

UNITED STATES DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY

A FEW INTERESTING FACTS REGARDING THE NATURAL FLOW FROM ARTESIAN WELL 4
OWNED BY THE SAN ANTONIO PUBLIC SERVICE COMPANY, SAN ANTONIO, TEXAS

By

Penn P. Livingston

June 17, 1942

Reprinted July 1951

PREPARED IN COOPERATION WITH THE TEXAS STATE BOARD OF WATER ENGINEERS

C. S. Clark, Chairman

A. H. Dunlap, Member

J. W. Pritchett, Member

A FEW INTERESTING FACTS REGARDING THE NATURAL FLOW FROM ARTESIAN WELL 4
OWNED BY THE SAN ANTONIO PUBLIC SERVICE COMPANY, SAN ANTONIO, TEXAS

By

Penn P. Livingston

June 17, 1942

INTRODUCTION

Following a rumor that a well drilled at San Antonio in 1941 by the San Antonio Public Service Company probably has the largest discharge of any flowing well in the United States, a measurement of the flow was made on June 16, 1942 by the U. S. Geological Survey in cooperation with the Texas State Board of Water Engineers. The well (Public Service Co. no. 4) was drilled with rotary equipment by the Layne-Texas Company from March 4 to April 28, 1941. It is 1,032 feet deep and cased to 940 feet with 24-inch casing cemented with 850 bags of cement. Below 940 feet the well was drilled with a 22-inch roller bit and is an open hole. The flow developed at 998 feet below the surface and no increase was noted below that depth. The log of this well is not available but the driller's log of well 2, only 18 feet away, is included with this memorandum.

The water from the Edwards limestone from which this well obtained its flow is of good quality and is used for the municipal supply of San Antonio without treatment. The well, however, is to be used for cooling purposes only. A chemical analysis made by W. W. Hastings of the Quality of Water Division is included with this memorandum. The relative locations of the wells at the San Antonio Public Service Company power plant and other wells visited during the test are shown by figures 1 and 2, herewith. The well has not yet been brought into service and is tightly capped. The valve was opened its full width and the well started to discharge into the San Antonio River at

5:08 p.m. on June 15. The measurement was taken by measuring the discharge of the San Antonio River above and below the well.

In order to obtain some information regarding the effect of the flow on the artesian pressure in the vicinity, a pressure gage was connected to an artesian well (no. 4, fig. 1) owned by the San Antonio and Aransas Pass Railroad, about 2,000 feet northwest of the large well and on a well at the City Mission Pumping Plant (no. 6, fig. 1) about 4,000 feet southwest of the well. The chart made by a recording gage on a well (no. 1, fig. 1) at the Beverly Lodges about $5\frac{1}{2}$ miles northeast, near Fort Sam Houston was also observed. The pressure on the two wells was read before, during, and after the well was allowed to flow (see table of water-level observations).

Discharge measurements

The discharge of the San Antonio River was measured simultaneously at one point about 500 yards upstream from the well outlet and at another about 500 yards below the outlet. See figure 2. Two measurements were made at each of these locations between 11:30 a.m. and 1:10 p.m., the upper measurements being made by Dale Yost and the lower measurements by Pat Holland of the Surface Water Division. The results of the measurements are as follows: 66.4 and 64.6 second-feet at the upper section and 105.8 and 101.5 second-feet at the lower section. The average of the upper measurements is 65.5 second-feet and the average of the lower measurements 103.6 second-feet, and the average difference is 38.1 second-feet. A flow

of 1.1 second-feet has been subtracted from the apparent flow from the well. This represents a flow of 500 gallons a minute which has been estimated by the plant engineer as part of 700 gallons a minute taken from well 2 during the test and discharged into the river between the two measuring sections. Temporary staff gages at each measuring section showed less than .01 feet change at the upper section and slightly more than .02 feet change during the last measurement at the lower section.

Previous measurements of flow

On October 12, 1941 the plant was shut down and the flow from well 4 measured over a weir set on top of the low dam by engineers with the San Antonio Public Service Company. The flow of the river was first determined and then the wells were allowed to flow. The flow from well 4 was 19,300 gallons a minute and the combined flow from wells 2 and 4 was 21,600 gallons a minute. The pressure on well 1, two feet above ground, was 27 pounds and on well 2 it was 27.8 pounds two feet above ground before and after the wells were allowed to flow. On the same day the pressure on a well south of the San Antonio & Aransas Pass Railroad roundhouse was 21.1 pounds about 6:00 a.m. and while wells 1, 2 and 4 were all allowed to flow simultaneously, the pressure was again read at 9:00 a.m. and found to be 20.1 pounds. On October 19, 1941 a large centrifugal pump was connected to well 4 and the yield was said to have increased to 20,000 gallons a minute with 22 inches of vacuum (mercury) at 2 feet above ground.

CONCLUSIONS

On June 16, 1942 well 4 had a natural flow of 37 cubic feet per second (23.9 m.g.d. or 16,800 g.p.m.) through a 24-inch valve about 10 feet below

ground. The temperature of the water was 82° F. The static water level was about 56 feet above the ground or at an altitude of about 674 feet. The full static level was reached as soon as the discharge valve was completely closed. The pressure in well 2, 18 feet away, was lowered about $12\frac{1}{2}$ pounds (29 feet), when well 4 was allowed to flow its full capacity. The pressure at the San Antonio & Aransas Pass Railroad and Mission Plant wells changed less than a foot during June 15 and 16 but the pressures were taken with pressure gages and may not have been within a foot of the true pressure. However, the change in pressure during the test should be within about .1 of a pound of the true change in pressure.

It is possible that the water level at Beverly Lodges was lowered .1 or .2 of a foot when well 4 was allowed to flow but the daily fluctuation of the artesian pressure in this well amounts to nearly a foot during this part of the year. These daily fluctuations are caused largely by fluctuations in pumpage but may also be affected by recharge from rains and changes in the barometric pressures. The effect of the flow, therefore, upon the water level at the Beverly Lodges well is not very clear.

The artesian water level is about the same within the city limits of San Antonio and from an inspection of the chart obtained by the Beverly Lodges well it was found that the water level on October 12, 1941 was about 5 feet higher than it was on June 16, 1942, which may account for a large part of the difference in flow that was measured on these dates. The artesian pressure on the wells owned by the San Antonio Public Service Company also showed a pressure about 2 pounds higher on October 12 than was found on June 16.

Log of test on San Antonio Public Service Company Well 4, near Roosevelt Park

June 15 and 16, 1942

Date	Time	Water levels in feet above graph				Water level in feet Recording gage at Beverly Lodges (below ground)	Remarks		
		San Antonio & Aransas Pass R.R. Well	City Mission Plant	San Antonio Pub. Ser. Co. Wells					
				1	2	3	4		
1942									
June 15	4:15 p.m.	45.8							Altitude of gage 630.8 feet.
	4:35		72.5						Altitude of gage 601 feet.
	4:50			55.4					Altitude of gage about 619 feet. Well flowing about 700 gallons a minute.
	5:08								Opened valve on well 4.
	5:09			27.5					
	5:19					57.8			Altitude of gage about 603 feet.
	5:30		72.2						
	5:40 p.m.	45.6							
June 16	10:10 a.m.							51.04	Altitude of measuring point 724.06 feet.
	11:30		72.2						Measured flow of river at upper and lower sections 66.4 and 105.8 second-feet.
	11:44	45.2							
	12:07 p.m.			25.9	60.5				
	12:30				61.2				Temperature 32°F.
	1:10 p.m.								Measured flow of river at upper and lower sections 64.6 and 101.5 second-feet.
	1:55								Closed valve in 7 minutes from 1:55 to 2:02.
	2:11					64.5			Altitude of gage about 609 feet.
	2:15					63.6			Opened valve on well 2 a little.
	3:30			61.9	63.6				
	6:30							50.97	

Driller's log of well 2

San Antonio Public Service Company.
Drilled by Burkett & Sons, March 22, 1928

	<u>Thickness</u> (feet)	<u>Depth</u> (feet)
Pump pit	13	13
Gravel	7	20
Yellow clay	27	47
Blue clay	8	55
Hard rock	4	59
Blue clay	91	150
Hard rock	3	153
Blue clay	227	380
Lime rock	12	392
Blue clay	88	480
Lime rock	13	493
Blue clay	15	508
Austin chalk	14	522
"Cary" clay	16	538
Austin chalk	60	598
Shale	30	628
Austin chalk	57	685
Water strata	20	705
Austin chalk	83	788
Lignite	27	815
Buda lime	63	878
Del Rio clay mud	58	936
Blue lime rock	17	953
Yellow lime rock	45	998
Big water		998

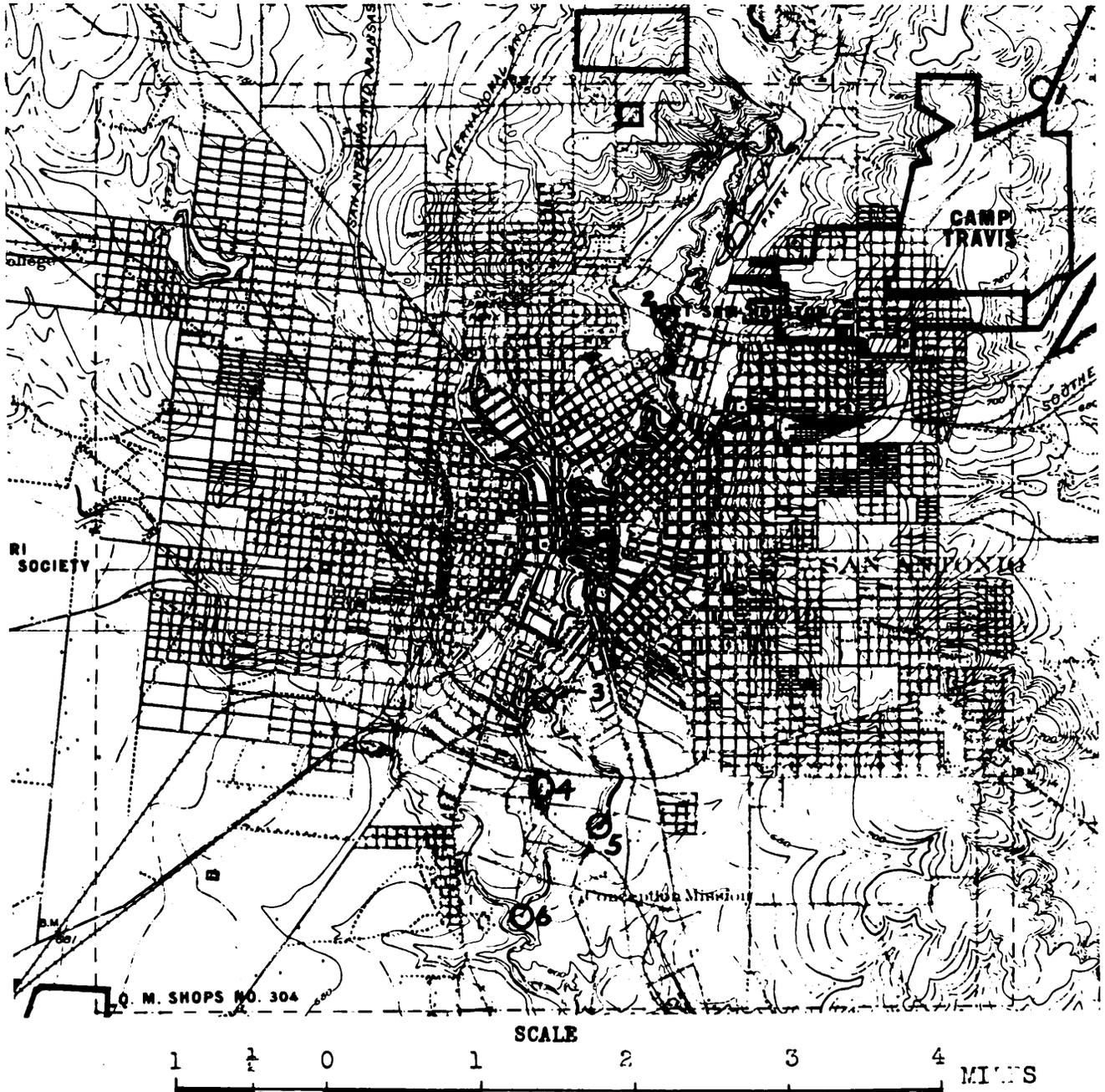
Analysis of water from flowing artesian well 4

Texas Public Service Company, owner. Collected June 16, 1942.
Analyzed by D. Ireland.

(Results are in parts per million)

Total dissolved solids	268
Silica dioxide (SiO ₂)	15
Iron (Fe)	0.14
Calcium (Ca)	64
Magnesium (Mg)	17
Sodium and potassium (Na + K) Calc.	9.9
Carbonate (CO ₃)	0
Bicarbonate (HCO ₃)	242
Sulphate (SO ₄)	26
Chloride (Cl)	16
Fluoride (F)	0.1
Nitrate (NO ₃)	3.0
Total hardness as CaCO ₃	230
pH (not in parts per million)	7.6

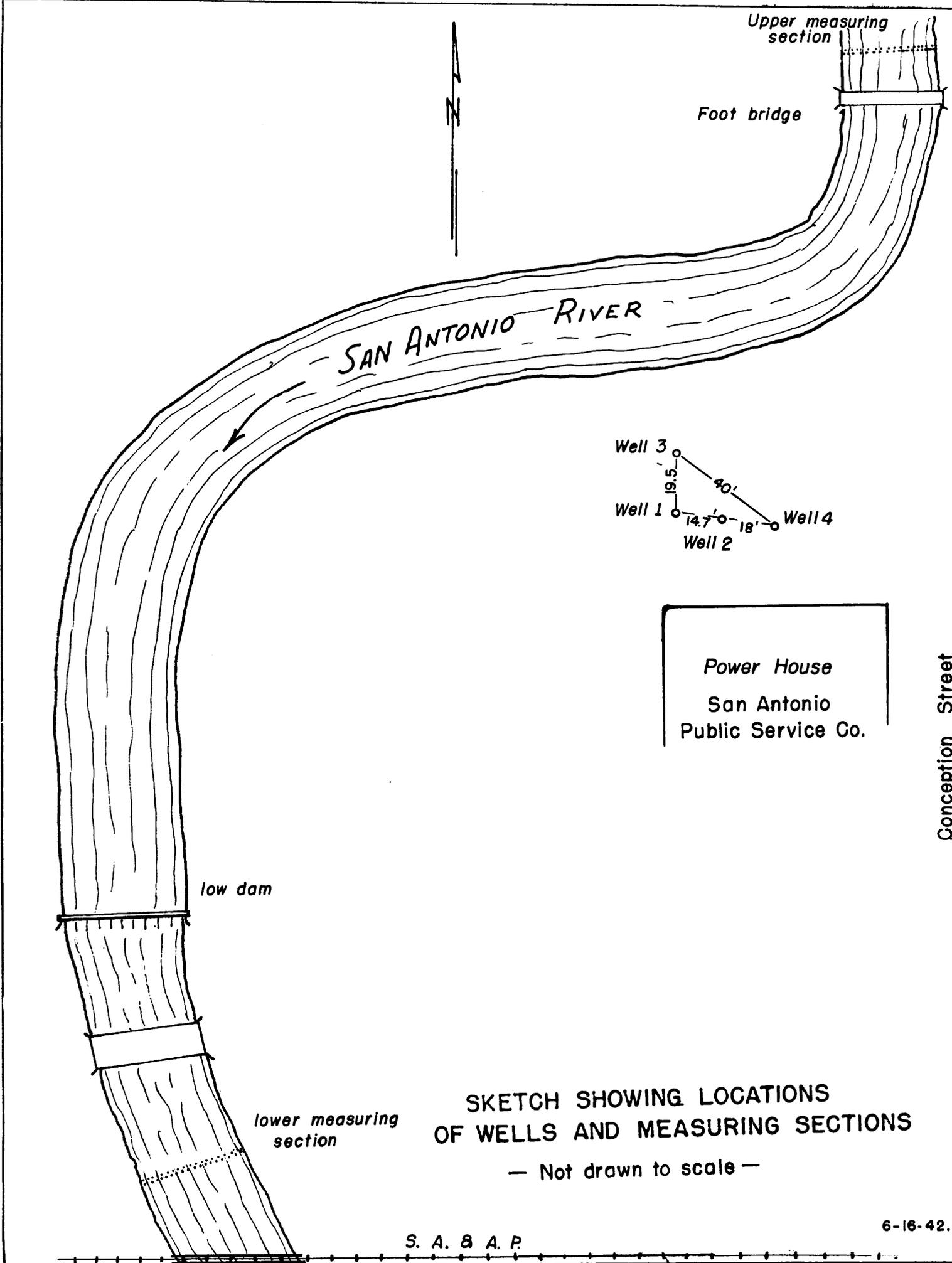
MAP 1



MAP OF SAN ANTONIO, TEXAS, SHOWING LOCALITIES WHERE DATA WERE OBTAINED IN CONNECTION WITH TEST ON FLOWING WELL OF SAN ANTONIO PUBLIC SERVICE CO.

EXPLANATION

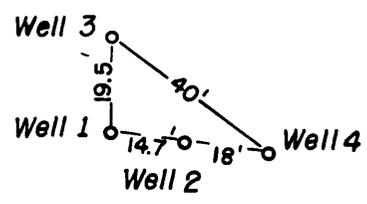
- | | |
|---|--|
| 1. BEVERLY LODGES WELL | 4. S. A. P. RAILROAD WELL |
| 2. SAN ANTONIO RIVER, AT JOSEPHINE STREET | 5. SAN ANTONIO PUBLIC SERVICE CO., WELLS NO. 1, 2, AND 3 |
| 3. SAN ANTONIO RIVER, AT ALAMO STREET | 6. MISSION PUMPING PLANT, CITY OF SAN ANTONIO |



Upper measuring section

Foot bridge

SAN ANTONIO RIVER



Power House
San Antonio
Public Service Co.

Conception Street

low dam

lower measuring section

SKETCH SHOWING LOCATIONS OF WELLS AND MEASURING SECTIONS

— Not drawn to scale —