4.4 DROUGHT

SECTION 4.4 DROUGHT

4.4-1 HAZARD OVERVIEW

Hazard Definition

Drought is a period typically characterized by long durations of below normal precipitation. However, they can also be "flash" events which come upon an area within months and weeks during warmer seasons. Drought is a temporary irregularity and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought conditions occur in virtually all climatic zones, yet its characteristics vary significantly from one region to another, since it is relative to normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life, causing far reaching impacts on economic, environmental, and social systems.

There are four different ways that drought can be defined or grouped:

- *Meteorological drought* is a measure of departure of precipitation from normal. It is defined solely on the relative degree of dryness. Due to climatic differences, what might be considered a drought in one location of the country may not be a drought in another location.
- *Agricultural drought* links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, and other parameters. It occurs when there is not enough water available for a particular crop to grow at a particular time. Agricultural drought is defined in terms of soil moisture deficiencies relative to water demands of plant life, primarily crops.
- *Hydrological drought* is associated with the effects of periods of precipitation shortfalls (including snowfall) on surface or subsurface water supply. It occurs when these water supplies are below normal. It is related to the effects of precipitation shortfalls on stream flows and reservoir, lake, and groundwater levels.
- *Socioeconomic drought* is associated with the supply and demand of an economic good with elements of meteorological, hydrological, and agricultural drought. This differs from other types of droughts because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods depends on the weather (for example water, forage, food grains, fish, and hydroelectric power). Socioeconomic drought occurs when the demand for an economic good exceeds supply because of a weather-related shortfall in water supply (National Drought Mitigation Center, 2012).

Secondary Hazards

Droughts may have devastating effects on communities and the surrounding environment. The amount of devastation depends on the strength and duration of a drought event. One impact of drought is its impact on water supply. When drought conditions persist with little to no relief, water restrictions may be put into place by local or state governments. These restrictions can include watering of lawns, washing cars, etc. In exceptional drought conditions, watering of lawns and crops may not be an option. If crops are not able to receive water, farmland will dry out and crops will die. This can lead to crop shortages, which, in turn, increases the price of food (North Carolina State University, 2013).

Droughts also have the potential to lead to, or exacerbate, water pollution due to the lack of rainwater to dilute any chemicals in water sources from sources such as discharge from wastewater treatment plants. Contaminated water supplies may be harmful to plants and animals. If water is not getting into the soils, the ground will dry up and become unstable. Unstable soils increase the risk of erosion and loss of topsoil (North Carolina State University, 2013).

The impacts on public health from drought can be severe which includes increase in heat-related illnesses, waterborne illnesses, recreational risks, limited food availability, and reduced living conditions. Those individuals who rely on water, such as farmers, may experience financial-related stress. Decreased amounts and quality of water during drought events have the potential to reduce the availability of electricity (hydropower, coal-burning, and nuclear).

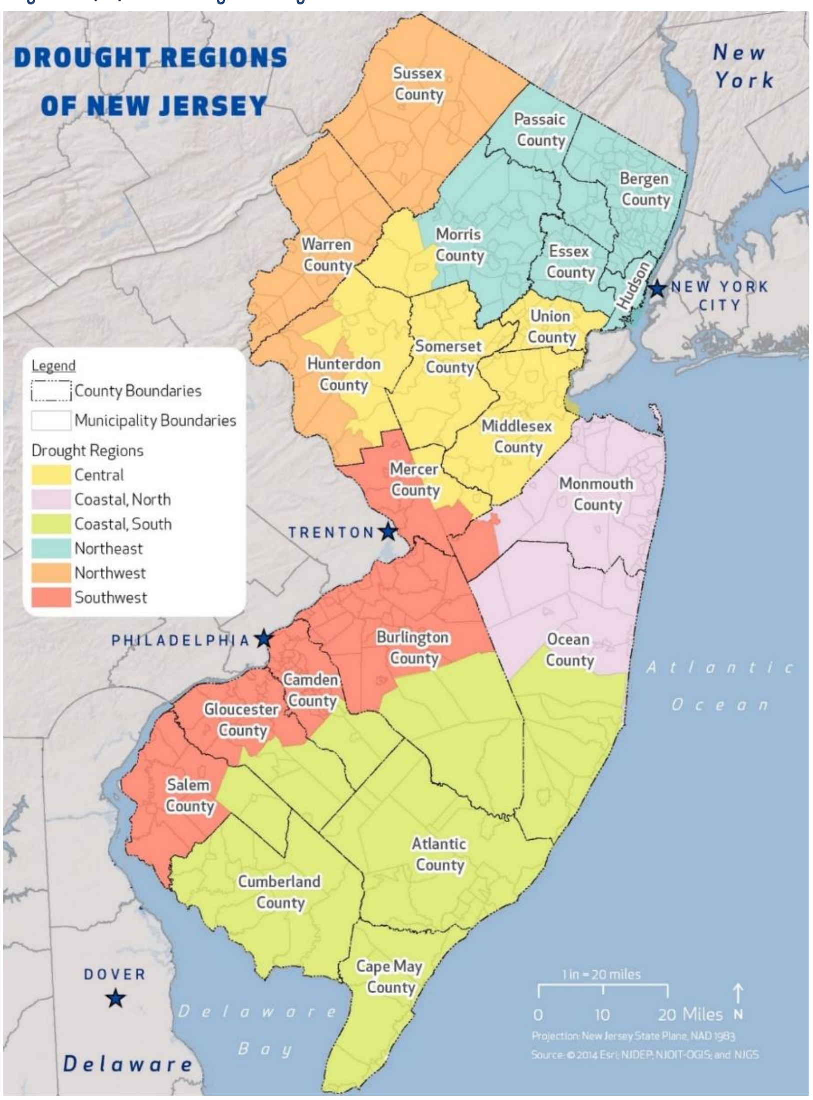
Drought, especially in combination with high temperatures can also increase the risk of wildfire due to increased evaporative demand, dry soils, and large-scale tree deaths which create fuel.

4.4-2 LOCATION, EXTENT, AND MAGNITUDE

Location

Climate divisions are regions within a state that are climatically homogenous. They are defined by National Oceanic and Atmospheric Administration. The boundaries of these divisions typically coincide with county boundaries, except in coastal areas (e.g. Division 3 in New Jersey) and the western United States, where they are based largely on drainage basins. According to NOAA, New Jersey is made up of three climate divisions: Northern, Southern, and Coastal (NOAA, 2012). The New Jersey Department of Environmental Protection divides New Jersey into six drought regions that are based on regional similarities in water supply sources and rainfall patterns (Hoffman and Domber, 2003). Drought regions allow New Jersey to respond to changing conditions without imposing restrictions on areas not experiencing water supply shortages. These regions were developed based upon hydro-geologic conditions, watershed boundaries, municipal boundaries, and water supply characteristics. Drought region boundaries are contiguous with municipal boundaries because during a water emergency, the primary enforcement mechanism for restrictions is municipal police forces.

Figure 4.4-1 Drought Regions



Source: New Jersey Department of Environmental Protection (NJDEP) GWS, 2004

Extent and Magnitude

The dimensions of drought can depend on the duration, intensity, geographic extent, and the regional water supply demands made by human activities and vegetation. The intensity of the impact from drought could be minor to major damage in a localized area or regional damage affecting human health and the economy. With the exception of flash droughts, impacts of drought evolve gradually over months or a season or two, and regions of maximum intensity change with time. The severity of a drought is determined by areal extent as well as intensity and duration. The frequency of a drought is determined by analyzing the intensity for a given duration, which allows determination of the probability or percent chance of a more severe event occurring in each mean return period.

National Drought Indices

Several indices developed by Wayne Palmer, the Palmer Drought Severity Index (PDSI) and Crop Moisture Index (CMI), as well as the Standardized Precipitation Index (SPI), are useful for describing the many scales of drought. Other indices include accumulated departure from normal stream flows, low-flow frequency estimates, and changes in water storage, groundwater levels and rates of decline, and lake levels. Most common indices that are used to measure or identify the severity and classification of past and present droughts primarily include, but not limited to, the following:

The PDSI was developed in 1965 and indicates prolonged and abnormal moisture deficiency or excess. The PDSI is an important climatological tool for evaluating the scope, severity, and frequency of prolonged periods of abnormally dry or wet weather. It can be used to help delineate disaster areas and indicate the availability of irrigation water supplies, reservoir levels, range conditions, amount of stock water, and potential intensity of forest fires.

The PDSI has become the semi-official drought index. It is the most effective in determining long-term droughts; it is not good with short-term determination. Table 4.4-1 lists the Palmer Classifications. A Palmer Classification of 0 is used as normal and drought is shown in terms of negative numbers. For example, -2 is moderate drought, -3 is severe drought, and -4 is extreme drought. The PDSI also reflects excess precipitation using positive numbers.

Table 4.4-1 PDSI Classification

Palmer Classification	Description
4.0 or more	Extremely Wet
3.0 to 3.99	Very Wet
2.0 to 2.99	Moderately Wet
1.0 to 1.99	Slightly Wet
0.5 to 0.99	Incipient Wet Spell
0.49 to -0.49	Near Normal
-0.5 to -0.99	Incipient Dry Spell
-1.0 to -1.99	Mild Drought
-2.0 to -2.99	Moderate Drought
-3.0 to -3.99	Severe Drought
-4.0 or less	Extreme Drought

Source: National Drought Mitigation Center (NDMC), 2013

The CMI, developed by Palmer in 1968, can be used to measure the status of dryness or wetness affecting warm season crops and field activities. It gives the short-term or current status of purely agricultural drought or moisture surplus and can change rapidly from week to week (National Weather Service Climate Prediction Center, 2005). According to NOAA, the CMI responds more rapidly than the PDSI, so it is more effective in calculating short-term abnormal dryness or wetness affecting agriculture. CMI is designed to indicate normal conditions at the beginning and end of the growing season; it uses the same levels as the Palmer Drought Severity Index.

The SPI is a probability index that considers only precipitation. It is based on the probability of recording a given amount of precipitation. The probabilities are standardized so that an index of zero indicates the median precipitation amount (half of the historical precipitation amounts are below the median, and half are above the median). The index is negative for drought, and positive for wet conditions. The SPI is computed by National Centers for Environmental Information (NCEI) for several time scales, ranging from one month to 24 months, to capture the various scales of both short-term and long-term drought.

The Keetch-Byram Drought Index (KBDI) is a drought index designed for fire potential assessment. It is a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. The index increases each day without rain and decreases when it rains. The scale ranges from 0 (no moisture deficit) to 800 (maximum drought possible). The range of the index is determined by assuming that there is eight inches of moisture that is readily available to the vegetation in saturated soil. For different soil types, the depth of soil required to hold eight inches of moisture varies. A prolonged drought influences fire intensity, largely because more fuel is available for combustion. The drying of organic material in the soil can lead to increased difficulty in fire suppression. The Precipitation Index is a comparison of measured precipitation amounts (in inches) to historic normal precipitation. Cumulative amounts for 3-, 6- and 12-month periods are factored into the drought determination. Data are available on the New Jersey Forest Fire Service website at http://www.nj.gov/dep/parksandforests/fire/firedanger- restrictions.html.

New Jersey Drought Indices

New Jersey developed a unique set of indices following issues measuring droughts in 1998 and 1999. This new set of statewide indicators, implemented in 2001, supplements the PDSI with the measurement of regional precipitation, streamflow, reservoir levels, and groundwater levels. New Jersey currently measures the status of each indicator as near or above normal, moderately dry, severely dry, or extremely dry. The status is based on a running 90-day statistical analysis of historical values with generally the driest 10% being classified as extremely dry, from 10% to 30% as severely dry, and 30% to 50% as moderately dry.

When there is less precipitation than normal, New Jersey experiences drought. However, a few dry days or even a month of dry weather does not create a water supply drought. It can take months of less than average rainfall to do this. The difference between the actual amount of precipitation measured during a month and the historical average for that month is either a negative or positive number, indicating a deficit or surplus. The monthly surplus or deficit can vary significantly from month-to-month and is not a good indicator of a water supply drought. A better method to use is a running 3-month total. This number is the surplus or deficit in a given month added to the values of the two previous months. To use the indicator on a daily basis, precipitation during the previous 90-day period is compared to the average in past years. This data comes from the Office of the New Jersey State Climatologist and the NWS's Middle Atlantic River Forecast Center (Hoffman and Domber, 2003). Precipitation data is collected from NWS Cooperative Observing Program (COOP) Stations. COOP is a weather and climate observing network that is made up of more than 11,000 volunteers across the nation who take daily observations. Data collected support the NWS climate program. Observers typically record temperature and precipitation daily and send those reports electronically to the NWS and are eventually quality controlled and archived at NCEI (NWS, 2013). Approximately 30 NJ Coop stations are augmented by observations from the Rutgers New Jersey Weather Network and New Jersey Community Collaborative Rain, Hail, and Snow Network (Robinson, 2013).

The Groundwater Level Index is based on the number of consecutive months that groundwater levels are below normal (lowest 25% of period of record for the respective months). The United States Geological Survey (USGS) monitors groundwater levels in a network of monitoring wells throughout New Jersey. Groundwater condition maps showing areas of above normal, normal, and below normal (monthly conditions compared to monthly normals) are provided by the USGS on a monthly basis.

The Stream Flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record for the respective months). The USGS monitors stream flow in a network of 111 gages throughout New Jersey. Stream flow conditions maps showing areas of above normal, normal, and below normal (monthly conditions compared to monthly normals) are provided by the USGS on a monthly basis. In addition, USGS provides a table that describes the cumulative monthly stream flow condition as normal, above normal, or below normal (USGS 2023).

New Jersey maintains a real-time groundwater level monitoring system consisting of seven observation wells throughout the state. The network, a cooperative between the USGS and NJDEP, uses satellite telemetry to provide observations in four-hour increments. Observations are available on the USGS website at http://water.usgs.gov/nj/nwis/current/?type=gw. The primary purpose of the network is to provide information regarding the status of wells throughout the state and to anticipate potential shortages (NJDEP, 2002).

The Reservoir Index is based on the water levels of small, medium, and large index reservoirs across the state. The reservoir level relative to normal conditions will be considered. The NJDEP maintains a listing of current reservoir levels across the State and the Northeast. The current reservoir levels are available at http://www.njdrought.org/reservoir.html.

New Jersey also maintains a real time Regional Drought Indicator Status, showing the level of 90-day precipitation, 90-day stream flow, reservoir levels, the Delaware River Basin Commission reservoir levels, and the unconfined groundwater levels in terms of dryness indices. These indicators determine the Declared Drought Status for each drought region. The observations and status are available at http://www.njdrought.org/current.html.

4.4-3 PREVIOUS OCCURRENCES AND LOSSES

FEMA Disaster Declarations

Since 2010, there have been no FEMA Disaster Declarations for droughts in New Jersey.

Historical Events Summary

Historically in New Jersey there have been several severe drought periods. Major droughts occurred in the State from 1929 to 1932, 1949 to 1950, 1953 to 1955, 1961 to 1966, 1980 to 1981, 1998 to 2002, and 2016 to 2017(USGS, 1989; Robinson, 2013, NJDEP, 2017).

Many sources provided historical information regarding previous occurrences and losses associated with drought events throughout New Jersey. With so many sources reviewed for the purpose of this HMP, loss and impact information for many events could vary depending on the source. Therefore, the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP.

The most recent significant drought occurred from July to December 2022. During this time a drought condition was declared for at least some part of every county in the state. The counties that experienced severe drought conditions were Atlantic, Bergen, Cape May, Cumberland, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, and Union. USDA declared seven different drought-related disaster declaration over the course of the year. For this plan update, drought events that occurred in the State since 2010 are included in this section and listed in Table 4.4-2. This table incorporates observations of the extent of drought conditions from the National Drought Monitor, as well as declarations made by the New Jersey Department of Environmental Protection where drought status impacts water supply.

Table 4.4-2 Significant Historic Drought Events Since 2010

Date of Event	Counties Affected	Description
July to October 2010	Statewide	On August 5, the NJDEP issued a drought watch for northeast New Jersey. At the height of the drought event in September, over 27 percent of the state was experiencing severe drought conditions while 56 percent and 16 percent of the state was experiencing moderate drought and abnormally dry conditions, respectively. The meteorological summer was the 10th driest (8.65 inches) on record dating back to 1895 in New Jersey and was also the driest summer since 1966.
March to June 2012	Statewide	Lowest PDSI of -3.29 in April, with 5 weeks of the entire state experiencing moderate drought conditions across April and May. Drought conditions were most persistent in Cape May and Cumberland Counties, lasting until mid-June.
October 2014	Passaic and Sussex Counties	Small areas of northern Passaic and Sussex Counties experienced moderate drought conditions in late October 2014.

Date of Event	Counties Affected	Description
May to June 2015	Bergen, Hudson, Morris, Passaic, Somerset, Sussex, Union, and Warren Counties	At the height of the drought event in late May, over 29 percent of the state was experiencing moderate drought conditions. Drought conditions were most persistent in parts of Passaic, Sussex, and Warren Counties, lasting just over a month.
September 2015 to January 2016	Statewide	A drought watch was issued that impacted more than two-thirds of New Jersey's Population. At the height of the drought event in late September, 43 percent of the state was experiencing moderate drought conditions. The northeast region of the state, specifically Bergen, Essex, Hudson, Middlesex, Monmouth, and Union Counties, dealt with the most extended periods of drought.
October 2016 to April 2017	Bergen, Essex, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union and Warren Counties	Drought conditions were the worst faced by New Jersey in 14 years. The entire state was experiencing some level of drought conditions at the height of the drought event in late November and early December, with nearly 38 percent of the state experiencing severe drought conditions, 34 percent experiencing moderate drought, and 28 percent was abnormally dry. NJDEP issued a Drought Warning for much of Northern and Central New Jersey due to the severity of this period of drought.
September 2019 to October 2019	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Middlesex, Monmouth, Ocean, Salem, and Somerset Counties	At the heigh of the drought event, 37 percent of the state was experiencing moderate drought conditions. Salem County experienced drought conditions the longest, with parts of the county under moderate drought for around a month.
March to April 2022	Atlantic, Camden, Cape May, Cumberland, Gloucester, and Salem Counties	At the height of the drought event, nearly 27 percent of the state was experiencing moderate drought conditions. Atlantic, Cape May, and Cumberland Counties experiencing drought conditions the longest, with moderate drought persisting for over a month.
July to December 2022	Statewide	A statewide Drought Watch was instituted from early August to late December. September was the most severe month, as 67 percent of the state was under moderate drought conditions and an additional 29 percent were under severe drought conditions during the first two weeks of the month.
April 2023	Bergen, Essex, Morris, and Passaic Counties	Parts of northern counties experienced moderate drought for around 2 weeks, with the largest areas in Bergen and Passaic Counties.

Sources: NJDEP; NRCC, 2013; Hardison, 1968; NJDEP, 1983; NOAA-NCEI, 2023

Agriculture-Related Drought Disasters

Agriculture-related drought disasters are quite common. One-half to two-thirds of the counties in the United States have been designated as disaster areas in each of the past several years. The USDA Secretary of Agriculture is authorized to designate counties as disaster areas to make emergency loans to producers suffering losses in those counties and in counties that are contiguous to a designated county. Table 4.4-3 presents USDA declared drought and excessive heat events impacting the State.

Table 4.4-3 USDA Drought-Related Disaster Declarations 2012 to 2023

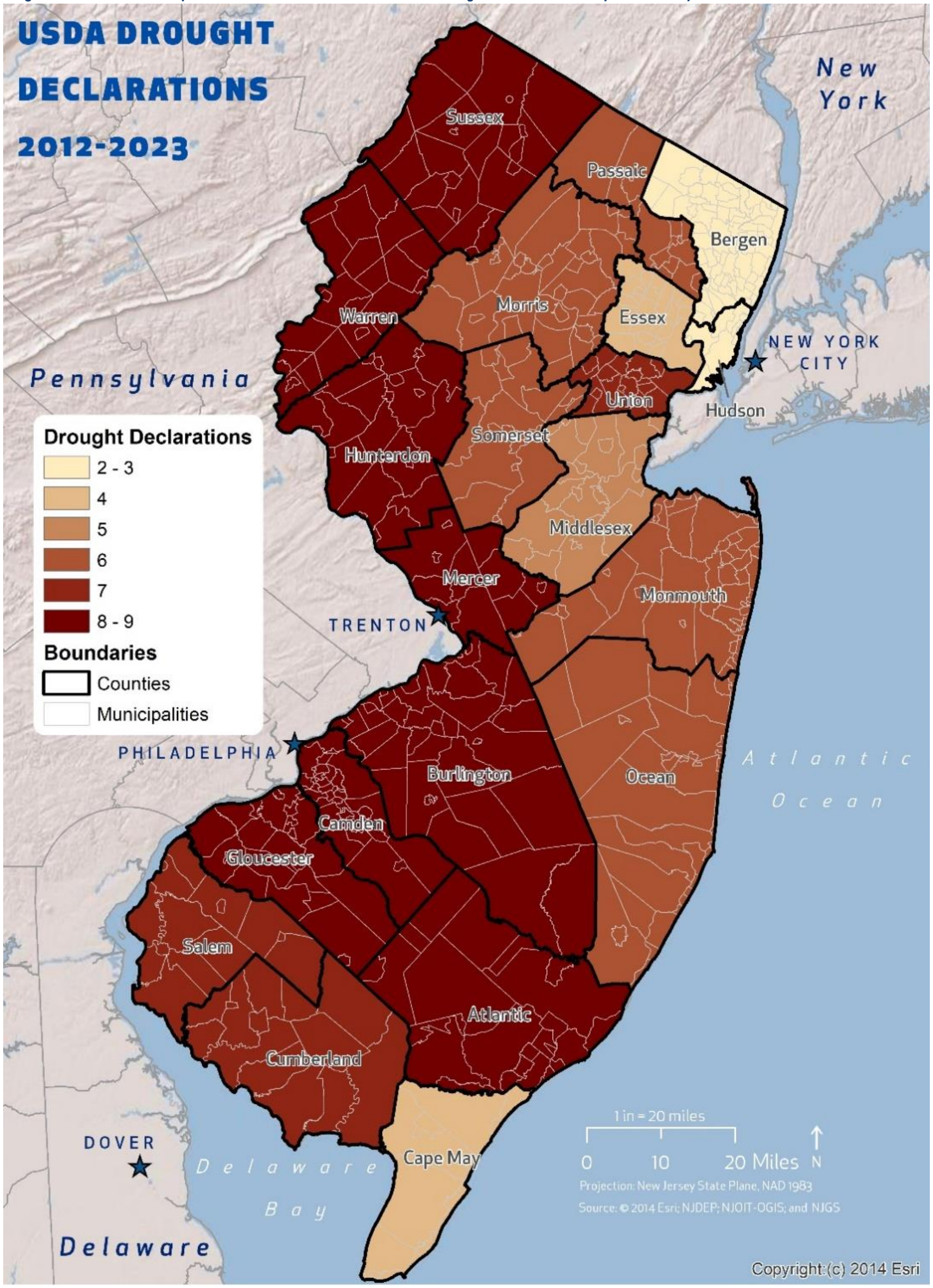
Incidence Period	Event Type	USDA Designation Number	Counties Included in Disaster
June 2012	Drought, Excessive Heat	S3427	Passaic, and Sussex
June 28, 2012, to November 9, 2012	Drought, High Winds, Hail, Excessive Heat, Excessive Rain, Flash Flood, Hurricane Sandy, Snowstorm, and Nor'easter	S3487	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Monmouth, Morris, Ocean, Passaic, Salem, Sussex, and Warren
August 15, 2014	Drought	S3759	Sussex and Passaic
April 1, 2015, to September 29, 2015	Drought, Heat, Excessive Heat, High Temperature	S3930	Atlantic, Burlington, Camden, Essex, Cumberland, Mercer, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union and Warren
July 16, 2015, to September 29, 2015	Drought, Heat, Excessive Heat, High Temperature	S3932	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Ocean, Salem

Incidence Period	Event Type	USDA Designation Number	Counties Included in Disaster
April 1, 2016, to September 19, 2016	Combined effects of freeze, excessive heat, and drought	S4071	Atlantic, Burlington, Camden, Cape May, Cumberland, Essex, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean, Salem, Somerset, Union,
November 15, 2016	Drought	S4114	Sussex
June 24, 2018, to July 21, 2018	Excessive Heat and Drought Conditions	S4425	Atlantic, Camden, Cumberland, Gloucester, Salem
May 1, 2016, to December 10, 2016	Drought, Heat, Excessive Heat, High Temperature, Frist	S4165	Hunterdon, Mercer, Warren, Burlington
August 15, 2019, to October 16, 2019	Drought	S4602	Atlantic, Camden, Cumberland, Gloucester, Salem
August 9, 2022, to N/A	Drought*	S5305	Bergen, Essex, Hudson, Union
August 9, 2022, to N/A	Drought*	S5306	Bergen, Passaic, Sussex
August 16, 2022, to N/A	Drought*	S5312	Hunterdon, Mercer, Middlesex, Monmouth, Morris, Somerset, Union
April 7, 2022, to October 3, 2022	Drought	S5338	Burlington, Hunterdon, Mercer, Warren
July 1, 2022, to August 18, 2022	Drought and Excessive Heat	S5345	Essex, Hunterdon, Morris, Passaic, Somerset, Sussex, Union, Warren
July 1, 2022, to September 14, 2022	Drought	S5346	Hunterdon, Mercer, Middlesex, Morris, Somerset, Union, Warren
June 18, 2022, to September 5, 2022	Drought and Excessive Heat	S5347	Atlantic, Burlington, Camden, Gloucester, Mercer, Monmouth, Ocean
July 1, 2022, to Present	Drought and Excessive Heat	S5348	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Ocean, Salem, Somerset, Union
July 1, 2022, to September 4, 2022	Drought	S5359	Sussex and Warren
August 1, 2022, to November 11, 2022	Excessive Heat and Drought	S5364	Cumberland and Sussex

** These Disaster Declarations were "Fast Tracked" by USDA, so they were approved and given a designation before events earlier in the year.*

Source: USDA, 2023

Figure 4.4-2 Map of USDA and FEMA Drought Events by County



Source: USDA, 2023

4.4-4 PROBABILITY OF FUTURE OCCURRENCES

Based upon risk factors for past occurrences, it is likely that droughts can occur across New Jersey in the future. In addition, as projected temperatures increase, the probability for future droughts will likely increase. Therefore, it is likely that droughts will occur in New Jersey of varied severity in the future.

Potential Effects of Climate Change

Climate change is anticipated to increase the risk of drought in the State due to factors including changes in precipitation patterns and increases in temperature. Climate change is a major driver of changes in the frequency, duration, and geographic distribution of rainfall. Paradoxically, although New Jersey is becoming wetter overall, it is also projected to experience more frequent and severe droughts with the potential to seriously impact people's health and threaten food supplies (NJDEP, 2022).

The state's 2020 Scientific Report on Climate Change makes clear that changes in precipitation patterns and particularly extended periods of low rainfall are likely to make droughts more frequent, adding stress to local water supplies (NJDEP, 2020). Climate models project that droughts lasting three to six months and longer may increase in frequency in the Northeastern United States. Also, short-term summer droughts could increase in frequency (NJDEP, 2020)

Average annual temperatures in New Jersey are expected to increase by 4.1° F to 5.7° F by 2050 (NJDEP, 2020). Higher temperatures cause increased human consumption of water through increased demand and from agricultural activity due to increased evapotranspiration (the release of moisture from open water and soils by evaporation and from plants by transpiration). In some regions reduced snow-to-rain ratios due to warmer winter temperatures may lead to significant differences between timing of water supply and demand (NCA, 2018) and impacting the ability of groundwater to recharge. These factors could significantly affect the sustainability of water supplies in the future.

Additionally changing climatic norms can cause compounded effects if occurring simultaneously. For example, a heatwave in conjunction with extended periods of dry weather in the summer season can lead to drought and result in more significant impacts than when either event occurs alone (NJDEP, 2020).

4.4-5 VULNERABILITY ASSESSMENT

To understand risk, the assets exposed and vulnerable to the hazard areas are identified. For the drought hazard, the entire State of New Jersey is exposed. Impacts on the public, responders, continuity of operations, delivery of services; property, facilities, and infrastructure; and the environment, economic condition of the State, and the public confidence in the State's governance is discussed in Section 10 in accordance with Emergency Management Accreditation Program (EMAP) standards. This section addresses assessing vulnerability and estimating potential losses by jurisdiction within New Jersey and to State facilities.

It should be noted that New Jersey has a robust water supply management program which has the adaptive capacity to move surface water across the state to meet water supply needs. This capacity is finite however, as not all of the state is served by interconnected systems which have this ability. More isolated, less densely populated areas of the state may have less flexibility in drought conditions.

Vulnerable Jurisdictions

A review of the historic record indicates that all counties have experienced drought. Further, all counties identified drought as a hazard of concern in their hazard mitigation plans, as summarized in the table below. In addition to the rankings created by the counties, Table 4.4-4 includes the Hazard Risk Rating data from the National Risk Index. For drought, the ratings are based on agricultural (crop only) impacts.

Table 4.4-4 Drought Risk Rankings

County	NRI Drought Hazard Risk Rating	Ranking of Drought Hazard by County HMP
Atlantic	Relatively Moderate	Low
Bergen	Very Low	Profiled, Not Ranked
Burlington	Relatively Low	Medium
Camden	Relatively Low	Low
Cape May	Relatively Low	Low
Cumberland	Relatively Low	Low

County	NRI Drought Hazard Risk Rating	Ranking of Drought Hazard by County HMP
Essex	Very Low	Low
Gloucester	Relatively Low	Medium
Hudson	Very Low	Low
Hunterdon	Relatively Low	Low
Mercer	Relatively Low	Low
Middlesex	Relatively Low	Medium
Monmouth	Relatively Low	Low
Morris	Relatively Low	Low
Ocean	Relatively Low	Medium
Passaic	Relatively Low	Low
Salem	Relatively Low	Low
Somerset	Relatively Low	Medium
Sussex	Relatively Low	Low
Union	Very Low	Medium
Warren	Relatively Low	Medium

Source: FEMA NRI (accessed June 2023), County HMPs (accessed June 2023)

Built Environment

Buildings are not anticipated to be directly affected by a drought, however the building's reliance on water supply may affect its operation during periods of drought. New Jersey has a robust water supply management program that has the adaptative capacity to move surface water across the state to meet water supply needs. Additionally, the state's water supply plan identifies that the practice of aquifer storage and recovery (ASR) to transfer water between groundwater sources is being piloted across 16 locations across the state. There are approximately 200,000 wells across the state that service both individual homes and municipal water systems. The water supply management programs at NJDEP are designed to minimize the potential impacts to the operation of critical infrastructure during drought. There may be need to evaluate and enhance capacity for this program in the future.

Lifeline Impacts

FEMA created the eight Community Lifelines to contextualize information from incidents, communicate impacts in plain language, and promote a more unified effort across a community that focuses on stabilizes these lifelines during response. More information on these lifelines can be found in Section 4.1: Risk Assessment Overview. Table 4.4-5 showcases the most likely lifelines to be impacted by drought, including a short description of anticipated impacts.

Table 4.4-5 Lifelines Most Likely Impacted by Drought

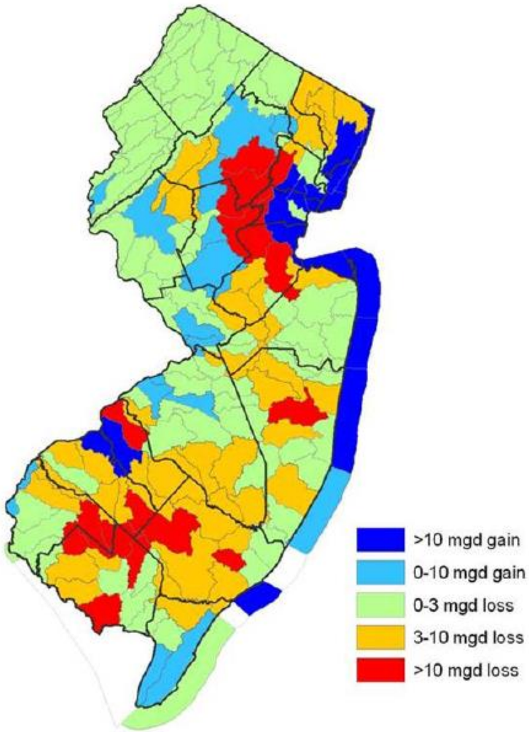
Lifeline Categories	Notable Impacts
Food, Hydration, Shelter	Drought can pose a significant threat to the Food, Hydration, and Shelter Lifeline. Drought can have devastating impacts on agricultural production, impacting local and sometimes international food supply chains.
Energy	Drought can impact the Energy lifeline in regions that derive a significant amount of electrical supply from hydropower.
Water Systems	Drought can have an adverse impact on Water System lifelines. In cases where water demand exceeds supply, utilities may have to ration water. Severe drought may result in a loss of water pressure and water supply. Additionally, water quality may be impacted requiring additional treatment.

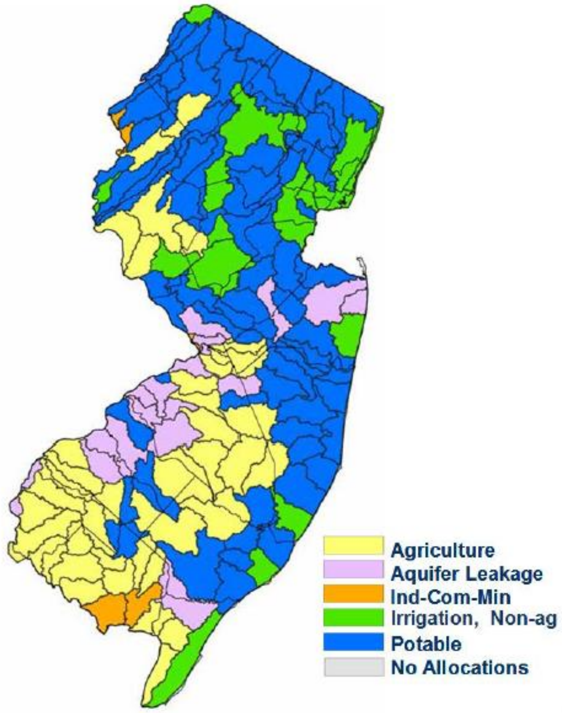
Population and Economy

Population Impacts

Drought impacts cross jurisdictional boundaries and primarily impact the population's water supply. The New Jersey Water Supply Plan identifies depletive and consumptive loss from unconfined groundwater and surface water sources at peak use rates and compares this loss with the primary causes of depletive and consumptive loss at peak use rates. Figure 4.4-3 illustrates this comparison below.

Figure 4.4-3 Depletive and Consumptive Loss from Unconfined Groundwater and Surface Water Sources (LEFT) and Primary Causes of Depletive and Consumptive Loss at Peak Use Rates (RIGHT)





Source: NJ Water Supply Plan, 2017

As development continues in New Jersey, the demand for water will increase as well. While New Jersey is not particularly prone to extreme instances of drought, increased demand has the potential to exacerbate moderate or severe droughts. New development in the southern portion of the State could increase the vulnerability to drought events in terms of water supply. This is because the major source of water in southern New Jersey is the unconfined Kirkwood-Cohansey aquifer with a limited number of reservoirs for the collection and storage of back-up supply. As indicated in Section 3.0: State Profile, New Jersey population is anticipated to grow. Growth in population will increase demand for water and may make the area increasingly vulnerable to the direct and indirect water supply impacts associated with drought.

Economic Impacts

Drought can produce a range of impacts that span many sectors of an economy and can reach beyond an area experiencing physical drought. This is because water is integral to our ability to produce goods and provide services. Direct economic impacts of drought include reduced crop yield, increased fire hazard, reduced water levels, and damage to wildlife and fish habitat. The indirect consequences of these impacts can include reduction in crop, rangeland, and forest productivity that may result in reduced income for farmers and agribusiness, and increased prices for food and timber. Industries that rely on water for business may be impacted the hardest (e.g., landscaping businesses). Even though most businesses will still be operational, fewer people may be employed due to production declines causing high levels of unemployment. Additionally, some businesses may be impacted aesthetically. These aesthetic impacts are most significant to the recreation and tourism industry.

The agricultural industry is most at risk. Damaged and dead crops are also vulnerable to insect infestation, plant disease, and wildland fires which can spread easily during periods of drought. A prolonged drought event could have significant impacts to the State's economy, particularly in counties that have large amounts of agricultural lands. While agriculture is not the primary commodity for New Jersey, it is significant enough to impact the State should a prolonged drought occur. Damage or complete loss of a crop will have direct economic impacts on the agricultural industry in New Jersey. Refer to Table 4.4-6 for detailed statistics on the agricultural industry's influence on New Jersey's economy.

To estimate land exposure to drought, agricultural land acreage was used. Table 4.4-6 lists the counties that have the greatest acreage of farmland across the State, which include: Burlington, Cumberland, Gloucester, Hunterdon, Monmouth, Salem, Sussex, and Warren. These counties also have the greatest number of farms.

Table 4.4-6 Agricultural Statistics for New Jersey

County	Number of Farms	% of Total Farms In State	Land In Farms (Acres)	Market Value of Products Sold	% of State Total
Atlantic	450	4.55%	29,016	$120,673,000	10.99%
Bergen	74	0.75%	1,051	Data Withheld*	N/A
Burlington	915	9.26%	96,256	$98,580,000	8.98%
Camden	197	2%	9,298	$22,893,000	2.09%
Cape May	164	1.66%	8,135	$9,838,000	0.90%
Cumberland	560	5.67%	66,256	$212,649,000	19.37%
Essex	22	0.22%	191	Data Withheld*	N/A
Gloucester	580	5.87%	49,381	$102,454,000	9.33%
Hudson	4	0.04%	26	Data Withheld*	N/A
Hunterdon	1,604	16.22%	101,290	$92,246,000	8.40%
Mercer	323	3.27%	25,230	$24,981,000	2.28%
Middlesex	217	2.20%	16,023	$38,359,000	3.49%
Monmouth	838	8.48%	39,198	$80,633,000	7.34%
Morris	418	4.22%	14,514	$24,824,000	2.26%
Ocean	260	2.63%	8,510	$24,640,000	0.26%
Passaic	89	0.90%	1,893	$2,863,000	9.32%
Salem	781	7.90%	98,239	$102,342,000	1.83%
Somerset	452	4.57%	35,862	$20,118,000	1.66%
Sussex	1008	10.19%	59,766	$18,226,000	N/A
Union	9	0.09%	75	Data Withheld*	8.49%
Warren	918	9.23%	73,874	$93,217,000	10.99%
State Total	9,883	00%	734,084	$1,097,950,000	100%

Withheld to avoid disclosing data for individual operations.

Source: USDA, 2017

Droughts have the potential to impact agriculture-related facilities and critical facilities that are associated with potable water supplies. Table 4.4-7 contains estimated annual loss values for agriculture per county due to drought according to the FEMA NRI tool. The tool estimates that drought could cause an annual loss of $3,522,252.85 in agricultural productivity alone.

Table 4.4-7 Estimated Annual Losses for Agriculture- Drought

County	Annual Estimated Losses - Agriculture
Atlantic	$324,625.75
Bergen	$24,216.10
Burlington	$233,954.31
Camden	$251,200.63
Cape May	$213,336.58
Cumberland	$251,733.34

County	Annual Estimated Losses - Agriculture
Essex	$11,276.38
Gloucester	$265,442.67
Hudson	$11,106.06
Hunterdon	$229,826.00
Mercer	$211,017.23
Middlesex	$301,806.70
Monmouth	$190,741.37
Morris	$247,322.09
Ocean	$71,281.87
Passaic	$28,344.77
Salem	$205,202.01
Somerset	$196,383.55
Sussex	$50,278.45
Union	$10,821.33
Warren	$192,335.66
Total	**$3,522,252.85**

Source: FEMA NRI (accessed June 2023)

Ecosystems and Natural Assets

Wildlife

Drought impacts on animal populations impact the overall ecosystem. Lack of feed and drinking water and decrease in habitat quality can lead to disease, loss of biodiversity, increased vulnerability to predation, and disruption of reproductive cycles.

Water Resources

Drought has the potential to impact the State's water supply. New Jersey relies on reservoirs and groundwater as the main sources of water. However, the majority of these reservoirs are located in the northern part of the state and the major source of water in the southern part of the state is unconfined groundwater. The water supply in the southern part of the State has the potential to be vulnerable to prolonged periods of drought, since there are a limited number of reservoirs to back up the groundwater supply.

Drought can also result in the degradation of water quality by increasing the concentration of pollutants in the waterbody. Additionally, the associated decreased flow in the stream or river may cause stagnation, which reduces water quality and there may be a reduction in oxygen levels that occur when water temperatures warm.

Freshwater and Coastal Wetlands

Many species harvested by commercial fisheries and shellfisheries rely on freshwater, coastal, and brackish wetlands for food or habitat. Prolonged draught has the potential to dry up wetlands resulting in damage to fish habitat and loss from fishery production. Loss of wetlands can lead to a loss to the recreational fisheries and tourism industry, as well.