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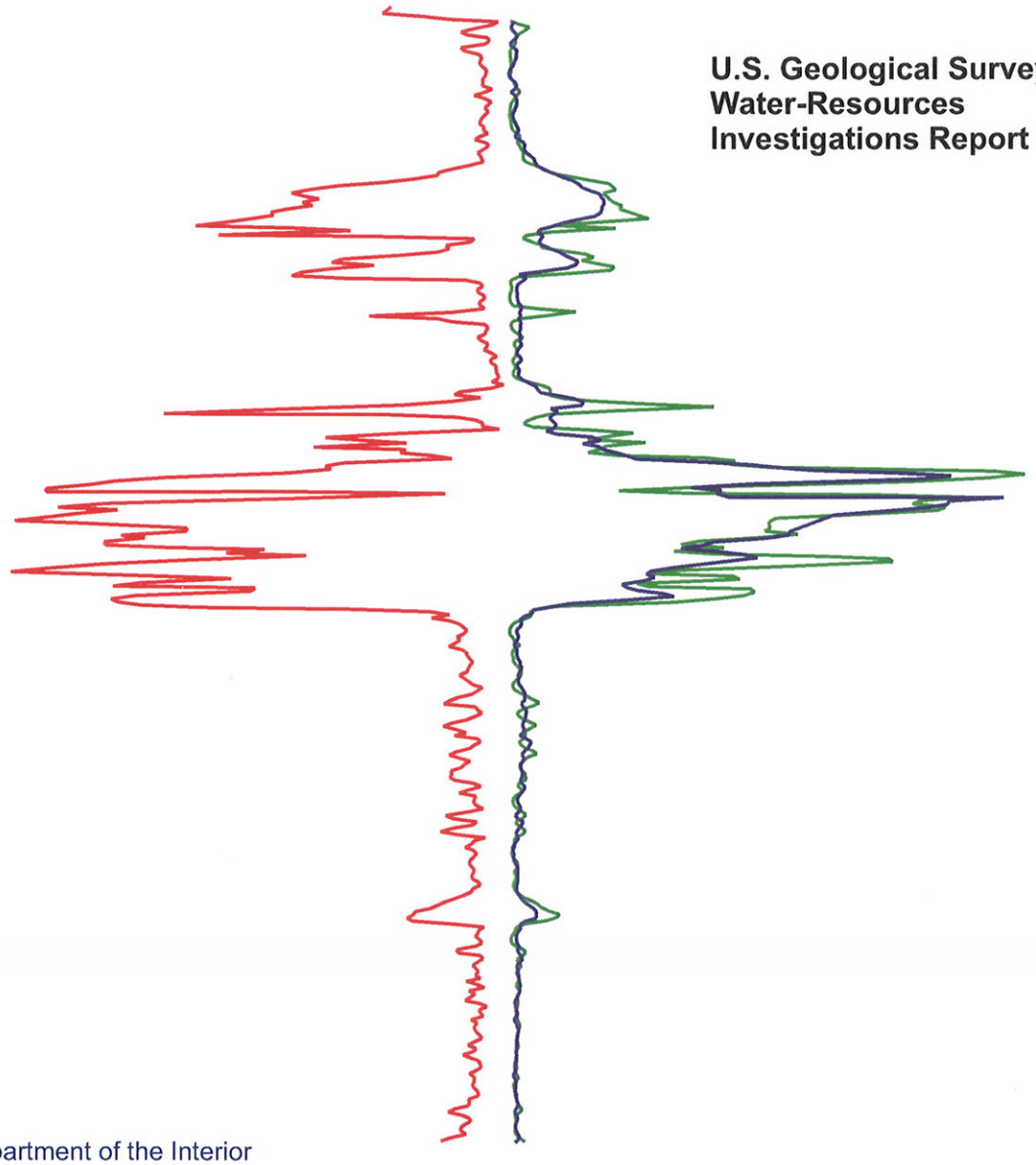
Analysis of Geophysical Log Data from the Fort Polk Military Reservation, Vernon Parish, Louisiana



U.S. Geological Survey
Water-Resources
Investigations Report 00-4111

U.S. Department of the Interior
U.S. Geological Survey

Analysis of Geophysical Log Data from the Fort Polk Military Reservation, Vernon Parish, Louisiana

By Lawrence B. Prakken and Jason M. Griffith

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 00-4111

Prepared in cooperation with the
U.S. ARMY JOINT READINESS TRAINING CENTER
AND FORT POLK

Baton Rouge, Louisiana

2000

U.S. DEPARTMENT OF THE INTERIOR
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ABSTRACT

Geophysical log data from 36 boreholes in the Fort Polk Military Reservation, Vernon Parish, Louisiana, have been analyzed and are presented in a graphical format. These logs have been annotated to show sand and clay layers as well as hydrogeologic units (aquifers and confining units). The hydrogeologic units identified from the geophysical logs include the Evangeline aquifer; the Castor Creek confining unit; the Jasper aquifer system, which consists of the Williamson Creek aquifer, Dough Hills confining unit, and Carnahan Bayou aquifer; and the Lena confining unit. Most of the boreholes penetrated into the Williamson Creek aquifer with some continuing through the Dough Hills confining unit into the underlying Carnahan Bayou aquifer.

The Evangeline aquifer crops out in the southern part of the study area and immediately underlies the Fort Polk cantonment. An examination of 16 geophysical logs of boreholes that penetrated the Evangeline aquifer indicated a discontinuous sand layer at its base. This basal sand has a median thickness of about 30 feet but ranges in thickness from 0 to 53 feet. The upper part of the aquifer was not shown on most of the geophysical logs, so sand-layer percentages could not be determined.

The Williamson Creek aquifer crops out several miles north of the study area and underlies the southern two-thirds of Vernon Parish. This aquifer is a major source of freshwater for the Fort Polk Military Reservation. Analysis of 22 geophysical logs from boreholes that completely penetrated the Williamson Creek aquifer in the study area indicated that sand layers constitute a median of 33 percent of the aquifer.

Two boreholes in the study area appeared to have penetrated the Carnahan Bayou aquifer completely and ended in the top of the Lena confining unit. Sand layers, based on these two logs, constitute 27 percent of the aquifer. The Lena confining unit underlies the Carnahan Bayou aquifer and is composed of a silty clay. No boreholes discussed in this report completely penetrated the Lena confining unit.

INTRODUCTION

The Fort Polk Military Reservation (hereinafter called the Reservation), located in central Vernon Parish, Louisiana (fig. 1), has used ground water as a source for drinking water and other uses since 1941. In 1996, about 3.6 million gallons per day of ground water were withdrawn for use at the Reservation (Edward Ducote, Water and Wastewater Branch, Directorate of Public Works, Fort Polk, written commun., 1997). The Reservation occupies 107,024 acres of land; 66,998 acres are owned by the Army, and 40,026 acres are owned by the U.S. Forest Service (Dan Nance, Fort Polk Public Affairs Office, electronic commun., 1998). A large area of the Reservation is restricted to military personnel with specified zones such as live fire areas, special purpose training areas, and an artillery impact area.

In the course of water-well drilling operations, subsurface stratigraphic data have been gathered in the form of geophysical logs. Paper copy geophysical log data from the Reservation are stored in files of the U.S. Geological Survey (USGS) office in Baton Rouge, Louisiana, and are a source of information for managers of ground-water resources near the Reservation. Although the data are available in files, analysis and descriptive presentation of these data are needed to make the data more useful to ground-water resource managers, to improve understanding of the hydrogeologic setting of the area, and as an aid for future development of ground-water resources. In response to these needs, the USGS, in cooperation with the U.S. Army Joint Readiness Training Center and Fort Polk, began a study in 1997 to analyze and interpret available geophysical log data from boreholes in the western third of the Reservation, and to present the data in a format that would illustrate the hydrogeologic units (aquifers and confining units) underlying this area.

This report describes the results of the study and presents graphical representations of the geophysical log data. Discussion of each hydrogeologic unit, based on previous investigations, is included along with thickness and sand-layer percentage data (for aquifers) from the geophysical logs. The geophysical logs have been annotated to emphasize sand layers rather than to define the physical composition of the intervening layers of silt, clay, or shale. For the purpose of this report, sand annotation refers to aquifer materials and includes fine to coarse sands; the clay refers to confining-unit materials such as silt, clay, and shale. The information in this report will be useful for Federal, State, and local water planners and managers as well as others with ground-water-related responsibilities.

Description of Study Area

The study area (fig. 2) is composed approximately of the western third of the Reservation, and includes two cantonment areas, Fort Polk and North Fort Polk (a later addition) (Maher and others, 1955, p. 3), which provide office space, housing, maintenance areas, and other facilities for military and civilian personnel. The study area occupies about 67 mi^2 (square miles) or nearly 43,000 acres (about 40 percent of the Reservation) and is within the boundaries of latitude 31°00′ to 31°10′N., longitude 93°05′ to 93°15′W. This area occupies most of township 1 N., range 8 W., a smaller part of township 2 N., range 8 W., and a small area at the northern boundary of township 1 S., range 8 W. Small areas along the western edges of townships 1 and 2 N., range 7 W., also are included. In and near the two cantonment areas, water wells have been drilled for public supply and are the source for most of the geophysical logs described in this report.

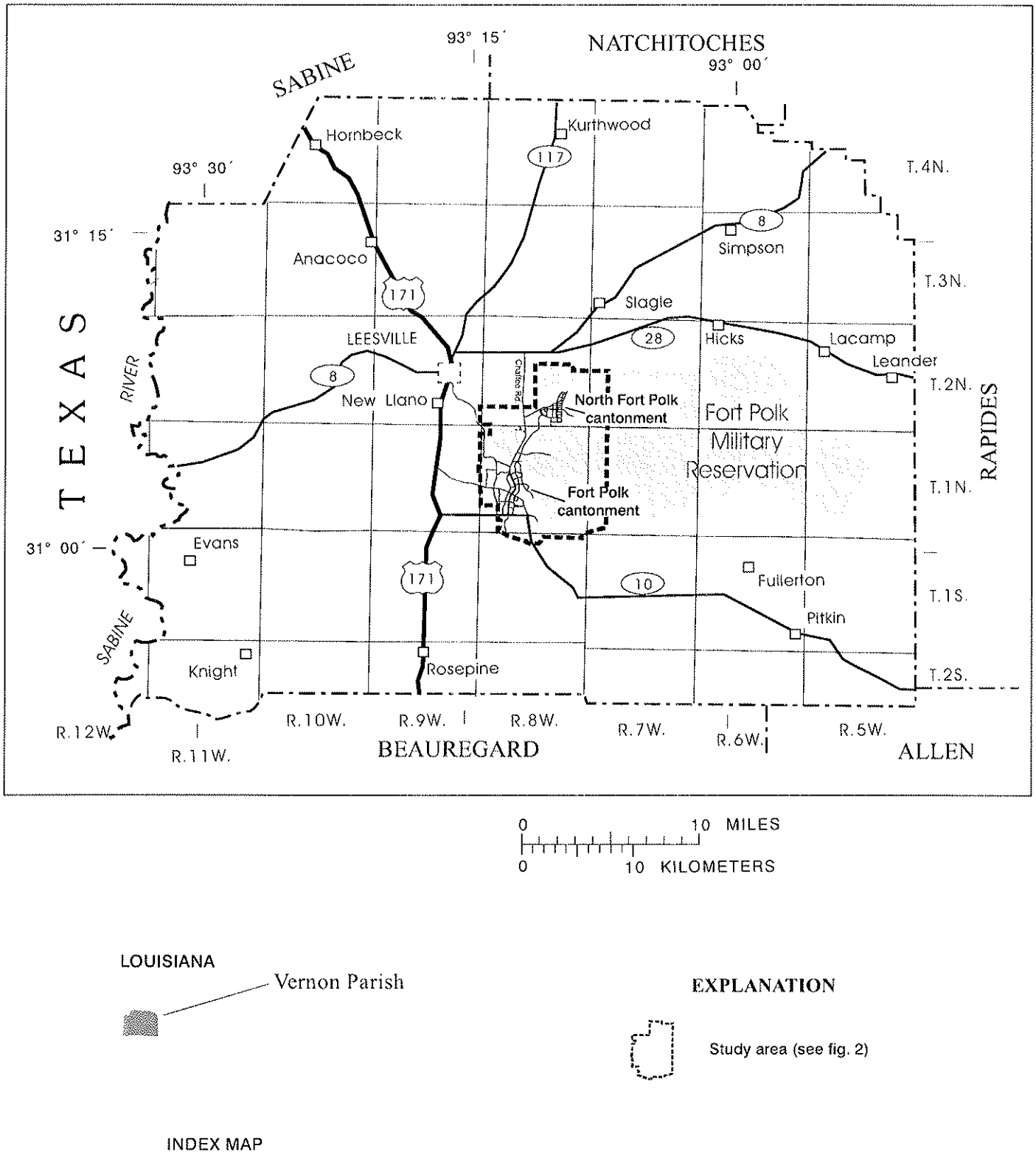

Figure 1. Fort Polk Military Reservation, Vernon Parish, Louisiana.

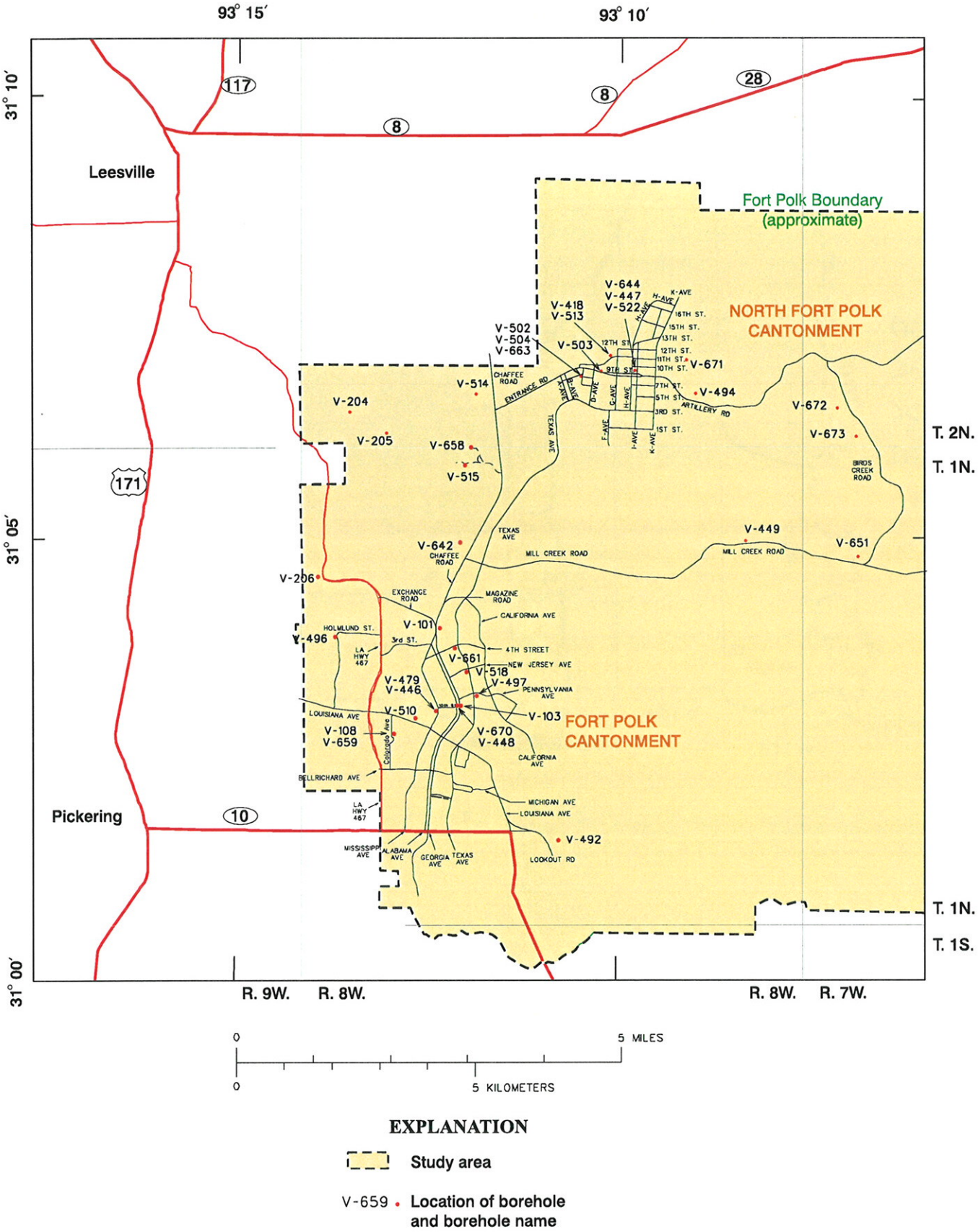

Figure 2. Location of study area and boreholes in the Fort Polk Military Reservation, Vernon Parish, Louisiana.

Hydrogeology

The hydrogeologic units present in the study area, from shallowest to deepest, are the alluvial aquifer, Chicot aquifer system, Upland terrace aquifer, Evangeline aquifer, Castor Creek confining unit, Jasper aquifer system, Lena confining unit, and Catahoula aquifer. The Jasper aquifer system consists of an upper unit (the Williamson Creek aquifer), a middle unit (the Dough Hills confining unit), and a lower unit (the Carnahan Bayou aquifer). These stratigraphic and corresponding hydrogeologic units within the study area are shown in figure 3, and the outcrop areas of these hydrogeologic units in Vernon Parish are shown in figure 4.

<table>
<tr><th>System</th><th>Series</th><th colspan="2">Stratigraphic unit</th><th colspan="2">Hydrogeologic unit</th></tr>
<tr><td>Quaternary</td><td>Pleistocene</td><td colspan="2">Northern Louisiana terrace deposits
Unnamed Pleistocene deposits</td><td colspan="2">Alluvial aquifer
Chicot aquifer system
Upland terrace aquifer or
surficial confining unit</td></tr>
<tr><td rowspan="8">Tertiary</td><td>Pliocene</td><td rowspan="7">Fleming Formation</td><td>Blounts Creek Member</td><td colspan="2">Evangeline aquifer or
surficial confining unit</td></tr>
<tr><td>?</td><td>Castor Creek Member</td><td colspan="2">Castor Creek confining unit</td></tr>
<tr><td rowspan="4">Miocene</td><td>Williamson Creek Member</td><td rowspan="3">Jasper aquifer system</td><td>Williamson Creek aquifer</td></tr>
<tr><td>Dough Hills Member</td><td>Dough Hills confining unit</td></tr>
<tr><td>Carnahan Bayou Member</td><td>Carnahan Bayou aquifer</td></tr>
<tr><td>?</td><td>Lena Member</td><td colspan="2">Lena confining unit</td></tr>
<tr><td>Oligocene</td><td colspan="2">Catahoula Formation</td><td colspan="2">Catahoula aquifer</td></tr>
</table>

Figure 3. Stratigraphic and hydrogeologic units in west-central Louisiana (modified from Lovelace and Lovelace, 1995).

All the hydrogeologic units, excluding alluvial aquifers, dip and thicken with increasing depth in a generally southern direction. The alluvial aquifers are present in stream floodplains and consist of gravel, sand, silt, and clay. However, the alluvial aquifers within the study area are not of sufficient area to be illustrated in figure 4.

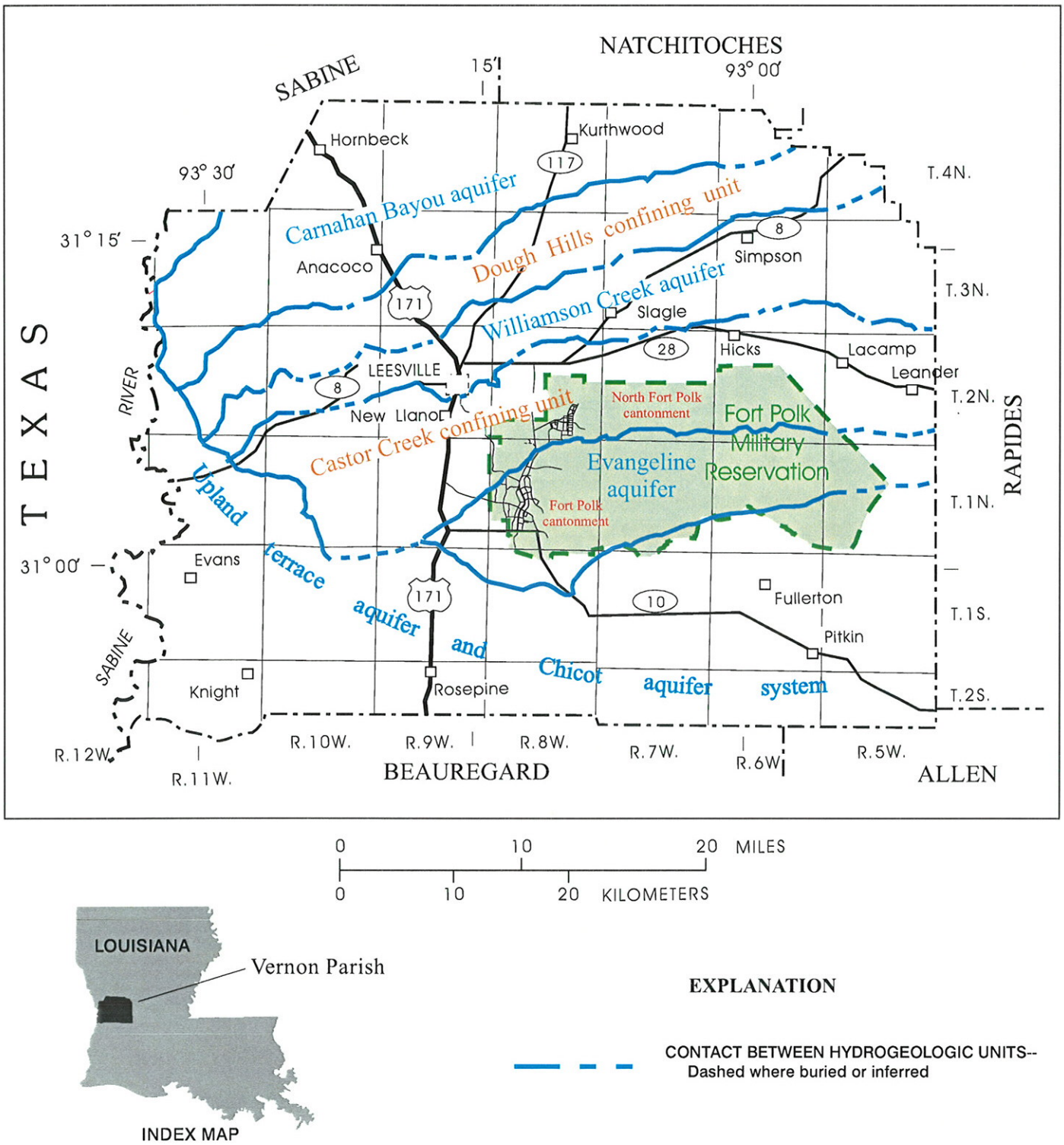

Figure 4. Outcrop areas of hydrogeologic units in strata of Miocene age and younger, Vernon Parish, Louisiana (adapted from McWreath and Smoot, 1989).

Methods of Study

Geophysical log data and previous studies of the stratigraphy (Rogers and Calandro, 1965) and hydrogeology (McWreath and Smoot, 1989) were used to identify hydrogeologic units in the study area. Thirty-six geophysical logs, selected by a data retrieval from the USGS Ground-Water Site Inventory (GWSI) data base, were analyzed to identify the thickness and depth below land surface of sand and clay layers. These geophysical logs were annotated to show the depth of occurrence of sand and clay beds within the lower depths of the Evangeline aquifer, Castor Creek confining unit, and the Jasper aquifer system.

Geophysical logs were digitized from paper copies maintained by the USGS office in Baton Rouge. In some instances, data gaps occurred in the digitized tracings because the original data trace went off scale or was illegible. Scale settings are made at the time of the measurement based on anticipated range and desired sensitivity. Varied-range recording devices are now often used, but older data recorders without this option sometimes went off scale. Illegible tracings occur when the recording pen, which pushes on the paper, does not make good contact, runs low on ink, or has excessive movement within a small interval. If a borehole site location had more than a single borehole, just one borehole was used for sand-layer percentage computations.

GRAPHICAL REPRESENTATIONS OF GEOPHYSICAL LOG DATA

Graphical representations of data for the 36 geophysical logs (figs. 5-40, at back of report) are presented in numerical order by USGS borehole name. This name consists of a letter (first letter of the parish name) and sequential number. The sequential number was assigned when the borehole was registered into the USGS GWSI data base. Each graphical representation shows digitized tracings from geophysical logs annotated with sand and clay intervals in a lithology column. Generally, sand and clay streaks or lenses less than 8 feet in thickness are not illustrated. Because the transition between sand and clay intervals is often gradational, such as from clay to silty-sand to fine sand, an exact point separating clay and sand layers is often undefinable. Therefore, annotations are interpretive. Each geophysical log also is annotated with identification of the hydrogeologic units which the boring penetrates. Delineations of hydrogeologic unit boundaries are illustrated by solid lines and are dashed and queried (-?-) where approximated. Each log is referenced to land surface, and the altitude of the borehole site is noted on the illustration.

Three types of logs are generally available for analysis from drilling activities at Fort Polk: (1) a spontaneous potential (SP) log with output in millivolts, (2) a short-normal resistivity (R16) log with an electrode spacing of 16 inches and output in ohm-meters, and (3) a long-normal resistivity (R64) log with an electrode spacing of 64 inches, also with output in ohm-meters. Occasionally gamma-ray (GR) logs, with output in counts per second or American Petroleum Institute (API) units[1], and induction-resistivity (IR) logs, which are another type of electric log with output in ohm-meters, were used. An in-depth explanation of geophysical logging is given in Keys and MacCary (1971) and Keys (1990).

[1]The API gamma-ray unit is defined as 1/200 of the difference in deflection of a gamma log between an interval of negligible radioactivity in the API pit and the interval that contains the same relative proportions of radioisotopes as an average shale, but about twice the total radioactivity (Keys, 1990, p. 80).

The SP logs are graphic plots of small differences in voltage that occur at the contacts between shale or clay beds and a sand aquifer (Keys, 1990, p. 49). The SP traces in this report normally deflect to the left (negative) when moving from a clay layer into a sand layer, and to the right (positive) when moving from a sand layer into a clay layer.

Resistivity logs such as short-normal (R16), long-normal (R64), and induction resistivity (IR) logs are plots of the apparent electrical resistivity of a volume of earth material under the direct or induced application of an electric current (Keys and MacCary, 1971, p. 37). R16, R64, and IR traces in this report normally deflect to the right (higher resistance) when moving from a clay layer into a sand layer, and to the left (lower resistance) when moving from a sand layer into a clay layer. This occurs because, in freshwater formations, sand layers are relatively ion-poor compared to clay layers, and so do not conduct electric currents as well. Because SP, R16, and R64 geophysical logging electrodes need to be immersed in borehole fluid, the top of the log often begins far below land surface.

The GR logs record the amount of natural-gamma radiation present in the formation. In this report, the GR traces normally deflect to the left (lower radiation levels) when moving from a clay layer into a sand layer, and to the right (higher radiation levels) when moving from a sand layer into a clay layer. This occurs because, in general, the natural gamma activity of clay-bearing sediments is much higher than that of quartz sands and carbonates (Keys and MacCary, 1971, p. 65).

Using borehole V-518 (11A) (fig. 28) as a representative geophysical log of the Fort Polk cantonment area, the boring initially penetrated the Evangeline aquifer (about 165 feet thick), then the Castor Creek confining unit (about 310 feet thick), the Williamson Creek aquifer (about 515 feet thick), and continued through the Dough Hills confining unit (about 420 feet thick) into the Carnahan Bayou aquifer.

Using borehole V-447 (2APD) (fig. 13) as a representative geophysical log of the North Fort Polk cantonment area, the boring initially penetrated the Castor Creek confining unit (about 205 feet thick), then the Williamson Creek aquifer (about 405 feet thick), continued through the Dough Hills confining unit (about 380 feet thick), then ended in the Carnahan Bayou aquifer.

ANALYSIS OF GEOPHYSICAL LOG DATA

The hydrogeologic units, from shallowest to deepest, identified on the geophysical logs from boreholes in the study area include the Evangeline aquifer, Castor Creek confining unit, Williamson Creek aquifer, Dough Hills confining unit, Carnahan Bayou aquifer, and the Lena confining unit. Because the geophysical logs included in this report typically start below land surface, the alluvial aquifer, Chicot aquifer system, and upland terrace aquifer are not present on any of the logs. The Lena confining unit is only partially penetrated by 2 boreholes in the study area, and the deeper Catahoula aquifer (fig. 3) is not penetrated by any of the boreholes; therefore, the Lena confining unit is only briefly mentioned, and the Catahoula aquifer is not discussed. Analysis of the geophysical log data includes identification of the thickness and extent of hydrogeologic units in the area and includes percentages of sand layers within the Williamson Creek and Carnahan Bayou aquifers.

Sand-layer percentages were computed by the authors by summing sand-interval ($\geq$10 feet) and sand-streak (<10 feet) thicknesses as determined from original geophysical logs. This value was divided by the aquifer thickness and multiplied by 100. Aquifer thickness at each borehole location was determined by the authors using their best judgment.

Borehole locations are shown in figure 2, and descriptions for the geophysical logs are listed in table 1. Results of the geophysical-log analyses are included in the following discussions, by hydrogeologic unit.

Table 1. Description of geophysical logs of boreholes in the Fort Polk Military Reservation, Vernon Parish, Louisiana

[Geophysical log types are as follows: SP, spontaneous-potential, measured in millivolts; R16, short-normal resistivity with electrode spacing of 16 inches, measured in ohm-meters; R64, long-normal resistivity with electrode spacing of 64 inches, measured in ohm-meters; IR, induction-resistivity, measured in ohm-meters; and GR, gamma-ray, measured as counts per second or American Petroleum Institute units. USGS, U.S. Geological Survey; S, section; T, township; R, range]

USGS borehole name	Fort Polk borehole name or number	Land-net location	Geophysical log type	Geophysical log depth (feet below land surface)	Land-surface altitude (feet above sea level[1])
V-101	1	S 17 T 1N R 8W	SP, R16, R64	900	367
V-103	3	S 21 T 1N R 8W	SP, R16, R64	906	337
V-108	8	S 20 T 1N R 8W	SP, R16, R64	667	305
V-204	CAPEHART 1	S 31 T 2N R 8W	SP, R16, R64	1,219	303
V-205	CAPEHART 2	S 32 T 2N R 8W	SP, R16, R64	1,213	270
V-206	CAPEHART 3	S 07 T 1N R 8W	SP, R16, R64	620	245
V-418	7APD	S 27 T 2N R 8W	SP, R16, R64	1,303	339
V-446	6B	S 20 T 1N R 8W	SP, R16, IR	674	325
V-447	2APD	S 35 T 2N R 8W	SP, R16, IR	1,232	325
V-448	5A	S 21 T 1N R 8W	SP, R16, IR	925	340
V-449	RANGE 17	S 12 T 1N R 8W	SP, R16, R64	748	340
V-479	6C	S 20 T 1N R 8W	SP, R16, R64	920	325
V-492	S PREWASH1	S 34 T 1N R 8W	SP, R16, IR	1,635	286
V-494	N PREWASH1	S 36 T 2N R 8W	SP, R16, R64	684	340
V-496	14D	S 18 T 1N R 8W	SP, R16, R64	2,121	284
V-497	9A	S 21 T 1N R 8W	SP, R16, R64	1,552	325
V-502	6APD TEST	S 34 T 2N R 8W	SP, R16, R64	1,319	340
V-503	4APS	S 34 T 2N R 8W	SP, R16, R64	1,068	340
V-504	6APD	S 34 T 2N R 8W	SP, R16, R64	1,299	335
V-510	7A	S 20 T 1N R 8W	SP, R16, R64	946	305
V-513	7BPD	S 27 T 2N R 8W	SP, R16, R64	1,280	335

Table 1: Description of geophysical logs of boreholes in the Fort Polk Military Reservation, Vernon Parish, Louisiana—Continued

USGS borehole name	Fort Polk borehole name or number	Land-net location	Geophysical log type	Geophysical log depth (feet below land surface)	Land-surface altitude (feet above sea level[1])
V-514	16D	S 33 T 2N R 8W	SP, R16, R64	1,303	290
V-515	15D	S 04 T 1N R 8W	SP, R16, R64	1,835	320
V-518	11A	S 16 T 1N R 8W	SP, R16, R64	1,506	335
V-522	2APS	S 35 T 2N R 8W	SP, R16, R64	623	325
V-642	CHAF-T2	S 09 T 1N R 8W	SP, R16, IR	341	348
V-644	2BPS	S 35 T 2N R 8W	SP, R16, IR	702	325
V-651	CAA1	S 08 T 1N R 7W	SP	1,050	350
V-658	16AD	S 04 T 1N R 8W	SP, R16, R64	1,001	309
V-659	8C	S 20 T 1N R 8W	SP, R16, IR	928	310
V-661	12A	S 17 T 1N R 8W	SP, R16, IR	959	332
V-663	6BPS	S 34 T 2N R 8W	GR, R16, R64	616	330
V-670	5B	S 20 T 1N R 8W	SP, R16, IR	921	340
V-671	MOUT 1	S 26 T 2N R 8W	GR, R16, R64	772	360
V-672	MOUT 2	S 31 T 2N R 7W	SP, R16, R64	972	400
V-673	MOUT 3	S 32 T 2N R 7W	GR, R16, R64	785	380

[1] In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Evangeline Aquifer

The Evangeline aquifer crops out in the southern part of the study area and immediately underlies the Fort Polk cantonment. This aquifer primarily consists of a deltaic sequence of fine to medium sand interbedded with silt, soft to moderately hard greenish-gray laminated clay, and local beds of coarse sand (Whitfield, 1975, p. 12). An examination of 16 geophysical logs of boreholes (V-101, 103, 108, 446, 448, 449, 479, 492, 496, 497, 510, 518, 651, 659, 661, and 670) that penetrated the Evangeline aquifer indicated a discontinuous sand layer at its base. This basal sand has a median thickness of about 30 feet but ranges in thickness from 0 at boreholes V-448, V-492, V-661, and V-670 to 53 feet at borehole V-497. The upper part of the aquifer was not shown on most of the geophysical logs, so sand-layer percentages could not be determined.

Castor Creek Confining Unit

The Castor Creek confining unit crops out in the northern part of the study area and immediately underlies the North Fort Polk cantonment. The Castor Creek confining unit consists of interfingered lentils of calcareous and non-calcareous clay (light gray and red), silt, and very fine sand (Welch, 1942, p. 48, 57); interspersed sand streaks and scattered sand lenses are thin and limited in areal extent. Analysis of the 36 geophysical logs indicated the minimum thickness of the unit is 160 feet at boreholes V-418 and V-514, which are located in the outcrop area in the northern part of the study area, and the maximum thickness is 336 feet at borehole V-659, which is located in the southern part of the study area.

Williamson Creek Aquifer

Within the Williamson Creek aquifer, which is the upper unit of the Jasper aquifer system, sand beds of varying thicknesses and areal extents are present. The sand beds often grade laterally or vertically into silt and clay deposits that separate the sand beds (Rogers and Calandro, 1965, p. 8). Welch (1942, p. 56) described the aquifer as consisting of predominantly poorly sorted gray silt that is locally indurated into lenticular-shaped masses of friable siltstone. Mixed in with the silt are particles ranging from clay to coarse sand; at some localities, sufficient sand occurs in the rock to classify it as sandstone (Welch, 1942, p. 56). This aquifer crops out several miles north of the study area (fig. 4) and underlies the southern two-thirds of Vernon Parish. This aquifer is a major source of freshwater for the Reservation. In this report, the aquifer is defined as the entire interval from the base of the Castor Creek confining unit to the top of the Dough Hills confining unit and does not neccessarily start or end with a distinct sand layer. The geophysical logs generally indicate the bottom of the Castor Creek confining unit and the top of the Dough Hills confining unit because the traces deflect at these points. At these points a silt or silty sand of the Williamson Creek aquifer may be present, but only sands are shown in the graphical representations, which may make it appear that the aquifer starts or ends in a clay. Some hydrogeologic unit boundaries are estimated, based upon data from other boreholes in the area. Analysis of geophysical logs (V-101, 204, 205, 447, 492, 494, 496, 497, 503, 504, 510, 513, 514, 515, 518, 651, 658, 659, 661, 671, 672, and 673) from boreholes that completely penetrated the Williamson Creek aquifer in the study area indicated that sand layers constitute a median of 33 percent of the aquifer. Sand layers constitute as much as 61 percent of the aquifer at borehole V-205 and as little as 19 percent at borehole V-204. The median

aquifer thickness indicated from these 22 logs is 448 feet; the minimum thickness is 355 feet at borehole V-205 near the northwest corner of the study area, and the maximum thickness is 550 feet at borehole V-492 near the southeast edge of the study area.

Dough Hills Confining Unit

The Dough Hills confining unit is the middle unit of the Jasper aquifer system and underlies the Williamson Creek aquifer (see fig. 4 for outcrop area). This confining unit consists of a lower bentonitic clayey siltstone facies of possible fluviatile origin and an upper facies of calcareous clay and silt lentils (gray and white) interbedded with non-calcareous silt and siltstone (Welch, 1942, p. 48, 54). The Dough Hills confining unit contains scattered sand streaks and lenses of very fine sand. Similar to the Castor Creek confining unit, these sands are thin and limited in areal extent. These thin sands have provided hard water to some domestic wells within Vernon Parish (Rogers and Calandro, 1965, p. 25). Within the study area, only one well is completed in the Dough Hills confining unit. Well V-671 (MOUT1) is completed at a depth of 740 to 780 feet below land surface in a sandy layer in the upper part of the confining unit and has a reported hardness of 56.3 milligrams per liter as calcium carbonate, which is considered soft. Domestic wells completed in this confining unit are located north of the study area and are much shallower than V-671. Generally, domestic wells are completed in the Dough Hills confining unit only in areas where wells that yield water of better quality require deeper drilling (Rogers and Calandro, 1965). Analysis of 13 geophysical logs (V-204, 205, 418, 447, 496, 497, 502, 503, 504, 513, 514, 515, and 518) from boreholes that completely penetrated the Dough Hills confining unit in the study area indicated a median thickness of 392 feet. The minimum thickness is about 351 feet at borehole V-514 in the north-central part of the study area. The maximum thickness is at least 525 feet at borehole V-492 near the southern boundary of the study area. The log ends within the Dough Hills confining unit but is presumably near the bottom of that unit.

Carnahan Bayou Aquifer

The lower unit of the Jasper aquifer system is the Carnahan Bayou aquifer, which Welch (1942, p. 48, 51) described as being composed of gray clays, gray and white silts, and sands, which are sporadically consolidated into shale, siltstone, and sandstone. This aquifer crops out in the northern and northwestern parts of Vernon Parish (fig. 4) and underlies the entire parish. This aquifer provides freshwater in the study area, although Smoot (1988) reports saltwater in the southeastern corner of the parish. Two boreholes in the study area appear to penetrate the Carnahan Bayou aquifer completely and end in the top of the Lena confining unit. The geophysical log from borehole V-515, located towards the north-central end of the study area, indicated an estimated aquifer thickness of 730 feet with sand layers constituting about 32 percent of the aquifer, and the log from borehole V-496, located in the west-central part of the study area, indicated an estimated aquifer thickness of 814 feet with sand layers composing about 21 percent of the aquifer. Sand layers make up an average of 27 percent of the aquifer, based on these two logs. The Lena confining unit underlies the Carnahan Bayou aquifer and is composed of a silty clay (Rogers and Calandro, 1965, p. 21).

SUMMARY

Geophysical log data from 36 boreholes in the Fort Polk Military Reservation, Vernon Parish, Louisiana, have been analyzed and are presented in a graphical format. The logs have been annotated to show sand and clay layers as well as hydrogeologic units (aquifers and confining units). The hydrogeologic units identified on the geophysical logs from the boreholes in the study area include the Evangeline aquifer; the Castor Creek confining unit; the Jasper aquifer system, which consists of the Williamson Creek aquifer, Dough Hills confining unit, and Carnahan Bayou aquifer; and the Lena confining unit.

The Evangeline aquifer crops out in the southern part of the study area and immediately underlies the Fort Polk cantonment. An examination of 16 geophysical logs of boreholes that penetrated the Evangeline aquifer indicated a discontinuous sand layer at its base. This basal sand has a median thickness of about 30 feet but ranges in thickness from 0 to 53 feet. The upper part of the aquifer was not shown on most of the geophysical logs, so sand-layer percentages could not be determined.

The Castor Creek confining unit crops out in the northern part of the study area and immediately underlies the North Fort Polk cantonment. Analysis of the geophysical logs indicated the minimum thickness of the unit is 160 feet in the outcrop area in the northern part of the study area, and the maximum thickness is 336 feet in the southern part of the study area.

The Williamson Creek aquifer crops out several miles north of the study area and underlies the southern two-thirds of Vernon Parish. This aquifer is a major source of freshwater for the Reservation. Analysis of 22 geophysical logs from boreholes that completely penetrated the Williamson Creek aquifer in the study area indicated that sand layers constitute a median of 33 percent of the aquifer. Sand layers constitute as much as 61 percent of the aquifer at borehole V-205 and as little as 19 percent at borehole V-204. The median aquifer thickness indicated from 22 logs is 448 feet. The minimum thickness is 355 feet near the northwest corner of the study area, and the maximum thickness is 550 feet near the southeast edge of the study area.

Analysis of 13 geophysical logs from boreholes that completely penetrate the Dough Hills confining unit in the study area indicated a median thickness of 392 feet. The maximum thickness is at least 525 feet (the log ends while still in the Dough Hills confining unit but is presumably near the bottom) near the southern boundary of the study area, and the minimum thickness is 351 feet at the middle-northern part of the study area.

Two boreholes in the study area appeared to have penetrated the Carnahan Bayou aquifer completely and ended in the top of the Lena confining unit. The geophysical log from a borehole located towards the middle-northern end of the study area indicated an estimated aquifer thickness of 730 feet with about 32 percent composed of sand layers, and the log from another borehole located in the middle-southwest part of the study area indicated an estimated aquifer thickness of 814 feet with sand layers comprising about 21 percent. Sand layers, based on these two logs, constitute 27 percent of the aquifer. The Lena confining unit underlies the Carnahan Bayou aquifer and is composed of a silty clay. No boreholes discussed in this report completely penetrated the Lena confining unit.

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Whitfield, M.S., Jr., 1975, Geohydrology of the Evangeline and Jasper aquifers of southwestern Louisiana: Department of Conservation, Louisiana Geological Survey, and Louisiana Department of Public Works Water Resources Bulletin no. 20, 72 p.

USGS borehole name: V-101
Fort Polk borehole number: 1
Land-net location: S17, T1N, R8W
Reference: Land surface Altitude: 367 feet above sea level

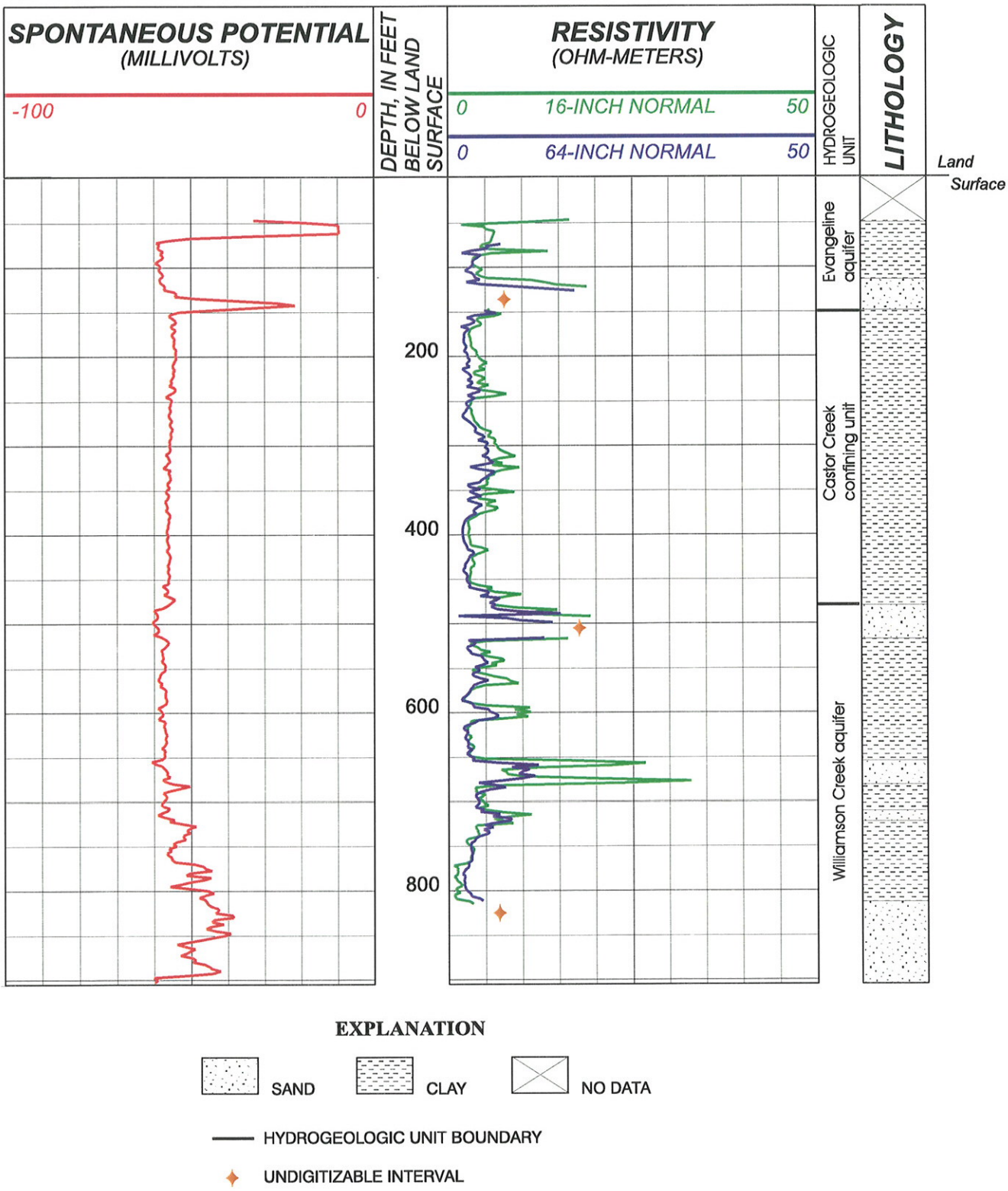

Figure 5. Geophysical log of borehole V-101, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-103
Fort Polk borehole number: 3
Land-net location: S21, T1N, R8W
Reference: Land surface Altitude: 337 feet above sea level

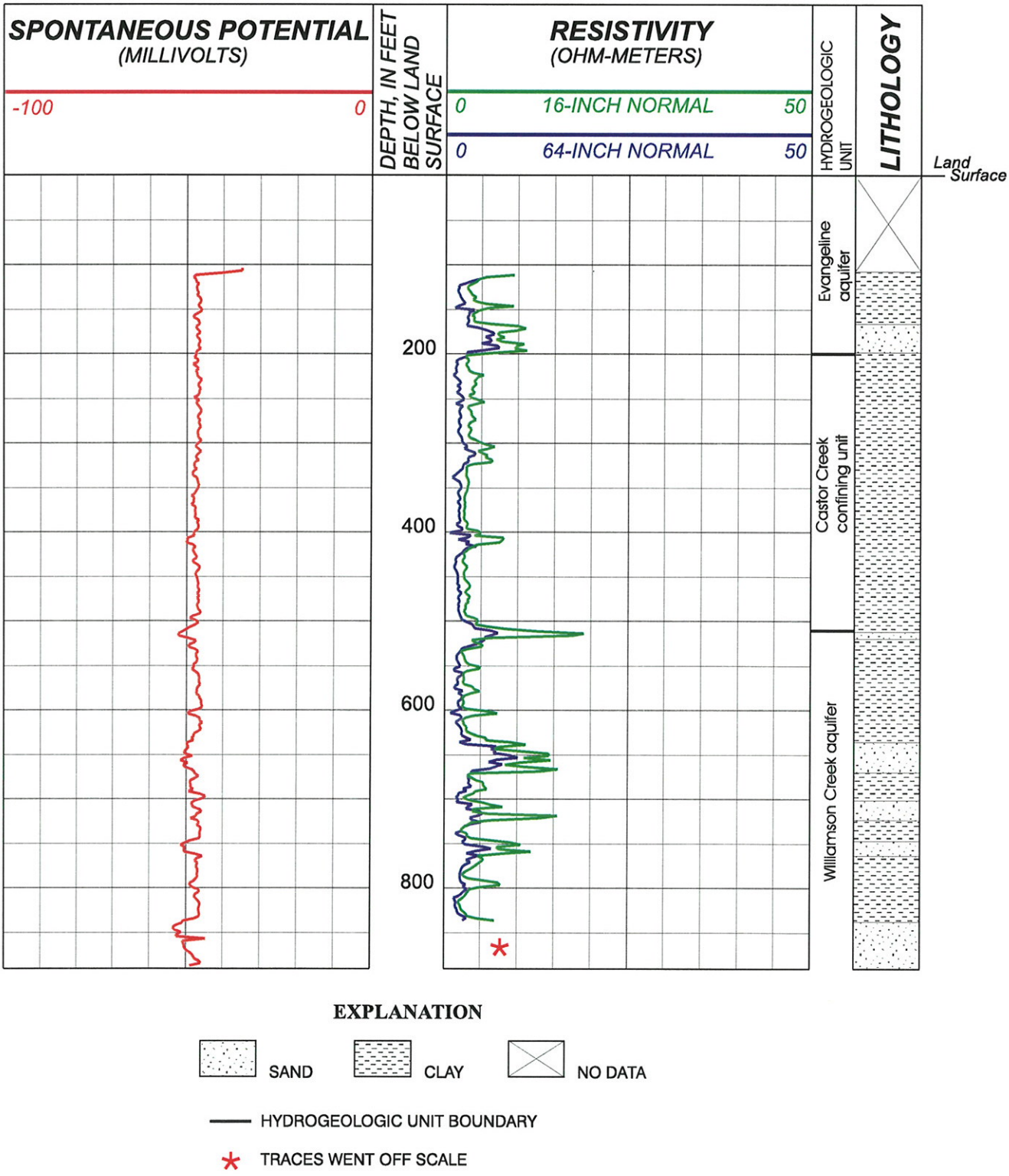

Figure 6. Geophysical log of borehole V-103, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-108
Fort Polk borehole number: 8
Land-net location: S20, T1N, R8W
Reference: Land surface Altitude: 305 feet above sea level

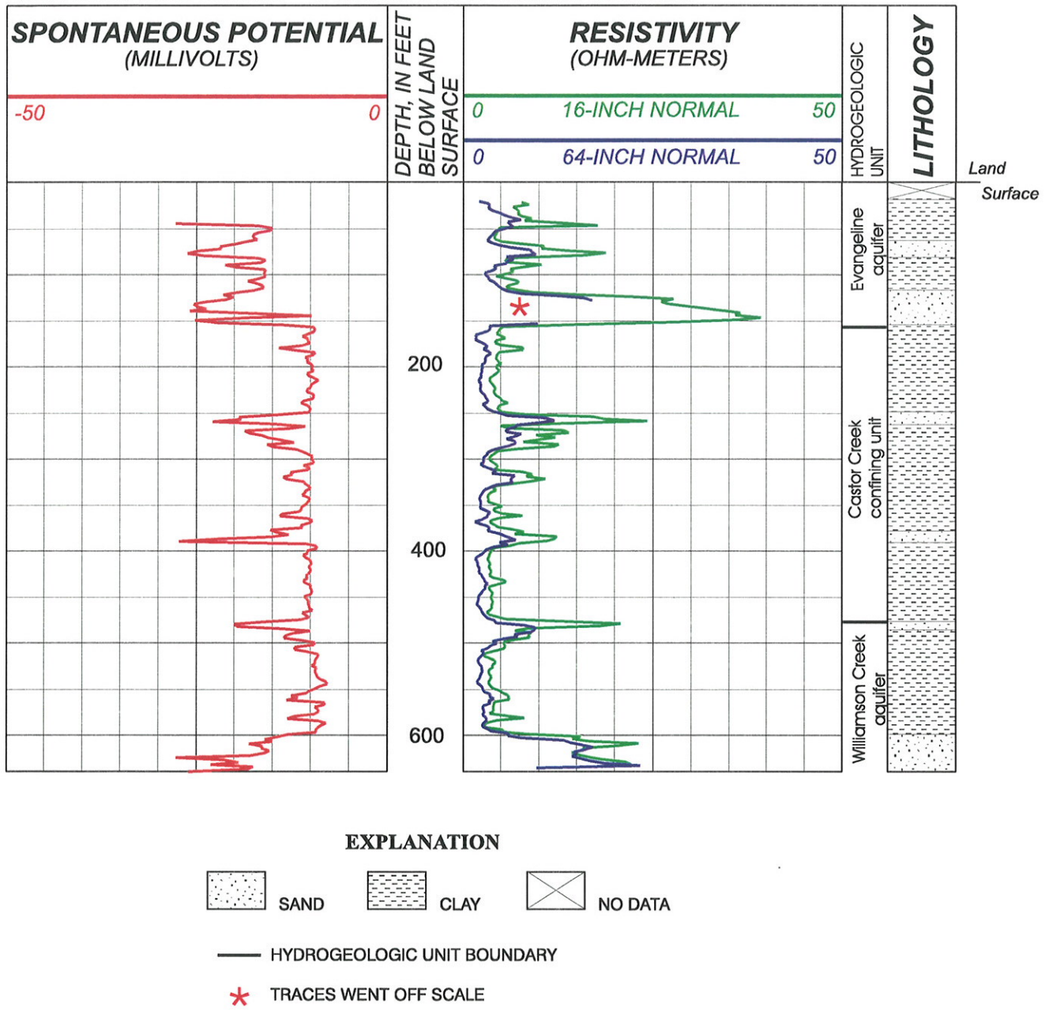

Figure 7. Geophysical log of borehole V-108, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-204
Fort Polk borehole name: CAPEHART 1
Land-net location: S31, T2N, R8W
Reference: Land surface Altitude: 303 feet above sea level

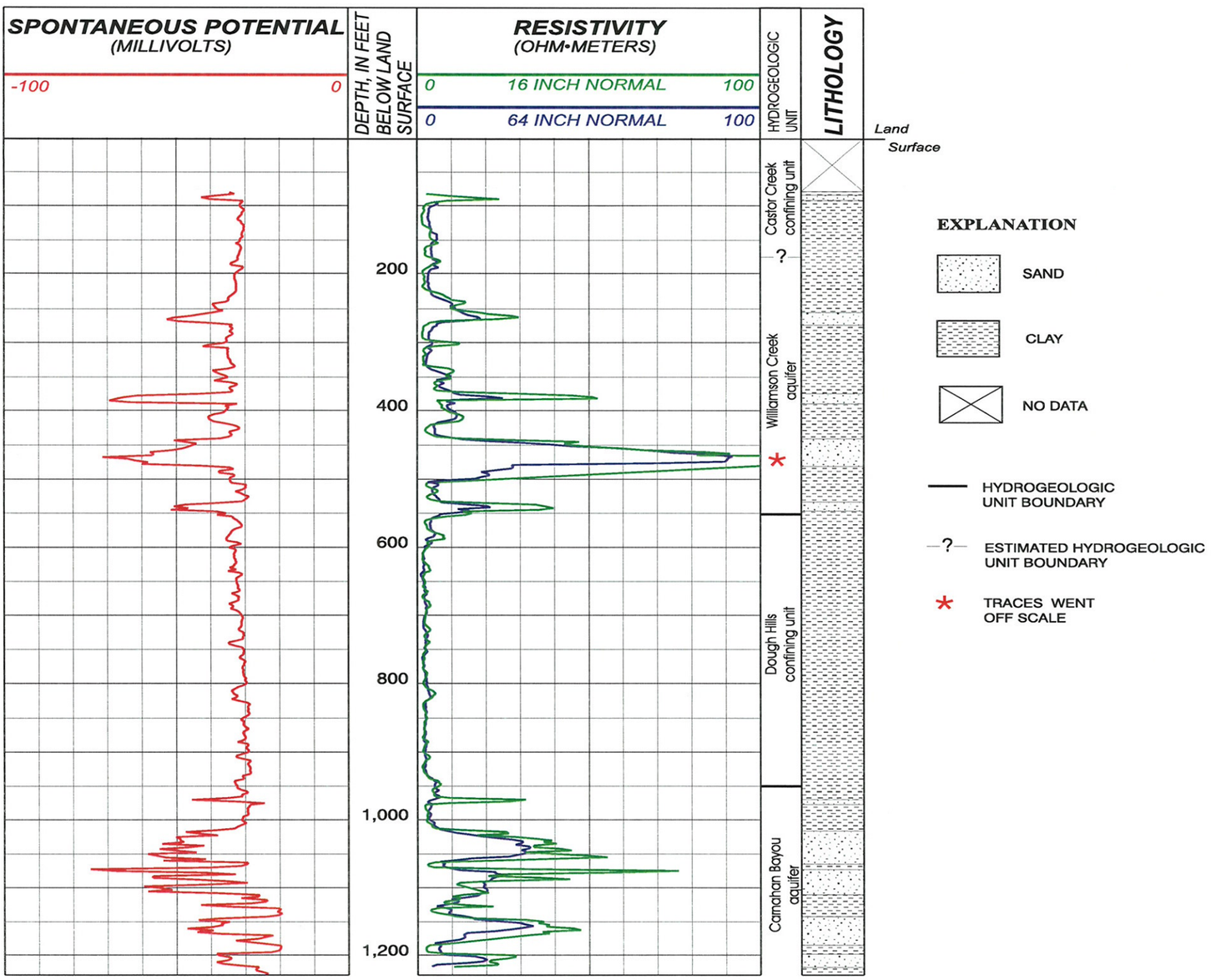

Figure 8. Geophysical log of borehole V-204, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-205
Fort Polk borehole number: CAPEHART 2
Land-net location: S32, T2N, R8W
Reference: Land surface Altitude: 270 feet above sea level

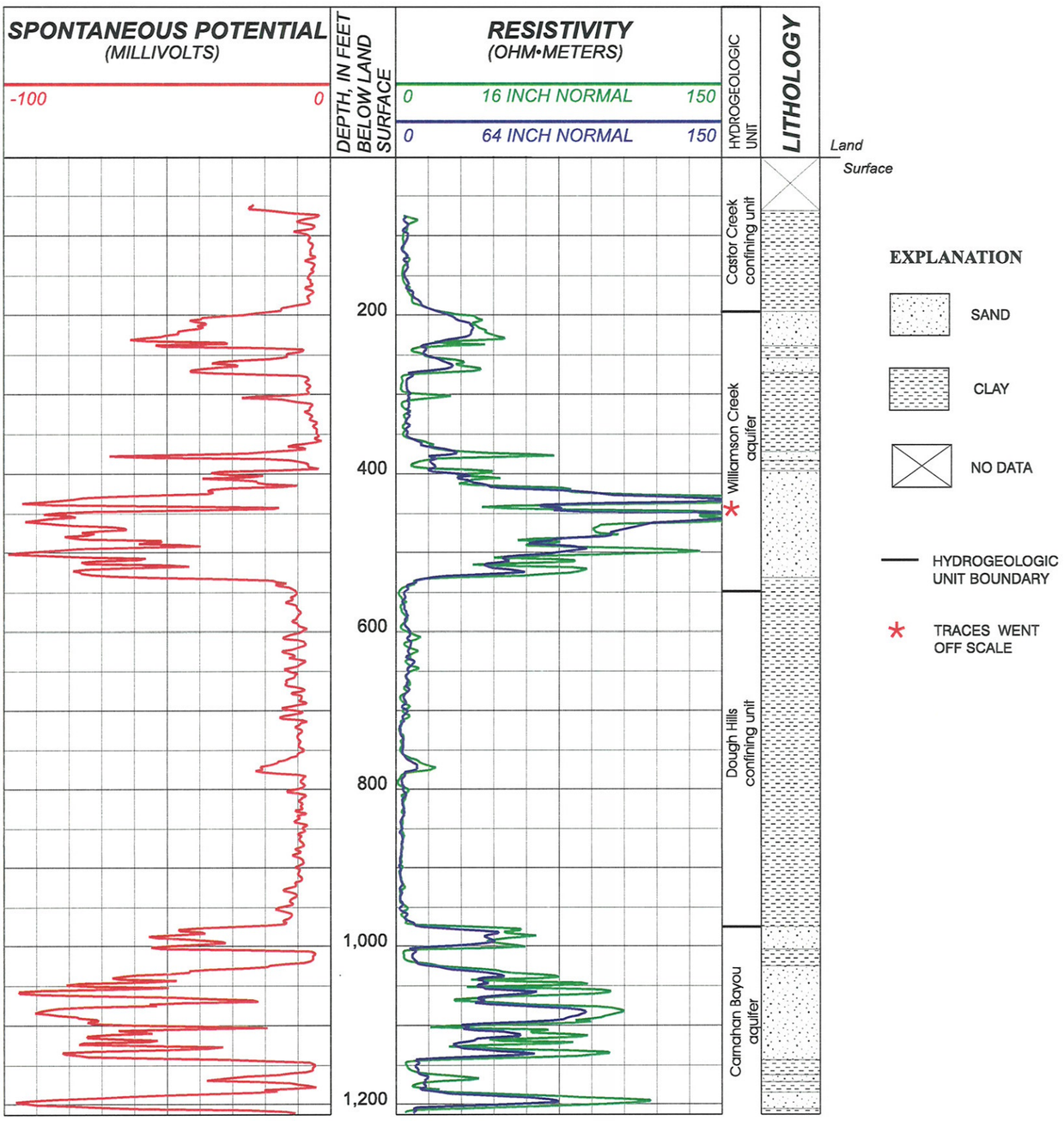

Figure 9. Geophysical log of borehole V-205, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-206
Fort Polk borehole name: CAPEHART 3
Land-net location: S07, T1N, R8W
Reference: Land surface Altitude: 245 feet above sea level

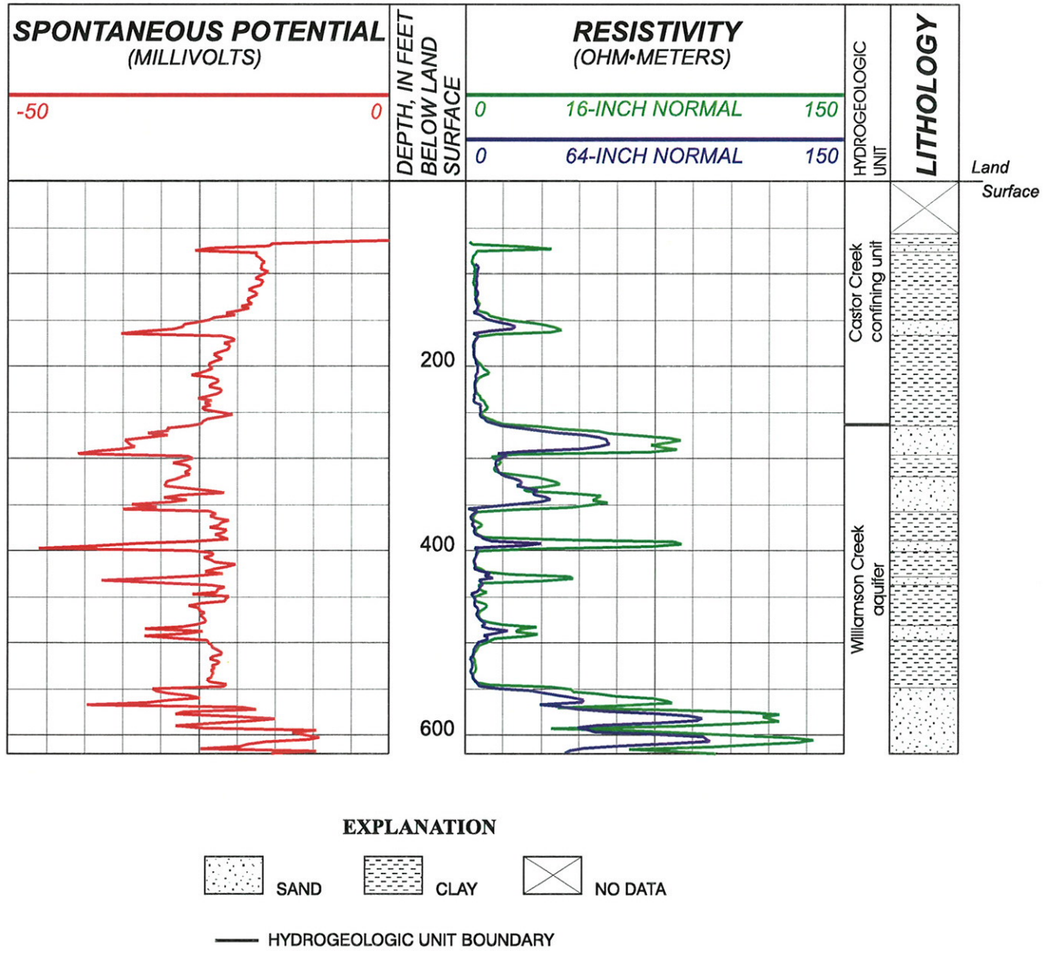

Figure 10. Geophysical log of borehole V-206, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-418
Fort Polk borehole name: 7APD
Land-net location: S27, T2N, R8W
Reference: Land surface Altitude: 339 feet above sea level

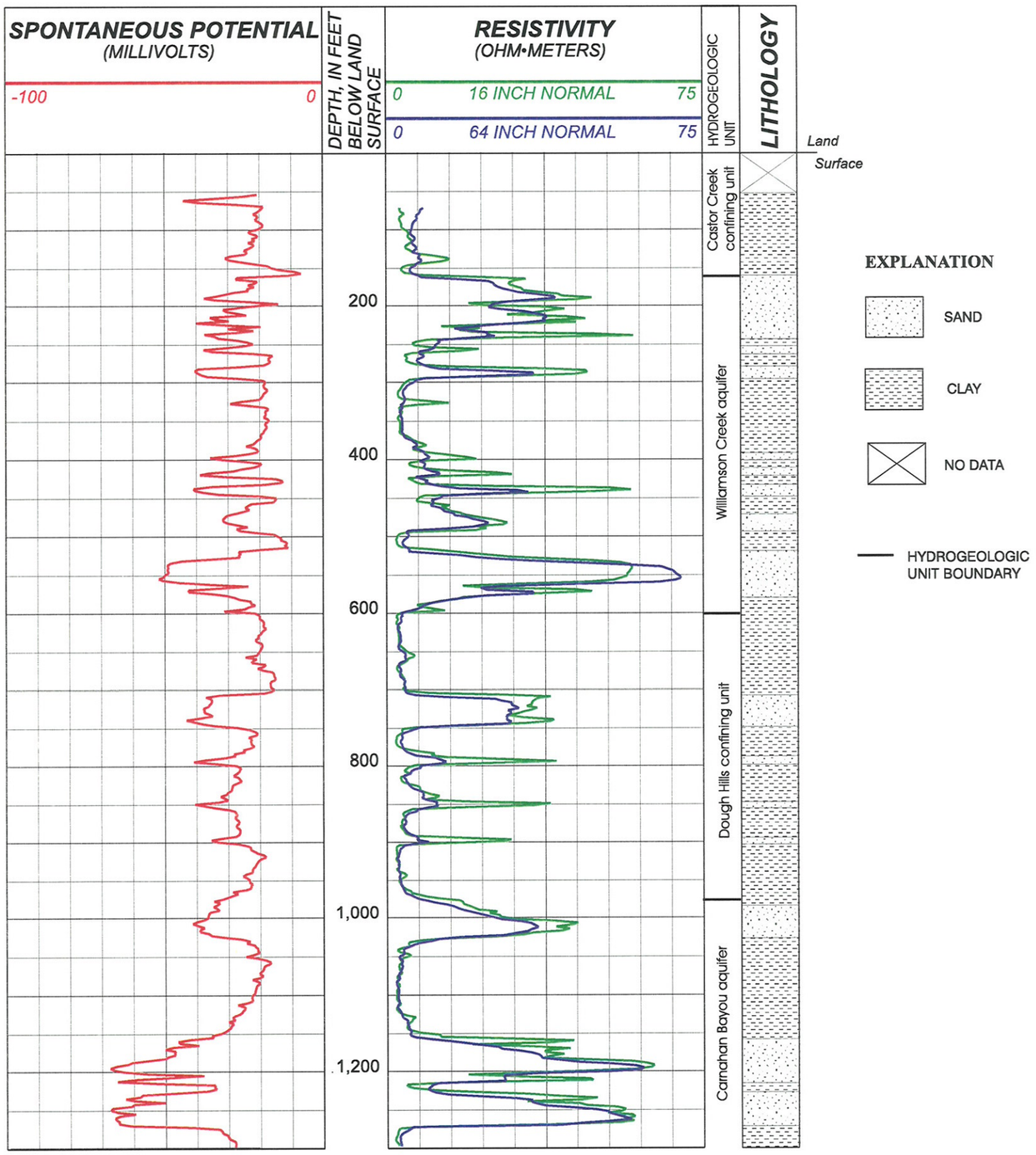

Figure 11. Geophysical log of borehole V-418, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-446
Fort Polk borehole name: 6B
Land-net location: S20, T1N, R8W
Reference: Land surface Altitude: 325 feet above sea level

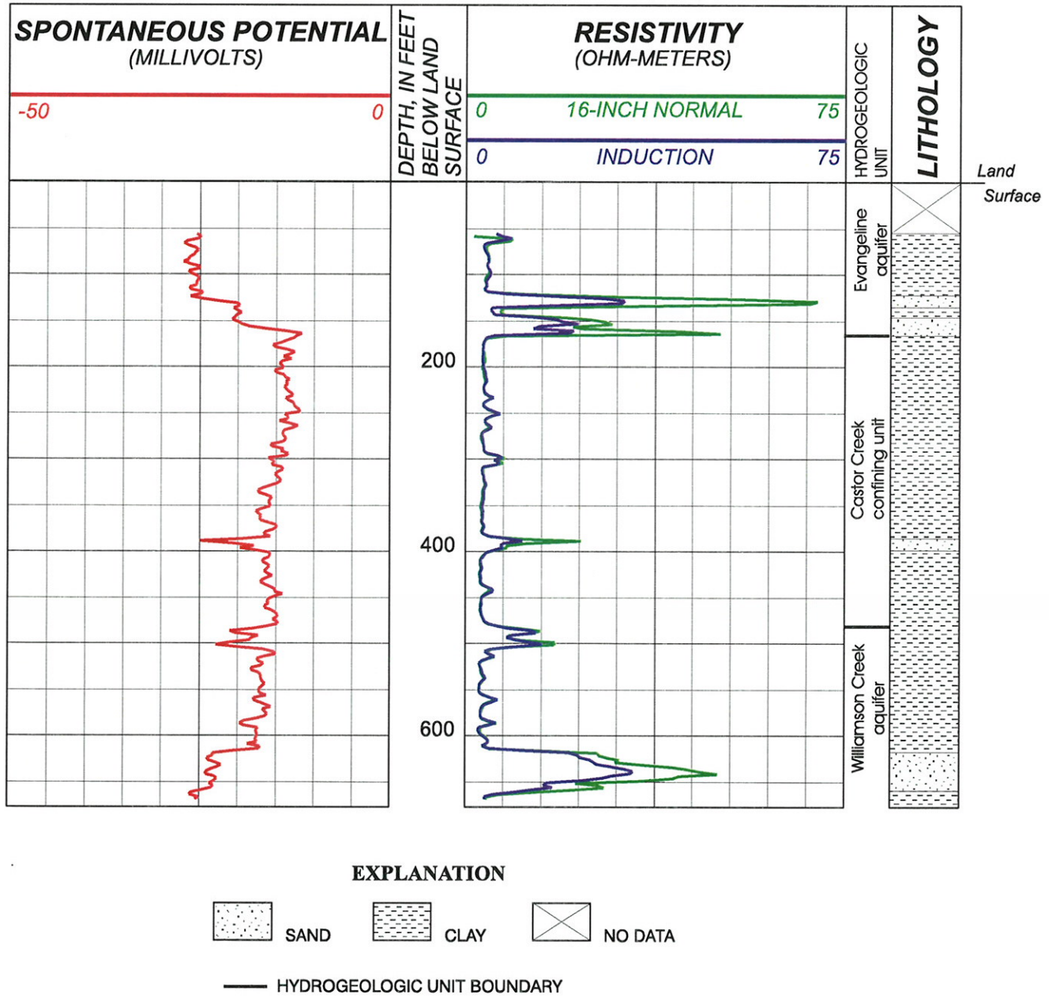

Figure 12. Geophysical log of borehole V-446, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-447
Fort Polk borehole name: 2APD
Land-net location: S35, T2N, R8W
Reference: Land surface Altitude: 325 feet above sea level

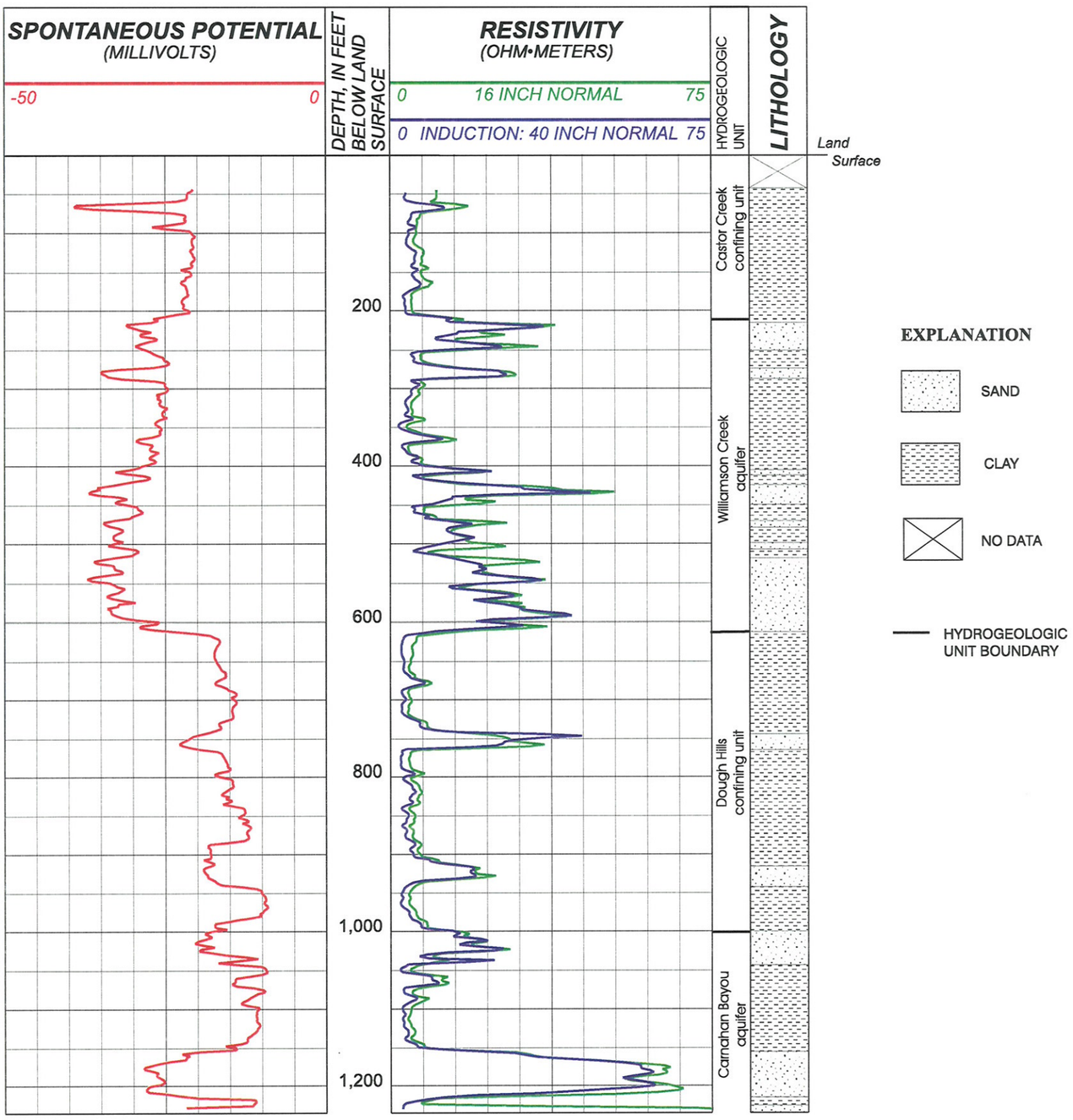

Figure 13. Geophysical log of borehole V-447, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-448
Fort Polk borehole name: 5A
Land-net location: S21, T1N, R8W
Reference: Land surface Altitude: 340 feet above sea level

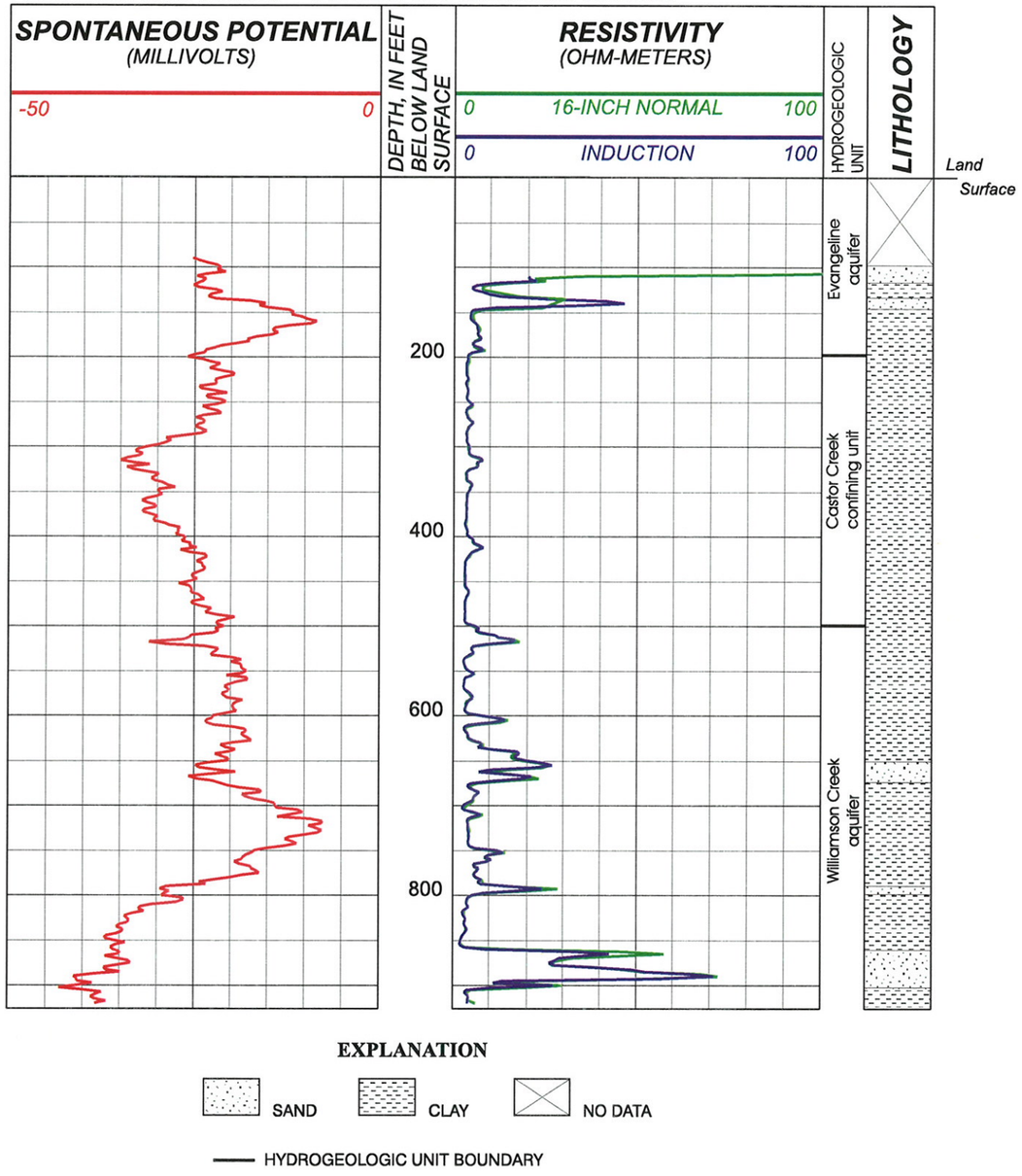

Figure 14. Geophysical log of borehole V-448, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-449
Fort Polk borehole name: RANGE 17
Land-net location: S12, T1N, R8W
Reference: Land surface Altitude: 340 feet above sea level

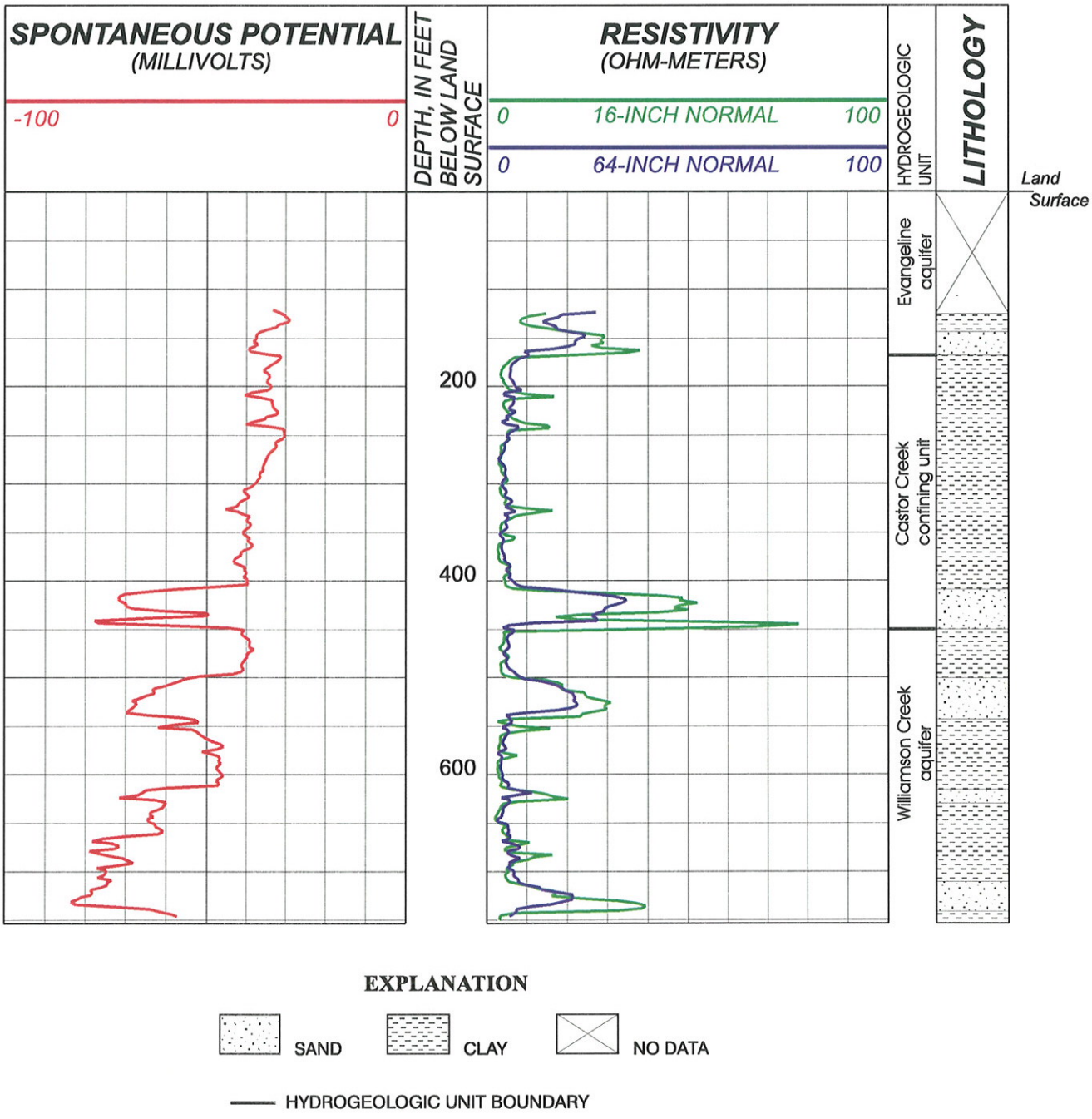

Figure 15. Geophysical log of borehole V-449, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-479
Fort Polk borehole name: 6C
Land-net location: S20, T1N, R8W
Reference: Land surface Altitude: 325 feet above sea level

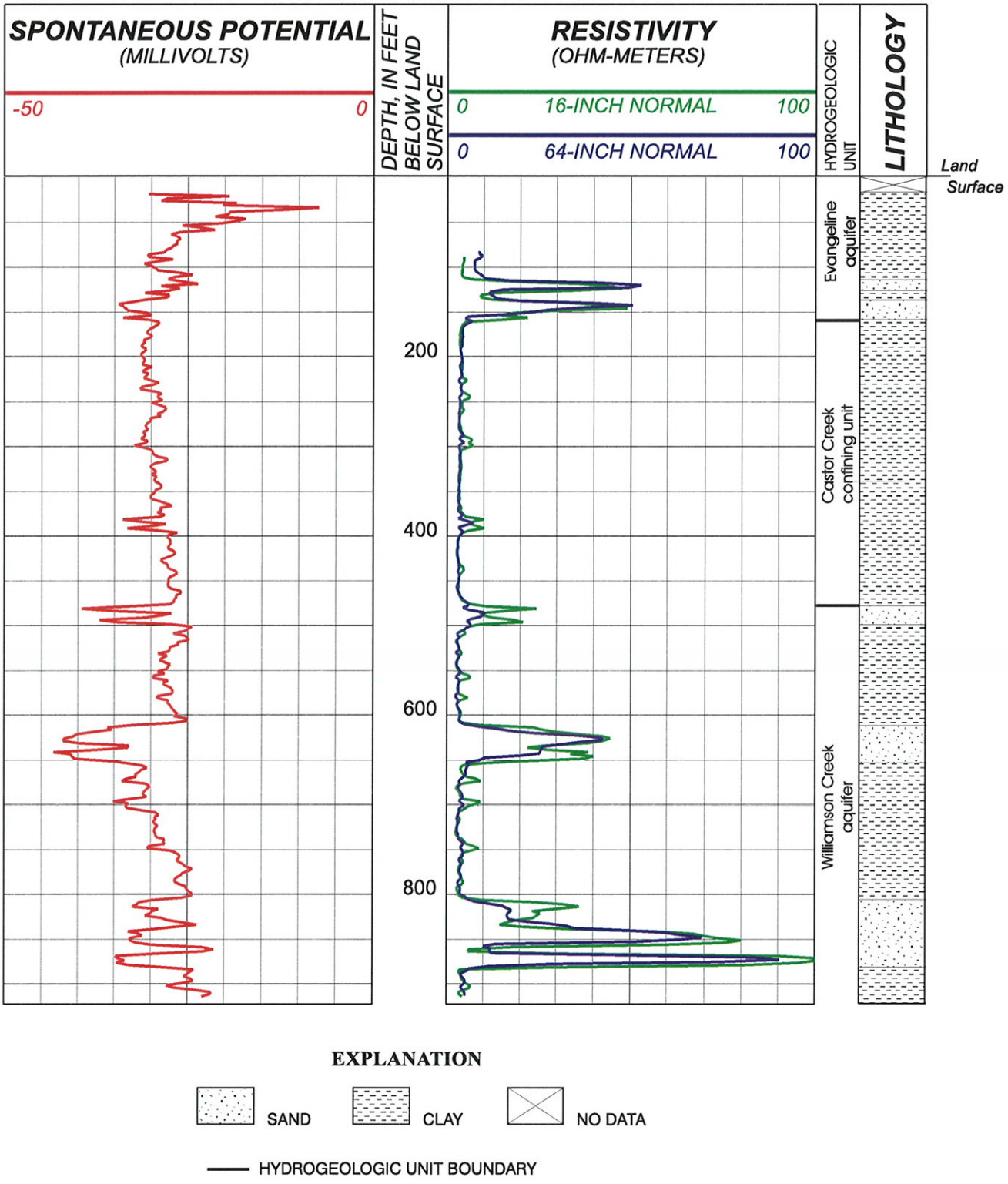

Figure 16. Geophysical log of borehole V-479, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-492
Fort Polk borehole name: S PREWASH1
Land-net location: S34, T1N, R8W
Reference: Land surface Altitude: 286 feet above sea level

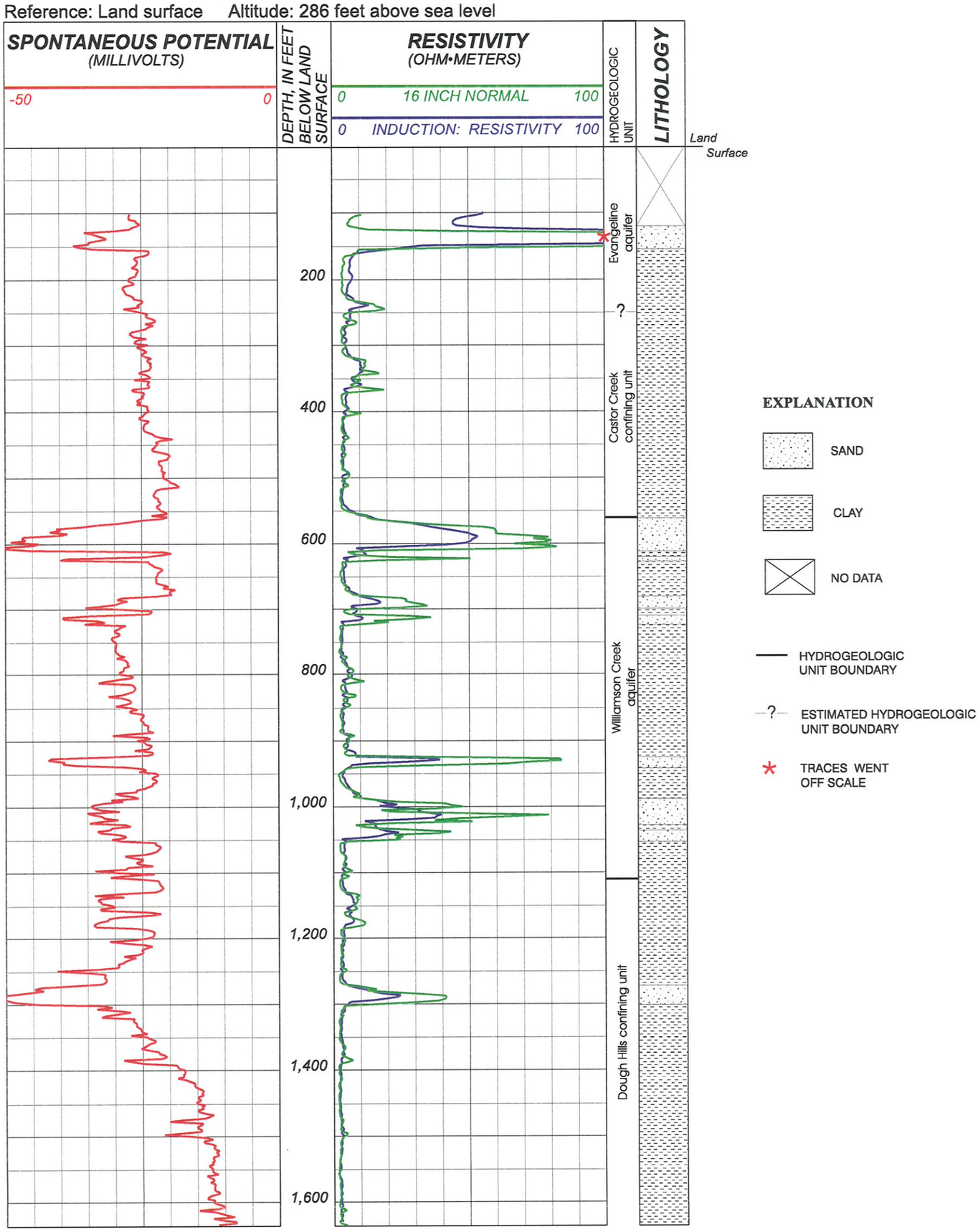

Figure 17. Geophysical log of borehole V-492, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-494
Fort Polk borehole name: N PREWASH1
Land-net location: S36, T2N, R8W
Reference: Land surface Altitude: 340 feet above sea level

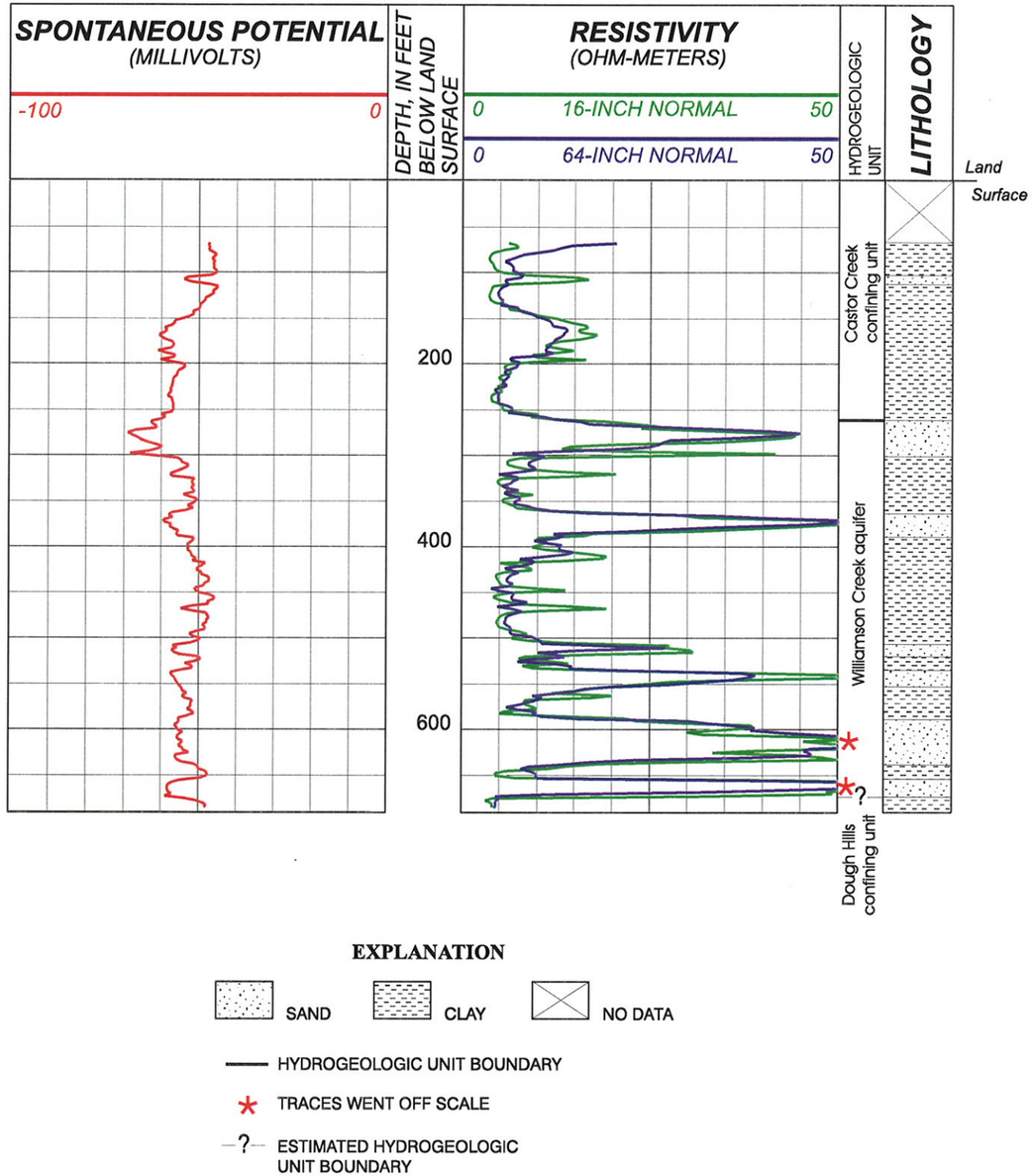

Figure 18. Geophysical log of borehole V-494, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-496
Fort Polk borehole name: 14D
Land-net location: S18, T1N, R8W
Reference: Land surface Altitude: 284 feet above sea level

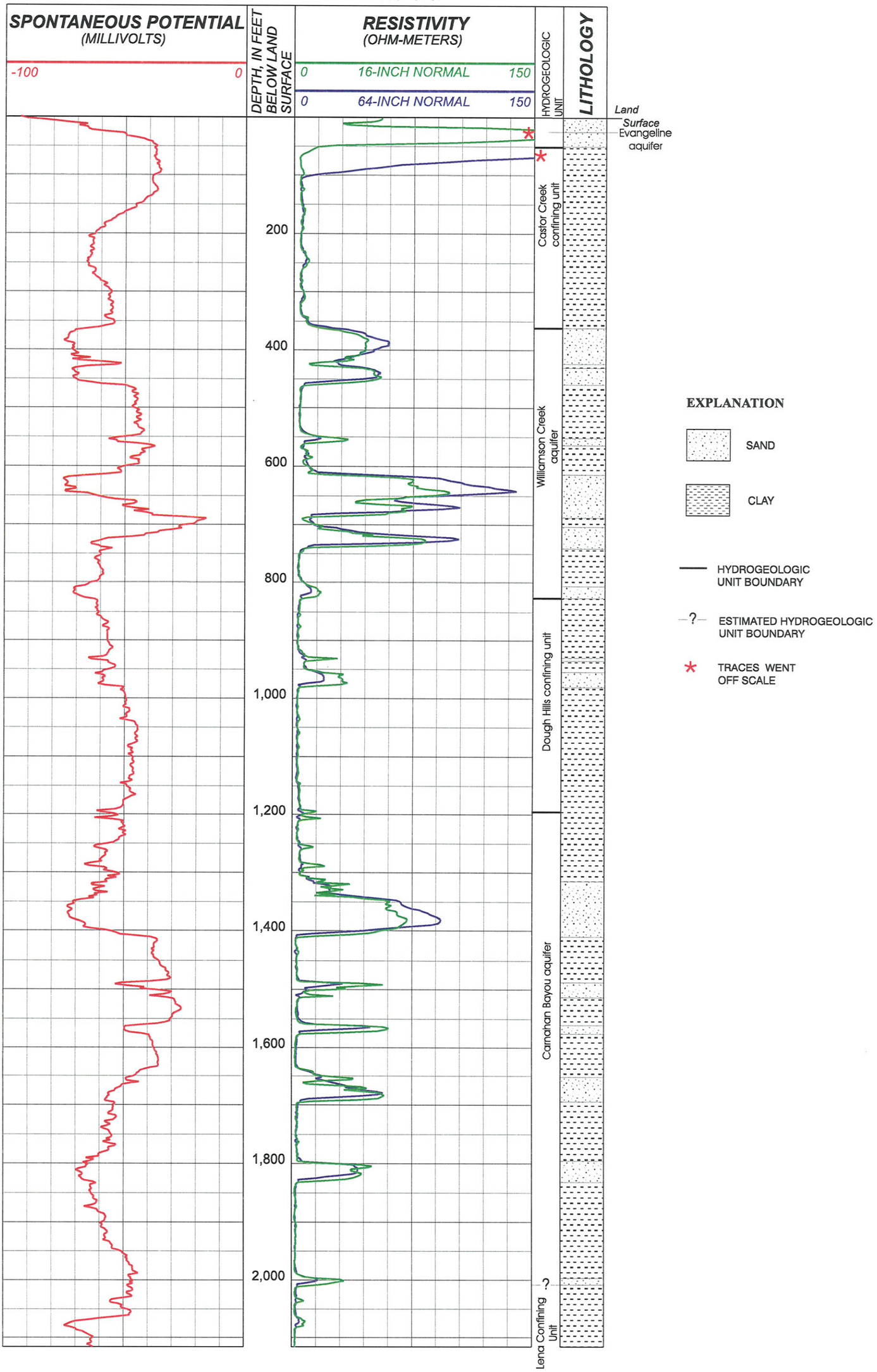

Figure 19. Geophysical log of borehole V-496, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-497
Fort Polk borehole name: 9A
Land-net location: S21, T1N, R8W
Reference: Land surface Altitude: 325 feet above sea level

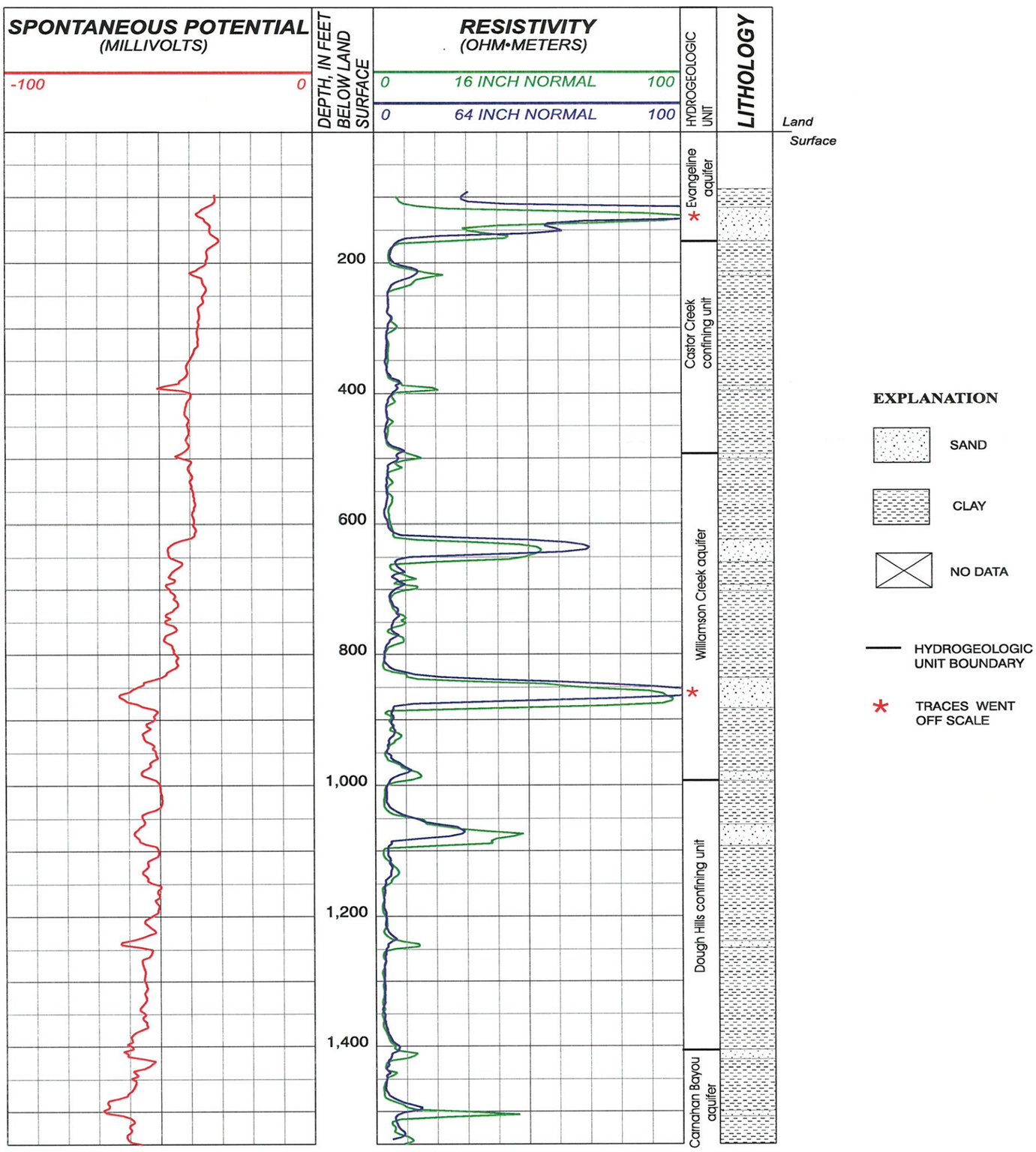

Figure 20. Geophysical log of borehole V-497, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-502
Fort Polk borehole name: 6APD TEST
Land-net location: S34, T2N, R8W
Reference: Land surface Altitude: 340 feet above sea level

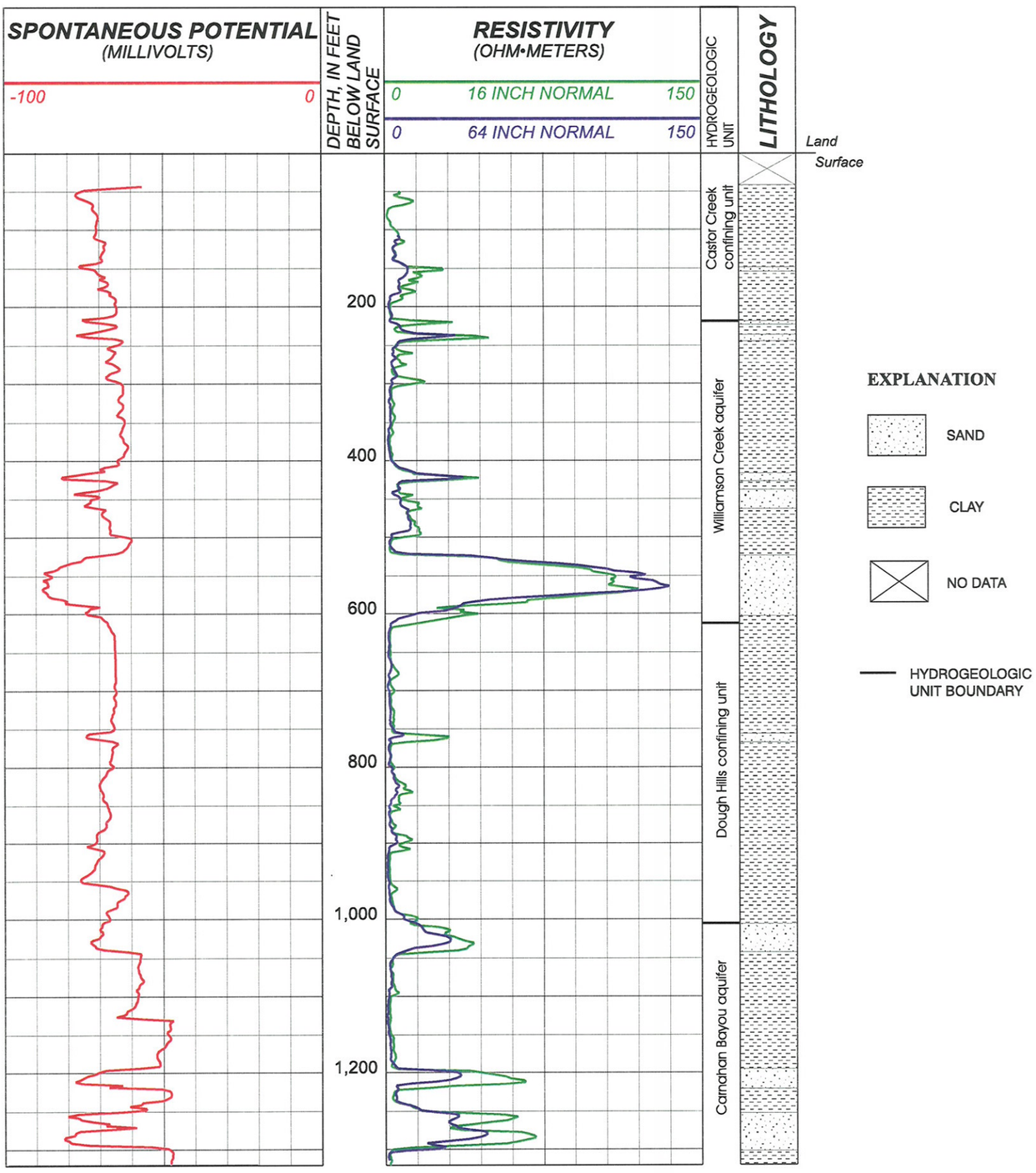

Figure 21. Geophysical log of borehole V-502, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-503
Fort Polk borehole name: 4APS
Land-net location: S34, T2N, R8W
Reference: Land surface Altitude: 340 feet above sea level

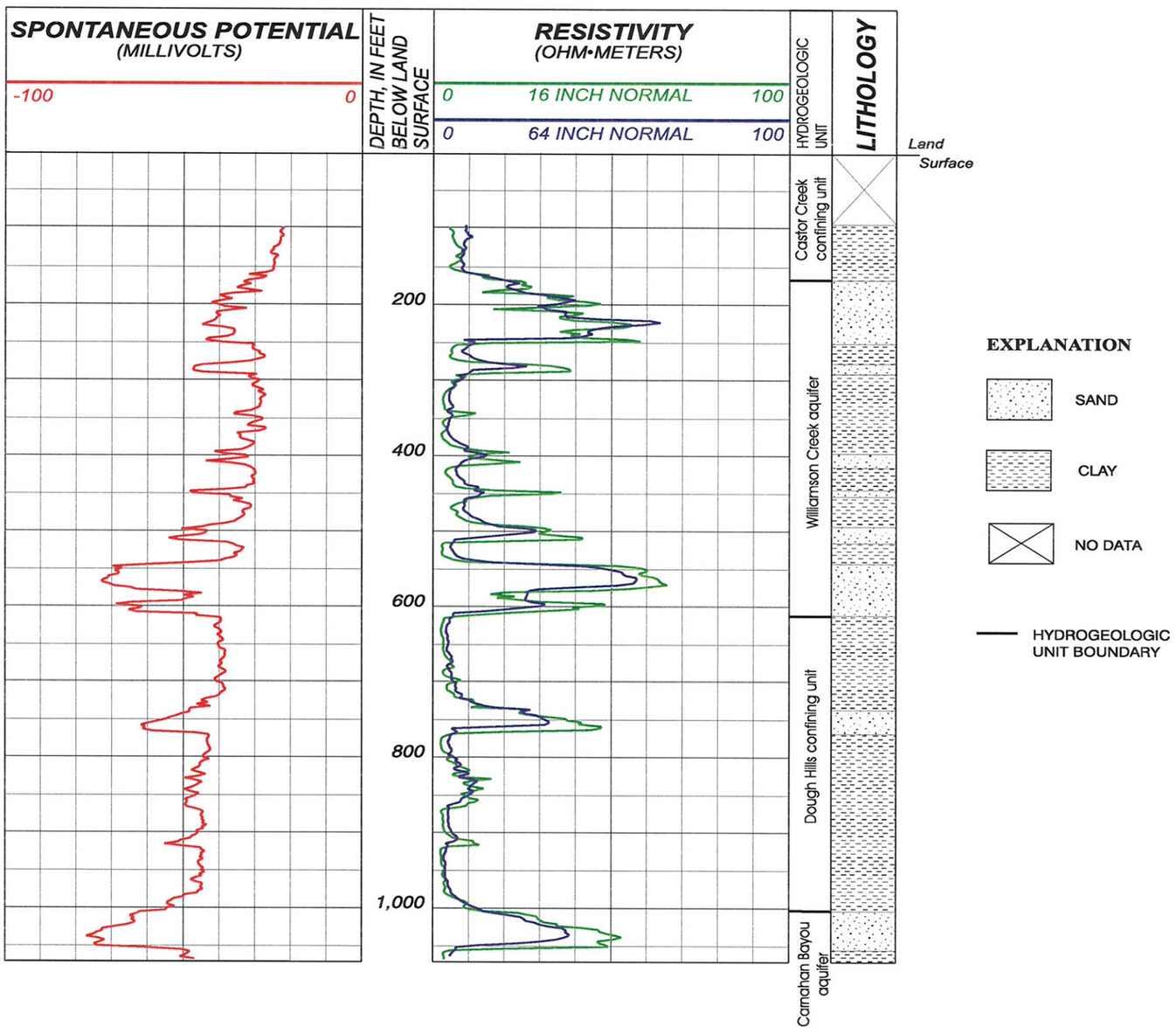

Figure 22. Geophysical log of borehole V-503, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-504
Fort Polk borehole name: 6APD
Land-net location: S34, T2N, R8W
Reference: Land surface Altitude: 335 feet above sea level

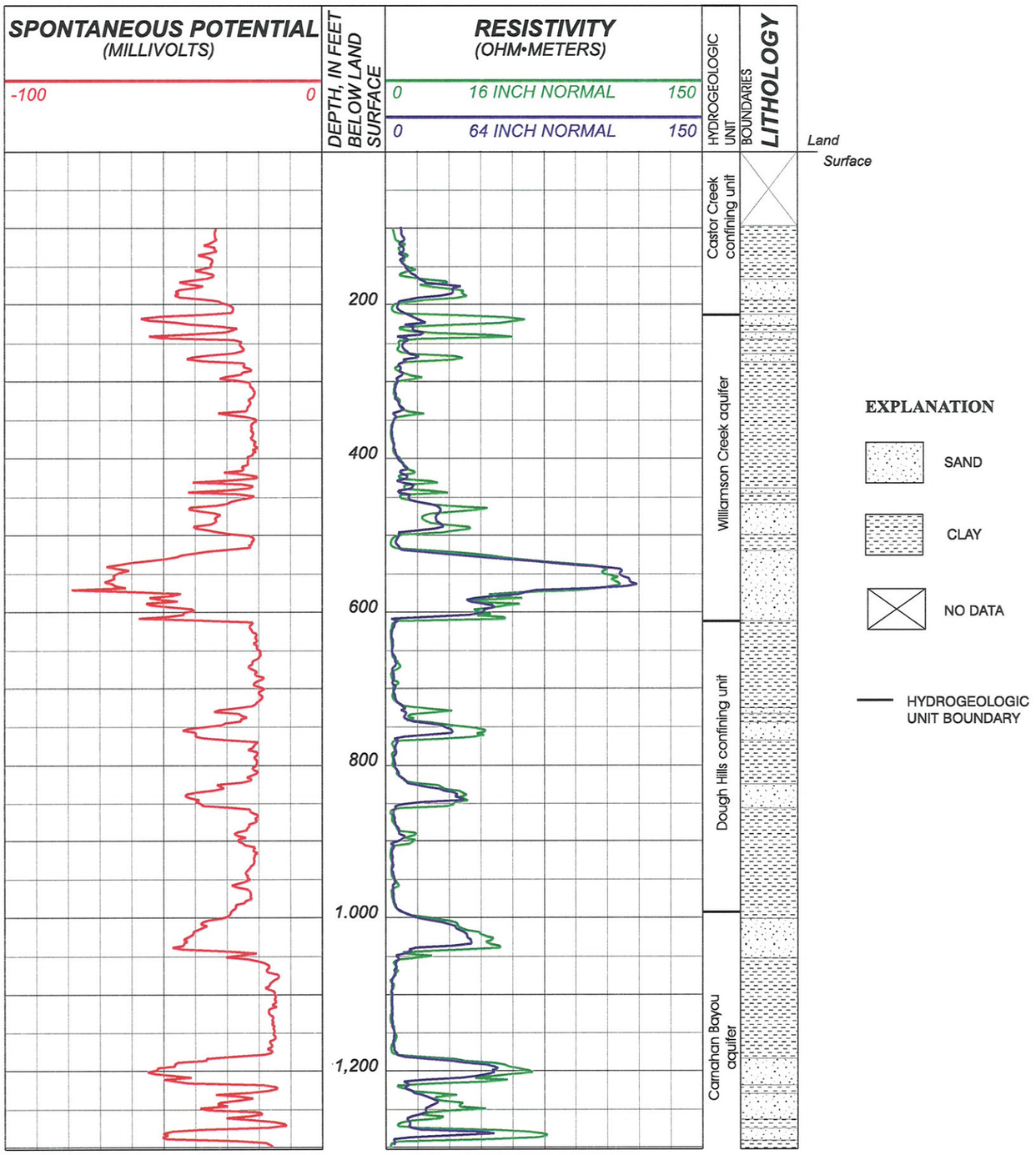

Figure 23. Geophysical log of borehole V-504, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-510
Fort Polk borehole name: 7A
Land-net location: S20, T1N, R8W
Reference: Land surface Altitude: 305 feet above sea level

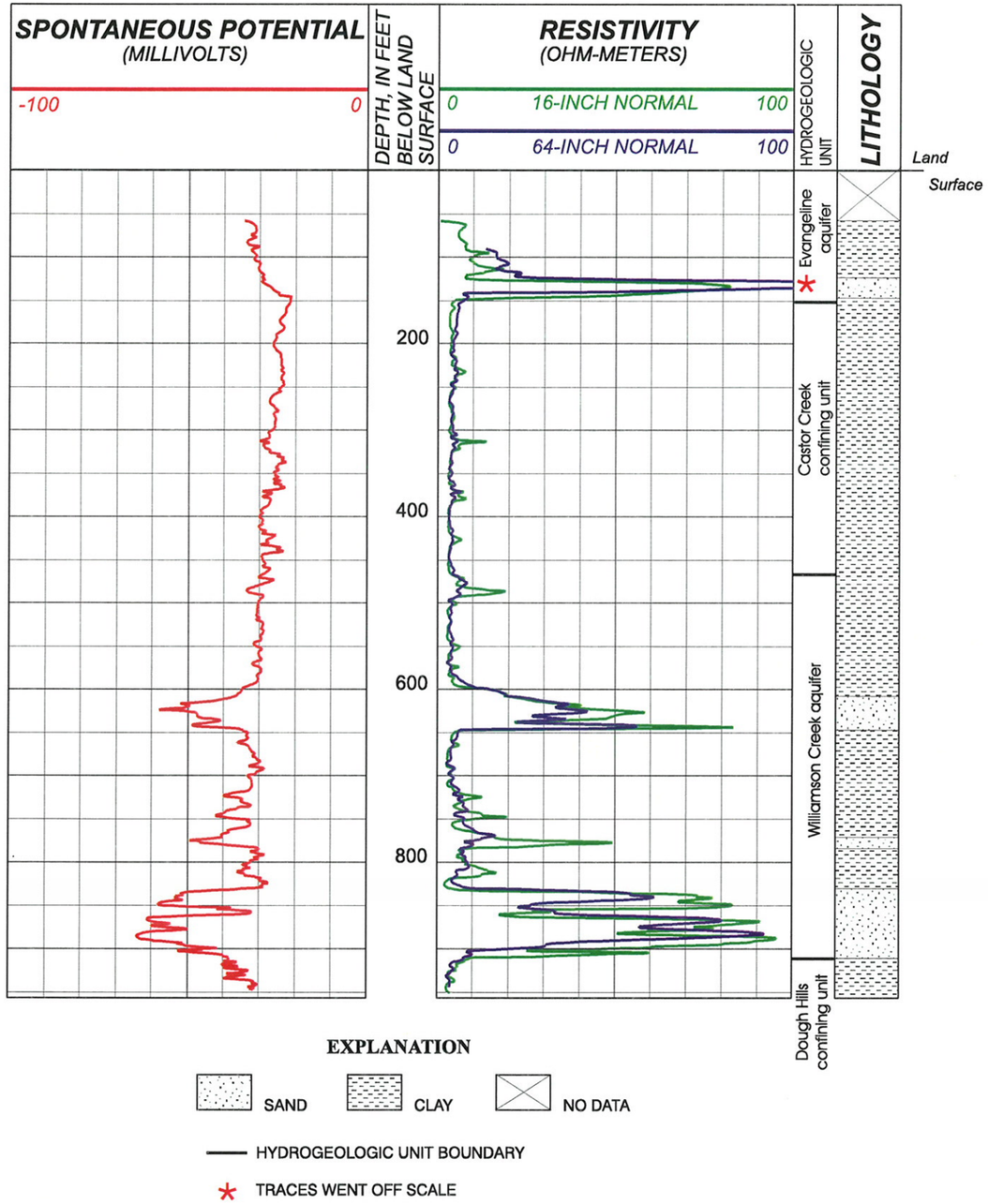

Figure 24. Geophysical log of borehole V-510, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-513
Fort Polk borehole name: 7BPD
Land-net location: S27, T2N, R8W
Reference: Land surface Altitude: 335 feet above sea level

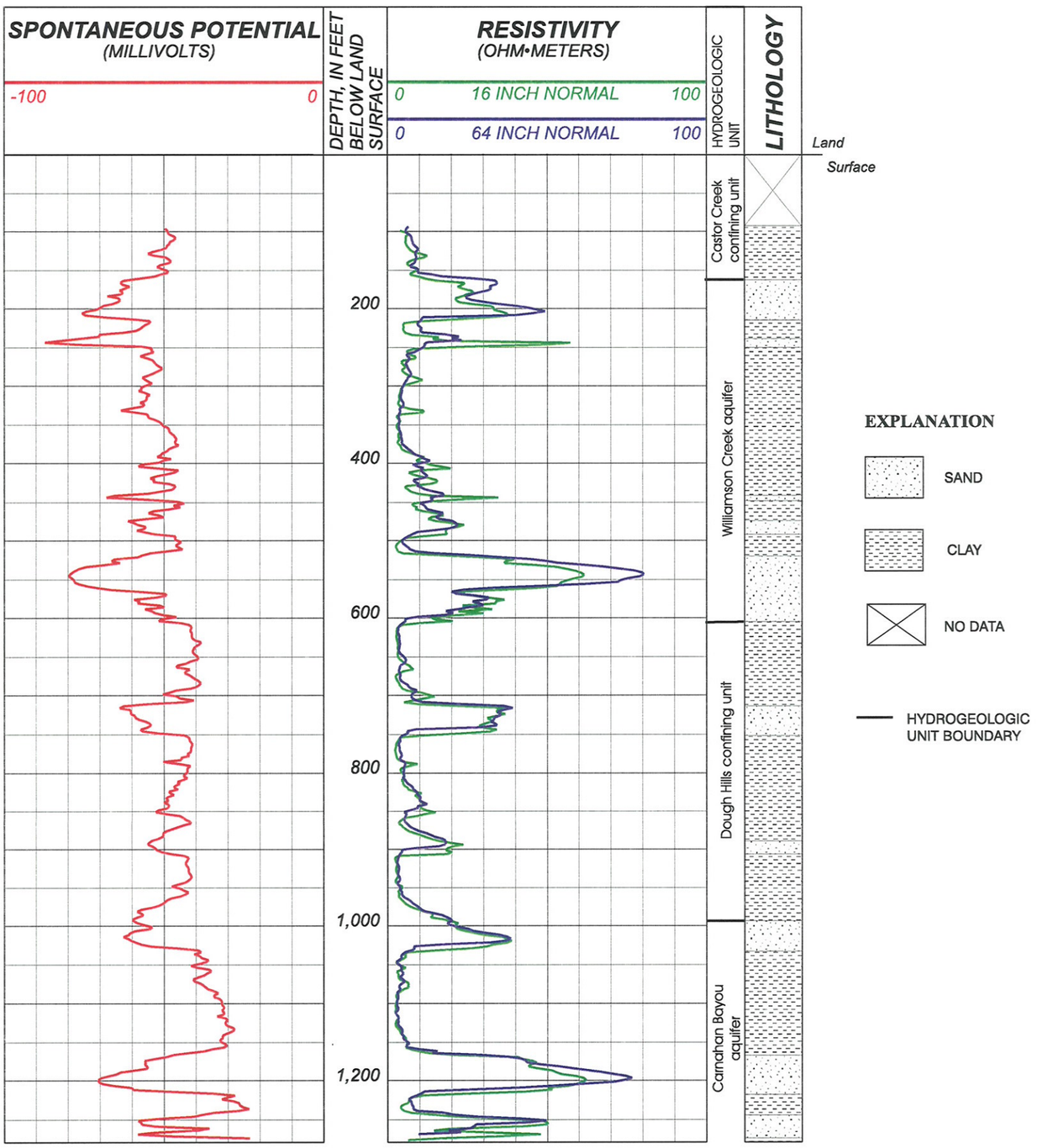

Figure 25. Geophysical log of borehole V-513, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-514
Fort Polk borehole name: 16D
Land-net location: S33, T2N, R8W
Reference: Land surface Altitude: 290 feet above sea level

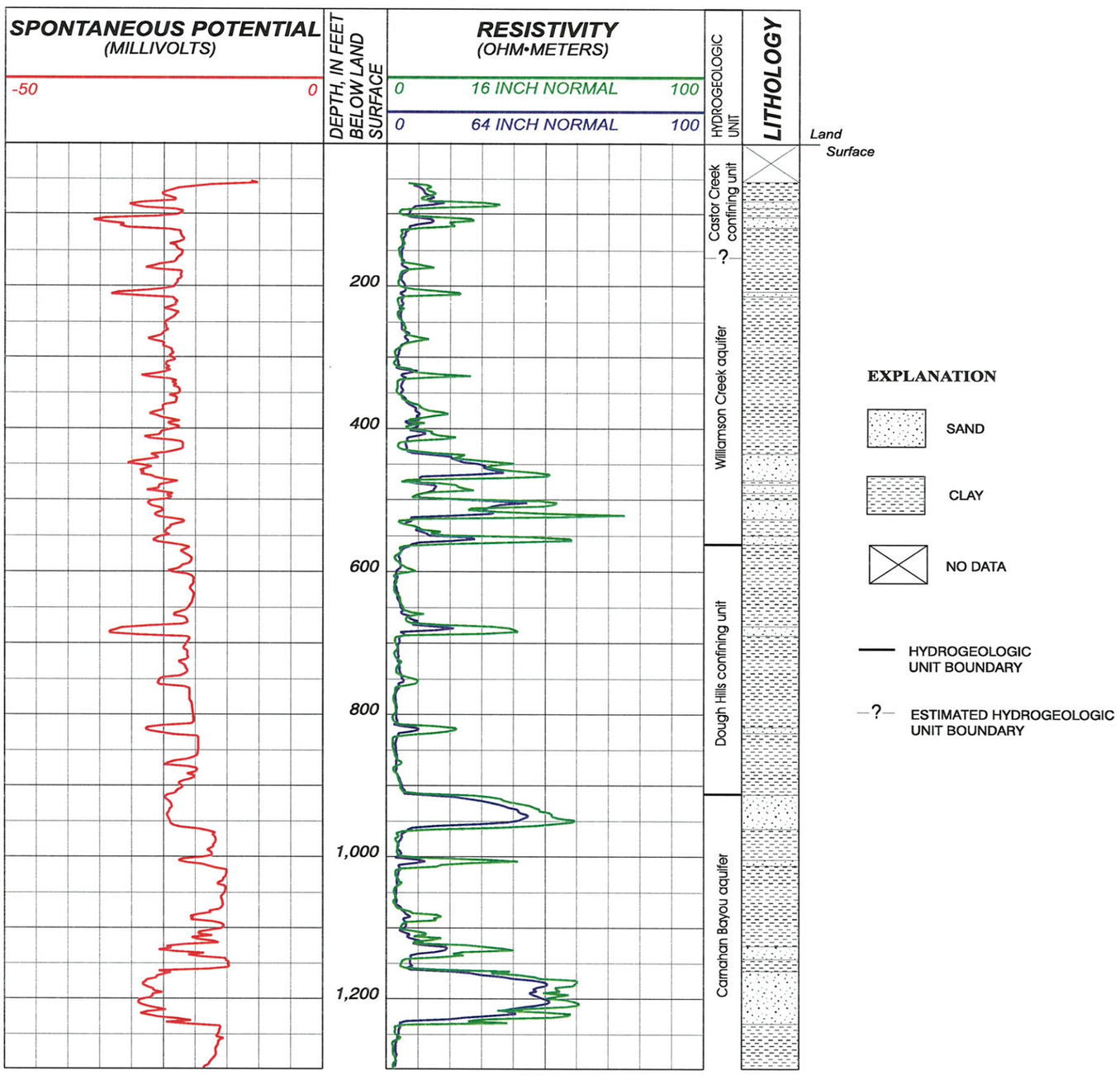

Figure 26. Geophysical log of borehole V-514, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-515
Fort Polk borehole name: 15D
Land-net location: S04, T1N, R8W
Reference: Land surface Altitude: 320 feet above sea level

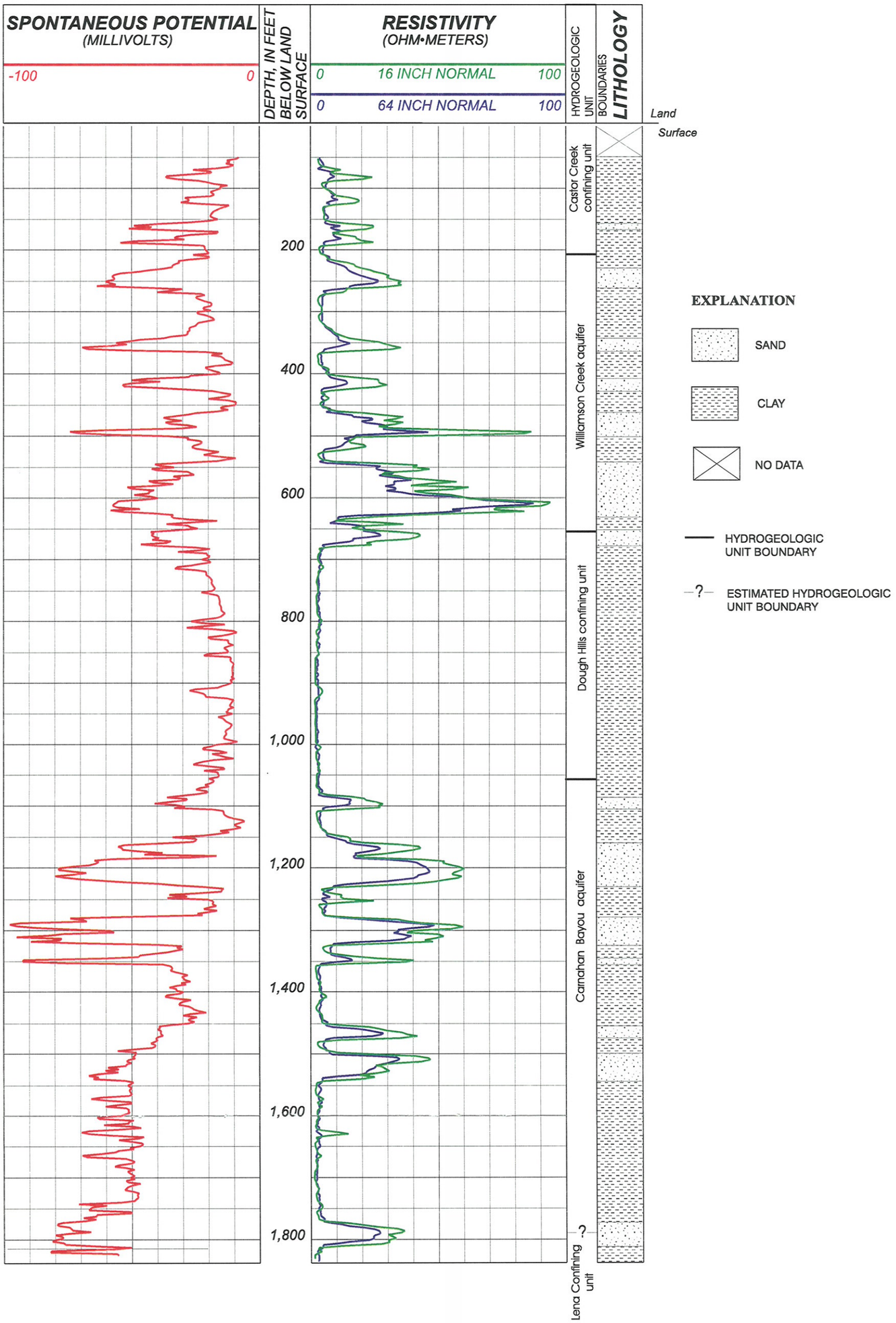

Figure 27. Geophysical log of borehole V-515, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-518
Fort Polk borehole name: 11A
Land-net location: S16, T1N, R8W
Reference: Land surface Altitude: 335 feet above sea level

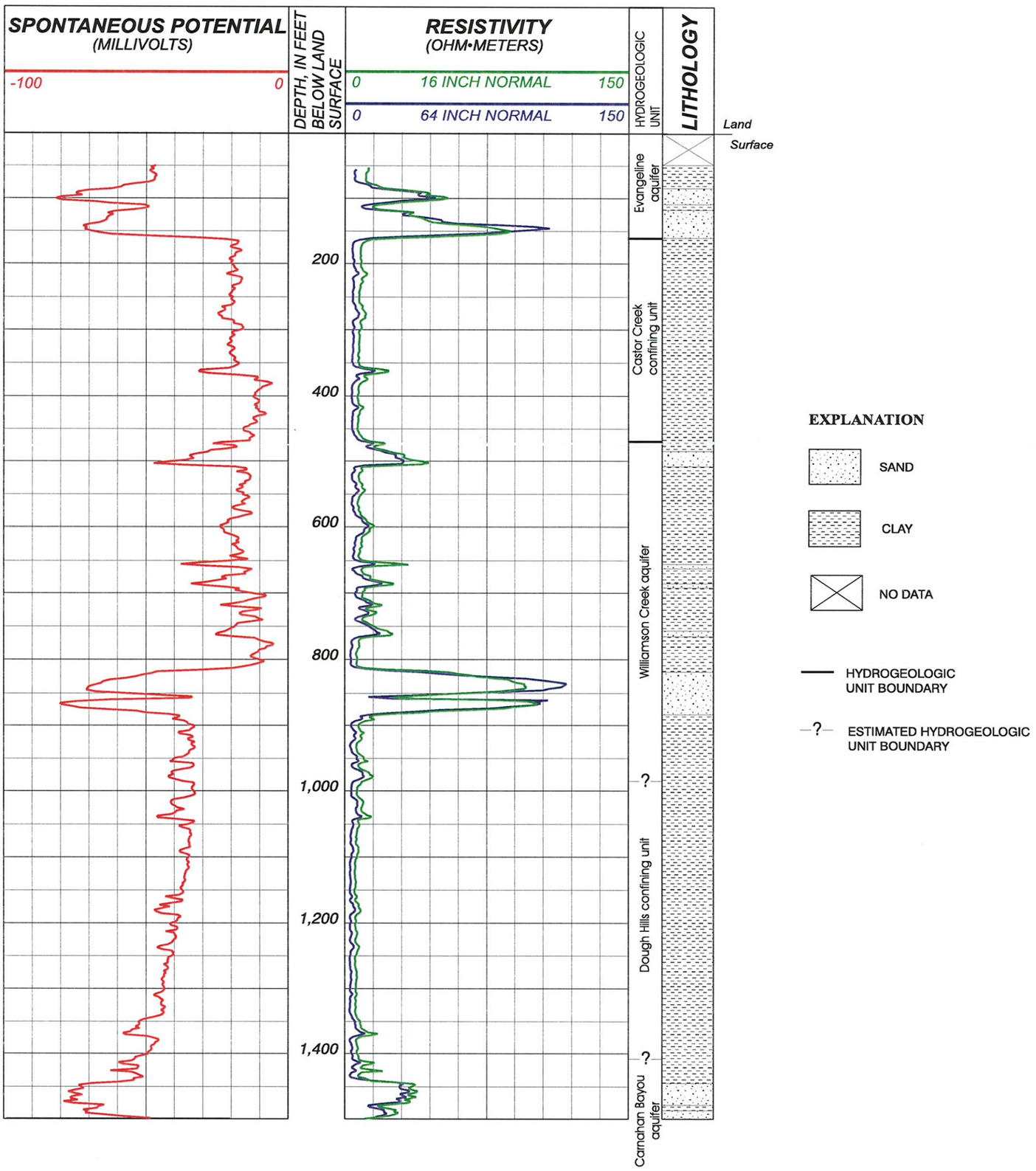

Figure 28. Geophysical log of borehole V-518, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-522
Fort Polk borehole name: 2APS
Land-net location: S35, T2N, R8W
Reference: Land surface Altitude: 325 feet above sea level

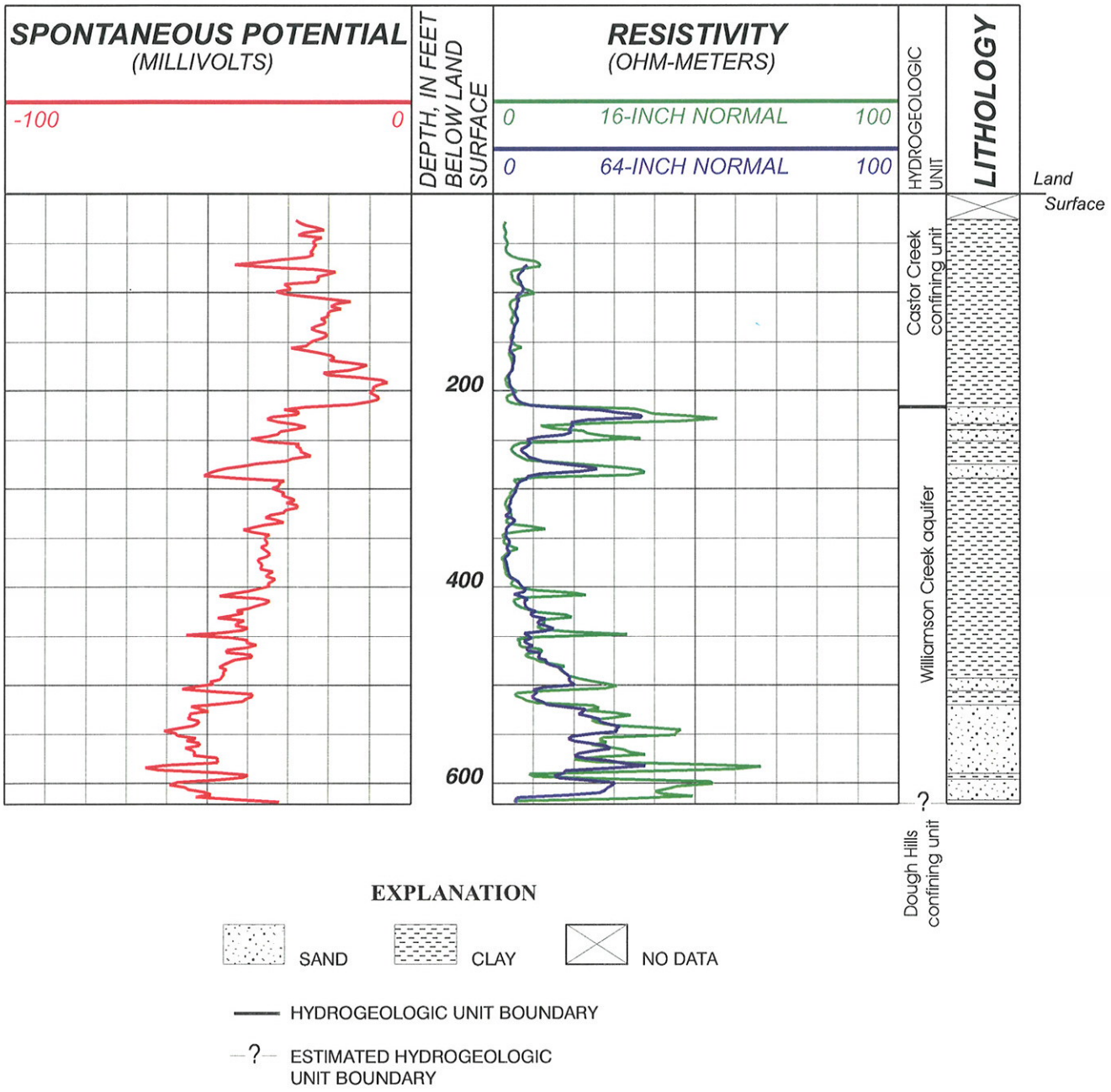

Figure 29. Geophysical log of borehole V-522, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-642
Fort Polk borehole name: CHAF-T2
Land-net location: S09, T1N, R8W
Reference: Land surface Altitude: 348 feet above sea level

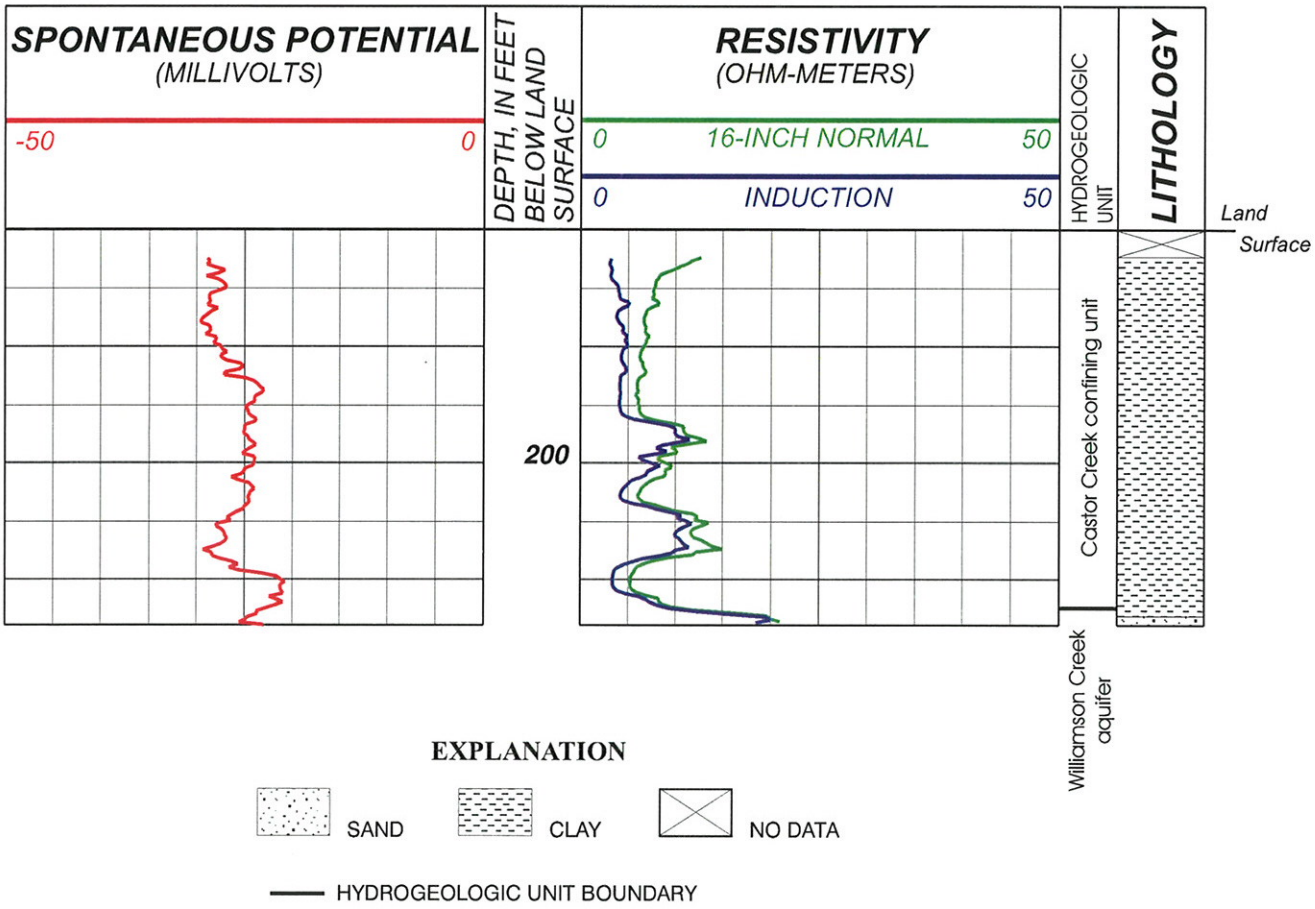

Figure 30. Geophysical log of borehole V-642, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-644
Fort Polk borehole name: 2BPS
Land-net location: S35, T2N, R8W
Reference: Land surface Altitude: 325 feet above sea level

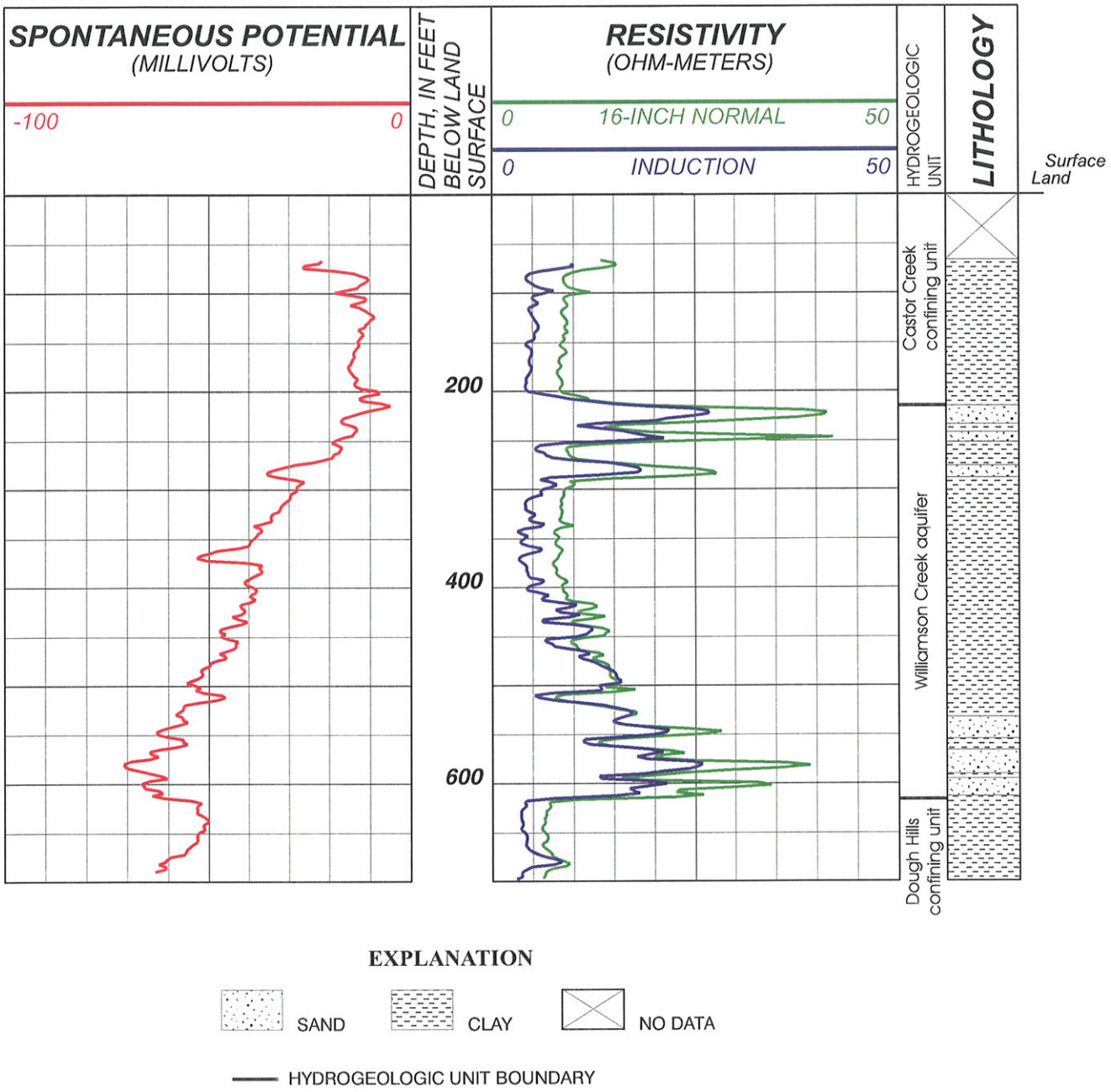

Figure 31. Geophysical log of borehole V-644, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-651
Fort Polk borehole name: CAA1
Land-net location: S08, T1N, R7W
Reference: Land surface Altitude: 350 feet above sea level

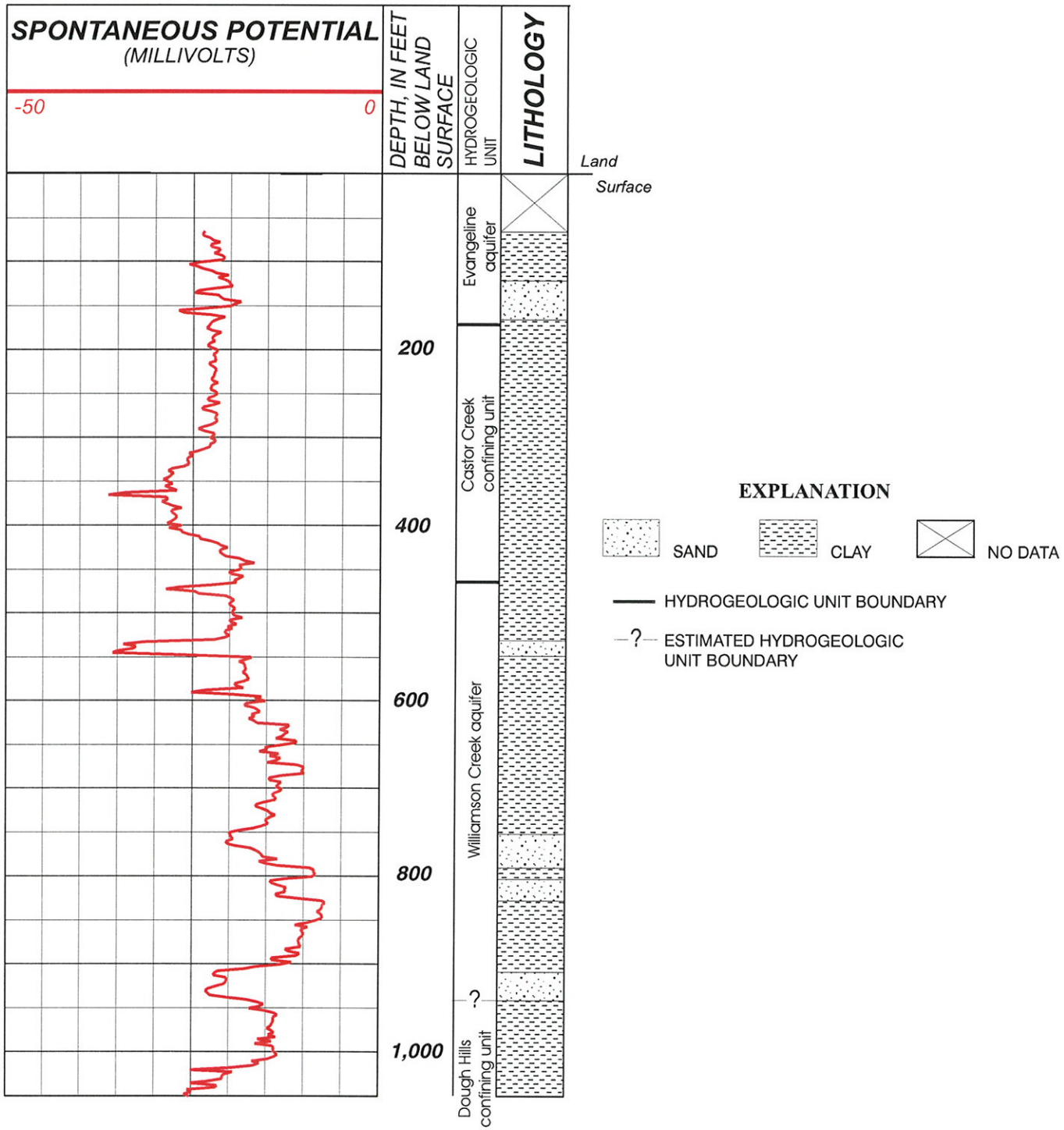

Figure 32. Geophysical log of borehole V-651, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-658
Fort Polk borehole name: 16AD
Land-net location: S04, T1N, R8W
Reference: Land surface Altitude: 309 feet above sea level

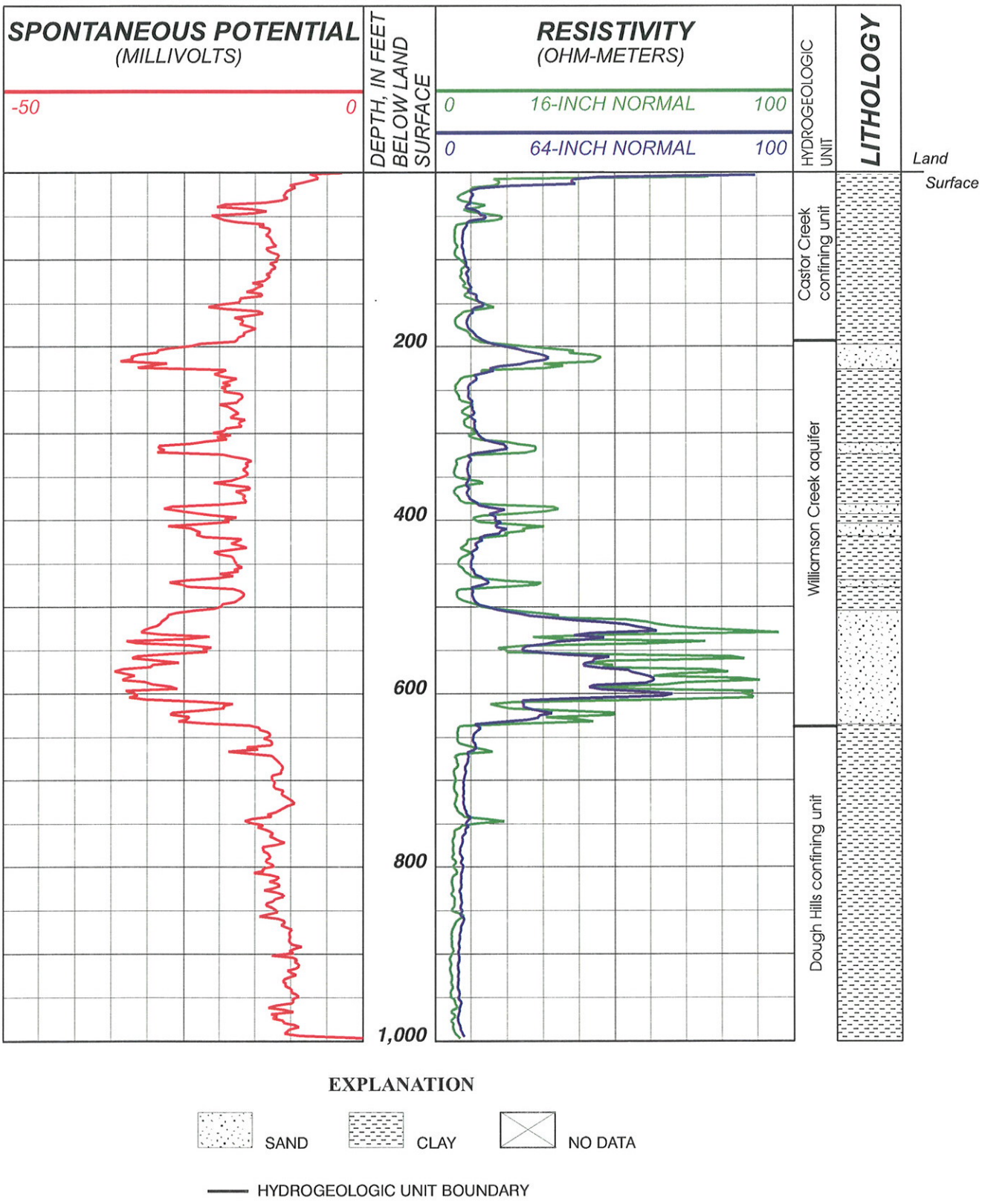

Figure 33. Geophysical log of borehole V-658, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-659
Fort Polk borehole name: 8C
Land-net location: S20, T1N, R8W
Reference: Land surface Altitude: 310 feet above sea level

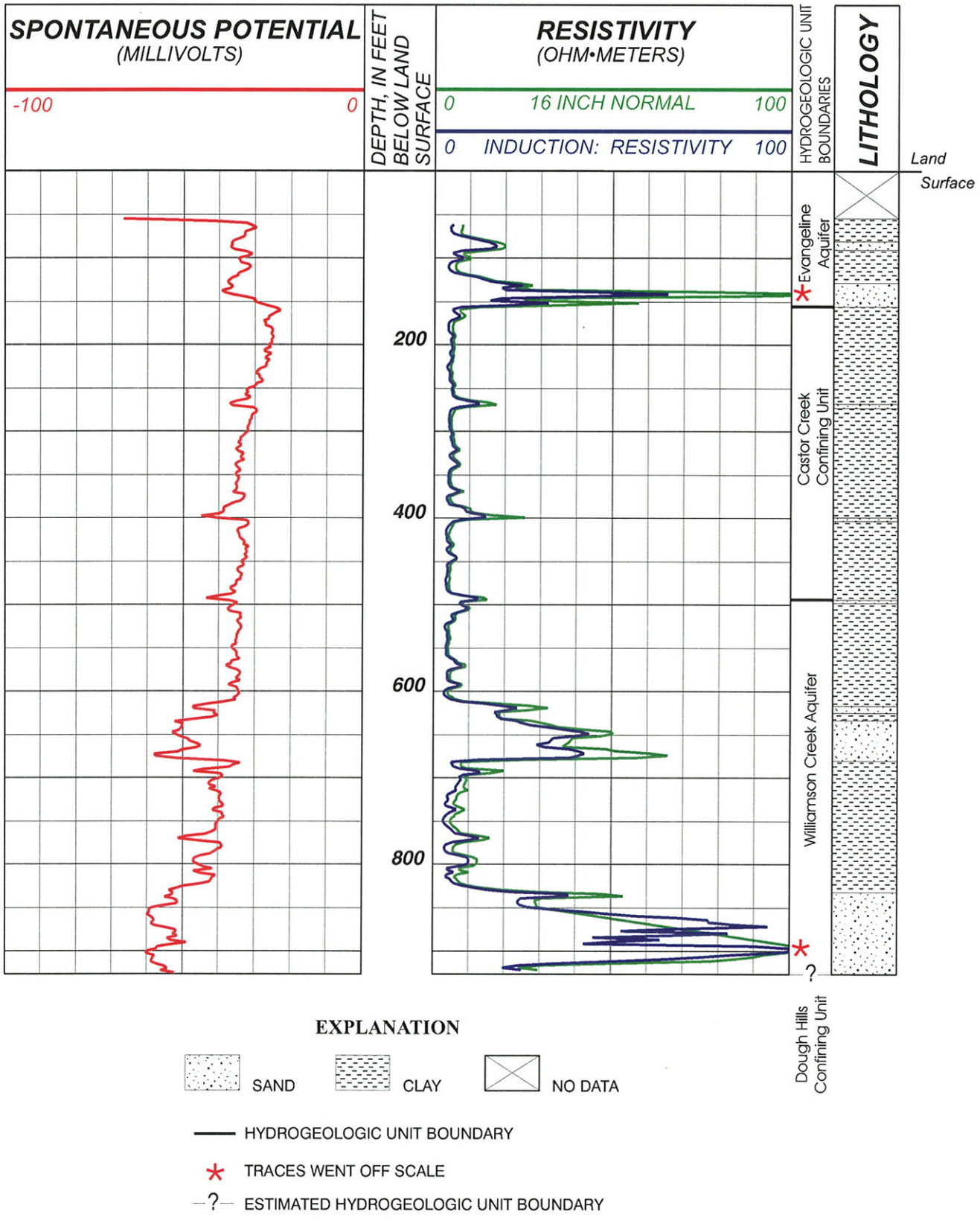

Figure 34. Geophysical log of borehole V-659, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-661
Fort Polk borehole name: 12A
Land-net location: S17, T1N, R8W
Reference: Land surface Altitude: 332 feet above sea level

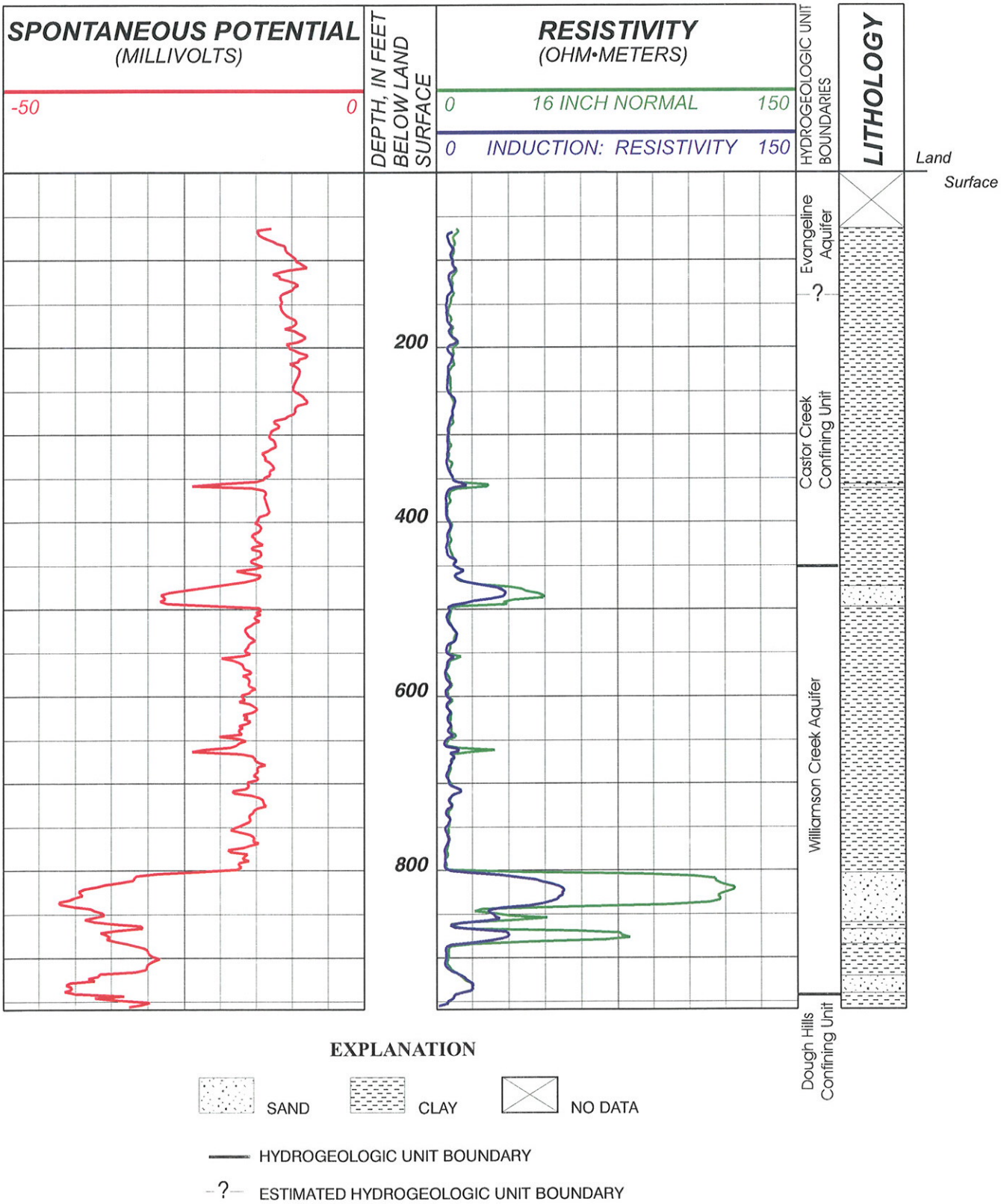

Figure 35. Geophysical log of borehole V-661, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-663
Fort Polk borehole number: 6BPS
Land-net location: S34, T2N, R8W
Reference: Land surface Altitude: 330 feet above sea level

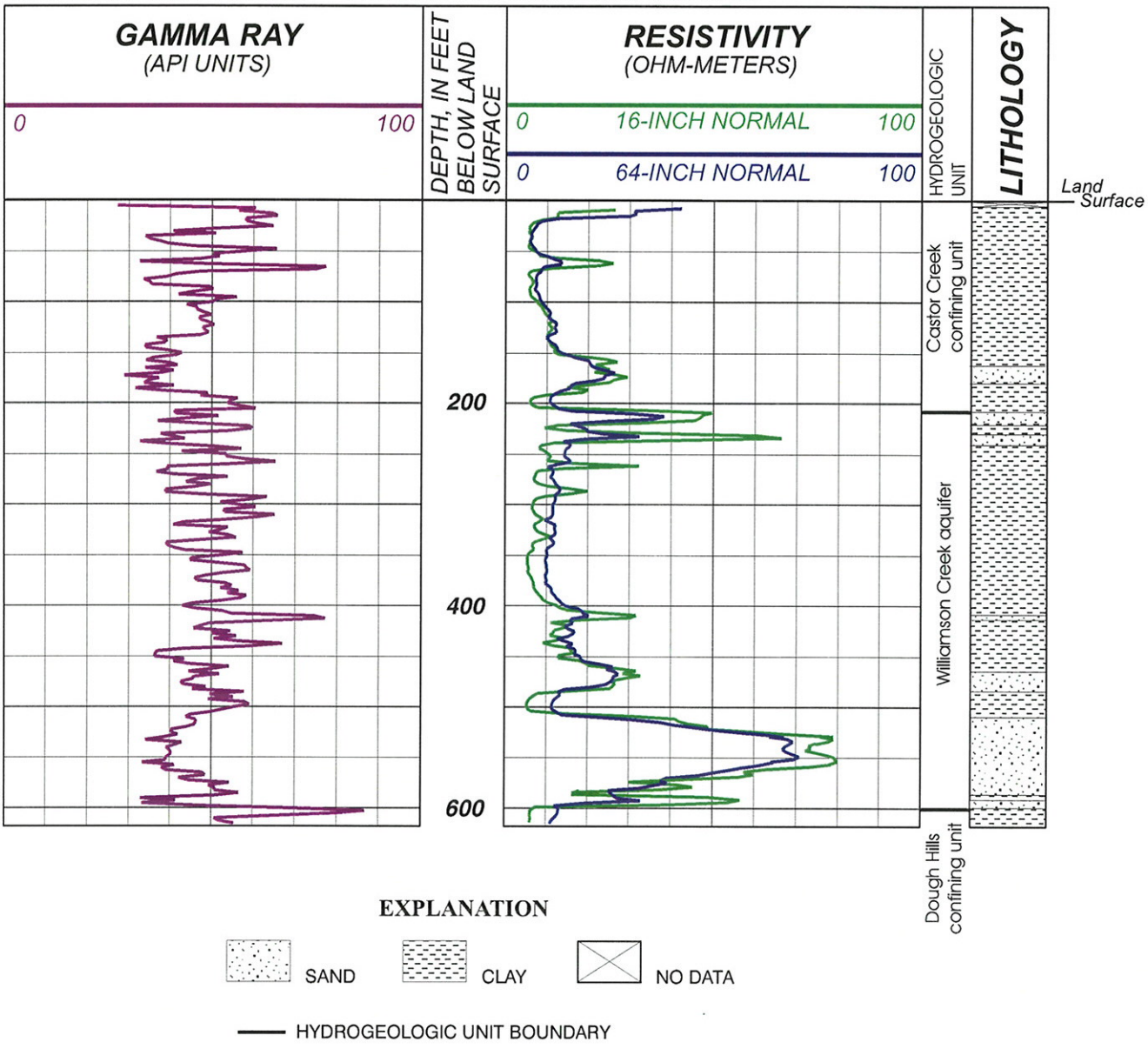

Figure 36. Geophysical log of borehole V-663, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-670
Fort Polk borehole name: 5B
Land-net location: S20, T1N, R8W
Reference: Land surface Altitude: 340 feet above sea level

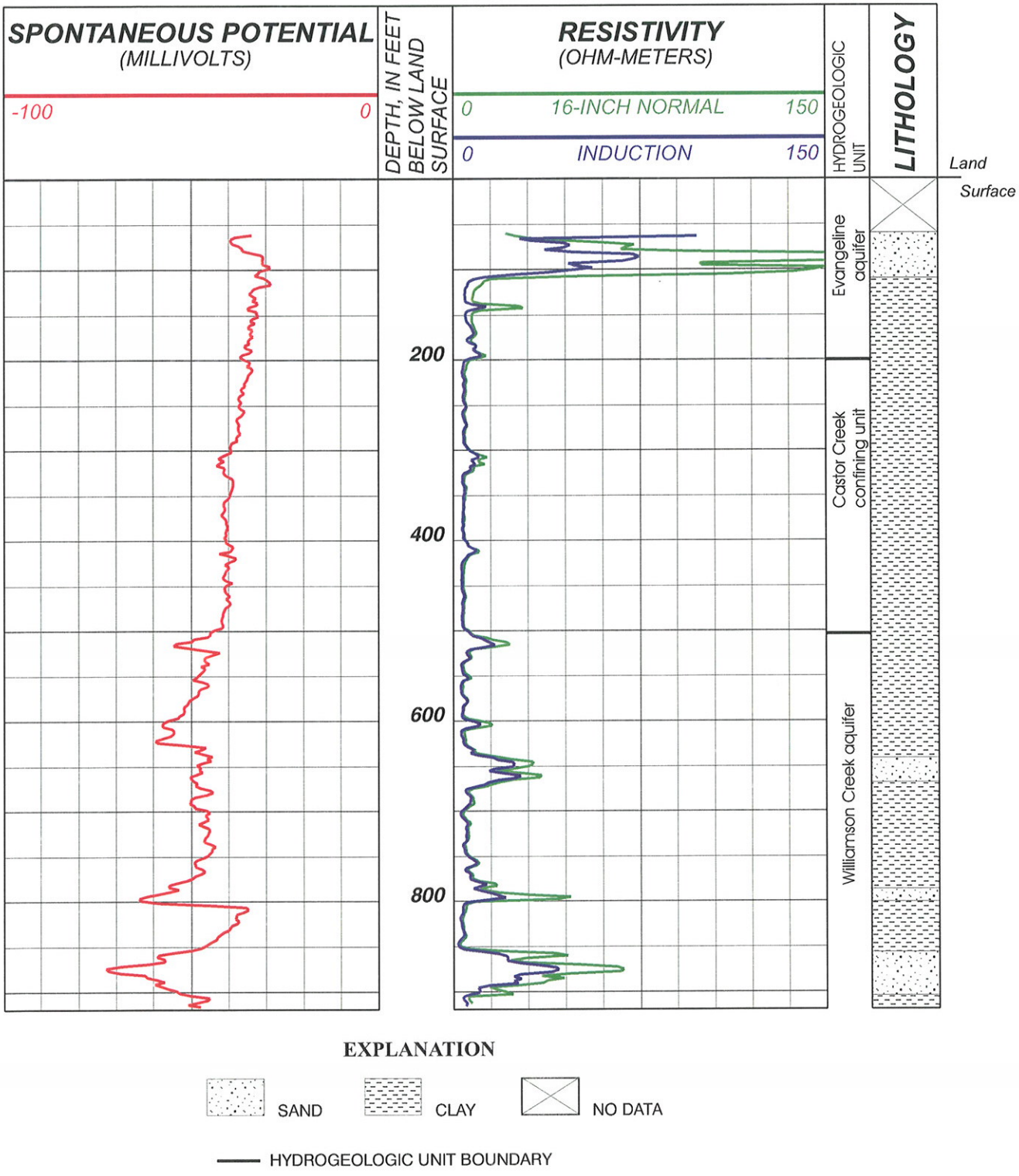

Figure 37. Geophysical log of borehole V-670, Fort Polk Military Reservation, Vernon Parish, Louisiana.

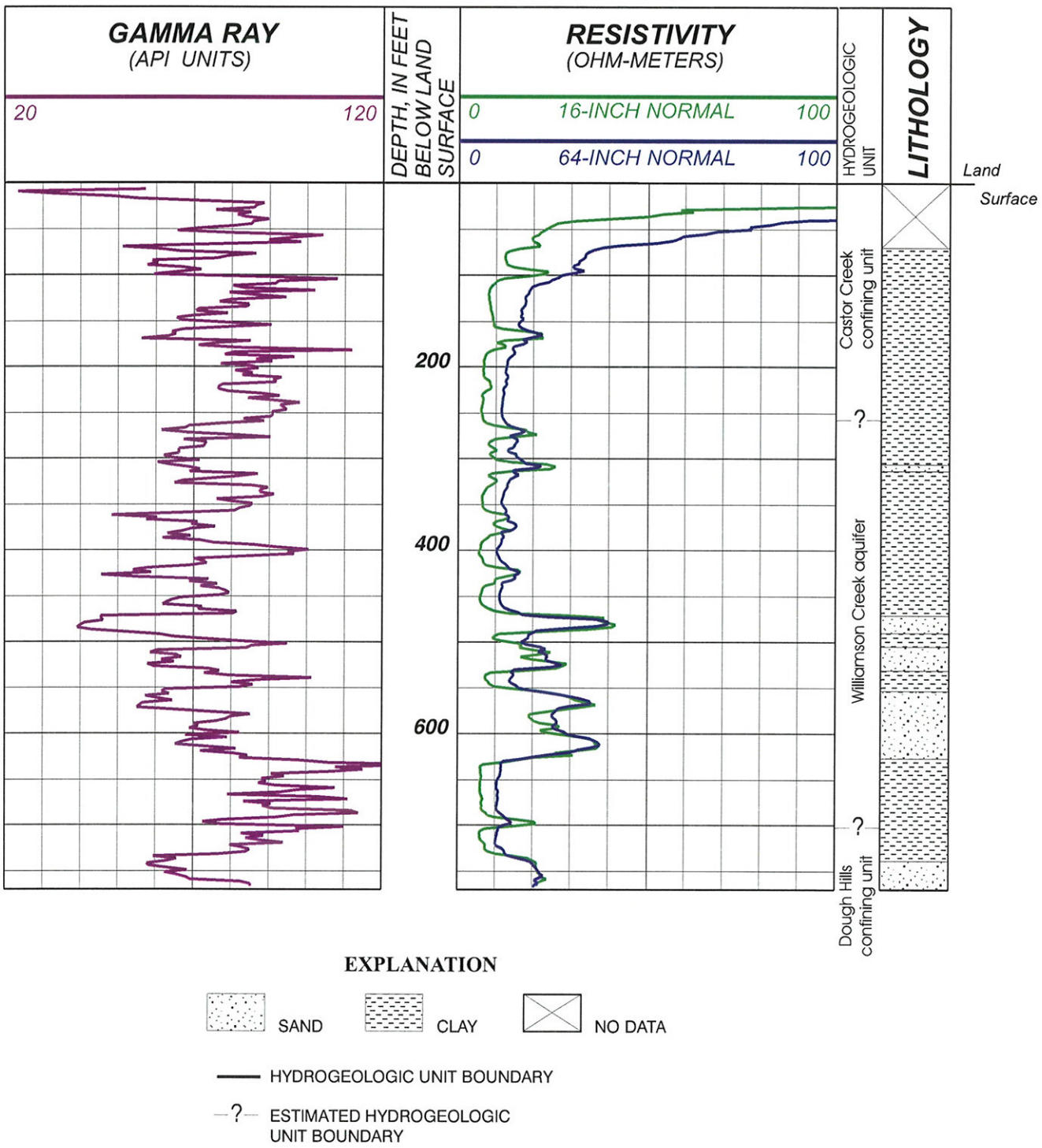

Figure 38. Geophysical log of borehole V-671, Fort Polk Military Reservation, Vernon Parish, Louisiana.

USGS borehole name: V-672
Fort Polk borehole name: MOUT 2
Land-net location: S31, T2N, R7W
Reference: Land surface Altitude: 400 feet above sea level

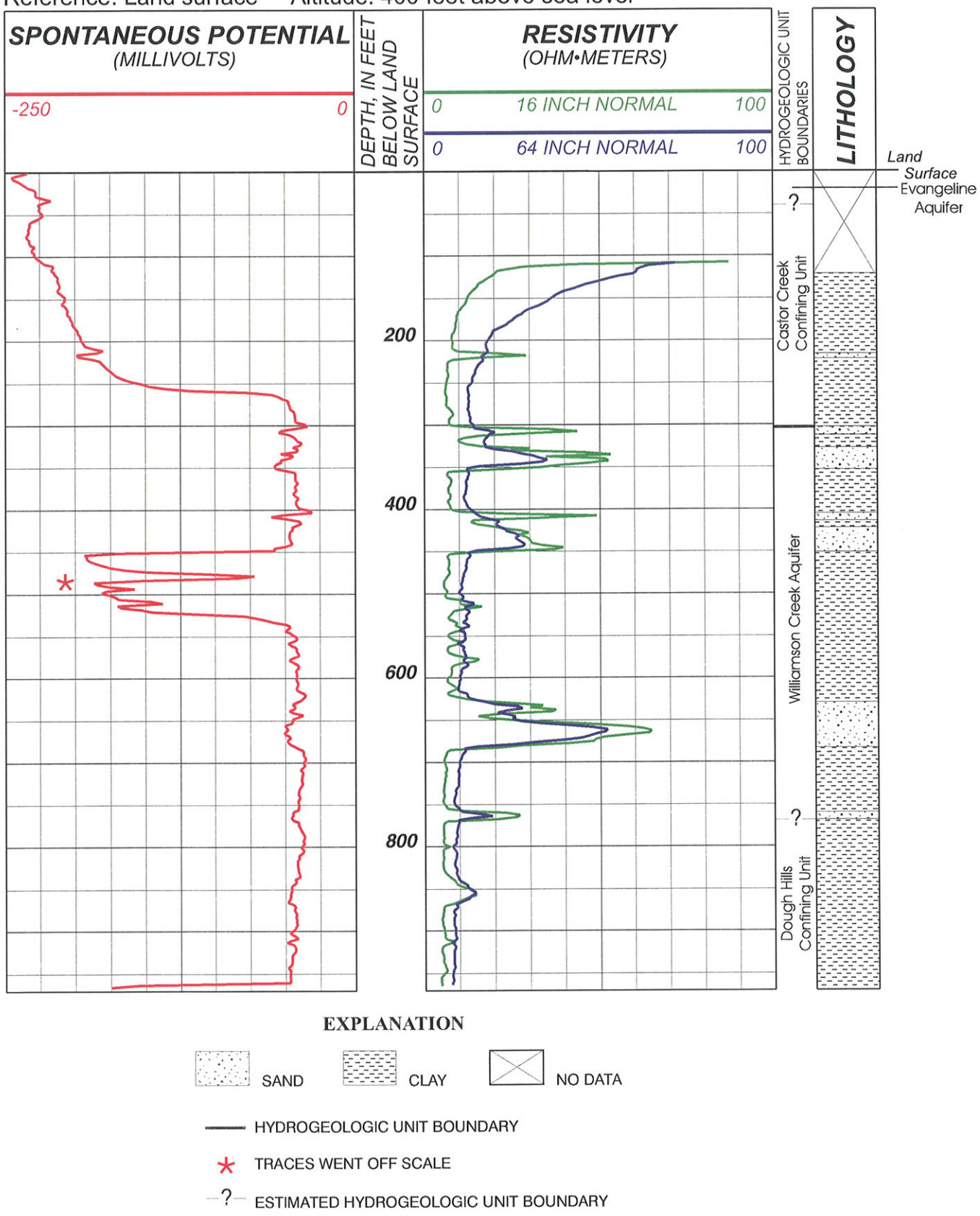

Figure 39. Geophysical log of borehole V-672, Fort Polk Military Reservation, Vernon Parish, Louisiana.

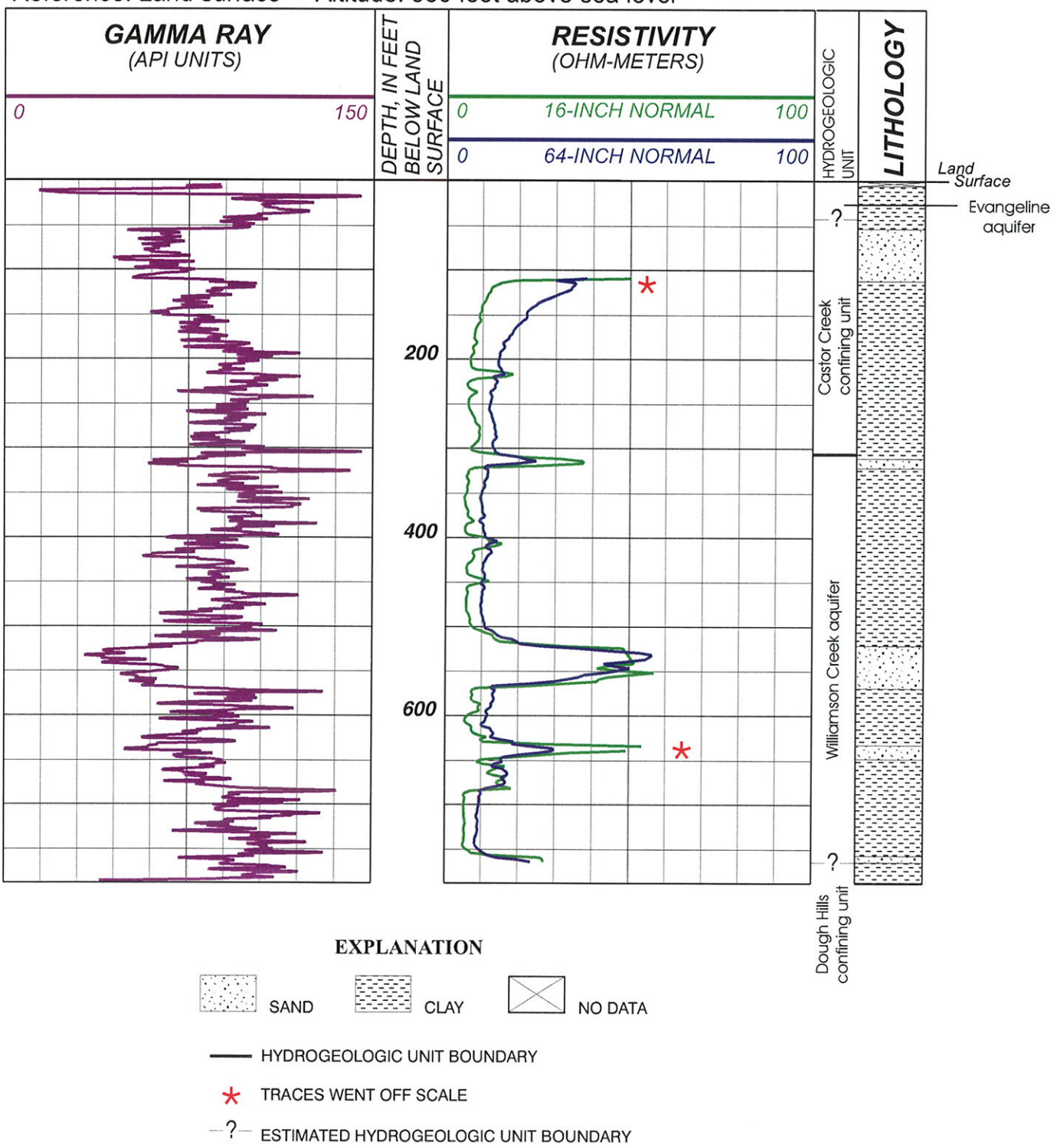

Figure 40. Geophysical log of borehole V-673, Fort Polk Military Reservation, Vernon Parish, Louisiana.