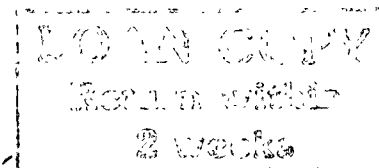


CONSTRUCTION, GEOLOGIC, AND GROUND-WATER DATA FOR OBSERVATION WELLS NEAR THE SHELBY COUNTY LANDFILL, MEMPHIS, TENNESSEE



U.S. GEOLOGICAL SURVEY
Open-File Report 88-486



**Prepared in cooperation with the
SHELBY COUNTY DEPARTMENT OF PUBLIC WORKS**

and the

**TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT,
DIVISION OF SOLID WASTE MANAGEMENT**

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By Michael W. Bradley

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**Nashville, Tennessee
1988**

**DEPARTMENT OF INTERIOR
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U.S. GEOLOGICAL SURVEY
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Denver, Colorado 80225

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FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM OF UNITS (SI)

For the convenience of readers who may want to use metric units rather than inch-pound units, the data may be converted by using the following factors:

<i>Multiply inch-pound units</i>	<i>By</i>	<i>To obtain metric units</i>
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi ²)	2.590	square kilometer (km ²)
gallons per minute (gal/min)	0.06309	liters per second (L/s)

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

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ABSTRACT

Forty-one observation wells and two stratigraphic test holes were drilled near the Shelby County landfill in east Memphis. These wells were installed as part of an investigation on possible vertical leakage of ground water from the shallow aquifer into the Memphis Sand aquifer. The shallow aquifer consists of about 45 to 55 feet of alluvial silt, sand, and gravel. This is separated from the underlying Memphis Sand aquifer by about 30 to 60 feet of silt, silty sand, and clay in the confining layer.

Thirty wells completed in the alluvium were generally less than 50 feet deep. The depth to the water table ranged from about 15 to more than 45 feet below land surface. Four observation wells were completed in the upper part of the Memphis Sand at two sites. Water levels in the Memphis Sand were generally 35 to 40 feet below land surface.

INTRODUCTION

The Shelby County landfill, operated by the Shelby County Department of Public Works, receives domestic and municipal waste. Proposed expansions of the landfill led to the investigation of an area to the west of the current landfill in 1978 (Garman, Tennessee Department of Public Health, written commun., 1978) and north of Walnut Grove Road in early 1986 (Ashner, Tennessee Department of Health and Environment, written commun., 1986) by the Tennessee Division of Solid Waste Management. Data from the investigations indicated an area of depressed water levels in the shallow aquifer that could have been caused by vertical leakage to the underlying Memphis Sand aquifer.

The U.S. Geological Survey (USGS), in cooperation with the Shelby County Department of Public Works and the Tennessee Department

of Health and Environment, Division of Solid Waste Management, began an investigation of the landfill area in July 1986 to investigate the extent and amount of vertical leakage. The purpose of this report is to present data concerning well construction, lithology, and ground-water levels near the Shelby County landfill.

SITE DESCRIPTION

The Shelby County landfill is located on the east side of Memphis and has been constructed on the flood plain of the Wolf River (fig. 1). Agricultural land surrounds the landfill to the north and east, and the Wolf River forms the western and southern boundaries. The landfill area is drained by a number of intermittent streams that flow to the Wolf River. The top of the landfill is at an elevation of 290 feet above sea level, about 40 to 45 feet higher than the surrounding land surface.

The area around the landfill is underlain by unconsolidated sand, silt, and clay. The general stratigraphic sequence of concern in this area includes, in descending order, the Wolf River alluvial deposits, the Jackson Formation-upper Claiborne Group confining unit, and the Memphis Sand of the Claiborne Group (Graham and Parks, 1986).

WELL CONSTRUCTION

During July and August 1986, 30 observation wells were installed in the landfill area. Thirteen additional wells were constructed

during November 1986 and June 1987 (fig. 1). Thirty-two wells were completed in the alluvial aquifer. Four of the shallow wells were later destroyed. Four wells were completed in the upper part of the Memphis Sand. These four wells are MS-1, MS-2, MS-3, and MS-4. Five observation wells (11, 24, C-1, C-2, and C-3) were completed in the confining layer. Multiple wells were installed at two sites. The first is located southwest of the landfill, near the Wolf River. The other site is located in a field north of the landfill (fig. 1). Two stratigraphic test holes, SH:Q-124 and SH:Q-130, were also drilled.

Most of the wells were drilled with a CME-55 auger rig by USGS personnel. The wells were constructed in June 1987 and the two test holes were drilled by the U.S. Army Corps of Engineers using a Failing 1500 mud-rotary drill rig. All of the wells were completed with polyvinylchloride (PVC) casing and screen and were sealed with bentonite pellets and cement slurry. Well-construction data are summarized in table 1, and construction diagrams are included in Appendix A.

All wells completed in the alluvial aquifer and underlying silt and clay of the confining unit were completed with either 2- or 4-inch screen and casing. The formation was allowed to collapse around the screen and a bentonite seal was installed to prevent the movement of water along the borehole. The remaining annulus was back-filled and a well protector and surface seal were installed. Wells drilled with the mud-rotary rig were flushed with water from the drill rig to remove the drilling mud from the borehole. Wells MS-1 and MS-2 were developed for about 8 hours using compressed air.

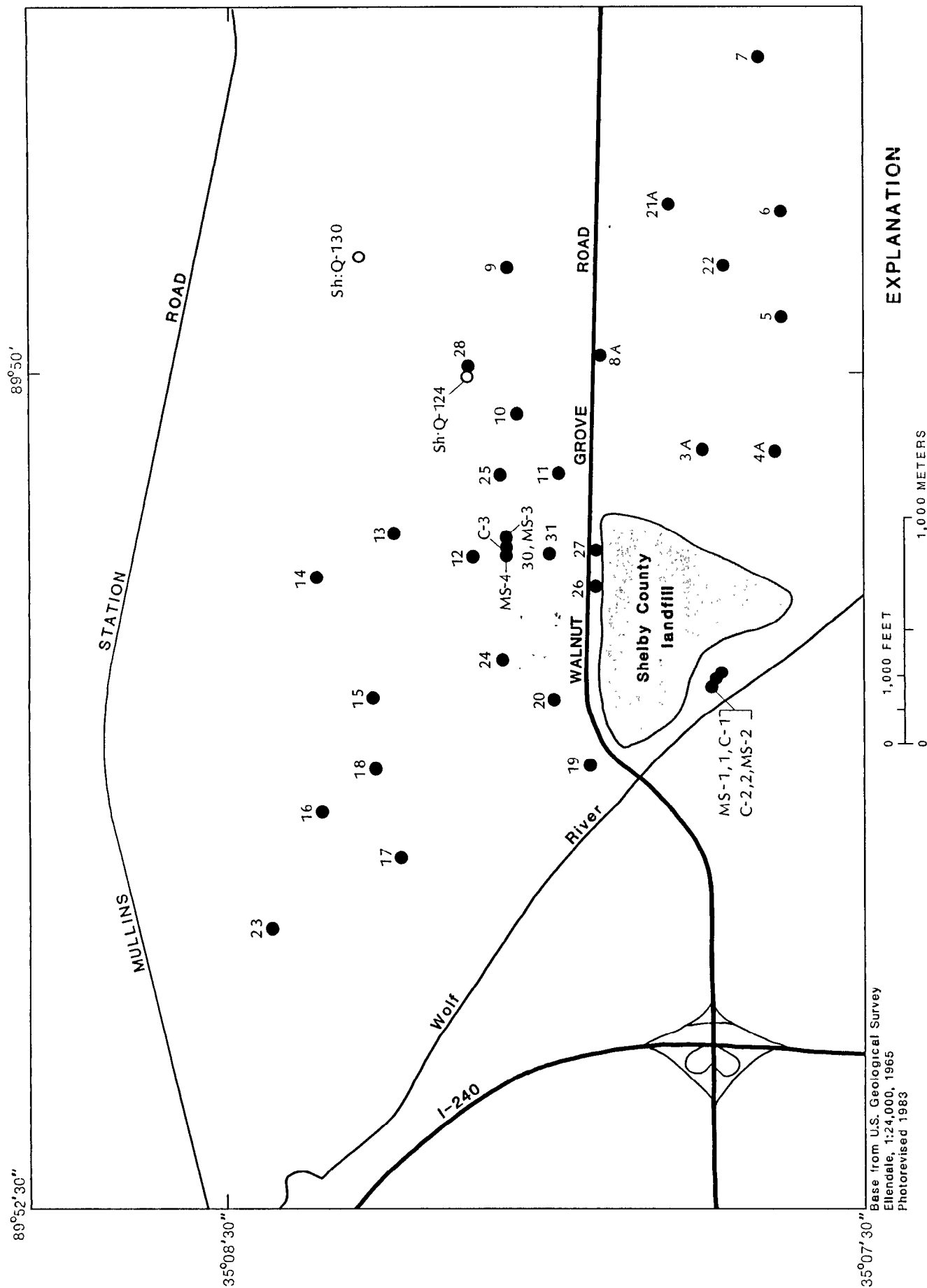


Figure 1.--Location of observation wells in the area of the Shelby County landfill.

Table 1.--Construction data for observation wells near the Shelby County landfill

[Method Constructed: A - Auger, M - Mud rotary]

Well number				Land elevation surface (feet)	Formation	Screened interval (feet below land surface)	Screen diameter (inches)	Date well constructed	Method constructed
Local	Project	Latitude	Longitude						
SH:Q- 95	1	350749	0895058	247	Alluvium	30.8 - 35.8	2	08-11-86	A
SH:Q- 96	2	350749	0895058	247	Alluvium	43.3 - 48.3	2	08-12-86	A
SH:Q- 97	3A	350750	0895017	253	Alluvium	45 - 50	2	08-16-86	A
SH:Q- 98	4A	350739	0895017	254	Alluvium	47.5 - 52.5	2	08-16-86	A
SH:Q- 99	5	350737	0894955	251	Alluvium	28.4 - 33.4	2	07-29-86	A
SH:Q-100	6	350732	0894930	254	Alluvium	29 - 34	2	07-28-86	A
SH:Q-10	7	350741	0894909	258	Alluvium	32.7 - 37.7	4	07-30-86	A
SH:Q-102	8A	350803	0894959	262	Alluvium	48.7 - 53.7	2	08-15-86	A
SH:Q-103	9	350814	0894943	275	Alluvium	39.3 - 44.3	2	07-28-86	A
SH:Q-104	10	350816	0895009	267	Alluvium	39 - 44	2	07-28-86	A
SH:Q-105	12	350822	0895040	252	Alluvium	38.7 - 43.7	2	04-27-87	A
SH:Q-106	13	350833	0895030	264	Alluvium	38.8 - 43.8	2	07-26-86	A
SH:Q-107	14	350844	0895032	264	Alluvium	39.5 - 44.5	2	07-26-86	A
SH:Q-108	15	350836	0895032	260	Alluvium	38.3 - 43.8	2	07-25-86	A
SH:Q-109	16	350845	0895121	257	Alluvium	39.7 - 44.7	2	07-25-86	A
SH:Q-110	17	350833	0895121	255	Alluvium	39.2 - 44.2	2	07-25-86	A
SH:Q-111	18	350838	0895113	259	Alluvium	38.3 - 43.3	2	07-25-86	A
SH:Q-112	19	350807	0895111	247	Alluvium	39.4 - 44.4	2	07-26-86	A
SH:Q-113	20	350812	0895059	248	Alluvium	38.2 - 43.2	2	07-26-86	A
SH:Q-114	21A	350753	0894933	260	Alluvium	40 - 45	2	08-16-86	A
SH:Q-115	22	350745	0894945	255	Alluvium	49.2 - 54.2	2	08-15-86	A
SH:Q-116	23	350853	0895140	246	Alluvium	23.3 - 28.3	2	11-10-86	A
SH:Q-117	24	350817	0895053	250	Alluvium	37.7 - 42.7	2	11-10-86	A
SH:Q-119	26	350804	0895041	260	Alluvium	60.1 - 65.1	2	11-12-86	A
SH:Q-120	27	350804	0895035	262	Alluvium	60.2 - 65.2	2	11-12-86	A
SH:Q-121	28	350822	0895003	273	Alluvium	22.5 - 27.5	2	11-14-86	A
SH:Q-128	30	350817	0895035	250	Alluvium	33.7 - 38.7	2	06-03-87	M
SH:Q-129	31	350810	0895035	249	Alluvium	34 - 39	2	06-08-87	M
SH:Q- 91	11	350808	0895021	262	Confining Unit	83.7 - 88.7	4	07-30-86	A
SH:Q-118	25	350717	0895019	262	Confining Unit	74 - 79	2	11-10-86	A
SH:Q-122	C-1	350749	0895058	247	Confining Unit	103 -108	2	08-12-86	A
SH:Q-123	C-2	350749	0895058	247	Confining Unit	78.5 - 83.5	2	08-12-86	A
SH:Q-127	C-3	350817	0895035	250	Confining Unit	53.3 - 55.3	2	06-17-87	M
SH:Q- 90	MS-1	350749	0895058	247	Memphis Sand	140 -170	4	07-31-86	M
SH:Q- 92	MS-2	350749	0895058	247	Memphis Sand	150 -180	6	08-15-86	M
SH:Q-125	MS-3	350817	0895035	250	Memphis Sand	80 -100	4	06-04-87	M
SH:Q-126	MS-4	350817	0895035	250	Memphis Sand	68.7 - 97.7	6	06-16-87	M

Wells 3, 4, 8, 9, 10, 11, 13, 21, and 25 were completed in the alluvial aquifer and were later found to be dry. Wells 11 and 25 were deepened and completed in the confining unit below the alluvial aquifer. Wells 3A, 4A, 8A, and 21A were installed to about 50 to 55 feet below land surface near the dry wells. The screens were filled with bentonite pellets and the casing was then grouted to land surface. Gamma and lithologic logs indicated that wells 9, 10, and 13 were completed near the base of the alluvial aquifer and that deeper wells at these sites would not provide reliable water-level data for the alluvial aquifer.

The four wells in the Memphis Sand aquifer were drilled by the mud-rotary method and completed with PVC casing and screen. Wells MS-1 and MS-2 were constructed with 30 feet of PVC screen. The formation was allowed to collapse around the screens. These wells were grouted from about the middle of the confining unit to land surface. Gravel and sand packs were placed in wells MS-3 and MS-4 and then grouted to land surface. The wells were developed by flushing the casing using the drill rig and later by surging with air.

LITHOLOGY

During well construction, geologist's logs describing the lithology at approximately 5-foot intervals and drilling conditions were recorded. Samples were collected from the auger flights, the drilling mud, and selected intervals were sampled with a split-spoon sampler. Natural gamma geophysical logs were run on all wells. Lithologic and select gamma logs are presented in Appendix A.

The stratigraphy encountered during drilling near the Shelby County landfill can be briefly summarized as: near-surface clay and silt, alluvial sand and gravel, silt, silty-sand and clay of the confining unit, and sand in the upper Memphis Sand.

The shallow clay consists of about 10 to 15 feet of top soil and brown silty clay changing to gray-brown clay near the top of the alluvial sands. These are fine- to coarse-grained sand with occasional layers of gravel. The alluvial deposits are generally 45 to 55 feet thick at this site. The confining unit underlies the alluvial deposits.

The confining unit is approximately 30 to 60 feet thick and consists of silt, silty-sand, and clay. However, the lithology and thickness of this unit may change rapidly as evidenced by gamma logs for wells MS-1 and MS-2. A clay layer encountered at 61 and 69 feet below land surface at MS-2 pinched out and is not present at well MS-1, only 50 feet away.

Wells MS-1, MS-2, MS-3 and MS-4, and the two stratigraphic test holes SH:Q-124 and SH:Q-130 were drilled into the upper part of the Memphis Sand. The upper Memphis Sand in this area consists primarily of fine- to medium-grained, gray to light gray sand. Some layers of silt and silty sand were encountered. Gamma logs for all of the Memphis Sand wells are included in Appendix A.

GROUND-WATER LEVELS

Ground-water levels were measured periodically at the observation wells (table 2). Water

levels in the alluvial aquifer generally ranged from 15 to 45 feet below land surface. Water levels at well 6 were near land surface, but the well is believed to be plugged. The shallowest water levels in the alluvial aquifer occurred at wells 1 and 2, and the deepest at wells 26 and 27. Ground-water levels in the Memphis Sand aquifer were generally 30 to 40 feet below land surface. The water level in the Memphis Sand aquifer is lower than the water table in the alluvial aquifer. Continuous water-level recorders were installed on wells MS-1, 7, and 22. Hydrographs for these wells are shown in figures 2, 3, and 4, respectively.

Table 2.--Water-level data for wells near the Shelby County landfill

Well number		Land surface elevation (feet)	Water level, feet below land surface			
Local	Field		08-02-86	08-25-86	11-4-86	06-10-87
SH:Q- 95	1	247	--	15.04	--	16.36
SH:Q- 96	2	247	--	15.31	--	16.41
SH:Q- 97	3A	253	--	34.78	35.79	34.08
SH:Q- 98	3	253	dry	dry	dry	well destroyed
	4A	254	--	34.27	35.25	--
SH:Q- 99	4	254	dry	dry	dry	well destroyed
	5	251	29.74	30.10	31.15	--
SH:Q-100	6	254	.33	.12	well plugged	
SH:Q-101	7	258	33.18	33.55	34.15	33.98
SH:Q-102	8A	262	--	43.65	44.48	43.98
SH:Q-103	8	262	dry	dry	dry	well destroyed
	9	275	dry	dry	dry	dry
SH:Q-104	10	267	dry	dry	dry	dry
SH:Q- 91	11	262	60.07	48.52	48.11	44.92
SH:Q-105	12	252	36.39	36.48	37.25	37.75
SH:Q-106	13	264	dry	dry	31.65	dry
SH:Q-107	14	264	23.1	25.36	25.86	25.59
SH:Q-108	15	260	39.07	38.12	39.38	39.81
SH:Q-109	16	257	31.01	31.08	31.54	31.28
SH:Q-110	17	255	30.46	30.58	--	30.59
SH:Q-111	18	259	35.56	35.64	36.08	35.42
SH:Q-112	19	247	20.98	21.05	21.97	20.54
SH:Q-113	20	248	31.50	31.66	32.14	32.18
SH:Q-114	21A	260	--	42.37	43.14	2.91
	21	260	dry	dry	dry	well destroyed
SH:Q-115	22	255	--	42.37	43.14	42.91
SH:Q-116	23	246	--	--	16.74	16.47
SH:Q-117	24	250	--	--	30.64	32.22
SH:Q-118	25	262	--	--	50.17	51.64
SH:Q-119	26	260	--	--	46.32	45.84
SH:Q-120	27	262	--	--	48.10	47.74
SH:Q-121	28	273	--	--	--	20.03
SH:Q-128	30	250	--	--	--	34.30
SH:Q-129	31	249	--	--	--	32.94
SH:Q-122	C-1	247	--	33.39	--	--
SH:Q-123	C-2	247	--	22.12	--	--
SH:Q- 90	MS-1	247	35.08	37.01	--	--
SH:Q- 92	MS-2	247	--	28.88	--	--
SH:Q-125	MS-3	250	--	--	--	39.55

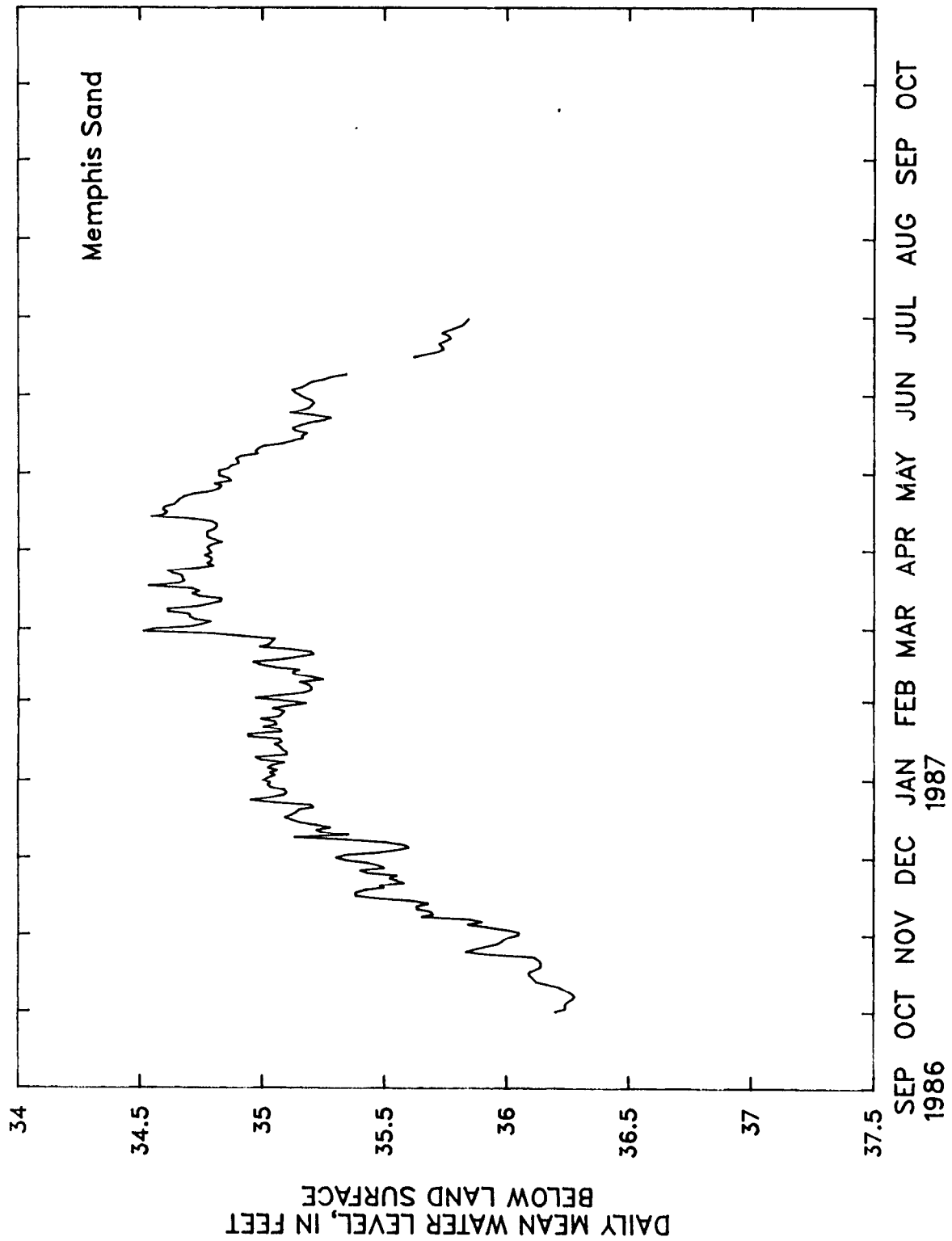


Figure 2.--Ground-water levels in well MS-1.

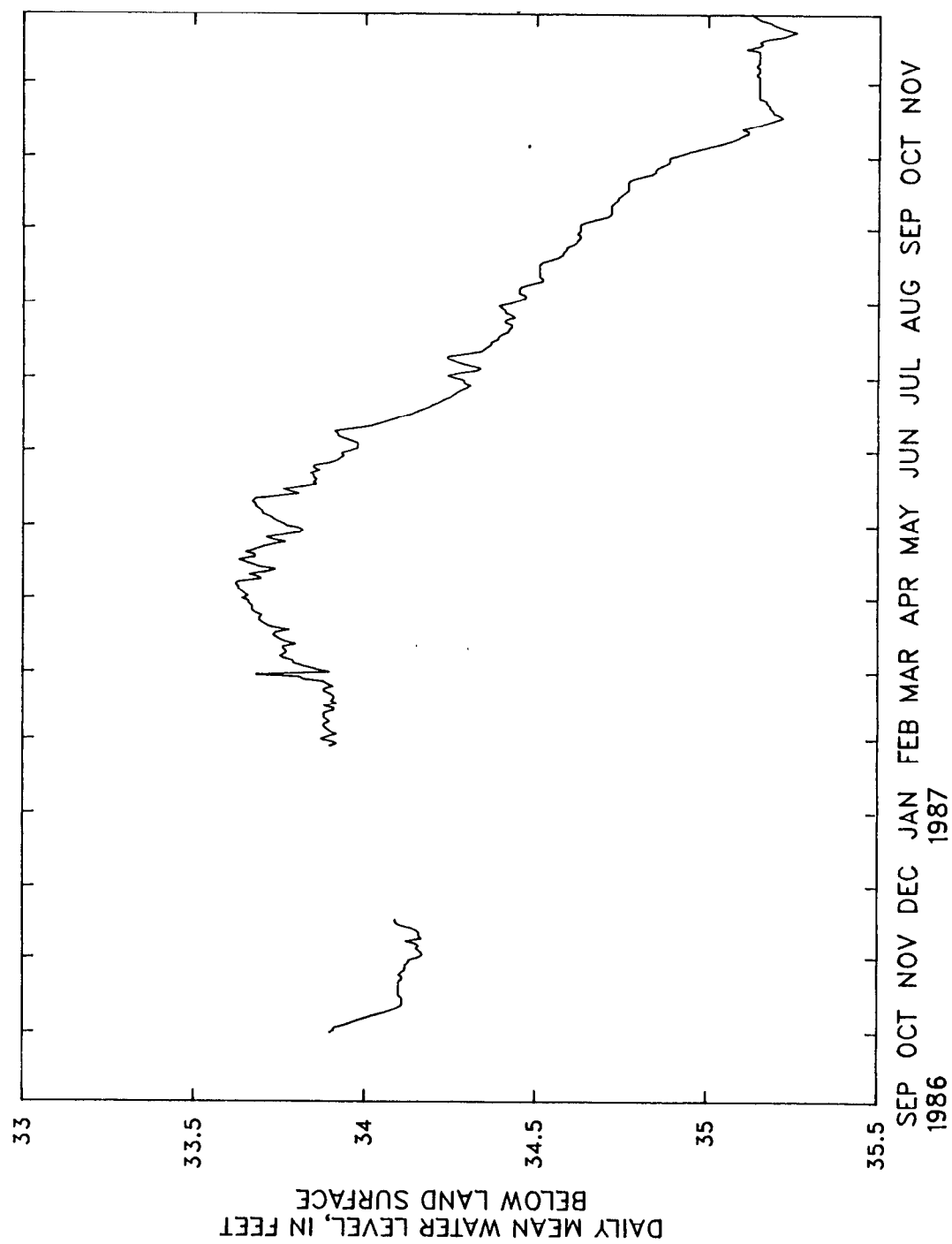


Figure 3.--Ground-water levels in well 7.

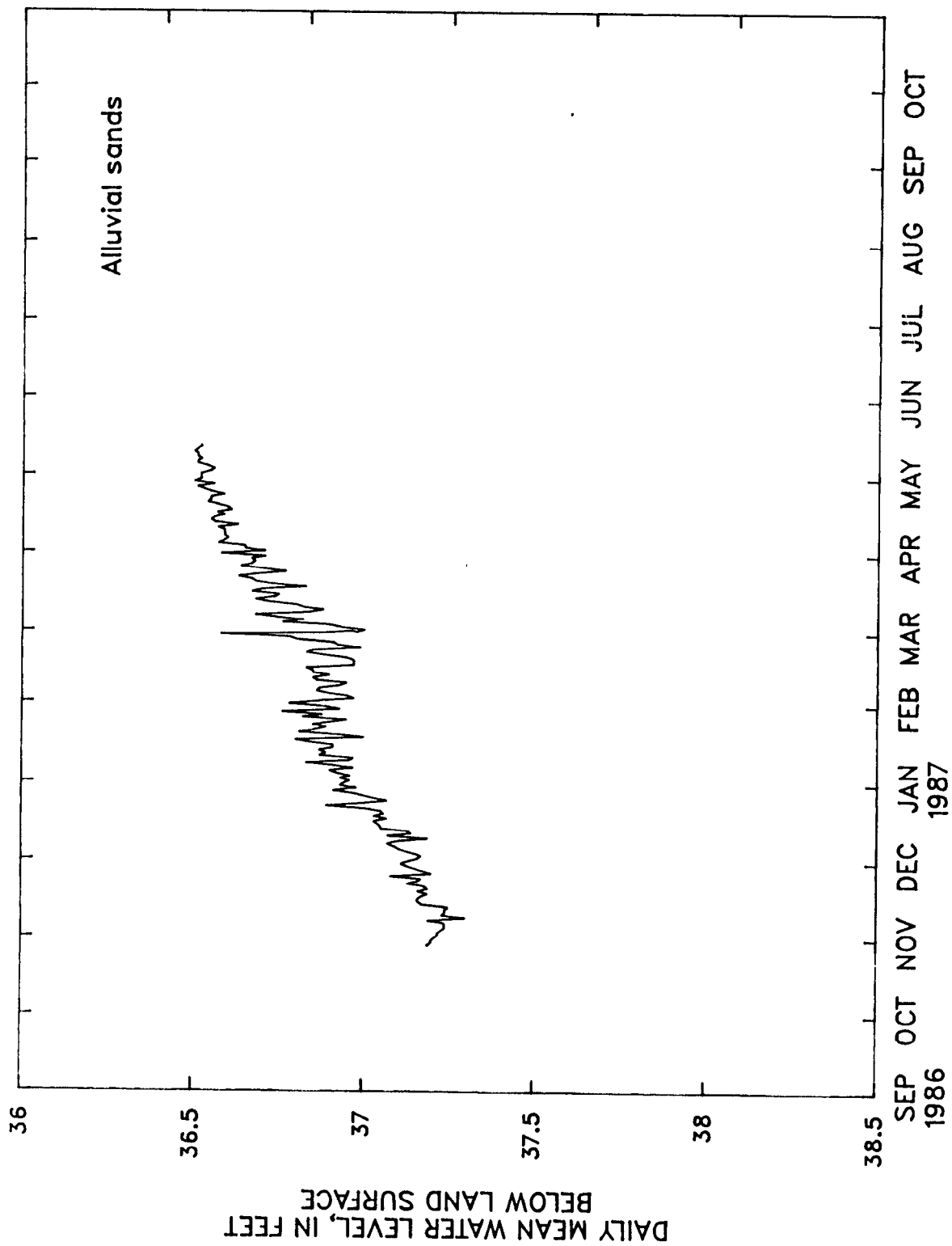


Figure 4.--Ground-water levels in well 22.

REFERENCE

Graham, D.D., and Parks, W.S., 1986, Potential for leakage among principal aquifers in the Memphis area, Tennessee: U.S. Geological Survey Water-Resources Investigations Report 85-4295, 46 p.

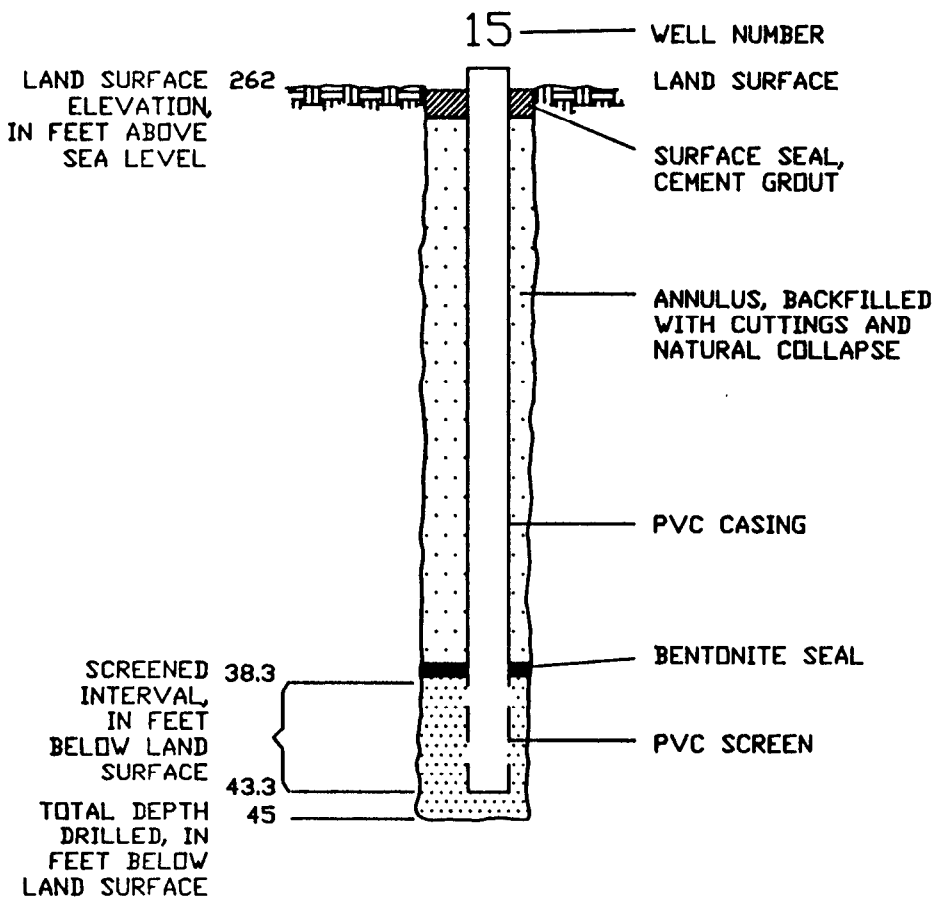
APPENDIX A

Well-construction diagrams, lithology, and gamma logs

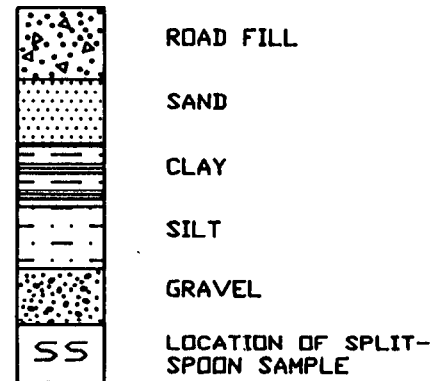
APPENDIX A

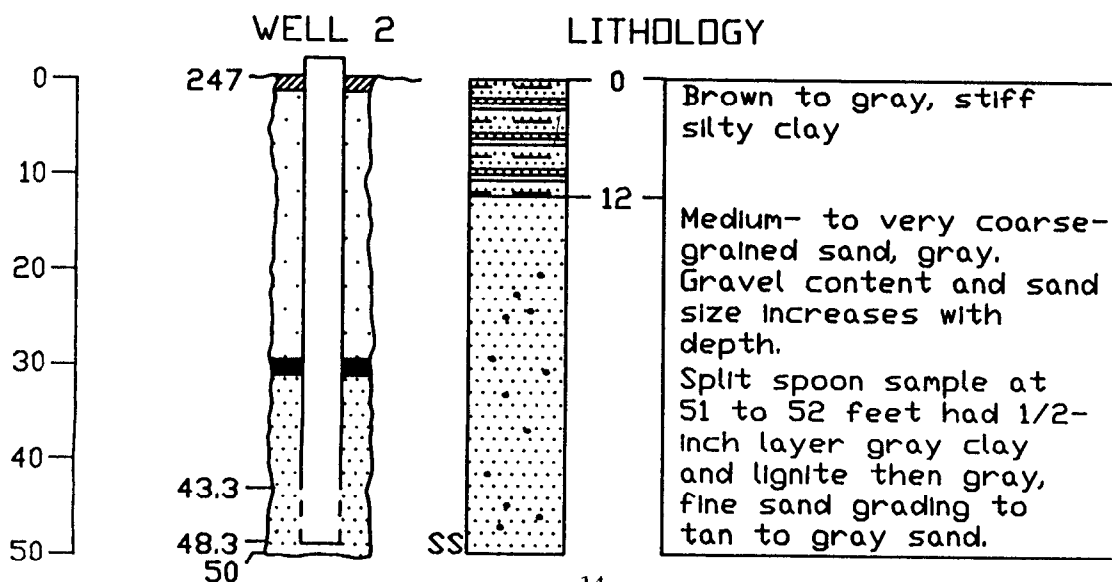
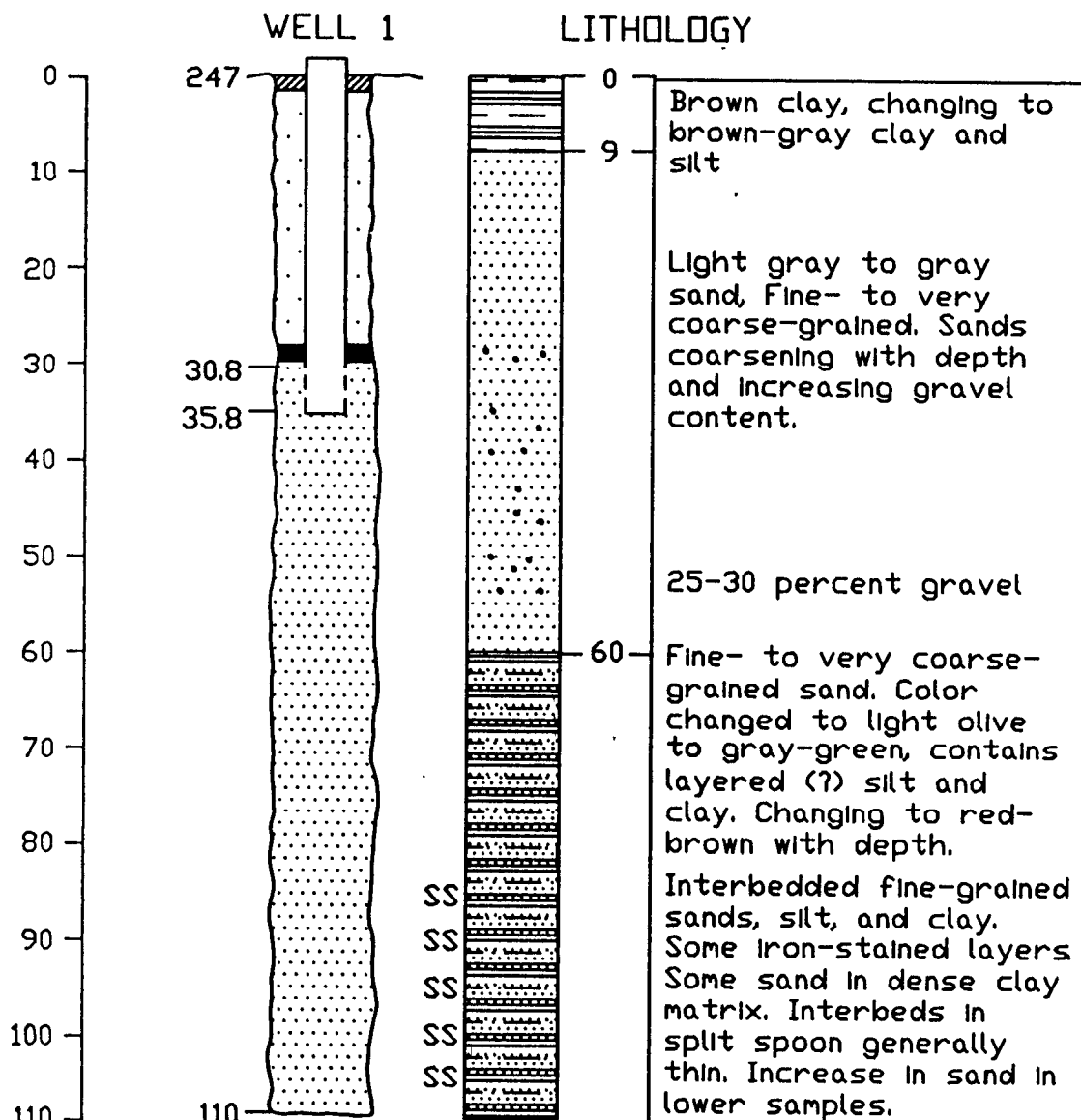
Well-construction diagrams, lithology, and gamma logs

EXPLANATION

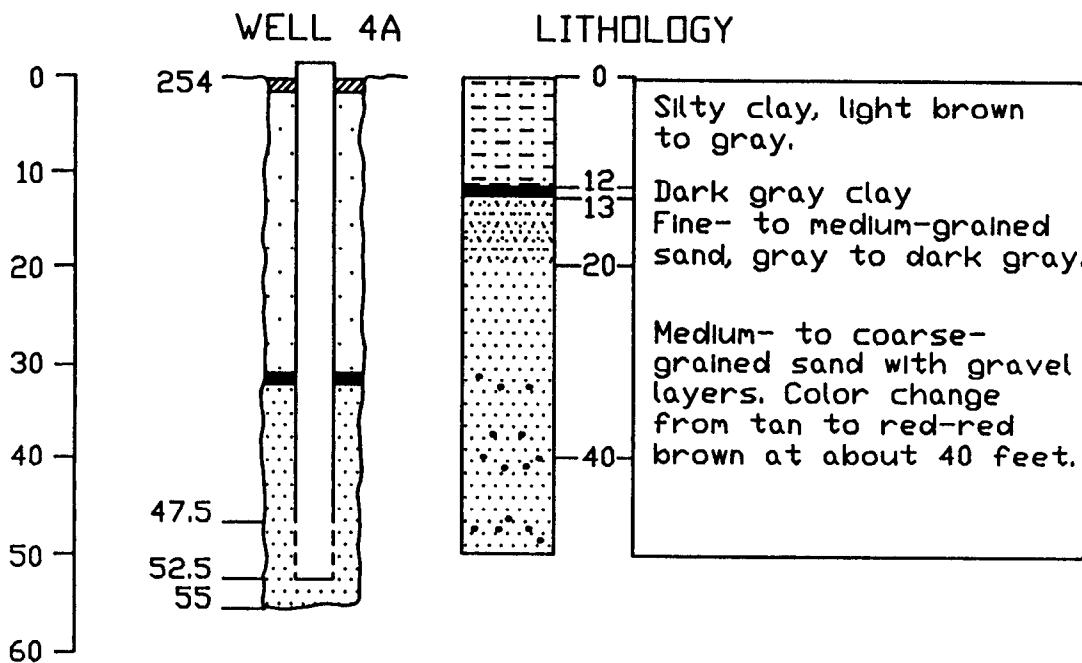
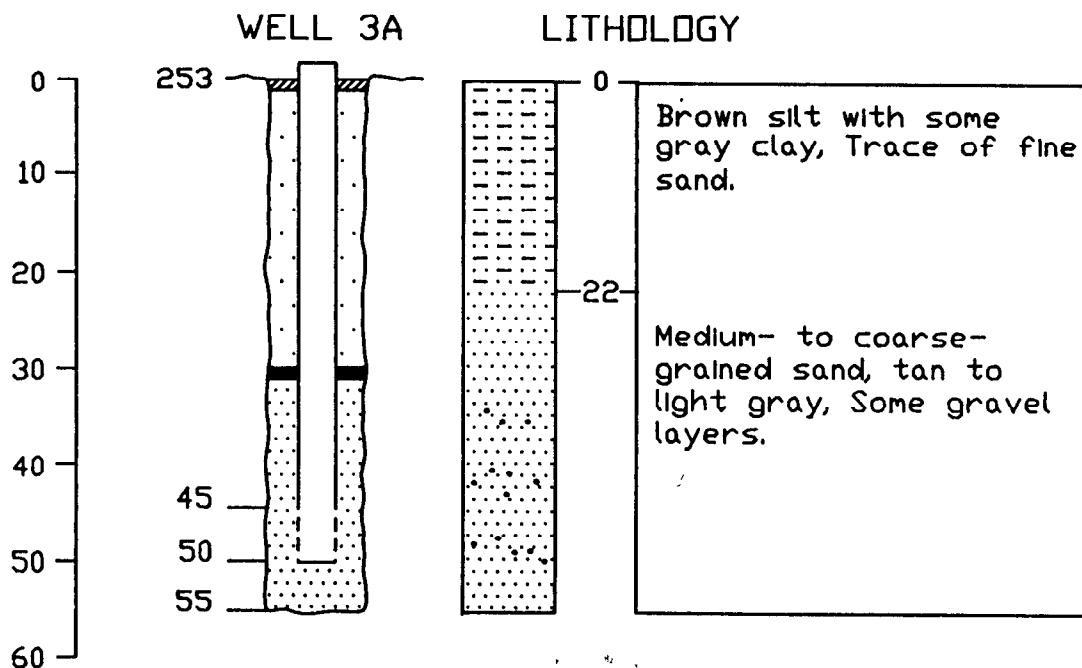


LITHOLOGY

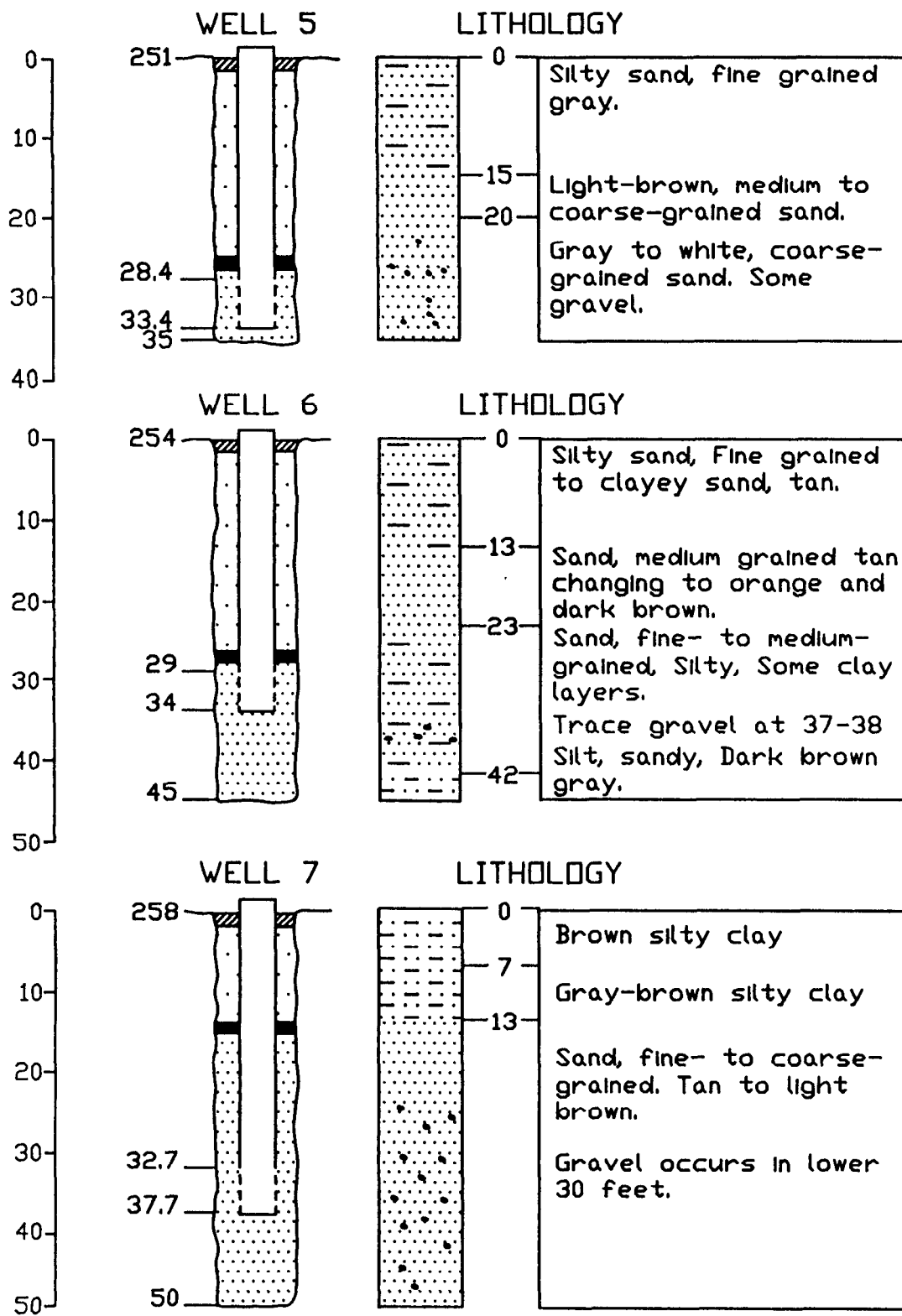




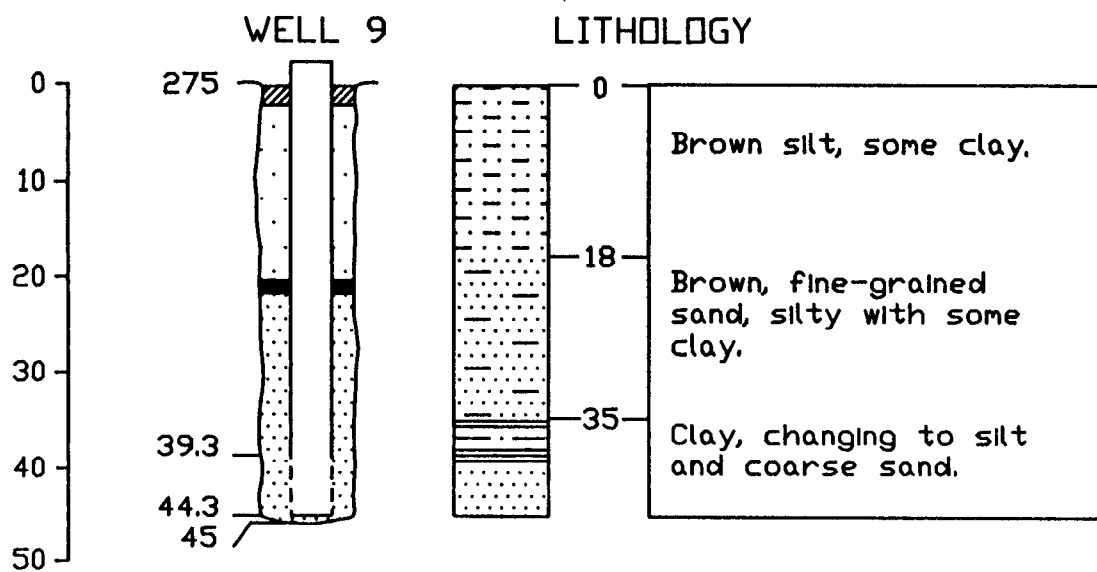
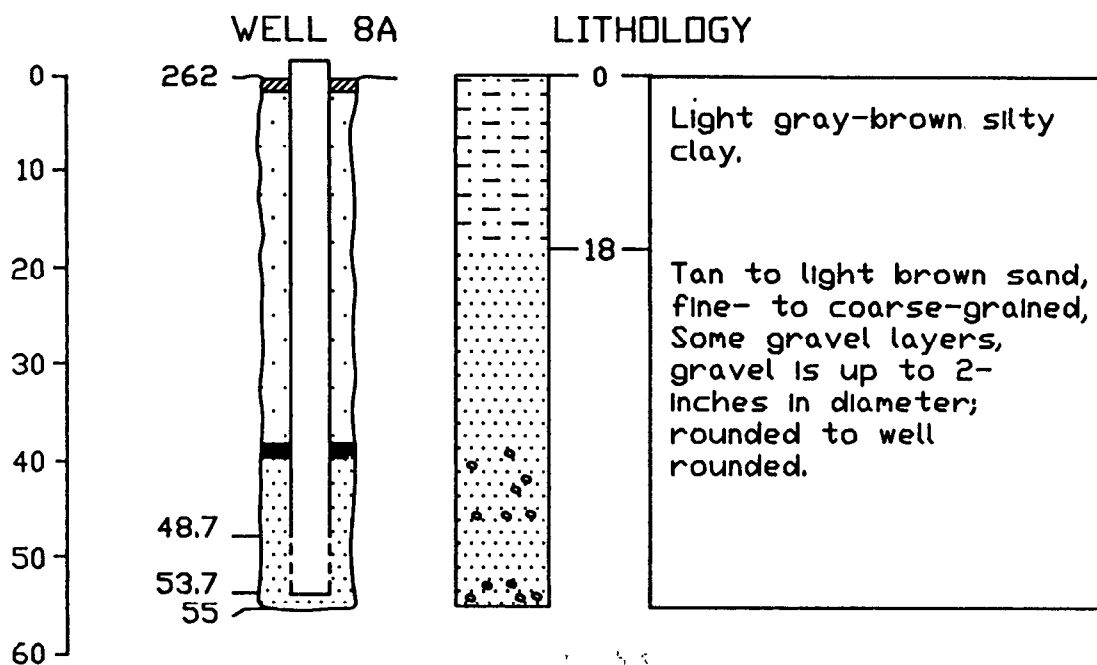
DEPTH, IN FEET BELOW LAND SURFACE



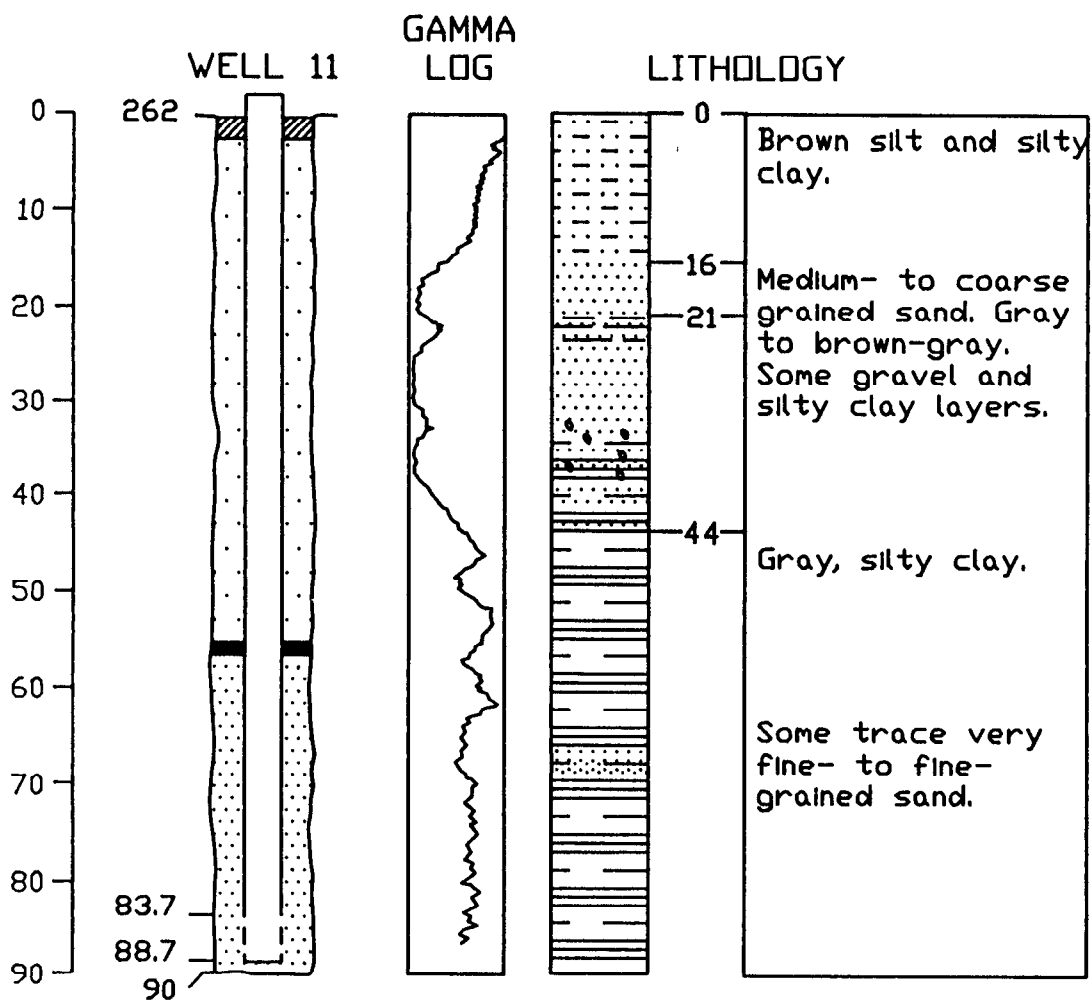
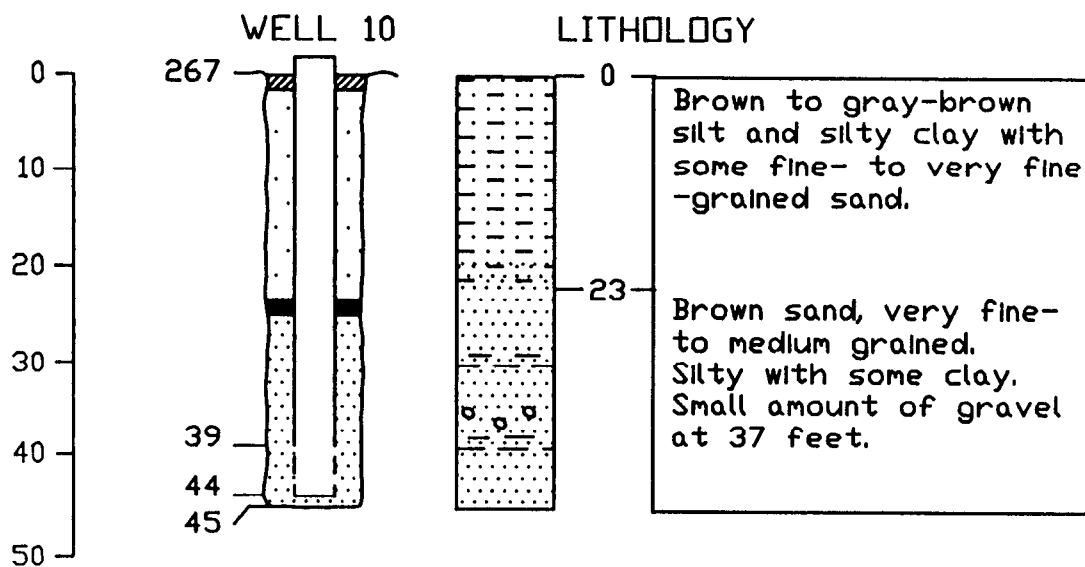
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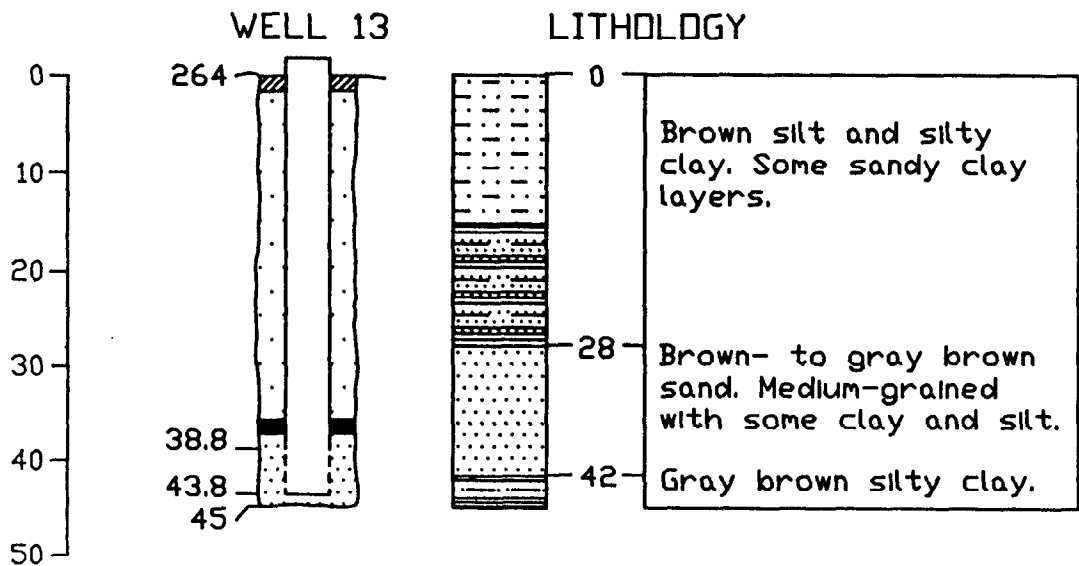
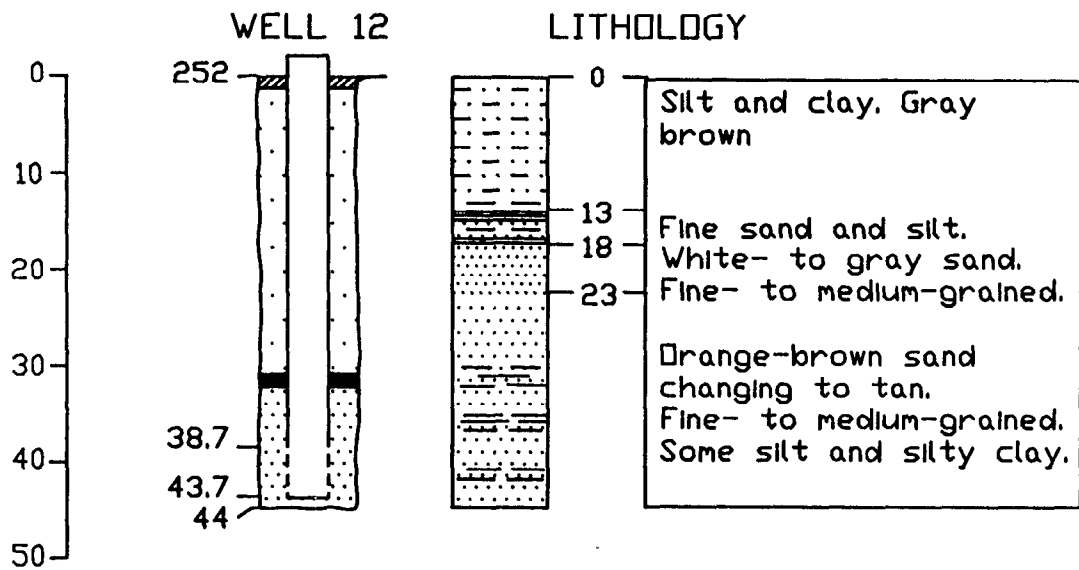
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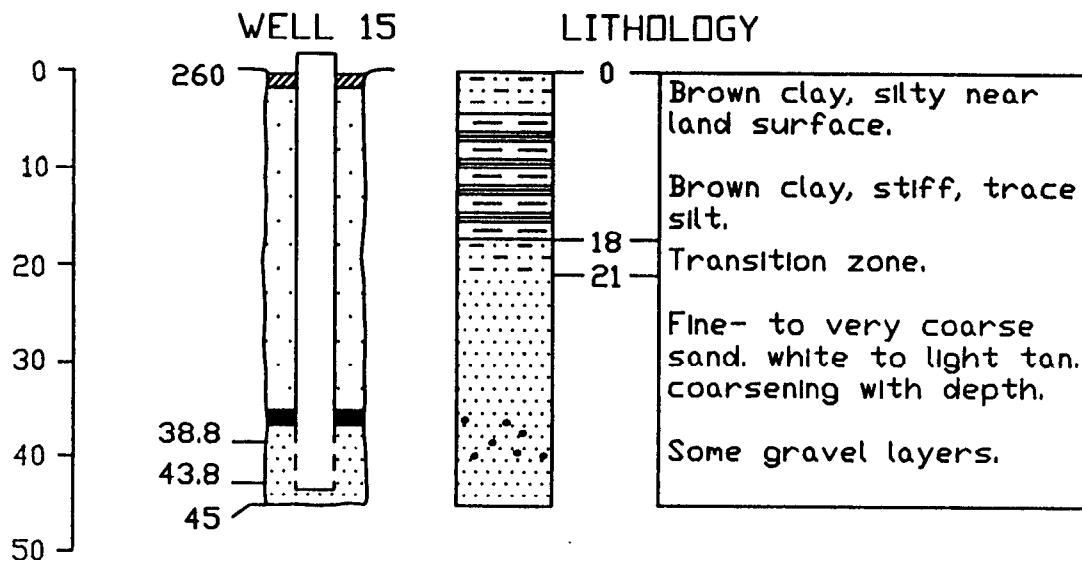
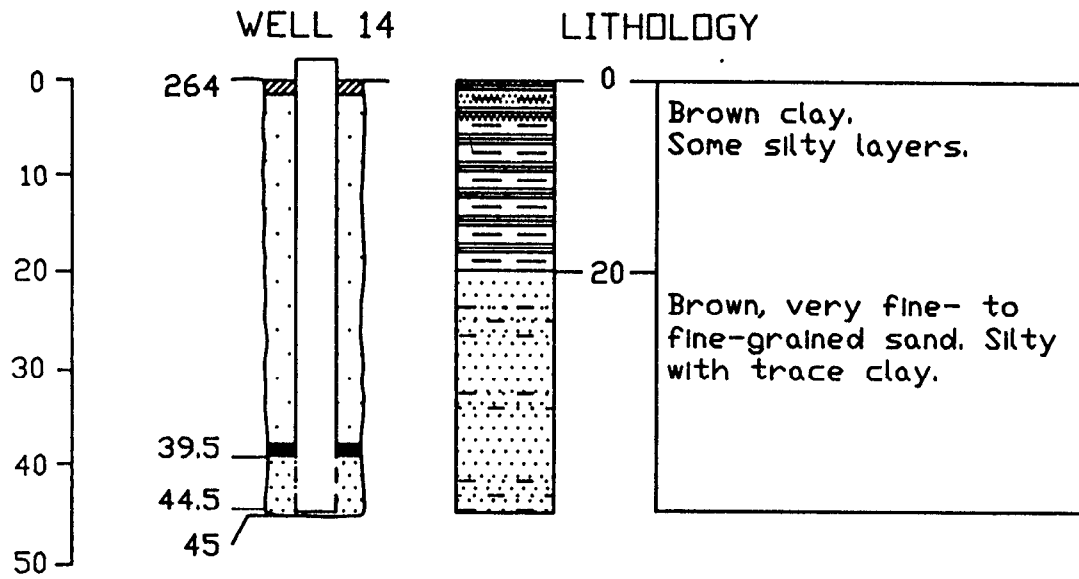
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DEPTH, IN FEET BELOW LAND SURFACE

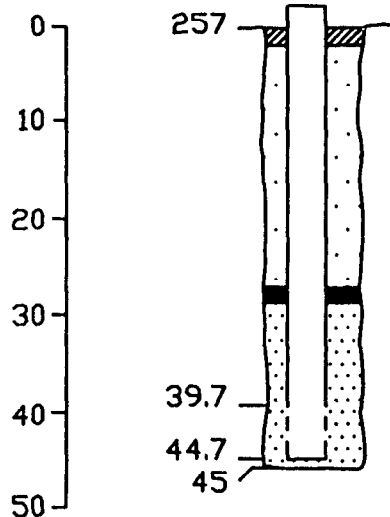


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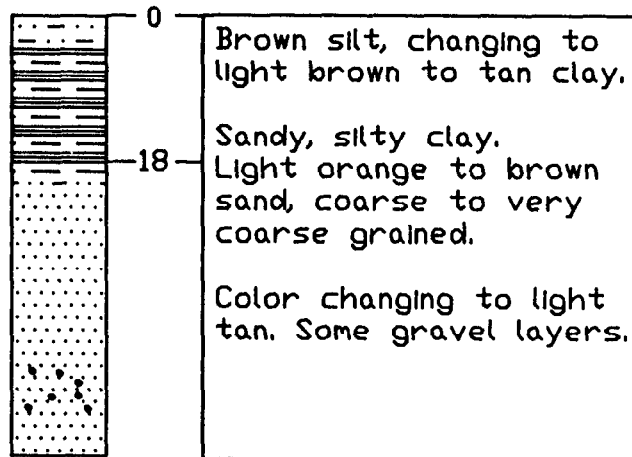


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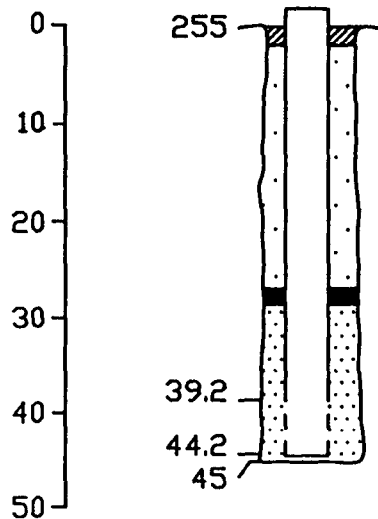
WELL 16



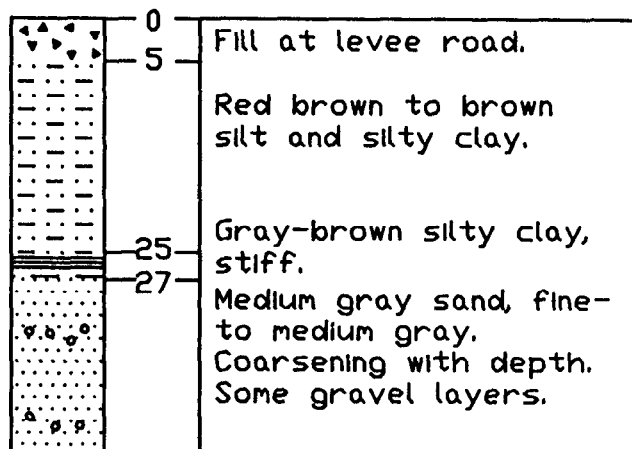
LITHOLOGY



WELL 17

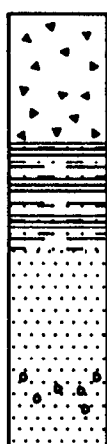
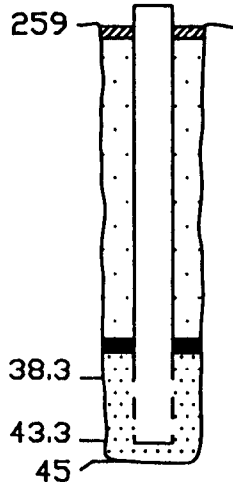
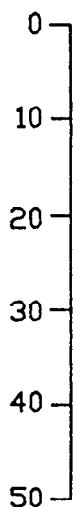


LITHOLOGY



WELL 18

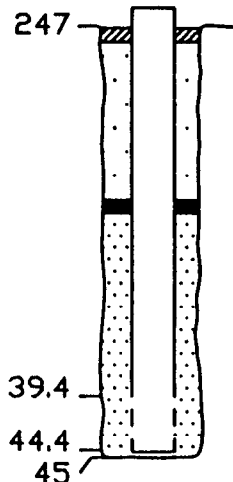
LITHOLOGY



Fill for levee road.
Red brown to gray clay with some silt.
Light tan to white sand, fine- to medium-grained, became coarser with depth. Some very coarse-grained sand and gravel.

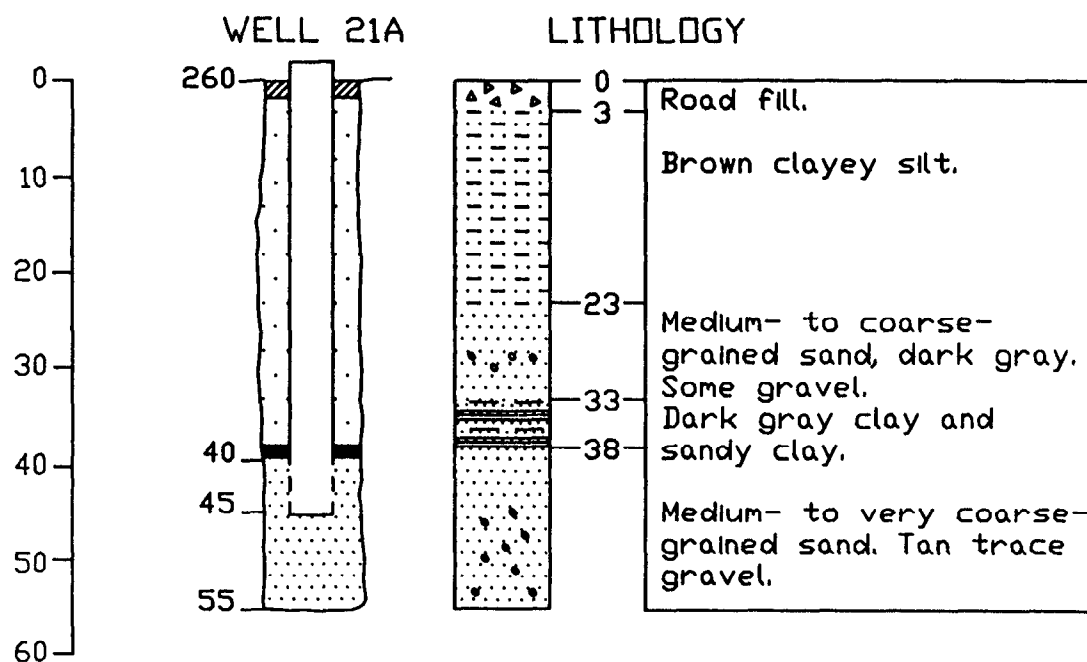
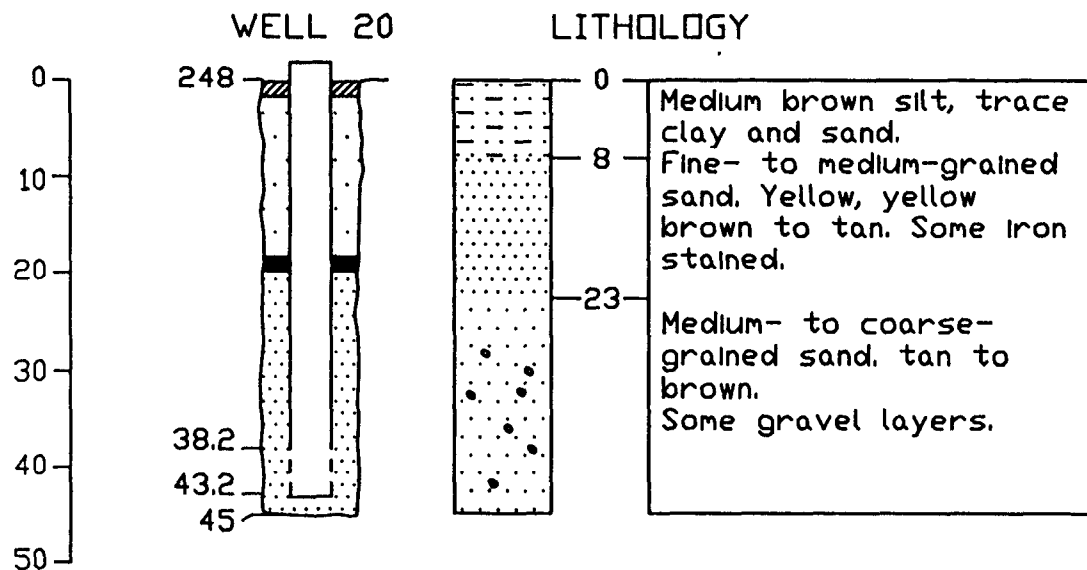
WELL 19

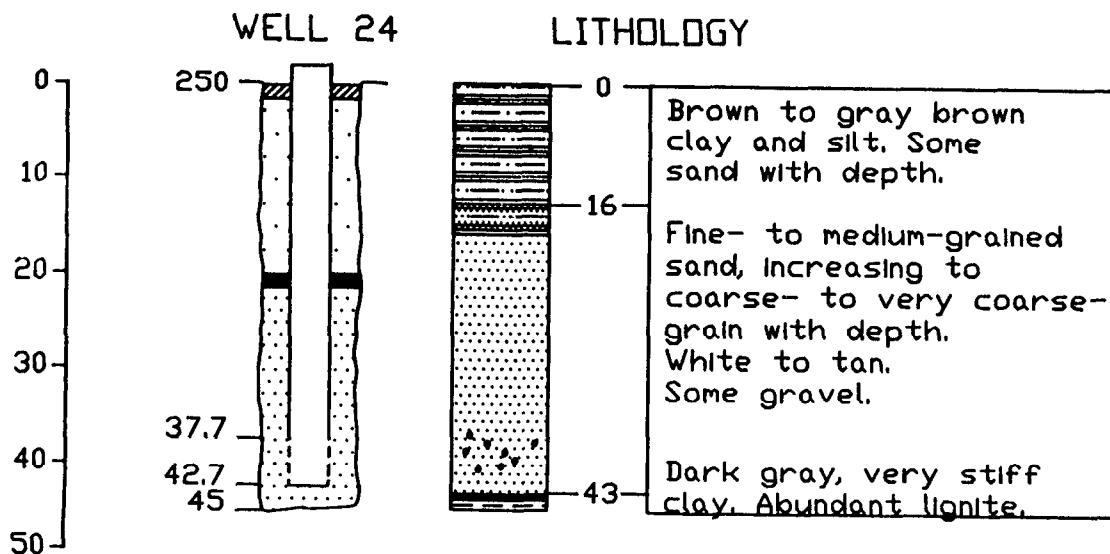
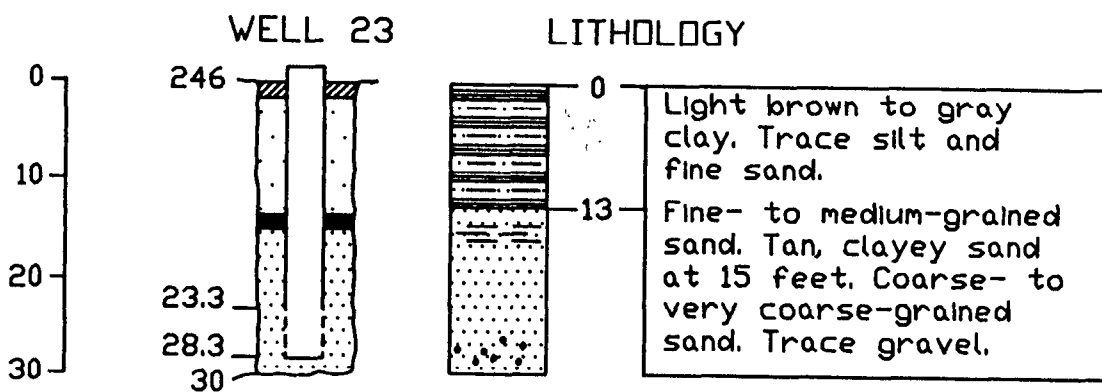
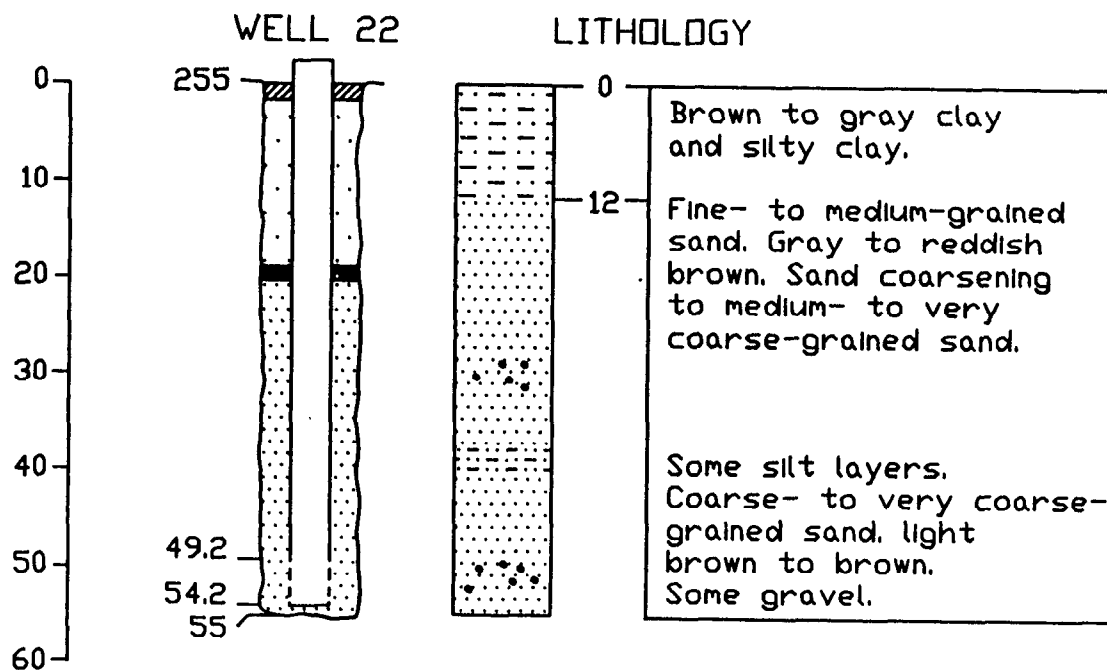
LITHOLOGY



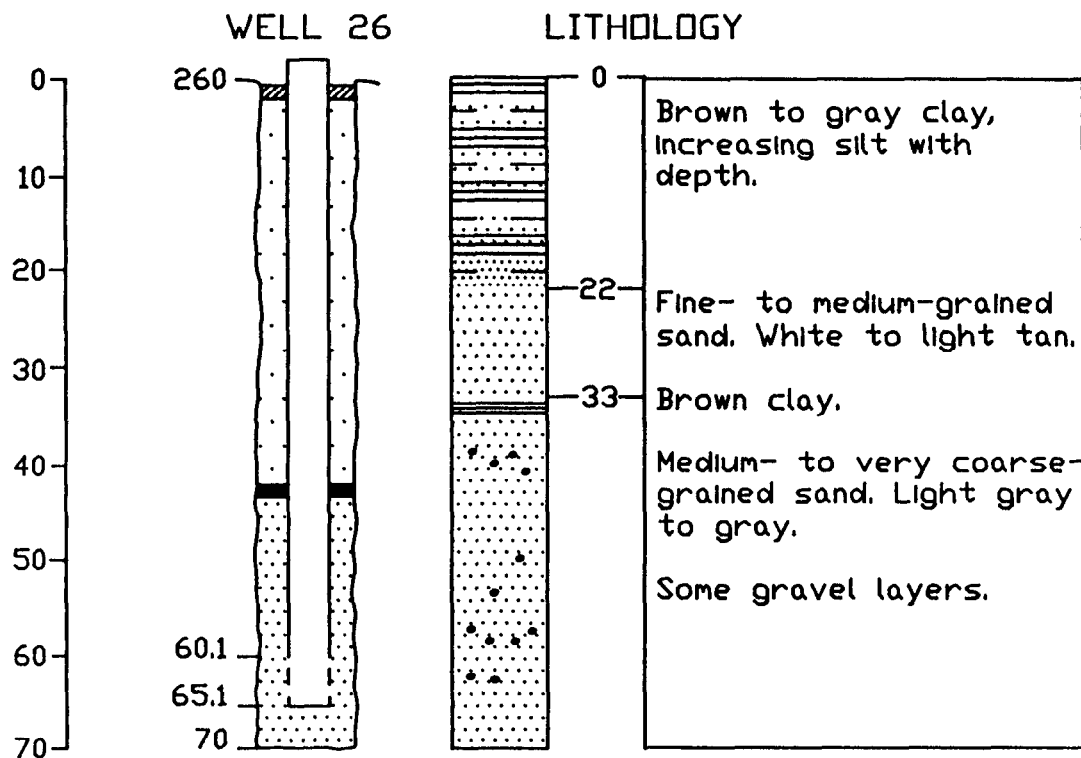
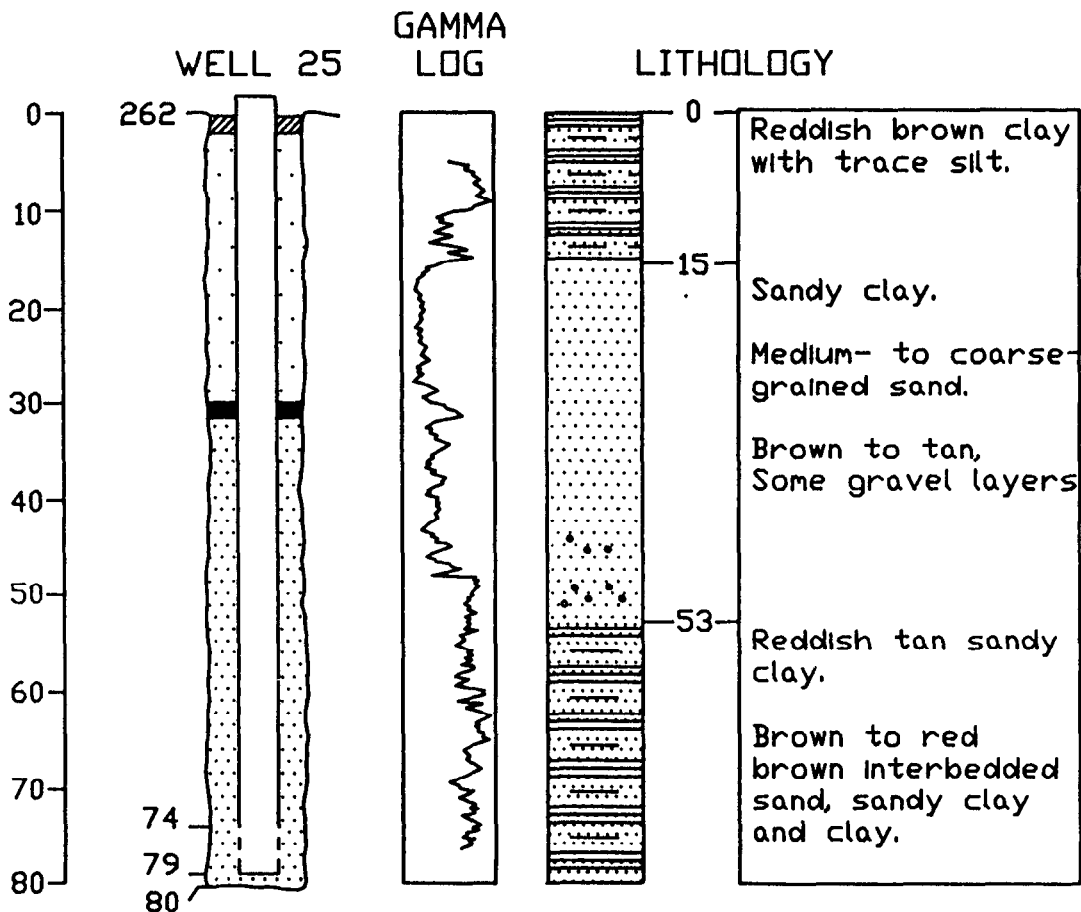
Brown silt, trace clay, and fine sand.
Dark gray to gray, fine- to coarse-grained sand. Trace gravel.
White to gray sand medium- to coarse-grained. Trace gravel. Color changing to brown gray with depth.

DEPTH, IN FEET BELOW LAND SURFACE

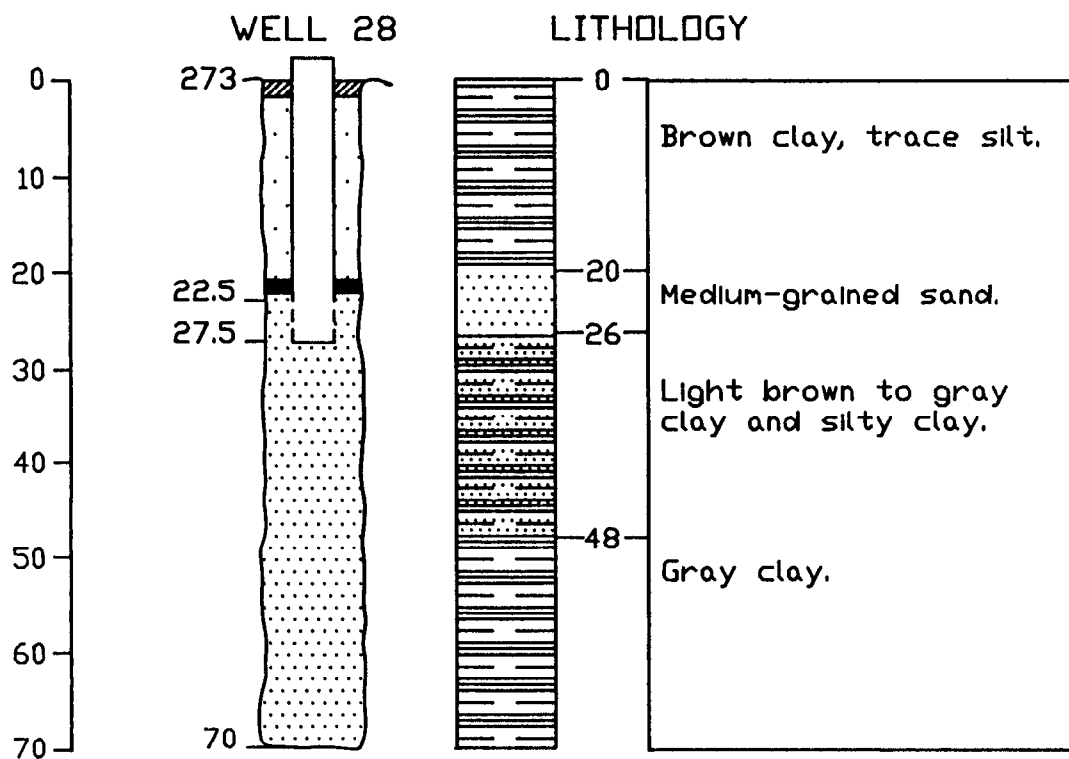
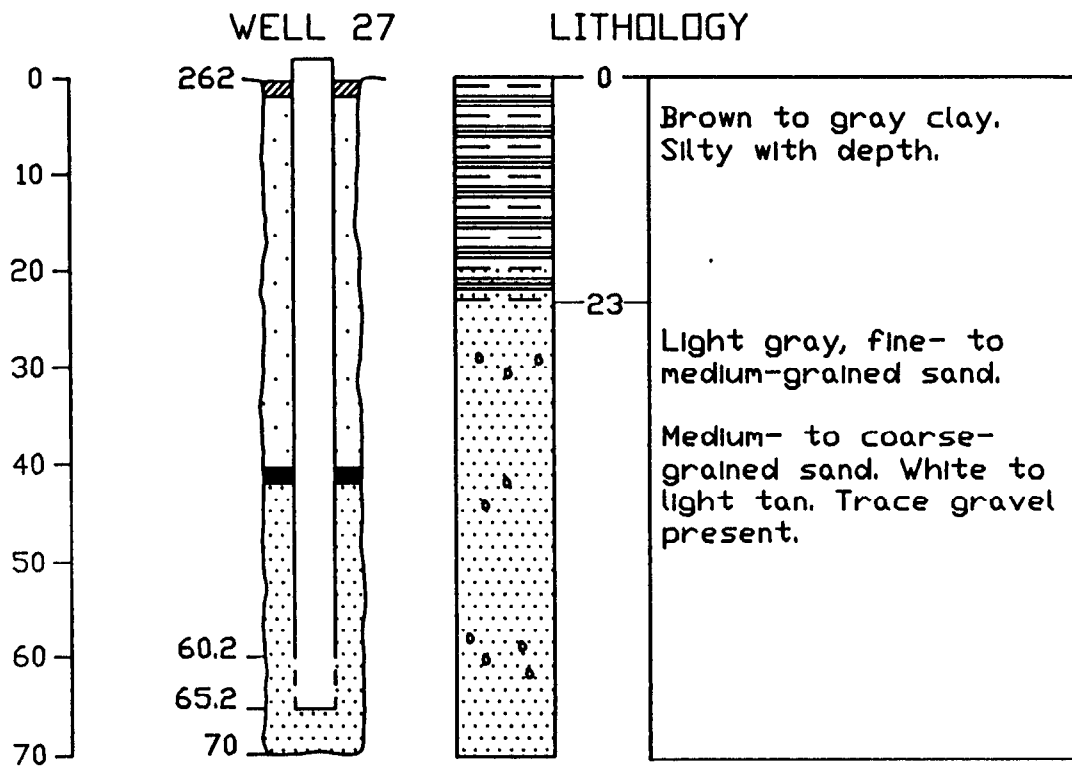




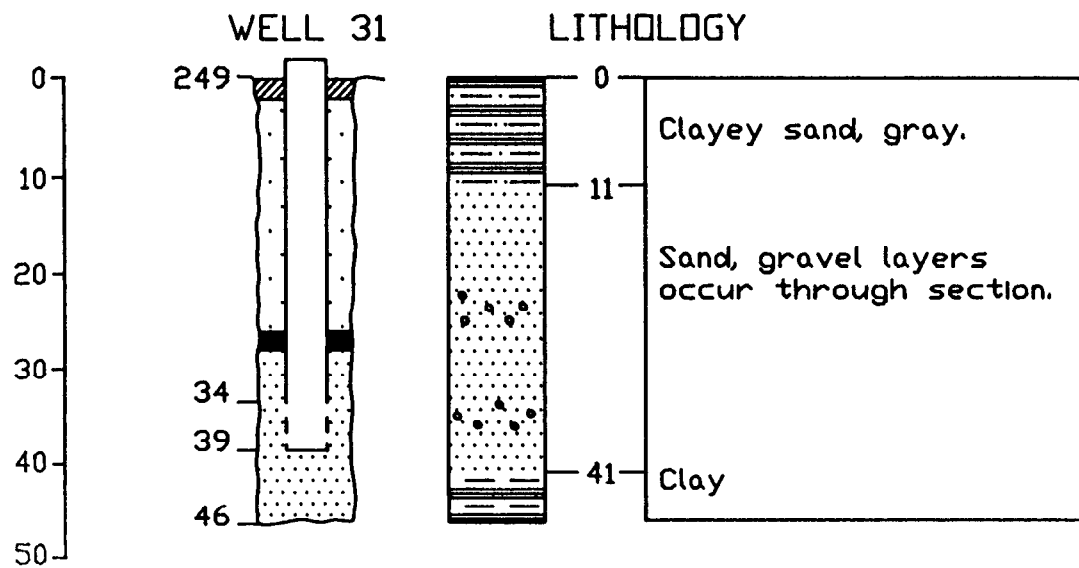
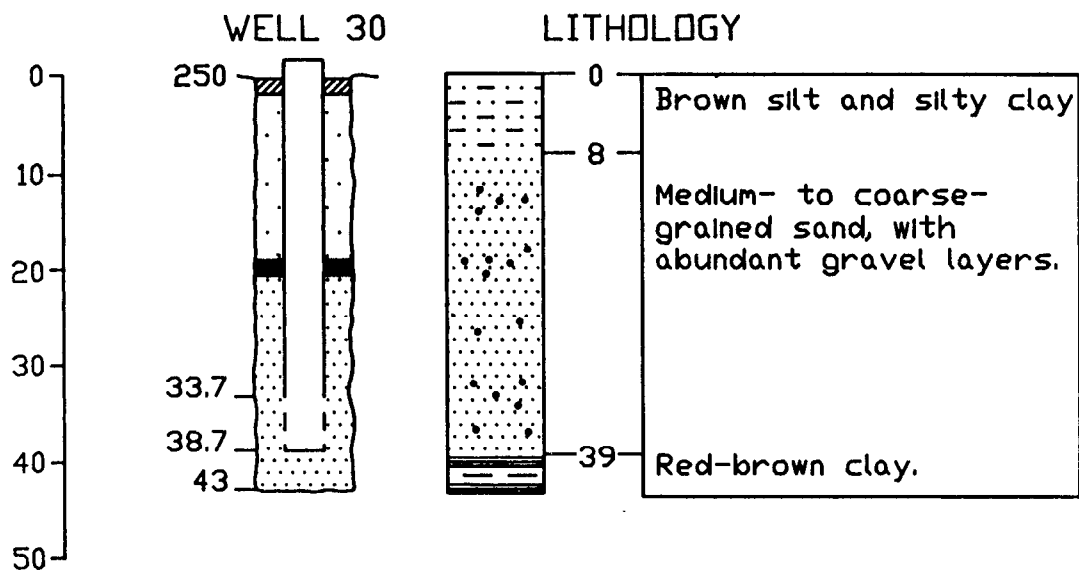
DEPTH, IN FEET BELOW LAND SURFACE



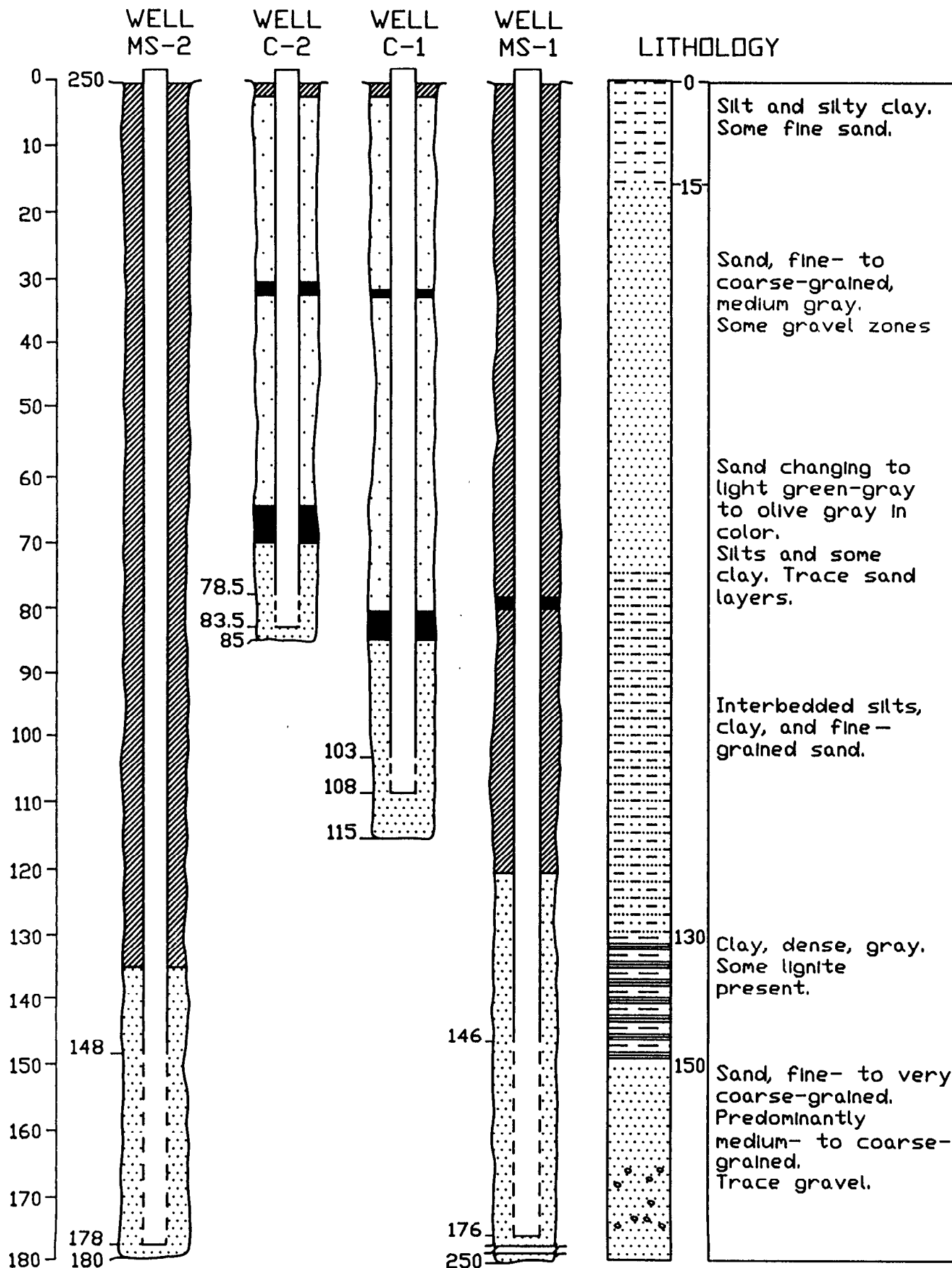
DEPTH, IN FEET BELOW LAND SURFACE

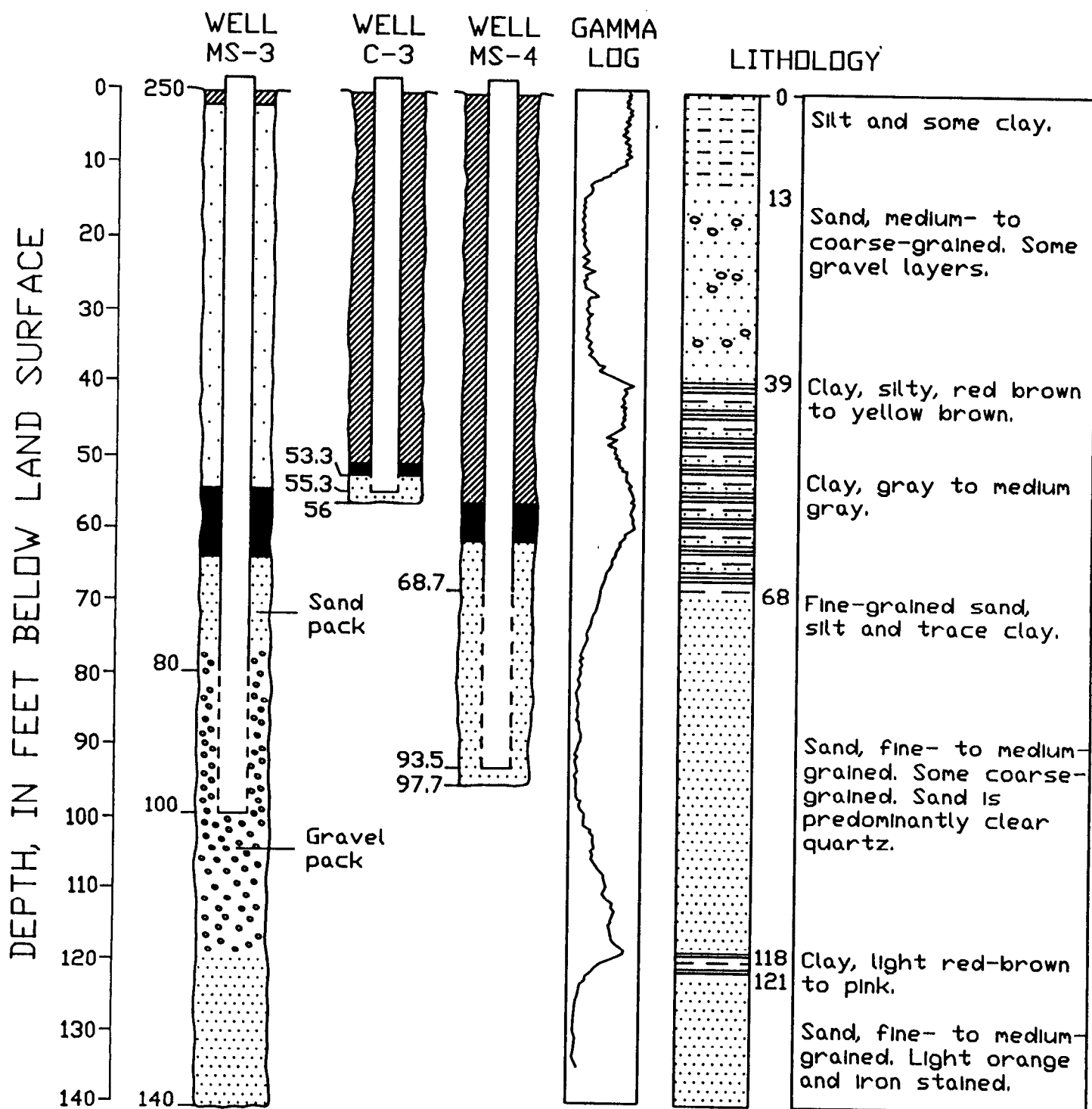


DEPTH, IN FEET BELOW LAND SURFACE

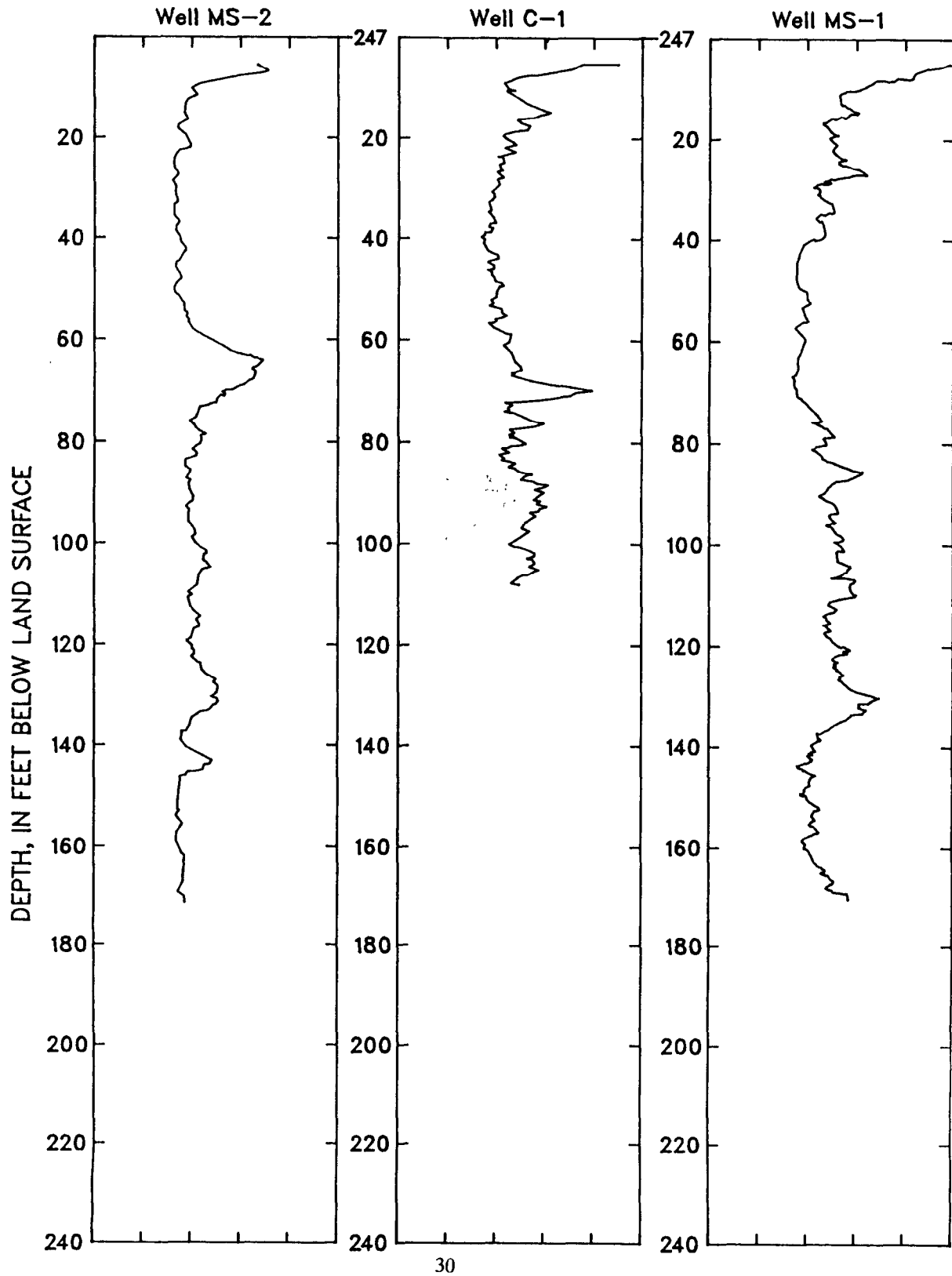


DEPTH, IN FEET BELOW LAND SURFACE

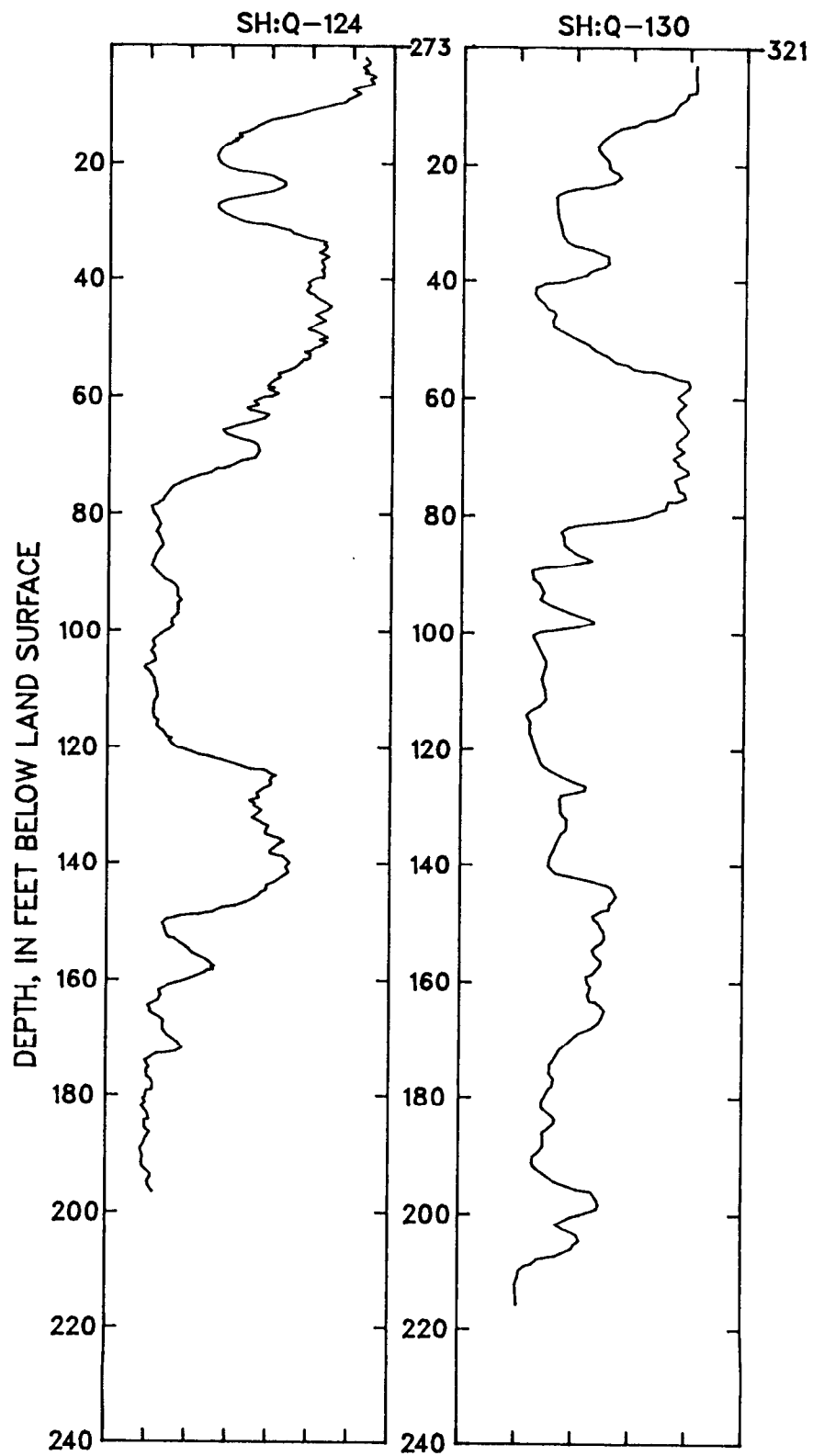




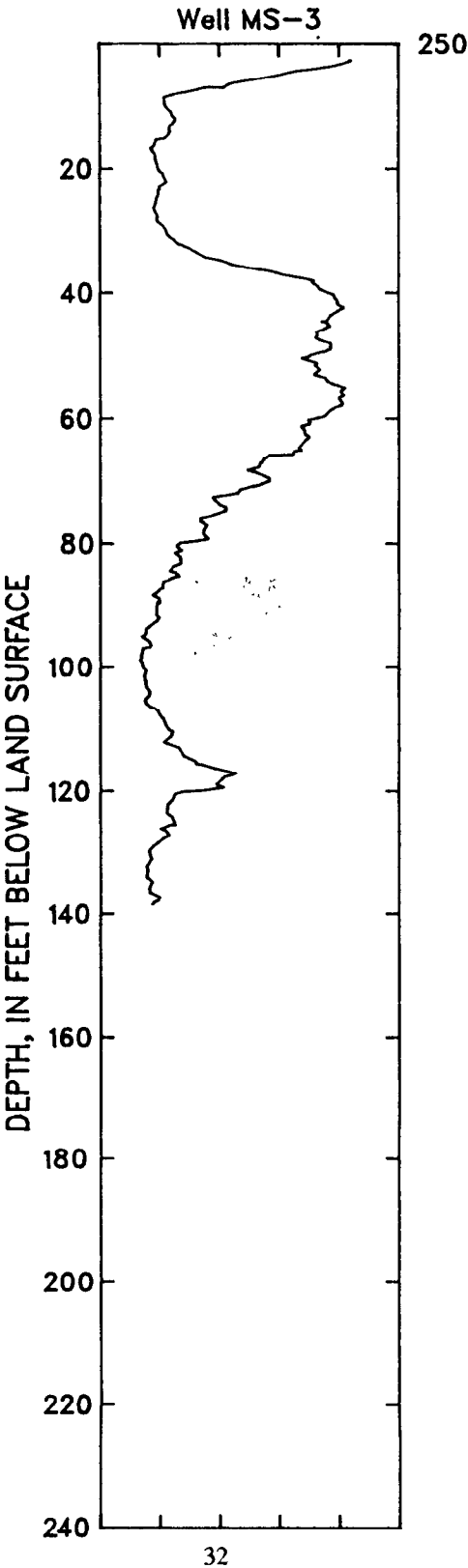
GAMMA LOGS



STRATIGRAPHIC TEST HOLES. GAMMA LOGS



GAMMA LOG



Bradley

CONSTRUCTION, GEOLOGIC, AND GROUND-WATER DATA FOR OBSERVATION WELLS
NEAR THE SHELBY COUNTY LANDFILL, MEMPHIS, TENNESSEE

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