#### U.S. DEPARTMENT OF THE INTERIOR U.S. GEOLOGICAL SURVEY

### WATER LEVELS IN, EXTENT OF FRESHWATER IN, AND WATER WITHDRAWAL FROM EIGHT MAJOR CONFINED AQUIFERS, **NEW JERSEY COASTAL PLAIN, 1993**

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#### ABSTRACT

Water levels in 722 wells in the Coastal Plain of New Jersey, Pennsylvania, and northeastern Delaware were measured during October and November 1993 and were used to define the potentiometric surface of the eight major confined aquifers of the area. Isochlors (lines of equal chloride concentration) for 250 and 10,000 milligrams per liter are included to show the extent of freshwater in each of the aquifers. Estimated water withdrawals from the eight major confined aquifers are reported for 1978-94. Water-withdrawal and water-level maps including isochlors were constructed for the Cohansey aquifer of Cape May County, the Atlantic City 800-foot sand, the Piney Point aquifer, the Wenonah-Mount Laurel aquifer, the Englishtown aquifer system, the Upper Potomac-Raritan-Magothy, the Middle and undifferentiated Potomac-Raritan-Magothy, and the Lower Potomac-Raritan-Magothy aquifers.

From 1988 to 1993, water levels near the center of the large cones of depression in the Middlesex-Monmouth County area rose as much as 120 ft in the Wenonah-Mount Laurel aquifer and Englishtown aquifer system, 40 ft in the Upper Potomac-Raritan-Magothy aquifer, and 96 ft in the Middle and undifferentiated Potomac-Raritan-Magothy aquifers. Large cones of depression in the potentiometric surface of aquifers of the Potomac-Raritan-Magothy aquifer system in the Burlington-Camden-Gloucester area remained at about the same altitude; that is, the potentiometric surface neither rose nor fell in the aquifers by more than 5 feet. In the same area, water levels in the Englishtown aquifer system were static, whereas the water levels in the Wenonah-Mount Laurel aquifer declined 5 to 20 feet, forming an expanded cone of depression. Water levels in the Cohansey, Atlantic City 800-foot sand, and Piney Point aquifers declined by 1 to 10 feet during 1988-93.

#### **INTRODUCTION**

Ground-water withdrawals from the major confined aquifers in the New Jersey Coastal Plain began in the late 1800's. Several regional cones of depression in the potentiometric surfaces of the aquifers have developed as a result of the withdrawals. Before 1978, the cones of depression were mapped locally on a sporadic basis. During 1978, the U.S. Geological Survey (USGS), in cooperation with the New Jersey Department of Environmental Protection (NJDEP), mapped the potentiometric surfaces of the major aquifers in the New Jersey Coastal Plain and developed a plan to map the potentiometric surfaces of the major confined aquifers at 5-year intervals.

#### **Purpose and Scope**

This report presents the potentiometric-surface maps of the major confined aquifers of the New Jersey Coastal Plain for 1993. Specifically, the report (1) documents estimated water withdrawal during 1978-94, (2) shows major water-withdrawal areas in 1992, (3) presents hydrographs showing water levels in observation wells during 1978-94, (4) shows the estimated location of the 250-mg/L and 10,000-mg/L isochlors, and (5) shows the freshwater-saltwater interface in the outcrop area of each aquifer. Maps showing water levels, water withdrawal, and extent of freshwater and hydrographs showing water levels and withdrawal are presented for the Cohansey aquifer in southern Cape May County, the Atlantic City 800-foot sand, the Piney Point aquifer, the Wenonah-Mount Laurel aquifer, the Englishtown aquifer system, the Upper Potomac-Raritan-Magothy aquifer, the Middle and undifferentiated Potomac-Raritan-Magothy aquifer, and the Lower Potomac-Raritan-Magothy aquifer. Water levels in 722 wells were measured during October 18-December 9, 1993, and are listed together with water levels measured during the 1978, 1983, and 1988 ground-water-level studies. Hydrographs of water levels for 85 observation wells during 1978-94 show long-term changes in water level in each of the eight aquifers.

### Study Area

The study area (fig. 1-1) is about 9,500 mi<sup>2</sup> and includes the Coastal Plain of New Jersey and Pennsylvania and parts of the Coastal Plain in Delaware, New York, and nearshore areas of the Atlantic Ocean. The area of study focuses on Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Monmouth, Ocean, Salem, and parts of Mercer and Middlesex Counties in New Jersey; Kent and New Castle Counties in

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## EXPLANATION Study area **A**-A' Line of hydrogeologic section shown in figure 1-2 BUCKS MONMOUTH Asbury Park Avon-by-the-Sea pring Lake Heights PENNSYLVANIA NEW\JERSEY Browns Mills OCEAN DEL AWARE BURLINGTON Medford Lakes Forked River GLOUCESTER SALEN ATI ANTIC UMBERI ANI Dover KENT DELAWARI 8 MILES ┝᠇ᡃ᠇᠇ᡟ᠇᠊ᡟ 8 KILOMETERS SUSSE e modified from U.S. Geological Survey digital data, 1:100,000, Universal Transverse Mercator projection, Zone 18

Figure 1-1. Location of study area.



#### **Cohansey Aquifer**

#### Water withdrawal and extent of freshwater

Estimated water withdrawal from the Cohansey aquifer in southern Cape May County has remained between 5 and 6 Mgal/d during 1978-94 (fig. 1-3). Withdrawals were primarily from public-supply wells in the southern part of the county (fig. 1-4). Water withdrawal by Wildwood Water Utility and Lower Township Municipal Utilities Authority (MUA) has increased since 1978 (P. J. Lacombe, U.S. Geological Survey, written commun., 1993); however, water withdrawals by Cape May City Water Utility have decreased because saltwater has intruded from the south. The location of the 250-mg/L isochlor showing the extent of freshwater (fig. 1-5) was mapped by Lacombe and Carleton (1992). The location of the 10,000-mg/L isochlor is outside the area shown on the map. Saltwater intrusion has forced the abandonment or severely curtailed the use of 12 to 15 public- and industrial-supply wells in southern Cape May County since 1950 (Gill, 1962; Lacombe and Carleton, 1992).

#### Water Levels

Water-level altitude measurements for 33 wells screened in the Cohansey aquifer are listed in table 1-2 (reverse side of sheet 1), and the potentiometric surface based on these data is shown in figure 1-5. Maps of simulated water levels by Martin (1990, fig. 50) were modified to close the contours south and west of the Cape. The locations of the contour lines are about the same as those mapped for 1988 (Rosman and others, 1996). The map shows a major cone of depression centered under the southern part of the Cape. Within this cone are three localized cones of depression centered on the public-supply wells of Wildwood Water Utility, Lower Township MUA, and Cape May City Water Utility. Water-level altitudes at each of these pumping centers are at about -20 ft or deeper. The minimum water-level altitude measured during the study was -30 ft at well 9-54. The maximum water-level altitude was +14 ft at well 9-350.

Water-level changes from 1988 to 1993 were calculated for 20 wells (table 1-2). Water levels declined 1 to 14 ft in 16 wells and rose 1 to 7 ft in 4 wells. Water levels were measured in early December 1988 and in mid-November 1993. The reason for the apparent decline in water levels during 1988-93 could be that 1993 water levels were measured a few weeks earlier in the season, when water levels are slightly lower. The water level declined more than 10 ft in well 9-54 (14 ft). Water withdrawal from this well increased during 1990-93 to supply new service areas of the Lower Township MUA.

Water-level hydrographs for three observation wells are shown in figure 1-6. Hydrographs for wells 9-60 and 9-80 show little change in the annual high-water level from 1978 to 1994. The water-level hydrograph for well 9-150 shows an increase in annual high-water level during 1978-85, then a constant high-water level during 1985-94. This well is near Cape May City Water Utility public-supply wells, where water withdrawals decreased during 1978-85 because of saltwater intrusion. Water levels in these and other available observation wells have a seasonal fluctuation of 8 to 15 ft, which reflects increased withdrawal rates during the summer and reduced withdrawal rates during the rest of the year.

In summary, water levels in the Cohansey aquifer have remained fairly constant or have declined less than 10 ft in most areas because water withdrawals from the aquifer have remained fairly constant since 1988. The extent of freshwater in this aquifer is limited, and the saltwater front is within 2,000 ft of some supply wells.

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Introduction, Cohansey Aquifer, Summary, References - SHEET 1 OF 8 Lacombe, P.L., and Rosman, Robert, 1997, Water levels in, extent of freshwater in, and water withdrawal from eight major confined aquifers, New Jersey Coastal Plain, 1993







Delaware; and Bucks, Philadelphia, and Delaware Counties in Pennsylvania.

### **Previous Investigations**

Previous potentiometric-surface maps in this series show ground-water levels in 1978 (Walker, 1983), 1983 (Eckel and Walker, 1986), and 1988 (Rosman, Lacombe, and Storck, 1996).

#### <u>Hydrogeology</u>

The aquifers included in the study area are part of the wedge-shaped deposits of sand, silt, and clay that range in age from Cretaceous to Quarternary (table 1-1). These deposits are less than 50 ft thick along the Fall Line and are greater than 6,500 ft thick in southern Cape May County. Zapecza (1989) describes the hydrogeology in detail. The relative positions of the aquifers of the Coastal Plain are illustrated in figure 1-2.

#### **Methods of Data Collection**

Estimated water-withdrawal data were compiled from NJDEP records and stored in the USGS, State Water Use Data System. Static water-level altitudes in 722 wells screened in the major confined aquifers were measured by USGS personnel from late October to early December 1993 to represent the average of the low water level that occurs during late summer and the high water level that occurs during spring. Water levels were measured in public-, industrial-, commercial-, irrigation-, and domestic-supply wells and observation wells.

Wells were selected on the basis of areal distribution within each aquifer. As in previous studies, waterlevel altitudes were measured by use of (1) a steel measuring tape, which is the most accurate device, (2) an electric measuring tape, which is slightly less accurate, and (3) an airline, which is the least accurate. The airline method was used only where wells were inaccessible for measuring with the steel tape or electric tape.

The pumps in high-capacity supply wells were turned off at least 1 hour before measurement of the water level in the well. In addition, pumps in all other high-capacity supply wells screened in the same aquifer within 0.25 mile of the measured well were turned off for at least 1 hour before measurement of the water level. Following USGS methods for water-level measuring, field personnel made several measurements in each well until two similar readings were obtained at least 5 minutes apart to ensure that the water-level measurement reflected the local static water level. In this report, "observation well" means a well that had not been pumped during the previous 24 hours, and "production well" means a well that had not been pumped in the hour before water-level measurement but may have been pumped during the previous 24 hours. In previous reports, the terms "observation well" and "production well" were applied to the original use of the well, not to its use during this investigation.

Water levels were referenced to the land-surface altitude at each well site. The altitude of land surface was used to adapt water levels to the sea-level datum.

The location of the 10,000-mg/L isochlor was estimated by use of data from the saltwater front as modeled for each major aquifer of the New Jersey Coastal Plain (D.A. Pope and A.D. Gordon, U.S. Geological Survey, written commun., 1993). This is the simulated location of water that is about one-half freshwater and onehalf seawater. The location of the 250-mg/L isochlor is based on published maps that show the estimated location of the isochlor in each aquifer. If no map was available to show the location of the 250-mg/L isochlor in a particular aquifer, then the isochlor was interpreted from chloride data stored in the U.S. Geological Survey Water Quality Data Base. The 250-mg/L isochor designates the limit of the fresh drinking water as defined by the U.S. Environmental Protection Agency's secondary drinking-water standards. The surface-water saltwater/freshwater interface near the coastline is based on U.S. Fish and Wildlife Service (1992) wetland delineation maps that separate estuarine and marine wetlands populated by saltwater-tolerant plants from palustrine, lacustrine, and riverine wetlands and upland areas not populated by saltwater-tolerant plants. The location of the saltwater fronts is used to determine the extent of freshwater supplies and the location of the saltwater/density-driven component of ground-water flow.

#### **Description of Data Presented**

Data on ground-water withdrawal, extent of freshwater, and ground-water levels are presented and discussed for each aquifer. Estimated water-withdrawal data are presented as hydrographs and maps for each aguifer. The 250- and 10.000-mg/L isochlors delineate the extent of freshwater and are shown on the potentiometric-surface maps. Water-level data are presented as tables, hydrographs, and maps to show regional and long-term trends in water levels for each aquifer. The three data sets are presented together to show the regional and temporal effects of ground-water withdrawal on the potentiometric surface of an aquifer and the proximity of saltwater to the major pumping centers.

The water-level tables contain a well-identification number for each well; site location (latitude, longitude, and land-surface altitude); owner's name; local well identifier; year drilled; screen interval; date of 1993 waterlevel-altitude measurement; water-level altitudes measured for the previous surveys in 1978, 1983, and 1988, if available; and changes in water levels from 1988 to 1993, if available.

The scale of the 1993 potentiometric-surface maps, like previous maps in this series, is 1:250,000. The maps were prepared from the water-level data listed in respective tables and adapted from water levels simulated by Martin (1990). The simulated water-level contours on the maps are represented by the dashed contour lines in the eastern part of each map and are labeled "approximate". Changes in water level between 1988 and 1993 of 10 ft or more are discussed in some detail. The accuracy of the potentiometric contours depends upon the distribution of wells, accuracy of land-surface-altitude data, and accuracy of the water-level measurements. Differences in heads in a few randomly spaced wells may be caused by local variations in withdrawal or recharge, measurement-





#### CONVERSION FACTORS, ABBREVIATED UNITS, AND DEFINITIONS OF TERMS

Multiply	By	To obtain
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi <sup>2</sup> )	2.59	square kilometer
gallon (gal)	3.785	liter
foot per year(ft/yr)	0.3048	meter per year
cubic foot $(ft^3)$	0.02832	cubic meter
gallons per minute (gal/min)	0.000228	cubic feet per second
million gallons per day (Mgal/d)	0.0438	cubic meter per second
million gallons per year (Mgal/yr)	$3.78 \times 10^3$	cubic meter per year

ABBREVIATED UNITS

#### Chloride concentrations in this report are expressed in milligrams per liter (mg/L)

#### DEFINITIONS OF TERMS

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

Altitude: In this report altitude refers to distance above or below sea level.

Potentiometric surface: A surface which represents the static head in a aquifer. The potentiometric surface is defined by the levels to which water will rise in tightly cased wells open to an aquifer.

Isochlor: Line of equal chloride concentration.



Figure 1-3. Estimated water withdrawal from the Cohansey aquifer, Cape May County, 1978-94.

#### SUMMARY AND CONCLUSIONS

The principal sources of water supply in the New Jersey Coastal Plain are the eight major confined aquifers that underlie the region. Ground-water withdrawals have stressed many of the aquifers, causing formation of large regional cones of depression and movement of the saltwater front within the aquifers.

Water levels were measured in 722 wells in during October 18-December 9, 1993, and compared with water levels measured during a similar study in 1988. Water levels measured during the 1993 study were used to construct potentiometric-surface maps for the eight aquifers. Water-level hydrographs for observation wells screened in the aquifers were used to evaluate long term as well as seasonal trends in water levels since 1978.

Ground-water-withdrawal data for 1978-94 were compiled from the New Jersey Department of Environmental Protection to compare water withdrawals from and the potentiometric surface of each aquifer. Water-withdrawal hydrographs were used to evaluate the trends in water withdrawal during 1978-94, and waterwithdrawal maps were used to show the locations of major withdrawal areas in each aquifer in 1992.

The extent of freshwater was determined from published maps that show the location of the 250-mg/L isochor (lines of equal chloride concentration) or from water-quality data available from the USGS water quality data base. The location of the 10,000-mg/L isochlor was determined by means of computer simulations.

Water withdrawals from the Cohansey aquifer remained fairly constant, between 5 and 6 Mgal/d during 1978-88, but increased slightly during 1988-94. As a result, the potentiometric surface in 1993 was generally about the same size as in 1988, but slightly lower in the Lower Township area. The extent of freshwater continued to decrease, and saltwater intrusion continued to restrict the withdrawal of freshwater in certain supply wells along the shore.

Water withdrawals from the Atlantic City 800-foot sand increased from about 6.3 to 6.8 Mgal/d in Cape May County and from 4.5 to 5.0 Mgal/d in Ocean County and decreased from 9.0 to 8.5 Mgal/d in Atlantic County during 1978-94. As a result, the potentiometric surface declined about 1 to 9 ft in most areas during 1988-93 except in Ocean City, where it declined about 10 ft. The water level in the center of the cone of depression was about -92 ft, about the same as in 1988. The extent of freshwater remained about the same.

Water withdrawals from the Piney Point aquifer in eastern Ocean County remained fairly constant, about 1.7 Mgal/d during 1978-93, although withdrawals increased slightly after 1988. During the same time, water withdrawals in the Buena area increased from 0.1 to 0.3 Mgal/d, and withdrawals in Dover, Del., increased from about 3.8 to 4.5 Mgal/d. As a result of withdrawals in the eastern Ocean County area, the potentiometric surface in 1993 was 1 to 9 ft lower than in 1988. In the Buena area, water levels declined about 12 ft. Water levels in Cumberland County were about 5 ft lower in 1993 than in 1988 as a result of withdrawals in the greater Dover, Del., area. Water level altitudes in the Atlantic City area declined from -31 to -34 ft as a result of continued withdrawals from the overlying Atlantic City 800-foot sand. The extent of freshwater in 1993 is interpreted to be about the same as in 1988.

Water withdrawal from the Wenonah-Mount Laurel aquifer in the northern Coastal Plain decreased from 1.4 to 0.9 Mgal/d during 1978-93. The NJDEP mandated decreased withdrawals for this and deeper aquifers in the area. As a result of decreased withdrawal from the aquifer, the water levels at the center of the cone of depression in the northern Coastal Plain rose about 120 ft, and the cone decreased in size during 1988-93. Water withdrawal from the aquifer in the southern Coastal Plain increased from 3.6 to 6.3 Mgal/d during 1984-94. This near doubling of withdrawal is the result the NJDEP's request of water users to limit planned increases in withdrawal from the deeper aquifers. As a result of increased withdrawals, the cone of depression centered in the greater Camden County area expanded into Gloucester County, and the water-level altitudes in the center of the cone of depression declined 15 to 20 ft so that in 1993 they were about -30 and -50 ft. The extent of freshwater appears to be about the same as in 1988.

Water withdrawal from the Englishtown aquifer system in the northern Coastal Plain remained constant at about 9 Mgal/d during 1978-87 and decreased to about 5 Mgal/d in 1994 as a result of a NJDEP mandate to substitute surface-water supply for ground-water supply in the region. Because of decreased withdrawal from the Wenonah-Mount Laurel aquifer and the Englishtown aquifer system, the potentiometric surface at the center of the



#### Figure 1-5. Potentiometric surface of the Cohansey aquifer, Cape May County, 1993.





accuracy limitations, or differences in the recovery periods at recently pumped wells. Seasonal water-level fluctuations and long-term trends in the altitude of the potentiometric surface can be extrapolated from the waterlevel hydrographs. Water-level hydrographs for observation wells show water-level trends during 1978-94.

#### Well-Numbering System

The well-numbering system used in this report is based on the system used by the USGS office in New Jersey since 1978. The well number consists of a county code and a sequence number for the well inventoried in that county. The code for New Jersey, and Pennsylvania, counties in this report are

Atlantic, 1	Cumberland, 11	Monmouth, 25
Burlington, 5	Gloucester, 15	Ocean, 29
Camden, 7	Mercer, 21	Salem, 33
Cape May, 9	Middlesex, 23	Philadelphia County, PH

For example, well number 7-221 is the 221st well inventoried in Camden County. The well numbers used in Delaware are numbers assigned by the Delaware Geological Survey.

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STEM	SERIES	GEOLOGIC UNIT	LITHOLOGY	HY		HYDROLOGIC CHARACTERISITICS
2		Alluvial deposits	Sand, silt, and black mud			
uaternai	Holocene	Beach sand and gravel	Sand, quartz, light-colored, medium- to coarse-grained, pebbly	ι	Indifferentiated	Surficial material, commonly hydraulically connected to underlying aquifers. Locally some units may act as confinient units. Thicker sends are
Ø	Pleistocene	Cape May Formation				capable of yielding large quantities of water
		Pensauken Formation	Sand, quartz, light-colored, heterogeneous, clayey, pebbly			
		Bridgeton Formation				
		Beacon Hill Gravel	Gravel, quartz, light-colored, sandy	Kirk	wood-Cohansey	A major aquifer system. Ground water occurs generally
				e	quifer system	under water-table conditions.
	Miocene	Cohansey Sand	Sand, quartz, light-colored, medium- to coarse-grained, pebbly; local clay beds	-	Cohansey aquifer	In Cape May County the Cohansey Sand is under artesian conditions
					Confining unit	
			Sond quarty grow and tap yony final to	I	Rio Grande	Thick diatomaceous clay bed occurs along coast and for a short distance
		Kirkwood Formation	medium-grained, micaceous, and dark-colored diatomaceous clay	2	vater-bearing zone	inland. A thin water-bearing sand is present in the middle of this unit
ertiary				(	Confining unit	
ř					300-foot sand	A major aquiter along the coast
	Oligocene			-		Poorly permeable sediments
		Piney Point Formation <sup>1</sup>	Sand, quartz and glauconite, fine- to coarse-grained		Piney Point aquifer	Yields moderate quantities of water
	Eocene	Shark River Formation	Clay silty and sandy glauconitic, green, gray, and			
		Formation	clay, sity and sandy, glauconitic, green, gray, and brown, contains fine-grained quartz sand	ifining		Poorly permeable sediments
	Vincentown Formation Paleocene		Sand, quartz, gray and green, fine- to coarse-grained, glaucontic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite	osite con	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	Comp		Poorly permeable sediments
		Tinton Sand	Sand, quartz, and glauconite, brown and gray, fine- to coarse-grained, clayey, micaceous			Vielde emell succetities of water
		Red Bank Sand			Red Bank Sand	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	Mou	Wenonah- nt Laurel aquifer	A major aquifer
		Wenonah Formation	Sand, very fine- to fine-grained, gray and brown, silty, slightly glauconitic	Mars	halltown-Wenonah	A leaky confining unit
		Marshalltown Formation	Clay, silty, dark greenish-gray, glauconitic quartz sand		confining unit	
sno	Upper Cretaceous	Englishtown Formation	Sand, quartz, tan and gray, fine- to medium-grained; local clay beds	Eng	glishtown aquifer system	A major aquifer. Two sand units in Monmouth and Ocean Counties
etace		Woodbury Clay	Clay, gray and black, micaceous silt			
ō		Merchantville Formation	Clay, glauconitic, micaceous, gray and black; locally very fine-grained quartz and glauconitic sand	Merc	nantville-Woodbury confining unit	A major confining unit. Locally the Merchantville Formation may contair a thin water-bearing sand
		Magothy Formation	Sand, quartz, light-gray, fine- to coarse-grained. Local beds of dark-gray lignitic clay. Includes Old Bridge Sand Member	athy	Upper aquifer	A major aquifer system In the
		Paritan	Sand, quartz, light-gray, fine- to coarse-grained	ח-Mago stem	Confining unit	northern Coastal Plain, the upper aquifer is equivalent to the Old Bridge aquifer and the middle
		Formation	peoply arkosic; contains red, white, and variegated clay. Includes Farrington Sand Member	Raritai fer sys	Middle aquifer	aquifer is equivalent to the Farrington aquifer. In the Delaware
				omac-	Confining unit	recognized. In the deeper sub- surface, units below the upper
	Lower Cretaceous	Potomac Group	Alternating clay, silt, sand, and gravel	Potc	Lower aquifer	aquifer are undifferentiated
Pre-Cr	etaceous	Bedrock	Precambrian and Lower Paleozic crystalline rocks, metamorphic schist and gneiss; locally Triassic sandstone and shale and Jurassic diabase are present	Bedr	ock confining unit	No wells obtain water from these consolidated rocks, except along Fall line

cone of depression rose about 60 ft during 1988-93 in the northern Coastal Plain. Water withdrawals in the southern Coastal Plain remained constant at about 0.8 Mgal/d during 1978-94; therefore, the potentiometric surface in the greater Camden County area remained the same. The extent of freshwater is unknown because the chloride concentration of well water in 1993 was less than 25 mg/L in all wells.

Water withdrawals in the Upper Potomac-Raritan-Magothy aquifer in the northern Coastal Plain decreased from 46 to 27 Mgal/d during 1988-94 as a result of the NJDEP's mandate to restrict withdrawal of ground water from the Potomac-Raritan-Magothy aquifer system. Decreased withdrawals from these aquifers resulted in a higher potentiometric surface with less extensive cones of depression in 1993 than in 1988. Water levels rose about 40 ft in the Asbury Park area and about 30 ft in the northern Monmouth-eastern Middlesex County area. Water withdrawals in the southern counties increased slightly, from 28 to 32 Mgal/d, during 1978-88 and remained constant at about 32 Mgal/d during 1988-94. As result, the cone of depression centered under the greater Camden County area remained fairly constant. Water-level altitudes near the center of the cone of depression were about -100 ft in 1988 and 1993.

Water withdrawals from the Middle and undifferentiated Potomac-Raritan-Magothy aquifer in the northern Coastal Plain decreased from 32 to 20 Mgal/d during 1988-94. Again, this reduction was a result of the NJDEP mandate. The decrease in withdrawals caused the potentiometric surface at the center of the cone of depression to rise about 80 ft during 1988-93. Water withdrawals in the southern counties increased from 53 to 76 Mgal/d during 1978-88 but remained constant at about 76 Mgal/d during 1988-93. As a result, the cone of depression centered under the greater Camden County area remained fairly constant during 1988-93. Water-level altitudes at the center of the cone of depression were about -90 ft in 1988 and 1993. The extent of freshwater remained about the same.

Water withdrawals from the Lower Potomac-Raritan-Magothy aquifer decreased from 61 to 58 Mgal/d during 1986-94. As a result of decreased withdrawals from this and other aquifers in the Potomac-Raritan-Magothy aquifer system, the altitude of the potentiometric surface in 1993 was about the same as it was in 1988, and the extent of freshwater remained about the same as in 1988.



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### WATER LEVELS IN, EXTENT OF FRESHWATER IN, AND WATER WITHDRAWAL FROM EIGHT MAJOR CONFINED AQUIFERS, NEW JERSEY COASTAL PLAIN, 1993

Table 1.2 Water level data for wells screened in the Cohanse	w aquifer Cape May County 1978 93
Table 1-2. Water-level data for wens screened in the Conalise	y aquiter, Cape May County, 1970-95

[\*, well not shown in figure 1-5; --, data not available; ft, feet, WD, Water Department; TWP, Township; MUA, Municipal Utilities Authority; CO, Company]

Well number	Permit number	Lati- tude <sup>1</sup>	Longi- tude <sup>1</sup>	Owner	Local well identification	USGS Quadrangle	Year drilled	Land- surface altitude <sup>2</sup> (ft)	Screen interval <sup>3</sup> (ft)	<u>W</u> 1978 (ft)	<u>Vater-lev</u> 1983 (ft)	<u>vel altitu</u> 1988 (ft)	<u>ude<sup>2</sup></u> 1993 (ft)	1988-93 Water- level change (ft)	Date in 1993
9-11		385612	745457	CAPE MAY CITY WD	CMCWD 1 OBS	CAPE MAY	1940	7	281-321	-19	-21	-14	-17	-3	11-16
9-17		385651	745310	US COAST GUARD	USCG 1	CAPE MAY	1943	11	292-322	-14	-15	-10	-15	-5	11-16
* 9-27	37-00013	385643	745533	CAPE MAY CITY WD	CMCWD 3	CAPE MAY	1950	7	277-306				-21		11-15
9-36		385701	745528	CAPE MAY CITY WD	CMCWD 2/CMCWD4(NEW)	CAPE MAY	1966	10	174-282	-26	-33	-20	-23	-3	11-15
* 9-43	57-00011	385724	745521	CAPE MAY CITY WD	CMCWD 5	CAPE MAY	1966	15	246-276				-21		11-15
9-48		385748	745533	US GEOLOGICAL SURVEY	CANAL 5 OBS	CAPE MAY	1957	17	242-252	-18	-23	-17	-21	-4	11-5
9-49		385804	745742	US GEOLOGICAL SURVEY	HIGBEE BEACH 3 OBS	CAPE MAY	1957	6	241-250	-16	-15	-13	-14	-1	11-5
* 9-52	37-00113	385851	745715	LOWER TWP MUA	LTMUA 1	CAPE MAY	1956	18	241-262		-15	-16	-22	-6	11-12
9-54	37-00223	385905	745625	LOWER TWP MUA	LTMUA 2	CAPE MAY	1962	14	212-247		-18	-16	-30	-14	11-12
9-57	37-00293	385919	745518	LOWER TWP MUA	LTMUA 3	CAPE MAY	1974	20	263-303		-13	-13	-17	-4	11-12
9-60		390056	745426	US GEOLOGICAL SURVEY	AIRPORT 7 OBS	RIO GRANDE	1957	13	242-257	-13	-12	-12	-15	-3	11-5
9-74	57-00007	390139	745349	WILDWOOD CITY WD	RIO GRANDE 29	RIO GRANDE	1947	8	191-231				-23		11-12
9-80		390213	745056	US GEOLOGICAL SURVEY	CAPE MAY 42 OBS	STONE HARBOR	1957	14	242-252	-2	-2	-4	-5	-1	11-5
9-89	37-00158	390425	745446	US GEOLOGICAL SURVEY	OYSTER LAB 4 OBS	RIO GRANDE	1957	7	195-210	-2	-2	-2	-1	1	11-5
9-99	35-00680	390611	744838	US GEOLOGICAL SURVEY	CAPE MAY COUNTY PK 8 OBS	STONE HARBOR	1957	11	214-230	4	5	4	3	-1	11-5
9-150	37-00155	385607	745556	US GEOLOGICAL SURVEY	WEST CAPE MAY 1 OBS	CAPE MAY	1957	7	283-293	-18	-19	-13	-17	-4	11-5
9-155	37-00276	385935	744954	WILDWOOD CLAM CO	3-1971	WILDWOOD	1971	5	311-331		-5	-3	4	7	11-11
9-159	37-00241	385830	745021	WILDWOOD CITY WD	WWD 35	WILDWOOD	1967	8	249-360		-2	-2	-5	-3	11-11
9-187		390218	745609	CAPE MAY COUNTY	CAPE MAY F-35	RIO GRANDE	1965	10	186-190			-6	-7	-1	11-11
9-188		390215	745440	CAPE MAY COUNTY	CAPE MAY F-36	RIO GRANDE	1965	6	229-233			-9	-11	-2	11-11
9-210		385946	745725	CAPE MAY COUNTY	CAPE MAY C-1	CAPE MAY	1965	11	216-221			-8	-13	-5	11-11
9-213		390128	745639	CAPE MAY COUNTY	CAPE MAY F-41	RIO GRANDE	1965	12	203-208				-8		11-11
9-219	35-03380	390601	745245	BAYSHORE ASSOCIATES	1982-200 HAND & RT 47	RIO GRANDE	1982	19	150-200				1		11-10
9-261	37-00665	390032	745612	CAPE MAY COUNTY LIBRARY	LIBRARY 1024	RIO GRANDE	1982	10	145-160				-14		11-11
9-281	37-00254	390710	745134	SOIL CONSERVATION SERVICE	BD-21CH	STONE HARBOR	1967	11	176-181			3	5	2	11-10
9-292	37-03035	390337	744623	US GEOLOGICAL SURVEY	WETLANDS 1 OBS	STONE HARBOR	1988	5	251-261				2		11-11
9-310	37-01781	390018	744748	WILDWOOD CITY WD	RIO GRANDE 39NEW-RECHRG4	STONE HARBOR	1986	5	279-357			-1	2	3	11-11
9-314	37-00640	385930	744852	WILDWOOD CITY WD	RECHARGE 3	WILDWOOD	1982	10	212-325				2		11-12
9-338	37-01811	390124	744801	HEREFORD INLET MARINA	HEREFD/BISHOP 2-1986 PVC	STONE HARBOR	1986	5	276-296				2		11-10
9-350	36-16171	391218	744545	US GEOLOGICAL SURVEY	GRT CEDAR SWAMP 1-D OBS	WOODBINE	1992	16	227-237				14		11-16
9-353	37-04871	385855	745737	US GEOLOGICAL SURVEY	ROSLYN AVE OBS DEEP	CAPE MAY	1992	20	262-272				-21		11-15
9-354	37-04873	390147	744855	US GEOLOGICAL SURVEY	GRASSY SOUND 1-D OBS	STONE HARBOR	1992	5	230-240				2		11-10
9-395	37-04368	385909	745359	CAPE MAY NATIONAL GOLF CLUB	CMNGC CART BLDG 1991	CAPE MAY	1991	18	255-275				-17		11-15

### WATER-RESOURCES INVESTIGATIONS REPORT 96-4206

Atlantic City 800-foot sand - SHEET 2 OF 8 Lacombe, P.L., and Rosman, Robert, 1997, Water levels in, extent of freshwater in, and water withdrawal from eight major confined aquifers, New Jersey Coastal Plain, 1993

Water withdrawals from the Atlantic City 800-foot sand increased from about 18.5 to 20 Mgal/d during 1978-89, then decreased to 19 Mgal/d in 1994 (fig 2-1). Water withdrawals were made predominantly by barrierisland communities from Stone Harbor to Barnegat Light (fig. 2-2), but a few inland communities and industries also withdrew water from the aquifer. Water withdrawals during 1978-94 increased from about 5.5 to 6.8 Mgal/d in Cape May County, but decreased from 4.0 to 3.6 Mgal/d in Ocean County and from 9.0 to 8.6 Mgal/d in Atlantic County. The location of the 250-mg/L isochlor (fig. 2-3) was modified from maps by P.J. Lacombe (co-author of this report) and S.D. McAuley (U.S. Geological Survey, written commun., 1991). It is within 4 mi of public-supply wells in Stone Harbor. The location of the 10,000-mg/L isochlor was estimated by use of the saltwater model of the aquifers of the New Jersey Coastal Plain (D.A. Pope and A.D. Gordon, U.S. Geological Survey, written commun.,

Water-level data for 59 wells screened in the aquifer are listed in table 2-1 (reverse side of sheet 2) and

Water-level hydrographs for five observation wells show long-term trends and seasonal fluctuations in





Figure 2-1. Estimated water withdrawal from the Atlantic City 800-foot sand, 1978-94



Base modified from U.S. Geological Survey digital data, 1:100,000, 1983, Universal Transverse Mercator Projection, Zone 18

Figure 2-3. Potentiometric surface of the Atlantic City 800-foot sand, 1993.

WATER LEVELS IN, EXTENT OF FRESHWATER IN, AND WATER WITHDRAWAL FROM EIGHT MAJOR CONFINED AQUIFERS, NEW JERSEY COASTAL PLAIN, 1993

#### Table 2-1. Water-level data for wells screened in the Atlantic City 800-foot sand, 1978-93

## [Well depth given if screen interval is unknown; \*, well not shown in figure 2-3; --, data not available; ft, feet; MUA, Municipal Utilities Authority; WD, Water Department; TWP, Township; WC, Water Company; NJ, New Jersey; CO, Company; CTR, Center]

Well number	Permit number	Lati- tude <sup>1</sup>	Longi- tude <sup>1</sup>	Owner	Local well identification	USGS Quadrangle	Year drilled	Land- surface altitude <sup>2</sup> (ft)	Screen interval <sup>3</sup> (ft)	<u>Water</u> 1978 198 (ft) (f	<u>level alt</u> 3 198 t) (fr	<u>titude<sup>2</sup></u> 8 1993 t) (ft)	1988-93 Water- level change (ft)	Date in 1993
1-15 1-37 1-39 1-117 1-180	56-00071 56-00012 32-00477	392058 392151 392329 393213 392754	742711 742459 742348 743832 742701	PRESIDENT HOTEL ATLANTIC CITY MUA BRIGANTINE WD EGG HARBOR WATER WORKS US GEOLOGICAL SURVEY	PRESIDENT GALEN HALL OBS NEW 4 OW41 5 OCEANVILLE 1 OBS	ATLANTIC CITY ATLANTIC CITY OCEANVILLE EGG HARBOR CIT OCEANVILLE	1955 1904 1966 Y 1964 1959	10 10 10 40 27	779-831 782-837 733-788 350-432 560-570	-51 -65 -7 -60 -6 28 2 -28 -3	$ \begin{array}{cccc} & -7 \\ 0 & -8 \\ 5 & -7 \\ 1 & 1 \\ 2 & -3 \\ \end{array} $	7 -84 0 -83 4 -68 9 20 9 -41	-7 -3 6 1 -2	11-16 11- 4 11-18 11-19 11- 4
1-367 1-568 1-578 * 1-598 1-600	56-00038 36-00013  36-00371 56-00016	391859 392448 391826 392030 392045	743122 743028 743709 742852 742840	LONGPORT WD ATLANTIC CITY MUA US GEOLOGICAL SURVEY VENTNOR CITY VENTNOR CITY	LONGPORT 2 ACMUA 15 JOBS POINT OBS VCWD 9 WD VCWD 8 WD	OCEAN CITY PLEASANTVILLE OCEAN CITY ATLANTIC CITY ATLANTIC CITY	1947 1961 1959 1965 1931	10 8 10 8 8	750-800 583-633 670-680 740-800 750-810	-66 -6 4 -45 -5 -72 -7 -69 -7	8 -7 8 -5 1 -5 6 -8 3 -7	5 -80 8 -55 5 -59 1 -85 9 -83	-5 3 -4 -4 -4	11-17 11-19 11- 4 11-17 11-17
1-650 1-680 1-683 1-700 1-702	 36-02091 35-04274 	392651 392120 392410 392933 392032	744254 742606 742227 744604 743008	HAMILTON TWP WD CARNIVAL CLUB BRIGANTINE WD US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY	TEST 2-73 2 NEW 5 ACGS 4 BURKE AVE TW OBS	MAYS LANDING ATLANTIC CITY BRIGANTINE INL DOROTHY OCEAN CITY	1910 1980 1984 1985	20 8 8 40 5	380 773-835 725-775 479-539 740-750	1  	8 1 7 6 1 8	4 17 6 -83 4 -70 6 12 7 -92	3 -7 -6 -4 -5	11-18 11-17 11-18 11-12 11- 4
1-703 1-704 1-706 * 1-889 1-967	  36-11871 36-13010	392639 392343 392933 392007 392456	743232 743733 743130 743033 742121	US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY MARGATE CITY WD BRIGANTINE WD	FAA POMONA OBS EGG HARBOR HS STKTN ST COLL MCWD 8 WELL 6/2R 14TH ST NORTH	PLEASANTVILLE MAYS LANDING PLEASANTVILLE OCEAN CITY BRIGANTINE INL	1985 1985 1985 1989 1990	38 51 40 8 5	560-570 596-606 520-530 735-795 702-776	  	4 3 2	5 -46 7 -37 5 -25 86 62	-1 0 0 	11- 4 12- 8 11-18 11-17 11-18
1-985 9-2 9-4 9-79 * 9-92	36-15426 37-00280 37-00265  37-00240	391929 390420 390528 390210 390525	743127 744435 744338 744730 744851	MARGATE CITY WD AVALON WD AVALON WD HALLER, LEE NJ/AMERICAN WC	MCWD #9 AVALON WD 2R-71/NEW 7 AVALON WD 6 NUMMY IS 2 OBS NEPTUNUS 7	OCEAN CITY AVALON AVALON STONE HARBOR STONE HARBOR	1992 1971 1968 1968 1967	7 5 10 1 17	705-756 821-861 880-920 833-876 681-791	-36 -4 -40 -4 -32 -3	0 -4 2 -4 1 -3	85 6 -44 0 -43 36 4 -38	 -3 4	11-17 11-16 11-16 11-11 11-17
9-106 9-110 * 9-116 9-125 * 9-127	56-00006 36-00373 56-00007 36-00314 37-00064	391343 391604 391638 391726 390847	743755 743539 743451 743352 744200	NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC SEA ISLE CITY WD	SHORE DIV 7 SHORE DIV 12 SHORE DIV 8 SHORE DIV 11 SICWD 4	SEA ISLE CITY OCEAN CITY OCEAN CITY OCEAN CITY SEA ISLE CITY	1924 1965 1937 1962 1954	8 7 7 10 7	760-810 759-814 760-810 800 742-830	-46 -4 -53 -5 6  -38 -4	6 -5 3 -6 2 -6 6 4 -4	$ \begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	-3 -9 -10 -10 -1	11-17 11-17 11-17 11-17 11-16
9-129 * 9-132 9-135 9-136 9-144	57-00009 37-00079 37-00009 56-00147 36-00451	390926 390301 390323 391152 391703	744131 744545 744525 743927 743756	SEA ISLE CITY WD STONE HARBOR WD STONE HARBOR WD CORSONS INLET WD ATLANTIC ELECTRIC CO	SICWD 2 SHWD 4 SHWD 3 CIWC 1 ACEC 5	SEA ISLE CITY STONE HARBOR STONE HARBOR SEA ISLE CITY MARMORA	1926 1955 1949 1904 1975	7 10 9 7 9	801-861 830-880 838-878 802-834 650-690	2 -31 -3 3 2 -47 -5	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	7 -42 2 -34 3 -39 5 -47 0 -60	-5 -2 -6 -2 -10	11-16 11-15 11-15 11-17 11-16
9-161 * 9-173 9-185 9-291 9-296	37-00579 36-09846 35-06073	390704 390314 391621 390627 390500	744750 744532 744355 744254 744946	EASTERN SHORE CONVALESCENT STONE HARBOR WD US GEOLOGICAL SURVEY AVALON WD NJ/AMERICAN WC	CTR 1 SHWD 6 MACNAMARA W A AVALON WD 9 HAND AVE 8	STONE HARBOR STONE HARBOR MAMORA AVALON STONE HARBOR	1983 1981 1985 1988 1986	16 10 15 7 20	639-654 810-860 640-650 764-941 682-812	2 3  	6 -3 2 -3 3 2	2 -35 1 -36 5 -37 47 7 -33	-3 -5 -2 	11-16 11-15 11-16 11-16 11-17
9-302 9-306 9-311 9-337 9-359	37-03628-9  36-10378 37-04660 36-07286	385709 390422 390750 390012 390657	745128 745447 744242 744720 744500	US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY SEA ISLE CITY WD US GEOLOGICAL SURVEY MIDDLE TWP WATER DISTRICT	COAST GUARD 800 OBS OYSTER 800 OBS SICWD 6-1989 M-1 N WILDWOOD 800 OBS MTWD 2	WILDWOOD RIO GRANDE SEA ISLE CITY STONE HARBOR AVALON	1989 1989 1989 1992 1986	5 6 8 10 7	883-893 656-666 732-896 910-960 708-773	  	 	14 17 46 20 42	   	11- 5 11- 5 11-16 11- 5 11-16
9-423 * 9-461 29-9 29-111 29-112	37-05244 36-15182 53-00031 33-01180 33-00674	390134 391728 393346 394134 394218	745240 743810 741430 740832 740808	ATLANTIC ELECTRIC CO ATLANTIC ELECTRIC CO BEACH HAVEN WD HARVEY CEDARS WD HARVEY CEDARS WD	RIO GRANDE TEST #1 ACEC 6 DEEP BHWD 8 HCWD 4 HCWD 3	RIO GRANDE MAMORA BEACH HAVEN SHIP BOTTOM SHIP BOTTOM	1993 1993 1957 1968 1956	20 8 5 9 5	825-875 639-710 572-656 465-500 451-493	3 -26 -20 -3	2 6 -2	19 58 1 -32 3 -27 4 -27	 -1 -4 -3	12-9 11-16 12-8 11-12 11-12
29-464 29-544 29-557 29-561 29-565	32-00447 33-00219 33-01132 33-01268 32-00479	393428 393839 394042 393948 393610	742202 741052 741411 740954 742031	LITTLE EGG HARBOR MUA SHIP BOTTOM WD STAFFORD TWP MUA SURF CITY WD TUCKERTON MUA	MYSTIC 2 SBWD 4 STAFFORD 3 SCWD 5 TMUA 4(OW1)	TUCKERTON SHIP BOTTOM SHIP BOTTOM SHIP BOTTOM TUCKERTON	1963 1953 1965 1970 1964	19 5 8 10 10	485-542 536-578 385-428 520-562 463-497	-10 $-10-31$ $-3222$ $11-25$ $-22-4$ $-4$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{rrrrr} 7 & -23 \\ 9 & -34 \\ 6 & 14 \\ 4 & -20 \\ 8 & -16 \end{array}$	-6 -5 -2 4 -8	11-16 11-12 11-12 11-12 11-16
29-598 29-814 29-936 29-1063	33-00967 32-12329 33-24693 32-15207	394201 393253 393724 393511	741212 742308 741151 742158	AT&T LITTLE EGG HARBOR MUA LONG BEACH WC LITTLE EGG HARBOR MUA	TEST 1960 MYSTIC 7 BRANT BEACH 4 CENTER STREET WELL 8	SHIP BOTTOM NEW GRETNA BEACH HAVEN TUCKERTON	 1986 1988 1988	5 10 9 25	512-552 528-594 475-521	  	1 2	8 -25 24 5 -25 33	-7  0 	11-12 11-16 11-16 11-16

#### WATER-RESOURCES INVESTIGATIONS REPORT 96-4206 Piney Point aquifer - SHEET 3 OF 8

Lacombe, P.L., and Rosman, Robert, 1997, Water levels in, extent of freshwater in, and water withdrawal from eight major confined aquifers, New Jersey Coastal Plain, 1993



Lavallette area, water withdrawals decreased from about 1.8 Mgal/d in 1978 to 1.5 Mgal/d in 1992. Major be much less than 8 mi downdip in the Barnegat Light area. The location of the 10,000-mg/L isochlor was estimated by use of the saltwater model of the aquifers of the New Jersey Coastal Plain (D.A. Pope and A.D.

Water-level data for 33 wells screened in the Piney Point aquifer are listed in table 3-1 (reverse side of

During 1978-94, water levels declined 16 to 22 ft at wells 11-96, 11-44, and 11-163 in Cumberland

In summary, water levels measured in 1993 ranged from 4 ft higher to 16 ft lower than water levels the cone of depression in eastern Ocean County in 1993 was about 5 ft deeper than it was in 1988, the configuration of the cone was similar. The cone of depression in the Buena area was about 10 ft deeper in 1993





Figure 3-1. Estimated water withdrawal from the Piney Point aquifer, 1978-94.



Figure 3-4. Water-level hydrographs for observation wells screened in the Piney Point aquifer, 1978-94.

Figure 3-3. Potentiometric surface of the Piney Point aquifer, 1993.

WATER LEVELS IN, EXTENT OF FRESHWATER IN, AND WATER WITHDRAWAL FROM EIGHT MAJOR CONFINED AQUIFERS, NEW JERSEY COASTAL PLAIN, 1993

#### Table 3-1. Water-level data for wells screened in the Piney Point aquifer, 1978-93

[Well depth given if screen interval is unknown; \*, well not shown in figure 3-3; --, data not available; ft, feet; BORO, Borough; MUA, Municipal Utilities Authority; WD, Water Department; TWP, Township; WC, Water Company; NJ, New Jersey; DEL, Delaware; CO, Company; ASSOC, Association]

Well number	Permit number	Lati- tude <sup>1</sup>	Longi- tude <sup>1</sup>	Owner	Local well identification	USGS Quadrangle	Year drilled	Land- surface altitude <sup>2</sup> (ft)	Screen interval <sup>3</sup> (ft)	W 1978 (ft)	Vater-lev 1983 (ft)	<u>vel altitu</u> 1988 (ft)	<u>ide<sup>2</sup></u> 1993 (ft)	1988-93 Water- level change (ft)	Date in 1993
1-270	31-03648	393712	744720	AMERICAN HOME PRODUCTS	1958 WELL	NEWTONVILLE	1958	90	390-410				27		11-19
1-713	35-04656	392902	745051	US GEOLOGICAL SURVEY	MIZPAH DEEP	DOROTHY	1985	100	525-535			-2	-4	-2	12-8
1-834		392017	743002	US GEOLOGICAL SURVEY	MARGATE FIREHOUSE 1 OBS	OCEAN CITY	1988	5	970-991			-28	-30	-2	11-4
1-836	35-04559	393148	745617	BUENA BORO MUA	BBMUA 2	BUENA	1985	118	405-455			-8	-20	-12	12-9
1-1219	36-16546	392640	743724	HAMILTON TWP MUA	HTMUA 9	PLEASANTVILLE	1993	68	722-742				-14		11-18
5-407		394422	744309	US GEOLOGICAL SURVEY	ATSION 1 OBS	ATSION	1963	47	240-260	52	51	51	51	0	11-4
5-488	32-00913	393838	743855	STATE OF NJ	BATSTO 2	ATSION	1972	35	419-449	49	48	48	52	4	11-3
5-676		394914	742546	US GEOLOGICAL SURVEY	COYLE AIRPORT OBS	WOODMANSIE	1961	199	530-540	121	119	118	119	1	10-26
5-800	32-04454	394732	744526	SHAMONG TWP	1	MEDFORD LAKES	1978	85	200-210		73	72	73	1	11-3
5-1162	32-05879	394635	744409	GARDENER, HOBART	TRAILER PARK 1980	INDIAN MILLS	1980	60	215-235				55		11-5
7-572	31-14078	394100	745035	ELMTOWNE VILLLAGE ASSOC	1	HAMMONTON	1979	110	304-314		62	57	55	-2	11-3
11-44	35-01197	392732	750929	CUMBERLAND COUNTY	VOCATIONAL SCHOOL 3 OBS	BRIDGETON	1972	82	361-376	17	12	7	0	-7	11-9
11-61	34-01191	391926	751921	GRIFFITH, MAE	SEA BREEZE	BEN DAVIS POINT	1976	4	281-354		-35	-45	-50	-5	11-11
11-92		391746	751510	BAY POINT ROD AND GUN	BAY POINT 2	BEN DAVIS POINT	1970	5	397-417		-28	-37	-44	-7	11-11
11-96		391829	751208	CUMBERLAND COUNTY	JONES ISLAND 2 OBS	CEDARVILLE	1971	10	365-375	-15	-20	-28	-34	-6	11-9
11-163	35-01196	392526	750643	CUMBERLAND COUNTY	FAIR GROUNDS 3 OBS	MILLVILLE	1972	80	463-473	22	13	8	2	-6	11-9
* 11-341	34-00991	391938	751923	SOBUSIAK, WALTER	2	BEN DAVIS POINT	1974	4	300-357		-35	-44	-49	-5	11-11
11-349	34-01463	391647	751233	VANDVELT, THOMAS	BEACH FRONT DOM	CEDARVILLE	1979	5	380-410		-28	-35	-42	-7	11-9
* 29-2	33-01206	394522	740636	BARNEGAT LIGHT WD	BLWD 3	BARNEGAT LIGHT	1969	7	597-654		-40	-33	-38	-5	11-12
29-18		394829	740535	US GEOLOGICAL SURVEY	ISLAND BEACH 2 OBS	BARNEGAT LIGHT	1962	9	468-474	1	0	0	-2	-2	10-25
29-23	33-01494	395423	740458	SHORE WC	SWC 2	SEASIDE PARK	1973	7	490-527		-42	-60	-57	3	11-12
29-116	53-00020	395641	740853	ISLAND HEIGHTS WD	IHWD 7R	TOMS RIVER	1948	3	267-293		0		0		10-26
29-425		395322	742252	US GEOLOGICAL SURVEY	WEBBS MILLS 2 OBS	WHITING	1962	128	348	121	121	118	119	1	10-26
29-537	53-00001	395636	740439	SEASIDE HEIGHTS WD	SHWD 2	SEASIDE PARK	1941	4	400-430		-35	-30	-35	-5	10-26
* 29-541	53-00022	395451	740455	SEASIDE PARK WD	SPWD 2/SPWD 3 (NEW)	SEASIDE PARK	1932	10	525		-30	-56	-57	-1	10-25
29-582	33-04511	395547	740434	SEASIDE PARK WD	4-R/SEASIDE 6 (NEW)	SEASIDE PARK	1977	12	435-485		-75	-43	-51	-8	10-25
29-585		395028	741044	STATE OF NJ	DOE-FORKED RIVER OBS	FORKED RIVER	1978	15	412-422		15	15	12	-3	11-2
29-607	33-07876	394454	740655	BARNEGAT LIGHT WD	BLWD 4	LONG BEACH NE	1980	5	597-662		-41	-34	-38	-4	11-12
29-739	33-01247	400044	740957	OCEAN COUNTY COLLEGE	REC FIELD 1	LAKEWOOD	1970	20	200-220		13	11	13	2	10-27
* 29-808	33-06595	395606	740445	SEASIDE PARK WD	SPWD 7	SEASIDE PARK	1979	5	395-475		-58	-30	-46	-16	10-25
29-1039	33-26307	395943	741214	TOMS RIVER WC	TRWC PARKWAY 39	TOMS RIVER	1989	75	248-288				9		10-27
Id55-01	ID55-01	391026	753049	CITY OF DOVER	WHITE OAK ROAD	DOVER		20	329-349			-132	-128	4	11-19
001509	001509	390834	753053	DEL GEOLOGICAL SURVEY	ROOSEVELT AVE 1 OBS	DOVER		26	400-440			-129	-125	4	11-3

#### WATER-RESOURCES INVESTIGATIONS REPORT 96-4206 Wenonah-Mount Laurel aquifer - SHEET 4 OF 8

Lacombe, P.L., and Rosman, Robert, 1997, Water levels in, extent of freshwater in, and water withdrawal from eight major confined aquifers, New Jersey Coastal Plain, 1993

75<sup>°</sup>30'

### Wenonah-Mount Laurel Aquifer

#### Water withdrawal and extent of freshwater

Water withdrawal from the Wenonah-Mount Laurel aquifer has increased from about 4.3 Mgal/d in 1978 to 7.0 Mgal/d in 1994 (fig. 4-1). Water withdrawal in the northern Coastal Plain is predominantly in Point Pleasant and nearby communities (fig. 4-2). Withdrawals in this area decreased from about 1.4 Mgal/d in 1978 to 0.9 Mgal/d in 1993. Water withdrawal in the southern counties of the Coastal Plain were predominantly in central Burlington and Camden Counties. Water withdrawal increased in the southern counties from about 3.6 Mgal/d in 1978 to 6.3 Mgal/d in 1994. The interpreted location of the 250-mg/L isochlor in southern Cumberland and Salem because they are all sealed wells.) The location of the 250-mg/L isochlor in the northern Coastal Plain cannot be

 $40^{\circ}$ 30'

Counties (fig. 4-3) was determined from chloride data for four wells. (The four wells are not shown in figure 4-3 determined because no observation wells were available in the downdip area. The location of the 10,000-mg/L isochlor was estimated by use of the saltwater model of the aquifers of the New Jersey Coastal Plain (D.A. Pope and A.D. Gordon, U.S. Geological Survey, written commun., 1993). This is the simulated location of water that is about one-half freshwater and one-half seawater.

#### Water levels

Water-level data for 103 wells screened in the Wenonah-Mount Laurel aquifer are listed in table 4-1 (reverse side of sheet 4). The water-level altitudes in these wells were used to define the 1993 potentiometric surface shown in figure 4-3. Maps of simulated water levels by Martin (in press, fig. 48) and A.D. Gordon (U.S. Geological Survey written commun., 1992) were modified to close the contours east of Ocean and Monmouth Counties. The water-level map shows two major cones of depression. The northern cone of depression is centered west of Point Pleasant. The water-level altitude at the center of the cone is about -120 ft. The southern cone of depression is elongated and underlies central Burlington, Camden, and Gloucester Counties. For the purpose of this report, the southern cone of depression is loosely defined as the area encompassed by the +20-ft water-level altitude contour. The southern cone of depression contains three smaller local cones of depression. The northernmost local cone of depression underlies the Browns Mills quadrangle; the minimum water-level altitude was -50 ft. A small local cone of depression underlies the Pemberton quadrangle; the minimum water-level altitudes were -5 ft. The southernmost local cone of depression is centered in the Clementon quadrangle, where the minimum water-level altitude was -22 ft. The maximum water-level altitude measured for the aquifer was +148 ft, in western Monmouth County.

In 1993, the location of the 0-ft contour line on the west side of the cone of depression in the northern counties of the Coastal Plain was about 4 mi east of the location in 1988. In the area north of the cone of depression, the 0-ft contour line was about 10 mi south of the location mapped in 1988. Therefore, it is interpreted that the breadth of the cone has decreased by about 4 mi on the west perimeter and 10 mi on the north perimeter. Changes in water levels during 1988-93 were calculated for 92 wells in the aquifer. In Monmouth and Ocean Counties, the changes in water levels for 35 wells indicate that water levels rose 1 to 119 ft in 31 wells, declined 2 to 10 ft in 3 wells, and remained the same in 1 well. Water levels rose 10 ft or more in the 16 wells in the eastern part of the two counties; the wells are near the center of the cone of depression. The water level declined 10 ft in well 29-234, as a result of large local withdrawals, and 11 ft in well 29-227, possibly as a result of local changes in withdrawal.

Changes in water levels also were calculated for 57 wells in Burlington, Camden, Gloucester, and Salem Counties. Water levels declined 1 to 22 ft in 29 wells, rose 1 to 29 ft in 20 wells, and remained the same in 8 wells. Water-level declines greater than 10 ft occurred in eight wells. Six of the wells are screened in the cone of

PENNSYLVANIA

either are production wells or are near production wells; therefore, the water levels could have been affected by withdrawals shortly before the measurement was made in 1988. Water-level hydrographs for 10 USGS observation wells for 1978-94 indicate that annual water-level altitudes remained fairly constant or have decreased less than 2 ft in wells 29-140, 7-118, 33-20, 33-2, and 33-252 (fig. 4-4). Water levels declined about 15 ft in well 7-478 and about 10 ft in well 7-401 during 1988-94. Water levels rose 20 and 30 ft, respectively, in wells 25-353 and 25-637 during 1990-94. The water-level hydrograph for well 25-486 shows that the water level rose 90 ft from -180 ft to -90 ft during 1990-94. Seasonal water-level fluctuations were greatest near the center of the cone of depression; for example, seasonal water-level fluctuation of 5 to 15 ft occurred in well 25-486 (fig. 4-4).

In summary, the potentiometric surface of the Wenonah- Mount Laurel aquifer in 1993 is significantly different than the potentiometric surface mapped in 1988 (Rosman and others, 1996). The water level at the center of the cone of depression in the northern counties of the Coastal Plain increased in altitude to at least -120 ft near Point Pleasant. The perimeter of the northern cone of depression at the 0-ft contour line contracted by about 4 mi on the west side and about 10 mi on the north side of the cone.

 $75^{\circ}$ 

The cone of depression has decreased in size because the NJDEP mandated a reduction in withdrawals from this and deeper aquifers after 1988 (General Water Supply Management Regulations, Water Supply Management Act, N.J.S.A. paragraph 7:19-6 to 19-13). Upon completion of the Manasquan reservoir in 1991, water users in the northern Coastal Plain began to withdraw less water from the confined aquifers and to withdraw more water from surface-water reservoirs. The result of reduced withdrawals has been the rise of water levels near the center of the cone of depression and a decrease in the extent of the cone of depression.

Since 1988, the cone of depression in the southern counties of the Coastal Plain has deepened more than 20 ft in the central Camden County area and expanded more than 12 mi toward the southwest and more than 3 mi toward the northwest. The expansion and deepening of the cone of depression in the Wenonah-Mount Laurel aquifer is the result of the NJDEP encouragement to not increase withdrawals from the Upper, Middle, and Lower Potomac-Raritan-Magothy aquifers. As a result of this encouragement, the major water users have kept withdrawals fairly constant in the Upper and Middle Potomac-Raritan-Magothy aquifers, reduced withdrawals from the Lower Potomac-Raritan-Magothy aquifer, and increased withdrawals from the Wenonah-Mount Laurel aquifer.

BUCKS









Figure 4-4. Water-level hydrographs for observation wells screened in the Wenonah-Mount Laurel aguifer, 1978-94.

Universal Transverse Mercator Projection, Zone 18

Figure 4-3. Potentiometric surface of the Wenonah-Mount Laurel aquifer, 1993.

## WATER LEVELS IN, EXTENT OF FRESHWATER IN, AND WATER WITHDRAWAL FROM EIGHT MAJOR CONFINED AQUIFERS, NEW JERSEY COASTAL PLAIN, 1993

#### Table 4-1. Water-level data for wells screened in the Wenonah-Mount Laurel aquifer, 1978-93

## [Well depth given if screen interval is unknown; \*, well not shown in figure 4-3; --, data not available; X, probable measurement error; ft, feet; MUA, Municipal Utilities Authority; WD, Water Department; TWP, Township; WC, Water Company; NJ, New Jersey; DEL, Delaware, CO, Company; CTR, Center; ED, Education; EPA, Environmental Protection Agency; ELEM, Elementary]

Well number	Permit number	Lati- tude <sup>1</sup>	Longi- tude <sup>1</sup>	Owner	Local well identification	USGS Quadrangle	Year drilled	Land- surface altitude <sup>2</sup> (ft)	Screen interval <sup>3</sup> (ft)	Water-level altitude²           1978         1983         1988         1993           (ft)         (ft)         (ft)         (ft)	1988-93 Water- level change (ft)	Date in 1993
5-245 5-247 * 5-257 5-354 5-355	31-00163 31-00110 51-00156 32-00103 52-00004	395112 395145 395516 395813 395826	745123 745111 745103 743950 744109	MEDFORD TWP WD MEDFORD TWP WD JOHNSON, W E JR SUNBURY VILLAGE PEMBERTON TWP WD	MTWD 4-5 / MTWD 5 (NEW) MTWD 2 JOHNSON NEW SVWC 1 PBWD 1	MEDFORD LAKES MEDFORD LAKES MOUNT HOLLY PEMBERTON PEMBERTON	1950 1950 1965 1953 1939	57 52 80 62 81	230-252 180-200 90 178-198 155-185	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-5 3 -11 4 3	11- 3 11- 3 11- 1 10-29 10-28
5-359 5-365 5-366 5-389 5-427	32-00539 32-00386 32-00775  32-00749	395727 395752 395755 395958 395330	744118 743452 743239 743933 744205	LAKE VALLEY WC PEMBERTON TWP WD PEMBERTON TWP WD PEMBERTON TWP SCHOOLS HAMPTON LAKE WC	LVWC 1 PTWD 4 PTWD 4 INCH OB HIGH SCH 1 HLWC 2	PEMBERTON BROWNS MILLS BROWNS MILLS PEMBERTON PEMBERTON	1967 1960 1972 1959 1971	70 93 90 80 70	181-242 290-330 301-323 140-150 260-348	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-3 -1 11 2 8	10-28 10-29 10-29 10-29 10-28
5-695 5-720 5-724 5-725 5-744	32-01240 31-11574 32-03118 48-00021	395328 395112 395413 400212 395639	743720 744535 744231 743708 742953	SUNNY PINES CONTRACTING CO ALLENWOOD MOBILE ESTATE HAMPTON LAKE WC WRIGHTSTOWN MUA WHITE J J CO	TEST HOLE 1-74 ALLEN 2 HLWC 3 WMUA 2 DOMEST 66	BROWNS MILLS MEDFORD LAKES PEMBERTON NEW EGYPT WHITING	1974 1978 1977 1971 1966	111 125 43 145 100	428-496 410 199-275 142-162 456	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-6 8 0 1 0	11- 1 11- 3 10-28 10-23 10-27
5-1004 5-1080 * 5-1082 5-1087 5-1155	32-08631 31-21601 31-19052 32-09937 31-39849	395801 395353 395941 395333 395315	744344 745112 744720 744441 744946	LAKE VALLEY WC HADDON HOUSE FOOD PRODUCTS TIDSWELL III, BROOKE RED LION FAITH CHAPEL MEDFORD TWP WD	LVWC 2 HADDON HOUSE OFFICE TIDSWELL DOMESTIC RED LION DOMESTIC MEDFORD TWP MW-1 OBS	PEMBERTON MOUNT HOLLY MOUNT HOLLY PEMBERTON MOUNT HOLLY	1982 1984 1982 1984 1992	65 65 35 55 46	209-254 99-130 82-92 227-232 120-180	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	3 0 -7	10-28 11- 6 11- 2 10-28 10-29
5-1165 5-1166 5-1178 5-1186 7-17	32-00490 28-17342 32-13264 32-15968 31-00179	395855 400430 395541 395915 394705	743513 743354 744415 743308 745444	HILLTOP TRAILER PARK SARGEANT, HAROLD W MT HOLLY WC PEMBERTON TWP WD OWENS CORNING CO	WELL 1 RD 2 DOM RETREAT RD 2 PTWD 8A 1	BROWNS MILLS NEW EGYPT PEMBERTON BROWNS MILLS CLEMENTON	1965 1986 1987 1989 1951	105 135 40 90 160	275-307 119-129 140-180 267-358 410-440	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	 5  29	11- 2 10-28 11- 1 10-29 11- 9
7-22 7-118 7-228 7-308 * 7-391	31-00513 31-04898 31-05139 51-00014 31-05628	394738 395229 394556 394928 394639	745614 745712 745835 750021 745750	BERLIN WD NJ/AMERICAN WC CAMDEN COUNTY BOARD OF ED NJ/AMERICAN WC LOWER CAMDEN REGIONAL SCHOOL	BWD 8 HUTTON HILL 2 OBS VOC&TECH H S1 LAUREL 10 OVERBROOK HS 1	CLEMENTON CLEMENTON CLEMENTON RUNNEMEDE CLEMENTON	1952 1965 1967 1923 1971	147 158 145 77 160	310-360 137-147 325-400 126 315-335	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-18 0 -13 -1 -14	11- 8 11- 1 11- 5 11- 1 11- 5
7-401 7-414 7-421 7-449 7-478	31-02371 51-00010  31-04749 	394722 394922 395109 394618 394215	745810 745633 745715 745413 745617	PINE VALLEY GOLF CLUB NJ/AMERICAN WC RCA WINSLOW TWP WC US GEOLOGICAL SURVEY	GOLF CLUB ELM TREE 26 RCA/DCA INDOOR WELL WINSLOW TWP 5 NEW BROOKLYN PARK 3 OBS	CLEMENTON CLEMENTON CLEMENTON CLEMENTON WILLIAMSTOWN	1955 1960 1955 1965 1961	85 150 175 159 111	267 237-275 220-234 420-460 520-530	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-14 15 0 -18 -18	11- 5 11- 2 11- 8 11- 8 11- 1
* 7-513 7-526 7-685 15-14 15-31	31-07766  31-22273 	394532 394932 394444 394827 394001	745623 745847 745944 750758 751234	JOHNS-MANVILLE CO LINDENWALD BORO MUA GARDEN STATE WC THOMPSON, MARION MOOD, RICHARD J	3 SEWAGE PL2 GSWC 10 ERIAL DEPTFORD TWP 1	CLEMENTON CLEMENTON WILLIAMSTOW WOODBURY PITMAN WEST	1974 1972 1985 1953 1954	166 78 180 102 125	410-460 138-158 322-427 83-107 285	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-8 1  -2 -4	11- 4 11- 9 11- 3 11- 4 11-10
15-125 15-367 15-542 15-687 15-910	30-00649 31-16873 30-02454	394324 394234 394147 394638 394155	751315 751307 750654 751201 751401	CHRIST CHURCH GANGEMI, VICENT RON SON MUSHROOM CO US EPA WOLFSON, BENJAMIN	1 1 1 Kramer LF X-6S Wolfson Domestic 1981	PITMAN WEST PITMAN WEST PITMAN EAST WOODBURY PITMAN WEST	1950  1980 1984 1981	92 73 150 28 84	84-105 500 265-295 6-24 140-160	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 2 -22 1 -1	11-12 11-12 11-5 11-12 11-9
15-953 15-1009 15-1040 15-1060 * 15-1104	31-06570 31-22018 30-05046 31-30571 30-02422-6	394718 394426 394257 394100 394350	750604 750633 751825 750553 751916	WEHRAN ENGINEERING CO FLAHERTY, JOSEPH STRING, DONALD 0 GLASSBORO WD GRASSO, JOSEPH S	KINSLEY 1 DW-2 FLAHERTY DOMESTIC SPRINGFIELD FARMS 2 GWD6 GRASSO FOODS MW 3	RUNNEMEDE PITMAN EAST WOODSTOWN PITMAN EAST WOODSTOWN	1972 1984 1988 1989 1981	81 100 120 136 102	86-100 149-178 77-87 335-386 40	56 55 65 62 77 79 20 81	-1 -3 2 	11- 9 11- 5 11- 9 11- 4 11-10
25-14 25-88 25-95 25-164 25-173	49-00017 29-05886 29-04709 29-01995 29-04626	401138 401444 401618 400839 401244	740125 741700 741644 741439 741135	AVON WD CENTRAL JERSEY BANK STEGERS, KURT HOWELL TWP MUA NJ CONCRETE CO	AWD 1 1 1965 ALDRICH W CO 1/HTMUA 1 HOWELL TWP	ASBURY PARK ADELPHIA FREEHOLD FARMINGDALE FARMINGDALE	1925 1969 1965 1956 1965	28 150 160 130 90	424-504 143-163 128-140 349-370 226-257	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	119 -2  66 20	10-18 10-21 11- 9 10-21 10-20
25-185 25-243 25-335 25-353 25-391	29-02607   29-07506	401438 401854 401215 401542 400928	741025 741325 740409 740530 740211	NAD EARLE IENTILE, F J WELSH FARMS US ARMY SPRING LAKE HEIGHTS WD	TRANS DEPOT S7 MARLBORO TWP WARDELL 1 FORT MONMOUTH 1-NCO OBS SPRING LK HGT4	FARMINGDALE MARLBORO ASBURY PARK LONG BRANCH ASBURY PARK	1958 1963 1941 1972 1974	119 120 80 140 25	229-250 80 465-480 321-327 485-561	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	9 2 90 25 109	10-20 10-25 10-19 11- 2 10-19
25-392 25-396 25-405 25-412 25-426	28-00676 28-06896  28-05835 	400617 400658 401005 401045 400817	743037 743135 742913 742821 740744	HOPKINS, RUSSELL RUTGERS UNIVERSITY PUNK BROTHERS ERB, GEORGE H THOMPSON HOME	U FREEHOLD TWP 1 3 1 GERALDINE M H2	NEW EGYPT NEW EGYPT ROOSEVELT ROOSEVELT FARMINGDALE	 1970 1964 1966 	80 122 158 190 120	87 92-102 124 100-140 580	93         83         80         82           85         85         83         86           127         128         126         127           149         145         147         148           -108         -115         -129         -74	2 3 1 1 55	10-27 10-25 10-22 10-27 10-21
* 25-478 25-486 25-521 25-533 25-542	29-09914 29-09867 29-05113 	400642 400711 401020 400816 400953	741312 740202 741937 741334 740726	AMERADA HESS CORP STATE OF NJ AMARESCU, DONALD MOON MOTEL BRISBANE CHILD TREATMENT CTR	2-79 DOE-SEA GIRT OBS FREEHOLD TWP 1 2	LAKEWOOD POINT PLEASANT ADELPHIA FARMINGDALE ASBURY PARK	1979 1978 1979 1966	60 10 150 120 60	377-392 604-614 222-228 349-365 430-450	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	25 83 3 53 54	10-28 10-25 10-20 10-18 10-19
25-546 25-637 25-720 29-31 29-36	29-12717 29-18400-2 29-16821 29-04663 29-06021	400713 401105 401053 400234 400410	741016 741202 741558 740814 740917	DUTTON, ANTHONY US GEOLOGICAL SURVEY ADELPHIA WC BRICK TWP BOARD OF ED BRICK TWP BOARD OF ED	1 HOWELL TWP 3 OBS AWC T-2/4-B EMMA YOUNG 1 HIGH SCHOOL	LAKEWOOD FARMINGDALE ADELPHIA LAKEWOOD LAKEWOOD	1983 1987 1986 1965 1970	60 112 120 17 25	420-445 307-317 235-255 605-625 518-548	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	67 35  9 36	10-27 10-21 10-25 10-28 10-28
29-37 29-49 29-140 29-227 29-234	29-04283 29-06022 28-04785 29-05007 28-08255	400429 400505 400414 400604 400809	740652 740649 742702 741915 742532	SAINT DOMINICS CHURCH BRICK TWP BOARD OF ED US GEOLOGICAL SURVEY MEADOWBROOK VILLAGE GREAT ADVENTURE	1 VET MEMORL SCH COLLIERS MILLS 3 OBS HOLMANSVILLE 1 GA 2	POINT PLEASANT POINT PLEASANT CASSVILLE LAKEHURST ROOSEVELT	1964 1970 1964 1966 1974	20 20 135 110 170	576-591 556-586 257-267 358 180-200	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	31 36 0 	10-29 10-28 10-26 10-21 10-22
29-699 29-713 29-740 29-781 29-783	28-07966 28-10063 29-08522 29-09069 29-09681	400915 400636 400352 400622 400745	742336 742102 742145 741957 741817	JACKSON TWP BOARD OF ED JACKSON TWP OCEAN COUNTY VOCATIONAL SCHOOL IVINE, WILLARD FOUNTAIN HEAD PARK	GETZ SCHOOL LIBRARY JACKSON 2 JACKSON TWP JACKSON TWP	ROOSEVELT LAKEHURST LAKEHURST LAKEHURST ADELPHIA	1973 1978 1976 1977 1979	160 130 105 110 115	214-226 318-324 340-380 302-325 310-325	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2 2 2 -4 5	10-26 10-18 10-18 11-19 10-21
29-784 * 29-786 29-926 33-2 33-8	29-10449 29-08581 28-18902 30-00030	400550 400630 400610 393202 393330	741808 741730 742728 751630 751817	EMMUS, ROLAND JACKSON TWP JELLYSTONE PARK CUMBERLAND COUNTY STRANG, ARNOLD	JACKSON TWP HULSE RD 1 JELLYSTONE 3 BOSTWICK NO 3 STRANG 1	LAKEHURST LAKEHURST CASSVILLE ALLOWAY ALLOWAY	1980 1977 1987 1972 1949	90 110 105 85 70	341-347 364-379 127-160 462-472 322-345	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	2 7 1 -1 -2	10-18 10-18 10-25 11- 2 11- 9
33-20 * 33-22 * 33-32 33-50 33-56	31-04612 34-00758 	393534 393533 392740 393538 393606	751752 751018 753201 752640 752524	HORNER, EPHRAIM ELMER WC PUBLIC SERVICE ELECTRIC & GAS SALEM MEMORIAL HOSPITAL MANNINGTON TWP ELEM SCHOOL	HORNER OBS EWC 6 PW3 HOSP 1-1950 MTES 1	ALLOWAY ELMER TAYLORS BRIDGE SALEM SALEM	1929 1963 1970 1950 1959	77 105 12 20 25	283 460-500 242-293 73-97 93	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-2 -7 2 1	11- 9 11-12 11-10 11- 8 11- 9
33-241 33-252 33-351 * 33-381 33-384	 30-00042 30-01505 30-01356	393253 393348 393903 393453 393126	752422 752755 751941 752709 752521	SALEM CITY WD US GEOLOGICAL SURVEY LAZOZ, TED MANNINGTON MILLS WILD OAK COUNTRY CLUB	QUINTON SALEM 2 OBS SPINOSI 1/WOODSTOWN R&D MILLS 6 1-IRR-73	SALEM SALEM WOODSTOWN SALEM SALEM	1965 1950 1977 1973	10 3 45 10 20	248 91-96 84-116 84-125 320	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-1 0 1 0 -1	11-10 11-12 11-10 11- 8 11- 8
33-456 33-670 Gd33-04	31-19206 30-04467 Gd33-04	393507 393355 392212	751045 751915 753243	ELMER WC LICCIARDELLO, MARK DEL GEOLOGICAL SURVEY	EWC 8 LICCIARDELLO DOMESTIC DEAKYNVILLE #4	ELMER ALLOWAY SMYRNA	1982 1987 	125 64 18	443-503 310-320 395-427	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	-5 -1 -1	11-12 11-12 11-19

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#### PREPARED IN COOPERATION WITH THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

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#### WATER-RESOURCES INVESTIGATIONS REPORT 96-4206 Englishtown aquifer - SHEET 5 OF 8 Lacombe, P.L., and Rosman, Robert, 1997, Water levels in, extent of freshwater in, and water withdrawal from eight major confined aquifers, New Jersey Coastal Plain, 1993

 $75^{\circ}$ 74°30' 74° /----\_\_\_ HUNTERDON Northern Coastal Plain counties SOMERSET Flemington \_\_\_\_\_ Raritan Bay Southern Coastal Plain counties 5 \_\_\_\_\_ 1978 1980 1982 1984 1986 1988 1990 1992 Figure 5-1. Estimated water withdrawal from the Englishtown aquifer system, 1978-94. 25-9 **Q** MIDDLESEX EXPLANATION Water withdrawal, in million gallons per year <sup>25-132</sup>0 Lambertville Jamesburg Princeton) MERCER 300-399 400-50 25-68 BUCKS **O**25-107 ONMOU **O**25-105 **Q** 25-96 **O**<sub>25-38</sub> PENNSYLVANIA 25-704**Q** 107 5-80 73 **O PHILADEL Q**25-213 OCEAN BUCKS NEW DELAWARE BURLINGTON CAMDEN NEW CASTI -106 Q -106 Q 25-389 120 -**X**<sup>78</sup> GLOUCESTER **O**<sub>25-162</sub> 3740 SALEM -1182 0

Water withdrawal from the Englishtown aquifer system decreased from about 9.5 to 5.8 Mgal/d during 1978-94 (fig. 5-1). Water withdrawals in the northern Coastal Plain were made predominantly in Monmouth and northern Ocean Counties (fig. 5-2). Withdrawals in this area decreased from about 8.8 to 5.0 Mgal/d during 1978-93. Water withdrawals in the southern Coastal Plain were limited to a few wells in central Burlington and Camden Counties and remained fairly constant at 0.8 Mgal/d or less during 1978-94. Concentrations of chloride do not exceed 25 mg/L in samples from any wells screened in the Englishtown aquifer system; therefore, it is not possible to estimate the location of the 250-mg/L isochlor (fig. 5-3). In addition, the simulation shows that the 10,000-mg/L isochlor is southeast of the downdip limit of the aquifer (D.A. Pope and A.D. Gordon, U.S. Geological Survey, written commun., 1993); therefore, the 10,000-mg/L isochlor is not within the aquifer and is not shown.

**Englishtown Aquifer System** 

75<sup>°</sup> 30'

#### Water Levels

Water-level data for 74 wells screened in the Englishtown aquifer system are listed in table 5-1 (reverse side of sheet 5). Water levels in these wells were used to define the potentiometric surface in 1993 (fig. 5-3). Maps of simulated water levels by Martin (1990, fig. 46, p. 87) and A.D. Gordon (U.S. Geological Survey, written commun., 1992) were adapted to close the potentiometric-surface contours in the southeastern part of the Coastal Plain. The water-level map shows a major cone of depression in eastern Monmouth and northern Ocean Counties that encompasses two local cones of depression. The easternmost local cone of depression is elongated and is centered under shore communities from Lavallette to Spring Lake Heights. It had a minimum water-level altitude of about -150 ft in 1993. The westernmost local cone of depression is circular and is centered under the greater Lakewood area; the minimum water-level altitude within the cone was about -130 ft. The maximum water-level altitude measured during the 1993 water-level synoptic study was +111 ft, at well 25-213 in western Monmouth County.

Water-level changes between 1988 and 1993 were calculated for 64 wells screened in the aquifer. Waterlevel altitudes were measured in 50 wells in Monmouth and Ocean Counties for the 1988 and 1993 studies. In northern and western Monmouth County, water levels rose 1 to 9 ft in six wells. Water levels rose 10 to 49 ft in 15 wells, most of which are a few miles west of Lakewood. Water levels rose 50 to 99 ft in 11 wells, mostly near Lakewood, Point Pleasant, and Farmingdale. Water levels rose 100 to 121 ft in five wells near Avon-by-the-Sea and Brielle. Water levels declined 1 to 7 ft in nine wells in the greater Freehold area, and declined 22 ft in a production well in the Roosevelt quadrangle. Water levels remained the same in three wells.

Water levels were measured in 13 wells in Burlington, Camden, Gloucester, and Salem Counties in 1988 and 1993. Water levels declined 1 to 23 ft in six wells, rose 1 to 7 ft in five wells, and did not change in two wells. Water levels declined more than 10 ft in production well 7-529 in the Clementon quadrangle and in well 33-581, west of Woodstown.

Water-level hydrographs for 1978-94 for nine observation wells are shown in figure 5-4. Annual waterlevel altitudes remained fairly constant or decreased less than 5 ft in wells 23-104, 29-138, and 5-259 during 1978-94. Water levels in well 25-250 and 29-534 declined 5 to 15 ft during 1978-93. Water levels declined in well 25-429 and are interpreted to have declined in wells 25-638 and 29-530 during 1978-90; however, since 1990, water levels rose 40 ft in well 25-638, 70 ft in well 25-429, and at least 125 ft in well 29-530. The rise in water levels is interpreted to be a result of the NJDEP mandate to reduce withdrawals from the Englishtown aquifer system and deeper aquifers and to substitute the ground water with surface water from reservoirs in Monmouth County (General Water Supply Management Regulations, Water Supply Management Act, N.J.S.A. paragraph 7:19-6 to 19-13). The mandated reduction of withdrawals resulted in an increase in water levels near the center of the cone of depression and a decrease in the extent of the cone of depression.

In summary, the potentiometric surface in 1993 was significantly different from that mapped in 1988 (Rosman and others, 1996). The major cone of depression in the northern Coastal Plain decreased in size, and two local cones of depression formed within it. The water level at the center of the elongated cone of depression along the coastline rose about 100 ft, and the center shifted southward about 4 mi from the Avon-by-the-Sea/Brielle area to the Point Pleasant area. The water level at the center of the circular cone in the northern counties rose about 60 ft. The western part of the cone of depression, represented in both reports by the 0-ft contour, contracted about 0.5 mi on the west side. Water levels in the southern Coastal Plain, for the most part, remained about the same.





ATLANTIC

Figure 5-3. Potentiometric surface of the Englishtown aquifer, 1993.

WATER LEVELS IN, EXTENT OF FRESHWATER IN, AND WATER WITHDRAWAL FROM EIGHT MAJOR CONFINED AQUIFERS, NEW JERSEY COASTAL PLAIN, 1993

Figure 5-4. Water-level hydrographs for observation wells screened in the Englishtown aquifer system, 1978-94.

#### Table 5-1. Water-level data for wells screened in the Englishtown aquifer system, 1978-93

[Well depth given if screen interval is unknown; \*, well not shown in figure 5-3; --, data not available; L, well screened in lower Englishtown aquifer system; ft, feet; BORO, Borough; MUA, Municipal Utilities Authority; WD, Water Department; TWP, Township; WC, Water Company; NJ, New Jersey; CO, Company; EPA, Environmental Protection Agency; SR, Senior; BR, Bridge]

Well number	Permit number	Lati- tude <sup>1</sup>	Longi- tude <sup>1</sup>	Owner	Local well identification	USGS Quadrangle	Year drilled	Land- surface altitude <sup>2</sup> (ft)	Screen interval <sup>3</sup> (ft)	<u>W</u> 1978 (ft)	<u>/ater-lev</u> 1983 (ft)	<u>'el altitu</u> 1988 (ft)	<u>de<sup>2</sup></u> 1993 (ft)	1988-93 Water- level change (ft)	Date in 1993
5-195 5-197 5-259 5-375 5-387	31-01164 31-01191  32-02276 32-01103	395833 395653 395524 395807 395943	745042 744921 745025 743837 744120	THOMAS, ALFRED JONES, LESTER US GEOLOGICAL SURVEY BURLINGTON COUNTY INSTITUTE PEMBERTON TWP SCHOOLS	THOMAS D-1 LUMBERTON TWP MEDFORD 2 OBS BUR CO INST 3 HIGH SCH 2 (3)	MOUNT HOLLY MOUNT HOLLY MOUNT HOLLY PEMBERTON PEMBERTON	1954 1953 1963 1956 1973	60 41 73 70 50	70-74 148-159 253-263 343-378 208-228	25 26 25  44	23 25 20 29 54	22 19 24 25 49	26 26 24 20 52	4 7 0 -5 3	11- 8 11- 2 10-29 10-27 10-29
5-437 5-754 * 5-1180 5-1182 7-166	28-03831 28-31303 28-31265 31-01202	400210 395941 400300 400150 394807	744138 743250 743514 743428 745806	KAUFFMAN, MINTER US ARMY US AIR FORCE US AIR FORCE CLEMENTON WD	SPRINGFIELD TWP RANGE HQ 7 ECASTLE & SBOLLING TW B BLDG 1904 TW C CWD 9	COLUMBUS BROWNS MILLS NEW EGYPT NEW EGYPT CLEMENTON	1960 1975 1993 1993 1954	74 100 125 102 150	94-105 418-447 257-277 285-305 367-457	62 50  	61 46  46	61 43  11	66 37 75 87 15	5 -6  4	11-11 10-28 10-27 10-27 11- 5
7-529 7-672 7-731 15-188 15-676	31-13543 31-24779 31-29319 	394832 394929 395001 394605 394638	745915 750023 745851 751057 751201	CLEMENTON WD NJ/AMERICAN WC NJ/AMERICAN WC YAHRLING, F US EPA	CWD 11 LAUREL SP TEST2 OBS1EF LINDEN AVE OW-57 YAHRLING 1 KRAMER LANDFILL X-6D	CLEMENTON RUNNEMEDE CLEMENTON WOODBURY WOODBURY	1978 1986 1989 1955 1984	55 76 65 80 28	250-283 195-215 216-236 134-160 68-78	1  	50   	26 50 31 30	3 46 48 31 26	-23 -4  0 -4	11-5 11-1 11-2 11-3 11-3
23-104 * 23-605 25-9 * 25-16 25-26	 29-10983 49-00050 29-00045 49-00024	402143 402159 402441 401037 401102	741849 741908 740234 740148 740045	OLYMPIA & YORK BR DEVELOPMENT OLYMPIA & YORK BR DEVELOPMENT ATLANTIC HIGHLANDS WD BELMAR BORO WD BELMAR BORO WD	MORRELL1 OBS O&Y CC2 AHWD 2 BWD 3 ELEC(12) BWD 4 ELEC(11)	FREEHOLD FREEHOLD SANDY HOOK ASBURY PARK ASBURY PARK	1923 1981 1923 1949 1941	77 120 15 20 15	0-11 37-47 200 563-594 601-671	 10 -188 -165	 11 -196 -174	86 5 -202 -173	74 85 10 -91 -84	-1 5 111 89	10-21 10-21 10-19 10-18 10-18
25-28 * 25-30 25-38 25-47 25-63	29-05292 29-00069 49-00012 29-02171 29-04386	400623 400645 401622 401803 401143	740429 740345 741156 740814 741018	BRIELLE WD BRIELLE WD HOMINY HILLS GOLF CLUB DORBROOK PARK FARMINGDALE WD	BWD 3 BWD 2 GLF CLB 1-1941 ROSENBERG 1 FARMINGDALE 3	POINT PLEASANT POINT PLEASANT MARLBORO MARLBORO FARMINGDALE	1967 1950 1941 1957 1964	90 33 126 80 75	770-820 690-750 328-338 322-342 420-460	-219 -233 60 35 	-220 -249 57 33 	-207 -225 50 27 -84	-119 -116 50 34 -38	88 109 0 7 46	10-29 10-29 10-27 11-11 10-22
25-80 25-96 25-105 25-107 25-132	29-05417 29-04435 29-05302 29-03177 29-02079	401415 401624 401654 401701 402202	741501 741502 741736 741417 741002	WORTHINGTON BIOTECHNOLOGY FREEHOLD TWP WD FREEHOLD TWP WD MUELLER, R W DR BELL TELEPHONE CO	1-1967 5-OLD SO.GULF1 FREEHOLD TWP 3 DURAND,E. 1960 BELL LAB 2	ADELPHIA FREEHOLD FREEHOLD MARLBORO MARLBORO	1967 1964 1967 1960 1960	120 200 112 163 120	294-334 327-356 150-212 249-257 191-221	75 87 104 81 64	78 88 100 81 64	73 81 69 73 63	73 74 66 70 63	0 -7 -3 -3 0	10-21 10-20 10-20 10-26 10-26
25-150 25-162 25-165 25-184 25-213	29-03737 29-07043 29-05346 29-04186 28-06560	402432 400815 400844 401429 401253	740848 741043 741324 741254 742122	LILY TULIP CUP CO NJ NATURAL GAS HOWELL TWP MUA DIXON FARMS BLUE STAR STABLE	LILY TULIP 2 1-1973 ALDRICH W CO 4/HTMUA 4 HOWELL TWP 1969	KEYPORT FARMINGDALE FARMINGDALE FARMINGDALE ADELPHIA	1962 1973 1967 1963 1969	65 69 135 140 165	97-122 500-560 363-550 360-380 275-285	114  117	36 -120  69 116	38 -125 -94 65 114	36 -66 -46 69 111	-2 59 48 4 -3	10-18 10-21 10-21 10-22 10-20
25-250 25-256 25-365 25-374 25-385	29-04437 49-00010 29-04513 29-04102 49-00016	401918 401937 402046 400804 400915	741529 741428 740105 740227 740146	GORDONS CORNERS WC MARLBORO STATE HOSPITAL RUMSON COUNTRY CLUB SEA GIRT WD SPRING LAKE WD	VILLAGE 215 OBS STATE HOSP 4 RUMSON C C 2 SGWD 5 SLWD 3	FREEHOLD MARLBORO LONG BRANCH ASBURY PARK ASBURY PARK	1964  1965 1963 1941	139 125 7 20 20	185-215 124 268-333 660-710 640-705	100  -205 -197	99  -218 -208	95  -216 -210	92 79 6 -113 -106	-3  103 104	10-19 10-25 10-20 10-18 10-18
25-389 25-408 25-429 25-441 25-638	29-00398 28-06655 29-04140 29-05289 29-18401-1	400859 401007 400834 401028 401105	740308 743201 740834 740638 741202	SPRING LAKE HEIGHTS WD CLAYTON CONCRETE PRODUCTS US GEOLOGICAL SURVEY WALL TWP WD US GEOLOGICAL SURVEY	SPRING LK HGT2 D T ASSOC 1 ALLAIRE STATE PARK C OBS RT 34 WELL HOWELL TWP 4 OBS	ASBURY PARK ALLENTOWN FARMINGDALE ASBURY PARK FARMINGDALE	1953 1969 1963 1968 1987	60 105 98 120 112	660-711 96-119 623-633 549-649 483-493	-203 -143 -162	-232 100 -149 -163	-230 100 -149 -170 -53	-109 99 -78 -74 -14	121 -1 71 96 39	10-19 10-21 10-21 10-19 10-21
25-686 25-687 25-692 25-697 25-704	29-15362 29-15008 29-14852 29-13591 29-15337	401757 401756 401813 401950 401450	740754 740258 741818 740446 741832	BAILEY, RICHARD E. EATONTOWN SR CITIZENS HOUSING WEINGARTEN-SIEGEL GROUP BOWERS, PHILIP J KAPLAN RAIN TREE GOLF COURSE	OVERBROOK FM 2 IRR EATONTOWN SR HOUSING JUSTIN CORP CNTR PJ BOWERS & CO WEMROCK RD IRRIGATION	MARLBORO LONG BRANCH FREEHOLD LONG BRANCH ADELPHIA	1985 1985 1985 1984 1985	80 40 110 50 195	320-340 177-187 120-150 247-277 290-320		  	21 90 -2	31 18 86 11 107	3 -4 13	10-26 10-20 10-21 10-18 10-20
25-710 25-715 29-5 29-138 29-233	29-16728 29-25384  29-04689	400555 402426 400405 400414 400742	740850 740019 740242 742702 741639	PARKWAY WC ATLANTIC HIGHLANDS WD NJ/AMERICAN WC US GEOLOGICAL SURVEY JACKSON TWP MUA	PARKWAY 1 A AHWD B OBS BAY HEAD 5 COLLIERS MILLS 1 OBS JACKSON 4	LAKEWOOD SANDY HOOK POINT PLEASANT CASSVILLE ADELPHIA	1986 1991 1947 1964 1965	45 220 10 137 100	594-644 350-360 750-834 417-427 448-500	-226 65 -52	-219 64 -36	-164 -202 60 -36	-96 4 -153 61 -5	68  49 1 31	10-29 10-19 10-25 10-26 10-22
29-236 29-237 29-430 29-433 29-434	29-03883 28-08254 29-05721 29-05110 29-04304	400823 400800 400220 400309 400354	741533 742543 741154 741120 741310	JACKSON TWP MUA GREAT ADVENTURE LAKEWOOD TWP MUA LAKEWOOD TWP MUA NJ/AMERICAN WC	JACKSON 2 GA 1 S LAKEWOOD 1 S LAKEWOOD 3 LAKEWOOD 7	ADELPHIA ROOSEVELT LAKEWOOD LAKEWOOD LAKEWOOD	1962 1974 1969 1966 1964	170 140 90 45 85	541-577 358-388 752-817 673-741 697-757	 -178 -207 	-43 -196 -202	-53 122 -190 -184	-16 100 -98 -105 -130	37 -22 92 79	10-22 10-22 10-28 10-27 10-27
29-438 29-441 29-443 29-449 29-450	29-04834 29-05068 29-02231 29-05496 29-03324	400443 400505 400515 400614 400622	741352 741114 741251 741157 741349	NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC	LAKEWOOD 8 LAKEWOOD OBS LAKEWOOD 5 LAKEWOOD 9 LAKEWOOD 6	LAKEWOOD LAKEWOOD LAKEWOOD LAKEWOOD LAKEWOOD	1965 1966 1957 1968 1960	78 30 36 55 70	600-758 726-736 547-604 569-698 520-582	-152 -136  -170 -135	-170 -141 -151 -178 -153	-161 -140 -154 -189 -133	-112 -112 -94 -161 -112	49 28 60 28 21	10-27 10-27 10-27 10-27 10-27
29-451 L*29-452 L 29-454 29-503 29-518	29-02207 33-00001 53-00002 29-01325	400636 395741 395808 400210 400401	741515 740437 740421 740310 743200	LAKEWOOD TWP PINE PARK LAVALLETTE WD LAVALLETTE WD NJ/AMERICAN WC NEW EGYPT WC	ST GABRIELS 1 LWD 3 LWD 2 MANTOLOKING 6 OBS 2-1903	LAKEHURST SEASIDE PARK SEASIDE PARK POINT PLEASANT NEW EGYPT	1957 1948 1931 1955 1903	60 7 5 5 75	510-530 1,120-1,180 1,010-1,140 845-906 218-238	-102 -117 -119 	-108 -119 -118 -194	-103 -108 -107 -194 61	-64 -89 -85 -133 62	39 19 22 61 1	10-18 10-25 10-25 10-25 10-27
29-530 L 29-534 29-938 33-581	29-04530 33-01117 28-20499 30-01467	400454 395609 400404 393846	740413 741240 742137 752300	POINT PLEASANT WD US GEOLOGICAL SURVEY JACKSON ESTATES COWTOWN AUCTIONEERS	PPWD 6 OBS TOMS RIVER 2 OBS 1988 WELL COWTOWN AUCTIONEERS 2	POINT PLEASANT TOMS RIVER LAKEHURST PENNS GROVE	1965 1965 1988 1975	20 18 130 35	730-790 1,080-1,150 487-527 95-115	78 	-211 -86 	-202 -86 -8 29	-146 -85 7 14	56 1 15 -15	10-25 10-25 10-18 11-10

74°30'

SOMERSE1

74°

### WATER-RESOURCES INVESTIGATIONS REPORT 96-4206

Upper Potomac-Raritan-Magothy aquifer - SHEET 6 OF 8 Lacombe, P.L., and Rosman, Robert, 1997, Water levels in, extent of freshwater in, and water withdrawal from eight major confined aquifers, New Jersey Coastal Plain, 1993

### **<u>Upper Potomac-Raritan-Magothy Aquifer</u>**

75<sup>°</sup> 30'

#### Water withdrawal and extent of freshwater

Estimated water withdrawal from the Upper Potomac-Raritan-Magothy aquifer ranged from about 73 to 79 Mgal/d during 1978-87, then steadily decreased to 58 Mgal/d in 1994 (fig. 6-1). Water withdrawals in the northern Coastal Plain were predominantly in southern Middlesex County and northern Monmouth County (fig. 6-2). Withdrawals in this area decreased from about 46 to 27 Mgal/d during 1978-94. Water withdrawals in the southern Coastal Plain were predominantly in the greater Camden County area. Water withdrawals in the southern  $40^{\circ}$ counties increased slightly; about 28 Mgal/d was withdrawn in 1978, and 32 Mgal/d was withdrawn in 1994. The location of the 250-mg/L isochlor in the Raritan Bay area (fig. 6-3) was mapped by Schaefer (1983). The 30' 250-mg/L isochlor in Salem County was based on water-quality data stored in the U.S. Geological Survey waterquality data base. The location of the 10,000-mg/L isochlor was estimated by use of the saltwater model of the

Water-level measurements for 189 wells screened in the Upper Potomac-Raritan-Magothy aquifer are listed in table 6-1 (reverse side of sheet 6). The water-level altitudes in these wells were used to define the 1993 potentiometric surface shown in figure 6-3. Maps of simulated water levels by Martin (in press, fig. 48) and A.D. Gordon (U.S. Geological Survey, written commun., 1992) were adapted to close the potentiometric-surface contours in the southeastern part of the Coastal Plain.

Coastal Plain. A shallow, broad cone of depression underlies the greater Monmouth County area in the northern Coastal Plain and a small cone of depression underlies western Salem County. The cone of depression underlying the greater Camden area encompasses six local cones of depression. Each of the six local cones is located near a major withdrawal center. From north to south the minor cones are near Mount Holly, Evesham, Somerdale, Pine

typically about -15 ft. Five small local cones of depression within the northern cone are centered at or near the pumping centers for the communities of Keansburg, Marlboro, Asbury Park, Lavallette and Lakewood. The Coastal Plain and underlying the Atlantic Ocean are based on a modification of the simulated potentiometric surface developed by Martin (in press, fig. 46, p. 87) and A.D. Gordon (U.S. Geological Survey written commun.,

depression in the Asbury Park area and in the northern Monmouth-eastern Middlesex County area. The rise in

fluctuations that reflect the response of the potentiometric surface to ground-water withdrawals and recovery (fig. 6-4). Hydrographs for wells 33-348, 33-342, 15-728, and 15-297 show fairly constant water levels during 1978-94. Hydrographs for most of the remaining wells in the southern counties show water-level declines of about 10 to 15 ft during 1978-88 but declines of only 1 to 2 ft during 1989-94. The small decline in water levels during that latter time is the result of the NJDEP's attempt to stabilize the cone of depression in the southern Coastal Plain

by restricting new and increased withdrawals. The seasonal water-level fluctuations were greatest in wells 15-741, 5-258, 7-477, and 7-117, ranging from 10 to 25 ft/yr. These wells are near the center of the Camden County area cone of depression and are far from the outcrop/recharge area. Water levels in well 7-322 annually fluctuate less than 5 ft because the well is near the outcrop area. Water levels in well 33-253 declined 7 ft during 1978-93, but did not fluctuate annually because the well is far from major withdrawal areas. The cone of depression the southern counties as mapped in 1993 (fig. 6-3) is similar to the cone as mapped in 1988 (Rosman and others, 1996). The -20-ft, -40-ft, and -60-ft contours are in about the same locations.

 $75^{\circ}$ 

The -80-ft contour for 1993 shifted downdip, expanded toward the northeast, and contracted from southwest. The 100-ft contour lines are in slightly different locations but cover the same general area. The water-level hydrographs for nine observation wells in the northern counties show annual and seasonal water-level fluctuations reflecting the response of the potentiometric surface to ground-water withdrawals and recovery (fig. 6-5). The hydrograph for well 23-351 shows fairly constant water levels during 1978-94. Hydrographs for wells 23-292 and 23-228 show that water levels decreased about 8 to 10 ft during 1978-94. Hydrographs for wells 25-316, 25-206, 25-639, and 25-351 show static water levels from 1978 to 1990 and

Supply Management Act, N.J.S.A. paragraph 7:19-6 to 19-13).

Monmouth-eastern Middlesex County area (about 30 ft). The cone of depression in the southern Coastal Plain remained stable in many areas and declined slightly in some areas during 1988-93.





Figure 6-1. Estimated water withdrawal from the Upper Potomac-Raritan-Magothy aquifer, 1978-94.



Figure 6-4. Water-level hydrographs for observation wells screened in the Upper Potomac-Raritan-Magothy aquifer in the southern counties of the New Jersey Coastal Plain, 1978-94.



Base modified from U.S. Geological Survey digital data, 1:100,000, 1983, Universal Transverse Mercator Projection, Zone 18

Figure 6-3. Potentiometric surface of the Upper Potomac-Raritan-Magothy aquifer, 1993.

WATER LEVELS IN, EXTENT OF FRESHWATER IN, AND WATER WITHDRAWAL FROM EIGHT MAJOR CONFINED AQUIFERS, NEW JERSEY COASTAL PLAIN, 1993

#### Table 6-1. Water-level data for wells screened in the Upper Potomac-Raritan-Magothy aquifer, 1978-93

[Well depth given if screen interval is unknown; \*, well not shown in figure 6-3; --, data not available; ft, feet; BORO, Borough; MUA, Municipal Utilities Authority; WD, Water Department; TWP, Township; WC, Water Company; NJ, New Jersey; DEL, Delaware; CO, Company; CORP, Corporation; ED, Education; AUTH, Authority; ; CTR, Center; OBS, Observation; WMC, Water Commission]

	Well number	Permit number	Lati- tude <sup>1</sup>	Longi- tude <sup>1</sup>	Owner	Local well identification	USGS Quadrangle	Year drilled	Land- surface altitude <sup>2</sup>	Screen interval <sup>3</sup>	Wa 1978	ter-leve	e <u>l altitud</u> 1988 1	$\frac{e^2}{1993}$	1988-93 Water- level change	Date in 1993
*	5-45 5-76 5-116	31-01751 28-02847	400716 400324 400708	744228 745152 743836	SANDMAN MOTEL HEAL, CHARLES JR CHESTERFIELD SCHOOL	SANDMAN 1 HEAL 1	COLUMBUS BRISTOL COLUMBUS	 1955 1957	85 50 102	59-80 247-253	 -3 7	 -4 6	8 -6 3	10 1 4	2 7 1	10-21 11- 8 11- 5
	5-165 5-167 5-207 5-209	31-05458 31-07883  28-06599	395233 395247 400356 400412	745418 745157 744039 744323	EVESHAM MUA EVESHAM MUA VAN MATER, CHAS COLUMBUS WC	EMUA4 EMUA5 CRESANT FARMS CWC 2(OLD 3)	MOORESTOWN MOUNT HOLLY COLUMBUS COLUMBUS	1970 1973  1969	110 50 95 73	464-500 478-548 325 259-274	-75 -70 -13	-81 -79 -16 -18	-89 -84 -20 -22	-104 -88 -20 -32	-15 -4 0 -10	11- 8 11- 8 11- 2 11- 1
	5-212 5-218 5-229	28-03560  31-08922 31.05282	400515 400718 395630	744109 744453 745855	NORTHERN BURLINGTON COUNTY RIVER FRONT MOTEL MAPLE SHADE WD	HIGH SCHOOL 1 MOTEL MSWD9 MTWD2/MTWD1	COLUMBUS COLUMBUS MOORESTOWN	1959  1975	83 60 40	290-310 100 160-200	-13 -2 -47	-15 -4 -57	-18 -4 -56	-18 3 -53	0 7 3	11-5 10-22 11-3
*	5-249 5-254 5-258 5-310 5-315	31-03282 31-10560 31-04627 	395209 395430 395524 395728 395845	743043 744929 745025 745504 745240	MEDFORD LEASE US GEOLOGICAL SURVEY STATE OF NJ - TURNPIKE AUTH LARCHMONT FARMS	MEDFORDI OBS MAINT 2 FARM WELL 1	MOUNT HOLLY MOUNT HOLLY MOORESTOWN MOORESTOWN	1908 1977 1963 1952 1958	50 71 40 55	451-471 400-410 120-160 200-238	-03 -52 -40 -39	-73 -65 -48 -45	-84 -66 -50 -49	-80 -77 -69 -51 -46	-2 -3 -1 3	11- 3 11- 1 10-29 11-15 11- 3
	5-317 5-383 5-728 5-729 5-731	31-00212 32-00380 31-00060	395850 395839 395819 395725 400739	745318 744249 744341 745914 744228	STATE OF NJ - TURNPIKE AUTH SYBRON CHEMICAL MOBILE ESTATES MAPLE SHADE WD INTERSTATE WASTE	4N-1 IONAC CHEM 2 FIELD PUMP MSWD 2 MONITOR 8	MOORESTOWN PEMBERTON PEMBERTON MOORESTOWN TRENTON EAST	1951 1960 1972  1978	45 30 55 20 93	192-222 490-521 485-500 91-121 118-128	-34 -31  2	-20 -31  4	-45 -38 -37 -26 2	-46 -42 -42 -36 3	-1 -4 -5 -10 1	11-15 10-29 10-28 11- 5 10-21
*	5-745 5-755 5-795 5-821 5-1077	27-05937 31-06840 31-09595 27-07360 28-12619	400157 395049 395239 400033 400426	744819 745338 745308 745131 744621	BURLINGTON COUNTY COUNTRY CLUB EVESHAM MUA MOUNT LAUREL MUA FEDERAL LAND BANK BURLINGTON COUNTY	CLUB 1R KGWC 1 MLWC 5 1 FLRNCE LND RCN/GM-38	BRISTOL CLEMENTON MOORESTOWN BRISTOL BRISTOL	1974 1973 1976 1983 1981	102 90 60 65 30	260-290 547-593 416-463 214-219 78-98	-18   	-17 -79 -96 -21	-21 -91 -97 -25 -11	-23 -91 -97 -25 -13	-2 0 0 0 -2	11-2 11-8 11-8 11-8 11-2
	5-1157 5-1159 5-1181 5-1183 5-1194	28-28845 28-15286 31-41329 28-28543 31-29146	400312 400350 395935 400333 395546	744333 744510 744653 744629 745343	COLUMBUS FARMERS MARKET HOMESTEAD WATER & TREATMENT ELIZABETHTOWN WC INTERSTATE STORAGE & PIPE CO RUDDEROW JOHN	COLUMBUS FM WTR TREATMENT PLANT PW 2 GREEN ST 3R INTERSTATE NEW 1991 RUDDEROW DOM ELBO LN	COLUMBUS BRISTOL MOUNT HOLLY BRISTOL MOORESTOWN	1992 1985 1993 1991 1989	45 50 19 75 70	251-266 165-205 313-343 200-220 300-310		  		-25 -9 -63 -16 -74		10-26 11-4 11-1 11-8 11-3
* '	7-3 7-13 7-15 7-18 7-15	31-02492 51-00032 31-06208 31-02079	395146 395221 394648 394738	750254 750636 745622 745614 745900	OWENS CORNING CO BELLMAWR BORO WD BERLIN WD BERLIN WD	CORNING 1 BBWD 1 BWD 11 BWD 9 CLUB 1	RUNNEMEDE RUNNEMEDE CLEMENTON CLEMENTON	1956 1952 1972 1955	60 31 150 145 70	285-315 111- 160 675-745 650-713	 -78 	-102 -46 -89 	-96 -44 -97 -95	-78 -39 -97 -98	18 5 0 -3	11-9 11-9 11-9 11-8
	7-117 7-131 7-143 7-149	31-04897 31-05096 31-03305	395229 395353 395441 395503	745712 745708 750104 750221	NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC STATE OF NJ - NATIONAL GUARD	HUTTON HILL 1 OBS OLD ORCHARD B ELLISBURG 16 1 COLUMBIA 24	CLEMENTON MOORESTOWN CAMDEN CAMDEN	1965 1967 1957 1956	158 71 40 15	552-562 342 187-220 96-111	-75 -74 -61 -52	-79 -79 -65 -54	-84 -83 -67 -59	-91 -86 -64 -53	-7 -3 3 6	11- 1 11- 2 11- 3 10-26
	7-102 7-242 7-249 7-252 7-274	31-02703 31-05581 31-05226	394712 394754 394759 395030	750220 750343 750158 750347	SOCIETY DIVINE GARDEN STATE WC GARDEN STATE WC NJ/AMERICAN WC	SAVIOR BLACKWOD DIV 3 BLACKWOD DIV 6 OTTERBROOK 39	RUNNEMEDE RUNNEMEDE RUNNEMEDE RUNNEMEDE	1901 1951 1956 1971 1968	107 65 75 60	492-512 426-447 407-477 269-349	-40  -73 -81	-76  -84 -87	-82 -86 -81 -81	-83 -86 -85 -86	-1 0 -4 -5	11-10 11-3 11-3 11-1
*	7-275 7-285 7-293 7-311	31-03375 31-03308 31-04986 31-04723	395231 395248 395416 394928	750312 750433 750336 750027	NJ/AMERICAN WC NJ/AMERICAN WC HADDON BOARD OF ED NJ/AMERICAN WC	HADDON 20 EGGBERT 18 HADDON TWP HS1 LAUREL 15	CAMDEN CAMDEN CAMDEN RUNNEMEDE	1958 1958 1966 1964	60 24 15 75	236-267 144-191 142-162 395-473	-77 -63 -56 -80	-78 -64 -57 -86	-79 -64 -57 -91	-72 -58 -55 -88	7 6 2 3	11-2 11-11 10-25 11-1
	7-316 7-322 7-392	31-05100 31-04283 31-04521	395134 395359 394641	750230 750445 745909	NJ/AMERICAN WC NJ/AMERICAN WC PINE HILL MUA	MAGNOLIA 33 OAKLYN TEST PHMUA 1	RUNNEMEDE CAMDEN CLEMENTON	1967 1961 1962	75 33 150	271-348 101-112 627-669	-52 -71	-53 -88	 -50 -96	-79 -46 -92	 4 4	11- 2 11- 1 11- 9
	7-404 7-410 7-422 7-477	31-03307 31-02360 31-03306 	395055 395041 395124 394215	750420 750056 745952 745617	NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC US GEOLOGICAL SURVEY	RUNNEMEDE 19 SOMERDALE 14 ASHLAND 17 NEW BROOKLYN PARK 2 OBS	RUNNEMEDE RUNNEMEDE CLEMENTON WILLIAMSTOWN	1958 1956 1957 1961	67 95 68 111	297-339 441 379-421 829-839	-78 -90 -87 -64	-83 -95 -91 -73	-82 -94 -107 -77	-75 -93 -112 -81	7 1 -5 -4	11- 1 11- 3 11- 3 11- 1
	7-521 7-573 7-727 15-1	31-12301  31-31110 31-02889	394742 395355 395455 393913	745931 750738 745924 750517	CLEMENTON WD US GEOLOGICAL SURVEY NJ/AMERICAN WC CLAYTON WD	CWD 10 COAST GUARD 2 RANOLDO TERR KINGSTON 62 CWD 3	CLEMENTON PHILADELPHIA MOORESTOWN PITMAN EAST	1978 1966 1989 1956	180 11 40 133	600-629 89 175-202 746-800	  -62	 -9  -69	-103 -9  -77	-104 -5 -70 -80	-1 4  -3	11- 9 11- 3 11- 4 11- 4
	15-3 15-28 15-60 15-63	31-06676 30-00432 31-02358 31-04176	394015 394755 394206 394308	750559 751327 750758 750702	CLAYTON WD EAST GREENWICH WD GLASSBORO WD GLASSBORO WD	4-1973 EGWD 2 GWD 3 GWD 4	PITMAN EAST WOODBURY PITMAN WEST PITMAN EAST	1973 1956 1955 1961	140 70 150 150	670-740 191-216 562-612 549-599	-63 -21 -60 -63	-23 -70 -65	-71 -23 -66 -64	-74 -27 -70 -67	-3 -4 -4 -3	11- 4 11- 3 11- 1 11- 4
	15-129 15-187 15-194	50-00049  31-05309	394409 394543 394732	751330 750746 751037	SOUTH JERSEY WC INVERSAND CO MANTUA TWP MUA	SJWC 1 #2 MTMUA 4	PITMAN WEST WOODBURY WOODBURY	1950 1956 1969	35 45 10	263 325-355 230-265	-25  -48	-30  -53	-31 -64 -51	-32 -56 -52	-1 8 -1	11-10 11- 2 11- 3
	15-227 15-240 15-248 15-253	31-04061 30-00973 51-00029 31-04741	394426 394510 394339 394437	750747 751838 750433 750249	PITMAN WD DEL MONTE CORP WASHINGTON TWP MUA WASHINGTON TWP MUA	PWD P3 9 WTMUA 5 6(FRIES MLS 1)	PITMAN WEST BRIDGEPORT PITMAN EAST PITMAN EAST	1960 1963 1973 1964	99 32 125 152	447-487 190-231 559-618 584-652	-60 -22 -63 -65	-64 -19 -68 -76	-71 -21 -80 -81	-68 -21 -73 -92	3 0 7 -11	11-10 11- 5 11- 3 11- 2
*	15-261 15-275 15-276	31-03913 31-00170 31-04567 31-03021	394520 394751 394821 304012	750218 750912 751026 751026	WASHINGTON TWP MUA WENONAH WD WEST DEPTFORD TWP WD	WTMUA 1 WWD 2 WDTWD 4 WDTWD 3	RUNNEMEDE WOODBURY WOODBURY WOODBURY	1959 1951 1963 1957	100 50 60	581-612 268-310 242-289 227 243	-72 -51 -39	-81 -53 -44	-85 -62 -46 37	-91 -63 -48	-6 -1 -2	11-2 11-5 11-3
	15-281 15-297 15-303	30-00903	394912 394942 395030 394858	751026 751317 751236 750845	HUNTSMAN POLYPROPYLENE CORP PENNWALT CORP WOODBURY HEIGHTS BORD	SHELL 6 OBS	WOODBURY WOODBURY WOODBURY	1957 1962 1969	21 10	84-114 190 235	-55 -11 -6	-40 -11 -8	-37 -11 -9	-38 -11 -8 47	-1 0 1 2	11- 3 11- 3 11- 2
*	15-332 15-339 15-345	51-00350 51-00100 30-01161 	395009 394350 394642	750922 751910 751823	WOODBURY WD GRASSO, J S MUSUMECI, PETER	PARKING LOT 3 1	WOODBURY WOODSTOWN BRIDGEPORT	1972 1946 1969 1954	40 50 90 62	190-233 148-188 247-267 94-100	-31 -19 -12	-45 -19 -12	-49 -38 -20 -12	-36 -21 -13	2 -1 -1	11- 3 11- 4 11-10 11- 4
*	15-346 15-355 15-378 15-379	30-01565 30-01426  31-06640	394529 394822 394523 394601	751340 751247 751610 751005	TOMARCHIO, ALFRED S EAST GREENWICH WD STATE OF NJ - TURNPIKE AUTH MANTUA TWP MUA	1 EGWD 3 MAINT 1 MTMUA 6	WOODBURY WOODBURY BRIDGEPORT WOODBURY	1977 1977  1973	80 42 100 145	267-343 205-245 98 368-398	-28 	-24 -30 	-29 -28 -26 -40	-35 -28 -21 -41	-6 0 5 -1	11-2 11-4 11-15 11-3
*	15-433 15-617 15-674 15-728	31-17801  30-01511 30-04549	394631 394637 395053 394808	750517 751916 751346 751724	WASHINGTON TWP MUA US GEOLOGICAL SURVEY ESSEX CHEMICAL CO OBS US GEOLOGICAL SURVEY	WTMUA 9 SHIVELER UPPER 1 STEFKA 4 OBS	RUNNEMEDE BRIDGEPORT WOODBURY BRIDGEPORT	1981 1985 1977 1987	135 30 9 4	512-552 60-70 21-41 46-56		-69  	-78  4 -7	-82 7 5 -7	-4 7 1 0	11- 3 11- 4 11- 2 11- 3
	15-741 15-779 15-1000	31-26239 31-21614	394652 395223 394646	751004 751117 750631	US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY ANGELINI, RAY	MANTUA SHALLOW OBS NATIONAL PK #11- OW-BU ANGELINI 1	WOODBURY WOODBURY RUNNEMEDE	1986 1987 1984	82 5 75	293-313 25-35 354-359			-46 -5 -71	-46 -1 -70	0 4 1	11- 3 11- 2 11-10
	15-1013 15-1031 21-18 21-19	31-21557 30-03412  28-05897	394351 394553 401558 401608	750611 751920 743003 743354	SCHULTES, RICHARD J MATLACK TRUCKING CAPAZELLO FARMS EAST WINDSOR MUA	SCHULTES 1 MATLACK TRUCKING MW-1B 1-IRR EWMUA 5	PITMAN EAST BRIDGEPORT HIGHTSTOWN HIGHTSTOWN	1985 1984 1941 1966	105 47 110 90	483-493 95-105 250 133-181	 52 71	 47 68	-65 -9 44 69	-75 -10 49 70	-10 -1 5 1	11- 5 11- 5 10-20 10-26
*	21-21 21-84 21-103 23-15 23-20	28-02937 48-00063 28-00801 48-00064 28-06292	401631 401622 401309 401842 401847	743246 743129 743702 743055 742900	MCGRAW HILL PUBLICATION HIGHTSTOWN WD SUBURBAN NATURAL GAS CRANBURY TWP WD CARTER WALLACE	MCGRAW HILL 1 HIGHTSTOWN 2 SUBURBAN 1 CTWD 2 CW 3A	HIGHTSTOWN HIGHTSTOWN ALLENTOWN HIGHTSTOWN JAMESBURG	1958 1947 1953 1917 1968	97 84 110 95 100	153-173 181-205 183-186 110 122-172	57 77 61 59	53 54 59 65	52 51 58 64	55 56 60 67 53	3 5 2 3	10-18 10-18 10-22 10-22 10-19
*	23-22 23-96 23-98 23-101 23-108	48-00001 28-07432 28-01426 28-07904 48-00194	401857 402236 402051 402030 402253	742908 742535 742604 742115 742247	CARTER WALLACE HELMETTA WC NJ/AMERICAN WC MOLDER FISH DUHERNAL WC	CW 9 6(4-R) JAMESBURG 6 1973 DUHERNAL 13	JAMESBURG NEW BRUNSWICK JAMESBURG FREEHOLD NEW BRUNSWICK	1951 1972 1954 1973 1947	120 40 50 50 25	209 32-42 99-120 211-223 87-107	59 38 47 17	52 37 44 	53 36 41 11	55 38 45 19 -15	2 2 4 8	10-19 10-20 10-25 10-25 10-19
	23-109 23-142 23-143 23-173		402302 402346 402347 402406	742256 741832 742038 741620	DUHERNAL WC OLD BRIDGE MUA DUHERNAL WC OLD BRIDGE BOARD OF ED	DUHERNL OBS 26 BROWNTOWN 1 DUHERNL OBS 2 IRA-71 BROWNTOWN ODS	NEW BRUNSWICK SOUTH AMBOY SOUTH AMBOY SOUTH AMBOY	1942  1938 1971	24 90 30 60	101 199-249 81-91 173-193	1 8  -4	-1 4 5 -7	-2 9 5 -8	-2 8 7 1	0 -1 2 9	10-19 10-18 10-19 10-21
÷.	23-174 23-180 23-182 23-205 23-228	29-03635  29-00022 28-04251	402407 402438 402449 402700 402015	741924 742129 741819 741454 742757	DUHERNAL WC BOWNE, CLYDE OLD BRIDGE MUA MONROE TWP MUA	DUHERNAL OBS 1 BROWNTOWN LAWRENCE HAR 8 FORSGATE 3 OBS	SOUTH AMBOY SOUTH AMBOY SOUTH AMBOY KEYPORT JAMESBURG	1961 1938 1932 1948 1961	45 19 31 60 147	57-67 66-71 193-213 128-138	4 17  66	4 15 -4 58	4 13 -5 55	5 16 -2 60	1 3 3 5	10-18 10-19 10-20 10-18 10-22
*	23-292 23-344 23-351 23-490	28-04250  28-08490	402109 402558 402605 401925	743012 742013 741959 742620	MONROE TWP MUA SAYREVILLE WD SAYREVILLE WD MONROE TWP MUA	FORSGATE 2 OBS SWD 2 OBS SWD 1 OBS 8-R POINTER TO	HIGHTSTOWN SOUTH AMBOY SOUTH AMBOY JAMESBURG	1961 1957  1974	107 22 35 167	93-104 31-37 76-82 287-325	72 15  51	71 13 43	71 14  48	72 17 20 47	1 3  -1	10-22 10-22 10-18
	23-508 23-557 23-1156 23-1159	26-04812 29-12379 29-19607	401801 402820 402225 402720 401047	743154 741629 741820 741950	DANSER, FRANK SOUTH AMBOY WD JOCAMA CONSTRUCTION CORP E I DUPONT GADDED WALLAGE	DOMEST-73 SAWD 9A JOCAMA BLDG 3 PM-8D	HIGHTSTOWN SOUTH AMBOY FREEHOLD SOUTH AMBOY	1973 1979 1982 1987	105 10 60 86	90 48-58 230-238 95-105	68  	65 4 	63 4 -4 	65 8 4 43	2 4 8 	10-20 10-20 10-21 10-21
	25-1198 25-13 25-37 25-45 25-56	29-07461 29-04068 29-03972 28-05400	401347 401137 401607 401810 401744	740121 741209 740957 742135	AVON WD HOMINY HILLS GOLF CLUB FLOCK AND SONS ENGLISHTOWN BORO WD	AWD 4 GLF CLB 2-1963 1 ENGLISHTOWN 2	ASBURY PARK MARLBORO MARLBORO FREEHOLD	1983 1974 1963 1963 1965	29 137 66 70	1,110-1170 686-706 649-677 363-384	-16 -30 -31 9	-27 -35 -39 1	-29 -30 -40 18	-15 -14 -16 16	14 16 24 -2	10-19 10-18 10-27 10-25 10-20
	25-62 25-91 25-97 25-103	29-03492 29-05708 29-04708 29-07494	401134 401516 401625 401646	741014 741530 741501 741737	ROKEACH AND SONS CO BROCKWAY GLASS FREEHOLD TWP WD FREEHOLD TWP WD	4-DEEP BROCKWAY 2 6-OLD SO.GULF2 7-74	FARMINGDALE FREEHOLD FREEHOLD FREEHOLD	1961 1969 1966 1974	80 140 195	831-885 632-685 596-656 478-575	-25 -38 -42 -53	-34 -47 -47 -36	-31 -34 -38 -39	-11 -13 -19 -6	20 21 19 33	10-22 10-22 10-20
	25-112 25-117 25-121 25-154	29-03096 49-00005 29-03033 29-04207	402537 402401 402023 402445	740933 735920 741100 741019	SHORELANDS WC HIGHLANDS WD PENNWALT CORP SHORELANDS WC	W KEANSBURG 2 HWD 4 1 (PENNWALT) W KEANSBURG 3	KEYPORI SANDY HOOK MARLBORO KEYPORT	1960 1973 1960 1964	44 20 80 73	312-352 630-680 560-590 400-430	-40  -26 -39	-35 -33 -35	-39 -11 -35 -38	-13 -1 -15 -12	26 10 20 26	10-19 10-19 10-25 10-19
	25-177 25-195 25-197 25-206	29-05691 29-01297 29-08379	401255 402621 402535 402625	741147 740743 741214 741145	SCHROTH, EMIL A KEANSBURG MUA KEYPORT BORO WD KEYPORT BORO WD	SCHROTH KWD 5A KEYPORT 7 KEYPORT 4 OBS	FARMINGDALE KEYPORT KEYPORT KEYPORT	1969 1954 1976 1939	87 15 35 14	781-801 290-350 304-354 225-249	-24  -14	-27 -35 -26 -15	-36 -32 -25 -17	-14 -21 -10 -3	22 11 15 14	10-21 10-18 10-20 10-19
	25-220 25-244 25-259	28-06114 29-05790 29-00073	401537 401848 402035	742012 741504 741423	BATTLEGROUND COUNTRY CLUB GORDONS CORNERS WC MARLBORO STATE HOSPITAL	IRRIGATION GORDONS 7 STATE HOSP 12	FREEHOLD FREEHOLD MARLBORO	1967 1969 1950	120 160 155	539-569 524-594 508-593	-21 -47 -18	-29 -43 -26	-29 -48 -27	-10 -20 -5	19 28 22	10-21 10-22 10-25
	25-282 25-284 25-288	29-08486 29-01731 29-05351	402507 402515 402349	741344 741450 741232	BAYSHORE SEWER AUTH MATAWAN BORO WD ABERDEEN TWP MUA	BAYSHORE 1 MATAWAN BORO 3 MATAWAN MUA 3	KEYPORT KEYPORT KEYPORT	1976 1956 1967	10 90 83	245-260 231-271 345-425	-13  -31	-13 	-13 -36	-1 4 -11	12  25	10-19 10-18 10-28
	25-303 25-316 25-321 25-322 25-322	29-05164 29-04299  28-01842 20.01922	402106 402536 402706 401157 401214	740810 735905 735952 742418 740255	BAMM HOLLOW COUNTRY CLUB STATE OF NJ NATIONAL PARK SERVICE RESTINE, P J NUAMERICAN WC	BHCC 1 SANDY HOOK SP1 OBS FT HANCOCK 4 RESTINE 1 IMMING PD 5	MARLBORO SANDY HOOK SANDY HOOK ROOSEVELT ASPLIPY DAPK	1966 1965 1941 1956	70 11 5 210 25	527-600 371-397 332-486 667-697	 -5 -4 4	 -4 -3 -2 23	-61 -9 -3 -4	-19 -2 -2 7	42 7 1 11 24	11-11 10-19 10-19 10-25
	25-353 25-351 25-358 25-362	29-01922  29-00079 28-02219	401214 401323 402047 401312	740333 740156 740420 742802	NJ/AMERICAN WC RED BANK WD ROOSEVELT WD	WHITESVILLE 1B-1950/RB 4 ROOSEVELT 3	ASBURY PARK LONG BRANCH ROOSEVELT	 1950 1956	18 40 198	777 637-687 442-472	-22 -29 28	-38 -38 -33 30	-41 -40 -37 28	-17 -26 -19 39	14 18 11	10-28 10-28 10-20
	25-434 25-436 25-459	29-05218 29-06193 29-09335	400926 400952 402219	740749 740725 740337	STATE OF NJ BRISBANE CHILD TREATMENT CTR NAVESINK, C C	ALLAIRE S P 3 1 (OLD 3-1971)	FARMINGDALE ASBURY PARK	1950 1967 1971 1978	50 60 80	1,000-1,030 990-1,030 551-612	-31 -26 -23	-42 -41 -24	-45 -43	-12 -17 -15	33 26	10-20 10-22 10-19
*	25-462 25-493 25-513 25-514	29-05558 29-07784 29-11230 29-12732	402717 401231 402442 402641	740816 741127 740242 740911	KEANSBURG AMUSEMENTS HOWELL TWP MUA ATLANTIC HIGHLAND WD INTERNATIONAL FLAVOR FRAGRANCE	1-69 1-1975/YELLOW BRK WELL AHWD 5 IFF-2R	KEYPORT FARMINGDALE SANDY HOOK KEYPORT	1969 1975 1981 1983	10 115 20 14	200-250 860 506-548 266-312	-13	-16 -35 	-15 -38 	-7 -17 -8 -15	8 21 	10-18 10-21 10-19 10-19
*	25-550 25-567 25-568	29-13610 29-15851 29-16343	401258 402630 402652	741629 741029 741100	FREEHOLD TWP WD OBS US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY	9 UB WATER TOWER JCP&L	ADELPHIA KEYPORT KEYPORT	1984 1986 1986	105 10 10	636-656 250-270 245-265			-39 -23 -12	-12 -9 -2	27 14 10	10-20 10-19 10-20
*	25-639 25-705 25-724 25-726	29-18403 28-14142 29-17817 29-24702	401105 401518 401913 401420	741202 742227 741513 741607	US GEOLOGICAL SURVEY MANALAPAN TWP WD GORDONS CORNERS WC FREEHOLD TWP WD	HOWELL TWP5 OBS MANALAPAN 2 GCWC 9-A RIVER RD KOFNIG LANE T DLANT 12	FARMINGDALE FREEHOLD FREEHOLD ADEI DULA	1988 1984 1987	112 120 140	891-901 505-636 446-551 584 672			-37 -76	-16 -69 -21	21 7 	10-21 10-22 10-22
	25-729 29-70 29-100	29-24703 29-21611 33-01159 33-00360	401904 395905 395956	740702 740359 740344	NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC	SWIMMING R RES TP 2 MONTEREY 1 NORMANDY 3	LONG BRANCH SEASIDE PARK SEASIDE PARK	 1967 1954	35 5 8	575-655 1,370-1,490 1,430-1,480	 -21 -18	 -28 -27	 -26 -24	-17 -22 -21	 4 3	10-28 10-25 10-25
	29-134 29-238 29-504 29-531	29-03570 28-08229 29-03142 29-03345	400329 400824 400210 400454	741947 742630 740310 740414	JACKSON TWP MUA JACKSON TWP MUA NJ/AMERICAN WC POINT PLEASANT WD	SCM 1 JACKSON 7 MANTOLOKING 7 PPWD 5	LAKEHURST ROOSEVELT POINT PLEASANT POINT PLEASANT	1961 1974 1960 1960	95 130 5 18	846-962 584-648 1,260-1,370 1,260-1,340	-24 -10 -18 -19	-28 -4 -27 -33	-31 -8 -25 -29	-33 -5 -18 -18	-2 3 7 11	10-26 10-22 10-25 10-28
	29-577 33-74 33-76	33-05553 30-01151 30-00661	395741 394241 394328	740437 752201 752446	LAVALLETTE WD OLDMANS TWP WD DAWSON, H W LOVELAND WL S C	LWD 5 1 (AUBURN W C) DAWSON 1	SEASIDE PARK WOODSTOWN PENNS GROVE	1978 1968 1957	7 80 27	1,390-1,500 185-206 118-123	  	-22  0	-20 -13 2	-20 -13 1	0 -1	10-25 11-11 11- 8
	33-105 33-111 33-253 33-242	30-01253	393458 393746 393348	752945 752955 752755	LOVELAND III, S C PENNSVILLE TWP WD US GEOLOGICAL SURVEY STATE OF NI	DILWOKTH/LOVELAND (NEW) HOOK RD OBS SALEM 3 OBS PENNS GROVE 24	SALEM PENNS GROVE SALEM	1950 1971 1965	10 10 3	263 190-235 335-340 46 51	-14 -22	-22 -15 -23	-26 -17 -27	-26 -19 -28	0 -2 -1	11- 9 11- 9 11-12
*	33-348 33-355 33-361 33-671	  30-01815 30-05148	394317 393914 394205 393954	752619 751930 752700 753013	STATE OF NJ WOODSTOWN ICE CO PENNS GROVE WATER SUPPLY CO PENNSVILLE TWP WD	PENNS GROVE 14 OBS C1 SCHULTES 4 PTWD 3A	PENNS GROVE WOODSTOWN PENNS GROVE WILMINGTON SO	1940 1927 1978 1988	18 25 58 13 7	18 360 44-54 87-102	9 -29 -9	-22 -8	-1 -24 -9 -5	-1 18 -17 -6 -3	 7 3 2	11-10 11-10 11- 9
	33-686 Jd25-09 Eb23-22 Gd33-05	30-08335 Jd25-09 Eb23-22 Gd33-05	393749 393450 393316 392212	753149 753842 754216 753243	PENNSVILLE TWP WD TEXACO US GEOLOGICAL SURVEY (DEL) DELAWARE GEOLOGICAL SURVEY	PTWD 4A RPL TEXACO #3A LUMS POND A OBS DEAKNEVILLE #5 OBS	WILMINGTON SO SAINT GEORGES SAINT GEORGES SMYRNA	1992  	10 57 60 18	110-130 114-156 101-105 627-660	  		7  -8	-10 -9 33 -11	2  -3	11-9 11-19 11-2 11-19

 $40^{\circ}$ 

30'

#### PREPARED IN COOPERATION WITH THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

74°30'

23-29

23-229

<sup>23-552</sup> 88 80

Somerville

 $74^{\circ}$ 

Raritan Bay

Eatontow

**X**25-272

25-268

### WATER-RESOURCES INVESTIGATIONS REPORT 96-4206

Middle and undifferentiated Potomac-Raritan-Magothy aquifer - SHEET 7 OF 8 Lacombe, P.L., and Rosman, Robert, 1997, Water levels in, extent of freshwater in, and water withdrawal from eight major confined aquifers, New Jersey Coastal Plain, 1993

75<sup>°</sup>30'

#### Middle and Undifferentiated Potomac-Raritan-Magothy Aquifer

#### Water withdrawal and extent of freshwater

Water withdrawal in the Middle and undifferentiated Potomac-Raritan-Magothy aquifer increased from about 84 Mgal/d in 1978 to 88 Mgal/d in 1994 (fig. 7-1). The four major withdrawal centers are (1) southern Middlesex-northern Monmouth County area, (2) southern Monmouth-northern Ocean County area, (3) Burlington-Camden-Gloucester County area, and (4) Salem and New Castle County area (fig. 7-2). Water withdrawal in the two northern withdrawal areas decreased from about 32 Mgal/d to 20 Mgal/d during 1978-94. Water withdrawal in the two southern New Jersey areas increased from about 53 to 66 Mgal/d during 1978-94. The location of the 250-mg/L isochlor (fig. 7-3) is modified from Pucci and others (1994), Schaefer (1983), and Gill and Farlekas (1976). The location of the 10,000-mg/L isochlor was estimated by use of the saltwater model of the aquifers of the New Jersey Coastal Plain (D.A. Pope and A.D. Gordon, U.S. Geological Survey, written commun., 1993). This is the simulated location of water that is about one-half freshwater and one-half seawater.

#### Water Levels

Water-level measurements for 156 wells screened in the Middle and undifferentiated Potomac-Raritan-Magothy aquifer are listed in table 7-1 (reverse side of sheet 7). The water levels in these wells were used to define the 1993 potentiometric surface shown in figure 7-3. Maps of simulated water levels by Martin (in press, fig. 43) and A.D. Gordon (U.S. Geological Survey written commun., 1992) were adapted to close the contours in the eastern part of the study area. The water-level map shows a regional, elongated cone of depression in the Coastal Plain in which water levels are below sea level. The regional cone of depression extends from Raritan Bay to New Castle County, Del., and can be divided, from north to south, into four subregional cones of depression: (1) Middlesex-western Monmouth County area, minimum water-level altitude about -30 ft; (2) southern Monmouthnorthern Ocean County area, minimum water-level altitude about 45 ft; (3) Burlington-northern Gloucester County area with a local cone of depression north of Browns Mills, minimum water-level altitude about -63 ft and a larger local cone of depression in central Camden County, minimum water-level altitude about -90 ft; and (4) Salem-New Castle County area, minimum water-level altitude -75 ft. The maximum water-level altitude measured during the 1993 synoptic study was +88 ft in well 23-552 north of Hightstown.

The water level in well 11-137 was converted from a measured altitude of -53 ft to a freshwater equivalent altitude of -37 ft because salty water in the well has a density of 1.011 grams per cubic centimeter (table

Water-level changes during 1988-93 were calculated for 140 wells. Water levels declined 1 to 13 ft in 33

remained static during 1985-94. Hydrographs for well 23-439 and 25-272 show increasing water levels during 1980-83, decreasing water levels during 1983-90, and increasing water levels during 1991-94. The increase was greatest after mid-1990, when the Manasquan Reservoir began supplying surface water and the water users decreased withdrawals from this and other confined aquifers. The water-level hydrographs from nine observation wells in the southern counties (Salem, Gloucester, Camden, and Burlington) show annual and seasonal fluctuations that reflect the response of the potentiometric surface to ground-water withdrawals and recovery (fig. 7-5). Water levels in most of the observation wells declined during 1978-94 except for well 5-101 in which water levels were static. Hydrographs for the wells in the southern counties show water-level declines of about 5 to 15 ft during 1978-88 and declines of 1 to 3 ft during 1988-94. The SOMERSET

 $75^{\circ}$ 

seasonal water-level fluctuations were greatest in wells 7-413 and 5-261 and ranged from 3 to 15 ft/yr. These wells are near the center of the cone of depression and distant from the outcrop/recharge area. Water levels in well 33-251 declined during 1978-94 but did not fluctuate annually because the well is far from the cone of depression. Water-level hydrographs for six observation wells in the undifferentiated part of the Potomac-Raritan-Magothy aquifer system show annual and seasonal fluctuation in the downdip part of the aquifer system (fig. 7-6). Water levels in this part of the aquifer system in the northern part of the Coastal Plain declined during 1978-87, then rose during 1988-94. This trend is similar to the trend of water levels for the Middle Potomac-Raritan-Magothy aquifer in the northern counties. Water levels in the southern Coastal Plain (fig. 7-5) reflect the general decline in water levels that also occurred in the Middle Potomac-Raritan-Magothy aquifer in the region. The center of the cone of depression in the northern Middlesex-western Monmouth County area is about 80 ft shallower in 1993 than it was in 1988. The most obvious difference is that the -80-, -60-, and -40-ft contours are absent and the -20-ft contour is present only in the Keyport and South Amboy areas. The center of the cone in the southeastern Monmouth-northern Ocean County area is about 20 ft shallower. The -60-ft contour line is absent, and

the -40-ft contour encircles only well 29-47. The cone of depression in the greater Camden County area is more elongated in 1993 than it was in 1988. The -60-ft contour is more elongated and encompasses much of central Gloucester County. The -80-ft contour encompasses a larger area. The Salem-New Castle County area cone of depression has remained in virtually the same configuration, except that the local cone of depression near the Salem Power plant may have expanded and nceton) become deeper.

In summary, water levels in the Middle and undifferentiated Potomac-Raritan-Magothy aquifer rose in the northern Coastal Plain as a result of decreased ground-water withdrawals. Water levels in the southern Coastal Plain declined during 1988-93 but to a much smaller extent than during the previous 5 years.







Figure 7-4. Water-level hydrographs for observation wells screened in the Middle Potomac-Raritan-Magothy aquifer in northern counties of the New Jersey Coastal Plain, 1978-94.









aquifer in southern counties of the New Jersey Coastal Plain, 1978-94.



Figure 7-6. Water-level hydrographs for observation wells screened in the undifferentiated part of the Potomac-Raritan-Magothy aquifer system in the New Jersey Coastal Plain, 1978-94.

#### Table 7-1. Water-level data for wells screened in the Middle and undifferentiated Potomac-Raritan-Magothy aquifer, 1978-93

# [Well depth given if screen interval is unknown; \*, well not shown in figure 7-3; --, data not available; #, well in the undifferentiated part of the Potomac-Raritan-Magothy aquifer system; ft, feet; BORO, Borough; MUA, Municipal Utilities Authority; WD, Water Department; TWP, Township; WC, Water Company; NJ, New Jersey; DEL, Delware; CO, Company; CORP, Corporation; DEPT, Department; DEP, Department of Environmental Protection; SERV, Service; WMC, Water Commission]

	Well number	Permit	Lati- tude <sup>1</sup>	Longi- tude <sup>1</sup>	Owner	Local well	USGS Quadrangle	Year drilled	Land- surface altitude <sup>2</sup>	Screen interval <sup>3</sup>	W 1978	ater-leve	<u>el altitua</u> 1988	<u>le<sup>2</sup></u> 1993	1988-93 Water- level change	Date in 1993
	5-48 5-63		400800 400213	744309 745108	STATE OF NJ - DEFENSE DEPT WILLINGBORO MUA	NAT GUARD 1 WILLINGBORO 1 OBS	TRENTON EAST BRISTOL	1952 1965	(ft) 83 45	(ft) 230 284-294	(ft) 2 -16	(ft) 4 -16	(ft) 0 -21	(ft) 4 -21	(ft) 4 0	10-21 10-29
	5-84 5-87 5-101	27-03694	400342 400407 400543	744948 745246 744948	MASONIC HOME TENNECO CHEMICALS HERCULES POWDER	MASONIC 1 TENNECO 5-OBS HERCULES 3 OBS	BRISTOL BEVERLY BRISTOL	1921 1961 1945	60 14 19	174-194 50-60 94-104	8  1	-10 -8 2	-16 -13 2	-14 -9 5	2 4 3	11- 4 10-25 11- 3
*	5-114 5-122 5-126 5-127 5-145	28-02901 28-05042 31-04276 31-04697 27 02821	400606 400941 395929 395938 400110	743923 744017 745922 745810 745713	DEMARCO, RALPH STATE OF NJ - REFORMATORY NJ/AMERICAN WC NJ/AMERICAN WC HOLY, CROSS HIGH SCHOOL	DEMARCO NJSR 5 DVWC 12-POMONA RIVERTON 14 HIGH SCHOOL	COLUMBUS TRENTON EAST MOORESTOWN MOORESTOWN BEVEDLY	1958 1964 1961 1964 1958	85 75 73 35 70	388-392 337-367 157-196 179-229 154-174	-7 4 -8 -13 2	-8 0 -17 -17	-12 -1 -16 -20 3	-13 -4 -16 -21 2	-1 -3 0 -1	10-22 10-27 11- 5 11- 5 10-28
*	5-147 5-182 5-206	27-02321 27-05202 27-04411 28-03595	400110 400126 400722 400325	745647 744918 744456	NJ/AMERICAN WC GRIFFIN PIPE CO CARTY, RONALD	FAIRVIEW ST GRIFFIN A RALPH PARKER	BEVERLY BRISTOL COLUMBUS	1958 1970 1964 1959	83 26 62	180-235 92-113 370-380	-1  -24	1  -25	-2 -7 -23	1 6 -29	3 13 -6	11-5 11-4 11-2
	5-214 5-232 5-261	31-06020	400531 395727 395525	744430 745915 745025	WALDER, THOMAS MAPLE SHADE WD US GEOLOGICAL SURVEY	1 MSWD 8 MEDFORD 5 OBS	COLUMBUS MOORESTOWN MOUNT HOLLY	1972 1967	60 20 73	319 210-270 740-750	-10 -29 -48	-35 -58	-13 -33 -61	-12 -35 -62	1 -2 -1	11- 8 11- 5 10-29
*	5-268 5-273 5-290 5-297	31-04770 31-06674 31-01610	395751 395835 395936 395525	745832 745643 744655 745416	MARLAC ELECTRONICS MOORESTOWN FIELD CLUB MOUNT HOLLY WC RUDDEROW, J E	LAYNE 1 FIELD CLUB 1 MHWC 6 SPRING VALLEY	MOORESTOWN MOORESTOWN MOUNT HOLLY MOORESTOWN	1960 1964 1973 1954	70 70 15 48	288 274-302 545-615 441-457	-30 -27 -55 	-35 -29 -57	-39 -32 -63 -71	-38 -33 -60 -69	1 -1 3 2	11- 3 11- 3 11- 3 11- 1
#* #	5-304 5-330 5-332 5-336	31-04793 52-0008 48-00269 28-00795	395608 395949 400106 400150	745644 743655 743720 743428	MOUNT LAUREL MUA US ARMY US ARMY US AIR FORCE	MLWC 2 FORT DIX 4 FORT DIX 5 MCGUIRE C	MOORESTOWN BROWNS MILLS NEW EGYPT NEW EGYPT	1965 1943 1969 1953	20 140 150 102	362-399 1,060-1,090 1,060-1,100 1,040-1,090	-54 -49 -39	-63 -51 -42	-64 -65 -52 -58	-68 -65 -51 -63	-4 0 1 -5	11- 1 10-28 10-28 10-27
#	5-340 5-385 5-388 5-436	28-03943 32-03778 52-00009	400300 395839 395939 400118	743514 744249 743742 744010	US AIR FORCE SYBRON CHEMICAL US ARMY HELIS, WM G	MCGUIRE B IONAC CHEM 5 FORT DIX 6 STOCK FARM 1	NEW EGYPT PEMBERTON PEMBERTON COLUMBUS	1960 1977 1970 1928	130 30 160 96	747-823 1,090-1,140 757-800	-32 -42	-30 -52 -47	-34 -61 -62 -51	-32 -70 -50 -42	-9 12 9	10-27 10-29 10-28 10-22
*	5-440 5-634 5-637	28-05128 47-00001 27-04710 27 03066	400242 400041 400107 400122	744223 744809 745058 745308	RHODIA CORP MOUNT HOLLY WC CAMPBELL SOUP CO WILLINGROPO MUA	RHODIA 1 OBS MHWC 5 RANCOCAS #1	COLUMBUS BRISTOL BRISTOL BEVEDI V	1964 1965 1966	72 55 50	603-613 516 316-336	-29 -56	-29 -58 	-36 -60	-35 -64 -33	1 -4 	10-26 11-3 11-4
#	5-667 5-683 5-726	27-03000 27-02723  28-08443	400122 400250 395122 400213	745308 745321 743017 743653	WILLINGBORO MUA US GEOLOGICAL SURVEY WRIGHTSTOWN MUA	WMUA 5 BUTLER PLACE 1 OBS WMUA 3	BEVERLY BEVERLY CHATSWORTH NEW EGYPT	1959 1958 1964 1974	39 141 140	230-256 2,100-2,120 692-726	-11 -30 	-22 -16 -34 	-17 -42 -41	-22 -39 -36	-5 3 5	10-29 10-29 10-26 10-25
*	5-749 5-751 5-801 5-1089 5-1158	31-07140 31-07139 27-06877 27-08534 28-28844	395508 395546 400020 400201 400316	745539 745622 750114 745307 744334	RAMBLEWOOD COUNTRY CLUB RAMBLEWOOD COUNTRY CLUB TEXACO CO WILLINGBORO MUA COLUMBUS FARMERS MARKET	3 TEE 2 TEE OW 10 WMUA 10 COLUMBUS EM 1992 DEEP	MOORESTOWN MOORESTOWN FRANKFORD BEVERLY COLUMBUS	 1980 1986 1992	75 20 20 19 45	425 325 5-25 176-250 450-460	-60 -55 	-69 -64 0 	-75 -69 -1 	-73 -58 -4 -25 -28	2 11 -3 	11- 1 11- 1 10-26 10-29 10-25
	5-1184 7-48 7-124	27-12174 31-00013 31-07020	400701 395527 395252	744833 750646 745943	FLORENCE TWP WD CAMDEN CITY WD NJ/AMERICAN WC	FTWD OBS 1 CITY 6N BROWNING 45	BRISTOL CAMDEN MOORESTOWN	1992 1948 1973	30 14 77	110-120 111-135 483-626	-26 -77	-26 -84	-20 -92	2 -18 -85	2 7	11- 4 11- 1 11- 4
*	7-135 7-142 7-186 7-284	31-05218 31-04098	395353 395438 394950 395247	745708 750107 745855 750432	NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC	OLD ORCHARD 38 ELLISBURG 23 GIBBSBORO OB 3 EGGBERT 35	MOORESTOWN CAMDEN CLEMENTON CAMDEN	1968 1960 1969 1967	72 32 70 22	443-493 321-378 680 484	  -77	  -84	-73 -66 -88 -74	-81 -64 -89 -69	-8 2 -1 5	11- 3 11- 3 11- 4 11- 4
	7-304 7-329 7-413	31-05108 31-04836 31-04561	395404 395628 394922	750202 750406 745630	HADDONFIELD WD MERCANTVILLE PENNSAUKEN WCM NJ/AMERICAN WC	LAKE ST WELL BROWNING 2A/BROWNING 1 ELM TREE 3 OBS	CAMDEN CAMDEN CLEMENTON	1967 1965 1963	50 16 149	307-372 110-140 706-717	-36 -69	-31 -78	-72 -34 -82	-75 -29 -85	-3 5 -3	10-26 10-27 11- 1
#	7-476 7-534 7-564 7-726 7-733	  31-31111 31-40817	394215 395553 395712 395455 395127	745617 750207 750612 745924 750233	US GEOLOGICAL SURVEY GARDEN STATE RACE TRACK STATE OF NJ - DEP NJ/AMERICAN WC NJ/AMERICAN WC	NEW BROOKLYN PARK 1 OBS 2 HARRISON 4 RANOLDO TERR KINGSTON 59 HIGHLAND & WALNUT OW-64	WILLIAMSTOWN CAMDEN CAMDEN MOORESTOWN RUNNEMEDE	1960  1980 1989 1993	111 40 15 40 75	1,490-1,500  15-35 276-422 452-535	-46   	-53 -48 -12 	-57 -49 -12 	-58 -45 -5 -70 -82	-1 4 7 	11- 1 11- 1 10-28 11- 4 11- 1
#	11-137 11-221	35-14298	392514 393124	745217 745527	DE ROSA, SAM BUENA BORO MUA	RAGOVIN 2100 OBS (freshwater equivalent heads) SEWER PLANT INJ 1	DOROTHY BUENA	1964 1993	85 100	2,080-2,090 1,530-1,980	-37 -16	-43 -22	-49 -28	-53 -31 -37	-4 -3 	11- 9 12-9
*	15-24 15-135 15-140	31-05513 30-01314 30-01248	395115 394516 394608 394947	750706 752241 752135 751416	DEPTFORD TWP MUA SHELL OIL CO OBS WELL PURELAND WC PAUL SBORO WD	DIMUA 4 8A TEST WELL 4 PWD 5	RUNNEMEDE MARCUS HOOK BRIDGEPORT WOODBURY	1971 1972 1970	40 7 6	282-345 130-180 132-184	-48  -10	-50 4 1 -10	-46 3 -2	-39 -2 -11	-5 -9 0	11-10 11-9 11-9
	15-236 15-279 15-348 15-359	30-01177 30-00916 30-01776	394434 394857 394910 395015	751843 751250 751541 751727	SWEDESBORO WD HUNTSMAN POLYPROPYLENE CORP GREENWICH TWP WD E I DUPONT	SBWD 3 SHELL OBS7 GTWD 6 C POWER 22	WOODSTOWN WOODBURY BRIDGEPORT BRIDGEPORT	1969 1962 1978 	75 17 20 5	241-312 315-320 105-135 103	-21  -9 1	-20 -24 -10 2	-22 -26 -11 0	-12 -26 -10 0	10 0 1 0	11-10 11- 8 11- 5 11-10
*	15-374 15-415 15-431 15-450 15-569	31-13385 31-14478 33-07973 30-02026 30-02405	394843 394834 395034 394750 394529	750728 751044 750842 752331 752045	DEPTFORD TWP MUA WEST DEPTFORD TWP WD WOODBURY WD MONSANTO CHEMICALS PURELAND WC	DTMUA 6 TEST 8-79 RED BANK 6 10D PWC 3	RUNNEMEDE WOODBURY WOODBURY MARCUS HOOK BRIDGEPORT	1979 1979 1980 1979 1981	50 40 30 13 32	430-486 287-307 211-305 60-65 161-201		-65 -42 -46 	-63 -39  -12	-63 -42 -39 -12 -9	0 -3  3	11-10 11-3 11-3 11-5
*	15-585 15-586 15-616 15-620 15-679	30-02522 30-02539  30-03677 30-03624	394704 394720 394637 394804 394946	752058 752052 751916 751933 751612	ROLLINS ENVIRONMENTAL SERV ROLLINS ENVIRONMENTAL SERV US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY MOBIL OIL CO	DP5 DP4 SHIVELER MIDDLE GAVENTA MIDDLE 1 W-5D	BRIDGEPORT BRIDGEPORT BRIDGEPORT BRIDGEPORT BRIDGEPORT	1981 1981 1985 1985 1985	8 12 31 7 10	79-89 95-125 230-240 131-141 118-128	  	  	-1 2 -8 2 -3	1 -8 5 -7	2 0 0 3 -4	11- 9 11- 9 11- 5 11-11 11- 9
*	15-713 15-727 15-771 15-780 15-1036	30-04348 30-04548 31-26243 31-26244 31-22504	394808 394808 395202 395223 394733	751724 751724 751115 751117 750812	US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY DEPTFORD TWP MUA	STEFKA 2 OBS STEFKA 3 OBS NATIONAL PARK #2-PW-M NATIONAL PK #10-OW-BM DTMUA 7	BRIDGEPORT BRIDGEPORT WOODBURY WOODBURY WOODBURY	1986 1987 1987 1987 1985	6 5 10 5 60	125-155 194-204 92-123 75-85 259-319	  	  	-8 -8 -6 1	-7 -8 -3 -5 -63	1 0 3 -6 	11- 3 11- 3 11- 1 11- 2 11- 1
*	21-12 21-22 21-25 21-26 21-43	28-07034 28-05440  28-04935 28-05409	401536 401702 401717 401725 401103	742920 743106 743352 743159 744155	EAST WINDSOR MUA EAST WINDSOR MUA CARTER WALLACE EAST WINDSOR MUA BORDENTOWN WD	6 TWIN RIVERS EWMUA 3 KENTILE 1 EWMUA 2 WHITE HORSE 2	JAMESBURG HIGHTSTOWN HIGHTSTOWN HIGHTSTOWN TRENTON EAST	1971 1965 1954 1964 1965	115 100 100 100 10	520-560 337-367 205-226 260-290 118-138	28 47 65  -4	27 42 64 72 6	23 32 67 65 8	25 38 64 70 8	2 6 -3 5 0	10-26 10-26 10-19 10-26 10-22
	21-54 21-73 21-92 21-101	28-04602 28-02927 28-04078 28-06030	401305 401419 401152 401238	743921 744007 744528 743448	GARDEN STATE WC GARDEN STATE WC CHAMPALE PRINCETON MEMORIAL PARK	ROBERT FROST 10 PAXSON AVE 9 YARD WELL MEMORIAL PK1	TRENTON EAST TRENTON EAST TRENTON WEST ALLENTOWN	1962 1958 1961 1966	85 80 27 135	194-243 128-144 70-80 366-421	 -1 30	 2 36	38 42 3 35	40 47 2 38	2 5 -1 3	10-22 10-22 11- 3 10-22
	23-9 23-16 23-57 23-70	28-00180 28-07800 28-01202	401800 401842 402441 402555	743206 743055 742448 742719	DANSER, FRANK CRANBURY TWP WD EAST BRUNSWICK TWP WD WEISS, ABE	IKK-1950 CTWD 1A COLONIAL OAKS FISCHER OBS	HIGHTSTOWN HIGHTSTOWN NEW BRUNSWICK NEW BRUNSWICK	1950 1972 1954 1936	95 122 73	230-260 216-241 0-21	66 -28 57	67 61 -21 56	64 58 -20 56	67 62 10 57	3 4 30 1	10-20 10-22 10-22 10-21
*	23-97 23-106 23-114		402247 402251 402319	742503 742248 742246 742126	DUHERNAL WC DUHERNAL WC DUHERNAL WC	DUHRNL OBS 49F DUHRNL OBS 32 DUHRNL OBS 52F	NEW BRUNSWICK NEW BRUNSWICK NEW BRUNSWICK	1946 1944 1945	39 27 26	236-301 132 225-237	2  -33	2  -30	6  -30	29 4 4	23  34	10-19 10-19 10-19
*	23-132 23-147 23-171 23-176	29-04998 48-00208 29-06429	402353 402350 402404 402407	742130 741840 742204 741924	OLD BRIDGE MUA DUHERNAL WC OLD BRIDGE MUA OBS	BROWNTOWN 4 DUHERNAL BF 1-1972	SOUTH AMBOY SOUTH AMBOY SOUTH AMBOY SOUTH AMBOY	1947 1966 1946 1972	80 20 45	425-475 240-300 321-363	-44 -53 -61	-38 -79 -44 -53	-50 -65 -44 -66	-3 -16 -8 -14	33 49 36 52	10-19 10-18 10-19 10-18
*	23-179 23-194 23-206 23-229 23-240	29-06430  29-00768 28-04252 28-04090	402436 402536 402700 402015 402051	742041 742018 741454 742757 742746	OLD BRIDGE MUA OBS PERTH AMBOY WD OLD BRIDGE MUA MONROE TWP MUA MONROE TWP MUA	2-1972 RUNYON 1 OBS LAWRENCE HAR 9 FORSGATE 4 OBS 12-1961	SOUTH AMBOY SOUTH AMBOY KEYPORT JAMESBURG JAMESBURG	1972 1930 1953 1961 1961	10 18 60 147 140	250-292 201-281 360-395 319-330 305-353	-61 -76 -75 58 58	-50 -46 -78 51 46	-62 -59 -86 48 40	-12 -8 -31 55 49	50 51 55 7 9	10-18 10-22 10-18 10-22 10-18
	23-273 23-291 23-306 23-329	28-04249 28-06538 28-09567	401932 402109 402147 402315	743529 743013 742847 742652	STATE OF NJ MONROE TWP MUA PHELPS DODGE CO DEY BROTHERS	PLAINSBORO POND OBS FORSGATE 1 OBS PHELPS DODGE 3 2	HIGHTSTOWN HIGHTSTOWN JAMESBURG NEW BRUNSWICK	1970 1961 1968 1955	76 107 120 115	70-75 192-203 201-207 215-248	73 75 35	65 69 34	 64 69 33	47 67 72 46	 3 13	10-22 10-22 10-19 10-21
*	23-365 23-380 23-411 23-430	 46-00144 26-04485	402633 402659 402822 402923	742120 742020 741630 741651	DUHERNAL WC HERCULES POWDER SOUTH AMBOY WD JERSEY CENTRAL POWER & LIGHT	DUH SAY 4 OBS HERCULES 2 SAWD 8 7-1972	SOUTH AMBOY SOUTH AMBOY SOUTH AMBOY SOUTH AMBOY	1931 1927 1947 1972	6 48 10 12	148-160 184-237 209-234 135-165	-53 -56 -68 -40	-43 -43 -69 -41	-51 -37 -69 -42	-9 -5 -17 -9	42 32 52 33	10-22 11- 9 10-20 10-19
*	23-438 23-439 23-441	28-09722 28-05987 	402559 402633 402742	742142 742200 742309	SOUTH RIVER WD SOUTH RIVER WD HERBERT SAND CO	SRWD 5 SRWD 2 OBS HSC 3	SOUTH AMBOY SOUTH AMBOY NEW BRUNSWICK	1977 1967 1964	20 21 6	132-182 121-126 49-52	-49 -40 2	-38 -32	-46 -38 1	-3 -2 4	43 36 3	10-19 10-22 10-21
	23-482 23-506 23-552 23-1160	28-03020 28-10991 28-20882	403242 402358 402018 402720	742612 743021 741950	SMITH, LAWRENCE SOUTH BRUNSWICK MUA E I DUPONT	3-1958 SBMUA 15 FW-2	NEW BRUNSWICK HIGHTSTOWN SOUTH AMBOY	1958 1979 1988	11 120 105 86	213-223 116-166 210-230	-3  	  	10 9 59 -54	29 88 -13	20 29 41	10-19 10-21 10-19 10-21
	23-1181 25-153 25-230 25-247 25-268	29-19615 29-05942 29-06353 29-04285 29-06361	402742 402444 402004 401902 402117	741906 741010 741853 741811 741511	E I DUPONT SHORELANDS WC GORDONS CORNERS WC GORDONS CORNERS WC MARL BORO TWP MUA	PM-2D PARLIN PLANT W KEANSBURG 4 GORDONS 5 GORDONS 2 2-PROD	SOUTH AMBOY KEYPORT FREEHOLD FREEHOLD FREEHOLD	1987 1970 1972 1964 1972	108 65 125 146 114	127-137 635-690 580-670 762-832 632-698	-47 -41 -26 -40	-70 -36 -34 -50	-116 -49 -48 -64	-24 -20 -14 -8 -12	96 35 40 52	11-10 10-19 10-21 10-22 10-26
	25-272 25-320 25-495 25-509 25-634	29-06527  28-12280 29 16237	402208 402705 401850 401315 401520	741452 735959 740301 742810 741712	MARLBORO TWP MUA NATIONAL PARK SERVICE DEPARTMENT OF ENERGY ROOSEVELT WD EREEHOLD A SSOCIATES	MARLBORO 1 OBS FT HANCOCK 5A DGE TC-40 ROOSEVELT 4 EREEHOLD D RACEWAY 1	MARLBORO SANDY HOOK LONG BRANCH ROOSEVELT EREEHOLD	1972 1970  1985	117 14 10 170	670-680 838-878 1,000 390-430 877-914	-44 -4 	-55 -8  29	-73 -10 -11 17	-17 -1 -3 26 22	56 9 8 9	10-19 10-19 10-26
#	25-635 25-711 25-728 29-19 20.47	29-18402 29-14303 28-21488	401105 401743 401752 394829 400433	741202 741902 742126 740535 740833	US GEOLOGICAL SURVEY GORDONS CORNERS WC ENGLISHTOWN BORO WD US GEOLOGICAL SURVEY PRICK TWP MUA OPS	HOWELL TWP 1 OBS GORDONS 12 ENGLISHTOWN 3 ISLAND BEACH 3 OBS	FARMINGDALE FREEHOLD FREEHOLD BARNEGAT LIGHT	1987 1986 1988 1962	111 90 70 9	1,230-1,330 649-756 541-621 2,740-2,760	   26	  -6 41	-39 0  -11 65	-23 -4 -1 -10 45	16 -4  1	10-21 10-22 10-20 10-25
# # # #	29-85 29-118 29-132 29-440 29-400	29-04322 29-03726 29-06549 33-01242	395929 400200 400319 400504 395901	741420 742110 741957 741324 742017	CIBA-GEIGY CORP LAKEHURST NAVAL AIR STATION JACKSON TWP MUA NJ/AMERICAN WC AMERICAN SMEITING & DEENING	- TOMS RIVER 84 OBS LAKE NAS32 SCM 3 LAKEWOOD 10 2	TOMS RIVER LAKEHURST LAKEHURST LAKEWOOD KESWICK GROUT	1968 1964 1962 1972 1972	67 96 95 72	1,460-1,480 1,400-1,580 1,610-1,730 1,360-1,600 1,440 1,640	-23 -23 -33 -20	-29 -28 -37 -31	-40 -42 -51 -44	-30 -29 -20 -29 -29	10 13 31 15	11-2 10-29 10-26 10-27 10-27
# # #	29-576 29-581 29-588 29-626 33-71	29-08936 48-00056 29-09259 33-10224 30-00196	400653 400821 400435 395721 394151	741717 742630 741105 741230 752407	JACKSON TWP MUA JACKSON TWP MUA LAKEWOOD TWP MUA TOMS RIVER WC STATE OF NI - TURNPIKE AUTH	JACKSON 8 JACKSON TWP 10 S LAKEWOOD 7 TRWC 30 1S-2	LAKEHURST ROOSEVELT LAKEWOOD TOMS RIVER PENNS GROVE	1977  1978 	135 130 70 9 38	1,280-1,460 876-976 1,410-1,620 1,700-1,880 344	-32 -1 	-35 -16 -27 -23	-48 -26 -56 -34	-35 -17 -34 -23 -24	13 9 22 11	10-22 10-22 10-27 10-27 11-15
	33-106 33-119 33-158 33-198 33-251	30-00018 30-00763 30-01383	393514 394009 393848 394117	752917 753043 752010 752207 752755	LINSKI, ALEX PENNSVILLE TWP WD ACME MARKETS CO DUBOICE, MAURICE US GEOLOGICAL SUBVEY	1 PTWD 2 ACME 1 IRR 74 SALEM LODS	SALEM WILMINGTON SO WOODSTOWN WOODSTOWN	1962 1949 1960 1974	5 7 62 51	359-365 210-230 562-575 337-362	-46 -21	-39 -23	-30 -43 -25 -25	-31 -44 -22 -26	-1 -1 3 -1	11-10 11-9 11-10 11-11
#	33-364 88-303 059128 Eb22 24	34-01031 059128	392743 393620 393548 302214	753158 753309 753740	PUBLIC SERVICE ELECTRIC & GAS US ARMY TEXACO	PW 5 HOUSE WELL #1 TEXACO #27	TAYLORS BRIDGE DELAWARE CITY SAINT GEORGES	1974  	17 10 30	765-840	-27 -78 	-20 -66 	-62 28	-75 -20 -29	-13  -1	11-10 11-15 11-4
	Dc34-06 PH-5	DC34-06	393755 395342	753648 751021	U S NAVY	NAT GUARD #2 PH 12	WILMINGTON SO	  1944	28 8	90-100 101			-34 -28 -7	-33 -28 -4	0	11-2 11-10 11-3

#### WATER-RESOURCES INVESTIGATIONS REPORT 96-4206 Lower Potomac-Raritan-Magothy aquifer - SHEET 8 OF 8

Lacombe, P.L., and Rosman, Robert, 1997, Water levels in, extent of freshwater in, and water withdrawal from eight major confined aquifers, New Jersey Coastal Plain, 1993



Universal Transverse Mercator Projection, Zone 18

Figure 8-3. Potentiometric surface of the Lower Potomac-Raritan-Magothy aquifer, 1993.

## WATER LEVELS IN, EXTENT OF FRESHWATER IN, AND WATER WITHDRAWAL FROM EIGHT MAJOR CONFINED AQUIFERS, NEW JERSEY COASTAL PLAIN, 1993

#### Table 8-1. Water-level data for wells screened in the Lower Potomac-Raritan-Magothy aquifer, 1978-93

## [Well depth given if screen interval is unknown; \*, well not shown in figure 8-3; --, data not available; ft, feet; BORO, Borough; MUA, Municipal Utilities Authority; WD, Water Department; TWP, Township; WC, Water Company; NJ, New Jersey; DEL, Delaware; CO, Company; CORP, Corporation; DEP, Department of Environmental Protection]

Well number	Permit number	Lati- tude <sup>1</sup>	Longi- tude <sup>1</sup>	Owner	Local well identification	USGS Quadrangle	Year drilled (ft)	Land- surface altitude <sup>2</sup> (ft)	Screen interval <sup>3</sup> (ft)	W 1978 (ft)	Vater-lev 1983 (ft)	<u>vel altitud</u> 1988 (ft)	<u>le<sup>2</sup></u> 1993 (ft)	1988-93 Water- level change	Date in 1993
5-123 5-125 5-130 5-143 5-228	31-05321 31-03835 31-04576 27-04247 31-08923	395904 395929 400002 400105 395630	750009 745922 750044 745734 745855	NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC MAPLE SHADE WD	DVWC 28 DVWC 10 RIVERTON 13 DVWC 23 MSWD 10	CAMDEN MOORESTOWN FRANKFORD BEVERLY MOORESTOWN	1969 1959 1963 1964 1975	25 79 70 36 40	226-261 239-281 167-198 176 440-500	-10 -11 -3  -47	-12 -15 -3  -51	-16 -16 -14 -7 -60	-16 -19 -12 6 -53	0 -3 2 13 7	11- 4 11- 4 11- 5 11- 5 11- 4
5-262 5-274 5-645 5-648 5-746	31-03674  31-12925	395524 395841 400010 400103 395727	745025 745905 745216 745409 745915	US GEOLOGICAL SURVEY DENTON VACUUM WILLINGBORO MUA WILLINGBORO MUA MAPLE SHADE WD	MEDFORD 4 OBS CAMPBELL 1 OBS WILLINGBORO 2 OBS WMUA 3-OBS MSWD 11	MOUNT HOLLY MOORESTOWN BRISTOL BEVERLY MOORESTOWN	1967 1958 1965 1965 1978	72 40 40 34 20	1,130-1,150 241-262 431-441 306-316 389-450	-48 -20 -31 -20 -29	-58 -26 -35 -23 -34	-60 -29 -41 -29 -36	-61 -31 -41 -27 -36	-1 -2 0 2 0	10-29 10-29 10-29 10-29 11- 3
5-819 5-823 * 5-1075 7-12 7-79	31-19212 31-26130 31-02687	395608 395615 395632 395221 395617	745649 745512 745555 750637 750710	MOUNT LAUREL MUA MOUNT LAUREL MUA MOUNT LAUREL MUA BELLMAWR BORO WD CAMDEN CITY WD	MLMUA 6 MLMUA 4 ELBO LANE 7 BBWD 3 CITY 12	MOORESTOWN MOORESTOWN MOORESTOWN RUNNEMEDE CAMDEN	1982 1974 1987 1956 1945	20 35 40 35 23	499-590 590-640 528-644 334-359 136-166	 -53 -17	-59 -62  -56 -13	-68 -75 -63 -48 -11	-65 -64 -61 -46 -10	3 11 2 2 1	11- 1 11- 1 11- 1 11- 9 11- 1
* 7-112 7-121 7-130 7-144 7-163	31-01430 31-05077 31-00684 31-04051	395728 395252 395353 395442 395609	750520 745943 745708 750103 750028	NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC NJ/AMERICAN WC	CAMDEN DIV 48 BROWING T-1 OLD ORCHARD A ELLISBURG 13 COLUMBIA 22	CAMDEN MOORESTOWN MOORESTOWN CAMDEN CAMDEN	1954 1973 1967 1953 1960	10 80 71 39 39	122-164 672-729 743-748 491-527 371-453	-85 -67 -60 -46	-30 -94 -75 -64 -51	-34 -103 -80 -67 -53	-46 -99 -79 -65 -45	-12 4 1 2 8	11- 4 11- 4 11- 3 11- 3 11- 3
7-172 7-188 * 7-207 7-221 7-273	31-04799 31-05950  31-04756	395426 395002 395332 395356 395030	750514 745851 750734 750738 750347	COLLINGSWOOD WD NJ/AMERICAN WC CORSONS FOOD US GEOLOGICAL SURVEY NJ/AMERICAN WC	CWD 6(A) GIBBSBORO 42 JERSEY AVE 1 COAST GUARD 1 OTTERBROOK 29	CAMDEN CLEMENTON PHILADELPHIA PHILADELPHIA RUNNEMEDE	1965 1972 1945 1966 1965	10 65 9 11 60	218-312 934-986 230-250 162-170 612-712	 40 -72	 -47 -35 -71	 -36 -30 -77	-38 -97 -23 -26 -76	 13 4 1	10-25 11-4 11-3 11-3 11-1
7-281 7-283 7-292 7-302 7-320	31-01124 31-04282 31-04855 31-02130 31-04642	395242 395246 395406 395319 395652	750323 750434 750332 750140 750307	NJ/AMERICAN WC NJ/AMERICAN WC HADDON TWP WD HADDONFIELD WD MERCHANTVILLE PENNSAUKEN WCM	HADDON 14 EGBERT OBS HTWD 4 RULON WOODBINE 1	CAMDEN CAMDEN CAMDEN CAMDEN CAMDEN	1954 1962 1965 1956 1963	76 24 45 25 65	506-598 445-455 417-448 523-572 245-285	-62 -63 -72 -37	-64 -64 -79 -40	-64 -67 -85 -38	-80 -61 -64 -91 -36	 3 3 -6 2	11- 3 11- 1 10-26 10-26 10-27
* 7-335 7-341 7-348 7-372 7-390	31-02915 31-01417 31-03534 31-05110 51-00050	395720 395800 395801 395902 395944	750225 750417 750119 750153 750211	MERCHANTVILLE PENNSAUKEN WCM MERCHANTVILLE PENNSAUKEN WCM MERCHANTVILLE PENNSAUKEN WCM MERCHANTVILLE PENNSAUKEN WCM CAMDEN CITY WD	MARION 1 DELA GARDEN 2 PARK AVE 3 NATIONAL HWY 1 MORRIS 1	CAMDEN CAMDEN CAMDEN CAMDEN CAMDEN	1957 1954 1958 1967 	61 39 25 40 9	243-278 115-145 240-275 195-230 107	-33 -28 -34  -6	-35 -27 -35  -5	-35 -25 -34 -51 -8	-34 -27 -35 -48 -6	1 -2 -1 3 2	10-27 10-27 10-27 10-27 11- 1
7-412 7-523 7-528 7-541 7-563	31-09560 31-12315 31-08526 31-15720 31-17116	394922 395152 395835 395611 395712	745630 750542 750302 750546 750612	NJ/AMERICAN WC BELLMAWR BORO WD CAMDEN CITY WD CAMDEN CITY WD STATE OF NJ - DEP	ELM TREE 2 OBS BELLMAWR BORO PUCHACK 7 TW-8-79 HARRISON 3	CLEMENTON RUNNEMEDE CAMDEN CAMDEN CAMDEN	1963 1977 1975 1979 1980	149 75 20 20 15	1,080-1,090 458-557 140-180 215-253 97-117	-62 -62 -23 	-72 -64 -28 -34 -16	-78 -67 -32 -31 -15	-80 -64 -22 -26 -8	-2 3 10 5 7	11- 1 11- 9 11- 1 11- 1 10-28
* 7-596 * 7-724 15-133 15-139 15-282	31-19765 31-18947 30-01222 30-01223 31-07056	395239 395728 394510 394608 394913	750754 750502 752244 752135 751105	BROOKLAWN BORO WD NJ WC PURELAND WC PURELAND WC WEST DEPTFORD TWP WD	BBWD 4 CLEVELAND AVE PW 53 TEST WELL 1 TEST WELL 3 5 KINGS HIWAY	PHILADELPHIA CAMDEN MARCUS HOOK BRIDGEPORT WOODBURY	1982 1982 1970 1970 1973	10 32 20 7 55	263-293 154-194 317-367 301-345 388-450	  -9 -30	-52  -9 	-51  -2 -10 -34	-45 -27 -4 -1 -32	6  -2 9 2	11-11 11-4 11-12 11-9 11-3
* 15-296 15-312 15-316 * 15-323 15-331	30-00902 15-00063 31-00035 31-00037 31-04259	394942 395107 395159 395235 394955	751317 750946 750907 750950 750908	HUNTSMAN POLYPROPYLENE CORP WEST DEPTFORD TWP WD COASTAL EAGLE POINT OIL CO COASTAL EAGLE POINT OIL CO WOODBURY WD	SHELL 5 OBS 6 RED BANK AVE EAGLE PT OBS 1 EAGLE POINT 3 OBS RAILROAD 5	WOODBURY WOODBURY WOODBURY PHILADELPHIA WOODBURY	1962 1973 1948 1948 1960	21 20 32 21 35	321-326 322-372 288-298 255-275 405-457	-16 -58 -67 -52 -44	-16 -55 -54 -43 -47	-18 -56 -58 -44 -53	-18 -45 -42 -30 -49	0 11 16 14 4	11-3 11-3 11-3 11-3 11-4
15-349 15-398 15-615 15-618 15-671	 30-02016  	394650 394935 394637 394804 394957	752316 751938 751916 751933 750530	PURELAND WC PETTIT, LOUIS US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY	LANDTECT 2 419 SHIVELER LOWER GAVENTA DEEP DEPTFORD DEEP OBS	MARCUS HOOK BRIDGEPORT BRIDGEPORT BRIDGEPORT RUNNEMEDE	1973 1979 1985 1985 1986	6 1 29 7 35	170-220 50-60 378-388 230-240 650-670	6  	-6  	-9 -2 -15 -7 -69	-5 1 -16 -4 -69	4 3 -1 3 0	11-12 11-4 11-4 11-11 11-3
* 15-678 15-680 * 15-711 15-712 * 15-737	30-03625 30-03602 30-03608 30-04347 30-03604	394946 395038 395048 394808 395024	751612 751605 751518 751724 751450	MOBIL OIL CO MOBIL OIL CO MOBIL OIL CO US GEOLOGICAL SURVEY MOBIL OIL CO	W-5C W-7C W-8C STEFKA 1 OBS W-2C	BRIDGEPORT BRIDGEPORT BRIDGEPORT BRIDGEPORT WOODBURY	1985 1985 1985 1986 1985	9 9 12 7 12	194-204 186-196 153-163 275-290 240-250	  	  	-8 -5 -10 	-5 -7 -5 -11 -8	3 -2 0 -1	11-9 11-9 11-9 11-3 11-2
15-738 15-742 15-770 15-1004 15-1125	30-03612-7  31-26237-6  30-4112	394948 394652 395202 394421 394937	751524 751004 751115 750604 751728	MOBIL OIL CO US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY US GEOLOGICAL SURVEY E I DUPONT	W-4C MANTUA DEEP OBS NATIONAL PARK #1-PW-L CEDAR LAKE DEEP REPAUNO M-47	BRIDGEPORT WOODBURY WOODBURY PITMAN EAST BRIDGEPORT	1985 1986 1987 1988 1986	5 84 10 80 15	188-198 757-777 204-224 1,040-1,210 186-196	  	  	-9 -39 -25 	-8 -37 -21 -63 7	1 2 4 	11-9 11-3 11-2 11-4 11-10
33-86 33-187 33-330 33-458 Ec3207	30-01139 50-00098 Ec3207	394557 394037 394205 392751 393209	752523 751914 752657 753207 753802	B F GOODRICH CO US GEOLOGICAL SURVEY PENNS GROVE WATER SUPPLY CO PUBLIC SERVICE ELECTRIC & GAS UNION CARBIDE	4 (PW-3) POINT AIRY OBS LAYTON 11 PSEG 6-OBS ST. GEORGES #7	MARCUS HOOK WOODSTOWN PENNS GROVE TAYLORS BRIDGE SAINT GEORGES	1967 1958 1936 1980	13 73 16 20 11	169-189 664-672 394 1,110-1,130 575-585	-10 -25 -38 	-12 -26 -15 	-11 -28 -23 -24 -91	-17 -29 -40 -32 -85	-6 -1 -17 -8 6	11-9 11-12 11-10 11-10 11-3
Eb23-35 Dc34-O5 PH-3 PH-63 PH-750	Eb23-35 Dc34-05  	393316 393755 395314 395408 395445	075421 753684 751010 751040 750831	US GEOLOGICAL SURVEY (DEL) DELAWARE NATIONAL GUARD US NAVY CITY OF PHILADELPHIA PASHA	LUMS POND D OBS DEL NAT GUARD 1 OBS PH #19 CITY POOL SAF #1	SAINT GEORGES WILMINGTON SO PHILADELPHIA PHILADELPHIA PHILADELPHIA	  	60 28 9 6 10	540-544 546-551 242-247 	   		-49 -68 22 -5 -8	-52 -65 -18 -4 -6	-3 3 4 1 2	11-2 11-10 11-3 11-3 11-3