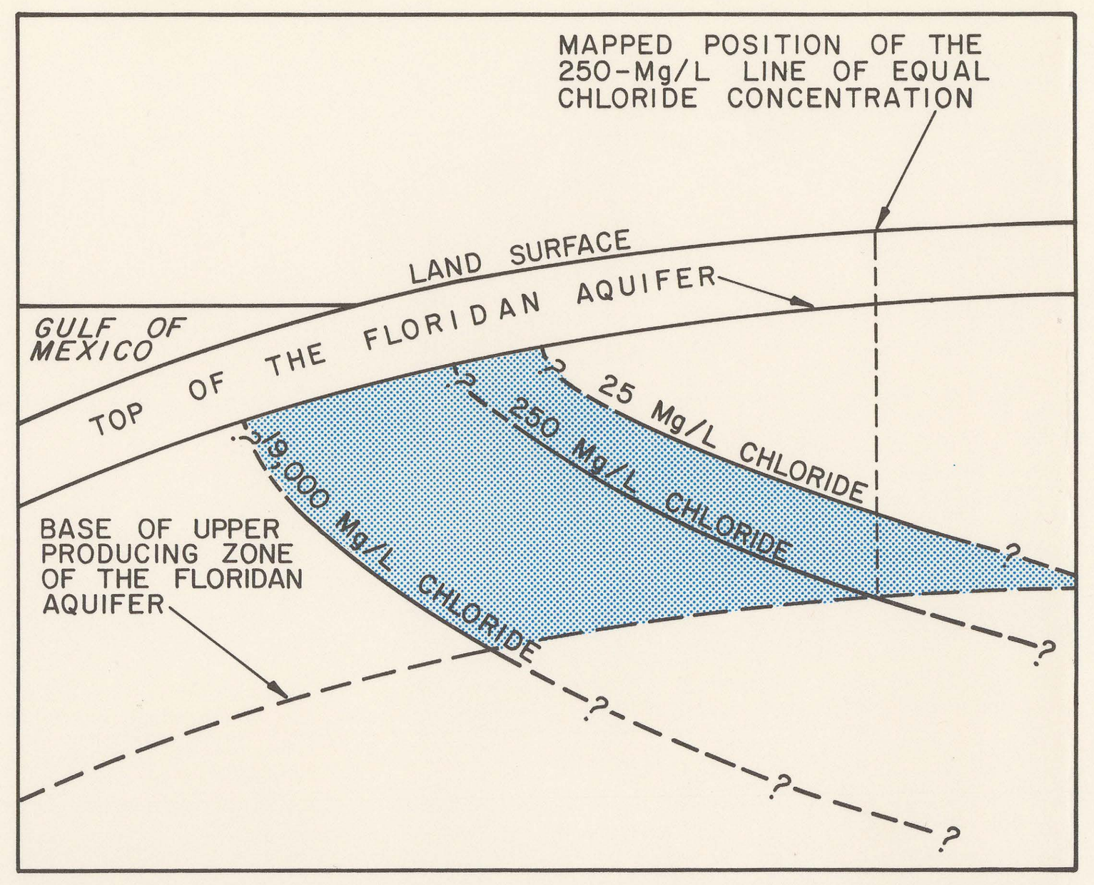

Figure 6.—Hypothetical cross section of the zone of transition between freshwater and saltwater showing the projection to land surface of the intersection of the 250-milligram-per-liter line of equal chloride concentration with the base of the upper producing zone of the Floridan aquifer. (Queried where doubtful).

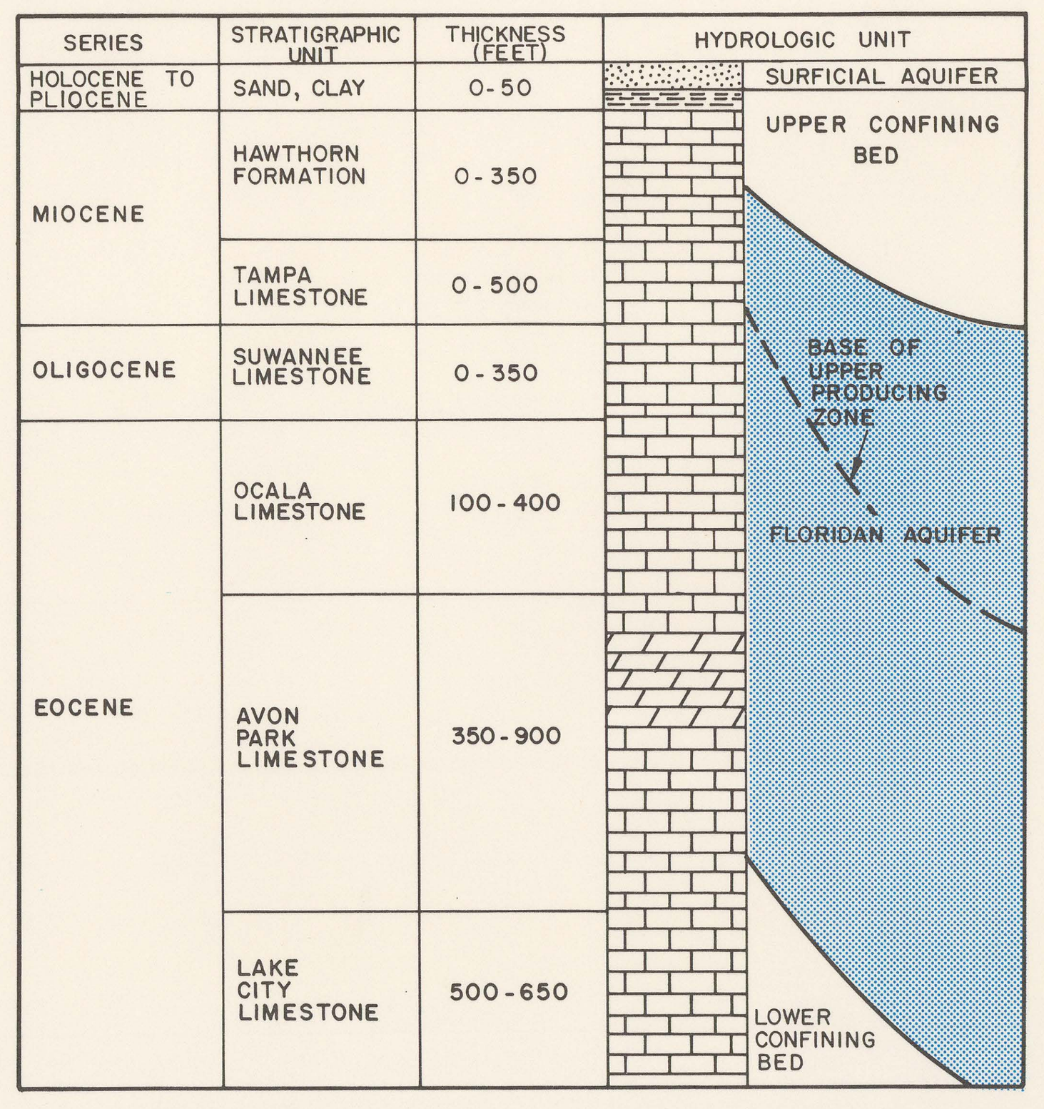

Figure 2.—Generalized hydrogeologic column along coastal southwest Florida.

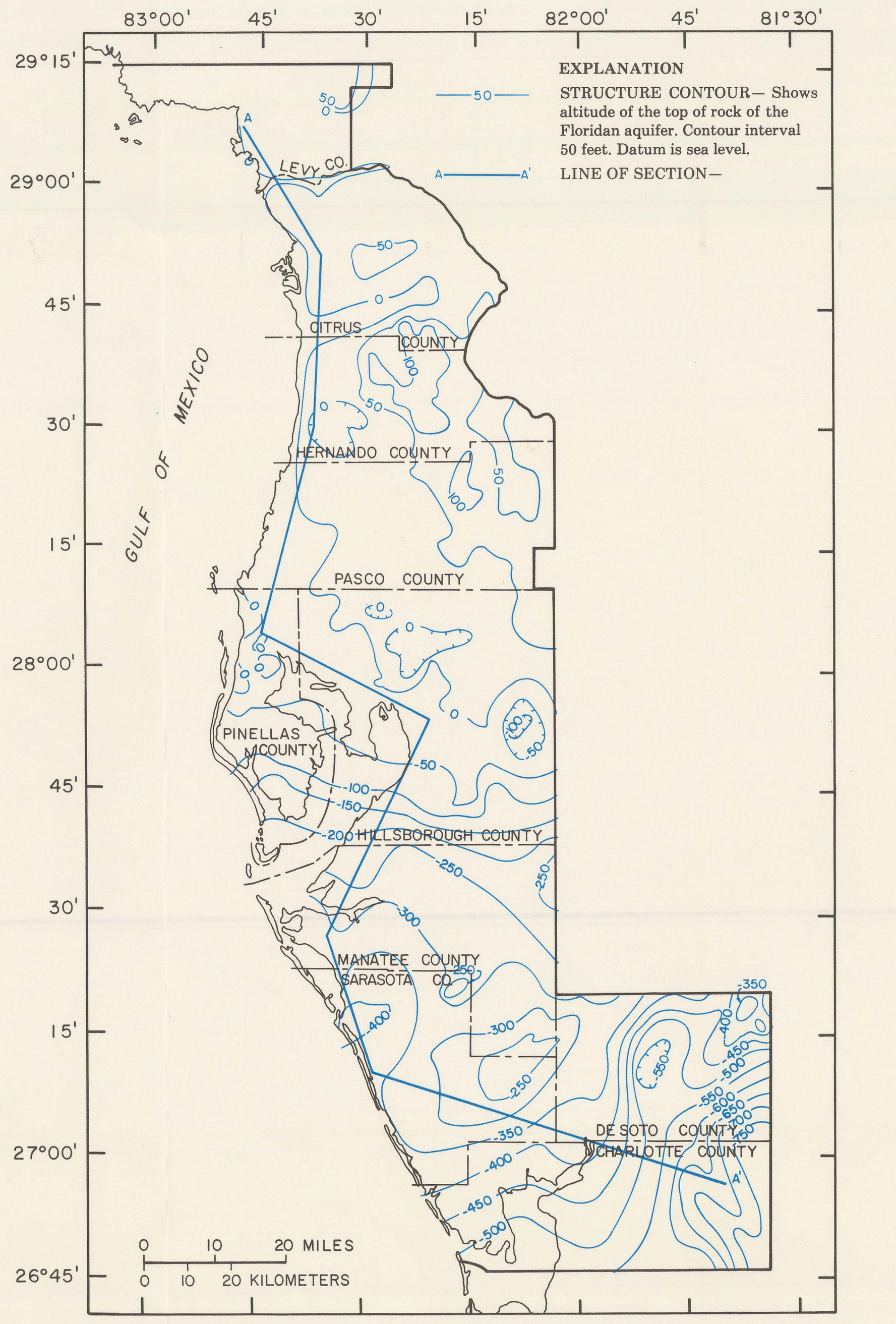

Figure 4.—Configuration of the top of the Floridan aquifer (from Buono and Rutledge, 1978).

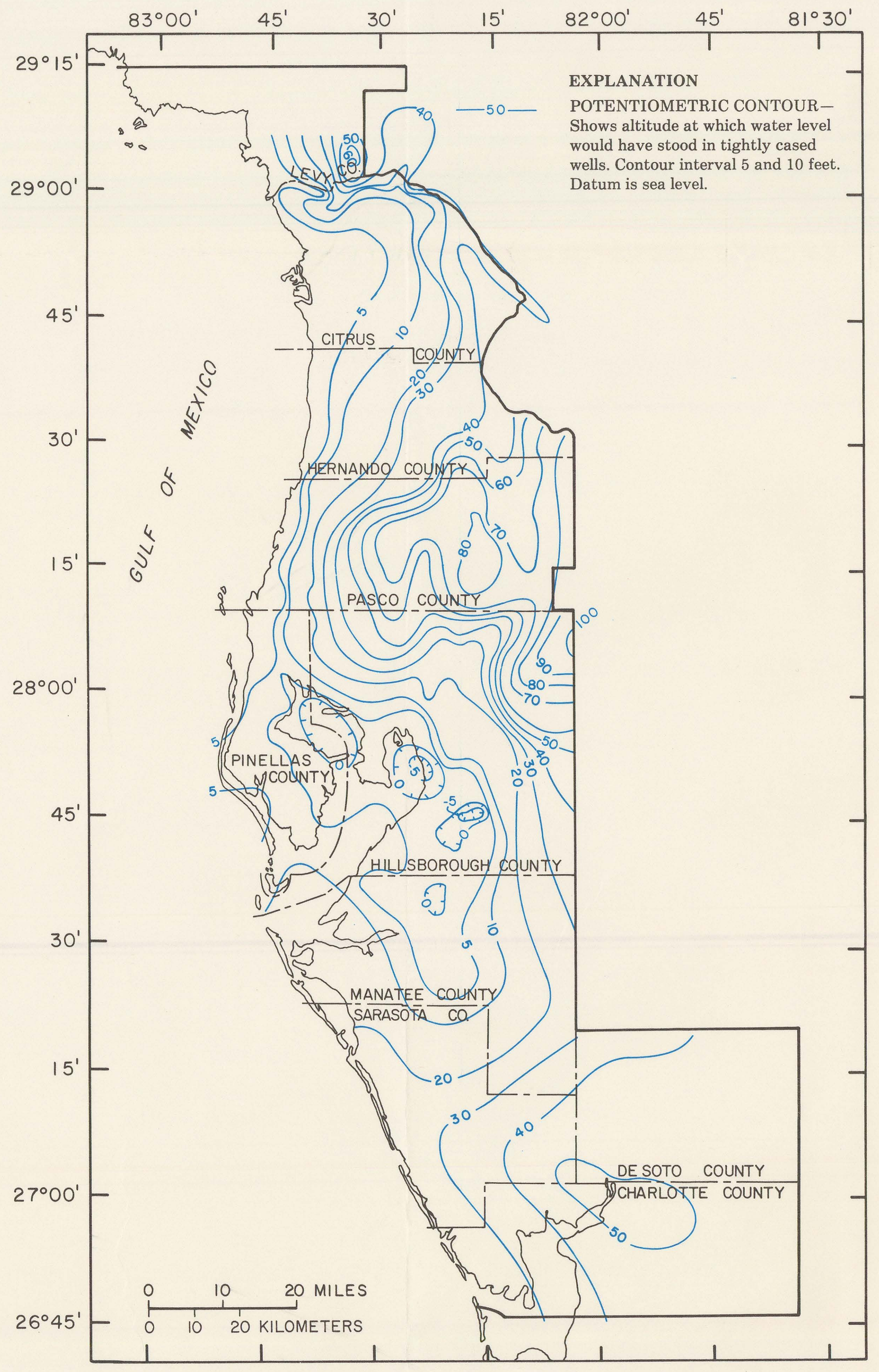

Figure 5.—Potentiometric surface of the Floridan aquifer, May 1980 (from Yobbi and others, 1980).

Table 1.—*List of wells used in compiling the 250-milligram-per-liter line of equal chloride concentration in the upper part of the Floridan aquifer in southwest Florida.*

SITE NO.	USGS WELL NO.	WELL DEPTH (FT.)	CASING DEPTH (FT.)	DATE SAMPLED (MO/YR)	CHLORIDE CONC. (MG/L)
	LEVY COUNTY				
1	290402082384901	37		05/66	9
2	290220082431501	253	200	09/77	45
3	290205082421201	52	49	11/78	19
4	290138082432001	30		12/70	2,025
	CITRUS COUNTY				
5	290145082421901	61	30	07/79	9
6	290117082404501	150		10/78	4
7	290115082401001	40		10/78	16
8	285737082413001	47	42	09/78	450
9	285737082400601	88	67	09/78	16
10	285642082372101	68		10/68	12
11	285508082365701	50	40	12/75	28
12	285421082361602	176	162	06/78	3,000
13	285356082352801	152	100	12/75	4
14	285248082351801	123	112	09/78	6
15	285220082361001	85	82	06/64	506
16	285116082351401	100	70	12/75	43
17	285102082361001	75	60	09/78	280
18	284939082344701	60		12/75	146
19	284938082350301	48		12/75	550
20	284803082351701	50	44	09/78	65
21	284720082345801	86	40	12/75	33
22	284551082345301	99	81	09/78	170
23	284547082361201	53	40	09/78	580
24	284317082330601	176	166	09/78	7
25	284247082343201	92		12/75	170
26	284144082334501	100		12/75	4
	HERNANDO COUNTY				
27	284040082342301	8		12/75	4
28	283555082372901	110		09/78	200
29	283527082365701	125	123	09/78	53
30	283243082365701	302	277	09/78	500
31	283227082335801	190		12/75	6
32	282923082380301	180		12/75	30
33	282742082380001	444		08/77	8
34	282704082394301	195	176	01/76	18,000
	PASCO COUNTY				
35	282519082394301	111		09/78	50
36	282339082395801	112		09/78	25
37	282229082405801	178	156	09/78	9,400
38	282228082402001	100	47	09/78	110
39	282202082414901	72		07/66	202
40	281954082413401	100	42	09/78	39
41	281922082403901	525	185	07/78	500
42	281917082420900	139	131	07/77	136
43	281803082420501	125		09/78	60
44	281652082423301	200	104	09/78	130
45	281648082430201	235	223	09/78	1,200
46	281543082421201	200	120	05/76	110
47	281512082423401	200	120	09/71	292
48	281445082414501	425	401	09/78	490
49	281403082421501	311		05/79	75
50	281324082435601	162	137	01/78	940
51	281236082424901	171	84	02/73	62
52	281138082421701	175		05/79	8
53	281128082445501	100	35	09/78	74
54	281051082442801	70	69	09/78	340
55	281046082470802	112	104	09/78	1,200
56	281036082440901	121	112	09/69	575
57	281023082450701	188	176	09/78	11,000
	PINELLAS COUNTY				
58	281023082420701	350	250	09/78	20
59	280907082424801	305	205	10/78	54
60	280843082451001	103	40	06/75	120
61	280734082442101	150	147	09/78	720
62	280720082454101	98		08/75	1,040
63	280705082415001	110		09/78	8
64	280630082415401	350		09/78	360
65	280616082460301	200		08/75	1,400
66	280611082412101	261	135	09/78	115
67	280604082435801	172	120	05/67	40
68	280556082405701	235	44	04/79	81
69	280513082442601	130	66	05/67	430
70	280511082405601	200	73	04/79	92
71	280457082420402	310	300	10/78	1,300
72	280457082420401	90	82	10/78	830
73	280420082451901	325		09/78	540
74	280405082451901	140	80	10/75	130
75	280320082455201	234		05/67	280
76	280311082433701	138		05/76	13
77	280254082441602	405	390	09/78	460
78	280228082465001	165		09/78	1,100
79	280219082400701	174		10/78	650
80	280214082464201	178	84	09/78	18
81	280133082415102	120		09/78	130
82	280122082471101	400		09/78	1,900
83	280104082463101	242	67	05/76	91
84	280015082471201	182	68	09/78	170
85	280004082394201	175	152	03/67	17,500
86	275754082471401	195		06/63	72
87	275753082433701	548	523	09/78	11,000
88	275748082435301	284	60	01/64	21
89	275739082462601	183	88	09/71	63
90	275711082442801	244	60	05/67	113
91	275613082481501	311	69	10/63	52
92	275535082470201	180	100	09/71	43
93	275524082430801	133		10/62	270
94	275448082435201	100	96	10/62	200
95	275342082470701	90		10/62	270
96	275342082465801	210		10/62	200
97	275312082423201	195	100	10/75	200
98	275304082502501	133	42	04/74	340
99	275244082503701	590	490	05/78	19,000
100	275222082504602	150		10/78	92
101	275217082500701	300		04/74	390
102	275207082434601	255	100	10/62	108
103	275141082443701	200	120	09/75	280
104	275135082381901	115		10/78	340
105	275047082401601	192	62	09/75	160
106	275036082380301	265		10/75	230
107	275013082452901	278		09/75	300
108	274934082370704	267	206	09/78	7,200
109	274929082443504	250	200	09/78	600
110	274910082380401	140		10/78	120
111	274907082450501	240		09/75	240
112	274906082435901	153	125	08/75	270
113	274734082433001	344		09/75	600
114	274652082432201	354	190	09/75	140
115	274606082423601	285	185	09/75	360
	HILLSBOROUGH COUNTY				
116	280358082380101	87		10/78	9
117	280305082385401	700		01/65	395
118	280204082253101	400		09/63	10
119	280202082273301	115	87	11/56	1,185
120	280152082371201	104	40	05/76	160
121	280142082350201	182		05/77	8
122	280140082371001	71	40	05/76	260
123	280118082340801	220	213	09/78	76
124	280112082270101	318	80	10/78	3,800
125	280104082235601	105	70	10/63	68
126	280054082361301	100	42	05/76	200
127	280053082350202	330	315	10/78	2,200
128	280042082301201	125		08/63	18
129	280034082362401	104	41	09/78	440
130	280025082353701	80		05/76	230
131	280025082342801	135		06/66	455
132	280025082335401	110	68	09/78	420
133	280003082324101	140	97	05/76	110
134	275955082245301	120		09/63	34
135	275942082331701	200		09/78	170
136	275924082311601	208	87	05/65	86
137	275851082274301	450		05/80	30
138	275844082243501	700		09/63	7
139	275817082325001	128	123	12/78	860
140	275734082274301	165	100	01/59	760
141	275724082221001	240		02/74	72
142	275701082230304	202		09/78	420
143	275657082270402	250	34	01/67	420
144	275657082251601	693	426	06/66	19,000
145	275642082224201	72		09/78	290
146	275634082305701	124		11/79	110
147	275632082295601	224	90	04/80	67
148	275629082242201	93		05/78	750
149	275615082230601	165	54	09/78	19
150	275611082211701	302	71	05/78	170
151	275558082282401	120		09/63	29
152	275509082240501	136	24	05/78	360
153	275353082225501	106		09/76	240
154	275319082232701	137		09/76	810
155	275316082285901	85	30	11/79	80
156	275237082304201	208		11/79	520
157	275216082225101	350		05/76	2,500
158	275140082314501	85		11/79	410
159	275045082223601	250	32	05/76	940
160	275008082220201	315	42	05/74	38
161	274837082232901	145		10/78	120
162	274735082234901	350	30	09/75	110
163	274602082244001	300		10/74	380
164	274508082245501	320	22	10/74	200
165	274446082260601	450		07/55	25
166	274416082275401	288	124	09/78	30
167	274347082283201	350		05/75	37
168	274221082282401	337		05/78	30
169	274107082303701	348	30	05/74	24
	MANATEE COUNTY				
170	273723082321101	284	170	09/67	32
171	273503082365701	330		09/75	240
172	273340082353501	550	8	05/79	320
173	273333082332901	403	47	03/71	190
174	273129082354401	561		08/71	540
175	273043082373701	405		01/54	295
176	273012082372901	548		03/55	144
177	272953082402101	380		01/54	598
178	272758082415301	586		03/72	340
179	272740082373001	410		01/78	300
180	272738082383101	506	306	06/72	400
181	272713082381101	480	51	07/72	140
182	272708082343001	500		02/55	217
183	272618082411101	385		06/76	150
184	272558082360601	399		05/79	330
185	272417082390901	433	280	11/72	220
186	272324082383101	417		06/76	320
	SARASOTA COUNTY				
187	272308082330701	400	30	11/64	190
188	272144082371801	405		09/66	520
189	272122082330801	804	316	05/79	190
190	272023082354801	546	304	01/72	120
191	272019082322601	346	24	03/72	170
192	271914082342601	425	90	05/79	120
193	271813082310401	343	43	11/64	100
194	271802082320301	600		03/62	400
195	271706082334201	450		05/62	300
196	271654082331101	415	254	05/71	75
197	271626082333001	315	133	04/63	80
198	271608082323301	515	77	10/62	364
199	271603082323201	262	134	07/63	69
200	271523082321301	418	138	07/62	175
201	271308082305701	148		01/66	136
202	271213082290801	501	74	07/63	57
203	271118082285301	255	157	02/66	100
204	271037082274801	424	28	01/68	300
205	270944082264901	600	305	05/80	98
206	270943082281401	513	43	12/71	278
207	270818082055901	740		12/64	75
208	270813082270501	500	18	01/71	80
209	270757082274701	200		01/71	260
210	270748082260601	300		01/71	100
211	270718082275701	480	140	01/64	80
212	270714082155201	342	280	04/66	118
213	270650082260101	381	32	10/63	250
214	270637082255501	423		05/73	440
215	270630082233701	422	64	09/63	98
216	270629082202101	159	21	08/72	60
217	270559082273301	245	84	04/71	120
218	270556082240301	349	32	05/72	300
219	270555082220801	400		07/62	1,050
220	270528082263701	420		04/66	292
221	270406082262601	308	72	05/67	140
222	270333082214301	300	212	08/72	460
223	270239082235701	475	460	05/80	290
224	270221082082001	637		02/67	960
225	270159082033101	427	69	11/65	420
226	270156082234401	627	197	12/71	274
227	270137082235301	305	263	08/66	56
228	270109082250401	400	66	04/66	420
	DE SOTO COUNTY				
229	270412081474901	460	112	09/63	71
230	270406081583501	375	114	12/71	155
231	270345082001601	515	126	05/71	232
232	270326081410301	500	70	04/71	112
233	270312082024401	616	97	10/62	292
234	270239081574601	456	85	04/71	395
	CHARLOTTE COUNTY				
235	270152082002802	575	303	08/79	225
236	270107081425801	590	45	12/63	425
237	270105081534001	392	144	10/68	194
238	265941081561401	360	329	08/68	610
239	265853081414801	536	81	01/69	760
240	265843081424601	535	105	01/69	180
241	265833081530201	653	142	05/65	810
242	265648081475201	527		11/69	710
243	265558081460801	605	158	12/64	380

POSITION OF THE SALTWATER-FRESHWATER INTERFACE IN THE UPPER PART OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA, 1979

By
K.W. Causseaux and J.D. Fretwell

1982