BOARD OF COUNTY COMMISSIONERS
PALM BEACH COUNTY, FLORIDA

WATERWORKS PROJECT

Systems 1, 2, & 5 - Specific Capacity Test

Systems 2 & 5 - Potentiometric
Head Monitoring Program

Projects 629-741-26-4 through 31-4

RUSSELL & AXON, INC.
167 N.E. 2nd AVENUE
DELRAY BEACH, FLORIDA 33444

BARKER, OSHA & ANDERSON, INC.
860 U.S. HIGHWAY ONE
NORTH PALM BEACH, FLORIDA 33408

ENGINEERING REPORT

BOARD OF COUNTY COMMISSIONERS
PALM BEACH COUNTY, FLORIDA

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Head Monitoring Program

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BARKER, OSHA & ANDERSON, INC. AND RUSSELL & AXON, INC.

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A JOINT VENTURE

BARKER, OSHA & ANDERSON, INC. and RUSSELL & AXON, INC.

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August 25, 1981

Mr. William A. Bryan, P.E.
Administrator
Water Utilities Department
Palm Beach County
Post Office Box 16097
West Palm Beach, Florida 33406

Subject: Systems 1, 2, & 5 - Specific Capacity Test
Systems 2 & 5 - Potentiometric Head
Monitoring Program

Dear Mr. Bryan:

We have enclosed for the Department's use ten (10) copies of the above referenced report. A discussion of the System No. 1 shallow well program is not included as it was decided several months ago that the department would handle this program in its entirety.

If there are any suggestions or comments, do not hesitate to contact us.

Very truly yours,

BARKER, OSHA & ANDERSON, INC. &
RUSSELL & AXON, INC.

C. Henry Glaus

C. Henry Glaus, P.E.
For the Joint Venture

CHG/db

cc: Mr. Sam Barker
File

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I. Introduction

The South Florida Water Management District (S.F.W.M.D.), as permitting agency for ground and surface water withdrawal from the Palm Beach County Area, requires certain special conditions as part of their permits. These special conditions are pertinent to withdrawal of groundwater and are an attempt to prevent damage caused by water demand on the aquifer beyond its hydraulic capabilities. Exceeding the capacity of the aquifer to store and supply water will result in a lowering of the water table, with possible damage to certain varieties of plant life and, in coastal areas, increase the possibility of salt water intrusion. The danger of salt water intrusion is also present inland in areas above bodies of connate, or geologically trapped, salt water. Local excessive drawdown may also cause damage to well pumps or render them periodically useless, if under heavy demand, the water level falls below the pump suction level.

In an effort to prevent conditions such as these from occuring, the S.F.W.M.D. is placing the responsibility on the Water System Utilities to monitor ground and surface water elevations in the vicinity of their well fields. Along with other water quantity data, the data from these Utilities will allow the S.F.W.M.D. to monitor water usage in a more detailed manner, district wide.

II. Scope of Program

The Potentiometric Head Monirtoring Program (POHMOP) and specific capacity tests will provide the means whereby Palm Beach County Water Utilities Department will be able to accurately monitor the groundwater elevation in the system's well field and the surrounding area.

Withdrawal of groundwater causes a lowering of the potentiometric surface, which takes the shape of an inverted cone centered on the withdrawal well. This is called the cone of depression and its depth, extent and rate of curvature as it slopes toward the well are functions of the withdrawal rate, the ability of the aquifer to transmit water, and of the well construction.

The POHMOP wells will be used to measure the elevations of the potentiometric surface at varying distances from the well field and will enable calculations of the transmisivity and storage coefficents to be made. These calculations in turn can be used to predict the areal extent of the cone of depression.

Florida's rainfall is highly seasonal, and although approximately 60 inches of rainfall is common in an average year, it is not uncommon to receive little or no rain for a month or more during the dry season. These dry periods can cause a serious lowering of the water table since increased demands usually occur during the same period due to seasonal population increases and accelerated commercial and domestic irrigation.

The monitoring system will provide an "early warning system" of significant water table lowering and allow the utilities to take any precautionary measures they feel necessary to avert a water shortage condition.

III. Palm Beach County System No. 1 - Palm Beach International Airport

A) Location Description

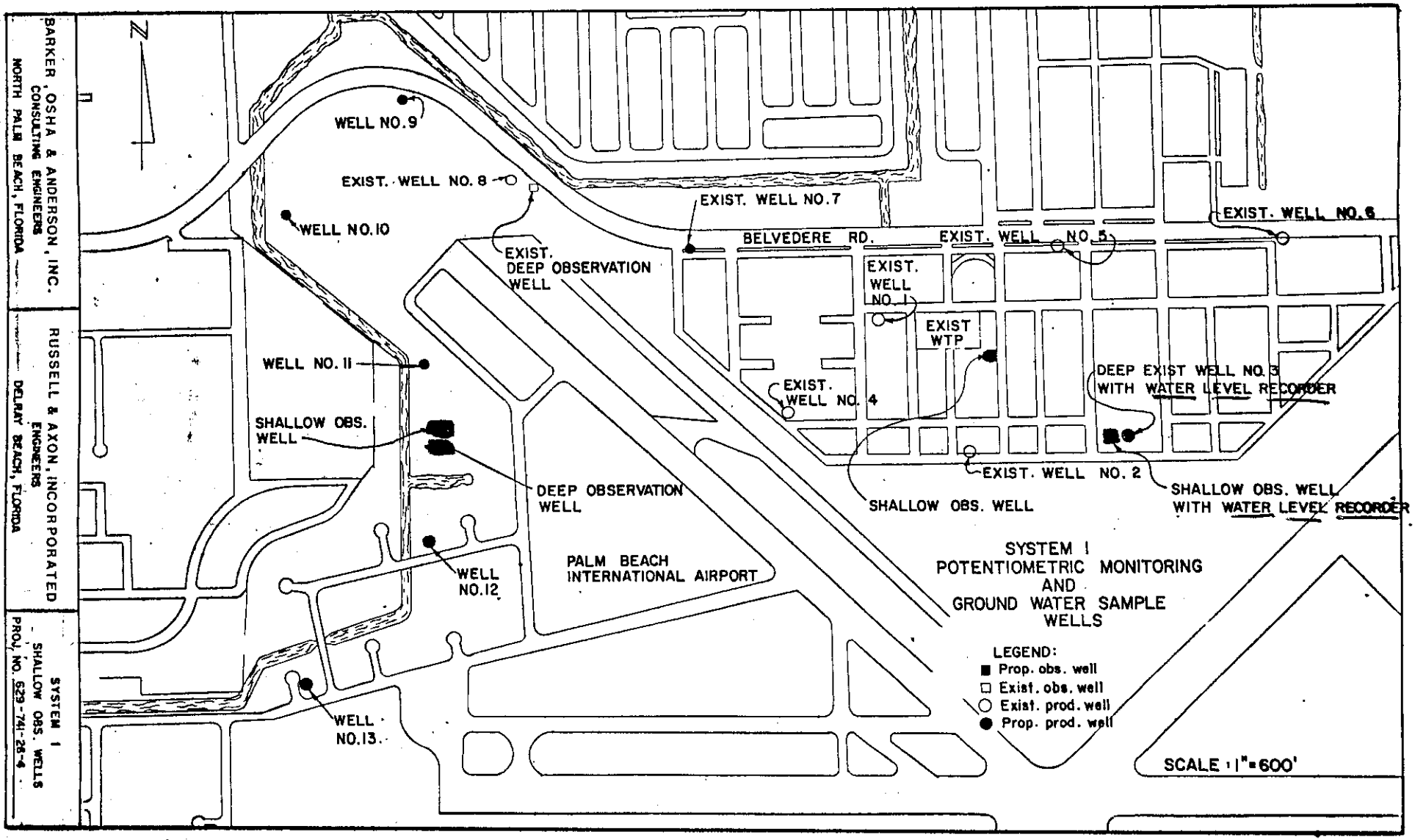
P.B.I.A. System No. 1 is located on the north side of Palm Beach International Airport south of Belvedere Road.

between Congress Avenue and the town of Golfview. See Location Map page 4.

B) Existing Facilities

P.B.I.A. System No. 1 consists of six existing production wells numbered 1 through 7 with well number 3 abandoned. Under current construction are six additional production wells numbered 8 through 13. Estimated completion of the six additional wells will be June, 1981. The rated capacity of each well is as follows:

WELL NO.	DESIGN CAPACITY (GPM)
1	350
2	350
3	(Abandoned)
4	350
5	350
6	350
7	750
8	750
9	850
10	1,000
11	800
12	1,000
13	900


N
WELL NO.9
EXIST. WELL NO. 8
WELL NO.10
EXIST. DEEP OBSERVATION WELL
EXIST. WELL NO.7
BELVEDERE RD.
EXIST. WELL NO. 5
EXIST. WELL NO. 6
EXIST. WELL NO. 1
EXIST WTP
DEEP EXIST WELL NO. 3 WITH WATER LEVEL RECORDER
EXIST. WELL NO. 4
WELL NO. 11
SHALLOW OBS. WELL
DEEP OBSERVATION WELL
EXIST. WELL NO. 2
SHALLOW OBS. WELL
SHALLOW OBS. WELL WITH WATER LEVEL RECORDER
PALM BEACH INTERNATIONAL AIRPORT
WELL NO.12
WELL NO.13
SYSTEM I
POTENTIOMETRIC MONITORING AND GROUND WATER SAMPLE WELLS
LEGEND:
Prop. obs. well
Exist. obs. well
Exist. prod. well
Prop. prod. well
SCALE 1"=600'
BARKER, OSHA & ANDERSON, INC.
CONSULTING ENGINEERS
NORTH PALM BEACH, FLORIDA
RUSSELL & AXON, INCORPORATED
ENGINEERS
DELRAY BEACH, FLORIDA
SYSTEM I
SHALLOW OBS. WELLS
PROJ. NO. 529-741-28-4

Wells No. 1, 2, 4, 5, 6, 8 and 9 are between 170 feet and 180 feet in depth and are located in a relatively poor water bearing formation predominantly consisting of fine shell fragments, streaks of various sandstone and fine sand.

Wells No. 7, 10, 11, 12 and 13 proved to be the exceptions, the aquifer for this area being much more porous, consisting of sandstone with less shell compared to the other wells. Well total depths vary from 155 feet to 180 feet. The driller's logs reflect the porosity of the formation with mention of lost circulation at several depths. Circulation at one point on Well No. 7 was not regainable and drilling was completed by using the reverse air method.

C) Specific Capacity Tests

1) Description of Tests:

The specific capacity tests were performed by Alsay-Pippin Company, Inc. during the initial construction of the well field. All wells were pumped individually at the capacity shown in the summary of results. The water was discharged a minimum of 500 feet from the well header to prevent recharge during the test.

2) Equipment:

The equipment used in performing the specific capacity test was an orifice meter to measure the

water yield and electric continuity probe (M-Scope) to measure drawdown.

3) Summary of Results:

TABLE I - SPECIFIC CAPACITY TESTS

P.B.I.A. SYSTEM NO. 1 WELLFIELD

WELL NO.	DATE OF TEST	Q (GPM)	D/D (FT.)	S (GPM/FT.)
1	No Data Available			
2	11/13/75	366	17' - 11"	20.4
3	Abandoned			
4	10/21/75	363	49' - 2"	7.4
5	10/27/75	366	24' - 2"	15.1
6	12/23/75	363	27' - 8"	13.1
7	11/7/75	406	1' - 10"	221.5

Tests on Wells No. 2 through 7, except No. 3, which is an existing well, were performed by Alsay-Pippin Company, Inc. and observed by Russell & Axon, Inc. personnel.

It is interesting to note the approximately 30 times increase in specific capacity between Wells No. 4 and No. 7, confirming the greater transmissivity of the formation at Well No. 7.

4) Recommendations:

It is recommended that Palm Beach County Water Utilities Department establish a monitoring program

to collect and evaluate specific capacity test data on a yearly basis to establish a pattern of well fluctuation. This will allow advance warning on decreased well efficiency and proper scheduling of well field maintenance.

D) Potentiometric Head Monitoring Program

1) Description of Proposed Potentiometric Head Monitoring Program:

P.B.I.A. System No. 1 consists of six existing wells drilled on the north side of Palm Beach International Airport south of Belvedere Road, and six future wells currently being constructed on the west and northwest sides of the airport.

The aquifer in the airport area varies considerably from a tight, fragmented, sandy, shell formation to a highly permeable sandstone. Whether all the new wells will be in the high-transmissivity zone will only be known upon actual drilling.

As a result of discussions with the South Florida Water Management District, the pattern for the observation wells are shown on the Location Map on page 4 . The observation well locations shown on the attached map may be altered somewhat depending on the results of the production well drilling logs.

what is this well used for? It is never mentioned again in data collection

The location description of the observation wells are as follows: One shallow well will be installed in the approximate center of the existing well field near the water treatment plant as shown on the attached drawing. Another shallow well will be installed adjacent to existing abandoned production Well No. 3, and one pair of deep and shallow wells will be installed on the eastern side of the western canal and south of proposed Well No. 11. The deep observation well will be completed at the same depth as the adjacent proposed production wells. The shallow wells will be completed approximately 20 to 25 feet below land surface. All observation wells without recorders will have a minimum diameter of two inches, and all observation wells with recorders will have a minimum diameter of four inches.

2) Method of Data Collection:

The most convenient method for measuring the depth to water below the top of the well casing is with a conductivity, or continuity, probe. These generally consist of a depth marded wire on a hand cranked reel, a weighted 2-conductor probe and a continuity-indicating meter on the reel. The probe is simply lowered down the well until the meter indicates continuity (contact with the water surface) and

the depth read from measurements on the wire. These instruments, sometimes known as "M-Scopes" are commonly used by well drillers for measuring well drawdown.

Abandoned production Well No. 3 and the shallow well to be constructed adjacent to production Well No. 3 will both be equipped with one month Steven's Type "F" continuous chart recorders. Copies of the continuous charts should be submitted to the District on a monthly basis. The charts should clearly indicate a vertical elevation scale (referenced to mean sea level), a horizontal time scale indicating days of the month, the elevation of the initial and final chart readings, the dates and time of day of the initial and final chart readings, the location of the well, the well depth, the water use permit number and the system name.

The water level elevations of the pair of deep and shallow wells, to be installed east of the western canal and south of proposed production Well No. 11, will be determined on a monthly basis for the first year and on a quarterly basis thereafter. The data sheet submitted to the District should indicate the date and time of day of data collection, the water level elevation (referenced to mean sea

level), the location of the observation well, the well depth, the water use permit number and the permit name. All data should be submitted to the District within one month of the date of collection. See Date Collection Form page 11.

The elevations of the top of the casings for the four on-site monitoring wells will be determined referenced to mean sea level. The four wells will be; existing abandoned production Well No. 3, the shallow well to be constructed adjacent to Well No. 3, and the pair of deep and shallow wells to be constructed east of the western canal and south of proposed production Well No. 11.

The four observation wells will be used to determine the profile and area extent of the cone of influence of the Palm Beach International Airport well field from water level data collected from these wells at the prescribed intervals.

3) Summary:

The foregoing report details the Potentiometric Head Monitoring Program. Its implementation will enable the County Water Utilities Department to secure accurate information regarding the condition of the well field and provide the means to answer potential critics of increased withdrawal. It is

SYSTEM NO. 1 - POTENTIOMETRIC WELL DATA

DATE	WELL NO. 1 CASING ELEV.=		WELL NO. 2 CASING ELEV.=		WELL NO. 3 CASING ELEV.=		WELL NO. 4 CASING ELEV.=	
	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.

SAMPLE FORM

recommended that the County adopt the Potentiometric Head Monitoring Program as summarized:

a) One shallow well be installed adjacent to existing abandoned production Well No. 3, and one pair of deep and shallow wells will be installed on the eastern rather than western side of the western canal and south of proposed Well No. 11. The deep well will be completed at the same depth as the adjacent proposed production wells. The shallow wells will be completed approximately 20 to 25 feet below land surface. All observation wells constructed will have a diameter of two inches.

b) Water level elevations (referenced to mean sea level) will be determined for four on-site monitoring wells. The four wells will be existing abandoned production Well No. 3, the shallow well to be constructed adjacent to Well No. 3, and the pair of deep and shallow wells to be constructed east of the western canal and south of proposed production Well No. 11.

c) Abandoned production Well No. 3 and the shallow well to be constructed adjacent to production Well No. 3 will both be equipped with one month F type continuous chart recorders rather than one week recorders. Copies of the continuous

charts should be submitted to the District on a monthly basis. The charts will clearly indicate a vertical elevation scale (referenced to mean sea level), a horizontal time scale indicating days of the month, the elevation of the initial and final chart readings, the dates of the initial and final chart readings, the location of the well, the well depth, the water use permit number and the system name.

d) The water level elevations of the pair of deep and shallow wells to be installed east of the western canal and south of proposed production Well No. 11 will be determined on a monthly basis for the first year and on a quarterly basis thereafter. The data sheet submitted to the District should indicate the date of data collection, the water level elevation (referenced to mean sea level), the location of the observation well, the well depth, the water use permit number and the permit name. All data should be submitted to the District within one month of the date of collection.

IV. Central Regional Water Wellfield

A) Location Description:

The Central Regional Water Well Field is located adjacent

to the Florida Turnpike between Okeechobee Blvd. and Belvedere Road. See Location Map page 15.

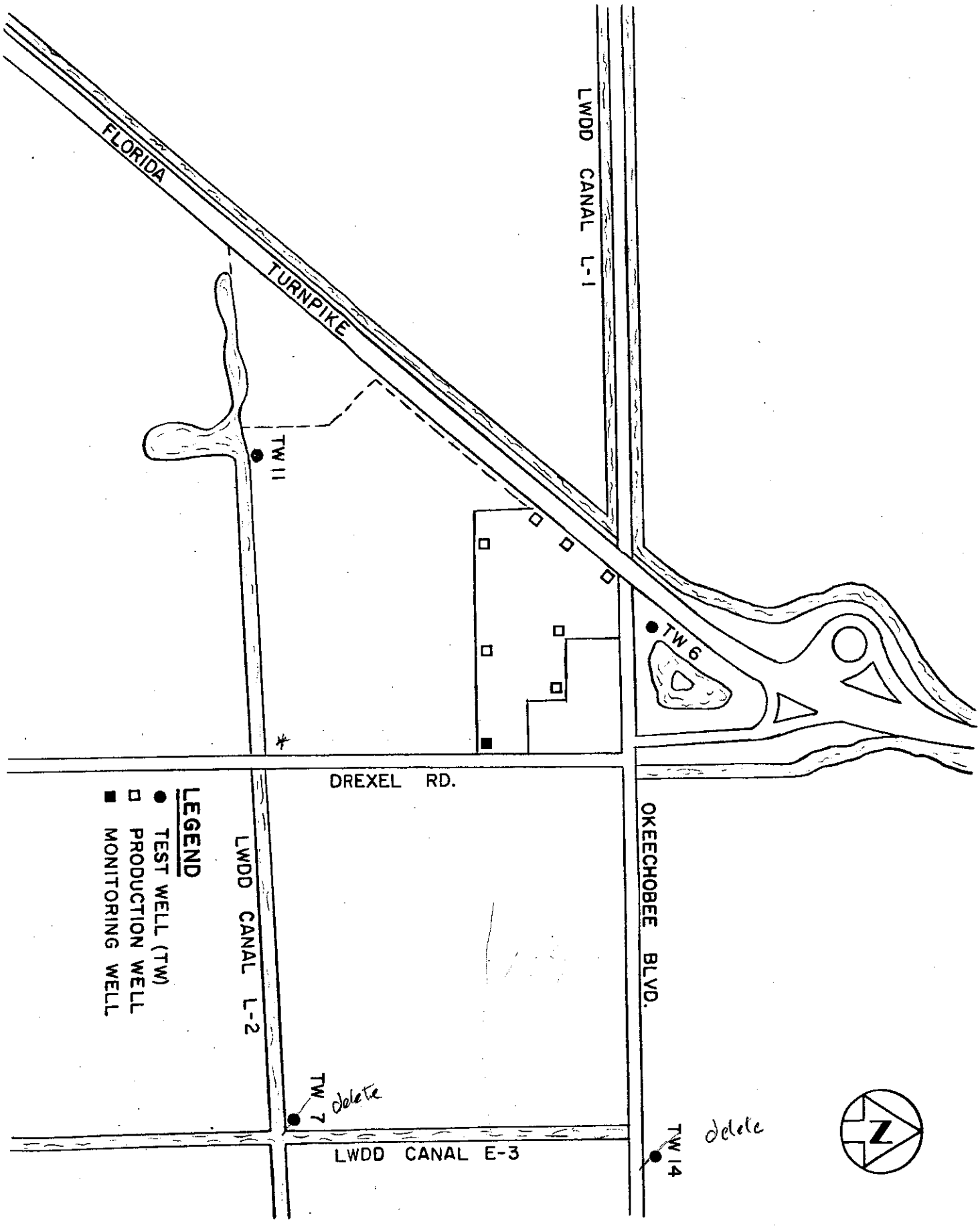
B) Existing Facilities: & proposed

The Central Regional Water Facilities consist of a proposed 32 MGD Water Treatment Plant and associated 28 wells. This facility will be constructed in four phases with the first phase involving the construction of 7 wells and the conversion of an existing 12-inch test well to a production well. The initial 8 wells will be rated at 1,000 GPM and spaced as shown on the attached Location Map.

C) Specific Capacity Test:

1) The test production well was pumped at 1,450 GPM for the entire test. The discharged water was carried over 500 feet away before it was allowed to contact the land surface to prevent the possibility of recharge. The water level measurements were taken in all four observation wells and in the test production well, (see summary of results). Water level measurements were taken in all wells simultaneously. Drawdown measurements during the pumping test were taken on the following schedule:

	Total Time in Minutes
Every minute for the first 20 minutes.	20
Every 5 minutes for next 30 minutes.	50



BARKER, OSHA & ANDERSON, INC. CONSULTING ENGINEERS NORTH PALM BEACH, FLORIDA	**RUSSELL & AXON INCORPORATED** ENGINEERS DELRAY BEACH, FLORIDA	SYSTEM NO. 1- CENTRAL REGIONAL WATER WELLFIELD POTENTIOMETRIC WELL DATA

Every 10 minutes for next 50 minutes.	100
Every 20 minutes for next 220 minutes.	320
Every 40 minutes for next 280 minutes.	600

Recovery water level measurements were taken after pumping stopped until it was apparent that the well had stabilized. Recovery measurements were taken on the same schedule as drawdown measurements.

2) Equipment:

The test production well flow was measured by a circular orifice weir and piezometer tube. Water level measurements were taken with an electrical depth gauge (M-Scope) and by the wetted tape method. All M-Scopes were calibrated with an Engineer's rule prior to taking any readings.

3) Summary of Results:

See Table I of Water Level Data in Appendix.

4) Recommendations:

Calculations based on test well data, pumping tests, and previous reports, indicate that a withdrawal of 32 MGD can easily be obtained with no adverse environmental impact. Specific capacity of wells in this area are higher than 760 GPM/ft. of drawdown. If an individual well in the area is pumped at a constant 1,000 GPM for three days, the maximum calculated drawdown would be 1.3 feet.

It is recommended that Palm Beach County Water Utilities Department establish a monitoring program to collect and evaluate specific capacity test data on a yearly basis to establish a pattern of well fluctuation. This will allow advance warning on decreased well efficiency and proper scheduling of well field maintenance.

D) Potentiometric Head Monitoring Program

1) Description of Proposed Potentiometric Head Monitoring Program:

The Central Regional Water Facility well field consists of one test production well located at Lake Worth Drainage District L-2 Canal and the Florida Turnpike.

The aquifer in this area is exceptionally good, with transmissivity that varied from a low of 1.3×10^6 GPD/ft., computed by the U.S. Geological Survey, to a high of 3.8×10^6 GPD/ft. by the straight line method. Values of storage coefficient range from .013 to a high of 0.75.

As a result of discussions with the South Florida Water Management District and the data submitted in the Aquifer Performance Evaluation Report, dated August, 1979, as prepared by Barker, Osha & Anderson,

SYSTEM NO. 1 - CENTRAL REGIONAL WATER WELLFIELD
POTENTIOMETRIC WELL DATA

DATE	TEST WELL NO. 6 CASING ELEV.=____		TEST WELL NO. 7 CASING ELEV.=____		TEST WELL NO. 11 CASING ELEV.=____		TEST WELL NO. 14 CASING ELEV.=____	
	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.

BARKER, OSHA & ANDERSON, INC.	RUSSELL & AXON INCORPORATED	SAMPLE FORM
CONSULTING ENGINEERS NORTH PALM BEACH, FLORIDA	ENGINEERS DELRAY BEACH, FLORIDA	

Inc. and Russell & Axon, Inc. the District agreed to the following monitoring wells. Initial construction phase of the well field would require a continus recorder installed in the two-inch diameter observation well. To reduce construction cost, the South Florida Water Management District will allow utilization of existing observation wells No. TW6, TW7, TW11 and TW14 which were constructed under the Aquifer Performance Evaluation Program.

2) Method of Data Collection:

The most convenient method for measuring the depth of water below the top of the well casing is with a conductivity, or continuity, probe.

A test well located in the S.E. corner at the new well field will be equipped with one month Steven's Type "F" continuous chart recorder. Copies of the continuous charts will be submitted to the District on a monthly basis. The charts will clearly indicate a vertical elevation scale, (referenced to mean sea level), a horizontal time scale indicating days of the month, the elevation of the initial and final chart readings, the date and time of day of the initial and final chart readings, the location of the well, the well depth the water use permit number and the system name. The four existing observation wells, TW6, TW7, TW11 and TW14 will

be monitored on a weekly basis. All data should be submitted to the District within one month of the date of collection.

The four observation wells adjacent to the well field will be used to determine the profile and extent of the cone of influence of well field from water level data collected from these wells at the prescribed intervals. See Location Map page 15.
See Data Collection Form page 18.

V. Palm Beach County System Number 2

A) Location Description:

Palm Beach County System No. 2 well fields are located adjacent to Pinehurst Drive approximately one mile south of Forest Hill Blvd. System No. 2 is unique in that its well field is bordered on three sides by canals. Well field No. 1, the field of seven wells now in use, is bordered on the south by the L.W.D.D. L-10 Canal, on the north by the L.W.D.D. L-9 Canal and on the west by a new canal yet unnamed. Future well field No. 2 west of Pinehurst Drive, is also bordered by three canals, the L.W.D.D. L-10

Canal on the south, the new canal on the north and a canal along the Florida Turnpike right-of-way on the west.

B) Existing Facilities:

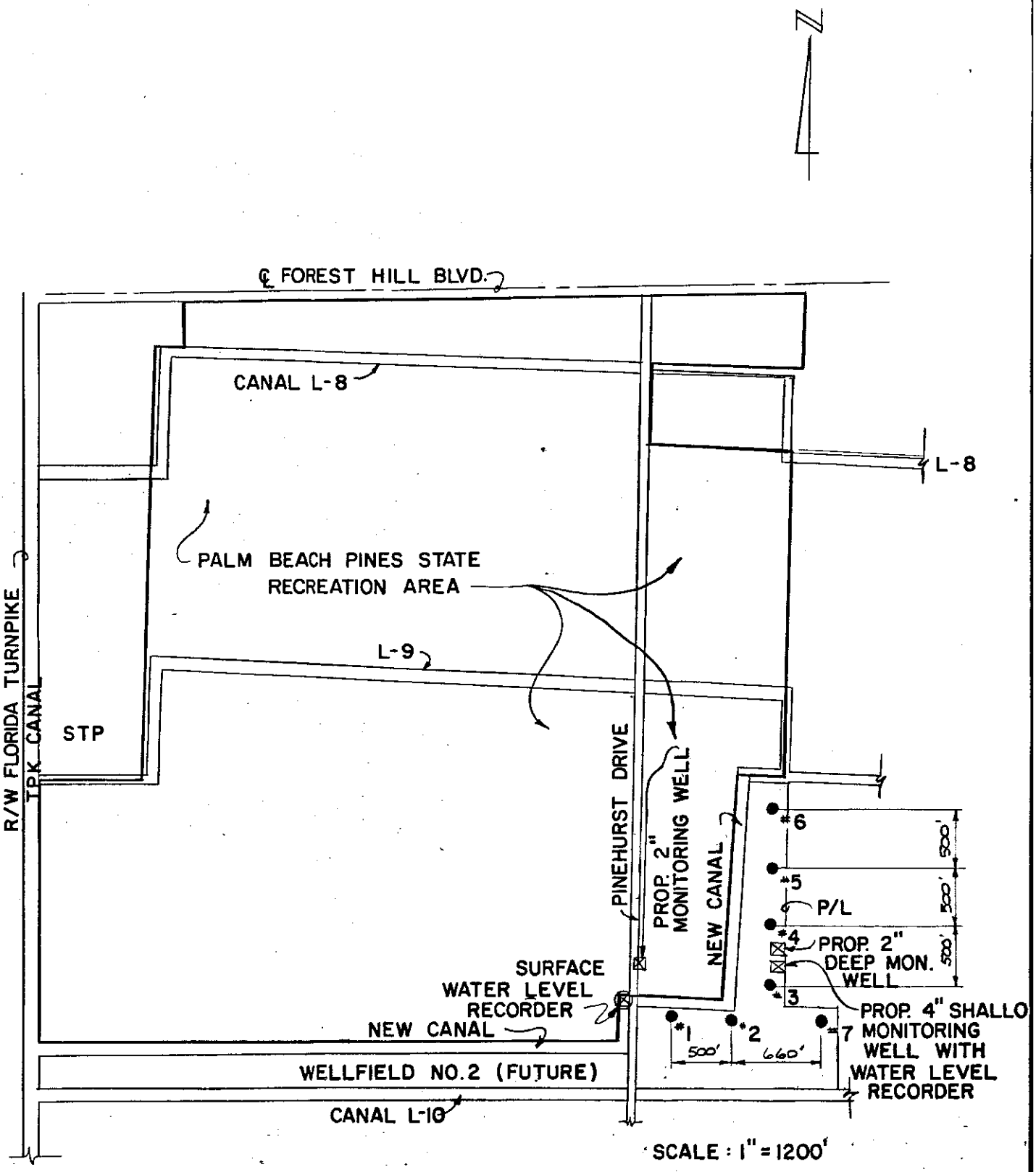
Palm Beach County System No. 2 well field consists of 7 existing wells located as shown on the Location Map on page 22. These 7 wells are spaced approximately 500 feet apart to minimize the affects on each individual well.

C) Specific Capacity Tests:

1) Description of Tests:

In compliance with the South Florida Water Management District's Water Withdrawl Permit No. 50-00584-W for System No. 2, Palm Beach County, a Specific Capacity Test was performed on the well field on January 18, 1980.

All wells were shut down at 4:00 A.M. that morning to allow at least 5 hours for the field to recover and stabilize before beginning the test. Each well was tested individually with all other wells shut off. Drawdown measurement was initially attempted using the individual well's airlines, but none worked satisfactorily and all were removed except for those on Well's No. 3 and No. 5, which were jammed in place.



BARKER, OSHA & ANDERSON, INC. CONSULTING ENGINEERS NORTH PALM BEACH, FLORIDA	RUSSELL & AXON, INCORPORATED ENGINEERS DELRAY BEACH, FLORIDA	SYSTEM 2 POTENTIOMETRIC MONITORING WELLS PROJ. NO. 629-741-28-4

2) Equipment:

Drawdown was measured using a continuity-type probe to sense the water surface after discovering that the one working airline gauge read 1/4 of that using the continuity probe.

Flow measurements were made using the System 2 Plant Raw Water Meter which has maintained it's accuracy since last calibrated, according to plant personnel.

3) Summary of Results:

The following table summarizes the results of the Specific Capacity Test:

WATER LEVEL (FT.)

Has W.T. stabilized?

Well No.	Yield (GPM)	Static	Pumping	Time	Drawdown	Specific Capacity
1	600	8.00	12.04	10 min.	4.04 ft.	149 GPM/ft.
2	900	8.25	10.10	15 min.	1.85 ft.	486 GPM/ft.
3	Probe broke off in well - no test.					
4	900	6.50	9.08	15 min.	2.58 ft.	349 GPM/ft.
5	Airline could not be pulled - no test.					
6	1250	7.00	10.92	30 min.	3.92 ft.	319 GPM/ft.
7	1250	8.00	10.42	20 min.	2.96 ft.	422 GPM/ft.

Well Field Specific Capacity Average = 345 GPM/ft.

4) Recommendations:

It is recommended that Palm Beach County Water Utilities Department establish a monitoring program to collect and evaluate specific capacity test data on a yearly basis to establish a pattern of well fluctuation. This will allow advanced warning on decreased well efficiency and proper scheduling of well field maintenance.

D) Potentiometric Head Monitoring Program:

1) Description of Proposed Potentiometric Head Monitoring Program:

With the known high transmissivity of the aquifer in the area of System No. 2 and the fortunate location of the well field relative to the canals, it is unlikely that any significant drawdown will occur in the proposed Palm Beach Pines Park north and west of the well field.

The Management District conducted computer calculations of the cone of influence of the well field, one at 4.0 MGD and one at 7.78 MGD, before the new canal was dug. Even without the boundary condition of the new canal, drawdown was minimal. The existence of the new canal will certainly compress the hydraulic gradient west of the well field, although to what extent is not known at this time.

In order to monitor the ground-water levels in and around the well field two 2-inch diameter wells and one 4-inch diameter well will be installed, as shown on the accompanying map. The shallow well of the deep/shallow pair located within the well field will have a Stevens Type "F" or similar battery or weight operated water level strip chart recorder that will continuously record ground-water fluctuations for a 32 day period.

The remaining wells, dependent on field conditions, will be drilled in the general locations shown on the map. These monitoring wells will be used to determine the shape of the cone of influence on the well field water level through the use of a conductivity-type probe or similar instrument. The shallow wells will be drilled 20 to 25 feet below land surface, and the deep well to the same depth as the production wells, approximately 100 feet. After installation all wells will be surveyed to establish casing elevations relative to mean sea level. In order to correlate ground-water levels with surface water elevations, a second water level recorder will be installed at Pinehurst Drive and the new canal. The water level recorder will be surveyed to establish a base elevation.

2) Method of Data Collection:

The most convenient method for measuring the depth to water below the top of the well casing is with a conductivity, or continuity, probe.

The shallow well of the newly installed pair of deep and shallow wells and the surface water station will be equipped with a one month continuous chart recorder.

Copies of the continuous charts will be submitted to the District on a monthly basis. The charts will clearly indicate a vertical elevation scale (referenced to mean sea level), a horizontal time scale indicating day of the month, time of day, the elevations of the initial and final chart readings, the location of the sampling point, the depth of the well (if not a surface water source), the water use permit number and the system name.

The water level elevations of the two deep wells will be determined on a monthly basis for the first year and on a quarterly basis thereafter. The data-sheet submitted to the District should indicate the date and time of day of data collection, the water

level elevation (referenced to mean sea level), the location of the observation with respect to production well No. 1, the well depth, the water use permit number and the permit name. All data should be submitted to the District within one month of the date of collection. See Data Collection Form page 28.

3) Summary:

a) The monitoring program for System 2 will require the construction of one shallow monitoring well, one pair of deep and shallow monitoring wells and one surface water recording station. The single shallow monitoring well will be completed 20 to 25 feet below land surface and located along Pinehurst Drive approximately 1200 feet west of production wells No. 3 and 4. The pair of deep and shallow observation wells will be located to the east of production wells No. 3, 4, 5 and 6 rather than to the west of the production wells where observations may be influenced by canal stages. The exact location for the pair of wells should receive S.F.W.M.D.

SYSTEM NO. 2 - POTENTIOMETRIC WELL DATA

DATE	WELL NO. 1 CASING ELEV.=		WELL NO. 2 CASING ELEV.=		WELL NO. 3 CASING ELEV.=		WELL NO. 4 CASING ELEV.=	
	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.

SAMPLE FORM

staff concurrence prior to the installation of the wells. The deep well of the pair will be completed at the same depth of existing production wells and the shallow well of the pair will be completed 20 to 25 feet below land surface. All observation wells constructed will have a diameter of 2-inches. The surface water level recording station will be located approximately 450 feet northwest of production well No. 1 and at the intersection of the newly constructed canal and Pinehurst Drive. There are no monitoring wells proposed in the vicinity of the area designated for the development of Well Field No. 2.

b) Water level elevations (referenced to mean sea level) will be determined for three on-site monitoring wells and one surface water station. The three wells will consist of a single shallow monitoring well to be located along Pinehurst Drive and a pair of deep and shallow monitoring wells to be located east of production wells No. 3, 4, 5 and 6. The surface water station will be located at the intersection of the newly constructed canal and Pinehurst Drive.

c) The shallow well of the newly installed pair of deep and shallow wells and the surface water station will be equipped with a one month "F" type continuous chart recorder rather than a one week recorder. Copies of the continuous charts should be submitted to the District on a monthly basis. The charts should clearly indicate a vertical elevation scale (referenced to mean sea level), a horizontal time scale indicating day of the month, the elevations of the initial and final chart readings, the location of the sampling point, the depth of the well (if not a surface water source), the water use permit number and the system name.

d) The water level elevations of the two deep wells will be determined on a monthly basis for the first year and on a quarterly basis thereafter. The data sheet submitted to the District should indicate the date of data collection, the water level elevation (referenced to mean sea level), the location of the observation with respect to production well No. 1, the well depth, the water use permit number and the permit name. All data should

be submitted to the District within one month of the date of collection.

VI. Palm Beach County System Number 5

A) Location Description:

Palm Beach County System No. 5 well field is located on Jog Road approximately 400 feet north of Lake Worth Drainage District's L-22 Canal.

B) Existing Facilities:

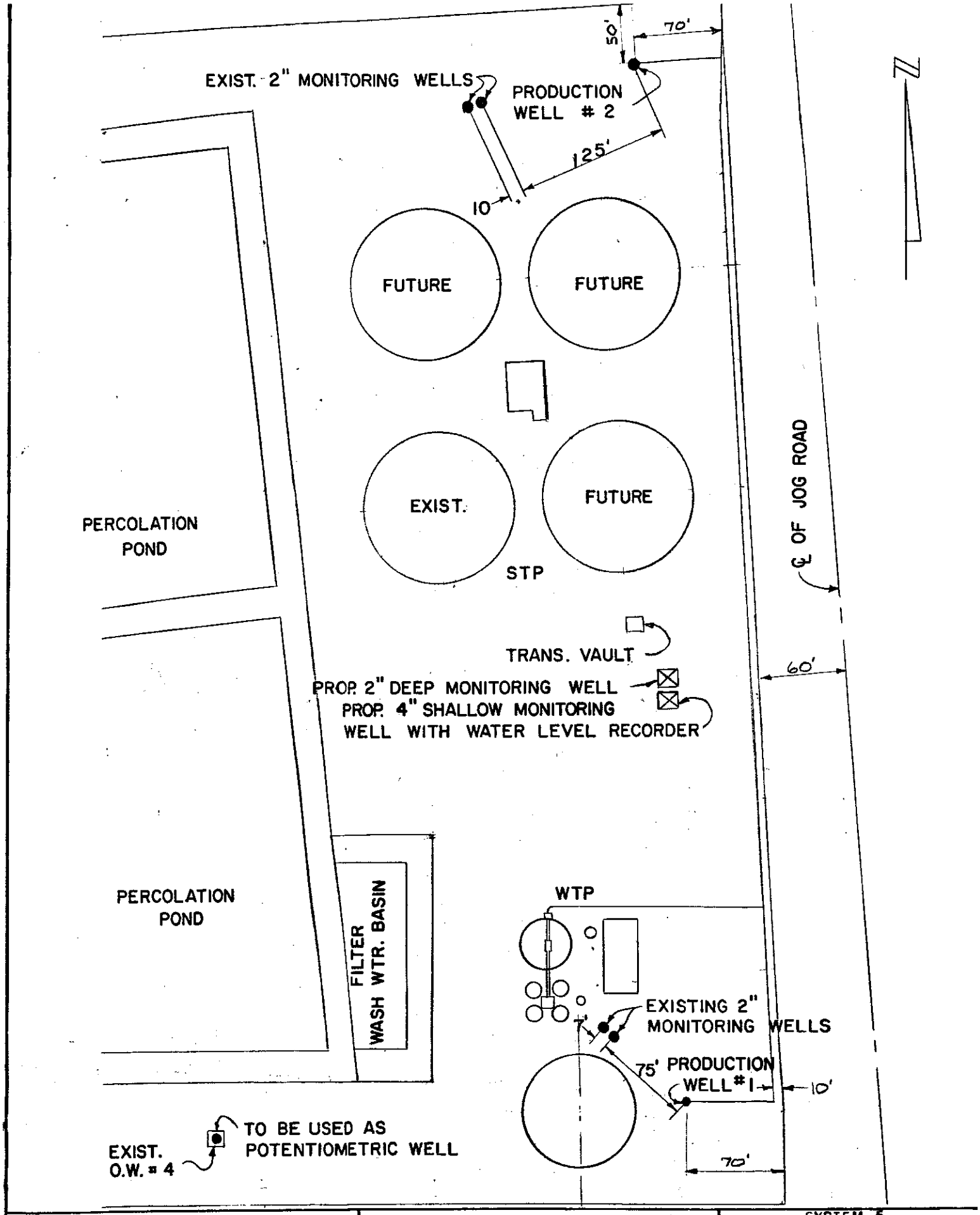
System No. 5 is presently a small, two production well facility serving Le Chalet Subdivision. The two wells are located at the extreme south (Well No. 1) and north (Well No. 2) ends of the property, the bulk of which is occupied by the percolation ponds of the Sewage Treatment Facility.

See Location Map on page 32.

C) Sepcific Capacity Tests:

1) Description of Tests:

Palm Beach County System No. 5 well field was shut down to allow the ground water to stabilize. Static water level readings were obtained to determine when stabilization of the ground water table occured. After the ground water stabilized, each well was pumped at its rated capacity into the Water Treatment Plant. Draw-down levels were recorded.



BARKER, OSHA & ANDERSON, INC. CONSULTING ENGINEERS NORTH PALM BEACH, FLORIDA	RUSSELL & AXON, INCORPORATED ENGINEERS DELRAY BEACH, FLORIDA	SYSTEM 5 POTENTIOMETRIC MONITORING WELLS PROJ. NO. 629-741-30-4

2) Equipment:

Drawdown was measured by the use of an electric continuity probe (M-Scope). Water yield from each well was obtained by utilizing the existing flow meter on the influent line in the Water Treatment Plant.

3) Summary of Results:

The following table summarizes the results of the Specific Capacity Test for System No. 5.

Well	Yield (GPM)	Static W.L. Ft.	Pumping	Time	Drawdown	Specific Capacity
North	700	6.00	9.73	30 min.	3.73 ft.	188 GPM/ft.
South	700	6.47	10.71	45 min.	4.24 ft.	165 GPM/ft.

4) Recommendations:

It is recommended that Palm Beach County Water Utilities Department establish a monitoring program to collect and evaluate specific capacity test data on a yearly basis to establish a pattern of well fluctuation. This will allow advance warning on decreased well efficiency and proper scheduling of well field maintenance.

D) Potentiometric Head Monitoring Program:

1) Description of proposed Potentiometric Head Monitoring Program:

Monitoring of the System's ground water elevations will be accomplished by installation of a deep and shallow pair of observation wells. The deep well will be 2-inches in diameter and the shallow well will be 4-inches in diameter. They will be located about 350 feet north of Well No. 1. The deep well will be installed to the same depth as the existing production wells and the shallow well will be installed 20 to 25 feet below ground surface. The shallow well will have a Steven's Type "F" water level recorder (or similar instrument) in a weatherproof housing and have a 32 day recording capability. The recorder may be clock or weight driven.

An existing ground water quality monitoring well, Well No. 4, south of the percolation ponds, will also be used as a potentiometric monitoring well. The top of the well casing of all three wells will be surveyed to establish reference elevations relative to mean sea level.

2) Method of Data Collection:

The most convenient method for measuring the depth to water below the top of the well

casing is with a conductivity, or continuous probe.

The shallow well of the newly installed pair of deep and shallow wells will be equipped with a one month continuous chart recorder. Copies of the continuous charts should be submitted to the District on a monthly basis. The charts should clearly indicate a vertical elevation scale (referenced to mean sea level), a horizontal time scale indicating days of the month, the elevations of the initial and final chart readings, the dates and times of the initial and final chart readings, the location of the well with respect to production Well No. 1, the well depth, the water use permit number and the system name.

The water level elevations, of existing observation Well No. 4 and the deep well of the newly installed pair of deep and shallow wells, will be determined on a monthly basis for the first year and on a quarterly basis thereafter. The data sheet submitted to the District should indicate the date and time of day of data collection, the water level elevation (referenced to mean sea level),

the location of the observation well with respect to production Well No. 1, the well depth, the water use permit number and the permit name. All data should be submitted to the District within one month of the date of collection. See Data Collection Form page 37.

3) Summary:

a) One deep and one shallow monitoring well will be constructed approximately 350 feet north of existing production Well No. 1. The deep well will be completed at the same depth as the existing production wells. The shallow well will be completed approximately 20 to 25 feet below land surface. All observation wells constructed will have a diameter of 2-inches.

b) Water level elevations (referenced to mean sea level) will be determined for three on-site monitoring wells. The three wells will be existing observation Well No. 4 and the newly installed pair of deep and shallow wells to be located approximately 350 feet north of production Well No. 1.

c) The shallow well of the newly installed pair of deep and shallow wells will be equipped

SYSTEM NO.5 - POTENTIOMETRIC WELL DATA

DATE	WELL NO. 1 CASING ELEV.=		WELL NO. 2 CASING ELEV.=		WELL NO. 3 CASING ELEV.=		WELL NO. 4 CASING ELEV.=	
	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.	DEPTH BELOW CASING	WATER ELEV.

SAMPLE FORM

with a one month F type continuous chart recorder rather than a one week recorder. Copies of the continuous charts should be submitted to the District on a monthly basis. The charts should clearly indicate a vertical elevation scale (referenced to mean sea level), a horizontal time scale indicating days of the month, the elevations of the initial and final chart readings, the dates of the initial and final chart readings, the location of the well with respect to production Well No. 1, the well depth, the water use permit number and the system name.

d) The water level elevations of existing observation Well No. 4 and the deep well of the newly installed pair of deep and shallow wells will be determined on a monthly basis for the first year and on a quarterly basis thereafter. The data sheet submitted to the District should indicate the date of data collection, the water level elevation (referenced to mean sea level), the location of the observation well with respect to production Well No. 1, the well depth, the water use permit number and the permit name. All data should be submitted to the District within one month of the date of collection.

VII. APPENDIX

(MP=Measuring Point
above mean sea lev

TABLE I
WATER LEVEL MEASUREMENTS

MINUTES	WELL NO. 1 (MP=17.38 ft.)	WELL NO. 2 (MP=20.41 ft.)	WELL NO. 3 (MP=19.60 ft.)	WELL NO. 4 (MP=17.98 ft.)	WELL NO. 5 (MP=17.27 ft.)
Static	6.12				
Static	6.12	9.52	8.08	7.25	5.90
Static				7.16	5.85
Static	6.11			7.11	5.82
0	6.11	9.54	8.12	7.11	5.82
1	7.50		8.50	7.11	6.00
2	7.70		8.50	7.11	5.97
3	7.70		8.59	7.11	5.94
4	7.70	9.52		7.11	6.04
5	7.73	9.51		7.11	6.04
6	7.74			7.11	6.06
7	7.75		8.60	7.12	6.06
8	7.76		8.66	7.13	6.07
9	7.75		8.65	7.14	6.08
10	7.75			7.14	6.08
11	7.75			7.13	6.08
12	7.82	9.52		7.13	6.08
13	7.80			7.13	6.08
14	7.80		8.65	7.13	6.07
15	7.80		8.65	7.13	6.06
16	7.73	9.52		7.13	6.08
17	7.75	9.48		7.12	6.08
18	7.74			7.12	6.08
19	7.73		8.62	7.12	6.08
20	7.74	9.51	8.64	7.12	6.07
25	7.74	9.55	8.64	7.12	6.08
30	7.73	9.53	8.64	7.14	6.08
35	7.72	9.55	8.62	7.13	6.09
40	7.72	9.55	8.65	7.12	6.09
45	7.73	9.52	8.68	7.15	6.12
50	7.72	9.52	8.69	7.14	6.11
60	7.74	9.49	8.66	7.14	6.11
70	7.74	9.45	8.66	7.14	6.11
80	7.73	9.53	8.67	7.14	6.11
90	7.74	9.52	8.67	7.14	6.10
100	7.73	9.44	8.64	7.13	6.11
120	7.74	9.51	8.65	7.12	6.11
140	7.72	9.52	8.74	7.12	6.11
160	7.74	9.52	8.68	7.12	6.11
180	7.75	9.52	8.69	7.13	6.12
200	7.77	9.51	8.68	7.13	6.11
220	7.76	9.48	8.74	7.15	6.10
240	7.76	9.48	8.74	7.12	6.12
260	7.74	9.50	8.70	7.14	6.12
280	7.74	9.52	8.72	7.18	6.11
300	7.73	9.53	8.71	7.18	6.12
320	7.76	9.52	8.75	7.18	6.11
360	7.78	9.60	8.75	7.18	6.12

(MP=Measuring Point above mean sea level

TABLE I
WATER LEVEL MEASUREMENTS
PAGE 2

MINUTES	WELL NO. 1 (MP=17.38 ft.)	WELL NO. 2 (MP=20.41 ft.)	WELL NO. 3 (MP=19.60 ft.)	WELL NO. 4 (MP=17.98 ft.)	WELL NO. 5 (MP=17.27 ft.)
400	7.72	9.51	8.76	7.18	6.14
440	7.76	9.50	8.71	7.21	6.14
480	7.76	9.50	8.72		
520	7.76	9.51	8.71	7.36	6.27
560	7.78	9.65	8.76	7.45	6.37
600	7.85	9.63	8.75	7.48	6.36
660	7.91	9.57	8.73	7.41	6.28
720	7.91	9.60	8.73	7.38	6.31
780	7.90	9.56	8.76	7.39	6.32
840	7.87	9.57	8.74	7.40	6.35
900	7.90	9.59	8.74	7.39	6.29
960	7.90	9.63	8.73	7.43	6.33
1020	7.90	9.74	8.74	7.44	6.37
1080	7.90	9.62	8.74	7.46	6.34
1140	7.92	9.62	8.74	7.49	6.34
1200	7.92	9.64	8.73	7.48	6.35
1260	7.91	9.65	8.74	7.47	6.35
1320	7.91	9.68	8.79	7.48	6.40
1380	7.93	9.72	8.78	7.50	6.40
1440	7.93	9.67	8.75	7.52	6.43
1500	8.02	9.70	8.80	7.54	6.49
1560	7.95	9.72	8.83	7.59	6.43
1620	8.05	9.70	8.83	7.55	6.45
1680	8.03	9.71	8.80	7.60	6.49
1740	8.02	9.23	8.80	7.65	6.45
1800	8.02	9.72	8.82	7.59	6.47
1860	7.98	9.75	8.79	7.58	6.48
1920	7.97	9.70	8.82	7.61	6.50
1980	7.96	9.70	8.83	7.59	6.48
2040	8.00	9.73	8.83	7.56	6.47
2100	7.97	9.71	8.76	7.58	6.45
2160	7.97	9.72	8.82	7.57	6.50
2220	8.02	9.70	8.83	7.60	6.50
2280	7.95	9.72	8.76	7.57	6.41
2340	7.92	9.73	8.78	7.55	6.41
2400	7.93	9.71	8.77	7.56	6.41
2460	7.92	9.72	8.77	7.77	6.40
2520	7.95	9.72	8.77	7.56	6.40
2580	7.93	9.73	8.77	7.57	6.40
2640	7.93	9.73	8.78	7.56	6.39
2700	7.95	9.71	8.78	7.56	6.39
2760	7.97	9.72	8.84	7.56	6.44
2820	7.97	9.72	8.83	7.56	6.44
2880	8.00	9.76	8.83	7.60	6.47
2940	7.97	9.74	8.85	7.60	6.49
3000	7.95	9.73	8.90	7.60	6.45
3060	7.98	9.78	8.84	7.75	6.48
3120	7.98	9.79	8.90	7.62	6.50
3180	7.97	9.68	8.74	7.60	6.42

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above mean sea lev

TABLE I
WATER LEVEL MEASUREMENTS
PAGE 3

MINUTES	WELL NO. 1 (MP=17.38 ft.)	WELL NO. 2 (MP=20.41 ft.)	WELL NO. 3 (MP=19.60 ft.)	WELL NO. 4 (MP=17.98 ft.)	WELL NO. 5 (MP=17.27 ft.)
3240	7.98	9.71	8.77	7.66	6.47
3300	8.05	9.70	8.82	7.74	6.44
3360	8.00	9.75	8.79	7.64	6.46
3420	8.05	9.79	8.90	7.77	6.60
3480	8.10	9.84	8.96	7.77	6.60
3540	8.09	9.84	8.97	7.80	6.62
3600	8.20	9.86	9.02	7.80	6.66
3660	8.15	9.90	8.95	7.84	6.68
3720	8.07	9.81	8.98	7.80	6.68
3780	8.09	9.80	9.02	7.90	6.68
3840	8.08	9.78	9.05	7.88	6.68
3900	8.01	9.81	9.05	7.89	6.68
3960	8.01	9.98	9.03	7.89	6.69
4020	8.04	10.00	9.03	7.89	6.68
4080	8.02	9.82	8.83	7.71	6.47
4140	8.01	9.74	8.85	7.63	6.48
4200	8.00	9.72	8.84	7.67	6.47
4260	8.03	9.78	8.86	7.69	6.53
4320	8.02	9.78	8.83	7.67	6.47
		PUMPING STOPPED-RECOVERY WATER LEVEL MEASUREMENTS			
4355	8.02	9.85	8.83	7.70	6.37
4356	6.87	9.83	8.64	7.71	6.33
4357	7.07	9.76	8.55	7.71	6.33
4358	7.07	9.77	8.56	7.68	6.31
4359	7.17	9.80	8.46	7.68	6.30
4360	7.17	9.84	8.47	7.66	6.28
4361	7.12	9.77	8.42	7.68	6.31
4362	7.12	9.75	8.50	7.66	6.28
4363	7.12	9.78	8.49	7.66	6.23
4364	7.12	9.81	8.47	7.68	6.23
4365	7.12	9.84	8.45	7.67	6.26
4366		9.83	8.52	7.65	6.28
4367		9.82	8.52	7.65	6.28
4368		9.79	8.53	7.66	6.26
4369		9.78	8.51	7.63	6.28
4370		9.84	8.50	7.65	6.28
4371		9.79	8.48	7.67	6.26
4372	7.12	9.75	8.47	7.66	6.26
4373		9.79	8.53	7.66	6.30
4374		9.77	8.50	7.67	6.26
4375		9.79	8.47	7.65	6.27
4380		9.79	8.42	7.65	6.25
4385	7.08	9.79	8.50	7.65	6.26
4390		9.80	8.46	7.65	6.26
4395	7.03	9.77	8.43	7.65	6.22
4400	7.01	9.78	8.46	7.65	6.21

(MP=Measuring Point
above mean sea lev

TABLE I
WATER LEVEL MEASUREMENTS
PAGE 4

MINUTES	WELL NO. 1 (MP=17.38 ft.)	WELL NO. 2 (MP=20.41 ft.)	WELL NO. 3 (MP=19.60 ft.)	WELL NO. 4 (MP=17.98 ft.)	WELL NO. 5 (MP=17.27 ft.)
4405	6.99	9.80	8.33	7.65	6.20
4415	7.02	9.79	8.47	7.65	6.22
4425	7.03	9.77	8.46	7.65	6.23
4435	7.03	9.77	8.45	7.65	6.23
4445	7.01	9.72	8.42	7.65	6.20
4455	6.97	9.77	8.42	7.65	6.19
4475	7.04	9.78	8.46	7.65	6.23
4495	6.97	9.80	8.43	7.65	6.19
4515	6.99	9.78	8.48	7.65	6.24
4535		7.75	8.31	7.65	6.21
4555					
4575					
4595	6.50	9.75	8.33	7.65	6.24
4615	6.50	9.75	8.36	7.65	6.22
4635	6.50	9.75	8.35	7.65	6.23
4955		9.66	8.35	7.64	6.12