

WATER USE

Information on the water budget, population, water use, water-withdrawal, and aquifer-recharge and discharge statistics for the study area is presented, and the locations of hazardous-waste sites are shown.

The withdrawal of water from the Kirkwood-Cohansey aquifer system in the study area for public supply, domestic supply, industrial self-supply, and irrigation use is, for the most part, limited to the Maurice and Great Egg Harbor River basins. No significant amounts of water are withdrawn from the Kirkwood-Cohansey aquifer system in the four river basins in the northwestern part of the study area, either because the aquifer is typically less than 200 ft thick (fig. 1-7) or because the residents are supplied with public water derived from deeper aquifers. Total water withdrawn from the Kirkwood-Cohansey aquifer system in the two basins was calculated from population statistics, from reported public- and industrial-supply data, and from reported irrigated acreage.

Population

The population statistics for the 12 townships that are wholly or partly in the study area for the period 1930-87 are given in table 5-1.

Table 5-1.—Population of the study area by township

County	Township	1930	1940	1950	1960	1970	1980	1987
Atlantic	Beacon	—	—	2,640	3,243	3,283	3,642	3,708
Cumberland	Vineland	21,600	24,439	29,573	37,685	47,399	53,753	54,586
Gloucester	Clayton	2,351	2,320	3,023	4,711	5,193	6,013	5,669
	Elk	1,656	1,624	2,074	2,655	2,707	3,187	3,411
	Franklin	3,563	3,464	5,056	7,451	8,990	12,306	14,111
	Glassboro	4,399	4,925	5,267	10,253	12,938	14,574	14,668
	Harrison	1,827	1,805	2,225	2,440	2,661	3,385	3,599
	Mantua	2,077	2,433	3,548	7,991	9,643	9,193	10,003
	Monroe	4,084	4,310	5,531	9,396	14,071	21,639	23,901
	Newfield	899	899	1,010	1,299	1,487	1,563	1,563
	Pittman	5,411	5,807	6,960	8,644	10,257	9,744	9,447
	South Harrison	681	686	908	914	1,226	1,286	1,396
	Washington	2,068	2,048	2,496	4,953	15,741	27,878	35,547
Salem	Pittsgrove	2,001	2,157	2,808	3,785	4,618	6,954	8,013
	Upper Pittsgrove	1,899	1,825	2,204	2,715	2,884	3,139	3,301

Use Types

Public Supply

Table 5-2 shows annual water withdrawal during 1975-87 for public-supply systems that obtain water from the Kirkwood-Cohansey aquifer system. Seven public-supply systems are located in the Maurice and Great Egg Harbor River basins in the study area. The municipal public-supply systems of Glassboro, Clayton, and part of Buena obtain water from confined aquifers below the Kirkwood-Cohansey aquifer system. The public-supply systems of Monroe, Newfield, Vineland, Nationwide Mobile Homes and part of Buena obtain water from the Kirkwood-Cohansey aquifer system.

Twenty-three percent of the City of Vineland is in the study area; therefore, 23 percent of the public water supply is estimated to come from and to be used in the study area. Sewage from Vineland, Monroe, and Nationwide Mobile Homes is processed and ultimately disposed of outside the study area; therefore, 100 percent consumptive use of these public water supplies is assumed.

The public water supply of Newfield and Buena is obtained and used, and the sewage water is disposed of, in the study area. The estimated consumptive use of public supply water in New Jersey is 18 percent (Solley and others, 1988). The sum of consumptive use of the public supply water in 1987 in the Maurice River basin was 766.08 Mgal/yr, and in the Great Egg Harbor River basin of Gloucester County, consumptive use was 419.01 Mgal/yr.

Table 5-2.—Water use for public supply from the Kirkwood-Cohansey aquifer system in the Maurice River and Great Egg Harbor River basins, 1975-87, and consumptive water use in 1987

Year	Maurice River Basin		Great Egg Harbor Basin		Consumptive use of public water supply (Mgal/yr)
	Withdrawal	Consumptive	Withdrawal	Consumptive	
1975	2025.86	272.39	16.55	244.47	—
1976	2334.71	330.39	12.11	263.19	—
1977	2420.59	347.29	14.16	285.65	—
1978	2436.15	303.29	12.24	244.77	—
1979	2543.00	268.99	8.74	293.25	—
1980	2790.00	197.59	8.58	242.42	—
1981	2352.19	169.99	8.89	324.29	—
1982	2740.00	167.84	10.42	323.29	—
1983	2978.00	152.56	12.71	360.09	—
1984	2795.00	187.52	11.52	335.67	24.81
1985	2915.00	77.67	12.29	358.21	26.74
1986	3166.00	75.96	12.69	346.97	25.45
1987	3180.00	175.82	15.65	393.55	25.46

Domestic Supply

Domestic self-supplied water use from the Kirkwood-Cohansey aquifer system in the upper Maurice and Great Egg Harbor River basins was estimated by applying a per capita use rate of 100 gal/d (Marble Horn, U.S. Geological Survey, and coauthors, 1988) and subtracting the amount of water available from public supply. Table 5-3 shows population and township land area in the Maurice River basin and Great Egg Harbor River basin and land area in the study area outside these two basins. An even population distribution within each community was assumed.

Annual per capita water use in the upper Maurice River basin is 1,798.78 Mgal. Water withdrawn from the Kirkwood-Cohansey aquifer system for public supply amounts to 926.50 Mgal/yr, and domestic supply is 737.99 Mgal/yr. The remaining 134.29 Mgal/yr consists of a combination of water withdrawn from deeper aquifers and from the Kirkwood-Cohansey aquifer system outside the basin, and inaccuracies in calculating estimates of water use. Annual per capita water use in the Great Egg Harbor River basin is 899.23 Mgal. Water withdrawn from the Kirkwood-Cohansey aquifer system for public supply amounts to 393.55 Mgal/yr, and domestic supply is 505.74 Mgal/yr. The remainder, 86.47 Mgal/yr, is attributed to the public supply system and may be used by industry or for irrigation, or result from transmission-line loss or inaccuracies in calculating estimates of water use.

The consumptive use of domestic supply water is estimated to be 21 percent (Solley and others, 1983). Therefore, consumptive use of domestic supply water is 147.60 Mgal/yr in the Maurice River basin and 113.35 Mgal/yr in the Great Egg Harbor River basin.

Table 5-3.—Water use for domestic supply from the Kirkwood-Cohansey aquifer system in the Maurice River and Great Egg Harbor River basins by Township, 1987

County	Township	Population	LAND AREA (in square miles)		ANNUAL PER CAPITA USE		PUBLIC SUPPLY		DOMESTIC SUPPLY						
			Total	Maurice Harbor	Other	Maurice Harbor	Other	Maurice Harbor	Other	Maurice Harbor	Other				
Atlantic	Beacon	3,708	7.40	2.16	0	5.24	39.51	0	95.84	0	96.64	6.73	0	16.33	
Cumberland	Vineland	54,586	69.50	16.05	0	53.45	460.11	0	13,522.28	735.58	0	2,446.30	0	0	
Gloucester	Clayton	5,669	7.26	2.26	0	0	206.07	0	0	0	0	215.51	0	0	
	Elk	3,411	19.60	13.09	0	0	6.60	82.58	0	41.92	0	0	82.58	0	41.92
	Franklin	14,111	56.47	35.68	20.79	0	325.43	189.62	0	0	0	325.43	189.62	0	
	Glassboro	14,668	9.37	4.40	0	5.27	273.95	0	300.71	0	0	507.00	0	0	
	Harrison	3,599	19.08	0	0	0	194.68	0	0	0	0	0	0	144.50	
	Mantua	10,003	15.96	0	0	0	15.96	0	365.11	0	0	211.14	0	365.11	
	Monroe	23,191	46.56	8.35	38.48	0.13	158.51	693.62	2.34	0	395.55	0	80.53	371.13	1.25
	Newfield	1,563	1.71	1.71	0	0	57.05	0	0	175.82	0	0	0	0	
	Pittman	9,447	2.26	0	0	0	2.26	0	344.82	0	0	312.53	0	312.53	
	South Harrison	1,396	1.78	1.78	0	0	1.78	0	65.19	0	0	0	0	65.19	
	Washington	35,547	21.65	2.00	0.10	19.55	119.86	5.99	1,171.61	0	0	1,180.22	119.86	5.99	
Salem	Pittsgrove	8,013	46.50	17.65	0	29.45	107.24	0	185.23	0	0	107.24	0	185.23	
	Upper Pittsgrove	3,301	40.10	5.20	0	34.90	15.62	0	106.86	0	0	15.62	0	106.86	
Total		192,943	379.45	112.56	59.37	207.52	1,798.78	899.23	4,184.41	926.50	419.06	5,029.34	737.99	506.74	1,523.68

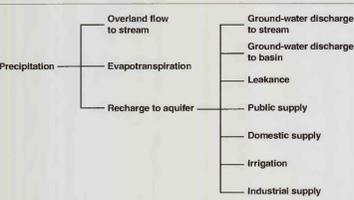


Figure 5-1. Diagram showing relation among the various components of the water budget in the study area.

WATER BUDGET

With the data that are compiled in this report, it is possible to develop a water budget for the Maurice River basin north of the gaging station at Norma. This budget is assumed to be applicable to the Great Egg Harbor River basin in Gloucester County, but it may or may not be applicable to the basins northwest of these two basins in the study area.

Precipitation is measured in inches per year; river discharge is measured in cubic feet per second; and ground-water withdrawal rates are measured in million gallons per day, per month, or per year. Symbols used in the following equations are given below.

- P = Precipitation
- ET = Evapotranspiration
- Qb = Stream discharge, base-flow component
- Qs = Stream discharge, overland-flow component
- Qg = Basin discharge, ground-water component
- R = Aquifer recharge
- L = Leakage to deeper aquifers
- Wp = Withdrawal, public-supply, consumptive
- Wd = Withdrawal, domestic self-supply, consumptive
- Wi = Withdrawal, irrigation supply, consumptive
- Wn = Withdrawal, industrial self-supply, consumptive

The basic hydrologic equations for the water budget are as follows:

1. Land surface—
 $P = ET + Qb + R$

2. Aquifer—
 $R = Qb + Qi + L + Wp + Wd + Wi + Wn$

By using data from this report, in inches per year, the equation for the Maurice River basin north of the gaging station at Norma becomes

$44.50 = 24.84 + 3.01 + R$
and
 $R = 17.24 + 0.12 + 0.10 + 0.39 + 0.08 + 0.42 + 0.02$
 $R = 18.57$

Therefore,
 $44.50 = 45.82$

The two sides of this budget equation differ by less than 3 percent. The techniques used to measure precipitation and stream discharge are accurate to 5 percent, and techniques used to estimate ET, leakage, and water use typically are much less accurate. Therefore, these two values may be said to balance, although they are not equal.

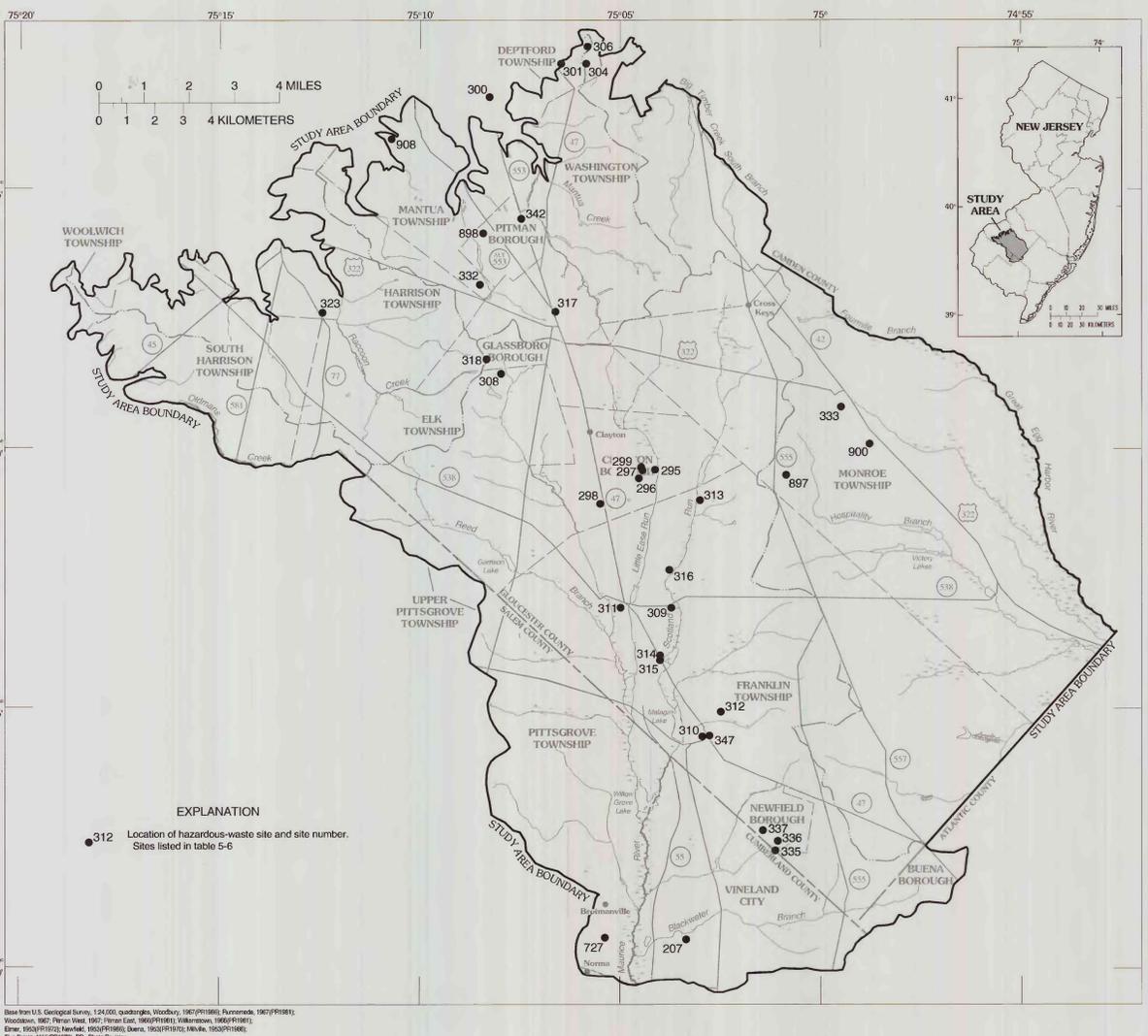


Figure 5-2. Locations of hazardous-waste sites in the study area.

EXPLANATION

● 312 Location of hazardous-waste site and site number. Sites listed in table 5-6

Irrigation Water

Records that show the amount of water used for irrigation are limited. Records exist, however, that show the amount of irrigated land in each township. Water used for irrigation in the Maurice and Great Egg Harbor River basins is assumed to come from the Kirkwood-Cohansey aquifer system. Table 5-4 shows the total acreage and irrigated acreage in each township, the calculated irrigated acreage in each basin, and the amount of water used annually for irrigation. The New Jersey Department of Agriculture calculates that 8 in. of water per acre per year typically is applied to irrigated land (M.F. Ali, New Jersey Department of Agriculture, written communication, 1989).

Consumptive water use for irrigation in New Jersey is estimated to be 90 percent of annual water use (Solley and others, 1988). Therefore, the consumptive water use is estimated to be 909.15 Mgal/yr in the upper Maurice River basin and 248.85 Mgal/yr in the Great Egg Harbor River basin.

Table 5-4.—Water use for irrigation in the Maurice River and Great Egg Harbor River Basins by township, 1987

County	Township	Land Area in River Basin in acres		Irrigated Land in River Basin in acres		Water Use in million gallons	
		Total	Maurice Harbor	Total	Maurice Harbor	Maurice Harbor	Great Egg Harbor
Atlantic	Beacon	4,736	1,382	0	0	0	0
Cumberland	Vineland	41,480	10,272	0	2,869	663	144.01
Gloucester	Clayton	4,646	4,646	0	22	22	4.74
	Elk	12,544	8,320	0	1,579	1,047	227.63
	Franklin	36,141	22,835	13,305	2,909	1,839	1,071
	Glassboro	5,997	652	0	86	38	8.24
	Harrison	12,211	0	0	1,888	0	0
	Mantua	10,214	0	0	639	0	0
	Monroe	30,854	3,344	24,627	433	77	355
	Newfield	1,694	1,694	0	116	116	23.18
	Pittman	2,646	0	0	2	0	0
	South Harrison	10,002	0	0	1,110	0	0
	Washington	13,856	1,280	64	1,006	93	4
Salem	Pittsgrove	29,740	10,912	0	2,014	791	160.56
	Upper Pittsgrove	29,664	3,328	0	2,245	739	63.28
Total		332,875	71,680	37,996	16,918	4,925	1,430

Industrial Self-Supply

Available industrial-water-use data are shown in table 5-5. The maximum annual withdrawals for industrial use during the period of record are indicated. These maximum values were used to estimate the annual industrial water use in the Maurice and Great Egg Harbor River basins.

Consumptive water use for self-supply industries is estimated to be approximately 10 percent of total use (Solley and others, 1988). Estimated total water use in the Maurice River basin is 344.06 Mgal/yr, and consumptive use is 34.41 Mgal/yr. In the Great Egg Harbor River basin, estimated total use is 11.19 Mgal/yr, and consumptive water use is 1.20 Mgal/yr.

Table 5-5.—Water use for industrial supply in the Maurice River and Great Egg Harbor River Basins, 1975-87

Year	Maurice River Basin		Great Egg Harbor River Basin	
	A	B	C	D
1975	30.89	0.34	30.89	0.34
1976	38.96	7.05	38.96	7.05
1977	41.00	8.44	41.00	8.44
1978	47.20	9.02	47.20	9.02
1979	47.70	6.08	47.70	6.08
1980	53.97	0.81	53.97	0.81
1981	53.97	0.81	53.97	0.81
1982	53.97	0.81	53.97	0.81
1983	53.97	0.81	53.97	0.81
1984	80.06	6.31	112.56	11.29
1985	137.08	6.29	124.43	10.41
1986	201.33	10.17	83.13	9.43
1987	203.92	15.68	44.14	8.53

CONVERSIONS FACTORS AND ABBREVIATIONS

Multiply	by	To obtain
	Length	
inch (in.)	2.54	centimeter
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
acre	4,047	square meter
acre	0.4047	hectare
square mile (mi ²)	2,590	square kilometer
	Volume	
gallon (gal)	3.785	liter
gallon (gal)	0.000785	cubic meter
million gallons (Mgal)	3.785	cubic meter
cubic foot (ft ³)	0.02832	cubic meter
	Flow	
cubic foot per second (ft<		