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**Geologic Characterization of the
Paducah Gaseous Diffusion Plant
and Surrounding Area Determined
from Geophysical Logs**

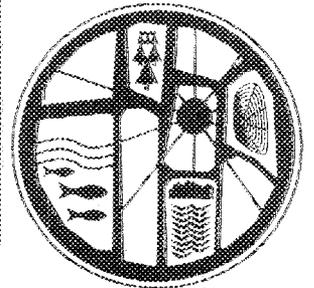
R. B. Dreier
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ENVIRONMENTAL SCIENCES DIVISION
PUBLICATION NO. 3428

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ENVIRONMENTAL SCIENCES DIVISION

**GEOLOGIC CHARACTERIZATION
OF THE PADUCAH GASEOUS DIFFUSION PLANT AND
SURROUNDING AREA DETERMINED FROM GEOPHYSICAL LOGS**

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Environmental Sciences Division
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REMEDIAL ACTION PROGRAM

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LIST OF ACRONYMS

| | |
|------|------------------------------------|
| cps | counts per second |
| DOE | United States Department of Energy |
| ORNL | Oak Ridge National Laboratory |
| PGDP | Paducah Gaseous Diffusion Plant |
| USGS | United States Geological Survey |
| TCE | trichloroethylene |
| TVA | Tennessee Valley Authority |

EXECUTIVE SUMMARY

DREIER, R. B., R. O. Kennard, and R. J. Selfridge. 1990. Geologic Characterization of the Paducah Gaseous Diffusion Plant and Surrounding Area Determined from Geophysical Logs. 116 pp.

The Paducah Gaseous Diffusion Plant (PGDP), located in Paducah, Kentucky, and operated by Martin Marietta Energy Systems for the U. S. Department of Energy, discovered in August 1988 that several private wells, generally north of the plant, were contaminated with trichloroethylene and/or ^{99}Tc . Presumably, PGDP is the source of both contaminants, and the most likely pathway for contaminant transport is within a regional aquifer that underlies the site. However, it is not possible to characterize potential flow paths and remediate the contamination until the geologic setting of the site is determined and additional well construction information is obtained.

As a result, it was decided to conduct a geophysical logging project of 25 wells/piezometers on- and off-site to determine the stratigraphic characteristics of the region. Four types of geophysical logs were obtained from each well: caliper, natural gamma ray, thermal neutron, and gamma-gamma density. This report presents the results of the geophysical logging.

This investigation shows that the gravel and clay facies of the Continental Deposits in the vicinity of the PGDP can be divided into five lithologic units. These are, in ascending order; (1) gravel unit, (2) sand/silt transition zone, (3) clay unit, (4) silt/sand unit, (5) and sand unit. These units are locally covered with loess and have subsequently been covered in places with fill. The gravel unit and overlying sand units have the greatest potential for transmitting fluids. The sand units are thickest and most continuous in the immediate plant area. However, the sands thin considerably and locally pinch out to the north in the direction of the Ohio River. Cobble beds within the gravel show either enhanced or reduced porosity characteristics; without the geophysical data, differentiating between these porosity changes would be difficult.

This study shows that geophysical logging can be very useful for determining lithologic sequences in the vicinity of PGDP. The logs can (1) differentiate gravels, sand, silt, clay, loess and fill; (2) indicate a gradational or abrupt transition between lithologic types; (3) provide a continuous downhole record of the geology; (4) delineate high- and low-porosity zones within the regional gravel aquifer; and (5) substantiate or provide some well construction data. If additional lithologic information is required from areas not covered by this study, follow-on geophysical logging in wells located in these areas would be appropriate.

1. OBJECTIVES

The Paducah Gaseous Diffusion Plant (PGDP), located in Paducah, Kentucky, and operated by Martin Marietta Energy Systems for the U. S. Department of Energy (DOE), discovered in August 1988 that several private wells, generally north of the plant, were contaminated with trichloroethylene (TCE) and/or ^{99}Tc . Presumably, PGDP is the source of both contaminants, and the most likely pathway for contaminant transport is within a regional aquifer that underlies the site. However, it is not possible to characterize potential flow paths and remediate the contamination until the geologic setting of the site is determined and additional well construction information is obtained. Adequate well completion and lithologic information is not available for the PGDP wells installed before 1985 or for the private wells located off-site.

As a result, it was decided to conduct a geophysical logging project of selected wells on- and off-site. The primary objective of the project is to determine the stratigraphic characteristics in the immediate vicinity of the wells. These data can then be compared with existing lithologic information available from PGDP. A secondary objective of the project is to determine, if possible, basic well construction information.

2. METHODS

2.1 WELL SELECTION

Twenty-five wells/piezometers (see Fig. 1) were logged as part of this project. In addition, relevant available construction and geologic information is given in Table 1. The wells were selected by PGDP staff using the following criteria: well location, well depth, minimum borehole diameter required by the logging tools, existing well completion information, condition of the casing, availability of access for the logging truck, and ease in removing piping and pumps from the wells.

Piezometers 80 and 81 were chosen as standards for comparing lithologic differences with geophysical logs. Both piezometers are close to soil boring S-3, which has been logged geologically in detail (ERC 1989). The high density of geophysical logging activities at the existing sanitary landfill site was completed as part of PGDP's Low Level Waste Disposal Facility project in order to aid in assessing the performance of the site. Some of the off-site wells were chosen for logging because they show TCE and/or ^{99}Tc contamination (location 2, location 3, and location 18) and because there is an immediate need for lithologic data at these sites. The Tennessee Valley Authority (TVA) wells (D1, D3, D4 and D10) were selected because their depths and locations are appropriate for constructing a cross section north of the plant.

2.2 DATA ACQUISITION

During normal logging operations, the logging probes are attached to a steel cable and are lowered into the well by a hoist and boom assembly. Power is supplied by an electric generator located in the logging truck. Because of the possibility of encountering TCE and ^{99}Tc , decontamination procedures were used for all logging operations.

Each probe detector transmits its signal to an analog interface, which in turn transmits the signal to a portable computer. The well log information is recorded in digital form. Depth information is recorded electronically as each probe is lowered and raised in the well bore. A mechanical depth counter provides independent depth information and provides a useful quality assurance check of the electronically recorded depths.

A real-time graphic log of the data is plotted to provide on-site field logs of the original unprocessed data. All geophysical field records were taken with English units. Therefore, to facilitate correlation with the original records, this report maintains the use of English units.* The data acquisition system reads and records the incoming data at a user specified digitization rate of once every 0.10 vertical ft. All of the upgoing logs were collected at a maximum speed of 15 ft/min. All the data are stored electronically for additional processing and archiving purposes.

*Conversion from English to metric units is as follows: (1) feet times 0.0348 = meters and (2)degrees Fahrenheit - 32/1.8 = degrees Celsius.

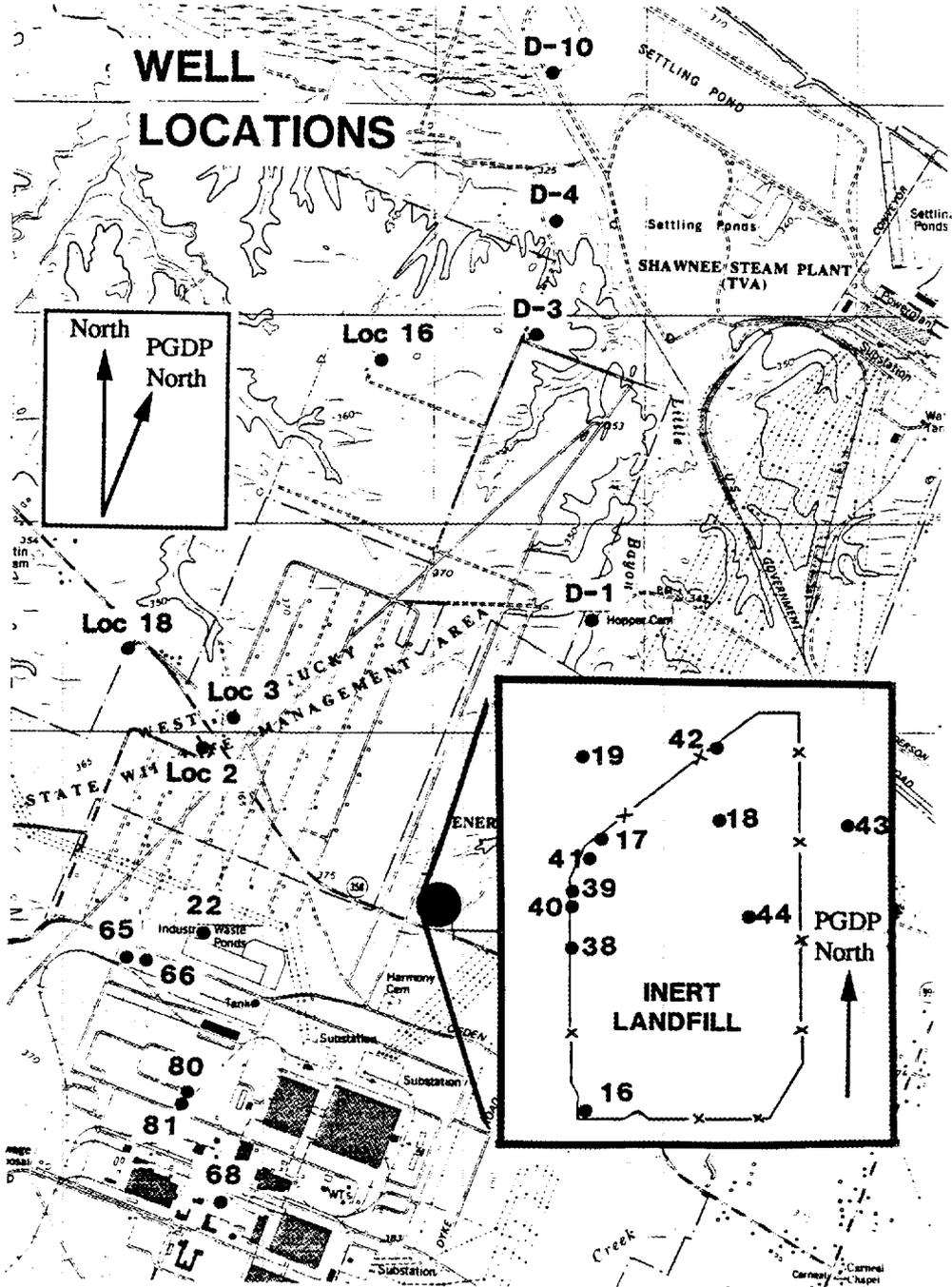


Fig. 1. Well location map. Unless otherwise noted, true north is always referenced.

Table 1. Well construction and logging information^a

| Well name | PDGP N/S | PDGP W | Elevation TOC | Stickup | Inner casing | Outer casing | Screen type | Notes ^b | Well depth |
|-----------|----------|--------|---------------|---------|--------------|--------------|-------------|--------------------|------------|
| 16 | 3093N | 2897W | 373.75 | 2.3 | 6" PVC | 8" Steel | 6" PVC | 1 | 40.9 |
| 17 | 4154N | 2822W | 376.46 | 2.6 | 6" PVC | 8" Steel | 6" PVC | 1 | 62.4 |
| 18 | 4223N | 2365W | 405.93 | 4.3 | 6" PVC | 8" Steel | 6" PVC | 1 | 58.2 |
| 19 | 4475N | 2993W | 364.92 | 3.9 | 6" PVC | 8" Steel | 6" PVC | 1 | 48.8 |
| 22 | 1520N | 6230W | 370.12 | 2.9 | 4" PVC | none | 4" PVC | | 53.4 |
| 38 | 3730N | 2950W | 384.49 | 1.8 | 4" PVC | 6" Steel | 4" PVC | | 72.7 |
| 39 | 3950N | 2950W | 381.52 | 2.0 | 4" PVC | 6" Steel | 4" PVC | | 73.6 |
| 40 | 3950N | 2950W | 381.92 | 2.6 | 4" PVC | 6" Steel | 4" PVC | | 102.7 |
| 41 | 4090N | 2870W | 378.68 | 2.4 | 4" PVC | 6" Steel | 4" PVC | | 70.7 |
| 42 | 4539N | 2394W | 363.08 | 4.1 | 4" PVC | 6" Steel | 4" PVC | | 50.7 |
| 43 | 4200N | 1875W | 373.85 | 2.8 | 4" PVC | 6" Steel | 4" PVC | | 74.4 |
| 44 | 3850N | 2260W | 403.19 | 1.9 | 4" PVC | 6" Steel | 4" PVC | | 98.5 |
| 65 | 865N | 7239W | 372.99 | 1.5 | 2" SS | 6" Steel | 2" SS | | 93.6 |
| 66 | 934N | 7022W | 371.44 | 2.2 | 2" SS | 6" Steel | 2" SS | | 65.0 |
| 68 | 2074S | 4358W | 380.21 | 2.4 | 2" SS | 6" Steel | 2" SS | | 104.3 |
| 80 | 855S | 5500W | 376.89 | 3.1 | 2" PVC | 6" Steel | 2" PVC | | 89.3 |
| 81 | 880S | 5499W | 376.88 | 3.1 | 2" PVC | 6" Steel | 2" PVC | | 89.1 |
| D01 | 8630N* | 5450W* | 358.08 | 3.2 | 4" PVC | none | N/A | | 78* |
| D03 | 12250N* | 4880W* | 361.69? | 1.9 | 4" PVC | 6" Steel | N/A | | 70* |
| D04 | 14130N* | 5300W* | 336.46 | 3.4 | 4" PVC | 6" Steel | N/A | | 38* |
| D10 | 16250N* | 6140W* | 351.65 | 0.8 | 4" PVC | none | N/A | | 46* |
| LOC 2 | 4350N* | 7150W* | 365.56 | 0.1 | 4" PVC | none | N/A | | 75* |
| LOC 3 | 5070N* | 6950W* | 363.80 | 0.2 | 4" PVC | none | N/A | | 73* |
| LOC 16 | 11200N* | 6980W* | 365+0/-5* | 0.2 | 4" PVC | none | N/A | | 117.7 |
| LOC 18 | 5650N* | 8850W* | 361+4/-1* | 1.7 | 4" PVC | none | N/A | | 73.6 |

^a construction information obtained from prelogging reports, all measurements in feet.

^b 1 = 2--3 feet of grout seal above monitored interval; sand packed to surface.

N/A = not available.

* = estimated .

Table 1. (continued)^a

| Well Name | Soil Boring | Soil Boring Reference | Depth to Water ^c | Depth to Water ^d | Water elevation | Date Logged (1989) |
|-----------|-------------|-----------------------|-----------------------------|-----------------------------|-----------------|--------------------|
| 16 | 7 | Geotek (1979) | 19.1 | 19.0 | 354.7 | 8/14 |
| 17 | 8 | Geotek (1979) | 48.3 | 48.0 | 328.1 | 8/16 |
| 18 | 1 | Geotek (1979) | ? | 33.5 | 372.4 | 8/15 |
| 19 | 9 | Geotek (1979) | 37.8 | 37.2 | 327.1 | 8/16 |
| 22 | | | 42.4 | 42.5 | 327.7 | 7/17 |
| 38 | 5P | J. Jones (1981)(f) | 57.5 | 57.5 | 327.0 | 8/17 |
| 39 | 3P(e) | J. Jones (1981)(f) | 54.6 | 54.5 | 327.0 | 8/17 |
| 40 | 4P(e) | J. Jones (1981)(f) | 54.9 | 55.0 | 327.1 | 7/17 |
| 41 | 2P | J. Jones (1981)(f) | 51.5 | 52.0 | 327.2 | 8/15 |
| 42 | N6P(e) | J. Jones (1981)(f) | 36.0 | 36.0 | 327.1 | 8/15 |
| 43 | N7P(e) | J. Jones (1981)(f) | 43.6 | 46.5 | 327.4 | 8/15 |
| 44 | 1P | J. Jones (1981)(f) | 76.0 | 76.0 | 327.2 | 8/14 |
| 65 | S-2 | MCI (1986) | 44.5 | N/A | 328.5 | 7/16, 8/13 |
| 66 | 66 | MCI (1986) | 48.8 | N/A | 322.6 | 8/17 |
| 68 | S-1 | MCI (1986) | 51.0 | N/A | 329.2 | 7/16, 8/17 |
| 80 | S-3 | ERC (1989) | 48.8 | N/A | 328.1 | 7/15 - 16, 8/13 |
| 81 | S-3 | ERC (1989) | 50.0 | N/A | 326.9 | 7/16, 8/13 |
| D01 | | | 31.8 | 32.0 | 326.3 | 7/18 |
| D03 | | | 38.7 | 38.5 | 323.2 | 7/18 |
| D04 | | | N/A | 14.5 | 322.0 | 7/18 |
| D10 | D10 | TVA (1989) | 44 | 37.5 | 307.7 | 7/18 |
| LOC 2 | | | N/A | 37.5 | 328.1 | 7/19 |
| LOC 3 | | | N/A | 38* | 325.8 | 7/19 |
| LOC 16 | | | N/A | 39.5 | 329.5 | 7/19 |
| LOC 18 | | | 37.6 | 37.5 | 327.5 | 8/16 |

^a construction information obtained from prelogging reports, all measurements in feet.

^c water depth determined from m-scope; water depths were not measured on the same day and cannot be used to delineate flow directions.

^d water depth determined from neutron log; water depths were not measured on the same day and cannot be used to delineate flow directions.

(e) documentation from the driller for wells 38 to 44 is limited. Some evidence suggests that lithologic and depth information for wells 39 and 40 and 42 and 43, respectively, were switched following completion. These well designations represent an attempt to reconcile inconsistencies.

(f) records from J. Jones' drilling logs on file at PGDP.

N/A = not available

Four types of geophysical logs were obtained from each well: caliper, natural gamma ray, thermal neutron, and gamma-gamma density. The caliper log provides a record of the diameter of the borehole or casing. This information is used to determine the location of the well screen and the casing section length and to identify any constrictive or collapsed sections of the casing that would prohibit use of other probes. A three-arm summation type probe was used for this study. A schematic of the components used in the logging operation is shown in Fig. 2.

The natural gamma log is used to measure the amount of naturally occurring formation radioactivity, primarily due to the presence of ^{40}K . Increases in gamma radiation correspond to an increase in the count rate, which is generally indicative of a clay or shale lithology, unless the sands or gravels are feldspathic. Lower count rates normally indicate a sand or gravel lithology in which the relative abundance of clay minerals is lower.

The thermal neutron log provides information on the hydrogen content of the surrounding media. Because hydrogen occurs both in water and in clay minerals, the log reflects a response to porosity or to clay mineral content. The log is presented in counts per second, with an increase in counts representing either a porosity or clay mineral increase.

The density (gamma-gamma) log provides information on the attenuation of gamma radiation through the surrounding medium, which is a function of the density of the medium. A calibration was not used in this project for quantitative interpretation because little or no information was available concerning borehole diameter, grout thickness in the annulus, and, in some cases, the type of casing used at depth. Therefore, the logs are interpreted only qualitatively. The log is presented in counts per second, with a decrease in counts representing an increase in density.

The radius of investigation and the vertical resolution vary among the three probes. However, these values are calculated in a similar manner because they are affected by similar parameters: the detector, borehole fluid, borehole diameter, casing thickness and density, grout or sandpack type and thickness, and the density of the rock or soil of interest. The detectors' sampled volume is roughly spherical, and a unit volume of material close to the detector exerts a much greater influence on the measured radiation intensity than the same unit of material farther away from the detector. Because the grout, sand pack, or void directly behind the casing is closer to the detector than the rock (or soil) of interest, any variation in the thickness of this material (i.e., infilling of a cave-in or washout) has a very strong effect on the measured radiation intensity. In addition, the use of bentonite during well construction should have a strong effect on the natural gamma log because bentonite has a much higher concentration of naturally occurring radioactivity than a non-bentonite material. Sand packs also can vary in the concentration of radioactivity depending on the depositional environment and provenance of the sand source.

The vertical resolution is determined from the radius of investigation because the sensors detect a change in measured radiation intensity in advance of and after the bed has been passed. This also implies that a bed with a thickness of less than twice the radius of investigation will not record the full amplitude of the measured radiation intensity unless the bed thickness is twice the radius of investigation. Using this information about radius of investigation and vertical resolution, these values have been estimated for the three probes used in this study: 1. The natural gamma probe has a radius of investigation of 6 to 12 in. and a vertical resolution of 12 to 14 in. 2. The neutron probe has a radius of investigation of 6 to 24 in. and a vertical resolution of 12 to 48 in. 3. The density probe has a radius of investigation of 6 in. and a vertical resolution of 12 in.

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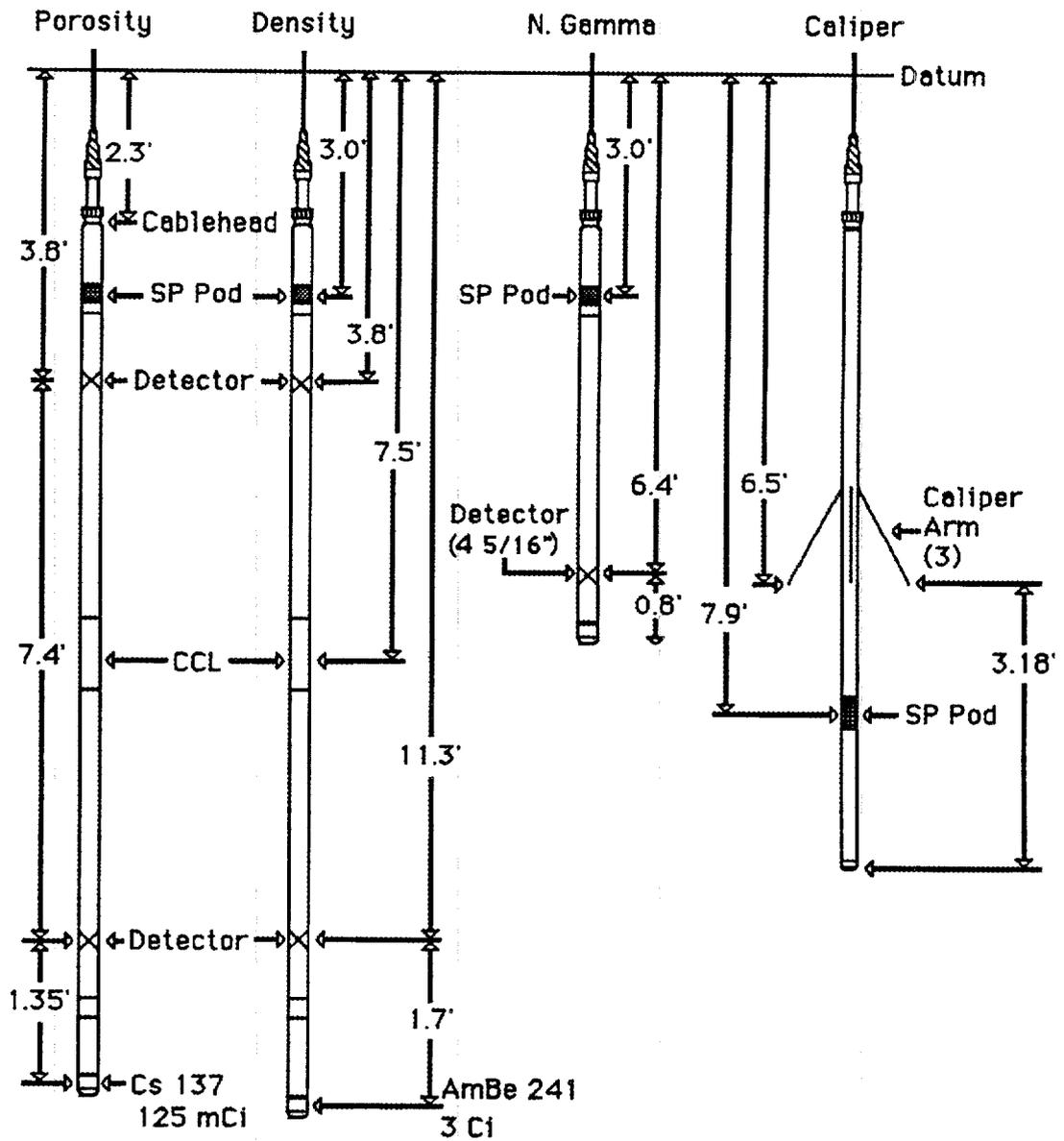


Fig. 2. Schematic configuration of the logging probes.

Natural gamma ray, thermal neutron, and gamma-gamma density logs all provide lithologic information. However, the natural gamma ray is the most useful in this setting, particularly as the thermal neutron and gamma-gamma density signal are difficult to interpret above the water level in the well. The latter two logs are useful for identifying subtle porosity and lithologic changes in units that are below the water level.

No field problems were encountered during data acquisition other than minor incidents listed below. Wells 16, 17, 18, and 19 contained several feet of mud, with the most mud evident in 17 and 18. Caliper logs for wells 80 and 81 revealed a constriction in the casing from 7 to 11 ft and from 72 to 78 ft, respectively. The casing distortion in well 80 was visible from the surface. Constriction in the casing was not severe enough to prohibit additional logging and did not interfere with the uphole log. The downgoing log, or repeat section, contains an error within +/- 10 ft of the constricted interval because cable spooled off the draw works while the probe was temporarily lodged in the constricted zone.

No caliper log was recorded for well 66. Reliable well construction information was available, and the reported contamination level was elevated enough that on-site personnel considered it prudent to first use the natural gamma log. Because the natural gamma probe is the same diameter as the density and neutron probes, any serious constrictions would be detected by the natural gamma probe. In addition, the natural gamma probe does not contain any small protrusions that are difficult to decontaminate. During logging, no constrictions in the casing were observed, and wipe samples collected by the on-site health physicist indicated that standard decontamination procedures were successful in removing any contamination that may have adhered to the logging probe or cable during logging. Standard procedures were then followed for the density and the neutron logs. A final survey of the truck, probes, and cable indicated no contamination on the equipment.

2.3 DATA PROCESSING

The data are read at a rate of 18.2 Hz and are averaged for each of the probes in the following manner:

| | |
|---------------|--------------------------|
| Caliper | 3-point running average |
| Natural Gamma | 12-point running average |
| Density | 8-point running average |
| Neutron | 8-point running average |

This provides a raw data set that is recorded on the hard disk every 0.1 ft and printed on a field record for instant verification. A convolution-type filter is then applied to the data in the following manner:

| | |
|---------------|--------------------------|
| Caliper | 3-point weighted average |
| Natural Gamma | 7-point weighted average |
| Density | 5-point weighted average |
| Neutron | 7-point weighted average |

The filtered data provide a log trace that (1) can be used easily for interpretive purposes and (2) does not hide small features. The filtering program also depth shifts the log data for individual sensor to its correct location on the tool and truncates any input trace values collected after the probe is removed from the well.

3. GEOLOGIC DATA INTERPRETATION

3.1 GEOLOGIC BACKGROUND

PGDP lies near the northern margin of the Mississippi embayment in western Kentucky. The Mississippi embayment is a large Cretaceous- to Tertiary-age sedimentary trough that trends roughly north-south and contains sediments derived from the central part of the North American continent. The sedimentary sequence found in the vicinity of PGDP consists mainly of fine- to medium-grained clastic materials including, from oldest to youngest, a basal gravel (Tuscaloosa Formation), the McNairy Formation, the Porters Creek Clay, and undifferentiated Eocene sands. These strata dip gently to the southwest toward the axis of the embayment and form a post-Paleocene, pre-Pliocene (?) erosional surface. Subsequent deposition of late Tertiary and Quaternary strata, designated the Continental Deposits (Davis et al. 1973), results in an angular unconformity at the base of the Pliocene. Pleistocene loess, which originated as wind-blown material generated by glacial activity to the north, immediately overlies the Continental Deposits. The entire post-Paleozoic sedimentary column for this region is presented in Fig. 3 and a schematic diagram of relationships between the different stratigraphic units is shown in Fig. 4.

The Continental Deposits can be subdivided into two facies: a lower gravel or sandy gravel unit (Gravel Facies) that is reported to vary in thickness from 0 to 106 ft and an upper clay-sand unit (Clay Facies) with a comparable range in thickness (Olive 1966; Finch 1967). The Gravel Facies is interpreted by Potter (1955a,b) as an alluvial fan deposited by high-energy streams. It appears to be continuous throughout the region of PGDP and extends northward to the Ohio River (Davis et al. 1973). Recent interpretations (Early et al. 1989) have indicated the presence of one or more paleochannels during Gravel Facies time that truncate the plant area (Fig. 5). Although fewer data exist for the Clay Facies, it has been interpreted to consist of discontinuous, fine, sand lenses enclosed by the dominant clay (MCI 1986; EDGe 1987, 1988). This interpretation is partially supported by this study, although some sand beds appear to be laterally continuous on the scale of the plant area (see Sect. 3.4.4).

Most of the wells that were logged as part of this project are finished in the Gravel Facies of the Continental Deposits. The remaining wells are finished in the Clay Facies, except for the location 16 well, which may extend down through the Continental Deposits into the McNairy Formation.

GENERALIZED COLUMNAR SECTION AND WATER-BEARING CHARACTER OF GEOLOGIC FORMATIONS

| SYSTEM | SERIES | GROUP | FORMATION | SECTION | THICKNESS IN FEET | LITHOLOGY | TOPOGRAPHY AND GEOLOGIC SETTING | HYDROLOGY |
|---------------|------------------------|-------|----------------------------------|---------|-------------------|---|---|--|
| QUATERNARY | Pleistocene and Recent | | Alluvium | | 0-40 | Brown or gray sandy and silty clay or clayey silt with streaks of sand. Some brown sand with streaks of clay and silt. | Recent flood-plain deposits in the valleys of the Ohio river and its larger tributaries. | No wells tap the alluvium in the area. In the tributary valleys, the alluvium is above the zone of saturation. Near the Ohio River, bored wells penetrating streaks of sand may yield enough water for domestic use. |
| | | | Loess | | 0-43 | Brown or yellowish-brown unstratified silty clay. | Wind-laid deposits covering all upland areas. | Above the zone of saturation. When saturated by precipitation, transmits water to underlying aquifers. |
| | Pleistocene | | CLAY FACIES | | 0-60 | Orange to yellowish-brown clayey silt, some very fine sand, trace of fine to medium sand; occasional layers of light gray clay. Commonly micaceous. | Continental deposits underlying loess throughout the area. Occasionally present beneath the alluvium. | Yields from bored wells generally are reported adequate for domestic use. However, present yields probably are inadequate for modern suburban homes; larger yields can be had from the underlying Pliocene (?) gravel. Most of the wells in this aquifer penetrate about 7 to 18 ft into the zone of saturation; generally, the bottom of these wells is within 5 ft of the underlying gravel. The water generally is moderately hard and has about 240 ppm of dissolved solids. It contains about 0.4 ppm of iron; an iron content greater than 0.3 ppm imparts a disagreeable taste to water and may cause staining of clothing and utensils. It contains about 20 ppm of nitrate; in 3 of 10 samples, it contains more than 45 ppm nitrate. Water containing more than 45 ppm of nitrate may cause methemoglobinemia ("blue baby" disease), sometime fatal in infants, and should not be used in their formulas. |
| | | | GRAVEL FACIES | | 3-121 | Reddish-brown silty and sandy gravel, trace of clay; occasional lenses of clay. | Continental deposits lying on an irregular surface consisting of channels and terraces cut by an intricate drainage system into sediments of Paleocene and Cretaceous ages. Coastal-plain sediments of Eocene age may underlie the gravel near the intersection of Bethel Church Road and the south edge of the quadrangle. | Below the 330-ft water-level contour, yields from bored wells are more than adequate for domestic and stock use. Drilled wells will supply as much as 1000 gallons per minute to meet many industrial needs, except in the small part of the area where the saturated gravel is less than 10 ft thick. Above the 330-ft water-level contour, yields from bored wells generally are reported adequate for domestic use. Occasionally, additional storage (wells penetrating the Porters Creek Clay or more than one well) may be necessary to meet daily peaks of domestic consumption. Where the saturated gravel is thin, or absent, yields will be inadequate. If coastal-plain sediments of Eocene age are present above the Porters Creek Clay, the overlying Pliocene (?) and Pleistocene gravel probably will be above the zone of saturation and the shallowest aquifer may be the Eocene deposits. The shallowest alternative aquifer is the sand in the McNairy Formation, which underlies the Porters Creek Clay at depths increasing from about 100 ft to about 175 ft southward. The shallowest alternative aquifer adequate for industrial needs may be the Mississippian limestone at a depth of about 500 ft. |
| TERTIARY | Pliocene(?) | | GRAVEL FACIES | | 3-61 | Reddish-brown silty and sandy gravel, trace of clay; occasional lenses of clay. | Continental deposits lying on an irregular surface consisting of channels and terraces cut by an intricate drainage system into sediments of Paleocene and Cretaceous ages. Coastal-plain sediments of Eocene age may underlie the gravel near the intersection of Bethel Church Road and the south edge of the quadrangle. | Below the 330-ft water-level contour, yields from bored wells are more than adequate for domestic and stock use. Drilled wells will supply as much as 1000 gallons per minute to meet many industrial needs, except in the small part of the area where the saturated gravel is less than 10 ft thick. Above the 330-ft water-level contour, yields from bored wells generally are reported adequate for domestic use. Occasionally, additional storage (wells penetrating the Porters Creek Clay or more than one well) may be necessary to meet daily peaks of domestic consumption. Where the saturated gravel is thin, or absent, yields will be inadequate. If coastal-plain sediments of Eocene age are present above the Porters Creek Clay, the overlying Pliocene (?) and Pleistocene gravel probably will be above the zone of saturation and the shallowest aquifer may be the Eocene deposits. The shallowest alternative aquifer is the sand in the McNairy Formation, which underlies the Porters Creek Clay at depths increasing from about 100 ft to about 175 ft southward. The shallowest alternative aquifer adequate for industrial needs may be the Mississippian limestone at a depth of about 500 ft. |
| | | | Porters Creek Clay | | 0-89 | Dark gray montmorillonitic clay, commonly silty or sandy; occasionally micaceous. Glauconitic at the base and in the upper part. | Marine deposits underlying the Pliocene (?) and Pleistocene gravel south of the 330-ft water-level contour. Pinched out near the contour; it thickens southward. | Not an aquifer. Retards ground-water movement between the Pliocene (?) and Pleistocene gravel and the sand in the McNairy Formation. |
| CRETACEOUS | Upper Cretaceous | | McNairy Formation | | 200-300 | Grayish-white to dark gray micaceous clay, often silty, interbedded with light gray to yellowish-brown very fine- to medium-grained sand. The upper part is mostly clay; the lower part is predominantly micaceous fine sand. | Deltaic deposits underlying the Porters Creek Clay south of the 330-ft water-level contour and the Pliocene (?) and Pleistocene gravel north of it. | Drilled wells may yield enough water for domestic use; however, the water contains sufficient iron that it may need iron-removal treatment to be satisfactory for most uses. |
| | | | Tuscaloosa Formation | | 0-7 | White, well-rounded or broken chert gravel with tripolitic clay matrix. | Discontinuous stream-laid deposits on post-Paleozoic erosional surface. Present in parts of adjacent quadrangles; may be present in this area. | Not an aquifer because of fine-grained matrix and poor sorting. |
| MISSISSIPPIAN | | | Carbonate rocks undifferentiated | | 300-500 | The Paleozoic consolidated rocks underlying the Cretaceous sediments are the "bedrock" of well drillers. Dark gray limestone interbedded with chert. | | No wells penetrate the bedrock in this area. In the Illinois part of the Joppa quadrangle, the yield of an industrial well penetrating Mississippian limestone exceeds 1000 gallons per minute. Probably the water is hard. |

Age undetermined. Estimates of age range from Pliocene(?) to Pleistocene.
Upper part may include layers of Clayton age.

Fig. 3. Generalized stratigraphic section in the vicinity of the PGDP.

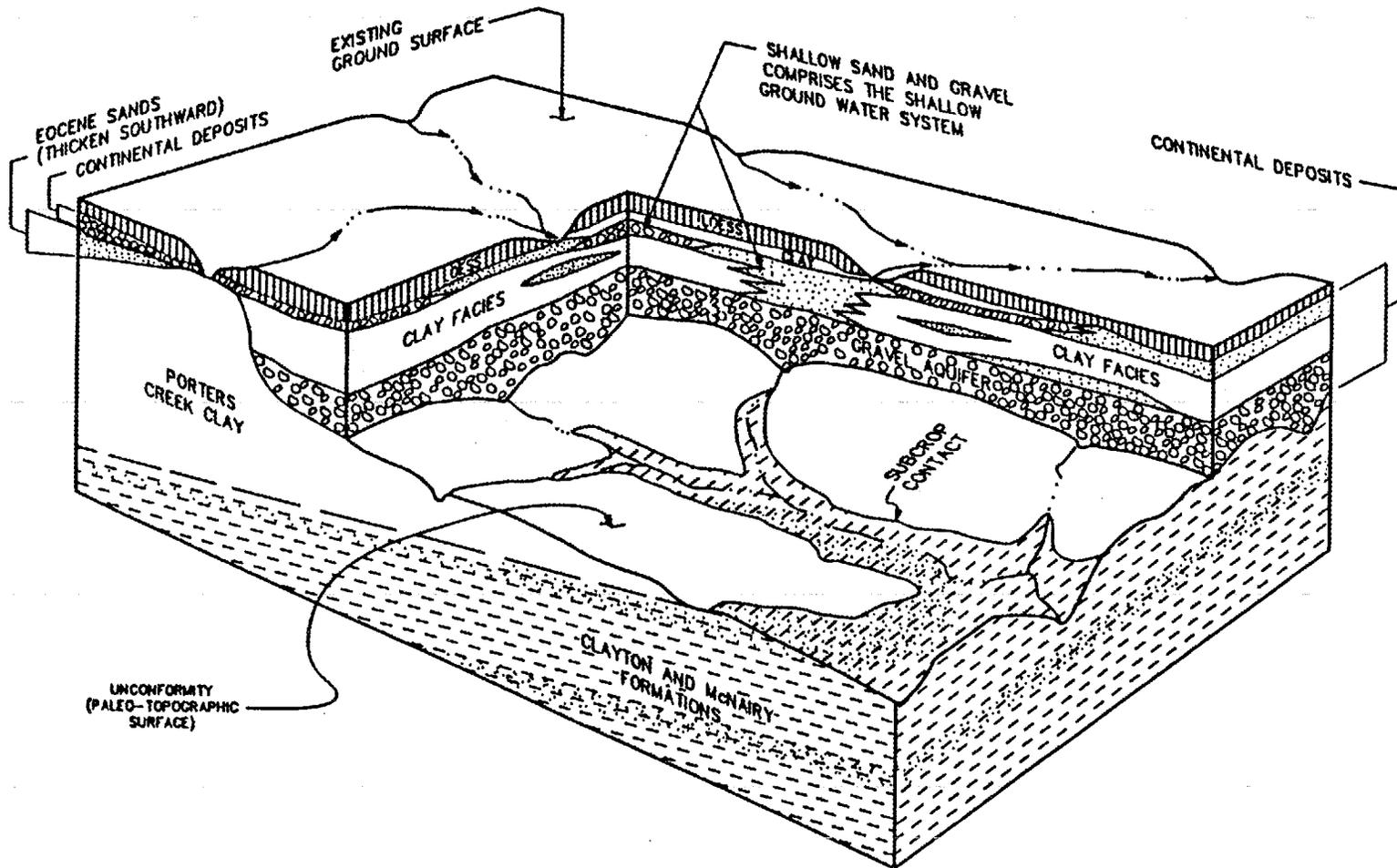


Fig. 4. Conceptual Stratigraphy in the vicinity of the PGDP. Source: *Ground Water Monitoring Phase 2, ESO 16749, ERC Environmental and Energy Services Co., Nashville, Tenn., May 30, 1989.*

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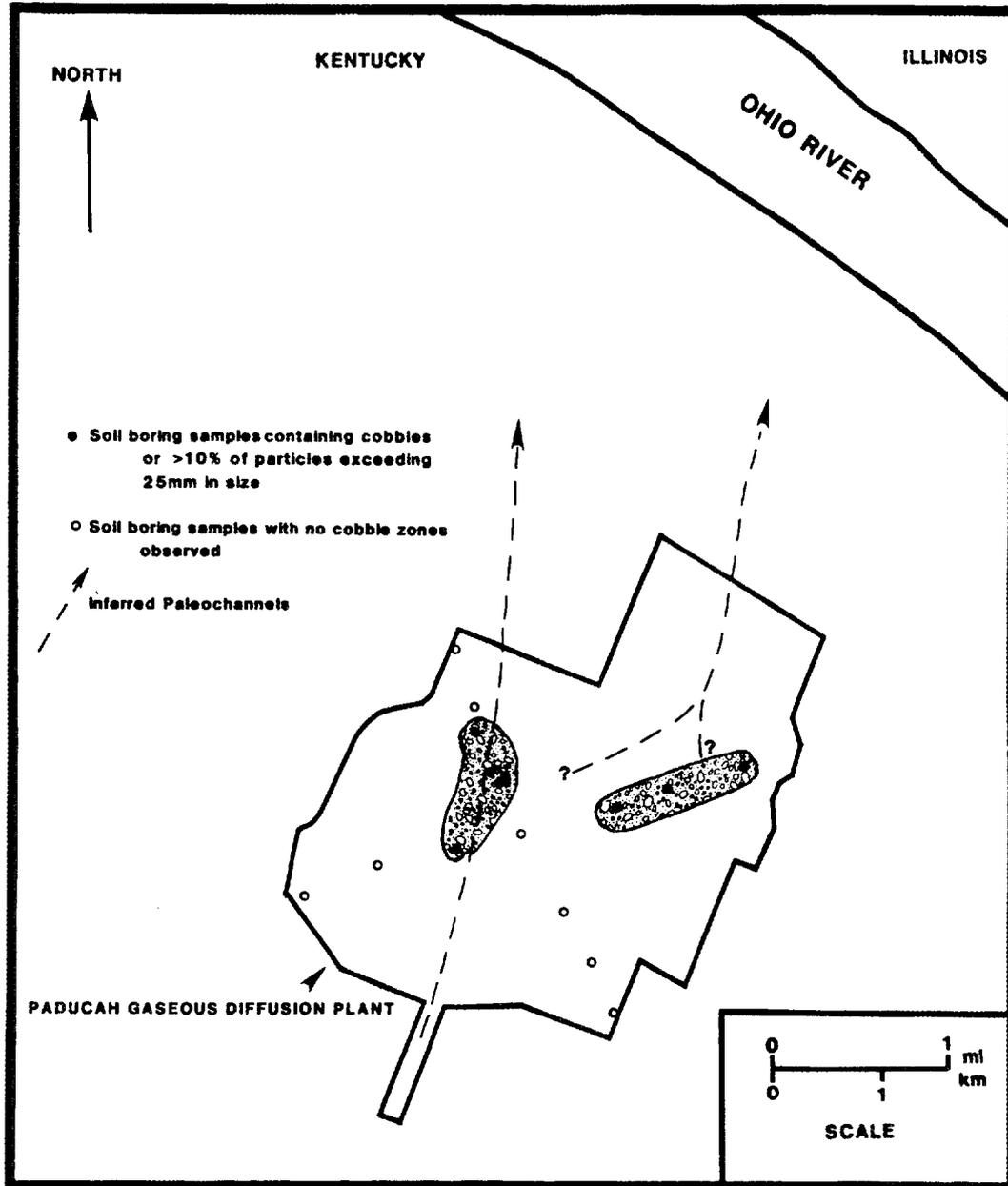


Fig. 5. Inferred location of paleochannels in the upper part of the gravel aquifer. *Source:* T.O. Early, C. F. Sigmon, and R. T. Williams, *Groundwater Monitoring Plan for the Paducah Gaseous Diffusion Plant, Paducah Gaseous Diffusion Plant, August 3, 1989.*

3.2 LITHOLOGY IDENTIFICATION METHODS

The natural gamma ray log proved to be the most useful for interpreting lithologic changes in the geophysical logs. Because the natural gamma ray log is sensitive to clay mineral content, lithologies with the highest proportion of clay minerals, such as clay or loess, will show the greatest gamma ray values. Similarly, clean, quartz-rich gravels and sands will show a low gamma count. Siltstones tend to fall between clays and sands. The absolute value of the geophysical log signature is a function of the well construction and the geology. Hence, although the geology may be consistent between wells, the corresponding gamma ray logs may also vary if the wells have varying construction histories (such as the annulus width, the type and quality of the grouting and the type and diameter of well casing).

Gamma ray values [in counts per second(cps)] for different lithologies are itemized by well in Table 2. These values are made by using several assumptions. First, if a well is completed in the gravel aquifer, the baseline gamma ray value at the base of the well is considered to be representative of a gravel lithology. Second, the highest-count-rate baselines are considered to represent clay-rich lithologies. Because the baselines are average values, locally the count rate of a very clay-rich horizon can exceed the baseline. This is observed from most wells. Third, intermediate lithologies (sand and silt) are assigned between the gravel and clay end members. Finally, gamma ray signatures are compared among the wells, particularly for similarly constructed wells, to check for possible inconsistencies in assigning a geophysical log signature to a lithologic type. Generally gamma values for gravel were less than 20 cps, sand ranged from 20 to 40 cps, silt ranged from 40 to 50 cps, and clay and loess were greater than 50 cps. Deviations from the above classification appears greatest for wells 65, 66, and 68 and for some of the wells constructed by TVA (the D-series wells). Wells 65, 66, and 68 have a 2 in. stainless steel well casing whereas most other wells have 4 in. and/or PVC casing.

The change from one lithology to the next is commonly gradational, as shown by a sloping baseline, and the naming of one lithology may be slightly arbitrary. However, the lithologic interpretations are internally consistent among wells. After lithologies were assigned to horizons within a particular well, all the natural gamma logs were aligned by elevation above mean sea level and lithologic correlations were made among wells.

3.3 SOIL-BORING CORRELATIONS

Soil-boring logs are available from selected wells that were logged geophysically or from wells drilled close to geophysically logged wells (Table 1). The soil-boring logs were compiled by various techniques and vary in resolution with respect to depth and narrative descriptive detail. There has been variable success in correlating the soil-boring narrative descriptions with the natural gamma log; but, in general, the more recent the soil-boring log (e.g., logs presented in ERC 1989), the better the correlation with the geophysical data. As a result, the geophysical logs were relied on more than the soil-boring logs. Comparisons between soil-boring logs and the natural gamma ray logs are presented in Appendix B. The soil-boring logs show all lithologic breaks given in the narrative description. Additional detailed descriptions, and remarks are available for logs presented in ERC 1989.

Table 2. Lithologic baselines determined from the natural gamma ray log^a

| Well name | Gravel | Sand | Silt | Clay & Loess | Well casing |
|-----------|--------|-------|-------|--------------|-------------|
| 16 | - | - | 40-50 | 50-55 | 6" PVC |
| 17 | - | - | 40-50 | 50-55 | 6" PVC |
| 18 | - | 30-40 | 40-50 | - | 6" PVC |
| 19 | - | 30-40 | 40-50 | 50-55 | 6" PVC |
| 22 | - | 30-40 | 40-50 | 50-60 | 4" PVC |
| 38 | <25 | 25-40 | 40-50 | 50-55 | 4" PVC |
| 39 | <21 | 21-42 | 42-50 | 50-55 | 4" PVC |
| 40 | <25 | 25-40 | 40-50 | 50-52 | 4" PVC |
| 41 | <21 | 21-40 | 40-50 | 50-55 | 4" PVC |
| 42 | <21 | 21-40 | 40-50 | 50-55 | 4" PVC |
| 43 | <20 | 20-40 | 40-50 | 50-55 | 4" PVC |
| 44 | <20 | 20-40 | 40-50 | 50-55 | 4" PVC |
| 65 | <20 | 20-35 | 35-45 | 45-50 | 2" SS |
| 66 | <20 | 20-35 | 35-45 | 45-50 | 2" SS |
| 68 | <20 | 20-35 | 35-45 | 45-55 | 2" SS |
| 80 | <20 | 20-40 | 40-50 | 50-60 | 2" PVC |
| 81 | <20 | 20-38 | 38-48 | 48-55 | 2" PVC |
| D01 | - | 20-30 | 30-40 | 40-60 | 4" PVC |
| D03 | <20 | 20-40 | 40-50 | 50-60 | 4" PVC |
| D04 | <15 | 15-30 | 30-45 | >45 | 4" PVC |
| D10 | - | 40-50 | 50-65 | 70 | 4" PVC |
| LOC 2 | <25 | 25-40 | 40-55 | 55-60 | ? PVC |
| LOC 3 | 15-20 | 20-35 | 35-45 | 45-55 | ? PVC |
| LOC 16 | <15 | 15-40 | 40-50 | 50-55 | 4" PVC |
| LOC 18 | 20-25 | 25-40 | 40-50 | 50-55 | 4" PVC |

^a all natural gamma ray values are given in counts per second.

3.4 STRATIGRAPHIC CORRELATION RESULTS

In general, results of this study suggest that the gravel and clay facies of the Continental Deposits in the vicinity of PGDP can be divided into five lithologic units, which are described below in greater detail. These are, in ascending order, (1) gravel unit, (2) sand/silt transition zone, (3) clay unit, (4) silt/sand unit, and (5) sand unit. These units are locally covered with loess and have been covered subsequently with fill in places. The divisions between the silt/sand and the sand units are preliminary and may change with additional data or alternate interpretations of the geophysical logs.

The interpretations are presented as transects across the plant area and north of the plant to the Ohio River (Fig. 6). The order of wells shown in the interpretations was picked to best illustrate geologic features whenever possible. Figure 7 is a transect through the northwestern plant area. Figure 8 is a transect through the north plant area and was chosen to show changes across proposed paleochannels, determined from gravel elevation and thickness data. In addition, Fig. 9 shows south-north changes in the geology along a paleoridge that separates the paleochannels. Figure 10 shows detailed characteristics of a relatively small area, the current inert/residential landfill site, which contains a high density of wells.

3.4.1 Gravel Unit

The gravel unit is one of the most easily distinguishable lithologies at the site. Its natural gamma ray signature is characterized by a straight baseline that ranges between 15 and 25 cps. Previous studies have shown that the topography of both the lower and upper contacts of the gravel unit define two regional paleochannels separated by a ridge (Early et al. 1989). Because most wells penetrate the upper contact and are finished within the gravel, this study can only confirm muted topographic changes at the top of the gravel. The plant area (Fig. 7) is primarily located in the western paleochannel, and the top of gravel shows an elevation between 307 and 310 ft. Continuing east, the landfill site (Fig. 10) and the transect shown in Fig. 9 are located on a ridge with top-of-gravel elevations of 317 ft, except for the easternmost landfill well (well 43), which shows a top-of-gravel decrease to 312 ft. Farther east and north, the top of gravel is at 289 ft, giving a total relief of the upper surface of this regional aquifer of almost 30 ft. Lithologic units above the gravel show much more local undulations, but their overall relief is not as great as that of the gravel.

3.4.2 Sand/Silt Transition Zone

Above the gravel, the natural gamma ray log shows a sloping baseline that marks a lithologic transition from the gravel to a persistent clay bed. This zone ranges in thickness from 0 to 20 ft and consists of sand +/- silt. Locally, at the landfill site (Fig. 10) and in the ridge region (Fig. 9), the lithologic transition is more abrupt and is marked by stepped vertical baselines that correspond primarily to thin silt beds. The immediate plant area (Fig. 7) shows a transition zone that is dominantly sand with minor silt, particularly in comparison with the other transects. The zone is absent at the southernmost well (well 68), and the clay unit rests immediately on top of the gravel. This is the only site in the study where the transition zone is missing. The area between well 68 and the landfill must show a pinch-out of the sand/silt transition zone similar to that observed between wells 81 and 68. However, no geophysical logs are available from that area. The northern region transition zone (Fig. 8) shows fairly constant sand thickness. However, silt thicknesses vary considerably, are thickest on the ridge crest, and pinch out on the west side of the ridge.

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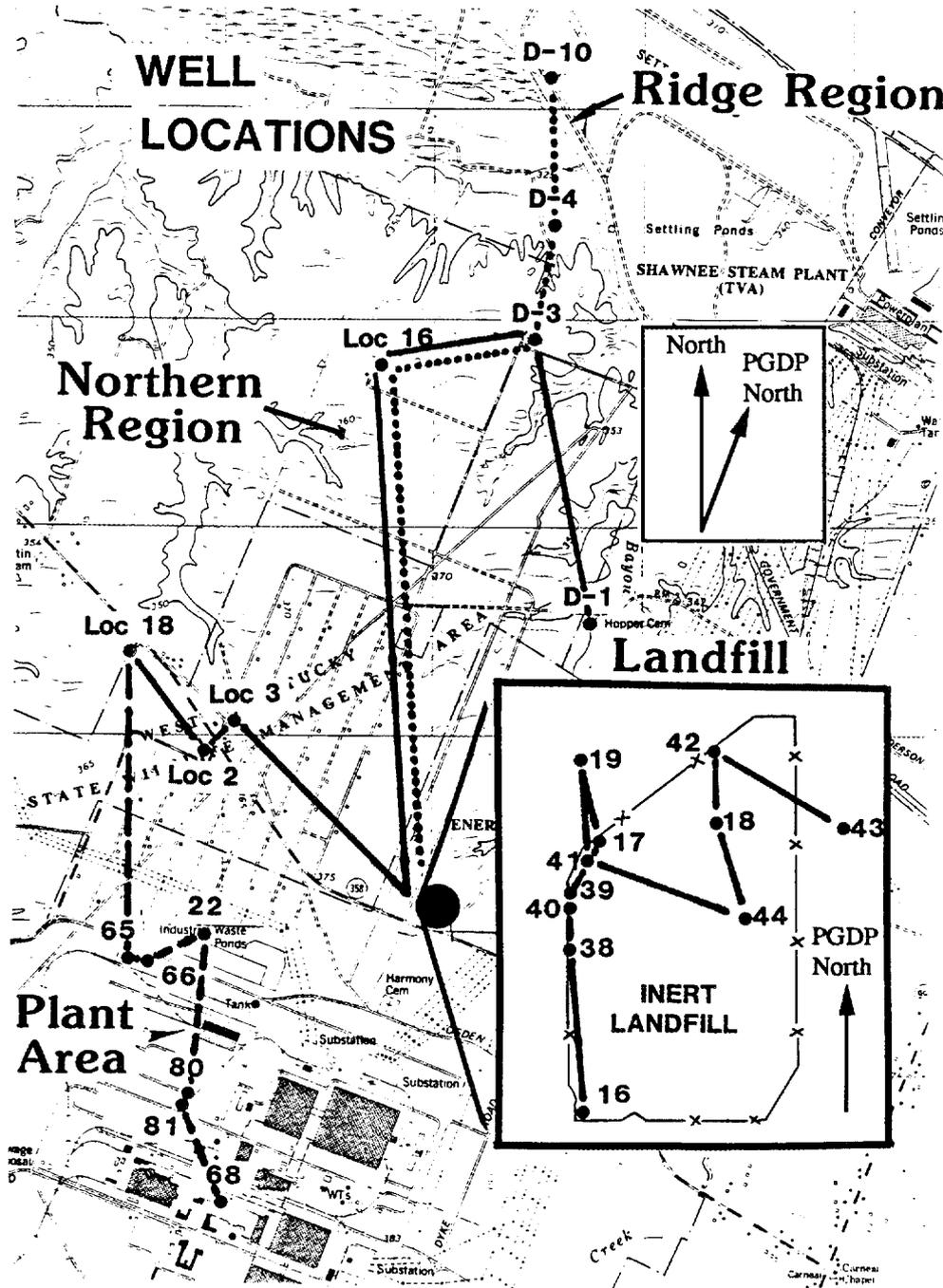


Fig. 6. Index map of transects. Unless otherwise noted, true north is always referenced.

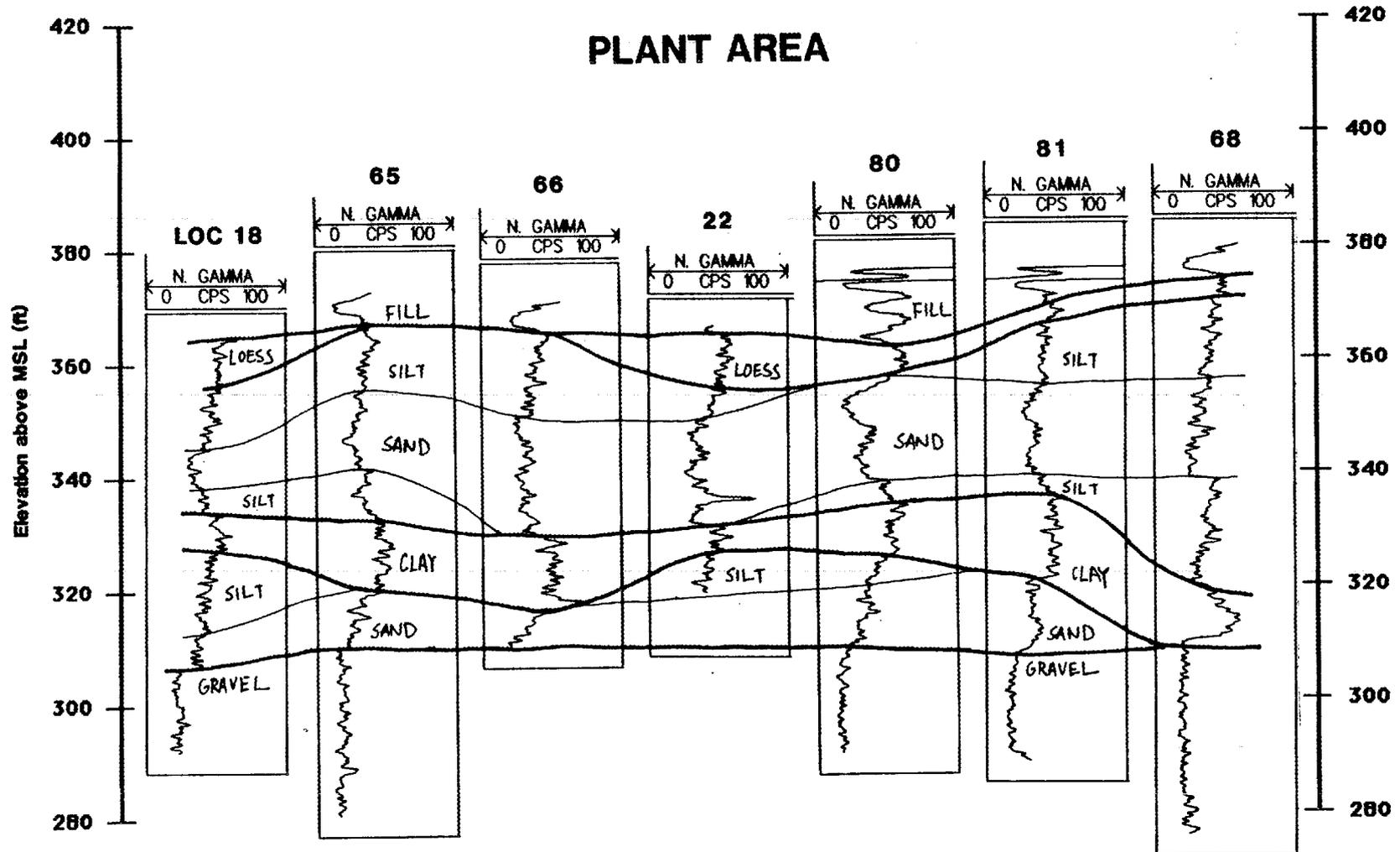


Fig. 7. Geologic interpretation -- plant area. Reference Fig. 6 for transect location, direction, and well spacing. In particular, note that the wells are not evenly spaced.

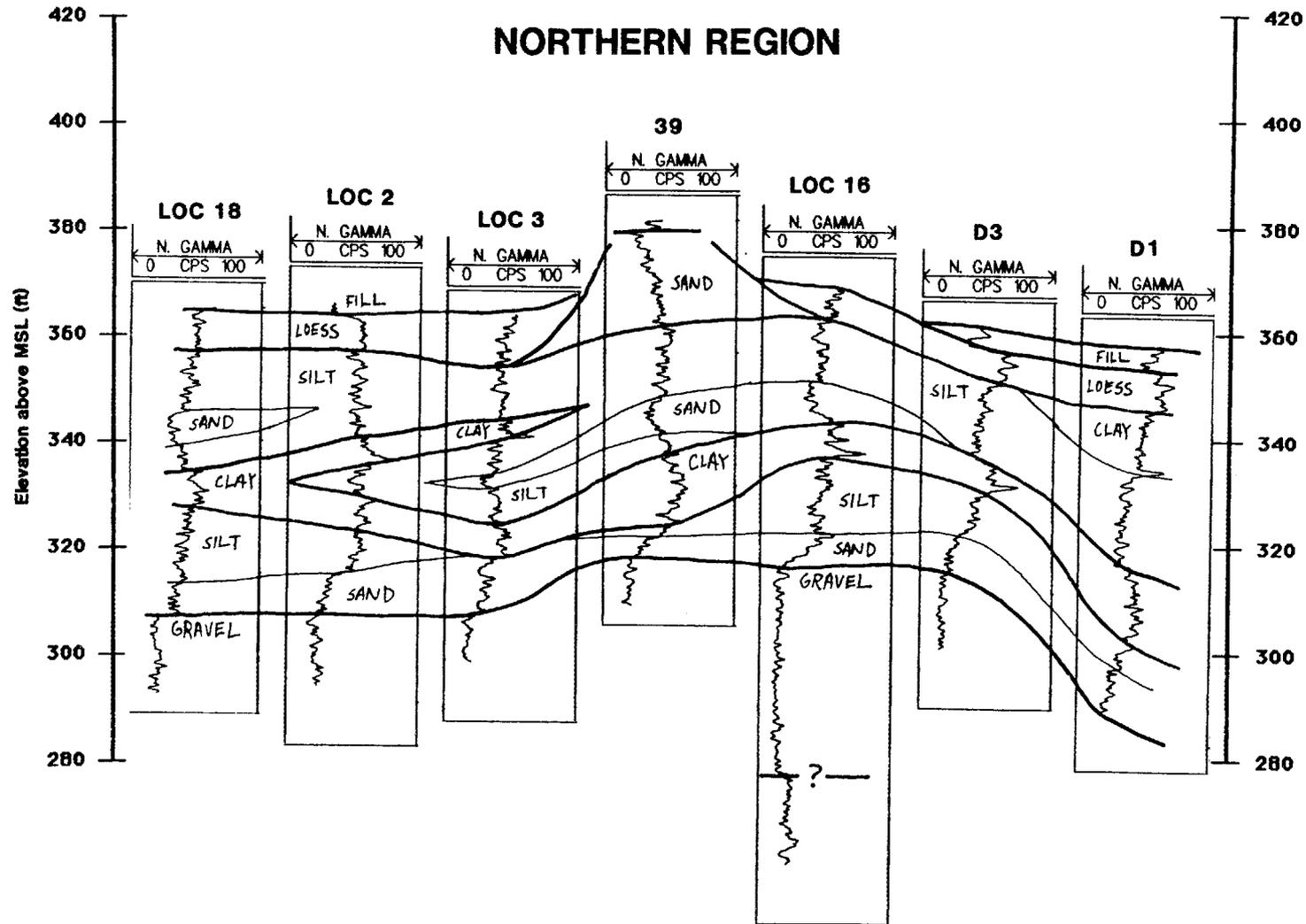


Fig. 8. Geologic interpretation -- north of plant and transverse to paleochannels. Reference Fig. 6 for transect location, direction, and well spacing. In particular, note that the wells are not evenly spaced.

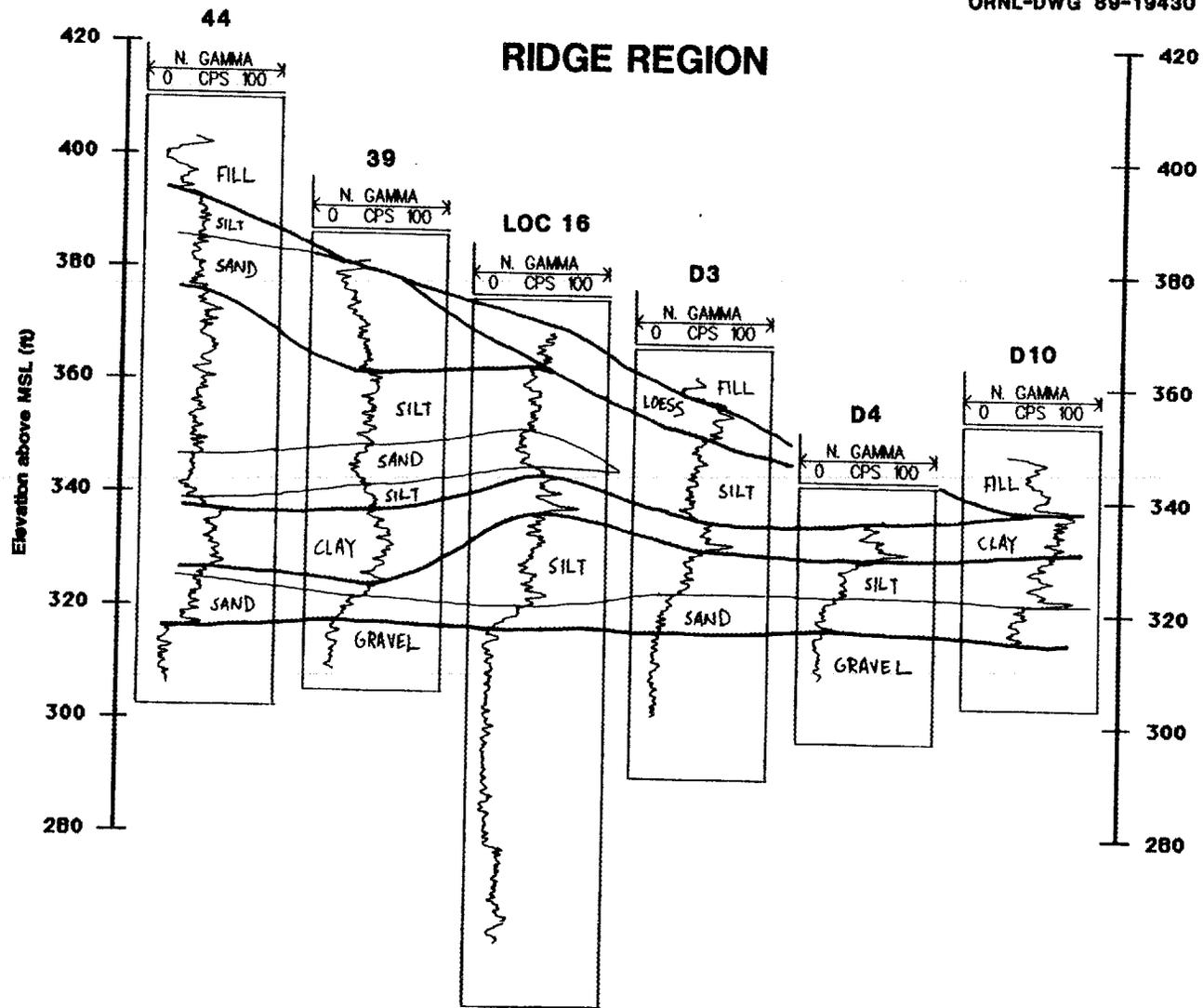


Fig. 9. Geologic interpretation -- ridge region between paleochannels. Reference Fig. 6 for transect location, direction, and well spacing. In particular, note that the wells are not evenly spaced.

LANDFILL

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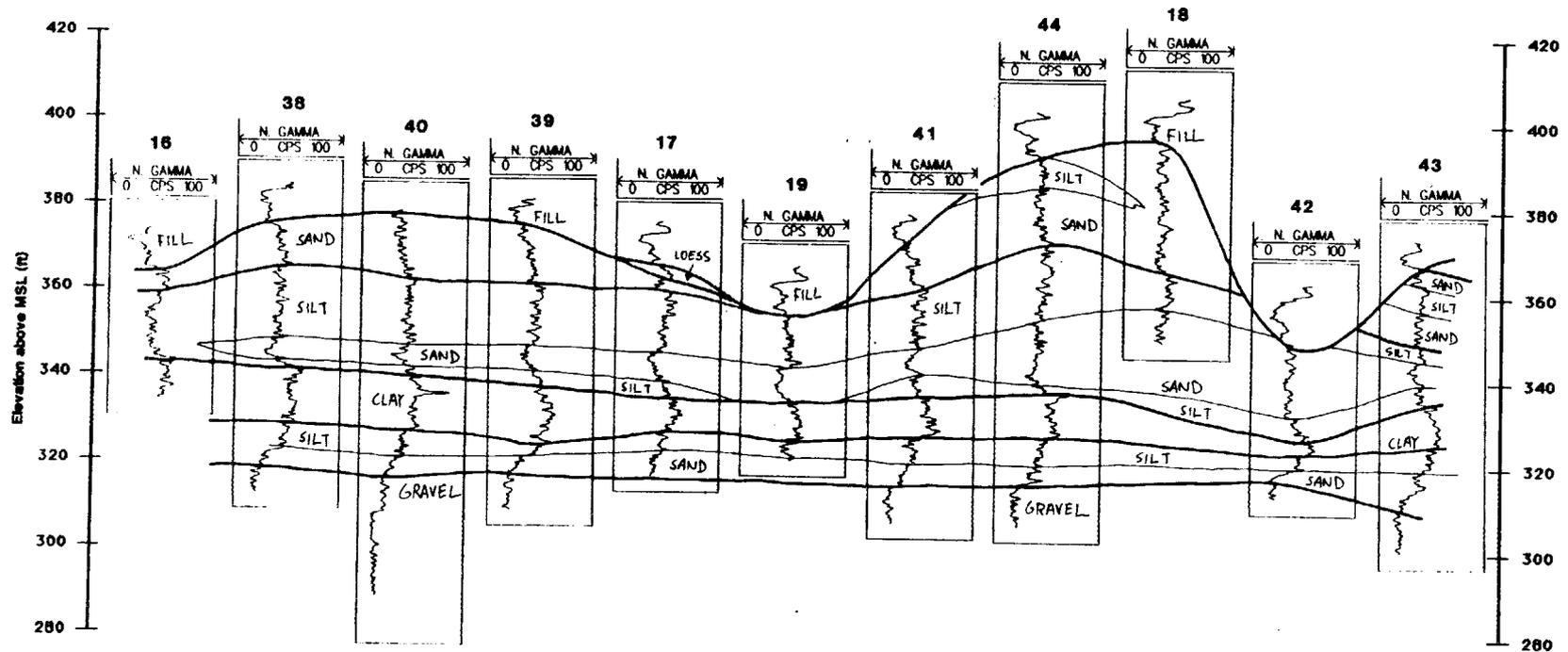


Fig. 10. Geologic interpretation -- landfill site. Reference Fig. 6 for transect location, direction, and well spacing. In particular, note that the wells are not evenly spaced.

3.4.3 Clay Unit

This unit is easily identified by high natural gamma ray values, generally greater than 50 cps, and the highest observed for each well except for surface loess deposits. The unit ranges in thickness from 4 ft (well 42) to 14 ft (wells 39 and D1). This clay unit is identified in all wells with the possible exception of location 18, where the observed clay may correlate with the upper clay beds observed in wells at location 2 and location 3 (Fig. 8). However, the interpretation adopted in this report shows the two clay beds merging between location 16 and location 3 (Fig. 8). In the plant area (Fig. 7), the clay unit may be more silt rich than other areas because the baseline varies between 45 and 55 cps, rather than being strictly greater than 50 cps. However, as mentioned earlier, it currently is not possible to determine if this difference is the result of true lithologic change or is a function of the well construction.

3.4.4 Silt/Sand Unit

This unit is very heterogeneous in comparison with the underlying units but generally consists of a sand of variable thickness that is sandwiched between silt beds. Locally, however, sand rests directly on the underlying clay unit (Fig. 7). The unit ranges in thickness from 15 ft [well 16, (Fig. 10)] to 39 ft [well 44, (Fig. 10)]. Comparisons with soil boring logs show that this unit is commonly called a clay (Appendix B). However, because there is a measurable difference in the natural gamma baseline between this unit and the underlying clay unit, and because the clay appears to show a specific hydrologic function, we have chosen to distinguish this unit.

In the plant area (Fig. 7), this unit is predominantly sand, in contrast to more silt-rich sites north of the plant (Figs. 8, 9, and 10). This appears to be a general characteristic of the plant area because both the sand/silt transition zone and the lower silt/sand unit show greater sand content. In addition, sand lithologies in the plant area are locally gravelly, and individual sand beds can be correlated between wells (compare for example wells 66, 22, 80, 81 and 68 in Fig. 7).

At the landfill site and in the ridge region, the sand is thin and pinches out both to the south [well 16, (Fig. 10)] and north [well D3, (Fig. 9)]. Locally, in the northeastern portion of the landfill, the upper silt appears to grade into a clay lithology [well 17, (Fig. 10)]. In addition, at the landfill, this unit shows the greatest local relief, up to 15 ft.

The northern region transect (Fig. 8), which is roughly aligned across the paleochannels, shows the greatest heterogeneity of this unit. Similar to the landfill and ridge region, the unit is generally dominated by silt. In addition, the topographically high ridge region shows a sand bed (well 39, location 3, and location 16) that pinches out toward the neighboring channels, which are located northeast and southwest of the ridge. The channel regions, or topographic lows, show the introduction of discontinuous clay beds that are observed on the flanks of the central ridge. This clay is observed in location 2 and location 3 wells on the west side of the ridge and in well D1 on the east flank of the ridge. The westernmost well (location 18) shows an additional lithology where a discontinuous sand bed is observed several feet above the clay. All of the clay and sand is then overlain by silt.

3.4.5 Sand Unit

The sand unit is only observed at the landfill site (Fig. 10) and also is shown in transects that use wells from the landfill site (Figs. 8 and 9). This unit shows a maximum thickness of 29 ft (well 18) and a more common thickness is 14 ft (well 39). The top of the unit, however, is truncated by fill. Therefore it is not possible to determine the true thickness of this unit.

The absence of this unit at other locations can be explained by either geologic or man-induced processes. The later is favored for the mound near wells 44 and 18 because pre-landfill USGS topographic maps record surface elevations between 370 and 380 ft and the mound shows an elevation greater than 380 ft. Geologic explanations include: 1. The unit was never deposited. 2. The unit undergoes a facies change between the landfill site and other areas. The latter explanation is supported in part by a local transition from sand to silt to clay (wells 40, 38, and 16 respectively) in the southern part of the landfill. In addition, the elevation of the sand unit matches the elevation of the upper silt lithologies in the plant area. Hence, the sand unit at the landfill may be a stratigraphic equivalent of part of the silt/sand unit in the plant area. 3. The unit was deposited and subsequently eroded. This interpretation is favored for the northern and ridge regions because these wells are either collared at lower elevations in stratigraphically lower horizons, or show loess deposits at comparable sand unit elevations.

3.4.6 Loess

Lithologies interpreted as loess are observed in all the transects and are characterized by natural gamma ray count rates equivalent to or greater than those observed for clay lithologies. As a wind blown deposit, loess is deposited into regions of low topography. This is best illustrated in Fig. 7, where the loess is concentrated in topographic lows in the silt/sand unit. In general, the loess appears to have been deposited on an erosional surface developed on the silt/sand unit and locally on the sand unit [well 17, (Fig. 10)].

3.4.7 Fill

The low frequency signal on the natural gamma log that commonly occurs at the top of the well [e.g. well 80, (Fig. 7)] is interpreted to be fill material. This characteristic signal is observed for the plant, landfill, and TVA wells, but is not observed for the private off-site wells [locations 2, 3, 16 and 18 (Fig. 8)]. This lends support to the fill interpretation because more fill is expected at the TVA sites, and a considerable amount of fill was placed at the PGDP during its construction (C. Winkler, PGDP, Paducah, Kentucky, personal communication with R. B. Dreier, Oak Ridge National Laboratory, (ORNL), Oak Ridge, Tenn., November, 1989). In addition, fill identification from well 66, a recently drilled and logged well, shows excellent correlation with the geophysical log identification (Appendix B).

3.5 CHARACTER OF THE GRAVEL AQUIFER

Because of difficulties in interpreting the neutron and density logs above the water level, only the gravel unit was examined for smaller scale heterogeneities, by using the three available geophysical logs (natural gamma ray, thermal neutron, and gamma-gamma density). However, this unit is one of the most important hydrologic units in the area because it is a regional aquifer, shows local contamination, and can be quite thick.

In general, the geophysical log signature of the gravel falls into one of three categories, the first of which is potentially the most significant because it highlights a high porosity and possibly high permeability zone within the gravel. The gravel characteristics observed in the wells is summarized in Table 3.

Category one This signature is characterized by a neutron porosity increase, no density change, or a density decrease and no change in the natural gamma ray baseline (Fig. 11). The signature is observed in two wells from the plant area (wells 65 and 68), and fortunately, both wells are near recent soil borings [S-2 and S-1 respectively (ERC 1989)]. Examination of the boring logs shows that these intervals correspond to cobble-rich horizons. For example, soil boring S-2 shows "Probably gravel and sand, medium to coarse, variably silty, brown with occasional beds of large cobbles" (ERC 1989) from a depth of 70.0 to 78.5 ft. Hence the geophysical logs indicate higher porosity zones within the gravel that are related to cobbles. Other wells that show this geophysical log signature are located at the landfill site (wells 38, 39, 40, 41, 43, and 44) and in the plant area (well 80). However, the neutron porosity shift observed in these wells is very slight, generally occurs near the bottom of the hole, and may be a logging artifact that results from well construction (Appendix A).

Category two This signature is characterized by a neutron porosity decrease, no density change, or a density increase and no change in the natural gamma ray baseline (Fig. 11). For available soil boring logs, the zone corresponds either to horizons with reduced grain size, and presumably reduced porosity [well 68 (Fig. 11)], or to a well-indurated cobble-rich horizon [wells 65 (Fig. 11) 81 and location 16)]. For example, soil boring S-2 shows "Probably gravel and sand, fine to coarse, silty with occasional clayey zones, brown with occasional beds of large cobbles" (ERC 1989) from a depth of 78.9 to 88.5 ft. Note that the geophysical logs appear to distinguish between high- (category one) and low- (category two) porosity cobble beds. To further substantiate this interpretation, hydrologic well testing should be conducted in appropriate wells. Other wells that show this geophysical log signature do not have corresponding soil boring logs (location 2, location 3, D3, and D4).

Category three This signature is characterized by a natural gamma ray count rate decrease and a complimentary neutron count rate increase, which presumably indicate a decrease in clay minerals. In addition, the density log shows a density decrease (Fig. 12). Because the gamma ray log also shows a shift, this signal suggests a cleaner gravel with less clay minerals, rather than purely a porosity, or grain size, change. The only well to show this feature is well 40, located in the landfill site. No other wells at the landfill site are deep enough to further substantiate this characteristic. Other wells in the plant area, or north of the plant, that are deep enough to penetrate this horizon do not show this signature. Apparently, it is a rather isolated feature.

Table 3. Geophysical characteristics of the gravel^a

| Well | Depth (ft) | Category one | Category two | Category three | Soil boring | No change | Geophysical logs do not sample gravel |
|--------|--------------|--------------|--------------|----------------|--------------|-----------|---------------------------------------|
| 16 | - | - | - | - | - | - | X |
| 17 | - | - | - | - | - | - | X |
| 18 | - | - | - | - | - | - | X |
| 19 | - | - | - | - | - | - | X |
| 22 | - | - | - | - | - | - | X |
| 38 | 68-72 (BOH) | X | - | - | - | - | - |
| 39 | 68-72 (BOH) | X | - | - | - | - | - |
| 40 | 74-94 | - | - | X | - | - | - |
| 40 | 94-101 (BOH) | X | - | - | - | - | - |
| 41 | 68-71 (BOH) | X | - | - | - | - | - |
| 42 | - | - | - | - | - | X | - |
| 43 | 68-73 (BOH) | X | - | - | - | - | - |
| 44 | 92-94 (BOH) | X | - | - | - | - | - |
| 65 | 72-80 | X | - | - | S-2 | - | - |
| 65 | 80-92 | - | X | - | S-2 | - | - |
| 66 | - | - | - | - | - | - | X ^b |
| 68 | 78-96 | X | - | - | S-1 | - | - |
| 68 | 96-104 (BOH) | - | X | - | S-1 | - | - |
| 80 | - | - | - | - | - | X | - |
| 81 | 67-85 | - | X | - | S-3 | - | - |
| D01 | - | - | - | - | - | - | X |
| D03 | 48-68 | - | X | - | - | - | - |
| D04 | 27-36 (BOH) | - | X | - | - | - | - |
| D10 | - | - | - | - | - | - | X |
| LOC 2 | 76-80 (BOH) | - | - | - | - | - | - |
| LOC 3 | 57-78 (BOH) | - | - | - | - | - | - |
| LOC 16 | 66-82 | - | X | - | Drillers log | - | - |
| LOC 18 | - | - | - | - | - | X | - |

^a categories described in text.

^b Well 66 is installed in the gravel aquifer. However, the geophysical logging tool did not penetrate deep enough to sample gravel at the base of the well.

BOH = Bottom of hole.

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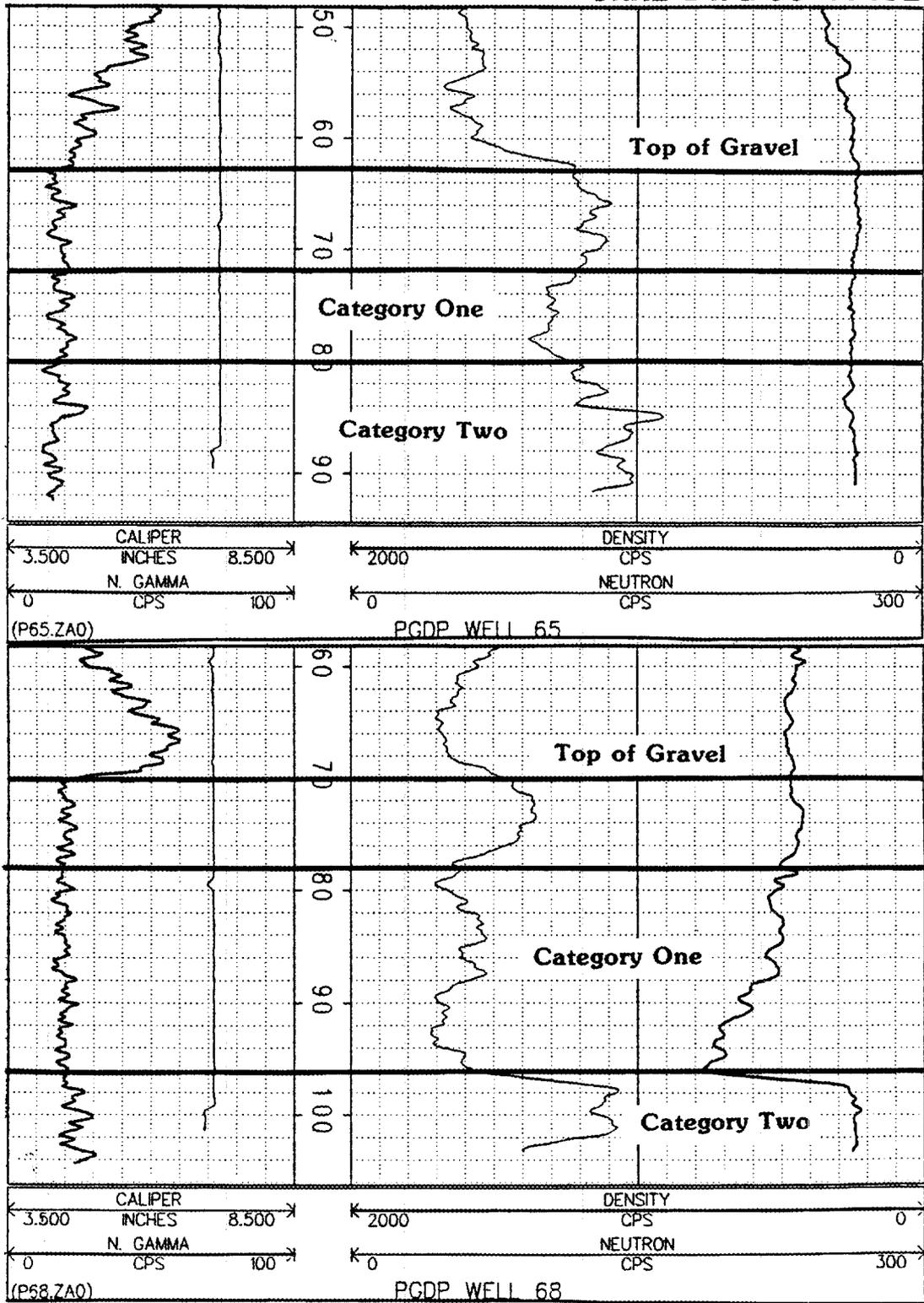


Fig. 11. Category-one and category-two characteristics of the gravel aquifer.

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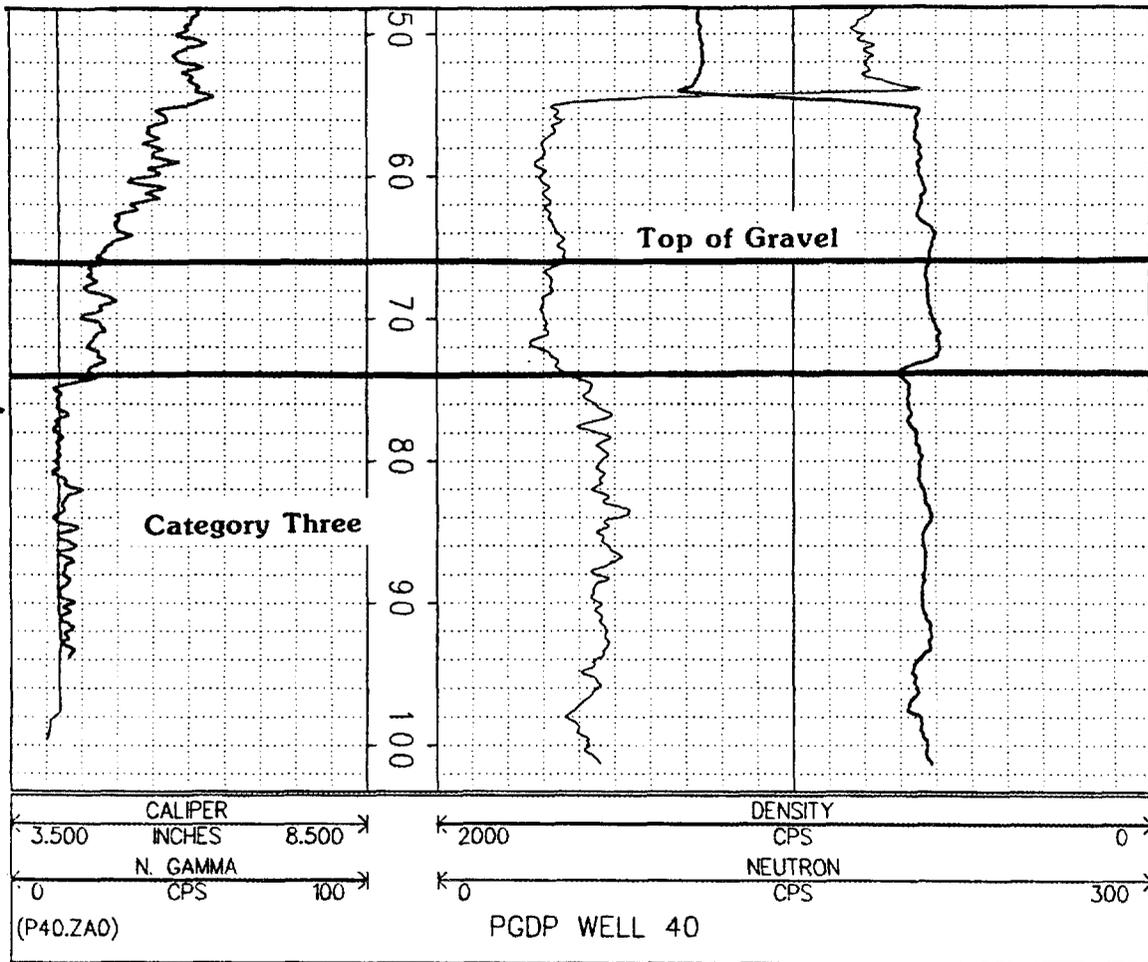


Fig. 12. Category three characteristics of the gravel aquifer.

4. WELL CONSTRUCTION

The caliper log showed limited success in identifying the screened interval for the wells, but was useful when wells had a smaller inner diameter well screen than the well casing. Preliminary identification of these intervals are listed in Table 4. However, the log did show that the wells were generally free of constrictions, as discussed in Sect. 2.2. The density and neutron logs were useful for determining continuity of grout in the annulus behind the well casing. A grout-free annulus is shown on the density log by a sharp density decrease spike and is commonly accompanied by a neutron spike, which is indicative of an air pocket or hydrogen-deficient zone (Fig. 13). Table 4 lists wells that show these low density shifts, which are related to grouting discontinuities.

Wells 80 and 81 were grouted to the land surface with a bentonite slurry, whereas the other wells in the PGDP plant area were sealed with a bentonite-cement grout (C. J. Winkler, PGDP, Paducah, Kentucky, personal communication with R. B. Dreier, ORNL, Oak Ridge Tenn., November, 1989). Because of the difference in sealing agents, it was expected that wells 80 and 81 would show higher natural gamma cps. The fact that this was not observed may be the result of several factors. For example, the difference in bentonite content between the slurry and the grout may not have been large enough to show a significant difference in the natural gamma log response; or, the annular space may have been small, and the small seal volume may not have exerted a strong enough influence on the log signal. At present, these factors remain undetermined.

Table 4. Well construction characteristics determined from geophysical logs

| Well name | Grout deficiency | Depth of discontinuity | Screen identified | Depth of screen |
|-----------|------------------|------------------------|-------------------|-----------------|
| 16 | - | - | - | - |
| 17 | X | 24-27 | - | - |
| 18 | X | 29-30 | - | - |
| 19 | - | - | - | - |
| 22 | - | - | - | - |
| 38 | - | - | X | 68.3-73.3 |
| 39 | - | - | X | 68.6-73.6 |
| 40 | X? | 16-18 | X | 97.7-102.7 |
| 41 | - | - | - | - |
| 42 | - | - | X | 45.8-50.8 |
| 43 | - | - | X | 68.8-73.8 |
| 44 | X | 66-68 | X | 93.0-98.0 |
| 65 | - | - | X | 88.2-93.2 |
| 66 | - | - | - | - |
| 68 | X | 4-6 | X | 100.1-105.1 |
| 80 | - | - | X | 81.0-86.0 |
| 81 | - | - | <i>a</i> | <i>a</i> |
| D1 | X | 2-4?, 28-30 | - | - |
| D3 | - | - | - | - |
| D4 | - | - | - | - |
| D10 | - | - | - | - |
| Loc 2 | - | - | - | - |
| Loc 3 | X | 47-49 | - | - |
| Loc 16 | X | 49-51 | - | - |
| Loc 18 | - | - | - | - |

^a The geophysical logging did not extend as deep as the screened interval .

ORNL-DWG 89-19434

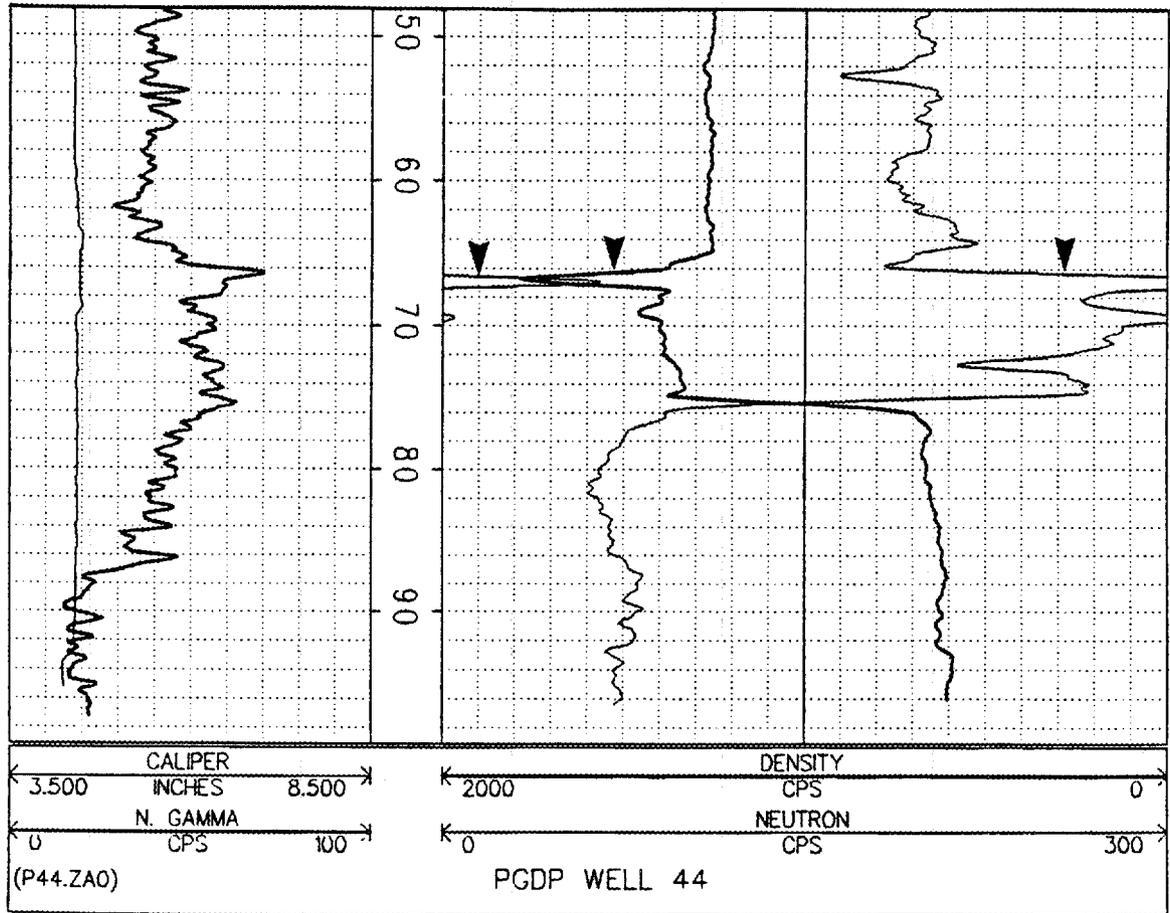


Fig. 13. Geophysical log response to deficient grout in a well annulus.

5. SUMMARY AND RECOMMENDATIONS

Results of this investigation show that the gravel and clay facies of the Continental Deposits in the vicinity of the PGDP can be divided into five lithologic units. These are, in ascending order (1) gravel unit, (2) sand/silt transition zone, (3) clay unit, (4) silt/sand unit, and (5) sand unit. These units are locally covered with loess and have subsequently been covered in places with fill. The gravel unit and overlying sand units have the greatest potential for transmitting fluids. The sand units are thickest and most continuous in the immediate plant area. However, the sands thin considerably and locally pinch out to the north in the direction of the Ohio River. Cobble beds within the gravel show either enhanced or reduced porosity characteristics, and without the geophysical data, it would be difficult to differentiate between these porosity changes.

In summary, this study shows that geophysical logging can be very useful for determining lithologic sequences in the vicinity of the PGDP. The logs can differentiate gravels, sand, silt, clay, loess and fill; indicate a gradational or abrupt transition between lithologic types; they provide a continuous downhole record of the geology; delineate high and low porosity zones within the regional gravel aquifer; and substantiate or provide some well construction data.

If additional lithologic information is required from areas not covered by this study, follow-on geophysical logging in wells located in these areas would be appropriate. For example, data are lacking from the region between well 68 and the landfill that would help to locate changes in the sand/silt transition zone and the overlying clay unit. Also, more detailed coverage of the region north of the plant area may be required to predict groundwater flowpaths.

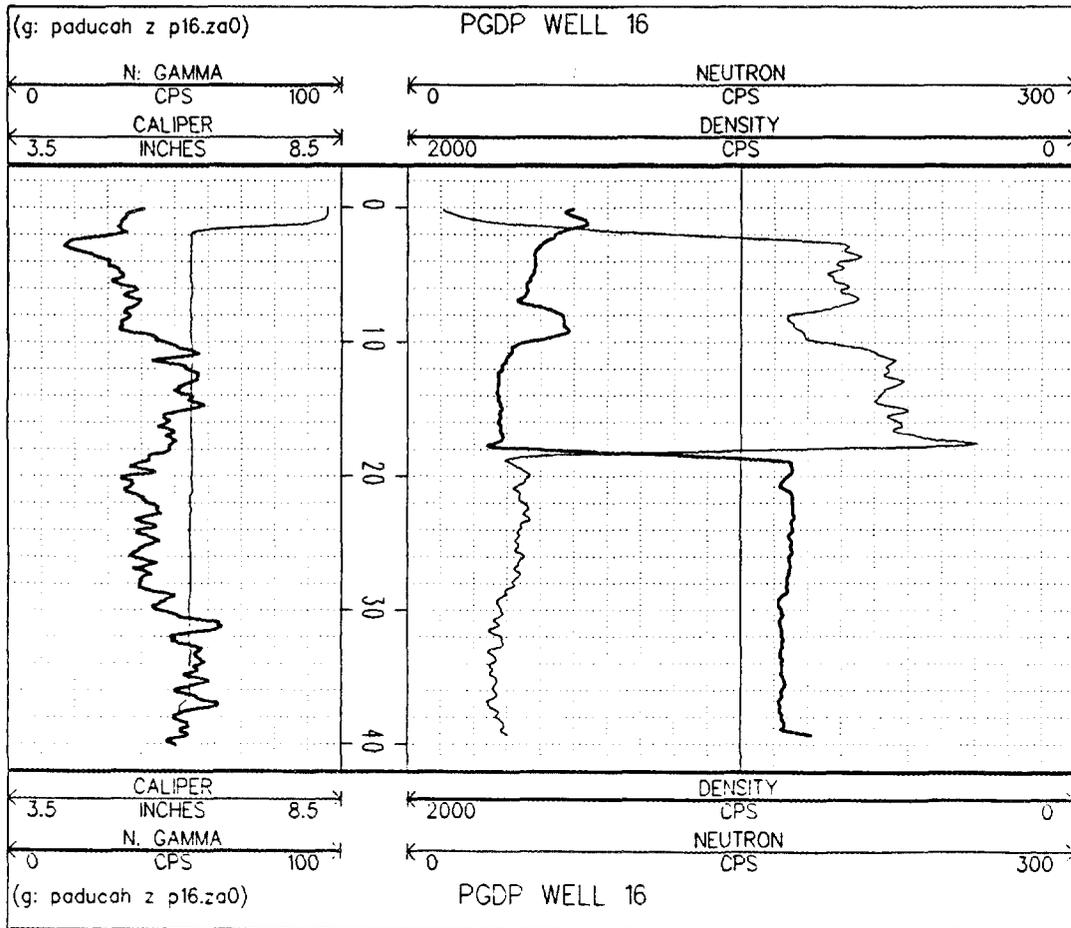
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APPENDIX A
GEOPHYSICAL LOGS

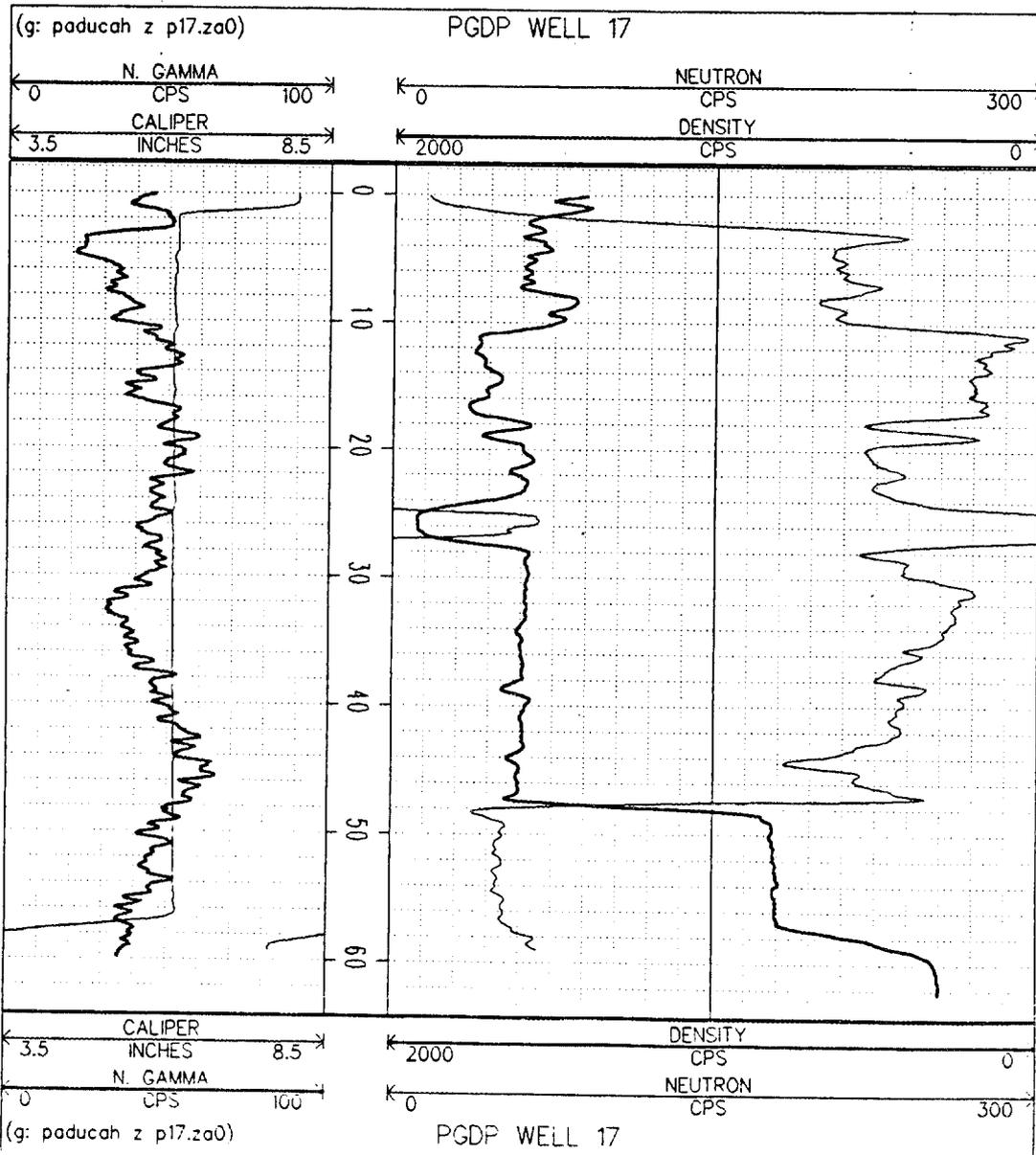
| | | | | | | |
|---|---|---|---------------|-------------------|-------|--------|
|  | ORNL GEOPHYSICS GROUP | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 16 | | | | |
| | P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | | | | | |
| PROJECT: PGDP Site Investigation 1 | | DATE LOGGED: 14 August 1989 | | | | |
| CLIENT: MMES RAP -- Winkler/Krispin | | ORNL ID NO: PGDP0016 | | | | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | | | |
| STATE: Kentucky | COUNTY: McCracken | ELEV: 373.75' DEPTH REF: TOSC | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? | | | | | | |
| DRILLER TD: ? LOGGED TD: 40.88 | | | | | | |
| RUN | BIT RECORD | | CASING RECORD | | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 8" steel | 0.0' | ? |
| 2 | | | | 6" PVC | 1.55' | 40.88' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger | | | | | | |
| CASING STICK UP: 2.3' TOSC--outer, 0.75' TO(PVC)C | | | | | | |
| DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | | UNIT/TRUCK: GEL 1 | | |
| LOGGING ENGINEER: R. O. KENNARD | | | | | | |
| GEOPHYSICIST: R. J. SELFRIDGE | | | | | | |
| OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | 1x-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | Jamm sum | | | none | | 37.7' | TOSC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 40.1' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 39.3' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Be | 3.0 C | 39.3' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S) caliper at wellhead 8/14/89 DIGITAL FILE NAME(S) PGDP0016.CA0,CB0,GA2,CB2,DA1,DB1,NA1,NC1 REMARKS: Repeat log files: GA0,DA0,NA0 water level 8-03-89 19.1' from TOSC | | | | | | | | | | | | | | |



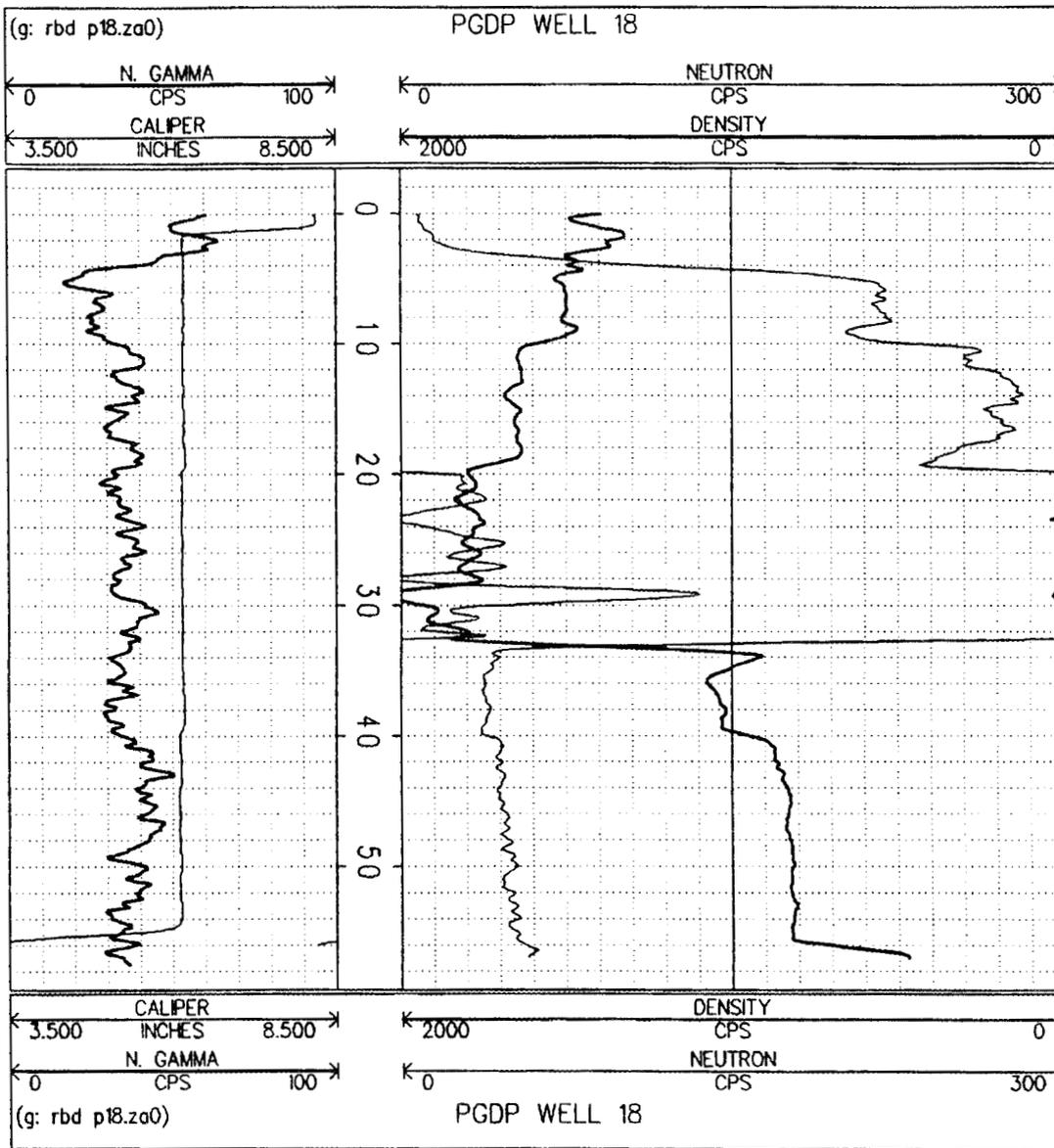
| | | | | | | |
|--|---|--|----|---------------|-------|--------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 17 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 17 August 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0017 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 376.46' DEPTH REF: TOSC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 62.38' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 8" steel | 0.0' | ? |
| 2 | | | | 6" PVC | 1.58' | 62.44' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 2.55 TOSC-outer, 0.97' TO(PVC)C DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | 1x-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | Jarm sum | | | none | | 59.2' | TOSC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 59.8' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Ce137 | 125mC | 62.2' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bk | 3.0 C | 59.0' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/16/89 DIGITAL FILE NAME(S): PGDP0017.GA0,CB0,GA1,GB1,DA1,DB1,NA1,NB1 REMARKS: Repeat log files: GA0,DA0,NA0 water level 8-16-89 33.0' from TOSC | | | | | | | | | | | | | | |



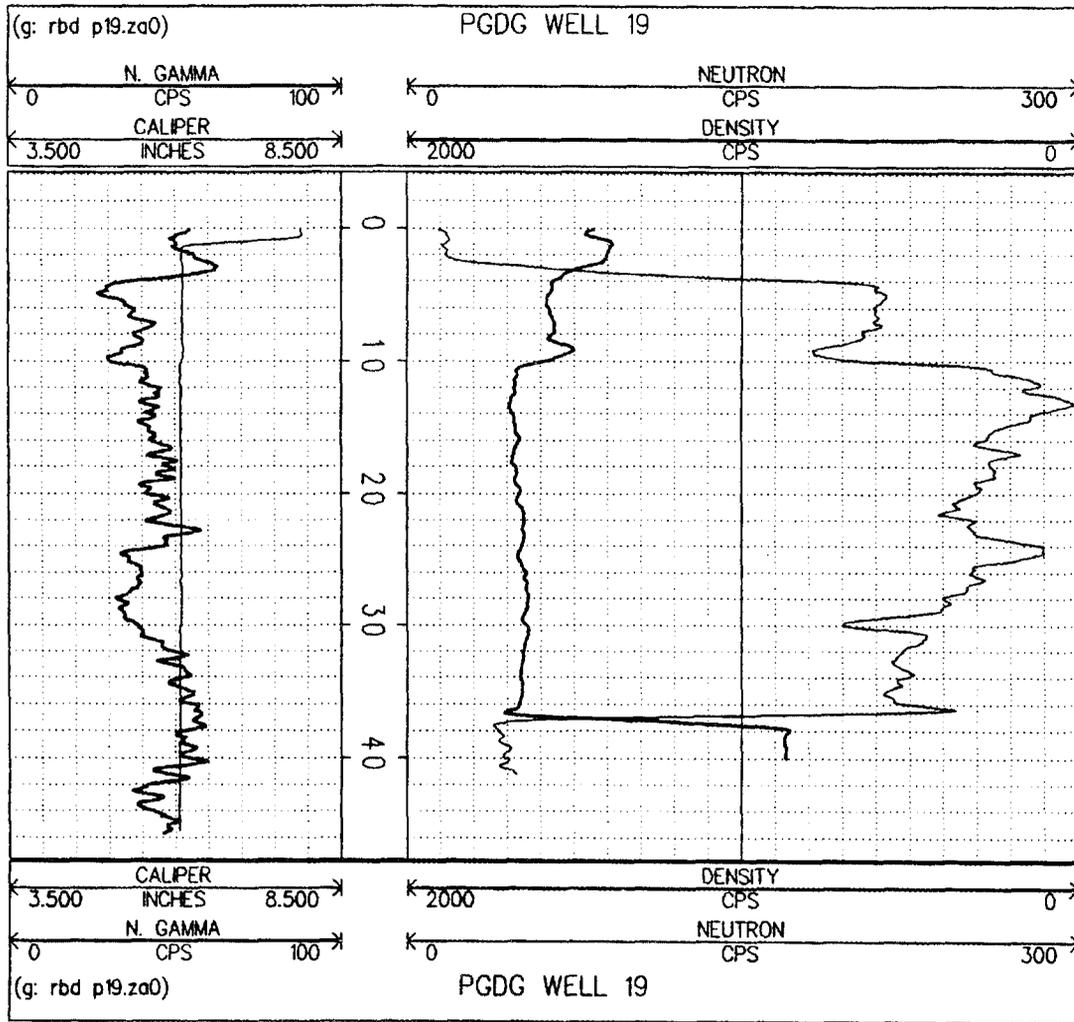
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|---|---|---|----|-------------------|-------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 18 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 15 August 1989 CLIENT: MMES RAP -- Winkler/Krispin ORNL ID NO: PGDP0018 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 405.93' DEPTH REF: TOSC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 59.18 | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 8" steel | 0.0' | ? |
| 2 | | | | 6" PVC | 1.47' | 58.2' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 4.25 TOSC-outer, 0.97' TO(PVC)C DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | UNIT/TRUCK: GEL 1 | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 56.0' | TOSC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 57.5' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 57.0' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bp | 3.0 C | 56.9' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/15/89 DIGITAL FILE NAME(S): PGDP0018.CA0,CB0,GA1GB1DA1DB1NA1NB1 REMARKS: Repeat log files: GA0,DA0,NA0 water level 8-15-89 48.33 from TOSC | | | | | | | | | | | | | | |



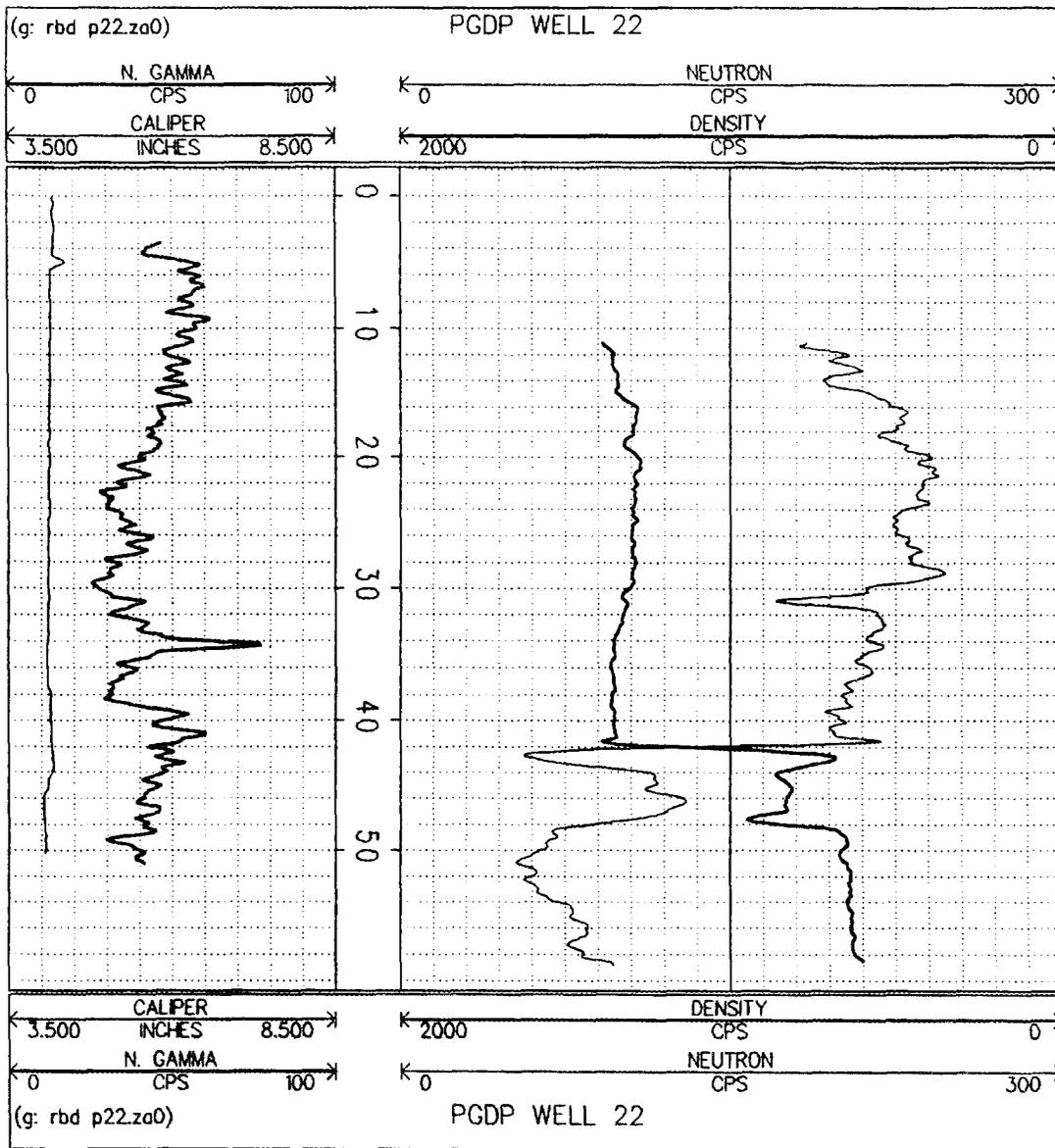
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|---|---|-------------------|---|-------------------------------|
|  | ORNL GEOPHYSICS GROUP | | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 19 | |
| | P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | | | |
| PROJECT: PGDP Site Investigation 1 | | | DATE LOGGED: 16 August 1989 | |
| CLIENT: MMES RAP - Winkler/Krispin | | | ORNL ID NO: PGDP0019 | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | |
| STATE: Kentucky | | COUNTY: McCracken | | ELEV: 364.92' DEPTH REF: TOSC |
| BOREHOLE DATA | | | | |
| DRILLING CONTRACTOR: ? | | | | |
| DRILLER TD: ? LOGGED TD: 48.68 | | | | |
| BOREHOLE DATA | | | | |
| GENERAL DATA | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | UNIT/TRUCK: GEL 1 | |
| LOGGING ENGINEER: R. O. KENNARD | | | | |
| GEOPHYSICIST: R. J. SELFRIDGE | | | | |
| OTHER SERVICES: | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|---------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INTS FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | Jorn sum | | | none | | 45.5' | TOSC | 0.1' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 45.7' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 40.0' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bk | 3.0 C | 41.2' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/16/89 DIGITAL FILE NAME(S): PGDP0019.CA0,CB0,GA1,GB1,DA1,DB1,NA1,NB1 REMARKS: Repeat log files: GAO,DAO,NAO water level 8-16-89 37.8' from TOSC | | | | | | | | | | | | | | |



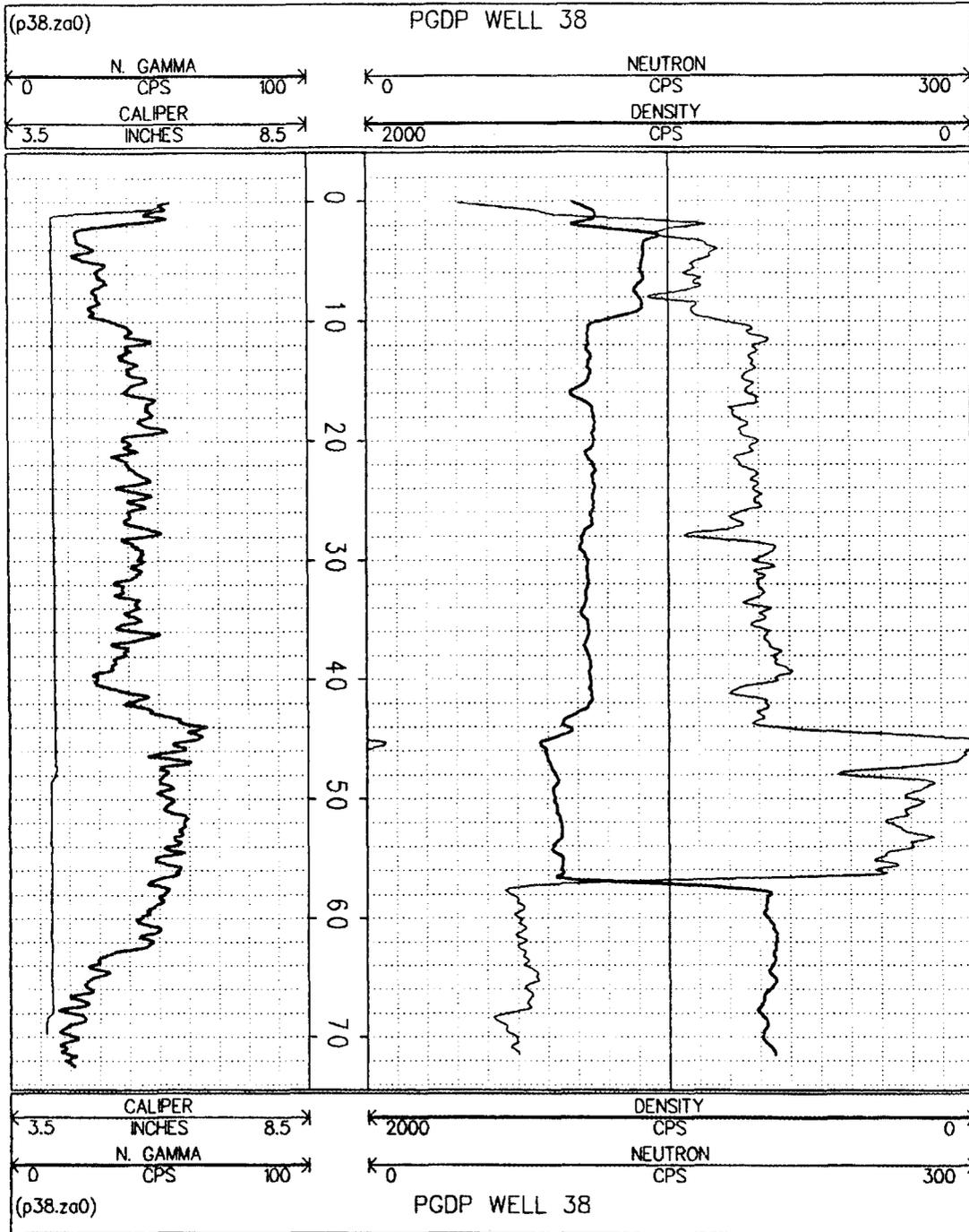
| | | | | | | |
|---|---|---|----|---------------|------|--------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 22 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 17 August 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0022 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 370.12' DEPTH REF: TOC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 60.15 | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 4" PVC | 0.0' | 60.15' |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 2.9' TOC DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|-------------------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 50.2' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 51.0' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 58.5' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/B _e | 3.0 C | 58.8' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/17/89 DIGITAL FILE NAME(S): PGDP0022.CA0,CB0,DA1,DD1,NA1,NC1 REMARKS: Repeat log files: DAO,NAO water level 8-17-89 42.38' FROM TOC ESD GEOPHYSICAL ARCHIVES #89-001 | | | | | | | | | | | | | | |



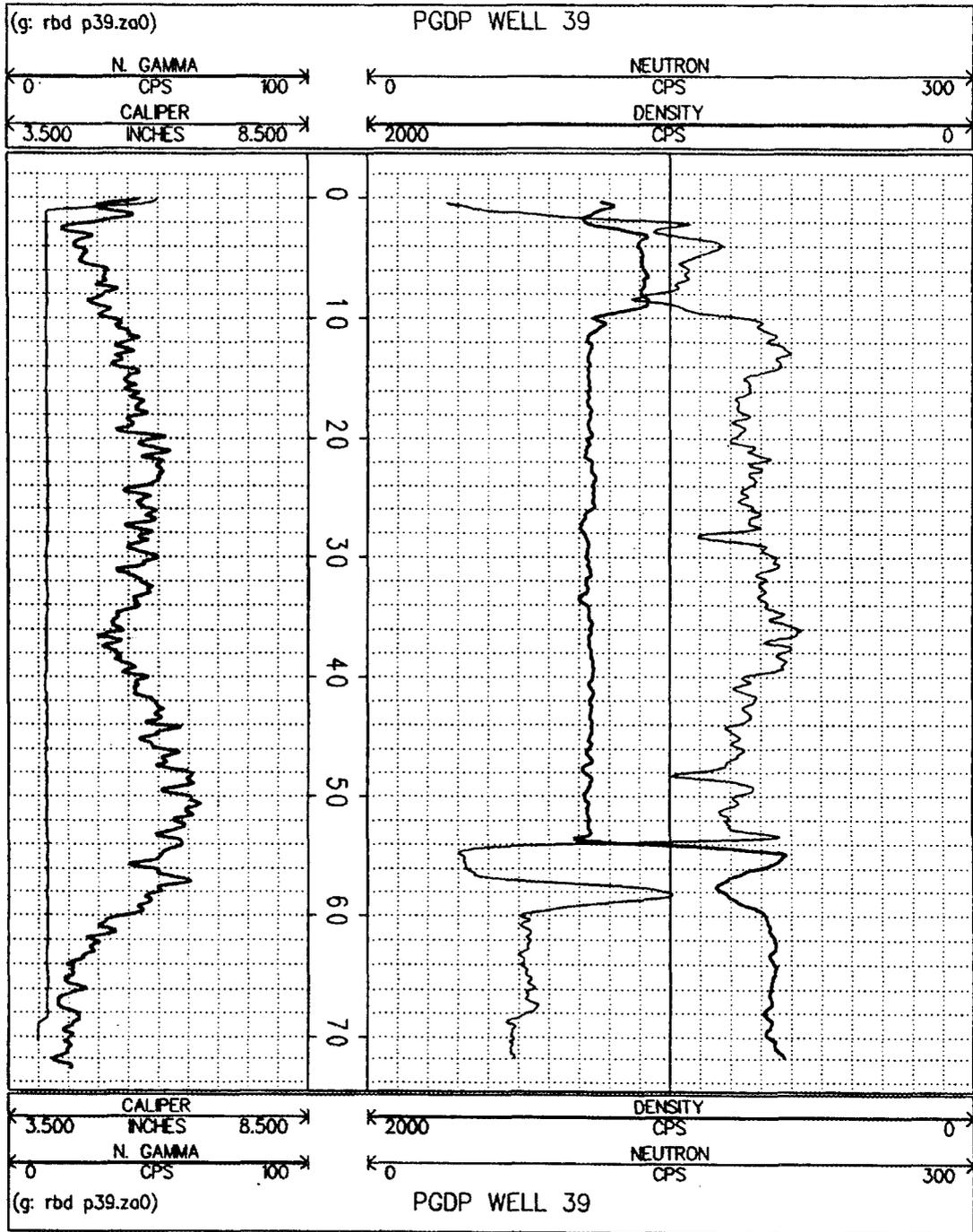
| | | | | | | |
|--|---|--|----|-------------------|-------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 38 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 17 August 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0038 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 384.49' DEPTH REF: TOSC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 73.3' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | 0.0' | ? |
| 2 | | | | 4" PVC | 1.09' | 73.3' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 1.8' TOSC-outer, 0.72' TO(PVC) DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | UNIT/TRUCK: GEL 1 | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | Jorn sum | | | none | | 68.8' | TOSC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 72.5' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 71.9' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bt | 3.0 C | 72.0' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/17/89 DIGITAL FILE NAME(S): PGDP0038.CA0.C80.GA1GB1DA1DB1NA1NB1 REMARKS: Repeat log files: GAO,DAO,NAO water level 8-17-89 57.49 from TOSC ESD GEOPHYSICAL ARCHIVES #89-001 | | | | | | | | | | | | | | |



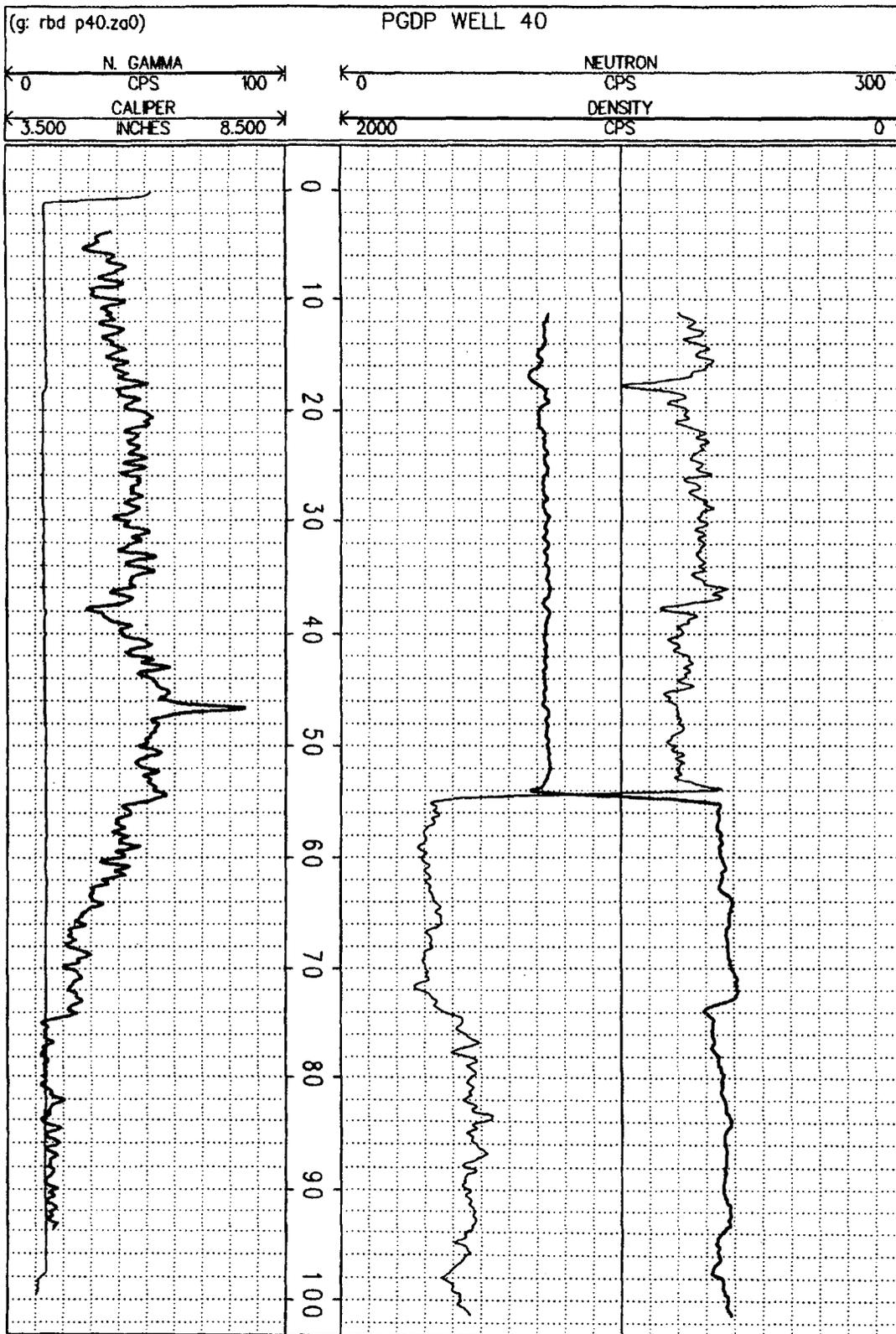
| | | | | | | |
|--|---|--|----|---------------|------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 39 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 17 August 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0039 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 381.52' DEPTH REF: TOSC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 73.6' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | 0.0' | ? |
| 2 | | | | 4" PVC | 2.5' | 73.6' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 2.6' TOSC-outer, 2.5' TO(PVC)C DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|-------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG IN FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 70.40 | TOSC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 72.8' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 71.9' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bp | 3.0 C | 72.0' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/17/89 DIGITAL FILE NAME(S): PGDP0039.CA0,C80,GA1GB1,DA1,DA1,NA1,NB1 REMARKS: Repeat log files: GA0,DA0,NA0 water level 8-17-89 54.85' from TOSC | | | | | | | | | | | | | | |



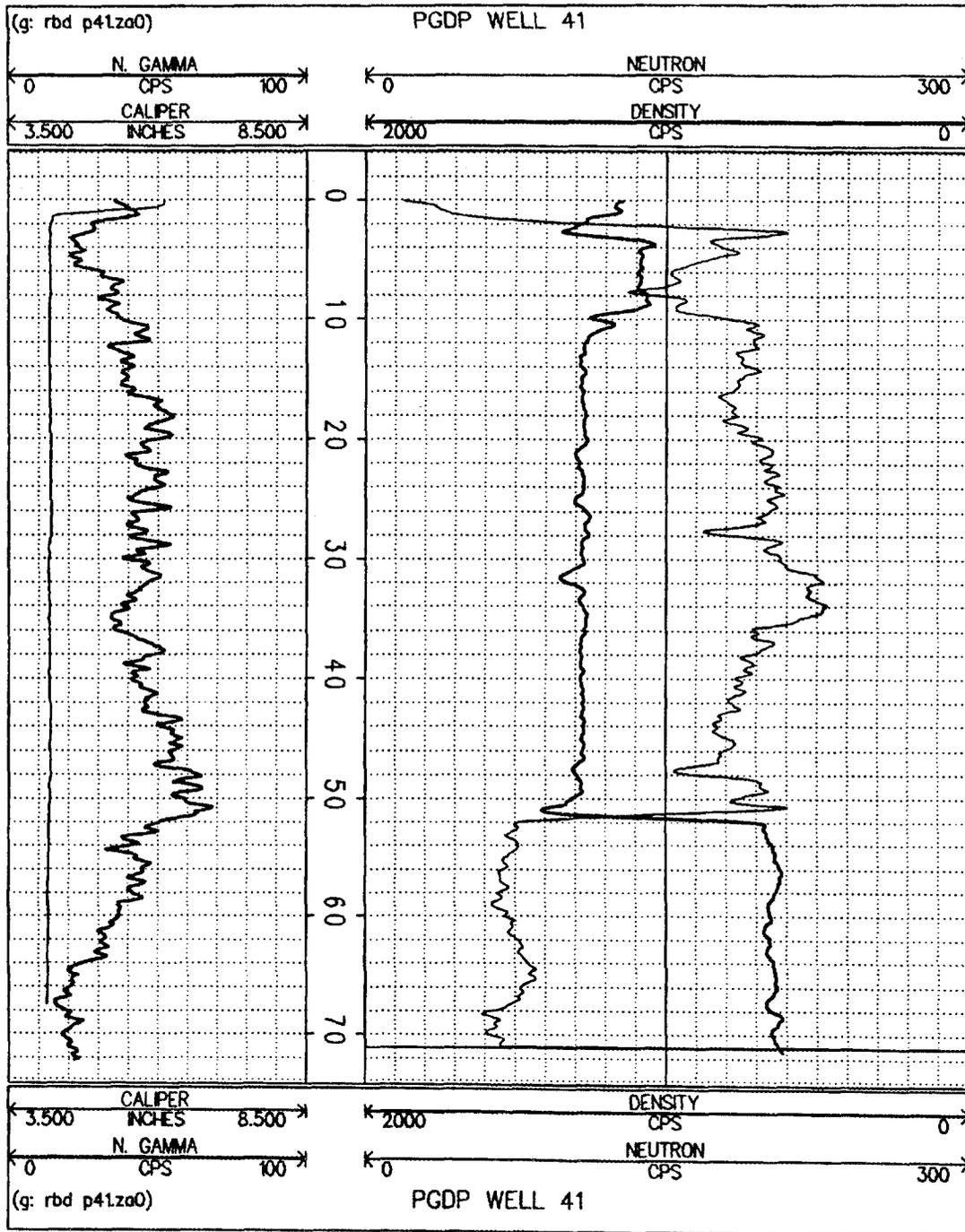
| | | | | | | |
|--|---|--|----|-------------------|------|--------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 40 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 17 July 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0040 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 381.92' DEPTH REF: TOSC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 102.7 | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | 0.0' | ? |
| 2 | | | | 4" PVC | ? | 102.7' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 2.6' TOSC-outer, ? TO(PVC)C DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | UNIT/TRUCK: GEL 1 | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | 1x-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 99.8' | TOSC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 93.8' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 101.3 | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bk | 3.0 C | 101.3 | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/17/89 DIGITAL FILE NAME(S): PGDP0040.CA0,CB0,DA1,DB1,NA1,NC1 REMARKS: Repeat log files: DA0,NA0 water level ?-?-? 54.85' from TOSC | | | | | | | | | | | | | | |



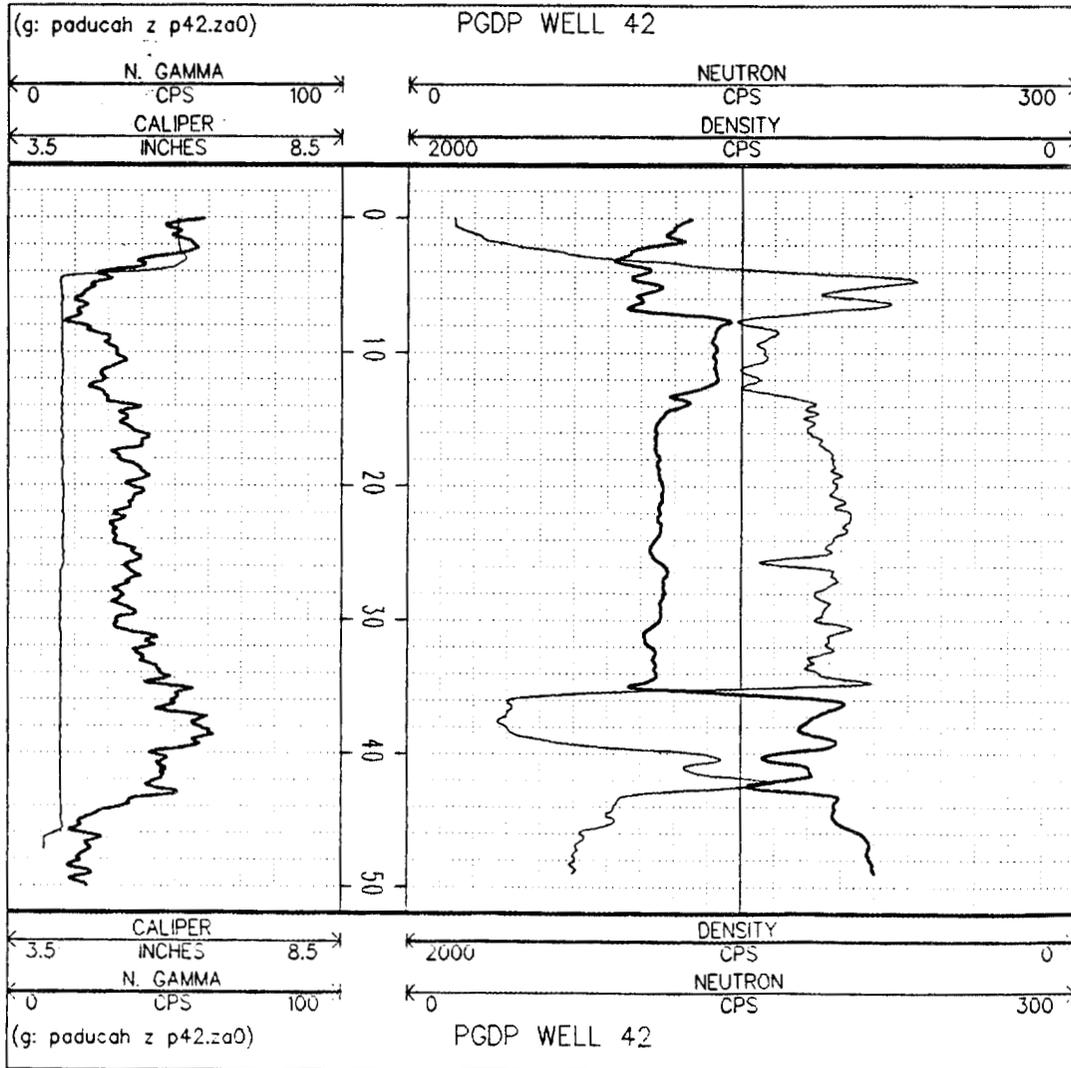
| | | | | |
|---|---|-------------------|---|-------------------------------|
|  | ORNL GEOPHYSICS GROUP | | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 41 | |
| | P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | | | |
| PROJECT: PGDP Site Investigation 1 | | | DATE LOGGED: 15 August 1989 | |
| CLIENT: MMES RAP - Winkler/Krispin | | | ORNL ID NO: PGDP0041 | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | |
| STATE: Kentucky | | COUNTY: McCracken | | ELEV: 378.68' DEPTH REF: TOSC |
| BOREHOLE DATA | | | | |
| DRILLING CONTRACTOR: ? | | | | |
| DRILLER TD: ? LOGGED TD: 73.2' | | | | |
| BOREHOLE DATA | | | | |
| GENERAL DATA | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | UNIT/TRUCK: GEL 1 | |
| LOGGING ENGINEER: R. O. KENNARD | | | | |
| GEOPHYSICIST: R. J. SELFRIDGE | | | | |
| OTHER SERVICES: | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm surr | | | none | | 67.5' | TOSC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 72.4' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 71.5' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bt | 3.0 C | 71.5' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/15/89 DIGITAL FILE NAME(S): PGDP0041.CA0,CB0,GA1,GB1,DA1,DB1,NA1,NB1 REMARKS: Repeat log files: GA0,DA0,NA0 water level 8-15-89 51.47' from TOSC | | | | | | | | | | | | | | |



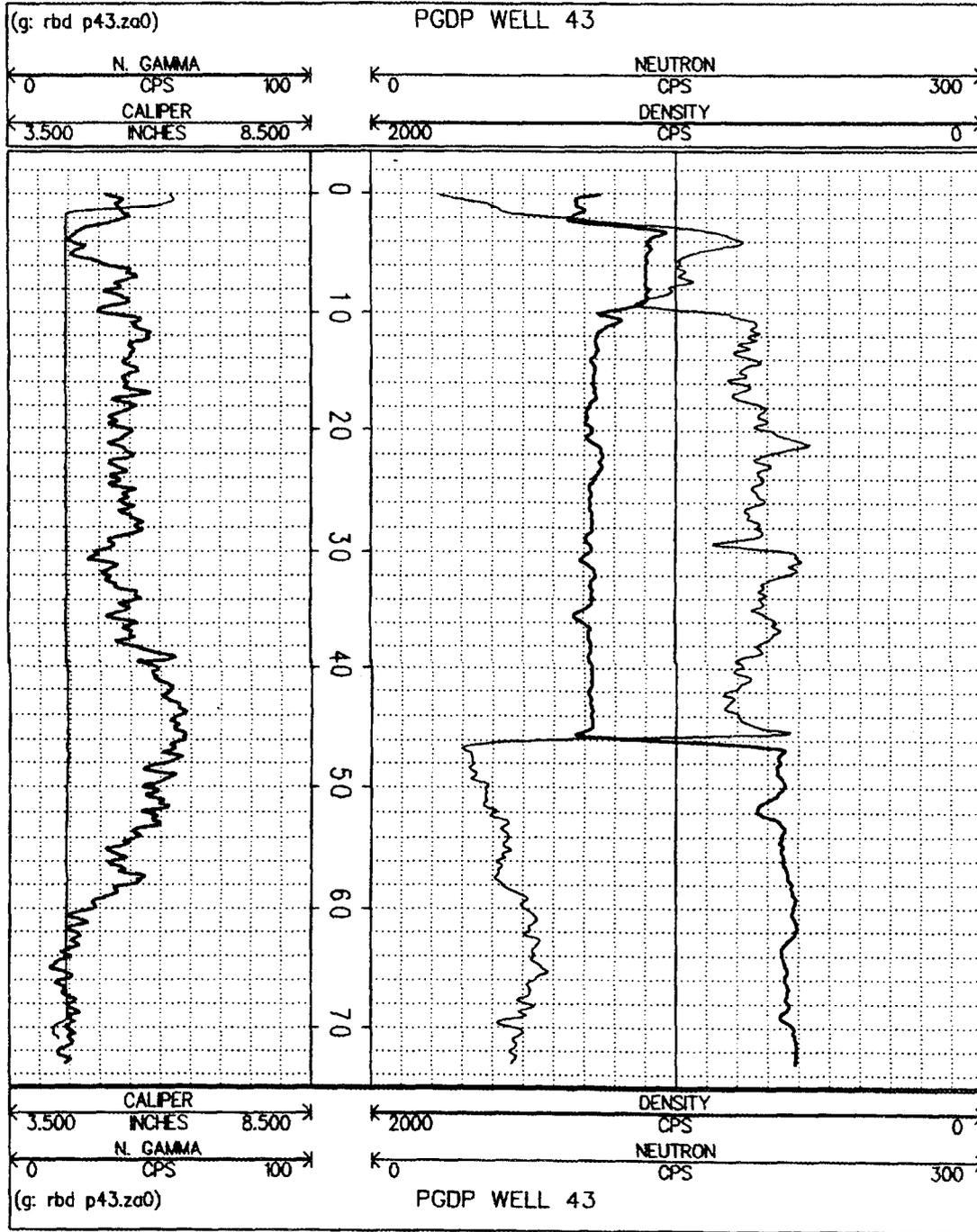
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|--|---|---|----|---------------|-------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 42 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 15 August 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0042 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 363.08' DEPTH REF: TOSC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 50.8' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | 0.0' | ? |
| 2 | | | | 4" PVC | 4.17' | 50.8' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 4.1' TOSC-outer, -0.07' TO(PVC)C DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|----------|-------------------|---------------|------------|------------|-------------------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG FEET | INT SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | Jarm sum | | | none | | 47.3' | TOSC | 0.1 |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 50.0' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 49.0' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/B _e | 3.0 C | 49.0' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/15/89 DIGITAL FILE NAME(S): PGDP0042.CA0,CB0,GA1,GB1,DA1,DB1,NA1,NB1 REMARKS: Repeat log files: GA0,DA0,NA0 water level 8-15-89 36.0' from TOSC | | | | | | | | | | | | | | |



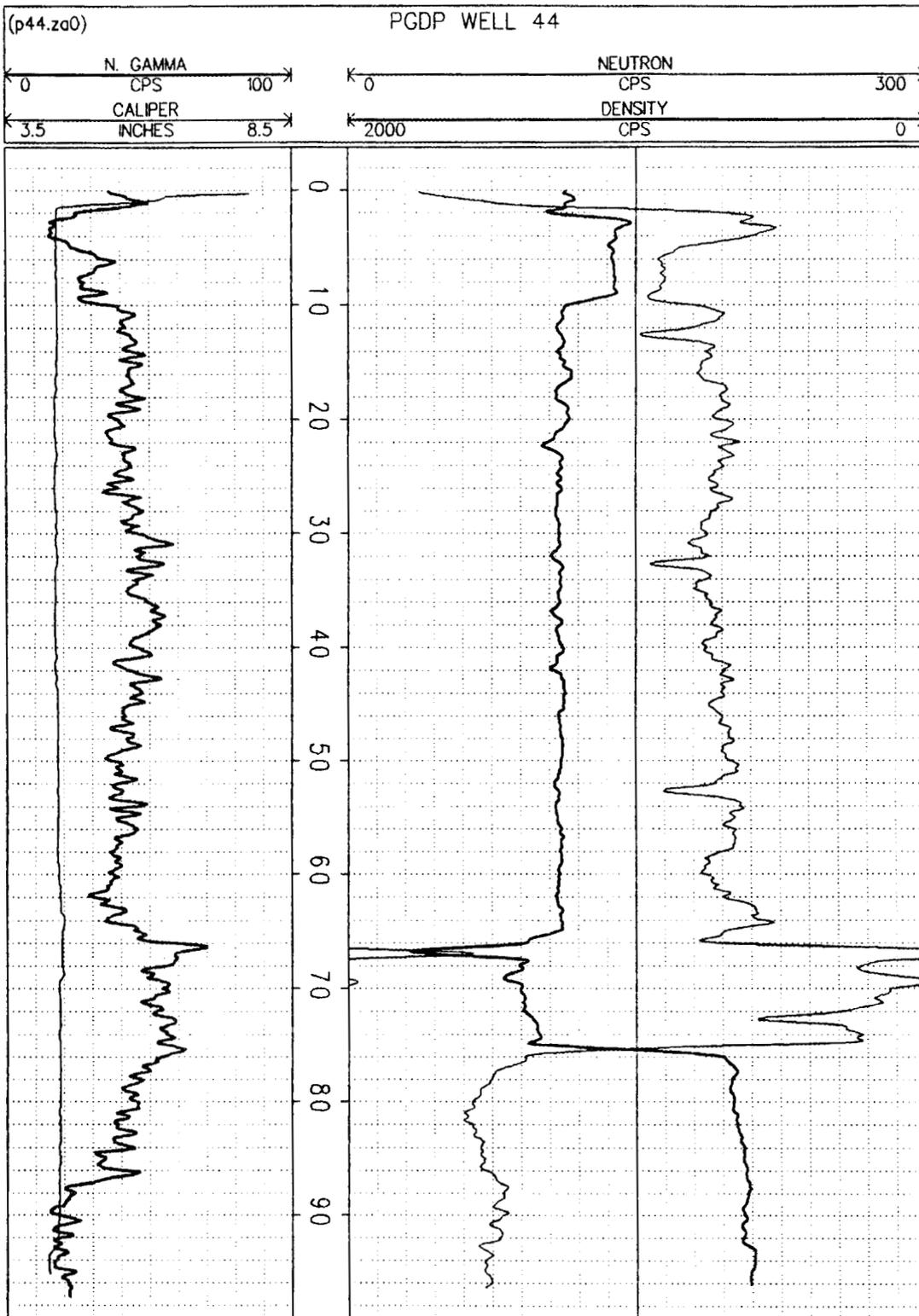
| | | | | | | |
|--|---|--|----|---------------|------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 43 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 15 August 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0043 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 363.08' DEPTH REF: TOSC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 73.8' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | 0.0' | ? |
| 2 | | | | 4" PVC | 1.5' | 73.8' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 2.8' TOSC-outer, 1.2' TO(PVC)C DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|---------|---------------|---------------|------------|------------|-------------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | Jarm sum | | | none | | 71.0' | TOSC | 0.1' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 73.0' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 73.0' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bk 3.0 C | | 73.0' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/15/89 DIGITAL FILE NAME(S): PGDP0043.CA0,CB0,GA2,GB2,DA1,DB1,NA1,NB1 REMARKS: Repeat log files: GA0,DA0,NA0 water level 8-15-89 43.6' from TOSC | | | | | | | | | | | | | | |



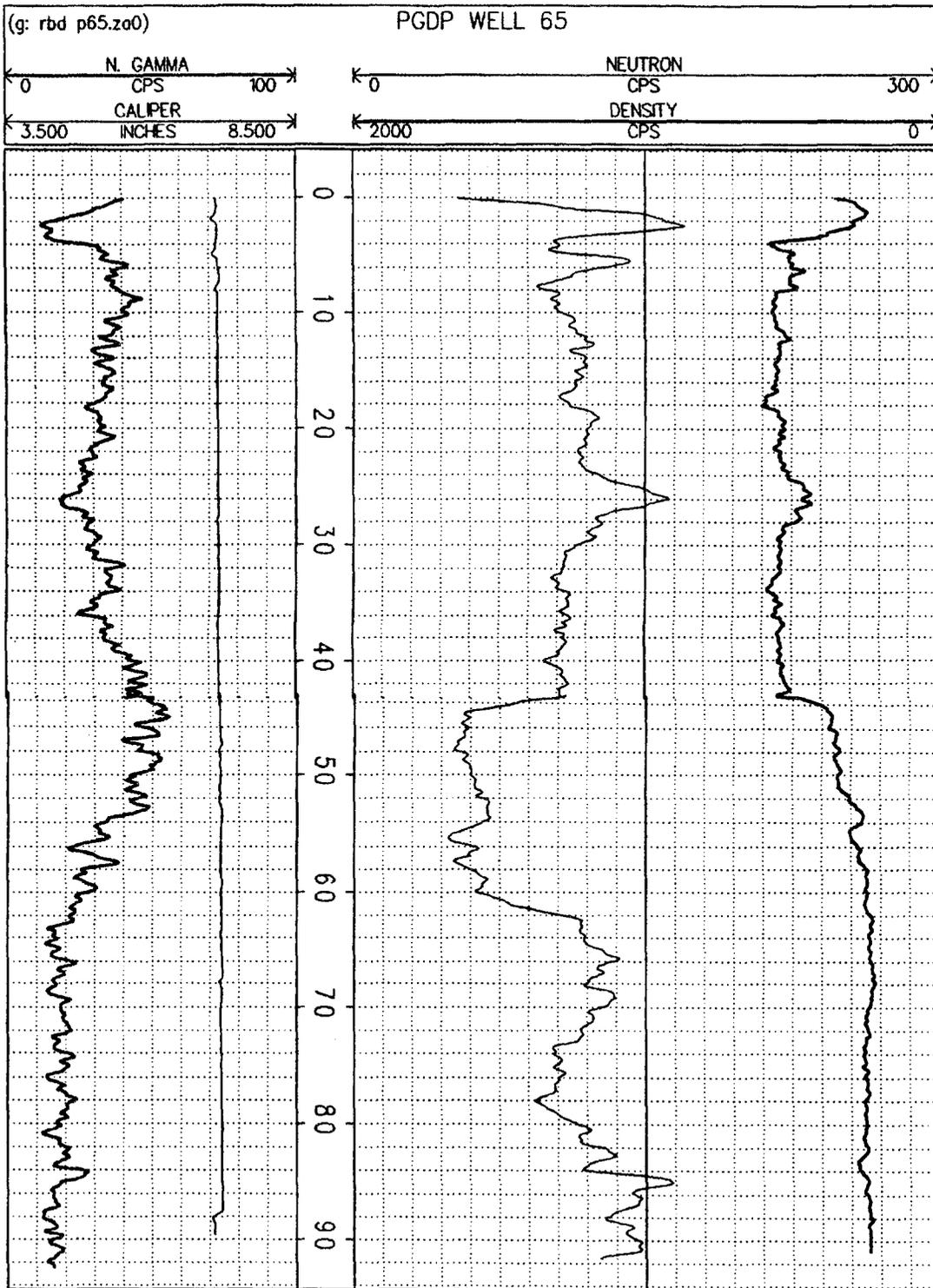
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|--|---|---|----|---------------|------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 44 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 14 August 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0044 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 403.19' DEPTH REF: TOSC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 98.0' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | 0.0' | ? |
| 2 | | | | 4" PVC | 1T | 98.0' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 1.9' TOSC-outer, 0.8' TO(PVC)C DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|------|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | 3arm surt | | | none | | 95.2' | TOSC | 0.2' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 97.2' | TOSC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 96.1' | TOSC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bs | 3.0 C | 96.4' | TOSC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 8/14/89 DIGITAL FILE NAME(S): PGDP0044.CA0,CB0,GA2,GB2,DA1,DC1,NA1,NB1 REMARKS: Repeat log files: GAO,DAO,NAO water level 8-14-89 76.0' from TOSC | | | | | | | | | | | | | | |



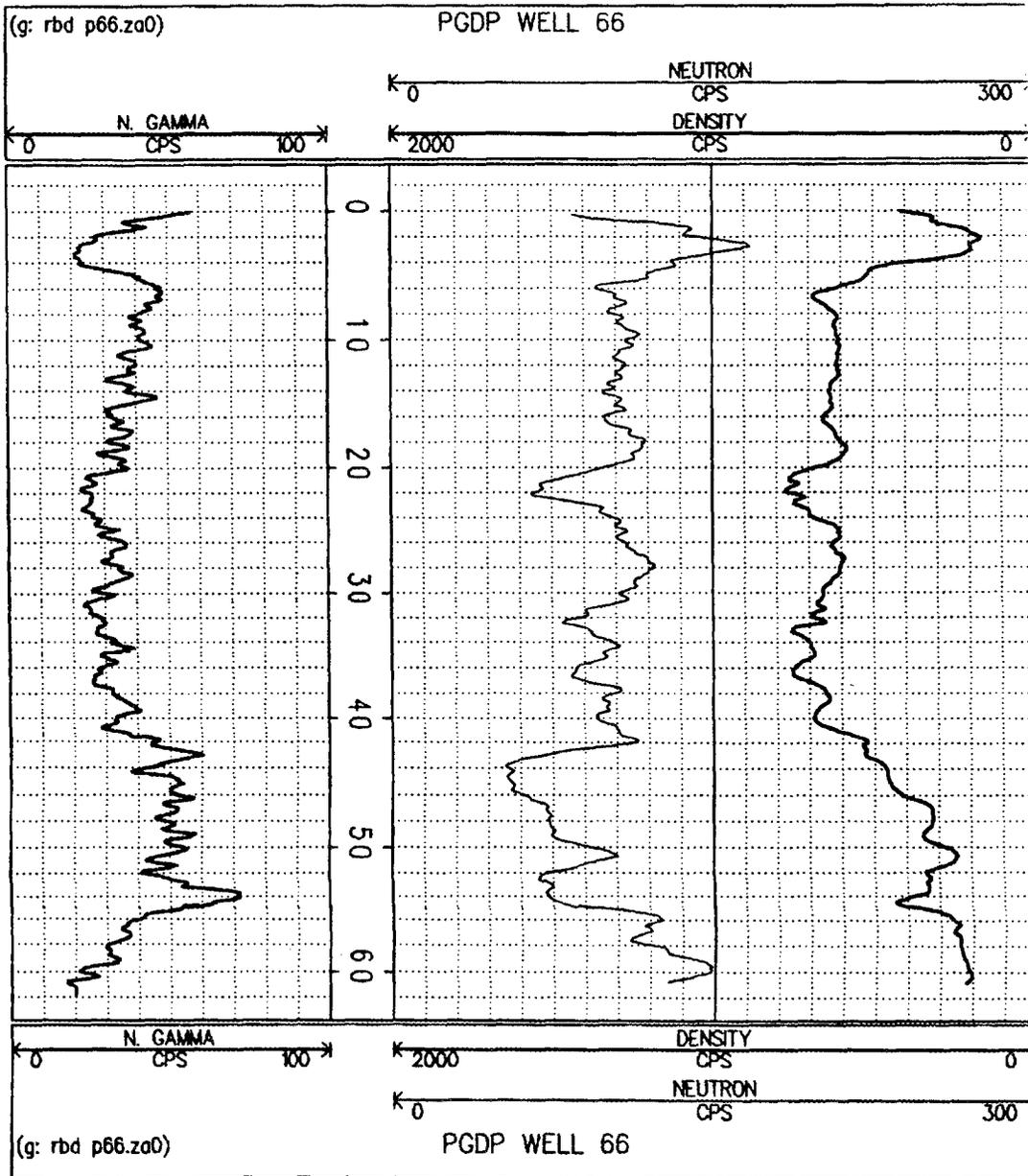
| | | |
|---|---|--|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 65 |
| PROJECT: PGDP Site Investigation 1 | | DATE LOGGED: 16 July 1989 |
| CLIENT: MMES RAP -- Winkler/Krispin | | ORNL ID NO: PGDP0065 |
| LOCATION: Paducah Gaseous Diffusion Plant | | |
| STATE: Kentucky | COUNTY: McCracken | ELEV: 372.99' DEPTH REF: TOC |
| BOREHOLE DATA | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 93.2' | | |
| RUN NO. | BIT RECORD | CASING RECORD |
| NO. | Bit Size | From To |
| 1 | 8" | Ground Level ? |
| 2 | | 6" steel |
| 3 | | 2" SS 0.0' |
| 4 | | 93.2' |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 1.45 TOC DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | |
| GENERAL DATA | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | UNIT/TRUCK: GEL 1 |
| LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm surr | | | none | | 89.6' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 92.4' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Ca137 | 125mC | 90.9' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Ba | 3.0 C | 91.8' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/16/89 DIGITAL FILE NAME(S): PGDP0065.CA1,CC1,GA1,GB1,DA5,DC5,NA3,NB3 REMARKS: Repeat log files: GA0,DA4,NA2 water level 7-16-89 44.5' from TOC | | | | | | | | | | | | | | |



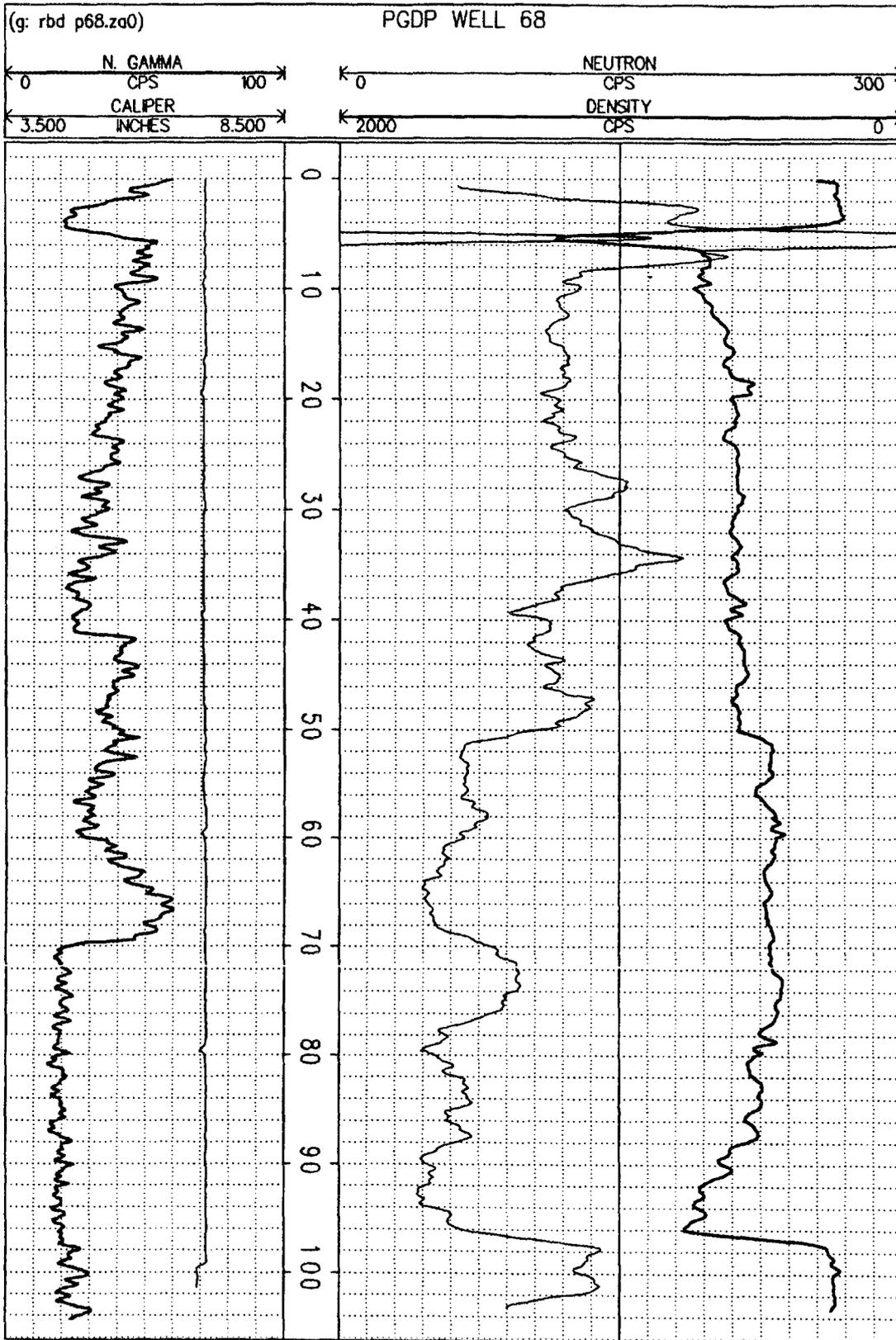
| | | | | | | |
|--|---|--|----|-------------------|------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 66 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 17 August 1989 CLIENT: MMES RAP -- Winkler/Krispin ORNL ID NO: PGDP0066 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 371.44' DEPTH REF: TOC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 62.6' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | | |
| 2 | | | | 2" | 0.0' | 62.6' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 2.22'TOC DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | | UNIT/TRUCK: GEL 1 | | |
| LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|-------------------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | 1x-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | | | TOC |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 81.8' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 80.8' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/B ₂ | 3.0 C | 80.8' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead NONE DIGITAL FILE NAME(S): PGDP0066.GA1GB1DA1DB1NA1NB1 REMARKS: Repeat log files: GAO,DAO,NAO water level 8-17-89 48.81' from TOC NO CALIPER RUN DUE TO HIGH CONTAMINATION LEVEL IN WELL | | | | | | | | | | | | | | |



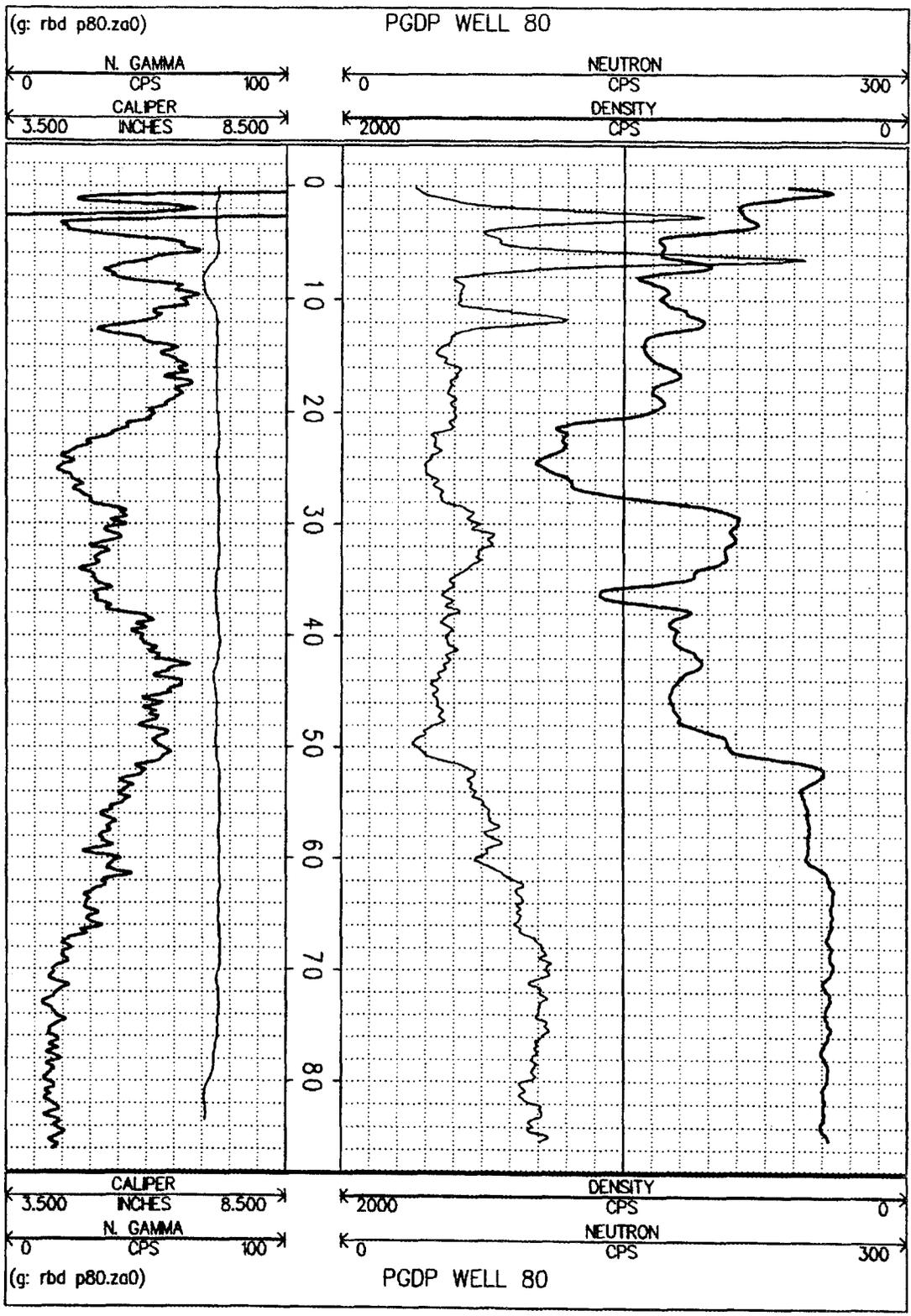
| | | | | | |
|---|---|---------------------------|---|-----------------------------|-------------|
|  | ORNL GEOPHYSICS GROUP | | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 68 | | |
| | P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | | | | |
| PROJECT: PGDP Site Investigation 1 | | DATE LOGGED: 15 July 1989 | | | |
| CLIENT: MMES RAP - Winkler/Krispin | | ORNL ID NO: PGDP0068 | | | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | | |
| STATE: Kentucky | | COUNTY: McCracken | | ELEV: 380.21 DEPTH REF: TOC | |
| BOREHOLE DATA | | | | | |
| DRILLING CONTRACTOR: ? | | | | | |
| DRILLER ID: ? | | LOGGED TO: 105.1' | | | |
| RUN | BIT RECORD | | | CASING RECORD | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From To |
| 1 | 8" | Ground Level | ? | 6" steel | |
| 2 | | | | 2" SS | 0.0' 105.1' |
| 3 | | | | | |
| 4 | | | | | |
| DRILL METHOD: Hollow Stem Auger | | | | | |
| CASING STICK UP: 2.38 TOC | | | | | |
| DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | |
| GENERAL DATA | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | UNIT/TRUCK: GEL 1 | | |
| LOGGING ENGINEER: R. O. KENNARD | | | | | |
| GEOPHYSICIST: R. J. SELFRIDGE | | | | | |
| OTHER SERVICES: | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|--------------------|---------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT SPEED FEET | FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 101.4' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 104.3' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Ca137 | 125mC | 103.2' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bk | 3.0 C | 103.3' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/15/89 DIGITAL FILE NAME(S): PGDP0068.CA0,CB0,GA1GB1DA3,DB3,NA3,NB3 REMARKS: Repeat log files: GA0,DA2,NA2 water level 7-15-89 -51.0' from TOC | | | | | | | | | | | | | | |

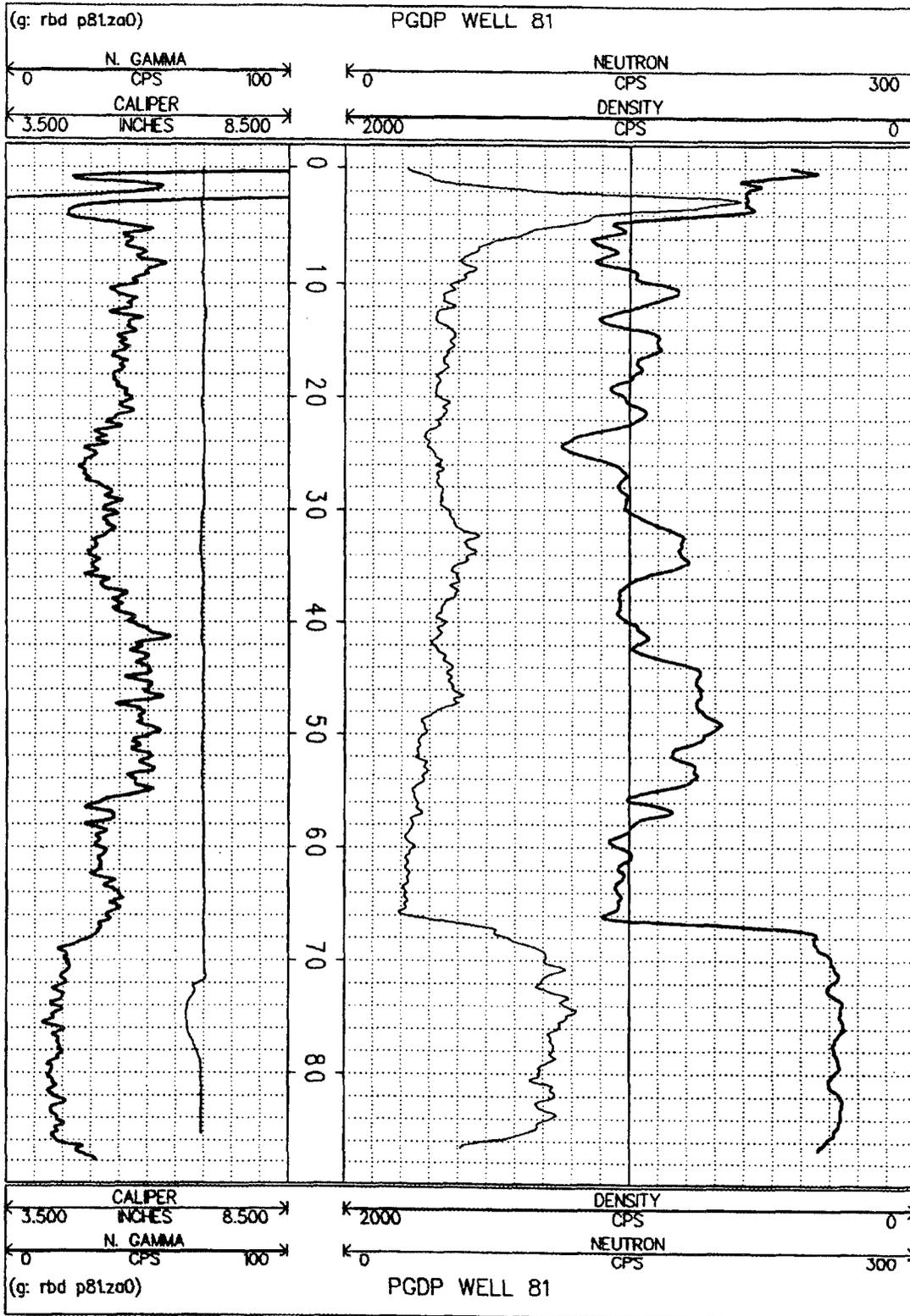


| | | | | | | |
|---|---|--|----|-------------------|------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 80 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 15 July 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDP0080 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 376.89' DEPTH REF: TOC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 87.0' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | | |
| 2 | | | | 2" SS | 0.0' | 87.0' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 3.1' TOC DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | UNIT/TRUCK: GEL 1 | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm surr | | | none | | 83.5' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 86.2' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 85.1' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Ba | 3.0 C | 85.3' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/15/89 DIGITAL FILE NAME(S): PGDP0080.CA0,CB0,GA2,CB2,DA5,DB5,NA7,NB7 REMARKS: Repeat log files: GA1,DA3,NA0 water level 7-15-89 48.8' from TOC | | | | | | | | | | | | | | |

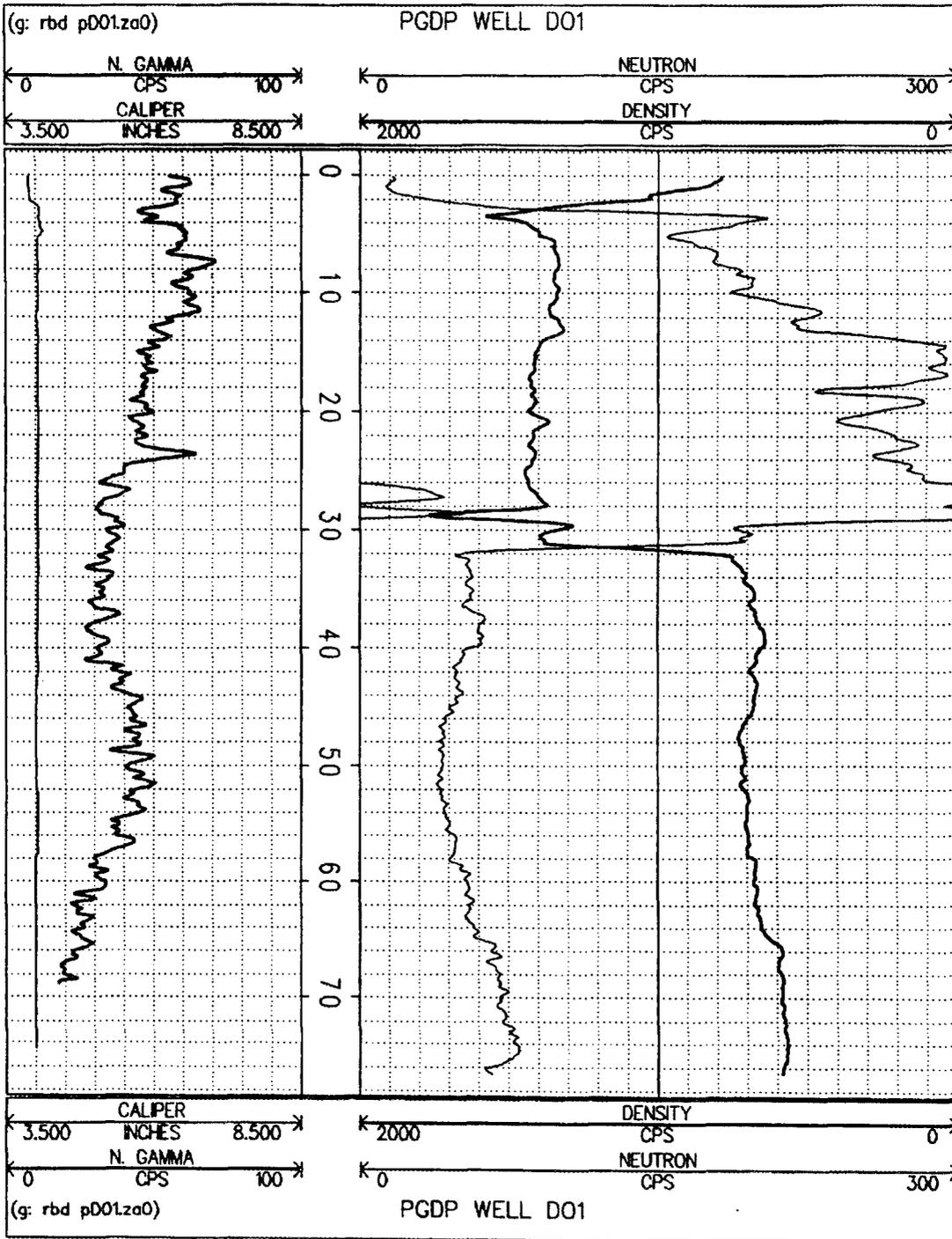


|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: 81 | | | | | | | | | | | | |
|--|---|--|----------------------|--------------------------|--------------|---------------|-----------|------------|------------|--------|------------|-----------------|-----|-----------|
| PROJECT: PGDP Site Investigation 1 | | DATE LOGGED: 16 July 1989 | | | | | | | | | | | | |
| CLIENT: MMES RAP - Winkler/Krispin | | ORNL ID NO: PGDP0081 | | | | | | | | | | | | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | | | | | | | | | | | |
| STATE: Kentucky | COUNTY: McCracken | ELEV: 376.88' DEPTH REF: TOC | | | | | | | | | | | | |
| BOREHOLE DATA | | | | | | | | | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 88.6' | | | | | | | | | | | | | | |
| RUN | BIT RECORD | | CASING RECORD | | | | | | | | | | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To | | | | | | | | |
| 1 | 8" | Ground Level | ? | 6" steel | | | | | | | | | | |
| 2 | | | | 2" SS | 0.0' | 88.6' | | | | | | | | |
| 3 | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 3.14' DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | | | | | | | | | |
| GENERAL DATA | | | | | | | | | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | | UNIT/TRUCK: GEL 1 | | | | | | | | | | |
| LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | | | | | | | | | |
| LOGGING DATA | | | | | | | | | | | | | | |
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DRG INT FEET | SPEED FT./MIN | TYPE | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | 3arm surr | | | none | | 85.4' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 87.8' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 88.8' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Ba | 3.0 C | 88.7' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/16/89 DIGITAL FILE NAME(S): PGDP0081.Cc0.C90.GA1GB1DA3.DB3.NA4.Nb4 REMARKS: Repeat log files: GAO,DAZ,NA3 water level 7-16-89 50.0' from TOC | | | | | | | | | | | | | | |



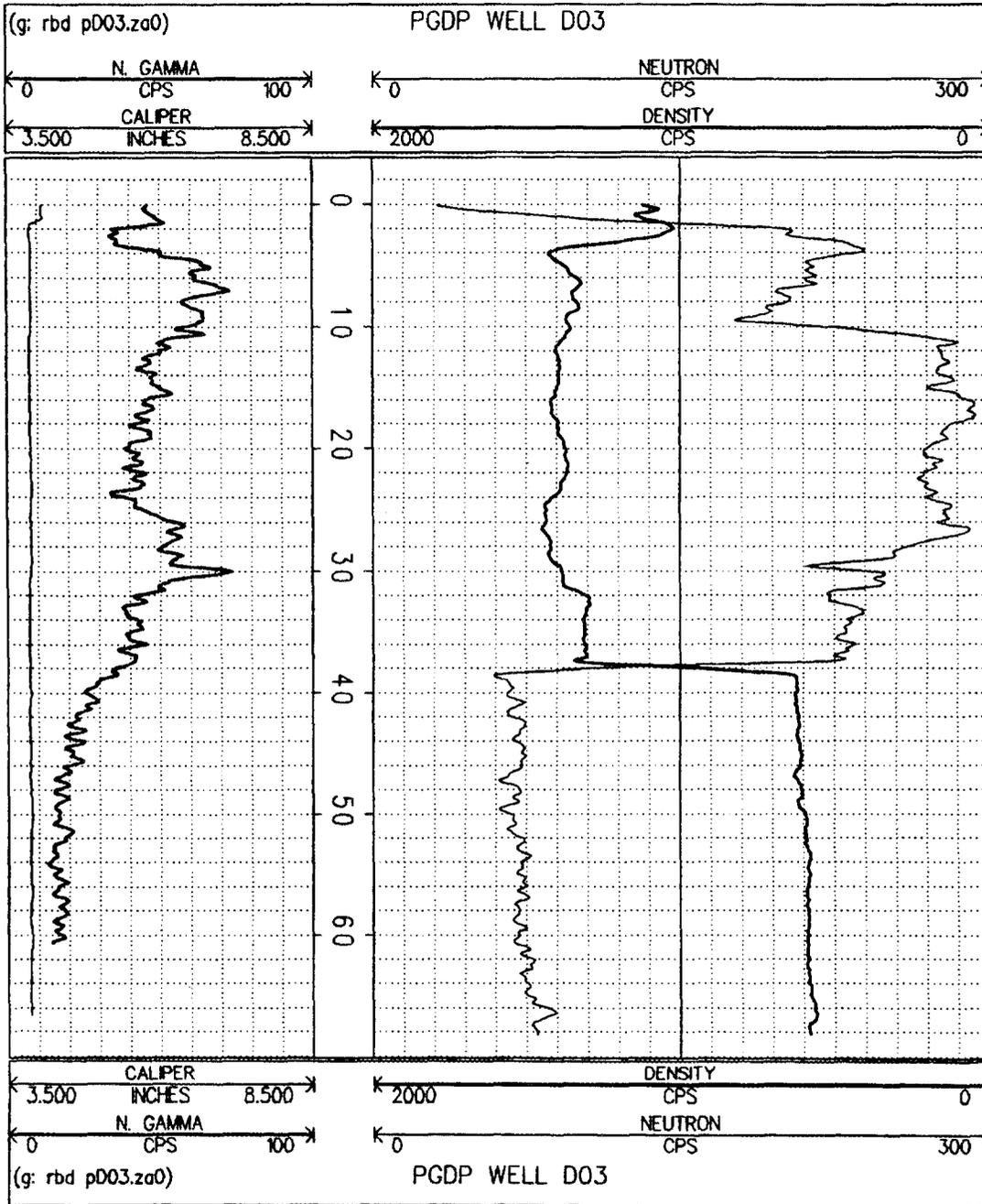
| | | | | | |
|---|---|---------------------------|---|---------------|-------------|
|  | ORNL GEOPHYSICS GROUP | | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: D01 | | |
| | P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | | | | |
| PROJECT: PGDP Site Investigation 1 | | DATE LOGGED: 18 July 1989 | | | |
| CLIENT: MMES RAP - Winkler/Krispin | | ORNL ID NO: PGDP001 | | | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | | |
| STATE: Kentucky | | COUNTY: McCracken | ELEV: 358.08' DEPTH REF: TOC | | |
| BOREHOLE DATA | | | | | |
| DRILLING CONTRACTOR: ? | | | | | |
| DRILLER TD: ? LOGGED TD: 77.68' | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From To |
| 1 | 8" | Ground Level | ? | 4" PVC | 0.0' 77.68' |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| DRILL METHOD: Hollow Stem Auger | | | | | |
| CASING STICK UP: 3.2' TOC | | | | | |
| DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | |
| GENERAL DATA | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | UNIT/TRUCK: GEL 1 | | |
| LOGGING ENGINEER: R. O. KENNARD | | | | | |
| GEOPHYSICIST: R. J. SELFRIDGE | | | | | |
| OTHER SERVICES: | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|-------------------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 74.5' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 88.9' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 78.4' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/B _e | 3.0 C | 78.5' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/18/89 DIGITAL FILE NAME(S): PGDP001CA1CB1DA1DC1NA1NB1 REMARKS: Repeat log files: DAO,NAO water level 7-18-89 31.8' from TOC | | | | | | | | | | | | | | |



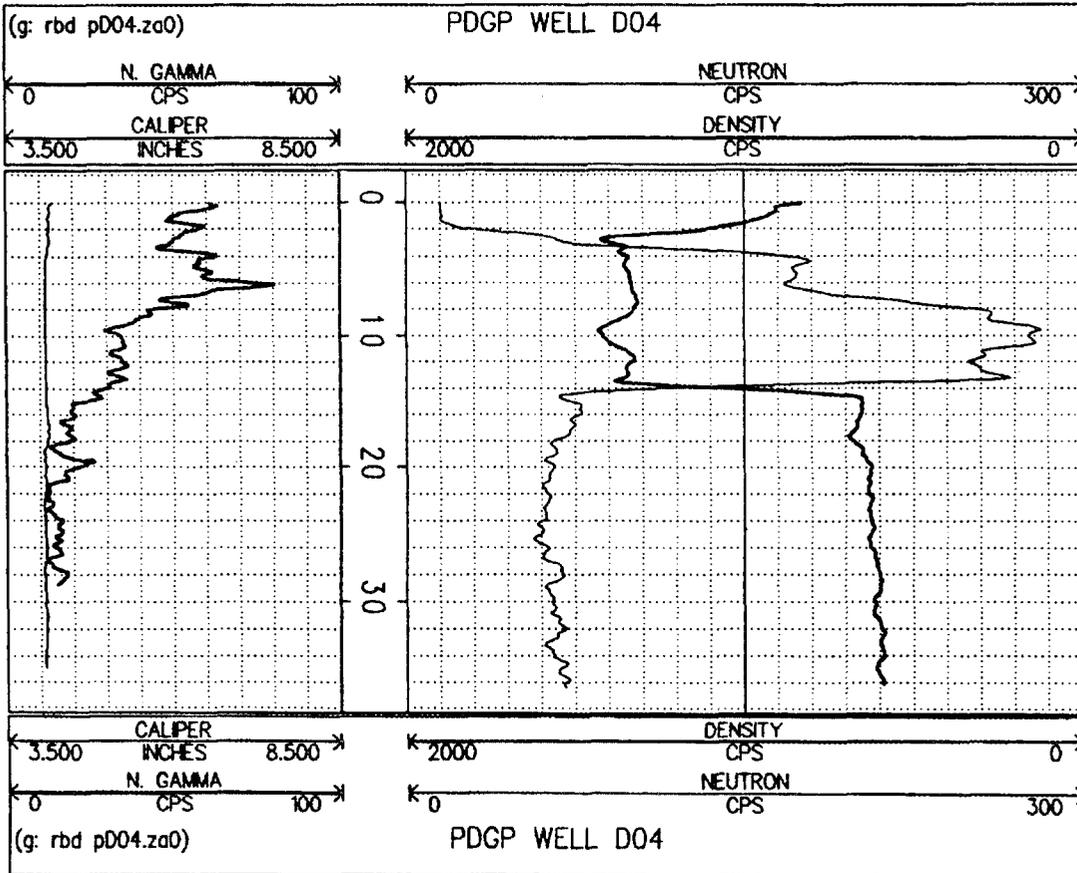
| | | | | | | |
|---|---|-------------------|--|----------------|------|--------|
|  | ORNL GEOPHYSICS GROUP | | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: D03 | | | |
| | P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | | | | | |
| PROJECT: PGDP Site Investigation 1 | | | DATE LOGGED: 18 July 1989 | | | |
| CLIENT: MMES RAP - Winkler/Krispin | | | ORNL ID NO: PGDP0D03 | | | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | | | |
| STATE: Kentucky | | COUNTY: McCracken | ELEV: 361.78' | DEPTH REF: TOC | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? | | | | | | |
| DRILLER TD: ? LOGGED TD: 69.78 | | | | | | |
| BIT RECORD | | CASING RECORD | | | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 6" steel | | |
| 2 | | | | 4" PVC | 0.0' | 69.78' |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger | | | | | | |
| CASING STICK UP: 1.9' TOC | | | | | | |
| DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | UNIT/TRUCK: GEL 1 | | | |
| LOGGING ENGINEER: R. O. KENNARD | | | | | | |
| GEOPHYSICIST: R. J. SELFRIDGE | | | | | | |
| OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | 1x-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm surr | | | none | | 66.6' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 60.6' | TOC | 0.0' |
| DENSITY | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 68.1' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bk | 3.0 C | 68.2' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/18/89 DIGITAL FILE NAME(S): PGDP0D03.CA0,CB0,DA1,DC1,NA1,NB1 REMARKS: Repeat log files: DAO,NAO water level 7-18-89 38.7' from TOC | | | | | | | | | | | | | | |



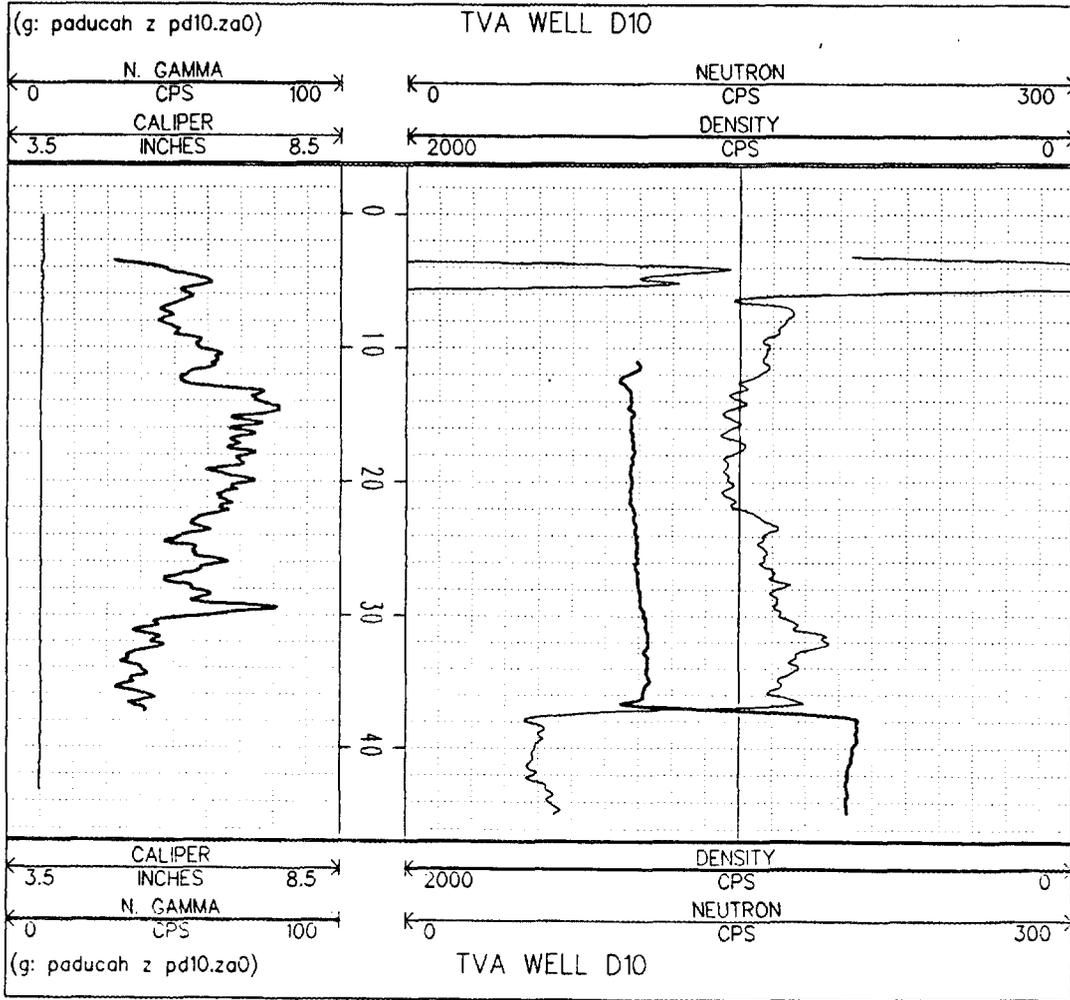
| | | | | | |
|---|---|-------------------|---|------------------------------|---------|
|  | ORNL GEOPHYSICS GROUP | | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: D04 | | |
| | P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | | | | |
| PROJECT: PGDP Site Investigation 1 | | | DATE LOGGED: 18 July 1989 | | |
| CLIENT: MMES RAP - Winkler/Krispin | | | ORNL ID NO: PGDP0D04 | | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | | |
| STATE: Kentucky | | COUNTY: McCracken | | ELEV: 336.46' DEPTH REF: TOC | |
| BOREHOLE DATA | | | | | |
| DRILLING CONTRACTOR: ? | | | | | |
| DRILLER TD: ? LOGGED TD: 38.05' | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From To |
| 1 | 8" | Ground Level | ? | 6" steel | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| DRILL METHOD: Hollow Stem Auger | | | | | |
| CASING STICK UP: 3.42 TOC | | | | | |
| DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | |
| GENERAL DATA | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | UNIT/TRUCK: GEL 1 | | |
| LOGGING ENGINEER: R. O. KENNARD | | | | | |
| GEOPHYSICIST: R. J. SELFRIDGE | | | | | |
| OTHER SERVICES: | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 34.9' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 28.7' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 36.2' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1086 | 0.1 | 15.0 | He3 | | | Am/Ba | 3.0 C | 36.4' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/18/89 DIGITAL FILE NAME(S): PGDP0D04.CA2,CB2,DA1,DC1,NA1,NB1 REMARKS: Repeat log files: DAO,NAO water level 7-18-89 14.2' from TOC | | | | | | | | | | | | | | |



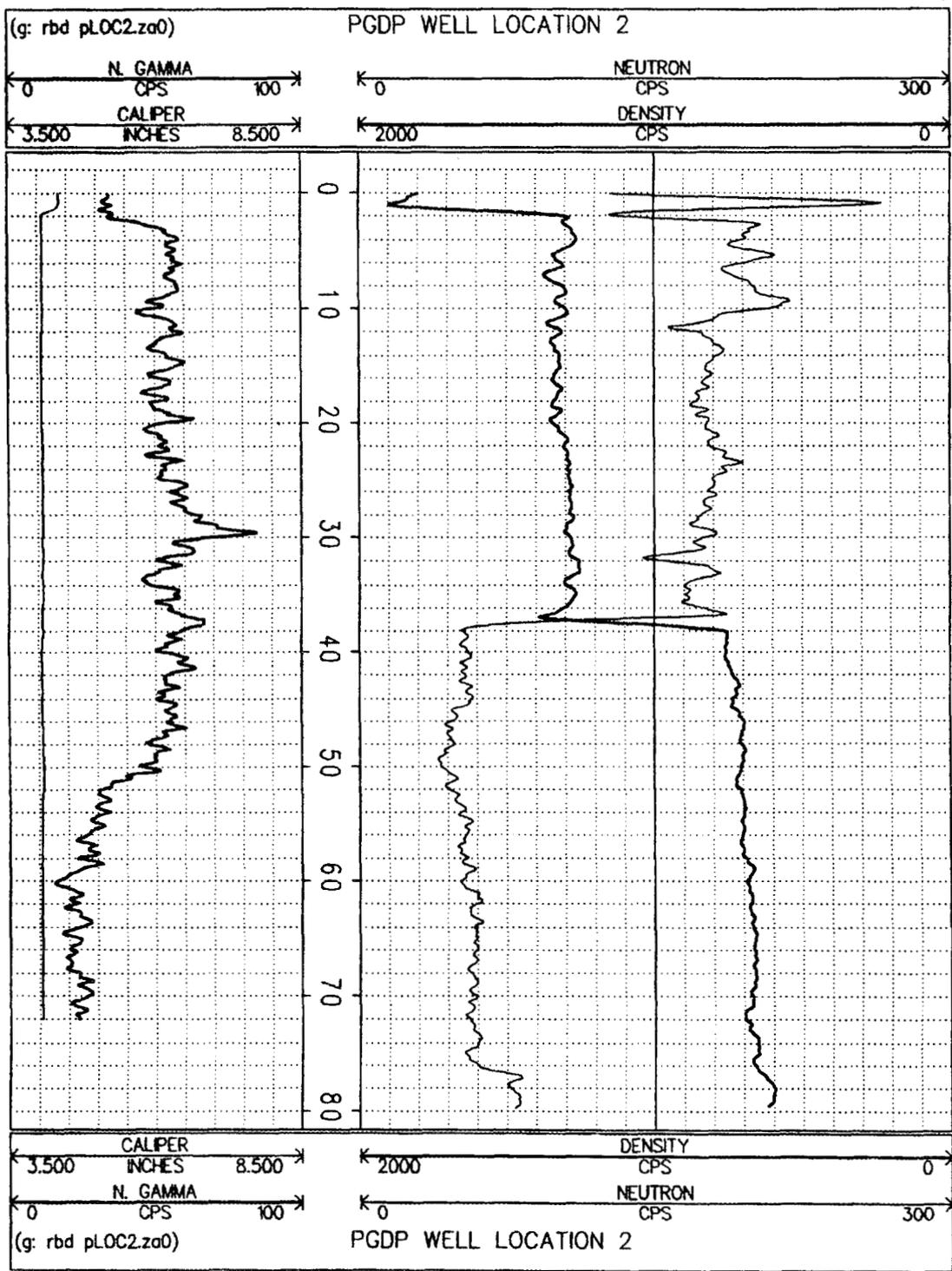
| | | | | | | |
|---|---|---|---------------|--------------------------|------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: D10 | | | | |
| PROJECT: PGDP Site Investigation 1 | | DATE LOGGED: 18 July 1989 | | | | |
| CLIENT: MMES RAP - Winkler/Krispin | | ORNL ID NO: PGDPOD10 | | | | |
| LOCATION: Paducah Gaseous Diffusion Plant | | | | | | |
| STATE: Kentucky | COUNTY: McCracken | ELEV: 351.65' DEPTH REF: TOC | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? | | | | | | |
| DRILLER TD: ? LOGGED TD: 46.4' | | | | | | |
| RUN | BIT RECORD | | CASING RECORD | | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 4" PVC | 0.0' | 46.4' |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger | | | | | | |
| CASING STICK UP: 0.8' TOC | | | | | | |
| DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES | | | | UNIT/TRUCK: GEL 1 | | |
| LOGGING ENGINEER: R. O. KENNARD | | | | | | |
| GEOPHYSICIST: R. J. SELFRIDGE | | | | | | |
| OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 43.2' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 37.3' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 44.8' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Bp | 3.0 C | 44.9' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/18/89 | | | | | | | | | | | | | | |
| DIGITAL FILE NAME(S): PGDPOD10.CA0,CB0,DA1,DC1,NA1,NB1 | | | | | | | | | | | | | | |
| REMARKS: | | | | | | | | | | | | | | |
| Repeat log files: DA0,NA0 | | | | | | | | | | | | | | |
| water level 7-18-89 44.0' from TOC | | | | | | | | | | | | | | |



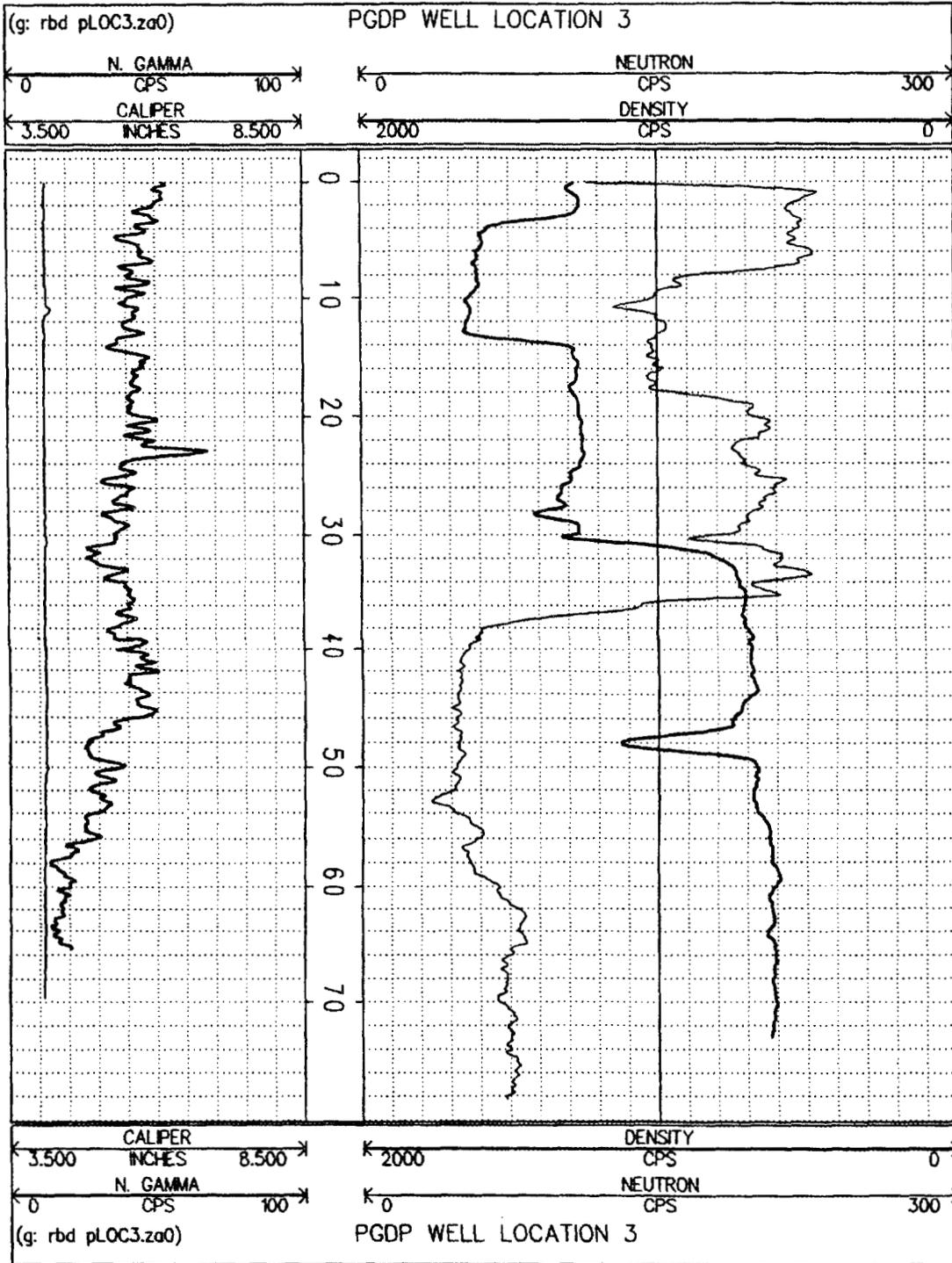
| | | | | | | |
|---|---|---|----|---------------|------|--------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: LOC2 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 19 July 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDPLOC2 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 365.56' DEPTH REF: TOC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 75.81 | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 4" PVC | 0.0' | 75.81' |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 0.1 TOC DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm surr | | | none | | 72.0' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 72.2' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 79.5' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/B+ | 3.0 C | 79.7' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/19/89 DIGITAL FILE NAME(S): PGDPLOC2.CA0,CB0,DA1,DC1,NA1,NB1 REMARKS: Repeat log files: DAO,NAO water level ? from TOC | | | | | | | | | | | | | | |



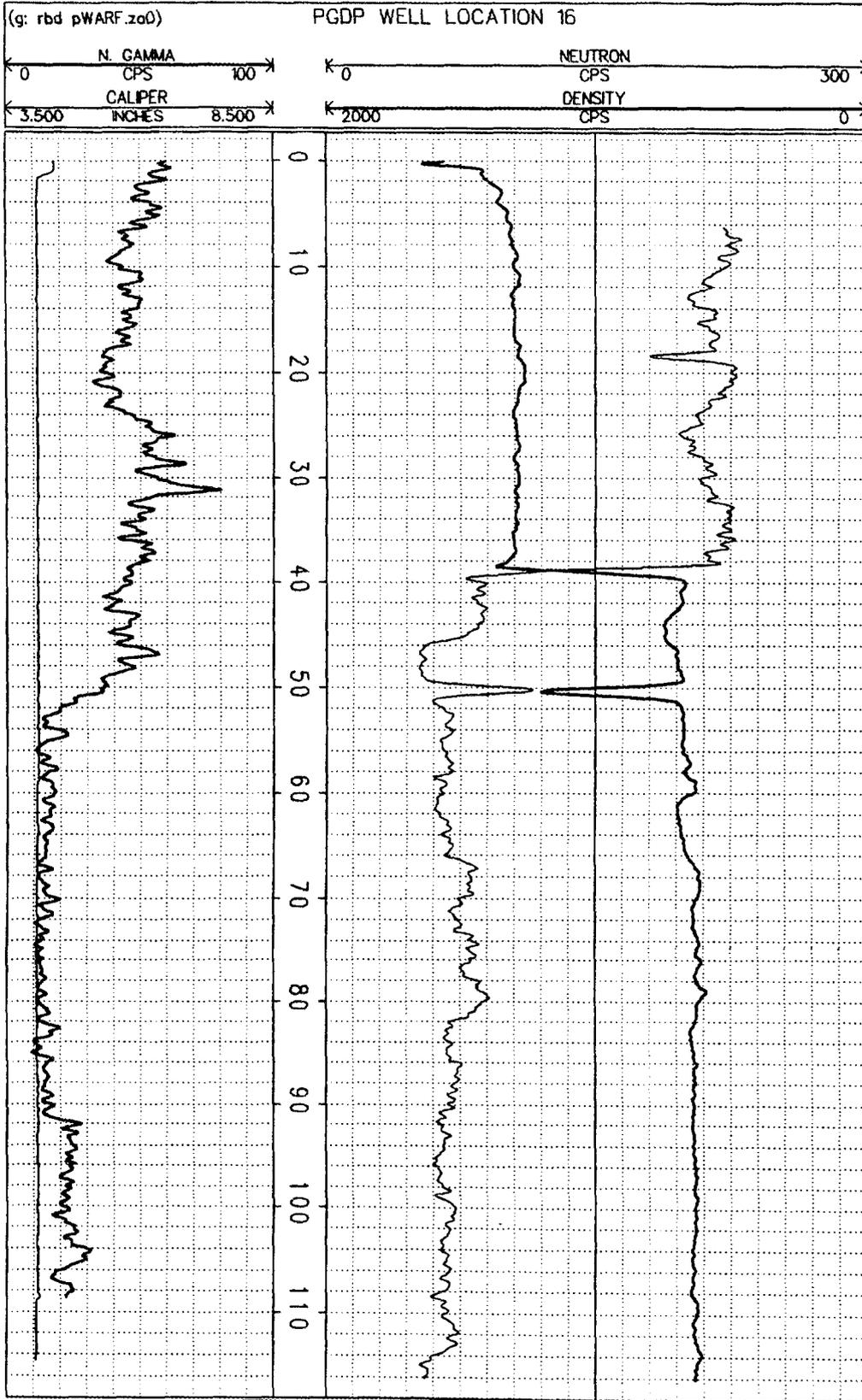
| | | | | | | |
|---|---|---|----|---------------|------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: LOC3 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 19 July 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDPLOC3 LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 363.80' DEPTH REF: TOC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 80.0' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 4" PVC | 0.0' | 78.2' |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: ? CASING STICK UP: 0.1' TOC DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 69.7' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | NaI | | | none | | 71.0' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | NaI | | | Cs137 | 125mC | 78.2' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/B | 3.0 C | 78.2' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/19/89 DIGITAL FILE NAME(S): PGDPLOC3.CA0,C80,DA1,DD1,NA1,NB1 REMARKS: Repeat log files: DA0,NA0 water level ? from TOC | | | | | | | | | | | | | | |



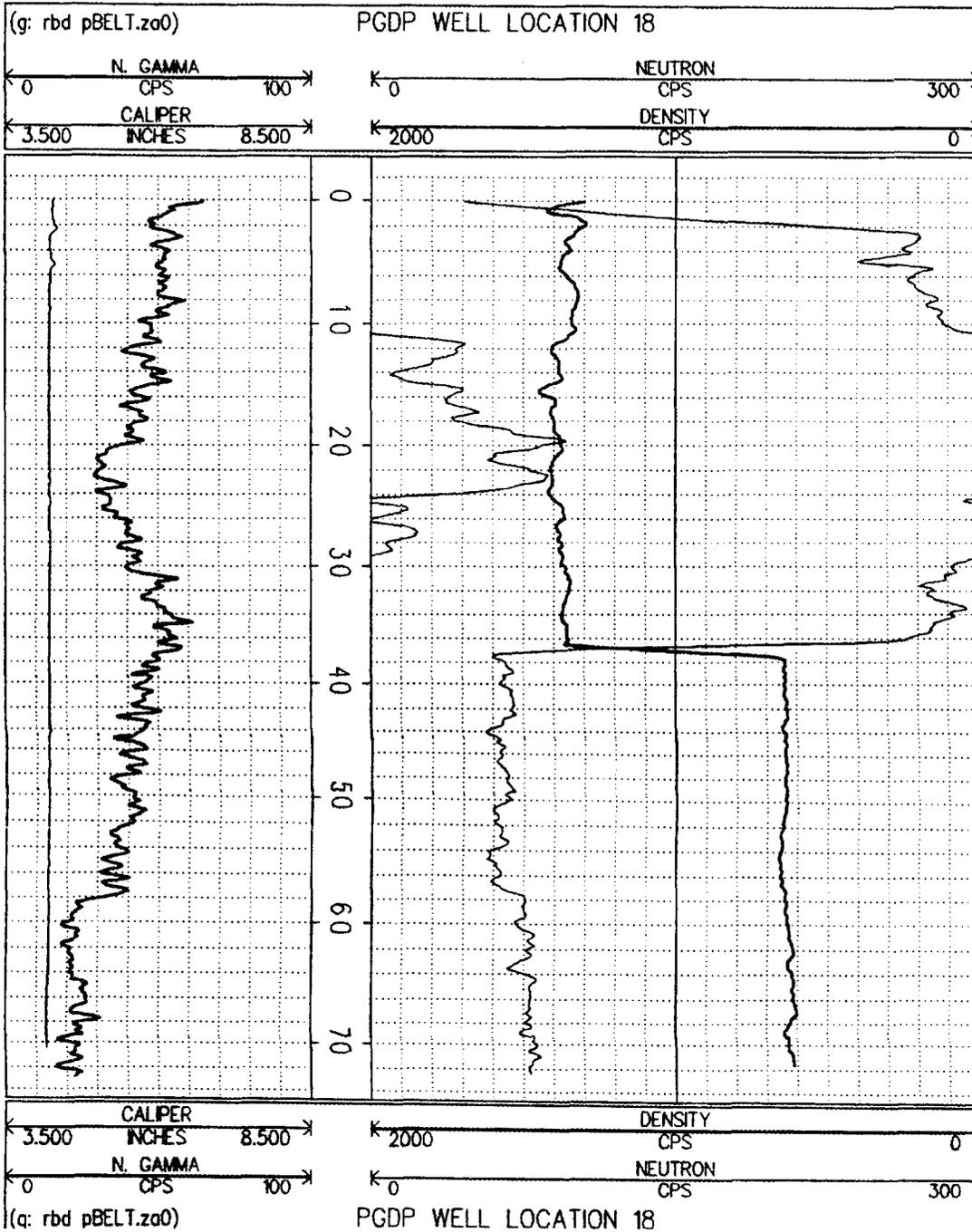
| | | |
|--|---|--|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: LOC16 |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 19 July 1989 | | CLIENT: MMES RAP — Winkler/Krispin ORNL ID NO: PGDPWARF |
| LOCATION: Paducah Gaseous Diffusion Plant | | |
| STATE: Kentucky COUNTY: McCracken ELEV: 365.0' DEPTH REF: TOC | BOREHOLE DATA | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 118.41' | | |
| RUN NO. | BIT RECORD | CASING RECORD |
| NO. | Bit Size From To | Size/Wgt/Thk. From To |
| 1 | 8" Ground Level ? | 4" PVC 0.0' 118.41' |
| 2 | | |
| 3 | | |
| 4 | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 0.2' TOC DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | |
| GENERAL DATA | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES UNIT/TRUCK: GEL 1 | | |
| LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | |

| LOGGING DATA | | | | | | | | | | | | | | |
|---|---------|-----------|-------|------------|--------------|----------------|---------------|------------|------------|--------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG INT FEET | SPEED FT./MIN. | | 1x-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 125" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 114.6' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 108.6' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 116.1 | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/Be | 3.0 C | 116.1 | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S): caliper at wellhead 7/19/89 DIGITAL FILE NAME(S): PGDPWARF.CAQ,CB0,DA1,DD1,NA1,NB1 REMARKS: Repeat log files: DA0,NA0 water level '?' from TOC ESD GEOPHYSICAL ARCHIVES #89-001 | | | | | | | | | | | | | | |



| | | | | | | |
|--|---|--|----|-------------------|------|-------|
|  | ORNL GEOPHYSICS GROUP P. O. BOX 2008, OAK RIDGE, TN. 37831-6317 PHONE: (615) 574-7312 (615) 574-4558 | CALIPER, NAT. GAM DENSITY, NEUTRON WELL: LOC18 | | | | |
| PROJECT: PGDP Site Investigation 1 DATE LOGGED: 16 August 1989 CLIENT: MMES RAP - Winkler/Krispin ORNL ID NO: PGDPBELT LOCATION: Paducah Gaseous Diffusion Plant STATE: Kentucky COUNTY: McCracken ELEV: 361.0' DEPTH REF: TOC | | | | | | |
| BOREHOLE DATA | | | | | | |
| DRILLING CONTRACTOR: ? DRILLER TD: ? LOGGED TD: 74.2' | | | | | | |
| RUN | BIT RECORD | | | CASING RECORD | | |
| NO. | Bit Size | From | To | Size/Wgt/Thk. | From | To |
| 1 | 8" | Ground Level | ? | 4" PVC | 0.0' | 74.2' |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| DRILL METHOD: Hollow Stem Auger CASING STICK UP: 1.7' TOC DEPTHS WHERE CIRCULATION WAS LOST OR VARIABLE: | | | | | | |
| GENERAL DATA | | | | | | |
| INSTRUMENTATION: ORNL DAS & COMPROBE SONDES LOGGING ENGINEER: R. O. KENNARD GEOPHYSICIST: R. J. SELFRIDGE OTHER SERVICES: | | | | UNIT/TRUCK: GEL 1 | | |

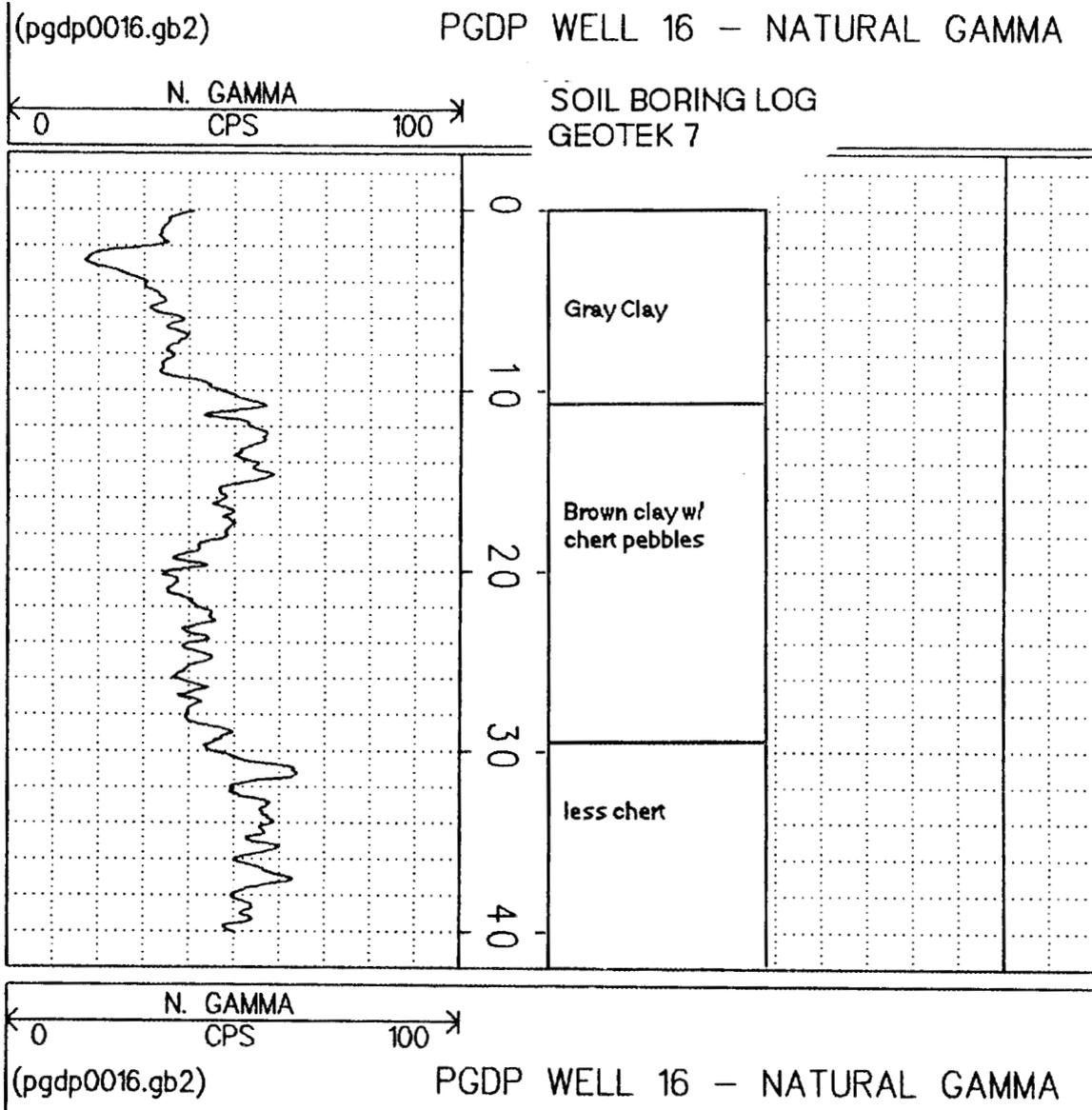
| LOGGING DATA | | | | | | | | | | | | | | |
|--|---------|-----------|-------|------------|--------------|---------------|---------------|------------|------------|---------------------|------------|-----------------|-----|-----------|
| LOG FUNCTION | RUN NO. | EQUIPMENT | | | LOGGING | | DETECTOR TYPE | SPACING | | SOURCE | | LOGGED INTERVAL | | |
| | | ORNL S.N. | MODEL | PROBE S.N. | DIG BIT FEET | SPEED FT./MIN | | Tx-Rx FEET | Rx-Rx FEET | TYPE | SIZE CURIE | FROM | TO | INT. FEET |
| Caliper | 1 | 0109 | 1.25" | 0109 | 0.1 | 15.0 | 3arm sum | | | none | | 70.4' | TOC | 0.0' |
| Nat. Gamma | 2 | 0103 | 103 | 1089 | 0.1 | 15.0 | Nal | | | none | | 64.1' | TOC | 0.0' |
| Density | 3 | 0102 | 104 | 1224 | 0.1 | 15.0 | Nal | | | Cs137 | 125mC | 71.6' | TOC | 0.0' |
| Neutron | 4 | 0101 | 104P | 1088 | 0.1 | 15.0 | He3 | | | Am/B ²⁵² | 3.0 C | 72.4' | TOC | 0.0' |
| | | | | | | | | | | | | | | |
| CALIBRATION FACTOR(S) Caliper at wellhead 8/16/89 DIGITAL FILE NAME(S) PGDPBELT.CA0,CB0,GA1,GB1,DA1,DB1,NA2,NB2 REMARKS: Repeat log files: GAO,DAO,NAO water level 8-16-89 37.58' from TOC | | | | | | | | | | | | | | |



APPENDIX B
SOIL BORING LOG CORRELATIONS

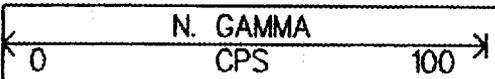
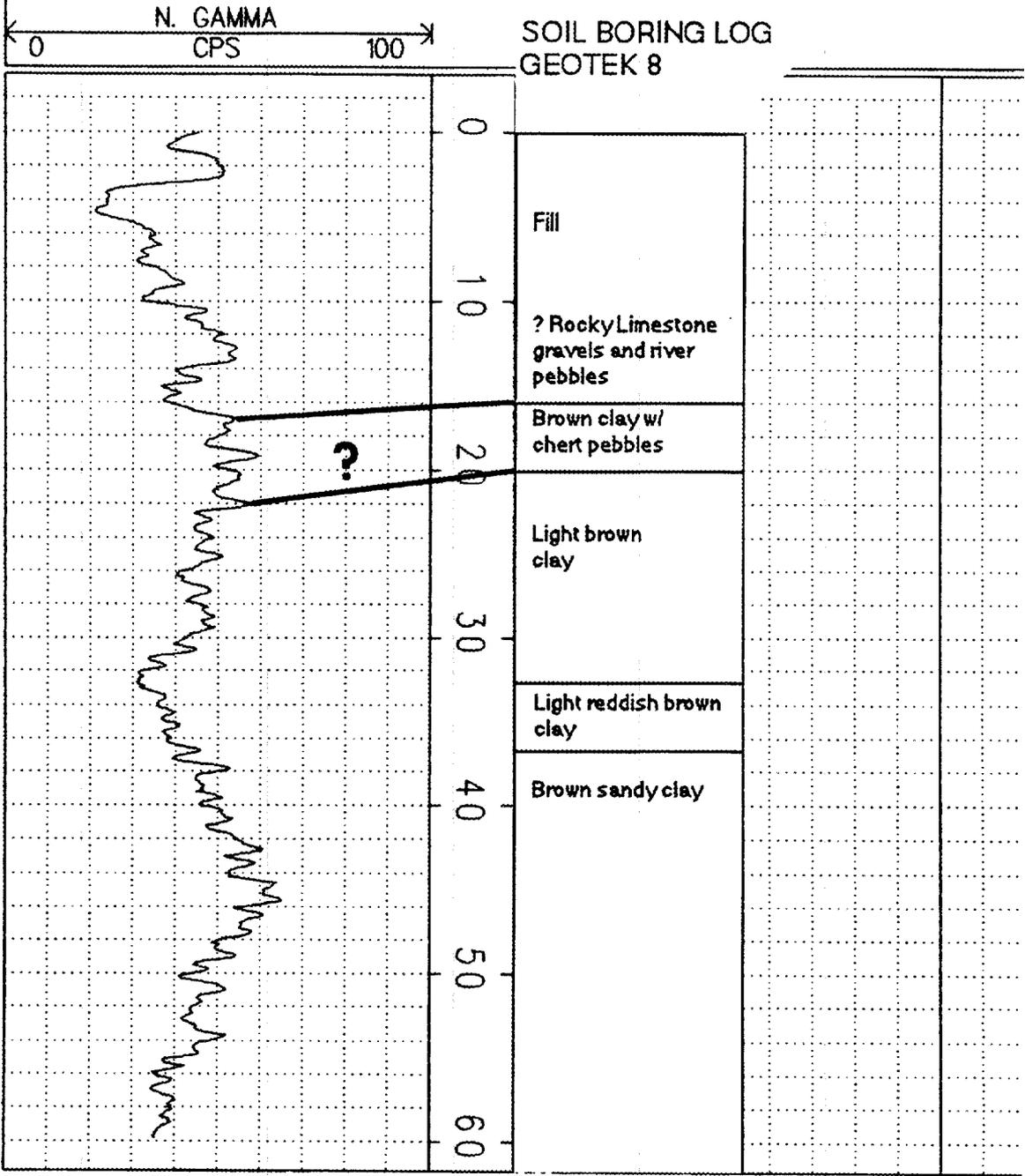
APPENDIX B

Elevations for soil borings that correspond to wells 16 -- 44 (pages 84 -- 94) are not absolute. These wells are from the inert landfill site and elevation discrepancies exist among surveys at this site: the area has been regraded, and historical records are not precise or clear. Discrepancies are also noted in Table 1. In addition to the illustrated soil boring logs shown in this appendix, additional soil descriptions are available in ERC (1989).



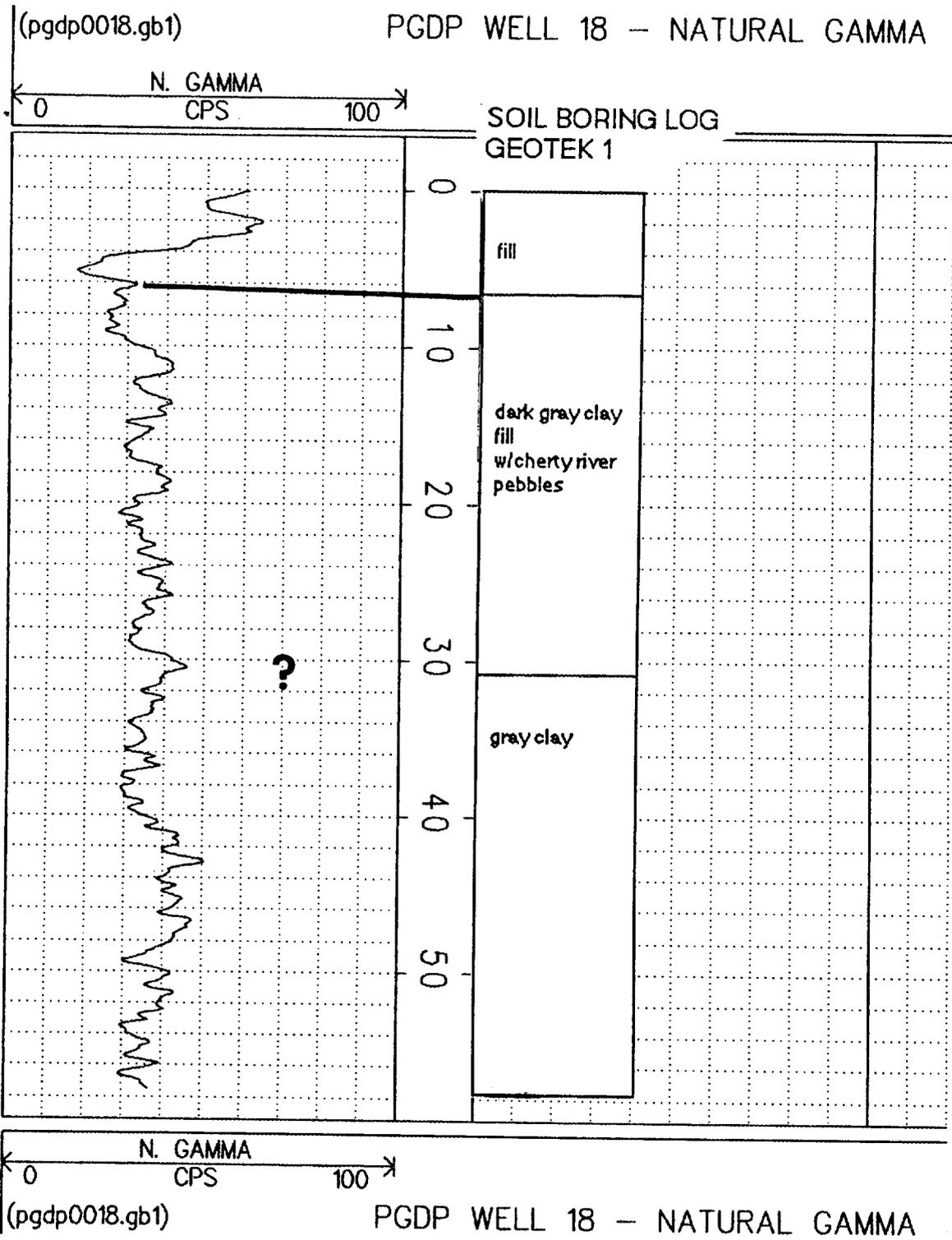
(pgdp0017.gb1)

PGDP WELL 17 - NATURAL GAMMA

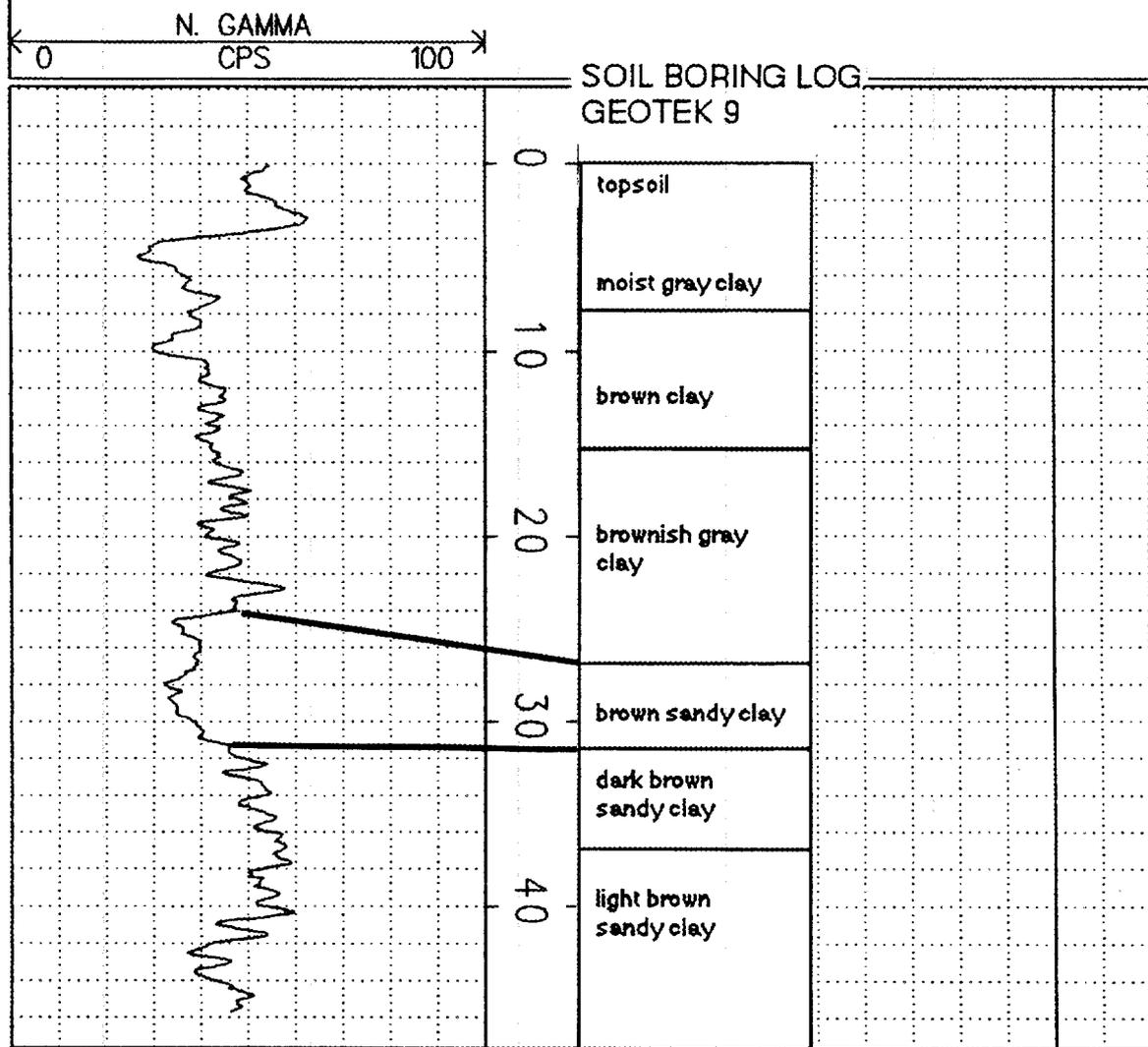


(pgdp0017.gb1)

PGDP WELL 17 - NATURAL GAMMA



(pgdp0019.gb1) PGDP WELL 19 - NATURAL GAMMA



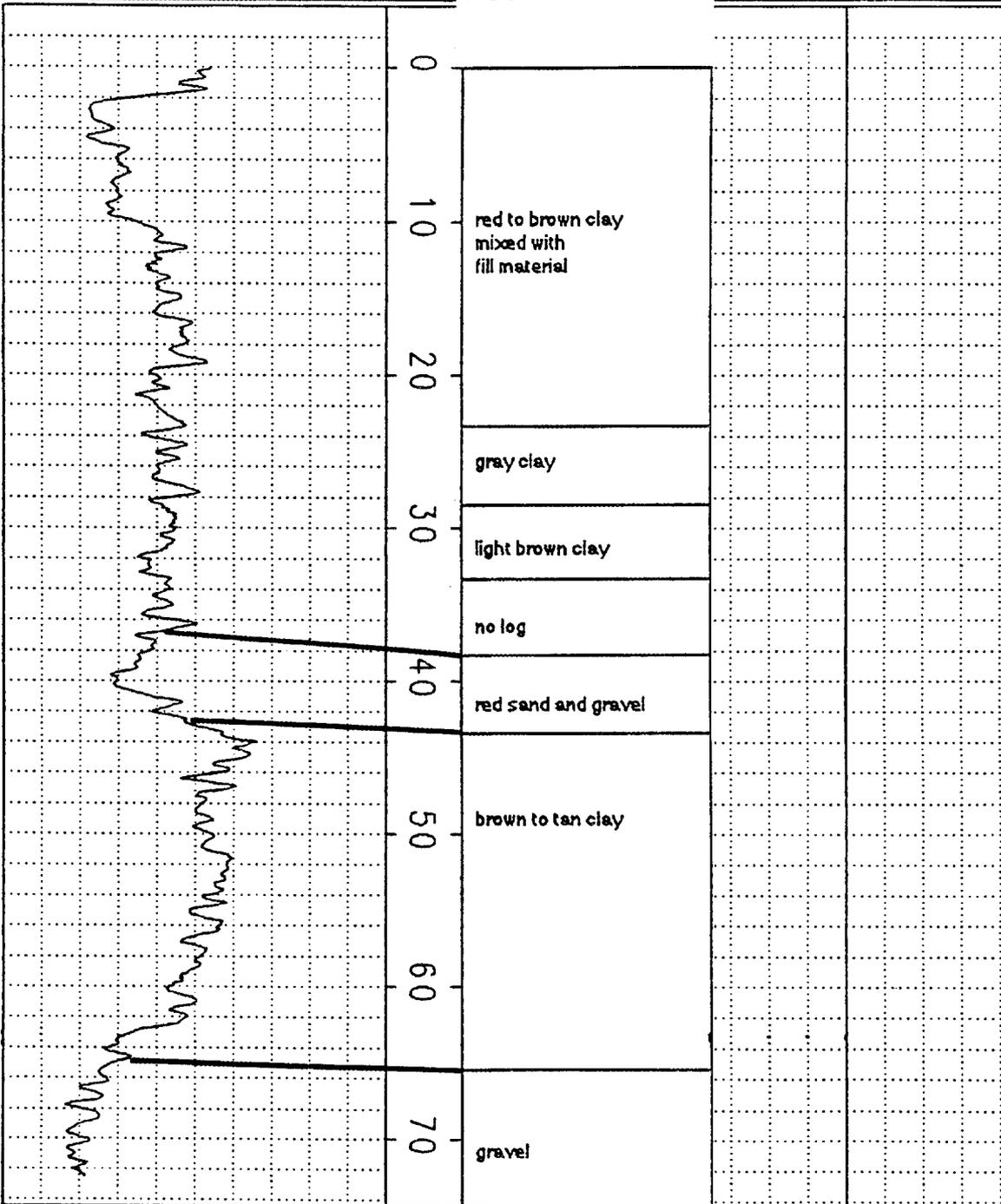
(pgdp0019.gb1) PGDP WELL 19 - NATURAL GAMMA

(pgdp0038.gb1)

PGDP WELL 38 - NATURAL GAMMA

N. GAMMA
CPS 0 100

SOIL BORING LOG
WELL 5P



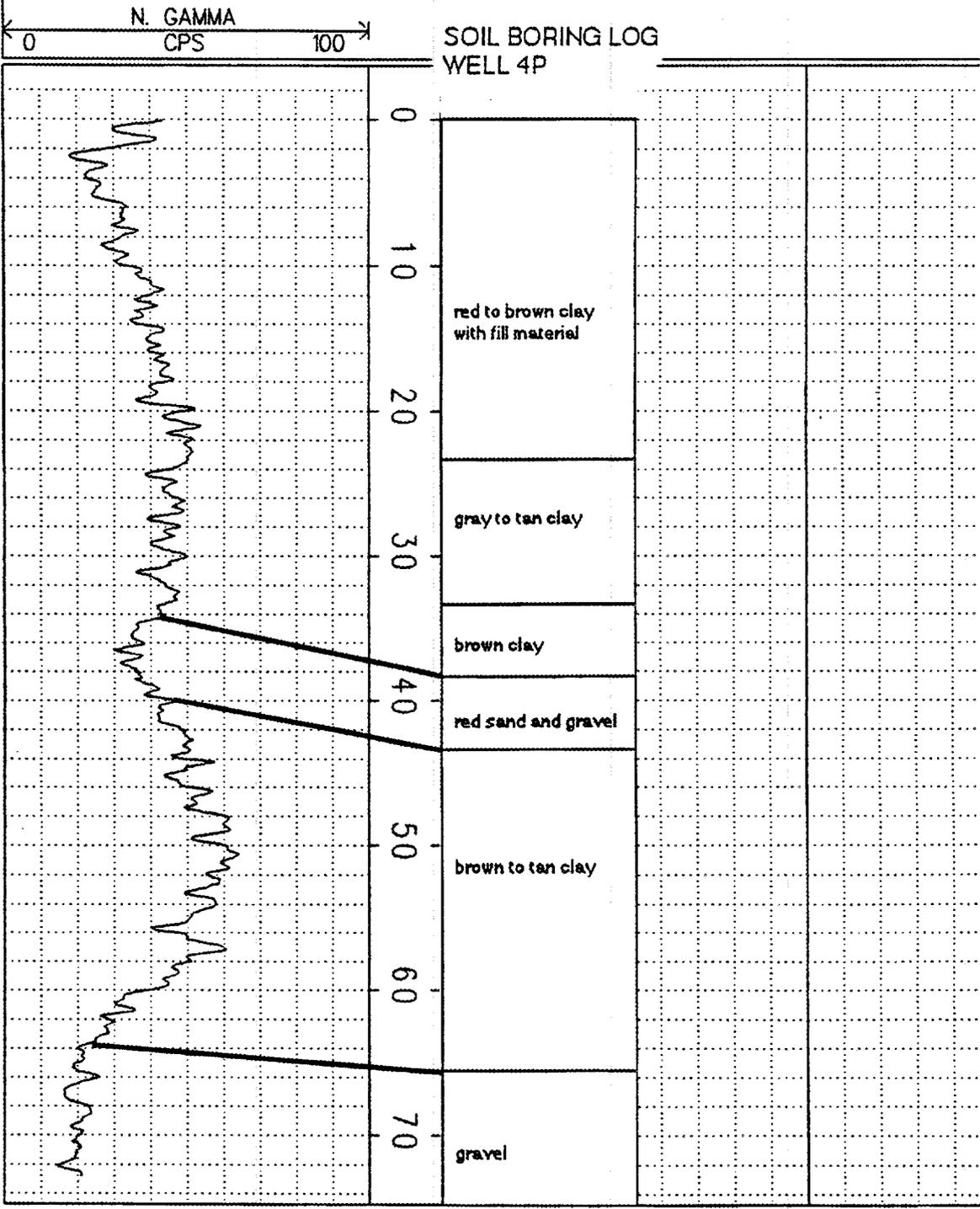
N. GAMMA
CPS 0 100

(pgdp0038.gb1)

PGDP WELL 38 - NATURAL GAMMA

(pgdp0039.gb1)

PGDP WELL 39 - NATURAL GAMMA



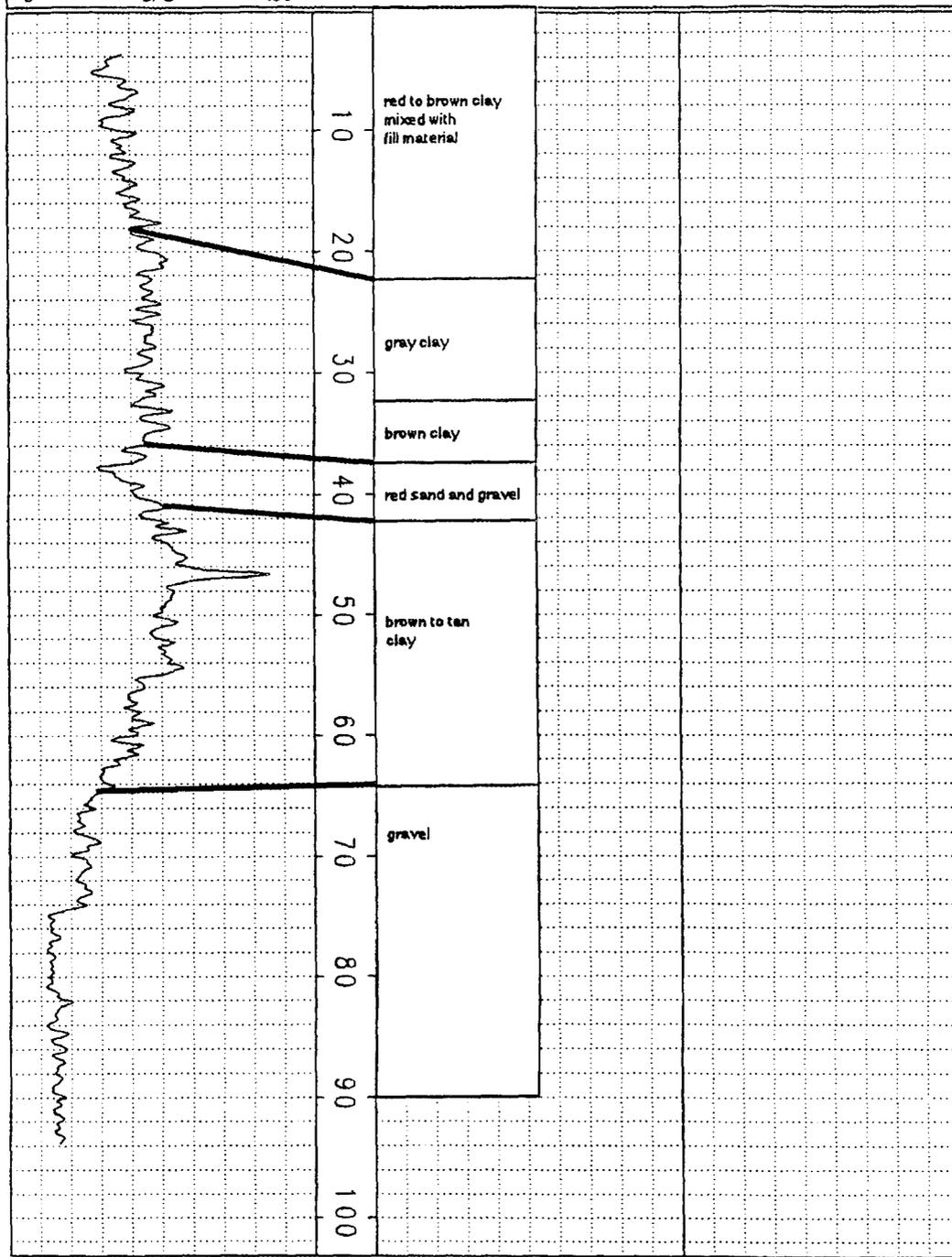
(pgdp0039.gb1)

PGDP WELL 39 - NATURAL GAMMA

(pgdp0040.db1)

PGDP WELL 40 - NATURAL GAMMA
SOIL BORING LOG
WELL 3P

N. GAMMA
CPS 0 100



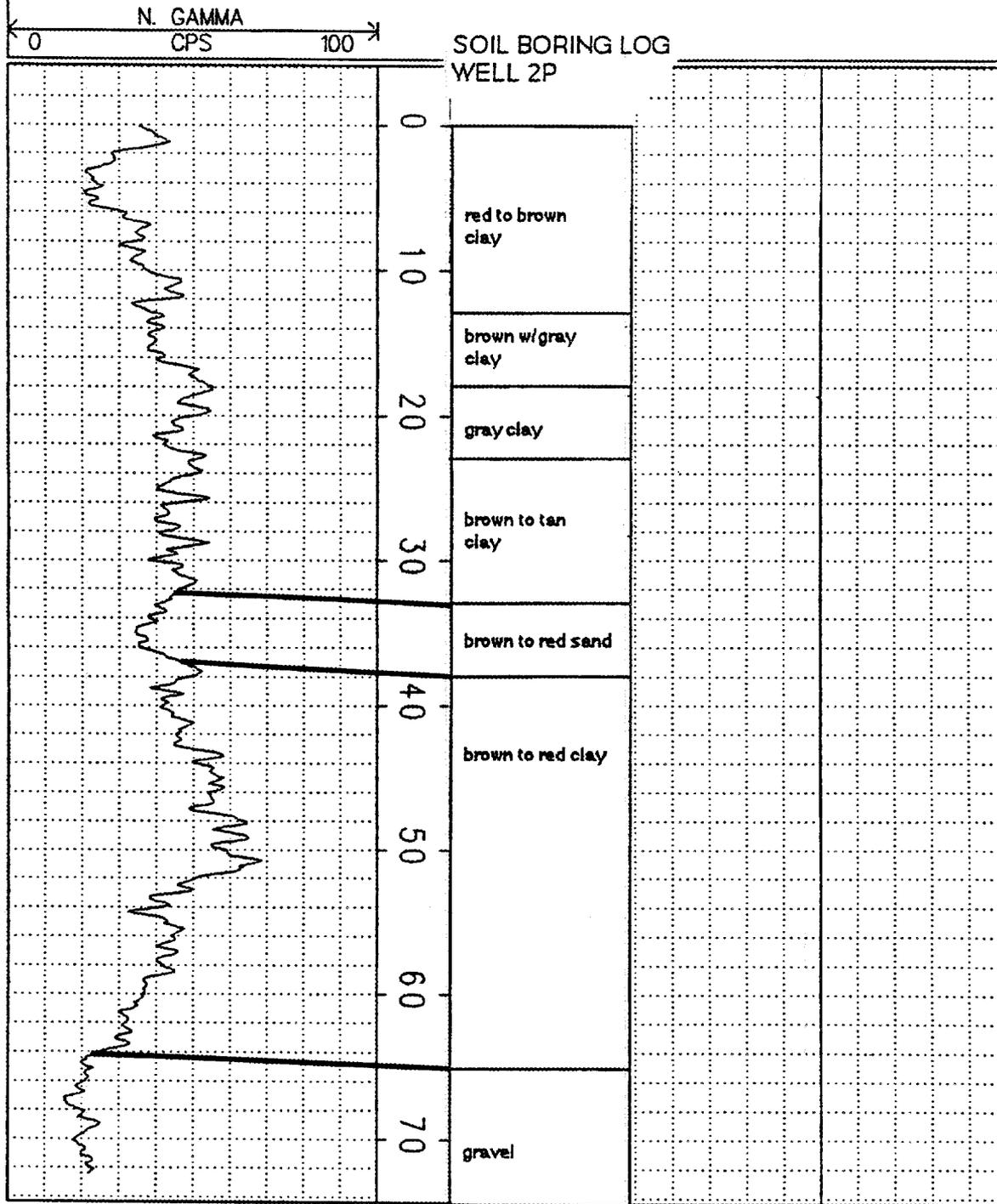
N. GAMMA
CPS 0 100

(pgdp0040.db1)

PGDP WELL 40 - NATURAL GAMMA

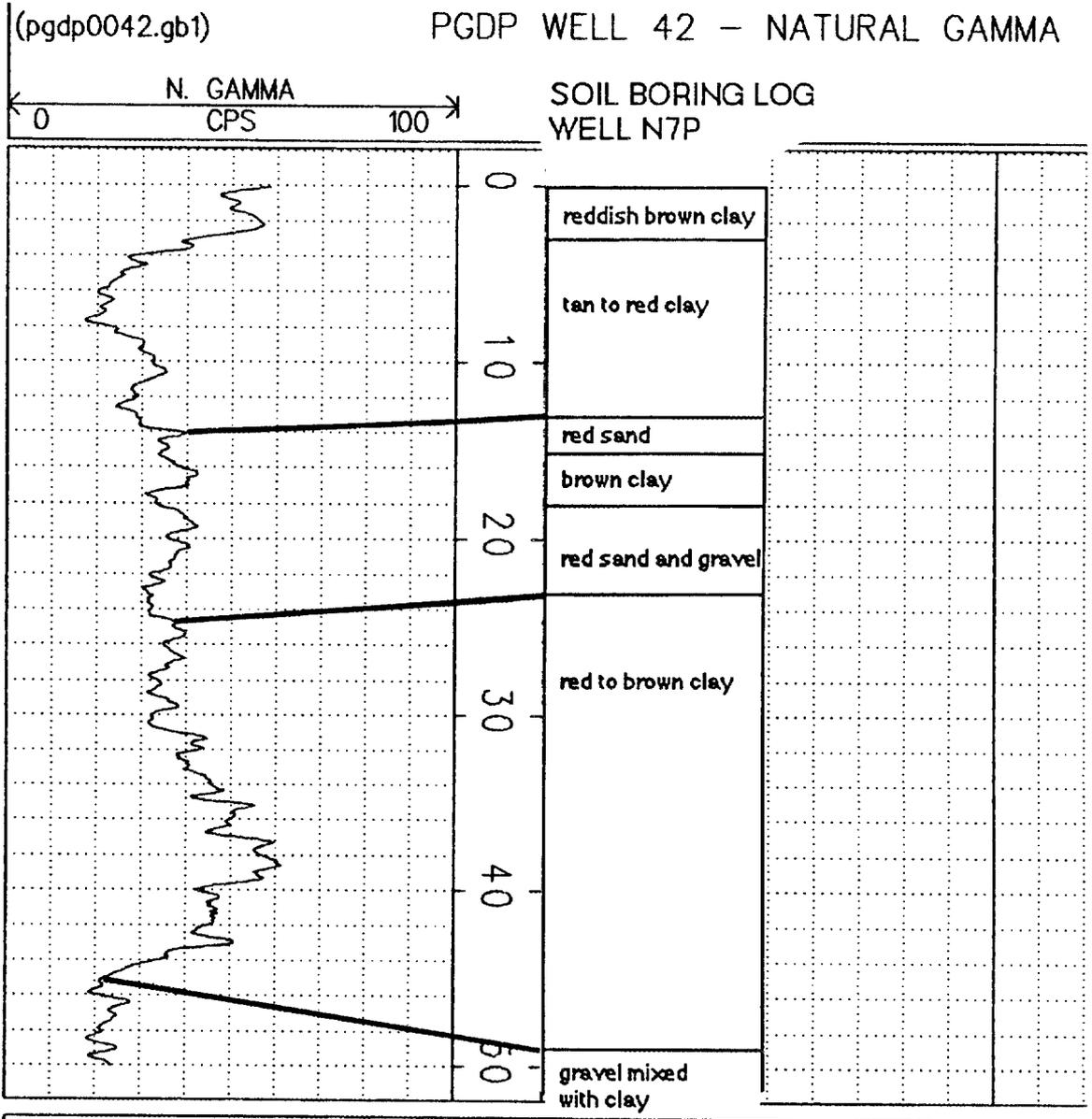
(pgdp0041.gb1)

PGDP WELL 41 - NATURAL GAMMA



(pgdp0041.gb1)

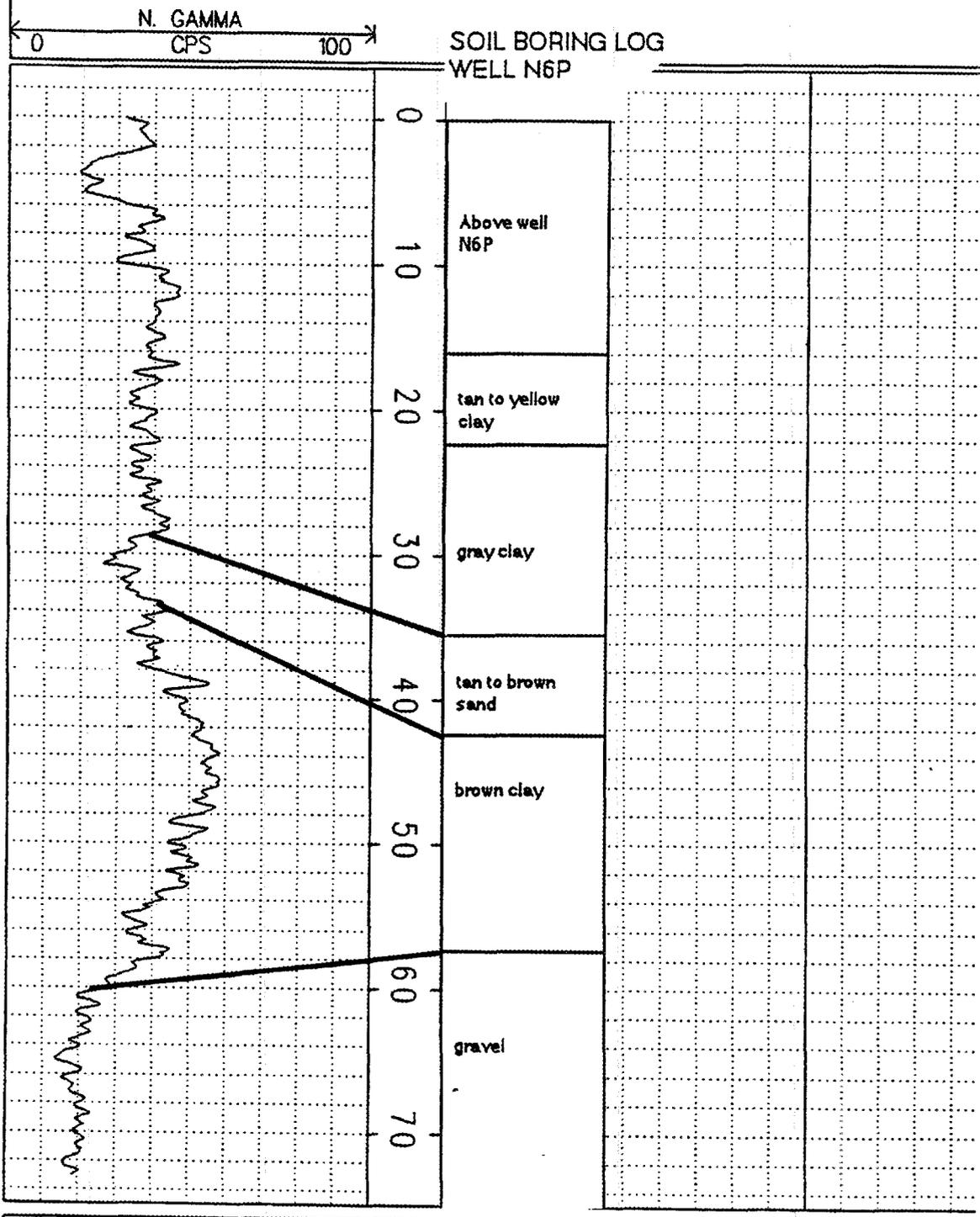
PGDP WELL 41 - NATURAL GAMMA



(pgdp0042.gb1) PGDP WELL 42 - NATURAL GAMMA

(pgdp0043.gb2)

PGDP WELL 43 - NATURAL GAMMA



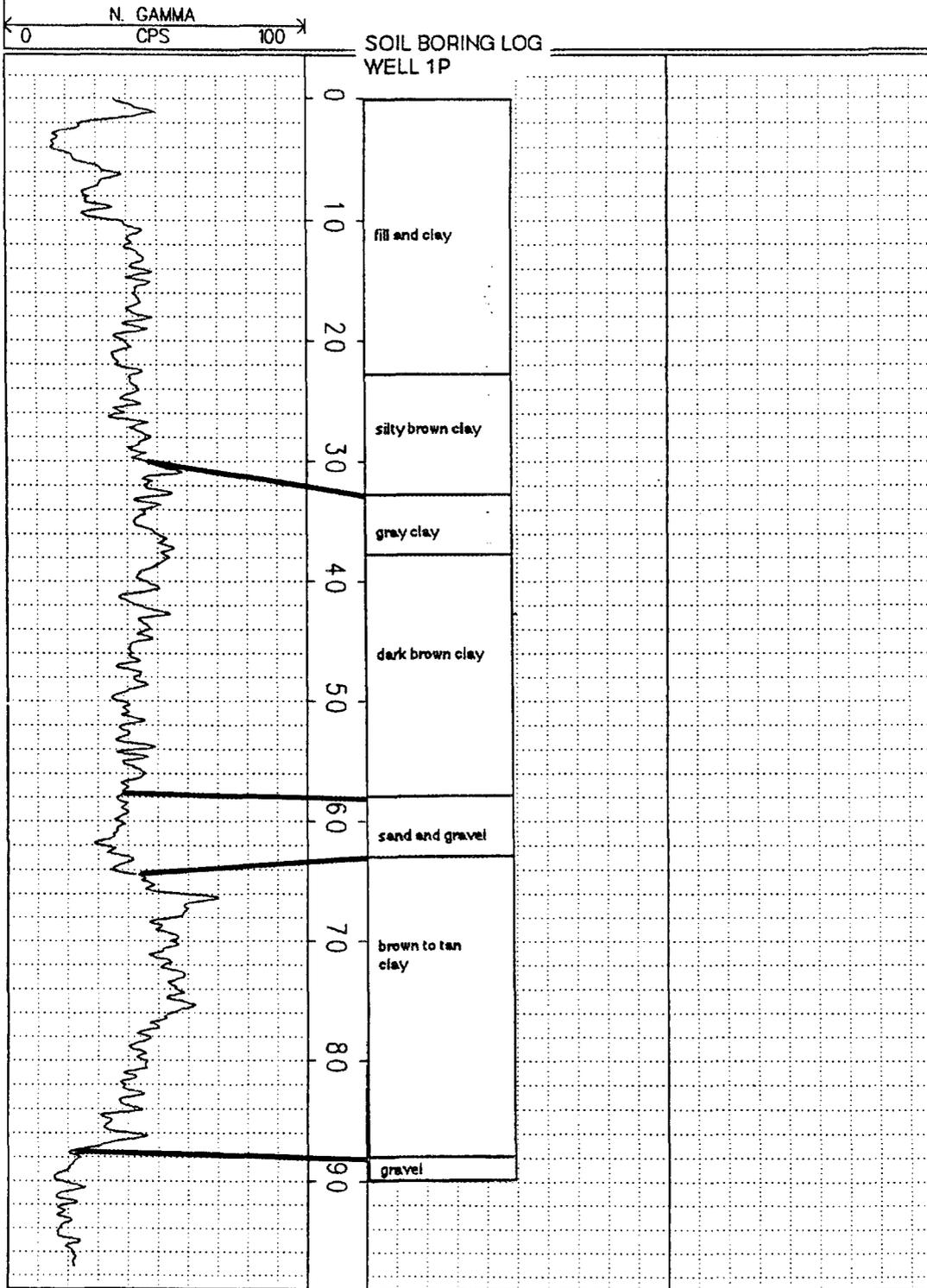
N. GAMMA
CPS 0 100

(pgdp0043.gb2)

PGDP WELL 43 - NATURAL GAMMA

(pgdp0044.gb2)

PGDP WELL 44 - NATURAL GAMMA

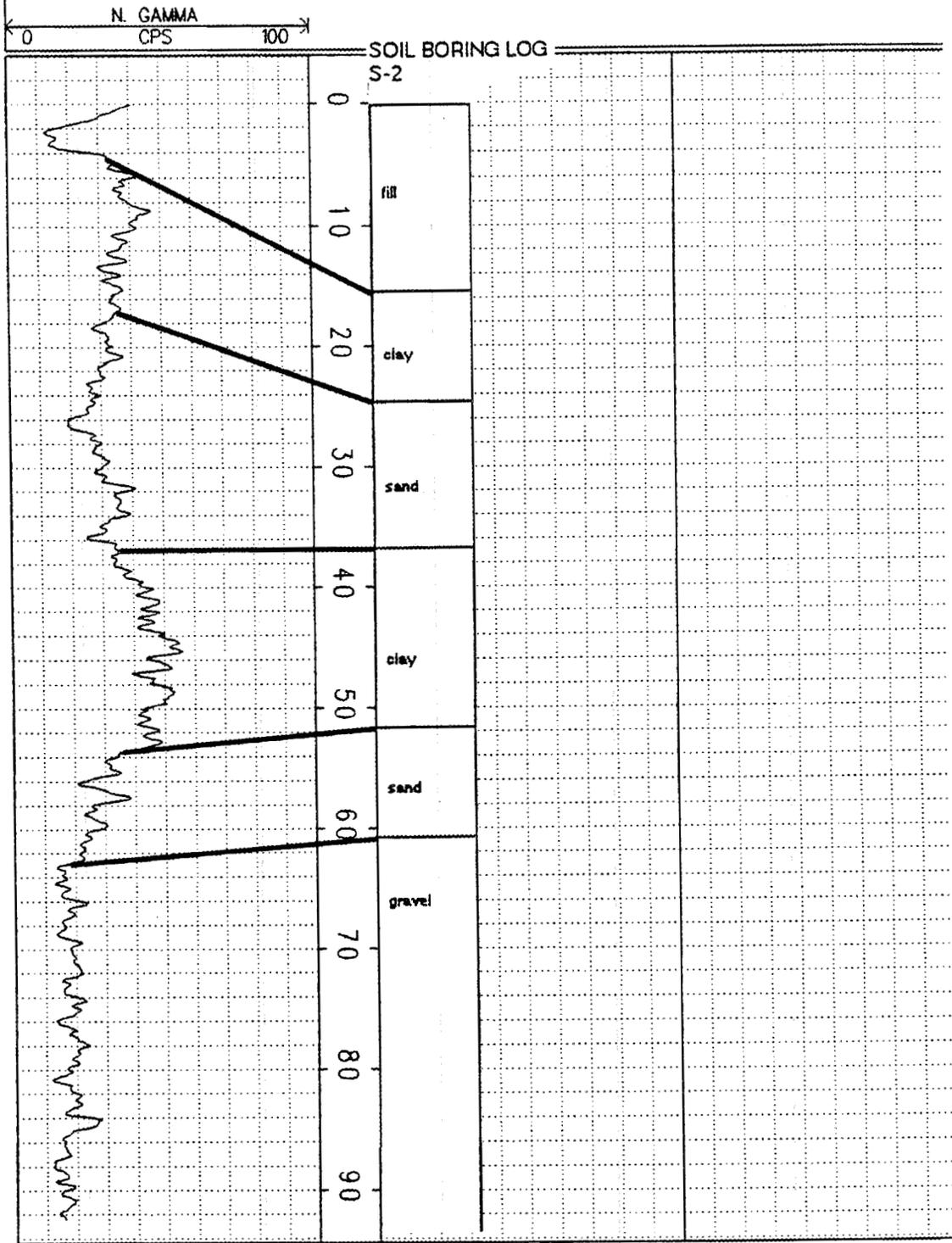


(pgdp0044.gb2)

PGDP WELL 44 - NATURAL GAMMA

(pgdp0065.gb1)

PGDP WELL 65 - NATURAL GAMMA

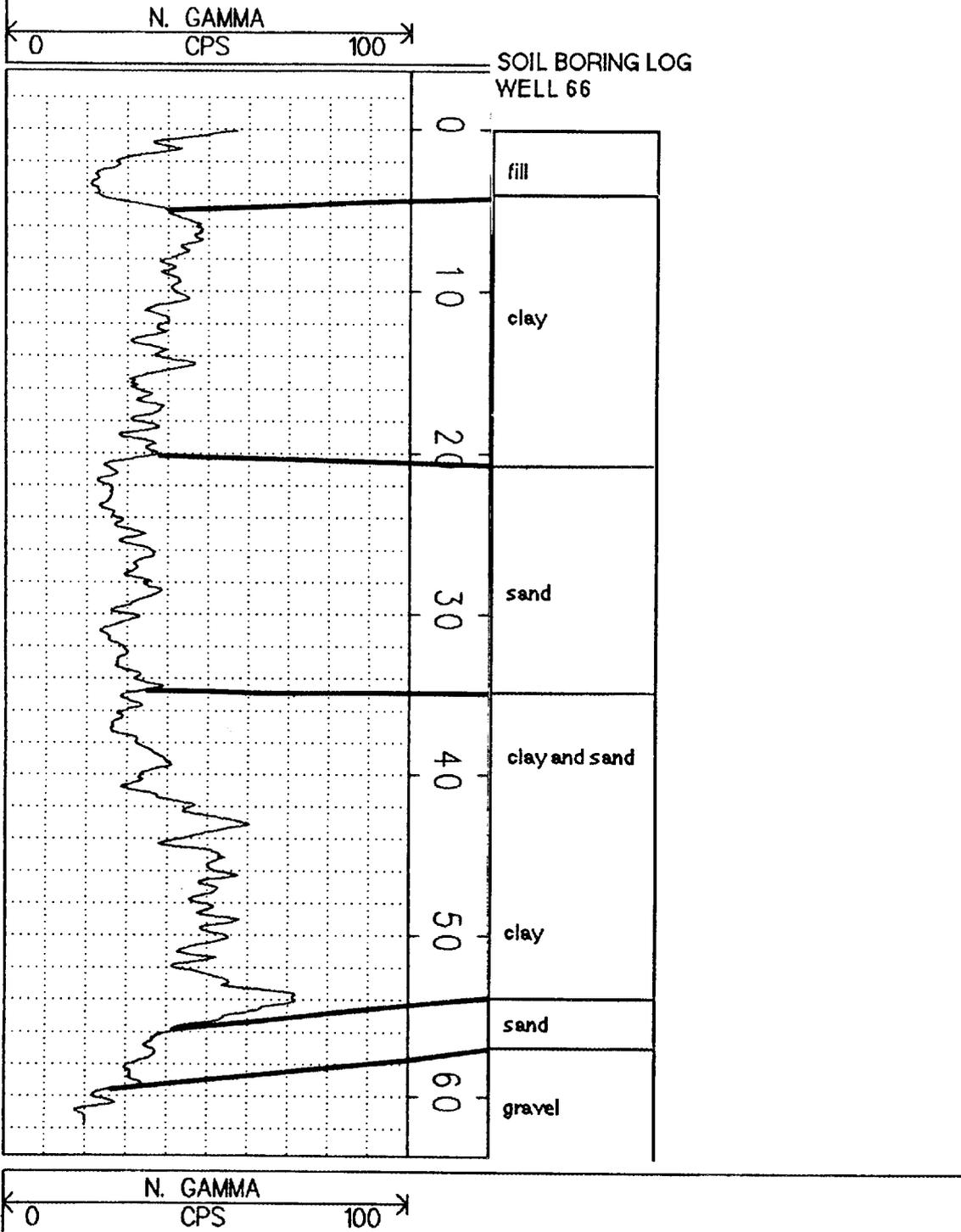


N. GAMMA
CPS 100

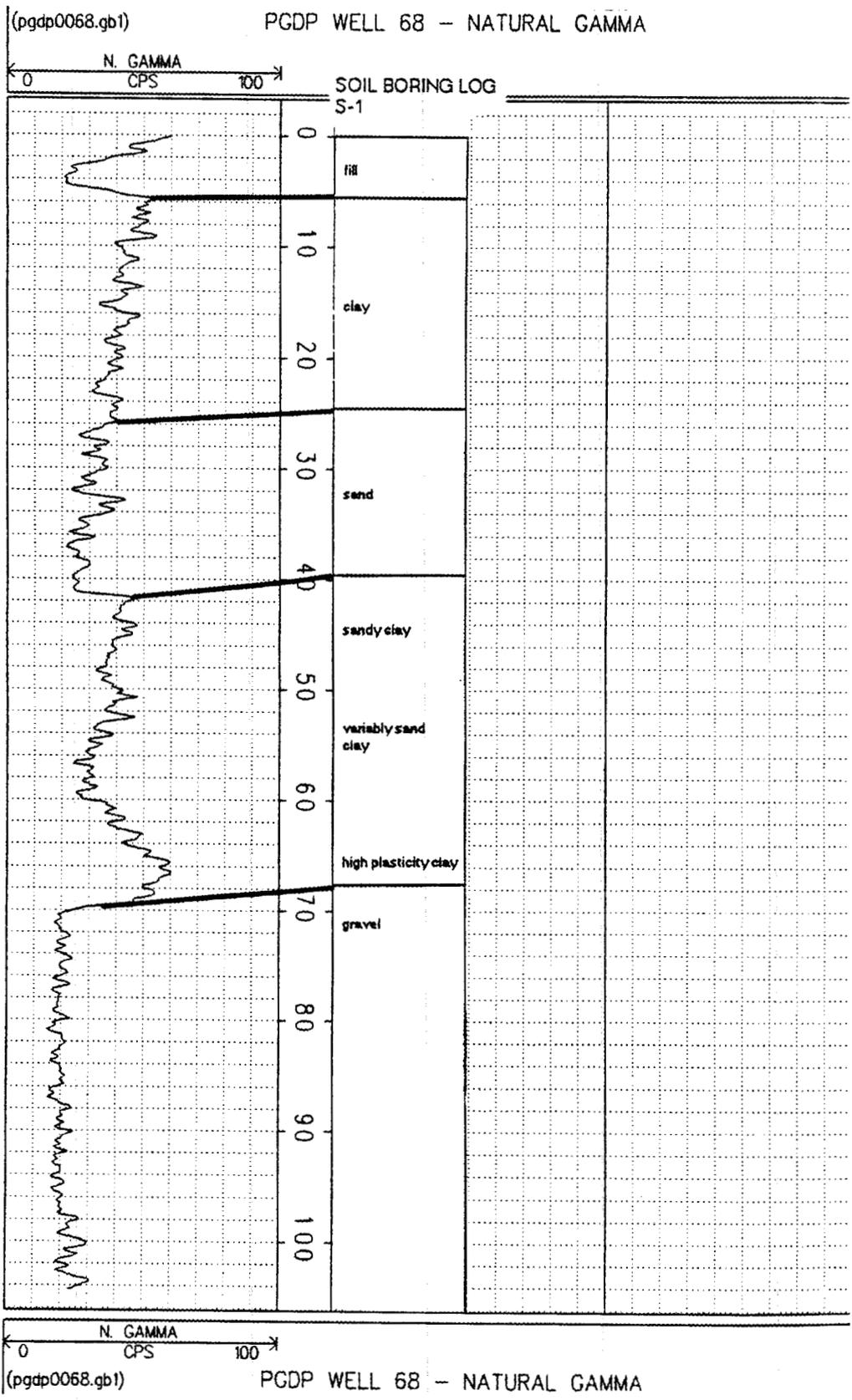
(pgdp0065.gb1)

PGDP WELL 65 - NATURAL GAMMA

(pgdp0066.gb1) PGDP WELL 66 - NATURAL GAMMA

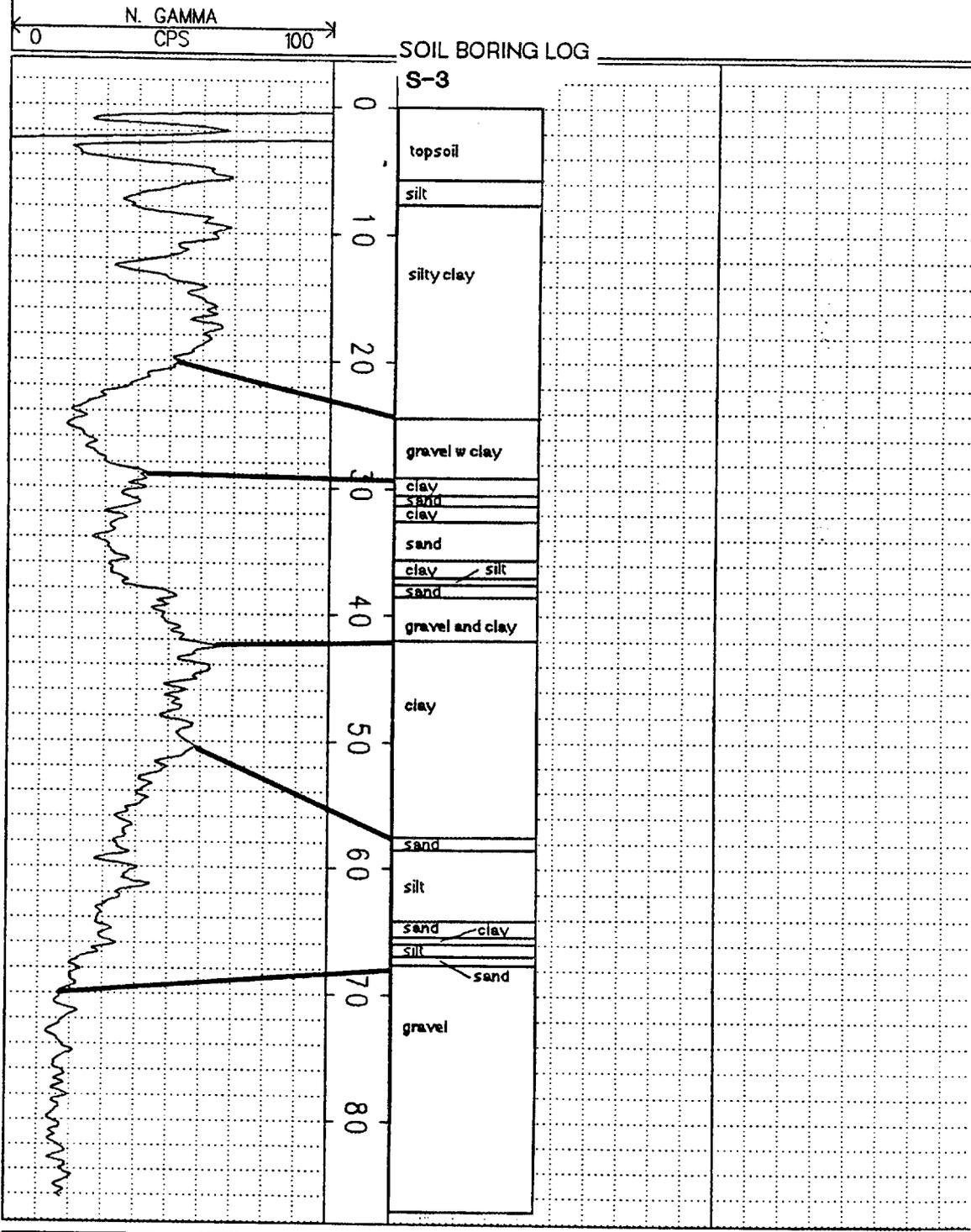


(pgdp0066.gb1) PGDP WELL 66 - NATURAL GAMMA



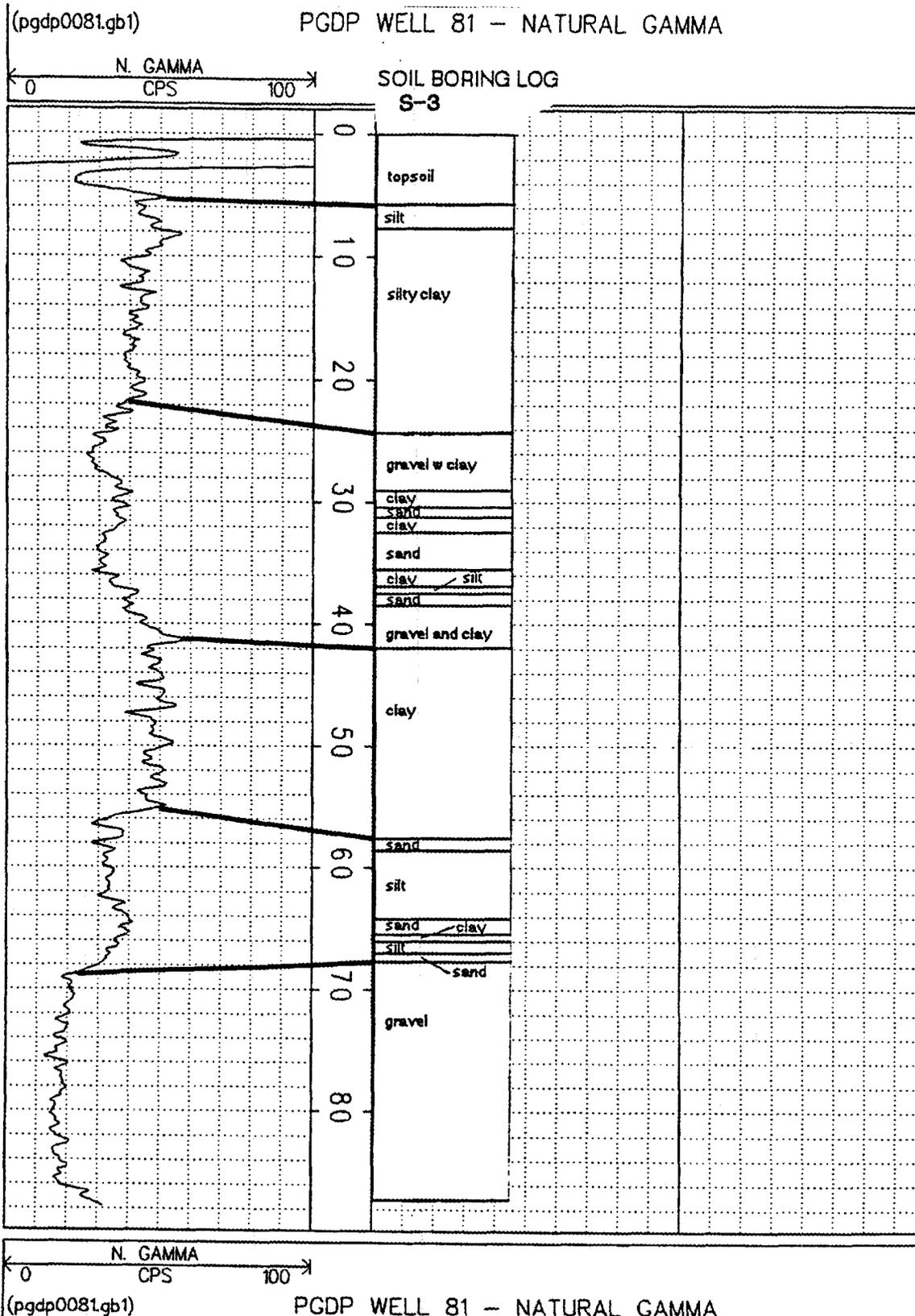
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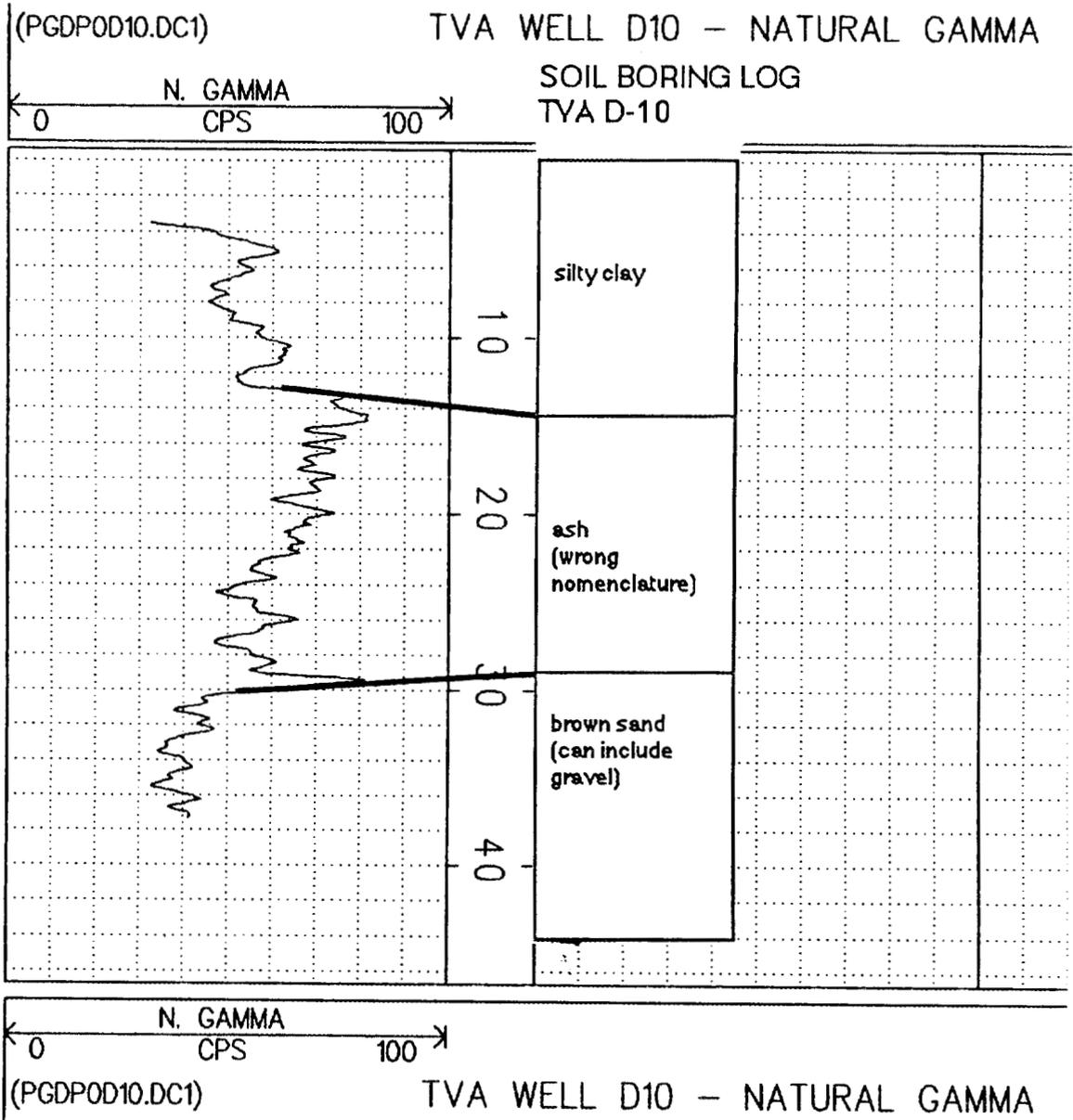
PGDP WELL 80 - NATURAL GAMMA

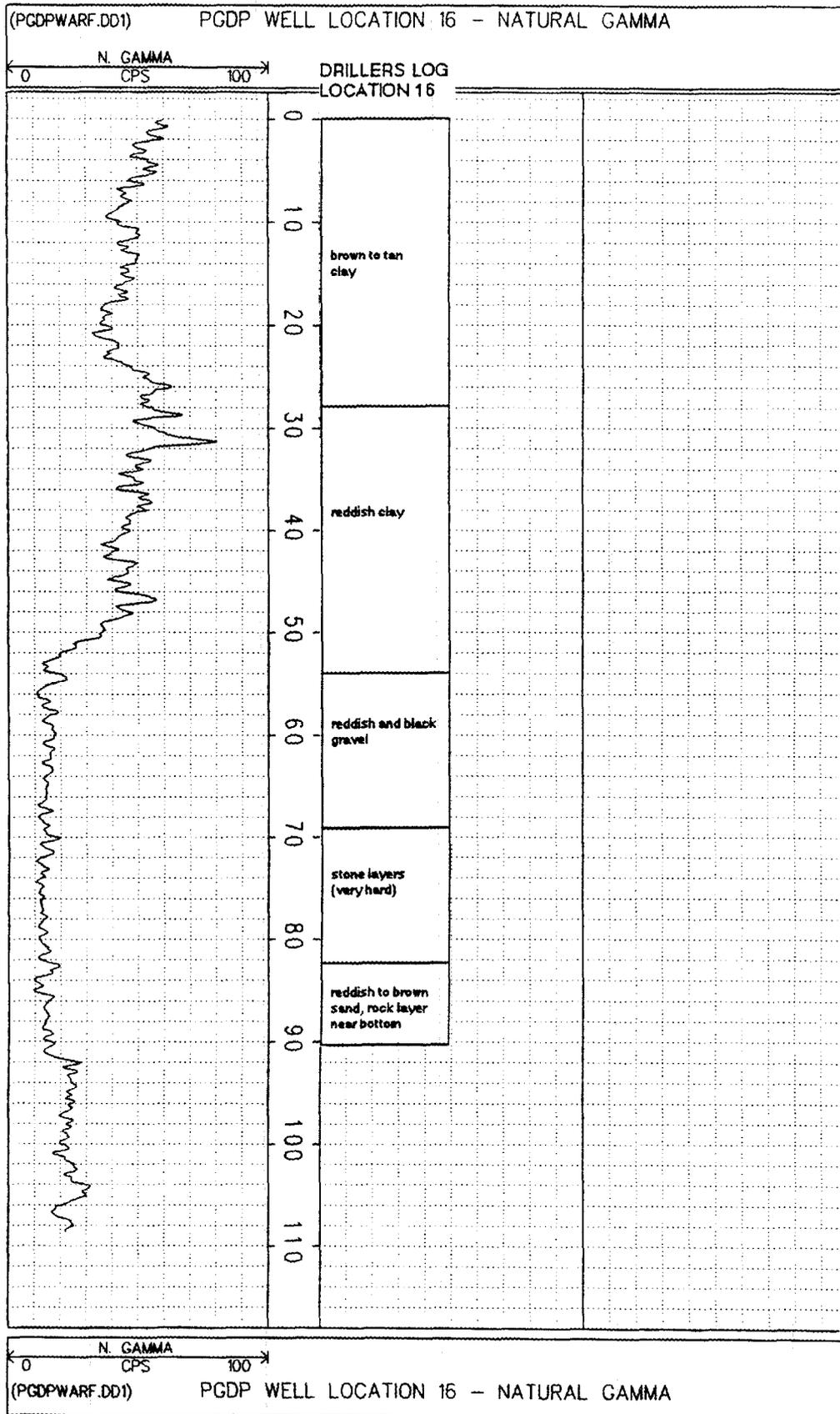


(pgdp0080.gb2)

PGDP WELL 80 - NATURAL GAMMA







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