

HYDROGEOLOGIC ASSESSMENT AND  
GROUNDWATER MONITORING PLAN  
FOR THE TREATED RAFFINATE POND AREA

SEQUOYAH FUELS CORPORATION  
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## EXECUTIVE SUMMARY

Condition No. 12 for Sequoyah Fuels Corporation's Nuclear Regulatory Commission License No. SUB-1010 provides that:

Within 3 months of the renewal of this license, the licensee shall reevaluate the existing groundwater conditions in the area of the treated raffinate storage ponds and prepare and submit for NRC review a report which describes these conditions and either justifies the current monitoring program or proposes a new program for groundwater monitoring.<sup>(1)</sup>

Five lined ponds for the storage of treated raffinate have been constructed in the subject area since 1979. The last two ponds were completed in 1985. Each pond was constructed on a hard, dense sandstone base on which two feet of compacted clay were placed. A leak detection/collection system consisting of perforated pipe in a sand/gravel layer has been installed above the clay liner in each pond. A Hypalon liner was installed over the sand/gravel leak detection layer.

The License Condition 12 evaluation was designed to provide a comprehensive description of groundwater conditions in the treated raffinate storage pond area and to provide the basic plan for further investigations and monitoring. The evaluation involved reviewing historical data, installing

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<sup>(1)</sup> A license amendment, No. 1, was issued by NRC on December 23, 1985 extending the report due date to January 20, 1986.



new monitor wells, preparing hydrostratigraphic sections and conducting an electromagnetic survey. Groundwater data developed in assessing uranium and nitrate values in a nearby fertilizer test plot monitor well (License Condition 14) were also incorporated where appropriate.

Environmental data submitted in support of the facility license renewal show that some of the shallowest monitor wells in the subject area have been dry when the water table has dropped several feet during periods of drought. This periodic dry monitor well occurrence underlies the Condition 12 directive. To address this concern, ten additional monitor wells were installed at greater depths (7 for Condition 12 and 3 for Condition 14) increasing the total monitoring program in the area to eighteen wells. Installation of six additional wells placed between the ponds is proposed to provide further information about the groundwater conditions.

The current expanded monitoring program and the new data fulfill the License Condition 12 requirements. Additional and ongoing work will further verify the interpretations and conclusions presented in this report.

## CONCLUSIONS

The data developed in the expanded groundwater monitoring program for the treated raffinate pond area lead to the following conclusions:

1. The leak detection/collection system and the expanded monitoring program are sufficient to detect and control any significant leakage from the five lined treated raffinate storage ponds should any develop.
2. The electromagnetic survey of the pond area established an excellent reference condition for future surveys and revealed no pattern which suggests pond leakage to area groundwater. Monitor wells drilled near electromagnetic anomalies showed no evidence of aquifer contamination due to the ponds.
3. Calculations of potential leakage through the Hypalon liner and clay liner show that elevated nitrate values cannot be traced to any occurrence of pond leakage.
4. Any effects of residual nitrate concentrations in the subsurface, due to the earlier experimental fertilizer application program, would not be distinguishable from pond leakage effects except by noting future trends in monitor wells and making periodic electromagnetic surveys.

PROPOSED FURTHER EVALUATION AND  
EXPANDED MONITORING PROGRAM

Based upon this hydrogeologic evaluation, Sequoyah Fuels Corporation will:

1. Continue monitoring of fifteen of the eighteen monitor wells on a quarterly frequency to note trends in nitrate values. (Three closely-spaced wells for Condition 14 may be plugged and abandoned).
2. Conduct electromagnetic survey(s) annually and compare with previous survey data to document notable changes. Any significant anomalies will be investigated by installing new monitor wells.
3. Install six new monitoring wells, 2 each between ponds 3E, 3W and 4, in early 1986, bringing the final monitoring program to a minimum of 21 wells.

HYDROGEOLOGIC ASSESSMENT AND  
GROUNDWATER MONITORING PLAN FOR  
THE TREATED RAFFINATE POND AREA

INTRODUCTION

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

Condition 12: Within 3 months of the renewal of this license, the licensee shall reevaluate the existing groundwater conditions in the area of the treated raffinate storage ponds and prepare and submit for NRC review a report which describes these conditions and either justifies the current monitoring program or proposes a new program for groundwater monitoring.

This report addressing Condition 12 was prepared by Kerr-McGee Corporation's Hydrology Department after (1) a thorough site investigation and review of historical records and (2) field studies which involved a geophysical (electromagnetic) survey and new monitoring well installations. Evaluation of a separate issue, Condition 14, concerning anomalous uranium and nitrate concentrations in an old fertilizer test plot monitor well, is ongoing and will be addressed in a subsequent report. Appropriate information from that effort, such as water level data, has been incorporated in this report.

POND MANAGEMENT PROGRAM

The treated raffinate pond area environmental management program consists of the following:

Use of lined ponds installed upon a compacted low permeability clay base overlying a natural low permeability subsurface foundation.

Construction of ponds with a leak detection/collection system installed between the clay and the Hypalon liner. This assures any leaks will be detected so that repairs can be made. This system also allows for collection of any leakage and return to the pond by pumping, which avoids formation of a source of fluid for leakage through the clay liner.

Use of the previous groundwater monitoring program around the periphery of the ponds to certify the absence of pond leakage and identify potential problems for remedial action.

Use of the proposed expanded groundwater monitoring program to provide greater certainty of the positive containment of the treated raffinate in the ponds and to allow earlier detection and correction of any potential problems.

This tiered program provides effective management of the treated raffinate stored in the ponds.

## SITE GEOLOGY

The Sequoyah Facility is located on a thin Pleistocene terrace deposit which overlies the Atoka formation bedrock. The greatest thickness of terrace material within the facility boundary is about fifteen feet, and in some areas is absent. The terrace material is approximately four feet thick in the area around the treated raffinate ponds. The unconsolidated terrace sediment is composed generally of both well graded and intermixed gravel, silt and clay with scattered chert pebbles. Both the gravel and clay materials of the terrace deposit have been used for facility construction projects.

The terrace deposits are underlain by the Pennsylvania age Atoka formation, an irregularly bedded sandstone, siltstone and shale sequence. Deep site borings show this formation thickness to be upwards of 390 feet. In areas where the soil cover and terrace deposits have been eroded or stripped away, the discontinuous members of the Atoka are visible. The dense nature of the Atoka rocks results in a formation with low water-bearing capacity, and monitor wells completed in this interval yield little water. This formation characteristic commonly results in a recovery time of a week or more for monitor wells which have been bailed to near dryness. A few wells in this formation intersect fractures in the sandstones and shales and therefore recover much quicker. Thus, fracture flow is the predominant avenue of groundwater storage and movement in this formation.

### Lithologic Data

Construction of treated raffinate storage ponds in the study area has both removed and disturbed the natural, in-situ ground cover. In some areas, several feet of soil and terrace material have been removed, while other areas have been covered with compacted fill and clay.

Extensive borehole drilling associated with treated raffinate storage pond construction has resulted in the collection of comprehensive subsurface lithologic data to a depth of about sixty feet. Figure 1 shows the location of boreholes and monitor wells drilled in the vicinity of treated raffinate ponds 3E, 3W, 4, 5 and 6. Lithologic logs from each of the borings are provided in Appendix A. Boreholes were plugged following data collection. In general, the area around the ponds is characterized by a thin (one to two feet) silty soil cover, underlain by about six to eight feet of native silty clay. Below the clay is a seventeen to twenty-five foot thick alternating shale/sandstone sequence, followed by a distinctive and laterally continuous gray to blue fissile shale, sixteen to thirty feet in thickness. Two borings which fully penetrate this shale member indicate an underlying hard sandstone unit which is at least ten feet thick. Figure 2 has been constructed from this data to show a general lithologic section of the area.

The only obvious sign of moisture in the cuttings during



drilling is generally at the interface of the laterally continuous thick shale unit and the overlying shaley-sandstone. Approximately 10% of the time, moisture will be evident in the gray shaley-sandstone, before the interface is reached (see Figure 2, 15-to-20 foot interval).

#### Geologic Cross-Sections

Two geologic cross-sections have been prepared from the lithologic logs provided in Appendix A. Figure 3 is a plan view of the treated raffinate storage pond area showing the location of the cross-sections presented in Figures 4 and 5. Cross-section A-A' is an east-west profile, and B-B' is a north-south profile view.

The geologic sections show a generally flat-lying stratigraphy, with an apparent gentle westerly dip. Outcrop measurements at other locations at the Sequoyah Facility site show the true dip to be at approximately 4° in a northwesterly direction.

Correlation of the stratigraphy encountered during drilling is relatively easy across the site, particularly when the thick, fissile shale unit described previously is encountered. Although some uncertainty develops in correlating the borehole information from well 2344 near pond 6 because of inter-tonguing of an unconsolidated sand and a sandstone unit, the geologic cross-section in Figure 5 represents a realistic interpretation of the subsurface data and is



consistent with the lithologic discontinuities observed in outcrops of the Atoka formation.

Pond locations have been superimposed on the geologic sections to provide a reference to the earth-moving work done for pond construction. The ponds were specifically constructed to rest upon the dense, hard, dry, tan-gray sandstone unit. The sandstone unit was easily identifiable during excavation.

#### POTENTIOMETRIC SURFACE IN THE TREATED RAFFINATE POND AREA

The monitor wells in the treated raffinate pond area allow construction of an area potentiometric surface. The potentiometric surface map shown in Figure 6 was constructed from water levels of December 4, 1985. The data show a west-southwesterly groundwater flow direction beneath the eastern ponds, which gently turns more to a west-northwesterly direction beneath pond 5. A gradient of about 0.02 is fairly constant across the site.

#### POND CONSTRUCTION

The treated raffinate storage ponds were constructed to provide optimum groundwater protection. The ponds are lined with a synthetic material (Hypalon) which is underlain with a leak detection/collection system. Below the detection system is a two-foot-thick (minimum) compacted natural clay liner. Additionally, groundwater monitor wells are in place

around the pond area to detect any leakage through the synthetic and clay liners into the uppermost aquifier.

Each of the five ponds (3E, 3W, 4, 5 and 6) has a storage capacity of  $14.4 \times 10^6$  gallons with a 3-foot freeboard.

Ponds 3E and 3W were constructed in 1979. Construction involved excavation to the top of the hard, dry, dense sandstone previously described. A two-foot-thick (minimum) natural clay liner was installed on the hard sandstone and the embankments and compacted to 95% of standard Proctor density to produce a liner with a laboratory permeability equal to or less than  $10^{-9}$  cm/sec. A slope of 3% to the south was maintained on the clay liner to allow for a collection point should pond leakage occur through the synthetic liner. Six, three-inch perforated PVC underdrains were installed 75 feet apart, above the clay liner and extend across the width and up the embankments of each pond. These underdrains comprise the leak detection/collection system.

The PVC pipes were installed in approximately 15-inch deep trenches in the clay liner. The trenches were excavated into the underlying sandstone formation to maintain a two foot thick compacted clay liner beneath the underdrains. The trenches were then backfilled with gravel and sand to assure collection of any fluid. A two inch thick sand layer was extended across the entire pond bottom to provide a permeable pathway for movement of any leakage to the

underdrains. The impervious, synthetic Hypalon liner overlies the sand layer and leak detection/collection system.

Pond 4 is immediately east of pond 3E (see Figure 1) and was constructed in mid-1980 in the same manner as that described above for ponds 3E and 3W, except that the leak detection/collection system uses four-inch PVC pipe.

Ponds 5 and 6 were constructed in early 1985, using the same design as pond 4.

Construction of all five ponds was supervised by Hemphill Corporation of Tulsa, Oklahoma, an engineering consulting firm. A field technician was on-site and performed daily inspections and tests to insure the ponds were constructed to specifications. A professional engineer monitored the pond installations and certified that the ponds were constructed in strict accord with design specifications.

#### POND PERFORMANCE

Pond 3W developed raised areas or blisters in the synthetic liner in 1979 as fluid was introduced, indicating gas development beneath the liner and possible leakage through the synthetic liner. Leakage of the top liner was verified by fluid collected in several of the pond underdrains. Fluid also collected in pond 3E underdrains, although the liner did not blister. Both ponds were emptied, the underdrains

were pumped dry, and the synthetic liners were either replaced (3W) or repaired (3E). Following the repairs, monthly sampling of the leak detection/collection system did not detect any fluid until July 1985 when less than 1 gallon of fluid was detected in the southernmost underdrains of each pond. Re-sampling on a weekly schedule thereafter failed to detect additional fluid.

Pond 4 has not experienced any fluid collection in the pond underdrains since utilization began in mid-1980.

The leak detection/collection systems in both ponds 5 and 6 have collected small amounts of pond fluid since being put into service. Fluid was detected following first introduction of treated raffinate solution. The ponds were emptied immediately, the underdrains were pumped to dryness, and the synthetic liners were resealed along suspected leaky seams. When fluid was subsequently placed in the ponds, liner leakage occurred at estimated rates of 18 gallons per day (gpd) from pond 5 and 22 gpd from pond 6. These leakage rates are calculated from the amount of fluid pumped from the underdrains back into the ponds each week.

The small quantity of fluid appearing in the leak detection/collection system indicates each synthetic liner may have a small hole. An estimate as to the size of the holes is possible using Darcy's law:

$$Q = KA (dh/dl)$$

where Q = discharge (i.e., rate of fluid accumulation in underdrains)

K = hydraulic conductivity (estimated permeability of sand layer beneath synthetic liner)

A = cross sectional area (i.e., area of hole in liner)

dh/dl = hydraulic gradient (i.e., height of fluid column in pond over 2" sand layer beneath liner)

Rearranging the above equation and substituting numerical values, the size of the hole in the pond 5 synthetic liner is calculated to be:

$$A = \frac{Q}{K (dh/dl)}$$

$$A = \frac{18 \text{ gpd}}{100 \frac{\text{gpd}}{\text{ft}} \cdot \frac{18 \text{ ft}}{0.167 \text{ ft}}}$$

$$A = 0.00167 \text{ sq. ft.} = 0.24 \text{ sq. inch (hole size)}$$

For pond 6,

$$A = \frac{22 \text{ gpd}}{100 \frac{\text{gpd}}{\text{ft}} \cdot \frac{19 \text{ ft}}{0.167 \text{ ft}}}$$

$$A = 0.00193 \text{ sq. ft.} = 0.28 \text{ sq. inch (hole size)}$$

Such holes with a combined area calculated above would be extremely difficult to find in liners that each cover more than 2 acres.

The time it would take for any leakage through the synthetic liners to pass through the 2 foot clay liner can also be theoretically calculated by applying Darcy's Law.

$$v = \frac{K_v (dh/dl)}{\phi}$$

where v = velocity of fluid

$K_v$  = vertical hydraulic conductivity  
( $10^{-9}$  cm/sec, liner placement criteria)

$dh/dl$  = hydraulic gradient (i.e., unit gradient  
assumed because fluid is not allowed  
to build up in the collection system)

$\phi$  = porosity (assumed to be 20%)

Substituting the appropriate values, the travel time for the fluid to cross the two foot thick clay liner is calculated to be 386 years.

No evidence has been developed which suggests that there have been any leaks from the pond systems to the surrounding environment.

#### TREATED RAFFINATE POND GROUNDWATER MONITOR WELLS

##### Monitor Well Locations

The existing monitor well network in the pond 3E, 3W, 4, 5 and 6 area is shown in Figure 7. These wells surround the pond area and include replacement wells for those removed due to pond construction. In addition, those wells that occasionally go dry (wells 2322 and 2323) have been paired with nearby deeper wells. (Three of these wells, FTP-2B, -2C, -2D, were installed to evaluate nitrate and uranium concentration in the well FTP-2A area south of the ponds in accordance with license Condition 14 (report in preparation).)

The wells, aside from the FTP wells, were installed specifically to provide a comprehensive monitoring program for detecting potential treated raffinate pond leakage effects on groundwater, in accordance with License Condition 12. The wells are located in the likely direction of fluid movement should leakage occur through the pond liners. Their



location also takes into account the results of a detailed area electromagnetic survey.

#### Monitor Well Construction

Eighteen groundwater monitor wells have been installed around ponds 3E, 3W, 4, 5 and 6 (Figure 7) to monitor potential pond leakage effects on the groundwater. All wells have been completed in the uppermost groundwater horizon, as this represents the route of potential migration should leakage occur. Three monitor wells that were previously installed in the late 1970's (wells OW-1, OW-4 and OW-4A) have been drilled out and plugged (bentonite/cement slurry), as they were located in areas of new pond construction (see Figure 1). Other existing older wells (2322 and 2323) have been supplemented with deeper wells after the shallower wells became dry. Appendix A contains all well completion records for the treated raffinate pond area monitor wells.

All but one of the eighteen wells were installed using the air-rotary method of drilling. This method allows careful logging of drill cuttings and early detection of moisture. In one case a liquid detergent solution was erroneously introduced during drilling to aid in returning cuttings to the surface (well 2343).

As previously described, the probability is very low for finding significant quantities of water in monitor wells established in the first water bearing horizon on the facility



property. This is characteristic of a tight formation where only fractures provide a potential means for any quantity of water movement. Therefore, the drilling procedure often involved boring to a specified depth and then waiting 30 to 60 minutes to see if moisture was evident on the wall of the borehole. If moisture was not detected, drilling continued a few feet further, and the hole was re-checked. This procedure continued until moisture was evident in the cuttings or until moisture was observed on the sidewalls of the boring.

Once the presence of moisture was confirmed, well completion involved gravel or sand packing around a section of PVC screen or perforated PVC pipe. Although some of the older monitor wells (e.g., FTP-2) were backfilled around the PVC pipe with gravel or cuttings to the surface, all recent construction practices have used the placement of a bentonite seal and cement backfill from just above the completed screen interval to the surface. This method of well completion prevents infiltration of surface water and is recommended by the U.S. Environmental Protection Agency.

## GEOPHYSICAL STUDY

### Electromagnetic Survey

Electromagnetic (EM) survey instruments measure earth conductivity to depths of several meters and are used routinely in groundwater studies. The method is based on

induction of currents in the earth via a "transmitter" and determination of the resultant conductivity via a "receiver." The receiver values constitute a weighted average of the earth conductivity with depth and are related primarily to depth and quality of groundwater in addition to rock type and soil saturation.

Conductivity values are obtained along a grid pattern at a pre-determined spacing interval and plotted on the grid and contoured. The contouring delineates anomalous features associated with or indicative of conditions such as buried metallic objects, bedrock "highs" and "lows", buried stream channels, or groundwater plumes of other than background composition.

In October 1985, the immediate area of the treated raffinate storage ponds was EM surveyed, using a Geonics Model EM-31 ground conductivity meter, with a ground penetration depth of 18 feet. Profile lines spaced approximately 50 feet apart were traversed and ground conductivity values recorded every 10 feet. Figure 8 shows the locations of each of the profile lines and recording stations. In total, 11,380 linear feet of profiles were made, and approximately 1,240 data points were obtained.

The contoured data resulting from the detailed EM survey are shown in Figure 9. Several anomalous features were identified and numbered and interpretations made regarding

what the features represent, e.g., "bedrock highs" or potential groundwater plumes possibly originating from the nearby raffinate ponds. Subsurface topographic features and "bedrock highs" were eliminated as possible causes of the anomalies, based on consistent lithologic data over the area. To enhance the interpretation, groundwater monitor wells were installed and carefully logged in each of the apparent anomalous areas and provided site specific data.

#### AREA GROUNDWATER QUALITY

##### Interpretation of the EM Survey Results

Water obtained from the groundwater wells installed in each of the three apparent EM anomalies was analyzed for nitrate. The nitrate concentration is a key parameter in interpreting the reason for the anomalous features and whether the anomalies are related to leakage from the treated raffinate storage ponds or some other cause. The nitrate concentration in the ponds is approximately 30,000 mg/l; therefore high levels in the groundwater could be an indication of seepage effects. Nitrate movement through clay would approximate that of water, and attenuation would be low, meaning leakage would be expected to show levels closer to 500-1000 mg/l or higher rather than the much lower concentrations noted.

The groundwater data (Table 1) show nitrate levels to be less than 10 mg/l in two wells (2345 and 2347) and 20 mg/l

in a third (2346). These low nitrate concentrations would not be a significant contribution to the conductivity anomalies detected by the EM survey. The data also show sulfate, a double charged anion in solution, is present at elevated concentration, which would contribute to higher conductivity values for water in each of the three wells.

The origin of the sulfate found in these three wells is not certain. The source is clearly unrelated to the storage of treated raffinate solution in the lined ponds or to the application of treated raffinate as fertilizer -- the treated raffinate solution does not contain appreciable sulfate concentrations. There are also no reported near-surface sulfate minerals in the area.

The elevated sulfate values may be a result of alum,  $(\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O})$ . Alum was stored in 1979 on the ground surface in the vicinity of the treated raffinate pond area. Impinging rainfall and surface run-off could have dissolved some of the alum and carried the sulfate down through the soil profile to the water table.

#### Overall Groundwater Quality in the Raffinate Pond Area

Groundwater quality in the treated raffinate pond storage area may be interpreted from water chemistry and elevation data summarized in Table 1. These data lead to four key observations:

First, nitrate concentrations are irregular and do not correlate with apparent water flow directions,

Second, suggested potentiometric surfaces are smooth, indicating no subsurface mounding associated with a liner leak;

Third, sulfate concentration is irregular and can be explained by early practices which are not now followed; and

Fourth, the uranium concentrations are background levels for all wells.

Wells 2345, 2346 and 2347 were located in areas found to be anomalous noted by the EM survey. Nitrate levels were 10 mg/l in two wells and 20 mg/l in the third. Such low levels clearly do not indicate a close source of high-nitrate fluid.

Well 2343 was installed to monitor water quality near Pond 6. High initial pH (8.5) and sulfate concentration (4200 mg/l) can be traced to detergent added by the drilling contractor to return cuttings to the surface, contrary to instructions by Sequoyah Fuels. Nitrate level in the well is approximately 40 mg/l, and may be due to concentrated fertilizer runoff leaching from a preconstruction topographic low spot down to groundwater. Longer monitoring is required before definite statements can be made.

Well 2344, also near Pond 6, exhibits nitrate concentrations of approximately 20 mg/l. Small elevations over background can be indicative of leaching from the experimental raffinate applications of several years ago. Continued careful monitoring is planned.

Wells 2340 and 2341 were installed in Spring 1985 to monitor potential leakage from Pond 5. Well 2340 apparently was improperly cemented by the drilling contractor as evidenced by high pH and was drilled out and plugged in November 1985. An offset well, 2340A, shows a small elevation of nitrate over background (19 mg/l) which will be followed.

Two wells north of ponds 3 and 4, wells 2348 and 2349 show the highest nitrate concentrations in the area, at approximately 60 mg/l. Three possible reasons can be postulated for the higher readings;

- (1) possible residual fluid from Pond 3 liner leakage, which was repaired,
- (2) past raffinate application in the area, or
- (3) a present day leak.

The last option is ruled out as no fluid is being captured in the adjacent pond underdrains, the potentiometric surface does not indicate a flow in the direction of the wells and the observed groundwater concentration is much lower than the treated raffinate fluid.

Wells 2323, 2322, 2322A, 2341, 2342 and 2350 are the remaining wells in the treated raffinate pond area monitor program. Well 2323 was dry certain times during the year so it was offset with 2349. Well 2322 is also frequently dry and was offset with 2322A. The four wells, 2322A, 2341, 2342, and 2350 all exhibit background water quality, with nitrates less than 10 mg/l. Careful measurements of these wells will be included in the future water quality monitoring program.

The data do not show any leakage of treated raffinate solution taking place to the aquifier. With the expanded monitoring program in place and the data reported by this investigation, the intent of the license requirement has been met. Continued detailed monitoring will provide an excellent record to better assess the groundwater situation in the area and to provide future assurance of no impact.



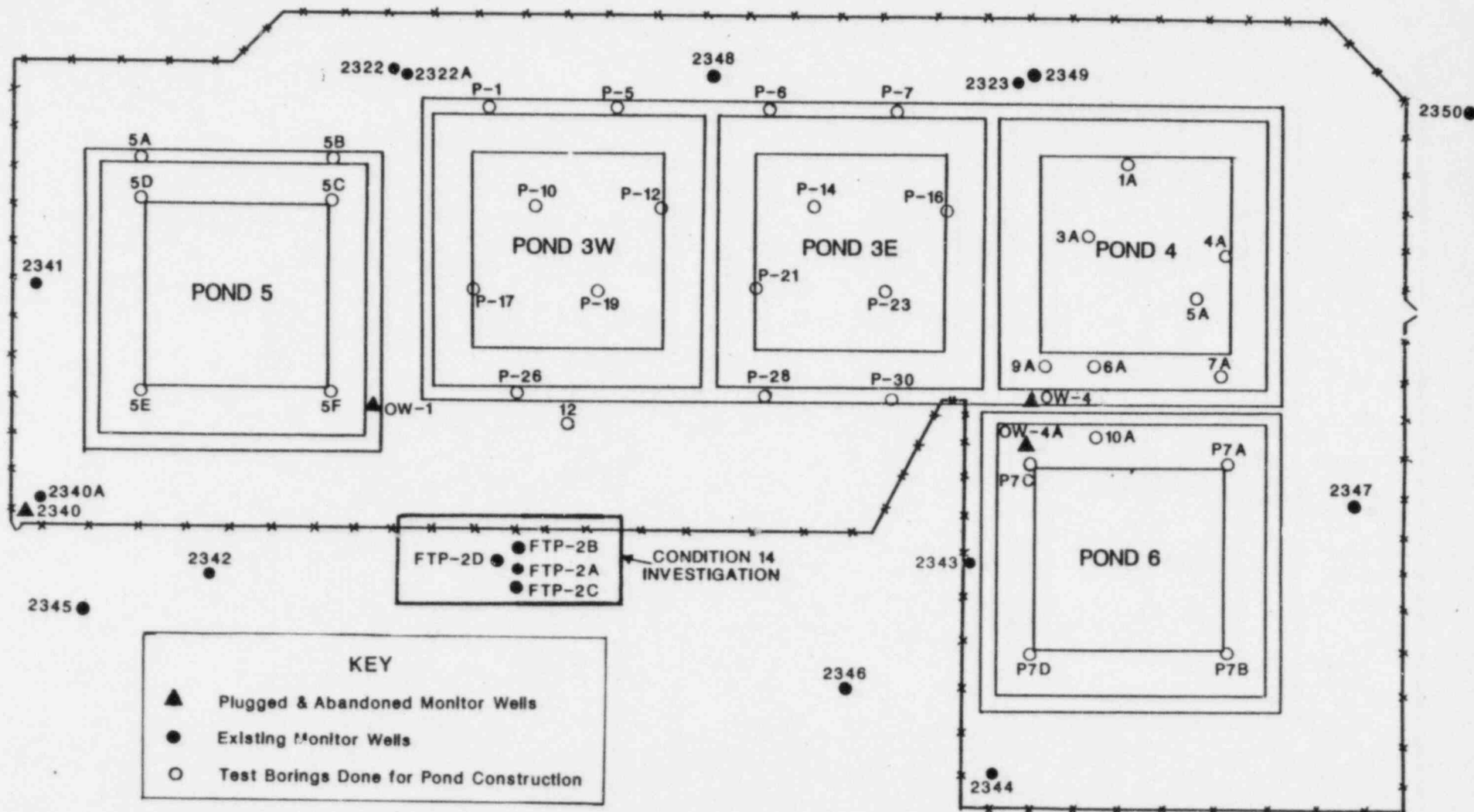


FIGURE 1 LOCATION OF ALL BOREHOLES AND MONITOR WELLS DRILLED TO DATE IN THE POND 3, 4, 5 AND 6 AREA



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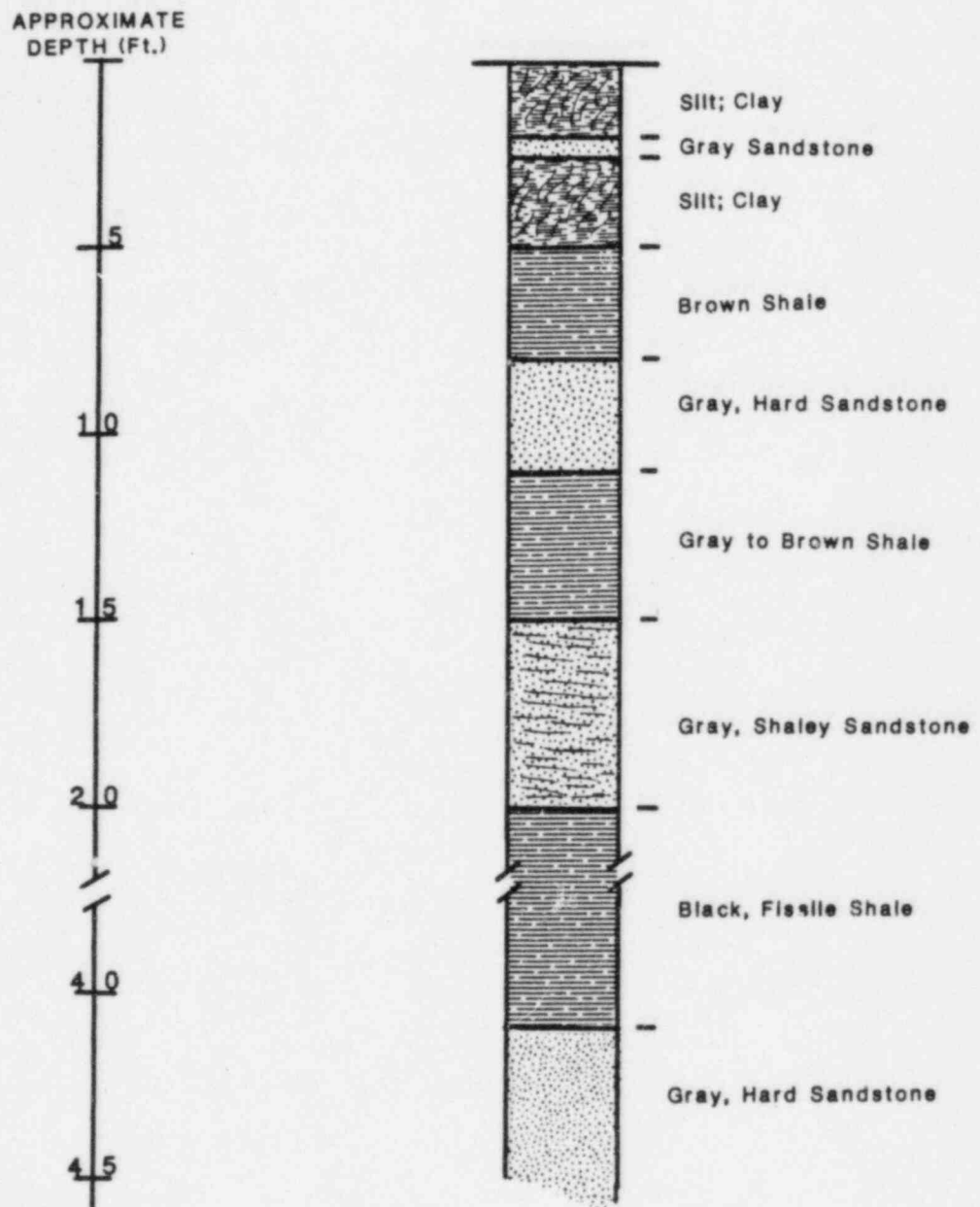


FIGURE 2 GENERALIZED LITHOLOGY IN THE RAFFINATE POND AREA

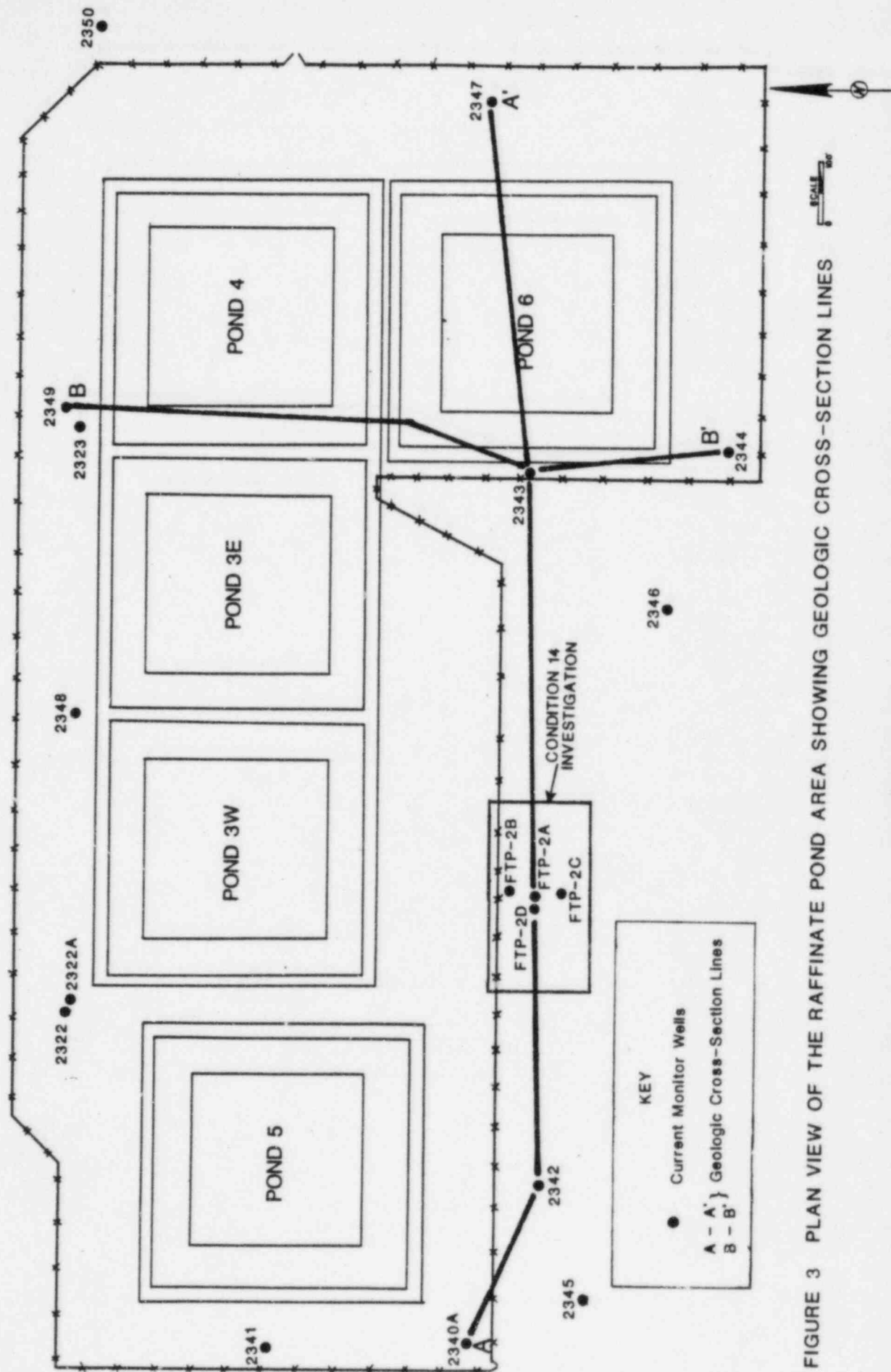


FIGURE 3 PLAN VIEW OF THE RAFFINATE POND AREA SHOWING GEOLOGIC CROSS-SECTION LINES

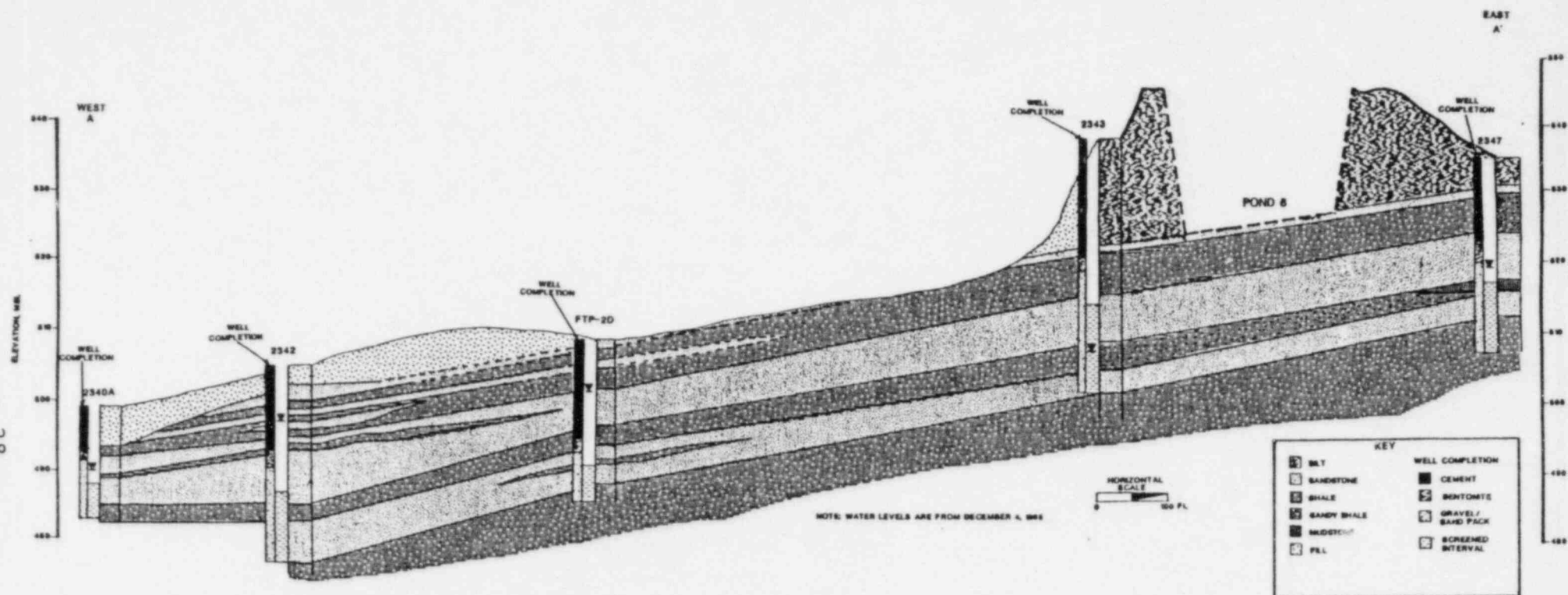


FIGURE 4 EAST-WEST CROSS-SECTION THROUGH LINED RAFFINATE POND AREA

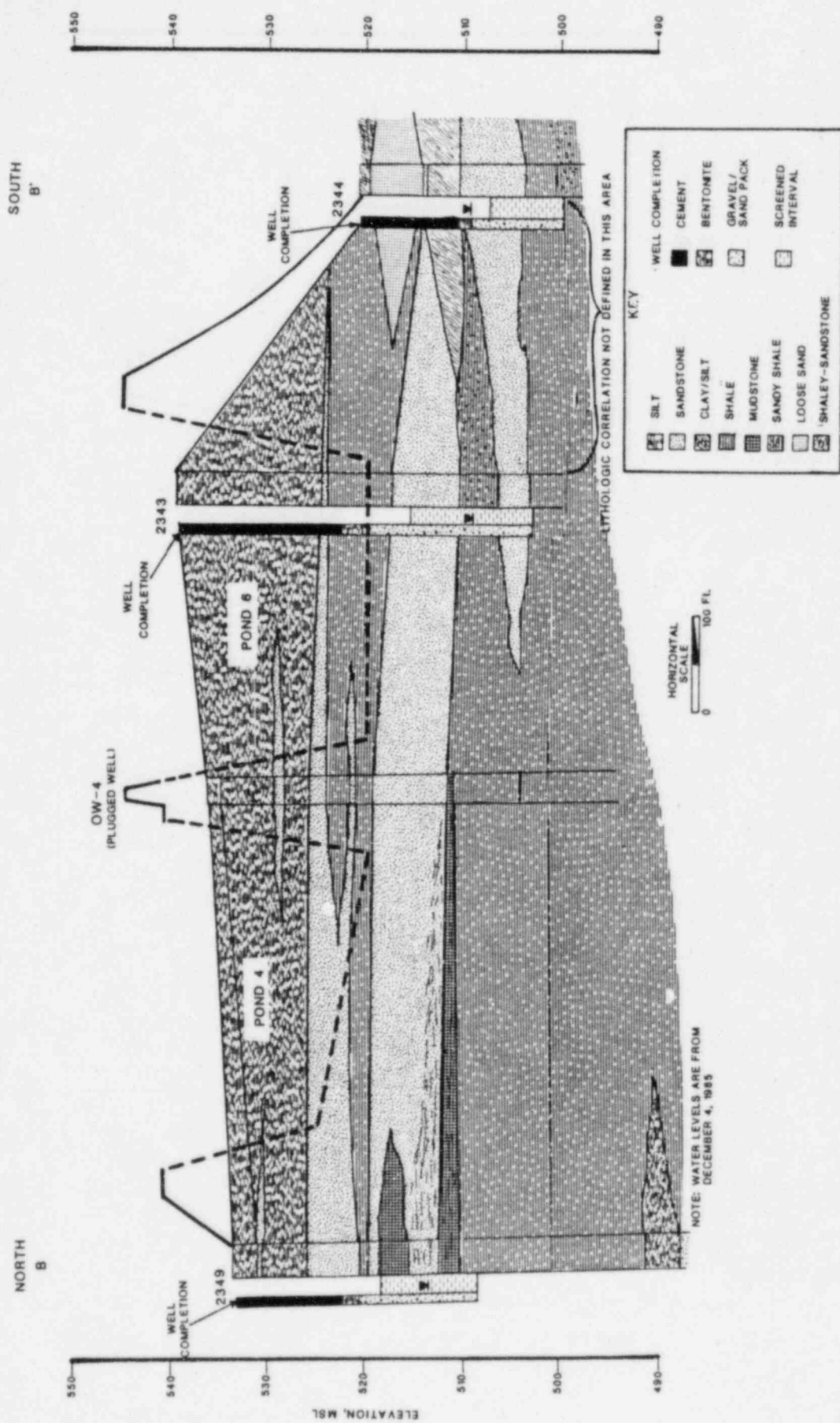
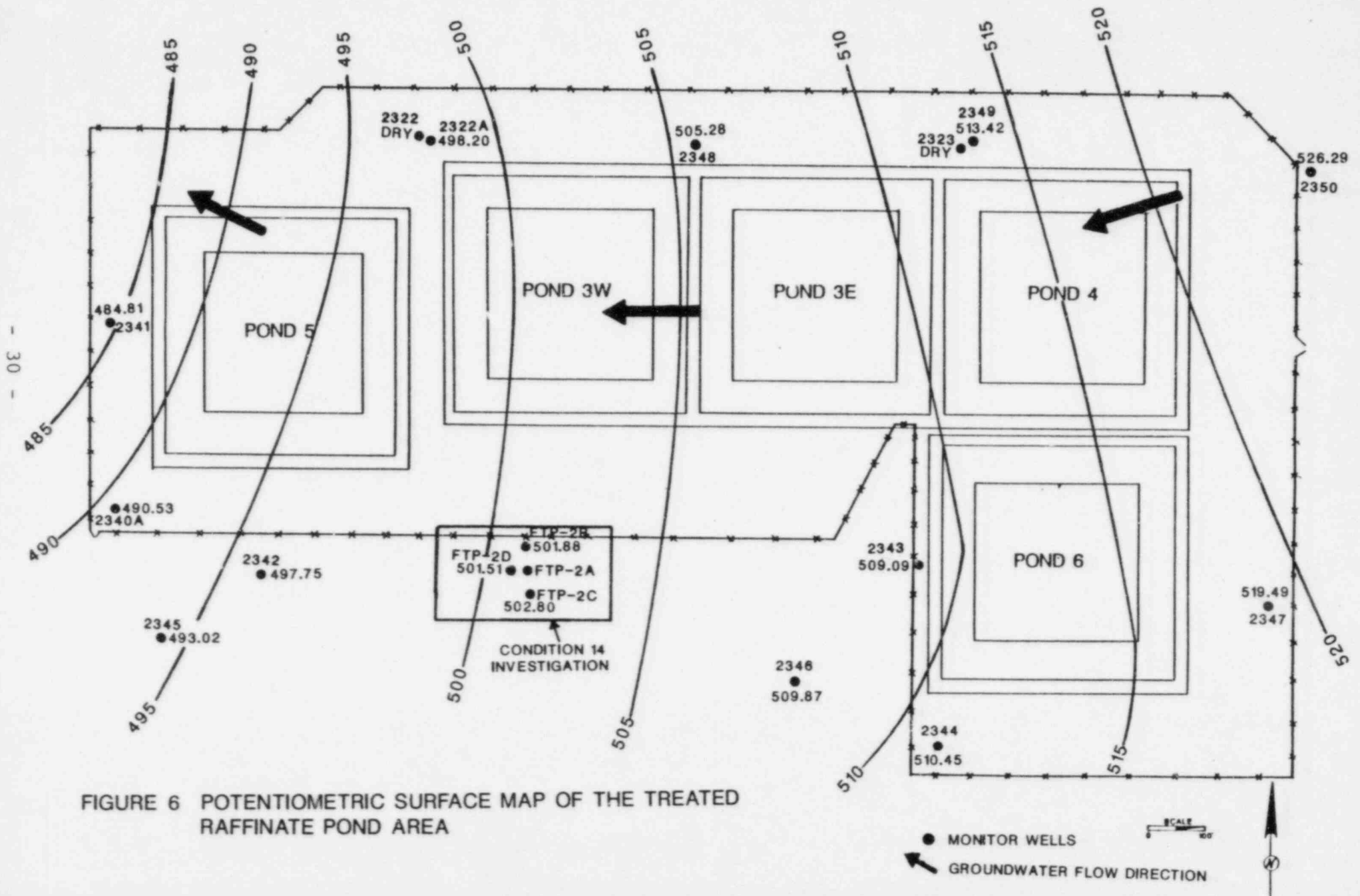


FIGURE 5 NORTH-SOUTH CROSS-SECTION THROUGH LINED RAFFINATE POND AREA



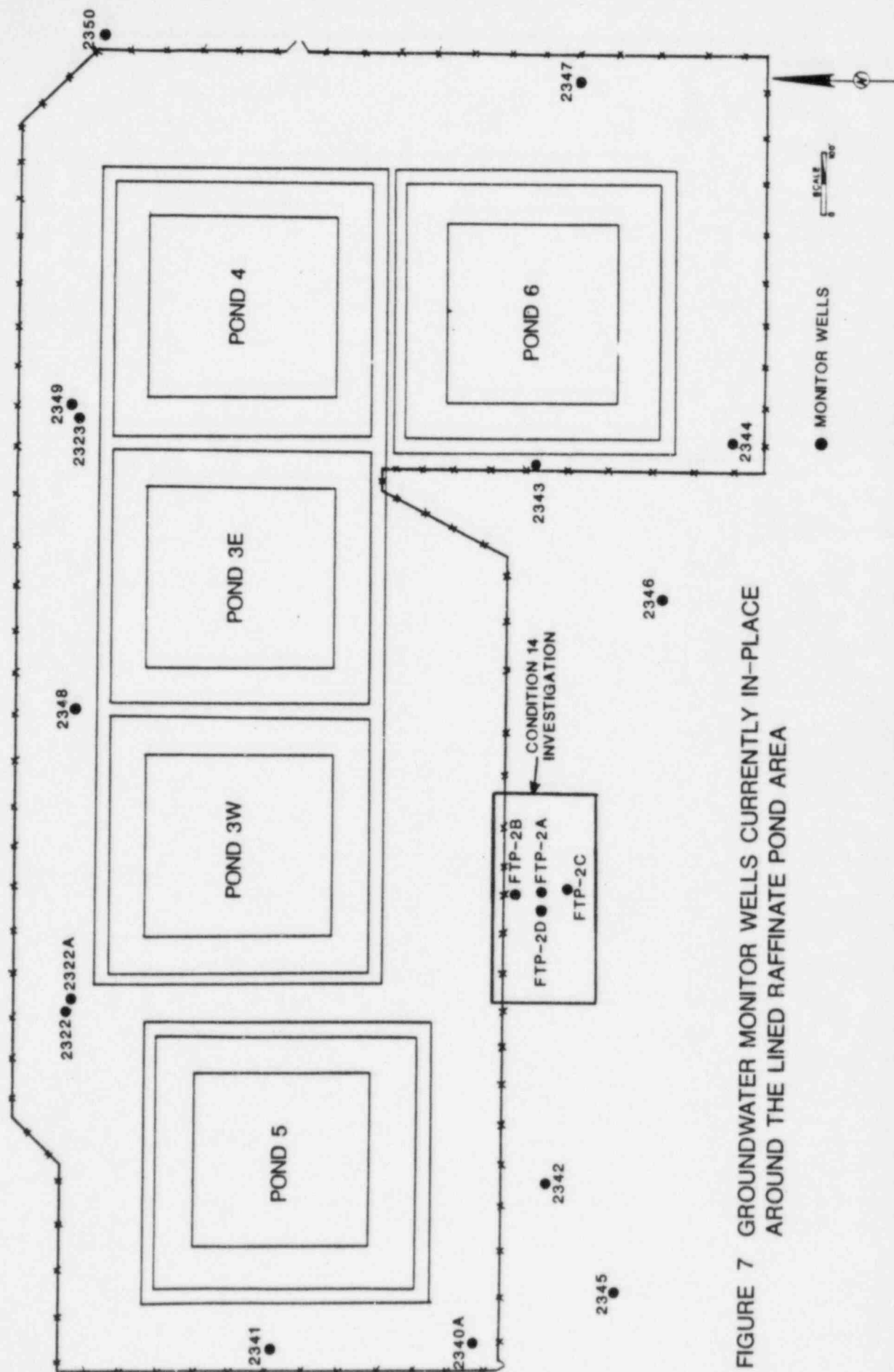


FIGURE 7 GROUNDWATER MONITOR WELLS CURRENTLY IN-PLACE  
AROUND THE LINED RAFFINATE POND AREA

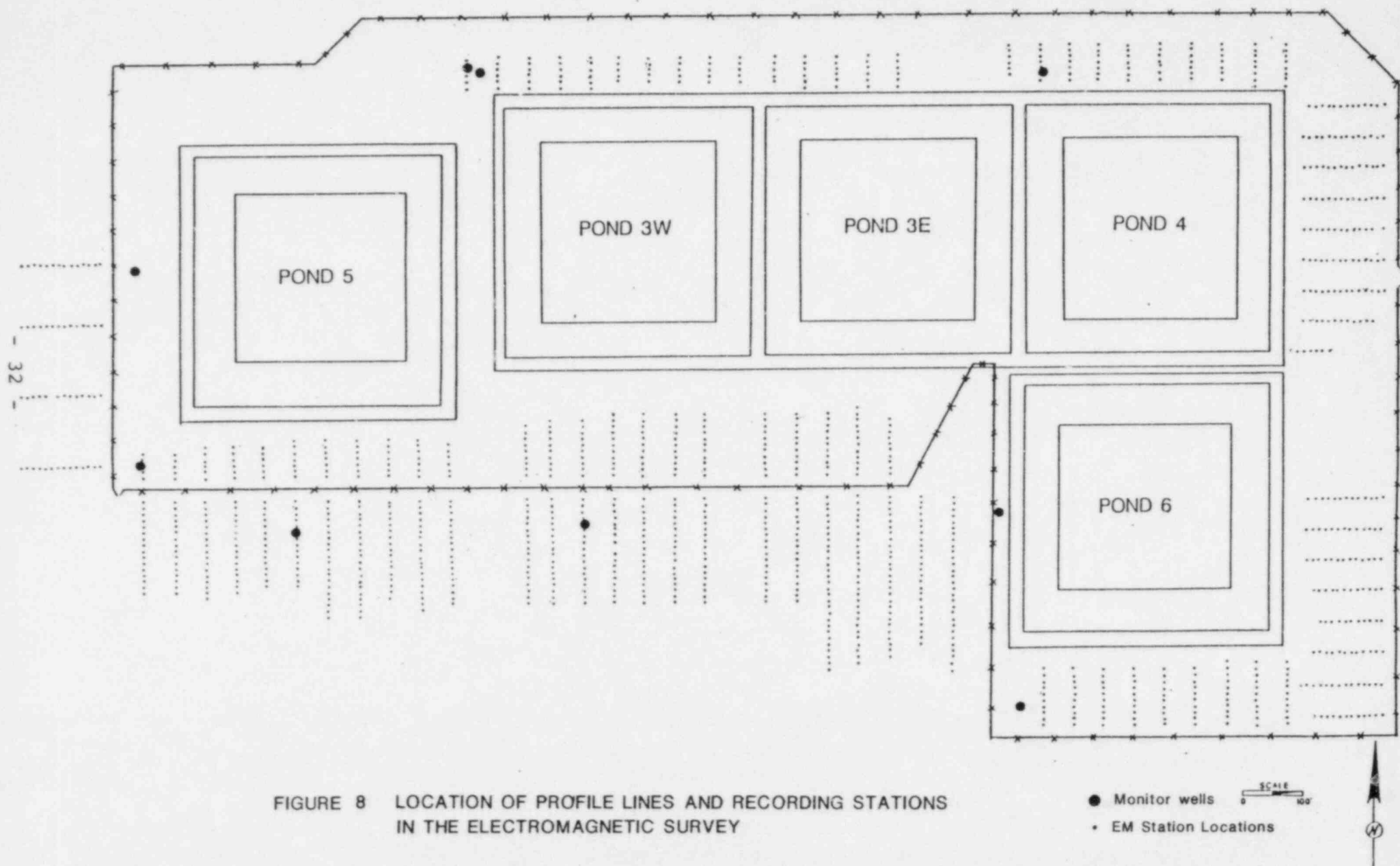


FIGURE 8 LOCATION OF PROFILE LINES AND RECORDING STATIONS  
IN THE ELECTROMAGNETIC SURVEY



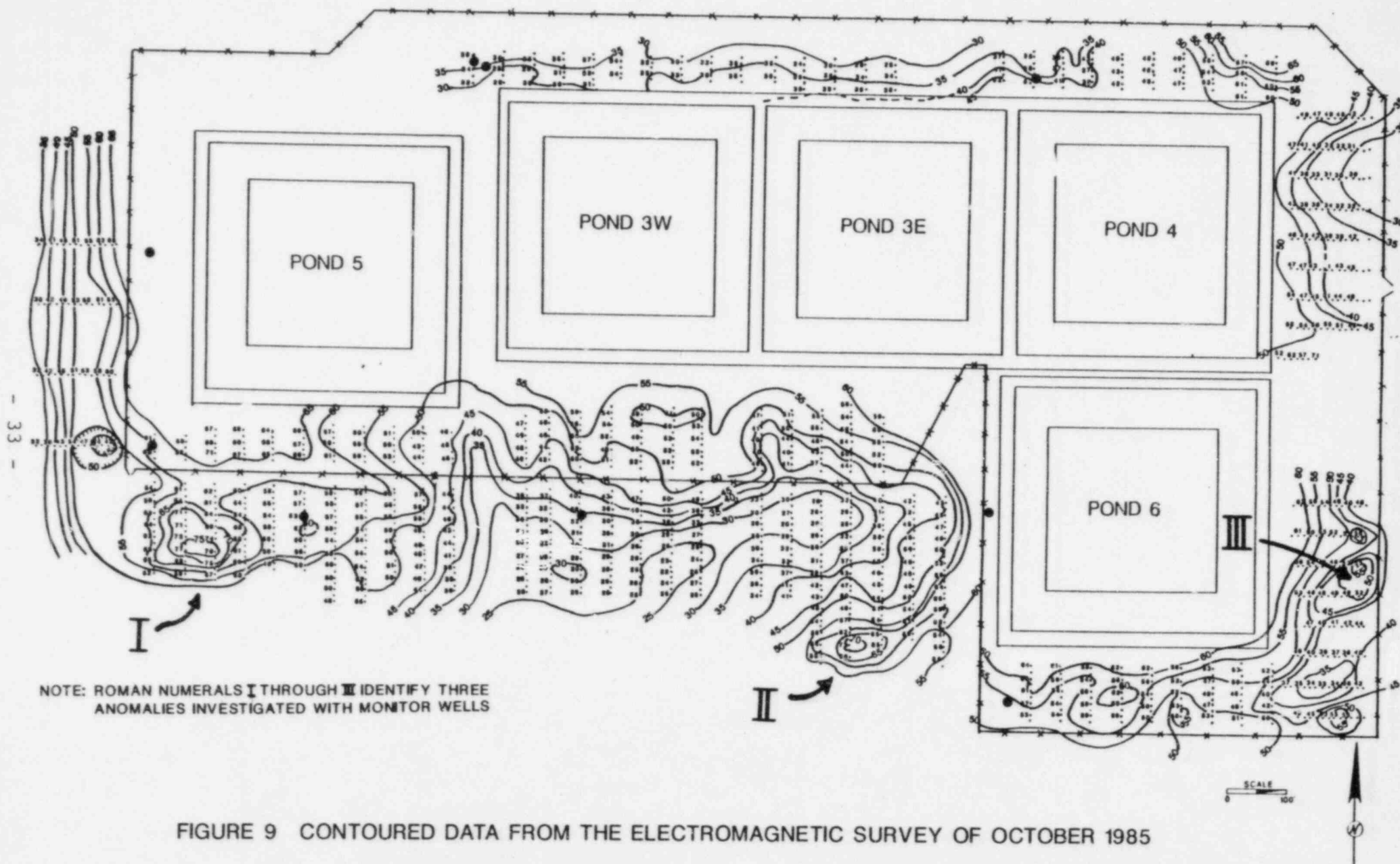




TABLE 1. RECENT WATER QUALITY DATA  
FROM ALL WELLS IN THE  
LINED RAFFINATE POND AREA  
(EXCLUDES FERTILIZER TEST PLOT (FTP) WELLS)

| <u>Well</u> | <u>Date<br/>Sampled</u> | <u>Conductivity<br/>(umhos/cm)</u> | <u>pH</u> | <u>NO<sub>3</sub>-N<br/>(mg/l)</u> | <u>SO<sub>4</sub><br/>(mg/l)</u> | <u>U<br/>(mg/l)</u> | <u>Water Level<br/>(ft-MSL)</u> |
|-------------|-------------------------|------------------------------------|-----------|------------------------------------|----------------------------------|---------------------|---------------------------------|
| 2350        | 11-26-85                | 571                                | 7.9       | 4                                  | 66                               | 0.055               | 526.29                          |
| 2347        | 11-26-85                | 3240                               | 7.7       | 5                                  | 980                              | 0.013               | 519.49                          |
| 2349        | 11-26-85                | 1200                               | 7.3       | 58                                 | 250                              | 0.008               | 513.42                          |
| 2344        | 8-85                    | --                                 | --        | 14                                 | 1,030(4/85)                      | 0.008               | 510.45                          |
| 2346        | 11-26-85                | 3540                               | 7.3       | 20                                 | 1,650                            | 0.016               | 509.87                          |
| 2343        | 6-85                    | --                                 | 7.2       | 41 (8/85)                          | 4,200                            | 0.027               | 509.09                          |
| 2348        | 11-26-85                | 1300                               | 7.6       | 56                                 | 219                              | 0.013               | 505.28                          |
| 2322A       | 8-85                    | --                                 | --        | 0.2                                | 450(4/85)                        | 0.009               | 498.20                          |
| 2342        | 8-85                    | --                                 | --        | 0.1                                | 1,030(4/85)                      | 0.005               | 497.75                          |
| 2345        | 11-26-85                | 2660                               | 7.4       | 1                                  | 1,250                            | 0.021               | 493.02                          |
| 2340A       | 11-26-85                | 3990                               | 7.3       | 19                                 | 2,340                            | 0.010               | 490.53                          |
| 2341        | 8-85                    | --                                 | --        | 0.4                                | 2,000(4/85)                      | 0.006               | 484.81                          |
| 2322        | 11-26-85                | (dry)                              | --        | --                                 | --                               | --                  | (dry)                           |
| 2323        | 8-85                    | (dry)                              | --        | --                                 | --                               | --                  | (dry)                           |

Data arranged in decending water level elevation, i.e. upgradient to downgradient

APPENDIX A

Lithologic Data From Borings And  
Monitor Wells In The  
Lined Raffinate Pond Area

## HEMPHILL CORPORATION

4834 SOUTH 23RD EAST AVENUE  
TULSA, OKLAHOMA 74145

OFFICE (918) 622-5133

AFTER HOURS 587-5822

## DAILY DRILL REPORT AND LOG

Hole No. FTP-2A Date 8-10-78 Depth 0 To 23 Shift \_\_\_\_\_ Drill No. CF-15  
 Client Kerr - McGee Address Gore, Oklahoma  
 Project Location Raffinate Pond Area Hole Location As Directed  
 Client's Representative Jim Carr Driller Curtis Cooper Hrs. \_\_\_\_\_  
 Helper Sidney Land Hrs. \_\_\_\_\_ Helper Matt Ferguson Hrs. \_\_\_\_\_

## BITS USED

| No. | Type | Size  | From | To |
|-----|------|-------|------|----|
|     | Rock | 4 3/4 | 0    | 12 |
|     | Rock | 12"   | 0    | 12 |
|     | Rock | 7 7/8 | 12   | 23 |

## DIAMOND BITS USED

| Serial No. | Size | From | To |
|------------|------|------|----|
|            |      |      |    |
|            |      |      |    |
|            |      |      |    |

## MUD AND LOSS CIRCULATION MATERIAL

| Manufacturer | No. Sacks | Weight |
|--------------|-----------|--------|
|              |           |        |
|              |           |        |
|              |           |        |

## CEMENT

| No. Sacks | Size |
|-----------|------|
| 5         | 8"   |
|           | 5"   |

## CASING INFORMATION

| Ft - Run | Ft - Pulled | Ft - Left |
|----------|-------------|-----------|
| 13'      |             | 13'       |
| 25'      |             | 25'       |

## STAND BY TIME (HRS.)

Rig

Rig &amp; Crew

| DEPTH |      | FORMATIONS                           | TYPE<br>DRLG. | DRILLING TIME |      |      |    | CORE<br>LOSS |
|-------|------|--------------------------------------|---------------|---------------|------|------|----|--------------|
| From  | To   |                                      |               | Start         | Stop | From | To |              |
| 0     | 1.4  | SILT, Brown, Dry                     |               |               |      |      |    |              |
| 1.4   | 4.7  | SHALE, Weathered, Brown, Dry, Silty  |               |               |      |      |    |              |
| 4.7   | 5.0  | CLAY, Brown, Shaley, Moist           |               |               |      |      |    |              |
| 5.0   | 6.4  | SHALE, Brown, w/Sandstone Lenses     |               |               |      |      |    |              |
| 6.4   | 7.8  | SANDSTONE, Brown, Shale Lenses       |               |               |      |      |    |              |
| 7.8   | 10.2 | SANDSTONE, Solid, Tan & Gray         |               |               |      |      |    |              |
| 10.2  | 10.8 | SANDSTONE, Gray, Hard                |               |               |      |      |    |              |
| 10.8  | 11.0 | SHALE, Tan & Gray                    |               |               |      |      |    |              |
| 11.0  | 13.0 | SANDSTONE, Gray                      |               |               |      |      |    |              |
| 13.0  | 15.5 | SHALE, Dark Gray                     |               |               |      |      |    |              |
| 15.5  | 16.5 | SHALE, Dark Gray, w/Sandstone Lenses |               |               |      |      |    |              |
| 16.5  | 20.0 | SANDSTONE, Gray Hard                 |               |               |      |      |    |              |
| 20.0  | 23.0 | SHALE, Gray                          |               |               |      |      |    |              |

Observation Well

8" PVC - 13' &amp; Cemented

5" PVC - 25'

Perforated 12' - 23' (3 Holes  
Per 1' Intervals)

Gravel Pack 0 - 23

## PENETRATION TESTS

| From | To | Blows | From | To | Blows |
|------|----|-------|------|----|-------|
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |

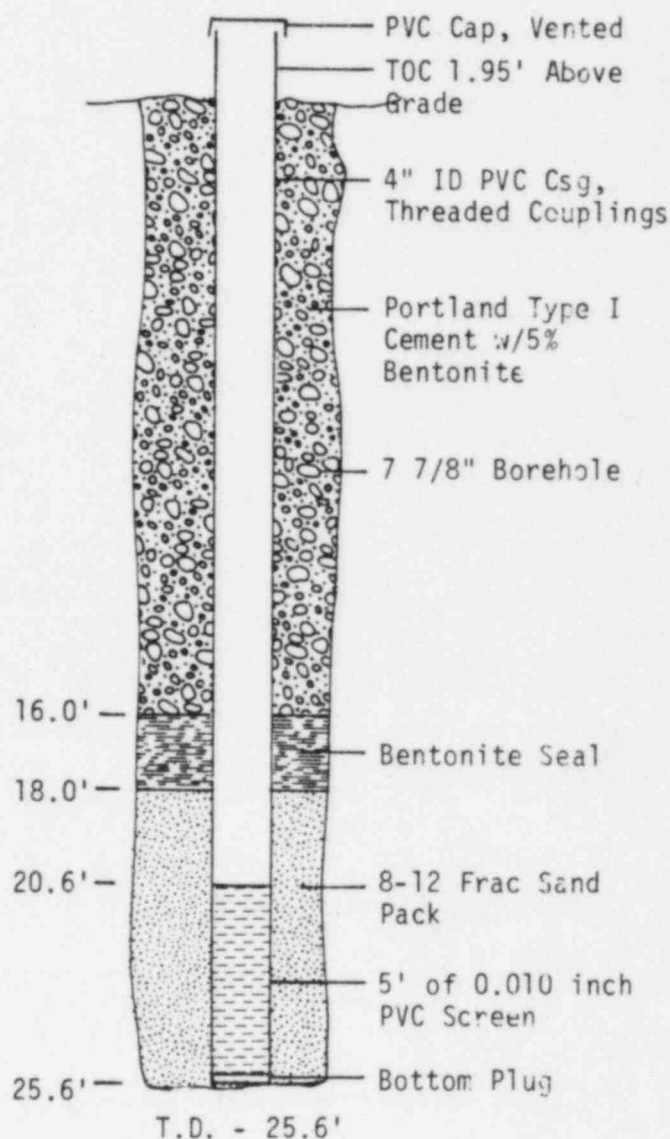
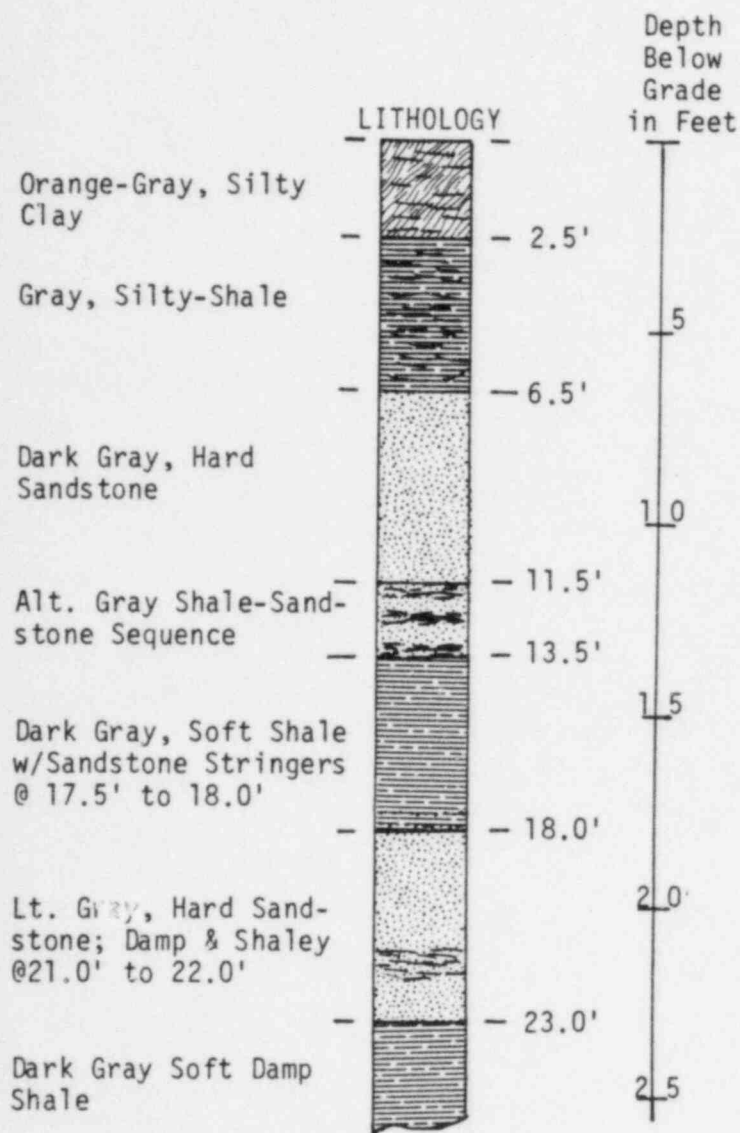
## SHELBY TUBE SAMPLES

| From | To | From | To | From | To |
|------|----|------|----|------|----|
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |

WATER DEPTH WHILE DRILLING (FT)

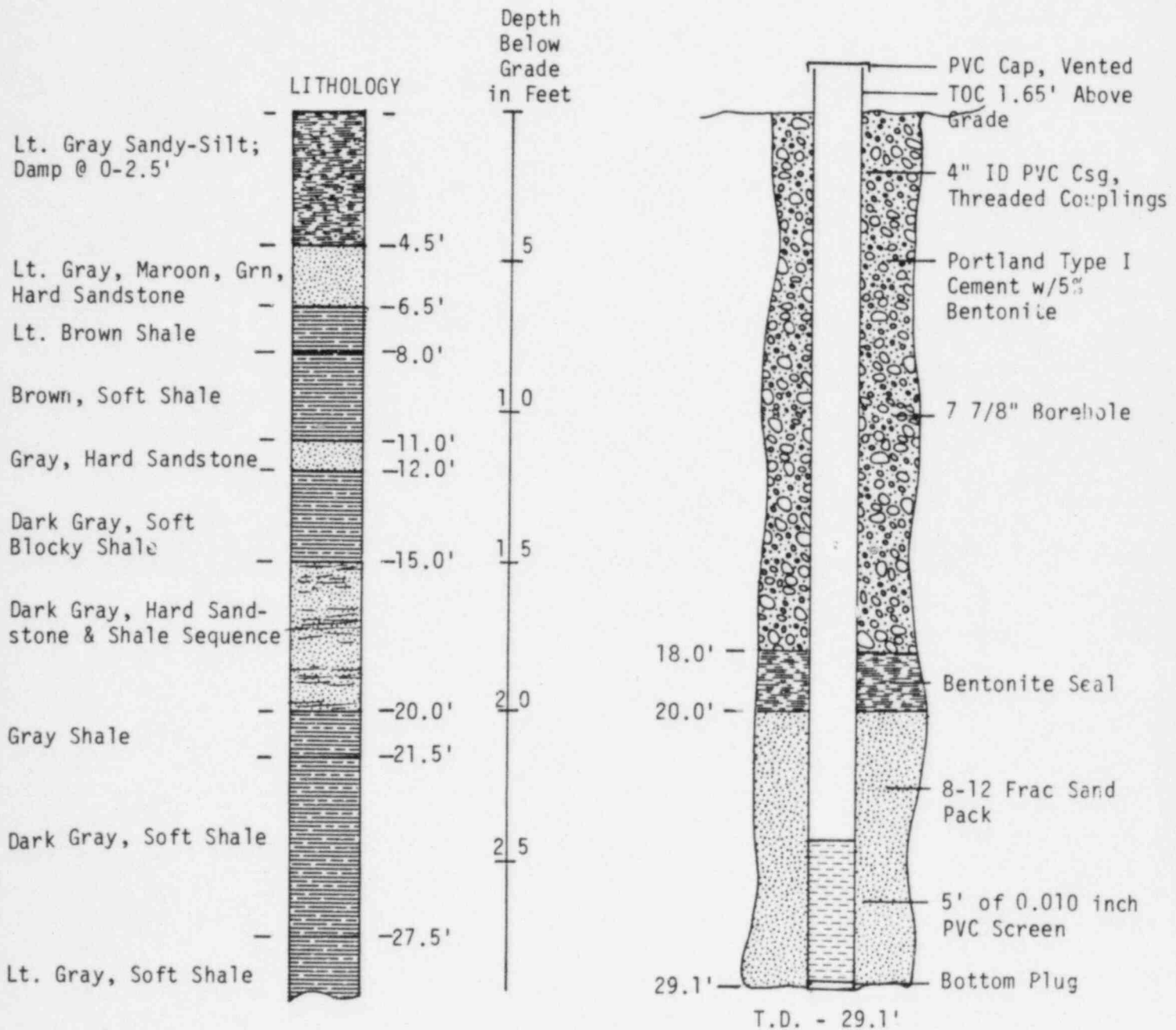
(24 HR)

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



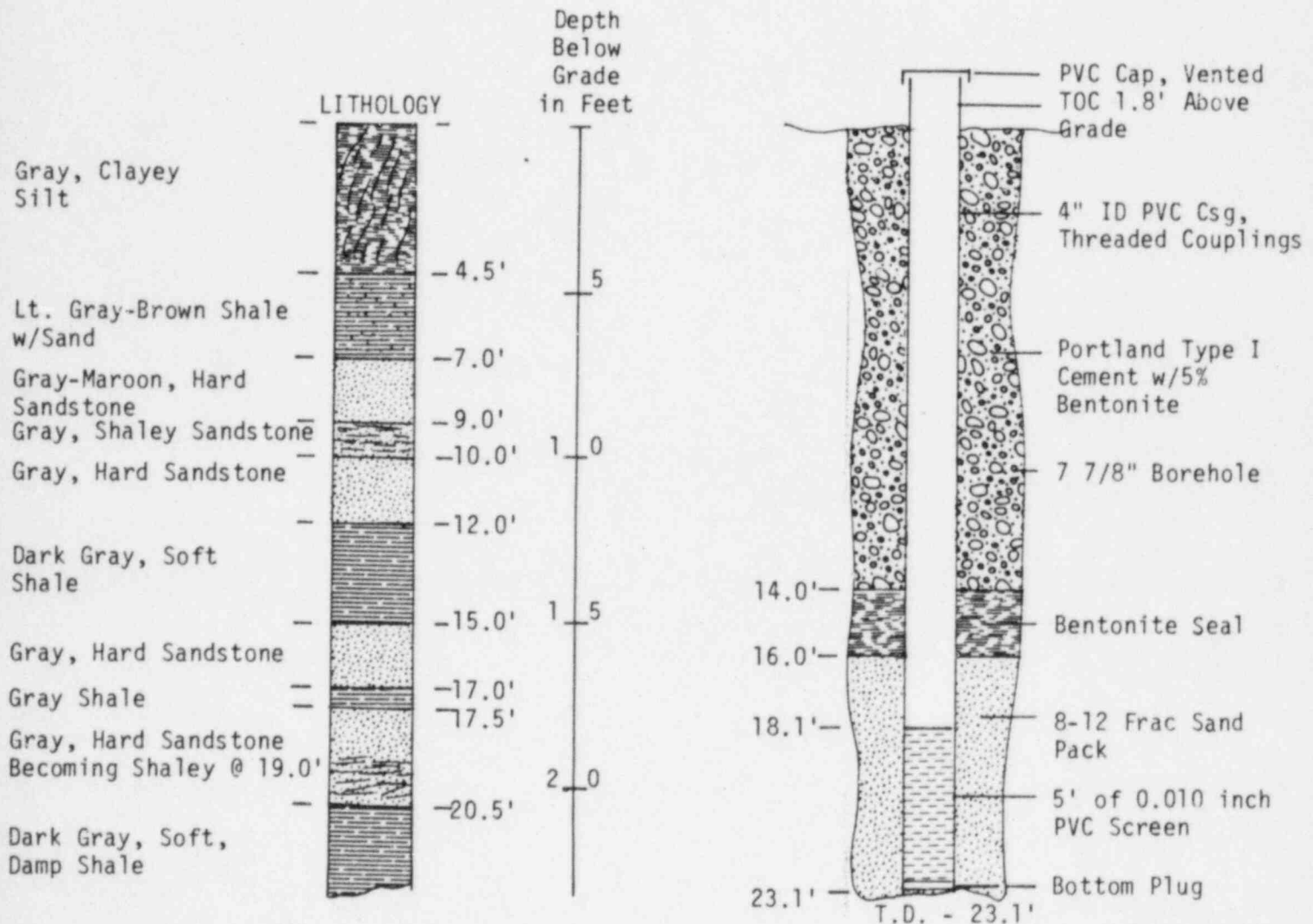
Well Installed: 11-11-85 by Jim Winnek, Inc.

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



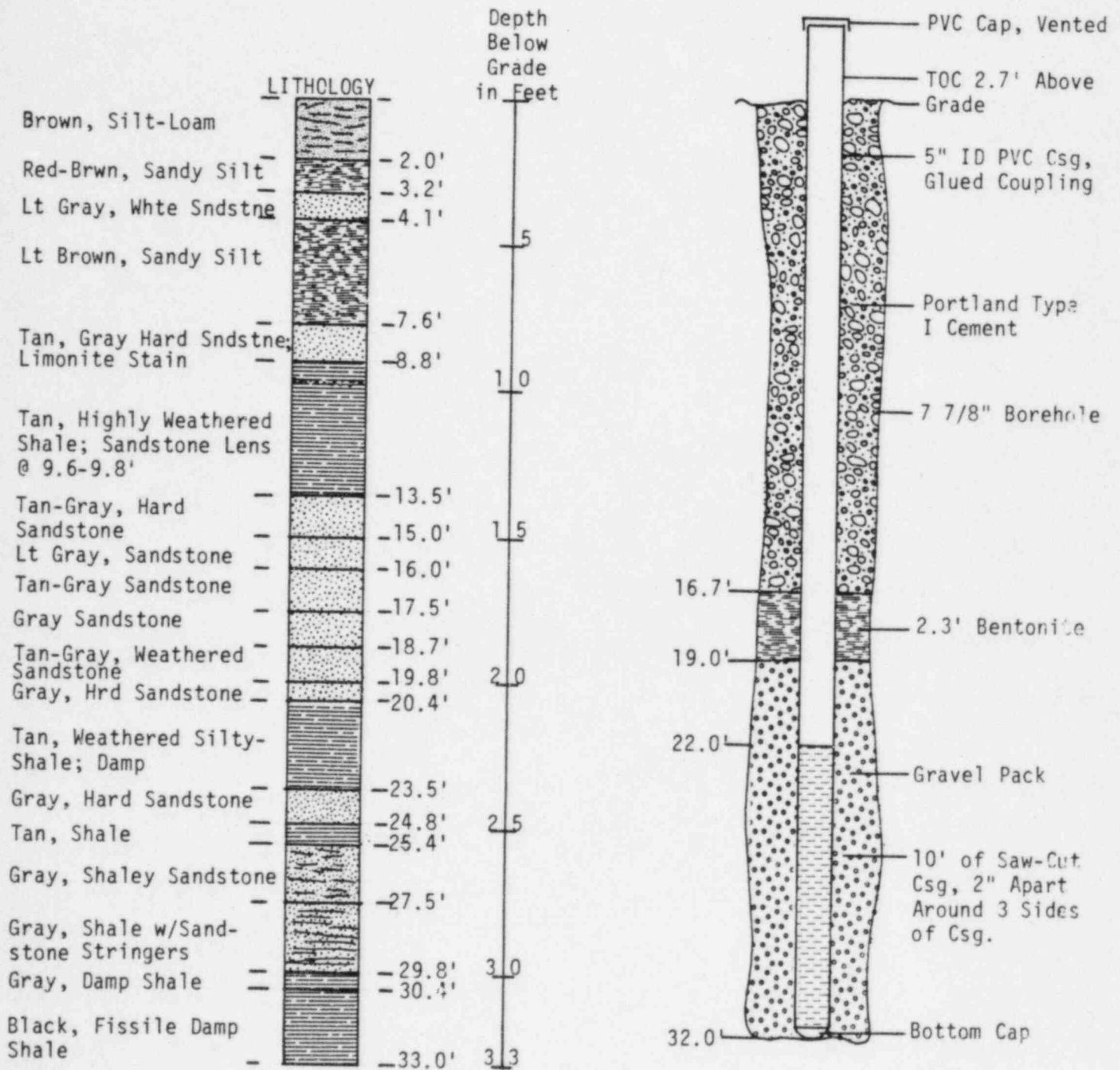
Well Installed: 11-11-85 by Jim Winnek, Inc.

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



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

MONITOR WELL 2322A  
NORTHWEST OF POND #3  
SEQUOYAH FUELS CORPORATION  
GORE, OK.

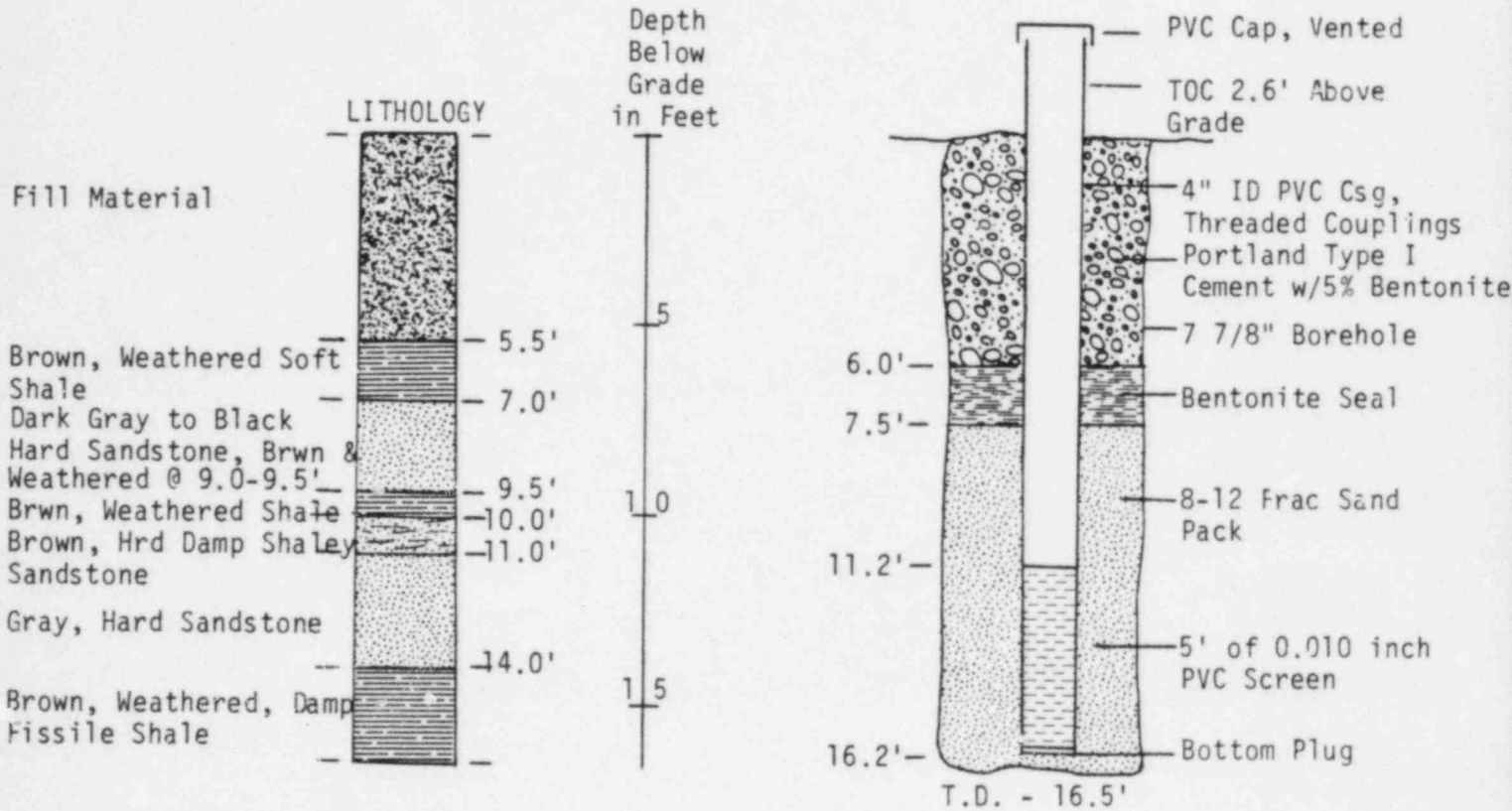


Well Installed: 4-3-85 By Hemphill Corporation

4/85

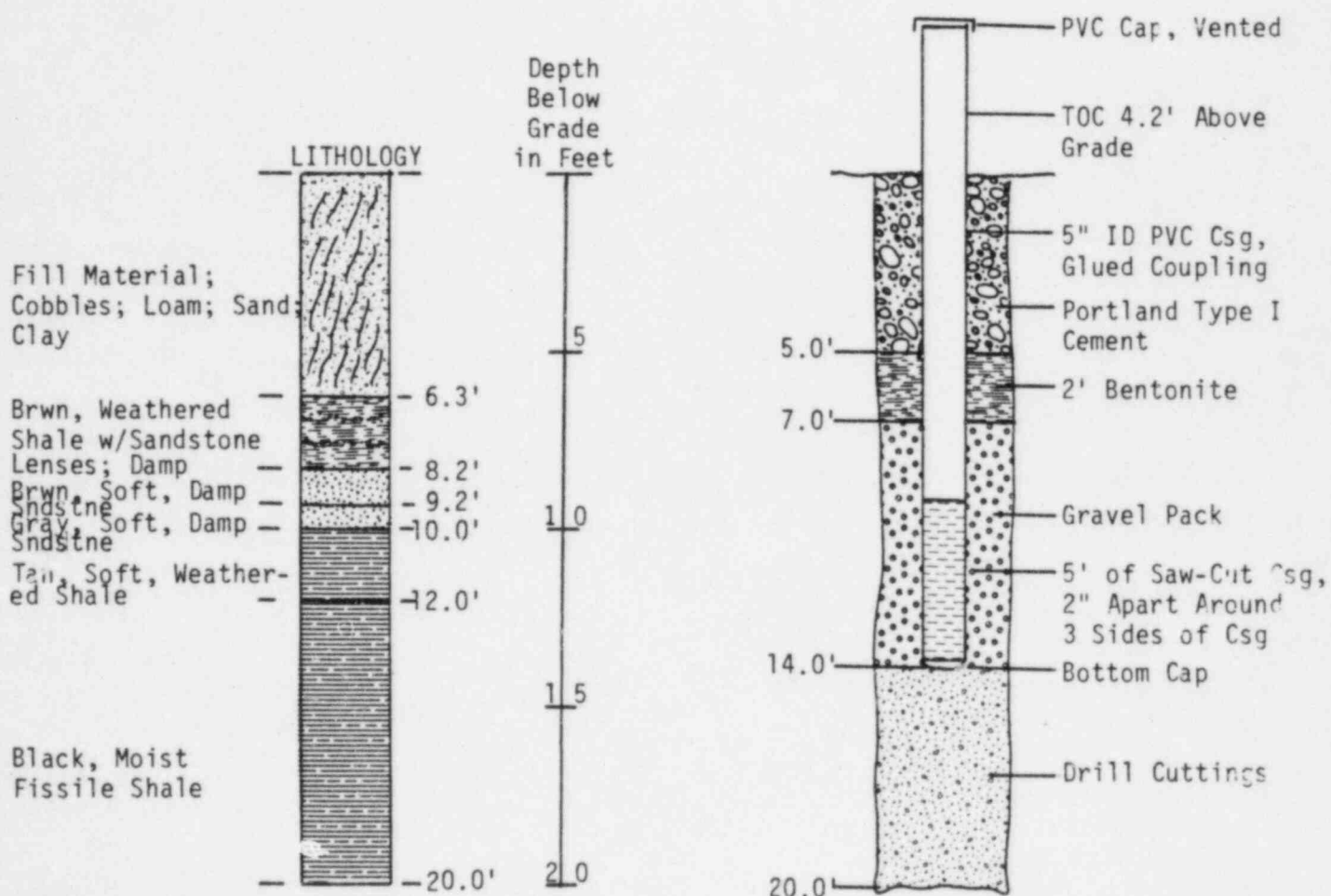


MONITOR WELL 2340A  
SOUTHWEST OF POND 5  
SEQUOYAH FUELS CORPORATION  
GORE, OK



Well Installed: 11-13-85 by Jim Winnek, Inc.

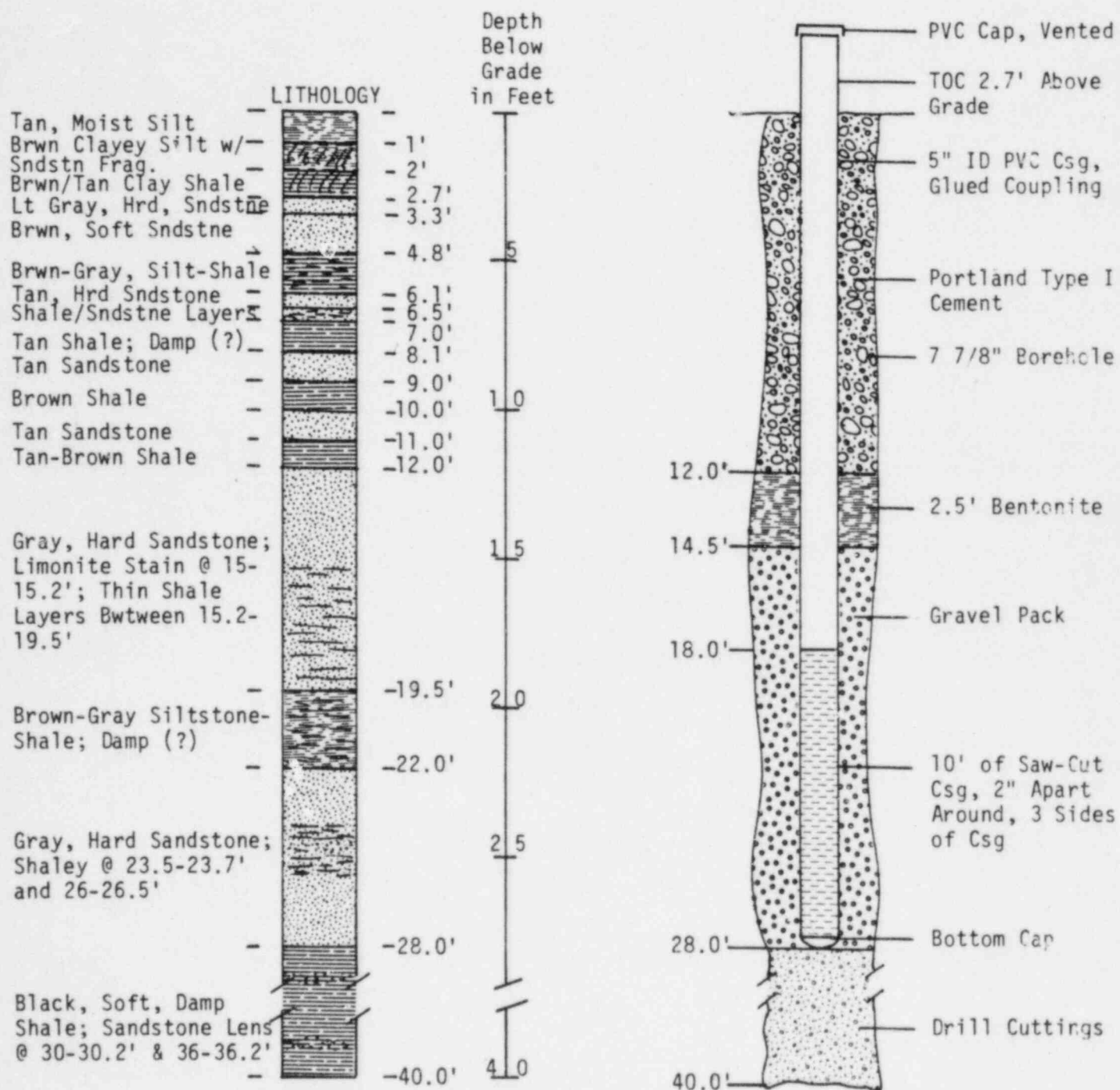
MONITOR WELL 2341  
WEST OF POND #5  
SEQUOYAH FUELS CORPORATION  
GORE, OK.



Well Installed: 4-4-85 By Hemphill Corporation

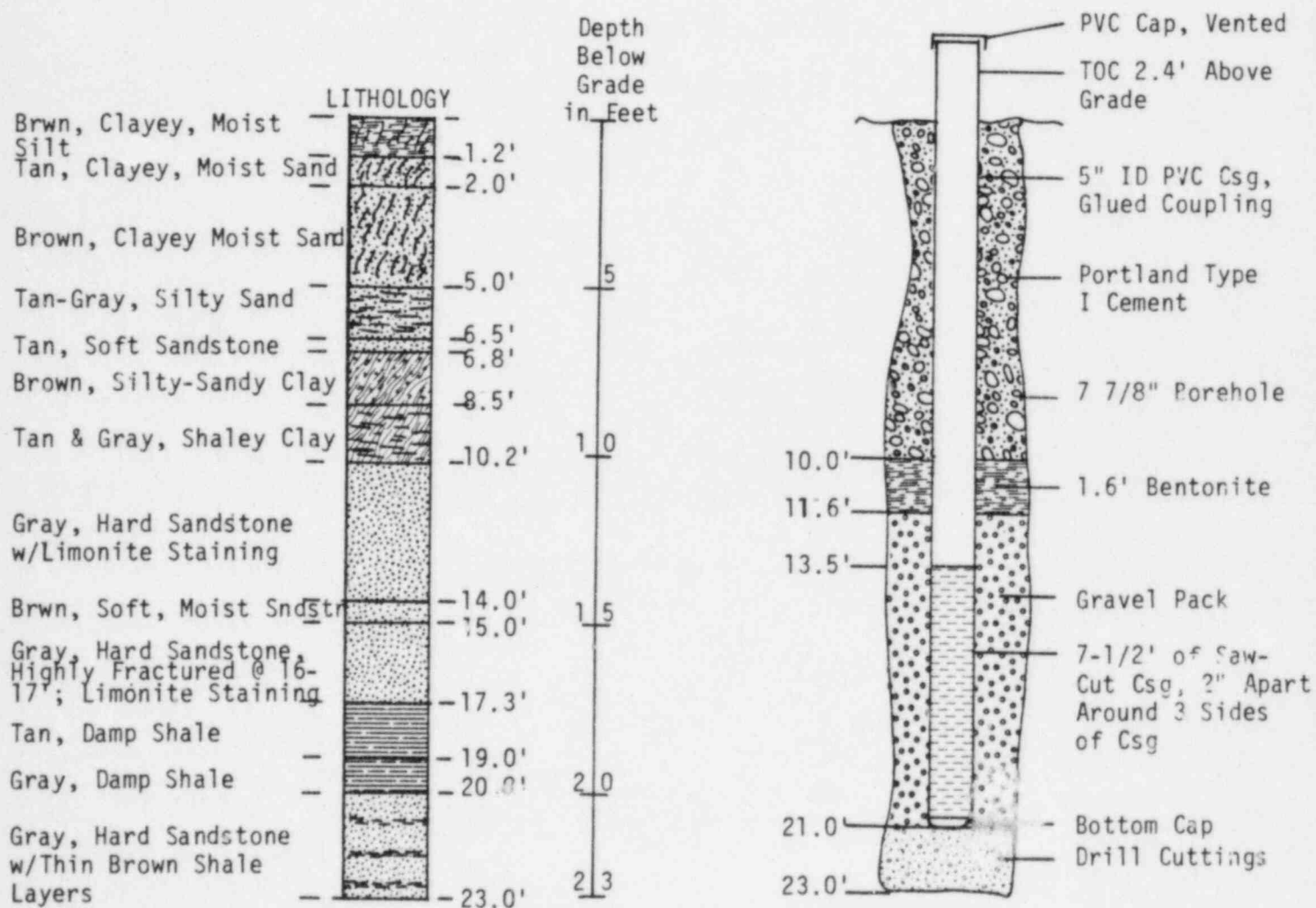
40 4/5

MONITOR WELL 2342  
SOUTH OF POND #5  
SEQUOYAH FUELS CORPORATION  
GORE, OK.



Well Installed: 4-2-85 By Hemphill Corporation

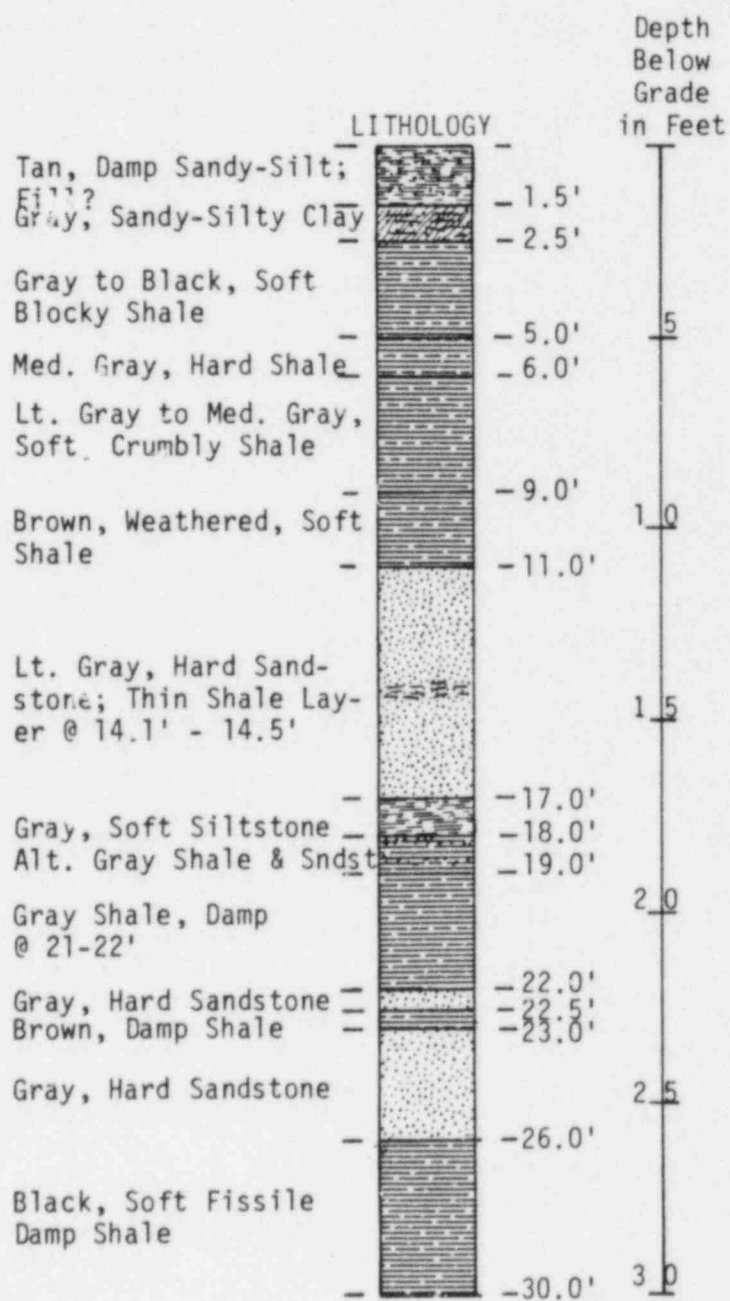
MONITOR WELL 2344  
SOUTHWEST OF POND #6  
SEQUOYAH FUELS CORPORATION  
GORE, OK.



Well Installed: 4-2-85 By Hemphill Corporation

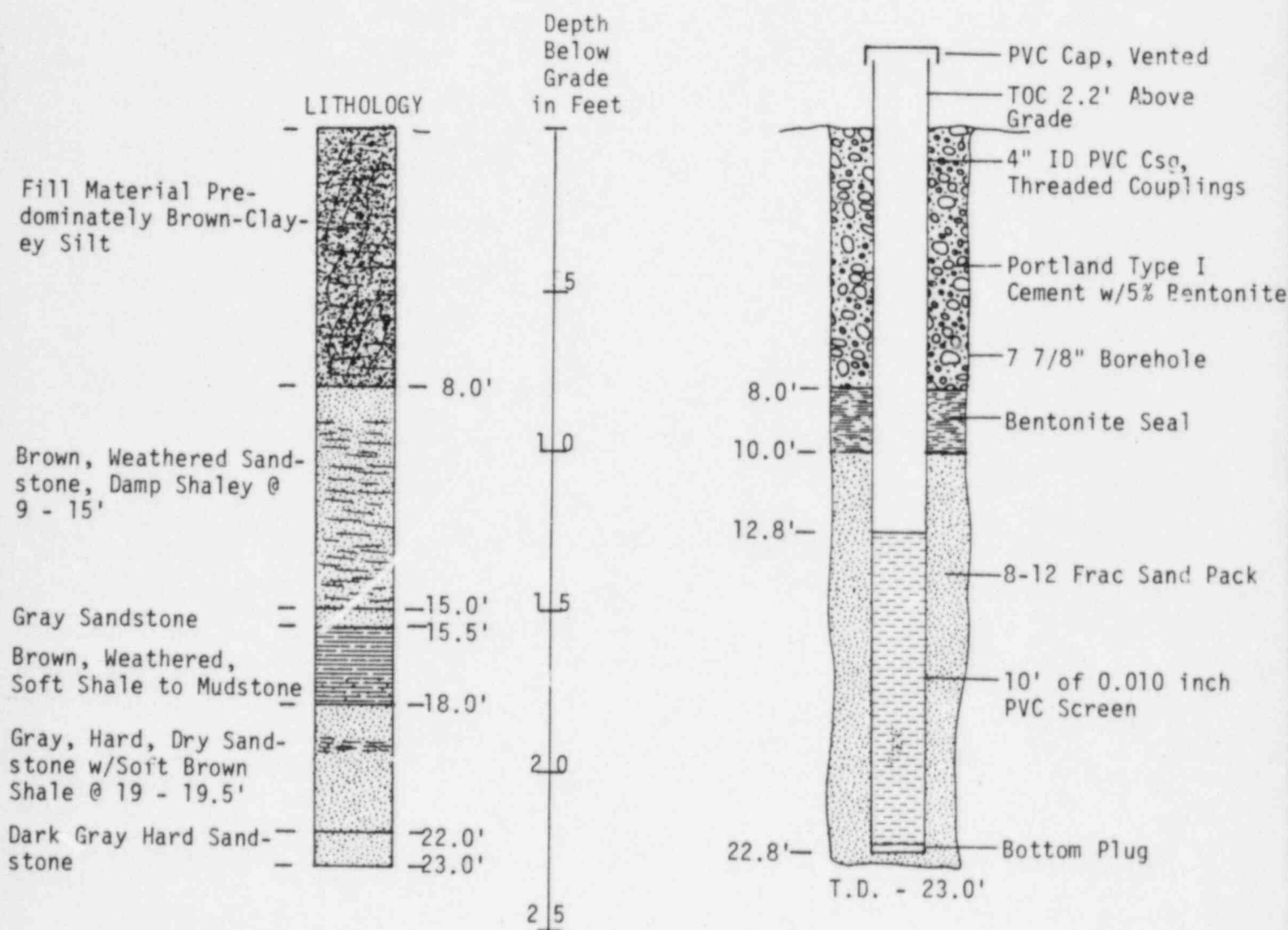
KB 6/85

MONITOR WELL 23  
SOUTH OF POND  
SEQUOYAH FUELS CORP  
GORE, OK



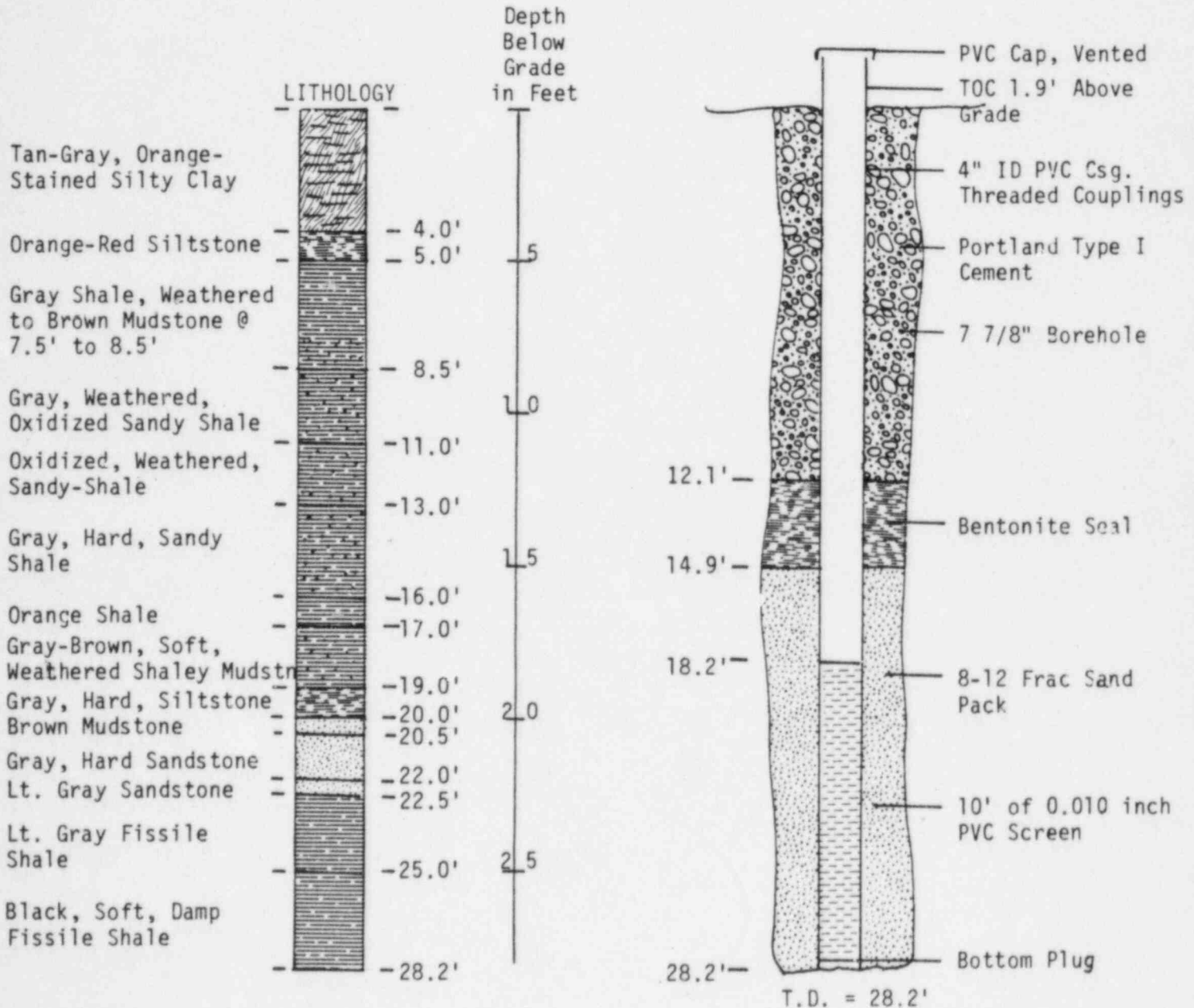
Well Installed: 11-12-85 by Jim Winnek, Inc.

MONITOR WELL 2346  
SOUTHWEST OF POND 6  
SEQUOYAH FUELS CORPORATION  
GORE, OK



Well Installed: 11-13-85 by Jim Winnek, Inc.

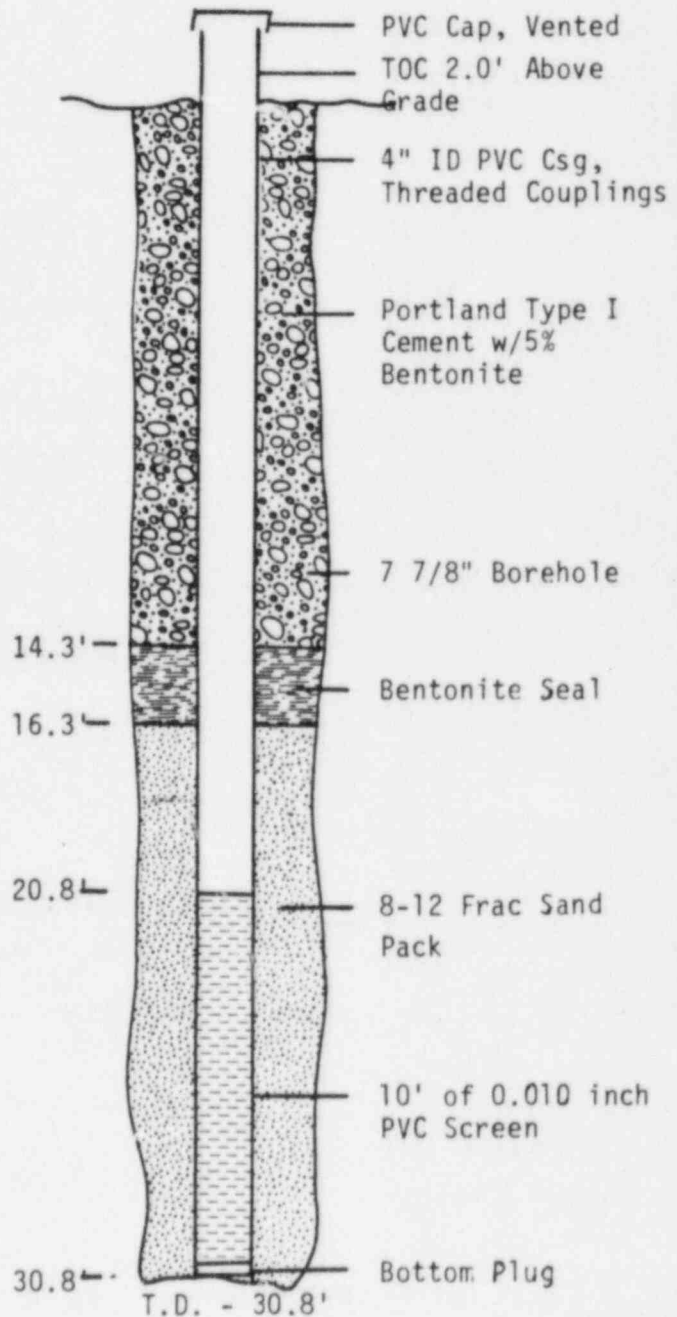
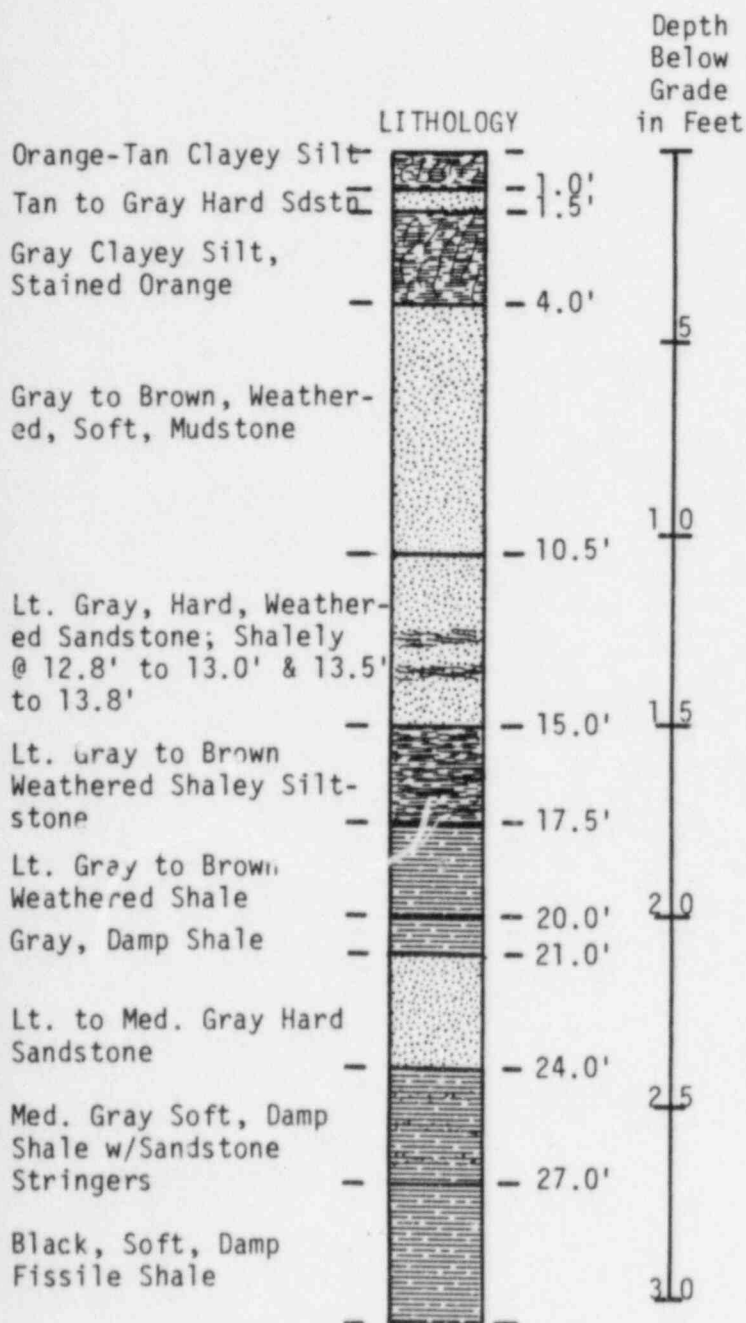
MONITOR WELL 2347  
EAST OF POND 6  
SEQUOYAH FUELS CORPORATION  
GORE, OK



Well Installed: 11-18-85 by Jim Winnek, Inc.

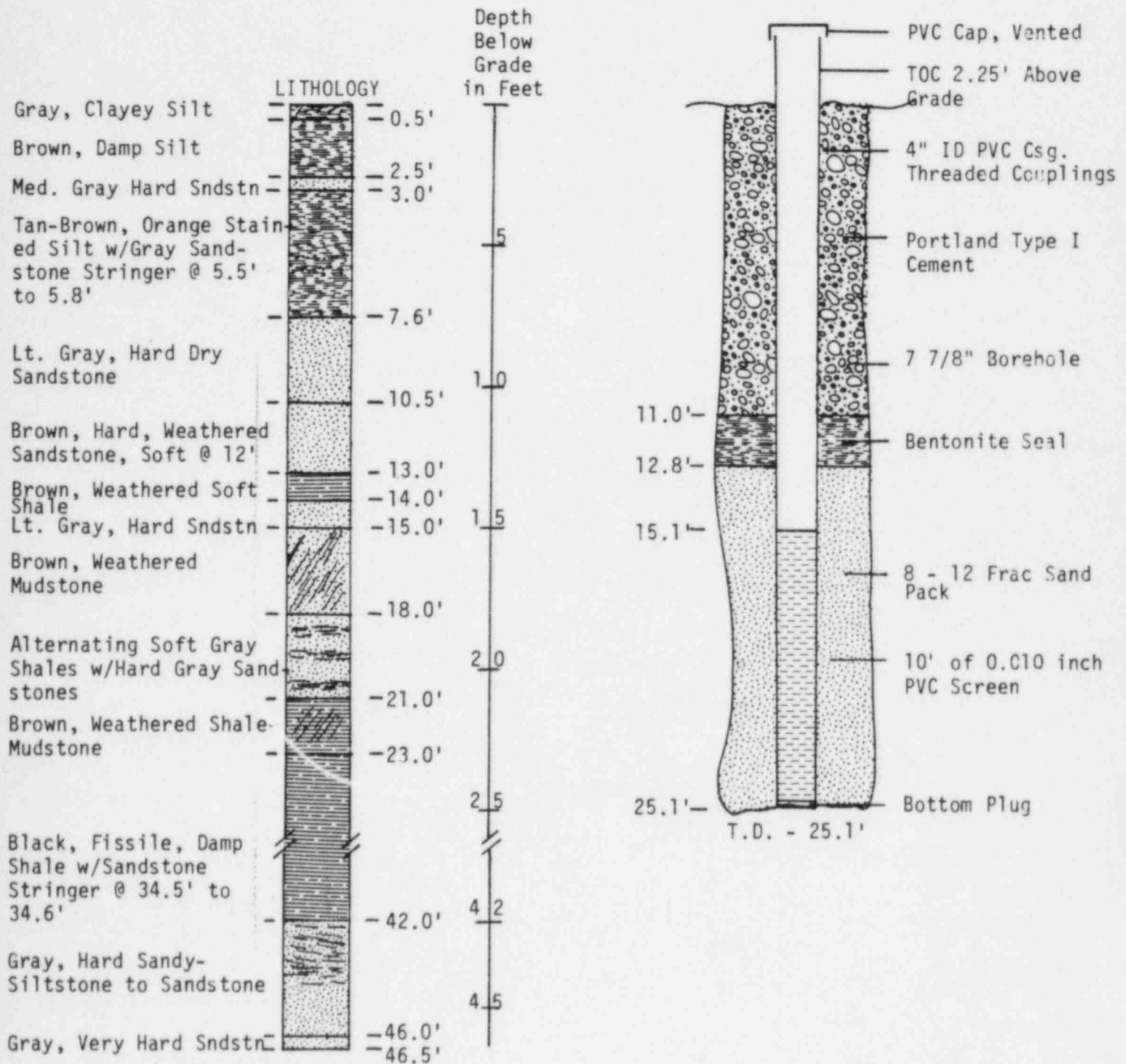


MONITOR WELL 2348  
NORTH OF POND 3  
SEQUOYAH FUELS CORPORATION  
GORE, OK



Well Installed: 11-13-85 by Jim Winnek, Inc.

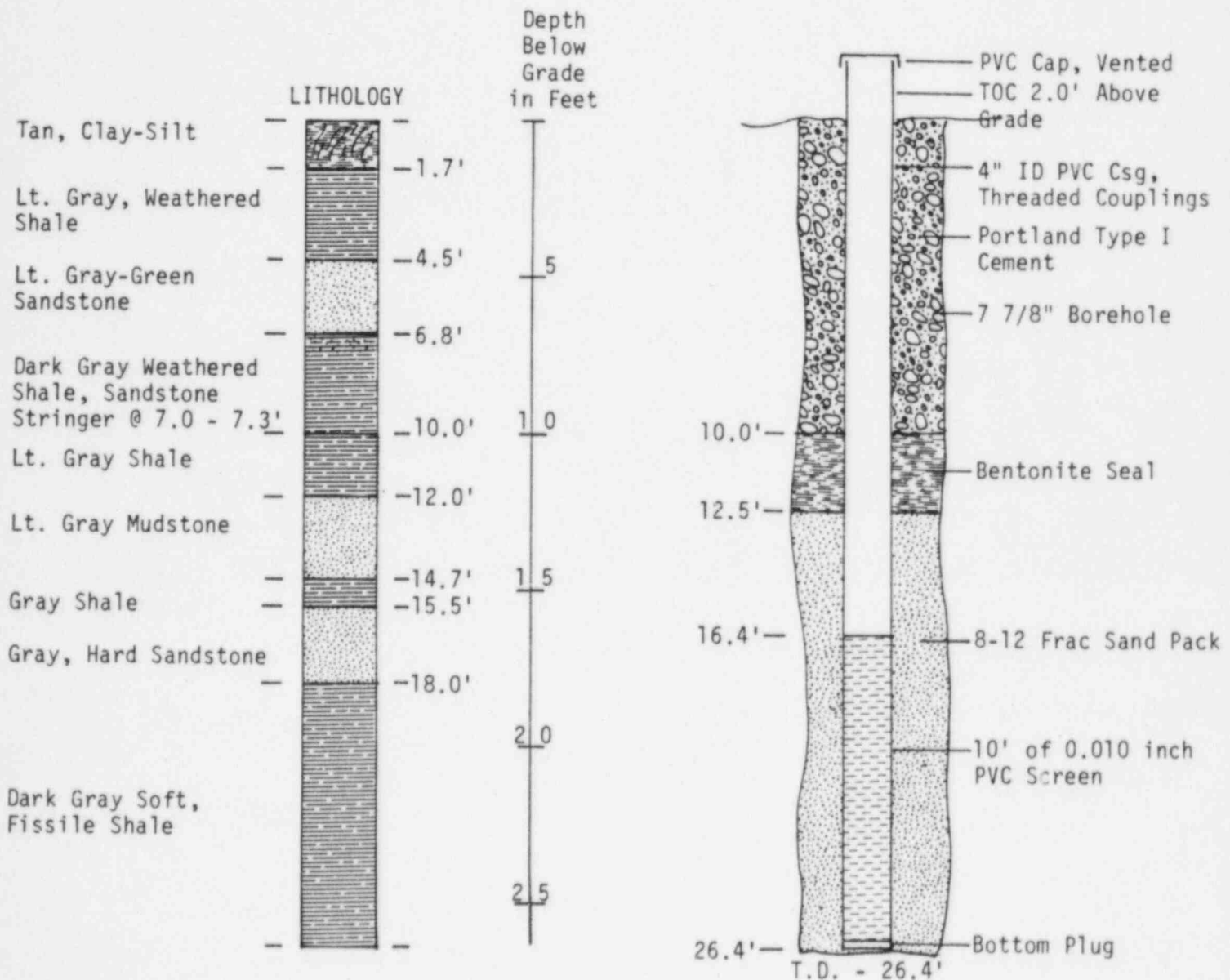
MONITOR WELL 2349  
NORTH OF POND 4  
SEQUOYAH FUELS CORPORATION  
GORE, OK



Well Installed: 11-14-85 by Jim Winnek, Inc.

Note: Lithologic Log From Pilot Hole Offset 5' From Monitor Well

MONITOR WELL 2350  
EAST OF POND 4  
SEQUOYAH FUELS CORPORATION  
GORE, OK



Well Installed: 11-19-85 by Jim Winnek, Inc.

## BORING LOG

HOLE NO. 1-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 1 OF 1

HOLE LOCATION See Boring Location Plan

DATE 11-19-67

G.S.D. ELEV. 536.6' G.W. ELEV.

BORED BY Risenhoover

LOGGED BY Same

SAMPLE DATA 2" Split Spoon

WT. OF HAMMER 140#

FALL OF HAMMER 30"

PENETROMETER DATA

WT. OF HAMMER

FALL OF HAMMER

AUGER DATA

CORE BARREL &amp; BIT DATA

| ELEV. | DEPTH AND SCALE | LOGS | NO. OF BLOWS PER FOOT | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency)                          | CODE RECOVERY | SAMPLE NO. | REMARKS<br>(Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.) |
|-------|-----------------|------|-----------------------|--|---------------|------------|---|
| 536.6 | 0.0             |      |                       |  |               |            |   |
|       |                 |      |                       | Silt, Brown, Sandy,<br>A little Clay, Moist  |               |            | Air Drilling  |
| 535.1 | 1.5             |      |                       |  |               |            | 1.0   |
|       |                 |      |                       | Clay, Tan and Brown,<br>Sandy, Silty, Moist,<br>Stiff w/Some Chert<br>Gravels up to 1/2" |               |            | Shelby Tube   |
|       | 3.0             |      |                       |  |               |            | 2.0   |
|       | 4.0             |      | 16                    |  |               |            |   |
| 531.1 | 5.5             |      |                       |  |               |            |   |
|       |                 |      |                       | Shale, Tan and Brown,<br>Soft w/Brown, Hard,<br>Sandstone Fragments                      |               |            |   |
| 528.1 | 8.5             |      |                       |  |               |            |   |
|       |                 |      |                       | Shale, Gray and Tan,<br>Firm   |               |            |   |
| 524.9 | 11.8            |      |                       |  |               |            |   |
|       |                 |      |                       | Sandstone, Gray, Fine<br>Grained, Hard   |               |            |   |
| 522.6 | 14.0            |      |                       |  |               |            | 14.0  |
|       |                 |      |                       | Bottom of Hole   |               |            |   |

HEMPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 1-A






## BORING LOG CONTINUATION SHEET

HOLE NO. 3-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 2 OF 2

| ELEV. | DEPTH AND SCALE | LEGEND  | NO. OF BLOWS PER FOOT |     |     |     |     | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | % CORE RECOVERY | SAMPLE NO. | REMARKS<br>(Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.) |
|-------|-----------------|---|-----------------------|-----|-----|-----|-----|---|-----------------|------------|---|
|       |                 |   | 0-1                   | 1-2 | 2-3 | 3-4 | 4-5 |   |                 |            |   |
|       | 22.9            |  |                       |     |     |     |     | Sandstone, Gray, Fine Grained, Hard w/Thin Gray Shale Lenses    |                 |            | Coring Cont'd   |
|       |                 |   |                       |     |     |     |     | Bottom of hole  |                 |            |   |

HEMPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 3-A

HOLE NO. 4-1

SHEET NO. 1 OF 2

DATE 11-20-67

LOGGED BY Same

WT. OF HAMMER 140# FALL OF HAMMER 30"

WT. OF HAMMER

FALL OF HAMMER

CODE BARREL &amp; BIT DATA

Heavy Duty NX

HOLE NO. 4-A


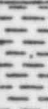
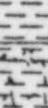
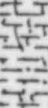
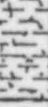


## BORING LOG CONTINUATION SHEET

HOLE NO. 4-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 2 OF 2

| ELEV. | DEPTH AND SCALE<br>20.0 | LEGEND  | NO. OF BLOWS PER FOOT | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | % CORE RECOVERY | SAMPLE NO. | REMARKS<br>(Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.) |
|-------|-------------------------|---|-----------------------|---|-----------------|------------|---|
|       |                         |   |                       |   |                 |            |   |
| 516.7 | 21.7                    |  |                       | Sandstone, Calcareous, Hard                                     | 86%             |            | Coring Cont'd   |
| 514.4 | 24.0                    |  |                       | Shale, Gray, Tan, Friable                                       |                 |            |   |
| 510.4 | 28.0                    |  |                       | Shale, Gray, Sandy  |                 |            |   |
| 504.4 | 34.0                    |  |                       | Shale, Gray   |                 |            | Note: Water Seepage in Core.  |
|       |                         |  |                       | Bottom of Hole  |                 |            | 34.0  |

HEMPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 4-A

# BORING LOG

HOLE NO. 5-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 1 OF 3

WELL LOCATION See Boring Location Plan

DATE 11-15-67

SPD. ELEV. 541.1'

G.W. ELEV.

LOGGED BY Risenhoover

LOGGED BY Same

SAMPLER DATA 2" Split Spoon

WT. OF HAMMER 140#

FALL OF HAMMER 30"

PENETROMETER DATA

WT. OF HAMMER

FALL OF HAMMER

AUGER DATA

CORE BARREL & BIT DATA

Heavy Duty NX

| ELEV. | DEPTH AND SCALE | GRIT | NO. OF BLOWS PER FOOT | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | % CORE RECOVERY | SAMPLE NO. | REMARKS<br>(Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.) |
|-------|-----------------|------|-----------------------|---|-----------------|------------|---|
| 541.1 | 0.0             |      |                       |   |                 |            |   |
| 540.1 | 1.0             |      |                       | Silt, Brown, Loose, Moist                                       |                 |            | Air Drilling  |
|       |                 |      |                       | Clay, Silty, Yellow, Moist                                      |                 |            |   |
| 538.6 | 2.5             |      |                       |   |                 |            |   |
|       | 3.0             |      |                       | Clay, Silty, Multicolored w/Some Gravel 1/4" to 1/2"            |                 |            |   |
|       | 4.0             |      | 20                    |   |                 |            |   |
| 536.1 | 5.0             |      |                       |   |                 |            |   |
|       |                 |      |                       | Clay, Shaley, Multicolored                                      |                 |            |   |
| 534.8 | 6.3             |      |                       |   |                 |            |   |
| 533.6 | 7.5             |      |                       | Sandstone w/Clay Layers Weathered, Tan, Medium to Fine Grained  |                 |            |   |
|       |                 |      |                       | Shale, Tan, Silty, Friable Soft                                 |                 |            |   |
| 530.8 | 10.3            |      |                       |   |                 |            |   |
|       |                 |      |                       | Sandstone, Gray, Tan w/Shale Layers Weathered                   |                 |            | Coring 11.0   |
|       |                 |      |                       |   | 74.2%           |            |   |
| 523.1 | 18.0            |      |                       |   |                 |            |   |
| 522.6 | 18.5            |      |                       | Sandstone, Gray-Tan   |                 |            |   |
|       |                 |      |                       | Sandstone, Gray, Medium to Fine Grained, Calcareous Hard        |                 |            |   |
|       | 20.0            |      |                       |   |                 |            | Cont'd 20.0   |

HEMPHILL & SHELLEY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 5-A

## HOLE NO. 5-4

SHEET NO. 2 OF 3

Cont'd 42.5

HOLE NO. 5-A

## BORING LOG CONTINUATION SHEET

HOLE NO. 5-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 3 OF 3

| ELEV. | DEPTH<br>AND<br>SCALE | LEGEND | NO. OF BLOWS<br>PER FOOT |   |   |   |   | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | % CORE<br>RECOVERY | SAMPLE<br>NO. | REMARKS<br>(Drilling Characteristics, Drilling<br>Fluid Loss, Casing Data, Etc.) |
|-------|-----------------------|--------|--------------------------|---|---|---|---|---|--------------------|---------------|--|
|       |                       |        | 0                        | 1 | 2 | 3 | 4 |   |                    |               |  |
|       |                       |        |                          |   |   |   |   | Shale, Blue   | 74.2%              |               | Coring Cont'd  |
| 491.7 | 49.4                  |        |                          |   |   |   |   | Sandstone, Gray (Shaley)<br>Calcareous                          |                    |               |  |
| 481.9 | 59.2                  |        |                          |   |   |   |   | Bottom of Hole  |                    |               | 59.2   |

HEMPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 5-A

# BORING LOG

HOLE NO. 6-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

WELL LOCATION See Boring Location Plan

SHEET NO. 1 OF 2

GRID ELEV. 541.1 G.W. ELEV.

BORED BY Risenhoover

DATE 11-20-67

SAMPLER DATA 2" Solit Spoon

LOGGED BY Same

PENETROMETER DATA

WT. OF HAMMER 140#

FALL OF HAMMER 30"

AUGER DATA

WT. OF HAMMER

FALL OF HAMMER

CORE BARREL & BIT DATA Heavy Duty NX

| ELEV. | DEPTH AND SCALE | CIRCUIT | NO. OF BLOWS "PER FOOT" |   |   |   |   |    | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | CORE RECOVERY % | SAMPLE NO. | REMARKS<br>(Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.) |
|-------|-----------------|---------|-------------------------|---|---|---|---|----|---|-----------------|------------|---|
|       |                 |         | 1                       | 2 | 3 | 4 | 5 | 6  |   |                 |            |   |
| 541.1 | 0.0             |         |                         |   |   |   |   |    |   |                 |            |   |
| 540.1 | 1.0             |         |                         |   |   |   |   |    | Silt, Sandy, Brown  |                 |            | Air Drilling  |
|       | 3.0             |         |                         |   |   |   |   |    | Clay, Sandy, Silty, Yellow, Multicolored                        |                 |            | 2.0   |
|       | 4.0             |         |                         |   |   |   |   | 24 |   |                 |            | Shelby Tube 3.0   |
| 532.6 | 8.5             |         |                         |   |   |   |   |    |   |                 |            |   |
| 531.1 | 10.0            |         |                         |   |   |   |   |    | Shale, Clayey, Tan  |                 |            |   |
|       |                 |         |                         |   |   |   |   |    | Sandstone, Green, Gray w/Clay Layers                            |                 |            | Coring 10.2   |
| 528.3 | 12.0            |         |                         |   |   |   |   |    |   |                 |            |   |
|       |                 |         |                         |   |   |   |   |    | Shale, Clayey, Gray, Tan  |                 |            |   |
| 522.1 | 19.0            |         |                         |   |   |   |   |    |   |                 |            |   |
|       | 20.0            |         |                         |   |   |   |   |    | Sandstone, Gray, Shaley, Calcareous                             |                 |            | Cont'd 20.0   |

HENPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 6-A


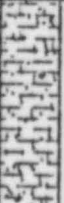


## BORING LOG CONTINUATION SHEET

HOLE NO. 6-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 2 OF 2

| ELEV. | DEPTH<br>AND<br>SCALE | LEGEND  | NO. OF BLOWS<br>PER FOOT |   |   |   |   | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | CORE<br>RECOVERY | SAMPLE<br>NO. | REMARKS<br>(Drilling Characteristics, Drilling<br>Fluid Loss, Casing Data, Etc.) |
|-------|-----------------------|---|--------------------------|---|---|---|---|---|------------------|---------------|--|
|       |                       |   | 0                        | 1 | 2 | 3 | 4 |   |                  |               |  |
| 516.1 | 25.0                  |  |                          |   |   |   |   | Sandstone, Gray, Shaley,<br>Calcareous                          | 63%              |               | Coring Cont'd  |
| 510.9 | 30.2                  |  |                          |   |   |   |   | Shale, Sandy, Gray, Hard  |                  |               | 30.2   |
|       |                       |   |                          |   |   |   |   | Bottom of Hole  |                  |               |  |

HEMPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 6

## BORING LOG

HOLE NO. 7-1

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 1 OF 1

HOLE LOCATION See Boring Location Plan

DATE 11-19-67

GND. ELEV. 543.7' G.W. ELEV.

BORED BY Risenhoover

LOGGED BY Same

SAMPLER DATA 2" Split Spoon

WT. OF HAMMER 140#

FALL OF HAMMER 30"

PENETROMETER DATA

WT. OF HAMMER

FALL OF HAMMER

AUGER DATA

CORE BARREL &amp; BIT DATA

Heavy Duty NX

| ELEV. | DEPTH AND SCALE | LEGEND | NO. OF BLOWS PER FOOT | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | CORE RECOVERY % | REMARKS<br>(Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.) |
|-------|-----------------|--------|-----------------------|---|-----------------|---|
| 543.7 | 0.0             |        |                       |   |                 |   |
|       | 1.0             |        |                       | Silt, Brown, Sandy, A Little Clay, Moist                        |                 | Air Drilling  |
| 542.2 | 1.5             |        |                       |   |                 |   |
|       | 2.0             |        | 9                     | Clay, Brown, Tan, Sandy, Silty, Moist, Stiff                    |                 | 2.0   |
|       |                 |        |                       |   |                 | Shelby Tube 3.0   |
|       |                 |        |                       |   |                 | Shelby Tube 4.0   |
| 538.2 | 5.5             |        |                       |   |                 |   |
|       |                 |        |                       | Shale, Tan, Soft  |                 |   |
| 535.9 | 7.8             |        |                       |   |                 |   |
|       |                 |        |                       | Shale, Tan and Gray, Firm                                       |                 |   |
| 533.7 | 10.0            |        |                       |   |                 | Coring 10.0   |
|       |                 |        |                       | Sandstone, w/Shale Layers, Gray                                 | 40%             |   |
| 529.7 | 14.0            |        |                       |   |                 |   |
|       |                 |        |                       | Shale, Gray, Tan, Weathered, Friable                            |                 |   |
| 523.7 | 20.0            |        |                       | (Bottom of Hole)  |                 | 20.0  |

HEMPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 7



# BORING LOG

HOLE NO. 9-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 1 OF 1

HOLE LOCATION See Boring Location Plan

DATE 11-21-67

SPD. ELEV. 537.5' G.W. ELEV.

BORED BY Risenhoover

LOGGED BY Same

SAMPLER DATA 2" Split Spoon

WT. OF HAMMER 140# FALL OF HAMMER 30"

PENETROMETER DATA

WT. OF HAMMER FALL OF HAMMER

AUGER DATA

CORE BARREL & BIT DATA Heavy Duty NX

| ELEV. | DEPTH AND SCALE | CORRECTION | NO. OF BLOWS PER FOOT |   | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | % CORE RECOVERY | SAMPLE NO. | REMARKS<br>(Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.) |
|-------|-----------------|------------|-----------------------|---|---|-----------------|------------|---|
|       |                 |            | 0                     | 1 |   |                 |            |   |
| 537.5 | 0.0             |            |                       |   |   |                 |            |   |
| 536.7 | 0.8             |            |                       |   | Silt, Sandy (Moist)   |                 |            | Air Drilling  |
|       | 1.0             |            |                       |   |   |                 |            |   |
|       | 2.0             |            | 14                    |   | Clay, Sandy, Silty, Multicolored                                |                 |            |   |
|       | 4.0             |            |                       |   |   |                 |            |   |
|       | 5.0             |            | 32                    |   |   |                 |            |   |
| 531.5 | 6.0             |            |                       |   |   |                 |            |   |
|       |                 |            |                       |   | Shale, Clayey, Soft, Tan, Friable                               |                 |            |   |
| 529.3 | 8.2             |            |                       |   |   |                 |            |   |
| 528.5 | 9.0             |            |                       |   | Sandstone, Gray, Green, Weathered w/Clay Lenses                 |                 |            |   |
|       |                 |            |                       |   | Shale, w/Sandstone Lenses, Tan                                  |                 |            |   |
| 526.8 | 10.5            |            |                       |   |   |                 |            |   |
|       | 10.7            |            |                       |   |   |                 |            | 10.7  |
|       |                 |            |                       |   | Bottom of Hole  |                 |            |   |

HEMPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 9

# BORING LOG

HOLE NO. 10-A

PROJECT Kerr-McGee - Uranium Hexafluoride Conversion Facility

SHEET NO. 1 OF 2

HOLE LOCATION See Boring Location Plan

DATE 11-21-67

END. ELEV. 537.1' G.W. ELEV.

BORED BY Risenhoover

LOGGED BY Same

SAMPLER DATA 2" Split Spoon

WT. OF HAMMER 140#

FALL OF HAMMER 30"

PENETROMETER DATA

WT. OF HAMMER

FALL OF HAMMER

AUGER DATA

CODE BARREL & BIT DATA

Heavy Duty IX

| ELEV. | DEPTH AND SCALE | NO. OF BLOWS PER FOOT | DESCRIPTION OF MATERIALS<br>(Type, Color, Texture, Consistency) | % CORE RECOVERY | REMARKS<br>(Drilling Characteristics, Drilling Fluid Loss, Casing Data, Etc.) |
|-------|-----------------|-----------------------|---|-----------------|---|
| 537.1 | 0.0             |                       |   |                 |   |
| 536.1 | 1.0             |                       | Silt, Sandy, Brown, Moist                                       |                 | Air Drilling  |
|       |                 |                       | Clay, Sandy, Silty, Multicolored                                |                 | 2.0   |
|       | 3.5             |                       |   |                 | Shelby Tube   |
|       | 4.5             | 24                    |   |                 | 3.0   |
| 530.6 | 6.5             |                       |   |                 |   |
| 529.4 | 7.7             |                       | Shale, Clayey, Tan, Soft  |                 |   |
|       |                 |                       | Sandstone, Tan & Gray, Green, Hard                              |                 |   |
| 522.6 | 14.5            |                       |   | 46.1%           | Coring 13.5   |
|       |                 |                       | Sandstone & Shale, Tan, Soft                                    |                 |   |
| 517.1 | 20.0            |                       |   |                 | Cont'd 20.0   |

HEMPHILL & SHELBY DRILLING COMPANY  
TULSA, OKLAHOMA

HOLE NO. 10-A





# BORING LOG

HOLE NO. 58

PROJECT Borrow Area for Raffinate Pond Five

SHEET 1 OF 1

HOLE LOCATION 11,520N 7,650E

DATE 9-27-83

GR. ELEV. WATER TABLE Dry

BORED BY Gabby

LOGGED BY Matheson

| ELEV. | DEPTH AND SCALE | COND | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY)       | CASING INFORMATION                          |        |           |         |
|-------|-----------------|------|--|---|--------|-----------|---------|
|       |                 |      |  | SIZE  | FT-RUN | FT-PULLED | FT-LEFT |
|       | 4.0             |      | CLAY, Sandy, Silty, Red-Tan  |   |        |           |         |
|       | 5.7             |      | CLAY, Shaley, Sandy, Silty, Red-Tan                                  |   |        |           |         |
|       | 9.3             |      | SANDSTONE, Tan, Soft to Medium Hard, w/Shale and Clayey Shale Layers |   |        |           |         |
|       | 12.0            |      | SHALE, Tan w/Trace of Black w/Sandstone Lenses                       |   |        |           |         |
|       | 14.0            |      | SANDSTONE, Gray, Hard to Very Hard                                   |   |        |           |         |
|       |                 |      | Bottom of Hole   |   |        |           |         |
|       |                 |      |  | DRILLING MUD<br>TYPE NO SACKS               |        |           |         |
|       |                 |      |  | PENETRATION TEST<br>FROM TO BLOWS/6"        |        |           |         |
|       |                 |      |  | SHELL TUBE SAMPLES<br>NO FROM TO            |        |           |         |
|       |                 |      |  | CORING<br>FROM TO RECOVERY                  |        |           |         |
|       |                 |      |  | WATER LOSS<br>CEMENT (NO. SACKS)<br>REMARKS |        |           |         |



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TULSA, OKLAHOMA 74145

AFTER HOURS 597-8822















## BORING LOG

HOLE NO. p7B

PROJECT Sequoyah Fuels, Raffinate Ponds, 6, 7, 8 SHEET 1 OF 1  
 HOLE LOCATION Coordinates: N= 10800 E= 8990 (See Plan) DATE 1-9-85  
 GR. ELEV. 533.5 WATER TABLE None BORED BY Lane LOGGED BY Lane

AFTER DRILLING - Dry

| ELEV. | DEPTH AND SCALE | LOG | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION  |        |           |         |
|-------|-----------------|-----|--|---------------------|--------|-----------|---------|
|       |                 |     |  | SIZE                | FT-RUN | FT-PULLED | FT-LEFT |
| 532.1 | 1.4             |     | SILT, Sandy, Brown, Moist                                      |                     |        |           |         |
| 531.5 | 2.0             |     | SAND, Fine Grained, Silty, Tan, Moist                          |                     |        |           |         |
|       |                 |     | CLAY, Silty, Tan, Moist  |                     |        |           |         |
| 527.0 | 6.5             |     |  |                     |        |           |         |
|       |                 |     | CLAY, Sandy, Silty, Tan-Gray, Moist                            |                     |        |           |         |
| 523.0 | 10.5            |     |  |                     |        |           |         |
|       |                 |     | SANDSTONE, Hard, Gray  |                     |        |           |         |
| 520.5 | 13.0            |     |  |                     |        |           |         |
|       |                 |     | Bottom of hole   |                     |        |           |         |
|       |                 |     | NOTE: Cemented hole bottom to top<br>(1.5 Sacks)               |                     |        |           |         |
|       |                 |     |  | DRILLING MUD        |        |           |         |
|       |                 |     |  | TYPE NO. SACKS      |        |           |         |
|       |                 |     |  | BAG SAMPLES         |        |           |         |
|       |                 |     |  | NO.                 | FROM   | TO        |         |
|       |                 |     |  | 1                   | 0.0    | 1.4       |         |
|       |                 |     |  | 2                   | 2.0    | 4.0       |         |
|       |                 |     |  | 3                   | 4.0    | 6.5       |         |
|       |                 |     |  | 4                   | 6.5    | 8.8       |         |
|       |                 |     |  | 5                   | 8.8    | 10.3      |         |
|       |                 |     |  | 6                   | 10.3   | 13.0      |         |
|       |                 |     |  | SHELBY TUBE SAMPLES |        |           |         |
|       |                 |     |  | NO.                 | FROM   | TO        |         |
|       |                 |     |  | 1                   | 4.0    | 5.0       |         |
|       |                 |     |  | 2                   | 9.5    | 10.5      |         |
|       |                 |     |  | CORING              |        |           |         |
|       |                 |     |  | FROM                | TO     | RECOVERY  |         |
|       |                 |     |  |                     |        |           |         |
|       |                 |     |  |                     |        |           |         |
|       |                 |     |  |                     |        |           |         |
|       |                 |     |  |                     |        |           |         |
|       |                 |     |  |                     |        |           |         |
|       |                 |     |  |                     |        |           |         |
|       |                 |     |  |                     |        |           |         |
|       |                 |     |  |                     |        |           |         |
|       |                 |     |  | WATER LOSS          |        |           |         |
|       |                 |     |  | CEMENT (NO. SACKS)  |        |           |         |
|       |                 |     |  | REMARKS             |        |           |         |



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AFTER HOURS 587-5822







HOLE NO. p7D

AFTER DRILLING - Dry

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TULSA, OKLAHOMA 74145

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AFTER HOURS 587.5822

[illegible]

# BORING LOG

HOLE NO. P-3

PROJECT Raffinate Pond 3 SHEET 1 OF 1  
 HOLE LOCATION Station: N11600, E8069 DATE 1-4-78  
 GR. ELEV. \_\_\_\_\_ WATER TABLE None BORED BY Lane LOGGED BY Hemphill  
 (After 24 hours)

| ELEV. | DEPTH AND SCALE | LGND     | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION   |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-------|-----------------|----------|--|--|--------|-----------|---------|------|------|----------|---|-----|-----|---|-----|-----|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
|       |                 |          |  | SIZE   | FT-RUN | FT-PULLED | FT-LEFT |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       | 2.1             |          | SILT, Brown  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       | 3.9             |          | CLAY, Sandy, Tan-Red Brown, Moist                              | DRILLING MUD<br>TYPE _____ NO. SACKS _____   |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       | 5.2             |          | SANDSTONE, Gray  | PENETRATION TEST<br><table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>FROM</th> <th>TO</th> <th>BLOWS/6"</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>               |        |           |         | FROM | TO   | BLOWS/6" |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FROM  | TO              | BLOWS/6" |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       | 7.5             |          | CLAY, Silty, Tan-Gray  | SHELBY TUBE SAMPLES<br><table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>NO.</th> <th>FROM</th> <th>TO</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3.0</td> <td>4.0</td> </tr> <tr> <td>2</td> <td>7.0</td> <td>7.5</td> </tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table> |        |           |         | NO.  | FROM | TO       | 1 | 3.0 | 4.0 | 2 | 7.0 | 7.5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| NO.   | FROM            | TO       |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1     | 3.0             | 4.0      |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2     | 7.0             | 7.5      |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       | 9.0             |          | SANDSTONE, Tan w/Clay Seam at 8.5-9.0.                         |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          | Bottom of hole   | CORING<br><table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>FROM</th> <th>TO</th> <th>RECOVERY</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>                         |        |           |         | FROM | TO   | RECOVERY |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| FROM  | TO              | RECOVERY |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|       |                 |          |  |  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|       |                 |          | NOTE: Bag samples taken at: 6.0-7.0.                           | WATER LOSS _____<br>CEMENT (NO. SACKS) _____<br>REMARKS _____  |        |           |         |      |      |          |   |     |     |   |     |     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

## HEMPHILL CORPORATION

4834 SOUTH 83RD EAST  
TULSA, OKLAHOMA 74145

OFFICE (918) 822-8133

AFTER HOURS 987-9822



## BORING LOG

HOLE NO. P-7

PROJECT Raffinate Pond 3

SHEET 1 OF 1

HOLE LOCATION Station: N11,00, E8489

DATE 1-4-78

GR. ELEV. WATER TABLE 11.00 BORED BY Lane  
(After 24 hours)

LOGGED BY Hemphill

| ELEV. | DEPTH AND SCALE | LGND. | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION  |        |           |         |
|-------|-----------------|-------|--|---------------------|--------|-----------|---------|
|       |                 |       |  | SIZE                | FT-RUN | FT-PULLED | FT-LEFT |
|       | 0.7             |       | SILT, Brown  |                     |        |           |         |
|       | 1.6             |       | CLAY, Very Silty, Tan, Moist                                   | DRILLING MUD        |        |           |         |
|       |                 |       | CLAY, Red Brown  | TYPE                |        | NO. SACKS |         |
|       | 3.0             |       | CLAY, Silty w/Sandstone Fragments, Tan-Gray                    | PENETRATION TEST    |        |           |         |
|       |                 |       |  | FROM                | TO     | BLOWS/6"  |         |
|       | 5.0             |       |  |                     |        |           |         |
|       |                 |       |  |                     |        |           |         |
|       |                 |       |  |                     |        |           |         |
|       |                 |       | CLAY, Tan w/Sandstone Lenses, Broken                           |                     |        |           |         |
|       | 7.0             |       |  |                     |        |           |         |
|       | 7.5             |       | SANDSTONE, Broken, Gray  |                     |        |           |         |
|       |                 |       | CLAY, Sandy w/Sandstone Fragments, Tan-Gray                    |                     |        |           |         |
|       | 8.5             |       | SHALE, Clayey, Tan-Gray w/Sandstone Lenses                     | SHELBY TUBE SAMPLES |        |           |         |
|       |                 |       |  | NO.                 | FROM   | TO        |         |
|       |                 |       |  | 1                   | 2.0    | 3.0       |         |
|       |                 |       |  |                     |        |           |         |
|       |                 |       |  |                     |        |           |         |
|       | 12.8            |       |  |                     |        |           |         |
|       |                 |       | SANDSTONE, Gray-Tan, Firm                                      | CORING              |        |           |         |
|       |                 |       |  | FROM                | TO     | RECOVERY  |         |
|       | 14.0            |       |  |                     |        |           |         |
|       |                 |       | Bottom of hole   |                     |        |           |         |
|       |                 |       |  |                     |        |           |         |
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CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

HEMPHILL CORPORATION

4834 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74145

OFFICE (918) 822-9133

AFTER HOURS 987-9122









# BORING LOG

HOLE NO. P-14

PROJECT Raffinate Pond 3

SHEET 1 OF 1

HOLE LOCATION Station: N11460, E8391

DATE 1-4-71

GR. ELEV.            WATER TABLE None BORED BY Lane

LOGGED BY           

(After 24 hours)

| ELEV. | DEPTH AND SCALE | LOG | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION |        |           |         |
|-------|-----------------|-----|--|--------------------|--------|-----------|---------|
|       |                 |     |  | SIZE               | FT-RUN | FT-PULLED | FT-LEFT |
|       | 1.0             |     | SILT, Brown  |                    |        |           |         |
|       | 2.0             |     | SILT, Tan  |                    |        |           |         |
|       | 4.0             |     | CLAY, Red Brown-Tan, Sandy                                     |                    |        |           |         |
|       | 6.0             |     | CLAY, Silty, Red Brown, Low Moisture                           |                    |        |           |         |
|       | 7.0             |     | CLAY, Tan, Sandy,  |                    |        |           |         |
|       | 8.0             |     | CLAY, Silty w/Sandstone Fragments, Tan                         |                    |        |           |         |
|       | 9.0             |     | SANDSTONE, Tan   |                    |        |           |         |
|       | 9.5             |     | SANDSTONE, Gray  |                    |        |           |         |
|       | 11.5            |     | CLAY, Shaley, Sandy, Tan                                       |                    |        |           |         |
|       | 13.0            |     | SANDSTONE, Gray  |                    |        |           |         |
|       | 13.8            |     | SHALE, Gray-Tan  |                    |        |           |         |
|       | 14.2            |     | SANDSTONE, Gray  |                    |        |           |         |
|       | 17.0            |     | SHALE, Gray-Tan w/Sandstone Lense at 16.0                      |                    |        |           |         |
|       |                 |     | Bottom of hole   |                    |        |           |         |
|       |                 |     | NOTE: Bag samples taken at:<br>4.0-5.0, 7.0-8.0.               |                    |        |           |         |

DRILLING MUD  
TYPE            NO SACKS           

PENETRATION TEST  
FROM            TO            BLOWS/6"           

SHELBY TUBE SAMPLES  
NO.            FROM            TO           

CORING  
FROM            TO            RECOVERY           

WATER LOSS             
CEMENT (NO. SACKS)             
REMARKS           



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

HEMPHILL CORPORATION

4834 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74145

OFFICE (918) 822-5133

AFTER HOURS 587-8822

# BORING LOG

HOLE NO. P-16

PROJECT Raffinate Pond 3

SHEET 1 OF 1

HOLE LOCATION Station: 411460, F8586 Hole offset 15' South DATE 1-4-78

GR. ELEV. WATER TABLE None BORED BY Lane LOGGED BY Hemphill  
(After 24 hours)

| ELEV | DEPTH AND SCALE | LGND | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION |        |           |         |
|------|-----------------|------|--|--------------------|--------|-----------|---------|
|      |                 |      |  | SIZE               | FT-RUN | FT-PULLED | FT-LEFT |
|      |                 |      | SILT, Brown, Moist   |                    |        |           |         |
|      | 2.0             |      |  |                    |        |           |         |
|      |                 |      | SILT, Tan, Very Moist  |                    |        |           |         |
|      | 3.0             |      |  |                    |        |           |         |
|      |                 |      | CLAY, Red Brown-Tan, Moist                                     |                    |        |           |         |
|      | 4.1             |      |  |                    |        |           |         |
|      |                 |      | CLAY, Silty, Tan   |                    |        |           |         |
|      | 5.0             |      |  |                    |        |           |         |
|      |                 |      | CLAY, Silty, Gray-Tan, Moist                                   |                    |        |           |         |
|      | 6.1             |      |  |                    |        |           |         |
|      |                 |      | CLAY, Silty, Brown & Gray w/Sandstone & Shale Seams            |                    |        |           |         |
|      | 8.0             |      |  |                    |        |           |         |
|      |                 |      | SHALE, Tan-Gray, Sandy   |                    |        |           |         |
|      | 9.2             |      |  |                    |        |           |         |
|      |                 |      | SANDSTONE w/Tan Shale Lenses                                   | 1                  | 3.0    | 4.0       |         |
|      | 10.0            |      |  | 2                  | 8.0    | 9.0       |         |
|      |                 |      | SHALE, Sandy, Tan-Gray w/Sandstone Lenses                      |                    |        |           |         |
|      |                 |      |  |                    |        |           |         |
|      |                 |      |  |                    |        |           |         |
|      |                 |      |  |                    |        |           |         |
|      | 15.0            |      |  |                    |        |           |         |
|      |                 |      | SANDSTONE, Gray, Fine-Grained, Hard                            |                    |        |           |         |
|      |                 |      |  |                    |        |           |         |
|      |                 |      |  |                    |        |           |         |
|      |                 |      |  |                    |        |           |         |
|      |                 |      |  |                    |        |           |         |
|      | 18.0            |      |  |                    |        |           |         |
|      |                 |      | Bottom of hole   |                    |        |           |         |
|      |                 |      | NOTE: Bag samples taken at:<br>4.0-5.0, 5.0-6.1, 7.0-8.0       |                    |        |           |         |

WATER LOSS

CEMENT (NO. SACKS)

REMARKS



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

## HEMPHILL CORPORATION

4834 SOUTH 83RD EAST AVENUE

TULSA, OKLAHOMA 74145

OFFICE: (918) 822-9133

AFTER HOURS 887-8822

## BORING LOG

HOLE NO. P-17

PROJECT Raffinate Pond 3

SHEET 1 OF 1

HOLE LOCATION Station: N11320, E7874

DATE 1-4-78

GR. ELEV. WATER TABLE None BORED BY Lane  
(After 24 hours)

LOGGED BY hemphill

| ELEV.                                   | DEPTH AND SCALE | LGND | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION  |        |           |         |
|---|-----------------|------|--|---------------------|--------|-----------|---------|
|   |                 |      |  | SIZE                | FT-RUN | FT-PULLED | FT-LEFT |
|   | 1.8             |      | CLAY, Sandy, Brown   |                     |        |           |         |
|   | 4.0             |      | CLAY, Silty w/Sandstone Fragments, Red Brown                   |                     |        |           |         |
|   |                 |      | Bottom of hole   |                     |        |           |         |
| NOTE: Bag samples taken at:<br>3.0-4.0. |                 |      |  | DRILLING MUD        |        |           |         |
|   |                 |      |  | TYPE                |        | NO SACKS  |         |
|   |                 |      |  | PENETRATION TEST    |        |           |         |
|   |                 |      |  | FROM                | TO     | BLOWS/FT  |         |
|   |                 |      |  |                     |        |           |         |
|   |                 |      |  |                     |        |           |         |
|   |                 |      |  |                     |        |           |         |
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|   |                 |      |  |                     |        |           |         |
|   |                 |      |  | SHELBY TUBE SAMPLES |        |           |         |
|   |                 |      |  | NO.                 | FROM   | TO        |         |
|   |                 |      |  | 1                   | 2.0    | 3.0       |         |
|   |                 |      |  |                     |        |           |         |
|   |                 |      |  |                     |        |           |         |
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|   |                 |      |  | CORING              |        |           |         |
|   |                 |      |  | FROM                | TO     | RECOVERY  |         |
|   |                 |      |  |                     |        |           |         |
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|   |                 |      |  | WATER LOSS          |        |           |         |
|   |                 |      |  | CEMENT (NO. SACKS)  |        |           |         |
|   |                 |      |  | REMARKS             |        |           |         |



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

HEMPHILL CORPORATION

4834 SOUTH 83RD EAST AVENUE

TULSA, OKLAHOMA 74145

OFFICE (918) 822-5133

AFTER HOURS 887-9822













# BORING LOG

HOLE NO. P-28

PROJECT Raffl: ate Pond 3

SHEET 1 OF 1

HOLE LOCATION Station: N11180, E8294

DATE 1-4-76

GR. ELEV. WATER TABLE None BORED BY Lane

LOGGED BY Hemphill

(After 24 hours)

| ELEV                                    | DEPTH AND SCALE | LGND | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION |        |           |         |            |
|---|-----------------|------|--|--------------------|--------|-----------|---------|------------|
|   |                 |      |  | SIZE               | FT-RUN | FT-PULLED | FT-LEFT |            |
|   | 2.0             |      | SILT, Brown, Moist   |                    |        |           |         |            |
|   | 3.3             |      | CLAY, Silty, Tan   |                    |        |           |         |            |
|   | 4.0             |      | CLAY, Red Brown-Gray w/Gravel                                  |                    |        |           |         |            |
|   |                 |      | Bottom of hole   |                    |        |           |         |            |
| NOTE: Bag samples taken at:<br>2.0-3.0. |                 |      |  | DRILLING MUD       |        |           |         |            |
|   |                 |      |  | TYPE               |        | NO. SACKS |         |            |
|   |                 |      |  | PENETRATION TEST   |        |           |         |            |
|   |                 |      |  | FROM               |        | TO        |         | BLOWS / FT |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
| SHELBY TUBE SAMPLES                     |                 |      |  |                    |        |           |         |            |
| NO.                                     |                 | FROM |  | TO                 |        |           |         |            |
| 1                                       |                 | 3.0  |  | 4.0                |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
| CORING                                  |                 |      |  |                    |        |           |         |            |
| FROM                                    |                 | TO   |  | RECOVERY           |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
|   |                 |      |  |                    |        |           |         |            |
| WATER LOSS                              |                 |      |  |                    |        |           |         |            |
| CEMENT (NO. SACKS)                      |                 |      |  |                    |        |           |         |            |
| REMARKS                                 |                 |      |  |                    |        |           |         |            |



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

HEMPHILL CORPORATION

4834 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74145

OFFICE: (918) 822-5133

AFTER HOURS 587-8822

|          |      |
|----------|------|
| HOLE NO. | P-30 |
|----------|------|

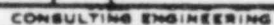
2-30

SHEET 1 OF 1

DATE 1-4-

LOGGED BY Hempfl.

NOTE: Bag samples taken at:  
3.0-4.0, 5.0-6.5.



GEOLOGICAL INVESTIGATION

[illegible]

4834 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74145

OFFICE: (010) 622-5133

AFTER HOURS 587-2822



2321

Blugged 4/85

WELL FILE

HEMPHILL CORPORATION

OFFICE (918) 622-5132

4834 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74145

AFTER HOURS 587-5822

## DAILY DRILL REPORT AND LOG

# 2321

Hole No. OW-1 Date 8-3/4/8/9-78 Depth 0 To 20 Shift \_\_\_\_\_ Drill No. CF-15  
 Client Kerr - McGee Address Gore, Oklahoma  
 Project Location Raffinate Pond Area Hole Location As Directed  
 Client's Representative Jim Carr Driller Curtis Cooper Hrs. \_\_\_\_\_  
 Helper Sidney Lane Hrs. \_\_\_\_\_ Helper Matt Ferguson Hrs. \_\_\_\_\_

## BITS USED

| No. | Type  | Size   | From | To |
|-----|-------|--------|------|----|
|     | Drag  | 5'     | 0    | 10 |
|     | Auger | 12"    | 0    | 10 |
|     | Rock  | 7 5/8" | 8    | 20 |

## DIAMOND BITS USED

| Serial No. | Size | From | To |
|------------|------|------|----|
|            |      |      |    |
|            |      |      |    |
|            |      |      |    |

## MUD AND LOSS CIRCULATION MATERIAL

| Manufacturer | No. Sacks | Weight | CEMENT | Size | Ft - Run | Ft - Pulled | Ft - Left |
|--------------|-----------|--------|--------|------|----------|-------------|-----------|
| Cement       | Old Hole  |        | 4      | 8"   | 11'      |             | 11'       |
|              |           |        | 4      | 5"   | 22'      |             | 22'       |

## STAND BY TIME (HRS.)

Rig

Rig &amp; Crew

| DEPTH |      | FORMATIONS                            | TYPE DRLG. | DRILLING TIME |      |      |    | CORE LOSS |
|-------|------|---------------------------------------|------------|---------------|------|------|----|-----------|
| From  | To   |                                       |            | Start         | Stop | From | To |           |
| 0     | 2.8  | SILT, Dark Brown, Dry                 |            |               | :    |      |    |           |
| 2.8   | 3.8  | SILT, Tan, Dry                        |            |               |      |      |    |           |
| 3.8   | 7.0  | CLAY, Tan, Dry                        |            |               |      |      |    |           |
| 7.0   | 10.5 | SHALE, Tan & Gray, Clayey             |            |               |      |      |    |           |
| 10.5  | 13.5 | CLAY, Tan, w/Sandstone Fragments, Tan |            |               |      |      |    |           |
| 13.5  | 17.0 | SANDSTONE, Gray, Hard                 |            |               |      |      |    |           |
| 17.0  | 19.5 | SANDSTONE, w/Shale Lenses, Hard       |            |               |      |      |    |           |
| 19.5  | 20.0 | SHALE, Black                          |            |               |      |      |    |           |

Observation Wells

8" PVC - 11' &amp; Cemented

5" PVC - 22'

Perforated 15' - 20' (3 Holes  
Per 1' Intervals)

Gravel Pack 0-20

## PENETRATION TESTS

| From | To | Blows | From | To | Blows |
|------|----|-------|------|----|-------|
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |

Note: Drilled out Old Hole  
& Grouted to Surface

SAME HOLE AS 1-6-78

## SHELBY TUBE SAMPLES

| From | To | From | To | From | To |
|------|----|------|----|------|----|
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |

WATER DEPTH WHILE DRILLING (FT)

(24 HRS)

P. Lugged 185  
LOG

HOLE NO. 091

SHEET 2 OF 2

DATE 1-6-78

LOGGED BY Hemphill

(After 24 hours)

| ELEV. | DEPTH AND SCALE | LGND | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION  |        |            |         |
|-------|-----------------|------|--|---------------------|--------|------------|---------|
|       |                 |      |  | SIZE                | FT-RUN | FT-PULLED  | FT-LEFT |
|       | 22.0            |      | SANDSTONE, Fine Grained, Gray w/Limonite Partings              |                     |        |            |         |
|       | 24.0            |      | SHALE, Gray, Weathered, Moist                                  | DRILLING MUD        |        |            |         |
|       | 25.5            |      | SHALE, Silty, Gray, Hard w/Vertical Fracture                   | TYPE                |        | NO. SACKS  |         |
|       | 27.0            |      | SHALE, Silty, Gray, Hard                                       | PENETRATION TEST    |        |            |         |
|       | 28.5            |      | SHALE, Silty, Gray, Hard w/Vertical Fracture                   | FROM                | TO     | BLOWS / FT |         |
|       | 30.3            |      | SHALE, Silty, Gray, Hard                                       | SHELBY TUBE SAMPLES |        |            |         |
|       | 30.3            |      | SHALE, Black, Moist w/Iron Pyrite Lense at 38.1                | NO.                 | FROM   | TO         |         |
|       | 39.5            |      | Bottom of hole   | CORING              |        |            |         |
|       |                 |      |  | FROM                | TO     | RECOVERY   |         |
|       |                 |      |  | 20.0                | 24.5   | 62.2%      |         |
|       |                 |      |  | 24.5                | 29.5   | 100%       |         |
|       |                 |      |  | 29.5                | 34.5   | 86%        |         |
|       |                 |      |  | 34.5                | 39.5   | 100%       |         |
|       |                 |      |  | WATER LOSS          |        |            |         |
|       |                 |      |  | CEMENT (NO. SACKS)  |        |            |         |
|       |                 |      |  | REMARKS             |        |            |         |



GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

HEMPHILL CORPORATION

4834 SOUTH 83RD EAST AVENUE

OFFICE-(218) 622-5133

TULSA OKLAHOMA 74145

AFTER HOURS 567.5822

G-24



## BORING LOG

HOLE NO. 0W1

11081 N

SHEET 1 OF 2

7711 E

DATE 1-6-78

WATER TABLE 13.5'

BORED BY

Lane

LOGGED BY Hemphill

(After 24 hours)

| ELEV. | DEPTH AND SCALE | LOG NO. | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION |        |           |         |
|-------|-----------------|---------|--|--------------------|--------|-----------|---------|
|       |                 |         |  | SIZE               | FT-RUN | FT-PULLED | FT-LEFT |
|       |                 |         | SILT, Tan  |                    |        |           |         |
|       | 3.5             |         |  |                    |        |           |         |
|       | 4.5             |         | CLAY, Sandy, Tan w/Some Gray                                   |                    |        |           |         |
|       | 6.0             |         | CLAY, Silty, Red-Brown-Tan, Low Moisture                       |                    |        |           |         |
|       | 7.5             |         | CLAY, Silty, Red-Brown, Moist                                  |                    |        |           |         |
|       | 10.0            |         | CLAY, Sandy, Tan w/Some Gray, Moist                            |                    |        |           |         |
|       | 12.5            |         | CLAY, Sandy, Tan w/Gravel                                      |                    |        |           |         |
|       | 14.0            |         | SANDSTONE, Tan-Gray  |                    |        |           |         |
|       | 20.0            |         | SANDSTONE, Fine Grained, Gray w/Limonite Partings              |                    |        |           |         |



GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

HEMPHILL CORPORATION

4834 SOUTH 83RD EAST AVENUE

TULSA, OKLAHOMA 74145

AFTER HOURS 587-5822

2322

## HEMPHILL CORPORATION

4834 SOUTH 82ND EAST AVENUE  
TULSA, OKLAHOMA 74145

OFFICE (918) 622-5133

AFTER HOURS 587-2822

## DAILY DRILL REPORT AND LOG

# 2322

Hole No. Off-2 Date 8-8/9-78 Depth 0 To 17 Shift \_\_\_\_\_ Drill No. Cf-15  
 Client Kerr-McGee Address Gore, Oklahoma  
 Project Location Raffinate Pond Area Hole Location As Directed  
 Client's Representative Jim Carr Driller Curtis Cooper Hrs. \_\_\_\_\_  
 Helper \_\_\_\_\_ Hrs. \_\_\_\_\_ Helper Sidney Lane Hrs. \_\_\_\_\_

## BITS USED

| No. | Type | Size   | From | To |
|-----|------|--------|------|----|
|     | Drag | 5"     | 0    | 12 |
|     | Rock | 12"    | 0    | 12 |
|     | Rock | 7 5/8" | 12   | 17 |

## DIAMOND BITS USED

| Serial No. | Size | From | To |
|------------|------|------|----|
|            |      |      |    |
|            |      |      |    |
|            |      |      |    |

## MUD AND LOSS CIRCULATION MATERIAL

| Manufacturer | No. Sacks | Weight |
|--------------|-----------|--------|
|              |           |        |
|              |           |        |
|              |           |        |

## CEMENT

| No. Sacks | Size |
|-----------|------|
| 4         | 8"   |
| 4         | 5"   |

## CASING INFORMATION

| Ft - Run | Ft - Pulled | Ft - Left |
|----------|-------------|-----------|
| 13'      |             | 13'       |
| 19'      |             | 19'       |

## DEPTH

## STAND BY TIME (HRS.)

## Rig

## Rig &amp; Crew

| From | To   | FORMATIONS                      | TYPE DRLG. | Start | Stop | From | To | CORE LOSS |
|------|------|---------------------------------|------------|-------|------|------|----|-----------|
| 0    | 1.5  | SILT, Tan, Dry                  |            |       |      |      |    |           |
| 1.5  | 3.5  | CLAY, Brown, Shaley             |            |       |      |      |    |           |
| 3.5  | 4.3  | SANDSTONE, Tan, Hard            |            |       |      |      |    |           |
| 4.3  | 7.4  | CLAY, Tan, Shaley               |            |       |      |      |    |           |
| 7.4  | 8.0  | SANDSTONE, Tan, Medium Hard     |            |       |      |      |    |           |
| 8.0  | 13.8 | SHALE, Weathered, Tan & Gray    |            |       |      |      |    |           |
| 13.8 | 15.0 | SANDSTONE, Gray, Hard           |            |       |      |      |    |           |
| 15.0 | 17.0 | SHALE, Gray, w/Sandstone Lenses |            |       |      |      |    |           |

## Observation Wells

8" PVC - 13' &amp; Cemented

5" PVC - 19'

Perforated 12' - 17' (3

Holes Per 1' Intervals)

Gravel Pack 0-17

Note: Drilled Out Old

Hole & Grouted To  
Surface

## PENETRATION TESTS

| From | To | Blows | From | To | Blows |
|------|----|-------|------|----|-------|
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |

## SHELBY TUBE SAMPLES

| From | To | From | To | From | To |
|------|----|------|----|------|----|
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |

WATER DEPTH WHILE DRILLING (FT)

(24 HRS)

2322

042

[Signature]  
 [Signature]

# 7322

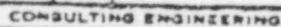
2-1-1963

DATE 1-5-78

BORED BY      Lane

LOGGED BY Hemphill

| Casing Information  |        |             |           |  |  |
|---------------------|--------|-------------|-----------|--|--|
| Size                | ft-run | ft-pulled   | ft-let    |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
| Drilling Mud        |        |             |           |  |  |
| Type                |        |             | No. Sacks |  |  |
| Penetration Test    |        |             |           |  |  |
| From                | To     | BloWS / ft. |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
| SHELBY TUBE SAMPLES |        |             |           |  |  |
| No.                 | FROM   | TO          |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
| CORING              |        |             |           |  |  |
| FROM                | TO     | RECOVERY    |           |  |  |
| 24.0                | 29.0   | 100%        |           |  |  |
| 29.0                | 34.0   | 90%         |           |  |  |
| 34.0                | 39.0   | 98%         |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
|                     |        |             |           |  |  |
| WATER LOSS          |        |             |           |  |  |
| CEMENT (NO. SACKS)  |        |             |           |  |  |
| REMARKS             |        |             |           |  |  |



GEOLOGICAL INVESTIGATION

## ENGINEERING INSPECTION

4034 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74145

OFFICE (918) 622-5133

AFTER HOURS 587.5822

# BORING LOG

2322

PROJECT Raffinate Pond 3

11653 N

WELL NO. OW2

HOLE LOCATION 75' N.W. of Point "E"

7757 E

SHEET 1 OF 2

GR. ELEV. 526

WATER TABLE 33.5'

BORED BY Lane

DATE 1-5-78

(After 24 hours)

| ELEV. | DEPTH AND SCALE | LOG | -DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION |        |           |         |
|-------|-----------------|-----|---|--------------------|--------|-----------|---------|
|       |                 |     |   | SIZE               | FT-RUN | FT-PULLED | FT-LEFT |
|       | 1.0             |     | SILT, Brown   |                    |        |           |         |
|       | 2.0             |     | SILT, Red-Brown   |                    |        |           |         |
|       | 3.8             |     | CLAY, Red-Brown-Tan   |                    |        |           |         |
|       | 4.2             |     | CLAY W/Gravel   |                    |        |           |         |
|       | 5.0             |     | SANDSTONE, Tan  |                    |        |           |         |
|       | 7.5             |     | CLAY, Sandy, Tan  |                    |        |           |         |
|       | 8.5             |     | SANDSTONE, Tan  |                    |        |           |         |
|       | 8.9             |     | SANDSTONE, Gray   |                    |        |           |         |
|       |                 |     | SHALE, Weathered, Tan-Gray, Sandy w/<br>Sandstone Lense at 12.0 |                    |        |           |         |
|       | 13.5            |     | SANDSTONE, Tan  |                    |        |           |         |
|       | 14.6            |     | SANDSTONE, Fine Grained, Gray w/Limonite<br>Partings            |                    |        |           |         |
|       | 18.3            |     | SANDSTONE, Shaley, Tan  |                    |        |           |         |
|       | 20.0            |     |   |                    |        |           |         |

## DRILLING MUD

TYPE \_\_\_\_\_ NO. SACKS \_\_\_\_\_

## PENETRATION TEST

FROM \_\_\_\_\_ TO \_\_\_\_\_ BLOWS/6" \_\_\_\_\_

## SHELBY TUBE SAMPLES

NO. \_\_\_\_\_ FROM \_\_\_\_\_ TO \_\_\_\_\_

## CORING

FROM \_\_\_\_\_ TO \_\_\_\_\_ RECOVERY \_\_\_\_\_

WATER LOSS

CEMENT (NO. SACKS)

REMARKS



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

**HEMPHILL CORPORATION**

4834 SOUTH 83RD EAST AVENUE

TULSA, OKLAHOMA 74145

OFFICE (918) 622-5133

AFTER HOURS 587-5022



2323

# HEMPHILL CORPORATION

OFFICE (918) 622-5133

4834 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74145

AFTER HOURS 587-5822

## DAILY DRILL REPORT AND LOG

# 2323

Hole No. OW-3 Date 8-4/7/9-78 Depth 0 To 20 Shift \_\_\_\_\_ Drill No. CF-15

Client Kerr-McGee Address Gore, Oklahoma

Project Location Raffinate Pond Area Hole Location As Directed

Client's Representative Jim Carr Driller Curtis Cooper

Helper Sidney Lane Hrs. \_\_\_\_\_ Helper Matt Ferguson Hrs. \_\_\_\_\_

### BITS USED

| No. | Type | Size  | From | To |
|-----|------|-------|------|----|
|     | Drag | 4     | 0    | 5  |
|     | Rock | 4 3/4 | 0    | 15 |
|     | Rock | 12    | 0    | 15 |
|     | Rock | 7 7/8 | 15   | 20 |

### DIAMOND BITS USED

| Serial No. | Size | From | To |
|------------|------|------|----|
|            |      |      |    |
|            |      |      |    |
|            |      |      |    |
|            |      |      |    |

### MUD AND LOSS CIRCULATION MATERIAL

| Manufacturer    | No. Sacks | Weight |
|-----------------|-----------|--------|
|                 |           |        |
| Cement Old Hole |           |        |
|                 |           |        |

### CEMENT

| No. Sacks | Size | Ft - Run | Ft - Pulled | Ft - Left |
|-----------|------|----------|-------------|-----------|
| 5         | 8"   | 16'      |             | 16'       |
| 4         | 5"   | 22'      |             | 22'       |

### CASING INFORMATION

STAND BY TIME (HRS.) Rig \_\_\_\_\_ Rig & Crew \_\_\_\_\_

### DEPTH

| From | To   | FORMATIONS   | TYPE DRLG. | DRILLING TIME |      |      |    | CORE LOSS |
|------|------|--|------------|---------------|------|------|----|-----------|
|      |      |  |            | Start         | Stop | From | To |           |
| 0    | 1.0  | SILT, Brown, Dry                                     |            |               |      |      |    |           |
| 1.0  | 2.6  | SANDSTONE, Tan, Broken                               |            |               |      |      |    |           |
| 2.6  | 4.0  | CLAY, Tan & Gray                                     |            |               |      |      |    |           |
| 4.0  | 5.5  | SHALE, Tan & Gray, Weathered                         |            |               |      |      |    |           |
| 5.5  | 9.0  | SANDSTONE, Gray, Hard                                |            |               |      |      |    |           |
| 9.0  | 15.0 | SANDSTONE, Gray & Tan, w/Shale Lenses<br>Medium Hard |            |               |      |      |    |           |
| 15.0 | 16.3 | SHALE, Tan & Gray, Weathered                         |            |               |      |      |    |           |
| 16.3 | 17.0 | SANDSTONE, Gray, Hard                                |            |               |      |      |    |           |
| 17.0 | 18.2 | SHALE, Tan & Gray                                    |            |               |      |      |    |           |
| 18.2 | 19.4 | SANDSTONE, Gray Hard                                 |            |               |      |      |    |           |
| 19.4 | 20.0 | SHALE, w/Sandstone Lenses, Tan & Gray                |            |               |      |      |    |           |

Observation Well  
8" PVC - 16' & Cemented  
5" PVC - 22'

Perforated - 15' - 20' (3  
Holes Per 1' Intervals)  
Gravel Pack 0-20'

Note: Drilled Out Old Hole  
& Cemented Surface

*Hole Same as 1-5-78*

### PENETRATION TESTS

| From | To | Blows | From | To | Blows |
|------|----|-------|------|----|-------|
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |
|      |    |       |      |    |       |

### SHELBY TUBE SAMPLES

| From | To | From | To | From | To |
|------|----|------|----|------|----|
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |
|      |    |      |    |      |    |

WATER DEPTH WHILE DRILLING (FT)

(24 HRS)

2325

OK 3

SHEET 2 OF 2

DATE 1-5-78

(After 24 hours)

WATER LOSS

CEMENT (NO. SACKS)

REMARKS



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

## ENGINEERING INSPECTION

4834 SOUTH 83RD EAST AVENUE

OFFICE (018) 622-5133

TULSA, OKLAHOMA 74145

AFTER HOURS 587-5812



# BORING LOG

2320

HOLE NO. OW3

PROJECT Raffinate Pond 3

11635N

SHEET 1 OF 2

HOLE LOCATION 50' NE of point "A"

8685E

DATE 1-5-78

GR. ELEV. 532

WATER TABLE 30.0'

BORED BY Lane

LOGGED BY Hemphill

(After 24 hours)

| ELEV. | DEPTH AND SCALE | LGND | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION |        |           |         |
|-------|-----------------|------|--|--------------------|--------|-----------|---------|
|       |                 |      |  | SIZE               | FT-RUN | FT-PULLED | FT-LEFT |
|       |                 |      | SILT, Brown  |                    |        |           |         |
|       | 1.0             |      |  |                    |        |           |         |
|       | 1.5             |      | CLAY, Silty, Red-Brown   |                    |        |           |         |
|       | 1.8             |      | SANDSTONE, Broken, Gray, Gravelly                              |                    |        |           |         |
|       |                 |      | SANDSTONE, Tan w/Clay Seams                                    |                    |        |           |         |
|       | 3.0             |      |  |                    |        |           |         |
|       |                 |      | CLAY, Sandy, Tan, Moist  |                    |        |           |         |
|       | 5.0             |      |  |                    |        |           |         |
|       |                 |      | CLAY, Shaley, Sandy, Tan                                       |                    |        |           |         |
|       | 6.8             |      |  |                    |        |           |         |
|       |                 |      | SANDSTONE, Gray-Tan  |                    |        |           |         |
|       | 9.0             |      |  |                    |        |           |         |
|       |                 |      | SANDSTONE, Red-Brown   |                    |        |           |         |
|       | 10.0            |      |  |                    |        |           |         |
|       |                 |      | SANDSTONE, Tan   |                    |        |           |         |
|       | 12.0            |      |  |                    |        |           |         |
|       |                 |      | SANDSTONE, Tan w/Clay  |                    |        |           |         |
|       | 12.7            |      |  |                    |        |           |         |
|       |                 |      | SANDSTONE, Tan   |                    |        |           |         |
|       | 13.9            |      |  |                    |        |           |         |
|       |                 |      | SHALE, Sandy, Tan, Weathered                                   |                    |        |           |         |
|       | 16.7            |      |  |                    |        |           |         |
|       |                 |      | SANDSTONE, Gray-Tan  |                    |        |           |         |
|       | 17.2            |      |  |                    |        |           |         |
|       |                 |      | SANDSTONE, Shaley, Gray  |                    |        |           |         |
|       | 17.8            |      |  |                    |        |           |         |
|       |                 |      | SANDSTONE, Fine Grained, Gray                                  |                    |        |           |         |
|       | 20.0            |      |  |                    |        |           |         |

DRILLING MUD

TYPE

NO. SACKS

PENETRATION TEST

FROM

TO

BLOWS/3"

SHELBY TUBE SAMPLES

NO.

FROM

TO

CORING

FROM

TO

RECOVERY

WATER LOSS

CEMENT (NO. SACKS)

REMARKS



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

ENGINEERING INSPECTION

## HEMPHILL CORPORATION

4334 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74145

OFFICE (918) 622-5133

AFTER HOURS 587-2822

4834 SOUTH 63RD EAST AVENUE  
TULSA, OKLAHOMA 74145

# 2324

SUPERVISOR: BOB MASTEN J.P.#2375 BILL EFFE-SS 951-70

DIAMOND BITS USED

| MUD AND LOSS CIRCULATION MATERIAL |  |
|-----------------------------------|--|
| 1                                 |  |
| 2                                 |  |
| 3                                 |  |
| 4                                 |  |
| 5                                 |  |
| 6                                 |  |
| 7                                 |  |
| 8                                 |  |
| 9                                 |  |
| 10                                |  |
| 11                                |  |
| 12                                |  |
| 13                                |  |
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| 15                                |  |
| 16                                |  |
| 17                                |  |
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| 19                                |  |
| 20                                |  |
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| 94                                |  |
| 95                                |  |
| 96                                |  |
| 97                                |  |
| 98                                |  |
| 99                                |  |
| 100                               |  |

CEMENT

|                    |     |
|--------------------|-----|
| CASING INFORMATION |     |
| 1                  | 2   |
| 3                  | 4   |
| 5                  | 6   |
| 7                  | 8   |
| 9                  | 10  |
| 11                 | 12  |
| 13                 | 14  |
| 15                 | 16  |
| 17                 | 18  |
| 19                 | 20  |
| 21                 | 22  |
| 23                 | 24  |
| 25                 | 26  |
| 27                 | 28  |
| 29                 | 30  |
| 31                 | 32  |
| 33                 | 34  |
| 35                 | 36  |
| 37                 | 38  |
| 39                 | 40  |
| 41                 | 42  |
| 43                 | 44  |
| 45                 | 46  |
| 47                 | 48  |
| 49                 | 50  |
| 51                 | 52  |
| 53                 | 54  |
| 55                 | 56  |
| 57                 | 58  |
| 59                 | 60  |
| 61                 | 62  |
| 63                 | 64  |
| 65                 | 66  |
| 67                 | 68  |
| 69                 | 70  |
| 71                 | 72  |
| 73                 | 74  |
| 75                 | 76  |
| 77                 | 78  |
| 79                 | 80  |
| 81                 | 82  |
| 83                 | 84  |
| 85                 | 86  |
| 87                 | 88  |
| 89                 | 90  |
| 91                 | 92  |
| 93                 | 94  |
| 95                 | 96  |
| 97                 | 98  |
| 99                 | 100 |

STAND BY TIME (HRS.)Rig 7

Fig. 8. Crew

## PENETRATION TESTS

| From | To | Views | From | To | Views |
|------|----|-------|------|----|-------|
|------|----|-------|------|----|-------|

|  |  |  |  |  |  |
|--|--|--|--|--|--|
|  |  |  |  |  |  |
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|  |  |  |  |  |  |
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|  |  |  |  |  |  |

SHELBY TUBE SAMPLES

| From | To | From | To | From | To |
|------|----|------|----|------|----|
|------|----|------|----|------|----|

(24 = 5)

4534 SOUTH 63RD EAST AVENUE  
TULSA, OKLAHOMA 74145

AFTER HOURS 587.5822

2324

Client KEEL MCGEE

Address GORE, OMA

Project Location SENGUEN FACILITY

Hole Location RAFFINATE Pond 4

Client's Representative LEE KIEN

Driller T. E. W. O. O. O.

HR. 13.5

Kelpar

Hrs.

Helper Edmund

Hrs 13.5

SUPERVISOR: BOE MORTEN HP #2375 BILL & GENE-55-451-70

BITS USED

|                                   |  |  |  |  |  |
|-----------------------------------|--|--|--|--|--|
| MUD AND LOSS CIRCULATION MATERIAL |  |  |  |  |  |
|-----------------------------------|--|--|--|--|--|

DEPTH

## FORMATIONS

TYPE  
DRLG

DRILLING TIME

| Start | Stop | From | To |
|-------|------|------|----|
|-------|------|------|----|

CORE  
LOSS

## PENETRATION TESTS

| From | To | Blows | From | To | Blows |
|------|----|-------|------|----|-------|
|------|----|-------|------|----|-------|

SHELBY TUBE SAMPLES

| FROM | TO | FROM | TO | FROM | TO |
|------|----|------|----|------|----|
|------|----|------|----|------|----|

(24 FRS)

4234 SOUTH B3RD EAST AVENUE  
TULSA, OKLAHOMA 74143

OFFICE (D18) 622-5133

AFTER HOURS 557.5522

2324

SUPERVISOR: BOE MASTEN JR #2375 BILL & FE-SS-901-70

|                                 |          | SHELBY TUBE SAMPLES |    |      |    |      |    |
|---------------------------------|----------|---------------------|----|------|----|------|----|
|                                 |          | From                | To | From | To | From | To |
|                                 |          |                     |    |      |    |      |    |
|                                 |          |                     |    |      |    |      |    |
|                                 |          |                     |    |      |    |      |    |
|                                 |          |                     |    |      |    |      |    |
|                                 |          |                     |    |      |    |      |    |
|                                 |          |                     |    |      |    |      |    |
| WATER DEPTH WHILE DRILLING (FT) | (24 HRS) |                     |    |      |    |      |    |



# HEMPHILL CORPORATION

OFFICE (918) 822-8133

4834 SOUTH 83RD EAST AVENUE  
TULSA, OKLAHOMA 74143

AFTER HOURS 587-5822

## DAILY DRILL REPORT AND LOG

Hole No. CW-4 Date 3-6-80 Depth 0 To 42 Shift \_\_\_\_\_ Drill No. 5029

Client KEAR MCGEE Address COCKE, OKLA

Project Location SEEDIAN FACILITY Hole Location RAFFINATE POND 4

Client's Representative BOB KEHN Driller THELMA Hrs. \_\_\_\_\_

Helper \_\_\_\_\_ Hrs. \_\_\_\_\_ Helper COUM Hrs. \_\_\_\_\_

SUPERVISOR: BOB MASTEN AFE-55-901-70

### BITS USED

### DIAMOND BITS USED

| No. | Type     | Size  | From | To  | Serial No. | Size | From | To |
|-----|----------|-------|------|-----|------------|------|------|----|
| 1   | ROCK BIT | 7 1/8 | 6.0  | 11  |            |      |      |    |
| 1   | ROCK BIT | 4 3/4 | 11   | 22  |            |      |      |    |
| 1   | AUGER    | 9"    | 0    | 6.0 |            |      |      |    |
| 1   | ROCK BIT | 5 1/8 | 11   | 42  |            |      |      |    |

### MUD AND LOSS CIRCULATION MATERIAL

### CEMENT

### CASING INFORMATION

| Manufacturer | No. Sacks | Weight | No. Sacks | Size | Ft - Run    | Ft - Pulled | Ft - Left |
|--------------|-----------|--------|-----------|------|-------------|-------------|-----------|
| PORTLAND     |           | 94#    | 10        | 5"   | DRILLED CUT |             |           |
|              |           |        |           | 5"   | DRILLED CUT |             |           |

### STAND BY TIME (HRS.)

### Rig

### Rig & Crew

| DEPTH | From | To | FORMATIONS | TYPE DRLG. | DRILLING TIME      | CORE LOSS |
|-------|------|----|------------|------------|--------------------|-----------|
|       |      |    |            |            | Start Stop From To |           |

DRILLED CUT PVC SURFACE AND  
INNER STRING CASING. GRATED  
FROM GROUND SURFACE TO  
TOTAL DEPTH

RIG HOURS 10.0  
SUPT HOURS 10.0  
MATERIALS 46.50

### PENETRATION TESTS

From To Blows From To Blows

### SHELBY TUBE SAMPLES

From To From To From To

WATER DEPTH WHILE DRILLING (FT)

(24 HRS)



1. *Journal of the American Medical Association*, 1977; 237: 1000-1001.

## AFTER HOURS 927.5822

## G-22

Plugged 1980  
HOLE NO. CW4

SHEET 3 OF 3

DATE 1-5-78

(After 24 hours)

|      | WATER LOSS |
|------|------------|
| 100% | 100%       |
| 90%  | 80%        |
| 80%  | 60%        |
| 70%  | 40%        |
| 60%  | 20%        |
| 50%  | 10%        |
| 40%  | 5%         |
| 30%  | 2%         |
| 20%  | 1%         |
| 10%  | 0.5%       |
| 0%   | 0%         |

CEMENT (NO. SACKS)

REMARKS



CONSULTING ENGINEERING

GEOLOGICAL INVESTIGATION

選 擇 3 1 種 選 擇 1 種 1 種 選 擇 1 種 1 種

4834 SOUTH 83RD EAST AVENUE

OFFICE (918) 622-5133

TULSA, OKLAHOMA 74145

AFTER HOURS 587-5833

# BORING LOG

1988  
HOLE NO. 046

PROJECT Raffinate Pond 3 SHEET 2 OF 3  
HOLE LOCATION 40' SE of point "B" DATE 1-5-78  
GR. ELEV. \_\_\_\_\_ WATER TABLE 28.0' BORED BY Lane LOGGED BY Hemphill  
(After 24 hours)

| ELEV. | DEPTH AND SCALE | LGND. | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION |        |           |         |
|-------|-----------------|-------|--|--------------------|--------|-----------|---------|
|       |                 |       |  | SIZE               | FT-RUN | FT-PULLED | FT-LEFT |
|       |                 |       | SANDSTONE, Fine Grained, Gray                                  |                    |        |           |         |
|       | 24.4            |       |  |                    |        |           |         |
|       | 25.0            |       | SHALE, Gray-Tan, Weathered                                     |                    |        |           |         |
|       |                 |       | SHALE, Dark Gray w/Limonite Partings                           |                    |        |           |         |
|       | 27.0            |       |  |                    |        |           |         |
|       |                 |       | SHALE, Sandy, Gray   |                    |        |           |         |
|       | 32.0            |       |  |                    |        |           |         |
|       |                 |       | SHALE, Dark Gray   |                    |        |           |         |
|       | 37.0            |       |  |                    |        |           |         |
|       |                 |       | SHALE, Black   |                    |        |           |         |
|       | 40.0            |       |  |                    |        |           |         |

## DRILLING MUD

TYPE \_\_\_\_\_ NO. SACKS \_\_\_\_\_

## PENETRATION TEST

FROM \_\_\_\_\_ TO \_\_\_\_\_ BLOWS/FT

## SHELBY TUBE SAMPLES

NO. \_\_\_\_\_ FROM \_\_\_\_\_ TO \_\_\_\_\_

## CORING

FROM \_\_\_\_\_ TO \_\_\_\_\_ RECOVERY \_\_\_\_\_

22.0 27.0 100%

27.0 31.8 100%

31.8 37.0 100%

37.0 42.0 90%

## WATER LOSS

CEMENT (NO. SACKS) \_\_\_\_\_

REMARKS \_\_\_\_\_



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HEMPHILL CORPORATION

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TULSA, OKLAHOMA 74145

OFFICE (918) 822-5133

AFTER HOURS 587-5822

# BORING LOG

Plugged 1980

HOLE NO. 0W4

PROJECT Raffinate Pond 3

11,200 N

SHEET 1 OF 3

HOLE LOCATION 40' SE of point "B"

8700 E

DATE 1-5-78

GR. ELEV. 536 WATER TABLE 28.0' BORED BY Lane  
(After 24 hours)

LOGGED BY Hemphill

| ELEV. | DEPTH AND SCALE | LGND. | DESCRIPTION OF MATERIAL<br>(TYPE, COLOR, TEXTURE, CONSISTENCY) | CASING INFORMATION  |        |           |         |
|-------|-----------------|-------|--|---------------------|--------|-----------|---------|
|       |                 |       |  | SIZE                | FT-RUN | FT-PULLED | FT-LEFT |
|       | 1.5             |       | SILT, Tan, Dry   |                     |        |           |         |
|       | 4.0             |       | CLAY, Red-Brown  | DRILLING MUD        |        |           |         |
|       | 6.6             |       | CLAY, Red-Brown w/Some Gray, Low Moisture                      | PENETRATION TEST    |        |           |         |
|       | 7.0             |       | CLAY, Shaley w/Sandstone, Weathered                            |                     |        |           |         |
|       | 8.0             |       | SANDSTONE, Tan, Firm   |                     |        |           |         |
|       | 10.5            |       | SHALE, Sandy, Tan w/Sandstone Lenses                           | SHELBY TUBE SAMPLES |        |           |         |
|       | 12.0            |       | SANDSTONE, Gray-Tan  |                     |        |           |         |
|       | 16.7            |       | SHALE, Tan-Gray w/Sandstone Lense at 15.2.                     | CORING              |        |           |         |
|       | 17.5            |       | SANDSTONE, Tan   |                     |        |           |         |
|       | 20.0            |       | SANDSTONE, Fine Grained, Gray                                  |                     |        |           |         |

WATER LOSS

CEMENT (NO. SACKS)

REMARKS



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TULSA, OKLAHOMA 74145

OFFICE (918) 622-5133

AFTER HOURS 587-3822