4.2 Drought

4.2.1 Description

A drought is a shortage in atmospheric moisture or precipitation over an extended period of time resulting in a water shortage for some activity, group, or environmental sector. Droughts are common throughout all climatic zones and can range in length from a couple weeks to multiple years or decades in some areas. According to the National Oceanic and Atmospheric Administration (NOAA), there are three common types of drought: (1) meteorological, (2) agricultural, and (3) hydrological. Each type of drought has different indicators and occur at different times after a prolonged absence of water.

Meteorological drought severity is calculated by the amount of the rainfall deficit (compared to annual averages) and the length of the dry period. Impacts of a meteorological drought may extend beyond the borders of the precipitation-deficient area.

Agricultural drought is based on the effects to agriculture by factors such as rainfall and soil water deficits or diminished groundwater/reservoir levels needed for irrigation. The volume of water available for agricultural use depends on prevailing weather conditions, biological characteristics of the specific crop, its stage of growth, and the physical and biological properties of the soil.

Hydrological drought is based on the effects of rainfall shortages on the water supply, such as stream flow, reservoir and lake levels, and groundwater table decline. Snowfall can also impact the water supply level. Hydrological droughts are often defined at the watershed or river basin scale, as deficiency in the hydrologic system can have negative impacts within hydrologic storage systems. Competition for water between hydrologic storage systems, such as reservoirs and rivers, can result in conflicts between water users.

4.2.2 Location

Drought is a countywide hazard that can affect all locations and jurisdictions in Clinton County. More specifically, this hazard typically occurs at a regional scale. Droughts most commonly occur in Ohio from spring through autumn; however, they may occur at any time throughout the year.

4.2.3 Extent

Due to the regional nature of droughts, impacts may be noticed throughout the County in the urbanized and rural areas. All jurisdictions with the County may be affected in a single drought event. In Clinton County, droughts are often linked to prolonged periods of above average temperatures and little to no precipitation. Compared to more urban counties in Ohio, Clinton County will likely experience more effects on agricultural production. As such, drought conditions are also likely to impact the economy.

Initial effects of drought can be noticed within a short period, as soils may dry out and plants may wither and die. When drought conditions persist over several weeks, months, or years, effects may be more pronounced with reductions in water levels of wells, lakes, reservoirs, streams, and rivers. Water supply issues for agriculture, commercial/industrial activities, and private consumption may arise if drought conditions persist over a long term.

The extent of the drought is determined by the Palmer Drought Severity Index (PDSI). In this way, the Index can be utilized as a tool to help define disaster areas and indicate the availability of irrigation water supplies, reservoir levels, range conditions, amount of stock water, and potential for forest

fires. The PDSI depicts prolonged (in months or years) abnormal dryness or wetness and is slow to respond, changing little from week to week. It also reflects long-term moisture runoff, recharge, and deep percolation, as well as evapotranspiration.

The PDSI is a standardized index with values typically falling between -4.00 and +4.00, although extreme conditions can be greater in value (**Table 4.2.1**). Negative values indicate drought conditions while positive values represent wet conditions. Values around zero represent near-normal conditions.

Table 4.2.1: Palmer Drought Severity Index Classifications

Palmer Classifications	
4.0 or greater	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 to -2.99	Moderate Drought
-3.0 to -3.99	Severe Drought
-4.0 or less	Extreme Drought

4.2.4 History

According to the U.S. Drought Monitor, since 2000, the longest duration of drought in Ohio lasted 44 weeks beginning on July 23, 2002 and ending on May 20, 2003. Additionally, the most intense period of drought occurred the week of September 4, 2007. Periods of drought specific to Clinton County are provided in **Table 4.2.2** (Source: U.S. Drought Monitor).

Table 4.2.2: Periods of Drought in Clinton County, Ohio, 2000-2020

Start Date	End Date	Consecutive Weeks
1/4/2000	2/22/2000	8
3/27/2001	5/22/2001	9
7/23/2002	10/1/2002	11
6/21/2005	6/28/2005	2
7/12/2005	8/30/2005	8
10/11/2005	11/8/2005	5
5/15/2007	11/27/2007	29
8/26/2008	1/27/2009	23
3/24/2009	5/5/2009	7
6/9/2009	6/23/2009	3

Start Date	End Date	Consecutive Weeks
4/27/2010	5/11/2010	3
8/31/2010	11/30/2010	14
12/28/2010	2/15/2011	8
6/19/2012	1/29/2013	33
9/30/2014	10/14/2014	3
5/26/2015	6/16/2015	4
10/20/2015	10/27/2015	2
6/21/2016	8/16/2016	9
11/15/2016	12/13/2016	5
8/6/2019	11/5/2019	14
7/7/2020	7/28/2020	4

In Clinton County, the NCEI has record of one ongoing drought event from July – August 1999, which did not result in any reported crop or property damages through the NCEI. Another drought event was recorded by the National Weather Service (NWS) and the United States Department of Agriculture (USDA) during the summer of 2012. Additionally, local news sources reported moderate drought conditions during late summer to early autumn in 2019.

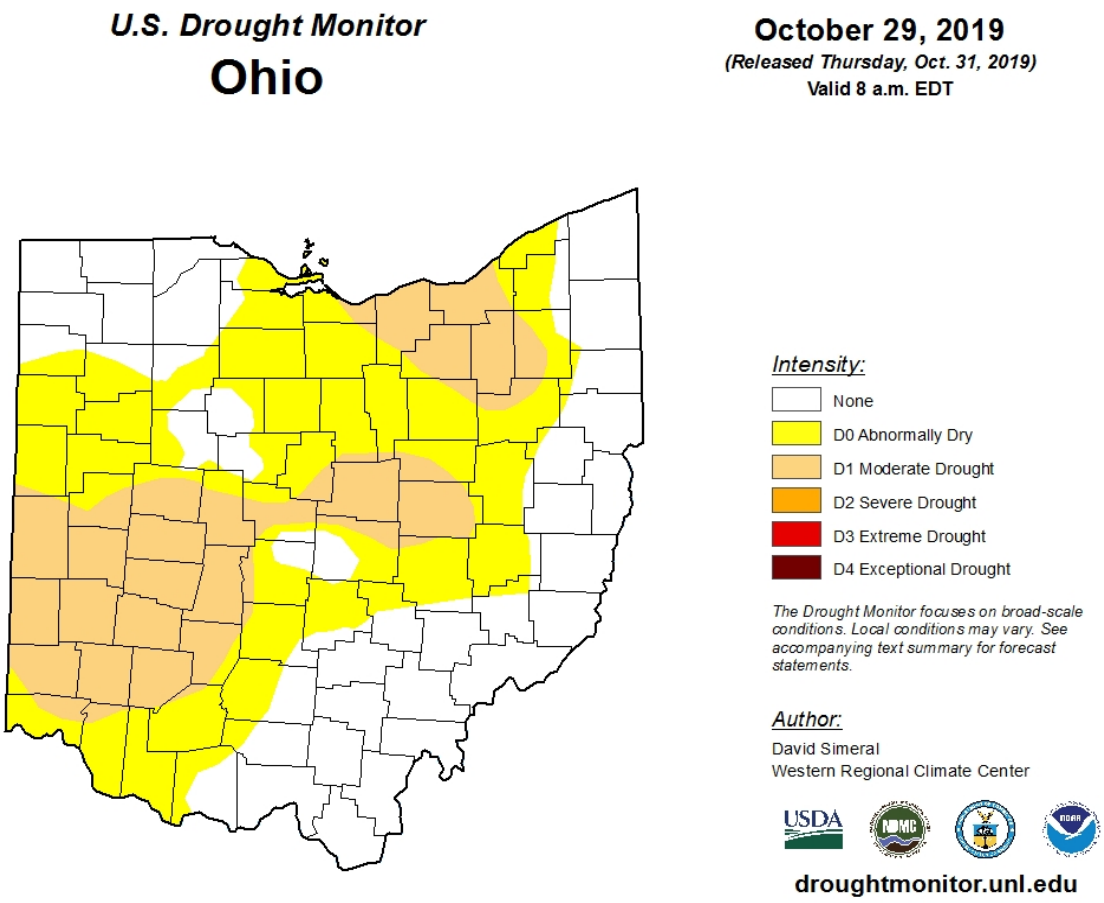
While not all drought events resulted in disaster declarations made for drought events in the County, all drought events with descriptions provided by the NCEI, NWS, USDA, or local news sources are described below.

Drought, Summer 2019

Dry weather persisted throughout the Miami Valley. On October 18, 2019, local news channel WHIO TV 7 reported, "The most recent US Drought Monitor released October 17, shows that the Miami Valley has seen no real improvement. The moderate drought has gotten worse, spreading to Butler, Warren and Clinton counties. Looking at the state, 26 percent of it is now in a moderate drought with another 68 percent considered to be abnormally dry! Several inches of rain will be needed to bring the soil back to normal." (Source: WHIO).

Following this report, the drought conditions continued to spread into Clinton County over the next several weeks. The U.S. Drought Monitor for October 29, 2019 is provided below in **Figure 4.2.1**.

Figure 4.2.1: U.S. Drought Monitor for October 29, 2019



Source: U.S. Drought Monitor

Drought, Summer 2012

The National Weather Service recorded the drought of Summer 2012 with the following description:

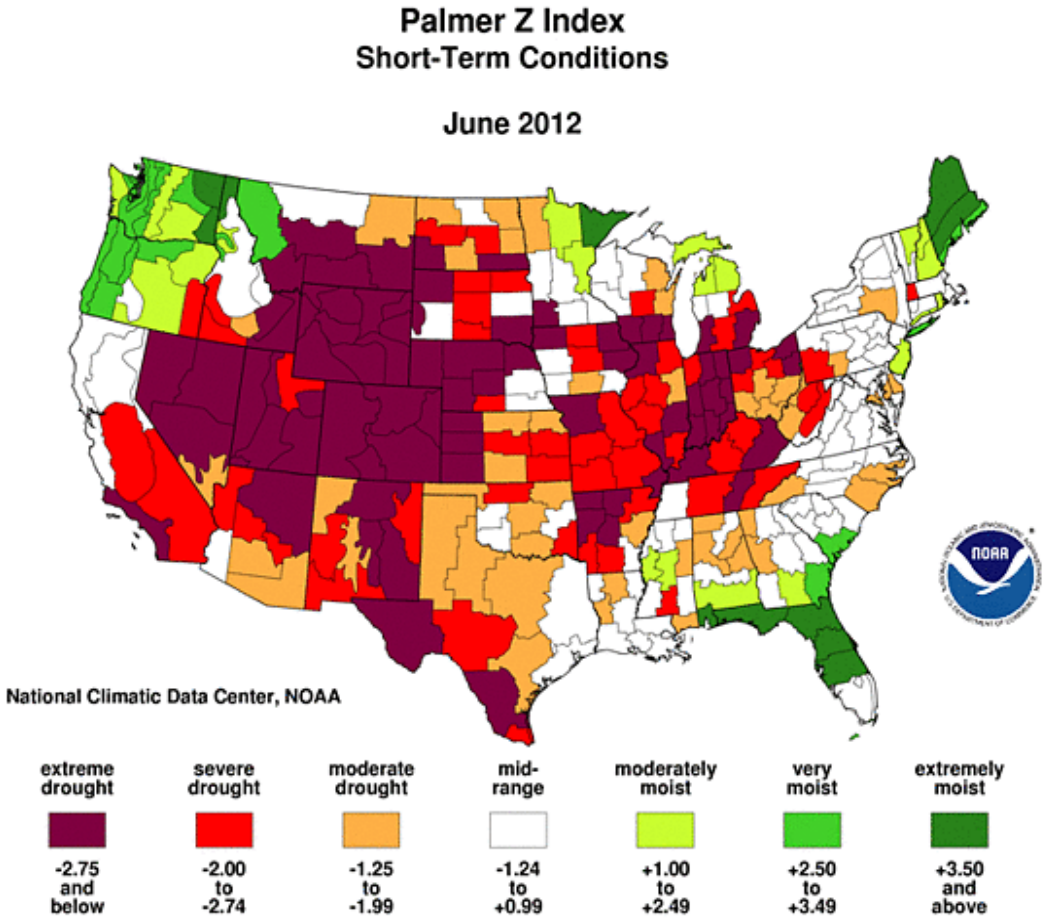
"The warm and dry spring of 2012 became the hot and dry summer of 2012. Temperatures in June and July were well above normal, with monthly temperatures in July averaging 4 to 5 degrees above normal. High temperatures reached 90 or above on dozens of days. The mercury topped 90 degrees 28 times at Cleveland and 32 times at Toledo. At Toledo, the temperature soared above 100 degrees 4 times! Other locations in northern Ohio and northwest Pennsylvania got close to 100 or exceeded 100 at least once or twice. There was little relief at night, with many nights seeing low temperatures barely dropping into the 70s, especially in July. The lack of rain compounded the summer stress. Rainfall was below normal in most areas from April through July. The combination of heat and drought left many farmers with parched soil. Rainfall in September and October was much above normal but was too little too late for many of the farmers."

Furthermore, by mid-June, Clinton County was designated with moderate drought conditions. On July 30, 2012, the Governor of Ohio sent a memorandum to the USDA Ohio State Executive Director requesting primary county natural disaster designations for eligible counties due to agricultural losses caused by drought and additional disasters during the 2012 crop year. The USDA reviewed the Loss Assessment Reports and determined that there were sufficient production losses in 85

counties, including Clinton County, to warrant a Secretarial Disaster Declaration. This declaration was issued on September 5, 2012.

Figure 4.2.2 displays the PDSI of June 2012 for the continental United States. This image shows that the region containing Clinton County experienced extreme drought, with a Palmer Index of -2.75 or below, during the 2012 drought. Further estimates of crop losses associated with this drought are located in **Table 4.2.3**.

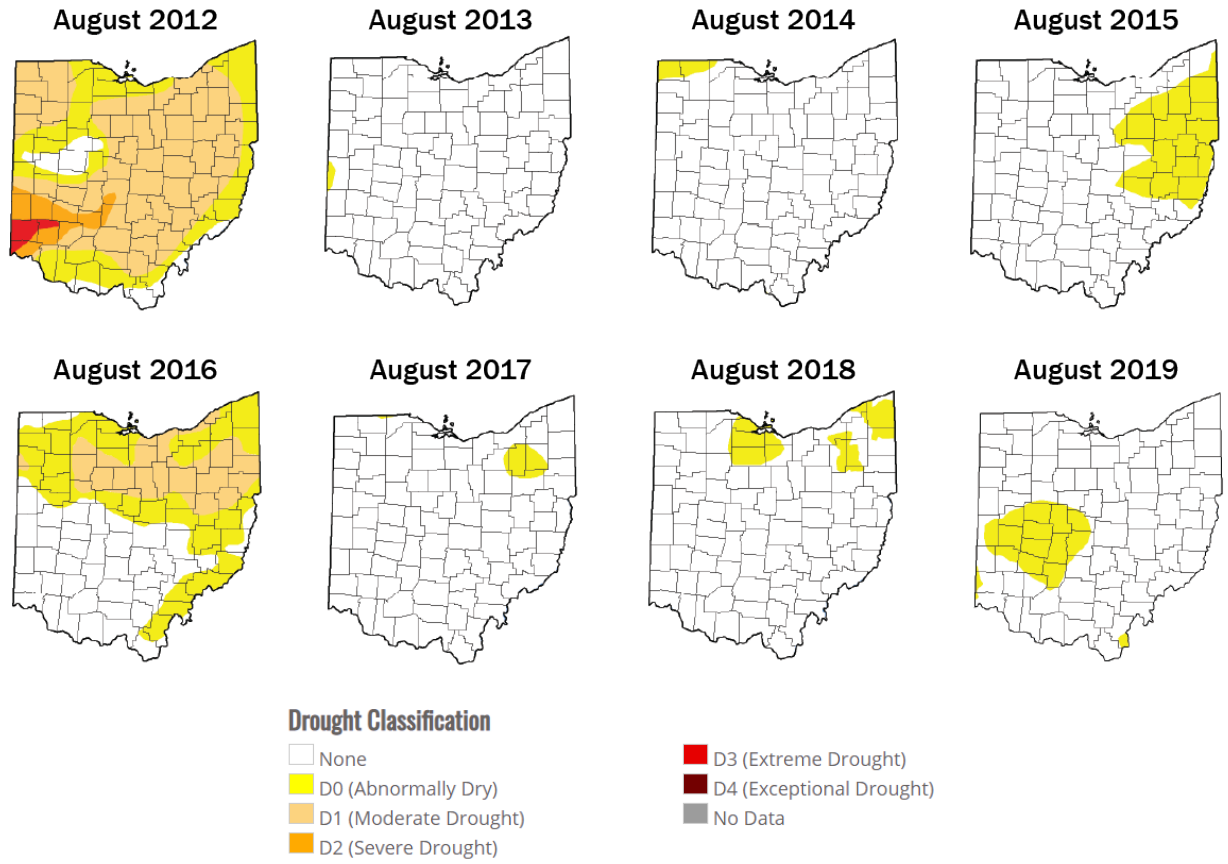
Figure 4.2.2: Palmer Drought Severity Index for the United States in June of 2012



Source: NOAA

Figure 4.2.3 depicts the Drought Monitor for the State of Ohio for the month of August from 2012 through 2019. The image indicates the widespread nature of the Summer 2012 Drought, which was one of the worst on record for the State of Ohio.

Figure 4.2.3: Drought Monitor for the State of Ohio, 2012-2019



**The Statistics Comparison above is calculated as a percent area in those drought conditions. Source: U.S. Drought Monitor.*

Drought, Summer 1999

The local newspaper provided the following description of the drought events in July and August of 1999, as referenced in the NCEI:

July: Dry conditions that began in the spring and early summer continued into July. Excessive heat contributed to substantial crop loss across much of the Buckeye state. Rainfall was widely scattered and did little to help farmers. Crop damage amounts were not available at the time of this writing.

August: Drought conditions continued across the Ohio Valley through August with most areas receiving well below normal rainfall for the month. In some areas around 50 percent of crops were considered total losses. Most counties in southwest Ohio were declared Federal Disaster Areas by the US Department of Agriculture. At the time of this writing, no monetary estimates were available concerning the crop loss.

4.2.5 Probability

Clinton County has experienced droughts and excessive heat in the past, and the potential exists for the County to experience droughts in the future. Seasons of drought have the potential to occur during any particular year when necessary conditions are met, and they are most likely to occur from

spring through autumn. More specifically, the County has record of 21 drought events from the U.S. Drought Monitor from January 2000 through July 2020, averaging just over one drought each year with an average duration of 10.2 weeks per drought event. The longest drought recorded for Clinton County was 33 weeks long. While no crop or property losses were recorded through the NCEI, a more detailed commodity loss analysis is provided in the Vulnerability Assessment below.

Based on current climate reports:

- Drought projections suggest that some regions of the U.S. will become drier and that most will have more extreme variations in precipitation.
- Even if current drought patterns remained unchanged, warmer temperatures will amplify drought effects.
- Drought and warmer temperatures may increase risks of large-scale insect outbreaks and wildfires.
- Drought and warmer temperature may accelerate tree and shrub death, changing habitats and ecosystems in favor of drought-tolerant species.
- Forest-based products and values, such as timber, water, habitat and recreation opportunities, may be negatively impacted.
- Forest and rangeland managers can mitigate some of these impacts and build resiliency in forests through appropriate management actions.

4.2.6 Vulnerability Assessment

Drought does have the potential for significant impacts to structures, businesses, and people, as well as critical infrastructure. Additionally, the greatest impacts of drought tend to be on agricultural interests, as crops may fail and livestock may not have sufficient water resources. Economic losses are the greatest threat from droughts to Clinton County. According to the 2012 Census of Agriculture developed by the USDA, top crop items based on acreage for Clinton County include soybeans for beans, corn for grain, forage land used for all hay and haylage, grass silage, greenchop, wheat for grain, and winter wheat. Commodity Loss Statistics for crops with available data provided by the United States Department of Agriculture (USDA) are included in **Table 4.2.3** and compare a non-drought year (2011) with the production and harvest of crops in a drought year (2012).

Based on data from the USDA, Clinton County's soybean yields remained constant between 2011 and 2012; however, the yield of soybeans decreased by 3.6 bushels per acre harvested. Additionally, the yield of corn harvested compared to corn planed increased by 0.14 percent, but the County's corn production decreased by 22 bushels per acre harvested between 2011 and 2012. The County's winter wheat yield increased by 6.8 bushels per acre harvested; however, the raw yield of acres harvested decreased by 0.54 percent.

Table 4.2.3: Commodity Loss Statistics between 2011 and 2012

Commodity	Units	Non-Drought Year 2011	Drought Year 2012	Change	Change Amount
Soybeans, Planted	Acres	97,500	100,500	Up	9,300
Soybeans, Harvested	Acres	97,400	100,400	Down	-1,268
Yield	%	99.90%	99.90%	No Change	0.00%

Commodity	Units	Non-Drought Year 2011	Drought Year 2012	Change	Change Amount
Soybeans, production	Bushels	4,989,000	4,778,000	Down	-211,000
Yield	Bushels/Acre Harvested	51.2	47.6	Down	-3.6
Corn for grain, planted	Acres	71,400	76,900	Up	5,500
Corn for grain, harvested	Acres	70,000	75,500	Up	5,500
Yield	%	98.04%	98.18%	Up	0.14%
Corn, production	Bushels	11,700,000	10,958,000	Down	-742,000
Yield	Bushels/Acre Harvested	167.1	145.1	Down	-22.0
Winter Wheat, planted	Acres	5,900	3,600	Down	-2,300
Winter Wheat, harvested	Acres	5,850	3,550	Down	-2,300
Yield	%	99.15%	98.61%	Down	-0.54%
Winter Wheat, production	Bushels	315,000	215,000	Down	-100,000
Yield	Bushels/Acre Harvested	53.8	60.6	Up	6.8

Source: USDA

4.2.7 Land Use and Development Trends

Drought is most likely to impact agriculture land uses; however, it can also have an economic impact that might result in changes to development plans.