



## Water Withdrawals in New Jersey from 2000 to 2009

### Introduction

Almost a trillion gallons of fresh water are used each year in New Jersey. This water comes from reservoirs, rivers and underground aquifers. The water supports a variety of uses - from drinking and irrigation to power generation and mining. Water withdrawals are classified by water source (fig. 1), use (fig. 2), and where the water is withdrawn (fig. 3).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 2000 to 2009. 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 47 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 precipitation amounts to about 3 trillion gallons of water. This sustains streamflow and replenishes surface and groundwater 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 flow to allow withdrawals during low-flow periods.

Most reservoirs (fig. 4) 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 consist of a dam on 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. It is filled by pumping water from the nearby Raritan River. During dry periods the reservoir releases water to the Raritan River in order to maintain streamflows that will sustain downstream withdrawals.

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

### Total Withdrawals

Water for use in New Jersey comes from surface water (rivers and reservoirs) and groundwater. 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 first decade of the 21<sup>st</sup> century total annual withdrawals (fig. 1) in New Jersey ranged from a high of 1.08 trillion gallons in 2003 to a low of 915 billion gallons (bg) in 2009. Average withdrawals (table 1) over this period were 989 billion gallons a year (bg). On average, 224 bg came from groundwater, 60 bg from the Delaware River, 596 bg from other rivers, and 109 bg from reservoirs. Of water withdrawn for all uses in NJ, about 77% comes from surface water.

Figure 2 illustrates four categories of New Jersey water use. The largest, 447 bg on average, is water treated to potable standards and supplied by purveyors to the public. New Jersey's citizens use this water to drink, cook with, bathe in, and for other household needs. This also includes water used to irrigate lawns. About 41% of potable water comes from groundwater, the rest from surface supplies.

Water used for power generation averaged 436 bg. Some of this volume is used by hydropower plants to produce electricity and then is returned to the river. Other water is used by oil- or gas-burning power plants for cooling; some of this water evaporates in the process and the remainder is returned to the source. Water for industrial, commercial and mining purposes averaged 63 bg while irrigation and agriculture accounted for 43 bg.

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. Statewide precipitation in 2003 was about 58 inches, the greatest in the 2000's (fig. 1).

### County Withdrawals

Figure 3 shows average annual withdrawals for all water used by New Jersey's twenty-one counties. The actual amounts are given in table 1. Passaic County had the greatest average annual total withdrawal (258 bg) followed by Mercer County (219 bg). Hudson County had the least (0.7 bg).

As shown on figure 1 and in table 1, the relative importance of surface and groundwater 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. Groundwater supplies most of southern New Jersey's water.

It is important to note that water is not always used near its source. Purveyors often move water significant distances in order to meet demands. Reservoirs in Morris and Passaic Counties supply much of the water needed by Essex and Hudson Counties (fig.

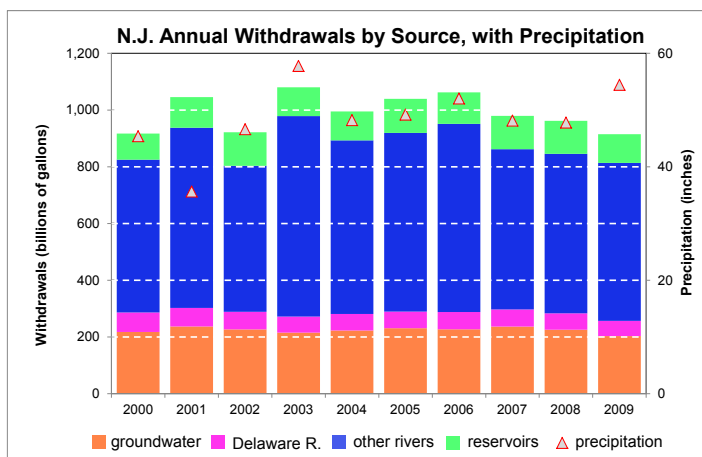


Figure 1. Statewide annual withdrawals by source, with precipitation.

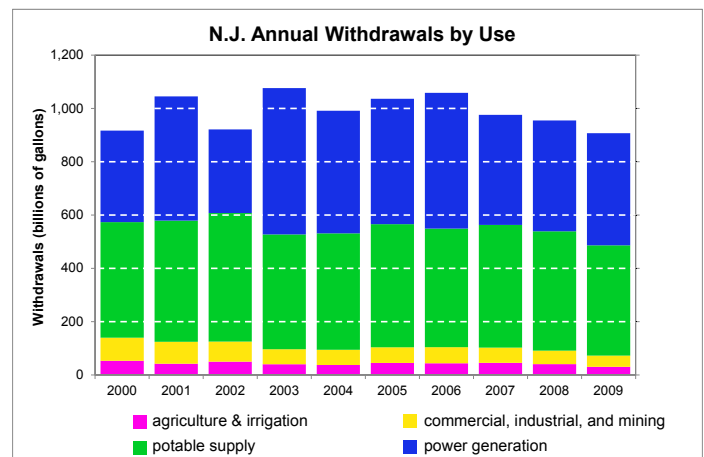
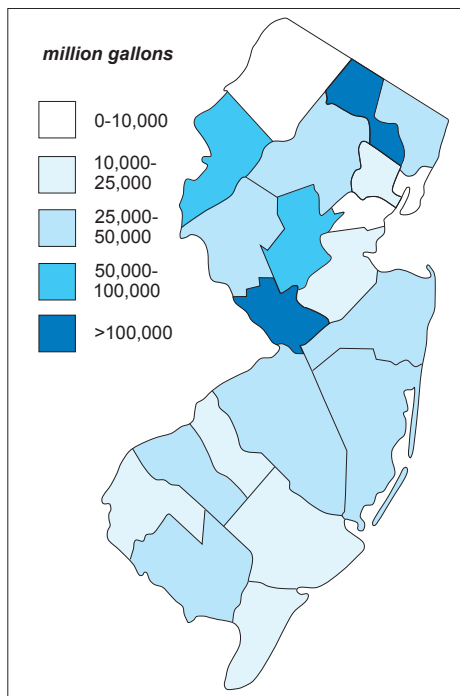


Figure 2. Statewide annual withdrawals by use.



**Figure 3.** Average annual fresh water withdrawals, 2000 to 2009, by county.

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. This transfer process also complicated analysis. Middlesex County (fig. 3) shows little surface water withdrawals. This is because water for several large treatment plants in the county comes from the Delaware and Raritan Canal. This analysis assigns this water withdrawal to Hunterdon County

where the canal's intake takes water from the Delaware River.

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

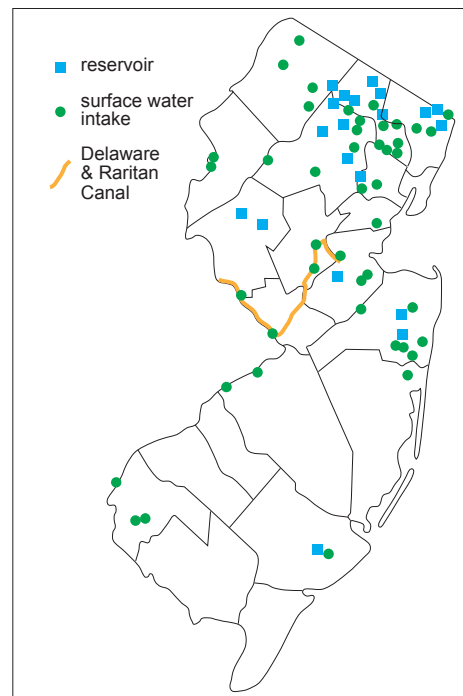
Withdrawals for power generation are concentrated in five counties – Hunterdon, Mercer, Passaic, Union, and Warren. Annual withdrawals averaged 436 bg. The plants use fresh water for cooling equipment or to produce hydroelectricity. Water used for cooling is partially evaporated while hydropower plants 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.

Requests for water withdrawal permits are reviewed and administered by the Bureau of Water Allocation and Well Permitting (BWAWP) in the DEP's Division of Water Supply and Geosciences. All users must report the volumes of water withdrawn. This report is based on data from those reports.



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



The methodologies behind data compilation are explained more thoroughly in the report "New Jersey water withdrawals 1990-1996." This report is available as NJ Geological and Water Survey Open File Report OFR 00-1 The data summarized in this information circular are available as Digital Geodata Series report DGS10-3. Both reports, and this information circular, are available at <http://www.njgeology.org/>.

The New Jersey State Climatologist provides annual precipitation data at <http://www.climate.rutgers.edu.stateclim/>.

County	Average Annual Withdrawal	Source of Withdrawal				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	Reservoir Systems						
Atlantic County	20,497	19,041	0	1,390	66	28	1,091	14,821	4,553	14,028	793
Bergen County	45,628	11,056	0	2,128	32,443	14	2,451	42,894	268	10,046	32,847
Burlington County	43,035	17,177	8,257	17,601	0	30	3,240	22,670	17,093	14,033	8,637
Camden County	20,405	19,535	0	870	0	0	713	18,896	781	18,896	0
Cape May County	10,133	7,033	0	3,099	0	4	3,287	6,370	465	6,364	6
Cumberland County	27,872	16,816	0	11,056	0	0	14,271	8,102	5,499	8,102	0
Essex County	12,396	9,423	0	2,972	0	0	249	11,926	221	9,035	2,891
Gloucester County	27,228	13,246	7,690	6,292	0	0	15,004	10,062	2,161	10,037	24
Hudson County	70	64	0	6	0	0	60	4	6	4	0
Hunterdon County	42,153	5,079	33,260	3,812	2	3,577	1,152	37,107	317	4,288	32,819
Mercer County	219,354	5,345	27,371	186,639	0	203,922	137	15,094	201	5,142	9,953
Middlesex County	16,605	15,131	0	1,474	0	0	2,523	13,480	588	12,334	1,146
Monmouth County	29,459	9,695	0	13,060	6,705	33	379	27,967	1,065	8,849	19,119
Morris County	41,184	20,974	0	1,898	18,312	0	1,772	39,099	312	20,090	19,009
Ocean County	32,770	23,405	0	9,364	0	0	6,700	23,619	2,448	21,217	2,402
Passaic County	258,463	3,496	0	203,623	51,344	172,582	354	85,431	92	3,173	82,257
Salem County	10,738	5,382	0	5,356	0	247	4,880	2,700	2,910	2,553	147
Somerset County	5,604	3,847	0	1,757	0	0	428	4,775	400	3,299	1,476
Sussex County	6,351	4,916	0	1,434	0	3	979	5,213	152	4,722	492
Union County	54,394	4,329	700	49,365	0	1,066	901	52,288	136	3,325	48,963
Warren County	64,239	8,753	386	55,100	0	54,716	2,024	4,198	3,299	4,198	0
<b>Total</b>	<b>988,577</b>	<b>223,744</b>	<b>72,664</b>	<b>583,298</b>	<b>108,870</b>	<b>436,219</b>	<b>62,596</b>	<b>446,715</b>	<b>42,966</b>	<b>183,735</b>	<b>262,980</b>

**Table 1.** Average annual fresh water withdrawals by county in millions of gallons, 2000 to 2009.

**STATE OF NEW JERSEY**  
 Chris Christie, Governor  
 Kim Guadagno, Lieutenant Governor  
**Department of Environmental Protection**  
 Bob Martin, Commissioner  
**New Jersey Geological and Water Survey**  
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*This information circular is available upon written request or by downloading a copy from the NJGWS web site.*

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