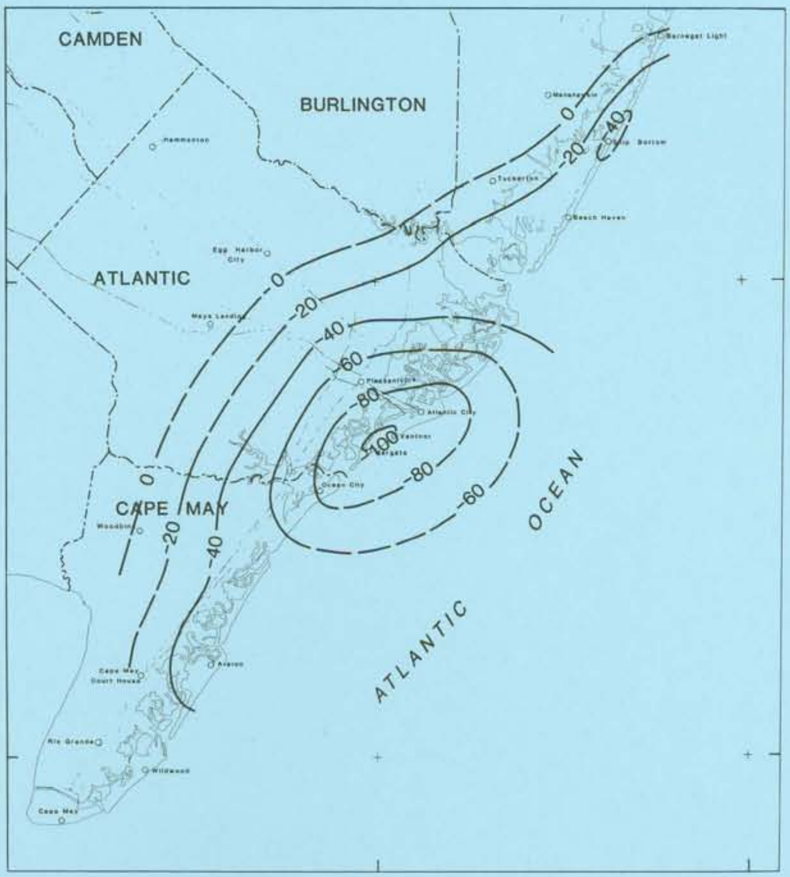
NEW JERSEY GEOLOGICAL SURVEY

OPEN-FILE REPORT 88-3

Water Levels in the Principal Aquifers of Atlantic County and Vicinity, New Jersey, 1985-86



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New Jersey Geological Survey
Open-File Report 88-3

Water Levels in the Principal Aquifers of Atlantic County and Vicinity, New Jersey, 1985-86

by
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Prepared by the United States Geological Survey
in cooperation with the
New Jersey Department of Environmental Protection
Division of Water Resources

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Data in this report are in inch-pound units. To convert inch-pound units to metric (International System) units, use the following factors:

Multiply inch-pound unit	By	To obtain metric unit
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
foot per mile (ft/mi)	0.189	meter per kilometer (m/km)
square mile (mi^2)	2.590	square kilometer (km^2)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

Temperature Conversion

Temperature in degrees Celsius (°C) is converted to degrees Fahrenheit (°F) by the equation: $°F = (9/5)°C + 32$

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

WATER LEVELS IN THE PRINCIPAL AQUIFERS OF ATLANTIC COUNTY AND VICINITY, NEW JERSEY, 1985-86

By Jeffrey S. Clark and Gary N. Paulachok

ABSTRACT

This report documents water levels measured during 1985-86, and contemporaneous changes in these levels, in the principal aquifers of Atlantic County and vicinity, New Jersey. The report is one of a series of products for the Atlantic City and vicinity ground-water-supply investigation, a study funded by the New Jersey Water-Supply Bond of 1981.

Water levels were measured during December 1985 in 83 wells screened in the unconfined Kirkwood-Cohansey aquifer system in Atlantic County. The Kirkwood-Cohansey aquifer system is the principal source of water supply for parts of the study area on the mainland. The ground-water levels, supplemented by 54 measurements of water-surface elevation in small streams, were used to prepare maps of the altitude of the water table and depth to the water table. These maps show that the water table is at or near the land surface in low-lying or swampy areas, and can be more than 25 feet below the land surface in topographically higher localities or in areas affected by ground-water withdrawals. Hydrographs prepared from continuous and periodic water-level measurements in 22 observation wells depict short-term and seasonal water-level fluctuations in the unconfined aquifer system.

Water levels were measured during April and September 1986 in 68 wells screened in the confined Atlantic City 800-foot sand of the Kirkwood Formation. This aquifer is the principal source of water supply for the barrier-island communities in Atlantic, Ocean, and Cape May Counties. Potentiometric-surface maps prepared from these water-level data show a regional cone of depression that extends from southern Ocean County to southern Cape May County and to more than 5.3 miles seaward of Atlantic City. In April 1986, under conditions of annual minimum pumping stress, water levels in the deepest part of the cone were more than 70 feet below sea level. In September 1986, under conditions of annual maximum pumping stress, water levels in the deepest part of the cone were more than 100 feet below sea level. A map of potentiometric change for the period April to September 1986 illustrates the maximum change in water level during 1986 in the Atlantic City 800-foot sand. Hydrographs developed from continuous water-level measurements in six observation wells show short-term and seasonal water-level fluctuations in the confined aquifer.

The information on ground-water levels presented in this report can be used to estimate the general direction, velocity, and quantity of ground-water flow; to quantify the change in ground-water storage; and to identify recharge and discharge areas. The information also may be used when dealing with situations involving construction, drainage, and dewatering.

INTRODUCTION

Overview

Ground water is the principal source of water supply for Atlantic County and vicinity, New Jersey, and, in many parts of this area, it is an abundant resource. However, large withdrawals in the coastal-resort communities have resulted in declining ground-water levels (May, 1985, p. 8), and have increased the potential for water-supply shortages and for contamination of freshwater aquifers by encroaching saltwater. The Statewide Water-Supply Master Plan (New Jersey Department of Environmental Protection, 1981) indicates that a steady increase in ground-water withdrawals, as well as contamination of fresh ground-water supplies by saltwater, will likely accompany the redevelopment of Atlantic City and vicinity. This redevelopment began in 1977 with the introduction of legalized gambling in Atlantic City (fig. 1).

Purpose and Scope

The purpose of this report is to present information on ground-water levels and their fluctuations in the principal aquifers of Atlantic County and vicinity, New Jersey. This information may be of particular interest to agencies and individuals concerned with ground-water resources development and management. Synoptic measurements of water level during 1985-86 were used to prepare maps of altitude of the water table, depth to the water table, potentiometric surface, and potentiometric change. Continuous or periodic measurements of water levels in observation wells were used to develop hydrographs showing short-term and seasonal fluctuations. Water-level data also are given in tabular form. This report was prepared in cooperation with the New Jersey Department of Environmental Protection, Division of Water Resources. It is one of a series of products originating from the Atlantic City and vicinity ground-water-supply investigation, a study funded by the New Jersey Water-Supply Bond of 1981. For additional information on the objectives, approach, and anticipated products of this investigation, the interested reader is referred to the report by Leahy and others (1987).

Description of Study Area

Atlantic County, an area of approximately 565 mi^2 (square miles), is in the southeastern part of New Jersey (fig. 1); it is the focal area of this report. Atlantic County and vicinity, as used in this report, occupies about 1,200 mi^2 and includes all of Atlantic County and parts of adjoining Ocean, Burlington, Cumberland, and Cape May Counties (fig. 1). The study area is bounded on the east by the Atlantic Ocean.

Atlantic County and adjoining counties are in the Coastal Plain physiographic province. The unconsolidated sediments that comprise the Coastal Plain form broad areas of low relief. In Atlantic County, the land surface slopes generally eastward toward the coast, and, consequently, surface drainage ultimately is to the Atlantic Ocean. Land-surface altitudes in Atlantic County range from about 150 ft (feet) above sea level near Hammonton (fig. 1) to sea level along the coast.

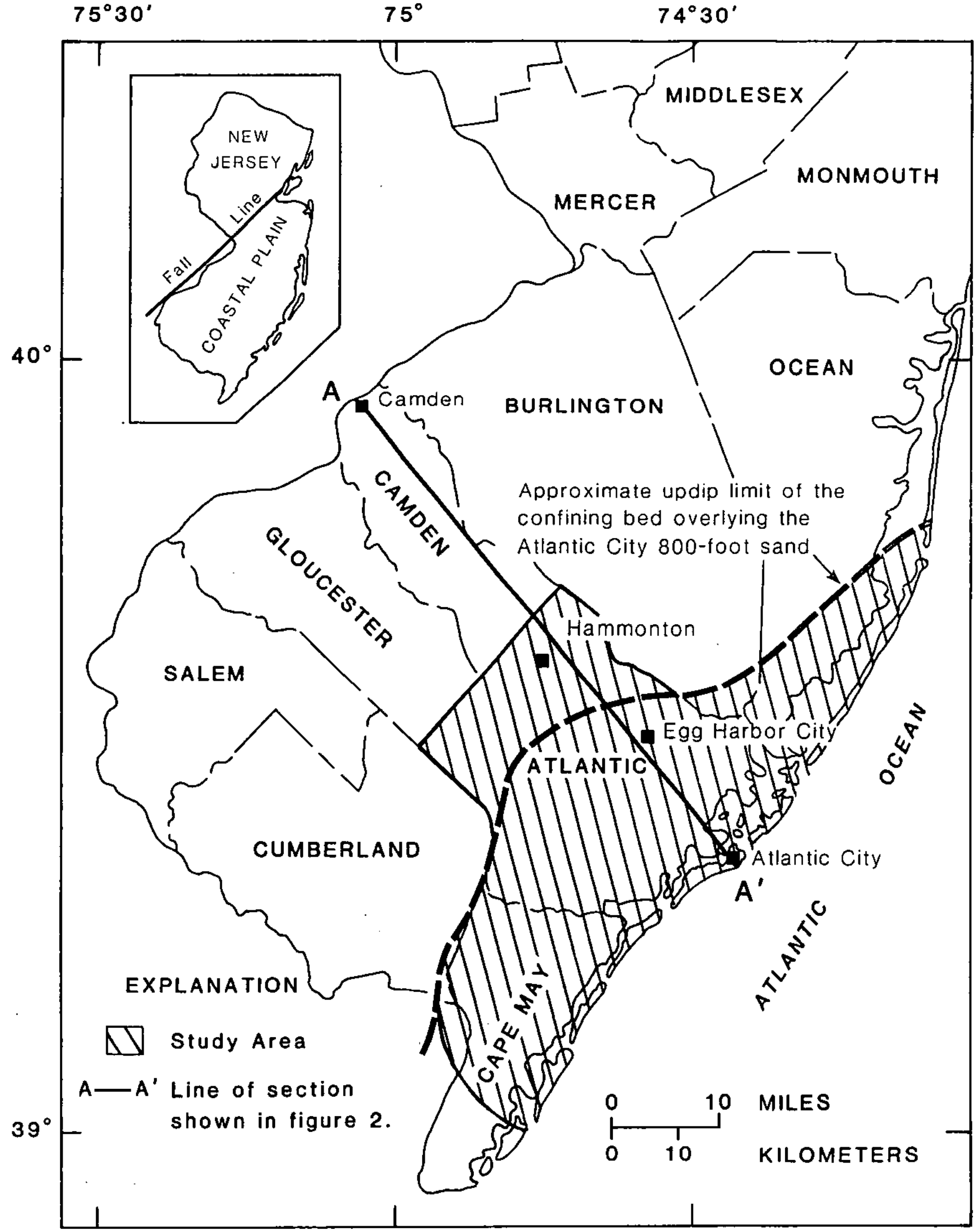


Figure 1.--Location of the study area.

The climate of the study area is considered to be of the warm-temperate type. It is influenced substantially by the Atlantic Ocean, and is characterized by large annual temperature ranges and ample precipitation. Generally, temperatures in the area are moderate, and the normal mean annual air temperature for the period 1951-80 is approximately 12 degrees Celsius. Precipitation also is moderate, and the normal mean annual total is about 42 in. (inches). Precipitation is distributed fairly evenly throughout the year, with maximum amounts during the late summer months. Much of the summer rainfall is due to thunderstorms; consequently, amounts throughout the study area may be quite variable during a particular summer (Ludlum, 1983).

According to the Federal Census of 1980 (U.S. Department of Commerce, 1982), the resident population of Atlantic County was 194,119, or approximately 350 persons per square mile. Most of the population is concentrated in the eastern part of the county. Atlantic City, with 40,199 inhabitants, has the largest population of any urban area in the county. The population of the study area increases greatly during the summer months because of the influx of tourists to the coastal resorts.

In 1981, wooded acreage accounted for approximately 61 percent of the total area of Atlantic County; wetlands, 14 percent; residential areas, 10 percent; and farmland, 9 percent. In order of decreasing percentage of total, the remainder of the area was used for commercial, recreation, public, and industrial purposes (John Brennan, Atlantic County Department of Regional Planning and Development, oral commun., 1986).

Previous Investigations

Reports by Woolman (1890-1902) on artesian wells in New Jersey recorded much of the earliest information on ground-water levels in the study area. Several of these reports contain data on the original static or pumping water levels in wells. Usually, no subsequent measurements were made in the same wells. Since 1923, the U.S. Geological Survey, in cooperation with various state agencies concerned with water-supply matters, has conducted numerous studies of the ground-water resources of New Jersey. The regular measurement of water levels in observation wells was and continues to be an important aspect of many of these investigations. The principal reports on several such investigations in Atlantic County and vicinity are summarized below.

Thompson (1928), who reported on the ground-water supplies of the Atlantic City region, elaborated on water-level fluctuations in the Atlantic City 800-foot sand of the Kirkwood Formation (herein commonly referred to as the 800-foot sand), and displayed hydrographs for several wells tapping that aquifer. Barksdale and others (1936) defined the ground-water hydrology of the Atlantic City region, presented water-level data for selected wells, and related withdrawals from the 800-foot sand to water-level fluctuations therein. Gill (1962) described the availability and quality of ground water in Cape May County; this report contains records of selected wells and gives water-level data for many of those wells. Rush (1962), in a report on records of wells and ground-water quality in Burlington County, provided data on water levels in selected wells. Clark and others (1968) presented a general summary of the geohydrology of Atlantic County; a well table that includes water-level data is a major part of that report. Anderson and Appel (1969) described the geology and ground-water resources of Ocean County, and listed construction details and water levels for wells tapping the principal aquifers. Walker (1983), and Eckel and Walker (1986), mapped synoptic potentiometric surfaces during 1978 and 1983, respectively, in the principal aquifers of the New Jersey Coastal Plain.

Several data-tabulation reports present additional information on water levels in observation wells in the study area. Annual summaries of water-level data for 1935-74 are given in the following U.S. Geological Survey Water-Supply Papers (WSP):

Calendar year	WSP no.	Calendar year	WSP no.	Calendar year	WSP no.
1935	777	1944	1016	1953	1265
1936	817	1945	1023	1954	1321
1937	840	1946	1071	1955	1404
1938	845	1947	1096	1956-57	1537
1939	886	1948	1126	1958-62	1782
1940	906	1949	1156	1963-67	1977
1941	936	1950	1165	1968-72	2140
1942	944	1951	1191	1973-74	2164
1943	986	1952	1221		

Since 1975, water levels in observation wells in the Atlantic drainage basin of New Jersey have been published annually by the U.S. Geological Survey in the report "Water Resources Data for New Jersey, Volume 1, Atlantic Slope Basins, Hudson River to Cape May." Since 1979, water levels in observation wells in the study area have been tabulated in these annual reports. Although data on water levels during 1975-78 in wells in the study area have not been published, they are available for public inspection at the District office of the U.S. Geological Survey, West Trenton, New Jersey.

Methods of Data Collection

For this study, water levels were measured during three short periods. In early December 1985, water levels in 83 wells screened in the Kirkwood-Cohansey aquifer system and 54 water-surface elevations in small streams were measured in Atlantic County. In mid- to late-April 1986, and again in September 1986, water levels in 68 wells screened in the confined Atlantic City 800-foot sand of the Kirkwood Formation were measured in Atlantic County and vicinity. Data on water levels in observation wells were collected from June 1985 to November 1986.

Wells selected for water-level measurements were chosen on the basis of areal distribution, aquifer tapped, and ease of measurement. Most wells measured for water levels in the Kirkwood-Cohansey aquifer system are used for irrigation, public-supply, industrial, commercial, or domestic purposes. For this study, 11 small-diameter wells were installed in this aquifer system in parts of Atlantic County where water-level data were sparse or unavailable. Measured wells in the Atlantic City 800-foot sand are used chiefly for public-water supply. Water levels in these wells, and in observation wells in the unconfined and confined aquifer systems, comprise much of the database for this report.

To standardize the data-collection procedure and to reduce localized drawdown effects caused by pumping, pumps on wells used for water-level measurements, along with those on all high-capacity wells within a 1/2-mile radius of the well being measured, were shut down for at least 1 hour prior to measurement. Successive measurements were made to insure that the rate of water-level recovery was negligible. In most high-capacity wells in the study area, the rate of recovery was insignificant after about 1 hour of pump shutdown.

Depending on conditions in a particular well, water levels were measured using either a wetted-steel tape, an electric tape (water-level finder), or an airline. Because of the ease and accuracy of the technique, the wetted steel-tape method was preferred and was used wherever possible. Although slightly less accurate than the steel-tape method, electric-tape measurements were more effective in some wells where measurements with a steel tape through a pump were difficult. In wells where access was extremely difficult or impossible with a steel tape or an electric tape, water levels were estimated by airline measurements. The latter technique is the least accurate of those implemented.

Water levels in two marine-observation wells, located 1.9 mi (miles) and 5.3 mi offshore of Atlantic City, were determined with differential pressure transducers permanently installed in each well. Measurements were made by retrieving peripheral connections stored on the seafloor, attaching them to a frequency counter aboard ship, and monitoring the downhole transducers for information on water levels.

Water-surface elevations in streams were determined by measuring with a surveyor's tape the vertical distance between the water surface and a nearby land-surface reference point of known altitude. These measurements were made during low streamflow, when the flow consisted almost entirely of ground-water discharge or baseflow. Water depths in these streams ranged typically from 1 to 2 ft.

Except for those in the marine wells, water levels were referenced to the land-surface datum at each measuring site. Levels in the marine wells were referenced to a temporary datum at each drilling site. Altitudes of the land surface and the temporary datums are based on sea level, and were used to compute the altitude of the water level (head) in each well. Most land-surface altitudes were estimated from U.S. Geological Survey 7½-minute topographic quadrangle maps and are considered to be accurate to within 5 ft (one-half of the contour interval). Several altitudes, including those of the temporary datums at the marine-drilling sites, were determined by leveling surveys, and generally are accurate to within 1 ft.

Data from continuous recorders were used to prepare the water-level hydrographs of several wells. These hydrographs are based on the daily minimum water level for the period September 1985 to October 1986. Other hydrographs, chiefly those of wells tapping the Kirkwood-Cohansey aquifer system, are based on water-level measurements made once-monthly from June 1985 to November 1986.

Well-Numbering System

The well-numbering system in this report is that used since 1978 in New Jersey by the U.S. Geological Survey. The well number consists of a county code number and a sequential number assigned at the time the well was inventoried originally. County codes presented in this report include Atlantic (01), Cape May (09), and Ocean (29). For example, well number 010037 represents the 37th well inventoried in Atlantic County.

Acknowledgments

The authors acknowledge the cooperation of various firms and individuals who kindly permitted the measurement of water levels in their wells, particularly, the many water-company superintendents who authorized periodic measurements and who were inconvenienced temporarily by the shutdown of their production wells. Appreciation is extended to Joseph M. Oschwald, formerly of the U.S. Geological Survey, who conducted the initial work on the water-table map that is part of this report.

HYDROGEOLOGIC FRAMEWORK

The study area is in the Coastal Plain of New Jersey, which consists of unconsolidated deposits of gravel, sand, silt, and clay. The area is underlain by two principal freshwater aquifers--the surficial Kirkwood-Cohansey aquifer system and the Atlantic City 800-foot sand of the Kirkwood Formation. The Rio Grande water-bearing zone of the Kirkwood Formation is situated approximately midway within the confining unit that separates the Kirkwood-Cohansey aquifer system from the 800-foot sand. Throughout most of the study area, however, the Rio Grande is an aquifer of minor importance. Near Atlantic City, aquifers deeper than the 800-foot sand have not been developed for water supply, as they may contain brackish or saline water.

A generalized hydrogeologic section (fig. 2) shows the principal aquifers and confining units of the New Jersey Coastal Plain. Table 1 presents information on the lithology and hydrologic characteristics of these aquifers and confining units, and shows the relations between geologic units and hydrogeologic units.

Kirkwood-Cohansey Aquifer System

In the study area, the upper part of the Kirkwood Formation, together with the overlying Cohansey Sand, both of Miocene age, form the Kirkwood-Cohansey aquifer system (table 1). Although these two units are components of this composite aquifer system, for this study they have not been differentiated individually because of their similar geologic and hydrologic properties. The Kirkwood-Cohansey aquifer system thickens toward the southeast, and, near Atlantic City, it is approximately 400 ft thick

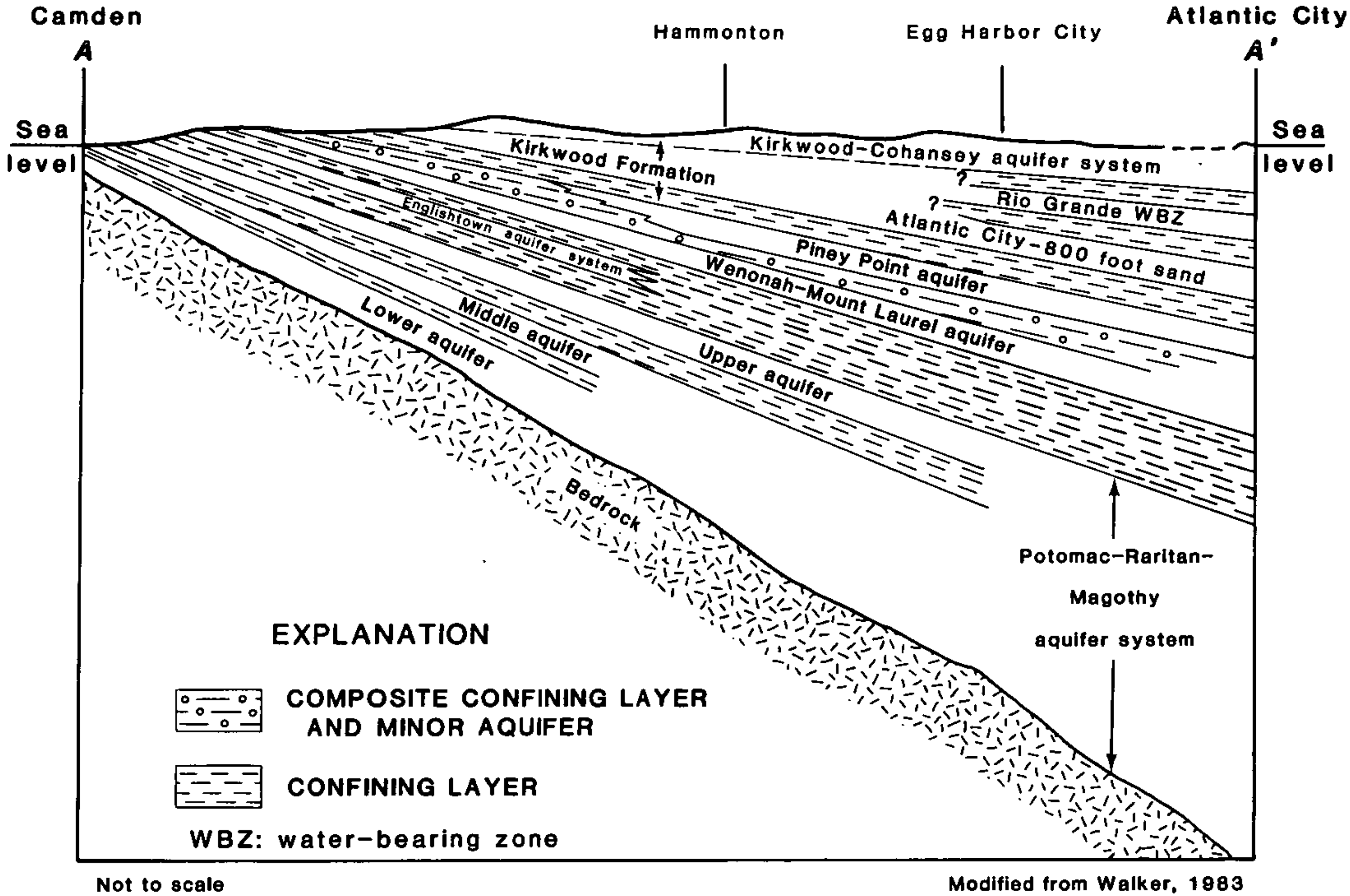


Figure 2.--Generalized hydrogeologic section of the Coastal Plain of New Jersey. (line of section shown on figure 1).

Table 1.--Geologic and hydrogeologic units in the Coastal Plain of New Jersey

SYSTEM	SERIES	GEOLOGIC UNIT	LITHOLOGY	HYDROGEOLOGIC UNIT	HYDROLOGIC CHARACTERISTICS
Quaternary	Holocene	Alluvial deposits	Sand, silt, and black mud.	Undifferentiated	Surficial material, commonly hydraulically connected to underlying aquifers. Locally some units may act as confining units. Thicker sands are capable of yielding large quantities of water.
		Beach sand and gravel	Sand, quartz, light-colored, medium-to coarse-grained, pebbly.		
	Pleistocene	Cape May Formation	Sand, quartz, light-colored, heterogeneous clayey, pebbly.		
Tertiary	Miocene	Pensauken Formation			
		Bridgeton Formation		Kirkwood-Cohansey aquifer system	A major aquifer system. Ground water occurs generally under water-table conditions. In Cape May County the Cohansey Sand is under artesian conditions.
		Beacon Hill Gravel	Gravel, quartz, light colored, sandy.		
		Cohansey Sand	Sand, quartz, light-colored, medium to coarse-grained, pebbly; local clay beds.		
		Kirkwood Formation	Sand, quartz, gray and tan, very fine-to, medium-grained, micaceous, and dark-colored diatomaceous clay.	Confining unit Rio Grande water bearing zone Confining unit	Thick diatomaceous clay bed occurs along coast and for a short distance inland. A thin water-bearing sand is present in the middle of this unit.
				Atlantic City 800-foot sand	A major aquifer along the coast.
				Composite confining unit	Poorly permeable sediments.
	Oligocene	Piney Point Formation	Sand, quartz and glauconite, fine-to coarse-grained.	Piney Point aquifer	Yields moderate quantities of water.
	Eocene	Shark River Formation			
		Manasquan Formation	Clay, silty and sandy, glauconitic, green, gray and brown, fine-grained quartz sand.		Poorly permeable sediments.
	Paleocene	Vincentown Formation	Sand, quartz, gray and green, fine-to coarse-grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite.	Vincentown aquifer	Yields small to moderate quantities of water in and near its outcrop area.
		Hornerstown Sand	Sand, clayey, glauconitic, dark green, fine to coarse-grained.		Poorly permeable sediments.
Cretaceous	Upper Cretaceous	Tinton Sand	Sand, quartz, and glauconite, brown and gray, fine-to coarse-grained, clayey, micaceous.		
		Red Bank Sand		Red Bank sand	Yields small quantities of water in and near its outcrop area.
		Navesink Formation	Sand, clayey, silty, glauconitic, green and black, medium-to coarse-grained.		Poorly permeable sediments.
		Mount Laurel Sand	Sand, quartz, brown and gray, fine-to coarse-grained, slightly glauconitic.	Wenonah-Mount Laurel aquifer	A major aquifer.
		Wenonah Formation	Sand, very fine-to fine-grained, gray and brown, silty, slightly glauconitic.	Marshalltown-Wenonah confining unit	A leaky confining unit.
		Marshalltown Formation	Clay, silty, dark greenish gray, glauconitic quartz sand.		
		Englishtown Formation	Sand, quartz, tan and gray, fine-to medium-grained; local clay beds.	Englishtown aquifer system	A major aquifer. Two sand units in Monmouth and Ocean Counties.
		Woodbury Clay	Clay, gray and black, micaceous silt.	Merchantville-Woodbury confining unit	A major confining unit. Locally the Merchantville Formation may contain a thin water-bearing sand.
		Merchantville Formation	Clay, glauconitic, micaceous, gray and black; locally very fine-grained quartz and glauconitic sand.		
		Magothy Formation	Sand, quartz, light-gray, fine-to coarse-grained. Local beds of dark-gray lignitic clay.	Potomac-Raritan-Magothy aquifer system: Upper aquifer	A major aquifer system. In the northern Coastal Plain, the upper aquifer is equivalent to the Old Bridge aquifer and the middle aquifer is equivalent to the Farrington aquifer. In the Delaware River Valley three aquifers are recognized. In the deeper subsurface, units below the upper aquifer are undifferentiated.
		Raritan Formation	Sand, quartz, light-gray, fine-to coarse-grained, pebbly, arkosic, red, white, and variegated clay.	Confining unit Middle aquifer	
	Lower Cretaceous	Potomac Group	Alternating clay, silt, sand, and gravel.	Confining unit Lower aquifer	
Pre-Cretaceous		Bedrock	Precambrian and lower Paleozoic crystalline rocks, metamorphic schist and gneiss; locally Triassic sandstone, shale and Jurassic basalt.	Bedrock confining unit	No wells obtain water from these consolidated rocks, except along Fall Line.

Modified from Zapecza, 1984, table 1

(Zapecza, 1984, p. 34). This aquifer system is the principal source of water supply in parts of the study area on the mainland. However, on the barrier islands and along the coastal fringe, the system contains brackish or salty water and cannot be used as a source of water supply.

In most areas, the Kirkwood-Cohansey aquifer system is highly permeable and unconfined. The system is recharged chiefly by precipitation. Natural recharge to the Cohansey Sand averages about 0.95 million gallons per day per square mile (Rhodehamel, 1970, p. 18). Water is discharged from the aquifer system by evaporation, transpiration, withdrawals through wells, flow to underlying geohydrologic units, and seepage to surface-water bodies.

Atlantic City 800-Foot Sand

The Atlantic City 800-foot sand of the Kirkwood Formation is a highly permeable confined aquifer. It is interbedded midway between an overlying, thick massive confining unit, and an underlying, relatively thin confining unit (fig. 2). At Atlantic City, the overlying confining unit is approximately 300 ft thick, the 800-foot sand is more than 150 ft thick, and the underlying confining unit is about 125 ft thick (Zapecza, 1984). The overlying confining unit thins with distance inland; northwest of Egg Harbor City (fig. 1), it grades into the gravel and sand deposits of the Kirkwood-Cohansey aquifer system. This lithologic change is accompanied by a change from confined to unconfined ground-water conditions. The 800-foot sand is, with few exceptions, the sole source of water supply for the barrier-island communities in the study area. This aquifer is recharged directly by precipitation on the outcrop area of the Kirkwood Formation (fig. 2) and where the aquifer is connected hydraulically to the Kirkwood-Cohansey aquifer system. Leakage of water from adjacent hydrogeologic units also is an important source of recharge. Loss of water from the 800-foot sand chiefly is through wells and by seepage to the Atlantic Ocean.

GROUND-WATER LEVELS

Kirkwood-Cohansey Aquifer System

Water Table, December 1985

Plate 1 shows the altitude of the water table in Atlantic County in December 1985. The water-table contours are based on water-level measurements made in 83 wells and 54 streams. In addition to water-level data, table 2 lists information on owner, location, land-surface altitude, and depth of the wells measured. Table 3 presents data on location and water-surface elevation of the streams measured.

The water table in Atlantic County is the upper surface of the ground-water reservoir in the Kirkwood-Cohansey aquifer system. The shape of this surface depends primarily on aquifer hydraulic properties, the location of recharge and discharge areas, and the magnitude of the recharge and discharge fluxes. In unstressed ground-water systems, the water table generally is a subdued replica of the land-surface topography. Commonly, the altitude of the water table is highest under topographic highs, and lowest under topographic lows, where intersections of the water table with the land surface are manifested as streams, swamps, lakes, and ponds. In

Table 2.--Water-level data for wells screened in the Kirkwood-Cohansey aquifer system in Atlantic County, New Jersey, December 1985

WELL NUMBER	OWNER	LATITUDE (DEGREES)	LONGITUDE (DEGREES)	ALTITUDE OF LAND SURFACE (FEET)[1]	DEPTH OF WELL (FEET)[2]	HYDRAULIC HEAD (FEET)[1]	DEPTH TO WATER TABLE (FEET)[2]	DATE OF WATER-LEVEL MEASUREMENT
010005	ATLANTIC CITY MUA	392511	743052	8	210	7	0.64	12/11/85
010074	LEVARI, NICK	392731	745305	80	194	77	3.24	12/11/85
010092	CASAZZA, L	392857	745337	98	90	89	8.96	12/11/85
010097	SIKKING BROS	392925	745629	82	75	81	0.81	12/11/85
010106	LEVARI, PETER JR	393003	745513	94	98	87	7.32	12/11/85
010112	PUZZUTILLO, C	393141	745428	93	24	87	5.68	12/10/85
010135	NJ WATER CO	392244	743455	20	127	7	12.50	12/10/85
010137	TUBOLO, CARMAN	392248	743544	35	146	19	15.84	12/09/85
010138	NJ WATER CO	392254	743434	15	123	4	10.50	12/10/85
010154	S JERSEY GAS CO	392515	743824	55	157	44	10.69	12/11/85
010166	INGEMI, H	393548	745048	69	70	62	7.06	12/10/85
010174	SEAVIEW C C	392653	742825	35	232	18	16.52	12/13/85
010175	SEAVIEW C C	392702	742826	49	250	14	35.10	12/11/85
010177	SEAVIEW C C	392659	742823	40	253	-6	46.38	12/11/85
010185	LENOX INC	392919	743605	66	173	50	16.04	12/11/85
010198	SOHN, EMMA	393025	743615	67	136	52	14.91	12/12/85
010208	KERTZ, JOHN	393123	743638	44	63	43	1.13	12/12/85
010242	EATON, BRIT	392927	743722	64	43	55	8.65	12/10/85
010256	SCHOLLER BROS	393333	744424	93	275	55	37.47	12/11/85
010261	MORTELLITE, G	393639	744915	77	99	72	4.99	12/12/85
010272	BERTINO, JOHN	393746	744413	60	62	55	4.80	12/10/85
010273	JACOBS, SALVATORE	393728	745008	85	101	80	4.58	12/10/85
010274	BERTINO, JOHN	393738	744437	64	86	54	10.26	12/10/85
010286	BROWN, JAMES	393815	744728	87	100	74	13.11	12/09/85
010287	BERTINO, JOHN	393823	744515	57	60	55	1.59	12/10/85
010288	BERTINO, JOHN	393828	744519	57	58	55	1.85	12/10/85
010295	BERTINO BROS	393835	744435	51	60	47	4.01	12/10/85
010296	BERTINO BROS	393842	744422	55	58	48	7.10	12/10/85
010298	BRIDGE AVE FARM	393845	744414	58	120	49	9.30	12/10/85
010300	BERTINO, JOHN	393837	744526	60	77	58	1.85	12/10/85
010313	COLUMBIA FARMS	393918	744624	66	65	64	2.44	12/09/85
010325	COLUMBIA FARMS	393927	744602	62	65	61	2.02	12/09/85
010330	COLUMBIA FARMS	393943	744548	60	60	57	2.80	12/09/85
010334	COLUMBIA FARMS	393950	744601	61	60	59	2.07	12/09/85
010348	STATE OF NJ	394316	744415	50	15	48	2.36	12/09/85
010349	STATE OF NJ	394041	744604	58	150	56	2.52	12/09/85
010352	STATE OF NJ	394156	744508	53	25	49	4.13	12/09/85
010353	NJ WATER CO	392001	743522	10	71	0	10.44	12/10/85
010356	PRUDENTIAL INS	392053	743455	10	258	5	4.56	12/11/85
010360	LINWOOD C C	392113	743341	20	165	2	18.48	12/11/85
010362	NJ WATER CO	392119	743424	17	165	3	14.14	12/10/85
010378	FRANCESCHINI, R	393359	744056	75	176	67	8.39	12/10/85
010382	MULLICA TWP	393441	744303	94	154	70	24.10	12/10/85
010387	RAMBERG, RALPH	393557	744114	63	136	57	5.89	12/10/85
010399	BIRDSALL, CLYDE	393736	743916	10	95	>11	<0	12/09/85
010405	PLSNT MILLS COMMN	393743	743859	5	67	>7	<0	12/09/85
010542	US GEOL SURVEY	394028	744000	21	76	15	5.66	12/10/85
010545	US GEOL SURVEY	394046	744010	20	23	15	5.30	12/10/85
010549	NJ WATER CO	392157	743317	24	152	6	18.23	12/10/85
010567	ATLANTIC CITY MUA	392440	743035	7	208	7	0.52	12/11/85
010575	ATLANTIC CITY WD	392548	743119	9	195	9	0.35	12/11/85
010582	NJ WATER CO	391906	743629	17	99	6	11.47	12/10/85
010589	NJ WATER CO	391924	743550	22	159	8	16.37	12/10/85
010603	NJ WATER CO	392304	743515	26	95	17	8.83	12/10/85
010615	GRECO, JOSEPH	392954	745334	100	100	84	15.58	12/11/85
010630	ATL C MEDICAL	392841	743225	68	176	46	21.70	12/13/85
010639	VAL, PETER	393059	745850	100	160	91	8.88	12/10/85
010645	LA MONACA, HUGH	394007	744726	71	90	65	5.79	12/10/85
010650	HAMILTON TWP WD	392653	744254	19	380	16	3.34	12/10/85
010654	WUILLERMIN, EDWARD	393600	744750	74	120	67	7.49	12/10/85

Table 2.--Water-level data for wells screened in the Kirkwood-Cohansey aquifer system in Atlantic County, New Jersey, December 1985--Continued

WELL NUMBER	OWNER	LATITUDE (DEGREES)	LONGITUDE (DEGREES)	ALTITUDE OF LAND SURFACE (FEET)[1]	DEPTH OF WELL (FEET)[2]	HYDRAULIC HEAD (FEET)[1]	DEPTH TO WATER TABLE (FEET)[2]	DATE OF WATER-LEVEL MEASUREMENT
010684	NJ WATER CO	392302	743515	24	130	14	10.03	12/10/85
010699	US GEOL SURVEY	392933	744604	40	160	23	17.26	12/11/85
010714	US GEOL SURVEY	391946	745125	41	73	27	14.03	12/10/85
010718	US GEOL SURVEY	391957	744657	33	26	20	12.60	12/10/85
010719	US GEOL SURVEY	393241	744818	67	38	44	23.28	12/10/85
010720	US GEOL SURVEY	393549	745059	65	22	57	5.72	12/10/85
010721	US GEOL SURVEY	393145	743009	30	25	15	15.03	12/11/85
010722	US GEOL SURVEY	392339	743337	42	36	23	19.42	12/10/85
010723	US GEOL SURVEY	392704	743818	75	41	51	24.10	12/11/85
010724	US GEOL SURVEY	393049	743958	61	23	53	8.22	12/11/85
010725	US GEOL SURVEY	393418	743537	20	23	12	7.60	12/11/85
010726	US GEOL SURVEY	392938	742543	29	31	9	19.58	12/11/85
010727	US GEOL SURVEY	392931	743125	40	22	27	12.58	12/11/85
010729	US GEOL SURVEY	392346	744916	72	31	60	11.82	12/10/85
010740	EGG HARBOR CITY	393210	743717	41	25	40	21.10	12/12/85
010743	BROWNING FERRIS CO	392133	743641	30	40	14	15.75	12/11/85
010754	WINZINGER, ROBERT	392640	743715	72	32	51	21.10	12/12/85
010756	GALLOWAY TWP	392830	742812	30	34	18	11.82	12/11/85
010757	GALLOWAY TWP	392834	742826	41	32	25	16.23	12/11/85
010758	GALLOWAY TWP	393139	743935	53	9	51	1.91	12/12/85
010759	GALLOWAY TWP	393050	743441	55	19	43	11.88	12/12/85
010760	GALLOWAY TWP	393047	743443	54	17	46	8.46	12/12/85
010776	ATLANTIC CITY MUA	392639	743232	38	93	18	20.47	12/11/85

Notes: [1]Datum is sea level

[2]Datum is land surface

Table 3.--Water-surface elevations of selected streams in Atlantic County, New Jersey, December 1985

STREAM LEVEL REFERENCE NUMBER	LATITUDE (DEGREES)	LONGITUDE (DEGREES)	WATER-SURFACE ELEVATION (FEET)[1]	DATE OF WATER-LEVEL MEASUREMENT
SL01	393017	745736	85	12/12/85
SL02	393115	745329	78	12/12/85
SL03	392617	745135	88	12/12/85
SL04	392513	745032	<78	12/12/85
SL05	392507	744936	69	12/12/85
SL06	393418	744936	47	12/12/85
SL07	383333	744714	48	12/12/85
SL08	393316	744846	46	12/12/85
SL09	393218	744923	<68	12/12/85
SL10	393229	744721	39	12/12/85
SL11	393115	744742	48	12/12/85
SL12	392922	744919	68	12/12/85
SL13	392831	744758	49	12/12/85
SL14	392718	744846	49	12/12/85
SL15	392712	744613	38	12/12/85
SL16	392707	744520	22	12/12/85
SL17	392613	744826	49	12/12/85
SL18	392459	744802	49	12/12/85
SL19	392422	743646	29	12/12/85
SL20	392343	744500	18	12/12/85
SL21	392208	744724	47	12/12/85
SL22	392410	744848	59	12/12/85
SL23	391857	744931	10	12/12/85
SL24	391853	744834	9	12/12/85
SL25	391822	744607	12	12/12/85
SL26	393922	744052	19	12/09/85
SL27	393901	744052	18	12/09/85
SL28	393840	744015	18	12/09/85
SL29	393330	744025	58	12/11/85
SL30	393134	744050	58	12/11/85
SL31	392951	744216	38	12/11/85
SL32	392950	744002	48	12/11/85
SL33	392908	744243	31	12/11/85
SL34	392827	744239	27	12/11/85
SL35	392540	744206	3	12/11/85
SL36	392448	744006	31	12/11/85
SL37	392421	744125	17	12/11/85
SL38	392230	744159	10	12/11/85
SL39	393813	743944	13	12/11/85
SL40	393625	743941	39	12/09/85
SL41	393506	743646	16	12/11/85
SL42	393450	743941	48	12/10/85
SL43	393340	743648	23	12/10/85
SL44	393240	743740	28	12/11/85
SL45	392832	743830	47	12/09/85
SL46	392228	743900	<28	12/11/85
SL47	393435	743410	7	12/10/85
SL48	393052	743210	24	12/10/85
SL49	393005	743044	19	12/10/85
SL50	393021	743420	49	12/10/85
SL51	393100	742959	6	12/10/85
SL52	392302	743500	18	12/10/85
SL53	392943	742736	16	12/10/85
SL54	392652	742750	5	12/10/85

Note: [1]Datum is sea level

December 1985, at the time of the measurements, the water table in the Kirkwood-Cohansey aquifer system was recovering gradually from its annual lowest level (during September and October, on the average) toward its annual highest level (during March and April). Accordingly, the water-table map represents conditions intermediate between these two extremes.

The water-table map of Atlantic County was prepared by contouring primarily to measured water levels and by considering the distance of a particular measuring site from principal discharge areas. The topographic contours were used to establish the general shape and placement of the water-table contours. In several areas, contours of the water table were estimated by considering the boundaries of swamps. These boundaries were determined from the most recent editions of the U.S. Fish and Wildlife Service 7½-minute National Wetlands Inventory quadrangles and the U.S. Geological Survey 7½-minute topographic quadrangles. The placement of the water-table contours is such that, in areas not affected materially by pumping, water-table levels can be expected to be accurate to within one-half of the contour interval.

Except where diverted by wells, water in the Kirkwood-Cohansey aquifer system flows naturally from recharge areas toward discharge areas. A recharge area is that part of the flow system in which the net saturated flow of ground water is directed away from the water table. In a recharge area, there is a downward component to the direction of shallow ground-water flow. For example, data on water-table levels in clustered shallow observation wells, finished at various depths at the Atlantic City Airport (plate 1), indicate significant components of downward flow. A discharge area is that part of the flow system in which the net saturated flow of ground water is directed toward the water table. In a discharge area, there is an upward component to the direction of shallow ground-water flow. For example, water-table levels in the discharge area along the Mullica River near Sweetwater (plate 1) indicate substantial upward-flow components, and deeper wells in this area flow freely throughout the year. The local hydrogeologic framework also controls to some degree the location of areas in which flowing wells occur. In this report, water levels in the Kirkwood-Cohansey aquifer system are assumed to represent points on the regional water table. No attempt has been made to delineate areas of significant vertical flow.

Ground water flows from regions of higher head to regions of lower head, in a direction that is perpendicular to the water-table contours. In the central and western parts of Atlantic County, regional flow in the Kirkwood-Cohansey aquifer system mostly is toward the Great Egg Harbor River. Water-table gradients commonly range from 20 to 40 ft/mi (feet per mile) in the western parts of this river basin and from 15 to 20 ft/mi in the eastern parts. In unstressed areas, these gradients are controlled chiefly by the slope of the land surface. Regional flow in the northern part of the county generally is toward the Mullica River. Gradients in this basin are on the order of 20 to 30 ft/mi. Regional ground-water flow in the eastern part of the county is toward tidal streams and marshes; gradients in this area are about 5 to 20 ft/mi.

Depth to Water Table, December 1985

Plate 2 shows depths to the water table in Atlantic County in December 1985. This map was prepared by discretizing with a square grid (each grid cell encompassed about 0.25 mi^2) the water-table and topographic-contour maps of Atlantic County. An average value of water-table and land-surface altitude was estimated for each grid cell. The difference between these two values, the depth to the water table, was then computed and contoured manually. Additional control for contouring was provided by water-level measurements in 83 wells throughout the county, surface-water features, and topography.

Depths to the water table range from 0 ft in swamps and along stream channels to more than 25 ft in areas of high topographic relief or where the water table has been lowered by pumping. In swampy, low-lying, and forested parts of the county, the water table generally is shallow. Such areas usually are undeveloped and are not affected by pumping. Localities where the land surface is higher tend to be more developed and support a larger population. In several developed areas, such as Hammonton, Absecon, Pleasantville, and Somers Point (locations shown on plate 2), withdrawals for public supply from the Kirkwood-Cohansey aquifer system have caused the water table to decline, resulting in a greater depth to the water table. In agricultural areas, mostly in the western part of Atlantic County, withdrawals for irrigation cease by autumn and water levels begin to recover gradually. The recovery period generally lasts until early spring. Accordingly, plate 2 represents conditions intermediate between maximum and minimum depth to the water table.

Water-Table Fluctuations

Hydrographs of 22 wells (figs. 3-13) illustrate water-table fluctuations in various parts of Atlantic County. These fluctuations are caused mainly by changes in ground-water storage, which arise because of imbalances between recharge and discharge. Natural changes in storage generally give rise to gradual changes in water levels. The Kirkwood-Cohansey aquifer system is recharged chiefly by precipitation; peaks on the hydrographs of daily minimum water levels (figs. 3A and B) reflect such events. Water from the unconfined aquifer system discharges to surface-water bodies, to deeper aquifers, and to the atmosphere by evaporation and transpiration. Water also is withdrawn from the aquifer system through wells. The hydrographs of daily minimum and once-monthly water levels (figures 3-13) show that the water table recedes during summer and autumn when discharge of water from the aquifer system generally exceeds recharge, and recovers during winter and spring when recharge exceeds discharge. The maximum observed annual water-table fluctuation is about 5 ft (fig. 13B); on the average, however, annual fluctuations commonly are less than 4 ft.

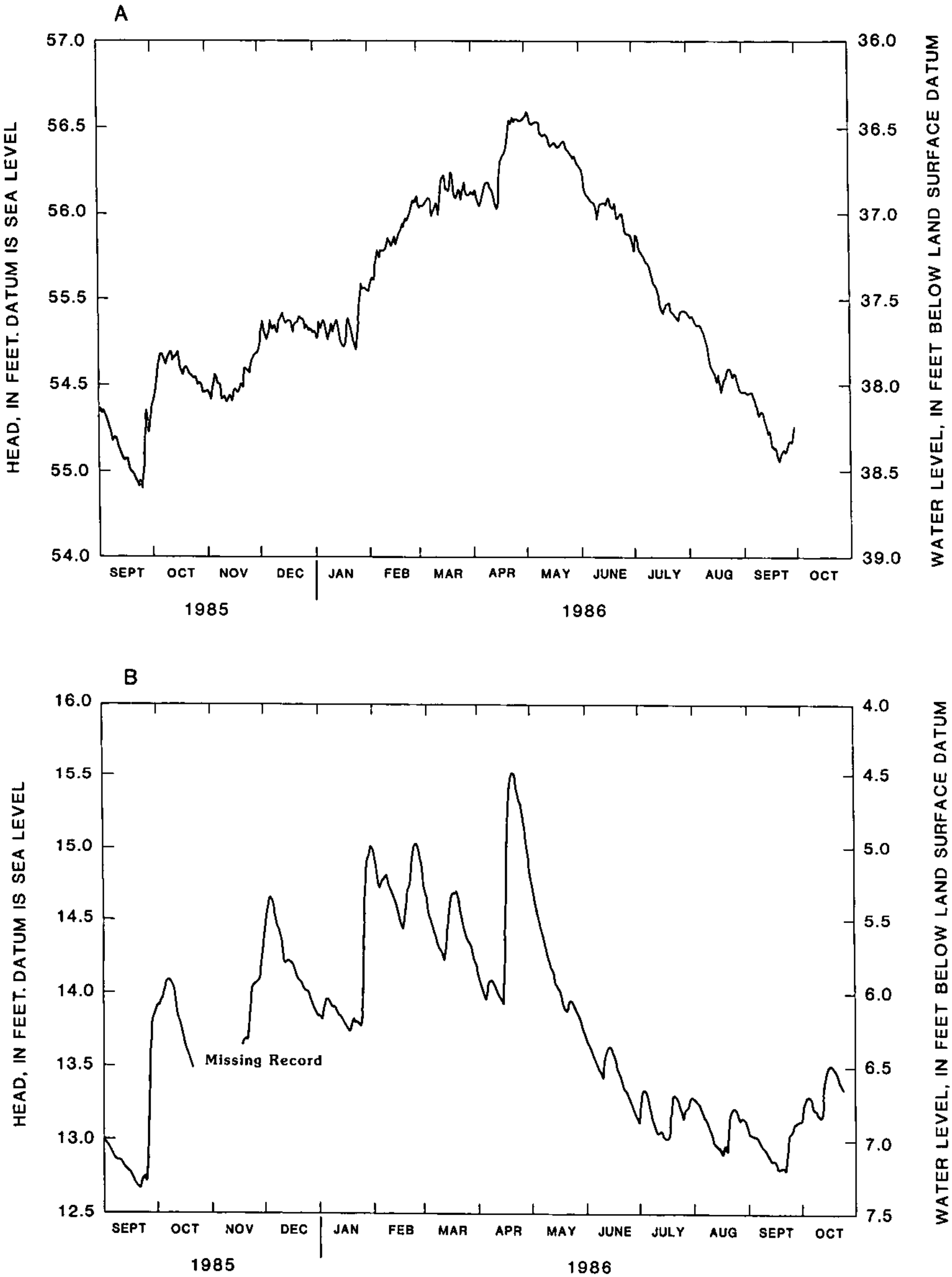


Figure 3.--Hydrographs of daily minimum water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010256: (B) 010542.

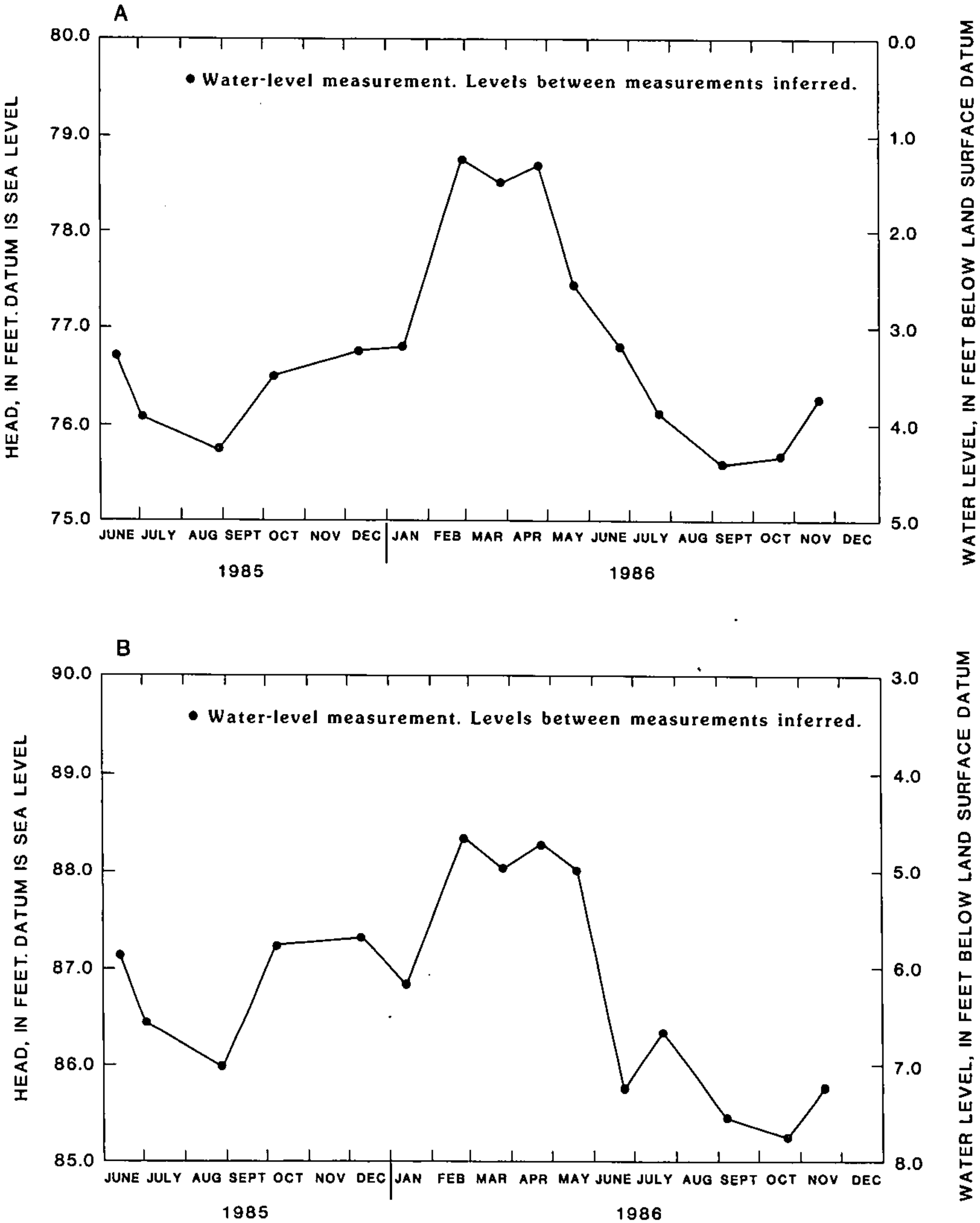
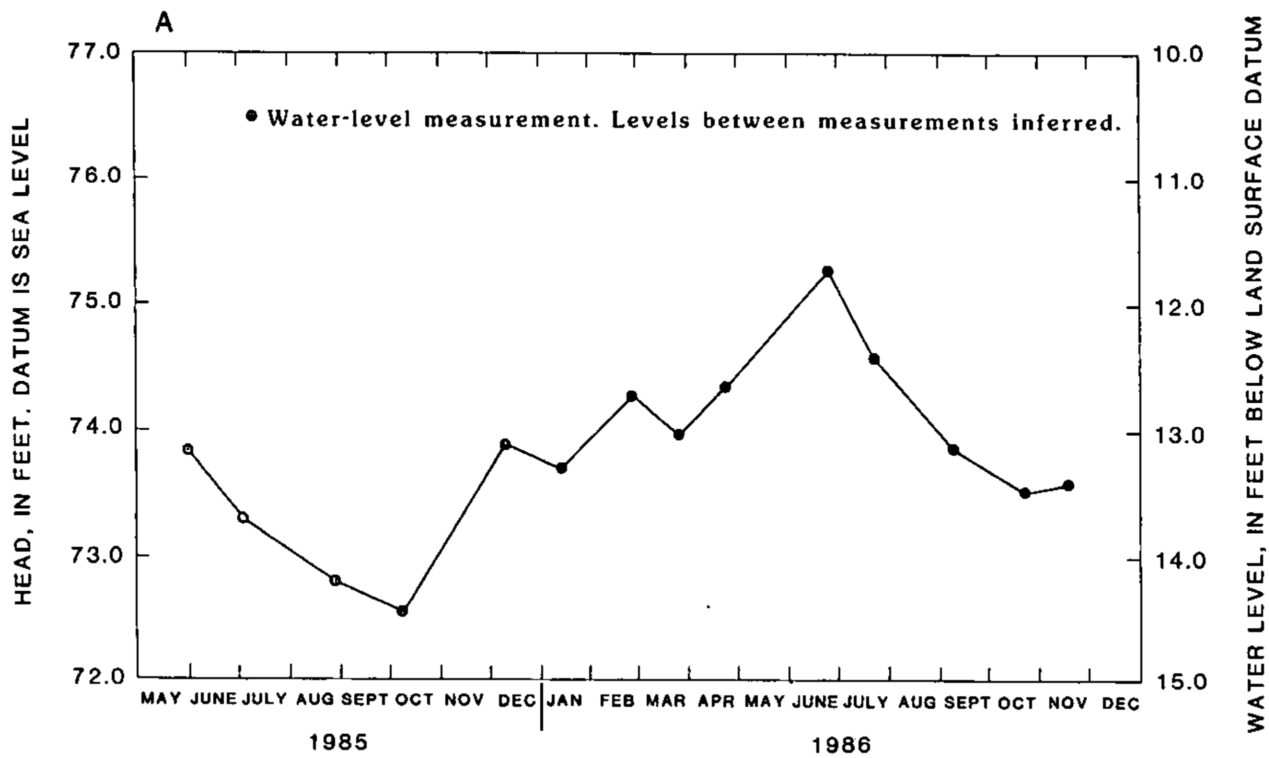


Figure 4.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010074; (B) 010112.



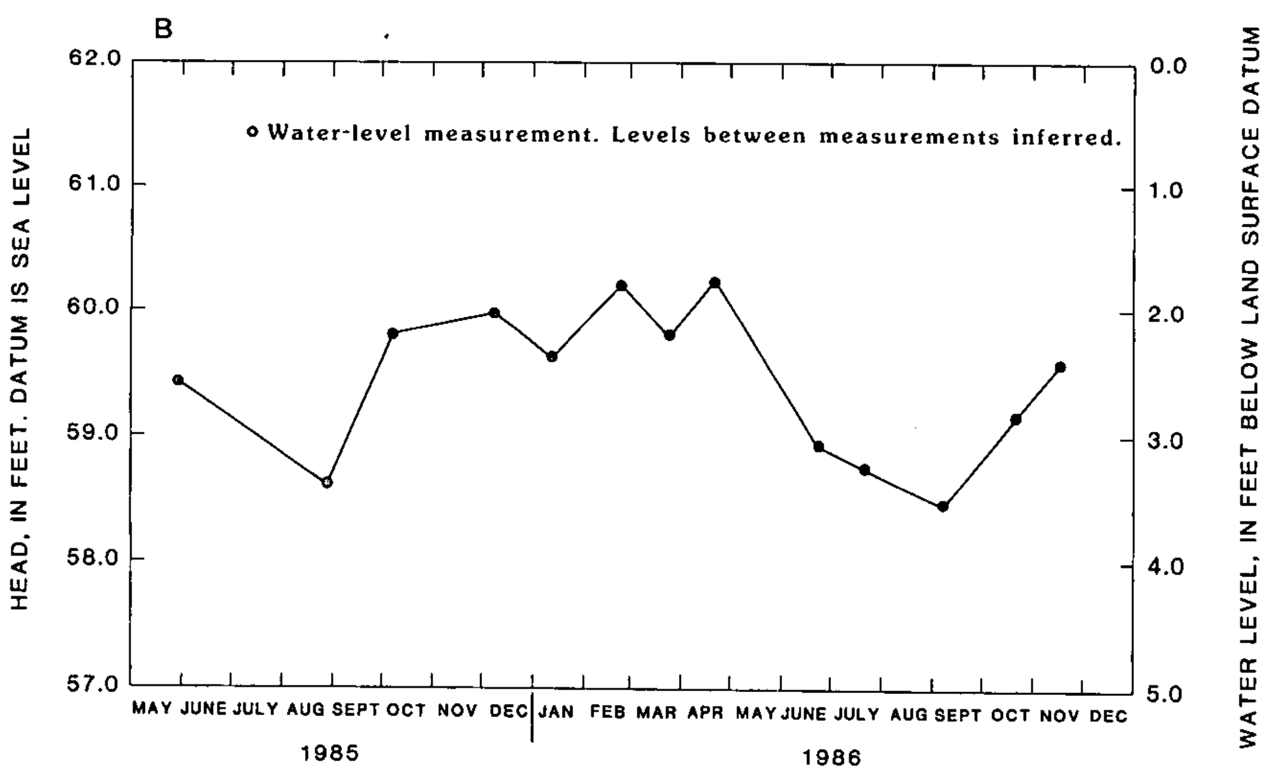


Figure 5.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010286; (B) 010325.

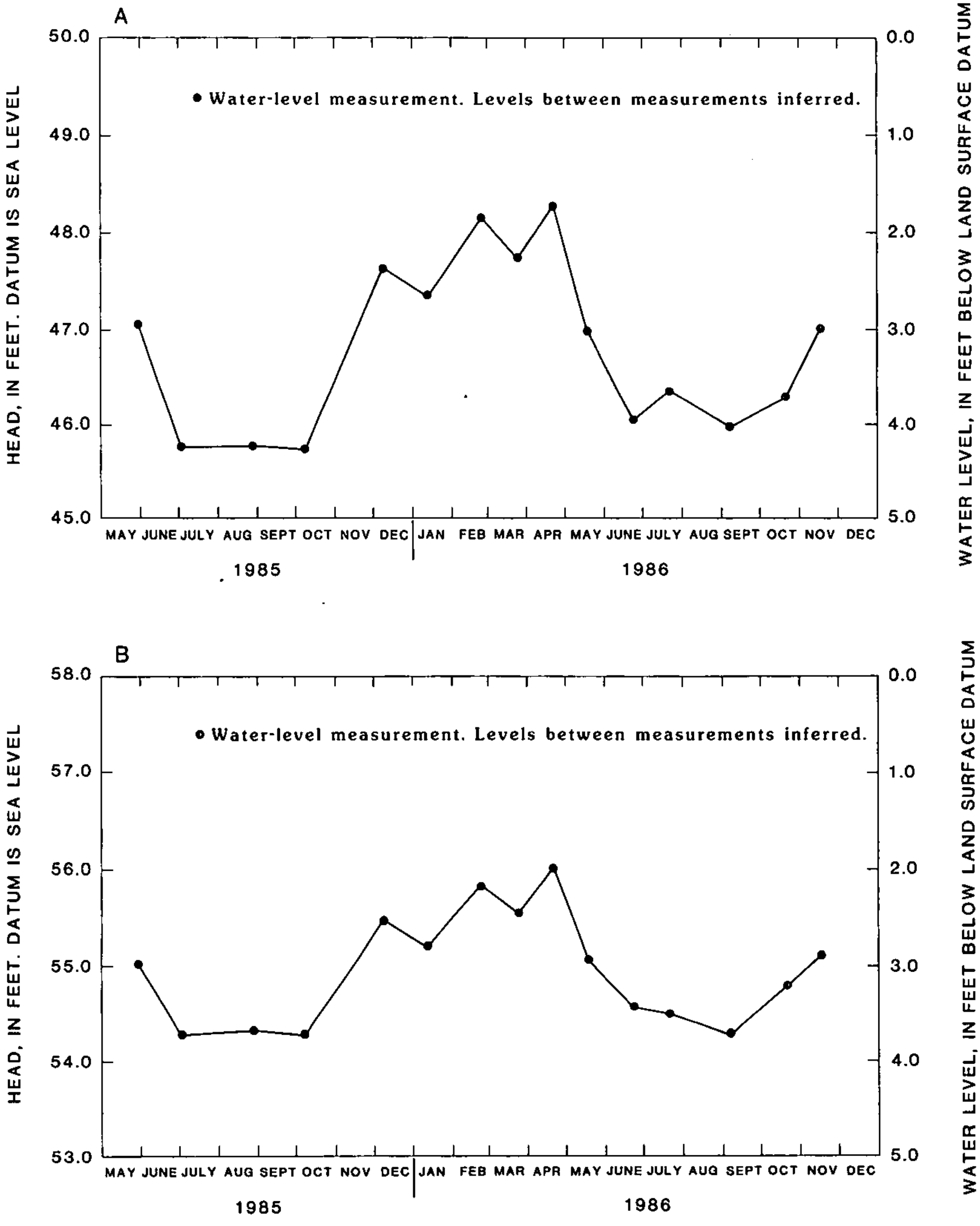


Figure 6.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010348; (B) 010349.

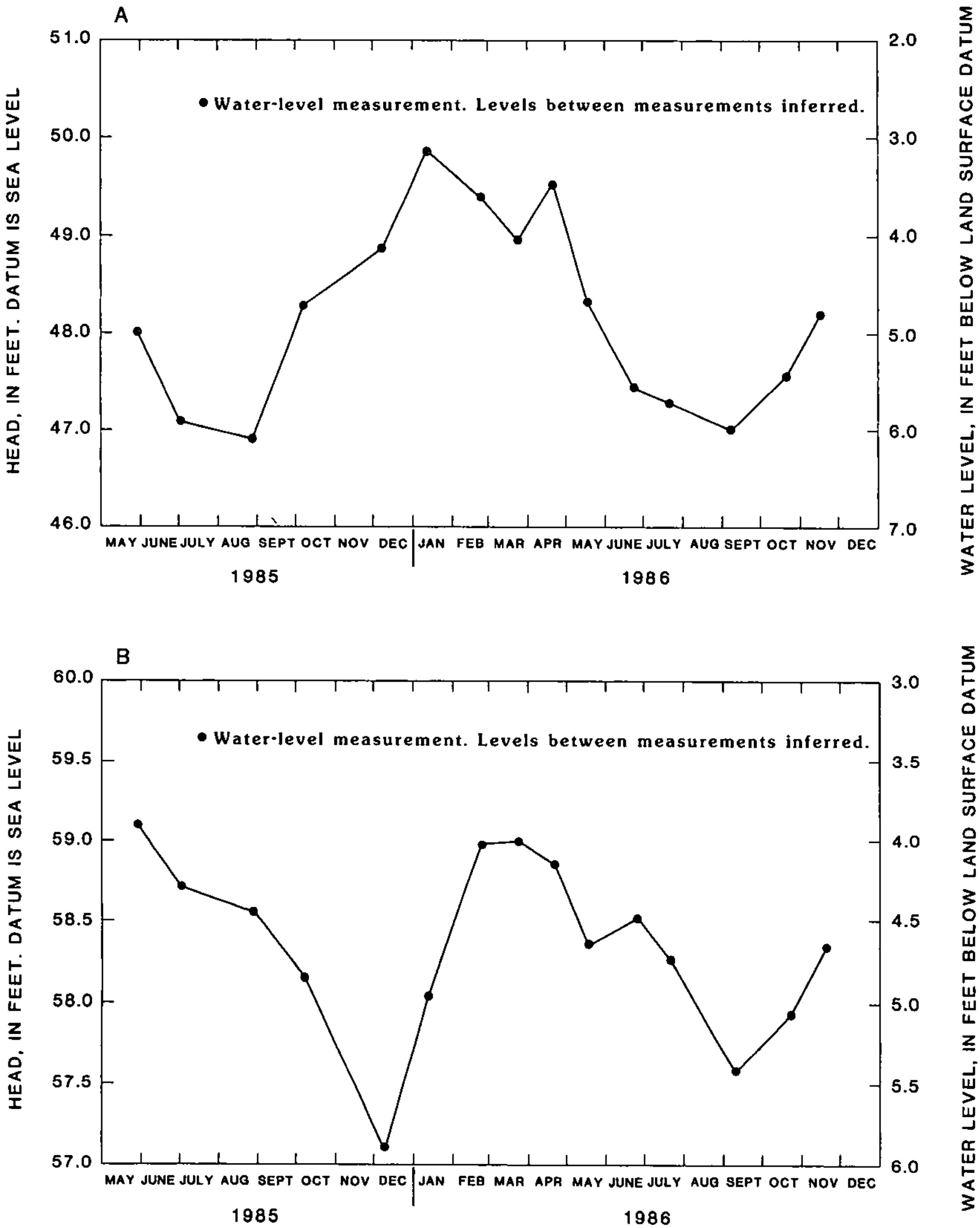


Figure 7.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010352; (B) 010387.

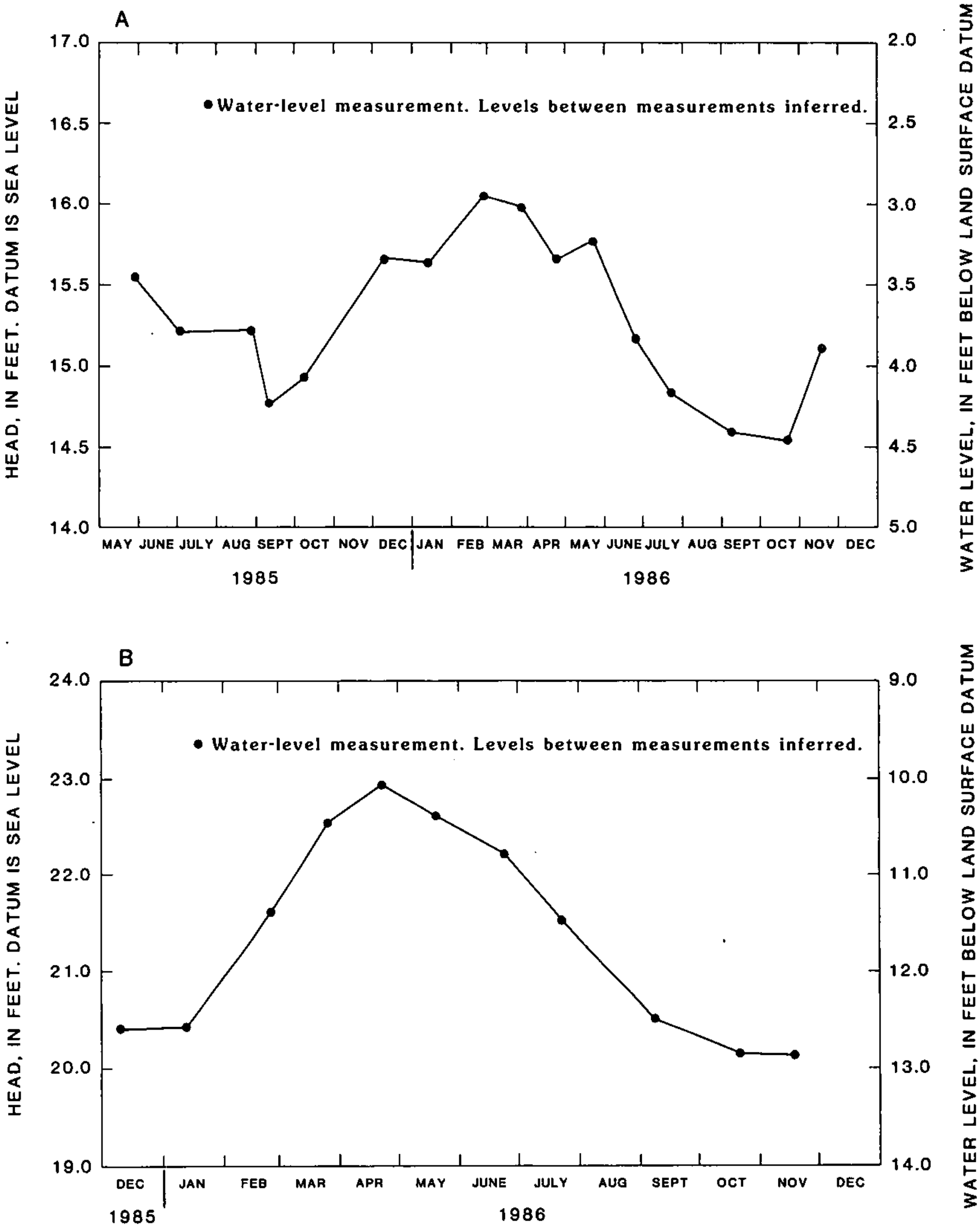


Figure 8.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010650; (B) 010718.

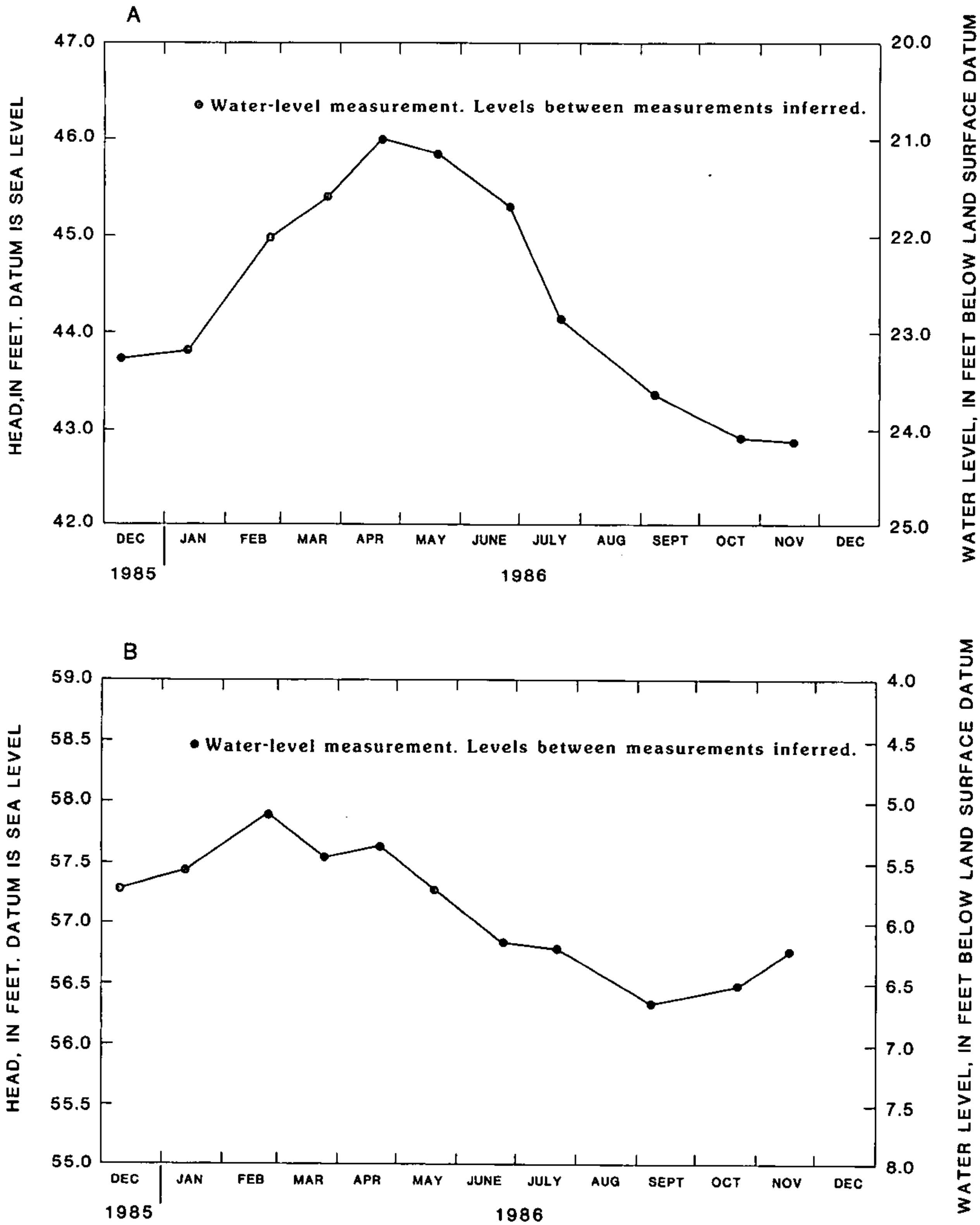


Figure 9.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010719; (B) 010720.

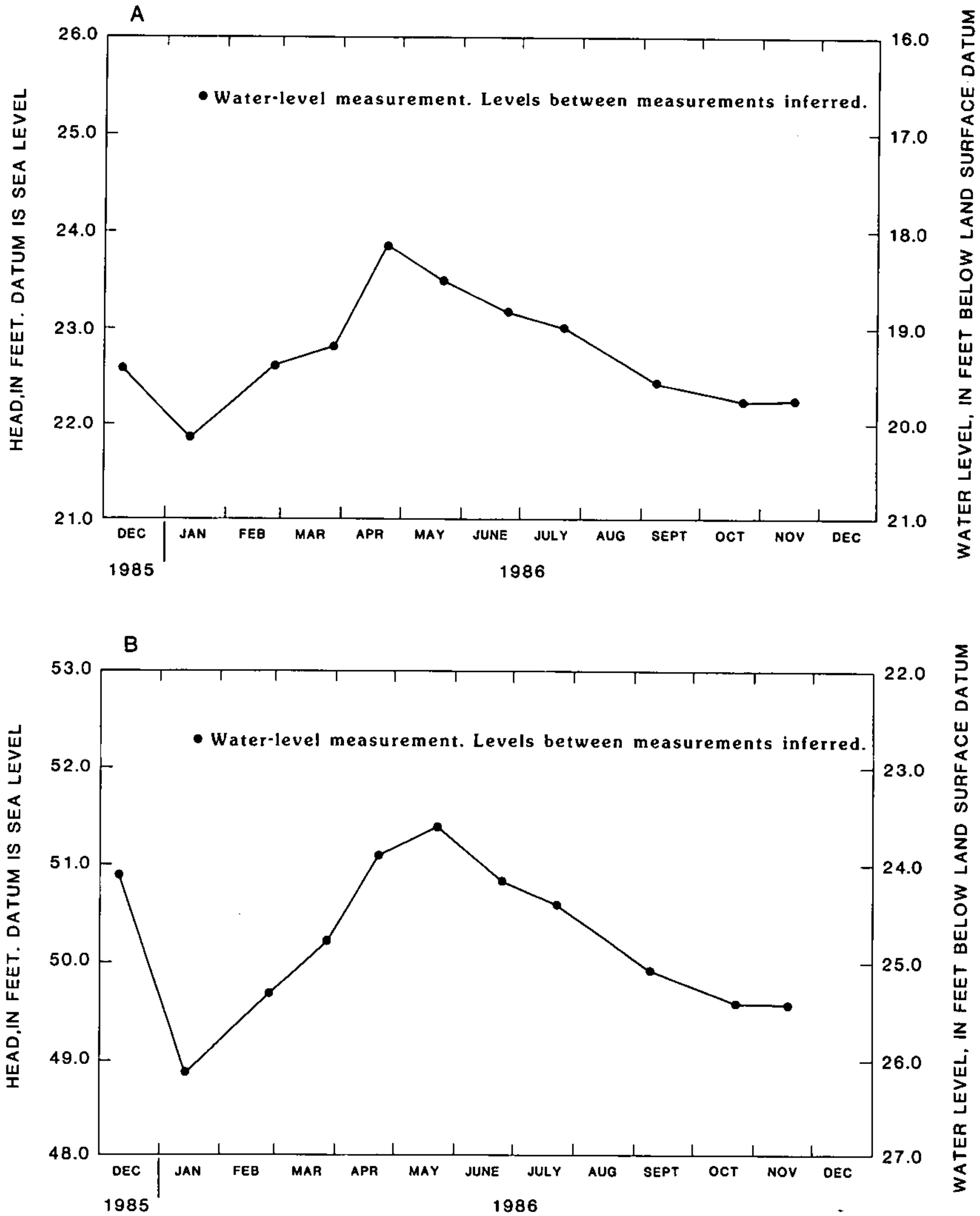


Figure 10.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010722; (B) 010723.

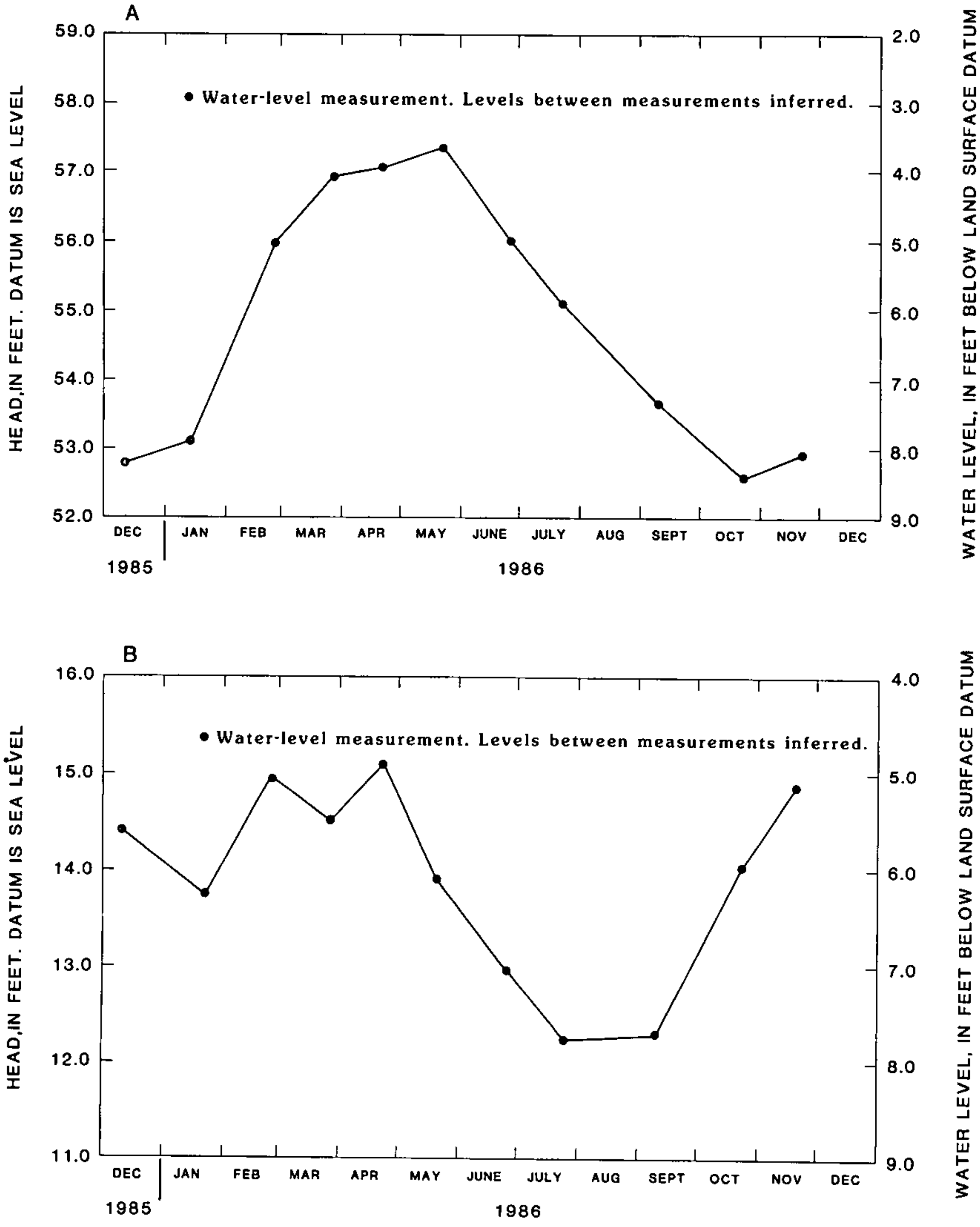
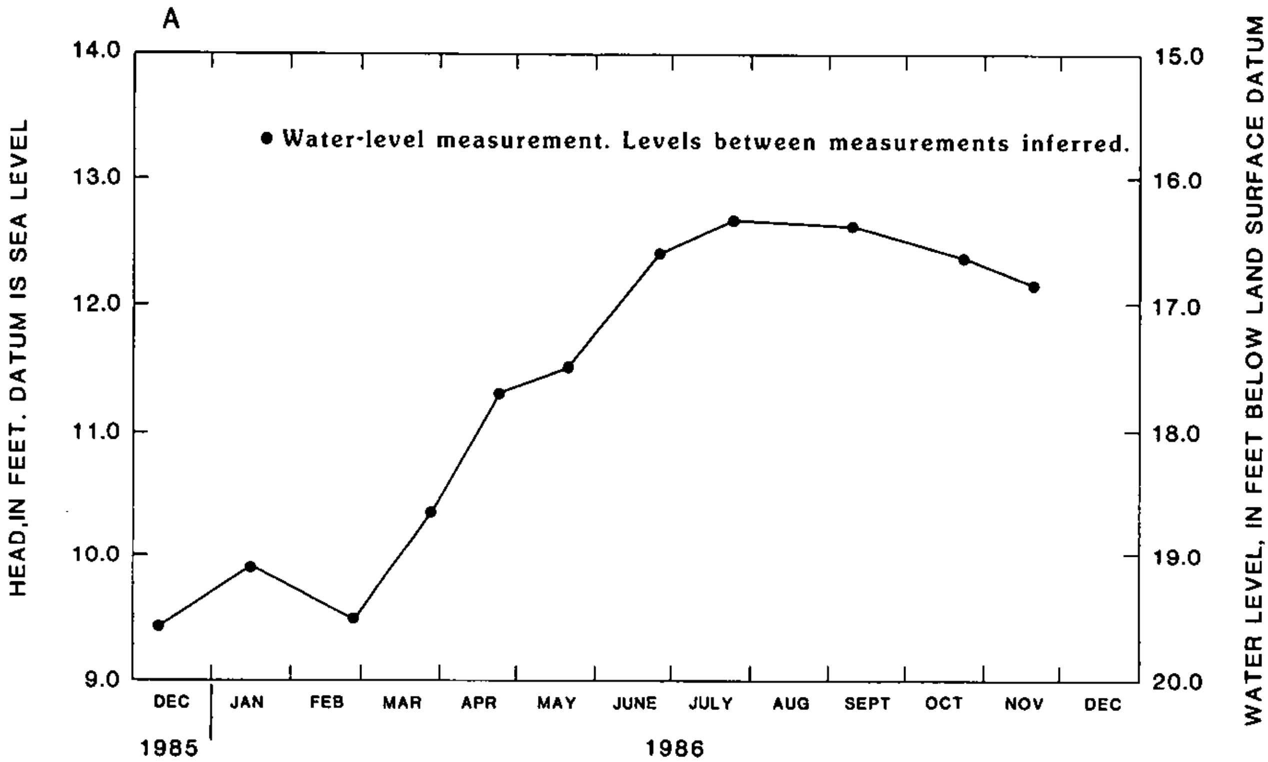


Figure 11.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010724; (B) 010725.



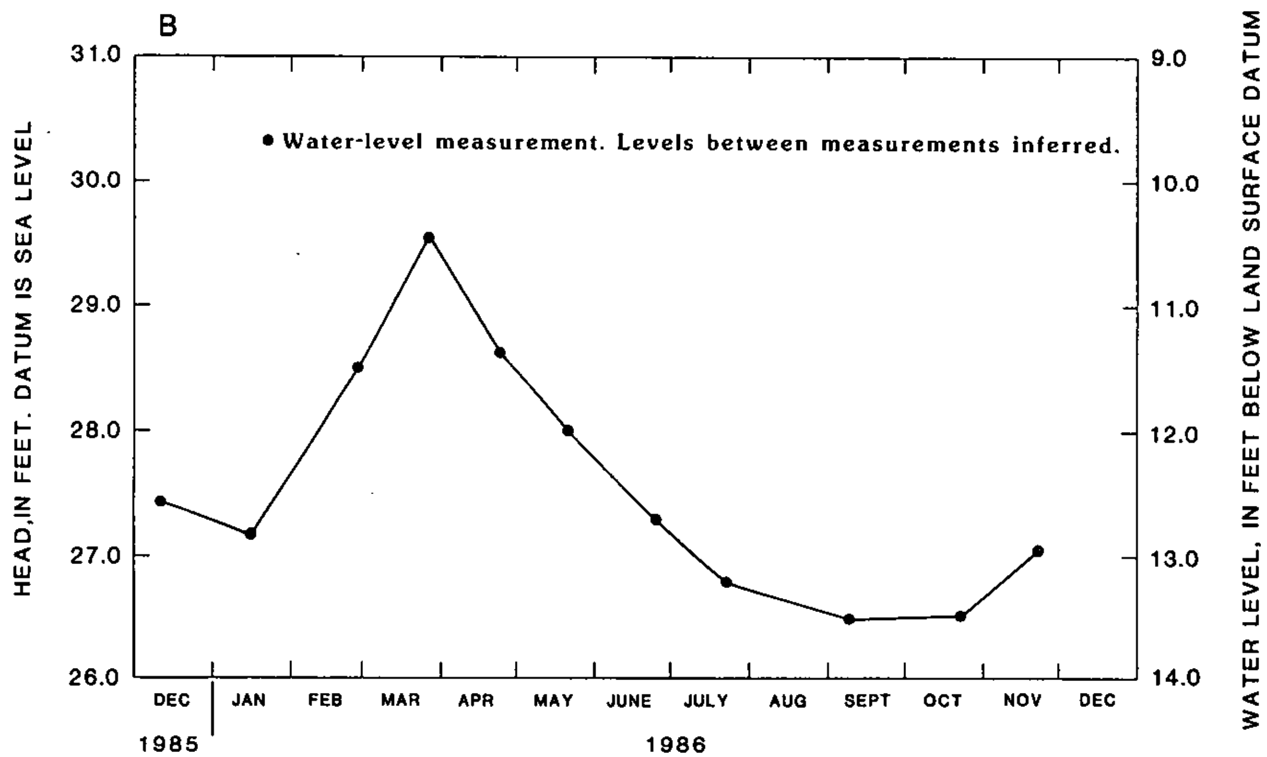


Figure 12.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010726; (B) 010727.

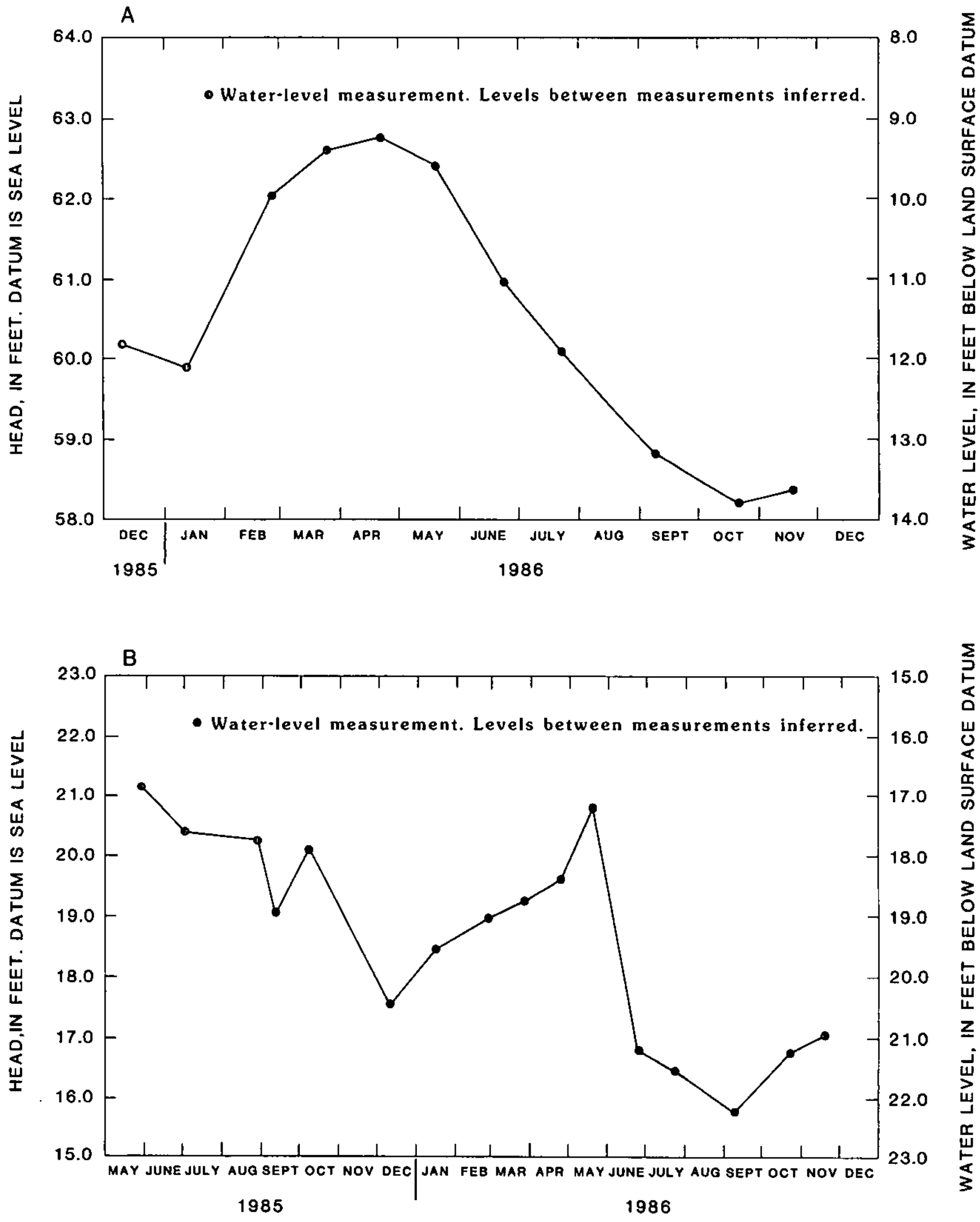


Figure 13.--Hydrographs of monthly water levels for selected wells in the Kirkwood-Cohansey aquifer system, 1985-86: (A) 010729; (B) 010776.

Atlantic City 800-Foot Sand

Table 4 presents the water-level data used to prepare the potentiometric-surface maps of the 800-foot sand for April and September 1986. Most of the water levels are for wells on the barrier islands in Atlantic, Ocean, and Cape May Counties. Data for the two marine-observation wells also are included in this table; well 010710 is 5.3 mi offshore of Atlantic City, and well 010711 is 1.9 mi offshore.

Contours on the potentiometric-surface maps were drawn manually, compared to computer-generated contours, and then adjusted manually to refine the representation of each surface. The computer-generated contours were prepared by a universal-kriging algorithm. Kriging is a statistical technique that furnishes unbiased estimates of parameter values (in this case, water levels) over a region; these estimates are computed such that the variance among values is minimized (Skrivan and Karlinger, 1980, p. 2).

Potentiometric Surface, April 1986

The map of the potentiometric surface in April 1986 (plate 3a), which represents conditions of annual minimum pumping stress on the 800-foot sand, shows an elongated regional cone of depression that extends from southern Ocean County to southern Cape May County, and to more than 5.3 mi seaward of Atlantic City. This cone is centered around Margate and Ventnor, Atlantic County, where water levels were more than 70 ft below sea level. With transducers, the water level in marine well 010711 was measured at 65 ft below sea level. Because of logistical problems, the level in marine well 010710 was not measured; however, in preparing the map, a water level of 50 ft below sea level was assumed. This value was estimated by considering previously determined water-level gradients between the two wells, along with the water level measured in well 010711 in April 1986. The gradient in September 1985 was 4.70 ft/mi, whereas the gradient in January 1986 was 3.82 ft/mi. Water levels in the localized cone of depression near Ship Bottom, Ocean County, were more than 20 ft below sea level. The regional cone of depression is shallowest in western parts of the study area, where water levels were nearly 20 ft above sea level near Egg Harbor City, Atlantic County.

Potentiometric gradients vary around the cone of depression because of its elliptical shape. To the west of Margate and Ventnor, gradients were approximately 5 ft/mi; to the north and east, 4 ft/mi; and to the south, 3.5 ft/mi. Maximum gradients in the localized cone of depression near Ship Bottom were nearly 12 ft/mi.

Potentiometric Surface, September 1986

The map of the potentiometric surface in September 1986 (plate 3b) represents conditions of annual maximum pumping stress on the 800-foot sand. Although the shape of the cone of depression is similar to the shape in April 1986, the regional cone was much deeper in September. Near Margate and Ventnor, water levels were more than 100 ft below sea level, whereas water levels in marine-observation wells 010711 and 010710 were measured at 84 ft and 68 ft, respectively, below sea level. Near Ship Bottom, water

Table 4.--Water-level data for wells screened in the Atlantic City 800-foot sand of the Kirkwood Formation, April and September, 1986

WELL NUMBER	OWNER	LATITUDE (DEGREES)	LONGITUDE (DEGREES)	ALTITUDE OF LAND SURFACE (FEET)[1]	DEPTH OF WELL (FEET)[2]	WATER LEVEL (FEET)[1] APRIL 1986	WATER LEVEL (FEET)[1] SEPT 1986	WATER-LEVEL CHANGE (FEET) APRIL-SEPT 1986
010015	PRESIDENT HOTEL	392058	742711	10	831	-63	-88	-25
010037	ATLANTIC CITY WD	392152	742459	9	837	-60	-86	-26
010039	BRIGANTINE WD	392329	742348	10	788	-51	-80	-29
010040	BRIGANTINE WD	392342	742328	10	766	-51	-79	-28
010041	BRIGANTINE WD	392431	742153	9	829	-54	-68	-14
010042	BRIGANTINE WD	392456	742121	10	788	-37	-59	-22
010117	EGG HAR WTR WKS	393206	743836	40	432	18	17	-1
010180	US GEOL SURVEY	392754	742701	30	570	-27	-37	-10
010367	LONGPORT WD	391859	743122	10	800	-65	-92	-27
010370	MARGATE CITY WD	391928	743055	10	804	--	-101	--
010372	MARGATE CITY WD	391933	743058	10	800	-72	--	--
010376	MARGATE CITY WD	392008	743017	10	791	-69	-100	-31
010578	US GEOL SURVEY	391826	743709	10	680	-44	-63	-19
010593	VENTNOR CITY WD	392018	742945	9	790	-69	-99	-30
010598	VENTNOR CITY WD	392032	742852	8	800	-82	-100	-18
010600	VENTNOR CITY WD	392045	742840	8	810	-68	-101	-33
010637	EGG HAR WTR WKS	393217	743823	40	428	17	15	-2
010680	CARNIVAL CLUB	392120	742606	8	835	-64	-86	-22
010682	RESORTS INTRNTL	392134	742521	10	840	-60	-87	-27
010683	BRIGANTINE WD	392410	742227	20	775	-45	-67	-22
010702	US GEOL SURVEY	392032	743008	5	750	-74	-100	-26
010703	US GEOL SURVEY	392639	743232	30	570	-33	-43	-10
010704	US GEOL SURVEY	392232	742344	50	606	-27	-38	-11
010706	US GEOL SURVEY	392933	743130	40	530	-16	-22	-6
010710	US GEOL SURVEY	391726	742221	--	981[3]	-50	-68	-18
010711	US GEOL SURVEY	391955	742507	--	835[3]	-65	-84	-19
090002	AVALON WD	390420	744435	5	861	-46	-56	-10
090004	AVALON WD	390528	744338	10	920	-37	-52	-15
090008	AVALON WD	390621	744248	10	925	--	-46	--
090092	NJ WATER CO	390525	744851	15	791	-30	--	--
090100	MIDDLE TWP WD	390647	744438	10	827	-34	-53	-19
090106	NJ WATER CO	391343	743755	10	810	-39	-58	-19
090109	NJ WATER CO	391535	743611	10	809	-47	-71	-24
090110	NJ WATER CO	391604	743539	5	814	-55	-72	-17
090116	NJ WATER CO	391638	743451	10	810	-57	-83	-26
090117	NJ WATER CO	391642	743447	10	798	-54	--	--
090121	NJ WATER CO	391649	743449	8	825	-51	-81	-30
090122	NJ WATER CO	391710	743408	6	825	-48	-86	-38
090124	NJ WATER CO	391712	743340	10	846	--	-92	--
090125	NJ WATER CO	391726	743352	10	800	-59	--	--
090126	SEA ISLE CITY WD	390747	744241	7	759	-38	-55	-17
090127	SEA ISLE CITY WD	390847	744200	10	830	-27	-52	-25
090128	SEA ISLE CITY WD	390902	744153	7	870	--	-55	--
090129	SEA ISLE CITY WD	390926	744131	10	861	-30	--	--
090132	STONE HARBOR WD	390301	744545	10	880	-29	-38	-9
090135	STONE HARBOR WD	390323	744525	10	878	-30	--	--
090136	CORSONS INLET WC	391152	743927	10	834	-37	-55	-18
090144	ATL CITY ELEC	391703	743756	9	691	-46	-64	-18
090148	ATL CITY ELEC	391707	743756	10	675	-49	-65	-16
090161	E SHORE CNVLSC	390704	744750	16	654	-24	-35	-11
090166	STONE HARBOR WD	390351	744504	5	860	-31	-50	-19
090173	STONE HARBOR WD	390314	744532	10	862	-29	--	--
090185	US GEOL SURVEY	391621	744355	15	650	-27	-37	-10
290009	BEACH HAVEN WD	393346	741430	5	656	-23	-36	-13
290012	BEACH HAVEN WD	393346	741434	5	665	--	-34	--
290111	HARVEY CDRS WD	394134	740832	10	500	-16	-38	-22
290112	HARVEY CDRS WD	394218	740808	10	493	-20	-34	-14
290457	LONG BEACH WC	393510	741327	8	495	-18	-33	-15
290461	LONG BEACH WC	393725	741150	9	615	-19	-38	-19
290462	LITTLE EGG HMUA	393253	742308	10	564	-15	-23	-8
290464	LITTLE EGG HMUA	393428	742202	30	543	-8	-15	-7
290544	SHIP BOTTOM WD	393839	741052	10	578	-26	-43	-17
290549	SHIP BOTTOM WD	393848	741053	5	589	-25	-45	-20
290557	STAFFORD TWP MUA	394042	741411	10	428	12	7	-5
290560	SURF CITY WD	393938	741006	5	557	-25	--	--
290564	TUCKERTON MUA	393610	742031	10	481	-2	-9	-7
290597	TUCKERTON MUA	393610	742021	25	500	2	-6	-8
290774	STAFFORD TWP MUA	394042	741411	10	484	14	10	-4

Notes: [1]Datum is sea level

[2]Datum is land surface, unless noted otherwise

[3]Datum is seafloor

levels were greater than 40 ft below sea level. In the vicinity of Egg Harbor City, water levels remained essentially unchanged at about 20 ft above sea level.

As the configuration of the potentiometric surface remains about the same throughout the year, the general direction of ground-water flow remains essentially unchanged. However, due to increased withdrawals during the summer months, gradients increased to approximately 8 ft/mi to the west of Margate and Ventnor and to 5 ft/mi on the north, east, and south. Near Ship Bottom, gradients increased to a maximum of approximately 16 ft/mi. This increase in gradient results in an increase in the rate of ground-water flow toward pumping centers.

Potentiometric Change

The map of potentiometric change from April to September 1986 (plate 3c), shows the maximum water-level change in the Atlantic City 800-foot sand during 1986. The map was prepared by discretizing with a square grid (each grid cell encompassed about 2.5 mi^2) the potentiometric-surface maps of April and September 1986 (plates 3a and 3b, respectively), estimating the water level at each grid node, and computing the value of change for each node. The contours of equal potentiometric change were generated by kriging these spatially discretized values. Computed values of change in 55 wells measured both in April and September 1986 were used for additional control and to refine the generalized contours.

The greatest potentiometric change occurs on the barrier islands in Atlantic, Cape May, and Ocean Counties, due to increased ground-water withdrawals associated with the summer tourist trade. In Margate, Ventnor, and Ocean City, water levels declined about 30 ft. In marine wells 010711 and 010710, and at Ship Bottom, water levels declined nearly 20 ft. West of the barrier islands, near the edge of the confining unit overlying the 800-foot sand, withdrawals from the aquifer are relatively small and constant, and there was no observable net potentiometric change between April and September 1986.

Water-Level Fluctuations

Plate 3d shows hydrographs of six wells screened in the Atlantic City 800-foot sand in Atlantic and Cape May Counties. Each hydrograph depicts 1 year of essentially continuous record for an individual well.

Water levels in the Atlantic City 800-foot sand fluctuate seasonally, chiefly because of variations in ground-water withdrawals. An increase in withdrawals during the warmer months causes water levels to decline. This declining trend, which is greatest in coastal parts of the study area, generally occurs from early spring until early autumn. Beginning in early autumn and continuing into early spring, a reduction in withdrawals causes water levels to recover. Data on withdrawals from the 800-foot sand currently are not available for April and September 1986, the periods of water-level measurement represented by plate 3. However, data for April and September 1985 suggest that withdrawals in September are more than twice as great as those in April (C.L. Qualls, U.S. Geological Survey, written commun., 1987).

Water levels in the 800-foot sand also fluctuate on a short-term basis. Such fluctuations of as much as several feet occur commonly in response to tidal loading and periodic pumping of nearby wells. Although usually it is difficult or impossible to distinguish them from fluctuations caused by tidal loading and pumping, water-level fluctuations due to changes in barometric pressure invariably occur, but to a lesser extent. The amplitude of fluctuations caused by loading is greatest in wells on the barrier islands (maximum observed amplitude about 3 ft) and decreases inland with increasing distance from the shoreline. The amplitude of short-term water-level fluctuations caused by pumping decreases with increasing distance from the pumping center.

POSSIBLE USES OF THIS REPORT

The maps and hydrographs in this report can be used for various purposes. Agencies and individuals concerned with ground-water resources management can use these products to estimate the general direction, velocity, and quantity of ground-water flow; to quantify the change in ground-water storage; and to identify recharge and discharge areas. Others may use the information on water levels when dealing with situations involving construction, drainage, and dewatering. However, these products are intended to represent general conditions, and, therefore, should not be used to predict the precise level of ground water at a particular site. This limitation arises because the nature and density of the data are not sufficient to show all temporal and areal variations, especially those caused by local activities and conditions.

SUMMARY

This report presents information on ground-water levels and their fluctuations during 1985-86 in the principal aquifers of Atlantic County and vicinity, New Jersey. Maps of altitude of the water table, depth to the water table, potentiometric surface, and potentiometric change, along with hydrographs prepared from continuous and periodic water-level measurements in observation wells, are used to represent this information.

In December 1985, water levels were measured in 83 wells screened in the unconfined Kirkwood-Cohansey aquifer system, the principal source of water supply for parts of the study area on the mainland. These water levels, along with 54 water-surface elevations measured in small streams, were used to prepare maps of altitude of the water table and depth to the water table in Atlantic County. The water table ranges in depth from at the land surface in low-lying or swampy areas to more than 25 ft below the land surface in areas that are topographically high or are affected by ground-water withdrawals. Hydrographs for observation wells screened in the Kirkwood-Cohansey aquifer system show water-table response to short-term and seasonal variations in recharge and discharge.

In April and September 1986, water levels were measured in wells screened in the confined Atlantic City 800-foot sand of the Kirkwood Formation, the principal source of water supply for the barrier-island communities in Atlantic, Ocean, and Cape May Counties. The potentiometric-surface maps prepared from these water-level measurements show a regional cone of depression that extends from southern Ocean County to southern Cape

May County and to more than 5.3 mi seaward of Atlantic City. In April 1986, under conditions of annual minimum pumping stress, water levels in the deepest part of the cone were more than 70 ft below sea level. In September 1986, under conditions of annual maximum pumping stress, water levels in the deepest part of the cone were more than 100 ft below sea level. Water-level hydrographs for observation wells screened in the Atlantic City 800-foot sand depict short-term and seasonal fluctuations.

The information on ground-water levels presented in this report can be used to estimate the general direction, velocity, and quantity of ground-water flow; to quantify the change in ground-water storage; and to identify recharge and discharge areas. The information also may be used when dealing with situations involving construction, drainage, and dewatering. However, these products are intended to represent general conditions, and, therefore, should not be used to predict the precise level of ground water at a particular site.

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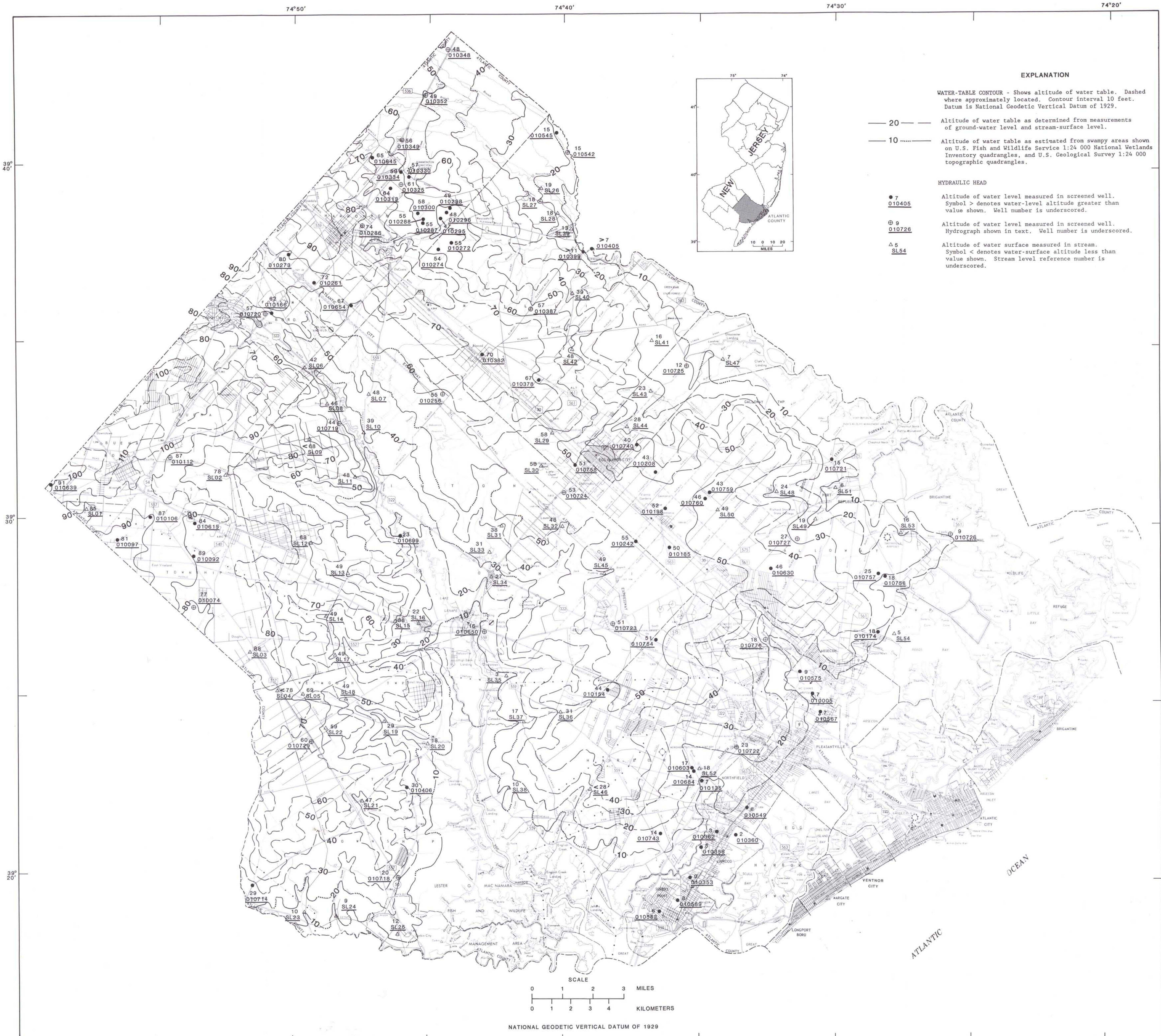
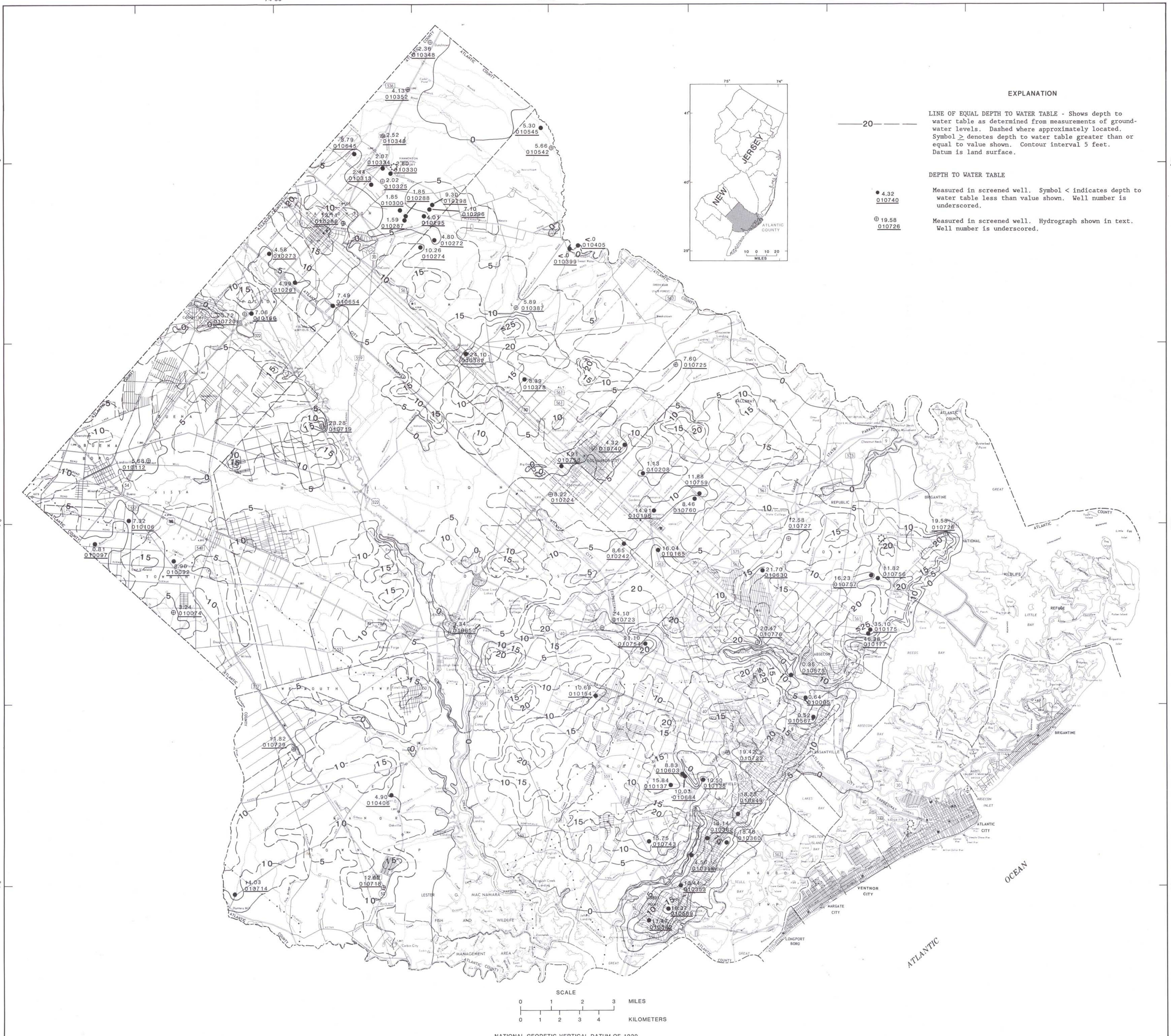


Base from New Jersey Department of Transportation Atlantic County highway map, 1978

Hydrology by J.S. Clark, 1986

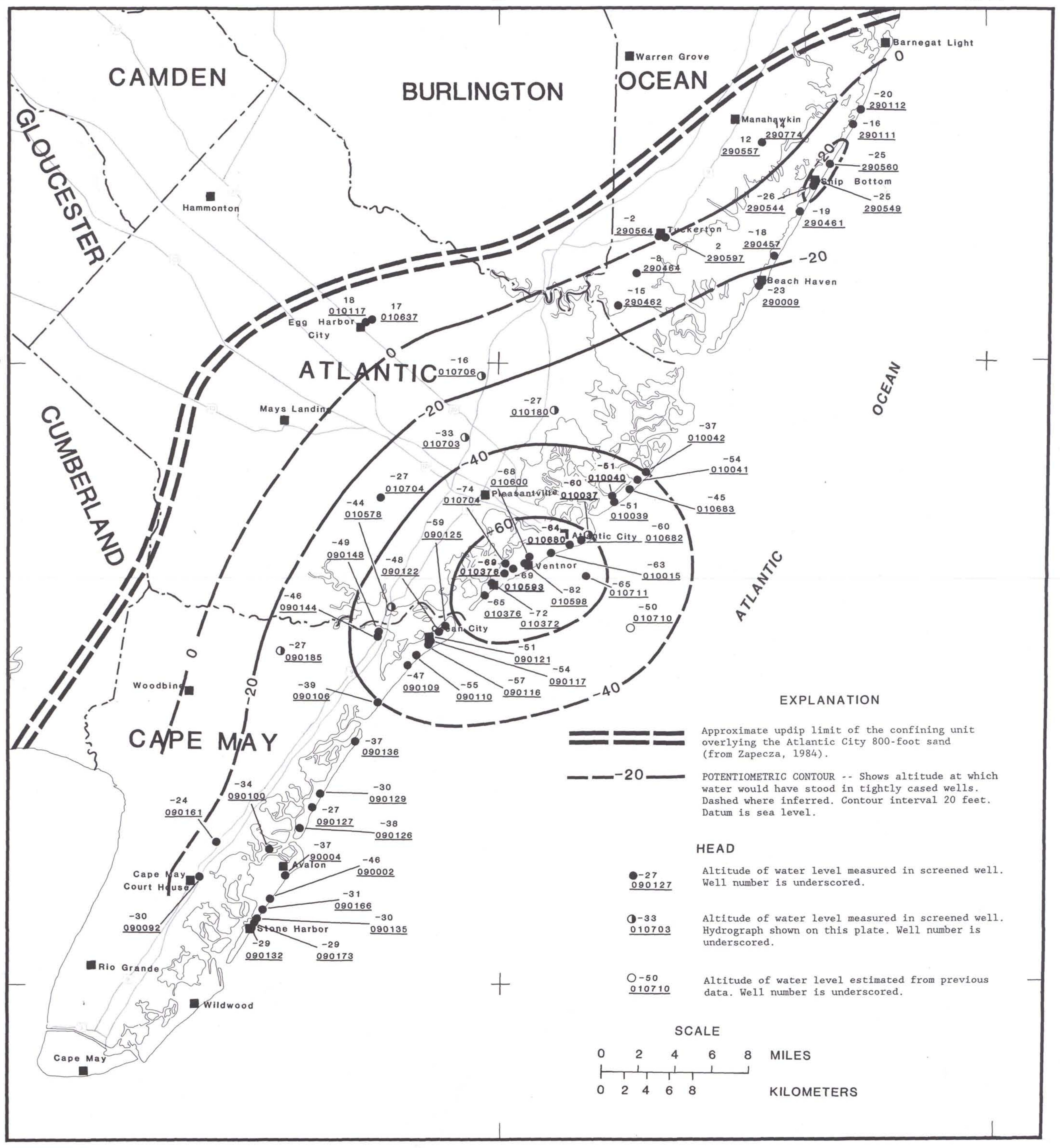
Altitude of the water table in Atlantic County, New Jersey, December 1985.



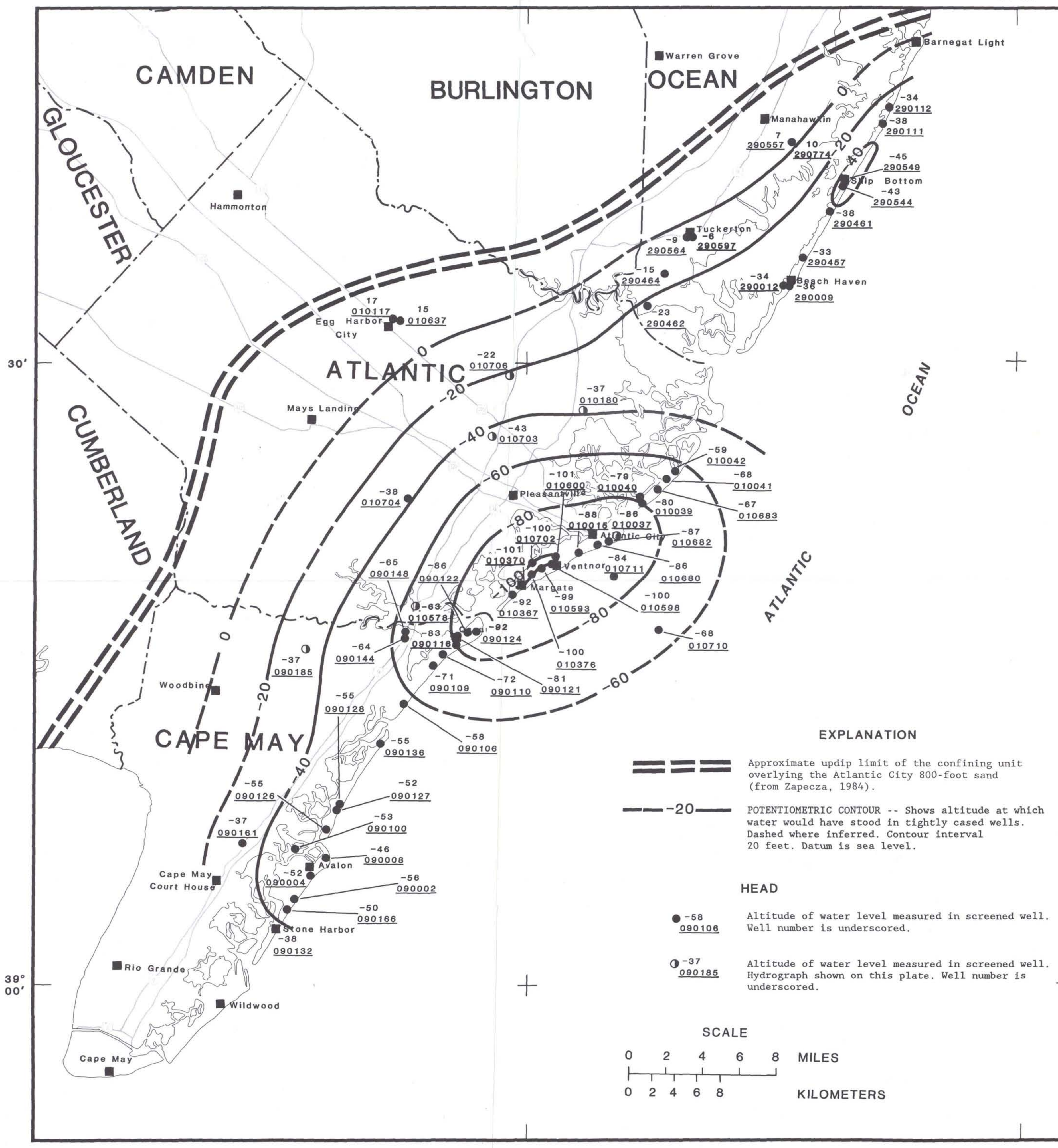
Base from New Jersey Department of Transportation Atlantic County highway map, 1978.

Hydrology by J.S. Clark, 1986

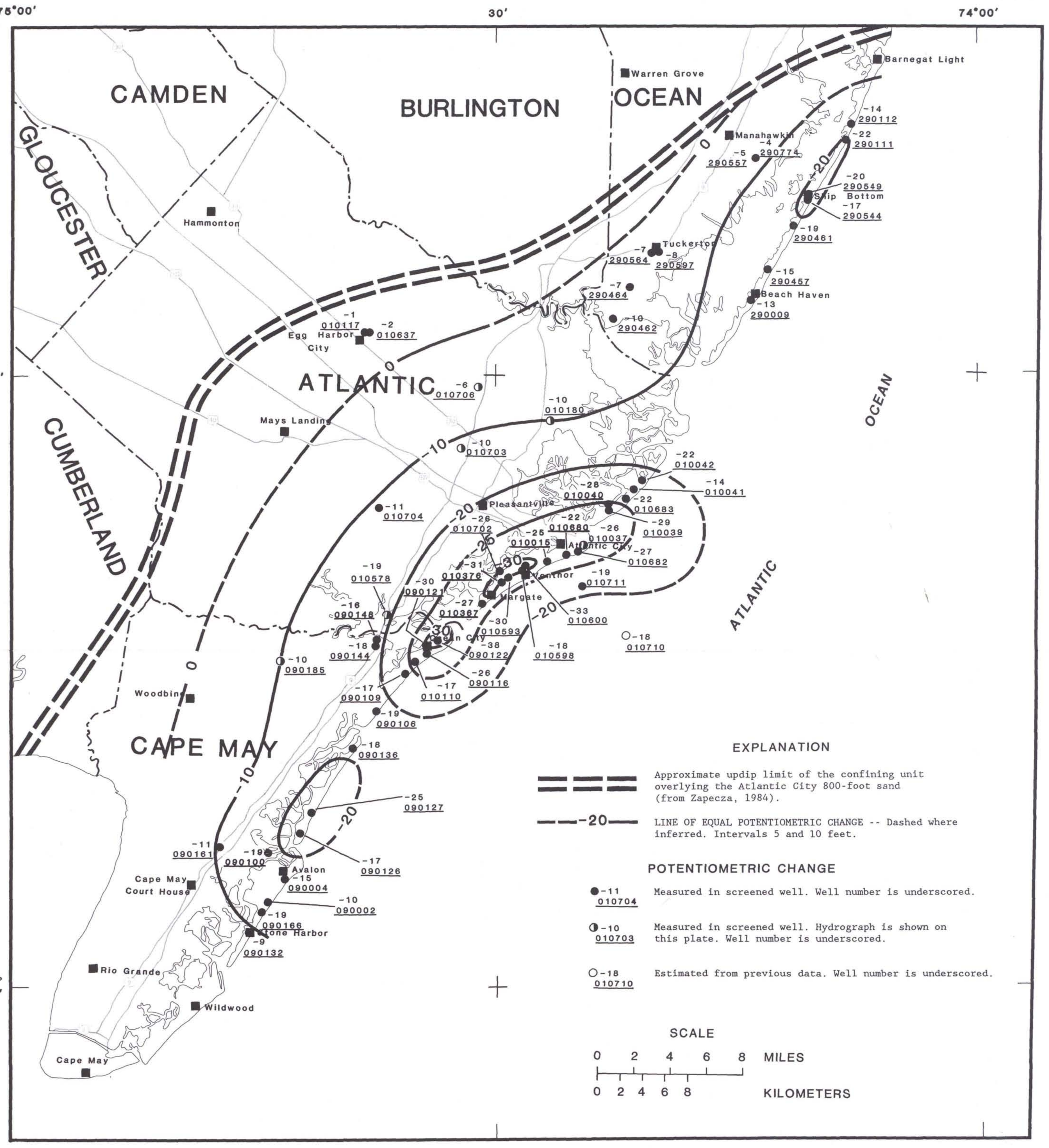
Depth to the water table in Atlantic County, New Jersey, December 1985.



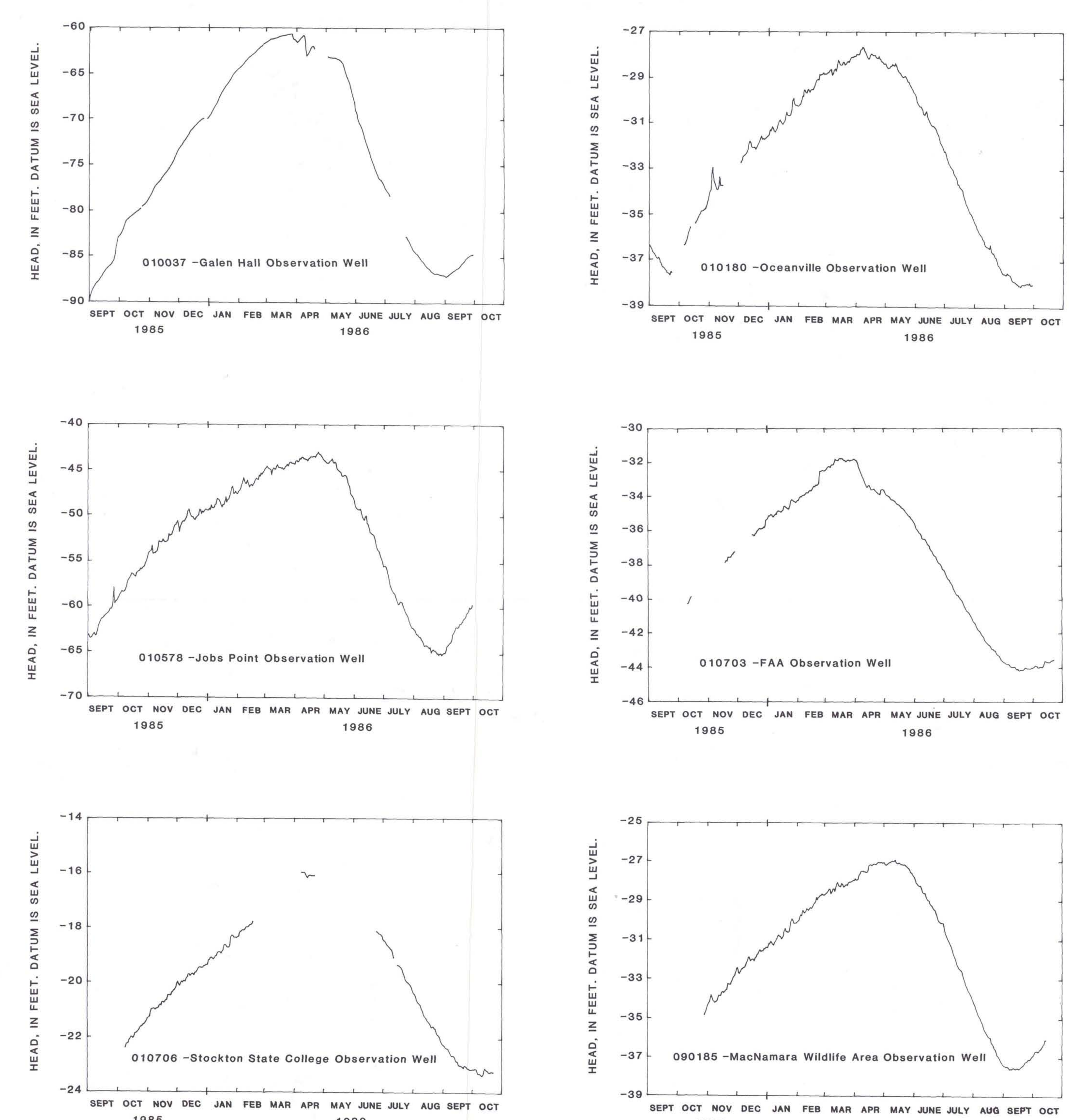
a. Potentiometric surface, April 1986



b. Potentiometric surface, September 1986



c. Potentiometric change, April to September 1986



d. Hydrographs for selected wells, 1985-86

Water levels in the Atlantic City 800-foot sand of the Kirkwood Formation, 1985-86.

Base from U.S. Department of Agriculture, Soil Conservation Service, scale 1:250 000

Hydrology by J.S. Clark, 1986

Water Levels in the Principal Aquifers of Atlantic County and Vicinity, New Jersey, 1985-86 (New Jersey Geological Survey Open-File Report 88-3)