Hydrogeology and Migration of Septic-Tank Effluent in the Surficial Aquifer System in the Northern Midlands Area, Palm Beach County, Florida

By Wesley L. Miller

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 91-4175

Prepared in cooperation with
PALM BEACH COUNTY

Tallahassee, Florida

1992

U.S. DEPARTMENT OF THE INTERIOR
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CONTENTS

FIGURES

TABLES

CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
acre	0.4047	hectare
square mile (mi^2)	2.590	square kilometer
foot per day (ft/d)	0.3048	meter per day

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

ABBREVIATIONS USED IN REPORT:

mg/L	=	milligrams per liter
DCR	=	Direct-current resistivity
FDER	=	Florida Department of Environmental Regulation
GPR	=	Ground-penetrating radar
TOC	=	Total organic carbon

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ABSTRACT

The northern Midlands area in Palm Beach County is an area of expected residential growth, but its flat topography, poor drainage, and near-surface marl layers retard rainfall infiltration and cause frequent flooding. Public-water supplies and sewer services are not planned for the area, thus, residents must rely on domestic wells and septic tanks. The water table in the northern Midlands area is seldom more than 5 feet below land surface, and regional ground-water flows are east, southwest, and south from the north-central part of the area where ground-water levels are highest. Ground-water quality in the western part of the area and in the Loxahatchee Slough is greatly influenced by residual seawater emplaced during the Pleistocene Epoch. Chloride and dissolved-solids concentrations of ground water in the surficial aquifer system in these areas often exceed secondary drinking-water standards. Residual seawater has been more effectively flushed from the more permeable sediments elsewhere in the eastern and southeastern parts of the study area. Tests at three septic-tank sites showed traces of effluent in ground water (38-92 feet from the septic-tank outlets) and that near-surface marl layers greatly impede the downward migration of the effluent in the surficial aquifer system throughout the northern Midlands.

INTRODUCTION

Pressures are increasing for construction of single-family residences in an unincorporated area of about 270 mi^2 in northeastern Palm Beach County (fig. 1). Palm Beach County officials have recently designated the area a part of the "Midlands," a planning area encompassing unincorporated lands both north and south of the West Palm Beach, C-51, Canal (fig. 2). Residential development in the northern Midlands area is areally limited by land uses, such as the West Palm Beach Catchment Area and Loxahatchee Slough to the east, the Corbett Wildlife Management Area to the west, and an industrial complex to the northwest (fig. 2), which prohibit development.

The northern Midlands is categorized as very low to low-density residential; that is, one dwelling unit per 2 to 5 acres (Palm Beach County Department of Planning, Building, and Zoning, 1980). Most of the land was sold as 1.25-acre lots during the 1960's, but most of the lots have not been developed. The density is not limited by the Palm Beach County Comprehensive Plan and is expected to increase in the future. The development of home sites is expected to be unevenly distributed within the northern Midlands as clusters of homes develop near improved drainage facilities and roads. About 2,500 homes exist in the northern Midlands at present (1991). County officials have recently projected that 15,000 to 20,000 homes served by septic tanks and individual wells will exist in the area by the year 2000.

Although the northern Midlands is topographically one of the highest parts of Palm Beach County, with land-surface altitudes of 15 to 25 ft above sea level, much of the land is often inundated because of heavy rainfall, the occurrence of

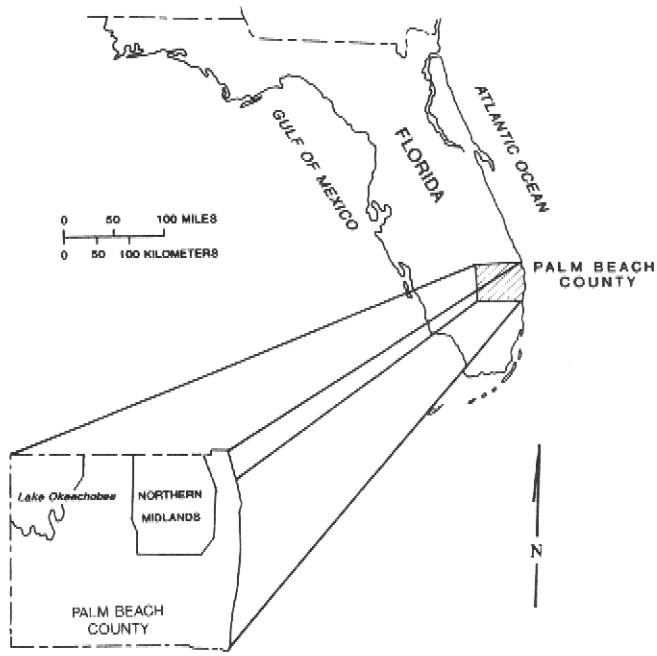

Figure 1. Location of the northern Midlands study area, Palm Beach County.

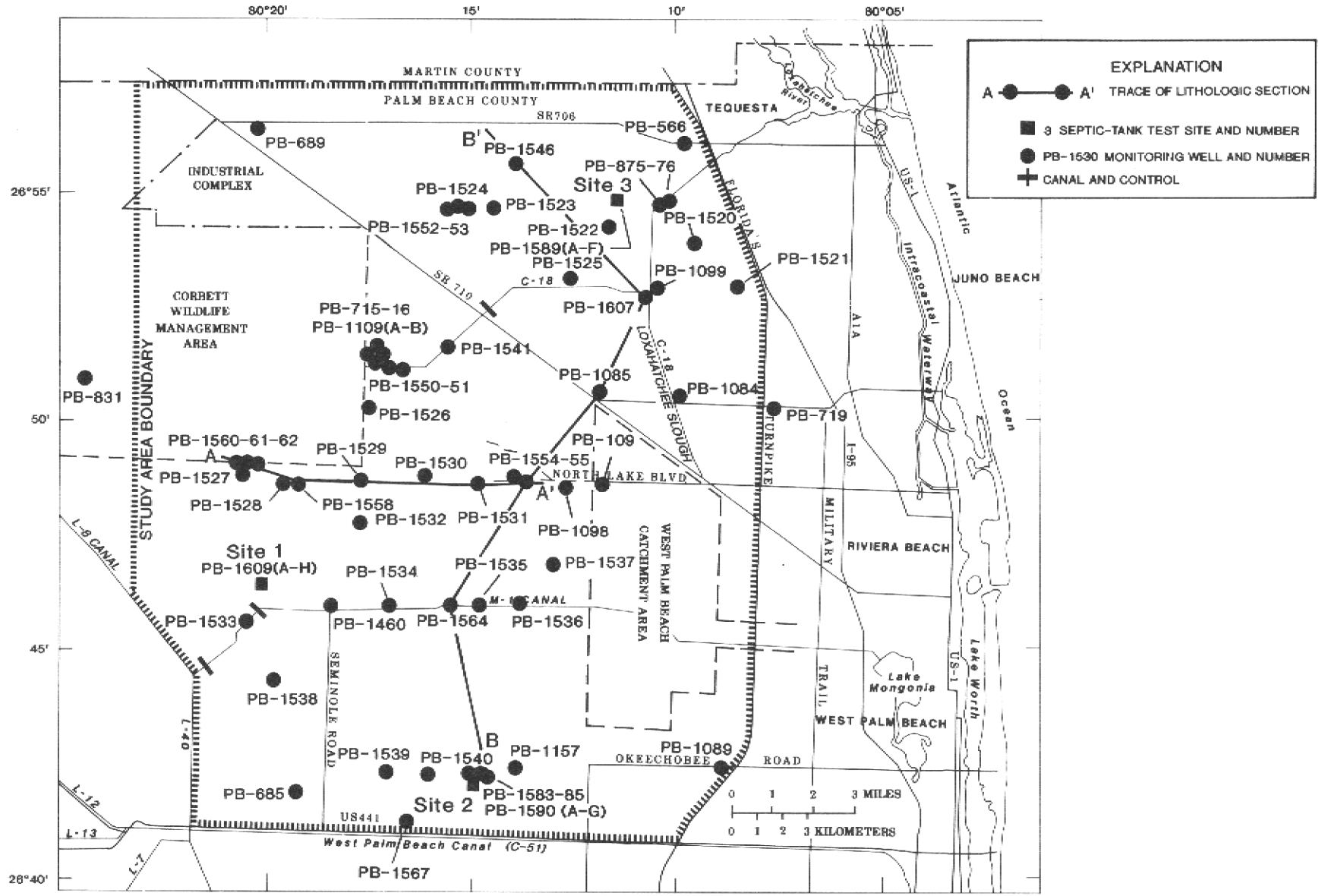

Figure 2. Location of the monitoring wells, lithologic sections A-A′ and B-B′, and septic-tank test sites in the northern Midlands.

near-surface marls that retard rainfall infiltration, and poor surface drainage. Regional water-table contour maps prepared since 1970 (Land and others, 1973; Rodis and Land, 1976; Schneider, 1977; Swayze and Miller, 1984; Miller, 1985a; 1985b) consistently indicate this area to be on the eastern flank of a ground-water divide and upgradient of several public water-supply well fields that serve the coastal area. The most recent of these maps shows that combined withdrawals from domestic wells in a new development just west of the West Palm Beach Catchment Area (fig. 2) have lowered the water-table sufficiently to reverse the ground-water flow direction in the eastern half of the affected area.

Pockets of residual seawater containing high chloride concentrations have been identified both within the northern Midlands and immediately to the west (Miller and Lietz, 1976; Swayze and Miller, 1984; Miller, 1988), but boundaries of the areas are undefined. Lower permeabilities in the surficial aquifer system and the occurrence of near-surface marls have retarded dilution or flushing of residual Pleistocene seawater (Miller, 1988).

Concerns about the effects of future development on the resources of the area include possible effects of large numbers of individual septic tanks and wells on ground-water quality and water levels, the scarcity of predevelopment hydrogeologic data, and the possible lack of potable ground water. To address these concerns, the U.S. Geological Survey, in cooperation with Palm Beach County, initiated a study in 1985 to describe the hydrogeology of the area and to evaluate the potential migration of septic-tank effluent in ground water in the area.

Purpose and Scope

This report describes the lithology of the uppermost part of the surficial aquifer system, identifies preresidential development ground-water quality characteristics, provides a water-table map of the northern Midlands, and describes septic-tank effluent migration (vertical and horizontal) at three test sites in the northern Midlands. The study results presented in this report also increase the data base of predevelopment hydrogeologic and water-quality data for the area.

The work conducted as part of this study included construction of 60 test and monitoring wells and data collection at 19 wells constructed during previous studies (fig. 2, tables 1 and 2). Of the new wells, 21 wells were constructed at three residences selected as septic-tank test sites. These shallow monitoring wells were used to measure ground-water levels and to collect water-quality samples in the immediate vicinity of septic tanks to examine migration of effluent. The remaining 39 wells constructed were selectively used for collecting water-quality samples, for making water-level measurements, and for gathering lithologic data. Geologic samples collected during drilling were used to prepare lithologic logs for 30 wells (appendix I).

Direct-current resistivity (DCR) and ground-penetrating radar (GPR) surface-geophysical surveys were made throughout the study area to supplement lithologic and water-quality data. Locations of these surveys are shown in figures 3 and 4.

Previous Investigations

Numerous U.S. Geological Survey reports contain information pertinent to the northern Midlands of Palm Beach County. Countywide and more localized reports containing geologic, hydrologic, and water-quality information on this and adjacent areas include those by Schroeder and others (1954), Land and others (1973), Miller and Lietz (1976), Rodis and Land (1976), Scott (1977), Fischer (1980), Swayze and Miller (1984), and Miller (1985a; 1985b; 1986; 1988). The only report specifically relating to the northern Midlands is one by Peterson (1988), which describes DCR surface-geophysical data collected as part of this investigation.

Acknowledgments

The author is indebted to many individuals whose assistance made this report possible. Appreciation is expressed to James Register, Kathryn Fleming, and Michael Slayton for permitting the septic tanks and drainfields at their residences to be used as test sites. Gratitude is also expressed to Frank J. Gargiulo, Palm Beach County Health Department, for his assistance in the initial design of the investigative program.

METHODS OF INVESTIGATION

Monitoring wells were drilled, geophysical surveys were prepared, and septic-tank test sites were selected in the northern Midlands to obtain data necessary for the investigation. Methods used for each part of this effort were determined by the primary types of data desired and the criteria used to ensure validity of the data obtained.

Installation of Monitoring Wells

Each monitoring well was installed (fig. 2) for one or more purposes: ground-water level monitoring, lithologic interpretation, preresidential development ground-water quality characterization, or determination of septic-tank effluent migration. The primary use of the well determined the drilling technique used. All wells were completed with casing and screen.

Table 1. Well inventory data for the study area

[Drilled (borehole) depth and finished depths not necessarily the same. P, polyvinyl chloride; S, steel; e, estimated; --, not screened]

Well number	Site identification number	Completed well depth (feet)	Screen length (feet)	Altitude of well (feet above sea level)	Casing material
PB-109	264841080114901	14	--	22.75	S
PB-566	265604080094401	11	--	17.00e	S
PB-685	264208080192201	17	--	16.45	S
PB-689	265633080203001	17	--	27.43	S
PB-715	265114080173101	67	5	19.73	S
PB-716	265114080173102	15	5	20.72	S
PB-719	265018080074101	24	5	17.20e	S
PB-831	265106080241402	25	5	24.90	P
PB-875	265439080102904	22	4	18.46	P
PB-876	265439080102903	41	4	15.07	P
PB-1084	265027080100201	138	8	16.60e	P
PB-1085	265027080115702	200	--	18.00e	P
PB-1089	264225080084701	135	5	15.78	P
PB-1098	265835080130201	80	10	18.26	P
PB-1099	265250080103601	90	10	19.61	P
PB-1109A	265115080173102	128	10	24.71	P
PB-1109B	265115080173102	40	10	24.00e	P
PB-1157	264216080134403	100	5	18.19	P
PB-1460	264553080182701	30	5	23.54	P
PB-1520	265412080092701	22	3	18.23	P
PB-1521	265255080083901	22	3	17.61	P
PB-1522	265417080130301	22	3	18.50e	P
PB-1523	265445080140301	22	3	21.40e	P
PB-1524	265443080152001	22	3	21.51	P
PB-1525	265256080123201	22	3	19.15	P
PB-1526	265017080173201	21	3	21.00e	P
PB-1527	264856080203701	20	3	21.20e	P
PB-1528	264834080123401	20	3	20.02	P
PB-1529	264832080173301	22	3	21.15	P
PB-1530	264841080161101	23	3	21.10e	P
PB-1531	264841080144201	20	3	20.44	P
PB-1532	264833080173401	22	3	20.85	P
PB-1533	264555080203401	22	3	22.25	P
PB-1534	264553080161701	22	3	21.59	P
PB-1535	264554080144801	22	3	20.00e	P
PB-1536	264550080132201	22	3	19.45	P
PB-1537	264547080125301	22	3	19.00e	P
PB-1538	264420080194301	22	3	19.00e	P
PB-1539	264224080165501	22	3	19.50e	P
PB-1540	264222080152401	22	3	19.50e	P
PB-1541	265145080152701	20	3	21.60e	P
PB-1546	265606080135501	140	40	20.11	P
PB-1550	265134080172701	135	55	23.00e	P
PB-1551	265134080172702	130	60	23.00e	P
PB-1552	265443080152002	100	5	20.84	P
PB-1553	265443080152003	37	--	21.28	P
PB-1554	264843080125001	40	20	20.15	P
PB-1555	264843080125002	130	30	20.49	P
PB-1558	264834080193402	190	60	19.71	P
PB-1560	264856080203702	56	10	23.34	P
PB-1561	264856080203703	163	6	22.83	P
PB-1562	264856080203704	250	20	22.12	P
PB-1564	264555080151701	131	60	20.08	P
PB-1567	264101080163001	190	70	17.00e	P
PB-1583	264057080151001	160	10	20.48e	P
PB-1584	264057080151002	70	10	20.48e	P
PP-1585	264057080151003	110	10	20.48e	P
PB-1607	265248080103801	164	100	18.00e	P

Table 2. Well inventory data for the septic-tank test sites

[Casing material: P, polyvinyl chloride; S, steel]

Site number	Well number	Site identification number	Depth (feet)	Screen length (feet)	Altitude of well (feet above sea level)	Casing material
1	PB-1609A	264658080200001	13	4	18.49	P
	PB-1609B	264658080200002	13	4	20.63	P
	PB-1609C	264658080200003	10	4	21.78	P
	PB-1609D	264658080200004	10	4	21.97	P
	PB-1609E	264658080200005	12	4	21.42	P
	PB-1609F	264658080200006	14	4	21.50	P
	PB-1609G	264658080200007	12	4	21.37	P
	PB-1609H	264658080200008	11	4	19.64	P
2	PB-1590A	264057080151004	20	2	20.48	P
	PB-1590B	264057080151005	15	2	21.73	P
	PB-1590C	264057080151006	18	2	21.44	P
	PB-1590D	264057080151007	10	2	21.06	P
	PB-1590E	264057080151008	15	2	21.36	P
	PB-1590F	264057080151009	15	2	20.62	P
	PB-1590G	264057080151010	20	2	20.25	P
3	PB-1589A	265458080113001	8	2	20.01	S
	PB-1589B	265458080113002	8	2	18.17	S
	PB-1589C	265458080113003	5	2	18.09	S
	PB-1589D	265458080113004	8	2	18.10	S
	PB-1589E	265458080113005	10	2	18.01	S
	PB-1589F	265458080113006	20	2	18.94	S

Three arrays of wells were installed at varying distances hydraulically upgradient of three septic-tank test sites to determine water quality at various depths in the surficial aquifer system prior to increased residential development in the area. These wells (PB-1524, PB-1552, and PB-1553 in the northern part of the area; PB-1560, PB-1561, and PB-1562 in the western part, and PB-1583, PB-1584, and PB-1585 in the southern part) (fig. 2) were drilled by the reverse-air rotary method to avoid aquifer contamination with drilling fluids. The wells ranged in depth from 22 to 250 ft (table 1).

An additional 21 wells (PB-1520 to PB-1523 and PB-1525 to PB-1541), 20 to 23 ft deep, for ground-water level measurements, and 15 wells (PB-1590A-G and PB-1609A-H), 10 to 20 ft deep at the septic-tank test sites (fig. 2, tables 1 and 2), were drilled by the rotary method using only local ground water as a drilling fluid. Wells PB-1589A-F, 5 to 20 ft deep at septic-tank test site 3 in the northeastern part of the area (fig. 2; table 2), were driven with a handheld hydraulic hammer because of space limitations.

Surface-Geophysical Surveys

DCR and GPR surveys (figs. 3 and 4) were conducted throughout the northern Midlands to supplement ground-water quality and lithologic data. Information obtained from the surveys also was used to indicate areas where additional water-quality and geologic data were needed.

DCR soundings were obtained at 94 sites in the northern Midlands (fig. 3) using a DCR meter and a Wenner electrode configuration (Zohdy and others, 1974). Most soundings were spaced at 1- to 2-mi intervals along dirt roads to form seven east-west traverses and four north-south traverses, totaling about 50 mi of surface-geophysical transects. These data were used to locate areas of probable high chloride concentrations in water in the surficial aquifer system and to evaluate proposed shallow monitoring well site locations in the area. The DCR sounding data and a more detailed description of the technique are described by Peterson (1988).

GPR was used to determine the areal extent, continuity, and depths of near-surface marls in the northern Midlands. The septic-tank test sites were included in the areas surveyed. GPR was selected because of known attenuation of radar signals by colloidal-size particles, such as clays and marls (Olhoeft, 1984). A continuous stream of electromagnetic pulses is discharged from a radar antenna-receiver. Each transmitted pulse travels through the subsurface until it reaches a geologic unit with different transmission properties, such as a marl unit. When the pulse hits this unit, part of the pulse is reflected back to the antenna-receiver, while the rest of the pulse travels into and through the reflecting unit unless it is totally attenuated. A continuous stream of reflected pulses is received by the antenna and fed into a graphic recorder which produces the profile. The proportion of colloidal-size particles (marl) and the thickness of each unit into which the pulse travels determine attenuation of the pulse and the depth of penetration.

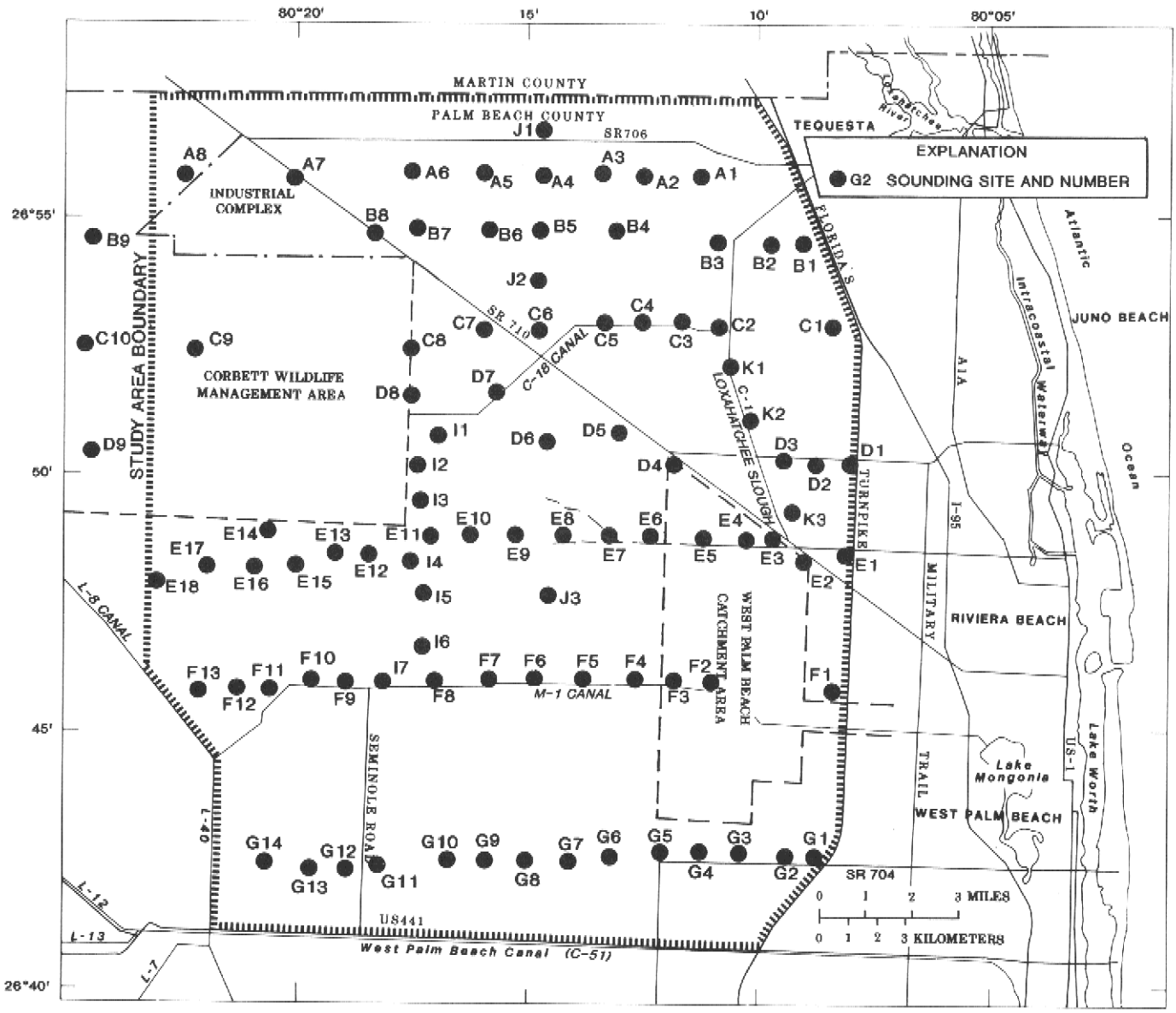

Figure 3. Location of direct-current resistivity sounding sites in the northern Midlands.

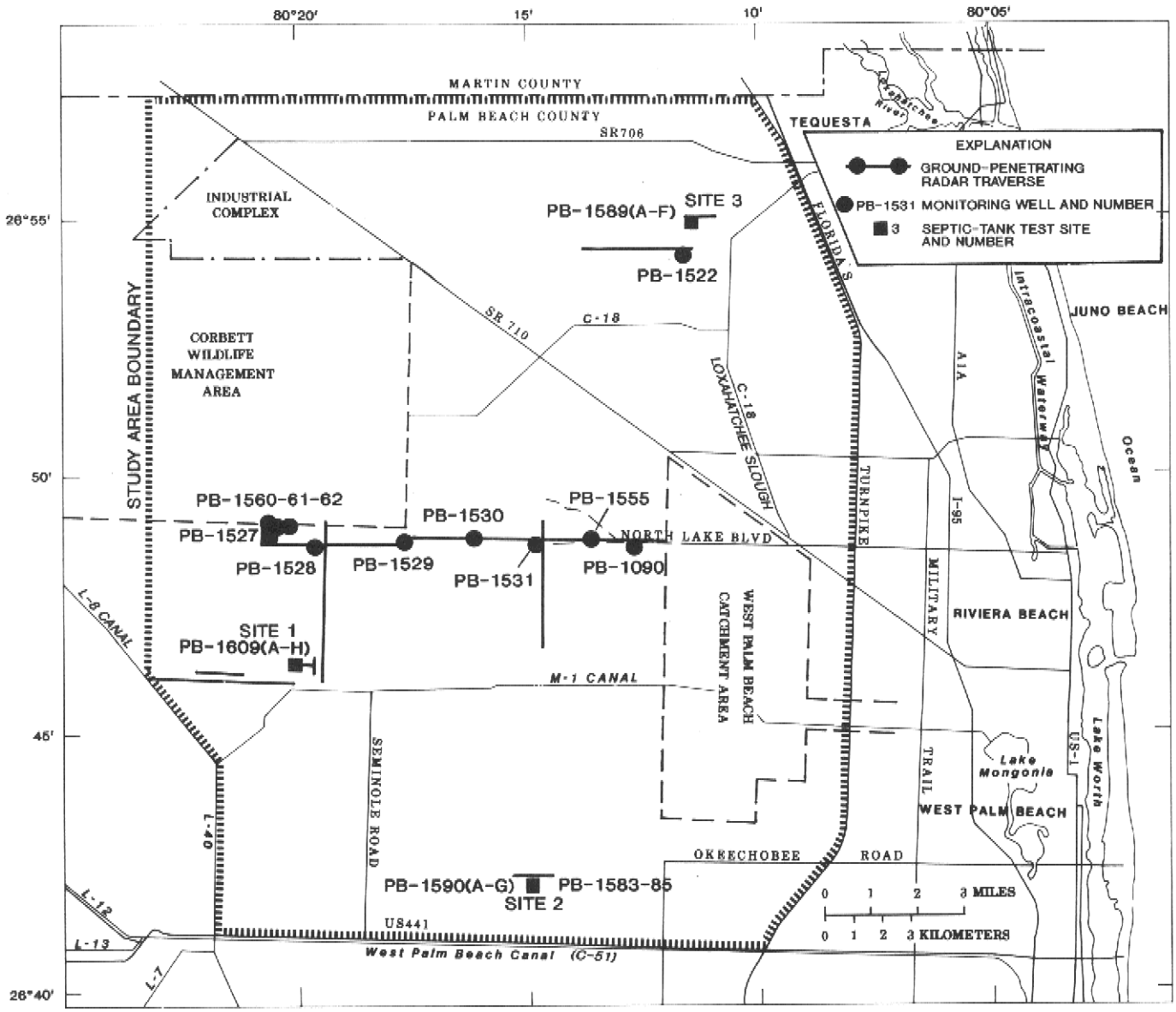

Figure 4. Location of ground-penetrating radar traverses in the northern Midlands.

Eleven continuous GPR profiles (fig. 4) were run and repeated, traveling in the opposite direction, to determine reproducibility, and a short section of one profile was frequently repeated to ensure that the equipment was working properly. Depth to the uppermost marl units, indicated by GPR, was calibrated using lithologic logs and depths to water for nearby wells and marl outcrops in nearby canals and excavations.

Septic-Tank Test Site Selection

Three residences were selected as test sites (fig. 2) to investigate migration of septic-tank effluent in the ground water. When the investigation began, the septic tank and drainfield at site 1 had been in use for 5 years, and those at sites 2 and 3 had been in use 11 or 12 years. The drainfields (Canter and Knox, 1985, p. 22-29) at all three sites were downgradient from the septic tanks, relative to regional hydraulic gradients (Miller, 1985a; 1985b). Drainfield distribution lines at all three sites were consistently in saturated materials throughout the investigation.

Selection of the septic-tank test sites was delayed until geologic data obtained during drilling of water-level and water-quality monitoring wells elsewhere in the area and the DCR data had been evaluated. This approach was used to ensure that each test site was hydrogeologically similar to large parts of the study area surrounding the individual sites.

HYDROGEOLOGY

This section describes the geology, ground-water levels and movement, and ground-water quality of the surficial aquifer system in the northern Midlands. The geologic discussion is limited to the uppermost part of the surficial aquifer system, although lithologic logs (appendix I) contain data for depths to the base of the surficial aquifer system. Ground-water levels and movement in the area are discussed as they relate to geology, topography, and cultural features. Ground-water quality (tables 3-5) under predevelopment conditions and under the influence of pockets of residual seawater are also described.

Lithologic and ground-water quality data collected throughout the network of wells (fig. 2) were interpreted using supplementary DCR (Peterson, 1988) and GPR data.

Geology

The uppermost part of the surficial aquifer system (to a depth of 50 ft below land surface) is primarily composed of unconsolidated sand and marl. Localized lenses of shell and shelly limestone were penetrated during construction of the monitoring wells. Previous studies indicate that these sediments are part of the Fort Thompson Formation and Pamlico Sand deposited during the Pleistocene Epoch (Parker and others, 1955; Miller, 1988).

Semiconfining layers of muddy organic sand and silt or marl are common between land surface and a depth of about 40 ft throughout most of the northern Midlands (figs. 5 and 6). A clayey marl unit, 4- to 10-ft thick near land surface, is apparent throughout the northern Midlands area. In most of the area, the top of this marl unit is about 4 to 10 ft below land surface, and probably was deposited in a lagoonal or swampy environment in which organic debris also accumulated. The marl is dark-olive-gray to bluish-green and is composed of micrite or lime mud, containing 25 to 30 percent fine to very fine quartz sand. At some sites, it contains 10 to 20 percent shell fragments. Another semiconfining layer of muddy organic sand occurs below the marl layer. The sand is dark-yellowish-brown to olive-gray and is composed of fine to very fine quartz grains and silt-size organic material. In places, units containing 20 to 30 percent shell fragments are interlayered with organic sand.

Organic fine sand and shallower marl layers form a nearly continuous semiconfining section of sediments, which tends to retard (but not prevent) downward infiltration of rainfall, thereby reducing the rate of recharge to, and the effective flushing of, the main producing zones of the surficial aquifer system. Hydraulic conductivities for the semiconfining section were determined to be less than 25 ft/d, as compared with those of main producing zones that ranged from 40 to 1,230 ft/d (L.J. Swayze, U.S. Geological Survey, written commun., 1989).

In general, the uppermost marl unit commonly occurs 4 to 5 ft below land surface. However, because most of the drilling of test and monitoring wells was along canal levees and road rights-of-way, where the upper 4 ft has been disturbed and replaced with fill, the marl could have been less than 4 ft from the undisturbed land surface. Marl units were observed at land surface in many undisturbed locations. The marl layer at well PB-1533 near the southwest corner of the area (fig. 2) is 8 ft below the surface. Information from wells drilled near the northeastern corner of the area indicates that the upper marl unit there is between 5 and 10 ft below land surface. Lithologic logs, observations along canal and other excavations, and data from GPR surveys were used to prepare the map showing depth to the marl (fig. 7). It shows the approximate depth below land surface of the uppermost confining marl layer and indicates that within most of the area the marl occurs within 5 ft of land surface. The shallow position of near-surface marl and its low permeability will affect the operation of the septic tanks proposed for this part of Palm Beach County by limiting effluent infiltration and migration.

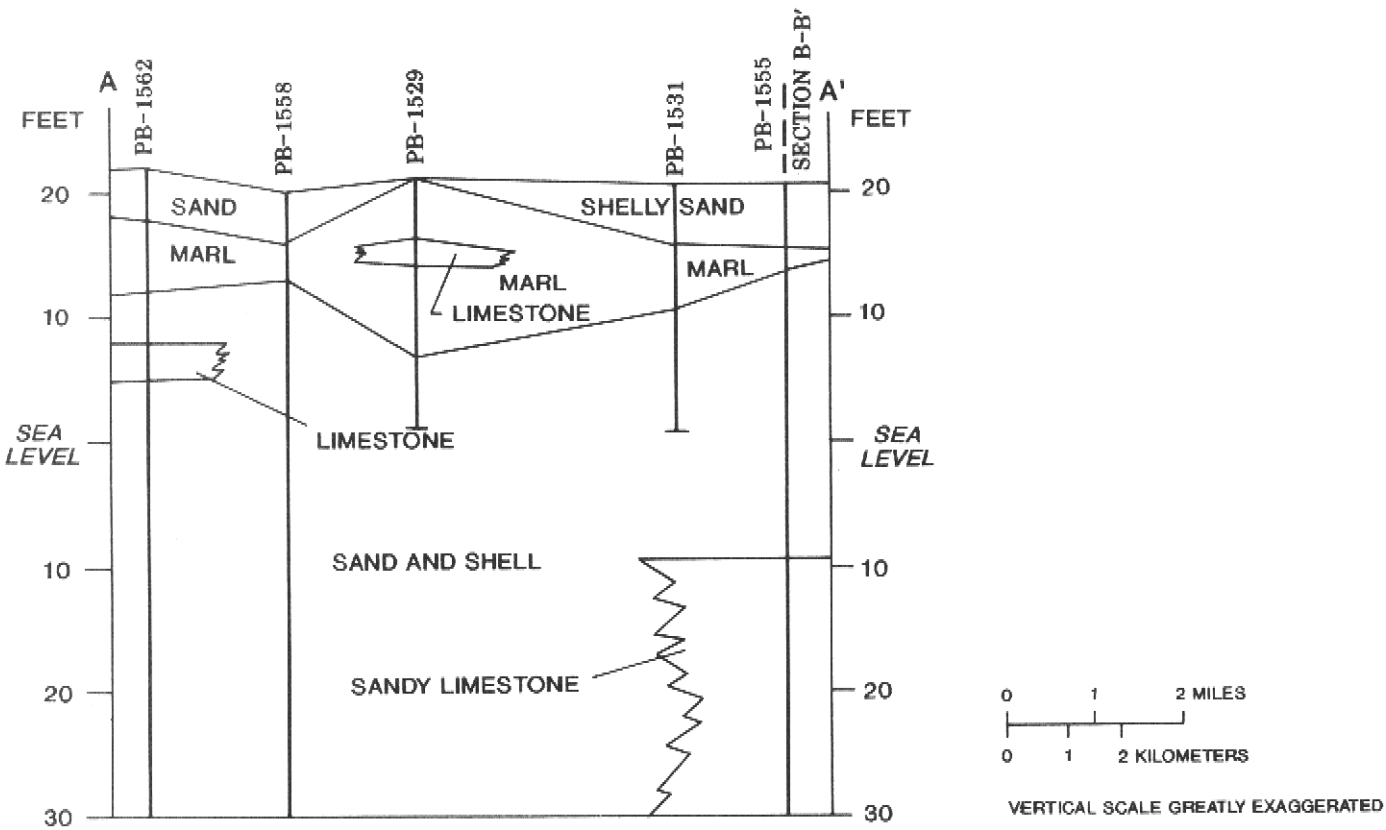

Figure 5. Generalized lithologic section A-A'.

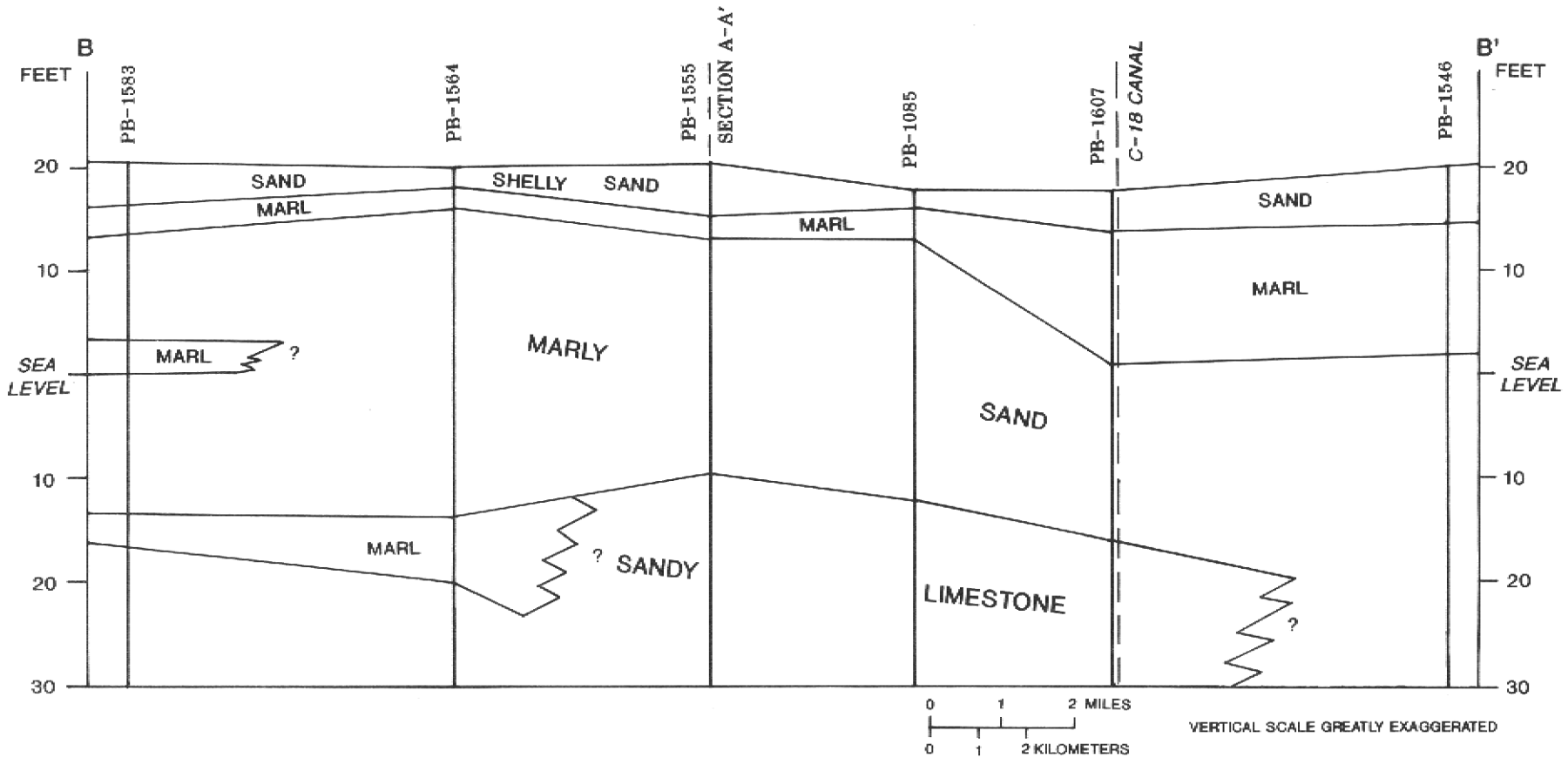

Figure 6. Generalized lithologic section B-B'.

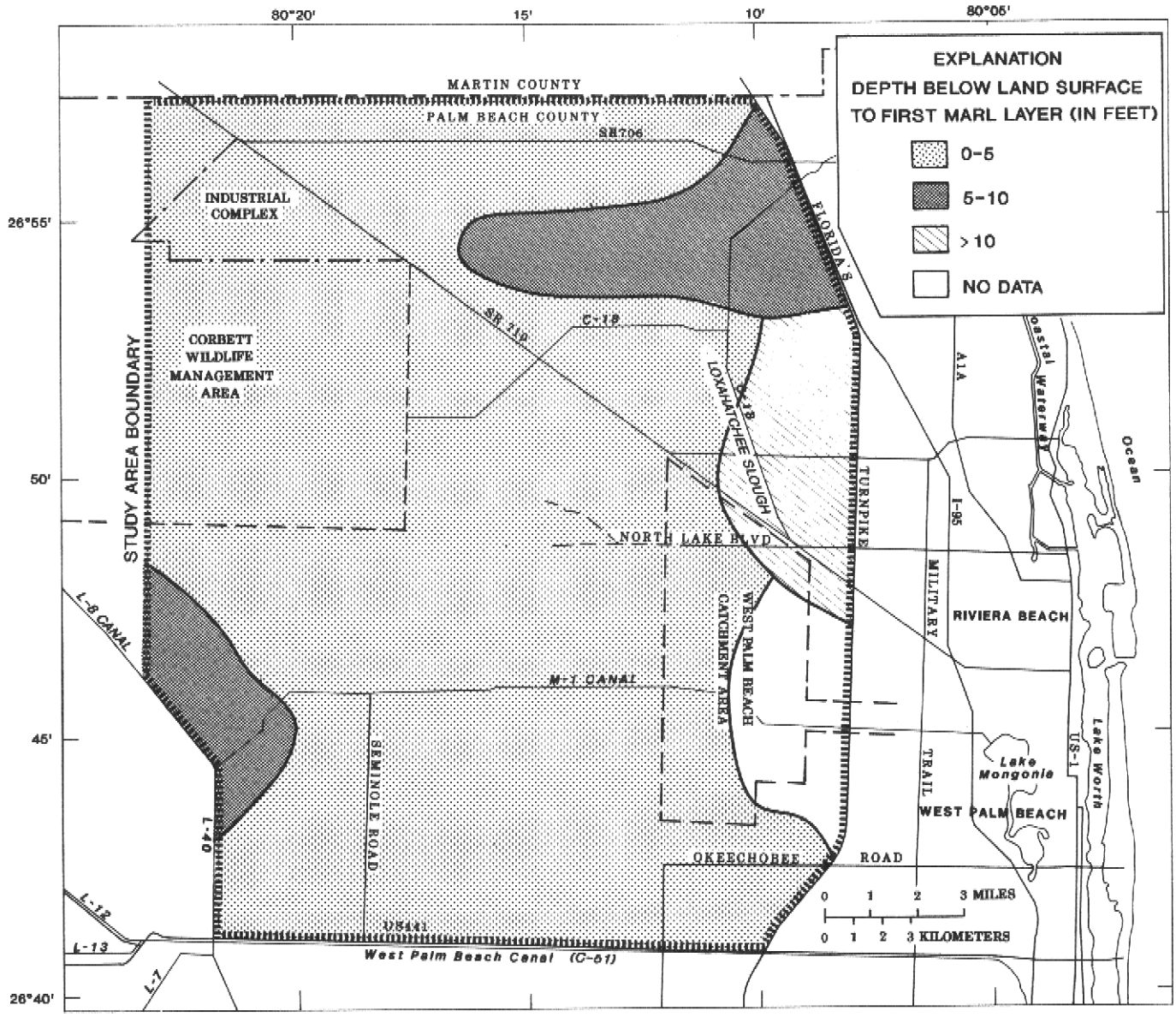

Figure 7. Depth below land surface of uppermost marl layers in the northern Midlands.

Ground-Water Levels and Movement

Much of the study area is affected by frequent flooding as a result of near-surface low-permeability marl, heavy seasonal rainfall, flat topography, and lack of adequate drainage by canals. In general, the water table is highest in the northwestern part of the area and lowest in the eastern and southern parts where drainage canals have been dug to reduce flooding (fig. 2).

The altitude and configuration of the water table in the area north of the C-51 Canal and northeast of the L-8 Canal were depicted in reports prepared by Miller (1985a; 1985b). The most prominent feature of these water-table maps is a ground- water mound in the northwestern part of the area where the water-table altitude exceeded 22 ft above sea level. Based on these maps, the regional directions of ground-water flow are east toward the Atlantic Ocean, southwest toward the L-8 Canal, and south toward the C-51 Canal. The ground-water mound in the northwestern area conforms with land-surface altitudes in that area. In the south-central part of the study area, ground-water levels were maintained by regulated flows and stages in the L-8 and M-1 Canals that drain to the West Palm Beach Catchment Area. Wide spacing of water-level contours in the northeastern part of the study area in the maps prepared by Miller indicate a relatively flat water table that results from the drainage effect of the southern and southwestern reaches of the C-18 Canal.

Ground-Water Quality

Ground-water quality prior to extensive residential development in the northern Midlands was determined by several sampling and analytical approaches. Water samples were collected at 10-ft intervals during drilling of 10 wells that fully penetrate the surficial aquifer system (table 3) to identify variations in chloride concentrations with depth. Periodically, water samples were collected and analyzed for chloride concentrations at 46 wells, ranging in depth from 15 to 250 ft (table 4), to determine whether concentrations varied during the study. Also, analyses of major constituents, nutrients, and related characteristics of water from three arrays of wells that tap producing zones in the surficial aquifer system (fig. 8) were made to characterize ground-water quality upgradient from the septic-tank sites at widely separated areas. Analyses were performed by the U.S. Geological Survey laboratory.

Chloride Concentrations

Ground water in the northern Midlands (fig. 2) has a large range of chloride concentrations because of varying extents of dilution or flushing of residual seawater in the sediments. Water samples collected from 51 wells (15-250 ft deep) during drilling and after completion in 1986-87 contained chloride concentrations (tables 3 and 4) ranging from 6 mg/L (well PB-1538) to 5,950 mg/L (well PB-1562). Residual seawater in the western part of the study area and the Loxahatchee Slough (Miller, 1988, p. 23-33) is the principal source of high chloride concentrations in ground water. In those parts of the northern Midlands most affected by pockets of residual seawater, chloride concentrations in ground water generally are a function of depth (table 3) but, to some extent, vary seasonally (table 4).

Much of the northernmost part of the northern Midlands (including the Corbett Wildlife Management Area) is greatly affected by residual seawater (fig. 2). Chloride concentrations were high at all depths near the southern border of the management area; water from well PB-1527 (20 ft deep) had chloride concentrations as high as 1,400 mg/L, well PB-1558 (190 ft deep) as high as 3,000 mg/L, and well PB-1562 (250 ft deep) as high as 5,950 mg/L (tables 3 and 4). At the eastern perimeter, water from well PB-716 (15 ft deep) and well PB-1109A (128 ft deep) had chloride concentrations ranging from 22 to 960 mg/L (table 4), indicating that residual seawater has been flushed from only the uppermost part of the surficial aquifer system. East of the management area, water from well PB-1524 (22 ft deep) had chloride concentrations as high as 580 mg/L, and water from adjacent well PB-1552 (100 ft deep) had chloride concentrations as high as 700 mg/L (table 4). Water samples collected at the 140-ft depth during drilling of well PB-1552 (backfilled and cased to 100 ft) contained a chloride concentration of 950 mg/L (table 3).

In the vicinity of Loxahatchee Slough (fig. 2), deeper ground water contains residual seawater. Data from three wells adjacent to the C-18 Canal indicate that at depths greater than about 50 to 75 ft, chloride concentrations exceed the secondary drinking-water standard of 250 mg/L (Florida Department of Environmental Regulation 1989a; 1989b). Water from well PB-1607 (180 ft deep), drilled adjacent to the C-18 Canal, had chloride concentrations ranging from 270 mg/L at 60 ft to 1,950 mg/L at 180 ft (table 3). About 3 mi south, also along the canal, water from well PB-1084 (133 ft deep) had chloride concentrations as high as 1,550 mg/L (table 4). Water from well PB-1099, sampled during a previous study, had a chloride concentration of 1,100 mg/L at 88 ft (Miller, 1988, p. 52).

Generally, in areas other than the northernmost part of the Midlands or near the Loxahatchee Slough, chloride concentrations from the water table to a depth of about 100 ft ranged from 6 to 195 mg/L (tables 3 and 4). One exception was water from well PB-1540 (22 ft deep), which had chloride concentrations that ranged from 105 to 260 mg/L. At depths ranging from 100 to 160 ft, water from six wells in these areas had chloride concentrations ranging from 30 to 360 mg/L (tables 3 and 4). Water from only two wells in these areas had chloride concentrations higher than 250 mg/L; water from wells PB-1555 and PB-1564 had concentrations of 450 mg/L at 130 ft (table 3).

Table 3. Chloride concentrations in samples collected during test-well drilling in the northern Midlands

[Concentrations shown in milligrams per liter; --, data not available]

[Concentrations shown in milligrams per liter; --, data not available]

Local well number	Well depth (feet)	Date of collection
PB-1546	140	6/15/86
PB-1551	130	7/15/86
PB-1552	140	7/17/86
PB-1555	130	7/18/86
PB-1558	190	7/22/86
PB-1562	250	7/25/86
PB-1564	130	7/30/86
PB-1567	170	8/1/86
PB-1583	170	10/21/86
PB-1607	180	1/20/87

Local well number	Chloride concentrations at respective depths below land surface (feet)										
	30	40	50	60	70	80	90	100	110	120	130
PB-1546	60	70	--	60	70	--	110	150	--	225	350
PB-1551	--	--	--	70	130	120	85	240	360	350	410
PB-1552	--	--	--	--	--	570	580	630	630	650	830
PB-1555	--	--	--	--	90	130	175	215	280	350	450
PB-1558	--	--	--	--	--	--	--	--	--	2,800	2,950
PB-1562	--	--	--	2,500	--	2,700	3,100	3,700	3,700	3,800	3,700
PB-1564	--	--	120	90	120	130	145	240	255	340	450
PB-1567	60	--	--	--	--	120	110	90	115	115	115
PB-1583	--	40	30	30	20	30	40	40	30	30	40
PB-1607	--	160	225	270	330	350	450	560	710	900	1,350

Local well number	Chloride concentrations at respective depths below land surface (feet)									
	140	150	160	170	180	190	200	220	240	250
PB-1546	440	--	--	--	--	--	--	--	--	--
PB-1551	--	--	--	--	--	--	--	--	--	--
PB-1552	950	--	--	--	--	--	--	--	--	--
PB-1555	--	--	--	--	--	--	--	--	--	--
PB-1558	3,100	3,000	3,050	3,000	3,100	3,000	--	--	--	--
PB-1562	4,600	4,700	4,700	4,800	4,900	4,800	4,900	5,100	5,000	4,900
PB-1564	--	--	--	--	--	--	--	--	--	--
PB-1567	105	104	180	175	--	--	--	--	--	--
PB-1583	80	145	175	240	--	--	--	--	--	--
PB-1607	1,550	1,650	1,750	1,900	1,950	--	--	--	--	--

The distribution of chloride concentrations in ground water in the west-east profile A-A′ is shown in figure 9. Decreasing chloride concentrations toward the suburban eastern part of the area indicates the effect that canal drainage has on flushing highly mineralized water from shallow sediments. The relatively thick section of ground water with chloride concentrations less than 200 mg/L in the southern part of the area, as shown in north-south profile B-B′ (fig. 10), probably is the result of drainage by the C-51 and M-1 Canals and subsequent flushing of residual seawater. Miller (1988, p. 22) concluded that mineralized water in the sediments was a result of residual seawater from the Pleistocene Epoch. Low permeability of sand and marl sediments has retarded flushing of poor quality ground water in recent geologic time. Permeability of the surficial aquifer system generally increases eastward, facilitating rainfall infiltration, a higher rate of ground-water movement, and dilution and flushing of residual seawater.

Major Constituents and Characteristics

Because of the diversity of ground-water quality due to patchy areas of residual seawater, three arrays of wells drilled to various depths were constructed in different areas of the northern Midlands (fig. 8) to characterize the water chemistry. Array 2 wells are about 120 ft upgradient from septic-tank test site 2 in an area that is seemingly less affected by residual seawater (except possibly at depths much greater than 100 ft). Ground-water chloride concentrations at array 2 average less than 70 mg/L. Array 3 wells are in the northern part of the study area, about 3 mi west of septic-tank test site 3. Ground-water chloride concentrations at array 3 average about 550 mg/L. Array 1 wells are about 3 mi upgradient from septic-tank test site 1, in an area where ground water is affected by residual seawater and chloride concentrations are higher than 1,000 mg/L.

Table 4. Chloride concentrations in water from selected wells in the northern Midlands

[Concentrations in milligrams per liter; --, data not available; **, well destroyed]

Well number	Cased depth (feet)	Chloride concentration on indicated sampling date				
		July 24-25, 1986	January 5-7, 1987	May 12-19, 1987	September 2-4, 1987	December 3-7, 1987
PB-685	17	--	16	10	--	12
PB-715	67	100	95	80	100	95
PB-716	15	31	26	22	22	24
PB-719	24	--	10	6	12	10
PB-875	22	33	38	30	38	32
PB-876	41	40	28	30	50	42
PB-1084	133	--	--	--	1,550	1,380
PB-1089	135	--	95	84	82	89
PB-1098	80	47	62	34	38	62
PB-1109A	128	--	860	880	940	960
PB-1109B	40	18	20	34	35	22
PB-1157	100	--	14	**	--	--
PB-1460	30	48	78	110	105	100
PB-1520	22	19	28	28	30	22
PB-1521	22	--	34	34	18	19
PB-1522	22	42	42	40	44	38
PB-1523	22	57	**	--	--	--
PB-1524	22	500	540	580	550	560
PB-1525	22	--	14	16	20	15
PB-1526	21	--	--	--	11	11
PB-1527	20	1,220	1,050	1,220	1,400	--
PB-1528	20	42	40	38	39	34
PB-1529	22	14	10	12	14	12
PB-1530	23	--	18	20	21	--
PB-1531	20	16	10	11	14	14
PB-1532	22	14	10	13	14	16
PB-1533	22	90	92	90	115	99
PB-1534	22	90	112	90	105	90
PB-1535	22	58	50	50	**	--
PB-1536	22	12	10	18	48	10
PB-1537	22	21	16	**	--	--
PB-1538	22	10	6	6	10	8
PB-1539	22	195	180	185	195	170
PB-1540	22	--	110	260	115	105
PB-1541	20	--	18	58	--	40
PB-1546	140	--	85	--	--	275
PB-1552	100	--	680	550	700	680
PB-1553	37	--	590	660	600	600
PB-1554	40	--	33	26	29	26
PB-1555	130	--	360	--	100	150
PB-1560	56	--	1,200	1,120	1,180	1,100
PB-1561	163	--	--	2,300	2,600	2,350
PB-1562	250	--	--	--	5,950	**
PB-1583	160	--	95	202	90	140
PB-1584	70	--	28	28	28	26
PB-1585	110	--	--	35	31	30

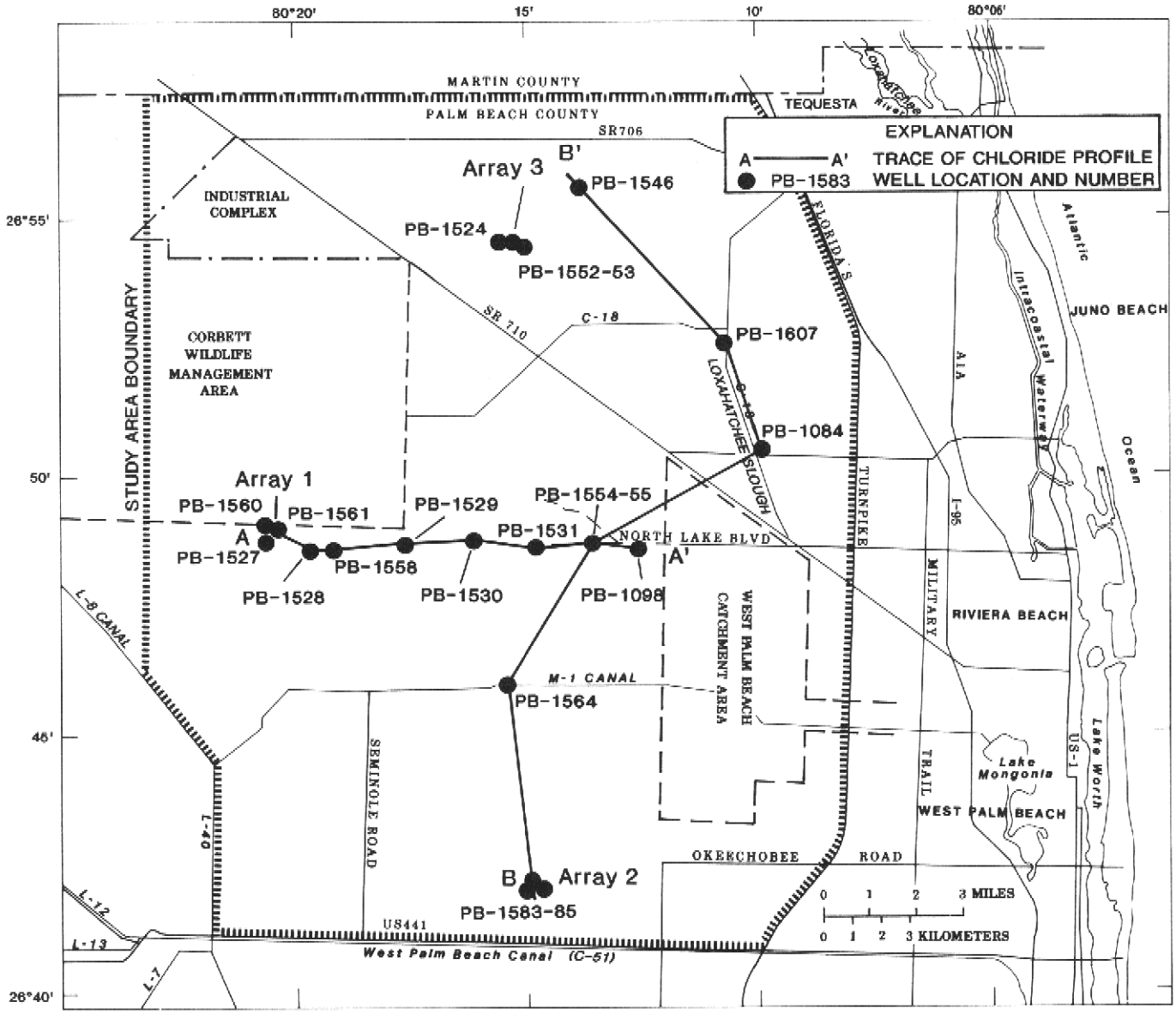

Figure 8. Location of chloride profiles A-A' and B-B' and arrays of quality-of-water wells in the northern Midlands.

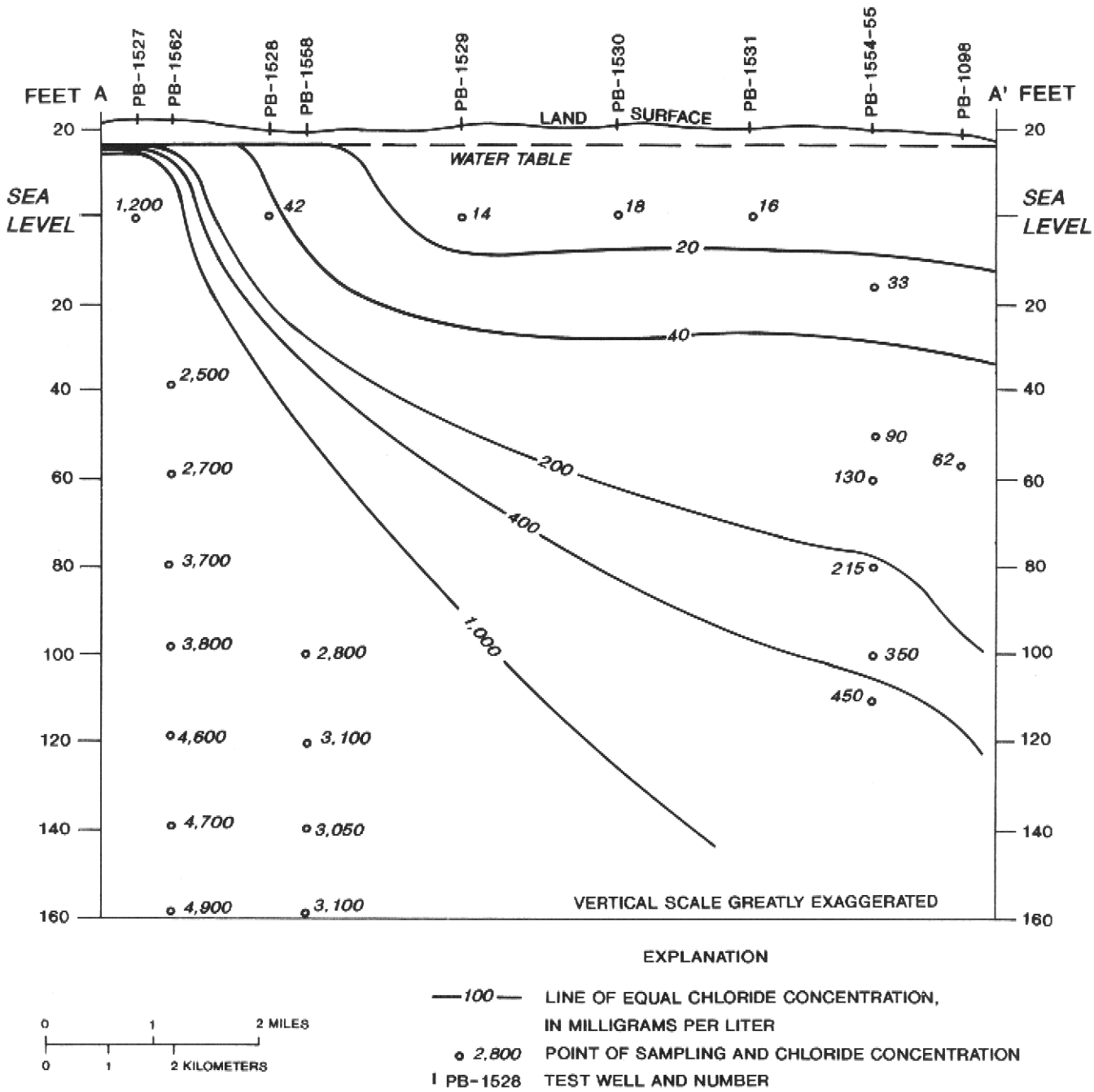

Figure 9. Chloride concentrations along profile A-A' in the northern Midlands.

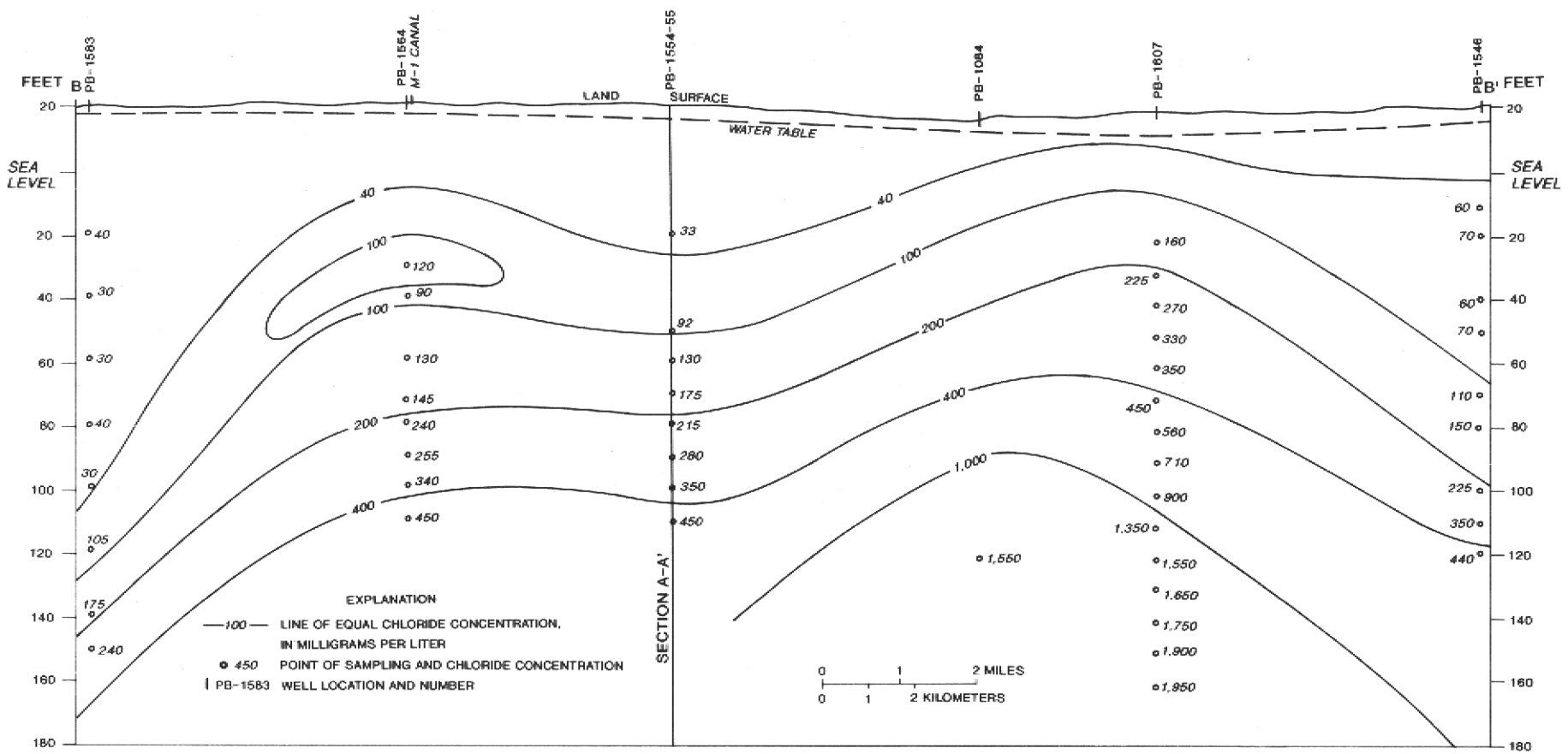

Figure 10. Chloride concentrations along profile B-B′ in the northern Midlands.

Water from each well was sampled three or four times between December 1986 and December 1987. The results of analyses of these samples (table 5-7) indicate a relation between chloride concentration, a measure of residual seawater content, and other major inorganic ions (calcium, magnesium, sodium, potassium, and sulfate). These constituents have highest concentrations in water samples from array 1 wells (table 5), in the area of greatest residual seawater effect; the lowest concentrations were in water samples from array 2 wells (table 6), in the area least affected by residual seawater.

Analytical results (table 5-7) indicate that nitrogen, phosphorus, ammonia, organic nitrogen, and organic carbon are not related to chloride concentrations. These constituent concentrations generally are similar at all three well arrays, regardless of depth and residual seawater content: ammonia plus organic nitrogen concentrations range from 1.0 to 2.2 mg/L, with a median of 1.6 mg/L. Nitrite and nitrate concentrations are almost nonexistent because anaerobic conditions in the fine sand and marl of the surficial aquifer system limit oxidation reactions (Hem, 1985, p. 124). Total phosphorus, though in trace amounts, shows a wide range in concentration, from 0.02 to 0.36 mg/L. Total organic carbon (TOC) concentrations had a median of about 14 mg/L, and there seems to be no relation between TOC concentrations and concentrations of other constituents that were analyzed.

Several constituent concentrations listed in tables 5 to 7 exceed primary and secondary drinking-water standards of the Florida Department of Environmental Regulation (FDER). For comparison of values, the following is a list of constituents for which analyses were made during the study and for which there are standards established by the Florida Department of Environmental Regulation (1989a; 1989b). The Palm Beach County drinking-water standards are the same as those established by FDER for the inorganic constituents in the list. However, the County also has a primary drinking-water standard for nitrite (NO_2) of 1 mg/L and a different secondary drinking water-standard for pH of 6.9 to 9.5 (Alan Trefry, Palm Beach County Department of Environmental Regulation and Management, oral commun., 1989).

Property or constituent	FDER standards[1]	
	Primary drinking-water standard	Secondary drinking-water standard
Nitrate (NO_3) as nitrogen, in mg/L	10	
Sodium (Na), in mg/L	160	
Chloride (Cl), in mg/L		250
Sulfate (SO_4), in mg/L		250
Color, in platinum-cobalt units		15
Dissolved solids, in mg/L		500
pH, in standard units		6.5-8.5

[1]Florida Department of Environmental Regulation (1989a; 1989b) standards. The primary drinking-water standard is established for contamination which may cause adverse human health effects. The secondary drinking-water standard is established for contamination that affects the esthetic quality of drinking water. At considerably higher concentrations, health implications may exist.

Water from array 1 wells were greatly influenced by residual seawater (table 5). Sodium concentrations (760-1,400 mg/L) greatly exceeded the primary drinking-water standard (160 mg/L) of FDER. Chloride (1,100-2,300 mg/L), sulfate (340-520 mg/L), and dissolved solids (2,850-5,200 mg/L) concentrations in water from these wells greatly exceeded FDER secondary drinking-water standards. The concentrations increased with depth.

Water from array 2 wells PB-1584 and PB-1585 (70 and 110 ft deep) had relatively low chloride concentrations (21-24 and 24-27 mg/L), indicating the absence of residual seawater (table 6). Water from well PB-1583 (160 ft deep) had concentrations of 72 to 190 mg/L (table 6), less than the 250 mg/L secondary drinking-water standard but still an indication that flushing of highly mineralized residual seawater near the base of the surficial aquifer system was not complete in the area. None of the constituents for which standards exist exceeded drinking-water standards in water the three wells at array 2, except dissolved solids which exceeded the standards in two water samples (593 and 719 mg/L) from well PB-1583.

Water from array 3 wells PB-1524, PB-1552, and PB-1553 (22-100 ft deep) had chloride concentrations (440-670 mg/L) that were lower than those in water from array 1 wells, but which exceeded the FDER secondary drinking-water standard of 250 mg/L (tables 5 and 7) . Concentrations of sodium (310-430 mg/L) and dissolved solids (1,480-1,820 mg/L) in ground water from array 3 wells were two or three times greater than the secondary drinking-water standards (table 7). The color of water in these wells, generally a physical indicator of organic material, also exceeded the FDER secondary drinking-water standard.

Water-quality data collected from the three well arrays (tables 5-7) along with chloride data from other wells (tables 3 and 4) indicate that, in some areas and at some depths, the surficial aquifer system in the northern Midlands contains mineralized water that is unsuitable for drinking. Use of water from the surficial aquifer system in these areas for domestic or public-water supply may not be feasible without extensive treatment.

MIGRATION OF SEPTIC-TANK EFFLUENT

Because of the frequency of flooding and the low permeability of surficial sedimentary material, many problems are associated with using septic tanks and drainfields in much of the northern Midlands (Canter and Knox, 1985, p. 22). Fill is commonly used to elevate residential building sites above flood level, including the area in which septic tanks and drainfields are to be constructed. The matrix of the drainfield generally is composed of highly permeable material, such as gravel, shell, or coarse sand, to accept and transmit septic-tank effluent away from the septic-tank outlet.

Three rural residences, each served by a water-supply well and a septic tank and drainfield, were selected to

Table 5. Concentrations of major constituents, nutrients, and related characteristics of water from wells PB-1560 and PB-1561 in array 1 in the northern Midlands

[All concentrations shown in milligrams per liter, except for pH, in standard units; specific conductance, in microsiemens per centimeter; and color, in platinum-cobalt units. <, less than the value; --, not determined]

Property or constituent	Well PB-1560				Well PB-1561		
	12/16/86	5/15/87	9/4/87	12/4/87	5/15/87	9/4/87	12/4/87
pH	7.5	8.0	7.4	8.2	7.4	7.4	8.0
Specific conductance	4,850	4,740	4,750	4,650	8,440	8,370	8,310
Dissolved solids	2,940	2,860	2,860	2,850	5,180	5,120	5,200
Fluoride	0.4	0.4	0.3	0.3	0.4	0.4	0.3
Silica	22	22	20	21	28	27	26
Calcium	180	180	170	170	220	220	220
Magnesium	52	52	52	52	100	100	100
Sodium	790	770	770	760	1,400	1,400	1,400
Potassium	24	24	25	24	61	2.0	61
Sulfate	340	340	340	340	510	520	520
Chloride	1,200	1,100	1,100	1,100	2,300	2,300	2,300
Color	35	35	30	30	30	15	15
Nitrogen, total organic	0.60	0.53	0.63	0.56	0.60	0.60	0.60
Nitrogen, total ammonia	0.90	0.87	0.87	0.84	1.20	1.20	1.10
Nitrogen, total nitrite	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen, total ammonia plus organic	1.5	1.4	1.5	1.4	1.8	1.8	1.7
Nitrogen, tal nitrite plus nitra	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus, total orthophosphate	0.04	0.02	0.02	0.02	0.01	0.01	0.01
Phosphorus, total	0.22	0.14	0.09	0.15	0.10	0.04	0.08
Hardness noncarbonate	--	250	200	210	510	500	510
Carbon, total organic	13	14	15	--	13	15	--

investigate migration of effluent from drainfields (fig. 2). The sites are widely separated--one is in the southwestern part of the study area (site 1), one is near the extreme southern boundary of the area (site 2), and the third is in the northeastern part of the area (site 3). Monitoring wells ranging in depth from 5 to 20 ft below land surface were drilled at different distances immediately upgradient and downgradient (relative to the regional hydraulic gradient) of the septic tanks at sites 1 and 2 (table 2). Space limitations at site 3 (table 2) prevented drilling upgradient wells. Water levels in the monitoring wells were measured prior to collecting water-quality samples (tables 8-10) to determine local hydraulic gradients at the sites.

Most monitoring wells were sampled four times during 1986-87. Chemical analyses of these water samples were made for some constituents commonly associated with septic-tank effluent, including chloride, nitrogen, ammonia, and phosphorus (tables 11-13). Specific conductance, an indicator of the mineralization of ground water (and possible contaminant loading), was also determined for each well.

Site 1

Site 1 is in the southwestern part of the northern Midlands, about 0.5 mi north of the M-1 Canal (figs. 2 and 11). Fill material was used to elevate the house and drainfield above the flood plain as required by Palm Beach County building codes. The water-supply well (not shown) is near the northern side of the property and is completed at a depth of 35 ft in the upper part of the surficial aquifer system. The drainfield is west of the residence, about 100 ft southwest from the supply well and is in an area filled with locally obtained sand to a depth of about 2 ft above preconstruction land surface. Shallow monitoring wells

Table 6. Concentrations of major constituents, nutrients, and related characteristics of water from wells PB-1583, PB-1584, and PB-1585 in array 2 in the northern Midlands

[All concentrations shown in milligrams per liter, except for pH, in standard units; specific conductance, in microsiemens per centimeter ; and color, in platinum-cobalt units. <, less than the value; --, not determined]

Property or constituent	Well PB-1583				Well PB-1584				Well PB-1585		
	12/16/86	5/19/87	9/2/87	12/3/87	12/16/86	5/19/87	9/2/87	12/3/87	5/19/87	9/2/87	12/3/87
pH	7.3	7.4	8.0	7.5	7.3	7.5	7.8	7.8	7.5	7.6	7.9
Specific conductance	795	1,350	830	992	510	458	542	589	580	599	589
Dissolved solids	487	719	471	593	349	364	372	363	367	376	360
Fluoride	0.2	0.2	0.2	0.4	0.2	0.2	0.1	0.3	0.2	0.2	0.2
Silica	18	19	17	18	23	20	19	17	18	17	17
Calcium	110	120	110	110	96	110	100	100	110	110	110
Magnesium	7.7	13	7.2	11	3.7	4.0	4.0	3.9	4.8	4.7	4.7
Sodium	47	130	43	88	14	14	14	14	13	12	12
Potassium	3.0	6.4	2.3	4.9	1.0	0.9	0.9	1.0	1.1	0.8	0.8
Sulfate	10	19	6.5	16	2.5	<0.1	0.4	1.0	1.6	0.4	1.6
Chloride	80	190	72	140	24	22	24	21	25	27	24
Color	25	40	20	30	40	40	20	30	30	25	30
Nitrogen, total organic	0.58	0.32	0.47	0.54	0.50	0.48	0.70	0.70	0.32	0.50	0.49
Nitrogen, total ammonia	0.62	0.68	0.63	0.66	1.40	0.36	1.50	1.50	0.78	0.80	0.81
Nitrogen, total nitrite	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen, total ammonia + organic	1.2	1.0	1.1	1.2	1.9	0.8	2.2	2.2	1.1	1.3	1.3
Nitrogen, total nitrite + nitrate	<0.02	<0.02	<0.02	<0.02	<0.02	0.65	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus, total orthophosphate	0.03	0.01	0.01	0.01	0.04	0.04	0.05	0.07	0.02	0.02	0.03
Phosphorus, total	0.20	0.04	0.03	0.02	0.18	0.12	0.15	0.27	0.04	0.04	0.05
Hardness noncarbonate	0	10	0	4	0	98	24	0	23	10	29
Carbon, total organic	7.5	11	11	--	13	13	13	--	11	11	--

(PB-1609A-II), completed 10 to 14 ft below land surface, were installed upgradient and downgradient (relative to the regional ground-water gradient) of the drainfield (fig. 11). The wells penetrate the uppermost marl layer (fig. 7) and are completed in very fine sand that overlies a 15-ft thick marl layer, 16 to 18 ft below land surface.

During 1987, ground-water levels in each well were measured (table 8) prior to the four water-quality sampling events to determine ground-water flow directions. Fill material used to elevate the house and drainfield to meet building codes altered local hydraulic gradients and resulted in ground-water flows to the north and the south from the septic tank (fig. 11 and table 8). The regional gradient is to the southwest. Wells C and D on either side of the septic-tank outlet had nearly identical water levels during each of the four measurements. The greatest hydraulic gradient on the south side of the outlet where the drainfield is located was between wells D and H--1.06×10^{-2} on both March 19, 1987, and May 19, 1987. The greatest gradient to the north was 1.84×10^{-2} on May 19, 1987, between wells C and A.

Ground-water samples collected from well D (in the drainfield and 12 ft from the septic-tank outlet) had the greatest specific conductance and concentrations of chloride, total nitrogen, nitrite plus nitrate, total phosphorus, and orthophosphate (table 11). Ground-water quality at wells C, E, F, and G (10-38 ft from the outlet) was influenced by septic-tank effluent, with one or more constituents, including chloride, nitrogen, and ammonia having elevated concentrations (table 11). Water from wells A, B, and H (59-150 ft from the outlet) showed little, if any, effect from the effluent; water from well

Table 7. Concentrations of major constituents, nutrients, and related characteristics of water from wells PB-1524, PB-1552, and PB-1553 in array 3 in the northern Midlands

[All concentrations shown in milligrams per liter, except for pH, in standard units; specific conductance, in microsiemens per centimeter; and color, in platinum-cobalt units. <, less than the value; --, not determined]

Property or constituent	Well PB-1524				Well PB-1552				Well PB-1553			
	12/17/86	5/14/87	9/4/87	12/3/87	12/17/86	5/14/87	9/4/87	12/3/87	12/17/86	5/14/87	9/4/87	12/3/87
pH	7.1	7.2	7.4	7.5	7.2	7.4	7.5	8.0	7.7	7.1	7.4	7.5
Specific conductance	2,460	2,580	2,590	2,600	3,040	2,720	3,050	2,990	2,640	3,050	2,720	2,730
Dissolved solids	1,480	1,540	1,520	1,520	1,820	1,620	1,770	1,800	1,610	1,810	1,600	1,620
Fluoride	0.3	0.3	0.3	0.5	0.3	0.4	0.4	0.6	0.3	0.3	0.3	0.5
Silica	20	20	20	20	22	21	22	22	20	23	20	20
Calcium	170	170	170	160	160	160	150	160	180	160	170	170
Magnesium	24	23	23	23	37	24	37	36	26	35	26	26
Sodium	310	320	330	340	430	350	420	430	350	430	360	370
Potassium	7.3	8.4	7.9	9.9	16	9.4	18	18	8.3	17	9.8	11
Sulfate	140	140	140	150	180	150	90	190	140	180	160	160
Chloride	520	520	540	440	650	560	670	570	520	640	570	490
Color	55	40	40	50	40	40	30	30	50	40	40	50
Nitrogen, total organic	0.30	0.60	0.50	0.85	0.56	0.70	0.66	0.59	0.40	0.55	0.70	0.88
Nitrogen, total ammonia	1.30	1.10	1.20	0.95	0.84	1.00	0.84	0.81	1.10	0.85	1.00	0.92
Nitrogen, total nitrite	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen, total ammonia + organic	1.6	1.7	1.7	1.8	1.4	1.7	1.5	1.4	1.5	1.4	1.7	1.8
Nitrogen, total nitrite + nitrate	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phosphorus, total orthophosphate	0.19	0.17	0.16	0.18	0.02	0.17	0.03	0.04	0.18	0.02	0.18	0.18
Phosphorus, total	0.22	0.20	0.22	0.20	0.17	0.29	--	0.09	0.23	0.15	0.36	0.21
Hardness noncarbonate	--	120	120	120	--	90	110	200	--	130	130	120
Carbon, total organic	16	16	17	--	13	17	16	--	16	14	18	--

B, with total phosphorus concentrations ranging from 0.44 to 0.98 mg/L, may have been affected by effluent. Chloride concentrations in water from these three wells ranged from 9 to 20 mg/L. Well A, the greatest distance upgradient from the outlet, was selected to represent background conditions. Trace amounts of other constituents at wells B and H were close to background levels. The maximum and minimum concentrations of ammonia plus organic nitrogen concentrations in water from each well are shown in figure 11. Concentrations of ammonia plus organic nitrogen were highest in water samples collected from wells C, D, E, and G.

Site 2

Site 2 is in the southern part of the study area where the water-table gradient is south toward the C-51 Canal (figs. 2 and 12). The septic tank and drainfield are installed in permeable fill material raised 1.5 ft above preconstruction land surface. Fill was obtained from a borrow pond south of the site. Seven monitoring wells (PB-1590A-G), ranging in depth from 10 to 20 ft, were drilled through the uppermost marl layer that is about 5 ft below land surface (fig. 7). Of these wells, six were south and southeast of the septic tank

Table 8. Ground-water levels at septic-tank test site 1 in the northern Midlands prior to water-quality sampling

Well number	Altitude of water, in feet above sea level			
	March 19, 1987	May 17, 1987	September 2, 1987	December 4, 1987
PB-1609A	17.65	16.20	15.95	17.27
PB-1609B	18.19	17.76	17.48	18.79
PB-1609C	18.34	17.88	17.58	18.89
PB-1609D	18.30	17.88	17.52	18.82
PB-1609E	18.16	17.78	17.44	18.71
PB-1609F	18.16	17.86	17.50	18.58
PB-1609G	18.18	17.77	17.46	18.70
PB-1609H	16.71	16.29	15.95	18.04

Table 9. Ground water levels at septic-tank test site 2 in the northern Midlands prior to water-quality sampling

Well number	Altitude of water, in feet above sea level			
	December 16, 1986	May 12, 1987	September 2, 1987	December 3, 1987
PB-1590A	17.55	17.61	17.36	19.18
PB-1590B	17.43	17.30	17.09	19.04
PB-1590C	17.53	17.40	17.23	19.23
PB-1590D	17.30	16.96	16.95	19.12
PB-1590E	17.30	17.22	17.01	19.02
PB-1590F	17.46	17.26	17.19	19.20
PB-1590G	17.18	17.19	16.90	18.81

Table 10. Ground-water levels at septic-tank test site 3 in the northern Midlands prior to water-quality sampling

Well number	Altitude of water, in feet above sea level			
	December 16, 1986	May 12, 1987	September 8, 1987	December 4, 1987
PB-1589A	16.46	14.61	13.95	16.77
PB-1589B	15.27	13.62	12.97	15.73
PB-1589C	15.44	13.52	12.94	15.64
PB-1589D	15.08	13.50	12.75	15.61
PB-1589E	15.07	13.41	12.74	14.91
PB-1589F	16.17	14.48	13.78	16.71

and one was northwest of the tank (fig. 12). Each well is completed in silt and very fine sand of low permeability that lies above a relatively impermeable marl layer at a depth of about 20 ft.

At site 2, regional and local hydraulic gradients (fig. 12) are to the south. Water-level measurements made during 1986-87 (table 9) indicate that gradients across the site between wells A and G ranged from 1.2×10^{-3}3 to 1.5×10^{-3}. Between wells B (10 ft south of the septic-tank outlet) and C (just outside the drainfield), gradients were reversed to the north, ranging from 6.13×10^{-3} to 3.23×10^{-2} during sampling. However, between wells C and D, gradients consistently were to the south. This apparent mounding is caused when ground water reaches the end of the drainfield, and low-permeability surficial materials impede downgradient flow.

Elevated concentrations of chloride, total nitrogen, organic nitrogen, ammonia, and total phosphorus in water from wells B, C, D, E, and F (table 12) indicate that effluent had migrated at least 92 feet laterally downgradient from the outlet. Total phosphorus concentrations of 1.5 to 3.2 mg/L (table 12) in water from well G (182 ft from the outlet) may have been caused by a fertilizer spill found adjacent to the well or may have been from an undetected source. Because well G is relatively remote from the outlet and other analytical data do not indicate the effects of effluent, the elevated total phosphorus concentrations in water from well G are not thought to be related to effluent. Water samples from well D (57 ft from the outlet) generally contained higher concentrations of nitrogen and ammonia and occasionally had higher concentrations of total phosphorus than did samples from surrounding wells C, E, and F. The fact that well D (10 ft deep) is shallower than wells C, E, and F (15-18 ft deep) indicates that either constituents were more effectively attenuated during vertical migration than during lateral migration or there was little vertical migration.

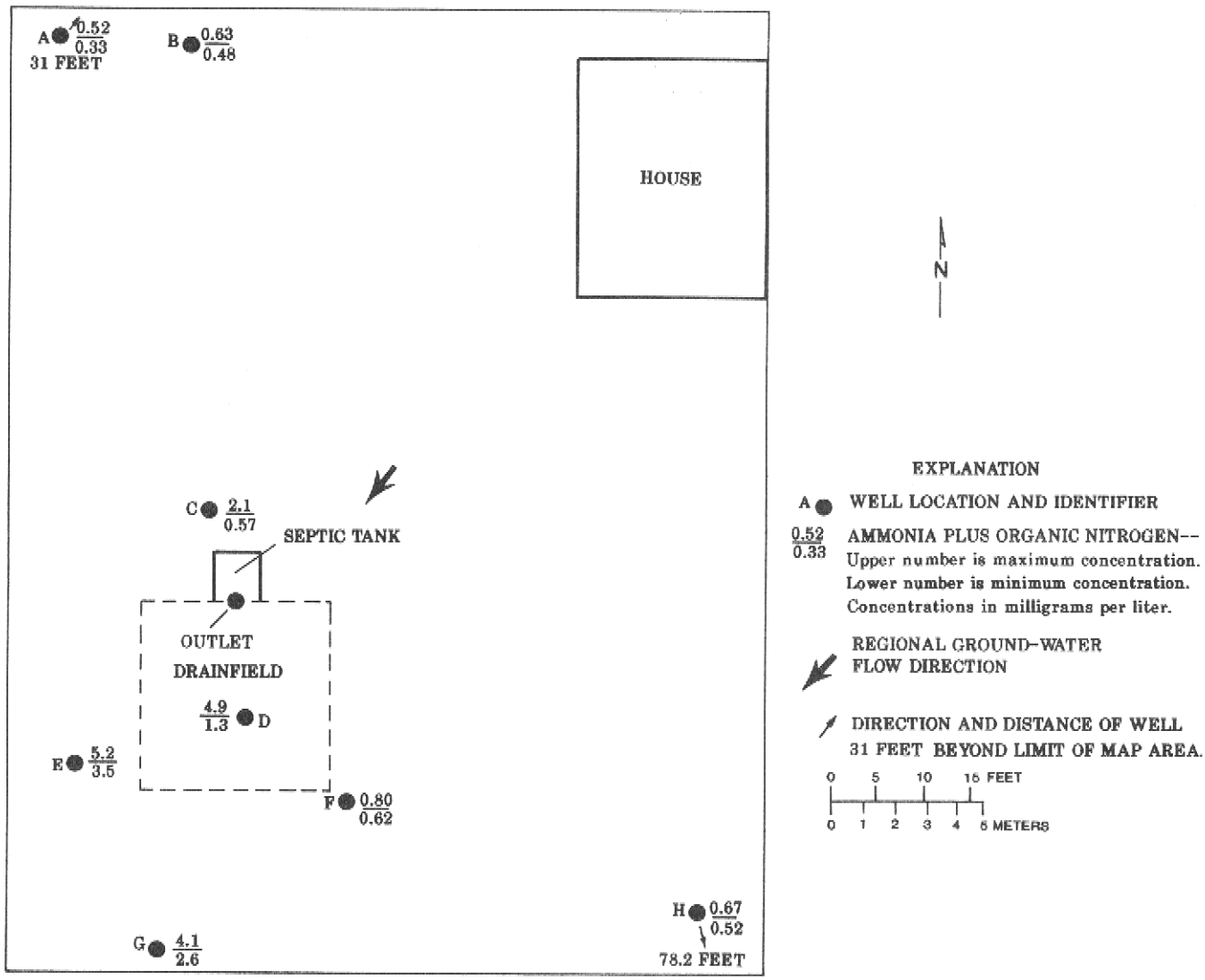

Figure 11. Septic-tank test site 1, location of nearby wells (PB-1609A-H), and minimum and maximum concentrations of ammonia plus organic nitrogen.

The maximum and minimum concentrations of ammonia plus organic nitrogen in water from each well are shown in figure 12. The maximum concentration of ammonia plus organic nitrogen in water from wells C, D, E, and F equaled or exceeded the maximum concentration in water from well B within the drainfield.

Although the pond about 10 ft south of well F was observed to periodically have heavy algal blooms during the study, water samples collected and analyzed by the Palm Beach County Health Department (Paul Davis, written commun., 1987) did not indicate that septic-tank effluent had entered the water.

Site 3

Site 3 is in the northeastern part of the study area, and its hydrology is influenced by the C-18 Canal (figs. 2 and 13). The drainfield area has not been raised by fill. Six monitoring wells (PB-1589A-F) were drilled south, east, and northeast of the septic tank to depths ranging from 5 to 20 ft below land surface (fig. 13). Wells A, B, C, D, and E are completed in low-permeability marly sand, just above a relatively impermeable marl layer that occurs 5 to 10 ft below land surface (fig. 7). Well F is completed about 6 ft below the marl layer.

Table 11. Concentrations of selected constituents in ground water at septic-tank test site 1 in the northern Midlands, 1986-87

[All concentrations shown in milligrams per liter, except for specific conductance which is in microsiemens per centimeter. <, less than the value]

Well number	Well depth (feet)	Distance to tank outlet (feet)	Date of collection	Specific conductance	Chloride	Nitrogen, total	Nitrogen, total organic	Nitrogen, total ammonia plus organic	Nitrogen, total nitrite plus nitrate	Phosphorus total	Phosphorus, total ortho-phosphate
PB-1609A	13	92	03-17-87	642	13	--	0.13	0.33	<0.02	0.10	0.01
			05-19-87	656	10	--	.34	.52	<.02	.13	.02
			09-02-87	625	17	--	.19	.40	<.02	.10	.01
			12-08-87	488	11	--	.27	.47	<.02	.05	<.01
PB-1609B	13	59	03-17-87	872	15	--	.38	.57	<.02	.98	.01
			05-19-87	720	11	--	.45	.63	<.02	.78	.02
			09-02-87	892	20	--	.28	.48	<.02	.44	.01
			12-08-87	754	15	--	.37	.55	<.02	.73	.01
PB-1609C	10	10	03-17-87	877	30	1.2	.84	1.2	.02	.11	.02
			05-19-87	902	33	--	.75	1.0	<.02	.11	.04
			09-02-87	769	18	--	.46	.57	<.02	.08	.01
			12-08-87	1,130	110	--	1.6	2.1	<.02	.07	.01
PB-1609D	10	12	03-17-87	1,270	130	20	.90	4.9	15.0	3.8	3.4
			05-19-87	1,420	150	32	.80	3.0	29.0	6.7	3.9
			09-02-87	1,370	150	29	.75	1.3	28.0	6.2	4.8
			12-08-87	1,380	160	3.0	1.0	1.8	1.2	15.0	11.0
PB-1609E	12	24	03-17-87	920	54	4.3	1.3	4.3	.03	.21	.14
			05-19-87	936	51	3.8	1.2	3.8	.02	.10	.03
			09-02-87	828	75	5.2	2.0	5.2	.02	.10	.02
			12-08-87	964	65	--	1.3	3.5	<.02	.05	.02
PB-1609F	14	24	03-17-87	1,040	95	--	.35	.62	<.02	.14	.01
			05-19-87	957	94	.82	.60	.80	.02	.12	.03
			09-02-87	1,060	100	--	.48	.68	<.02	.14	.02
			12-08-87	1,170	140	--	.43	.68	<.02	.05	<.01
PB-1609G	12	38	03-17-87	571	18	--	.80	3.2	<.02	.31	.03
			05-19-87	522	20	3.3	.90	3.3	.04	.31	.09
			09-02-87	506	19	4.1	1.7	4.1	.03	.26	.05
			12-08-87	615	47	--	.60	2.6	<.02	.08	.02
PB-1609H	11	150	03-17-87	625	14	--	.39	.52	<.02	.08	<.01
			05-19-87	632	20	--	.55	.67	<.02	.06	.02
			09-02-87	451	9	--	.51	.63	<.02	.07	.02
			12-08-87	463	9	--	.43	.52	<.02	.05	.01

During 1986-87, ground-water levels in the monitoring wells were measured (table 10) prior to water-quality sampling to determine ground-water flow directions. The direction of regional ground-water flow is to the east in the vicinity of site 3 (fig. 13). The local gradient across the site between wells A and D during sampling was also east, ranging from 1.90×10^{-2} to 1.98×10^{-2}. Water levels in well F were consistently above those in the shallower monitoring wells at the site. At well F, and possibly at other sites, higher heads below the marl layer effectively prevent the downward migration of ground water through the marl.

Water from well A, closest to the outlet (6 ft), had the highest concentrations of chloride, total nitrogen, nitrite plus nitrate, total phosphorus, and orthophosphate (table 13). Concentrations of constituents commonly associated with septic-tank effluent in water from other wells generally decreased with distance from the outlet. The exception to this was well C (5 ft deep), which was shallower than the other wells (8-20 ft deep). As at site 2, either there is greater attenuation of effluent with vertical migration than with lateral migration or little downward flow occurs. At site 3, well D (67 ft from the outlet) is affected by effluent. Water samples collected December 16, 1986 (table 13), indicate that septic-tank effluent may have reached wells E or F (102 and 176 ft from the outlet). However, subsequent analyses were inconclusive, and higher heads at well F completed below the marl layer make it unlikely that septic-tank effluent had affected that well. The cause of the anomalous concentration is unknown. The maximum and minimum concentrations of ammonia plus organic nitrogen in water from each well are shown in figure 13. The maximum concentration of ammonia plus organic nitrogen in water samples collected at site 3 was in a sample from well C, the shallowest well at the site.

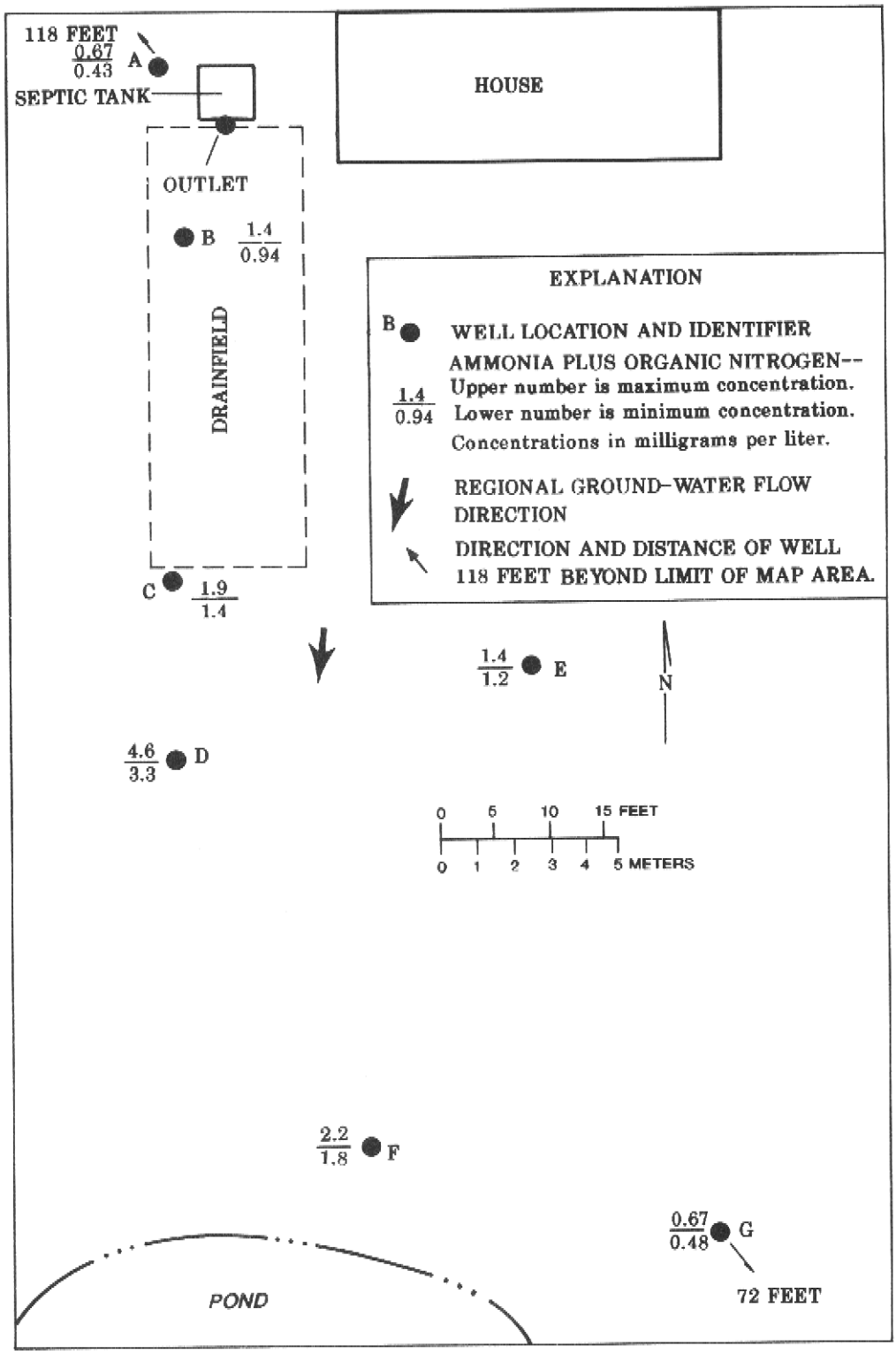

Figure 12. Septic-tank test site 2, location of nearby wells (PB-1590A-G), and minimum and maximum concentrations of ammonia plus organic nitrogen.

Table 12. Concentrations of selected constituents in ground water at septic-tank test site 2 in the northern Midlands, 1986-87

[All concentrations shown in milligrams per liter, except for specific conductance which is in microsiemens per centimeter. <, less than the value]

Well number	Well depth (feet)	Distance to tank outlet (feet)	Date of collection	Specific conductance	Chloride	Nitrogen, total	Nitrogen, total organic	Nitrogen, total ammonia plus organic	Nitrogen, total nitrite plus nitrate	Phosphorus total	Phosphorus, total ortho-phosphate
PB-1590A	20	126	12-16-86	596	20	--	0.43	0.53	<0.02	1.2	0.05
			05-12-87	663	32	.69	.56	.67	.02	.85	.04
			09-02-87	595	20	--	.37	.46	<.02	.18	.03
			12-03-87	616	16	--	.33	.43	<.02	.26	.02
PB-1590B	15	10	12-16-86	1,020	110	1.2	.85	1.2	.03	6.6	.12
			05-12-87	1,040	120	.96	.71	.94	.02	1.0	.04
			09-02-87	1,650	260	1.3	.90	1.3	.03	2.0	.10
			12-03-87	1,570	220	--	.99	1.4	<.02	.66	.04
PB-1590C	18	39	12-16-86	1,690	260	--	.82	1.7	<.02	.63	.03
			05-12-87	1,710	280	--	.98	1.9	<.02	.28	.03
			09-02-87	1,240	170	--	.89	1.4	<.02	.24	.03
			12-03-87	1,440	210	--	.87	1.6	<.02	.15	.03
PB-1590D	10	57	12-16-86	1,770	280	--	1.6	4.0	<.02	5.0	.03
			05-12-87	1,840	280	3.4	1.3	3.4	.02	.88	.08
			09-02-87	1,510	220	--	2.1	4.6	<.02	.78	.09
			12-03-87	1,110	140	--	1.1	3.3	<.02	1.7	.11
PB-1590E	15	57	12-06-86	1,550	220	--	.83	1.3	<.02	1.5	.05
			05-12-87	1,790	280	1.2	.91	1.2	.02	.68	.04
			09-02-87	1,630	250	1.4	.98	1.4	.02	1.6	.07
			12-03-87	1,640	240	--	.77	1.2	<.02	.39	.03
PB-1590F	15	92	12-16-86	907	84	--	.60	2.0	<.02	3.2	.06
			05-12-87	951	96	1.9	.70	1.9	.02	3.2	.05
			09-02-87	1,030	110	2.2	1.0	2.2	.02	2.56	.08
			12-03-87	976	96	--	.60	1.8	<.02	.80	.03
PB-1590G	20	182	12-16-86	584	13	--	.28	.48	<.02	3.2	.04
			05-12-87	637	13	.69	.48	.67	.02	2.4	.05
			09-02-87	666	16	.61	.40	.59	.02	3.2	.07
			12-03-87	562	15	--	.41	.60	<.02	1.5	.04

SUMMARY

The northern Midlands, a sparsely developed area of northeastern Palm Beach County, is undergoing increased pressures for construction of single- family residences. As many as 20,000 new homes are expected to be built in the area by the year 2000. The area has low-topographic relief and is often inundated because of heavy rainfall, poor drainage, and the occurrence of near-surface marls that retard infiltration. No public-water supplies and sewer services are currently planned for the northern Midlands. Homes in the area are, and will probably continue to be, served by domestic wells completed in the surficial aquifer system and by septic-tank systems. The possible effects of the use of a large number of individual septic tanks and wells on ground-water quality and water levels are major concerns for the area.

The uppermost part of the surficial aquifer system is primarily composed of unconsolidated sand and marl, with localized lenses of shell and shelly limestone. Marl layers extend throughout the northern Midlands at various depths in the upper 50 feet of sediments. The shallowest of these marl layers is a 4- to 10-foot thick unit that generally exists at depths of less than 10 feet below land surface. The marl is of very low permeability and greatly retards infiltration of rain and surface water. Deeper marl layers further retard infiltration.

Ground-water levels in the northern Midlands during the study were seldom more than 5 feet below land surface. The water table was highest, about 22 feet above sea level in the northwestern part of the area. Regional directions of ground-water flow were from this water-table high, east toward the Atlantic Ocean, southwest toward the L-8 Canal, and south toward the C-51 Canal.

Ground-water quality in the northern Midlands is primarily influenced by residual seawater that was emplaced during the Pleistocene Epoch. Chloride and dissolved-solids concentrations that exceed secondary drinking-water standards exist at depths ranging from near land surface to the base of the surficial aquifer system mainly in the northern and western parts of the study area. Chloride concentrations in water from the upper 100 feet of the aquifer ranged from

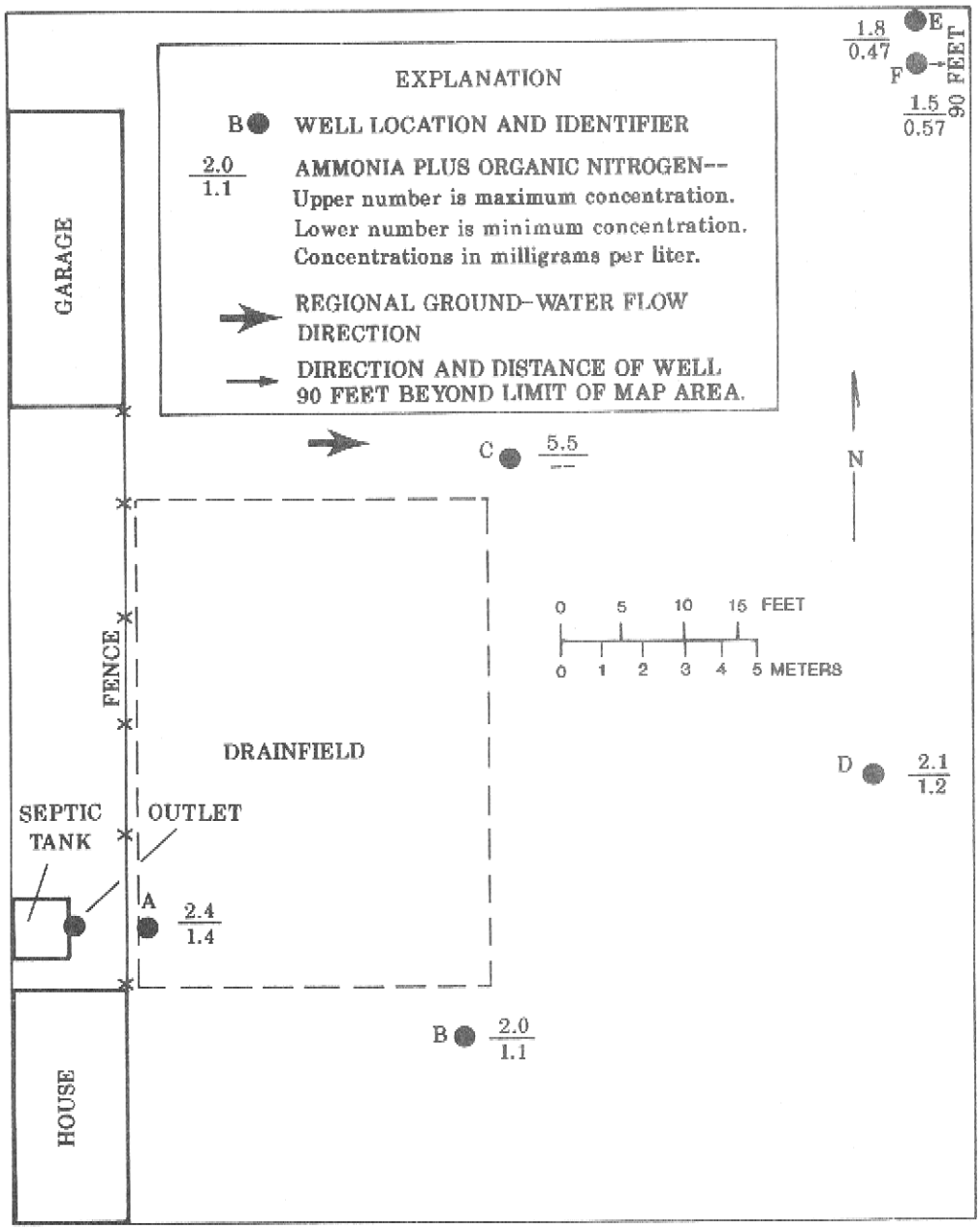

Figure 13. Septic-tank test site 3, location of nearby wells (PB-1589A-F), and minimum and maximum concentrations of ammonia plus organic nitrogen.

Table 13. Concentrations of selected constituents in ground water at septic-tank test site 3 in the northern Midlands, 1986-87

[All concentrations shown in milligrams per liter, except for specific conductance which is in microsiemens per centimeter. <, less than the value]

Well number	Well depth (feet)	Distance to tank outlet (feet)	Date of collection	Specific conductance	Chloride	Nitrogen, total	Nitrogen, total organic	Nitrogen, total ammonia plus organic	Nitrogen, total nitrite plus nitrate	Phosphorus total	Phosphorus, total orthophosphate
PB-1589A	8	6	12-16-86	941	48	15	1.1	1.4	14	4.0	0.74
			05-14-87	741	65	11	1.4	2.2	8.8	3.8	.25
			09-08-87	2,300	240	2.6	1.9	2.4	.21	2.4	.04
			12-04-87	706	26	8.4	.93	1.9	6.5	2.1	.55
PB-1589B	8	33	12-16-86	1,220	67	4.6	1.6	2.0	2.6	1.3	.07
			05-14-87	1,110	67	3.1	1.0	1.5	1.6	.90	.03
			09-08-87	799	82	--	.74	1.1	<.02	.24	.02
PB-1589C	5	52	12-16-86	804	64	6.0	5.2	5.5	.45	1.1	.02
			05-14-87	878	58	--	--	--	--	--	--
PB-1589D	8	67	12-16-86	653	44	2.2	1.9	2.1	.08	.43	<.01
			05-14-87	573	50	1.2	1.0	1.2	.03	.18	.01
			09-08-87	718	78	--	.87	1.2	<.02	.20	<.01
			12-04-87	1,020	65	--	.86	1.2	<.02	.23	.01
PB-1589E	10	102	12-16-86	677	20	1.8	1.6	1.8	.02	.31	<.01
			05-14-87	516	27	.04	.76	.88	.06	.19	.01
			09-08-87	549	36	--	.55	.79	<.02	.14	<.01
			12-04-87	575	24	--	.34	.47	<.02	.05	<.01
PB-1589F	20	176	12-16-86	509	47	1.5	1.3	1.5	.04	.25	.01
			05-14-87	307	26	--	.50	.64	<.02	.10	.01
			09-08-87	289	10	--	.40	.60	<.02	.10	>.01
			12-04-87	1,690	99	--	.30	.57	<.02	.05	>.01

6 mg/L (milligrams per liter) in well PB-1538 to 3,700 mg/L in well PB-1562, and all water samples from depths greater than 100 feet contained chloride concentrations higher than 500 mg/L, except in well PB-1546. Wells in arrays 1 and 3, in the western part of the study area, yielded water that exceeded secondary drinking-water standards for chloride and dissolved-solids concentrations at all depths sampled during drilling operations or during subsequent pumping of the completed wells.

In the eastern and southeastern parts of the study area, higher permeabilities of sediments in the surficial aquifer system have allowed more effective flushing and dilution of residual seawater. With the exception of wells in the area of Loxahatchee Slough, chloride concentrations in water from wells in these parts of the study area were less than 250 mg/L. Water samples collected from wells in the area of Loxahatchee Slough, during (and periodically after) drilling operations, had chloride concentrations that exceeded 250 mg/L at depths greater than about 60 feet. The chloride concentration in water from well PB-1607, which is 180 feet deep, was 1,950 mg/L.

Three residential sites representative of hydrogeologic conditions in the northern Midlands were selected to study the migration of septic-tank effluent. All three sites are characterized by near-surface marl layers and fine silty sands that retard vertical migration of effluent and ground water. In the vicinity of the septic-tank drainfields, migration of effluent was controlled by the local water-table gradient within the drainfield fill material on which the house and drainfield were constructed. Once away from the ground-water mound, within the fill material, the effluent flowed in the direction of regional ground-water movement or toward a local hydrologic feature, such as a pond, canal, or pumping well.

Water from the shallowest wells nearest the septic-tank outlet contained the highest concentrations of chloride, nitrogen, and phosphorus associated with the effluent. Concentrations of these constituents in the ground water attenuated with distance and depth from the drainfield. Sampled ground water (5-20 feet deep) contained elevated concentrations of these constituents as far as 38 feet from the outlet at site 1, 92 feet from the outlet at site 2, and 67 feet from the outlet at site 3--all in the direction of regional ground-water flow. The Florida Department of Environmental Regulation drinking-water standard of 10 mg/L maximum concentration for nitrate plus nitrite was exceeded in ground water at two sites: 29 mg/L at site 1 and 14 mg/L at site 3.

The northern Midlands is an area of flat topography, frequent flooding, and low permeability of surficial sedimentary materials that retard percolation of ground water and promote surface flow. These factors need to be considered when septic-tank disposal systems are constructed in the area.

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Appendix: Description of lithologic logs

Well PB-1521

Lat 26°25'50", long 80°08'39"
Sec. 22, T. 41 S., R. 42 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, brownish-gray; fine grained; 10 percent shell fragments.
5	5 - 10	Sand, brown; fine grained; some black organics; marl at 8 feet.
5	10 - 15	Sand, light-gray; quartzose, fine to very fine, 10 to 15 percent heavy minerals; 35 to 40 percent shell fragments.
5	15 - 20	Sand, light-gray; quartzose as above; 5 to 10 percent heavy minerals; 30 to 35 percent shell fragments; streaks of marl.
2	20 - 22	Sand, grayish-brown; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 3 to 5 shell fragments; 5 percent dark-gray silt and clay nodules.

Well PB-1522

Lat 26°54'17", long 80°13'03"
Sec. 14, T. 41 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, light-brown to dark-brown; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 5 percent shell fragments.
5	5 - 10	Sand, light-gray; quartzose, fine to very fine; 1 to 3 percent heavy minerals; 40 percent shell fragments, bivalves, gastropods, bryozoans; interbedded with limestone rock fragments; marl at 10 feet.
5	10 - 15	Sand, light-gray to medium-gray; quartzose, fine to very fine; 10 to 15 percent heavy minerals; about 15 percent shell fragments; 10 percent marl.
5	15 - 20	Sand, brownish-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; black organics; 5 to 10 percent silt-size particles.
2	20 - 22	Sand as in 15 to 20 feet.

Well PB-1523

Lat 26°54'45", long 80°14'03"
Sec. 14, T. 41 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, grayish-brown; quartzose, fine to very fine; some organics; 15 to 20 percent heavy minerals.
5	5 - 10	Sand, dark-brown; as above; 20 percent shell fragments; marl at 8 feet.
5	10 - 15	Sand, light-brown; quartzose, very fine; 10 to 15 percent heavy minerals; 30 percent marl; 20 percent shell; some mud and organics.
5	15 - 20	Sand, grayish-brown; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 5 percent shell; 20 percent marl.
2	20 - 22	Sand, grayish-brown to greenish-gray; quartzose, very fine; 3 to 5 percent heavy minerals.

Well PB-1524

Lat 26°54'43", long 80°15'20"
Sec. 16, T. 41 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, brownish-gray; quartzose, fine to very fine, well sorted; 3 to 5 percent heavy minerals.
5	5 - 10	Sand, brownish-gray to dark-brown; as above; 5 to 10 percent heavy minerals; abundant organics; marl layers.
5	10 - 15	Sand, grayish-green; quartzose, very fine; 3 to 5 percent heavy minerals; 15 to 20 percent shell fragments.
5	15 - 20	Sand, light-gray; same as above.

Well PB-1525

Lat 26°52'56", long 80°12'32"
Sec. 24, T. 41 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Mud, brownish-gray to black; organic mud and marl; 20 percent quartzose, very fine to silt.
5	5 - 10	Mud, brownish-gray to black; organic mud; 50 percent quartzose, greenish-gray, very fine to silt.
5	10 - 15	Sand, light-brown to light-gray; quartzose, very fine, well sorted; 20 percent organics, black.
5	15 - 20	Sand, light-brown to tan; same as above; 5 to 10 percent heavy minerals.

Well PB-1526

Lat 26°50'17", long 80°17'32"
Sec. 7, T. 42 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, brownish-gray to grayish-green; quartzose, very fine; 5 to 10 percent heavy minerals; 30 percent marl.
5	5 - 10	Marl, greenish-gray to light-brown; silt and clay-size particles; 30 percent quartzose, very fine; 3 to 5 percent heavy minerals.
2	10 - 12	Marl as above; 10 percent quartzose as above.
3	12 - 15	Sandy shell; brownish-gray to greenish-gray; 40 percent quartzose, very fine to fine, 10 to 15 percent heavy minerals.
5	15 - 20	Sandy shell, brownish-gray to greenish-gray; 40 percent quartzose, medium to fine; 10 to 15 percent heavy minerals; 10 to 15 percent marl.

Well PB-1527

Lat 26°48'56", long 80°20'37"
Sec. 15, T. 42 S., R. 40 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, brown; quartzose, fine to very fine; 3 to 5 percent heavy minerals; marl nodules at 2 to 5 feet.
7	5 - 12	Marl, greenish-gray to brownish-gray; quartzose, very fine; interbedded with limestone (loosely cemented) at 8 to 9 feet.
1	12 - 13	Limestone, black; loosely cemented; 50 percent shell fragments.
2	13 - 15	Coquina; 20 percent quartzose, very fine.
5	15 - 20	Coquina; 30 percent quartzose, very fine; 5 to 10 percent heavy minerals.

Well PB-1528

Lat 26°48'34", long 80°12'34"
Sec. 14, T. 42 S., R. 40 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Sand, brownish-tan; quartzose, fine to very fine; 5 to 10 percent heavy minerals.
1	4 - 5	Marl, medium-gray; clay and silt size; quartzose, very fine.
5	5 - 10	Marl, same as above; interbedded with limestone and 30 percent shell at 8 to 10 feet.
5	10 - 15	Sand; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 10 to 15 percent shell.
5	15 - 20	Sand, medium-gray; quartzose, fine to very fine; 15 to 20 percent shell; 10 to 15 percent heavy minerals.

Well PB-1529

Lat 26°48'32", long 80°17'33"
Sec. 13, T. 42 S., R. 40 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sandy marl, pink-gray to brownish-gray; silt and clay; 30 percent quartzose, fine to very fine; 3 to 5 percent heavy minerals; 15 to 20 percent shell fragments at 4 to 5 feet.
2	5 - 7	Limestone or sandstone, greenish-gray to brownish-gray; quartzose, fine to very fine, poorly cemented; 20 to 30 percent shell fragments; 5 to 10 percent heavy minerals.
3	7 - 10	Sandy marl, grayish-green; clay and silt; quartzose, fine to very fine.
5	10 - 15	Marl, same as above; with sand increasing to 50 percent at 9 to 10 feet; 3 to 5 percent heavy minerals.
5	15 - 20	Sand, grayish-green to brownish-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; some marl 15 to 18 feet; 25 to 30 percent organics at 18 to 20 feet; brown sandstone nodules at 18 feet.

Well PB-1531

Lat 26°48'41", long 80°14'42"
Sec. 16, T. 42 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sandy shell, grayish-brown to brownish-tan; 30 to 35 percent quartzose, fine to very fine; 5 to 10 percent heavy minerals; abundant bivalvia.
2	5 - 7	Sandy marl, grayish-green to medium-gray; quartzose, very fine; 3 to 5 percent heavy minerals; 20 to 30 percent shell fragments.
3	7 - 10	Sandy marl, greenish-gray; clay and silt; quartzose, very fine; 3 to 5 percent heavy minerals.
5	10 - 15	Sand, greenish-gray to brownish-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 20 percent shell fragments; marl, increasing to 30 percent from 12 to 15 feet.
5	15 - 20	Sand, grayish-green to greenish-gray; quartzose, very fine; 10 to 20 percent heavy minerals; shell fragments at 18 to 20 feet.

Well PB-1532

Lat 26°48'33", long 80°17'34"
Sec. 24, T. 42 S., R. 40 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, greenish-gray to brownish-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 30 percent organics; marl layer at 4 to 5 feet.
5	5 - 10	Sandy marl, greenish-gray; clay and silt; quartzose, very fine; 3 to 5 percent heavy minerals; 3 to 5 percent shell fragments.
5	10 - 15	Sandy marl, greenish-gray to grayish-brown; silt and clay; quartzose, very fine; 3 to 5 percent heavy minerals; 5 to 10 percent shell fragments.
5	15 - 20	Sand, grayish-brown to greenish-gray; quartzose, medium to very fine; 0 to 3 percent heavy minerals; streaks of marl.

Well PB-1533

Lat 26°45'55", long 80°20'34"
Sec. 34, T. 42 S., R. 40 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, grayish-tan to yellowish-brown; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 10 to 15 percent shell fragments; 5 to 10 percent marl; 5 percent sandstone nodules.
5	5 - 10	Sand, grayish-tan to greenish-gray; quartzose, medium to fine, 35 to 40 percent shell fragments; 3 to 5 percent heavy minerals; marl layer at 8 to 10 feet; some organics.
5	10 - 15	Sandy marl, greenish-gray; clay and silt; quartzose, very fine; 1 to 3 percent heavy minerals; 15 to 20 percent shell fragments from 10 to 12 feet, increasing to 40 percent from 12 to 15 feet; some organics.
5	15 - 20	Sandy marl, greenish-gray; clay and silt; quartzose, very fine to fine; 5 to 10 percent heavy minerals; bivalvia, gastropoda, Turritella, coral; 10 to 15 percent rock fragments.

Well PB-1534

Lat 26°45'53", long 80°16'17"
Sec. 32, T. 42 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, yellowish-brown; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 5 to 10 percent shell fragments; 15 to 20 percent organics; 40 percent marl at 4 to 5 feet.
5	5 - 10	Sand, grayish-tan to medium-gray; quartzose, medium to very fine; 5 to 10 percent heavy minerals; 10 to 15 percent shell fragments; 5 to 10 percent streaks of clay or silt.
5	10 - 15	Sand, pale-gray to beige; quartzose, medium to very fine; 3 to 5 percent heavy minerals; 3 to 5 percent shell fragments.
5	15 - 20	Sand, grayish-brown to yellowish-brown; quartzose, same as above; 3 to 5 percent heavy minerals; 5 to 10 percent organics; about 5 percent rock fragments.

Well PB-1535

Lat 26°45'54", long 80°14'48"
Sec. 3, T. 43 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
3	0 - 3	Sand, grayish-tan to dark-brown; quartzose, fine to very fine; 40 to 45 percent organics; 5 to 10 percent heavy minerals.
2	3 - 5	Marl, yellowish-brown to reddish-brown; clay and silt; quartzose, very fine; 5 to 10 percent shell fragments; 15 to 20 percent organics.
2	5 - 7	Sandstone, reddish-brown to light-gray; quartzose, medium to fine; 5 to 10 percent heavy minerals; 10 to 15 percent shell fragments; poorly cemented.
3	7 - 10	Sand, white to light-gray; quartzose, fine to very fine; 3 to 5 percent heavy minerals.
5	10 - 15	Sand, light-gray to grayish-tan; same as above.
5	15 - 20	Sand, light-gray to grayish-tan; quartzose, medium to fine; 0 to 3 percent heavy minerals; 15 to 20 percent sandstone; loosely cemented.
2	20 - 22	Sand, light-gray to grayish-tan; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 15 to 20 percent marl.

Well PB-1536

Lat 26°45'55", long 80°13'22"
Sec. 35, T. 42 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
3	0 - 3	Sand, brownish-gray to reddish-brown; quartzose, fine to very fine; 3 to 5 percent heavy minerals.
2	3 - 5	Marl, greenish-brownish-gray; silt; quartzose, very fine; interbedded with calcite and dolomite gravel-size rock fragment.
3	5 - 8	Sandy shell, brownish-gray; 25 to 30 percent quartzose, fine to very fine; 5 to 10 percent heavy minerals; abundant bivalvia; interbedded with limestone rock fragments.
2	8 - 10	Sand, white to olive-gray; quartzose, fine to very fine; 3 to 5 percent heavy minerals.
4	10 - 14	Sand, white to olive-gray; quartzose, fine to very fine; 3 to 5 percent heavy minerals; 10 to 15 percent shell fragments; interbedded with 5 to 10 percent limestone rock fragments.
6	14 - 20	Sand, dark-brown; quartzose, fine to very fine.

Well PB-1537

Lat 26°45'47", long 80°12'53"
Sec. 35, T. 42 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Road fill.
5	5 - 10	Sandy marl, medium-gray to brownish-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 20 to 30 percent shell fragments, decreasing to 5 to 10 percent at 10 feet.
5	10 - 15	Sand, light-gray to blue-gray; 30 to 35 percent quartzose, fine to very fine; 1 to 3 percent heavy minerals; 20 to 25 percent shell fragments; 20 to 25 percent marl, blue-gray; clay and silt; 10 to 15 percent dolomite, orange, weathered.
5	15 - 20	Sand, dark-brown to grayish-tan; quartzose, coarse to very fine; 1 to 3 percent heavy minerals.

Well PB-1538

Lat 26°44'20", long 80°19'43"
Sec. 11, T. 43 S., R. 40 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, medium-brown to dark-brown; quartzose, fine to very fine; 1 to 3 percent heavy minerals; abundant organic materials; marl at 4 to 5 feet.
5	5 - 10	Marly sand, brownish-tan to medium-brown; quartzose, fine to very fine; silt; 1 to 3 percent heavy minerals.
3	10 - 13	Sand, white to light-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals.
2	13 - 15	Shell, white to light-gray; 80 percent shell fragments; interbedded with about 20 percent limestone, black.
5	15 - 20	Shell interbedded with limestone, same as above.
2	20 - 22	Calcareous sand, light-gray to grayish-tan; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 35 percent shell fragments.

Well PB-1539

Lat 26°42'24", long 80°16'55"
Sec. 19, T. 43 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Road fill.
5	5 - 10	Sand, white to light-gray to grayish-tan; quartzose, fine to very fine; 5 to 10 percent heavy minerals; about 10 percent organics at 5 to 6 feet.
10	10 - 20	Sand, white to light-gray to gray-tan; quartzose, coarse to very fine, well rounded.

Well PB-1540

Lat 26°42'22", long 80°15'24"
Sec. 21, T. 43 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Road fill.
5	5 - 10	Sand, greenish-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 10 to 15 percent shell fragments; interbedded with 5 to 10 percent limestone.
5	10 - 15	Sand, white to light-gray to greenish-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 20 to 25 percent shell fragments; 5 to 10 percent marl; 20 to 25 percent limestone rock fragments.
3	15 - 18	Sand, greenish-gray; interbedded with limestone as above.
2	18 - 20	Sand, blue-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 25 to 30 percent shell fragments; 15 to 20 percent marl, clay and silt (blue-gray).
2	20 - 22	Sand, blue-gray to grayish-tan; quartzose, fine to very fine; marl to 21 feet; shells increase to 50 percent at 22 feet, Turritella.

Well PB-1541

Lat 26°51'45", long 80°15'27"
Sec. 33, T. 41 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Sand, yellowish-brown to light-gray; quartzose, fine to very fine; 3 to 5 percent heavy minerals; 3 to 5 percent shell fragments.
2	4 - 6	Sandy marl, brownish-gray to olive-gray; silt and very fine quartzose.
2	6 - 8	Sandy shell, olive-gray; quartzose, medium to fine; abundant bivalvia; 15 to 20 percent limestone rock fragments.
2	8 - 10	Sandy marl, olive-gray; silt; quartzose, very fine; 3 to 5 percent heavy minerals; 15 to 20 percent limestone rock fragments.
5	10 - 15	Sand, white to light-gray; quartzose, fine to very fine; 3 to 5 percent heavy minerals; 20 to 25 percent marl, greenish-gray, clay and silt.
5	15 - 20	Sand, white to light-gray; quartzose, fine to very fine; 5 to 10 percent heavy minerals; 15 to 20 percent shell fragments; 10 to 15 percent marl, same as above.

Well PB-1546

Lat 26°56'06", long 80°13'55"
Sec. 3, T. 41 S, R. 41 E

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, dark-brown to medium-brown; 40 to 45 percent quartzose, moderately sorted, medium to coarse, subrounded to subangular; 1 to 3 percent heavy minerals, fine to very fine, subrounded to rounded, well sorted; 5 to 10 percent shell fragments; 10 to 15 percent organics; 20 to 25 percent calcite; grades down to lime mud marl.
5	5 - 10	Marl, bluish-gray; 20 to 25 percent quartzose, fine to very fine, moderately sorted, subrounded to rounded; 10 to 15 percent shell fragments, abundant bivalvia, Venus; 1 to 3 percent heavy minerals, fine to very fine, rounded to subrounded, well sorted; 45 to 50 percent calcite crystals and lime mud; semi-impermeable.
3	10 - 13	Marl, bluish-gray to brownish-gray; quartzose, silt to very fine, moderately sorted, subrounded to rounded; 5 to 10 percent shell fragments; 1 to 3 percent heavy minerals as above; 20 to 25 percent carbonates; semi-impermeable.
5	13 - 18	Sandy marl, brownish-gray to bluish-gray; quartzose, very fine to fine, well sorted, subrounded to rounded; 3 to 5 percent heavy minerals, very fine, subrounded to subangular, well sorted; 1 to 3 shell fragments; 5 to 10 percent carbonates; semi-impermeable.
2	18 - 20	Shelly sand, brownish-gray; quartzose, fine to very fine, moderately sorted, subrounded to rounded; 1 to 3 percent heavy minerals, very fine, well sorted subrounded to rounded; 40 to 45 percent shells, abundant bivalvia.
3	20 - 23	Carbonate sand, brownish-gray; 45 to 50 percent detrital carbonates, fine to very fine, subangular to angular, moderately sorted; 10 to 15 percent heavy minerals, very fine, well sorted, rounded; 25 to 30 percent shell fragments, abundant bivalvia; interbedded with 10 to 15 percent limestone, brownish-gray to bluish-gray; packed biomicrite to sparse biosparite.
3	23 - 26	Limestone, dark-brownish-gray to medium-brownish-gray; fossiliferous intramicrite; 1 to 3 percent bivalvia; 5 to 10 percent calcite intraclast, fine to very fine, moderately sorted, subrounded to subangular; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; very well cemented; very porous.
4	26 - 30	Carbonate sand, medium-brownish-gray; detrital calcite crystals, medium to fine, subrounded to angular, poorly sorted; 30 to 35 percent shell fragments; 10 to 15 percent heavy minerals, fine to very fine, subangular to rounded, poorly sorted.
6	30 - 36	Carbonate sand, medium-brownish-gray; detrital calcite crystals as above; 40 to 45 percent shell fragments, abundant bivalvia; 10 to 15 percent heavy minerals as above.
7	36 - 43	Carbonate sand, dark-gray to medium-gray; detrital carbonates, coarse to fine, angular to rounded, poorly sorted; 40 to 45 percent shell fragments as above; 10 to 15 percent heavy minerals as above.
3	43 - 46	Carbonate sand, dark-gray to medium-gray; detrital carbonates, very fine to medium, angular to subrounded, poorly sorted; 40 to 45 percent shell fragments, bivalvia; 5 to 10 percent heavy minerals, fine to very fine, rounded, well sorted.
4	46 - 50	Carbonate sand, same as above; Galeodea.
3	50 - 53	Carbonate sand, dark-gray to medium-gray; detrital carbonates, very fine to medium, subangular to subrounded, poorly sorted; 3 to 5 percent heavy minerals, fine to very fine, rounded to subrounded, moderately sorted; 35 to 40 percent shell fragments, bivalvia, Mya.
3	53 - 56	Carbonate sand, dark-gray to medium-gray; detrital carbonates, fine to very fine, subrounded to subangular, moderately sorted; 5 to 10 percent heavy minerals as above; 35 to 40 percent shell fragments, Mya, Anadora, gastropods.
4	56 - 60	Carbonate sand, dark-gray to medium-gray to grayish-brown; detrital carbonates, very fine to medium, subrounded to subangular, moderately sorted; 3 to 5 percent heavy minerals, fine to very fine, rounded to subrounded; 40 to 45 percent shell fragments, Turritella, Anadora, Mya, Glycymeris, worms, others; about 20 to 30 percent cemented into sandstone and limestone nodules, quartzose, fine to very fine, subrounded to rounded, moderately sorted.
3	60 - 63	Carbonate sand interbedded with 25 percent limestone, dark-gray to medium-gray to grayish-brown; detrital carbonate, very fine to very coarse, angular to rounded, poorly sorted; 40 to 45 percent shell fragments, gastropods, Viviporus, bivalves as above, barnacles, worms; fossiliferous limestone; poorly washed biosparite to sorted biosparite; quartzose, fine to very fine, rounded to subrounded; carbonates as above; 10 to 15 percent heavy minerals, fine to very fine, rounded to subrounded; abundant gastropod molds; very porous.

Thickness (feet)	Depth below land surface (feet)	Description
7	63 - 70	Carbonate sand interbedded with 10 percent limestone, medium-gray to grayish-green; detrital carbonates, fine to very fine, subrounded to rounded, well sorted; 25 to 30 percent microscopic shell fragments; 5 to 10 percent heavy minerals, fine to very fine, rounded to subrounded, well sorted; cemented in places to intrasparite limestone; semi-impermeable.
3	70 - 73	Carbonate sand with interbedded limestone, medium-gray to brownish-gray; about 50 percent detrital carbonates and shell fragments, bivalves, gastropods, barnacles; 10 to 15 percent heavy minerals, fine to very fine, rounded to subrounded, some phosphates and elongate gypsum crystals; 25 to 30 percent limestone; intrasparite to sparse biosparite.
3	73 - 76	Carbonate sand with interbedded sandy limestone; medium-gray to brownish-gray; detrital carbonates and shell fragments as above; 10 to 15 percent heavy minerals as above; about 5 to 10 percent sandy limestone, intrasparite; 25 to 30 percent quartzose, fine to very fine.
4	76 - 80	Sandy limestone, medium-gray to brownish-gray; poorly washed biosparite; 25 to 30 percent quartzose, fine to medium, subrounded to subangular; 10 to 15 percent heavy minerals, fine to very fine, rounded to subrounded; 25 to 30 percent shell fragments, Anadora, others, gastropods; moldic, vugs, very porous; about 25 to 30 percent loose detrital carbonate and shell fragments.
3	80 - 83	Sandy, calcareous limestone; packed biosparite; medium-gray to brownish-gray; quartzose as above; 5 to 10 percent heavy minerals, very fine, rounded, well sorted; 35 to 40 percent shell fragments, scallops, other bivalves, gastropods, Turritella; moldic, vugs, very porous; moderately cemented; 25 to 30 percent loose detrital carbonates and shell fragments.
3	83 - 86	Sandy, calcareous limestone as above, medium-gray to olive-gray to brownish-gray.
4	86 - 90	Sandy, calcareous limestone, medium-gray; packed biosparite to coquina in places; 20 to 25 percent quartzose, fine to very fine, subangular to subrounded, well sorted; 3 to 5 percent heavy minerals, very fine, rounded, well sorted; abundant bivalvia, scallops; moldic, vugs; moderately cemented; porous; 25 to 30 percent loose detrital carbonates and shell fragments.
3	90 - 93	Carbonate sand interbedded with limestone, medium-gray to brownish-gray; 20 to 25 percent quartzose, fine to very fine, subangular to subrounded, well sorted; 5 to 10 percent heavy minerals and phosphates, very fine to medium, well rounded, well sorted (fine); 30 to 35 percent shell fragments, abundant bivalvia, gastropods; about 10 to 15 percent limestone; sandy, packed biosparite; moldic, vugs; poorly to moderately cemented; porous.
3	93 - 96	Calcareous sand, medium-gray to brownish-gray; 10 to 15 percent quartzose as above; 5 to 10 percent heavy minerals as above; 45 to 50 percent shell fragments, Neptunea, Terebra, Glycymeris; about 5 to 10 percent loosely cemented nodules.
4	96 - 100	Sandy shell, medium-gray to brownish-gray; 20 to 25 percent detrital carbonates, fine to coarse, angular to rounded, poorly sorted; 5 to 10 percent heavy minerals as above; abundant gastropods, Turritella, Conus, Terebra, Olivella, Clathrodrilla, bivalvia, Cerastroderma, Lirophora, scallops, Chlorophyta (algae).
3	100 - 103	Sandy shell as above, dark-gray to medium-gray; Cypraea and other shell fragments as above; 5 to 10 percent cemented as nodules.
3	103 - 106	Sandy shell, dark-gray to medium-gray to brownish-gray; 10 to 15 percent quartzose, very fine to medium, subrounded to angular, poorly sorted; 3 to 5 percent heavy minerals, very fine, rounded, well sorted; 25 to 30 percent detrital carbonates; shell fragments, Turritella (abundant), other gastropods and bivalves, barnacles, algae.
4	106 - 110	Sandy shell as above; shell fragments, abundant Turritella, Oliva, Cypraea, oysters, and clams, Glycymeris bryozoan, Conopeum.
3	110 - 113	Sandy shell, dark-gray to medium-gray; 20 to 25 percent quartzose, fine to medium, subrounded to angular, moderately sorted; 3 to 5 percent heavy minerals, very fine to medium, rounded to subangular, moderately sorted; 5 to 10 percent cemented as coquina; shell fragments as above, coral, Septastrea.
3	113 - 116	Sandy shell as above; not cemented.
4	116 - 120	Sandy shell, dark-gray to medium-gray to brownish-gray; 15 to 20 percent quartzose, very fine to medium, subrounded to angular, poorly sorted; 3 to 5 percent heavy minerals, rounded to subrounded, fine to very fine, moderately sorted; 20 to 25 percent detrital carbonates; shell fragments, abundant gastropods, Turritella, Conus, Oliva, Chione, coral.

Well PB-1546--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	120 - 123	Sandy shell as above; about 5 to 10 percent partially cemented.
3	123 - 126	Shelly sand, medium-gray to beige-gray; quartzose, very fine to medium, moderately sorted, subrounded to angular; 5 to 10 percent heavy minerals, very fine to fine, rounded to subrounded, well sorted, 40 to 45 percent detrital carbonates and shell fragments; 5 to 10 percent loosely cemented as coquina.
4	126 - 130	Shelly sand interbedded with coquina, medium-gray to beige-gray; quartzose, very fine to coarse, subrounded to angular, poorly sorted; 3 to 5 percent heavy minerals and phosphates, very fine to fine, rounded to subrounded, well sorted; 40 to 45 percent detrital carbonates and shell fragments; interbedded with 20 to 25 percent coquina.
3	130 - 133	Shelly sand, medium-gray to beige-gray; quartzose, fine to coarse, subrounded to angular, poorly sorted; 5 to 10 percent heavy minerals, very fine to medium, rounded to subangular, poorly sorted; 40 to 45 percent detrital carbonates and shell fragments, bivalvia, barnacles, worms, spines; loosely consolidated.
3	133 - 136	Shelly sand with interbedded limestone, medium-gray to beige-gray; quartzose, very fine to medium, angular to subrounded, moderately sorted; 5 to 10 percent heavy minerals, very fine to fine, rounded to subrounded, moderately sorted; 30 to 35 percent shell fragments and detrital carbonates; 20 to 25 percent loosely cemented limestone; sparse biosparite.
7	136 - 143	Sand, medium-gray to light-gray; quartzose, fine to medium, subangular to angular, well sorted; 3 to 5 percent heavy minerals, fine to very fine, rounded to subrounded, moderately sorted; 5 to 10 percent detrital carbonates and shell fragments.
3	143 - 146	Sand, medium-gray to light-gray; quartzose, fine to medium, subrounded to angular, moderately sorted; 5 to 10 percent heavy minerals as in 135 to 140 feet; 1 to 3 percent phosphates; 5 to 10 percent detrital carbonates and shell fragments.
4	146 - 150	Sand, medium-gray to light-gray; quartzose, fine to medium, subrounded to angular, moderately sorted; 5 to 10 percent heavy minerals, rounded to subrounded, well sorted, 1 to 3 percent phosphates; 3 to 5 percent detrital carbonates and shell fragments.
6	150 - 156	Sand interbedded with sandstone, medium-gray to grayish-green; quartzose, fine to very fine, angular to subrounded, moderately sorted; 5 to 10 percent heavy minerals, fine to very fine, rounded to angular, moderately sorted; 1 to 3 percent detrital carbonates; 1 to 3 percent phosphates; 5 to 10 percent loosely cemented quartz sandstone.
4	156 - 160	Sand, grayish-green to olive-green; quartzose, silt size to fine, subrounded to angular, well sorted; 3 to 5 percent heavy minerals, fine to very fine, rounded to subrounded, well sorted; 3 to 5 percent phosphates; 1 to 3 percent detrital carbonates.
3	160 - 163	Sand interbedded with sandstone, grayish-green to olive-green; quartzose as above; 5 to 10 percent heavy minerals, fine to very fine, rounded to subrounded, well sorted; 5 to 10 percent phosphates; 5 to 10 percent loosely cemented sandstone with micritic matrix.
3	163 - 166	Sand, olive-green; quartzose, very fine to fine, subrounded to angular, moderately sorted; 3 to 5 percent heavy minerals as above; 5 to 10 percent phosphate; 3 to 5 percent detrital carbonates.
4	166 - 170	Sand, dark-greenish-gray to olive-green; quartzose, silt size to fine, rounded to subrounded, well sorted; 3 to 5 percent heavy minerals, rounded to subangular, silt to fine; 5 to 10 percent phosphates; 10 to 15 percent detrital carbonates and micritic mud.

Well PB-1550

Lat 26°51'34", long 80°17'27"
Sec. 6, T. 42 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
5	0 - 5	Sand, pale-yellowish-brown (10 YR 6/2) to light-olive-gray (5 Y 6/1), medium to coarse, rounded to subrounded, moderately sorted; 1 to 3 percent heavy minerals, fine to very fine, rounded to subrounded, well sorted; 1 to 3 percent detrital carbonates.
5	5 - 10	Sandy marl, grayish-brown (5 YR 3/2) to olive-gray (5 Y 4/1); 40 to 45 percent quartzose, clay size to coarse, rounded to angular, poorly sorted; 3 to 5 percent heavy minerals, fine to very fine, rounded to subrounded, well sorted; 10 to 15 percent organics, micritic mud; 5 to 10 percent detrital shell fragments.
6	10 - 16	Sandy, shelly marl, yellowish-gray (5 Y 8/1) to light-olive-gray (5 Y 6/1); 20 to 25 percent quartzose, clay size to medium, rounded to subangular, poorly sorted; 5 to 10 percent heavy minerals, fine to very fine, rounded to subrounded, well sorted; micritic mud with 25 to 30 percent detrital carbonate and shell fragments; 5 to 10 percent organics.
4	16 - 20	Shelly sand, light-gray (N 7) to yellowish-gray (5 Y 8/1); quartzose, silt size to fine, rounded to subangular, well sorted; 10 to 15 percent heavy minerals, very fine to medium, rounded to subangular, moderately sorted; 35 to 40 percent shell fragments and detrital carbonates.
3	20 - 23	Muddy sand, light-olive-gray (5 Y 6/1); quartzose, silt size to very fine, rounded to subrounded, well sorted; 5 to 10 percent heavy minerals, very fine to fine, well sorted, rounded to subrounded; micritic lime mud; 10 to 15 percent shell fragments, Chione, Pitar, Cardita, Cardium.
3	23 - 26	Muddy sand as above; Diplodonta.
4	26 - 30	Muddy sand, light-olive-gray (5 Y 6/1) to olive-gray (5 Y 4/1); quartzose, silt size to very fine, subrounded to angular; moderately sorted; 10 to 15 percent heavy minerals, very fine to fine, rounded to subrounded, well sorted; micritic mud; 5 to 10 percent shell fragments, Chione, Mya, Olivella, Terebra, Cerithium, Calliostoma.
3	30 - 33	Sandy lime mud with rock fragments, medium-gray (N 5) to light-olive-gray (5 Y 6/1); micrite; 30 to 35 percent quartzose, silt size to fine, angular to subrounded, moderately sorted; 5 to 10 percent heavy minerals as above; 5 to 10 percent shell fragments, Busycon, Chione; 5 to 10 percent partially cemented, sandy, sparse biosparite.
3	33 - 36	Sandy lime mud with rock fragments; micrite; 30 to 35 percent quartzose as above; 5 to 10 percent heavy minerals as above; 10 to 15 percent detrital carbonates and shell fragments, Chione, Oliva, Cardita; 10 to 15 percent limestone; poorly washed biosparite; 30 to 35 percent quartzose as above.
4	36 - 40	Carbonate sand, light-olive-gray (5 Y 6/1) to light-bluish-gray (5 B 7/1); 20 to 25 percent quartzose, fine to very fine, angular to subrounded, poorly sorted; 5 to 10 percent heavy minerals, very fine to fine, rounded to subrounded, well sorted; detrital carbonates and shell fragments, Chione, limpets, Olivella; 5 to 10 percent rock fragments; poorly washed biosparite; 20 to 25 percent quartzose as above.
3	40 - 43	Carbonate sand as above; Cypraea, Chione, Calliostoma, Terebra.
3	43 - 46	Carbonate sand, color as above; 30 to 35 percent quartzose, very fine to medium, angular to subrounded, poorly sorted; 5 to 10 percent heavy minerals, very fine to coarse, rounded to subrounded, poorly sorted; detrital carbonates and shell fragments, Chione, Cypraea, Oliva, limpet, Crepidula, Cardita.
4	46 - 50	Carbonate sand as above; Anadara, Strombus, Conus.
3	50 - 53	Sandy shell, yellowish-gray (5 Y 8/1) to medium-bluish-gray (5 B 5/1); 30 to 35 percent quartzose as above; 5 to 10 percent heavy minerals, very fine to coarse, rounded to subrounded, poorly sorted; 1 to 3 percent heavy minerals; detrital carbonates and shell fragments, abundant bivalvia, Chione, oysters.
3	53 - 56	Sandy shell, medium-gray (N 5) to yellowish-gray (5 Y 8/1); 15 to 20 percent quartzose, very fine to medium, angular to subrounded, moderately sorted; 3 to 5 percent heavy minerals, very fine to medium, rounded to subrounded, moderately sorted; detrital carbonates and shell fragments, oysters, Chione, Cypraea, Cerithium.
7	56 - 63	Shelly sand, yellowish-gray (5 Y 8/1) to medium-gray (N 5); quartzose, angular to subrounded, very fine to medium, moderately sorted; 3 to 5 percent heavy minerals, very fine to medium, rounded to subrounded, moderately, moderately sorted; 35 to 40 percent detrital carbonates and shell fragments, abundant bivalvia, oysters, Anadara.

Thickness (feet)	Depth below land surface (feet)	Description
3	63 - 66	Sandy limestone, yellowish-gray (5 Y 7/2) to medium-gray (N 5); intramicrite; 20 to 25 percent quartz, very fine to medium, rounded to subangular, moderately sorted; 15 to 20 percent shell fragments, worm colony, molds; 15 to 20 percent detrital carbonates; very porous, vugs; interbedded with sand; quartzose, very fine to fine, angular to subrounded, well sorted; 3 to 5 percent heavy minerals, very fine to fine, rounded to subangular, moderately sorted; 3 to 5 percent phosphates; 35 to 40 percent detrital carbonates and shell fragments, Chione.
4	66 - 70	Sandy shell, medium-gray (N 5) to yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments, Conus, Cerastoderma, Oliva, Anadara; 30 to 35 percent quartzose, very fine to fine, rounded to subrounded, well sorted; 5 to 10 percent phosphates; about 5 to 10 percent partly cemented as packed biosparite.
3	70 - 73	Sandy shell as above; Chione, limpets, Oliva; algae, barnacles, abundant bivalvia.
3	73 - 76	Sandy shell, medium-light-gray (N 6) to yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments, Chione, Terebra, bivalves and gastropods abundant; 25 to 30 percent quartzose, very fine to medium, angular to subangular, moderately sorted; 3 to 5 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 5 to 10 percent phosphates, rounded to subrounded, very fine to medium, moderately sorted.
4	76 - 80	Sandy shell as above; 30 to 35 percent quartzose, Conus, Cancellaria.
3	80 - 83	Sandy shell, yellowish-gray (5 Y 8/1) to medium-light-gray (N 6); detrital carbonates and shell fragments, Chione, Crepidula, Cancellaria, oysters; quartzose, very fine to medium, angular to subangular, moderately sorted; 5 to 10 percent heavy minerals as above; 3 to 5 percent phosphates as above.
3	83 - 86	Sandy shell as above; 35 to 40 percent quartzose.
	86 - 90	Sandy shell, partially cemented, yellowish-gray (5 Y 8/1) to medium-gray (N 5); detrital carbonates and shell fragments, Terebra, Crepidula, oysters, scallops, barnacles; 30 to 35 percent quartzose as above; 5 to 10 percent heavy minerals, very fine to medium, rounded to subrounded, moderately sorted; 5 to 10 percent phosphates; interbeddad with 10 to 15 percent limestone; packed biosparite; moldic, vugs, very porous; loosely cemented.
3	90 - 93	Sandy shell; interbedded with limestone, medium-gray (N 5) to yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments, Conus, Turritella, Olivella, Chione, barnacles, worm tubes, algae; 20 to 25 percent quartzose, very fine to medium, angular to subrounded, moderately sorted; 3 to 5 percent heavy minerals, very fine to medium, rounded to subrounded, moderately sorted; 3 to 5 percent phosphates; interbedded with limestone, dark-gray; packed biosparite; 20 to 25 percent quartz as above; 40 to 45 percent shell fragments; very porous, moldic, vugs; loosely cemented.
3	93 - 96	Sandy shell; interbedded with limestone nodules as above; Chione, Turritella, barnacles, abundant bivalves, Conus.
4	96 - 100	Sandy shell; interbedded with limestone nodules; detrital carbonates and shell fragments, Conus, Turritella, Chione, Murex, Cancellaria, Arca, abundant bivalvia, barnacles, worm tubes, Conopeum; 15 to 20 percent quartzose, very fine to medium, subrounded to angular, poorly sorted; 3 to 5 percent heavy minerals, very fine to fine, rounded to subrounded, well sorted; 1 to 3 percent phosphates; interbedded with limestone nodules; packed biosparite; quartz and heavy minerals as above; moldic, vugs, very porous; loosely cemented.
3	100 - 103	Sandy limestone, yellowish-gray (5 Y 8/1) to medium-gray (N 5); packed biosparite, barnacles, Conopeum, abundant bivalvia, worm tubes; 10 to 15 percent quartz, very fine to medium, rounded to subrounded, moderately sorted; 3 to 5 percent heavy minerals, rounded to subrounded, fine to very fine, moderately sorted; interbedded with about 45 to 50 percent loose sand and detrital carbonates and shell fragments; Conus, Chione, Turritella, Olivella, Cardita, Terebra, Cypraea, abundant bivalvia; 15 to 20 percent quartzose, angular to subrounded, very fine to medium, moderately sorted; 3 to 5 percent heavy minerals as above; 3 to 5 percent phosphates.
3	103 - 106	Sandy shell; interbedded with limestone, yellowish-gray (5 Y 8/1) to medium-gray (N 5); detrital carbonates and shell fragments, Turritella, Clavilithes, abundant gastropods, Cancellaria, Glycymeris, abundant bivalvia, Clathrodrillia; 15 to 20 percent quartzose, very fine to medium, angular to subangular, moderately sorted; 5 to 10 percent heavy minerals, rounded to subrounded, very fine to fine, moderately sorted; 1 to 3 percent phosphates; interbedded with 5 to 10 percent limestone; packed biosparite; very porous, moldic, vugs; loosely cemented.
4	106 - 110	Sandy shell; interbedded with limestone as above; 20 to 25 percent quartzose; Turritella, Clathrodrilla, Glycymeris, Conus, Fusinus.
3	110 - 113	Sandy shell, yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments, Chione, Turritella, Conus, Cypraea, Lirophora; 15 to 20 percent quartzose, very fine to medium, angular to subangular, moderately sorted; 5 to 10 percent heavy minerals and phosphates, very fine to fine, rounded to subrounded, moderately sorted.

Thickness (feet)	Depth below land surface (feet)	Description
3	113 - 116	Sandy shell as above; interbedded with loosely cemented limestone rock fragments; packed biosparite, Turritella, Chione, abundant bivalvia.
7	116 - 123	Sandy shell, yellowish-gray (5 Y 8/1) to medium-gray (N 5); detrital carbonates and shell fragments, Oliva, Glycymeris, Fusinus, Architectonica, Turritella; 25 to 30 percent quartzose, very fine to medium, subrounded to angular, moderately sorted; 5 to 10 percent heavy minerals and phosphates, rounded to subrounded, very fine to fine, moderately sorted.
3	123 - 126	Sandy shell, yellowish-gray (5 Y 8/1) to light-gray (N 7); detrital carbonates and shell fragments, Turritella, abundant gastropods, abundant bivalvia, scallops, barnacles; 15 to 20 percent quartzose, very fine to coarse, subrounded to angular, poorly sorted; 3 to 5 percent heavy minerals and phosphates, very fine to medium, rounded to subrounded, moderately sorted; loosely cemented in places.
4	126 - 130	Sandy limestone, light-gray (N 7) to yellowish-gray (5 Y 8/1) changes to light-olive-gray (5 Y 5/2) when wet with water; packed biosparite, abundant bivalvia; 20 to 25 percent quartzose, fine to coarse, subrounded to subangular, moderately sorted; 3 to 5 percent heavy minerals, fine to coarse, moderately sorted; moderately cemented; moldic, vugs, very porous; interbedded with sandy shell as in 123 to 126 feet.
6	130 - 136	Sandy shell, yellowish-gray (5 Y 8/1) to light-gray (N 7); quartzose, very fine to medium, angular to subrounded, poorly sorted; 5 to 10 percent heavy minerals, fine to very fine, rounded to subrounded, moderately sorted; 15 to 20 percent detrital car bonates and shell fragments, echinoid plates and spines; about 3 to 5 percent cemented as sandstone with carbonate cement.
4	136 - 140	Sand, very light gray (N 8) to yellowish-gray (5 Y 8/1); quartzose, very fine to medium, rounded to subangular, moderately sorted; 5 to 10 percent heavy minerals and phosphates, very fine to fine, rounded to subrounded, well sorted; 15 to 20 percent detrital carbonates and shell fragments.
3	140 - 143	Sand, very light gray (N 8); quartzose as above; 5 to 10 percent heavy minerals and phosphates as above; 10 to 15 percent detrital carbonates and shell fragments; about 3 to 5 percent sandstone as in 130 to 133 feet; 5 to 10 percent silt nodules, light-olive-gray (5 Y 6/1).
3	143 - 146	Sand, very light gray (N 8); quartzose, very fine to medium, subrounded to subangular; moderately cemented; 5 to 10 percent heavy minerals and phosphates, very fine to medium, rounded to subrounded, moderately sorted; 10 to 15 percent detrital carbonates and shell fragments; 10 percent silt nodules as above.
4	146 - 150	Silty sand, light-olive-gray (5 Y 6/1) changing to light-olive-gray (5 Y 5/2) when wet; quartzose, silt size to medium, rounded to subangular, moderately sorted; 15 to 20 percent heavy minerals and phosphates, very fine to medium, rounded to subrounded, moderately sorted; 20 to 25 percent detrital carbonates and shell fragments; about 5 to 10 percent steaks of olive-green clay.
3	150 - 153	Sand with clay streaks, light-olive-gray (5 Y 6/1); quartzose, silt size to medium, rounded to subangular, moderately sorted; 15 to 20 percent heavy minerals and phosphates, very fine to fine, rounded to subrounded, well sorted; 5 to 10 percent detrital carbonates and shell fragments; 10 to 15 percent globs of olive-green clay.
7	153 - 160	Clayey sand, light-olive-gray (5 Y 5/2); quartzose, very fine to fine, subrounded to subangular, well sorted; 35 to 40 percent olive-green silt and clay-size particles; 5 to 10 percent heavy minerals and phosphates, very fine to fine, rounded to subrounded, well sorted; 1 to 3 percent detrital carbonates.
3	160 - 163	Sandy clay, light-olive-gray (5 Y 5/2); clay and silt-size particles; 35 to 40 percent quartzose, very fine to fine, subrounded to angular, well sorted; 10 to 15 percent heavy minerals and phosphates as above.
3	163 - 166	Sandy clay as above; 1 to 3 percent shell fragments.
4	166 - 170	Sandy clay, light-olive-gray (5 Y 5/2); clay, silt, and micrite; 20 to 25 percent quartzose, silt size to very fine, subrounded to subangular, well sorted; 10 to 15 percent heavy minerals and phosphates, fine to silt, rounded to subrounded, well sorted.
3	170 - 173	Sandy clay, light-olive-gray (5 Y 5/2).
3	173 - 176	Clay, light-olive-gray (5 Y 5/2); clay and silt-size particles; 15 to 20 percent quartzose, very fine, subrounded to subangular, well sorted; 5 to 10 percent heavy minerals and phosphates, silt to very fine, rounded to subrounded, well sorted.
4	176 - 180	Clay, light-olive-gray (5 Y 5/2); clay and silt-size particles; 10 to 15 percent heavy minerals and phosphates as above.

Well PB-1552

Lat 26°54'43", long 80°15'20"
Sec. 16, T. 41 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
3	0 - 3	Road fill.
2	3 - 5	Sand, dusky-brown (5 YR 2/2); quartzose, medium to very fine, moderately sorted, subangular to subrounded; about 1 percent carbonates; 20 to 25 percent organic mud, clay and silt size.
5	5 - 10	Sand, dark-yellowish-brown (10 YR 4/2); quartzose as above; 20 to 25 percent micritic mud; about 3 to 5 percent organic fragments; 5 to 10 percent detrital carbonates and shell fragments; Chione, Tellina.
14	10 - 24	Sand, dark-yellowish-brown (10 YR 4/2); quartzose, medium to very fine, moderately sorted, subrounded to rounded; about 1 percent heavy minerals, fine to very fine, subrounded to rounded; about 1 percent detrital carbonates; about 5 to 10 percent mud, clay and silt size.
3	24 - 27	Sand, light-olive-gray (5 Y 5/2); as above; 1 to 3 percent mud, clay and silt size.
	27 - 30	Sand as above.
4	30 - 34	Sand, light-gray (N 7) to yellowish-gray (5 Y 7/2); quartzose, medium to very fine, moderately sorted, subangular to subrounded; 1 to 3 percent heavy minerals, fine to very fine, moderately sorted, subangular to rounded; 3 to 5 percent detrital carbonates and shell fragments, Chione, Cardita, other bivalves.
3	34 - 37	Sand, light-gray (N 7) to yellowish-gray (5 Y 8/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 1 to 3 percent heavy minerals as above; 30 to 35 percent detrital carbonates and shell fragments, Chione, Ostrea, Cardita, Limopsis, Donat, Cerithium, Crepidula, Prunum, Olivella, Philippia, Chlamys.
3	37 - 40	Sand, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 8/1); as above; 3 to 5 percent heavy minerals.
4	40 - 44	Sand; as above; about 1 to 3 percent rock fragments.
3	44 - 47	Sand; as above; 35 to 40 percent detrital carbonates and shell fragments, Busycon.
7	47 - 54	Sand, olive-gray (5 Y 4/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, moderately sorted, subangular to rounded; 30 to 35 percent detrital carbonates and shell fragments.
3	54 - 57	Sand, olive-gray (5 Y 4/1); quartzose, fine to very fine, well sorted, subangular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subangular to rounded; 35 to 40 percent detrital carbonates and shell fragments.
3	57 - 60	Sand; as above; interbedded with 10 percent limestone and claystone, light-olive-gray (5 Y 5/2); micrite and clay.
4	60 - 64	Sand, olive-gray (5 Y 4/1); quartzose, fine to very fine, well sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subangular to rounded; 35 to 40 percent detrital carbonates and shell fragments.
6	64 - 70	Sand, light-olive-gray (5 Y 5/2); as above.
4	70 - 74	Sand, light-olive-gray (5 Y 6/1); as above; quartzose, medium to very fine, angular to subrounded.
3	74 - 77	Sand, light-olive-gray (5 Y 6/1); quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subangular to rounded; 1 to 3 percent micrite; 35 to 40 percent detrital carbonates and shell fragments.
3	77 - 80	Sand, olive-gray (5 Y 4/1);/ detrital carbonates and shell fragments; 25 to 30 percent quartzose, very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subangular to rounded; about 5 percent micrite.
4	80 - 84	Sand, light-olive-gray (5 Y 6/1); as above.
6	84 - 90	Sand, light-olive-gray (5 Y 6/1); quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphate as above; 35 to 40 percent detrital carbonates and shell fragments, Terebra.
7	90 - 97	Sand, olive-gray (5 Y 4/1); quartzose, fine to very fine, angular to subrounded, well sorted; 5 to 10 percent heavy minerals and phosphates, fine to very fine, moderately sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments.

Well PB-1552--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	97 - 100	Sand, olive-gray (5 Y 4/1) to medium-dark-gray (N 4); quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 20 to 25 percent detrital carbonates and phosphates, very coarse to very fine; 20 to 25 percent shells and shell fragments, Turritella, Chione, echinoid plates, Crucibulum, Tellina, Anadora.
4	100 - 104	Sand, olive-gray (5 Y 4/1); as above; interbedded with about 20 percent fossiliferous limestone, light-olive-gray (5 Y 6/1), packed biosparite, bivalves; 15 to 20 percent quartz, medium to very fine, subangular to subrounded; poorly cemented; very porous.
3	104 - 107	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, subangular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments; interbedded with about 10 percent limestone, packed biosparite; 20 percent quartz, medium to very fine, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, subrounded to rounded; poorly cemented; very porous.
3	107 - 110	Sand, interbedded with about 10 percent limestone as above.
	110 - 114	Sand, light-olive-gray (5 Y 6/1); quartzose, fine to very fine, well sorted, subangular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 30 to 35 percent detrital carbonates and shell fragments; lost circulation at 113 feet.
3	114 - 117	Marl, yellowish-gray (5 Y 8/1); clay and micrite; impermeable.
3	117 - 120	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subangular to subrounded; 25 to 30 percent detrital carbonates and shell fragments, abundant bivalve fragments; interbedded with about 20 percent marl as above.
4	120 - 124	Sand, yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments, bivalve fragments; 35 to 40 percent quartzose, fine to very fine, well sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; interbedded with about 10 percent limestone, packed biosparite; 10 percent quartz, fine to very fine, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, subrounded to rounded; poorly cemented; very porous, moldic.
3	124 - 127	Sand; as above; quartzose, medium to very fine, moderately sorted, angular to subrounded; interbedded with 20 percent limestone, light-olive-gray (5 Y 6/1); sandy, sparse biosparite; 20 to 25 percent quartz, medium to very fine, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, subrounded to rounded; poorly cemented; very porous, moldic.
7	127 - 134	Sand, very light gray (N 8) to yellowish-gray (5 Y 8/1); quartzose, medium to silt size, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 15 to 20 percent detrital carbonates and shell fragments.
6	134 - 140	Sand, very light gray (N 8) to yellowish-gray (5 Y 8/1); quartzose, fine to very fine, well sorted, subangular to subrounded; 1 to 3 percent detrital carbonates, coarse to very fine; 1 to 3 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 5 to 10 percent sandstone nodules, micritic matrix; very poorly cemented.
4	140 - 144	Sand as above; quartzose, medium to very fine.
6	144 - 150	Clayey sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates as above; 1 to 3 percent detrital carbonates; 15 to 20 percent marl, micritic, clay and silt.
4	150 - 154	Sand as above; 20 to 25 percent clay and silt.
3	154 - 157	Clayey sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 1 to 3 percent detrital carbonates; 25 to 30 percent clay and silt.
3	157 - 160	Sandy clay, grayish-olive (10 Y 4/2); clay and silt; 35 to 40 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates as above; 1 to 3 percent detrital carbonates.
4	160 - 164	Sandy clay, pale-olive (10 Y 7/2) to light-olive-gray (5 Y 5/2); clay and silt; 3 to 35 percent quartzose as above; 5 to 10 percent heavy minerals and phosphates as above; 3 to 5 percent detrital carbonates.
6	164 - 170	Sandy clay, light-olive-gray (5 Y 5/2); as above.

Well PB-1555

Lat 26°48'43", Long 80°12'50"
Sec. 14, T. 42 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Sand, grayish-orange (10 YR 7/4) to yellowish-gray (5 Y 7/2); quartzose, medium to fine, well sorted, angular to subangular; 1 to 3 percent heavy minerals, medium to fine, well sorted, subrounded to rounded.
3	4 - 7	Marl, light-olive-gray (5 Y 5/2); micrite, clay and silt size particles; 30 to 35 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 20 to 25 percent detrital carbonates and shell fragments.
3	7 - 10	Sand, yellowish-gray (5 Y 7/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; about 20 to 25 percent marl; 1 to 3 percent heavy minerals, fine to very fine, subangular to rounded; 5 to 10 percent detrital carbonates and shell fragments.
4	10 - 14	Sand, yellowish-gray (5 Y 7/2); quartzose as above; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subangular to rounded; 1 to 3 percent detrital carbonates; about 3 to 5 percent mud, clay and silt size particles.
3	14 - 17	Sand, yellowish-gray (5 Y 7/2) to light-olive-gray (5 Y 7/2); quartzose as above; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; about 10 percent mud, clay and silt size.
3	17 - 20	Sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subrounded; 3 to 5 percent heavy minerals as above; about 10 percent mud.
7	20 - 27	Sand, medium-gray (N 5) to medium-bluish-gray (5 B 5/1); quartzose, fine to very fine, well sorted, subangular to subrounded; 5 to 10 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; 20 to 25 percent detrital carbonates and shell fragments.
3	27 - 30	Sand, medium-bluish-gray (5 B 5/1) to olive-gray (5 Y 4/1); quartzose as above; 10 to 15 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subangular to rounded; 20 to 25 percent detrital carbonates and shell fragments; about 5 percent mud.
4	30 - 34	Limestone, medium-bluish-gray (5 B 5/1); sandy, sparse biosparite; 10 to 15 percent quartz, fine to very fine, subangular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, subangular to rounded; very porous, vugs; poorly to moderately cemented; interbedded with about 40 percent sand, medium-bluish-gray (5 B 5/1) to light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments, abundant bivalve fragments, Olivella, Chione.
3	34 - 37	Sand, light-gray (N 7) to light-bluish-gray (5 B 7/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments, abundant bivalve fragments; interbedded with about 30 percent limestone as above.
3	37 - 40	Limestone, medium-light-gray (N 6); sandy, sparse biosparite; 5 to 10 percent quartz, medium to very fine, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, subrounded to rounded; very porous, moldic, vugs; moderately to well cemented; interbedded with about 20 percent sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, medium to very fine, subrounded to rounded; 20 to 25 percent detrital carbonates and shell fragments, Cardita and other bivalves.
4	40 - 44	Limestone, medium-gray (N 5); sandy, sparse biosparite, bivalvia; 10 to 15 percent quartz, medium to very fine, moderately sorted, angular to subangular; moderately cemented; moldic, vugs, very porous; interbedded with about 30 percent sand; detrital carbonates and shell fragments; 25 to 30 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, subangular to rounded.
3	44 - 47	Limestone, medium-gray (N 5); sandy, sparse biosparite, bivalvia; 10 percent quartz, medium to very fine, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, subangular to rounded; moderately cemented; moldic, vugs, very porous; interbedded with about 30 percent sand as above.
3	47 - 50	Limestone interbedded with sand as above.
4	50 - 54	Limestone, medium-gray (N 5) to light-olive-gray (5 Y 6/1); sandy, sparse biosparite; 10 to 20 percent quartz, medium to very fine, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, subrounded to rounded; moderately to well cemented; vugs, very porous; interbedded with 20 percent sand; detrital carbonates, very coarse to very fine, shell fragments; 30 to 35 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals, medium to very fine, moderately sorted, subangular to rounded.

Thickness (feet)	Depth below land surface (feet)	Description
3	54 - 57	Limestone interbedded with sand as above.
3	57 - 60	Sand, light-gray (N 7); quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; 30 to 35 percent detrital carbonates and shell fragments; interbedded with about 30 percent limestone, medium-gray (N 5); sandy, sparse biosparite; 15 to 20 percent quartz, medium to very fine, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, subrounded to rounded; moderately cemented; moldic, vugs, very porous.
4	60 - 64	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments; interbedded with about 40 percent limestone, medium-dark-gray (N 4); sandy, sparse biosparite; 15 to 20 percent quartz, medium to very fine, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, subrounded to rounded; moderately cemented; vugs, very porous.
3	64 - 67	Limestone, medium-light-gray (N 6) to yellowish-gray (5 Y 8/1); sandy, packed biosparite, Chione, Conopeum, Tellina; 5 to 10 percent quartz, medium to fine, angular to subangular; 1 to 3 percent heavy minerals, medium to very fine, subrounded to rounded; moderately to well cemented; moldic, vugs, very porous; interbedded with about 20 percent sand; detrital carbonates and shell fragments; 20 to 25 percent quartzose, coarse to very fine, poorly sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded.
3	67 - 70	Limestone as above; interbedded with 30 percent sand as above.
4	70 - 74	Sand, yellowish-gray (5 Y 7/2); detrital carbonates and shell fragments, Oliva, Tellina, barnacles, Chione, Cardita; 25 to 30 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; interbedded with about 40 percent limestone as above.
3	74 - 77	Sand as above; interbedded with about 10 percent limestone as above; poorly cemented; Turritella.
3	77 - 80	Shell and shell fragments, yellowish-gray (5 Y 7/2); Turritella, Tellina, Olivella, Cardita, bryozoans, Chione; 20 to 25 percent detrital carbonates, very coarse to very fine; 20 to 25 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; interbedded with about 20 percent limestone, medium-light-gray (N 6); sandy, packed biosparite; 20 to 25 percent quartz, medium to very fine, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, subrounded to rounded; poorly cemented; moldic, vugs, very porous.
4	80 - 84	Shell and shell fragments as above; interbedded with limestone as above.
3	84 - 87	Shell and shell fragments, yellowish-gray (5 Y 7/2); Terebra, Glycymeris, Turritella, Diplodonata, Tellina, bryozoans, Cardita, Olivella, Crepidula; 20 to 25 percent detrital carbonates, very coarse to very fine; 20 to 25 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to very fine, poorly sorted, subrounded to rounded; interbedded with about 10 percent limestone; sandy, packed biosparite.
3	87 - 90	Shell and shell fragments as above; Chlamys, Cancellaria, worm shells, Calliostoma, Chione, limpet; interbedded with about 5 percent limestone; rock fragments.
4	90 - 94	Shell and shell fragments, yellowish-gray (5 Y 8/1); Turritella, Turbonilla, Tellina, bryozoans, limpets, oysters, abundant bivalve fragments, barnacles; 15 to 20 percent detrital carbonates, very coarse to very fine; 20 to 25 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; interbedded with about 5 percent coquina.
6	94 - 100	Sand, medium-gray (N 5) to yellowish-gray (5 Y 7/2); detrital carbonates and shell fragments; Glycymeris, Chione, Turritella; 30 to 35 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subangular to rounded; about 3 percent rock fragments.
7	100 - 107	Sand, medium-light-gray (N 6) to yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments; Plicatula, echinoid plates, Limopsis, Anadara, oyster shells, bryozoans, Turritella, limpets; 25 to 30 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; interbedded with about 5 percent limestone; packed biosparite.

Well PB-1555--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	107 - 110	Shell and shell fragments, yellowish-gray (5 Y 8/1) to light-gray (N 7); abundant mollusks; 20 to 25 percent detrital carbonates, very coarse to very fine; 20 to 25 percent quartzose as above; 3 to 5 percent heavy minerals as above.
7	110 - 117	Sand, medium-gray (N 5) to yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments, abundant mollusks; 35 to 40 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded.
3	117 - 120	Sand as above; Turritella.
4	120 - 124	Sand, light-olive-gray (5 Y 6/1) to medium-light-gray (N 6); detrital carbonates, coarse to very fine; 15 to 20 percent shell fragments, mollusks; 35 to 40 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates as above; interbedded with about 5 percent limestone, light-olive-gray (5 Y 6/1); packed biosparite; poorly cemented; moldic, vugs, very porous.
3	124 - 127	Limestone, yellowish-gray (5 Y 7/2); sandy, sparse biosparite; 15 to 20 percent quartzose, medium to very fine, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, subrounded to rounded; well cemented; moldic, vugs, moderately to very porous.
3	127 - 130	Sand, light-gray (N 7) to yellowish-gray (5 Y 8/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments; bivalvia, barnacles, bryozoans; interbedded with about 10 percent limestone, yellowish-gray (5 Y 7/2); sandy, sparse biosparite; about 10 percent quartz, medium to very fine, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, subrounded to rounded; moderately cemented; vugs, moldic, moderately porous.
10	130 - 140	Sand, very light gray (N 8) to yellowish-gray (5 Y 8/1); quartzose, medium to fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 15 to 20 percent detrital carbonates and shell fragments; 5 to 10 percent streaks of clay and silt.
4	140 - 144	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 1 to 3 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 5 to 10 percent detrital carbonates, very coarse to very fine; about 5 percent clay and silt.
3	144 - 147	Sand, yellowish-gray (5 Y 8/1) to pale-olive (10 Y 6/2); quartzose, fine to very fine, well sorted, angular to subrounded; 1 to 3 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 1 to 3 percent detrital carbonates; about 10 percent clay and silt.
13	147 - 160	Sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subangular; 1 to 3 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 1 to 3 percent detrital carbonates; 5 to 10 percent clay and silt.
6	160 - 166	Sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subrounded; 1 to 3 percent heavy minerals and phosphates as above; 1 to 3 percent heavy minerals and phosphates as above; 1 to 3 percent detrital carbonates; 15 to 20 percent clay and silt.
9	166 - 175	Clayey sand, light-olive-gray (5 Y 5/2); quartzose as above; 1 to 3 percent heavy minerals and phosphates as above; 3 to 5 percent detrital carbonates; 20 to 25 percent clay and silt.
10	175 - 185	Clayey sand, grayish-olive (10 Y 4/2); quartzose as above; 5 to 10 percent heavy minerals and phosphates as above; 3 to 5 percent detrital carbonates; 30 to 35 percent clay and silt.
5	185 - 190	Sandy clay, grayish-olive (10 Y 4/2); clay and silt; 30 to 35 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates as above; 3 to 5 percent detrital carbonates.

Well PB-1558

Lat 26°48'34", long 80°19'34"
Sec. 14, T. 42 S., R. 40 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Sand, pale-yellowish-brown (10 YR 6/2); quartzose, medium to very fine, moderately sorted, angular to subangular; 1 to 3 percent heavy minerals, fine to very fine, well sorted, subangular to rounded; about 3 to 5 percent organic debris.
3	4 - 7	Sandy marl, light-olive-gray (5 Y 5/2); micrite, clay and silt; 30 to 35 percent quartzose, fine to very fine, well sorted, angular to subangular; 1 to 3 percent heavy minerals as above; 5 to 10 percent detrital carbonates and shell fragments.
3	7 - 10	Sand, light-olive-gray (5 Y 6/1); quartzose, fine to very fine, well sorted, angular to subrounded; 1 to 3 percent heavy minerals as above; 5 to 10 percent detrital carbonates and shell fragments; about 10 percent silt and clay.
4	10 - 14	Sand, yellowish-gray (5 Y 7/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 1 to 3 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 1 to 3 percent detrital carbonates.
3	14 - 17	Sand, light-olive-gray (5 Y 6/1); quartzose as above; 1 to 3 percent heavy minerals as above; 3 to 5 percent detrital carbonates and shell fragments; about 10 percent silt and clay.
3	17 - 20	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, medium to very fine, moderately sorted, subangular to rounded; 25 to 30 percent detrital carbonates and shell fragments.
4	20 - 24	Sand, light-olive-gray (5 Y 5/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 5 to 10 percent detrital carbonates and shell fragments.
6	24 - 30	Muddy sand, dark-yellowish-brown (10 YR 4/2); quartzose as above; 1 to 3 percent heavy minerals as above; 3 to 5 percent detrital carbonates; about 25 to 30 percent organic mud, clay and silt size.
4	30 - 34	Sandy, olive-gray (5 Y 3/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, angular to rounded; 20 to 25 percent detrital carbonates and shell fragments; about 10 percent organics.
6	34 - 40	Shelly sandy, light-olive-gray (5 Y 5/2); quartzose as above; 5 to 10 percent heavy minerals and phosphates as above; 10 to 15 percent detrital carbonates; 20 to 25 percent shells and shell fragments; Chione, Cardita, Ostrea, Prunum, Busycon, Conus, Latirus, Typhis.
4	40 - 44	Sand, olive-gray (5 Y 4/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 10 to 15 percent heavy minerals and phosphates, medium to very fine, well sorted, subangular to rounded; 3 to 5 percent detrital carbonates; 3 to 5 percent mud, clay and silt.
6	44 - 50	Muddy sand, brownish-black (5 YR 2/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 20 to 25 percent mud, clay and silt size; 5 to 10 percent detrital carbonates.
4	50 - 54	Sand, olive-gray (5 Y 4/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, well sorted, angular to rounded; 3 to 5 percent detrital carbonates; 3 to 5 percent mud, clay and silt.
6	54 - 60	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately to well sorted; 20 to 25 percent detrital carbonates and shell fragments.
4	60 - 64	Sand, yellowish-gray (5 Y 8/1); quartzose, medium to fine, well sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately to well sorted, subrounded to rounded; 15 to 20 percent detrital carbonates and shell fragments, Chione, Nassarius, Prunum, Cardita.
3	64 - 67	Marly sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; about 10 percent marl, clay and silt size; 5 to 10 percent detrital carbonates and shell fragments.
10	67 - 77	Marly sand, light-olive-gray (5 Y 6/1) as above; 20 to 25 percent marl, clay and silt size.

Thickness (feet)	Depth below land surface (feet)	Description
3	77 - 80	Marly sand, light-olive-gray (5 Y 5/2); as above; interbedded with about 25 percent limestone, grayish-black (N 2); fossiliferous micrite; 5 to 10 percent quartzose, medium to very fine, angular to subrounded; moldic, moderately porous; moderately to well cemented.
4	80 - 84	Sand, light-olive-gray (5 Y 5/2); quartzose, medium to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, well sorted, subrounded to rounded; 30 to 35 percent detrital carbonates and shell fragments, Turritella, Cancellaria; about 5 percent marl, silt and clay.
3	84 - 87	Marly sand, light-olive-gray (5 Y 6/1); as above; 10 percent marl, clay and silt.
3	87 - 90	Sandy shell, light-olive-gray (5 Y 6/1); shells and shell fragments, Cancellaria, Glycymeris, Plicatula, Crepidula, Fasciolaria, Olivella, Chione, other gastropods and bivalves; 15 to 20 percent detrital carbonates, very coarse to very fine; 30 to 35 percent quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded.
10	90 - 100	Shells and shell fragments, yellowish-gray (5 Y 8/1); Chione, Turritella, Terebra, Conus, Cancellaria, Plicatula, Olivella, Lunatia, Busycon, Mitra, coral, barnacles, Oliva; 20 to 25 percent detrital carbonates; 20 to 25 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; partly cemented coquina.
4	100 - 104	Shells and shell fragments, yellowish-gray (5 Y 7/2); Busycon, Lunatia, Oliva, Olivella, Cancellaria, Conus, Turritella, Terebra, Balanus, Plicatula, Chione, Glycymeris, coral, Lirophora, Arca, abundant bivalve and gastropod fragments, bryozoans; 20 to 25 percent detrital carbonates; 10 to 15 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals, medium to very fine, moderately sorted, subangular to angular.
3	104 - 107	Shells and shell fragments as above; echinoid plates; 20 to 25 percent quartz as above; about 3 to 5 percent partly cemented rock fragments.
3	107 - 110	Sandy shell, yellowish-gray (5 Y 7/2); shells and shell fragments as above, Turritella, echinoid plates, and bryozoans; 25 to 30 percent detrital carbonates, very coarse to very fine; 20 to 25 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates as above.
4	110 - 114	Shells and shell fragments, yellowish-gray (5 Y 8/1); Turritella, Terebra, Olivella, Conus, Trachycardium, Chione, Lirophora, Plicatula, Glycymeris, Anadara, scallops, Balanus, Lunatia, Oliva, Colus, Latirus, coral, bryozoans, abundant bivalve fragments; 20 to 25 percent detrital carbonates; 5 to 10 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 1 to 3 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded.
6	114 - 120	Sandy shell, light-olive-gray (5 Y 5/2); shells and shell fragments as above; 20 to 25 percent detrital carbonates; 10 to 20 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates as above.
7	120 - 127	Sandy shell, yellowish-gray (5 Y 7/2); shells and shell fragments, Olivella, Conus, Cancellaria, Chione, Turritella, Busycon, Prunum, coral, bryozoans, barnacles, abundant mollusk fragments; 20 to 25 percent detrital carbonates; 10 to 20 percent quartzose as above; 3 to 5 percent heavy minerals as above.
3	127 - 130	Shelly sand, light-olive-gray (5 Y 5/2); quartzose, medium to very fine, moderately sorted, angular to subangular; 30 to 35 percent shells and shell fragments as above; 20 to 25 percent detrital carbonates, very coarse to very fine; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded.
4	130 - 134	Shelly sand, light-olive-gray (5 Y 6/1); quartzose, coarse to very fine, poorly sorted, angular to subrounded; 30 to 40 percent detrital carbonates and shell fragments; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; interbedded with about 10 percent limestone; sandy, sparse biosparite; 20 to 30 percent quartzose, medium to very fine, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, subrounded to rounded; poorly cemented; very porous.
3	134 - 137	Shelly sand as above; interbedded with 10 percent limestone as above.

Well PB-1558--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	137 - 140	Limestone, light-olive-gray (5 Y 5/2); sandy, sparse biomicrite, mollusks; 10 to 20 percent quartz, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to very fine, poorly sorted, subrounded to rounded; moldic, vugs, moderately to very porous; moderately cemented; interbedded with about 30 percent sand, light-gray (N 7) to yellowish-gray (5 Y 8/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments.
4	140 - 144	Limestone as above; interbedded with about 40 percent sand, light-olive-gray (5 Y 6/1); quartzose as above; 10 percent heavy minerals and phosphates, very coarse to very fine, poorly sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments, echinoid plates, Anadara, Chione, abundant bivalves, Oliva, bryozoans.
3	144 - 147	Marl, light-olive-gray (5 Y 5/2) to yellowish-gray (5 Y 7/2); micrite, clay and silt; 20 to 30 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates as above; 10 to 20 percent detrital carbonates and shell fragments.
3	147 - 150	Sand, light-olive (5 Y 5/2); quartzose as above; 5 to 10 percent heavy minerals and phosphates as above; about 20 to 30 percent marl; 20 to 30 percent detrital carbonates and shell fragments.
4	150 - 154	Marl, grayish-olive-green (5 GY 3/2); micrite, silt and clay; interbedded with about 40 percent sand, light-gray (N 7) to light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 10 percent heavy minerals and phosphates, very coarse to very fine, poorly sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments, bryozoans, barnacles, bivalves, Chione, Plicatula.
3	154 - 157	Marl, grayish-olive-green (5 GY 3/2); micrite, silt and clay; about 10 percent quartzose, very fine, well sorted, angular to subangular; 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded.
3	157 - 160	Marl with sand as in 150 to 154 feet.
4	160 - 164	Marl, grayish-olive-green (5 GY 3/2); silt, clay and micrite; interbedded with about 30 percent sand; quartzose, medium to very fine, moderately sorted, angular to subangular; 10 percent heavy minerals and phosphates, very coarse to very fine, poorly sorted, subrounded to rounded; 30 percent detrital carbonates and shell fragments.
3	164 - 167	Marl with sand as above.
13	167 - 180	Marl, grayish-olive (10 Y 4/2); silt, clay and micrite; interbedded with 40 to 50 percent sand, light-olive-gray (5 Y 6/1); quartz, heavy minerals and phosphates as above; 30 to 40 percent detrital carbonates and shell fragments, bryozoans, Cardita, barnacles, Olivella, Tellina, Ostrea, Plicatula, Glycymeris, Chione.
5	180 - 185	Marl as above; interbedded with 30 to 40 percent sand and shell as above.
15	185 - 200	Marl as above; interbedded with 30 to 40 percent sand, grayish-olive (10 Y 4/2); quartzose, medium to very fine, moderately sorted, angular to subangular; 10 percent heavy minerals and phosphates, very coarse to very fine, poorly sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments, Plicatula, Glycymeris, Turritella, limpets, bryozoans, coral, barnacles.

Well PB-1562

Lat 26°48'56", long 80°20'37"
Sec. 15, T. 42 S., R. 40 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Sand, dark-yellowish-brown (10 YR 4/2); quartzose, medium to very fine, moderately sorted, subangular to subrounded; 1 to 3 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; about 10 percent mud, clay and silt size.
3	4 - 7	Sandy marl, light-olive-gray (5 Y 5/2); micrite; 25 to 30 percent quartzose, fine to very fine, well sorted, subangular to subrounded; 1 to 3 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 5 to 10 percent detrital carbonates, coarse to very fine; 5 to 10 percent organics.
3	7 - 10	Sandy marl light-olive-gray (5 Y 6/1) to olive-gray (5 Y 4/1); micrite; 20 to 25 percent quartz as above; 1 to 3 percent heavy minerals as above; 5 to 10 percent detrital carbonates, coarse to very fine; 5 to 10 percent organics; about 10 to 15 percent shells at 10 feet, Chione, Glycymeris.
4	10 - 14	Muddy sand, light-olive-gray (5 Y 6/11); quartzose, fine to very fine, well sorted, subangular to angular; 1 to 3 percent heavy minerals as above; 5 to 10 percent detrital carbonates and shell fragments; about 25 to 30 percent micrite.
3	14 - 17	Limestone, very light gray (N 8) to medium-gray (N 6); sandy, sparse biomicrite; Chione, Turritella, Terebra, Anadora; calcite-filled pore spaces; 20 to 25 percent quartzose, medium to very fine, moderately sorted, subangular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; interbedded with about 30 percent marl, micrite; 20 to 25 percent quartzose, medium to very fine, moderately sorted, subangular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; about 25 to 30 percent detrital carbonates and shell fragments, oysters.
3	17 - 20	Muddy sand, medium-gray (N 5) to light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, rounded to subrounded; about 25 to 25 percent micrite; 10 to 15 percent detrital carbonates and shell fragments, Chione; interbedded with about 5 to 20 percent rock fragments.
4	20 - 24	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, subangular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted rounded to subrounded; 20 to 25 percent detrital carbonates and shell fragments, Hyalina, Chione, Tellina; about 5 percent micrite.
3	24 - 27	Sand, dark-yellowish-brown (10 YR 4/2); quartzose, medium to very fine, moderately sorted, subangular to rounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 5 to 10 percent detrital carbonates; about 10 percent micrite.
3	27 - 30	Muddy sand, olive-gray (5 Y 4/1); quartzose, fine to very fine, well sorted, subangular to subrounded; 10 to 15 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 1 to 3 percent detrital carbonates; about 10 percent mud, clay and silt size.
4	30 - 34	Muddy sand, olive-gray (5 Y 3/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 10 to 15 percent heavy minerals, medium to very fine, well sorted, rounded to subrounded; 3 to 5 percent detrital carbonates; about 15 to 20 percent mud, clay and silt size.
3	34 - 37	Sand, olive-gray (5 Y 4/1); quartzose, fine to very fine, well sorted, subangular to subrounded; 10 to 15 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; about 5 to 10 percent mud, clay and silt size.
3	37 - 40	Sand, olive-gray (5 Y 4/1) to dark-yellowish-brown (10 YR 4/2); quartzose, fine to very fine, well sorted, subangular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 3 to 5 percent detrital carbonates and shell fragments; about 3 percent mud, clay and silt size.
4	40 - 44	Muddy sand, olive-black (5 Y 2/1); quartzose, medium to very fine, moderately sorted, subangular to subrounded; 1 to 3 percent heavy minerals as above; 1 to 3 percent detrital carbonates; 20 to 25 percent organic mud, clay and silt size.
3	44 - 47	Muddy sand as above.
3	47 - 50	Muddy sand, olive-gray (5 Y 4/1); quartzose as above; 3 to 5 percent heavy minerals as above; 3 to 5 percent detrital carbonates; about 10 percent mud, clay and silt size.
4	50 - 54	Muddy sand, light-olive-gray (5 Y 5/2); quartzose, medium to very fine, moderately sorted, subangular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 5 to 10 percent detrital carbonates and shell fragments; 15 to 20 percent micrite.

Well PB-1562--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	54 - 57	Muddy sand, light-olive-gray (5 Y 5/2); quartzose as above; 1 to 3 percent heavy minerals as above; 10 to 15 percent detrital carbonates and shell fragments.
3	57 - 60	Muddy sand, olive-gray (5 Y 4/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 1 to 3 percent heavy minerals as above; 10 to 15 percent organic mud; 15 to 20 percent detrital carbonates and shell fragments.
4	60 - 64	Sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subangular to rounded; 5 to 10 percent organic mud, clay and silt size; 10 to 15 percent detrital carbonates and shell fragments, Chione, Cardita, worm shells, Glycymeris; mangrove roots.
6	64 - 70	Muddy sand, grayish-olive (10 Y 4/2) to olive-gray (5 Y 4/1); quartzose, fine to very fine, well sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subangular to rounded; 3 to 5 percent detrital carbonates and shell fragments; 10 to 15 percent mud, clay and silt size.
4	70 - 74	Muddy sand, olive-gray (5 Y 4/1) to light-olive-gray (5 Y 5/2); quartzose as above; 3 to 5 percent heavy minerals as above; 5 to 10 percent detrital carbonates and shell fragments; 10 to 15 percent mud, clay and silt size.
6	74 - 80	Sand, live-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 10 to 15 percent detrital carbonates and shell fragments; 5 to 10 percent mud, clay and silt size.
4	80 - 84	Shell and shell fragments, light-olive-gray (5 Y 6/1); mollusks, including Turritella; 25 to 30 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 20 to 25 percent detrital carbonates, coarse to very fine.
3	84 - 87	Shell and shell fragments, yellowish-gray (5 Y 7/2); abundant mollusks, Turritella, Anachis, barnacles, bivalvia, bryozoans, Hyalina; 20 to 25 percent quartzose, fine to very fine, well sorted, angular to subrounded; 3 to 5 percent heavy minerals as above; 20 to 25 percent detrital carbonates, coarse to very fine.
3	87 - 90	Shell and shell fragments as above; scallops.
4	90 - 94	Shell and shell fragments, yellowish-gray (5 Y 7/2) to light-olive-gray (5 Y 6/1); Chione, Lirophora, abundant mollusks; 20 to 25 percent quartzose, medium to very fine, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, rounded to subrounded; 20 to 25 percent detrital carbonates, coarse to very fine.
3	94 - 97	Shell and shell fragments, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 8/1); Turritella, Chione, cockles, barnacles, abundant small clams; 20 to 25 percent quartzose, medium to very fine, moderately sorted; 5 to 10 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 20 to 25 percent detrital carbonates, coarse to very fine.
3	97 - 100	Shell and shell fragments as above; Oliva.
4	100 - 104	Shell and shell fragments, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 7/2), Turritella, Oliva, Chione, Lucina, barnacles, Hyalina, abundance of small clams; 20 to 25 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, well sorted, rounded to subrounded; 20 to 25 percent detrital carbonates, coarse to very fine.
3	104 - 107	Shell and shell fragments as above; Conus, bryozoans.
3	107 - 110	Shell and shell fragments as above; Busycon.
4	110 - 114	Shell and shell fragments, yellowish-gray (5 Y 7/2) to light-olive-gray (5 Y 6/1), Chione, Turritella, Conus, Olivella, oysters, Plicatula, Trachycardium Anadora, barnacles, bryozoans; 25 to 30 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, rounded to subrounded; 20 to 25 percent detrital carbonate, very coarse to very fine.
3	114 - 117	Shell and shell fragments as above; about 1 to 3 percent coquina.
3	117 - 120	Shell and shell fragments as above; Terebra, Mitrella.
4	120 - 124	Shell and shell fragments, yellowish-gray (5 Y 7/2) to light-olive-gray (5 Y 6/1); echinoid plate, Turritella, Chione, and others as above; 25 to 30 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subangular to rounded; 20 to 25 percent detrital carbonates, very coarse to very fine.

Well PB-1562--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	124 - 127	Shells and shell fragments, light-olive-gray (5 Y 5/2); Oliva, Chione, abundance of small clam shells, Turritella, bryozoan; 20 to 25 percent quartzose, fine to very fine, well sorted, subangular to subrounded; 5 to 10 percent heavy minerals and phosphates as above; 25 to 30 percent detrital carbonates; 3 to 5 percent silt and clay-size particles.
3	127 - 130	Sand, light-olive-gray (5 Y 5/2); detrital carbonates, coarse to very fine; 20 to 25 percent shells and shell fragments; 10 to 15 percent quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subangular to rounded; 15 to 20 percent clay and silt-size particles.
4	130 - 134	Shell and shell fragments, as in 120 to 124 feet, with Turritella, Terebra, Chione, echinoid plates, and other bivalves; interbedded with about 20 percent limestone becoming well cemented at 134 feet; medium-gray (N 5) packed biosparite; bivalvia and other mollusks; 20 to 25 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; moderately to well cemented; very porous.
3	134 - 137	Limestone, light-olive-gray (5 H 5/2) to grayish-olive (10 Y 4/2); sandy, sparse biosparite to biomicrite in places, mollusks; 10 to 15 percent quartzose, medium to very fine, subangular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, rounded to subrounded; moldic, vugs; well cemented; very porous; interbedded with about 30 percent sand; detrital carbonates, very coarse to very fine; 20 to 25 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; about 10 percent clay and silt in places.
3	137 - 140	Sand, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 7/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, rounded to subrounded; 25 to 30 percent detrital carbonates and shell fragments; interbedded with 10 percent limestone as above; interbedded with 10 percent sandstone, yellowish-gray (5 Y 8/1); quartzose, medium to very fine, angular to rounded; 3 to 5 percent heavy minerals, medium to very fine, angular to rounded; 5 to 10 percent detrital carbonates and phosphates, coarse to very fine; about 20 percent sparite matrix; 10 to 15 percent shells and shell fragments.
4	140 - 144	Sand, interbedded with sandstone as above.
3	144 - 147	Limestone, light-olive-gray (5 Y 6/1); sandy, sparse biosparite, mollusks; 25 to 30 percent quartzose, medium to fine, subangular to subrounded, moderately sorted; 5 to 10 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; interbedded with about 20 percent sand; quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments.
3	147 - 150	Limestone, dusky-yellow-green (5 GY 5/2) to light-olive-gray (5 Y 5/2); sandy, sparse biomicrite, mollusks; 5 to 10 percent detrital carbonates; 30 to 35 percent quartzose, medium to very fine, moderately sorted, subangular to angular; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subangular to rounded; moldic; well cemented; very porous; interbedded with 40 to 45 percent sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals fine to very fine, well sorted, rounded to subrounded; 25 to 30 percent detrital carbonates and shell fragments.
4	150 - 154	Sand, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 7/2); quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subangular to rounded; 15 to 20 percent detrital carbonates, very coarse to very fine; 20 to 25 percent shell and shell fragments, Colus, Hyalina, abundant bivalves; itnerbedded with about 10 percent limestone, light-olive-gray (5 Y 5/2) to dusky-yellow-green (5 GY 5/2); sandy, sparse biomicrite; 20 to 25 percent quartzose, fine to very fine, well sorted, subangular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, rounded to subrounded; 5 to 10 percent detrital carbonates, medium to fine.
6	154 - 160	Sandy clay, grayish-olive (10 Y 4/2); silt and clay; 30 to 35 percent quartzose, medium to very fine, moderately sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to very fine, subrounded to rounded; 20 to 25 percent detrital carbonates and shell fragments; interbedded with about 20 percent limestone; sandy, sparse biomicrite as above; poorly cemented; moderately to slightly porous.
4	160 - 164	Clayey, shelly sand, yellowish-gray (5 Y 7/2) to pale-olive (10 Y 6/2); quartzose, medium to very fine, moderately sorted, subangular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to very fine, poorly sorted, subrounded to rounded; 10 to 15 percent clay and silt; 20 to 25 percent shells and shell fragments, Turritella, Tellina.

Well PB-1562--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	164 - 167	Clayey, shelly sand, light-olive-gray (5 Y 5/2) as above; 20 to 25 percent clay and silt.
3	167 - 170	Sandy, shelly clay, grayish-olive (10 Y 4/2); clay and silt; 25 to 30 percent quartzose, medium to very fine, subangular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to very fine, subrounded to rounded; 25 to 30 percent carbonates and shell fragments, Tellina.
4	170 - 174	Shelly clay, grayish-olive-green (5 GY 3/2); silt and clay; 10 to 15 percent quartzose, medium to very fine, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, coarse to very fine, subrounded to rounded; 15 to 20 percent detrital carbonates and shell fragments, Tellina, bryozoans, abundant bivalve pieces.
3	174 - 177	Sandy clay, light-olive-gray (5 Y 6/1) to grayish-olive-green (5 GY 3/2); silt and clay; 30 to 35 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates as above; 15 to 20 percent detrital carbonates and shell fragments.
3	177 - 180	Sandy, shelly clay, grayish-olive-green (5 GY 3/2); silt and clay; 25 to 30 percent quartzose, medium to very fine, moderately sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, coarse to very fine, moderately sorted, subrounded to rounded; 20 to 25 percent detrital carbonates and shell fragments.
4	180 - 184	Sand, light-olive-gray (5 Y 5/2) to grayish-olive (10 Y 4/2); quartzose as above; 3 to 5 percent heavy minerals and phosphates as above; 20 to 25 percent clay and silt; 20 to 25 percent detrital carbonates and shell fragments, Tellina, Diplodonta, abundant bivalve shell pieces.
3	184 - 187	Sandy, shelly clay as in 177 to 180 feet.
3	187 - 190	Sandy, shelly clay as in 177 to 180 feet.
5	190 - 195	Sandy clay, grayish-olive (10 Y 4/2); clay and silt; 25 to 30 percent quartzose, fine to very fine, well sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 10 to 15 percent shells and shell fragments, echinoid plates.
5	195 - 200	Sandy, shelly clay, grayish-olive (10 Y 4/2), as in 177 to 180 feet.
5	200 - 205	Sandy, shelly clay, grayish-olive (10 Y 4/2); clay and silt; 25 to 30 percent quartzose, fine to very fine, well sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 20 to 25 percent detrital carbonates and shell fragments.
5	205 - 210	Sandy, shelly clay as above.
10	210 - 220	Sandy clay, grayish-olive-green (5 GY 3/2); clay and silt; 10 to 15 percent quartzose, fine to very fine, well sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 5 to 10 percent shells and shell fragments.
10	220 - 230	Clay, grayish-olive-green (5 GY 3/2); clay and silt; 5 to 10 percent quartzose, very fine, well sorted, subangular to subrounded; 3 to 5 percent heavy minerals, very fine, well sorted, subrounded to rounded; 5 to 10 percent shells and shell fragments.
5	230 - 235	Clay as above; 15 to 20 percent shells and shell fragments, Tellina, coral, abundant bivalve fragments.
10	235 - 245	Sandy clay, grayish-olive-green (5 GY 3/2); silt and clay; 20 to 25 percent quartzose, fine to very fine, well sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, coarse to very fine, subrounded to rounded; 15 to 20 percent shells and shell fragments.
5	245 - 250	Sandy, shelly clay, light-olive-gray (5 Y 5/2) to grayish-olive (10 Y 4/2); clay and silt; 20 to 25 percent quartzose, medium to very fine, moderately sorted, subangular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 20 to 25 percent detrital carbonates and shell fragments, Turritella, Tellina, Terebra, Cerodrilla, limpets, Anadora.

Well PB-1564

Lat 26°45'55", long 80°15'17"
Sec. 4, T. 43 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Sand, dusky-brown (5 YR 2/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 1 to 3 percent carbonates; 20 to 25 percent organic mud and debris.
10	4 - 14	Sand, dark-yellowish-brown (10 YR 4/2); quartzose, fine to very fine, well sorted, angular to subrounded; about 1 percent heavy minerals, fine to very fine, subrounded to rounded; 1 to 3 percent detrital carbonates; 10 to 20 percent mud, micrite, silt and clay.
3	14 - 17	Sand, moderate-yellowish-brown (10 YR 5/4); quartzose, fine to silt, well sorted, angular to subrounded; about 1 percent heavy minerals, fine to very fine, angular to rounded.
3	17 - 20	Sand, moderate-yellowish-brown (10 YR 5/4); quartzose, fine to very fine, well sorted, angular to subangular; about 1 percent heavy minerals as above; about 5 to 10 percent mud, silt size.
4	20 - 24	Sand, pale-yellowish-brown (10 YR 6/2); quartzose, medium to very fine, moderately sorted, angular to subangular; 1 percent heavy minerals as above; about 10 percent mud, silt size.
6	24 - 30	Sand, dark-yellowish-brown (10 YR 4/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; about 1 percent heavy minerals, fine to very fine, subrounded to rounded; about 10 percent mud, silt size.
4	30 - 34	Sand, olive-gray (5 Y 4/1); quartzose as above; 1 to 3 percent heavy minerals as above; about 10 to 20 percent mud, silt and clay size.
3	34 - 37	Marl, olive-gray (5 Y 4/1) to dark-yellowish-brown (10 YR 4/2); silt, clay and micrite; 40 to 50 percent quartzose as above; 3 to 5 percent heavy minerals as above.
3	37 - 40	Marl, olive-gray (5 Y 4/1) to moderate-yellowish-brown (10 YR 5/4); silt, clay and micrite; 30 to 40 percent quartzose as above; 3 to 5 percent heavy minerals; 5 to 10 percent carbonates, medium to very fine; interbedded with about 20 percent limestone; sandy, sparse intrasparite to sandy, sparse intramicrite; moderately cemented; impermeable.
4	40 - 44	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals, medium to fine, well sorted, subrounded to rounded; 40 to 50 percent detrital carbonates, coarse to very fine; about 10 percent limestone nodules; sandy, sparse biosparite; poorly cemented.
3	44 - 47	Sand, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 7/2); quartzose, medium to very fine, angular to subangular; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 40 to 50 percent detrital carbonates and shell fragments, Arca, Chione, Anadara, Turritella, abundant mollusks.
7	47 - 54	Sand, light-olive-gray (5 Y 5/2); as above; Arca, Chione, Cerithiopsis, Ficus, Murex.
6	54 - 60	Sand, light-olive-gray (5 Y 5/2); detrital carbonates and shell fragments, Chione, Cardita, Terebra, Cancellaria, Trigonostoma; 30 to 40 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subangular to rounded; about 5 percent micrite.
4	60 - 64	Sandy shell, light-olive-gray (5 Y 5/2); Oliva, Terebra, Olivella, Cylichna, Cancellaria, Murex, worm shells, Anadara, Pecten, Diunricella, Echinochama, Ventricolaria, Lucina, Chione, Cardita, limpet; 20 to 30 percent detrital carbonates, coarse to fine; 20 to 30 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; about 10 percent limestone; sandy, sparse biosparite; poorly cemented.
6	64 - 70	Sandy shell, light-olive-gray (5 Y 6/1); as above.
4	70 - 74	Sand, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 7/2); quartzose, coarse to very fine, poorly sorted, angular to subrounded; 3 to 5 percent heavy minerals, loose to very fine, poorly sorted, subrounded to rounded; about 40 percent detrital carbonates and shell fragments as above.
3	74 - 77	Sand, light-olive-gray (5 Y 5/2); quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments.

Thickness (feet)	Depth below land surface (feet)	Description
7	77 - 84	Sandy shell, yellowish-gray (5 Y 7/2); detrital carbonates and shell fragments as above; 30 to 40 percent quartzose, coarse to very fine, poorly sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, coarse to very fine, poorly sorted, subrounded to rounded; about 10 percent limestone rock fragments, medium-bluish-gray (5 B 5/1); sandy, sparse intrasparite; poorly cemented.
6	84 - 90	Sandy shell, yellowish-gray (5 Y 7/2) to light-olive-gray (5 Y 5/2); as above.
7	90 - 97	Sandy shell, yellowish-gray (5 Y 8/1); Turritella, Chione, Lirophora, Murex, Ostrea, Prunum, Pecten, Glycymeris, Olivella, barnacles, abundant bivalve fragments; 20 to 25 percent detrital carbonates; about 30 percent quartzose, coarse to very fine, poorly sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; about 10 to 20 percent limestone rock fragments, medium-bluish-gray (5 B 5/1) to light-olive-gray (5 Y 6/1); sandy, sparse biosparite.
3	97 - 100	Sand, yellowish-gray (5 Y 7/2) to olive-gray (5 Y 4/1); detrital carbonates, very coarse to very fine; 20 to 25 percent shells and shell fragments; about 30 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates as above; about 10 to 20 percent limestone rock fragments as above.
4	100 - 104	Sand, yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments, bryozoans, Cardita, worm shells, Olivella, Terebra, Conus, barnacles, Glycymeris; 20 to 30 percent quartzose as above; 3 to 5 percent heavy minerals as above; 10 to 20 percent limestone rock fragments, medium-bluish-gray (5 B 5/1).
3	104 - 107	Sand, light-olive-gray (5 Y 6/1); detrital carbonates and shell fragments as above; 30 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded.
3	107 - 110	Sand, yellowish-gray (5 Y 8/1) to dark-gray (N 3); detrital carbonates and shell fragments; Turritella; 20 to 30 percent quartzose as above; 5 to 10 percent heavy minerals and phosphates, coarse to very fine, poorly sorted, subrounded to rounded.
4	110 - 114	Sand, yellowish-gray (5 Y 8/1) to medium-dark-gray (N 4); detrital carbonates, very coarse to very fine; 20 to 30 percent shells and shell fragments, Murex, Architectonica, Turritella, Chione, Ostrea, barnacles, Glycymeris, scallops, Anadara, bryozoans, echinoid plates; about 20 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; about 5 percent limestone; sandy, sparse biosparite; poorly cemented; moldic, moderately porous.
3	114 - 117	Sand as above; 20 to 30 percent quartzose.
3	117 - 120	Sand, light-olive-gray (5 Y 6/1); detrital carbonates and shell fragments, echinoid plates; 30 to 40 percent quartzose, medium to very fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subangular to rounded; about 5 percent limestone nodules; sandy, sparse biosparite; poorly cemented; moderately porous.
10	120 - 130	Sand, light-gray (N 7); quartzose, medium to very fine, moderately sorted, angular to subangular; about 20 percent detrital carbonates and shell fragments; 3 to 5 percent heavy minerals and phosphates, coarse to very fine, poorly sorted, subangular to rounded; about 10 percent streaks of micrite and silt.
4	130 - 134	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately to well sorted, angular to subrounded; 10 to 20 percent detrital carbonates; 3 t 5 percent heavy minerals and phosphates, medium to very fine, subangular to rounded; about 10 percent micrite and silt; interbedded with about 10 percent sandstone nodules, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, subangular to rounded; 3 to 5 percent heavy minerals and phosphates as above, micritic matrix; poorly cemented.
3	134 - 137	Sand, light-olive-gray (5 Y 5/2) to yellowish-gray (5 Y 7/2); quartzose as above; 3 to 5 percent heavy minerals and phosphates as above; about 10 percent detrital carbonates; about 20 percent micrite and silt.
3	137 - 140	Sand, light-olive-gray (5 Y 6/1); as above.
10	140 - 150	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates as above; 10 percent detrital carbonates and shell fragments; about 20 percent micrite and silt; interbedded with about 10 to 20 percent limestone, light-olive-gray (5 Y 5/2) to medium-light-gray (N 6); sandy intramicrite; quartzose, medium to very fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; poorly cemented; vugs, poorly to moderately porous.

Well PB-1564--Continued

Thickness (feet)	Depth below land surface (feet)	Description
4	150 - 154	Sand, light-gray (N 7) to light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, coarse to very fine, poorly sorted, subangular to rounded; about 20 percent detrital carbonates and shell fragments; about 20 percent micrite, silt and clay.
3	154 - 157	Sand, light-olive-gray (5 Y 5/2); as above; 20 to 30 percent micrite, silt and clay.
3	157 - 160	Lime mud, light-olive-gray (5 Y 5/2); micrite, clay and silt; 30 to 40 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 10 to 20 percent detrital carbonates; 3 to 5 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded.
7	160 - 167	Sand, medium-light-gray (N 6) to light-olive-gray (5 Y 6/1); quartzose, coarse to very fine, poorly sorted, subangular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; about 30 percent detrital carbonates and shell fragments; about 10 percent micrite and silt; interbedded with about 10 to 20 percent limestone; sandy biomicrite; 30 to 40 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates as above; poorly to moderately cemented; poorly to moderately porous.
3	167 - 170	Marl, grayish-olive (10 Y 4/2); micrite, silt and clay; about 30 percent quartzose, fine to very fine, well sorted, angular to subangular; about 20 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; about 5 percent detrital carbonates.
4	170 - 174	Sand, light-olive-gray (5 Y 5/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; about 20 percent detrital carbonates and shell fragments; about 20 to 30 percent marl, micrite, silt and clay.
3	174 - 177	Marl, grayish-olive-green (5 GY 3/2); micrite, silt and clay; about 30 percent quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 3 to 5 percent detrital carbonates.
3	177 - 180	Marl, grayish-olive (10 Y 4/2); same as above.
7	180 - 187	Marl, grayish-olive (10 Y 4/2); micrite, silt and clay; about 30 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; about 10 percent detrital carbonates and shell fragments.
8	187 - 195	Marl, same as above; about 40 percent quartzose.
5	195 - 200	Marl, grayish-olive (10 Y 4/2); micrite, silt and clay; about 30 percent quartzose, fine to very fine, well sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded.
5	200 - 205	Marl as above; about 10 percent detrital carbonates and shell fragments, barnacles, oysters, Tellina, other bivalves.
5	205 - 210	Marl as in 195 to 200 feet.
4	210 - 214	Marl, grayish-olive (10 Y 4/2) to light-olive-gray (5 Y 6/1); micrite, silt and clay; 30 to 40 percent quartzose as above; 5 to 10 percent heavy minerals as above; 5 to 10 percent detrital carbonates and shell fragments as above.
6	214 - 220	Marl, grayish-olive (10 Y 4/2); micrite, silt and clay; about 30 percent quartzose, fine to very fine, well sorted, angular to subangular; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded.

Well PB-1567

Lat 26°41'01", long 80°16'30"
Sec. 32, T. 43 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Sand, dark-yellowish-brown (10 YR 4/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; about 1 percent heavy minerals, fine to very fine, subrounded to rounded; 30 to 40 percent marl; micrite, silt and clay.
3	4 - 7	Marl, dark-yellowish-brown (10 YR 4/2); micrite, silt and clay; about 40 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; about 1 percent heavy minerals as above; interbedded with about 20 percent limestone, yellowish-gray (5 Y 7/2); sandy, packed intramicrite; 30 to 40 percent quartzose, medium to very fine, angular to subrounded; moderately cemented; semiconfining.
3	7 - 10	Sand, dark-yellowish-brown (10 YR 4/2); quartzose, medium to very fine, moderately sorted, angular to subangular; about 1 percent heavy minerals as above; 5 to 10 percent detrital carbonates; about 30 to 40 percent marl; interbedded with about 20 percent limestone as above.
4	10 - 14	Sandstone, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 7/2); quartzose, coarse to very fine, poorly sorted, angular to subrounded; about 1 percent heavy minerals, fine to very fine, subangular to rounded; about 40 percent micritic matrix; moderately to well cemented; semiconfining; interbedded with about 40 percent sand and shell, Chione, Crepidula, Glycymeris, Cardita, Prunum, Terebra, Turritella; about 20 percent marl.
1	14 - 15	Limestone, yellowish-gray (5 Y 7/2); sandy intramicrite; 30 to 40 percent quartzose, coarse to very fine, poorly sorted, angular to subrounded; 1 percent heavy minerals, fine to very fine, angular to rounded; well cemented; semiconfining.
2	15 - 17	Sand, light-olive-gray (5 Y 6/1); quartzose, coarse to very fine, poorly sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 30 percent shells and shell fragments as in 10 to 14 feet.
7	17 - 24	Sand, dusky-yellow (5 Y 6/4) to light-olive-gray (5 Y 6/1); quartzose, coarse to fine, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals, medium to fine, well sorted, angular to rounded; 10 to 20 percent detrital carbonates and shell fragments, Chione, Olivella, Prunum, coral.
3	24 - 27	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to fine, well sorted, angular to subangular; 5 to 10 percent heavy minerals, medium to fine, well sorted, subrounded to rounded; about 10 percent detrital carbonates and shell fragments.
3	27 - 30	Sand as above; about 20 to 30 percent detrital carbonates and shell fragments; Anadara, Lirophora, Chione, Prunum, coral, Lucina; interbedded with about 30 to 40 percent calcareous quartz sandstone; quartzose, medium to fine, well sorted, angular to subrounded; 20 to 30 percent shells and shell fragments, micritic matrix; 3 to 5 percent heavy minerals, fine to very fine, subangular to rounded; moderately cemented; semiporous, vugs.
4	30 - 34	Sand, yellowish-gray (5 Y 8/1); quartzose, coarse to fine, moderately sorted, angular to subangular; 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 20 percent detrital carbonates and shell fragments; about 5 to 10 percent sandstone as above; loosely cemented.
3	34 - 37	Sand as above; about 20 to 30 percent detrital carbonates and shell fragments; interbedded with about 5 to 10 percent limestone; sandy, sparse biosparite; very loosely cemented; moderately to very porous.
3	37 - 40	Sand, yellowish-gray (5 Y 7/2); quartzose, coarse to very fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; about 30 percent detrital carbonates and shells.
4	40 - 44	Sand, yellowish-gray (5 Y 8/1) to light-olive-gray (5 Y 6/1); as above.
3	44 - 47	Sand, light-olive-gray (5 Y 5/1); quartzose, medium to silt size, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments.
3	47 - 50	Limestone, dark-gray (N 3); fossiliferous micrite, worm shells, gastropods, bivalves; interbedded with about 40 percent sand, yellowish-gray (5 Y 7/2); quartzose, medium to silt size, moderately sorted, angular to subangular; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 20 to 30 percent detrital carbonates and shell fragments, Chione, Prunum, Busycon, Strombus.

Thickness (feet)	Depth below land surface (feet)	Description
4	50 - 54	Shells and shell fragments, yellowish-gray (5 Y 7/2) to light-olive-gray (5 Y 6/1); Strombus, Chione, Aequipecten, Cardita, Epitonium, Planorbis, abundant mollusk; 10 to 20 percent detrital carbonates, very coarse to medium; 30 percent quartzose, coarse to silt size, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; interbedded with about 30 to 40 percent limestone as above.
3	54 - 57	Shells and shell fragments as above; interbedded with about 20 to 30 percent limestone, (5 Y 6/1); sandy, sparse biomicrite; 30 percent quartz, medium to very fine, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, subrounded to rounded; poorly cemented; poorly porous.
3	57 - 60	Limestone, medium-dark-gray (N 4) to yellowish-gray (5 Y 7/2); sandy, fossilifeorus micrite; 5 to 10 percent quartz, coarse to fine, angular to subrounded; moderately to well cemented; poorly porous; interbedded with about 30 percent sand, yellowish-gray (5 Y 7/2) to light-olive-gray (5 Y 7/2); quartzose, coarse to very fine, poorly sorted, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; 5 to 10 percent micrite; 30 to 40 percent detrital carbonates and shell fragments, Chione, Glycymeris, Prunum, Turritella.
4	60 - 64	Sand, yellowish-gray (5 Y 8/1) to medium-gray (N 5); quartzose, coarse to fine, moderately sorted, angular to subrounded; 30 to 40 percent detrital carbonates and shell fragments as above; interbedded with about 30 percent limestone as in 57 to 60 feet.
3	64 - 67	Sandy shell, light-olive-gray (5 Y 5/2); Turritella, Chione, barnacles, abundant bivalves; 0 to 20 percent detrital carbonates, very coarse to very fine; 20 to 30 percent quartzose as above; 5 to 10 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded.
7	67 - 74	Sand, yellowish-gray (5 Y 7/2); quartzose, medium to fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals, medium to fine, well sorted, subrounded to rounded; 30 percent detrital carbonates and shell fragments, echinoid plates.
3	74 - 77	Sand as above; Chione, Conus, Prunum, barnacles.
3	77 - 80	Sand as above; 30 to 40 percent detrital carbonates and shell fragments, Busycon, Cancellaria.
4	80 - 84	Sandy shell, yellowish-gray (5 Y 7/2) to medium-dark-gray (N 4); detrital carbonates and shells, Conus, Turritella, Chione, Busycon, abundant mollusks; 30 to 40 percent quartzose, coarse to fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals, medium to fine, well sorted, subrounded to rounded; interbedded with about 10 to 20 percent limestone, medium-dark-gray (N 4); sandy, sparse biosparite; about 30 percent quartz, medium to very fine, angular to subrounded; 5 percent heavy minerals, medium to fine, subrounded to rounded; poorly cemented; moderately porous.
3	84 - 87	Sandy shell as above; echinoid plates.
3	87 - 90	Sand, light-olive-gray (5 Y 6/1); quartzose, coarse to fine, moderately sorted, angular to subangular; 5 to 10 percent heavy minerals, coarse to fine, moderately sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments.
7	90 - 97	Sandy shell, yellowish-gray (5 Y 7/2) to light-olive-gray (5 Y 6/1); detrital carbonates and shell fragments, Busycon, Cancellaria, scallops, Olivella, abundant bivalvia, Crepidula; 30 to 40 percent quartzose, coarse to fine as above; 5 to 10 percent heavy minerals, coarse to fine as above; interbedded with about 10 percent limestone, medium-light-gray (N 6); sandy, sparse biomicrite; about 10 percent quartz, coarse to fine; 3 to 5 percent heavy minerals, medium to fine; moderately cemented.
3	97 - 100	Sandy shell as above; Turritella, Architectonica.
4	100 - 104	Sandy shell, yellowish-gray (5 Y 7/2); detrital carbonates and shell fragments, Oliva, Cancellaria, Terebra, Chione, Solen, Chlamys, worm shells, Turritella, barnacles, abundant bivalvia; 30 to 40 percent quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, coarse to very fine, poorly sorted, subangular to rounded; about 10 percent calcareous concretions.
3	104 - 107	Sandy shell, yellowish-gray (5 Y 8/1); detrital carbonates and shell fragments; 20 to 30 percent quartzose as above; 3 to 5 percent heavy minerals as above.
3	107 - 110	Sandy shell as in 100 to 104 feet.
4	110 - 114	Sandy shell, yellowish-gray (5 Y 7/2); detrital carbonates and shell fragments; abundant bivalves, Turritella, bryozoans; 30 to 40 percent quartzose, coarse to very fine, poorly sorted, angular to subangular; 5 to 10 percent heavy minerals, medium to very fine, subrounded to rounded.

Well PB-1567--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	114 - 117	Sandy shell as above; with calcareous concretions.
3	117 - 120	Sand, light-olive-gray (5 Y 6/1); quartzose as above; 3 to 5 percent heavy minerals as above; 30 to 40 percent detrital carbonates and shell fragments.
7	120 - 127	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, medium to very fine, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments; about 5 percent calcareous concretions.
3	127 - 130	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments.
4	130 - 134	Sandy shell, yellowish-gray (5 Y 8/1) to medium-gray (N 5); detrital carbonates and shell fragments, Turritella, barnacles, bryozoans, scallops, abundant bivalvia; 30 to 40 percent quartzose, coarse to very fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded.
3	134 - 137	Sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 30 to 40 percent detrital carbonates (medium to very fine) and shell fragments.
3	137 - 140	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, medium to very fine, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments; 5 to 10 percent micrite, silt and clay
4	140 - 144	Sand, yellowish-gray (5 Y 8/1); quartzose, coarse to medium, well sorted, subangular to subrounded; 3 to 5 percent heavy minerals, coarse to very fine, poorly sorted, subrounded to rounded; 10 to 20 percent detrital carbonates and shell fragments, bryozoans, Busycon, scallops, and other bivalves; interbedded with 10 percent sandstone; quartz, coarse to medium, subangular to subrounded; 3 to 5 percent heavy minerals; 10 to 20 percent detrital carbonates and shell fragments, sparite matrix.
3	144 - 147	Sandstone, yellowish-gray (5 Y 8/1); grading into limestone in places; quartz, coarse to medium, well sorted, angular to subrounded; 3 to 5 percent heavy minerals, coarse to fine, moderately sorted, subrounded to rounded; 20 to 30 percent detrital carbonates and shell fragments, sparite matrix.
3	147 - 150	Sand as in 140 to 144 feet; with 10 percent sandstone.
4	150 - 154	Sand, yellowish-gray (5 Y 8/1); quartzose, coarse to medium, well sorted, angular to subrounded; about 5 percent heavy minerals, coarse to fine, moderately sorted, subrounded to rounded; 35 to 40 percent detrital carbonates and shell fragments; about 10 percent loosely consolidated sand.
3	154 - 157	Sand as above; about 20 percent limestone, yellowish-gray (5 Y 8/1); sandy, sparse biosparite; about 40 percent quartz as above; about 5 percent heavy minerals as above; about 5 percent heavy minerals as above; moderately cemented; moderately porous.
3	157 - 160	Sand, yellowish-gray (5 Y 8/1); quartzose, coarse to medium, subangular to rounded, well sorted; 5 to 10 percent heavy minerals, coarse to medium, well sorted, subrounded to rounded; 25 to 30 percent detrital carbonates and shell fragments.
4	160 - 164	Sand, yellowish-gray (5 Y 8/1); quartzose as above; 5 to 10 percent heavy minerals as above; 30 to 40 percent detrital carbonates and shell fragments; about 20 percent loosely consolidated sandstone.
3	164 - 167	Sand as in 157 to 160 feet.
3	167 - 170	Sand, yellowish-gray (5 Y 8/1); quartzose, coarse to very fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, subangular to rounded; moderately sorted; 20 to 30 percent detrital carbonates and shell fragments; about 10 percent micrite and silt, light-olive-gray (5 Y 5/2); interbedded with about 20 to 30 percent limestone, yellowish-gray (5 Y 7/2); sandy, packed biosparite, bivalvia; 30 percent quartz, medium to very fine, angular to subangular; 5 to 10 percent heavy minerals, medium to very fine, angular to subrounded; very porous; moderately cemented.
4	170 - 174	Sand, light-olive-gray (5 Y 5/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 10 percent heavy minerals, medium to very fine, subangular to rounded; about 30 percent detrital carbonates and shell fragments; about 10 to 20 percent silt and micrite.

Thickness (feet)	Depth below land surface (feet)	Description
3	174 - 177	Sand, light-olive-gray (5 Y 5/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, medium to very fine, subangular to rounded; 20 to 30 percent detrital carbonates and shell fragments; 20 percent silt and micrite.
3	177 - 180	Sand, light-olive-gray (5 Y 5/2) to pale-olive (10 Y 6/2); quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, angular to rounded; about 5 percent shell fragments; 20 to 30 percent silt and micrite.
4	180 - 184	Sand, light-olive-gray (5 Y 6/1); quartzose as above; 5 to 10 percent heavy minerals as above; 10 to 20 percent detrital carbonates and shell fragments; about 5 to 10 percent silt and micrite.
6	184 - 190	Sand, light-olive-gray (5 Y 5/2); quartzose as above; 5 to 10 percent heavy minerals as above; 5 to 10 percent detrital carbonates and shell fragments; 20 to 30 percent silt and micrite.

Well PB-1583

Lat 26°40'57", long 80°15'10"
Sec. 28, T. 43 S., R. 41 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Sand, dark-yellowish-brown (10 YR 4/2); quartzose, coarse to fine, moderately sorted, angular to subangular; 1 to 3 percent heavy minerals, medium to fine, subrounded to rounded; about 25 percent organic mud, micrite, silt, and clay.
3	4 - 7	Marl, dark-yellowish-brown (10 YR 4/2); silt, clay, and micrite; sand as above from 5 to 7 feet.
7	7 - 14	Sand, dark-yellowish-gray (10 YR 4/2); quartzose, medium to very fine, moderately sorted, angular to subangular; 1 percent heavy minerals, fine to very fine, subrounded to rounded; about 25 percent organic mud, silt and clay size.
3	14 - 17	Sand as above; 10 to 20 percent mud, silt size.
6	17 - 24	Sand, pale-yellowish-brown (10 YR 6/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 1 percent heavy minerals, fine to very fine, subrounded to rounded; 10 to 20 percent mud, silt size; 70 percent marl from 18 to 20 feet.
6	24 - 30	Sand, dark-yellowish-brown (10 YR 4/2); quartzose as above; 1 percent heavy minerals as above; 10 to 20 percent mud, silt size.
4	30 - 34	Sand, dark-yellowish-gray (10 YR 4/2); quartzose, medium to very fine, moderately sorted, angular to subrounded; 1 to 3 percent heavy minerals, fine to very fine, subrounded to rounded, well sorted; about 3 percent carbonates, medium to very fine, angular to rounded; about 20 percent mud, silt size.
3	34 - 37	Marl, light-olive-gray (5 Y 5/2) to light-olive-brown (5 Y 5/6); silt and clay; 40 percent quartzose, medium to very fine, moderately to well sorted, angular to subangular; 5 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; 1 to 3 percent carbonates, medium to very fine, angular to rounded; about 10 percent sandstone, olive-gray (5 Y 4/1); quartz, medium to very fine, angular to subrounded to rounded; micritic matrix; moderately cemented; slightly porous.
3	37 - 40	Limestone, medium-dark-gray (N 4); sandy, fossiliferous sparite, calcite molds, Chione and other mollusks; 20 percent quartz, fine to very fine, angular to subrounded; 3 percent heavy minerals, fine to very fine, subrounded to rounded; moderately to partially cemented; moldic, vugs, moderately porous to good porosity; interbedded with about 40 to 50 percent sand, light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subangular; 5 percent heavy minerals, fine to very fine, subrounded to rounded; about 10 percent detrital carbonate fragments, medium to very fine; about 20 percent lime mud, silt size.
4	40 - 44	Limestone, light-gray (N 7); sandy, sparse biosparite, well worn mollusk fragments; 20 to 30 percent quartz, fine to very fine, angular to subangular; 5 to 10 percent heavy minerals, fine to very fine, subrounded to rounded; moderately cemented; moderately porous to good porosity; interbedded with about 40 percent sand; quartzose, fine to very fine, well sorted, angular to subangular; 5 to 10 percent heavy minerals, medium to very fine, subrounded to rounded; 40 percent detrital carbonate and shell fragments, coarse to very fine, angular to rounded.
3	44 - 47	Limestone as above; gravel and concretions.
7	47 - 54	Sandstone, light-gray (N 7); gravel and concretions; quartzose, fine to very well sorted, angular to subangular; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 20 percent carbonate and shell fragments, medium to very fine; sparite matrix; well cemented; nodules and gravel; slightly to moderately porous; about 30 percent sand as above.
6	54 - 60	Limestone, light-gray (N 7); sandy, sparse biosparite, Turritella, abundant bivalvia; abundant calcite molds present; about 30 to 40 percent quartz, medium, well sorted, subangular to subrounded; about 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; cavity-riddled gravel; moldic, good porosity; interbedded with about 20 to 30 percent sand; quartzose, medium to fine, well sorted, angular to subrounded; 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; about 30 percent carbonates.
4	60 - 64	Limestone, yellowish-gray (5 Y 8/1) to medium-gray (N 5); sandy, sparse biosparite (biomicrite in places), barnacles, bivalvia; 20 to 30 percent quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; moderately cemented; cavity-riddled gravel; good porosity; interbedded with about 20 to 30 percent sand as above; quartzose, coarse to fine.

Thickness (feet)	Depth below land surface (feet)	Description
3	64 - 67	Limestone as above; interbedded with 20 to 30 percent sand; quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; about 30 percent detrital carbonates and shell fragments, bryozoans, Balanus, Anadara, Chione, Corbula.
3	67 - 70	Limestone, light-gray (N 7) to yellowish-gray (5 Y 7/2); sandy, sparse biosparite; 20 to 30 percent quartzose, medium to fine, angular to subangular; 5 to 10 percent heavy minerals and phosphates, coarse to fine, subrounded to rounded; loosely cemented; cavity-riddled gravel; good porosity; interbedded with 30 percent sand and shell; quartzose, coarse to fine, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, subrounded to rounded; 30 to 40 percent detrital carbonates and shells, Busycon, Conopeum, Chione, shark teeth, Terebra, Turritella, Chlamys.
7	70 - 77	Calcareous sand, very light gray (N 8) to yellowish-gray (5 Y 8/1); quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shells, Turritella, Chione, Olivella, Tellina, Cardita, Chlamys, Terebra; interbedded with about 5 to 10 percent limestone nodules; sandy, packed biosparite.
7	77 - 84	Calcareous sand, yellowish-gray (5 Y 8/1); quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; about 40 percent detrital carbonates and shells, Chione, Turritella, Conus, Chlamys, Cancellaria, barnacles, Olivella.
3	84 - 87	Calcareous sand, yellowish-gray (5 Y 8/1) to medium-dark-gray (N 4); as above.
3	87 - 90	Calcareous sand, medium-dark-gray (N 4); quartzose, medium to fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; 40 percent detrital carbonates and shell fragments, Cancellaria, Turritella, Glycymeris, Echinochama, Prunum, Balanus, Septastrea, Plicatula, Chione.
7	90 - 97	Calcareous sand, yellowish-gray (5 Y 8/1); quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; about 40 percent detrital carbonates and shell fragments, Glycymeris, Turritella, Prunum, Plicatula, Terebra, Cardita, Olivella, Lucina.
3	97 - 100	Calcareous sand as above; Chione, Turritella, Terebra, Balanus, Conus, Oliva, Plicatula, Corbula, Lucina, Strombus, worm shells, echinoid spines; interbedded with about 20 percent limestone rock fragments; sandy, sparse biosparite; 20 to 30 percent quartzose, coarse to fine, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to fine, subrounded to rounded; loosely cemented; moderately porous.
4	100 - 104	Limestone, medium-dark-gray (N 4) to yellowish-gray (5 Y 8/1); sandy, sparse biosparite, mollusks; 20 to 30 percent quartzose, medium to fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to fine, moderately sorted, subrounded to rounded; moderately cemented; moderately porous; interbedded with about 30 to 40 percent calcareous sand; 40 percent quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; detrital carbonates and shell fragments, Cancellaria, Busycon, Corbula, Balanus, Turritella.
3	104 - 107	Calcareous sand, medium-dark-gray (N 4) to yellowish-gray (5 Y 8/1) as above; interbedded with about 20 to 30 percent limestone as above.
3	107 - 110	Limestone, medium-gray (N 5); sandy, sparse biosparite, mollusks; 30 to 40 percent quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 percent heavy minerals and phosphates, medium to fine, moderately sorted, subrounded to rounded; very well cemented; moldic, very porous; interlayered with about 20 to 30 percent sand; quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; about 30 percent detrital carbonates and shell fragments.
4	110 - 114	Calcareous sand, yellowish-gray (5 Y 8/1) to medium-gray (N 5); quartzose, medium to fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments, barnacles, Olivella, bivalves.
3	114 - 117	Calcareous sand, yellowish-gray (5 Y 7/2) as above, bryozoans.
3	117 - 120	Calcareous sand as above, Chlamys.

Thickness (feet)	Depth below land surface (feet)	Description
4	120 - 124	Calcareous sand, yellowish-gray (5 Y 8/1) to light-olive-gray (5 Y 5/2); quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; 30 to 40 percent detrital carbonates and shell fragments; interbedded with about 10 to 20 percent limestone rock fragments; sandy, sparse biosparite to biomicrite.
3	124 - 127	Calcareous sand as above; interbedded with about 25 percent limestone; sandy, sparse biomicrite to biosparite; 30 percent quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; loosely cemented; moldic, good porosity.
3	127 - 130	Calcareous sand, yellowish-gray (5 Y 8/1) as above; with about 5 to 10 percent limestone rock fragments, light-olive-gray (5 Y 5/2) as above.
4	130 - 134	Calcareous sand with limestone rock fragments as above.
6	134 - 140	Calcareous sand, yellowish-gray (5 Y 8/1); quartzose, coarse to fine, poorly sorted, subrounded to rounded; 5 to 10 percent heavy minerals and phosphates, coarse t fine, poorly sorted, subrounded to rounded; about 30 percent detrital carbonates and shell fragments.
7	140 - 147	Calcareous sand, very light gray (N 8) to yellowish-gray (5 Y 8/1); quartzose, coarse to medium, subangular to rounded; 5 to 10 percent heavy minerals and phosphates as above; 20 to 30 percent detrital carbonates and shell fragments; interbedded with about 20 to 30 percent limestone; sandy, sparse biosparite; 30 percent quartzose, coarse to medium, subangular to rounded; 5 to 10 percent heavy minerals and phosphates, coarse t fine, subrounded to rounded; loosely cemented; moldic, good porosity.
3	147 - 150	Calcareous sand, light-gray (N 7) to yellowish-gray (5 Y 8/1); quartzose, coarse to medium, moderately sorted, subangular to rounded; 5 to 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; about 30 percent detrital carbonates and shell fragments, Balanus, Chlamys; about 5 percent micrite, silt and clay, light-olive-gray (5 Y 5/2).
4	150 - 154	Calcareous sand as above with grayish-olive (10 Y 4/2); silt, clay and micrite increasing.
3	154 - 157	Calcareous sand, very light gray (N 8) to yellowish-gray (5 Y 8/1); quartzose, coarse to fine, poorly sorted, subangular to rounded; 5 to 10 percent phosphates as above; 20 to 30 percent detrital carbonates and shell fragments, Conus, echinoid plate, Balanus; about 10 percent micrite, silt and clay, grayish-olive (10 Y 4/2).
3	157 - 160	Calcareous sand as above; 20 percent silt, clay and micrite.
4	160 - 164	Sand, very light gray (N 8) to light-olive-gray (5 Y 5/2); quartzose, coarse to fine, poorly sorted subangular to subrounded; 10 percent heavy minerals and phosphates, coarse to fine, poorly sorted, subrounded to rounded; about 20 percent detrital carbonates and shell fragments, Conus, Balanus; about 20 percent silt, clay and micrite.
6	164 - 170	Silty sand, grayish-olive (10 Y 4/2); about 40 percent micrite, silt and clay; quartzose, medium to very fine moderately sorted, angular to rounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 3 to 5 percent detrital carbonates.
7	170 - 177	Silty sand as above; with silt and clay increasing.
3	177 - 180	Silty sand, grayish-olive (10 Y 4/2); quartzose, fine to very fine, angular to subangular, well sorted; about 40 percent silt, clay and lime mud; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; about 5 to 10 percent detrital carbonates and shell fragments, medium to very fine, well worn.
10	180 - 190	Sandy clay, grayish-olive (10 Y 4/2); silt, clay, and micrite; about 30 to 40 percent quartzose as above; 5 to 10 percent heavy minerals and phosphates, fine to very fine, well sorted, subrounded to rounded; 3 to 5 percent carbonates and shell fragments, fine to very fine, well worn.

Well PB-1607

Lat 26°52'48", long 80°10'38"
Sec. 29, T. 41 S., R. 42 E.

Thickness (feet)	Depth below land surface (feet)	Description
4	0 - 4	Organic soil, dusky-brown (5 YR 2/2); quartzose, medium to very fine, moderately sorted, angular to subangular; organic mud and debris.
3	4 - 7	Marl, olive-gray (5 Y 4/1); silt and clay; quartzose, fine to very fine, well sorted, angular to subrounded; about 30 to 40 percent shells, Chione, Anadara, Terebra, Tellina, Cardita, Marginella, Busycon.
3	7 - 10	Marl as above; about 30 percent shells.
4	10 - 14	Marl, olive-gray (5 Y 4/1); silt and clay; quartzose, fine to very fine, well sorted, angular to subrounded; 1 percent heavy minerals, very fine, subrounded to rounded; 25 percent shells and shell fragments.
3	14 - 17	Marl as above; about 10 to 20 percent shells and shell fragments.
7	17 - 24	Muddy sand, dark-yellowish-brown (10 YR 4/2) to light-olive-gray (5 Y 5/2); quartzose, fine to very fine, well sorted, angular to subangular; about 25 percent silt and clay; 1 to 3 percent heavy minerals as above; about 1 to 3 percent shell fragments.
3	24 - 27	Muddy sand, light-olive-gray (5 Y 5/2); quartzose as above; 1 to 3 percent heavy minerals as above; 10 to 20 percent silt and clay.
3	27 - 30	Muddy sand, light-olive-gray (5 Y 5/2) to dark-yellowish-brown (10 YR 4/2); as above.
4	30 - 34	Muddy sand, dark-yellowish-brown (10 YR 4/2).
3	34 - 37	Limestone, medium-light-gray (N 6); sandy, sparse biosparite; about 40 percent quartzose, fine to very fine, well sorted, angular to subrounded; 1 to 3 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; well cemented; very porus.
3	37 - 40	Limestone as above; interlayered with sand; quartzose, fine to very fine, well sorted, angular to subangular; 3 to 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; about 10 to 20 percent calcite.
7	40 - 47	Sandy limestone, light-gray (N 7) to medium-dark-gray (N 4); sandy, sparse biosparite, abundant calcite; 20 to 30 percent quartzose, medium to fine, moderately sorted, angular to subrounded; 3 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; moderately cemented gravel; very porous; interbedded with about 40 to 50 percent sand; quartzose, medium to fine, moderately to well sorted, angular to subrounded; 3 to 5 percent heavy minerals, fine to very fine, subrounded to rounded; 20 to 30 percent calcite crystals and other carbonates.
3	47 - 50	Limestone as above; interbedded with about 30 to 40 percent sand; quartzose, fine to very fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 10 to 20 percent carbonates and shell fragments, medium to very fine.
4	50 - 54	Limestone, medium-light-gray (N 6) to yellowish-gray (5 Y 7/2); sandy, sparse biosparite; 30 percent quartzose, fine to very fine, well sorted, angular to subrounded; 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; cavity-riddled gravel; very porous; about 10 to 20 percent dismicrite; interbedded with about 30 to 40 percent sand as above.
3	54 - 57	Limestone, light-gray (N 7) to yellowish-gray (5 Y 8/1); sandy, sparse biosparite, abundant mollusks; 10 to 20 percent quartzose, medium to fine, angular to subrounded, moderately sorted; 5 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; cavity-riddled gravel, very porous; interbedded with 30 to 40 percent sand; quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; 30 to 40 percent shell fragments and detrital carbonates.
3	57 - 60	Sand, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 8/1); quartzose, coarse to fine, poorly sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to fine, moderately sorted, subangular to rounded; 30 to 40 percent detrital carbonates and shell fragments, Balanus, gastropods, and bivalve fragments; interbedded with about 20 percent limestone gravel; sandy, sparse biosparite; about 30 percent quartz, coarse to fine, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to very fine, subrounded to rounded; moderately cemented; moderately porous, vugs.

Well PB-1607--Continued

Thickness (feet)	Depth below land surface (feet)	Description
4	60 - 64	Limestone, medium-gray (N 5); sandy, sparse biosparite, packed biosparite in places, Olivella, Turritella, Chione, Mitra; 25 percent quartz, medium to fine, moderately to well sorted, angular to subrounded; 5 percent heavy minerals and phosphates, medium to very fine, subrounded to rounded; well cemented with gravel in places; porous, moldic, vugs; interlayered with about 20 to 30 percent sand, light-olive-gray (5 Y 6/1); quartzose, medium to fine, moderately to well sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; about 30 to 40 percent detrital carbonates and shell fragments.
3	64 - 67	Sandy shell, light-olive-gray (5 Y 6/1) to yellowish-gray (5 Y 8/1); 20 to 30 percent quartzose as above; 3 to 5 percent heavy minerals and phosphates as above; shells and shell fragments and detrital carbonates, Anadara, Oliva, Glycymeris, Venericardia, other mollusks; interbedded with about 25 percent limestone gravel as above.
3	67 - 70	Sandy shell as above; Turritella, Crepidula; interbedded with about 20 to 30 percent limestone, light-gray (N 7) to light-olive-gray (5 Y 6/1); sandy, packed biosparite with sparse biosparite in places; 10 to 20 percent quartz, medium to fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; moderately cemented; porous.
4	70 - 74	Limestone as above; well cemented with gravel; interbedded with about 30 percent sandy hell as above.
3	74 - 77	Limestone gravel as above; interbedded with about 20 percent sandy shell as above.
3	77 - 80	Limestone gravel, light-gray (N 7) to yellowish-gray (5 Y 8/1); sandy, packed biosparite, mollusks; about 20 percent quartz, medium to fine, moderately sorted, angular to subrounded; 3 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; moderately cemented gravel; porous; interbedded with about 30 to 40 percent sandy shell, light-olive-gray (5 Y 6/1); 20 to 30 percent quartz, medium to fine, moderately sorted, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; shells and shell fragments and detrital carbonates, Glycymeris, other bivalves and gastropods.
4	80 - 84	Limestone gravel as above; interbedded with sandy shell as above.
3	84 - 87	Limestone, light-olive-gray (5 Y 6/1); sandy, sparse biosparite to packed biosparite (biomicrite in places); 10 to 30 percent quartz, coarse to fine, poorly sorted, angular to subrounded; 3 to 5 percent heavy minerals and phosphates, medium to fine, moderately sorted, rounded to subangular; well to moderately cemented with with gravel; porous; interbedded with 30 to 40 percent sandy shell as above.
3	87 - 90	Sandy shell, yellowish-gray (5 Y 8/1) to light-olive-gray (5 Y 6/1); about 30 percent quartzose, coarse to very fine, poorly sorted, angular to subrounded; 3 to 5 percent heavy minerals, medium to very fine, poorly sorted, subrounded to rounded; detrital carbonates, shells and shell fragments, abundant bivalve fragments; interbedded with 30 percent limestone gravel; sandy, sparse biosparite to sparse biomicrite; moderately porous.
4	90 - 94	Sandy shell as above; interbedded with limestone gravel as above.
3	94 - 97	Sandy shell, yellowish-gray (5 Y 8/1) to light-olive-gray (5 Y 6/1); about 30 percent quartzose, coarse to very fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, coarse to very fine, poorly sorted, subrounded to rounded; detrital carbonates, shells and shell fragments.
3	97 - 100	Sandy shell as above; Olivella, Conus, Lirophora, Chlamys, echinoid plates; interbedded with about 10 percent limestone gravel, light-olive-gray (5 Y 5/2); poorly washed biomicrite; moderately cemented.
4	100 - 104	Sandy shell as above; Crassatellities.
3	104 - 107	Sandy shell as above; Glycymeris, Mitra, shark teeth.
3	107 - 110	Sandy shell, medium-dark-gray (N 4) to yellowish-gray (5 Y 8/1); as above; Glycymeris, Oliva, Chlamys, Crassatellities; interlayered with about 10 to 20 percent limestone; packed biosparite; moderately to well cemented.
4	110 - 114	Sandy shell as above; interbedded with 10 to 20 percent limestone; packed biosparite; 25 percent quartz, medium to very fine; 5 percent heavy minerals, medium to very fine; moderately cemented; moderately porous.
3	114 - 117	Sandy shell, medium-gray (N 5) to yellowish-gray (5 Y 8/1); 30 percent quartzose, medium to very fine, moderately to poorly sorted, subrounded to angular; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; detrital carbonates, shells and shell fragments, mollusks, Anadara, Crassatellities, Conus, Glycymeris.

Well PB-1607--Continued

Thickness (feet)	Depth below land surface (feet)	Description
3	117 - 120	Sandy shell, medium-light-gray (N 6) to yellowish-gray (5 Y 8/1); about 30 percent quartzose, coarse to fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, poorly sorted, subrounded to rounded; detrital carbonates, shells and shell fragments, Glycymeris, Olivella, Conus, Chlamys, Crepidula, Chione, Crassatellities.
7	120 - 127	Sandy shell, light-gray (N 7) to yellowish-gray (5 Y 8/1); about 40 percent quartzose as above; 5 to 10 percent heavy minerals and phosphates as above; detrital carbonates, shells and shell fragments as above; interbedded with about 20 to 30 percent limestone; sandy, sparse biosparite, mollusks; 40 percent quartz, coarse to fine, poorly sorted, angular to subrounded; about 5 percent heavy minerals and phosphates, medium to very fine, subrounded to rounded; moderately cemented; porous.
3	127 - 130	Sandy shell as above; Olivella, Polinices, Chlamys, Chione, coral, barnacles; interbedded with about 20 to 30 percent limestone; sandy, sparse biosparite as above; 30 to 40 percent quartz as above; moderately cemented; porous.
4	130 - 134	Sandy shell, light-gray (N 7) to yellowish-gray (5 Y 8/1); about 30 to 40 percent quartzose, medium to very fine, poorly sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; detrital carbonates and shell fragments.
3	134 - 137	Limestone, light-olive-gray (5 Y 6/1); sandy, sparse biomicrite, mollusks; 30 to 40 percent quartz, medium to very fine, moderately sorted, angular to subrounded; about 5 percent heavy minerals, medium to very fine, moderately sorted, subrounded to rounded; well cemented; porous, moldic; interbedded with about 20 to 30 percent sandy shell as above.
3	137 - 140	Sandy shell as above; interbedded with about 10 percent limestone as above; moderately cemented.
4	140 - 144	Sand, light-gray (N 7) to yellowish-gray (5 Y 8/1); quartzose, medium to very fine, moderately sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; about 40 percent detrital carbonates and shell fragments, barnacles, bivalves and gastropod pieces.
3	144 - 147	Sand as above; 30 to 40 percent carbonates; interbedded with 10 to 20 percent limestone gravel; sandy, sparse biosparite; 40 to 50 percent quartz; 5 to 10 percent heavy minerals and phosphates; porous; moderately cemented.
3	147 - 150	Sand, light-gray (N 7); quartzose, medium to fine, moderately sorted, angular to rounded; 5 to 10 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; 20 to 30 percent detrital carbonates and shell pieces.
14	150 - 164	Sand as above; with echinoid plates.
10	164 - 174	Sand, light-gray (N 7); quartzose, medium to fine, moderately to well sorted, angular to subrounded; about 10 percent heavy minerals and phosphates, medium to fine, moderately to well sorted, subrounded to rounded; about 25 percent detrital carbonates and shell pieces, echinoid plates; stringers of silt and clay, grayish-olive (10 Y 4/2).
3	174 - 177	Sand, light-olive-gray (5 Y 6/1); quartzose, medium to fine, well sorted, angular to subrounded; 5 to 10 percent heavy minerals and phosphates, medium to fine, well sorted, subrounded to rounded; 10 to 20 percent detrital carbonates and shell pieces, echinoid plates; about 10 percent silt and clay, grayish-olive (10 Y 4/2).
3	177 - 180	Sand as above; oyster shells.
10	180 - 190	Silty sand, light-olive-gray (5 Y 6/1); quartzose, medium to fine, well sorted, angular to rounded; about 5 percent heavy minerals and phosphates, medium to very fine, moderately sorted, subrounded to rounded; about 10 to 20 percent detrital carbonates and shell pieces; about 25 percent silt and clay.
10	190 - 200	Silty sand, light-olive-gray (5 Y 6/1); quartzose, fine to very fine, well sorted, angular to subrounded; 5 percent heavy minerals, fine to very fine, well sorted, subrounded to rounded; about 10 percent detrital carbonates and shell pieces; about 30 percent silt and clay.
5	200 - 220	Silty sand as above; 30 to 40 percent silt and clay.

*U.S. Government Printing Office: 1992 — 631-117/40017