WATER SUPPLY TEST WELL
AT SAILFISH POINT

FOR

MOBIL OIL ESTATES
(SAILFISH POINT) LTD., INC.

October 1977

73-50I

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PLATES

EXHIBITS

GEE & JENSON ENGINEERS-ARCHITECTS-PLANNERS, INC.
2019 OKEECHOBEE BOULEVARD, WEST PALM BEACH, FLORIDA . . . 33409 . . . 305 - 683-3301

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PHILIP A. CRANNELL, JR., A.I.A.
REED B. FULLER, A.I.A.

Director Emeritus
H. C. GEE, P.E.
THEODORE B. JENSON, P.E.

October 18, 1977

Dr. Patrick Gleason
South Florida Water
Management District
Post Office Box V
West Palm Beach, Florida 33402

Re: Mobil Oil Estates
(Sailfish Point) Ltd., Inc.
Test Well

Dear Dr. Gleason:

Attached is a copy of our report covering the recently completed test well at Sailfish Point.

Very truly yours,

GEE & JENSON
Engineers-Architects-Planners, Inc.

W. B. Sydow, P.E.

wbs:cl
enc as stated
73-50I

WATER SUPPLY TEST WELL
AT SAILFISH POINT

for

Mobil Oil Estates (Sailfish Point) Ltd., Inc.

GENERAL

A six inch test well was drilled into the Floridan aquifer in the northeast corner of Sailfish Point. The location of the site and the test well is shown on Plates 1 and 2. The purpose of the test well was:

1. To determine the characteristics of the aquifer.

2. Determine the quantity of water available from the aquifer.

3. Determine the chemical characteristics of the available water and its suitability as a source of water supply for the proposed development of Sailfish Point.

Construction of the well was started on May 20, 1977 and testing was completed on August 20, 1977.

Well Construction

The well was drilled by Douglass L. Arnold. The specifications for the test well construction were based on the

information obtained from three wells that were recently drilled by Mr. Arnold at Indian River Plantation, about 12,000 feet north of Sailfish Point. The well was constructed with an eight inch steel surface casing and a six inch PVC inner casing to be set into the upper rock of the artesian aquifer. The PVC inner casing was provided so that the wall could be used as a water supply using reverse osmosis treatment.

When the test well was drilled it was learned that the underground conditions were considerably different than anticipated. A total of 420 feet of eight inch surface casing was installed. Due to plastic formation problems, the six inch PVC casing was set to a depth of about 630 feet. Concrete grout was placed down to a depth of about 690 feet and the space between the PVC casing and the open hole was grouted in. The concrete was then drilled. There is about 60 feet of concrete lined well to a depth of 690 feet.

During the drilling it was learned that the comparable strata at the test well were about 150 feet deeper than those encountered at the Indian River Plantation wells.

It was initally intended to drill the well to a depth of about 1,000 feet, at which depth it was anticipated that a free-flow rate of up to 300 gallons a minute might be obtained. However, the quantity of water that was developed at a depth of 1,000 feet was estimated at about 70 gallons a minute. As a similar condition had occurred in one of the Indian River Plantation wells, it was hoped that by drilling the well deeper the higher flow rate strata would be encountered. The well was drilled to a depth of 1,525 feet without an appreciable increase in flow. Drilling was completed on August 5, 1977.

Geophysical Logging

Geophysical logging was performed by Black, Crow & Eidsness, Inc. on August 10, 1977. The following logging operations were performed:

1. Well caliper
2. Water velocity
3. Fluid resistivity
4. Temperature
5. Gamma Ray
6. Electric

Well calipering measures the diameter of the well at the various depths. The caliper log indicates that the well had diameters of about 10 inches from a depth of 690 feet to about 765 feet, about eight inches from 765 feet to about 1,040 feet, varied between eight inches and ten inches to a depth of about 1,200 feet and then varied from ten inches to six inches to the bottom of the hole.

The flow velocity log measures the velocity of the water flowing through the well under free-flowing conditions. A flow meter is lowered into the well and then raised at a constant rate. The changes in metered flows at different depths indicates where water is entering the well. Due to the low total free-flow rate that was observed, about 75 gallons per minute, the changes in flow rates were difficult to determine.

Normally, the temperature of water increases with depth. Sudden changes in temperature can indicate a flow of water from the strata into a well. The temperature in the test well varied between 81 degrees F. and slightly more than 85 degrees F. at the bottom of the well.

The conductivity of the water in the well is a measure of total dissolved solids; the lower conductivities meaning

lower quantities of dissolved solids. Changes in conductivity can indicate flow of water into the well.

The electric logging consists of measuring the self-potential and the apparent resistivity of the aquifers. There is a natural reoccurring potential difference between the surface electrode and the electrode in the column of conductive mud. Variations in the self-potential currents are indications of clay layers and permeable strata. Resistivity measures the resistence between a probe and the various strata in the aquifer. These measurements are indicators of strata which are water producing and strata which are generally not water producing.

Gamma ray logging is a measurement of the natural radiation of gamma rays from certain radioactive elements that occur in various amounts in the formations. In general, clay and shell contain more radioactive elements than do limestone or sandstone and sand.

The results of the various indicators of the above logs must be evaluated by comparison with each other to achieve meaningful results. The logs indicate that the upper confining beds of the artesian aquifer exist at a depth of about 760 feet and that the lower confining bed exists at a depth of about 1,050 feet. The analysis of the logs

indicates that most of the water flowing into the well occurred between depths of 760 and 860 feet with minor amounts between 860 and 1,050 feet.

Driller's Log

A copy of the driller's log maintained by the well driller is attached.

Pumping Test

A pumping test was made on August 17, 1977, for a period of about five hours and 15 minutes. An engine driven turbine pump was installed in the well and the flow from the pump was measured with a standard orifice type meter.

An existing artesian well with a reported depth of 935 feet, located 487 feet from the test well, was used as an observation well. A sensitive pressure gage was installed on this well and used to determine the change in potentiometric head during the pumping of the test well.

The pumping rate varied between 235 gpm and 266 gpm, with an average of 240 gpm during the test period.

Due to engine failure of the pump, the pumping test was somewhat abbreviated. However, the change in drawdown of the test well did not vary during the last three hours of the test. The drawdown of the test well was 83 feet and resulted in a specific yield of 2.89 gallons per foot of head change.

The transmissivity and specific capacity were calculated from the drawdown and recovery data of the observation well. The drawdown curves and calculations are attached. The transmissivity was calculated to be 12,700 gallons per day per foot and the storage coefficient was calculated to be 0.0005.

Free-Flow Tests

Following the pumping test, the pump was removed and two free-flow tests performed. The first test was for a period of six hours during which time the flow of the existing (observation) well was shut off. The free-flow rate started at 125 gpm, dropped to 101 gpm in one hour and 25 minutes, and remained essentially at this rate for the duration of the test. The second flow test was for a period of 30 hours during which time the existing well was flowing. The rate of flow of the test well was 78 gpm at the end of the test.

Chemical Characteristics

Water analyses were obtained starting at a depth of 1,025 feet, with field checks for chloride being taken prior to that point. The field checks of the chlorides were in the range of 600 mg/l. Water samples were taken prior to the pumping test and at the end of the pumping test and analyses made. Copies of these analyses are attached. A comparison of these two analyses indicates the pumping caused an increase in total dissolved solids from 1,419 to 1,504 mg/l and an increase in chloride concentration from 570 to 585 mg/l, an increase in hydrogen sulfide from seven-tenths to one mg/l, and a decrease in iron. None of these changes are considered to be significant.

The character of the water is similar to that of the existing well. It is not suitable for use as a public water supply without treatment and will consequently require treatment by a demineralizing method.

The water is suitable for irrigation of species of ornamental shrubs and grass that can withstand relatively high concentrations of chlorides and other minerals. It should be noted that the water contains about one part of hydrogen sulfide and a total sulfide concentration of about

five mg/l. A portion of the hydrogen sulfide would be released during an irrigation sprinkler operation and could result in a possible odor problem. If the water is to be used for irrigation, it may be necessary to oxidize the hydrogen sulfide to prevent odor complaints. The sulfides can also create staining and corrosion problems if direct contact with buildings or metal occurs.

Quantity of Water

As stated in the Engineering Summary of February 1977, the average daily demand for the area to be developed is estimated to be 150 gallons per person per day or a total of about 375,000 gallons per day. If the reverse osmosis type of demineralization treatment is utilized, it is estimated that a water supply of 625,000 gallons per day, on a yearly average, would be required, with peak days of about double this amount, or 1,250,000 gallons per day.

Assuming that water supply for the project would be constructed in three phases, (Alternate 1 of the Engineering Summary) and reverse osmosis treatment would be used, the following raw water quantities would be required:

Phase	Treated Water Average Day (Gal.)	Treated Water Peak Day (Gal.)	Raw Water Average Day (Gal.)	Raw Water Peak Day (Gal.)
1	75,000	150,000	125,000	250,000
2	225,000	450,000	375,000	750,000
3	375,000	750,000	625,000	1,250,000

The transmissivity of the aquifer at the test site is very low as compared to that generally found in the Stuart area where wells having a free-flow of 300 to 500 gpm are common. One well at Indian River Plantation has a free-flow rate of about 1,000 gpm. This low transmissivity indicates a very high frictional resistance to the flow of water through the aquifer. Whether this condition is limited to the northeast corner of Sailfish Point or covers the entire Sailfish Point area is not known. It is our opinion that the aquifer characteristics at the test and observation wells probably represents the worst condition that would be encountered in the Sailfish Point area.

The low transmissivity results in a high well drawdown. The drawdown in a well is affected by the drawdown of adjacent wells. When adjacent wells are pumped simultaneously, the total drawdown of each well is the sum of the effects of the pumped well and of the other wells.

Assuming that the low transmissivity prevails throughout the Sailfish Point area, it was calculated that four wells spaced about 1,000 feet apart could produce the average day requirement with a total drop in potentiometric surface in each well of about 50 feet. The water level in each well would be about 25 feet below the ground. Peak day pumping would increase the drawdown in the wells to about 75 to 80 feet below the ground. The cone of depression around the well field is quite steep and after 100 days of continuous average daily use, the distance from the well field to a point where the potentiometric head would be at sea level was calculated to be about 1,000 feet.

The effect of the drawdown of the aquifer on artesian wells in the general area can not be calculated. It is apparent that the high yield water bearing strata at Indian River Plantation does not exist at the test well site and interference between the two sites would be minor, if at all. Due to the location of Sailfish Point, it is our opinion that the impact of the estimated water supply requirements on other artesian wells in use in the vicinity would be minimal.

CONCLUSIONS

Based on the test well drilling program, we have made the following conclusions:

1. There is an adequate supply of artesian water in the Floridan aquifer to provide the estimated potable water supply requirements of the proposed development.

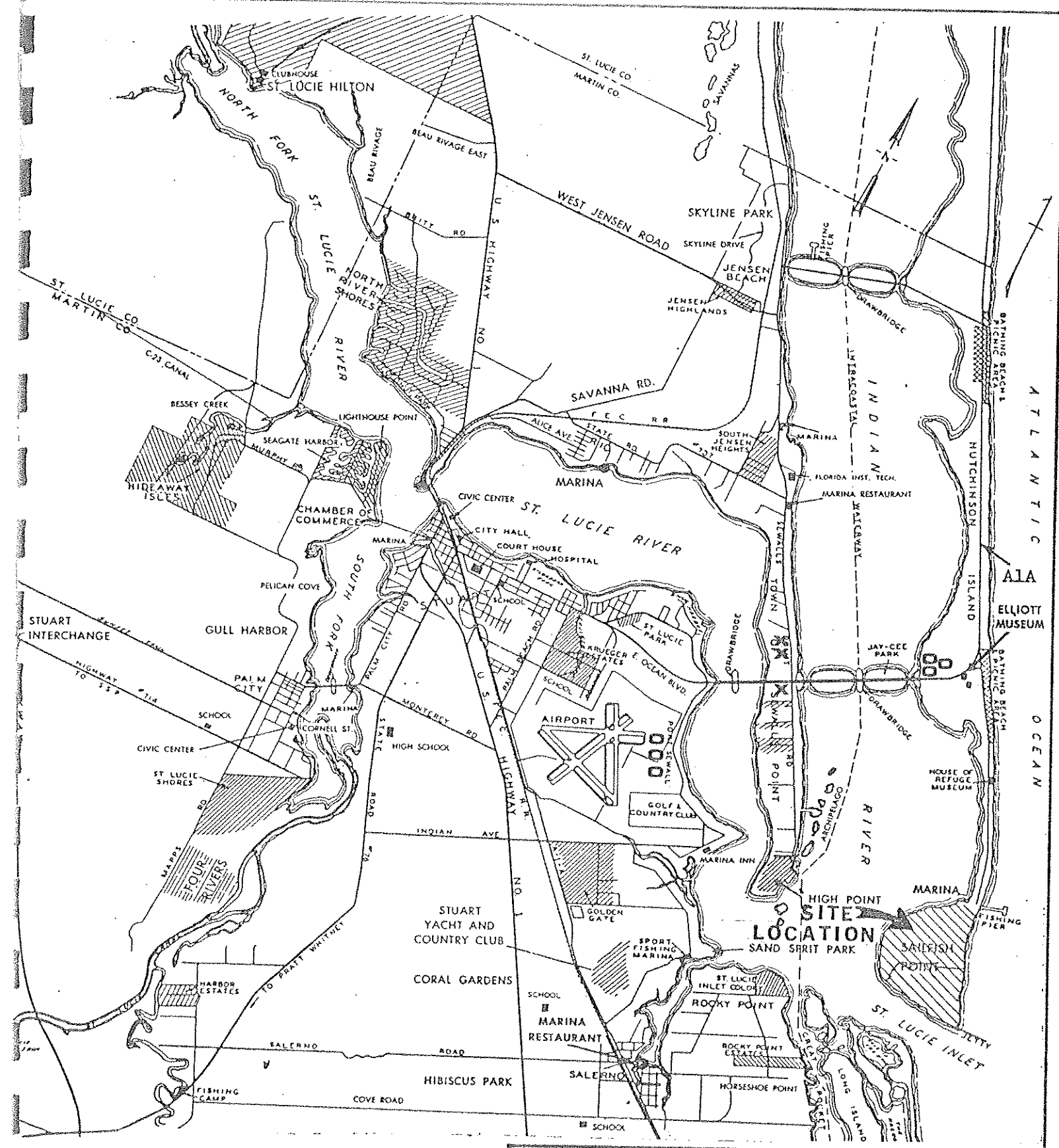
2. The chemical characteristics of the raw water is suitable for treatment by reverse osmosis.

3. Five or six wells equipped with suitable pumps will probably be required for the ultimate raw water requirements for potable use.

Respectfully submitted,

GEE & JENSON
Engineers-Architects-Planners, Inc.

W. B. Sydow, P.E.
Florida Certificate No. 5927



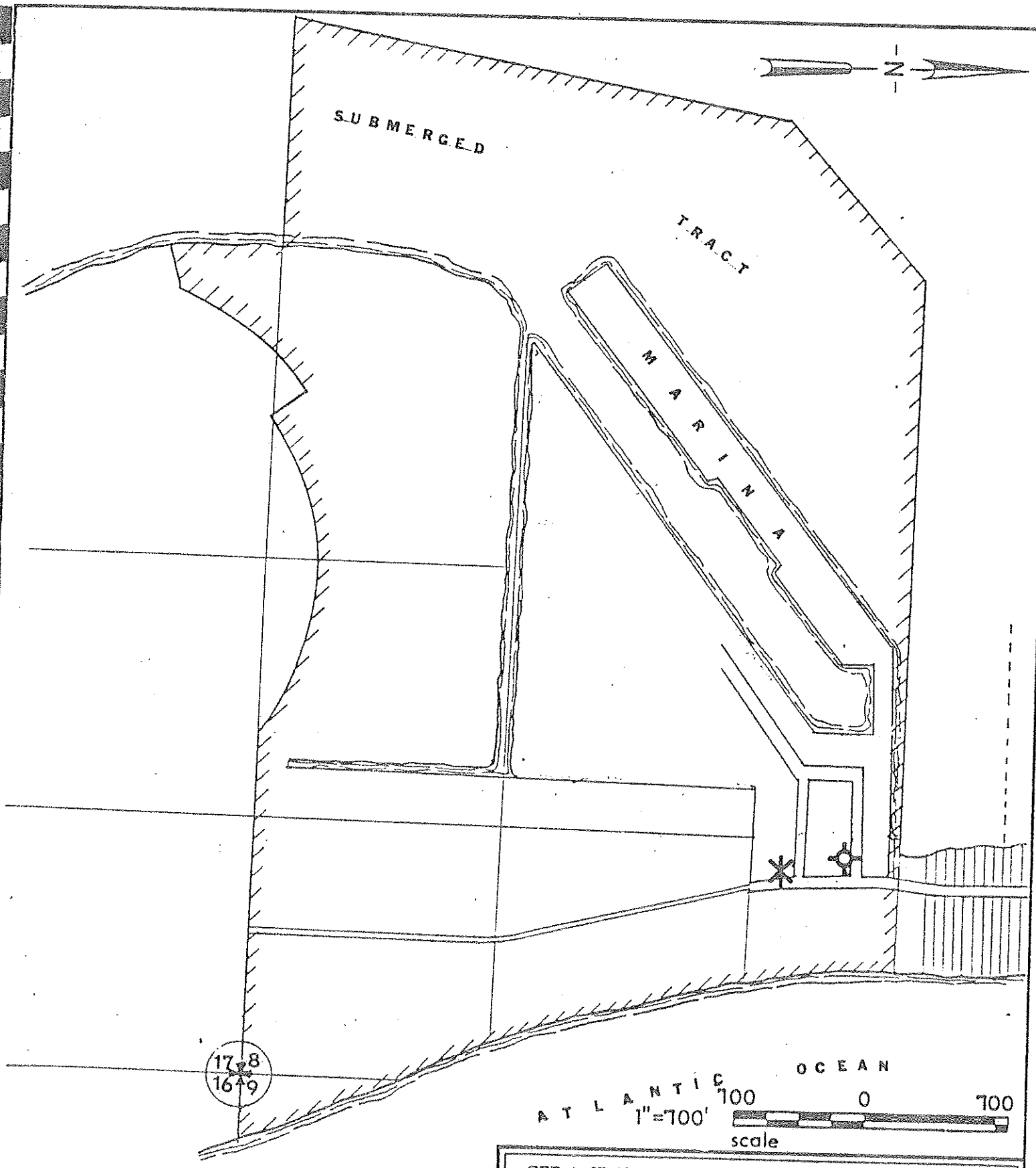
LEGEND

- ○ KNOWN EXISTING ARTESIAN WELLS IN USE IN VICINITY
- X KNOWN ABANDONED ARTESIAN WELLS IN VICINITY

GEE & JENSON ENGINEERS-ARCHITECTS-PLANNERS, INC.
WEST PALM BEACH, FLORIDA

MOBIL OIL ESTATES (SAILFISH POINT) LTD., INC.
LOCATION PLAN

DESIGNED	DRAWN	CHECKED	JOB NO.	DRAWING NO.
	HJB		73-50 I	
DATE	SCALE	APPROVED	FILE NO.	SHEET OF
Apr. 77	1" = 6,500'			



LEGEND

PROPERTY LINE

TEST WELL

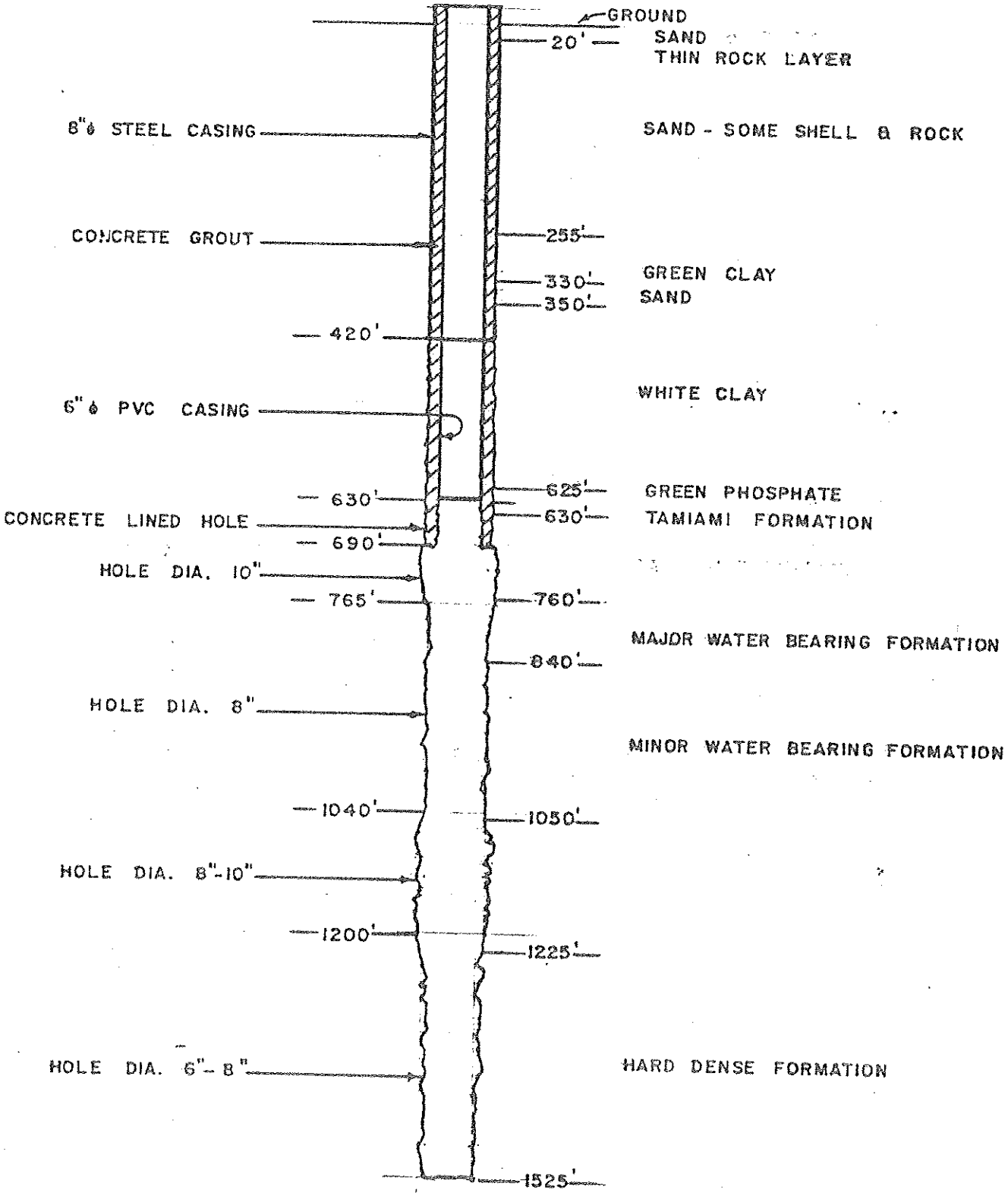
EXISTING ARTESIAN WELL

PLATE 2

GEE & JENSON ENGINEERS-ARCHITECTS-PLANNERS, INC.
WEST PALM BEACH, FLORIDA

MOBIL OIL ESTATES (SAILFISH POINT) LTD., INC.
SITE PLAN

DESIGNED	DRAWN	CHECKED	JOB NO.	DRAWING NO.
	HJB		73-501	
DATE	SCALE	APPROVED	FILE NO.	SHEET OF
Apr. 77				



GEE & JENSON ENGINEERS-ARCHITECTS-PLANNERS, INC.
WEST PALM BEACH, FLORIDA

MOBIL OIL ESTATES (SAILFISH POINT) LTD., INC.
TEST WELL SECTION

DESIGNED	DRAWN	CHECKED	JOB NO. 73-50-I	DRAWING NO.
DATE 10-14-77	SCALE NONE	APPROVED	FILE NO.	SHEET OF

ANALYTICAL REPORT

PAUL R. McGINNES AND ASSOCIATES

CONSULTING LABORATORIES

513 U.S. Highway 1 · North Palm Beach, Florida 33408 · (305) 842-2849

Client: Sailfish Point - Mobil Oil Estates / Gee & Jenson

Attention: Mr. Ted Caldwell

Sample: Samples Collected August 16 and 17, 1977

Analysis and Comments:

	8/16/77	8/17/77
Total Dissolved Solids, mg/l	1419	1504
pH	7.65	7.5
Total Hardness, mg/l as $CaCO_3$	381	394
Total Alkalinity, mg/l as $CaCO_3$	150	151
Non-Carbonate Hardness, mg/l as $CaCO_3$	231	243
Bicarbonate, mg/l HCO_3^-	183	184
Bicarbonate, mg/l as $CaCO_3$	150	151
Carbonate, mg/l as $CaCO_3$	0	0
Hydroxide, mg/l as $CaCO_3$	0	0
Calcium, mg/l Ca	85	85
Magnesium, mg/l Mg	40	40
Iron, mg/l Fe	0.1	0.02
Sulfate, mg/l $SO_4^=$	180	187
Hydrogen Sulfide, mg/l H_2S	0.7	1.0
Sulfide, mg/l $S^=$	4.7	5.1
Chloride, mg/l Cl^-	570	585
Color, units	< 5	5
Silica, mg/l SiO_2	26	26
Barium, mg/l Ba	ND	ND
Strontium, mg/l Sr	6.0	6.0

ANALYTICAL REPORT

PAUL R. McGINNES AND ASSOCIATES

CONSULTING LABORATORIES

513 U. S. Highway 1 · North Palm Beach, Florida 33408 · (305) 842-2849

Client: Sailfish Point - Mobil Oil Estates / Gee & Jenson

Attention: Mr. Ted Caldwell

Sample: Collected August 8, 1977 Job No. 77-8-8-MO-11

Analysis and Comments:

	Well Point	Casing
Total Dissolved Solids, mg/l	1417	1522
pH	7.8	7.5
Total Hardness, mg/l as $CaCO_3$	354	392
Total Alkalinity, mg/l as $CaCO_3$	136	156 ←
Non-Carbonate Hardness, mg/l as $CaCO_3$	218	236
Bicarbonate, mg/l HCO_3^-	166	190
Bicarbonate, mg/l as $CaCO_3$	136	156
Carbonate, mg/l as $CaCO_3$	0	0
Hydroxide, mg/l as $CaCO_3$	0	0
Calcium, mg/l Ca	55	75
Magnesium, mg/l Mg	52	49
Iron, mg/l Fe	0.3	ND
Sulfate, mg/l $SO_4^=$	220	183
Hydrogen Sulfide, mg/l H_2S	0.2	1.0
Sulfide, mg/l $S^=$	1.5	4.8
Chloride, mg/l Cl^-	500	535
Color, units	7	7
Silica, mg/l SiO_2	40	35
Barium, mg/l Ba	ND	ND
Strontium, mg/l Sr	2.2	6.5

PAUL R. McGINNES AND ASSOCIATES
CONSULTING LABORATORIES, INC.
513 U.S. HIGHWAY 1 · NORTH PALM BEACH, FLORIDA 33408 · (305) 842-2849

Client: Sailfish Point - Mobil Oil Estates / Gee & Jenson — August 4, 1977

Attention: Mr. Ted Caldwell

Sample: Samples 1 - 5 delivered July 26, 1977; Samples 6 & 7 collected August 3, 1977

Sample No. (See page 2)	5	6	7
otal Dissolved Solids, mg/l	1423	1325	1382
H	* -	7.7	7.35
otal Hardness, mg/l as $CaCO_3$	386	380	387
otal Alkalinity, mg/l as $CaCO_3$	154	148	160
lon-Carbonate Hardness, mg/l as $CaCO_3$	232	232	227
icarbonate, mg/l HCO_3^-	188	181	195
icarbonate, mg/l as $CaCO_3$	154	148	160
arbonate, mg/l as $CaCO_3$	0	0	0
ydroxide, mg/l as $CaCO_3$	0	0	0
alcium, mg/l Ca	78	55	45
lagnesium, mg/l Mg	45	58	65
on, mg/l Fe	ND* <0.02	0.6	0.05
ulfate, mg/l $SO_4^=$	183	200	175
ulfide, mg/l $S^=$	* --	1.15	4.25
ydrogen Sulfide, mg/l H_2S	* --	0.15	1.1
arium, mg/l Ba	ND	ND	ND
trontium, mg/l Sr	8	2.2	3.8
olor, units	0	17	< 1
ilica, mg/l SiO_2	15	18	35

PAUL R. McGINNES AND ASSOCIATES
CONSULTING LABORATORIES, INC.
513 U.S. HIGHWAY 1 · NORTH PALM BEACH, FLORIDA 33408 · (305) 842-2849

Client: Sailfish Point - Mobil Oil Estates (continued)

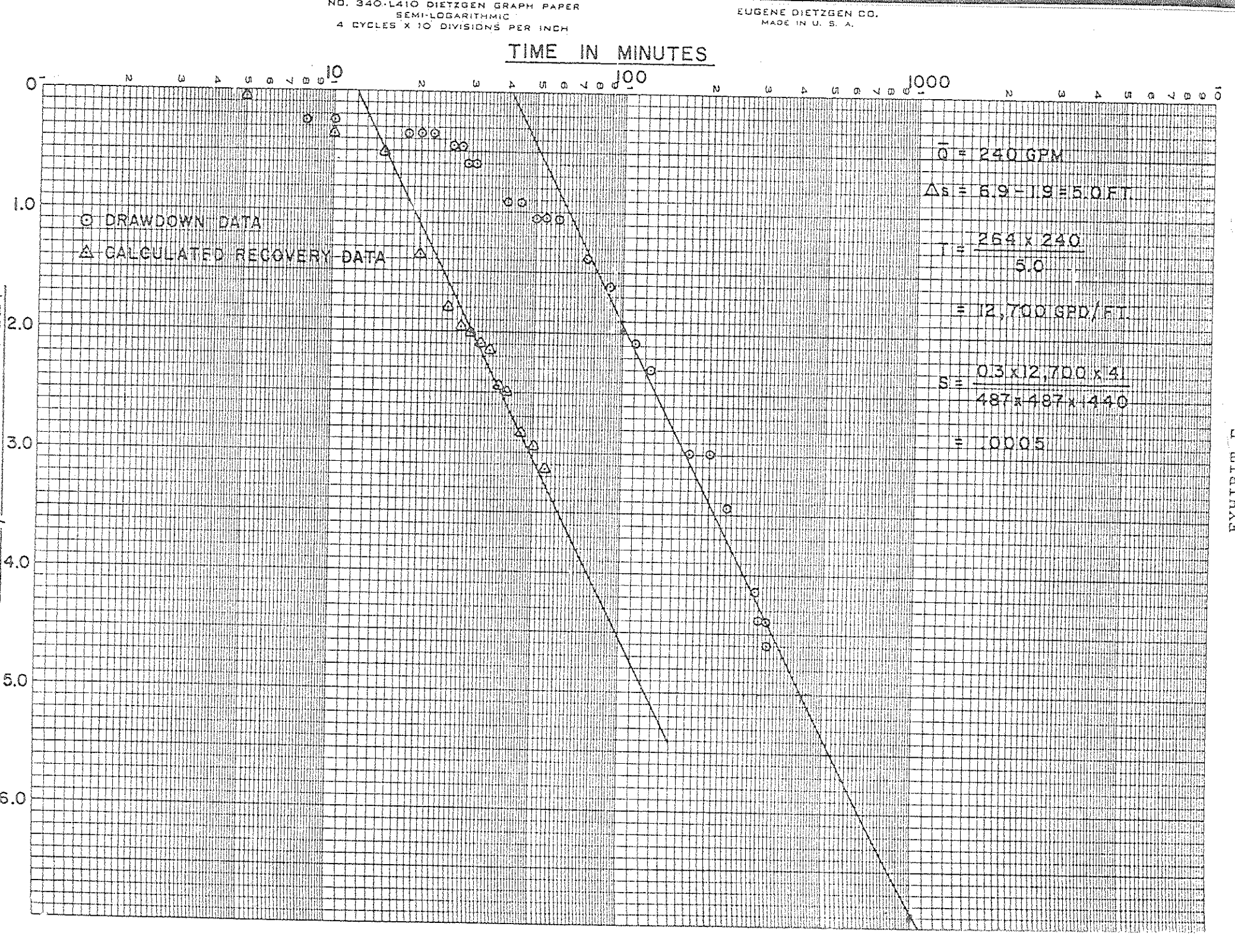
Sample: Samples 1 - 5 delivered July 26, 1977; Samples 6 & 7 collected August 3, 1977

Sample	Depth	Date Collection	Chlorides, mg/l
1	1025'	7/23/77 a.m.	591
2	1065'	7/23/77 p.m.	569
3	1110'	7/24/77 p.m.	608
4	1165'	7/25/77 p.m.	586
5	1225'	7/26/77 a.m.	597
6	1435'	8/3/77 a.m.	506
7	X	8/3/77 a.m.	554

* This sample was not preserved in the field for any of these analyses.

Samples 1 - 5 were not collected by McGinnes Laboratories personnel and the results are warranted to represent samples only as received by McGinnes Laboratories.

NO. 340-L410 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
4 CYCLES X 10 DIVISIONS PER INCH
EUGENE DIETZGEN CO.
MADE IN U. S. A.



14. WELL LOG: Material

Well bore (in)	Depth (feet) From	Depth (feet) To	Note each type of material, producing zones, & cavities if any. Give description at not less than 20 foot intervals and at changes.
8	0	10	Beachsand
	10	20	Beach Sand
	20	30	Shells Broken
		33	Lime stone to 38 ft
	40	50	Shells and sand , quartz
	50	60	same as above
	60	90	" "
	90	100	Tan Lime stone chips And sand
	100	250	Same as above
		255	Green clay and sand
	255	300	Same as above
	330	358	Sand
	360	400	Green clay
	400	560	" "
	560	570	White clay (Marl)
	570	600	" "
	600	625	" "
	625	650	Green phosphate
	650	700	Tamiami formation
	700	710	" "
	710		Hard Bump Black Chips
	715	725	Lime stone and white Marl
	725	750	White lime stone
	750	1000	White lime stone
		1025	water sample Cl 555 ppm flow 55 gpm.
	1025	1065	Lime stone cl 555 ppm. flow 60 gpm.
	1110		lime stone cl. 580 gpm 60
	1065	1225	lime stone With Layers of churt 2" to 2 ft. With lime stone Betwen CL. 597 flow 75 gpm.
	1225	1280	Lime stone With layers do hard chirt (chinged bit) cl. 600 75 gpm.
	1325		same as above Cl 605 gpm 78
	1375		Harr chirt change bit cl. 634 flow 75 gpm.
	1425		hard layers at 1434, 1442 1445, cl 680 flow same Drill stem cl. 575
	1425	1525	churt 3" to 24" Lime stone betwen 1444 and 1449 harp change bit

EXHIBIT F