HYDROGEOLOGIC ASSESSMENT OF THE ELEVATED URANIUM AND NITRATE CONCENTRATIONS IN MONITOR WELL FTP-2A

SEQUOYAH FACILITY
SEQUOYAH FUELS CORPORATION
GORE, OKLAHOMA

Prepared By:

Roy K. Widmann
Senior Hydrologist
Engineering Services Division
Hydrology Section
Kerr-McGee Corporation

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License Condition 14
License: SUB-1010
Docket: 40-8027

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HYDROGEOLOGIC ASSESSMENT OF THE ELEVATED URANIUM AND NITRATE CONCENTRATIONS IN MONITOR WELL FTP-2A

INTRODUCTION

The Nuclear Regulatory Commission renewal of the Sequyah Fuels Corporation (SFC) License SUB-1010 on September 20, 1985, included the following condition related to groundwater:

> Condition 14: The licensee shall investigate and verify that the elevated uranium and nitrate concentrations found in Well FTP-2A are not the result of the liquid seepage from Ponds 3 and 4. A report of the investigation shall be submitted to NRC within 6 months from the date of renewal of the license.

This report fulfills the Condition 14 requirement and was prepared by the Hydrology Department of Kerr-McGee Corporation. The report is based upon a thorough review of historical monitor well records and field investigations which included a geophysical (electromagnetic) survey and the installation of three new monitor wells in close proximity to well FTP-2A. Some additional related information was submitted previously to NRC (Kerr-McGee Corporation, 1986) in the report fulfilling License Condition 12.

These studies indicate the elevated uranium and nitrate concentrations in well FTP-2A were not due to seepage from the treated raffinate ponds. The elevated concentrations were caused by improper sealing of the well, which allowed treated raffinate solution applied as fertilizer and commercial phosphate fertilizer to

impact this well. Properly installed monitor wells located nearby have background levels of uranium and nitrate. Detailed hydrogeologic studies have shown no evidence of pond leakage. Consequently, SFC plans to plug and abandon three of the four existing wells, with one well retained as a part of the quarterly monitoring program for the treated raffinate storage ponds.

BACKGROUND

An amendment of source material license SUB-1010, approved by the NRC on May 4, 1977, authorized the test application of treated raffinate solution as nitrogen fertilizer on approximately 160 acres of Sequoyah Fuels owned land (Figure 1). Treated raffinate is a dilute, neutral pH ammonium-nitrate solution, produced as a byproduct during the conversion of uranium yellowcake to uranium hexafluoride. In conjunction with the treated raffinate application, five monitor wells (FTP-1 through FTP-5) were installed in the 160 acre area in June 1977 to monitor potential impacts to the shallow groundwater system. Monitor well FTP-2 showed no significant nitrate concentration until April 1978 when an abrupt increase occurred. The concentration returned to background by July 1978; however, this occurrence appeared to indicate contamination.

Upon detailed evaluation, well FTP-2 was found to have been constructed without a well seal (Appendix A). The rapid nitrate increase was concluded to have resulted from the infiltration of runoff down the improperly sealed well bore, rather than from an over-application of the ammonium-nitrate fertilizer. Monitor well FTP-2A was therefore installed in August 1978 to replace FTP-2.

For seven consecutive months after installation, well FTP-2A water quality data showed background nitrate concentrations (Figure 2 and Table 1), indicating the treated-raffinate spreading had no impacts to the shallow groundwater system in the test application area. However, nitrate levels rose abruptly in March 1979 (Figure 2 and Table 1), followed by an abrupt increase in uranium levels in April 1979. The uranium levels have exhibited an overall general decline since 1980. The nitrate concentrations decreased gradually to background levels by early 1980, but showed a gradual increase beginning in 1982.

Treated raffinate storage ponds 3E and 3W were constructed on land within the 160 acre test application area in late 1978, but did not receive fluid until January 1979. The ponds were constructed with a minimum of 2 feet of a compacted clay base, above which was installed a leak detection system and an impermeable synthetic Hypalon liner (see the report to the NRC on License Condition 12, "Hydrogeologic Assessment and Groundwater Monitoring Plan for the Treated Raffinate Pond Area," January 20, 1986).

ELECTROMAGNETIC SURVEY

An electromagnetic (EM) survey was conducted in October 1985 in the treated raffinate pond and FTP-2A monitor well area to characterize the sub-surface hydrology and geology. A detailed description of the survey was contained in the January 20, 1986 License Condition 12 report to the NRC (Kerr-McGee Corporation, 1986).

The ground conductivity data from the October 1985 electromagnetic survey are interpreted in Figure 3. In the well FTP-2A area, the iso-conductivity lines are

smooth and regular and do not exhibit a plume-shaped configuration. This contour pattern indicates no evidence of pond leakage and plume migration which could affect the well water quality.

NEARBY MONITOR WELL DATA

Sequoyah Fuels Corporation installed three new monitor wells near well FTP-2A (Figure 4) in November 1985 to investigate any areal distribution of nitrate and uranium levels in the groundwater. Monitor wells FTP-2B, FTP-2C and FTP-2D were installed using an air-rotary drilling rig and were located 55 feet north, 50 feet south, and 24 feet west (respectively) from well FTP-2A (well logs are contained in Appendix A). These new wells, together with well FTP-2A, were sampled in November 1985. The analytical results of these samples are presented in Table 2 and interpreted below.

Nitrate Data:

The data in Table 2 clearly show the elevated nitrate concentration in well FTP-2A is localized. There is no widespread areal impact to the shallow aquifer in the study area from either the treated raffinate application program or from the lined ponds. Water quality in FTP-2A is a very localized phenomenon and is totally unlike that of the three newer wells.

Uranium Data:

Well FTP-2A has exhibited uranium concentrations upwards of 5.0 mg/l (January, April, June, July 1980), yet the treated raffinate stored in the lined ponds for controlled land application has a typical uranium concentration of < 0.16 mg/l. The average uranium concentration in treated raffinate produced from 1977

through 1979 was 0.083, 0.153 and 0.044 mg/l. Data from 1980 through 1984 show average uranium concentrations in the raffinate to be 0.045, 0.013, 0.020, 0.040 and 0.033 mg/l. Therefore, the elevated uranium concentration in well FTP-2A cannot be attributed to the raffinate application program or pond leakage.

General Well Water Chemistry:

The difference in water chemistry of all these wells confirms that well FTP-2A is anomalous and does not reflect the aquifer area water chemistry.

POTENTIOMETRIC SURFACE IN THE WELL FTP-2A AREA

The numerous monitor wells in the treated raffinate pond area have allowed construction of an area potentiometric surface. The potentiometric surface map shown in figure 5 was constructed from water levels of December 4, 1985. The data clearly show a smooth groundwater flow direction that is west-southwesterly beneath the eastern pond area, with a gentle turn toward the west-northwesterly direction beneath pond 5. A gradient of about 0.02 is fairly constant across the site, with no water level anomalies evident which would indicate any localized flow character or pond leakage.

EXPLANATIONS OF WELL FTP-2A ANOMALOUS CONCENTRATIONS

The information in this report and in the Condition 12 report submitted on January 20, 1986 shows the elevated nitrate and uranium levels in well FTP-2A are not the result of treated raffinate pond leakage. Based upon a thorough review of historical records and the current data, the conclusion is that the elevated levels in well FTP-2A are due to localized impacts. The probable sources and routes of entry are discussed below.

Figure 6 shows nitrate and uranium concentrations and water level data with time for wells FTP-2 and FTP-2A. The peaks labelled 1, 2 and 4 show sharp increases over a very short period of time (two months) and subsequent decreases. This is indicative of direct introduction of material into the monitor well. Such spikes would not occur as a result of aquifer contamination, but would only occur by a "short circuited" pathway in which a contaminant was introduced and quickly detected.

In the case of peak #1, well FTP-2 was contaminated from the application of treated raffinate because the well did not contain a surface seal. The gravel pack from the surface to total well depth created a pathway by which surface runoff or treated raffinate fertilizer entered the well. Likewise, the sudden spike in nitrate concentration in 1979 in well FTP-2A (peak #2) indicates local entry of nitrate. Although well FTP-2A had been installed as a replacement well for FTP-2 and had a surface casing, the inside well casing was gravel packed from total depth to the surface. This manner of completion provided a direct routh for material from the surface to enter the well. (See Appendix A for a completion diagram of well FTP-2A).

Peak #4, for uranium, is as sudden as peaks #1 and #2 for nitrate, and therefore also indicates direct contamination of the well. The uranium concentration aproaches 5 mg/l. Treated raffinate could not be the cause of this peak, because the average yearly uranium concentrations of treated raffinate applied to the land from 1977 through 1979 were 0.083, 0.153 and 0.044 mg/l. However, the 1979 Completion Report (Kerr-McGee Corporation, 1979) shows that a pelletized commercial phosphate fertilizer applied to the land during that year contained 227

ppm uranium. A very small amount of phosphate introduced inadvertently into the exposed gravel-packed area of the well, followed by rainfall, would easily account for the nearly 5 mg/l uranium found in the well. Since that time, only uranium-free commercial phosphate fertilizer has been applied to the land treated acreages. This accounts for the steady decline of uranium concentration toward background levels for the past several years.

That the phosphate fertilizer probably migrated down through the gravel pack of the FTP-2A well casing is supported by the similarity of the well water chemistry with that expected for surface water runoff from fertilized agricultural lands. The local entry from the surface is also the reason why the water chemistry of FTP-2A is significantly different from that of the three newer wells (see Table 2). The water quality of well FTP-2A reflects the application of fertilizers and nutrients in the area and is not representative of aquifer quality.

Peak #3 shows the nitrate level increased gradually over a period of about three years and in 1983 began a slow but consistent decline. The pattern suggests a slight impact to the near surface groundwater and probably reflects the high rate of ammonium-nitrate application (1000 lbs. nitrogen/acre) in 1977 (Kerr-McGee Corporation, 1978). The excess nitrate was able to migrate below the root zone without being taken up by vegetation. Once below this zone, the nitrate would migrate with infiltrating rainwater to a depth where well FTP-2A was impacted. Treated raffinate fertilizer solution application has been discontinued in this area.

SUMMARY AND CONCLUSIONS

The investigation of the elevated uranium and nitrate concentrations in fertilizer test plot well FTP-2A shows the following:

1. Nitrate concentration in the original FTP-2 well began to rise one year before the introduction of ammonium-nitrate solution into nearby holding ponds 3E and 3W. The increase was due to direct introduction of surface runoff carrying ammonium-nitrate solution down the outside of the well casing and is not the result of pond leakage.

2. Replacement well FTP-2A showed several months of background nitrate concentation before exhibiting a sharp increase. The increase was also due to direct introduction of amonium-nitrate fertilizer solution. Well completion information shows a cemented surface casing to be present, but a gravel pack still exists from the surface to total depth on the outside of the inner well casing.

3. Increasing nitrate concentration in well FTP-2A from 1982-84 is a remnant effect of the over-application of treated raffinate in 1977.

4. A uranium spike in concentration in well FTP-2A in late 1979 is the result of applying commercial pelletized phosphate fertilizer, which contained 227 ppm uranium. The treated raffinate contains less than 0.16 mg/l uranium.

5. An electromagnetic survey in the FTP-2A well areas shows no evidence of pond leakage and therefore no plume movement toward the well.

6. An area potentiometric surface map shows no evidence of pond leakage or preferential groundwater flow direction toward well FTP-2A.

7. Three newly installed monitor wells adjacent to well FTP-2A show background uranium and nitrate concentrations and no evidence of aquifer contamination.

8. The water chemistry of well FTP-2A reflects the chemical characteristics of commercial fertilizer and other nutrients in the area rather than any pond leakage.

RECOMMENDATION

Based upon the results of this study, monitor wells FTP-2A, FTP-2C and FTP-2D should be properly plugged with a cement/bentonite grout and abandoned. Monitor well FTP-2B should be incorporated into the quarterly monitoring program for the treated raffinate storage ponds.

REFERENCES

Kerr-McGee Corporation, 1986, Hydrogeologic assessment and groundwater monitoring plan for the treated raffinate pond area, Sequoyah Fuels Corporation, Gore, Oklahoma, (report submitted to Nuclear Regulatory Commission on January 20, 1986).

Kerr-McGee Corporation, 1979 Completion report - raffinate program, license SUB-1010, amendment no. 4 (annual report on raffinate spreading program at Sequoyah Facility, submitted to Nuclear Regulatory Commission on April 15, 1980).

Kerr-McGee Corporation, 1978 Completion report - raffinate program, license SUB-1010, amendment no. 9 (annual report on raffinate spreading at Sequoyah Facility, submitted to Nuclear Regulatory Commission on March 2, 1979).

Kerr-McGee Corporation, 1977 Completion report - raffinate program, license SUB-1010, amendment no. 8 (annual report on raffinate spreading at Sequoyah Facility, submitted to Nuclear Regulatory Commission on April 17, 1978).

Kerr-McGee Corporation, November 1977 report - raffinate program, license SUB-1010, amendment no. 8 (preliminary report on raffinate spreading at Sequoyah Facility, submitted to Nuclear Regulatory Commission on November 30, 1977).

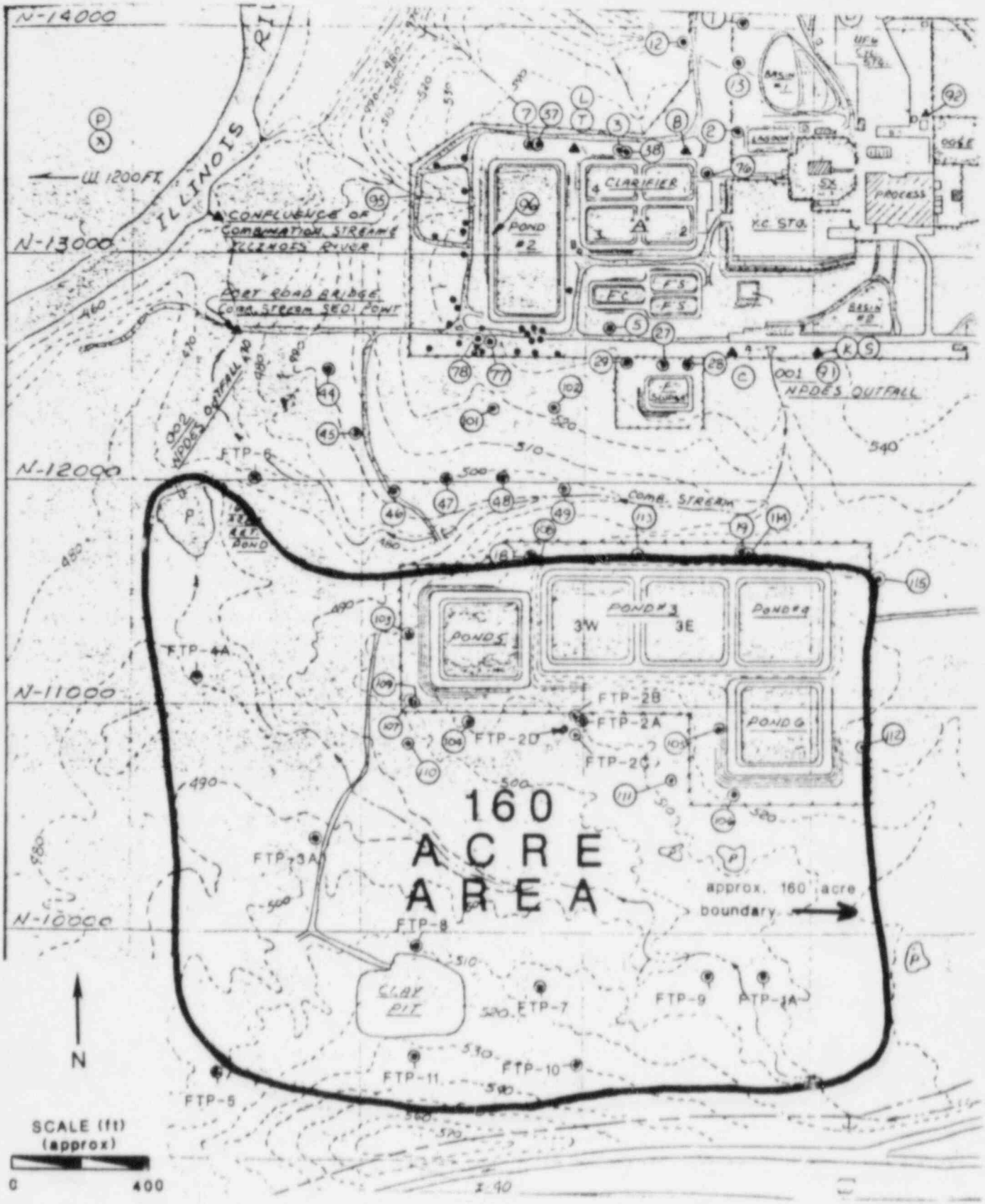


Figure 1: Sequoyah Fuels Corporation Site Gore, Oklahoma

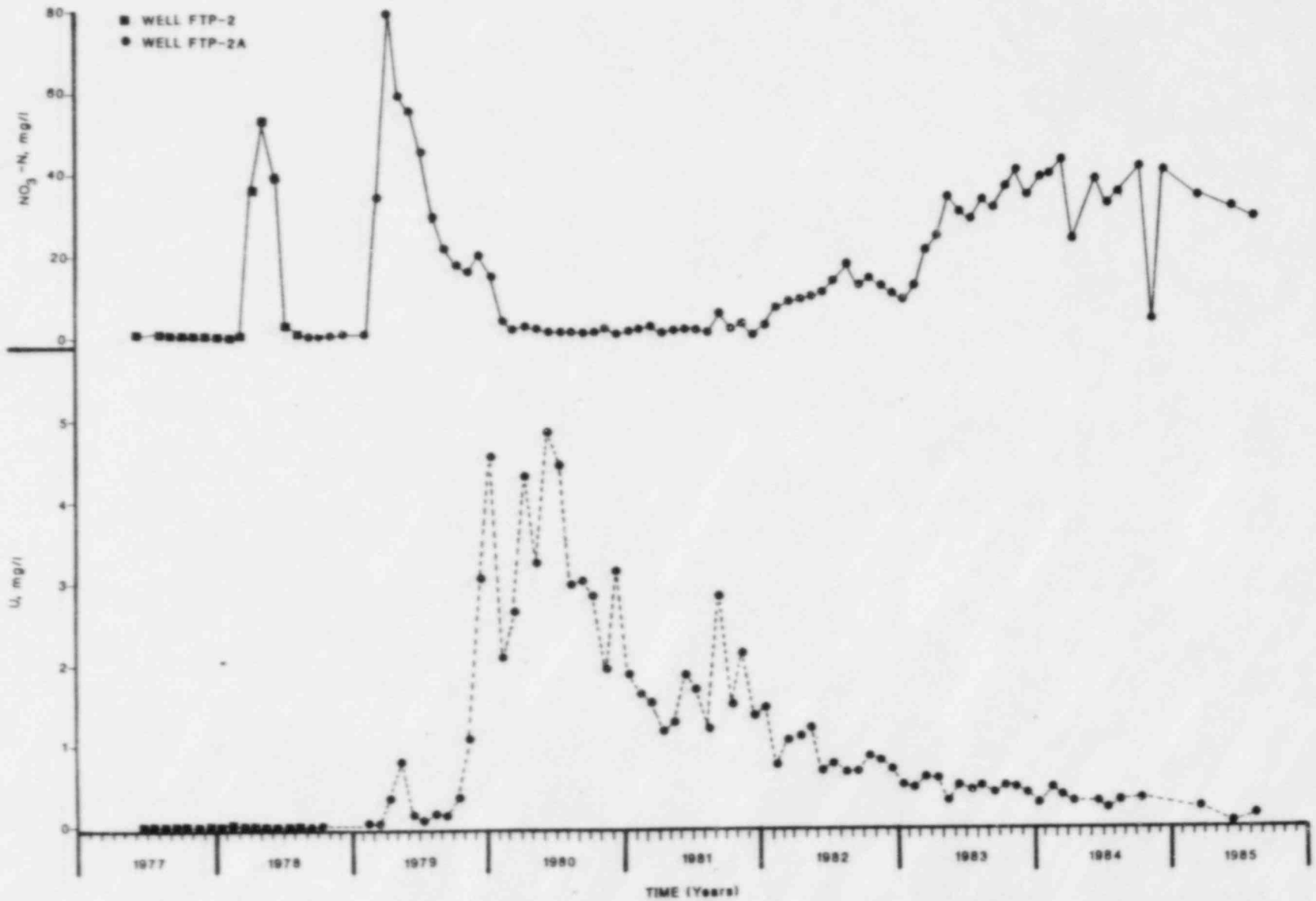


FIGURE 2 PLOT OF NITRATE AND URANIUM DATA VERSUS TIME FOR MONITOR WELL FTP-2A

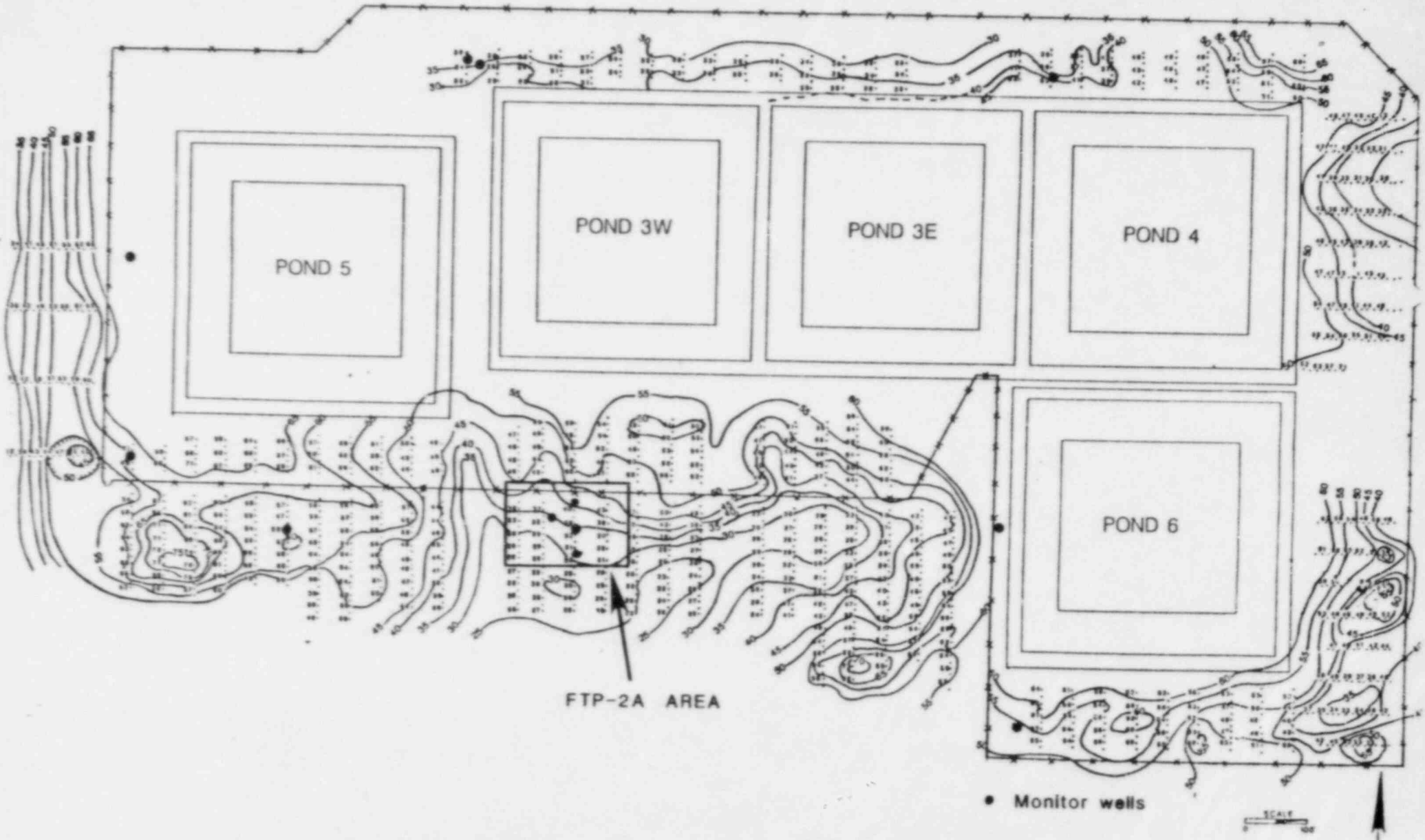


FIGURE 3 CONTOURED DATA FROM THE ELECTROMAGNETIC SURVEY OF OCTOBER 1985

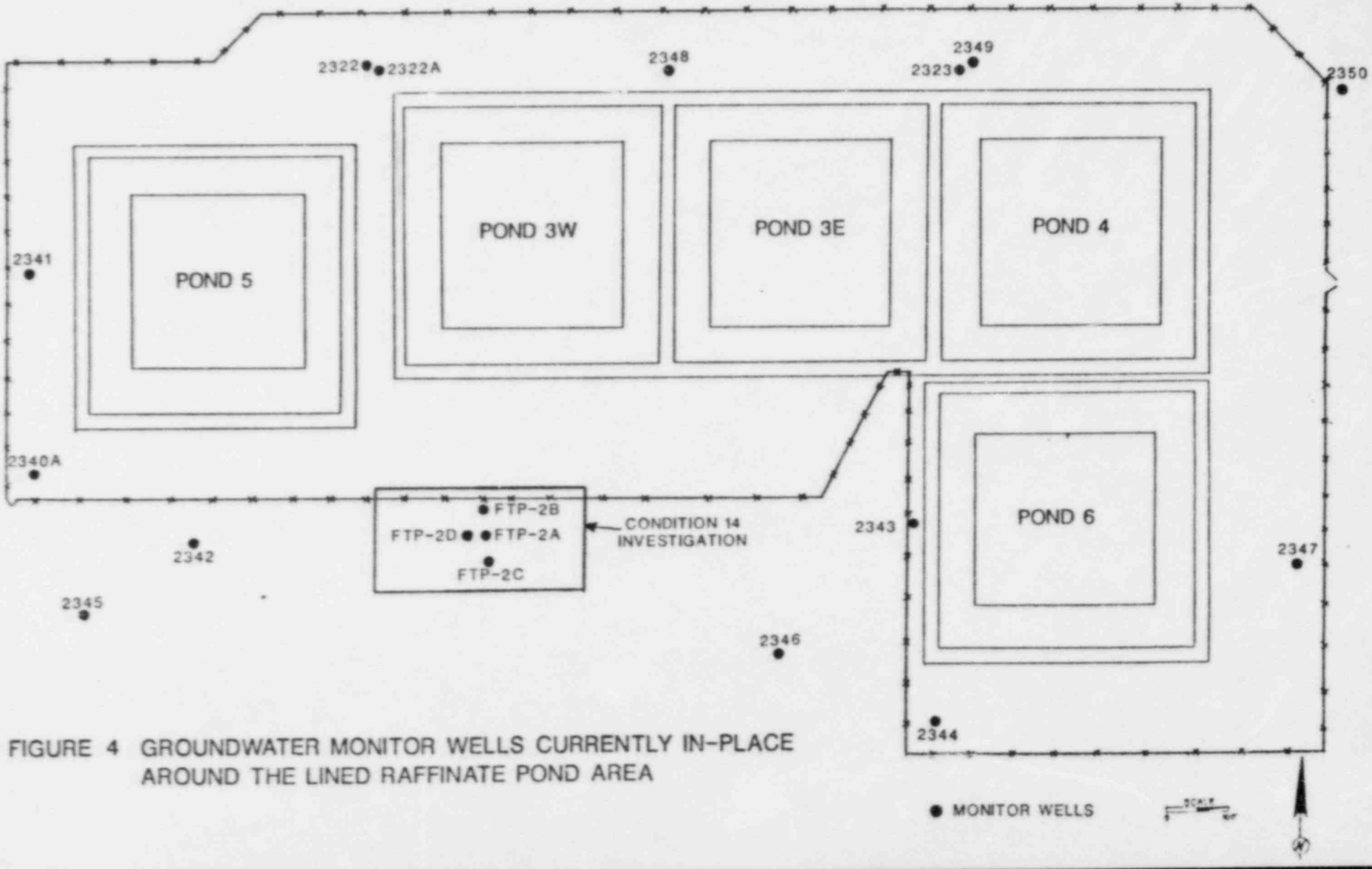


FIGURE 4 GROUNDWATER MONITOR WELLS CURRENTLY IN-PLACE AROUND THE LINED RAFFINATE POND AREA

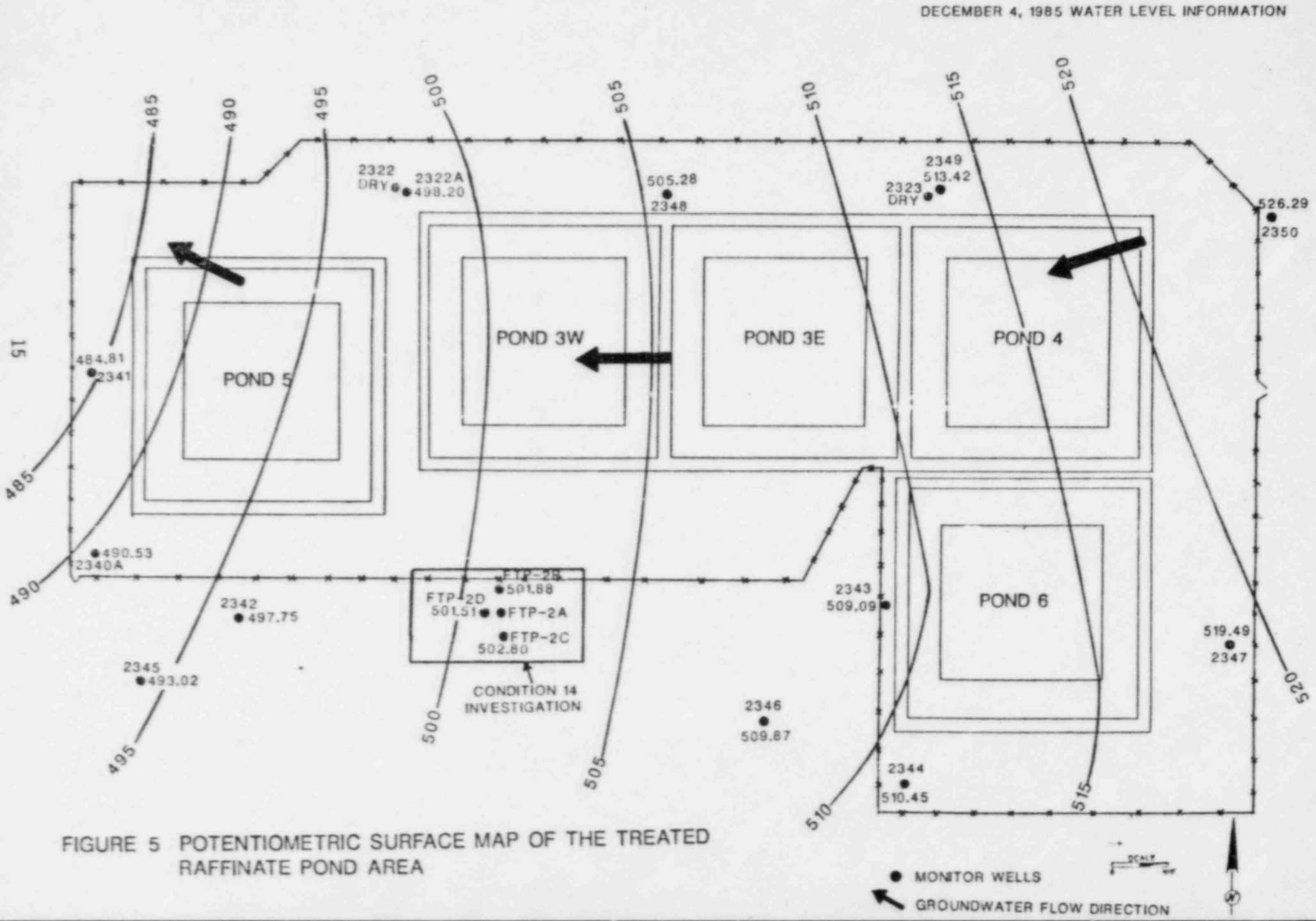


FIGURE 5 POTENTIOMETRIC SURFACE MAP OF THE TREATED RAFFINATE POND AREA

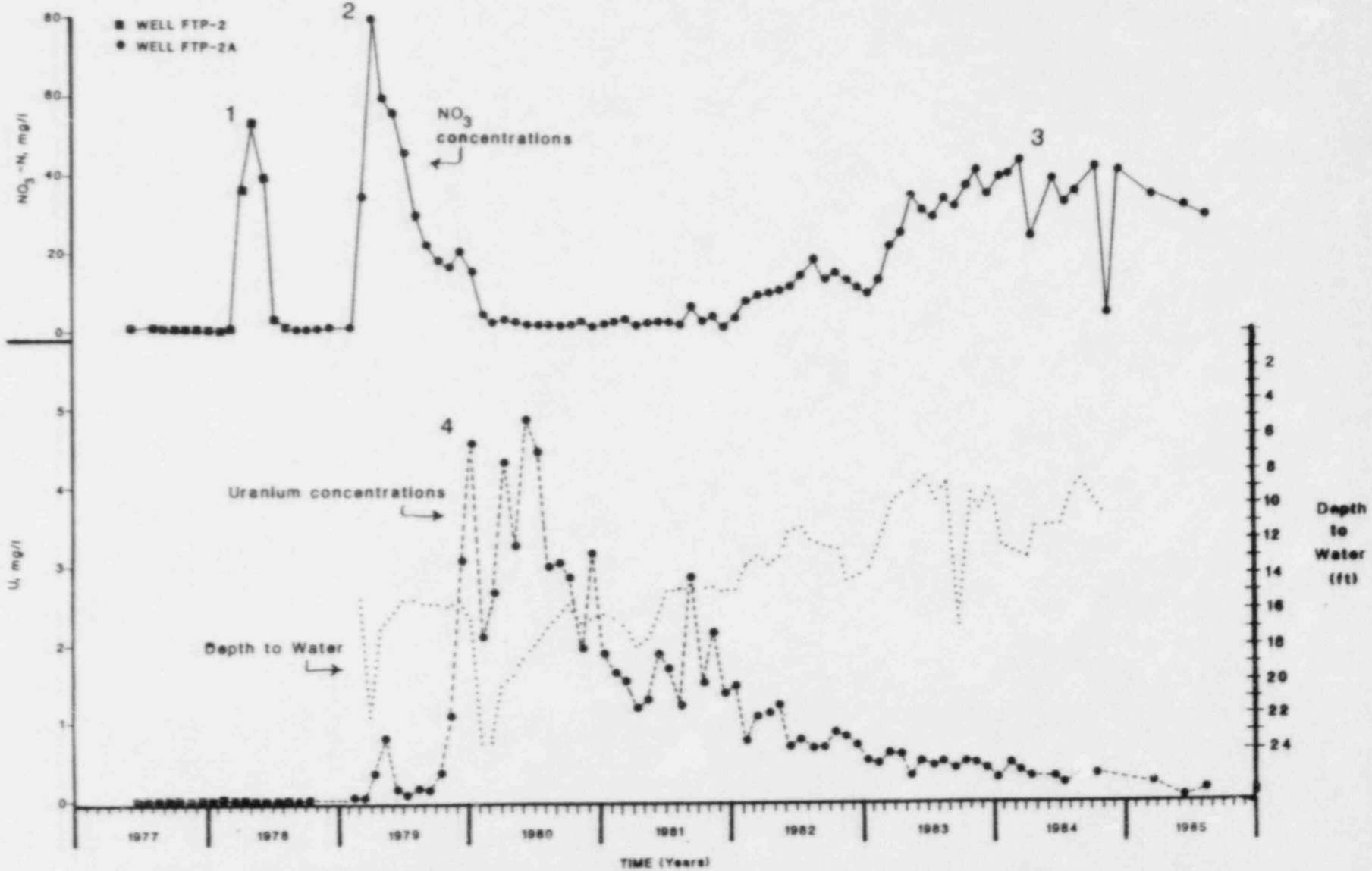


FIGURE 6 PLOT OF NITRATE, URANIUM AND WATER LEVEL DATA VERSUS TIME FOR MONITOR WELL FTP-2A

TABLE 1. HISTORICAL WATER QUALITY DATA
FOR FERTILIZER TEST PLOT WELLS
FTP-2 AND FTP-2A

NO_3-N (mg/l)

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
FTP-2												
1977	-	-	-	-	-	1.0	-	0.4	0.6	0.7	0.5	0.5
78	0.4	0.4	1.2	36	53	39	2.8	1.0	-	-	-	-
FTP-2A												
1978	-	-	-	-	-	-	-	<0.2	<0.1	0.2	0.8	1.0
79	-	0.8	34	79	59	55	45	29	22	18	16	20.5
80	15	4	20	2.4	2.0	1.4	1.4	1.2	1.0	1.2	2.08	0.7
81	1.5	1.9	2.7	1.0	1.7	2	1.6	0.9	5.5	2.0	3.0	0.2
82	2.4	6.8	8.5	9.0	9.5	10.5	13.0	17.5	12	14	12	10.5
83	8.5	12	21	24	34	30	28	33	31	36	40	34
84	38	39	43	23	-	38	32	35	-	41	3.7	40
85	-	-	34	-	-	31	-	29	-	-	28	-

U (mg/l)

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
FTP-2												
1977	-	-	-	-	-	0.019	-	0.010	0.017	0.013	0.008	0.007
78	0.014	0.044	0.010	0.029	0.018	0.015	0.010	0.004	-	-	-	-
FTP-2A												
1978	-	-	-	-	-	-	-	0.008	<0.002	0.010	-	-
79	-	0.043	0.029	0.340	0.782	0.151	0.083	0.167	0.134	0.355	1.076	3.076
80	4.550	2.009	2.640	4.310	3.230	4.846	4.451	2.985	3.086	2.834	1.911	3.134
81	1.859	1.613	1.516	1.175	1.272	1.859	1.663	1.174	2.839	1.467	2.103	1.321
82	1.417	0.707	1.025	1.071	1.173	0.641	0.756	0.638	0.630	0.853	0.786	0.661
83	0.462	0.446	0.581	0.561	0.287	0.461	0.411	0.431	0.373	0.442	0.441	0.375
84	0.250	0.419	0.344	0.283	-	0.283	0.198	0.295	-	0.304	-	-
85	-	-	0.207	-	-	<0.005	-	0.109	-	-	0.013	-

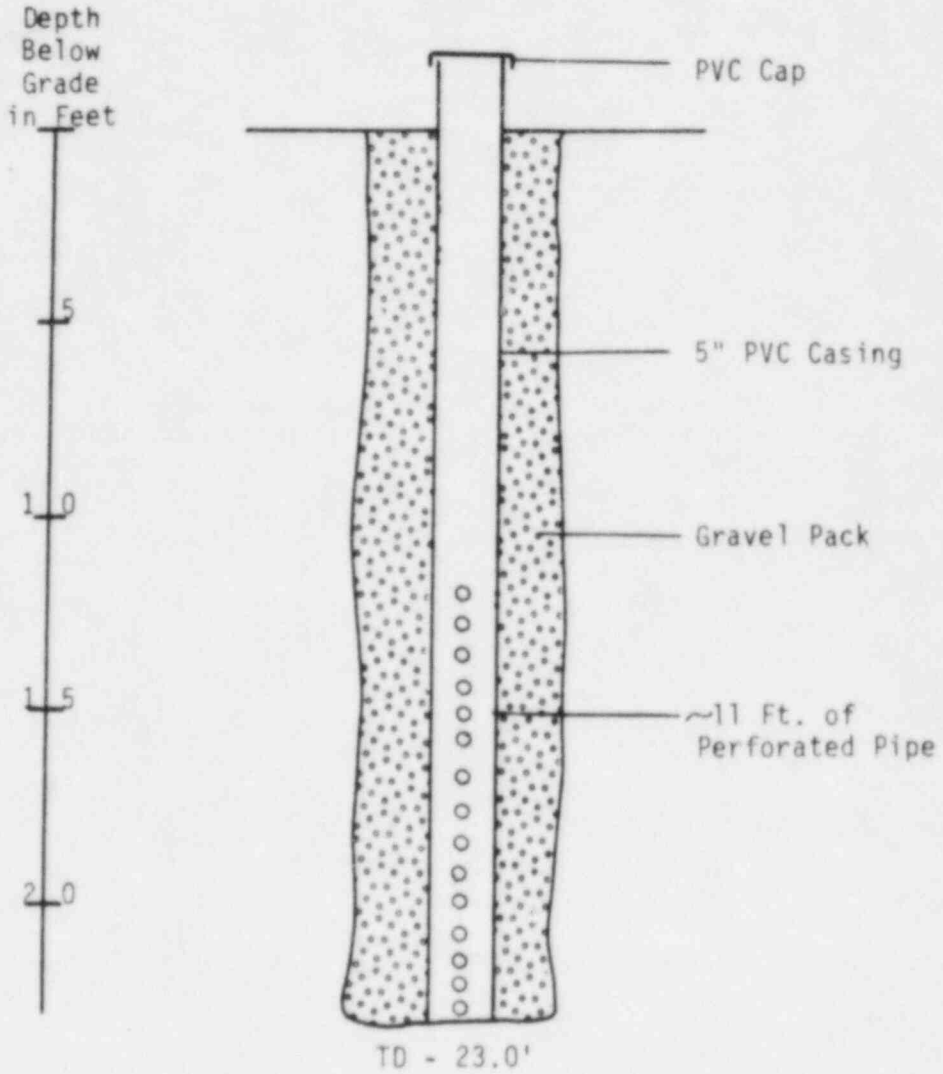
TABLE 2. RECENT WATER QUALITY DATA
FROM FERTILIZER TEST PLOT WELL FTP-2A
AND SURROUNDING NEW WELLS

Well	Date Sampled	Conductivity (μmhos/cm)	pH	NO_3-N (mg/l)	SO_4 (mg/l)	U (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Ca (mg/l)
FTP-2A	11-26-85	1870	7.7	28	580	0.013	53	200	10.0	127
FTP-2B	11-26-85	2880	8.0	2	980	0.010	24	490	2.9	65
FTP-2C	11-26-85	2400	8.0	1	900	0.007	26	430	2.5	70
FTP-2D	11-26-85	2520	7.9	2	900	0.011	27	460	2.5	74

APPENDIX A

WELL COMPLETION DIAGRAMS

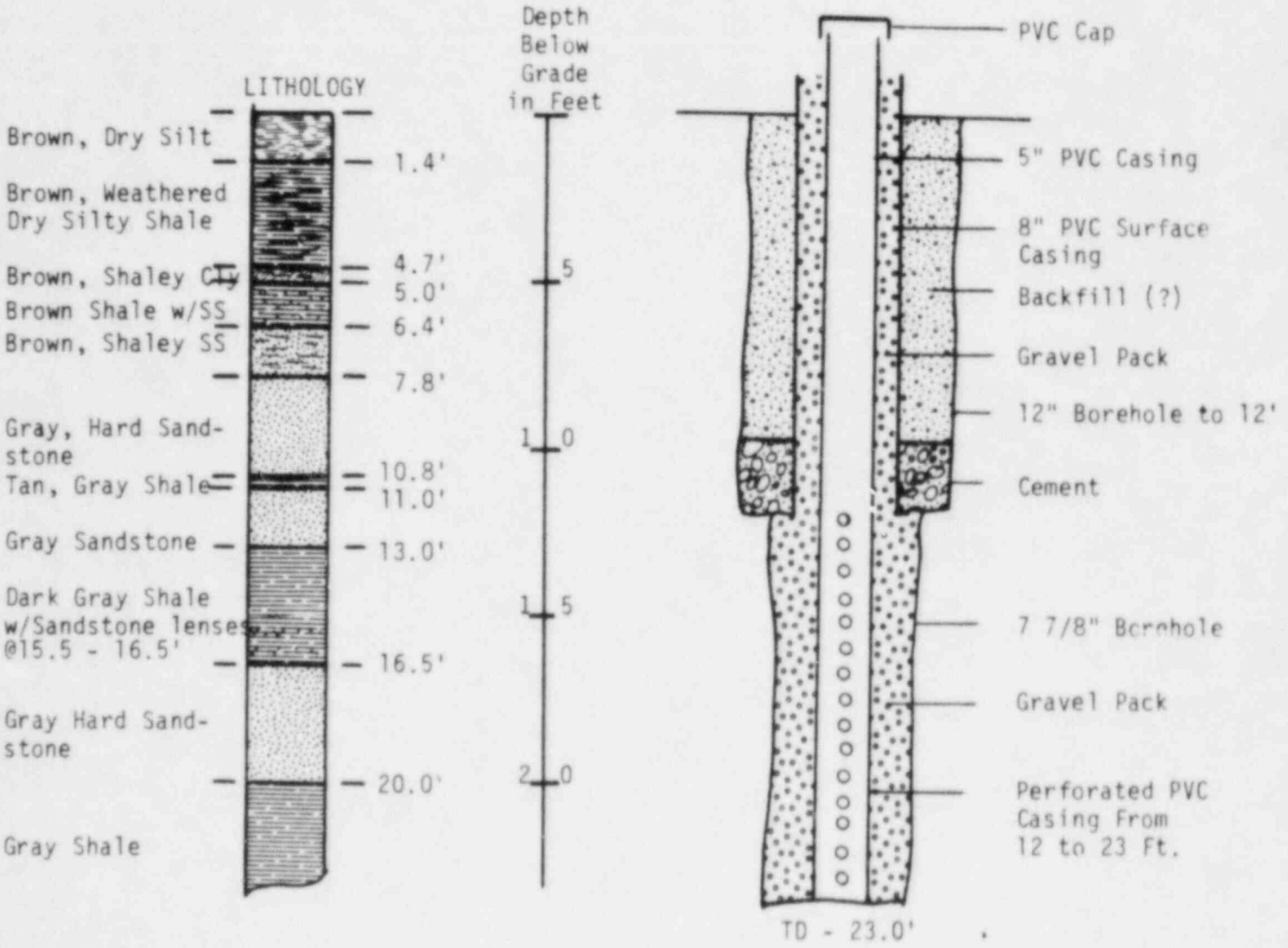
MONITOR WELL FTP-2
SOUTH OF POND 3
SEQUOYAH FUELS CORPORATION
GORE, OK



Well Installed: 6-77

Well Completion Diagram Constructed After Oral Communications With Facility Personnel

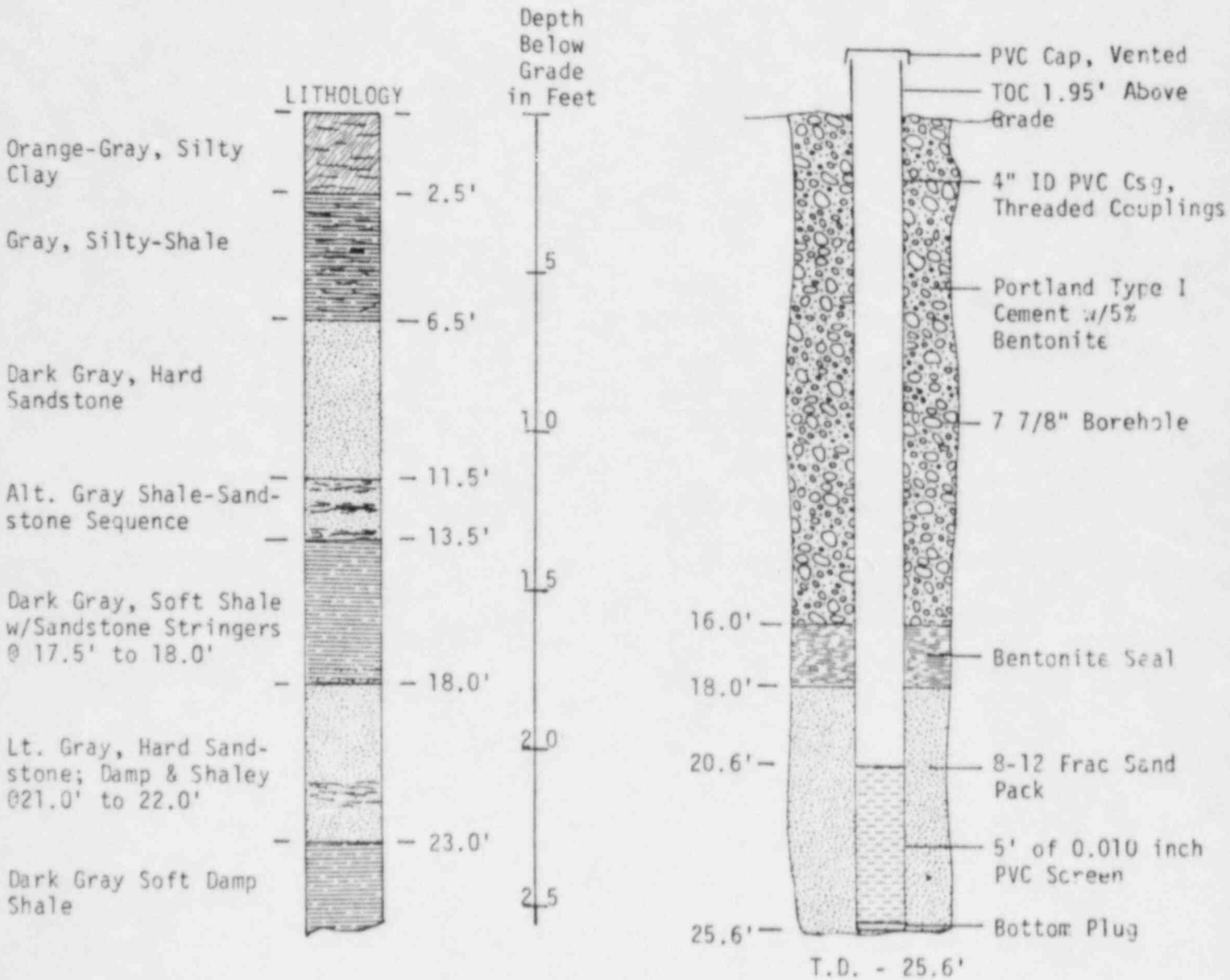
MONITOR WELL FTP-2A
SOUTH OF POND 3
SEQUOYAH FUELS CORPORATION
GORE, OK



Well Installed: 8-10-78 by Hemphill Corporation

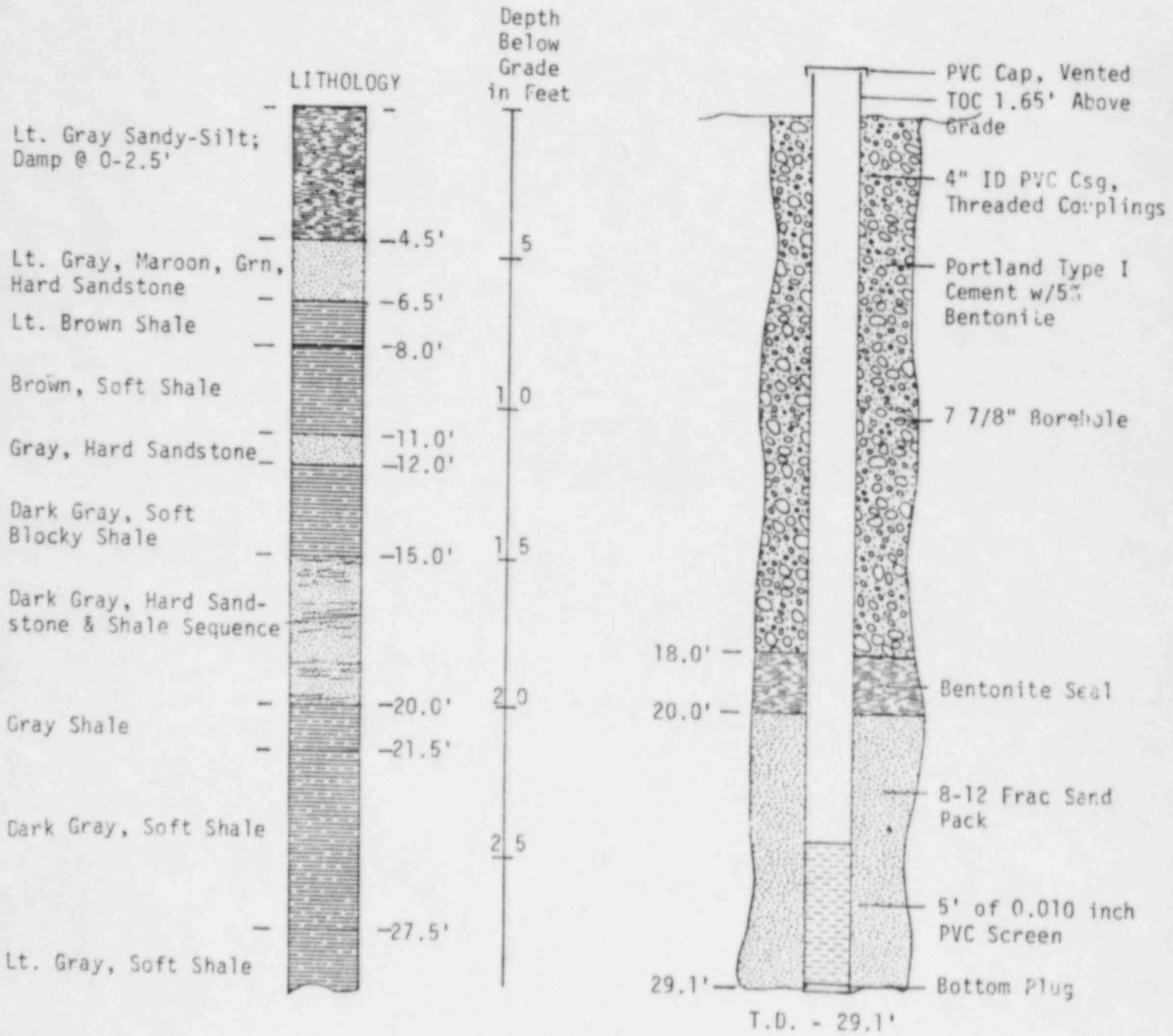
Well Completion Diagram Constructed From Driller's Notes and Log

MONITOR WELL FTP-2B
SOUTH OF POND 3
SEQUOYAH FUELS CORPORATION
GORE, OK



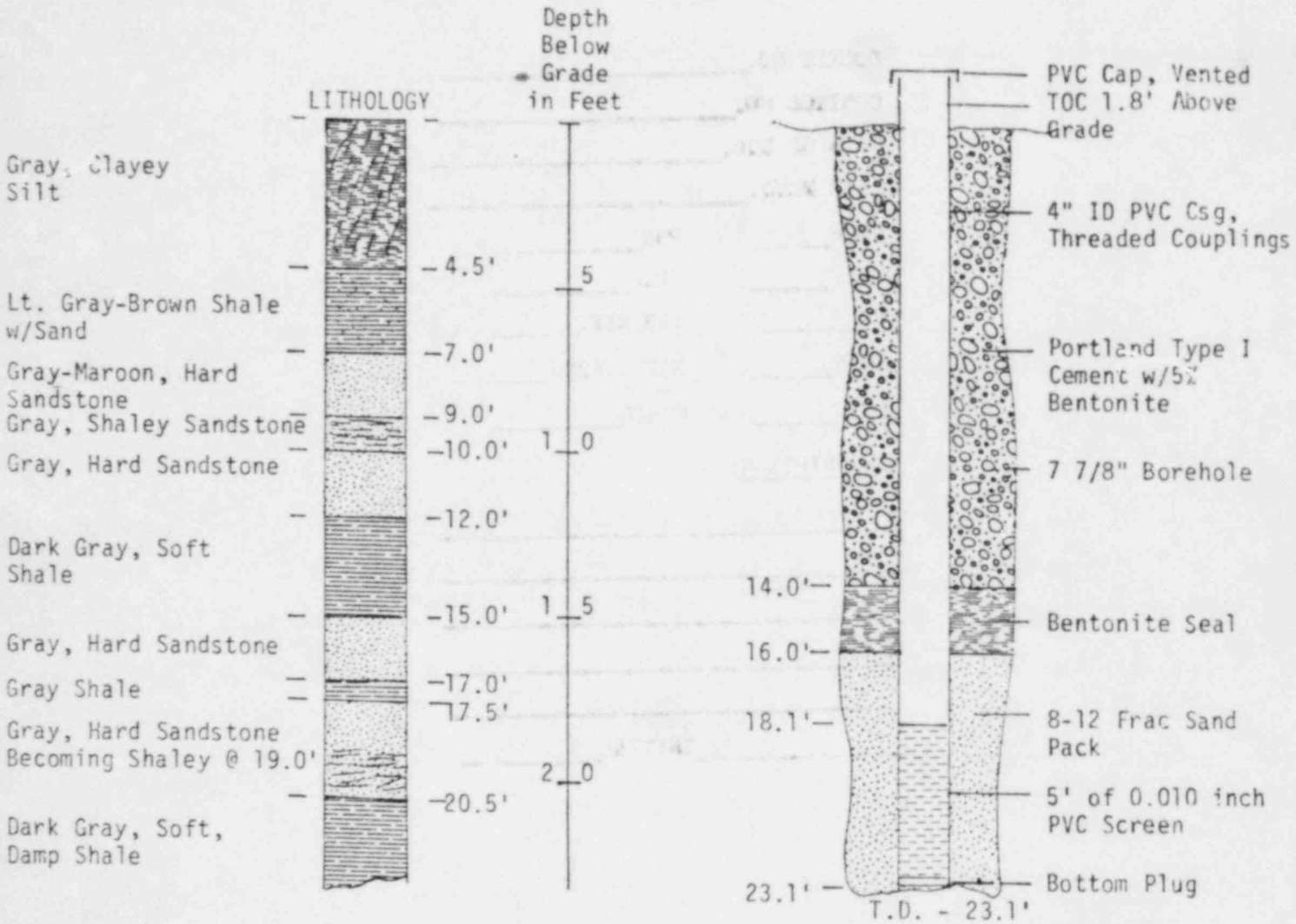
Well Installed: 11-11-85 by Jim Winnek, Inc.

MONITOR WELL FTP-2C
SOUTH OF POND 3
SEQUOYAH FUELS CORPORATION
GORE, OK



Well Installed: 11-11-85 by Jim Winnek, Inc

MONITOR WELL FTP-2D
SOUTH OF POND 3
SEQUOYAH FUELS CORPORATION
GORE, OK



Well Installed: 11-11-85 by Jim Winnek, Inc.

DOCKET NO. 40-8027

CONTROL NO. 26680

DATE OF DOC. 03/20/86

DATE RCVD. 03/25/86

FCUF ✓	PDR ✓
FCAF	LPDR ✓
WM	I&E REF. ✓
WMUR	SAFEGUARDS
FCTC	OTHER

DESCRIPTION:

attached for NRC's review is their report in response to license condition 14

03/27/86 INITIAL CEC