2023
Delaware County Multi-Hazard Mitigation Plan

Delaware County Office of Homeland Security and Emergency Management (EMA)
10 Court St. Delaware, Ohio 43015 | Phone: (740) 833-2180 | www.delcoema.org

Table of Contents

Table of Figures

Acknowledgements

Many thanks go to all the students and professionals who helped to put this plan together and to the people who supported the students in this effort.

City and Regional Planning Studio - Knowlton School, The Ohio State University
Kimberly Burton
Ruthann Richards
Karina Peggau
Christopher Santos Cruz
Jeremiah Commey
Mosé Lattimore
Jack Mangan
Zachary Dichtl

Delaware County Office of Homeland Security and Emergency Management (DCOHSEM)
Sean Miller
Scott Stewart
Shawn Dysert
Jecy Weber

Ohio Emergency Management Agency
Steve Ferryman
Luan Nguyen

Federal Emergency Management Agency
Steve Greene
Andrew Davis
Michelle Staff

Glossary

CDC	Centers for Disease Control and Prevention
CISA	Cybersecurity & Infrastructure Security Agency
DCEO	Delaware County Engineer's Office
DCOHSEM	Delaware County Office of Homeland Security and Emergency Management
DCRPC	Delaware County Regional Planning Commission
DCSO	Delaware County Sheriff's Office
DCSWCD	Delaware County Soil & Water District
DGHD	Delaware General Health District
DMPG	Delaware Mitigation Planning Group
EAP	Emergency Action Plan
EHS	Extremely Hazardous Substances
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FEMA	Federal Emergency Management Agency
HAZMAT	Hazardous Materials
HIRA	Hazard Identification and Risk Assessment
IoT	Internet of Things
KDOH	Kiser Lake State Park Station
LEPC	Local Emergency Planning Committee
MFOH	Malabar Farm State Park
MHMP	Multi-Hazard Mitigation Plan
MMS	Moment Magnitude Scale
NCDC	National Climactic Data Center
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NSHMP	National Seismic Hazard Maps
NWS	National Weather Service
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
ODNR	Ohio Department of Natural Resources
ODPS	Ohio Department of Public Safety
Ohio EMA	Ohio Emergency Management Agency
Plan	Delaware County Multi-Hazard Mitigation Plan
PUCO	Public Utilities Commission of Ohio
SHELDUS	Spatial Hazard Events and Losses Database for the United States
STACC	Statewide Terrorism Analysis & Crime Center
TWP	Township
USACE	U.S. Army Corp of Engineers
USGS	United States Geological Survey
WS	Water Supply

1. Introduction

The consequences of disasters generated by both man-made and natural causes affect all places and people throughout the United States, interrupting trade, causing property damage, and even taking lives. Delaware County, Ohio stakeholders acknowledge the need for hazard mitigation planning in anticipating such disasters. Planning also ultimately reduces social, environmental, and economic impacts of disasters. Delaware County officials, local jurisdiction representatives, and numerous other interested stakeholders dedicated their time and efforts to develop this Delaware County Multi-Hazard Mitigation Plan (the Plan) with help from the Ohio Department of Public Safety's (ODPS) Emergency Management Agency (Ohio EMA) and the Federal Emergency Management Agency (FEMA). Delaware County Office of Homeland Security and Emergency Management (DCOHSEM) has acted as administrators for the following plan.

This Plan is composed of six sections detailing the methods, analysis, and discussion surrounding the various hazards that threaten Delaware County and its jurisdictions. The current section entails a discussion about the general purpose and goals that the county wishes to achieve throughout the development and implementation of the Plan along with a basic description of the Plan's authority within the policy-making process. Additionally, this section includes a brief description of Delaware County and each of the participating jurisdictions including their population size, important sites, and other general information.

Section 2 of this Plan details the process involved in the conception of this Plan including a description of those who actively participated in the process, how community engagement was incorporated, and how the Plan was composed through deliberations, reviews, and evaluations. Sections 3 and 4 contain the analysis of the potential natural and man-made hazards and the resulting mitigation strategy derived through the Hazard Identification and Risk Assessment (HIRA) process. Section 5 includes the mitigation actions developed to address the hazards; and the proposed Plan adoption and maintenance is included in Section 6.

Plan Purpose and Authority

A Countywide agreement for Delaware County creating a countywide Emergency Management Agency was approved by the Board of County Commissioners and a majority of the Chief Executives of the political subdivisions within the county on July 18, 1977. It was amended in July of 1986, March of 2002, early 2010, early 2012, 2017, and 2022.

The initial All-Natural Hazard Mitigation Plan was presented upon its completion to Delaware County and its political subdivisions on July 5, 2006, and was subsequently adopted by them in September and October of 2006. The 2014 Plan was officially implemented/adopted on May 22nd, 2014. The 2019 Multi-Hazard Mitigation Plan was officially implemented/adopted in 2019. This Plan will be submitted to the DCOHSEM Executive Board as it provides representation for Delaware County and its political subdivisions (Cities of Dublin, Columbus, and Westerville excluded) for adoption after final approval from Ohio EMA or FEMA. The jurisdictions will then adopt the Plan following agency review and final approval.

This Plan will serve many purposes through being a helpful tool for citizens, policymakers, local businesses, and many other interested stakeholders who all share a public interest in keeping Delaware County as safe as possible. These purposes include but are not limited to the following:

- Lessen injuries and loss of human life – to achieve the plan's main goal of reducing the impact of natural and man-made hazards on the wellbeing of Delaware County's citizens.

- Enhance public awareness and education-to widen the public's understanding of natural and manmade hazards and how they might affect public health and safety, the environment, the local economy, and basic day-to-day operations.

- Coordinate inter-jurisdictional preparedness measures-to encourage and ensure multi-jurisdictional cooperation in countywide mitigation actions and programs so that they may be implemented efficiently and effectively.

- Provide decision-making tools for interested stakeholders-to formulate a comprehensive, updated analysis of Delaware County's vulnerability to hazards so that decision-makers can better prepare for natural and manmade disasters.

- Achieve regulatory compliance-to ensure that the county and its political subdivisions meet state and federal mitigation planning requirements so that they may be eligible to participate in grant programs, policies, and regulations.

This Plan is comprised of six sections, which detail the methods, analysis, and discussion surrounding the various hazards that threaten Delaware County and its jurisdictions. These sections are as follows:

1. Introduction (Section 1) provides a discussion about the general purpose and goals that Delaware County wishes to achieve throughout the development and implementation of this Plan. This section also includes a summary of the Plan's contents.

2. Jurisdiction Profiles (Section 2) includes a description of Delaware County and each participating jurisdiction, including their history, population, and other general information.

3. Planning Process (Section 3) details the process of the development of this Plan. This section includes details about the process used to develop this plan, including a description of who participated, how the community was involved, which hazards were included in the Plan and why, as well as how the Plan was developed through public meetings, reviews, and evaluations. This section also details the review and incorporation of existing plans, studies, reports, and technical information.

4. Hazard Identification and Risk Assessment (HIRA) (Section 4) provides detailed descriptions and a corresponding analysis for each hazard that could potentially affect Delaware County. The nature, location, extent historical impact, vulnerability, and likelihood of occurrence for each hazard are provided for each hazard. These analyses include the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; an estimate of the potential dollar losses to vulnerable structures; and a general description of land uses and development trends within the community.

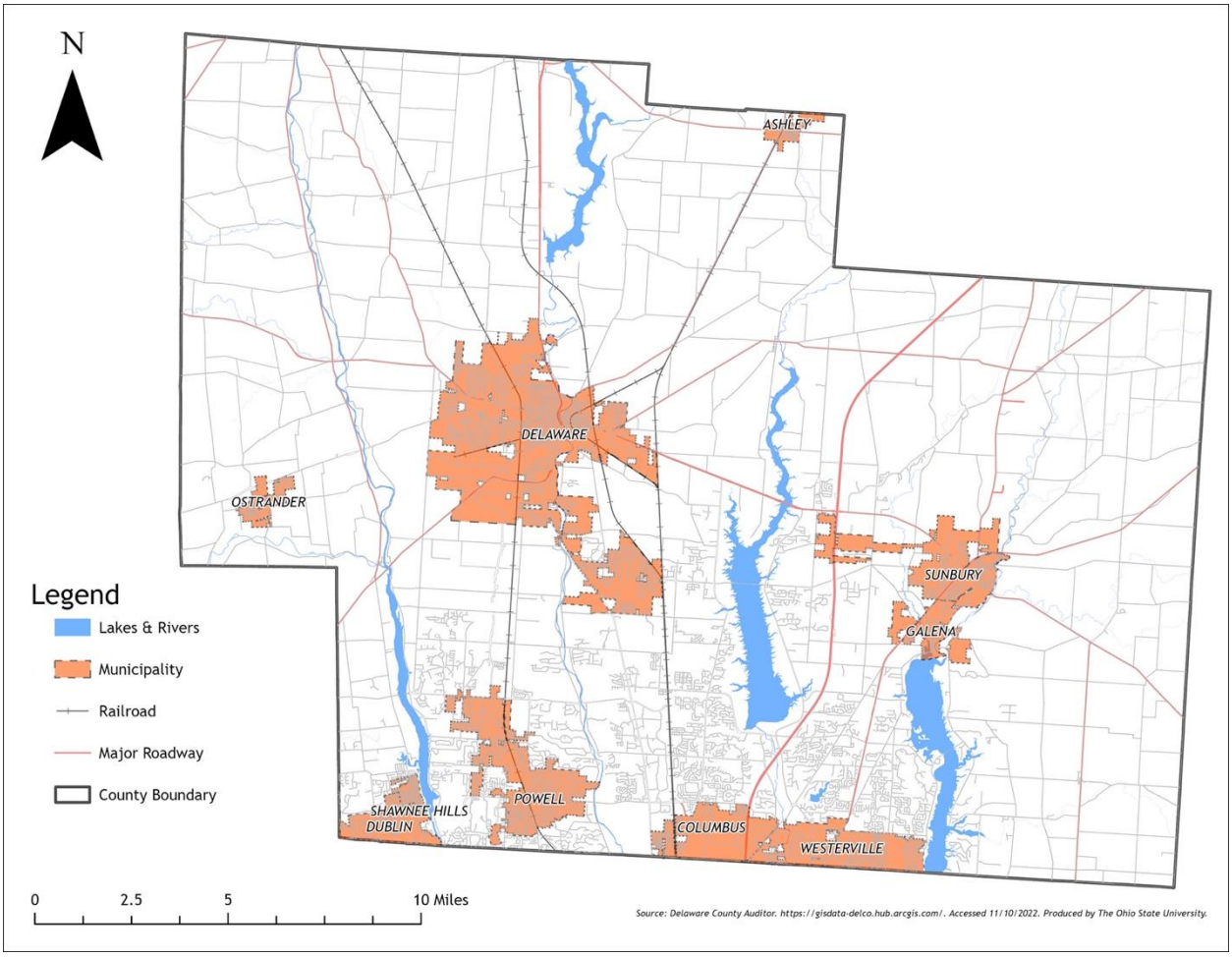
5. Hazard Mitigation Actions (Section 5) outlines the goals, strategies, and actions for the County. The proposed actions are presented in tables, categorized by the associated hazard and community, and then ranked from highest to lowest priority based on feedback received from County officials and participating jurisdictions and stakeholders.

6. Schedule and Maintenance (Section 6) is the final section of this Plan and provides a summary of the proposed plan adoption, integration, and maintenance schedule. This section describes how the county will view and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five years in order to continue to be eligible for mitigation project grant funding.

1.2 Setting

Delaware County is in the center of the Ohio and has a total area of approximately 460 square miles. The County contains three cities, four villages, and 18 townships. The jurisdictions can be seen in **Figure 1**. The City of Delaware serves as the county seat. Delaware County is bordered by six counties: Marion County and Morrow County to the north, Knox County and Licking County to the east, Franklin County to the south, and Union County to the west.

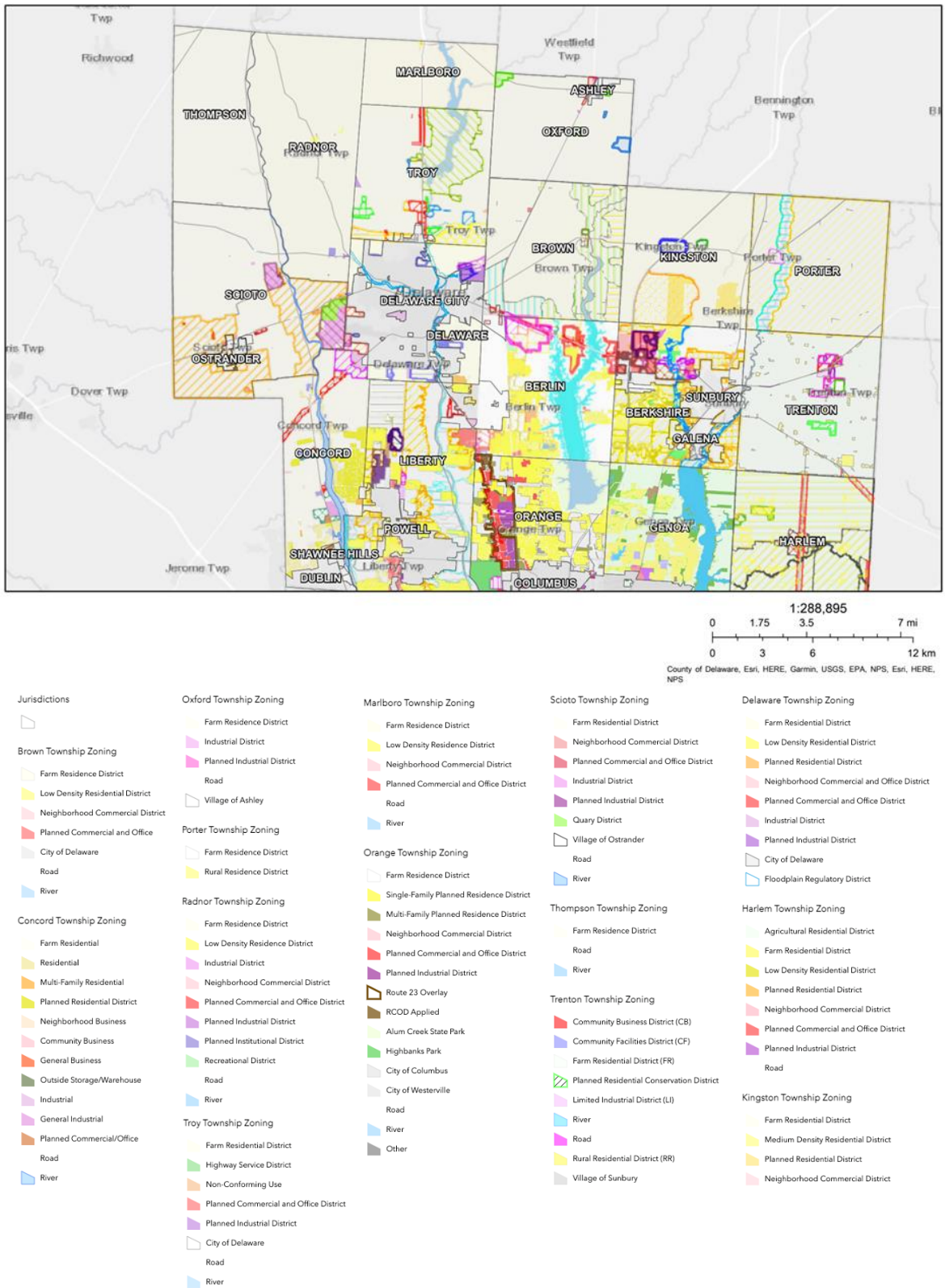
Figure 1 *Delaware County Jurisdiction Map*



Source: DCOHSEM, Date Created/Gathered: December 5th 2022

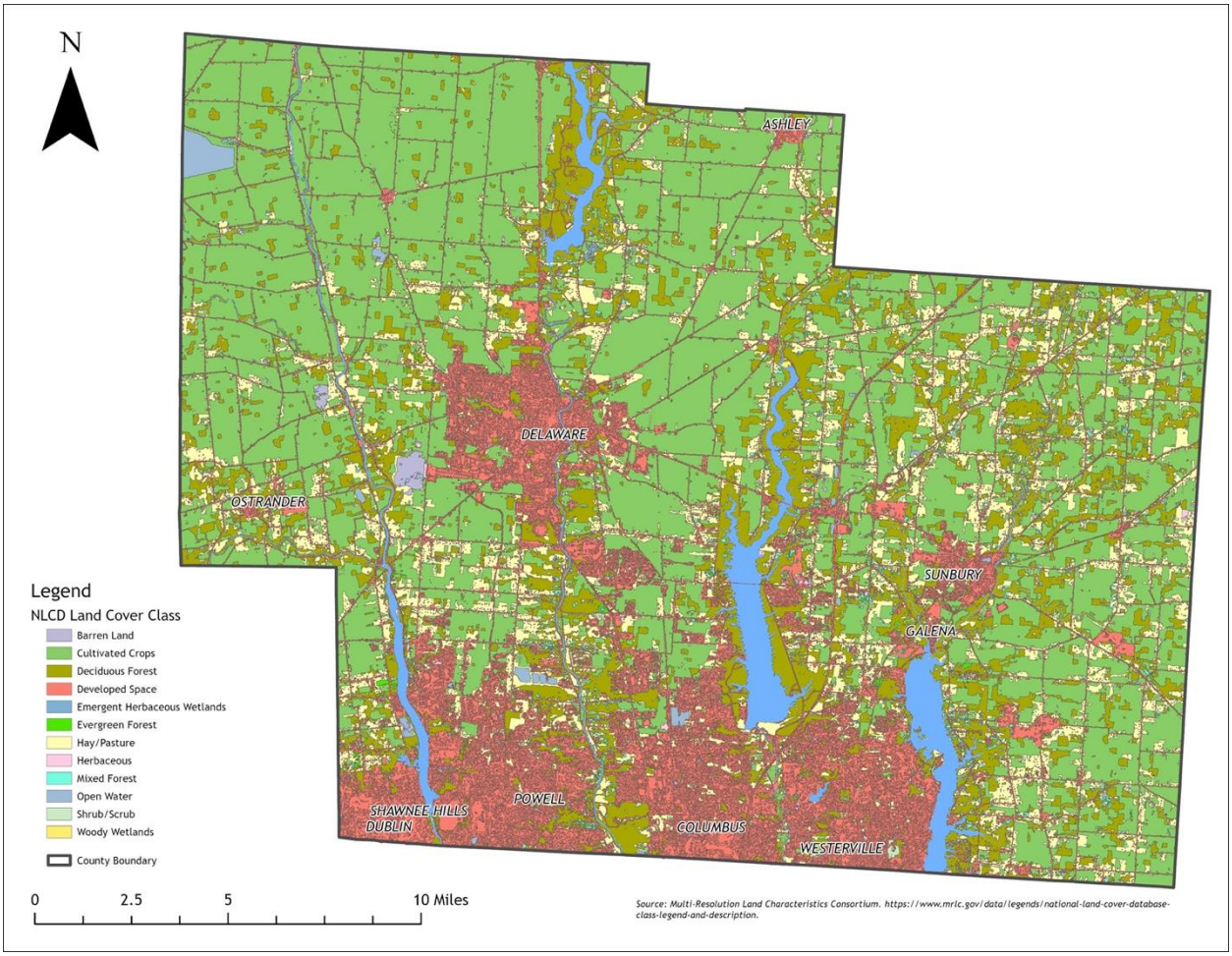
Zoning patterns in Delaware County are consistent with similar counties in Ohio and is shown in **Figure 2**. There are a variety of zoning districts in Delaware County, including Farm Residence, Industrial, Low Density Residential, Neighborhood Commercial, Planned Commercial and Office, Recreational, Planned Residential, and Multi-Family Planned Residence. Land cover in Delaware County is shown in **Figure 3.** Land cover types include barren land, cultivated crops, deciduous forest, developed spaces, emergency herbaceous wetlands, evergreen forest, and hay/pasture. The most common land cover in the county is Cultivated Crop.

Figure 2 *Delaware County Zoning Map*



Source: Delaware County's Auditor GIS Office, Date Created/Gathered: December 10th 2022

Figure 3 *Delaware County Land Cover Map*



Source: DCOHSEM, Date Created/Gathered: December 5th 2022

1.3 Transportation

1.3.1 Transportation

Delaware County contains several major roadways, including Interstates (I), US Routes (US), and State Route (SR). Major roadways in Delaware County Include: I-71, US-23, US-36, US-42, SR-4, SR-37, SR-47, SR-203, SR-229, SR-257, SR-315, SR-521, SR-750.

The Ohio Department of Transportation (ODOT) has record of one public airport and six private airports in Delaware County, which are listed in **Figure 4**.

Figure 4 *Airports in Delaware County*

Facility Name	*Location*	*Facility Type*	*Ownership/Use Type*
Delaware Muni-Jim Moore Field	City of Delaware	Airport	Public

Facility Name	Location	Facility Type	Ownership/Use Type
Berlin Station Landing Strip	City Delaware	Airport	Private
Erdy Farm	Kilbourne	Airport	Private
Obi One	City of Delaware	Airport	Private
Grover (Head)	Cheshire	Airport	Private
Seymour Airfield	Radnor	Airport	Private
Grady Memorial Hospital Helistop	City of Delaware	Heliport	Private

Source: ODOT Date Created/Gathered: November 29th 2022

The Ohio Department of Transportation (ODOT) has record of two rail lines in Delaware County. Both are freight lines that run primarily north and south through the City of Delaware. One also runs through the City of Powell.

1.3.2 Natural Features

Delaware County also has numerous water bodies, parks, and nature areas, which are listed in ***Figures 5 and 6*** below.

Figure 5 *Principal Streams and Water Bodies in the Region*

Water Body	
Alum Creek Lake	Hoover Reservoir
Columbus Upground Reservoir	Scioto River
Delaware Lake	Olentangy River
Alum Creek	Big Walnut Creek
O'Shaughnessy Reservoir	

Source: ODOT Date Created/Gathered: November 29th 2022

Figure 6 *Federal, State & County Parks and Nature Areas*

Parks & Nature Areas	
Alum Creek State Park	Hogback Ridge Park
Char-Mar Ridge Preserve	Highbanks Metro Park
Deer Haven Park	Olentangy Scenic River
Delaware Lake Fishing Area	O'Shaughnessy Reservoir Fishing Area
Delaware State Park	Seymour Woods State Natural Area
Emily Traphagen Park	Shale Hollow Park
Fort Cheshire	Strafford Wood State Nature Preserve
Gallant Farm	Sycamore Run Park
Gallant Woods Park	US Army Corp of Engineers-Delaware Lake
Hickory Wood Parks	US Army Corp of Engineers-Alum Creek Lake

Source: Delaware County Federal, State & County Parks Date Created/Gathered: November 29th 2022


10
2. Participating Jurisdiction Profiles

2.1 History

Originally a part of Franklin County, Delaware County was authorized on February 10th, 1808, by Ohio. Residents of Delaware County based its name on the Delaware Native American tribe. Delaware has had a long history of deeply religious groups throughout the 1800s that played an important role in the Underground Railroad. Despite its population growth within the past decade, Delaware County remains a heavily rural area. The northern portion of the county is more rural than the southern portion of the county, which is experiencing some of the fastest growth in the state.

2.2 Communication Outlets

The primary communication outlets for public and stakeholder feedback and information sharing about the Plan are listed in **Figure 7** below.

***Figure 7** Delaware County Communication Outlets*

Communication Type	Source
Website	u.osu.edu/delawarehmp
Facebook	https://www.facebook.com/DelCoEMA
Twitter	https://twitter.com/DelCoEMA

Source: DCOHSEM Date Created/Gathered: November 29th 2022

2.3 Demographics Overview

Delaware County

According to the 2020 American Community Survey, Delaware County had a total population of approximately 220,000 residents as of July 2021. Delaware County resides within an area of approximately 443 square miles. Delaware County has consistently been one of the fastest growing of Ohio's 88 counties in the past decade. It has also been named as one of the fastest growing, wealthiest, and most educated areas in the country. Delaware County has moved up to the 13th largest county in Ohio from being 14th in 2019. Situated directly north of Franklin County, which contains the City of Columbus, Ohio's capital city, Delaware County is a diverse community in identities and economic profiles.

Of the residents in Delaware County, about half are female and the other half are male. The county has a majority White population with 84% of its population identifying as White and the other 16% identifying as Black or other races. About 5% of the population falls below the poverty line. The median household income is $111,411, which is well above the national median household income of $65,000, according to the Federal Census Bureau. There are 71,521 households in Delaware County, of which 81% are owner-occupied. The average household size is 2.84 people. More than half of residents, 57%, have a bachelor's degree or higher in the county and about 5% of the county's population identifies as a veteran.

Delaware County contains the City of Delaware, City of Powell, City of Sunbury, and portions of the City of Columbus, City of Westerville, and City of Dublin, and the Village of Ashley, Village

of Galena, Village of Ostrander, and Village of Shawnee Hills. There are 18 townships in Delaware County. Washington Township, City of Columbus, City of Westerville, and City of Dublin are not included in this Plan as they are included in the Franklin County's Mitigation Plan. Of the participating 18 townships, 15 townships have enacted township zoning and have completed comprehensive plans. The additional 3 townships have adopted Delaware County as their zoning entity and have no comprehensive plan.

All of the unincorporated areas in Delaware County are subject to the Delaware County Subdivision Regulations, Section 711 of the Ohio Revised Code, which enables the Delaware County Commissioners and the Delaware County Planning Commission to adopt regulations governing plans and subdivisions of land within their jurisdiction. These regulations were first adopted in 1967, revised in 1997, and most recently revised in 2018 with minor modifications. Incorporated areas still have their own zoning.

The rise in population and education within the county has lured big industries such as PPG, Nippert Company, Trus Joist, and the Liebert Corporation. Some tourist destinations within the county include the Columbus Zoo and Aquarium and the Olentangy Caverns.

Socially Vulnerable Population

FEMA has developed the National Risk Index to map natural hazards at the county level as well as at the census tract level for all counties and census tracts in the United States. The risk index is calculated through a combination of three factors: expected annual loss, social vulnerability, and community resilience. The expected annual loss is calculated by the by the amount of loss – building value, population, and agricultural value – that is likely to occur each year due to natural hazards. Social vulnerability is the vulnerability or susceptibility of social groups to natural hazard impacts. Lastly, community resilience is a community's ability to withstand natural hazard events through preparation, recovery, and adaptability.

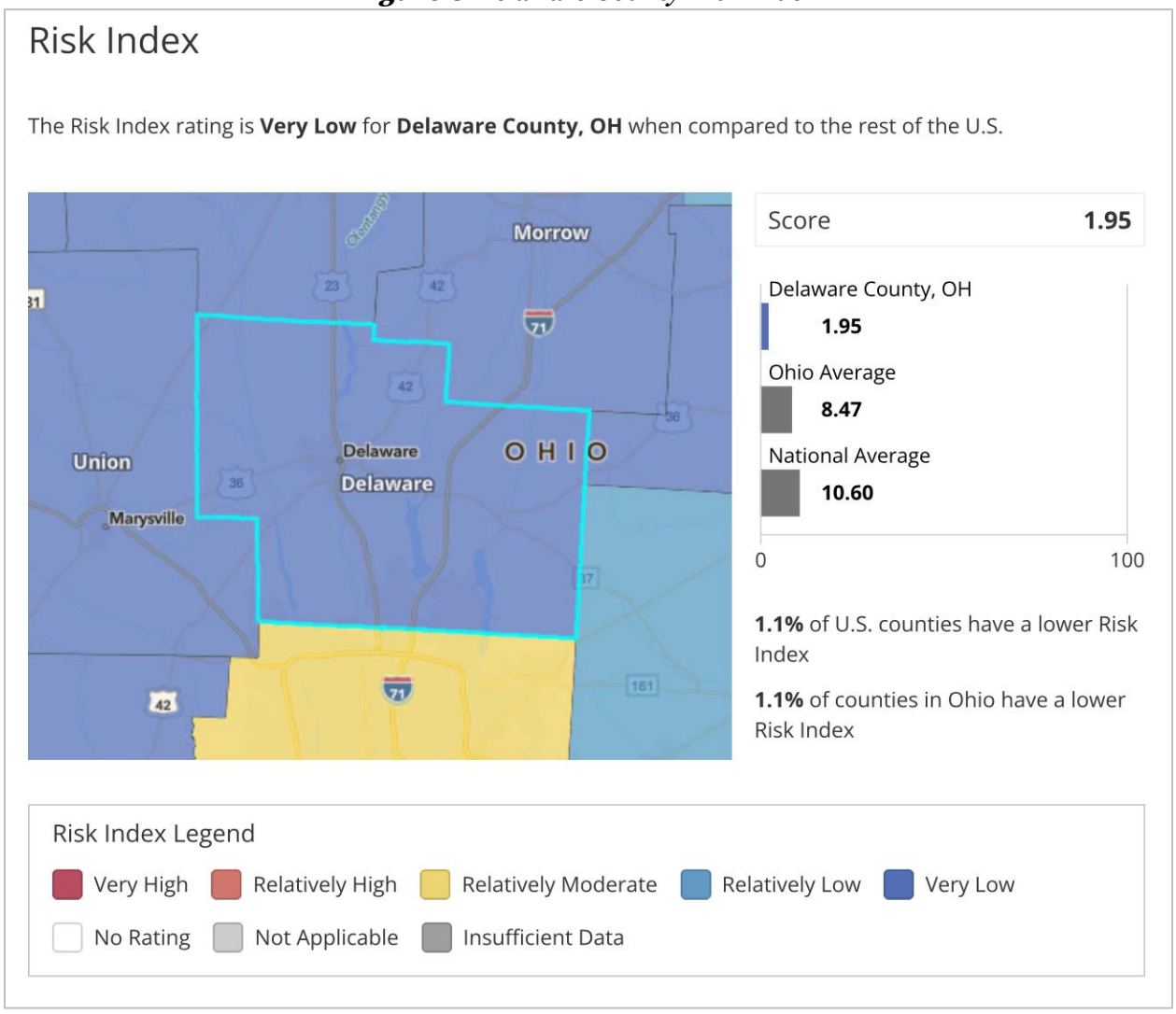
$$\frac{Expected\ Annual\ Loss * Social\ Vulnerability}{Community\ Resilience} = Risk\ Index$$

The Risk Index as a whole and each factoring attribute, is ranked as a scale. The index, from low risk to high risk includes Insufficient Data, Not Applicable, No Rating, Very Low, Relatively Low, Relatively Moderate, Relatively High, and Very High.

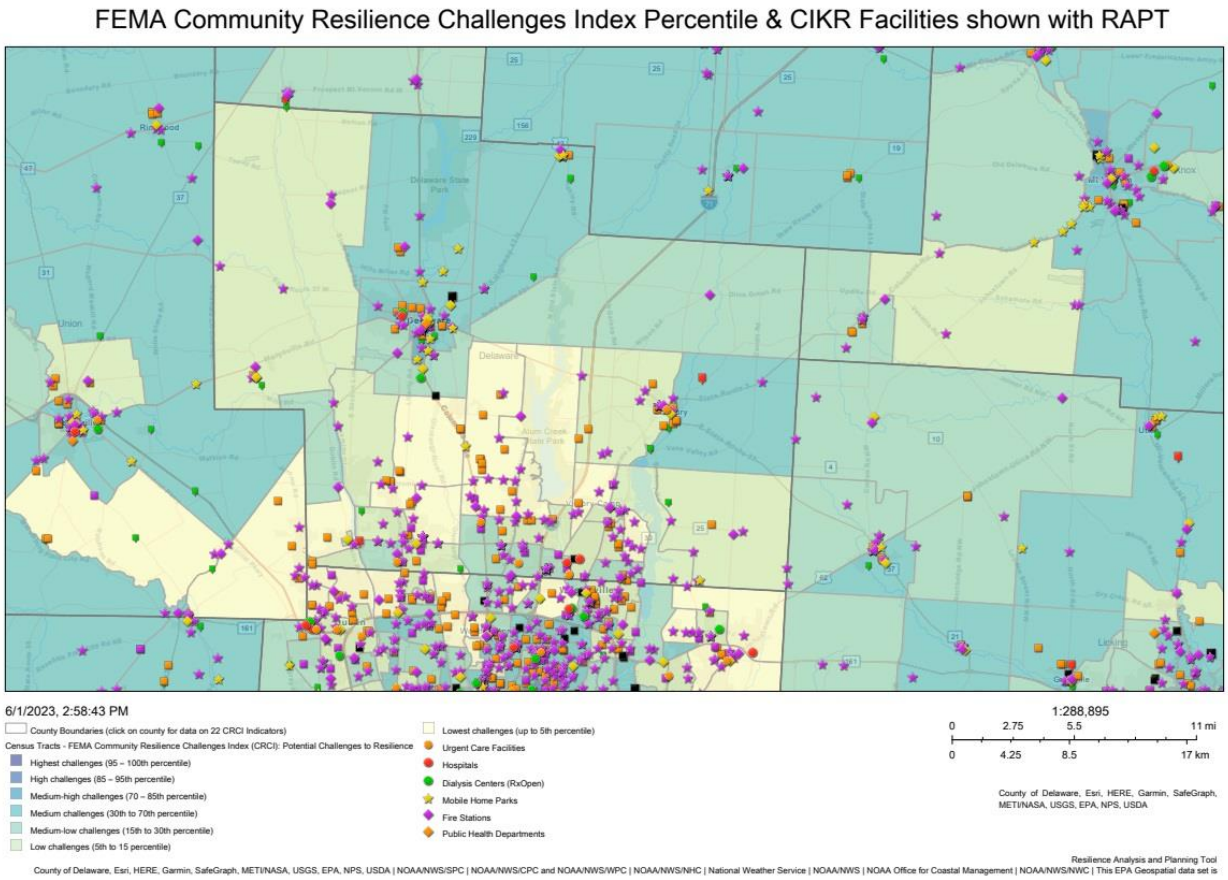
According to the National Risk Index Map, Delaware County has a Risk Index of very low, Expected Annual Loss risk of Relatively Low, Social Vulnerability risk of Very Low, and Community Resilience of Relatively High. Delaware County has a Risk Index rating of 1.95 – shown below in **Figure 8** – this is Very Low. The Ohio Average is 8.47 and the National Average is 10.60. 1.1 percent of both U.S. counties and Ohio counties have a lower Risk Index. Delaware County has an Expected Annual Loss of $7,371,874 - $5,491,027 in building value losses, 0.23 fatalities, $1,773,024 in population equivalence losses, and $107,823 in agriculture value losses. Delaware County has a score of 15.76, the Ohio Average is 12.08, and the National Average is 13.33. 75.9 percent of U.S. counties have a lower Expected Annual Loss and 87.5 percent of counties in Ohio have a lower Expected Annual Loss. Delaware County scored 6.23 in Social Vulnerability. The Ohio Average is 34.28 and the National Average is 38.35. Only 0.3 percent of

U.S. counties have a lower Social Vulnerability and 1.1 percent of counties in Ohio have a lower Social Vulnerability. Lastly, Delaware County scored 58.08 in Community Resilience. The Ohio Average is 56.84 and the National Average is 54.59. Only 11.8 percent of U.S. counties have a higher Community Resilience and 26.2 percent of counties in Ohio have a higher Community Resilience.

Figure 8 *Delaware County Risk Index*



FEMA National Risk Index							
Census Track	**Area of County**	**Risk Index Score**	**Risk Index Percentile Ohio**	**Risk Index Category**	**Expected Annual Loss**	**Social Vulnerability**	**Community Resilience**
12000	Thompson Twp, Radnor Twp, Scioto Twp, Village of Ostrander	38.33	83.80	Relatively Low	Relatively Low	Very Low	Very High
11200	Marlboro Twp, Troy Twp, Village of Ashley	28.47	70.50	Relatively Low	Relatively Low	Relatively Low	Very High
10422	City of Delaware, Delaware Twp	24.34	65.00	Very Low	Relatively Low	Very Low	Very High
10420	City of Delaware, Delaware Twp	7.46	25.80	Very Low	Very Low	Very Low	Very High
10200	City of Delaware, Delaware Twp	40.86	85.90	Relatively Low	Relatively Low	Relatively High	Very High
12200	City of Delaware, Delaware Twp	43.80	88.18	Relatively Low	Relatively Low	Relatively High	Very High
10520	City of Delaware, Delaware Twp	45.77	89.80	Relatively Low	Relatively Low	Relatively High	Very High
10421	City of Delaware, Delaware Twp	13.88	44.30	Very Low	Very Low	Relatively Low	Very High
10100	City of Delaware, Delaware Twp	37.60	82.90	Relatively Low	Relatively Low	Relatively Low	Very High
10530	City of Delaware, Delaware Twp	29.15	71.70	Relatively Low	Very Low	Very High	Very High
11101	Oxford Twp, Brown Twp	15.64	48.00	Very Low	Very Low	Relatively Low	Very High
11102	Brown Twp, Kingston Twp, Porter Twp	24.91	65.70	Very Low	Relatively Low	Relatively Low	Very High
12300	Trenton Twp, City of Sunbury, Village of Galena	25.47	66.60	Very Low	Relatively Low	Very Low	Very High
11604	Berkshire Twp, City of Sunbury, Village of Galena	49.31	92.30	Relatively Low	Relatively Moderate	Very Low	Very High
11760	Harlem Twp	18.58	55.20	Very Low	Relatively Low	Very Low	Very High
11764	Genoa Twp	7.26	25.20	Very Low	Very Low	Very Low	Very High
11740	Genoa Twp	21.64	60.80	Very Low	Relatively Low	Very Low	Very High
11766	Genoa Twp	17.37	52.10	Very Low	Relatively Low	Very Low	Very High
11765	Genoa Twp, Berkshire Twp	3.88	11.40	Very Low	Very Low	Very Low	Very High
11762*	Genoa Twp, Orange Twp	37.51	82.70	Relatively Low	Relatively Low	Very Low	Very High
11763	Berkshire Twp, Orange Twp	18.28	54.50	Very Low	Relatively Low	Very Low	Very High
11565	Berlin Twp	17.68	52.80	Very Low	Relatively Low	Very Low	Very High
11562	Berlin Twp, City of Delaware	45.67	89.80	Relatively Low	Relatively Low	Very Low	Very High
11564	Berlin Twp, Orange Twp	16.44	49.70	Very Low	Relatively Low	Very Low	Very High
11540*	Orange Twp	31.70	75.50	Relatively Low	Relatively Low	Very Low	Very High
11563	Orange Twp	37.15	82.40	Relatively Low	Relatively Low	Very Low	Very High
11530*	Orange Twp	14.45	45.50	Very Low	Very Low	Very Low	Very High
11561	Orange Twp, Liberty Twp	36.58	81.80	Relatively Low	Relatively Low	Very Low	Very High
11520	Orange Twp, Liberty Twp	31.76	75.60	Relatively Low	Relatively Low	Very Low	Very High
11421*	Liberty Twp, City of Powell	39.61	84.90	Relatively Low	Relatively Low	Very Low	Very High
11423	Liberty Twp, City of Powell	32.81	77.10	Relatively Low	Relatively Low	Very Low	Very High
12100	Liberty Twp, Berlin Twp, City of Delaware	49.01	92.00	Relatively Low	Relatively Moderate	Very Low	Very High
11432	Liberty Twp, Concord Twp	32.51	76.50	Relatively Low	Relatively Low	Very Low	Very High
11431	Concord Twp	4.04	12.30	Very Low	Very Low	Very Low	Very High
11412	Concord Twp, Village of Shawnee Hills	23.60	63.90	Very Low	Relatively Low	Very Low	Very High
11411*	Concord Twp, Village of Shawnee Hills	12.28	40.10	Very Low	Relatively Low	Very Low	Very High
11430	Liberty Twp, Concord Twp, City of Powell	22.33	61.90	Very Low	Relatively Low	Very Low	Very High
11900	Liberty Twp, Concord Twp, City of Powell	32.04	75.90	Relatively Low	Relatively Low	Very Low	Very High
*These census tracts also contain jurisdictions not covered in this plan, including Westerville, Columbus & Dublin							



Source: National Risk Index Date Created/Gathered: December 5th 2022/ May 31st, 2023

2.4 Local Jurisdictions

City of Delaware

The City of Delaware is the largest city within Delaware County and contains the majority of the County's public offices, infrastructure, and operations. Some important sites include the Delaware Fairgrounds and Ohio Wesleyan University. Historically occupied by the Delaware Native American Tribe. Delaware was platted on the west side of the bank of the Olentangy River in 1808 and has flourished with industrial and commercial development.

Topographically the city is mostly flat, with a few hills throughout the residential areas of the city. The most important body of water in the city is the Olentangy River which runs along the eastern edge of US-23 until it gets to SR-315, where it flows south into Franklin County. Delaware City contains several crucial transportation networks including US-42, US-36, SR-37, and US-23, also known as Columbus Pike in the southern portion of Delaware City. Two major railroads also dissect Delaware City: CSX and Norfolk Southern.

According to the American Community Survey, the City of Delaware has a population of 41,818. In this community, 49% of the population is male and 51% of the population is female. Delaware has a majority White population with 82% of its residents identifying as White, with about 18% identifying as Black or other races. Additionally, 8% of the population falls below the poverty line. The median household income in Delaware is $74,130, which is well above the national median household income. There are 15,471 households in Delaware, 63% which are owner-occupied. A little over 43% of residents of the city of Delaware have a bachelor's degree or higher, and about 4% of residents are veterans.

City of Powell

Recognized as a municipality in 1947 and registered as a city in 2000. Located in the southwest corner of Delaware County, the City of Powell has celebrated phenomenal population growth. Although a rural area lies to the north of the city, it is within very close proximity to Dublin, Ohio which is a densely populated area of Franklin County.

Like much of Delaware County, the City of Powell resides on flat lands just to the west of the Del-Co Water reservoirs, and between the Olentangy and Scioto Rivers. SR-9 and SR-750 serve as the two most heavily traveled roads within the city and intersect downtown in the City of Powell. The same CSX railroad that dissects the center of the City of Delaware also runs through the center of the City of Powell.

According to the American Community Survey, the City of Powell has a population of 13,353 with 51% of the population being male and 49% of the population is female. The City of Powell has a majority White population with 86% of its residents identifying as White and less than 14% identifying as Black or other races. Around 1% of the City of Powell's population falls below the poverty line. The median household income in the City of Powell is $159,368, which is over double the national median household income. There are 4,443 households in the City of Powell, 96% of which are owner-occupied. Most adults in the City of Powell have a bachelor's degree or higher, 74% of those over 25 years old, and about 6% of residents are veterans.

City of Sunbury

The City of Sunbury lies just north of the Village of Galena, in the heavily rural eastern portion of Delaware County. It is the home of the Ohio Fallen Heroes Memorial which memorializes all of the service men from Ohio who have lost their lives since September 11, 2001, in the Global War on Terrorism. Its rapid development can be attributed to the intersection of US-36, US-37, and SR-3, which split off around the village square.

According to the American Community Survey, the City of Sunbury has a population of 5,934. In this community 45% of the population is male and 55% of the population is female. The City of Sunbury has a majority White population with 97% of its residents identifying as White and less than 3% identifying as Black or other races. Additionally, 8% of the population falls below the poverty line. The median household income in the City of Sunbury is $80,663, which is well above the national median household income. There are 1,960 households in the City of Sunbury, 70% of which are owner-occupied. Close to the national percentage, about 35% of the City of Sunbury residents have a bachelor's degree or higher, and about 4% are veterans.

Village of Ashley

At the northeastern corner of Delaware County – on the border of Morrow County – resides the Village of Ashley. Its historical development can be attributed to its fertile lands and its proximity to the railroad that connected Cleveland and Cincinnati, which also borders a small eastern portion of the City of Delaware. The aforementioned railroad cuts through the center of the village along with SR-229 and US-42.

According to the American Community Survey, the Village of Ashley has a population of 1,672, of which 53% are male and 47% are female. This is a mostly White community, with 99% of people identifying as White. The median household income is $56,646, which is below the national median household income. Of the 565 households in the Village of Ashley, 14% of residents are below the poverty line, which is more than any other jurisdiction in the county. In this community, 53% of homes are owner occupied, therefore 47% of homes are renter occupied. About 10% of the residents hold a bachelor's degree, while about 6% of the residents of the Village of Ashley are veterans.

Village of Ostrander

Originally founded in 1852 due to its growth surrounding the CCC&I railroad that connected Springfield and Delaware. The Village of Ostrander is housed on US-36 and is centered between the City of Delaware and the City of Marysville in Union County. The closest body of water is Mill Creek which is a small branch of the Scioto River.

According to the American Community Survey, the Village of Ostrander has a population of 904, 52% of which is male and 48% of which are female. Similar to the Village of Ashley, 97% of the community's residents are White. Similar to the Village of Galena, the median household income is $102,813 which is well above the national median household income. There are 281 households in the Village of Ostrander and 7% of them are classified as being below the poverty line. Of the homes occupied by these households, 91% of them are owner occupied. In the Village of Ostrander, 35% of residents hold a bachelor's degree, which is about the same as the national rate. About 3% of residents of the Village of Ostrander are veterans, which is less than many other jurisdictions in this county.

Village of Galena

The Village of Galena lies on the southern border of the City of Sunbury. It enjoyed historical development due to the presence of the Galena Shale Tile and Brick Company which operated from the 1890s to 1983. The citizens of the Village of Galena also enjoy several of the amenities of the City of Sunbury. The Village of Galena is positioned at the confluence of Little Walnut Creek and Big Walnut Creek which are the headwaters of the Hoover Reservoir, just north of Columbus, Ohio. No major railroads exist within the community, but SR-3 does form part of the border and dissects a small portion of the village.

According to the American Community Survey, the Village of Galena has a population of 753, 52% of which are female, and 48% of which are male. The village is predominantly a White

community with 90% identifying as White. Similar to the Village of Ostrander, the Village of Galena has a median household income of $102,083 which is above the national median household income. There are 228 households in the Village of Galena with 89% being owner occupied. About 44% of the population holds a bachelor's degree or higher and about 8% of the population are veterans, which is higher than many jurisdictions in the county.

Village of Shawnee Hills

The Village of Shawnee Hills is the smallest village of Delaware County and was originally founded as a resort fishing community near O'Shaughnessy Reservoir in the southwestern Delaware County. Like other cities, villages, and areas in the southern part of Delaware County, the Village of Shawnee Hills has seen rapid growth and development, particularly within the last decade, with its current population at 891 residents. It is mostly residential, but not as densely populated as the City of Dublin, just south of Shawnee Hills. The only major roadway that passes through the village is SR-745 which bisects the village in half. The village itself lies on the western bank of the O'Shaughnessy Reservoir.

Of the 891 residents in the Village of Shawnee Hills, 52% are male and 48% are female according to the American Community Survey. This is a mostly White community, with 93% of people identifying as White. The median household income is $122,500, which is nearly double the national median household income. There are 308 households in the Village of Shawnee Hills, less than 1% of which are below the poverty line. Of the households in the Village of Shawnee Hills, 93% are owner occupied. More than 60% of those over 25 have a bachelor's degree or higher. About 3% of the residents are veterans.

Other Areas

There are several other named incorporated areas in Delaware County. These are: Radnor, Olive Green, East Liberty, Center Village, Harlem, Condit, Condit Station, North Condit, Cheshire, Lewis Center, Hyatts, Bellpoint, Rathbone, Norton, Kilbourne, Leonardsburg, and Warrensburg.

3. Planning Process

3.1 Methodology

The Planning Process section describes the steps involved in developing the Plan, including methodology of preparing the plan, who was involved, how community involvement was organized and promoted, how stakeholders were engaged throughout plan development, and usage of data from previous and existing plans. This section will also describe the formation of the Core Planning Committee and how stakeholder and community feedback contributed to the updated Delaware County Hazard Mitigation Plan.

3.2 Existing Plans and Regulations

Delaware County maintains several plans and tools that were pertinent to reference in the development of this Multi-Hazard Mitigation Plan, including:

- *City of Delaware County Comprehensive Plan*
- *Delaware County 2019 Multi-Hazard Mitigation Plan*
- *Delaware County Hazard Specific Plans*
- *County of Delaware Code of Ordinances*
- *Delaware County Zoning Resolution*
- *Delaware County Auditor's Map*
- *Delaware County Zoning Maps*
- *Delaware County Parks and Recreation Master Plan Needs Assessment*

3.3 Delaware County Authority to Adopt Plan

Responsibilities in the Delaware County government are divided amongst the elected official offices, Delaware County government departments and agencies, and publicly funded Delaware County organizations. Within the government departments and agencies are building safety, emergency management agency, economic development, regional planning commission, and soil & water conservation district. Members of the public can also be appointed to the Board of Building Appeals to work with building safety to review building decisions; the Board of Zoning and Appeals to review zoning decisions made by local officials; the Delaware County Rural Zoning Commission to review zoning resolutions and amendments; and the Delaware Metropolitan Housing Authority to develop safe, affordable housing throughout the county. These public appointments serve for five-year terms. **Figure 9** lists the existing authorities and regulations in place in Delaware County and its municipalities.

Figure 9 *Existing Authorities and Regulations in Delaware County*

Community	*Planning Commission*	*Comprehensive Plan*	*Flood Regulation*	*Building Codes**	*Zoning Ordinances*
Delaware County	Yes	*Yes*	Yes	Yes	Yes
City of Delaware	Yes	Yes	Yes	Yes	Yes
City of Powell	Yes	Yes	Yes	Yes	Yes

Community	*Planning Commission*	*Comprehensive Plan*	*Flood Regulation*	*Building Codes**	*Zoning Ordinances*
City of Sunbury	Yes	Yes	Yes	Yes	Yes
Village of Ashley	Yes	No	Yes	Yes	Yes
Village of Shawnee Hills	Yes	Yes	Yes	Yes	Yes
Village of Ostrander	Yes	No	Yes	Yes	Yes
Village of Galena	Yes	Yes	Yes	Yes	Yes

Source: Various (Check appendix D) Date Created/Gathered: November 29th 2022

**All jurisdictions within the state follow the Ohio Building Code (Ohio Administrative Code 4101:1)*

The Delaware County Authority administers county zoning for Marlboro, Radnor, and Thompson Townships. All other zoning regulations are adopted by local jurisdictions.

For a detailed break-down of available resources and capabilities for each participating jurisdiction go to **Appendix H**.

For the expansion or improvement of current capabilities, the different jurisdictions would need to pass legislation through their respective legislative bodies. The respective legislative bodies could also work together to solve problems which result from a disaster or pre-disaster to achieve a mitigation action. Depending on the jurisdiction or capability which is to be expanded there may be legal restrictions or another jurisdiction or agency may have legal responsibly for that capability, which would impede the expansion of that capability by those who are not a designated authority by law.

3.4 Community Outreach Process

Core Planning Committee members were invited to participate at the beginning of the planning process through a Kick-Off Meeting announcement. Prior to each additional meeting, members of the Core Planning Committee were invited to participate via email notification. The public was invited to participate via the Delaware County Facebook and Twitter pages, a listing on the Delaware County websites, and on the Historic Courthouse bulletin board. The meetings were also advertised at all libraries in Delaware County. All kickoff materials and information regarding each individual planning meeting were made available on the project's website – u.osu.edu/delawarehmp. Representatives from the entities in **Figure 10**, **Figure 11,** and **Figure 12** were invited to participate in the planning process. Included in this listing are organizations which directly serve vulnerable population. These organization cover a wide range of those populations from those who are socially vulnerable, economically vulnerable to those

who have access and functional needs. Their input into the plan allowed for more complete picture of those factors and situations vulnerable populations experience.

Figure 10 *Invited Organizations Part 1*

Delaware County	City and Village Members	Township Members
Delaware County Commissioners	City of Delaware	Berkshire Township
Delaware County Emergency Management	City of Powell	Berlin Township
Delaware County	City of Sunbury	Brown Township
Delaware County Board of Developmental Disabilities	Village of Ashley	Concord Township
Delaware County Convention and Visitors Bureau	Village of Ashley	Delaware Township
Delaware County Emergency Medical Service	Village of Galena	Genoa Township
Delaware County Engineer's	Village of Ostrander	Harlem Township
Delaware County Facilities	Village of Shawnee Hills	Kingston Township
Delaware County Public Health District		Liberty Township
Delaware County Sheriff's Office		Marlboro Township
Delaware County Soil & Water		Orange Township
Veteran's Affairs		Oxford Township
Delaware County Building Safety		Porter Township
Delaware County Coroner's Office		Radnor Township
Delaware County Human Resources		Scioto Township
Delaware County Jobs & Family Services		Thompson Township
Delaware County Engineer's Office		Trenton Township
Delaware County Adult Court Services		Troy Township
Delaware County Recorder's Office		
Delaware County Treasurer's Office		
Regional Sewer District		
Delaware County Emergency Communications		

Delaware County	City and Village Members	Township Members
Regional Planning Commission		

Source: DCOHSEM Date Created/Gathered: November 29th 2022

Figure 11 *Invited Organizations Part 2*

Courts	Other Organizations	
Probate Court Probate/Juvenile Court Domestic Relations Courts General Division Court Prosecutor's Office Public Defender **Organization Who Outreach to Socially Vulnerable Populations** DATA Bus Delaware Library Helpline People in Need of Delaware County Red Cross United Way Wornstaff Library-Village of Ashley YMCA Veteran's Affairs Delaware County Board of Developmental Disabilities Delaware County Jobs & Family Services	Administrative Resources American Electric Power - Ohio Amateur Radio Auditor's Office Big Walnut Schools Board of Elections Berkshire, Sunbury, Trenton & Galena Fire District Buckeye Valley Schools Bureau of Workers' Compensation / Human Resources Coordinator Clerk of Courts Columbus State Community College Columbus Zoo Commissioner Contiguous EMAs: Union County, Licking County, Franklin County, Knox County, Morrow County, Marion County DATA Bus Data Center Delaware Area Career Center Delaware City Schools Delaware Fair Board Delaware Library DelCo Water Delinquent Tax Services	Main Street Delaware IT Director, Sheriff Kroger National Oceanic and Atmospheric Administration Ohio Division of Natural Resources Ohio Department of Transportation Ohio EMA Mitigation Branch Ohio Health Ohio Highway Patrol Ohio Living Ohio National Guard Ohio Wesleyan University Olentangy School District Ohio State University People in Need of Delaware County Perkins Observatory PPG Paints Preservation Parks Red Cross Sanitary Search & Rescue Ohio Source Point Strand Theatre United Way US Army Corps of Engineers

Courts	Other Organizations	
	GIS Helpline Highbanks Metro Park	Wornstaff Library-Village of Ashley YMCA

Source: DCOHSEM Date Created/Gathered: November 29th 2022

***Figure 12** Participating Jurisdictions*

Community/ Organization	Representative(s)	Goals	Surveys Completed			Meetings Attended		
			Hazard Priorities	Previous Mitigation Actions	New Mitigation Actions	1	2	Other
Delaware County								
Delaware County Auditors	George Kaitsa	✓	✓			✓		
Delaware County Board of Elections	Sam Kindred	✓						
Delaware County Building Safety	Duane Matlack	✓	✓	✓		✓		
DCOHSEM	Jecy Weber/Scott Stewart	✓	✓	✓		✓	✓	
Delaware County Common Pleas Court	Kristin Schultz	✓	✓	✓				✓
Delaware County Convention and Visitors Bureau	Tim Wilson	✓	✓	✓				
Delaware County Coroner's Office	Charles Carlson	✓	✓	✓				✓
DCOHSEM	Sean Miller	✓	✓	✓	✓	✓	✓	
Delaware County Engineer's	Jerry Ungashick/Lee Bodnar	✓	✓	✓	✓			✓
Delaware County Probate/ Juvenile Court	David Hejmanowski	✓	✓	✓				✓
Delaware County Public Health Department	Traci Whittaker/James Schwaderer	✓	✓	✓	✓			✓
Delaware County Regional Sewer District	Erik McPeek	✓	✓	✓		✓		✓
Delaware County Transit	Grant Bias				✓			✓
Delaware County Sheriff's Office	Scott Vance	✓	✓	✓	✓			✓
Jurisdictions								
City of Delaware	John L. Donahue/Susie Daily, Fire Chief/Admin	✓	✓	✓	✓	✓		
City of Powell	Steven Hrytzik, Police Chief	✓	✓	✓		✓		
City of Sunbury	Rob Stambaugh/Steve Pyles, Fire Chief/Admin	✓	✓	✓	✓		✓	✓

Community/ Organization	Representative(s)	Goals	Surveys Completed			Meetings Attended		
			Hazard Priorities	Previous Mitigation Actions	New Mitigation Actions	1	2	Other
Village of Ashley	Scott Santos, Chief of Police	✓						✓
Village of Galena	Rob Stambaugh/Jill Love, Fire Chief, Mayor	✓	✓	✓	✓			✓
Village of Ostrander	Christopher Greasmar/John Bowden, Mayor/Admin				✓			✓
Village of Shawnee Hills	Russel Baron, Administrator	✓	✓	✓				✓
Townships								
Berkshire Township	Rob Stambaugh, Fire Chief	✓	✓	✓	✓			✓
Berlin Township								
Brown Township	Troy Morris, Fire Chief	✓	✓	✓	✓			✓
Concord Township	Jill Davis, Fiscal Officer	✓	✓	✓	✓			✓
Delaware Township	Troy Morris, Fire Chief	✓	✓	✓	✓			✓
Genoa Township								
Harlem Township	Keith Unterbrink/Michael McKeen, Fire Chief/Trustee	✓	✓		✓			✓
Kingston Township								
Liberty Township	Jim Reardon, Fire Chief			✓	✓			✓
Orange Township								
Oxford Township								
Porter Township	Matthew Isganitis, Trustee	✓	✓	✓	✓			✓
Radnor Township	Randy Butts, Trustee	✓	✓		✓			✓
Scioto Township	Sandra Stults and Marv McIntire, Trustee/Fire Chief	✓	✓	✓	✓	✓		✓
Thompson Township								
Trenton Township	Rob Stambaugh, Fire Chief	✓	✓	✓	✓			✓
Troy Township	Troy Morris, Fire Chief	✓	✓	✓	✓			✓

Source: Ohio State University City Regional Planning Studio Participation Tracker
Date Created/Gathered: December 5th 2022

If representatives did not attend the synchronous in-person or virtual meetings, they participated via "Other" formats, including online surveys, as documented in **Appendix F**.

3.5 Meetings

The following section details the meetings that took place during the planning process. Documentation from each meeting including meeting minutes, sign-in sheets, completed surveys, and marketing materials, can be found in **Appendix F**.

3.5.1 Plan Update Kickoff

The kick-off meeting for updating the plan was with the Ohio State University City & Regional Planning students, DCOHSEM, Ohio EMA, and FEMA staff. It took place on August 31, 2022, at 6:00 PM in a hybrid format, with members joining virtually through Zoom and in-person at The Ohio State University. During this meeting, the project team discussed the contents and importance of a hazard mitigation plan and officially began the process of updating the plan. This meeting laid the groundwork for the planning process, including creating a schedule, setting goals, and delegating administrative responsibilities.

3.5.2 Core Planning Committee Kickoff

A kickoff announcement was emailed to stakeholders on July 27, 2022. The email invited them to participate in the Plan update process as part of the Core Planning Committee; the email explained the importance of the Plan and the process, and invited them to attend the September meeting. Two email reminders were sent on August 2, 2022, and September 6, 2022, regarding the September meeting.

3.5.3 Core Planning Committee & Public Meeting 1

The first Core Planning Committee and public meeting took place on Wednesday, September 14, 2022, at 6:30 PM. This meeting was held in a hybrid format, with some members of the Core Planning Committee and the public attending in-person and others joining virtually using Zoom. Those who were unable to come to the Public Meeting were invited to review the recorded meeting offline. A total of fourteen people attended the in-person meeting. Additionally, three representatives from OSU, one representative from the Ohio EMA, and three representatives from DCOHSEM were in attendance. The Public Meeting started with sign-in forms, followed by introductions, delivery of a presentation about hazard mitigation planning, and ended with the completion of the Goals, Hazard Priority, and Previous Mitigation Actions surveys.

This invitation was also posted on DCOHSEM website, local libraries, and in the Historic courthouse.

3.5.4 Core Planning Committee & Public Meeting 2

A second public meeting was held on Wednesday, October 26, 2022, at 6:30 PM. This meeting was held in-person, but a virtual recording of the meeting was provided for asynchronous attendees. This meeting included an update on the planning process, including requirements of the planning process and results from the Hazard Priority survey distributed at the previous meeting. The update was followed by the distribution of a New Mitigation Actions Scoring Matrix to determine which actions Delaware County and its communities would like to see in the

updated Multi-Hazard Mitigation Plan. The matrix consisted of a list of proposed actions and blank rows for adding other actions. The new mitigation actions were scored in five categories: cost effective, technically feasible, environmentally sound, immediate need, and total risk reduction. These scores were used to determine the priority of mitigations actions included in the updated plan.

This invitation was also posted on DCOHSEM website, local libraries, and in the Historic courthouse.

3.6 Public Comment Period

The Plan was made available to the public and Core Planning Committee for review on November 20, 2022, for a 15-day public comment period. Hard copies of the Plan were made available for review in-person at the DCOHSEM office, and a digital draft of the Plan was made available online on the project's website. Both physical and digital surveys were provided to the public and Core Planning Committee for their comments on the Plan.

This comment invitation was also posted on DCOHSEM website, local libraries, and in the Historic courthouse.

3.7 Planning Process Summary

Stakeholder and public input are essential for determining hazard prioritization, as well as which hazards should be included or excluded from the plan. The Core Planning Committee reviewed feedback to determine which hazards are not of concern to Delaware County and its communities and will therefore not include those hazards in the plan. Other hazards such as hurricanes and coastal flooding, are not applicable to Delaware County and have not been included in previous hazard mitigation plans. More details about how survey feedback aided in determining which hazards to exclude can be found in Section 5, Hazard Mitigation Action Priority.

Section 4, Hazard Identification and Risk Assessment follows this section and is organized alphabetically and not in order of risk. The ranking of hazard priorities can be found in Section 5, Hazard Mitigation Action Priority.

The *Hazard Identification and Risk Assessment* (HIRA) section provides detailed descriptions and a corresponding analysis for each hazard that could potentially affect Delaware County. The nature, location, extent historical impact, vulnerability, and likelihood of occurrence for each hazard are provided for each hazard. These analyses include the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas; an estimate of the potential dollar losses to vulnerable structures; and a general description of land uses and development trends within the community.

4.1 Civil Disturbance

Description

Although Delaware County has not experienced a significant civil disturbance there have been several threats in the county. There have also been several towns across the United States that have unfortunately fallen victim to such an attack, drawing attention to the need for the county and its encompassing jurisdictions to consider the possibility and implications of this hazard. This hazard was ranked 7th out of the 15 hazards that were analyzed in this study.

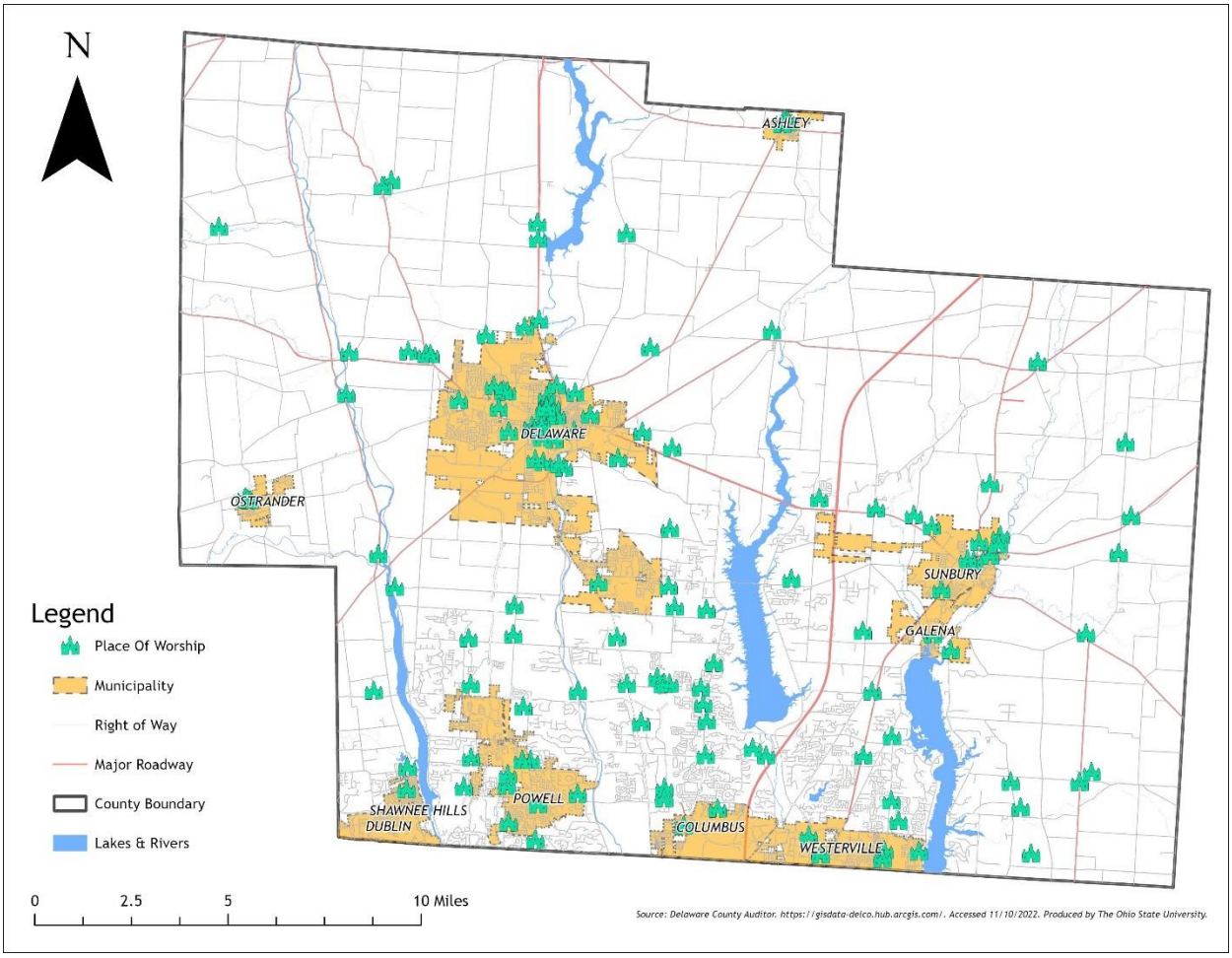
A civil disturbance, which includes a riot, public shooting, small bomb, or labor dispute, can disrupt civil order and require public safety support in their control or suppression. This hazard can impact anywhere in the county at any time but would probably be limited to the larger cities. A civil disturbance event differs from terrorism in its motivation and its consequences. A civil disturbance is considered a violent form of public unrest whether conducted by one or many individuals, such as a riot, without concern for political gain. This may sometimes involve a threat or use of firearms or the detonation of a small bomb.

Civil disturbance threats may also occur among school districts within the county. Threats can last several hours or even days and cause multiple problems such as disturbing a school's order, causing traffic jams, and inducing civil panic. Individuals, groups, and institutions should be aware of and understand how to react to such potential threats immediately and appropriately.

Location

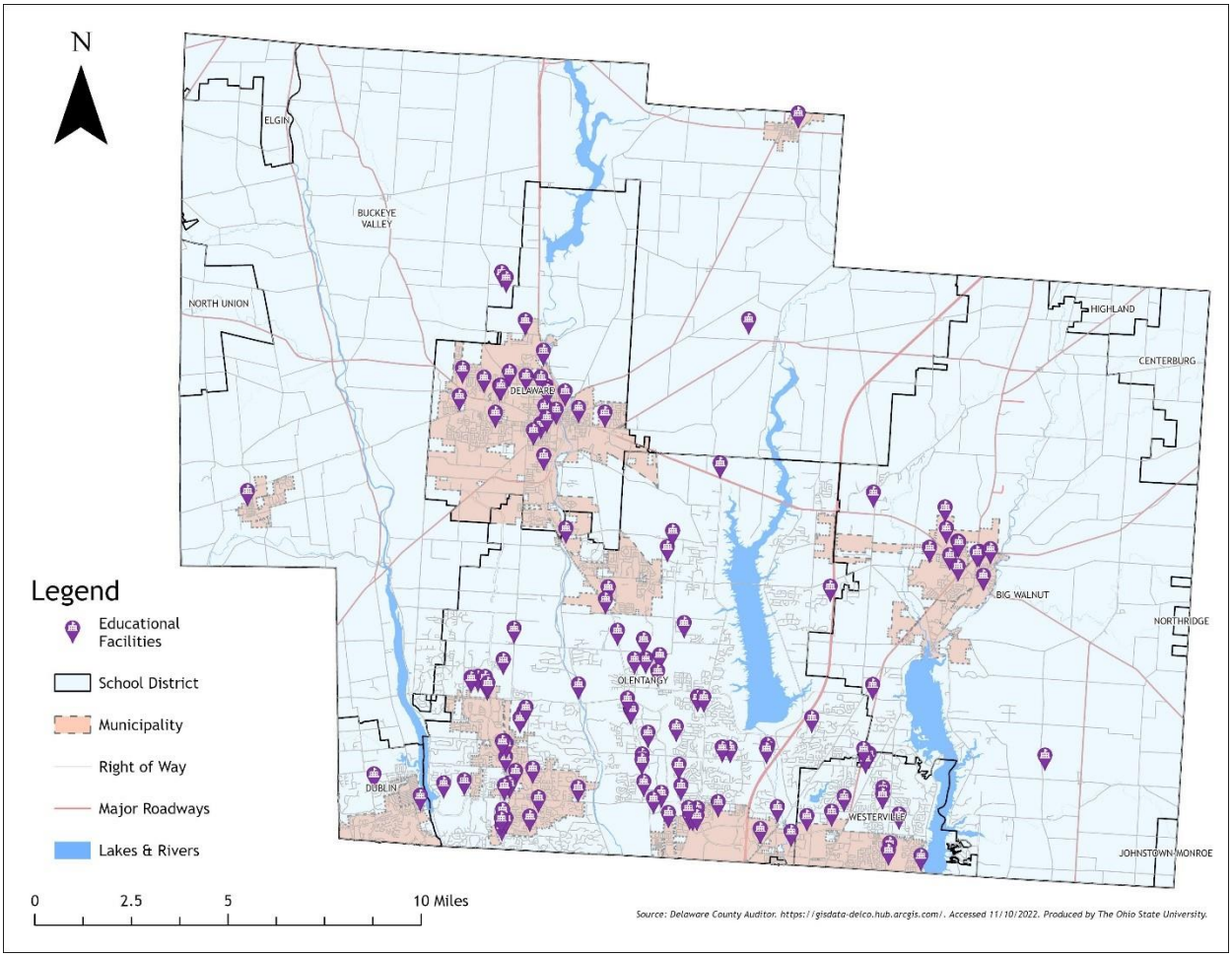
Although a civil disturbance could hypothetically occur anywhere, history has shown that critical facilities such as schools, churches, and other high-traffic public areas tend to result in the highest-profile cases of civil disturbance. Areas that have a higher probability of events with large numbers of the public participating are most vulnerable to incidences. The following **Figure 13** and **Figure 14** show the locations of churches and educational facilities throughout the county.

Figure 13 *Approximate Location of Churches in the County*



Source: Delaware County Auditor Date Created/Gathered: December 5th 2022

Figure 14 *Approximate Location of Educational Facilities in the County*



Source: Delaware County Auditor Date Created/Gathered: December 5th 2022

Extent

The geographic extent of such an attack would most likely be highly contained due to the nature of the act, but the actual magnitude could result in several deaths and injuries that might surpass those associated with natural hazards. Like many other man-made hazards, it is difficult to quantify the probability of such an event.

History

Delaware County has had six recorded forms of civil disturbance in the county. It is important to note that these are only the documented incidents of civil disturbance, but there have been cases of threats that were undocumented and therefore are unrepresented in the plan. Below are the three most recent events. A complete list of events can be found in **Appendix A**.

2017- On June 15th, 2017, two high school students in the Olentangy School district of Delaware County were charged with possession of bomb-making materials after an explosive device was

found attached to a fire hydrant in a pond. Approximately 15 other improvised explosive devices, approximately five pounds of explosive powders and many other components of explosives and improvised explosive devices were found in the home of one of the students.

2018- On November 8th, 2018, the Hayes High School of Delaware County was closed due to a violent threat on the school. The Hayes High School student was charged with a felony count of inducing panic after threats he made caused officials to cancel classes. The threat was allegedly referring to a planned school shooting.

2022- On March 11th, 2022, I-71 north was shut down due to a shooting occurring at I-71 at East Powell Road. A suspect fired a gun at cars passing by on the interstate. Gunfire was also exchanged between the suspect and Columbus Police officers. The shooter was eventually arrested and charged with attempted murder.

Probability

Although these events are infrequent in Delaware County, protests or demonstrations linked to political movements, views, and racially charged events are a growing concern due to the increasing incidents of civil disturbance occurring at these events in the United States. While these events on their own are not illegal there may be an added risk with this type of gathering.

Vulnerability Analysis

Infrastructure Impact

The losses incurred by a civil disturbance are highly circumstantial and depend on the form of violence, the use of weaponry, the population present, and other factors. If a small bomb is not involved, then the risk to infrastructure may be limited to damage from small arms or vandalism; however, should a small bomb be detonated, it would most likely place the building or area in which it exploded at risk. The structural losses would be highly circumstantial but would most likely be isolated to a small number of buildings, if any were damaged. Property damage is a typical result of vandalism caused by civil disturbance.

Population Impact

People can be affected by the preparedness and readiness of first responders and safety measures taken by Delaware County as well as the availability of medical facilities and resources in the county. The population of Delaware County is likely to be impacted should loss of life occur as a result of civil disturbance events.

The areas which are high concentrations of facilities which may be centers of civil disturbance are also the locations where the National Risk Index shows there are the most socially vulnerable people. As population in Delaware County continues to increase these populations will be the first to experience the effects of civil disturbance.

Although not included in the National Risk Index, civil disturbance events may happen anywhere throughout the county and have effects on the socially vulnerable population, especially as a result of political and racially motivated civil disturbance occurrences.

Property Damage

In order to determine the number of structures and their value that are most vulnerable to a small bomb, parcel data from the auditor's office was utilized. **Figure 15** shows the value of properties that could be affected by civil disturbance by structure type. Buildings within the City of Dublin, City of Columbus, and City of Westerville were excluded. Residential structures were not considered as civil disturbances tend to occur in areas of high population density in commercial or industrial sectors. Structures that were classified as motels, hotels, nursing homes, hospitals, shopping centers or theaters were considered vulnerable non-residential structures. Buildings owned by the U.S. Government, State of Ohio government, Delaware County government, a local township or municipality were considered publicly owned.

Figure 15 *Potential Damage for the Whole County*

Structure Type	Number of Properties Exposed	Value of Vulnerable structures		
		Land	Building	Total
Residential	N/A	N/A	N/A	N/A
Non-Residential	7,671	$2,904,228,800	$5,323,882,800	$8,228,111,600
Critical Facilities	401	$294,181,180	$1,770,499,270	$2,064,680,450
Total	8,072	$3,198,409,980	$7,094,382,070	$10,292,792,050

Source: Delaware County Auditor Date Created/Gathered: December 5th 2022

Loss of Life

Although not common in Delaware County, civil disturbances can cause loss of life especially when the threat of a shooting or small bomb is present. The number of lives lost is situational depending on the event type, geography, and the number of people affected.

Economic Losses

Civil disturbance events like vandalism can cause damage to infrastructure such as county roads and public & private buildings. Structural damage to vulnerable buildings by a small bomb event may have economic consequences due to business closures and the need for infrastructure repair.

Climate Change

Climate change does have an effect on the likelihood of civil disturbance events. According to the Association for Psychological Science, uncomfortable heat can cause irritability and short tempers, and may result in aggression or violence. Indirect effects such as riots related to climate-related policymaking, or violence from food insecurity are also possible.

Land Use and Development Trends

Civil disturbance events can occur anywhere. Non-residential land uses are more likely to be targeted for civil disturbance events. Schools, government buildings, and places of large gathering should have plans in place to manage a civil disturbance emergency.

Delaware County is the fastest growing county in Ohio according to the 2020 U.S. Census. The increase in development will lead to more schools, government buildings, and large gathering places. This increase will also lead to urban areas possibility to being denser. All of these factors could combine to increase the frequency of civil disturbance.

4.2 Cyber-Attack and Ransomware

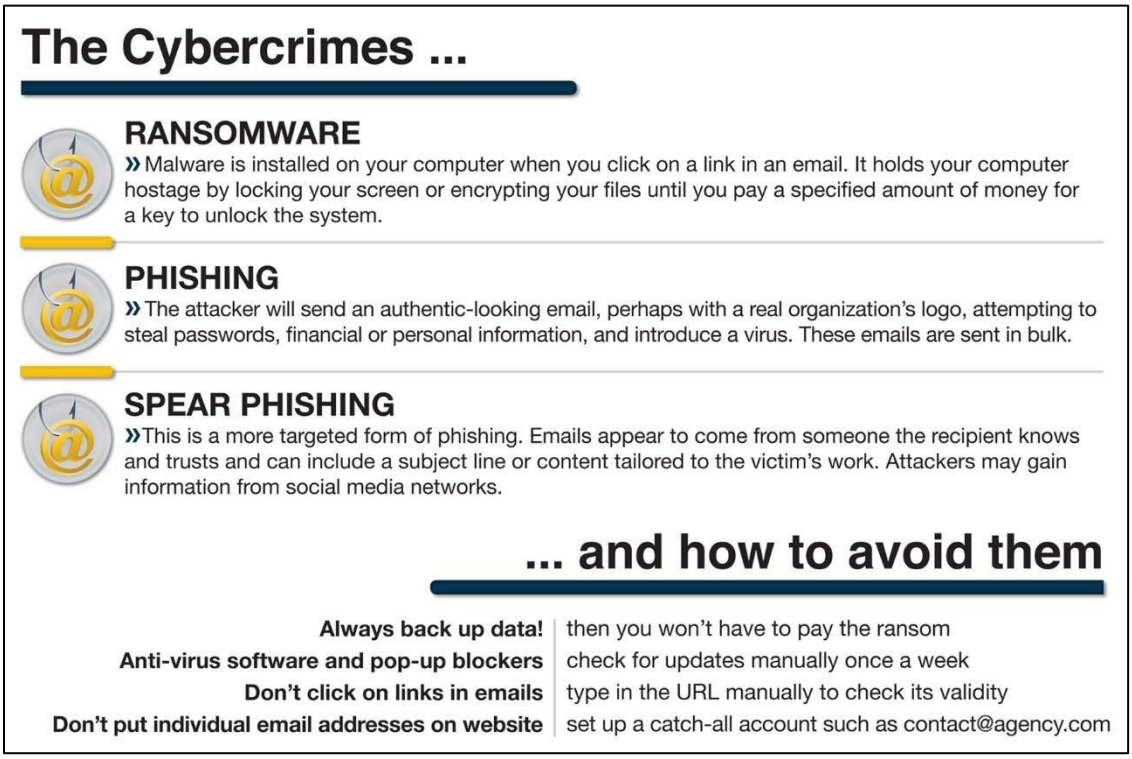
Description

A cyber-attack is an intentional human-caused hazard that is a growing concern for all local government organizations. Cyber-attacks or ransomware are the illegal access to a computer or computer system to expose, alter, disable, destroy, steal, or gain unauthorized information or make unauthorized use of an asset for the purpose of causing damage, harm, or financial gain. A sharp increase in the number of cyber-attacks involving government and corporate computer networks in America has caused Delaware County to launch initiatives to combat cyber threats. Many of the initiatives have focused on protecting critical infrastructure command and control systems, preventing access to sensitive government information, and thwarting acts of fraud and theft targeting business financial systems. This hazard was ranked 9th out of the 15 hazards that were analyzed in this study.

Cybercrimes vary in how they scam individuals and governments, but typically involve an email – a practice known as 'phishing' – that contains either a link or an attachment that, when opened, infects computers or entices the recipient to share account information and passwords. Some of the attachments launch viruses that essentially take data hostage until a ransom is paid (known as ransomware).

The Ohio Auditor of State created an infographic about common cyber-attacks and ways to potentially avoid being affected by them, shown in **Figure 16** below.

Figure 16 *Types of Cyber-Attacks*



Source: Ohio Auditor of State Date Created/Gathered: December 8th 2022

The Cybersecurity & Infrastructure Security Agency (CISA) gives good insight into what cybersecurity is:

> Cyberspace and its underlying infrastructure are vulnerable to a wide range of risks stemming from both physical and cyber threats and hazards. Sophisticated cyber actors and nation-states exploit vulnerabilities to steal information and money and are developing capabilities to disrupt, destroy, or threaten the delivery of essential services. Cyberspace is particularly difficult to secure due to a number of factors: the ability of malicious actors to operate from anywhere in the world, the linkages between cyberspace and physical systems, and the difficulty of reducing vulnerabilities and consequences in complex cyber networks. Of growing concern is the cyber threat to critical infrastructure, which is increasingly subject to sophisticated cyber intrusions that pose new risks. As information technology becomes increasingly integrated with physical infrastructure operations, there is increased risk for wide scale or high-consequence events that could cause harm or disrupt services upon which our economy and the daily lives of millions of Americans depend. (CISA)

For the purposes of this document, all types of cyber intrusions and attacks will be referred to as cyber-attacks.

Cyber-attacks can happen in any device which is connected to the internet, this configuration is called the Internet of Things (IoT). The IoT includes servers and individual computers but also printers, smart devices, medical equipment, industrial equipment, agricultural equipment, and any other device which can connect to the internet or intranet.

Containment of this hazard is about building defensive layers instead of one large defense. The adaption of cyber actors is fast; information about cyber-attacks and vulnerabilities that is shared this year may be out of data by next year and will likely be obsolete in two years. Because of the change and developments in all types of technology, the places and types of cyber-attacks are changing faster than protections can be replaced. This is why a layered approach is best when it comes to cybersecurity.

Location

Cyber-attacks occur virtually. They can originate from anywhere in the world and can target anywhere else in the world. Although a cyber or ransomware attack could occur anywhere, history has shown that critical facilities tend to result in the highest profile cases of cyber-attacks. Local government agencies of Delaware County and critical infrastructures, such as, hospitals, Emergency Medical Services, 911-operations, Fire and Police Departments, or any public service that has access to important public records and finances have a high probability of being targeted. The geographic extent of such an attack would most likely be highly contained due to the nature of the act, but the actual magnitude could result in the loss of critical facilities that could lead indirectly to a limited treatment of those injured and the extortion of funds. Like many other human-made hazards, it is difficult to quantify the probability of such an event, but the writers of this document believe the probability of a major attack is low.

Extent

Delaware County has a great deal of economic activity and is moderately larger than some other counties and because of that, the chance of a cyber-attack may be higher than smaller counties. Although the probability of a major event is low, there is still a possibility it could occur when considering the number of surrounding counties in Ohio that have experienced attacks.

Local government agencies are one of the easiest targets for skilled hackers. These local governments tend to be attractive targets in part, because of their connection to state systems or other large networks.

The losses incurred by cyber-attacks are highly circumstantial and depend on the form of cyber-attacks, the targeted group, and other factors involved.

History

Although Delaware County has only experienced one significant cyber-attack event in its history, it is undoubtedly a necessary new concern that government agencies and all critical infrastructure operations will have to be prepared to handle. The statics listed below came from Techjury and AAG IT:

- Globally, 30,000 websites are hacked each day.
- 64% of companies globally have been the target of at least one form of cyber-attack.
- In 2021, there were 22 billion breaches with ransomware cases growing by 92.7%.
- 94% of all malwares comes in the form of an email.
- A cyber-attack occurs every 39 seconds, which totals roughly 2,200 attacks per day.
- Average cost of a data breach was over $4 million in 2021.

2016 – In early May of 2016, an employee in the treasurer's office of Big Walnut Local School District in Delaware County, received an official-looking email from the treasurer asking that a vendor be promptly paid. The email had all of the markings of a district email, including the appropriate email address and letterhead, but was in fact a spear phishing email. The employee and an individual who was appearing to be her boss exchanged several emails to answer questions before the transfer of $38,520 was made. Fortunately, all of the money was later recovered by the district through the bank and other sources. This attack is an example of spear phishing.

Probability

Cyber-attacks occur virtually. They can originate from anywhere in the world and can target anywhere else in the world. Although a cyber or ransomware attack could occur anywhere, history has shown that critical facilities tend to result in the highest profile cases of cybercrimes. Local government agencies of Delaware County and critical infrastructures such as hospitals, EMS, 911-operations, fire and police departments, or any public service that has access to important public records and finical backings are the most at risk. The geographic extent of such an attack would most likely be highly contained due to the nature of the act, but the actual magnitude could result in the loss of critical facilities that could lead indirectly to a limited treatment of those injured and the extortion of funds. Like many other man-made hazards, it is

difficult to quantify the probability of such an event; although the probability of major event is low there is still a high possibility that it could occur when looking at the number of surrounding counties in Ohio that have occurred attacks. Delaware County has a great deal of economic activity and is moderately larger than some other counties. Therefore, the likelihood of a cyber-attack may be higher than other smaller counties.

Local government agencies are one of the easiest targets for skilled hackers. These local governments tend to be attractive targets in part, because of their connection to state systems or other large networks.

The losses incurred by cyber-attack events are highly circumstantial and depend on the form of cyber-attack, the targeted group, and other factors involved.

Vulnerability Analysis

Since a cyber-attack only directly has economic consequences, there is little to no risk to incur property damage. A significant cyber-attack would stress county resources and available facilities but would not likely cause any permanent property damage or long-term devaluation.

Cyber-attacks carried out on public infrastructure can directly impact the county's ability to operate essential facilities and provide services. Forms of sabotage to computer systems include the introduction of viruses, malware, and spyware that can cripple a computer network or steal private and public information.

Emergency services, such as 911 dispatch, may have difficulties because most phone lines work via the Internet. Medical response and care are reliant on electricity, water, information systems, and the Internet to access medical records. If the Internet was not available, many information systems would be useless and operations for many of the critical infrastructure sectors may stop altogether, causing major problems for both the public and private sector.

While sabotage of computer systems normally would not lead to harm, it is possible. As technology becomes more integrated into society, hackers will have more access to sensitive systems. Integration of systems (such as electrical grids, air traffic control centers, traffic lights, etc.) can leave these systems vulnerable to attack. If these critical systems are compromised, it is possible that people may be indirectly injured or killed in their absence.

Infrastructure Impact

Cyber-attacks can impact a wide array of infrastructure such as the power grid, water lines, Internet access, access to sensitive data, and access to money.

Population Impact

Anyone in the Delaware County could be a target of cyber-attacks or ransomware. It is important for the population to know and understand the ways cyber-attacks and ransomware occur. Cyber-attacks are not in the National Risk Index as it is not a natural disaster. Delaware County would have a very low expected annual loss, as they have only had one big cyber-attack. Their risk index

for cyber-attacks would also be very low as they do not have frequent attacks. As the county has programs in place and working on other ways to help mitigate the impacts of cyber-attacks.

Cyber-attacks are not included in the National Risk Index but there are groups that tend to be at higher risk such as large corporations, wealthy people, and the elderly. These groups tend to be targeted more because of the high reward of money and by the trusting of people on the internet.

Socially vulnerable population may be at risk of increased cyber-attacks because of possible lower education about how to prevent/respond to these attacks, and less connectivity to the internet leading to less knowledge of safe internet usage.

Property Damage

Even though cyber-attacks occur virtually, property damage can occur if there are cyber-attacks in the power grid, water lines, or Internet access. These damages are hard to predict.

Loss of Life

Loss of life is very unlikely when it comes to cyber-attacks. It is not the objective but can occur as a byproduct if the power grid, water lines, or Internet are affected.

Economic Losses

Economic loss can occur if someone is a victim of ransomware or a phishing email, turning money over to someone who is pretending to be someone they are not. Economic losses can also occur if the power grid, water lines, or internet are affected. The goal of most cyber-attacks is to extort finances from the victim. A 2016 nationwide estimate indicates that a cyber-attack may cost the U.S. economy between $57 billion and $109 billion.

Climate Change

Cyber-attacks or ransomware are not directly connected to climate change.

Land Use and Development Trends

Cyber-attacks and ransomware attacks can occur anywhere. Businesses and government agencies should have trainings in place to reduce the impact of cyber-attacks.

Delaware County is the fastest growing county in Ohio according to the 2020 U.S. Census. Because of this growth not only in population but in industry, the amount of people and places which are vulnerable to cyber-attacks will increase. The increase in population will also increase the amount of socially vulnerable people wo are also at higher risk of cyber-attack.

4.3 Dam Failure

Description

Dam failure is of major concern for Delaware County as there are 88 dams and reservoirs located within the county; if these dams fail or become inundated, it could result in significant losses. Some of the significant dams located in the county are Delaware, Alum Creek, O'Shaughnessy, Westerville, Whispering Pines, seven dams owned by Del-Co Water, Lexington Glen, Columbus Upground Reservoir in northwest Delaware County (Thompson Township), and two Sunbury Reservoirs. The Hoover Dam structure is located within Blendon Township in Franklin County, but a significant portion of its reservoir exists within Delaware County and should be considered a potential hazard to Delaware County residents.

The dams located within Delaware County are regulated by the U.S. Army Corp of Engineers (USACE), Ohio Department of Natural Resources- Division of Water (ODNR) and Federal Energy Regulatory Commission (FERC). Dam failure or excessive release of water from the dam could occur in Delaware County because of numerous reasons including, but not limited to neglect, storm damage, flash flooding upstream, or a catastrophic event (human-made or natural). This would often result in personal injury, death, or significant high-water damage to property downstream in Delaware County and Franklin County. It could also lead to road closures and destroyed bridges. The released waters may extend to other ponds and reservoirs in its path, causing continued damage as those sites are potentially overloaded.

This hazard is unique because failure or excessive release of water could be the result of either natural occurrences such as heavy rainfall or a man-made disaster such as an act of terrorism that would compromise the dam and cause inundation. It is worth noting that there are no levee systems in Delaware County. This hazard was ranked 4th out of the 16 hazards that were analyzed in this study.

Common dam- and levee-related terms include:

- Spillway: A structure that is part of a dam or found beside a dam which allows the controlled release of water from a reservoir.
- Outlet works: Used to regulate or release water flow from a dam. An outlet works is a device which consists of one or more pipes or tunnels which move water through the dam.
- Auxiliary spillway: Also known as an emergency spillway, the auxiliary spillway is a secondary spillway only designed to operate during periods of increased water inflow or high reservoir levels.
- Structural failure: Caused by foundation defects such as settlement and slope instability or earthquakes.
- Mechanical failure: Dam failure due to malfunctioning gates, conduits, or valves.
- Hydraulic failure: Occurs when water overtops the dam, usually causes by inadequate spillway design, blockages in spillways, or dam crest settlement.
- Levee System: A flood protection system which consists of a levee or other structures, such as closure or drainage devices.

There are three main types of dam failures that behave differently but can often be interrelated depending on the causes and conditions of the dam failure.

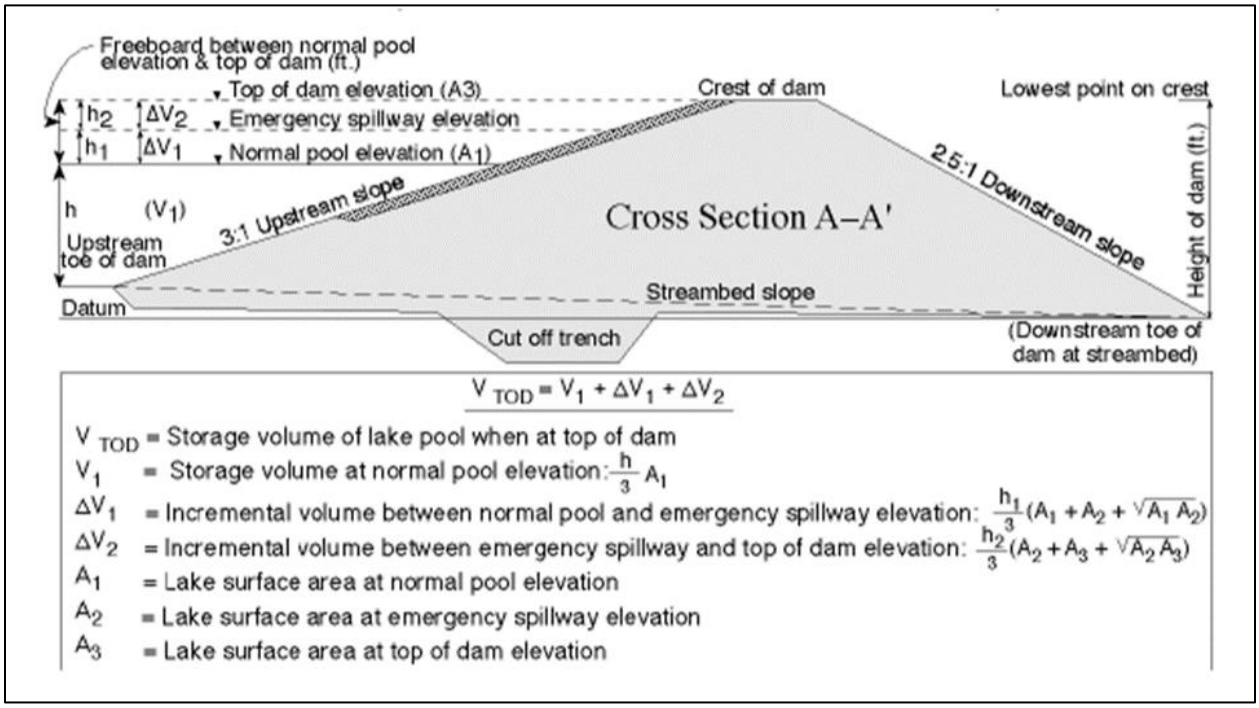
1) Overtopping: this sort of failure results from water eroding the embankment due to uncontrolled water flow over, around, and adjacent to the dam. Earth Embankments are not designed to be overtopped and they are particularly susceptible to erosion which is almost impossible to stop once it has begun in the overtopping process.

2) Seepage: internal movement of water that may take place through the dam, the foundation, or the abutments. Although all earthen dams have seepage slowly permeating through the dam and its foundation, if uncontrolled, it can progressively erode soil from the embankment or its foundation. Erosion of the soil begins at the downstream side of the dam, progressively works towards the reservoir, eventually developing a direct connection otherwise known as "piping". Once fully developed piping exists, complete dam failure is practically inevitable.

3) Structural: such a failure can occur in either the embankment or the appurtenances, typically indicated by cracking, settlement, and slides. Such failure can sometimes be prevented if the dam is properly monitored and lowered at the first signs of structural compromise.

Figure 17 below shows a system diagram of a typical dam structure. The diagram shows how storage volume of dams is calculated, which is used for determining potential downstream hazards.

Figure 17 *Dam System Diagram*



Source: ODNR Date Created/Gathered: December 8th 2022

OAC Section 1501:21-13-01 of the ODNR Division of water classifies dams under three major criteria. The criteria for the classification are based on height of the dam, the volume of storage, and potential downstream hazard. **Figure 18** below illustrates how each criterion is divided into different classes and shows the names of dams, their classes and location in Delaware County.

***Figure 18** Classes of Dams*

Class	Height of Dam	Storage Volume	Potential Hazards
Class I	Greater than 60 ft	Greater than 5,000 acre-feet	Probable loss of life
Class II	Greater than 40 ft	Greater than 500 acre-feet	Health hazard, flood water damage to homes, businesses, industrial structures (no loss of life envisioned), damage to state and interstate highways, railroads, downstream dams, only access to residential areas
Class III	Greater than 25 ft	Greater than 50 acre-feet	Low value non-residential structures, local roads, agricultural crops and livestock
Class IV	Less than or equal to 25 ft	Less than or equal to 50 ft	Losses restricted mainly to the dam

Source: OAC Section 1501:21-13-01 Date Created/Gathered: December 8th 2022

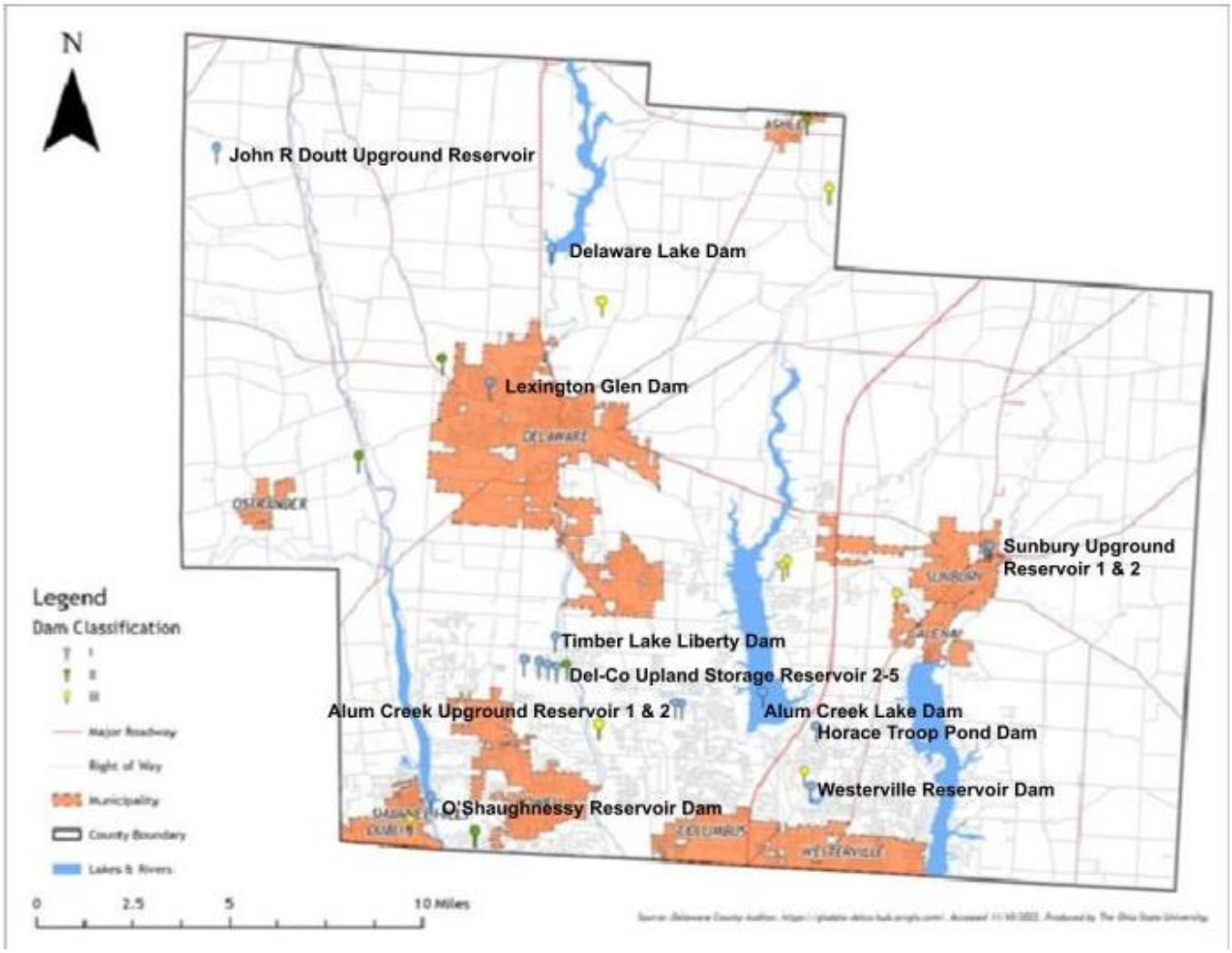
Dams are classified based on the highest criterion that is met. For example, if a dam is taller than 60 feet, but has a storage volume of 550 acre-feet and rated health and property hazard for potential downstream hazard, it would still be classified as a Class I dam.

Emergency action planning is an important component of dam safety. FEMA describes an Emergency Action Plan (EAP) as a document which identifies hazardous conditions at a dam and outlines the actions to be followed to minimize property damage and loss of life. In addition to procedures for issuing early warning messages, the EAP also includes inundation maps which outline critical areas for action in case of a dam failure. The EAP should be updated at least every 5 years.

Location

Dam and levee failure can occur throughout Delaware County where dams are located. Dam failure is more likely to occur if the dam is not maintained or operated correctly but can occur in other situations as well. Delaware County has 16 Class I dams, and these dams are relatively dispersed throughout the county as can be seen in **Figure 19**. Individual jurisdictions which include dams are Thompson twp., Radnor Twp., Troy twp., Oxford twp., Brown twp., Berkshire twp., Orange twp., Liberty twp., Concord twp., Scioto twp., Village of Shawnee Hills, Village of Ashley, Village of Galena, City of Delaware, and the City of Sunbury.

Figure 19 *Dam Locations in Delaware County*



Source: ODNR & Delaware County Auditor Date Created/Gathered: December 8th 2022

Extent

Sixteen Class I dams could cause extensive damages Delaware County due to their larger capacities and capabilities to incur losses, as detailed in **Figure 20**. If the Delaware Dam should breach or experience an excessive release, it could inundate a wide variety of infrastructure. A failure or excessive release at the Alum Creek Dam would inundate a wide variety of infrastructure, could cause issues with the Westerville Dam and proceed down Alum Creek through Westerville and into Franklin County. The failure of either of these dams would have the most serious impacts on Delaware and Franklin Counties. O'Shaughnessy Dam, located on the Scioto River, is owned and operated by the City of Columbus and regulated by the Federal Energy Regulatory Commission (FERC). A breach would affect extreme southern Delaware County and Franklin County, especially because it produces electrical power for the City of Columbus.

Figure 20 *Class I Dams in Delaware County*

Class	Name	Jurisdiction (township)	Owner	Type	Storage (Acre ft)	Length (ft)	Height (ft)	EAP
I	Alum Creek Lake Dam	Orange	U.S. Army Corps of Engineers	Earthfill	3387	10000	93	Yes- USACE
I	Alum Creek Upground Reservoir No. 1 (Del-Co)	Orange	Del-Co Water Co.	Earthfill, Homogenous	53.4	6985	24	Approved
I	Alum Creek Upground Reservoir No. 2 (Del-Co)	Orange	Del-Co Water Co.	Earthfill, Homogenous	52	7140	36	Approved
I	Delaware Lake Dam	Troy	U.S. Army Corps of Engineers	Earthfill	1300	18600	65	Yes-USACE
I	Del-Co Upland Storage No. 2	Liberty	Del-Co Water Co.	Earthfill	30.5	4580	42.5	Approved
I	Del-Co Upland Storage No. 3	Liberty	Del-Co Water Co.	Earthfill, Homogenous	29.3	4490	51	Approved
I	Del-Co Upland Storage No. 4	Liberty	Del-Co Water Co.	Earthfill, Homogenous	28.5	3850	53	Approved
I	Del-Co Upland Storage No. 5	Liberty	Del-Co Water Co.	Earthfill	84.9	7973	45.3	Approved
I	Horace Troop Pond Dam	Genoa	Private Ownership	Earthfill	3.1	625	20.7	No
I	John R. Doutt Upground Reservoir	Thompson	City of Columbus	Earthfill	842	25930	46	Approved

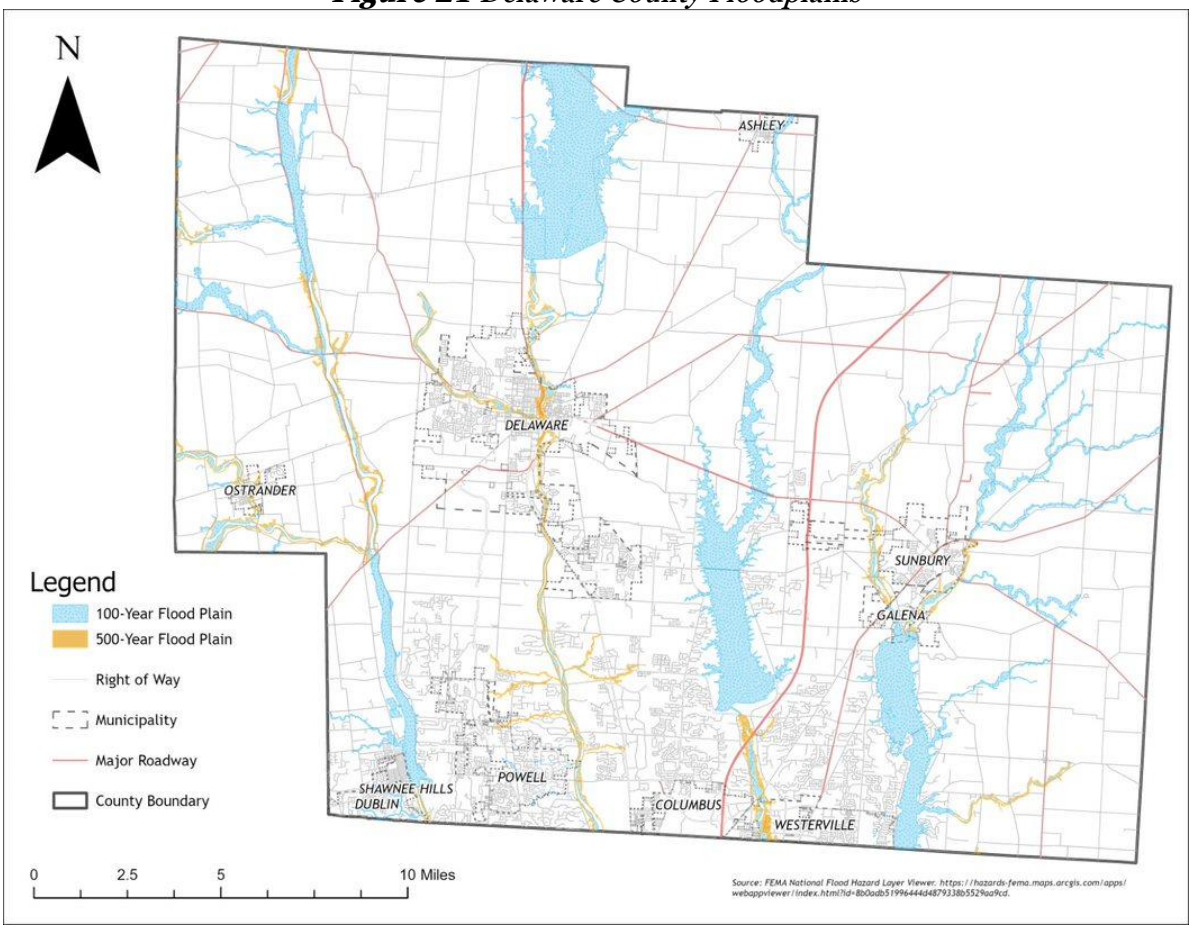
Class	Name	Jurisdiction (township)	Owner	Type	Storage (Acre ft)	Length (ft)	Height (ft)	EAP
I	Lexington Glen Dam	Delaware	Lexington Glen Owners Association	Earthfill, Zoned	4.9	175	23.1	No
I	O'Shaughnessy Reservoir Dam	Concord	City of Columbus	Concrete, Gravity & Earthfill	902	1750	91.3	Approved
I	Sunbury Upground Reservoir No. 1	Berkshire	City of Sunbury	Earthfill	7.2	2251	16.5	Approved
I	Sunbury Upground Reservoir No. 2	Berkshire	City of Sunbury	Earthfill	8.8	2535	19.5	Approved
I	Timber Lake Liberty Dam	Liberty	Judith Hook	Earthfill	2.5	285	34	No
I	Westerville Reservoir Dam	Genoa	City of Westerville	Earthfill	52.3	820	47	Approved

Source: DCOHSEM Date Created/Gathered: December 8th 2022

The dams owned by the U.S. Army Corps of Engineers (USACE) do not need to be approved by the State. The Del-Co water reservoirs are small and would cause relatively small damage as compared to the Delaware and Alum Creek Reservoirs. The Del-Co reservoirs are partitioned and are in close proximity to each other. Five of them are located north of Home Road and west of SR-315. The remaining two are situated on the southwestern edge of Alum Creek Reservoir popularly known as McNamara Reservoir. The Lexington Glen Dam is located north of SR-37 and north of Chatham Lane W and Chatham Lane E. In the event of dam failure of Lexington Glen Dam, properties downhill of this location would be affected. There are currently no inundation maps for Westerville, Sunbury Dams, and Columbus Upground Reservoir. Inundation from a dam failure may behave similarly to a major flood event. See the map in **Figure 21** showing the 100-year and 500-year floodplains.

Dam risk data for Class I dams with EAPs is available through DCOHSEM or through ODNR. However, this information is considered highly sensitive and is not available for the public. This does limit the information available in this plan, however, if projects are needed for a dam and the dam risk data is required a non-public amendment can be made to this plan which contains the needed information.

Figure 21 *Delaware County Floodplains*



Source: DCOHSEM Date Created/Gathered: December 5th 2022

History

There has not been any complete dam failure or inundation of any of the dams within Delaware County, but there have been a few historic occurrences where there was concern for failure. These instances of such have been listed below.

1987 - According to the Ohio Mitigation Plan, Lexington Glen Dam near SR-37, in Delaware, Ohio failed in 1987 due to erosion on the emergency spillway and four erosion rills in the downstream slope.

1960's - According to the Ohio Mitigation Plan, the Above Ground Reservoir No. 1 located in Sunbury, Ohio overtopped in the 1960s; however, no downstream damage was recorded.

2005 - In January of 2005, a set of severe winter storms with average 5-8 inches of rainfall throughout Central Indiana and Ohio caused Delaware Lake, in northern Delaware County, to flood. The water level rose from its typical height of about 905 feet above sea level to approximately 945 feet above sea level reaching between 1 and 5 feet of the top of the Delaware Dam. The dam was not overtopped and the floodgates were not opened, but it was the closest to

inundation the Delaware Dam had ever experienced since its construction in 1948. Alum Creek Dam, in South Central Delaware County, also saw record levels reaching 17 feet above its average height in the same month as the incident at Delaware Lake. The City of Sunbury created a dam Emergency Action Plan (EAP) in 2020 to deal with this issue.

May/June 2020, Greenwood Lake Dam caused concerns over its structural integrity. However, the water level never reached the top nor did the situation become an emergency. During the time period of concern, ODNR dam safety and Delaware County public safety agencies monitored the situation closely. This dam has since been removed.

Probability

The likelihood of dam failure will vary by the individual dam. Regular dam inspections are necessary to identify potential risks to the dam and to mitigate them. There has never been an incident of complete dam failure in the county's history, hence, it is difficult to assess the probability of a future occurrence of this hazard. The ODNR and USACE implement Dam Safety Programs that reduces the risk of dam failure through education and monitoring activities, thereby lessening the probability of failure. The historical occurrences of almost-failures and the age of the dams were used to estimate the probability of future occurrences. The average age of the three largest dams (Delaware, Alum Creek, and O'Shaughnessy Dam) was about 73 years old at the composition of this plan and there has only been one natural or man-made event (the 2005 flood) in which there was extremely high possibility of dam inundation; therefore, the stakeholders estimate a 1.4% (or 1/73) annual chance of dam failure. Additionally, the previous failure at the much smaller dam (1987 failure at Lexington Glen Dam) justifies the 1.4% annual chance of failure.

Vulnerability Analysis

Each dam exists under different conditions and would affect its surrounding residents and environment differently should they fail. Like flooding, it is easy to identify the populations and structures most vulnerable to dam failure as the flow of the water is determined by the topography of the land. Structures within a close vicinity of each dam are at the greatest risk of injury, loss of life, and structural damage as they will experience the greatest amount of water at its greatest velocity should any of the dams fail. This is particularly true for the Del-Co, McNamara, and Sunbury reservoirs as their failure would most likely result in water surrounding the dam rather than feeding into a river. In contrast, populations, and structures within the 1% (100-yr) and .2% (500-yr) floodplains of Alum Creek, Scioto, and Olentangy rivers are highly vulnerable if the Alum Creek Dam, the O'Shaughnessy Dam, or the Delaware Dam were to fail as they flow into each river respectively and would most likely cause severe flooding. Alum Creek, Delaware, O'Shaughnessy, and the John R. Doutt reservoirs are by far the largest dams within Delaware County and can induce the greatest amount of harm and damage should any of them fail. However, the John R. Doutt Upground Reservoir is not in a densely populated area and the magnitude of damage from a failure would be largely dependent upon which part of the reservoir failed.

<u>Infrastructure Impact</u>

Dam failure can impact roadways, including interstates and state routes, by blocking them due to high water or by filling them with debris. Water, sediment, and refuse materials from a dam failure can permanently damage or destroy homes and businesses. During a dam failure, the surrounding environment would suffer greatly. A failure of the Delaware Dam would disperse sediment from erosion in an unnatural way, altering the landscape of the surrounding ecosystem in Delaware State Park and along the Olentangy River. Flooding from the inundation into residences could also release hazardous materials into the environment.

Population Impact

Dam failure in the United States has caused damage to homes in the past by rapidly washing away properties. After dam failure events, shelter may need to be provided to those impacted by the event. Deaths and injuries are also possible during dam failure events. The Delaware Lake serves as a reservoir and a means of flood control for the Olentangy River which dissects the City of Delaware. Although it is difficult to estimate the number of lives that would be lost, it is likely that there will be limited casualties, especially if proper evacuation measures are taken. According to the Association of Dam Safety Officials, most dam failures that have occurred since 1980 resulted in between zero and 12 casualties with only Hurricane Katrina's levee failures resulting in hundreds of casualties.

Dam failure is not in the National Risk Index as it is not a natural disaster. However, natural disasters like flooding can cause dams to fail. The risk index for flooding in Delaware County is relatively low as such the risk for dam failure would also be low. This is because the natural causes of dam failure could be the result of flooding. People that are most vulnerable to dam failure are those who live within the dam inundation areas.

Some of the areas which the National Risk Index shows are most socially vulnerable by census tract are the areas which would be affected by Dam inundation. These areas include urban areas, such as the City of Delaware, and areas just outside the city like campgrounds and mobile home parks. These populations are also ones with a higher vulnerability to this hazard because of their lesser ability to leave the area if an event were to happen. If an event were to happen the socially vulnerable would be at higher risk of casualties then the rest of the population.

Property Damage

During a dam failure, large amounts of water, sediment, and refuse materials can inundate communities downstream and cause permanent destruction to homes and buildings in the floodplain. Delaware County would also experience severe structural losses in addition to the lives that would be lost in the event of an inundation of the Delaware Dam. Should the Delaware Dam fail, several parks, businesses and homes would be threatened in Delaware County and Franklin County.

Loss of Life

Loss of life is possible during a Class I dam failure, especially when the failure occurs unexpectedly, or when there is no evacuation protocol in place. The potential for loss of life is heightened by Class I dams due to the volume of water impounded by the dam. The loss of life

would likely be the result of drowning in the flood waters or being trapped in a structure that is damaged or collapsed due to the flooding.

Economic Losses

Economic losses can include damages from flooding crops, damaged goods, damages to structures worth thousands of dollars and the flooding of vital roadways. Should the Delaware Dam fail, the potential economic losses could be very high since the inundation area contains much of the City of Delaware downtown area which includes several publicly owned buildings. Such an occurrence would have direct and indirect consequences.

Climate Change

Climate change is having an uneven effect on precipitation (rain and snow) in the United States, with some locations experiencing increased precipitation and flooding, while others suffer from drought. If Delaware County experiences the effects of climate change such as heavy rainfall, it could lead to flooding which could lead to dam failure

Land Use and Development Trends

Currently, there are no requirements or regulations regarding development in inundation areas. While development is unlikely to cause dam failure, nearby development will be at risk if a dam failure occurs.

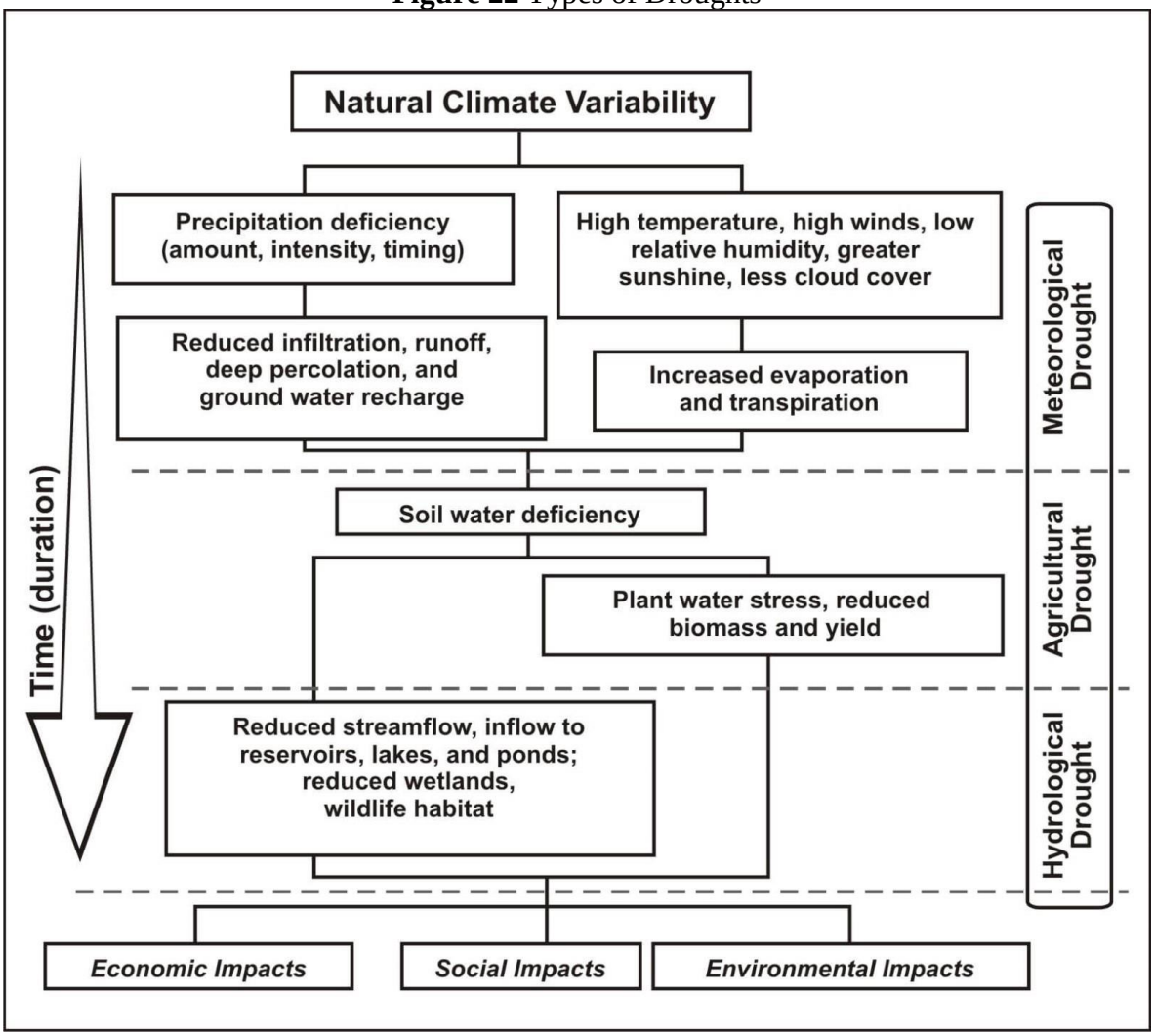
Delaware County is the fastest growing county in Ohio. Because of this growth more homes and commercial structures are being built. This increase in development includes development inside of the inundation zone for several dames in the county. Increasing development of these areas puts more people at risk if an event were to happen.

4.4 Droughts

Description

Droughts are normal, recurring climatic events that originate from a deficiency of precipitation over an extended period of time. This hazard can occur in many climates and can be categorized into four primary types: agricultural, hydrological, meteorological (see **Figure 22**), and socioeconomic. Agricultural droughts and hydrological droughts can occur simultaneously and are most common in Ohio. Although droughts are not considered to be a large threat within Delaware County, droughts still have a possibility of occurring within the county. Drought was ranked 4th out of the 15 hazards that were analyzed in this study.

Figure 22 Types of Droughts



Source: National Drought Mitigation Center, University of Nebraska-Lincoln, USA.
https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx
Date Created/Gathered: December 8th 2022

Drought effects can be difficult to identify and predict given their gradual accumulation of effects. All four drought types are explained below:

Hydrological Drought— Hydrological drought is associated with the effect of precipitation (including snowfall) shortfalls on the surface or subsurface water (stream flow, reservoir, lake levels, and groundwater) supply. The frequency and severity of hydrological drought are often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. There are multiple factors that contribute to hydrological droughts including changes in land use, deforestation, land degradation, and the construction of dams, all of which can affect hydrological characteristics of a basin.

Agricultural Drought— Agricultural drought links characteristics of hydrological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced groundwater or reservoir levels. A good definition of agricultural drought accounts for the variable susceptibility of crops during different stages of crop development, from emergence to maturity. The amount of water available for agricultural use demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. Deficient topsoil moisture at planting may hinder germination, leading to low plant populations per acre and a reduction of final yield.

Meteorological Drought – Meteorological drought is a measure of departure of precipitation from normal. Due to climactic differences, what is considered a drought in one location may not be a drought in another location.

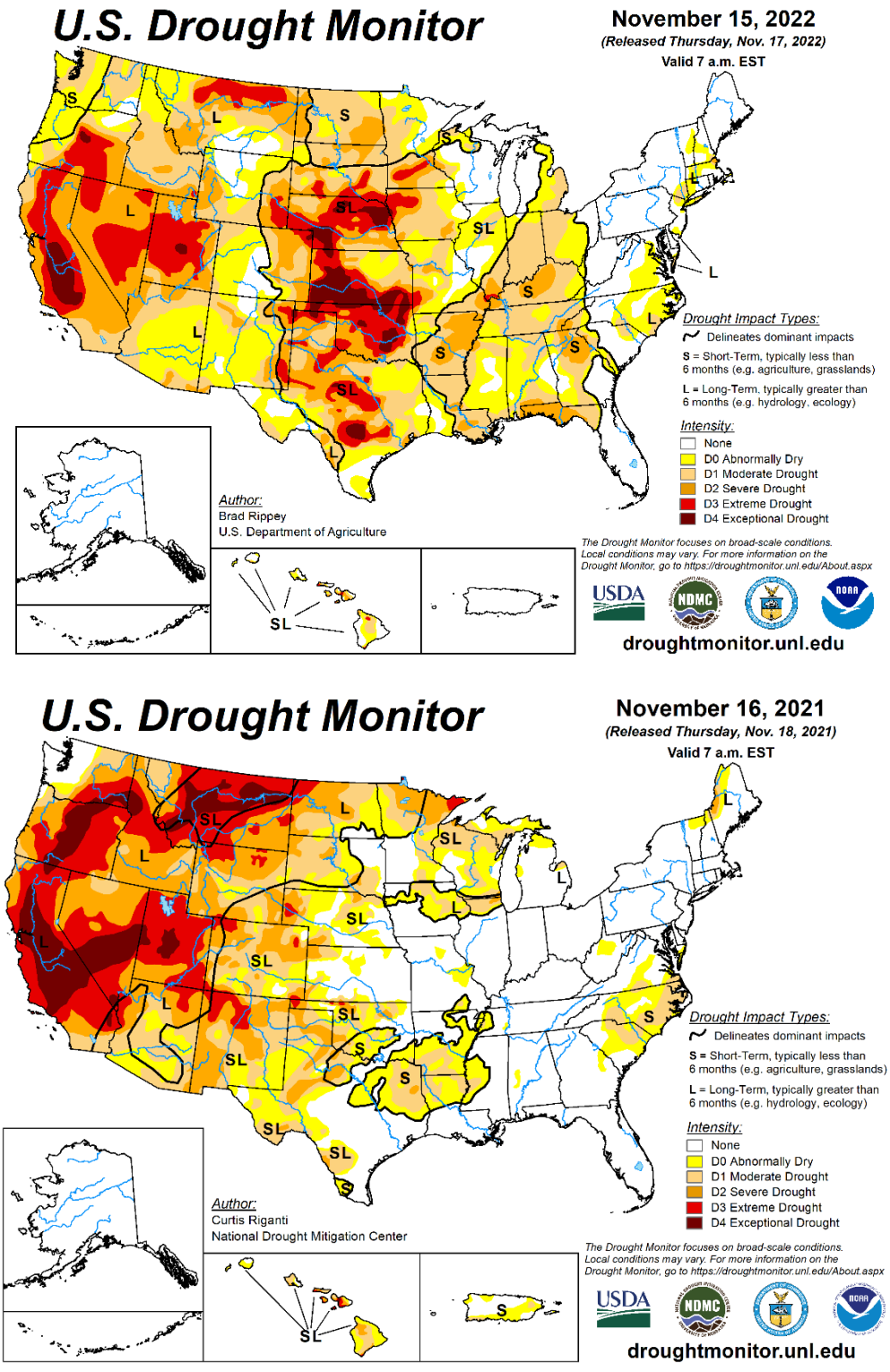
Socioeconomic Drought – Socioeconomic drought refers to the situation that occurs when physical water shortage begins to affect people.

Location

Droughts often cover multiple states and are therefore considered regional events. Since these events are so widespread, any drought that occurs would most likely cover the entire county, and possibly the whole state. As can be seen in **Figure 23 and Figure 24**, in November 2022 there is a moderate drought in parts of Ohio; however, in most of Delaware County it is only abnormally dry.

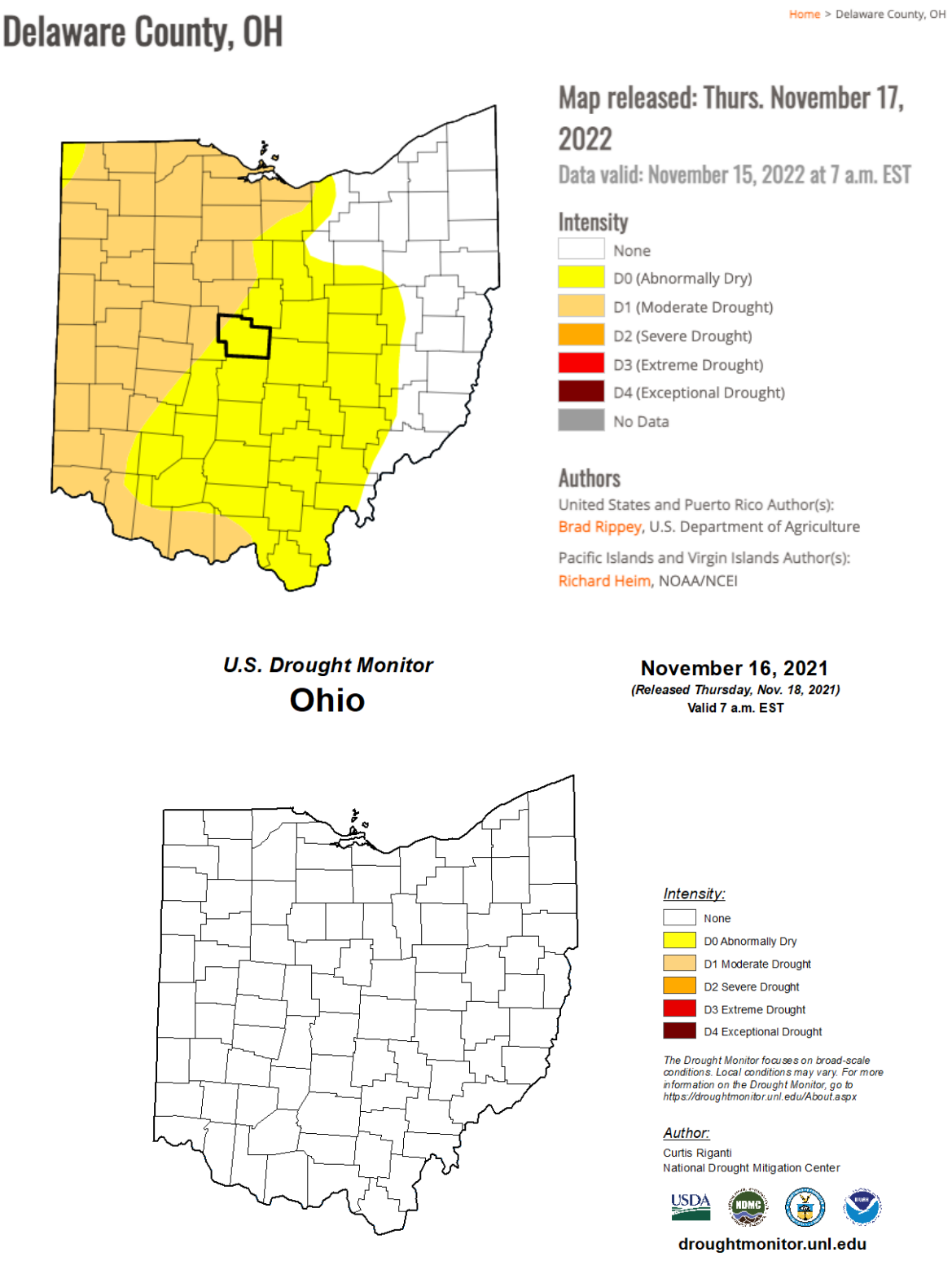
According to several historical maps in the National Climactic Data Center's (NCDC) archive, Ohio is not within a region that is frequently or intensely affected by droughts and dry weather. This is shown in their most recent seasonal outlook in **Figure 25**, where there is no expected drought for Delaware County; for the parts of Ohio that are in a moderate drought, that drought is expected to be remedied.

Figure 23 *US Drought Monitor Map*



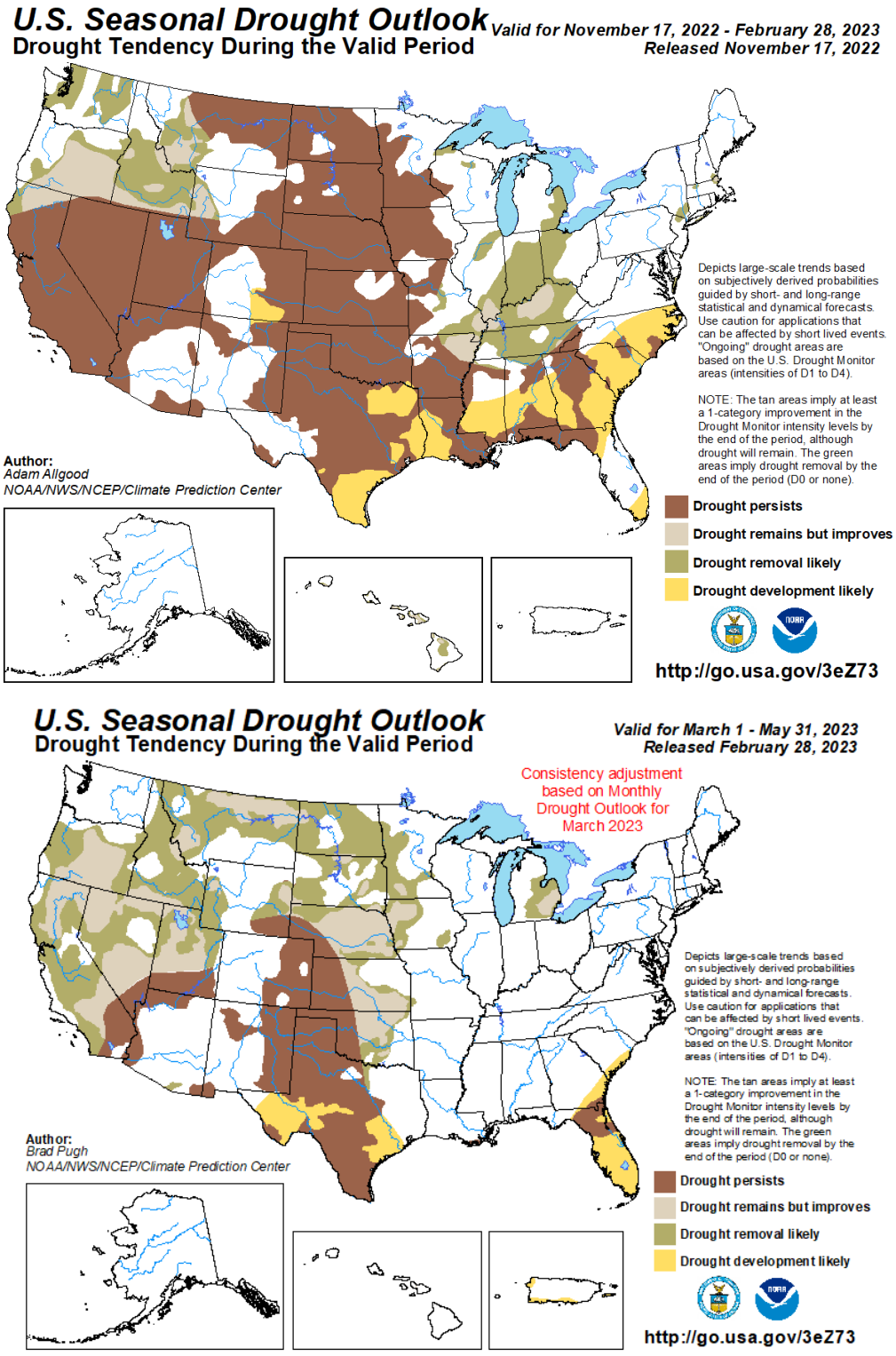
Source: U.S. Drought Monitor https://droughtmonitor.unl.edu/Maps/MapExport.aspx
Date Created/Gathered: December 5th 2022

Figure 24 *US. Drought Monitor Map of Ohio*



Source: U.S. Drought Monitor https://droughtmonitor.unl.edu/Maps/MapExport.aspx
Date Created/Gathered: December 5th 2022

Figure 25 US Seasonal Drought Outlook



Source: NOAA https://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php
Date Created/Gathered: December 5th 2022

Extent

The magnitude of a drought not only depends on its duration and intensity, but also on the regional water supply demands made by human activity and vegetation. Most of Delaware County is in the service area for Del-Co water company where water is sourced from the Olentangy River, Alum Creek, and aquifer located in northern Morrow County and southern Knox County. A severe drought could affect all three of these sources.

All places in the county should be concerned with hydrological drought, however Delaware County should also be concerned with the effects of agricultural drought since, according to the Census of Agriculture, there are 132,875 acres of farm-land in the county. Agriculture is critically important for the county's economy and is an emerging and growing industry.

History

According to the Geological Society of America's "Managing Drought" Factsheet, there have been multiple severe droughts since 1996 that have had a substantial economic, social and environmental impact on several regions within the country. The Dust Bowl days of the 1930s affected 50,000,000 acres of land, which rendered farmers helpless. In the 1950s, the Great Plains suffered a severe water shortage when several years went by with rainfall well below normal, therefore the water supply fell, and crop yields failed.

The worst drought in 50 years affected at least 35 states during a long hot summer of 1988, when some areas had suffered a lack of rainfall since 1984. In 1988, rainfall totals over the mid-west, Northern Plains and the Rockies were 50% to 85% below normal. Crops and livestock died, and desertification occurred in some areas. Forest fires began over the Northwest and by the fall had resulted in 4,100,000 acres of destroyed forest.

There have only been two recorded droughts in Delaware County according to the NCDC's Storm events database and they are detailed below.

1999 - In July of 1999, dry conditions that began in the spring and early summer continued into July. Excessive heat contributed to substantial crop loss across much of the state. Rainfall was widely scattered and did little to help farmers. Crop damage amounts were not available at the time of this writing.

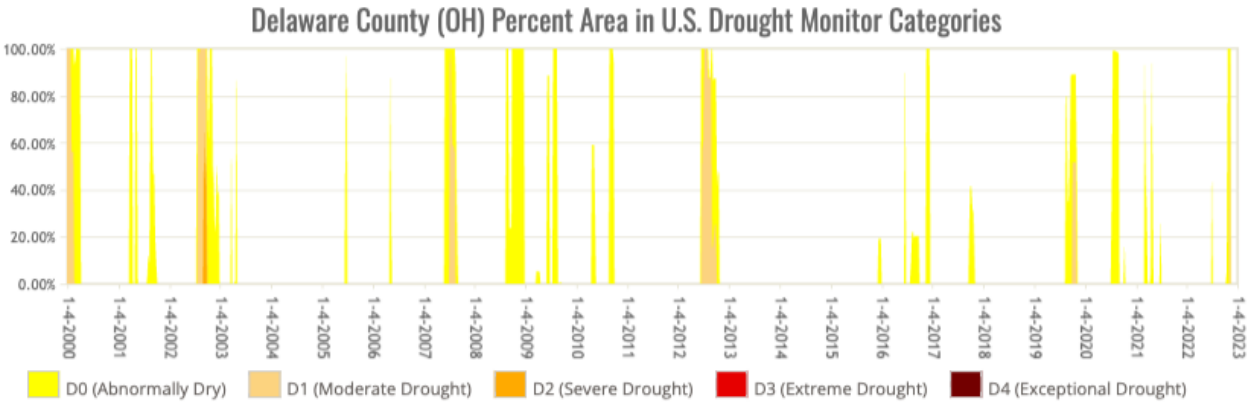
1999 –In August of 1999, drought conditions continued across the Ohio Valley through August with most areas receiving well below normal rainfall for the month. In some areas around 50% of crops were considered total losses. Most counties in southwest Ohio were declared Federal Disaster Areas by the US Department of Agriculture. At the time of this writing, no monetary estimates were available concerning the crop loss.

Probability

There is a low probability that Delaware County will experience a drought, based on the county's history. NOAA has only recorded two droughts in the past 25 years, so there is only an 8% chance of a drought each year. This is supported by **Figure 25,** which depicts the expectation

that the moderate drought in part of the state will recede. It should be noted here that NCDC Storm Center and the US Drought Monitor define drought differently, with the US Drought Monitor being more sensitive. However, even with this increased sensitivity and therefore increased representation of moderate drought, it has still only occurred a few times in the past two decades. A time series of droughts in the county according to the US Drought Monitor is shown in **Figure 26**. Even with this low probability, preparations for this hazard should not be neglected.

Figure 26 *Delaware County, Ohio Historical Drought Time Series*



Source: U.S. Drought Monitor https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx
Date Created/Gathered: December 5th 2022

Vulnerability Analysis

Infrastructure Impact

In many cases, infrastructure is defined as roads, bridges, and electricity supply structures. However, in the case of drought and its impact on the agricultural sector, soil could be considered infrastructure since it is a basic structure that is needed for the sector to operate. When thought of in this way, drought can be incredibly detrimental to the natural infrastructure for the agricultural sector (soil) since drought is the lack of soil moisture. In addition, if it rains too heavily amid a drought then it could cause a flash flood, which would remove topsoil, further damaging the agricultural infrastructure. In addition, flash floods damage more commonly accepted infrastructure such as roads. More information on the impact of floods can be found in the flood hazard section.

Population Impact

Since droughts in Ohio do not normally become as severe as socioeconomic droughts, there are no population effects of drought. There will, most likely, still be enough water for common daily use.

Due to the lack of drought history in Delaware County, the National Risk Index states there is a hazard risk score of 0. There is no expected annual economic loss because there have been no droughts in the last 18 years.

However, if there were to be a socioeconomic drought in Delaware County, those who are already socially vulnerable would be at higher risk. If the access to water becomes more difficult than those who already have difficulty in this area will have increased difficulty.

Property Damage

Drought does not pose a threat to residential structures, public structures or critical facilities and the two droughts in Delaware County's history have no reported property damage. However, it must be noted that drought is usually, but not always, accompanied by extreme heat. Extreme heat can cause some limited property damage, but this is nothing like what is caused by a tornado or earthquake.

Loss of Life

Since the droughts that have historically occurred in Ohio are not to the severity of a socioeconomic drought, it has not caused any human loss of life. A drought that causes the loss of human life is also not expected to occur in Delaware County in the near future.

Economic Losses

As agricultural and hydrological droughts are more likely to occur in Delaware County compared to other drought types, the economic loss that could occur from a drought is in the agricultural sector. The most recent Agricultural Census shows that the market value for all agricultural products originating in Delaware County totaled over $86 million. The following table **(Figure 27)** shows the number of crops at risk in Delaware County in 2020. Also, in order to prepare for droughts, farmers would need to invest in more irrigation equipment, which could cause increased economic strain for this sector.

***Figure 27** 2020 Delaware County Crop Yield*

Commodity	Acres Harvested	Yield Per Acre	Production (Bushels)	Rank compared to Counties in Ohio
Corn	31,600	173.1	5,470,000	42
Soybean	75,100	55.8	4,191,000	31
Wheat	5,100	74.7	381,000	31
Total	**111,800**	**303.6**	**10,042,000**	

Source: USDA Ohio Agricultural Statistics 2020-2021 Annual Bulletin
Date Created/Gathered: December 5th 2022

Climate Change

It is predicted that the climate will get warmer and there will be increased summer droughts throughout the state in the coming decades. However, a warming climate also means more frost-free days and therefore a longer growing season. This will help some crops, but crops like corn and soybean will be negatively affected by the severe heat in the summer, which will decrease these crops' yields.

Land Use and Development Trends

This hazard should not impact land use and development trend behavior because drought does not currently have a large impact on Delaware County. However, as climate change progresses and the state warms, there could be lands that become less favorable for agriculture, which would affect what land should be zoned for agriculture and where new agricultural uses develop in the county.

Also because of the increased growth in the county according to the U.S. Census 2020, the amount of land being used for residential or commercial developments will increase. This increase will reduce the amount of land under agricultural use, as well as increase the population of the county. The increase in population will also put more pressure on the water supply. The increasing pupation of the City of Columbus and adjoining jurisdictions will also put increased pressure to build more upground reservoirs in Delaware County which will remove more water from the local water supply and could cause supply chain problems if a drought were to happen.

4.5 Earthquakes

Description

Earthquakes are sudden and rapid movements caused by the abrupt shifting of Earth's tectonic plates deep beneath the surface. These movements vary in length and may last from a few seconds to several minutes. In areas where tectonic plates collide often, earthquakes can be more common. Earthquakes occur along faults, which are zones of weakness in the upper crust where two blocks of rock can collide or slide against each other. Frictional resistance builds between the two blocks of crust on either side of the fault line before the blocks slip suddenly, releasing energy in the forms of seismic waves and heat. These waves are felt on the surface as earthquakes. Earthquakes were ranked 15th out of the 15 hazards that were analyzed in this study.

The seismicity, or seismic activity, of an area refers to the frequency, type, and size of earthquakes experienced over a period. Earthquakes are measured using observations from seismometers, which can transform ground motion (seismic waves) into computable data or into visual data, most commonly known as squiggly up-and-down lines on a paper, or seismogram. The Moment Magnitude Scale (MMS), which was developed in the 1970s, is the most common scale on which earthquakes larger than approximately 5.0 in magnitude are reported for the entire world. Earthquakes smaller than magnitude 5.0, which are more numerous, are reported by national seismological observatories and measured most commonly on the local magnitude scale – also referred to as the Richter Scale. These two scales are numerically similar in their range of validity. Earthquakes of magnitude 3.0 or lower are often almost imperceptible or weak, while earthquakes of magnitude 7.0 or greater can potentially cause serious damage over larger areas.

Damage from an earthquake also depends on the earthquake's depth in the Earth's crust. The shallower an earthquake's epicenter, the more damage to structures it will cause. Alternatively, an earthquake can also be measured by its intensity. Intensity is based on the observed effects of ground shaking on people, buildings, and natural features. The Modified Mercalli Intensity Scale (MMI) ranges in value I to XII, in roman numerals. Both the Modified Mercalli Intensity Scale and the Richter Scale are represented in **Figure 28**.

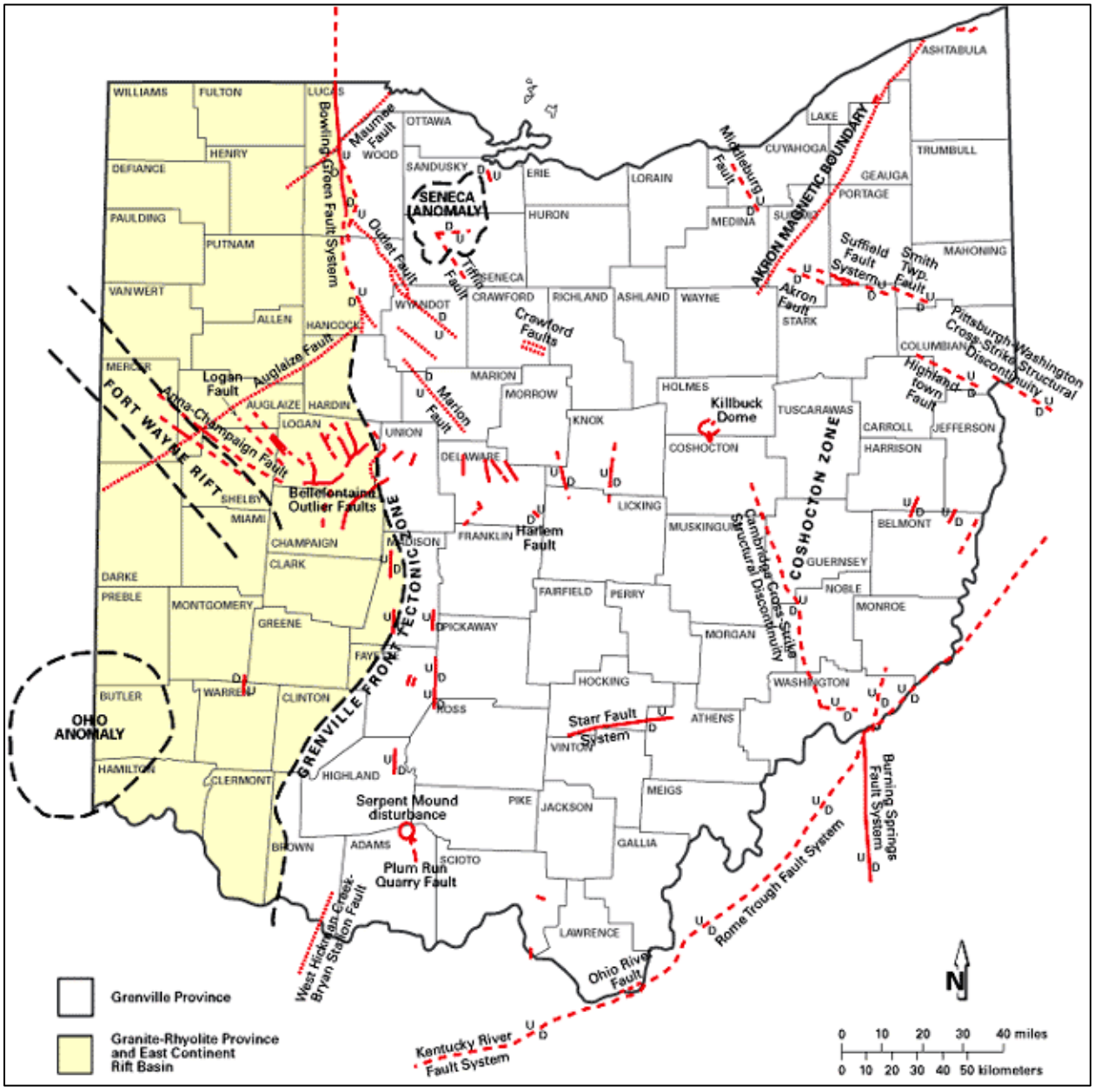
Earthquakes can happen anywhere without warning; they are low-probability, high-consequence events. Most major earthquakes in the U.S. have occurred along tectonic plate boundaries, which can be found in California as well as in Alaska, Hawaii, Oregon, Puerto Rico, and Washington. In 1811, a major earthquake occurred in the Mississippi River Valley, which later revealed a large fault line in the Midwest U.S., called the New Madrid Seismic Zone. There have been recorded earthquakes throughout the U.S., and the Ohio River Valley has experienced several earthquakes exceeding the 3.0 magnitude within the last 25 years. Ohio and Delaware County have numerous faults that may cause earthquakes (**Figure 29**).

Figure 28 *Modified Mercalli Intensity Scale*

Modified Mercalli Intensity Scale		Magnitude (Richter Scale)
I	Detected only by sensitive instruments.	1.5
II	Felt by few persons at rest, especially on upper floors; delicately suspended objects may swing.	2
III	Felt noticeably indoors, but not always recognized as earthquake; standing autos rock slightly, vibrations like passing truck.	2.5
IV	Felt indoors by many, outdoors by few, at night some awaken; dishes, windows, doors disturbed; standing autos rock noticeably.	3
V	Felt by most people; some breakage of dishes, windows, and plaster; disturbance of tall objects.	3.5
VI	Felt by all, many frightened and run outdoors; falling plaster and chimneys, damage small.	4
VII	Everybody runs outdoors; damage to buildings varies depending on quality of construction; noticed by drivers of autos.	4.5
VIII	Panel walls thrown out of frames; walls, monuments, chimneys fall; sand and mud ejected; drivers of autos disturbed.	5
IX	Buildings shifted off foundations, cracked, thrown out of plumb; ground cracked; underground pipes broken.	5.5
X	Most masonry and frame structures destroyed; ground cracked, rails bent, landslides.	6
XI	Few structures remain standing; bridges destroyed, fissures in ground, pipes broken, landslides, rails bent.	6.5
XII	Damage total; waves seen on ground surface, lines of sight and level distorted, objects thrown up into air.	7 7.5 8

Source: ODNR Date Created/Gathered: December 5th 2022

Figure 29 *Map of Deep Structures in Ohio*



Source: ODNR Date Created/Gathered: December 5th 2022

Location

Earthquakes are countywide hazards and can affect all areas and jurisdictions within Delaware County. According to the Ohio Department of Natural Resources, Ohio is located on the periphery of the New Madrid Seismic Zone.

Extent

Earthquakes pose a risk to life and property depending on the severity. To monitor earthquakes, the State of Ohio and the Ohio Department of Natural Resources (ODNR) Division of Geological Survey coordinates a 20-station network (**Figure 30**) of seismograph stations throughout the state in order to continuously record earthquake activity. The Ohio Seismic Network (OhioSeis) stations are distributed across the state but are concentrated in the most seismically active areas or in areas that provide optimal conditions for detecting earthquakes. While the seismic network cannot predict earthquakes or provide an alert prior to an event, it can provide insight into earthquake risks in the state so that informed decisions about building and facility design and construction, insurance coverage, and other planning decisions can be made by individuals, business and industry, and governmental agencies.

Figure 30 *Earthquake Seismometers in Ohio*

Source: ODNR Date Created/Gathered: December 5th 2022

In the event of an earthquake, three seismometers are used to triangulate the location of the earthquake's epicenter. The Malabar Farm State Park (MFOH) seismometer situated in eastern Richland County, the Kildeer Plains Wildlife Area (KDOH) in southern Wyandot County, and the Kiser Lake State Park Station (KLOH) seismometer situated in western Champaign County are the three OhioSeis Stations located in closest proximity to Delaware County. Seismic Station US ACSO of United States Geological Survey (USGS) US Array is located in Alum Creek State Park in southcentral Delaware County.

Earthquakes can yield a variety of different outcomes. With the ground shaking associated with earthquake events, buildings have a high potential to be impacted. If soil liquefaction, or the mixing of sand and soil with groundwater occurs, buildings can sink into the ground. Earthquakes also have the potential to rupture dams or levees along a river, resulting in flooding

and even tsunamis (see Dam Failure section). Earthquakes can cause landslides or avalanches in high-risk areas and can cause mines to subside. Furthermore, earthquakes that break gas and power lines can result in fires.

History

The State of Ohio has experienced more than 300 earthquakes of 2.0 magnitude or greater since 1776, of which fifteen (15) earthquakes have caused minor-to-moderate damage. The largest historic earthquake in western Ohio was centered in Shelby County in 1937. This event was estimated to have had a magnitude of 5.4 on the Richter scale.

The Ohio Department of Natural Resources (ODNR) and the United States Geological Survey (USGS) maintains a record of earthquake events. No earthquakes have been thought to originate in Delaware County or adjacent counties in the last ten years. Below are the most significant earthquake events that have affected Delaware County.

January 4th, 1873 - The only earthquake historically recorded in Delaware County occurred in Orange Township with a magnitude of 3.8.

1811-1812 - There were a series of earthquakes in New Madrid, Missouri which were the largest earthquakes in historic times in the continental United States. Half the town of New Madrid was destroyed. The Mississippi River changed its course, creating numerous geographic exclaves, including Kentucky Bend. Some sections of the Mississippi River appeared to run backward for a short time. Church bells were reported to ring as far as Boston and sidewalks were reported cracked and broken in Washington, DC.

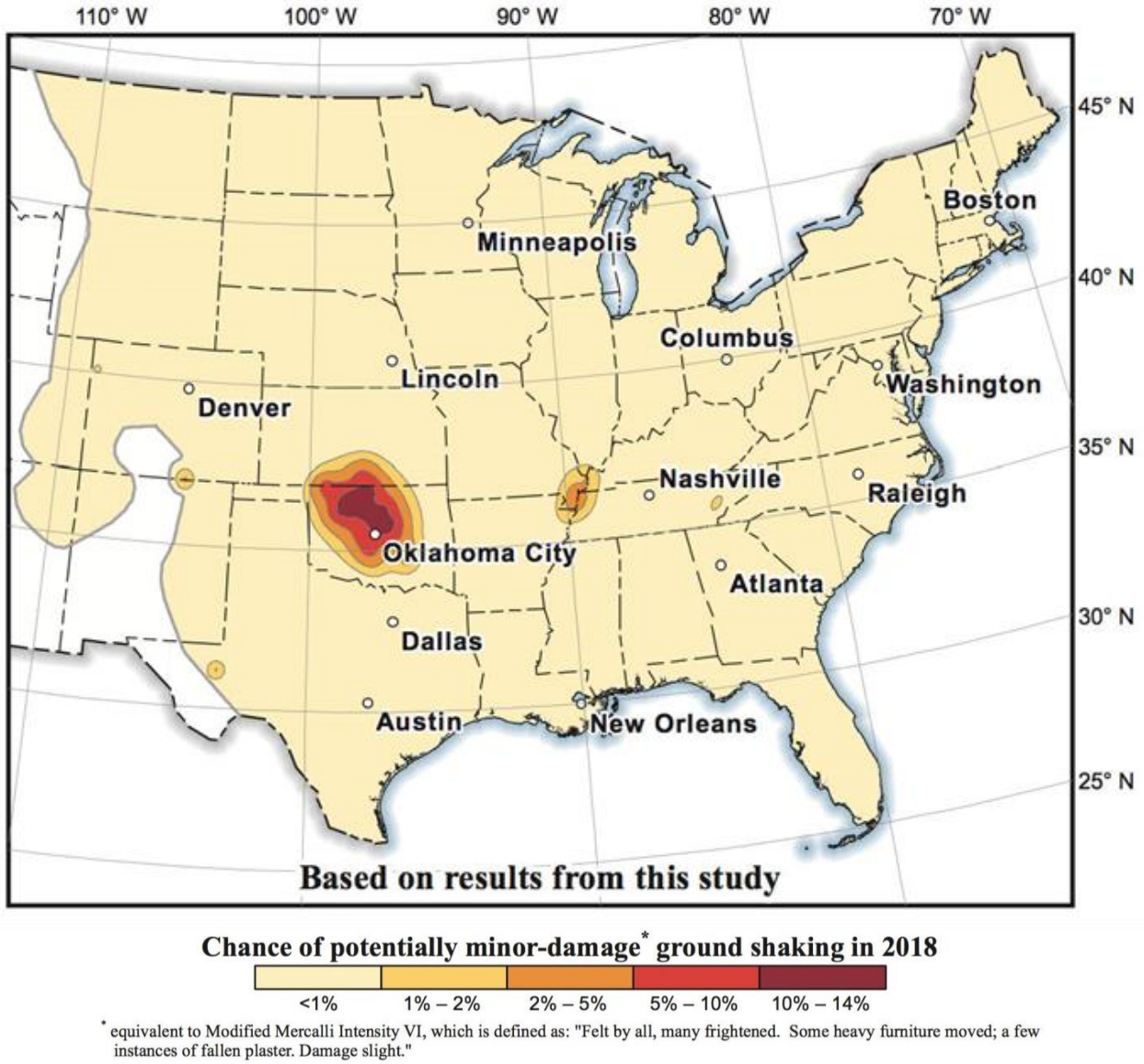
March 8th, 1937 – An earthquake measuring 5.4 in magnitude was recorded in the town of Anna in Shelby County. In Anna, which most of the damage occurred, 69 chimneys toppled, foundations and plaster cracked, water wells were disturbed, and cemetery monuments were rotated. The earthquake caused building damage as far away as Fort Wayne, Indiana and was reportedly felt in Indiana, Illinois, Kentucky, Michigan, Missouri, West Virginia, Pennsylvania, and Southern Canada.

January 31st, 1986 – A 5.0 earthquake in Lake and Geauga counties strongly shook Ohio causing moderate damage. It was felt in 10 other states and southern Canada.

Probability

The USGS has both long-term and short-term probabilistic seismic hazard forecasts. In the 2018 one-year probabilistic seismic hazard forecast, the United States Geological Survey estimates that there is a less than one percent chance of potentially minor-damage ground shaking in 2018 for Delaware County (**Figure 31**).

Figure 31 *Chance of Potentially Minor-Damage Ground Shaking in 2018*



Source: USGS Date Created/Gathered: December 5th 2022

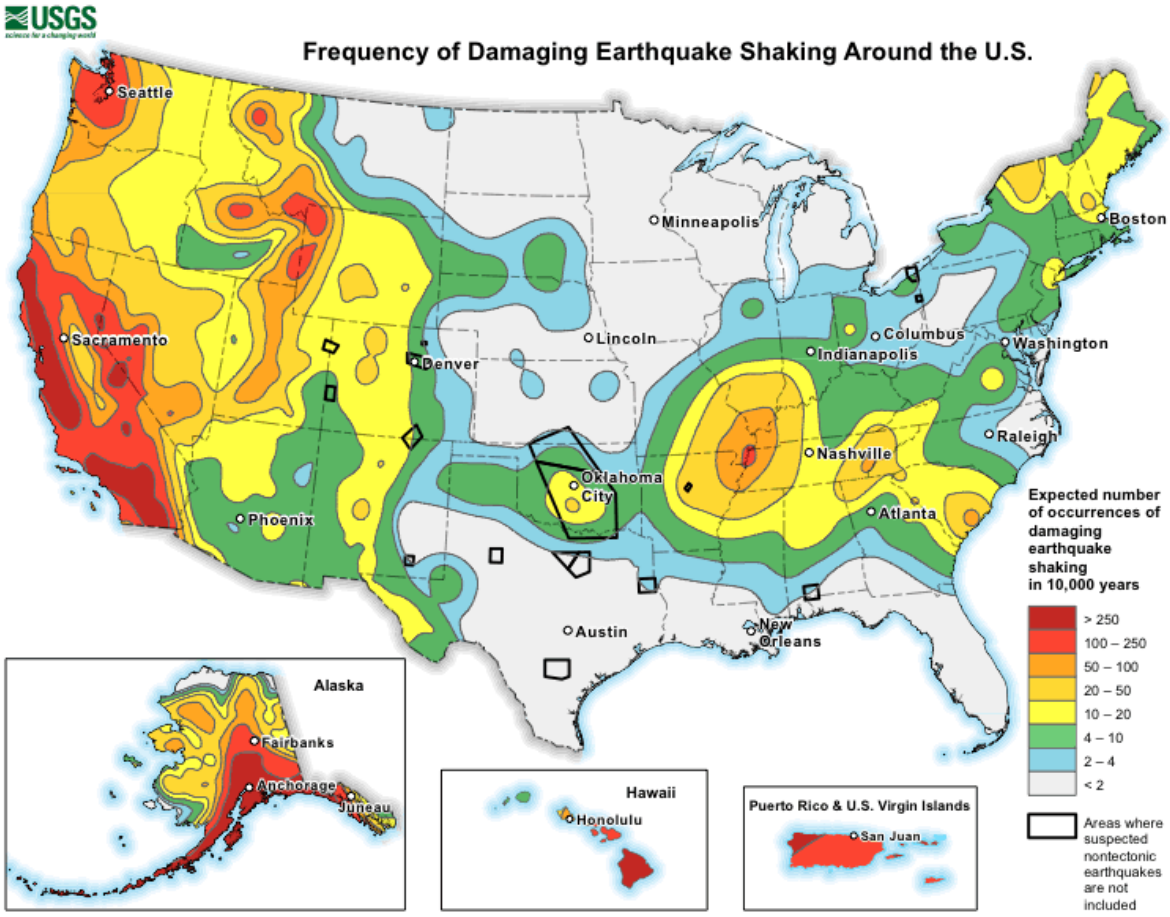
The USGS also determined the long-term hazard of earthquakes for the United States (**Figure 32**). The measurement used in this estimation is based on the chance of ground shaking – peak ground acceleration – as a percentage of the natural force of gravity over time. This map identifies that most of Delaware County has the probability of experiencing an earthquake between 2 and 4 times in 10,000 years.

The USGS also prepared national seismic hazard maps (NSHMP) for the United States. These time-independent maps are shown for 2-percent and 10-percent probability of earthquake ground-shaking exceedance levels at specified probabilities over a 50-year time period at several hundred thousand sites across the United States. The map (**Figure 33)** identifies that western

Delaware County has an 8- to 10-percent peak ground acceleration for 2-percent probability of exceedance in 50 years in and eastern Delaware County has 4- to 8-percent probability.

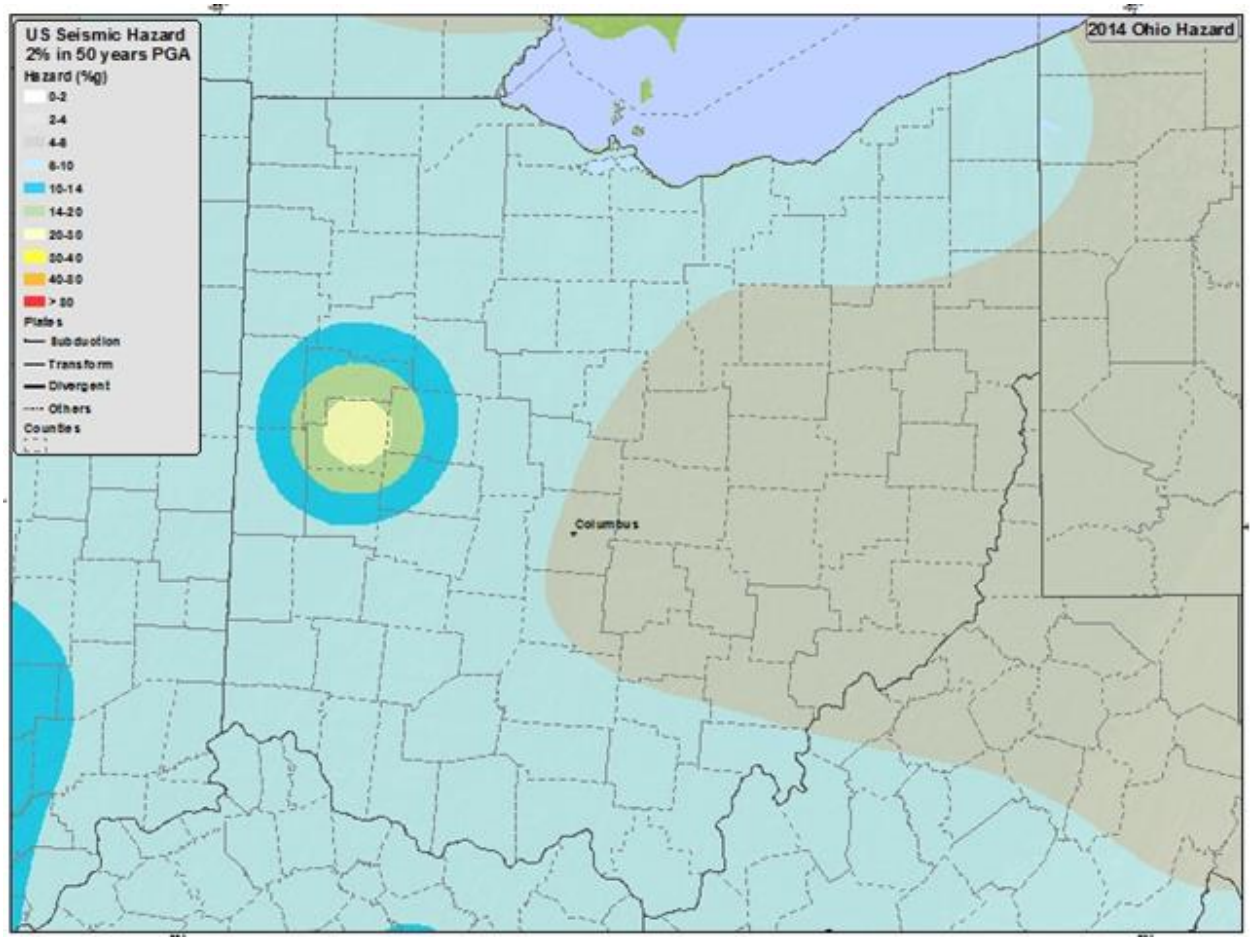
Furthermore, the ODNR indicates that the brief historic record of Ohio earthquakes suggests a risk of moderately damaging earthquakes in the western, northeastern, and southeastern parts of the State.

Figure 32 *Probability of Earthquakes in the United States*



Source: USGS Date Created/Gathered: December 5th 2022

Figure 33 *2014 Seismic Hazard Map of the State of Ohio*



Source: USGS Date Created/Gathered: December 5th 2022

Vulnerability Analysis

Infrastructure Impact

Since there are no recent earthquake events with recorded damages, exact potential damages to infrastructure are unknown. Buildings, roadways, and utilities, such as gas and power lines have the potential to be affected. Since the probability of an earthquake occurring in Delaware County is less than one percent, there is a low risk of impact to infrastructure as a result.

Population Impact

There is a low risk of earthquakes occurring in Delaware County. Accordingly, there is low risk of impact to the population. If an earthquake would occur within the County, the population could be impacted by loss of homes, loss of utilities, as well as potential reduction of air quality. Minor earthquakes could briefly interrupt daily activities but would otherwise have minimal impact.

The National Risk Index indicates that the population in Delaware County has a very low risk of being impacted by earthquakes. Earthquakes are unlikely to occur in Delaware County; therefore, the population is unlikely to be affected by earthquakes. Socially vulnerable populations may be more affected by earthquakes if they live in older housing units or apartment complexes that do not have adequate earthquake-resilient infrastructure. A worst-case scenario earthquake could affect the entire population and cause up to $28,795,675,160 in damages.

Property Damage

With any earthquake event, there is potential for property damage to occur, as ground shaking can lead to damaged buildings. Due to the non-site-specific nature of this hazard, all structures within Delaware County have potential impacts from earthquakes.

Loss of Life

Delaware County has no recorded earthquake events that have resulted in loss of life; however, in the event that an earthquake occurs, there is potential for loss of life. If there are more people and structures in an earthquake prone location, there is likely to be more of an impact. Loss of life can be mitigated by educating the public on proper protection in the event of an earthquake. For example, the USGS resources on preparing for an Earthquake hazard (USGS Resources for Earthquake Preparedness) as well as the Ready Campaign (Ready.gov) is a national public service campaign designed to educate and empower the American people to prepare for, respond to, and mitigate disasters. These resources provide materials for how to educate the public on earthquake preparedness.

Economic Losses

Earthquakes have the potential to damage infrastructure, resulting in the economic burden of clean up and repairs. Potential economic losses and structural damage associated with a worst-case scenario earthquake in Delaware County are recorded in **Figure 34.** Compared with other hazards, earthquakes are relatively unlikely to occur in Delaware County, meaning there is low risk of economic loss as a result of an earthquake.

Figure 34 *Structural Vulnerability from Earthquakes According to HAZUS Earthquake run at 5.0 Magnitude, Epicenter in Central Delaware City*

Table 3: Expected Building Damage by Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	857.22	1.64	343.19	2.18	404.84	4.96	208.46	8.41	49.29	7.58
Commercial	2595.00	4.95	984.02	6.24	948.33	11.61	414.71	16.73	111.93	17.22
Education	72.29	0.14	24.64	0.16	23.53	0.29	9.00	0.36	2.54	0.39
Government	59.24	0.11	28.37	0.18	34.40	0.42	14.46	0.58	4.53	0.70
Industrial	477.64	0.91	173.64	1.10	179.20	2.19	84.73	3.42	21.79	3.35
Other Residential	1459.32	2.78	629.59	3.99	402.53	4.93	149.10	6.01	39.46	6.07
Religion	150.49	0.29	53.82	0.34	46.45	0.57	21.93	0.88	6.31	0.97
Single Family	46732.59	89.18	13539.75	85.82	6127.52	75.03	1577.13	63.61	414.02	63.71
Total	**52,404**		**15,777**		**8,167**		**2,480**		**650**	

Table 5: Expected Damage to Essential Facilities

Classification	Total	# Facilities		
		At Least Moderate Damage > 50%	Complete Damage > 50%	With Functionality > 50% on day 1
Hospitals	3	0	0	2
Schools	74	5	0	65
EOCs	1	0	0	1
PoliceStations	11	1	0	10
FireStations	19	2	0	17

Structure Type	Number of Properties Exposed	Total Value of Vulnerable structures	1% Damage Scenario	5% Damage Scenario
Residential	53,779	$18,499,879,010	$184,998,790	$924,993,951
Non-Residential	7,671	$8,228,125,200	$82,281,252	$411,406,260
Critical Facilities	401	$2,067,670,950	$20,676,710	$103,383,548
Total	61851	$28,795,675,160	$287,956,752	$1,439,783,758

Table 11: Building-Related Economic Loss Estimates

(Millions of dollars)

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Losses							
	Wage	0.0000	9.1616	94.0899	3.9240	14.6058	121.7813
	Capital-Related	0.0000	3.8970	89.9899	2.4375	4.0728	100.3972
	Rental	28.1080	19.6942	51.5138	1.6840	5.0410	106.0410
	Relocation	100.9985	12.2879	80.5205	9.0319	51.1375	253.9763
	Subtotal	**129.1065**	**45.0407**	**316.1141**	**17.0774**	**74.8571**	**582.1958**
Capital Stock Losses							
	Structural	237.8112	27.0283	131.2561	28.8093	105.7442	530.6491
	Non_Structural	911.8414	203.1914	350.8637	93.0901	187.6988	1,746.6854
	Content	364.7230	67.6417	195.1371	66.6227	118.3630	812.4875
	Inventory	0.0000	0.0000	36.8737	11.4426	39.5240	87.8403
	Subtotal	**1514.3756**	**297.8614**	**714.1306**	**199.9647**	**451.3300**	**3177.6623**
	Total	**1643.48**	**342.90**	**1030.24**	**217.04**	**526.19**	**3759.86**

Source: DCOHSEM Date Created/Gathered: December 5th 2022; HAZUS Data Created December 2, 2022

Climate Change

Climate change has an unknown effect on earthquakes or earthquake probability.

Land Use and Development Trends

Because incidence and likelihood of earthquakes is low in Delaware County, all communities are at low risk. By planning for and managing land use to accomplish social, ecological, and economic sustainability, communities can reduce the negative impacts caused by earthquakes. This can be accomplished through comprehensive land-use plans and supportive federal and state policies. As such, enforcement of stricter building codes that ensure that all new developments are built up to code can reduce risk. Infrastructure (constructed facilities and lifelines) should be designed and constructed to resist earthquake shaking following the current state-of-the-art engineering and technology practices.

4.6 Floods

Description

A flood is an overflowing of large amounts of water beyond its normal confines. Most often floods are a result of heavy rainfall that raises the water level of existing bodies of water over their flood level. The impact of flood events may vary with the water crest height. Floodwaters may damage homes, businesses, and other structures. This hazard was ranked 6th highest in regard to its potential impact on Delaware County.

There are different types of flooding that affect Delaware county including riverine and flash flooding.

1. Riverine flooding is generally characterized by a gradual rise in waters from both large water basins and small tributaries. This flooding is typically gradual and can last for long periods of time.
2. Flash flooding occurs when large amounts of water rise rapidly with little warning or time to evacuate.

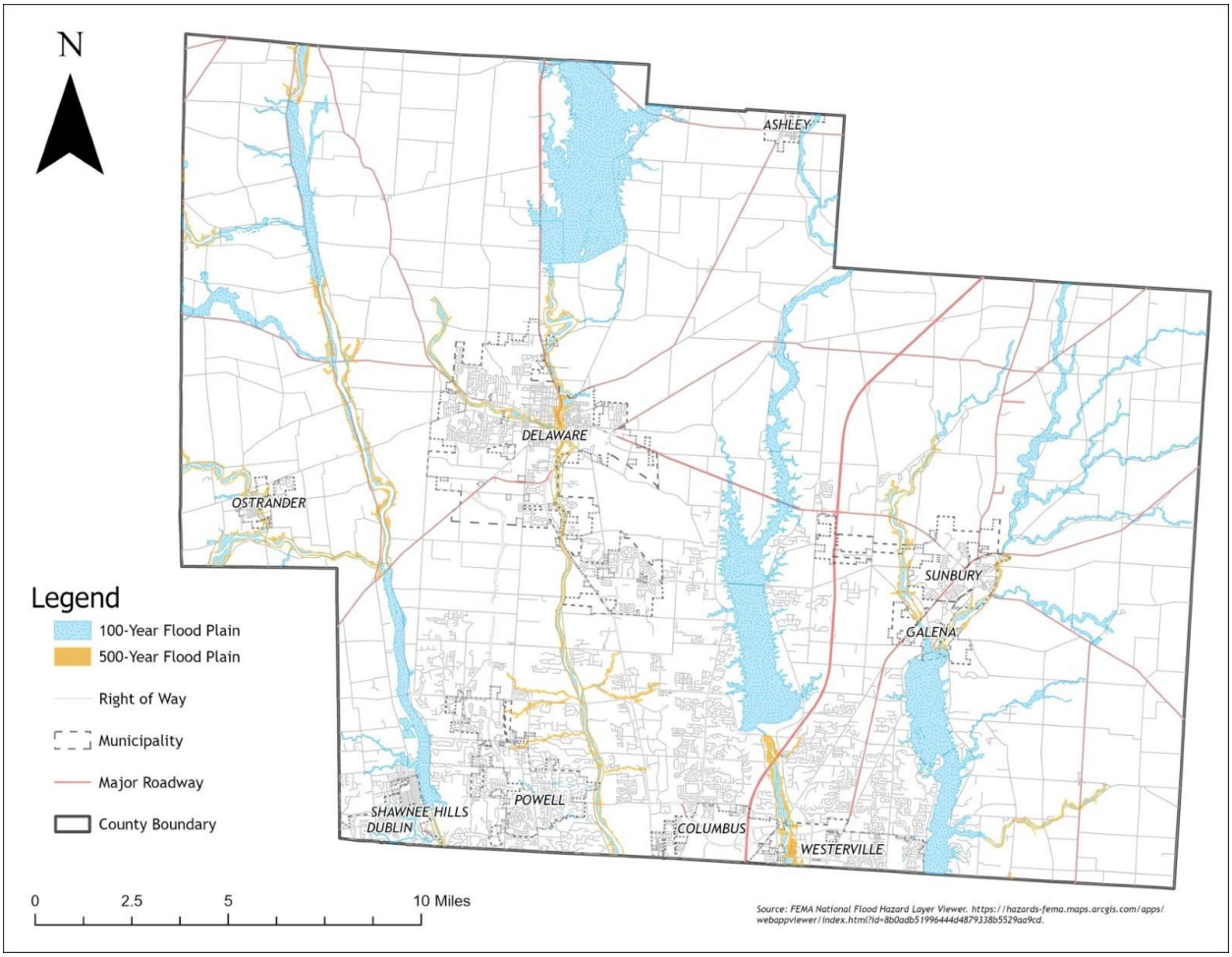
Common flood-related terms include:

- 1% (100-Year) Flood: A flood that has a one percent chance to occur each year. The 1% (100-year) floodplain can be seen in **Figure 35**. The elevation of the water from the 1% (100-year) flood is also known as the base flood. Mitigation strategies should be based on the base flood elevation.
- Floodplain: An area that has the potential to flood from any source.
- Flash flood: Flash floods are typically caused by heavy rainfall over a short period of time. These floods are particularly dangerous because they can occur in minutes and can sometimes occur even without rainfall, such as when an ice jam breaks or dissolves. Areas impacted by wildfires are particularly susceptible to flash floods.

Location

Flooding can occur throughout Delaware County. Flash flooding is more likely to occur in developed areas or areas where waterways can become obstructed, such as narrow or winding streams, streams with dense vegetation, abandoned dams, or encroachments. **Figure 35** shows the location of the 1% (100-year) floodplain.

Figure 35 *1% (100-Year) and .2% (500-Year) Floodplains in Delaware County*



Source: DCOHSEM Date Created/Gathered: December 5th, 2022

Extent

As shown in **Figure 36,** Delaware County and seven communities within the County participate in the National Flood Insurance Program (NFIP).

Figure 36 *NFIP Participating Communities*

NFIP Participating Communities	
Village of Ashley	City of Delaware
Village of Galena	City of Powell
Village of Ostrander	City of Sunbury
Village of Shawnee Hills	Delaware County

Source: FEMA Date Created/Gathered: December 5th, 2022

For Delaware County the NFIP Floodplain Management Administrators are the Chief Building Official for the City of Delaware and CBO/FPA for Delaware County Building Regulation Department. For the Village of Ashley, the Flood Plain Administrator is the Mayor, for the Village of Galena it is the Zoning Inspector, for the Village of Ostrander it is the Mayor, for the Village of Shawnee Hills it is the Village Administrator, for the City of Powell it is the Development Planner, for the City of Sunbury it is the Zoning Inspector, and for the City of Delaware it is the Chief Building Official.

Delaware County has seven repetitive loss and two severe repetitive loss properties within the county as shown in **Figure 37.**

Figure 37 *Repetitive and Severe Repetitive Property Loss in Delaware County*

Repetitive and Severe Repetitive Property Loss in Delaware County				
	Community Name	Occupancy	Is NFIP Severe Repetitive Loss Flag	Losses
Severe Repetitive Loss	Delaware County Unincorporated	Single Family	Yes	5
	Delaware County Unincorporated	Single Family	Yes	6
Repetitive Loss	Delaware County Unincorporated	Single Family	No	6
	Delaware County Unincorporated	Single Family	No	5
	Delaware County Unincorporated	Single Family	No	3
	Delaware County Unincorporated	Single Family	No	2
	Delaware County Unincorporated	Single Family	No	2
	Delaware County Unincorporated	Single Family	No	2
	City of Powell	Single Family	No	2
Total				33

Source: DCOHSEM Date Created/Gathered: March 2, 2023

Repetitive loss structure means a structure covered under an NFIP flood insurance policy that (1) has incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceeded 25% of the value of the structure at the time of each such flood event; and (2) at the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage. (44 CFR § 77.2(i))

Severe repetitive loss structure means a structure that is covered under an NFIP flood insurance policy and has incurred flood-related damage (1) for which four or more separate claims have been made under flood insurance coverage, with the amount of each claim (including building

and contents payments) exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or (2) for which at least two separate flood insurance claims payments (building payments only) have been made, with cumulative amount of such claims exceeding the value of the insured structure. (44 CFR § 77.2(j))

The areas of concern within Delaware County that could lead to significant flooding are areas along the major rivers (Alum Creek, Olentangy River, Big Walnut Creek, and Scioto River), which are controlled by dams forming the O'Shaughnessy Reservoir, Delaware Reservoir, Alum Creek Reservoir, and Hoover Reservoir. All the dams have floodgates to control water flow except for the O'Shaughnessy Reservoir which has a spillway. Other tributaries and creeks in Delaware County may pose flood risks, but these are on a smaller geographic scale.

FEMA Flood Insurance Rate Map data was utilized in order to determine the 1% (100-year) floodplain which represents regions with 1% probability of flooding every year. **Figure 35** displays areas within the 1% (100-year) floodplain within Delaware County, along with the outlined jurisdictions incorporated within this plan.

History

There have been 52 floods or flashfloods in Delaware County between January 1996 and August 2021. These events have caused an estimated $51,000 in property damages with no deaths or injury. A complete list of flood events can be found in **Appendix A**.

Obtaining updated information regarding significant costly occurrences of flooding in Delaware County involved compiling data from several sources including the NCDC database and the 2019 Delaware County Hazard Mitigation Plan. The top three most expensive flooding events in Delaware County are profiled below.

1996 – On January 17th, 1996, Flooding occurred over a two-day period. Most locations received between two and a half and three inches of rain during that time period. What made the flooding worse was the ground was already saturated from recent snow melting. Known as the worst flood in decades, some areas received up to four and a half inches of rain. The total estimated damages for this flood event were $5,000.

2005 – On January 5th, 2005, a frontal boundary swept across the Ohio Valley with an extended period of heavy rain. Many locations received two to four inches of rain within a 24-hour period. The ground was already saturated from recent snow melting. I-70 and east bound SR-79 interchange was closed. The total estimated damages for this flood event were $20,000.

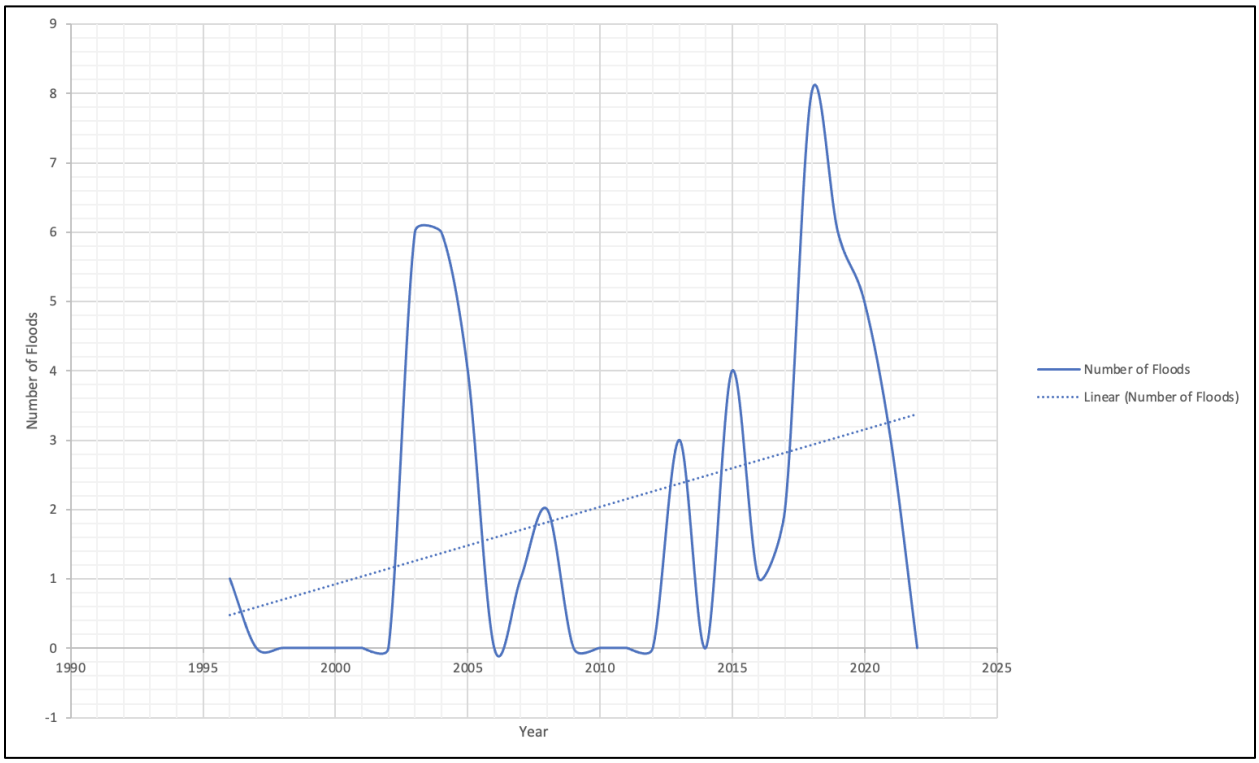
2005 – On January 11th, 2005, a widespread area of showers and thunderstorms affected much of central and western Ohio. A range from one to three inches of rain fell across the region, increasing the flooding from earlier rainfall and the melting of the snow. The heaviest of the rainfall from this storm was in west central Ohio, southeast of Columbus. Many roads and low-lying areas were flooded, and many creeks and streams rose above the banks. A few days later an area of showers with embedded thunderstorms ahead of a cold front produced nearly an inch of rain across central Ohio during the evening. This event resulted in several road closures due to

flooding. The I-270/US-23 interchange on the south side of Columbus was closed because of the high water. The total estimated damages for this flooding were $15,000.

Probability

According to the National Climate Data Center database, 1% (100-year floods) can occur within Delaware County more than once every 100 years. **Figure 38** depicts the 67 floods that have occurred within the county since January 1996. Based on the data, the number of probable floods a year in Delaware County is 2.68 or approximately 3 floods per year. However, flood occurrences per year increases slightly over time, meaning Delaware County can expect to have more annual flood events than have occurred in the recent past. This is shown by the dotted line in the graph below, representing the average number of floods per year. As shown, it is trending upward.

Figure 38 *Trend of Floods in Delaware County*



Source: National Climate Data Center Date Created/Gathered: December 5th 2022

Vulnerability Analysis

Infrastructure Impact

Floods can damage roads, bridges, and traffic structures by blocking them due to high water or by filling them with debris. Flooding can also impact sewer systems, water treatment systems, and other utilities.

Population Impact

Floods and flash floods have caused damages to occupied homes in the past. People displaced due to flooding may need access to shelters. Residents with riverfront properties and those whose reside in floodplain areas may experience property damage during a flood. Floods may also cause health hazard risks including mold as well as contamination with substances like raw sewage or hazardous materials.

In the National Risk Index, flooding scored very low and relatively low for the categories of risk, historic loss ratios, and expected annual loss. There is an estimated total damaged of $21,622,326,464 for flooding in the county. This estimate is made up of building value, population equivalence, and agriculture value.

Because those who are socially vulnerable are more likely to live in flood prone areas, they are at higher risk of occurring damages and/or causalities from a flooding event.

Property Damage

Property damage is likely during floods, to both residential and non-residential properties. **Figure 39** illustrates the number of structures at risk for a 100-year flood.

Figure 39 *Structural Vulnerability for Floods in Delaware County*

Structure Type	Value *(in $1,000)*	Percent of Total
Residential	2,399,933	79.5%
Commercial	392,386	13%
Industrial	94,684	3.1%
Agriculture	31,975	1.1%
Religious	51,079	1.7%
Government	18,837	0.6%
Education	29,276	1.0%
Total	**3,018,170**	**100%**

STRUCTURES IN 100 YR FLOOD ZONE										
	Structures at Risk					Damage in Dollars				
JURISDICTION	Residential	Non-Residential	Critical	Publicly Owned	Total	Residential	Non-Residential	Critical	Publicly Owned	Total
Delaware	61	69	3	3	136	$8,708,400	$53,811,900	$1,873,500	$375,200	$64,769,000
Powell	15	0	0	0	15	$4,963,800	0	0	0	$4,963,800
Galena	1	1	0	4	6	$386,400	$3,604,600	0	$39,900	$4,030,900
Shawnee Hills	1	0	0	0	1	$363,200	0	0	0	$363,200
Ashley	0	0	0	0	0	0	0	0	0	$0
Ostrander	13	2	0	0	15	$962,400	$151,000	0	0	$1,113,400
Sunbury	1	0	0	0	1	$295,700	0	0	0	$295,700
Other	445	489	3	4	941	$61,205,300	$183,011,900	$350,300	$0	$244,567,500
TOTAL	537	561	6	11	1,115	$76,885,200	$240,579,400	$2,223,800	$415,100	$320,103,500

The portions of the City of Columbus in Delaware County were not included in the floodplain data. Market improvement values of Delaware County parcels provided by the Delaware County Auditor's office were utilized in the determination of damage in dollars. Structures determined from 2021 Building Outlines provided by the Delaware County Auditor's GIS Office. Note: Building Outlines include outbuildings and accessory structures. 500 year flood analysis includes all structures/damages from the 100 year floodplain.

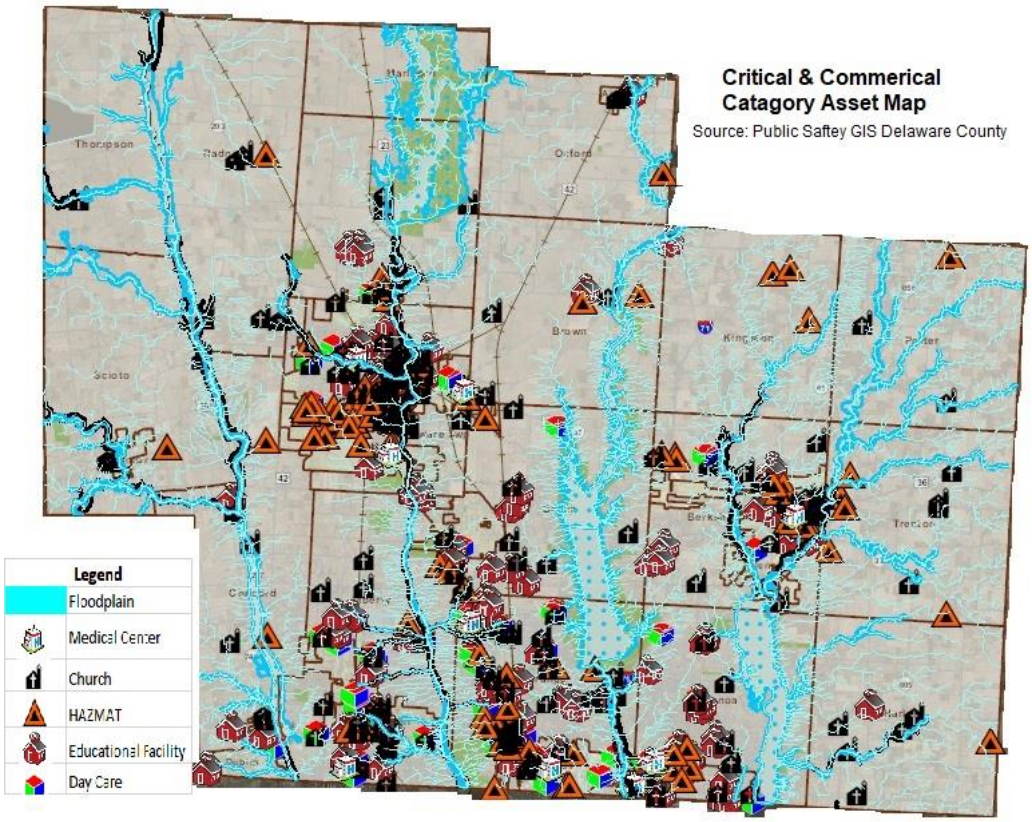
STRUCTURES IN 500 YR FLOOD ZONE										
	Structures at Risk					Damage in Dollars				
JURISDICTION	Residential	Non-Residential	Critical	Publicly Owned	Total	Residential	Non-Residential	Critical	Publicly Owned	Total
Delaware	182	130	4	6	322	$20,384,500	$123,887,100	$2,018,600	$5,236,300	$151,526,500
Powell	15	0	0	0	15	$4,963,800	0	0	0	$4,963,800
Galena	1	1	0	4	6	$386,400	$3,604,600	0	$39,900	$4,030,900
Shawnee Hills	1	0	0	0	1	$363,200	0	0	0	$363,200
Ashley	0	0	0	0	0	0	0	0	0	$0
Ostrander	14	2	0	0	16	$1,041,500	$151,000	0	0	$1,192,500
Sunbury	1	0	0	0	1	$295,700	0	0	0	$295,700
Other	632	655	9	4	1,300	$91,456,000	$228,821,800	$433,300	$0	$320,711,100
TOTAL	846	788	13	14	1,661	$118,891,100	$356,464,500	$2,451,900	$5,276,200	$483,083,700

The portions of the City of Columbus in Delaware County were not included in the floodplain data. Market improvement values of Delaware County parcels provided by the Delaware County Auditor's office were utilized in the determination of damage in dollars. Structures determined from 2021 Building Outlines provided by the Delaware County Auditor's GIS Office. Note: Building Outlines include outbuildings and accessory structures. 500 year flood analysis includes all structures/damages from the 100 year floodplain.

Codes Used to Classify Vulnerable Structures on At-Risk Parcels for Hazard Risk Assessment		
Category	Class Codes Used	Description
Residential	510-599	Family dwellings, residential, condominiums
Non-Residential	100-505	Agricultural, Industrial, manufacturing, retail, commercial, hotels, recreational, vacant, other
Critical	601-881 (excluding publicly owned codes)	schools, owned by parks, universities, churches, charities, utilities
Publicly Owned	600,610,620,630,640	Owned by USA, state, county, township, or municipality
Each Parcel Land Use Code can be found at : http://delaware-auditor-ohio.manatron.com/UseCodes.aspx		

Source: DCOHSEM & Delaware County GIS Date Created/Gathered: December 5th, 2022/March 1, 2023

Figure 40 Critical & Commercial Category Assets in Floodplain



Source: Delaware County GIS Date Created/Gathered: May 31, 2023

Loss of Life

There have been no deaths due to floods in Delaware County. Loss of life is possible in future floods or flashfloods depending on the depth of floodwater. For example, six inches of fast-moving water can sweep an adult off their feet and two feet of water can displace vehicles.

Economic Losses

Floods can halt economic activity, block roadways, and destroy agricultural crops. One inch of flood water can cause more than $25,000 in damages to a residential structure. Crop losses are also expected during floods and flashfloods.

Climate Change

According to the State of Ohio Hazard Mitigation Plan, increased precipitation and variability by climate change will also increase the likelihood and intensity of flood events. Increased precipitation will mostly occur during the summer and fall months. The state expects between 10 and 40% increase in stream flows after the year 2040. This will mainly occur in the later summer until early winter, increasing the likelihood of cool season flood events in the late autumn and early winter.

Land Use and Development Trends

Any development that occurs in flood zones will be at risk. Development in these areas should be limited. Flash flooding is more likely to occur in areas with a high percent of impervious surfaces. Future land use practices should limit the percentage of impervious surfaces.

Delaware County is increasing in population according to the 2020 U.S. Census. It is the fastest growing county in Ohio. Because of this growth development in flood zone will be a risk some are willing to take, but limiting this will also limit the amount of damages caused by floods. Also, these areas trend towards housing of the most socially vulnerable who are less likely to be resilient in times of disaster, such as a major flood. Concentrations of the most socially vulnerable are currently around urban areas in Delaware County, which are areas prone to flooding. As these areas develop socially vulnerable people may be pushed into areas which put them at even higher risk. Future practices and zoning could help mitigate some of this development.

Communities that are participating in the National Flood Insurance Program (NFIP) are required to adopt and enforce regulations and codes that apply to new development in Special Flood Hazard Areas (SFHAs). These local floodplain management regulations must contain, at a minimum, NFIP requirements and standards that apply not only to new structures, but also to existing structures that are Substantially Improved (SI), or Substantially Damaged (SD) from any cause, whether natural or human-induced hazards.
According to 44 CFR 59.1, Substantial improvement means any reconstruction, rehabilitation, addition, or other improvements to a structure, the total cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. Likewise, substantial damage means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred. SI/SD requirements are also triggered when any combination of costs to repair and improvements to a structure in an SFHA equals or exceeds 50 percent of the structure's market value (excluding land value).

((Cost to Repair)+(Cost of Improvements))/(Market Value of Structure) ≥ 50 Percent

Enforcing the SI/SD requirements is a very important part of a community's floodplain management responsibilities. The purpose of the SI/SD requirements is to protect the property owner's investment and safety, and, over time, to reduce the total number of buildings that are exposed to flood damage, thus reducing the burden on taxpayers through the payment of disaster assistance. SD/SI requirements are enforced by the local floodplain administrator and monitored by the Ohio Department of Natural Resources (ODNR) Floodplain Management Program during Community Assistance Visits. If a local floodplain administrator is overwhelmed by the number of SD/SI inspections after a large event, ODNR has developed a network of building code officials that are trained in conducting SD/SI field determinations. Help with SD/SI inspections can be requested through the county emergency management agency director.
For more information regarding Substantial Improvement and Substantial Damage, please refer to FEMA's Substantial Improvement/ Substantial Damage Desk Reference, P-758 or contact the ODNR Floodplain Management Program.

4.7 Hazardous Material (HAZMAT) Incident

Description

A HAZMAT incident is an event in which there is a large and extensive release of hazardous materials. These events can occur at locations where HAZMAT material is stored, manufactured, and/or transported. The majority of hazardous material releases in Delaware County are fuel spills, but more toxic substances exist in the county and have caused incidents. A HAZMAT incident can occur on its own or may be incited by a natural disaster or intentional act. Such an event can occur either at the location where the material is used and/or stored, or when the material is being transported. This hazard was ranked 13th regarding its potential impact on Delaware County.

Hazardous substances are regulated at both the state and federal level. Depending on the substance type, amount, and concentration there can be different regulations which must be followed during the transport, storage, and containment of spills of the substance.

In 1986, the Superfund Amendments and Reauthorization Act (SARA) passed Title III, establishing the Emergency Planning and Right to Know Act. This act requires the classifying of facilities that process, use, or store extremely hazardous substances (EHS) is further codified in the Ohio Revised Code, Chapter 3750, and the Ohio Administrative Code Chapter 3750. The tracking of these EHS is overseen by the Ohio EPA and at the local level by Delaware County Local Area Planning Committee (LEPC).

Delaware County has a (LEPC) which documents the facilities in Delaware County which have hazardous substances. Hazardous substances/materials are defined under ORC 3750.02 referencing Comprehensive Environmental Response, Compensation, and Liability Act of 1980," 94 Stat. 2779, 42 U.S.C.A. 9602, as amended.

Only the most impactful and harmful hazardous events have been used in the risk assessment for the Plan. These events met one or more of the following predetermined qualifications:

- Event involved the spilling of over 500 gallons of hazardous materials
- Event required the full activation of the HAZMAT Team
- Event directly injury to people or property
- Events with extremely hazardous materials, including Fluorine/Fluorite, Acetone, Sulfuric Acid, Cobalt, Acrylonitrile.

Location

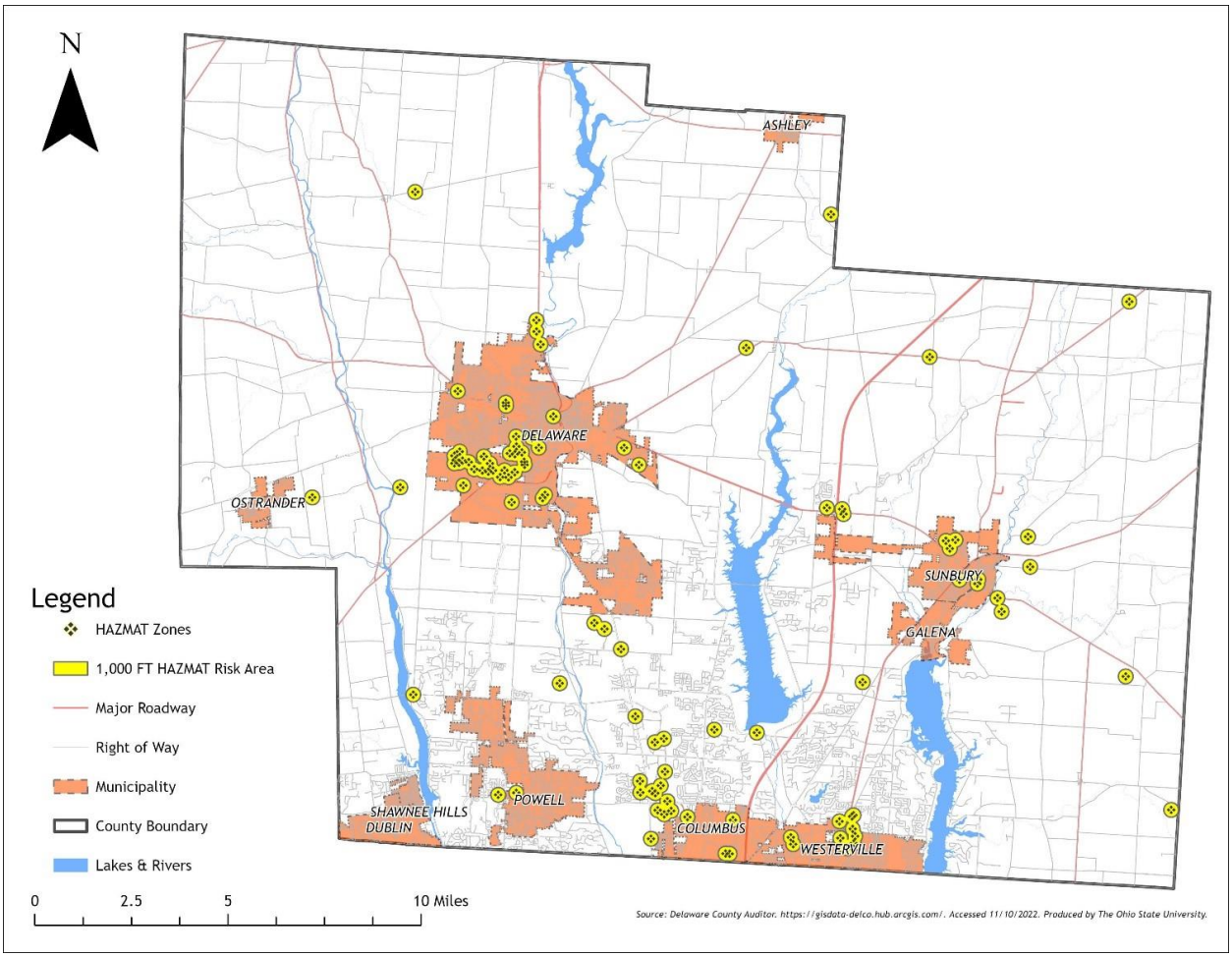
Ohio Revised Code Section 3750 defines the reporting requirements for facilities that have hazardous materials on site. Per this section, 44 facilities in Delaware County are identified as sites with Extremely Hazardous Substances (EHS). Records of facilities containing EHS are kept and maintained by the Ohio EPA and by Delaware County LEPC. Hazardous materials each have varying levels of toxicity, dependent on their chemical components, concentration, and storage volume. In order to determine the threat potential, concentrations should be measured in parts per million (PPM). Commonly, chemicals can be safe at low volumes and concentrations, increasing in risk level with increases in each. Furthermore, certain chemicals present risk when

exposed to oxygen or other materials. Threats to environmental health, including soil and drinking water, arise as a result of untreated ground spills. Chemicals that have corrosive, flammable, or explosive properties may cause infrastructure damage in some cases.

Extent

As mentioned above, the most likely locations of a HAZMAT incident would be at the location of a company, industry, etc. storing or utilizing hazardous materials. Additionally, transport of these materials creates a potential for incidents. Delaware County has hazardous material transported both by roadway and railroad. **Figure 41** displays locations across Delaware County that host the highest risk of impact in the event of a HAZMAT spill due to an onsite presence of HAZMAT.

Figure 41 *HAZMAT Impact Zones*



Source: DCOHSEM Date Created/Gathered: December 5th 2022

History

Since the late 1990s, several HAZMAT incidents have been recorded in Delaware County. However, only 16 are considered an impactful event due to the meeting of the aforementioned

qualifications. To date, no one has been directly injured due to a HAZMAT incident. The four most recent impactful incidences are listed below. A complete list of events can be found in **Appendix A**.

2019 – On January 9th, 2019, unknown parties abandoned three 300-gallon totes on a property on Mills Rd, West of Dix Rd. This incident occurred in Concord Township. Two were unlabeled, while the third had a class 8 corrosive placard described as containing a corrosive liquid

2019 – On September 15th, 2019, a truck transporting 30,000lbs of tires was involved in a trailer fire traveling northbound on US-23

2020 – On December 27th, 2020, the containment section of DART was deployed on a spill

2021 – On June 14th, 2021, the containment section of DART was deployed for a spill

Probability

Quantification of HAZMAT spill probabilities is extremely difficult due to the unpredictable nature of the incidents, as well as the likely influence of human error. Due to this, as well as the possibility of occurrence at any time, HAZMAT spills should be considered "likely" events. Delaware County averaged 21.09 spills/incidents a year between 2000-2021, with the majority of the spills occurring in August (these are spills which fit EPA reporting criteria, not the criteria listed above). There has also been an increase in the overall number of reporting Tier II facilities and an increase in the number of those facilities which have EHS.

Vulnerability Analysis

Infrastructure Impact

Roadways, waterways, soil and groundwater are vulnerable in the event of a HAZMAT spill. These pieces of infrastructure could be impacted by a HAZMAT event, up to and including permanent or long-lasting damages.

Population Impact

In the event of a large spill, the population may require evacuation. Socially vulnerable population will need more help with the evacuation process then other populations. Evacuations are intensive processes and planning for all populations during an evacuation is important.

Although this hazard was not in the National Risk Index, socially vulnerable populations may need additional support in evacuation and may be more sensitive to some hazardous materials.

Property Damage

Damage to property is likely in the event of a spill, especially for those involving EHS facilities. If the spill also impacts soil or water, further damage may occur during clean-up and restoration efforts.

Loss of Life

Loss of life is unlikely when proper procedures are followed in response to an incident. However, extreme precaution is required in the event of an incident due to the toxicity of certain chemicals.

Economic Losses

Economic losses can occur primarily as a result of product spilled in a HAZMAT incident. These can be economic losses due to the damages caused by the hazardous material spilled, loss of the material itself and its production value and also losses due to the clean-up of the material. Damages can be focused on the site of the spill or then can be widespread especially if the material is airborne.

Figure 42 shows the structures at risk of a HAZMAT incident. Features were selected from parcels that had their center within a 1000 ft. buffer around each individual hazard site recorded in Delaware County and all jurisdictions covered within this plan. In this case, the total market value (including land and improvement) was included because a HAZMAT incident would cause significant damage to the land.

Figure 42 *HAZMAT Structural Vulnerability*

Structures Most Vulnerable to HAZMAT Incidents								
	Structures At Risk				Damage In Dollars			
JURISDICTION	Residential	Non-Residential	Critical Facilities	Total	Residential	Non-Residential	Critical Facilities	Total
City of Delaware	169	1,052	61	1,282	18,144,500	359,865,900	240,382,700	618,393,100
City of Powell	47	35	2	84	7,208,100	23,863,800	13,799,300	44,871,200
Village of Galena	N/A	N/A	N/A	0	N/A	N/A	N/A	-
Village of Shawnee Hills	N/A	N/A	N/A	0	N/A	N/A	N/A	-
Village of Ashley	N/A	N/A	N/A	0	N/A	N/A	N/A	-
Village of Ostrander	N/A	N/A	N/A	0	N/A	N/A	N/A	-
City of Sunbury	261	384	10	655	26,073,300	76,976,500	12,144,200	115,194,000
Other	1,154	1,169	117	2,440	98,563,500	482,238,700	363,416,500	944,218,700
TOTAL	1,631	2,640	190	4,461	149,989,400	942,944,900	629,742,700	1,722,677,000

Source: DCOHSEM Date Created/Gathered: December 5th, 2022

Climate Change

Climate change has severe impacts on the frequency and severity of natural disasters, increasing both. As a result of this, the probability that natural disasters may cause a HAZMAT incident increases. HAZMAT incidents occurrence increases in likelihood and probability as an indirect consequence of climate change, however, but do not increase the severity.

Land Use and Development Trends

Due to the relatively controlled spatial distribution of incidents, as well as the low likelihood of occurrence, communities throughout Delaware County are at low risk. Through adherence to zoning and state laws regarding location of facilities containing hazardous materials, the impacts of HAZMAT spills can be reduced to on site occurrences. Furthermore, enforcement of existing regulations as well as implementation of additional mitigation strategies can reduce the risk of spatially impacted land, including on-site and on-route incidents, this will come into increasing importance as Delaware County continues its fast development.

4.8 Invasive Species

Description

Invasive species are defined by the Ohio Department of Natural Resources as a species that is not native to a specific location and tends to spread to a degree that causes damage to the environment, economy, or human health. Their establishment often arose as a result of human introduction, deliberate or accidental, and are further propagated through continued human activity. This hazard is ranked 14th regarding its potential impact on Delaware County.

Further identifying factors include the ability to reproduce rapidly, spread over large distances at an aggressive pace, and actively cause harm to the aforementioned societal components. ODNR recognizes 78% of the 2,300 plants found in Ohio as native, recognized as such for remaining prominent from before the time of substantial European settlement in the state. Of the 22% recognized as non-native, only a portion become invasive. These non-native species were introduced in Ohio for a variety of reasons, including for agricultural, horticultural, ornamental, erosion control, and medicinal purposes.

The ability of non-native, invasive species to produce monocultures as a result of lacking natural predators creates the risk of disrupting entire ecosystems. These species may be either terrestrial (includes plant, tree, shrub, animal, bird, and insect species), or aquatic (includes plants, algae, fish, mollusk, amphibian, and insect species).

Location

Invasive species have the potential to impact any location within the State and exist throughout the entirety of Ohio's counties. Terrestrial invasive species have the capacity to degrade woodlands, wetlands, and prairies throughout the state, degrading these ecosystems and disrupting food webs. Aquatic invasive species utilize Ohio's many waterways to spread throughout county lines. Delaware County has roughly 140 miles of shoreline, the most in the state, offering ample opportunity for the propagation of aquatic invasive species

Extent

Upon establishment of invasive species, limitation becomes enormously difficult, while eradication becomes nearly impossible. Removal is expensive, labor intensive, and potentially damaging to the surrounding ecosystem. Thus, it is highly probable that invasive species have and will continue to impact Delaware County. Additionally, in connection to the increased global trade and travel, intentional and unintentional mobility of species will likely increase. Exotic trade bans and other forms of legislation diminish this probability but does not reduce it in its entirety.

Even considering these safeguards, ODNR reports with certainty that new invasive, non-native species will enter Ohio. Despite this reality, January of 2018 saw new laws enacted by Ohio banning the sale and distribution of 38 invasive species.

Figures 43 and 44 are tables of the lists of species invasive to Ohio, both aquatic and terrestrial.

Figure 43 *List of Invasive Plant Species in Ohio, as of 2022*

Scientific Name	Common Name
Lanicera maackii	Amur Honeysuckle
Elaeaanus umbellate	Autumn Olive
Vincetoxicum nigrum	Black dog-strangling vine
Pyrus calleryana	Callery pear
Centaurea stoebe ssp. Micranthos	Spotted knapweed
Berberis vulgaris	Common barberry
Phragmites australis	Common reed
Dipsacus fullonum	Common teasel
Potamogeton crispus	Curly-leaved pondweed
Dipsacus laciniatus	Cutleaf teasel
Hesperis matronly	Dame's rocket
Egeria densa	Brazilian Elodea
Myriophyllum spicatum	Eurasian water-milfoil
Rhamnus cathartica	European buckthorn
Hydrocharis morsus-ranae	European frog-bit
Lythrum virgatum	European wand loosestrife
Ficaria verna	Fig buttercup/lesser celandine
Butomus umbellatus	Flowering rush
Alliaria petiolate	Garlic mustard
Heracleum mantegazzianum	Giant hogweed
Frangula alnus	Glossy buckthorn
Epilobium hirsutum	Hairy willow herb
Typha x glauca	Hybrid cattail
Hydrilla verticillate	Hydrilla
Lonicera japonica	Japanese honeysuckle
Microstegium vimineum	Japanese stiltgrass
Pueraria montana var. lobate	Kudzu
Lonicera morrowii	Morrow's honeysuckle
Rosa multiflora	Multiflora rose
Typha angustifolia	Narrow-leaved cattail
Celastrus orbiculatus	Oriental bittersweet
Myriophyllum aquaticum	Parrotfeather
Lythrum salicaria	Purple loosestrife
Elaeagnus angustifolia	Russian olive
Lonicera tatarica	Tatarian honeysuckle
Ailanthus altissima	Tree-of-heaven
Trapa natans	Water chesnut
Nymphoides peltate	Yellow floating heart

Source: Ohio Department of Agriculture Date Created/Gathered: December 5th 2022

Figure 44 *List of Aquatic Invasive Species in Ohio*

Type	Scientific Name	Common Name
Plant	Egeria densa	Brazilian waterweed
Plant	Najas minor	Brittle Naiad
Plant	Phragmites australis	Common reed
Plant	Ludwigia peploides	Creeping water-primrose
Plant	Potmogeton crispus	Curly-leaf Pondweed
Plant	Myriophyllum spicatum	Eurasian watermilfoil
Plant	Hydrocharis morsus-ranae	European Frog-bit
Plant	Marsilea quadrifolia	European Water Clover
Plant	Callitriche stagnalis	European Water-starwort
Plant	Cabomba caroliniana	Fanwort
Plant	Butomus umbellatus	Flowering-rush
Plant	Salvinia molesta	Giant Salvinia
Plant	Hydrilla verticillate	Hydrilla
Plant	Lysimachia nummularia	Moneywort
Plant	Typha angustifolia	Narrowleaf Cattails
Plant	Nelumbo nucifera	Pink Lotus
Plant	Lythrum salicaria	Purple Loosestrife
Plant	Phalaris arundinacea	Reed Canary Grass
Plant	Trapa natans	Water Chesnut
Plant	Eichhornia crassipes	Water Hyacinth
Plant	Nymphoides peltate	Yellow Floating Heart
Plant	Iris pseudacorus	Yellow Iris
Invertebrate	Corbicula fluminea	Asian Clam
Invertebrate	Hemimysis anomala	Bloody-red Shrimp
Invertebrate	Eriocheir sinensis	Chinese Mitten Crab
Invertebrate	Bithynia tentaculata	Faucet Snail
Invertebrate	Cercopagis pengoi	Rishhook Waterflea
Invertebrate	N/A	Marbled Crayfish
Invertebrate	Potamopyrgus antipodarum	New Zealand Mudsnail
Invertebrate	Dreissena bugensis	Quagga Mussel
Invertebrate	Procambarus clarkia	Red Swamp Crayfish
Invertebrate	Faxonius rusticus	Rusty Crayfish
Invertebrate	Faxonius virilis	Virile Crayfish
Invertebrate	Dreissena polymorpha	Zebra Mussel
Fish	Alosa pseudoharengus	Alewife
Fish	Hypophthalmichthys nobilis	Bighead Carp
Fish	Mylopharyngodon piceus	Black Carp
Fish	Cyprinus carpio	Common Carp
Fish	Gambusia holbrooki and Gambusia affinis	Eastern and Western Mosquitofish
Fish	Fundulus diaphanus diaphanous	Eastern Banded Killifish
Fish	Gymnocephalus cernuus	Euraisna ruffe
Fish	Scardinius erythrophthalmus	European Rudd

Type	Scientific Name	Common Name
Fish	Carassius auratus	Goldfish
Fish	Ctenopharyngodon Idella	Grass Carp
Fish	Channa argus	Northern Snakehead
Fish	Fundulus catenatus	Northern Studfish
Fish	Misgurnus anguillicaudatus	Oriental Weatherfish
Fish	Osmerus mordax	Rainbow Smelt
Fish	Neogobius melanostomus	Round Goby
Fish	Petromyzon marinus	Sea Lamprey
Fish	Hypophthalmichthys molitrix	Silver Carp
Fish	Proterorhinus semilunaris	Tubenose Goby
Fish	Morone americana	White Perch

Source: ODNR Date Created/Gathered: December 5th 2022

History

Invasive species of plants, animals, and insects have been introduced and existed within Ohio since European settlements in the 1750s. Coinciding with improvements in the scale and speed of human transportation and shipping, the introduction of potentially invasive species has increased.

Probability

The probability that Delaware County experiences continued invasive species establishment and presence is extremely high. This classification is due to the difficulty associated with eradication and the likelihood of transference events.

Vulnerability Analysis

Infrastructure Impact

Major impacts to roadways, utilities, and other major forms of infrastructure as a result of invasive species is unlikely. Certain aquatic invasive pose threats to water quality, dam, levee, and sewer and irrigation system functionality. Additionally, some cleaning of water-based infrastructure is required in the event of establishment of certain aquatic invasive establishment (i.e., Zebra Mussels). Furthermore, other species may increase fire risk.

Population Impact

Loss of life due to the impacts of invasive species is unlikely. It is highly unlikely that invasive species have any impact on human populations.

Although this hazard was not included in the National Risk Index, invasive species could be widespread throughout the county and have some effects on the socially-vulnerable populations who are involved in agriculture.

Property Damage

Property damage as a result of invasive species presence is likely, and could occur through a reduction in property value

Loss of Life

Loss of life due to the impacts of invasive species is unlikely.

Economic Losses

The extent of economic impacts resulting from invasive species is variable. These losses could arise indirectly through extensive ecosystem collapse and loss of associated services. Additional impacts may result from decreased recreation in afflicted waterways. Finally, economic resources may require diversion in order to manage invasive species. Two of the most expensive invasive species to manage are as follows:

- The Multiflora Rose is estimated to cost Ohio residents millions of dollars per year, according to agricultural experts associated with Ohio State University
- Estimates for the treatment and controlling of Zebra Mussel infestations range from 2 to 10 million dollars, due to their impact on aquatic infrastructure and drinking water

Climate Change

Species and ecosystems are typically most at risk when climate stressors like temperature increase interact with land use changes, habitat loss, pollution, nutrient inputs and nonnative species. Changes such as these can decrease the ability of native species to thrive and increase the available of habitat and make ecosystems more favorable to invasive species.

Land Use and Development Trends

As a result of the high likelihood of continued establishment of invasive species and the low likelihood of eradication in Delaware County, development and land use trends are likely to exacerbate this risk. Through the thorough management of shipping and landscape industries, establishment may be mitigated thus allowing for a focus on spatially concentrated species. Policy concerning and regulation of public space, parks, business landscapes, etc., may be implanted to curb the use of foreign and potentially invasive species.

4.9 Pandemic and Serious Illness

Description

A pandemic can be defined as a disease that has 8 characteristics: wide geographic extension, disease movement that is traceable, high rates of symptomatic infection, quick spread, minimal population immunity, caused by a new or novel strain of bacteria or viruses, spreads from human to human, and causing severe illness. The United States has endured many pandemics throughout its history, the most recent being the COVID-19 pandemic. Pandemics and Serious Illness outbreaks were ranked 2nd out of the 15 hazards analyzed in this study.

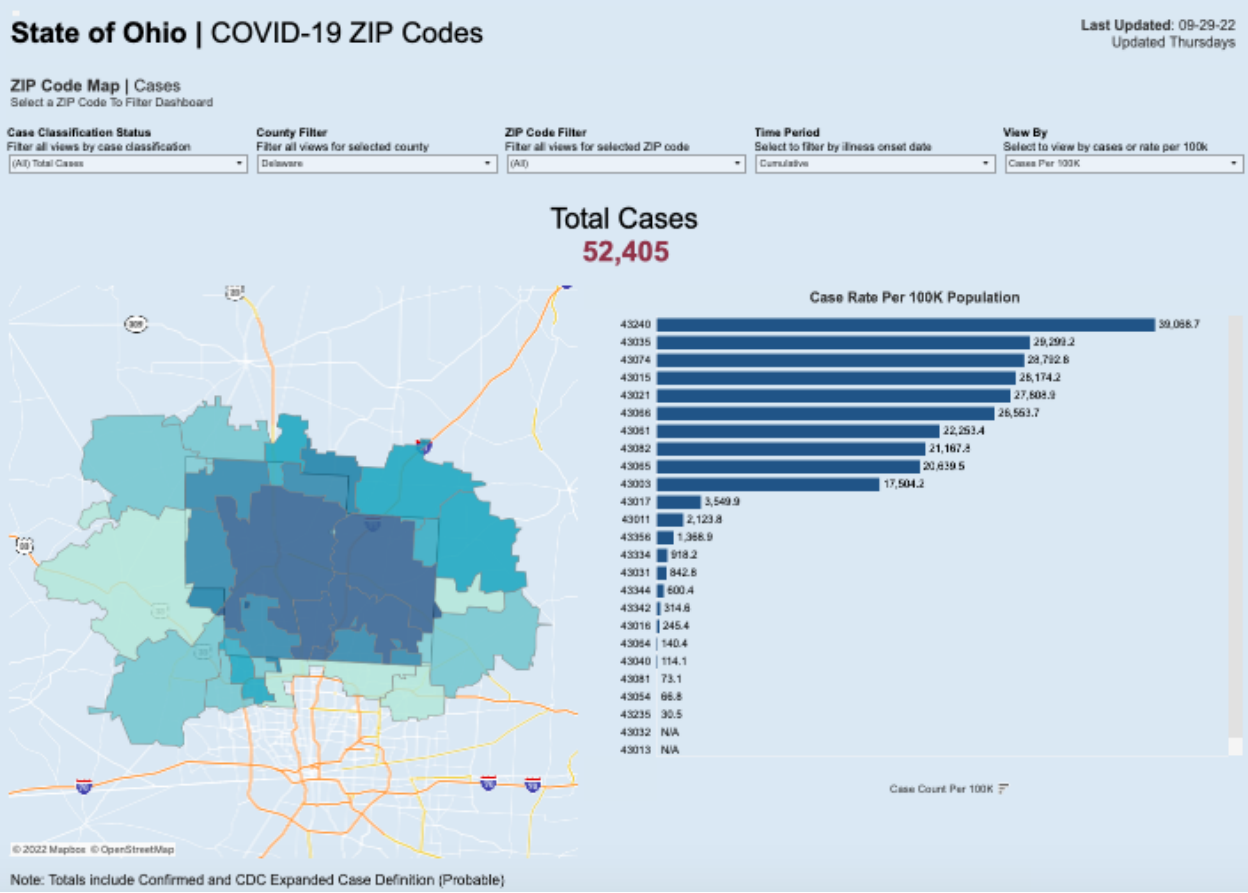
As stated earlier, pandemics have wide geographic extension, meaning that they affect a large area. To be considered a pandemic, the disease must spread from country to country and be widespread within each country. Even though pandemics are usually understood at the country-scale, this section will report on how Ohio and in some cases Delaware County reacted to pandemics. Diseases can be spread through direct contact, food, insects, and water or by airborne methods. Before the COVID-19 pandemic, pandemic studies by the Federal Centers for Disease Control (CDC) mainly focused on flu pandemics, but now there is increased focus on all illnesses that can transfer from animals to humans and between humans. A pandemic can lead to a plethora of problems including but not limited to lack of workforce, panic, loss of social capital, negative economic impacts, and educational disruptions.

An epidemic may be described as “increase, often sudden, in the number of cases of a disease above what is normally expected in a population in that area." There are many epidemics that have affected Delaware County throughout the years. One of the most newsworthy was an outbreak of a gastrointestinal disease in 2018. Epidemics are common in human history, so an important aspect of mitigation is to have the personnel and equipment needed to quell the epidemic quickly.

Location

Pandemics are widespread, country-level disease outbreaks; therefore, when looking at it through the lens of a county, the entire county will be affected. Even if there is not a case of the illness at the focus of the pandemic in the county, the county’s public health system will still be on watch for a case. During the COVID-19 pandemic, every zip code in the county was affected. A map of the cumulative cases of COVID-19 in Delaware County represented by cases per 100,000 in each zip code is in **Figure 45** below.

Figure 45 *Cumulative cases of COVID-19 in Delaware County*



Source: CDC & State of Ohio Date Created/Gathered: December 5th, 2022

Location can affect the propensity for a disease to spread. It is thought that cities with high population density make it easier for a disease to spread, while more dispersed cities have slower disease spread. However, human intervention is also considered when assessing potential distribution of a disease. Restriction of mobility works well in cities with high population density to curb the spread of disease, while alternative measures are required in more dispersed cities.

All illnesses are spread through direct and/or indirect contact. Direct contact is characterized by human-to-human contact, including kissing, shaking hands, or hugging. Indirect contact can be airborne (such as when bacteria or viruses attach to dust particles), on vehicles (meaning an object that carries the virus such as a table, blood, food, or water), and by vectors (which are living beings other than humans that carry diseases such as fleas, mosquitoes, and ticks). Severe illnesses that have the potential to reach pandemic levels can start anywhere.

Extent

Illnesses spread through a variety of means, but an illness needs people, a mode of transmission, and a lack of protection for it to become an outbreak or even a pandemic. The nature of the illness, its mode of transmission, and its severity all determine the risk level for Delaware County. Pandemics and severe illness do not negatively impact infrastructure but can cause

catastrophic damage to social infrastructures, such as hospital systems and economies. Pandemics can be incredibly disruptive to the global economy, potentially disrupting travel and tourism industries, among other sectors. If an outbreak associates with a certain business, it could negatively affect its reputation in the area. Also, individually, there can be financial interruptions due to an inability to work.

At its worst, pandemics can lead to large loss of life, also civil unrest, food shortages, and fuel shortages due to and the reaction of residents and the changes implemented by the government.

History

Pandemics and other severe illness outbreaks have occurred throughout history. One such incidence was the use of smallpox infected blankets by colonialists to systemically kill Native Americans, which spread through tribes in the 1830s. In more recent history, the 21st century and forward, there have been many pandemics. Noteworthy outbreaks that have occurred in the last 15 years are listed below. Events were deemed as noteworthy by being well-spread and/or making national headlines or local reports. A complete list of pandemic and other severe illness events can be found in **Appendix A.**

2009- In the fall of 2009, the H1N1 virus gained momentum as a new strain of flu that was not recognized by our immune systems. The Ohio Department of Health used CDC recommended methodology to estimate 10,266 hospitalizations and 471 deaths in the State of Ohio from this flu virus.

2015-2018- From January 1st, 2015, to October 31st, 2018, there were 5,728 symptomatic Zika virus disease cases reported in the United States (not including United States territories), 86 cases specifically for Ohio, and one in Delaware County. The virus raged through the country for 2 years, but once the country reached herd immunity, infections dropped suddenly. Nationally, infections went from 224 locally acquired cases to 7 locally acquired cases between 2016 and 2017. The last case of Zika in Delaware County was in 2016.

2018- In July 2018, Delaware County health officials identified 647 customers of a restaurant located in the City of Powell that reported becoming ill. It was caused by a toxin formed in the gastrointestinal tract by the *Clostridium perfringens* bacteria, commonly found when food is left at an unsafe temperature. Symptoms include nausea, vomiting, diarrhea, fever and other ailments.

2020 – The COVID-19 pandemic was first recognized in the United States in March of 2020, and by September of 2022, there were 96 million cumulative recorded cases and over 1 million deaths nationwide. In Ohio there have been over 3 million cases, over 126,000 hospitalizations, and over 39,000 deaths as of September 2022. There were multiple waves of the COVID-19 pandemic due to variants of the virus, however it is still considered one pandemic. Every ZIP Code in Delaware County has had a case of COVID-19. After 1 year of COVID-19, a vaccine was created and by September 2022, 82% of Delaware County's population above 5 years old is fully vaccinated for the disease.

2021 – There was a larger than normal amount of Lyme disease in Delaware County. Lyme disease is spread by the bite of a black-legged tick and originates from the bacteria *Borrelia burgdorferi*. In 2020, there were only eight cases in the whole county compared to 25 cases in 2021. Ten of these cases were in children 10 – 14 years old.

Probability

Depending on the disease, pandemics can impact a variety of populations. For example, Zika could be caught by everyone, but has debilitating effects on the brains of unborn children. Polio could be caught by anyone, but cases are more severe in children. COVID-19 could be caught by everyone but was more deadly among those 65 and older and those with underlying conditions such as having a habit of smoking, having asthma, or being overweight. There is no way to predict how many pandemics or other illness outbreaks will occur in each year, but due to climate change the occurrence is predicted to increase. This increased occurrence of illnesses is due to a variety of features including but not limited to wildlife habitats disappearing (increased human – animal interaction) and the climate in Delaware County becoming warmer (increasing the range of various diseases).

The virus that caused COVID-19 is the same type of virus that caused severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). After the end of these respective pandemics, the funding to research the virus diminished. Public health officials believe that proactive research into vaccine creation, as opposed to reactive, offers the potential to save lives in the face of future outbreaks.

Vulnerability Analysis

Since pandemics and severe illnesses are not expected to decrease in their occurrence, it is important to understand the impact that pandemics and severe illnesses can have on the county.

Infrastructure Impact

As mentioned, social infrastructure such as hospital systems can fall under immense strain in the event of a pandemic. The failure of a hospital system can have strong cascading effects in other parts of the economy and surrounding areas. The construction and infrastructure sectors that rely on global supply chains and supply of labor from around the world, may also face consequences.

Population Impact

Due to the nature of pandemics, populations are impacted based on level of preparedness. A pandemic may lead to workforce disruption, loss of social capital, and disruption to education. All residents are at risk of interruptions to their daily life.

Although pandemics and serious illness outbreaks are naturally occurring, they are not considered a natural hazard by the standard definition, therefore these hazards are not represented in the National Risk Index. Although the county did not lose as many lives as many other counties in the country due to the most recent pandemic, there were tens of thousands of

people who caught the COVID-19 virus. Also learned from the recent pandemic is that socially vulnerable populations and populations in close living environments can be at higher risk of illness as well as not having as much ability or the resources to work through the illness and be resilient because of their current vulnerabilities, which can magnify the effects of an illness.

This heavily impacted the economy, education, and many other aspects of daily life. The City of Powell serious illness outbreak from a restaurant in 2018 also serves as an example of how impactful these types of events can be to the general population. Pandemics and serious illness outbreaks are dangerous hazards that should be the county should stay vigilant for any signs of their occurrence.

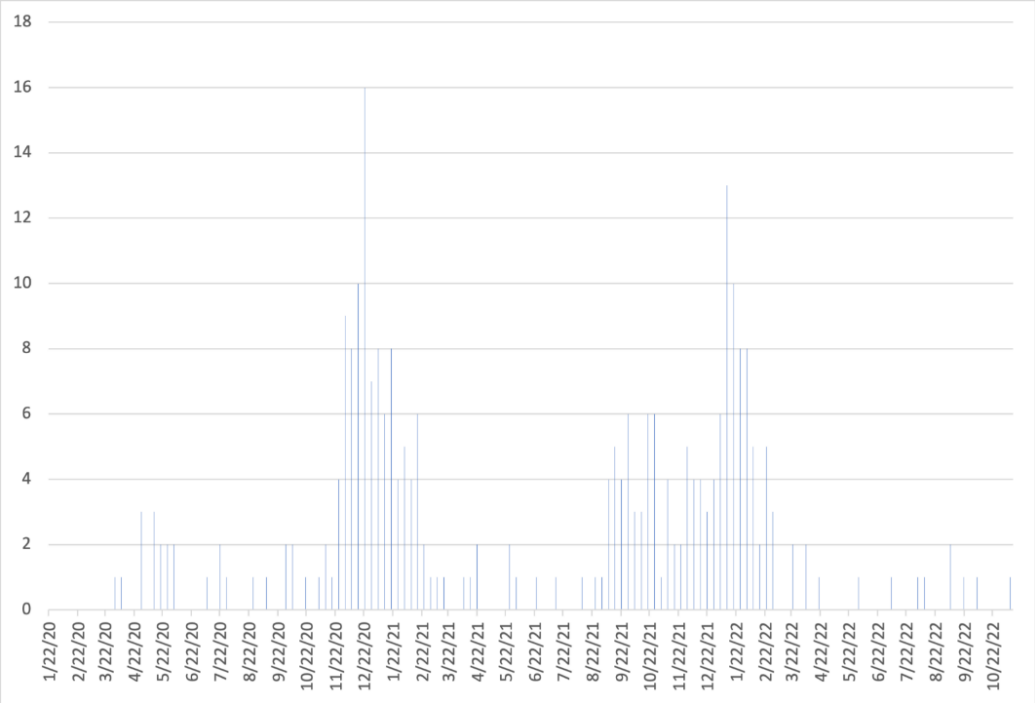
Property Damage

All physical property is safe from the disease itself during a pandemic or severe illness outbreak.

Loss of Life

With the COVID-19 pandemic alone, more than 1 million Americans lost their lives. There were 281 recorded deaths in Delaware County from January 2020 to November 2022. A graph of weekly deaths in Delaware County is shown in **Figure 46**. This graph shows a bi-modal peak of succumbing to COVID-19 between November 2020 and February 2021 and another peak between September 2021 and February 2022.

Figure 46 *Weekly Deaths in Delaware County due to COVID-19*



Source: CDC Date Created/Gathered: November 14th 2022

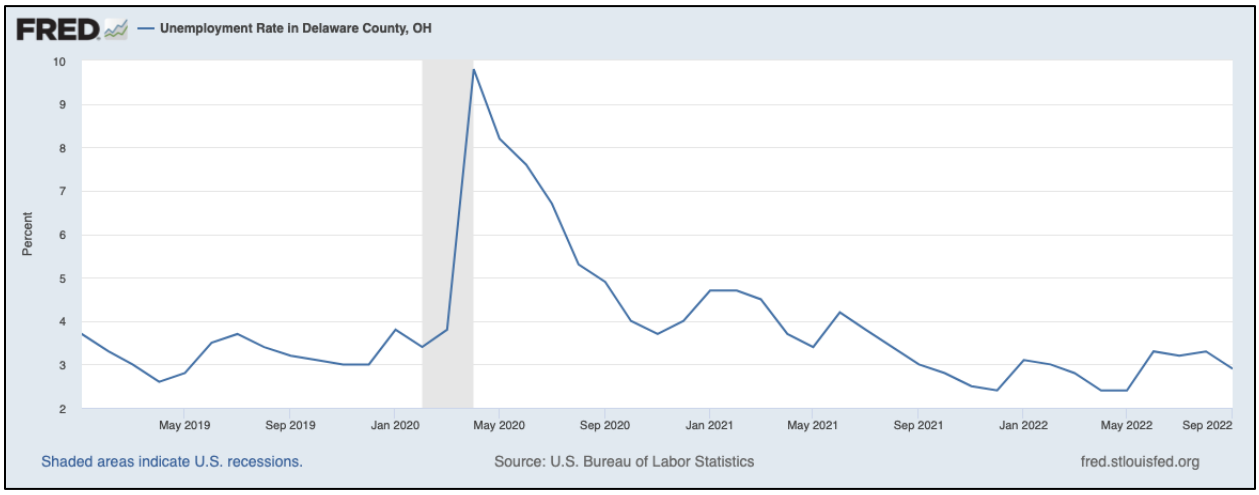
There are some groups that are more at risk of infection and succumbing to an illness during a pandemic or severe illness outbreak. This includes those that are young and have not received vaccinations, those that have weakened immune systems, and social groups that are faced with long standing social and medical inequity, such as racial minorities and those with disabilities.

Economic Losses

There has been a history of pandemics in the United States from Smallpox in the 1830s to the COVID-19 Pandemic in the 2020s. The semiannual Global Economic Prospects report released by the World Bank in January 2021, claimed that the world's economy shrank by 4.3% between 2020 and 2021 because of the COVID-19 pandemic. The Economist took this analysis further and posited that the world economy shrank by 6.6% in 2020 and remained 5.3% below previously projected figures in 2021. That led to a loss of at least $10.3 trillion in global output, with the United States losing $1.7 trillion alone. These calculations are educated guesses about how the economy could have grown, however there is no true way to know the full cost of any pandemic. What these figures show is that pandemics have an extensive, long-lasting impact.

On a smaller scale, pandemics and severe illness can cause many people to lose their jobs. During the COVID-19 Pandemic, many industries shut down which caused many people to be laid off or to lose their job temporarily. In Ohio alone, there were over 770,000 continued unemployment claims filed by April 2020. In Delaware County, the unemployment rate increased from 3.8% in January 2020 to 9.8% in April 2020, as displayed in **Figure 47**.

Figure 47 *Delaware County Unemployment Rate*



Source: US Bureau of Labor Statistics Date Created/Gathered: November 14th 2022

Climate Change

Scientists predict that pandemics will occur more frequently due to climate change. The climate in Delaware County in the coming decades will become warmer, with wetter springs and drier summers. These changes can increase the possibility of disease and disease transmission. This is a result of habitat loss, while tropical diseases like dengue fever can spread to more places due to warming temperatures creating more habitat for mosquitoes.

Land Use and Development Trends

As seen in the COVID-19 pandemic, pandemics can affect land use and development trends or behaviors. An example of how pandemics could affect land use and development trends and behaviors is to encourage and allow outdoor seating in the right of way or close to the right of way. Severe illness outbreaks are usually relatively short compared to pandemics, so they will not affect land use and development trends or behaviors.

Pandemics also can affect the supply chain which effects how quickly housing and industry can build facilities and homes. Supply chain can shortage can make it difficult for development to continue or new affordable housing to be available to those who are socially vulnerable. Delaware County continues a high rate of development in 2020, as the fastest growing county in Ohio.

4.10 Severe Summer Weather and Extreme Heat

Description

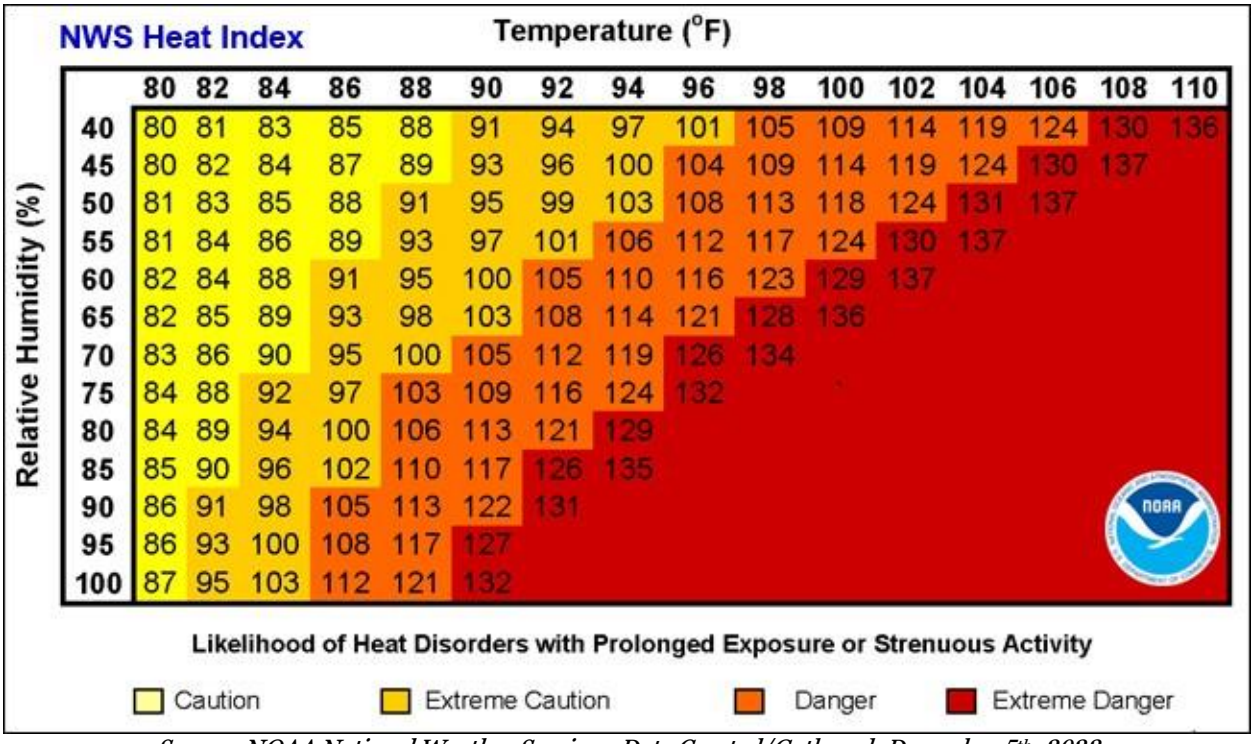
Ohio is in a temperate region of the country, and therefore can experience extremely hot summers and extremely cold winters. According to the union of concerned scientists, Ohio usually has 17 days per year with a heat index above 90°F, but it is projected that by 2050, with no climate action, those days could increase to 60 days per year. If no action is taken by 2100, then it is estimated that there will be 93 days with a heat index above 90°F per year. This extreme heat could lead to major issues such as increased rates of heat illnesses, increased urban heat island effect, increased use of electricity, and more. Severe summer weather and extreme heat is ranked 5th out of the 15 hazards that were analyzed in this study.

Extreme summer weather includes excessive heat, hailstorms, heavy rain, high wind, and thunder/lightning storms that occur between April and September of each year.

According to the National Weather Service, a thunderstorm is classified as severe if the wind gusts are greater than 50 knots or 58 mph, if there is hail with a 3/4 inch or greater diameter, or if the storm produces a tornado. A typical thunderstorm is 15 miles in diameter, lasts for approximately 20-30 minutes and usually occurs at the forefront of an incoming cold front. Strong straight-line winds can cause severe damage to property, especially if winds are strong enough to topple trees and power lines. A key component of thunderstorms is lightning which is a rapid atmospheric discharge of electricity. It tends to strike tall, conductible objects such as trees, utility lines, and buildings.

Extreme or excessive heat is classified as uncharacteristically high temperatures within a region and can come in the form of a “heat wave” which is more than two consecutive days under these conditions. Dangerous heat levels are measured and categorized using the National Oceanic and Atmospheric Administration’s (NOAA) National Weather Service Heat Index which can be seen in **Figure 48** below. Stagnant air conditions, poor air quality and high humidity often exacerbate the effects of extreme heat on the local population and the environment. It is a particularly threatening hazard because evaporation is slowed under high humidity, and the human body requires more effort to maintain a normal body temperature. Additionally, extreme heat can lead to a variety of heat related illnesses such as heat rash, sunburn, heat cramps, heat exhaustion, and heat stroke. Heat illnesses are mostly preventable by staying inside, staying hydrated, keeping cool, and wearing proper protective clothing.

Figure 48 *National Weather Service Heat Index Chart of Dangerous Heat Levels*



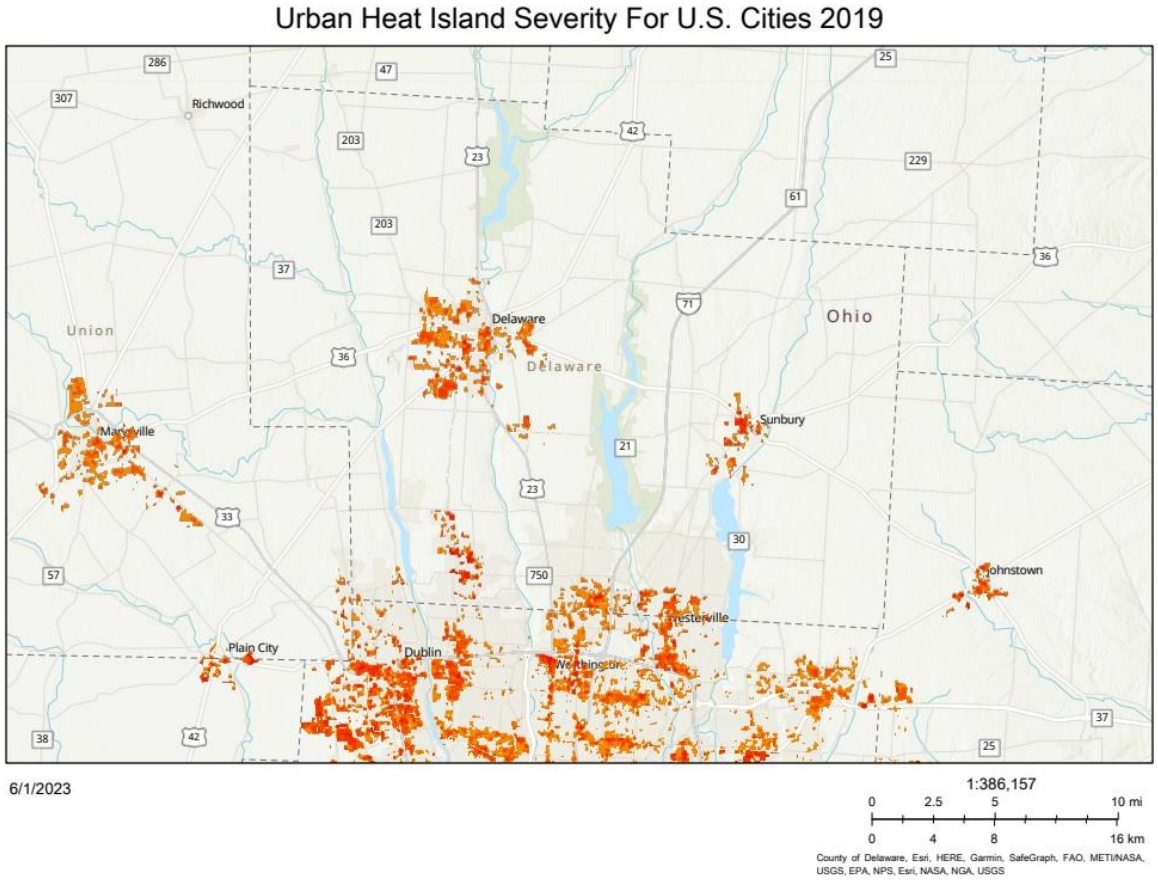
Source: NOAA National Weather Service Date Created/Gathered: December 5th, 2022

Location

Periods of excessive heat and high wind can affect most of the county, while hailstorms, heavy rain, and thunder/lighting storms are more localized. Over time, usually a period of a few hours, this latter category of storms can move to cover a wider area.

Excessive heat can also be concentrated in urban areas and create an effect known as a heat island. NOAA has created GIS mapping of heat island severity. Delaware County was included in this mapping and the results are below. These results show that the urban areas and cities o Delaware County are at greater risk of severe heat then the more rural areas because of the heat island affect. The severe heat areas shown are also areas where the most socially vulnerable people in Delaware County reside.

Figure 49 *NOAA Urban Heat Island Severity for U.S. Cities 2019*

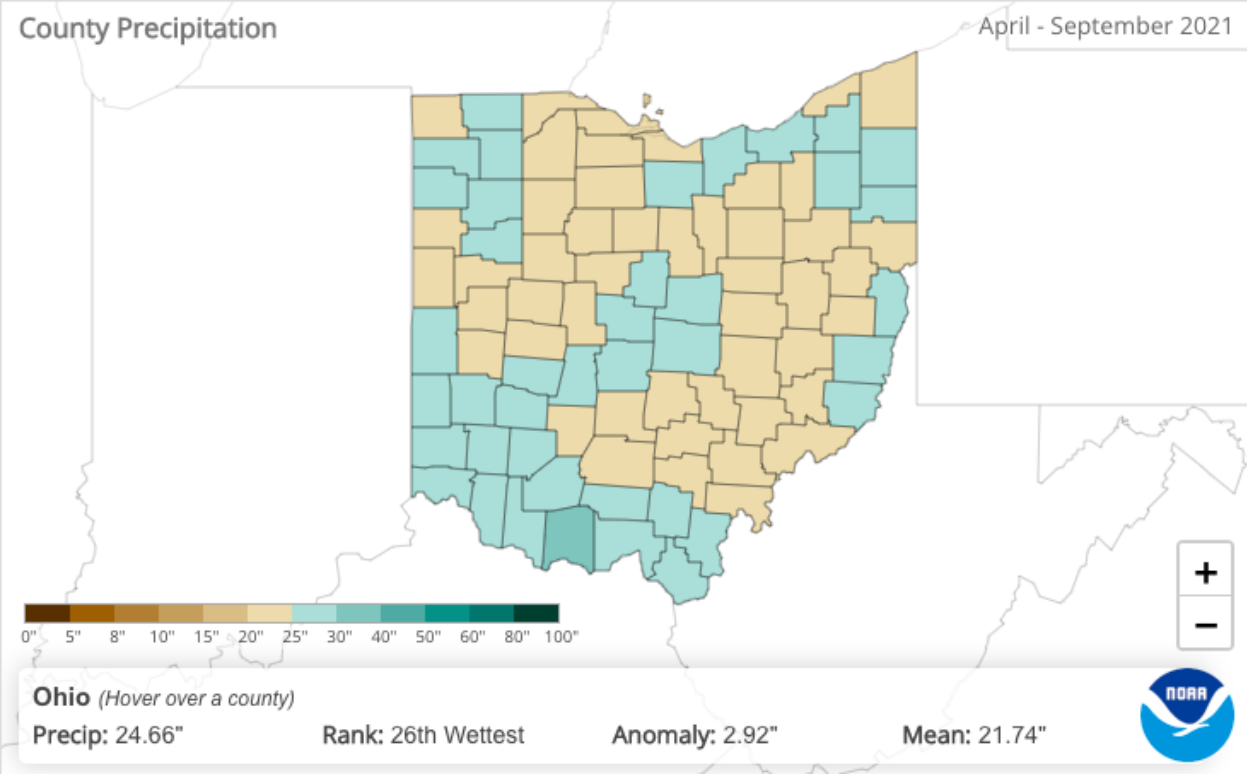


Source: NOAA National Weather Service Date Created/Gathered: June 1st, 2023

Extent

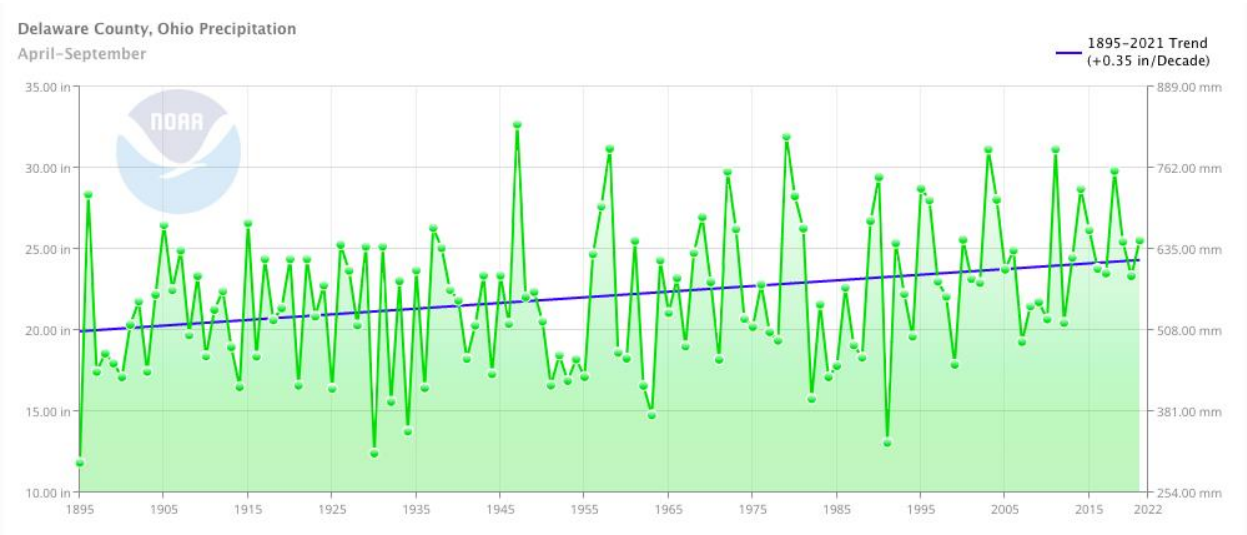
Delaware County sees an average summer (April – September) precipitation of 21.79 inches, while in 2021 the county received 25.55 inches of rain. The precipitation in the summer of 2021 was about the same as the state as a whole, which can be seen in the map below. The trend between 1895 and 2021 is positive, meaning that in general the county is getting more rainfall each year, as is shown in **Figure 50 and Figure 51**.

Figure 50 *NOAA Map of Summer Rainfall in Ohio*



Source: NOAA Date Created/Gathered: December 5th 2022

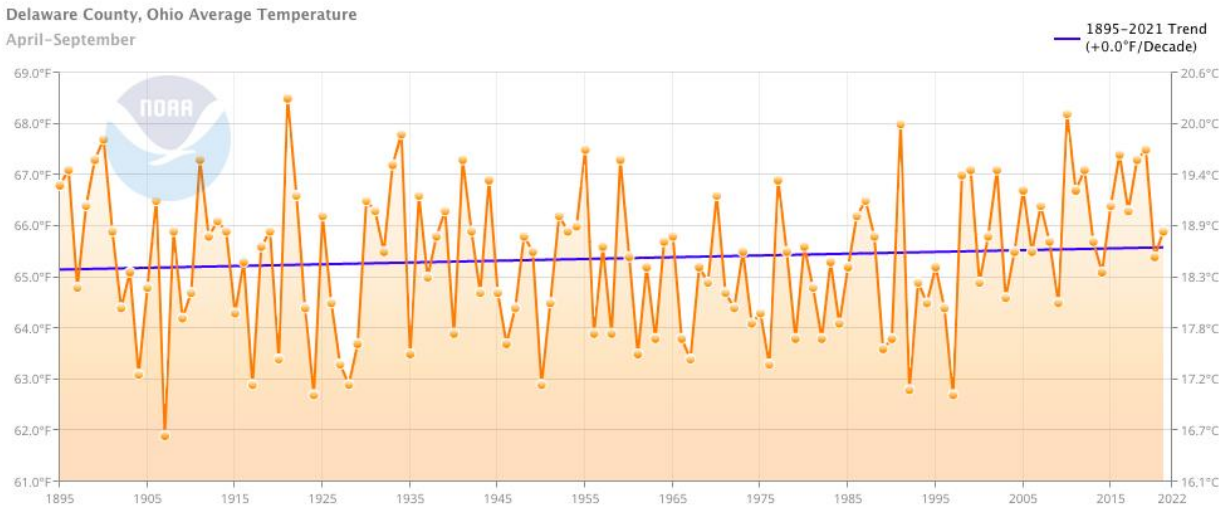
Figure 51 *Trend of Summer Rainfall in Ohio*



Source: NOAA Date Created/Gathered: December 5th, 2022

The average temperature for Delaware County has been stable since 1895 (**Figure 50**), but it is predicted that the trend will become more positive in the future due to climate change.

Figure 52 *Trend of Average Summer Temperature in Ohio*



Source: NOAA Date Created/Gathered: December 5th 2022

Severe summer weather and extreme heat cover the entire county and can affect anyone. Between 2012 and 2022 there have been 251 deaths due to lighting strikes in the United States and in 2021 there were no deaths in Ohio due to lightning. It is important to know that only 10% of those struck by lightning are killed. Property is at risk of being damaged during this event due to high winds, flooding, and hail.

Due to the large geographic area that most types of extreme summer weather cover, there is no geographic area that is at higher risk than other geographic areas for excessive heat, hailstorms, heavy rain, high wind, and thunder/lightning storms. All structures within the county were deemed equally vulnerable, including critical facilities and those that are publicly owned. What could put individuals at risk are behaviors such as being outside during these occurrences and health factors such as age.

History

Historical events of severe summer weather in Delaware County were found by searching the National Climactic Data Center (NCDC) Storm Events Database and isolating the occurrences of excessive heat, hail, heat, heavy rain, high wind, lightning, strong wind, and thunderstorm wind. These events were further restricted to those that occurred between January 1st, 1960, and June 30th, 2022. Storms that occur between April 1st and September 30th in any given year are considered summer events. Between 1960 and 2022, there were 305 incidents of severe summer weather and two instances of excessive heat, totaling over $85 million in property damages. Due to the large number of occurrences, only the most severe and within the last decade are listed below. Severity was determined by causing more than $20,000 in property damage and/or having a widespread effect:

2012- On June 29th, 2012, Delaware County and most of Central Ohio experienced a derecho, or a widespread, long-lived windstorm, that produced highly damaging straight-line winds. Winds were measured at 56 knots or 64 miles per hour. Over 300,000 people in the area lost power and some went without it for almost 10 days. Additionally, the Concord Township Fire Station sustained severe damage to its roof. This storm caused about $15,000 in property damage.

2013 – On July 10th, 2013, much of Delaware County, covering Radnor, Delaware, and Berkshire townships, had thunderstorm winds of up to 65 knots or 75 miles per hour. From this storm, there was reported flash flooding and three large, downed trees near I-71 and SR- 37. This storm caused $27,000 in property damage.

2014- On April 29th, 2014, a thunderstorm developed along and south of a warm front. Some of the storms during this time had the potential to become severe. The main threats from these storms were damaging winds and sub-severe hail. There was approximately $25,000 worth of property damage from this storm.

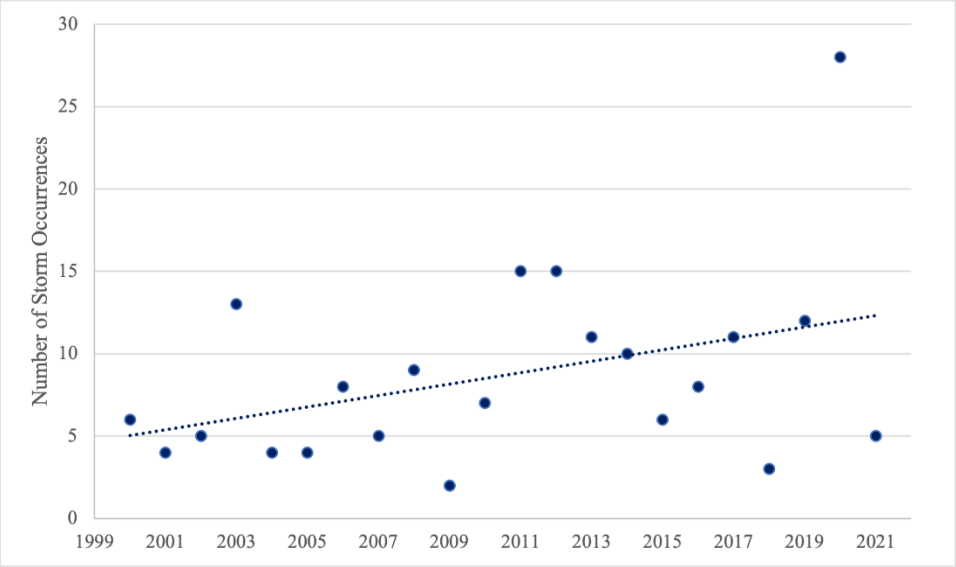
2020 – On Sept 7th, 2020, thunderstorms occurred over most of Delaware County including the areas of Leonardsburg, Chesire, and Lewis Center. Winds reached up to 60 knots or 69 miles per hour and the storm caused upwards of $39,500 of property damage.

2022 – On June 13th, 2022, thunderstorms affected much of Delaware County, especially Olive Green. Winds were estimated to be around 60 knots or 69 miles per hour and the storm caused about $60,000 of property damage. Many trees and powerlines were downed throughout the county and a roof was ripped off a barn.

Probability

There were 339 summer weather hazardous events between January 1st, 1963, and December 31st, 2021. These events include occurrences of excessive heat, hail, heat, heavy rain, high wind, lightning, strong wind, and thunderstorm wind. By dividing the total number of events by the number of years, it was found that there is an average of 5.8 severe summer storms per year; therefore, the county can expect to get about six severe summer weather events in the future. However, between 2000 and 2021, there were 191 occurrences of severe summer weather and as the years progressed, the number of storms has been increasing (**Figure 53**). Therefore, it is likely that there will be more than 6 storms in the coming years.

Figure 53 *Increasing Number of Occurrences of Summer Storms in the Past 21 years*



Source: NCDC Date Created/Gathered: December 5th 2022

Vulnerability Analysis

Extreme summer weather includes excessive heat, hailstorms, heavy rain, high wind, and thunder/lightning storms that occur between April and September of each year, and it is likely that Delaware County will continue to experience any combination of these conditions in the future.

Infrastructure Impact

Extreme summer storms have the potential to disrupt the power grid and block roads, which can take many days to repair. Above ground infrastructure is the most vulnerable from winds, hail, and debris. In many of the historical events, one of the most disruptive elements has been a loss of power due to debris or wind destroying above-ground powerlines. In addition to disruption electricity supply to homes and businesses, downed power lines are still live and therefore pose a threat of electrocution to those in the nearby area.

Population Impact

According to the United States Census Bureau, Delaware County has a total population of 220,740. With a county wide hazard such as this, everyone is at risk. Additionally, the socially vulnerable including those who live in mobile homes, are elderly, young children, or work outside are at increased risk of property damage and physical injury. During summer events, everyone should take precautions and especially those who reside in mobile homes or are unhoused, should seek shelter.

Those who are socially vulnerable also can experience greater risk with severe heat events. These populations may require outside resources in order to survive these events.

According to the Hazard Type Risk Index from the National Risk Index, Delaware County has "very low" risk index rating for hail, lighting, and strong wind compared to the nation, yet those three scores are the second, fifth, and seventh highest scored hazards out of 14 identified natural hazards in the county among the scoring provided by the National Risk Index. This information also shows that severe summer storms are relatively frequent, with hail projected to occur 4 times a year, a serious lightning event projected to occur 64 times a year, and strong wind projected to occur 2 times a year. From the National Risk Index, we can glean that there is a risk to the residents of Delaware County from severe summer storm events.

Property Damage

The average amount of damage for all events between 2000 and July 2022 is around $414,141.38 ($84,070,700 / 191), but it is important to note that about 32% of events resulted in $0 dollars of property damage, the median damage from storms is $1000, and most of the total property damage was due to a storm in 2003 ($65 Million) and 2008 ($18 Million). From this, we can understand that although damage is common, it is usually around $1,000. However, as storms get more common these costs will occur more frequently.

The NCDC website does not separate events that happen in different seasons, so the following numbers will be for these events throughout the year. Between January of 1963 and December of 2021, Delaware County experienced 339 of these types of events over a total of 222 days, incurring over $85,533,000 in property damages. The average amount of damage per event based on all events between 1963 and 2021 is around $252,300 ($85,533,000 / 339). However, it is important to note that about 52% of events resulted in $0 dollars of property damage and the events that resulted in property damage had totals ranging from $100 - $65,000,000. The average amount of property damage for events that caused damage between 1963 and 2021 is $488,800 ($85,533,000 / 175). The county can expect around 5.8 severe summer storms per year based on previous years.

The two most damaging storms were caused by the remnants of Hurricane Ike in 2008 and created $18 million in property damage, and a large hailstorm in 2003 that caused $65 million in property damage. The two incidents of excessive heat caused no property damage, however extreme heat combined with low precipitation can lead to drought conditions. Damages from drought can be found in the drought risk assessment. All structures in Delaware County are at risk from structural damage from severe summer weather. The value of that potential damage is shown in **Figure 54**.

Figure 54 *Potential Damage for the Whole County*

Structure Type	Number of Properties Exposed	Value of Vulnerable structures		
		Land	Building	Total
Residential	53,779	$4,263,730,130	$14,236,148,880	$18,499,879,010
Non-Residential	7,671	$2,904,235,800	$5,323,889,400	$8,228,125,200

Critical Facilities	401	$294,292,580	$1,773,378,370	$2,067,670,950
Total	61,851	$7,462,258,510	$21,333,416,650	$28,795,675,160

Source: DCOHSEM Date Created/Gathered: December 5th, 2022

Loss of Life

Since 2000, there have been no deaths due to extreme summer storms; however, there have been four injuries. Extreme summer storms and extreme heat can also cause heat illness, which can cause death and injury if not treated promptly.

Economic Losses

Other than extreme property damage, the impact on businesses and the economy from summer severe weather and extreme heat would only last for a short period during and immediately after the event and would probably not incur long-term consequences for the economy as a whole. However, as the rate of occurrences increases, these damages could become more detrimental.

Climate Change

Based on multiple studies, the climate of Ohio is expected to rise by 1 - 3°C over the next several decades. In recent Ohio history, there has not been a recorded instance of excessive heat for more than two days, a heat wave, but scientists expect an increase in heat waves in the coming decades. Additionally, scientists have modeled that there will be increased variability in storms in the summer and fall, leading to droughts in the summer and floods in the fall.

Land Use and Development Trends

Severe summer weather and extreme heat are county-wide hazards and therefore can occur everywhere. All previous and future developments are at risk of being affected by this hazard, but this should not limit development.

Delaware County is the fastest growing county in Ohio as of 2020 according to the U.S. Census. The increase in population and development in the county increases the number of people and the infrastructure needed to support them. This also but s greater strain on the infrastructure if there were to be damage, and creates a larger area which could be damaged by this hazard.

4.11 Severe Winter Weather Events

Description

Unlike some areas of the country, Ohio residents and local governments are quite accustomed to and prepared for instances of severe winter weather as it is common within the county and across the state during winter months. Yet, occasional blizzard and extreme winter events can make conditions dangerous and disruptive. Ice is especially dangerous to motorists and pedestrians when it accumulates on bridges, roads, and walkways. It can also affect poles, lines, electrical wires and communication towers which can affect power and telecommunications for days.

Ohio, including Delaware County, has a long history with winter weather events. The severity of this hazard is characterized by blizzards, cold wind/chill, extreme cold/wind, frost freeze, freezing temperatures, ice storms, heavy snow, and other winter precipitation like freezing rain and sleet. By weighing different vulnerability factors and hazard profiles, severe winter weather events rank 1st on Delaware County's hazards priority list out of the 15 hazards that were analyzed in this study.

Blizzard conditions occur when these conditions last at least 3 hours or longer:

- Wind speeds of ≥ 35 mph,
- Considerable snowfall and snow-related limited visibility below ¼ mile, and,
- Temperatures of 20°F or lower

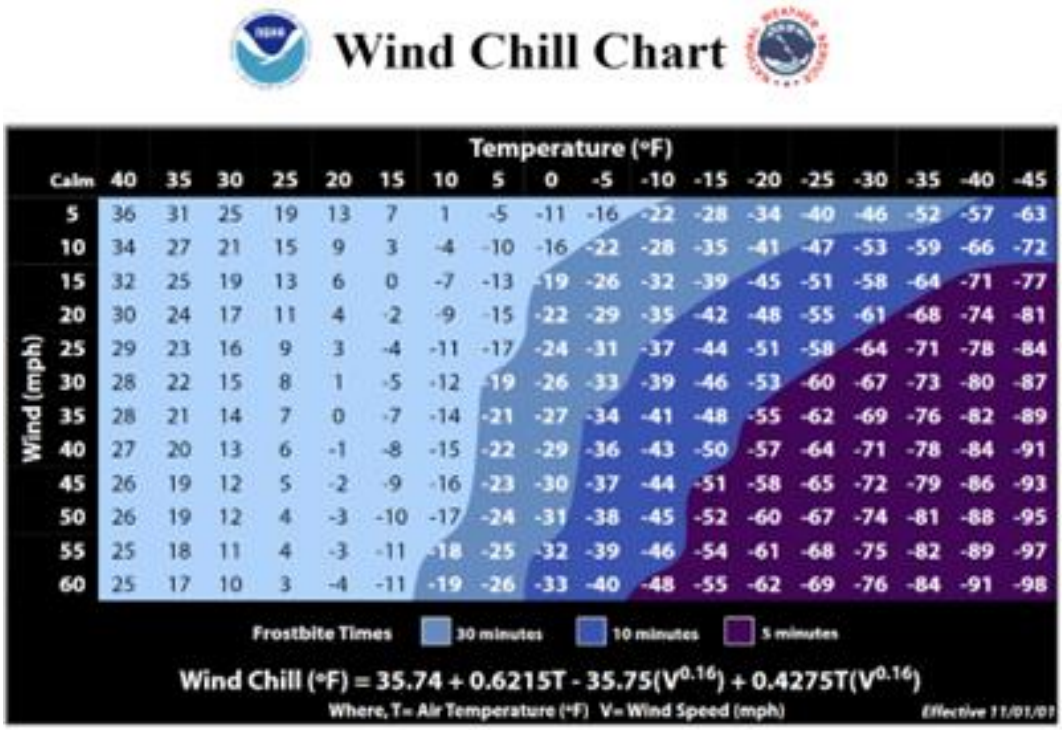
Severe blizzard events are characterized by extreme conditions including:

- Wind speeds exceeding 45 mph,
- Near-zero visibility, and,
- Temperatures of 10°F or lower

Two other types of winter precipitation are freezing rain and sleet. Freezing rain or drizzle is a form of precipitation that falls as a liquid but freezes into glaze or rime upon contact with the cold ground or surface structures. Sleet is defined as pellets of ice composed of frozen or mostly frozen raindrops.

Wind chill is another dangerous aspect of winter storms as it accelerates heat loss from exposed skin contributing to frostbite. Although there are no specific rules to determine when the wind chill is dangerous, it is generally accepted that -20°F and below is highly likely to be dangerous. For more information, see **Figure 53** for the NOAA's National Weather Service wind chill chart which illustrates the risk of frostbite through exposure times. The Wind Chill Temperature (WCT) index uses advances in science, technology, and computer modeling to provide an accurate, understandable, and useful formula for calculating the dangers from winter winds and freezing temperatures.

Figure 55 *Wind Chill Chart*



Source: NOAA's National Weather Service (2001) Date Created/Gathered: November 5th 2022

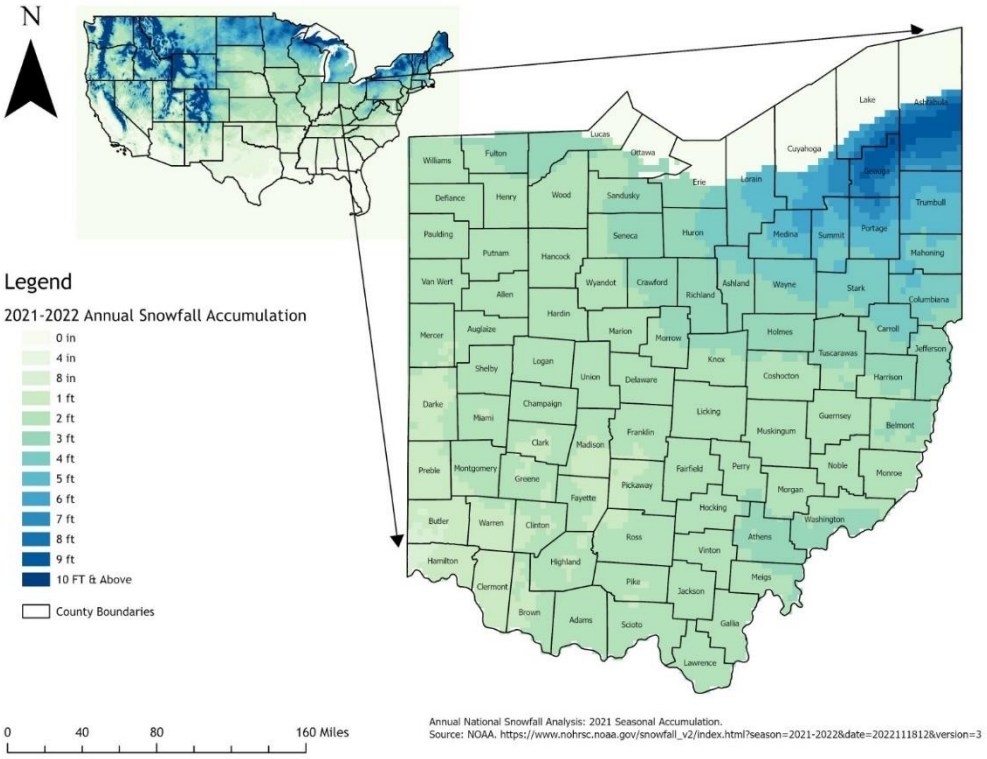
Location

Severe winter weather events are typically large weather events that will impact entire regions of the U.S. and have the potential to impact multiple counties within Ohio. Delaware County as a whole gets impacted by winter weather systems moving across the county. These systems most often move from the west to the east.

Extent

Survey data collected during the public involvement process for this Plan showed that severe winter weather hazards are ranked as the most threatening hazard within Delaware County. According to **Figure 56**, the average annual snowfall accumulation for Delaware County was recorded to an average of 2 feet for the 2021-2022 snowfall season. This snowfall season typically occurs between November of 2021 and March of 2022.

Figure 56 *Annual Snowfall Map*



Source: NOAA Date Created/Gathered: December 5th 2022

History

According to the National Climactic Data Center's (NCDC's) Storm events database Delaware County did not experience any blizzards or instances of life-threatening extreme cold/wind chill since 1950, but there were winter storms, winter weather, cold/wind chill, ice storms, frost/freeze, high wind and instances of heavy snow. Those events that occurred November 1 through March 30 in any given year were included in the final count as they could be considered winter events. Due to the large number of occurrences, only the most severe incidents are described below:

2007- On February 13th, 2007, the county experienced heavy snow and ice along with a mixture of other winter weather conditions. Eight inches of snow was reported at a county garage; however, ice pellets lowered snowfall totals. Icing brought down several trees and powerlines, causing power outages.

2011- On February 1st, 2011, the county experienced an ice storm with snow and sleet which transitioned into freezing rain. Three-quarters of an inch of ice was measured in Delaware along with several inches of sleet accumulation. This resulted in approximately a quarter million power outages and four indirect injuries including two people who were taken to hospital for carbon monoxide poisoning.

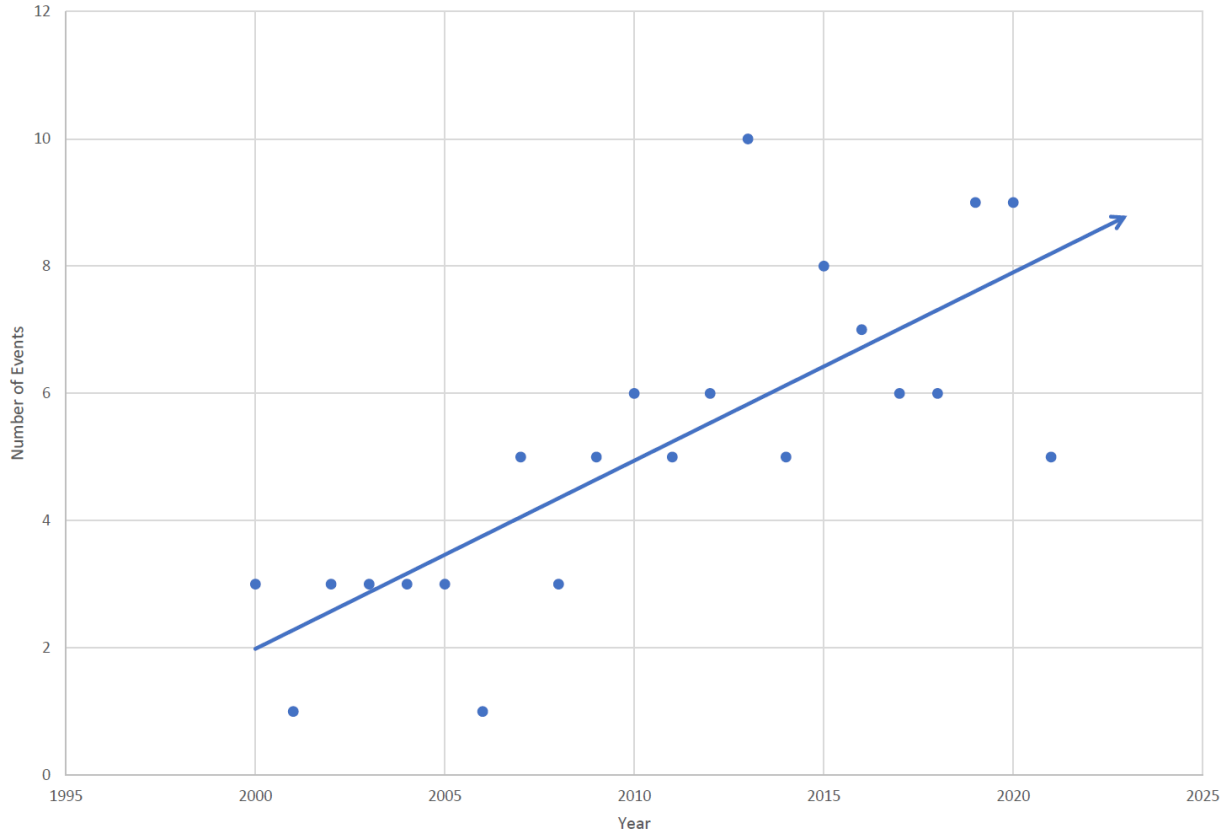
2014- On February 4th, 2014, Delaware County received four to five inches of snow, with an estimated six inches along the southern border with Franklin County. A fast-moving winter storm moved across the Ohio Valley. Locations across northern Kentucky and southern Ohio started with heavy snow and transitioned to sleet and freezing rain. Significant ice accumulations caused tree damage and power outages to 5-10,000 people. Further north, snow mixed briefly with sleet, before changing to freezing rain as precipitation tapered off. The resulting five to ten inches of snow and sleet accumulation in west-central and Central Ohio. This storm brought widespread travel impacts, with many schools and businesses closed on Wednesday, February 5.

2019- On January 19th -20th, 2019, the county garage east of the City of Delaware measured seven inches of snow. A level 3 snow emergency was declared, which limited travel to essential personnel only. An upper-level trough of low pressure in the Mississippi Valley tracked northeast through the Ohio Valley. Mixed freezing rain and sleet early on the evening of the 19th quickly transitioned to heavy snow overnight. This system was followed by bitter cold and sub-zero wind chills.

Probability

Figure 57 displays the probability of experiencing measurable severe winter events each year in Delaware County. By looking at the hazard history in the previous section, it can be estimated that there is a high likelihood that severe winter weather events will affect the Delaware County area. From 1996 to 2021, there were 124 severe winter weather events. Every winter season has an average rate of approximately 5 severe winter events occurring per year. However, the number of events per year is trending up, as shown on the graph below.

Figure 57 *Severe Weather Probability*



Source: NCDC Date Created/Gathered: December 5th 2022

Vulnerability Analysis

Severe winter weather can occur as any combination of several different conditions, and it can occur at a mild to catastrophic magnitude. Winter weather occasionally incurs property damage and crop damage but appears to affect humans more than the structural environment. In the past decade, there have been no recorded winter weather events that have caused any deaths directly according to the NOAA Storm Events Database. There has not been any recent property or crop damage recorded since the last update of this plan. Due to severe winter weather usually being a county wide event, all structures within the county are deemed equally vulnerable, including critical facilities and those that are publicly owned.

Infrastructure Impact

Utilities such as water pipes and electric lines are at higher risk of damage from severe winter events from accumulated snow and ice on overhead wires to freezing underground pipes that can cost thousands in water damage. Debris from falling trees, icy road conditions, and snowfall can also damage roadways and pose a serious safety risk if not cleared in advance from de-icing protocols within the county state department of transportation garage.

Population Impact

Although Delaware County is more accustomed to and prepared for winter weather than other regions of the country, there still exists a possibility that the county will experience mild or catastrophic magnitudes of severe winter storms. Should the county encounter a severe ice storm as it did in 2007 and 2011, there is an elevated risk of injury or even death from slippery road conditions. The National Risk Index reports that Delaware County has a "very low risk" rating for hazards such as cold waves, ice storms, and winter weather. Despite these low-risk ratings, cold waves (.7 events/year), ice storms (0.5 events/year), and winter weather (3.3 events/year) hazards are some of the most damaging hazards for Delaware county, only slightly behind hail, lightning, tornados, and strong winds. These hazards could potentially sum over $900K dollars annually in losses.

As with other hazards those who are socially vulnerable are at greater risk for this hazard as well. The greatest risk is for those who live in urban area, for example the City of Delaware, because that is where those who are most socially vulnerable already reside.

These hazard impacts are mitigated through strong community resilience, which the National Risk Index reports that Delaware County is very high in community resilience and is competent to prepare for anticipated natural hazards, adapt to changing conditions, and withstanding and recovering rapidly from disruptions compared to the rest of the country.

Property Damage

It is also not uncommon that property can be damaged from heavily iced tree limbs or power lines; although it is likely that such damage would be limited to a few thousand dollars. **Figure 58** displays the total value of vulnerable structures within Delaware County in the event of a county-wide uncommonly destructive severe winter weather event. The county could expect a potential loss of millions of dollars in structural damage.

The average amount of damage for all events between 1996 and March 2022 is around $75.781.01 ($19,551,500 / 129), but it is important to note that about 91% of events resulted in $0 dollars of damage, and most of the total property damage was due to a storm in 2008 ($18.4 Million) and 2007 ($540.000)

Figure 58 *Value of Vulnerable Structures by Structure Type*

Structure Type	Number of Properties Exposed	Value of Vulnerable structures		
		Land	Building	Total
Residential	53,779	$ 4,263,730,130	$ 14,236,148,880	$ 18,499,879,010
Non-Residential	7,671	$ 2,904,235,800	$ 5,323,889,400	$ 8,228,125,200
Critical Facilities	401	$ 294,292,580	$ 1,773,378,370	$ 2,067,670,950

Total	61,851	$ 7,462,258,510	$ 21,333,416,650	$ 28,795,675,160

Source: DCOHSEM Date Created/Gathered: December 5th 2022

Loss of Life

While there have not been any reported deaths (directly or indirectly) from severe winter weather events within Delaware County according to the National Weather Service, it is a possibility that deaths may occur due to the threat of exposure, vehicle accidents, structural failure from heavy snow, and even slips and falls from icy pavement conditions.

Economic Losses

Such storms can also cause power outages which disrupt law enforcement, public safety, and business operations and can be unfavorable to the local economy throughout the duration of the icy conditions. Heavy snow conditions can lead to jurisdictions issuing snow alerts, which can keep people in their homes and slow down local business economies.

Climate Change

According to the U.S. EPA, climate change poses significant risks for Ohio's climate over time. Rising temperatures in the last century have caused Ohio's winters to become warmer. This has caused reduced ice and snow packs in early spring. One advantage of rising temperatures is that warmer winters reduce the number of icy days.

Land Use and Development Trends

Winter storms can occur anywhere. Any development that has occurred since that previous plan and any future development has the potential to be impacted by winter storms. All land uses are equally impacted by severe winter weather. Because this is a county wide hazard the increasing population and infrastructure coming to Delaware County will only increase the possible affected areas.

4.12 Land Subsidence

Description

Land subsidence hazard encompasses subsidence, erosion and landslide activity. The Ohio Department of Natural Resources (ODNR) defines a landslide as "a variety of downslope movements of earth materials. Some slides are rapid, occurring in seconds, whereas others may take hours, weeks, or even longer to develop." Landslides are commonly triggered by human-induced vibrations, over-steepened slopes, increased weight on a slope, and removal of vegetation on areas with landslide-prone slopes. Landslides can also be caused by heavy precipitation. There are three major types of landslides:

1. Rotational slump, or a mass of weak rock or sediment moving as a block unit along a slope. These are the largest types of landslides found in Ohio.
2. Earthflow, or a mass of rock or sediment flowing downslope. These are the most common landslides in Ohio.
3. Rock fall, or a rapid downslope movement of large blocks of bedrock. Most rock falls in Ohio involve sandstone or limestone that has been weakened by surface water.

Erosion is the geological process in which earthen materials are worn away and transported by natural forces such as wind or water.

Subsidence is the motion of the earth's surface as it shifts downward relative to a benchmark (often sea level) of the surrounding terrain. In Ohio, the two primary causes are abandoned underground mines (AUMs) and karsts. Karst is a topographic feature formed when carbonate rock, such as limestone, dolomite, and gypsum is eroded by water draining or moving from these areas. Karsts are commonly represented as caves and are the more common subsidence-related hazard in Delaware County.

According to the Ohio Administrative Code 3901-1-48, mine subsidence is loss caused by the collapse or lateral or vertical movement of structures resulting from the caving in of underground mines including coal mines, clay mines, limestone mines, and salt mines. Mine subsidence does not include loss caused by earthquakes, landslides, volcanic eruptions, or collapse of strip mines, storm and sewer drains, or rapid transit tunnels. Several factors determine the potential for mines to collapse including depth, mining technique used, types of rock and/or soils, and the development on the ground surface. Additionally, abandoned underground coal mines in Ohio have the potential to discharge acidic water which, if discharged into creeks or streams, can alter the chemical composition of the water habitat and cause considerable harm to sensitive aquatic life. There are two major types of mine subsidence:

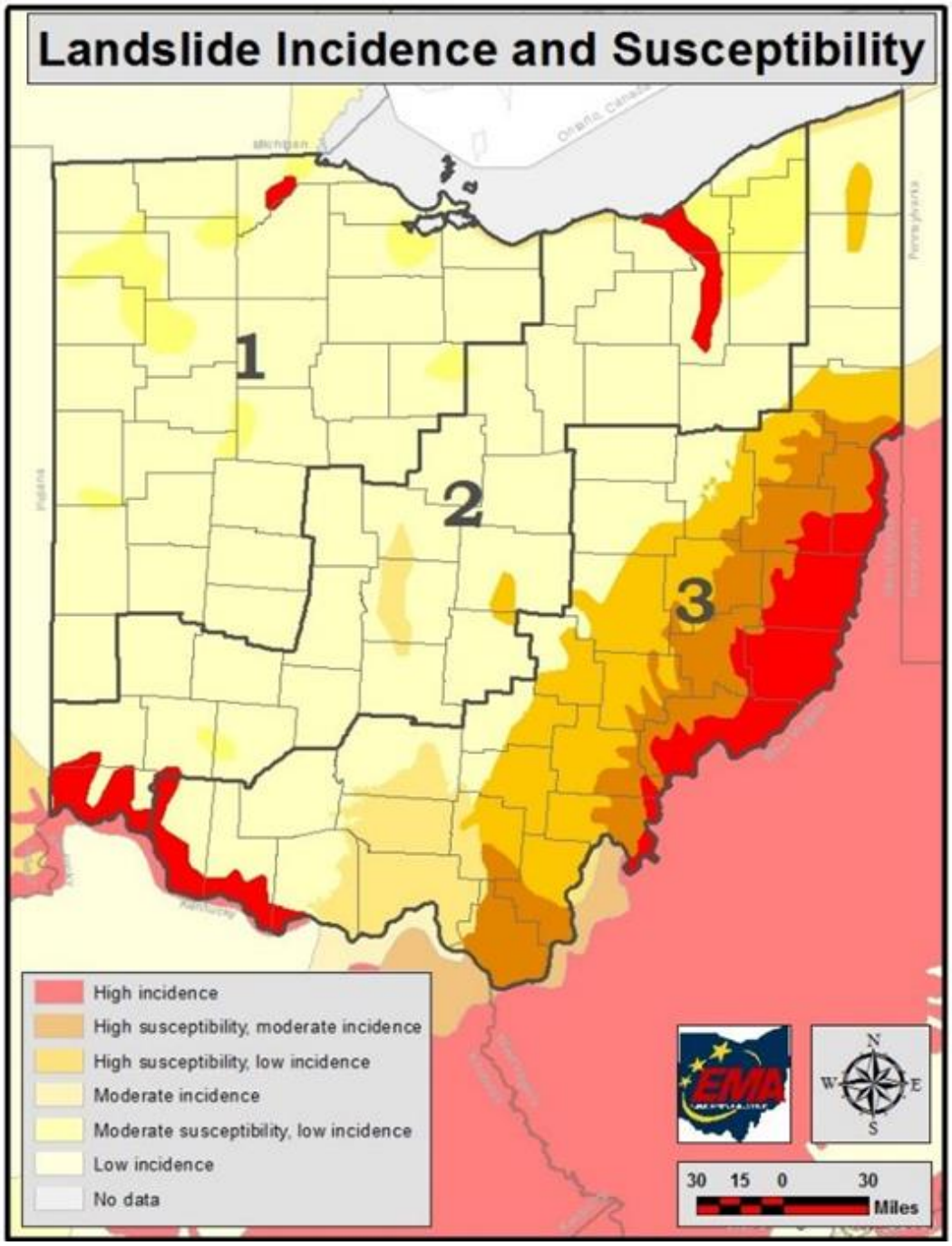
1. Pit, also known as a sinkhole or pothole, is an abrupt sinking of the ground surface that causes a circular crater with steep sides. Pit subsidence is associated with total roof collapse of a mine that is less than 90 feet below ground.
2. Sag or trough, or a gentle, gradual settling of the ground associated with the roof or pillar collapse of a deeper mine.

Subsidence, landslides, and erosion are ranked as the 12th priority hazard out of the 15 hazards that were analyzed in this study.

Location

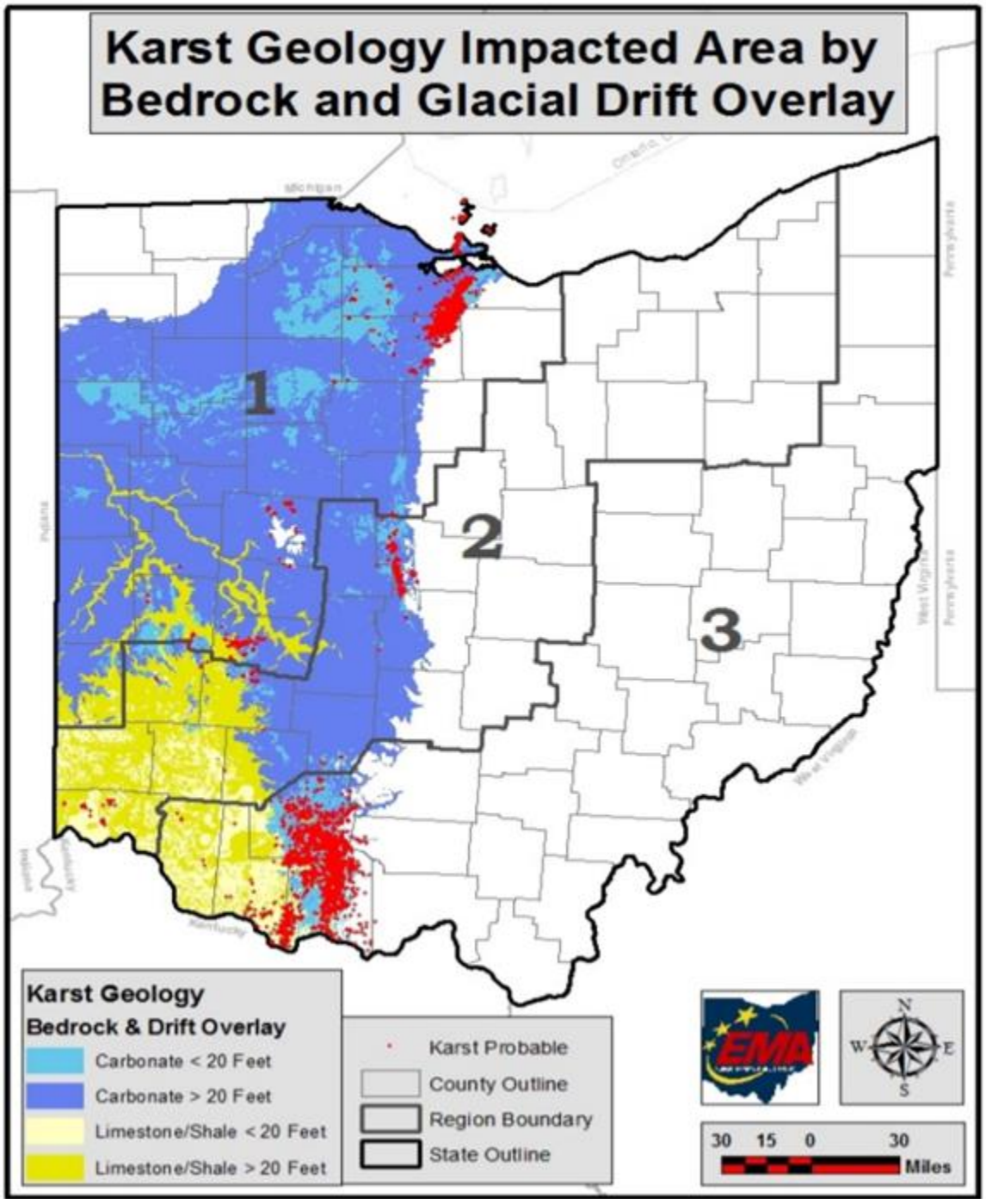
Figure 59 shows the location of areas at risk for landslides. Delaware County is in Region 2 and has some moderate incidence for landslides, but most of Delaware County is low incidence. **Figure 60** shows the karst geology for Ohio. According to the *2019 Ohio Hazard Mitigation Plan*, karst features are associated with the south third of Ohio, but do include areas outside of that including Delaware County. The limestone and dolomite layers were deposited between 408 and 505 million years ago as the floor of an ancient sea. Later, the continental plate rose above the existing sea level creating dry land and vast salt deposits. These carbonate rock layers are naturally porous and dissolve into the water which passes through them.

Figure 59 *Landslide Incidence and Susceptibility Map*



Source: OHIO EMA Date Created/Gathered: November 5th 2022

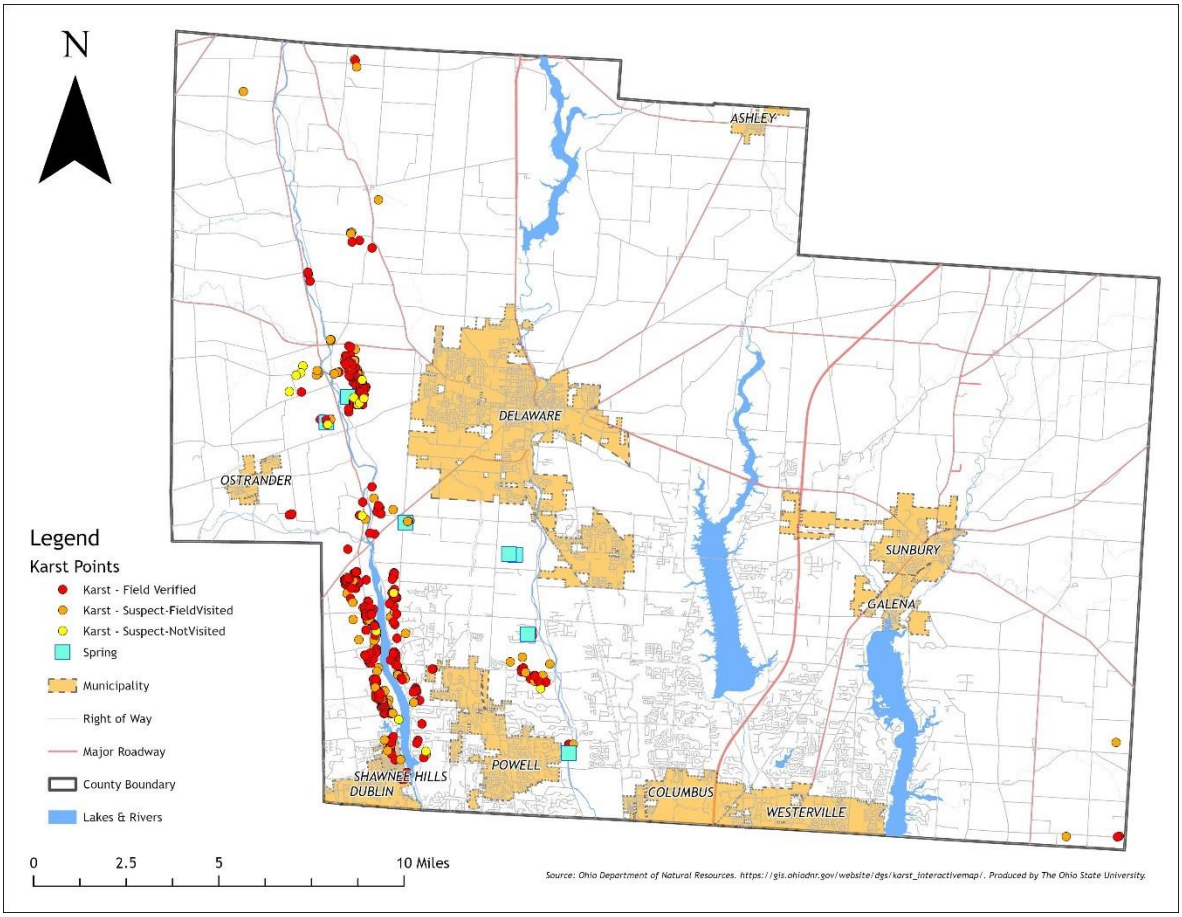
Figure 60 *State of Ohio Karst Geology*



Source: OHIO EMA Date Created/Gathered: December 5th 2022

Figure 59 shows the locations of karsts in Delaware County. Karsts are categorized by whether they are field verified (red), suspected and field visited (orange), or suspected but not visited (yellow). Springs are noted in blue. Karsts are the primary cause of subsidence in Delaware County.

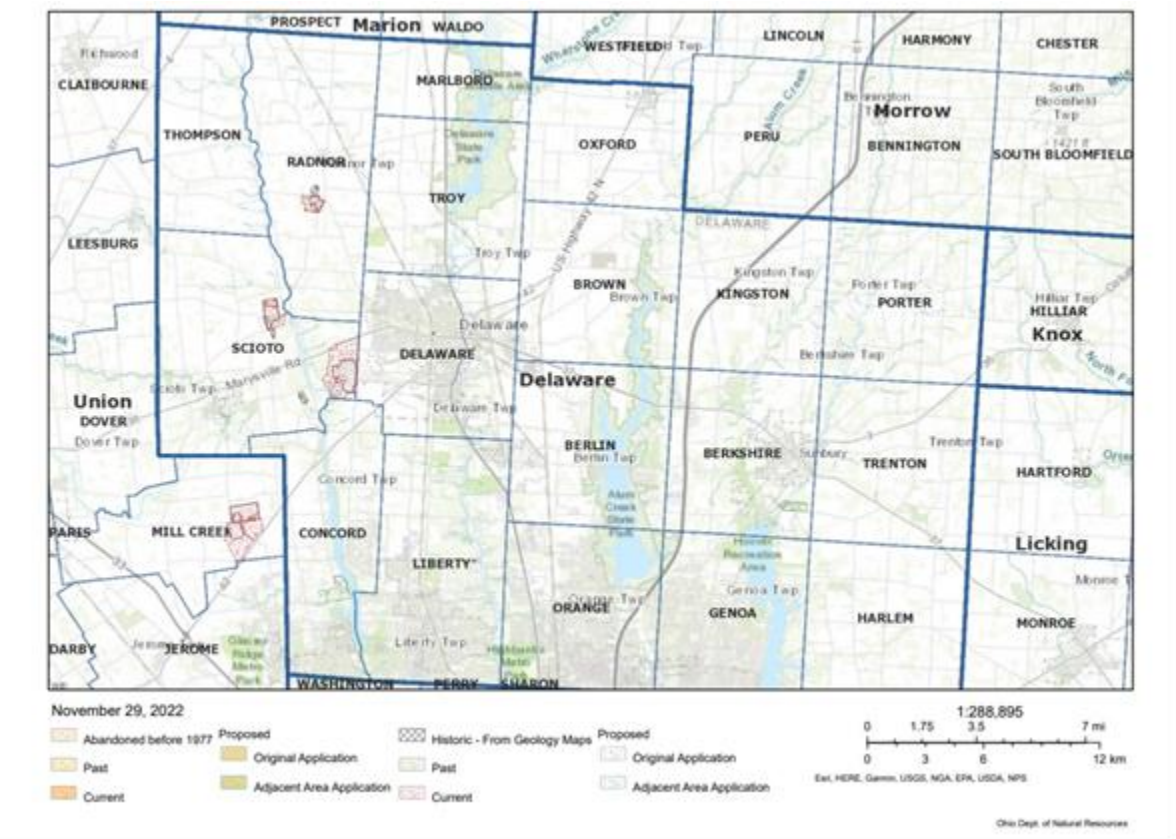
Figure 61 *Delaware County Karst Inventory*



Source: ODNR Date Created/Gathered: December 5th 2022

Figure 62 shows the extent of mines in Delaware County. Current mines are marked in red. Although mines are present in Delaware County, they are not the primary cause of subsidence in Delaware County.

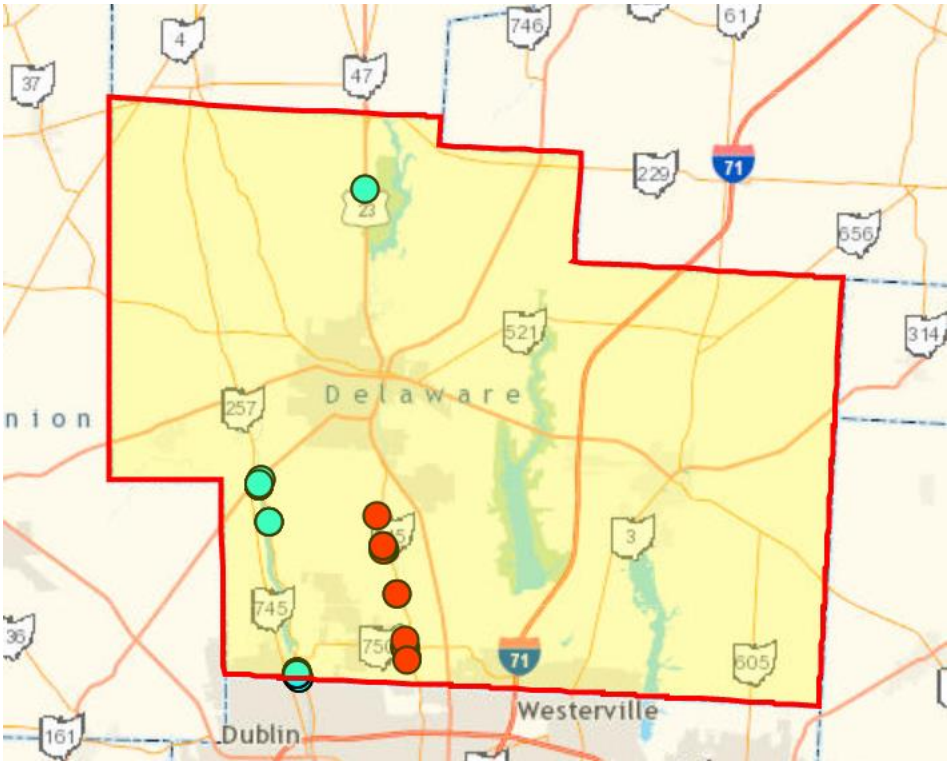
Figure 62 *Mines in Delaware County*



Source: ODNR Date Created/Gathered: December 5th 2022

Figure 63 shows the hazard locations of all landslides (red) or rock slopes (green) in Delaware County. Rock falls and rock slopes are grouped together. These incidences primarily occur along the Olentangy and Scioto Rivers.

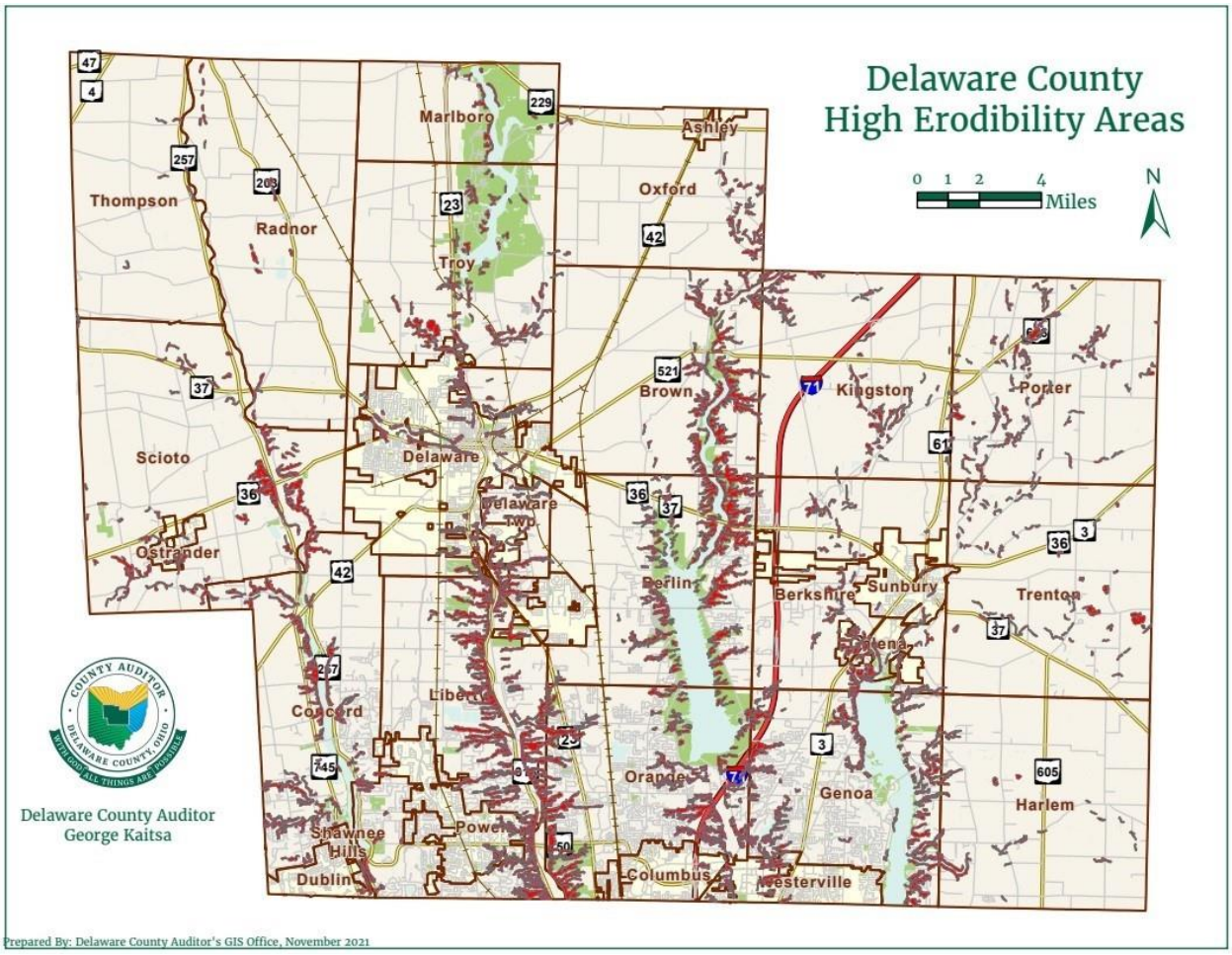
Figure 63 *Delaware County Landslide and Rock Slope Geohazard Inventory*



Source: ODOT Date Created/Gathered: December 5th 2022

Figure 64 shows areas in Delaware County which are prone to high erodibility with a buffer of 50ft to indicate any structures that may be impacted. These areas exist mostly along river corridors but also include areas near soil with erodible properties.

Figure 64 *Delaware County Areas of High Erodibility*



Source: Delaware County Auditor& Delaware County Soil and Water Conservation District
Date Created/Gathered: December 5th 2022

Extent

According to the USGS karst landscapes are more prone to have land subsidence and sinkholes due to the nature of the rocks where karsts are commonly found. Delaware County has a mix of shale, sandstone, and carbonate rocks throughout. Limestone and dolomite cover 32% of the area and can be found up to 105 feet below the surface, shale covers 49% of the area and can be found up to 120 feet below the surface, and interbedded sandstone, shale, and limestone cover 17% of the area and can found up to 180 feet below the surface. Limestone and carbonate rocks are both soluble in water and are more likely to collapse when the water level within karst systems decline due to pumping and groundwater percolation.

According to an assessment of highly erodible land in Delaware County, the USDA National Resources Conservation Service reports several soils that are highly erodible or potentially highly erodible, including the Alexandria, Cardington, Loudonville, Milton, Morley, Ockley, and Rarden silt loam soils.

History

There have been several land subsidence events in Delaware County since January 1995. The three most recent events are listed below. A table containing all recorded erosion events can be found in **Appendix A.**

2021- In November DCOHSEM was approached by the City of Sunbury about the undercutting of Walnut St near McGill St by the Big Walnut Creek. The creek eroding under the roadway has made the area unstable to the point of closure.

2022- In March, ODOT reported an embankment collapse along a northbound lane of SR-315 near Woodland Hall Dr. A total road closure was put into effect on the day of discovery and a traffic detour was provided for one week.

2022- In May, a sinkhole appeared beneath Cheshire Rd. between Africa Rd. and Winter St. Cheshire Rd. was closed for three days while the sinkhole was repaired.

Probability

Landslides are rare in much of Ohio due to a lack of steep slopes and bedrock geology prone to failure, but there are a few areas that are home to conditions where landslides could occur. Areas prone to soil erosion are less than five percent in Delaware County and the lack of topography aids in the prevention and low probability of catastrophic erosion events. Predicting landslides is site-specific and data indicates that Delaware County is low risk for landslides.

From the data, there is a 37% chance of any land subsidence event occurring. The data contains 10 events from 1995 to 2022.

Vulnerability Analysis

<u>Infrastructure Impact</u>

Landslides can block or damage roadways and damage existing utility infrastructure. Mine and karst subsidence can occur under existing roadways or utility infrastructure causing anything from minor damage to complete destruction. Erosion can undercut or wash out roadways, destabilize foundations and utilities, or result in loss of farmland.

<u>Population Impact</u>

Landslides can cause injury or death if a person is struck by or trapped under falling earthen material. Mine and karst subsidence can cause sinkholes under occupied structures which could

lead to injuries. Erosion could compromise the structural integrity of buildings which may result in injury. Socially vulnerable populations are at a greater risk for this hazard because they can reside in higher numbers in lad which could be prone to land subsidence. Fortunately, those who are the most socially vulnerable, according to the National Risk Index, reside in areas where there is less land subsidence activity.

Erosion and subsidence are not listed in the National Risk Index, but landslide is listed as a very low risk hazard in Delaware County. In general, the Delaware County population is more resilient to these hazards because they are not severe in nature. The flat topography in Delaware aids in minimizing landslide risk.

Property Damage

Properties caught in the path of a landslide can be completely destroyed or severely damaged. Properties, including their structures, can be completely destroyed by mine and karst subsidence and erosion.

Loss of Life

Loss of life is possible during sudden karst or mine subsidence, landslides, or erosion, however, there are no known fatalities in Delaware County due to mine and karst subsidence, landslides, or erosion.

Economic Losses

Economic losses due to land subsidence can cause damage both by blocking transportation routes and casing damage to other infrastructure. Landslides, erosion, and mine & karst subsidence can block or destroy sections of roadways vital to shipping. Stores, storage facilities, and other structures that are important to economic activity can also be severely damaged or destroyed. It can also be quite expensive to repair sinkholes when they occur.

Climate Change

According to the Midwest National Climate Assessment, the likelihood of precipitation has increased nine percent, and the amount of rain falling during heavy precipitation events has increased by 30-percent on average since 1901-1960. Extreme precipitation could increase the likelihood of landslides in areas with steep slopes. Flooding caused by heavy precipitation could increase the rate of erosion along rivers and streams.

4.13.2 Land Use and Development Trends

Land use in areas of high karst or mine subsidence, landslides, or erosion are susceptible to damage. Since these areas have been or are known, uses that serve vulnerable populations, such as schools and hospitals, should not be placed in these areas. Development should be limited to areas with minimal slope to reduce potential losses during landslides.

Recently the City of Sunbury has applied for mitigation funding for stabilization of the bank of Big Walnut Creek near the intersection of Walnut St. and McGill St. This section of roadway has been eroded by the creek and not stable for first responder traffic or other traffic to travel. There are also homes along this section of creek, which could be in danger if the erosion continues. Development should also consider low-impact techniques to reduce the likelihood of erosion to underlying structures, like the creek wall in the City of Sunbury's case as well as location of developments which could put residents in areas where over larger time scales their homes could be at risk. Also reduce erosion by reducing runoff from precipitation and therefore reduce the risk of landslides or erosion.

4.13 Terrorism

Description

Terrorism is a deliberate act of violence used for political gain. Ever since the United States fell victim to the attack on the World Trade Center in September 2001, citizens, emergency responders, public officials and many more have grown more cautious and concerned about the prospect of their locale being subject to an act of terrorism. The impetus for terrorism can be, but are not limited to, political, religious, social, or environmental. The types of terrorism include cyberterrorism, agroterrorism, biological terrorism, chemical terrorism, and active aggressor. There is a growing concern within the country of biological, chemical, or cyber terrorism due to technological advancements in these areas. These types of terrorism and other complex/coordinated events are defined below:

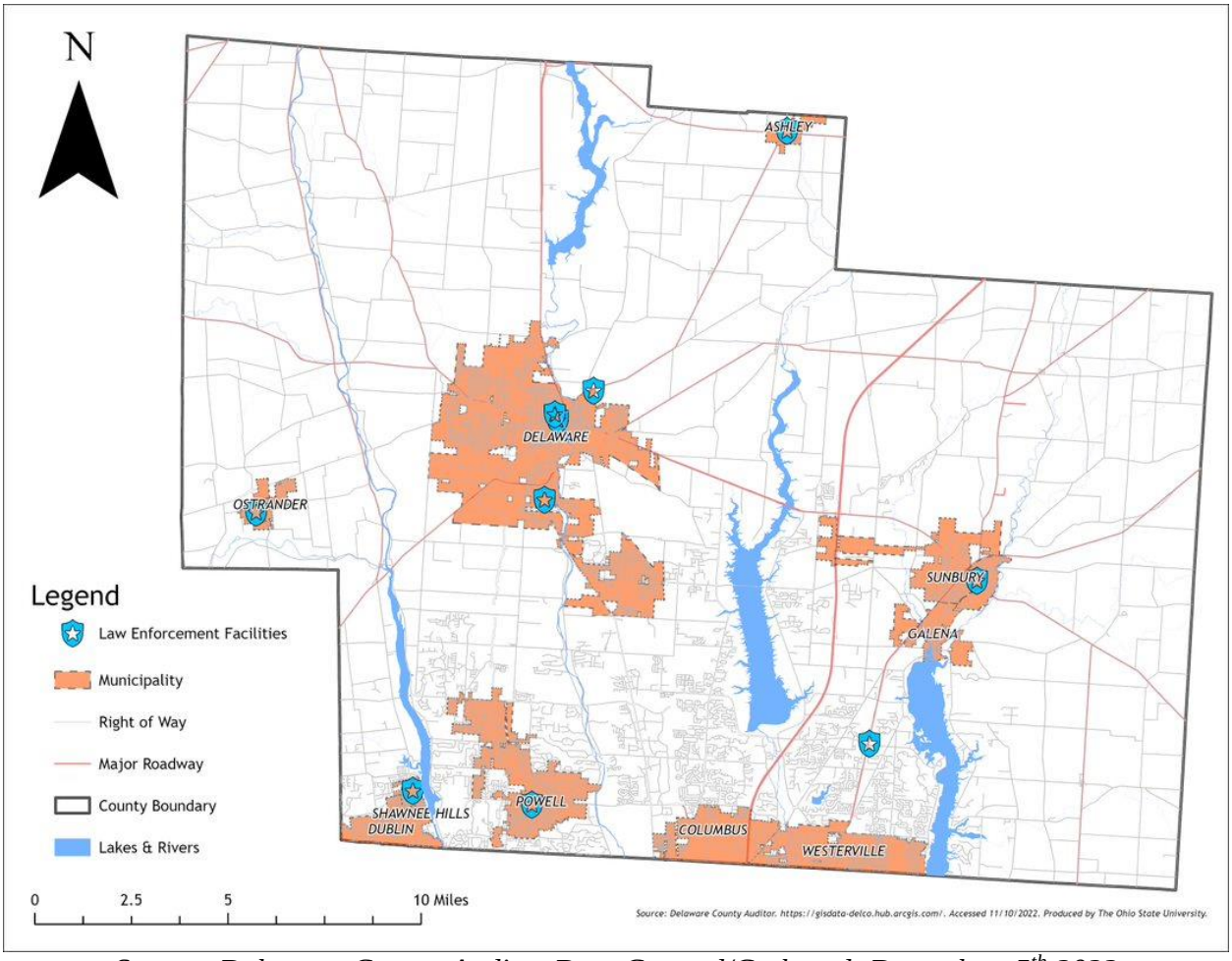
- Cyberterrorism: Cyberterrorism is an electronic attack using one computer system against another, and attacks can be directed towards computers, networks, or entire systems. A cyber-attack may last minutes to days. Homeland Security, the Federal Bureau of Investigation, and the Federal Communications Commission Department of Justice are often involved in developing countermeasures that focus on reducing the threat, vulnerability, and likelihood of attack. (This category is assessed separately in this Section in **Section 4.2 Cyber-Attack and Ransomware**.)
- Agroterrorism: Agroterrorism is a direct, generally covert contamination of food supplies or the introduction of pests and/or disease agents to crops and livestock. An agricultural-based terror attack can last days to months.
- Biological Terrorism: Biological terrorism includes use of bacteria, viruses, or toxins to incite terror. This mode of terrorism can last minutes to months.
- Chemical Terrorism: Chemical terrorism includes use of nerve agents, choking agents, blood agents, or blister agents to attack normal bodily functions of the nervous, respiratory, circulatory, and skin respectively. Usually, an act of chemical-based terror lasts only minutes.
- Active Aggressor: An active aggressor is an armed individual or group of individuals that is intending to cause harm or inflict terror on a civilian population. An active aggressor (or group) may be armed with guns, knives, bombs, or any other weapon/implement that may be used to inflict harm.

This hazard was ranked 11th highest out of the 15 hazards that were analyzed in this study.

Location

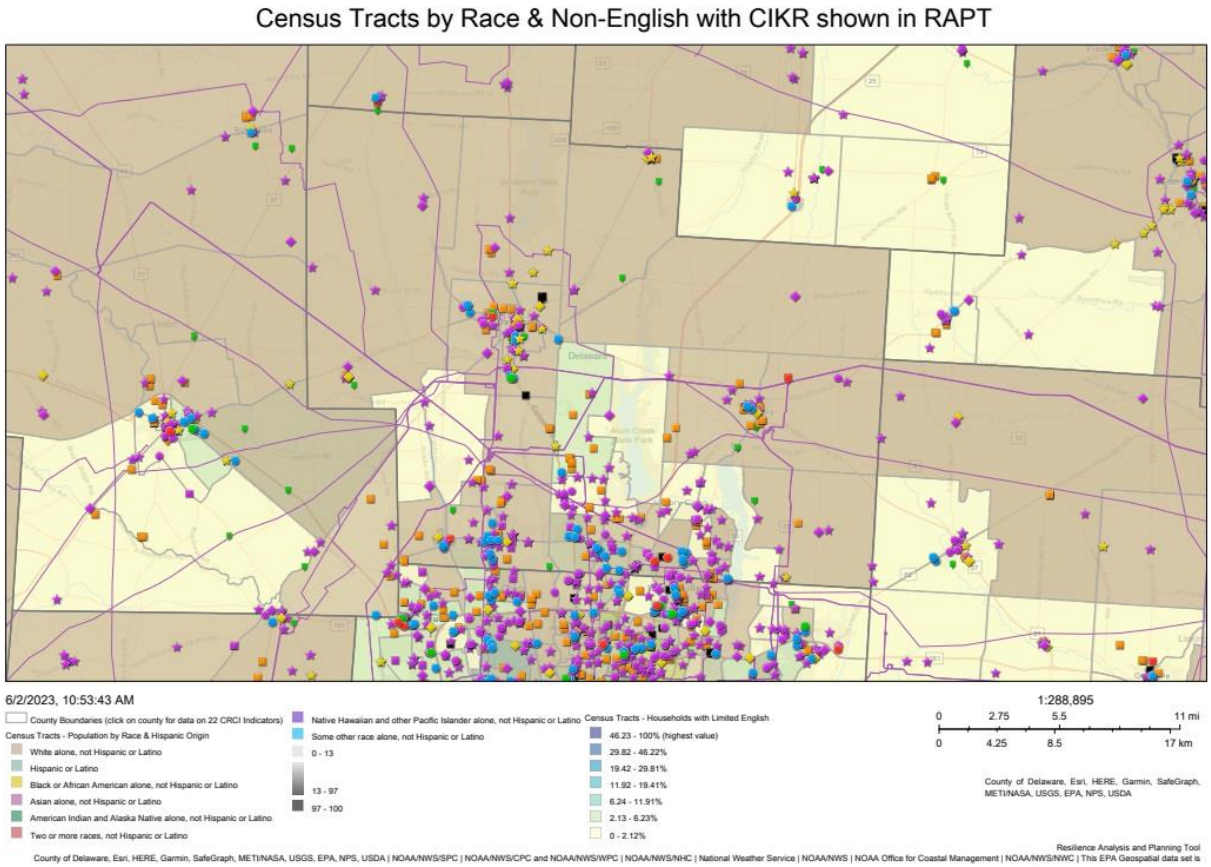
Like many man-made hazards, the geographic location of areas vulnerable to terrorism varies although it is based around highly visible and heavily occupied structures. Firstly, the critical infrastructure is subject to great threat because their disruption or destruction can result in massive economic, social, and environmental consequences. Secondly, there are critical points of interest in Delaware County that might incite an attack due to their nature. **Figure 65** shows the locations of law enforcement facilities in the County and the FEMA RAPT map shows the locations of critical infrastructure facilitates and the locations of key resources such as churches and socially vulnerable populations who could be subject to terrorist actions.

Figure 65 *Map of Delaware County Law Enforcement*



Source: Delaware County Auditor Date Created/Gathered: December 5th 2022

Figure 66 Census Tracts by Race & Non-English Speaker with CIKR shown in RAPT



Source: FEMA RAPT Date Created/Gathered: May 31st, 2023

Extent

The extent of each of these terrorism events includes:

- Cyberterrorism: Typically, the built environment is unaffected by a cyber-attack. Inadequate security can facilitate access to critical computer systems allowing them to be used to conduct attacks. Though the infrastructure may not be destroyed, it may be made to malfunction, causing additional hazards. Cyberterrorism may also include online wire fraud, which is often targeted to the elderly. This abusive practice often extorts the elderly and results in economic losses.
- Agroterrorism: Agroterrorism is a viable primary aspiration for terrorists, as agriculture is the largest single sector in the US economy. It lacks the traditional shock factor of attacks, but its extent could be large and longer lasting. The extent of the effects varies by type of incident. Inadequate security can facilitate the adulteration of food and introduction of pests and disease agents to crops and livestock resulting in animal suffering, loss of valuable animals, cost of containment of outbreaks, and loss of trade and other economic effects.
- Biological Terrorism: A biological attack could cause illness and even kill hundreds of thousands of people, overwhelm public health capabilities, and create significant

economic, societal, and political consequences. Public health infrastructure must be prepared to prevent illness and injury that would result from biological terrorism.

- Chemical Terrorism: Many chemical agents are capable of causing serious injuries or death, and their often-rapid course of action means there is very little time to act when an act of chemical terrorism occurs. Public health infrastructure must be prepared to prevent illness and injury that would result from chemical terrorism. Terrorism events that are caused due to chemicals impact the environment as well. Impacts can be large and felt by the environment in several different ways such as altering the quality of air and water, affecting sewage and wastewater systems, and displacing aquatic ecosystems and soils that sustain wildlife
- Active Aggressor: Active aggressor incidents often occur in areas where several people gather regularly. This may be a place of employment, a neighborhood gathering area (church, recreational center, etc.), or other locations.

History

Even though Delaware County has not witnessed a significant terrorist event in its history, it is irrefutable that the successful attacks on the World Trade Center on September 11, 2001, altered the United States' perspectives about terrorism and the likelihood of an attack within its borders. There have been several events within the past decade in which potential terrorist incidents almost occurred or did occur involving Ohio residents. The four most recent cases of terrorism involving Ohio residents have been listed below:

2016- On February 2016, a Somali man attacked patrons in the Nazareth Mediterranean Cuisine restaurant located in the City of Columbus with a machete, wounding four patrons. At the time, FBI agents said there was no indication that the man was working with anyone or being directed by someone. But that he had been on a watch list for "espousing extremist views." This appeared to be a "lone-wolf" terrorist attack.

2016- A man from the Northeast Side of Columbus was arrested at John Glenn Columbus International Airport after it was found that he provided material support to a foreign terrorist group. Federal agents said he intended to fly to Libya to fight for the Islamic State. He also sent $250 to a known intermediary of ISIS recruiter in January, according to an indictment in United States District Court in Columbus.

2016- On November 28th, a terrorist vehicle-ramming and stabbing attack occurred at 9:52 a.m. EST at Ohio State University's Watts Hall in the City of Columbus in Franklin County. The attacker, a Somali refugee, was shot and killed by the first responding OSU police officer, and 13 people were hospitalized for injuries. The assailant rammed his car into a group of people on the Columbus campus and then got out and charged at passersby with a knife. The attack appeared to be inspired by terrorist propaganda from ISIS and is considered as "lone-wolf" terrorism.

2022- A man from the City of Columbus and two other men pleaded guilty to crimes related to conspiring to attack power grids throughout the United States in furtherance of racially or ethnically motivated violent extremism advocating for the supremacy of the white race. In February 2020, two of them met in the City of Columbus in Franklin County to further discuss their plot. Upon arriving in the City of Columbus, they purchased spray paint and painted a

swastika flag under a bridge at a park with the caption, "Join the Front." They had additional propaganda plans for their time in Ohio, but they were derailed during a traffic stop, during which one of them swallowed his suicide pill but ultimately survived.

Probability

Terrorism-related events have a low probability and are not predictable. The nature of a terrorist attack would determine the magnitude of the incident, and like other human-made hazards, it is difficult to quantify a probability.

Vulnerability Analysis

Infrastructure Impact

Above ground structures such as utility systems, government buildings, churches, libraries, and schools, as well as below-ground infrastructure such as natural gas pipelines, are at risk for terrorism damage. Acts of cyberterrorism have the potential to target systems that may influence or control infrastructure.

Population Impact

The population of Delaware County is likely to be impacted should an act of terror occur. Places within Delaware County that could face the greatest population impact due to terrorist attacks are the Columbus Zoo and Aquarium which attracts thousands of people. The zoo, which spans 582 acres, is home to over 10,000 animals and sees more than 2 million visitors annually. The Polaris Mall sees upwards of 8 million people yearly, with daily and seasonal attendance varying greatly, meaning a daily average of nearly 22,000 visitors. Delaware County also hosts a variety of community events and festivals which could become targets, for example the Delaware County Fair, and First Friday in the City of Delaware. Should any of those locations be attacked, there could be countless lives lost and many injuries.

Terrorism is not in the National Risk Index as it is not a natural disaster. All residents are at risk of interruptions to their daily life should there be a terrorist attack; however, some socially vulnerable populations may be specifically targeted for terrorist attacks.

Property Damage

Since coordinated incidents can occur anywhere within Delaware County, property damage is a possible outcome of such an event. Agroterrorism may result in damage to crops, and an active aggressor situation may result in minimal property damage.

Loss of Life

Acts of terror are likely to result in loss of life and cause long-term impact to health. It is important that public health and healthcare organizations are prepared to act quickly should an act of terror occur.

Economic Losses

Since the probability of a coordinated attack happening in Delaware County is low, local terrorism-related economic losses are estimated at zero. However, terror attacks occurring in other locations have the potential to have economic impacts in Delaware County. A 2016 nationwide estimate indicates that a cyber-attack may cost the U.S. economy between $57 billion and $109 billion.

Transportation networks, such as air transportation, can be shut down as a result of terrorism impeding profits and resulting in economic losses to organizations within Delaware County. Any nationwide complex/coordinated attack or act of terror that results in a temporary freeze of goods or services has the potential to limit or suspend economic activity in Delaware County as well.

Climate Change

Any act of terrorism such as agroterrorism, biological terrorism or chemical terrorism could have adverse effects on the environment and local ecosystem. Security concerns linked to climate change include impacts on food, water and energy supplies, increased competition over natural resources, loss of livelihoods, climate-related disasters, and forced migration and displacement.

Land Use and Development Trends

Terrorism-related events can occur anywhere. Non-residential land uses are more likely to be targeted for terror events or active shooters. Schools and government buildings should have active shooter plans in place. Farmers must be prepared for agroterrorism by locking certain areas of their farms or using cameras to monitor who is on their fields.

Increased development across the county will increase the number of potential targets as population increases. The increases of infrastructure, commercial facilities, festivals, community events and other events as the population increases will increase more potential targets. Also, many parts of Delaware County have increased in diversity from 2010 to 2020 per the 2020 U.S. Census. This increase in diversity could also increase the socially vulnerable groups which could be the targets of terrorist actions.

4.14 Tornadoes

Description

Tornadoes are rotating columns of air marked by a funnel-shaped downward extension of a cumulonimbus cloud whirling at destructive speeds of up to 300 mph, usually accompanying a thunderstorm. Tornado damage paths can be more than one mile wide and 50 miles long. Tornadoes are the most violent of all atmospheric storms and are capable of tremendous destruction; they can have the same pressure differential that fuels 300-mile-wide hurricanes across a path less than 300 yards wide. Funnel clouds, which are rotating columns of air and condensed water droplets that do not contact the ground, are also associated with tornadoes.

Tornadoes have been known to lift and move heavy objects, including homes, and can siphon water from water bodies. Tornadoes also generate a tremendous amount of flying debris or "missiles," which often become airborne shrapnel that causes additional damage. If wind speeds are high enough, missiles can be thrown at a building with enough force to penetrate windows, roofs, and walls.

Tornadoes are most common in the central plains of North America, east of the Rocky Mountains and west of the Appalachian Mountains. They occur primarily during the spring and summer – the tornado season comes early in the south and later in the north according to seasonal changes in relation to latitude – usually during the late afternoon and early evening. In the right conditions, tornadoes have occurred in every state in the United States and every continent on the earth, any day of the year, and at any hour.

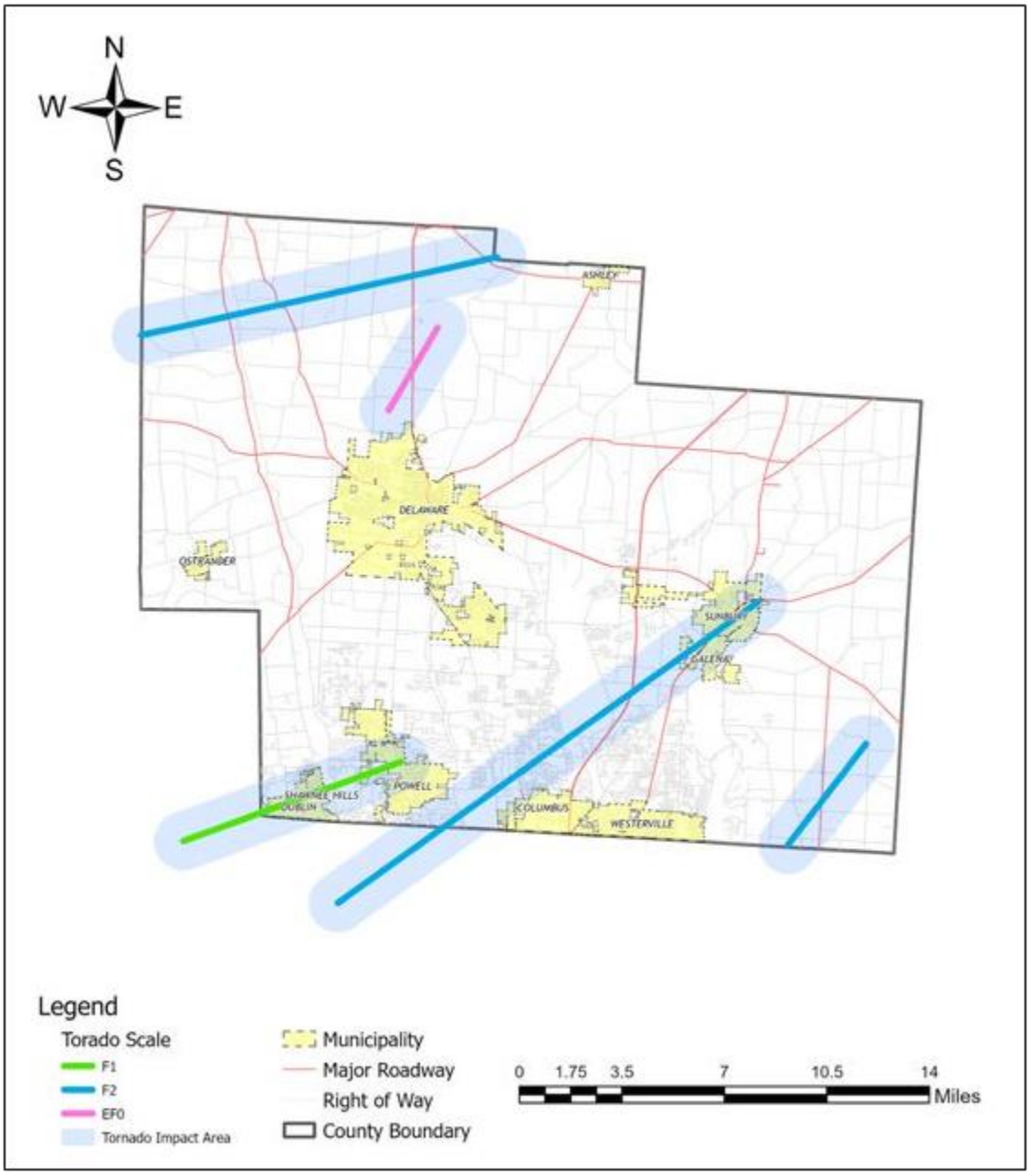
Tornado warnings are issued when a tornado is indicated by the WSR-88D radar or sighted in person. The WSR-88D radar is an advanced Weather Surveillance Doppler Radar utilized by the National Weather Service (NWS) to generate a radar image. Warnings will include the location of the tornado as well as potential communities in its path. A tornado warning can be issued without a tornado watch and are typically issues for 30 minutes at a time. Once a warning has been issued, people in the warning area should seek shelter immediately. The National Weather Service Forecast Office in Wilmington, Ohio is responsible for issuing Tornado Watches/Warnings and Wind Advisories to Delaware County.

Tornadoes were ranked 8th out of the 15 hazards that were analyzed in this study.

Location

Since tornadoes are highly unpredictable, all areas of the county are vulnerable to a tornado. Since tornadoes can occur anywhere in the county, any future development will have to be made with this hazard in mind. Mobile home parks, campgrounds, or any other infrastructure without a secure foundation or basement will always be more vulnerable to this hazard. Although a tornado can occur at any time, a majority of tornadoes affecting Delaware County have either been in the early summer months (April, May) or the late summer months (August, September). **Figure 67** shows five of the eleven tornadoes that occurred in Delaware County since 1950. Only five tornadoes have been mapped due to limited geographic coordinate data.

Figure 67 *Historic Tornado Paths*



Source: Delaware County Auditor Date Created/Gathered: December 5th 2022

Extent

Tornadoes are classified according to the Enhanced Fujita tornado intensity scale. Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita (EF) scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis, and better correlation between damage and wind speed. It is also more precise because it considers the materials

affected and the construction of structures damaged by a tornado. The Enhanced Fujita Scale ranges from low-intensity EF0 with effective wind speeds of 65 to 85 miles per hour, to EF5 tornadoes with effective wind speeds of over 200 miles per hour. The Enhanced Fujita intensity scale is included in **Figure 68** below.

Figure 68 *Enhanced Fujita Scale Description and Fujita Scale*

Enhanced Fujita Scale			
Rating	**Description**	**Wind Speed**	**Damages to Expect**
EF0	Gale tornado	65-85 mph	Light Damage: Some damage to chimneys; break branches off trees; push over shallow rooted trees; damage to signboards
EF1	Moderate tornado	86-110 mph	Moderate Damage: Surface peeled off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off roads
EF2	Significant tornado	111-135 mph	Considerable Damage: Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	Severe tornado	136-165 mph	Severe Damage: Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; cars lifted off ground and thrown
EF4	Devastating tornado	166-200 mph	Devastating Damage: Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated
EF5	Incredible tornado	>200 mph	Incredible Damage: Strong frame houses lifted off foundations and carried considerable distance

Source: OHIO EMA Date Created/Gathered: December 5th 2022

Fujita Tornado Damage Scale		
Rating	**Wind Estimate (MPH)**	**Typical Damage**
F0	< 73	Light damage. Some damage to chimneys; branches broken off trees; shallow-rooted trees pushed over; sign boards damaged.
F1	73-112	Moderate damage. Peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos blown off roads.
F2	113-157	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars overturned; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
F3	158-206	Severe damage. Roofs and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown
F4	207-260	Devastating damage. Well-constructed houses leveled; structures with weak foundations blown away some distance; cars thrown and large missiles generated.

F5	261-318	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 meters (109 yds.); trees debarked; incredible phenomena will occur

Source: NOAA, Date Created/Gathered March 6, 2023

History

Although Delaware County and its encompassing jurisdictions do not experience tornadoes as frequently as other regions of the Midwest, the potential devastation suggests the need for consideration within this Plan. The three most recent & impactful tornadoes are recorded below. A complete list of hazard events can be found in **Appendix A**.

1965- On April 11th, 1965, the county experienced an F2 tornado at 10:30 pm reaching across the northern part of county across the top of the Delaware Lake (12.3 miles) resulting in four fatalities and 62 injuries. It has been nicknamed the "Palm Sunday tornado".

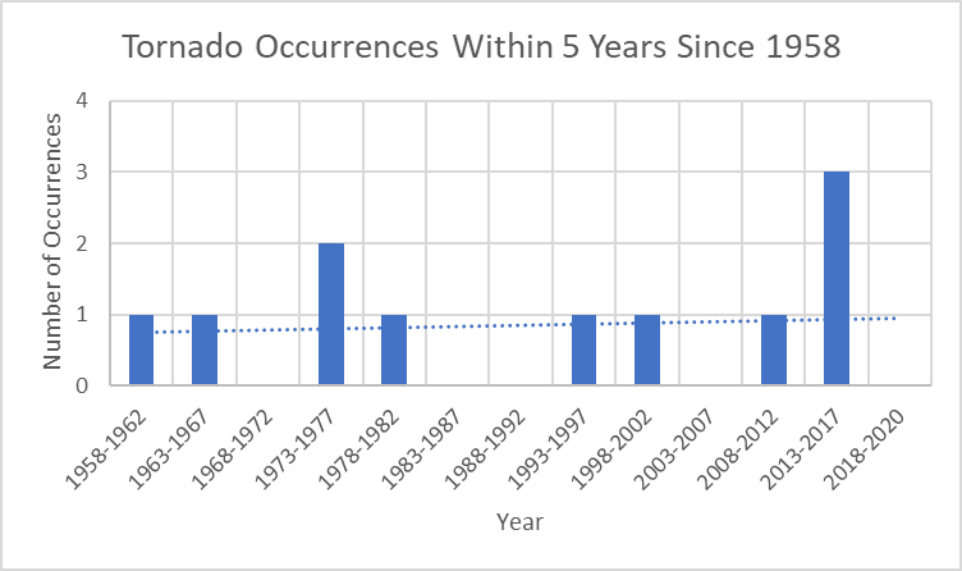
1974- On April 4th, 1974, the county experienced an F2 tornado which appeared to be a part of the Super Outbreak of 1973. The tornado caused damage to a mobile home park in the extreme southeastern corner of Delaware County and also affected Madison and Franklin counties.

2000- On September 20th, 2000, the county experienced an F2 tornado in Harlem Township at 6:31 pm with no fatalities and two injuries. Two high tension power line towers were damaged, and 14 houses were either damaged or destroyed.

Probability

According to the National Centers for Environmental Information (NCEI), Delaware County has recorded eleven tornadoes since 1958. There is a 15.3% probability that a tornado will occur within the county each year. **Figure 66** shows the trend in number of tornado events since 1958. In recorded data, Delaware County has not experienced more than one tornado per year. Therefore, tornado occurrences have been grouped in five years to measure tornado frequency. Trends suggest a very slight increase in tornado frequency since 1958.

Figure 69 *Tornado Frequency in five-year intervals from 1958 - 2022*



Source: NCEI Date Created/Gathered: December 5th 2022

Vulnerability Analysis

Infrastructure Impact

Above-ground infrastructure can be damaged by high winds and tornadoes. Debris caught in the high winds as well as fallen trees can also cause damage to buildings and infrastructure including road closure. Above ground utility infrastructure can be damaged or destroyed, which can cause service outages.

Population Impact

Tornadoes are random in nature and have the potential to occur anywhere in the county. Everyone within the county should be prepared for a tornado and high wind events. Socially vulnerable populations are at higher risk during these events, an example is residents in mobile home parks are particularly vulnerable and should have a plan in place. High wind events are widespread and may impact the entire county.

According to the National Risk Index, tornadoes have a 3.87% chance of occurring in Delaware County each year. The index also indicates 26.87% of expected annual losses to come from tornadoes. Tornadoes in the county experience very low historic loss ratios due to the county's history of weaker tornadoes rated EF-2 or lower.

Property Damage

Tornado damage can range from minor damage to complete destruction of properties. Regarding the environment, a tornado can do minor damage to a local ecosystem or potentially cause the

release of hazardous materials from residences and non-residences which could potentially contaminate sites and water sources.

Loss of Life

Due to the widespread nature of high wind events and the short warning time for tornadoes, the potential for loss of life exists. People located near large trees, in mobile/manufactured homes, or exposed directly to the elements may be at a higher risk for injury or loss of life.

Economic Losses

Tornadoes can cause major damage to structures and roads. Higher severity tornadoes have the potential to destroy structures. Debris also has the potential to cause damage to structures by breaking windows, damaging walls, or falling directly onto buildings and above-ground infrastructure. Damaged utilities and roadways may also have economic effects due to business closures, destruction of goods that require electricity, and halting the transportation of goods.

Figure 70 represents a worst-case scenario tornado situation in one of the most populous regions of Delaware County (Census Tracts 101, 102, 104.21, 104.22, 105.2, 105.3, and 122). This estimate was modeled after a real event, a 400-yard-wide F2 tornado that traveled 12.3 miles within the county, that was scaled up to an EF5.

***Figure 70** Economic Damage from EF 5 Tornado in Delaware County*

Cost if all buildings in affected area are destroyed	
Residential	$ 162,684,664.01
Agricultural	$ 2,612,842
Industrial	$ 3,044,638
Commercial	$ 16,413,902
Mineral	$ 292
Total Cost	$ 184,756,341

Source: OHIO EMA Date Created/Gathered: December 5th 2022

Climate Change

According to the Fourth National Climate Assessment, severe storms are brief and cover small areas, thus the effects of climate change are difficult to measure. It is known that tornado activity has become more variable, with a decrease in the number of days per year with tornados but an increase in the number of tornadoes that occur on these days. In general, there is some indication that the frequency and intensity of thunderstorms will increase in a warmer climate. However, the effect on tornadoes is unclear.

Land Use and Development Trends

Tornadoes can occur anywhere and are common in western Ohio. Tornadoes may happen at any time of the year, though they statistically are more common in spring and autumn. Any development that has occurred since the previous plan and any future development has the potential to be impacted by tornadoes.

The increasing growth in Delaware County should consider the possibility of tornados whenever possible. This could be with planning for tornado shelters, structures with shelters inside to and distribution of warning and notification methods for new resident populations.

4.15 Utility Failure

Description

Utility failure refers to the loss of electric power (blackouts), sewage, natural gas, internet, or other utilities. These events can be caused by system overload, damage, or outdated infrastructure but can also be caused by a deliberate act of civil disturbance or terrorism. Power failures are also caused by natural events such as severe storms, blizzards, tornadoes, and high winds. Due to the nature of storms, power failures can be unpredictable yet common; however, updates to infrastructure can reduce the amount and frequency of outages.

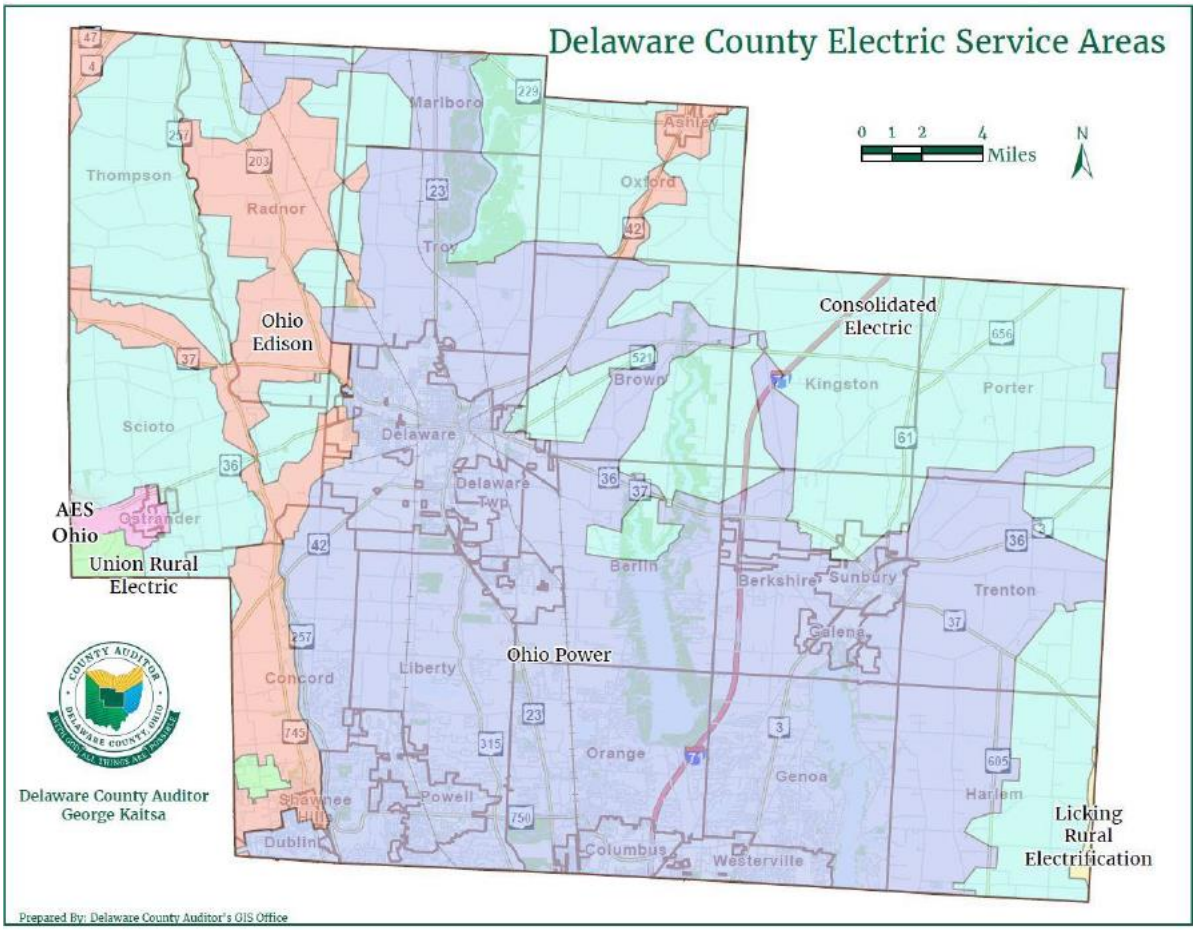
Utility failure is ranked as the 3rd priority hazard out of the 15 hazards that were analyzed in this study.

According to Ohio Administrative Code: 4901: 1-10-7, "outage" means an interruption of service to:

1. One thousand, two hundred fifty customers (1,250) in an area for a projected or actual period of two hours or more.
2. Six hundred twenty-five customers (625) in an area for a projected or actual period of eight hours or more.
3. One hundred or more customers (100+) in an area for a projected or actual period of twenty-four hours or more.
4. A facility of any telephone company, electric light company, natural gas company, water-works company, or a sewage disposal system company, including a company that is operated not-for-profit, or owned or operated by a municipal corporation, when an interruption to that facility for a projected period of four hours or more, affects or will affect public safety.
5. Any police department, fire department, hospital, or countywide 9-1-1 system, for a projected period of four hours or more.

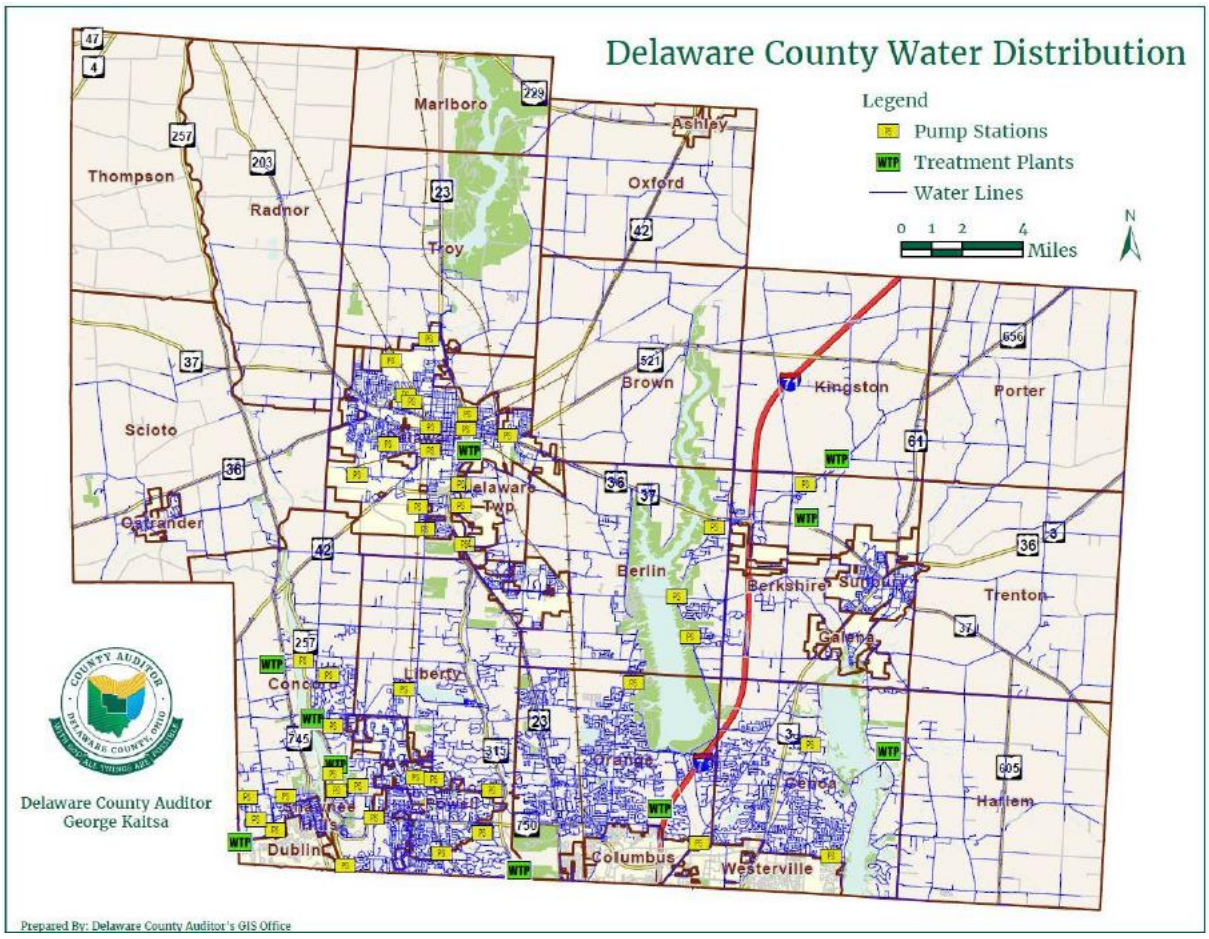
Delaware County residents receive natural gas services from Columbia Gas of Ohio, Consolidated Gas, and Suburban Natural Gas Company. **Figure 71** shows the electrical coverage in Delaware County. As of 2018, electric services in Delaware County are provided by Ohio Edison, Consolidated Electric, AES Ohio, Licking Rural Electrification, and Ohio Power. **Figure 72** shows the water distribution across Delaware County, including pump stations, treatment plants, and water lines. Water is provided by the DelCo Water Company as well as wells on private property. Sewer services are provided by Delaware County and many residential areas also have septic systems.

Figure 71 *Delaware County Electric Service Areas*



Source: Delaware County Auditor (2019) Date Created/Gathered: December 5th 2022

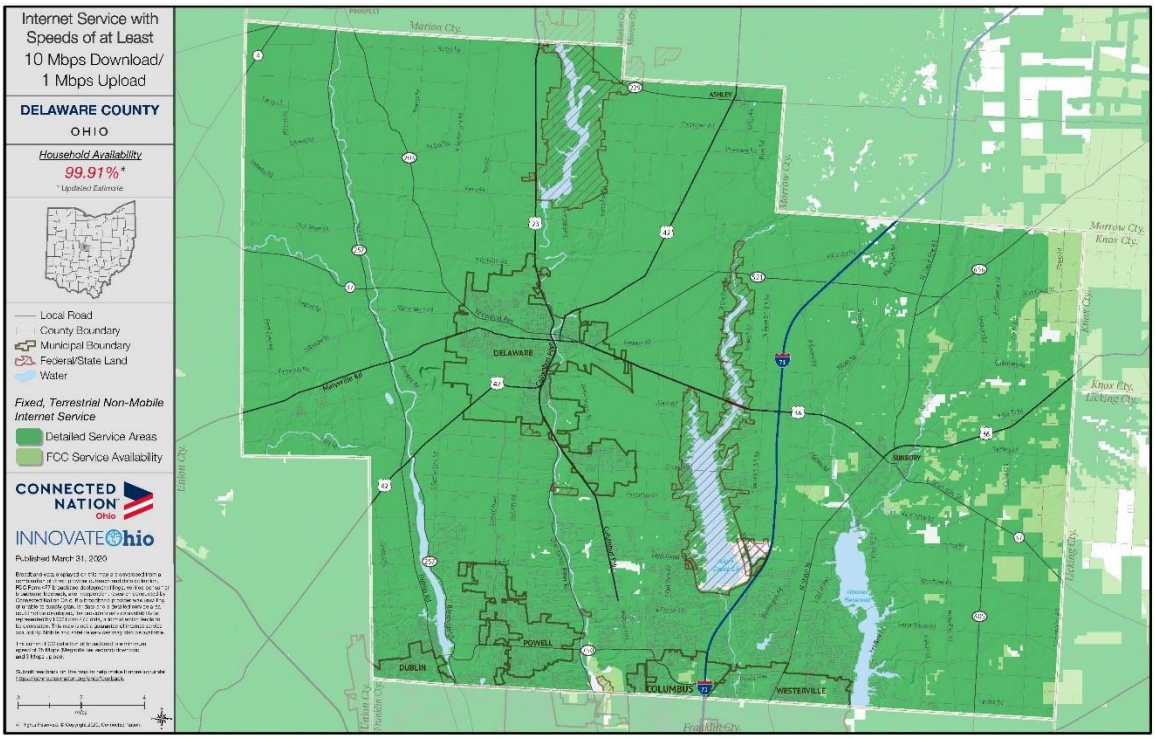
Figure 72 *Delaware County Water Distribution*



Source: Delaware County Auditor (2019) Date Created/Gathered: December 5th 2022

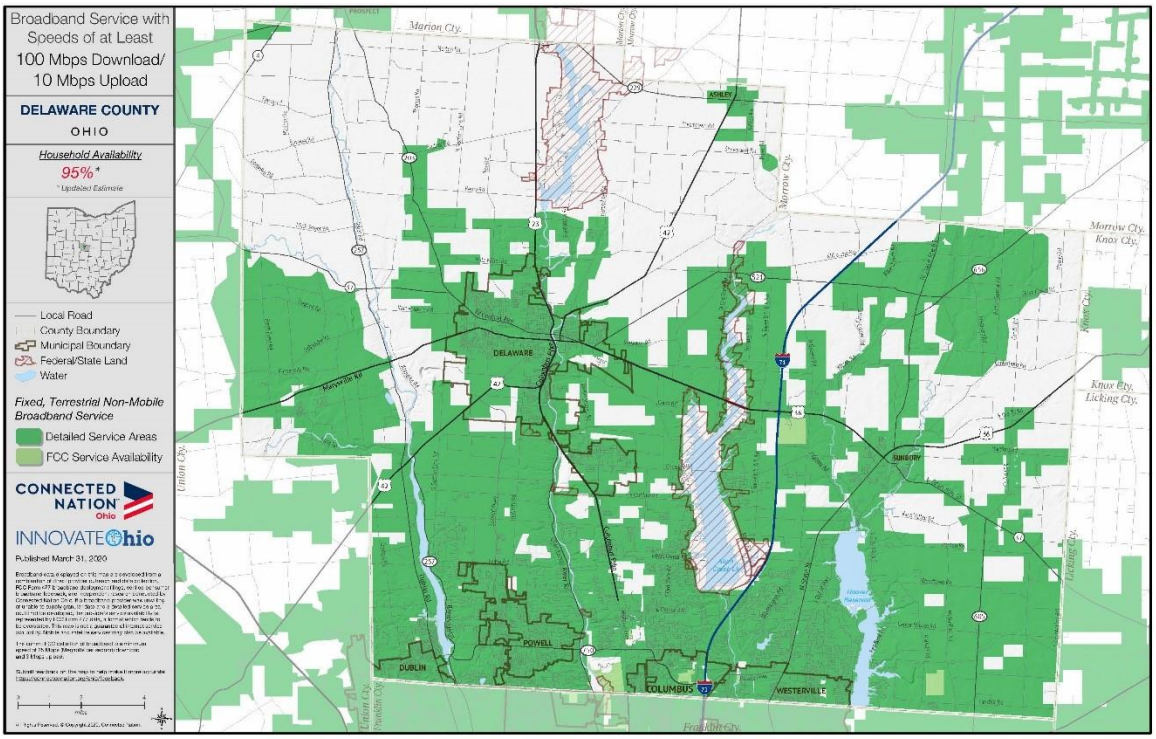
Residents may also select from one of several internet providers depending on their location within Delaware County, including Spectrum, Century Link, and Frontier Communications. **Figure 73** and **Figure 74**, below, show the internet coverage in Delaware County. According to the images and data provided by Connected Nation Ohio, 99.91% of Delaware County has access to internet service with speeds of at least 10 Mbps download and 1 Mbps upload. Similarly, 95% of Delaware County has broadband service with speeds of at least 100 Mbps download and 10 Mbps upload.

Figure 73 *Internet Service with Speeds of at Least 10 Mbps Download/ 1 Mbps Upload*



Source: Connected Nation Ohio Date Created/Gathered: December 5th 2022

Figure 74 *Internet Service with Speeds of at Least 100 Mbps Download/10 Mbps Upload*



Source: Connected Nation Ohio Date Created/Gathered: December 5th 2022

Location

Depending on the cause, blackouts can be isolated events or countywide. Utility failures can occur in any area where the utility is provided.

Extent

Utility failures due to damaged infrastructure have the potential to impact large areas of the county, particularly when utilities affected are one that provide necessary services for the population. Loss of electricity or gas can affect household temperatures, which can lead to severe dehydration, heat exhaustion, hypothermia or loss of life if outdoor temperatures are extremely high or low. Utility failure affecting water and sewer services could lead to contamination of the water supply.

During larger events such as epidemic/pandemic, as seen with the COVID-19 pandemic, lack of utility/internet access can result in the inability to perform work duties remotely. This could have economic consequences at the individual, family, and large scales.

History

There have been 77 recorded utility failures in Delaware County from July 2003 through May 2021. The cause of these outrages varies from transmission interruption to severe weather. None

of the outrages have been caused by a deliberate act of terrorism or civil disruption. The three most recent & disruptive events are below. A table containing all recorded utility failures can be found in **Appendix A.**

2018 - On May 31st, 2018, a storm moved through Ohio at 3 a.m. and caused 2085 outages for American Electric Power (AEP) customers in Delaware due to a tree falling on three phase lines. Outages were restored by noon of May 31, 2018.

2018 - On July 2nd, 2018, a severe thunderstorm developed around 2 p.m. and moved through Franklin County and Delaware County. Additional storms followed within the state. The storms caused trees and wires to be down around the area. Around 11,244 AEP customers were affected by outages and were completely restored by 3:30 p.m. the next day July 3rd, 2018.

2018 - On October 19th-22nd, 2018, a severe windstorm caused power outages for around 23,000 customers of AEP. High winds with gusts exceeding 60 mph, took down poles, trees, and powerlines. The majority of outages were restored by Monday the 22nd, 2018.

Probability

Due to the unpredictable nature of when a utility failure will occur, it is difficult to quantify the likelihood of such an event. Utility failures in the form of power outages may occur at any given point in the year due to severe winter and summer weather, tornadoes, and other natural hazards. The probability of these natural hazards can be found in their respective sections.

Vulnerability Analysis

Infrastructure Impact

Fallen power lines may cause road closures. Loss of electricity at major intersections could increase the chance of automotive accidents and can cause loss of emergency functions, for example hospital carrying capacities. With many objects and structures depending on the Internet of Things (IoT) to continue operation, the loss of electrical, internet and water supply could shut down whole areas of infrastructure and cause permanent damage if the utility outage was prolonged. Utility infrastructure may suffer long-term damage as a result of an extreme weather event which could cause a prolonged outage long enough to cause this cascade of failures.

Population Impact

Loss of electricity could have widespread effects on the health and safety of the public. During extreme temperature events, the impacts on residents are heightened. Loss of utilities that provide temperature control can create a safety hazard, particularly for socially vulnerable population, for example children or elderly populations.

Utility failure is not in the National Risk Index because utility failure is not a natural hazard. However, utility failure is a probable outcome of natural hazards and therefore the public is at

risk of damage. Communities with subterranean utilities are more resilient to utility failure. Utility failure may affect socially vulnerable populations, particularly in the event of an electrical outage, during which food may spoil, heating and cooling systems cannot function, or medical equipment could fail.

Property Damage

Direct damage to property and fire may result from fallen power lines. Damage could also occur to equipment connected to the Internet of Things who are no longer receiving the information or power they need to function properly.

Loss of Life

Loss of electricity for extended periods can cause loss of life. Those who depend on electricity for medical treatment are at risk. Hospitals, nursing homes, and other critical facilities should be prepared to manage medically sensitive populations in the event of a utility failure both in their own facilities and if their facility needs to be evacuated or receive aid. Also, exposure to fallen power lines can also lead to electrical shock and loss of life.

Economic Losses

Economic losses can occur from reduced commercial activity as a result of utility failure. Goods that need electricity or other utilities for preservation may also be lost. In the event of a widespread blackout, people may not be able to work, and wages may be lost as a result. Potential impacts from various utility failure extent are in Delaware County are recorded in **Figure 75.**

Figure 75 *Structural Vulnerability from Utility Failure*

Structure Type	Number of Structures in Delaware County	20% Outage Scenario
Residential	53,779	10,756
Non-Residential	7,671	1,534
Critical Facilities	401	80
Total	61,851	12,730

Source: DCOHSEM Date Created/Gathered: December 5th 2022

Climate Change

Climate change can increase the likelihood of natural disasters. Increased frequency and intensity of severe summer and winter storms, flooding, and tornadoes can result in an increased

frequency of damaged utility infrastructure. During drought, extreme cold, or extreme heat events, increased use of heating or cooling resources may overload utility infrastructure.

Land Use and Development Trends

Utility failure can impact any development at any time. Future land use and development trends should consider more resilient infrastructure or back-up strategies to reduce the impact of utility failure.

The increasing development in Delaware County also puts increased pressure on the utilities systems which are already in place. Development of these systems or updating may become necessary as Delaware County's population increases.

5. Hazard Mitigation Goals, Objectives, Actions

5.1 Hazard Mitigation Strategy

To determine the most threatening natural and man-made hazards for Delaware County, the stakeholders underwent a thorough ranking system. Additional variables were taken into consideration to determine the hazard priority for Delaware County. The various variables were weighted and rated on a scale of 1 to 5.

To determine the probability of a severe natural hazard, the number of historical severe events were divided by the length of the data collection period (since 1950 or 68 years) in order to determine the probability percentage. An event was deemed significant if it was within the Ohio EMA's State of Ohio Disaster History document of presidential disaster declarations or if it was listed in the NOAA disaster database as causing any injuries, death or property damages of over $5,000.

Due to the varying nature of the hazards and the conditions in which they occur, ad-hoc estimation based on personal experience and review of the threat analyses in this plan was used to score potential population sizes affected under each hazard.

Participants in the public/stakeholder meetings engaged in the ranking process, utilizing their own intuition to quantify their perception of Delaware County's vulnerability to each individual hazard. All scores were combined, and the average was used, in addition to the other variables, in calculating the priority scores. **Figure 76** shows the results of the scores and lists the hazards from its highest weighted score, or those which threaten Delaware County the most to the lowest weighted score or hazards which threaten Delaware County the least. The information used to develop the priorities can be found in the Matrix Score Spreadsheet in **Appendix B.**

Figure 76 *Hazard Priority Scores*

Hazard	Priority Score	Rank
Severe Winter Events	4.3951	1
Pandemic and Serious Illness	4.0167	2
Utility Failure	3.2762	3
Droughts	3.1828	4
Severe Summer Weather and Extreme Heat	3.1444	5
Floods	2.8049	6
Civil Disturbance	2.6508	7
Tornadoes	2.6243	8
Cyber-Attack and Ransomware	2.3095	9
Dam Failure	2.0487	10
Terrorism	1.9449	11
Land Subsidence	1.7834	12
HAZMAT Incident	1.7141	13
Invasive Species	1.6877	14
Earthquakes	0.9979	15

Source: DCOHSEM Date Created/Gathered: December 5th 2022

In addition to the scoring by the stakeholders and the public, the other variables used to calculate the overall score and ranking included. The formula used to calculate with these variables is below. For information on the formula can be found in **Appendix D Section 5**.

Formula:
(P *0.118) + (PS*0.118) + (S*0.168) + (D*0.098) + (C*0.098) + (Prep *0.078) + (Raw*0.322) = Hazard Score

Probability: The probability of occurrence of a hazard in the County. The average occurrence of each hazard per year was found and was turned into a percentage to determine what rating would be assigned on a 1-5 scale.

Severe Occurrence: That probability that the county would experience the event to a degree that it would warrant a presidential disaster declaration or any amount of property or crop damage, or injuries and/or loss of life. Events of an individual hazard were counted if they were listed on the presidential disaster declaration, caused $5000 or more dollars in damage, or directly caused any injury or death. The events were totaled for each hazard and then classified to determine its 1-5 scale rating.

Population Size: The geographic extent to which a populated area could be potentially affected by this hazard. Categorized according to Delaware County EMA stakeholders' experience and past history of hazard characteristics. The county was broken down by its 18 townships and used to determine how to what extent an individual hazard event would affect. That total was then valued on a 1-5 scale to regulate the score.

Preparedness: This was calculated by counting the number of exercises from 2010-2022 that were completed that included each hazard. Then a scale from 1-7 was used.

Cascade occurrence: This was calculated by counting the number of days that a hazard had an overlap with another hazard. Then a scale of 1-5 was used.

Duration: This is the measure of how long a hazard lasted in terms of days. The total was then valued on a 1-7 scale.

Figure 77 and Figure 78 shows how these variables were weighted in the scoring.

***Figure 77** Hazard Ranking Category Scale Part 1*

Hazard Ranking Category Scale									
Probability			Probability of Severe Occurrence			Cascade			Population Size (TWP)	
1	<1-2%		1	None		1	None		1	Localized: 1
2	2-10%		2	1-2		2	1-5		2	Limited: 2-5
3	10-50%		3	3-5		3	6-10		3	Critical: 5-10
4	50-100%		4	6-8		4	11-20		4	Excessive: 10-15
5	>100+%		5	9+		5	21+		5	Catastrophic: 15+

Source: DCOHSEM Date Created/Gathered: December 5th 2022

***Figure 78** Hazard Ranking Category Scale Part 2*

Preparedness Weight			Duration Weight	
1	<5		1	Day
2	5-10		2	2-3 Days
3	11-20		3	Week
4	21-30		4	Month
5	31-40		5	6-8 Month
6	41-50		6	Year
7	51+		7	Year+

Source: DCOHSEM Date Created/Gathered: December 5th 2022

Figure 79 explains how the weighting was determined by category.

Figure 79 *Hazard Prioritization Categories Weighting Determination*

Ranking Category	Definition	% of Score	How it was determined
Probability	The probability of occurrence of a hazard in the county	11.8	Varies according to each hazard. Most natural hazards are found using the NOAA storm events database or citable publications and personal accounts. For both natural and man-made hazards, the probability of an event per year that has been recorded is used to determine a percentage. The percentage was then valued on a 1-5 scale to regulate the score.
Probability of Severe Occurrence	That probability that the county would experience the event to a degree that it would warrant a presidential disaster declaration or $5000+ dollars of property or crop damage, or any injuries and/or loss of life	11.8	Varies according to each hazard. Most natural hazards found using the NOAA storm events database, and FEMA's presidential declaration database. Counts all events of the hazard that is included on the presidential declaration list for the county and any events that directly caused $5000 or more of damage, or any injuries recorded. The total was then valued on a 1-5 scale to regulate the score.
Population Size	The geographic extent to which a populated area could be potentially affected by this hazard	16.8	Categorized according to Delaware County EMA stakeholders' experience and history of hazard characteristics. The county was broken down by its 18 townships and used to determine how many could be on average affected by an individual hazard event. That total was then valued on a 1-5 scale to regulate the score.
Duration	This is the measure of how long a hazard lasted in terms of days	9.8	Determined by looking at the historical data of hazards and how long they lasted.
Cascade	This was calculated by counting the number of days that a hazard had an overlap with another hazard	9.8	Determined by looking at the number of times hazards overlap with each other.

Ranking Category	Definition	% of Score	How it was determined
Preparedness	This was calculated by counting the number of exercises from 2010-2022 that were completed that included each hazard	7.8	Determined by taking into consideration the number of preparedness exercises completed for each hazard.
Raw Scores	The average of hazard rankings by stakeholders	32.2	Determined using the questionnaire rankings of all hazards by the stakeholders. Ranking answers were averaged.

Source: DCOHSEM Date Created/Gathered: December 5th 2022

The planning committee felt it necessary to omit a number of hazard's from FEMA's list of potentially threatening hazards as they were deemed either a minor or non-existent threat to Delaware County as a whole and to all of its jurisdictions profiled within this plan. Those excluded hazards are listed below with the grounds for their omission from this plan.

Avalanche- No history of occurrence and unlikelihood of future occurrence as Delaware County's terrain is mostly flat.
Coastal Erosion/Flooding- No oceanic or large coastal area within Delaware County.
Coastal Storm- No oceanic or large coastal area within Delaware County, however, if remnants of hurricanes or tropical storms were experienced as thunderstorms, thunderstorm winds, or high/severe winds, those events were included in the severe summer weather and tornadoes assessments.
Hurricane- County not located within an area in which hurricanes are a threat
Tsunami- County not located in an area in which tsunamis are a threat
Volcano- There are no volcanoes located in Delaware County.
Wildfire- ODNR ranks the entirety of Delaware County as having the lowest risk possible of wildfires
Windstorm- Considered as a part of Severe Summer Storm.

Two new hazards were included in this Plan that were not included in the 2019 Plan. These hazards include invasive species and land subsidence. Severe winter weather received the highest ranking.

Mitigation projects will only be implemented if the benefits outweigh the associated cost of the proposed project. The stakeholders in coordination with DCOHSEM, performed a general assessment of each action that would require FEMA funding as part of the planning process. A detailed cost-benefit analysis of each mitigation action will be required during the project planning phase in order to determine the economic feasibility of each action. Projects will also be evaluated for social and environmental impact-related feasibility, as well as technical feasibility and any other criteria that evaluate project effectiveness. This evaluation of each project will be performed during the pre-application phase of a grant request. Project implementation will be

subject to the availability of FEMA grants and other funding sources, as well as local resources. Projects that are determined to be infeasible during this review process will be re-evaluated for re-scheduling or deletion.

5.2 Hazard Mitigation Goals and Mitigation Actions

Developing achievable goals forms the foundation for all mitigation actions and activities that will aid Delaware County in attaining the overall mission of the stakeholders. As such, the stakeholders assessed the goals of the 2019 Delaware County Multi-Hazard Mitigation Plan and had the opportunity to develop new goals for this update. Goals were reviewed and established based upon their relationship to the potential adverse impact upon the community.

This plan covers Delaware County, including the following jurisdictions: the City of Delaware, the City of Powell, the City of Sunbury, the Village of Ostrander, the Village of Ashley, the Village of Galena, the Village of Shawnee Hills, and the unincorporated areas of Delaware County. This plan does not include the City of Columbus, the City of Westerville, or the City of Dublin because these cities, including the portions within Delaware County's boundary, participate in an agreement with Franklin County Emergency Management and Homeland Security

The goals, as well as the hazards assessed for this Plan, informed the development of actions that the region and participating jurisdictions can take to mitigate the impacts of each of the hazards. The goals of this Multi-Hazard Mitigation Plan are as follows:

Goal 1: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to tornadoes.

Goal 2: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to severe winter weather.

Goal 3: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to floods.

Goal 4: Reduce the probability of damages or losses of existing assets, people, and the economy due to a pandemic event.

Goal 5: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to severe summer weather and extreme heat.

Goal 6: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to dam failure.

Goal 7: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to hazmat incidents.

Goal 8: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to terrorism.

Goal 9: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to utility disruption or failure.

Goal 10: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to civil disturbance, a small shooting or small bomb.

Goal 11: Reduce the probability of damages or losses of existing assets, people, critical facilities/infrastructure, and publicly owned facilities due to drought.

Goal 12: Reduce the probability of damages or losses of existing assets, critical facilities/infrastructure, and publicly owned facilities due to a cyber-attack.

Goal 13: Reducing the impact of land subsidence and erosion

Goal 14: Reduce impact/chance of cybersecurity events through preparation and training.

Goal 15: Reduce the probability of damages or losses of existing assets, critical facilities/infrastructure, and publicly owned facilities due to earthquakes

5.3 Hazard Mitigation Action Priority

Stakeholders completed a Previous Mitigation Action Status survey, which indicated the status of mitigation actions included in the 2019 Multi-Hazard Mitigation Plan. This survey asked representatives to indicate whether the mitigation action from the previous plan was completed, deleted, deferred, unchanged, or ongoing. It also asked the representative if the action should be included in the updated Plan.

Once all mitigation actions from the previous plan were reviewed and their status indicated (Appendix B), all mitigation actions for the updated Delaware County Multi-Hazard Mitigation Plan were reviewed and rated on a scale of one to five by stakeholders based on the several criteria, including whether the action was cost-effective, technically feasible, environmentally sound, needed immediately, and the action's total risk reduction.

All the surveys collected were tabulated to develop a single raw score for each individual mitigation action. These scores are indicated on the Hazard Mitigation Action Priority Table on the following pages. Overall, the score was determined by two factors:

1. The rankings of the hazard, as determined by the Hazard Priority Survey.
2. The ratings received from the stakeholders and the public on each of the mitigation actions.

The raw scores were then ranked, and each mitigation action was assigned a number (Example: 1-94) to indicate the priority of that specific action, according to the survey responses with the number one action being the highest priority. For example, an action assigned a priority of "1" should be prioritized higher than an action assigned a priority score of "45".

Hazard Mitigation Action priorities are organized by hazard in **Figure 80**. The information used to develop the priorities can be found in the Matrix Score Spreadsheet, which is located in **Appendix C**. Comments from the jurisdictions responsible for each action can be found in **Appendix F**, along with all completed surveys that were used to develop the mitigation action priorities.

The hazard mitigation action table below lists both the community the action is to take place in and the lead agency. The community listed for each action is the community who would be the one completing the action, the funding holder if funding for this action is available. The lead agency is an agency(s) that the community can work with to guide action along through the process as needed.

Figure 80 *Hazard Mitigation Actions - Priorities Table by Hazard*

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
All Hazards								
1	Bolster back-up power sources and provisions for snow removal and sheltering within the county	Delaware County, All Participating Cities & Villages	1	3	DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction	Capital Improvement Budgets	6/1/23-5/31/28	New
2	Updates to the Residential Code of Ohio and the Ohio Building Code. Code updates expected to take place in early 2024.	Delaware County	1	4	State and County Building Divisions, State Fire Marshal Office	Capital Improvement Budgets	6/1/23-5/31/28	New
3	Implement outreach, shelter in place education programs	Delaware County, All Participating Cities & Villages	1	1	DCOHSEM	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
4	Purchase backup generators for all critical facilities and public buildings in case of power failure	Delaware County, All Participating Cities & Villages	1	2	DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction	Capital Improvement Budgets	6/1/23-5/31/28	New
Civil Disturbance								
5	Institute active aggressor training program	Delaware County	8	46	DCSO	DCSO and/or Department of Justice/FBI through Texas State University (ALERRT Program)	6/1/23-5/31/28	Ongoing
6	Educational awareness on different types of Civil Disturbance	Delaware County, All Participating Cities & Villages	8	47	Mayors, Council, and/or Administrator of Participating Jurisdiction	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
7	Educational awareness on different types of Civil Disturbance	Delaware County, All Participating Cities & Villages	8	48	DSCO, Law Enforcement	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	New
Cyber-Attack and Ransomware								
8	Continue to update, install, and maintain sufficient firewall, data backups, malware detection and antivirus software.	Delaware County, All Participating Cities & Villages	10	54	DCOHSEM, IT departments of County, Township, Cities & Villages	General Operating Budget	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
9	Promote best practices for cybersecurity through education campaign to employees and the public	Delaware County, All Participating Cities & Villages	10	55	DCOHSEM, Engineer's Office, Data Center, County and Townships	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
10	Continue to test disaster recovery and business continuity drills	Delaware County	10	57	DCOHSEM, IT departments of County, Township, Cities & Villages	General Operating Budget	6/1/23-5/31/28	Ongoing
11	Implement a public awareness program educating citizens about the dangers of cyber attacks	Delaware County, All Participating Cities & Villages	10	59	DCOHSEM, IT departments of County, Township, Cities & Villages	General Operating Budget	6/1/23-5/31/28	New
12	Track all cyber-attacks within the county	Delaware County, All Participating Cities & Villages	10	58	DCOHSEM, IT departments of County, Township, Cities & Villages	General Operating Budget	6/1/23-5/31/28	New
13	Continue to Perform Random Phishing Testing	Delaware County, All Participating Cities & Villages	10	56	DCOHSEM, IT departments of County, Township, Cities & Villages	General Operating Budget	6/1/23-5/31/28	New
Dam Failure								
14	Implement a public awareness and education program	Delaware County	11	65	US Army Corp of Engineers, ODNR, City of Columbus	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
15	Create or update warning systems in the incident of impending dam inundation and or failure	Delaware County	11	64	US Army Corp of Engineers, City of Columbus, ODNR, DCOHSEM	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
16	Create or update Dam Safety Program for each dam within Delaware County	Thompson twp., Radnor Twp., Troy twp., Oxford twp., Brown twp., Berkshire twp., Orange twp., Liberty twp., Concord twp., Scioto twp., Village of Shawnee Hills, Village of Ashley, Village of Galena, City of Delaware, City of Sunbury	11	62	US Army Corp of Engineers, City of Columbus, ODNR, DCOHSEM	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
17	Continue to perform periodic Dam Inspections	Thompson twp., Radnor Twp., Troy twp., Oxford twp., Brown twp., Berkshire twp., Orange twp., Liberty twp., Concord twp., Scioto twp., Village of Shawnee Hills, Village of Ashley, Village of Galena, City of Delaware, City of Sunbury	11	60	US Army Corp of Engineers, City of Columbus, ODNR, DCOHSEM, Dam owners	Emergency Management Performance Grant (EMPG), Special Project Grants	6/1/23-5/31/28	Ongoing
18	Create Inundation Maps for Sunbury Dam	City of Sunbury	11	67	City of Sunbury Administrator, ODNR, DCOHSEM	General Operating Budget	6/1/23-5/31/28	Ongoing
19	Train personnel in monitoring and evaluation processes for the dams	Thompson twp., Radnor Twp., Troy twp., Oxford twp., Brown twp., Berkshire twp., Orange twp., Liberty twp., Concord twp., Scioto twp., Village of Shawnee Hills, Village of Ashley, Village of Galena, City of Delaware, City of Sunbury	11	61	US Army Corp of Engineers, ODNR, City of Columbus	General Operating Budget	6/1/23-5/31/28	New

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
20	Update Zoning and Land use planning policies in areas near dams	Thompson twp., Radnor Twp., Troy twp., Oxford twp., Brown twp., Berkshire twp., Orange twp., Liberty twp., Concord twp., Scioto twp., Village of Shawnee Hills, Village of Ashley, Village of Galena, City of Delaware, City of Sunbury	11	63	Delaware County and Township Zoning, Delaware County Regional Planning, Mayors, Council, and/or Administrator of Participating Jurisdiction of affected local entities	General Operating Budget	6/1/23-5/31/28	New
21	Update contents of current dam plans and implement plans for dams without a plan	Thompson twp., Radnor Twp., Troy twp., Oxford twp., Brown twp., Berkshire twp., Orange twp., Liberty twp., Concord twp., Scioto twp., Village of Shawnee Hills, Village of Ashley, Village of Galena, City of Delaware, City of Sunbury	11	66	US Army Corp of Engineers, ODNR, City of Columbus, DCOHSEM, Dam Owner	General Operating Budget	6/1/23-5/31/28	Ongoing
22	Rehabilitation of High Hazard Potential Dams as needed	Thompson twp., Radnor Twp., Troy twp., Oxford twp., Brown twp., Berkshire twp., Orange twp., Liberty twp., Concord twp., Scioto twp., Village of Shawnee Hills, Village of Ashley, Village of Galena, City of Delaware, City of Sunbury	11	94	ODNR, City of Columbus, DCOHSEM, Dam Owner	General Operating Budget and/or Special Projects Grant Funding	6/1/23-5/31/28	New
Droughts								
23	Implement a public awareness program and education program concerning water saving and other preventative measures.	Delaware County, All Participating Cities & Villages	5	22	Del-Co Water, Delaware County Soil and Water, DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
24	Develop a contingency plan should the County experience severe drought conditions.	Delaware County, All Participating Cities & Villages	5	19	Delaware County Sheriff, Fire Department, DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
25	Provide resources for agriculture representatives to reduce drought and flood risk mitigation actions such as utilizing continuous living covers to improve soil quality and absorption	Delaware County, All Participating Cities & Villages	5	21	DCOHSEM, Delaware County Soil & Water, OSU Extension, Farm Bureau and State Agricultural Department	General Operating Budget	6/1/23-5/31/28	New
26	Invest in a new water storage facility or upgrade older ones.	Delaware County, All Participating Cities & Villages	5	20	Del-Co Water, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing
Earthquakes								
27	Promote earthquake exercise participation and preparedness information	Delaware County, All Participating Cities & Villages	16	94	DCOHSEM	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
Subsidence, Erosion, and Landslides								
28	Repair damages and protect creek bank from future damages due to erosion at Walnut St and McGill St in Sunbury Ohio	City of Sunbury	13	75	City of Sunbury, DCOHSEM	General Operating Budget	6/1/23-5/31/28	New

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
29	Survey Delaware County roadways with Delaware County Soil & Water Conservation District (DCSWCD) to identify areas near meandering streams that may be prone to erosion in the future. Create soil management plans for these areas.	Delaware County, All Participating Cities & Villages	13	76	Delaware County Soil & Water Conservation District & US Army Corps, ODOT	General Operating Budget	6/1/23-5/31/28	New
30	Limit or prohibit development in known areas of high risk of erosion	Delaware County, All Participating Cities & Villages	13	80	Delaware County Soil & Water Conservation District, Delaware County Regional Planning, Ohio Clean Water, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	New
31	Use GIS and field surveys to identify and map all suspected karsts and erosion prone areas	Delaware County	13	77	Delaware County Soil & Water Conservation District, Delaware County Regional Planning, Auditor	General Operating Budget	6/1/23-5/31/28	New
32	Develop public education program concerning the hazards associated with sinkholes and subsidence that form from karst topography.	Delaware County	13	79	Delaware County Soil & Water Conservation District, DCOHSEM, Delaware County Engineer's Office, ODNR, County Auditor	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	New

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
33	Develop a notification platform for public to report land subsidence or sinkhole development in coordination with Soil & Water Conservation District	Delaware County, All Participating Cities & Villages	13	78	Delaware County Soil & Water Conservation District, DCOHSEM, Delaware County Engineer's Office, ODNR, County Auditor	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	New
Floods								
34	Remove and/or retrofit flood prone structures	Delaware County, All Participating Cities & Villages	7	40	Delaware County Regional Planning, DCOHSEM Building Safety	General Operating Budget	6/1/23-5/31/28	Ongoing
35	Conduct wet and/or dry flood proofing of vulnerable critical infrastructure	Delaware County, All Participating Cities & Villages	7	36	DCOHSEM, Delaware County Regional Planning, Delaware County Soil & Water Conservation District Building Safety	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
36	Implement Storm water reduction incentive	Delaware County, All Participating Cities & Villages	7	39	Delaware County Regional Planning, DCOHSEM, County Engineer's Office Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing
37	Adopt stricter storm water management standards	Delaware County, All Participating Cities & Villages	7	38	Delaware County Regional Planning, DCOHSEM, Delaware County Engineer's Office, Mayors, Council, and/or Administrator of Participating Jurisdiction, Delaware County Planning and Zoning	General Operating Budget	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
38	Complete requirements to participate in FEMA'S Community Rating Systems (CRS)	Delaware County, All Participating Cities & Villages	7	37	DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing
39	Transfer or purchase development rights to prevent development in vulnerable spaces	Delaware County, All Participating Cities & Villages	7	45	Delaware County Regional Planning, DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction, Delaware County Building Safety	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
40	Adopt conservation easements in vulnerable areas	Delaware County, All Participating Cities & Villages	7	42	Delaware County Regional Planning, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing
41	Implement balanced growth plans to prevent development in vulnerable spaces	Delaware County, All Participating Cities & Villages	7	34	Delaware County Soil & Water Conservation District, Delaware County Regional Planning, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing
42	Implement a public awareness program educating citizens about flooding	Delaware County, All Participating Cities & Villages	7	35	DCOHSEM, Local Fire Departments, Red Cross Building Safety	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
43	Assess and update the current flood warning system	Delaware County, All Participating Cities & Villages	7	33	DCOHSEM, DELCOMM	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
44	Upgrade and improve current flood maps	Delaware County, All Participating Cities & Villages	7	43	Delaware County Engineer's Office, Delaware County Soil & Water Conservation District, ODNR Building Safety	General Operating Budget	6/1/23-5/31/28	Ongoing
45	Promote community monitoring of development in floodplain areas	Delaware County, All Participating Cities & Villages	7	41	Delaware County Soil & Water Conservation District, DCOHSEM, ODNR	General Operating Budget	6/1/23-5/31/28	Ongoing
46	Adopting ASCE 24-05 Flood Resistant Design and Construction in Building Code	Delaware County, All Participating Cities & Villages	7	44	Delaware County Regional Planning, Local leadership Building Safety	General Operating Budget	6/1/23-5/31/28	New
HAZMAT Incident								
47	Engage in public awareness of hazardous material, location, transportation times and routes, policy, codes, regulations, and statutes, and response	Delaware County, All Participating Cities & Villages	14	83	DCOHSEM, Local Emergency Planning Commission	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
48	Implement safety procedure and policy trainings regarding policy, storage, transportation, handling, and processing of hazardous materials	Delaware County, All Participating Cities & Villages	14	81	DCOHSEM, ODOT, Ohio EPA	General Operating Budget	6/1/23-5/31/28	Ongoing
49	Conduct commodity flow studies every 3 years	Delaware County	14	85	DCOHSEM, ODOT, Local Emergency Planning Commission	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
50	Educate industry partners on best practices for regular equipment checks and maintenance involved with the storage, transportation, handling, and processing of hazardous materials	Delaware County	14	82	DCOHSEM, Local Emergency Planning Commission	General Operating Budget	6/1/23-5/31/28	New
51	Develop and enforce land-use plans and zoning codes that regulate locations of hazardous material storage and processing facilities, past spill locations, and transportation routes	Delaware County	14	84	Delaware County Reginal Planning, Local emergency Planning Commission	General Operating Budget	6/1/23-5/31/28	New
Invasive Species								
52	Perform county-wide assessment of invasive species	Delaware County, All Participating Cities & Villages	15	91	Delaware County Soil & Water Conservation District, Delaware Public Health District, ODNR, OSU Extension, Preservation Parks	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	New
53	Assess native species at highest risk of becoming threatened, endangered, or outcompeted by invasive species	Delaware County, All Participating Cities & Villages	15	90	Delaware County Soil & Water Conservation District, Delaware Public Health District, ODNR, OSU Extension, Preservation Parks	General Operating Budget	6/1/23-5/31/28	New

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
54	Engage in public awareness of invasive species, the risk to local biodiversity that they induce, how to prevent their establishment, and how to eradicate them	Delaware County, All Participating Cities & Villages	15	88	Delaware County Soil & Water Conservation District, Delaware Public Health District, ODNR, OSU Extension, Preservation Parks	General Operating Budget	6/1/23-5/31/28	New
55	Engage in public awareness of the importance of fostering local biodiversity	Delaware County, All Participating Cities & Villages	15	91	Delaware County Soil & Water Conservation District, Delaware Public Health District, ODNR, OSU Extension, Preservation Parks	General Operating Budget	6/1/23-5/31/28	New
56	Engage in forms of Biological, Chemical, Cultural, Mechanical, and Physical forms of Invasive Species Control on existing populations	Delaware County, All Participating Cities & Villages	15	93	Delaware County Soil & Water Conservation District, Delaware Public Health District, ODNR, OSU Extension, Preservation Parks	General Operating Budget	6/1/23-5/31/28	New
57	Prepare a preferred Native Species List for Development	Delaware County, All Participating Cities & Villages	15	86	Delaware County Soil & Water Conservation District, Delaware Public Health District, ODNR, OSU Extension, Preservation Parks , Local jurisdiction leadership	General Operating Budget	6/1/23-5/31/28	New
58	Train Delaware Parks and Recreation staff on Integrated Pest Management Strategies (IPM)	Delaware County, All Participating Cities & Villages	15	87	Delaware County Soil & Water Conservation District, Delaware Public Health District, ODNR, OSU Extension, Preservation Parks	General Operating Budget	6/1/23-5/31/28	New

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
59	Educate Developers, Landscapers, Farmers, and any additional stakeholders, on Best Management Practices (BMP) for preventing invasive species establishment	Delaware County, All Participating Cities & Villages	15	89	Delaware County Soil & Water Conservation District, Delaware Public Health District, ODNR, OSU Extension, Preservation Parks	General Operating Budget	6/1/23-5/31/28	New
Pandemic and Serious Illness								
60	Promote immunization throughout the community	Delaware County, All Participating Cities & Villages	3	9	Delaware Public Health District, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing
61	Increase community education on disease prevention and control	Delaware County, All Participating Cities & Villages	3	10	Delaware Public Health District	General Operating Budget	6/1/23-5/31/28	Ongoing
62	Increase community education about the history of pandemics in Delaware county and how vaccines have worked	Delaware County, All Participating Cities & Villages	3	12	Delaware Public Health District	General Operating Budget	6/1/23-5/31/28	New
63	Do research on the prevalence and causes of vaccine hesitancy	Delaware County, All Participating Cities & Villages	3	14	Delaware Public Health District	General Operating Budget	6/1/23-5/31/28	New
64	Update building codes to have incentives for outdoor spaces for restaurants	All Participating Cities & Villages in Delaware County	3	15	Delaware Public Health District	General Operating Budget	6/1/23-5/31/28	New

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
65	Conduct more frequent community health assessments (2 years instead of 4 years) - maybe a "light" one annually?	Delaware County	3	13	Delaware Public Health District	General Operating Budget	6/1/23-5/31/28	New
66	Research on the county level, in universities, and non-profits in upcoming, potentially dangerous diseases that can transfer between animals and humans	Delaware County	3	11	Delaware Public Health District	General Operating Budget	6/1/23-5/31/28	New
Severe Summer Weather and Extreme Heat								
67	Create and implement a tree management program to reduce the risk of trees falling on property or powerlines.	Delaware County, All Participating Cities & Villages	6	26	Delaware County Engineer's Office, DCOHSEM	General Operating Budget	6/1/23-5/31/28	Ongoing
68	Promote further use of designed-failure mode power line design	Delaware County, All Participating Cities & Villages	6	23	DCOHSEM	General Operating Budget	6/1/23-5/31/28	Ongoing
69	Install surge protection on critical electronic equipment	Delaware County, All Participating Cities & Villages	6	28	DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
70	Incorporate a responsible generator program to ensure the safety of critical facilities and vulnerable populations	Delaware County, All Participating Cities & Villages	6	32	DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	Ongoing
71	Assess and improve current communication plan and measures between critical county officials to ensure sufficient communication	Delaware County, All Participating Cities & Villages	6	25	DCOHSEM, Crisis Communication Team	General Operating Budget	6/1/23-5/31/28	Ongoing
72	Implement public awareness and education program to inform citizens about the trends and dangers of severe weather.	Delaware County, All Participating Cities & Villages	6	29	DCOHSEM	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
73	Educate residents about what to do in the case of extreme heat and severe summer storms and how to limit property damage	Delaware County, All Participating Cities & Villages	6	30	Delaware Public Health District, DCOHSEM	General Operating Budget	6/1/23-5/31/28	New
74	For new development enforce burying power lines	Delaware County, All Participating Cities & Villages	6	24	Delaware County Regional Planning, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	New
75	Perform a study into the feasibility of burying powerlines.	Delaware County	6	31	Delaware County Regional Planning	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	New

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
76	Establish community cooling locations in the event of a blackout during extreme heat	Delaware County	6	27	DCOHSEM, local libraries	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	New
Severe Winter Events								
77	Implement snow load design standards.	Delaware County	2	7	Delaware County Regional Planning, Building Safety	General Operating Budget	6/1/23-5/31/28	Ongoing
78	Implement an animal protection plan.	Delaware County	2	8	Delaware Public Health District	General Operating Budget	6/1/23-5/31/28	Ongoing
79	Promote preparedness best practices for severe winter weather. This could include public and private sectors to prepare for ice storms, etc.	Delaware County, All Participating Cities & Villages	2	5	DCOHSEM, Delaware County Sheriff's Office	General Operating Budget	6/1/23-5/31/28	Ongoing
80	Establish community heating locations in the event of a blackout during extreme cold	Delaware County, All Participating Cities & Villages	2	6	DCOHSEM, Delaware County Sheriff's Office	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	New
Terrorism								
81	Conduct community risk assessment	Delaware County	12	74	DCOHSEM, Delaware County Sheriff's Office	General Operating Budget	6/1/23-5/31/28	Ongoing
82	Implement local monitoring and reporting program to prevent terrorist incidents or sabotage	Delaware County	12	70	DCOHSEM, Delaware County Sheriff's Office	General Operating Budget	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
83	Increase emergency responder preparedness through planning and training	Delaware County, All Participating Cities & Villages	12	68	DCOHSEM, Delaware County Sheriff's Office	General Operating Budget	6/1/23-5/31/28	Ongoing
84	Implement a buffer zone protection planning for utilities, critical facilities and other vulnerable areas or sites	Delaware County, All Participating Cities & Villages	12	71	Delaware County Regional Planning, Mayors, Council, and/or Administrator of Participating Jurisdiction, private owners	General Operating Budget	6/1/23-5/31/28	Ongoing
85	Implement source water protection planning for vulnerable areas	Delaware County	12	73	ODNR	General Operating Budget	6/1/23-5/31/28	Ongoing
86	Leverage grants to procure mobile vehicular barricades	Delaware County	12	69	DCOHSEM, Delaware County Sheriff's Office	General Operating Budget	6/1/23-5/31/28	Ongoing
87	Public education to empower residents to report suspicious activities through an online platform	Delaware County, All Participating Cities & Villages	12	72	DCOHSEM, Delaware County Sheriff's Office	General Operating Budget	6/1/23-5/31/28	New
Tornadoes								
88	Improve and expand early warning system	Delaware County	9	49	DCOHSEM	General Operating Budget	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
89	Construct safe rooms and /or shelters in vulnerable public areas – this would include building of community safe rooms and promotion of residential safe room rebate program	Delaware County, All Participating Cities & Villages	9	53	DCOHSEM	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
90	Maintain debris management plan	Delaware County	9	51	DCOHSEM	General Operating Budget	6/1/23-5/31/28	Ongoing
91	Conduct manufactured home tie-downs for vulnerable properties (mobile homes).	Delaware County	9	52	Delaware Public Health District, DCOHSEM Building Safety	Emergency Management Performance Grant (EMPG) Special Project Grants	6/1/23-5/31/28	Ongoing
92	Conduct Tornado Awareness Activities - such as distributing tornado shelter information and conducting drills in schools and public buildings	Delaware County, All Participating Cities & Villages	9	50	DCOHSEM, Mayors, Council, and/or Administrator of Participating Jurisdiction	General Operating Budget	6/1/23-5/31/28	New
Utility Failure								
93	Coordinate a program to contact and assist vulnerable populations during periods of utility and infrastructure failure.	Delaware County, All Participating Cities & Villages	4	18	Delaware Public Health District, Delaware County Building Safety	General Operating Budget	6/1/23-5/31/28	Ongoing

Hazard Mitigation Actions - Priorities Table by Hazard								
#	Mitigation Action	Community	Hazard Priority	Action Priority	Lead Agency	Funding Source	Start/ End	Status
94	Protect electrical and communications systems from lightning strikes	Delaware County, All Participating Cities & Villages	4	16	DCOHSEM, DELCOMM	General Operating Budget	6/1/23-5/31/28	Ongoing
95	Engage in tree trimming and maintenance	Delaware County, All Participating Cities & Villages	4	17	Mayors, Council, and/or Administrator of Participating Jurisdiction, Delaware County regional Planning, ODOT	General Operating Budget	6/1/23-5/31/28	Ongoing

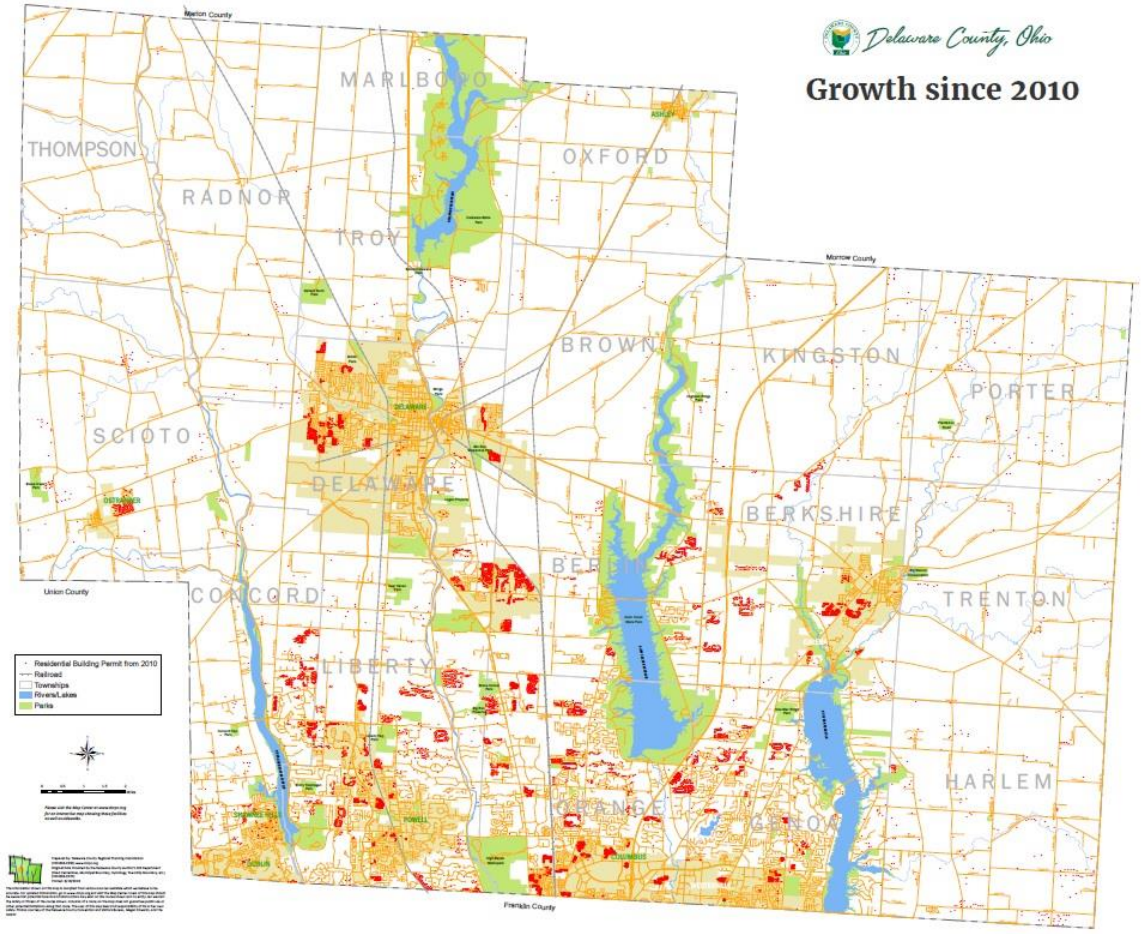
Source: DCOHSEM Date Created/Gathered: December 5th 2022

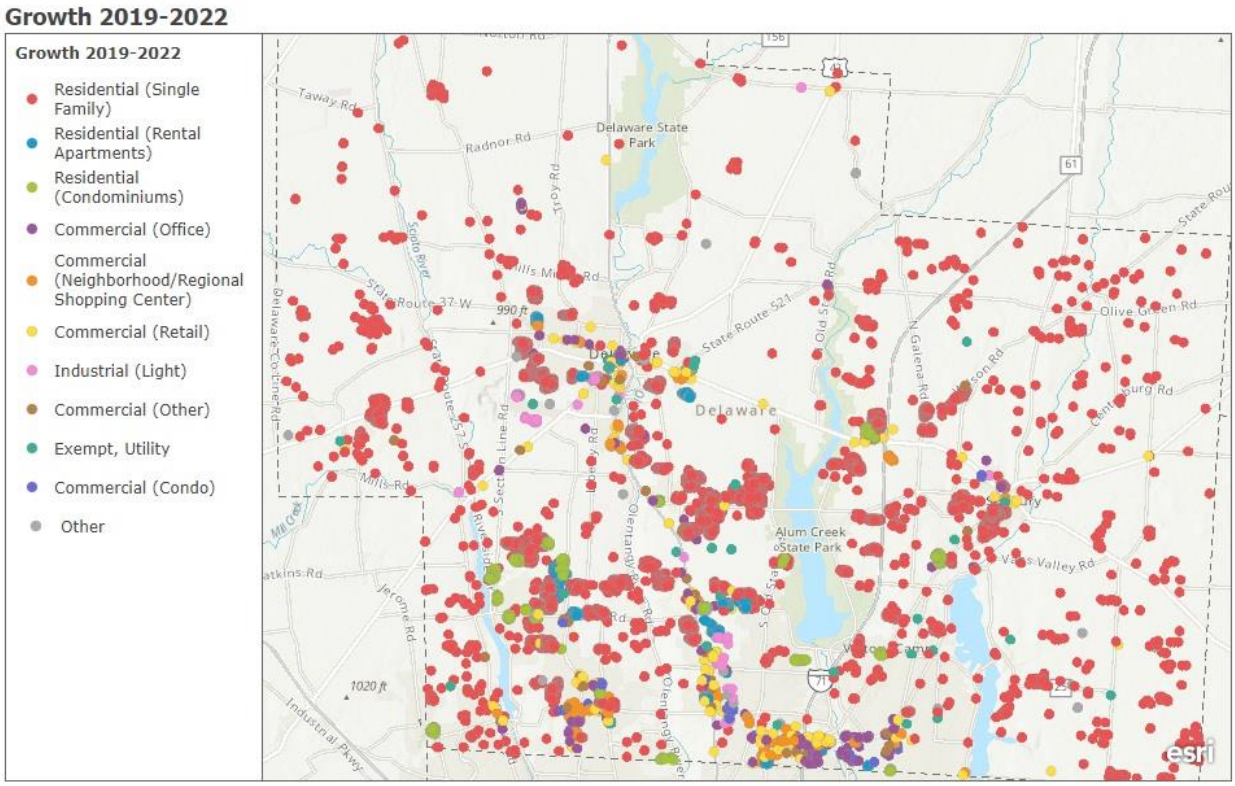
6. Schedule and Maintenance

6.1 Participation Overview

The updated Delaware County Multi-Hazard Mitigation Plan will be adopted by all jurisdictions in Delaware County, including the county, all townships, and the cities and villages. After the jurisdictions have adopted the plan, their signed resolutions or ordinances will be added to the plan as an Appendix. Participation in the plan is important especially as Delaware County continues to grow. Below in **Figure 81** it shows how Delaware County as grown and the areas the population of the county continued to grow shown by the results of the 2020 U.S. Census.

Figure 81 Growth 2010-2019 & Raw Date Showing Growth 2019-2022





Source: Delaware County Regional Planning Date Created/Gathered June 1, 2023

6.2 Continued Public Involvement

The public will continue to provide feedback on the Plan, as the Plan will be available through the Delaware County Homeland Security and Emergency Management Agency (DCOHSEM) and Ohio Emergency Management Agency websites. DCOHSEM will provide access to the Plan to all county, municipality, and township offices, and will make the Plan available in hardcopy and electronic format to the public as appropriate. The DCOHSEM Director will post notices of any meetings for updating and evaluating the Plan, using the usual methods for posting meeting announcements in the County to invite the public to participate. All meetings will be open to the general public. DCOHSEM will publicly announce the mitigation action items that are slated for development in the current year, as well as any updates to the Plan as part of the annual review process.

6.3 Previous Integration Efforts

DCOHSEM and previously engaged jurisdictions have worked to integrate the previous Hazard Mitigation Plan into each responsible entity's actions. Representatives from these jurisdictions indicated that the County Sheriff's department instituted an active shooter training program in 2018/2019 and the County has procured two trailers of barricades in response to the previous Hazard Mitigation Plan.

DCOHSEM creates Hazard Specific Mitigation Plans which are operational outlines to prepare for specific hazards. Each plan is updated on a three-year cycle, and in 2022 the office updated 28 Hazard Specific Mitigation Plans which were informed by the 2019 Hazard Mitigation Plan. In addition, the Ohio Department of Natural Resources, DCOHSEM, and other partners worked together to implement a

tornado shelter at Delaware State Park, which affected their most recent Parks Master Plan. Lastly, the City of Sunbury was heavily impacted by the addendum about land subsidence in the 2019 Hazard Mitigation Plan. Due to this addendum, they applied for and received Building Resilient Infrastructure and Communities (BRIC) funding to fix a road that has been in disrepair due to erosion for over a decade.

6.4 Future Integration Efforts

Local government plays a key role in the execution and implementation of mitigation strategies. This happens in large part during the daily operations that guide the development of various communities in Delaware County. As such, each community will be responsible for understanding which items they are accountable for implementing. Annually, jurisdictions and responsible agencies should provide a status update for each mitigation action that is under their purview. This meeting should coincide with the budget process so that future funding sources can be determined and set aside for actions slated for that particular year. This meeting will also be available to the public. Additionally, each jurisdiction and the county will review the Multi-Hazard Mitigation Plan during other planning processes, such as development of comprehensive plans or capital improvement plans and incorporate appropriate goals and mitigation actions into such documents.

Furthermore, the County and its participating jurisdictions will make a concerted effort to integrate the multi-hazard mitigation plans and its mitigation actions into existing plans and regulations, such as, but not limited to, the comprehensive land use plans, capital improvement plans, crisis communication functional plans, subdivision regulations, zoning resolutions, zoning maps, parks and open space plans, active shooter plans, and emergency operations plans. This will be done to have a cohesive and consistent message across county documents and to ensure the integration of hazard preparedness ideology into the fabric of the city.

Specifically, there are many ways to integrate the findings from this Multi-Hazard Mitigation Plan into land use regulation and a few examples follow. Related to the findings in the flooding and dam failure risk assessments, potential impact areas should be designated for limited to no development and there could be limitations on the use of impervious surfaces. The findings in the pandemics and serious illness outbreaks section indicate that a possible change in land use regulation could be to allow for seating in the right of way. To account for erosion, landslides, and karsts, land use regulations could change to disallow uses that serve vulnerable populations, such as schools and hospitals, in areas that are in high-risk zones for erosion, landslides, or karst subsidence.

Tracking of the overall plan and how the mitigation actions are progressing will be done by DCOHSEM. This tracking of the overall plan will be done by survey every quarter, bi-annually and/or annually as the different actions, projects and jurisdictions dictate. (Different projects have different time scales.) These updates on the progress and/or actions on the different mitigation goals will be kept with the mitigation plan at DCOHSEM facility.

6.5 Updating the Plan

The Delaware County Multi-Hazard Mitigation Plan must be updated within five years and re-adopted by the county and all participating jurisdictions to maintain compliance with federal regulations and ensure eligibility for certain federal mitigation grant funds. DCOHSEM will identify any necessary modifications to the Plan, including changes in mitigation goals and actions that should be incorporated into the next update. The DCOHSEM Director and the County Commissioners will initiate the process of updating the plan in accordance with federal guidelines in sufficient time to meet state and federal deadlines.

Appendix A: Historical Hazard Events

Presidentially Declared Disaster Declarations

Declaration Date	Declaration Date	Disaster Number	Incident Subcategory
3/31/2020	03/31/2020	4507	Biological
3/13/2020	03/13/2020	3457	Biological
6/30/2012	06/30/2012	3346	Severe Storm
10/24/2008	10/24/2008	1805	Severe Storm
4/24/2008	04/24/2008	3286	Snowstorm
9/13/2005	09/13/2005	3250	Hurricane
2/15/2005	02/15/2005	1580	Severe Storm
1/11/2005	01/11/2005	3198	Snowstorm
9/19/2004	09/19/2004	1556	Severe Storm
6/3/2004	06/03/2004	1519	Severe Storm
3/14/2003	03/14/2003	1453	Severe Storm
1/26/1978	01/26/1978	3055	Snowstorm
4/4/1974	04/04/1974	421	Tornado
4/14/1965	04/14/1965	191	Tornado

A.1 Civil Disturbance

Date	Summary	School	City	State	School Level
2/6/70	Argument in school hallway escalated into shooting	John F. Kennedy High School	Cleveland	OH	High
10/27/70	Shot victim in the bathroom	Appleseed Junior High School	Mansfield	OH	Junior High
2/25/71	Victim shot 5 times in the head in the school bathroom	Franklin D. Roosevelt Junior High School	Cleveland	OH	Junior High
1/24/72	Student shot teacher, put down gun, walked outside	Stow High School	Stow	OH	High
9/21/72	Shooter attempted to rob teacher in classroom. Teacher fought back and was shot.	Thorton Junior High	Akron	OH	Junior High
5/1/73	Argument over a girl	Rayen High School	Youngtown	OH	High

10/23/73	Argument over absentee marks at school	Barberton High School	Barberton	OH	High
12/13/73	Witness intimidation after robbery	Hughes High School	Cincinnati	OH	High
3/21/75	Unknown shooter shot teacher during class	Patterson Cooperative High School	Dayton	OH	High
1/23/76	Student shot teacher and cafeteria manager	Columbus Central High School	Columbus	OH	High
6/14/79	Youths playing with gun when accidentally went off killing student	New Carlisle Elementary School	New Carlisle	OH	Elementary
12/12/80	Shot school counselor - held 30 hostages until surrendered to police	Longfellow Junior HIgh School	Lorain	OH	Junior High
1/21/81	14-year old student walks into class before school and shoots teacher in hip	Willetts Middle School	Brunswick	OH	Junior High
4/2/81	Shooter tried to talk victim out of testifying	Alexander Hamilton Junior High School	Cleveland	OH	Junior High
3/17/82	Student carrying bible, pulled out gun during lunch and shot self in stomach	Lorain High School	Lorain	OH	High
5/23/83	Ongoing conflict over a girl ended with victim shot	Mansfield Senior High School	Mansfield	OH	High
5/22/84	Shooter dropped bag with gun inside. Gun went off striking victim	Cleveland Heights High School	Cleveland Heights	OH	High
10/24/84	Female shooter killed bus driver, fired multiple shots at the bus, and rammed the bus with her car multiple times as a result of a custody dispute	West Elementary School Bus	Celina	OH	Elementary

9/25/85	Shooter accidentally shot two students while showing off gun.	Trotwood-Madison Senior High	Trotwood	OH	High
10/22/85	Accidental - Police Officer showing students his weapon - accidental discharge	Southern Hills Joint Vocational High School	Georgetown	OH	High
2/20/90	Struck by bullet while watching fight at school	Taft High School	Cincinnati	OH	High
5/10/91	Shooter fired at group of students standing outside the school, previous conflict with the group	Franklin Alternative Middle School	Columbus	OH	Middle
3/5/92	Shot specific victim in school cafeteria	Hamilton Middle School	Obetz	OH	Middle
11/7/94	Stopped taking medications, fired at multiple school employees	Wickliffe Middle School	Wickliffe	OH	Middle
5/20/97	Showing off gun at lunch	Dunbar High School	Dayton	OH	High
3/23/00	Took class hostage, wanted to go to jail to be with mother	McKinley Elementary School	Lisbon	OH	Elementary
7/26/00	Ongoing feud with victim, shot him in parking lot of school	Timken Senior High School	Canton	OH	High
9/5/00	Cafeteria worker shot by estranged husband, fled, later commit suicide at home	Bidwell Porter Elementary School	Bidwell	OH	Elementary
9/18/00	Fired shot into classroom ceiling, surrendered gun to SRO after 25 minutes, motive unclear	Mount Healthy North Junior High	Mount Healthy	OH	Junior High
4/25/01	Janitor shot outside of school, no suspects	John Marshall High School	Cleveland	OH	High
10/7/03	Argument over car being broken into, third student shot at two arguing	Kenmore High School	Akron	OH	High
2/13/04	Student shot during carjacking in parking lot	Colonel White High School	Dayton	OH	High

3/14/05	Student showing off gun in classroom shot himself in hand	Leawood Elementary School	Columbus	OH	Elementary
4/29/05	Shot fired at window of the school office	Daniel E. Morgan Elementary School	Cleveland	OH	High
1/19/06	Shooting in parking lot behind the school, two parties in different cars, fled the scene	Withrow High School	Cincinnati	OH	High
8/19/06	Shots fired during fight between adults at football game, part of Ongoing conflict	South High School	Youngstown	OH	High
1/8/07	Student with 2 guns confronted by principal, fired, and fled	Robert A. Taft Information Technology High School	Cincinnati	OH	High
5/3/07	16 year old boy shooting pellet gun at bus loaded with children	Gettysburg Elementary School	Dayton	OH	Elementary
10/10/07	Planned attack, recently suspended, targeted teacher then killed self	SuccessTech Academy	Cleveland	OH	Other
9/2/08	Planned to kill himself in front of ex-girlfriend, surrendered to school officials	South High School	Willoughby	OH	High
2/27/12	Planned attack, fired at random victims then walked out of school to surrender to police	Chardon High School	Chardon	OH	High
4/29/13	Suicide attempt during class in classroom	La Salle High School	Cincinnati	OH	High
2/11/14	Shots fired during fight in parking lot during basketball game	Charles F. Brush High School	Lyndhurt	OH	High
4/10/14	Two non-student teens shot in front of school during argument over cell phone	Liberty Elementary School	Columbus	OH	Elementary

5/4/15	Adult victims shot outside of school	Willow Elementary School	Cleveland	OH	Elementary
2/29/16	Fired multiple shots in school cafeteria	Madison High School	Middletown	OH	High
8/17/16	2 people shot in a car; shooter was in another car	Wedgewood Middle School	Columbus	OH	Middle
9/27/16	3 shot after soccer game concluded	Elder High School	Cincinnati	OH	High
10/13/16	Drive-by involving gang members outside of school	Linden McKinley STEM Academy	Columbus	OH	High
1/20/17	Student snuck shotgun into school, prepared in bathroom, shot student, and fired indiscriminately in hallway	West Liberty-Salem High School	West Liberty	OH	High
9/8/17	Shooting by emotionally disturbed student	Columbus Scioto 6-12	Columbus	OH	12-Jun
10/20/17	Shots fired in parking lot during football game	Start High School	Toledo	OH	High
11/29/17	Gun discharged in man's pocket while at basketball referees' meeting	Bath High School	Lima	OH	High
2/20/18	Planned attack, walked out of bathroom then immediately back in, shot himself in head	Jackson Memorial Middle School	Massillon	OH	Middle
6/15/18	Shot fired during domestic dispute on basketball court	Valley Elementary School	Beaver Creek	OH	Elementary
6/25/18	Attempted robbery in school parking lot, gun jammed when shooter fired, victim ran over shooter with car	Fulton Elementary School	Springfield	OH	Elementary
7/11/18	Shots fired during large fight between teens	Milkovich Middle School	Maple Heights	OH	Middle
11/24/18	Two adult men shot in fight outside of school during weekend night	Africentric Early College High School	Columbus	OH	K-12

5/22/19	13 year old shot two other teens during dispute over cell phone	Shady Lane Elementary School	Columbus	OH	Elementary
8/30/19	16YOM non-student shot when crowd was exiting football game	Central Catholic High School	Toledo	OH	High
10/18/19	Shots fired during football game, stadium evacuated	Woodward High School	Toledo	OH	High
5/22/20	Adult man found dead outside of school from gunshot to chest	Miles Elementary School	Cleveland	OH	Elementary
5/27/20	Two men shot each other during sale of handgun at school parking lot	Luis Munoz Marin Middle School	Cleveland	OH	Middle
6/30/20	Adult male with AK-47 shot the front glass doors of the school	Lakota Career Readiness Academy	West Chester Township	OH	K-12
9/10/20	School bus struck by multiple shots fired from vehicle	Saint Francis DeSales High School	Columbus	OH	High
9/17/20	Teen shot another teen and bystander during dispute at football game	Ellet High School	Akron	OH	High
1/21/21	Man shot while watching fight in school parking lot	Eastmoor Academy	Columbus	OH	High
3/9/21	Bullet fired from outside the school went through the gym wall with 59 students inside	Bishop Hartley High School	Columbus	OH	High
3/11/21	Person in vehicle shot and crashed in front of school	Cincinnati College Preparatory Academy	Cincinnati	OH	K-12
4/18/21	Two teens found shot inside a vehicle near the school playground	Westwood Elementary School	Dayton	OH	Elementary
8/10/21	Group of teens was playing with gun, one shot was fired striking a teen	East Linden Elementary School	Columbus	OH	Elementary
8/26/21	Coach fired shots into the air during fight at football game	Northpointe Academy	Toledo	OH	Elementary

		Elementary School			
9/16/21	Seven shots fired when fans were leaving the football game	Beechcroft High School	Columbus	OH	High
9/20/21	Three teens shot on the school playground	Eastside Arts Academy	Cleveland	OH	Elementary
9/21/21	Occupied school bus shot by multiple BBs	Middletown Preparatory and Fitness Academy	Middletown	OH	High
9/29/21	Shot fired in school parking lot during football game	Shaker Heights Middle School	Shaker Heights	OH	Middle
10/4/21	Student shot across the street, ran to school for assistance	Woodward High School	Toledo	OH	High
11/23/21	Man robbed school bus driver at gunpoint	Cleveland School Bus	Cleveland	OH	null
11/30/21	Teen shot himself while engaged in horseplay with two other teens	Whitehall Yearling High School	Whitehall	OH	High
12/10/21	Man fired shots at officers and fled across campus	Canal Winchester High School	Canal Winchester	OH	High
1/3/22	School bus struck by bullet while driving	Columbus School Bus	Columbus	OH	null

A.2 Cyber-Attack and Ransomware

Year	Description
2016	In early May of 2016, an employee in the treasurer's office of Big Walnut Local School District in Delaware County, received an official -looking email from the treasurer asking that a vendor be promptly paid. The email had all of the markings of a district email, including the appropriate email address and letterhead, but was in fact a spear phishing email. The employee and an individual who was appearing to be her boss exchanged several emails to answer questions before the transfer of $38,520 was made. Fortunately, all of the money was later recovered by the district through the bank and other sources. This attack is an example of spear phishing.

A.3 Dam Failure

Year	Description
1987	According to the Ohio Mitigation Plan, Lexington Glen Dam near State Route 37, in Delaware, Ohio failed in 1987 due to erosion on the emergency spillway and four erosion points on the downstream slope.
1960s	According to the Ohio Mitigation Plan, the Above Ground Reservoir No. 1 located in Sunbury, Ohio overtopped in the 1960s; however, no downstream damage was recorded.
2005	In January of 2005, a set of severe winter storms with average 5-8 inches of rainfall throughout Central Indiana and Ohio caused Delaware Lake, in northern Delaware County, to flood. The water line rose from its typical height of about 905 feet above sea level to approximately 945 feet above sea level reaching between 1 and 5 feet of the top of the Delaware Dam. Thankfully the dam was not overtopped, and the floodgates were not opened, but it was the closest to inundation the Delaware Dam had ever experienced since its construction in 1948. Alum Creek Dam, in South Central Delaware County, also saw record levels reaching 17 feet above its average height in the same month as the incident at Delaware Lake. The Village of Sunbury created a Dam Emergency Action Plan (EAP) in 2020 to deal with this issue.
May/June 2020,	Greenwood Lake Dam caused concerns over its structural integrity. However, the water level never reached the top nor did the situation become an emergency. During the time period of concern, ODNR dam safety and Delaware County public safety agencies monitored the situation closely. This dam has since been removed

All in risk assessment

A.4 Droughts

Year	Description
1999	In July of 1999, 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.
1999	In August of 1999, 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% 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.

HAZARD	DATE	EVENT TYPE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Drought	7/1/99	Drought	N/A	0	0	0	0
Drought	8/1/99	Drought	N/A	0	0	0	0

A.5 Earthquakes

HAZARD	DATE	EVENT TYPE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Earthquake	01/04/1873	Earthquake	3.8	0	0	Unknown	Unknown

A.6 Floods

HAZARD	DATE	EVENT TYPE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Flooding	1/17/96	Flood	N/A	0	0	5000	0
Flooding	5/11/96	Flash Flood	N/A	0	0	3000	0
Flooding	6/1/97	Flash Flood	N/A	0	0	100000	0
Flooding	6/16/97	Flash Flood	N/A	0	0	5000	0
Flooding	1/3/00	Flash Flood	N/A	0	0	3000	0
Flooding	4/8/00	Flash Flood	N/A	0	0	3000	0
Flooding	9/23/00	Flash Flood	N/A	0	0	10000	0
Flooding	6/23/01	Flash Flood	N/A	0	0	3000	0
Flooding	5/9/03	Flood	N/A	0	0	0	0
Flooding	5/15/03	Flood	N/A	0	0	0	0
Flooding	7/23/03	Flood	N/A	0	0	0	0
Flooding	8/12/03	Flood	N/A	0	0	0	0
Flooding	9/1/03	Flood	N/A	0	0	2000	0
Flooding	9/27/03	Flood	N/A	0	0	0	0
Flooding	1/4/04	Flood	N/A	0	0	0	0
Flooding	1/4/04	Flood	N/A	0	0	0	0
Flooding	5/21/04	Flood	N/A	0	0	0	0
Flooding	6/13/04	Flood	N/A	0	0	0	0
Flooding	6/15/04	Flood	N/A	0	0	0	0
Flooding	6/15/04	Flash Flood	N/A	0	0	250000	0
Flooding	6/15/04	Flood	N/A	0	0	0	0
Flooding	1/5/05	Flood	N/A	0	0	20000	0
Flooding	1/11/05	Flood	N/A	0	0	15000	0

Flooding	1/13/05	Flood	N/A	0	0	0	0
Flooding	11/9/05	Flood	N/A	0	0	0	0
Flooding	3/1/07	Flood	N/A	0	0	3000	0
Flooding	3/4/08	Flood	N/A	0	0	2000	0
Flooding	3/19/08	Flood	N/A	0	0	3000	0
Flooding	7/24/11	Flash Flood	N/A	0	0	20000	0
Flooding	6/23/13	Flood	N/A	0	0	1000	0
Flooding	7/22/13	Flood	N/A	0	0	0	0
Flooding	12/22/13	Flood	N/A	0	0	0	0
Flooding	6/25/14	Flash Flood	N/A	0	0	1000	0
Flooding	6/17/15	Flood	N/A	0	0	0	0
Flooding	6/17/15	Flood	N/A	0	0	0	0
Flooding	6/17/15	Flood	N/A	0	0	0	0
Flooding	6/17/15	Flood	N/A	0	0	0	0
Flooding	6/15/16	Flash Flood	N/A	0	0	500	0
Flooding	6/23/16	Flash Flood	N/A	0	0	5000	0
Flooding	6/23/16	Flash Flood	N/A	0	0	0	0
Flooding	7/18/16	Flood	N/A	0	0	0	0
Flooding	11/18/17	Flood	N/A	0	0	0	0
Flooding	11/18/17	Flash Flood	N/A	0	0	0	0
Flooding	11/18/17	Flash Flood	N/A	0	0	0	0
Flooding	11/18/17	Flash Flood	N/A	0	0	0	0
Flooding	11/19/17	Flood	N/A	0	0	0	0
Flooding	5/21/18	Flood	N/A	0	0	0	0
Flooding	6/22/18	Flood	N/A	0	0	0	0
Flooding	6/22/18	Flood	N/A	0	0	0	0
Flooding	6/22/18	Flood	N/A	0	0	0	0
Flooding	6/22/18	Flood	N/A	0	0	0	0
Flooding	6/22/18	Flood	N/A	0	0	0	0
Flooding	6/22/18	Flood	N/A	0	0	0	0
Flooding	9/1/18	Flood	N/A	0	0	0	0
Flooding	2/7/19	Flood	N/A	0	0	0	0

Flooding	6/19/19	Flood	N/A	0	0	0	0
Flooding	7/3/19	Flood	N/A	0	0	0	0
Flooding	7/3/19	Flood	N/A	0	0	0	0
Flooding	7/3/19	Flood	N/A	0	0	0	0
Flooding	7/3/19	Flood	N/A	0	0	0	0
Flooding	3/28/20	Flash Flood	N/A	0	0	0	0
Flooding	5/19/20	Flood	N/A	0	0	0	0
Flooding	5/19/20	Flash Flood	N/A	0	0	5000	0
Flooding	5/19/20	Flood	N/A	0	0	0	0
Flooding	5/19/20	Flood	N/A	0	0	0	0
Flooding	5/19/20	Flood	N/A	0	0	0	0
Flooding	9/7/20	Flood	N/A	0	0	0	0
Flooding	7/1/21	Flood	N/A	0	0	0	0
Flooding	7/11/21	Flood	N/A	0	0	0	0
Flooding	8/31/21	Flood	N/A	0	0	0	0

A.7 HAZMAT Incident

Year	Description
1999	On February 4th, 1999, a tanker driving Northbound on Berkshire I-71 with Flourspar (Flourite) spilled its contents. The quantity spilled was not recorded.
1999	On June 6th, 1999, a semi-truck was involved in an accident in Troy on US 23 at the Tractor Supply Company, causing a spill of combined diesel fuel, acetone, and paint. The quantity spilled was not recorded.
2007	On May 18th, 2007, an unnamed, third-party company was transporting equipment from a dock area of PPG in Delaware City. An unsecured floor scrubber and forklift fell, causing the battery of the floor scrubber to crack, releasing 30 gallons of sulfuric acid. The forklift was lying within the spilled sulfuric acid, creating a hazard due to propane tank proximity. The HAZMAT Team was activated to the incident.
2007	On November 2nd, 2007, a transfer line valve malfunctioned, resulting in approximately 2,000 gallons of raw sewage to be spilled into the Alum Creek waterway located in Berlin Township at Cheshire Road and Route 21. The Olentangy Environmental Control Center (OECC) wastewater treatment facility was contacted. Ohio Environmental Protection Agency (OEPA) was notified of the incident but did not respond.
2008	On January 13th, 2008, a semi tanker transporting 5,500 gallons of phenol sulfonic acid leaked approximately 50 gallons into the Wal-Mart Super Center parking lot in Orange Township. This spill was a result of a hole found

	underneath the tank towards the rear axle. The HAZMAT Team was activated to the incident.
2008	On July 8th, 2008, Shelly Company spilled 20 tons of asphalt, while re-surfacing the Sunbury Road at Hoover Gate Lane. The dump truck in question was dumping asphalt into the paving machine when its load shifted, resulting in the truck tipping over and losing its load. This incident occurred in Genoa Township.
2009	On December 1st, 2009, a semi trailer's damaged drum leaked 55 gallons of potassium hydroxide solution on 7682 SR 37 E. at Pilot Travel Center. This incident occurred in Berkshire Township. The HAZMAT Team was activated to the incident.
2011	On February 17th, 2011, emergency crews required the shutdown of I-71 for several hours as a car was investigated for the suspected transport of hazardous materials. The car was stopped by an officer who thought he smelled Anhydrous Ammonia, and upon investigation, magnesium carbonate, powdered lidocaine and some form of bath salts was discovered. Four law enforcement officials and two men riding in the car were taken to receive medical treatment. While this event did not have strong HAZMAT implication, the repercussions of the incident resulted in the closing of the highway.
2016	On January 27th, 2016, a fire on Green Meadows Drive caused damage to a 55-gallon drum of toluene. The HAZMAT Team was activated to the incident. This incident occurred in Orange Township.
2016	On August 5th, 2016, a tanker trailer with a faulty/cracked overflow drain released 5,000 gallons of asphalt emulsion (tar) on US HWY 23 in Delaware City.
2017	On January 14th, 2017, 800 gallons of ground granite was found in a storm sewer on Delaware Run, found to be coming from Howald Industrial Park. No honing/lubricating oil was detected.
2017	On November 9th, 2017, a broken tank traveling Northbound on I-71 released an unknown amount of Sodium Hydroxide Solution.
2019	On January 9th, 2019, unknown parties dumped three 300-gallon totes on a property on Mills Rd, West of Dix Rd. This incident occurred in Concord Township. Two were unlabeled, while the third had a class 8 corrosive placard described as containing a corrosive liquid.
2019	On September 15th, 2019, a truck transporting 30,000 pounds of tires was involved in a trailer fire traveling northbound on US 23.
2020	On December 27th, 2020, the HAZMAT Team was activated to the incident.
2021	On June 14th, 2021, the HAZMAT Team was activated to the incident.

A.8 Invasive Species

There is no precise history of invasive species being introduced to Delaware County because it coincides with improvements in the scale and speed of human transportation and shipping, which happens constantly.

A.9 Pandemic and Serious Illness

Pandemics

Year	Description
1940 - 1945	Between 1940 and 1945, there were more than 1 million reported cases of Pertussis, otherwise known as Whooping Cough, in the United States. After the introduction of the whole-cell Pertussis vaccine in the 1940s, disease incidence levels receded to 15,000 cases reported in 1960. This trend continued and disease reporting got as low as 2,900 cases a year between 1980 and 1990. In the last 20 years, whooping cough has had a resurgence. In 2012, there were over 48,000 reported Pertussis cases. This resurgence is thought to be for a variety of reasons including changes to the vaccine, heightened recognition and reporting, and molecular changes to the organism. Due to high population immunity to the disease generally and how long it has been in the United States populace, it is now considered an endemic disease, otherwise known as a common disease. Nationally, there were about 18,600 cases of Pertussis in 2019, but Delaware County only accounted for 115 of those cases.
1950s	Polio was a disease that struck fear into the hearts of parents across the United States because of its ability to disable children. In the early 1950s, there were 15,000 cases of paralysis caused by Polio in the United States. According to Ohio History Connection, “several Ohio hospitals, including Akron's Children's Hospital and Elyria's Gates Hospital for Crippled Children, became leaders in treatment of the disease.” Due to development of an oral vaccine in 1957, polio rates dropped precipitously. There have been no cases of Wild Polio in the United States since 1979. Although, a traveler brought Polio into the country in July of 2022, this incident did not cause an outbreak.
1968	One of the flu pandemics occurred in 1968. This particularly flu was part avian flu and was first found in the United States. It is estimated that this virus killed 1 million people worldwide and 100,000 in the United States. It is now considered endemic because this strain of flu still circulates to this day. Another flu that got to the state of a pandemic was H1N1 2009. In the fall of 2009, the H1N1 virus gained momentum as a new strain of flu that was not recognized by our immune systems. The Ohio Department of Health estimated 10,266 hospitalizations and 471 deaths in the State of Ohio from this virus. The flu has many strains and modern vaccines contain protection from multiple strains. In the 2022-2023 flu season, the vaccines included protection from 4 strains of the flu. There are many people who get the flu, but only a few normally lead to hospitalizations. In 2019, there were 73 flu-associated hospitalizations in Delaware County.
2009	In the fall of 2009, the H1N1 virus gained momentum as a new strain of flu that was not recognized by our immune systems. The Ohio Department of Health used CDC recommended methodology to estimate 10,266 hospitalizations and 471 deaths in the State of Ohio from this flu virus.
2014	In October 2014, a nurse in the United States contracted Ebola and then flew to Ohio. There were 29 Ohioans, 87 airline passengers and 177 other individuals that were placed under quarantine U.S. wide. No Ohioans were diagnosed with

	Ebola, but this scare led to extensive coordination and planning with state and federal partners.
2015 - 2018	From January 1st, 2015, to October 31st, 2018, there were 5,728 symptomatic Zika virus disease cases reported in the United States (not including United States' territories), 86 cases specifically for Ohio, and 1 in Delaware County. The virus raged through the country for 2 years, but once the country reached herd immunity, infections dropped suddenly. Nationally, infections went from 224 locally acquired cases to 7 locally acquired cases between 2016 and 2017. The last case of Zika in Delaware County was in 2016.
2018	In July 2018, Delaware County health officials identified 647 customers of a restaurant located in Powell that reported becoming ill. It was caused by a toxin formed in the gastrointestinal tract by the *Clostridium perfringens* bacteria, commonly found when food is left at an unsafe temperature. Symptoms include nausea, vomiting, diarrhea, fever and other ailments
2020	The COVID-19 pandemic was first recognized in the United States in March of 2020, and by September of 2022, there were 96 million cumulative recorded cases and over 1 million deaths nationwide. In Ohio there have been over 3 million cases, over 126,000 hospitalizations, and over 39,000 deaths as of September 2022. There were multiple waves of the COVID-19 pandemic due to variants of the virus, however it is still considered one pandemic. Every ZIP Code in Delaware County has had a case of COVID-19. After 1 year of COVID-19, a vaccine was created and by September 2022, 82% of Delaware County's population above 5 years old is fully vaccinated for the disease
2021	There was a larger than normal amount of Lyme disease in Delaware County. Lyme disease is spread by the bite of a black –legged tick and originates from the bacteria *Borrelia burgdorferi*. In 2020, there were only eight cases in the whole county compared to 25 cases in 2021. Ten of these cases were in children 10 – 14 years old

Serious Illness mixed with Pandemics

Date	Illness Type	Virus vs. Bacteria	city	Mode of Transmission	# cases	# ill
2009		H1N1			10266	471
2/5/14	Respiratory	Influenza virus	Delaware			28
2/14/14	Gastrointestinal	Salmonella	Galena	Zoonotic	2	2
3/28/14		Norovirus	Sunbury	Person-to-Person		98
6/26/14		Coxsackie virus	Delaware	Person-to-Person		13
7/15/14		Coxsackie virus	Delaware	Person-to-Person		10
7/21/14	Neurologic	Other	Delaware	Waterborne	2	2
7/31/14		Coxsackie virus	Westerville	Person-to-Person		17
11/20/14	Other	Streptococcus	Delaware			40

12/11/14		Bordetella pertussis	Delaware	Person-to-Person	2	3
2015-2018		Zika			83	
3/3/15	Gastrointestinal	Norovirus	Delaware		2	21
3/9/15	Gastrointestinal	Norovirus	Delaware	Person-to-Person	3	37
8/31/15	Gastrointestinal	Cryptosporidium	Columbus	Waterborne	0	27
10/7/15	Gastrointestinal	Chemical	Delaware	Foodborne	0	13
11/2/15	Gastrointestinal	Norovirus	Delaware	Person-to-Person		13
11/19/15	Respiratory	Bordetella pertussis	Powell		1	4
1/8/16	Gastrointestinal		Delaware	Person-to-Person	0	47
3/16/16	Respiratory	Varicella-Zoster virus	Delaware		5	5
5/16/16	Dermatologic	Hand, foot, mouth disease	Delaware		0	11
5/16/16	Gastrointestinal	Other: Enteroaggregative E. coli	Galena	Foodborne	3	10
5/17/16	Gastrointestinal	Norovirus	Ostrander	Foodborne	0	3
6/20/16	Gastrointestinal	Unknown	Powell	Foodborne	0	6
7/19/16	Gastrointestinal	Cryptosporidium	Powell	Waterborne	79	228
8/31/16	Gastrointestinal	Cryptosporidium	Delaware	Waterborne	4	26
12/8/16	Other	Lice	Powell	Person-to-Person	0	26
3/20/17	Dermatologic	Varicella-Zoster virus	Ashley		6	6
5/4/17	Gastrointestinal	Norovirus	Lewis Center	Person-to-Person	2	17
5/4/17	Gastrointestinal	Yersinia enterocolitica	Lewis Center	Person-to-Person	2	17
5/25/17	Gastrointestinal		Sunbury	Foodborne	0	5
6/15/17	Respiratory	Bordetella pertussis	Powell		2	3
7/31/17	Gastrointestinal	Clostridium perfringens	Delaware	Foodborne	2	2
8/4/17	Gastrointestinal	Norovirus	Ashley	Person-to-Person	2	44
8/22/17	Dermatologic	Coxsackie virus	Powell	Person-to-Person	0	17
8/22/17	Gastrointestinal	Escherichia coli	Westerville	Person-to-Person		4
9/28/17	Respiratory	Parainfluenza virus	Lewis Center	Person-to-Person	0	16
10/17/17	Dermatologic	Coxsackie virus	Lewis Center		0	17
10/26/17	Gastrointestinal	Norovirus	Delaware	Person-to-Person	0	34
12/7/17	Gastrointestinal	Unknown	Powell	Foodborne	0	3
12/8/17	Respiratory	Influenza virus	Delaware	Person-to-Person	7	23
12/11/17	Gastrointestinal	Unknown	Delaware	Foodborne	0	2
12/12/17	Gastrointestinal	Norovirus	Powell	Person-to-Person		12

12/26/17	Dermatologic	Hand, foot, mouth disease	Delaware	Person-to-Person	0	3
1/8/18	Respiratory	Influenza virus	Delaware	Person-to-Person	3	3
1/10/18	Respiratory	Influenza virus	Sunbury	Person-to-Person	2	2
1/12/18	Respiratory	Influenza virus	Powell	Person-to-Person	6	17
1/22/18	Respiratory	Influenza virus	Sunbury	Person-to-Person	4	4
1/25/18	Respiratory	Influenza virus	Delaware	Person-to-Person	2	34
1/26/18	Respiratory	Influenza virus	Delaware	Person-to-Person	1	65
2/8/18	Respiratory	Influenza virus	Delaware	Person-to-Person	0	100
4/20/18	Gastrointestinal	Norovirus	Delaware	Person-to-Person	3	36
6/25/18	Gastrointestinal	Norovirus	Powell	Foodborne	2	6
7/30/18	Gastrointestinal	Ciguatoxin	Ostrander	Foodborne		4
8/1/18	Gastrointestinal		Powell	Foodborne		518
8/6/18	Dermatologic	Pseudomonas aeruginosa	Powell	Waterborne	0	3
8/21/18	Dermatologic	Hand, foot, mouth disease	Lewis Center	Person-to-Person		7
8/27/18	Dermatologic	Hand, foot, mouth disease	Lewis Center	Person-to-Person		12
9/20/18	Dermatologic	Impetigo	Lewis Center			7
9/26/18	Gastrointestinal					96
10/5/18	Dermatologic	Impetigo	Powell	Person-to-Person	0	7
10/5/18	Dermatologic	Coxsackie virus	Powell	Person-to-Person	0	6
10/9/18	Dermatologic	Varicella-Zoster virus	Delaware		6	6

A.10 Severe Summer Weather and Extreme Heat

HAZARD	DATE	EVENT TYPE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Severe Summer Weather	6/12/94	Thunderstorm Wind	0	0	0	5000	0
Severe Summer Weather	6/20/94	Thunderstorm Wind	0	0	0	5000	0
Severe Summer Weather	6/20/94	Thunderstorm Wind	0	0	0	5000	0

Severe Summer Weather	6/29/94	Thunderstorm Wind	0	0	0	5000	0
Severe Summer Weather	7/2/94	Thunderstorm Wind	0	0	0	500000	0
Severe Summer Weather	7/7/94	Thunderstorm Wind	0	0	1	5000	0
Severe Summer Weather	7/21/94	Thunderstorm Wind	0	0	0	5000	0
Severe Summer Weather	7/25/94	Hail	0.75	0	0	5000	0
Severe Summer Weather	8/28/94	Thunderstorm Wind	0	0	0	5000	0
Severe Summer Weather	4/21/95	Thunderstorm Wind	0	0	0	3000	0
Severe Summer Weather	5/24/95	Thunderstorm Wind	0	0	0	10000	0
Severe Summer Weather	7/13/95	Thunderstorm Wind	0	0	0	40000	0
Severe Summer Weather	4/29/96	Thunderstorm Wind	55	0	0	3000	0
Severe Summer Weather	7/7/96	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	7/18/96	Lightning		0	0	620000	0

Severe Summer Weather	7/18/96	Lightning		0	0	20000	0
Severe Summer Weather	11/7/96	Thunderstorm Wind	60	0	0	15000	0
Severe Summer Weather	1/5/97	Thunderstorm Wind	50	0	0	10000	0
Severe Summer Weather	5/18/97	Thunderstorm Wind	60	0	0	100000	0
Severe Summer Weather	7/2/97	Thunderstorm Wind	60	0	0	20000	0
Severe Summer Weather	7/18/97	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	7/18/97	Thunderstorm Wind	52	0	0	5000	0
Severe Summer Weather	7/26/97	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	7/26/97	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	7/27/97	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	5/29/98	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	5/29/98	Thunderstorm Wind	59	0	0	10000	0

Severe Summer Weather	6/16/98	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	8/25/98	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	11/10/98	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	5/6/99	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	10/13/99	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	6/14/00	Thunderstorm Wind	53	0	0	7000	0
Severe Summer Weather	7/14/00	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	9/23/00	Thunderstorm Wind	50	0	0	50000	0
Severe Summer Weather	4/9/01	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	5/21/01	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	10/24/01	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	12/14/01	High Wind	54	0	0	20000	0

Severe Summer Weather	3/9/02	High Wind	66	0	0	25000	0
Severe Summer Weather	3/9/02	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	5/12/02	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	6/26/02	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	6/27/02	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	7/29/02	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	11/10/02	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	4/20/03	Hail	1.5	0	0	65,000,000.00	0
Severe Summer Weather	7/5/03	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	7/7/03	Thunderstorm Wind	54	0	0	20000	0
Severe Summer Weather	7/8/03	Thunderstorm Wind	55	0	0	8000	0
Severe Summer Weather	8/26/03	Thunderstorm Wind	50	0	0	6000	0

Severe Summer Weather	8/27/03	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	8/27/03	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/1/03	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	11/12/03	High Wind	50	0	0	10000	0
Severe Summer Weather	11/12/03	Thunderstorm Wind	50	0	0	15000	0
Severe Summer Weather	5/21/04	Hail	1.75	0	0	10000	0
Severe Summer Weather	6/15/04	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	6/24/04	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	7/25/05	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/23/05	Thunderstorm Wind	50	0	0	4000	0
Severe Summer Weather	11/6/05	Thunderstorm Wind	50	0	0	4000	0
Severe Summer Weather	4/7/06	Thunderstorm Wind	50	0	0	5000	0

Severe Summer Weather	6/22/06	Thunderstorm Wind	50	0	0	8000	0
Severe Summer Weather	7/3/06	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	12/1/06	High Wind	35	0	0	5000	0
Severe Summer Weather	4/11/07	Hail	0.75	0	0	2000	0
Severe Summer Weather	5/15/07	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	5/15/07	Hail	0.75	0	0	1000	0
Severe Summer Weather	6/2/07	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	6/19/07	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	1/9/08	Thunderstorm Wind	50	0	0	8000	0
Severe Summer Weather	5/31/08	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	6/21/08	Hail	0.75	0	0	1000	0
Severe Summer Weather	6/28/08	Thunderstorm Wind	52	0	0	1000	0

Severe Summer Weather	6/28/08	Thunderstorm Wind	52	0	0	10000	0
Severe Summer Weather	7/8/08	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	7/8/08	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	8/5/08	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	8/7/08	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	9/14/08	High Wind	50	0	0	18,400,000.00	0
Severe Summer Weather	2/11/09	Thunderstorm Wind	56	0	0	2000	0
Severe Summer Weather	2/11/09	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	6/19/09	Thunderstorm Wind	50	0	0	4000	0
Severe Summer Weather	6/6/10	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	6/23/10	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	8/4/10	Thunderstorm Wind	55	0	0	15000	0

Severe Summer Weather	8/4/10	Thunderstorm Wind	55	0	0	5000	0
Severe Summer Weather	9/16/10	Thunderstorm Wind	61	0	1	40000	0
Severe Summer Weather	5/26/11	Heavy Rain		0	0	1000	0
Severe Summer Weather	6/4/11	Thunderstorm Wind	50	0	0	15000	0
Severe Summer Weather	6/10/11	Thunderstorm Wind	50	0	0	8000	0
Severe Summer Weather	6/17/11	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/3/11	Thunderstorm Wind	50	0	0	20000	0
Severe Summer Weather	6/29/12	Thunderstorm Wind	56	0	0	10000	0
Severe Summer Weather	6/29/12	Thunderstorm Wind	56	0	0	3000	0
Severe Summer Weather	6/29/12	Thunderstorm Wind	56	0	0	2000	0
Severe Summer Weather	7/26/12	Thunderstorm Wind	50	0	0	10000	0
Severe Summer Weather	7/26/12	Thunderstorm Wind	50	0	0	2000	0

Severe Summer Weather	9/21/12	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	9/21/12	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	5/10/13	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	6/13/13	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	7/10/13	Thunderstorm Wind	55	0	0	25000	0
Severe Summer Weather	7/10/13	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	11/17/13	Thunderstorm Wind	50	0	0	10000	0
Severe Summer Weather	4/29/14	Thunderstorm Wind	55	0	0	25000	0
Severe Summer Weather	7/27/14	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	7/27/14	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	6/8/15	Thunderstorm Wind	45	0	0	250	0
Severe Summer Weather	6/12/15	Thunderstorm Wind	50	0	0	1000	0

Severe Summer Weather	6/12/15	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	7/14/15	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	4/3/16	High Wind	52	0	0	500	0
Severe Summer Weather	6/5/16	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	6/5/16	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	6/15/16	Thunderstorm Wind	39	0	0	100	0
Severe Summer Weather	7/13/16	Thunderstorm Wind	45	0	0	500	0
Severe Summer Weather	7/13/16	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	4/5/17	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	4/5/17	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	7/7/17	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	7/7/17	Thunderstorm Wind	50	0	0	2000	0

Severe Summer Weather	7/7/17	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	7/10/17	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	7/22/17	Thunderstorm Wind	55	0	0	3000	0
Severe Summer Weather	7/22/17	Thunderstorm Wind	50	0	3	5000	0
Severe Summer Weather	7/22/17	Thunderstorm Wind	50	0	0	10000	0
Severe Summer Weather	8/19/17	Hail	1.25	0	0	1000	0
Severe Summer Weather	11/18/17	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	5/14/18	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	5/14/18	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	7/1/18	Thunderstorm Wind	45	0	0	250	0
Severe Summer Weather	6/2/19	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	6/2/19	Thunderstorm Wind	50	0	0	1000	0

Severe Summer Weather	6/2/19	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	6/2/19	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	6/2/19	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	6/2/19	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	7/2/19	Thunderstorm Wind	50	0	0	250	0
Severe Summer Weather	8/18/19	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	8/18/19	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	4/8/20	Thunderstorm Wind	45	0	0	2000	0
Severe Summer Weather	6/4/20	Thunderstorm Wind	50	0	0	500	0
Severe Summer Weather	6/4/20	Thunderstorm Wind	50	0	0	5000	0
Severe Summer Weather	6/10/20	Thunderstorm Wind	45	0	0	3000	0
Severe Summer Weather	6/10/20	Thunderstorm Wind	50	0	0	1000	0

Severe Summer Weather	6/10/20	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	6/10/20	Thunderstorm Wind	50	0	0	500	0
Severe Summer Weather	6/21/20	Thunderstorm Wind	50	0	0	4000	0
Severe Summer Weather	7/10/20	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	7/10/20	Thunderstorm Wind	50	0	0	10000	0
Severe Summer Weather	7/10/20	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	8/28/20	Thunderstorm Wind	50	0	0	500	0
Severe Summer Weather	8/28/20	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	8/28/20	Thunderstorm Wind	50	0	0	4000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	60	0	0	10000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	2000	0

Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	60	0	0	5000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	60	0	0	1000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	500	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	3000	0
Severe Summer Weather	9/7/20	Thunderstorm Wind	50	0	0	2000	0
Severe Summer Weather	11/15/20	High Wind	50	0	0	5000	0
Severe Summer Weather	7/29/21	Thunderstorm Wind	50	0	0	3000	0

Severe Summer Weather	8/11/21	Thunderstorm Wind	50	0	0	1000	0
Severe Summer Weather	8/11/21	Thunderstorm Wind	50	0	0	100	0
Severe Summer Weather	8/12/21	Thunderstorm Wind	50	0	0	8000	0
Severe Summer Weather	8/27/21	Thunderstorm Wind	50	0	0	3000	0

A.11 Severe Winter Weather Events

HAZARD	DATE	EVENT TYPE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Severe Winter Weather	1/2/96	Winter Storm		0	0	25000	0
Severe Winter Weather	1/6/96	Winter Storm		0	0	500000	0
Severe Winter Weather	1/11/96	Heavy Snow		0	0	1000	0
Severe Winter Weather	2/1/96	Cold/Wind Chill		0	0	20000	0
Severe Winter Weather	3/6/96	Ice Storm		0	0	0	0
Severe Winter Weather	3/19/96	Winter Storm		0	0	0	0
Severe Winter Weather	1/1/99	Winter Storm		0	0	0	0

Severe Winter Weather	1/7/99	Winter Storm		0	0	0	0
Severe Winter Weather	1/13/99	Winter Storm		0	0	0	0
Severe Winter Weather	3/9/99	Heavy Snow		0	0	0	0
Severe Winter Weather	1/19/00	Heavy Snow		0	0	0	0
Severe Winter Weather	12/11/00	High Wind	58	0	0	0	0
Severe Winter Weather	12/13/00	Ice Storm		0	0	0	0
Severe Winter Weather	12/14/01	High Wind	54	0	0	20000	0
Severe Winter Weather	3/9/02	High Wind	66	0	0	25000	0
Severe Winter Weather	3/26/02	Winter Storm		0	0	0	0
Severe Winter Weather	12/25/02	Winter Storm		0	0	0	0
Severe Winter Weather	1/26/03	Winter Storm		0	0	0	0
Severe Winter Weather	2/15/03	Winter Storm		0	0	0	0
Severe Winter Weather	5/11/03	High Wind	50	0	0	0	0
Severe Winter Weather	11/12/03	High Wind	50	0	0	10000	0

Severe Winter Weather	1/25/04	Winter Storm		0	0	0	0
Severe Winter Weather	3/16/04	Winter Storm		0	0	0	0
Severe Winter Weather	12/22/04	Winter Storm		0	0	0	0
Severe Winter Weather	1/22/05	Winter Storm		0	0	0	0
Severe Winter Weather	12/9/05	Winter Storm		0	0	0	0
Severe Winter Weather	12/15/05	Winter Storm		0	0	0	0
Severe Winter Weather	12/1/06	High Wind	35	0	0	5000	0
Severe Winter Weather	2/13/07	Heavy Snow		0	0	0	0
Severe Winter Weather	4/6/07	Frost/Freeze		0	0	0	540000
Severe Winter Weather	12/5/07	Heavy Snow		0	0	0	0
Severe Winter Weather	12/7/07	Winter Weather		0	0	0	0
Severe Winter Weather	12/15/07	Heavy Snow		0	0	0	0
Severe Winter Weather	2/22/08	Winter Weather		0	0	0	0
Severe Winter Weather	3/7/08	Winter Storm		0	0	0	0

Severe Winter Weather	9/14/08	High Wind	50	0	0	18400000	0
Severe Winter Weather	12/19/08	Winter Weather		0	0	0	0
Severe Winter Weather	1/10/09	Ice Storm		0	0	0	0
Severe Winter Weather	1/14/09	Heavy Snow		0	0	0	0
Severe Winter Weather	1/27/09	Heavy Snow		0	0	0	0
Severe Winter Weather	2/11/09	High Wind	50	0	0	0	0
Severe Winter Weather	12/9/09	High Wind	50	0	0	0	0
Severe Winter Weather	2/5/10	Heavy Snow		0	0	0	0
Severe Winter Weather	2/9/10	Winter Weather		0	0	0	0
Severe Winter Weather	2/15/10	Heavy Snow		0	0	0	0
Severe Winter Weather	2/26/10	Winter Weather		0	0	0	0
Severe Winter Weather	3/25/10	Winter Weather		0	0	0	0
Severe Winter Weather	12/12/10	Winter Weather		0	0	0	0
Severe Winter Weather	1/11/11	Winter Weather		0	0	0	0

Severe Winter Weather	1/20/11	Winter Weather		0	0	0	0
Severe Winter Weather	2/1/11	Ice Storm		0	0	0	0
Severe Winter Weather	2/24/11	Winter Weather		0	0	0	0
Severe Winter Weather	1/13/12	Winter Weather		0	0	0	0
Severe Winter Weather	1/20/12	Winter Weather		0	0	0	0
Severe Winter Weather	2/10/12	Winter Weather		0	0	0	0
Severe Winter Weather	12/26/12	Winter Storm		0	0	0	0
Severe Winter Weather	12/28/12	Winter Weather		0	0	0	0
Severe Winter Weather	1/25/13	Winter Weather		0	0	0	0
Severe Winter Weather	2/21/13	Winter Weather		0	0	0	0
Severe Winter Weather	3/5/13	Winter Storm		0	0	0	0
Severe Winter Weather	3/24/13	Winter Storm		0	0	0	0
Severe Winter Weather	11/11/13	Winter Weather		0	0	0	0
Severe Winter Weather	11/26/13	Winter Weather		0	0	0	0

Severe Winter Weather	12/6/13	Winter Weather		0	0	0	0
Severe Winter Weather	12/10/13	Winter Weather		0	0	0	0
Severe Winter Weather	12/14/13	Winter Weather		0	0	0	0
Severe Winter Weather	12/16/13	Winter Weather		0	0	0	0
Severe Winter Weather	1/2/14	Winter Weather		0	0	0	0
Severe Winter Weather	2/4/14	Winter Storm		0	0	0	0
Severe Winter Weather	3/2/14	Winter Weather		0	0	0	0
Severe Winter Weather	11/16/14	Winter Weather		0	0	0	0
Severe Winter Weather	11/22/14	Winter Weather		0	0	0	0
Severe Winter Weather	1/5/15	Winter Weather		0	0	0	0
Severe Winter Weather	1/25/15	Winter Weather		0	0	0	0
Severe Winter Weather	2/4/15	Winter Weather		0	0	0	0
Severe Winter Weather	2/14/15	Winter Weather		0	0	0	0
Severe Winter Weather	2/15/15	Winter Weather		0	0	0	0

Severe Winter Weather	2/21/15	Winter Storm		0	0	0	0
Severe Winter Weather	3/1/15	Winter Weather		0	0	0	0
Severe Winter Weather	3/23/15	Winter Weather		0	0	0	0
Severe Winter Weather	1/10/16	Winter Weather		0	0	0	0
Severe Winter Weather	1/12/16	Winter Weather		0	0	0	0
Severe Winter Weather	2/15/16	Winter Weather		0	0	0	0
Severe Winter Weather	4/3/16	High Wind	52	0	0	500	0
Severe Winter Weather	4/8/16	Winter Weather		0	0	0	0
Severe Winter Weather	12/11/16	Winter Weather		0	0	0	0
Severe Winter Weather	12/13/16	Winter Weather		0	0	0	0
Severe Winter Weather	12/30/16	Winter Weather		0	0	0	0
Severe Winter Weather	1/5/17	Winter Weather		0	0	0	0
Severe Winter Weather	2/8/17	Winter Weather		0	0	0	0
Severe Winter Weather	3/13/17	Winter Weather		0	0	0	0

Severe Winter Weather	12/9/17	Winter Weather		0	0	0	0
Severe Winter Weather	12/24/17	Winter Weather		0	0	0	0
Severe Winter Weather	12/29/17	Winter Weather		0	0	0	0
Severe Winter Weather	1/12/18	Winter Weather		0	0	0	0
Severe Winter Weather	1/15/18	Winter Weather		0	0	0	0
Severe Winter Weather	2/6/18	Winter Weather		0	0	0	0
Severe Winter Weather	3/7/18	Winter Weather		0	0	0	0
Severe Winter Weather	3/20/18	Winter Weather		0	0	0	0
Severe Winter Weather	4/1/18	Winter Weather		0	0	0	0
Severe Winter Weather	4/6/18	Winter Weather		0	0	0	0
Severe Winter Weather	1/12/19	Winter Weather		0	0	0	0
Severe Winter Weather	1/19/19	Winter Storm		0	0	0	0
Severe Winter Weather	1/30/19	Extreme Cold/Wind Chill		0	0	0	0
Severe Winter Weather	2/1/19	Winter Weather		0	0	0	0

Severe Winter Weather	2/10/19	Winter Weather		0	0	0	0
Severe Winter Weather	2/20/19	Winter Weather		0	0	0	0
Severe Winter Weather	11/11/19	Winter Weather		0	0	0	0
Severe Winter Weather	12/15/19	Winter Weather		0	0	0	0
Severe Winter Weather	12/30/19	High Wind	50	0	0	0	0
Severe Winter Weather	2/6/20	Winter Weather		0	0	0	0
Severe Winter Weather	2/12/20	Winter Weather		0	0	0	0
Severe Winter Weather	2/26/20	Winter Weather		0	0	0	0
Severe Winter Weather	2/27/20	Winter Weather		0	0	0	0
Severe Winter Weather	11/15/20	High Wind	50	0	0	5000	0
Severe Winter Weather	11/30/20	Winter Weather		0	0	0	0
Severe Winter Weather	12/1/20	Winter Weather		0	0	0	0
Severe Winter Weather	12/16/20	Winter Weather		0	0	0	0
Severe Winter Weather	12/24/20	Winter Weather		0	0	0	0

Severe Winter Weather	1/1/21	Winter Weather		0	0	0	0
Severe Winter Weather	1/30/21	Winter Weather		0	0	0	0
Severe Winter Weather	2/8/21	Winter Weather		0	0	0	0
Severe Winter Weather	2/10/21	Winter Weather		0	0	0	0
Severe Winter Weather	4/20/21	Winter Weather		0	0	0	0
Severe Winter Weather	1/16/22	Winter Weather		0	0	0	0
Severe Winter Weather	1/28/22	Winter Weather		0	0	0	0
Severe Winter Weather	2/2/22	Winter Storm		0	0	0	0
Severe Winter Weather	2/24/22	Winter Weather		0	0	0	0
Severe Winter Weather	3/11/22	Winter Weather		0	0	0	0

A.12 Subsidence, Erosion, and Landslides

HAZARD	DATE	EVENT TYPE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE
Subsidence, Erosion, Landslide	5/7/2022	Subsidence	N/A	0	0	0	0
Subsidence, Erosion, Landslide	3/31/2022	Erosion	N/A	0	0	0	0
Subsidence, Erosion, Landslide	1995	Subsidence	N/A	0	0	Unknown	0

Subsidence, Erosion, Landslide	2015	Erosion	N/A	0	0	Unknown	0
Subsidence, Erosion, Landslide	Jul-17	Subsidence	N/A	0	0	Unknown	0
Subsidence, Erosion, Landslide	2017	Erosion	N/A	0	0	Unknown	0
Subsidence, Erosion, Landslide	Feb-18	Subsidence	N/A	0	0	Unknown	0
Subsidence, Erosion, Landslide	May-20	Subsidence	N/A	0	0	Unknown	0
Subsidence, Erosion, Landslide	Nov-21	Erosion	N/A	0	0	Unknown	0
Subsidence, Erosion, Landslide	Nov-21		N/A	0	0	Unknown	0

A.13 Terrorism

Year	Description
2003	On May 1st, 2003, an Ohio truck driver with a license to carry hazardous material, pleaded guilty to providing material support to Al-Qaida and conspiring to do so. He and another Al-Qaida member later revealed their intention to target the Brooklyn Bridge.
2003	A Somali man based in Columbus, Ohio owner of a small cell phone business was charged for conspiring with an Al-Qaida member for planning to detonate a bomb at a shopping mall in the Columbus Area. Federal authorities announced that a secret cell of Al-Qaida terrorists plotted to bring "death and destruction" to Columbus by blowing up shopping malls. An indictment unsealed in the United States District Court in Columbus said the Somali immigrant and an admitted Al-Qaida member plotted with a third Columbus man to bring down a mall, perhaps during the Christmas season.
2008	A Worthington man accused of plotting to help Al-Qaida, pleaded guilty to conspiring with terrorists to use weapons of mass destruction in Europe and the United States. He was sentenced to 20 years in prison in 2009.

2011	On June 2011 a Somali man living in Franklin County was arrested by FBI agents after he was charged in Minnesota with providing money and other assistance to the Somali terrorist group Al-Shabab, which has been linked to Al-Qaida. He had moved to the Westerville area that year and appeared in federal court in Columbus but was transferred to Minnesota to face charges there
2016	On February 2016, a Somali man attacked patrons in the Nazareth Mediterranean Cuisine restaurant located in Columbus with a machete, wounding four patrons. At the time, FBI agents said there was no indication that the man was working with anyone or being directed by someone. But that he had been on a watch list for "espousing extremist views." This appeared to be a "lone- wolf" terrorist attack.
2016	A man from the Northeast Side of Columbus was arrested at John Glenn Columbus International Airport after it was found that he provided material support to a foreign terrorist group. Federal agents said he intended to fly to Libya to fight for the Islamic State. He also sent $250 to a known intermediary of ISIS recruiter in January, according to an indictment in United States District Court in Columbus.
2016	On November 28th, a terrorist vehicle-ramming and stabbing attack occurred at 9:52 a.m. EST at Ohio State University's Watts Hall in Columbus, Ohio. The attacker, a Somali refugee, was shot and killed by the first responding OSU police officer, and 13 people were hospitalized for injuries. The assailant rammed his car into a group of people on the Columbus campus and then got out and charged at passersby with a knife. The attack appeared to be inspired by terrorist propaganda from ISIS and is considered as "lone-wolf" terrorism.
2022	A man from Columbus and two other men pleaded guilty to crimes related to conspiring to attack power grids throughout the United States in furtherance of racially or ethnically motivated violent extremism advocating for the supremacy of the white race. In February 2020, two of them met in Columbus, Ohio, to further discuss their plot. Upon arriving in Columbus, they purchased spray paint and painted a swastika flag under a bridge at a park with the caption, "Join the Front." They had additional propaganda plans for their time in Ohio, but they were derailed during a traffic stop, during which one of them swallowed his suicide pill but ultimately survived.

A.14 Tornadoes

HAZARD	DATE	EVENT TYPE	MAGNITUDE	DEATHS	INJURIES	PROPERTY DAMAGE	CROP DAMAGE

Tornado	8/14/58	Tornado	F1	0	1	0	0
Tornado	4/11/65	Tornado	F2	4	35	2500000	0
Tornado	4/19/78	Tornado	F1	0	0	250000	0
Tornado	8/17/97	Tornado	F0	0	0	50000	0
Tornado	9/20/00	Tornado	F2	0	2	1000000	0
Tornado	9/16/10	Tornado	EF0	0	0	3000	0
Tornado	6/13/13	Tornado	EF0	0	0	200000	5000
Tornado	2/21/14	Tornado	EF0	0	0	100000	0
Tornado	8/20/16	Tornado	EF0	0	0	20000	0
Tornado	9/7/20	Tornado	EF0	0	0	25000	0

A.15 Utility Failure

Date Event Begins	Area Affected	NERC Region	Type of Disturbance	Number of Customers Affected	Duration
7/8/03	Ohio	ECAR	Severe Thunderstorms	134,500	12:00
8/14/03	Geographic areas for MISO Reliability Coordination footprint: Michigan and Ohio	ECAR	Unknown * Aug 2003 blackout	NA	2:00
5/25/06	Southwest Ohio, Northern Kentucky, Central Indiana	RFC	Severe Weather	210,000	13:10
6/22/06	Ohio and Indiana	RFC	Severe Thunderstorms	195,000	9:00
8/1/06	Northern Ohio	RFC	Made Public Appeals/Heat Wave	N/A	7:00

8/1/06	Ohio, Indiana, Kentucky	RFC	Made Public Appeals	N/A	7:30
8/2/06	Midwest ISO's Market Sub-regions: AMRN, CIN, CILC, CWLD, CWLP, FE, HE, IP, IPL, LGEE, MECS, NIPS, SIGE, SIPC	MRO	Declared Energy Emergency Alert 2/Heat Wave	N/A	4:45
12/1/06	Ohio	RFC	Wind Storm	59,106	11:40
2/10/08	Virginia, West Virginia, Ohio, Pennsylvania	RFC	High Winds	212,560	12:36
9/14/08	Ohio, Kentucky, Indiana	RFC	Tropical Depression Ike	875,000	8:08
9/14/08	Northern Indiana, Central and Central Southern Ohio	RFC	Wind Storm	650,000	5:13
9/14/08	Southern, Eastern, and Central Ohio	RFC	Wind Storm	564,728	0:11
1/28/09	Illinois, Indiana, Ohio and Kentucky	RFC	Winter Storm	230,300	5:03
2/11/09	Kentucky, West Virginia and Ohio	RFC	Severe Thunderstorms	279,813	23:00
2/12/09	Central and Eastern Ohio	RFC	High Winds	184,000	3:30

2/13/09	Central and Eastern Ohio	RFC	High Winds	184,000	0:30
12/9/09	Ohio	RFC	Severe Weather	48,102	16:53
2/5/10	Indiana, Ohio, W. Virginia and Virginia	RFC	Winter Storm	102,225	3:08
8/4/10	Ohio, West Virginia, Kentucky	RFC	Severe Weather	37,000	11:00
8/11/10	Ohio	RFC	Severe Weather	57,000	20:51
2/1/11	Indiana, Ohio	RFC	Winter Storm	158,013	21:00
3/23/11	Indiana. Kentucky, Michigan, Ohio, Tennessee, Virginia, West Virginia	RFC	Major Storm	60,596	10:25
4/20/11	Indiana, Kentucky, Ohio	RFC	Severe Weather - High Winds	165,711	10:00
4/27/11	Ohio, Tennessee, Virginia	SERC	Severe Weather	69,000	12:00
6/7/11	Ohio	RFC	Severe Weather	52,747	16:00
7/11/11	Indiana, Michigan, Ohio	RFC	Severe Weather	120,000	1:23
7/22/11	Ohio	RFC	Load Shed	23,000	5:52
5/31/12	Columbus, Ohio	RFC	Physical Attack	0	4:45
6/29/12	Indiana; Michigan; Ohio; West Virginia	RFC	Severe Weather - Thunderstorms	1,355,919	0:00

10/29/12	Indiana; Kentucky; Michigan; Ohio	RFC; SERC	Severe Weather - Nor'easter	173,273	10:00
5/31/12	Columbus, Ohio	RFC	Physical Attack	0	4:45
6/29/12	Dayton, Ohio	RFC	Severe Weather - Thunderstorms	175,000	3:50
6/29/12	Indiana; Michigan; Ohio; West Virginia	RFC	Severe Weather - Thunderstorms	1,355,919	0:00
10/29/12	Indiana; Kentucky; Michigan; Ohio	RFC; SERC	Severe Weather - Nor'easter	173,273	10:00
6/13/13	Ohio; Virginia; West Virginia	RFC; SERC	Severe Weather - Thunderstorms	90,247	5:50
7/10/13	AEP Ohio Power Footprint	RFC	Severe Weather - Thunderstorms	122,314	2:30
10/27/14	Delaware County			Unknown	0:00
1/17/14	Ohio	RFC	Suspected Physical Attack	Unknown	0:00
1/22/14	Ohio	RFC	Physical Attack - Vandalism	68,339	10:34
7/13/15	Ohio, Kentucky	RFC	Severe Weather	0	15:46
6/23/16	Delaware County		High Winds	20,389	0:00
8/11/16	Ohio:	RFC	Severe Weather	71012	2:45
3/8/17	Ohio	RFC	Severe Weather	92390	8:22
5/1/17	Ohio	RFC	Severe Weather	89216	0:20
6/13/17	Delaware County		Construction	416	0:00

11/5/17	Ohio:	RF	Severe Weather	104000	3:34
11/12/17	Delaware-Vassell		schduled co		
11/15/18	Kentucky: Ohio:	SERC	Severe Weather	86501	0:22
3/1/18	Ohio:	RF	Severe Weather	249322	12:17
3/2/18	Ohio:	RF	Severe Weather	Unknown	13:47
5/31/18	Delaware County			2085	20:49
7/2/18	Delaware County			11,244	0:00
7/14/18	Ohio:	RF	System Operations	0	0:00
9/28/18	Ohio:	RF	System Operations	Unknown	0:31
10/1/18	Ohio: Indiana: Michigan: Kentucky: West Virginia: Virginia:	RF	System Operations	104000	4:48
10/19/18	Delaware County			23,000	0:00
11/15/18	Kentucky: Ohio:	SERC	Severe Weather	0	0:22
1/24/19	Ohio:	RF	System Operations	118781	0:37
2/24/19	Ohio, Virginia, West Virginia	RF	Severe Weather	157274	6:08
2/24/19	Ohio	RF	Severe Weather	0	2:26

4/28/19	Ohio:	RF	Transmission Interruption	70000	15:23
8/8/19	Ohio:	RF	Severe Weather/Transmission Interruption	1397	6:25
8/21/19	Ohio:	RF	Vandalism	0	0:00
10/15/19	Ohio:	RF	Transmission Interruption	0	3:19
12/5/19	Ohio: Kentucky:	RF	System Operations	11964	12:28
3/26/20	Ohio:	RF	Transmission Interruption	78314	0:18
4/8/20	Ohio: Kentucky:	RF	Severe Weather	82509	11:02
4/8/20	Ohio:	WECC	Severe Weather	0	2:35
5/29/20	Ohio: Franklin County;	RF	Vandalism	85822	6:52
6/10/20	Ohio: Indiana: Kentucky: West Virginia:	RF	Severe Weather	16107	0:36
10/23/20	Ohio:	RF	Transmission Interruption	85677	7:29
11/1/20	Ohio:	RF	Severe Weather	123361	0:09
11/15/20	Ohio:	RF	Severe Weather	75000	7:22
11/15/20	Ohio: West Virginia: Virginia: Indiana:	RF	Severe Weather	170190	15:55

12/1/20	Ohio:	RF	Severe Weather	0	10:18
12/25/20	Ohio: Kentucky:	RF	Suspicious Activity	0	0:33
2/6/21	Ohio: Kentucky:	RF	Transmission Interruption	0	7:53
5/25/21	Ohio:	RF	System Operations	0	0:45
1/25/03	Cincinnati, Ohio	ECAR	Cyber Threat From Internet	NA	12:00
7/4/03	Southwest Ohio, portions of Indiana	ECAR	Severe Storms	55,142	21:19
4/1/05	Cleveland, Ohio and northeast Ohio	ECAR	Winter Storm	211,000	12:00
8/14/03	Northeast, Ohio	ECAR	Unknown * Aug 2003 blackout	1,203,000	4:17
4/23/05	Cleveland, Ohio and northeast Ohio	ECAR	Winter Storm	150,000	0:00
2/13/07	Indiana and Southwest Ohio	RFC	Ice/Wind Storm	367,500	#VALUE!
1/29/08	South Metropolitan Areas of Dayton, Ohio	RFC	High Winds	45,000	21:50

7/22/08	Southwest Ohio	RFC	Severe Thunderstorms	56,000	0:13
9/14/08	Dayton Ohio Area	RFC	Hurricane Ike	95,000	22:00
9/14/08	Northeast Ohio	RFC	Wind Storm	245,164	10:20
12/19/08	Indiana, Michigan and Northwest Ohio	RFC	Ice Storm	140,000	3:30
1/28/09	Northern Kentucky and Southwest Ohio	RFC	Ice/Snow Storm	53,600	11:20
4/7/21	Ohio: Lake County;	RF	Suspicious Activity	0	4:27
2/11/09	Northern Kentucky and Southwest Ohio	RFC	Severe Thunderstorms	63,000	#VALUE!
6/26/09	Southwest Ohio, Northern Kentucky, Central and Southern Indiana	RFC	Severe Thunderstorms	85,000	8:00

8/4/09	Northern Kentucky, Southwest Ohio and Central and South Indiana	RFC	Thunderstorms	63,700	7:15
1/31/11	Southwestern Ohio and Indiana	RFC	Ice Storm	272,880	14:00
3/18/11	Greene County, Ohio	RFC	Vandalism	N/A	5:40
4/28/11	Cleveland area, Ohio	RFC	Severe Weather	86,000	13:30
7/1/11	Greene County Ohio	RFC	Vandalism	0	6:00
7/11/11	Southwest Ohio	RFC	Vandalism	0	0:00
8/8/11	Greene County, Ohio	RFC	Suspected Physical Attack	0	0:00
8/25/11	Cleveland area, Ohio	RFC	Severe Weather	107,833	19:30
8/31/11	Southwest Ohio	RFC	Suspected Physical Attack	0	0:00
9/22/11	Montgomery County, Ohio	RFC	Vandalism	0	0:01
10/17/11	Southwest Ohio	RFC	Vandalism	2,000	0:00
12/13/11	Clinton County Ohio	RFC	Suspected Physical Attack	0	0:00

5/7/12	Eastern Ohio	RFC	Load Shed/Severe Weather - Lightning Storm	1	0:21
6/29/12	Dayton, Ohio	RFC	Severe Weather - Thunderstorms	175,000	3:50
6/29/12	Eastern Indiana; Northern Kentucky; Greater Cincinnati area Ohio	RFC	Severe Weather - Thunderstorms	4,645,572	6:44
7/18/12	Southeast Ohio, Northern Kentucky, Southern Indiana	RFC	Severe Weather - Thunderstorms	103,000	9:42
7/18/12	Eastern Ohio	RFC	Severe Weather - Thunderstorms	67,000	2:45
7/26/12	Eastern Ohio	RFC	Severe Weather - Thunderstorms	57,054	22:52
10/29/12	Greater Cleveland Ohio	RFC	Severe Weather - Hurricane Sandy	346,000	7:59

5/7/12	Eastern Ohio	RFC	Load Shed/Severe Weather - Lightning Storm	1	0:21
6/29/12	Eastern Indiana; Northern Kentucky; Greater Cincinnati area Ohio	RFC	Severe Weather - Thunderstorms	4,645,572	6:44
7/18/12	Southeast Ohio, Northern Kentucky, Southern Indiana	RFC	Severe Weather - Thunderstorms	103,000	9:42
7/18/12	Eastern Ohio	RFC	Severe Weather - Thunderstorms	67,000	2:45
7/26/12	Eastern Ohio	RFC	Severe Weather - Thunderstorms	57,054	22:52
10/29/12	Greater Cleveland Ohio	RFC	Severe Weather - Hurricane Sandy	346,000	7:59
2/7/13	Cincinnati, Ohio	RFC	Vandalism	0	1:15
11/1/15	Ohio: Hamilton County;	RFC	Vandalism	62140	0:07

8/28/18	Ohio: Montgomery County;	RF	System Operations	0	0:32
5/27/19	Ohio: Montgomery County, Drake County, Mercer County, Miami County, Greene County;	RF	Severe Weather/Transmission Interruption	5600	4:53
10/24/19	Ohio: Lorain County;	RF	Transmission Interruption	0	0:07
8/19/20	Ohio: Trumbull County;	RF	Transmission Interruption	Unknown	1:36

Appendix B: Previous Mitigation Actions Status

Mitigation Action (Strategy)	Status	Associated Action in Update
TORNADOES		
Improve and expand early warning system	Ongoing: 75%, Social Media used	#89
Construct safe rooms and /or shelters in vulnerable public areas – this would include building of community safe rooms and promotion of residential safe room rebate program	Completed in 2018	#90
Coordinate temporary debris removal sites	Ongoing: 99% Yearly maintenance required	#91
Conduct manufactured home tie-downs for vulnerable properties (mobile homes).	Deferred: Function of Zoning and Building Regulations	#92
SEVERE WINTER WEATHER EVENTS		
Implement snow load design standards	Completed: 2017, 2019, mandated by state	#78
Implement an animal protection plan	Ongoing	#79
Promote preparedness best practices for severe winter weather. This could include public and private sectors to prepare for ice storms, etc.	Completed 2019, yearly meetings conducted	#80
FLOODS		
Remove or elevate structures identified as repetitive loss structures within floodplains	Ongoing: 75%, several projects in progress	#33
Conduct wet and/or dry flood proofing of vulnerable critical infrastructure	Ongoing: 90%, Required for new structures in floodplains	#34
Implement storm water reduction incentive	Ongoing: 20%	#35
Adopt stricter storm water management standards	Ongoing: Concurrent with new growth	#36
Complete requirements to participate in FEMA's Community Rating System (CRS)	Deferred	#37
Transfer or purchase development rights to prevent development in vulnerable spaces	Ongoing: Under jurisdiction of Zoning and Building	#38
Adopt conservation easements in vulnerable areas	Ongoing: 50%	#39
Implement balanced growth plans to prevent development in vulnerable spaces	Ongoing: 40%	#40
Implement a public awareness program educating citizens about flooding	Ongoing: 50%, Ongoing outreach	#41

Mitigation Action (Strategy)	Status	Associated Action in Update
Assess and update the current flood warning system	Ongoing: 75%,	#42
Upgrade and improve current flood maps	Ongoing: 60%, Continual project, slated for adoption in 2023	#45
Promote community monitoring of development in floodplain areas	Ongoing: 75%, Reported flooding in Sunbury prompted subsidence project	#46
PANDEMIC		
Promote immunization throughout the community	Ongoing: 50%, Health department continually works on this	#61
Increase community education on disease prevention and control	Ongoing: 50%, Progress made but nature of the goal requires continued efforts	#63
SEVERE SUMMER STORM AND EXTREME HEAT		
Create and implement a tree management program to reduce the risk of trees falling on property or powerlines	Ongoing: Property owners and utility companies work together on this.	#68
Promote further use of designed-failure mode power line design	Ongoing: 60%, Continued work	$69
Install surge protection on critical electronic equipment	Ongoing: 30%, Some facilities have accomplished this.	#70
Incorporate a responsible generator program to ensure the safety of critical facilities and vulnerable populations.	Ongoing: 60%	#71
Assess and improve current communication plan and measures between critical county officials to ensure sufficient communication.	Ongoing: 60%, included in 2021 plan update	#72
Implement public awareness and education program to inform citizens about the trends and dangers of severe weather.	Ongoing: 90%, StormReady smartphone app submitted to NWS	#73
DAM FAILURE		
Implement a public awareness and education program.	Ongoing: 99%, Completed in 2022 but program continuation required	#14

Mitigation Action (Strategy)	Status	Associated Action in Update
Create or update warning systems in the incident of impending dam inundation and or failure	Ongoing: 75%, development for WEA systems ongoing	#15
Create or update Dam Safety Program for each dam within Delaware County	Completed 2022, yearly updated required	#16
Create Inundation Maps for Sunbury and Ashley Dams	Deferred	#18
Update contents of current dam plans and implement plans for dams without a plan	Completed 2022	#21
HAZMAT INCIDENTS		
Engage in public awareness and worker education programs	Ongoing: 60%, site visits ongoing	#48
Implement safety procedure and policy trainings regarding hazardous materials	Ongoing: 50%	#49
Conduct commodity flow studies	Completed 2022	#50
Implement outreach, shelter in place education programs	Ongoing: 60%	#3
TERRORISM		
Conduct community risk assessment	Ongoing: 75%, Area continues to receive additional resources	#82
Implement local monitoring and reporting program to prevent terrorist incidents or sabotage	Ongoing: 40%	#83
Increase emergency responder preparedness through planning and training	Ongoing: 80%, CART Team nationally Certified, Westerville Central Active Aggressor Drill, and LEPC TTX	#84
Implement a buffer zone protection planning for utilities, critical facilities and other vulnerable areas or sites	Ongoing: 40%	#85
Implement source water protection planning for vulnerable areas	Ongoing: 40%, Conducted by DCSWC	#86
Leverage grants to procure mobile vehicular barricades	Ongoing: 95%, have two trailers of barricades	#87
UTILITY FAILURE		
Protect electrical and communications systems from lightning strikes	Deferred: Utility company responsible for this.	#95
Engage in tree trimming and maintenance	Ongoing: 50%, Yearly maintenance	#96

Mitigation Action (Strategy)	Status	Associated Action in Update
Coordinate a program to contact and assist vulnerable populations during periods of utility and infrastructure failure	Ongoing: 40%	#94
EARTHQUAKES		
Promote earthquake exercise participation and preparedness information	Ongoing: 50%	#26
CIVIL DISTURBANCE		
Institute active shooter training program	Ongoing: 50%, DCSO conducted exercises at Westerville Central and County Fair, annual drills	#5
Assess and updates planning and documentation in preparation for civil disturbance incidents	Completed 2022 in Civil Disturbance Plan 2022	#7
DROUGHTS		
Implement a public awareness and education program concerning water saving and other preventative measures.	Ongoing: 15%, Conducted by schools yearly	#22
Develop a contingency plan should the County experience severe drought conditions	Ongoing	#23
Invest in a new water storage facility or upgrade older ones	Ongoing: 50%	#25
CYBER-ATTACK AND RANSOMWARE		
Continue to update, install and maintain sufficient firewalls, data back-ups, malware detection and anti-virus software.	Ongoing: 85%, current equipment assessed and updated	#8
Promote “best practices” for cybersecurity through education campaign to employees and the public	Ongoing: 90% social media campaign	#9
Continue to test disaster recovery and business continuity drills	Ongoing, tested annually	#10
SUBSIDENCE, EROSION, AND LANDSLIDES		
Repair damages and protect creek bank from future damages due to erosion at Walnut St. & McGill St. in Sunbury, OH	Ongoing	#27

Appendix C: Community Lifelines/Critical Facilities List

Critical Facility Type	County Total
Aviation	1
County Facilities	23
Courts	3
Defense	2
Transit	1
Dialysis Centers	3
Emergency Services	48
Food & Agriculture	16
Hazmat	110
Hospitals	3
Nursing & Assisted Living	25
Outpatient Facilities	7
Pipeline Systems	3
Place Of Worship	141
Roads & Highways	2
Schools	148
TOTAL	**536**

Appendix D: Sources

Section 1 – Introduction
https://gis.dot.state.oh.us/tims
https://ohiodnr.gov/
https://www.dalisproject.org/
https://ohiowatersheds.osu.edu/watershed-groups
https://co.delaware.oh.us/

Section 2 – History and Demographics
data.census.gov
- 2020 5 - Year DP05 ACS Demographic and Housing Table
- 2020 5 - Year S1903 Median income in the past 12 months (inflation adjusted)
- 2020 5 - Year S1701 Poverty Status in the past 12 months
- 2020 5 - Year S1101 Households and Families
- 2020 Decennial Census H1 Occupancy Status
- 2020 5 - Year S1601 Language Spoken at Home
- 2020 5 - Year S2101 Veterans Status

https://devresearch.ohio.gov/reports_countytrends_map.htm
https://co.delaware.oh.us/

Section 3 – Planning Process
https://regionalplanning.co.delaware.oh.us/
https://www.delawareohio.net/government/departments/planning-community-development
https://cityofpowell.us/government/development-department/planning-and-zoning-commission/
https://sunburyvillage.com/188/Planning-Zoning-Commission
https://ostranderohio.us/committees/
https://www.villageofashley.org/
https://shawneehillsoh.org/
https://www.galenaohio.gov/planning-and-zoning
https://co.delaware.oh.us/

Section 4 - HIRA
Civil Disturbance
https://www.psychologicalscience.org/observer/global-warming-and-violent-behavior

Cyber-Attack and Ransomware
https://techjury.net/blog/how-many-cyber-attacks-per-day/#gref
https://aag-it.com/how-often-do-cyber-attacks-occur/

Dam Failure
https://sunburyohio.org/AgendaCenter/ViewFile/Item/883?fileID=2928
https://nid.sec.usace.army.mil/
https://gis.ohiodnr.gov/mapviewer/?config=ohiodams
https://levees.sec.usace.army.mil/#/

https://auditor.co.delaware.oh.us/

Droughts
https://drought.unl.edu/Education/DroughtIn-depth/TypesofDrought.aspx
https://droughtmonitor.unl.edu/Maps/MapExport.aspx
https://droughtmonitor.unl.edu/Maps/MapExport.aspx
https://droughtmonitor.unl.edu/Maps/MapExport.aspx
https://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php
https://economicdevelopment.co.delaware.oh.us/entreprenerurship-in-delaware-county/
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/Ohio/cp39041.pdf
https://droughtmonitor.unl.edu/DmData/TimeSeries.aspx
https://www.ncdc.noaa.gov/stormevents/
https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-oh.pdf
https://delcowater.org/del-co-service-area/
https://delcowater.org/history/
https://www.cc-ema.org/plans
https://co.delaware.oh.us/
https://burtonplanning.com/miami-hmp/

Earthquakes
https://ohiodnr.gov/discover-and-learn/land-water/earthquakes
https://cmerwebmap.cr.usgs.gov/catalog/item/5a8c98d7e4b069906054df7e
https://www.usgs.gov/media/images/2014-seismic-hazard-map-ohio
https://gis.ohiodnr.gov/MapViewer/?config=earthquakes

Floods
https://www.ncdc.noaa.gov/oa/ncdc.html
https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd
http://www.fema.gov/cis/OH.html

Hazardous Material (HAZMAT) Incident
https://data-oepa.opendata.arcgis.com/datasets/oepa::solid-waste-facilities-historic/explore
https://data-oepa.opendata.arcgis.com/datasets/5684b8ecaf014901be58e8fca593050c/explore?location=40.030298%2C-83.516108%2C7.74

Invasive Species
https://nca2014.globalchange.gov/report/
https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/wildlife/invasive-species
https://www.invasivespeciesinfo.gov/us/ohio

Pandemic and Serious Illness

https://academic.oup.com/jid/article/200/7/1018/903237
https://www.cdc.gov/csels/dsepd/ss1978/lesson1/section11.html
https://www.cdc.gov/csels/dsepd/ss1978/lesson1/section11.html
https://coronavirus.ohio.gov/dashboards/key-metrics/cases-by-zipcode
https://www.nature.com/articles/s41598-022-06720-8
https://www.cdc.gov/csels/dsepd/ss1978/lesson1/section10.html
https://www.nativeteachingaids.com/cfd-blog/2020/7/24/smallpox-blankets
https://www.cdc.gov/zika/reporting/index.html
https://www.delawarehealth.org/wp-content/uploads/2022/06/2020-Annual-CD-Report-UPDATED.pdf
https://www.science.org/content/article/zika-has-all-disappeared-americas-why
https://covid.cdc.gov/covid-data-tracker/#datatracker-home
https://coronavirus.ohio.gov/dashboards/current-trends
https://covid.cdc.gov/covid-data-tracker/#county-view?list_select_state=Ohio&data-type=CommunityLevels&list_select_county=39041
https://www.delawarehealth.org/wp-content/uploads/2022/04/2021-CD-ANNUAL-REPORT_FINAL.pdf
https://www.hsph.harvard.edu/news/features/preparing-for-next-pandemic-g7-pact/
https://www.nature.com/articles/s41591-022-01918-9
https://covid.cdc.gov/covid-data-tracker/#county-view?list_select_state=Ohio&data-type=Deaths&list_select_county=39041&metric-deaths=deaths_7_day_count_change
https://www.economist.com/finance-and-economics/2021/01/09/what-is-the-economic-cost-of-covid-19
https://ui-claims.chrr.ohio-state.edu/#
https://fred.stlouisfed.org/series/OHDELA5URN
https://franklincountypa.gov/index.php?section=des_mitigation_plan
https://ema.ohio.gov/mip/

Severe Summer Weather and Extreme Heat

https://www.ucsusa.org/resources/killer-heat-united-states-0
https://www.weather.gov/safety/heat-during#:~:text=A%20heat%20wave%20is%20a,with%20or%20without%20high%20humidity
https://www.cdc.gov/disasters/extremeheat/warning.html
https://www.weather.gov/bgm/heat
https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/mapping/33/pcp/202109/6/value
https://www.ncei.noaa.gov/cag/county/time-series/OH-041/pcp/6/9/1895-2022?trend=true&trend_base=10&begtrendyear=1895&endtrendyear=2022
https://www.ncei.noaa.gov/cag/county/time-series/OH-041/tavg/6/9/1895-2022?trend=true&trend_base=10&begtrendyear=1895&endtrendyear=2022
https://www.weather.gov/safety/lightning-fatalities
https://www.wkbn.com/weather/ohio-ranks-in-the-top-10-for-highest-lightning-deaths/
https://www.census.gov/quickfacts/fact/table/delawarecountyohio/PST045221
https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-oh.pdf
https://www.ncdc.noaa.gov/stormevents/

https://franklincountypa.gov/index.php?section=des_mitigation_plan
https://ema.ohio.gov/mip/
https://www.nass.usda.gov/Statistics_by_State/Ohio/index.php

Severe Winter Events
http://www.ncdc.noaa.gov/stormevents/
https://www.ncdc.noaa.gov/stormevents/

Subsidence, Erosion, and Landslides
https://ohiodnr.gov/discover-and-learn/safety-conservation/geologic-hazards/landslides
https://gis.ohiodnr.gov/website/dgs/karst_interactivemap/
https://ohiodnr.gov/static/documents/geology/MiscMap_OhioKarst_2016.pdf
https://efotg.sc.egov.usda.gov/references/Delete/2004-12-4/041hel.doc
https://nca2014.globalchange.gov/report/regions/midwest
https://www.usgs.gov/media/images/karst-landscapes-are-more-prone-have-land-subsidence-and-sinkholes
https://www.transportation.ohio.gov/working/engineering/geotechnical/asset-management#page=1

Terrorism
https://www.justice.gov/usao-sdoh/pr/3-men-plead-guilty-domestic-terrorism-crime-related-plans-attack-power-grids

Tornadoes
https://nca2014.globalchange.gov/report/regions/midwest
http://www.delawarecountyauditor.org/
http://tornadoproject.com/

Utility Failure
https://connectednation.org/ohio/2020-county-maps/
https://codes.ohio.gov/ohio-administrative-code/rule-4901:1-10-07

Section 5-Mitigation Math

Formula:

(P *0.118) + (PS*0.118) + (S*0.168) + (D*0.098) + (C*0.098) + (Prep *0.078) + (Raw*0.322) = Hazard Score

The variables P, PS, S, D, and C are hazard statistical variables, and the variables Prep and Raw are stakeholder variables.

Statistical Variables:

P is the probability of occurrence of a hazard. It is imputed in the formula with a score based on the table below.

Probability	
1	<1-2%
2	2-10%
3	10+-50%
4	50-100%
5	100+%

PS is the probability of severe occurrence. This is defined as:

Severe Occurrence: That probability that the county would experience the event to a degree that it would warrant a presidential disaster declaration or any amount of property or crop damage, or injuries and/or loss of life. Events of an individual hazard were counted if they were listed on the presidential disaster declaration, caused $5000 or more dollars in damage, or directly caused any injury or death. The events were totaled for each hazard and then classified to determine its 1-5 scale rating.

Severe	
1	None
2	1-2
3	3-5
4	6-8
5	9+

S is population size. The geographic extent to which a populated area could be potentially affected by this hazard. The county was broken down by its 18 townships and used to determine how to what extent an individual hazard event would affect. That total was then valued on a 1-5 scale to regulate the score.

Size (Pop.)	
1	Localized: 1
2	Limited: 2-5
3	Critical: 5-10
4	Excessive: 10-15
5	Catastrophic: 15+

D is duration. Duration is the measure of how long a hazard lasted in terms of days. The total was then valued on a 1-7 scale.

Duration Weight	
Day	1
2-3 Days	2
Week	3
Month	4
6-8 Month	5
Year	6
Year +	7

C is cascade occurrence. This was calculated by counting the number of days that a hazard had an overlap with another hazard. This number was then valued on a scale from 1-5.

Cascade	
1	None
2	1-5
3	5-10
4	10-20
5	20+

Prep is preparedness. This was calculated but counting the number of exercises from 2010-2022 that were completed that included each hazard. Then a scale from 1-7 was used.

Prepardness Weight	
< 5	1
5 to 10	2
11 to 20	3
21 to 30	4
31 to 40	5
41 to 50	6
51 +	7

Stakeholder Variables:

These variables are calculated based on stakeholder responses. This scoring information was collected on the hazard priorities survey (#2). The scores given were averaged across all the surveys received and this final number was the raw score for each hazard.

Finally, the numbers are multiplied by the individual variables. For example, the P (probability) is multiplied by 0.118. These numbers are the weights given to each variable by Delaware County Stakeholders in the development of the 2019 plan. The weights changed for this plan based on the addition of three new variables.

For the statistical variables, the average of each of all the variables in this category was taken from the 2019 Plan and this average was the weight given to the variables of Duration and Cascade.

The same was done for the stakeholder variables and this average was assigned to Preparedness.

The addition of these variables however made it so the weights used no longer equaled 100% so the equation was rebalanced.

Without balancing the equation, the statistical variable weights add up to 0.76, and stakeholder weights add up to 0.56. This adds up to 1.32. Meaning there are 0.32 points to distribute.

Since the equation is divided into two types of variables this average was divided in half. 0.16 points to be removed from each side of the equation.

The 0.16 was removed by dividing it evenly between the variable on each side of the equation. Statistical variables had 5 to divide it between and stakeholder variables also had 5 (using the original variables in 2019 as a count). The 0.16/5=0.032, so that amount was subtracted from each variable, and the new weights were applied in the final equation. With the new weights, statistical variables have weights adding up to 0.6, and stakeholder variables have weights adding up to 0.4 making the total weight back at 100%.

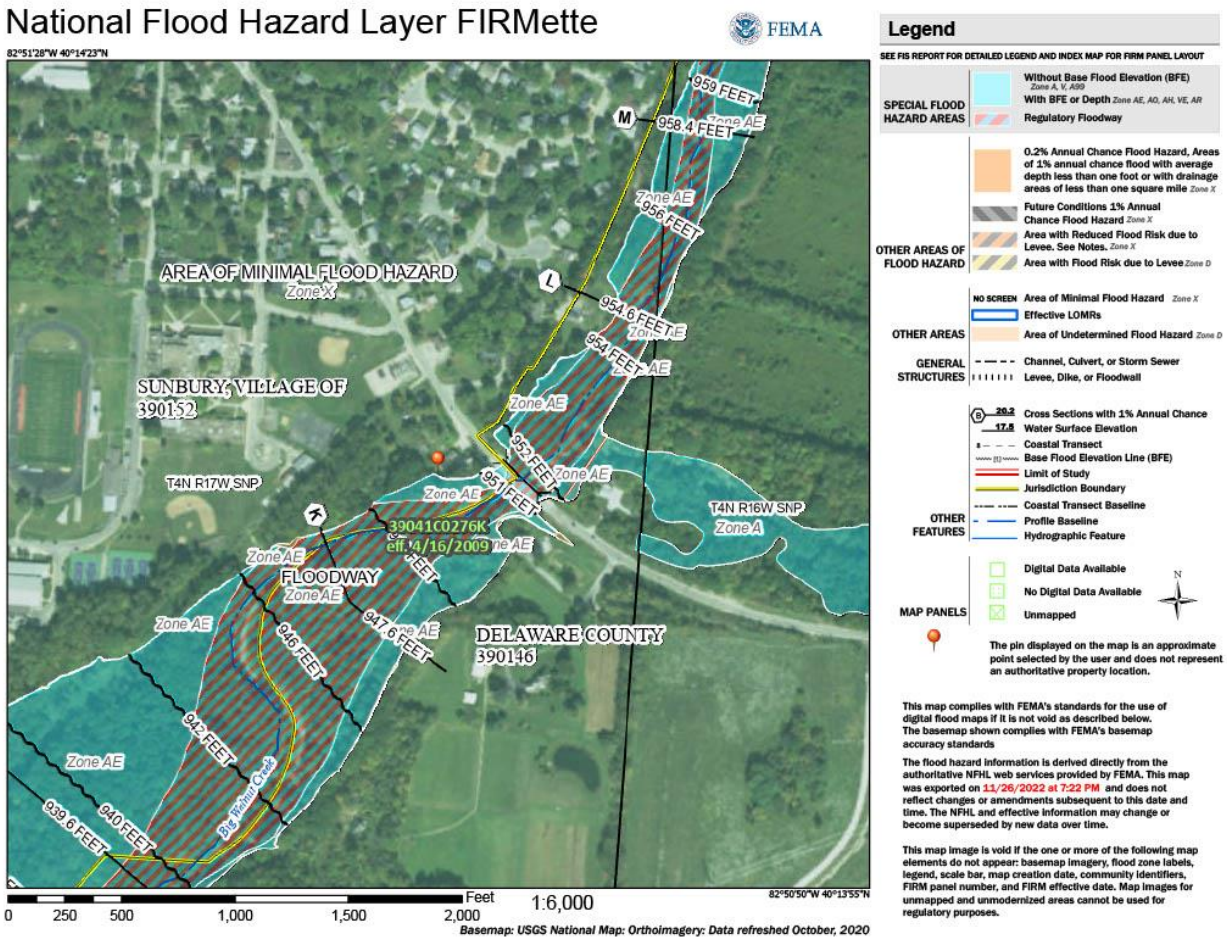
See the table below for more information.

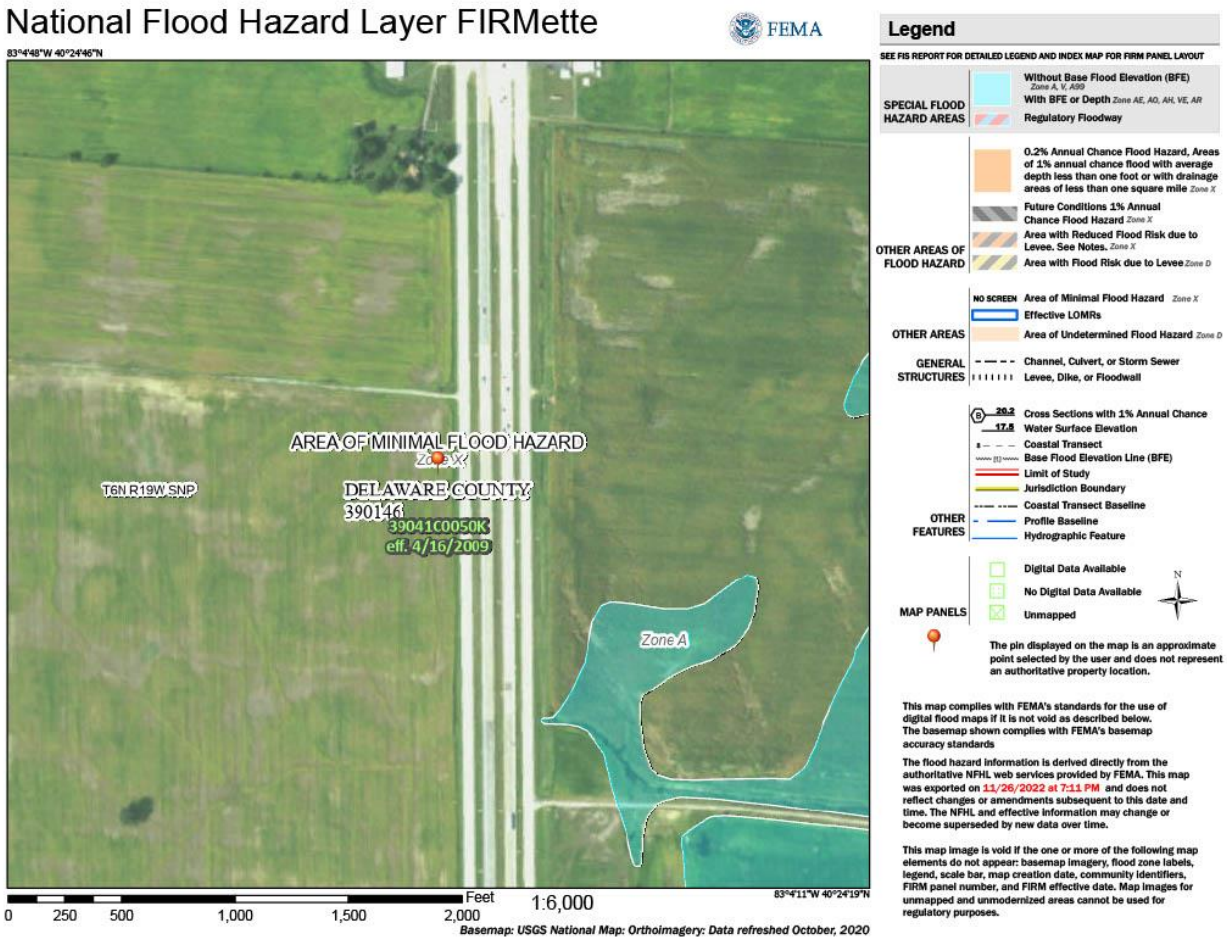
Statistical Variables		**Stakeholder Variables**	
Variable	**2019 Weight**	**Variable**	**2019 Weight**
Probability	0.15	Life	0.2
Probability Severe	0.15	Property	0.1
Onset (removed)	0.05	Economic	0.1
Population Size affected	0.2	Environment	0.05
Average of Variables	**0.13**	**Average of Variables**	**0.11**
New Variables 2022		**New Variables 2022**	
Duration	0.13	Preparedness	0.11
Cascade	0.13		
Sum of Weights	**0.81**	**Sum of Weights**	**0.56**
Grand Total Variable Weights minus Onset Weight		**1.32**	
Overage amount		**0.32**	
Number of varibles used	5	Number of varibles used	5
Amount to remove from each variable	0.032	Amount to remove from each variable	0.032
Variable	**2022 Wegiht**	**Variable**	**2022 Weight**
Probability	0.118	Life	
Probability Severe	0.118	Property	0.322
Population Size affected	0.168	Economic	
		Environment	
New Variables 2022			
Duration	0.098	**New Variables 2022**	
Cascade	0.098	Preparedness	0.078
Sum of Weights	0.6	**Sum of Weights**	0.4
Grand Total Variable Weights		1	

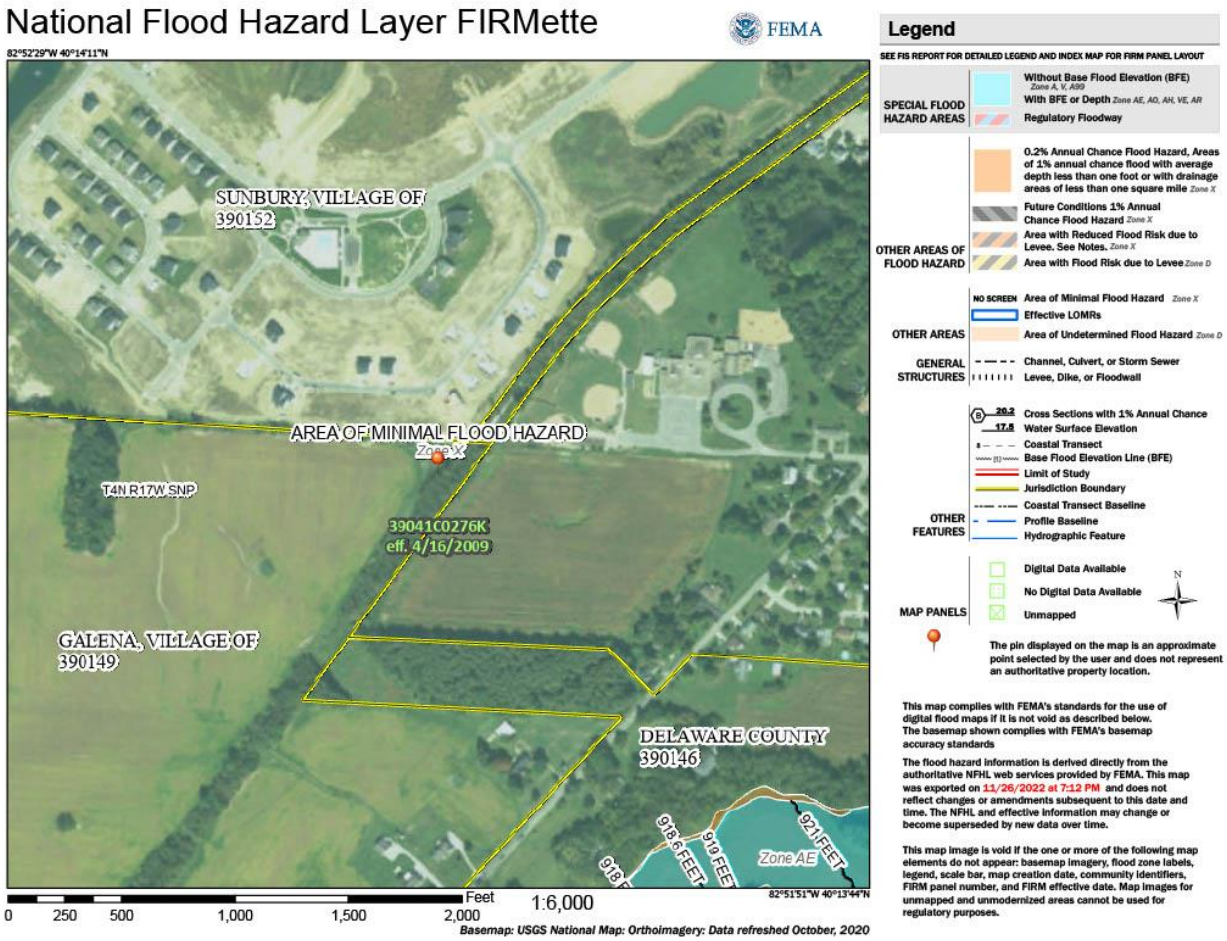
Raw Score

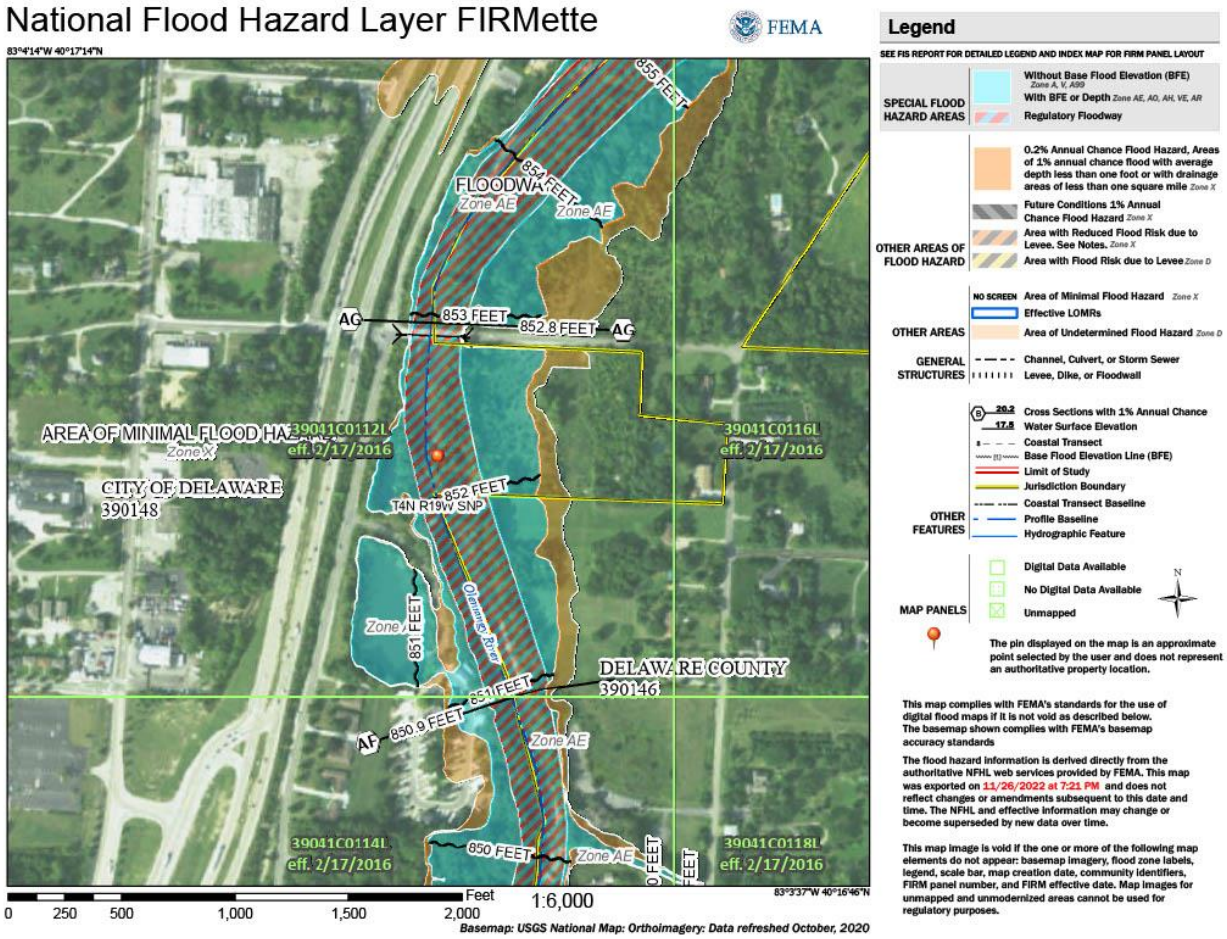
Appendix E: FEMA Flood Maps
https://www.fema.gov/flood-maps/products-tools/hazus

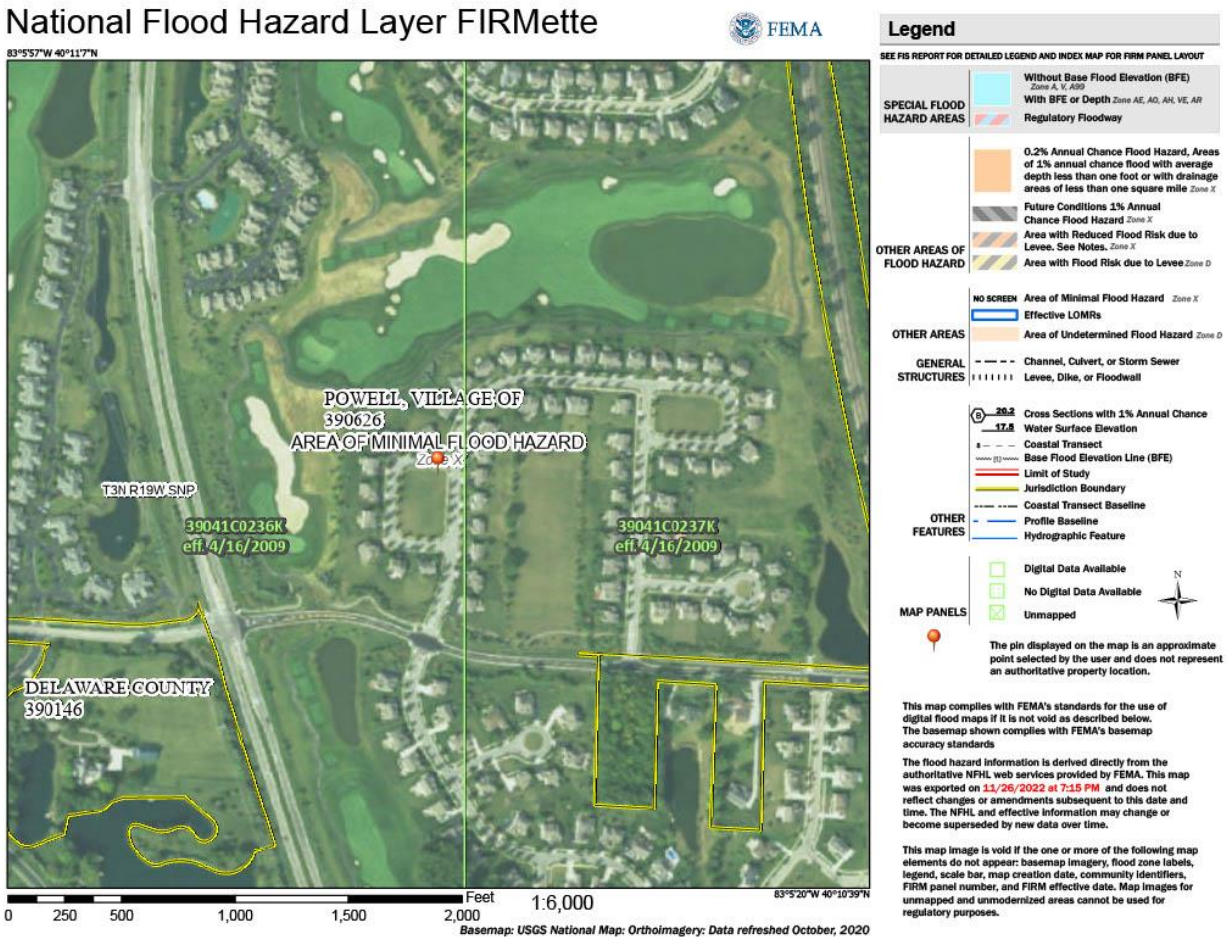
Appendix E: FEMA Flood Maps

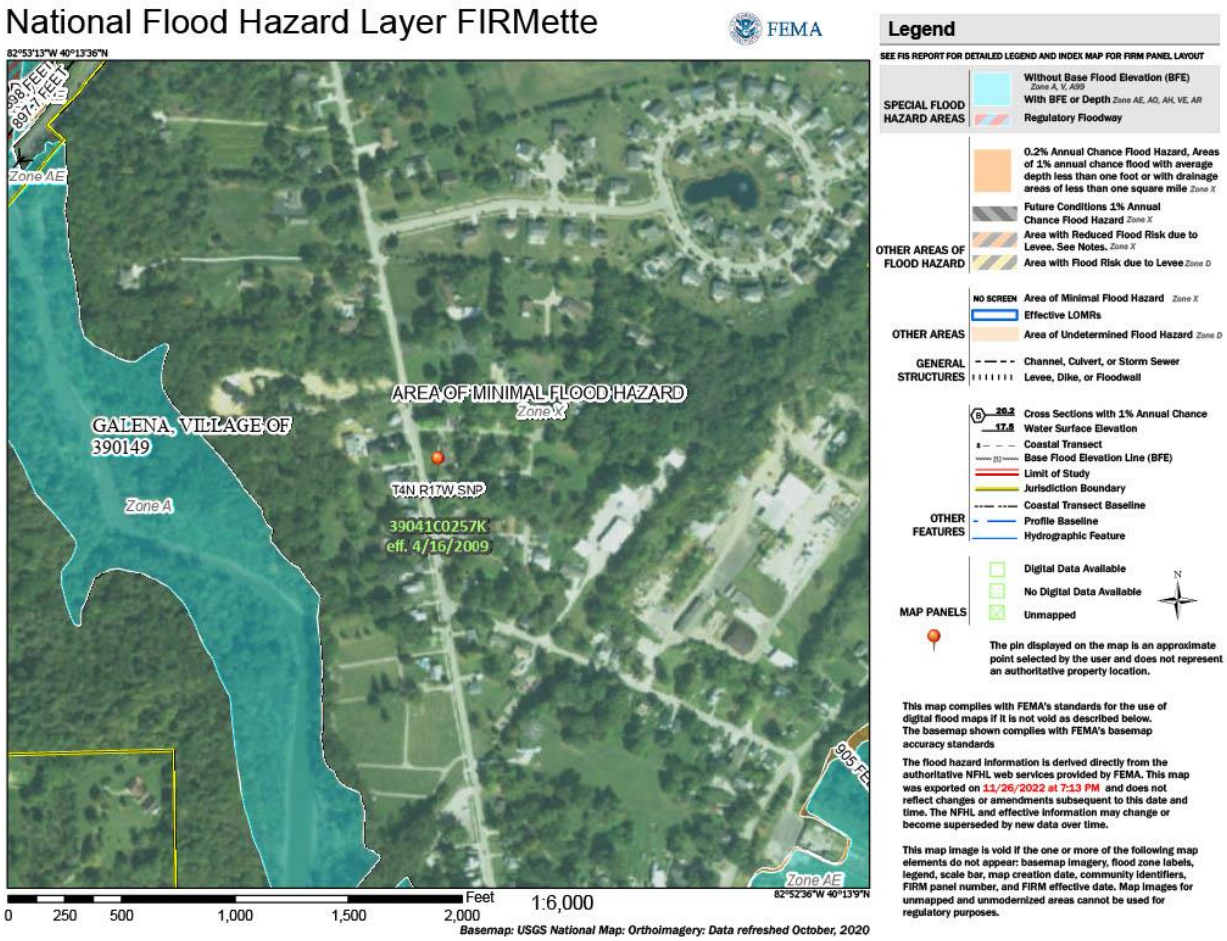

National Flood Hazard Layer FIRMette
FEMA
82°51'28"W 40°14'23"N
82°50'50"W 40°13'55"N
AREA OF MINIMAL FLOOD HAZARD
Zone X
SUNBURY, VILLAGE OF
390152
T4N R17W SNP
T4N R16W SNP
Zone A
DELAWARE COUNTY
390146
39041C0276K
eff. 4/16/2009
FLOODWAY
959 FEET
958.4 FEET
956 FEET
954.6 FEET
954 FEET
952 FEET
951 FEET
947.6 FEET
946 FEET
942 FEET
940 FEET
939.6 FEET
Zone AE
Big Walnut Creek
0
250
500
1,000
1,500
2,000
Feet
1:6,000
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE)
With BFE or Depth
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile
Future Conditions 1% Annual Chance Flood Hazard
Area with Reduced Flood Risk due to Levee. See Notes.
Area with Flood Risk due to Levee
OTHER AREAS
Area of Minimal Flood Hazard
Effective LOMRs
Area of Undetermined Flood Hazard
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:22 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


National Flood Hazard Layer FIRMette
FEMA
83°4'48"W 40°24'46"N
AREA OF MINIMAL FLOOD HAZARD
Zone X
T6N R19W SNP
DELAWARE COUNTY
390146
39041C0050K
eff. 4/16/2009
Zone A
Feet
0
250
500
1,000
1,500
2,000
1:6,000
83°4'11"W 40°24'19"N
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2
17.5
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:11 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

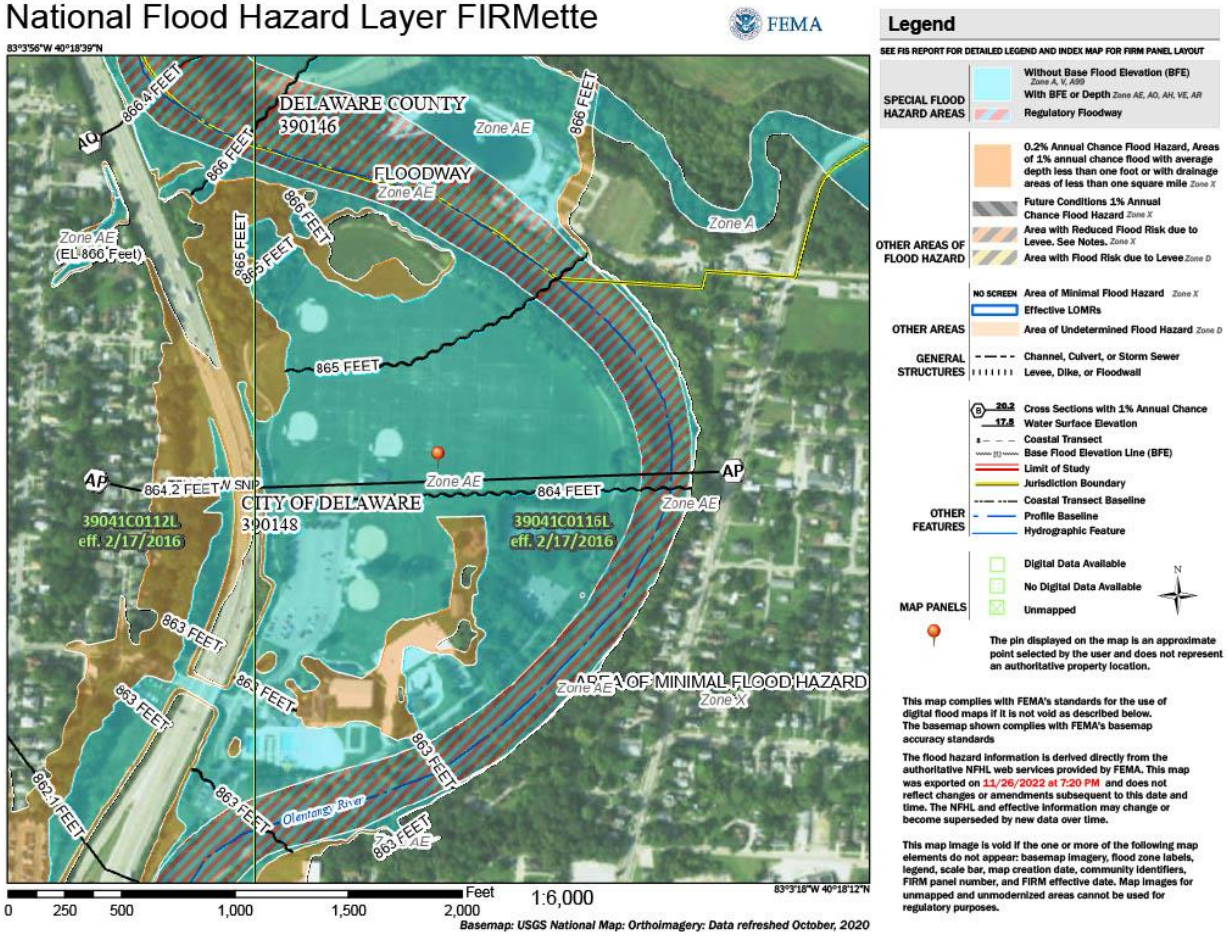

National Flood Hazard Layer FIRMette
FEMA
82°52'29"W 40°14'11"N
SUNBURY, VILLAGE OF
390152
AREA OF MINIMAL FLOOD HAZARD
Zone X
T4N R17W SNP
39041C0276K
eff. 4/16/2009
GALENA, VILLAGE OF
390149
DELAWARE COUNTY
390146
Zone AE
82°51'51"W 40°13'44"N
0 250 500 1,000 1,500 2,000 Feet
1:6,000
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2 Cross Sections with 1% Annual Chance
17.5 Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:12 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


National Flood Hazard Layer FIRMette
FEMA
83°4'14"W 40°17'14"N
855 FEET
854 FEET
FLOODWAY
Zone AE
Zone AE
AG
853 FEET
852.8 FEET
AG
AREA OF MINIMAL FLOOD HAZARD
Zone X
39041C0112L
eff. 2/17/2016
39041C0116L
eff. 2/17/2016
CITY OF DELAWARE
390148
852 FEET
T4N R19W SNP
Zone A
851 FEET
Olentangy River
DELAWARE COUNTY
390146
851 FEET
AE
850.9 FEET
Zone AE
39041C0114L
eff. 2/17/2016
850 FEET
Zone AE
39041C0118L
eff. 2/17/2016
83°3'37"W 40°16'46"N
Feet
0 250 500 1,000 1,500 2,000
1:6,000
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2
17.5
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:21 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


National Flood Hazard Layer FIRMette
FEMA
83°5'57"W 40°11'7"N
POWELL, VILLAGE OF
390626
AREA OF MINIMAL FLOOD HAZARD
Zone X
T3N R19W SNP
39041C0236K
eff. 4/16/2009
39041C0237K
eff. 4/16/2009
DELAWARE COUNTY
390146
0 250 500 1,000 1,500 2,000 Feet
1:6,000
83°5'20"W 40°10'39"N
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2
17.5
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:15 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


National Flood Hazard Layer FIRMette
FEMA
82°53'13"W 40°13'36"N
98 FEET
897.1 FEET
Zone AE
AREA OF MINIMAL FLOOD HAZARD
Zone X
GALENA, VILLAGE OF
390149
Zone A
T4N R17W SNP
39041C0257K
eff. 4/16/2009
905 FE
Zone AE
82°52'36"W 40°13'9"N
0 250 500 1,000 1,500 2,000 Feet
1:6,000
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2
17.5
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:13 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- SPECIAL FLOOD HAZARD AREAS: Without Base Flood Elevation (BFE) Zone A, V, A99; With BFE or Depth Zone AE, AO, AH, VE, AR; Regulatory Floodway
- OTHER AREAS OF FLOOD HAZARD: 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X; Future Conditions 1% Annual Chance Flood Hazard Zone X; Area with Reduced Flood Risk due to Levee. See Notes. Zone X; Area with Flood Risk due to Levee Zone D
- OTHER AREAS: NO SCREEN Area of Minimal Flood Hazard Zone X; Effective LOMRs; Area of Undetermined Flood Hazard Zone D
- GENERAL STRUCTURES: Channel, Culvert, or Storm Sewer; Levee, Dike, or Floodwall
- OTHER FEATURES: 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation; Coastal Transect; Base Flood Elevation Line (BFE); Limit of Study; Jurisdiction Boundary; Coastal Transect Baseline; Profile Baseline; Hydrographic Feature
- MAP PANELS: Digital Data Available; No Digital Data Available; Unmapped

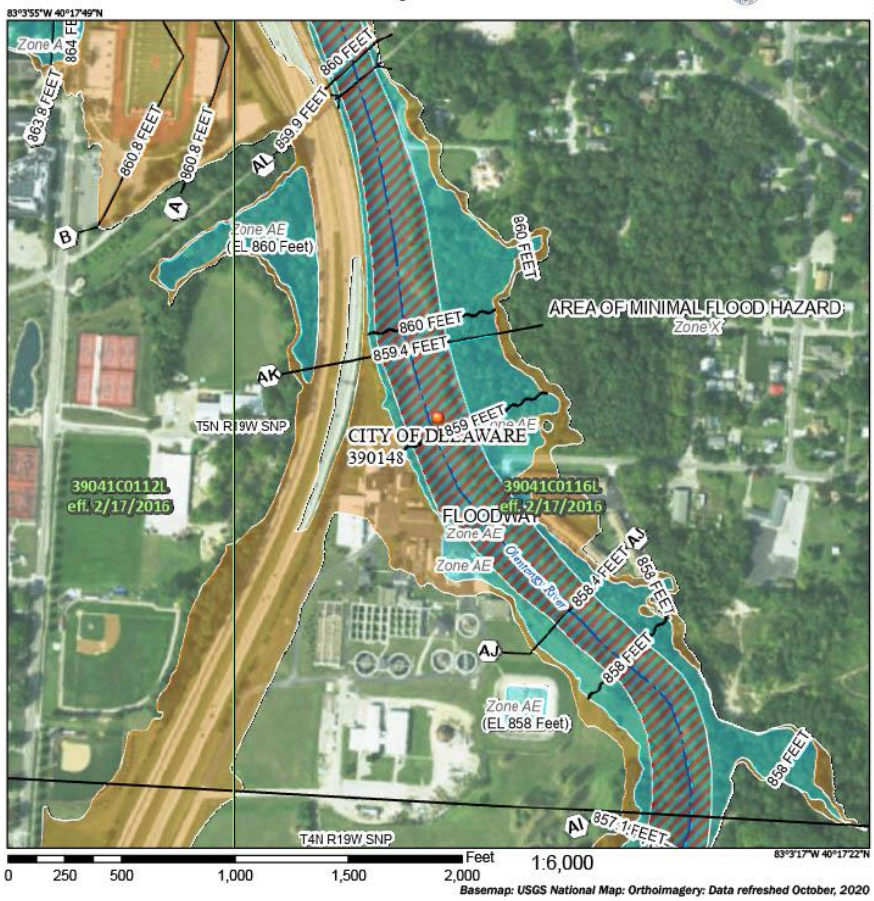
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:20 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

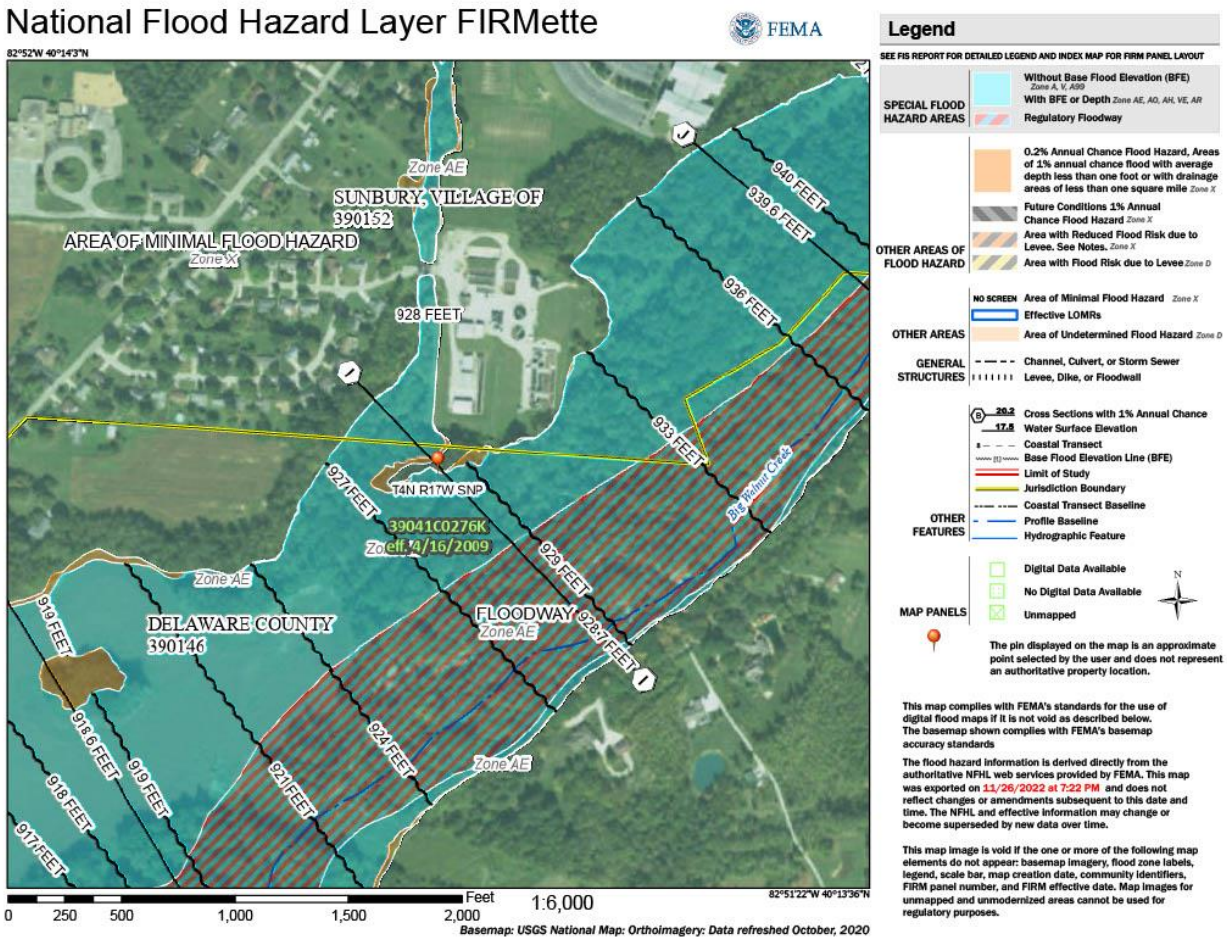
MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

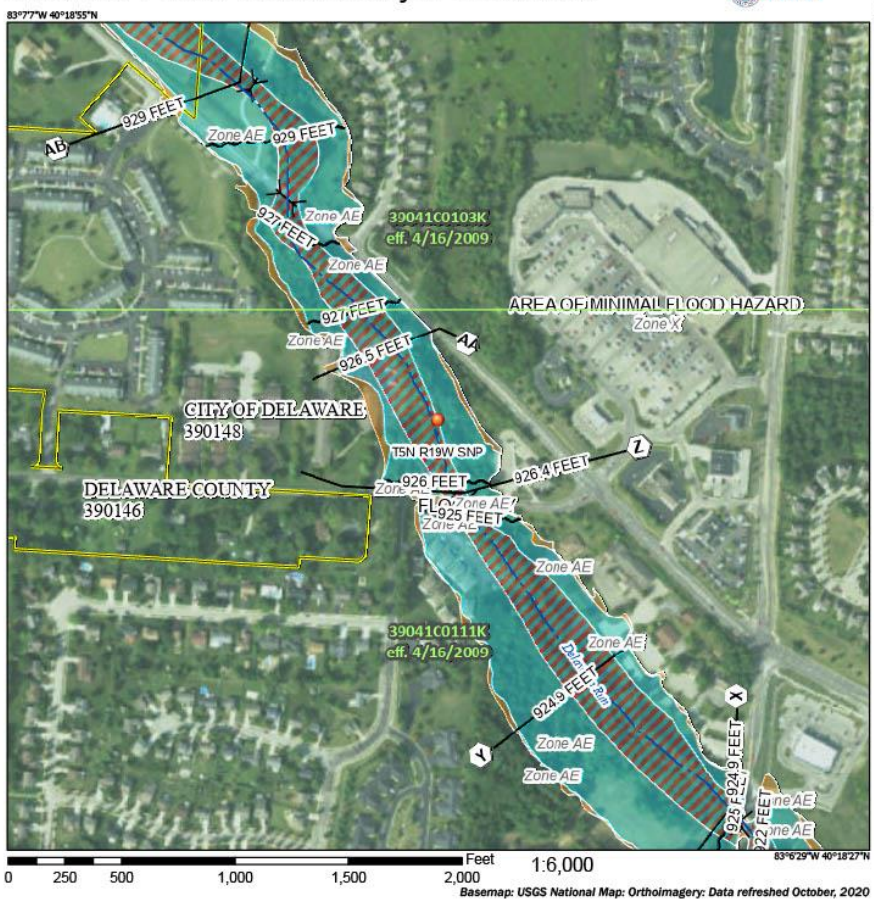
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:21 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


National Flood Hazard Layer FIRMette
FEMA
82°52'W 40°14'3"N
SUNBURY, VILLAGE OF
390152
AREA OF MINIMAL FLOOD HAZARD
Zone X
Zone AE
928 FEET
940 FEET
939.6 FEET
936 FEET
933 FEET
927 FEET
929 FEET
T4N R17W SNP
39041C0276K
Eff. 4/16/2009
Big Walnut Creek
DELAWARE COUNTY
390146
FLOODWAY
928.7 FEET
919 FEET
918.6 FEET
919 FEET
918 FEET
917 FEET
921 FEET
924 FEET
Feet
0 250 500 1,000 1,500 2,000
1:6,000
82°51'22"W 40°13'36"N
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2
17.5
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:22 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette



Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

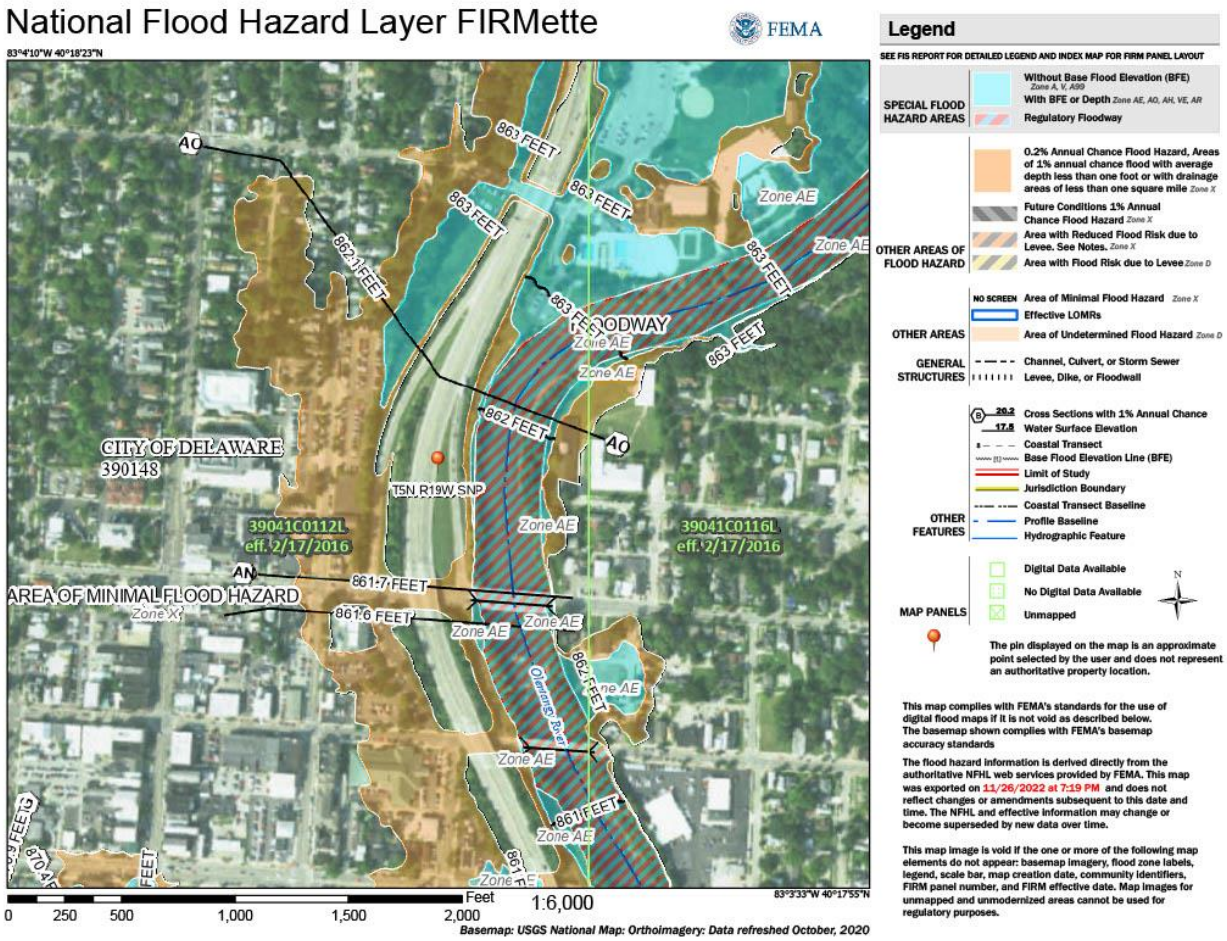
N

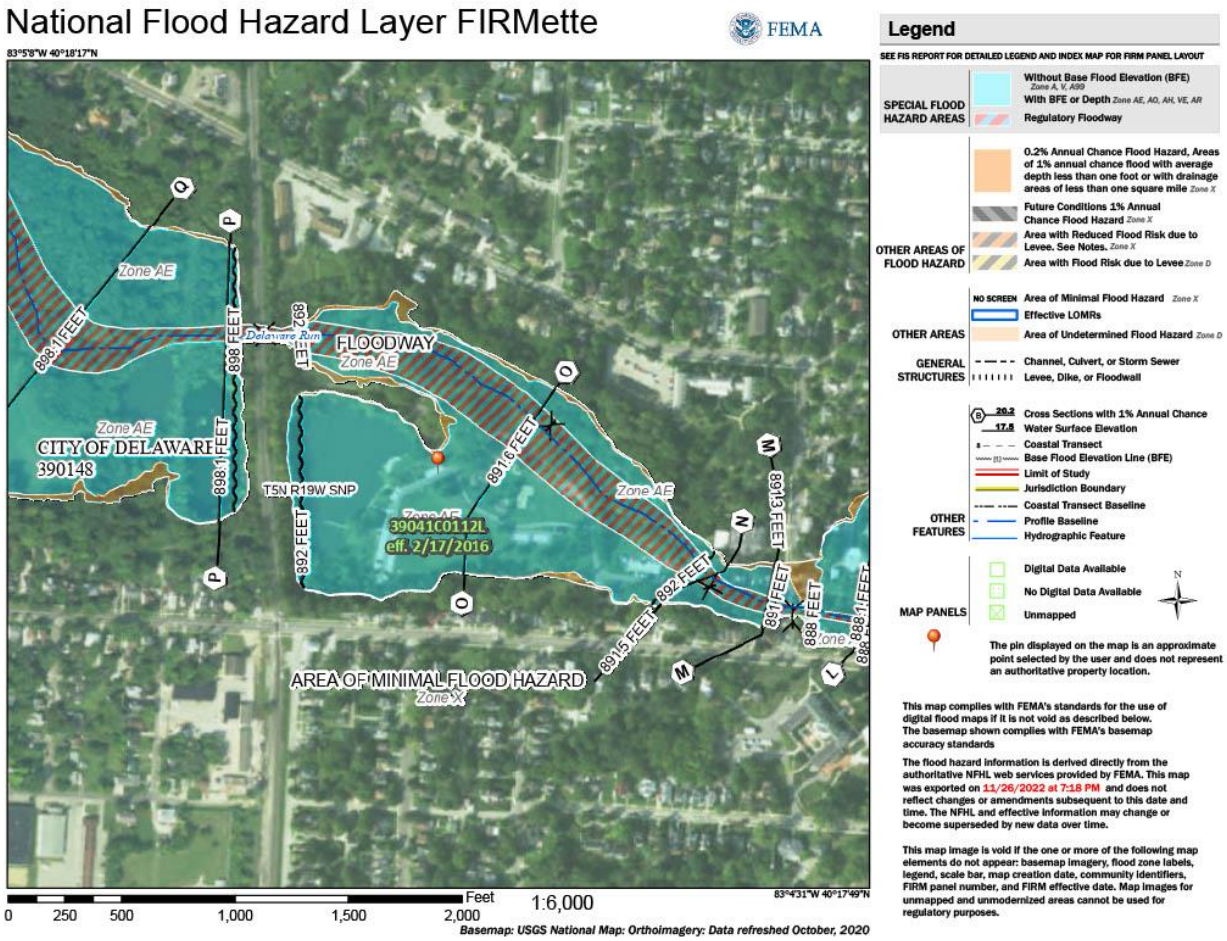
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:19 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


National Flood Hazard Layer FIRMette
FEMA
83°4'10"W 40°18'23"N
83°3'33"W 40°17'55"N
CITY OF DELAWARE
390148
T5N R19W SNP
39041C0112L
eff. 2/17/2016
39041C0116L
eff. 2/17/2016
AREA OF MINIMAL FLOOD HAZARD
Zone X
Zone AE
FLOODWAY
863 FEET
862 FEET
861.7 FEET
861.6 FEET
Olentangy River
0 250 500 1,000 1,500 2,000 Feet
1:6,000
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE)
With BFE or Depth
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile
Future Conditions 1% Annual Chance Flood Hazard
Area with Reduced Flood Risk due to Levee. See Notes.
Area with Flood Risk due to Levee
OTHER AREAS
Area of Minimal Flood Hazard
Effective LOMRs
Area of Undetermined Flood Hazard
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
Cross Sections with 1% Annual Chance
Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:19 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.


National Flood Hazard Layer FIRMette
FEMA
83°5'8"W 40°18'17"N
Zone AE
898.1 FEET
898 FEET
892 FEET
Delaware Run
FLOODWAY
Zone AE
CITY OF DELAWARE
390148
T5N R19W SNP
39041C0112L
eff. 2/17/2016
891.6 FEET
891 FEET
892 FEET
888 FEET
AREA OF MINIMAL FLOOD HAZARD
Zone X
Feet
0 250 500 1,000 1,500 2,000
1:6,000
83°4'31"W 40°17'49"N
Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020
Legend
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee. See Notes. Zone X
Area with Flood Risk due to Levee Zone D
OTHER AREAS
NO SCREEN Area of Minimal Flood Hazard Zone X
Effective LOMRs
Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES
Channel, Culvert, or Storm Sewer
Levee, Dike, or Floodwall
OTHER FEATURES
20.2 Cross Sections with 1% Annual Chance
17.5 Water Surface Elevation
Coastal Transect
Base Flood Elevation Line (BFE)
Limit of Study
Jurisdiction Boundary
Coastal Transect Baseline
Profile Baseline
Hydrographic Feature
MAP PANELS
Digital Data Available
No Digital Data Available
Unmapped
N
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/26/2022 at 7:18 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.
This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix F: Public Comments

Please see attached separate file

Appendix G: HAZUS Earthquake Run

Please see attached separate file

Appendix H: Available Resources & Capabilities of Participating Jurisdictions

Entity with AUTHORITY over the resource	Delaware County & Unincorporated Areas	Delaware City	City of Powell	City of Sunbury	Village of Ashley	Village of Shawnee Hills	Village of Ostrander	Village of Galena
Planner(s) or engineer(s) with knowledge of land development and land management practices.	Regional Planning; County Engineers' office	City Engineering Services, City Planning & Community Development	City Engineering Department, City Development Department					Mayor, Village Admin. &Zoning Insp.
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure.	Building - Code Compliance; Infrastructure – County Engineer, Regional Sewer District	City Planning & Community Development, City Engineering Services, City Public Utilities	City Building Department, City Engineering Department					Mayor, Zoning Insp., Village Admin.& Wastewater
Floodplain manager	Building Safety	City Planning & Community Development	City Development Department	City Zoning & Planning	Village Zoning	Village Code Enforcement	Village Mayor &/or Council	Village Zoning & Planning
Staff with education or expertise to assess the community's vulnerability to hazards.	Via Delaware County EMA via ORC 5502.26 and	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and	Via Delaware County EMA via ORC 5502.26 and	Via Delaware County EMA via ORC 5502.26 and	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and

	Agreement		Agreement	Agreement	Agreement			Agreement
Grant writers.	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement
Building code	Building Safety	City Planning & Community Development (Building Dept.)	City Building Department	Residential – City Building Department; Commercial – State of Ohio	Delaware County Building Safety	Delaware County Building Safety	Delaware County Building Safety	Residential - Delaware County Building Safety; Commercial– State of Ohio
Zoning ordinance	See List of Zoning Inspectors	City Planning & Community Development	City Development Department	City Zoning & Planning	Village Zoning	Village Code Enforcement	Village Zoning	Village Zoning & Planning
Growth management ordinances	Township or County Zoning; Regional Planning	City Planning & Community Development	City Development Department	City Zoning & Planning	Village Zoning	Village Code Enforcement	Village Zoning	Village Zoning & Planning
Site plan review requirements	Regional Planning	City Planning & Community Development	City Development Department	City Zoning & Planning	Village Zoning	Village Code Enforcement	Village Zoning	Village Zoning & Planning

An emergency response plan	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement
A post-disaster recovery plan	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement
Capital improvements project funding	Internal	Internal	Internal	Internal	Internal	Internal	Internal	Internal
Entity with CAPABILITY to maintain the resource	**Delaware County & Unincorporated Areas**	**Delaware City**	**City of Powell**	**City of Sunbury**	**Village of Ashley**	**Village of Shawnee Hills**	**Village of Ostrander**	**Village of Galena**
Authority to levy taxes for specific purposes	Levy	Levy	Levy	Levy	Levy	Levy	Levy	Levy
Impact fees for homebuyers or developers for	Not applicable in	City Planning & Community						

new developments/homes	Delaware County	Development						
Planner(s) or engineer(s) with knowledge of land development and land management practices.	Regional Planning; County Engineers' office	City Engineering Services, City Planning & Community Development	City Engineering Department, City Development Department					
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure.	Delaware County Building Safety; Infrastructure – County Engineer, Regional Sewer District	City Planning & Community Development, City Engineering Services, City Public Utilities	City Engineering Department, City Development Department					
Floodplain manager	Delaware County Building Safety	City Planning & Community Development	City Development Department	City Zoning & Planning	Village Zoning	Village Code Enforcement	Village Mayor &/or Council	Village Zoning & Planning
Staff with education or expertise to assess the community's vulnerability to hazards.	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement

Grant writers.	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement
Building code	Delaware County Building Safety	City Planning & Community Development (Building Dept.)	City Building Department	Residential – City Building Department; Commercial – State of Ohio	Delaware County Code Compliance	Delaware County Code Compliance	Delaware County Code Compliance	Residential – Delaware County Code Compliance; Commercial – Delaware County Code Compliance
Zoning ordinance	See List of Zoning Inspectors	City Planning & Community Development	City Development Department	City Zoning & Planning	Village Zoning	Village Code Enforcement	Village Zoning	Village Zoning & Planning
Growth management ordinances	Township or County Zoning; Regional Planning	City Planning & Community Development	City Development Department	City Zoning & Planning	Village Zoning	Village Code Enforcement	Village Zoning	Village Zoning & Planning
Site plan review requirements	Regional Planning	City Planning & Community	City Development	City Zoning & Planning	Village Zoning	Village Code Enforcement	Village Zoning	Village Zoning & Planning

		Development	Department					
An emergency response plan	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement
A post-disaster recovery plan	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement	Via Delaware County EMA via ORC 5502.26 and Agreement
Capital improvements project funding	Internal	Internal	Internal	Internal	Internal	Internal	Internal	Internal
Authority to levy taxes for specific purposes	Levy	Levy	Levy	Levy	Levy	Levy	Levy	Levy
Impact fees for homebuyers or developers for new developments/homes	Not applicable in Delaware County	City Planning & Community Development						