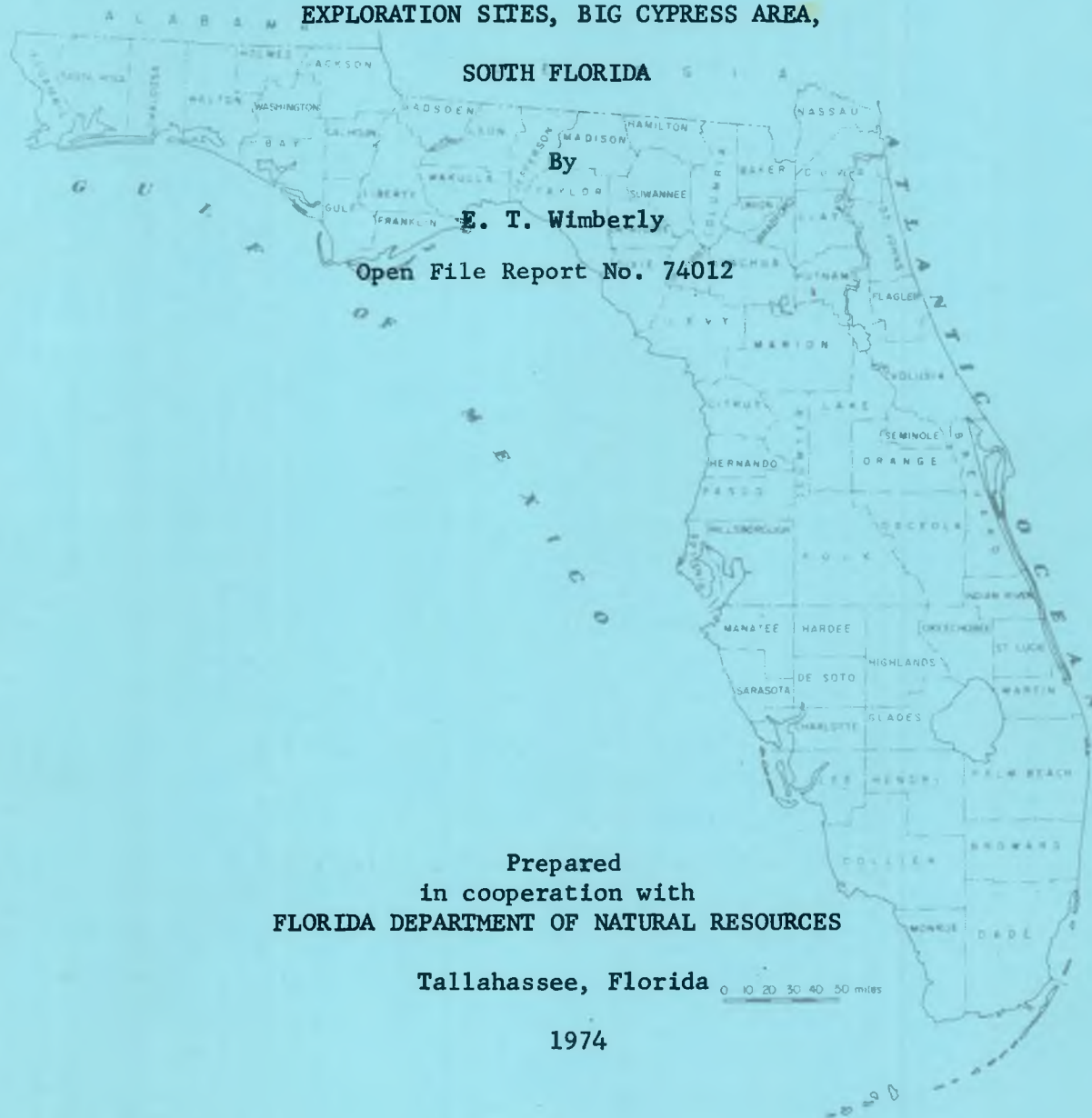


UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



QUALITY OF SURFACE WATER IN THE VICINITY OF OIL
EXPLORATION SITES, BIG CYPRESS AREA,



SOUTH FLORIDA

By

E. T. Wimberly

Open File Report No. 74012

Prepared
in cooperation with
FLORIDA DEPARTMENT OF NATURAL RESOURCES

Tallahassee, Florida

1974

FL- 74012 QUALITY OF SURFACE WATER IN THE VICINITY OF OIL EXPLORATION SITES, BIG CYPRESS AREA, SOUTH FLORIDA.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
TALLAHASSEE, FLORIDA
32303



From...

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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

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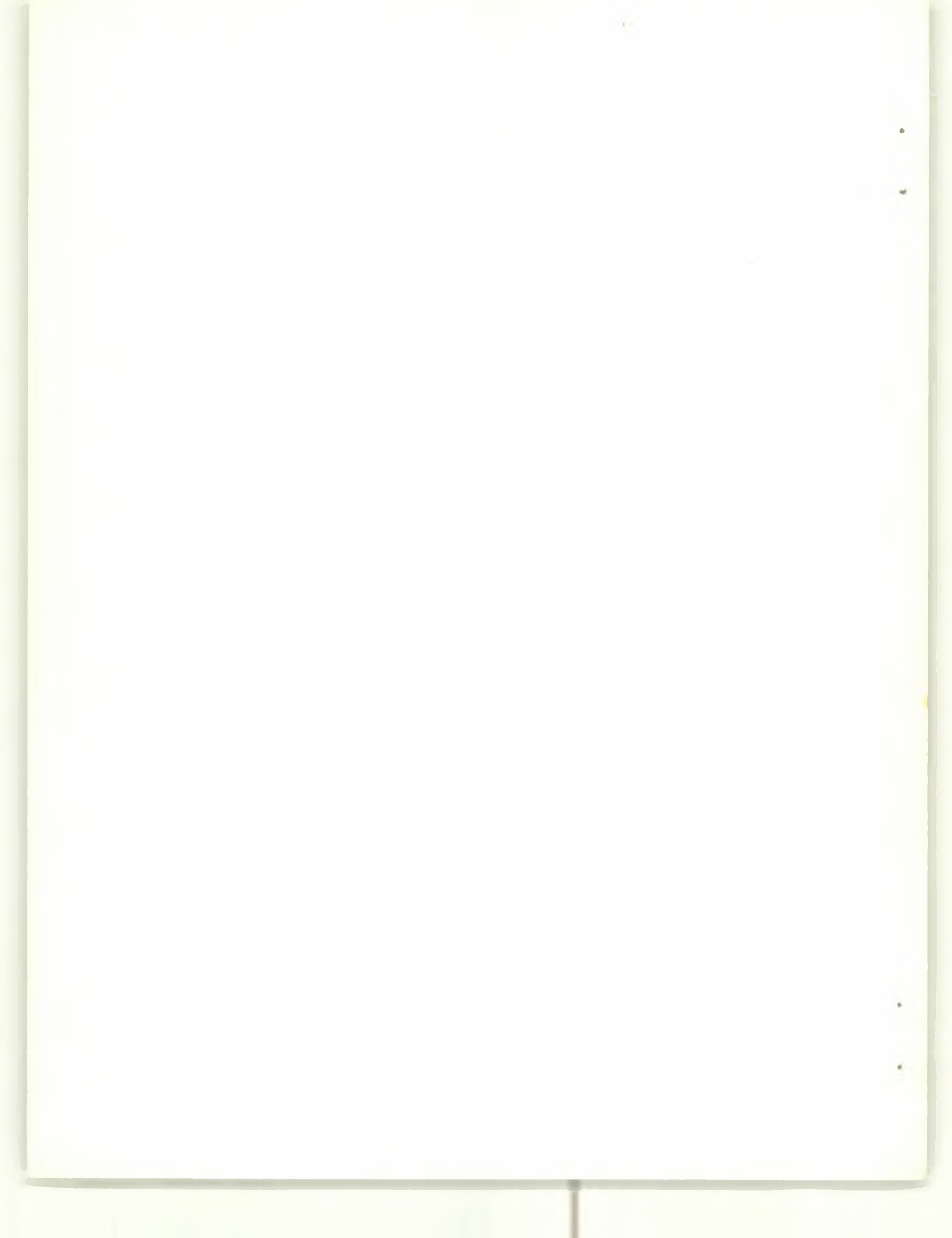
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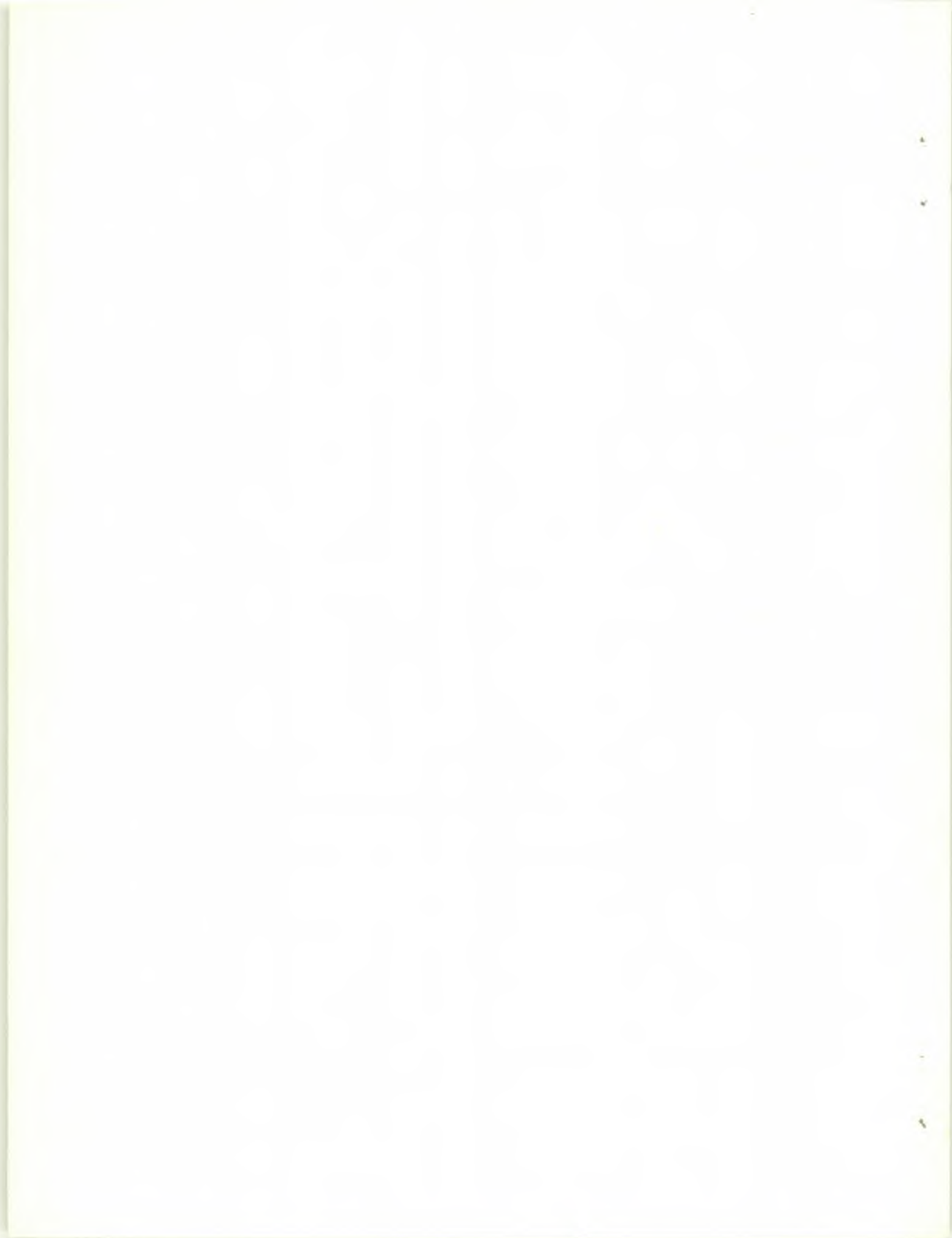


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ILLUSTRATION

Figure 1. Map of south Florida showing oil test-sampling sites in the big Cypress Area.	3
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QUALITY OF SURFACE WATER IN THE VICINITY OF OIL
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SOUTH FLORIDA

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INTRODUCTION

Exploration for oil in the Big Cypress area of south Florida (fig. 1) during the early 1970's caused concern that this activity might change the quality of surface water in the vicinity of the drilling sites. In late 1972 concern was intensified by the State's proposal to declare part of the Big Cypress as an area of "Critical State Concern," where development activities would be closely regulated to prevent damage to the environment. As a result of this concern the Florida Department of Natural Resources and the U.S. Geological Survey during 1971-73 cooperatively investigated the quality of surface water in those areas where oil exploration was being undertaken.

During 1971-72 samples of surface water were collected in an existing oil field at Sunniland, Florida to determine whether water quality was affected (Wimberly, 1973). Concurrently, beginning in August 1971 samples of surface water were collected near the proposed exploration sites before oil drilling activities commenced in order to assemble background water-quality data. After the drilling

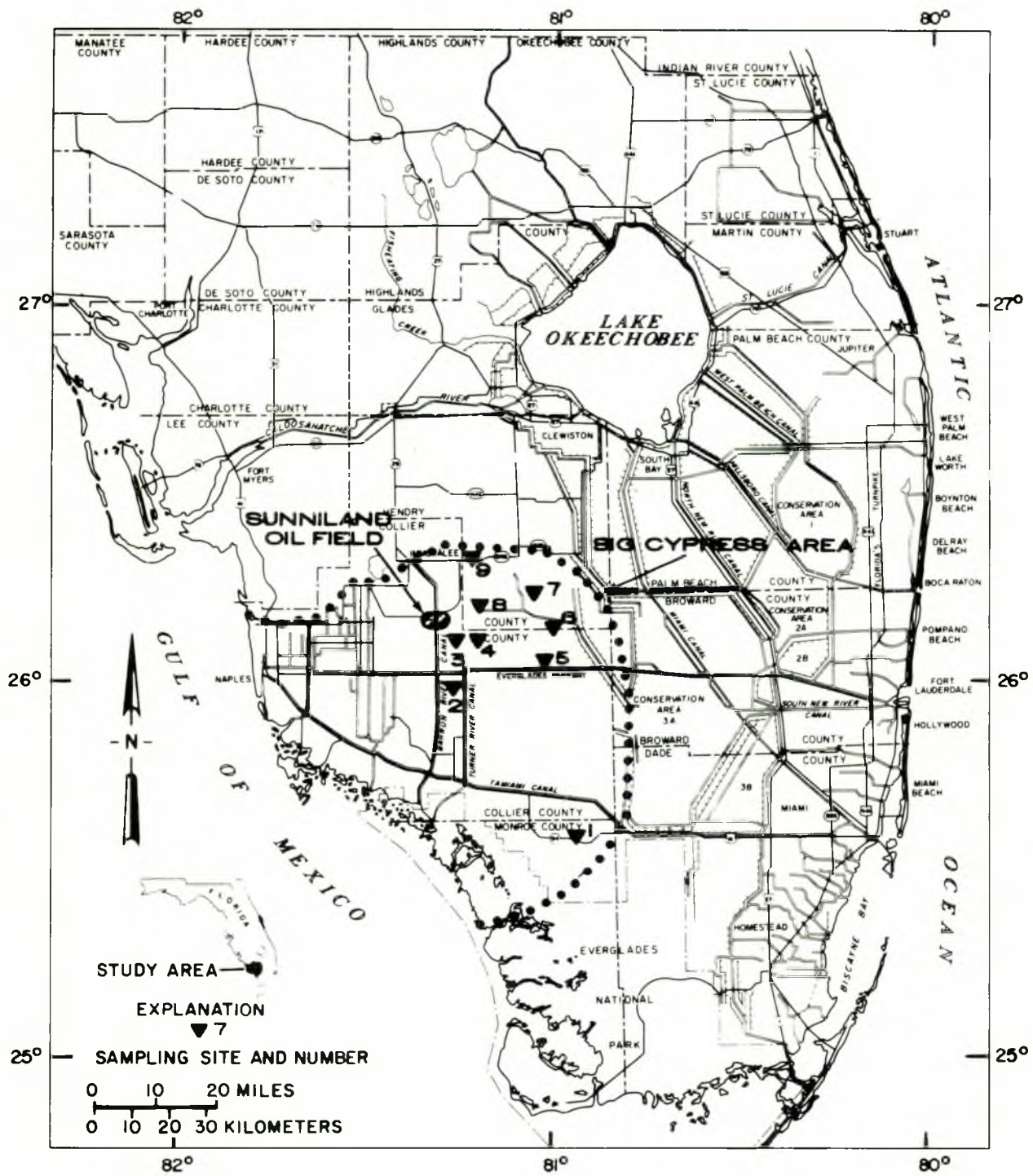


Figure 1.--Map of south Florida showing oil test-sampling sites in the Big Cypress Area.

sites were actually in use the surface water was again sampled to determine whether the exploration activities had caused any water-quality changes. The results are presented in the site summaries.

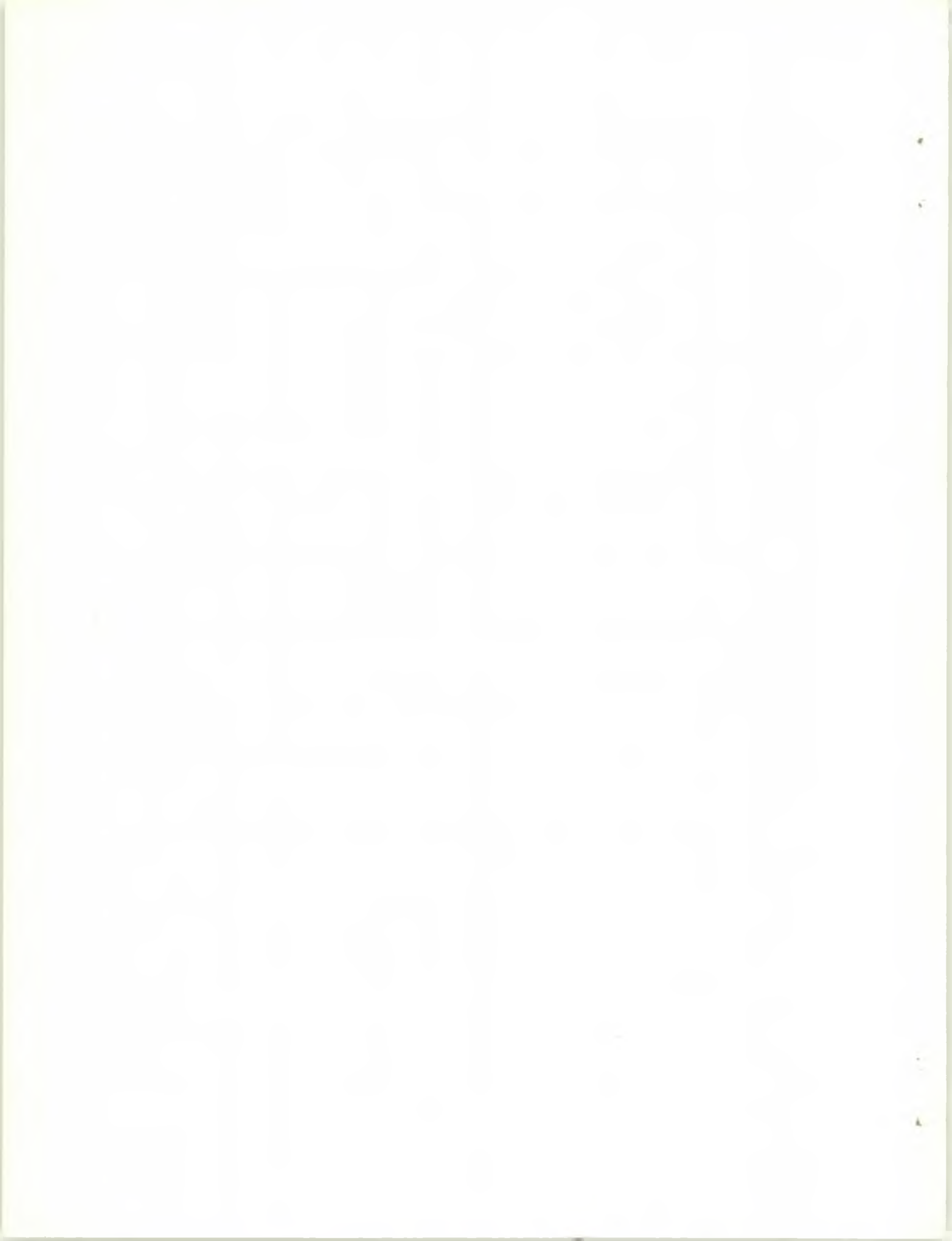
The general location of each site is shown on figure 1. The sketch map which is a part of each site summary shows direction and approximate distances from the exploratory well site where samples were collected. The drilling chronologies were furnished by the Bureau of Geology, Florida Department of Natural Resources.

The sampling sites were chosen "downstream" from the exploration sites in the sense that they were in the general direction of surface-water flow from each site. As the exact location of some of the drilling sites could not be pinpointed prior to the location being staked, some of the background samples collected in 1971 are as much as half a mile from the actual drilling site. These background samples ranged in chloride concentration from 12 to 28 mg/l (milligrams per liter) and averaged 19 mg/l. The lack of samples near some of the drilling sites is not considered significant as the chloride range was so narrow.

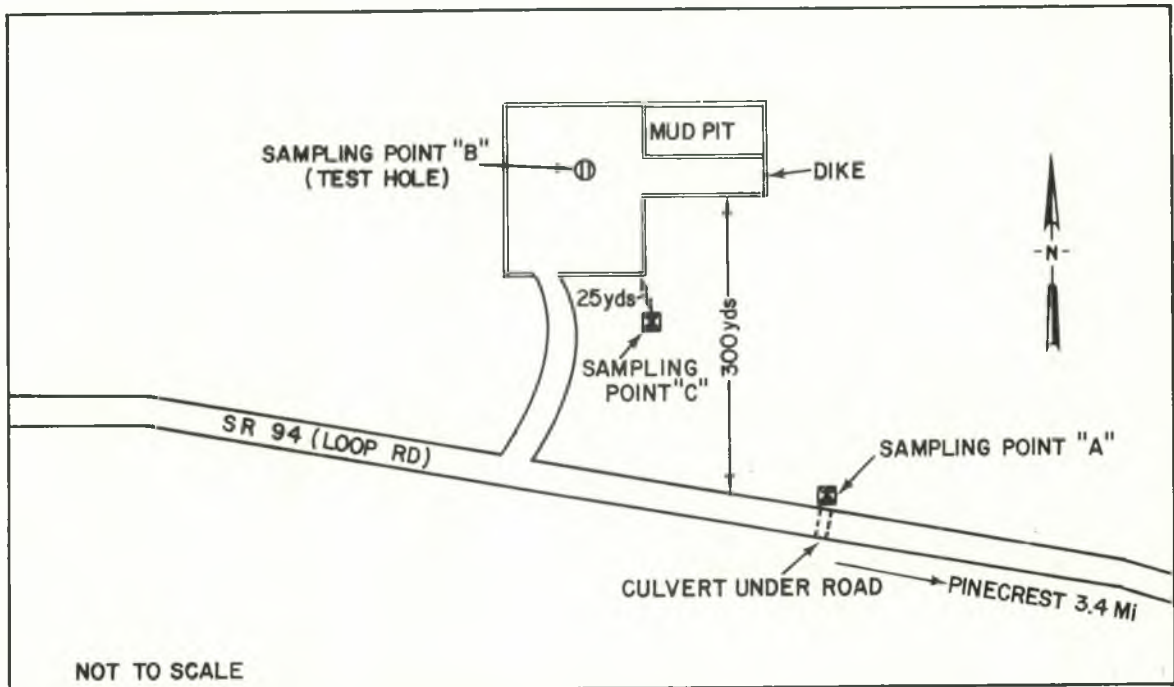
Distances on the sketches are shown in yards and miles, their International System Unit equivalents are:

1 yard = 0.9144 meters

1 mile = 1.609 kilometers.



Site 1: Raymond D. Reynolds, Mrs. Ivar Axelson, et al, No. 1 Permit #564, sec. 14, T.54 S., R.33 E., Monroe County.



Drilling History

Site prepared		June 1972
Spudded		July 27, 1972
Drilling at:	2,288 feet	July 31, 1972
	4,500	August 7, 1972
	9,700	August 14, 1972
	11,066	August 18, 1972
	12,500	August 28, 1972
Total depth reached		August 30, 1972

Casing History

20-inch set surface to 200 feet
 13 3/8-inch set surface to 1,367 feet
 9 5/8-inch set surface to 3,570 feet

Plugging Record

Cement plugs set:

0 to 100 feet	September 2, 1972
3,470 to 3,570 feet	September 2, 1972
11,325 to 11,825 feet	September 2, 1972

Annulus plugged

0 to 100 feet	February 18, 1973
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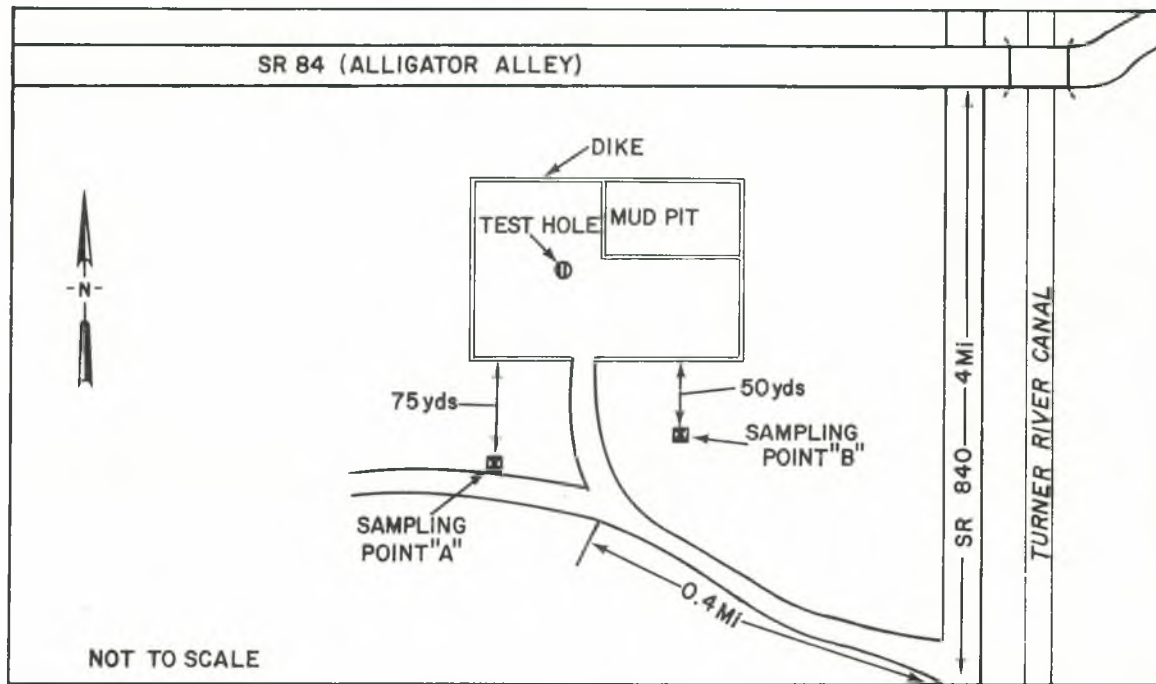
Site 1 (Continued)

Sampling point	Chemical and physical analyses of water and bottom sediment samples						
	A	A	A	B		A	C
Date	8-30-71	10-28-71	1-2-73	1-2-73 ^{a/}	4-25-73	6-21-73	10-26-73
Temperature (°C)	28.0	27.0	28.0	28.0	<u>b/</u>	24.5	22.0
Dissolved oxygen (mg/l)	4.0	7.6	11.2	0.9			3.9
pH	7.9	7.6	8.2	7.6		7.3	7.6
Specific conductance (micromhos at 25°C)	274	250	1,150	9,800		445	295
Chloride (mg/l)	18	28	250	2,800		16	15
Total carbon (mg/l)	44		35	45		62	54
Inorganic carbon (mg/l)	25		31	39		56	37
Organic carbon (mg/l)	19		4.0	6.0		6.0	17
Oil and grease:							
water at surface (mg/l)	.0						
water 0.5' below surface (mg/l)	7.0	7.5					
bottom sediment (mg/kg)	1,700	900					

a/ This sample was of water flowing from casing where the test well had been drilled. It is presumed to have been flowing up the annulus between the 13 3/8 and 9 5/8-inch casing since the drilling records show that casing was plugged with cement on September 2, 1972, but the annulus was not plugged until February 18, 1973.

b/ When this well site was visited April 25, 1973 the sampling points were dry and there was no surface water in the immediate area.

Site 2: Barron Collier Jr., et al, 24-4, Permit #646, sec. 24,
T.50 S., R.30 E., Collier County.



Drilling History

Site prepared		April 1973
Spudded		April 16, 1973
Drilling at:	1,402 feet	April 23, 1973
	2,533	April 30, 1973
	3,675	May 7, 1973
	8,743	May 14, 1973
	11,101	May 21, 1973
Total depth	11,997	May 26, 1973

Casing History

20-inch set surface to 236 feet
 13 3/8-inch set surface to 1,402 feet
 9 5/8-inch set surface to 3,675 feet

Plugging Record

Cement plugs set:	
0 to 105 feet	May 29, 1973
3,415 to 3,615 feet	May 29, 1973
11,475 to 11,975 feet	May 29, 1973
Annulus plugged:	
0 to 100 feet	May 29, 1973

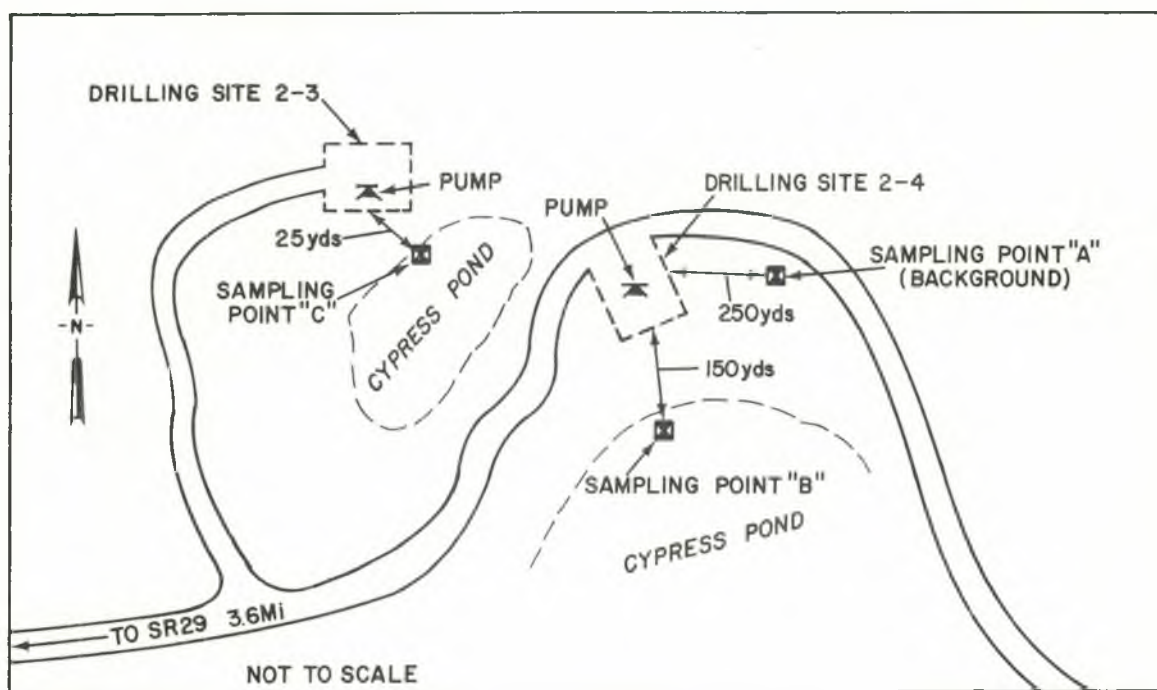
Site 2 (Continued)

Chemical and physical analyses of water samples

Sampling point	A	A	B
Date	4-25-73	6-21-73	10-26-73
Temperature (°C)	a/	25.0	22.5
Dissolved oxygen (mg/l)			2.3
pH		7.5	7.4
Specific conductance (micromhos at 25°C)	414	510	550
Chloride (mg/l)	36	23	25
Total carbon (mg/l)	43		84
Inorganic carbon (mg/l)	28		68
Organic carbon (mg/l)	15		16

a/ When this well site was visited April 25, 1973 the sampling points were dry and there was no surface water in the immediate area.

Site 3: Gulf Coast Realities 2-3 and 2-4, Permit #641 and 563,
 sec. 2, T.49 S., R.30 E., Collier County.



Drilling History Well 2-3

Site prepared	March 1973
Spudded	March 7, 1973
Drilling at: 1,661 feet	March 12, 1973
4,442	March 19, 1973
9,581	March 26, 1973
11,444	April 2, 1973
Total depth 11,880	April 7, 1973

Casing History 2-3

20-inch set surface to 204 feet
 13 3/8-inch set surface to 1,363 feet
 9 5/8-inch set surface to 3,600 feet
 7-inch set surface to 11,880 feet

This well was not plugged; it is a Bear Island Field well.

Site 3 (Continued)

Drilling History Well 2-4

Site prepared	August 1972
Spudded	August 18, 1972
Drilling at: 60 feet	August 18, 1972
3,195	August 28, 1972
6,197	September 4, 1972
10,761	September 11, 1972
11,655	September 18, 1972
Total depth 11,827	September 20, 1972

Casing History 2-4

20-inch set surface to 200 feet
13 3/8-inch set surface to 1,358 feet
9 5/8-inch set surface to 3,540 feet
7-inch set surface to 11,827 feet

This well was not plugged; it is a Bear Island Field discovery well.

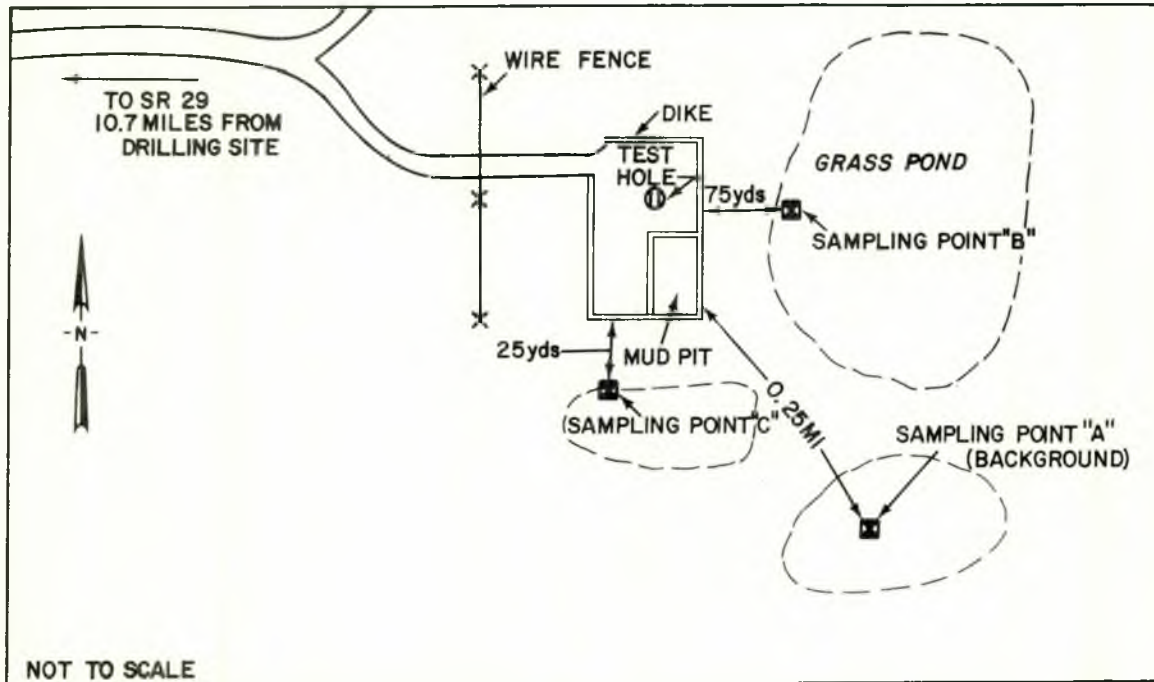
Site 3 (Continued)

Chemical and physical analyses of water and bottom sediment samples

Sampling point	A			B	C
Date	8-31-71	4-25-73	6-22-73	10-26-73	10-26-73
Temperature (°C)	30.0	a/	a/	21.5	21.5
Dissolved oxygen (mg/l)	2.6			2.6	1.4
pH				7.5	7.8
Specific conductance (micromhos at 25°C)	380			315	315
Chloride (mg/l)	17			35	35
Total carbon (mg/l)	61			60	61
Inorganic carbon (mg/l)	42			39	32
Organic carbon (mg/l)	19			21	29
Oil and grease:					
water at surface (mg/l)				.5	
water 0.5' below surface (mg/l)				2.3	
II bottom sediment (mg/kg)	1,300				

a/ When these well sites were visited April 25 and June 22, 1973 the sampling points were dry and there was no surface water in the immediate area.

Site 4: Raymond D. Reynolds 16-2, Permit #619 and 619A, sec. 16,
T. 49 S., R. 31 E., Collier County.



Drilling History

Site prepared		November 1972
Spudded (original hole)		December 2, 1972
Drilling at:	558 feet	December 4, 1972
	1,757	December 11, 1972
	3,718	December 18, 1972
	5,456	December 27, 1972
	7,800	January 2, 1973
Hole abandoned	8,476	January 8, 1973
Spudded (offset hole)		January 25, 1973
Drilling at:	1,290	January 29, 1973
	1,441	February 5, 1973
	3,906	February 12, 1973
	7,400	February 19, 1973
	10,100	February 26, 1973
	11,494	March 5, 1973
Total depth reached	11,795	March 11, 1973

Site 4 (Continued)

Casing History (original hole)

20-inch set surface to 208 feet
 13 3/8-inch set surface to 1,364 feet
 9 5/8-inch set surface to 3,694 feet

(offset hole)

20-inch set surface to 200 feet
 13 3/8-inch set surface to 1,441 feet
 9 5/8-inch set surface to 3,906 feet

Plugging Record (original hole)

Cement plugs set:

0 to 100 feet	Date not reported
500 to 900 feet	Do.
1,000 to 1,200 feet	Do.
2,500 to 2,700 feet	Do.

(offset hole)

Cement plugs set:

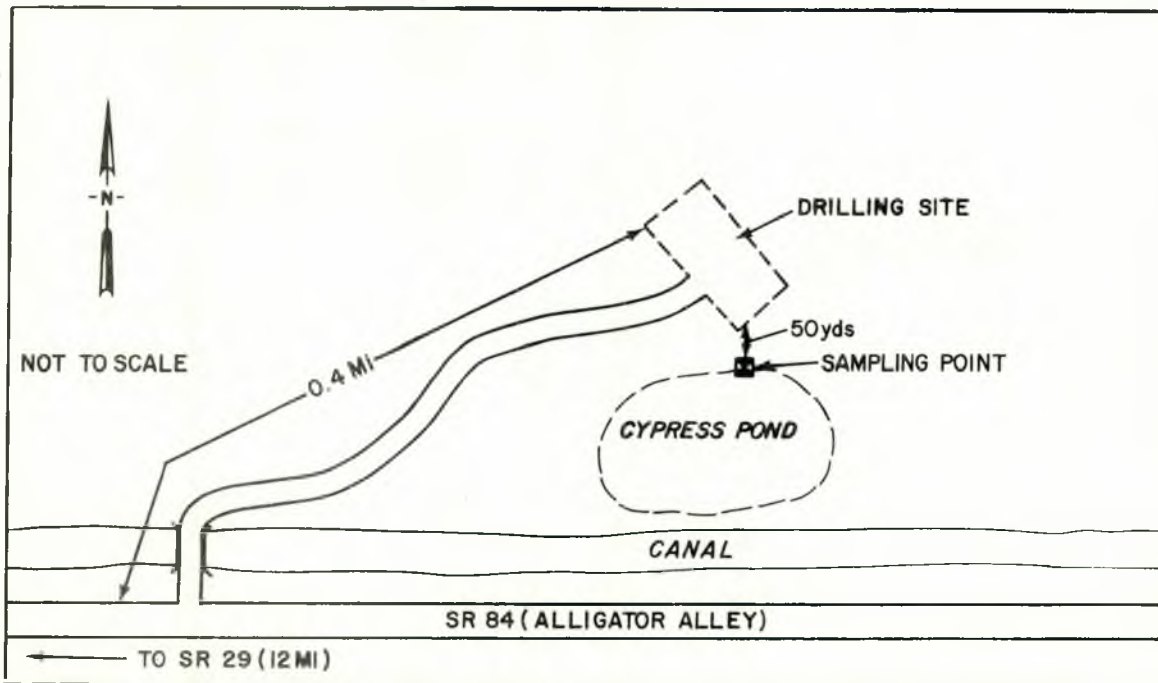
0 to 25 feet	Date not reported
1,100 to 1,350 feet	Do.
2,532 to 2,732 feet	Do.
11,280 to 11,780 feet	Do.

Chemical and physical analyses of water and bottom sediment samples

Sampling point	A	B	B	C
Date	8-31-71	4-25-73	6-22-73	10-26-73
Temperature (°C)	30.0		29.0	24.5
Dissolved oxygen (mg/l)	7.2			6.8
pH		a/	7.3	7.7
Specific conductance (micromhos at 25°C)	210		16,200	335
Chloride (mg/l)	12		5,400	22
Total carbon (mg/l)	40			47
Inorganic carbon (mg/l)	23			32
Organic carbon (mg/l)	17		43	15
Oil and grease:				
water at surface (mg/l)	.0			
water 0.5' below surface (mg/l)	8.6			
bottom sediment (mg/kg)	90			

a/ When this well site was visited April 25, 1973, the sampling points were dry and there was no surface water in the immediate area.

Site 5: Barron Collier Jr., et al, 31-3, Permit #562, sec. 31,
T.49 S., R.33 E., Collier County.



Drilling History

Site prepared		March 1972
Spudded		April 15, 1972
Drilling at:	1,336 feet	April 17, 1972
	3,028	April 25, 1972
	4,920	May 1, 1972
	9,952	May 9, 1972
	11,109	May 15, 1972
Total depth	11,760	May 21, 1972

Casing History

20-inch set surface to 250 feet
 13 3/8-inch set surface to 1,504 feet
 9 5/8-inch set surface to 3,650 feet

Plugging Record

Cement plugs set:		
0 to 250 feet		Date not reported
3,286 to 3,886 feet		Do.
11,250 to 11,592 feet		Do.

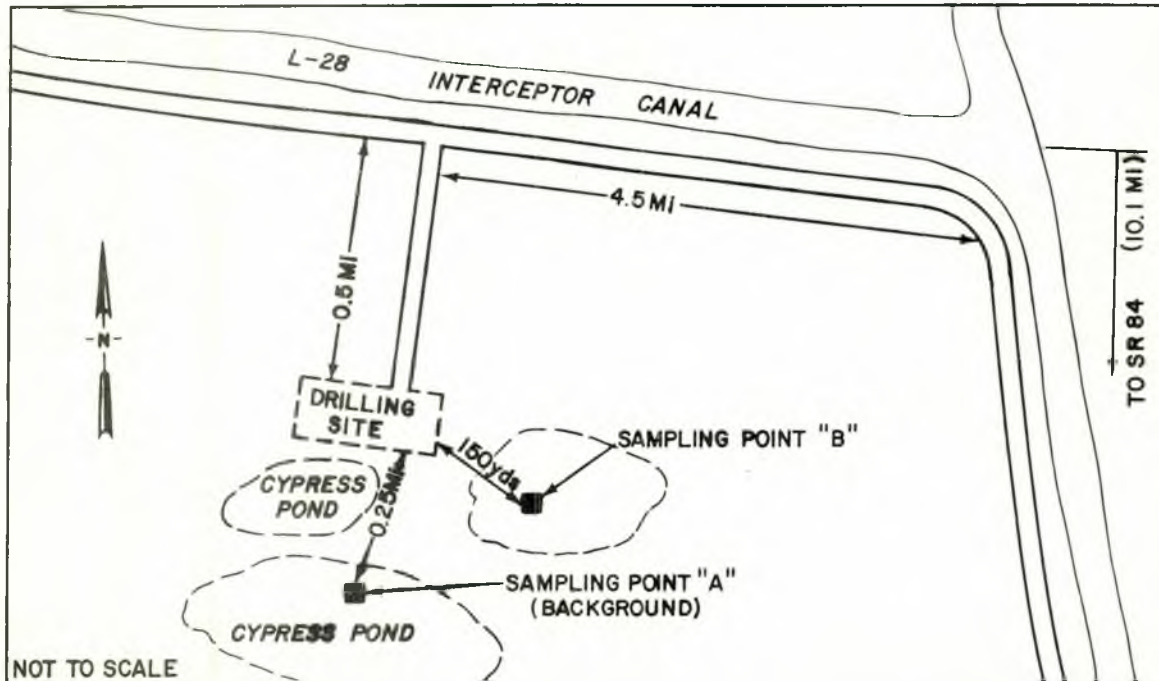
Site 5 (Continued)

Chemical and physical analyses of water and bottom sediment samples

Date	8-31-71	7-19-72	4-26-73	6-22-73	10-26-73
Temperature (°C)	28.0	28.5		28.5	23.0
Dissolved oxygen (mg/l)	2.2	9.0			4.7
pH		8.5	a/	7.4	7.7
Specific conductance (micromhos at 25°C)	362	190		1,790	310
Chloride (mg/l)	19	24		340	18
Total carbon (mg/l)	60	28		81	60
Inorganic carbon (mg/l)	34	22		45	37
Organic carbon (mg/l)	26	6.0		36	23
Oil and grease:					
water at surface (mg/l)	.0				
water 0.5' below surface (mg/l)					.0
bottom sediment (mg/kg)	850				

a/ When this well site was visited April 26, 1973, the sampling point was dry and there was no surface water in the immediate vicinity.

Site 6: Seminole Tribe 1-B, Permit #565, sec. 28, T.48 S., R.33 E.,
Hendry County.



Drilling History

Site prepared		March 1972
Spudded		March 22, 1972
Drilling at:	874 feet	March 27, 1972
	2,980	April 3, 1972
	4,970	April 10, 1972
	9,662	April 17, 1972
	11,372	April 25, 1972
	12,745	May 1, 1972
	13,701	May 9, 1972
	14,820	May 15, 1972
	15,857	May 22, 1972
	16,865	May 28, 1972
Total depth	17,000	May 30, 1972

Casing History

20-inch set surface to 250 feet
 13 3/8-inch set surface to 1,504 feet
 9 5/8-inch set surface to 3,650 feet

Site 6 (Continued)

Plugging Record

Cement plugs set:

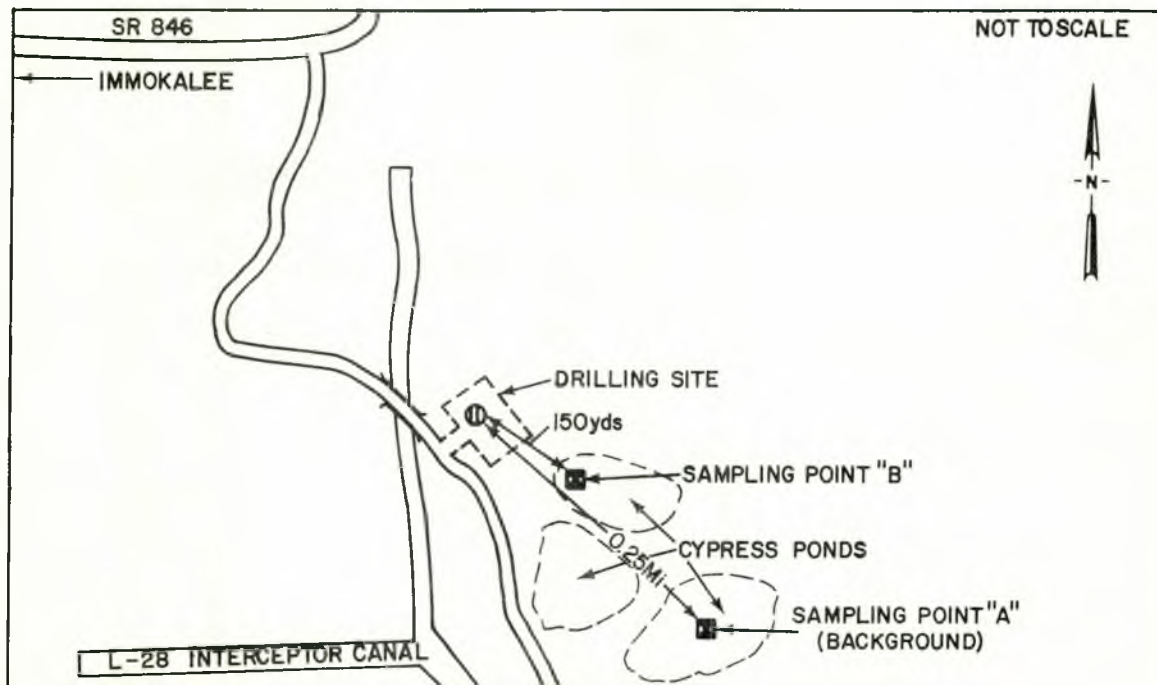
0 to 50 feet	Date not reported
1,300 to 1,350 feet	Do.
3,950 to 4,250 feet	Do.
15,620 to 15,670 feet	Do.

Chemical and physical analyses of water and bottom sediment samples

Sampling point	A			B
Date	8-31-71	4-26-73	6-22-73	10-26-73
Temperature (°C)	25.0			23.0
Dissolved oxygen (mg/l)	1.0	<u>a/</u>	<u>a/</u>	5.8
pH				7.6
Specific conductance (micromhos at 25°C)	350			760
Chloride (mg/l)	25			43
Total carbon (mg/l)	67			180
Inorganic carbon (mg/l)	37			98
Organic carbon (mg/l)	30			82
Oil and grease:				
water at surface (mg/l)	6.4			
water 0.5' below surface (mg/l)	2.8			
bottom sediment (mg/kg)	180			

a/ When this well site was visited April 26 and June 22, 1973, the sampling points were dry and there was no surface water in the immediate area.

Site 7: Oleum Corporation 25-3, Permit #560, sec. 25, T.47 S.,
R.32 E., Hendry County.



Drilling History

Site prepared		December 1972
Spudded		December 23, 1972
Drilling at:	2,549 feet	December 27, 1972
	3,691	January 2, 1973
	8,855	January 8, 1973
	11,482	January 15, 1973
Total depth	11,800	January 17, 1973

Casing History

20-inch set surface to 200 feet
 13 3/8-inch set surface to 1,354 feet
 9 5/8-inch set surface to 3,691 feet

Plugging Record

Cement plugs set:		
0 to 100 feet		Date not reported
3,418 to 3,618 feet		Do.
11,288 to 11,700 feet		Do.

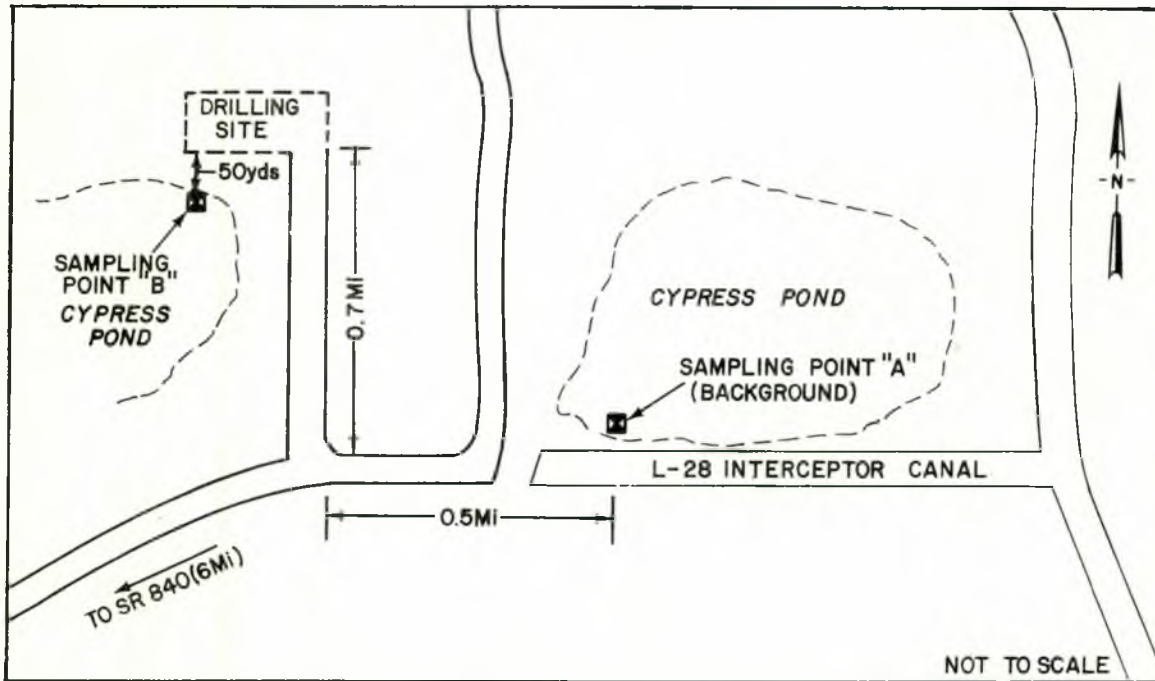
Site 7 (Continued)

Chemical and physical analyses of water and bottom sediment samples

Sampling point	A		B
Date	8-31-71	4-26-73	10-26-73
Temperature (°C)	24.0	<u>a/</u>	24.0
Dissolved oxygen (mg/l)	1.2		4.2
pH			7.8
Specific conductance (micromhos at 25°C)	280		190
Chloride (mg/l)	17		5.5
Total carbon (mg/l)	63		39
Inorganic carbon (mg/l)	31		14
Organic carbon (mg/l)	32		25
Oil and grease:			
water at surface (mg/l)	2.0		
water 0.5' below surface (mg/l)		.0	
bottom sediment (mg/kg)	730		

a/ When this well site was visited April 26, 1973, the sampling point near the well was dry and there was no surface water in the immediate area.

Site 8: Oleum Corporation 6-3, Permit #561, sec. 6, T.48 S., R.32 E.,
Hendry County.



Drilling History

Site prepared		May 1972
Spudded		June 4, 1972
Drilling at:	218 feet	June 5, 1972
	3,725	June 12, 1972
	8,985	June 19, 1972
Total depth	11,589	June 26, 1972

Casing History

20-inch set surface to 218 feet
 13 3/8-inch set surface to 1,362 feet
 9 5/8-inch set surface to 3,725 feet

Plugging Record

Cement plugs set:	
0 to 50 feet	Date not reported
3,542 to 3,742 feet	Do.
11,289 to 11,589 feet	Do.

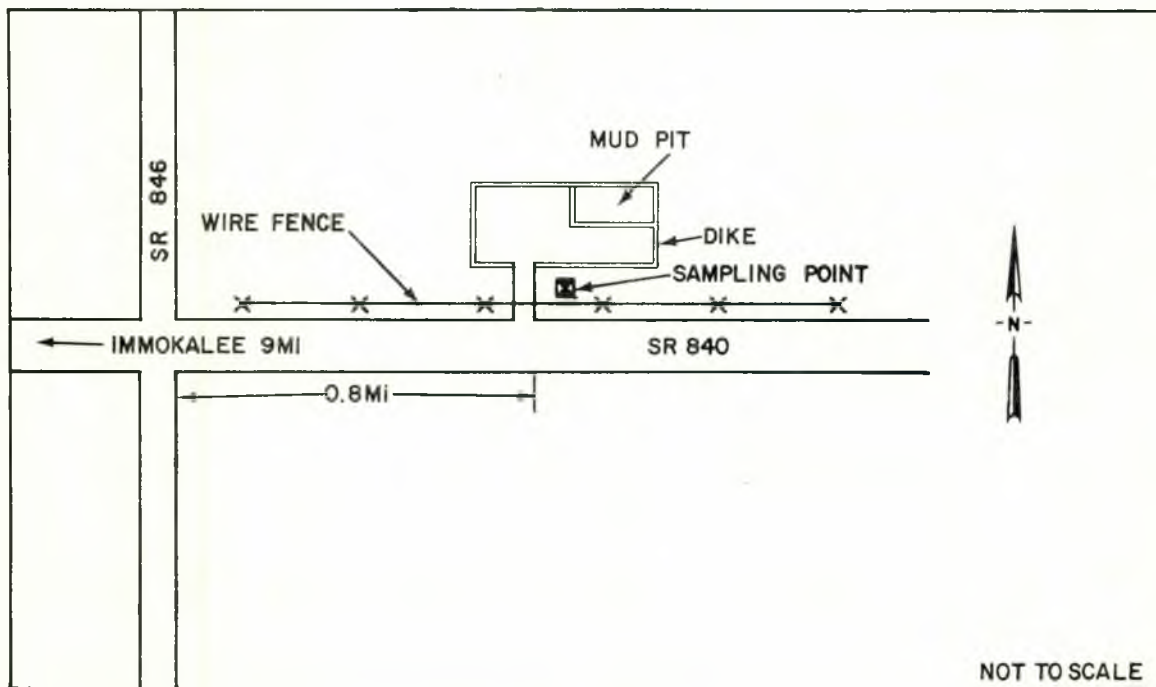
Site 8 (Continued)

Chemical and physical analyses of water and bottom sediment samples

Sampling point	A		B	B
Date	8-31-71	4-26-73	6-21-73	10-26-73
Temperature	27.0		26.5	25.5
Dissolved oxygen (mg/l)	3.5	<u>a/</u>		4.3
pH			7.5	7.5
Specific conductance (micromhos at 25°C)	310		630	300
Chloride (mg/l)	15		130	16
Total carbon (mg/l)	57		43	60
Inorganic carbon (mg/l)	35		25	35
Organic carbon (mg/l)	22		18	25
Oil and grease:				
water 0.5' below surface (mg/l)				.9
bottom sediment (mg/kg)				160

a/ When this well site was visited April 26, 1973, the sampling point near the well was dry and there was no surface water in the immediate area.

Site 9: Robert Mosbacher Collier No. 1, Permit #567, sec. 6,
T.47 S., R.31 E., Hendry County.



Drilling History

Site prepared		April 1972
Spudded		May 27, 1972
Drilling at:	204 feet	May 28, 1972
	2,800	June 5, 1972
	4,642	June 12, 1972
	9,555	June 19, 1972
	11,510	June 26, 1972
Total depth	11,711	June 28, 1972

Casing History

20-inch set surface to 204 feet
 13 3/8-inch set surface to 1,401 feet
 9 5/8-inch set surface to 4,003 feet

Plugging Record

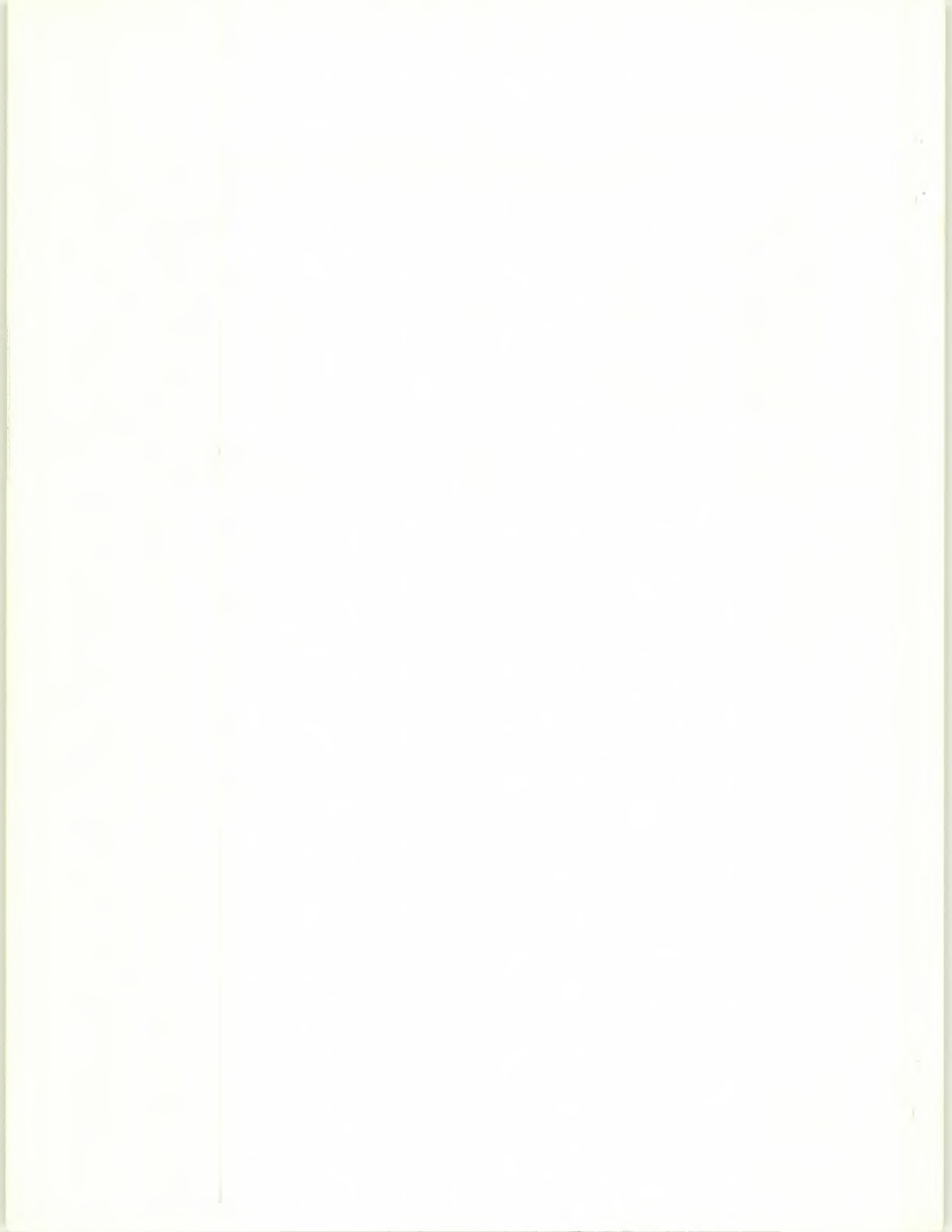
Cement plugs set:		
0 to 60 feet		Date not reported
3,785 to 4,085 feet		Do.
11,410 to 11,610 feet		Do.

Site 9 (Continued)

Chemical and physical analyses of water samples

Date	7-19-72	4-26-73	6-21-73	10-26-73
Temperature (°C)	30.0		30.0	24.0
Dissolved oxygen (mg/l)		<u>a/</u>		2.1
pH	6.7		7.6	7.0
Specific conductance (micromhos at 25°C)	1,650		298	160
Chloride (mg/l)	460		22	22
Total carbon (mg/l)	40		64	45
Inorganic carbon (mg/l)	20		32	11
Organic carbon (mg/l)	20		32	34

a/ When this well site was visited April 26, 1973 the sampling point was dry and there was no surface water in the immediate vicinity.



DATA SUMMARY

The chemical and physical analyses shown in each site summary are of water and bottom sediment samples collected at various times, from before drilling began at most sites until October 1973. It is useful when studying the data in the site summaries to note the status of activities at the oil test sites when the sample was collected. Of the parameters analyzed only chloride and specific conductance varied significantly during the sampling period.

Organic carbon and oil and grease analyses are included in the site summaries. These analytical results are of little value in detecting oil spills because the analytic techniques used for these two parameters also detect organic compounds which occur naturally in surface waters, in addition to any petroleum hydrocarbons which might be present (Wimberly, 1973).

At site 1 background samples were collected in August and October 1971; the average chloride concentration for these two samples was 23 mg/l. In January 1973 a water sample collected at the same point had a chloride concentration of 250 mg/l, about 11 times the average of the previous samples. At this same time water which was flowing from casing at the drilling location had a chloride concentration of 2,800 mg/l. When site 1 was resampled in June 1973 the chloride concentration had declined to the lowest value of record at the sampling point (16 mg/l); the flow of water from the casing at the drilling location had been stopped.

The following are comparisons between chloride concentration of background samples and chloride concentration of water from the sampling points at the respective sites after drilling activities had started. Site 4, concentration of June 1973 was about 445 times higher than that of August 1971; site 5, concentration of June 1973 was about 15 times higher than that of August 1971 and July 1972; site 8, concentration of June 1973 was about 8 times higher than that of August 1971. At site 9 no background sample was collected; however, the chloride concentration was 460 mg/l in June 1972 soon after drilling had ceased, but by June 1973 it had declined to 22 mg/l. This value is essentially the same as the average of 19 mg/l obtained from eight background samples collected in 1971. At sites 2, 3 and 7 no changes were detected. At site 2 no background sample was collected, but the chloride concentration in June 1973 was within the range of other background samples collected. At site 3 and 7 no sample was available from the dry period in June 1973. The October 1973 sampling showed that chloride concentration at all sites were at background level.

REFERENCE CITED

Wimberly, E. T., 1973, Reconnaissance of water quality in the vicinity of Sunniland oil field, Collier County, Florida, 1971-72: Tallahassee, Fla., U.S. Geol. Survey Water-Resources Inv. 35-73, 10 p.





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