Water Supply

Background

Annual water withdrawals in New Jersey have averaged close to three-quarters of a trillion gallons over the last five years. This water comes from aquifers or surface water sources including rivers and reservoirs. The water is used for a variety of purposes including potable drinking water; agriculture and irrigation; industry, including commercial use and mining operations; and power generation.

Sustainable water supply is a key factor in the potential development and redevelopment of the State. Despite statewide average precipitation of 46 inches per year, New Jersey must plan its water use carefully to prevent regional shortages and avoid ecological impacts associated with a depleted resource.

New Jersey has a formal water supply planning process. The New Jersey Statewide Water Supply Plan provides a framework to guide the management, conservation, and development of the State's water resources. It balances the demand for potable, industrial, recreational, and ecological uses to ensure that a safe and adequate water supply will be available into the foreseeable future, including during drought. The Plan and its periodic revision are mandated by the 1981 Water Supply Management Act. The first plan was released in 1982 and the first major revision in 1996. An update of the New Jersey Statewide Water Supply Plan was released on October 5, 2017.

Status and Trends

The population of New Jersey grew by nearly 100,000 individuals, or about 1%, over the 10-year period between 2010 and 2019 and is expected to grow by nearly 10% from 2014 to 2034. This population growth and associated population shifts in combination with a range of water use trends and in light of a changing climate will place additional stresses on water supplies and infrastructure that will require proactive and adaptive management at the state and local level.

Data for the following assessments are drawn from the New Jersey Water Transfer Model Withdrawal, Use, and Return Data Summaries. The associated databases contain measured and estimated monthly withdrawal, use, and return volumes at the municipal and watershed scales. Data includes withdrawals for potable water, self-supplied industrial, commercial, mining, and irrigation uses, as well as sanitary sewer discharges, and transfers of potable water between water purveyors.

The source of the State's water supply is either from surface waters (streams, rivers, and reservoirs) or from the ground (confined and unconfined aquifers). In New Jersey, nearly 75% of all withdrawals come from a surface-water source. The remaining withdrawals are distributed among confined and unconfined aquifers (Figure 1). State-wide production from domestic wells totals about 3% of total withdrawals. Confirmation of the aquifer source for any domestic well is extremely difficult to determine due to the large number of wells and limited data available. For this analysis all domestic wells are assumed to come from unconfined aquifers[4]. Withdrawals from surface water and groundwater sources have fluctuated between 1990 and 2018 (Figure 1). A significant reduction is present among withdrawals from surface water sources and from total groundwater sources (all confined and unconfined groundwater withdrawals) (Kendall tau Correlation, tau = -0.749, $p < 0.01$ and tau = -0.586, $p<0.01$). Estimated withdrawals from domestic (private) wells have increased by 1% on average each year from 1990 to 2007, then remained steady from 2008 to 2018.

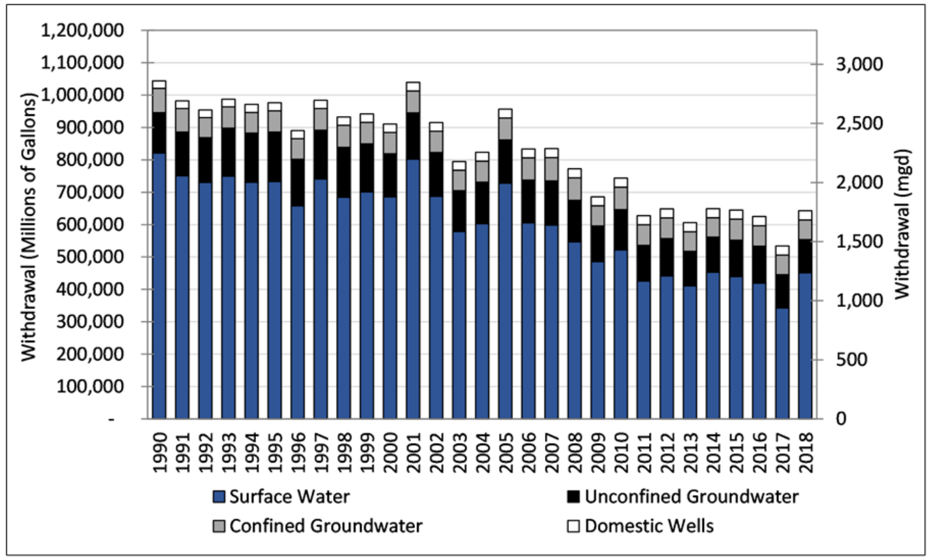

Figure 1. Source of water withdrawals for the period 1990 – 2018. Domestic wells are in large part located in unconfined aquifer units. Surface water withdrawals include hydropower.

The NJDEP's data indicates that statewide total annual water withdrawals have declined since 1990 (Kendall Tau correlation, tau = -0.744, $p < 0.01$). Three particular use groups, power generation, agriculture/irrigation, and commercial/industrial/mining, show a steady decrease in withdrawals since 1990 (Kendall Tau correlations, tau = -0.764, $p<0.001$; tau = -0.567, $p < 0.001$; and tau = -0.680, $p < 0.001$, respectively) (Figure 2). Water withdrawals for potable supply have not changed over this 29-year period. The recent reductions in withdrawals for power generation are due in part to reduced electricity production at coal burning and hydroelectric power plants.

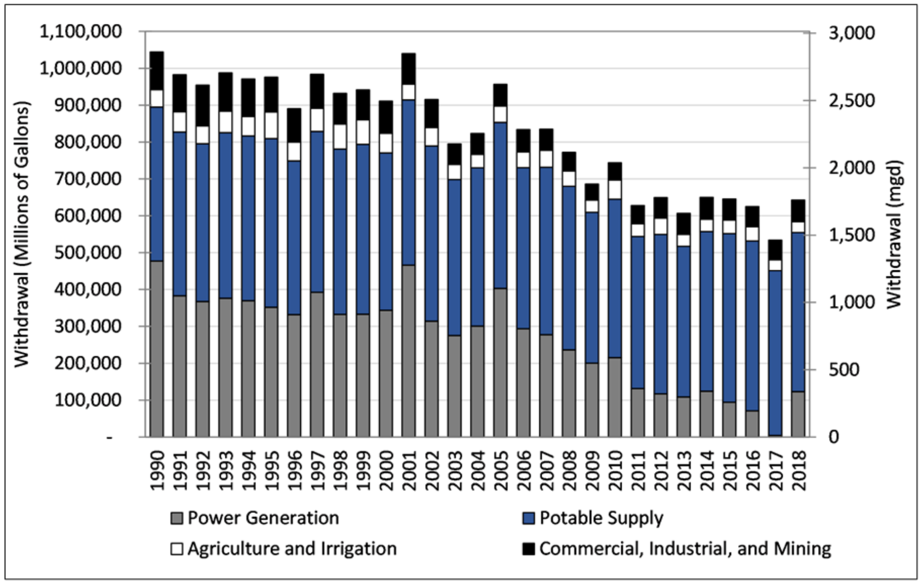

Figure 2. Annual withdrawals per year (1990-2018) by group.

Regional changes in water withdrawals from 2009 to 2018 are illustrated in Figure 3. The largest changes were for those watersheds where withdrawals decreased between 5% and 50%. That range of decrease occurred in 28% of the watersheds. Twenty-six percent of the watersheds experienced minor changes (between -5% and +5%) in withdrawals while 20% percent of the watersheds saw withdrawals increase between 5% and 50%. It should be noted though that percent changes can be quite large when withdrawals in 2009 were nonexistent or low and were present, or substantially greater, in 2018.

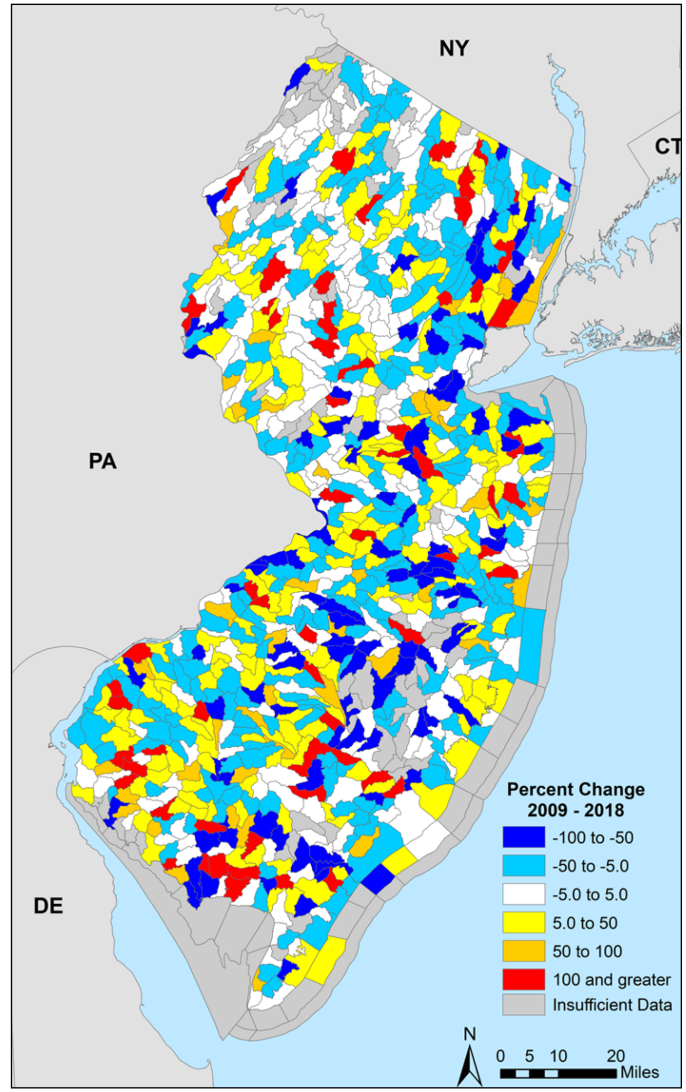

Figure 3. Percent Change in Water Withdrawals in New Jersey HUC14 Watersheds from 2009 to 2018.

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Potable supply usage shows no significant trend over the 29-year period or over the last ten years (Figure 4), consistent with water supply withdrawals. Withdrawals and usage are measured separately because usage does not always equal withdrawals, for instance water may be withdrawn then held in storage for later usage. Excluding water used for power generation, about eighty percent of total use has gone to potable supply over the past ten years (Figure 5). Potable supply has a number of users, mainly domestic consumers but some water is also directed to industrial and commercial users.

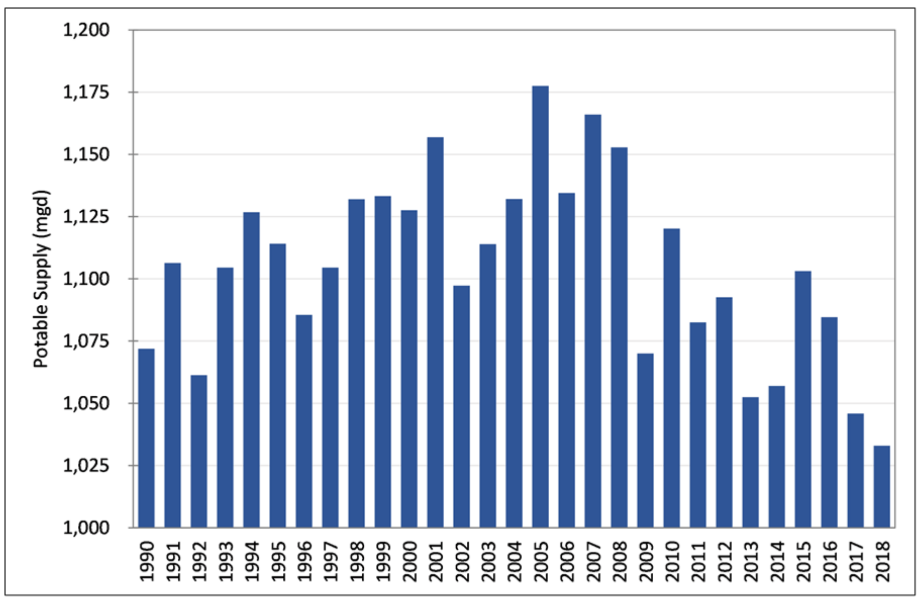

Figure 4. Annual potable supply use (million gallons per day, mgd) for the period 1990 – 2018.

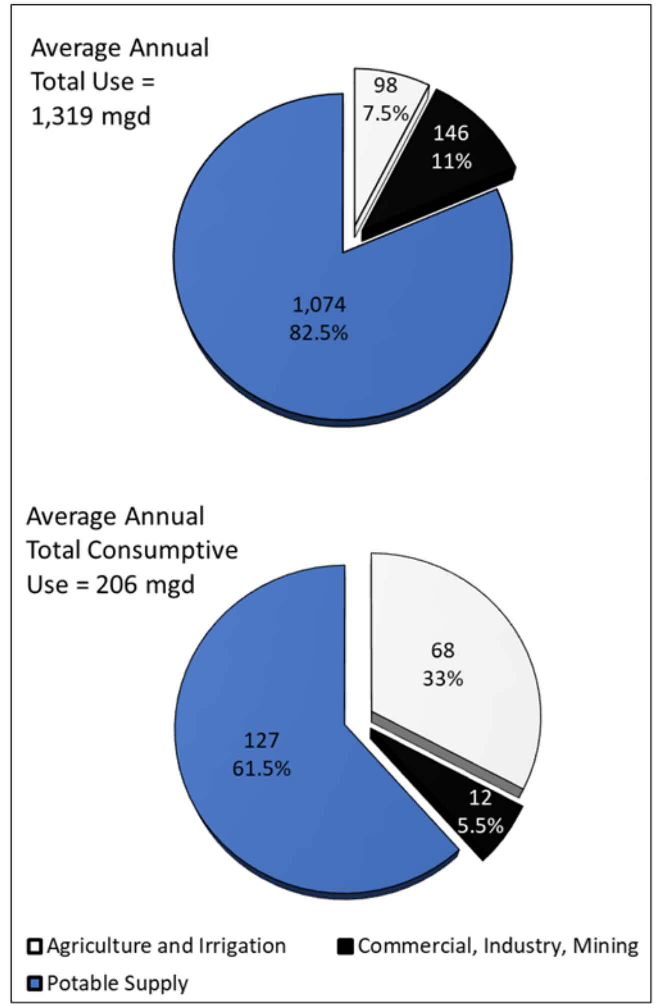

Figure 5. Pie charts showing the average annual use (million gallons per day, mgd) for the 10-year period 2009 – 2018 (top) and the average annual consumptive use (million gallons per day, mgd) for the same period (bottom). Water used by the power generation sector is not included because virtually all NJ power plants either use saline water for cooling or use freshwater in a flow-through, i.e. non-consumptive, manner.

Consumptive use (a.k.a. consumptive loss) describes water that is lost via evaporation and transpiration and is otherwise unavailable for reuse within the basin from which the withdrawal took place. No significant trend in total consumptive use was observed for the period 1990 to 2018 or the more recent 10-year period (Figure 6). The amount of consumptive use depends on the specific user and the season but is typically greatest as a percentage of total use for agricultural and irrigational purposes. Excluding water used for power generation, over half of the consumptive use is associated with potable supply. Consumptive use as a percentage of the total annual use has ranged from 10.4 to 19.5% over the 29-year period (Figure 6) and showed a slight increasing trend (Kendall Tau Correlation, tau = 0.463, $p < 0.01$), there has been no significant trend evident over the past 10 years.

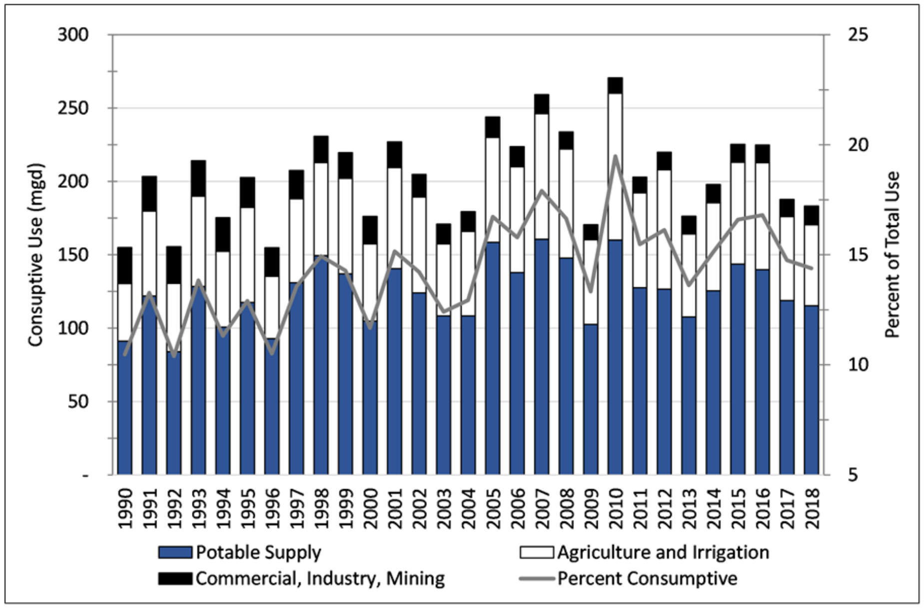

Figure 6. Annual (1990 – 2018) consumptive water use by group and the amount of consumptive use as a percentage of total water usage for the combined groups. Water used by the power generation sector is not included because virtually all NJ power plants either use saline water for cooling or use freshwater in a flow-through, i.e. non-consumptive, manner.

Consumptive use from agriculture and irrigation purposes ranged from 30.4 to 71.6% of total agricultural and irrigation use and has steadily increased over the 29-year period (Kendall Tau Correlation, tau = 0.724, $p < 0.001$), but shows no significant trend over the past 10 years. An explanation for the long-term increase in consumptive use for agriculture and irrigation may be in part, due to changing summer irrigation practices and shifting agricultural crops.

Over the 29-year period, consumptive losses associated with potable water supply have accounted for 54 to 65 percent of total consumptive losses with no significant trend over that time. Potable water supply consumptive losses ranged from 7.9 to 14.3 percent of total potable water use and shows no appreciable change over time. Total per capita potable usage has declined (Kendall Tau Correlation, tau = -0.737, $p < 0.001$) due in large part to plumbing code changes, increasing water efficiencies, and education. However, consumptive per capita rates of potable water show no significant changes over time (Figure 7).

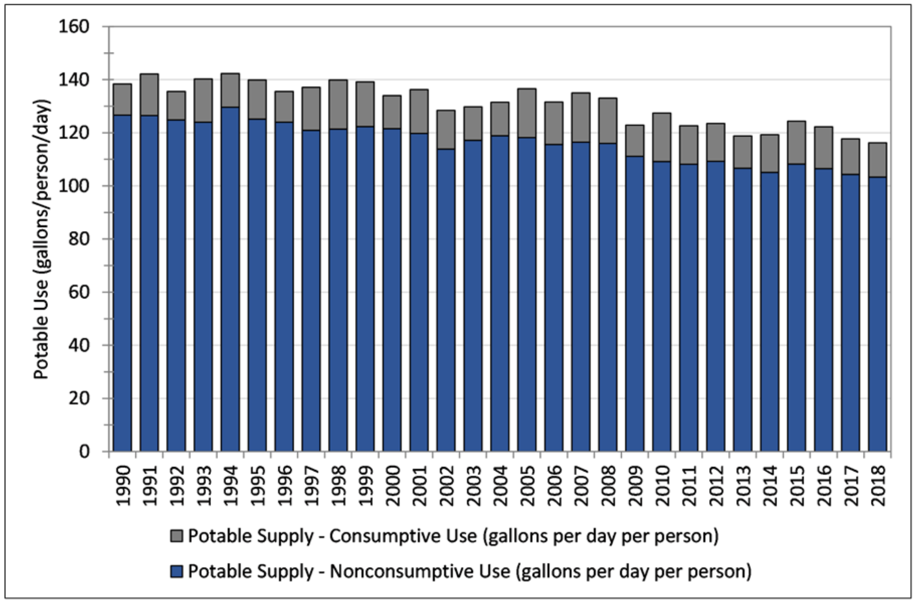

Figure 7. Per capita use rate of potable water supply.

When necessary, regional or statewide drought warnings and emergencies have been issued in order to protect the State's water resources. Current drought conditions are reported on the NJDEP Drought Information website at www.njdrought.org. Restrictions on water use during droughts may have an impact on the state's economy, but are necessary to protect potable supplies and aquatic resources. Potential adverse effects associated with extreme drought conditions include reduced assimilative capacity of streams, reduction of reservoir volume below sustainable levels, impacts to aquatic biota, increased saltwater intrusion potentially impacting drinking water sources, and added stress to water purveyor distribution systems. Increasing annual water demands without efficiency improvements and reduced consumptive losses represents a significant threat to the State's ecology because it translates to direct losses from the hydrologic system.

Outlook and Implications

Each day New Jersey discharges approximately 980 million gallons of sanitary sewer effluent directly to the ocean and bays.[5] One NJDEP program, Reclaimed Water for Beneficial Reuse (RWBR), involves using highly treated, reclaimed wastewater, to offset potable ground and surface water withdrawals. Reuse reduces demand on public water supplies and keeps water in the natural hydrologic system, which can be extremely beneficial during drought. Some examples of RWBR are landscape and agricultural irrigation, industrial uses, fire protection, aesthetic fountains and lagoons, construction uses, and sewer flushing. Depending upon the specifics of a source, extensive treatment and disinfection may be required to protect public health and the environment, while other applications involving limited public access may require substantially less treatment. RWBR is especially promising in areas where regional sewage treatment plants discharge to the ocean or bays. RWBR programs may only be authorized by the Department under the authority of a NJPDES discharge permit.

Regionally, some areas (for example, the Northeast drought region and the lower Cape May peninsula) currently face water supply challenges, which will require continued scrutiny and innovative water management strategies moving forward. Overall statewide, sufficient water supplies exist to meet demands – both current and as projected– provided efforts to increase efficiency, reduce consumptive water loss (from outdoor water use/landscape irrigation), and adequately maintain/enhance interconnections between water systems and other related infrastructure are instituted.

More Information

Data summarized for this chapter were provided by the Department of Environmental Protection, Division of Water Supply and Geoscience. Visit their website at https://www.njgeology.org/ for additional information and data sources.

References

1 New Jersey Office of the State Climatologist, available at http://climate.rutgers.edu/stateclim_v1/nclimdiv/

2 N.J.S.A. 58:1A-1 et. seq.

3 New Jersey Department of Labor and Workforce Development. 2019. Annual Estimates of the Population: April 1, 2010 to July 1, 2019. Table 1. Available online at https://nj.gov/labor/lpa/dmograph/est/est_index.html

4 New Jersey Department of Labor and Workforce Development. 2014. Population and Labor Force Projections for New Jersey: 2014 to 2034. Table 1. Available online at https://www.nj.gov/labor/lpa/dmograph/lfproj/sptab1.htm

5 New Jersey Geological and Water Survey. DGS10-3 New Jersey Water Transfer Model Withdrawal, Use, and Return Data Summaries. Updated January 2021. Available at https://www.nj.gov/dep/njgs/geodata/dgs10-3.htm.

6 Hoffman, J.L. and S.E. Lieberman. 2000. New Jersey Water Withdrawals 1990-1996. New Jersey Geological Survey Open-File Report OFR 00-1. Available online at www.state.nj.us/dep/njgs/pricelst/ofreport/ofr00-1.pdf.

7 Personal Communication with Steve Domber, New Jersey Geological and Water Survey. January 27, 2017.