

5.4.2 Drought

This section provides a hazard profile (description, location, extent, previous occurrences and losses, probability of future occurrences, and impact of climate change) and vulnerability assessment of the drought hazard for the Allegany County Hazard Mitigation Plan (HMP).

5.4.2.1 Hazard Profile

This section presents information regarding the description, location and extent, previous occurrences and losses, and probability of future occurrences for the drought hazard.

Description

Drought is a period characterized by long durations of below normal precipitation levels. Drought is a temporary irregularity that differs from aridity, which is a permanent feature of climate restricted to regions with typically low rainfall. Drought conditions occur in virtually all climatic zones. Drought characteristics vary significantly from one region to another, and are relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

Drought can be defined or grouped in the following four ways:

- **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.
- **Hydrological** drought is associated with the effects of periods of precipitation shortfalls (including snowfall) on surface or subsurface water supply, and 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.
- **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 groundwater 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.
- **Socioeconomic** drought is associated with the supply and demand of an economic good with elements of meteorological, hydrological, and agricultural drought. This differs from the aforementioned types of drought 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 weather (for example, water, forage, food grains, fish, and hydroelectric power). Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply (National Drought Mitigation Center 2014).

Extent

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts (National Oceanic and Atmospheric Administration [NOAA] Date Unknown). The New York State Department of Environmental Conservation (NYSDEC) and the New York State Drought Management Task Force identifies droughts in the following four stages:

- **Normal** is considered the standard moisture soil levels found throughout New York State.

- **Drought Watch** is the first stage of drought. This stage is declared by the NYSDEC and is intended to give advance notice of a developing drought. As this stage, the general public is urged to conserve water. Public water purveyors and industries are urged to update and begin to implement individual drought contingency plans.
- **Drought Warning** is the second stage of drought. This stage is also declared by the NYSDEC and is a notice of impending and imminent severe drought conditions. A warning declaration includes stepping up public awareness and increasing voluntary conservation. Public water supply purveyors and industries are urged to continue to implement local drought contingency plans. Federal, state, and local water resource agencies are notified to prepare for emergency response measures.
- **Drought Emergency** is the third stage of drought. This stage is declared by the New York State Division of Homeland Security & Emergency Services (NYS DHSES), based upon recommendation of the Task Force. It is a notice of existing severe and persistent drought conditions. An emergency declaration is a notice for local water resources agencies to mandate conservation and implement other emergency response measures. A continuing and worsening drought emergency may result in the New York State governor declaring a drought disaster. It is a notice of the most severe and persistent drought conditions. At this stage, a significant proportion of communities in the impacted area likely are unable to respond adequately.

New York State applies two methodologies to identify the different drought stages. The most commonly used indicator is the Palmer Drought Severity Index (PDSI), which is primarily based on soil conditions. Soil with decreased moisture content is the first indicator of an overall moisture deficit. The second methodology applied in New York State, created by the NYSDEC, is known as the State Drought Index (SDI).

According to the National Integrated Drought Information System (NIDIS), the PDSI was developed in 1965, and indicates prolonged and abnormal moisture deficiency or excess. It uses temperature and precipitation data to calculate water supply and demand, incorporates soil moisture, and is considered most effective for assessing moisture conditions in unirrigated cropland. The PDSI primarily indicates long-term drought and has been used extensively as a signal to initiate drought relief (NIDIS 2014).

Table 5.4.2-1 lists the PDSI classifications. Zero is used as normal, and drought is indicated by 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. For example, 2 is moderate rainfall (National Drought Mitigation Center [NDMC] 2013).

Table 5.4.2-1. PDSI Classifications

| Palmer Classifications | |
|------------------------|---------------------|
| 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: NDMC 2013

The SDI evaluates drought conditions more comprehensively by determining whether numerous indicators reach dire thresholds. It compares the following four parameters to historical or “normal” values to evaluate drought

conditions: stream flows, precipitation, lake and reservoir storage levels, and groundwater levels. The State’s Drought Management Task Force uses those factors along with levels of water use, duration of the dry period, and season to assess drought within different areas of the State. The data acquired are compared to critical threshold values to indicate a normal or changeable drought condition. The indicators are weighted regionally to reflect the different circumstances within each drought management region (NYS DHSES 2014; NYSDEC 2013). Table 5.4.2-2 lists the SDI range of values within the Normal stage and the three drought stages.

Table 5.4.2-2. State Drought Index Range of Values

| Drought Stage | Drought Index Range |
|---------------|---------------------|
| Normal | 100 to 150 |
| Watch | 75 to 100 |
| Warning | 50 to 70 |
| Emergency | 0 to 50 |

Source: NYS DHSES 2014

In Allegany County, the greatest agricultural impact of drought would be insufficient water for consumption by and cooling of farm animals. Table 5.4.2-3 shows the typical water consumption for a number of animals common to Allegany County farms.

Table 5.4.2-3. Typical Water Consumption of Animals

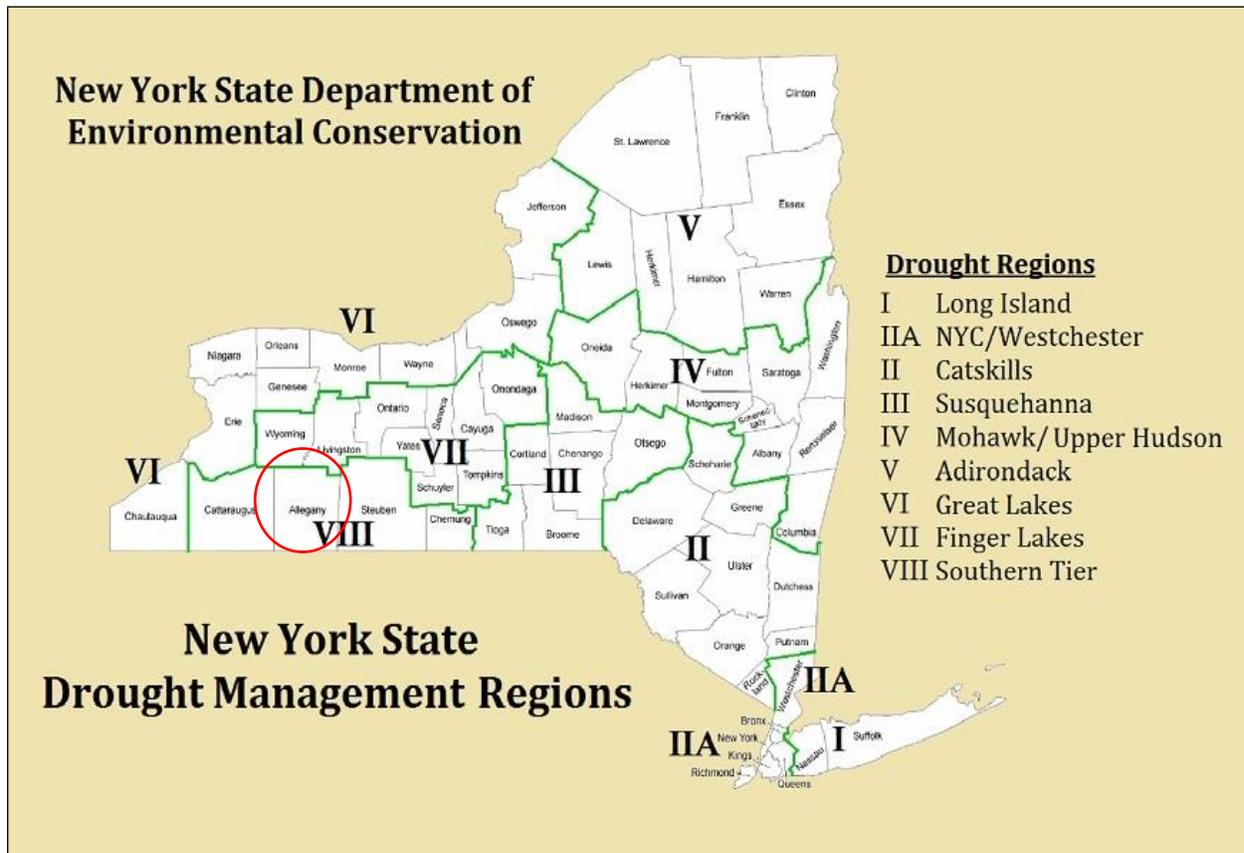
| Animal | Water Consumption, Typical | |
|------------------------------|----------------------------|------------------|
| | (gallons per day) | (liters per day) |
| Chickens/100 | 6 | 23 |
| Cow, Dry | 15 | 57 |
| Milking Cow | 35 | 130 |
| Dairy Calf (1-4 months) | 2.4 | 9 |
| Dairy Heifer (5 - 24 months) | 6.6 | 25 |
| Dry Cow | 9.3 | 41 |
| Hog | 4 | 15 |
| Horse, Steer | 12 | 45 |
| Pig, feeder | 1.1 - 2 | 5-9 |
| Sheep | 2 | 7.5 |
| Turkeys/100 | 20 | 75 |

Source: King, et. al. 2006

Location

New York State is divided into nine drought management regions based roughly on drainage basin and County lines. NYSDEC monitors precipitation, lake and reservoir levels, stream flow, and groundwater levels on a monthly basis within each region, and more frequently during periods of drought. NYSDEC uses these data to assess the condition within each region, which can range from “normal” to “drought disaster” (NYSDEC 2013). Allegany County is included in NYSDEC Drought Management Region 6, the Great Lakes Drought Region (Figure 5.4.2-1).

Figure 5.4.2-1. NYSDEC Drought Management Regions of New York State



Source: NYSDEC 2015

Note: The red circle indicates the location of Allegany County.

Previous Occurrences and Losses

Many sources provide historical information regarding previous occurrences and losses associated with drought events throughout New York State and Allegany County. Information about loss and impact resulting from each of many events can vary depending on the source. Notably, monetary amounts cited in this section on drought derive solely from information obtained during research for this HMP.

Between 1954 and 2015, Federal Emergency Management Agency (FEMA) declared that New York State underwent one drought-related disaster (DR) or emergency (EM) that was classified a water shortage. Generally, drought-related disasters affect a wide region of the State and thus may have impacted many counties. However, Allegany County was not included in the disaster declaration.

U.S. Department of Agriculture (USDA)-reported crop losses provide another indicator of the severity of previous events. Additionally, crop losses can have a significant impact on the economy by reducing produce sales and purchases. Such impacts may have long-term consequences, particularly if crop yields are low the following years as well. USDA records indicate that Allegany County has experienced crop losses from drought events. Details are provided in the Table 5.4.2-4 below.

Table 5.4.2-4. USDA Crop Losses from Drought in Allegany County

| Year | Crop Type | Losses |
|------|------------------|---------------|
| 2013 | Oats | \$ 1,740.00 |
| 2013 | Corn | \$ 10,715.00 |
| 2013 | Soybeans | \$ 3,754.00 |
| 2012 | Corn | \$ 30,654.00 |
| 2012 | Processing Beans | \$ (3,150.00) |
| 2012 | Processing Beans | \$ 14,906.00 |
| 2012 | Soybeans | \$ 8,005.00 |
| 2012 | All Other Crops | \$ 9,419.00 |
| 2012 | All Other Crops | \$ 7,172.00 |
| 2011 | Corn | \$ 2,515.00 |
| 2011 | Corn | \$ 26,869.00 |
| 2011 | Corn | \$ 19,322.00 |
| 2011 | Soybeans | \$ 35,921.00 |
| 2010 | All Other Crops | \$ 5,333.00 |
| 2007 | All Other Crops | \$ 3,497.00 |
| 2007 | All Other Crops | \$ 687.00 |
| 2005 | All Other Crops | \$ 2,716.00 |
| 2005 | All Other Crops | \$ 10,815.00 |
| 2001 | All Other Crops | \$ 1,972.00 |
| 2001 | All Other Crops | \$ 4,157.00 |
| 1999 | All Other Crops | \$ 1,647.00 |
| 1999 | All Other Crops | \$ 238.00 |
| 1998 | All Other Crops | \$ 97.00 |
| 1995 | All Other Crops | \$ 2,109.00 |
| 1993 | All Other Crops | \$ 4,937.00 |
| 1993 | All Other Crops | \$ 7,033.00 |
| 1993 | All Other Crops | \$ (412.00) |
| 1993 | All Other Crops | \$ 900.00 |
| 1991 | All Other Crops | \$ 1,875.00 |
| 1991 | All Other Crops | \$ 1,566.00 |
| 1991 | All Other Crops | \$ 6,183.00 |
| 1989 | All Other Crops | \$ 457.00 |

Source: USDA 2015

Based on all sources researched, Table 5.4.2-5 identifies known drought events between 1988 and 2015 that have affected Allegany County and its municipalities. Not all sources have been identified or researched; therefore, Table 5.4.2-5 may not include all events that have occurred throughout the County and region.

Table 5.4.2-5. Drought Events in Allegany County between 1988 and 2015

| Dates of Event | Event Type | FEMA Declaration Number | County Designated ? | Losses / Impacts |
|---|---|-------------------------|---------------------|---|
| January 23 through March 20, 2001. | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across Allegany County from January 23 through March 20, 2001. USDA crop losses in 2001 for Allegany County totaled \$6,129 because of two reported losses due to drought. The loss came from the “All Other Crops.” |
| Early May 2001 through Mid-December 2001. | Nearing Drought Conditions/Severe Drought | N/A | No | Beginning in early May 2001, Allegany County was designated as having D0, or “abnormally dry,” conditions by the U.S. Drought Monitor. This condition was increased to D1, “Moderate Drought,” by late May and continued into mid-June. Conditions returned to D0 by late June but the northern section of the County increased back up to Moderate Drought. By early August the entire County was designated as D1 and increased to D2, Severe Drought, and held there through most of the County through August. Conditions returned to D1 in September and decreased across the southeast corner of the County until October when the whole County was designated D0. The designation held into late December 2001. USDA crop losses in 2001 for Allegany County totaled \$6,129 because of two reported losses due to drought. The loss came from the “All Other Crops.” |
| Late January through early March 2002 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status in the southeastern corner from late January through early March 2002. |
| Mid to late July 2002 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across Allegany County during the second half of July 2002. |
| September 2002 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across Allegany County in September, 2002 with the designation being lifted in the southwestern corner from mid to late September 2002. |
| Late April 2003 through early May 2003 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status along the western edge of Allegany County from late April 2003 through early May, 2003. |
| Late May 2005 through Mid-June 2005 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across most of Allegany County from late May 2005 through mid-June 2005. USDA crop losses in 2005 for Allegany County totaled \$13,531 because of two reported losses due to drought. The loss came from the “All Other Crops.” |

| Dates of Event | Event Type | FEMA Declaration Number | County Designated ? | Losses / Impacts |
|--------------------------------------|---|-------------------------|---------------------|---|
| Mid-July 2005 through August 2005 | Nearing Drought Conditions | N/A | No | Beginning in mid-July 2005, Allegany County was designated as having D0, or “abnormally dry,” conditions by the U.S. Drought Monitor. This continued up to August when the designation was raised to D1, Moderate Drought, throughout August, 2005. USDA crop losses in 2005 for Allegany County totaled \$13,531 because of two reported losses due to drought. The loss came from the “All Other Crops.” |
| May 2006 through June 2006 | Nearing Drought Conditions/Moderate Drought | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry,” in the southeast corner of Allegany County in early May 2006. The designation was expanded County-wide in late May but shifted to the western part of the County by June where it held until July 2006. |
| Mid-June 2007 through September 2007 | Nearing Drought Conditions/Moderate Drought | N/A | No | Beginning in mid-June 2007, Allegany County was designated as having D0, or “abnormally dry,” conditions by the U.S. Drought Monitor. This continued into early July when the western part of the County was increased to a D1 designation indicating moderate drought. By late July the County as a whole was back to a D0 designation which lasted until about early August when the southeast portion of the State was no longer designated D0. By early September, only the far northern portion of the County maintained a D0 designation which ceased by October 2007. USDA crop losses in 2007 for Allegany County totaled \$4,184 because of two reported losses due to drought. The loss came from the “All Other Crops.” |
| June 10, 2008 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across all of Allegany County in early June 2008. |
| October 2008 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status in the southwest corner of Allegany County in mid-October 2008. |
| April 28, 2009 through May 26, 2009 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across Allegany County from April 28 through May 26, 2009. |
| October 2009 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across Allegany County in late October 2009. |
| April 2010 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, D0 designated conditions, or “abnormally dry,” were identified in the western portion of Allegany County. These conditions spread across the County for the month of April. By early May 2010, these conditions, “Nearing Drought Conditions,” were limited to western Allegany County before ceasing. USDA crop losses in 2010 for Allegany County totaled \$5,333 because of one reported loss due to drought. The loss came from the “All Other Crops.” |

| Dates of Event | Event Type | FEMA Declaration Number | County Designated ? | Losses / Impacts |
|----------------------------------|----------------------------|-------------------------|---------------------|--|
| June 1, 2010 | Nearing Drought Conditions | N/A | No | <p>According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across the northwestern half of Allegany County in early June 2010.</p> <p>USDA crop losses in 2010 for Allegany County totaled \$5,333 because of one reported loss due to drought. The loss came from the “All Other Crops.”</p> |
| July 2011 through September 2011 | Moderate Drought | N/A | No | <p>Beginning the week of July 19, 2011, the southwestern corner of New York State slipped into a period of abnormally dry weather, which included all of Allegany County. According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across the County until August when the U.S. Drought Monitor increased the designation to D1 “Moderate Drought” for the County. The condition was reduced to “abnormally dry” for much of the County by mid-August with the northwest and southeast corners still being designated as “Moderate Drought.” By late August, only the northwest and southeast corners still held an “abnormally dry” designation, which ended in early September 2011.</p> <p>USDA crop losses in 2011 for Allegany County totaled \$84,627 because of four reported losses due to drought. The greatest losses came from the corn crop, which had \$48,706 in losses from three claims due to the dry conditions.</p> |
| July 2012 through October 2012 | Nearing Drought Conditions | N/A | No | <p>Beginning in July 2013, drought conditions struck much of New York State. According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across the much of the State including all of Allegany County. Drought conditions worsened across the State but held steady at “abnormally dry” in Allegany County through September 2013. By mid-September the “abnormally dry” status was contained to the northwestern portion of the State and continued through October 2013.</p> <p>USDA crop losses in 2012 for Allegany County totaled \$67,006 because of four reported losses due to drought. The greatest losses came from the corn crop, which had \$30,654 in losses from one claim due to the dry conditions.</p> |
| Early April 2013 | Nearing Drought Conditions | N/A | No | <p>According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across the southern half of Allegany County through early April 2013.</p> <p>USDA crop losses in 2013 for Allegany County totaled \$16,209 because of three reported losses due to drought. The greatest losses came from the corn crop, which had \$10,715 in losses from one claim due to the dry conditions.</p> |
| May 7, 2013 | Nearing Drought Conditions | N/A | No | <p>According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status in the southeast corner of the County during the week of May 7, 2013.</p> <p>USDA crop losses in 2013 for Allegany County totaled \$16,209 because of three reported losses due to drought. The greatest losses came from the corn crop, which had \$10,715 in losses from one claim due to the dry conditions.</p> |

| Dates of Event | Event Type | FEMA Declaration Number | County Designated ? | Losses / Impacts |
|---|----------------------------|-------------------------|---------------------|---|
| October 2013 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across almost the entirety of the County throughout the month of October 2013. USDA crop losses in 2013 for Allegany County totaled \$16,209 because of three reported losses due to drought. The greatest losses came from the corn crop, which had \$10,715 in losses from one claim due to the dry conditions. |
| November 18, 2014 through early December 2014 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status in the southeast corner of Allegany County in mid-November through early December. |
| December 2014 through July 2015 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status along the eastern border of Allegany County from December 2014 through mid-March 2015. The drought then expanded in mid-March to then include the eastern and southern regions of the County. Much of the State of New York was suffering abnormally dry condition during this period. This continued through mid-April when the dry conditions lessened in the south eastern corner of the County leaving a strip of abnormally dry conditions stretching from the south western corner of the State to the northeastern corner. This continued until early June. By mid-June, dry conditions were isolated to the northwest corner of the County and remained in that condition until mid-July 2015. |
| September 2015 | Nearing Drought Conditions | N/A | No | According to the U.S. Drought Monitor, conditions held at a D0, or “abnormally dry” status across the southern half of Allegany County through most of September. |

Sources: USDA 2016; NDMC 2016
 FEMA Federal Emergency Management Agency
 N/A Not applicable
 NRCC Northeast Regional Climate Center
 NWS National Weather Service
 USDA U.S. Department of Agriculture

Probability of Future Occurrences

Based on risk factors and past occurrences, it is likely that droughts will occur across New York State and Allegany County in the future. In addition, as temperatures increase (see climate change impacts), the probability for future droughts will likely increase as well. Therefore, it is likely that droughts will occur in the State and County of varied severity in the future.

It is estimated that Allegany County will continue to experience direct and indirect impacts of drought and its impacts on occasion, with the secondary effects causing potential disruption or damage to agricultural activities and creating shortages in water supply within communities.

In Section 5.3, the identified hazards of concern for Allegany County were ranked. The probability of occurrence, or likelihood of the event, is one parameter used for hazard rankings. Based on historical records and input from the Planning Partnership, the probability of occurrence for drought in the County is considered “frequent” (likely to occur within 25 years, as presented in Table 5.3-3).

Climate Change Impacts

According to the 2014 New York State HMP, rising summer temperatures, along with little change in summer rainfall, are projected to increase frequency of short-term droughts. This scenario will lead to impacts on the natural and managed ecosystems across New York State. Water management and hydrology are also affected (NYS DHSES 2014).

Climate change is beginning to affect both people and resources in New York State, and these impacts are projected to continue growing. Impacts related to increasing temperatures and sea level rise are already evident within the State. ClimAID: the Integrated Assessment for Effective Climate Change in New York State (ClimAID) was undertaken to provide decision-makers with information on the State’s vulnerability to climate change, and to facilitate development of adaptation strategies informed by both local experience and scientific knowledge (New York State Energy Research and Development Authority [NYSERDA] 2011).

Each region in New York State, as defined by ClimAID, has attributes that will be affected by climate change. Allegany County is part of geographical Region 3, the Southern Tier. Some of the issues in this region that are affected by climate change include relatively low rainfall and increased fall drought risk, and the potential need for irrigation for high-value crops (NYSERDA 2014).

Temperatures and precipitation amounts are expected to increase throughout the State, as well as within Region 3. The State’s temperature is expected to rise between 2.0 and 3.4 degrees Fahrenheit (°F) by the 2020s, between 4.1 and 6.8 °F by the 2050s, and between 5.3 and 10.1 °F by the 2080s. The lower ends of these ranges assume lower greenhouse gas emissions scenarios, and the higher ends of these ranges assume higher greenhouse gas emission scenarios. By the end of the century, the greatest warming is projected to be in the northern parts of the State (NYSERDA 2014).

Within Region 3, temperatures are anticipated to increase between 3.6 and 7.1 °F by the 2050s, and between 4.2 and 11.6 °F by the 2080s (baseline of 47.5°F). Precipitation totals will change between two (2) and 15 percent by the 2050s, and between three (3) and 16 percent by the 2080s (baseline of 35 inches). Table 5.4.2-6 lists projected seasonal precipitation changes within the Southern Tier ClimAID Region (NYSERDA 2014).

Table 5.4.2-6. Projected Seasonal Precipitation Change in Region 3, 2050s (percent change)

| Winter | Spring | Summer | Fall |
|----------|----------|----------|-----------|
| 5 to +15 | 0 to +10 | -5 to +5 | -10 to +5 |

Source: NYSERDA 2011

Annual temperatures have been rising throughout New York State since the start of the 20th century. State average temperatures have increased by approximately 0.6 °F since 1970, with winter warming exceeding 1.1 °F per decade. Extreme heat events are likely to increase throughout New York State, and short-duration warm season droughts will become more common.

With the increase in temperatures, heat waves will become more frequent and intense, as shown in Table 5.4.2-7 below. Heat waves, defined as three (3) or more consecutive days with maximum temperatures at or above 90 °F. Summer droughts are projected to increase under these conditions, affecting water supply, agriculture, ecosystems, and energy projects (NYSERDA 2014).

Table 5.4.2-7. Extreme Event Projections for Region 3 – Southern Tier

| Middle Range (25th to 75th Percentile) | 2020s | 2050s | 2080’s |
|--|------------|------------|------------|
| Days over 90 °F (10 days) | 17 to 21 | 26 to 41 | 33 to 67 |
| # of Heat Waves (0.7 heat waves) | 2 to 3 | 3 to 6 | 4 to 9 |
| Duration of Heat Waves (4 days) | 4 to 5 | 5 to 5 | 5 to 6 |
| Days below 32 °F (133 days) | 122 to 130 | 100 to 114 | 79 to 103 |
| Days over 1” Rainfall (5 days) | 6 to 7 | 7 to 7 | 7 to 8 |
| Days over 2” Rainfall (0.6 days) | 0.7 to 0.9 | 0.8 to 1.0 | 0.8 to 1.0 |

Source: NYSERDA 2014

By the end of the 21st century, the number of droughts is likely to increase, as the effect of higher temperatures on evaporation is likely to outweigh the increase in precipitation. Droughts in the northeast United States have been associated with local and remote modes of multi-year ocean-atmosphere variability that are unpredictable and may change with climate change. Changes in distribution of precipitation throughout the year and in timing of snowmelt could increase frequency of droughts (NYSERDA 2011).

5.4.2.2 Vulnerability Assessment

To understand risk, a community must evaluate its assets that are exposed or vulnerable to the identified hazard. Regarding the drought hazard, all of Allegany County is exposed to this hazard. Therefore, all assets within the County (population, structures, critical facilities, and lifelines), as described in the County Profile (Section 4), are potentially vulnerable to a drought. This section addresses the following factors to evaluate and estimate potential impacts of the drought hazard on the County:

- Overview of vulnerability
- Data and methodology used for the evaluation
- Impacts to (1) life, health, and safety of residents; (2) general building stock; (3) critical facilities; (4) economy; and (5) future growth and development
- Change of vulnerability as compared to that presented in the 2011 Allegany County HMP

- Further data collections that will assist understanding of this hazard over time.

Overview of Vulnerability

Drought is a significant concern to Allegany County, mainly due to its impact on public health, natural resources, and agriculture. Estimated losses are difficult to quantify; however, drought events can impact Allegany County’s population and economy. Assets at particular risk would include areas used for agricultural purposes (farms and cropland) and forested areas at increased risk of plant and wildlife loss and increased threat of wildfires. As a result of dry conditions, lightning strikes during drought periods may result in wildfires. Dry periods could impact local agriculture production and the availability of water, which could result in impacts to local food supplies and trade markets. Drought conditions can also impact water-based recreational markets, affecting the local economy. Year-round recreation and tourism activities that rely on water (such as boating and fishing) could also be impacted, as well as winter recreation activities that rely on snowfall.

In addition, water supply resources could be impacted by extended periods of below-average rainfall. The County’s public water supply system is a mix of public and privately owned water systems, but much of the rural populations are served by private wells and are significantly affected by periods of diminished groundwater resources. Particularly susceptible to the drought hazard and cascading impacts are populations vulnerable because of age, health conditions, limited ability to mobilize to shelter, and limited accessibility to cooling and medical resources.

Potential drought impacts are agricultural, hydrologic, and socioeconomic. The sequence of these impacts highlights the differences among them. When a drought begins, the agricultural sector is typically the first to be affected due to its heavy dependence on stored soil water. During dry periods, soil water can deplete quickly. If precipitation deficiencies continue, people who depend on other sources of water will begin to feel impacts of the shortage. Those who rely on surface water (for example, reservoirs and lakes) and subsurface water (for example, groundwater) are usually the last to be affected. A short-term drought that persists for three (3) to six (6) months may have little impact on these sectors, depending on characteristics of the hydrologic system and intensity of water use (NYS DHSES 2014).

Because agriculture and related sectors (including forestry, fisheries, and water activities) rely on surface and subsurface water supplies, they are vulnerable to numerous economic impacts. Droughts often result in loss of crop yields and livestock production, increased issues with insect infestations, increased forest diseases, and reduced growth. Forest and grass fires also increase substantially during extended drought periods, posing higher levels of risk to human and wildlife populations, as well as to property (NYS DHSES 2014).

Loss of income is another factor in assessment of impacts of drought. Examples of income loss include reduced income for farmers, and for retailers and others who provide goods and services to farmers. The recreation and tourism industries may also undergo a loss of income because of increased costs of food, energy, and other products as supplies decrease. Some local shortages of certain goods trigger the need to import goods from outside the affected region. Reduced water supply affects use of rivers and other water bodies. Hydropower production may also be impacted by drought (NYS DHSES 2014).

Environmental losses from drought include damages to plant and animal species, wildfire habitat, and air and water quality; forest and grass fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Considering that Allegany County has 46,307 acres of State forest lands, 2,050 acres of County reforestation areas, and 10,378 acres of wildlife management area, drought poses a substantial threat to these resources and assets. Some impacts may be short term and others may linger for longer periods of time. If changes in climate intensify, environmental impacts and losses may become more significant. Wildfire habitat may be degraded through loss of wetlands, lakes, and vegetation. Increased soil erosion can lead to a more permanent loss of

biological productivity of landscapes. However, quantifying environmental losses is difficult (NYS DHSES 2014).

Social impacts primarily involve public safety, health, conflicts among water users, reduced quality of life, and inequities in distribution of impacts and disaster relief. Many economic and environmental effects induce social impacts as well (NYS DHSES 2014).

Data and Methodology

Data were acquired from the following sources: FEMA Hazards U.S.—Multi Hazard (HAZUS-MH), USDA, NOAA-National Climatic Data Center (NCDC), Allegany County, and the Planning Partnership. Insufficient data were available to model the long-term potential impacts of a drought on the County. Over time, additional data will be obtained to allow better analysis of this hazard. Available information and a preliminary assessment appear below.

Impact on Life, Health, and Safety

The entire population of Allegany County is vulnerable to drought events. According to the 2010 U.S. Census, the County had a population of 48,946. Drought conditions can affect health and safety, including health problems related to low water flows and poor water quality, and health problems related to dust. Droughts also can lead to loss of human life (NDMC 2013). Other possible impacts on health from drought include increased recreational risks; effects on air quality; diminished living conditions related to energy, air quality, and sanitation and hygiene; compromised food and nutrition; and increased incidence of illness and disease. Health implications of drought are numerous. Some drought-related health effects are short term while others can be long term (Center for Disease Control and Prevention [CDC] 2012).

As previously stated, drought conditions can cause shortages of water for human consumption. Droughts can also lead to reduced local firefighting capabilities. The drought hazard is a concern for Allegany County because rural populations within the County rely upon private water supply from local groundwater resources.

The 2014 New York HMP states that between 2010 and 2012, more than 50 percent of the County experienced drought for 22 weeks during an abnormally dry period, and for two (2) weeks during a drought-moderate period (NYS DHSES 2014).

Impact on General Building Stock

A drought event is not expected to directly affect any structures. However, droughts contribute to conditions conducive to wildfires and reduce fire-fighting capabilities. Risk to life and property is greatest within those areas where forested areas adjoin urbanized areas (high-density residential, commercial, and industrial) or wildland urban interface (WUI). Therefore, all assets within and adjacent to the WUI zone—including population, structures, critical facilities, lifelines, and businesses—are considered vulnerable to wildfire. Refer to Section 5.4.13 for additional information on the wildfire hazard in Allegany County.

Impact on Critical Facilities

Water supply facilities may be affected by short supplies of water. As mentioned, drought events generally do not impact buildings; however, droughts can impact agriculture-related facilities and critical facilities associated with potable water supplies. Also, those critical facilities in and adjacent to the WUI zone are considered vulnerable to wildfire.

Impact on the Economy

Drought causes many economic impacts on agriculture and related sectors (forestry, fisheries, and waterborne activities). In addition to losses in yields in crop and livestock production, drought is associated with increased insect infestations, plant diseases, and wind erosion. Drought can lead to other losses because so many sectors are affected—losses that include reduced income for farmers and reduced business for retailers and others who provide goods and services to farmers. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue. Prices for food, energy, and other products may also increase as supplies decrease (NYS DHSES 2014).

When a drought occurs, the agricultural industry is most at risk for economic impact and damage. Crops do not mature during droughts, which results in smaller crop yield, undernourishment of wildlife and livestock, decreases in land values, and ultimately financial loss to the farmer (FEMA 1997). The agricultural sector in New York State encompasses more than 34,000 farms that occupy approximately one-quarter of the State’s land area and contribute \$4.5 billion annually to the State’s economy. A large majority of the State’s agriculture is rain-fed without irrigation; however, summer precipitation is currently not sufficient to fully meet crop water needs during most years (NYSERDA 2011).

Table 5.4.2-8 summarizes direct and indirect losses to agricultural producers, livestock producers, timber producers, fishery producers, and tourism (NYS DHSES 2014).

Table 5.4.2-8. Impacts on the Economy

| Losses to Agricultural Producers | Losses to Livestock Producers | Losses to Timber Producers |
|---|--|--|
| Annual and perennial crop losses | Reduced productivity of rangeland | Losses from wildland fires |
| Damage to crop quality | Reduced milk production | Losses from tree disease |
| Income loss for farmers due to reduced crop yields | Forced reduction of foundation stock | Losses from insect infestation |
| Reduced productivity of cropland (wind erosion, long-term loss of organic matter, etc.) | High cost/unavailability of water for livestock | Impaired productivity of forest land |
| Insect infestation | Cost of new or supplemental water resource development (wells, dams, pipelines) | Direct loss of trees, especially young ones |
| Plant disease | High cost/unavailability of feed for livestock | Transportation Industry |
| Wildlife damage to crops | Increased feed transportation costs | Loss from impaired navigability of streams, rivers, and canals |
| Increased irrigation costs | High livestock mortality rates | Decline in food production/disrupted food supply |
| Cost of new or supplemental water resource development (wells, dams, pipelines) | Disruption of reproduction cycles (delayed breeding, more miscarriages) | Increase in food prices |
| Loss from fishery production | Decreased stock weights | Increased importation of food (higher costs) |
| Damage to fish habitat | Increased predation | |
| Loss of fish and other aquatic organisms due to decreased flows | Grass fires | |
| Loss to Recreation and Tourism Industry | Energy-Related Effects | Water Suppliers |
| Loss to manufacturers and sellers of recreational equipment | Increased energy demand and reduced supply because of drought-related power curtailments | Revenue shortfalls and/or windfall profits |

| Loss to Recreation and Tourism Industries (cont'd) | Energy-Related Effects (cont'd) | Water Suppliers (cont'd) |
|---|--|--------------------------|
| Losses related to curtailed activities: hunting and fishing, bird watching, boating, etc. | Costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power | |

Source: NYS DHSES 2014

Based on the 2012 Census of Agriculture, 784 farms were present in Allegany County, encompassing 150,383 acres of total farmland. The average farm size was 192 acres. Allegany County farms had a total market value of products sold of \$73.4 million (\$20.9 million in crops including nursery and greenhouse; and \$52.5 million in livestock, poultry, and related products), averaging \$93,569 per farm. The Census indicated that 406 farm operators reported farming as their primary occupation (USDA 2012). Table 5.4.2-9 lists the acreage of agricultural land exposed to the drought hazard.

Table 5.4.2-9. Agricultural Land in Allegany County in 2012

| Number of Farms | Land in Farms (acres) | Total Cropland (acres) | Harvested Cropland (acres) | Total Cropland Used Only For Pasture/Grazing (acres) |
|-----------------|-----------------------|------------------------|----------------------------|--|
| 784 | 150,383 | 71,285 | 59,612 | 3,238 |

Source: USDA 2012

In 2012, the top three agricultural products sold in Allegany County were milk from cows at \$30.6 million; cattle and calves at \$11.5 million; and grains, oilseeds, dry beans, and dry peas at \$9.7 million (USDA 2012).

If the average production (dollar value) per crop type could be identified on a per-acre basis, loss estimates could be developed based on assumed percent damage that could result from a drought. If a drought impacted 40 percent of the agricultural products sold from Allegany County farms, based on 2012 market values, this would be a loss of \$29.3 million. This figure does not include how the tourism industry and local jobs are impacted.

A prolonged drought can have a serious economic impact on a community. Increased demand for water and electricity may result in shortages and higher costs for these resources. Industries that rely on water for business may be impacted the most (for example, landscaping businesses). Although most businesses will still be operational, they may be impacted aesthetically. These aesthetic impacts are most significant within the recreation and tourism industry. Moreover, droughts within another area could impact the food supply/price of food for residents within the County.

Future Growth and Development

As discussed in Section 4, areas targeted for future growth and development have been identified across Allegany County. Future growth could affect the amount of potable water available due to a drain on available water resources. Other areas that could be impacted include agriculture and recreational facilities such as golf courses, farms, and nurseries. Areas targeted for potential future growth and development within the next five (5) years have been identified across the County at the municipal level. The jurisdictional annexes in Volume II of this HMP contain additional information.

Effect of Climate Change on Vulnerability

Nearly every region in the country is facing some increased risk of seasonal drought. Climate change can significantly affect the sustainability of water supplies in the future. As parts of the United States get drier, the amount and quality of water available will likely decrease, impacting people’s health and food supplies. With

climate change, the entire country will likely face some level of drought. A report by the Natural Resources Defense Council (NRDC) found that 1,100 counties (one-third of all counties in the contiguous 48 states) face higher risks of water shortages by mid-century as a result of climate change. More than 400 of these counties will face extremely high risks of water shortages.

Change of Vulnerability

An examination of change in the County’s vulnerability to drought events from the 2011 HMP to this update must scrutinize each exposed and vulnerable entity. Total population across the County has decreased, as indicated by a comparison of the 2000 U.S. Census with the 2010 U.S. Census.

Regarding the agricultural industry within Allegany County, from 2007 to 2012, the number of farms decreased by seven (7) percent (847 to 784 farms), however, land within farms had a negligible decrease of less than one (1) percent (150,832 to 150,383 acres). The County experienced an eight (8) percent increase in the average size of farms—from 178 acres in 2007 to 192 acres in 2012. Additionally, the County experienced a 59 percent increase in market value of products sold—from more than \$46 million in 2007 to more than \$73 million in 2012. Therefore, due to this increase in market values of products sold, the County’s potential crop loss due to drought may increase overall (USDA Census of Agriculture, 2012).

Additional Data and Next Steps

For the HMP update, any additional information regarding localized concerns and past impacts will be acquired and analyzed. These data will be developed to support future revisions to the plan. Attempts at mitigation could include extensions of current New York State, Allegany County, and local efforts. The lead state agency for drought preparedness is the NYSDEC.