Water Withdrawals in New Jersey, 1990 - 1999

Introduction

Almost a trillion gallons of fresh water are used each year in New Jersey. This water comes from reservoirs, rivers and underground aquifers. It is used for a variety of purposes - from drinking and irrigation to power generation and mining. Water withdrawals can be classified by water source (fig. 1), use (fig. 2), and where the water is withdrawn (fig. 3). This information circular presents a brief overview of New Jersey's water withdrawals from 1990 to 1999. The State will need more water as its population increases, and understanding where it comes from and how it is used is an essential step towards meeting future needs.

Sources of Water

In a normal year, New Jersey receives about 44 inches of rainfall. About half of this either evaporates or is used by plants for transpiration (a process that pulls water up from the plant's roots for photosynthesis, mineral distribution, and cooling). Over New Jersey's approximately 7,800 square miles the remaining 22 inches of precipitation amounts to about 3 trillion gallons of water. This sustains streamflow and replenishes water supplies.

Streams and rivers are an important source of water to New Jersey. Water-supply intakes (fig. 4) are usually located on the larger streams, where there is sufficient water in them to allow withdrawals during low-flow periods.

Reservoirs (fig. 4) are designed to capture flood flows. Water may be pulled from the reservoir for direct use or released for withdrawal at downstream surface-water intakes. On-stream reservoirs are created by building a dam across a stream to capture streamflow. Off-stream reservoirs are usually created by damming a small stream near a larger river, which is then filled by pumping water from the river. Round Valley is an example of such an off-stream reservoir that is filled by pumping water from the nearby Raritan River. During dry periods water is released from the reservoir to the Raritan River to maintain water levels that will sustain downstream withdrawals.

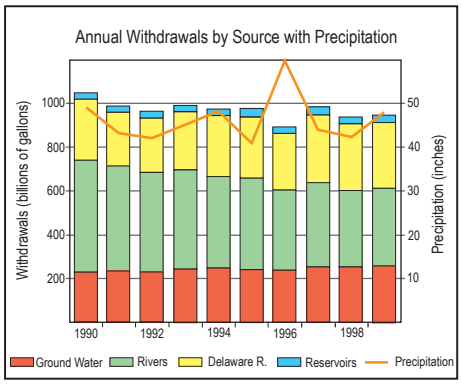

Figure 1. Annual withdrawals by source, with precipitation.

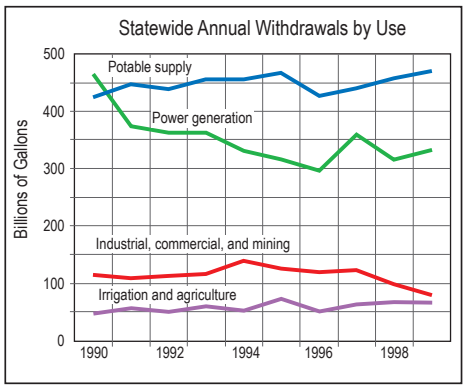

Figure 2. Statewide annual withdrawals by use.

Some rain infiltrates the ground and becomes ground water. A geologic unit that can yield water to a well is known as an aquifer. Aquifers throughout the State are important sources of water, especially in southern New Jersey.

Total Withdrawals

Water is withdrawn from both surface water (rivers and reservoirs) and ground water. In this circular, withdrawals from the Delaware River are differentiated from withdrawals from other rivers in New Jersey. Reservoirs are counted only when there are direct withdrawals from them. Water released from a reservoir to supply a downstream surface-water intake is included in the river withdrawal volumes.

During the 1990's total annual withdrawals (fig. 1) in New Jersey ranged from a high of 1.05 trillion gallons in 1990 to a low of 895 billion gallons (bg) in 1996. Average withdrawals (table 1) over this period were 971 billion gallons a year (bgy). On average, 245 bgy came from ground water, 275 bgy from the Delaware River, 421 bgy from other rivers, and 30 bgy from reservoirs. Of water withdrawn for all uses in NJ, about 75% comes from surface water.

Figure 2 illustrates four categories of New Jersey water use. The largest amount is supplied by purveyors to the public for potable use and, on average, amounted to about 447 bgy. Once delivered, this water is used to drink and cook, bathe in, and for other household needs. About 40% comes from ground water, the rest from surface supplies.

Water for power generation averaged 351 bgy. Some of it was used by hydropower plants to produce electricity and then is returned to the river. Other water was used by oil- or gas-burning power plants for cooling; some of this evaporated in the process and the remainder returned to the river. In the 1990's, water for industrial, commercial and mining purposes averaged 114 bgy while irrigation and agriculture accounted for 59 bgy.

The amount of water withdrawn during a year partially depends on the season and the amount of precipitation. For example, withdrawals for potable use, irrigation and agriculture are greater during the growing season and greater still if it is a dry year. In 1996 statewide precipitation was about 60 inches, the greatest in the 1990's (fig. 1). Consequently, withdrawals in New Jersey were the lowest in the decade (895 bg that year). Potable supplies are affected by dry seasons because some of the potable water supplied to households is used for lawn irrigation and homeowners water more during dry summers than wet ones.

County Withdrawals

Figure 3 shows average withdrawals for all water used by New Jersey's twenty-one counties. The actual amounts are given in table 1. Mercer County had the greatest average annual total withdrawal (209 bg) followed by Passaic County (166 bg). Hudson County had the least (0.2 bg).

As shown on figure 1 and in table 1, the relative importance of surface and ground water to water supply varies across the State. Surface supplies have become the major source of water in northern New Jersey because of large rivers, favorable terrain and a large population. Throughout most of southern New Jersey, however, surface-water is not as abundant and potential reservoir sites are scarcer. Ground water supplies most of southern New Jersey's water. Statewide in the 1990's an average of

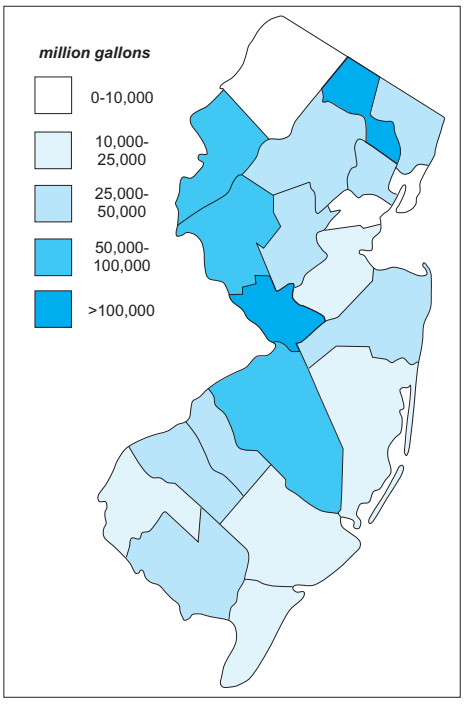

Figure 3. Fresh water withdrawals, 1990-1999, by county.

58 percent of the potable water used was from surface water.

It is important to note that water is not always used near where it is withdrawn. In order to meet demands, water is often moved across New Jersey. Reservoirs in Morris and Passaic Counties supply much of the water needed by Essex and Hudson Counties (fig. 4). The Delaware and Raritan Canal (fig. 4) moves water from the Delaware River to the Raritan River Basin in central New Jersey to supply municipalities in Mercer, Middlesex and Somerset Counties. An intake on the Delaware River in Burlington County supplies water to inland areas of Burlington and Camden Counties.

Withdrawals for agricultural needs are greatest in southern New Jersey where this activity is concentrated. In addition, water use for industrial, commercial and mining purposes is also greater in the south.

Withdrawals for power generation are concentrated in just four counties - Mercer, Passaic, Warren, and Burlington. Annual withdrawals averaged 346 bg, which is 99 % of the state's total demand for this use. The plants use fresh water for cooling equipment or to produce hydroelectricity. Water used for cooling is partially evaporated while hydropower plants consume no water and return it to the stream where it is available for other uses downstream.

The withdrawals for power generation reflect only fresh-water withdrawals. New Jersey's four nuclear power plants (Oyster Creek in Ocean County and Salem 1 and 2 and Hope Creek in Salem County) withdraw saline water for cooling. These withdrawals are not reported here.

Other Sources of Information

The waters of New Jersey belong to the citizens of the State and are managed by the Department of Environmental Protection. Most water purveyors must apply to the DEP for permission to use water. As part of the approval process, the applicant must prove that the withdrawal is in the best interest of the citizens of the State and that no other water user will be adversely affected. Additionally, water purveyors must report volumes of water withdrawn. The data presented here were compiled from those reports.

Requests for water withdrawal permits are reviewed and administered by the Bureau of Water Allocation (BWA) in the DEP's Water Supply Administration. After approval, all users must report the volumes of water withdrawn. This report is based on raw data from those reports on file with BWA. Potable-water purveyors are regulated by the Bureau of Safe Drinking Water. They must report quantities of treated water delivered to customers as well as regular reports on water quality.

The data summarized here are explained more thoroughly in the report " New Jersey water withdrawals 1990-1996." This report is available as NJ Geological Survey Open File Report 00-1 for $10 from the DEP Maps and Publications Sales Office (609-777-1038).

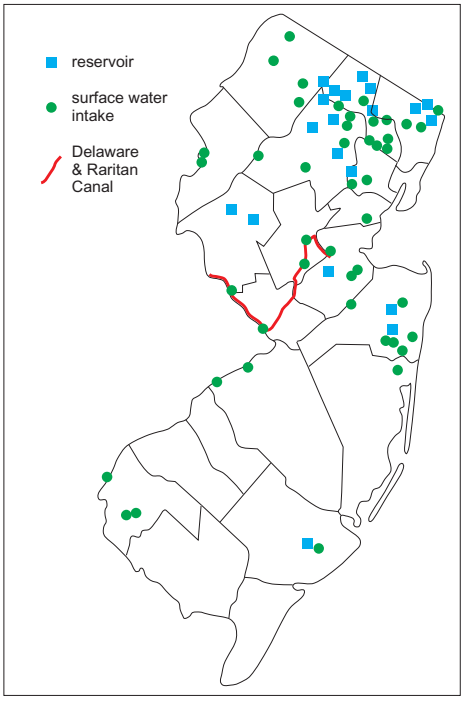

Figure 4. Reservoirs and public-supply surface-water intakes in New Jersey.

County	Average Annual Withdrawals	Source of Withdrawals				Use of Withdrawals				Source of Potable Withdrawals	
		Ground Water	Surface Water			Power Generation	Industrial, Commercial, and Mining	Potable Supply	Irrigation and Agriculture	Ground Water	Surface Water
			Delaware River	Other Rivers	Reservoirs						
Atlantic	18,488	17,178	0	1,309	2	0	1,012	13,293	4,183	12,842	451
Bergen	46,762	10,973	0	35,789	0	0	5,673	40,802	287	9,714	31,089
Burlington	80,068	25,612	22,977	25,042	6,436	0	23,032	18,547	38,489	15,168	3,379
Camden	26,516	25,170	523	823	0	0	1,592	24,305	619	24,305	0
Cape May	10,252	9,388	0	864	0	159	2,464	7,196	433	7,196	0
Cumberland	33,281	15,780	0	17,501	0	0	23,298	6,256	3,727	6,256	0
Essex	29,316	9,477	0	19,826	12	0	338	28,801	177	9,008	19,793
Gloucester	33,317	14,725	10,834	7,758	0	0	21,460	9,579	2,279	9,576	3
Hudson	176	176	0	0	0	0	172	3	0	3	0
Hunterdon	74,137	5,175	37,645	31,315	2	31,149	7,579	35,269	141	3,938	31,331
Mercer	209,175	5,342	201,459	2,373	0	190,276	2,450	16,212	237	5,034	11,179
Middlesex	20,383	18,827	0	1,556	0	24	3,626	16,056	677	14,773	1,283
Monmouth	27,133	9,340	0	12,307	5,486	11	358	25,803	961	8,589	17,214
Morris	42,027	22,613	0	1,172	18,242	0	3,089	38,678	260	19,751	18,927
Ocean	24,212	21,926	0	2,286	0	0	3,537	19,869	807	18,303	1,565
Passaic	165,523	4,787	0	160,460	276	78,163	473	86,777	110	4,504	82,274
Salem	11,026	4,772	0	6,253	0	0	6,497	2,735	1,794	2,290	445
Somerset	44,154	4,028	0	40,125	0	0	413	43,461	280	3,452	40,008
Sussex	7,091	6,520	0	571	0	39	2,385	4,573	95	4,064	509
Union	8,889	5,263	0	3,619	7	2,537	1,491	4,721	140	3,640	1,081
Warren	59,047	8,118	1,335	49,576	19	49,040	2,602	4,023	3,381	3,554	470
Total	970,972	245,190	274,774	420,526	30,483	351,398	113,539	446,959	59,076	185,959	261,000

Table 1. Average annual withdrawals by county, 1990 - 1999 (millions of gallons).

This information circular, along with an Excel spreadsheet that holds the data shown in table 1 and used to create the figures are available on the internet at: **http://njgeology.org**.

The withdrawal data are available in a GIS-ready format as the NJ Geological Survey Digital Geodata Series report DGS 01-2 at: **http://njgeology.org**.

Information on precipitation in New Jersey is made available by the State Climatologist at: **http://www.climate.rutgers.edu.stateclim/**

STATE OF NEW JERSEY

James E. McGreevy, *Governor*

Department of Environmental Protection

Bradley M. Campbell, *Commissioner*

Land Use Management

Ernest P. Hahn, *Assistant Commissioner*

New Jersey Geological Survey

Karl Muessig, *State Geologist*

Prepared by Jeff Hoffman - 2002

Comments or requests for information are welcome.
Write: NJGS, P.O. Box 427, Trenton, NJ 08625
Phone: 609-292-2576, Fax: 609-633-1004
Visit the NJGS web site @ www.njgeology.org

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