HOCKING COUNTY

ALL- HAZARD MITIGATION PLAN

HOCKING COUNTY, OHIO

AUGUST 2019

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1. INTRODUCTION

Overview

Hocking County, Ohio's previous Hazard Mitigation Plan took effect in 2007, after adoption by the county and all participating municipalities, it expired in 2012. This plan serves as an update to the 2007 Plan. Under the Disaster Mitigation Act of 2000 (DMA2K), local jurisdictions must have a disaster mitigation plan in effect to receive funds from the Federal Emergency Management Agency (FEMA) in the event of a natural or man-made disaster. This plan meets the criteria as set forth by FEMA in the DMA2K and provides the county and its participating municipalities with a comprehensive guide for future mitigation efforts to combat the hazards that affect their communities.

Man-made and natural hazards and disasters present a variety of risks to lives, businesses, and property. Hocking County recognizes the effectiveness of proper mitigation planning to prepare for and ultimately minimize the social, environmental, and economic costs of such events. Hocking County officials, local jurisdiction representatives, and other interested stakeholders dedicated their time and efforts to develop this updated Hocking County Multi-Hazard Mitigation Plan (the Plan) with assistance from the Ohio Emergency Management Agency (OEMA) and FEMA.

The Plan is comprised of six sections, detailing the methods, analysis, and discussion surrounding the various hazards that threaten Hocking County and its jurisdictions.

- This introduction (Section 1) includes 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 summary of the Plan's contents.
- Section 2 includes a short description of Hocking County and each of the participating jurisdictions, including their history, population, and other general information.
- Section 3 of this Plan details the process involved in the development of this plan, including a description of who participated in the process, how community involvement was incorporated, what hazards were included in the Plan and why, and how the Plan was composed through public meetings, reviews, and evaluations.
- Section 4 contains the Hazard Identification and Risk Assessment (HIRA) process: descriptions and analysis of the potential natural and manmade hazards that could affect the county. Section 4 includes a comprehensive list of the natural and manmade hazards that are considered in the mitigation plan and a list of excluded hazards, including the reason for their exclusion. Each hazard is subsequently profiled by discussing its nature, location, extent, historical impact on Hocking County (if applicable), and likelihood of occurrence. Each hazard profile concludes

with an assessment of the county's vulnerability to the hazard, including the number of vulnerable structures and/or crops and their asset values, including critical facilities and publicly owned structures (if information is available).

- Section 5 then outlines the goals, strategies, and actions for the county and its jurisdictions. The proposed actions are presented in tables, grouped by which hazard they principally address. They are ranked from highest to lowest priority, according to feedback received from county officials and participating jurisdictions and stakeholders.
- Section 6 is a summary of the proposed Plan adoption, integration and maintenance schedule.

This updated Multi-Hazard Mitigation Plan will be submitted to the OEMA and, subsequently, FEMA for review. The jurisdictions will then review the plan for adoption following the agency review. This plan serves many purposes as a helpful tool for citizens, policymakers, local businesses, and many other interested stakeholders who all share a public interest in keeping Hocking County as safe as possible. These purposes include but are not limited to the following listed below:

- Minimize property damage, economic loss, and injuries and loss of human life- to achieve the plan's main goal of reducing the impact of natural and manmade hazards on the county's economy and on the well-being of its 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 county-wide mitigation actions and programs so that they may be implemented efficiently and effectively.
- Provide decision-making tool for interested stakeholders- to formulate a comprehensive, updated analysis of Hocking County 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 the receive funding from grant programs, policies, and regulations.

2. HISTORY & DEMOGRAPHICS

HOCKING COUNTY

History

Hocking County was created from parts of Ross, Fairfield and Athens counties by an Ohio Legislature Act on January 3, 1818, becoming effective March 1 of the same year. On April 25 of that year, the Hocking County Commissioners held their first meeting.

The original boundaries of Hocking County included the following townships: Green, Falls, Gore, Good Hope, Laurel, Salt Creek, Benton, Washington, Swan, Jackson, Eagle, the western half of Starr, the western half of Brown, the southern two-sevenths of Perry and the southern two-thirds of Marion.

The total land area at that time was approximately 432 square miles as compared with 423 square miles today.

(See county by township map on page 10).

The County name is taken from the Hocking River that flowed through the County. Hocking was a contraction of the original Indian name, which has also been applied to the river itself. Hocking signifies “Bottleneck” in the language of the Delaware Indians.

Hocking County is located in the northwest portion of the foothills of the Appalachian Mountains of southeastern Ohio. The surrounding countryside features rocky gorges and cliffs created by glacial deposits. The forested terrain and unique geology have led to the development of a large network of state parks and lodging facilities, attracting millions of visitors per year. Many forces and events have influenced the development of Hocking County since the first Settlers invaded the ancient lands of the Native American Indians. Early in the County’s history it became apparent that prime agricultural land was scarce and the hilly countryside lacked the fertility and availability of farmlands to the north and west. As a result, subsistence agriculture dominated the local economy and prospects for wealth and industry appeared to be dim. Abruptly the picture changed around 1840. Drawing upon wide reserves of iron ores discovered in the county’s Hanging Rock Region, in parts of Starr and Washington townships, local entrepreneurs quickly built iron smelting furnaces to turn this ore into basic iron in the 1840s. At first the vast forests of the region furnished fuel for the smelting furnaces. Increasing production, however, brought great demands for charcoal and soon the timber was gone. Again, the economy reached a crisis in the 1880s. With the use of local coal for fuel, however, the problem with the lack of charcoal availability passed almost as soon as it arrived.

As coal reserves were tapped for the smelting furnaces, it became increasingly apparent that a vast reserve of coal was available, far surpassing the quantity and quality of local iron ore.

Shortly after the American Civil War, the mining of coal for export became the predominant industry of the area. The production of iron ore met severe competition to the east in Pittsburgh and as a result, the industry collapsed. Only local coal mining and lingering subsistence agriculture endured to support the majority of Hocking County citizens. By the end of the 19th century there were clear signs that a dark future lay ahead for Hocking County if alternate sources of income were not developed. These alternatives unfortunately did not materialize.

From the early twentieth century to a period following World War II, the economy and population suffered decline and stagnation. Coal mining lingered throughout the pre-Depression years and finally collapsed with the national economy during the 1930's. Jobs were scarce and only the worldwide economic Depression slowed down the mass migration of Hocking County citizens into America's cities.

By 1950, signs appeared that perhaps a brighter future lay ahead. Slowly, and with little fanfare, small industries appeared in and around Southeastern Ohio. As the national economy quickly recovered from the Depression and experienced a vast post-war expansion, more and more firms became interested in establishing new plants in areas with labor surpluses. In Hocking County alone, several major corporations established large, modern plants in the space of a few years. Almost overnight an abundance of once-scarce jobs were available for local inhabitants.

By the early 1960's, twenty-two companies had established themselves in Hocking County with various leading products: clay products, aircraft parts, pottery, furniture, flour and feed, shoes, oil well tools and supplies, steel pipe and vent, metal powder products, abrasives, automobile dash board components, glass tubing, packing products, office and filing supplies, tomb memorials, building tile, dairy products, oil and gas wells, the re-emergence of the coal industry and numerous diversified farms.

Companies established included the following: Smead Manufacturing, William Wallace Company-Metalbestos, General Electric, Goodyear, Carborundum, General Hocking Brick, Logan Clay, Keynes Brothers, National Supply-Armco Steel, Coffman Stair, Metal Powder and Lockheed Aircraft.

The Cherrington Hospital, which opened in 1908 in the stately brick house originally built by Robert Wright, later became the Hocking Valley Hospital. In 1966 a new and modern facility was dedicated for the health care of its residents. The Hocking Valley Community Hospital, located on State Route 664 North, boasted a capacity of 54 beds and 20 bassinettes.

In the mid 1960's it became apparent to the Hocking County leadership that the community was doubtlessly going to undergo substantial growth and change. In order to guide this growth and plan for changes ahead, the Hocking County Board of Commissioners established the Hocking County Planning Commission. The Planning Commission, charged with the duty of preparing a comprehensive master plan for the development and growth of the entire county, prepared the 1968 Comprehensive Land Use and Infrastructure Plan.

By the late 1970's through the 1980's, and into the 1990's, the county industrial base had begun to change dramatically. Unlike the operations of yesteryear that supported the custom manufacture of products to serve local needs, Hocking County industries had become mostly plants belonging to larger corporations. Due to aging plant facilities as well as jobs being moved to other parts of the country and world, Hocking County experienced the loss of several established industries. Among those to leave were Godman Shoe Factory, Lockheed Aircraft, National Supply-Armco Steel, Carborundum (which was later purchased from Sohio in 1984 and re-opened under local ownership), Goodyear, Metal Powder and General Hocking Brick. During this time however, some new industries were also established including Wolsky Stair Company (that purchased the old Coffman Stair Company), Amanda Bent Bolt, Records Programs, Gabriel-Logan and the Columbus Washboard Company.

Also beginning in the 1970's was the re-emergence of the timber industry as second and third growth timber became available to harvest. It was realized that timber, when managed properly, is a viable and renewable crop for the rugged terrain of the Hocking Hills.

Early in the 1980's it was also apparent that tourism in Hocking County had become a very real and viable contributor as a newly emerging industry. Today there are over 165 private lodging operators with more than 500 units available, as well as two new national chain motels.

From 1990 to 2000, the increased growth of Hocking County became quite evident. According to the 2000 Census for the previous decade, Hocking County was the fastest growing county in southeast Ohio, with a rate of growth at nearly 10%. Highway improvements to US Route 33, including the Lancaster (2005) and Nelsonville (2009) bypasses, and the upgrade to a super 2-lane from Athens to I-77 (2004), forecast the advent of rapid growth for Hocking County. Since the millennium, a new industrial park was completed at the northwest edge of Logan and is a designated foreign trade zone. Renewed interest from retail businesses marked the establishment of a Wal-Mart store with an adjoining shopping mall complex of related retail businesses at the US Route 33 and State Route 664 interchange. A privately owned and operated Farmers Market complex sprang up nearby at Rockbridge, just north of the Wal-Mart establishment. Currently, a commercial business site at the US Route 33 and State Route 664/Lake Logan road interchange, containing the new Holiday Inn Express, is under development and presents significant interest from "outside" businesses that see Hocking County's potential for growth.

However, downtown Logan has seen an exodus of retail stores to the US 33 corridor. New downtown storefronts have emerged, including an emporium, ice cream shop, restaurants and artisan gallery/studio facilities.

With the establishment of the Hocking County Regional Planning Office by the Hocking County Commissioners in 2001, the first order of business was to update the County's comprehensive plan to prepare for the anticipated challenges of growth and change that undoubtedly lied ahead. Below in Figure 2-1 it shows how Hocking county's population has changed and

estimated population for the future. Figure 2-2 below shows the Population Growth by Township and Figure 2- shows the County's Townships.

FIGURE 2-1: POPULATION GROWTH

YEAR OF CENSUS	ACTUAL POPULATION	YEAR OF CENSUS	ACTUAL POPULATION
1820	2,130	2010	29,380
1850	14,119	2015	28,491
1900	24,398	2020	29,480
1950	19,520	2030	28,620
2000	28,241	2040	27,870

FIGURE 2-2: POPULATION GROWTH BY TOWNSHIP

NAME	ACTUAL	ACTUAL	ESTIMATED	ESTIMATED
OF TOWNSHIP	2000	2010	2015	2016
BENTON	814	803	786	790
FALLS GORE	11,409	11,731	11,605	11,562
GOOD HOPE	1,444	1,399	1,364	1,356
GREEN	2,585	3,261	3,202	3,184
LAUREL	1,190	1,166	1,144	1,149
MARION	2,411	2,463	2,415	2,402
PERRY	2,554	2,560	2,504	2,491
SALT CREEK	1,260	1,210	1,181	1,174
STARR	1,477	1,560	1,523	1,514
WARD	1,937	1,933	1,481	1,474
WASHINGTON	1,160	1,294	1,253	1,260
VILLAGE OF MURRAY CITY	452	453	438	440
VILLAGE OF LAURELVILLE	533	525	510	513
VILLAGE OF BUCHTEL	574	558	553	553
CITY OF LOGAN	6,704	7,111	7,104	7,085

FIGURE 2-3: HOCKING COUNTY TOWNSHIPS

**Note: Buchtel is located in both Hocking and Athens counties. They have chosen to participate in Athens County's Hazard Mitigation Plan, so they are not included in this plan.*

DEMOGRAPHIC INFORMATION: CITY, VILLAGES, & TOWNSHIPS

CITY OF LOGAN

The City of Logan is located on the Hocking River, 48 miles southeast of Columbus. The population was 7,152 at the 2010 census with 2,982 households. It is the county seat of Hocking County. Residents name the town in honor of Chief Logan of the Mingo Indian tribe. He and his band lived in this area at the time of European-American settlement. Ohio Governor Thomas Worthington established the community in 1816.

VILLAGE OF LAURELVILLE

The Village of Laurelville is located outside of The Hocking State Forest. Laurelville was laid out in 1871 by John and W.S. Albin, and Solomon Riegel. The village was named for the laurel growing near the original town site. The Village has a total area of 0.21 square miles. The population was 527 at the 2010 census with 252 households.

VILLAGE OF MURRAY CITY

The Village of Murray City was platted in 1873. It was named for one Mr. Murray, the original owner of the town site. It is located along the Snow Fork, a tributary of Monday Creek. The 2010 census calculated the population at 449 residents and 175 households.

BENTON TOWNSHIP

Benton Township is located in the southwestern part of the county. No municipalities are located within the township, although the unincorporated community of South Bloomingville lies in the central part of the township. It is situated in the heart of the Hocking Hills region, Benton Township includes much of Hocking Hills State Park, including the popular Old Man's Cave and Ash Cave. The 2010 census showed the population was 803 residents with households unknown.

FALLS TOWNSHIP

Falls Township consists of 11,731 residents based on the 2010 census, of who 5,209 live in the unincorporated portions of the township. The City of Logan is located in the southwestern portion of Falls Township. The township takes its name from a waterfall on the Hocking River, where a mill had been built in 1814, prior to the township's formation.

GOOD HOPE TOWNSHIP

Good Hope Township is located in the northwestern part of the county with 1,399 residents (2010 census). The unincorporated community of Rockbridge lies in the northern part of the township. Its name was likely after the former Our Lady of Good Hope Catholic Church.

GREEN TOWNSHIP

Green Township is located in the eastern part of the county with a population of 3,261 in 2010. The township increased in population by 676 residents from the 2000 census. As of 2010, 2,631 of the population lived in the unincorporated portion of the township. Southeast of Logan lies the unincorporated community of Haydenville. Green Township was organized in 1825.

LAUREL TOWNSHIP

Laurel Township has a population of 1,166 residents per the 2010 census. It is located in the western part of the county. Laurel was named from the mountain-laurel native in the area.

MARION TOWNSHIP

Marion Township is located in the northern part of the county and has 2,463 residents (2010 census).

PERRY TOWNSHIP

Perry Township is located in the northwestern corner of the county with 2,560 residents, whom 2,033 live within unincorporated portions of the township (2010 census). The Village of Laurelville is located in Perry Township's southwestern corner.

Perry Township was not a part of Hocking County when it was created in 1818. It remained a part of Fairfield County until 1850. At the time, the creation of Vinton County south of Hocking

County took some of Hocking County's acreage. To recompense Hocking County for its loss, Perry Township was taken from Madison township of Fairfield and given to Hocking County.

SALT-CREEK TOWNSHIP

Salt-Creek Township has 1,210 residents based on the 2010 census. It is in the southwestern corner of the county. Salt-Creek was named from the creek and associated salt production there.

STARR TOWNSHIP

Starr Township is located in the southeastern corner of the county with a population of 1,560 residents (2010 census). It encompasses the unincorporated community of Union Furnace, which lies in the central part of the township. It was named for Joseph Starr, a pioneer settler who was instrumental in that township's organization.

WARD TOWNSHIP

Ward township is located in the far eastern portion of the county and has a population of 1,933 of whom 1,469 live in the unincorporated portions of the township (2010 census). Murray City, the smallest municipality in Hocking County, is located in Ward Township, as are the unincorporated communities of Carbon Hill and Sand Run. Ward Township was organized in 1836. It was named for Naham Ward, a landowner. Most of the township includes Wayne National Forest.

WASHINGTON TOWNSHIP

Washington Township is in the southern part of the county with 1,294 residents, up from 1,160 at the 2000 census. The unincorporated communities of Washington Township are Ewing and Ilesboro.

3. PLANNING PROCESS

METHODOLOGY

This chapter details the process involved in the development of this plan, including a description of who participated in the process, how community involvement was incorporated, what hazards were included in the Plan and why, and how the Plan was composted through public meetings, research, review, and evaluations.

NOTIFICATION PROCESS

All incorporated jurisdictions of the county, agencies that work within the county or incorporated jurisdictions, and neighboring counties, received notification of the mitigation planning process. The Hocking County EMA Office created a master list of jurisdictions and agencies that should participate in this planning effort. The comprehensive list was reviewed to ensure that all the appropriate agencies as well as jurisdictions would be invited to participate in this effort. A Core Group representing a wide array of political subdivisions, as well as agencies and private businesses, was notified of the mitigation planning process.

FIGURE 3-1: CORE GROUP

NAME	AGENCY	STAKEHOLDER
COUNTY EMA STAFF		
CESALIE GUSTAFSON	HOCKING COUNTY EMA	Director
SONJA MILLER	HOCKING COUNTY EMA	Admin
CITY OFFICIALS		
Seth Warthman	CITY OF LOGAN	Storm Water Mgmt
Jerry Mellinger	CITY OF LOGAN	Police Chief
Brian Robertson	CITY OF LOGAN	Fire Chief
Roger Stivison	CITY OF LOGAN	Transit Authority
Chester Smith	CITY OF LOGAN	Water Division
Nick Maniskas	CITY OF LOGAN	Cemetery & Parks
Richard Burcham	CITY OF LOGAN	Recreation
Andy Good	CITY OF LOGAN	Chamber of Commerce
Bruce Walker	CITY OF LOGAN	City Manager
COUNTY OFFICIALS		
Jeff Dickerson	HC Commissioners	Commissioner
Lanny North	HC Sheriff	Law Enforcement
Audie Wykle	HC Exec Director	Regional Planning Comm.
Debbie Later	HC Soil and Water	District Program Administrator
Benjamin Fickel	Prosecuting Attorney	Asst. Pros Attorney
Stacey Gabriel	Local Planning Comm.	LEPC President
Michelle Matheny	HVCH	
Ken Wilson	HC Auditor	Tax assessment/ real estate
Tim Meehling	HC Sewer Department	
William Shaw	HC Engineer	Engineer
Joy Davis	Econ Develoment	CIC
STATE AGENCIES		
Debbie Fought	State of Ohio ODOT	State dept. Transportation
Peter George	State of Ohio ODNR	State Dam Safety
Lori Haukedahl	State of Ohio EMA	Southeast Region Liasion
Daron Price	State of Ohio EMA	Southeast Region Supervisor
Luan Nguyen	State of Ohio EMA	Planning/ Mitigation
OTHER AGENCIES		
Mary McCord	American Red Cross	Disaster Services
Julie Dian-Reed	National Weather Service	Senior Hydrologist/Meterologist
Andy Good	Faith Based	Pastor
Monte Bainter	Logan School System	Academia
James Martin	Hocking Hills Tourism	
Karen Raymore	Hocking Hills Tourism	
Jeff Daubenmire	Hocking College	Academia
MAYORS		
Greg Fraunfelter	CITY OF LOGAN	Mayor
Michael Dupler	Village of Murray City	Mayor
Brent Ebert	Village of Laurelville	Mayor
NOTE: A spreadsheet with office number and email addresses is retain in the Hocking County EMA office.		
Will not be part of this plan due to sensitivity.		

MEETINGS

The planning process began with a kick-off email to the members of the Core Group. The two Core Group Public Meetings (October 3rd and 29th of 2018) were primarily attended by the Core Group and by stakeholders in the planning process but were open to the general public.

The committee meetings that occurred were by invitation and by public notice in The Logan Daily. All meetings of the Core Group were open to the public and the public was invited to attend and provide input on the Plan Update. The existing Hazard Mitigation Plan could be viewed at the Hocking County EMA website at http://www.co.hocking.oh.us/ema/ and sent to neighboring jurisdictions for review and comment. Comments were made available through the EMA website, email, and calling into the office. An article about the plan update was published on Facebook and through The Logan Daily.

A public notice announcing the availability of the Plan Update for public review and comment, including a four-question survey was advertised through social media accounts and on HCEMA's website on July 14, 2017. The county received multiple surveys back, as listed in Appendix A. Following final federal approval, the final draft will be sent to all interested parties including all municipalities in Hocking County and neighboring jurisdictions.

After the planning process was finished, the public had the opportunity to review and comment on the revised plan. These methods followed the same as those listed above when the public reviewed the previous plan.

ASSESSING RISK

To establish a comprehensive understanding of Hocking County and its communities, including past characteristics and present-day and future plans, a thorough review of data sources and County and community plans was performed, as listed in **Appendix E Sources**. This information was used to establish an accurate baseline for the County and then develop risk assessments for potential hazards.

Hocking County and its communities then reviewed and updated this information and potential consequences of hazards in order to understand how much of the community could be affected by specific hazards and what the impacts would be on important community assets. This plan was prepared by the Hocking County EMA Office. Therefore, information gathered from the Core Group meetings allowed the EMA Office to then update the plan. Data gathered was in regards to its assets for residential, non-residential, and critical facilities. The Core Group reviewed each hazard event profiles for description, location, extent, history, and probability of occurrence. Based on the last several years, the Core Group adjusted the probability of each hazard according to history, location, and variations of extent. Coupled with updated inventory data, the Core Group estimated the losses projected for the types of buildings, numbers, and estimated damage in the County as a whole and as thorough as data would allow.

MITIGATION PLAN DEVELOPMENT & UPDATE

Armed with the understanding of the risks posed by hazards, the Core Group determined what their priorities should be and look at possible ways to minimize the effects of each hazard. This resulted in the updated Hocking County Natural Hazard Mitigation Plan: and the strategy for implementation. After examining existing mitigation goals and objectives, the Mitigation Planning Team also took new goals and objectives into consideration. A revised approach was formed that identified existing and new mitigation actions that re-prioritized. The Core Group prepared the implementation strategy that identifies the action, priority, timeline, lead, organization, and resources needed as well as status. This beginning section of the revised plan documents the planning process of the Hocking County Core Group.

FIGURE 3-2: HOCKING COUNTY REGULATORY GUIDANCE

JURISDICTION	ZONING ORDINANCES	SUBDIVISION REGULATIONS	FLOODPLAIN MANAGEMENT REGULATIONS	STORMWATER MANAGEMENT REGULATIONS	BUILDING CODES	HISTORIC PRESERVATION ORDINANCE
CITIES						
City of Logan	*X*	*X*	*X*	*X*	*X*	*X*
VILLAGES						
Village of Laurelville		*X*	*X*			*X*
Village of Murray City		*X*	*X*			
TOWNSHIPS						
Benton Twp.		*X*	*X*			
Falls Twp.		*X*	*X*			*X*
Good Hope Twp.		*X*	*X*			
Green Twp.		*X*	*X*			*X*
Laurel Twp.		*X*	*X*			
Marion Twp.		*X*	*X*			
Perry Twp.		*X*	*X*			
Salt Creek Twp.		*X*	*X*			*X*
Starr Twp.		*X*	*X*			
Ward Twp.		*X*	*X*			
Washington Twp.		*X*	*X*			

**Note: Hocking County has a Planning Commission and Comprehensive Plans. All jurisdictions within the State now follow the State Building Code. (Ohio Administrative Code 4101:1.)*

4. HAZARD RISK ASSESSMENT

DAM FAILURE

DESCRIPTION

FEMA describes dams as "man-made structures built across a stream or river that impound water and reduce the flow downstream." Dam failure occurs when that impounded water is suddenly released in an uncontrollable manner. There are varying degrees of dam failure, but FEMA describes any malfunction or abnormality which adversely affects a dam's primary function of impounding water as a degree of failure. Water released from the dam during failure will always flow downhill, so any property located below the dam failure site is at risk of serious property damage and even loss of life.

Dams can fail for one or a combination of the following reasons:

- Overtopping caused by floods that exceed the capacity of the dam
- Structural failure of materials used in dam construction
- Movement and/or failure of the foundation supporting the dam
- Settlement and cracking of concrete or embankment dams
- Piping and internal erosion of soil in embankment dams
- Inadequate maintenance and upkeep
- Deliberate acts of sabotage

LOCATION

Dam failures are categorized as either sunny day failure or rainy-day failures. Sunny day failures occur during a non-flooding situation with the reservoir at or near normal pool level. Rainy day failures usually involve periods of rainfall and flooding and can exacerbate inadequate spillway capacity.

The National Inventory of Dams (NID) classifies dam hazards by at least one of the following criteria:

- High hazard classification- loss of one human life is likely if the dam fails
- Significant hazard classification- possible loss of human life and likely significant property or environmental destruction
- Low hazard or undetermined potential classification dams which
    - Equal or exceed 25 feet in height and exceed 15 acre-feet in storage
    - Equal or exceed 50 acre-feet storage and exceed six feet in height

FIGURE 4-1: DAM CLASS (LOCATION & EAP'S)

HOCKING COUNTY CLASS I DAMS

Dam Class	Name	Township	EAP's
Class I	LAKE LOGAN DAM	FALLS	X
Class I	OLD MAN'S CAVE LAKE DAM	BENTON	X
Class I	LAKE OF THE FOUR SEASONS DAM	MARION	
Class I	HAMBLETON LAKE DAM	WARD	

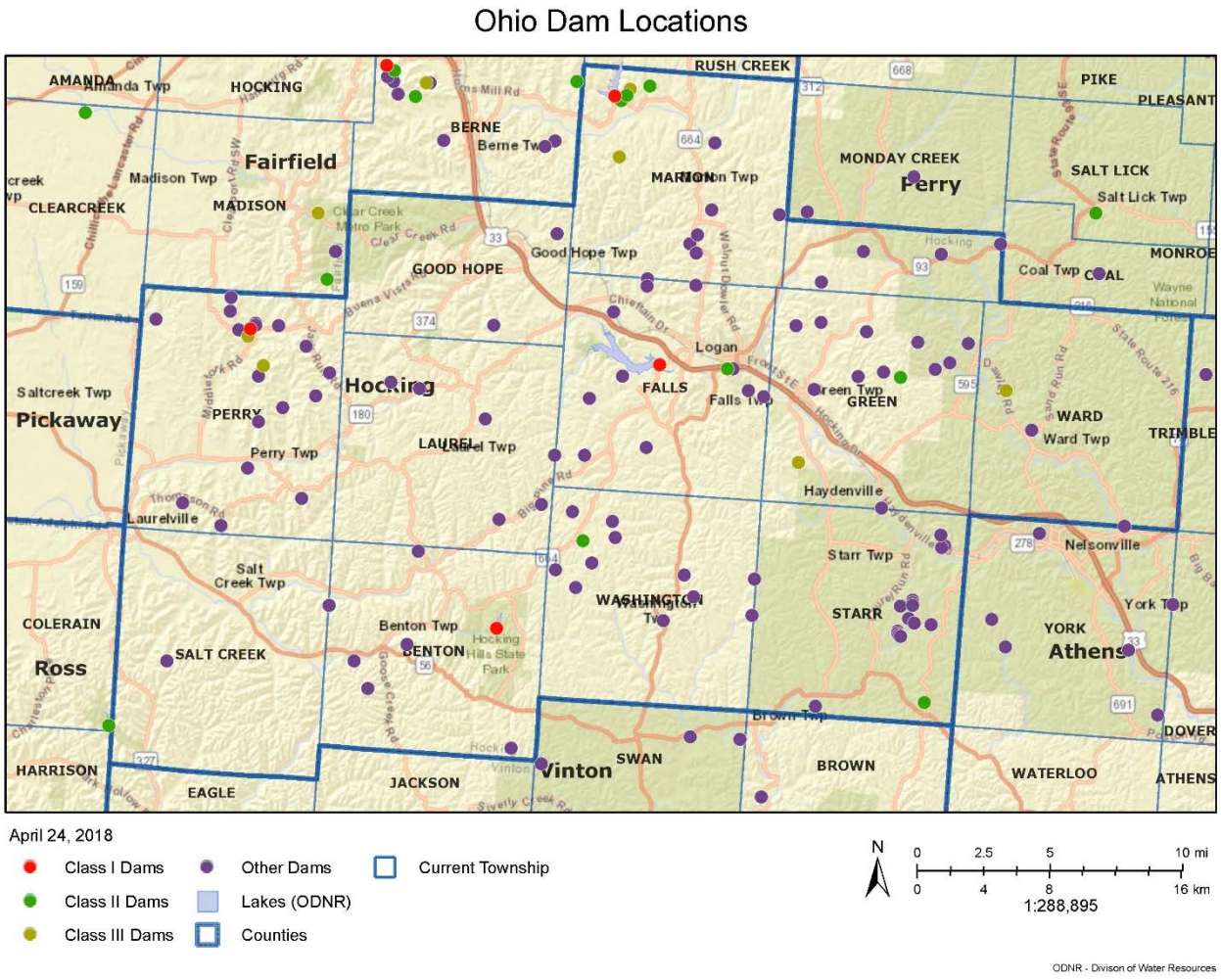
HOCKING COUNTY CLASS II DAMS

Dam Class	Name	Township	EAP's
Class II	LOGAN WATER TREATMENT PLAN LEVEE	CITY OF LOGAN	
Class II	HAPPY HILLS LAKE DAM	STARR	
Class II	HIDDEN LAKE DAM	WASHINGTON	X
Class II	LAKE RICE DAM	GREEN	X
Class II	LAKE EAGLE CLAW	MARION	X
Class II	LAKE DEER FOOT	MARION	X
Class II	LAKE ARROWHEAD	MARION	X

HOCKING COUNTY CLASS III DAMS

Dam Class	Name	Township	EAP's
Class III	HIDDEN LAKE DAM	PERRY	
Class III	SAND RUN LAKE DAM	WARD	
Class III	LAKE TOMAHAWK	MARION	X
Class III	CAMP AKITA DAM	CITY OF LOGAN	X
Class III	CAMP OTTERBEIN LAKE DAM	GREEN	

FIGURE 4-2: DAM LOCATION MAP



EXTENT

Hocking County has a total of 4 Class I dams, 3 Class II dams, 3 Class III dams. According to Ohio Administrative Code Rule 1501:21-12-01 (2010), dams are classified as follows:

- Class I: Dams having a total storage volume greater than five thousand acre-feet or a height of greater than 60 feet shall be placed in Class I. A dam shall be placed in Class I when sudden failure of the dam would result in one of the following conditions:
  - Probable loss of human life
  - Structural collapse of at least one residence or one commercial or industrial business

- Class II: Dams having a total storage volume greater than five hundred acre-feet or a height of greater than 40 feet shall be placed in Class II. A dam shall be placed in Class II when sudden failure of the dam would result in at least one of the following conditions, but loss of human life is not probable:
    - Disruption of public water supply or wastewater treatment facility, release of health hazardous industrial or commercial waste, or other health hazards
    - Flooding of residential, commercial, industrial, or publicly owned structures
    - Flooding of high-value property
    - Damage or disruption to major roads including but not limited to interstate and state highways, and the only access to residential or other critical areas such as hospitals, nursing homes, or correctional facilities
    - Damage or disruption to railroads or public utilities
    - Damage to downstream Class I, II or III dams or levees, or other dams or levees or high value. Damage to dams or levees can include, but is not limited to, overtopping of the structure
- Class III: Dams having a total storage volume greater than fifty acre-feet or a height of greater than 25 feet shall be placed in Class III. A dam shall be placed in Class III when sudden failure of the dam would result in at least one of the following conditions, but loss of human life is not probable:
    - Property losses including but not limited to rural building not otherwise described in paragraph (A) of the Ohio Administrative Code Rule 1501:21-12-01, and class IV dams and levees not otherwise listed as high-value property in paragraph (A) of this rule. At the request of the dam owner, dams may be exempt from the criterion of this paragraph if the dam owner owns the potentially affected property.
    - Damage or disruption to local roads including but not limited to roads not otherwise listed as major roads in paragraph (A) of this rule.
- Class IV: Dams which are 25 feet or less in height and have a total storage volume of 50 acre-feet or less may be placed in Class IV. When sudden failure of the dam would result in property losses restricted mainly to the dam and rural lands, and loss of human life is not probable, the dam may be placed in Class IV. Class IV dams are exempt from the permit requirements of section 1521.06 of the Revised Code pursuant to paragraph (C) of rule 1501:21-19-01 of the Administrative Cods.

HISTORY

Hocking County, Hide Away Hills Ohio - fall 2013:

In the fall on 2013 the class 1 dam at Hide Away Hills (Lake of four seasons) had a slide occur on the upstream side of the dam while dropping the lake to winter pool. Hide Away Hills contacted ODNR, the dam was deemed stable with the lowered water levels. An engineering plan for repair was approved in 2016. The lake was returned to full level in 2017.

Hocking County, Logan Ohio – 1950:

The Lake Logan Dam breached in 1950 when the lake was being filled after construction, this was credited to poor design and construction. There was no reported damage other than to the dam. Construction was successfully completed in 1954.

PROBABILITY

The probability of a dam failure occurring in Hocking County has an annual 2% chance of occurring based on previous occurrences.

VULNERABILITY ASSESSMENT

Monetary Damages

Monetary damages caused by flooding due to dam failure range from minor water damage to total loss. They include deaths, crop damage or loss, structural damage, damage to infrastructure, power failure, ruined flooring, and damages caused by flowing objects.

Impact Damages

There are many dams in the County and some are located on watersheds where a dam failure could seriously affect the areas downstream. Water released from the dam during failure will always flow downhill, so any property located below the dam failure site is at risk of serious property damage and even loss of life.

Estimated Losses

Estimated loss was determined based on each Class I dam being a complete failure:

- Lake Logan Dam: would result in loss of life and significant property damage in the City of Logan. Logan's total population is 7,152 per the 2010 census with 3,374 housing units. US Rt. 33, St. Rt. 93, St. Rt. 664, and St. Rt. 328 would be affected as well. Property damage to residential, businesses and industrial properties would be $386 million based off of Hocking County's average property costing $114,400 times 3,374 housing units.
- Old Man's Cave Lake Dam: would result in loss of life and significant property damage in and around Old Man's Cave area. There are roughly 54 structures either critically inundated or inundated if the dam were to fail. The roads affected would be; State Routes 664 and 56, Steele Road, Chapel Ridge Road at State Route 56, and County Road 249. With the average property in Hocking County costing $114,400 the estimated damage would be around $6.2 million.

- Lake of the Four Seasons Dam: This Dam is currently working on their Emergency Action Plan which includes inundation mapping. It is still in draft form. Once it is approved it will be sent to the EMA office and updated in the Natural Hazards Mitigation Plan.
- Hambleton Lake Dam: The Emergency Action Plan did not have inundation studies to observe in order to obtain a dollar figure for damages.

DAMAGING WINDS

DESCRIPTION

Wind is horizontal motion of the air past a given point. Winds begin with differences in air pressures; pressure that is higher at one place than another sets up a force pushing from the high toward the low pressure. The greater the difference in pressures, the stronger the force. The distance between the area of high pressure and the area of low pressure also determines how fast the moving air is accelerated. Meteorologists refer to the force that starts the wind flowing as the "pressure gradient force'. High and low pressures are relative. There is no set number that divides high and low pressure. Wind is used to describe the prevailing direction from which the wind is blowing with the speed given usually in miles per hour or knots.

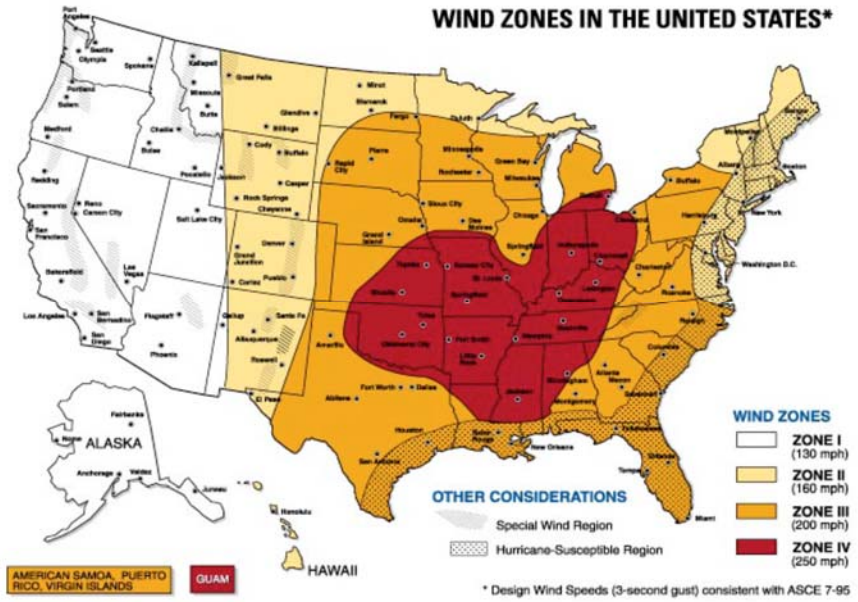
- Straight-line wind is a term used to define any thunderstorm wind that is not associated with rotation and is used mainly to differentiate from tornadic winds. Most thunderstorm winds that cause damage at the ground are a result of outflow generated by a thunderstorm downdraft. Damaging winds are classified as those exceeding 50-60 mph.
- Downdrafts are a small-scale column of air that rapidly sinks toward the ground.
- A downburst is a result of a strong downdraft. A downburst is a strong downdraft with horizontal dimensions larger than 4 km (2.5 mi) resulting in an outward burst of damaging winds on or near the ground. (Imagine the way water comes out of a faucet and hits the bottom of the sink.) Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.
- A microburst is a small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally small (less than 4km across) and short-lived, lasting only 5-10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.
- A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud of detached roll cloud.
- A derecho is a widespread, long-lived wind storm that is associated with a band of rapidly moving showers or thunderstorms. A typical derecho consists of numerous microbursts, downbursts, and downburst clusters. By definition, if the wind damage swath extends more than 240 miles (about 400 kilometers) and includes wind gusts of at

least 58 mph (93 km/h) or greater along most of its length, then the event may be classified as a derecho.

LOCATION

Severe winds are a county-wide hazard in Hocking County, potentially affecting all areas and jurisdictions.

FIGURE 4-3: WIND ZONES IN THE UNITED STATES



EXTENT

Damage from severe thunderstorm winds account for half of all severe reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. Since most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft, anyone living in thunderstorm-prone areas of the world is at risk for experiencing this hazard. People living in mobile homes are especially at risk for injury and death. Even anchored mobile homes can be seriously damaged when winds gust over 80 mph.

The Beaufort Wind Chart rates the severity of wind (based on speed) on a 0-12 scale. As a wind event gains force, the likelihood of damage increases as shown below:

FIGURE 4-4: BEAUFORT WIND CHART

Beaufort Wind Chart – Estimating Winds Speeds

Beaufort Number	MPH Range	MPH Average	Terminology	Description
0	0	0	Calm	Calm. Smoke rises vertically.
1	1-3	2	Light air	Wind motion visible in smoke.
2	4-7	6	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	8-12	11	Gentle breeze	Leaves and smaller twigs in constant motion.
4	13-18	15	Moderate breeze	Dust and loose paper is raised. Small branches begin to move.
5	19-24	22	Fresh breeze	Smaller trees sway.
6	25-31	27	Strong breeze	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult.
7	32-38	35	Near gale	Whole trees in motion. Some difficulty when walking into the wind.
8	39-46	42	Gale	Twigs broken from trees. Cars veer on road.
9	47-54	50	**Severe gale**	**Light structure damage.**
10	55-63	60	**Storm**	**Trees uprooted. Considerable structural damage.**
11	64-73	70	**Violent storm**	**Widespread structural damage.**
12	74-95	90	**Hurricane**	**Considerable and widespread damage to structures.**

Webpage: http://www.weather.gov/iwx
Twitter: @nwsiwx
Facebook: NWSNorthernIndiana

HISTORY

Event Types: High Wind

Hocking county contains the following zones:

'Hocking' 8 events were reported between 01/01/1950 and 05/31/2019 (25353 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	8
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	5
Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	3.449M	0.00K
HOCKING (ZONE)	HOCKING (ZONE)	OH	12/11/2000	21:00	EST	High Wind	58 kts. M	0	0	0.00K	0.00K
HOCKING (ZONE)	HOCKING (ZONE)	OH	3/9/2002	17:00	EST	High Wind	53 kts. E	0	0	12.00K	0.00K
HOCKING (ZONE)	HOCKING (ZONE)	OH	5/11/2003	13:00	EST	High Wind	50 kts. EG	0	0	0.00K	0.00K
HOCKING (ZONE)	HOCKING (ZONE)	OH	12/1/2006	12:00	EST-5	High Wind	36 kts. ES	0	0	10.00K	0.00K
HOCKING (ZONE)	HOCKING (ZONE)	OH	9/14/2008	18:00	EST-5	High Wind	50 kts. EG	0	0	3.400M	0.00K
HOCKING (ZONE)	HOCKING (ZONE)	OH	2/11/2009	17:35	EST-5	High Wind	50 kts. EG	0	0	0.00K	0.00K
HOCKING (ZONE)	HOCKING (ZONE)	OH	12/9/2009	13:30	EST-5	High Wind	50 kts. EG	0	0	2.00K	0.00K
HOCKING (ZONE)	HOCKING (ZONE)	OH	4/3/2016	12:00	EST-5	High Wind	50 kts. EG	0	0	25.00K	0.00K
Totals:								0	0	3.449M	0.00K

- **December 11, 2000:** A strong low-pressure system dragged a sharp cold front across the region dropping temperatures by 30 degrees. Very strong winds occurred along and behind the front with numerous locations receiving gusts over 58 mph. The highest recorded gust was 69 mph in Ostrander in Delaware county. Numerous trees, large limbs, and power lines were knocked down across the region. Some of the trees fell on cars and homes. A motel sign was blown onto a truck in Warren county. A church that was under construction collapsed due to the winds. One woman was killed in Clermont county when a 200-foot tree fell through her mobile home and landed on her.
- **March 09, 2002:** A widespread area of high winds blew down trees, power poles, and various other smaller structures and signs. At one time, approximately 100,000 people were without power. One man was killed when his semi-tractor overturned, and several others were injured in automobile accidents, and when trees fell on the buildings that they were in. Two people were briefly trapped in a mobile home when a tree fell on it. The hardest hit area was just southwest of Columbus in Grove City where an 84-mph wind was recorded and several structures at the high school were damaged or destroyed.
- **May 11, 2003:** High winds occurred across much of central and west central Ohio during the afternoon in the wake of a strong cold front. Wind gusts ranged from 50 to 60 mph, downing numerous trees and large limbs.
- **December 01, 2006:** A deep low-pressure system tracked through the northern Ohio Valley during the morning of Friday December 1st. This system produced gradient winds that were sustained at 40 to 45 mph, and gusts in excess of 50 mph for much of the region. Trees and powerlines were blown down countywide. At one point in time there was 1000 households without power.
- **September 14, 2008:** The remnants of hurricane Ike raced northeast through the Midwest and merged with a frontal boundary across the lower Ohio Valley Sunday morning. Abundant sunshine promoted deep mixing of the atmosphere, and warm, dry air aloft translated down to the surface. Gusty winds in excess of 70 mph persisted for a period of several hours, causing significant damage and widespread power outages. Strong winds of 40 to 50 miles per hour were sustained for several hours. Gusts over 60 mph were common. Widespread damage occurred across the region, from trees being blown down on powerlines, to significant crop losses and structural damage.
- **February 11, 2009:** A cold front crossed the Ohio Valley on the evening of the 11th. A very tight pressure gradient behind this front in the cold air created damaging winds during the late evening of the 11th. Numerous trees and power lines were blown down around Logan.
- **December 09, 2009:** A strong center of low pressure tracked out of the plain's states to the Great Lakes region. Ahead of this low in the Ohio Valley, southwest winds of 30 to 40 mph with gusts to 50 and 60 mph were common throughout the day. These strong winds peaked in the early afternoon with the passage of a cold front and diminished later in the evening. Several trees and power lines were blown down across the county.
- **April 03, 2016:** A strong cold front crossed the Ohio Valley in the afternoon of Saturday, April 2nd. The highest gusts following the passage of the front came in the early evening for much of the region. A tree tore through the middle of a house in Logan. Thirty to forty trees or large limbs were blown down across the county.

Collective Damage Cost: $3,474,000 in total property damages, 0 injuries, 0 deaths.

Thunderstorm Wind

Event Types: Thunderstorm Wind

132 events were reported between 01/01/1950 and 05/31/2019 (25353 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	104
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	1
Number of Days with Event and Property Damage:	85
Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	1	625.00K	0.00K
LAURELVILLE	HOCKING CO.	OH	7/26/1997	21:30	EST	Thunderstorm Wind	70 kts.	0	0	50.00K	0.00K
LAURELVILLE	HOCKING CO.	OH	5/31/2002	19:50	EST	Thunderstorm Wind	50 kts. E	0	0	20.00K	0.00K
LOGAN OWENS FLD ARPT	HOCKING CO.	OH	6/26/2008	4:00	EST-5	Thunderstorm Wind	53 kts. EG	0	0	20.00K	0.00K
LAURELVILLE	HOCKING CO.	OH	7/1/2012	18:00	EST-5	Thunderstorm Wind	50 kts. EG	0	0	20.00K	0.00K
LAURELVILLE	HOCKING CO.	OH	3/1/2017	3:14	EST-5	Thunderstorm Wind	60 kts. EG	0	0	100.00K	0.00K
MURRAY CITY	HOCKING CO.	OH	7/10/2017	16:23	EST-5	Thunderstorm Wind	60 kts. EG	0	0	20.00K	0.00K
Totals:								0	1	625.00K	0.00K

The summarized events below were ones that caused at least $20,000 dollars or more worth of damage and/or if someone was injured.

- **April 27, 1987:** A thunderstorm in Laurelville uprooted several trees and damaged two buildings. A man suffered minor injuries when struck by a piece of fallen roofing. No cost damage to property or crops were reported.
- **July 26, 1997:** A warm front which was across central Ohio at peak heating on the 26th became the focus for a Mesoscale Convective System that lasted well into the early morning hours on the 27th. Severe thunderstorms moved repeatedly over the same areas causing substantial damage. The continuous rainfall also caused flash flooding in Licking county. Over 400 homes received damage from the combined severe thunderstorm and flooding event. Hundreds of trees were downed of which many fell across power lines. Sixteen telephone poles were broken during the storm.
- **June 26, 2008:** A weak mid-level disturbance passed over an axis of surface-based instability in western Ohio. Thunderstorms that developed as a result of these factors produced damaging winds, large hail, and very heavy rainfall. About forty large trees were downed.
- **July 01, 2012:** An upper level disturbance combined with daytime heating to produce numerous thunderstorms during the afternoon and evening. The main threats from these storms were large hail and damaging winds. Multiple trees and power lines were downed in Laurelville and other portions of southwestern Hocking County due to thunderstorm winds.
- **March 01, 2017:** An unseasonably warm and moist air mass was in place across the region during the morning hours of March 1st. Showers and thunderstorms developed across the Ohio Valley during the early morning hours as a strong low-pressure system lifted northeast into the Great Lakes region. These storms produced heavy rain, large hail and several tornadoes. A squall line then moved through the region during the mid-morning hours ahead of an approaching cold front. These storms resulted in damaging winds and additional heavy rain. Some homes and businesses sustained roof and siding damage. Numerous trees were also snapped and uprooted and a tractor trailer was flipped on its side.
- **July 10, 2017:** A series of upper level disturbances moving across the region brought several rounds of severe storms through the day. Numerous trees and power lines were downed.

Collective Damage Cost: $625,000 in total property damage, 1 injury, and 0 deaths.

PROBABILITY

According to the National Oceanic and Atmospheric Administration (NOAA) between 1950 and 2019, including both high winds and thunderstorm winds there were 140 strong wind events in Hocking County. Over the 69-year duration, there was an average of 1.8 strong wind events annually in the county. Countywide, there is approximately a 0.005 percent chance of having a strong wind event of any size on any given day (1.8 strong wind events divided by 365 days= 0.005 occurrences per day). The Beaufort wind chart characterizes winds: of 32-38 MPH as near gale force, 39-46 MPH as gale force and, 47-54 MPH as severe gale force. Of the 140 events: all

but 4 events had registered winds of 50 knots or more. The most prevalent type of strong wind event to hit Hocking County has been severe gale force winds.

VULNERABILITY ASSESSMENT

Infrastructure Impact

Above ground infrastructure is at risk for storm damage by wind and falling debris. For infrastructure the most damaging part of a storm are the high winds and hail. High winds can strip a tree of bark and detach limbs. If large branches fall, they can damage buildings and supporting above ground infrastructure. Large trees, upwards of 200 feet tall, can be uprooted and can fall on buildings or through houses which can cause serious harm or death.

Utilities that are out in the open are at risk for damage by severe storms. Electrical lines are spread throughout the county connecting homes, businesses, and other facilities to one another. Large branches from trees or other debris can strike above ground electrical lines, causing power outages. Further, downed lines that are still live and active are extremely hazardous and can cause death by electrocution.

Roads are spread throughout Hocking County and can be affected by downed trees, branches, or other debris. Larger debris or trees will take more time and effort to remove and can adversely affect the flow of traffic until safely removed.

Wastewater facilities can experience backup and blockages if debris falls into the tanks. There are 3 wastewater treatment plants throughout Hocking County.

Population Impact

According to the Census Bureau's 2015 population estimates, the population of Hocking County is approximately 28,491. The population is expected to be around 27,870 in the year 2040, so the number of individuals affected by storm events may fall. Summer storms are random in nature and affect the entire area of the county. Everyone within the county should be prepared during a storm event. Populations residing in mobile home parks are particularly vulnerable and should seek out shelters.

- *Tourism:* Hocking County is home to Hocking Hills State Park which is Ohio's second most popular travel spot for tourism destination. The parks receive approximately four million visitors through-out the year.

Property Damage

According to the United States Census Bureau (2010-2014 American Community Survey 5-Year Estimates), the median home value within Hocking County was $114,400. There are 13,261 housing units within Hocking County.

Since 1950, according to the NOAA, there have been eight high wind events and five days with events causing property damage. There have been 98 days with thunderstorm wind events, with 79 causing property damage. Strong wind events caused $3.449 million in property damages and one injury. While thunderstorm wind events caused $600,000 in property damages and both had zero dollars in crop damages.

Loss of Life

According to the NOAA, high winds and thunderstorm wind events have been responsible for zero deaths and one injury (attributed to thunderstorm winds) during events that passed through Hocking County since 1950.

Economic Losses

High wind storms usually cause minor damage to structures, like blowing shingles off roofs. Large branches may break windows or fall onto buildings and above ground infrastructure. However, five of the 98 reported thunderstorm winds and two of the eight reported strong wind events recorded in Hocking County have caused more than $20,000 worth of property damage countywide.

The majority of damage sustained by Hocking County occurred in September 2008, when a 50 Knot high wind caused $3.4 million in property damages.

Below in Figure 4-4 is a table of potential dollars based on damage that could occur from any hazard through-out Hocking County.

FIGURE 4-4: PHYSICAL POTENTIAL DOLLAR LOSSES (2018 CALCULATIONS)

Property	# of Parcels	Total Value	Minor Damage (20%)	Moderate Damage (60%)	Major Damage (120%)
Agricultural	1,293	$43,634,100	$8,726,820	$26,180,460	$52,360,920
Residential	17,526	$460,148,080	$92,029,616	$276,088,848	$552,177,696
Commercial	651	$43,766,040	$8,753,208	$26,259,624	$52,519,248
Industrial	63	$7,568,050	$1,513,610	$4,540,830	$9,081,660
Mineral	622	$439,880	$87,976	$263,928	$527,856
Public Utility	267	$87,670	$17,534	$52,602	$105,204
Exempt	777	$74,984,680	$14,996,936	$44,990,808	$89,981,616
Totals	21,199	$630,628,500	$126,125,700	$378,377,100	$756,754,200

DROUGHT

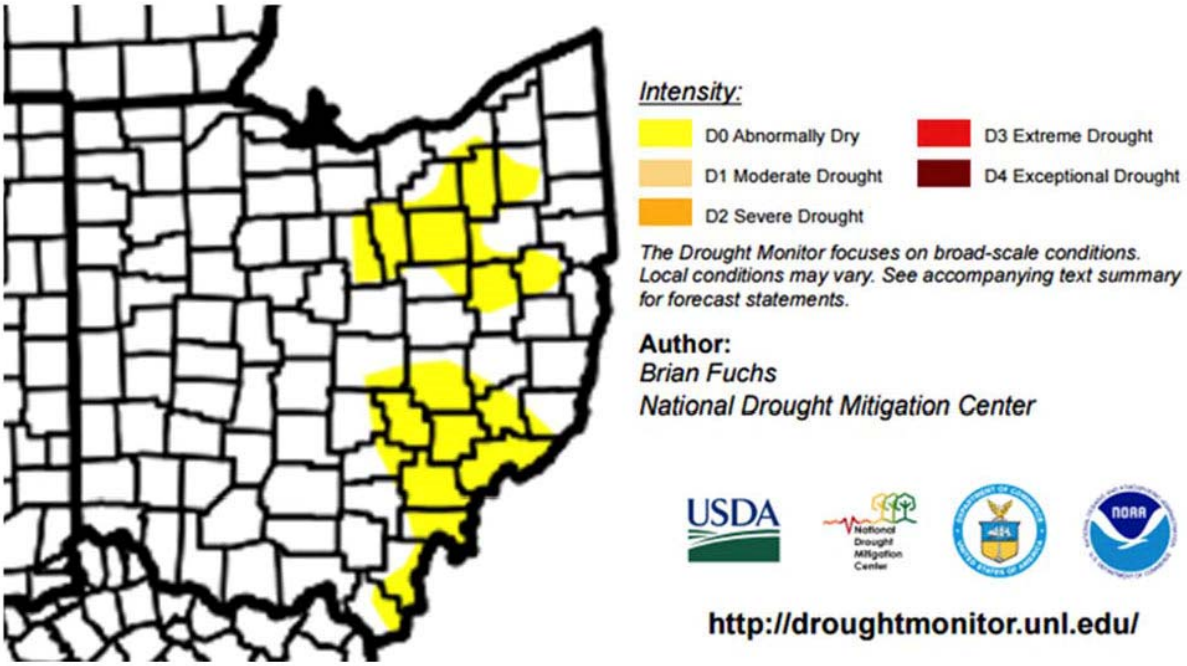
DESCRIPTION

Droughts are a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield. According to the National Oceanic and Atmospheric Administration (NOAA), there are three types of droughts: Meteorological Drought, Agricultural Drought and Hydrological Drought. Each kind of drought starts and ends at different times. High temperatures may also contribute to meteorological droughts which results from minimum or no precipitation which will eventually lead to deficiencies in soil moisture.

LOCATION

Droughts are regional events that will affect all areas and jurisdictions within Hocking County. They may occur any time from spring through fall.

FIGURE 4-5: DROUGHT INTENSITY MONITOR FOR THE STATE OF OHIO



EXTENT

Usually drought is region specific and the whole of the state experience the dry spell for which heat is the precursor. Drought is generally a prolonged event involving drier-than-normal conditions and has the potential to be a countywide hazard. However, the map in Figure 4-5 shows it as more specific to the eastern side of the county.

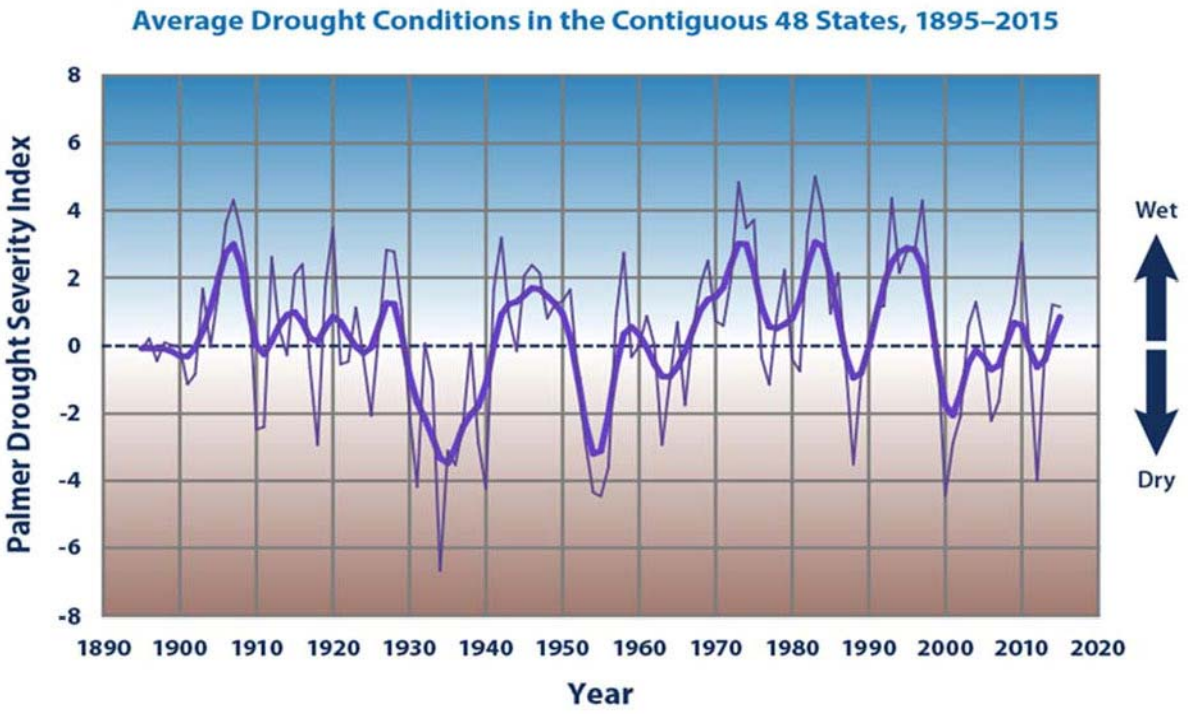
Drought can affect all jurisdictions and all areas of the county creating the possibility of excessive heat or periods of extreme cold that result in water-related problems. The amount of

precipitation at a particular location varies from year to year but, over a period of years, the average amount is fairly constant. Even if rainfall for a year is above average, rainfall shortages can occur during a period of excessive heat or when rainfall is crucial for plant and crop growth.

When there is little or no rainfall for short periods of time, soils can dry out and plants can die, but when rainfall is short for prolonged periods of time (several weeks, months, or years), water levels in wells, lakes, reservoirs, streams, and rivers fall and flow declines. If dry conditions persist, water supply problems develop and the dry period can become a drought.

The extent of the drought is determined by the Palmer Drought Index shown in Figure 4-6. The index depicts prolonged (in months or years) abnormal dryness or wetness; responds slowly; changes little from week to week; and reflects long-term moisture runoff, recharge, and deep percolation, as well as evapotranspiration.

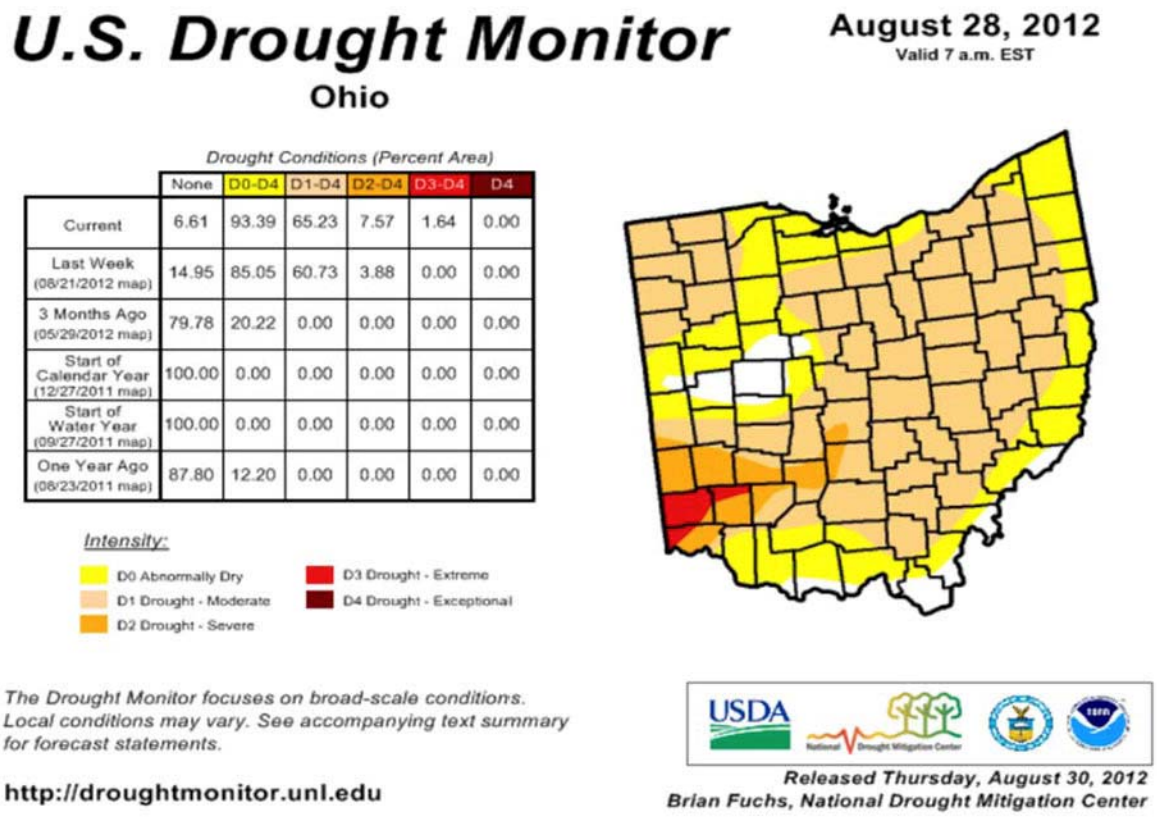
FIGURE 4-6: PALMER DROUGHT SEVERITY INDEX CHART



Data source: NOAA (National Oceanic and Atmospheric Administration). 2016. National Centers for Environmental Information. Accessed January 2016. www7.ncdc.noaa.gov/CDO/CDODivisionalSelect.js.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

FIGURE 4-7: DROUGHT MONITOR FOR THE STATE OF OHIO



HISTORY

Event Types: Drought

Hocking county contains the following zones:
'Hocking'

2 events were reported between 01/01/1950 and 05/31/2019 (25353 days)

Summary Info:

Number of County/Zone areas affected:	1
Number of Days with Event:	2
Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	0

Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1

- **July 01-31, 1997:** Dry conditions that began in the spring and early summer continued into July. Excessive heat contributed to substantial crop loss across much of the Buckeye state. Rainfall was widely scattered and did little to help farmers. Crop damage amounts were not available at the time of this writing.
- **August 01-31, 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

Hocking County has experienced droughts and dry seasons in the past and the potential exists for the County to experience droughts in the future. Increases in water usages and leakage may result in a deficiency in coming years. Water deficiencies and the threat of drought is expected to increase statewide, mainly because of the demand for water by residential, industrial and agricultural use. These situations can be closely monitored and predicted by the use of five parameters: stream-flows, precipitation, reservoir storage levels, groundwater elevations, and a measure of soil moisture. With a 3% chance of a drought occurring in any given year, the future occurrence of drought is possible, as defined by the Risk Factor Methodology probability criteria.

VULNERABILITY

Number of Structures

Drought hardly damages physical properties or structures, but at the same time heavily affects crops. Newly released information on droughts establishes a comprehensive baseline of available data that land managers can use to test how well their efforts to improve drought resilience and adaptation practices are working nationwide. Major findings from the report include:

- Drought projections suggest that some regions of the U.S. will become drier and that most will have more extreme variations in precipitation.
- Even if current drought patterns remained unchanged, warmer temperatures will amplify drought effects.
- Drought and warmer temperatures may increase risks of large-scale insect outbreaks and larger wildfires, especially in the western U.S.

- Drought and warmer temperature may accelerate tree and shrub death, changing habitats and ecosystems in favor of drought-tolerant species.
- Forest-based products and values- such as timber, water, habitat and recreation opportunities- may be negatively impacted.
- Forest and rangeland managers can mitigate some of these impacts and build resiliency in forests through appropriate management actions.

FIGURE 4-8: 2017 HOCKING COUNTY CROP MAP (USDA)

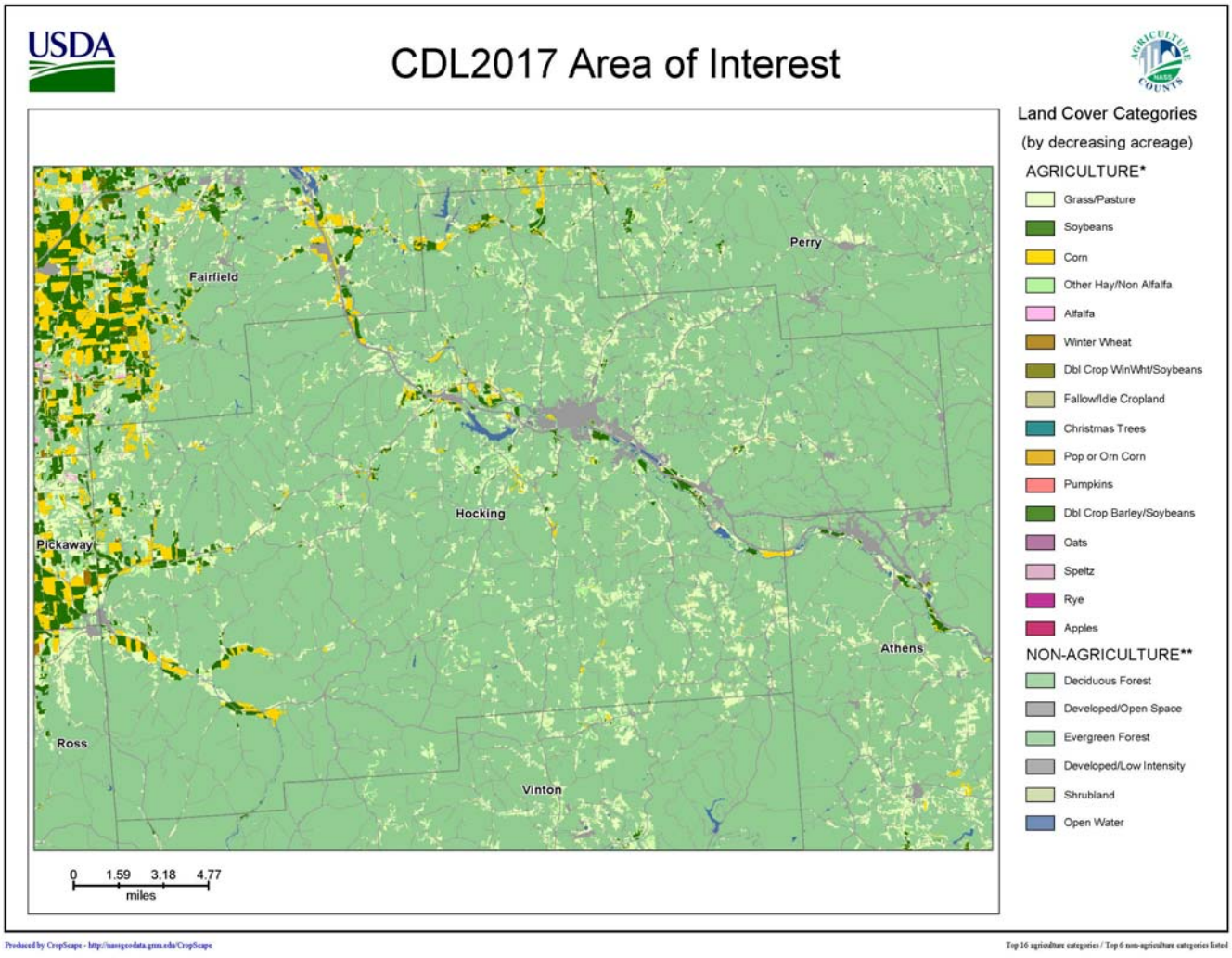


FIGURE 4-9: CENSUS OF AGRICULTURE, HOCKING COUNTY (USDA)

	2012	2007	% change
Number of Farms	367	387	- 5
Land in Farms	38,085 acres	41,992 acres	- 9
Average Size of Farm	104 acres	109 acres	- 5
Market Value of Products Sold	$5,303,000	$4,339,000	+ 22
Crop Sales $4,254,000 (80 percent) Livestock Sales $1,049,000 (20 percent)			
Average Per Farm	$14,450	$11,213	+ 29
Government Payments	$212,000	$300,000	- 29
Average Per Farm Receiving Payments	$2,980	$3,803	- 22

FIGURE 4-9: 2012 ECONOMIC CHARACTERISTICS (USDA)

Other County Highlights, 2012

Economic Characteristics	Quantity
Farms by value of sales:	
Less than $1,000	125
$1,000 to $2,499	72
$2,500 to $4,999	55
$5,000 to $9,999	31
$10,000 to $19,999	39
$20,000 to $24,999	6
$25,000 to $39,999	16
$40,000 to $49,999	5
$50,000 to $99,999	8
$100,000 to $249,999	6
$250,000 to $499,999	2
$500,000 or more	2
Total farm production expenses ($1,000)	6,612
Average per farm ($)	18,016
Net cash farm income of operation ($1,000)	-646
Average per farm ($)	-1,760

EARTHQUAKES

DESCRIPTION

FEMA describes earthquakes as “ground shaking caused by a sudden movement of rock in Earth’s crust. Such movements occur along faults, which are thin zones of crushed rock separating blocks of crust. When one block suddenly slips and moves relative to the other along a fault, the energy released creates vibrations called seismic waves that radiate up through the crust to Earth’s surface, causing the ground to shake”. Earthquakes may vary in length. They may last a few seconds or continue for up to several minutes. Earthquakes can occur at any time of the day or night and at any time of the year.

The seismicity, or seismic activity, of an area refers to the frequency, type and size of earthquakes experienced over a period of time. Earthquakes are measured using observations from seismometers. The moment magnitude scale is the most common scale on which earthquakes larger than approximately 5 are reported for the entire world. The more numerous earthquakes smaller than magnitude 5, reported by national seismological observatories, are measured mostly on the local magnitude scale; also referred to as the Richter scale. These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly imperceptible or weak, while magnitude 7 and over earthquakes 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 if all other factors are equal.

Major earthquakes are low probability, high consequence events. Most major earthquakes in the U.S. have occurred in California and other western states. However, in recent years, geologist, emergency planners and other government officials have taken a greater interest in understanding the potential for earthquakes in some areas of the Eastern U.S. and educating the population as to the risk in their areas.

LOCATION

Earthquakes are county-wide hazards and can affect all areas and jurisdictions.

EXTENT

The effect of an earthquake on the Earth’s surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally- total destruction. Although numerous intensity scales have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli (MM) Intensity Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale, composed of increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical

basis; instead it is an arbitrary ranking based on observed effects. The Modified Mercalli Intensity Value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects actually experienced at that place. The lower numbers of the intensity scale generally deal with the manner in which the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above.

FIGURE 4-10: THE MODIFIED MERCALLI SCALE, AS COMPARED TO THE RICHTER SCALE

Modified Mercalli Scale		Richter Magnitude 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, vibration like passing truck	2.5
IV	Felt indoors by many, outdoors by few, at night some may awaken; dishes, windows, doors disturbed; 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; fall of walls, monuments, chimneys; 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 in air	7
		7.5
		8

Monitoring Earthquakes

The ODNR Division of Geological Survey has established a 23-station cooperative network of seismograph stations throughout the State in order to continuously record earthquake activity. The network, which went online in January 1999, ended a five-year gap during which there was only one operating statin in Ohio. The State was dependent on seismographs in Kentucky and Michigan to record Ohio earthquakes. The 23 stations of the new seismograph network, which is called OhioSeis, are distributed across the State, but are concentrated in the most seismically active areas or in areas that provide optimal conditions for detecting and locating very small earthquakes that are below the threshold of human notice. These small micro earthquakes occur more frequently and help to identify the location of faults that may periodically produce larger, potentially damaging earthquakes.

The OhioSeis seismograph stations are located at colleges, universities and other institutions, employing new technology that not only makes them very accurate, but also relatively inexpensive and easy to operate and maintain. In contrast to the old technology, in which a pen made a squiggly line on a paper drum, the new system is entirely digital and uses a desktop computer to continuously record and display data. Two other innovations have made the system unique. An inexpensive Global Positioning System (GPS) receiver is used to keep precise time on the ontinuously recorded seismogram, and each station's computer is connected to the Internet for rapid data transfer. Each OhioSeis station is a cooperative effort. Seismometers, the instruments that detects Earth's motion, and other seismic components were purchased by the Division of Geological Survey with funds provided by FEMA through the OEMA, as part of the National Earthquake Hazards Reduction Program. The computers and Internet connection were purchased and provided by the cooperating institutions.

The Division of Geological Survey is coordinating the seismic network and has established the Ohio Earthquake Information Center at the Horace R. Collins Laboratory at Alum Creek State Park, north of Columbus. This facility functions as a repository and laboratory for rock core and well cuttings but has a specially constructed room for earthquake recording. The seismograph system allows for rapid location of the epicenter and calculation of the magnitude of any earthquake in the state. The earthquake records, or seismograms, from at least three seismograph stations are needed to determine earthquake locations (epicenters). These records can be downloaded from the internet at any station on the network to determine an earthquake's location and magnitude. Small earthquakes were, in many cases, not even detected by distant, out-of-date seismograph stations. The OhioSeis network provides a whole new dimension of understanding about the pulse of the Earth beneath Ohio. Although the new seismograph network will not predict earthquakes or provide an alert prior to an event, it will provide insight into earthquake risk in the state to help guide decision-making about building and facility design and construction, insurance coverage, and other planning decisions made by individuals, businesses, and governmental agencies.

Secondary Effects

Earthquakes may also result in other hazards including:

- Landslides or avalanches
- Surface faulting, in which the surface of the ground along one side of a fault is displaced horizontally or vertically in relation to the ground on the other side.
- Tsunamis, which can be triggered by earthquake-induced underwater landslides or by surface faulting that occurs on the floor of the ocean.
- Liquefaction, in which loosely packed, water-logged soils temporarily lose strength and stiffness and behave like liquids, causing the ground to sink or slide.
- Flash floods, which can be caused by liquefaction near rivers or lakes.

HISTORY

According to the Ohio Department of Natural Resources (ODNR), there have been zero earthquakes locally in Hocking County. However, Southeastern Ohio has been the site of at least 12 felt earthquakes since 1776. The 1776 event, recorded by a Moravian missionary, has a very uncertain location. Earthquakes in 1901 near Portsmouth (Scioto County), in 1926 near Pomeroy (Meigs County), and in 1952 near Crooksville (Perry County) caused minor to moderate damage.

The earliest earthquake recorded by ODNR in Ohio was in 1976. The historical earthquake was small and had a magnitude of 2.7. ODNR states, “Ohio’s earthquakes are concentrated in two primary zones, but also occur with less frequency and intensity in other areas of the state. The zones are the Western Ohio Seismic Zone which includes Allen, Auglaize, Mercer, and Shelby Counties and the rift zone which trends northwest from Champaign County into Indians.”

PROBABILITY

Since there have been zero earthquakes it is difficult to determine the probability of a chance occurrence. Therefore, by taking the 12 earthquakes felt since 1776 in the Southeastern Ohio, there is 0.5% chance of an earthquake on any given day of the year.

VULNERABILITY ASSESSMENT

Because of the limited history of earthquakes in Hocking County and its location in Ohio, this hazard used HAZUS, a loss estimation model that was developed by FEMA and the National Institute of Building Sciences, in order to provide a methodology of an earthquake simulated in Logan with a magnitude of 5 and depth at 5km.

Building Damage

HAZUS estimates that about 3,541 buildings will be at least moderately damaged. This is over 26% of the buildings in the region. There are an estimated 243 buildings that will be damaged beyond repair.

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are estimated costs to repair or replace the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the earthquake. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the earthquake.

The total building-related losses were 344.20 (millions of dollars); 19% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies which made up over 56% of the total loss.

FLOODING

DESCRIPTION

A flood is an event in which a large amount of precipitation cannot be contained or absorbed over a period of time, resulting in rising water. Floods vary in magnitude, cause, and resulting damage.

There are three main types of floods: riverine floods, flash floods, and urban floods, each have distinctive features. A riverine flooding event, also referred to as overland flooding, occurs when a river or stream is no longer able to contain the entirety of the water flowing into it from within its watershed. When this occurs, water rises above the banks and flows onto adjacent land located in the floodplain. In places without a large change in elevation, resulting water from a riverine flood may not recede for many days, or even weeks.

A flash flood occurs when a large amount of precipitation falls over a short period of time. Unlike riverine floods, flash flood water is not constrained by a river basin and may develop virtually anywhere during periods of slow-moving storms or sustained precipitation. However, other causes such as ice-jam release, dam or levee failure and debris dislodgement can also cause flash flooding. Flash floods can be particularly destructive elements such as trees, mud and rocks. The presence of hills, mountains or other steep slopes can factor into the development of flash floods. According to FEMA, flash floods cause the most deaths of any type of flood.

While flash floods and riverine floods have been commonplace throughout history, another type of flood, known as an urban flood, is a newly evolving concept. Urban floods are a product of increasing development: rainfall that might have been naturally absorbed by previously existing soils, vegetation or streams is no longer absorbed, due to the presence of buildings and other impermeable surfaces now blanketing the terrain. In other words, the level of development is connected to the severity of the flood itself. Such floods are often characterized by overflowing drainage systems, inundated streets, and flooded underpasses.

LOCATION

Hocking County terrain is made up of steep hills, deep ravines, and rocky outcropping. This leads to significant flash flooding in some areas of the county. Flooding is the number one hazard in Ohio and does affect county and township roads often causing their temporary closing. There has also been flooding in The City of Logan, the Villages Rockbridge, Laurelville, Murray City, Carbon Hill, and the unincorporated community of Enterprise. Flood plain mapping shows that all populated areas in the county may be affected by flooding.

Previous mitigation efforts have helped in some of the flood prone areas, and during the time period used in this plan there were no documented repetitive loss structures noted. However

due to the terrain in Hocking County flash flooding will continue to be a problem. Ongoing mitigation for removal of vegetation and maintain driveway culverts will be needed.

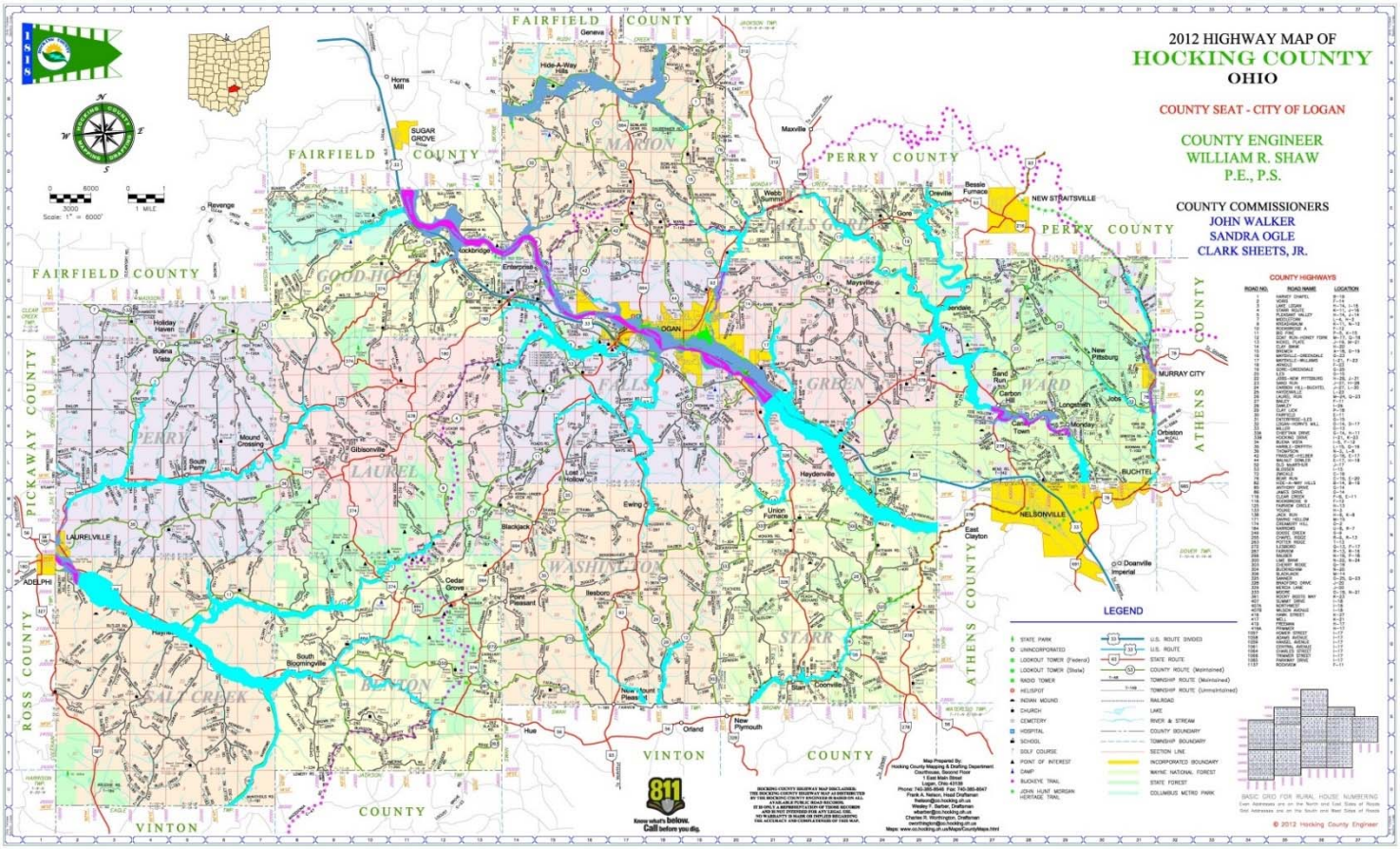
Waterway Locations

The geographic makeup of the County indicates the major drainage basins: The Hocking River, Salt Creek, and Monday Creek, have caused some of the flooding:

- The Hocking River enters Hocking from Fairfield County and continues southeast into Athens County. Two major tributaries Rush Creek and Clear Creek both join the river in the extreme southern part of Hocking County and cause occasional flooding in the villages Rockbridge and unincorporated community of Enterprise.
- Salt Creek though small compared to other waterways is fed by numerous tributaries that flow through steep narrow areas of the county. This leads to flash flooding that affects areas in Perry and Salt Creek Townships.
- Monday Creek enters the county from Perry County and flows through Falls-Gore, Perry, and Ward Townships before exiting into Athens County. Monday creek is also prone to flash flooding and affects the Village of Carbon Hill often closing roadways in that area. The Village of Murray City is also affected by flooding on a tributary flowing into Monday Creek.

Below in figure 4-11 is a map of the current Floodplain Map:

FIGURE 4-11: CURRENT FLOODPLAIN MAP



EXTENT

National Flood Insurance Program

The National Flood Insurance Program (NFIP) was established by the National Flood Insurance Act of 1968 and was strengthened by the Flood Disaster Protection Act of 1973. Participation in the NFIP ensures affordable flood insurance is made available to the community residents in flood prone areas. In turn, these communities adopt floodplain regulations that meet minimum criteria established by FEMA.

The Hocking County Regional Planning Office (RPO) administers Hocking County's Special Purpose Flood Damage Prevention Regulations. The RPO administers the regulations for the unincorporated areas of Hocking County, and the incorporated villages of Murray City and Laurelville. The regulations purpose is to encourage all jurisdictions to participate in the NFIP, promote public health, safety, and general welfare, and to minimize public and private loses due to flood conditions in specific areas.

The RPO is responsible for the issuance of Flood Hazard Building Permits for properties within the 100-year floodplain. The RPO will also conduct on-site monitoring visits to properties within the floodplain to ensure compliance with the regulations.

In March 2012 Hocking County and all Townships adopted Flood Damage Reduction Regulations Per. Resolutions # 11-148-0301-12. In accordance with ORC 1521.18.

The Flood Insurance Rate Map (FIRM) is the official map produced by FEMA which delineates where NFIP regulations apply. FIRM's area also used by insurance agents and mortgage lenders to determine if flood insurance is requiring and what insurance rates should apply.

The Natural Hazard Mitigation Core Group in cooperative with the jurisdictional leaders and/or representatives acknowledge that flooding is a major concern. Having the local jurisdictions participate in the NFIP is critical to reducing the potential damaging effects of flooding within the County. The short and long-term action items as well as the individual jurisdictional action items, support the identification of flooding and the compliance with NFIP.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State or jurisdictional agency will be able to understand and explain them.

FIGURE 4-12: NATIONAL FLOOD INSURANCE PROGRAM (NFIP) PARTICIPATION

CID	*Location*	*Init FHBM Identified*	*Init FIRM Identified*	*Curr Eff Map Date*	*Reg Emer Date*	*Tribal Yes/No*	*Participates Yes/No*
390273	*Village of Laurelville*	*2/8/1974*	*11/16/1995*	*11/14/2010*	*11/16/1995*	*No*	*Yes*
390274	*City of Logan*	*5/31/1974*	*1/17/1986*	*11/4/2010*	*1/17/1986*	*No*	*Yes*
390275	*Village of Murray City*	*11/15/1974*	*11/15/1978*	*11/4/1978*	*11/15/1978*	*No*	*Yes*

Community Rating System (CRS)

Discussed in Chapter 3, the Community Rating System (CRS) is a FEMA program which endorses sound floodplain management. The goals of CRS are to reduce flood losses and to promote the awareness of flood insurance. A community can benefit from actions it takes above and beyond the Federal minimum requirements of the National Flood Insurance Program. In a CRS participating community, the cost of flood insurance for residents is reduced from 5% to 45%

based on the number of activities it undertakes and the points it receives from those activities. Currently in Hocking County there are no villages, cities, or townships participating in the CRS.

Floodplain Data

Hocking County currently has subdivision regulations that were adopted in 1978 and amended in 2000 and these may only be enacted at the county or municipal level. Zoning regulations currently are in place in the city of Logan and regulate the uses of land within the corporation limits. General categories are:

- Business
- Industrial
- Residential (for urban areas)

In addition, rural areas may include agriculture, rural residential, green space and recreation. The Regulations require the Regional Planning commission review all proposed development activities located on property within areas identified by FEMA as flood Hazard areas (within the 100-yearflood boundary). All tracts that contain between 1.836 acres and up to 20 acres must be configured in a pattern that does not exceed a 3:1 depth to width ratio, meaning lot depth cannot be greater than 3 times the lot width. These tracts must meet flood plain requirements as adopted by Hocking County in 2012 and administered through the RPC.

Note: a complete list of all residential homes by address and value will not be included in the plan, rather we will maintain them on file here in the Hocking County EMA office due to its privacy nature.

HISTORY

According to the National Climate Data Center, Hocking County has experienced 62 flooding events from 1950 to current. The total damage from these events was $4,185,000.00 in property damage and $0.00 in crop damage.

Fortunately, Hocking County has had no fatalities have been reported in the last 69 years due to flooding, however with populated areas located in valleys, the possibility of fatalities is present.

Flooding in the county is a major concern with 62 documented events and 100% probability of another flooding event. The table below indicates all heavy rain, flash flood, and flooding event in Hocking County since 1950:

RECORDED FLOODS/HOCKING COUNTY/ 1950-2019

Number of County/Zone areas affected	3
Number of Days with Event	62
Number of Days with Event and Death	0
Number of Days with Event, Death, Injury	0
Number of Days with Event, Property Damage	25
Number of Days with Event, Crop Damage	0
Number of Event Types Report	2

Previous Events

- Hocking County: March 4, 2008. An area of low pressure tracking along a frontal boundary brought 2 to 4 inches of rain to the area. Numerous roads were flooded and closed. Flooding from Gibisonville to South Bloomingville was reported by Law Enforcement at 7:00am thru 3:00pm causing $3000 in property damage.
- Hocking County: March 19, 2008. Several waves of low pressure moved along a stationary front bringing extended periods of heavy rain to the area with 3 to 6 inches being reported. Road closures due to flooding included state routes 278 and 595.
- Laurelville Ohio: May 10-11, 2011. A very unstable air mass was in place south of a warm front in the area leading to widespread severe weather. Several evacuations occurred, vehicles were washed off of roadways, and roads were closed due to flash flooding. The event first reported by law enforcement at 6pm on the 10th, lasted until after midnight of the 11th. This event resulted in $70,000 in property damage.
- South Bloomingville Ohio: July 17, 2011. Thunderstorms developed in a very humid air mass over Ohio during the late afternoon, some of these storms became severe producing large amounts of rainfall in a short period of time. This created an enhanced potential for flash flooding in the area.
- Union Furnace Ohio: May 4, 2012. Thunderstorms developed in the afternoon in an environment of moderate instability and abnormally high atmospheric moisture. These storms continued to build over the same locations creating the potential for flash flooding. Driveway bridges were washed out, basement flooding was reported, and water was reported in the classrooms of an elementary school. This event resulted in $100,000 in property damage.
- Hocking County: March 1-2, 2017. Thunderstorms developed in the middle of the night into early morning. Early morning flash floods caused driveway bridges and roads to

wash out, basement flooding, water in an elementary school, and damaging winds. This event resulted in $430,688 in damage to roadways.

- Haydenville: June 21, 2018. Showers developed in a very moist tropical air mass, which was located ahead of a slow moving upper low. Between 1 and 3 inches of rain fell in general, with locally higher amounts. A water rescue occurred in a subdivision on the Hock Hocking Road. One home was reported off its foundation from the flash flooding. Around 100 houses were damaged by flooding around Logan. First responders worked for nearly twelve hours to rescue dozens of people trapped in their homes and cars. This event resulted in $500,000 in damage to residential and commercial properties.

PROBABILITY

Using the known flood history, there have been 62 Flood Events with 6 being Presidential Declaration between January 1950 and June 2017. This means the chance of a flood event occurring is approximately 60%. However, it must be noted, this may be inaccurate based on record keeping and data availability.

The CORE Group considered historical records of occurrences, recent (past ten years) damages within the County and damages recorded in adjoining counties and within the State and concluded the Hocking County has been fortunate but the probability for future natural hazard events is considered *high likely.*

VULNERABILITY

Repetitive Loss

A repetitive loss property is any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period. This is significant because a repetitive loss structure strains the National Flood Insurance Fund, which reduces financial preparedness for catastrophic events. Because of this, FEMA attempts to eliminate or reduce these properties through federal and state programs and policies.

Furthermore, a property that meets more stringent requirements based on flood history can be labeled a Severe Repetitive Loss. A property will be given this designation if:

- A single-family property that is covered under flood insurance or NFIP and incurred flood related damage for which four or more separate claim payments have been paid under flood insurance; and,
- Each claim has exceeded $5,000 with a cumulative amount of $20,000; or
- At least two separate claim payments have been made with the cumulative amount exceeding the reported value of the property.

The table below show the repetitive loss properties in Hocking County:

FIGURE 4-13: HOCKING COUNTY SEVERE REPETITIVE LOSS PROPERTY

State Name	Community Name	Comm Nbr	Tot Building Payment	Tot Contents Payment	Losses	Total Paid
OHIO	MURRAY CITY, VILLAGE OF	390275	27734.67	13270.52	4	41005.19
OHIO	HOCKING COUNTY *	390272	17511.94	2781.5	3	20293.44
OHIO	HOCKING COUNTY *	390272	3560.41	0	2	3560.41
OHIO	HOCKING COUNTY *	390272	2453.17	14376.83	2	16830
OHIO	HOCKING COUNTY *	390272	43237.32	0	4	43237.32
OHIO	HOCKING COUNTY *	390272	10050.86	3632.31	3	13683.17
OHIO	HOCKING COUNTY *	390272	12692.42	0	6	12692.42
OHIO	HOCKING COUNTY *	390272	4247.16	3200	2	7447.16
OHIO	MURRAY CITY, VILLAGE OF	390275	11361.71	0	3	11361.71
OHIO	MURRAY CITY, VILLAGE OF	390275	2648.58	18387.67	3	21036.25
OHIO	MURRAY CITY, VILLAGE OF	390275	5796.15	0	2	5796.15
OHIO	MURRAY CITY, VILLAGE OF	390275	31213.53	0	2	31213.53
OHIO	MURRAY CITY, VILLAGE OF	390275	17752.01	0	2	17752.01

Structures within 100-Year Floodplain

Using parcel data of Hocking County, there were 18,124 residential, commercial, and industrial structures in the county of which there are 101 commercial and industrial structures and 725 residential Structures that were located within the 100-year floodplain. Therefore, during a 100-year flood event, 22% of the residential, commercial, and industrial structures within Hocking County could be impacted.

Flooding can cause a range of damages from minor to extremely significant and on a small-scale to a county-wide scale. Damage can impact cropland, building structures, and infrastructure, and can cause power loss/failure, water contamination, and even death.

Hocking County Property Values within the 100-Year Floodplain

- Total value of all property at risk
- Average value of each parcel of property at risk

Assessing County-Wide Damages of Structures

HAZUS is a regional loss estimation model that was developed by the Federal Emergency Management Agency (FEMA) and the National Institute of Building Sciences (NIBS). A loss estimate for Hocking County was completed for a 25-Year and 100-Year flood. Using 2010 Census data, HAZUS estimated that there are 13,724 building in the County with a replacement value of 2,898 million dollars (2010 dollars). Approximately 92.04% of the buildings (and 77.98%

of the building value) are associated with residential housing. Results from both scenarios can be seen below:

FIGURE 4-14: POTENTIAL FLOOD EVENT LOSS

25-Year Flood Event

Building Type	Exposure ($1000)	Percent of Total
Residential	1,113,656	76.3%
Commercial	195,602	13.4%
Industrial	91,946	6.3%
Agricultural	8,196	0.6%
Religion	35,829	2.5%
Government	5,517	0.4%
Education	8,506	0.6%
Total	**1,459,252**	**100.0%**

100-Year Flood Event

Building Type	Exposure ($1000)	Percent of Total
Residential	2,260,255	78.0%
Commercial	358,285	12.4%
Industrial	134,860	4.7%
Agricultural	13,813	0.5%
Religion	69,376	2.4%
Government	28,507	1.0%
Education	33,352	1.2%
Total	**2,898,448**	**100.0%**

Building-Related Losses

The building losses are broken into two categories: direct building losses and business interruption losses. The direct building losses are the estimated costs to repair the damage caused to the building and its contents. The business interruption losses are the losses associated with inability to operate a business because of the damage sustained during the flood. Business interruption losses also include the temporary living expenses for those people displaced from their homes because of the flood.

The total building-related losses were 137.86 million dollars. 42% of the estimated losses were related to the business interruption of the region. The residential occupancies made up 34.76%

of the total loss. Figure 4-15 below provides a summary of the losses associated with the building damage.

FIGURE 4-15: BUILDING-RELATED ECONOMIC LOSS ESTIMATES

(Millions of dollars)

Cateory	Area	Residential	Commercial	Industrial	Others	Total
Building Loss						
	Building	41.08	10.02	7.53	2.32	60.96
	Content	20.08	27.61	17.9	8.01	73.6
	Inventory	0	0.54	2.65	0.11	3.31
	Subtotal	61.16	38.17	28.09	10.45	137.86
Business Interruption						
	Income	1.12	18.76	0.44	3.47	23.8
	Relocation	13.04	4.67	0.49	1.79	19.99
	Rental Income	4.82	2.8	0.11	0.18	7.9
	Wage	2.68	23.1	0.64	22.26	48.69
	Subtotal	21.66	49.33	1.68	27.7	100.38
	Total	82.82	87.5	29.77	38.15	238.24

Watershed

Hocking County is somewhat less vulnerable to flooding in 2010 than half a century ago due to water conservation efforts such as dam construction and watershed developments and improvements in Hocking, Fairfield and Perry Counties in the past 50 years.

FROZEN PRECIPITATION

DESCRIPTION

- Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. To be considered hail, the frozen precipitation pieces must have a diameter greater than 0.20.
- Graupel (soft hail or snow pallets) are soft small pellets of ice created when super cooled water droplets coat a snowflake.
- Sleet (ice pellets) are small, translucent balls of ice, and smaller than hail. They often bounce when they hit the ground.

Generally, only hail can directly damage aircraft, homes and cars, and can be deadly to livestock and people.

LOCATION

Frozen precipitation is a county-wide hazard in Hocking County, potentially affecting all areas and jurisdictions of the county.

EXTENT

Hail sizes can range from pea sized to as big as a softball. However, hail quarter size of one inch or larger is considered severe. Hailstone can cause damage to cars and vehicles, aircrafts, buildings, crops, livestock and people. More often, roofs take most of the hail damage including cracks and leaks in buildings. On the ground, hail can severely damage vehicles by breaking windshields, hoods and denting surfaces. In rural areas, hail is hazardous to most crops species. Wheat, corn, soybean, and tobacco are the most sensitive crop to hail damage. Hail can also directly harm people without proper shelters. It can cause concussions or, though rarely, fatal head trauma. It is also possible that hail damages power wires and results in blackout.

Other types of frozen precipitation including graupel and sleet could also be hazardous, especially for travelers. With either type, the ice can create slick spots on roadways, causing motorists to lose control of their automobiles with little to no warning. Bridges, overpasses and elevated roadways are especially susceptible to icing as they are surrounded on all sides by the cold air and freeze more quickly. In addition, ice can rapidly add weight to tree branches and power lines, causing them to snap or break causing damage to whatever they land on, power outages may also occur.

FIGURE 4-16: HAIL SIZE CONVERSION TABLE

Pea	0.25 - 0.375 inch	Lime	2.00 inches
Small Marble	0.50 inch	Tennis Ball	2.50 inches
Penny	0.75 inch	Baseball	2.75 inches
Nickel	0.88 inch	Large Apple	3.00 inches
Quarter	1.00 inch (15/16")	Softball	4.00 inches
Half Dollar	1.25 inch	Grapefruit	4.50 inches
Walnut/Ping Pong	1.50 inch	Computer CD/ DVD	4.75 – 5.00 inches
Golf Ball	1.75 inch		

HISTORY

Hail

According to hail event records from NOAA, there have been 27 days noted since 1950, in which 7 of those days caused damages of $22,000. No injuries or deaths were reported.

PROBABILITY

Hail

In total, hail occurrence in Hocking County are somewhat frequent. Since 1996-2019 (23 years) there has been 27 days with events. Seven days with damage reports equaling a total loss of $22,000. Hail in Hocking County tends to happen between April and June, with a 3% chance of occurring on any given day. Hail magnitudes that reach 0.75 inches and above are normally witnessed. The largest hail recorded was 2.00 inches. A total of 17 incidences of hail magnitudes over 0.75 inches was found in the records.

VULNERABILITY ASSESSMENT

Infrastructure Impact

Above ground infrastructure is at risk from direct hits and falling debris. If the hail is big enough, it can damage roofs and houses especially those houses which have less resistant roof tiles such as plastic sheeting, glass, corrugated fibers, terracotta, slate, and concrete tiles.

Electrical lines are spread throughout the county connecting homes, businesses, and other facilities to one another. Hail can strike above ground electrical lines, causing power outages. Further, downed lines that are still live and active are extremely hazardous and can cause death by electrocution.

Roads are spread throughout Hocking County and can be affected by the icy surfaces caused by graupel and sleet. When the frozen precipitation hits the ground, it freezes on contact, creating a smooth, solid glaze of ice that covers everything on the ground. This type of ice layer is

extremely slick – creating nearly zero friction conditions with vehicle tires. Correcting a skid on black ice can be nearly impossible, as the vehicle tires will have close to zero traction.

Population Impact

According to the U.S. Census Bureau's annual estimates of the resident population, the population of Hocking County is 29,380 as of 2010. The population in not expected to significantly change in the following years, so the number of people affected by frozen precipitation will remain approximately the same. Summer storms are random in nature and affect the entire area of the county. Everyone within the county should be prepared. Populations residing in mobile home parks and traveling in vehicles are particularly vulnerable and should pay close attention.

Property Impact

According to the United States Census (2010-2014), the median home value within Hocking County is $114,400. There are 17,526 residential housing units within Hocking County. Based on the probability of an event causing damage being 0.007% chance and with history showing it will be well below minor damage as shown on the table below this plan will not include more detail or mitigation actions for this hazard in order to focus on hazards that are more likely to affect the area.

FIGURE 4-17: PHYSICAL POTENTIAL DOLLAR LOSSES (2018 CALCULATIONS)

Property	# of Parcels	Total Value	Minor Damage (20%)	Moderate Damage (60%)	Major Damage (120%)
Agricultural	1,293	$43,634,100	$8,726,820	$26,180,460	$52,360,920
Residential	17,526	$460,148,080	$92,029,616	$276,088,848	$552,177,696
Commercial	651	$43,766,040	$8,753,208	$26,259,624	$52,519,248
Industrial	63	$7,568,050	$1,513,610	$4,540,830	$9,081,660
Mineral	622	$439,880	$87,976	$263,928	$527,856
Public Utility	267	$87,670	$17,534	$52,602	$105,204
Exempt	777	$74,984,680	$14,996,936	$44,990,808	$89,981,616
Totals	21,199	$630,628,500	$126,125,700	$378,377,100	$756,754,200

HAZARDOUS MATERIALS SPILL

DESCRIPTION

Hazardous materials are defined in different ways by different laws, regulations, and by different administrations: Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Department of Transportation (DOT), and the U.S. Nuclear Regulatory Commission (NRC). The Ohio EPA use the terms “hazardous chemicals” and “extremely hazardous substances” for reporting. They define “hazardous” as any chemical, element, compound, or mixture with any of these five characteristics: acute, chronic, fire, reactive, or sudden release of pressure. Spills of any of substance qualifying by these characteristics would qualify as a hazmat spill.

LOCATION

Hazardous material spills can occur at hazardous facilities, place that contain and store hazardous material, or in route to reaching these facilities. These hazardous materials can spill and contaminate the surrounding areas.

The EPA defines an extremely hazardous substance facility as any facility that is required to maintain material safety data sheets (MSDS) under the Occupational Safety and Health Administration (OSHA) regulations for hazardous chemicals in the workplace. Facilities with the following chemical quantifies meet the EHS facility qualifications and must report their holding to the EPA:

- Extremely Hazardous Substances (EHSs) of either 500 pounds or the Threshold Planning Quantity (TPQ), whichever is lower.
- All combined grades for gasoline at a retail gas station with a threshold level of 75,000 gallons if the tank(s) was stored entirely underground and was in compliance at all times during the preceding calendar year with all applicable Underground Storage Tank (UST) requirements.
- All combined grades for diesel fuel at a retail gas station with a threshold level of 100,000 gallons if the tank(s) was stored entirely underground and the tank(s) was in compliance at all times during the preceding calendar year with all applicable UST requirements at 40 CFR part 280 or requirements of the State UST program approved by the Agency under 20 CFR part 281.
- All other hazardous chemicals of 10,000 pounds.

Any future facility matching these criteria should be added to the list of known EHS facilities.

FIGURE 4-18: KNOWN EHS FACILITIES

FACILITY NME	LOCATION
AT&T MURRAY CITY 762 CO-L36704	MURRAY CITY, OHIO
FRONTIER COMMUNICATION- LAURELVILLE	LAURELVILLE, OHIO
FRONTIER COMMUNITCATION- LOGAN	LOGAN, OHIO
GE LOGAN GLASS	LOGAN, OHIO
MENNEL MILLING LOGAN	LOGAN, OHIO
LAURELVILLE GRAIN	LAURELVILLE, OHIO
LOGAN WATER TREATMENT PLANT	LOGAN, OHIO

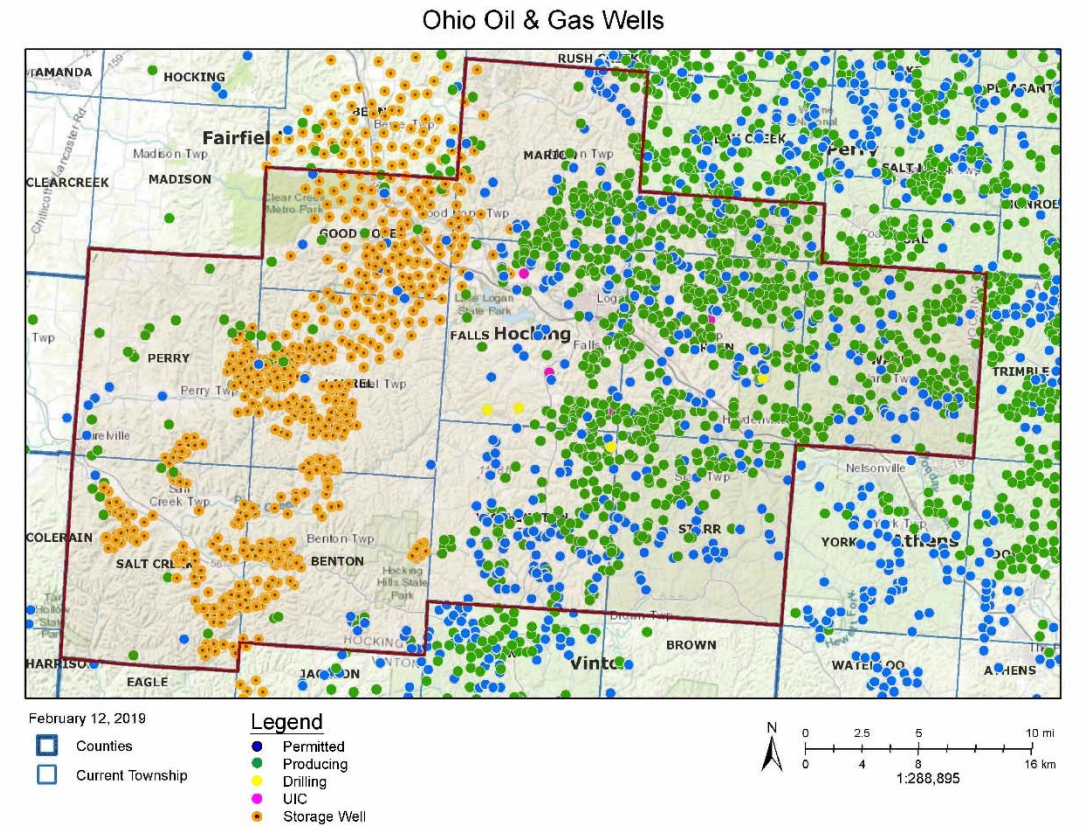
EXTENT

Facilities storing hazardous materials have a higher vulnerability for spills, water contamination, storage collapse, fire, and the release of toxic gases into the atmosphere. Toxic chemicals, when released into the air or water, are normally measured by their concentration in parts-per-million (ppm). Many chemicals are safe at low concentrations, but become toxic at higher concentrations. The point of toxicity varies by chemical. Concentration is also important for flammable materials, as flammable gasses require a suitable mixture of gas and oxygen to ignite. This blend is normally measured as a simple ratio or percentage of the local air by volume.

HISTORY

There is only a minor history of spills in Hocking County. Most of these spills are oil well spills and fuel spills. Below is Figure 4-19 that shows were the Oil and Gas Wells are in Hocking County.

Figure 4-19



PROBABILITY

With lack of significant documented occurrences, there is less than 1 percent chance of this type of hazard occurring in any given year.

VULNERABILITY ASSESSMENT

Number of Structures

Chlorine is the most toxic chemical transported throughout Hocking County. In the event of a spill, his chemical elicits a one-mile vulnerability zone. This requires a one-mile buffer to surround all Extremely Hazardous Facilities in the county. There is a total of seven EHS facilities. The number of structures is determined by the number of critical structures, residential structures, non-residential structures, and bridges that converse over open water and wetlands that fall within the vulnerability zones surround EHS facilities. Throughout Hocking County, there are approximately 5,500 such structures.

Damage of Structures & Estimated Loss

The assessment of this damage would be determined by the extent of damage that affects the structures present in the vulnerability zones and the water contamination or other

environmental contamination that occurs. The cost of the damage would be determined by the cost of the spill cleanup.

HEAVY SNOW

DESCRIPTION

Snow accumulation meeting or exceeding locally/regionally defined 12 and/or 24-hour warning criteria, on a widespread or localized basis (NOAA). This could mean such values as four, six, or eight inches or more in 12 hours or less; or six, eight, or 10 inches in 24 hours or less. In some heavy snow events, structural damage, due to the excessive weight of snow accumulations, may occur in the few days following the meteorological end of the event.

LOCATION

Heavy snow is a county-wide hazard in Hocking County, potentially affecting all areas and jurisdiction.

EXTENT

Heavy snow can immobilize a region and paralyze a city, stranding commuters, closing airports, stopping the flow of supplies, and disrupting emergency and medical services. The weight of snow can cause roofs to collapse and knock down trees and power lines. Homes and farms may be isolated for days and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. The cost of snow removal, repairing damages, and the loss of business can have severe economic impacts on cities and towns.

- Blizzard: Sustained winds or frequent gusts of 35 mph or more with snow and blowing snow frequently reducing visibility to less than a quarter mile for 3 hours or more.
- Blowing Snow: Wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind.
- Snow Squalls: Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant.
- Snow Showers: Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- Flurries: Light snow falling for short durations with little or no accumulation.

HISTORY

Heavy snow is commonly seen in Hocking County. According to NOAA's records, are almost yearly since 1999. No injuries or direct deaths are found.

- **March 09, 1999:** Low pressure brought abundant moisture northward into an arctic air mass producing very heavy snow. The heaviest snow fell between midnight and 800 am with snowfall rates of 1 to 2 inches an hour at times. The snow continued into the daylight hours but it was generally much lighter. Accumulations ranged from 5 to 10 inches with the highest amounts occurring on a line from Hamilton to Wilmington to Chillicothe.

- **March 13, 1999:** A strong low-pressure system brought a narrow band of heavy snow into southern Ohio. The snow fell faster than 1 inch an hour at times and thunder and lightning occurred in spots. A general area of 4 to 8 inches fell from Cincinnati northeastward to around Chillicothe. Within that band, parts of Adams and Scioto counties received from 14 to 20 inches.
- **January 19-20, 2000:** A fast-moving low-pressure system brought a band of heavy snow across central and southern Ohio. Many locations received 5 to 6 inches while the heaviest band of 7 inches fell from Dayton to Xenia to Chillicothe.
- **December 05, 2007:** Enterprise (incorporated) received 4.1 inches of snowfall. The far northwest part of the county was hardest hit with 6.2 inches falling west of Rockbridge. The ODOT garage in Logan got 4.8 inches of snow.
- **February 20, 2008:** A clipper system produced a narrow band of heavy snow that fell along the I-70 corridor from the Indiana border to just southeast of Columbus. Four inches of snow was measured at the county garage in Logan.
- **January 27-28, 2009:** A frontal boundary was stalled over the Tennessee Valley for the early part of the week. Upper level disturbances crossed through the Ohio Valley during this time and accumulating snowfall began on Tuesday. Warmer air aloft on Tuesday afternoon brought a significant amount of freezing rain to areas south of I-70 and especially near the Ohio River. Significant snowfall occurred on the back side of this system with snowfall rates on Wednesday morning approaching two inches per hour along the I-71 corridor between Cincinnati and Columbus. Six inches of snow was measured in Logan.
- **February 05-06, 2010:** Low pressure tracked from the Gulf of Mexico to the southern Appalachians on Friday, February 5th. A wintery mix overspread much of the region early on Friday and transitioned to all snow, bringing significant snowfall to the area on Saturday, February 6th. Snowfall ranged from 5 inches near Laurelville and Logan, up to 13.2 inches four miles west of Rockbridge.
- **January 20-21, 2011:** A low pressure system moved across the Tennessee Valley during the day of Thursday, January 20th. Widespread snow developed across the region in the morning and continued through the afternoon, tapering off in the evening. Snow became heavy at times during the afternoon. An observer near Logan measured 5 inches of snow. The highway department west of town measured 4 inches. Another cooperative observer south southeast of Laurelville measured 4.5 inches.

PROBABILITY

Heavy snow occurs countywide. The entire County population is susceptible and should be prepared. Heavy snow tends to occur from November to January in the next year and it can be observed almost every year.

NOAA's collected data shows 8 Heavy Snow events observed since 1999 (18 years). Therefore, there is an 44% chance of occurrence of a Heavy Snow event each year.

VULNERABILITY ASSESSMENT

Infrastructure Impact

Because snowfall in Hocking County is very common and can be stricken by ice storms, all of the structures erected in the County are susceptible to damage if not designed to the proper snow loading parameters. Heavy snow and ice accumulations can rip down power lines and trees. Loss of electricity for an extended period of time can also cause death from extreme cold and hypothermia. Excessive amount of snow accumulation could become the source of flooding.

Population Impact

According to U.S Census Bureau's annual estimates of the resident populations, the population of Hocking County was 29,380 as of 2010. The population is not expected to change significantly in the coming years, so the number of people affected by heavy snow will remain approximately the same. Motorists should be aware of declared snow emergencies and seek safety before becoming stranded. The risk of vehicle accidents becomes high during such events, due to slippery, ice-covered roads, poor visibility, or deep snow accumulation on the road. Sensitive populations will be most susceptible to snow and ice and should prepare for such events prior to the winter months.

Property Damage

NOAA's data concurred that there was no property damage from the Heavy Snowstorms that were observed.

Loss of Life

Since 1999, no deaths or injuries associated with heavy snow are recorded in Hocking County.

Economic Losses

Heavy snow can cause a variety of losses for a community such as fallen trees, power outages, roof collapses, other property damage, and hazardous driving conditions. Considering there were no previous costs associated with the recorded events, it is hard to determine economic loss costs based on history. With an 44% chance of a snow event each year, the below table shows the potential dollars lost based on a percentage of potential damage.

FIGURE 4-20: PHYSICAL POTENTIAL DOLLAR LOSSES (2018 CALCULATIONS)

Property	# of Parcels	Total Value	Minor Damage (20%)	Moderate Damage (60%)	Major Damage (120%)
Agricultural	1,293	$43,634,100	$8,726,820	$26,180,460	$52,360,920
Residential	17,526	$460,148,080	$92,029,616	$276,088,848	$552,177,696
Commercial	651	$43,766,040	$8,753,208	$26,259,624	$52,519,248

Industrial	63	$7,568,050	$1,513,610	$4,540,830	$9,081,660
Mineral	622	$439,880	$87,976	$263,928	$527,856
Public Utility	267	$87,670	$17,534	$52,602	$105,204
Exempt	777	$74,984,680	$14,996,936	$44,990,808	$89,981,616
Totals	21,199	$630,628,500	$126,125,700	$378,377,100	$756,754,200

LANDSLIDES

DESCRIPTION

The Ohio Department of Natural Resources (ODNR) Division of Geological Survey defines landslides as the downward and outward movement of soil along a hillside or slope. Fundamentally, a landslide is a slope failure that occurs when the slope soil strength is exceeded by the pressure from human and natural caused activities. ODNR Division of Geological Survey states that there are three main types of landslides in Ohio:

- Rotational slump is the movement of a mass of weak rock or sediment as a unit along a curved slip plane. Rotational slumps may develop comparatively slowly and require several months or even years to reach stability; however, on occasion, they may move rapidly, achieving stability in only a few hours. In Ohio, this type of landslide is the largest in that it can involve hundreds of thousands of cubic yards of materials.
- Earthflow is the movement of rock, sediment, or weathered surface materials moving downslope in a mass. The rate of movement of an earthflow is generally quite slow. In Ohio, this type of landslide is most common and involves a smaller area compared to the rotational slump landslides.
- Rockfall is the rapid downslope movement of bedrock material. Most rockfalls in Ohio involve massive beds of sandstone or limestone.

Additionally, ODNR Division of Geological Survey states that landslides generally include geological conditions that contribute to the occurrence of landslide events:

- Steep slope
- Jointed rocks
- Fine-grained, permeable rock or sediment
- Clay or shale units subject to lubrication
- Large amounts of water

Although an area might possess one or more of the above conditions, landslides require a trigger that will initiate the downslope movement of the soil. The list of triggers includes both human and natural caused events such as vibrations, over steepened slopes, increased weight on slopes, and removal of vegetation and trees.

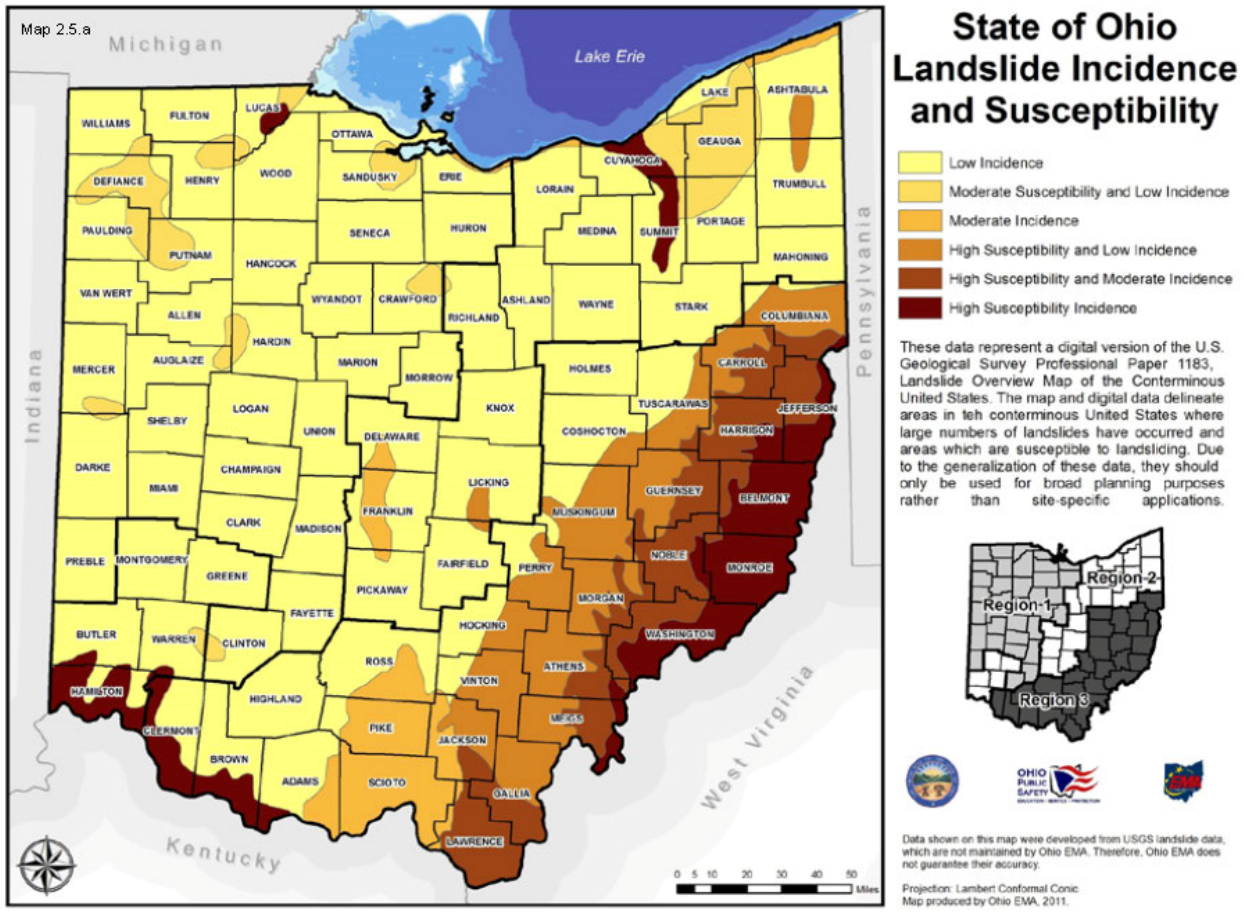
LOCATION

The United States Geological Survey (USGS) created a digital version of Geological Survey Professional Paper 1183, Landslide Overview Map of the Conterminous United States. The State of Ohio Enhanced Hazard Mitigation Plan 2011 provided a statewide version of the landslide map.

Using the Geological Survey data, Hocking County Landslide Incident and Susceptibility Map in Figure 4-21 shows the western side of the County has a low incident (<1.5% of the total area

involved) and susceptibility (<1.5% of the total area involved) to landslides. The eastern part of the County has a high susceptibility (>15% of the area involved) with low incidents (<1.5% of the total area involved). This shows that a large portion of the county might not have many incidences of landslides but have conditions that are favorable for landslide events.

FIGURE 4-21: HOCKING COUNTY LANDSLIDE & SUSCEPTIBILITY MAP



EXTENT

Severity of landslides is measured by a combination of loss of life, property and other infrastructure damage. Separate impact landslides can have in a rural area like Hocking County is the potential to damage county and state roads that connect throughout the county. Additionally, landslides can cause a chain reaction of greater impacts. An example of this chain reaction was from the landslide that occurred in Morgan County, it caused a pipeline explosion, which destroyed 50 acres and caused extensive damage.

HISTORY

The Ohio Department of Transportation (ODOT) District 10 records greater than 400 landslides within Hocking County (observed since 2010) per Figure 4-22 and 187 rockfalls within Hocking

County (observed since 2011) per Figure 4-23. These maps were created using geohazard landslide inventory and is as current as June 2019.

FIGURE 4-22: ODOT TOTAL GEOHAZARDS: LANDSLIDE INVENTORY

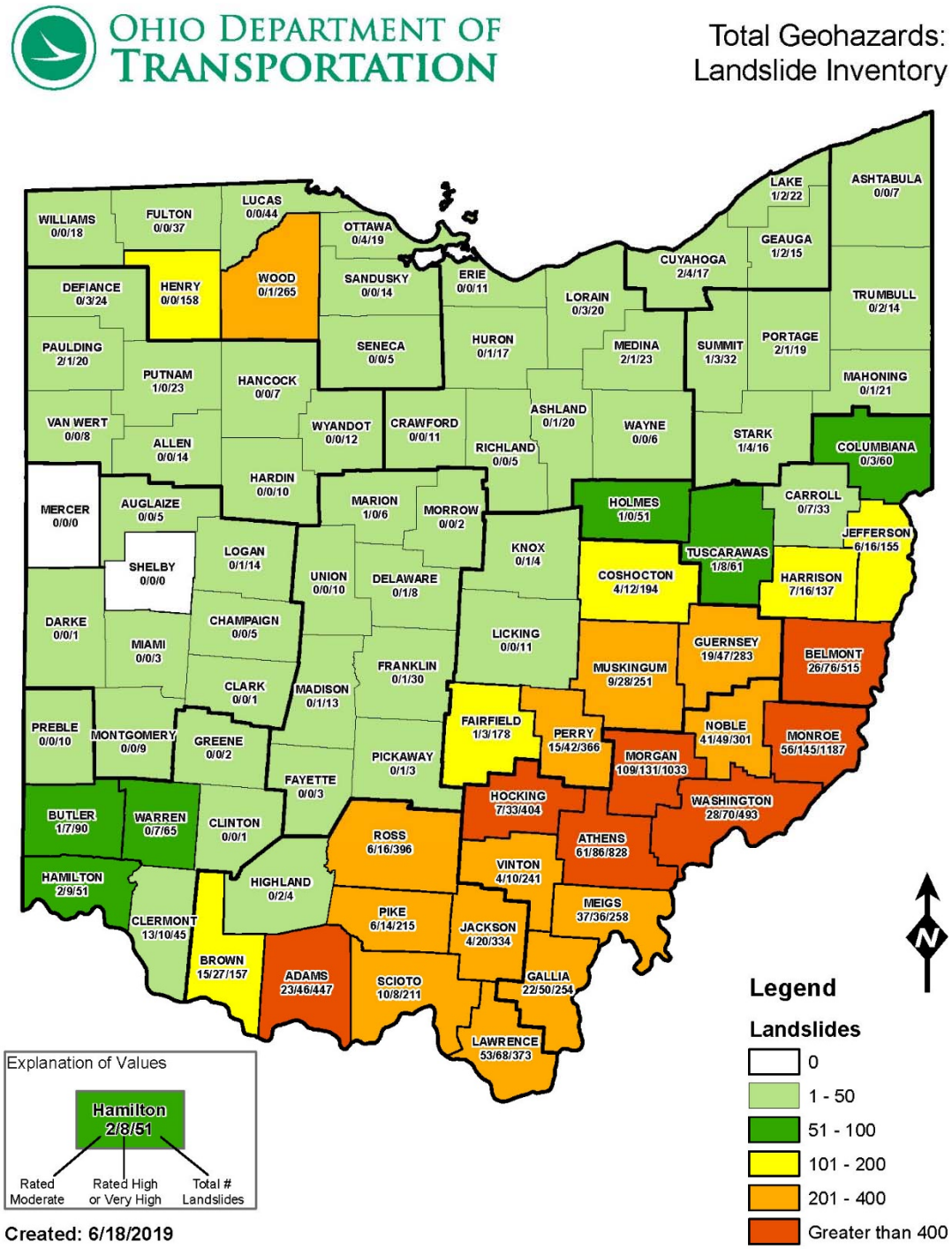
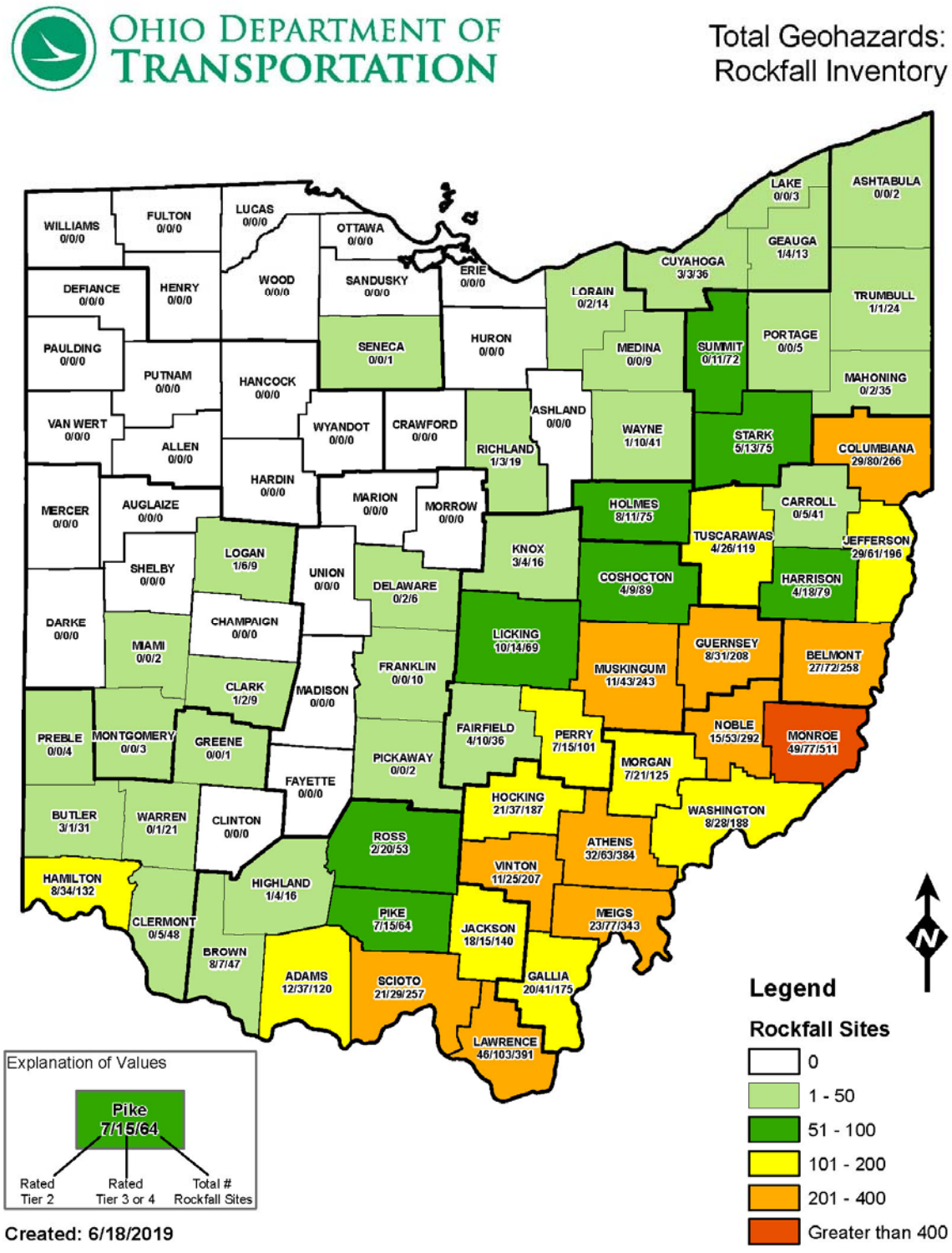


FIGURE 4-23: ODOT TOTAL GEOHAZARDS: ROCKFALL INVENTORY



PROBABILITY

Landslide probability is location specific, and cannot be accurately characterized on a countywide basis. Countywide analyses for potential landslides have been performed US Geological Survey (USGS). The possible landslide incidence and susceptibility was discussed earlier in this chapter and illustrated in Figure 4-15. When factoring for the previous USGS analyses (Figure 4-15) and the impacts documented in ODOT landslide (Figure 4-16) and Rockfall (Figure 4-17) manuals, the eastern side of the county is identified as having the most area susceptible to landslides.

VULNERABILITY ASSESSMENT

Infrastructure Impact

Landslides could significantly impact infrastructure is of concern in the west portion of Hocking County. Specifically, landslides can have a major impact to the county roadways. ODOT District 10 has recorded landslides impacting roadways as found in Figure 4-16. These impacts can cause minor injuries, fatalities, and potentially close roadways for emergency repair.

According to the State of Ohio Enhanced Hazard Mitigation Plan, Hocking County has a total of two exposed critical facilities. Exposed means these facilities could sustain potential losses from landslides. The total replacement value for the two facilities is $1,373,320. Hocking County does not have any critical facilities within an area of high incidence.

Population Impact

Since the most common type of landslide in Ohio is the slow-moving Earthflow landslide, the immediate impact to the population is low. However, due to the destructive potential of a landslide, site specific evacuations might be required if the landslides are near structures. The greatest potential impact to the population is the sudden transportation facility impacts. These impacts can either cut off evacuation routes or cause accidents on the roadway.

Loss of Life

The most common landslide in Ohio is the Earthflow landslide, which involves slow movement of earth material. This slow movement minimizes the chance for loss of life. Some minor injuries may result from falling objects, but the potential for loss of life involving the risks associated with landslides is low in Hocking County.

Property Damage

The most common landslide in Ohio is the Earthflow landslide, which involves slow movement of earth material. This slow movement minimizes the chance for loss of life. Some minor injuries may result from falling objects, but the potential for loss of life involving the risks associated with landslides is low in Hocking County.

LAND SUBSIDENCE & MINE SUBSIDENCE

DESCRIPTION

Subsidence is motion of the Earth's surface as it shifts downward relative to a benchmark (often sea-level) of the surrounding terrain. There are a number of causes for this effect. In Ohio the two primary causes are abandoned underground mines (AUMs) and karst. Underground mining of coal began in the early 1800's and continues to current day. In the 1900's underground salt, limestone and gypsum mining began. Most mining is accomplished by direct human action utilizing heavy machinery to remove the material; however, with salt there are cases where pressurized water is used to wash-out the deposit (solution mining). All of these mines create voids under the Earth's surface. Several key factors determining the potential for these voids to collapse include depth, mining technique used, types of rock and or soils above and development on the ground surface.

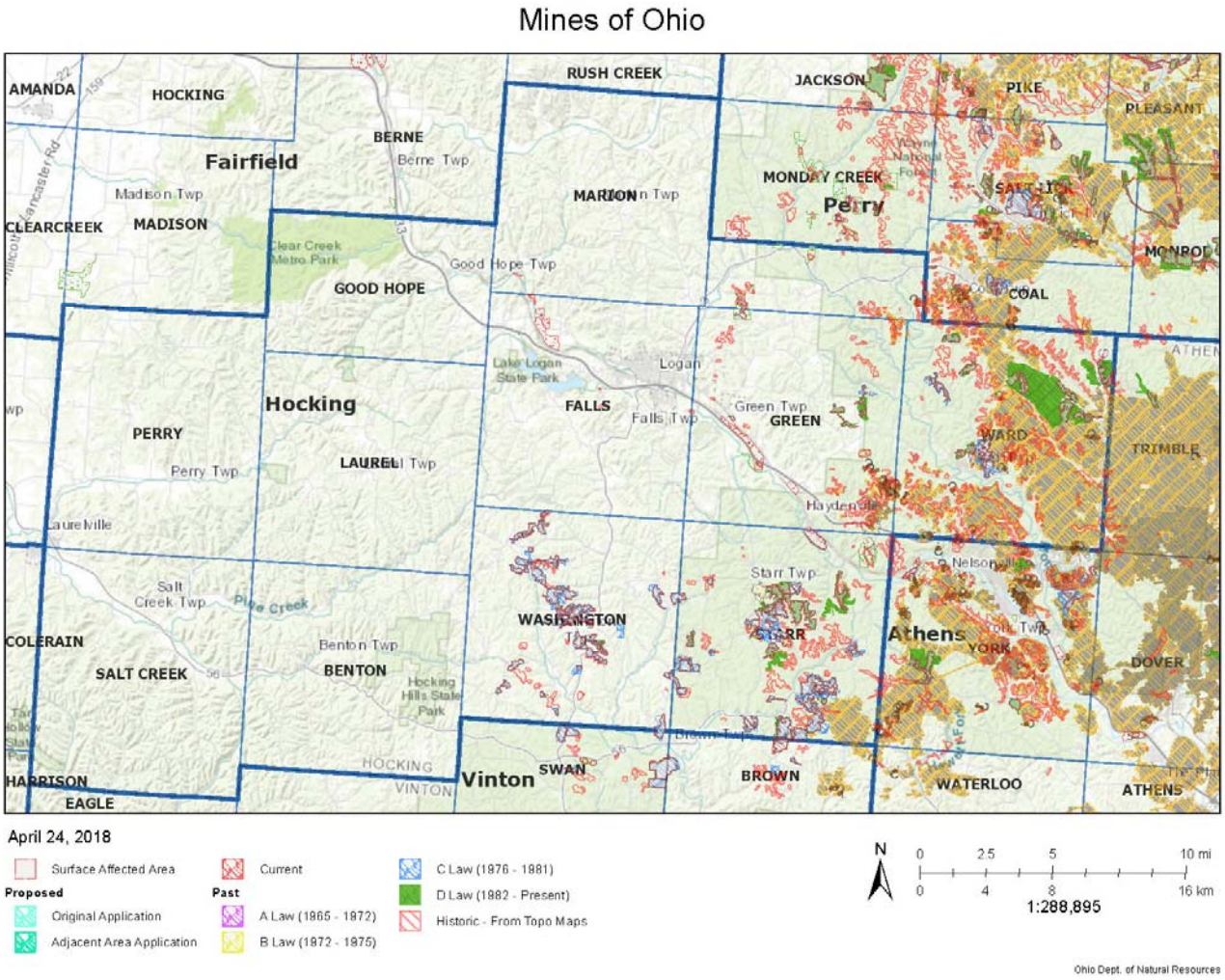
More than 80 percent of the identified subsidence in the Nation is a consequence of our exploitation of underground water, and the increasing development of land and water resources threatens to exacerbate existing land-subsidence problems and initiate new ones. In many areas of the arid Southwest, and in more humid areas underlain by soluble rocks such as limestone, gypsum, or salt, land subsidence is an often- overlooked environmental consequence of our land- and water- use practices.

LOCATION

Beginning in the 1700's and continuing to today there has been considerable coal mining in the generalized Appalachian region of Ohio. In addition to coal, several salts, clay and gypsum mines have opened in counties close to Lake Erie. Finally, in central and southeastern Ohio there are several isolated mines.

Land Subsidence does not pose a threat to the entire county but is a significant threat to some of Falls, Green, Starr, Washington, and Ward Townships. The entire Village of Murray City is at High Risk of damages due to subsidence. Hocking County has approximately 240 abandoned mines.

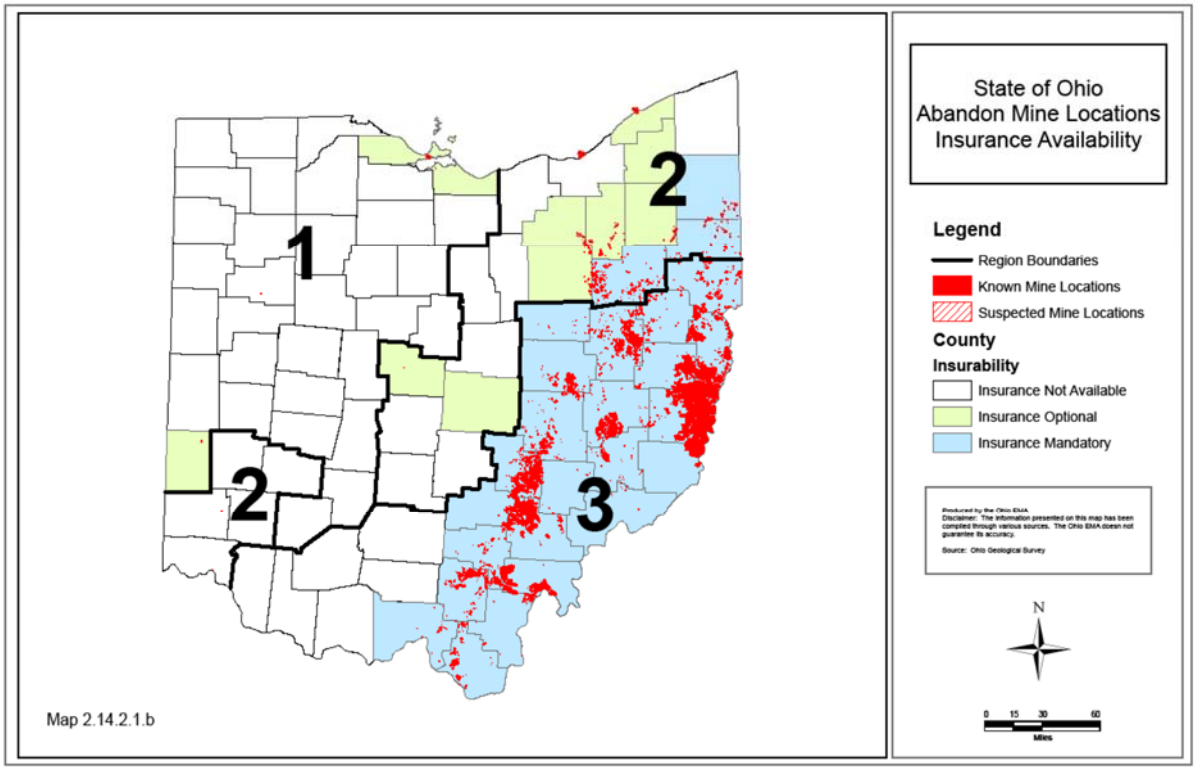
FIGURE 4-24: LOCATION OF MINES WITHIN HOCKING COUNTY & SURROUNDING REGION



EXTENT

Abandon underground mines are found in 44 Ohio counties, with 37 of those counties being eligible for low cost insurance for land subsidence. Hocking County is one of the 27 Ohio Counties that are required to have this insurance.

FIGURE 4-25: STATE OF OHIO ABANDON MINE LOCATION & INSURANCE AVAILABILITY



HISTORY

Ohio has had a long history of damage from landslides. Geologists at the University of Cincinnati report that the Cincinnati metropolitan area has one of the highest per capita costs of landslide damage of any metropolitan area in the United States. As shown by Figure 4-21, landslides in this area damage or destroy buildings, roads, and public utilities, and cost millions of dollars annually in lost productivity and repairs.

While landslides have been problematic in Cincinnati since the early to mid-1800s, documentation is limited. As the city began to expand and infrastructure was improved in the early 1900s, landslide hazards became better documented.

When large construction projects such as highway construction began in the 1950s, geotechnical concerns received little consideration, and major landslides soon

developed. In the 1960s and 1970s, landslides were so frequent that the area was included in a study of this hazard by the U. S. Geological Survey. The study found that landslide damage cost in Hamilton County, primarily due to public road construction, was on the average more than $5 million each year between 1973 and 1978. Well-publicized landslides that occurred in the 1970s included those along Columbia Parkway, Hillside Avenue, Delhi Pike, and Huffman Court.

PROBABILITY

Currently most of the subsidence's that ODNR has identified in Hocking County are on public land west of Murray City along Jobs-New Pittsburg Road. In addition to the ODNR's identification, 1 subsidence insurance claim has been closed in the county from 2012-2013 costing $1,274.43, according to the Ohio Mine Subsidence Insurance Underwriting Association. On average, there is a 1% chance of a mine subsidence event every year.

VULNERABILITY ASSESSMENT

According to the Ohio Department of Natural Resources, Jobs-New Pittsburg Road area of Hocking County identified as potential problem areas for underground mine subsidence. ODNR has completed projects in the past year involving the closing subsidence areas that occurred in the stream channel. They are currently developing several more projects in the same area to close stream capture subsidence's and mine entries. The areas that are currently affected would not have any impacted to homes are other structures.

Infrastructure Impact

Mine subsidence could significantly impact roads on or near the problem areas identified on the Hocking County Mine Subsidence Map.

Population Impact

Citizens located near the areas within Hocking County that have been identified as ODNR subsidence problem areas should be aware of the threat posed by potential mine subsidence events.

Economic Losses

Economic losses are summarized in the Estimated Loss table below.

FIGURE 4-26: Physical Potential Dollar Losses (2018 Calculations)

Property	# of Parcels	Total Value	Minor Damage (20%)	Moderate Damage (60%)	Major Damage (120%)
Agricultural	1,293	$43,634,100	$8,726,820	$26,180,460	$52,360,920
Residential	17,526	$460,148,080	$92,029,616	$276,088,848	$552,177,696

Commercial	651	$43,766,040	$8,753,208	$26,259,624	$52,519,248
Industrial	63	$7,568,050	$1,513,610	$4,540,830	$9,081,660
Mineral	622	$439,880	$87,976	$263,928	$527,856
Public Utility	267	$87,670	$17,534	$52,602	$105,204
Exempt	777	$74,984,680	$14,996,936	$44,990,808	$89,981,616
Totals	21,199	$630,628,500	$126,125,700	$378,377,100	$756,754,200

Loss of Life

Given the lack of recorded fatalities resulting from mine subsidence incidents, the potential for loss of life from such events is minimal.

LIGHTNING

DESCRIPTION

Lightning is a giant spark of electricity in the atmosphere between clouds, the air, or the ground. In the early stages of development, air acts as an insulator between the positive and negative charges in the cloud and between the cloud and the ground. When the opposite charges build up enough, this insulating capacity of the air breaks down and there is a rapid discharge of electricity that is known as lightning. The flash of lightning temporarily equalizes the charged regions in the atmosphere until the opposite charges build up again.

Lightning can occur between opposite charges within the thunderstorm cloud (intracloud lightning) or between opposite charges in the cloud and on the ground (cloud-to-ground lightning). There are roughly 5 to 10 times as many cloud flashes as there are cloud-to-ground flashes.

LOCATION

Lightning is a county-wide hazard in Hocking County, potentially affecting all areas and jurisdictions.

EXTENT

Lightning causes two major types of accidents:

- Accidents caused by a direct strike when the lightning strikes a building or a specific zone.
    - Thermal effects: These effects are linked to the amount of charge associated with lightning strikes. They result in fusion points melting holes of varying sizes at the point of impact of materials with high resistivity. For material which is a poor conductor, a large amount of energy is released in the form of heat. The heating of water vapor contained in the material results in very high abrupt localized pressure which may cause it to explode.
    - Effects due to the initiation: In the event of a lightning strike a substantial increase in the ground potential of the installation will occur depending on the grounding network and soil resistivity. Potential differences will also be created between various metal elements. Hence the need to pay attention when installing earth rods and inter-connection of metal structures adjoining the conductors.
- Accidents caused indirectly, as when the lightning strikes or causes power surges in power cables or transmission links.
    - The ever-increasing use of sensitive electronics means that electrical equipment is becoming more and more vulnerable to transient overvoltage caused by lightning.

- Conduction: An overvoltage that propagates along a conductor which has been in direct contact with the lightning strike. This effect is more destructive as most the lightning energy is propagated through the entire network.
- Induction: caused by the electromagnetic field radiated by the lightning strike. It generates an overvoltage on conductors within a range that is proportional to the power and the rate of speed variation of the lightning strike. Consequently, under the influence of abrupt variations in current, the cables, and even the ducts which act as aerials, may be subjected to destructive overvoltage.
- Rising from the ground: When a lightning strike hits, an overvoltage can rise up from the ground attempting to find a more favorable path to ground.

HISTORY

Lightning is a commonly observed natural phenomenon, however, it is recorded only when it directly strikes objects or causes secondary disasters like fire or blackout. According to the estimation of National Lightning Safety Institute, 1 out of 200 houses and 1 out of 280,000 people are struck by lightning per year.

- **June 22, 2006:** Ten people were injured, one seriously, from a lightning bolt that struck the outdoor pavilion they were standing under. All ten-people survived.

PROBABILITY

According to the NOAA Storm Events Database, there has been more than 132 thunderstorm events reported in Hocking County Between 1950 and 2017 (67 years). A thunderstorm implies that lightning is associated with the storm, otherwise it would be categorized as a heavy rain event. Therefore, there is a probability of 1 or 2 potentially destructive lightning events in the county in any given year.

VULNERABILITY ASSESSMENT

INFRASTRUCTURE IMPACT

There are no records of infrastructure damage by lightning in Hocking County so far. Because of the random nature of occurrence of the lightning hazard, it is difficult to assess future vulnerability with regard to this hazard. In general, all infrastructure will be exposed and therefore at risk to the lightning hazard. Especially, lightning sensitive infrastructures are more vulnerable to lightning. Such infrastructure includes but not limited to electrical equipment, cables or transmission links, wireless base stations, and power plants.

RESIDENCIAL POPULATION IMPACT

According to U.S. Census Bureau annual estimates of the resident population, the population of Hocking County is 28,491 in 2010. The population is not expected to significantly change in the following years. There has been 10 people injured and one seriously injured in June 2006 by a signal lightning bolt.

TOURISM POPULATION IMPACT

According to Hocking Hills Tourism Association there is approximately 4.5 million visitors to Hocking County each year. This population is susceptible to all hazards that face Hocking County when visiting. This population will receive weather related notifications if they have EAS turned on their phones and if they have service. The cell service through-out Hocking County is touch-and-go depending on the area. Therefore, it is important for tourist to actively watch the news and check for potential weather while traveling through the county.

PROPERTY DAMAGE & ECONOMIC LOSSES

Despite the severity of lightning strike, there are no report of property damage by lightning in Hocking County so far; however, the National Lightning Safety Institute estimates that 1 out of 200 houses are struck by lightning each year. Since there are 19,129 (residential, commercial, industrial, mineral, and public utility) structures in the County, that equates to 96 structures (0.5 percent) having the potential to be struck by lightning each year.

FIGURE 4-27: PROPERTY DAMAGE ESTIMATES

BUILDING TYPE	NUMBER OF STRUCTURES	TOTAL VALUE OF STRUCTURES	NUMBER OF STRUCTURES FOR 0.5% SCENARIO	DAMAGE FOR 0.5% SCENARIO
AGRICULTURAL	1,293	$43,634,100	7	$218,171
RESIDENTIAL	17,526	$460,148,080	88	$2,300,740
COMMERCIAL	651	$43,766,040	3	$218,830
INDUSTRIAL	63	$7,568,050	Less than 1	$37,840
MINERAL	622	$439,880	3	$2,199
PUBLIC UTILITY	267	$87,670	1	$438
EXEMPT	777	$74,984,680	4	$374,923
TOTALS	21,199	$630,628,500	106	$3,153,143

LOSS OF LIFE

Since 1950, no deaths have been recorded. However, in June 2006 there were 10 people injured, one seriously, from a lightning strike on an outdoor pavilion.

PIPELINES

DESCRIPTION

Pipelines are used to transport natural gas efficiently from extraction point to distribution points. Pipelines are usually divided into large transmission pipelines and smaller distribution pipelines that connect directly to consumers. Under extreme cold conditions, lack of heat could cause pipes to freeze, causing significant property damage. Utility distribution pipelines carry natural gas from the utility provider to the consumer. Natural gas is lighter than air, meaning gas would diffuse quickly in the event of a leak, and gas poses no toxic threat to humans, although a significant leak would pose a risk of asphyxiation if the gas is too concentrated. Natural gas will only ignite if mixed with oxygen in certain ratios. If the natural gas is too concentrated or not concentrated enough, it will not ignite. This nearly eliminates the risk of explosion in properly-maintained pipelines. Damage to gas lines could cause indirect property damage throughout the network if residents rely upon natural gas to operate equipment such as central heat. Transmission lines can transport a variety of chemicals including natural gas, oil, natural gas liquids, and other fossil fuel byproducts.

The majority of pipelines in Hocking County carry natural gas and fossil fuel byproducts and are operated by several companies that are under PUCO (Public Utilities Commission of Ohio under the Ohio Pipeline Safety Division). The county no longer has crude oil lines in operation. The Pipeline and Hazardous Materials Safety Administration defines a “significant pipeline incident” as any pipeline incident where any of the following conditions applied:

1. A fatality or injury requiring in-patient hospitalization
2. $50,000 or more in total costs, measured in 1984 dollars
3. Highly volatile liquid releases of 5 barrels or more or other liquid releases of 50 barrels or more, and/or
4. Liquid releases resulting in an unintentional fire or explosion.

LOCATION

Hocking County has several major transmission lines running across the county, generally as shown in the map below North to South orientations from extraction points throughout Southeast Ohio to distribution points nationwide. A pipeline and oil well map are included below in Figure 4-28 and Figure 4-29.

FIGURE 4-28: PIPELINE MAP

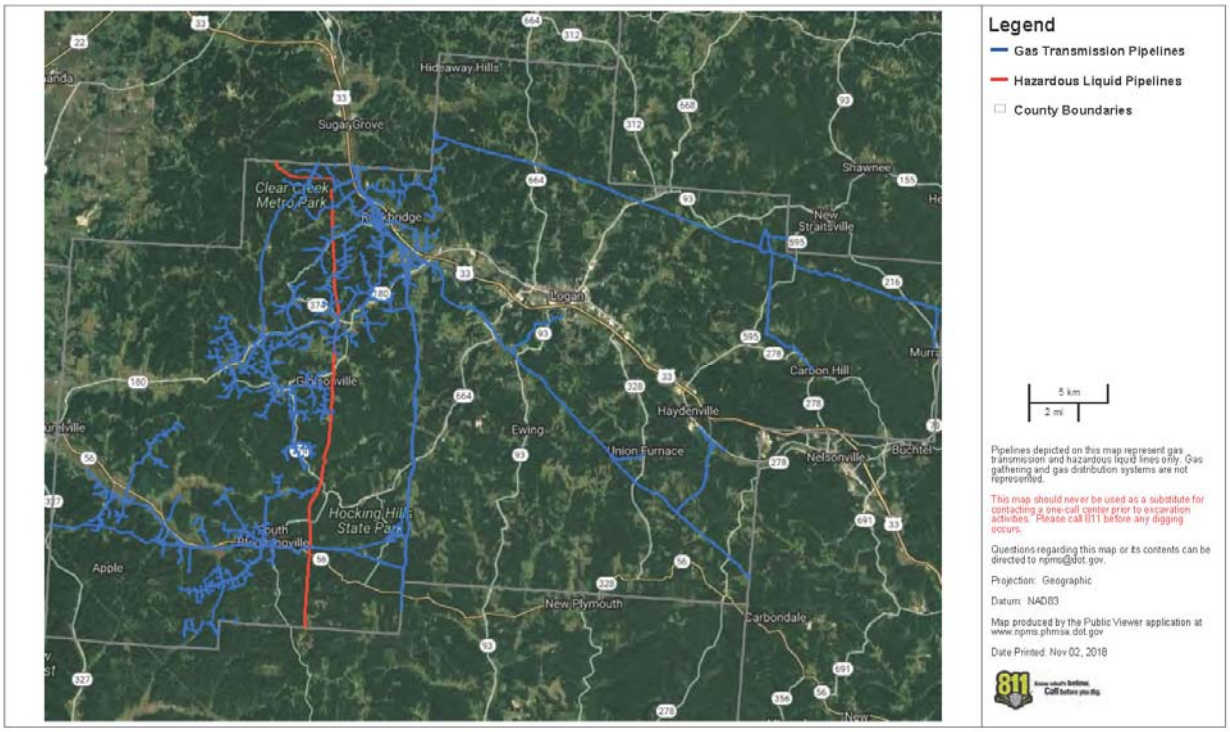
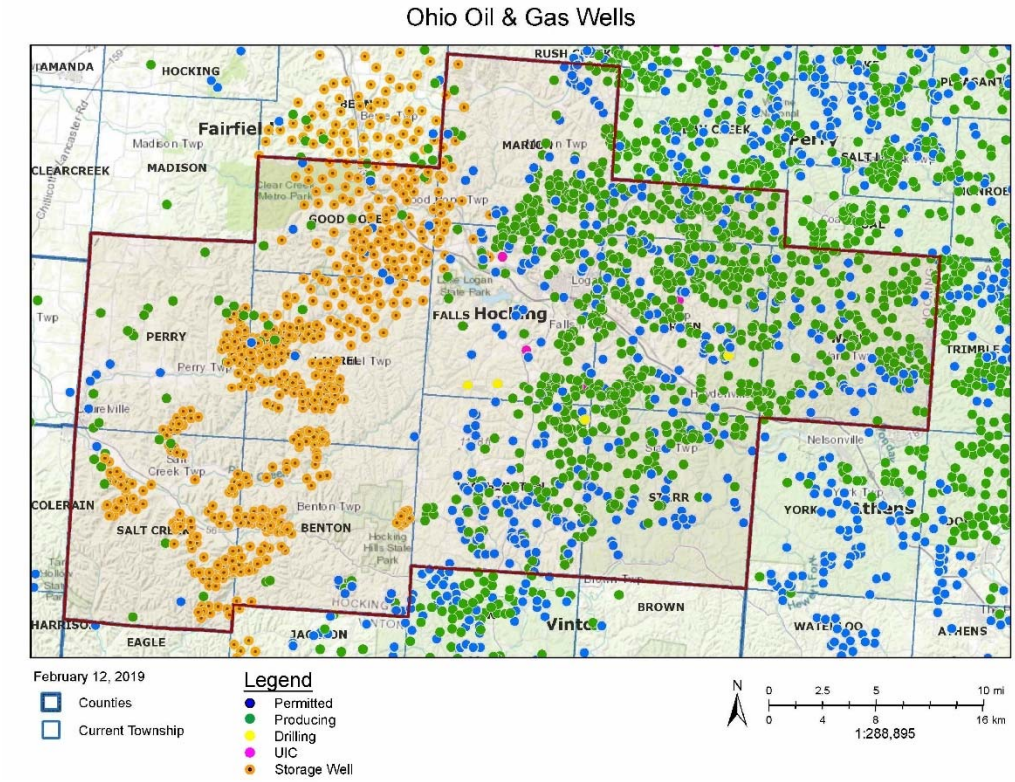


FIGURE 4-29: OIL WELL MAP



EXTENT

Pipelines are normally measured by their diameter or transmission capacity. The severity of an incident would normally be measured by a combination of resulting property damage and loss of life, or by the size of the evacuation perimeter established. In cases of spills or leaks, contaminants in the air or groundwater would be measured as a ratio demonstrating the concentration of that substance. This concentration is normally measured either in parts-per-million (ppm) for small traces, or as a percentage of the local air by volume.

HISTORY

Previous versions of this plan did not identify pipeline leaks or explosions as a potential hazard to Hocking County. According to the Pipeline and Hazardous Materials Safety Administration (PHMSA), there have been no significant incidents of pipeline leaks or explosions reported in Hocking County.

PROBABILITY

There is no history of any significant incident relating to a transmission pipeline in Hocking County. Additionally, state and federal regulations require that pipeline operators keep strict maintenance and observation schedules designed to provide advanced warning of any possible leak or fire. This report estimates the probability of a significant transmission pipeline incident occurring to be less than 1% in a given year.

The reported incidents were not significant according to the PHMSA.

VULNERABILITY ASSESSMENT

An emergency response to a pipeline-related incident will inherently vary by the material involved, the capacity of the pipeline in question, the size and nature of the leak, the presence or risk of fire and explosion, and the proximity of the event to other structures and buildings.

Given the lack of recorded incidents, the potential for loss of property and life from such event is minimal.

TERRORISM

DESCRIPTION

Terrorism is the unlawful use of force and violence against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives" (28 CFR, Section 0.85). "Terrorism" refers to the use of Weapons of Mass Destruction (WMD), including biological, chemical, nuclear, and radiological weapons; arson, incendiary, explosive, and armed attacks; industrial sabotage and intentional hazardous materials releases; and "cyberterrorism".

The FBI's annual report of Terrorism in the United States contains profiles and chronologies of terrorism incidents in America. The 1999 edition includes a comprehensive review of terrorist activities in the United States over the past three decades. This information is helpful to planners as data for hazard profiling; it also illustrates that manmade hazards impact not only large cities but commonly strike small to mid-sized communities as well-an important point when building public support for mitigating terrorism and technological hazards.

LOCATION

Even though terrorism has never occurred in Hocking County, it can happen at any location across Hocking County in the future. More importantly, major cities, towns, or villages where a higher population could be potential targeted, such as the City of Logan. Populous places need to be aware of the potential for danger.

EXTENT

Types of terrorism:

- Cyberterrorism
- Agroterrorism
- Terrorism (Biological)
- Terrorism (Chemical)

Cyberterrorism

- Application Mode: Electronic attack using one computer system against another.
- Hazard Duration: Minutes to days.
- Extent of Effects; Static/Dynamic: Generally, no direct effects on built environment.
- Mitigating and Exacerbating Conditions: Inadequate security can facilitate access to critical computer systems, allowing them to be used to conduct attacks.

Agroterrorism

- Application Mode: Direct, generally covert contamination of food supplies or introduction of pests and/or disease agents to crops and livestock.

- Hazard Duration: Days to months.
- Extent of Effects; Static/Dynamic: Varies by type of incident. Food contamination events may be limited to discrete distribution sites, whereas pests and diseases may spread widely. Generally, no effects on built environment.
- Mitigating and Exacerbating Conditions: Inadequate security can facilitate adulteration of food and introduction of pests and disease agents to crops and livestock.

Terrorism (Biological)

- Application Mode: Bacteria, viruses, or toxins
- Hazard Duration: minutes to months.
- Extent of Effects; Static/Dynamic: A biological attack could cause illness and even kill hundreds of thousands of people, overwhelm our public health capabilities, and create significant economic, societal and political consequences.
- Mitigating and Exacerbating Conditions: The public health infrastructure must be prepared to prevent illness and injury that would result from biological and chemical terrorism, especially a covert terrorist attack.

Terrorism (Chemical)

- Application Mode: the nervous system (nerve agents); the respiratory system (choking agents); the circulation system (blood agents); the skin (blister agents).
- Hazard Duration: Minutes.
- Extent of Effects; Static/Dynamic: Most chemical agents are capable of causing serious injuries or death. The severity of injuries depends on the type and amount of the chemical agent used, and the duration of exposure.
- Mitigating and Exacerbating Conditions: The public health infrastructure must be prepared to prevent illness and injury that would result from biological and chemical terrorism, especially a covert terrorist attack.

Moreover, terrorist threats may occur among school districts in Hocking County. Threats can last hours or even days and can 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.

HISTORY

No forms of terrorism have been documented as having occurred in Hocking County. However, based on the history of terrorism that has happened elsewhere in the country, it should be included in the mitigation plan for future references.

PROBABILITY

Since terrorism tends to occur in major cities, the probability of terrorism happening in Hocking County is very low. There is less than a 1 percent chance of this type of hazard occurring in any given year.

VULNERABILITY ASSESSMENT

Numbers of Structures

Above ground structures are at risk for terrorism damage. This includes government buildings, churches, libraries, and schools.

Damage of Structures

There are 97 critical structures in total, which means the hazard can affect all residential areas, businesses, and other structures potentially since a terrorism can happen anywhere in Hocking County.

Economic Losses

Since the probability of terrorism happening in Hocking County is very low, and there is less than a 1 percent chance of this type of hazard occurring in any given year, economic losses are estimated at zero.

TORNADOES

DESCRIPTION

Tornadoes are rapidly rotating funnels of wind extending from storm clouds to the ground. They form during severe thunderstorms when cold air overrides a layer of warm air, causing the warm air to rise rapidly. The midsection of the United States experiences a higher rate of tornadoes that other parts of the country because of the recurrent collision of moist, warm air moving north from the Gulf of Mexico with colder fronts moving east from the Rocky Mountains.

Tornadoes are most hazardous when they occur in populated areas. Tornadoes can topple mobile homes. Lift cars, snap trees, and turn objects into destructive missiles. Among the most unpredictable of weather phenomena, tornadoes can occur at any time of day, in any of the 50 states, and in any season. While the majority of tornadoes cause little or no damage, some are capable of tremendous destruction, reaching wind speeds of 200 mph or more.

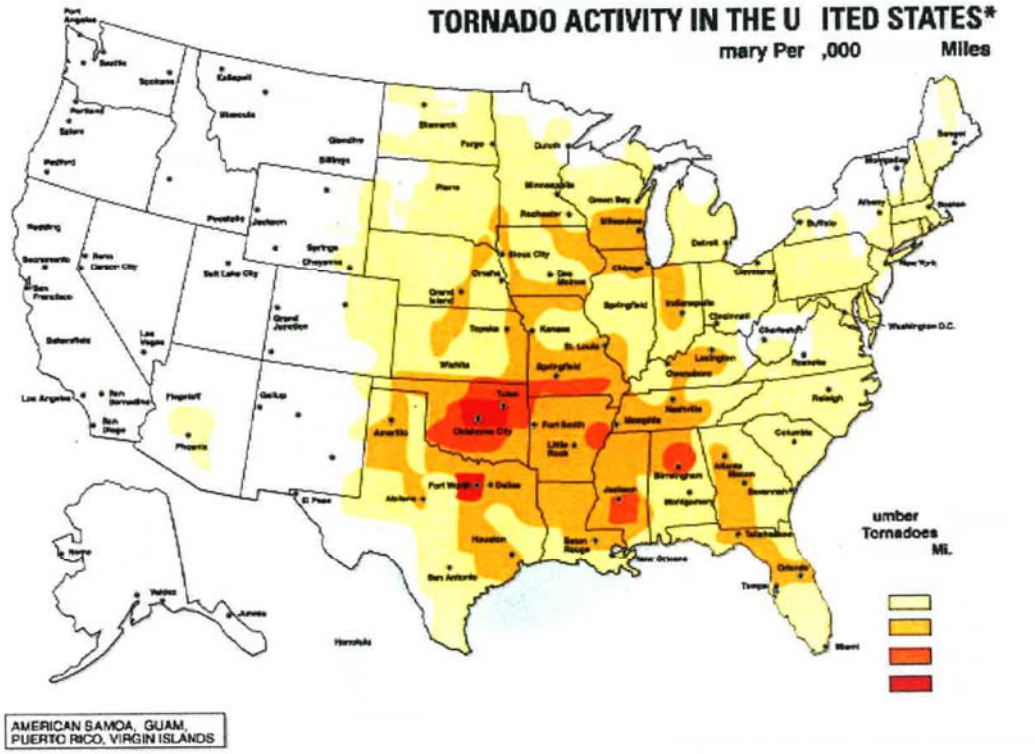
Tornadoes are not spatial hazards, so they can be difficult to profile to determine exact risks. However, this report makes estimates by analyzing historic occurrences and past declarations. While Ohio does not rank among the top states for the number of tornado events, it does rank within the top 20 states in the nation for fatalities, injuries, and monetary losses, indicating that it has a relatively high likelihood of damages resulting from tornadoes.

In this section covers Tornado and Funnel Clouds. High Winds are listed and associated with Severe Summer Storms, Chapter 8.0 and High Winds. See below for all past tornado events.

LOCATION

Tornadoes are a county-wide hazard in Hocking County, potentially affecting all areas and jurisdictions.

FIGURE 4-30: TORNADO ACTIVITY IN THE UNITED STAT



Extent

Tornadoes are measured by damage scale for their winds, greater damage would equate to greater wind speed. The original F-scale was developed without considering a structure's integrity or condition as it relates to the wind speed necessary to damage it. Different winds may be needed to cause the same damage depending on how well-build a structure is. Also, the process of rating the damage was largely a judgement call, lacking a sufficient number of objective criteria. The EF-scale took effect February 1, 2007.

The Enhanced F-scale starts with the original F-scale's F0-F5 ratings and also classifies tornado damage across 28 different types of damage indicators. These indicators mostly involve building/structure type and are assessed at eight damage levels from 1-8. Therefore, construction types and their relative strengths and weaknesses are incorporated into the EF classification given to a particular tornado. The most intense damage within the tornado path will generally determine the EF scale given the tornado. Figure 4-31 below lists the classifications under each scale. The wind speeds listed are estimates based on damage rather than measurements. Also, there are no plans by NOAA and NWS to re-evaluate the historical tornado data using the enhanced scale. Therefore, this Plan and subsequent plans will reference both scales until a complete switchover is deemed necessary.

High wind events are becoming a more frequent natural hazard event in Hocking County. Wind speeds of 52 miles per hour our more are classified as high wind events. Hocking County has witnessed more high wind events bringing down trees and tree limbs, blocking roadways, and downing power lines. Many homes in the county have received roof and siding damage from past events. Since 2000, Hocking County has experienced $3.49 million dollars in property damage due to wind storms.

FIGURE 4-31: FUJITA TORNADO SCALE

The Fujita Tornado Damage Scale

Scale	Wind Estimate/MPH	Typical Damage
F0	40-72 MPH	Light Damage -Some Damage to chimneys, branches groken from trees, shallow-rooted trees pushed over, sign boards damaged.
F1	73-112 MPH	Moderate Damage- Peels surface off roofs, mobile homes pushed off foundations or overturned, moving autos blown off roads. Attached garages may be destroyed
F2	113-157 MPH	Significant Damage- Roofs torn off frame houses, mobile homes demolished, boxcars overturned, large trees snapped or uprooted, light object missiles generaged, cars lifted off ground.
F3	158-206 MPH	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 MPH	Devastating Damage- Well-constructed homes leveled, structures with weak foundation blown away some distance, cars thrown and large missiles generated.
F5	261-318 MPH	Incredible Damage- Strong fram homes leveled, structures with weak foundations blwn away some distance, cars throun and large misseles generated.

NOTE: Developed in 1971 by T. Theodore Fujita/Univ of Chicago

An update to the original F-Scale, designed by a team of meteorologists and wind engineers, took effect in the U.S. on February 1, 2007.

FIGURE 4-32: ENHANCED FUJITA TORNADO SCALE

Fujita Scale			Derived EF Scale		Operational EF Scale	
F Number	Fastest 1/4- mile (mph)	3 Second Gust (mph)	EF Number	3 Second Gust (mph)	EF Number	3 Second Gust (mph)
0	40-72	45-78	0	65-85	0	65-85
1	73-112	79-117	1	86-109	1	86-110
2	113-157	118-161	2	110-137	2	111-135
3	158-207	162-209	3	138-167	3	136-165
4	208-260	210-261	4	168-199	4	166-200
5	261-318	262-317	5	200-234	5	Over 200

History

In the Midwest, the peak tornado season runs typically from April through July. However, Hocking County has experienced four tornadic events:

- Hocking County: August 7, 1968. The Logan area escaped heavy property damage when a tornado which moved toward the southeast skirted the community. It was the first tornado ever reported in the area. Many residents saw the funnel as it moved past the Bowers Heights housing development. The storm caused widespread damage to utility lines and trees but no other major property damage occurred. There was $2,500 worth of property damage.
- Hocking County: July 12, 1980. There was no detailed report available for this incident. It is reported $25,000 in property damage.
- Buena Vista: September 16, 2010. A strong shortwave trough arrived during peak heating out ahead of the cold front in a location that had received a couple hours of sunshine. A scattered to broken line of storms developed in an area of strong deep shear, which allowed for a high degree of organization with the storms. The reported property damage was $16,000.
- South Perry: May 28, 2019. Thunderstorms developed during the evening hours along a warm front lifting slowly north across the region. Many of the thunderstorms produced tornadoes, including a few strong to violent tornadoes. The tornado initially touched down about 50 yards west of Union Road/Township Highway 145, where extensive and somewhat severe tree damage was observed at multiple points. There was a total of $1.5 million dollars in damage. This event also resulted in a Presidential Declaration.

Tornado Events

Number of County/Zone areas affected	1
Number of Days with Event	4
Number of Days with Event and Death	0
Number of Days with Event, Death, Injury	0
Number of Days with Event, Property Damage	4
Number of Days with Event, Crop Damage	0
Number of Event Types Report	1

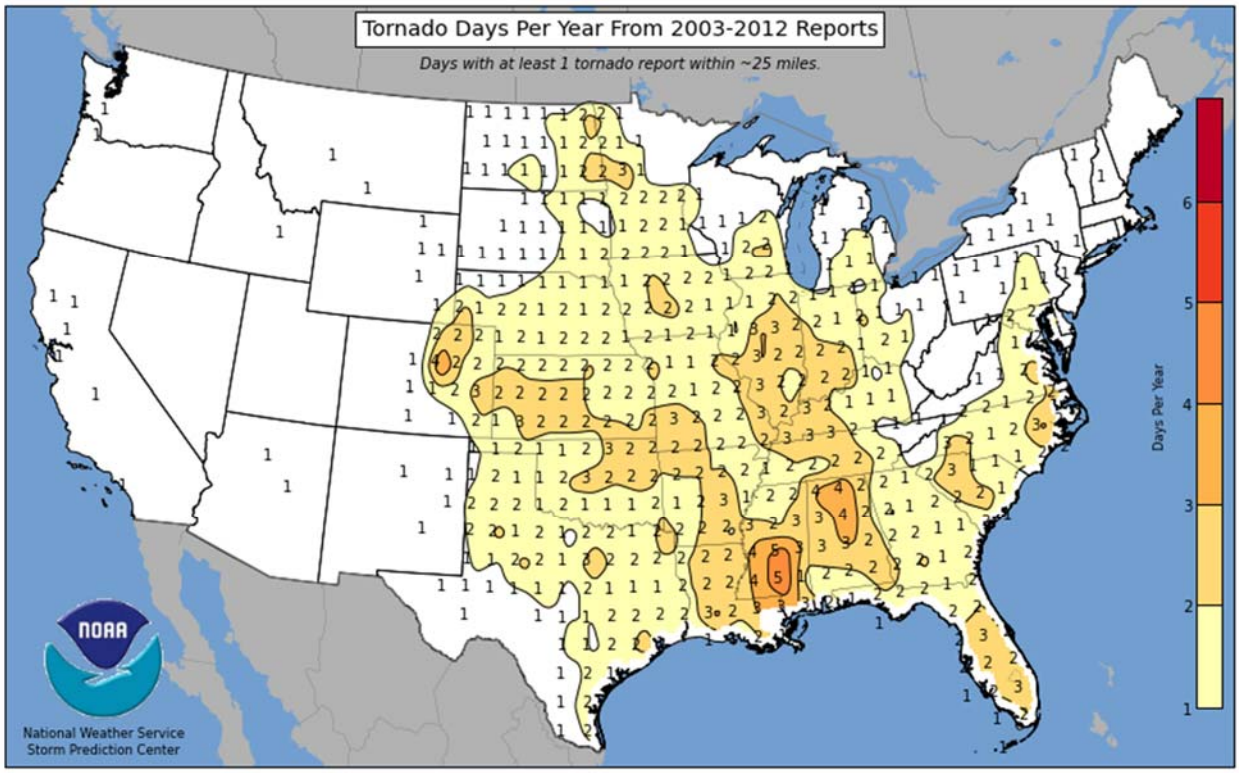
Location	County/Zone	St.	Date	Time	T.Z.	Type	Mag	Dth	Inj	PrD	CrD
Totals:								0	0	1.544M	0.00K
HOCKING CO.	HOCKING CO.	OH	8/7/1968	12:00	CST	Tornado	F1	0	0	2.50K	0.00K
HOCKING CO.	HOCKING CO.	OH	7/12/1980	19:45	CST	Tornado	F1	0	0	25.00K	0.00K
BUENA VISTA	HOCKING CO.	OH	9/16/2010	17:09	EST-5	Tornado	EF1	0	0	16.00K	0.00K
SOUTH PERRY	HOCKING CO.	OH	5/28/2019	0:17	EST-5	Tornado	EF2	0	0	1.500M	0.00K
Totals:								0	0	1.544M	0.00K

The National Weather Service tracks the amount and severity of tornados across the country.

Obviously, Ohio is not a stranger to tornados. In Ohio's history, destructive tornados have occurred leaving behind many fatalities and much damage. Two examples of these are:

- April 1974 devastating tornados once again hit Ohio, resulting in 41 fatalities and 2,000 injuries. The series of tornados that touched down in the western part of Ohio that day were classified as a super outbreak, producing a total of 148 tornados within a 24-hour span. The tornado travelled a total of 2,598 miles. Figure 4-33 below indicates the number of tornado days reported in a nine-**year** span.

FIGURE 4-33: TORNADO DAYS PER YEAR (2003-2012)



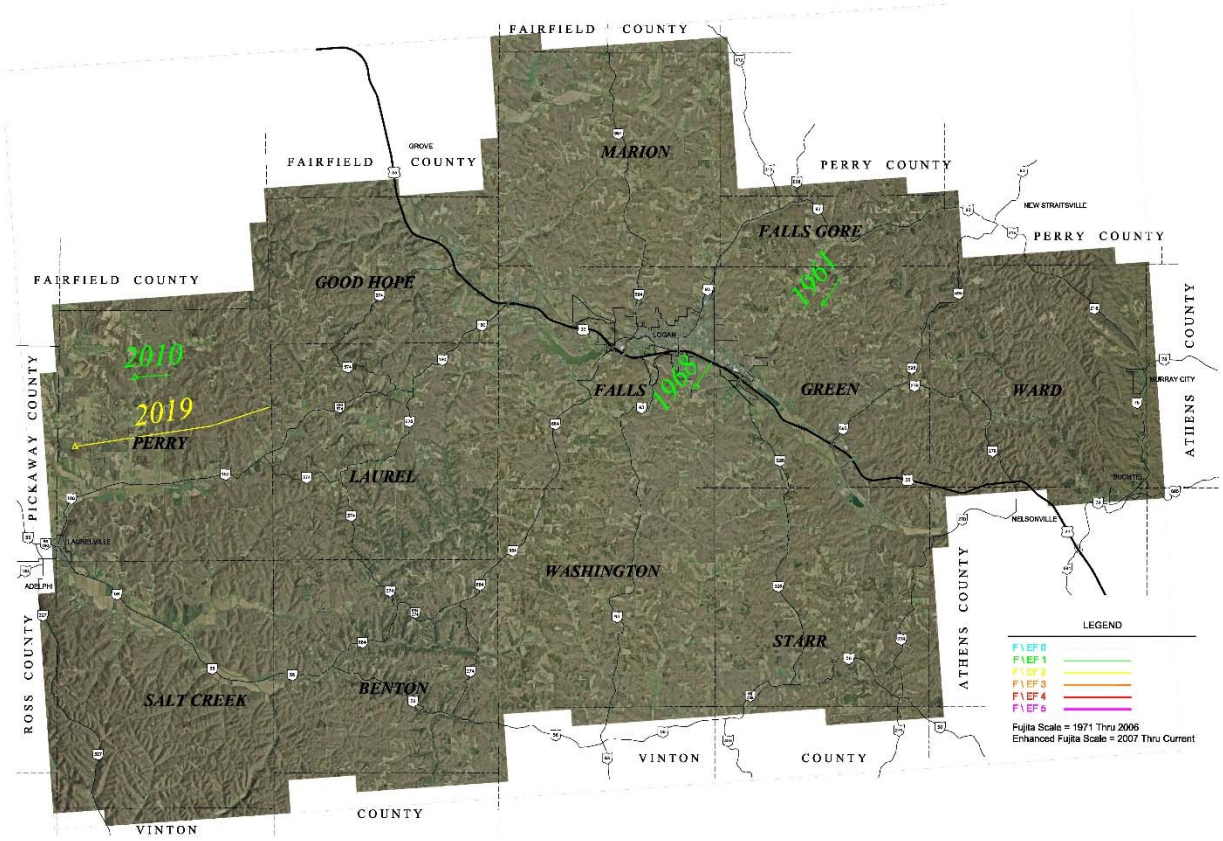
Probability

Acts of nature can never be scheduled, planned, or overlooked. This is why the probability of a tornado touching down in Hocking County, even one large enough to produce enough damage to disrupt our way of life, is very possible. With three events recorded since 1950 (1968,1980,2010), Hocking County could see one tornado every 15 to 20 years. The probability of future occurrences is 100% simply based on the principal that a tornado will happen, eventually.

Through mitigation and planning for the worst-case scenario, the saving of lives, reducing the impact of damage on property, and the protection of our environment will become the normal.

Tornados have been tracked by the National Weather Service for many years. In Hocking County from 1950 to 2017 the map below indicates the path of tornados identified.

FIGURE 4-34: TORNADOS TRACKED 1950-2016 HOCKING COUNTY



Vulnerability

Between 1990 and 2010, Ohio averaged approximately 18 tornadoes per year. Ohio's peak tornado season runs from April through July, with June experiencing the most storms by month. Most tornadoes occur between 2 p.m. and 10 p.m. Tornadoes are considered the most violent atmospheric phenomenon there is. There is a high probability that mobile homes and residential units built without wind-resistant construction standards would suffer catastrophic destruction as the result of a strike by an EF2 or stronger tornado. On a statewide basis, Ohio does not have building codes that address wind resistance for most types of residential dwellings. However, since 1995, many local governments around the state have adopted codes that address wind resistance. Therefore, structures constructed prior to 1995 are potentially more susceptible to catastrophic destruction as the result of a tornado strike than those constructed after 1995.

Infrastructure Impact

Above ground infrastructure is at risk for storm damage by wind and falling debris. For infrastructure the most damaging part of a storm are the high winds and hail. High winds can

strip a tree of bark and detach limbs. If large branches fall they can damage buildings and supporting above-ground infrastructure. Large trees, upwards of 200 feet tall, can be uprooted and can fall on buildings or through houses which can cause serious harm or death.

Utilities that are out in the open are at risk for damage by tornadoes. Electrical lines are spread throughout the county connecting homes, businesses, and other facilities to one another. Large branches from trees or other debris can strike above ground electrical lines, causing power outages. Further, downed lines that are still live and active are extremely hazardous and can cause death by electrocution.

Roads are spread throughout Hocking County and can be affected by downed trees, branches, or other debris. Larger debris or trees will take more time and effort to remove and can adversely affect the flow of traffic until safely removed.

Wastewater facilities can experience backup and blockages if debris falls into the tanks. There are 3 wastewater treatment plants throughout Hocking County.

Population Impact

According to the Census Bureau's 2017 population estimates, the population of Hocking County is approximately 28,474. The population is projects is projected to be 27,870 through the year 2040, so the number of individuals affected by storm events could fall. However, summer is a peak tourist season for Hocking County.

Property Damage

According to the United States Census Bureau (2010-2017 American Community Survey 5-Year Estimates), the median home value within Hocking County was $114,400. There are 17,421 residential housing units within Hocking County and an estimated 1,000 cabins.

Since 1950, according to the NOAA, there have been 3 tornado events, which all 3 caused a total of $43,500. There have been no instances of crop damage, according to NOAA.

Loss of Life

According to NOAA, tornado events have been responsible for no deaths and no injuries during events that passed through Hocking County since 1950.

Economic Losses

Depending on the severity, tornados can cause major damage to structures, such as complete destruction. Additionally, large branches may break windows or fall onto buildings and above ground infrastructure. All three tornado events recorded in Hocking County have caused $43,500 worth of property damage or more countywide.

The most damage sustained by Hocking County occurred in July 1980, when a tornado touched down in the southeast corner of Saltcreek Township and caused $25,000 worth of property damage.

Estimated Losses Caused by a Simulated Tornado

The City of Logan and Villages throughout the county that have high dense population would have more catastrophic damage and loss of life than in the far rural areas. In the City of Logan specifically damages could be several million dollars to several hundred-thousand million dollars.

TRANSPORTATION OF HAZARDOUS MATERIALS

DESCRIPTION

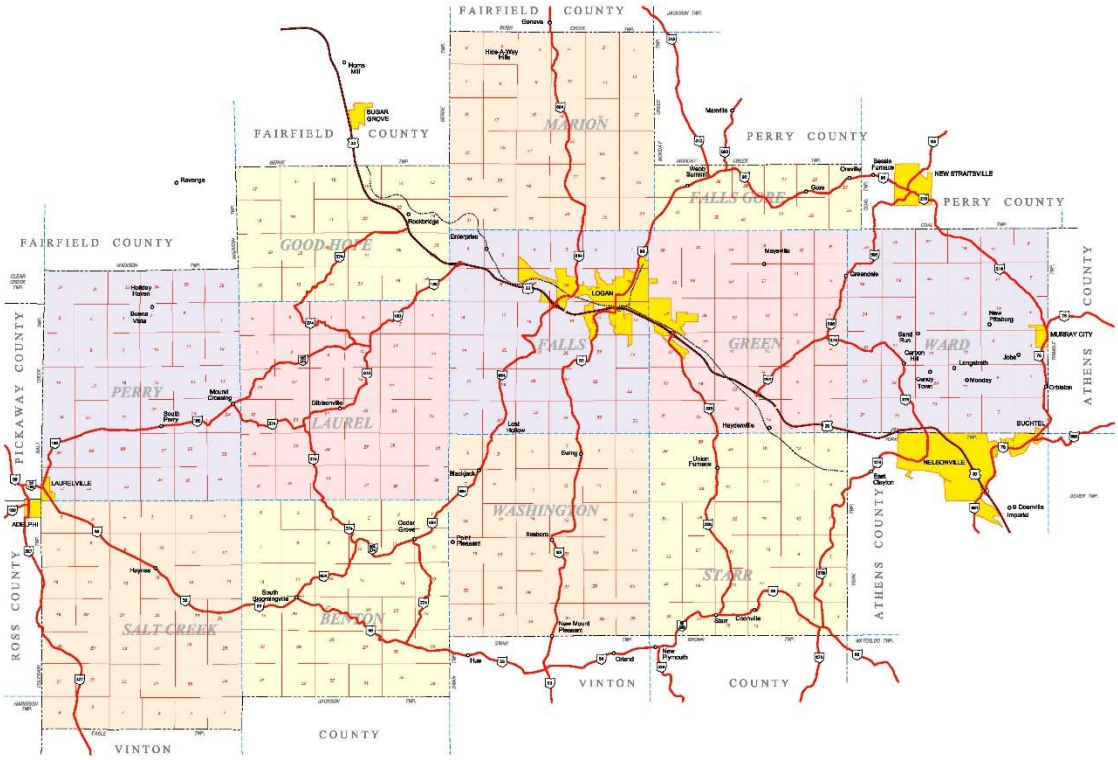
Hocking County has 13 State Routes two of which are only a quarter of a mile within Hocking County as they fall on the county line between Perry and Hocking. US highway 33 and one railway that comes in from Fairfield County into the City of Logan and ends. These routes are used to transport hazardous materials both through the county and into the county. Most of these materials are transported by truck along the State Routes and US 33.

Hazardous materials are not transported through the rail line in Hocking County.

LOCATION

The state routes and highways taken by transporters of hazardous materials are at a higher risk of chemical spills.

FIGURE 4-35: HIGHWAYS & STATE ROUTES IN HOCKING COUNTY



EXTENT

Facilities with hazardous materials and vehicles that carry these materials are more vulnerable for spills, water contamination, storage collapse, fire and the release of toxic fumes.

HISTORY

There is only a minor history of spills in Hocking County.

PROBABILITY

With lack of significant documented occurrences, there is less than 1 percent chance of this type of hazard occurring in any given year.

VULNERABILITY ASSESSMENT

Number of Structures

Chlorine is the most toxic chemical transported throughout Hocking County. In the event of a spill, this chemical elicits a one-mile vulnerability zone. This requires a one-mile buffer to extend off either side of the transportation route and to extend the entire length of the route. The number of structures is determined by the number of critical structures, residential structures, non-residential structures, and bridges that converse over open water and wetlands that fall within the vulnerability zones along the transportation routes. Throughout Hocking County, there are approximately 21,298 such structures.

Damage of Structures & Estimated Losses

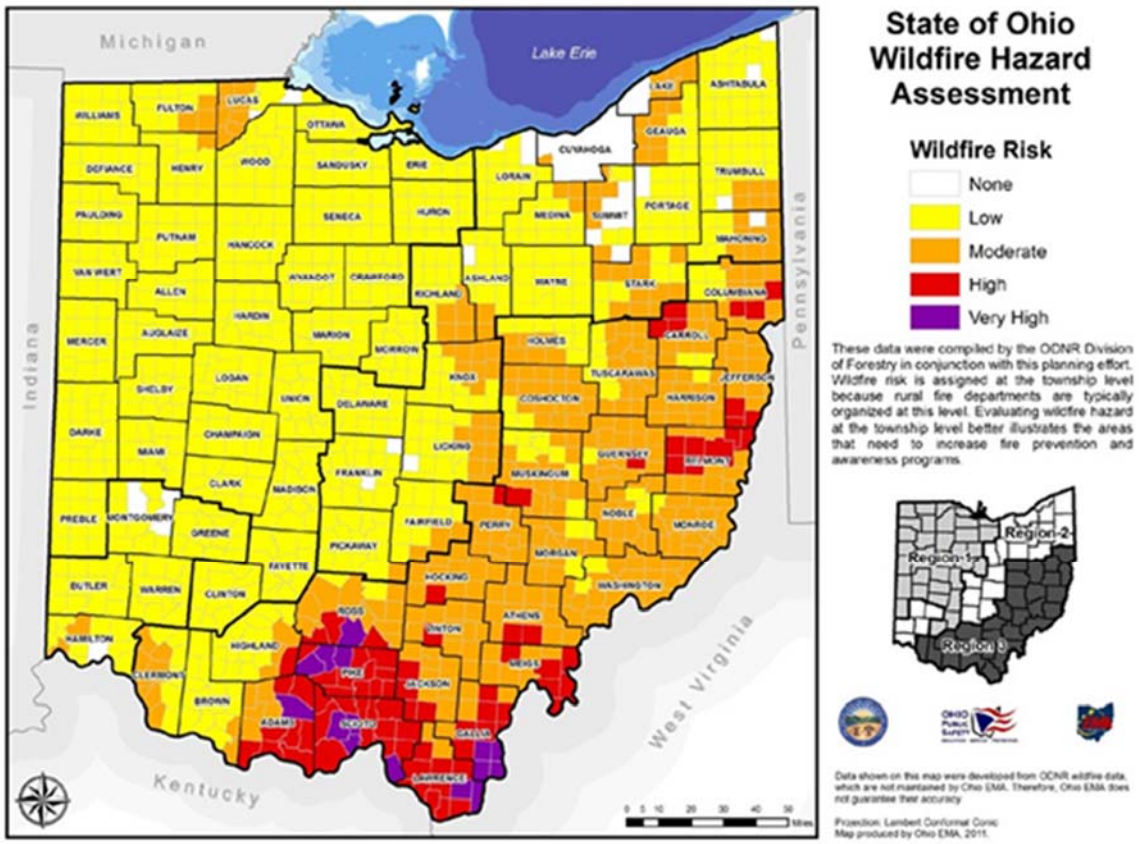
The assessment of this damage would be determined by the extent of damage that affects the structures present in the vulnerability zones and the water contamination or other environmental contamination that occurs. The cost of the damage would be determined by the cost of the spill cleanup.

WILDFIRES

DESCRIPTION

A wildfire is a fire in an area of combustible vegetation that occurs in the countryside or rural area. The Ohio Department of Natural Resources identifies Ohio's wildfire seasons as occurring primarily in the spring (March, April and May) before vegetation has "greened-up" and the fall (October and November) when leaf drop occurs. During these times and especially when weather conditions are warm, windy and with low humidity, cured vegetation is particularly susceptible to burning. Fuel (vegetation, woody debris), weather (wind, temperature, humidity) and topography (hills and valleys) can combine to present an extreme danger to unwary civilians and firefighters in the path of a wildfire. According to the statewide Hazard Mitigation Plan drafted by the Ohio EMA, Hocking County is at moderate risk, with the exception of Benton township which has a high risk compared to the rest of the County (see Figure 4-36). Each year an average of 1,000 wildfires burn 4,000 to 6,000 acres of forest and grassland within Ohio's forest fire protection district, which corresponds mostly to the state's unglaciated hill country.

FIGURE 4-36: STATE OF OHIO WILDFIRE HAZARD ASSESSMENT



LOCATION

Hocking County is over 80% forested areas. With Wayne National Forest and Hocking Hills State Forest being the largest park areas, there are an additional six parks in Hocking County. These areas are a large tourism draw for the county with an annual tourist population exceeding 3 million. Not only is October one of the more dangerous months for fires in the County but is also the largest tourism month with over 800,000 people visiting Hocking County.

There are approximately 1,000 cabins in the Hocking Hills region in addition to our permanent population. A fire could start at any of these locations within the county.

EXTENT

Hocking County offers a steep rugged landscape that is hard if not impossible to traverse with a motorized vehicle. Sheer cliffs over 100ft in height, deep ravines, and cave areas limit the availability of firefighting equipment in many areas. The extent of a wildfire would depend on the location, access to the area, weather conditions, and equipment available. The risk of personal injury, loss of life, and property damage is increasing each year with more homes, and vacation rentals being built in wildland areas.

HISTORY

Small wildfires are an annual event that is mostly contained quickly by local resources. However, each event has the potential to overwhelm local capabilities.

PROBABILITY

No wildfires have been detected in Hocking County by the USDA Forest Service Active Fire Mapping Program. The International Multiproxy Paleo Fire Database (IMPD) also does not show any historical evidence of significant wildfire events in Hocking County, or in the State of Ohio as a whole. Small-to-medium brush fires generally burn without issue intentionally and controlled by farmers and others that complicate recording reporting and actual occurrence of wildfires in the county. In addition to sparsely populated, Hocking County consist of one paid Fire Department and 7 Volunteer Fire Departments.

Mines, often abandoned and largely undocumented, also present a significant risk of spreading wildfires in the county. Also, cleanup and remediation of abandoned mines is becoming increasingly difficult due to financial strain of the energy sector, leading mine owners becoming unable to fulfill their required obligations for remediation. While little to nothing has been recorded under the traditional definition of wildfires.

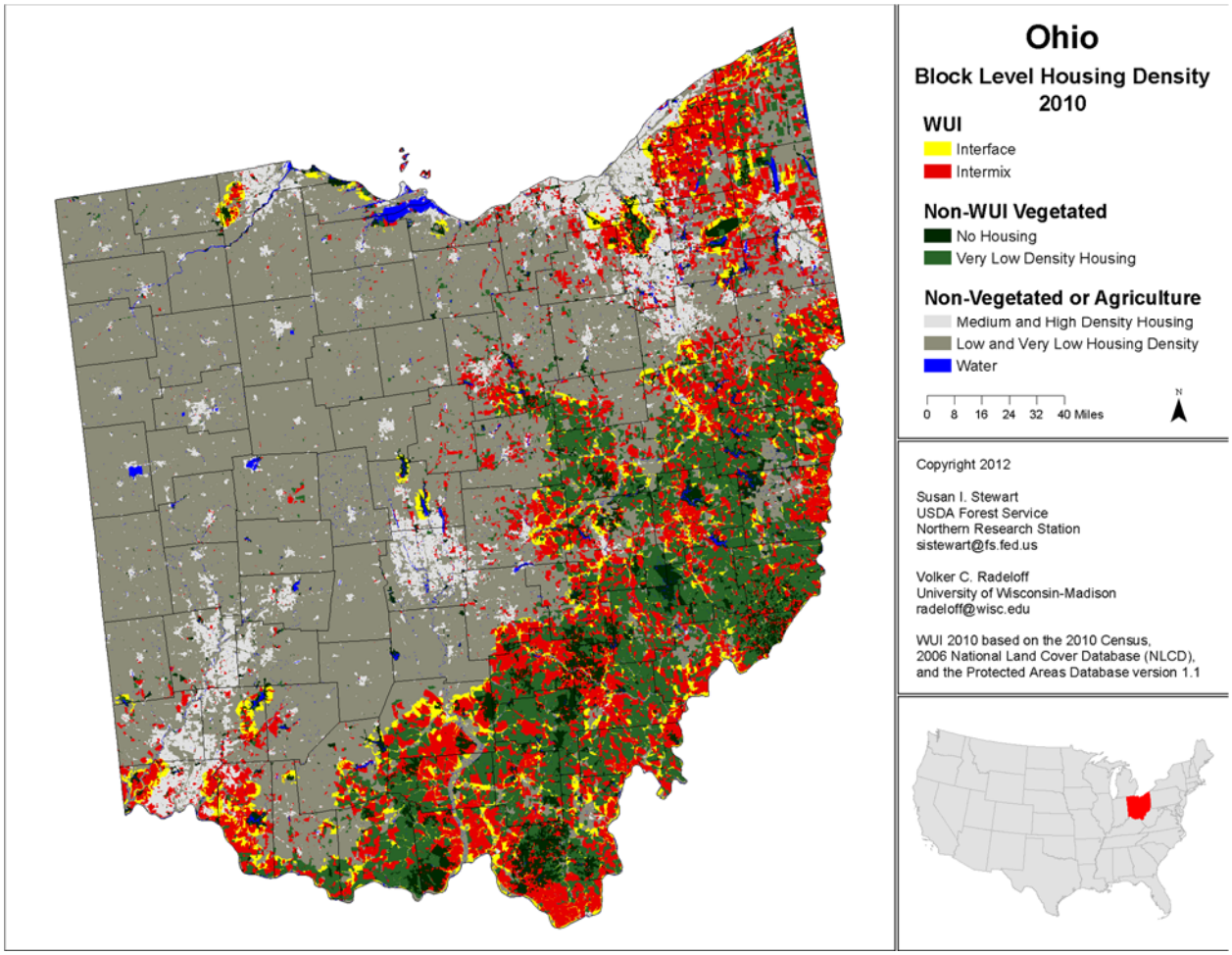
Hocking County is at an increased risk for wildfires, due to being within the dryer Appalachian region.

VULNERABILITY ASSESSMENT

Structures and Damage

Since even the most densely populated areas of Hocking County lie near forested and vegetated areas, most of the county is located on the inner mix area of the Wildfire Urban Interface, also known as the WUI. These areas are defined as areas with housing present that must meet or exceed a minimum density of one structure per 40 acres.

FIGURE 4-37: MAP OF WILDFIRE URBAN INDEX IN OHIO



Estimated loss was determined based on the number of structures that could potentially be affected if Hocking County experienced a wildfire. Wildfires area a countywide hazard, the total number of structures in the county was included in the vulnerability assessment. This loss estimate was derived by adding the total number and estimated values of residential, non-residential, and critical facilities in the county. The total economic losses are summarized in the table below:

FIGURE 4-38: PHYSICAL POTENTIAL DOLLAR LOSSES (2018 CALCULATIONS)

Building Type	# of Structures	Total Value	Damage for 1% Scenario	Damage for 5% Scenario
Agricultural	1,293	$43,634,100	$436,341	$2,181,705
Residential	17,526	$460,148,080	$4,601,481	$23,007,404
Commercial	651	$43,766,040	$437,660	$2,188,302
Industrial	63	$7,568,050	$75,681	$378,403
Mineral	622	$439,880	$4,399	$21,994
Public Utility	267	$87,670	$877	$4,384
Exempt	777	$74,984,680	$749,847	$3,749,234
Total	21,199	$630,628,500	$6,306,286	$31,531,426

IMPACT

Due to the increasing urban/wildland interface areas in Hocking County the possibility of loss to homes and lives is increasing. Every township has residence located in largely wooded areas. The Hocking Hills area of the county including 8 State Parks, and the Hocking Hills State Forest is over 17,000 acres. The adjoining private lands house numerous companies offering tourist activities, rental properties, retail, and dining establishments. The tourism industry is estimated to generate over 120 million dollars in local income, and over 13 million dollars in state and local taxes. Losses would need to be figured on not just the real property loss, but also on the potential losses due to lessening tourism activities and income.

Regardless of the lack of Wildfires currently in the County, this type of event is always a concern for the first responders. The potential of a wildfire could devastate the tourism to the county and tax the first responder's abilities.

5. HAZARD MITIGATION

HAZARD MITIGATION STRATEGY

The mitigation goals follow the ranking of hazards that affect Hocking County.

HAZARD RANK	HAZARD IDENTIFICATION
1	Flooding
2	Severe Thunderstorms
3	Frozen Precipitation
4	Winter/ Ice Storms
5	Power Outages
6	Pipeline
7	Tornado
8	Wildfire
9	Water System Failure
10	Transportation Hazardous Materials
11	Hazardous Materials Release
12	Land Subsidence
13	Dam Failures
14	Earthquake
15	Terrorism

There were changes in priorities. The Core Group in the 2005 Hocking County Natural Hazard Mitigation Plan concentrated on three natural hazards; wildfire, flooding, and winter storms/thunderstorms/windstorms.

Priority mitigation projects will only be implemented if the maximum benefits outweigh the associated costs of the proposed projects. The Core Group performed a general assessment of each mitigation measure that might require FEMA funding. A detailed cost-benefit review of each mitigation activity will be required during the project planning phase in order to determine economic feasibility. Projects will also be evaluated for eligibility and feasibility based on social and environmental impact, technical feasibility and any other criteria that measure project effectiveness. This detailed evaluation of projects will be performed during the pre-application phase of a grant request. Further, project implementation will be subject to the availability of FEMA grants and other sources of funds and local resources.

Projects are determined to be infeasible during this detailed review will be re-evaluated by the Core Group for re-scheduling or deletion.

HAZARD MITIGATION GOALS

The Core Group determined several goals and actions to mitigate the hazard risks identified in the County's hazard mitigation plan. These mitigation actions were developed based on projects thought to be the most feasible and the most beneficial to hazard reduction. The mitigation actions were also developed in accordance with the following types of mitigation strategies (in no particular order): 1) prevention; 2) property protection; 3) natural resource protection; 4) structural projects; 5) emergency services and 6) public education and awareness.

The mitigation goals, in order of priority, include:

1. Reduce the impact of flooding on people, property, and tourism population.
2. Reduce the impact of damaging winds on people and property.
3. Reduce the impact of frozen precipitation on people and property.
4. Reduce the impact of winter storms on people, property, crops and animals.
5. Reduce the impact of power outages on people and property.
6. Reduce the impact of pipeline releases on people and property.
7. Reduce the impact of tornadoes on people, property, and tourism population.
8. Reduce the impact of wildfires on people and property.
9. Reduce the impact of water system failures on people and property.
10. Reduce the impact of transportation spills on people, property, and waterways.
11. Reduce the impact of chemical spills on people, property, and waterways.
12. Reduce the impact of land subsidence on people and property.
13. Reduce the impact of dam failures on people and property.
14. Reduce the impact of earthquakes on people and property.
15. Reduce the impact of terrorism on people and property.

STAKEHOLDER MATRIX SCORING METHODOLOGY

The Matrix Scoring Spreadsheet contains the scoring information from the public and jurisdictions involvement process and calculates to develop the mitigation action priorities.

The first five numerical columns include averaged information from the stakeholder process, on a scale of 1-5, where 5 was the highest score/priority:

1. Cost-Effective Average Score
2. Technically Feasible
3. Environmentally Sound
4. Immediate Need
5. Total Risk Reduction

These scores were then summed into the next column, the Raw Score.

Next, the hazard priorities were converted from a rank (1-15) to a value, where:

- 1 = 1500
- 2 = 1400
- 3 = 1300
- 4 = 1200
- 5 = 1100
- 6 = 1000
- 7 = 900
- 8 = 800
- 9 = 700
- 10= 600
- 11= 500
- 12= 400
- 13= 300
- 14= 200
- 15= 100

The Raw Score was then added to the Hazard Priority Score to calculate the Adjusted Score. For the few mitigation actions that still had a "tie" score, the County EMA determined which should prioritized and a small adjustment value was then added to account for this decision.

The Adjusted Score resulted in a unique value for every mitigation action, so the mitigation actions were then sorted in order of the Adjusted Score value, from highest (1) to lowest (15), and then given a sequential priority value from 1 to 103, where 1 has the highest priority and 103 the lowest.

In Figure 5-1 Hazard Mitigation Action Plan the score column provides the results.

HAZARD MITIGATION ACTION PRIORITY

The following pages include the hazard mitigation actions and priorities tables, developed for all of the hazards and associated goals.

Note: under the "Agency" column, Representatives of All Participating Local Jurisdictions include: Village of Murray City, Village of Laurelville, and City of Logan

FIGURE 5-1: HAZARD MITIGATION ACTION PLAN

HAZARD MITIGATION ACTION PRIORITIES							
Hazard & Mitigation Action	**Score**	**Priority**	**Source**	**Agency**	**Start/End**	**Status**	**Update**
FLOODING							
Schedule detailed studies for exact flood plain boundaries in certain areas and update County Flood Hazards Maps in urbanizing areas.	1518.38	4	Hocking County Regional Planning Office	Hocking County Floodplain Manager, Hocking County EMA, Village of Laurelville, City of Logan, Village of Murray City	2005-2024	Ongoing	2018: As part of FEMA's Map Modernization Project, Hocking County's Flood Plain Maps were revised and updated in 2010. This project was completed in order to provide for digital mapping of the flood plain as well as more accurate floodplain mapping. New four foot contours were provided to FEMA by Hocking County as part of their 2007 aerial mapping project and several detailed studies for individual areas were provided as well. A total of 4 detailed studies were provided in addition to a total of 16 individual studies of homes and businesses.
Acquire, demolish, and/or retrofit flood-prone properties.	1517.75	6	Hocking County Commissioners & Hocking County EMA	Hocking County Floodplain Manager, Hocking County EMA, Laurelville, Logan, Murray City	2005-2024	Ongoing	There have been no new buy-outs for repetitive loss properties since 2005, however the process is on-going.
Re-size culverts/ bridges that are undersized.	1521.13	1	Township Trustees & County Engineer	Hocking County Engineer, All Townships, Laurelville, Logan, Murra City	2005-2024	Ongoing	This process has been an on-going project with the County Engineer and Township Trustees. All bridge replacements and new culverts and replacements have been re-sized to further control run-off and decrease flooding, based on and calculated per applicable watershed and flood potential. Since 2005: a total of 74 bridges have been replaced; a total of 56 concrete/box culverts have been put in place for both existing and newly identified locations; a total of 862 metal and ADS culverts have been put in place for both existing and newly identified locations.
Extend well casings above the flood level or install a public water system for the residents of Rockbridge.	1515.5	9	Hocking County EMA	Hocking County Commissioners, Village of Rockbridge	2005-2024	Ongoing	A new rural water project was completed in September, 2009, by the Old Straitsville Water Association, providing potable water to the village of Rockbridge and eliminating the need for individual water wells for potable water.

Flood-proof existing structures	1513.38	13	Hocking County EMA	Hocking County Floodplain Manager Good Hope Township Rockbridge	2005-2007	Unchanged due to lack of funding	
Install Water and Sediment Control Basins (WASCOBS), ponds and wetlands and ample free board to increase storage capacity.	Completed	Completed	Township Trustees & County Engineer	Hocking County Engineer, All Townships, Laurelville, Logan, Murra City	2005-2008	Unchanged due to lack of funding	No water or sediment control basins have been installed, however see the Update for item 6, page for new culverts installed to further control run-off and help decrease flooding.
Hire a nuisance trapper to remove the beavers from the creeks were they have built dams and caused flooding and then remove the beaver dams.	1515.25	10	Perry Township Trustees & Falls Township Trustees	Perry Township & Falls Township	six months	Ongoing	No progress yet but still a goal/action item
Raise approximately 100 yards of the road near the river. A portion of this road is next to the Hocking River and it floods whenever there are heavy rains-long before other areas in the county flood. This road is a dead-end road and is the only access to one residence and a cell tower. Every time the power goes out, the cell tower maintenance crew must get to the tower for repairs.	1513.13	14	Starr Township	Starr Township Trustees	undetermined	Ongoing	No progress yet but still a goal/action item
Purchase boats for use to evacuate victims of floods.	1517.13	7	Hocking County EMA All Jurisdictions Fire Departments	All Jusidictions FD, Hocking County EMA	six months	Ongoing	Boats have been purchased through-out the county. MOU's are in place with ODNR. However, to insure timely response to those affected by flood waters more boats need to be purchased.
Evaluate and design a storm sewer system for Haydenville	1514.5	12	Hocking County Commissioners & Green Township Trustees	Hocking County Commissioners, Green Township, Haydenville	2005-2008	Old/ Completed/ On-going	This project has been completed and is also on-going due to the need of maintaining drainage ways. See item 6 for further information.
County-Wide Reverse 911 System	Completed	Completed	Hocking County 911	Hocking County EMA, Laurelville, Logan, Murray City	ongoing	Completed	This project has been completed with the purchase of RAVE Notification System. This system is maintained and paid for through EMA.
Payne Road located in the Southwest corner of Falls Gore Twp. intersecting with St Rt. 93 needs raised.	1515.25	10	Falls Township, Hocking County	Falls Township, Hocking County Engineer, ODOT	2019-2021	New	
Bridge on St Rt. 78/ Main Street needs to be raised.	1516.75	8	Hocking County Commissioners, ODOT	ODOT, Murray City	2019-2021	New	

Clean brush from creek bank	1518	5	All Jurisdictions	Hocking County Commissioners, Laurelville, Logan, Murray City	2019-2020	New	
Conduct acquisition and relocation projects in flood-prone portions of the county.	1514.63	11	State or Federal Funds	County Commissioners, County EMA, Floodplain Manager	2019-2024	New	
Strategically place or identify existing sites that could be used as emergency shelters through-out the county.	1520.5	2	Existing Budget	County Commissioners, County EMA, All Jurisdictions	2019-2024	New	
Facilitate the formation of flood task forces throughout the county to address flooding problems on a regular basis.	1518.5	3	Existing Budget	County Commissioners, County EMA, All Jurisdictions, Floodplain Manager	2019-2024	New	
SEVERE THUNDERSTORMS/ LIGHTNING							
Retrofit Surge Protection for Government Buildings. Retrofit City buildings to ensure buildings and equipment are not damaged during lightening strikes.	1416.63	16		City of Logan	2019-2020	New	
Install Warning Sirens	1417	15	Grants	Hocking County EMA, Hocking County 911, All Jurisdictions	2005-2024	Ongoing	No progress yet but still a goal/action item
Develop a lightning brochure for distribution by recreation retailers and tourist areas.	1413.63	17	Existing Budget	ODNR, U.S. Forest Service, County EMA	2019-2024	New	
FROZEN PRECIPITATION							
HEAVY SNOW							
POWER OUTAGES							
Back up fuel delivery plan for critical facilities and vehicles. Access fuel at a depot during power outages for buildings and vehicles. Consider mutual aid with county or townships.	1118.13	19	IT Contractor	Hocking County EMA, City of Logan	2019-2021	New	
Establish a backup system to ensure communication is available	1118.5	18	Hocking County 911	Hocking County IT, City of Logan, Laurelville, Murray City	2019-2021	New	
Install generator for buildings that are used as shelters and critical facilities	1117.5	20	Grants	Hocking County EMA	2019-2021	New	

PIPELINE							
Conduct drills to prepare for hazards involving pipelines	1028.25	21	HMEP	LEPC	2019-2024	New	
TORNADO							
Provide back-up generators for critical facilities, including shelters, which need to maintain continuous power to protect human health and life.	930.88	22	PDM GRANT	County Commissioners, County EMA	2019-2024	New	
Provide/encourage NOAA weather radios for all critical facilities within the County.	918.13	24	State or Federal Sources	County Commissioners, County EMA	2019-2024	New	
Education about Emergency Alert System through smartphones	919.25	23	Existing Budget	County EMA	2019-2024	New	
Provide permanent shelters for residents of single family homes, mobile home parks, and campgrounds, and community centers where people may seek safety.	916.5	25	State or Federal Sources	County Commissioners, County EMA	2019-2024	New	
WILDFIRE							
Provide the local fire departments with the brush fire equipment & training necessary for them to fight wildfire and meet their requirements.	831.75	26	Hocking County Firefighters Association	Hocking County EMA, Laurelville, Logan, Murray City	2005-2024	Ongoing	Fire Departments are receiving training through a partnership with Wayne National Forest and MOU's have been created. No equipment has been purchased at this time.
Hold workshops for local residents & cabin rental businesses to educate them on fire safety, evacuation, and ways to protect their property; prepare brochures for distribution to residents and tourists on fire safety and awareness; and publish news articles on appropriate topics.	817.63	30	Hocking Hills Tourism Association & Hocking State Forest	Hocking County EMA, Laurelville, Logan, Murray City	2005-2024	Ongoing	EMA has been working on preparedness documents to present to the Hocking Hills Tourism Association as a resource for cabin owners.
Expand the number of dry hydrants in the county.	817	32	Hocking SWCD & Hocking County Regional Planning Office	Hocking County SWD, Laurelville, Logan, Murray City	2005-2018	Completed	A total of 9 new hydrants have been installed since 2005, providing for a minimum of one hydrant per township
Encourage refuse collection and recycling in the county to prevent open burning	819.88	27	Existing Budget	Athens Hocking Solid Waste District	2019-2024	New	
Provide chemical disposal station in County.	816.38	33	Existing Budget	Athens Hocking Solid Waste District	2019-2024	New	

Create a Navigation Sign Committee in order to create signs for trails, Hocking River, and evacuation routes during a wildfire.	817.38	31	Existing Budget, Research for possible grants	County Commissioners, County EMA, ODNR, U.S. Forestry Services, Hocking Hills Tourism Association, County 911, All Jurisdictions	2019-2024	New	
Encourage residents to change batteries during time change	819.63	28	Existing Budget	American Red Cross, County EMA	2019-2024	New	
Clear access brush away from potentially combustible properties and areas.	818.38	29	Grants	County Commissionrs, County EMA	2019-2024	New	
WATER SYSTEM FAILURE							
Replace water lines and valves in the City of Logan. Replacement of several feet of water lines	732	34	City of Logan	City of Logan	2019-2023	New	
Separate storm water sewer from waste water.	716.88	35	City of Logan	City of Logan	2020-2024	New	
TRANSPORTATION OF HAZARDOUS MATERIALS							
Identify vulnerability zones for chemicals in accordance with the commodity flow study	629	36	Existing Budget	LEPC	2019-2024	New	
Create commodity flow study for chemicals in Hocking County	614.5	37	Existing Budget	LEPC	2019-2024	New	
HAZARDOUS MATERIALS RELEASE							
Report if additional hazardous materials are added or removed to the site	530.38	38	HMEP	LEPC	2005-2024	Ongoing	These actions take place every year and are apart of daily operations of the LEPC.
New facilities to report what hazardous materials are being handled on-site	519.38	40	HMEP	LEPC	2005-2024	Ongoing	These actions take place every year and are apart of daily operations of the LEPC.
Report what hazardous materials are being handled on-site	519.5	39	HMEP	LEPC	2005-2024	Ongoing	These actions take place every year and are apart of daily operations of the LEPC.
Conduct a yearly drill to prepare for a disaster involving hazardous materials	519.38	40	HMEP	LEPC	2005-2024	Ongoing	These actions take place every year and are apart of daily operations of the LEPC.
LANDSLIDES & LAND SUBSIDENCE							
Develop a public education program concerning the hazards associated with landslides and how to report landslides.	428.25	41	Existing Budget	County Commissioners, County EMA, ODOT, ODNR	2019-2024	New	
EARTHQUAKE							

DAM FAILURE							
Coordinate with the ODNR, Dam Safety Engineering Program to conduct periodic safety inspections of existing dams in Hocking County.	333.13	42	Existing Budget	County Commissioners, County EMA, OEMA, ODNR, USACE	2019-2023	New	
Rehabilitation of high-hazard potential dams in Hocking County.	333.13	42	Existing Budget	County Commissioners, County EMA, OEMA, ODNR, USACE	2019-2023	New	
Assess the vulnerability of all dams in Hocking County.	321.88	43	Existing Budget	County Commissioners, County EMA, OEMA, ODNR, USACE	2019-2023	New	
TERRORISM							
Require government agencies to review and update emergency response procedures and communications systems, as well as provide the public with necessary information	145.38	44	Existin Budget	County EMA, Law Enforcement, County IT	2019-2024	New	
Increasing surveillance of critical locations, coordinating emergency plans with nearby jurisdictions and implementing contingency and emergency response plans.	120.38	45	Existin Budget	County EMA & Law Enforcement	2019-2024	New	
DROUGHT							
Develop a public education program concerning the hazards associated with droughts and water restrictions during drought conditions	15.5	47	Existing Budget	OEMA, County EMA, County Commissioners	2019-2024	New	
Educate residents on the benefits of conserving water at all times, not just during a drought.	14.25	48	Existing Budget	OEMA, County EMA, County Commissioners	2019-2024	New	
Develop a public education program concerning property owner/farmers water storage for emergency crop management.	14.25	48	Existing Budget	OEMA, County EMA, County Commissioners	2019-2024	New	
Construct additional water storage facility for emergency crop management and fire suppression.	14	49	Existing Budget	OEMA, County EMA, County Commissioners	2019-2024	New	
INSECT/ PEST DAMAGE							
Hold workshops for local residents and landowners on the insects and pests (such as the Gypsy Moth, Emerald Ash Borer, and Sudden Oak Death) that can adversely affect the forests of Hocking County.	16.25	46	The Ohio State University Extension & Hocking State Forest	Hocking County EMA, Laurelville, Logan, Murray City	2005-2024	Ongoing	No progress yet but still a goal/action item.

6. SCHEDULE & MAINTENANCE

ADOPTING THE PLAN

A sample resolution is included in Appendix D**.** Once all the jurisdictions adopt the updated plan, their signed resolutions will become part of Appendix I. As in past years, all jurisdictions readily embrace the NHMP as part of their community's resolution. Once the plan has been submitted to the State Hazard Mitigation Officer at the Ohio Emergency Management Agency and approved, it will be adopted by each jurisdiction. The Ohio EMA will submit the plan to the Federal Emergency Management Agency (FEMA) for review. Upon acceptance by FEMA, Hocking County will gain eligibility for Hazard Mitigation Gran Program funds.

The Plan will be adopted by all jurisdictions that chose to participate: Hocking County and the City of Logan, Village of Laurelville, and Village of Murray City.

CONTINUED PUBLIC INVOLVEMENT

The public will continue to have the opportunity to provide feedback about the Plan and fill-out a survey on the Hocking County EMA website (survey's in Appendix A). Copies of the Plan will be available through the Ohio EMA website and the Hocking County EMA website. The Hocking County EMA will provide access to the Plan to all county, municipality, and township offices and will make the Plan available, in physical or electronic format, to the public as appropriate. The Hocking County EMA Director will post notices of mitigation plan update and evaluation meetings using the usual methods for posting meeting announcements in the county to invite the public to participate. All such meetings shall be open to the general public. The Hocking County EMA will publicly announce the mitigation action items that are stated for development in the current year, as well as any updates to the Plan as part of the annual review process.

PLAN INTEGRATION

Local government feedback plays a major role in enforcing and implementing mitigation strategies. This happens not only during purposeful plan review, but also during daily operations that guide the growth and development of specific communities. Every village in Hocking County deal with growth issues in the municipality, referencing regulations, development plans, and mitigation strategies as they lead their jurisdiction.

Hocking County municipalities are small and have limited full-time staff, so the county as an organization provides strong leadership and oversight of economic development, community development, planning, programming and brokerage services for housing, transportation, water, land use, zoning and technology issues. Mitigation efforts are considered simultaneously with building code enforcement, zoning regulations, and land use rules at the county level.

Many local officials wear numerous hats as they guide, direct, and facilitate local growth and development through regulation. There is significant overlap between county officials when it comes to growth and development, including plan approval, issuance of permits, and occupancy approval responsibilities.

Hocking County also has a Floodplain Manager who works with the Hocking County Engineer to help plan, approve, modify, and regulate new facilities, subdivisions, and neighborhoods not only in the context of building codes, but also with consideration for flood risk. They also collaborate to be sure that new structures are not placed within flood risk zones without taking compensatory measures like elevation as early as the site development stage of construction. The Hocking County Regional Planner works with the Hocking County Auditor to manage the floodplain mapping and parcel identification and documentation by developing and maintaining GIS mapping.

The Hocking County EMA Director, Hocking County Engineer, and Hocking County Floodplain Manager are part of the planning committee that develops the Hocking County Floodplain Management Plan. The most recent plan was approved by FEMA in 2010. The committee meets on an as need basis and works with floodplain regulations, NFIP participations, CRS community rating, and other thresholds that signify smart development measures directed at creating resilient communities.

This wide collaboration between jurisdictional representatives and officials helps Hocking County engage in resilient development activities with the mitigation strategies. For example, with the high risk of flooding in many Hocking County communities, appointed and elected officials at the county and local levels work together to guide development activities that account for potential flood risks. These are the same officials who participated in this Hazardous Mitigation Plan update, and they will continue to meet with the County EMA Director on an annual basis to review the plan and update it as needed. They will work continuously to maintain, revise, and improve local land use plans, economic development plans, comprehensive plans, and other local planning efforts.

Hocking County will also consider mitigation planning as a part of all other community planning efforts and strive to include the concerns and challenges of disasters in all planning area. The County EMA Director will lead the effort to integrate disaster preparedness and mitigation planning into economic development, land use planning, zoning and development regulations, land conservation, response plans, and other plans that are important to the daily operations of the county. Hazard mitigation will be promoted as part of community development, thus being integrated into related community development activities, programs, and projects. Key stakeholders, including the County Commissioners, Village Mayors, Economic Development, Floodplain Administrator, County Engineer, City of Logan zoning officials, Wayne National Forest Fire Department, are all important partners in this effort. These individuals will work through their respective agencies to promote mitigation planning and its inclusion in the plans,

procedures, guidelines, and priorities of each agency, thus making mitigation a true community-wide effort.

ANNUAL REVIEW PROCESS

The Hocking County Hazard Mitigation Plan will be evaluated on an annual basis to determine the effectiveness of programs and to reflect changes in programs or land development that may affect mitigation priorities. Hocking County EMA, with consultation and collaboration from the Core Group, maintains overall responsibility for monitoring and evaluating the progress of the mitigation strategies and actions in the Plan. All jurisdictions will be encouraged to attend a yearly plan update meeting. These meetings will track project progress and discuss any new projects that need to be added. This will provide an opportunity for jurisdictions to discuss any current or new problems and prioritize future funding. The Core Group will review the goals and action items to determine their relevance to changing situations in the county, as well as changes in state or federal policy, and to ensure they are addressing current and expected conditions.

The Core Group will maintain an updated list of Critical Facilities to ensure that all actions and programs accurately reflect the latest development conditions in Hocking County. The coordinating organizations responsible for action items will present the status of their action items, the implementation processes and difficulties encountered, at which time strategies and actions may need to be revised.

UPDATING THE PLAN

This Plan must be updated within 5 years and again adopted by the county and participating jurisdictions in order to maintain compliance with Federal regulations and ensure eligibility for applying for and receiving certain Federal mitigation grant funds. The Hocking County EMA will identify necessary modifications to the Plan including changes in mitigation strategies and actions that should be incorporated in the next update. The Hocking County EMA Director and Hocking County Commissioners will initiate the process of updating the Plan in sufficient time to meet state and federal deadlines.

APPENDIX A: PUBLIC SURVEY

EMA Website Survey Results

1st Public Survey Feedback

In what city/township do you live

Starr Township

What natural disasters are of the most concern in Hocking County, Ohio?

Flooding

What other natural disasters are of concern that was not listed above in Hocking County, Ohio?

none

2nd Public Survey Feedback

In what city/township do you live

City of Logan

What natural disasters are of the most concern in Hocking County, Ohio?

Flooding

Severe Winter Storm

What other natural disasters are of concern that was not listed above in Hocking County, Ohio?

none

APPENDIX B: MEETING

(OCT 3 & 29, 2018)

CORE GROUP MEETING MINUTES

OCT 3 & 29, 2018

Hocking County EOC: 52 E 2nd St. Logan OH 43138

Attendees OCT 3, 2018

- Jeffrey Hatfield – Laurel Township
- Cesalie Gustafson – Hocking County EMA
- Debbie Later – Hocking Soil and Water
- Christine Manning – Fairfield County EMA
- Sonja Miller – Hocking County EMA
- Lorie Haukedahl – Ohio EMA
- James Martin – Hocking Hills Tourism Association
- Michelle Matheny – Hocking Valley Community Hospital
- Audi Wykle – Hocking County Regional Planning
- Jerry Mellinger – Logan Police Department
- Stacey Gabriel – Hocking Valley Community Hospital
- Andy Good – Hocking Hills Chamber of Commerce

Notes

- Present an overview of the construct of a general hazard mitigation plan.
- Cesalie Gustafson of Hocking County EMA went over the Hazard Mitigation Plan process. There were topics reviewed that are relevant to the needs of Villages, Townships, and City in Hocking County.
- Christine Manning of Fairfield County discussed the overview of a general hazard mitigation plan.
- Questions were answered about specific needs on a local level.
- A meeting was scheduled to set up to establish communication and feedback for the duration of the plan.

Attendees OCT 29, 2018

- Sonja Miller – Hocking County EMA
- Ron Cook – Murray City
- Brian Robertson – Logan Fire Department

- Cesalie Gustafson – Hocking County EMA
- Christy L. O'Nail – Hocking County Auditor
- Christine Manning – Fairfield County EMA
- Audie Wykle – Reg. Planning
- James Martin – Hocking Hills Tourist Association
- Rose Marshall – Hocking County Commissioners
- Wendy Hanna – Hocking County Health Department

Notes

- Present an overview of the construct of a general hazard mitigation plan.
- Cesalie Gustafson of Hocking County EMA went over the Hazard Mitigation Plan process. There were topics reviewed that are relevant to the needs of Villages, Townships, and City in Hocking County.
- Christine Manning of Fairfield County discussed the overview of a general hazard mitigation plan.
- Questions were answered about specific needs on a local level.
- A meeting was scheduled to set up to establish communication and feedback for the duration of the plan.

(NOTE: All persons listed in Figure 3-1 on page. 14 were invited to all meetings and asked to participate through emails. All jurisdictions within Hocking County participated as seen in Figure B-1 below)

FIGURE B-1

JURISDICTION PARTICIPATION				
JURISDICTION	**REPRESENATIVE(S)**	**TITLE/DEPARTMENT**	**INCLUDED**	**DESCRIPTION OF PARTICIPATION**
HOCKING COUNTY	Rose Marshall Cesalie Gustafson Audie Wykle	Clerk, Commissioners Director, HCEMA Regional Planner	YES	HCEMA members hosted, participated, and wrote the plan. The Hocking County Regional Planner helped HCEMA review, update, and approve the updated to the county projects. The HCEMA conducted numerous phone calls and traded emails with all jurisdictions including townships throughout the project.
CITY OF LOGAN	Bruce Walker Jerry Mellinger Brian Robertson	Service Director Chief, LPD Chief, LFD	YES	A City representative participated in all planning meetings. City of Logan completed the Short Term/ Long Term Action Plans, Hazard Ranking Assessment, and Mitigation Action Scoring Matrix
VILLAGE OF LAURELVILLE	Brent Ebert Butch Valentine	Mayor Chief LVFD	YES	A Village representative participated in all planning meetings. City of Logan completed the Short Term/ Long Term Action Plans, Hazard Ranking Assessment, and Mitigation Action Scoring Matrix
VILLAGE OF MURRAY CITY	Ron Cook	Service Director & Chief, VMCFD	YES	A Village representative participated in all planning meetings. City of Logan completed the Short Term/ Long Term Action Plans, Hazard Ranking Assessment, and Mitigation Action Scoring Matrix

APPENDIX C: CRITICAL FACILITIES LIST

HOCKING COUNTY CRITICAL FACILITIES

A critical facilities list with address is maintained and held in the EMA office.

Critical Facilities or Infrastructure			
TYPE OF INFRASTRUCTURE	NO. OF FACILITIES	TYPE OF INFRASTRUCTURE	NO. OF FACILITIES
Assisted Living Facilities	1	Jail	1
Churches	62	Law Enforcement Stations	5
Class I Dams	4	Nursing Homes	3
Daycare	6	Public Libraries	3
Dialysis Center	1	Red Cross Shelters	13
Electrical Substance	2	School Buildings	9
EMS Stations	3	Shelters	1
Fire Stations	7	Urgent Care	1
Government Buildings	30	Water Treatment Plants	1
Hospitals	1	Wastewater Treatment Plants	2
Independent Senior Living Facilities	2	Hocking County Board of Elections	1

APPENDIX D: SAMPLE RESOLUTION FOR HOCKING COUNTY JURISDICTIONS

The following is a sample resolution in support of the Hocking County All-Hazards Mitigation Plan. A resolution adopting the plan must be passed by Hocking County and in each participating city and village in Hocking County. Townships may adopt; however, they are covered under the Hocking County Commissioners adoption.

****************Copies of local adoption resolutions follow in this appendix****************

STATE OF OHIO (COMMUNITY NAME) RESOLUTION NUMBER_____

RESOLUTION ADOPTING THE HOCKING COUNTY ALL-HAZARDS MITIGATION PLAN

WHEREAS, The Federal Emergency Management Agency is the federal agency in charge of the Mitigation Program for the United States of America, and that Agency has directed that local jurisdictions, which may be eligible to participate in mitigation funding in the future, must participate in a County-wide Mitigation Program, and,

WHEREAS, The Ohio Emergency Management Agency is the state agency that oversees the mitigation program with the State of Ohio and is the agency directly involved with the County Emergency Management Agency for mitigation activities, and,

WHEREAS, The Hocking County Office of Emergency Management and Homeland Security is charged with developing a County All-Hazards Mitigation Plan for Hocking County which includes all jurisdictions, and,

WHEREAS, The Hocking County All-Hazard Mitigation Plan must include the Cities and Villages of the County, and those jurisdictions must adopt the FEMA approved plan in order to be covered under the plan.

THEREFORE, be it resolved that ___(city, village, township)____does hereby adopt the Hocking County All-Hazard Mitigation Plan as written by the Hocking County Office of Emergency Management and Homeland Security and approve by the Region IV of FEMA and hereby adopts the plan.

Adopted at a meeting of the _____, on this day _____.

Said resolution was adopted upon the following vote by:

_____ _____

_____ _____

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ALL JURISDICTION ADOPTIONS/RESOLUTIONS IN THIS APPENDIX

APPENDIX E: SOURCES

- Disaster Histories: http://www.ncdc.noaa.gov/stormevents/
- NFIP Participation: http://www.fema.gov/cis/OH.html
- Map modernization status: http://www.dnr.state.oh.us/Water/FloodPlains/map_modernization/MapModernization CountyMappingStatus/tabid/18986/Default.aspx
- Department of Development: https://development.ohio.gov/reports/reports_pop_proj_map.htm
- Dam Incident Histories: http://ce-npdp-serv2.stanford.edu/DamDirector/damincidentQuery/IncidentForm.jsp
- Earthquake information: http://geosurvey.ohiodnr.gov/earthquakes-ohioseis-home
- Earthquake history narratives: https://kb.osu.edu/dspace/bitstream/handle/1811/22284/V074N2_103.pdf?sequenc=1
- National Inventory of Dams: http://geo.usace.army.mil/pgis/f?p=397:1:0
- Ohio Department of Natural Resources: http://www.ohiodnr.gov
- FEMA online Map Store: http://msc.fema.gov/
- Watershed Groups: http://ohiowatersheds.osu.edu/
- FEMA Community Rating System (CRS) Communities and their Classes: http://www.fema.gov/media-library/assets/documents/15846
- National Weather Service: http://www.nrcs.NWS.gov/
- Ohio Insurance Institute: https://www.ohioinsurance.org/news/archived-newsroom-posts/
- Ohio County Profile: http://www.development.ohio.gov/reports/reports_countytrends_map.jtm
- Agriculture Statistics: http://quickstats.nass.usda.gov/?source_desc=CENSUS#F0CB0763-C5C8-37f6-9228-EF19112F5302
- State Mitigation Plan: http://ohiosharpp.ema.state.oh.us/OhioSHARPP/Planning.aspx#ehmp
- Mine Subsidence: http://ohiominesubsidence.com/AnnualReport.aspx
- NFIP Community Status Book: http://www.fema.gov/cis/PH.html
- U.S. Census-Population Census Count by County: http://quickfacts.census.gov/qfd/states/39/39049.html
- USGS Ohio Earthquake Hazard Program: http://earthquake.usgs.gov/

- Ohio Statewide Hazard Mitigation Plan, Ohio Emergency Management Agency
- USDA Forest Service Active Fire Mapping Program
- Ohio Department of Natural Resources