Project Report No. 9

South Georgia Minerals Program

Georgia
State Division of Conservation
Department of Mines, Mining and Geology

A. S. Furcron, Director

By

Mineral Engineering Branch, Engineering Experiment Station

Georgia Institute of Technology, and

Georgia Department of Mines, Mining, and Geology

November 1967

This program is being carried out under contract as Project A-880 of the Georgia Institute of Technology, Atlanta, Georgia

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ERRATA

The following corrections are applicable to Project Report No. 9:

Page 28, Percent Dry Feed . . . . . for 00.0 read 100.00

Page 46, Paragraph 1, line 5. . . . . for in-site read in situ

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INTRODUCTION

Eight project reports have been issued to date on this program which was initiated on July 1, 1965. All information is published and released as progress reports to the general public as soon as feasible. Accordingly, most of the reports have been completely factual as to results obtained over a relatively small area of the Coastal Plain. Project Report No. 7, however, presented a geological discussion of the phosphates of South Georgia and of northern Florida. Project Report No. 8 covered a preliminary investigation of "heavy minerals" occurring along coastal Georgia.

Project Report No. 6 noted (page 6) that phosphorite layers in Effingham County dipped to the north. Gamma-ray logs from deep wells along the coast show anomalous readings, believed correlatable with layers of phosphorites, that are relatively close to the surface, say about 100 ft., near Savannah and deeper near Brunswick. These data, when projected, showed the desirability of core drilling in Chatham County, where phosphorites should be rather close to the surface.

Project Report Nos. 3 and 4 had shown areas of phosphorite interest in western Echols County and in southwestern Lanier, the deposits being similar to those of northern Florida. Data were too few to show whether these areas were interconnected through Lowndes County or to give an approximation of the east-west width of the interesting phosphorites. Accordingly, core drilling operations were carried out in Chatham County and in Echols-Lowndes-Lanier Counties, with the results reported herein. The existence of "phosphates" as reported by S. M. Herrick, "Well Logs of the Coastal Plain of Georgia", The Geological Survey, Bulletin No. 70, 1961; drew attention to two areas of possible interest: (1) an area near the conjunction of Montgomery, Wheeler, and Jeff Davis Counties and (2) along a line, roughly paralleling the coast,

in Liberty, Long and Wayne Counties. Reconnaissance drilling was carried out in these areas to determine desirability of more detailed drilling.

Figure 1 is an index map showing the locations of holes drilled and reported to date.

With the anticipated delivery of a second drilling unit, designed for more rapid sampling at relatively shallow depths as desired for heavy minerals, clays, and sands reconnaissance, a heavy burden on the analytical laboratory's facilities is foreseen. Automated equipment for the arc emission spectrograph has been installed. A new radiation measuring technique for rapid determination of phosphorite matrices qualifying for beneficiation and chemical analyses has been investigated.

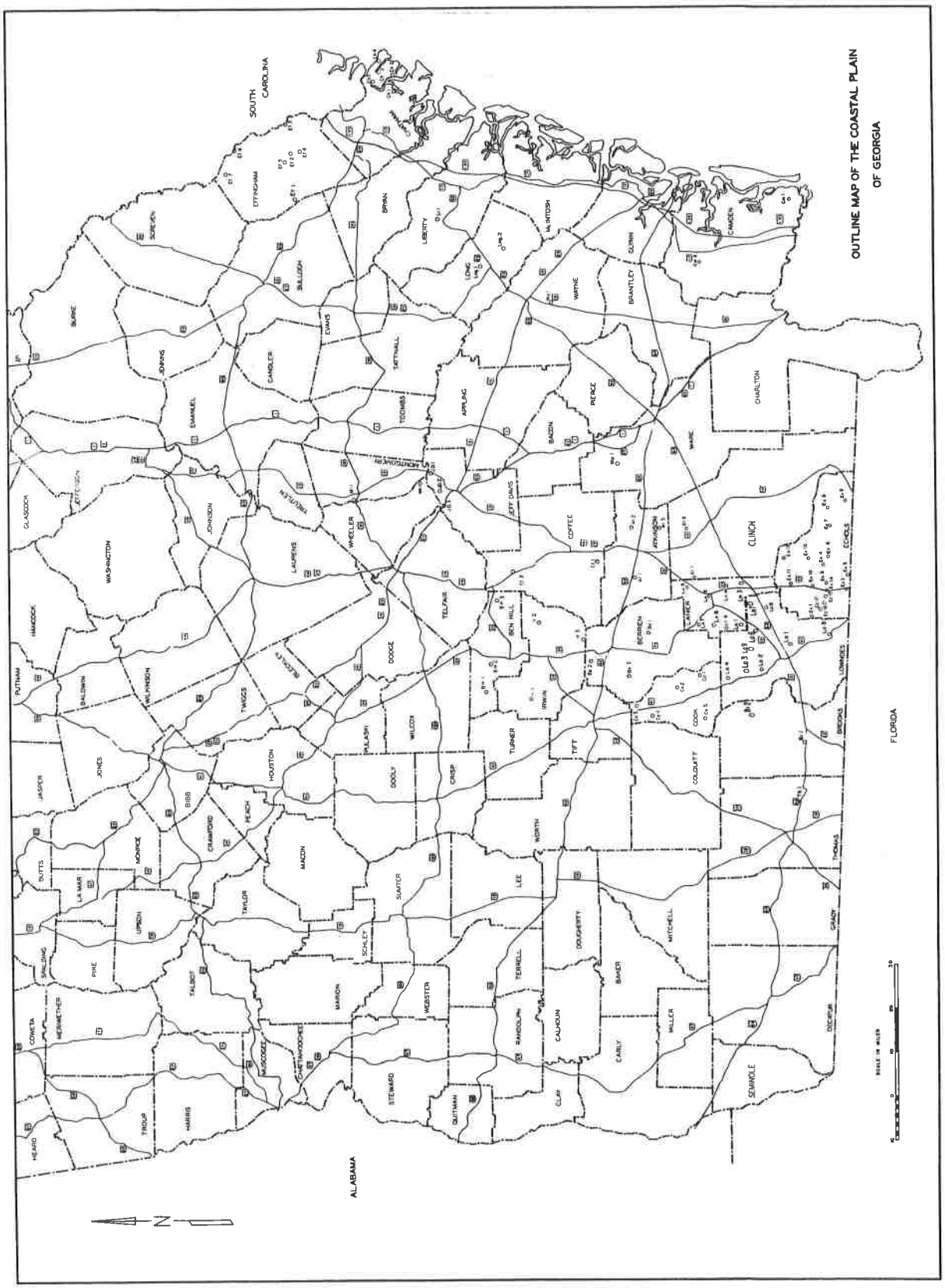

Figure 1. Index Map of Program Area

OBJECTIVE AND SCOPE

The objective of the South Georgia Mineral Program is to determine the existence, preliminary quality-quantity data, and approximate location of mineral deposits having economic feasibility potential for establishing new, or expanded, mineral industries in Georgia.

This report, Project Report No. 9, includes:

(1) Data obtained from core drilling in Chatham County.

(2) Data from holes drilled in Echols, Lowndes, and Lanier Counties to supplement data reported in Project Reports Nos. 2, 3, 4, 5, 6, and 7.

(3) Information from reconnaissance drilling in Jeff Davis, Liberty, Long, Montgomery, Wayne and Wheeler Counties.

(4) The development of a radiation measuring technique to reduce the time required for determining the matrices having the minimum BPL (Bone Phosphate of Lime) that has been selected to qualify a matrix for beneficiation investigation.

PROCEDURE

There were no changes in project procedures from those detailed in Project Report No. 5, and analytical procedures detailed in Project Report No. 6. The distinctly different characteristics of matrices from Chatham County required modifications of flotation techniques and warrant the special discussion under the Chatham County section of this report.

Radiation Technique for Determining Matrices for Beneficiation

A concentration of 9 percent BPL in a matrix has been chosen as the lower limit for selecting core layers for beneficiation studies. Matrices containing less than this concentration are deemed to have no commercial phosphate potential for the foreseeable future. The usual procedure is to take one inch diameter "plugs" at one foot intervals along the core, combine the plugs from a five foot layer (or a 10 foot or a given layer of visually apparent uniformity) and submit the composite representative sample to the laboratory for chemical analysis of BPL content. By this procedure, many samples are submitted, and analyzed, which have zero and well below the 9 percent BPL limit.

The question was raised if a simple and rapid technique could be developed for preliminary screening and save the time and effort in analyzing samples of no commercial interest. The association of uranium with the phosphates is well known and is the basis for indicating existence of phosphorite-containing layers of interest by the gamma-ray hole logging technique. Mr. C. C. Ostrander of Georgia Tech suggested the possibility that laboratory measurements of radiation emitted from a phosphorite sample would be sufficiently accurate for screening purposes.

One pint samples were taken from cores at 5 foot intervals, where possible, and inserted into the chamber of a TMC 400 channel pulse height analyzer. Radiation was counted for 10 minutes at the start of the feasibility study but later was counted for but one minute without any apparent loss of reliability.

It was not intended that the radiation technique would be used as an analytical tool to determine percent BPL. As a preliminary step, however, samples of known BPL content were "counted" and a calibration curve of the relationship established. Then samples at 5-foot intervals from the cores of both Ch-1 and Ch-2 were "counted", the percent BPL read from the curve and compared with the data obtained from chemical analyses of samples representing each 5-foot interval. Correlation was good over a range of BPL content from 0 to 37 percent and merited continuing the study.

The cores had been analyzed for BPL content prior to this study and were selected from those of both the Savannah and Valdosta areas as it was known the phosphorite deposits from these areas are distinctly different. Forty-two (42) samples (□) were counted in the 0.585 to 0.625 mev range and the "counts per minute" plotted against the percent BPL as shown on the log-log graph, Figure 2. The chart was then divided into sections. The horizontal line through 9 percent BPL had already been selected as the minimum BPL content required for further study. The question was "What radiation rate would indicate those samples which should be analyzed directly for BPL by chemical means and not miss any potentially commercial samples?"

An arbitrary level of 10 counts per minute was selected; any sample showing more than this level would then be analyzed chemically and beneficiated if over 9 percent BPL.

The quadrants therefor represent:

Upper Right: Matrices meriting beneficiation for economic evaluation.

Upper Left : A phosphorite sample would have unusually low "associated uranium"; apparently not occurring in Georgia.

Lower Right: Samples merit analysis only.

Lower Left : Matrices do not merit analysis nor beneficiation.

To further check the validity of this technique, 35 more samples were counted, prior to chemical analyses, and then plotted (•) on the chart.

A review of the chart shows that for the 77 samples:

(1) No phosphorite layers of commercial interest were missed by the radiation technique.

(2) Fifty-four samples were shown as having no commercial interest by both methods. (32 samples had less than 1% BPL)

(3) Ten samples were shown as of possible commercial interest by the radiation method but of no commercial interest by the analytical method. (4 samples had less than 1% BPL)

(4) Thirteen samples were indicated as of commercial interest by both methods.

In other words, preliminary screening of these 77 samples would have eliminated 54 (70%) as not meriting analytical laboratory attention.

Remembering that the sample for radiation counting is a point sample; the procedure to determine matrices of interest is:

(1) "Count" samples from each 5-foot depth; or where an interface is observed.

(2) When "counts" exceed 10 per minute, take average samples from core intervals on each side of the high count samples and analyze for BPL content in the analytical laboratory.

(3) Matrices having more than 9.0 percent BPL are submitted for beneficiation and economic evaluation.

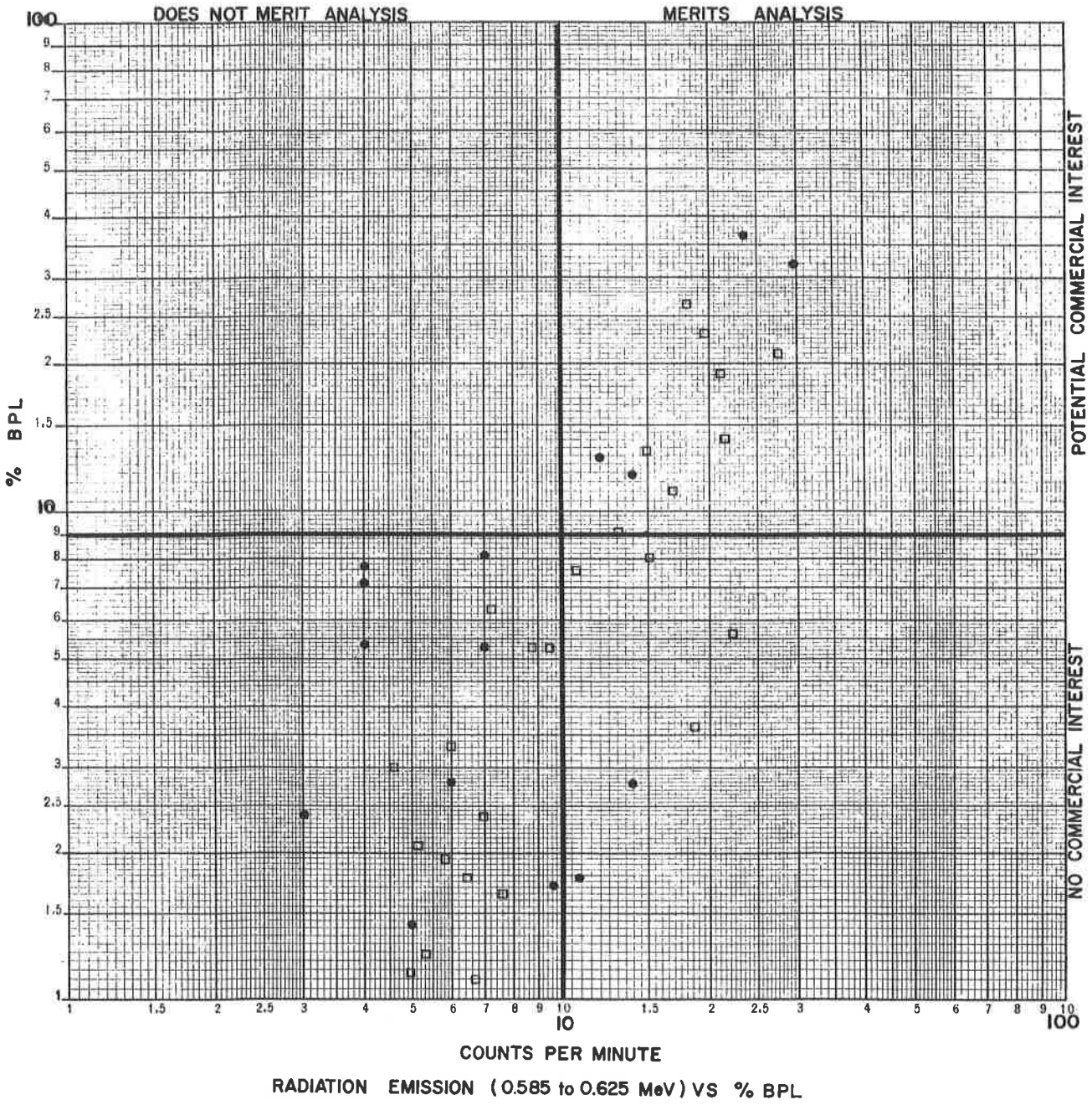

Figure 2. Radiation Emission (0.585 to 0.625 Mev) vs % B.P.L.

RESULTS

Data are presented under the individual counties listed in alphabetical order.

A drill site location map, lithologic logs (Figure 3, "Legend for Lithologic Logs", is used for all lithologic logs), core recovery and BPL content (by chemical analyses), and electric resistivity and gamma-ray logs are given for each hole. "WS" in tables denotes "wash samples" when necessitated by inability to recover satisfactory cores for that interval.

Phosphorite deposits in Chatham County east of Savannah were found to be distinctly different in characteristics from those in South Georgia and those just north in Effingham County. The Chatham County deposits are shown to meet economic criteria for utilization for the manufacture of elemental phosphorous by the electric-furnace process. They did not yield a beneficiated product, even with modifications to the flotation procedure to meet the minimum BPL content currently desired by the wet-acid phosphate fertilizer industry. Calcination of the flotation product will yield a marginal commercial material.

The existence of economically useful phosphorites in Echols County west and north of Statenville (see Project Report Nos. 2 and 4) was confirmed.

The occurrence of high quality deposits, which meet economic criteria, in southwestern Lanier County (see Project Report No. 3) also was confirmed. The area in Lowndes County between these good deposits in Echols and Lanier Counties was found to contain phosphorites of significantly less promise of interest to the fertilizer industry.

Analyses of BPL content showed insufficient levels for current or near future economic interest in holes drilled in Jeff Davis (3), Liberty (1), Long (2), Montgomery (1), Wayne (1), and Wheeler (1) Counties.

A laboratory measurement of radiation emissions from samples was developed and as previously shown is useful in reducing the number of samples submitted to the chemical laboratory for BPL analyses. The method was developed and tested concurrent with drilling reported herein.

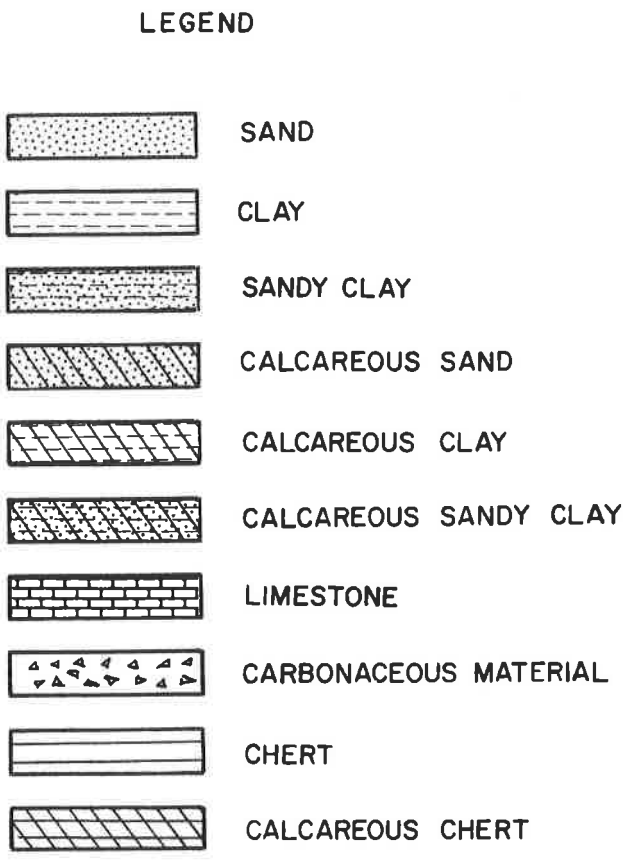

Figure 3. Legend for Lithologic Logs

CHATHAM COUNTY

SUMMARY OF RESULTS

Five holes were core drilled over the area east of the city of Savannah. One core from the western end of McQueens Island was made available by the U. S. Geological Survey. Data on the phosphorite deposits are of exceptional interest. Quantity and quality data show several areas of definite economically feasible utilization for electric furnace operations. The deposits are distinctly different from those of South Georgia and of Effingham County; beneficiation process modifications were necessary, and the product quality showed them suitable for electric furnace use but somewhat low to meet current specifications for wet acid fertilizer grade material. These Chatham County phosphorites appear similar to the North Carolina deposits near Aurora.

In Hole No. Ch-1, four layers of potential commercial interest were found, the first being at 60-70 feet below the surface and the fourth layer at 152-160. In Ch-5, just five miles NNE from Ch-1, only one layer, at 98-101 feet, was found to merit beneficiation. The matrices generally contained unusually high amounts of -150 mesh material, primarily of clays and other finely divided materials. Difficulties in flotation were considered to be due to the presence of hard clay chips which were not dispersed by the usual washing step and to unusually high calcium carbonates concentrations.

Figure CH-1. Location of Holes - Chatham County.

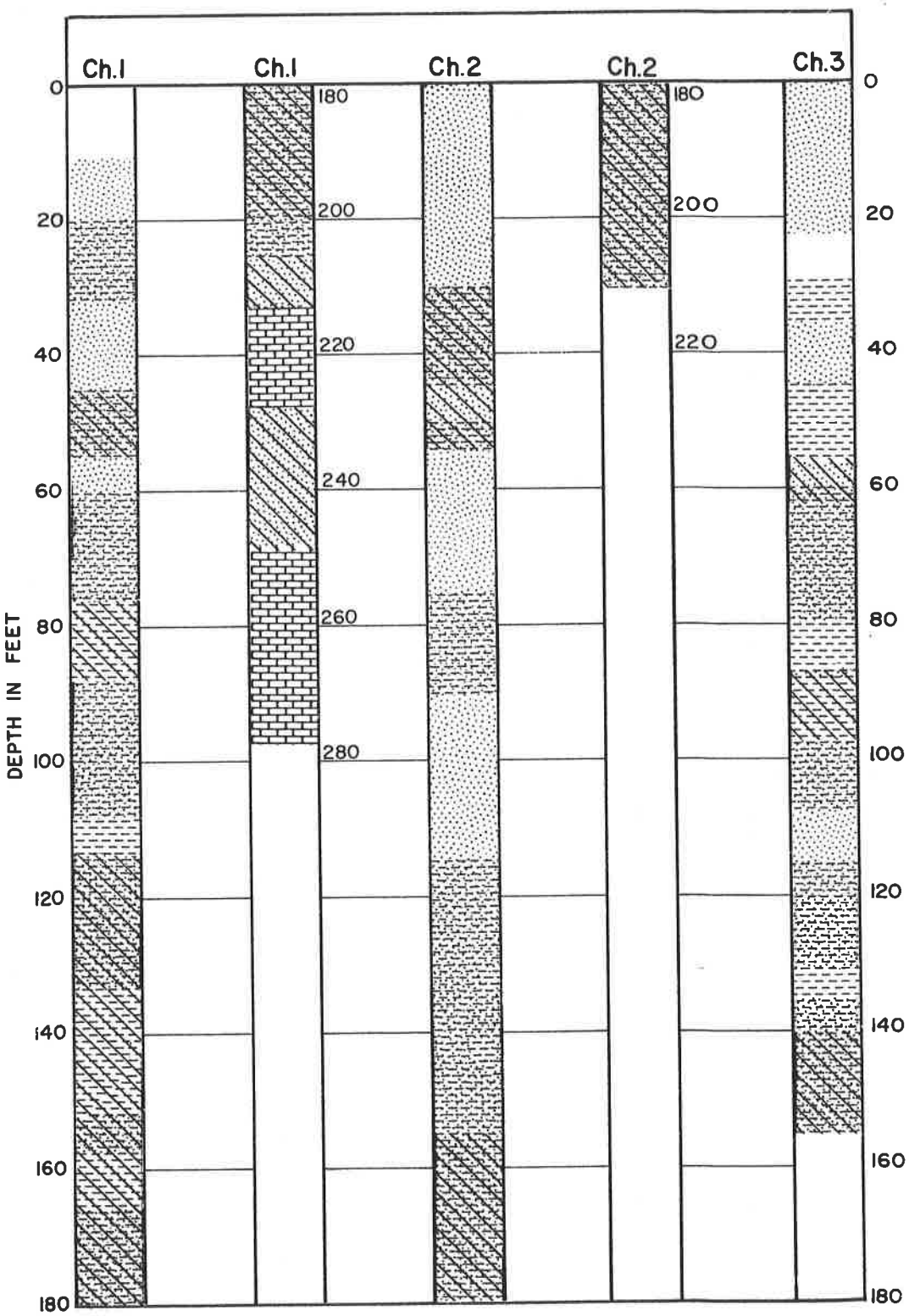

Figure CH-2. Lithologic Logs - Chatham County.

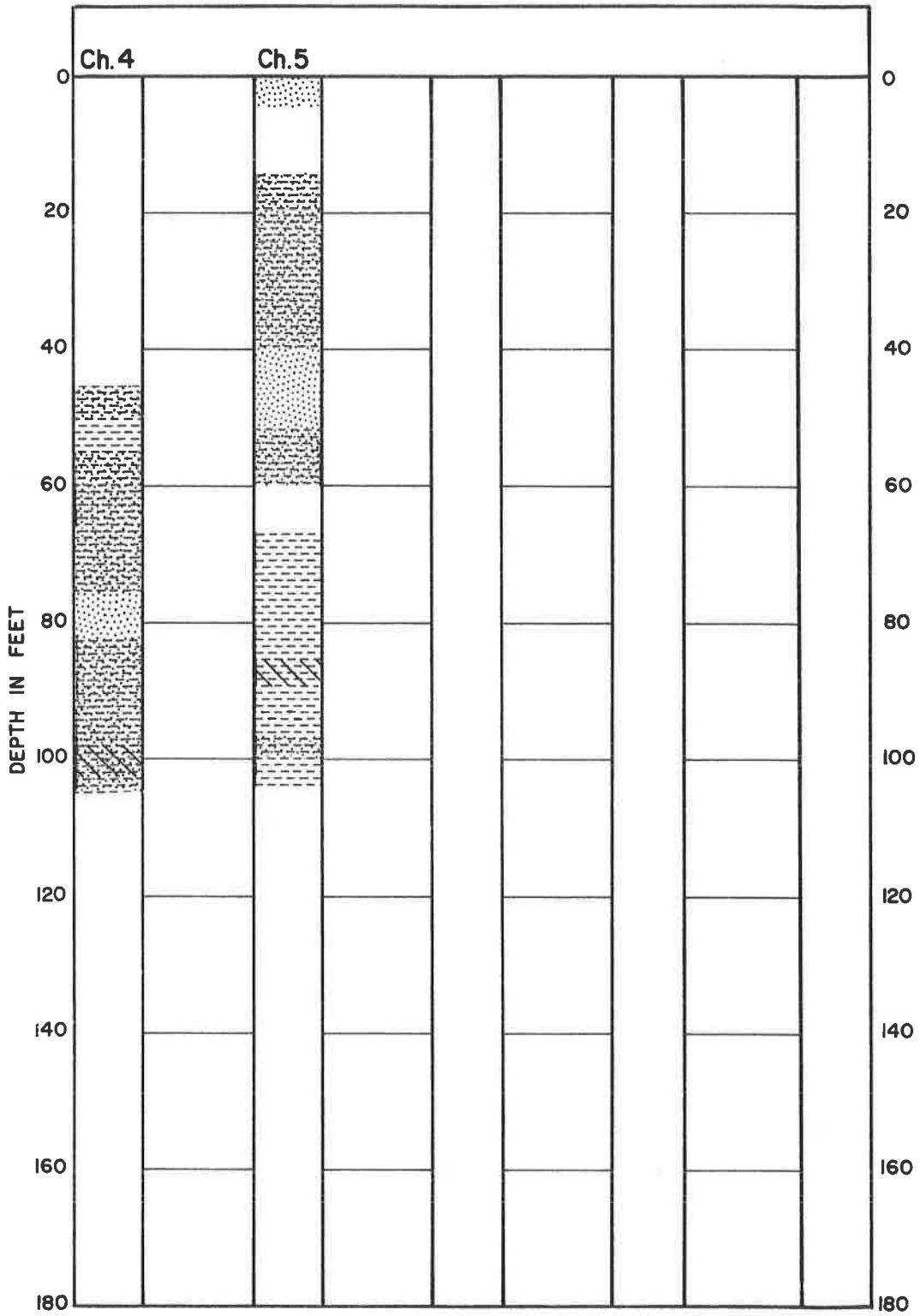

Figure CH-2. Lithologic Logs - Chatham County (Cont.).

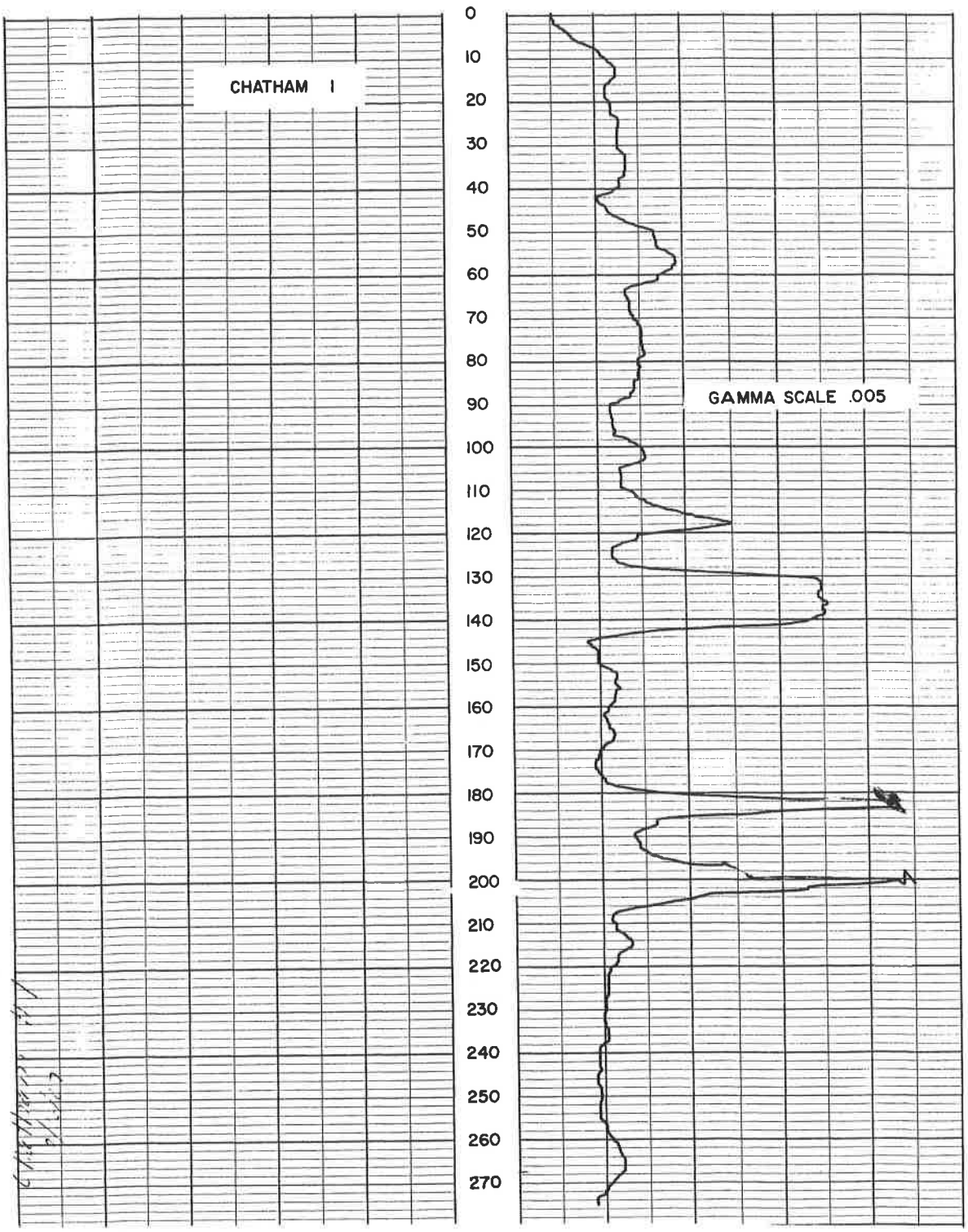

Figure CH-3. Electric and Gamma-Ray Logs - Chatham County Hole Ch-1

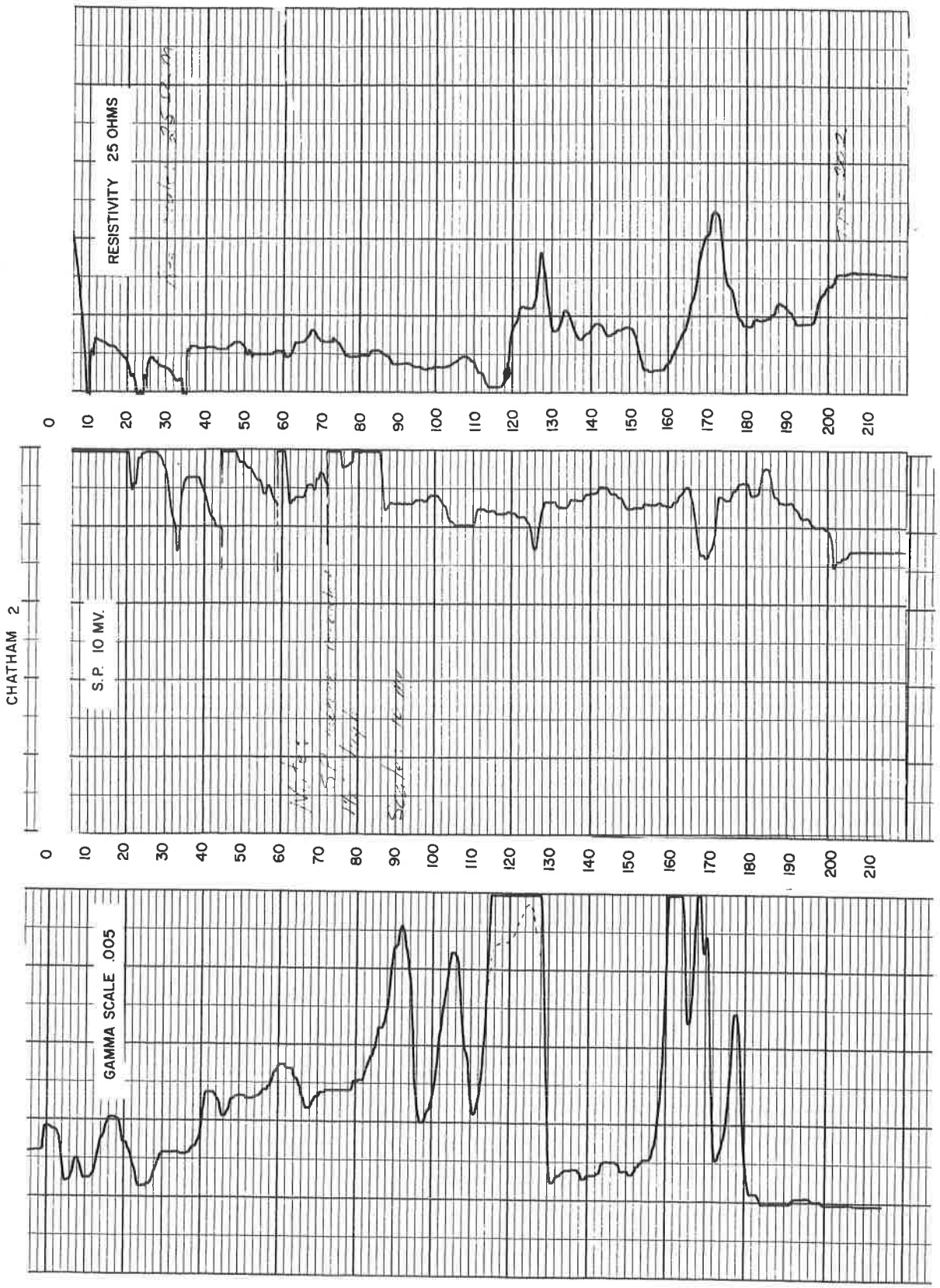

Figure CH-3. Electric and Gamma-Ray Logs - Chatham County
Hole Ch-2

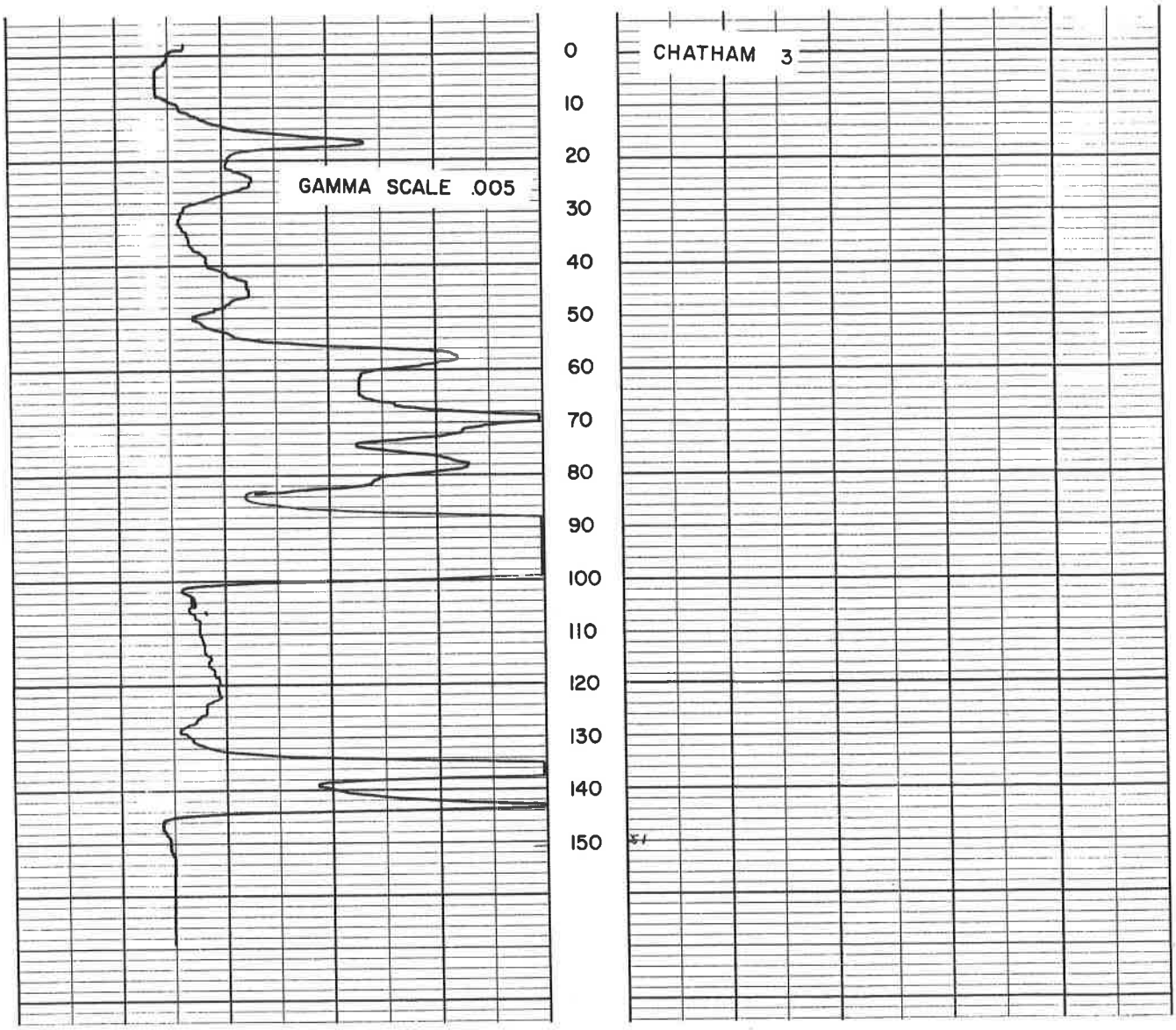

Figure CH-3. Electric and Gamma-Ray Logs - Chatham Hole Ch-3

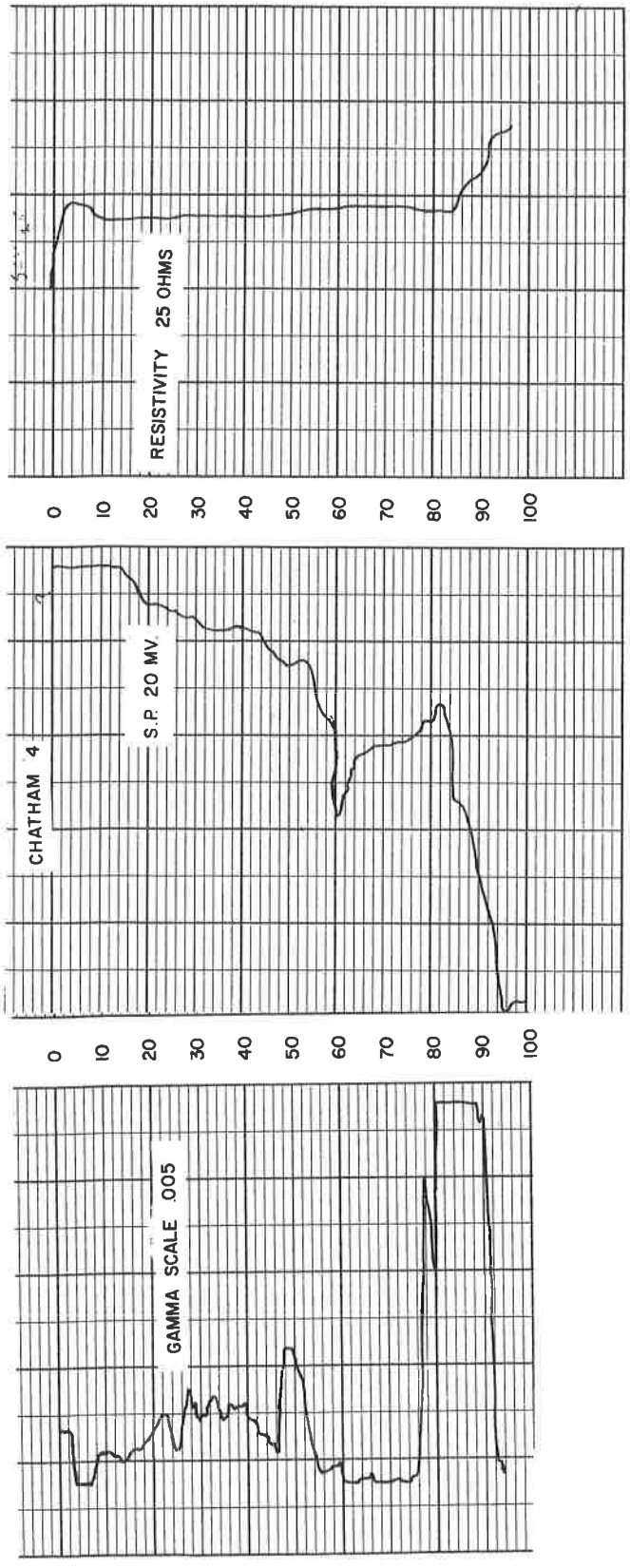

Figure CH-3. Electric and Gamma-Ray Logs - Chatham County
Hole Ch-4

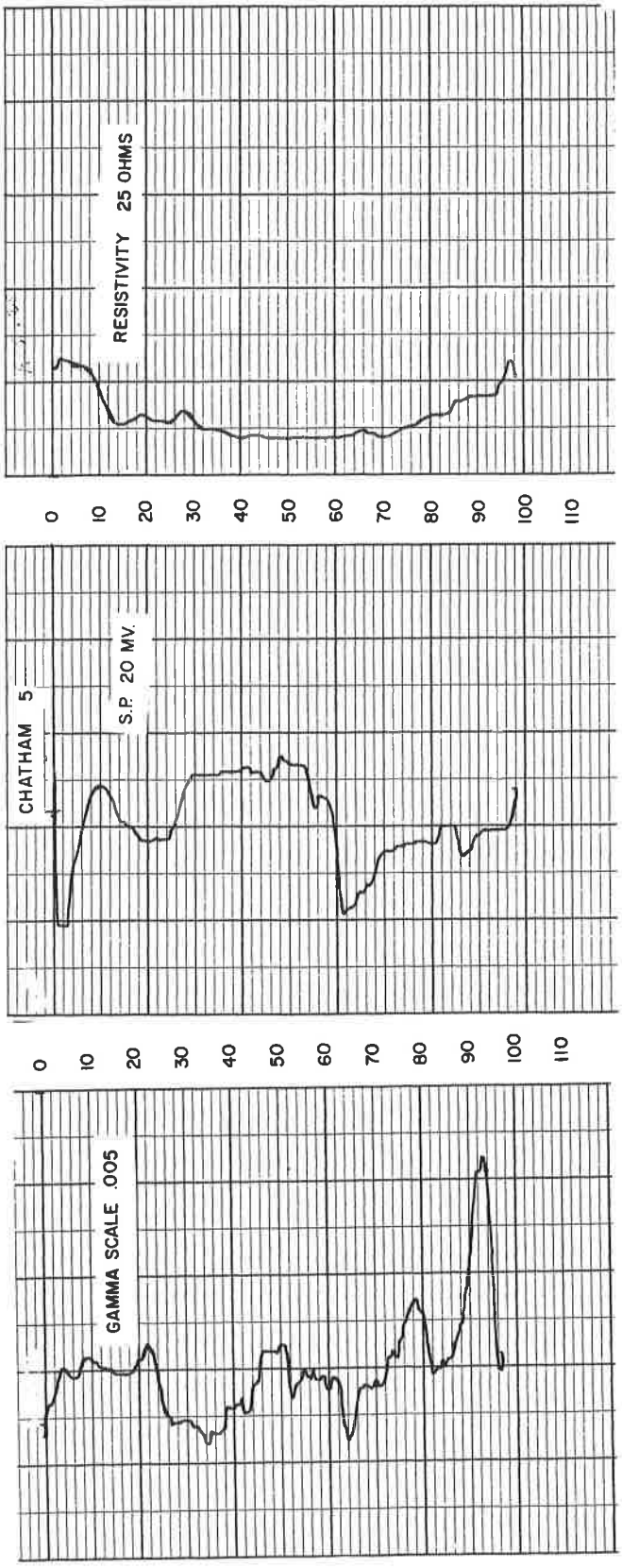

Figure CH-3. Electric and Gamma-Ray Logs - Chatham County
Hole Ch-5

TABLE CH-1

CORE RECOVERIES - BPL DETERMINATIONS ON CORES

Chatham County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Ch-1	12	0-10	Rat Hole	W.S.	0.0
		10-15	3	60	.10
		15-20	5	100	.51
		20-25	4	80	.71
		25-28	3	100	.71
		28-33	5	100	.74
		33-35	2	100	.74
		35-45	8	80	.88
		45-50	5	100	1.04
		50-55	5	100	3.44
		55-60	5	100	6.74
		60-65	5	100	9.58
		65-70	5	100	9.48
		70-75	5	100	6.20
		75-80	4	100	5.12
		80-87	6	85	5.26
		87-92	5	100	4.45
		92-97	5	100	4.62
		97-102	5	100	3.74
		102-107	5	100	55.40
		107-112	5	100	4.35
		112-117	5	100	3.94
		117-122	5	100	11.1
		122-127	5	100	7.92
		127-132	5	100	6.91
		132-137	5	100	25.4
		137-142	5	100	22.8
		142-147	5	100	20.8
		147-152	5	100	4.28
		152-157	5	100	31.5
		157-160	3	100	22.6
		160-165	5	100	4.38
		165-175	8½	85	3.71
		175-185	8	80	3.51
		185-190	5	100	2.90
		190-195	5	100	2.63
		195-200			2.02
		200-205			7.08
		205-208			2.36

(Continued)

TABLE CH-1 (Continued)

CORE RECOVERIES - BPL DETERMINATIONS ON CORES

Chatham County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Ch-1		208-213			1.67
		213-218			1.01
		218-228			2.70
		228-238			.67
		238-243			.33
		243-248			1.34
		248-258			.33
		258-268			.84
		268-278			.16

TABLE CH-1

CORE RECOVERIES - BPL DETERMINATION ON CORES

Chatham County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Ch-2	15	0-5	5	100	0.0
		5-10	5	100	0.0
		10-15	5	100	0.0
		15-20	5	100	0.0
		20-30	2	20	0.0
		30-40	3	30	3.81
		40-45	5	100	1.32
		45-50	5	100	.71
		50-55	5	100	3.68
		55-60	5	100	2.06
		60-65	5	100	1.72
		65-70	5	100	1.55
		70-75	5	100	1.32
		75-80	5	100	2.29
		80-85	5	100	3.03
		85-90	5	100	3.88
		90-95	5	100	4.01
		95-100	5	100	4.15
		100-105	5	100	4.05
		105-110	5	100	10.39
		110-115	5	100	6.78
		115-120	5	100	9.27
		120-125	5	100	6.54
		125-130	5	100	20.57
		130-135	5	100	30.11
		135-140	5	100	30.58
		140-145	5	100	34.30
		145-150	5	100	16.02
		150-155	5	100	2.87
		155-160	5	100	13.79
		160-165	5	100	3.64
		165-200	5	14	.51
		200-205	5	100	.74
		205-210	5	100	.47

TABLE CH-1

CORE RECOVERIES - BPL DETERMINATIONS ON CORES

Chatham County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Ch-3	13	0-5	5	100	0.0
		5-10	5	100	0.0
		10-15	0	0	0.0
		15-23	8	100	0.0
		23-30	0	0	0.0
		30-36	6	100	0.6
		36-40	4	100	0.3
		40-45	5	100	0.7
		45-49	4	100	0.3
		49-53	4	100	1.0
		53-56	3	100	0.5
		56-60	4	100	0.9
		60-63	3	100	2.2
		63-67	4	100	3.9
		67-71	4	100	5.0
		71-75	4	100	5.5
		75-59	4	100	4.6
		79-83	4	100	7.1
		83-87	4	100	30.2
		87-90	3	100	23.0
		90-93	3	100	4.1
		93-97	4	100	29.3
		97-101	4	100	42.0
		101-105	4	100	40.2
		105-108	3	100	38.8
		108-112	4	100	1.3
		112-116	4	100	2.2
		116-120	4	100	1.5
		120-123	3	100	1.9
		123-127	4	100	3.6
		127-131	4	100	3.5
		131-135	4	100	3.4
		135-140	4	100	3.7
		140-145	4	100	9.4
		145-150	5	100	3.6
		150-159	9	100	0.9

TABLE CH-1

CORE RECOVERIES - BPL DETERMINATIONS ON CORES

Chatham County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Ch-4	8	45-50	5	100	.57
		50-55	5	100	.77
		55-65	8	80	.84
		65-75	2	20	0.0
		75-82	4	80	3.20
		82-87	5	100	29.33
		87-90	3	100	38.92
		90-97	5	72	32.24
		97-102	5	100	4.49
		102-104	2	100	1.58
Ch-5	10	0-5	5	100	0.0
		5-15	-	-	-
		15-17	2	100	1.01
		17-28	3	27	.57
		28-35	5	71	0.0
		35-40	5	100	.78
		40-48	5	63	.61
		48-52	4	100	0.0
		52-60	5	63	1.35
		60-67	-	-	-
		67-75	5	50	2.77
		75-79	4	100	4.59
		79-82	3	100	7.35
		82-86	4	100	4.25
		86-90	4	100	5.80
		90-94	4	100	7.01
		94-98	4	100	8.80
		98-101	3	100	31.50
		101-104	3	100	6.91

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-1	Surface Elevation = 12 feet (sea level) Matrix Interval = 60-70 feet									
Total Matrix footage	10										
Dry Density lb/cu ft	57.66										
Percent dry weight	100.0	0.35	1.59	5.90	56.28	5.45	50.82	35.89	12.57	47.85	39.58
Percent BPL	10.05	16.93	12.41	10.52	12.95	16.12	13.42	5.25	63.67	4.01	7.15
Percent acid insol	77.37	72.48	74.42	79.76	79.80	73.71	78.99	73.34	8.88	93.53	88.88
Percent Fe_2O_3	1.53	0.80	1.14	1.06	0.57	0.67	0.46	3.14	0.99	0.24	0.44
Percent Al_2O_3	5.57	2.10	4.03	3.65	3.37	2.69	3.31	9.44	1.23	3.28	3.72
Percent CaO	10.06	18.01	14.52	13.99	11.98	14.78	12.59	6.13	52.47	8.74	8.57

Note 1: Iron and Alumina content of 4X8 and 8X16 are close to 5%.

Note 2: Flotation was slightly difficult. Standard flotation was modified to get clean concentrate. The sand floated in the amine float had to be given a cleaner float to increase recovery of phosphate.

(Continued)

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-1	Surface Elevation = 12 feet (Sea level) Matrix interval = 117-122 feet									
Total Matrix footage	5										
Dry density lb/cu ft	49.19										
Percent dry weight	100.0	0.20	0.45	1.69	34.33	3.58	30.85	63.33	19.01	42.25	38.73
Percent BPL	9.14	24.89	8.84	13.05	14.50	16.56	15.54	6.08	62.99	10.68	4.79
Percent acid insol	70.63	51.30	67.80	61.50	70.70	61.89	67.09	70.92	9.04	69.00	93.37
Percent Fe_2O_3	2.60	2.27	2.90	2.95	1.68	2.69	2.02	3.09	0.65	2.90	0.26
Percent Al_2O_3	9.32	6.84	8.78	8.77	8.00	8.31	7.85	10.06	1.28	8.72	5.14
Percent CaO	10.31	26.93	14.52	16.36	14.17	16.79	15.74	7.97	46.87	6.65	2.27

Note 1: Flotation was difficult. A second sample was run due to a possible mistake in labeling, but results were confirmed.

(Continued)

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-1	Surface Elevation = 12 feet (Sea Level) Matrix Interval = 132-142 feet.									
Total Matrix footage	10										
Dry density lb/cu ft	52.02										
Percent dry weight	00.0	0.08	0.26	2.20	38.91	3.47	35.44	58.55	23.02	75.79	1.19
Percent BPL	26.64	61.74	21.88	18.88	44.51	49.37	45.73	15.03	67.07	36.66	17.74
Percent acid insol	48.97	7.86	47.43	53.92	32.54	20.80	30.53	59.77	7.74	43.39	73.27
Percent Fe_2O_3	1.74	0.84	2.40	2.46	0.61	1.19	0.61	2.46	0.56	0.87	0.48
Percent Al_2O_3	6.35	1.74	6.77	7.42	2.91	3.08	2.63	8.60	1.13	4.04	4.79
Percent CaO	26.50	57.72	24.49	21.16	40.23	44.60	40.23	17.54	35.68	20.29	9.44

Notes: Iron and Alumina contents of 4X8 and 8X16 are more than 5%. Amine flotation very difficult.

(Continued)

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concentrates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-1	Surface Elevation = 12 feet (Sea Level)				Matrix Interval = 152-160 feet					
Total Matrix footage	8										
Dry density lb/cu ft	81.54										
Percent dry weight	100.0	2.17	0.47	2.68	66.91	10.64	56.27	27.77	48.95	47.48	3.57
Percent BPL	30.01	65.85	56.25	33.45	36.32	21.75	38.58	11.23	65.89	6.14	8.70
Percent acid insol	43.07	5.77	14.95	50.49	47.17	67.63	43.86	35.86	5.88	90.58	87.11
Percent Fe_2O_3	0.54	1.02	0.74	0.33	0.24	0.13	0.23	1.24	0.44	0.11	0.41
Percent Al_2O_3	2.66	0.88	1.84	1.65	1.64	1.60	1.78	5.37	0.60	2.60	3.07
Percent CaO	31.48	54.63	52.47	33.41	32.36	20.99	34.11	27.01	59.47	7.34	9.27

Notes: +4 is a composite of 2 samples: One is a chunk of bone and the other is pebble. They were analyzed separately.

	WT,gm	% DRY WT.	% BPL	% A.I.	% Fe_2O_3	% AL_2O_3	% Cao
"BONE"	128.3	1.87	69.20	3.46	1.06	0.72	59.47
"PEBBLES"	20.07	0.30	45.12	20.04	0.78	1.88	24.66
Compos. +4	149.0	2.17	65.85	5.77	1.02	0.88	54.63

Some trouble in the amine flotation.
A sample of a second concentrate was passed thru a magnetic separator with the following results:

Mag. - 31.8gm	7.15% wt.	7.15% AI	63.40% BPL	1.34% AL_2O_3	1.42 Fe_2O_3	51.42 Cao
Non Mag. 410.2gm	92.8 % wt.	6.73% AI	64.41% BPL	0.75% AL_2O_3	0.32 Fe_2O_3	52.12 Cao

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concentrates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-2	Surface Elevation = 15 feet (Sea level) Matrix Interval = 115-120 feet									
Total Matrix footage	5										
Dry density lb/cu ft	77.67										
Percent dry weight	100.0	0.25	0.68	4.75	55.71	4.79	51.07	38.61	13.51	80.79	5.70
Percent BPL	9.51	27.89	32.27	8.19	13.22	12.21	13.08	3.80	63.63	2.26	5.97
Percent acid insol	79.12	57.18	52.12	88.82	80.64	82.49	80.30	76.35	5.71	96.30	91.09
Percent Fe_2O_3	1.67	1.36	0.81	0.24	0.44	0.26	0.43	3.64	0.34	0.17	1.02
Percent Al_2O_3	5.59	0.90	1.96	0.76	1.54	0.94	1.50	12.12	0.80	0.92	2.38
Percent CaO	6.65	18.31	24.84	4.43	8.74	7.00	9.44	3.51	52.47	1.05	3.61

Note: Dereagentization proceeded with effervescence on addition of acid. It was not possible to attain a PH lower than 4.2.
Amine flotation was poor. Since the amount of flotation feed was very small, the products of the test were placed again into the cell and re-floated.

(Continued)

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concentrates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-2	Surface Elevation = 15 feet (Sea Level) Matrix Interval = 125-150 feet									
Total Matrix footage	25										
Dry density lb/cu ft	66.14										
Percent dry weight	100.0	0.26	0.52	1.12	50.51	1.82	48.69	47.59	57.07	25.63	17.31
Percent BPL	25.76	39.76	55.41	52.44	36.22	32.31	39.08	13.63	63.13	4.42	5.87
Percent acid insol	48.74	24.10	13.99	20.84	45.04	51.13	42.86	53.84	6.93	92.40	90.81
Percent Fe_2O_3	1.38	0.38	0.77	0.64	0.31	0.49	0.35	2.55	0.32	0.11	0.19
Percent Al_2O_3	5.06	1.74	1.82	1.41	1.39	1.68	1.85	9.09	0.94	1.38	1.86
Percent CaO	21.69	38.48	46.17	43.38	30.08	26.24	31.83	11.92	52.47	2.45	3.38

(Continued)

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-2	Surface Elevation = 15 feet (Sea Level) Matrix Interval = 155-160 feet									
Total Matrix footage	5										
Dry density lb/cu ft	89.62										
Percent dry weight	100.00	7.14	2.86	2.86	38.93	5.36	33.57	48.21	14.29	50.00	35.71
Percent BPL	14.06	33.92	39.59	35.78	11.67	26.34	9.14	10.25	39.86	2.60	6.31
Percent acid insol	43.15	18.39	15.08	17.94	69.67	31.29	75.44	28.56	3.71	92.08	91.75
Percent Fe_2O_3	0.78	0.68	0.88	0.75	0.41	0.64	0.31	1.09	0.46	0.12	0.46
Percent Al_2O_3	2.01	0.90	0.80	1.08	1.73	1.25	1.83	2.53	0.47	0.96	1.91
Percent CaO	28.33	43.38	43.02	42.32	12.42	34.28	10.14	37.25	54.57	2.68	7.00

Note: Flotation difficult. Dereagentization difficult, buffered at PH6. Required additional washing before amine float.

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concentrates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-3	Surface Elevation = 13 feet (Sea Level) Matrix Interval = 83-90 feet									
Total Matrix footage	7										
Dry density lb/cu ft	57.76										
Percent dry weight	100.0	0.05	0.05	0.43	52.18	4.02	48.16	47.29	61.32	20.38	18.29
Percent BPL	28.02	60.02	57.66	55.07	37.75	47.68	42.25	16.97	65.76	5.63	15.24
Percent acid insol	47.23	7.24	10.22	13.27	35.58	21.04	38.51	60.48	2.03	91.11	76.43
Percent Fe_2O_3	1.34	0.99	0.72	0.89	0.46	1.12	0.64	2.32	0.36	0.09	0.23
Percent Al_2O_3	5.42	1.82	1.77	2.20	2.36	2.98	2.89	8.83	0.76	2.40	3.77
Percent CaO	23.44	48.97	47.22	45.12	35.33	39.88	31.83	10.07	53.17	3.50	9.91

Note: Difficult to float. Required scrubbing before fatty acid flotation.

(Continued)

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-3	Surface Elevation = 13 feet (Sea Level) Matrix Interval 93-108 feet									
Total Matrix footage	15										
Dry density lb/cu ft	73.30										
Percent dry weight	100.0	0.36	0.89	4.06	63.14	10.61	52.53	31.55	57.22	29.40	13.38
Percent BPL	35.41	37.94	53.25	40.43	34.43	24.85	36.08	36.19	60.09	4.32	9.48
Percent acid insol	45.95	24.75	16.87	37.07	48.68	63.08	44.88	42.69	12.95	93.50	85.72
Percent Fe_2O_3	0.74	0.46	0.65	0.51	0.21	0.09	0.27	1.84	0.31	0.09	0.16
Percent Al_2O_3	3.27	1.18	1.55	1.55	1.04	0.88	1.25	8.03	0.94	1.02	1.34
Percent CaO	26.93	37.08	44.07	33.23	27.28	19.24	29.73	24.82	48.27	2.22	5.71

Note: When de-reagentized, the pH reached a buffer value of 4.5. Therefore it was hard to de-oil and performed badly in the amine circuit.

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-4	Surface Elevation = 8 feet (Sea Level) Matrix Interval = 82-97 feet									
Total Matrix footage	15										
Dry density lb/cu ft	80.19										
Percent dry weight	100.0	0.95	0.73	2.15	59.62	7.10	52.52	36.55	51.19	21.77	27.04
Percent BPL	34.40	10.69	41.01	40.94	41.95	23.94	43.91	22.18	66.50	2.90	24.75
Percent acid insol	41.31	22.96	29.05	35.55	38.60	64.90	36.04	46.79	2.68	95.30	62.80
Percent Fe_2O_3	0.64	0.34	0.71	0.41	0.34	0.18	0.34	1.15	0.39	0.10	0.34
Percent Al_2O_3	2.41	0.73	1.67	1.28	1.40	1.26	1.44	4.18	0.71	1.34	2.36
Percent CaO	28.33	28.33	35.68	32.18	32.88	17.84	33.93	20.53	52.47	1.05	18.89

TABLE CH-2

MATRIX BENEFICIATION RESULTS

Chatham County

	Feed	+4	4X8	+16* 8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ch-5	Surface Elevation = 10 feet (Sea Level) Matrix Interval = 98-101 feet									
Total Matrix footage	3										
Dry density lb/cu ft	64.16										
Percent dry weight	100.0	0.00	0.00	0.68	49.32	3.81	45.51	50.00	71.54	10.15	18.31
Percent BPL	31.16	0.00	0.00	67.54	48.16	64.88	47.85	13.89	66.30	20.84	6.27
Percent acid insol	44.07	0.00	0.00	2.13	28.45	4.69	27.24	60.05	2.12	63.84	89.50
Percent Fe_2O_3	1.63	0.00	0.00	0.50	0.60	0.44	0.49	2.66	0.46	0.94	0.30
Percent Al_2O_3	5.32	0.00	0.00	0.62	2.52	0.69	2.26	8.15	0.73	4.00	3.72
Percent CaO	25.88	0.00	0.00	52.30	38.13	51.77	38.13	13.44	52.47	15.74	4.20

*Note: The amount of +4 and 4X8 was very small, 0.7 and 2.6 gm respectively, therefore, they were included and analyzed as +16.

TABLE CH-3

ECONOMIC FACTORS - FIGURES OF MERIT

Chatham County

ITEM	UNIT (M=1000)	HOLE NO. Ch-1					Ch-2				Ch-3			Ch-4	Ch-5
Matrix No.:		First	Second	Third	Fourth	Combined	First	Second	Third	Combined	First	Second	Combined		
Matrix Interval, Ft.:		60-70	117-122	132-142	152-160		115-120	125-150	155-160		83-90	93-108		82-97	98-101
ECONOMIC FACTORS *															
* Overburden,	ft	60	47	10	10	127	115	5	5	125	83	3	86	82	98
Overburden,	MT/Ac	117.6	92.1	19.6	19.6	248.9	225.4	9.8	9.8	245	162.7	5.9	168.6	160.7	192.1
* Matrix,	ft	10	5	10	8	33	5	25	5	35	7	15	22	15	3
Matrix,	MT/Ac	12.6	5.4	11.3	14.2	43.5	8.5	36	9.8	54.2	8.8	23.9	32.7	26.2	4.2
* BPL in Matrix,	%	10.0	9.1	26.6	30.0	20.8	9.5	25.8	14.1	21.1	28.0	35.4	33.4	34.4	31.2
BPL in Matrix,	MT/Ac	1.3	.5	3.0	4.3	9.0	.8	9.3	1.4	11.5	2.5	8.5	10.9	9.0	1.3
* Overburden/Matrix,	Ratio	6.0	9.4	1.0	1.3	3.9	23.0	.2	1.0	3.6	11.9	.2	3.9	5.5	32.7
Wash-Screen Products															
+16 Mesh	MT/Ac	1.0	.1	.3	.8	2.2	.5	.7	1.3	2.4	.05	1.3	1.3	1.0	.03
-16+150	MT/Ac	7.1	1.8	4.4	9.5	22.8	4.7	18.2	3.8	26.7	4.6	15.1	19.7	15.6	2.1
-150 (Loss)	MT/Ac	4.5	3.4	6.6	4.0	18.5	3.3	17.1	4.7	25.1	4.2	7.6	11.7	9.6	2.1
* Flotation Concentrate Product	MT/Ac	.9	.3	1.0	4.7	6.9	.6	10.4	.5	11.6	2.8	8.7	11.5	8.0	2.0
Total Useful Products*	MT/Ac	1.9	.5	1.3	5.4	9.1	1.1	11.1	1.8	14.0	2.9	9.9	12.8	9.0	1.5
BPL Recovery															
+16 Mesh	MT/Ac	.1	.01	.06	.4	.6	.06	.4	.5	.9	.03	.5	.6	.3	.02
* -16+150 (Flot. Conc.),	% BPL	63.7	63.0	67.1	65.9	-	63.6	63.1	39.9	-	65.8	60.1	-	66.5	66.3
-16+150 (Flot. Conc.),	MT/Ac	.6	.2	.7	3.1	4.5	.4	6.6	.2	7.2	1.9	5.2	7.1	5.3	1.0
* Total	MT/Ac	.7	.21	.76	3.5	5.1	.46	7.0	.7	8.1	1.93	5.7	7.7	5.6	1.02
* Recovered from Matrix	%	53.6	48.4	24.5	80.5	56.3	57.5	1.0	4.5	70.1	76.2	67.7	69.6	62.7	76.6
* Overburden/Products	cu yd/T	80.7	.3	21.4	3.3	33.7	.2	1.0	4.5	18.3	73.0	1.0	14.3	16.5	77.0
* Matrix/Products	cu yd/T	8.6	17.0	12.4	2.4	5.9	7.2	3.6	4.5	7.2	3.9	2.4	2.8	2.3	3.2
* I+A in Flot. Conc.	%	2.2	1.9	1.7	1.0	1.7	1.1	1.3	1.0	1.2	1.1	1.3	1.2	1.1	1.2
FIGURES OF MERIT	Unit	Econ. Level													
Overburden	ft	88 max	1.5	1.9	8.8	8.8	.7	.8	17.6	17.6	.7	1.1	29.3	1.0	1.1	1.0
Matrix	ft	3 min	3.3	1.7	3.3	2.7	11.0	1.7	8.3	1.7	11.7	2.3	5.0	7.3	5.0	1.0
BPL in Matrix	%	10 min	1.0	.9	2.7	3.0	2.1	1.0	2.6	1.4	2.1	2.8	3.5	3.3	3.4	3.1
BPL in Flot. Conc.(1)	%	66 min	1.0	1.0	1.0	1.0	1.0	1.0	1.0	.6	.9	1.0	.9	.9	1.0	1.0
BPL in Flot. Conc.(2)	%	52 min	1.2	1.2	1.3	1.3	1.3	1.2	1.2	.8	1.2	1.3	1.2	1.2	1.3	1.3
Overburden/Matrix	Ratio	2 max	.3	.2	2.0	1.6	.5	.1	10.0	2.0	.6	.2	10.0	.5	.4	.1
Overburden/Products	cu yd/T	17.5 max	.2	.1	.8	5.3	.5	.1	17.6	3.9	1.0	.2	29.2	1.2	1.1	.1
I+A in Flot. Conc.	%	5 max	2.3	2.6	3.0	4.8	2.9	4.4	4.0	5.4	4.2	4.5	4.0	4.1	4.6	4.2
Products Recovery	T/Ac-ft	400 min	.5	.2	.3	1.7	.7	.6	1.1	.9	1.0	1.0	1.7	1.5	1.5	1.3
BPL (+150) Recovery	%	63 min	.9	.8	.4	1.3	.9	.9	1.2	.8	1.1	1.2	1.1	1.1	1.0	1.2
Matrix/Products	cu yd/T	6 max	.7	.4	.5	2.5	1.0	.8	1.7	1.3	1.5	1.5	2.5	2.2	2.2	1.9

(1) For wet acid process. (2) For electric furnace process. * Sum of +16 mesh and flotation concentrate.

NOTES: Overburden based on dry density @ average = 90 lb./cu. ft. Matrix factors based on actual dry density.
Factors used: ft. thickness x 1613 = cu. yd./Ac; cu. yd x 1.215 = T(2000 lb.); ft. x 1960 = T(2000 lb.)/Ac.

Flotation of Phosphorites

The Chatham County matrices of interest were unusual in their response to flotation. The current industrial beneficiation process, as has been detailed in prior reports, consists of washing and wet screening to remove the -150 mesh material (slimes) and then flotation of the 16X150 mesh material as follows:

Step 1: Fatty Acid Flotation (Conditioning). A fatty acid soap and diesel oil are added at a pH of 8.5 to 9.0 to the matrix and passed through a flotation cell. The phosphorites "float" and the tailings (sands) are discarded.

Step 2: Dereagentization. The phosphorites' rough concentrate from Step 1 is adjusted with sulphuric acid to a pH of about 3, and the slurry thoroughly mixed. The reagents separated from the mineral grains are decanted and the de-reagentized solids washed with fresh water to eliminate traces of both acid and reagents from the mineral grains.

Step 3: Amine Flotation. The material is readjusted to a pH of 7, an amine acetate and diesel oil added, the sands float off while the tailings are the desired phosphorite concentrate.

It may be noted that the phosphorites are in the froth float product from Step 1 and in the tailings product from Step 3. In neither of the two flotation steps is separation complete. Economic considerations usually determine the amounts of reagents to add, because, within a given range, the recovery of product is a function of the amount of reagent.

Clays usually are finely divided and are removed in the -150 mesh (slime) product from the washing step. The Chatham County matrices contained a quantity of clay chips, with a size distribution similar to the sand and phosphorites. It also appears that these chips had a high calcium content.

The chips were sufficiently hard to resist dispersion during washing and yet flaked during the dereagentizing and amine flotation steps. Comments on the effects of the presence of these clays and procedure modifications found necessary follow:

Washing. Normal washing did not break-up the clay chips. Scrubbing was needed to disperse most of the clays for removal as slimes.

Fatty Acid Flotation. The unusually high calcium content of the clays probably induced positive charges on the surface so that the fatty acid could coat the clay which would then float along with phosphorites. Vigorous scrubbing and desliming (screening through 150 mesh screens) was needed to obviate inclusion of clays entering subsequent steps and to reduce the amount of fatty acid-diesel oil reagents needed.

Dereagentization. Excess sulphuric acid was required for pH adjustment due to chips which apparently also contained carbonates (high calcium content.) The sulphuric acid plus the mechanical mixing may strip the surface of clay particles of all positive charges restoring the normal negative charges and hence the clays would float off with the sands in the amine flotation step.

Amine Flotation. Clays in the dereagentized product are undesirable for several reasons: they have a large surface area and consume large amounts of reagents; they may be adsorbed on the phosphorite surfaces rendering them floatable with consequent loss of desired phosphorite tailings product.

Conclusions. Concentrates with optimum feasibility were obtained with these Chatham County matrices when the following procedure was adopted:

Step 1. Scrubbing and desliming (wet screening through 150 mesh screen.

Step 2. Fatty Acid Flotation (Conditioning)

Conclusions (cont.)

Step 3. Dereagentization

Step 4. Scrubbing and Desliming.

Step 5. Amine Flotation. Larger amounts than usual of amine and oil are required.

Review of data - Chatham County

The phosphorite deposits of northeastern Chatham County should attract high-level interest from industry, particularly the producers of elemental phosphorous (electric furnace). They are of unusual mineralogical-geological interest because they differ from phosphorites found to date in other locations in Georgia. Their dark color, relatively small amounts of pebble phosphate, high iron and aluminum content, presence of clay "chips", and need for a modified beneficiation process to obtain a concentrate at, or nearly so, the lower limit of BPL content desired for wet phosphoric acid manufacture, all point to the distinctive nature of this field. Fossil content also appears to be higher. X-ray diffraction data indicates increase in the "C" axis parameter of the unit cell.

Layers of phosphorites of potential industrial interest were generally in good thickness (5 to 25 ft.) while the number of such layers varied from four in Ch-1 to one in Ch-4 and Ch-5. The BPL concentration in the matrices increased and the matrices came closer to the surface in going northward and eastward. In place concentration as high as 40 percent BPL were found, highest of any deposits found to date. These trends focus attention on the Wilmington Island, Little Tybee Island and Savannah Beach area. The marsh lands in this region would impose mining and production and water table difficulties.

Dry bulk densities of matrices varied from 50 to 80 lb. per cu. ft.. The relatively high iron and aluminum, usually associated with clays, persisted even in the flotation concentrate. A sample of concentrate from Ch-1, for the 152-160 foot layer, showed about 7 percent separable by a magnetic separator, with but minor differences, other than iron and aluminum, in the composition of the separate fractions. This would indicate that paramagnetic minerals formed part of the nodules.

A modified flotation procedure was found necessary, and produced a clean concentrate with BPL content of about 66-67 percent, except in Ch-2, which was 63-66 percent. Calcining of these products at 900°F for one-half hour raised the BPL about 6 percent.

ECHOLS - LANIER - LOWNDES COUNTIES

Objectives

Phosphorite deposits of probable economic interest had been noted as occurring in Western Echols County (Project Report No's 2 and 4) and of particular noteworthiness in southwestern Lanier County (Project Report No. 3). The Lanier County "find" is slightly west of due north from the Echols County field, hence an inference might be made that the trend of deposits of interest would run through western Echols and curve northeastward somewhat paralleling the coast, and eventually tie-in with the South Carolina and coastal North Carolina deposits. It was noted, however, that the results from cores from holes Lo-6 and Lo-7, in Lowndes County between western Echols and southwestern Lanier had not shown the economic potential which could have been expected.

The reconnaissance study of the Southern Railway System (Project Report No. 4) employed a wash-sampling technique which gave drill cuttings of a composite 5-foot drilling interval. This technique is relatively fast as compared to core drilling, does not give an in-site core section of the earth and geologic structure data are less accurate. Also finely divided particles are washed away from the sample before analysis, so that compositions determined are based on a coarser sample rather than on an as-is basis. Coarser phosphorite in clay would yield too high results whereas finely dissiminated phosphorite would yield low results. Yet it appeared that phosphate determinations on drilling vs coring samples were different by only about two percent. If this unexpectedly small difference was confirmed, it was felt that the faster drilling procedure could be used where structural information was not of immediate concern and reconnaissance for phosphates only was the objective.

For these reasons, supplemental core drilling in Lanier, Lowndes and Echols Counties was carried out, and the results included in this section of the report.

RESULTS

Echols County

Figures Ec-1, Ec-2, and Ec-3 present respectively the location, the lithologic and electric and gamma-ray logs of the three supplemental holes core-drilled in western Echols County. Hole no. Ec-15 caved in before the electric and gamma-ray probe could be used.

Table Ec-1 gives the core recoveries and the BPL content of core intervals in Echols County. Table Ec-2 presents the results of flotation beneficiation of matrices of interest, while Table Ec-3 shows the economic factors and figures of merit. Hole Ec-15, did not contain a matrix of potential economic interest.

Discussion of Results

Economic factors and figures-of-merit for hole Ec-17 are exceptionally high, even somewhat superior to La-1 (Lanier County). While data are insufficiently complete to make a factual interpretation, it appears that in and east of Statenville phosphorites occur at sea-level elevation, of 50 or less to about 60 feet with an in-site concentration of roughly 9 percent BPL, to the west of Statenville approximately along the Alapaha River, at sea elevations of 80-110 feet phosphorites occur in increasingly thick layers and with higher concentrations in a north westerly direction, with BPL content of 20-26 percent in a 15 foot layer starting but 35 feet below the surface. It is likely that the area around, and west and north of Ec-17 would receive greater industrial interest. The figures-of-merit for Ec-17 are for a layer thickness of 40 feet, and includes a five foot layer (50-55 feet) of but 12 percent BPL.

Core Sampling vs Drill Cuttings

Hole Ec-17 was core drilled within approximately 60 feet of Southern Railway Hole E-45 and permits a comparison of results from core drilling with drill cuttings (wash-sampling) techniques.

Table Ec-4 presents the respective BPL contents at the same depth intervals. With the wash-sampling technique it is acknowledged that some of the small particle sized clays are washed away, thus concentrating the sample which would result in higher percentage composition of remaining materials. On this basis, the differences in BPL content in the layers from 25 to 55 feet are understandable. The large difference in the layer from 50 to 55 feet appears unusually high and can be interpreted only as being due to a marked increase in the clay content. A lithologic description for E-45 was not included in Project Report No. 2. A log for E-44, the closest "E" hole to E-45 and 3/4 mile southwest of E-45 shows predominatly clays starting at 50 feet. The reverse

differences in BPL content in the layers from 55 to 65 feet can be explained only by a supposition that the particle size of the phosphorites decreased sharply and were disproportionately washed out with the clay. These certainly are specious arguments and clearly questionable.

It is however noted that the weighted average of BPL content by the wash-sampling technique is five percent higher than by core sampling, a difference which could be decisive in an evaluation. Project Report No. 4 had indicated a difference of about two percent. Because wash-sampling alone produces an unpredictable loss of fine material (clay or BPL) it appears that this technique is applicable primarily where concentrated drilling is used to "block-out" acreage where coring has established control.

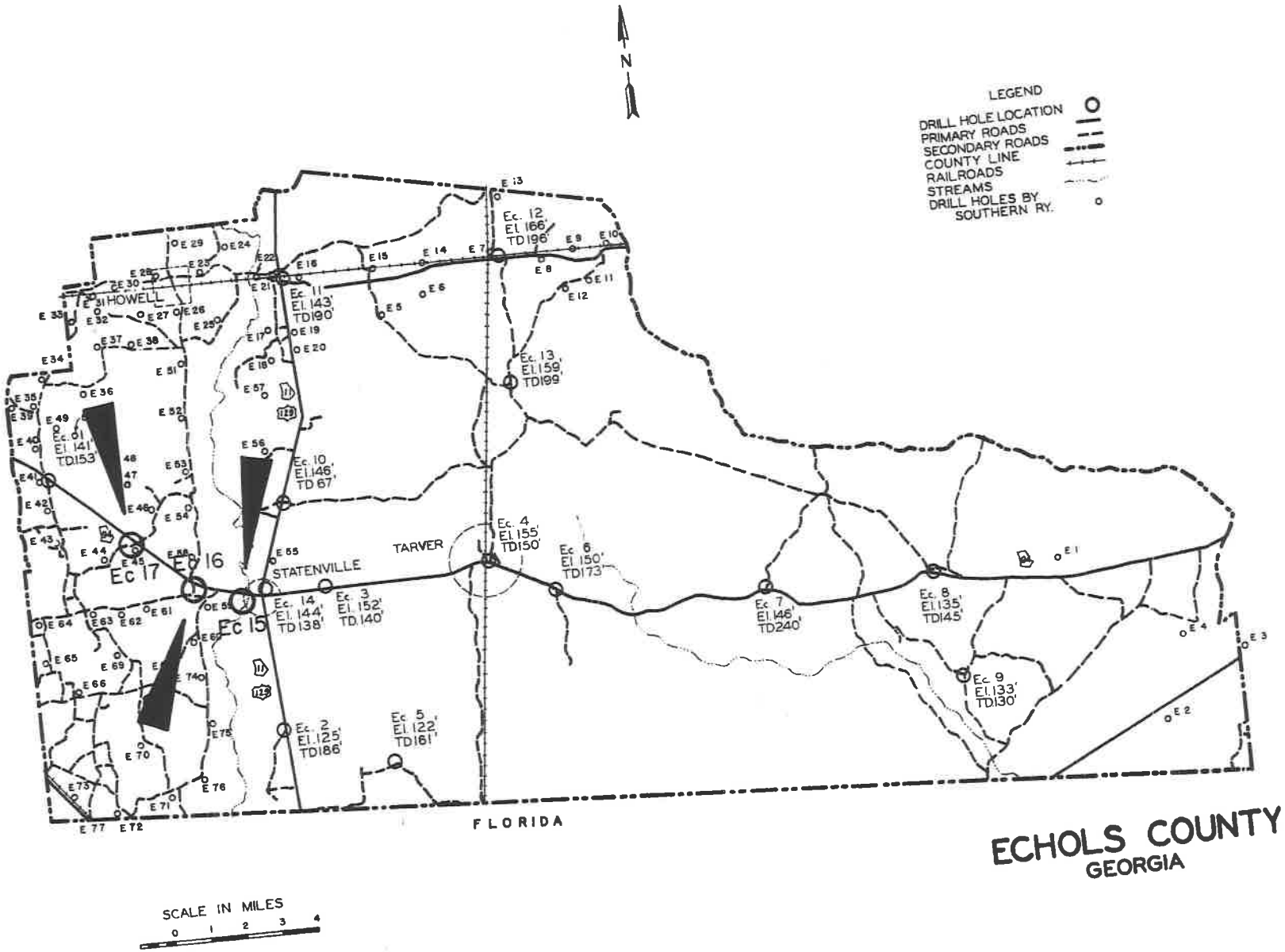

Figure EC-1. Location of Holes - Echols County

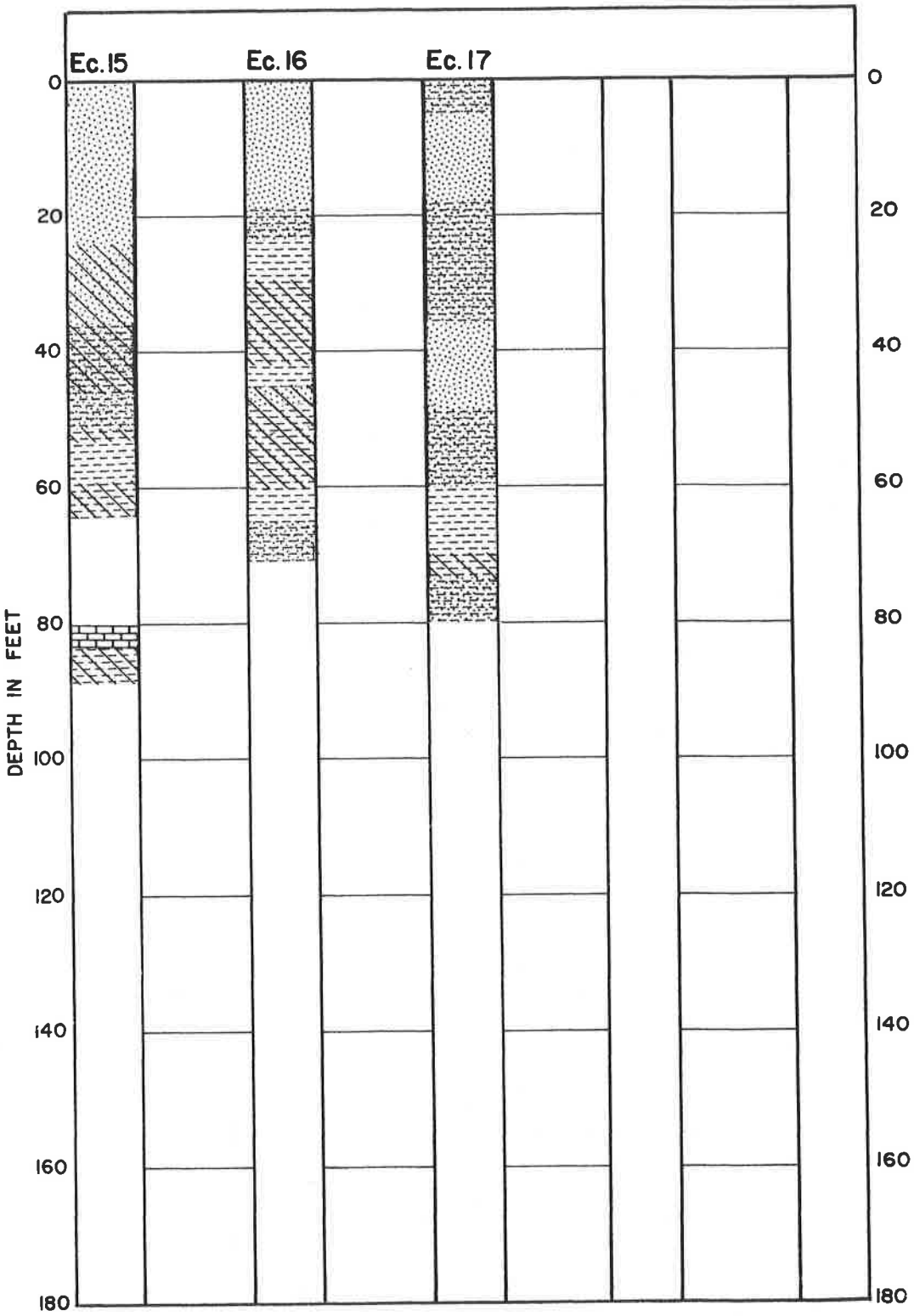

Figure EC-2. Lithologic Logs - Echols County

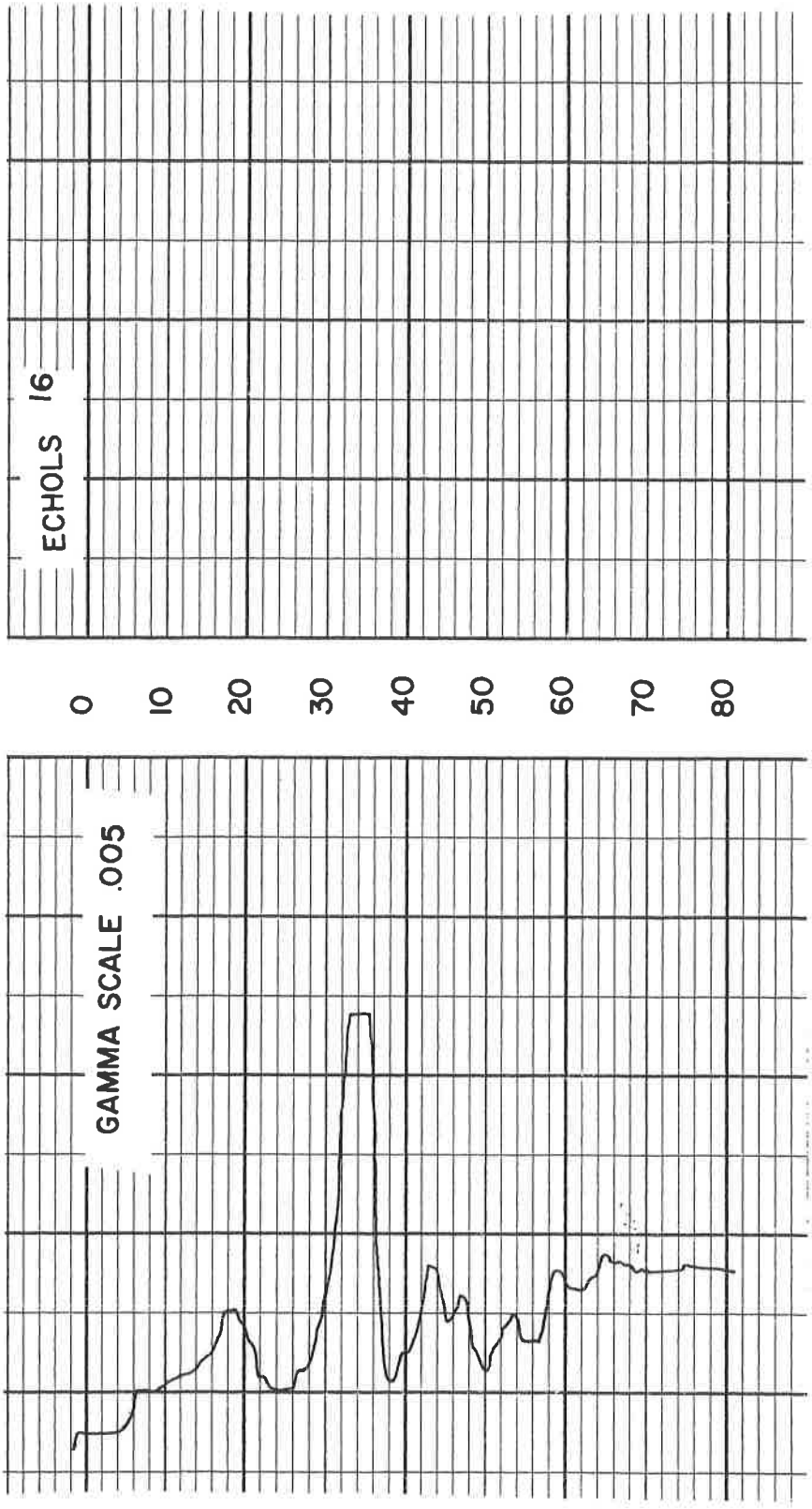

Figure EC-3. Electric and Gamma-Ray Logs - Echols County
Hole Ec-16

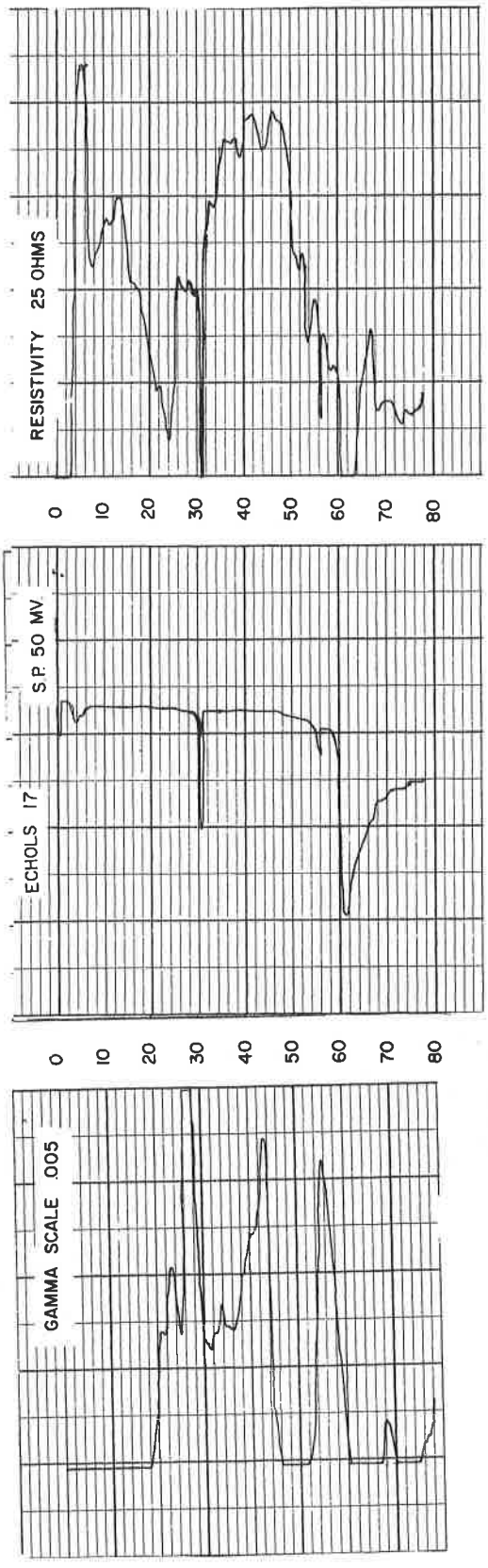

Figure EC-3. Electric and Gamma-Ray Logs - Echols County
Hole Ec-17

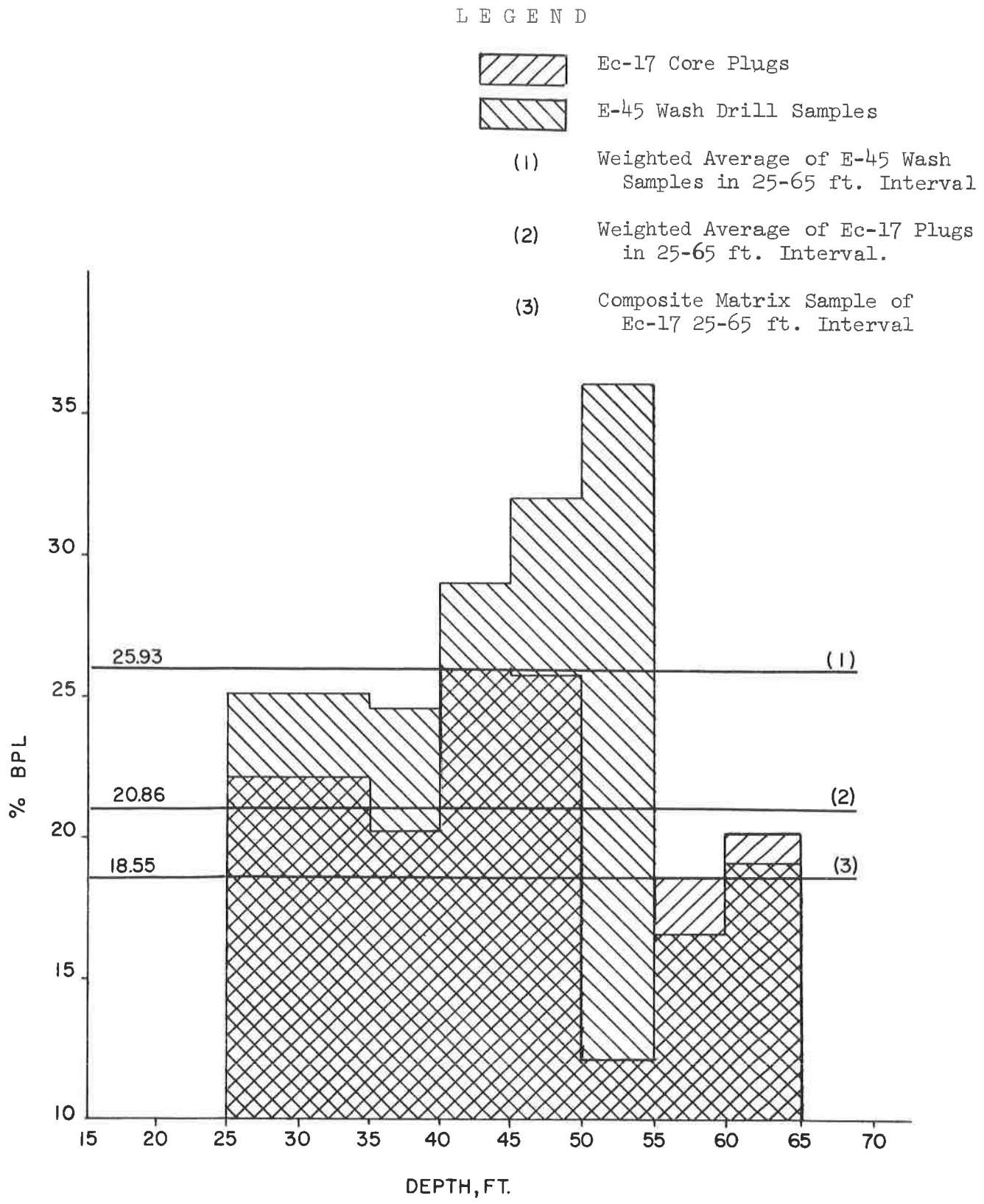

Figure EC-4 Comparison of Results Obtained by Drilling in Well No. Ec-17 and Wash Drilling in Well No. E-45.

TABLE EC-1

CORE RECOVERIES - BPL DETERMINATION ON CORES

Echols County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Ec-15	106	0-5	5	100	0.0
		5-10	5	100	0.0
		10-18	6	75	0.0
		18-23	4	80	10.0
		23-30	4	56	2.4
		30-35	2	40	0.9
		35-45	6	60	4.0
		45-47	2	100	1.3
		47-50	3	100	1.7
		50-52	2	100	3.2
		52-54	2	100	9.0
		54-58	4	100	3.9
		58-60	2	100	3.3
		60-63	3	100	2.9
		63-79	-	-	-
		79-82	3	100	0.5
		82-87	1	20	0.6
Ec-16	120	0-5	5	100	0.0
		5-10	5	100	0.0
		10-15	5	100	0.0
		15-16	1	100	0.0
		16-19	3	100	3.4
		19-24	5	100	1.8
		24-29	5	100	2.3
		29-34	5	100	3.0
		34-38	4	100	4.0
		38-42	4	100	18.5
		42-45	3	100	4.3
		45-48	3	100	3.3
		48-54	6	100	1.5
		54-55	1	100	1.5
		55-60	4	80	1.9
		60-64	4	100	0.3
		64-65	1	100	1.9
		65-70	5	100	3.2

(Continued)

TABLE EC-1

CORE RECOVERIES - BPL DETERMINATION ON CORES

Echols County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Ec-17	146	0-5	5	100	0.0
		5-10	5	100	0.3
		10-15	5	100	0.0
		15-18	3	100	0.0
		18-25	2	30	0.0
		25-35	5	50	22.1
		35-40	4	80	20.2
		40-45	4	80	25.9
		45-50	4	80	25.8
		50-55	5	100	12.1
		55-60	5	100	18.6
		60-65	5	100	20.1
		65-70	5	100	5.4
		70-74	3	75	2.5
		74-76	2	100	8.6
		76-80	5	100	1.3

TABLE EC-2

MATRIX BENEFICIATION RESULTS

Echols County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ec-16	Surface Elevation = 120 feet (sea level)						Matrix Interval = 38-42 feet			
Total matrix footage	4										
Dry density lb/cu ft	66.90										
Percent dry weight	100.0	6.04	6.49	7.59	33.73	9.45	24.28	46.14	14.11	68.80	17.10
Percent BPL	18.38	32.20	42.32	33.96	18.48	18.88	15.01	10.57	64.41	11.13	10.62
Percent acid insol	43.79	12.76	17.31	29.10	67.29	63.83	68.72	36.82	6.34	78.90	83.99
Percent Fe_2O_3	1.78	1.30	1.69	1.40	0.86	0.82	0.92	2.59	2.27	0.48	0.84
Percent Al_2O_3	3.25	0.83	1.00	1.26	1.54	1.14	1.93	5.46	0.77	1.26	1.78
Percent CaO	13.99	25.71	25.71	21.34	9.09	10.49	8.74	13.18	32.88	5.25	3.50

(Continued)

TABLE EC-2

MATRIX BENEFICIATION RESULTS

Echols County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Ec-17	Surface Elevation = 146 feet (sea level)					Matrix Interval = 25-65 feet				
Total Matrix footage	40										
Dry density lb/cu ft	90.20										
Percent dry weight	100.0	1.39	3.78	4.91	67.63	12.98	54.65	22.28	12.09	80.52	7.39
Percent BPL	18.55	67.10	64.75	45.52	9.44	12.14	9.10	29.38	74.18	0.67	6.74
Percent acid insol	74.33	9.61	13.02	39.33	88.17	84.42	88.42	54.48	3.74	98.07	90.99
Percent Fe_2O_3	0.74	0.90	0.61	0.57	0.20	0.12	0.16	2.43	0.84	0.02	0.95
Percent Al_2O_3	3.06	1.18	1.58	1.30	1.38	0.77	1.50	8.92	1.58	0.69	2.07
Percent CaO	6.70	31.66	30.43	20.64	2.80	4.20	2.80	9.88	34.98	0.00	1.40

EC-3

ECONOMIC FACTORS - FIGURES OF MERIT

Echols County

ITEM	UNIT (M=1000)	HOLE NO. Ec-16	Ec-17
Matrix No.:		First	First
Matrix Interval, Ft.:		38-42	25-65
ECONOMIC FACTORS			
* Overburden,	ft	38	25
Overburden,	MT/Ac	74.5	49
* Matrix,	ft	4	40
Matrix,	MT/Ac	5.8	78.6
* BPL in Matrix,	%	18.4	18.6
BPL in Matrix,	MT/Ac	1.1	14.6
* Overburden/Matrix,	Ratio	9.5	.6
Wash-Screen Products			
+16 Mesh	MT/Ac	1.2	7.9
-16+150	MT/Ac	2.0	53.1
-150 (Loss)	MT/Ac	2.7	17.5
* Flotation Concentrate Product	MT/Ac	.3	6.4
Total Useful Products*	MT/Ac	1.5	14.4
BPL Recovery			
+16 Mesh	MT/Ac	.4	4.4
* -16+150 (Flot. Conc.),	% BPL	64.4	74.2
-16+150 (Flot. Conc.),	MT/Ac	.2	4.8
* Total	MT/Ac	.6	9.2
* Recovered from Matrix	%	56.2	63.0
* Overburden/Products	cu yd/T	56.9	2.8
* Matrix/Products	cu yd/T	4.5	4.5
* I+A in Flot. Conc.	%	3.0	2.4

FIGURES OF MERIT	Unit	Econ. Level		
Overburden	ft	88 max	2.3	3.5
Matrix	ft	3 min	1.3	13.3
BPL in Matrix	%	10 min	1.8	1.9
BPL in Flot. Conc.(1)	%	66 min	1.0	1.1
BPL in Flot. Conc.(2)	%	52 min	1.2	1.4
Overburden/Matrix	Ratio	2 max	.2	3.2
Overburden/Products	cu yd/T	17.5 max	.3	6.2
I+A in Flot. Conc.	%	5 max	1.6	2.1
Products Recovery	T/Ac-ft	400 min	.9	.9
BPL (+150) Recovery	%	63 min	.9	1.0
Matrix/Products	cu yd/T	6 max	1.4	1.3

(1) For wet acid process. (2) For electric furnace process. * Sum of +16 mesh and flotation concentrate.

NOTES: Overburden based on dry density @ average = 90 lb./cu. ft. Matrix factors based on actual dry density.
Factors used: ft. thickness x 1613 = cu. yd./Ac; cu. yd x 1.215 = T(2000 lb.); ft. x 1960 = T(2000 lb.)/Ac.

TABLE EC-4

BPL DETERMINATIONS: CORE VS DRILL CUTTINGS SAMPLES

Layer Depth Feet	% BPL		
	No. Ec-17	No. E-45	Difference
25-35	22.1	25.1	+ 3.0
35-40	20.2	24.5	+ 4.3
40-45	26.0	29.0	+ 3.0
45-50	25.8	32.0	+ 6.2
50-55	12.0	36.0	+24.0
55-60	18.5	16.6	- 1.5
60-65	20.1	19.1	- 1.0
Weighted Average	20.9	25.9	+ 5.0

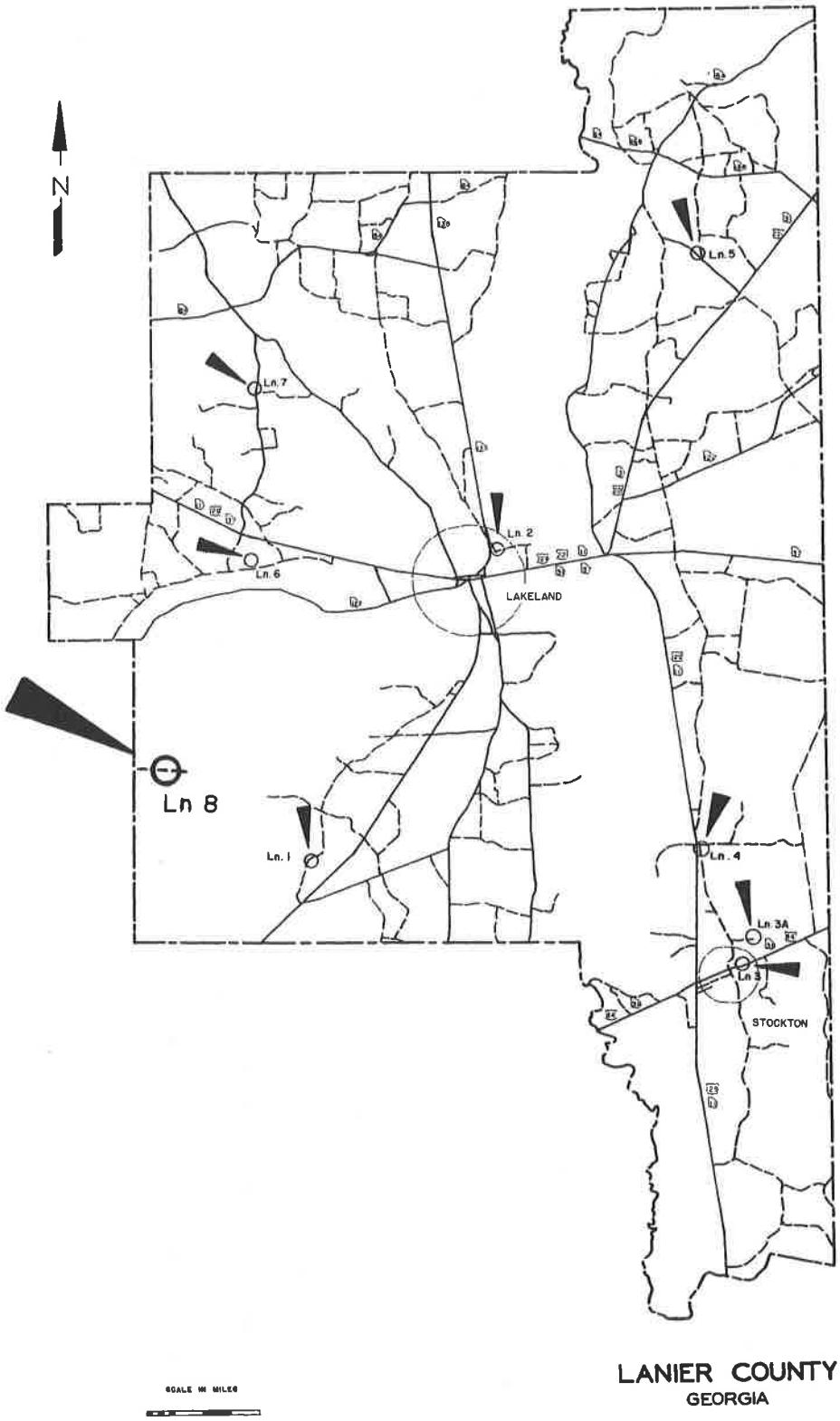

Figure LA-1. Location of Hole - Lanier County

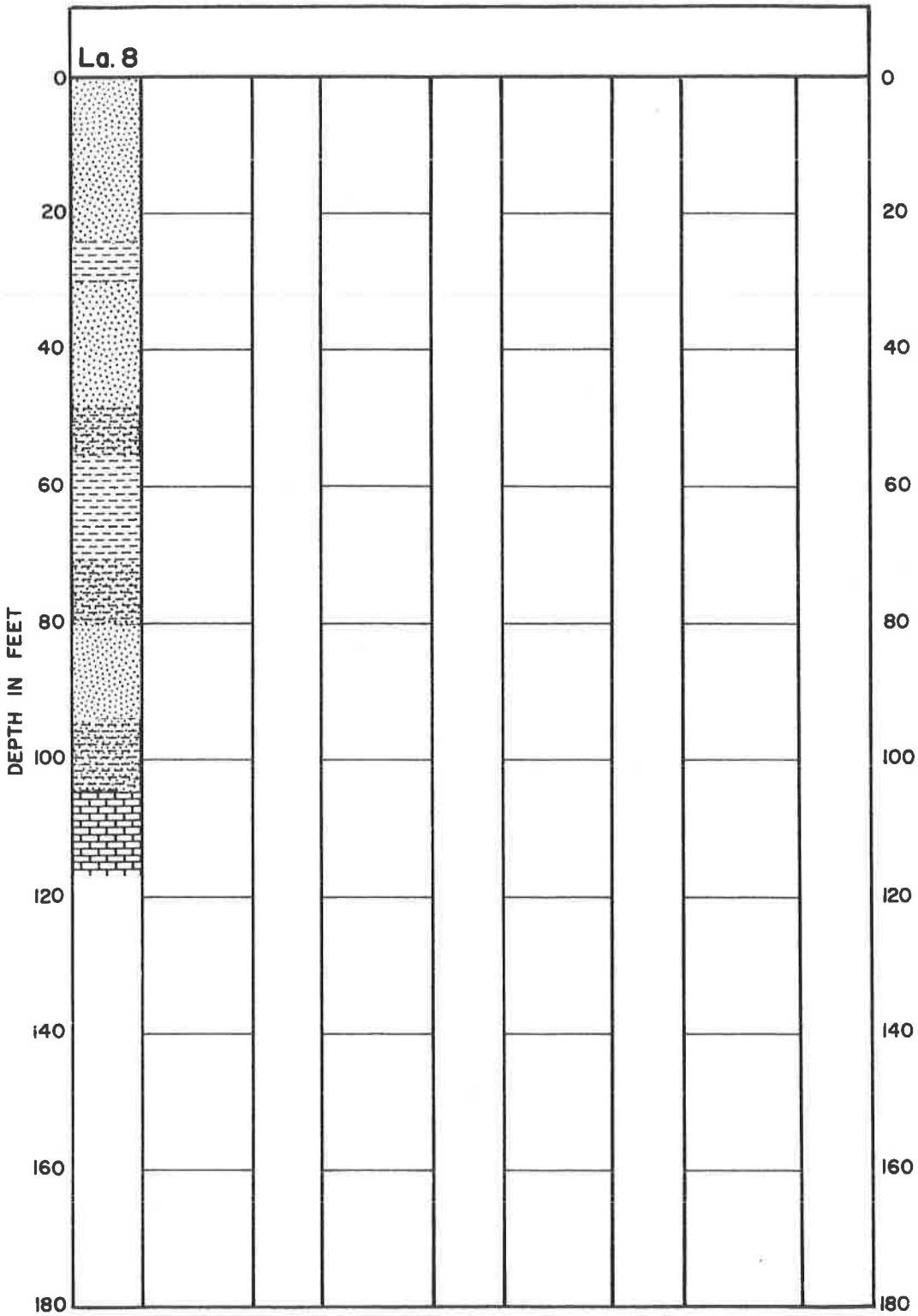

Figure LA-2. Lithologic Log - Lanier County
Hole La-8

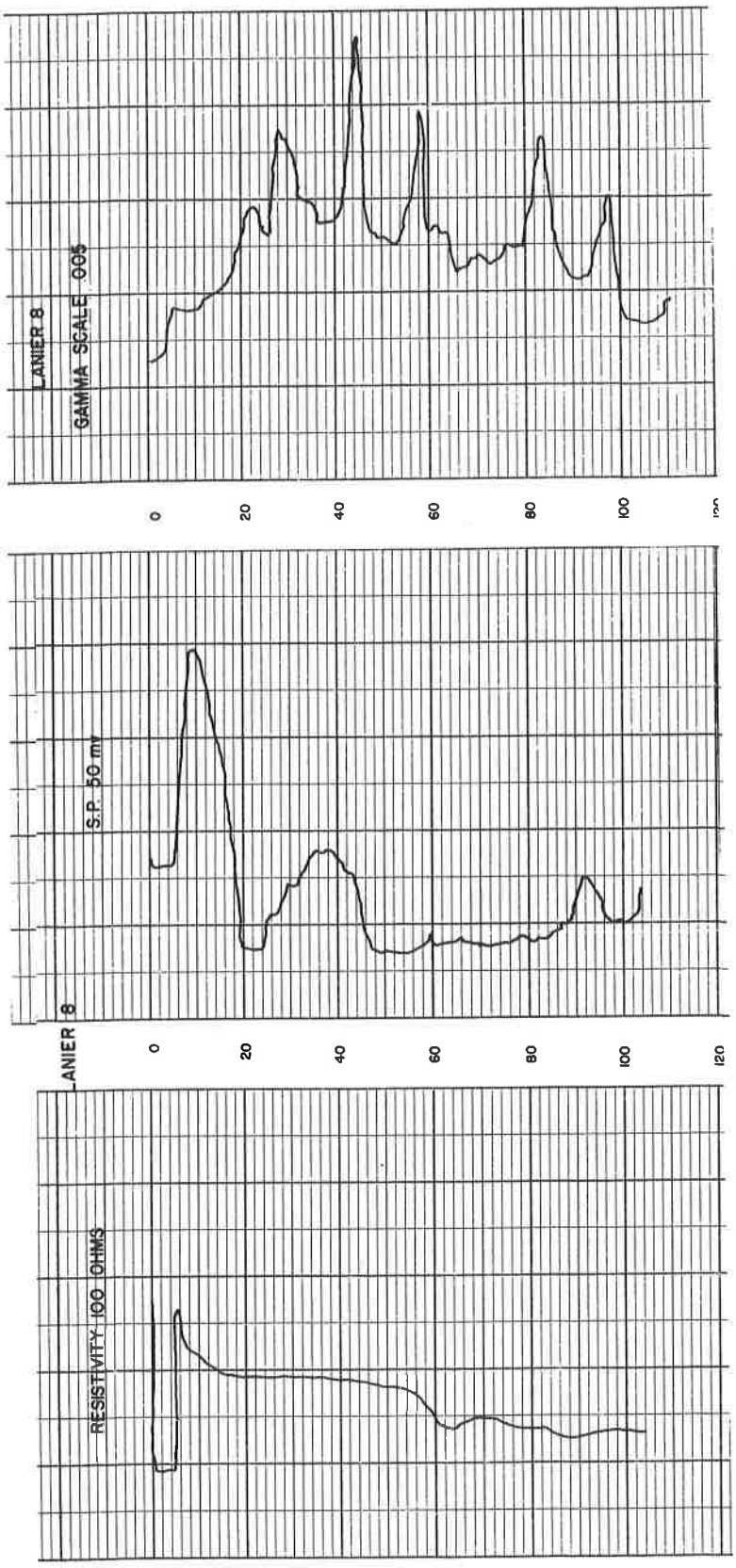

Figure LA-3. Electric and Gamma-Ray Logs - Lanier County
Hole La-8

TABLE LA-1

CORE RECOVERIES - BPL DETERMINATIONS ON CORES

Lanier County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
La-8	193	0-10	8	80	0.0
		10-13	2	67	0.0
		13-18	5	100	0.0
		18-20	2	100	0.0
		20-24	3	75	0.0
		24-29	5	100	0.9
		29-34	5	100	20.1
		34-37	2	67	39.3
		37-42	3	60	21.6
		42-48	3	50	21.1
		48-50	2	100	28.5
		50-55	5	100	29.8
		55-60	5	100	9.7
		60-70	8	80	19.6
		70-80	8	80	12.5
		80-85	5	100	10.2
		85-90	5	100	6.8
		90-93	3	100	4.7
		93-103	1	10	2.9
		103-115	3	25	1.6

TABLE LA-2

MATRIX BENEFICIATION RESULTS

Lanier County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	La-8	Surface Elevation = 193 feet (sea level)					Matrix Interval = 30-51 feet				
Total Matrix footage	21										
Dry density lb/cu ft	99.00										
Percent dry weight	100.0	1.08	1.83	4.45	70.70	13.37	57.34	21.94	10.62	83.57	5.81
Percent BPL	21.11	68.42	65.99	63.80	13.05	20.16	11.80	32.35	78.64	4.62	9.71
Percent acid insol	73.62	11.78	9.34	24.14	84.88	76.38	86.11	55.78	7.36	94.17	88.22
Percent Fe_2O_3	0.78	2.24	1.09	0.71	0.22	0.21	0.61	2.50	0.69	0.11	0.89
Percent Al_2O_3	2.48	2.67	2.08	1.30	0.71	0.56	0.87	8.45	1.19	0.62	1.67
Percent CaO	11.89	45.12	48.62	40.93	6.65	12.24	5.95	18.19	53.87	1.75	4.55

Note: Iron and Alumina content of +4 is higher than 5%. The analyses of plugs showed matrix BPL contents over 10% from 60 to 85 ft. When the matrix sample was taken, it was observed that the core from 60 to 85 ft. consisted on cherty rock and thin layers of sandy matrix. Therefore, the matrix was taken only from 30 to 51 feet.

TABLE LA-3

ECONOMIC FACTORS - FIGURES OF MERIT

Lanier County

ITEM	UNIT (M=1000)	La-6			La-8
					HOLE NO.
Matrix No.:		First	Second		First
Matrix Interval, Ft.:		46-65	65-95	Combined	30-51
ECONOMIC FACTORS					
* Overburden,	ft	46	0.0	46	30
Overburden,	MT/Ac	90.2	0.0	90.2	58.8
* Matrix,	ft	19	30	49	21
Matrix,	MT/Ac	37.8	43.5	81.3	45.3
* BPL in Matrix,	%	14.1	9.7	11.7	21.1
BPL in Matrix,	MT/Ac	5.3	4.2	9.6	9.6
* Overburden/Matrix,	Ratio	2.4	0.0	.9	1.4
Wash-Screen Products					
+16 Mesh	MT/Ac	.8	52.2	.9	3.3
-16+150	MT/Ac	30.6	21.0	51.6	32.0
-150 (Loss)	MT/Ac	6.4	22.4	28.8	9.9
* Flotation Concentrate Product	MT/Ac	1.5	.3	1.8	3.4
Total Useful Products*	MT/Ac	2.3	.4	2.7	6.7
BPL Recovery					
+16 Mesh	MT/Ac	.5	24.9	.5	2.2
* -16+150 (Flot. Conc.),	% BPL	78.6	77.7	--	78.6
-16+150 (Flot. Conc.),	MT/Ac	1.2	.2	1.5	2.7
* Total	MT/Ac	1.7	25.1	2.0	4.9
* Recovered from Matrix	%	31.7	6.0	20.3	50.6
* Overburden/Products	cu yd/T	31.5	0.0	32.9	6.5
* Matrix/Products	cu yd/T	13.2	139.6	29.6	5.0
* I+A in Flot. Conc.	%	1.5	1.7	1.6	1.9

FIGURES OF MERIT	Unit	Econ. Level				
Overburden	ft	88 max	1.9	-	1.9	2.9
Matrix	ft	3 min	6.3	10.0	16.3	7.0
BPL in Matrix	%	10 min	1.4	1.0	1.2	2.1
BPL in Flot. Conc.(1)	%	66 min	1.2	1.2	1.2	1.2
BPL in Flot. Conc.(2)	%	52 min	1.5	1.5	1.5	1.5
Overburden/Matrix	Ratio	2 max	.8	-	2.1	1.4
Overburden/Products	cu yd/T	17.5 max	.6	-	.5	2.7
I+A in Flot. Conc.	%	5 max	3.3	3.0	3.1	2.7
Products Recovery	T/Ac-ft	400 min	.3	.03	.1	.8
BPL (+150) Recovery	%	63 min	.5	.1	.3	.8
Matrix/Products	cu yd/T	6 max	.5	.04	.2	1.2

(1) For wet acid process. (2) For electric furnace process. * Sum of +16 mesh and flotation concentrate.

NOTES: Overburden based on dry density @ average = 90 lb./cu. ft. Matrix factors based on actual dry density.
Factors used: ft. thickness x 1613 = cu. yd./Ac; cu. yd x 1.215 = T(2000 lb.); ft. x 1960 = T(2000 lb.)/Ac.

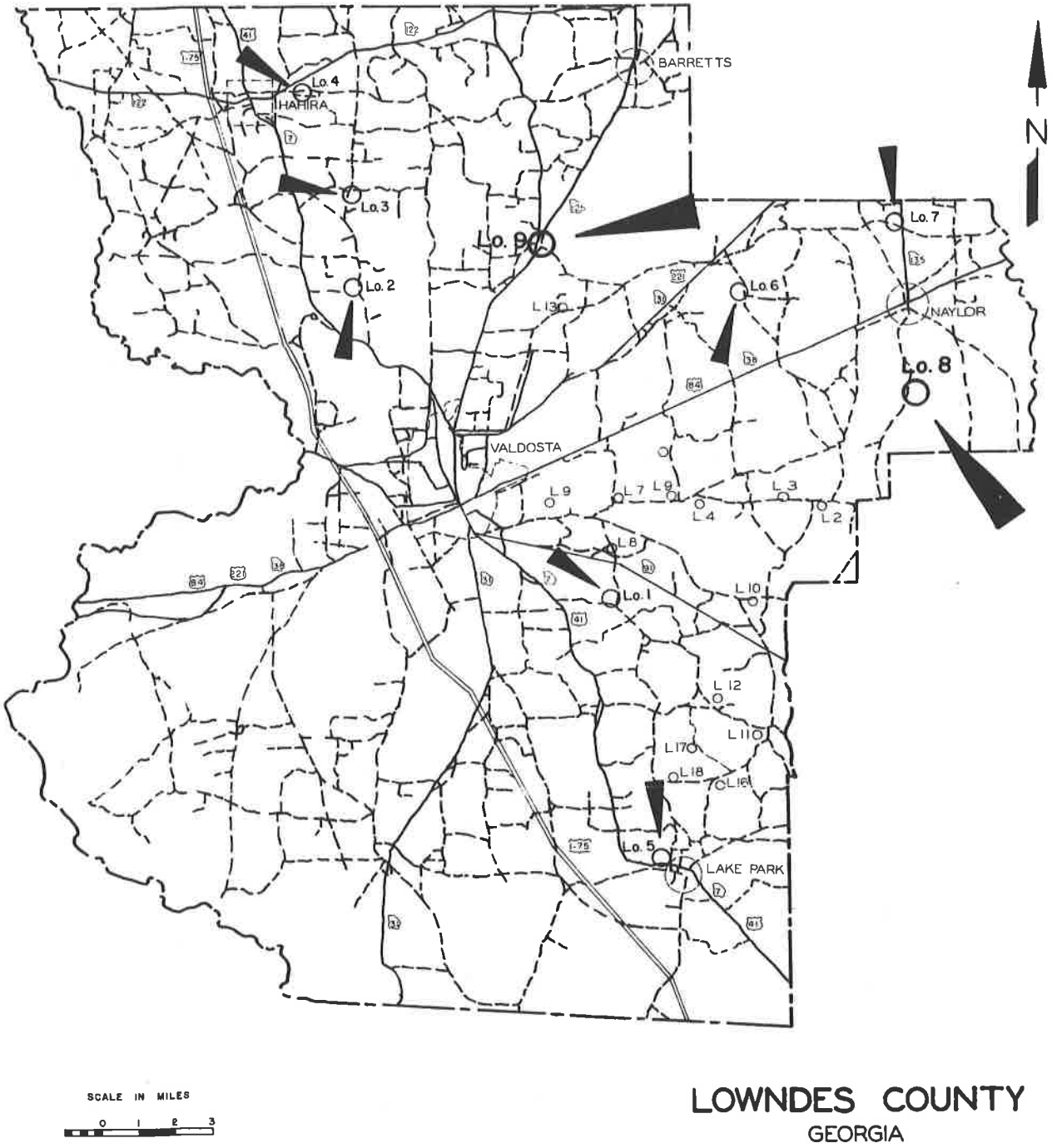

Figure LO-1. Location of Holes - Lowndes County

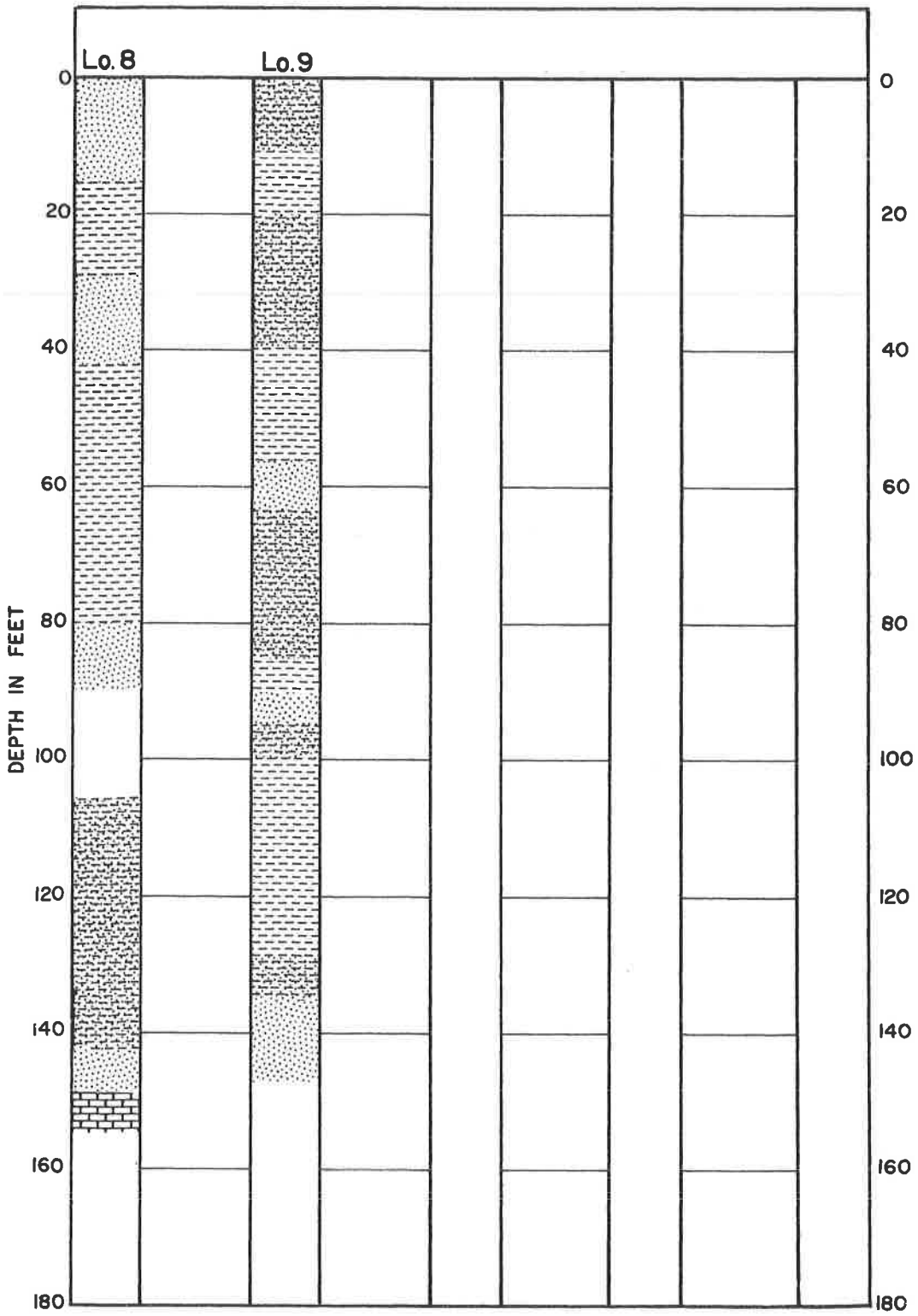

Figure LO-2. Lithologic Logs - Lowndes County

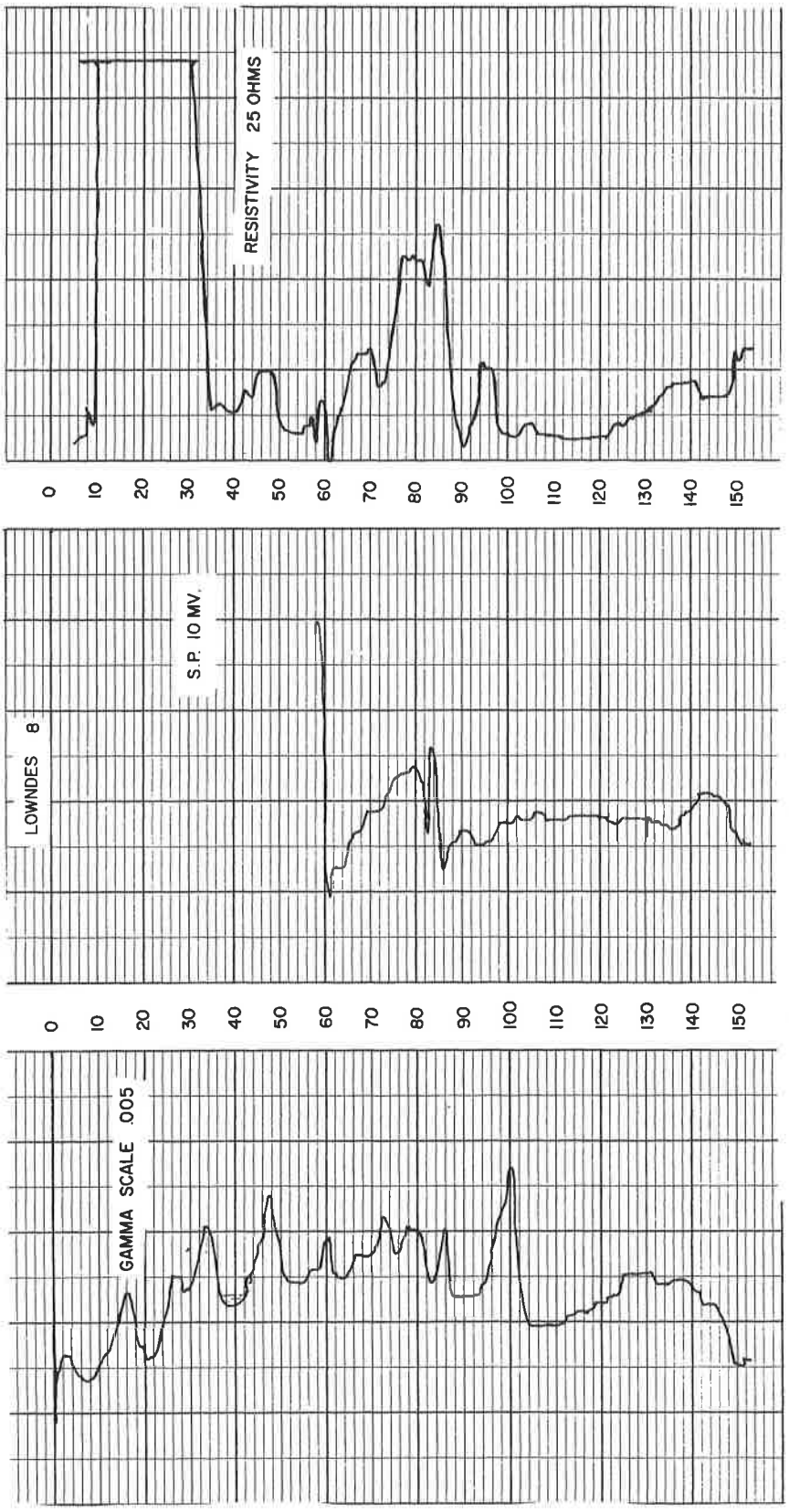

Figure LO-3. Electric and Gamma-Ray Logs - Lowndes County
Hole Lo-8

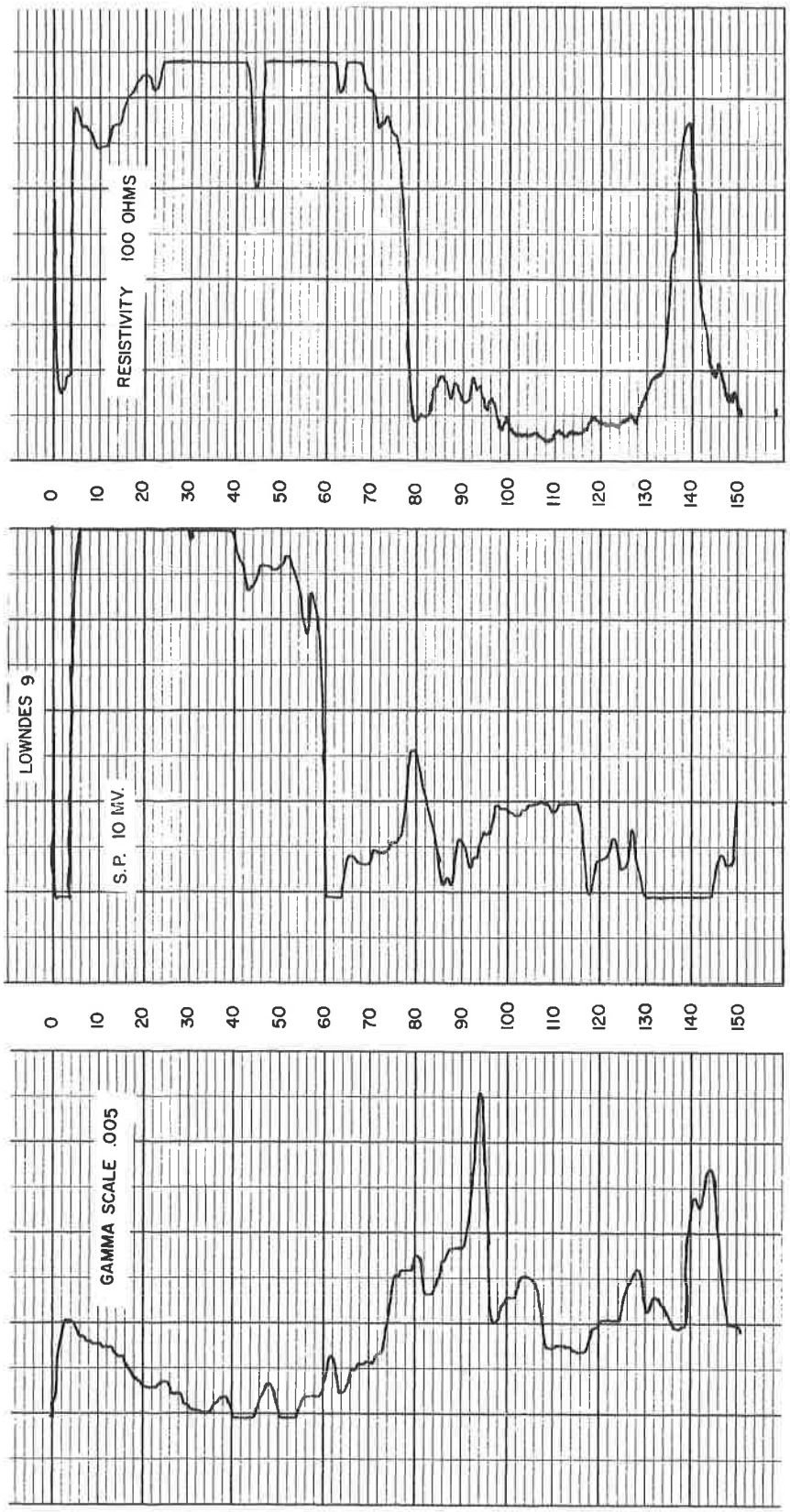

Figure LO-3. Electric and Gamma-Ray Logs - Lowndes County
Hole Lo-9

TABLE LO-1

CORE RECOVERIES - BPL DETERMINATIONS ON CORES

Lowndes County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Lo-8	188	0-5	5		0.0
		5-10	5		0.0
		10-15	5		0.0
		15-28	5		0.0
		28-36	5		1.0
		36-41	5		4.0
		41-46	5		3.6
		46-51	5		10.9
		51-56	5		9.8
		56-61	5		4.1
		61-66	5		5.3
		66-75	3		4.6
		75-80	5		6.7
		80-85	5		17.7
		85-90	3		14.9
		90-105	-		-
		105-110	5		1.4
		110-115	5		2.5
		115-120	8		4.2
		120-127	10		6.0
		127-129	4		9.8
		129-131	4		8.2
		131-140	2		7.7
		140-142	2		8.9
		142-148	5		5.7
		148-154	4		1.2
Lo-9	243	0-5	5		0.0
		5-10	5		0.0
		10-15	5		0.0
		15-20	5		0.0
		20-30	5		0.0
		30-34	5		0.0
		34-37	3		0.0
		37-45	5		0.0
		45-51	5		0.0
		51-57	5		0.0
		57-64	5		0.0
		64-75	5		0.0

(Continued)

TABLE LO-1

CORE RECOVERIES - BPL DETERMINATIONS ON CORES

Lowndes County

Hole No.	Surface Elevation (Sea Level) Feet	Depth, Feet	Core Recovery Feet	Core Recovery %	BPL %
Lo-9	243	75-80	5		7.6
		80-85	5		1.0
		85-90	5		3.7
		90-95	5		9.2
		95-100	5		10.6
		100-105	5		4.0
		105-110	5		5.4
		110-115	5		4.4
		115-120	5		8.6
		120-125	5		8.3
		125-129	7		2.9
		129-134	3		5.1
		134-135	1		13.2
		135-140	1		5.4
		140-143	3		3.9
		143-147	2		6.8

TABLE LO-2

MATRIX BENEFICATION RESULTS

Lowndes County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Lo-8	Surface Elevation = 188 feet (sea level)				Matrix Interval = 46-56 feet					
Total Matrix footage	10										
Dry density lb/cu ft	57.61										
Percent dry weight	100.0	1.14	1.44	5.72	55.53	30.49	25.04	36.16	1.38	90.56	8.06
Percent BPL	11.90	56.48	44.07	22.80	7.65	7.69	6.98	14.01	78.77	5.66	6.95
Percent acid insol	79.32	27.88	44.97	71.70	89.91	90.31	90.14	67.26	3.64	92.47	89.48
Percent Fe_2O_3	2.32	3.20	0.81	0.81	0.56	0.33	0.92	5.29	1.75	0.40	2.68
Percent Al_2O_3	6.37	2.27	2.06	1.64	1.21	0.71	1.71	15.35	1.36	1.13	2.26
Percent CaO	6.65	36.73	28.33	12.36	3.50	3.85	3.15	8.77	54.57	2.10	2.80

Note: Iron and Alumina content of +4 is higher than 5%.

(Continued)

TABLE LO-2

MATRIX BENEFICIATION RESULTS

Lowndes County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Lo-8	Surface Elevation = 188 feet (sea level)					Matrix Interval = 80-90 feet				
Total Matrix footage	10										
Dry density lb/cu ft	101.20										
Percent dry weight	100.0	1.66	0.91	3.27	63.66	17.00	46.66	30.51	10.47	83.84	5.69
Percent BPL	15.98	6.98	27.85	32.27	11.57	14.03	10.62	23.57	67.85	4.18	15.58
Percent acid insol	76.57	68.52	54.79	54.13	83.54	80.32	85.34	65.52	6.76	74.83	76.97
Percent Fe_2O_3	0.92	14.47	4.63	1.59	0.51	0.81	0.53	0.86	1.73	0.27	3.03
Percent Al_2O_3	1.83	1.58	1.89	1.58	1.40	1.82	1.40	2.77	1.36	1.05	2.90
Percent CaO	10.49	4.08	17.14	21.34	7.00	9.09	6.30	16.76	50.37	1.40	10.84

Note: Iron and Alumina content of +4, 4X8 is higher than 5%.

(Continued)

TABLE LO-2

MATRIX BENEFICIATION RESULTS

Lowndes County

	Feed	+4	4X8	8X16	(Flot. feed) 16X150	16X35	35X150	(Slime) -150	Concen-trates	Fatty Acid Tailing	Amine Float
HOLE NO.	Lo-9	Surface Elevation = 243 feet (sea level)				Matrix Interval = 90-100 feet					
Total Matrix footage	10										
Dry density lb/cu ft	92.03										
Percent dry weight	100.0	1.09	1.96	4.30	62.92	8.37	54.55	29.74	4.05	92.54	3.42
Percent BPL	14.94	48.63	75.00	66.26	9.10	19.79	7.72	14.69	79.45	5.43	9.31
Percent acid insol	80.21	41.89	7.44	21.50	89.12	76.48	90.74	76.04	5.22	94.07	88.84
Percent Fe_2O_3	0.92	0.51	0.61	0.48	0.13	0.18	0.13	2.69	0.66	0.07	1.05
Percent Al_2O_3	3.59	11.03	2.08	1.58	0.68	0.36	0.88	9.86	1.59	0.24	3.18
Percent CaO	8.74	21.69	46.17	41.28	4.55	12.24	3.50	9.96	54.57	2.10	3.50

Note: Iron and Alumina content of +4 is higher than 5%.

LO-3

ECONOMIC FACTORS - FIGURES OF MERIT

Lowndes County

ITEM	UNIT (M=1000)	HOLE NO. Lo-9			
Matrix No.:		First	Second		First
Matrix Interval, Ft.:		46-56	80-90	Combined	90-100
ECONOMIC FACTORS					
* Overburden,	ft	46	24	70	90
Overburden,	MT/Ac	90.2	47	137.2	176.4
* Matrix,	ft	10	10	20	10
Matrix,	MT/Ac	12.6	22	34.6	20
* BPL in Matrix,	%	11.9	16	14.5	14.9
BPL in Matrix,	MT/Ac	1.5	3.5	5.1	3.0
* Overburden/Matrix,	Ratio	4.6	2.4	3.5	9.0
Wash-Screen Products					
+16 Mesh	MT/Ac	1.0	1.3	2.3	1.5
-16+150	MT/Ac	7.0	14	21	12.6
-150 (Loss)	MT/Ac	4.5	6.7	11.3	6
* Flotation Concentrate Product	MT/Ac	.09	1.5	1.6	.5
Total Useful Products*	MT/Ac	1.1	2.8	3.9	2.0
BPL Recovery					
+16 Mesh	MT/Ac	.3	.3	.6	1.0
* -16+150 (Flot. Conc.),	% BPL	78.8	67.9	-	79.5
-16+150 (Flot. Conc.),	MT/Ac	.08	1.0	1.1	.4
* Total	MT/Ac	.38	1.3	1.7	1.4
* Recovered from Matrix	%	26.8	37.2	34.1	46
* Overburden/Products	cu yd/T	.1	12.5	32.9	71.6
* Matrix/Products	cu yd/T	14.2	5.9	8.3	8.1
* I+A in Flot. Conc.	%	3.1	3.1	3.1	2.3

FIGURES OF MERIT	Unit	Econ. Level				
Overburden	ft	88 max	1.9	3.7	1.3	1.0
Matrix	ft	3 min	3.3	3.3	6.7	3.3
BPL in Matrix	%	10 min	1.2	1.6	1.5	1.5
BPL in Flot. Conc.(1)	%	66 min	1.2	1.0	1.0	1.2
BPL in Flot. Conc.(2)	%	52 min	1.5	1.3	1.3	1.5
Overburden/Matrix	Ratio	2 max	.4	.8	.6	.2
Overburden/Products	cu yd/T	17.5 max	.2	1.4	.5	.2
I+A in Flot. Conc.	%	5 max	1.6	1.6	1.6	2.2
Products Recovery	T/Ac-ft	400 min	.3	.7	.5	.5
BPL (+150) Recovery	%	63 min	.4	.6	.5	.7
Matrix/Products	cu yd/T	6 max	.7	1.0	.7	.7

(1) For wet acid process. (2) For electric furnace process. * Sum of +16 mesh and flotation concentrate.

NOTES: Overburden based on dry density @ average = 90 lb./cu. ft. Matrix factors based on actual dry density.
Factors used: ft. thickness x 1613 = cu. yd./Ac; cu. yd x 1.215 = T(2000 lb.); ft. x 1960 = T(2000 lb.)/Ac.

PRELIMINARY RECONNAISSANCE DRILLING

JEFF DAVIS - MONTGOMERY - WHEELER COUNTIES

LIBERTY - LONG - WAYNE COUNTIES

Jeff Davis, Montgomery, and Wheeler Counties

Occurrences of phosphorites in wells in Jeff Davis, Montgomery and Wheeler Counties, were reported in "Well Logs of the Coastal Plain of Georgia", S. M. Herrick, The Geological Survey Bulletin 70, 1961. The occurrences were given in qualitative terms, e.g. "phosphatic", in general seemed to be at depths approaching the economic limit, but were sufficiently numerous to warrant preliminary core drilling for definitive data. Three holes were drilled in Jeff Davis County and one in Wheeler. C. W. King, of Atlanta, made available samples from a hole he drilled in Montgomery County.

For reconnaissance drilling, it was considered more desirable to present the data as a "group" rather than in the usual format of individual counties in alphabetical order. Further, as the maximum concentration of BPL in each of the holes was below that of current economic interest, tabular data are condensed and presented in Table JD-MONT-WH-1. Figures JD-1, MONT-1 and WH-1 show the locations of holes drilled in the respective counties. Figures JD-2, and WH-2 are lithologic logs, no log being available for the Montgomery County hole.

While the existence of phosphorites, as reported by Herrick, in this area was confirmed, the data indicate the deposits to be of such quality and of such depth to have no current commerical interest.

Figures JD-3 and WH-3 give the electrical and gamma-ray logs for holes which were so logged.

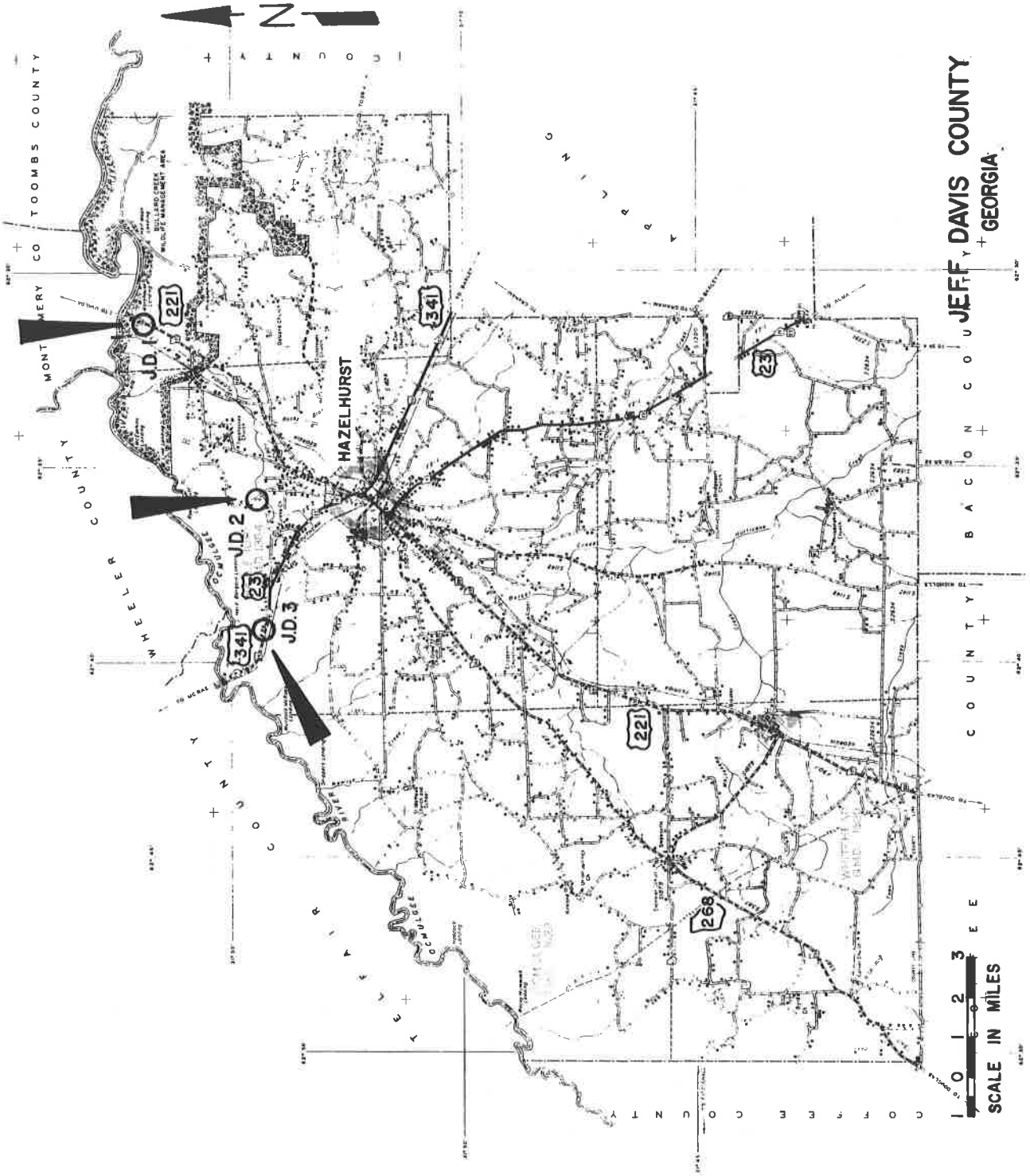

Figure JD-1. Location of Holes - Jeff Davis County

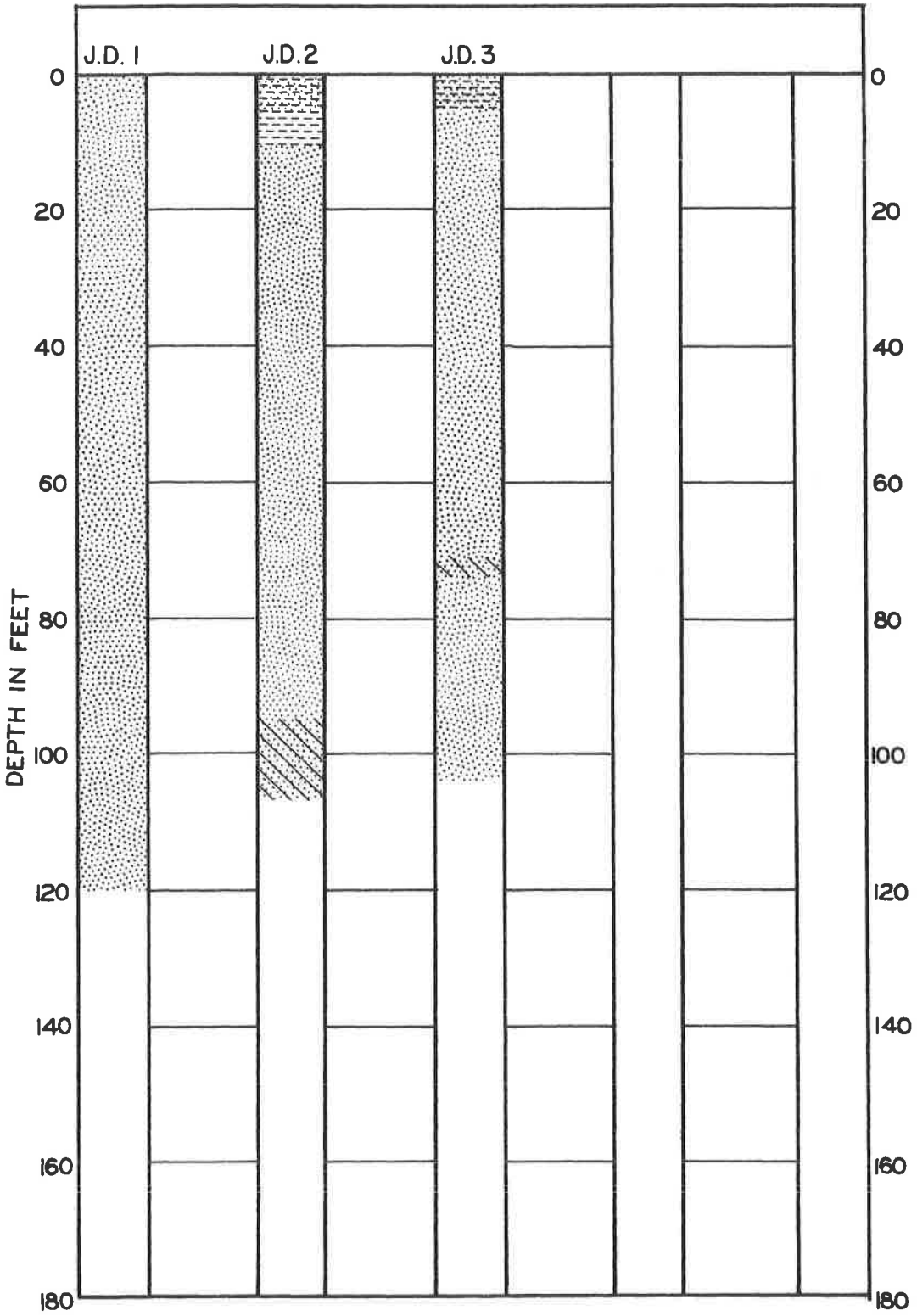

Figure JD-2. Lithologic Logs - Jeff Davis County

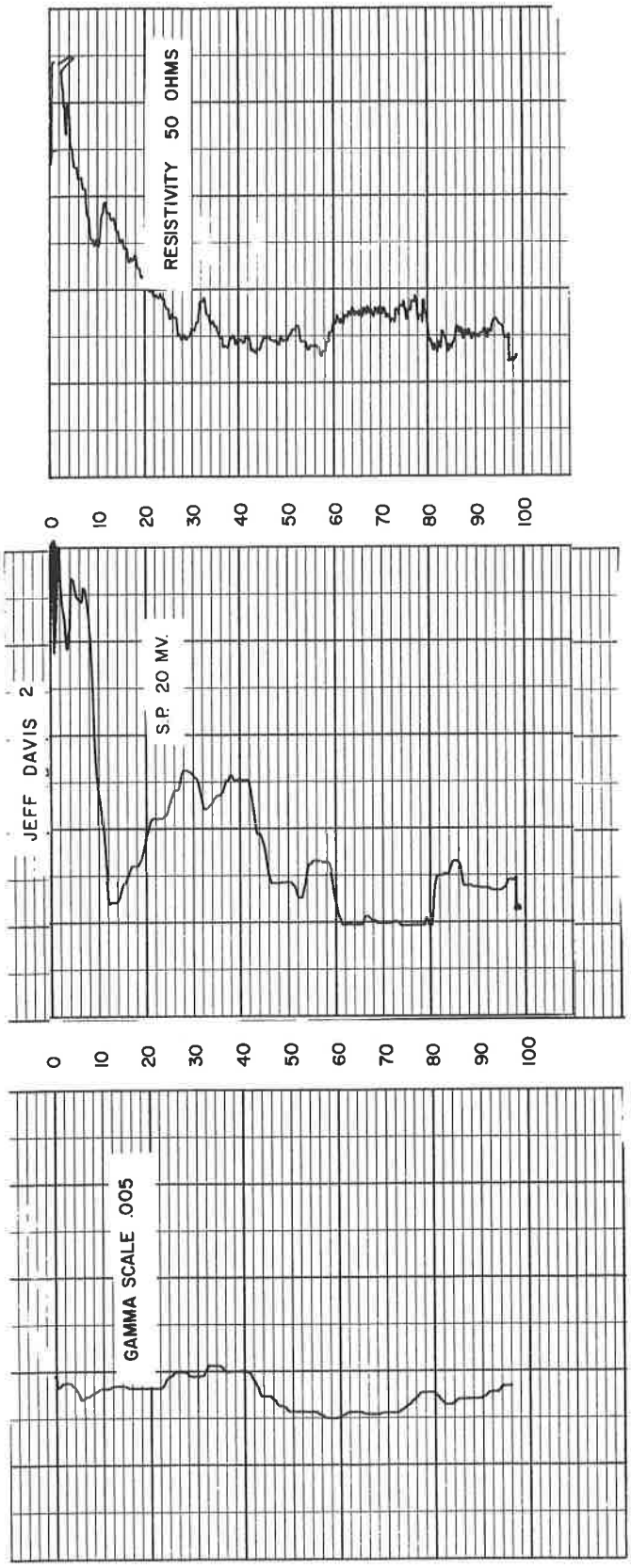

Figure JD-3. Electric and Gamma-Ray Logs - Jeff Davis County
Hole Jd-2

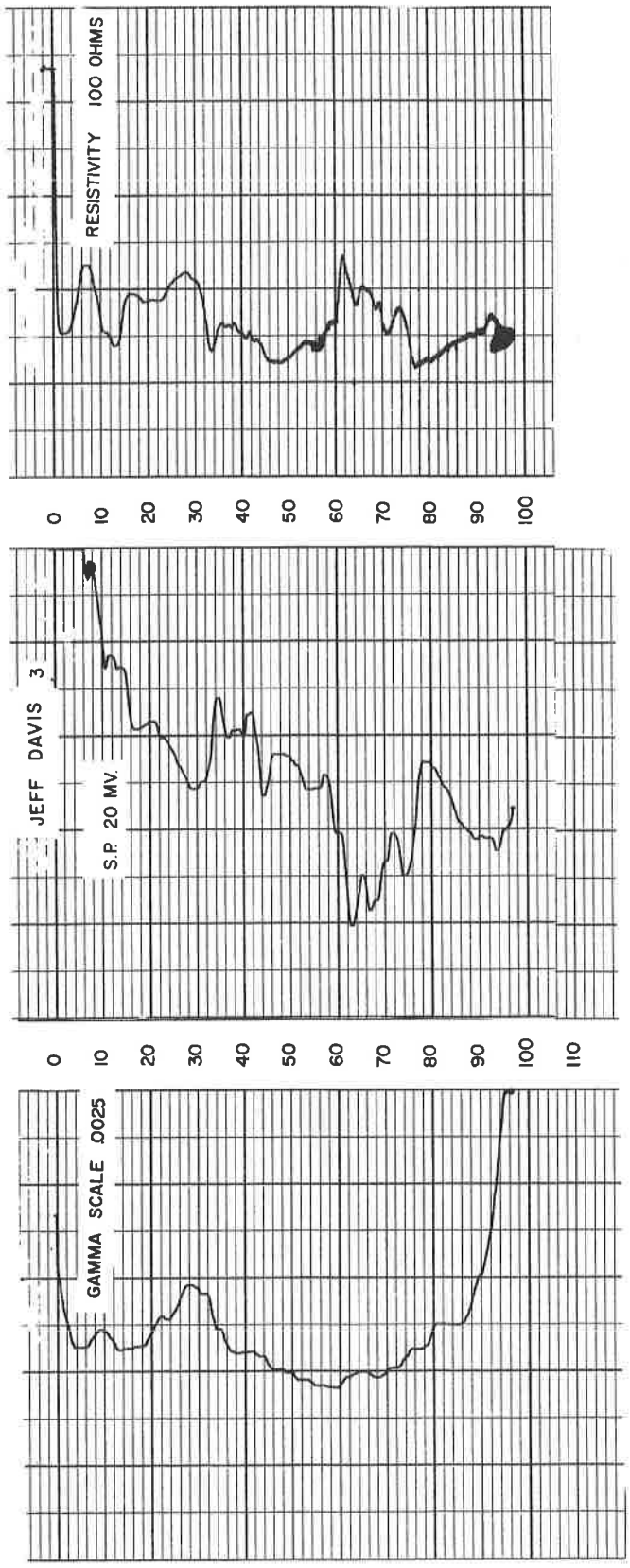

Figure JD-3. Electric and Gamma-Ray Logs - Jeff Davis County Hole JD-3

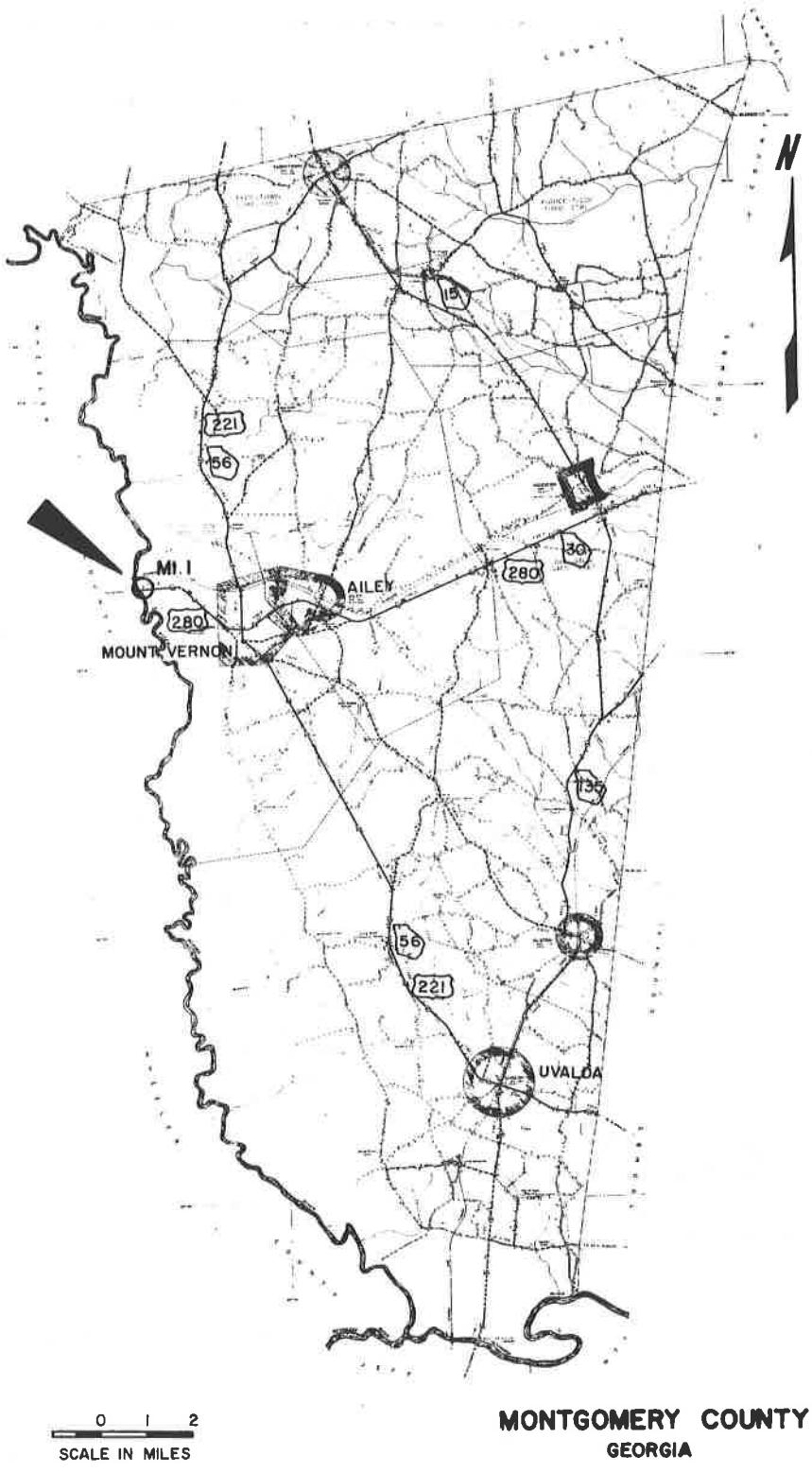

Figure MONT-1. Location of Hole - Montgomery County.

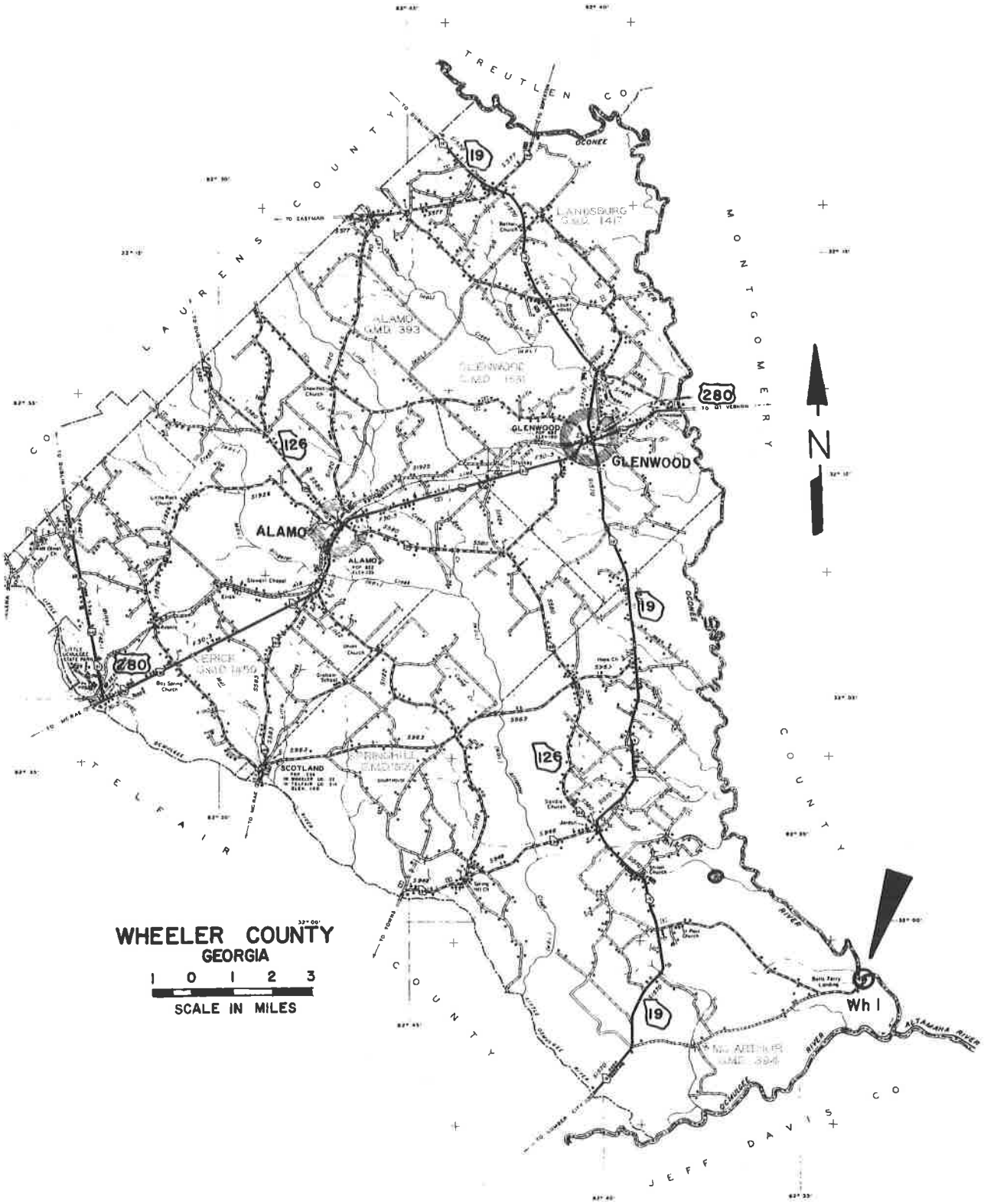

Figure WH-1. Location of Hole - Wheeler County.

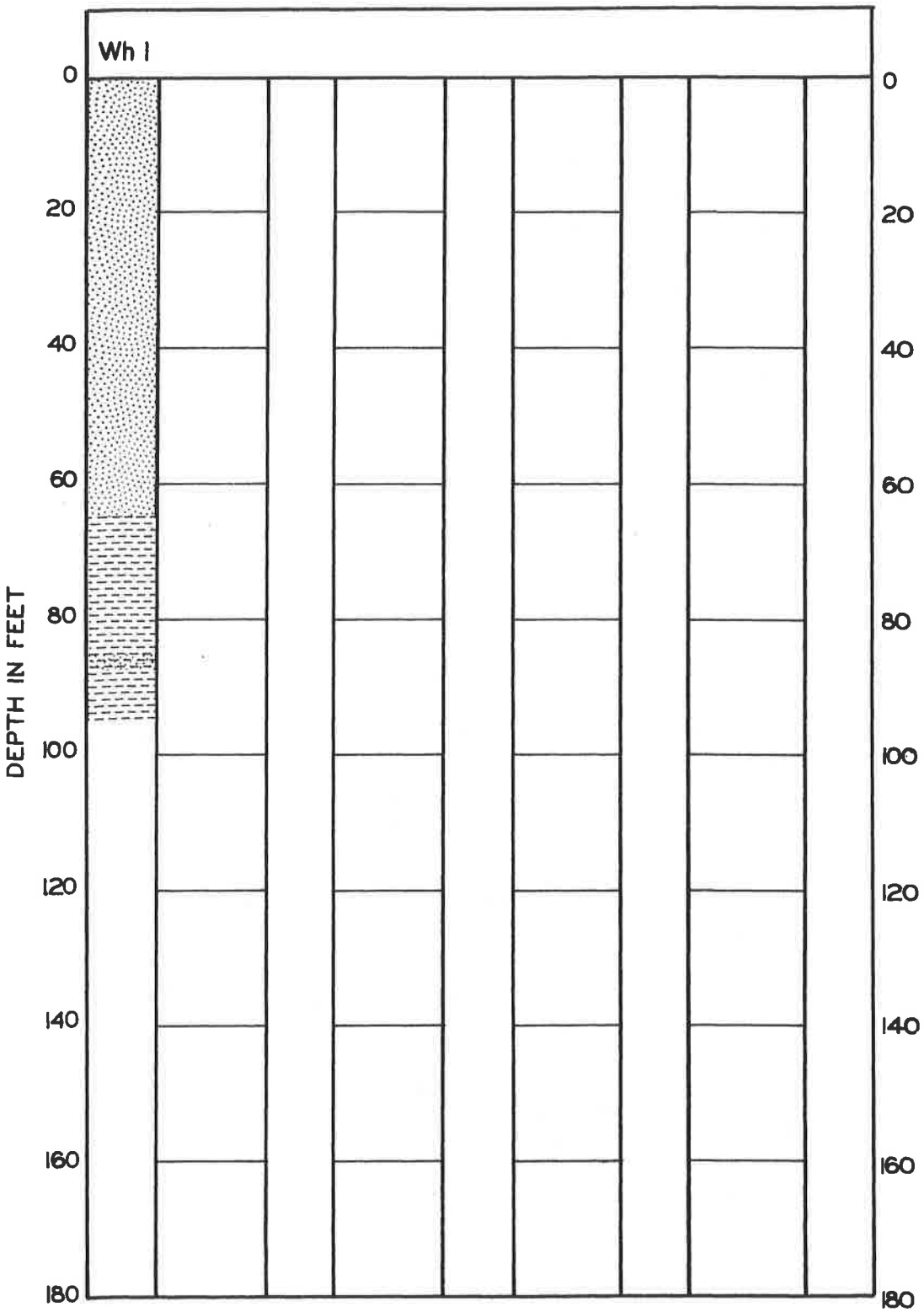

Figure WH-2. Lithologic Log - Wheeler County

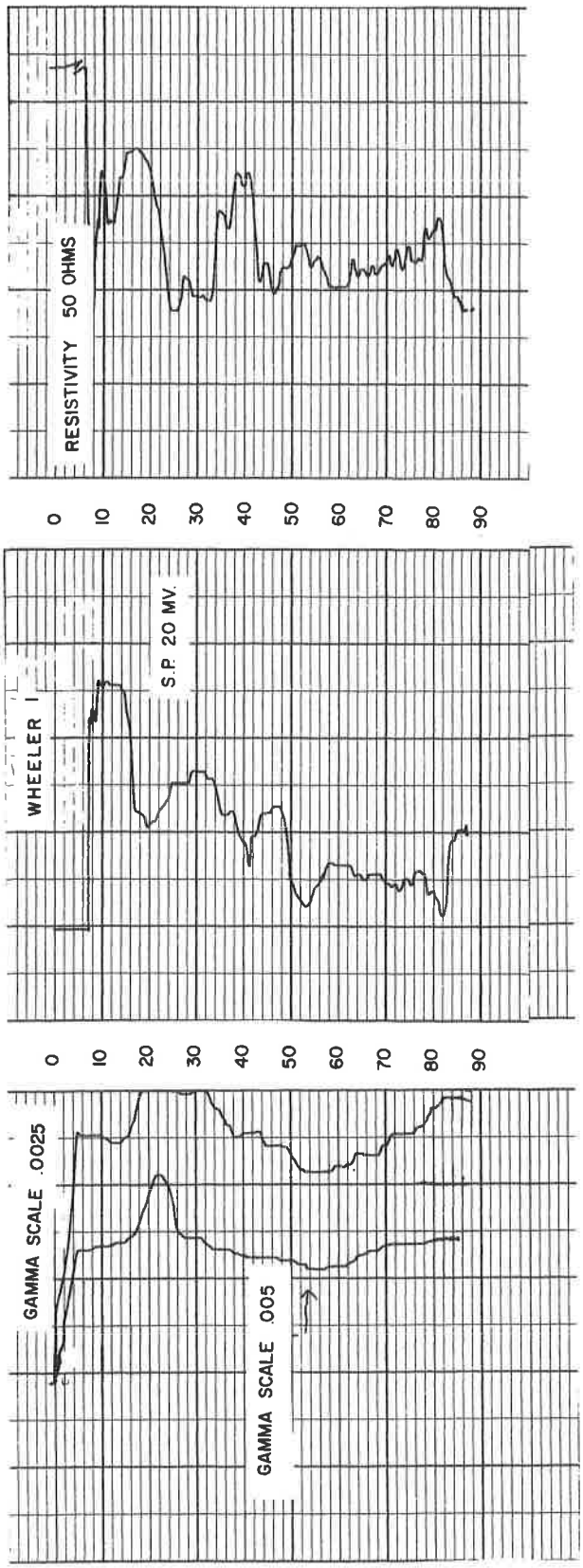

Figure WH-3. Electric and Gamma-Ray Log - Wheeler County
Hole Wh-1

TABLE JD - MONT - WH-1

BPL DETERMINATIONS - MAXIMUM - ON CORES

Jeff Davis, Montgomery and Wheeler Counties

Hole No.	Surface Elevation (Sea Level) Feet	Total Depth Drilled Feet	BPL Determination	
			%	Maximum depths, feet
Jd-1	171	120	2.1	85-95
Jd-2	199	107	8.4	87-95
Jd-3	112	104	2.9	96-104
Mont-1	-	148	5.2	130-135
Wh-1	138	95	2.1	75-85

Liberty, Long and Wayne Counties

Herrick (see preceding section) reported "finely disseminated phosphatic grains" in near surface "Pliocene to Recent" sediments in these counties; and also phosphorites in the Miocene sands and clays. Based upon Florida's phosphorites, it has been assumed that phosphorites in Miocene deposits have best economic possibilities. Herrick's information as to the top of the Miocene shows for Wayne County: 40, 44, 74, 75 and 100 feet below the surface, and for Liberty County wells: 55, 110, 150, 195 and 200 feet. This would indicate a Miocene dip to the north. Yet one well in Bryan County (Pembroke) showed the top of Miocene to be but 30 feet. An earlier review of gamma-ray logs from deep wells along the coast from Chatham to Glynn Counties had shown anomalies of layers, probably correlatable to phosphorites, as dipping to the south. It appears that the top of the Miocene, again based upon Herrick, approaches closer to the surface westward from the coast, but phosphorite grains, etc, are reported only at uneconomical depths in Appling and Tattnall Counties.

In view of these inconclusive data, it was considered advisable to carry out exploratory drilling in Liberty, Long, and Wayne Counties roughly across the centers of the counties and parallel to the coast to determine the actual abundance and quality of phosphorites at economical mining depths. Accordingly, one hole was drilled in each of Liberty and Wayne Counties and two in Long County (into different geologic substructures). The data, Table LI-LNG-WN-1, show insufficient amounts of phosphatic materials to have commercial interest at this time. A greater abundance may be at greater depths (based on Herrick's qualitative observations), but the cost of stripping the overburden make for an unattractive economic picture.

Figures LI-1, LI-2 and LI-3 give the hole location, lithologic logs and electric logs for Hole No. LI-1.

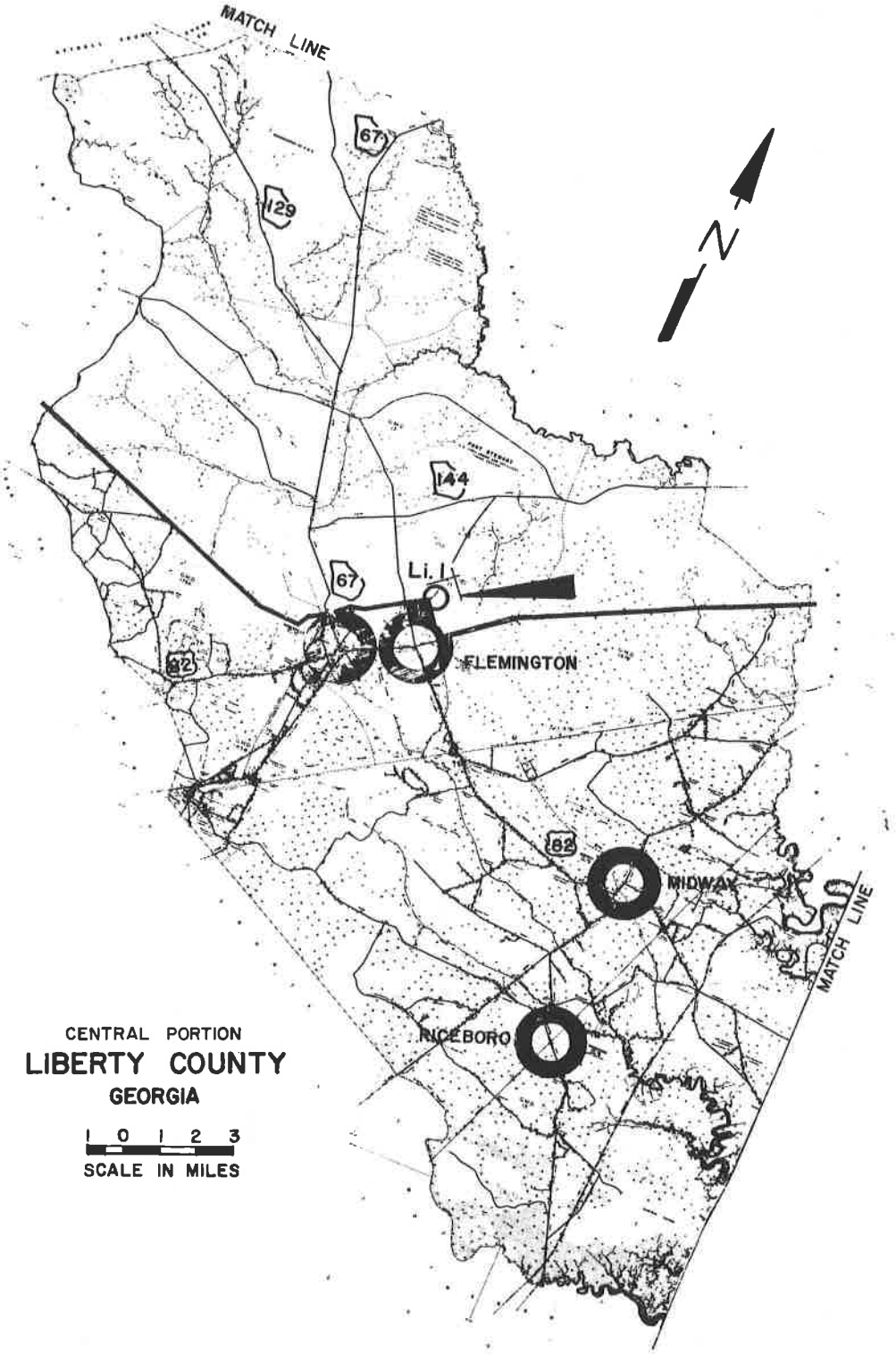

Figure LI-1. Location of Hole - Liberty County

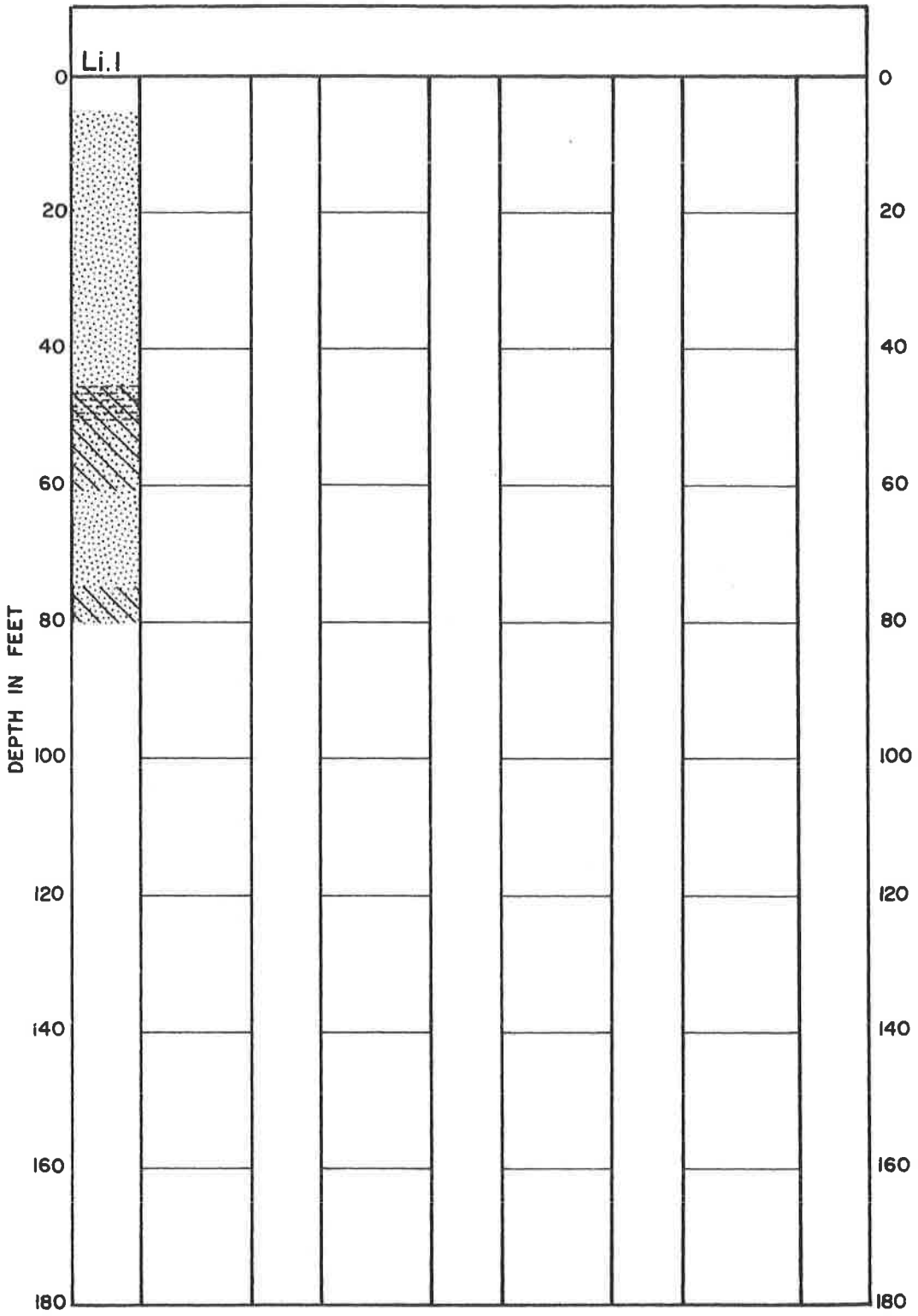

Figure LI-2. Lithologic Log - Liberty County

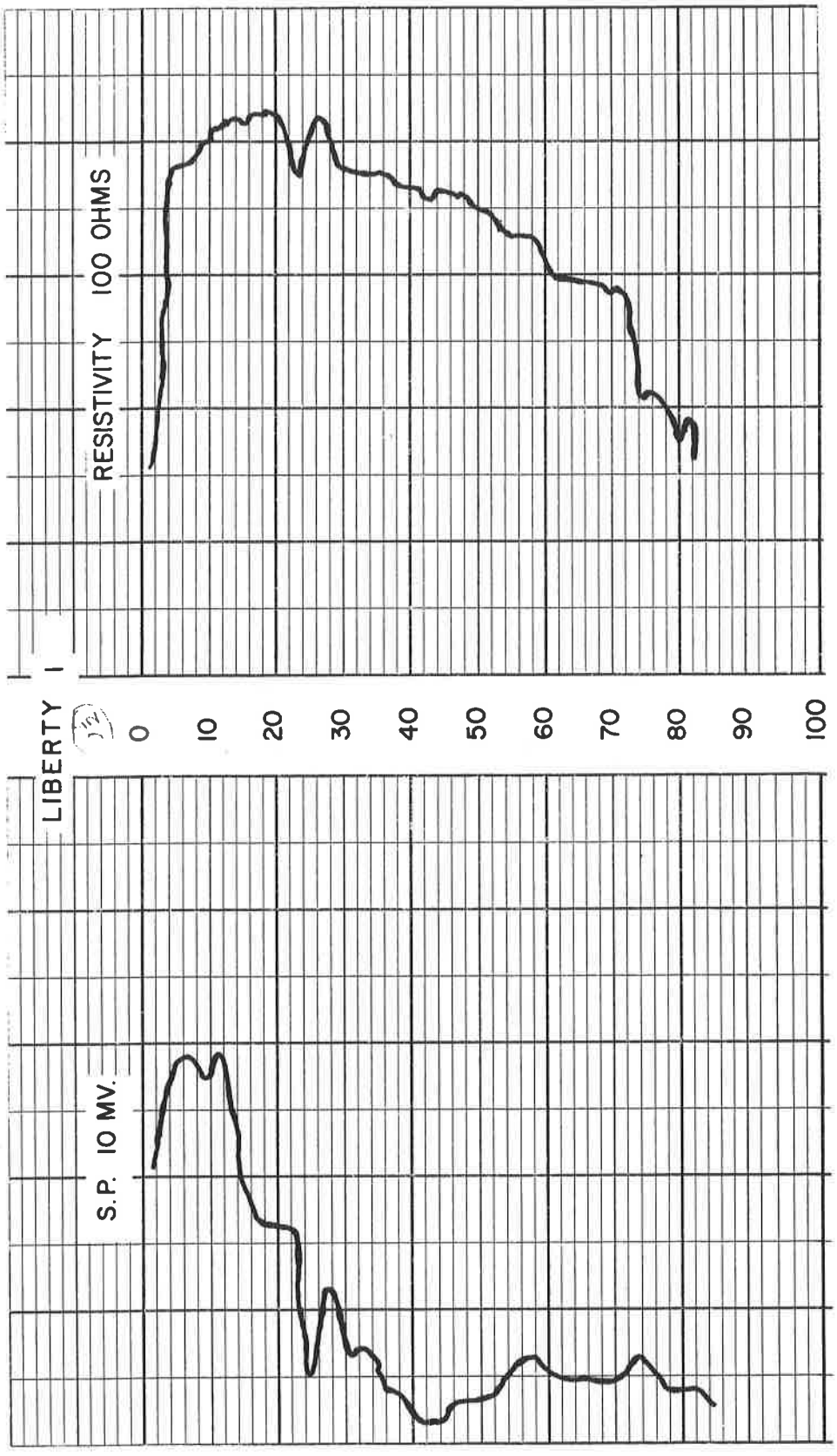

Figure LI-3. Electric Resistivity Logs - Liberty County

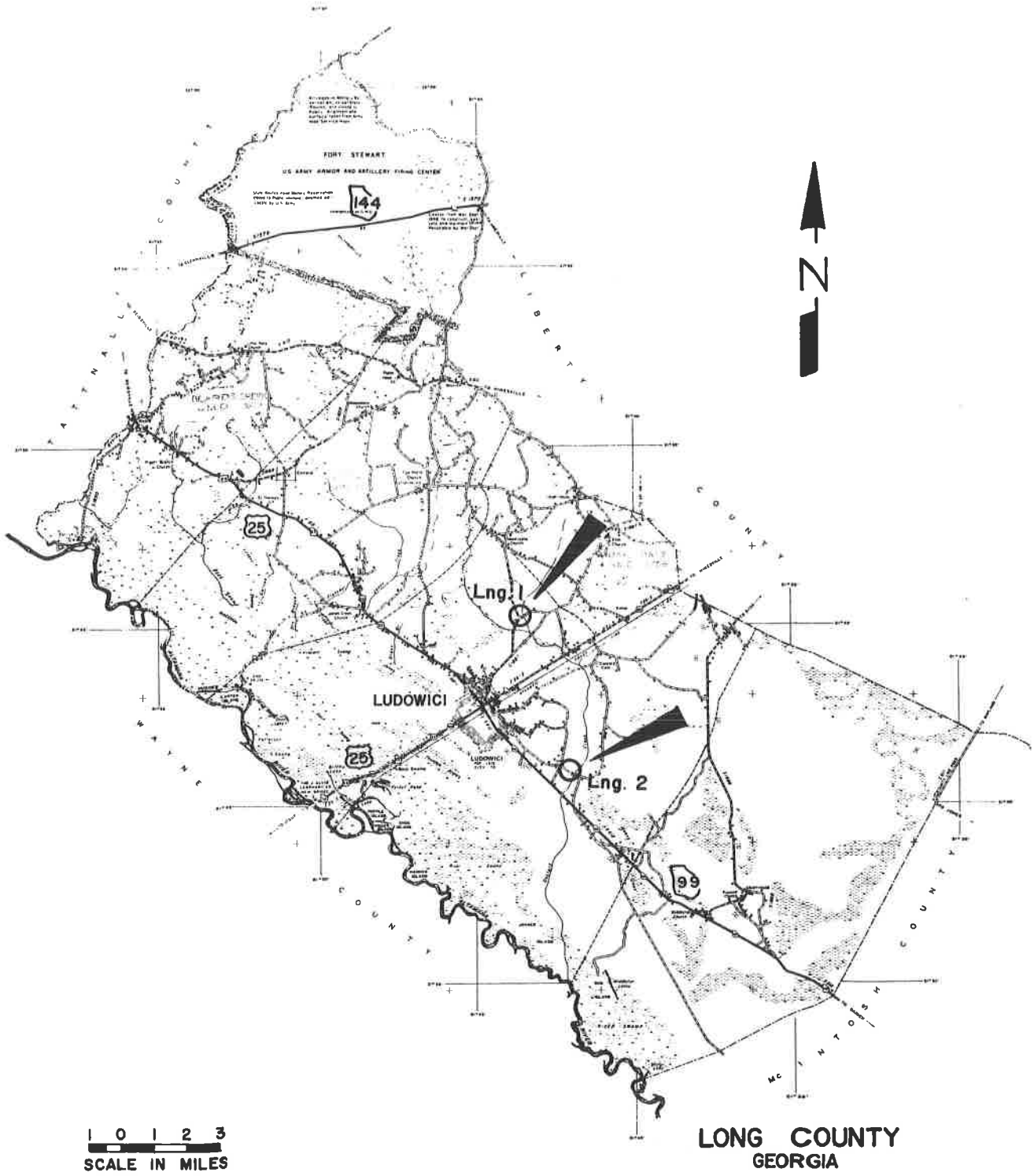

Figure LNG-1. Location of Holes - Long County

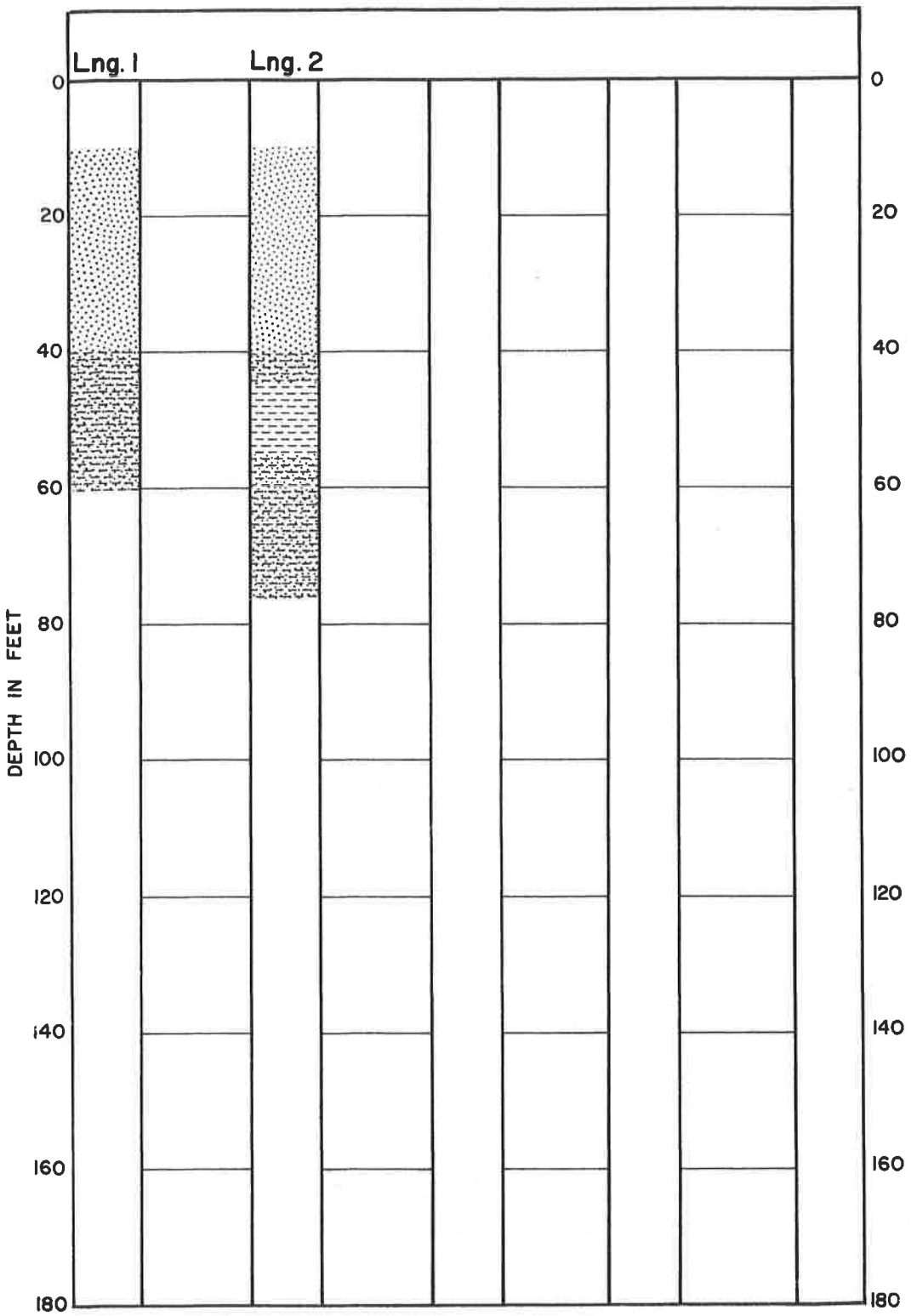

Figure LNG-2. Lithologic Logs - Long County

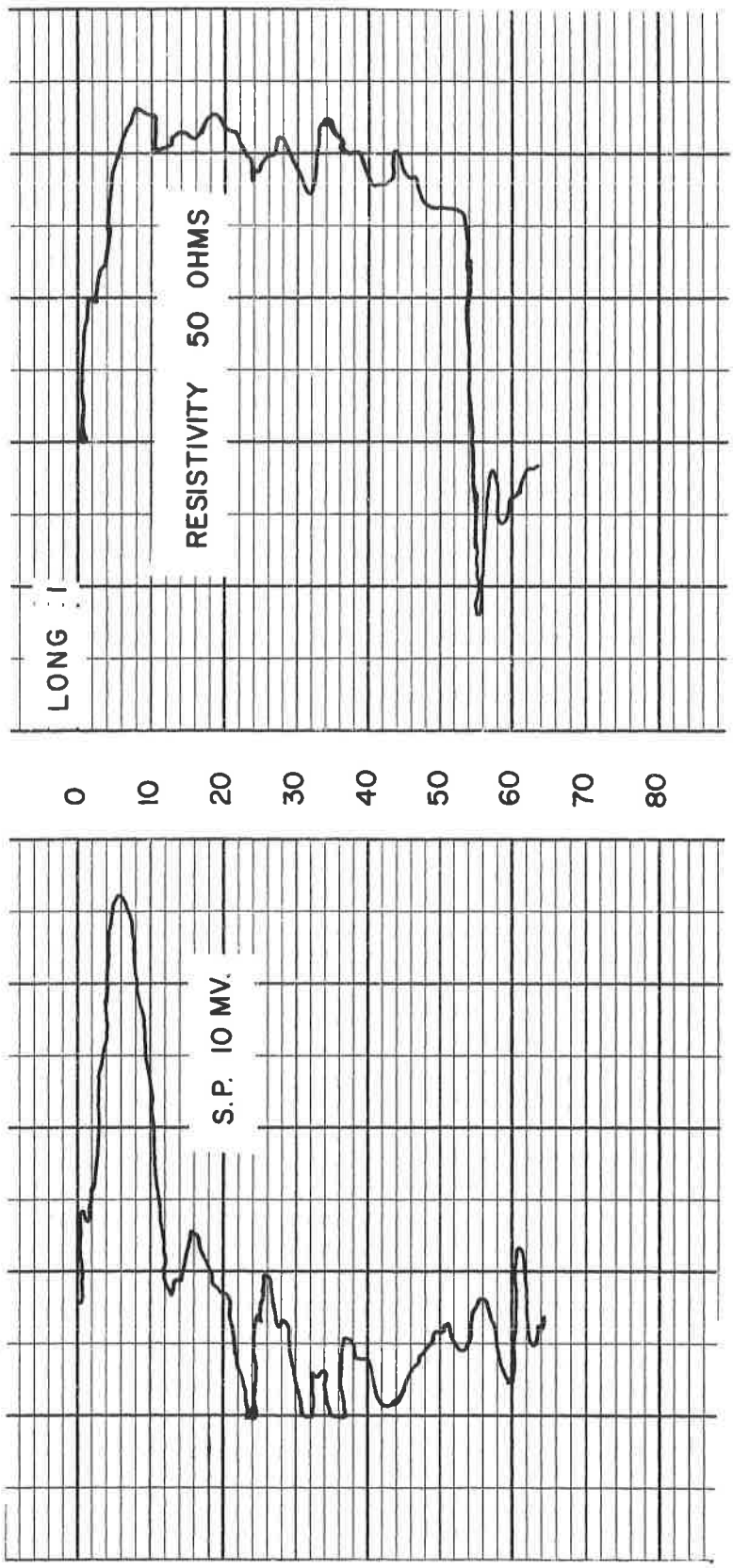

Figure LNG-3. Electric Logs - Long County

Figure WN-1. Location of Hole - Wayne County.

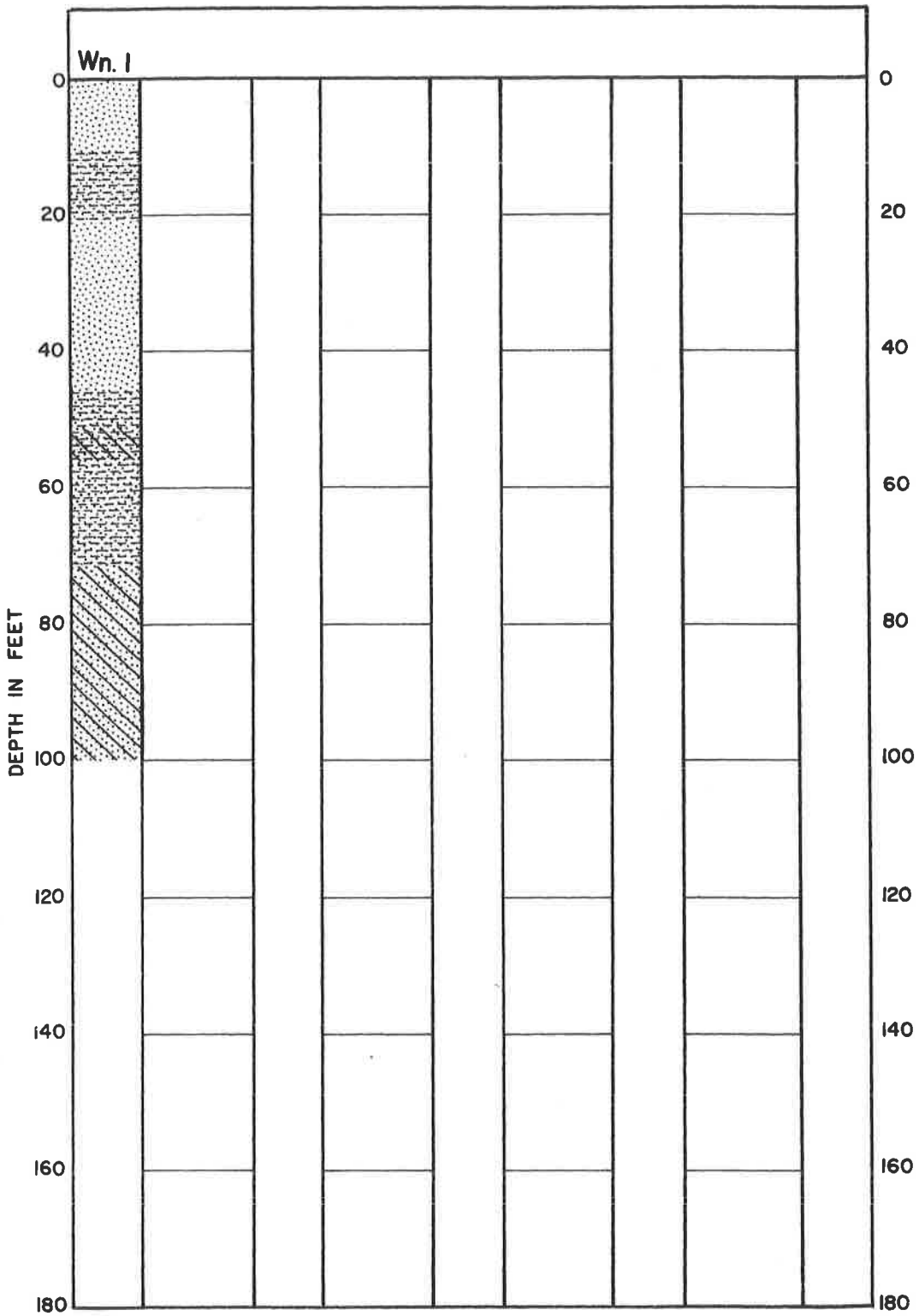

Figure WN-2. Lithologic Log - Wayne County

TABLE LI-LNG-WN-1

BPL DETERMINATIONS ON CORES

Liberty, Long and Wayne Counties

Hole No.	Surface Elevation (Sea Level) Feet	Total Depth Drilled Feet	Core Recovery Overall %	BPL Determination	
				Maximum %	At Depth Feet
Li-1	25	85	80	1.0	25-30
					75-85
Lng-1	66	60	76	1.0	40-45
Lng-2	59	75	90	5.1	55-60
Wn-1		100	100	0.81	90-95