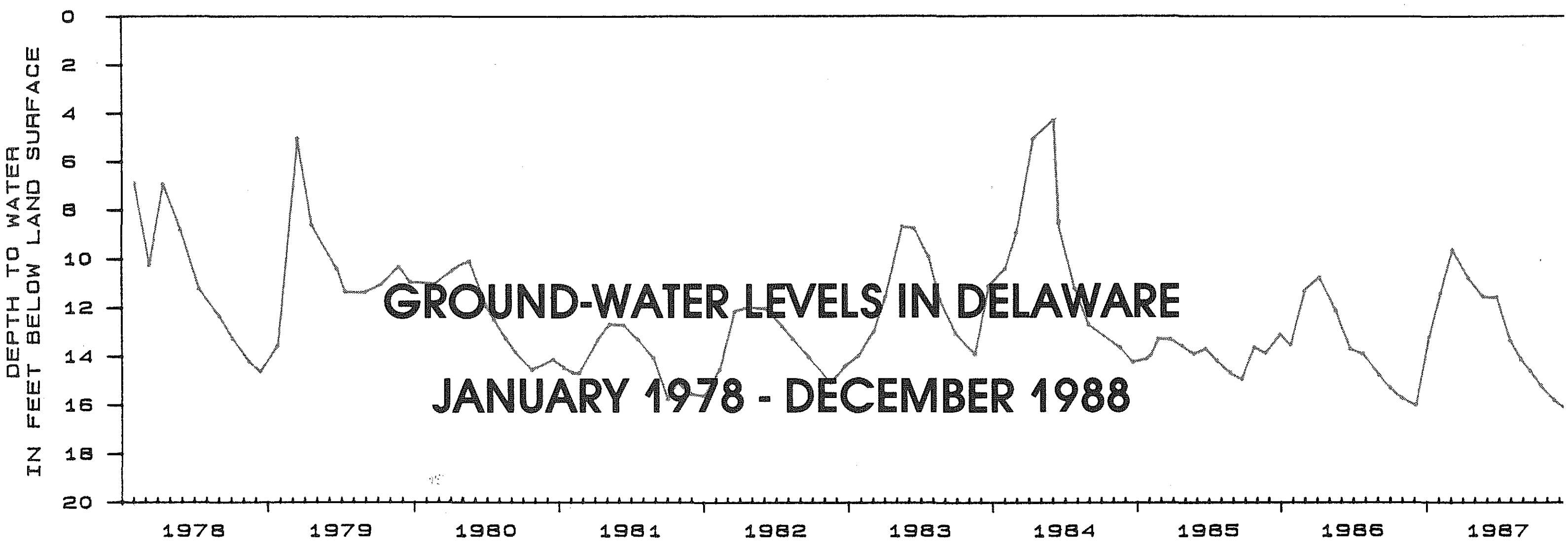
UNIVERSITY OF DELAWARE

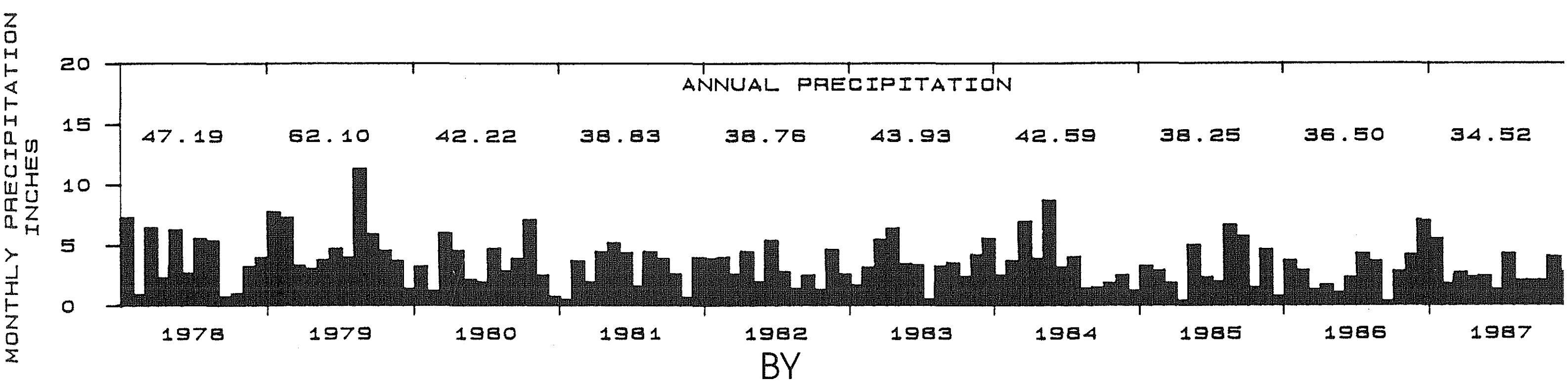
DELAWARE GEOLOGICAL SURVEY

REPORT OF INVESTIGATIONS NO. 44



GROUND-WATER LEVELS IN DELAWARE

JANUARY 1978 - DECEMBER 1988



BY

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STATE OF DELAWARE

NEWARK, DELAWARE

OCTOBER 1988

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ABSTRACT

Water-level records from 19 observation wells in Delaware for the period January 1978 - December 1987 provide the bases for analyses of water-level fluctuations.

Water levels in shallow water-table wells generally rise from November to March when recharge exceeds discharge and decline during the warm growing season from May through September. Although water levels in individual water-table wells fluctuated by as much as 11.72 feet during the 10-year period studied, the water-table system remained in a state of dynamic equilibrium and exhibited no significant changes in aquifer storage.

Water levels in two artesian observation wells (Id55-01 and Jd25-09, Piney Point aquifer) have declined significantly (20-50 feet) during the same ten-year period in response to high demands for ground water. Levels in two other wells (Dc34-06, upper Potomac aquifer and Nc13-03, Piney Point aquifer) declined 4-5 feet. Levels in six wells (Bc43-01, Wissahickon Formation; Cb12-10, Cockeysville Formation; Ec32-07, lower Potomac aquifer; Jd25-10, Cheswold aquifer; Rj22-06, Manokin aquifer; and Rj22-07, Pocomoke aquifer) remained relatively unchanged. Water levels in well Dc34-05, lower Potomac aquifer, rose approximately 25 feet because of a reduction in pumpage, or increase in ground-water recharge, or both.

INTRODUCTION

Purpose and Scope

The Delaware Geological Survey (DGS), in cooperation with the U. S. Geological Survey (USGS), maintains a network of permanent observation wells in Delaware to monitor the effects of both natural and induced conditions on water levels in water-table and artesian aquifers. This data acquisition program is necessary to properly evaluate, plan, and manage ground-water resources throughout Delaware.

The objectives of this report are: (1) to explain the relationship between precipitation, runoff, evaporation, and the change in water storage in water-table aquifers; (2) to present ground-water level data for 19 observation wells in graphic and tabular forms for the period January 1978 - December 1987; (3) to provide a summary of the fluctuations and trends of ground-water levels in these 19 observation wells; (4) to show the effect that ground-water development (pumping) has on artesian aquifers; and, (5) to assist those persons involved in evaluating ground-water conditions in both regional and local areas.

The 19 wells discussed in this report are not the only wells being monitored in Delaware. Others are monitored on either a temporary or continuous basis as part of water supply studies for municipalities and industry or other research.

English rather than metric units of measurement are used in this report. Conversion factors are presented in Appendix B.

Geologic Setting

The State of Delaware lies in parts of two physiographic provinces: the Appalachian Piedmont and the Atlantic Coastal Plain. These provinces are divided by the Fall Zone, a narrow area which runs from Newark to Wilmington parallel to Route 2 (Figure 1). The Piedmont, about 113 square miles of northern New Castle County, is located north of the Fall Zone and underlain by a complex of hard rocks of igneous and metamorphic origins.

Two wells monitored for this report are located in the Piedmont. Water in the crystalline rock of the Piedmont is stored between the grains in weathered rock and in fractures, joints, solution channels, and other openings in hard, unweathered rocks. Well Bc43-01 is completed as an open hole in the Wissahickon Formation (gneiss and schist) whereas well Cb12-10 is completed in the Cockeysville Formation (limestone and dolomite).

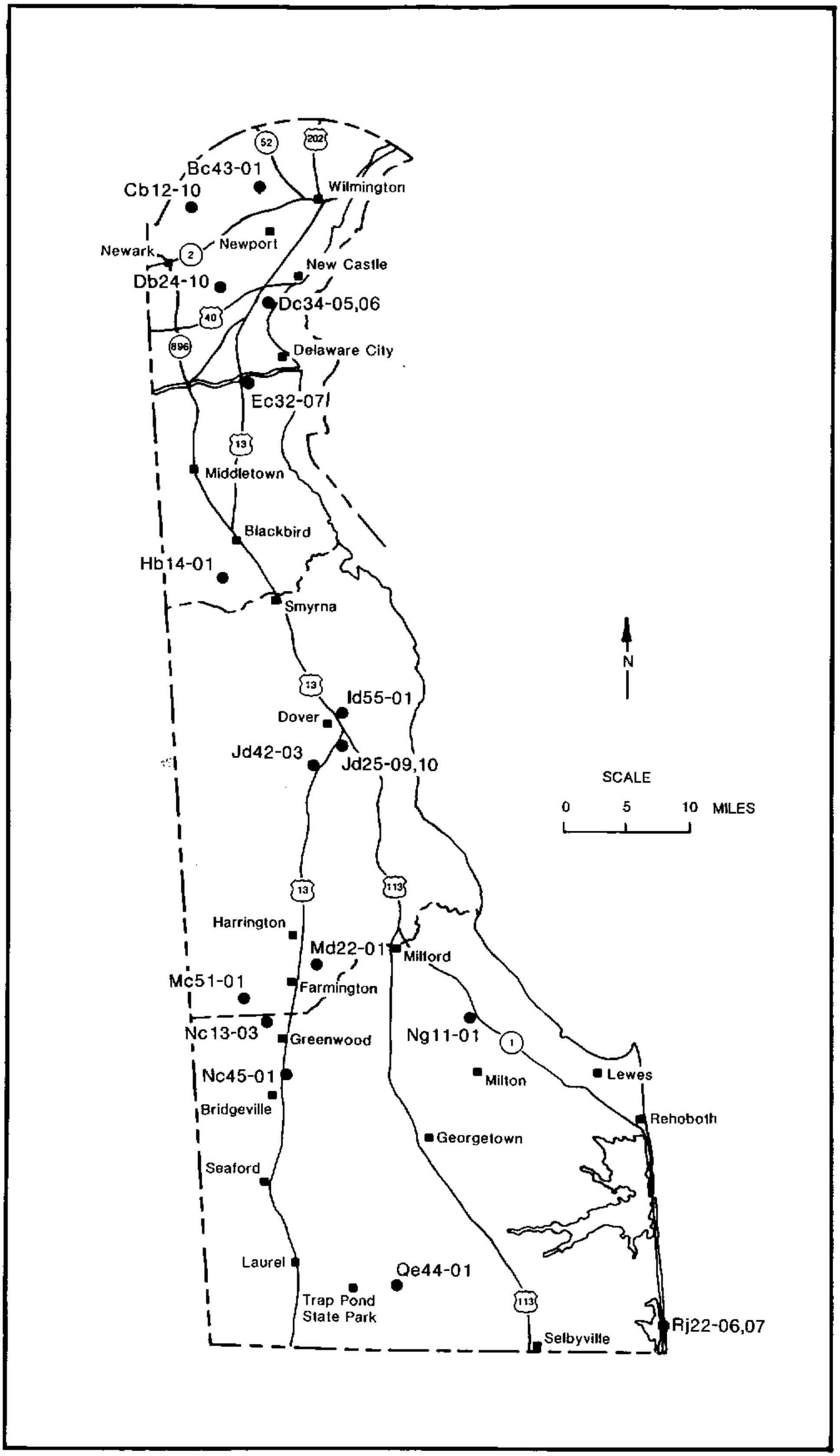

Figure 1. Index map of observation wells.

The Atlantic Coastal Plain is an area of relatively low relief underlain by a wedge-shaped mass of unconsolidated sands, gravels, silts, and clays that thickens from a "featheredge" at the Fall Zone to probably 10,000 feet in southeastern Delaware. Large bodies of sand and gravel contain vast amounts of ground water, both fresh and saline.

Seventeen of the wells discussed in this report are located in the Coastal Plain (Figure 1). Eight of the wells, Db24-10, Hb14-01, Jd42-03, Mc51-01, Md22-01, Nc45-01, Ng11-01, and Qe44-01, are shallow (less than 25 feet deep) water-table wells completed in the surficial sands and gravels of the Columbia deposits. They are located in areas not affected by ground-water development. The Columbia deposits occur at the surface in much of Delaware. The deposits range in thickness from a few feet to as much as 150 feet in deep, filled valleys (Jordan, 1964) and form a water-table (unconfined) aquifer of regional extent (Johnston, 1973).

Nine other wells are relatively deep (185 to 630 feet) and are completed in artesian (confined) aquifers. Wells Dc34-05 and Ec32-07 are screened in the lower Potomac aquifer; well Dc34-06 is completed in the upper Potomac aquifer. The Potomac aquifers are used extensively in New Castle County and provided more than 17.5 million gallons of water per day in 1981 (Martin, 1984). Wells Id55-01, Jd25-09, and Nc13-03 are completed in the Piney Point aquifer. The Piney Point occurs entirely in the subsurface in Delaware and is a major hydrologic unit consisting of an elongate lens of sand trending northeast-southwest across Kent County and adjacent Maryland (Cushing et al., 1973). In the Dover and Camden areas, this aquifer is highly developed and provided more than 2.8 million gallons of water per day in 1982 (Leahy, 1982).

Well Jd25-10 is completed in the Cheswold aquifer which supplies substantial quantities of water to wells throughout Kent County, especially in the Dover area.

Two wells located along the Atlantic Coast, Rj22-06 and Rj22-07, are completed in the Manokin and Pocomoke aquifers, respectively. Water from these aquifers is used extensively for public, commercial, and domestic purposes in southeastern Sussex County and nearby Ocean City, Maryland.

Previous Reports and Sources of Published Data

The systematic investigation of the geology and ground-water resources of Delaware was initiated in 1949 with the installation of a statewide network of observation wells. The program was begun as a cooperative effort between the USGS and the State of Delaware (Agricultural Extension Service of the University of

Delaware and the Delaware State Highway Department). On July 1, 1951 the DGS became the State's cooperating agency.

Water level information for the years 1951-1958 was published by the DGS in a series of water-level reports (Marine, 1954; Boggess and Coskery, 1954; Coskery and Boggess, 1956; Coskery and Rasmussen, 1958; Coskery, 1956, 1961).

Basic water-level data are also contained in several reports that provide information on aquifers and their water-bearing characteristics for both regional and local areas. Water levels in many wells in the Newark area are listed in Groot and Rasmussen (1954). Water levels throughout the State are included in Marine and Rasmussen (1955). Rasmussen et al. (1966) show water levels for many Sussex County wells. Other reports containing water levels in Delaware include Rasmussen et al. (1956), Rima et al. (1964), Baker et al. (1966), Woodruff (1966-1974, 1967), Spoljaric and Woodruff, (1970), Johnston (1973, 1976), Talley (1974-1987, 1978), U. S. Geological Survey (1978, 1979, 1980, 1981), James et al. (1982, 1983, 1984, 1985, 1986, 1987), Martin and Denver (1982), Talley and Andres (1987), and Phelan (1987).

Woodruff (1967) presented water-level data for nine observation wells located in areas of little or no pumping for the period January 1962 through June 1966. Talley (1978) expanded the coverage of water levels in the study and this report is, in turn, a further expansion.

A series of 33 Hydrologic Investigation Atlases (1963-1965) covering the entire Coastal Plain portion of Delaware show surface drainage, engineering soil types, and the average depth to the water table.

Historical summaries of water levels, ground-water pumpage, and water-level surface (potentiometric) maps are contained in reports by Johnston (1977), Leahy (1979, 1982), Hodges (1984), and Martin (1984). These data were used to calibrate ground-water flow models that simulated changes (generally declining) in water levels resulting from projected future pumpage in the water-table, Potomac, Piney Point, Cheswold, Manokin, and Pocomoke aquifer systems.

Acknowledgments

Nearly all of the water-level measurements included in this report, except those for wells Bc43-01, Cb12-10, Jd25-09, and Jd25-10, were made by the USGS in cooperation with the DGS.

Precipitation data were obtained from the Environmental Data Service of the National Oceanic and Atmospheric Administration

(NOAA), National Weather Service, City of Wilmington, Delaware Division of Highways, University of Delaware, and the City of Lewes.

The contributions of Nenad Spoljaric, Kenneth D. Woodruff, A. Scott Andres, and Richard N. Benson, all members of the DGS, in the form of discussions, constructive criticism, and text review are gratefully acknowledged.

HYDROLOGIC FACTORS IN DELAWARE

Ground-Water Occurrence

Ground water occurs in aquifers under water-table (unconfined) or artesian (confined) conditions. Water-table conditions exist when water in the pores of the rock at the top of the zone of saturation (water table) is in direct contact with the atmosphere and is, therefore, at atmospheric pressure. Ground water is under artesian conditions when the water in the aquifer is beneath a confining bed and is under hydrostatic pressure (greater than atmospheric). When a well is drilled through a confining bed, such as a relatively impermeable clay or silt, and into an artesian aquifer, the water will rise to some level above the top of the aquifer. These water levels represent the artesian or hydrostatic pressure in the aquifer and define the potentiometric surface.

Precipitation

Precipitation is the source of fresh water in Delaware. The average annual precipitation in the State is about 44 inches based on a 30-year period of record between 1951 and 1980 (NOAA, 1982). For any particular year the precipitation may deviate considerably from this average. For example, Table 1 shows that for the period January 1978 - December 1987, precipitation at New Castle ranged from 13.32 inches above average to 7.65 inches below average; at Porter Reservoir in Wilmington it was above average for 5 years and below average for 5 years with yearly totals ranging from 15.45 inches above average to 5.53 inches below average. The largest amount of annual precipitation recorded during the 10-year period was 62.10 inches at Bridgeville in 1979; the smallest was 33.73 inches at New Castle in 1985.

Water is dispersed in several ways once it lands on the surface. A large portion of the water is returned to the atmosphere by evaporation and transpiration. Some of the water becomes direct surface runoff. Other infiltrates the ground and becomes ground water.

	Porter Reservoir Wilmington, DE NOAA Sta. No. 9605 New Castle County			National Weather Service New Castle, DE NOAA Sta. No. 9595 New Castle County			Division of Highways Dover, DE NOAA Sta. No. 2730 Kent County		
Year	Precipitation	Normal	Departure	Precipitation	Normal	Departure	Precipitation	Normal	Departure
1978	54.07	42.99	+11.08	51.29	40.25	+11.04	49.07e	42.30	+ 6.77e
1979	57.40	42.99	+14.41	53.31	40.25	+13.06	54.45e	42.30	+12.15e
1980	37.46	42.99	- 5.53	33.92	40.25	- 6.33	43.89	42.30	+ 1.59
1981	40.57	42.99	- 2.42	35.28	40.25	- 4.97	35.59	42.30	- 6.71
1982	45.31	42.99	+ 2.32	41.07	40.25	+ 0.82	39.56	42.30	- 2.74
1983	60.35	44.90	+15.45	54.70	41.38	+13.32	58.69	44.44	+14.25
1984	49.43	44.90	+ 4.53	41.72	41.38	+ 0.34	41.64	44.44	- 2.80
1985	41.52	44.90	- 3.38	33.73	41.38	- 7.65	42.77	44.44	- 1.67
1986	44.71	44.90	- 0.19	42.87	41.38	+ 1.49	37.33	44.44	- 7.11
1987	43.16	44.90	- 1.74	35.98	41.38	- 5.40	36.82	44.44	- 7.62

	Bridgeville, DE NOAA Sta. No. 1330 *Greenwood, DE NOAA Sta. No. 3595 Sussex County			Lewes Dept. of Public Works Lewes, DE NOAA Sta. No. 5320 Sussex County			University of DE Research and Education Center Georgetown, DE NOAA Sta. No. 3570 Sussex County		
Year	Precipitation	Normal	Departure	Precipitation	Normal	Departure	Precipitation	Normal	Departure
1978	47.19	43.07	+ 4.12	48.99	-	-	48.31	-	-
1979	62.10	43.07	+19.03	56.83	-	-	53.03	-	-
1980	42.22	43.07	- 0.85	-	-	-	39.18e	-	-
1981	38.83	43.07	- 4.24	43.87e	-	-	36.67	-	-
1982	38.76	43.07	- 4.31	45.72	-	-	39.91	-	-
1983	43.93	44.36	- 0.43	-	45.08	-	59.75	43.71	+16.04
1984	42.59	44.36	- 1.77	47.42	45.08	+ 2.34	44.16	43.71	+ 0.45
1985	38.25	44.36	- 6.11	41.96e	45.08	- 3.12	43.00	43.71	- 0.71
1986	36.50*	-	-	34.62	45.08	-10.46	37.75	43.71	- 5.96
1987	34.52*	-	-	36.53	45.08	- 8.55	39.00	43.71	- 4.71

e = estimated

Precipitation normals from 1978-1982 are based on records for the 30-year period 1941-1970 inclusive, while normals from 1983-1987 are based on records for the 30-year period 1951-1980 inclusive. This follows the convention utilized by NOAA in presenting precipitation normals and departures from normals. Precipitation data for the period 1978-1986 were from NOAA; data for 1987 were provided by station operators.

Table 1. Precipitation in Delaware, 1978-1987.

Runoff

Runoff is that portion of precipitation that makes its way into streams after reaching the land surface. It varies from year to year, seasonally within each year, and daily. Runoff consists of two types: direct runoff and ground-water runoff.

Direct runoff occurs when precipitation flows over the land surface into stream channels and leaves the area in a relatively short period of time. This type of runoff characterizes streamflow during and shortly after storms and, if substantial, is referred to as flood flow. The equivalent of between 3 and 6 inches, or 7 to 14 percent of the average annual precipitation of 44 inches, occurs in the form of direct runoff (Johnston, 1976; Sundstrom and Pickett, 1971).

Ground-water runoff is that portion of runoff that has infiltrated the ground and is later discharged into streams as base or fair-weather flow. During dry periods streamflow is maintained entirely by continuous ground-water runoff. In Delaware about 11 to 15 inches of ground water (precipitation equivalent) is discharged into bodies of surface water, accounting for approximately 75 percent of annual streamflow. Ground-water runoff continues as long as the water levels in the aquifer are higher than the levels at which discharge is occurring.

Evapotranspiration and Ground-Water Recharge

A major portion of precipitation is lost to the atmosphere by evapotranspiration: approximately 26 inches (59 percent of annual precipitation) (Johnston, 1976). Some water is evaporated directly from streams, ponds, and other bodies of water. Transpiration, the process by which water absorbed by plants through roots is evaporated into the atmosphere from plant surfaces, accounts for a large part of evapotranspiration. Evapotranspiration is maximum during the growing season from June to August when the weather is hot, dry, and sometimes windy.

In Delaware approximately 13 to 16 inches of precipitation infiltrates the ground annually as ground-water recharge. This recharge is intermittent and varies from day to day, season to season, and year to year. Generally, most ground-water recharge occurs during late fall, winter, and early spring (November to March). Precipitation during this period is generally light and steady and has good potential for infiltration.

See Johnston (1976) for a detailed analysis of hydrologic budgets and the relationship of ground water to surface water in the shallow water-table aquifer in Delaware.

Water-Level Fluctuations

Water levels fluctuate continuously in response to both natural and artificial factors. In shallow water-table wells the largest and most prominent fluctuations result from ground-water recharge, natural ground-water discharge, and pumping from wells. In Delaware, water levels in shallow water-table wells generally begin to decline in April or May as the growing season commences and begin to rise in response to recharge during October and November.

A very important cause of water-level fluctuations is removal of water from aquifers by pumping. When pumping begins, the water level declines rapidly at first, and drawdown extends outward for some distance from the well. The drawdown is greatest near the well and gradually decreases with distance from the well. The shape of the lowered water surface resembles an inverted cone and is referred to as the cone of depression. The size and shape of this cone varies according to the pumping rate, length of pumping period, aquifer characteristics, and the rate of recharge within the cone of depression. As pumping continues, the areal extent of the cone expands, and the drawdown generally slows. At some point the extent of the cone may be sufficient to satisfy pumping demand and the water level may stabilize at a given pumping rate.

Minor fluctuations in water levels in artesian aquifers can result from changes in barometric pressure, land-surface loading, earthquakes, and earth and ocean tides. However, these fluctuations are generally small (less than 0.2 feet), cyclic, and cause insignificant changes in ground-water storage over relatively short time periods.

WATER-LEVEL MEASUREMENTS

Water levels in shallow water-table wells Db24-10, Hb14-01, Jd42-03, Mc51-01, Md22-01, Nc45-01, Ng11-01, and Qe44-01, and in artesian wells Dc34-05, Ec32-07, Jd25-09, Jd25-10, Rj22-06, and Rj22-07 were made by periodic (generally monthly) tape measurements.

The levels in well Bc43-01 were recorded on a continuous water-level recorder with a time chart of one month. Water levels were read from the charts at five-day intervals and also at the end of the month. The levels in wells Id55-01 and Nc13-03 were obtained with analog-to-digital recorders that record levels in punched paper format which are readily transferable to computers for processing. Levels in wells Cb12-10 and Dc34-06 were obtained both through use of continuous-record recorders and periodic tape measurements.

Well descriptions and water-level data are presented for each well in Appendix A.

ANALYSES OF MEASUREMENTS

Water-Table Wells

The ground-water hydrographs shown in Figures 2 through 9 suggest that no long-term trends in water-level rise or decline have occurred under natural conditions in the water-table aquifer. Thus, although levels have fluctuated widely on a seasonal and yearly basis in response to natural climatic factors, no significant changes in ground-water storage have occurred.

During the reporting period the yearly average ground-water levels in individual wells (Table 2) have ranged from a minimum of 1.68 feet below land surface in well Nc45-01 (13.10 feet in 1981 to 11.42 feet in 1979) to a maximum of 7.44 feet below land surface in well Db24-10 (14.91 feet in 1981 to 7.47 feet in 1978). The highest yearly average levels were recorded during 1979 for seven of the eight wells. These high levels correspond directly with above normal precipitation received during 1978-1979 (Table 1; Figures 2-9). The lowest average yearly levels that occurred during 1981 resulted from dry conditions during 1980-1981. Although water levels remained abnormally low during dry years, levels generally recovered rather quickly in response to normal to above normal precipitation.

Well	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Db24-10	7.47	8.25	10.87	14.91	11.81	9.27	8.53	13.52	14.17	12.32
Hb14-01	5.69	4.96	6.06	9.41	7.60	5.53	5.74	7.80	8.21	7.66
Jd42-03	5.64	5.39	6.24	8.18	8.27	6.41	5.67	8.25	8.20	7.74
Mc51-01	10.96	10.28	12.42	14.32	13.36	11.56	9.89	13.85	13.71	12.83
Md22-01	5.01	3.07	5.94	7.09	6.11	4.60	5.44	7.04	7.64	5.16
Nc45-01	12.63	11.42	12.65	13.10	12.24	11.91	11.67	12.26	12.69	12.43
Ng11-01	10.66	9.10	11.02	12.85	11.96	10.17	10.41	12.08	12.34	11.00
Qe44-01	7.82	6.42	8.54	9.85	8.84	7.32	8.24	8.34	9.97	8.68
Average of 8 wells	8.24	7.36	9.22	11.21	10.02	8.35	8.20	10.39	10.87	9.73

Table 2. Yearly average ground-water levels in feet below land surface for eight water-table wells, 1978-1987.

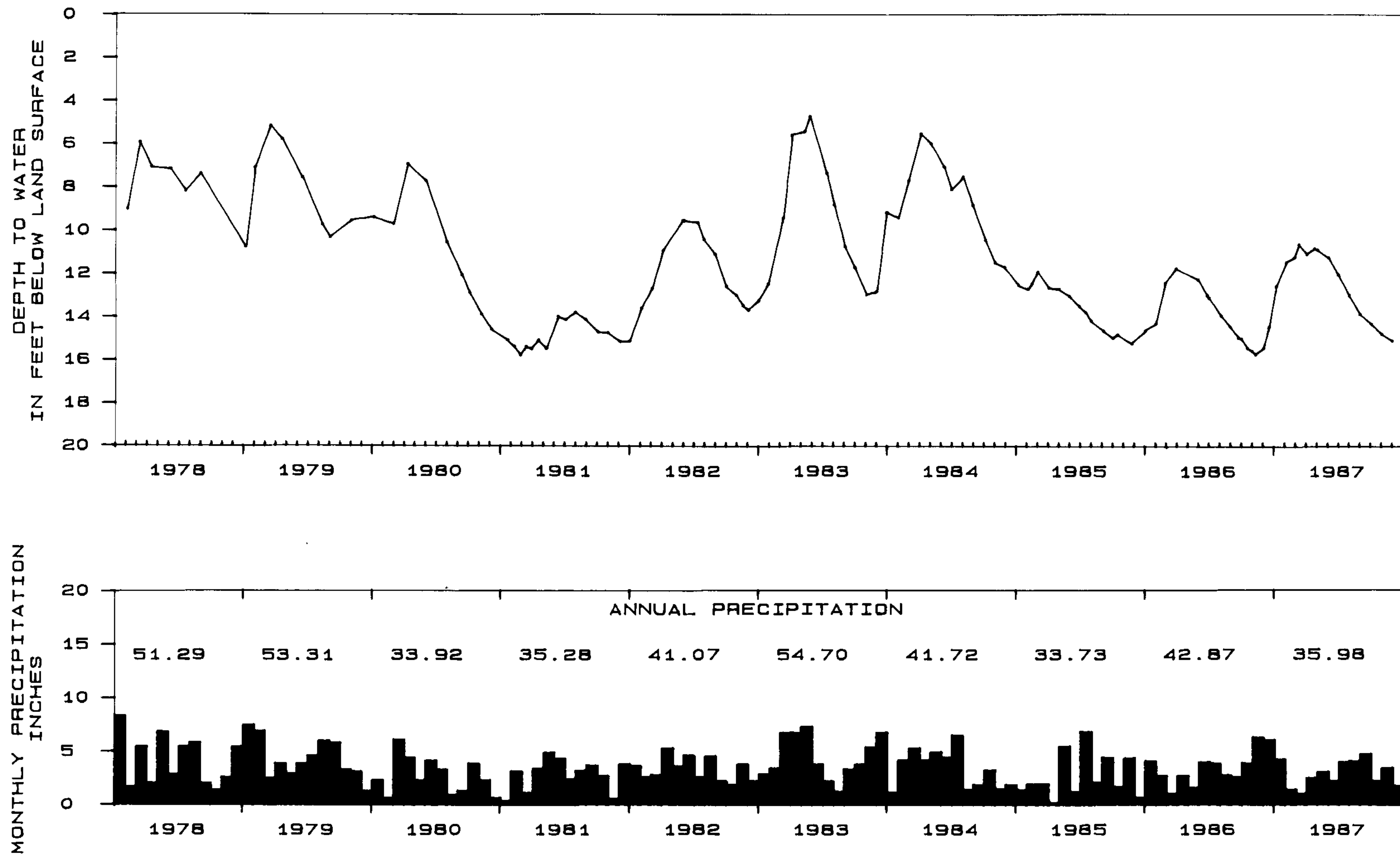

Figure 2. Graphs of water levels in well Db24-10 and precipitation at New Castle, Delaware.

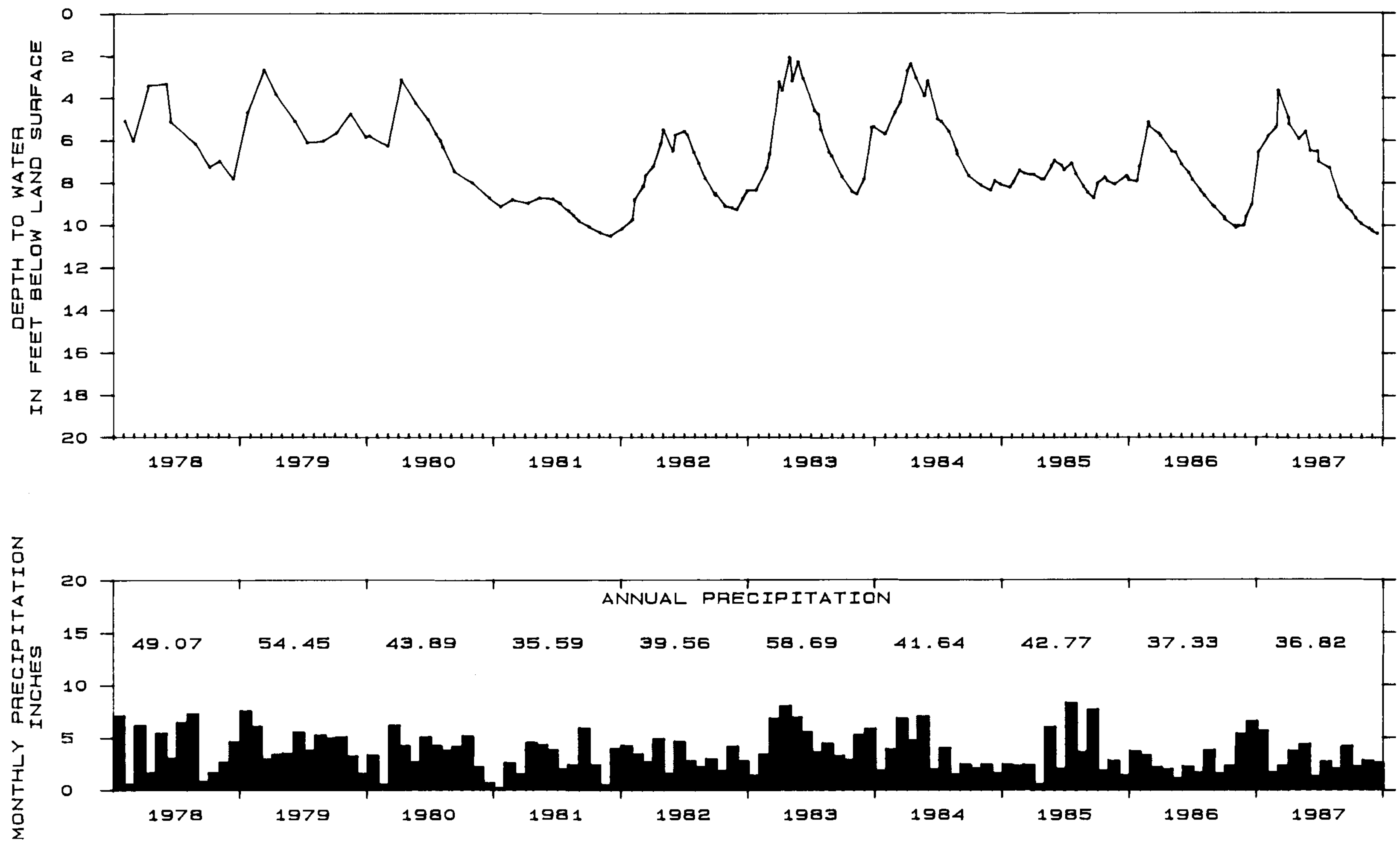

Figure 3. Graphs of water levels in well Hb14-01 and precipitation at Dover, Delaware.

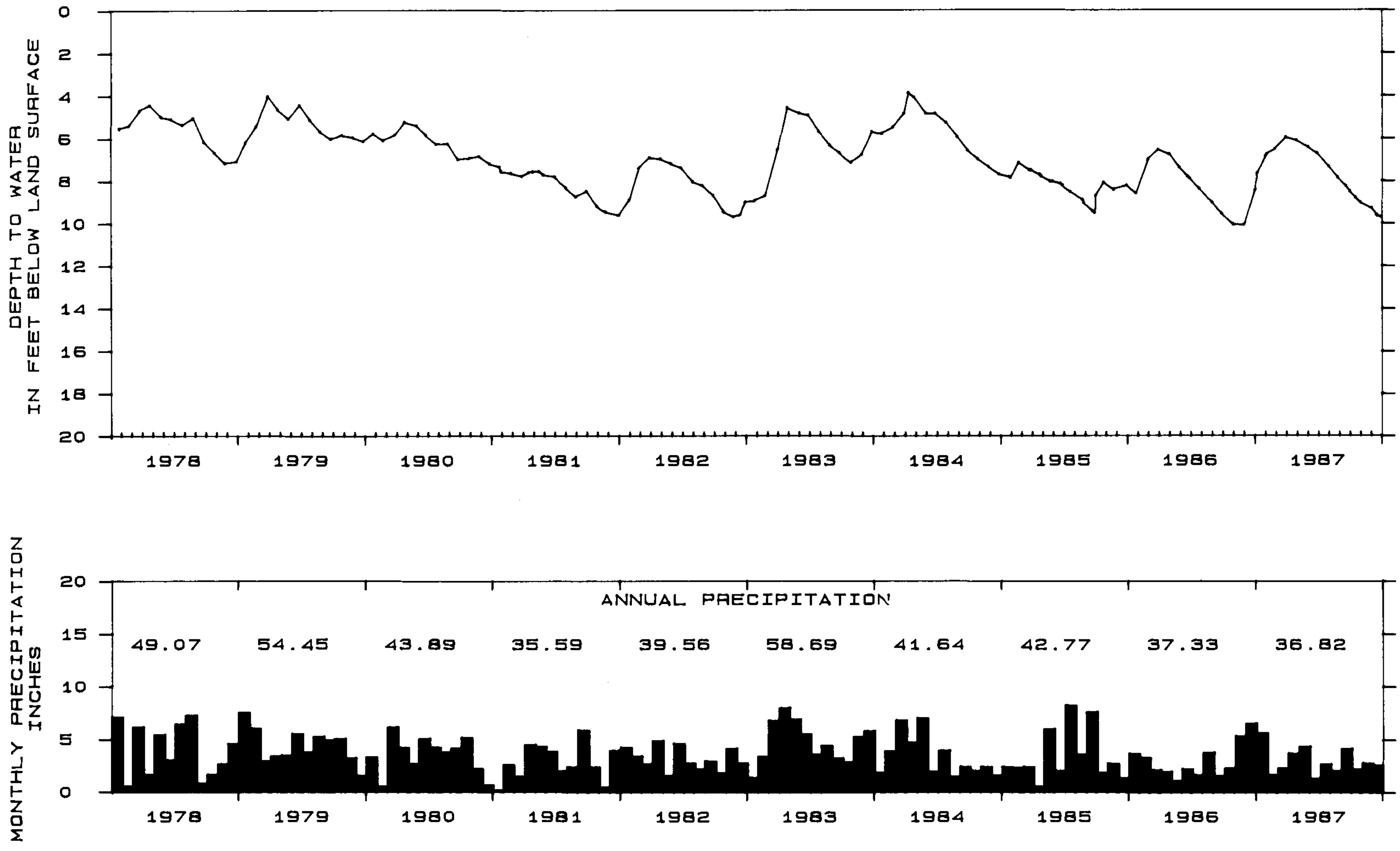

Figure 4. Graphs of water levels in well Jd42-03 and precipitation at Dover, Delaware.

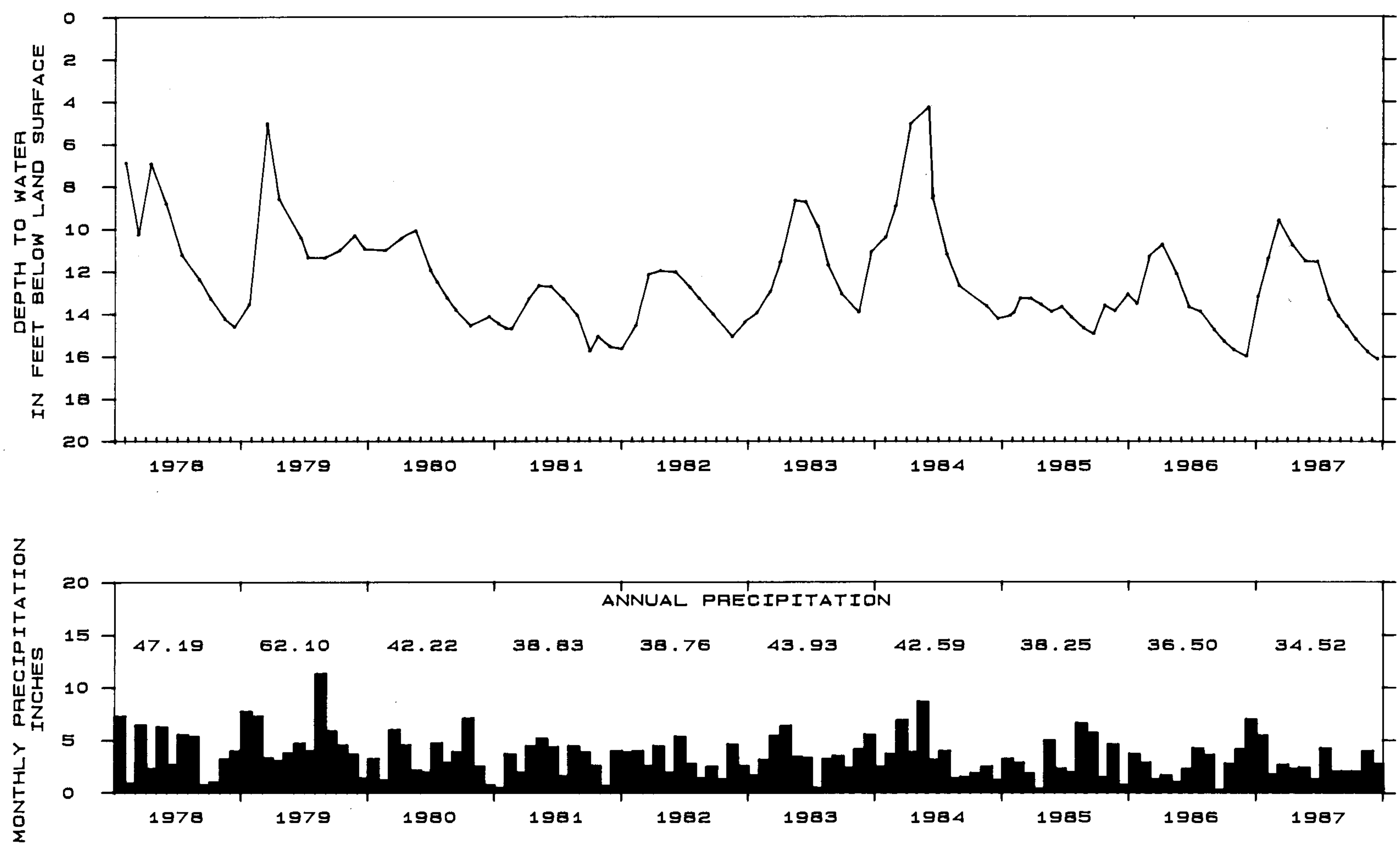

Figure 5. Graphs of water levels in well Mc51-01 and precipitation at Bridgeville and Greenwood, Delaware.

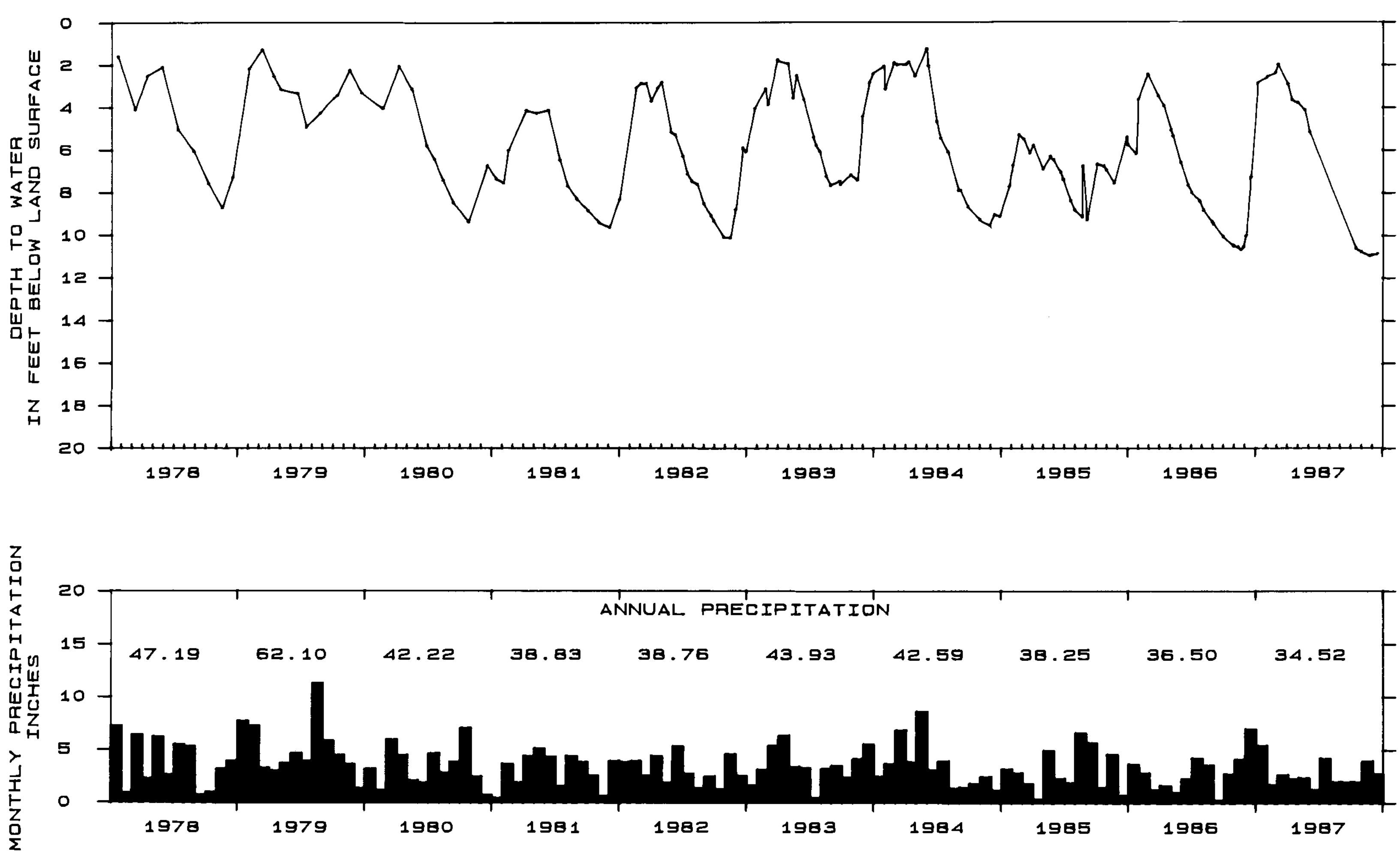

Figure 6. Graphs of water levels in well Md22-01 and precipitation at Bridgeville and Greenwood, Delaware.

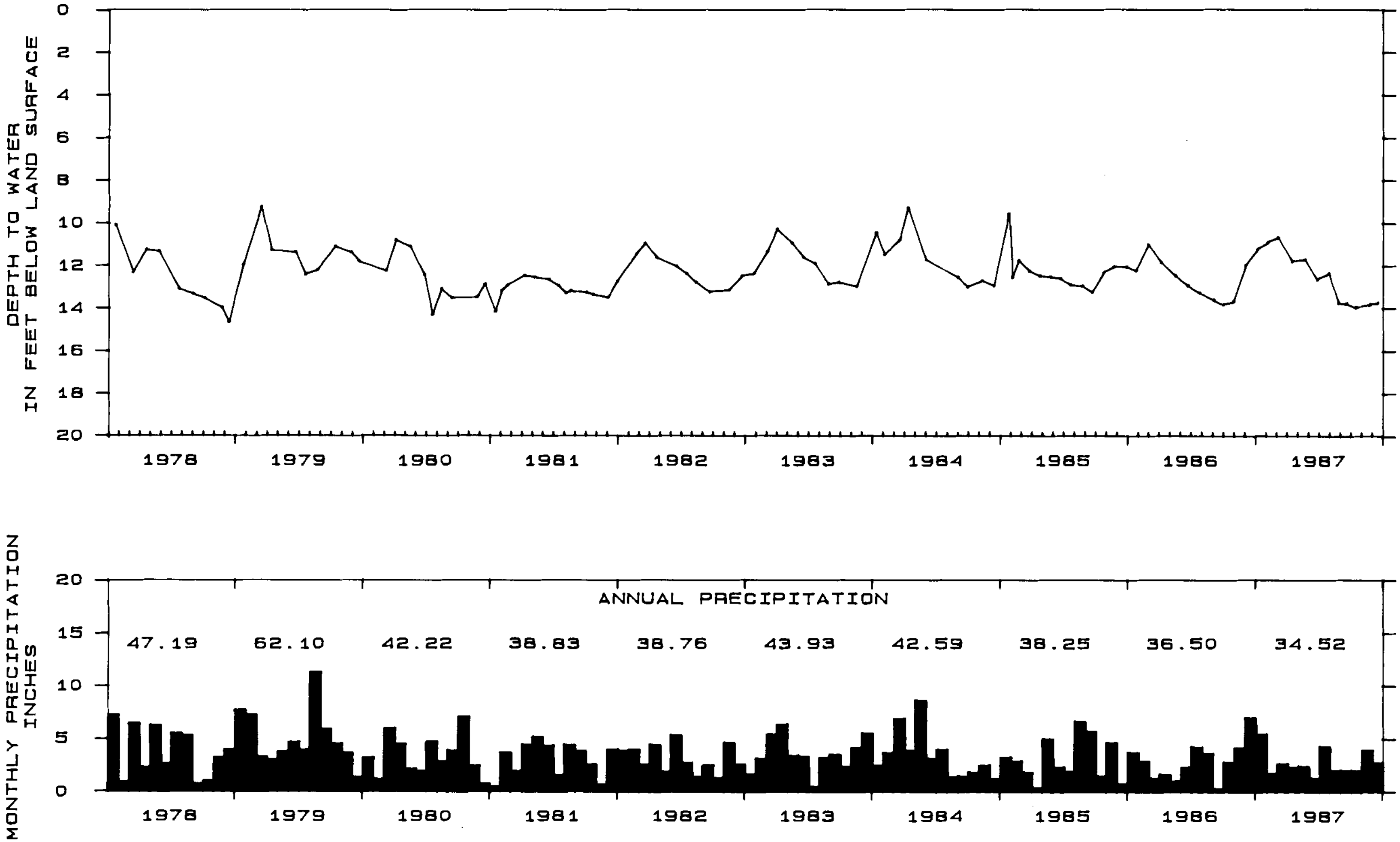

Figure 7. Graphs of water levels in well Nc45-01 and precipitation at Bridgeville and Greenwood, Delaware.

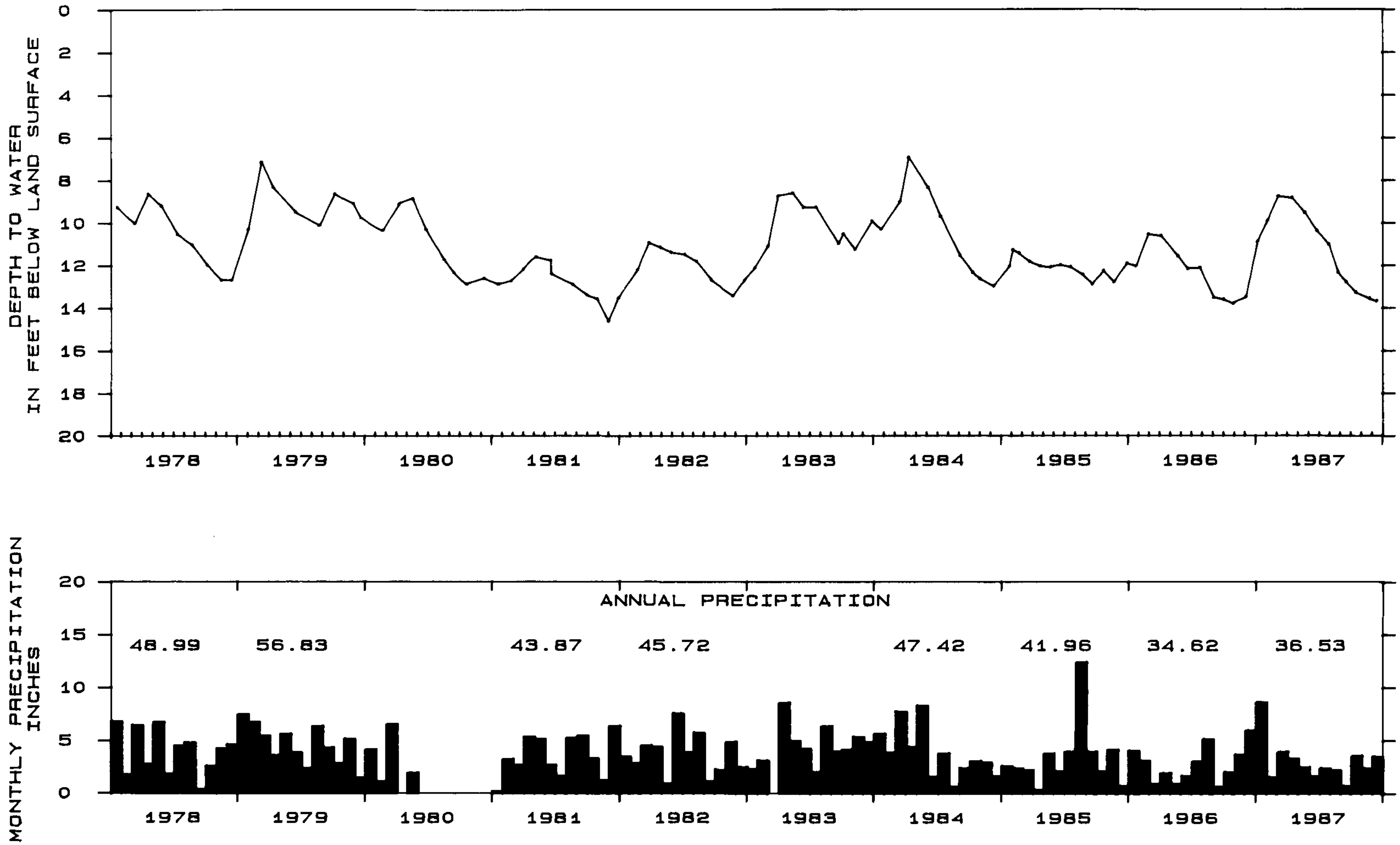

Figure 8. Graphs of water levels in well Ng11-01 and precipitation at Lewes, Delaware. Annual precipitation for 1980 and 1983 is unavailable.

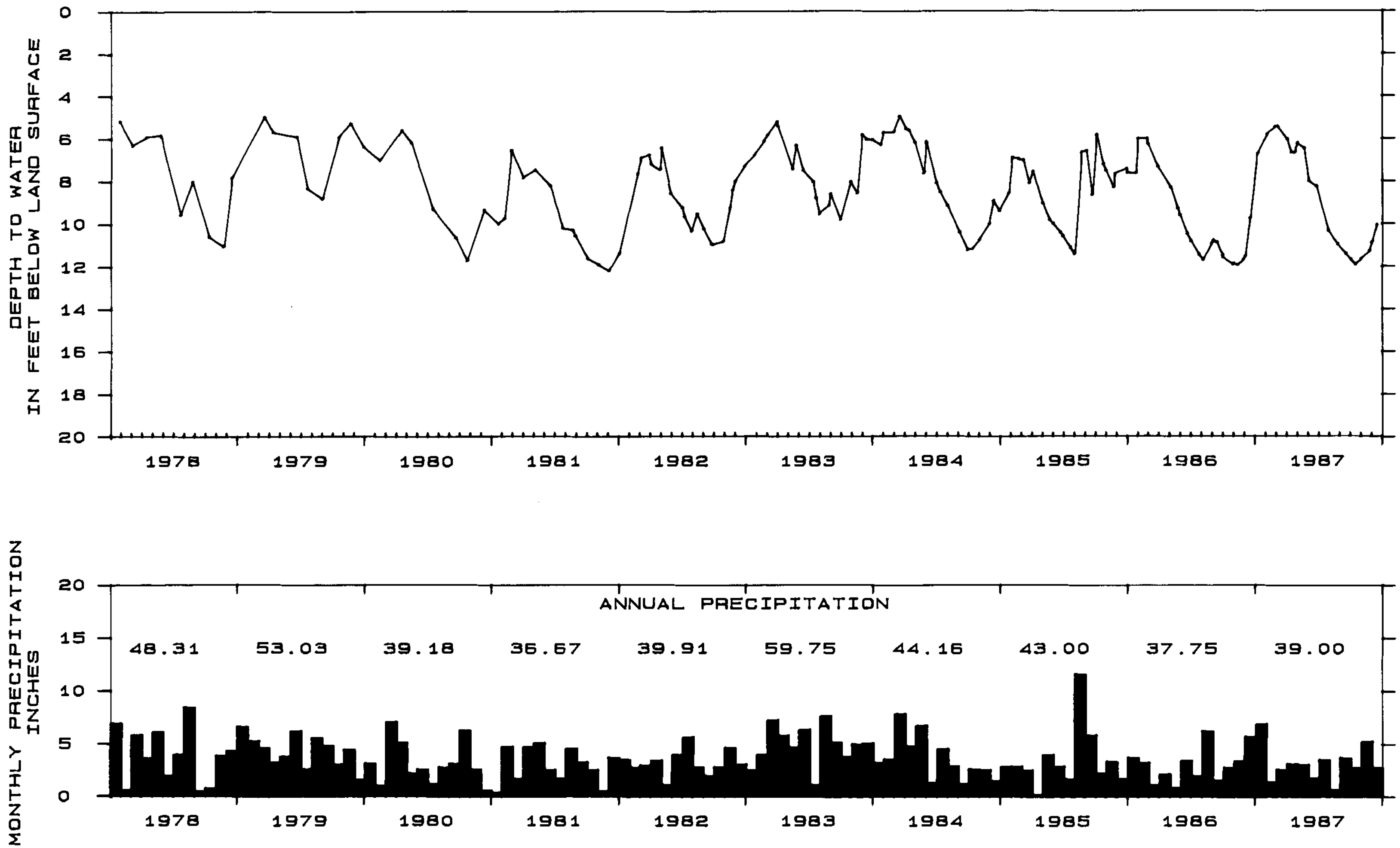

Figure 9. Graphs of water levels in well Qe44-01 and precipitation at Georgetown, Delaware.

Figures 2 through 9 compare water-level fluctuations to precipitation over the reporting period. Normal seasonal fluctuations are apparent. During years with average precipitation, water levels generally rose between November and March and were the highest in early spring when soil moisture was excessive, evapotranspiration was small, and frequent pulses of recharge took place. Johnston (1973) has shown that in many parts of Delaware, recharge to the Columbia deposits is rapid, with water levels rising within a few hours after the start of heavy rainfall. Levels generally declined from May to September and were usually lowest in the fall following a summer period when soil moisture was deficient, evapotranspiration high, and recharge infrequent.

The declining trend in water levels that began in March 1980 and continued through January and February 1982 is evident in Figures 2 through 5 and 8. This trend resulted from a period of below normal precipitation. Water levels began to rise seasonally in the winter of 1982 in response to above normal precipitation. Exceptions to this trend are evident in Figures 6 and 9. Conditions in these areas were conducive to ground-water recharge even though precipitation was somewhat below normal. Another period of relatively low water levels occurred in 1986-1987 as a result of below normal precipitation.

Table 3 shows the maximum fluctuation of the water table in eight shallow wells from 1978 - 1987. The largest fluctuation during the period was 11.72 feet in well Mc51-01; well Nc45-01 had the smallest, 5.41 feet.

Well	Maximum Level (lowest)	Minimum Level (highest)	Maximum Fluctuation
Db24-10	15.80	4.71	11.09
Hb14-01	10.53	2.06	8.47
Jd42-03	10.10	3.88	6.22
Mc51-01	16.00	4.28	11.72
Md22-01	10.94	1.25	9.69
Nc45-01	14.66	9.25	5.41
Ng11-01	14.61	6.91	7.70
Qe44-01	12.22	4.98	7.24

Table 3. Maximum range of water levels in feet for eight water-table wells, 1978-1987.

Artesian Wells

Eight of the eleven artesian observation wells (Dc34-05, Dc34-06, Ec32-07, Id55-01, Jd25-09, Jd25-10, Rj22-06, and Rj22-07) are located in areas where the aquifer systems are heavily pumped. The exception is well Nc13-03 located approximately 23 miles from areas of heavy pumping. Nevertheless, the water levels in well Nc13-03 are also affected by pumping in the heavy use areas in and near Dover, Delaware and Cambridge-Easton, Maryland. Two wells (Bc43-01 and Cb12-10) are located in the Piedmont Province and are not affected by pumping.

Observation Well Bc43-01

Well Bc43-01 is completed as an open hole in the Wissahickon Formation to a depth of 165 feet. Although it is constructed in an artesian aquifer, water levels respond fairly rapidly to precipitation, indicating that underlying fracture systems intersect the ground surface in the vicinity of the well.

No discernable long-term water-level trends are evident (Figure 10). However, hydrographs for the 22-year period 1966-

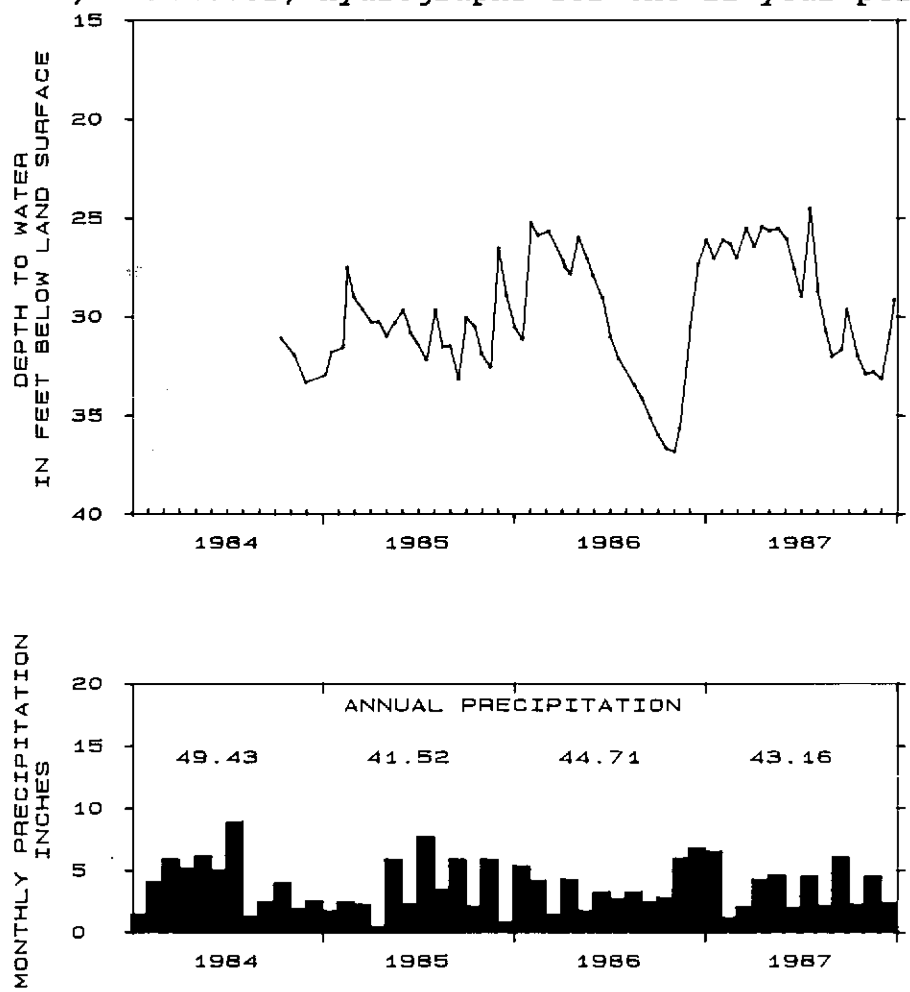

Figure 10. Graphs of water levels in well Bc43-01, Wissahickon Formation, and precipitation at Porter Reservoir, Wilmington, Delaware.

1987 indicate that maximum levels reached during any particular year have deepened slightly. For example, from 1966 through 1977 maximum levels remained above 35 feet; maximum levels were greater than 35 feet in each of the following years: 1980, 1981, 1982, and 1986.

During the 10-year period 1978-1987, maximum fluctuation of the water level was 17 feet. A record low level of 37.02 feet was established on October 25, 1986, following several months of below normal precipitation.

Observation Well Cb12-10

Well Cb12-10 is cased to 105 feet and completed as an open hole to 410 feet in the Cockeysville Formation. Figure 11 shows that annual and seasonal water-level trends are similar to those

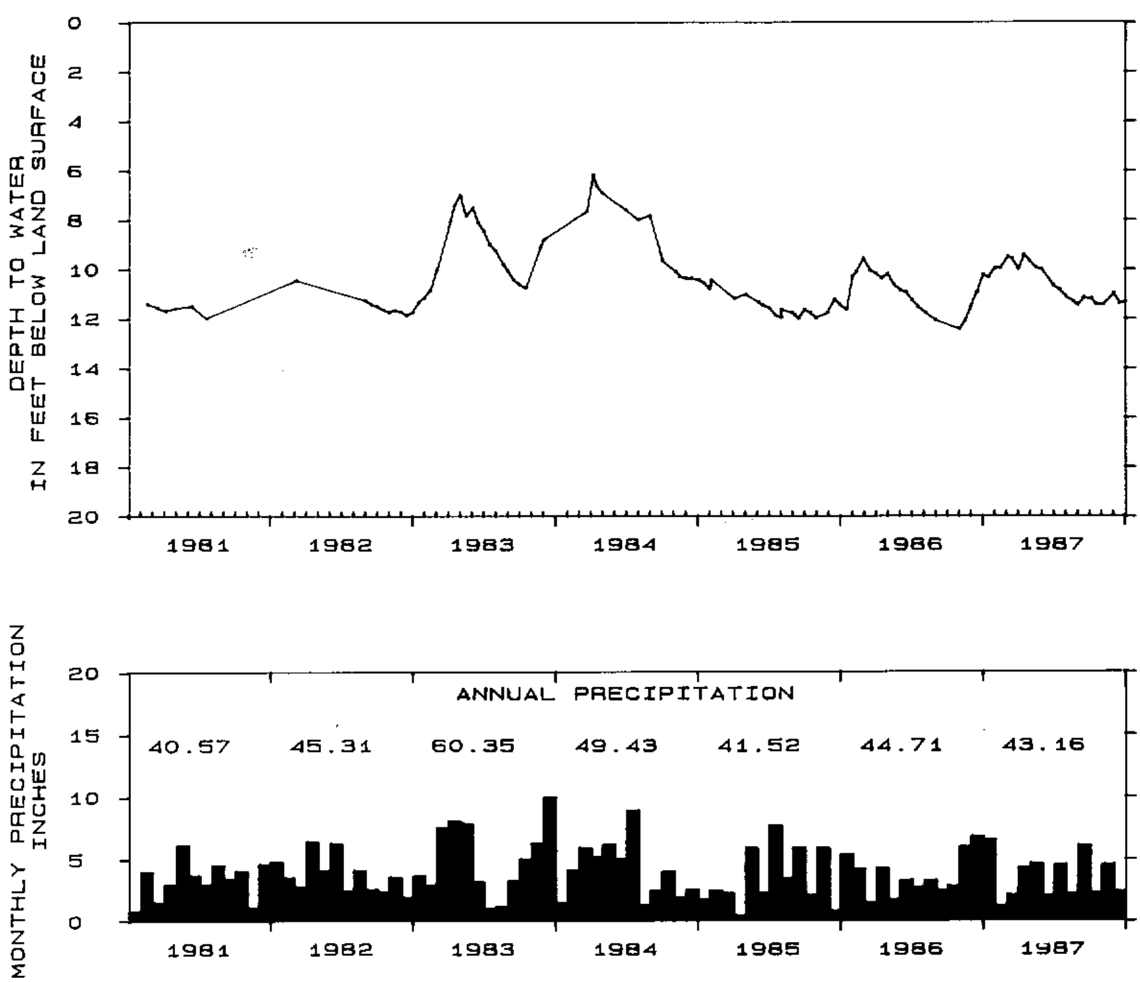

Figure 11. Graphs of water levels in well Cb12-10, Cockeysville Formation, and precipitation at Porter Reservoir, Wilmington, Delaware.

that characterize trends in the water-table aquifer system (Figures 2-9). Water levels are generally high during periods of normal to above normal precipitation (1983-1984) and relatively low during dry periods (1985).

Observation Well Dc34-05

Initial water levels in 1915, prior to extensive ground-water development, in the vicinity of Dc34-05 were within 4 to 10 feet of land surface (Marine and Rasmussen, 1955). However, by 1978 levels had decreased approximately 120 feet as a result of heavy pumpage.

During the 10-year period 1978-1987 water levels in Dc34-05 (lower Potomac aquifer) have shown a net rise of 20 feet (Figure 12). The rising trend is attributable to a decrease in ground-water withdrawals from industrial and public water-supply wells in the vicinity. Water levels have remained relatively stable since 1981 and are expected to remain so if current pumping rates for the aquifer system are maintained. Martin (1984) reported that ground-water pumpage from the Potomac aquifer system (upper, middle, and lower aquifers) remained relatively constant between 1973 and 1981. Annual pumpage ranged from 16.5 to 17.5 million gallons per day. On the basis of the results of simulated ground-water flow in the Potomac aquifer system, Martin (1984, p. 82) concluded that "...pumping at the average 1979-81 rate would produce little additional drawdown in the year 2005 with additional drawdown in the aquifer system of less than 15 feet."

Observation Well Dc34-06

The hydrograph of well Dc34-06 (Figure 13) shows a general rise in water levels from 1978 through 1980, a decline from 1980-1983, and little change since 1980. This well, which is screened from 183-188 feet below land surface in the upper Potomac aquifer, is situated in an area influenced by heavy pumpage. Levels will probably continue to remain relatively stable if the present pumping rates remain unchanged.

Observation Well Ec32-07

Well Ec32-07 is screened from 586 to 596 feet below land surface in the lower Potomac aquifer. As stated earlier, water levels in the lower Potomac aquifer were within 10 feet of land surface in the 1950s and have since declined as a result of ground-water pumpage, principally at the oil refinery at Delaware City.

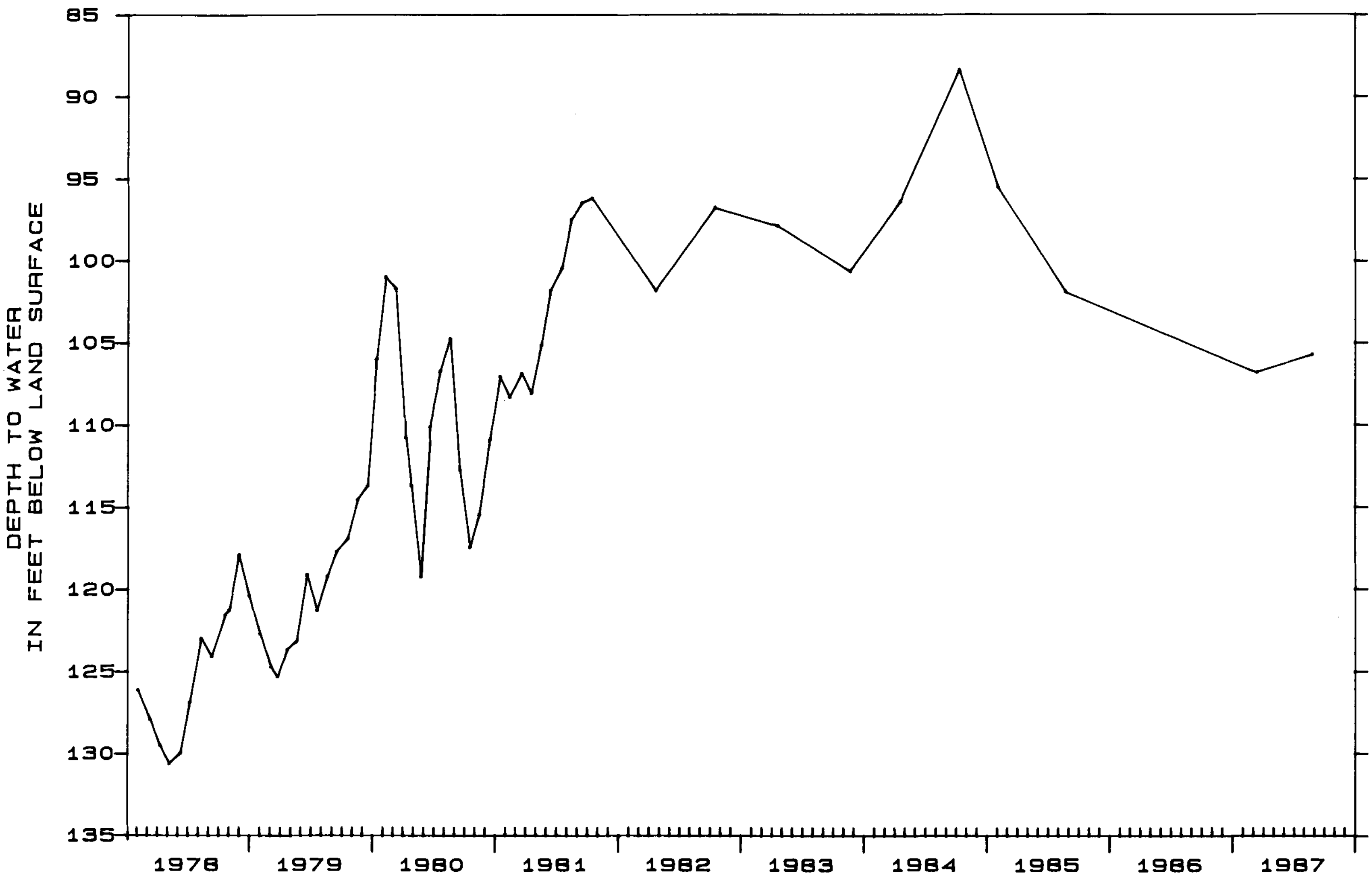

Figure 12. Hydrograph showing water-level fluctuations in well Dc34-05, lower Potomac aquifer.

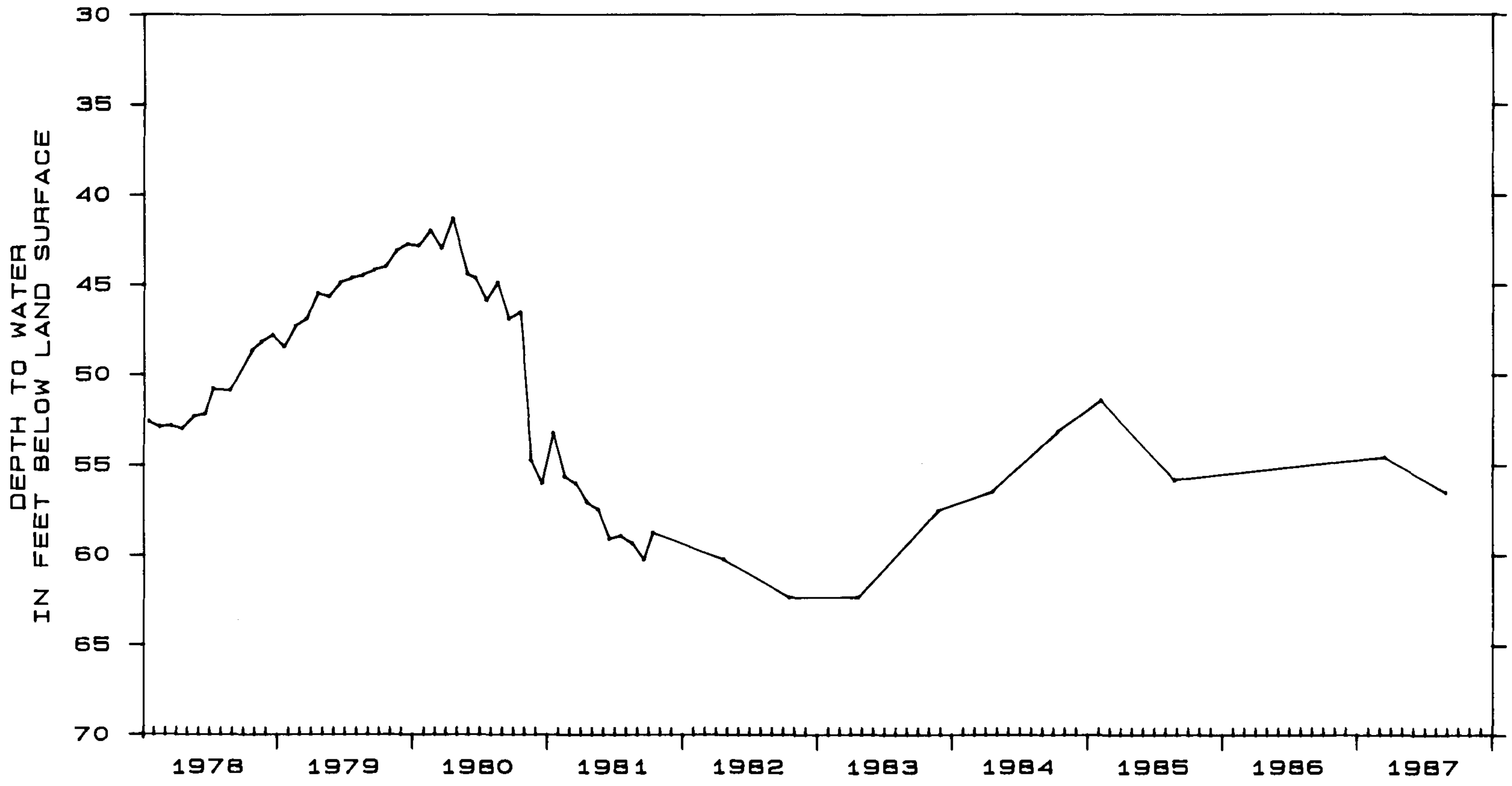

Figure 13. Hydrograph showing water-level fluctuations in well Dc34-06, upper Potomac aquifer.

During the past 10 years the highest water level recorded was 69.60 feet below land surface in May 1980; the lowest was 95.31 feet below land surface in February 1981. Levels have generally remained in a state of dynamic equilibrium between 80 and 90 feet during the 10-year period (Figure 14) and are expected to remain relatively stable if current pumping rates are maintained.

Observation Well Id55-01

Well Id55-01 is screened in the Piney Point aquifer from 329 to 349 feet below land surface. Figures 15 and 16 show a general downward trend of water levels from 1978 through 1987. The decline during this period was approximately 20 feet for an average annual decline of 2 feet attributable to ground-water withdrawals in the Dover and Camden areas. The rate of decline during the reporting period is significantly less than the rate (6.5 feet per year) reported by Talley (1978) for the period July 1966 - December 1977. Figure 15 shows that during the course of a year water levels generally undergo one cycle of rise and decline coincident with seasonal changes in pumpage by the City of Dover. Levels are generally highest during March and April and lowest in the summer as ground-water pumpage increases in response to seasonal demands for water.

The original water levels in the Piney Point aquifer were reported to be approximately 20 feet above sea level in a well at the mouth of the Mahon River in 1944 (Marine and Rasmussen, 1955). In 1962, the water level was approximately at sea level (20 feet below land surface) at Dover Air Force Base. Since 1962, the Piney Point aquifer has been used extensively in the Dover area. Pumpage has increased from 270 million gallons per year in 1962 to about 1,022 million gallons per year in 1977, the last year for which detailed pumpage data were compiled (Leahy, 1982). During the period 1962-1987 the water level in well Id55-01 has declined about 140 feet for an average decline of 5.4 feet per year. However, as previously indicated, the average decline from 1978 through 1987 has decreased to 2 feet per year. A relatively sharp decline of approximately 30 feet is evident from 1986 through the middle of 1987 and is attributable to increases in pumpage.

It is anticipated that levels will continue to decline in response to continued and increased demands for water in the Dover area. Evaluation of long-term water-level declines that would result from projected increases in withdrawals from the Piney Point aquifer in the Dover area are presented by Leahy (1979) and for both the Piney Point and Cheswold aquifers by Leahy (1982)

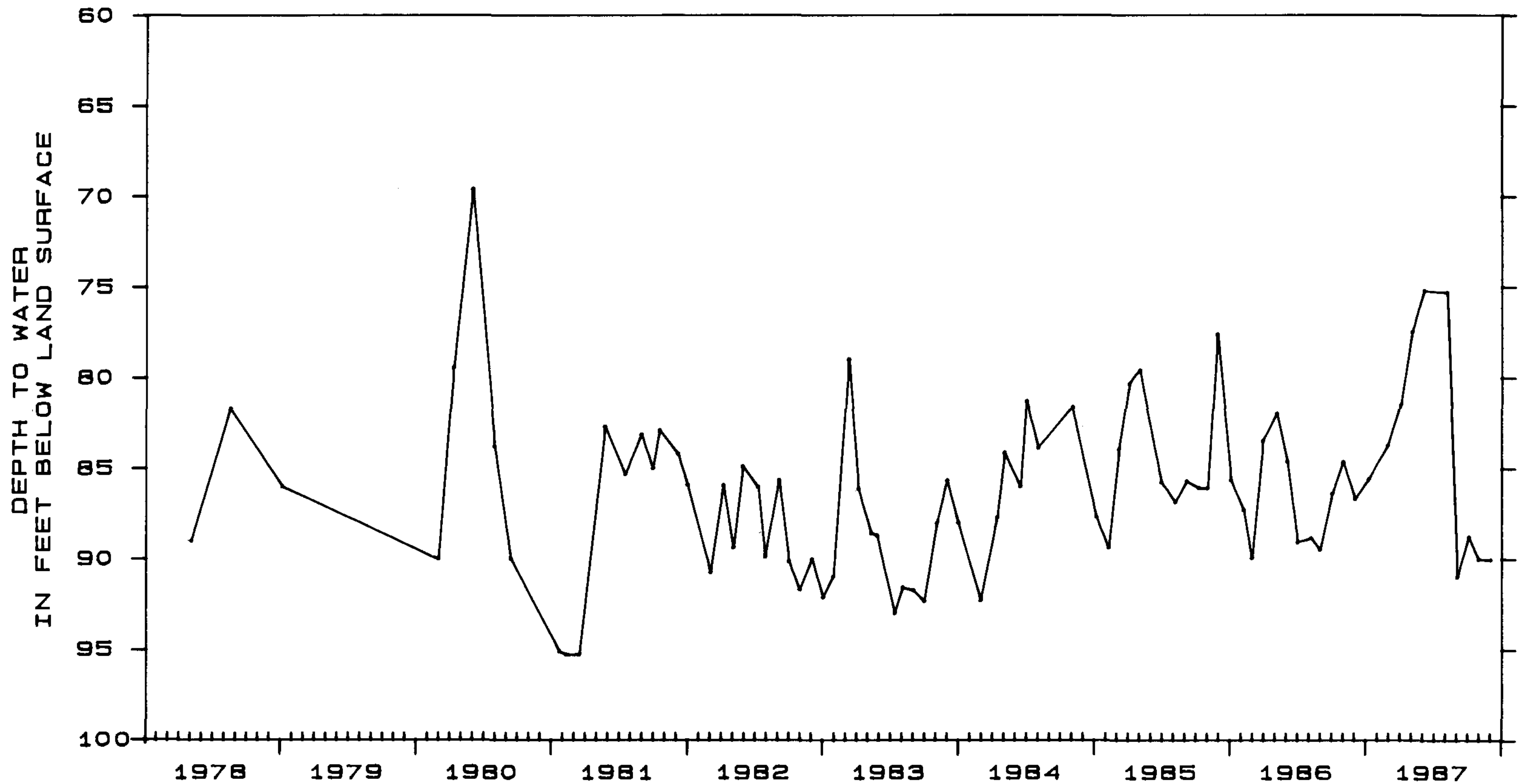

Figure 14. Hydrograph showing water-level fluctuations in well Ec32-07, lower Potomac aquifer.

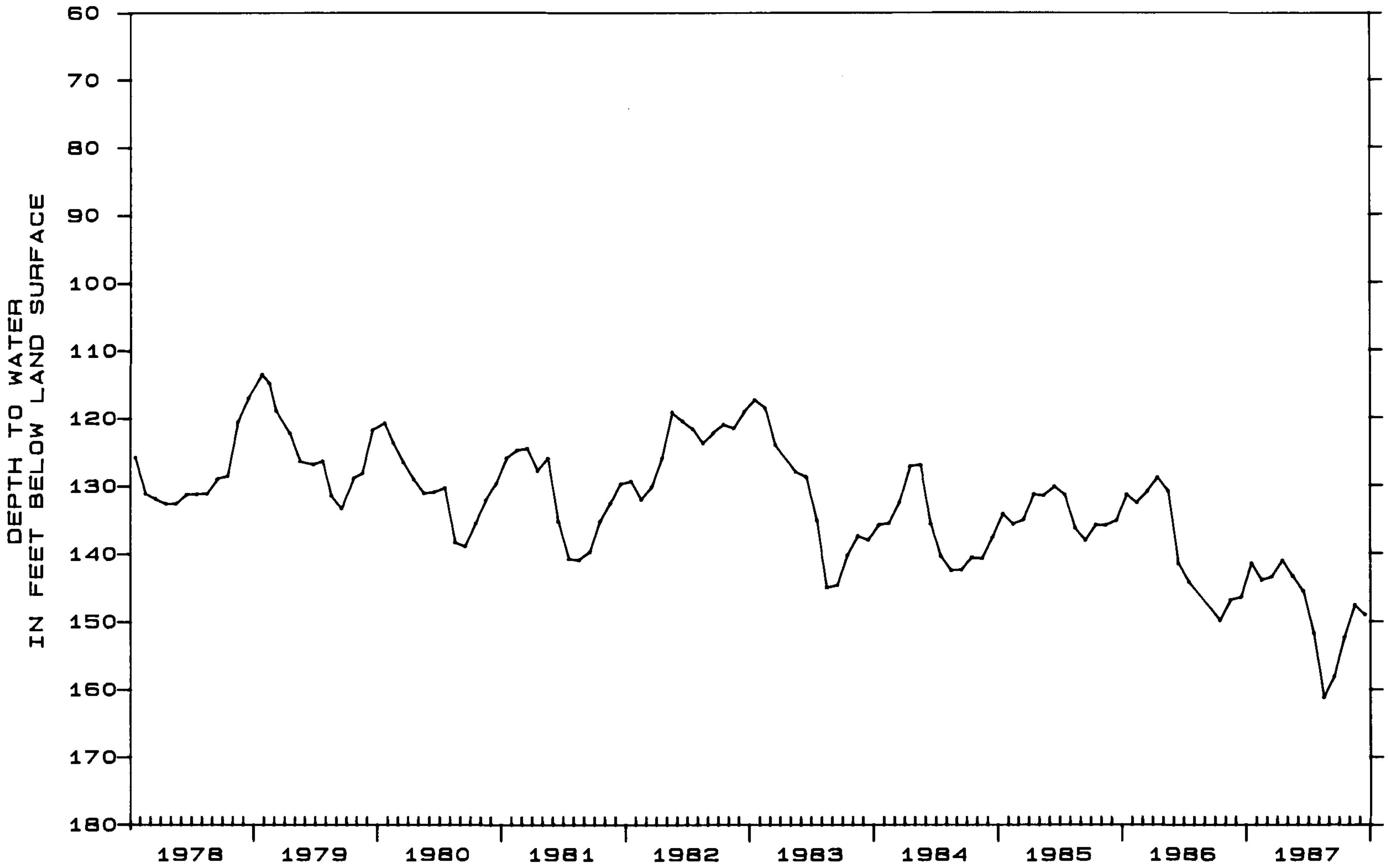

Figure 15. Hydrograph showing water-level fluctuations in well Id55-01, Piney Point aquifer.

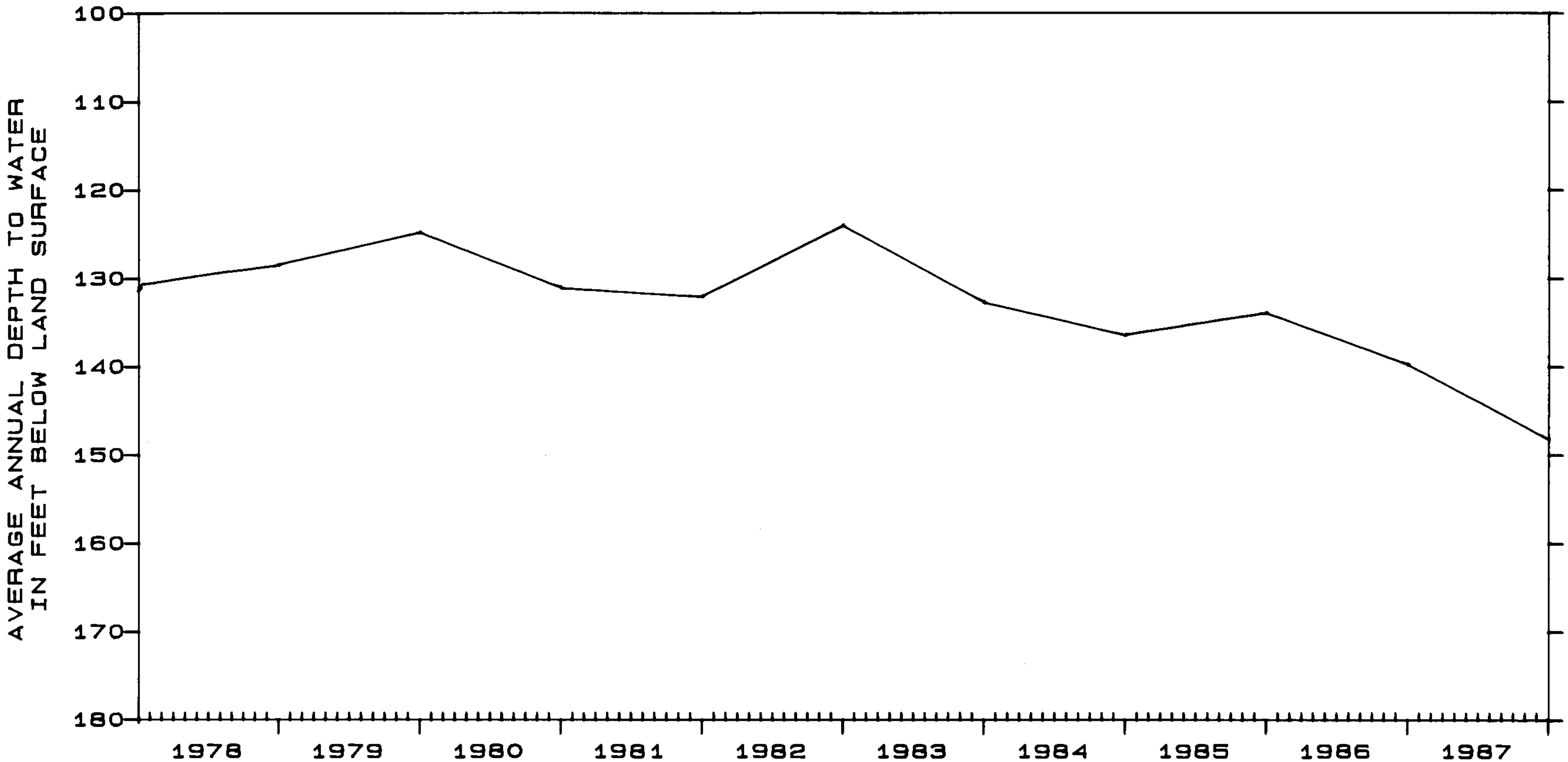

Figure 16. Hydrograph showing average annual water-level fluctuations in well Id55-01, Piney Point aquifer.

Observation Well Jd25-09

Well Jd25-09 is screened from 400 to 440 feet below land surface in the Piney Point aquifer. Water levels are affected by ground-water withdrawals from the Piney Point aquifer in the Dover area, primarily by wells owned and operated by the City of Dover and Dover Air Force Base. Levels have declined rather sharply during the period 1981-1987 from a level of 110 feet below land surface in May 1981 to 161 feet in December 1987 for a decline of approximately 62 feet (Figure 17). A record low water level of 172.37 feet was established in July 1987.

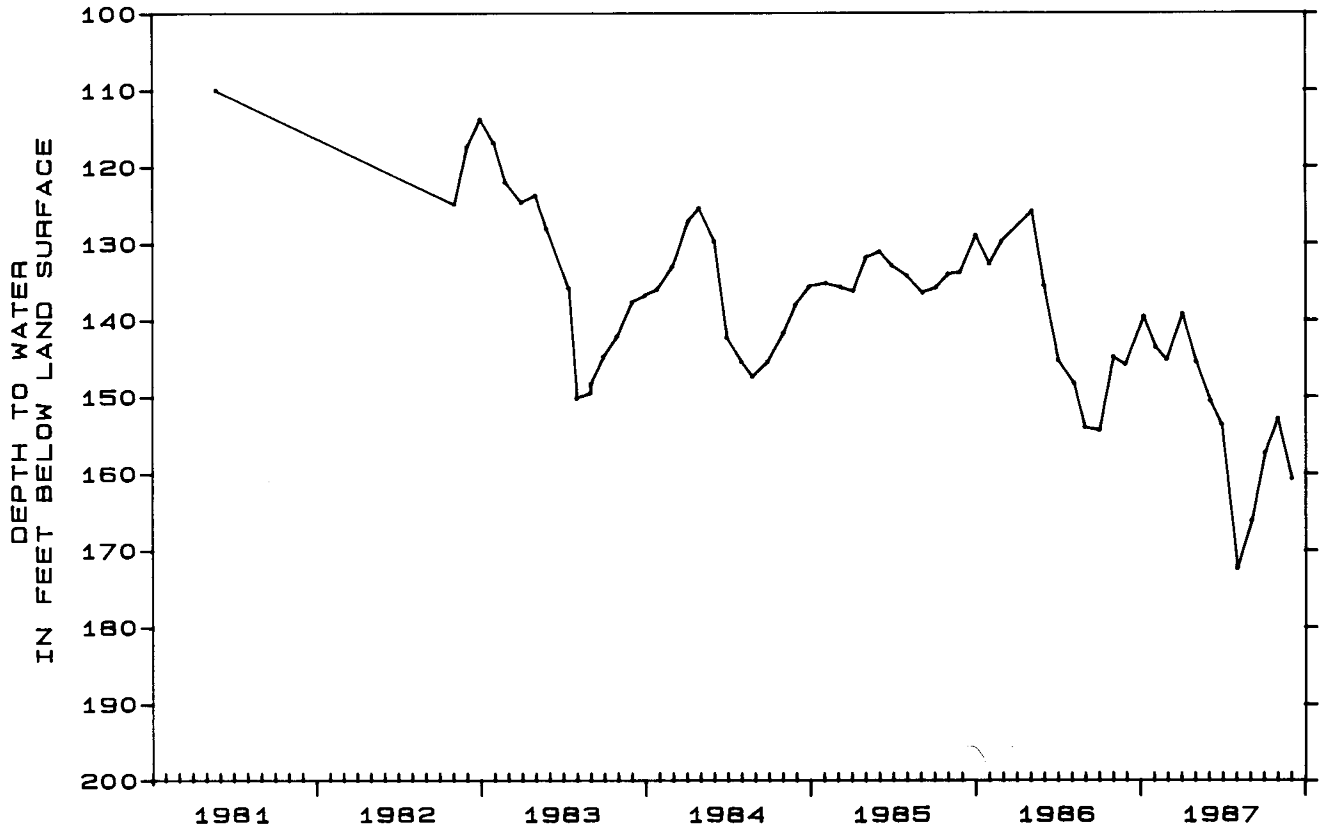

Figure 17. Hydrograph showing water-level fluctuations in well Jd25-09, Piney Point aquifer.

Observation Well Nc13-03

Well Nc13-03 is screened from 620 to 630 feet below land surface in the Piney Point aquifer. Hydrographs of observation well Nc13-03 (Figures 18 and 19) indicate a general downward trend of water levels from 1978 through 1987. Unlike the levels

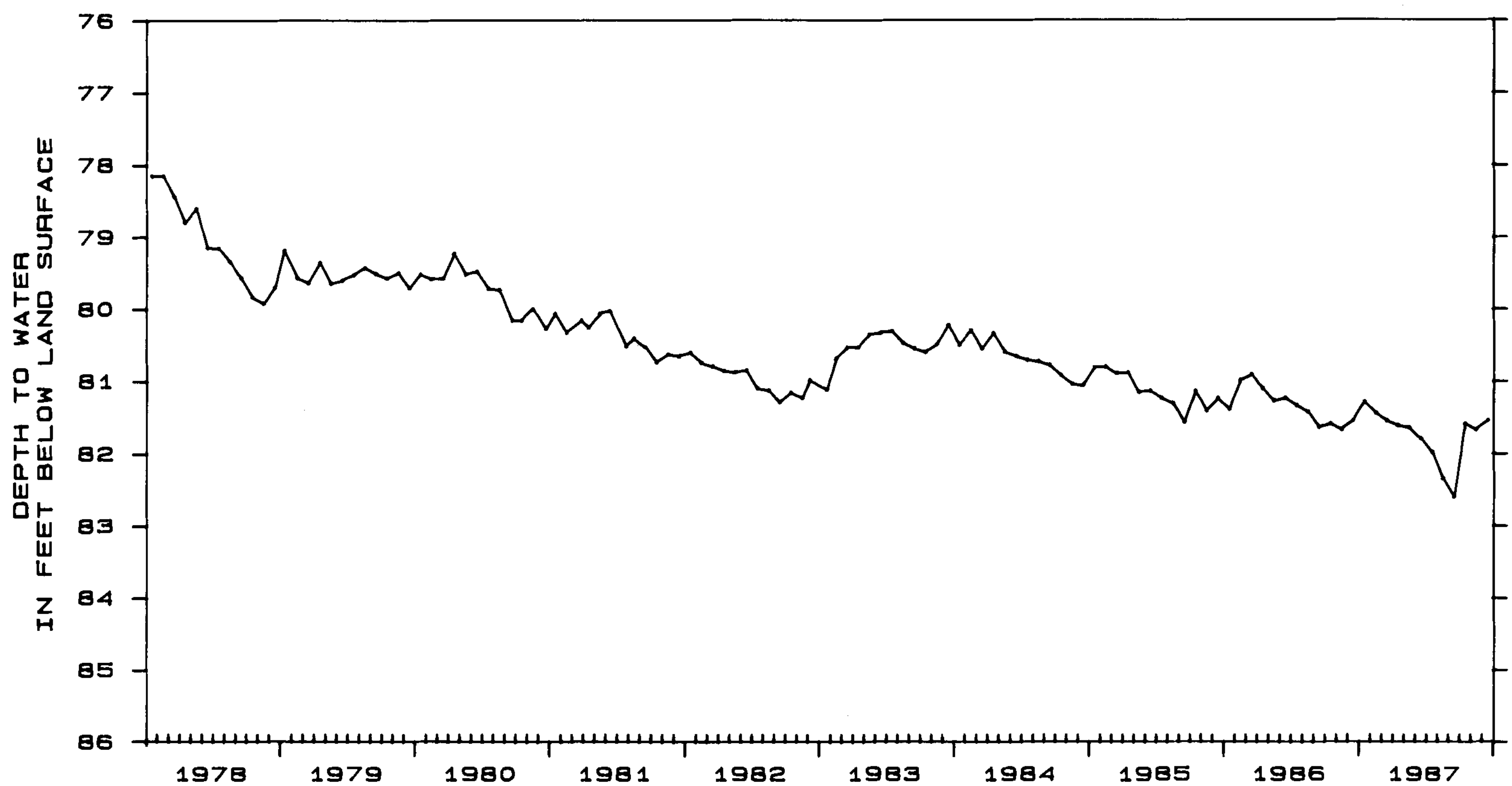

Figure 18. Hydrograph showing water-level fluctuations in well Nc13-03, Piney Point aquifer.

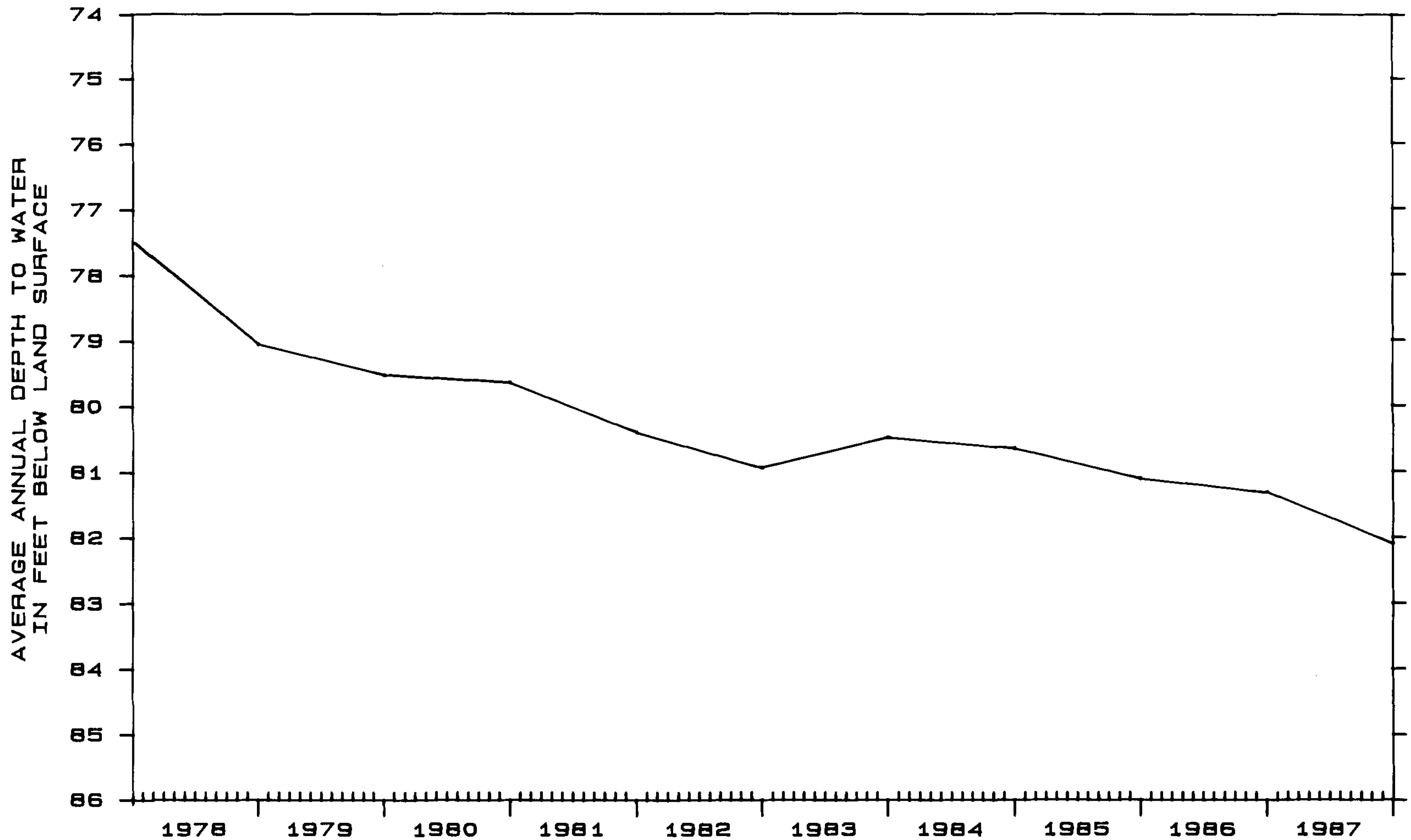

Figure 19. Hydrograph showing average annual water-level fluctuations in well Nc13-03, Piney Point aquifer.

in well Id55-01, the levels in Nc13-03 are affected only slightly by seasonal variations in ground-water pumpage. Nevertheless, trends in well Nc13-03 are consistent with those exhibited in well Id55-01, but of much smaller magnitude. In addition, the trends in Nc13-03 lag behind those in well Id55-01 by several months because of the distance between the pumping centers at Dover and well Nc13-03 (approximately 23 miles).

The total decline for the period 1978 to 1987 was 5 feet, an average of 0.5 foot per year which is 0.7 foot per year less than the 1.2 feet per year decline reported for the period 1971-1977 (Talley, 1978). Nevertheless, water levels in well Nc13-03 are likely to continue to decline if current or additional increases in pumpage occur.

Observation Well Jd25-10

Well Jd25-10 is screened 200 to 220 feet below land surface in the Cheswold aquifer. Water levels are affected by ground-water withdrawals from the Cheswold aquifer in the Dover area, principally by wells owned and operated by the City of Dover and Dover Air Force Base.

Water levels in this well have ranged between 68 and 91 feet below land surface during the reporting period (Figure 20). Water levels generally follow annual cycles of rise and decline which are correlative with ground-water withdrawals associated with seasonal demands for water. The highest levels occurred in 1983, a year in which precipitation at Dover was approximately 59 inches.

During the period 1981-1987, water levels in well Jd25-10 have remained relatively stable, indicating that ground-water withdrawals from the Cheswold aquifer in the vicinity of the well in south Dover have generally not increased.

A history of ground-water development of the Cheswold aquifer in the Dover area is presented by Marine and Rasmussen (1955), Sundstrom and Pickett (1968), and Leahy (1982).

Observation Well Rj22-06

Well Rj22-06 is screened 290 to 295 feet below land surface in the Manokin aquifer. Water levels in this well are influenced not only by natural seasonal fluctuations in water levels but also by ground-water pumpage in Bethany Beach, Delaware, and nearby Ocean City, Maryland. The largest effects result from nearby pumpage. Average daily pumpage, as computed from yearly totals in Ocean City for the period 1978-1986, ranged from 3.6 to 4.8 million gallons per day (Phelan, 1987). Because of the

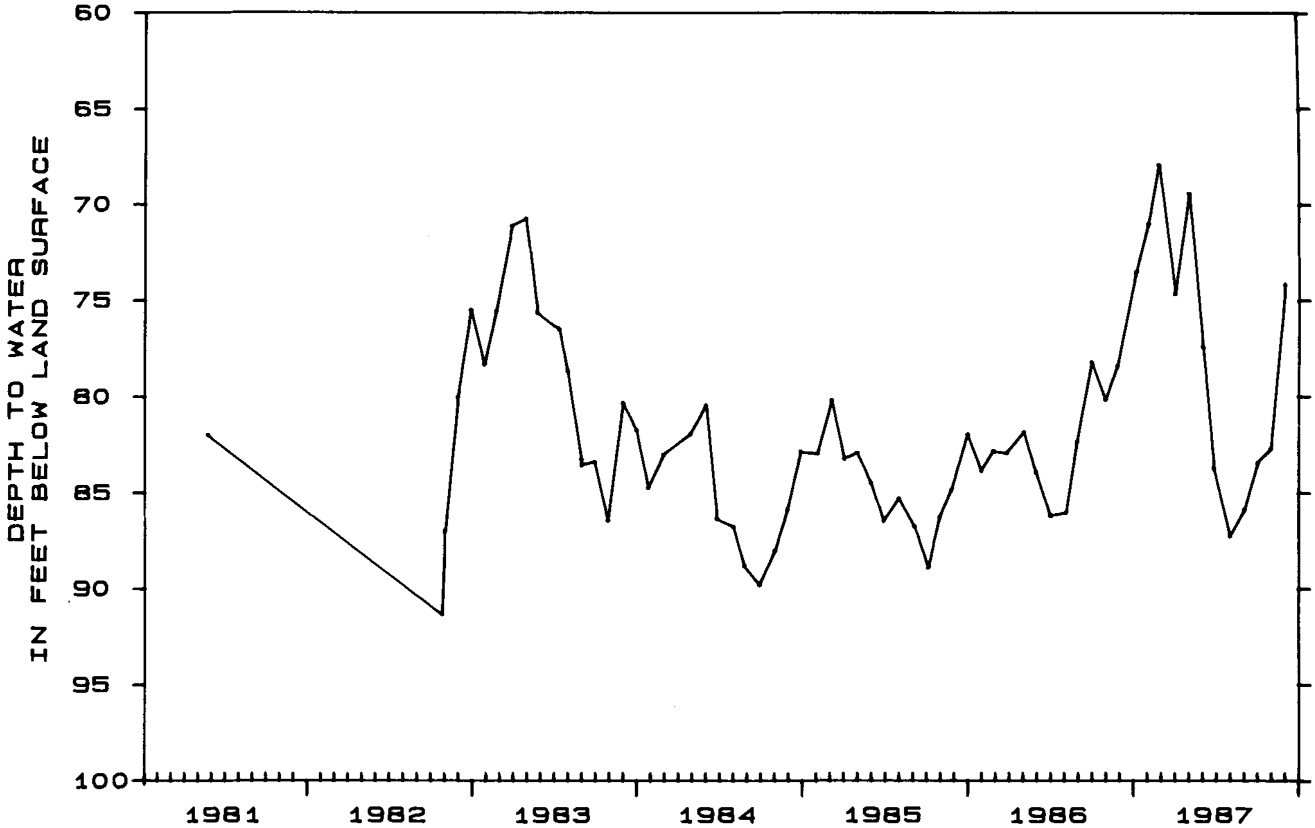

Figure 20. Hydrograph showing water-level fluctuations in well Jd25-10, Cheswold aquifer.

variation in population in resort areas, large ranges in daily pumpage occur from season to season. For example, average daily pumpage for February 1986 was 2.14 million gallons per day, whereas the average daily pumpage in July 1986 was 10.32 million gallons per day.

Figure 21 shows the seasonal variations with high levels occurring in late spring and low levels characterizing late summer and early fall. No long term declines in water levels are indicated as levels have recovered to prepumping conditions during the winter recovery period. High water levels have been above sea level during the reporting period. However, natural seasonal declines in water levels coupled with high summer pumping have caused water levels to fall up to 4 feet below sea level during summer and fall. It also appears that seasonal low levels have occurred at increasingly greater depths during the reporting period. For example, the lowest level recorded in 1978 was 6.06 feet below land surface (1.61 feet below sea level), whereas the lowest level in 1987 was 8.54 feet below land surface (4.09 feet below sea level).

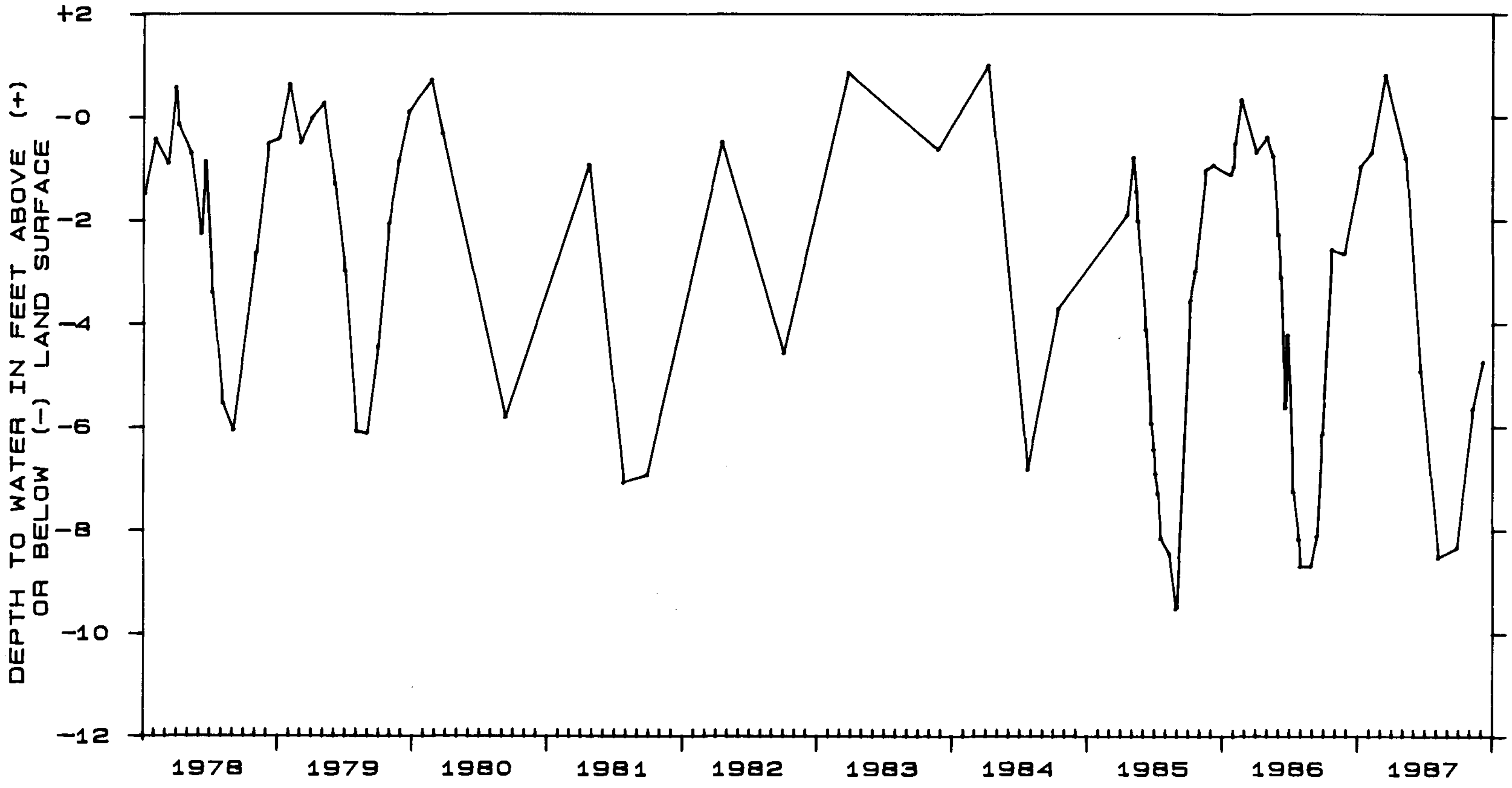

Figure 21. Hydrograph showing water-level fluctuations in well Rj22-06, Manokin aquifer.

Observation Well Rj22-07

Well Rj22-07 is located adjacent to well Rj22-06 and is screened from 180 to 185 feet below land surface in the Pocomoke aquifer. The Pocomoke and Manokin aquifers are part of the same hydrologic system and water levels in well Rj22-07 (Figure 22) react similarly to those in well Rj22-06. Maximum yearly fluctuations in well Rj22-07 are less than those recorded in well Rj22-06 which is constructed in the heavily pumped Manokin aquifer. Levels recover during the winter period in response to recharge and decreases in pumpage. Seasonal low water levels have increased during the reporting period. The maximum level reached in 1978 was 0.3 feet below sea level whereas the maximum level in 1987 was 2.12 feet below sea level.

CONCLUSIONS

There appear to have been no significant changes in ground-water storage in the shallow water-table aquifer in areas remote from ground-water development during the 10-year reporting period.

Hydrographs show the relationship between natural climatic factors and water-level rise and decline in the water-table aquifer. Levels generally rise from November through March, when recharge exceeds discharge, and decline from May through September during the warm growing season when soil moisture is deficient, evapotranspiration is high, and recharge is infrequent. Although levels in several wells declined for up to 18 months during relatively dry years in 1980-1981 and 1984-1985 as a result of below normal precipitation, levels recovered rather quickly in response to normal and above normal precipitation following extended dry periods.

The maximum water-level fluctuations during the 10-year period in the eight water-table wells was 11.72 feet in well Mc51-01 whereas the minimum was 5.41 feet in well Nc45-01. Although most shallow wells drilled in the past decade are greater than 20 feet deep, some owners of wells shallower than this can expect to experience supply difficulties during dry years. Those shallow wells that were constructed during periods when water levels were close to the surface are susceptible to shortages of supply during extended dry periods.

Ground-water pumpage in heavy-use areas of the Potomac, Piney Point, Cheswold, Manokin, and Pocomoke aquifers during the past several decades has resulted in the development of cones of depression with areas up to hundreds of square miles and long-term declines in water levels (Leahy, 1979, 1982; Hodges, 1984; Martin, 1984).

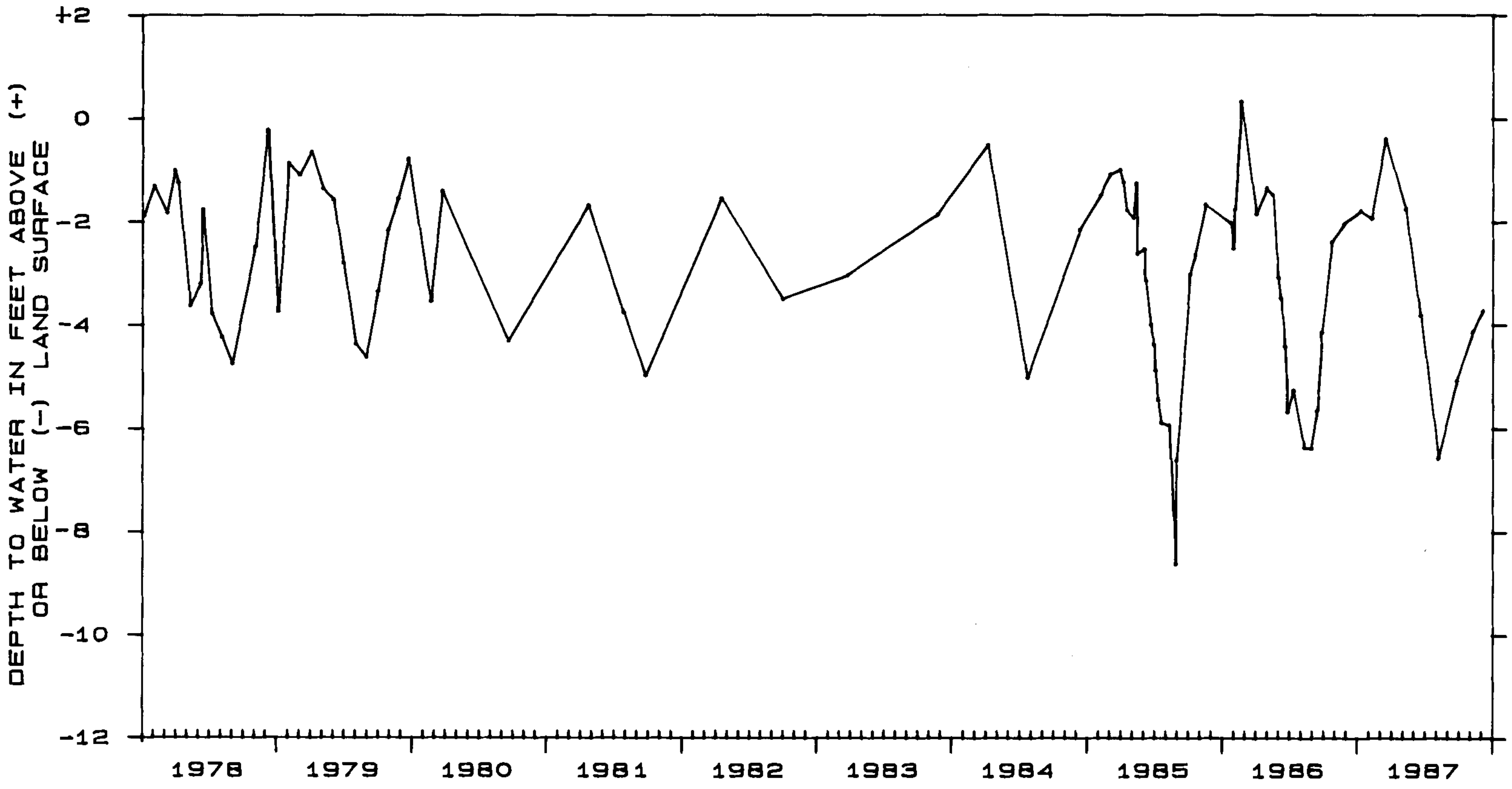

Figure 22. Hydrograph showing water-level fluctuations in well Rj22-07, Pocomoke aquifer.

Water levels in the Potomac aquifers in the vicinity of the three observation wells exhibited little change over the 10-year period with the exception of well Dc34-05 in which water levels rose approximately 25 feet. The establishment of a new dynamic equilibrium of water levels has resulted, at least partially, from ground-water allocations and maximum pumping levels enacted by the Delaware Department of Natural Resources and Environmental Control. A significant portion of the ground water used in northern New Castle County comes from the Potomac aquifer system, and it is imperative that pumpage, water-level, and water-quality data be collected and analyzed periodically to ensure proper management.

Wells Id55-01, Nc13-03, and Jd25-09, all constructed in the Piney Point aquifer, exhibited relatively large declines in water levels during the respective reporting period. Water levels in the aquifer will continue to decline if present rates of withdrawal are maintained or increased. Well field management should be reviewed periodically to ensure proper management of the resource.

Although water levels in well Jd25-10 (Cheswold aquifer) fluctuated from 70 to 90 feet below land surface, no long term trends are evident in the vicinity of the well.

Average annual water levels in the Manokin and Pocomoke aquifers as exhibited in wells Rj22-06 and Rj22-07 near Fenwick Island have remained relatively unchanged during the reporting period. However, maximum (lowest) levels that occur during the late summer months appear to be declining. Because of high seasonal demand for water from the Manokin and Pocomoke aquifer systems and associated potential for salt-water intrusion, water-level and water-quality monitoring programs in this environmentally sensitive area should be continued.

It is important that future development of all aquifer systems, both water-table and artesian, be carefully planned and managed by utilizing all available geologic and hydrologic data and application of ground-water models.

REFERENCES CITED

Baker, W. W., Varrin, R. D., Groot, J. J., and Jordan, R. R., 1966, Evaluation of the water resources of Delaware: Delaware Geological Survey Report of Investigations No. 8, 47 p.

Boggess, D. H., and Coskery, O. J., 1954, Water levels and artesian pressures in Delaware - 1953: Delaware Geological Survey Water-Level Report No. 2, 10 p.

Coskery, O. J., 1956, Water levels and artesian pressures in Delaware - 1955: Delaware Geological Survey Water-Level Report No. 4, 9 p.

______, 1961, Water levels in Delaware - 1957: Delaware Geological Survey Water-Level Report No. 6, 22 p.

______, 1961, Water levels in Delaware - 1958: Delaware Geological Survey Water-Level Report No. 7, 17 p.

Coskery, O. J., and Boggess, D. H., 1956, Water levels and artesian pressures in Delaware - 1954: Delaware Geological Survey Water-Level Report No. 3, 10 p.

Coskery, O. J., and Rasmussen, W. C., 1958, Water levels in Delaware - 1956: Delaware Geological Survey Water-Level Report No. 5, 21 p.

Cushing, E. M., Kantrowitz, I. H., and Taylor, K. R., 1973, Water resources of the Delmarva Peninsula: U. S. Geological Survey Professional Paper 822, 58 p.

Groot, J. J., and Rasmussen, W. C., 1954, Geology and ground-water resources of the Newark area, Delaware: Delaware Geological Survey Bulletin 2, 133 p.

Hodges, A. L., 1984, Hydrology of the Manokin, Ocean City, and Pocomoke aquifers of southeastern Delaware: Delaware Geological Survey Report of Investigations No. 38, 60 p.

Hydrologic Investigations Atlases (1963-1965) prepared cooperatively by the U. S. Geological Survey, Delaware Geological Survey, and Delaware State Highway Department (Published by the U. S. Geological Survey). Scale 1:24,000.

James, R. W., Simmons, R. H., and Strain, B. F., 1982, Water resources data, Maryland and Delaware, Water Year 1982: U. S. Geological Survey Water-Data Report MD-DE-82-1, p. 338-341.

James, R. W., Simmons, R. H., and Strain, B. F., 1983, Water resources data, Maryland and Delaware, Water Year 1983: U. S. Geological Survey Water-Data Report MD-DE-83-1, p. 277-279.

______, 1984, Water resources data, Maryland and Delaware, Water Year 1984: U. S. Geological Survey Water-Data Report MD-DE-84-1, p. 305-307.

______, 1985, Water resources data, Maryland and Delaware, Water Year 1985: U. S. Geological Survey Water-Data Report MD-DE-85-1, p. 249-251.

______, 1986, Water resources data, Maryland and Delaware, Water Year 1986: U. S. Geological Survey Water-Data Report MD-DE-86-1, p. 255-257.

______, 1987, Water resources data, Maryland and Delaware, Water Year 1987: U. S. Geological Survey Water-Data Report MD-DE-87-1, p. 263-265.

Johnston, R. H., 1973, Hydrology of the Columbia (Pleistocene) deposits of Delaware: an appraisal of a regional water-table aquifer: Delaware Geological Survey Bulletin 14, 78 p.

______, 1976, Relation of ground water to surface water in four small basins of the Delaware Coastal Plain: Delaware Geological Survey Report of Investigations No. 24, 56 p.

______, 1977, Digital model of the unconfined aquifer in central and southeastern Delaware: Delaware Geological Survey Bulletin 15, 47 p.

Jordan, R. R., 1964, Columbia (Pleistocene) sediments of Delaware: Delaware Geological Survey Bulletin 12, 69 p.

Leahy, P. P., 1979, Digital model of the Piney Point aquifer in Kent County, Delaware: Delaware Geological Survey Report of Investigations No. 29, 81 p.

______, 1982, Ground-water resources of the Piney Point and Cheswold aquifers in central Delaware as determined by a flow model: Delaware Geological Survey Bulletin 16, 68 p.

Marine, I. W., 1954, Water levels and artesian pressures in Delaware - 1952: Delaware Geological Survey Water-Level Report No. 1, 11 p.

Marine, I. W., and Rasmussen, W. C., 1955, Preliminary report on the geology and ground-water resources of Delaware: Delaware Geological Survey Bulletin 4, 336 p.

Martin, M. M., 1984, Simulated ground-water flow in the Potomac aquifers, New Castle County, Delaware: U. S. Geological Survey Water-Resources Investigations Report 84-4007, 85 p.

Martin, M. M., and Denver, J. M., 1982, Hydrologic data for the Potomac Formation in New Castle County, Delaware: U. S. Geological Survey Water-Resources Investigations Open-File Report 81-916, 148 p.

NOAA, 1982, Monthly normals of temperature, precipitation, and heating and cooling degree days 1951-1980, Delaware: Environmental Data and Information Service, National Climatic Center, Ashville, North Carolina, 7 p.

Phelan, D. J., 1987, Water levels, chloride concentrations, and pumpage in the coastal aquifers of Delaware and Maryland: U. S. Geological Survey Water-Resources Investigations Report 87-4229, 106 p.

Rasmussen, W. C., Groot, J. J., Martin, R. O. R., McCarren, E. F., Behn, V. C., and others, 1956, The water resources of northern Delaware: Delaware Geological Survey Bulletin 6, 223 p.

Rasmussen, W. C., Odell, J. W., and Beamer, N. H., 1966, Delaware water: U. S. Geological Survey Water-Supply Paper 1767, 106 p.

Rasmussen, W. C., Wilkens, R. A., and Beall, R. M., 1960, Water resources of Sussex County - a progress report: Delaware Geological Survey Bulletin 8, 228 p.

Rima, D. R., Coskery, O. J., and Anderson, P. W., 1964, Ground-water resources of southern New Castle County, Delaware: Delaware Geological Survey Bulletin 11, 54 p.

Spoljaric, Nenad, and Woodruff, K. D., 1970, Geology hydrology, and geophysics of Columbia sediments in the Middletown-Odessa area, Delaware: Delaware Geological Survey Bulletin 13, 156 p.

Sundstrom, R. W., and Pickett, T. E., 1968, The availability of ground water in Kent County, Delaware, with special reference to the Dover area: University of Delaware Water Resources Center Report, 123 p.

______, 1971, The availability of ground water in New Castle County, Delaware: University of Delaware Water Resources Center Report, 156 p.

Talley, J. H., August 1974-1987, Monthly reports on water conditions in Delaware: Delaware Geological Survey Special Publication No. 3, 49 p.

______, 1978, Ground-water levels in Delaware, July 1966 - December 1977: Delaware Geological Survey Report of Investigations No. 30, 50 p.

Talley, J. H., and Andres, A. S., 1987, Basic hydrologic data for coastal Sussex County, Delaware: Delaware Geological Survey Special Publication no. 14, 101 p.

U. S. Geological Survey, 1978, Water Resources Data for Maryland and Delaware, Water Year 1978: U. S. Geological Survey Water-Data Report MD-DE-78-1, p. 280-283.

U. S. Geological Survey, 1979, Water Resources Data for Maryland and Delaware, Water Year 1979: U. S. Geological Survey Water-Data Report MD-DE-79-1, p. 376-379.

U. S. Geological Survey, 1980, Water Resources Data for Maryland and Delaware, Water Year 1980: U. S. Geological Survey Water-Data Report MD-DE-80-1, p. 412-415.

U. S. Geological Survey, 1981, Water Resources Data for Maryland and Delaware, Water Year 1981: U. S. Geological Survey Water-Data Report MD-DE-81-1, p. 466-469.

Woodruff, K. D., November 1966 - July 1974, Monthly reports on Water conditions in Delaware: Delaware Geological Survey.

______, 1967, Ground-water levels in Delaware, January 1962 - June 1966: Delaware Geological Survey Report of Investigations No. 9, 28 p.

APPENDIX A

Well Descriptions and Water-Level Data

The well number is given first followed by the owner's name. The location is defined by latitude and longitude and sometimes more generally by reference to a nearby geographic feature. The aquifer screened, well construction data, highest and lowest water levels, period of record, and other pertinent information are also presented. Abbreviations used are listed below:

lat - latitude
long - longitude
lsd - land surface datum
msl - mean sea level
mp - measuring point

Db24-10. Department of Highways and Transportation. Lat. 39°38'56", long. 75°41'56". Near Newark. Bored observation water-table well in sand of Pleistocene age. Diameter 1 inch, depth 24.0 feet. Well point 21.0-24.0 feet. Lsd about 77 feet above msl. MP top of casing at lsd. Highest water level 4.88 feet below lsd, May 12, 1958; lowest 17.43 feet below lsd, Feb. 10, 1966. Records available 1957-1987.

Date	Water Level
1978	
Feb. 3	9.03
Mar. 8	5.95
Apr. 11	7.08
June 5	7.18
July 17	8.20
Aug. 29	7.39
1979	
Jan. 5	10.78
Jan. 31	7.09
Mar. 14	5.15
Apr. 16	5.79
June 13	7.55
Aug. 9	9.73
Aug. 31	10.33
Oct. 30	9.55
1980	
Jan. 3	9.38
Feb. 28	9.70
Apr. 8	6.93
May 29	7.70
July 28	10.58
Sept. 11	12.10
Oct. 2	12.90
Nov. 6	13.90
Dec. 4	14.60

Date	Water Level
1981	
Jan. 20	15.10
Feb. 9	15.40
Feb. 26	15.80
Mar. 12	15.40
Mar. 27	15.50
Apr. 16	15.10
May 8	15.50
June 11	14.00
July 2	14.15
July 29	13.80
Aug. 28	14.15
Oct. 1	14.70
Oct. 30	14.75
Dec. 3	15.15
Dec. 29	15.15
1982	
Feb. 2	13.60
Mar. 1	12.70
Apr. 2	10.92
May 27	9.55
June 1	9.55
July 8	9.63
July 26	10.43
Aug. 27	11.09
Sept. 30	12.60
Oct. 28	13.00
Nov. 17	13.48

Date	Water Level
1982	
Dec. 1	13.69
Dec. 30	13.25
1983	
Jan. 26	12.48
Mar. 7	9.44
Apr. 4	5.59
May 9	5.42
May 24	4.71
July 11	7.37
Aug. 2	8.82
Aug 31	10.73
Sept. 29	11.73
Nov. 2	12.97
Nov. 30	12.84
Dec. 29	9.15
1984	
Jan. 31	9.40
Feb. 29	7.69
Apr. 3	5.52
May 1	6.00
June 8	7.07
June 29	8.12
July 31	7.53
Aug. 29	8.86
Oct. 4	10.46
Nov. 1	11.50

Date	Water Level
1984	
Nov. 28	11.73
1985	
Jan. 7	12.53
Feb. 4	12.73
Feb. 15	12.45
Mar. 1	11.92
Apr. 3	12.67
May 1	12.73
May 31	13.06
June 28	13.52
July 16	13.80
Aug. 1	14.20
Sept. 5	14.65
Oct. 2	15.00
Oct. 15	14.83
Nov. 25	15.25
1986	
Jan. 2	14.65
Jan. 31	14.32
Feb. 28	12.44
Mar. 28	11.76
May 29	12.27
June 25	13.02
June 30	13.13
Aug. 4	13.96
Aug. 29	14.46

Date	Water Level
1986	
Sept. 22	14.96
Sept. 30	15.01
Oct. 17	15.44
Oct. 30	15.58
Nov. 10	15.74
Dec. 1	15.45
Dec. 16	14.48
1987	
Jan. 6	12.58
Feb. 4	11.49
Feb. 2	11.24
Mar. 9	10.65
Apr. 1	11.10
Apr. 23	10.82
May 1	10.89
June 1	11.24
June 29	12.04
Aug. 31	13.85
Oct. 2	4.32
Nov. 2	14.80
Dec. 1	15.10

Hb14-01. Department of Highways and Transportation. Lat. 39°19'49", long. 75°41'08". Near Blackbird. Bored observation water-table well in sand of Pleistocene age. Diameter 1 inch, depth 18.6 feet. Well point 15.6-18.6 feet. Lsd about 72 feet above msl. MP top of casing at lsd. Highest water level 1.49 feet below lsd, April 7, 1958; lowest 11.95 feet below lsd, Aug. 31, 1966. Records available: 1957-1987. Well is inclined to vertical and, therefore, levels reflect relative changes and not true distance from lsd.

Date	Water Level
1978	
Feb. 3	5.09
Feb. 27	6.03
Apr. 11	3.43
May 31	3.32
June 14	5.13
Aug. 25	6.18
Oct. 4	7.26
Nov. 2	6.97
Dec. 11	7.80
1979	
Jan. 22	4.67
Mar. 9	2.66
Apr. 12	3.80
June 6	5.10
July 11	6.12
Aug. 27	6.03
Oct. 4	5.64
Nov. 14	4.76
Dec. 27	5.85
1980	
Jan. 7	5.80
Feb. 29	6.27
Apr. 8	3.13
May 19	4.24
June 24	5.02
July 16	5.70
July 29	6.03
Aug. 5	6.32
Sept. 8	7.46
Oct. 30	8.01
Dec. 18	8.71

Date	Water Level
1981	
Jan. 20	9.14
Feb. 24	8.79
Apr. 8	8.97
May 11	8.69
June 19	8.75
July 9	8.98
Aug. 3	9.33
Aug. 17	9.55
Sept. 1	9.80
Oct. 1	10.09
Nov. 2	10.35
Dec. 1	10.53
1982	
Jan. 4	10.16
Feb. 2	9.75
Feb. 8	8.80
Mar. 2	8.18
Mar. 3	8.18
Mar. 9	7.68
Mar. 31	7.25
Apr. 22	6.18
Apr. 30	5.50
May 27	6.50
June 4	5.77
June 30	5.56
July 7	5.73
July 26	6.55
Aug. 10	7.07
Aug. 30	7.80
Sept. 28	8.58
Sept. 29	8.49
Oct. 26	9.09

Date	Water Level
1982	
Nov. 15	9.17
Nov. 30	9.25
Dec. 17	8.71
Dec. 29	8.37
1983	
Jan. 24	8.33
Feb. 24	7.29
Mar. 2	6.64
Mar. 29	3.23
Apr. 7	3.64
Apr. 29	2.06
May 6	3.19
May 23	2.29
June 7	3.08
July 11	4.60
July 22	4.77
July 29	5.50
Aug. 22	6.55
Aug. 30	6.75
Sept. 28	7.70
Oct. 27	8.40
Nov. 10	8.52
Nov. 30	7.83
Dec. 23	5.40
Dec. 29	5.35
1984	
Jan. 30	5.71
Feb. 1	5.69

Date	Water Level
1984	
Feb. 28	4.67
Mar. 13	4.20
Apr. 3	2.71
Apr. 12	2.38
Apr. 27	3.05
May 21	3.92
May 30	3.19
June 28	5.00
July 9	5.13
July 30	5.60
Aug. 22	6.49
Aug. 24	6.67
Sept. 27	7.68
Oct. 31	8.12
Nov. 28	8.37
Dec. 10	7.91
Dec. 27	8.08
1985	
Jan. 24	8.23
Feb. 4	7.94
Feb. 21	7.41
Mar. 5	7.56
Mar. 22	7.62
Apr. 2	7.62
Apr. 23	7.84
Apr. 30	7.85
May 22	7.20
May 30	6.95
June 20	7.19

Date	Water Level
1985	
June 27	7.42
July 18	7.08
July 30	7.58
Aug. 22	8.20
Sept. 4	8.47
Sept. 20	8.73
Oct. 1	8.05
Oct. 23	7.73
Oct. 29	7.90
Nov. 21	8.08
Dec. 24	7.66
Dec. 27	7.73
Dec. 30	7.84
1986	
Jan. 23	7.93
Jan. 30	7.22
Feb. 26	5.13
Feb. 28	5.31
Mar. 26	5.68
Mar. 31	5.80
May 2	6.50
May 12	6.56
May 29	7.12
June 20	7.52
June 30	7.85
July 23	8.35
Aug. 4	8.59
Aug. 28	9.07
Sept. 2	9.12

Date	Water Level
1986	
Sept. 30	9.62
Oct. 1	9.71
Oct. 30	10.05
Nov. 3	10.11
Nov. 11	10.03
Nov. 26	10.00
Dec. 1	9.60
Dec. 16	9.05
1987	
Jan. 6	6.56
Feb. 3	5.83
Feb. 26	5.40
Mar. 2	3.66
Mar. 31	4.95
Apr. 2	5.24
May 1	5.95
May 19	5.60
June 2	6.49
June 23	6.53
June 26	7.00
July 27	7.30
Aug. 24	8.67
Sept. 1	8.82
Sept. 17	9.15
Oct. 1	9.37
Oct. 14	9.68
Oct. 29	9.93
Nov. 23	10.16
Nov. 30	10.26
Dec. 15	10.40

Jd42-03. Division of Highways. Lat. 39°06'07", long. 75°33'15". Near Dover. Drilled observation water-table well in sand of Pleistocene age. Diameter 1.25 inches, depth 11 feet. Well point 8.5-11 feet. Lsd about 44 feet above msl. MP top of casing at lsd. Highest water level 2.69 feet below lsd, July 18, 1975; lowest 10.10 feet below lsd, Nov. 28, 1986. Records available Oct. 1950-Dec. 1961; August 1971-1987.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1979		1980		1981		1982	
Jan. 24	5.55	Jan. 23	6.17	Jan. 24	5.78	Jan. 22	7.36	Jan. 28	8.90
Feb. 22	5.41	Feb. 22	5.44	Feb. 22	6.11	Jan 27	7.59	Feb. 25	7.42
Mar. 23	4.69	Mar. 26	4.01	Mar. 26	5.84	Feb. 25	7.66	Mar. 26	6.90
Apr. 21	4.44	Apr. 24	4.64	Apr. 23	5.24	Mar. 26	7.81	Apr. 27	6.96
May 23	5.00	May 24	5.10	May 27	5.42	Apr. 15	7.62	May 27	7.19
June 21	5.10	June 25	4.44	June 23	5.86	Apr. 27	7.58	June 24	7.38
July 24	5.39	July 25	5.15	July 23	6.29	May 14	7.56	July 28	8.04
Aug. 24	5.05	Aug. 24	5.70	Aug. 25	6.26	May 26	7.73	Aug. 26	8.22
Sept. 25	6.16	Sept. 25	6.05	Sept. 24	7.02	June 29	7.82	Sept. 27	8.70
Oct. 25	6.67	Oct. 25	5.86	Oct. 27	6.95	July 30	8.33	Oct. 26	9.46
Nov. 24	7.18	Nov. 26	5.95	Nov. 25	6.86	Aug. 28	8.77	Nov. 24	9.70
Dec. 26	7.09	Dec. 26	6.15	Dec. 24	7.21	Sept. 28	8.50	Dec. 13	9.60
						Oct. 27	9.21	Dec. 27	9.01
						Nov. 23	9.48		
						Dec. 28	9.64		

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1983		1984		1985		1986		1987	
Jan. 24	8.94	Jan. 26	5.80	Jan. 24	7.83	Jan. 23	8.62	Jan. 5	7.69
Feb. 23	8.69	Feb. 27	5.49	Jan. 28	7.89	Feb. 27	7.07	Jan. 29	6.88
Mar. 29	6.54	Mar. 27	4.86	Feb. 22	7.16	Feb. 28	7.02	Feb. 3	6.78
Apr. 26	4.57	Apr. 10	3.88	Mar. 22	7.51	Mar. 27	6.56	Feb. 25	6.53
May 31	4.82	Apr. 26	4.10	Mar. 27	7.51	Apr. 29	6.77	Mar. 26	5.97
June 27	4.93	May 29	4.85	Apr. 22	7.73	May 27	7.39	Apr. 27	6.11
July 27	5.70	June 26	4.86	Apr. 26	7.80	June 20	7.82	May 29	6.43
Aug. 29	6.34	July 26	5.29	May 22	8.05	June 26	7.91	June 25	6.72
Sept. 26	6.69	Aug. 28	5.95	May 28	8.05	July 23	8.40	July 28	7.34
Oct. 28	7.15	Sept. 27	6.59	June 20	8.15	Aug. 29	9.05	Aug. 24	7.86
Nov. 28	6.78	Oct. 26	6.99	June 26	8.24	Sept. 26	9.57	Sept. 17	8.26
Dec. 27	5.71	Nov. 27	7.37	July 18	8.54	Oct. 29	10.09	Sept. 28	8.51
		Dec. 27	7.72	Aug. 22	8.91	Nov. 28	10.10	Oct. 14	8.80
				Aug. 26	9.07	Dec. 29	8.47	Oct. 28	9.03
				Sept. 20	9.44			Dec. 1	9.31
				Sept. 26	9.53			Dec. 15	9.63
				Sept. 30	8.71			Dec. 28	9.72
				Oct. 22	8.10				
				Nov. 21	8.45				
				Dec. 27	8.24				

Mc51-01. Department of Highways and Transportation. Lat. 38°50'42", long. 75°39'57". Near Farmington. Bored observation water-table well in sand of Pleistocene age. Diameter 1 inch, depth 18.1 feet. Well point 16.1-18.1 feet. Lsd about 55 feet above msl. MP top of casing at lsd. Highest water level 4.52 feet below lsd, July 16, 1975; lowest 15.74 feet below lsd, Sept. 30, 1981. Records available 1958-1987.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1980		1982		1985		1987	
Jan. 31	6.88	July 16	12.50	Aug. 11	13.29	Jan. 24	14.09	Jan. 5	13.18
Mar. 7	10.26	Aug. 15	13.26	Sept. 20	14.02	Feb. 4	13.93	Feb. 3	11.41
Apr. 13	6.93	Sept. 10	13.83	Nov. 15	15.08	Feb. 22	13.27	Mar. 3	9.61
May 26	8.81	Oct. 22	14.57	Dec. 20	14.39	Mar. 22	13.28	Apr. 13	10.77
July 11	11.23	Dec. 15	14.12			Apr. 22	13.57	May 19	11.52
Sept. 1	12.38			1983		May 22	13.91	June 23	11.55
Oct. 3	13.29	1981		Jan. 24	13.96	June 20	13.68	July 27	13.34
Nov. 13	14.23	Jan. 12	14.46	Mar. 1	12.98	July 18	14.17	Aug. 24	14.11
Dec. 11	14.62	Feb. 3	14.68	Mar. 30	11.55	Aug. 22	14.68	Sept. 17	14.60
		Feb. 19	14.70	May 13	8.65	Sept. 20	14.95	Oct. 14	15.21
1979		Apr. 7	13.29	June 13	8.73	Oct. 22	13.61	Nov. 17	15.79
Jan. 22	13.56	May. 5	12.66	July 18	9.90	Nov. 21	13.87	Dec. 15	16.13
Mar. 12	5.03	June. 10	12.71	Aug. 17	11.69	Dec. 27	13.08		
Apr. 16	8.59	July 16	13.31	Sept. 26	13.07				
June 18	10.41	Aug. 24	14.07	Nov. 14	13.93	1986			
July 9	11.35	Sept. 30	15.74	Dec. 19	11.10	Jan. 23	13.53		
Aug. 29	11.36	Oct. 23	15.06			Feb. 28	11.32		
Oct. 9	11.01	Nov. 27	15.53	1984		Apr. 4	10.73		
Nov. 21	10.31	Dec. 30	15.64	Jan. 30	10.40	May 15	12.12		
Dec. 19	10.93			Feb. 28	8.94	June 20	13.68		
		1982		Apr. 10	5.07	July 23	13.90		
1980		Feb. 9	14.55	May 31	4.28	Sept. 2	14.77		
Feb. 20	11.01	Mar. 16	12.16	June 12	8.56	Sept. 30	15.30		
Apr. 3	10.45	Apr. 20	11.96	July 22	11.21	Oct. 28	15.70		
May 15	10.09	June. 3	12.03	Aug. 28	12.69	Dec. 2	16.00		
June 27	11.95	July 14	12.76	Nov. 16	13.64				
				Dec. 18	14.24				

Md22-01. Department of Highways and Transportation. Lat. 38°53'10", long. 75°33'15". Near Harrington. Bored observation water-table Well in sand of Pleistocene age. Diameter 1 inch, depth 17.2 feet. Well point 14.2-17.2 feet. Lsd about 58 feet above msl. MP top of casing at lsd. Highest water level 1.07 feet below lsd, July 14, 1975; lowest 11.14 feet below lsd, Jan. 6, 1966. Records available 1958-1987.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1980		1982		1983		1985		1986	
Jan. 18	1.59	Oct. 24	9.37	Aug. 11	7.59	Dec. 19	2.85	Apr. 2	5.80	June 30	8.00
Mar. 7	4.11	Dec. 17	6.73	Aug. 30	8.53	Dec. 29	2.46	Apr. 30	6.91	July 23	8.40
Apr. 12	2.54			Sept. 20	9.08			May 21	6.31	Aug. 4	8.85
May 24	2.11	1981		Sept. 28	9.33	1984		May 22	6.35	Aug. 28	9.38
July 10	5.05	Jan. 13	7.37	Oct. 26	10.08	Jan. 30	2.08	May 30	6.48	Sept. 2	9.49
Aug. 25	6.08	Feb. 3	7.55	Nov. 15	10.12	Feb. 3	3.15	June 20	7.06	Sept. 30	10.09
Oct. 5	7.57	Feb. 17	6.01	Nov. 30	8.79	Feb. 28	1.91	June 27	7.41	Oct. 28	10.50
Nov. 15	8.73	Apr. 7	4.13	Dec. 20	5.87	Mar. 6	2.02	July 18	8.40	Oct. 30	10.53
Dec. 14	7.31	May 7	4.27	Dec. 29	6.08	Apr. 3	2.00	July 30	8.84	Nov. 11	10.57
		June 9	4.13			Apr. 9	1.89	Aug. 21	9.17	Nov. 19	10.71
1979		July 13	6.48	1983		Apr. 27	2.54	Aug. 22	9.09	Nov. 26	10.55
Jan. 31	2.18	Aug. 4	7.69	Jan. 24	4.04	May 30	1.25	Sept. 4	9.30	Dec. 2	10.05
Mar. 7	1.28	Aug. 31	8.32	Feb. 24	3.12	June 4	2.06	Oct. 3	6.67	Dec. 16	7.30
Apr. 10	2.54	Oct. 2	8.86	Mar. 1	3.86	June 28	4.68	Oct. 22	6.76		
Apr. 30	3.15	Nov. 3	9.40	Mar. 29	1.76	July 9	5.46	Oct. 29	6.95	1987	
June 18	3.36	Dec. 2	9.63	Mar. 30	1.80	July 30	6.12	Nov. 21	7.57	Jan. 6	2.90
July 13	4.93	Dec. 31	8.30	Apr. 29	1.96	Aug. 30	7.91	Dec. 27	5.41	Feb. 3	2.60
Aug. 22	4.29			May 13	3.56	Sept. 5	7.91	Dec. 30	5.77	Feb. 26	2.39
Oct. 9	3.45	1982		May 23	2.50	Sept. 27	8.70			Mar. 3	2.00
Nov. 15	2.25	Feb. 18	3.07	June 13	3.63	Oct. 31	9.29	1986		Mar. 31	2.93
Dec. 19	3.31	Mar. 2	2.85	July 11	5.40	Nov. 28	9.54	Jan. 23	6.20	Apr. 13	3.66
		Mar. 16	2.87	July 18	5.78	Dec. 11	9.03	Jan. 30	3.63	Apr. 30	3.79
1980		Mar. 31	3.70	July 29	6.08	Dec. 27	9.13	Feb. 26	2.47	May 19	4.15
Feb. 20	4.06	Apr. 19	3.07	Aug. 17	7.23			Feb. 28	2.52	June 2	5.17
Apr. 5	2.06	Apr. 30	2.81	Aug. 30	7.67	1985		Mar. 26	3.49	Oct. 14	10.61*
May 12	3.12	May 27	5.15	Sept. 26	7.47	Jan. 24	7.72	Apr. 12	3.96	Oct. 29	10.77
June 24	5.80	June 8	5.27	Sept. 28	7.62	Feb. 4	6.73	May 2	5.08	Nov. 23	10.96
July 15	6.42	June 30	6.28	Oct. 27	7.16	Feb. 22	5.29	May 7	5.36	Nov. 30	10.94
Aug. 11	7.43	July 13	7.10	Nov. 15	7.41	Mar. 5	5.50	May 29	6.61	Dec. 15	10.86
Sept. 11	8.49	July 26	7.45	Nov. 30	4.42	Mar. 22	6.17	June 20	7.67		

* Well destroyed June 1987. Replacement well constructed 5 feet from well Md22-01 on October 8, 1987.

Nc45-01. Department of Highways and Transportation. Lat. 38°46'40", long. 75°35'29". Near Greenwood. Driven observation water-table well in sand of Pleistocene age. Diameter 1 inch, depth 15.45 feet. Well point 12.95-15.45 feet. Lsd about 43 feet above msl. MP 1.05 feet above lsd. Highest water level 6.67 feet below lsd, Jan. 30, 1952; lowest 14.66 feet below lsd, Dec. 11, 1978. Records available 1950-1987.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1980		1982		1984		1986	
Jan. 19	10.09	June 23	12.45	Apr. 19	11.62	Aug. 30	12.56	June 20	12.95
Mar. 10	12.33	July 16	14.30	June 15	12.02	Sept. 27	13.02	July 23	13.29
Apr. 17	11.26	Aug. 11	13.10	July 13	12.37	Nov. 8	12.71	Sept. 2	13.62
May 22	11.33	Sept. 11	13.53	Aug. 11	12.79	Dec. 11	12.96	Sept. 30	13.84
July 20	13.08	Nov. 22	13.49	Sept. 20	13.25			Oct. 28	13.69
Sept. 1	13.35	Dec. 15	12.87	Nov. 15	13.16	1985		Dec. 2	11.98
Oct. 3	13.55			Dec. 20	12.51	Jan. 24	9.57		
Nov. 21	13.98	1981				Feb. 4	12.56	1987	
Dec. 11	14.66	Jan. 14	14.16	1983		Feb. 22	11.77	Jan. 5	11.23
		Feb. 3	13.20	Jan. 24	12.38	Mar. 22	12.26	Feb. 3	10.92
1979		Feb. 19	12.95	Mar. 1	11.34	Apr. 22	12.49	Mar. 3	10.68
Jan. 22	11.96	Apr. 7	12.47	Mar. 30	10.29	May 22	12.53	Apr. 13	11.80
Mar. 12	9.25	May 5	12.55	May 13	10.96	June 20	12.61	May 19	11.73
Apr. 11	11.27	June 16	12.65	June 15	11.62	July 18	12.90	June 23	12.65
June 18	11.37	July 13	12.95	July 18	11.92	Aug. 22	12.97	July 27	12.37
July 17	12.44	Aug. 4	13.29	Aug. 25	12.88	Sept. 20	13.25	Aug. 24	13.75
Aug. 20	12.23	Aug. 18	13.18	Sept. 26	12.78	Oct. 22	12.35	Sept. 17	13.78
Oct. 11	11.11	Nov. 2	13.27	Nov. 15	12.99	Nov. 21	12.06	Oct. 14	13.96
Nov. 27	11.39	Nov. 20	13.37			Dec. 27	12.06	Nov. 23	13.83
Dec. 18	11.80	Dec. 2	13.50	1984				Dec. 15	13.75
		Dec. 28	12.74	Jan. 9	10.46	1986			
1980				Feb. 3	11.49	Jan. 23	12.24		
Mar. 4	12.24	1982		Mar. 15	10.82	Feb. 28	11.02		
Apr. 2	10.80	Feb. 22	11.46	Apr. 9	9.29	Apr. 4	11.84		
May 12	11.10	Mar. 16	10.96	May 29	11.72	May 15	12.47		

Ng11-01. Department of Highways and Transportation. Lat. 38°49'55", long. 75°19'29". Near Milton. Bored observation water-table well in sand of Pleistocene age. Diameter 1 inch, depth 19.1 feet. Well point 16.1-19.1 feet. Lsd about 24 feet above msl. MP top of casing at lsd. Highest water level 6.91 feet below lsd, April 10, 1984; lowest 14.64 feet below lsd, Jan. 7, 1966. Records available 1959-1987.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1980		1982		1984		1986	
Jan. 18	9.25	June 24	10.30	July 6	11.47	Sept. 4	11.53	May 22	11.57
Mar. 8	10.02	Aug. 15	11.71	Aug. 9	11.80	Oct. 11	12.34	June 20	12.18
Apr. 17	8.63	Sept. 12	12.32	Sept. 22	12.68	Oct. 31	12.62	July 23	12.12
May 24	9.18	Oct. 20	12.90	Nov. 23	13.42	Dec. 10	12.98	Sept. 2	13.50
July 10	10.52	Dec. 9	12.59	Dec. 27	12.66			Sept. 30	13.60
Aug. 22	11.03					1985		Oct. 28	13.80
Oct. 4	11.98	1981		1983		Jan. 24	12.06	Dec. 2	13.49
Nov. 14	12.69	Jan. 20	12.90	Jan. 24	12.13	Feb. 4	11.26		
Dec. 13	12.68	Feb. 26	12.73	Mar. 1	11.08	Feb. 22	11.42	1987	
		Mar. 31	12.17	Mar. 30	8.74	Mar. 22	11.82	Jan. 5	10.86
1979		May 6	11.56	May 13	8.58	Apr. 22	12.03	Feb. 3	9.88
Jan. 30	10.31	June 17	11.74	June 13	9.27	May 22	12.09	Mar. 3	8.73
Mar. 7	7.12	June 20	12.37	July 18	9.25	June 20	11.98	Apr. 13	8.80
Apr. 10	8.32	Aug. 20	12.87	Sept. 22	10.97	July 18	12.08	May 19	9.50
June 14	9.48	Sept. 29	13.37	Oct. 5	10.51	Aug. 22	12.43	June 23	10.35
Aug. 22	10.11	Oct. 27	13.55	Nov. 9	11.24	Sept. 20	12.89	July 27	11.00
Oct. 4	8.62	Nov. 30	14.61	Dec. 27	9.91	Oct. 21	12.25	Aug. 24	12.33
Nov. 27	9.08	Dec. 28	13.50			Nov. 21	12.78	Sept. 17	12.78
Dec. 18	9.73			1984		Dec. 27	11.90	Oct. 14	13.26
		1982		Jan. 23	10.30			Nov. 23	13.55
1980		Feb. 22	12.20	Mar. 15	9.00	1986		Dec. 13	13.68
Feb. 21	10.35	Mar. 25	10.90	Apr. 10	6.91	Jan. 23	12.03		
Apr. 7	9.12	Apr. 26	11.12	June 4	8.33	Feb. 28	10.53		
May 16	8.85	May 27	11.37	July 9	9.69	Apr. 4	10.60		

Qe44-01. Department of Highways and Transportation. Lat. 38°31'39", long. 75°26'02". Near Trap Pond. Bored observation water-table well in sand of Pleistocene age. Diameter 1 inch, depth 25.0 feet. Well point 22-25 feet. Lsd about 50 feet above msl. MP top of casing at lsd. Highest water level 4.92 feet below lsd, Feb. 6, 1973; lowest, 12.22 feet below lsd, Dec. 2, 1981. Records available: 1959-1987.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1981		1982		1984		1985		1986	
Jan. 25	5.19	Jan. 20	10.00	Nov. 15	9.26	Apr. 3	5.56	Aug. 21	6.68	Oct. 30	11.91
Mar. 2	6.34	Feb. 6	9.76	Nov. 23	8.43	Apr. 11	5.64	Sept. 4	6.60	Nov. 11	11.96
Apr. 10	5.96	Feb. 27	6.56	Nov. 30	8.04	Apr. 27	6.19	Sept. 20	8.66	Nov. 26	11.72
May 22	5.84	Mar. 31	7.85	Dec. 27	7.29	May 23	7.65	Oct. 3	5.85	Dec. 2	11.53
July 19	9.57	May 4	7.48			May 30	6.17	Oct. 22	7.22	Dec. 16	9.75
Aug. 23	8.03	June 16	8.21	1983		June 28	8.10	Oct. 29	7.53		
Oct. 10	10.60	July 21	10.20	Jan. 25	6.78	July 9	8.52	Nov. 21	8.31	1987	
Nov. 21	11.06	Aug. 19	10.30	Feb. 22	6.13	July 30	9.17	Nov. 25	7.70	Jan. 6	6.75
Dec. 15	7.81	Aug. 26	10.56	Mar. 1	5.86	Sept. 4	10.42	Dec. 27	7.44	Feb. 3	5.85
		Oct. 2	11.63	Mar. 29	5.21	Sept. 27	11.25	Dec. 30	7.62	Feb. 26	5.50
1979		Nov. 3	11.93	Mar. 30	5.43	Oct. 11	11.20			Mar. 3	5.48
Mar. 16	4.98	Dec. 2	12.22	May 13	7.43	Oct. 31	10.77	1986		Mar. 31	6.08
Apr. 11	5.69	Dec. 29	11.39	June 13	7.50	Nov. 28	10.04	Jan. 23	7.66	Apr. 13	6.70
June 18	5.93			July 11	8.04	Dec. 10	8.95	Jan. 30	6.05	Apr. 23	6.71
July 17	8.33	1982		July 18	8.78	Dec. 27	9.42	Feb. 26	6.03	Apr. 30	6.25
Aug. 30	8.82	Feb. 23	7.65	July 29	9.55			Feb. 28	6.28	May 19	6.50
Oct. 17	5.93	Mar. 2	6.94	Aug. 25	9.15	1985		Mar. 26	7.33	June 2	8.04
Nov. 20	5.29	Mar. 25	6.78	Aug. 30	8.61	Jan. 24	8.56	May 2	8.31	June 23	8.28
Dec. 27	6.38	Mar. 31	7.19	Sept. 28	9.81	Feb. 4	6.89	May 22	9.29	July 27	10.36
		Apr. 26	7.46	Oct. 27	8.03	Feb. 22	6.97	May 29	9.62	Aug. 24	11.00
1980		Apr. 30	6.44	Nov. 15	8.57	Mar. 5	7.02	June 20	10.50	Sept. 17	11.44
Feb. 14	7.01	May 27	8.60	Nov. 30	5.83	Mar. 22	8.10	June 30	10.84	Oct. 1	11.71
Apr. 15	5.61	June 30	9.25	Dec. 12	6.05	Apr. 2	7.57	July 23	11.47	Oct. 14	11.95
May 12	6.17	July 6	9.66	Dec. 29	6.07	Apr. 30	9.04	Aug. 4	11.72	Oct. 29	11.70
July 14	9.31	July 26	10.36			May 20	9.83	Aug. 28	10.94	Nov. 23	11.32
Sept. 18	10.63	Aug. 12	9.53	1984		May 30	10.00	Sept. 2	10.81	Nov. 30	10.90
Oct. 20	11.71	Aug. 30	10.23	Jan. 23	6.32	June 20	10.42	Sept. 12	10.89	Dec. 15	10.07
Dec. 9	9.35	Sept. 22	10.95	Jan. 30	5.75	June 27	10.59	Sept. 30	11.60		
		Sept. 28	11.00	Feb. 28	5.73	July 18	11.13	Sept. 29	11.49		
		Oct. 26	10.84	Mar. 15	4.98	July 30	11.44	Oct. 28	11.94		

Bc43-01. Mrs. W. A. Worth. Lat. 39°46'52", long. 75°37'30". Near Hoopes Reservoir. Drilled unused well in Wissahickon Formation. Diameter 6", depth 165.35 feet. Lsd about 330 feet above msl. MP recorder platform 0.96 feet above lsd. Highest water level 20.98 feet below lsd, July 14, 1975; lowest, 37.02 feet below lsd, Oct. 25, 1986. Records available: Aug. 1950, Jan. 1956 to Sept. 1960, April 1961 to 1977, Oct. 1984 to 1987.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						1984						
5											31.94	32.51
10										31.09	31.89	31.34
15										31.30	32.10	31.74
20										31.63	32.24	31.87
25										31.76	32.23	32.07
eom										31.73	-	31.99
						1985						
5	31.97	31.92	29.54	29.41	29.55	30.02	31.85	31.35	32.57	29.20	32.30	26.07
10	31.77	32.52	29.67	29.99	30.00	30.32	32.15	29.95	32.93	29.75	32.31	27.70
15	31.82	27.50	29.66	30.28	30.33	30.85	32.22	31.55	33.17	30.50	32.57	28.95
20	31.91	28.75	30.14	30.56	28.55	30.65	32.58	32.23	33.50	31.10	31.71	28.84
25	32.01	28.78	30.19	30.72	29.10	31.15	32.87	32.41	33.80	31.70	30.75	29.95
eom	32.21	29.00	30.29	31.01	29.67	-	-	31.50	30.05	31.93	26.52	30.55
						1986						
5	30.45	25.65	-	27.50	26.26	28.67	31.45	32.87	34.40	36.17	36.87	26.30
10	30.60	25.40	26.15	27.38	26.64	29.30	31.78	33.10	34.75	36.48	35.50	28.45
15	31.16	25.88	26.35	27.85	27.00	29.07	32.15	33.48	35.15	36.69	34.94	27.32
20	30.95	24.80	26.03	25.35	27.37	29.65	32.45	33.84	35.50	36.63	34.96	26.15
25	28.93	24.82	26.80	25.67	27.54	30.55	32.68	33.85	35.85	37.02	33.10	27.65
eom	25.55	-	27.15	25.95	28.18	31.05	-	34.15	36.00	36.85	30.50	25.65
						1987						
5	-	-	24.70	25.45	25.55	26.65	29.18	29.75	32.60	30.65	33.05	30.01
10	26.26	25.95	25.00	25.00	25.52	26.95	29.60	29.90	32.71	31.38	33.35	30.56
15	27.05	26.30	25.50	25.43	25.50	27.58	24.50	30.75	31.70	32.00	32.80	30.86
20	26.10	26.83	25.76	25.50	25.83	28.05	26.05	31.35	27.30	32.45	32.93	29.13
25	25.55	26.97	26.15	25.72	25.57	28.34	27.76	31.90	29.65	32.79	33.18	29.14
eom	26.10	-	26.45	25.65	26.06	-	28.75	32.32	-	32.95	33.16	-

Cb12-10. Delaware Geological Survey. Lat. 39°44'27", long. 75°43'10". Near North Star. Drilled artesian observation well in Cockeysville Formation. Diameter 6 inches, depth 410 feet, cased to 103 feet; open hole 103 feet to 410 feet. Lsd about 175 feet above msl. MP base of water-level recorder housing 1.5 feet above lsd. Highest water level 6.16 feet below lsd, Apr. 5, 1984; lowest 12.44 feet below lsd, Oct. 31, 1986. Records available 1974-1987.

Date	Water Level	Date	Water Level
1978		1981	
Jan. 12	9.10	Feb. 17	11.40
Jan. 20	8.30	Feb. 26	11.15
Jan. 30	7.50	Mar. 13	11.55
Feb. 10	8.16	Mar. 17	11.62
Mar. 2	9.14	Mar. 20	11.68
Mar. 10	9.32	Apr. 3	11.70
Mar. 20	8.16	Apr. 7	11.72
Mar. 28	6.98	Apr. 10	11.74
		Apr. 28	11.60
1979	no data	June 10	11.50
		July 17	12.00
1980	no data		

Cb12-10 (continued).

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						1982						
5	-	-	-	-	-	-	-	-	11.34	-	11.72	11.62
10	-	-	10.45	-	-	-	-	-	11.36	11.62	11.76	11.80
15	-	-	-	-	-	-	-	-	11.42	11.67	11.66	11.86
20	-	-	-	-	-	-	-	-	11.45	11.70	11.77	11.41
25	-	-	-	-	-	-	-	-	11.54	11.77	11.86	11.62
eom	-	-	-	-	-	-	-	11.26	-	-	11.72	11.74
						1983						
5	11.84	-	10.09	8.05	7.27	7.56	-	9.45	10.22	10.68	-	-
10	11.84	-	9.84	8.14	7.64	7.88	8.76	-	10.35	10.84	-	-
15	11.35	10.85	-	7.43	7.84	8.08	8.99	-	10.44	10.76	-	-
20	11.48	-	-	6.80	7.86	8.34	9.10	9.82	10.54	-	-	-
25	11.24	10.01	-	6.74	7.16	8.27	8.98	10.02	10.56	-	9.10	-
eom	11.15	-	-	6.98	7.36	8.44	9.26	10.06	10.62	-	-	-
						1984						
5	-	-	-	6.16	-	-	-	-	-	9.67	10.11	-
10	-	-	-	6.40	-	-	-	-	-	-	-	10.17
15	-	-	-	6.62	-	-	-	-	-	-	10.30	10.38
20	-	-	7.64	6.65	-	-	-	-	-	-	10.40	-
25	-	-	-	6.82	-	-	-	-	-	-	10.43	-
eom	-	-	-	6.91	-	7.58	8.00	7.83	-	-	10.38	-
						1985						
5	-	10.45	-	11.20	11.04	11.35	-	11.64	11.86	11.62	-	11.05
10	10.62	-	-	-	-	11.38	-	-	11.91	11.71	-	11.17
15	10.56	-	-	-	-	11.48	11.87	-	12.01	11.78	-	11.22
20	10.59	-	-	-	-	11.49	11.93	-	12.02	11.89	-	11.28
25	10.70	-	-	-	-	11.53	-	-	11.78	11.90	-	11.29
eom	10.82	-	-	-	-	11.57	11.97	11.77	11.64	12.00	11.53	-
						1986						
5	11.53	10.44	9.87	10.34	10.37	10.99	11.40	11.78	-	-	-	11.20
10	11.57	10.10	10.09	10.34	10.54	11.08	11.42	-	-	-	12.20	11.09
15	11.64	10.17	10.06	10.39	10.63	10.94	11.53	-	-	12.23	12.11	10.97
20	11.57	10.04	9.82	10.08	10.67	-	11.58	-	-	-	12.14	10.83
25	11.31	9.57	10.15	10.08	10.76	11.22	11.66	-	-	-	11.87	10.70
eom	10.31	9.58	10.19	10.20	10.84	11.26	-	12.06	-	12.44	11.54	10.24
						1987						
5	-	-	-	9.76	9.90	-	10.74	11.17	11.52	11.21	11.46	10.95
10	10.20	9.89	9.38	9.19	9.82	-	10.81	11.18	11.32	11.38	-	11.08
15	10.35	9.97	9.59	9.43	9.95	-	10.86	11.30	11.17	11.43	-	11.39
20	10.21	10.18	9.73	9.58	10.03	-	10.97	11.34	11.00	11.46	-	11.25
25	9.95	10.27	9.99	9.70	9.98	-	11.06	11.44	10.82	11.54	-	11.25
eom	9.98	10.32	10.02	9.70	10.05	10.68	11.11	11.47	-	-	-	11.35

Dc34-05. State of Delaware, Delaware National Guard Rifle Range, near New Castle. Lat 39°37'55", long. 75°36'48". Drilled artesian observation well in the lower Potomac aquifer. Diameter 2 inches to 579 feet, depth 579 feet. Screened 574-579 feet. Lsd 28 feet above msl. MP top of 2 inch coupling 2.1 feet above lsd. Highest water level 88.38 feet below lsd, Oct. 10, 1984; lowest 130.62 feet below lsd, May 5, 1978. Records available Nov. 1975-1987. Water levels are influenced by nearby pumping.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1979		1980		1981		1984	
Feb. 1	126.13	Mar. 21	125.33	Apr. 23	113.69	June 12	101.81	Apr. 16	96.41
Mar. 7	127.90	Apr. 19	123.69	May 22	119.23	July 14	100.46	Oct. 10	88.38
Apr. 7	129.51	May 18	123.18	June 19	110.10	Aug. 13	97.49		
May 5	130.62	June 18	119.12	July 18	106.73	Sept. 14	96.50	1985	
June 7	129.98	July 18	121.27	Aug. 18	104.76	Oct. 14	96.20	Feb. 4	95.51
July 4	126.89	Aug. 17	119.20	Sept. 16	112.74			Aug. 22	101.90
Aug. 7	123.00	Sept. 14	117.70	Oct. 16	117.45	1982			
Sept. 8	124.08	Oct. 16	116.93	Nov. 13	115.48	Apr. 20	101.81	1986	
Oct. 18	121.57	Nov. 16	114.53	Dec. 15	110.92	Oct. 15	96.74	no data	
Oct. 30	121.27	Dec. 14	113.72						
Nov. 29	117.91			1981		1983		1987	
Dec. 29	120.40	1980		Jan. 15	107.05	Apr. 20	97.87	Mar. 11	106.79
		Jan. 11	105.97	Feb. 13	108.29	Nov. 21	100.66	Aug. 24	105.74
1979		Feb. 8	100.95	Mar. 18	106.85				
Jan. 30	122.72	Mar. 7	101.67	Apr. 16	108.04				
Mar. 2	124.73	Apr. 7	110.75	May 15	105.15				

Ec32-07. Union Carbide. Lat. 39°32'39", long. 75°38'01". Near St. Georges. Drilled artesian observation well in lower Potomac aquifer. Diameter 6 inches to 596 feet, depth 596 feet. Screened 586-596 feet. Lsd about 11 feet above msl. MP top of casing 1 foot above lsd. Highest water level 39.72 feet below lsd, Oct. 23, 1967; lowest 95.31 feet below lsd, Feb. 9, 1981. Records available August 1967-1987. Water levels are influenced by pumping in the Delaware City area.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1981		1983		1985		1986	
May 2	89.00	Sept. 28	85.00	Mar. 7	78.98	Jan. 4	87.67	Aug. 5	88.85
Aug. 16	81.70	Oct. 16	82.90	Apr. 4	86.13	Feb. 7	89.40	Aug. 29	89.50
		Dec. 4	84.20	May 9	88.58	Mar. 5	83.92	Oct. 1	86.38
1979		Dec. 29	85.90	May 24	88.71	Apr. 2	80.33	Oct. 30	84.64
Jan. 4	86.00			July 11	93.00	Apr 30	79.60	Dec. 1	86.70
		1982		Aug. 2	91.58	June 28	85.78		
1980		Mar. 1	90.75	Aug. 31	91.73	Aug. 5	86.87	1987	
Feb. 28	90.03	Apr. 5	85.94	Sept. 29	92.33	Sept. 5	85.71	Jan. 7	85.59
Apr. 8	79.45	May 1	89.38	Nov. 2	88.02	Oct. 7	86.08	Feb. 27	83.74
May 29	69.60	May 27	84.90	Nov. 30	85.67	Oct. 30	86.10	Apr. 1	81.48
July 28	83.80	July 7	86.04	Dec. 29	88.00	Nov. 26	77.61	May 1	77.48
Sept. 11	90.00	July 26	89.90					June 3	75.19
		Sept. 3	85.67	1984		1986		Aug. 3	75.30
1981		Sept. 30	90.16	Feb. 28	92.29	Jan. 2	85.66	Sept. 1	91.01
Jan. 21	95.10	Oct. 28	91.70	Apr. 11	87.71	Feb. 6	87.30	Oct. 2	88.77
Feb. 9	95.31	Dec. 1	90.02	May 1	84.12	Feb. 28	89.95	Oct. 29	90.01
Mar. 12	95.30	Dec. 31	92.13	June 13	86.00	Mar. 28	83.48	Dec. 1	90.04
May 22	82.70			June 29	81.29	May 5	81.97		
July 15	85.35	1983		July 31	83.88	June 2	84.62		
Aug 28	83.15	Jan. 27	91.00	Nov. 1	81.62	June 30	89.10		

Dc34-06. State of Delaware, Delaware National Guard Rifle Range, near New Castle. Lat. 39°37'55", long. 75°36'48". Drilled artesian observation well in upper Potomac aquifer. Diameter 6 inches to 43 feet; 2 inches to 190 feet, depth 190 feet. Screened 183-188 feet. Lsd 28 feet above msl. MP top of casing 2.0 feet above lsd. Highest water level 39.30 feet below lsd, Feb. 2, 1976; lowest 62.37 feet below lsd, Oct. 15, 1982. Records available Nov. 1975-1987. Water levels are influenced by nearby pumping. (Noon water level on 5th, 10th, 15th, 20th, 25th, and end of each month below land-surface datum for the period Nov. 11, 1975 to Nov. 13, 1981). e = estimate.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						1978						
5	52.70	52.47	52.62	52.08	52.16	51.13	50.75	-	-	-	48.34	48.08
10	52.63	52.35	52.30	52.47	52.49	52.41	-	-	-	-	48.45	48.13
15	52.58	52.92	52.84	53.00	52.31	52.14	-	-	-	-	48.20	47.80
20	51.50	52.34	52.88	52.07	52.50	51.60	-	-	-	48.67	48.38	47.46
25	52.01	52.57	52.80	52.98	52.33	52.03	-	-	-	48.42	48.45	47.98
eom	52.99	52.85	53.24	52.59	52.63	52.08	-	-	-	48.18	47.78	48.05
						1979						
5	49.22	48.22	47.71	46.30	45.50	44.95	44.15	44.25	43.88	44.20	-	42.05
10	48.65	47.64	46.50	46.20	45.55	44.59	43.86	43.40	44.93	43.70	-	43.07
15	48.47	47.33	46.89	45.47	45.67	44.90	44.65	44.50	44.20	44.00	-	42.75
20	48.10	47.92	47.05	45.88	45.03	44.48	43.92	43.90	43.60	44.22	42.67	42.36
25	47.60	46.95	45.85	45.50	44.59	41.15	44.56	44.10	47.35	-	42.95	41.92
eom	48.00	47.09	45.95	45.06	45.80	43.82	44.34	44.25	44.61	-	42.98	42.78
						1980						
5	42.50	42.40	42.08	42.66	-	45.78	45.51	45.22	45.96	46.90	46.70	55.77
10	43.59	42.37	42.56	41.63	-	44.84	44.96	45.23	46.20	46.33	53.30	55.15
15	42.85	42.01	43.04	41.33	-	44.64	45.88	44.90	46.89	46.55	54.75	56.02
20	42.93	42.25	43.15	41.94	-	45.23	45.04	45.34	46.52	46.60	55.00	-
25	43.25	43.13	43.56	-	44.43	45.13	44.59	45.51	45.64	45.10	55.35	-
eom	42.00	42.55	42.49	-	44.76	44.86	45.13	45.99	46.54	46.80	56.35	-
						1981						
5	-	54.30	55.25	55.78	57.00	-	-	59.85	60.02	59.20	-	-
10	-	55.30	54.95	57.17	57.70	-	59.15	59.55	59.90	58.75	59.70	-
15	53.22e	55.65	56.05	57.09	57.48	59.12	58.95	59.37	60.25	59.80	-	-
20	52.65	54.55	55.57	56.35	58.10	-	59.55	59.75	60.40	-	-	-
25	53.05	56.15	56.96	57.30	-	-	59.60	60.00	60.50	-	-	-
eom	53.30	56.10	56.85	57.15	-	-	59.80	59.55	59.75	59.87	-	-

1982	1983	1984	1985	1986	1987
Apr. 20 60.27	Apr. 20 62.35	Apr. 16 56.49	Feb. 4 51.43	no data	Mar. 11 54.49
Oct. 15 62.37	Nov. 21 57.58	Oct. 10 53.19	Aug. 22 55.87		Aug. 24 56.55

Id55-01. City of Dover. Lat. 39°10'26", long. 75°30'49". Drilled artesian observation well in the Piney Point aquifer. Diameter 2.5 inches, depth 349 feet. Screened 329-349 feet. Lsd about 20 feet above msl. MP top of casing at lsd. Highest water level 67.34 feet below lsd, May 4, 6, and 8, 1970; lowest 163.67 feet below lsd, Aug. 24, 1987. Records available 1969-1987. Water levels are influenced by pumping in the Dover area. (Noon water level on 5th 10th, 15th, 20th, 25th, and end of each month below land-surface datum from digital recorder). e = estimate.

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						1978						
5	-	132.42	131.94	131.59	133.00	129.78	132.50	130.05	129.75	129.74	121.41	118.50e
10	123.13	131.70	132.38	132.22	132.93	130.39	131.22	130.26	129.25	128.54	121.01	118.48e
15	125.75	131.12	131.90	132.58	132.62	131.28	131.19	131.11	129.00	128.50	120.45	117.25e
20	127.82	131.39	132.08	131.81	131.01	130.84	130.51	132.86	129.22	127.28	120.22	116.65e
25	-	131.10	132.09	132.66	130.35	132.18	129.65	132.86	130.65	125.00	119.30	116.10e
eom	-	131.20	131.82	132.62	129.25	133.03	129.56	131.75	130.42	123.28	118.82e	114.99e
						1979						
5	-	114.60	118.93	-	124.37	-	-	129.00	132.10	-	128.90	122.40
10	-	114.70	-	-	124.97	-	123.64	130.30	132.90	-	128.40	122.20
15	-	114.80	-	122.20	126.27	-	-	131.40	133.30	-	128.10	121.80
20	-	115.10	-	123.40e	127.15	-	126.30	-	132.50	128.90	126.90	121.40
25	113.50e	115.40	-	123.38	-	126.77	126.70	131.40	130.80	129.30	124.60	118.50
eom	114.10e	-	-	124.15	-	-	127.40	132.20	130.40	129.51	123.10	117.20
						1980						
5	-	122.50	124.90	128.70	130.40	131.80	130.90	136.80	138.80	137.70	133.60	129.00
10	-	123.00	126.20	128.70	131.30	131.20	129.70	137.10	138.90	137.70	132.60	129.00
15	-	123.60	126.50	129.00	131.10	130.90	130.30	138.30	138.90	135.50	132.10	129.70
20	120.70	123.60	127.20	129.30	131.30	130.60	133.20	137.60	138.30	134.60	131.30	129.30
25	121.30	124.00	127.40	130.20	131.20	131.30	135.90	137.50	137.80	134.90	130.20	127.90
eom	122.10	124.40	128.20	130.70	131.20	131.60	135.90	137.90	137.70	134.30	129.10	126.10
						1981						
5	125.20	125.60	124.60	127.40	128.00	131.20	137.30	141.60	141.60	137.00	134.20	129.60
10	126.20	125.50	124.40	128.10	127.50	133.20	137.70	140.50	140.20	136.50	133.90	129.30
15	126.00	124.80	124.50	127.80	126.00	135.30	140.80	141.00	139.80	135.30	132.60	129.80
20	125.10	124.20	124.40	126.40	126.90	136.70	142.60	140.70	139.70	135.50	132.00	130.40
25	125.30	123.80	125.60	126.60	128.50	137.20	143.90	140.10	140.10	135.90	131.70	129.90
eom	125.30	124.60	126.10	127.60	129.90	137.10	143.20	141.20	139.10	134.10	130.20	129.00

Id55-01 continued

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						1982						
5	127.50	132.50	129.40	130.00	121.90	120.80	121.20	121.90	123.30	122.01	121.30	120.25
10	128.50	132.20	129.80	128.00	120.20	120.90	121.80	122.50	122.10	121.46	121.91	119.61
15	129.40	132.10	130.20	126.00	119.20	120.50	121.70	123.80	122.30	120.95	121.57	119.13
20	130.60	131.80	130.40	125.20	119.60	120.70	122.60	123.50	124.50	120.18	121.91	119.02
25	132.00	130.20	130.50	124.70	119.30	120.90	123.20	122.60	124.00	119.46	121.87	118.83
eom	132.50	129.80	130.30	123.50	119.50	121.10	123.20	122.70	122.90	119.95	120.55	117.44
						1983						
5	117.11	116.84	122.49	-	126.98	128.01	133.25	143.80	143.19	140.94	139.89	137.82
10	117.12	118.25	123.07	-	127.51	128.32	133.72	144.46	144.23	140.44	139.56	138.29
15	117.32	118.53	123.90	-	127.91	128.69	135.04	145.03	144.66	140.20	137.39	138.05
20	117.31	120.24	124.70	-	127.91	130.78	137.59	145.10	143.35	140.00	138.06	138.23
25	116.84	121.02	124.94	-	128.16	131.43	139.63	145.57	144.08	139.83	137.81	137.44
eom	116.83	121.71	124.57	-	128.01	132.66	141.95	144.06	142.33	140.25	137.14	136.63
						1984						
5	135.56	136.10	133.70	128.65	126.03	129.63	139.51	141.79	141.61	141.72	141.04	138.59
10	135.26	136.12	133.24	127.89	126.50	131.91	139.20	141.43	141.83	141.13	140.82	137.98
15	135.87	135.56	132.42	127.14	126.89	135.61	140.42	142.49	142.44	140.53	140.66	137.63
20	136.05	134.99	131.80	126.46	127.94	137.53	142.04	144.35	141.53	141.00	140.78	137.16
25	136.43	133.99	131.40	125.56	129.90	138.47	142.62	144.13	141.10	141.08	139.98	136.74
eom	136.29	133.54	130.06	125.67	129.49	138.78	142.57	142.34	142.17	141.30	138.83	135.63
						1985						
5	134.75	135.37	135.94	132.28	130.98	129.93	130.55	134.34	136.21	135.75	135.75	135.32
10	134.65	135.61	135.61	131.82	131.20	129.75	130.73	135.10	137.19	-	135.76	135.73
15	134.14	135.69	135.02	131.23	131.40	130.08	131.30	136.23	138.00	-	135.85	135.13
20	134.45	135.79	134.18	130.75	131.23	130.08	132.04	138.00	136.79	-	136.25	134.68
25	134.80	136.16	133.30	130.78	130.81	130.12	132.83	137.94	135.76	-	136.28	133.84
eom	135.32	136.12	132.91	131.02	130.19	130.77	132.97	137.26	135.75	135.75	135.51	132.41
						1986						
5	131.46	132.74	131.19	129.10	127.18	136.70	141.27	145.84	148.00	150.37	147.01	146.42
10	131.22	132.74	131.39	128.87	129.41	139.07	142.77	147.13	148.40	150.37	147.37	146.54
15	131.29	132.48	130.82	128.79	130.78	141.52	144.23	148.47	149.76	149.88	146.92	146.47
20	131.60	131.83	129.99	128.07	132.61	142.60	145.25	149.36	150.36	149.18	146.47	145.63
25	132.28	131.67	129.73	126.99	133.89	142.20	146.12	149.22	150.17	147.94	146.56	144.27
eom	132.57	131.69	128.58	126.81	134.11	142.13	146.73	148.64	150.36	146.69	146.11	142.54
						1987						
5	141.56	142.65	145.52	140.93	142.08	144.91	148.82	159.55	160.59	154.68	148.42	149.41
10	141.67	143.22	144.75	141.09	142.65	144.80	149.24	160.27	159.01	153.81	148.06	-
15	141.53	143.97	143.47	141.09	143.40	145.59	151.78	161.23	158.15	152.34	147.67	149.09
20	141.31	144.29	142.38	141.65	143.43	147.75	153.41	162.58	158.38	151.61	147.15	148.27
25	141.85	144.27	141.78	141.92	143.18	147.79	155.41	163.51	157.07	150.57	148.37	145.82
eom	142.26	144.62	140.80	141.28	142.77	148.34	155.41	162.36	155.76	149.85	147.87	143.64

Nc13-03. University of Delaware, College of Agricultural Sciences. Lat. 38°49'30", long. 75°37'02". Near Greenwood. Drilled artesian observation well in the Piney Point aquifer. Diameter 6 inches, depth 630 feet. Screened 620-630 feet. Lsd 62.5 feet above msl. MP top of casing 3.0 feet above lsd. Highest water level 69.70 feet below lsd, Jan. 1, 1971; lowest 83.25 feet below lsd, Dec. 30, 1987. Records available 1970-1987. Water levels are influenced by pumping in the Dover area. (Noon water level on 5th, 10th, 15th, 20th, 25th, and end of each month below land-surface datum. From recorder graph Dec. 1970-June 1976; from digital record June 1976-Dec. 1987).

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						1978						
5	78.32	-	-	78.72	78.80	78.85	79.13	79.34	79.42	79.70	79.78	79.60
10	78.18	-	78.25	78.76	78.83	79.01	79.11	79.24	79.57	79.91	79.89	79.77
15	78.16	-	78.44	78.80	78.60	79.13	79.15	79.31	79.55	79.81	79.92	79.73
20	78.01	-	78.69	78.80	78.79	70.09	79.30	79.34	79.62	79.78	80.05	79.54
25	78.09	-	78.78	78.85	78.77	79.13	79.27	79.37	79.63	79.73	79.81	79.55
eom	79.37	-	78.63	78.83	78.81	79.12	79.23	79.44	79.75	79.97	79.74	79.80
						1979						
5	79.79	79.60	79.55	79.43	79.54	79.37	79.51	79.49	79.44	79.33	79.69	79.51
10	79.20	79.68	79.45	79.48	79.58	79.51	79.57	79.50	79.49	79.41	79.48	79.65
15	-	79.55	79.60	79.39	79.64	79.60	79.52	79.42	79.48	79.55	79.50	79.70
20	-	79.63	79.51	79.63	79.60	79.65	79.63	79.47	79.60	79.49	79.50	79.70
25	-	79.31	79.28	79.62	79.31	79.61	79.59	79.52	79.58	79.35	79.60	79.28
eom	79.38	79.55	79.55	79.56	79.60	79.47	79.59	79.44	79.47	79.69	79.53	79.50
						1980						
5	79.42	79.60	79.43	79.29	79.31	79.58	79.55	79.71	-	80.08	79.79	-
10	79.77	79.45	79.41	79.30	79.47	79.45	79.57	79.73	-	80.04	79.83	-
15	79.52	79.55	79.56	79.23	-	79.47	79.72	79.74	-	80.15	79.99	-
20	79.54	79.47	79.48	79.47	79.45	79.55	79.79	-	80.12	79.93	80.08	80.28
25	79.31	79.44	79.31	79.36	79.24	79.67	79.75	-	80.04	79.71	79.88	80.16
eom	79.52	-	79.28	79.29	79.52	79.45	79.71	-	80.04	79.91	-	80.05
						1981						
5	80.21	80.26	-	80.05	80.11	80.07	-	80.42	80.54	80.62	80.72	80.74
10	80.16	80.23	-	80.20	80.18	80.01	-	80.50	80.54	80.69	80.78	80.66
15	80.09	80.32	-	80.23	80.04	-	-	80.39	80.53	80.72	80.65	80.63
20	80.08	79.80	-	-	80.07	-	-	80.41	80.46	80.78	80.59	80.81
25	80.11	-	80.16	79.95	80.13	-	80.50	80.46	80.62	-	80.79	80.81
eom	80.28	-	80.10	80.05	80.10	-	80.54	80.49	80.63	-	80.85	80.87

Nc13-03 continued

Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
						1982						
5	80.66	80.83	80.61	80.70	80.85	80.76	81.02	-	81.30	81.32	81.24	81.00
10	80.62	80.70	80.83	80.73	80.78	80.86	80.99	-	81.30	81.33	81.44	-
15	80.60	80.74	80.78	80.85	80.88	80.83	81.08	81.11	81.26	81.15	81.25	-
20	80.79	80.53	80.68	80.80	80.80	80.80	-	81.07	81.23	81.40	81.33	-
25	80.64	80.80	80.66	80.84	80.81	80.95	-	81.02	81.27	81.24	81.38	-
eom	80.65	80.77	80.76	80.82	80.79	80.81	-	81.27	81.33	81.34	81.11	-
						1983						
5	-	80.97	80.77	80.60	-	80.22	80.22	80.42	80.41	80.38	80.44	80.37
10	-	80.90	80.49	80.36	-	80.38	80.31	80.42	80.50	80.69	80.36	80.51
15	-	80.69	80.53	80.43	80.36	80.33	80.30	80.46	80.52	80.58	80.46	80.25
20	81.12	80.89	80.46	80.25	80.41	80.36	80.26	80.38	80.51	80.66	80.44	80.60
25	80.88	80.62	80.59	80.11	80.33	80.15	80.26	80.61	80.62	80.41	80.26	80.35
eom	80.89	80.79	80.53	-	80.15	80.32	80.40	80.37	80.47	80.71	80.40	80.60
						1984						
5	80.30	80.21	80.42	80.11	80.45	80.50	80.55	80.67	80.90	80.97	80.83	81.09
10	80.38	80.58	80.56	80.42	80.51	80.51	80.63	80.70	80.91	81.02	80.96	80.91
15	80.50	80.31	80.53	80.32	80.57	80.62	80.69	80.73	80.80	80.91	81.05	81.09
20	80.51	80.29	80.39	80.45	80.49	80.52	80.71	80.74	80.81	81.00	81.09	80.96
25	80.27	80.23	80.35	80.33	80.62	80.47	80.68	80.85	80.90	81.14	81.06	81.09
eom	80.31	80.20	80.37	80.44	80.34	80.52	80.74	80.76	80.91	81.12	80.89	81.11
						1985						
5	80.77	80.87	80.80	80.81	81.00	81.04	81.20	81.45	81.26	81.02	81.00	81.24
10	81.06	80.93	80.95	81.09	81.10	80.94	81.15	81.23	81.25	81.20	81.35	81.29
15	80.82	80.80	80.92	80.89	81.13	81.09	81.21	81.28	81.53	81.14	81.41	81.24
20	80.79	80.96	80.91	80.99	81.04	81.06	81.26	81.25	81.49	81.30	81.34	81.28
25	80.71	80.90	80.90	80.90	80.92	81.15	81.41	81.27	81.43	81.22	81.36	81.09
eom	80.90	80.99	80.89	81.07	80.98	81.23	81.29	81.21	81.23	81.22	81.20	81.18
						1986						
5	81.08	80.94	81.01	81.21	81.12	82.23	81.35	81.40	81.42	81.50	81.64	81.66
10	81.19	81.08	81.05	80.91	81.21	81.31	81.27	81.34	81.59	81.79	81.76	81.42
15	81.39	80.99	80.91	81.08	81.26	81.24	81.33	81.41	81.61	81.59	81.67	81.54
20	80.94	81.02	81.02	81.04	81.13	81.22	81.21	81.48	81.61	81.70	81.57	81.46
25	81.28	80.93	81.30	81.06	81.19	81.28	81.34	81.46	81.57	81.71	81.69	81.19
eom	81.23	80.99	81.12	81.12	81.10	81.23	81.26	81.57	81.62	81.89	81.65	81.41
						1987						
5	81.42	81.52	81.62	81.43	81.65	81.79	81.94	82.15	82.64	82.72	82.85	82.96
10	81.20	81.38	81.51	81.47	81.62	81.87	82.00	82.14	82.55	82.89	82.98	82.98
15	81.29	81.44	81.55	81.62	81.64	81.80	81.99	82.35	82.60	82.90	83.12	82.94
20	81.32	81.56	81.43	81.61	81.73	81.86	82.11	82.39	82.56	82.86	82.83	83.04
25	81.36	81.54	81.56	81.62	81.80	81.91	82.16	82.51	82.64	82.98	83.12	83.07
eom	81.10	81.52	81.28	81.50	81.74	82.03	82.18	82.50	82.55	83.08	82.77	83.21

Jd25-09. City of Dover. Lat. 39°09'33", long. 75°30'51". Drilled artesian test well in Piney Point aquifer. Diameter 4 inches to 440 feet, depth 440 feet. Screened 400-440 feet. Lsd about 15 feet above msl. MP top of casing at land surface. Highest water level 110.00 feet below lsd, May 21, 1981; lowest 172.37 feet below lsd, July 31, 1987. Records available May 1981-1987. Water levels are influenced by pumping in the Dover area.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1981		1983		1984		1985		1987	
May 21	110.00	Aug. 30	148.33	Oct. 31	141.70	Nov. 25	133.81	Jan. 6	139.60
		Sept. 28	144.75	Nov. 28	138.00	Dec. 30	128.98	Feb. 3	143.58
1982		Oct. 27	142.13	Dec. 27	135.62			Feb. 26	145.17
Nov. 2	124.90	Nov. 30	137.69			1986		Mar. 31	139.21
Nov. 30	117.48	Dec. 29	136.75	1985		Jan. 30	132.65	May 1	145.51
Dec. 29	113.82			Feb. 4	135.13	Feb. 26	129.82	June 2	150.59
		1984		Mar. 5	135.62	May 2	125.85	June 26	153.61
1983		Jan. 25	135.96	Apr. 2	136.19	May 29	135.47	July 31	172.37
Jan. 28	116.84	Feb. 28	133.06	Apr. 30	131.93	June 30	145.29	Sept. 2	166.18
Feb. 24	122.00	Apr. 3	127.13	May 30	131.09	Aug. 4	148.30	Oct. 1	157.31
Mar. 29	124.70	Apr. 27	125.40	June 27	132.85	Aug. 28	153.98	Oct. 29	152.92
Apr. 29	123.75	May 30	129.77	July 30	134.23	Sept. 30	154.39	Nov. 30	160.74
May 23	128.12	June 28	142.30	Sept. 4	136.45	Oct. 30	144.80		
July 11	135.77	July 30	145.42	Oct. 3	135.75	Nov. 26	145.80		
July 29	150.25	Aug. 24	147.37	Oct. 29	134.09				
Aug. 29	149.50	Sept. 27							

Jd25-10. City of Dover. Lat. 39°08'33", long. 75°0'51". Drilled artesian test well in Cheswold aquifer. Diameter 4 inches to 220 feet, depth 220 feet. Screened 200-220 feet. Lsd about 15 feet above msl. MP top of casing at land surface. Highest water level 67.93 feet below lsd, Feb. 26, 1987; lowest 91.36 feet below lsd, Oct. 26, 1982. Records available May 1981-1987. Water levels are influenced by pumping in the Dover area.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1981		1983		1984		1985		1987	
May 21	82.00	Aug. 29	83.29	Oct. 31	88.00	Dec. 30	81.97	Jan. 6	73.54
		Aug. 30	83.60	Nov. 28	85.87			Feb. 3	71.04
1982		Sept. 28	83.42	Dec. 27	82.87	1986		Feb. 26	67.93
Oct. 26	91.36	Oct. 27	86.46			Jan. 30	83.87	Mar. 31	74.68
Nov. 2	87.00	Nov. 30	80.33	1985		Feb. 26	82.83	May 1	69.42
Nov. 30	79.99	Dec. 29	81.75	Feb. 4	82.96	Mar. 26	82.93	June 1	77.45
Dec. 29	75.49			Mar. 5	80.17	May 2	81.85	June 26	83.75
		1984		Apr. 2	83.25	May 29	83.97	July 31	87.28
1983		Jan. 25	84.77	Apr. 30	82.92	June 30	86.24	Sept. 2	85.89
Jan. 28	78.33	Feb. 28	83.05	May 30	84.50	Aug. 4	86.05	Oct. 1	83.47
Feb. 24	75.58	Apr. 27	81.96	June 27	86.47	Aug. 28	82.38	Oct. 29	82.75
Mar. 29	71.12	May 30	80.46	July 30	85.32	Sept. 30	78.23	Nov. 30	74.15
Apr. 29	70.73	June 24	86.35	Sept. 4	86.77	Oct. 30	80.18		
May 23	75.64	July 30	86.79	Oct. 3	88.90	Nov. 26	78.42		
July 11	76.50	Aug. 24	88.82	Oct. 29	86.27				
July 29	78.67	Sept. 27	89.82	Nov. 25	84.85				

Rj22-06. Fenwick Island State Park. Lat. 38°28'05", long. 75°03'04". Drilled artesian observation well in Manokin aquifer. Diameter 1.25 inches to 295 feet, depth 295 feet. Screened 290-295 feet. Lsd 4.45 feet above msl. MP top of casing 1 foot above lsd. Highest water level 1.00 foot above lsd, April 4, 1984; lowest 9.52 feet below lsd, Aug. 26, 1985. Negative (-) indicates water levels above lsd. Records available April 1977-1987. Water levels are influenced by pumping in the Fenwick Island, Delaware and Ocean City, Maryland areas.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1979		1982		1985		1986	
Jan. 4	1.48	May 3	-0.28	Apr. 15	0.47	June 20	5.92	Mar. 31	0.68
Feb. 2	0.42	May 31	1.28	Sept. 30	4.57	June 27	6.43	Apr. 29	0.39
Mar. 6	0.89	June 29	2.98			July 1	6.91	May 14	0.75
Mar. 27	-0.58	July 31	6.08	1983		July 8	7.29	May 29	2.27
Apr. 5	0.14	Aug. 28	6.12	Mar. 22	-0.87	July 17	8.16	June 6	3.10
May 8	0.69	Sept. 27	4.44	Nov. 22	0.63	Aug. 7	8.44	June 17	5.63
June 6	2.25	Oct. 26	2.06			Aug. 26	9.52	June 24	4.22
June 17	0.86	Nov. 23	0.85	1984		Aug. 28	9.51	July 9	7.25
July 6	3.41	Dec. 21	-0.11	Apr. 4	-1.00	Oct. 3	3.56	July 24	8.17
Aug. 3	5.54			July 19	6.82	Oct. 17	2.99	Aug. 26	8.69
Sept. 1	6.06	1980		Oct. 12	3.71	Nov. 15	1.04	Sept. 25	6.15
Nov. 2	2.63	Feb. 20	-0.72			Dec. 5	0.93		
Dec. 5	0.51	Mar. 20	0.31	1985		Dec. 30	0.81	1987	
		Sept. 8	5.81	Feb. 5	0.93			Mar. 13	-0.81
1979				Apr. 15	0.89	1986		May 7	0.80
Jan. 3	0.41	1981		May 2	0.78	Jan. 22	1.12	June 16	4.92
Feb. 2	-0.64	Apr. 21	0.92	May 10	1.44	Jan. 29	0.96	Aug. 4	8.54
Mar. 1	0.49	July 24	7.08	May 14	2.01	Feb. 3	0.51	Sept. 23	8.35
Apr. 2	0.00	Sept. 25	6.94	June 5	4.11	Feb. 20	-0.34	Nov. 6	5.65
								Dec. 3	4.74

Rj22-07. Fenwick Island State Park. Lat. 38°25'05", long. 75°03'04". Drilled artesian observation well in Pocomoke aquifer. Diameter 1.25 inches to 185 feet, depth 185 feet. Screened 180-185 feet. Lsd 4.45 feet above mean sea level. MP top of casing 1 foot above lsd. Highest water level 0.33 feet above lsd, Feb. 20, 1986; lowest water level 8.63 feet below lsd, Aug. 26, 1985. Negative (-) indicates water levels above lsd. Records available April 1977-1987. Water levels are influenced by pumping in the Fenwick Island, Delaware and Ocean City, Maryland areas.

Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level	Date	Water Level
1978		1979		1983		1985		1986	
Jan. 4	1.88	June 28	2.80	Mar. 22	3.04	July 1	4.88	May 29	3.08
Feb. 2	1.31	July 31	4.37	Nov. 22	1.85	July 8	5.45	June 6	3.48
Mar. 6	1.82	Aug. 28	4.63			July 17	5.89	June 17	4.41
Mar. 27	1.00	Sept. 29	3.34	1984		Aug. 7	5.94	June 24	5.69
Apr. 5	1.23	Oct. 26	2.16	Apr. 4	0.51	Aug. 26	8.63	July 9	5.27
May 8	3.63	Nov. 23	1.55	July 19	5.03	Aug. 28	6.61	July 24	6.12
June 6	3.21	Dec. 21	0.78	Dec. 10	2.16	Oct. 3	3.03	Aug. 26	6.39
June 12	1.76					Oct. 17	2.64	Sept. 25	4.14
July 6	3.78	1980		1985		Nov. 15	1.66		
Aug. 3	4.24	Feb. 20	3.54	Feb. 5	1.48	Dec. 30	1.66	1987	
Sept. 1	4.75	Mar. 20	1.40	Mar. 1	1.09			Mar. 13	0.39
Nov. 2	2.48	Sept. 18	4.31	Mar. 27	1.00	1986		May 7	1.75
Dec. 5	0.22			Apr. 5	1.23	Jan. 22	2.02	June 16	3.81
		1981		Apr. 15	1.77	Jan. 29	2.51	Aug. 4	6.57
1979		Apr. 21	1.68	May 2	1.92	Feb. 3	1.75	Sept. 23	5.07
Jan. 3	3.74	July 24	3.75	May 10	1.25	Feb. 20	-0.33	Nov. 6	4.13
Feb. 2	0.87	Sept. 23	4.98	May 14	2.62	Mar. 31	1.85	Dec. 3	3.72
Mar. 1	1.09			June 2	2.52	Apr. 29	1.35		
Apr. 2	0.65	1982		June 5	3.13	May 14	1.48		
May 3	1.36	Apr. 15	1.54	June 20	4.00				
May 31	1.57	Sept. 30	3.50	June 27	4.38				

APPENDIX B

For use of those readers who may prefer to use the International System of Units (SI) rather than English units, the conversion factors for the terms used in this report are listed below.

Multiply English Units	By	To obtain SI units
	Length	
inches (in)	25.4	millimeters (mm)
inches (in)	2.54	centimeters (cm)
feet (ft)	0.3048	meters (m)
miles	1.609	kilometers (km)
	Area	
square miles (mi2)	2.59	square kilometers (km2)
	Flow	
gallons	0.0038	cubic meters (m3)