State of OHIO
Hazard Mitigation Plan 2019

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LIST OF ACRONYMS

Acronym	Definition
AFRRI	Appalachian Flood Risk Reduction Initiative
ARC	Appalachian Regional Commission
AUM	Abandon Underground Mine
BCA	Benefit Cost Analysis
BOCA	Building Officials and Code Administrators International CAR
CAR	Communities At Risk
CCC	Civilian Conservation Corps
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CHIP	Community Housing Improvement Program
CRS	Community Rating System
DAE	Disaster Assistance Employee
DAS	Ohio Department of Administrative Services
DMA 2000	Disaster Mitigation Act of 2000
DOW	Division of Water (Ohio Department of Natural Resources)
DSP	Dam Safety Program
EAP	Emergency Action Plan
EMAP	Emergency Management Accreditation Program
ENSO	El Niño - Southern Oscillation
EOC	Emergency Operations Center
EPL	Estimate of Potential Losses
FD	Fire Department
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
FPM	Flood Plain Management
GAR	Governors Authorized Representative
GIS	Geographic Information System
HAZUS-MH	Hazards United States - Multi-Hazard
HIRA	Hazard Identification & Risk Assessment
HMGP	Hazard Mitigation Grant Program
HSIP	Homeland Security Infrastructure Program
HUD	Housing & Urban Development
IA	Individual Assistance
ICC	Increased Cost of Compliance
JCARR	Joint Committee on Agency Rule Review

LHMP	Local Hazard Mitigation Plan
LULC	Land Use/Land Cover
MCD	Miami Conservancy District
MHIRA	Multi-Hazard Identification and Risk Assessment
MMI	Modified Mercalli Intensity
MSA	Metropolitan Statistical Area
NCDC	National Climatic Data Center
NDMC	National Drought Mitigation Center
NEHRP	Nation Earthquake Hazards Reduction Program
NFIP	National Flood Insurance Program
NID	National Inventory of Dams
NOAA	National Oceanic Atmospheric Administration
NPDP	National Performance of Dams Program
NUCI	National Urban Change Indicator
NWS	National Weather Service
OAC	Ohio Administrative Code
OAKS	Ohio Administrative Knowledge System
OBBC	Ohio Basic Building Code
OBC	Ohio Building Code
OBM	Office of Budget and Management
ODC	Ohio Department of Commerce
ODH	Ohio Department of Health
ODI	Ohio Department of Insurance
ODNR	Ohio Department of Natural Resources
ODNR-DDS	Ohio Department of Natural Resources - Division of Dam Safety
ONDR-DOW	Ohio Department of Natural Resources - Division of Water
ODNR-FPM	Ohio Department of Natural Resources - Flood Plain Management
ODOD	Ohio Department of Development
ODOT	Ohio Department of Transportation
ODSA	Ohio Development Services Agency
OEPA	Ohio Environmental Protection Agency
Ohio EMA	Ohio Emergency Management Agency
OHPO	Ohio Historical Preservation Officer
OHS	Ohio Historical Society
OLCA	Ohio Lake Communities Association
OLEC	Ohio Lake Erie Commission
OMB	Office of Management and Budget
OMHC	Ohio Manufactured Homes Commission
OMPAT	Ohio Mitigation Plan Advisory Team
OMSIUA	Ohio Mine Subsidence Insurance Underwriting Association
OPWC	Ohio Public Works Commission
ORC	Ohio Revised Code

ORM	Office of Risk Management
OSU	The Ohio State University
OWRC	Ohio Water Resources Council
PA	Public Assistance
PAS	Planning Assistance to States
PDA	Preliminary Damage Assessment
PDM	Pre-Disaster Mitigation Grant Program
PDM-C	Pre-Disaster Mitigation-Competitive Grant
PDSI	Palmer Drought Severity Index
POC	Point of Contact
PUCO	Public Utilities Commission of Ohio
REC	Review of Environmental Consideration or Rural Electric
RFC	Repetitive Flood Claim
SBA	Small Business Administration
SCIP	State Capital Improvements Program
SFHA	Special Flood Hazard Area
SHARPP	State Hazard Analysis Resource and Planning Portal
SHMO	State Hazard Mitigation Officer
SHMP	State Hazard Mitigation Plan
SHMT	State Hazard Mitigation Team
SOHMP	State of Ohio Hazard Mitigation Plan
SOI	Southern Oscillation Index
SRL	Severe Repetitive Loss
STORMS	State of Ohio Rain/Snow Monitoring System
SWL	Still Water Level
SZEA	State Zoning Enabling Act
TRAC	Transportation Review Advisory Council
U.S.C.A.	United States Code Annotated
USACE	United States Corps of Engineers
USFW	United States Fish & Wildlife Service
USGS	United States Geological Survey
VOAD	Voluntary Organizations Active in Disasters
WMAO	Water Management Association of Ohio
WPCLF	Water Pollution Control Loan Fund
WUI	Wildland Urban Interface
WWTP	Waste Water Treatment Plant

STATE OF OHIO HAZARD MITIGATION PLAN - EXECUTIVE SUMMARY

The turn of the millennia witnessed a dramatic change in how our Nation prepares for and responds to disasters. The passage of the Disaster Mitigation Act of 2000 (DMA2K) reoriented the focus of the Federal Emergency Management Agency (FEMA) programs to promote projects and plans which reduce the exposure of Americans and their property to natural hazards. In 2002 Congress further defined how to implement DMA2K by publishing rules in the Federal Register containing criteria for state mitigation plan content. Ohio must have a FEMA-approved hazard mitigation plan to remain eligible for Federal Mitigation and Public Assistance funds associated with a Presidential disaster declaration.

The development of the state plan began in 2002, and it involved the participation of numerous state and federal agencies, adjacent state EMA representatives, and various subject-matter experts. The plan was approved by FEMA in 2005, and updated and re-approved in 2008, 2011, 2012, and 2014. The 2019 revision of the plan analyzes Ohio's highest priority hazards: flooding, tornado, winter storm, landslide, dam/levee failure, wildfire, coastal flooding/seiche, earthquake, coastal erosion, drought, severe summer storm, invasive species and land subsidence. The plan also evaluates future and emerging hazard risks. The state's vulnerability to those hazards is analyzed utilizing data from multiple sources to evaluate risk including: HAZUS software, historical damage data, input from subject-matter experts, and information from local hazard mitigation plans. The state hazard mitigation plan describes the unique vulnerabilities associated with the highest priority hazards in Ohio.

The plan also includes a statewide blueprint of actions that will mitigate the risk to the identified hazards. The State Mitigation Strategy includes: goals, objectives, and action items that will help reduce risk, an evaluation of state capability to accomplish this task, and identification of available funding sources. The State Mitigation Strategy is outlined in broad terms by the following goals described in this plan update:

- Reduce loss of life and injury from hazard events;
- Minimize damage to property and societal disruptions from hazard events;
- Integrate hazard mitigation into policies and programs;
- Eliminate vulnerable flood-prone repetitive loss structures;
- Promote research, education, and outreach activities to create a culture of mitigation in Ohio; and
- Provide leadership in hazard mitigation in Ohio.

Each of these goals has associated objectives and actions aimed at getting the state closer to realizing community resiliency. For example, Ohio EMA developed the Ohio Safe Room Rebate Program. This program provides funding to homeowners for the construction/installation of a safe room that is capable of providing near absolute protection from a tornado with 250 mph wind speeds.

The statewide blueprint for hazard reduction is only part of the solution. To effectively reduce hazard exposure the state plan must reflect the goals, objectives and actions identified in local mitigation planning efforts. While the state has a goal of eliminating structures that are repetitively flooded, it is local planning that leads to the projects that will mitigate those properties. The state plan contains information from various local hazard mitigation plans, ranging from hazard identification and vulnerability analysis to specific, community mitigation objectives and actions.

Ohio's mitigation plan addresses each required element for "standard" plan approval in 44 CFR 201.4 and "enhanced" plan approval in 44 CRF 201.5. Ohio is one of only twelve states that currently meet enhanced plan criteria. The enhanced plan status designation is a recognition of Ohio's comprehensive mitigation program, and qualifies the state for additional Federal mitigation funds following future disasters.

SECTION 1: INTRODUCTION

1.1 STATE PROFILE

INTRODUCTION

Ohio was the 17th territory to become part of the United States of America on March 1, 1803. Ohio is an Iroquoian word meaning "great river". Located in the north-central region of the United States, Ohio has been home to eight of the forty-five Presidents of the United States including Presidents W.H. Harrison, Grant, Hayes, Garfield, B. Harrison, McKinley, Taft, and Harding.

GEOGRAPHY

The state is divided into two broad geographic regions, loosely following a diagonal line running from the south-western corner to the north-eastern corner. The portion of the state above the line was repeatedly inundated by glaciers and is generally flat with glacial sediments conducive to agriculture and large population centers. One notable exception is a region in west central Ohio where an outcropping of large hills exists. The areas south and east of the line consist of the foothills to the Appalachian Mountains, which start in southeastern Ohio.

Ohio borders the states of Pennsylvania, Kentucky, West Virginia, Indiana, and Michigan while sharing an international border with the Canadian province of Ontario. A large portion of the state's border is associated with bodies of water including West Virginia and Kentucky along the Ohio River and Ontario near the center of Lake Erie. The majority of Ohio's northern border is encompassed by Lake Erie, which was created by and subsequently filled with water from glaciers. River systems in the northern third of Ohio flow north into Lake Erie. The remainder of the waterways in the state flow south into the Ohio River. Ohio covers 40,952 square miles of land. Land use percentages range from a high of 39.08 percent for cultivated crops to a low of .23 percent for barren (See Chart 1.1.a).

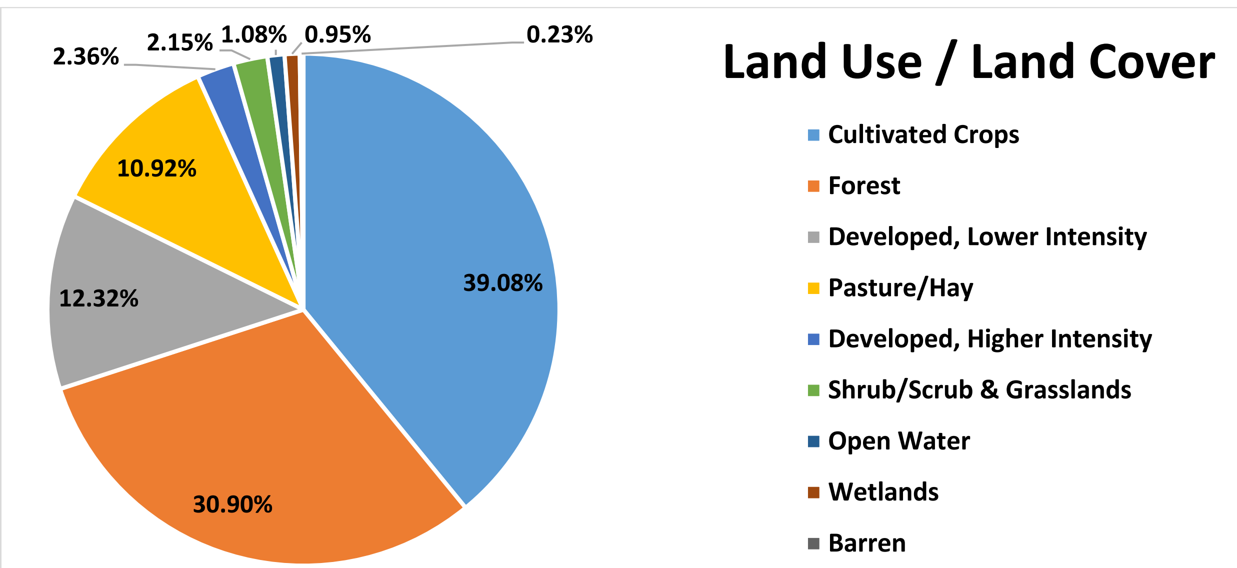


Chart 1.1.a

From the perspective of taxable land value, the distribution varies significantly from land use. Per the Ohio Development Services Agency – Ohio County Indicators Study for 2017, the State has approximately 238 billion dollars of taxable real property (See Chart 1.1.b).

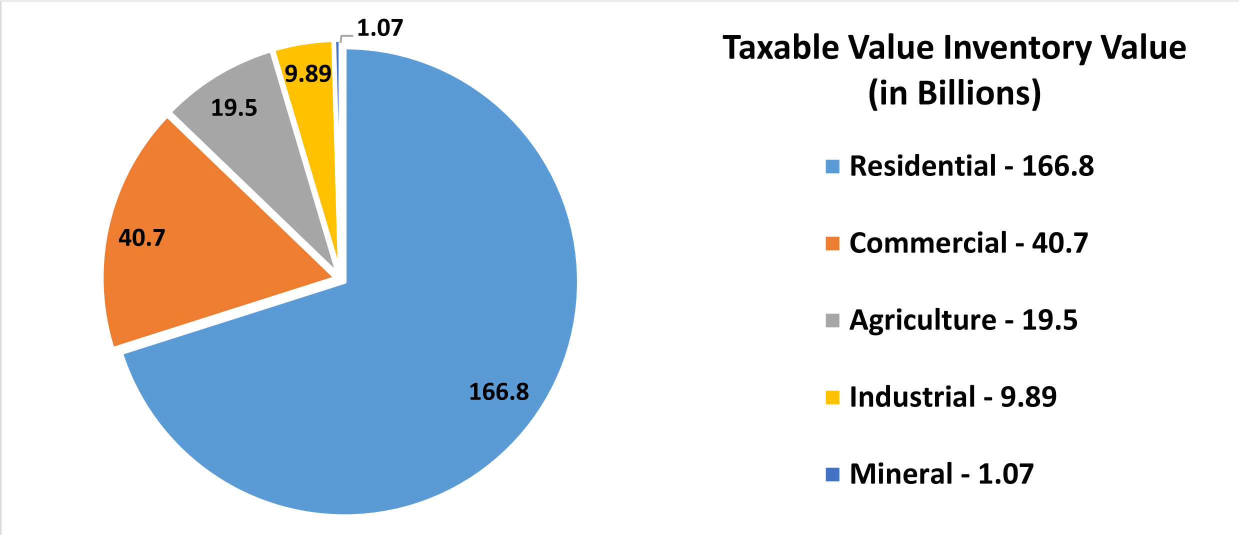
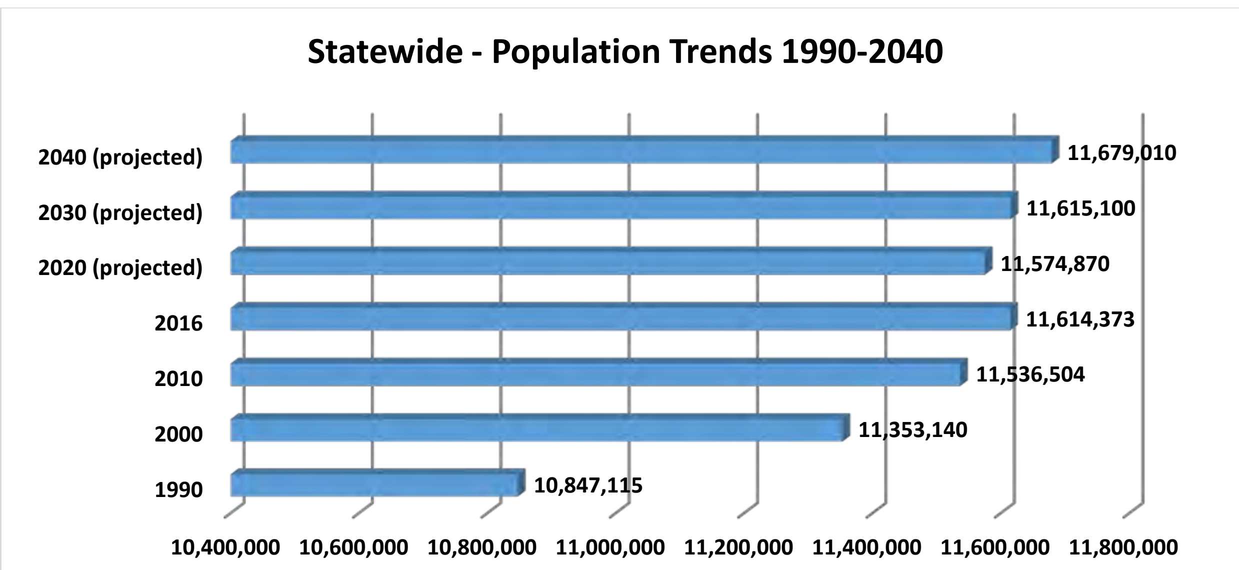


Chart 1.1.b

DEMOGRAPHY

The 2010 U.S. Census placed Ohio's population at 11,536,504, the American Community Survey (ACS) estimates the 2016 population to be 11,614,373 and the 2010 census projected the population in 2020 to be 11,574,870 (See Graph 1.1.c).



Graph 1.1.c (projections based on 2010 census)

Based on 2017 Development Services Agency statewide data, the largest racial group in Ohio is Caucasian followed by African-American. There are a total of 2,284,674 persons falling into minority categories making up 19.7 percent of the population (See Chart 1.1.d).

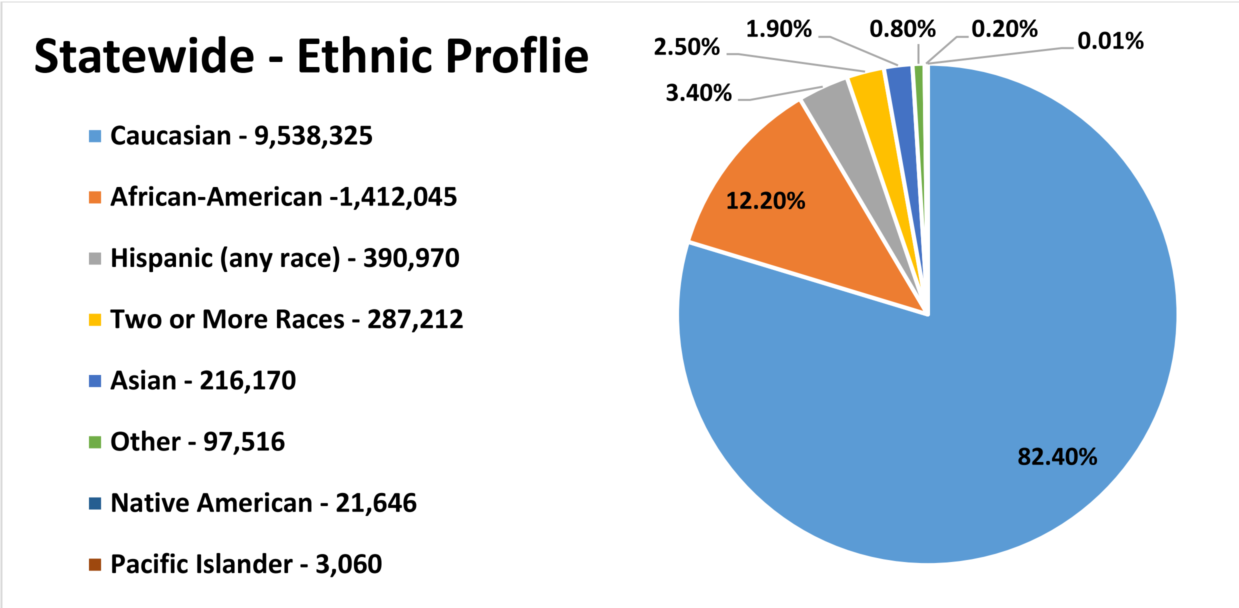


Chart 1.1.d

AGE PROFILES

The age categories, which require the most care after a disaster event, are those under 5 years of age and over 65 years of age. Statewide 6 percent of the population is under the age of 5 and 15.5 percent of the population is 65 years of age or greater. The median age of Ohioans is 39.2 years (see Chart 1.1.e).

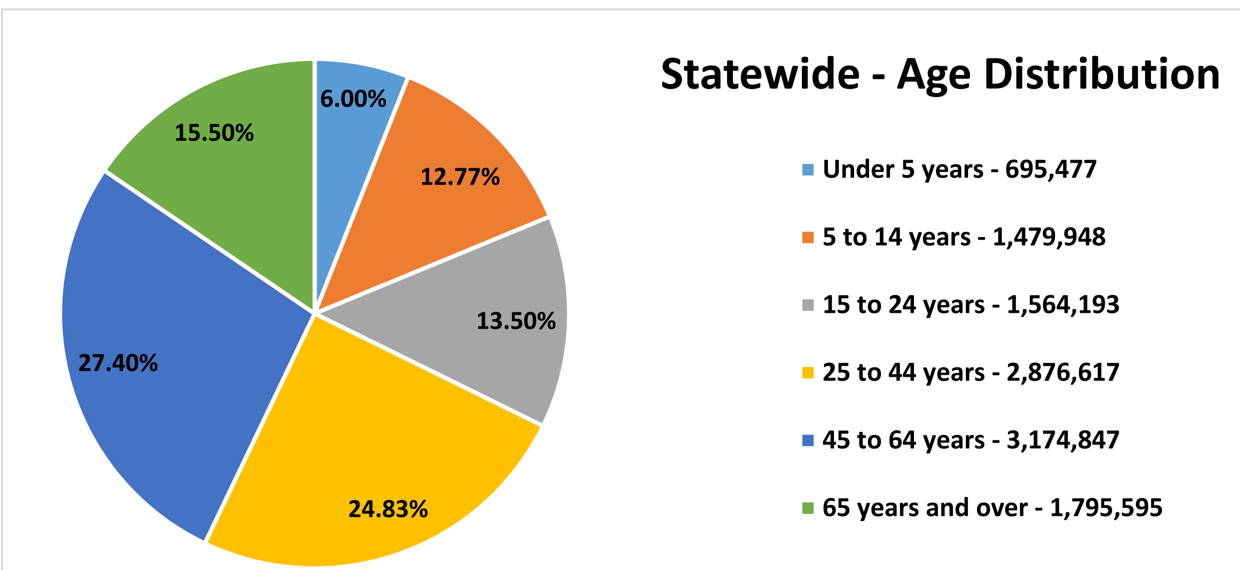
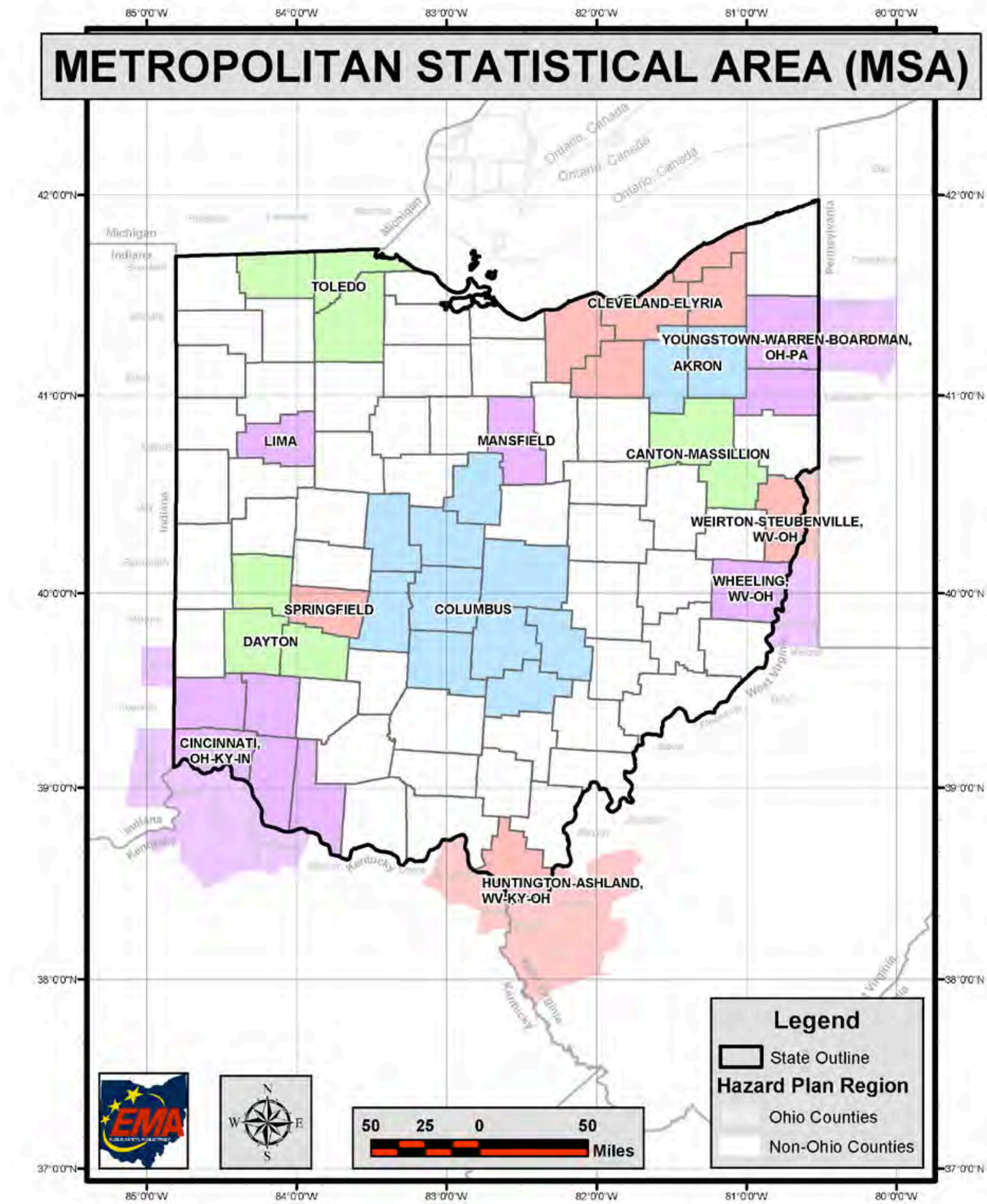


Chart 1.1.e


METROPOLITAN STATISTICAL AREA (MSA)
TOLEDO
CLEVELAND-ELYRIA
YOUNGSTOWN-WARREN-BOARDMAN, OH-PA
AKRON
LIMA
MANSFIELD
CANTON-MASSILLION
WEIRTON-STEUBENVILLE, WV-OH
WHEELING, WV-OH
SPRINGFIELD
COLUMBUS
DAYTON
CINCINNATI, OH-KY-IN
HUNTINGTON-ASHLAND, WV-KY-OH
Legend
State Outline
Hazard Plan Region
Ohio Counties
Non-Ohio Counties
50 25 0 50
Miles

Map 1.1.F

Ohio is home to three large metropolitan statistical areas (MSA) located around the cities of Cleveland (2,077,240), Columbus (1,836,536) and Cincinnati (2,130,151) based on the 2010 Census. There are an additional four moderate-sized MSAs located around the cities of Akron (703,200), Dayton (841,502), Toledo (651,429), and Youngstown (565,773), see Map 1.1.f. Combined, these MSAs account for 9,120,655 people or 76.3% of the state's population. Individual county populations range from a low of 13,435 in Vinton County to a high of 2,077,240 in Cuyahoga County.

APPALACHIA

Ohio contains a federally and state recognized region knows as Appalachia. In 1965, the U.S. Congress identified counties in thirteen states along the Appalachian Mountain Range as part of the Appalachian Regional Commission. The Governor's Office of Appalachia represents the interests of the 32 counties comprising the Appalachia Region is southern and eastern Ohio (See Map 1.1.g).

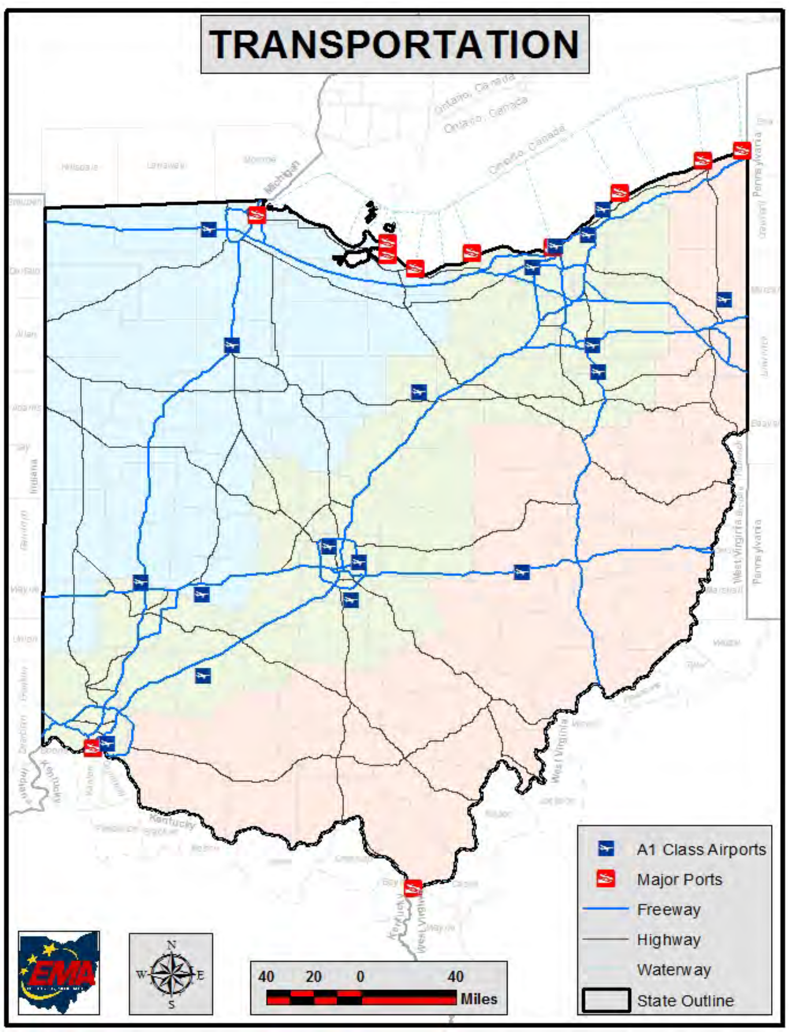
Map 1.1.g

TRANSPORTATION

Ohio has been dubbed the heart of it all connecting the eastern seaboard with the Midwest and South (See Map 1.1.h). Three major east-west interstates (I-70, I-80, and I-90) and three north-south interstates (I-75, I-71, and I-77) run through the state. Additionally, the State has a robust system of railways, airports, and sea/river ports which serve all 88 counties. Ohio's extensive rail line system ranks 4th in total rail miles and has the highest concentration of rail lines per square mile in the nation.

Ohio is the birthplace of aviation and enjoys to this day a strong aviation system. Part of the State's aviation heritage is the publicly-owned airport system. The system consists of seven commercial service and 97 general aviation airports and owes much of its development to a 1960's program championed by Governor Jim Rhodes.

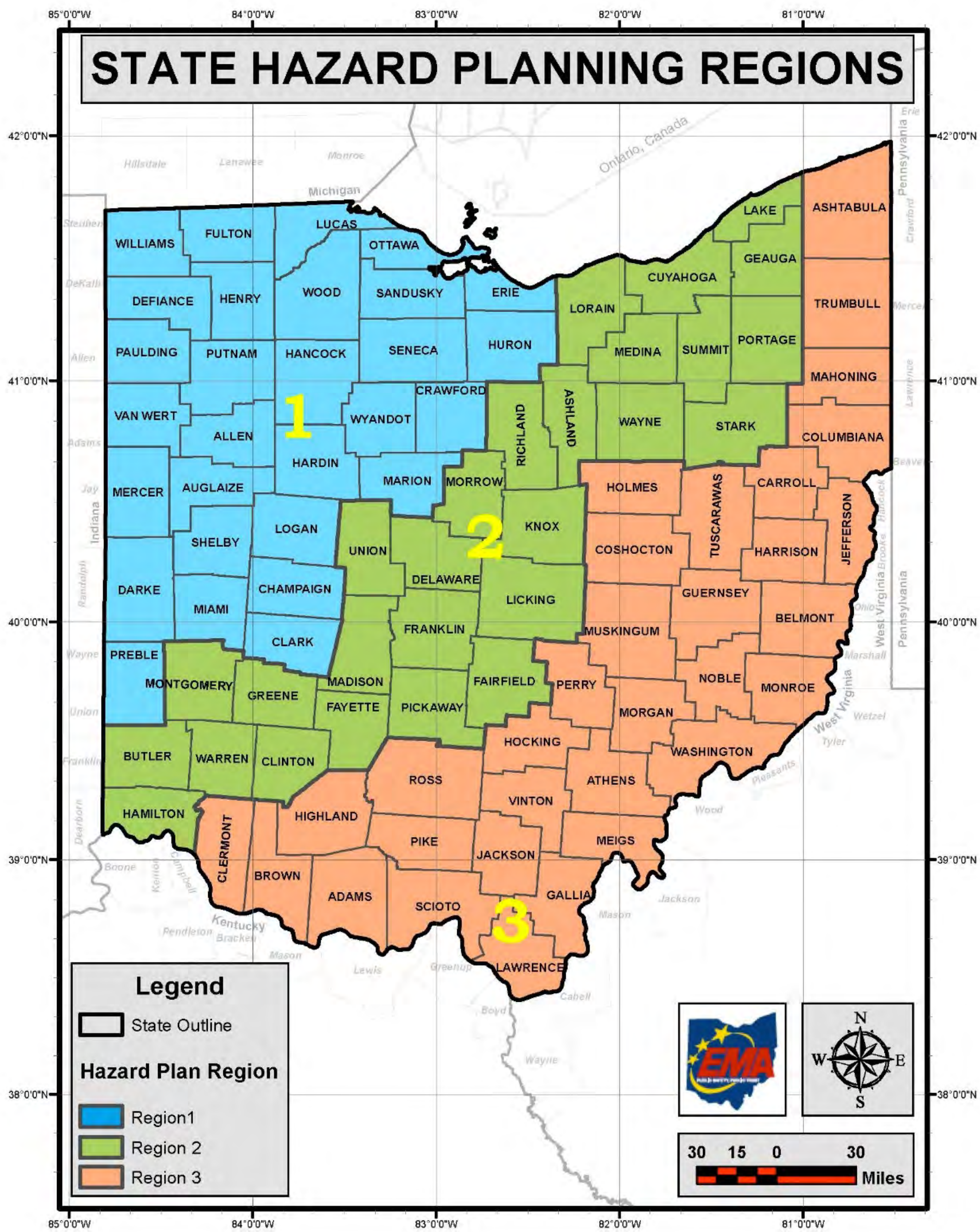
Ohio's Maritime Transportation System (MTS) is a key component of the state's multimodal transportation system. It is comprised of two major waterways Lake Erie and the Ohio River. The total MTS includes 736 navigable miles of waterway with eight principal ports on Lake Erie, 162 commercial docks, the majority of which are along the Ohio River and 9 locks and dams on the Ohio portion of the Ohio River. The ports, terminals, and docks that provide connectivity to Ohio's MTS handle between 80 million and 100 million short tons of freight per year (2011-2015), valued at over $12 billion (2015).



Map 1.1.h

REGIONAL LEVEL ANALYSIS

Ohio has elected to address hazard mitigation planning using three regions which have similar geographic, socio-economic, and land use characteristics. While the general trends within the regions are fairly consistent there will be variations. An example would be a region as a whole experiencing population growth, but certain counties within the region experiencing significant population decline. Analyses of these types of differences are a necessary process in the development of the risk and vulnerability assessments for each hazard as well as for the development of the hazard mitigation strategies.



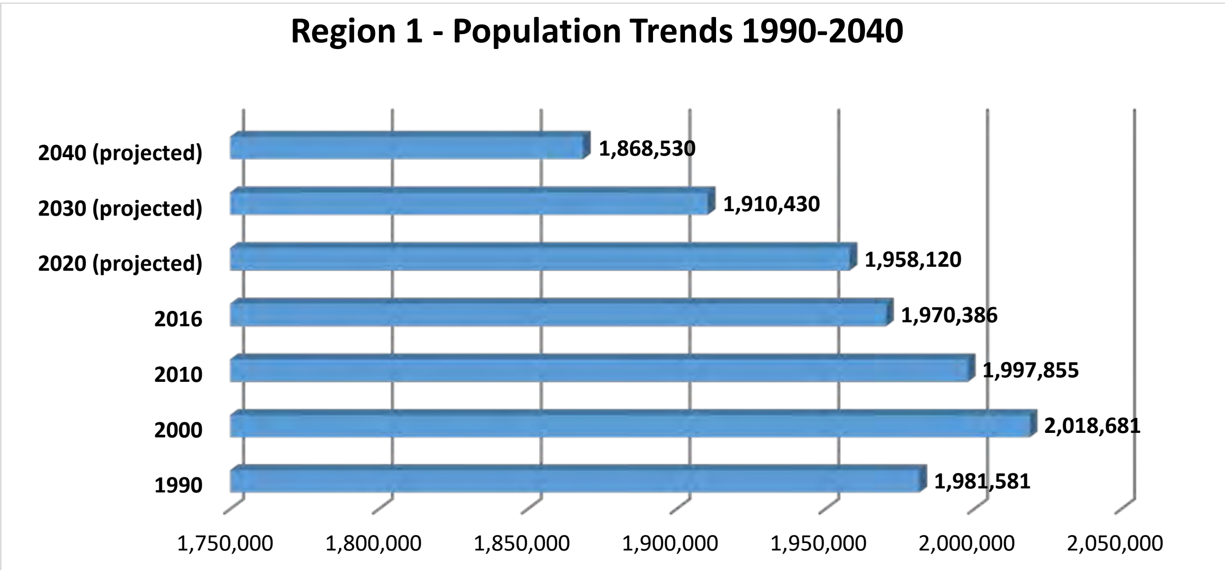
Map 1.1.i

REGION 1

Region 1 is characterized by largely rural, agricultural counties with flat to gently rolling topography. It is the western and northwestern portions of the state including portions of the state located on Lake Erie.

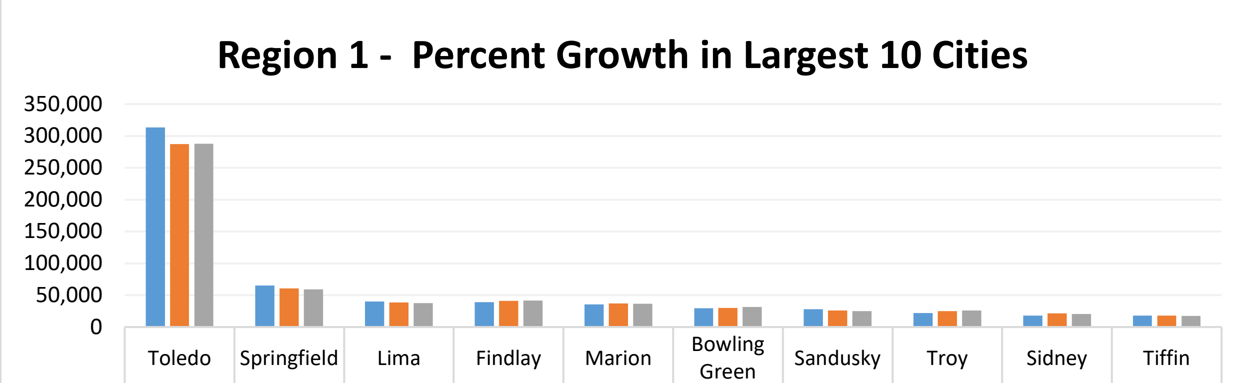
GENERAL POPULATION

The population in Region 1, according to the ACS, was 1,970,386, 17% of the Ohio total population, in 2016. Region 1 experienced minor population decreases between 1990 and 2016, with the average population decrease between these two dates being .56%. Regional contraction is expected to continue based upon current projections (See Graph 1.1.i).



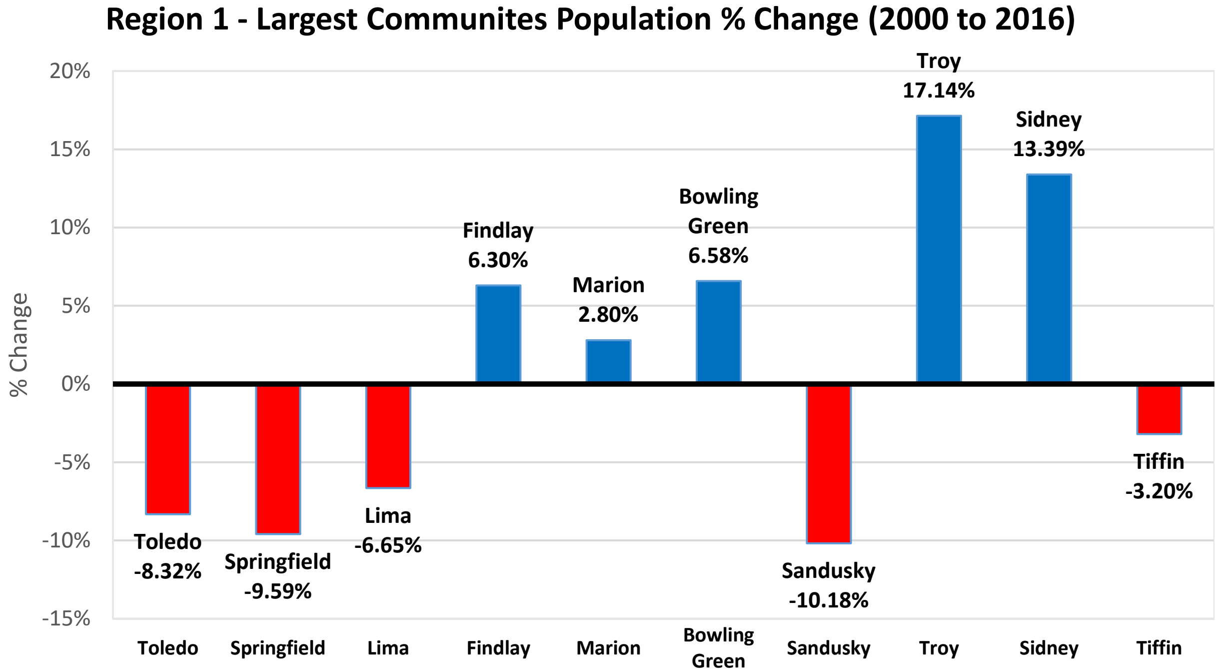
Graph 1.1.j (projections based upon the 2010 census)

Half of the ten largest communities experienced population decreases between 2000 and 2016 with Sandusky (Erie County) having the largest decrease at -10.18%. Five of the largest ten communities saw an increase with the most significant increase of 17.14% in Troy (Miami County) (See Graphs 1.1.k & 1.1.k).



	Toledo	Springfield	Lima	Findlay	Marion	Bowling Green	Sandusky	Troy	Sidney	Tiffin
2000	313,619	65,358	40,081	38,967	35,318	29,636	27,844	21,999	18,135	18,135
2010	287,208	60,608	38,639	41,184	36,828	30,052	25,919	25,111	21,222	17,961
2016	287,508	59,087	37,414	41,422	36,310	31,588	25,009	25,770	20,564	17,545

Graph 1.1.k



	Toledo	Springfield	Lima	Findlay	Marion	Bowling Green	Sandusky	Troy	Sidney	Tiffin
% Change	-8.32%	-9.59%	-6.65%	6.30%	2.80%	6.58%	-10.18%	17.14%	13.39%	-3.20%

Graph 1.1.l

SPECIAL POPULATIONS

The number of people within the special population category generally increases with the size of the county or community. These special population groups include: infant children, elderly, non-English speaking, convalescing, assisted living, and inmate populations.

CONVALESCING AND ASSISTED LIVING POPULATIONS

There are a number of facilities in Region 1 that house special or disabled populations. They include 119 nursing homes and 52 hospitals with a total of 24,610 beds. Although these facilities have their own contingency plans, they coordinate with state, county, and local hazard mitigation planning efforts.

INMATE POPULATIONS

There are four correctional facilities in Region 1 including a facility in Allen County, Lucas County, and two in Marion County. As of the fourth quarter of 2017, the combined inmate population in these facilities totals 6,725.

ETHNIC / POVERTY LEVEL CONSIDERATIONS

Caucasians comprise 89 percent of the region's ethnic mix compared to the state's average of 82 percent. The region's largest minority demographic is African-American (7.19 percent) and is more concentrated in urbanized areas such as Lucas, Allen, and Clark counties (Chart 1.1.m). The Hispanic population (4.61 percent) encompasses the region's third largest ethnic group. The main cores of Hispanic inhabitants are located in northwestern Ohio counties such as Lucas, Wood, and Sandusky.

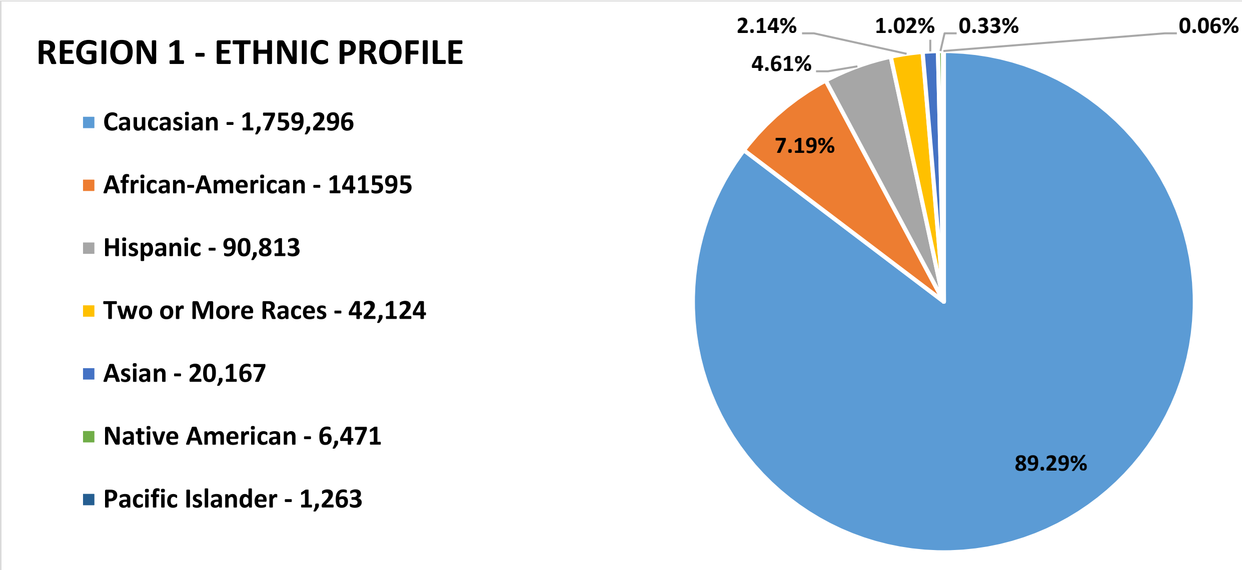


Chart 1.1.m

AGE PROFILES

The age categories which require the most care after a disaster event are the under 5 years of age and over 65 years of age. The percentage of children under the age of 5 is about the same throughout Region 1 counties, ranging from a low 4.3 percent (Ottawa) to a high 6.8 percent (Putnam). The percentage of people 65 years of age and older is also consistent with percentages ranging from a low of 13.9 percent in Wood County to a high of 22.1 percent in Ottawa county (Chart 1.1.n). The median age group in Region 1 is 40 and the highest median age for any of Ohio's counties occurs in Region 1 (47.3 in Ottawa).

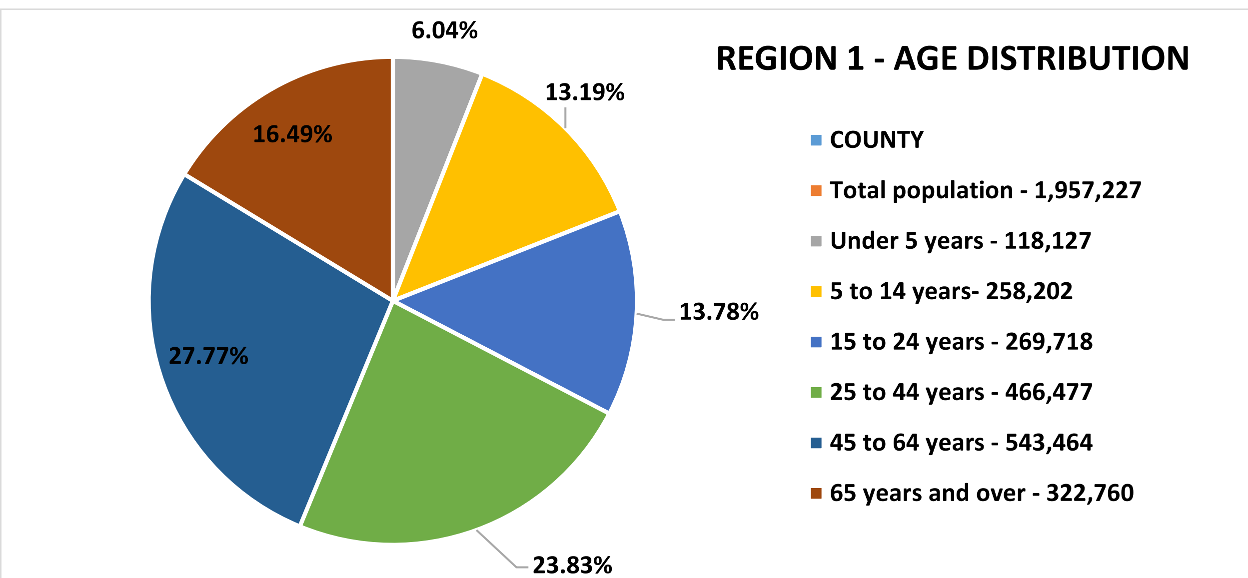


Chart 1.1.n

REGIONAL ECONOMY

The economy in Region 1 is firmly based in manufacturing both in terms of workforce and wages. Other economic sectors ranked in terms of workforce and wages include: (2) trade, transportation, and utilities,

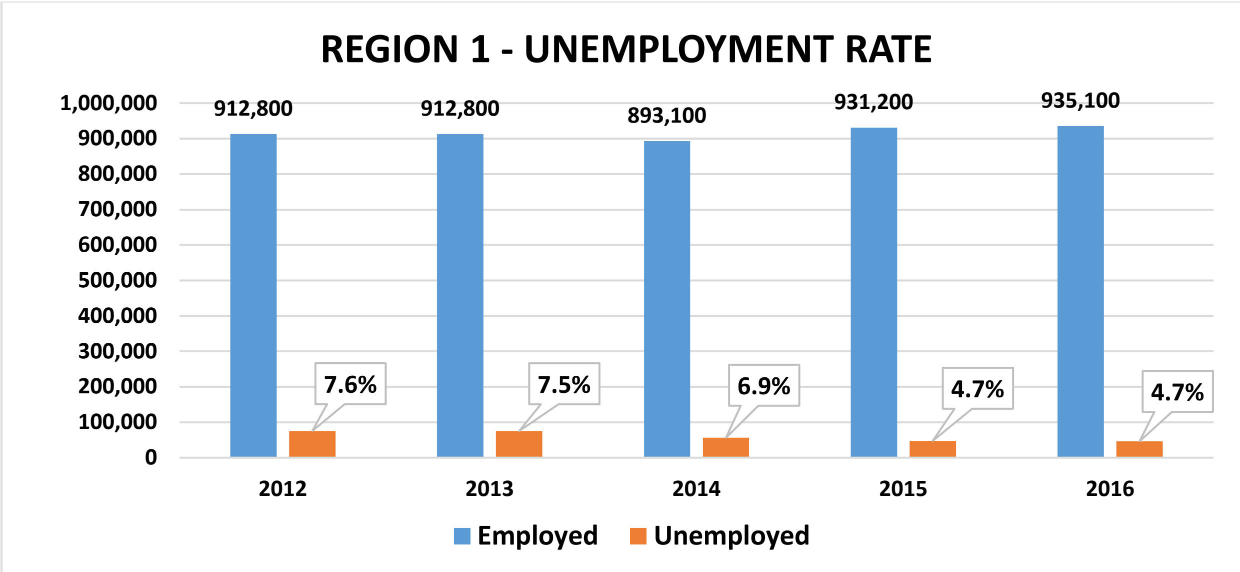
(3) education & health services, (4) leisure & hospitality, and (5) professional & business services (Table 1.1.o). While not addressed in the Bureau of Labor Statistics data, agriculture is an incredibly important economic driver in Region 1.

REGION 1 EMPLOYMENT AND WAGES BY SECTOR - 2016					
Industrial Sector	**Avg. Establishment #**	**Average Employment**	**Total Wages**	**Avg. Weekly Wage**	**Annual Avg. Pay**
Private Sector	40,911	739,174	$30,640,025,866	$759	$39,465
Goods Producing	7,319	231,525	$12,797,092,003	$999	$51,931
Natural Resources & Mining	684	8039	$304,185,326	$732	$38,076
Construction	3,740	33667	$1,923,729,043	$966	$50,254
Manufacturing	2,902	189,819	$10,569,177,634	$1,012	$52,609
Services-Providing	33,597	507,652	$17,842,933,863	$613	$31,876
Trade, Transportation & Utilities	10,102	158,620	$5,644,399,654	$667	$34,700
Information	517	6859	$297,458,088	$727	$37,809
Financial Services	4,064	26775	$1,374,614,667	$878	$45,644
Professional & Business Services	5,378	73,837	$3,366,502,359	$730	$37,933
Education & Health Services	4,985	126,871	$5,176,396,203	$679	$35,324
Leisure & Hospitality	4,776	88,455	$1,323,677,648	$254	$13,212
Other Services	3,756	26174	$658,098,211	$437	$22,738
Federal Government	447	5503	$324,107,403	$1,000	$52,011
State Government	289	15435	$907,437,690	$1,037	$53,899
Local Government	2,735	89,454	$3,653,423,587	$735	$38,233
Total	**126,202**	**2,327,859**	**$96,803,259,245**	**$764.09***	**$39.732.06***

*shows average not total

Table 1.1.o

As the regional economic situation has improved post the late 2000's downturn, regional unemployment rates have fallen from a high in 2012 of 7.6 percent to a low of 4.75 in 2016 (Graph 1.1.p).



Graph 1.1.p

The median annual income for Region 1 households is $48,768, which slightly exceeds that of the State of Ohio $48,446 (see table 1.1.q). 13.6 percent of the people residing in Region 1 live below the poverty level, which is less than the state average (15.3 percent). The Region 1 counties that have comparatively high numbers of people living below the poverty level include: Hardin, Lucas, Marion, and Clark. These counties may warrant special consideration in pre- and post- disaster planning.

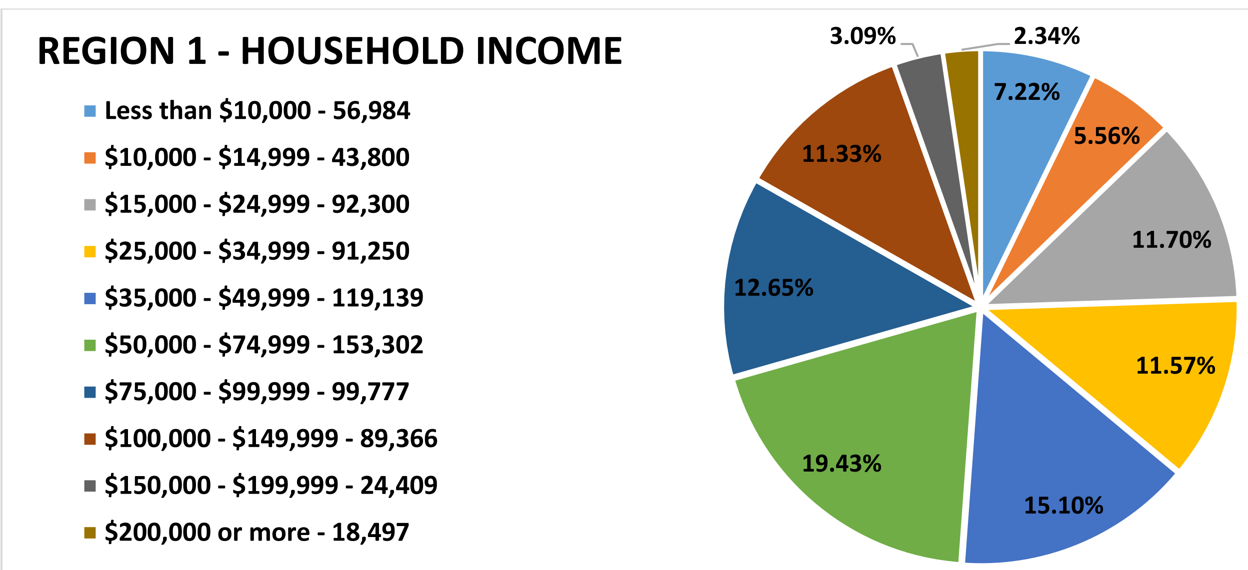
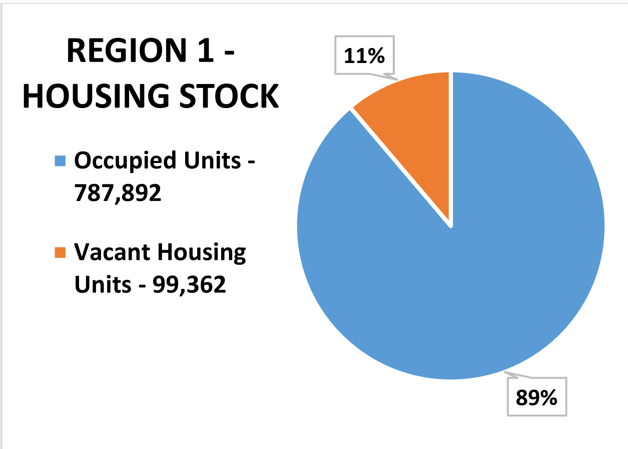


Chart 1.1.q

HOUSING

2016 ACS statistics indicate that there are approximately 887,214 housing units in Region 1, of which 99,362 (10.7 percent) are vacant (Chart 1.1.r). Ottawa and Logan counties have a surprisingly high number of vacant units. The reasons for such high vacancy rates are likely caused by housing used as seasonal and vacation property on Lake Erie, Grand Lake, St. Mary's and Indian Lake. More than half of the houses in Region 1 were constructed before the implementation of the National Flood Insurance Program, which has important mitigation implications. It is likely that a majority of homes built in the region's floodplains do not provide adequate flood protection.



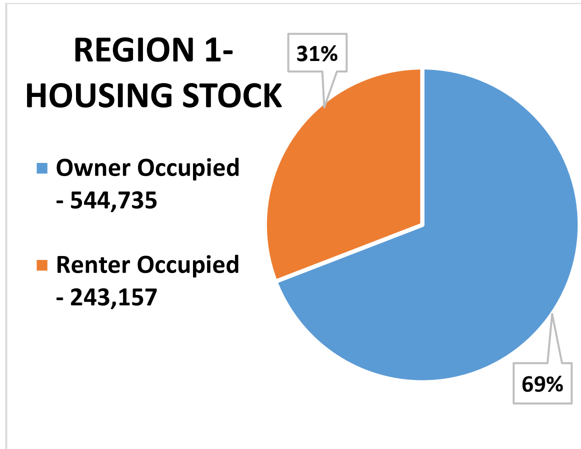


Chart 1.1.r

TRANSPORTATION

Region 1 has a well-developed transportation system, despite the fact that 15 of its 29 counties do not have interstate highways. State and U.S. highways coupled with extensive rail networks help meet the ground transportation needs in Region 1. Every county but two in Region 1 have at least 1 commercial airport and three of the counties boarding Lake Erie have ports (Table 1.1.s).

REGION 1 TRANSPORTATION SYSTEMS						
Counties	**Interstate Highways**	**U.S. Highways**	**Rail Lines**	**Class A Airports**	**Total Airports**	**Lake Ports**
Allen	X	X	4		1	
Auglaize	X	X	3		1	
Champaign		X	2		2	
Clark	X	X	3	1	1	
Crawford		X	3		1	
Darke		X	2		1	
Defiance		X	2		1	
Erie	X	X	1		3	2
Fulton	X	X	2		1	
Hancock	X	X	2	1	2	
Hardin		X	1		3	
Henry		X	3		1	
Huron		X	3		2	

Logan		X	2		1	
Lucas	X	X	3	1	2	1
Marion		X	2		1	
Mercer		X	1		2	
Miami	X	X	1		3	
Ottawa	X	X	2		5	1
Paulding		X	2			
Preble	X	X	1			
Putnam		X	3		2	
Sandusky	X	X	2		2	
Seneca		X	3		4	
Shelby	X		2		1	
Van Wert		X	2		1	
Williams	X	X	2		1	
Wood	X	X	2		4	
Wyandot		X	2		1	

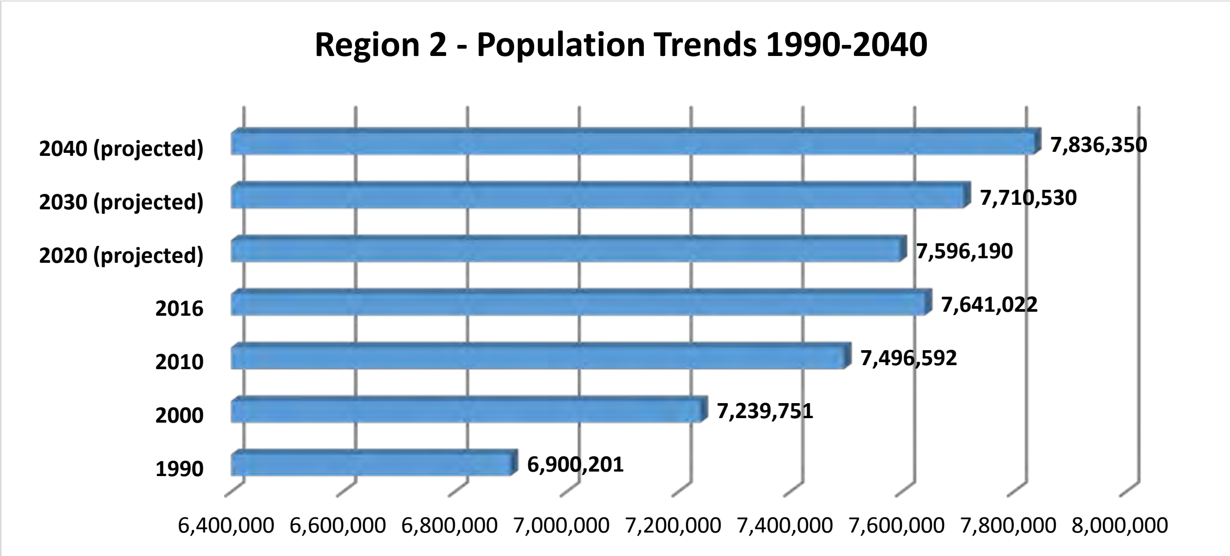
Table 1.1.s

REGION 2

Region 2 is defined by the I-71 corridor and contains Ohio's three largest cities: Cleveland, Columbus, and Cincinnati. Geographically it is the boundary between the previously glaciated portion of the state and the unglaciated Appalachian region.

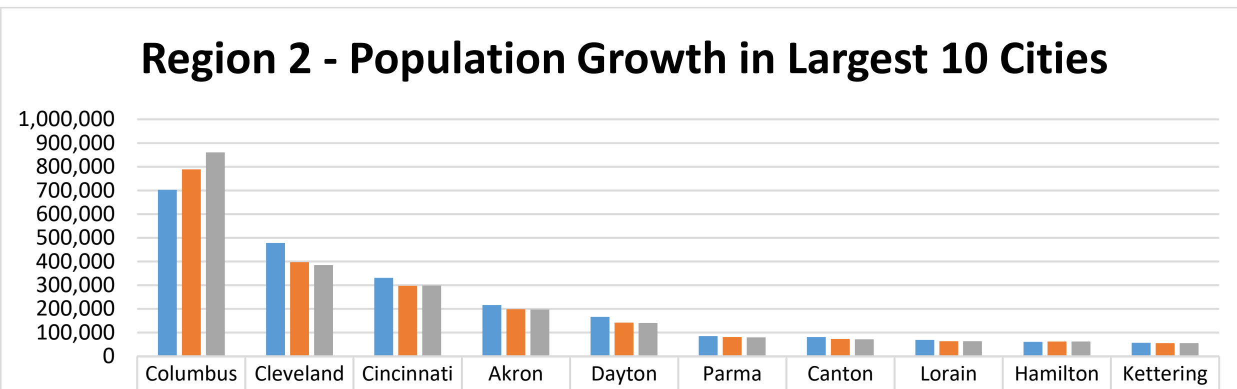
GENERAL POPULATION

The population in Region 2, according to the ACS was 7,641,022, 66% of the total population of Ohio, in 2016. The Region has experienced consistent population growth since 1990. The regional growth rate between 2000 and 2016 was 5.54% and this regional growth is expected to continue through 2040 (Graph 1.1.t). The majority of counties in Region 2 experienced minor changes in their population size, but there were several outliers. Delaware grew at a 58.4% while Cuyahoga declined by -8.2% in the same time period.



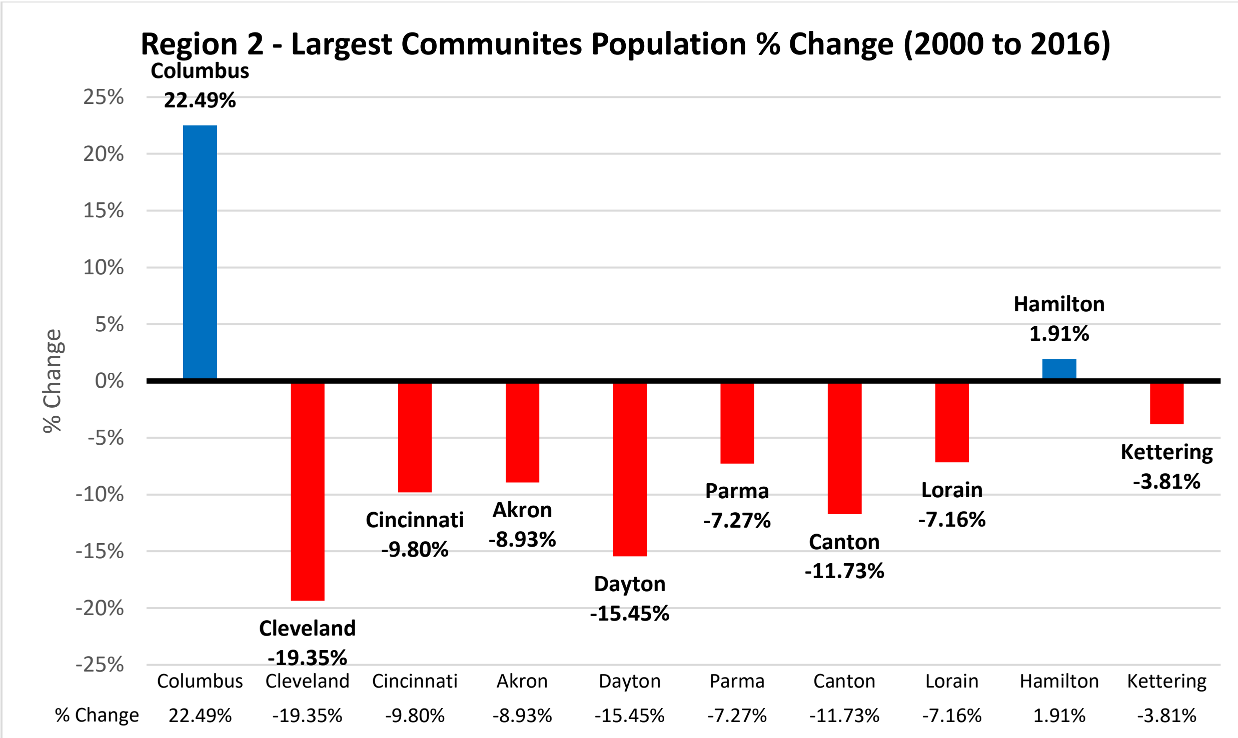
Graph 1.1.t

Eight of the ten largest communities experienced population decreases between 2000 and 2016 with the Cleveland (Cuyahoga County) having the largest decrease at -19.35 percent. The community that saw the largest increase was the Columbus (Franklin) with an increase of 22.49 percent (Graphs 1.1.u & 1.1.v).



	Columbus	Cleveland	Cincinnati	Akron	Dayton	Parma	Canton	Lorain	Hamilton	Kettering
2000	702,132	478,403	331,285	217,019	166,179	85,655	80,806	68,652	60,960	57,502
2010	788,866	396,697	296,946	199,079	141,869	81,601	73,053	64,099	62,272	56,161
2016	860,090	385,809	298,800	197,633	140,489	79,425	71,323	63,730	62,127	55,306

Graph 1.1.u



Graph 1.1.v

SPECIAL POPULATIONS

The number of people within the special population category generally increases with the size of the county or community. These special population groups include: infant children, elderly, non-English speaking, convalescing, assisted living, and inmate populations. Eight of the ten most-populated counties are in Region 2. Emergency managers and mitigation planners must pay particular attention to counties having larger numbers of special populations (Cuyahoga, Hamilton, and Franklin counties).

CONVALESCING AND ASSISTED LIVING POPULATIONS

There are a large number of hospitals (122) and nursing homes (547) in Region 2 and they account for 85,306 beds. Although these facilities have their own contingency plans, they must be coordinated with state, county, and local hazard mitigation planning efforts.

INMATE POPULATIONS

There are 15 prisons within Region 2 with a total inmate population of 27,101. The follow counties have prisons: Pickaway, Montgomery, Franklin, Lorain, Warren, Madison, Lorain, Madison, Richland, Cuyahoga, Union, Pickaway, Richland, and Fairfield, and Warren. Each prison has a contingency plan that addresses a variety of circumstances. The challenge then is coordination with prison officials.

ETHNIC / POVERTY LEVEL CONSIDERATIONS

The minority population in Region 2 is 1,916,998 or 25.1 percent of the total population in Region 2 (See Chart 1.1.w). African-Americans are the largest minority (16.4 percent) followed by Hispanics (3.8 percent), and Asians (2.9 percent). Their concentrations within the largest communities may be linked to the availability of jobs in the area. The greatest concentration of people with limited English skills is in those counties with the greatest Hispanic populations (Lorain, Cuyahoga, and Franklin).

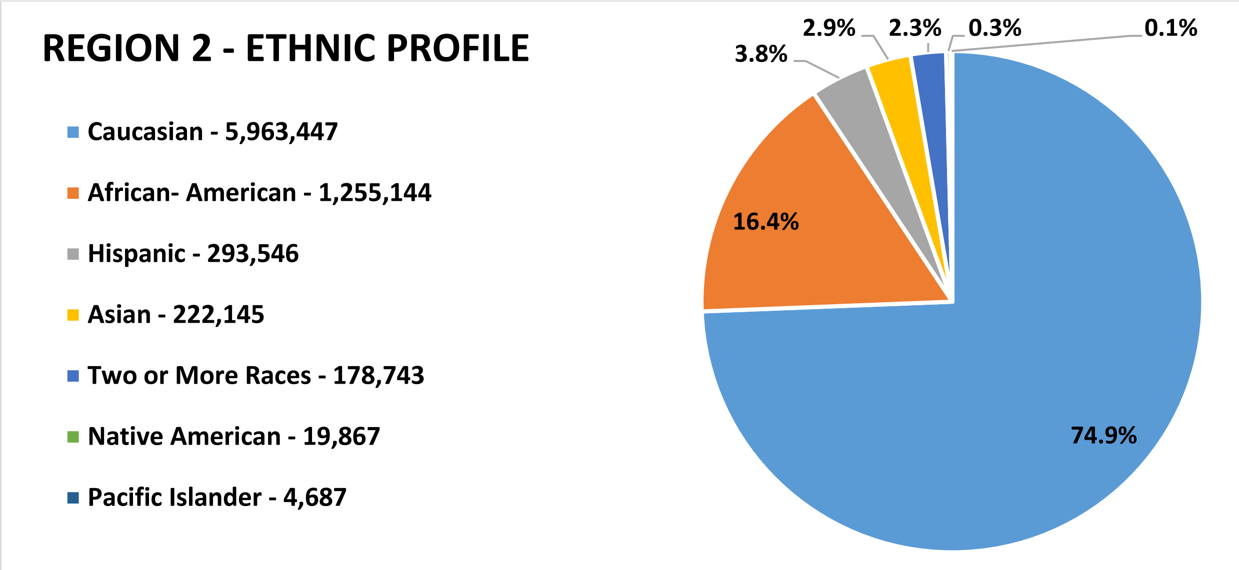


Chart 1.1.w

AGE PROFILES

The median age in Region 2 is 39.5. The age population categories which require the most care after a disaster event are the under 5 years of age and over 65 years of age. The percentage of children under the age of 5 is about the same throughout Region 2 counties with percentages ranging from a low of 4.6 percent in Portage County to a high of 7.2 percent in Franklin County. The percentage of people 65 years of age and older is also consistent with percentages ranging from a low of 11.2 percent in Union County to a high of 18 percent in Richland County (Chart 1.1.x).

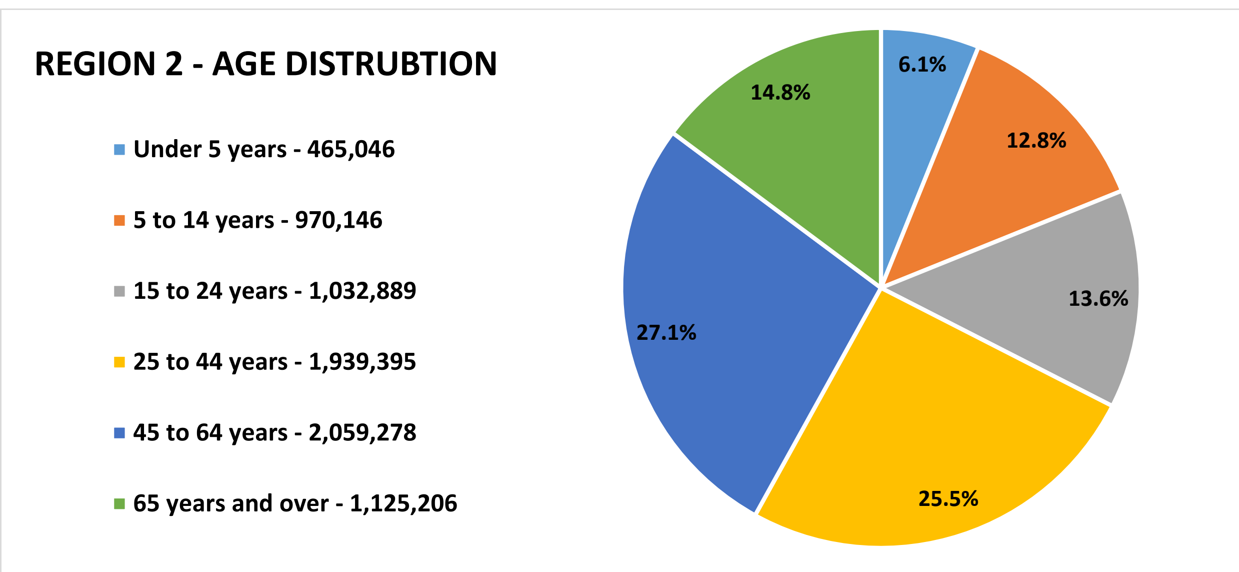


Chart 1.1.x

REGIONAL ECONOMY

Trade, transportation, and utilities are the region's principal economic sector. Other sectors, in order of economic importance, include (2) education & health services, (3) professional & business services, (4) manufacturing, and (5) leisure & hospitality (Table 1.1.y).

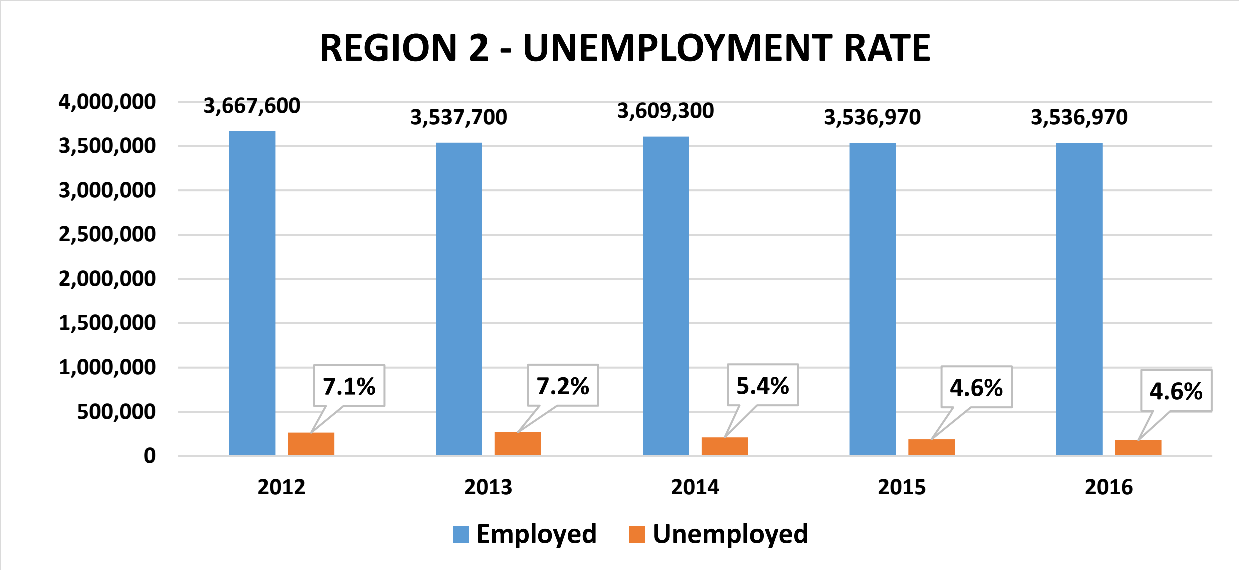
REGION 2 EMPLOYMENT AND WAGES BY SECTOR - 2016					
Industrial Sector	Avg. Establishment #	Average Employment	Total Wages	Avg. Weekly Wage	Annual Avg. Pay
Private Sector	181,079	3,220,086	$158,026,634,922	$832	$43,271
Goods Producing	25,016	555,616	$33,473,616,428	$1,092	$56,788
Natural Resources & Mining	986	10,860	$456,778,368	$758	$39,390
Construction	14,011	138,150	$7,992,588,068	$1,035	$53,803
Manufacturing	10,023	406,604	$25,024,249,992	$1,115	$57,958
Services-Providing	156,065	2,664,473	$124,553,018,494	$739	$38,403
Trade, Transportation & Utilities	41,373	684,948	$28,374,382,400	$709	$36,865
Information	2,641	54,646	$3,782,499,509	$1,034	$53,772
Financial Services	19,439	221,795	$15,545,488,310	$1,035	$53,792
Professional & Business Services	35,114	559,625	$36,036,405,318	$955	$49,632
Education & Health Services	22,621	642,552	$29,518,603,941	$761	$39,596
Leisure & Hospitality	18,600	390,901	$7,685,172,855	$306	$15,907
Other Services	15,869	109,560	$3,592,961,991	$553	$28,750
Federal Government	821	63,751	$4,921,759,094	$1,221	$63,474
State Government	546	87,616	$5,730,220,090	$1,029	$53,494
Local Government	5,802	321,989	$15,472,310,188	$766	$39,836
Total	**550,006**	**10,133,172**	**$500,186,689,968**	**$871.08***	**$45,295.73***

*Shows average not total

Table 1.1.y

The region contains the Cleveland-Columbus Cincinnati corridor which follows Interstate 71. Interstate 71 bisects the region from southwest to northeast and links to other freeways leading to both the Midwestern parts of the county and the eastern seaboard. Region 2 has a strong logistics industry and contains the majority of the state's rail lines with several intermodal sites. Region 2 also is home to many of the largest universities and colleges, which are typically clustered near the larger metropolitan statistical areas. This accounts for the slight employment increase in the education and health sectors as many of the universities are associated with the hospitals which are also teaching facilities. The region is home to aerospace and defense industries such as General Electric Aircraft Engines in Cincinnati, and Wright-Patterson Air Force Base in Dayton. While not addressed in the Bureau of Labor Statistics data, agriculture is an important economic driver in Region 2.

Region 2's unemployment rates have decreased from a high in 2012 of 7.1 percent to a low of 4.6 percent in 2016 (Graph 1.1.z).



Graph 1.1.z

The median annual household income in Region 2 is $55,596, which exceeds that of the state ($48,446). There are 13.1 percent of people living at or below the poverty level in Region 2, this is less than the state on average (15.3 percent). The Region 2 counties that have comparatively high numbers of people living below the poverty level include: Cuyahoga, Montgomery, Fayette, and Hamilton. These counties may warrant special consideration in pre- and post- disaster planning (Chart 1.1.aa).

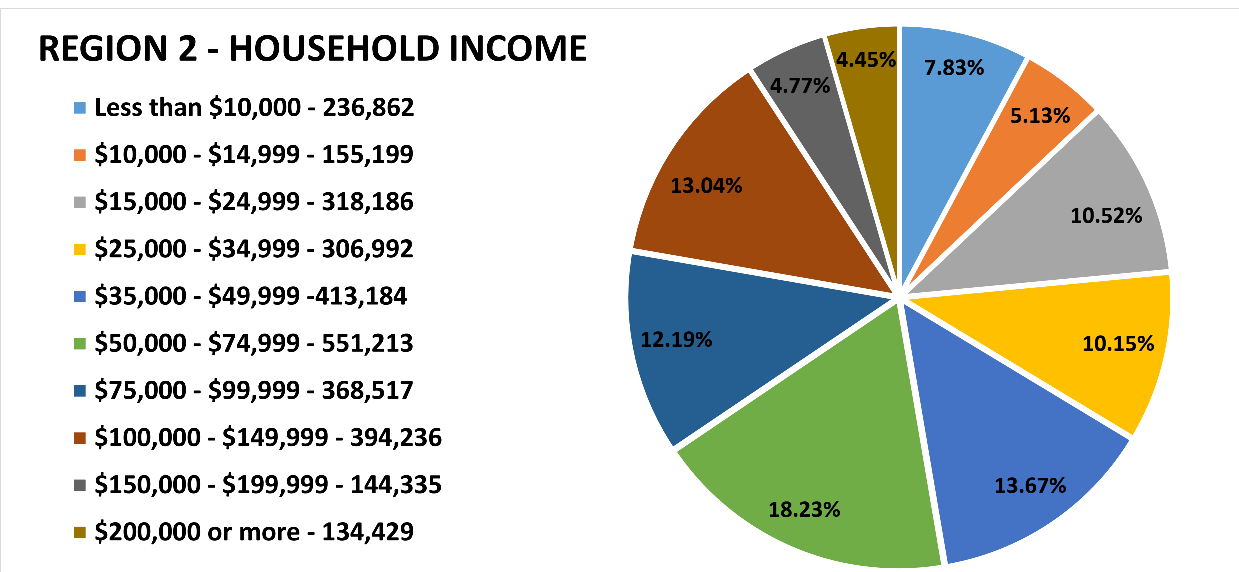
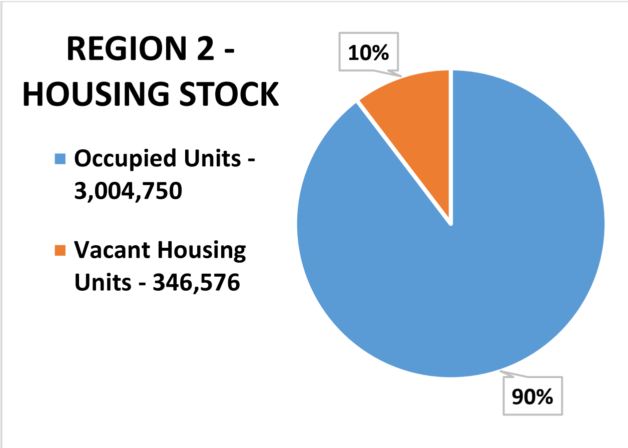


Chart 1.1.aa

HOUSING

About one half of Region 2’s housing stock was constructed prior to 1968, when the National Flood Insurance Program was created. This implies that a large number of houses constructed in the region’s floodplains do not have adequate flood protection. Most of the homes in Region 2 are owner occupied

(64.2 percent), as opposed to those occupied by renters (35.71 percent). The number of vacant homes is relatively low (11.5 percent), but livability of these vacant homes is unknown (Chart 1.1.bb).



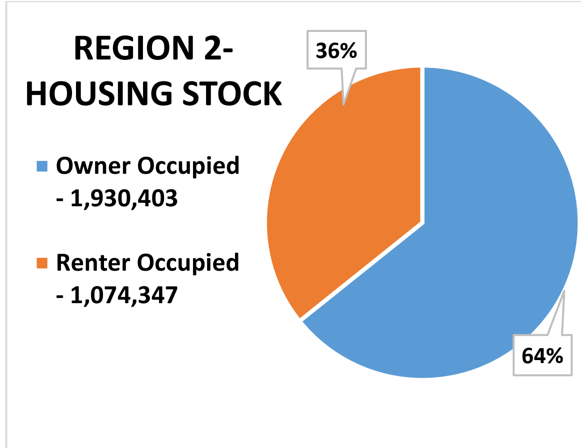


Chart 1.1.bb

TRANSPORTATION

Region 2 has a well-developed transportation system, which includes 14 Class A airports and at least one commercial airport in every county. Geauga and Knox Counties are the only Region 2 counties that do not have interstate highways. All counties are served by the U.S. Highway system and a variety of rail lines. The region possesses both lake and river port facilities (Table 1.1.cc).

REGION 2 TRANSPORTATION SYSTEMS						
Counties	Interstate Highways	U.S. Highways	Rail Lines	Class A Airports	Total Airports	Lake ports/ River ports
Ashland	X	X	3		2	
Butler	X	X	3		3	
Clinton	X	X	1	1	3	
Cuyahoga	X	X	7	3	4	1
Delaware	X	X	2		2	
Fairfield	X	X	2		2	
Franklin	X	X	4	3	7	
Geauga		X	1		2	
Green	X	X	1	*	1	
Hamilton	X	X	6	1	2	6
Knox		X	1		3	
Lake	X	X	2	1	2	1
Licking	X	X	3		2	
Lorain	X	X	4		5	1
Madison	X	X	4		1	
Medina	X	X	3		3	
Montgomery	X	X	3	1	7	

Pickaway	X	X	3		2	
Portage	X	X	4		2	
Richland	X	X	4	1	4	
Stark	X	X	5	1	3	
Summit	X	X	6	2	5	
Union		X	1		1	
Warren	X	X	5		2	
Wayne	X	X	5		1	

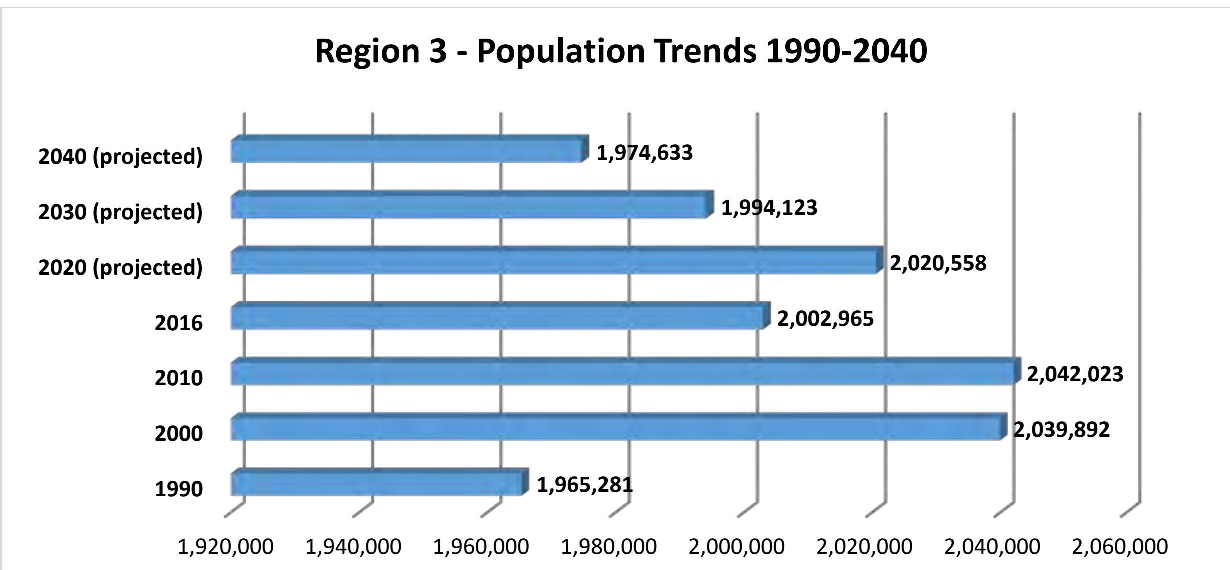
Table 1.1.cc – * Wright Patterson Airforce Base is not a commercial airport

REGION 3

Region 3 is defined largely as the Appalachian region of Ohio. This region consists largely of the Appalachian foothills, and also is the area of the state that has the most exposure to the Ohio River, a significant flooding source in the state.

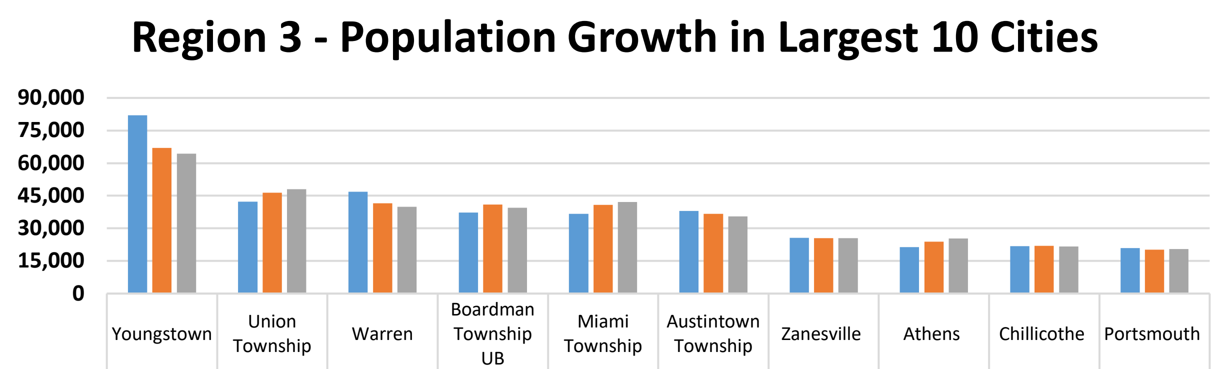
GENERAL POPULATION

The population of Region 3 in 2016 was 2,002,965, approximately 17% of the total population of Ohio, per the 2016 ACS. The region experienced a minor decrease of 36,927 people over a 16-year period (Graph 1.1.dd).



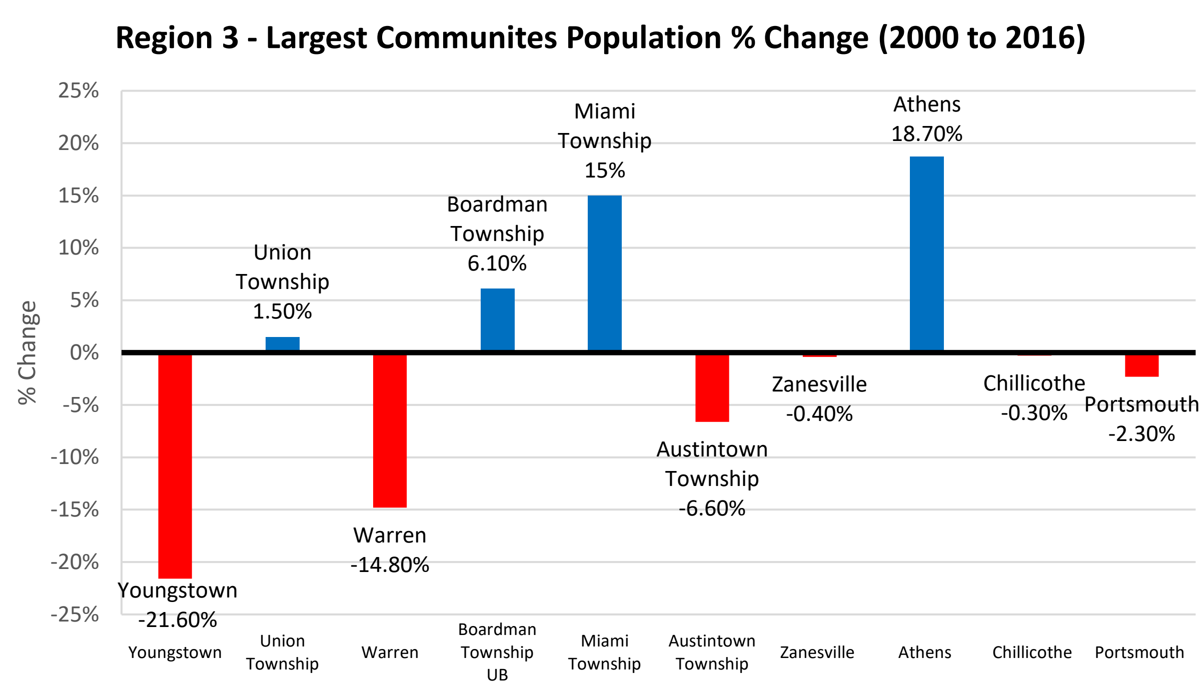
Graph 1.1.dd (projects based upon 2010 census)

The region as a whole has seen a minor decrease in population, the majority of the region's largest cities and areas have experienced larger losses in population between 2000 and 2016 (see Graph 1.1.dd). The greatest percentage loss of population occurred in Youngstown (Mahoning) with the city losing 21.6 percent of its population, while the greatest percentage increase in population occurred in Athens (Athens) gaining 18.7 percent (Graphs 1.1.ee & 1.1.ff).



	Youngstown	Union Township	Warren	Boardman Township UB	Miami Township	Austintown Township	Zanesville	Athens	Chillicothe	Portsmouth
2000	82,026	42,322	46,832	37,215	36,632	38,001	25,586	21,342	21,796	20,909
2010	66,979	46,417	41,553	40,882	40,848	36,713	25,472	23,838	21,903	20,226
2016	64,312	47,967	39,898	39,490	42,146	35,491	25,465	25,341	21,725	20,422

Graph 1.1.ee



	Youngstown	Union Township	Warren	Boardman Township UB	Miami Township	Austintown Township	Zanesville	Athens	Chillicothe	Portsmouth
% Change	-21.60%	1.50%	-14.80%	6.10%	15%	-6.60%	-0.40%	18.70%	-0.30%	-2.30%

Graph 1.1.ff

SPECIAL POPULATIONS

There is a significant part of the population in Region 3 that could require higher levels of assistance before and after a disaster occurs. These special population groups include: infant children, elderly, non-English speaking, convalescing, assisted living, and inmate populations.

CONVALESCING AND ASSISTED LIVING POPULATIONS

The convalescing and assisted living populations include hospitals, and nursing homes. There are 209 nursing homes and 49 hospitals in Region 3 with a total of 24,654 beds. There also are three psychiatric hospitals in the region. Although these facilities have their own contingency plans, they coordinate with state, county, and local hazard mitigation planning efforts.

INMATE POPULATIONS

Region 3 also contains nine prisons, which are spread across the region. The inmate population is 15,497, with Ross and Belmont Counties holding the largest percentage of inmates.

ETHNIC / POVERTY LEVEL CONSIDERATIONS

Approximately 90.9% of the Region 3 is Caucasian. This leaves a total minority population of 178,573, the total minorities category is computed by subtracting the non-Hispanic-one-race-only whites from the total population. The African-American (4.4 percent) and Hispanic (2.0 percent) populations in Region 3 are comparatively small. The largest percentages of African Americans reside in Mahoning, Trumbull, and Ross counties. The majority of Hispanics reside in Mahoning, Ashtabula, and Clermont counties. Twenty- eight of the thirty-two counties within the region exceed the state's average poverty level (15.3 percent) with Athens County having highest poverty level in the state (33 percent). Counties that are below the poverty level face potentially severe implications of ensuring that mitigation actions are implemented and often must depend on outside resources (Chart 1.1.gg).

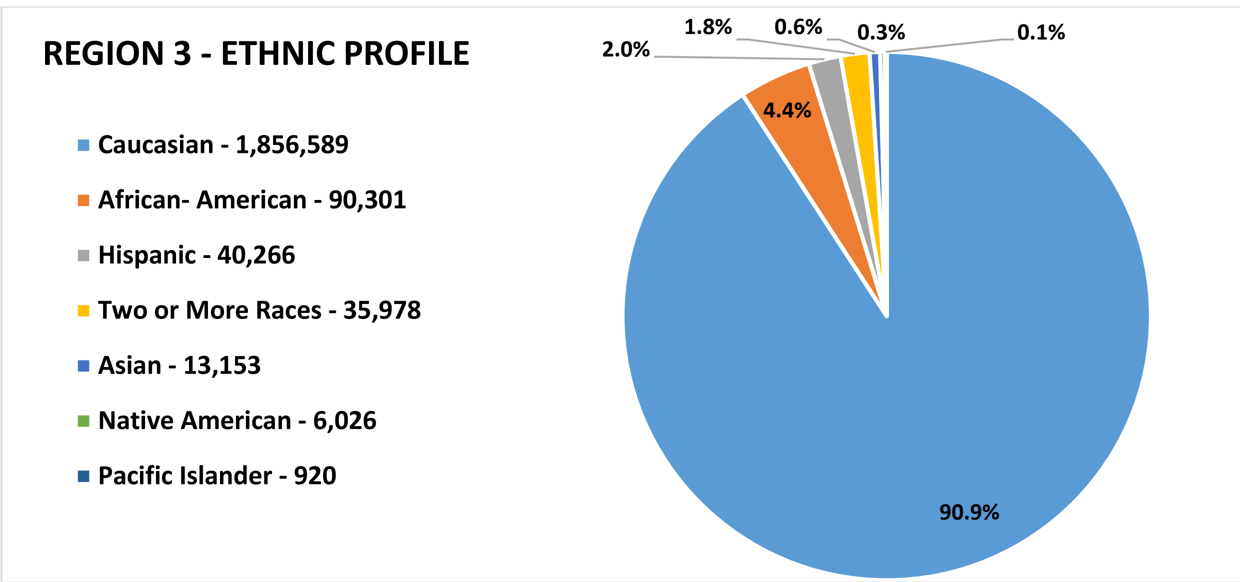


Chart 1.1.gg

AGE PROFILES

The median age in Region 3 is 41.3 years, which does not vary significantly from that in Region 1 or Region 2. The two populations, which often require special attention during disaster times are children under the age of 5 and those over the age or 65. At present, approximately 5.6 percent of the region's population is less than 5 years of age and 17.24 percent of the population is 65 or older. Within the region Trumbull and Mahoning counties contain the largest population 65 years or older. Clermont County contains the highest number of population under the age of 5 (Chart 1.1.hh).

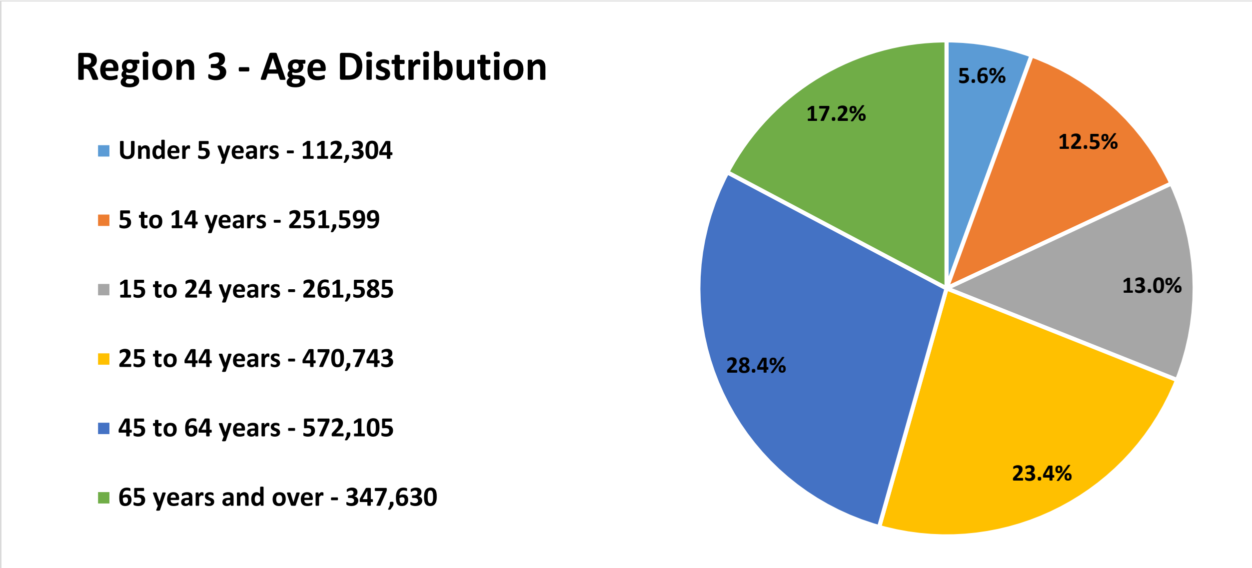


Chart 1.1.hh

REGIONAL ECONOMY

Trade, transportation, and utilities are the region's principal economic sector. Other sectors, in order of economic importance, include (2) health care, (3) professional & business services, (4) leisure and hospitality, and (5) construction (Table 1.1.ii).

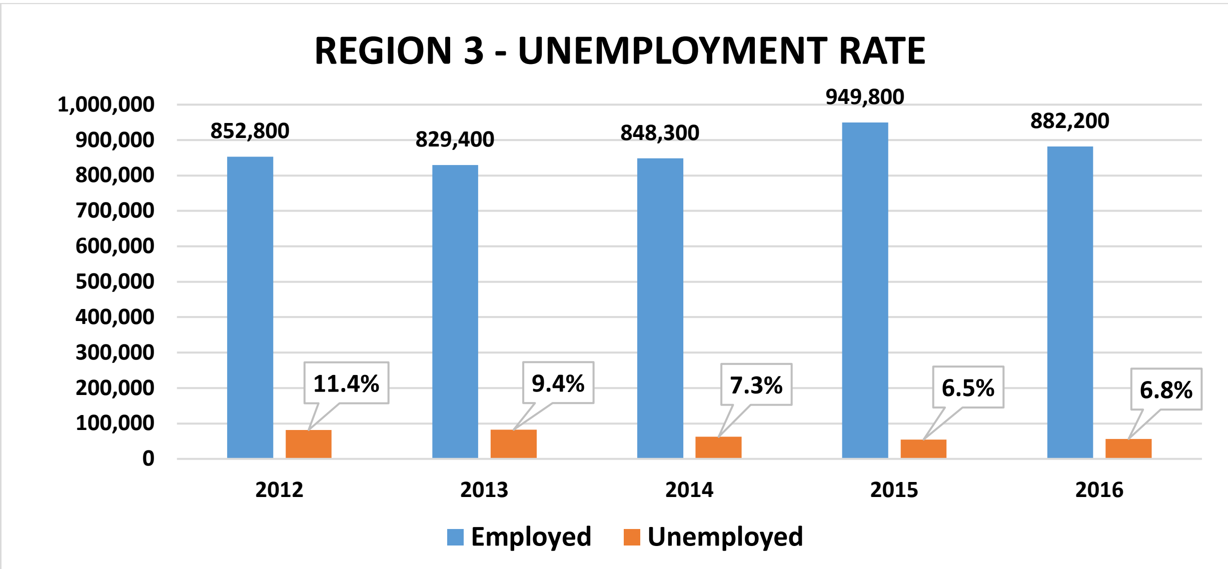
REGION 3 EMPLOYMENT AND WAGES BY SECTOR - 2016					
Industrial Sector	Avg. Establishment #	Average Employment	Total Wages	Avg. Weekly Wage	Annual Avg. Pay
Private Sector	33,115	469,459	$17,637,738,630	$691	$35,918
Goods Producing	6,210	108,578	$5,635,824,163	$947	$49,267
Natural Resources & Mining	637	5,644	$299,016,240	$860	$44,721
Construction	3,441	25,259	$1,283,591,263	$919	$47,772
Manufacturing	2,137	77,153	$4,027,941,773	$891	$46,343
Services-Providing	26,904	360,884	$12,001,914,467	$600	$31,190
Trade, Transportation & Utilities	8,422	117,855	$4,012,257,295	$627	$32,603
Information	370	5,316	$281,441,303	$720	$37,461
Financial Services	3,052	19,081	$892,839,264	$777	$40,395
Professional & Business Services	4,279	44,504	$1,831,576,148	$720	$37,429
Education & Health Services	4,360	98,183	$3,728,667,396	$652	$33,927
Leisure & Hospitality	3,450	59,848	$842,368,865	$256	$13,315
Other Services	2,945	15,967	$408,676,408	$443	$23,027
Federal Government	422	6,348	$383,777,816	$1,014	$52,708
State Government	274	11,418	$602,954,195	$981	$50,988
Local Government	2,412	69,662	$2,655,536,216	$693	$36,031
Total	**102,430**	**1,495,159**	**$56,526,121,442**	**$736.89***	**$38,318.60***

*Shows average not total

Table 1.1.ii

The 2010-2015 boom in the oil and gas industries in the state has slowed due to a number of reasons. Per the Ohio Oil and Gas Association, the number of oil and gas permits dropped by 44 percent in 2016. There were 561 permits issued in 2016, down from 997 in 2015. The drop is even more severe when compared with 2014, when there were 1,659 permits issued by state regulators at the peak of the state's Utica shale-driven boom in oil and natural gas extraction: Last year's 561 permits marks a 66 percent drop from 2014. This slowdown has caused the drop in the number of construction jobs in Region 3 from previous years. While not addressed in the Bureau of Labor Statistics data, agriculture is an important economic factor in Region 3.

Regional unemployment rates fluctuated between 2012 and 2016, from a high of 11.4% in 2012 to a low of 6.5% in 2015 (Graph 1.1.jj).



Graph 1.1.jj

In 2016, the median household income in Region 3 was $43,441 which is considerably lower than the state ($49,492) and national ($52,334) median incomes (Chart 1.1.kk).

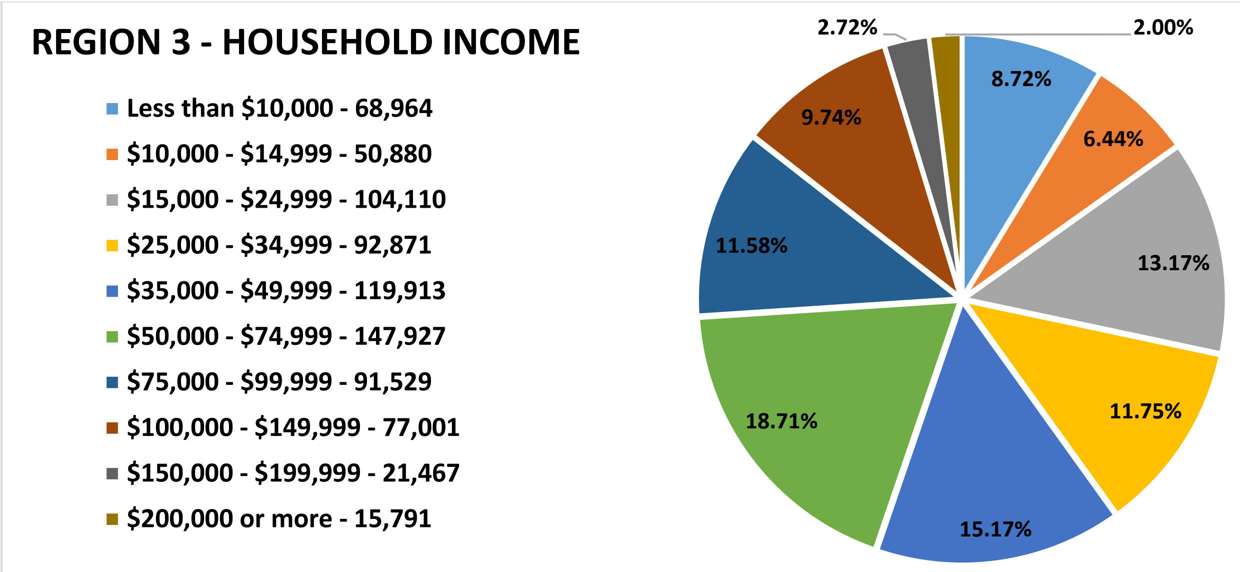
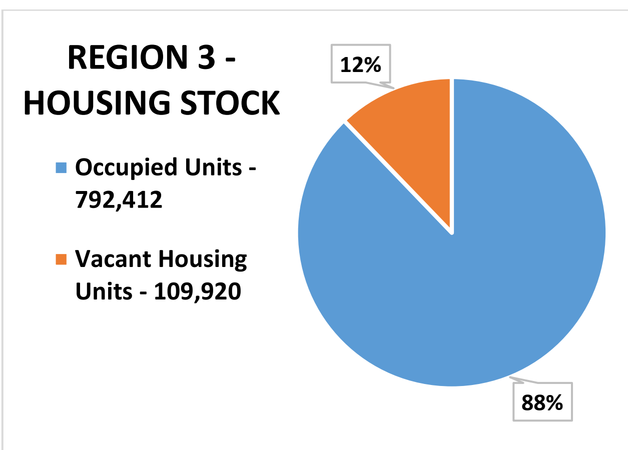


Chart 1.1.kk

HOUSING

There were 897,382 housing units in Region 3 (Chart 1.1.ll). The majority of the homes (71 percent) are owner-occupied and about 29 percent are rentals. Of the housing stock 12 percent of the region's stock was vacant. According to the Ohio DSA, 71 percent of the region's housing stock was built before 1970, which indicates most construction occurred prior to the creation of the National Floodplain Insurance Program (NFIP).



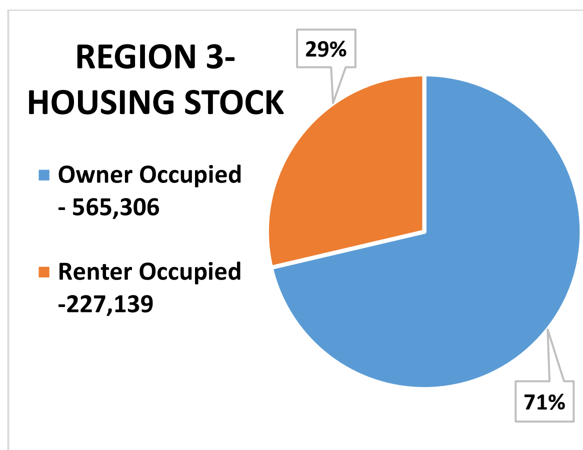


Chart 1.1.ll

TRANSPORTATION

Table 1.1.mm provides a general overview of Region 3 transportation systems, which include interstate highways, U.S. highways, rail lines, airports, and river ports. There is one Class A airport in the Region located in Trumbull County. Nine of thirty-two counties are served by the interstate system, but most counties have at least one U.S. highway. A major rail line serves all counties except Noble and Morgan counties. Seven counties have ports along the Ohio River and one county (Ashtabula) has Lake Erie Ports.

REGION 3 TRANSPORTATION SYSTEMS

Counties	Interstate Highways	U.S. Highways	Rail Lines	Class A Airports	Total Airports	Lake ports/ River ports
Adams		X	1		1	
Ashtabula	X	X	4		2	2
Athens		X	2		1	
Belmont	X	X	2		3	1
Brown		X	1		1	
Carroll			3		2	
Clermont	X	X	2		1	
Columbiana		X	3		2	4
Coshocton		X	1		2	
Gallia		X	2		1	1
Guernsey	X	X	1		2	
Harrison		X	3		1	
Highland		X	1		1	
Hocking		X	3			
Holmes		X	2		1	
Jackson		X	1		1	
Jefferson		X	4		2	1
Lawrence		X	1		1	2
Mahoning	X	X	4		5	
Meigs		X	2			
Monroe			1		1	
Morgan					1	
Muskingum	X	X	4		2	
Noble	X				1	
Perry		X	3		1	
Pike		X	3		1	
Ross		X	4		1	
Scioto		X	2		1	3
Trumbull	X	X	4	1	3	
Tuscarawas	X	X	4		1	
Vinton		X	1		1	
Washington	X	X	1			2

Table 1.1.mm

1.2 PLANNING PROCESS

According to 44CFR 201.4(c)(1) Ohio's hazard mitigation plan must provide a "Description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated."

The SOHMP was initially developed in 2005 and was subsequently updated in 2008, 2011, 2012, and 2014. The process used for the initial plan development and subsequent updates are summarized in the 2014 version of the SOHMP.

The first Ohio EMA Mitigation Branch meeting regarding the 2019 plan update occurred prior to applying for a PDM grant to update the document in February 2017. Bi-weekly Mitigation Branch meetings to monitor plan update status started in July 2018 and continued until the draft mitigation plan document was completed in late April 2019. The 2019 SOHMP update process is summarized below.

The Ohio EMA Mitigation Branch is the primary author of the plan. The team that authored the 2019 plan update is:

2019 State of Ohio Hazard Mitigation Plan Primary Authors	
Name	**Title**
Steve Ferryman, CFM	Mitigation Branch Chief, State Hazard Mitigation Officer
Jacob Hoover, AICP, CFM	Mitigation Branch Supervisor
Luan Nguyen	State Hazard Mitigation Planner
Gary Penn	GIS Database Administrator
Maeve Hogel	Mitigation Branch Intern
Alex Strawser	Mitigation Branch Intern

Although this team was primarily responsible for authoring the plan text, many different people, organizations and agencies contributed to the plan direction, content, and review. These contributors and their role in the plan update process is outlined below.

STATE HAZARD MITIGATION TEAM (SHMT)

Prior to DMA 2000, Ohio had created a mitigation team, the SHMT, which serves two primary functions: To provide input / score applications for FEMA mitigation programs and to provide general input on the State of Ohio's hazard mitigation policies. Today the SHMT continues to meet and is the lead advisory group involving mitigation project scoring and mitigation policy – which includes mitigation planning issues. The SHMT members provided general direction in some areas of the plan, reviewed and edited the plan text, and contributed mitigation action items.

Currently, the SHMT includes the following entities:

State Hazard Mitigation Team (2019)	
Agency	**Name**
Ohio EMA - Recovery Branch	Brigitte Bouska
Ohio DNR - Division of Water Resources	Dena Barnhouse
Ohio DNR - Division of Water Resources	Alicia Silverio
Ohio Development Services Agency	Timothy Allen
Ohio Public Works Commission	Linda Bailiff
Ohio Department of Administrative Services	Traci Heyer
Muskingum Watershed Conservancy District	Boris Slogar
US Army Corps of Engineers-Buffalo	Laura Ortiz
US Army Corps of Engineers-Huntington	Ashley Stephens
US Army Corps of Engineers-Huntington	JoAnn Combs
US Army Corps of Engineers-Louisville	Brandon Brummett
FEMA Region V	Pam Broviak
Emergency Management Association of Ohio	Sean Miller, Delaware Co. EMA
US Geological Survey	Dave Straub
Ohio EMA - Mitigation Branch (non-voting)	Steve Ferryman
Ohio EMA - Mitigation Branch (non-voting)	Jacob Hoover
Ohio EMA - Mitigation Branch (non-voting)	Keven Clouse
Ohio EMA - Mitigation Branch (non-voting)	Dan Clevidence
Ohio EMA - Mitigation Branch (non-voting)	Sharon Rolf
Ohio EMA - Mitigation Branch (non-voting)	Luan Nguyen
Ohio Voluntary Organizations Active in Disaster	Erin Cordle

EMERGENCY SUPPORT FUNCTION (ESF) PARTNERS

The Emergency Support Function Partners meet quarterly at Ohio EMA. These partners facilitate state agency support and input into the SOHMP. Current ESF Partner Leads are:

Emergency Support Function Leads (2017)		
Emergency Support Function	**Agency**	**Name**
#1 - Transportation	Ohio Dept. of Transportation	Leslie Bricker
#2 – Communications & I.T.	Ohio EMA	Dave Ford
#3 – Engineering & Public Works	Ohio DNR	Doug Johnson
#4 – Firefighting	Commerce/State Fire Marshall	Jeff Hussey
#5 – Information & Planning	Ohio EMA	Tyler Kempf
#6 – Mass Care	Ohio EMA	Rhonda Meggitt
#7 – Resources & Logistics	Ohio Dept. of Admin. Services	Jennifer Shaefer
#8 – Public Health & Medical	Ohio Dept. of Health	Tamara McBride
#9 – Search & Rescue	Ohio DNR	Doug Johnson
#10 – Hazardous Materials	Ohio EPA	Jim Mehl
#11 – Agriculture	Ohio Dept. of Agriculture	Terri Gerhardt
#12 – Energy	Public Utilities Comm. of Ohio	Lowell Miller
#13 – Law Enforcement	Dept. of Public Safety	Ken Kocab

#14 – Recovery & Mitigation	Ohio EMA	Laura Adcock-Elder
#15 – External Affairs	Ohio EMA	Jay Carey

The agencies that are part of ESF #14 have authority, programs, funding and expertise to supplement local mitigation and recovery actions after an event. The SOHMP update was coordinated with ESF #14 Partners. These agencies provided data that was incorporated into the state mitigation capability assessment. ESF#14 support agencies also contributed mitigation action items to the plan and provided review and comment on the document.

Current ESF #14 Partners are:

ESF #14 – Mitigation and Recovery Partners (2017)	
Adjutant General	Ohio Facilities Construction Commission
American Red Cross	Ohio Homeland Security
Board of Regents/Dept. of Education	Ohio Hospital Association
Corporation for National and Community Service	Ohio Housing Finance Agency
Department of Administrative Services	Ohio Public Works Commission
Ohio Attorney General’s Office	Ohio Rail Development Commission
Department of Aging	Ohio Rural Electric Cooperatives
Department of Agriculture	Ohio Statewide Independent Living Council
Department of Commerce	Ohio Treasurer of State
Department of Developmental Disabilities	Secretary of State
Department of Health	Ohio VOAD
Department of Insurance	Ohio Water Development Authority
Department of Job and Family Services	Public Utilities Commission of Ohio
Department of Medicaid	Salvation Army
Department of Mental Health & Addiction	U.S. Small Business Administration
Ohio Department of Natural Resources	State Historic Preservation Office
Ohio Department of Public Safety	U.S. Army Corps of Engineers
Ohio Department of Rehabilitation and	U.S. EPA
Ohio Department of Transportation	National Oceanic and Atmospheric Adm.
Department of Veteran’s Services	U.S. Department of Interior
Development Services Agency	U.S. Coast Guard
Ohio Emergency Management Agency	U.S. Fish and Wildlife
Emergency Management Association of Ohio	U.S. Geological Survey
Ohio Environmental Protection Agency	U.S. Housing and Urban Development
FEMA	U.S.D.A. Nat. Res. Conservation Service
Ohio Arts Council	U.S.D.A. Farm Services Agency
Office of Budget and Management	U.S.D.A. Rural Development
Ohio Commission on Service and Volunteerism	

THE OHIO SILVER JACKETS TEAM

The Ohio Silver Jackets Team is an interagency team dedicated to creating a collaborative environment to bring together all levels of government and other stakeholders to mitigate natural hazards by effectively combining available agency resources, programs, and technical expertise. The Ohio Silver Jackets team has funded multiple projects that were prioritized in the 2014 SOHMP. Some examples include: loss avoidance studies, HAZUS runs, and floodplain mapping projects. The Ohio Silver Jackets Team meets quarterly and for the 2019 SOHMP update provided hazard specific technical expertise, mitigation action items, and overall plan review.

2019 PLAN UPDATE AND ADOPTION PROCESS

Agencies from all levels of government and multiple non-profits participated in the 2019 SOHMP. The public was given multiple opportunities to review and comment on the draft plan. Efforts were also made to solicit input and comments from businesses and the private sector through the Ohio Public Private Partnership. Following is a brief outline of the process followed to update and adopt the 2019 SOHMP.

STEP 1: REVIEW THE EXISTING STATE MITIGATION PLAN, OTHER PLANS, AGENCY GOALS AND OBJECTIVES, TRENDS, ETC.

The 2014 Enhanced SOHMP was reviewed to determine areas of focus for the 2019 SOHMP update. It was determined that the entire document would be updated with a focus on:

- Reducing the size of the plan by eliminating outdated and extraneous information, and
- Creating an interactive digital summary of the SOHMP to increase public awareness of the document.

STEP 2: APPLY FOR PRE-DISASTER MITIGATION GRANT

The Ohio EMA Mitigation Branch applied for and received a Pre-Disaster Mitigation (PDM) grant from FEMA to help pay for the cost to update the plan and create the digital plan summary.

STEP 3: RESEARCH AND GATHER DATA

Significant time and effort was invested by the Ohio EMA Mitigation Branch to research data needed for the comprehensive plan update. In addition, subject matter experts in specific hazards were consulted and provided data and/or wrote portions of the plans risk analysis. Extensive research of current state mitigation laws, policies, and programs was also conducted to update the state capability portion of the plan document.

STEP 4: CREATE DRAFT PLAN AND OBTAIN STAKEHOLDER INPUT

Ohio EMA Mitigation Branch staff updated plan text based on information and data gathered from research and subject matter experts. Meetings to gather input on the draft document were held with the Ohio EMA Executive Office, the SHMT, ESF partners, and the Ohio Public Private Partnership. A draft version of the plan was also posted on the Ohio EMA website, in conjunction with a press release requesting public review and comment of the draft plan on February 28, 2019. As of April 16, 2019, six comments were received on the draft plan. Public input was evaluated and incorporated into the plan document.

STEP 5: SUBMIT DRAFT SOHMP TO FEMA FOR REVIEW

The draft SOHMP was submitted to FEMA for review and approval as meeting enhanced state mitigation plan requirements. Comments provided by FEMA on their review of the draft plan were incorporated into the final plan document.

STEP 6: SOHMP ADOPTION AND FINAL APPROVAL

The final SOHMP document was adopted according to state law and sent to FEMA for final review and approval. The SOHMP document was approved as meeting FEMA enhanced plan requirements in 44 CFR 201.5. The FEMA approval of the SOHMP as an enhanced plan enables the state to access additional mitigation funds after a major disaster declaration.

1.3 PLAN INTEGRATION WITH OTHER INITIATIVES

Effective state mitigation programs coordinate with various programs and agencies at all levels of government and the private sector to help achieve risk reduction. The Code of Federal Regulations 44 Part 201.4(b)(1) and Part 201.5(b)(1) recommends that state mitigation plans be integrated to the extent possible with 1) ongoing state and/or regional planning efforts, 2) FEMA mitigation programs, and 3) other initiatives that provide guidance to state and regional agencies. The list below identifies some of the many ways the SOHMP and programs are integrated.

LOCAL HAZARD MITIGATION PLANNING

Local entities are encouraged to review the State of Ohio Hazard Mitigation Plan (SOHMP); the state mitigation planner reviews all local plans for consistency with state plan and federal planning requirements. Local plan data will be reviewed and integrated into state plan.

OHIO HOMELAND SECURITY STRAGETIC PLAN

Ohio EMA Mitigation Branch continues to participate in the development of the Ohio Homeland Security strategic plan by ensuring that the plan was consistent with the SOHMP. The Mitigation Branch currently participates on the OHS Strategic Plan Infrastructure and Structural Recovery Advisory Committees.

OHIO EMA STRATEGIC PLAN

The Ohio EMA updates its strategic plan on an annual basis. Different branches, including the Mitigation Branch, formulate branch strategic goals, objectives, and actions. The Ohio EMA Mitigation Branch strategic plan is partially based on actions in SOHMP.

STATE EMERGENCY OPERATIONS PLAN

The Ohio EOP is structured on 15 Emergency Support Functions (ESF) that correspond to the format of the National Response Framework. ESF-14 is titled, Recovery and Mitigation and is updated and maintained by the respective branches.

STATE RECOVERY STRATEGIES

From 2014-2016, state agencies, along with our federal, local and non-governmental organization partners developed five state recovery strategies covering the following areas: 1) economy, 2) infrastructure, 3) housing, 4) health and social services, and 5) natural and cultural resources. All disasters, whether natural or human-caused, require some level of recovery for the impacted survivors, businesses and local governments. These strategies are intended to document the roles and capabilities of local, state, federal and non-governmental agencies in support of recovery efforts. Roles and capabilities can include financial assistance and/or technical assistance. The Mitigation Branch participated in the development of these strategies.

OHIO THREAT HAZARD IDENTIFICATION AND RISK ASSESSMENT

The Ohio EMA Plans Branch is responsible for the development and maintenance of the Ohio Threat Hazard Identification and Risk Assessment (THIRA) and the State Preparedness Report. The Ohio EMA Mitigation Branch participates in the annual update of both documents.

OHIO HAZARD IDENTIFICATION AND RISK ASSESSMENT

The Ohio EMA Plans Branch is responsible for the development and maintenance of the Ohio Hazard

Identification and Risk Assessment (HIRA). The Mitigation Branch participates in the review and update of the HIRA. Data from the Risk Analysis in Section 2 of the SOHMP is used to inform the HIRA.

INTEGRATION WITH OTHER MITIGATION PROGRAMS

CDBG AND HUD SUPPLEMENTAL FUNDS/ OHIO DEVELOPMENT SERVICES AGENCY

The Ohio Development Services Agency (ODSA) works both independently and with Ohio's mitigation programs to provide funding for non-structural mitigation projects in communities with populations of low to moderate income individuals. Such funds may match FEMA mitigation programs or may be used for projects independently. ODSA program staff are members of the SHMT.

OHIO SILVER JACKETS TEAM

Silver Jackets is a U.S. Army Corps of Engineers program that began in Ohio in 2006 and the program is now active in majority states around the country. Silver Jackets is a strategic and collaborative initiative of Federal and state agencies to advance natural hazard risk reduction activities that align with state priorities. The initiative seeks to leverage resources available through all levels of government, the private sector, and Non-Governmental Organizations (NGO's) to identify and implement local solutions to risk vulnerability. The USACE participates on the SHMT and has recently funded multiple action items identified as priorities in the SOHMP with the annual Silver Jackets Program funding. The following link to the Ohio Silver Jackets website contains additional details: https://silverjackets.nfrmp.us/State-Teams/Ohio.

NATIONAL FLOOD INSURANCE PROGRAM/ ODNR DIVISION OF WATER RESOURCES, FLOODPLAIN MANAGEMENT PROGRAM

The ODNR Division of Water Resources is the state coordinating entity for the National Flood Insurance Program as well as state floodplain management office. ODNR Coordinates closely with the Ohio EMA Mitigation Branch, and participates on the SHMT. The Floodplain Management Program participates extensively on SOHMP updates. They are responsible for working with Ohio EMA during events and post-flood issues, and coordinating education and outreach for community floodplain administrators.

Staff from ODNR and OHIO EMA collaborate on facilitating Risk MAP in the state. Risk Mapping, Assessment, and Planning (Risk MAP) is the Federal Emergency Management Agency (FEMA) Program that provides communities with flood information and tools they can use to enhance their mitigation plans and take action to better protect their citizens. Through more precise flood mapping products, risk assessment tools, planning and outreach support, Risk MAP strengthens local ability to make informed decisions about reducing risk.

OHIO DAM SAFETY PROGRAM/ ODNR DIVISON OF WATER RESOURCES

The Dam Safety Program has statutory authority for permitting/monitoring dams and levees in Ohio. The DSP provides data for the state plan HIRA and action items into the state mitigation strategy. The DSP coordinates closely with the National Dam Safety Program (NDSP) and has used NDSP grant funds to train state personnel and conduct dam safety awareness workshops.

OHIO BUILDING CODE/ OHIO DEPARTMENT OF COMMERCE

The Ohio Department of Commerce – Board of Building Standards and the Ohio Building Officials Association work on state building codes and issues related to hazards in Ohio. The Ohio Residential Code of Ohio includes provisions for flood hazards and the ODNR – Floodplain Management Program coordinates closely with them to ensure the Ohio RCO meets federal requirements. The state has utilized information provided in the "Flood Resistant Construction" section of the OBBC to outline expectations of the local jurisdictions, post-disaster, to help them achieve the flood reduction goals.

In 2013, the Ohio Board of Building Standards adopted reference standards in the Residential Building Code of Ohio specific to the construction and/or installation of tornado safe rooms. In 2015, the Ohio EMA Mitigation Branch hired experts from the National Storm Shelter Association to provide training to local and state building code officials on implementation of the ICC 500 standards and FEMA safe room design and construction requirements. Local and state building code officials review plans and inspect construction/installation of residential and community safe rooms. In 2017, the Board of Building Standards adopted the 2017 Ohio Building Code, which included Section 423, which now requires the construction of storm shelters in critical emergency operations structures and Group E occupancies.

OHIO MINE SUBSIDENCE INSURANCE/ OHIO MINE SUBSIDENCE INSURANCE UNDERWRITING ASSOCIATION

Underground mines, some of which have been abandoned for years, can be found in many parts of the state, particularly eastern Ohio. When buildings are constructed above mines, major damage to walls and foundations can occur if the mine collapses. The Ohio Legislature authorized the establishment of the Ohio Mine Subsidence Insurance Underwriting Association (OMSIUA), the Mine Subsidence Governing Board and the Mine Subsidence Insurance Fund in 1985. Ohio Mine Subsidence Insurance is a regional mitigation tool.

FIREWISE/ODNR DIVISON OF FORESTRY

The ODNR – Division of Forestry administers the Firewise program, which is a multi-organizational initiative designed to include not only fire safety professionals, but also homeowners, community leaders, planners, developers, and others in localized efforts to lessen the risk of interface with wildfires. The ultimate goal of this program is to reduce the susceptibility of homes, communities, and structures to wildfire through cooperative education and mitigation techniques. The Division of Forestry contributed to the wildfire portion of the HIRA.

HAZARD MITIGATION ASSISTANCE/ FEMA

FEMA's hazard mitigation programs are closely coordinated with and consistent with state hazard mitigation efforts. The Ohio EMA Mitigation Branch coordinates the HMA programs at the state level. The HMA programs provide a significant portion of the mitigation funding resources to implement mitigation activities. PDM and HMGP funds are used to partially pay for state and local mitigation plan updates. FEMA Hazard Mitigation Assistance Branch staff are invited to all SHMT meetings.

FLOOD GAUGING AND WARNING/ U.S. GEOLOGICAL SURVEY

The USGS's Ohio-Kentucky-Indiana Water Science Center assists local entities by entering into cooperative agreements for stream gauging and warning system development. These mitigation activities are identified in numerous local mitigation plans and factor into the state mitigation strategy. The USGS also attends the SHMT meetings and assist the Ohio EMA Mitigation Branch with data development for benefit cost analyses. Finally the USGS also produces reports on significant flood events in cooperation with Ohio DNR and Ohio EMA.

EMERGENCY MANAGEMENT ACCREDITATION PROGRAM

Emergency Management Accreditation Program (EMAP) is a standard-based voluntary assessment and accreditation process for state and local government. In June 2008, Ohio EMA received EMAP Accreditation for requirements pertaining to a state mitigation program. Ohio EMA received EMAP Re-Accreditation in 2014, and is preparing for the next Re-Accreditation in 2019.

RURAL ELECTRIC COOPERATIVES

Rural electric cooperatives (RECs) are customer owned organizations whose purpose is to deliver electricity to its members. Twenty-five different electric cooperatives serve more than 380,000 homes and businesses in 77 of Ohio's 88 counties. In the 2014 plan update, the Ohio EMA Mitigation Branch worked with the Ohio Rural Electric Cooperative, Inc. to develop an appendix to the SOHMP that includes a risk assessment and identification of projects that will reduce risk to electric infrastructure and expedite recovery efforts.

THE OHIO STATE UNIVERSITY

The Ohio EMA Mitigation Branch has partnered with the Ohio State University, Austin E. Knowlton School of Architecture City and Regional Planning program on several successful initiatives. Every two years, a graduate level planning studio is offered at the university that provides students with an opportunity to work directly with a county emergency management agency to update their countywide hazard mitigation plan. The students gain real world planning experience, and the county gets needed help to update their plan. Fayette County, Perry County, and Guernsey County developed FEMA-approved mitigation plans as a result of this collaboration.

EMERGENCY MANAGEMENT GRANT PROGRAM (EMPG)

Ohio EMA Mitigation Branch staff participate in EMPG exercise requirements and as such can be paid for certain mitigation related activities through the grant. Mitigation Branch staff have helped review applications for EMPG funding in the past and coordinates closely with the Ohio EMA Grants Branch to ensure that there is no duplication of programs and/or benefits.

COMMUNITY RATING SYSTEM (CRS)

The Ohio EMA Mitigation Branch staff recognize the value of the National Flood Insurance Programs CRS as mitigation tool to reward communities that take steps to exceed NFIP minimum standards. The CRS is promoted by Mitigation Branch staff as part of the Introduction to Emergency Management in Ohio Course, Local Mitigation Planning Course, and multiple other trainings throughout the year. Mitigation Branch staff also coordinate closely with the state coordinator for the CRS program at ODNR.

PUBLIC ASSISTANCE CATEGORIES C-G

At the onset of a disaster, the State Recovery Officer and the State Hazard Mitigation Officer coordinate with FEMA staff on how integration of mitigation through the 406 program will occur for that disaster. If it appears that there will be mitigation opportunities as part of the recovery process, the state requests that 406 Specialists are sent to the joint field office to ensure that 406 mitigation opportunities are considered in all Public Assistance worksheets. The need for assistance is outlined in the hazard mitigation strategy for that specific event.

1.4 PLAN MAINTENANCE AND MITIGATION PROJECT MONITORING

44 CFR 201.4(c)(5) requires that state mitigation plans have a maintenance process that includes an established method and schedule for monitoring, evaluating, and updating the plan. The Ohio EMA Mitigation Branch Chief is responsible for the maintenance of the SOHMP. The plan is a living document that is reviewed and updated constantly. The plan is revised if conditions under which the plan was developed change, such as new or revised state policy or a major disaster. At a minimum, the plan is revised and resubmitted for approval to the FEMA Region V Administrator every five years in accordance with 44 CFR 201.4(d).

Since the first SOHMP was developed in 2005, the document has been updated and approved by FEMA four times. The 2019 SOHMP update was authored by multiple staff members of the Ohio EMA Mitigation Branch, with input from the State Hazard Mitigation Team (SHMT), the Ohio Silver Jackets Team, and Emergency Operations Center Emergency Support Function (ESF) partners. The SHMT meets 2-4 times per year depending on the number of major disasters. The Ohio Silver Jackets Team and the ESF partners meet quarterly and on an as-needed basis. These meetings provide Ohio EMA Mitigation Branch staff the opportunity to solicit and incorporate updated information from partners into the SOHMP.

MONITORING PROJECT IMPLEMENTATION

44 CFR 201.4 (c) (5) (ii) requires that a state mitigation plan maintenance process include a description of the system used for monitoring implementation of mitigation measures and project closeouts. The Ohio EMA Mitigation Branch is responsible for monitoring implementation of mitigation projects under HMGP, PDM, and FMA. Review of implementation progress occurs quarterly with the submission of quarterly reports. These reports are verified by monitoring visits conducted by Ohio EMA Mitigation Branch staff. Details of the extensive monitoring and project closeout process program can be found in the Administrative Plan attached in Appendix H.

FEMA has determined that the SOHMP meets enhanced plan criteria in 44 CFR 201.5. Since the enhanced plan designation results in additional mitigation funds being made available to the state after a disaster, the enhanced plan criteria includes an evaluation of the state's grant management performance. The last FEMA Region V evaluation of Ohio's HMA grant management performance determined that Ohio EMA:

- Effectively use existing mitigation programs to achieve mitigation goals,
- Meets grant application deadlines,
- Maintains the capability to prepare and submit accurate environmental reviews and benefit-cost analyses,
- Submits complete and accurate quarterly progress and financial reports, and
- Completes projects within established performance periods, including financial reconciliation.

SHARPP contains an inventory of mitigation projects completed in the State of Ohio with HMA grant funding: https://sharpp.dps.ohio.gov/OhioSHARPP/MitigationProjects.aspx.

The Ohio EMA Mitigation Branch also monitors the implementation of mitigation actions identified in Section 3 of this plan. The status of mitigation actions identified in the plan is constantly tracked by the Mitigation Branch. Updates from state agencies with mitigation action items listed in this plan are discussed during meetings of the SHMT, Ohio Silver Jackets, and ESF partner meetings. The final status of mitigation action items identified in the previous version of the SOHMP can be found in Appendix E.

1.5 COMPLIANCE WITH FEDERAL LAWS AND REGULATIONS

44 CFR 201.4(c)(7) indicates that the SHMP must include assurances that the state will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 2 CFR Parts 200 and 3002. Through the development and enforcement of this plan, the State of Ohio will comply with all provisions in 44 Code of Federal Regulations, Part 200 and 3002. Additionally, the assurances listed below are provided as documentation that the state or any subsequent sub-recipients that receive federal grant funds will comply with all applicable Federal statutes and regulations. The state will amend the plan whenever necessary to reflect changes in federal statutes and regulations or material changes in state law, organization, policy or state agency operations.

To the extent the following provisions apply to the award of assistance:

a) Recipient possesses legal authority to enter into agreements and to execute the proposed programs;
b) Recipient's governing body has duly adopted or passed as an official act a resolution, motion or similar action authorizing the execution of hazard mitigation agreements, including all understandings and assurances contained therein, and directing and authorizing the Recipient's chief administrative officer or designee to act in connection with any application and to provide such additional information as may be required;
c) No member of or delegate to the Congress of the United States, and no Resident Commissioner, shall be admitted to any share or part of any agreement or to any benefit to arise from the same. No member, officer, or employee of the Recipient or its designees or agents, no member of the governing body of the locality in which the program is situated, and no other public official of such locality or localities who exercises any functions or responsibilities with respect to the program during his tenure or for one year thereafter, shall have any interest direct or indirect, in any contract or subcontract, or the proceeds thereof, for work to be performed in connection with the program assisted under this plan. The Recipient shall incorporate or cause to be incorporated, in all such contracts or subcontracts, a provision prohibiting such interest pursuant to the purpose state above;
d) All Recipient contracts for which the State Legislature is in any part a funding source, shall contain language to provide for termination with reasonable costs to be paid by the Recipient for eligible contract work completed prior to the date the notice of suspension of funding was received by the Recipient. Any cost incurred after the Recipient receives a notice of suspension or termination may not be funded with funds provided under a grant agreement unless previously approved in writing by the Department. All Recipient contracts shall contain provisions for termination for cause or convenience and shall provide for the method of payment in such event;
e) Recipient will comply with:
    a. Contract Work Hours and Safety Standards Act of 1962, 40 U.S.C. 327 et seq., requiring that mechanics and laborers (including watchmen and guards) employed on federally assisted contracts be paid wages of not less than one and one-half times their basic wage rates for all hours worked in excess of forty hours in a work week; and
    b. Federal Fair Labor Standards Act, 29 U.S.C. Section 201 et seq., requiring that covered employees be paid at least the minimum prescribed wage, and also that they be paid one and one-half times their basic wage rates for all hours worked in excess of the prescribed work-week.

f) Recipient will comply with:
   a. Title VI of the Civil Rights Act of 1964 (P.L. 88-352), and the regulations issued pursuant thereto, which provides that no person in the United States shall on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Recipient receives Federal financial assistance and will immediately take any measures necessary to effectuate this assurance. If any real property or structure thereon is provided or improved with the aid of Federal financial assistance extended to the Recipient, this assurance shall obligate the Recipient, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the Federal financial assistance is extended, or for another purpose involving the provision of similar services or benefits;
   b. Any prohibition against discrimination on the basis of age under the Age Discrimination Act of 1975, as amended (42 U.S.C.: 6101-6107), which prohibits discrimination on the basis of age or with respect to otherwise qualified handicapped individuals as provided in Section 504 of the Rehabilitation Act of 1973;
   c. Executive Order 11246 as amended by Executive Orders 11375 and 12086, and the regulations issued pursuant thereto, which provide that no person shall be discriminated against on the basis of race, color, religion, sex or national origin in all phases of employment during the performance of federal or federally assisted construction contracts; affirmative action to insure fair treatment in employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff/termination, rates of pay or other forms of compensation; and election for training and apprenticeship;

g) The Recipient agrees to comply with the Americans With Disabilities Act (Public Law 101-336, 42 U.S.C. Section 12101 et seq.), where applicable, which prohibits discrimination by public and private entities on the basis of disability in the areas of employment, public accommodations, transportation, state and local government services, and in telecommunications;

h) Recipient will comply with Title IX of the Education Amendments of 1972, as amended (20 U.S.C.: 1681-1683 and 1685 - 1686), which prohibits discrimination on the basis of sex;

i) Recipient will comply with the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970, (42 U.S.C. 4521-45-94) relating to nondiscrimination on the basis of alcohol abuse or alcoholism;

j) Recipient will comply with 523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. 290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records;

k) Recipient will comply with Title VIII of the Civil Rights Act of 1968, 42 U.S.C. 2000c and 42 3601-3619, as amended, relating to non- discrimination in the sale, rental, or financing of housing, and Title VI of the Civil Rights Act of 1964 (P.L. 88-352), which prohibits discrimination on the basis of race, color or nation origin;

l) Recipient will comply with the Intergovernmental Personnel Act of 1970, 42 U.S.C. 4728-4763;

m) Recipient will comply with the Rehabilitation Act of 1973, Section 504, 29 U.S.C. 794, regarding non-discrimination;

n) Recipient will establish safeguards to prohibit employees from using positions for a purpose that is, or gives the appearance of, being motivated by a desire for private gain for themselves or others, particularly those with whom they have family, business, or other ties pursuant to Section 112.313 and Section 112.3135, FS;

o) Recipient will comply with the Anti-Kickback Act of 1986, 41 U.S.C. Section 51 which outlaws and prescribes penalties for "kickbacks" of wages in federally financed or assisted construction activities;

p) Recipient will comply with the Hatch Act (18 USC 594, 598, 600-605), which limits the political activities of employees;
q) Recipient will comply with the flood insurance purchase and other requirements of the Flood Disaster Protection Act of 1973 as amended, 42 USC 4002-4107, including requirements regarding the purchase of flood insurance in communities where such insurance is available as a condition for the receipt of any Federal financial assistance for construction or acquisition purposes for use in any area having special flood hazards. The phrase "Federal financial assistance" includes any form of loan, grant, guaranty, insurance payment, rebate, subsidy, disaster assistance loan or grant, or any other form of direct or indirect Federal assistance;
r) Recipient will require every building or facility (other than a privately owned residential structure) designed, constructed, or altered with funds provided under a grant agreement to comply with the "Uniform Federal Accessibility Standards," (AS) which is Appendix A to 41 CFR Section 101-19.6 for general type buildings and Appendix A to 24 CFR Part 40 for residential structures. The Recipient will be responsible for conducting inspections to ensure compliance with these specifications by the contractor;
s) Recipient will, in connection with its performance of environmental assessments under the National Environmental Policy Act of 1969, comply with Section 106 of the National Historic Preservation Act of 1966 (U.S.C. 470), Executive Order 11593, 24 CFR Part 800, and the Preservation of Archaeological and Historical Data Act of 1966 (16 U.S.C. 469a-1, et seq.) by:
    a. Consulting with SHPO to identify properties listed in or eligible for inclusion in the National Register of Historic Places that are subject to adverse effects (see 36 CFR Section 800.8) by the proposed activity; and
    b. Complying with all requirements established by the State to avoid or mitigate adverse effects upon such properties.
    c. Notifying FEMA and the state if any project may affect a historic property. When any of Recipient's projects funded under a grant agreement may affect a historic property, as defined in 36 CFR 800. (2)(e), FEMA may require Recipient to review the eligible scope of work in consultation with SHPO and suggest methods of repair or construction that will conform with the recommended approaches set out in the Secretary of Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings 1992 (Standards), the Secretary of the Interior's Guidelines for Archeological Documentation (Guidelines) (48 Federal Register 44734-37), or any other applicable Secretary of Interior standards. If FEMA determines that the eligible scope of work will not conform with the Standards, Recipient agrees to participate in consultations to develop, and, after execution by all parties, to abide by, a written agreement that establishes mitigation and recondition measures, including but not limited to, impacts to archeological sites, and the salvage, storage, and reuse of any significant architectural features that may otherwise be demolished.
    d. Notifying FEMA and the state if any project funded under a grant agreement will involve ground disturbing activities, including, but not limited to: subsurface disturbance; removal of trees; excavation for footings and foundations; and installation of utilities (such as water, sewer, storm drains, electrical, gas, leach lines and septic tanks) except where these activities are restricted solely to areas previously disturbed by the installation, replacement or maintenance of such utilities. FEMA will request the SHPO's opinion on the potential that archeological properties may be present and be affected by such activities. The SHPO will advise Recipient on any feasible steps to be accomplished to avoid any National Register eligible archeological property or will make recommendations for the development of a treatment plan for the recovery of

archeological data from the property.

e. If Recipient is unable to avoid the archeological property, it will develop, in consultation with the SHPO, a treatment plan consistent with the Guidelines and take into account the Advisory Council on Historic Preservation (Council) publication "Treatment of Archeological Properties". Recipient shall forward information regarding the treatment plan to FEMA, the SHPO and the Council for review. If the SHPO and the Council do not object within 15 calendar days of receipt of the treatment plan, FEMA may direct Recipient to implement the treatment plan. If either the Council or the SHPO object, Recipient shall not proceed with the project until the objection is resolved.
f. Notifying the state and FEMA as soon as practicable: (a) of any changes in the approved scope of work for a National Register eligible or listed property; (b) of all changes to a project that may result in a supplemental DSR or modify an HMGP project for a National Register eligible or listed property; (c) if it appears that a project funded under a grant agreement will affect a previously unidentified property that may be eligible for inclusion in the National Register or affect a known historic property in an unanticipated manner. Recipient acknowledges that FEMA may require Recipient to stop construction in the vicinity of the discovery of a previously unidentified property that may be eligible for inclusion in the National Register or upon learning that construction may affect a known historic property in an unanticipated manner. Recipient further acknowledges that FEMA may require Recipient to take all reasonable measures to avoid or minimize harm to such property until FEMA concludes consultation with the SHPO. Recipient also acknowledges that FEMA will require, and Recipient shall comply with, modifications to the project scope of work necessary to implement recommendations to address the project and the property.
g. Acknowledging that, unless FEMA specifically stipulates otherwise, it shall not receive funding for projects when, with intent to avoid the requirements of the PA or the NHPA, Recipient intentionally and significantly adversely affects a historic property, or having the legal power to prevent it, allowed such significant adverse effect to occur.

t) Recipient will assist the awarding agency in assuring compliance with the National Historic Preservation Act of 1966, as amended, 16 U.S.C. 270;
u) Recipient will assist the awarding agency in assuring compliance with the Preservation of Archeological and Historical Preservation Act of 1966, 16 U.S.C. 469a, et seq;
v) Recipient will comply with the requirements of Titles II and III of the Uniform Relocation Assistance and Property Acquisition Policies Act of 1970, 42 U.S.C. 4621-4638, which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally assisted programs;
w) Recipient will assure project consistency with the approved State program developed under the Coastal Zone Management Act of 1972, 16 U.S.C. 1451-1464; and
x) With respect to demolition activities, recipient will:
   a. Create and make available documentation sufficient to demonstrate that the Recipient and its demolition contractor have sufficient manpower and equipment to comply with the obligations as outlined in a grant agreement.
   b. Return the property to its natural state as though no improvements had ever been contained thereon.
   c. Furnish documentation of all qualified personnel, licenses and all equipment necessary to inspect buildings located in Recipient's jurisdiction to detect the presence of asbestos and lead in accordance with requirements of the U.S. E.P.A., the Ohio E.P.A. and the County Health Department.

d. Provide documentation of the inspection results for each structure to indicate:
    i. Safety Hazards Present
    ii. Health Hazards Present
    iii. Hazardous Materials Present
e. Provide supervision over contractors or employees employed by Recipient to remove asbestos and lead from demolished or otherwise applicable structures.
f. Leave the demolished site clean, level and free of debris.
g. Notify the department promptly of any unusual existing condition which hampers the contractors work.
h. Obtain all required permits.
i. Provide addresses and marked maps for each site where water wells and septic tanks are to be closed, along with the number of wells and septic tanks located on each site. Provide documentation of closures.
j. Comply with mandatory standards and policies relating to energy efficiency that are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Public Law 94-163).
k. Comply with all applicable standards, orders, or requirements issued under Section 112 and 306 of the Clean Air Act (42 U.S.C. 1857 (h), Section 508 of the Clean Water Act (33 U.S. 1368), Executive Order 11738, and the U.S. Environmental Protection Agency regulations (40 CFR Part 15 and 61). This clause shall be added to any subcontracts.
l. Provide documentation of public notices for demolition activities.

y) Recipient will comply with Lead-Based Paint Poison Prevention Act (42 U.S.C.: 4821 et seq.), which prohibits the use of lead based paint in construction of rehabilitation or residential structures;
z) Recipient will comply with the Energy Policy and Conservation Act (P.L. 94-163; 42 U.S.C. 6201-6422), and the provisions of the state Energy Conservation Plan adopted pursuant thereto;
aa) Recipient will comply with the Laboratory Animal Welfare Act of 1966, 7 U.S.C. 2131 2159, pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by an award of assistance under this agreement;
bb) Recipient will comply with the Clean Air Act of 1955, as amended, 42 U.S.C. 7401-7642;
cc) Recipient will comply with the Clean Water Act of 1977, as amended, 42 U.S.C. 7419-7626;
dd) Recipient will comply with the Endangered Species Act of 1973, 16 U.S.C. 1531-1544;
ee) Recipient will comply with environmental standards which may be prescribed pursuant to the National Environmental Policy Act of 1969, 42 U.S.C. 4321-4347;
ff) Recipient will comply with the environmental standards that may be prescribed pursuant to the Safe Drinking Water Act of 1974, 42 U.S.C. 300f-300j, regarding the protection of underground water sources;
gg) Recipient will comply with the Wild and Scenic Rivers Act of 1968, 16 U.S.C.1271-1287, related to protecting components or potential components of the national wild and scenic rivers system;
hh) Recipient will comply with the following Executive Orders: EO 11514 (NEPA); EO 11738 (violating facilities); EO 11988 (FM); EO 11990 (Wetlands); and EO 12898 (Environmental Justice);
ii) Recipient will comply with the Coastal Barrier Resources Act of 1977, 16 U.S.C. 3510; Recipient will comply with the Fish and Wildlife Coordination Act of 1958; 16 U.S.C. 661-666.

1.6 ASSURANCES / PROMULGATION

The State of Ohio Hazard Mitigation Plan meets the standard requirements of Section 409 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988, 42 United States Code Sections 5121 and following (commonly referred to as the Stafford Act - Public Law 93-288). Additionally, this plan meets the SRL planning requirements of 44 Code of Federal Regulations, Part 79.4.

It is intended that this plan also meet the requirements of the Section 322 of the Stafford Act which requires that States, as a condition of receiving federal disaster mitigation funds, have a mitigation plan in place that describes the planning process for identifying hazards, risk and vulnerabilities, identifies and prioritizes mitigation actions, encourages the development of local mitigation plans and projects, and provides technical support for these efforts. In addition, the Act requires local and tribal governments to also have mitigation plans as a condition of receiving disaster mitigation funds.

The development and implementation of this strategy is authorized and/or required by the following state statutes:

- Ohio Revised Code Section 5502.22, which establishes the Ohio Emergency Management Agency and requires plan development), and
- Ohio Revised Code Sections 5502.26, 5502.27, and 5502.271, which require the establishment of county emergency management agencies and plan development.

The adoption and promulgation of the 2008, 2011 and 2014 and 2019 update is being done by the Executive Director of the Ohio EMA in her capacity as the Governor’s Authorized Representative (GAR). The original SHMP was promulgated by Governor Taft in 2005.

State of Ohio Hazard Mitigation Plan

STATEMENT OF ADOPTION

The State of Ohio Hazard Mitigation Plan (SOHMP) is a comprehensive description of the State's commitment to reduce or eliminate the impacts of natural and human-caused hazards. The Disaster Mitigation Act of 2000 requires that states have a natural hazard mitigation plan to maintain eligibility for federal disaster assistance and mitigation funds. The SOHMP is coordinated and maintained by the Ohio Emergency Management Agency, however, the plan is the culmination of input and recommendations from numerous stakeholders from local, state and federal government agencies, private sector organizations, and residents of Ohio.

The SOHMP was initially approved by FEMA on January 17, 2005 and has been updated in 2008, 2011, 2012, and 2014. The 2019 plan update meets "enhanced" plan criteria, which is a testament to the state's commitment to mitigation and enables Ohio to qualify for additional funds following future disaster declarations.

In adopting the 2019 update of the SOHMP, the State of Ohio agrees to comply with all applicable state and federal statutes and regulations, as stipulated in previously documented assurances, and will update the plan at least every five years as required. The SOHMP has been amended to reflect emerging hazard conditions and risks as well as new or revised state and federal statutes and regulations. Future amendments will also reflect changes to State organization or policy as appropriate.

As the Governor's Authorized Representative, I the undersigned do hereby formally adopt the State of Ohio Hazard Mitigation Plan 2019 update.

Signature:

Date: MAY 7, 2019

Sima S. Merick, Executive Director
Ohio Emergency Management Agency

SECTION 2:
RISK ANALYSIS

2.1 RISK ANALYSIS OVERVIEW

The State of Ohio is prone to many natural, manmade, and technological hazards. Ohio has experienced thousands of hazard events, resulting in millions of dollars in losses and casualties, and 48 Presidential disaster declarations. The Risk Analysis (RA) in Section 2 of this plan draws data and analysis from many different sources in order to analyze and mitigate impacts from the state's highest risk hazards.

In order to meet FEMA state mitigation planning requirements in 44 CFR 201.4(c) (2) and (d), a state mitigation plan risk assessment must:

- Include an overview of the type and location of all natural hazards that can affect the state,
- Provide an overview of the probabilities of future hazard events,
- Address the vulnerability of state assets located in hazard areas and estimate the potential dollar losses to these assets,
- Include an overview and analysis of the vulnerability of jurisdictions to the identified hazards and the potential losses to vulnerable structures, and
- Reflect changes in development

HAZARD IDENTIFICATION

The State of Ohio Hazard Identification and Risk Analysis (HIRA) provides an overview of the type and location of all natural hazards that can affect the state (see Appendix I). The HIRA is maintained by the Ohio EMA Plans Branch and is the authoritative source of hazard identification and analysis that informs all state plans related to emergency management. However, the SOHMP does not include an in-depth analysis of all thirty-one (31) hazards listed in the HIRA for several reasons some of which include:

- The hazard is human-caused or technological and the impacts of the hazard are more appropriately addressed in preparedness or law enforcement plans,
- The hazard probability is so low that an in-depth analysis is not justified or the data to conduct the analysis does not exist, and
- The State of Ohio has decided to focus limited mitigation resources on the hazards that will have the highest probability and greatest documented impact to people and property.

To support the hazards selected for a detailed analysis in the SOHMP, the state has applied multiple HIRA models that use different methodologies. The results of these analyses can be found in the 2014 SOHMP. All of the HIRA models applied concurred that flooding, tornado/windstorms, and winter storms are the highest threat hazards in Ohio. In the 2019 SOHMP update, the following hazards are analyzed in detail:

- Flooding (includes areal, riverine and flash flooding)
- Tornado
- Winter Storms (includes snow, ice, hail, and sleet)
- Landslide (includes mudslides)
- Dam/Levee Failure
- Wildfire
- Seiche / Coastal Flooding
- Earthquake
- Coastal Erosion
- Severe Summer Storms (includes windstorms and hail)
- Invasive Species
- Land Subsidence (includes abandoned mines)

Each hazard identified in this section includes an overview of the hazard and the probability of future hazard events. Each section also addresses, where appropriate, the vulnerability of state assets located in hazard areas and estimates the potential dollar losses to these assets. The methodology for estimating losses to state-owned critical facilities is different based on the characteristics of the hazard and data available to conduct the vulnerability analysis. The methodology used for each hazard is discussed in that section of the plan. Each section also contains an overview and analysis of the vulnerability of jurisdictions to the identified hazards and the potential losses to vulnerable structures based on analysis of data in local hazard mitigation plans.

STATE HAZARD ANALYSIS RESOURCE AND PLANNING PORTAL (SHARPP)

SHARPP is a repository for past, present, and future versions of all local natural hazard mitigation plans in Ohio. As local mitigation plans are updated they will be uploaded into SHARPP. There are seven factors for each hazard: Frequency, Response, Onset, Impact (magnitude), Impact on business, Impact on people, and Impact on Property. This allows for an increased ability to “ground truth” local priorities with respect to the SOHMP HIRA. For the 2019 SOHMP update, 57 local hazard mitigation plans were reviewed as part of this analysis. These 57 plans were the plans that were approved and not expired as of April 2018. Table 2.1.k shows the ranking of the top ten hazards based on local priorities. For more information regarding SHARPP entry and rankings, see Section 4.3.

Table 2.1.k

Overall Hazard Ranking		
Hazard	**Score**	**Rank**
Flooding	21.09	1
Winter Storms	20.54	2
Severe Summer Storms	18.44	3
Tornado	18.04	4
Drought	16.91	5
Earthquake	15.67	6
Dam/Levee Failure	14.71	7
Invasive Species	12.02	8
Landslide	11.97	9
Land subsidence	11.97	10
Wildfire	11.21	11
Coastal Erosion	10.39	12

Section 2.15 titled, Future Potential Areas of Risk, contains an analysis of future projected growth areas in the state in relation to known hazard risk. This section also evaluates activities with the potential to amplify the effects of existing hazards such as climate change and hydraulic fracturing for oil and gas, and Harmful Algal Blooms (HAB).

ASSESSING VULNERABILITY OF STATE FACILITIES

44 CFR 201.4 (c) (2) (ii) – The risk assessment shall include “an overview and analysis of the state’s vulnerability to the hazards described in this paragraph (c) (2), based on estimates provided in local risk assessments. State-owned or operated critical facilities located in the identified hazard areas shall be addressed.” The methodology for this section varies by hazard due to available data and their attributes, and is more thoroughly discussed below.

The State of Ohio Department of Administrative Services (DAS) Risk Management Section currently maintains a listing of state-owned and state-leased facilities. State leased buildings are only tracked if the lease requires that the state also insure the building. Both the state-owned and state-leased facility datasets are attributed and contain a geo-referenced point for each facility. The data includes facilities ranging from small salt buildings owned by the Department of Transportation (ODOT) to multi-story office buildings owned by DAS. While the previous state plans only evaluated structures whose values exceeded $1 million, this plan evaluates all state-owned structures as many facilities crucial to response are worth much less than $1 million. Additionally, the state leases nearly 300 facilities around the state, and a significant percentage of those are critical in nature. Therefore, it was deemed necessary to evaluate all state-owned and state-leased structures, and parse out those that are critical in nature.

A critical facility is defined as any facility whose services are necessary to the response and/or recovery operations following a disaster. Such facilities include (but are not limited to) administration office buildings, transportation facilities, highway patrol posts, armories, radio antenna towers etc. Also, numerous facilities exist at correctional institute complexes that are used for sheltering purposes immediately following a disaster, and such facilities include structures appurtenant and necessary to their function.

The state-owned and state-leased datasets are sufficient for vulnerability assessments, the state-owned dataset included estimated values for building and contents replacements and the state-leased dataset include estimated values for contents replacement. However, assumptions made for vulnerability using these datasets must be fairly general since additional attributed information is not complete. The majority of the datasets include year of construction, construction type, square footage, number of stories, etc. However, not all dataset include these pieces of information since the data were compiled through multi-agency efforts. As the data is refined and becomes more complete in the future, updates will be made to the methodologies used here for vulnerability assessments.

An additional dataset was acquired from the National Geospatial-Intelligence Agency in cooperation with FEMA. During DR-4002 recovery efforts, Ohio EMA worked with FEMA to gain access to the Homeland Security Infrastructure Program (HSIP) Gold Dataset 2011. The datasets are the products of collaborative efforts of various stakeholders in the Defense, Intelligence, and Homeland Security Communities. The data provides national critical infrastructure sectors as defined by Homeland Security. Much of the data is populated in major metropolitan areas, but gaps exist between highly populated areas. Additionally, replacement costs are not provided for various facilities, limiting the discussion on vulnerability in terms of dollars. The datasets are used to supplement the data obtained from DAS, especially for non-geographic hazards.

ESTIMATING POTENTIAL LOSSES OF STATE FACILITIES

44 CFR 201.4 (c) (2) (iii) – The risk assessment shall include "an overview and analysis of potential losses to identified structures, based on estimates provided in local risk assessments. The state shall estimate the potential dollar losses to state-owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas."

As mentioned above, the state-owned and state-leased datasets are sufficient for loss estimations, as all state-owned and state-leased datasets include estimated values for replacement costs. However, assumptions made for losses using these datasets must be fairly general since additional attributed information is not complete. Many of the datasets include year of construction, construction type, square footage, number of stories, etc. However, not all of the data includes these pieces of information since the data was compiled through multi-agency efforts. As these datasets are refined and become more complete in the future, updates will be made to the methodologies used here for loss estimations.

A summary of the state-owned and state-leased facilities by county and agency is provided in Appendix C. It should be noted that facility specifics (i.e., facility name, location, etc.) are not listed in this plan due to increased security. Further information can be obtained from the Ohio DAS-Risk Management Section.

Tables 2.1.a – 2.1.c list state-owned critical and non-critical facility numbers and replacement values within each county. Currently, there are a total of 6,514 state-owned facilities (3,454 critical and 3,060 non-critical) throughout Ohio worth an estimated $7.8 billion. For Region 1 there are 827 critical and 802 non-critical worth approximately $974 million and $235 million, respectively. The county with the largest dollar exposure of state-owned facilities is Lucas County with $311 million. Lucas County also has the highest dollar exposure of critical facilities at $275 million.

Presently, there are a total of 2,367 (1,586 critical and 781 non-critical) state- owned facilities in Region 2, worth an estimated $5.3 billion. The estimated worth for the critical facilities is over $4.3 billion, and non-critical is over $1 billion. As would be expected, Franklin County, which contains the state capital, represents the majority of the dollar value with $2.3 billion in state-owned facilities that include 230 critical in nature, worth approximately $2.1 billion. The total number of state-owned facilities located in Region 3 is 2,518, representing over $1.2 billion in worth. The estimated worth for critical facilities is $1 billion, and $262 million in non-critical facilities. Ross County has the highest dollar exposure of any county in the Region ($272 million).

Tables 2.1.d – 2.1.f list state-leased critical and non-critical facility numbers and their respective replacement costs within each county. Currently, there is a total of 301 state facilities that are leased annually, of which 49 are critical to response and recovery following a disaster. For Region 1, there are 4 critical and 39 non-critical with approximately $258,945 and $3.1 million in replacement costs. Region 2 has 35 critical and 176 non-critical leases with replacement costs of $53 million and $76 million. In Region 3 has 10 state-leased critical facilities ($3.9 million) and 46 state-leased non-critical facilities ($3.9 million).

Table 2.1.a

Region 1 State-Owned Critical and Non-Critical Facilities						
County	**Number of State-Owned Critical Facilities**	**Replaced Value of All State-Owned Critical Facilities**	**Number of Non-Critical State-Owned Facilities**	**Replacement Value of All Non-Critical Facilities**	**Total Number of State-Owned Facilities**	**Replaced Value of All State-Owned Facilities**
Allen	117	$89,669,386	16	$31,275,411	133	$120,944,797
Auglaize	20	$11,036,162	65	$9,296,282	85	$20,332,444
Champaign	23	$4,627,441	33	$2,305,453	56	$6,932,894
Clark	16	$8,087,767	62	$17,344,481	78	$25,432,248
Crawford	12	$9,677,920	0	_	12	$9,677,920
Darke	24	$6,650,078	4	$41,246	28	$6,691,324
Defiance	11	$7,562,674	8	$197,450	19	$7,760,124
Erie	51	$61,223,935	37	$13,080,766	88	$174,304,701
Fulton	14	$3,170,048	34	$465,870	48	$3,635,918
Hancock	22	$15,577,393	29	$4,470,945	51	$20,048,338
Hardin	10	$3,013,095	5	$137,500	15	$3,150,595
Henry	13	$2,547,412	25	$2,642,000	38	$5,189,412
Huron	21	$9,763,256	4	$239,989	25	$10,003,245
Logan	0	_	82	$11,386,440	82	$11,386,440
Lucas	45	$275,774,293	59	$55,854,581	104	$331,628,874
Marion	99	$127,860,942	15	$13,623,059	114	$141,484,001
Mercer	24	$5,649,522	2	$349,500	26	$5,999,022
Miami	22	$9,293,386	20	$3,809,669	42	$13,103,055
Ottawa	74	$64,951,967	114	$34,016,339	188	$98,968,306
Paulding	2	$577,267	0	_	2	$577,267
Preble	23	$4,624,095	88	$21,542,629	111	$26,166,724
Putnam	15	$2,763,489	0	_	15	$2,763,489
Sandusky	14	$4,765,069	7	$1,426,250	21	$6,191,319
Seneca	47	$32,793,980	8	$1,165,000	55	$33,958,980
Shelby	34	$26,176,043	25	$2,835,996	59	$29,012,039
Van Wert	12	$6,521,545	9	$770,598	21	$7,292,143
Williams	10	$4,071,906	6	$3,013,200	16	$7,085,106
Wood	34	$66,951,677	21	$1,962,240	55	$68,913,917
Wyandot	18	$9,513,296	24	$2,676,850	42	$12,190,146
REGIONAL TOTALS	827	$974,895,044	802	$235,929,744	1,629	$1,210,824,788

Table 2.1.b

Region 2 State-Owned Critical and Non-Critical Facilities						
County	**Number of State-Owned Critical Facilities**	**Replaced Value of All State-Owned Critical Facilities**	**Number of Non-Critical Facilities**	**Replacement Value of All Non-Critical Facilities**	**Total Number of State-Owned Facilities**	**Replaced Value of All State-Owned Facilities**
Ashland	139	$62,683,519	1	$28,000	140	$62,711,519
Butler	21	$17,563,033	10	$1,239,500	31	$18,802,533
Clinton	21	$10,968,912	47	$4,684,708	68	$15,653,620
Cuyahoga	75	$241,066,599	4	$2,792,701	79	$243,859,300
Delaware	36	$45,323,205	70	$22,471,765	106	$67,794,970
Fairfield	77	$85,858,500	11	$1,014,200	88	$86,872,700
Fayette	20	$4,117,291	18	$2,346,501	38	$6,463,792
Franklin	230	$2,107,432,879	58	$680,900,915	288	$2,788,333,794
Geauga	21	$6,690,893	50	$11,133,092	71	$17,823,985
Greene	20	$8,473,508	14	$162,640,206	34	$171,113,714
Hamilton	31	$169,769,037	3	$1,344,677	34	$171,113,714
Knox	31	$38,333,377	2	$58,750	33	$38,392,127
Lake	20	$5,337,835	30	$6,301,773	50	$11,639,608
Licking	58	$152,379,393	30	$11,446,588	88	$163,825,981
Lorain	88	$108,829,615	31	$2,474,957	119	$111,304,572
Madison	108	$320,905,230	27	$3,954,638	135	$324,859,868
Medina	19	$16,321,114	11	$1,205,776	30	$17,526,890
Montgomery	67	$76,369,896	12	$5,274,420	79	$81,644,316
Morrow	20	$6,306,221	15	$497,625	35	$6,803,846
Pickaway	131	$194,421,509	76	$37,335,516	207	$231,757,025
Portage	20	$6,530,887	79	$16,047,980	99	$22,578,867
Richland	71	$108,516,010	47	$12,081,234	118	$120,597,244
Stark	37	$99,410,340	4	$3,781,250	41	$103,191,590
Summit	64	$198,041,224	46	$8,907,138	110	$206,948,362
Union	51	$87,458,961	6	$341,758	57	$87,800,719
Warren	107	$147,595,469	70	$8,755,970	177	$156,351,439
Wayne	3	$5,646,013	9	$1,549,085	12	$7,195,098
REGIONAL TOTALS	1586	$4,332,350,470	781	$1,010,610,723	2367	$5,342,961,193

Table 2.1.c

Region 3 State-Owned Critical and Non-Critical Facilities						
County	**Number of State-Owned Critical Facilities**	**Replaced Value of All State-Owned Critical Facilities**	**Number of Non-Critical Facilities**	**Replacement Value of All Non-Critical Facilities**	**Total Number of State-Owned Facilities**	**Replaced Value of All State-Owned Facilities**
Adams	19	$3,210,607	9	$1,033,950	28	$4,244,557
Ashtabula	58	$18,061,398	152	$18,178,461	210	$36,239,859
Athens	25	$42,563,462	41	$5,068,078	66	$47,631,540
Belmont	59	$51,854,471	27	$2,347,130	86	$54,201,601
Brown	12	$31,554,442	14	$2,662,140	26	$34,216,582
Carroll	15	$2,290,075	1	$1,112,000	16	$3,402,075
Clermont	37	$17,540,161	52	$9,058,025	89	$26,598,186
Columbiana	34	$11,011,455	24	$5,814,746	58	$16,826,201
Coshocton	14	$8,669,467	10	$1,002,473	24	$9,671,940
Gallia	67	$32,190,875	13	$1,617,576	80	$33,808,451
Guernsey	50	$37,763,292	123	$48,231,119	173	$85,994,411
Harrison	26	$6,944,911	15	$2,002,170	41	$8,947,081
Highland	6	$8,833,500	53	$5,612,487	59	$14,445,987
Hocking	13	$2,902,923	147	$13,748,241	160	$16,651,164
Jackson	23	$8,964,361	17	$7,466,364	40	$16,430,725
Jefferson	35	$7,162,401	20	$3,654,238	55	$10,816,639
Lawrence	24	$8,724,700	4	$275,125	28	$8,999,825
Mahoning	63	$71,570,175	16	$10,976,579	79	$82,546,754
Meigs	13	$3,986,061	28	$1,539,230	41	$5,525,291
Monroe	18	$7,714,545	7	$201,319	25	$7,915,864
Morgan	8	$3,101,447	88	$20,026,230	96	$23,127,677
Muskingum	21	$7,726,690	84	$8,508,136	105	$16,234,826
Noble	30	$49,441,152	9	$554,025	39	$49,995,177
Perry	14	$3,266,059	2	$82,500	16	$3,348,559
Pike	8	$2,620,816	70	$9,446,266	78	$12,067,082
Ross	134	$259,985,420	125	$12,209,032	259	$272,194,452
Scioto	47	$166,624,490	69	$21,485,873	116	$188,110,363
Trumbull	57	$53,145,813	57	$4,746,863	114	$57,892,676
Tuscarawas	49	$53,883,450	50	$8,970,141	99	$62,853,591
Vinton	16	$3,074,322	124	$21,690,842	140	$24,765,164
Washington	46	$21,811,660	26	$13,208,305	72	$35,019,965
REGIONAL TOTALS	1041	$1,008,194,601	1477	$262,529,664	2518	$1,270,724,265

Table 2.1.d

Region 1 State-Leased Critical and Non-Critical Facilities						
County	Number of State-Leased Critical Facilities	Total Value of Building/Contents of All State-Leased Critical Facilities	Number of State-Leased Non-Critical Facilities	Total Value of Building/Contents of All State-Leased Non-Critical Facilities	Total Number of State-Leased Facilities	Total Value of Building/Contents of All State-Leased Facilities
Allen	1	$106,416	2	$856,366	3	$962,782
Auglaize	0	$0	1	$46,913	1	$46,913
Champaign	0	$0	1	$37,988	1	$37,988
Clark	0	$0	2	$72,425	2	$72,425
Crawford	0	$0	1	$30,487	1	$30,487
Darke	0	$0	1	$27,080	1	$27,080
Defiance	0	$0	1	$24,259	1	$24,259
Erie	0	$0	1	$34,154	1	$34,154
Fulton	0	$0	1	$67,554	1	$67,554
Hancock	0	$0	1	$37,171	1	$37,171
Hardin	1	$20,000	1	$49,005	2	$69,005
Henry	0	$0	1	$54,378	1	$54,378
Huron	0	$0	1	$45,858	1	$45,858
Logan	0	$0	1	$32,372	1	$32,372
Lucas	1	$203,366	10	$1,121,270	11	$1,324,636
Marion	0	$0	1	$87,996	1	$87,996
Mercer	0	$0	1	$32,253	1	$32,253
Miami	0	$0	1	$49,112	1	$49,112
Ottawa	0	$0	1	$67,529	1	$67,529
Paulding	0	$0	1	$38,342	1	$38,342
Preble	0	$0	1	$52,707	1	$52,707
Putnam	0	$0	1	$43,687	1	$43,687
Sandusky	0	$0	1	$54,183	1	$54,183
Seneca	0	$0	1	$50,077	1	$50,077
Van Wert	0	$0	1	$28,524	1	$28,524
Williams	0	$0	1	$30,022	1	$30,022
Wood	1	$199,166	1	$47,231	2	$246,397
Wyandot	0	$0	1	$50,678	1	$50,678
REGIONAL TOTALS	4	$528,948	39	$3,169,621	43	$3,698,569

Table 2.1.e

Region 2 State-Leased Critical and Non-Critical Facilities						
County	**Number of State-Leased Critical Facilities**	**Total Value of Building/Contents of All State-Leased Critical Facilities**	**Number of State-Leased Non-Critical Facilities**	**Total Value of Building/Contents of All State-Leased Non-Critical Facilities**	**Total Number of State-Leased Facilities**	**Total Value of Building/Contents of All State-Leased Facilities**
Ashland	0	$0	1	$27,322	1	$27,322
Butler	0	$0	4	$198,726	4	$198,726
Clinton	0	$0	1	$419,685	1	$419,685
Cuyahoga	1	$203,366	13	$3,966,473	14	$4,169,839
Delaware	0	$0	2	$129,094	2	$129,094
Fayette	5	$608,500	1	$44,150	6	$652,650
Franklin	13	$34,492,382	100	$68,636,110	113	$103,128,492
Geauga	0	$0	1	$50,737	1	$50,737
Greene	4	$1,366,335	1	$75,729	5	$1,442,064
Hamilton	3	$3,167,336	5	$1,590,142	8	$4,757,478
Knox	0	$0	1	$36,976	1	$36,976
Lake	0	$0	2	$117,015	2	$117,015
Licking	2	$13,363,695	2	$128,831	4	$13,492,526
Lorain	0	$0	4	$160,728	4	$160,728
Madison	0	$0	1	$54,644	1	$54,644
Medina	1	$200,000	3	$35,664	4	$235,664
Montgomery	2	$248,600	7	$912,612	9	$1,161,212
Morrow	0	$0	1	$25,707	1	$25,707
Pickaway	0	$0	1	$65,219	1	$65,219
Portage	3	$234,600	1	$61,748	4	$296,348
Richland	0	$0	3	$913,831	3	$913,831
Stark	0	$0	5	$1,157,612	5	$1,157,612
Summit	0	$0	10	$646,677	10	$646,677
Union	0	$0	1	$67,647	1	$67,647
Warren	0	$0	3	$108,011	3	$108,011
Wayne	1	$31,907	2	$84,626	3	$116,533
REGIONAL TOTALS	35	$53,916,721	176	$79,715,716	211	$133,632,437

Table 2.f

Region 3 State-Leased Critical and Non-Critical Facilities						
County	**Number of State-Leased Critical Facilities**	**Total Value of Building/Contents of All State-Leased Critical Facilities**	**Number of State-Leased Non-Critical Facilities**	**Total Value of Building/Contents of All State-Leased Non-Critical Facilities**	**Total Number of State-Leased Facilities**	**Total Value of Building/Contents of All State-Leased Facilities**
Adams	0	$0	1	$55,406	1	$55,406
Ashtabula	0	$0	1	$51,787	1	$51,787
Athens	1	$203,366	2	$140,711	3	$344,077
Belmont	0	$0	2	$65,489	2	$65,489
Brown	1	$625,000	1	$59,053	2	$684,053
Carroll	0	$0	1	$198,726	1	$198,726
Clermont	0	$0	3	$135,681	3	$135,681
Columbiana	0	$0	1	$48,841	1	$48,841
Coshocton	1	$1,250,000	1	$30,605	2	$1,280,605
Gallia	0	$0	1	$38,043	1	$38,043
Guernsey	1	$165,562	2	$492,525	3	$658,087
Harrison	0	$0	1	$46,382	1	$46,382
Highland	1	$145,600	1	$39,235	2	$184,835
Hocking	1	$172,150	1	$12,685	2	$184,835
Holmes	0	$0	1	$36,342	1	$36,342
Jackson	0	$0	1	$46,916	1	$46,916
Jefferson	0	$0	2	$82,088	2	$82,088
Lawrence	0	$0	1	$34,434	1	$34,434
Mahoning	1	$15,434	1	$15,434	2	$30,868
Meigs	0	$0	1	$39,508	1	$39,508
Monroe	0	$0	1	$48,917	1	$48,917
Morgan	0	$0	1	$41,739	1	$41,739
Muskingum	0	$0	1	$65,613	1	$65,613
Noble	0	$0	1	$40,702	1	$40,702
Perry	0	$0	1	$41,314	1	$41,314
Pike	0	$0	1	$24,534	1	$24,534
Ross	1	$937,500	2	$162,488	3	$1,099,988
Scioto	1	$122,770	3	$560,551	4	$683,321
Trumbull	1	$300,300	4	$1,082,976	5	$1,383,276
Tuscarawas	0	$0	2	$71,722	2	$71,722
Vinton	0	$0	1	$47,161	1	$47,161
Washington	0	$0	2	$134,233	2	$134,233
REGIONAL TOTALS	10	$3,937,682	46	$3,991,841	56	$7,929,523

2.2 FLOOD

Floods are natural and beneficial functions of stream and lacustrine systems. Floods occur when streams or lakes overflow their banks and spill onto the adjoining land area, which is called a floodplain. Loss of life and property can result when people build structures and develop in flood hazard areas. Numerous factors can cause or exacerbate flooding in Ohio including: heavy and/or prolonged periods of rainfall, snowmelt, soil saturation, ground freeze, severe wind events, and inadequate drainage systems. Floods damage private and public property and infrastructure in Ohio every year. Flooding is the most frequently occurring natural disaster in Ohio and the United States.

RISK ASSESSMENT

The two major drainage basins in Ohio are the Lake Erie and Ohio River basins. Streams in the northern third of the state flow into Lake Erie and eventually into the Atlantic Ocean. Streams in the southern two-thirds of the state flow into the Ohio River and eventually into the Gulf of Mexico.

There are many types of flooding that occur in Ohio including: riverine, flash flooding, coastal flooding, and shallow flooding. Riverine flooding is generally characterized by slower rising water, which allows for increased warning time, but has the potential to last for longer periods of time. Ohio communities experience riverine flooding on both large basins and smaller tributary streams throughout the state. Major sources of riverine flooding in Ohio include the Ohio River, Scioto River, Great Miami River, Muskingum River, Hocking River, Maumee River, Blanchard River, Sandusky River, Cuyahoga River, Grand River, Little Miami River, the Mahoning River and their larger tributaries.

Flash flooding can occur when a severe storm produces large amounts of rainfall in a short time. Flash flooding is generally characterized by high-velocity water that rises and recedes quickly allowing little or no warning time to evacuate. Ohio's Appalachian Region is particularly vulnerable to flash flooding because of the steep terrain and narrow stream valleys. Ohio's urban areas also experience flash flooding that may be attributed to inadequate or poorly maintained stormwater infrastructure, increased impervious area, and lost wetland areas. The U.S. Geological Survey (USGS) has concluded that urbanization generally increases the size and frequency of floods and may increase a community's flood risk.

Coastal flooding generally occurs in the counties that border Lake Erie. Flooding in coastal areas can be caused by stream overflow, wave run-up caused by strong winds, and higher than normal lake levels. Annual fluctuations in Lake Erie water levels are the result of seasonal changes and the amount of water flowing into and out of the lake. In-flow for Lake Erie includes drainage from the upper portion of the Great Lakes basin through the Detroit River, water from streams flowing directly into the lake, groundwater, and precipitation falling directly into the lake. Out-flow includes discharge into Lake Ontario through the Niagara River, evaporation, and any diversion or other withdrawals. Lake Erie levels also exhibit a wide range of long-term fluctuations that are the result of prolonged and persistent deviation from average climatic conditions.

Shallow flooding occurs in flat areas with inadequate channels that prevent water from draining easily. There are four types of shallow flooding: sheet flow, ponding, urban drainage, and rural drainage. Sheet flow flooding occurs in areas where channels are not defined. Sheet flow flooding moves downhill and covers a large area under a relatively uniform depth.

Ponding occurs in flat areas where runoff collects in depressions and cannot drain. Ponding can occur where glaciers carved out depressions in the landscape, and where manmade features such as roads have blocked drainage outlets.

Urban drainage systems can include combinations of ditches, storm sewers, detention ponds, house gutters, and yard swales. When a rainfall event exceeds the design capacity of the drainage system, it can result in the system's back-up and overflowing ditches. Basements are highly susceptible to flood damage caused by overloaded sewer and drainage systems. Urban drainage flooding can also occur behind levees when rainfall amounts exceed the capacity of pumps or other manmade systems designed to drain the landward side of the levees.

Rural drainage flooding in northwest Ohio is similar to urban drainage flooding in Ohio's cities and villages. Most of northwest Ohio was covered by a large swamp prior to European settlement that was subsequently drained for agriculture. The flat topography of this area is drained by an extensive system of ditches, swales, and small meandering streams. Rural drainage flooding occurs when rainfall exceeds the design capacity of the drainage system.

Ohio's river systems offer many benefits that have contributed to the development of the state such as: transportation, waste disposal, energy, commerce, recreation, and water supply. As a result, most major communities include development in flood hazard areas. Wetland areas have been developed, streamside forests have been removed, and streams have been straightened and channelized resulting in faster and increased runoff. After two centuries, these development patterns have drastically changed Ohio's riparian ecosystems, and resulted in escalating flood damages.

Historically, efforts to manage flooding can be divided into three major eras according to the Federal Interagency Floodplain Management Task Force. The Frontier Era (Pre-1917) is characterized by limited federal involvement in flood control or relief. During this time, many federal policies and programs encouraged land development with the common goal being "to conquer the wild landscape and to promote productive use of the land." Flood hazards were the problem of the individual property owner or dealt with cooperatively at the local level.

The Structural Era (1917-1959) is characterized by attempts to modify and control floodwater and move water off the land as quickly as possible. The federal government began assuming the costs to construct dams, levees, reservoirs, and other large structural flood control projects. As this era came to an end, resource managers began to realize that flood control projects were not eliminating flood damage and may be harming the environment.

During the Stewardship Era (1960-present), people began to recognize the important benefits and natural functions provided by floodplain areas such as natural flood and erosion control, water quality maintenance, groundwater recharge, recreation, wildlife habitat, agricultural production, and many others. The responsibility of floodplain management began to shift from the federal government to the local level again. The federal government began to focus on providing financial assistance to reduce and recover from the impacts of flooding. Congress created the National Flood Insurance Program (NFIP) in 1968 as a response to mounting flood losses and increasing disaster relief costs. The intent of the program is to reduce future flood damage through community floodplain management regulations, and provide a federally-subsidized insurance alternative to federal disaster relief.

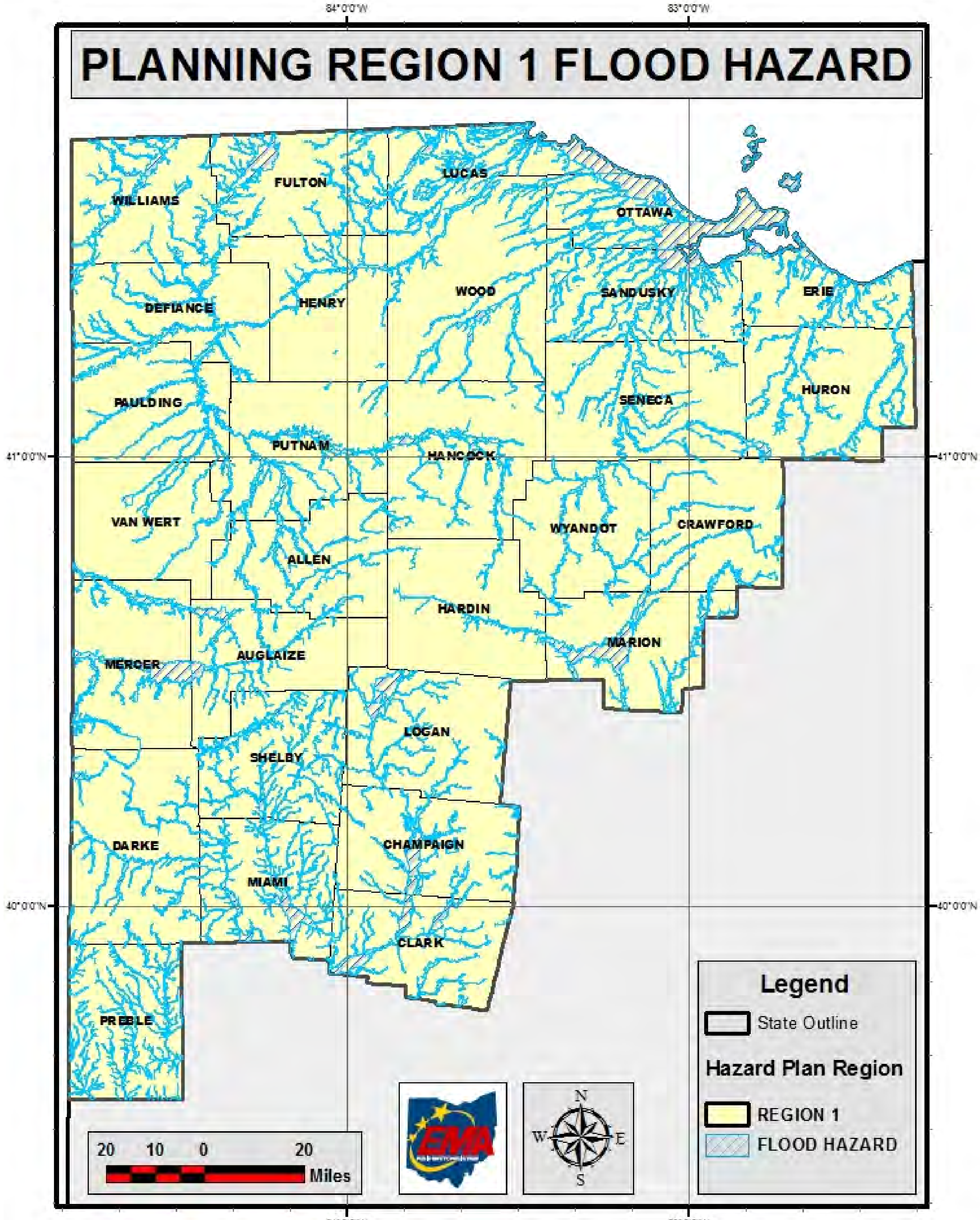
The political jurisdictions in Ohio that are eligible to participate in the NFIP include cities, villages, and unincorporated areas (through the county government). As of the 2010 Census, there are 247 cities, 686 villages, and 88 counties in Ohio. There are 754 Ohio communities that participate in the NFIP. The National Flood Insurance Program Community Status Book contains the complete list of communities in Ohio participating in the National Flood Program.

LOCATION

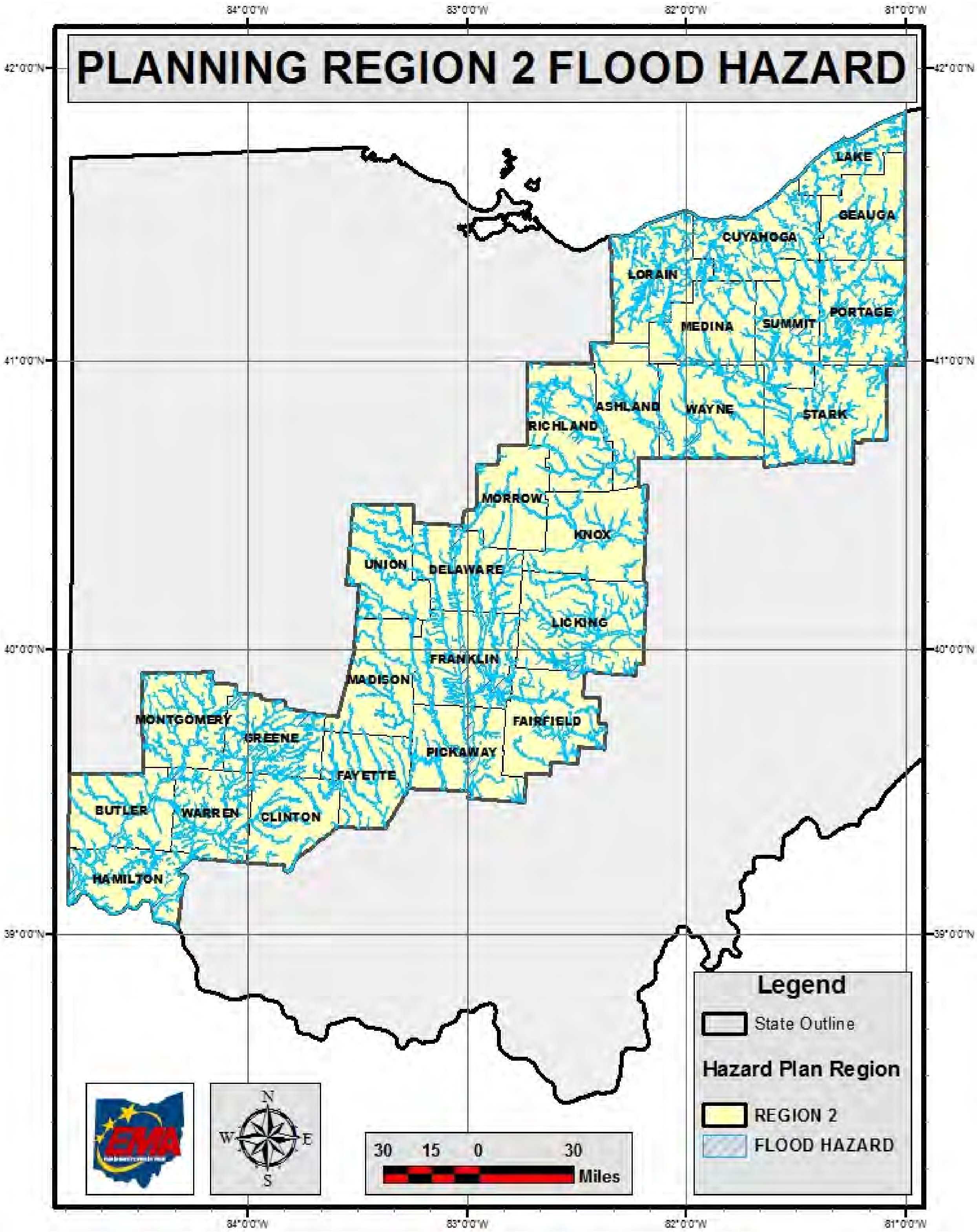
The four sources of information used to determine the location of flooding in Ohio are: FEMA flood maps and studies, NOAA data, information provided by the Ohio Department of Natural Resources - Division of Soil and Water Resources, and HAZUS analyses. Flood maps generated by FEMA to support the NFIP are the primary source of information on the location of special flood hazard areas (SFHAs) in the state. There are two main types of flood maps: the Flood Hazard Boundary Map (FHBM) and the Flood Insurance Rate Map (FIRM). The FHBM identifies approximate SFHAs based on the best available data at the time the map was created.

Generally, Flood Insurance Studies (FISs) and FIRMs are issued by FEMA following a detailed engineering analysis of flood hazard areas in participating communities. The FIS and FIRM identify 1%-annual-chance flood elevations and boundaries for selected stream reaches in the community. The FIRM will contain flood elevation information for various flood frequencies and may also delineate floodway boundaries. Flooding occurs in every county in Ohio. There are over 60,000 miles of named, unnamed, and intermittent streams in Ohio. FEMA has mapped approximately 2,777 square miles of flood hazard area in the state. Maps 2.2.a -2.2.c display FEMA's identified SFHAs in the State of Ohio for the designated Regions.

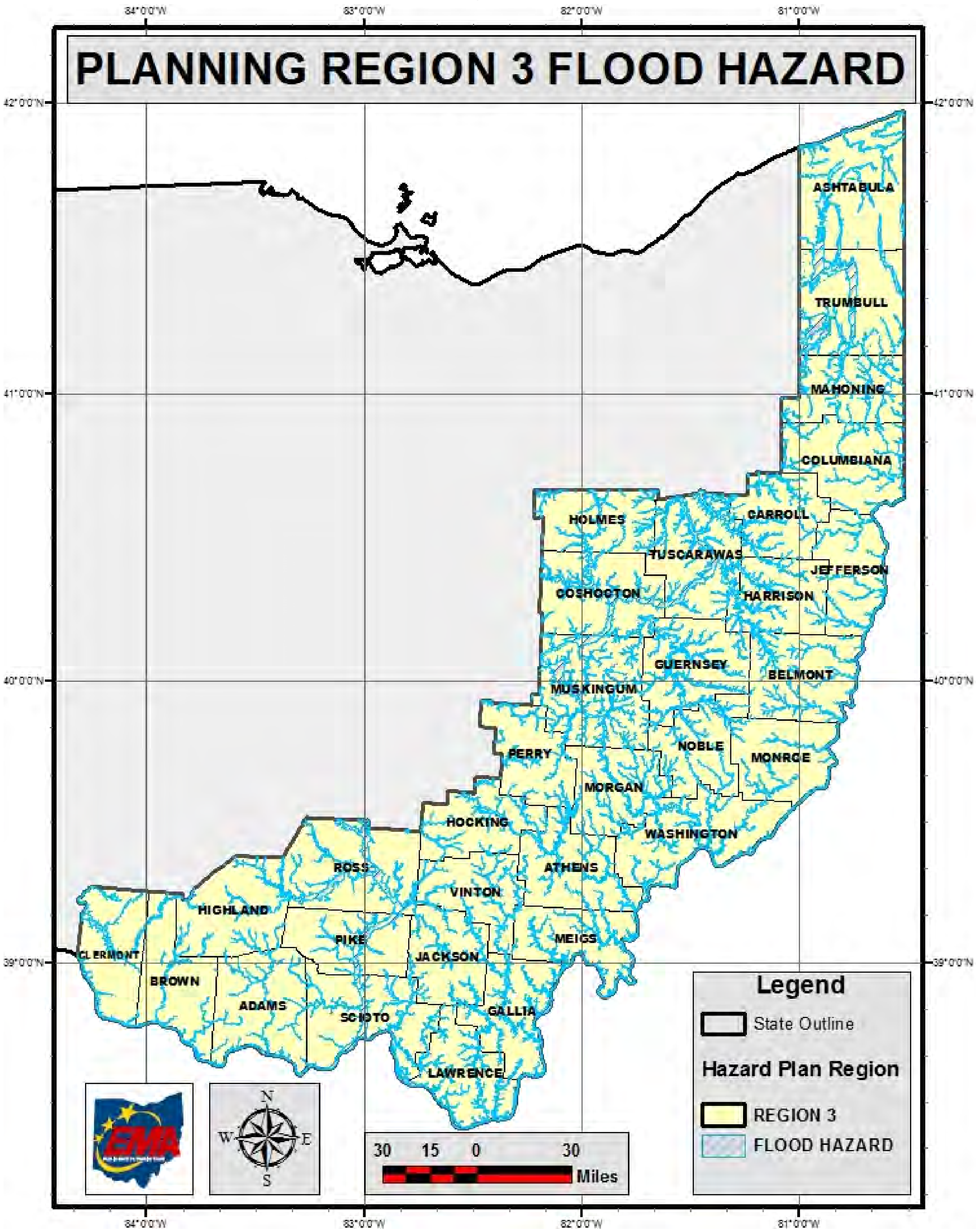
Map 2.2.a


PLANNING REGION 1 FLOOD HAZARD
84°0'0"W
83°0'0"W
41°0'0"N
40°0'0"N
WILLIAMS
FULTON
LUCAS
OTTAWA
DEFIANCE
HENRY
WOOD
SANDUSKY
ERIE
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
VAN WERT
ALLEN
WYANDOT
CRAWFORD
HARDIN
MARION
MERCER
AUGLAIZE
LOGAN
SHELBY
CHAMPAIGN
DARKE
MIAMI
CLARK
PREBLE
Legend
State Outline
Hazard Plan Region
REGION 1
FLOOD HAZARD
20 10 0 20
Miles
N
S
E
W

Map 2.2.b


PLANNING REGION 2 FLOOD HAZARD
84°0'0"W
83°0'0"W
82°0'0"W
81°0'0"W
42°0'0"N
41°0'0"N
40°0'0"N
39°0'0"N
LAKE
GEAUGA
CUYAHOGA
LORAIN
PORTAGE
MEDINA
SUMMIT
ASHLAND
WAYNE
STARK
RICHLAND
MORROW
KNOX
UNION
DELAWARE
LICKING
FRANKLIN
MADISON
MONTGOMERY
FAIRFIELD
GREENE
PICKAWAY
FAYETTE
BUTLER
WARREN
CLINTON
HAMILTON
Legend
State Outline
Hazard Plan Region
REGION 2
FLOOD HAZARD
30 15 0 30
Miles
N
S
E
W
EMA

Map 2.2.c


PLANNING REGION 3 FLOOD HAZARD
84°0'0"W
83°0'0"W
82°0'0"W
81°0'0"W
42°0'0"N
41°0'0"N
40°0'0"N
39°0'0"N
ASHTABULA
TRUMBULL
MAHONING
COLUMBIANA
HOLMES
CARROLL
TUSCARAWAS
JEFFERSON
COSHOCTON
HARRISON
GUERNSEY
BELMONT
MUSKINGUM
NOBLE
PERRY
MONROE
MORGAN
HOCKING
WASHINGTON
ROSS
ATHENS
VINTON
HIGHLAND
PIKE
MEIGS
CLERMONT
JACKSON
BROWN
ADAMS
SCIOTO
GALLIA
LAWRENCE
N
W
E
S
30 15 0 30
Miles
Legend
State Outline
Hazard Plan Region
REGION 3
FLOOD HAZARD

The NOAA's National Climate Data Center (NCDC) Storm Events Database contains information on the location of flood events in Ohio. The database can be searched by county and includes a written description of the location of flood events reported in the state. The database also contains latitude and longitude values for some events and contains information on reported deaths, injuries, and estimated property and crop damage. The database can be found on the NCDC website.

The Ohio Department of Natural Resources, Division of Soil and Water Resources is mandated to be a state repository for flood hazard information (Ohio Revised Code Section 1521.13(C)(2)). The Floodplain Management Program maintains copies of flood hazard data generated by various federal, state, local, and private entities.

PAST OCCURRENCES

Profiling past occurrences of flooding at the state level involves gathering and compiling data from many different sources. The data sources used to profile the past occurrences of flooding include FEMA, the ODNR, the Ohio EMA, the NOAA, and the book Thunder in the Heartland by Thomas W. and Jeanne Applehans-Schmidlin, 1996. Table 2.2.a displays a summary of historic flooding information from 1860 to 1990 based on the chronicle Thunder in the Heartland: A Chronicle of Outstanding Weather Events in Ohio. More specific information on these events as well as events post 1990 can be found in the narrative of this section.

Table 2.2.a

Summary of Historic Flood Events 1860-1990			
Date of Event	**Affected Area(s)**	**Water Bodies Affected**	**Event Description**
8/12/1861	Columbiana County, Elkton, Lisbon	Beaver Creek, Elk Run	Every home in Elkton was damaged and four persons drowned when one home was washed off its foundation.
2/17/1867	Toledo, Maumee		Ice jams destroyed one bridge and damaged several others. Flooding in downtown Toledo.
2/11/1881	Toledo, Grand Rapids, Columbus, Findlay	Maumee River, Scioto River, Blanchard River	Four bridges were damaged by ice jams and debris in Toledo. Flooding in downtown Toledo.
2/1883	Statewide	Auglaize, Blanchard, Maumee, Portage, and Sandusky Rivers	A combination of snow melt, ice jams, frozen ground and heavy rains caused flooding statewide.
2/14/1884	Statewide	Ohio, Hocking, Maumee, and Muskingum Rivers	Second highest stage on the Ohio River in Cincinnati. Thousands were evacuated and 3000 buildings were submerged.
5/12/1886	Xenia	Shawnee Creek	Flash flooding washed away several homes killing 21 people and destroying one bridge.
1/23/1904	Lorain, Toledo, Waverly	Black, Scioto, Mahoning and Maumee Rivers	Ships, bridges, and structures were damaged by ice jams and flooding.
3/14-18/1907	Ohio River Watershed	Southern 2/3 of Ohio	Large scale flooding in the Ohio River Watershed resulted in 32 casualties, hundreds of flooded structures, utility and infrastructure damage.
3/23-27/1913	Statewide	Statewide	Described as "Ohio's Greatest Weather Disaster". Four days of heavy rain on saturated soils resulted in 467 casualties, over 2,200 homes destroyed, over 40,000 damaged, and over $2.5 Billion damage in 2003 dollars.

Table 2.2.a (Continued)

Summary of Historic Flood Events 1860-1990			
Date of Event	**Affected Area(s)**	**Water Bodies Affected**	**Event Description**
7/16/1914	Cambridge	Wills Creek Watershed	Over 7.09 inches of rain in 1.5 hours causing flash flooding.
8/16/1920	Toledo	Maumee River	Flash flooding in dow ntow n Toledo damaged homes, businesses and infrastructure.
2/26/1929	Cleveland, Dayton, Mt. Vernon, Bridgeport, Springfield	Little Miami, Maumee, Miami, Rocky, Mad, and Kokosing Rivers, Wheeling and Buck Creeks	Tw o to three inches of rain, melting snow , and ice jams caused w idespread flooding.
3/21/1933	Cincinnati and Southern Ohio	Ohio River	Tw o periods of heavy rain cause w idespread minor flooding.
8/7/1935	Coshocton and surrounding counties	Tuscaraw as Watershed	Heavy rain on saturated soils saturated soils caused flash flooding.
3/19/1936	Ohio River Communities from Pittsburgh to Steubenville	Upper Ohio River	Snow melt and heavy rains in Penn. and W. Virginia caused the Ohio River to rise 20 feet in tw o days.
1/26/1937	All Ohio River Communities	Ohio River	Described as the "Greatest Flood on the Ohio River". Record levels on the Ohio River from Gallipolis to the confluence w ith the Mississippi.
7/7/1943	Akron and Steubenville	Cuyahoga River, Cross and Wills Creeks	Six to seven inches of rain in several hours caused flash flooding and landslides.
6/16/1946	Wayne and Holmes Counties	Killbuck and Salt Creeks	Heavy rain caused flash flooding resulting in one death, a train w reck destroying 5 bridges and seriously damaging 55 others.
6/8/1947	Adams, Law rence and Scioto Counties	South Fork of Scioto Brush Creek and other small tributaries to the south emptying into the Ohio River	Flash flooding damaged many homes, bridges, roads, and crops.
3/21/1948	Counties in the Lake Erie Watershed	Lake Erie Watershed	The most severe damage w as reported in along the Chagrin River in Cleveland. Tw enty buildings w ere destroyed and 153 w ere damaged.
6/16/1950	Crooksville, Roseville	Moxahala Creek Watershed	One of the most intense rainfalls ever know n in Ohio caused severe flood damages to homes and businesses.
1/21/1959	Statew ide	Statew ide	Rainfall in January 1959 ranging from 3-6 inches on snow -covered, frozen ground caused the most severe statew ide flooding since 1913. Streams reached flood stage from January 21-24 killing 16 people, forcing 49,000 people from their homes, and causing extensive damage to homes, businesses and infrastructure.
6/5/1963	Guernsey County	Wills Creek Watershed	Official records indicate 7.95 inches of rainfall in 16- hours in Cambridge. One railroad bridge w as destroyed, all major highw ays w ere inundated, and w ater supplies w ere polluted.
3/10/1964	Southern and Central Ohio	All Streams in Southern and Central Ohio	Tw o periods of heavy rain cause w idespread flooding resulting in eight deaths, thousands evacuated, 84 homes destroyed, and 8,200 damaged.
7/21/1964	Akron	Ohio Canal and Little Cuyahoga River	Official records indicate 3.05 inches of rain in 75 minutes, but rain distribution w as variable. The resulting flooding caused a sew er line to collapse a large section of road killing 3 people.

Table 2.2.a (Continued)

Summary of Historic Flood Events 1860-1990			
Date of Event	**Affected Area(s)**	**Water Bodies Affected**	**Event Description**
4/27/1966	Communities Along Lake Erie's Western Basin	Lake Erie's Western Basin	Several hours of winds up to 55 mph from the northeast pushed the western end of Lake Erie to flood stage. Fifteen hundred were evacuated, hundreds of homes were damaged, and utility services were interrupted.
7/12/1966	Erie, Ottawa, and Huron Counties	Sandusky and Huron River Watersheds	Rainfall totals ranging from 9-12 inches of rainfall over and approximately one-day period. Total damages exceed $27 million in 2003 dollars, including damages to 12,000 homes and businesses in Sandusky.
5/23-27/1968	Central and Southern Ohio	Hocking, Scioto, Little Miami	Two periods of heavy rain within 5 days on already saturated soils caused flooding on many streams. Four deaths have been attributed to this event.
7/4/1969	Northern Ohio	Lake Erie Watershed	Severe thunderstorms moved from Lake Erie into Ohio's coastal communities on July 4, 1969. Flooding combined with strong wind and tornadoes caused 41 deaths and injured 559 people. Loss estimates for this event totaled $65 million dollars in 1969, or over $328 billion in 2003 dollars.
11/14/1972	Coastal communities from Toledo to Cedar Point	Lake Erie	Northeast wind setup caused Lake Erie to rise 3 feet at Toledo and fall 4 feet at Buffalo resulting in coastal flooding. Total damages were estimated at $22 million in 1972 dollars.
4/9/1973	Coastal communities from Toledo to Port Clinton	Lake Erie	Northeast winds caused 8 to 10 foot waves and flooding.
9/14/1979	Southeastern half of the state	N/A	The remains of Hurricane Frederic brought six inches of rain in a band from Cincinnati to Youngstown causing widespread flooding.
3/12/1982	Communities in the Maumee River Watershed	Maumee River Watershed	Two inches of rainfall on snow covered, frozen ground caused flooding. Loss estimates totaled $11 million in 1982 dollars with Defiance County being the hardest hit.
6/14/1990	Shadyside in Belmont County	Pipe Creek and Wegee Creek	Twenty-six people died in a flash flood near Shadyside. Approximately 80 homes were destroyed and 250 were damaged. An estimated that 3-4 inches of rain fell in a little over an hour.
12/31/1990	Widespread	Widespread	The wettest year on record ended with extensive flooding on New Year's Eve causing $50 million (1990 dollars) in damages.

Historically, significant floods in Ohio occurred in 1913, 1937, 1959, and 1969. Heavy rain on saturated soils caused flooding throughout Ohio during March 23rd to 27th, 1913, killing 467 people, destroying 2,200 homes, and flooding 40,637 residences. Losses were totaled at $113 million in 1913 (approximately $2.5 billion in 2010 dollars), including: $78 million to buildings and personal property, $12 million to roads and bridges, $12 million to railroad property, which includes lost profit, $6 million to the agricultural industry, and $4 million dollars to machinery. This flood set record water levels on many Ohio streams. The Miami River Watershed experienced the highest casualties and damages during this event.

The flood of record for the Ohio River occurred the last two weeks in January 1937. Normal January precipitation in Ohio is 2-3 inches. The statewide average rainfall in January 1937 was 9.57 inches, with some stations recording over 14 inches. Ohio River levels on January 26th and 27th were the highest ever recorded from Gallipolis, Ohio to the confluence with the Mississippi River. Every Ohio community along the river was flooded resulting in 10 casualties, 16 injuries, thousands of damaged structures, and over 54,000 evacuations statewide.

Rainfall in January 1959, ranging from 3-6 inches on snow-covered, frozen ground, caused the most severe statewide flooding since 1913. Streams reached flood stage from January 21-24, killing 16 people, forcing 49,000 people from their homes, and causing extensive damage to homes, businesses, and infrastructure. Loss estimates for this event totaled $100 million in 1959, or over $752 million in 2010 dollars. Some of the factors that reduced casualties and damages from the 1913 flood include: less intense rainfall amounts, the construction of flood-control reservoirs built after 1913, and improved emergency management procedures and capabilities.

Severe thunderstorms moved from Lake Erie into Ohio's coastal communities on July 4th, 1969. This line of storms became nearly stationary for more than eight hours, aligned from Toledo southeast to Wooster. Official records indicate over 10 inches of precipitation lasting over a two-day period. Flooding combined with strong winds and tornadoes caused 41 deaths and injured 559 people. Loss estimates for this event totaled $65 million dollars in 1969, or over $388 million in 2010 dollars. This flood caused extensive damage to homes, businesses, infrastructure, utilities, boats, and automobiles.

Twenty-six people died in a flash flood near Shadyside, Ohio on June 14th, 1990. The National Weather Service estimated that 3-4 inches of rain fell in a little over an hour near Pipe Creek and Wegee Creek. Total rainfall is estimated at 5.5 inches in three hours. The saturated soils and narrow, steep-sided valleys caused the water to drain quickly into the creeks. Flash flooding began at 9:30 PM and was over in 30 minutes. During that time, a wall of water six feet high (reported to be 20 feet in some areas) rushed through the valley at seven to ten miles-per-hour. Approximately 80 homes were destroyed and 250 were damaged.

Storms that produced heavy rains during March 1st and 2nd, 1997, resulted in severe flooding in southern Ohio. The largest accumulations of rainfall were recorded in southern Adams and Brown Counties and ranged from 10-12 inches over the two-day period. Generally, rainfall amounts of four or more inches fell on most of the counties along or near the southern border of Ohio. Widespread damages to private and public property occurred throughout the area. Preliminary loss estimates totaled nearly $180 million in 1997, or over $245 million in 2010 dollars. Approximately 20,000 people were evacuated and 6,500 residences and 833 businesses were affected. Five deaths were attributed to flooding; all of the fatalities were the result of attempts to drive through flooded roads.

Storms during June 26th through 30th, 1998, resulted in flooding and widespread damage throughout much of central, east-central and southeastern Ohio. More than 10 inches of rain fell during a four-day period in parts of southeast Ohio. Twelve storm or flood-related fatalities were reported and infrastructure and utilities were heavily impacted. Loss estimates totaled nearly $178 million in 1998, or over $239 million in 2010 dollars.

PRESIDENTIAL DISASTER DECLARATION DATA

Flood vulnerability can also be expressed as historic expenditures on disaster recovery for flood events. Total expenditures for programs triggered by a Presidential Disaster Declarations are tracked and summarized by Ohio EMA (Appendix A). Between the 2005 and 2019 plan updates, six flood events resulted in Presidential disaster declarations. These six events are described below.

<u>DR-1651-OH declared July 2, 2006</u>

Severe thunderstorms and tornado touchdowns caused two deaths and widespread damage in northern Ohio from June 21st and 23rd, 2006. The primary causes of damage in this event were flash flooding, which overwhelmed urban stormwater infrastructure, and riverine flooding. Huron County and the City of Brecksville were especially impacted. The communities of Toledo, Norwalk, Valley View, and Independence also experienced significant flooding.

The USGS estimated flood recurrence intervals for gaged streams based on flood stage for this event. The flooding on the Vermilion River was estimated to be a 50-year event. The flooding on the Cuyahoga River and Tinkers Creek were estimated to be 25 to 50-year events.

<u>DR-1656-OH declared August 1, 2006</u>

Two separate weather systems produced storms resulting in more than 11 inches of rain in parts of Lake County, Ohio on July 27th and 28th, 2006. As a result of the storms and ensuing flooding, the counties of Lake, Geauga, and Ashtabula were declared Federal Disaster Areas. The flooding caused one fatality and 600 evacuations in Lake County. Over all of Lake County, 100 homes and businesses were destroyed and an additional 731 homes and businesses were damaged. Flooding destroyed five bridges in Lake County and closed 13 roads. The City of Painesville experienced heavy damages.

The USGS streamflow-gaging station at the Grand River near Painesville, Ohio had record peak stream flow and peak stage. The recurrence interval for this event was estimated to be 500 years (Ebner, A.D.; Sherwood, J.M.; Astifan, Brian; and Lombardy, Kirk, 2007, Flood of July 27-31, 2006, on the Grand River near Painesville, Ohio: U.S. Geological Survey Open-File Report 2007-1164).

<u>DR-1720-OH declared August 26, 2007</u>

Heavy rainfall inundated multiple communities across northern Ohio during a two-day period. The rain developed along a nearly stationary frontal boundary that was oriented from west to east across north central Ohio. Moisture from the Gulf of Mexico, as well as the remnants of Tropical Depression Erin, was drawn northward resulting in tropical downpours. The heaviest rains redeveloped each night, starting Sunday night August 19th, 2007, into Monday morning and then again on Monday night into the early morning hours of Tuesday, August 21st, 2007.

Stream gage reports from four locations in the affected area indicated that 24-hour rainfall totals ending at 8 AM on August 21st, 2007, exceeded the 1,000 year/24-hour rainfall frequency. Peak flood stage of the Blanchard River in the City of Findlay was 0.04 less than the flood of record in 1913 (National Weather Service Forecast Office in Cleveland, Ohio). Communities in the Blanchard, Sandusky, and Mohican River watersheds were heavily impacted. There were approximately 2,500 flooded structures in the City of Findlay. The communities of Ottawa, Bucyrus, Shelby, Lima, Carey, and Bluffton also had many flooded structures.

DR-4002-OH declared July 13, 2011

Heavy rains and thunderstorms moved through the state on February 27th, 2011, as 3-4 inches of rain accumulated over a 24-hour period in already saturated areas across northern Ohio. This system exited the state and a second wave of precipitation moved through Southern Ohio. Warm temperatures, heavy snow pack, and snowmelt resulted in moderate to major flooding in many areas of the state. The State monitored river crests and falling temperatures over a 48-hour period for impacts, including potential issues with debris, wastewater, sewage, and shelters. Major to moderate flood river levels were recorded in Northern Ohio. The Cuyahoga River reached near-record flood levels.

In March and April, much of Ohio continued to experience heavy rain, severe storms, flooding, and flash flooding across the southern portion of the state. The cumulative effect of these conditions, coupled with flooding in neighboring states along the Ohio and Mississippi Rivers, resulted in dangerous conditions and damages, which affected the health, safety, and welfare in 21 southern Ohio counties. More severe storms moved across the south-central part of the state in May, producing heavy rain and high winds. These conditions further intensified the previously affected citizens in Gallia, Jackson, Lawrence, Pike, Ross, Scioto, and Vinton Counties. During this time, the Governor had issued two proclamations and requested a Presidentially-declared disaster for 13 counties along the Ohio River and 8 adjacent counties.

DR-4098-OH declared January 3, 2013

Hurricane Sandy brought heavy rainfall and significant flooding to northern portions of Ohio on October 29th and 30th, 2012. The flooding was the result of three consecutive weather events; a cold front, hurricane Sandy remnants, and lake enhanced showers. Rain started on October 26th as a slow moving cold front moved into the Ohio Valley. This front brought widespread 0.75 to 2.0 inches of rainfall to northern Ohio, highest near the lake.

By Monday, the remnants of Hurricane Sandy moved into Pennsylvania, and the pressure gradient between it and high pressure over Missouri produced storm force winds over Lake Erie. Moisture from Sandy moved into the region producing an additional rainfall of 2 to 3 inches by Tuesday the 30th. Rain continued at a rate averaging 0.10 inches per hour for the day, but increased to 0.75 inches per hour overnight and early Wednesday morning. This band of heavier rain caused the rivers, which were receding to once again rise. Areal flooding was limited to more northern counties; however, some small streams and creeks came out of their banks as far south as Ashland County. Numerous roads were closed due to flooding in Cuyahoga, Lake, and Medina Counties. In Ashtabula County, docks were damaged at the Port of Ashtabula due to severe wind and violent wave actions on Lake Erie, and marinas had to be dredged at the Port Authority of Conneaut. A flood watch was in effect for the lakefront counties and flood advisories were issued during the event.

A few dozen homes and businesses were impacted as water inundated basements or first floors. A number of homes affected were located in the floodplain of the rivers or along the shoreline where the raised lake level combined with the increased stream flows to produce flooding in areas not typically affected. Two rivers along the lakeshore reached major flood stage (based on NWS stage categories), the Cuyahoga and the Huron Rivers. The rest of the Lake Erie tributaries saw minor or moderate flooding. Many basements flooded further inland as sump pumps failed due to power outages. As the result of Hurricane Sandy, an estimated $17.8 Million in public assistance funds has been awarded to this point.

DR-4360-OH declared April 17, 2018

Beginning on February 14, 2018, and continuing through February 25, 2018, a persistent band of moderate to severe storms moved across Region V impacting Illinois, Indiana, Michigan, Ohio, and Wisconsin. While precipitation levels and storm-related damages varied, Ohio experienced a significant amount of flooding and subsequent damage along the southern portion of the state. The snowmelt and continued rain throughout the incident period, combined with the frozen soils, led to flooding along area streams, rivers, and low-lying areas. Numerous flood gauges in this area rose to moderate flood stage, and rainfall totals in the impacted areas during the incident period ranged from a total of five to nine inches. Following these storms, there were several road closures as well as reports of inaccessible areas throughout southern Ohio due to standing water.

Widespread flooding culminated February 26, 2018, when the Ohio River at Cincinnati rain gauge showed a crest of 60.53 feet, 8 feet above flood stage and the highest crest since 1997. Communities near the river and its tributaries incurred damages to roads, bridges, and public buildings, as well as basement flooding and sewage backup. According to the Governor, preventative steps on the part of state and local agencies, such as Ohio EMA, shielded the area from the worst possible damage. The SEOC was partially activated with Emergency Support Functions (ESFs). A FEMA Region V Liaison Officer was deployed to the SEOC from February 25, 2018, through February 27, 2018, and the SEOC returned to normal operations on February 27, 2018.

There were several local evacuations due to flooding and the American Red Cross opened three shelters in the impacted areas. There was one confirmed fatality (Shelby County) as a result of this event, and at its peak, there were 10,449 customers without power statewide. On March 6, the Governor requested a joint preliminary damage assessment (PDA) conducted by local, state, and federal emergency management officials. The joint PDA resulted in documentation of approximately $44 million worth of damages to county, village and township roads, bridges, and public buildings. On March 26, the Governor requested a Presidential Disaster Declaration. On April 17, 2018, a disaster was declared for the State of Ohio, due to severe storms, flooding, and landslides that occurred during the incident period of February 14, 2018, through February 25, 2018. As a result of that declaration, Public Assistance has been made available for Adams, Athens, Belmont, Brown, Columbiana, Gallia, Hamilton, Jackson, Lawrence, Meigs, Monroe, Muskingum, Noble, Perry, Pike, Scioto, Vinton, and Washington Counties. The Disaster impact data is fluid as only half of the Public Assistance projects have been awarded as of January 2019.

NOAA DATA SUMMARY

Table 2.2.b lists the number of reported floods in Ohio since the year 2000, and associated loss totals according to the NOAA's NCDC Storm Events Database. The information in this database comes from NWS, who receives their data from a variety of sources including: county, state, and federal emergency management officials, local law enforcement officials, weather spotters, NWS damage surveys, newspaper clipping service, and the insurance industry and the public. An effort is made to use the best available information, but because of time and resource constraints, information from these sources may be unverified by the NWS.

Table 2.2.b

Ohio Flood Data Summary from the National Climatic Data Center					
Year	**Number of Reported Flood Events [1]**	**Deaths**	**Injuries**	**Estimated Property Damage (2017 Dollars)**	**Crop Damage (2017 Dollars)**
2000	44	3	2	$11,727,310	None Reported
2001	37	3	1	$16,151,620	None Reported
2002	38	1	None Reported	$2,831,820	None Reported
2003	63	4	None Reported	$391,232,610	$3,263,460
2004	40	2	None Reported	$164,640,140	$1,073,650
2005	39	3	None Reported	$71,997,770	None Reported
2006	33	4	1	$620,812,770	$42,438,060
2007	115	None Reported	None Reported	$277,897,680	$18,256,410
2008	105	1	None Reported	$5,871,830	$50,140
2009	38	1	None Reported	$5,004,190	$58,860
2010	71	5	4	$14,985,320	$1,090
2011	47	2	None Reported	$48,788,400	$194,020
2012	25	None Reported	2	$340,692	None Reported
2013	31	None Reported	None Reported	$4,292,160	$105,200
2014	31	None Reported	None Reported	$72,226,440	$78,660
2015	37	5	3	$27,679,146	$284,350
2016	26	None Reported	None Reported	$4,733,356	None Reported
2017	39	None Reported	None Reported	$18,762,000	$1,500,000
Total:	**859**	**34**	**13**	**$1,759,975,254**	**$61,892,000**

1 - The number of reported flood events was calculated by adding one record for each date in the data set.

PROBABILITY OF FUTURE EVENTS

The probability of occurrence of flooding is the likelihood that a specific event will happen. The likelihood of a flood event happening is usually expressed in terms of frequency. The NFIP provides maps and studies that use the 1 percent annual chance floodplain area (area inundated during a 100-year flood) as the national standard for regulating floodplain development. It is critical to establish the probability of occurrence for flooding so that the state and local communities can make informed decisions about the sustainability of future development, and determine the feasibility of proposed mitigation projects.

The primary sources of data for determining the probability of occurrence of flooding are the FEMA FISs and FIRMs. Nearly every community that participates in the NFIP has a map that identifies at least some area of flood hazard in the community that has a 1 percent annual chance of being equaled or exceeded in any given year. This area is referred to as the 1%-annual-chance floodplain, or the 100-year floodplain, and is graphically represented on a FIRM or FHBM.

Communities that do not have FISs, usually have an FHBM or FIRM that shows the approximate area that would be inundated by the 1%-annual-chance flood. An FHBM was intended for interim use in most communities, until a FIS could be completed. FHBMs are still being used in some Ohio communities where a detailed FIS has yet to be produced.

Approximately 81 percent of Ohio communities that participate in the NFIP have a portion of their flood hazard areas identified in a FIS. The purpose of a FIS is to investigate the existence and severity of flood hazards in a certain geographic area. The information in a FIS is used to establish actuarial flood insurance rates and assist the community in its efforts to regulate flood hazard areas. A FIS contains data on: historical flood events, the area and flood sources studied, and the engineering methods employed to generate the flood hazard data. A FIS will have flood elevation profiles for the 100-year recurrence probability flood, and usually the 10-, 50-, and/or 500-year floods. It may also contain tables summarizing floodway data and other flood hazard information; however, it does not usually contain data for every flood hazard area in a community. The remaining areas may have approximate flood hazard data, or none at all.

There are several other possible data sources for determining the area affected by a particular probability flood event. The Ohio Department of Natural Resources, Division of Soil and Water Resources, is the state repository for flood hazard information and has copies of flood hazard information generated by various federal, state, local and private entities. The Floodplain Management Program maintains current copies of all FEMA FISs and flood maps in the state.

LHMP DATA

As stated at the beginning of Section 2, integration of LHMP data into the state HIRA is an ongoing effort. As local plans continue to expire and jurisdictions update their plans, vulnerability information and loss estimation are collected and assembled. Highlighted below is some of the more notable jurisdictional plan information that has been assembled and integrated into the state HIRA.

<u>Hamilton County</u> - The 2013 updated Multi-Hazard Mitigation Plan examined flash flooding, river flooding and urban flooding (categorized in their plan as Non- Flood Zone flooding). Since the previously approved plan in October 2006, Hamilton County has experienced 31 events with a total of $82,000 in property damage. Additionally, river flooding assessment is conducted for each of the major watersheds that affect the county: the Great Miami River, the Little Miami River, the Ohio River, and the Mill Creek watershed plus its tributaries. Each of the watersheds are mapped and analyzed to include properties, repetitive loss areas, and critical facilities. These analyses projected 2,377 residential structures at risk at a value of $72,428,000, an estimated 750 non-residential structures valued at $319,464,000 and 173 critical facilities valued at $30,404,000.

<u>Belmont County</u> - The 2013-2018 Belmont County Multi-Jurisdictional Hazard Mitigation Plan provides an analysis of riverine and flash flooding. Although it is considered a small, rural county, projections show potential losses approaching $2 billion. A Level-1 HAZUS-MH 100-year flood scenario estimated 10,469 residential structures at risk at a value of $1,388,080,000, an estimated 3,552 non-residential structures valued at $471,071,000 and 839 critical facilities valued at $113,140,000. Flooding continues to be a frequent and damaging hazard as a result of the Ohio River, several streams and creeks. There have been eight Presidential declarations due to flooding since 1980, three of which occurred in the month of June. However, riverine flooding occurs in the winter as well. In January 1996, floodwaters from the conveyance of two rivers in Pittsburgh caused the Ohio River to crest over 4 feet above flood stage. This caused 61 residences to be destroyed, 136 with major damage, 107 with minor damage and 14 residences to be affected. Belmont County also has 52 repetitive loss properties: 37 are residential with 36 losses while 15

are classified as non-residential with 87 losses. One of the residential properties is a Severe Repetitive Loss property with four losses. Flash flooding occurs more often than riverine flooding with 65 events recorded between 1996 and 2013 and damaging $7,159,000 in property and $5 million in crop losses. The most significant event was in June 1990, recorded as the most devastating flash flood to strike Ohio in recent years, resulting in 26 fatalities.

Jackson County - The Jackson County Natural Hazards Mitigation Plan of 2017 used HAZUS-MH to project damage in its most flood prone areas. These are identified as the Cities of Jackson and Wellston, and the Villages of Coalton and Oak Hill and various unincorporated jurisdictions. These areas experienced flooding in 1997 when the Little Salt Creek, Meadow Run, Little Raccoon Creek and other watersheds exceeded their banks. A Level-1 HAZUS- MH 100-year flood scenario performed in 2017, estimated the value of residential structures at risk at $453,142,000 (68.7%), and estimated the value of non-residential structures at $206,755,000 (31.3%). There were 24 essential facilities (fire stations, hospitals, police stations, and schools) at risk with one school expected to have loss of use.

SHARPP

Flood ranks highly amongst local hazard mitigation plans. It ranks in terms of frequency and response time, second in terms of impact on property, and third in impact (magnitude), and impact on business.

FLOOD SHARPP RANK AND SCORE							
Flood Rank	**1**	**1**	**6**	**3**	**3**	**4**	**2**
Criteria Score	**3.70**	**2.95**	**2.54**	**2.42**	**2.11**	**1.96**	**2.19**
	Hazard Frequency	Response Time	Onset Time	Impact	Impact on Business	Impact on Humans	Impact on Property

VULNERABILITY ANALYSIS

Flooding vulnerability is the likelihood of something to be damaged in a flood. A vulnerability analysis is a measurement of a community's flood risk. Vulnerability can be measured using many different methods. The method selected is highly dependent on the type and format of available data. If site-specific information on flood elevation, lowest floor elevation, structure type, and replacement value exist, a detailed vulnerability analysis can be performed using flood damage curves. The State of Ohio, and most communities in the state, lack all or a component of the data required for a detailed analysis and must use more simplified methods. Several different data sources are utilized in this discussion to help develop a clearer picture of Ohio's flood vulnerability including: HAZUS-MH analyses, the statewide Structure Inventory, NFIP repetitive loss data, and local data uploaded into SHARPP.

NFIP REPETITIVE LOSS PROPERTIES

The NFIP has identified a subset of structures covered by flood insurance policies that are referred to as "repetitive loss" and "severe repetitive loss" (see Appendix B). For this analysis, a repetitive loss structure is any property covered under an NFIP flood insurance policy with two or more losses of more than $1,000 each, in any 10-year rolling period, and at least two losses that are more than 10 days apart.

Severe repetitive loss (SRL) structures are defined as residential structures that are covered under an NFIP flood insurance policy and a) that have at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amounts of such claims payments exceed $20,000; or b) for which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

NFIP repetitive loss data can be used to identify some of the structures vulnerable to flooding throughout the state. In Ohio, it is estimated that approximately 63% of the structures in the SFHA are not covered by flood insurance for any number of reasons. Some reasons include: misinformation about flood insurance as a mitigation option; the structure is not required to be covered by flood insurance because there is no current mortgage; lack of resources to purchase coverage; and lack of enforcement by the mortgage holder.

The Ohio EMA Mitigation Branch examined repetitive flood loss data for all 88 counties and their affected communities. First, data were compiled and analyzed for the top twelve communities with the greatest number of repetitive flood loss structures. These counties were identified as Belmont, Cuyahoga, Erie, Franklin, Guernsey, Hamilton, Hancock, Lake, Lucas, Ottawa, Summit, and Washington. The Mitigation Branch discussed the significance of both categories, counties and jurisdictions, and decided that the focus should be on the top 12 counties with the highest number of repetitive loss structures. The counties are summarized in Table 2.2.c. The “Total Paid” column is the summed building and contents payments from the repetitive loss structures.

Table 2.2.c

RANK	COUNTY	LOSS STRUCTURES			Losses	Total Paid
		TOTAL RL/SRL STRUCTURES	REPETITIVE LOSS STRUCTURES	SEVERE REPETITIVE LOSS STRUCTURES		
1	Hancock	266	221	45	835	$ 19,786,550
5	Cuyahoga	148	117	31	557	$ 21,638,500
2	Washington	202	183	19	510	$ 11,975,540
4	Hamilton	141	123	18	437	$ 12,824,763
3	Ottaw a	130	125	5	375	$ 3,291,518
6	Erie	99	84	15	331	$ 3,533,345
8	Lucas	80	72	8	227	$ 2,753,382
9	Lake	78	71	7	225	$ 3,369,267
7	Summit	89	84	5	222	$ 5,517,466
10	Franklin	70	68	2	164	$ 2,123,454
11	Belmont	61	59	2	146	$ 2,604,347
12	Guernsey	57	55	2	139	$ 4,874,974
TOTAL		**1,421**	**1,262**	**159**	**4,168**	**$ 94,293,107**

Appendix B lists the repetitive loss properties by county and region, indicates the status of flood insurance, estimates the structure and content value, and demonstrates the number of flood losses per structure. As of August 2018, there are 2,661 repetitive and severe repetitive loss structures in Ohio with a total of 7,589 losses and $154,034,302 dollars paid.

Region 1 has the highest number of repetitive loss and severe repetitive structures in the state as identified by the NFIP at 931 structures, including 107 severe repetitive loss structures. The amount paid out for repair of these structures through August 2018, is $47,531,834 for structure repairs and contents replacement. Within Region 1, the most significant concentration of repetitive loss structures is located in the City of Findlay (Hancock County), which is along the Blanchard River. In total, Findlay has 253 repetitive loss structures identified with 801 losses, which have paid a total of $19,317,244 for structure repairs and contents replacements.

Region 2 is identified as having the second highest number of repetitive loss structures in the State. All of the counties within the region have identified repetitive loss structures. As a whole Region 2 has 880 repetitive loss structures identified, with the total of contents replacements and total payments equaling $65,459,581 in paid claims. There are two areas of significant loss identified within the region. The City of Cincinnati (Hamilton County) is located in the southwestern portion of the state on the Ohio River. It has 65 repetitive loss structures with 220 claims for $8,736,956 in repairs paid and contents replaced. The second area includes the City of Independence (Cuyahoga County). Independence has 20 identified repetitive loss structures with 114 claims for a total of $12,103,200.

Region 3 is third in the state for all statistics regarding repetitive loss structures. In total, there are 880 repetitive loss structures with 2,195 losses totaling $41,042,888 in repairs and contents paid. The City of Marietta (Washington County) has 120 repetitive loss structures with 298 reported claims representing $8,092,239 in repairs and contents replacements. The second highest RFC count in this region resides in the unincorporated area of Washington County, 54 structures with 139 losses totaling $2,625,547 in repairs and contents replacements.

NFIP COMMUNITY RATING SYSTEMS (CRS) PROGRAM

According to the October 2018 NFIP Flood Insurance Manual, the Community Rating System (CRS) is a voluntary program for communities participating in the National Flood Insurance Program (NFIP). The CRS offers flood insurance policy premium discounts in communities that develop and execute extra measures beyond minimum floodplain management requirements to provide protection from flooding. A community's eligibility for the CRS depends upon participating in the Regular Program and maintaining full compliance with the NFIP. CRS flood insurance policy premium discounts range from 0 percent to 45 percent depending on the community's floodplain management measures and activities.

The CRS recognizes measures for flood protection and flood loss reduction. The four main activity categories include Public Information, Mapping and Regulation, Flood Damage Reduction, and Flood Preparedness.

In order to participate in the CRS, a community must complete and submit an application to FEMA. Subsequently, FEMA reviews the community's floodplain management efforts and assigns the appropriate CRS classification based on credit points earned for various activities. A community's classification may change depending on the level of continued floodplain management efforts. Classifications range from one to ten and determine the premium discount for eligible flood insurance policies. All community assignments begin at Class 10 with no premium discount. Communities with a Class 1 designation receive the maximum 45 percent premium discount.

The table below highlights the available CRS premium discounts organized by class and flood zone. In addition to the Rate Class of the, the discount amount also varies depending on whether the insured property is in a Special Flood Hazard Area (SFHA), or not.

CRS Premium Discounts by Class and Flood Zone

Rate Class	Discount for SFHA*	Discount for Non-SFHA**	Credit Points Required
1	45%	10%	4,500 +
2	40%	10%	4,000–4,499
3	35%	10%	3,500–3,999
4	30%	10%	3,500–3,499
5	25%	10%	3,000–2,999
6	20%	10%	2,500–2,499
7	15%	5%	1,500–1,999
8	10%	5%	1,000–1,499
9	5%	5%	500–999
10	0	0	0–499

* Special Flood Hazard Area

** Preferred Risk Policies are available only in B, C, and X Zones for properties that are shown to have a minimal risk of flood damage. The Preferred Risk Policy does not receive premium rate credits under the CRS because it already has a lower premium than other policies. Although they are in SFHAs, Zones AR and A99 are limited to a 5% discount. Premium reductions are subject to change.

Source: 2018 National Flood Insurance Program (NFIP) Community Rating System (CRS): A Local Official's Guide to Saving Lives, Preventing Property Damage, Reducing the Cost of Flood Insurance

As of October 2018, 13 communities in Ohio are currently participating in the CRS program. The table below shows their current class and status.

CRS Communities in Ohio

Effective October 1, 2018

STATE	COMMUNITY NUMBER	COMMUNITY NAME	CRS ENTRY DATE	CURRENT EFFECTIVE DATE	CURRENT CLASS	% DISCOUNT FOR SFHA[1]	% DISCOUNT FOR NON SFHA	STATUS[2]
OH	390183	Delta, Village of	10/1/1992	10/1/2016	8	10	5	C
OH	390038	Fairfield, City of	10/1/1993	10/1/1998	8	10	5	C
OH	390110	Highland Heights, City of	10/1/1991	10/1/1992	10	0	0	R
OH	390412	Kettering, City of	10/1/1995	10/1/2000	8	10	5	C
OH	390328	Licking County	10/1/1993	5/1/2009	7	15	5	C
OH	390378	Medina County	5/1/2007	5/1/2012	8	10	5	C
OH	390071	New Richmond, Village of	10/1/1992	10/1/2002	8	10	5	C
OH	390176	Obetz, Village of	10/1/1996	10/1/2016	10	0	0	R
OH	390737	Orange, Village of	10/1/1991	10/1/2016	7	15	5	C
OH	390472	Ottawa, Village of	10/1/1995	10/1/1995	9	5	5	C
OH	390432	Ottawa County	10/1/1992	10/1/1992	9	5	5	C
OH	390460	Preble County	10/1/1998	10/1/1998	9	5	5	C
OH	390479	Shelby, City of	10/1/1992	5/1/2012	8	10	5	C
OH	390131	South Euclid, City of	10/1/1991	10/1/2016	8	10	5	C
OH	390419	West Carrollton, City of	5/1/2002	5/1/2009	8	10	5	C

1. For the purpose of determining CRS discounts, all AR and A99 Zones are treated as non-SFHAs.
2. Status: C = Current, R = Rescinded

OCTOBER 2018 NFIP FLOOD INSURANCE MANUAL

Source: October 2018 NFIP Flood Insurance Manual, Appendix F

Risk MAP

Not only is flooding one of the most common and costly disasters, flood risk can also change over time because of new building and development, weather patterns and other factors. Although the frequency or severity of impacts cannot be changed, FEMA is working with federal, state, and local partners across the nation to identify flood risk and promote informed planning and development practices to help reduce that risk through the Risk Mapping, Assessment and Planning (Risk MAP) program

Risk MAP provides high quality flood maps and information, tools to better assess the risk from flooding and planning and outreach support to communities to help them take action to reduce or mitigate flood risk. Each Risk MAP flood risk project is tailored to the needs of each community and may involve different products and services.

Risk MAP outreach and discovery meetings in Ohio

The FEMA, ODRN, Ohio EMA and the Strategic Alliance for Risk Reduction hosted outreach and discovery meetings with local officials and the public to discuss floodplain mapping needs and potential mitigation projects on the following dates. Those meetings highlighted in black led directly to a Hazard Mitigation Assistance project being developed and funded.

2014

- **Cuyahoga County Pilot Meeting – 05/22/14**
- City of Columbus – 9/17/14
- Marion County – 9/18/14
- Delaware County 9/23/14
- City of Columbus – 12/9/14
- City of Reynoldsburg – 12/9/14
- Marion County – 12/10/14
- City of Marysville – 12/10/14

2015

- City of Miamisburg – 4/28/15
- City of Oxford – 4/29/15
- City of Eaton – 4/29/15
- City of Clayton – 4/30/15
- City of Hamilton – 4/30/15
- Shelby County – 6/30/15
- Sandusky County – 7/7/15
- Lake County – 7/7/15
- City of Westlake – 7/8/15
- City of Toledo – 7/9/15
- Tuscarawas County – 9/16/15 & 12/2/15
- Stark County – 9/16/15 & 12/1/15
- Mercer County – 11/4/15
- Summit County – 12/1/15
- Morrow County – 1/6/15
- Delaware County – 1/6/15
- City of Circleville – 1/7/15
- City of Hilliard – 1/7/15
- City of Eaton – 1/21/15
- Butler County – 1/21/15

2016

- Portage County – 7/27/16

2017

- **Summit County – 6/22/17**
- City of Troy – 8/8/17
- Coastal Map Meetings – Lucas, Ottawa, Erie, Lorain, Cuyahoga, Lake, Ashtabula – 11/28/17 thru 12/7/17

HAZARDS U.S.-MULTI-HAZARD (HAZUS-MH)

Ohio EMA cooperated with the US Army Corps of Engineers (USACE) to undertake a HAZUS analysis project under the USACE's Silver Jackets program. In this project, the USACE completed Level 2 flood analysis for 24 counties. The Corps analyzed Ashland, Ashtabula, Butler, Cuyahoga, Delaware, Fairfield, Franklin, Geauga, Greene, Hamilton, Lake, Licking, Mahoning, Medina, Montgomery, Pickaway, Portage, Richland, Stark, Summit, Warren, and Wayne Counties. The remainder of the state was done with a Level 1 analysis and was completed by Ohio EMA from 2017 to 2018. The analyses completed for all counties in the state included the 100-year and 25-year flood intervals. Results of these and other HAZUS-MH runs are shared with counties and jurisdictions when possible to assist in updating local mitigation plans.

The results of the HAZUS-MH runs have been broken down by region and are reported by county for total building exposure, number of structures impacted by percentage damaged, number of critical facilities impacted, total business interruption losses, and the total building loss (Tables 2.2.d, 2.2.e, 2.2.f, 2.2.g, 2.2.h, and 2.2.i). Tables ending in d, e, and f contain the results based on a 100-year event while g, h, and i contain the 25-year results. **It is important to remember all the information reported via the state's HAZUS-MH analyses is an estimate and cannot be interpreted as precise losses**. Future HAZUS analyses will include more refined property, flood, and topographic data to reduce this uncertainty.

RESULTS

Table 2.2.d

Table 2.2c Estimate of Potential Losses from Flooding in the 100-Year Event, Region 1*										
County	2010 Population	Building Exposure Value (thousands)	1-10% Damage Count	11-20% Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	>50% Damage Count	Estimated Business Interrupt	Estimated Building Loss
Allen	106,331	$ 2,938,683	144	133	38	15	10	8	$ 125,540,000	$ 108,770,000
Auglaize	45,949	$ 1,263,355	68	72	33	15	6	3	$ 330,000	$ 70,570,000
Champaign	40,097	$ 993,906	73	30	1	0	0	0	$ 50,000	$ 22,590,000
Clark	138,333	$ 2,509,518	136	144	29	7	3	6	$ 122,410,000	$ 124,430,000
Crawford	43,784	$ 660,181	8	11	2	0	0	0	$ 15,030,000	$ 16,410,000
Darke	52,959	$ 1,340,402	40	20	4	1	1	5	$ 35,660,000	$ 50,680,000
Defiance	39,037	$ 1,187,341	12	17	11	2	5	7	$ 42,380,000	$ 49,550,000
Erie	77,079	$ 2,524,903	132	130	35	25	3	10	$ 145,000,000	$ 91,790,000
Fulton	42,698	$ 685,737	17	19	3	1	0	0	$ 19,900,000	$ 19,640,000
Hancock	74,782	$ 2,026,624	137	76	11	4	1	4	$ 181,950,000	$ 95,970,000
Hardin	32,058	$ 726,799	20	26	7	2	2	5	$ 23,080,000	$ 24,940,000
Henry	28,215	$ 983,530	30	12	1	0	0	0	$ 17,250,000	$ 19,710,000
Huron	59,626	$ 1,556,642	60	66	12	2	0	0	$ 26,200,000	$ 39,930,000
Logan	45,858	$ 1,325,213	69	55	13	3	0	0	$ 22,960,000	$ 29,120,000
Lucas	441,815	$ 9,520,884	376	414	138	63	46	75	$ 373,160,000	$ 530,890,000
Marion	66,501	$ 1,299,338	74	79	15	2	0	0	$ 43,990,000	$ 43,330,000
Mercer	40,814	$ 926,354	23	15	3	1	1	0	$ 17,540,000	$ 22,850,000
Miami	102,506	$ 3,131,471	400	463	188	79	34	18	$ 285,810,000	$ 285,920,000
Ottawa	41,428	$ 1,650,536	39	25	1	0	0	0	$ 21,740,000	$ 15,460,000
Paulding	19,614	$ 727,272	18	13	3	0	0	0	$ 8,980,000	$ 17,520,000
Preble	42,270	$ 1,455,992	63	80	16	3	1	1	$ 47,820,000	$ 86,270,000
Putnam	34,499	$ 1,124,245	47	57	15	3	1	0	$ 29,140,000	$ 43,590,000
Sandusky	60,944	$ 1,436,449	37	17	1	0	0	0	$ 16,950,000	$ 24,730,000
Seneca	56,745	$ 1,341,176	81	125	33	11	3	7	$ 65,430,000	$ 80,830,000
Shelby	49,423	$ 983,159	30	60	26	15	3	4	$ 28,120,000	$ 54,230,000
Van Wert	28,744	$ 680,518	37	41	8	4	2	0	$ 41,040,000	$ 32,330,000
Williams	37,642	$ 1,192,933	12	27	12	5	1	0	$ 26,340,000	$ 35,760,000
Wood	125,488	$ 4,489,872	625	178	23	5	1	2	$ 1,410,000	$ 124,400,000
Wyandot	22,615	$ 663,692	16	26	4	1	0	0	$ 23,680,000	$ 20,550,000

Table 2.2.e

Table 2.2d Estimate of Potential Losses from Flooding in the 100-Year Event, Region 2*										
County	2010 Population	Building Exposure Value (thousands)	1-10% Damage Count	11-20% Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	>50% Damage Count	Estimated Business Interrupt	Estimated Building Loss
Ashland*	53,139	$ 676,389	174	49	37	20	20	92	N/A	$ 21,640,944
Butler*	368,130	$ 752,889	1064	365	177	78	3	33	N/A	$ 113,773,231
Clinton	42,040	$ 1,194,907	12	25	18	12	5	7	$ 26,790,000.00	$ 43,700,000
Cuyahoga*	1,280,122	$ 3,934,170	446	282	148	89	46	58	N/A	$ 220,686,769
Delaware*	174,214	$ 1,519,539	180	97	55	237	41	117	N/A	$ 331,691,349
Fairfield*	146,156	$ 1,177,309	504	323	189	148	86	208	N/A	$ 89,832,202
Fayette	29,030	$ 890,747	29	45	4	1	0	0	$ 21,830,000.00	$ 31,220,000
Franklin*	1,163,414	$ 4,144,131	1195	423	183	91	40	39	N/A	$ 93,598,477
Geauga*	93,389	$ 428,036	90	78	41	17	12	37	N/A	$ 23,147,161
Greene*	161,573	$ 1,099,886	206	104	41	22	26	52	N/A	$ 55,160,646
Hamilton*	802,374	$ 3,963,959	385	441	383	264	244	771	N/A	$ 739,490,735
Knox	60,921	$ 2,193,096	132	161	38	7	1	1	$ 201,930,000.00	$ 131,690,000
Lake*	230,041	$ 1,416,495	254	259	136	109	66	138	N/A	$ 84,988,502
Licking*	166,492	$ 1,521,162	640	461	183	104	70	157	N/A	$ 108,353,322
Lorain	301,356	$ 10,061,999	435	247	34	13	5	8	$ 501,730,000.00	$ 324,900,000
Madison	43,435	$ 1,335,970	50	64	9	1	0	0	$ 31,630,000.00	$ 31,690,000
Medina*	172,332	$ 713,878	225	172	144	61	26	77	N/A	$ 66,018,995
Montgomery*	535,153	$ 1,646,665	744	479	222	139	68	161	N/A	$ 197,349,805
Morrow	34,827	$ 920,900	9	12	0	0	0	0	$ 15,560,000.00	$ 13,260,000
Pickaway*	55,698	$ 1,182,662	61	22	11	10	0	16	N/A	$ 13,169,415
Portage*	161,419	$ 1,196,404	248	127	57	33	19	58	N/A	$ 28,462,660
Richland*	124,475	$ 466,770	211	146	70	51	23	93	N/A	$ 30,230,452
Stark*	375,586	$ 1,399,265	621	312	161	89	69	171	N/A	$ 116,659,799
Summit*	541,781	$ 1,933,070	614	252	114	48	36	105	N/A	$ 73,402,447
Union	52,300	$ 1,539,110	54	64	9	2	0	0	$ 120,000.00	$ 39,540,000
Warren*	212,693	$ 168,782	177	159	134	94	119	203	N/A	$ 31,784,842
Wayne*	114,520	$ 564,231	201	52	23	20	19	45	N/A	$ 21,676,031

** The figures provided for the specific county was a result of a HAZUS level 2 run done in collaboration with the US Army Corp of Engineers*

Table 2.2.f

Table 2.2e Estimate of Potential Losses from Flooding in the 100-Year Event Region 3*										
County	2010 Population	Building Exposure Value (thousands)	1-10% Damage Count	11-20% Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	>50% Damage Count	Estimated Business Interrupt	Estimated Building Loss
Adams	28,550	$ 819,637	2	16	9	4	3	24	$ 24,130,000	$ 49,170,000
Ashtabula*	101,497	$ 95,107,200	146	91	49	45	38	217	N/A	$ 52,565,007
Athens	64,757	$ 3,090,060	103	378	224	102	50	72	$ 577,820,000	$ 847,830,000
Belmont	70,400	$ 1,654,807	32	118	84	41	23	25	$ 98,460,000	$ 132,800,000
Brown	44,846	$ 1,264,472	6	26	14	5	4	7	$ 25,990,000	$ 48,350,000
Carroll	28,836	$ 1,113,047	62	121	48	14	4	4	$ 87,810,000	$ 61,300,000
Clermont	197,363	$ 4,224,485	3	25	36	28	22	62	$ 236,870,000	$ 361,230,000
Columbiana	107,841	$ 2,277,996	26	63	22	8	2	3	$ 67,550,000	$ 105,060,000
Coshocton	36,901	$ 1,322,188	9	69	73	39	30	81	$ 167,820,000	$ 242,940,000
Gallia	30,934	$ 1,185,928	5	23	9	2	1	5	$ 43,060,000	$ 82,340,000
Guernsey	40,087	$ 1,775,911	38	140	41	15	7	27	$ 299,980,000	$ 265,770,000
Harrison	15,864	$ 649,649	14	61	16	4	2	0	$ 62,210,000	$ 44,760,000
Highland	43,589	$ 1,102,474	10	20	7	3	0	0	$ 24,920,000	$ 25,350,000
Hocking	29,380	$ 1,441,311	91	121	45	13	6	10	$ 95,880,000	$ 125,170,000
Holmes	42,366	$ 1,066,689	21	35	11	3	0	0	$ 64,600,000	$ 44,420,000
Jackson	33,225	$ 866,659	10	47	11	1	0	0	$ 65,000,000	$ 88,490,000
Jefferson	69,709	$ 1,710,340	28	153	74	21	5	2	$ 58,460,000	$ 97,500,000
Lawrence	62,450	$ 2,123,631	3	68	62	42	32	287	$ 127,390,000	$ 308,560,000
Mahoning*	238,823	$ 680,989	89	46	20	17	4	39	N/A	$ 17,951,013
Meigs	23,770	$ 836,887	1	23	22	8	5	4	$ 34,880,000	$ 65,520,000
Monroe	14,642	$ 447,990	0	3	0	0	0	0	$ 22,340,000	$ 22,990,000
Morgan	15,054	$ 706,463	14	19	8	4	4	5	$ 15,760,000	$ 31,170,000
Muskingum	86,074	$ 2,836,667	50	137	108	58	46	135	$ 192,490,000	$ 309,180,000
Noble	14,645	$ 543,754	2	22	10	3	0	1	$ 38,060,000	$ 38,140,000
Perry	36,058	$ 999,528	31	70	20	6	1	1	$ 66,990,000	$ 59,610,000
Pike	28,709	$ 1,269,590	14	71	32	10	1	9	$ 105,850,000	$ 109,830,000
Ross	78,064	$ 2,160,166	74	184	94	39	21	36	$ 81,710,000	$ 137,990,000
Scioto	79,499	$ 2,235,436	36	190	118	42	15	40	$ 162,570,000	$ 210,770,000
Trumbull	210,312	$ 4,827,376	211	346	174	74	38	43	$ 296,600,000	$ 445,240,000
Tuscarawas	92,582	$ 3,440,893	267	489	225	80	44	76	$ 396,730,000	$ 542,600,000
Vinton	13,435	$ 525,275	2	21	11	3	2	1	$ 23,360,000	$ 38,190,000
Washington	61,778	$ 2,286,270	22	51	38	28	21	53	$ 96,540,000	$ 215,390,000

** The figures provided for the specific county was a result of a HAZUS level 2 run done in collaboration with the US Army Corp of Engineers*

Table 2.2.g

Table 2.2f Estimate of Potential Losses from Flooding in the 25-Year Event Region 1*										
County	**2010 Population**	**Building Exposure Value (thousands)**	**1-10% Damage Count**	**11-20% Damage Count**	**21-30% Damage Count**	**31-40% Damage Count**	**41-50% Damage Count**	**>50% Damage Count**	**Estimated Business Interrupt**	**Estimated Building Loss**
Allen	106,331	$ 2,854,063	140	114	29	13	7	2	$ 111,210,000	$ 92,100,000
Auglaize	45,949	$ 1,234,816	67	61	23	12	4	5	$ 250,000	$ 57,080,000
Champaign	40,097	$ 947,343	61	17	0	0	0	0	$ 40,000	$ 20,030,000
Clark	138,333	$ 2,757,199	144	109	17	4	3	7	$ 196,720,000	$ 123,160,000
Crawford	43,784	$ 660,181	7	8	2	0	0	0	$ 9,980,000	$ 9,760,000
Darke	52,959	$ 1,168,586	30	10	1	1	0	2	$ 29,960,000	$ 40,440,000
Defiance	39,037	$ 1,207,280	10	15	9	3	1	3	$ 34,220,000	$ 37,320,000
Erie	77,079	$ 2,926,531	129	135	30	20	3	8	$ 144,610,000	$ 93,310,000
Fulton	42,698	$ 662,743	14	14	2	0	0	0	$ 18,510,000	$ 16,320,000
Hancock	74,782	$ 1,785,086	121	61	9	4	0	1	$ 84,640,000	$ 81,020,000
Hardin	32,058	$ 668,841	12	17	6	1	2	6	$ 17,950,000	$ 20,850,000
Henry	28,215	$ 1,018,557	29	12	2	0	0	0	$ 16,840,000	$ 19,000,000
Huron	59,626	$ 1,498,457	61	55	5	0	0	0	$ 22,870,000	$ 30,630,000
Logan	45,858	$ 1,245,991	70	48	4	2	1	1	$ 20,710,000	$ 24,440,000
Lucas	441,815	$ 9,314,928	519	395	96	60	26	87	$ 381,250,000	$ 465,690,000
Marion	66,501	$ 1,138,768	69	59	5	0	0	0	$ 33,910,000	$ 30,380,000
Mercer	40,814	$ 935,039	20	16	3	1	1	0	$ 17,090,000	$ 19,740,000
Miami	102,506	$ 2,971,411	427	420	138	48	23	8	$ 227,060,000	$ 231,300,000
Ottawa	41,428	$ 1,524,829	45	17	0	0	0	0	$ 21,380,000	$ 13,950,000
Paulding	19,614	$ 715,293	14	8	1	1	0	0	$ 8,370,000	$ 15,180,000
Preble	42,270	$ 1,474,208	60	66	12	4	0	1	$ 44,040,000	$ 74,350,000
Putnam	34,499	$ 1,124,245	36	49	8	1	0	0	$ 25,250,000	$ 33,240,000
Sandusky	60,944	$ 1,436,449	23	11	1	0	0	0	$ 12,990,000	$ 17,790,000
Seneca	56,745	$ 1,341,176	79	76	16	5	1	4	$ 46,560,000	$ 55,280,000
Shelby	49,423	$ 983,159	23	49	18	8	3	2	$ 19,970,000	$ 38,370,000
Van Wert	28,744	$ 680,518	36	31	7	4	2	0	$ 37,390,000	$ 26,870,000
Williams	37,642	$ 1,131,286	11	22	9	3	0	0	$ 20,980,000	$ 25,270,000
Wood	125,488	$ 4,465,175	532	169	27	9	0	0	$ 1,190,000	$ 109,970,000
Wyandot	22,615	$ 651,674	18	26	3	2	0	0	$ 21,750,000	$ 18,510,000

Table 2.2.h

Table 2.2g Estimate of Potential Losses from Flooding in the 25-Year Event Region 2*										
County	2010 Population	Building Exposure Value (thousands)	1-10% Damage Count	11-20% Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	>50% Damage Count	Estimated Business Interrupt	Estimated Building Loss
Ashland*	53,139	$ 676,389	184	45	23	21	14	82	N/A	$ 17,946,325
Butler*	368,130	$ 752,889	1028	271	90	23	1	23	N/A	$ 65,543,481
Clinton	42,040	$ 1,194,907	10	23	17	9	5	3	$ 26,000,000	$ 38,490,000
Cuyahoga*	1,280,122	$ 3,934,170	422	253	107	58	21	43	N/A	$ 177,713,853
Delaware	174,214	$ 1,519,539	163	90	159	124	29	88	N/A	$ 125,570,218
Fairfield*	146,156	$ 1,177,309	526	293	165	106	90	136	N/A	$ 68,453,798
Fayette	29,030	$ 890,747	27	41	3	0	0	0	$ 19,990,000	$ 25,950,000
Franklin*	1,163,414	$ 4,144,131	1048	330	140	56	18	27	N/A	$ 65,380,387
Geauga*	93,389	$ 428,036	94	70	30	16	14	26	N/A	$ 18,474,542
Greene*	161,573	$ 1,099,886	208	72	27	23	18	36	N/A	$ 40,788,723
Hamilton*	802,374	$ 3,963,959	396	449	275	268	175	601	N/A	$ 592,195,632
Knox	60,921	$ 2,193,096	115	119	17	2	0	1	$ 238,890,000	$ 138,710,000
Lake*	230,041	$ 1,416,495	280	250	88	71	47	76	N/A	$ 59,442,599
Licking*	166,492	$ 1,521,162	731	356	173	76	36	92	N/A	$ 87,496,547
Lorain	301,356	$ 10,061,999	368	205	32	12	5	10	$ 451,210,000	$ 277,700,000
Madison	43,435	$ 1,335,970	46	39	5	0	0	0	$ 25,310,000	$ 23,660,000
Medina*	172,332	$ 713,878	238	160	142	43	24	63	N/A	$ 57,245,360
Montgomery*	535,153	$ 1,646,665	769	391	156	61	36	126	N/A	$ 157,825,299
Morrow	34,827	$ 920,900	10	10	0	0	0	0	$ 11,740,000	$ 9,990,000
Pickaway*	55,698	$ 1,182,662	57	17	8	6	3	9	N/A	$ 10,435,412
Portage*	161,419	$ 1,196,404	217	109	38	25	22	38	N/A	$ 21,273,296
Richland*	124,475	$ 466,770	231	119	62	25	23	61	N/A	$ 23,097,903
Stark*	375,586	$ 1,399,265	612	253	136	87	58	127	N/A	$ 91,000,581
Summit*	541,781	$ 1,933,070	595	192	100	36	30	79	N/A	$ 57,907,010
Union	52,300	$ 1,539,110	51	54	5	2	0	0	$ 110,000	$ 32,130,000
Warren*	212,693	$ 168,782	168	152	119	107	84	143	N/A	$ 25,556,553
Wayne*	114,520	$ 564,231	168	35	19	22	14	22	N/A	$ 12,835,621

** The figures provided for the specific county was a result of a HAZUS level 2 run done in collaboration with the US Army Corp of Engineers*

Table 2.2.i

Table 2.2h Estimate of Potential Losses from Flooding in the 25-Year Event Region 3										
County	2010 Population	Building Exposure Value (thousands)	1-10% Damage Count	11-20% Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	>50% Damage Count	Estimated Business Interrupt	Estimated Building Loss
Adams	28,550	$ 806,742	3	13	6	5	3	14	$ 22,260,000	$ 41,910,000
Ashtabula*	101,497	$ 95,107,200	154	87	48	42	33	170	N/A	$ 42,246,950
Athens	64,757	$ 2,970,685	125	357	175	79	32	42	$ 506,850,000	$ 690,570,000
Belmont	70,400	$ 1,641,711	49	116	70	29	14	17	$ 86,970,000	$ 107,760,000
Brown	44,846	$ 1,244,527	9	23	14	7	3	6	$ 24,350,000	$ 42,760,000
Carroll	28,836	$ 1,086,010	63	114	38	9	2	2	$ 82,760,000	$ 55,760,000
Clermont	197,363	$ 3,738,842	6	35	29	19	13	24	$ 180,520,000	$ 256,070,000
Columbiana	107,841	$ 2,019,902	26	50	13	3	1	1	$ 52,930,000	$ 76,820,000
Coshocton	36,901	$ 1,240,157	25	97	64	32	19	56	$ 152,680,000	$ 204,830,000
Gallia	30,934	$ 1,096,469	9	26	6	0	0	6	$ 34,480,000	$ 62,330,000
Guernsey	40,087	$ 1,446,710	31	95	26	7	7	20	$ 225,380,000	$ 163,920,000
Harrison	15,864	$ 567,174	15	40	9	2	0	0	$ 53,950,000	$ 33,040,000
Highland	43,589	$ 1,046,063	11	19	6	2	0	0	$ 21,180,000	$ 20,590,000
Hocking	29,380	$ 1,459,252	57	138	46	12	5	4	$ 100,380,000	$ 137,860,000
Holmes	42,366	$ 977,093	12	15	1	0	0	0	$ 50,610,000	$ 25,440,000
Jackson	33,225	$ 812,675	4	31	5	0	0	0	$ 62,450,000	$ 78,220,000
Jefferson	69,709	$ 1,665,524	25	151	54	124	4	3	$ 48,950,000	$ 81,560,000
Lawrence	62,450	$ 2,022,620	11	89	64	32	39	228	$ 112,640,000	$ 276,560,000
Mahoning*	238,823	$ 680,989	94	37	19	7	3	22	N/A	$ 12,850,170
Meigs	23,770	$ 745,723	4	24	18	8	2	1	$ 22,020,000	$ 45,340,000
Monroe	14,642	$ 386,960	0	2	2	0	0	0	$ 18,680,000	$ 19,150,000
Morgan	15,054	$ 668,989	9	12	5	4	0	4	$ 13,700,000	$ 25,800,000
Muskingum	86,074	$ 2,555,694	34	125	84	43	25	80	$ 149,160,000	$ 212,790,000
Noble	14,645	$ 546,848	2	24	7	2	0	0	$ 39,150,000	$ 34,800,000
Perry	36,058	$ 995,375	33	65	25	4	2	0	$ 62,050,000	$ 56,240,000
Pike	28,709	$ 992,569	8	39	9	3	0	0	$ 47,200,000	$ 50,540,000
Ross	78,064	$ 1,881,596	70	135	47	23	10	16	$ 75,070,000	$ 102,110,000
Scioto	79,499	$ 2,112,517	40	204	84	21	10	23	$ 119,590,000	$ 175,340,000
Trumbull	210,312	$ 4,577,649	170	274	123	51	25	21	$ 255,790,000	$ 360,200,000
Tuscarawas	92,582	$ 3,125,095	180	417	146	46	30	49	$ 319,120,000	$ 409,460,000
Vinton	13,435	$ 563,827	4	23	6	3	0	0	$ 22,180,000	$ 29,540,000
Washington	61,778	$ 2,143,932	12	42	41	27	16	22	$ 95,080,000	$ 172,360,000

** The figures provided for the specific county was a result of a HAZUS level 2 run done in collaboration with the US Army Corp of Engineers*

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

The estimates for losses to state-owned and state-leased critical facilities were developed using the DAS-maintained databases. The structures deemed critical facilities in Appendix C, were intersected with the 1-percent annual chance floodplain. Because first-floor elevations have not been collected for these structures, estimated damages cannot be calculated via depth/damage curves. Instead, an exposure analysis was used to determine the number of critical facilities in the floodplain and the value of these structures. For State-owned critical facilities, the full value of building and contents were assessed. For State-leased critical facilities, only the content value was assessed. A project being implemented by DAS in 2019-2022 will collect lowest floor data for all state-owned structures, which will enable a more accurate vulnerability analysis in the next plan update. Table 2.2.j lists the number and value of critical facilities in the floodplain by county.

RESULTS

In Region 1, there are 366 critical facilities within the 100-year floodplain with a total owned/leased value of $326,276,310.

- 165 of these facilities were in Ottawa County valued at $87,812,602.
    - 52 of these 165 are owned or leased by the Ohio Adjutant General's Department with a total value of $57,636,943.
    - 98 of these 165 are owned or leased by the Ohio Department of Natural Resources with a total value of $28,553,259.
- Erie County, however, had a larger value of critical facilities in the floodplain at $154,276,447 with only 39 critical facilities.
    - 21 of these 39 critical facilities are owned/leased by the Ohio Department of Veteran Services with a total value of $147,257,900.
    - 16 of these 39 critical facilities are owned/leased by the Ohio Department of Natural Resources with a total value of $3,752,121.

In Region 2, there are 159 critical facilities within the 100-year floodplain with a total owned/leased value of $365,023,256.

- The vast majority of critical facilities in the floodplain were in Franklin County at 56 facilities worth $300,571,406.
    - 2 of these 56 are owned or leased by the Capitol Square Review Board with a total value of $190,242,623.
    - 13 of these 56 are owned or leased by the Ohio Department of Rehabilitation and Correction with a total value of $37,404,034.

In Region 3, there are 244 critical facilities within the 100-year floodplain with a total owned/leased value of $126,000,433.

- The majority of critical facilities in Region 3 are in Tuscarawas with 44 facilities worth $50,705,402.
    - 35 of these 44 structures are owned or leased by the Ohio Department of Transportation with a total value of $45,976,154.

Table 2.2.j

State-Owned and State-Leased Critical Facilities in 100-Year Floodplain								
Region 1			Region 2			Region 3		
County	Critical Facilities in Floodplain	Value of CF in Floodplain	County	Critical Facilities in Floodplain	Value of CF in Floodplain	County	Critical Facilities in Floodplain	Value of CF in Floodplain
Allen	6	$ 216,859	Butler	4	$ 678,145	Athens	23	$ 28,215,959
Auglaize	2	$ 1,100,630	Fairfield	9	$ 1,011,336	Belmont	9	$ 907,461
Champaign	19	$ 498,450	Fayette	1	$ 392,391	Brown	1	$ 910,920
Clark	7	$ 1,172,191	Franklin	56	$ 300,571,406	Clermont	12	$ 1,346,611
Defiance	5	$ 176,750	Greene	4	$ 995,000	Coshocton	1	$ 1,250,000
Erie	39	$ 151,849,185	Knox	2	$ 58,750	Gallia	5	$ 927,908
Fulton	4	$ 407,208	Licking	12	$ 9,843,704	Guernsey	4	$ 328,064
Hancock	1	$ 37,171	Lorain	2	$ 691,715	Harrison	7	$ 966,956
Huron	2	$ 817,929	Medina	3	$ 131,288	Highland	1	$ 39,235
Logan	3	$ 112,000	Montgomery	2	$ 56,558	Holmes	1	$ 14,832
Lucas	59	$ 52,802,770	Morrow	1	$ 25,000	Jackson	5	$ 2,631,673
Marion	3	$ 864,811	Pickaway	29	$ 18,986,141	Jefferson	4	$ 402,000
Ottawa	165	$ 87,812,602	Portage	1	$ 1,400,000	Meigs	4	$ 2,902,674
Putnam	1	$ 43,687	Richland	1	$ 206,250	Monroe	9	$ 683,055
Sandusky	7	$ 1,426,250	Summit	16	$ 5,640,781	Morgan	3	$ 152,797
Seneca	38	$ 26,155,953	Warren	16	$ 24,334,791	Muskingum	51	$ 2,779,869
Shelby	3	$ 53,600	**Total**	**159**	**$ 365,023,256**	Noble	8	$ 4,117,405
Williams	1	$ 572,714				Pike	7	$ 2,585,816
Wyandot	1	$ 155,550				Ross	23	$ 19,816,292
Total	**366**	**$ 326,276,310**				Scioto	4	$ 1,002,216
						Tuscarawas	44	$ 50,705,402
						Vinton	8	$ 342,675
						Washington	10	$ 2,970,613
						Total	**244**	**$ 126,000,433**

2.3 TORNADO

National Oceanic Atmospheric Association (NOAA) defines a tornado as a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground. Because wind is invisible, it is hard to see a tornado unless it forms a condensation funnel made up of water droplets, dust and debris. Tornadoes are the most violent of all atmospheric storms and the 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 state in the union, 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.

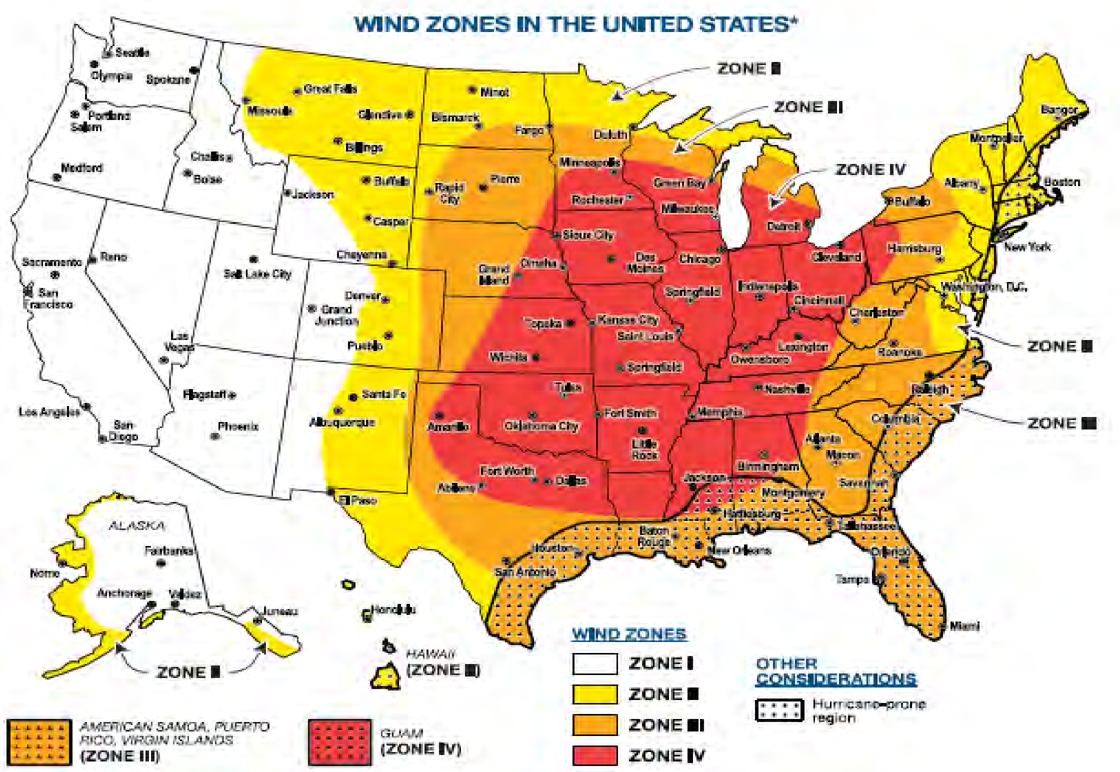


Figure 2-7: Wind Zones in the United States*

* If you are uncertain of your location because of the level of detail and size of the map, or if you live on or very near one of the delineation lines, use the highest adjacent wind zone.

Map 2.3.a

Tornadoes are non-spatial hazards; therefore, it is often difficult to profile tornadoes and determine the exact risk. However, estimations can be developed 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 for fatalities, injuries, and dollar losses, indicating that it has a relatively high likelihood for damages resulting from tornadoes. Tornadoes are measured by damage scale based on their winds, with greater damage equating to greater wind speed. The original Fujita-scale (F-scale) was developed without considering a structure's integrity or condition as it relates to the wind speed necessary to damage it. The process of rating the damage was subjective with the original F-scale and arbitrary judgments were the norm. In order to reduce this subjectivity, the Enhanced F-scale (EF- scale) took effect February 1, 2007.

The Enhanced F-scale uses the original F-scale (i.e., F0-F5) and classifies tornado damage across 28 different types of damage indicators, which mostly involve building/structure type, and these are assessed at eight damage levels (1-8). Therefore, construction types and their 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. Table 2.3.a. lists the classifications under the EF- and F-scale. It should be noted the wind speeds listed are estimates based on damage rather than measurements. Also, there are no plans by National Oceanic Atmospheric Administration or the National Weather Service to re- evaluate the historical tornado data using the Enhanced scale.

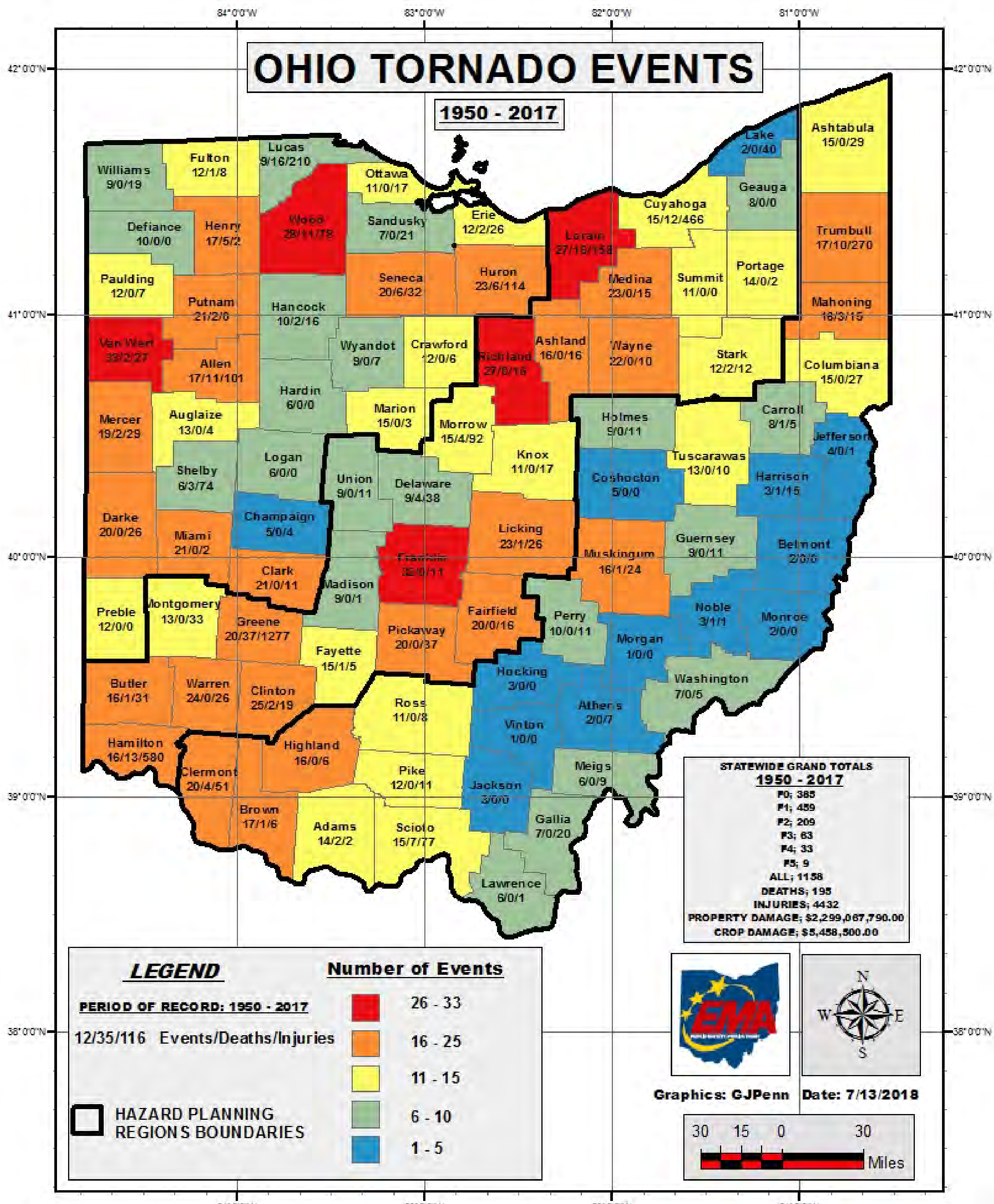
Fujita Scale 3-Second Gust (mph)		Damage Levels	Enhanced Fujita Scale 3-Second Gust (mph)	
F-0	45-78	Light - tree branches down	EF-0	65-85
F-1	79-117	Moderate - roof damage	EF-1	86-110
F-2	118-161	Considerable - houses damaged	EF-2	111-135
F-3	162-209	Severe - buildings damaged	EF-3	136-165
F-4	210-261	Devastating - structures leveled	EF-4	166-200
F-5	262-317	Incredible - whole towns destroyed	EF-5	Over 200

Table 2.3.a - Source*: http://www.spc.noaa.gov/faq/tornado/ef-scale.html*

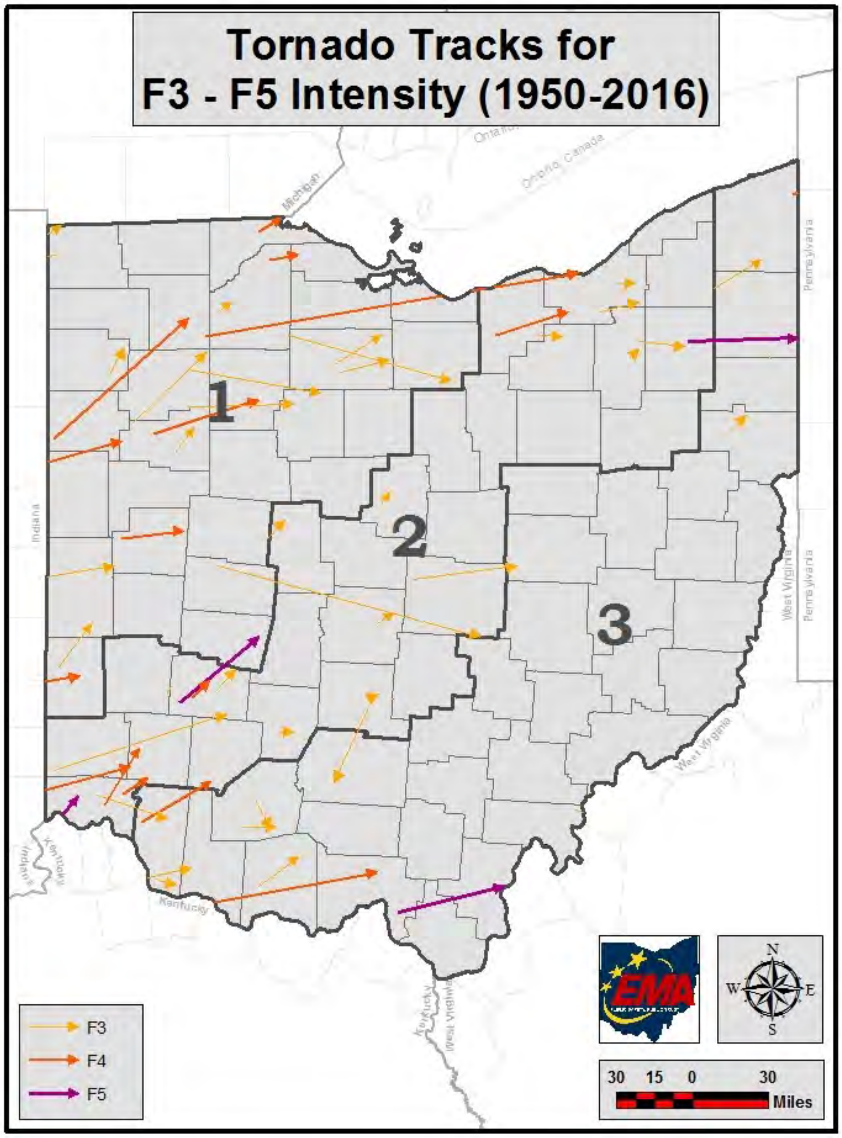
RISK ASSESSMENT

LOCATION

The wind zones in the United States map (Map 2.3.a) indicate that the entire state falls within the 250 mile per hour zone, but the frequency in which tornados occurs varies greatly depending on which county you are located. Ohio has a significant history of past tornado events. Map 2.3.b depicts the touchdowns of 1158 tornadoes that struck the State between 1950 and 2017. The counties in red have the greatest number of tornadoes touchdowns in that time period. In order, those counties are: Van Wert (33), Franklin (32), Wood (28), Lorain (27) and Richland (27). When looking at a regional perspective Region 1 (416) and Region 2 (454) have had significantly more tornados than Region 3 (288). Much of the variance in the number of tornados between Region 1 and 2, and Region 3 is due to the topography of Region 3.



Map 2.3.b – Source - NOAA Storm Database



Map 2.3.c indicates the tracks of the F 3 or greater tornados that have occurred in the state from 1950-2016. The tracks of these high intensity tornadoes are generally spread throughout the state with the exception of the southern and eastern portions of Region 3. The highest intensity, or F5 tornados tracks, are indicated in purple and have occurred in all of the regions in the state. Only one F5 tornado has occurred in Region 1, even though a large number of F 3 and F4 tornados occurred within that Region.

Map 2.3.c – Source - NOAA Storm Database

LHMP DATA

CLERMONT COUNTY

There were two events in 2012 that caused significant damages. The first was on March 2, 2012, and this tornado was categorized as an EF3. The Village of Moscow, parts of Franklin, Washington, & Tate Townships were all in the direct path, resulting in 353 structures damaged and 18 residential structures destroyed causing roughly $3,700,000 in damages with three lives lost and 13 injured. The second tornado event occurred on September 8, 2012. The Village of Moscow was hit the hardest with two homes destroyed. The location, frequency and impacts of tornadoes cannot be accurately predicted. However, an analysis of historic events can provide a reasonable understanding of expected future risks. Clermont County has had 18 tornadoes in 16 unique years since 1953, and they have sustained total losses of approximately $11.5 million. The annual chance of occurrence for a tornado is 23%. The annualized risk is approximately $190,883 with one injury and 3% chance of life loss.

GREENE COUNTY

Although tornadoes can occur throughout the state, the City of Xenia appears to be especially tornado-prone. According to the Greene County LHMP, "Nineteen tornadoes were reported in Greene County, Ohio since 1884. These tornadoes caused 43 deaths, 1,377 injuries and over $1 billion dollars of damage. Xenia was the location of seven tornadoes, responsible for the majority of the fatalities and caused the highest amount of damage." Greene County considers tornadoes major hazards with the potential of high damage, personal injury, and loss of life. They have conducted a number of studies involving tornadoes and have incorporated those studies into their LHMP.

CUYAHOGA COUNTY

The Cuyahoga County All-Hazards Mitigation Plan provides a comprehensive history of the tornado events that have occurred within Cuyahoga County from 1951-2015 including a tornado track map. According to the Cuyahoga County LHMP, fifteen tornadoes were reported in between 1951 and 2015. These tornadoes caused 12 deaths, 466 injuries and over 68 million dollars of damage. The Cuyahoga County LHMP states, while all County assets are considered at risk from this hazard, a particular tornado would only cause damages along its specific track. A high-magnitude tornado sweeping through densely populated portions of the County would have extensive injuries, deaths, and economic losses. There is no way to be sure how many people would be injured or killed due to the difference that time of day and year can make, but property values can provide an estimate of economic losses.

VAN WERT COUNTY

Per the 2014 Van Wert County LHMP, Van Wert County has the highest occurrences of tornados in the state. The most devastating event in recent history occurred on November 10, 2002, when a F4 tornado struck the City of Van Wert, killing 2 people and causing over $50 million dollars in damages and other economic losses. This event is ranked among the top 10 tornados to ever hit the northeastern United States. The Vulnerability Assessment in the Van Wert County LHMP provides the following estimates developed based on an EF 5 Tornado striking the heart Van Wert County, with a path 1-mile wide and 20-miles long. Using those assumptions, Van Wert County has a total exposure of 5,690 structures valued at $231,092,000.

PAST OCCURRENCES

XENIA – 1974

According to a Dayton Daily News article (April 2011), on April 3, 1974, an F-5 tornado tore through the heart of Xenia, killing 33 people and injuring more than 1,300 others. It bulldozed a path more than a half-mile wide, destroying or damaging more than 1,400 buildings, including 1,200 homes, dozens of businesses, 10 churches, and several schools. By the time it lifted into the sky near Cedarville, it left behind more than $100 million of damage in Greene County. The Xenia tornado was part of a super outbreak, when 148 twisters swept across several states, killing 335 people in a 16-hour period on April 3-4, 1974. It still ranks as one of the largest natural disasters in American history, with Xenia the hardest hit community.

The Xenia subdivision of “Arrowhead” was especially hard-hit, the tornado leaving it in ruins. The 4-year-old subdivision on the city’s southwest side lost more than 300 homes, many on concrete slabs with no basements. Greene Memorial Hospital in northeast Xenia narrowly escaped the tornado’s wrath, but lost its power and telephone service and its water quality was suspect. About 500 people were treated there in the first 24 hours, 34 of them being admitted with a number transferred to hospitals in nearby Dayton for treatment.

Photograph 2.3.a – Source - NWS

XENIA - 2000

Twenty-six years later another tornado (an F-4) struck at an unusual time – early autumn and after dark – on September 20, 2000. The tornado would follow an eerily familiar path of destruction through Xenia, killing one man and destroying or damaging more than 300 homes and 30 businesses.

Photograph 2.3.b – Source - Dayton Daily News

MAY TORNADO OUTBREAK - 1985

Per the NWS, on May 31, 1985, twenty-one tornadoes tracked across Northeast Ohio and Northwest Pennsylvania during that evening. Of these 21, one was rated an F5, and six were rated F4's. Tragically, these tornadoes killed 76 people in Ohio and Pennsylvania. In Ohio, this was the worst event since the April 3-4th, 1974 outbreak that killed 37 in Xenia.

The strongest of the tornadoes touched down at the Ravenna Arsenal in eastern Portage County around 6:35 p.m. The tornado intensified to an F5 as it tracked east across southern Trumbull County, devastating the communities of Newton Falls and Niles. Nine people were killed in the business district of Niles.

Photograph 2.3.c – Source - NWS

Photograph 2.3.d – Source - NWS

The residents of Ohio will long remember May 31, 1985. Rarely has such an outbreak of tornadoes been seen in this county and never before in this area. This day serves as a reminder that devastating tornadoes can occur in any month of the year at any time of the day and at any location in the country.

BLUE ASH TORNADO - 1999

Another notable tornado occurred in April 1999 in the counties of Clinton, Hamilton, and Warren. The tornadoes killed four people, injured 42, and damaged or destroyed 400 structures, causing about $82 million in losses (Ohio EMA 16). A lone supercell thunderstorm produced this F4 tornado, with winds between 207 and 260 mph.

Photograph 2.3.e – Source - Cincinnati Enquirer

DR-1444 - 2002 & DR-1484 - 2003

In more recent years, there have been two disaster declarations: DR-1444, which was for tornado-related damage, and DR-1484, which covered tornado and flood related damage. DR-1444 was in November 2002 and affected several counties throughout the state. Many of the residents of the impacted counties were left homeless or were trapped in debris, damage to commercial structures created localized unemployment, hundreds of injuries were reported, and multiple lives were lost.

Photograph 2.3.F – Source - OSHP

DR-1484 occurred in August 2003 and was the most recent declaration that included tornadic damage. The tornado was confirmed as an F-1 and affected part of the City of Youngstown and parts of the unincorporated areas of the County. The tornado was 50-100 yards wide and eight miles long. Sixty homes received major damage and 20 received minor damage. The estimated loss from this tornado was $900,000 and approximately 33% of the structures were insured.

2010 TORNADOS

The first event occurred in June 5 - 6, when a major tornado outbreak affected the Midwestern United States and Great Lakes Region. At least 46 tornadoes were confirmed from Iowa to southern Ontario and Ohio as well as northern New England. Tornadoes moved through northern Ohio affecting Fulton, Lucas, Wood, Ottawa, Richland, Holmes and Tuscarawas Counties. While all counties sustained heavy structural damage, the event resulted in seven people dead in Wood County. The Governor of Ohio issued an Emergency Proclamation for the event and requested a Presidential Declaration for the area, however, none was granted. Regardless, tornadoes ranged from EF-0 northeast of Lucas, Ohio in Richland County, to an EF-4 tornado that resulted in 78 homes with major damage and 97 with minor damage. The total residential loss was approximately $7,545,300. Thirty-two businesses had major damage and three had minor damage resulting in $4,661,000 in losses. The Counties experienced a total of $1,263,858 in infrastructure damage.

The second event occurred when severe weather and tornadoes swept across the state in the afternoon of September 16th. The National Weather Service confirmed 11 tornadoes in Wayne, Holmes, Fairfield, Athens, Perry, Meigs, Delaware and Tuscarawas Counties. The tornadoes ranged from EF-0 to EF-3, and Athens, Meigs, Pickaway, Perry and Wayne Counties declared a local state of emergency. Thirteen people were injured in Athens County, while six were injured in Meigs County. State and county teams assessed the damaged structures to be 62 destroyed, 77 with major damage, 113 with minor damage and 373 structures as affected. Residential loss equated to 2,227 claims amounting in $11,400,000, while business losses included 287 claims amounting in $4,700,000.

MOSCOW TORNADO - 2012

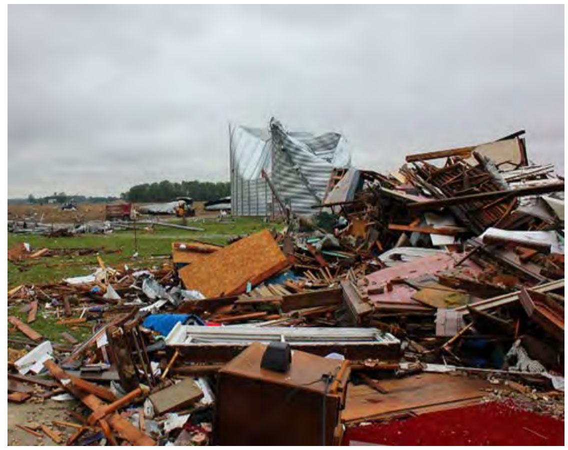
In March 2012, Brown and Clermont Counties experienced a devastating EF-3 tornado that came up from Kentucky and into Ohio. Thunderstorms developed during the afternoon in a high wind shear environment ahead of a strengthening low-pressure system. Many of these storms became severe, with large hail, damaging thunderstorm winds, and tornadoes all being the main threats. The tornado traveled seven miles in the Kentucky counties of Campbell and Pendleton. The tornado then moved into Clermont County, Ohio at 4:46 pm, where it hit the town of Moscow. It continued on the ground across Clermont County, crossing into Brown County around 4:58 pm. It then lifted south of Hamersville in western Brown County. This tornado caused extensive damage to structures and trees along its entire path on both sides of the Ohio River. Numerous homes were very heavily damaged or destroyed. Many homes lost their roofs, having complete exterior wall failure. Some modular homes were completely removed from their foundations, lifted, and thrown in excess of 100 yards where they were destroyed. The damage in Ohio from this tornado was consistent with maximum winds estimated at 160 miles per hour in Clermont County, and 100 miles per hour in Brown County. Clermont County experienced three deaths from the tornado. One fatality occurred in Moscow in Clermont County, while two others occurred in Bethel. Thirteen injuries were reported resulting from this storm. Property damage was estimated at $5,660,000.

Photograph 2.3.g – Source - OEMA

As this same system moved into Adams County, it caused an additional fatality. A tornado touched down just east of Highway 41, about 2 miles northeast of West Union. The tornado then traveled northeast for just over 11 miles, destroying at least 5 mobile homes and damaging two other houses. One of these homes was built of brick. A 99-year-old woman was in her mobile home in Tiffin Township when the tornado struck. She was injured from this tornado and passed away several days later. Two other people were also injured from this tornado. A dozen cattle were killed and major power transmission poles were knocked over. Numerous trees were snapped or uprooted. Based on the damage surveyed, the maximum estimated wind speed of this tornado was 125 miles per hour and caused an estimated $2 million in damage. The path of the tornado continued east into Pike and Scioto Counties causing an additional estimated $230,000 in damage, but no other fatalities or injuries were reported.

CEDARVILLE TORNADO - 2014

A narrow but intense tornado ripped through Greene County on May 14, 2014, while sparing the nearby town of Cedarville. The NWS in Wilmington confirmed an EF3 tornado hit the area, packing winds as high as 145 mph. Cedarville is nine miles northeast of Xenia, the site of a massive F5 tornado that killed dozens during the Super outbreak of April 4, 1974. The NWS says two people were injured and several homes were hit by the tornado. This includes completely destroying two homes and causing over $500,000 in damage.



Photograph 2.3.h - Source - NWS

PROBABILITY OF FUTURE EVENTS

Between 1950- 2017, Ohio has experienced 1,158 tornadoes, an average of 17.28 tornadoes annually. The majority of tornados that have occurred in the state have been between an EF-0 and EF-2 (90.1%). Table 2.3.b give a breakdown of the various EF tornado events that have occurred in the state from 1950-2017.

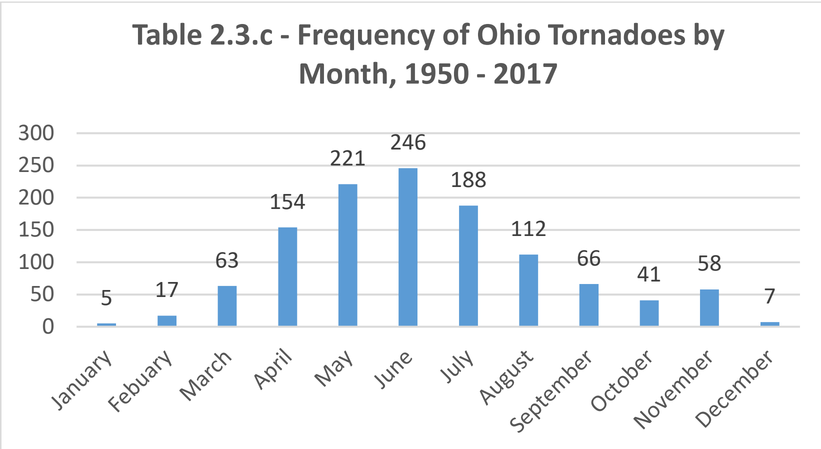
Probability of Future Tornado Events							
Year	**F0**	**F1**	**F2**	**F3**	**F4**	**F5**	**Total**
1951	0	1	2	0	0	0	**3**
1952	0	2	0	0	0	0	**2**
1953	0	1	1	0	6	0	**8**
1954	5	5	2	0	0	0	**12**
1955	0	2	2	2	0	0	**6**
1956	1	2	5	2	0	0	**10**
1957	0	1	3	0	0	0	**4**
1958	0	5	6	0	0	0	**11**
1959	5	2	2	1	0	0	**10**
1960	1	4	2	0	0	0	**7**
1961	4	6	4	3	1	0	**18**
1962	0	1	2	0	0	0	**3**
1963	2	8	6	0	0	0	**16**
1964	0	2	4	0	0	0	**6**
1965	2	14	12	3	8	0	**39**
1966	0	1	1	1	0	0	**3**
1967	0	3	3	0	0	0	**6**
1968	1	7	4	0	5	3	**20**
1969	1	11	1	8	0	0	**21**

1970	3	7	9	1	0	0	**20**
1971	1	3	7	4	0	0	**15**
1972	1	7	2	0	0	0	**10**
1973	17	17	11	10	0	0	**55**
1974	3	11	4	2	2	3	**25**
1975	2	6	4	0	0	0	**12**
1976	7	3	2	0	0	0	**12**
1977	5	15	3	1	0	0	**24**
1978	4	15	2	1	0	0	**22**
1979	1	2	1	0	0	0	**4**
1980	1	30	6	0	0	0	**37**
1981	6	14	6	1	0	0	**27**
1982	0	7	3	0	0	0	**10**
1983	0	6	2	2	0	0	**10**
1984	0	2	0	0	0	0	**2**
1985	2	11	5	4	2	3	**27**
1986	3	13	11	0	0	0	**27**
1987	2	3	1	0	0	0	**6**
1988	0	0	0	0	0	0	**0**
1989	4	11	4	0	0	0	**19**
1990	13	8	7	0	4	0	**32**
1991	6	2	0	1	0	0	**9**
1992	26	20	12	4	1	0	**63**
1993	2	3	0	0	0	0	**5**
1994	4	5	0	0	0	0	**9**
1995	1	2	0	0	0	0	**3**
1996	6	4	0	0	0	0	**10**
1997	7	6	1	1	0	0	**15**
1998	17	6	3	0	0	0	**26**
1999	10	9	1	1	1	0	**22**
2000	9	10	7	0	1	0	**27**
2001	4	2	2	1	0	0	**9**
2002	8	12	8	5	1	0	**34**
2003	7	4	2	0	0	0	**13**
2004	4	5	0	0	0	0	**9**
2005	2	2	0	0	0	0	**4**
2006	22	11	4	0	0	0	**37**
2007	8	5	0	0	0	0	**13**
2008	12	2	1	0	0	0	**15**
2009	10	3	0	0	0	0	**13**
2010	20	23	5	2	1	0	**51**
2011	24	14	2	0	0	0	**40**
2012	11	2	1	1	0	0	**15**

2013	20	14	3	0	0	0	**37**
2014	16	4	0	1	0	0	**21**
2015	5	2	0	0	0	0	**7**
2016	14	7	3	0	0	0	**24**
2017	13	11	2	0	0	0	**26**
Total	**385**	**459**	**209**	**63**	**33**	**9**	**1158**

Table 2.3.b - Source - NOAA Storm Database

Considering more tornadoes have formed in June than any other month, there is approximately a 20.8 percent chance of a tornado on any day in June. The likelihood of a tornado is lower during the winter and higher during the summer, as indicated in Graph 2.3.a.



Graph 2.3.a – Source NOAA Storm Database

Every County in the state of Ohio has experienced at least one tornado from 1950-2017, and six counties have each recorded at least 25 tornadoes (see table 2.3.d). Van Wert and Franklin Counties have had the most tornados with 33 and 32 respectively. Note that prior to 1900 tornados were not documented and rarely reported.

VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

The tables shown in this section were compiled using historic data from the NWS, and NOAA's National Centers for Environmental Information Storm Event Database. For each county in the State, information on tornadoes was entered in a spreadsheet using a time period of January 1, 1950, through December 31, 2017. Calculations were performed to obtain the following information: average damage amounts per tornado, annual probability, and estimated future annual losses.

The following are definitions of the terms used in the tables in this section:

- Total Damages = Cumulative sum of all reported damages associated with all tornadoes occurring in the 67 year period from January 1, 1950, to December 31, 2017 (reported damages obtained from the Storm Events Database)
- Average Damage per Tornado = Total damages divided by the number of tornadoes
- Estimated Annual Tornadoes = Number of tornadoes divided by the number of reporting years (67)
- Estimated Future Annual Losses = Average Damage per Tornado x Estimated Annual Tornadoes

Damage calculations include all reported property and crop damage as well as injuries and deaths sustained as a result of the tornadic event. Injury and death values were calculated as follows:

1. Injury was assigned a value based on the December 2011 FEMA Benefit-Cost Analysis Re-engineering (BCAR) Development of Standard Economic Values report, which incorporates research completed on behalf of the Department of Homeland Security in 2008. The values can be thought of as the "willingness-to-pay" (WTP) to avoid an injury.

The report recommends using 1997 values and adjusting for inflation using the US Bureau of Labor Statistics (BLS) Consumer Price Index (CPI) Inflation Calculator. These are the adjusted 2017 values:

Minor - $14,000
Moderate - $109,000
Serious - $406,000
Severe - $1,325,000
Critical - $5,391,000

2. Since the NWS does not differentiate between injury categories in their data, a combined injury value was calculated. 3.6 percent of tornadoes in the state are EF-4 to EF-5 (violent). About 23.5 percent are EF-2 to EF-3 (strong), and 72.8 percent are EF-0 to EF-1 (weak). That means that the types of injuries suffered will overwhelmingly be those types most likely to occur in weak tornadoes.

   According to FEMA's BCAR Tornado Safe Room Methodology Report (2009), on average, 5% of those injured will be hospitalized (injury categories Serious through Critical) in an EF-1 tornado and 10% in an EF-2. Therefore, the Serious through Critical injury WTP values were averaged and weighted as 10% of the total. The Minor and Moderate injury (non-hospitalization categories) WTP values were averaged and weighted as 90% of the total. The total was then rounded to the nearest thousand.

   {[($14,000 + $109,000)/2] x .9} +
   {[($406,000 + $1,325,000 + $5,391,000)/3] x .1} = $292,750

3. The CPI 2015 adjusted value of a statistical life is $7.07 million.

These calculations were done for each county to arrive at the future annual probability of a tornado and estimated annual losses from tornado events. Table 2.3.d lists the counties in alphabetical order and highlights the top five counties in each category. The top county is in black, the next four in grey.

County	Total # of Tornados	Total Damages	Avg. Damage per Event	Estimated Annual Tornados	Est. Future Annual Losses	Region
Adams	14	$4,327,105	$309,079	0.21	$64,584	3
Allen	17	$24,334,255	$1,431,427	0.25	$363,198	1
Ashland	16	$11,349,327	$709,333	0.24	$169,393	2
Ashtabula	15	$20,952,867	$1,396,858	0.22	$312,729	3
Athens	2	$1,683,093	$841,546	0.03	$25,121	3
Auglaize	13	$7,172,782	$551,752	0.19	$107,056	1
Belmont	2	$114,500	$57,250	0.03	$1,709	3
Brown	17	$47,933,351	$2,819,609	0.25	$715,423	3
Butler	16	$157,021,006	$9,813,813	0.24	$2,343,597	2

Carroll	8	$1,491,625	$186,453	0.12	$22,263	3
Champaign	5	$2,866,932	$573,386	0.07	$42,790	1
Clark	21	$16,425,120	$782,149	0.31	$245,151	1
Clermont	20	$33,461,205	$1,673,060	0.30	$499,421	3
Clinton	25	$32,697,805	$1,307,912	0.37	$488,027	2
Columbiana	15	$74,652,331	$4,976,822	0.22	$1,114,214	3
Coshocton	5	$64,768,200	$12,953,640	0.07	$966,690	3
Crawford	12	$7,173,778	$597,815	0.18	$107,071	1
Cuyahoga	15	**$353,263,446**	$23,550,896	0.22	**$5,272,589**	2
Darke	20	$79,928,571	$3,996,429	0.30	$1,192,964	1
Defiance	10	$6,156,855	$615,686	0.15	$91,893	1
Delaware	9	$23,330,489	$2,592,277	0.13	$348,216	2
Erie	12	$6,776,978	$564,748	0.18	$101,149	1
Fairfield	20	$6,588,032	$329,402	0.30	$98,329	2
Fayette	15	$13,892,275	$926,152	0.22	$207,347	2
Franklin	**32**	$101,400,430	$3,168,763	**0.48**	$1,513,439	2
Fulton	12	$14,241,637	$1,186,803	0.18	$212,562	1
Gallia	7	$20,530,908	$2,932,987	0.10	$306,431	3
Geauga	8	$5,514,050	$689,256	0.12	$82,299	2
Greene	20	**$1,376,241,590**	**$68,812,079**	0.30	**$20,540,919**	2
Guernsey	9	$14,225,350	$1,580,594	0.13	$212,319	3
Hamilton	16	$293,041,197	$18,315,075	0.24	$4,373,749	2
Hancock	10	$46,967,448	$4,696,745	0.15	$701,007	1
Hardin	6	$1,294,050	$215,675	0.09	$19,314	1
Harrison	3	$2,077,930	$692,643	0.04	$31,014	3
Henry	17	$7,232,458	$425,439	0.25	$107,947	1
Highland	16	$8,020,573	$501,286	0.24	$119,710	3
Hocking	3	$116,165	$38,722	0.04	$1,734	3
Holmes	9	$12,127,975	$1,347,553	0.13	$181,015	3
Huron	23	$33,799,378	$1,469,538	0.34	$504,468	1
Jackson	3	$8,507,500	$2,835,833	0.04	$126,978	3
Jefferson	4	$2,486,820	$621,705	0.06	$37,117	3
Knox	11	$4,732,072	$430,188	0.16	$70,628	2
Lake	2	$1,951,567	$975,783	0.03	$29,128	2
Lawrence	6	$8,526,589	$1,421,098	0.09	$127,263	3
Licking	23	$76,313,779	$3,317,990	0.34	$1,139,012	2
Logan	6	$1,965,000	$327,500	0.09	$29,328	1
Lorain	**27**	$225,473,132	$8,350,857	**0.40**	$3,365,271	2
Lucas	9	$215,581,412	**$23,953,490**	0.13	$3,217,633	1
Madison	9	$14,624,520	$1,624,947	0.13	$218,276	2
Mahoning	16	$18,135,126	$1,133,445	0.24	$270,674	3
Marion	15	$4,659,811	$310,654	0.22	$69,549	1
Medina	23	$13,618,884	$592,125	0.34	$203,267	2

Meigs	6	$3,472,484	$578,747	0.09	$51,828	3
Mercer	19	$31,396,989	$1,652,473	0.28	$468,612	1
Miami	21	$11,655,246	$555,012	0.31	$173,959	1
Monroe	2	$1,788,750	$894,375	0.03	$26,698	3
Montgomery	13	$20,618,124	$1,586,010	0.19	$307,733	2
Morgan	1	$68,400	$68,400	0.01	$1,021	3
Morrow	15	$104,942,762	$6,996,184	0.22	$1,566,310	2
Muskingum	16	$21,649,573	$1,353,098	0.24	$323,128	3
Noble	3	$729,544	$243,181	0.04	$10,889	3
Ottawa	11	$63,939,460	$5,812,678	0.16	$954,320	1
Paulding	12	$5,193,593	$432,799	0.18	$77,516	1
Perry	10	$15,800,575	$1,580,057	0.15	$235,829	3
Pickaway	20	$18,824,010	$941,201	0.30	$280,955	2
Pike	12	$2,665,815	$222,151	0.18	$39,788	3
Portage	14	**$591,200,591**	**$42,228,614**	0.21	**$8,823,889**	2
Preble	12	$67,178,530	$5,598,211	0.18	$1,002,665	1
Putnam	21	$31,619,797	$1,505,705	0.31	$471,937	1
Richland	**27**	$23,032,052	$853,039	**0.40**	$343,762	2
Ross	11	$11,596,973	$1,054,270	0.16	$173,089	3
Sandusky	7	$108,672,854	$15,524,693	0.10	$1,621,983	1
Scioto	15	$26,951,836	$1,796,789	0.22	$402,266	3
Seneca	20	$44,069,859	$2,203,493	0.30	$657,759	1
Shelby	6	$23,286,876	$3,881,146	0.09	$347,565	1
Stark	12	$88,937,842	$7,411,487	0.18	$1,327,430	2
Summit	11	$92,890,210	$8,444,565	0.16	$1,386,421	2
Trumbull	17	**$1,198,682,122**	**$70,510,713**	0.25	**$17,890,778**	3
Tuscarawas	13	$14,948,159	$1,149,858	0.19	$223,107	3
Union	9	$2,235,309	$248,368	0.13	$33,363	2
Van Wert	**33**	$51,911,893	$1,573,088	**0.49**	$774,804	1
Vinton	1	$25,500	$25,500	0.01	$381	3
Warren	24	$93,912,531	$3,913,022	0.36	$1,401,680	2
Washington	7	$4,958,252	$708,322	0.10	$74,004	3
Wayne	22	$75,075,209	$3,412,510	0.33	$1,120,526	2
Williams	9	$68,787,593	$7,643,066	0.13	$1,026,680	1
Wood	28	$192,134,845	$6,861,959	**0.42**	$2,867,684	1
Wyandot	9	**$872,714,153**	**$96,968,239**	0.13	**$13,025,584**	1
State	**1158**	**$7,519,337,586**	**$6,044,992**	**0.20**	**$112,228,919**	

Table 2.3.d –Source: NWS, NOAA and OEMA. All dollar amount have been adjusted to 2018 dollars

There are 14 counties in the Ohio (out of 88) which have experienced over $100 million in tornado damages, as reported by the NWS. Table 2.3 lists those top 14 counties.

County	Total # of Tornados	Total Damages
Greene	20	$1,366,757,514
Trumbull	17	$1,196,447,155
Wyandot	9	$872,683,567
Portage	14	$591,191,852
Cuyahoga	15	$349,961,028
Hamilton	16	$289,135,143
Lorain	27	$222,883,361
Lucas	9	$212,975,476
Wood	28	$190,633,284
Butler	16	$156,780,032
Sandusky	7	$108,581,096
Morrow	15	$104,118,686
Franklin	32	$101,352,366

Table 2.3.e – Source: NWS, NOAA and OEMA. All dollar amount have been adjusted to 2018 dollars

There is a large difference between the areas of the state that may experience the greatest number of tornados versus where the costliest tornados occur. Table 2.3.f lists the counties in Ohio which have on average experienced the costliest tornado events. Nine counties have experienced average reported damages that exceed 10 million dollars per event.

County	Total # of Tornados	Avg. Damage per Event
Wyandot	9	$96,964,841
Trumbull	17	$70,379,244
Greene	20	$68,337,876
Portage	14	$42,227,989
Lucas	9	$23,663,942
Cuyahoga	15	$23,330,735
Hamilton	16	$18,070,946
Sandusky	7	$15,511,585
Coshocton	5	$12,953,640

Table 2.3.f –Source: NWS, NOAA and OEMA. All dollar amount have been adjusted to 2018 dollars

When we look at the regional perspective, Region 2 had sustained more losses, other than crop damage, than another other region. Region 2 also leads in every other category related damages and possible future losses. Region 3 has the least amount in every category including related damages and possible future losses per Table 2.3.g.

County	Property Damage	Crop Damage	Total Damages	Avg. Damage per Event	Estimated Annual Tornados	Est. Future Annual Losses
Region 1	$2,038,000,183	$168,220	$2,049,138,150	$6,617,648	0.214	$1,416,851
Region 2	$3,799,492,312	$290,620	$3,822,722,240	$8,205,254	0.251	$2,059,251
Region 3	$1,641,377,786	$61,710	$1,647,477,196	$3,703,301	0.132	$487,223

Table 2.3.g –Source: NWS, NOAA and OEMA. All dollar amount have been adjusted to 2018 dollars

NWS data was used to project the annual probability of death and injury at the county level. Table 2.3.h lists the counties in alphabetical order for estimated future death and injury losses from tornado events with dollar amounts determined using the methodology explained earlier in this section.

County	Deaths	Estimated Annual Deaths	Estimated Annual Lost Due to Death	Injuries	Estimated Annual Injuries	Estimated Annual Lost Due to Injuries
Adams	2	0.030	$211,045	2	0.030	$8,739
Allen	11	0.164	$1,160,746	101	1.507	$441,310
Ashland	0	0.000	$0	16	0.239	$69,910
Ashtabula	0	0.000	$0	29	0.433	$126,713
Athens	0	0.000	$0	7	0.104	$30,586
Auglaize	0	0.000	$0	4	0.060	$17,478
Belmont	0	0.000	$0	0	0.000	$0
Brown	1	0.015	$105,522	6	0.090	$26,216
Butler	1	0.015	$105,522	31	0.463	$135,451
Carroll	1	0.015	$105,522	5	0.075	$21,847
Champaign	0	0.000	$0	4	0.060	$17,478
Clark	0	0.000	$0	11	0.164	$48,063
Clermont	4	0.060	$422,090	51	0.761	$222,840
Clinton	2	0.030	$211,045	19	0.284	$83,019
Columbiana	0	0.000	$0	27	0.403	$117,974
Coshocton	0	0.000	$0	0	0.000	$0
Crawford	0	0.000	$0	6	0.090	$26,216
Cuyahoga	**12**	**0.179**	**$1,266,269**	**466**	**6.955**	**$2,036,142**
Darke	0	0.000	$0	26	0.388	$113,604
Defiance	0	0.000	$0	0	0.000	$0
Delaware	4	0.060	$422,090	38	0.567	$166,037
Erie	2	0.030	$211,045	26	0.388	$113,604
Fairfield	0	0.000	$0	16	0.239	$69,910
Fayette	1	0.015	$105,522	5	0.075	$21,847
Franklin	0	0.000	$0	11	0.164	$48,063
Fulton	1	0.015	$105,522	8	0.119	$34,955
Gallia	0	0.000	$0	20	0.299	$87,388

Geauga	0	0.000	$0	0	0.000	$0
Greene	**37**	**0.552**	**$3,904,328**	**1277**	**19.060**	**$5,579,728**
Guernsey	0	0.000	$0	11	0.164	$48,063
Hamilton	**13**	**0.194**	**$1,371,791**	**580**	**8.657**	**$2,534,254**
Hancock	2	0.030	$211,045	16	0.239	$69,910
Hardin	0	0.000	$0	0	0.000	$0
Harrison	1	0.015	$105,522	15	0.224	$65,541
Henry	5	0.075	$527,612	2	0.030	$8,739
Highland	0	0.000	$0	6	0.090	$26,216
Hocking	0	0.000	$0	0	0.000	$0
Holmes	0	0.000	$0	11	0.164	$48,063
Huron	6	0.090	$633,134	114	1.701	$498,112
Jackson	0	0.000	$0	0	0.000	$0
Jefferson	0	0.000	$0	1	0.015	$4,369
Knox	0	0.000	$0	17	0.254	$74,280
Lake	0	0.000	$0	40	0.597	$174,776
Lawrence	0	0.000	$0	1	0.015	$4,369
Licking	1	0.015	$105,522	26	0.388	$113,604
Logan	0	0.000	$0	0	0.000	$0
Lorain	**18**	**0.269**	**$1,899,403**	158	2.358	$690,366
Lucas	**16**	**0.239**	**$1,688,358**	**210**	**3.134**	**$917,575**
Madison	0	0.000	$0	1	0.015	$4,369
Mahoning	3	0.045	$316,567	15	0.224	$65,541
Marion	0	0.000	$0	3	0.045	$13,108
Medina	0	0.000	$0	15	0.224	$65,541
Meigs	0	0.000	$0	9	0.134	$39,325
Mercer	2	0.030	$211,045	29	0.433	$126,713
Miami	0	0.000	$0	2	0.030	$8,739
Monroe	0	0.000	$0	0	0.000	$0
Montgomery	0	0.000	$0	33	0.493	$144,190
Morgan	0	0.000	$0	0	0.000	$0
Morrow	4	0.060	$422,090	92	1.373	$401,985
Muskingum	1	0.015	$105,522	24	0.358	$104,866
Noble	1	0.015	$105,522	1	0.015	$4,369
Ottawa	0	0.000	$0	17	0.254	$74,280
Paulding	0	0.000	$0	7	0.104	$30,586
Perry	0	0.000	$0	11	0.164	$48,063
Pickaway	0	0.000	$0	37	0.552	$161,668
Pike	0	0.000	$0	11	0.164	$48,063
Portage	0	0.000	$0	2	0.030	$8,739
Preble	0	0.000	$0	0	0.000	$0
Putnam	2	0.030	$211,045	0	0.000	$0
Richland	0	0.000	$0	16	0.239	$69,910

Ross	0	0.000	$0	8	0.119	$34,955
Sandusky	0	0.000	$0	21	0.313	$91,757
Scioto	7	0.104	$738,657	77	1.149	$336,444
Seneca	6	0.090	$633,134	32	0.478	$139,821
Shelby	3	0.045	$316,567	74	1.104	$323,336
Stark	2	0.030	$211,045	12	0.179	$52,433
Summit	0	0.000	$0	0	0.000	$0
Trumbull	10	0.149	$1,055,224	**270**	**4.030**	**$1,179,739**
Tuscarawas	0	0.000	$0	10	0.149	$43,694
Union	0	0.000	$0	11	0.164	$48,063
Van Wert	2	0.030	$211,045	27	0.403	$117,974
Vinton	0	0.000	$0	0	0.000	$0
Warren	0	0.000	$0	26	0.388	$113,604
Washington	0	0.000	$0	5	0.075	$21,847
Wayne	0	0.000	$0	10	0.149	$43,694
Williams	0	0.000	$0	19	0.284	$83,019
Wood	11	0.164	$1,160,746	78	1.164	$340,813
Wyandot	0	0.000	$0	7	0.104	$30,586
State	**195**	**0.033**	**$233,828**	**4432**	**0.752**	**$220,059**

Table 2.3.h– Source: NWS, NOAA and OEMA. All dollar amount have been adjusted to 2018 dollars

When we look at the regions, Region 1 has sustained more losses than another other region related to deaths and injuries. This is driven primarily by Greene, Lucas and Cuyahoga Counties.

County	Total # of Tornados	Deaths	Estimated Annual Deaths	Estimated Annual Lost Due to Death	Injuries	Estimated Annual Injuries	Estimated Annual Lost Due to Injuries
Region 1	416	69	0.036	$251,071	844	0.434	$127,165
Region 2	454	95	0.053	$371,282	2955	1.633	$478,207
Region 3	288	31	0.014	$102,225	633	0.295	$86,432

Table 2.3.i – Source: NWS, NOAA and OEMA. All dollar amount have been adjusted to 2018 dollars

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Tornadoes, being non-spatial hazards, make it difficult to predict their impact on state owned and leased critical facilities. The entire state is within the 250 mph wind speed zone per map 2.a.; therefore, the potential for tornado to impact state-owned or leased structures exists. When comparing the Counties with the greatest value of state owned and leased critical facilities noted in Appendix C and the vulnerability analysis and loss estimation performed above using historical data, there is only one county (Cuyahoga) who is in the top ten for both value of critical facilities and estimate future losses to property and crops.

County	Critical Facility Value	Total # of Tornados	Total Damages	Avg. Damage per Event	Est. Future Annual Losses
Adams	$ 6,635,481	14	$4,327,105	$309,079	$64,584
Allen	$ 90,950,176	17	$24,334,255	$1,431,427	$363,198
Ashland	$ 64,079,271	16	$11,349,327	$709,333	$169,393
Ashtabula	$ 18,832,622	15	$20,952,867	$1,396,858	$312,729
Athens	$ 33,380,530	2	$1,683,093	$841,546	$25,121
Auglaize	$ 11,545,804	13	$7,172,782	$551,752	$107,056
Belmont	$ 54,856,808	2	$114,500	$57,250	$1,709
Brown	$ 36,403,605	17	$47,933,351	$2,819,609	$715,423
Butler	$ 17,563,033	16	$157,021,006	$9,813,813	$2,343,597
Carroll	$ 3,661,999	8	$1,491,625	$186,453	$22,263
Champaign	$ 5,161,316	5	$2,866,932	$573,386	$42,790
Clark	$ 8,868,061	21	$16,425,120	$782,149	$245,151
Clermont	$ 17,885,810	20	$33,461,205	$1,673,060	$499,421
Clinton	$ 11,528,821	25	$32,697,805	$1,307,912	$488,027
Columbiana	$ 13,236,861	15	$74,652,331	$4,976,822	$1,114,214
Coshocton	$ 12,943,450	5	$64,768,200	$12,953,640	$966,690
Crawford	$ 10,357,812	12	$7,173,778	$597,815	$107,071
Cuyahoga	**$ 248,840,544**	15	**$353,263,446**	$23,550,896	**$5,272,589**
Darke	$ 8,619,026	20	$79,928,571	$3,996,429	$1,192,964
Defiance	$ 7,562,674	10	$6,156,855	$615,686	$91,893
Delaware	$ 46,217,477	9	$23,330,489	$2,592,277	$348,216
Erie	$ 162,265,731	12	$6,776,978	$564,748	$101,149
Fairfield	$ 86,519,830	20	$6,588,032	$329,402	$98,329
Fayette	$ 5,118,182	15	$13,892,275	$926,152	$207,347
Franklin	**$ 2,160,396,499**	**32**	$101,400,430	$3,168,763	$1,513,439
Fulton	$ 4,397,188	12	$14,241,637	$1,186,803	$212,562
Gallia	$ 35,860,837	7	$20,530,908	$2,932,987	$306,431
Geauga	$ 8,594,197	8	$5,514,050	$689,256	$82,299
Greene	$ 9,914,088	20	**$1,376,241,590**	**$68,812,079**	**$20,540,919**
Guernsey	$ 39,704,477	9	$14,225,350	$1,580,594	$212,319
Hamilton	$ 173,140,806	16	$293,041,197	$18,315,075	$4,373,749
Hancock	$ 16,195,898	10	$46,967,448	$4,696,745	$701,007
Hardin	$ 4,141,282	6	$1,294,050	$215,675	$19,314
Harrison	$ 9,054,441	3	$2,077,930	$692,643	$31,014
Henry	$ 3,113,844	17	$7,232,458	$425,439	$107,947
Highland	$ 9,678,402	16	$8,020,573	$501,286	$119,710
Hocking	$ 19,239,206	3	$116,165	$38,722	$1,734
Holmes	$ 10,336,112	9	$12,127,975	$1,347,553	$181,015
Huron	$ 10,543,997	23	$33,799,378	$1,469,538	$504,468
Jackson	$ 15,130,501	3	$8,507,500	$2,835,833	$126,978

Jefferson	$ 7,592,901	4	$2,486,820	$621,705	$37,117
Knox	$ 40,507,246	11	$4,732,072	$430,188	$70,628
Lake	$ 5,525,021	2	$1,951,567	$975,783	$29,128
Lawrence	$ 7,469,158	6	$8,526,589	$1,421,098	$127,263
Licking	$ 158,043,312	23	$76,313,779	$3,317,990	$1,139,012
Logan	$ 6,290,042	6	$1,965,000	$327,500	$29,328
Lorain	$ 110,598,850	**27**	$225,473,132	$8,350,857	$3,365,271
Lucas	**$ 276,597,391**	9	$215,581,412	**$23,953,490**	$3,217,633
Madison	**$ 321,691,881**	9	$14,624,520	$1,624,947	$218,276
Mahoning	$ 73,288,381	16	$18,135,126	$1,133,445	$270,674
Marion	$ 128,613,896	15	$4,659,811	$310,654	$69,549
Medina	$ 18,601,644	23	$13,618,884	$592,125	$203,267
Meigs	$ 8,547,106	6	$3,472,484	$578,747	$51,828
Mercer	$ 7,655,738	19	$31,396,989	$1,652,473	$468,612
Miami	$ 14,677,401	21	$11,655,246	$555,012	$173,959
Monroe	$ 6,530,556	2	$1,788,750	$894,375	$26,698
Montgomery	$ 78,066,704	13	$20,618,124	$1,586,010	$307,733
Morgan	$ 3,950,084	1	$68,400	$68,400	$1,021
Morrow	$ 6,874,959	15	$104,942,762	$6,996,184	$1,566,310
Muskingum	$ 10,647,135	16	$21,649,573	$1,353,098	$323,128
Noble	$ 50,867,811	3	$729,544	$243,181	$10,889
Ottawa	$ 65,293,745	11	$63,939,460	$5,812,678	$954,320
Paulding	$ 1,387,796	12	$5,193,593	$432,799	$77,516
Perry	$ 3,884,728	10	$15,800,575	$1,580,057	$235,829
Pickaway	$ 195,643,558	20	$18,824,010	$941,201	$280,955
Pike	$ 3,878,547	12	$2,665,815	$222,151	$39,788
Portage	$ 7,594,529	14	**$591,200,591**	**$42,228,614**	**$8,823,889**
Preble	$ 4,859,547	12	$67,178,530	$5,598,211	$1,002,665
Putnam	$ 5,590,738	21	$31,619,797	$1,505,705	$471,937
Richland	$ 109,750,465	**27**	$23,032,052	$853,039	$343,762
Ross	**$ 265,584,512**	11	$11,596,973	$1,054,270	$173,089
Sandusky	$ 5,519,069	7	$108,672,854	$15,524,693	$1,621,983
Scioto	$ 171,351,723	15	$26,951,836	$1,796,789	$402,266
Seneca	$ 33,546,722	20	$44,069,859	$2,203,493	$657,759
Shelby	$ 26,824,309	6	$23,286,876	$3,881,146	$347,565
Stark	$ 102,066,812	12	$88,937,842	$7,411,487	$1,327,430
Summit	$ 201,182,298	11	$92,890,210	$8,444,565	$1,386,421
Trumbull	$ 54,712,352	17	**$1,198,682,122**	**$70,510,713**	**$17,890,778**
Tuscarawas	$ 56,132,900	13	$14,948,159	$1,149,858	$223,107
Union	$ 88,869,557	9	$2,235,309	$248,368	$33,363
Van Wert	$ 7,459,562	**33**	$51,911,893	$1,573,088	$774,804
Vinton	$ 5,854,782	1	$25,500	$25,500	$381
Warren	$ 150,201,626	24	$93,912,531	$3,913,022	$1,401,680

Washington	$ 28,580,706	7	$4,958,252	$708,322	$74,004
Wayne	$ 7,056,104	22	$75,075,209	$3,412,510	$1,120,526
Williams	$ 5,459,757	9	$68,787,593	$7,643,066	$1,026,680
Wood	$ 67,981,624	**28**	$192,134,845	$6,861,959	$2,867,684
Wyandot	$ 10,280,904	9	**$872,714,153**	**$96,968,239**	**$13,025,584**

Table 2.3.j – Source: NWS, NOAA and OEMA. All dollar amounts have been adjusted to 2018 dollars

From a regional perspective, the impacts to Region 2 are significantly greater for two very clear reasons; one the amount of exposed critical facilities is significantly greater in Region 2 compared to the other regions. Second, Region 2 is impacted at a greater rate across all of the tornado related categories when compared to the other regions.

County	Critical Facility Value	Total # of Tornados	Total Damages	Avg. Damage per Event	Est. Future Annual Losses
Region 1	$ 1,011,761,050	416	$2,049,138,150	$6,617,648	$1,416,851
Region 2	$ 4,434,187,314	454	$3,822,722,240	$8,205,254	$2,059,251
Region 3	$ 1,095,714,524	288	$1,647,477,196	$3,703,301	$487,223

Table 2.3.k – Source: NWS, NOAA and OEMA. All dollar amount have been adjusted to 2018 dollars

2.4 WINTER STORM

Canadian and Arctic cold fronts that push cold temperatures, ice, and snow into the State generally cause winter storms, blizzards, and ice storms. Severe winter weather in Ohio consists of freezing temperatures and heavy precipitation, usually in the form of snow, freezing rain, or sleet. Severe winter weather affects all parts of the State.

Blizzard conditions occur when the following conditions last three hours or longer:

- 35 mph or greater wind speeds,
- Considerable snowfall and blowing snow bringing visibility below ¼ mile, and,
- Temperatures of 20º F or lower.

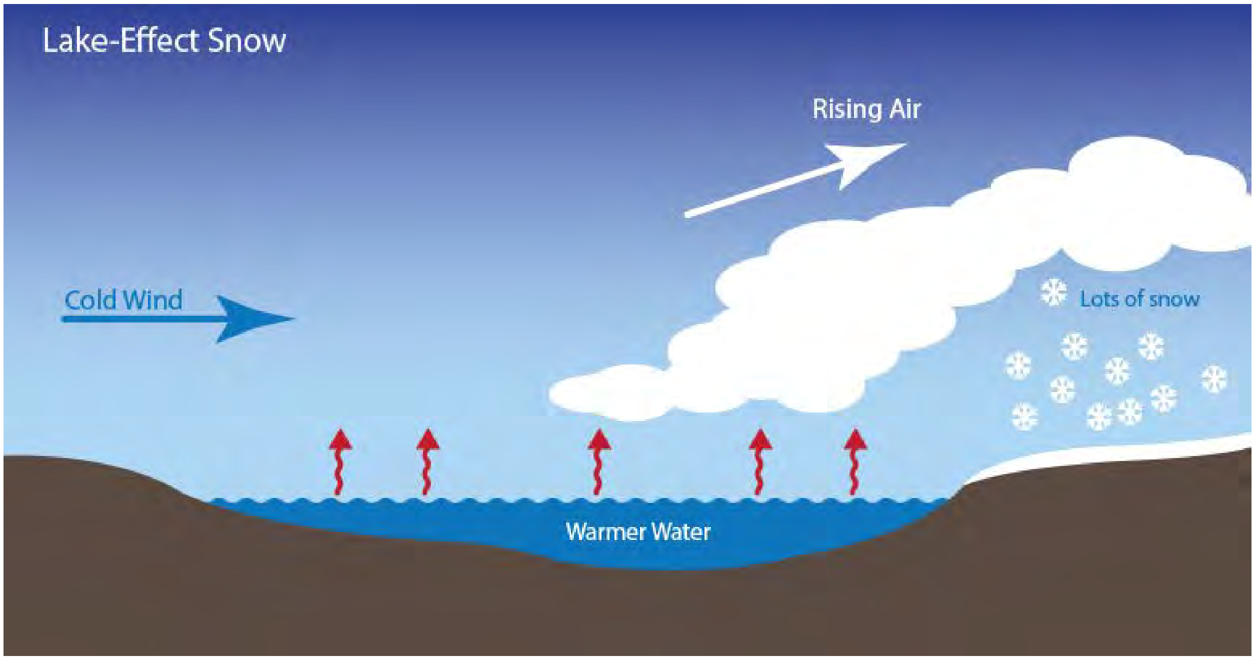
Severe blizzards have wind speeds exceeding 45 mph, visibility near zero, and temperatures of 10º F or lower.

While Ohio residents and governments are accustomed to handling winter storm events, occasional extreme events can make conditions dangerous and disruptive. Heavy snow volume makes snow removal difficult. Trees, cars, roads, and other surfaces develop a coating of ice, making even small accumulations of ice extremely hazardous to motorists and pedestrians. The most prevalent impacts of heavy accumulations of ice are slippery roads and walkways that lead to vehicle and pedestrian accidents; collapsed roofs from fallen trees and limbs from heavy ice and snow loads; and felled trees, telephone poles and lines, electrical wires, and communication towers. As a result of severe ice storms, telecommunications and power can be disrupted for days.

The northeastern portion of Ohio near the Great Lakes experiences what is known as “lake-effect snow” (see Figure 2.4.a). As cold air passes over the relatively warm waters of the large lakes, the weather system absorbs moisture and heat, and releases this in the form of snow. Lake effect snowfall intensity is affected by:

- The contrast between the lake and air temperatures,
- The distance air has traveled over water, known as the fetch, and
- The regional weather conditions-- a snow storm’s maximum penetration inland will generally be greatest during late autumn/early winter and shortest during the late winter.

Figure 2.4a
Generation of Lake Effect Snow



Source: https://scijinks.gov/lake-snow/

Lake-effect snowstorms have been known to cause continuous snowfall for as long as 48 hours over a sharply defined region. One single, intense local storm cell can yield as much as 48 inches of light-density snow in 24 hours or less. Consequently, snowfalls can vary greatly, with areas of deep snowfall adjacent to areas with relatively little snow.

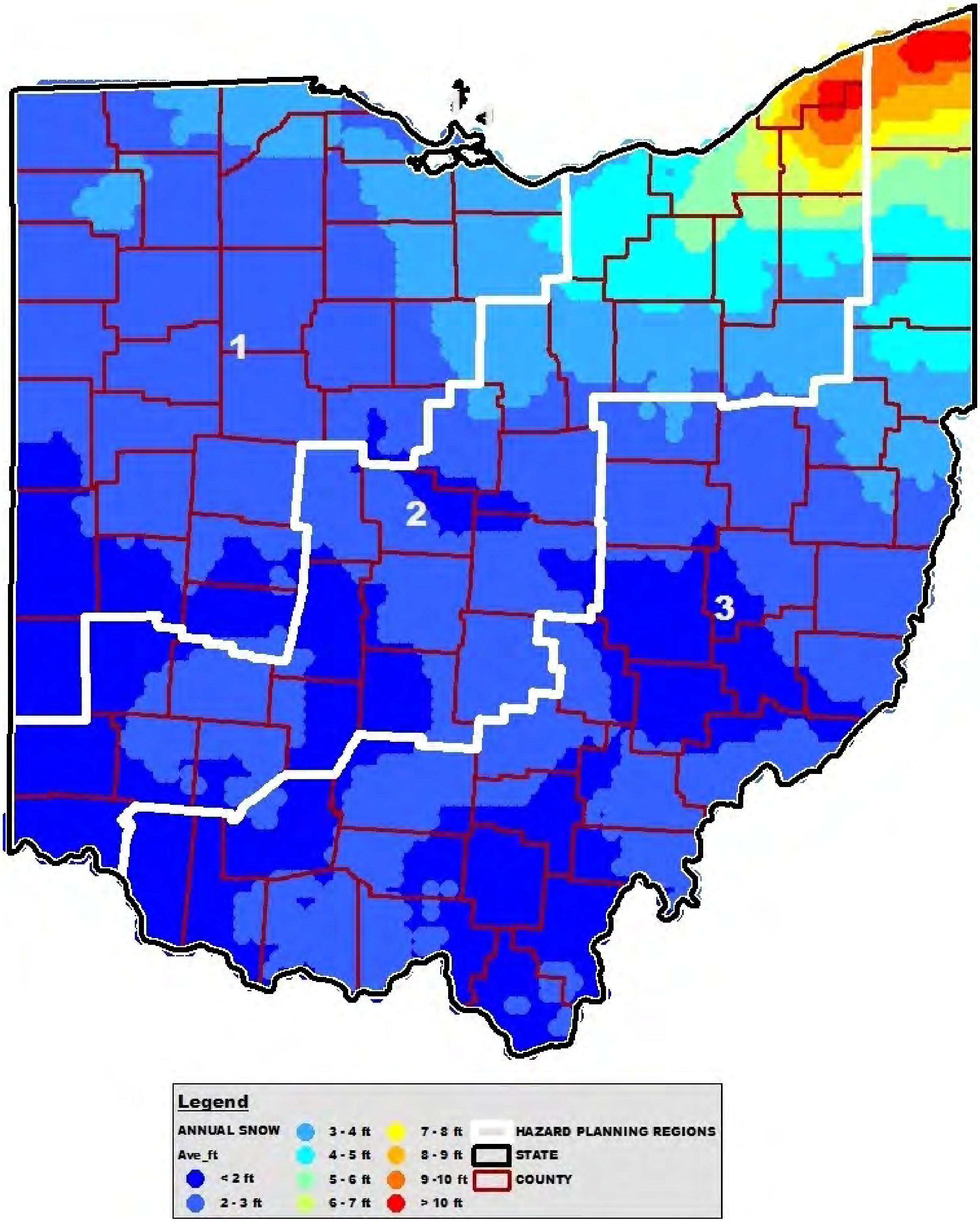
Snow and strong easterly wind conditions ahead of a warm front usually cause ice storms. The snow, however, changes temporarily to sleet and then to rain that freezes when it hits the ground, covering exposed surfaces with a layer of ice. Local accumulations of ice may be heavy if the storm halts over a region for extended periods of time. Ice storms lasting more than 12 hours usually produce ice accumulations several inches thick and affect an area that may range from a few square miles to areas covering several states. The typical ice storm swath is 30 miles wide and 300 miles long.

RISK ASSESSMENT

LOCATION

Winter storms are non-spatial hazards; therefore, it is difficult to determine the actual location of the damage that may result from a winter storm event. In an effort to address this limitation the mean annual snow depth from 2013 to 2017 was mapped (see Map 2.4.a).

State of Ohio
Map 2.4a: Annual Mean Snow Depth
2013-2017



Source: https://www.nohrsc.noaa.gov/snowfall/

In the last five years, the state of Ohio has experienced more snow in the northeastern part of the state. Counties that are closer to Lake Erie see greater levels of snowfall than the rest of the state. Lake, Geauga, and Ashtabula counties can see greater than ten feet of snowfall in a given year. This trend tapers off as the level of snowfall generally decreases as you move closer to the south and southwestern counties. Region 1 generally receives milder levels of snowfall compared to the other regions.

PAST OCCURANCES

Ohio experienced more than 280 severe winter storms between 1925 and 2014. Several storms were notable and since 1964, two involved federal declarations. In the 10-year window from the beginning of 2008 to the end of 2017, there were 69 days with winter storm events.

In January 1978, the Great Blizzard of 1978 closed homes and businesses for one week and caused the deaths of 51 people. Wind gusts reached 70 mph and caused blowing and drifting snow. The worst winter storm in Ohio history struck before dawn on Thursday, January 26th, 1978. The Blizzard of ’78 continued through Thursday and into Friday. Transportation, business, industry, and schools were closed statewide for two days with the normal pace of society not returning to the state for five days. Atmospheric pressure fell to 28.28 inches at Cleveland, the lowest ever recorded in Ohio, as the center of the blizzard crossed Ohio. This rapidly intensifying storm pulled bitterly cold air across Ohio on winds of 50 to 70 mph. These conditions, combined with heavy snow and blowing of deep snow already on the ground, caused extreme blizzard conditions all across Ohio. Enormous snowdrifts covered cars and houses, blocked highways and railways, and closed all airports for two days. More than 5,000 members of the Ohio National Guard were called to duty and were pressed into long hours of work with heavy equipment clearing roads, assisting electric utility crews, rescuing stranded persons, and transporting doctors and nurses to hospitals. Forty-five National Guard helicopters flew 2,700 missions across Ohio rescuing thousands of stranded persons, many in dire medical emergencies. Thousands of volunteers with snowmobiles and four-wheel drive vehicles responded to pleas from police statewide to deliver medicine and transport doctors and nurses to hospitals. The death toll of 51 made this one of the deadliest winter storms in Ohio history. As a result of this event, Ohio counties received a total of $3,546,669 in public assistance funds.

February 2003 (DR-1453): Prior to this event, a several series of low-pressure systems tracked through the Ohio River valley, producing up to four inches of snow across west central Ohio all through the month of January. The main event happened when a warm front ahead of low-pressure passing through the Tennessee Valley brought abundant moisture to the Ohio Valley on east-southeast winds. Cold air was already in place on the surface and conditions were right for snow accumulation of 6 to 8 inches to occur over much of the region north of the Ohio River. Counties closest to the Ohio River saw some ice accumulations to a quarter or a half inch, but the majority of the weather associated with this system was heavy snow along the I-70 corridor. Fayette, Franklin, Greene, Guernsey, Monroe, and Muskingum counties received record snowfall from this event. Adams, Gallia, Lawrence, Meigs, and Scioto Counties had severe ice accumulation in addition to snow that downed trees and power lines. Loss of power to water treatment and sewage systems resulted in the loss of water pressure to customers. For those who had some water, boil alerts were issued. In Gallia County, most of the water customers lost service and needed generators to restore service. Booster station in the affected areas did not have full power until a week after the storm hit the region. At one time more than an estimated 12,000 customers were without water. As a result of this event, thirty Ohio counties received a total of $15,761,979.42 in public assistance funds.

December 2004 – January 2005 (DR-1580): A low-pressure system moved into the northeast across the Ohio Valley. Cold west to northwest winds behind the low caused lake effect snow showers to develop in Northeast Ohio. This activity began during the predawn hours of the 16th and continued through midday on the 17th. The heaviest fell during the late afternoon and evening hours of the 16th when visibilities at times were near zero. Accumulations ranged from 6 to 8 inches in Geauga, southern Ashtabula, and eastern Cuyahoga Counties. This storm system affected four additional counties to the previous storm and caused an approximate $106,901,000 in property damage. As a result of this event, Ohio counties received a total of $7,948,685.48 in public assistance funds.

January - February 2005 (EM-3198): An Alberta Clipper passed to the north of Lake Erie during the evening hours of November 23rd. An arctic cold front trailing this low swept east across Ohio by the early morning hours of the 24th. Cold northwest winds behind this front caused lake effect snow showers to develop just before daybreak on the 24th. These bands quickly intensified and by mid-morning, visibilities in some areas were less than one-quarter mile. Northwest winds gusting in excess of 30 mph accompanied the snow and caused considerable blowing and drifting. The snow showers tapered to flurries during the early evening hours. Snowfall totals of 6 to 9 inches were reported in both Geauga and inland Ashtabula Counties by sunset on the 24th. Then, after midnight on the 25th, an upper-level disturbance rotated through the region. This caused a new round of lake effect snow showers to develop. This activity diminished during the afternoon of the 25th after another 6 to 9 inches of snow had fallen. Two-day totals for this event exceed a foot of snow in many locations.

A peak of 15.6 inches was measured in Hambden Township (Geauga County) with 14 inches at Hartsgrove (Ashtabula County). This storm system affected four additional counties to the previous storm and caused an approximate $5,475,000 in property damage. As a result of this event, Ohio counties received a total of $1,447,217.85 in public assistance funds.

March 2008 (EM-3286): On the morning of March 7th, snow spread into the region during the morning and afternoon hours, then tapered off during the evening and overnight into the 8th. Snow intensified across the area as low-pressure moved north into the Carolinas by the morning of the 8th. Snow persisted across much of the area but did mix with sleet and freezing rain at times across far eastern Ohio. By the evening hours of the 8th, snow began tapering off from west to east. Any areas of mixed precipitation across far eastern Ohio changed back to snow before ending. The low-pressure continued intensifying as it moved into New England by the morning hours of the 9th. Some light snow and flurries persisted overnight, mainly from around Cleveland and points east, but by midday on the 9th the snow tapered off across the entire area. Throughout this event, locations across northwest Ohio picked up between 5 and 10 inches. Those locations experienced a rather steep gradient for snowfall totals. In eastern Ohio, snowfall amounts were slightly lower as sleet and freezing rain mixed in at times causing reduced snowfall amounts. Locations across northeast and north-central Ohio saw the greatest snowfall amounts with 21.5 inches in Broadview Heights in Cuyahoga County, and 21.0 inches in Galion located in Crawford County. As a result of this event, Ohio counties received a total of $1,709,668.49 in public assistance funds.

PROBABILITY OF FUTURE EVENTS

Map 2.4.a depicts National Climatic Data Center figures of Ohio's annual mean snow depth for the years 2013 to 2017. South and Southwestern portions of Ohio have mean snow depths of one to two feet and central Ohio has between two and three feet. However, the northeastern corner of the state has mean snow depths of four feet or more. Lake, Geauga, and Ashtabula counties can see greater than ten feet of snowfall in a given year.

In the ten-year timeframe from January 1, 2008 to December 31, 2017, there were 69 days with winter storm events. In terms of probability, the state has a 100% chance of seeing snowfall in any given year, and 6.9 days with winter storm events per year. However, the level and severity of snowfall vary greatly by location. The vast majority of Ohio has the same chance of exceeding one to three feet of snow. The higher snowfall totals and probability for the northeastern portion of Ohio can be attributed to the lake effect snows caused by the area's proximity to the Great Lakes. Global climate change may have an impact on the probability of future events; however, it is unclear as to the extent of this impact.

LHMP DATA

Cuyahoga County: The Countywide All Natural Hazards Mitigation Plan of 2017 states that severe winter storm hazards can cause a range of damage to structures that will depend on the magnitude and duration of storm events. Losses may be as small as lost productivity and wages when workers are unable to travel or as large as sustained roof damage or building collapse. According to the National Climatic Data Center website, between January 1996 and February 2015, Cuyahoga County has been impacted by 69 severe winter weather events that have accounted for $17,770,000 in damages.

Lake County: The Lake County Hazard Mitigation Plan of 2017 indicates there have been 99 severe winter storms from 1950 to 2016 causing $27,787,000 in damages. These types of storms are known to cause utility, infrastructure, structural damages. They can also cause severe transportation problems and make travel extremely dangerous. After extensive examination and spreadsheet calculations, loss estimates show a total of $1,808,927.63 in possible structure damaged.

Ashtabula County: The HIRA of the Ashtabula County Countywide All Natural Hazards Mitigation Plan of August 2012 examines subcategories of winter storms: blizzards, ice storms, lake effect snow on the southeastern Lake Erie Snow Belt, and extreme cold. From 1993 to 2011, there were 105 severe winter events causing a total of over $200 million in property and crop damage. The frequency is the expectation of eight storms in any given year.

VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

A hybrid approach was taken using historical data and the taxable value of real property for each county within the state. First, a historical analysis was done first for each county. The total reported property damage of each event was adjusted to 2017 dollars and summed up to for each county. This was then divided by 10 for the number of years assessed. The result of this is the estimated annual damage for each county. This number was then divided by the total taxable value of real property within the county to determine the percentage of estimated damage for each of the 88 county in any given year. The problem with this approach was that in last ten years, only 34 of 88 counties reported damage and that the other 54 counties would then have an estimated annual damage of 0 dollars which is unrealistic whether the county has reported damage or not.

To offset the lack of data for these counties, the sum of the ten-year damages across the state ($144,653,100) was divided by 10 to determine the annual loss. This figure as well as the state-wide real value of property was respectively divided by the 88 (counties in the state) to determine the average damage per county and the average taxable value per county in the state. The first was then divided by the latter resulting in the percentage of estimated damage the average county, 0.00608%, in Ohio in any given year. This percentage was for the 54 counties determined to have a zero-percent of estimated damage and the eight with less than 0.00608%.

RESULTS

In Region 1, it is estimated that Lucas County will have the highest county-wide damage per year at $418,249.94. However, the county with the highest per-capita cost is tied between Crawford County and Wyandot at $6.67 dollars per person. At $278,348.50, Crawford has almost double the estimated annual damage than Wyandot County, however also has double the number of people in the county.

Table 2.4.a

Estimate of Potential Losses to Winter Storms by Region						
Region 1						
County	Region	Population	County-wide Taxable Value of Real Property	Percentage Relative to County-wide Real Property	Countywide Annual Damage	Annual Damage per Capita
Allen	1	103198	$ 1,826,294,900	0.00608%	$ 110,962.01	$ 1.08
Auglaize	1	45778	$ 1,045,961,280	0.00608%	$ 63,550.50	$ 1.39
Champaign	1	38840	$ 837,712,700	0.00608%	$ 50,897.74	$ 1.31
Clark	1	134557	$ 2,238,882,200	0.00608%	$ 136,029.98	$ 1.01
Crawford	1	41746	$ 682,344,300	0.04079%	$ 278,348.50	$ 6.67
Darke	1	51536	$ 1,204,199,630	0.00608%	$ 73,164.75	$ 1.42
Defiance	1	38156	$ 810,287,070	0.00608%	$ 49,231.41	$ 1.29
Erie	1	74817	$ 1,948,076,220	0.01147%	$ 223,352.50	$ 2.99
Fulton	1	42289	$ 962,533,270	0.00608%	$ 58,481.59	$ 1.38
Hancock	1	75754	$ 1,795,323,240	0.01374%	$ 246,661.00	$ 3.26
Hardin	1	31364	$ 498,135,770	0.00608%	$ 30,265.73	$ 0.96
Henry	1	27185	$ 733,870,540	0.00608%	$ 44,588.50	$ 1.64
Huron	1	58494	$ 1,082,908,850	0.02258%	$ 244,572.00	$ 4.18
Logan	1	45325	$ 1,184,524,350	0.00608%	$ 71,969.32	$ 1.59
Lucas	1	430887	$ 6,883,867,330	0.00608%	$ 418,249.94	$ 0.97
Marion	1	64967	$ 1,082,107,640	0.02203%	$ 238,396.00	$ 3.67
Mercer	1	40873	$ 1,085,979,200	0.00608%	$ 65,981.91	$ 1.61
Miami	1	105122	$ 2,201,940,990	0.00608%	$ 133,785.51	$ 1.27
Ottawa	1	40657	$ 1,704,672,130	0.01455%	$ 248,061.50	$ 6.10
Paulding	1	18845	$ 448,002,890	0.00608%	$ 27,219.75	$ 1.44
Preble	1	41120	$ 881,141,010	0.00608%	$ 53,536.36	$ 1.30
Putnam	1	33878	$ 895,134,450	0.00608%	$ 54,386.57	$ 1.61
Sandusky	1	59195	$ 1,190,519,630	0.02125%	$ 252,981.50	$ 4.27
Seneca	1	55243	$ 1,096,270,950	0.01387%	$ 152,083.00	$ 2.75
Shelby	1	48759	$ 1,126,081,630	0.00608%	$ 68,418.46	$ 1.40
Van Wert	1	28217	$ 692,123,620	0.00608%	$ 42,052.04	$ 1.49
Williams	1	36784	$ 753,802,910	0.00608%	$ 45,799.55	$ 1.25
Wood	1	130492	$ 2,940,024,810	0.00942%	$ 276,890.00	$ 2.12
Wyandot	1	22029	$ 528,510,740	0.02781%	$ 146,976.00	$ 6.67
Total					$ 3,906,893.60	

In Region 2, it is estimated that Cuyahoga County will have the highest county-wide damage per year at $1,612,463.18. Close behind are Lake and Franklin Counties at $1,590,875.00 and $1,585,949.85 respectively. The county with the highest per-capita cost is Geauga County at $8.53 dollars per person.

Region 2						
County	**Region**	**Population**	**County-wide Taxable Value of Real Property**	**Percentage Relative to County-wide Real Property**	**Countywide Annual Damage**	**Annual Damage per Capita**
Ashland	2	53628	$ 962,136,090.00	0.03724%	$ 358,262.50	$ 6.68
Butler	2	380604	$ 7,053,834,350.00	0.00608%	$ 428,576.79	$ 1.13
Clinton	2	42009	$ 903,332,250.00	0.00608%	$ 54,884.65	$ 1.31
Cuyahoga	2	1248514	$ 26,539,113,700.00	0.00608%	$ 1,612,463.18	$ 1.29
Delaware	2	200464	$ 6,748,868,310.00	0.00608%	$ 410,047.67	$ 2.05
Fairfield	2	154733	$ 3,379,701,100.00	0.00608%	$ 205,343.84	$ 1.33
Fayette	2	28752	$ 701,511,200.00	0.00608%	$ 42,622.41	$ 1.48
Franklin	2	1291981	$ 26,102,737,640.00	0.00608%	$ 1,585,949.85	$ 1.23
Geauga	2	93918	$ 2,986,153,270.00	0.02683%	$ 801,325.00	$ 8.53
Greene	2	166752	$ 3,823,992,400.00	0.00608%	$ 232,338.09	$ 1.39
Hamilton	2	813822	$ 17,484,107,920.00	0.00608%	$ 1,062,299.24	$ 1.31
Knox	2	61261	$ 1,257,755,060.00	0.01421%	$ 178,744.00	$ 2.92
Lake	2	230117	$ 5,479,741,000.00	0.02903%	$ 1,590,875.00	$ 6.91
Licking	2	173448	$ 3,737,212,631.00	0.00608%	$ 227,065.52	$ 1.31
Lorain	2	307924	$ 6,291,968,810.00	0.00937%	$ 589,724.50	$ 1.92
Madison	2	44036	$ 1,072,677,480.00	0.00608%	$ 65,173.73	$ 1.48
Medina	2	178371	$ 4,827,956,520.00	0.01211%	$ 584,555.00	$ 3.28
Montgomery	2	531542	$ 8,701,115,370.00	0.00608%	$ 528,662.27	$ 0.99
Morrow	2	34994	$ 758,945,430.00	0.02502%	$ 189,913.50	$ 5.43
Pickaway	2	57830	$ 1,206,929,010.00	0.00608%	$ 73,330.58	$ 1.27
Portage	2	162277	$ 3,284,252,070.00	0.01184%	$ 388,943.00	$ 2.40
Richland	2	120589	$ 1,892,485,930.00	0.03524%	$ 666,999.00	$ 5.53
Stark	2	372542	$ 6,849,294,110.00	0.00826%	$ 565,755.00	$ 1.52
Summit	2	541228	$ 11,172,733,850.00	0.00922%	$ 1,029,598.00	$ 1.90
Union	2	56741	$ 1,579,301,910.00	0.00608%	$ 95,955.21	$ 1.69
Warren	2	228882	$ 6,011,510,440.00	0.00608%	$ 365,247.29	$ 1.60
Wayne	2	116038	$ 2,282,848,540.00	0.01412%	$ 322,296.00	$ 2.78
Total					$ 14,256,950.81	

In Region 3, it is estimated that Ashtabula County will have the highest county-wide damage per year by far at \$1,572,526.50. The second highest is Trumbull County at \$573,621.50. Ashtabula County also had the highest per-capita cost at \$16.08 dollars per person and Holmes County had the second highest at \$4.56 per person.

Region 3						
County	**Region**	**Population**	**County-wide Taxable Value of Real Property**	**Percentage Relative to County-wide Real Property**	**Countywide Annual Damage**	**Annual Damage per Capita**
Adams	3	27726	\$ 413,701,850.00	0.00608%	\$ 25,135.69	\$ 0.91
Ashtabula	3	97807	\$ 1,708,599,100.00	0.09204%	\$ 1,572,526.50	\$ 16.08
Athens	3	66597	\$ 913,312,640.00	0.00608%	\$ 55,491.04	\$ 0.83
Belmont	3	68029	\$ 1,375,513,000.00	0.00608%	\$ 83,573.40	\$ 1.23
Brown	3	43576	\$ 761,341,030.00	0.00608%	\$ 46,257.55	\$ 1.06
Carroll	3	27385	\$ 795,006,730.00	0.00608%	\$ 48,303.01	\$ 1.76
Clermont	3	204214	\$ 3,954,639,620.00	0.00608%	\$ 240,275.95	\$ 1.18
Columbiana	3	103077	\$ 1,637,054,170.00	0.00608%	\$ 99,464.12	\$ 0.96
Coshocton	3	36544	\$ 652,306,860.00	0.00608%	\$ 39,632.85	\$ 1.08
Gallia	3	29973	\$ 520,288,280.00	0.00608%	\$ 31,611.67	\$ 1.05
Guernsey	3	39093	\$ 770,693,150.00	0.00608%	\$ 46,825.77	\$ 1.20
Harrison	3	15216	\$ 498,135,770.00	0.00608%	\$ 30,265.73	\$ 1.99
Highland	3	42971	\$ 751,637,960.00	0.00608%	\$ 45,668.01	\$ 1.06
Hocking	3	28474	\$ 548,516,950.00	0.00608%	\$ 33,326.79	\$ 1.17
Holmes	3	43957	\$ 958,818,840.00	0.02088%	\$ 200,225.50	\$ 4.56
Jackson	3	32449	\$ 472,159,990.00	0.00608%	\$ 28,687.49	\$ 0.88
Jefferson	3	66359	\$ 964,893,330.00	0.00608%	\$ 58,624.98	\$ 0.88
Lawrence	3	60249	\$ 913,035,320.00	0.00608%	\$ 55,474.19	\$ 0.92
Mahoning	3	229796	\$ 3,849,081,530.00	0.01228%	\$ 472,554.50	\$ 2.06
Meigs	3	23080	\$ 315,965,200.00	0.00608%	\$ 19,197.41	\$ 0.83
Monroe	3	13946	\$ 396,545,480.00	0.00608%	\$ 24,093.31	\$ 1.73
Morgan	3	14709	\$ 250,036,190.00	0.00608%	\$ 15,191.70	\$ 1.03
Muskingum	3	86149	\$ 1,490,291,520.00	0.00608%	\$ 90,547.12	\$ 1.05
Noble	3	14406	\$ 339,100,440.00	0.00608%	\$ 20,603.06	\$ 1.43
Perry	3	36024	\$ 542,980,750.00	0.00608%	\$ 32,990.42	\$ 0.92
Pike	3	28270	\$ 357,023,590.00	0.00608%	\$ 21,692.04	\$ 0.77
Ross	3	77313	\$ 1,212,098,990.00	0.00608%	\$ 73,644.70	\$ 0.95
Scioto	3	75929	\$ 950,713,830.00	0.00608%	\$ 57,763.46	\$ 0.76
Trumbull	3	200380	\$ 3,076,110,470.00	0.01865%	\$ 573,621.50	\$ 2.86
Tuscarawas	3	92297	\$ 1,737,945,240.00	0.00608%	\$ 105,594.06	\$ 1.14
Vinton	3	13092	\$ 170,345,810.00	0.00608%	\$ 10,349.87	\$ 0.79
Washington	3	60418	\$ 1,165,122,780.00	0.00608%	\$ 70,790.52	\$ 1.17
Total					\$ 4,330,003.88	

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

A similar method as Method B above was used to determine the estimated damage to state-owned and state-leased critical facilities in Ohio. The total value of all critical facilities in each county was multiplied by the percentage of estimated damage of their respective counties. Table 2.4.b depicts the estimated annual damage to State-owned and State-leased critical facilities by county.

RESULTS

Table 2.4b

Estimate of Potential Losses to Winter Storms by Region				
Region 1				
County	Percentage Relative to County-wide Real Property	Number of State-owned and State-leased Critical Facilities	Value of State-owned and State-leased Critical Facilities	Estimated Annual Damage to State-owned and State-leased Critical Facilities
Allen	0.00608%	120	$ 90,950,176.00	$ 5,525.95
Auglaize	0.00608%	21	$ 11,545,804.00	$ 701.50
Champaign	0.00608%	24	$ 5,161,316.00	$ 313.59
Clark	0.00608%	17	$ 8,868,061.00	$ 538.81
Crawford	0.04079%	13	$ 10,357,812.00	$ 4,225.26
Darke	0.00608%	27	$ 8,619,026.00	$ 523.67
Defiance	0.00608%	11	$ 7,562,674.00	$ 459.49
Erie	0.01147%	54	$ 162,265,731.00	$ 18,604.23
Fulton	0.00608%	16	$ 4,397,188.00	$ 267.16
Hancock	0.01374%	23	$ 16,195,898.00	$ 2,225.17
Hardin	0.00608%	12	$ 4,141,282.00	$ 251.62
Henry	0.00608%	14	$ 3,113,844.00	$ 189.19
Huron	0.02258%	22	$ 10,543,997.00	$ 2,381.33
Logan	0.00608%	1	$ 735,568.00	$ 44.69
Lucas	0.00608%	47	$ 276,597,391.00	$ 16,805.50
Marion	0.02203%	100	$ 128,613,896.00	$ 28,334.55
Mercer	0.00608%	26	$ 7,655,738.00	$ 465.15
Miami	0.00608%	23	$ 10,005,576.00	$ 607.92
Ottawa	0.01455%	75	$ 65,291,745.00	$ 9,501.16
Paulding	0.00608%	3	$ 1,387,796.00	$ 84.32
Preble	0.00608%	24	$ 4,859,547.00	$ 295.26
Putnam	0.00608%	18	$ 5,590,738.00	$ 339.68
Sandusky	0.02125%	15	$ 5,519,069.00	$ 1,172.78
Seneca	0.01387%	49	$ 33,546,722.00	$ 4,653.86
Shelby	0.00608%	35	$ 26,824,309.00	$ 1,629.79
Van Wert	0.00608%	13	$ 7,459,562.00	$ 453.23
Williams	0.00608%	13	$ 5,459,757.00	$ 331.72
Wood	0.00942%	36	$ 67,981,624.00	$ 6,402.47
Wyandot	0.02781%	19	$ 10,280,904.00	$ 2,859.06
TOTAL		871	$ 1,001,532,751.00	$ 110,188.13

In Region 1, Lucas County had the highest value of State-owned and State-leased critical facilities. However because they reported zero dollars in property damages due to winter storms from 2008 to

2017, they only had $16,805, the third highest estimated damage, to critical facilities in Region 1 based on the baseline average percentage of 0.00608%. Marion County had less than half the value of critical facilities compared to Lucas County, however had the highest estimated damage at $28,334 dollars.

Region 2				
County	Percentage of Real Property	Number of State-owned and State-leased Critical Facilities	Value of State-owned and State-leased Critical Facilities	Estimated Annual Damage to State-owned and State-leased Critical Facilities
Ashland	0.03724%	143	$ 64,539,880.00	$ 24,032.17
Butler	0.00608%	21	$ 17,563,033.00	$ 1,067.09
Clinton	0.00608%	22	$ 11,528,821.00	$ 700.47
Cuyahoga	0.00608%	84	$ 248,840,544.00	$ 15,119.05
Delaware	0.00608%	37	$ 46,217,477.00	$ 2,808.08
Fairfield	0.00608%	78	$ 86,519,830.00	$ 5,256.77
Fayette	0.00608%	26	$ 5,118,182.00	$ 310.97
Franklin	0.00608%	249	$ 2,147,726,878.00	$ 130,491.57
Geauga	0.02683%	24	$ 8,594,197.00	$ 2,306.23
Greene	0.00608%	25	$ 10,629,296.00	$ 645.81
Hamilton	0.00608%	35	$ 173,140,806.00	$ 10,519.69
Knox	0.01421%	34	$ 40,507,246.00	$ 5,756.63
Lake	0.02903%	21	$ 5,525,021.00	$ 1,604.02
Licking	0.00608%	64	$ 168,043,312.00	$ 10,209.97
Lorain	0.00937%	90	$ 110,138,241.00	$ 10,322.88
Madison	0.00608%	109	$ 321,691,881.00	$ 19,545.35
Medina	0.01211%	22	$ 18,601,644.00	$ 2,252.23
Montgomery	0.00608%	71	$ 77,351,496.00	$ 4,699.72
Morrow	0.02502%	21	$ 6,874,959.00	$ 1,720.34
Pickaway	0.00608%	133	$ 195,643,558.00	$ 11,886.91
Portage	0.01184%	25	$ 7,594,529.00	$ 899.39
Richland	0.03524%	73	$ 109,750,465.00	$ 38,681.11
Stark	0.00826%	41	$ 102,066,812.00	$ 8,430.77
Summit	0.00922%	67	$ 201,182,298.00	$ 18,539.50
Union	0.00608%	53	$ 88,869,557.00	$ 5,399.54
Warren	0.00608%	109	$ 150,201,626.00	$ 9,125.95
Wayne	0.01412%	6	$ 7,056,104.00	$ 996.19
TOTAL		1,683	$ 4,431,517,693.00	$ 343,328.40

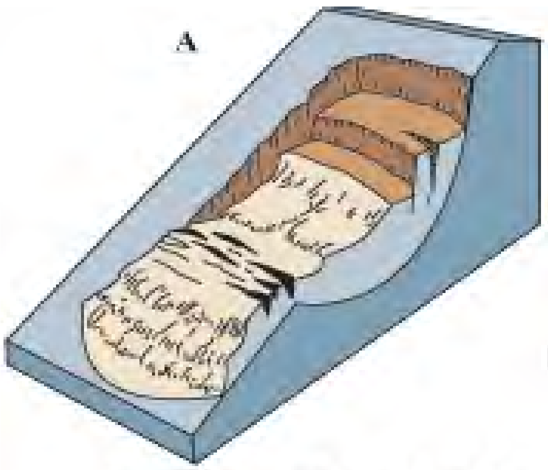
In Region 2, Franklin County had by far the highest estimated annual damage to State-owned and State-leased critical facilities at $130,491. This is largely due to it having the highest value of the assessed critical facilities in the region at 249. Richland County had the second highest estimated damage at $38,681 with 73 critical facilities and a higher percentage of damage relative to county-wide taxable real property.

Region 3				
County	**Percentage of Real Property**	**Number of State-owned and State-leased Critical Facilities**	**Value of State-owned and State-leased Critical Facilities**	**Estimated Annual Damage to State-owned and State-leased Critical Facilities**
Adams	0.00608%	24	$ 6,622,981.00	$ 402.40
Ashtabula	0.09204%	62	$ 20,008,110.00	$ 18,414.67
Athens	0.00608%	31	$ 45,496,640.00	$ 2,764.28
Belmont	0.00608%	62	$ 54,856,808.00	$ 3,332.99
Brown	0.00608%	18	$ 36,403,605.00	$ 2,211.81
Carroll	0.00608%	17	$ 3,661,999.00	$ 222.50
Clermont	0.00608%	38	$ 17,885,810.00	$ 1,086.71
Columbiana	0.00608%	38	$ 13,835,662.00	$ 840.63
Coshocton	0.00608%	19	$ 12,943,450.00	$ 786.42
Gallia	0.00608%	71	$ 35,860,837.00	$ 2,178.83
Guernsey	0.00608%	54	$ 39,704,477.00	$ 2,412.36
Harrison	0.00608%	30	$ 9,054,441.00	$ 550.13
Highland	0.00608%	8	$ 9,690,902.00	$ 588.80
Hocking	0.00608%	19	$ 7,123,096.00	$ 432.78
Holmes	0.02088%	25	$ 10,336,112.00	$ 2,158.44
Jackson	0.00608%	18	$ 15,130,501.00	$ 919.30
Jefferson	0.00608%	37	$ 7,592,901.00	$ 461.33
Lawrence	0.00608%	27	$ 11,760,373.00	$ 714.54
Mahoning	0.01228%	66	$ 72,389,280.00	$ 8,887.28
Meigs	0.00608%	18	$ 8,512,106.00	$ 517.18
Monroe	0.00608%	22	$ 11,202,381.00	$ 680.63
Morgan	0.00608%	10	$ 3,700,608.00	$ 224.84
Muskingum	0.00608%	25	$ 10,647,135.00	$ 646.90
Noble	0.00608%	31	$ 50,299,353.00	$ 3,056.09
Perry	0.00608%	16	$ 3,884,728.00	$ 236.03
Pike	0.00608%	10	$ 3,878,547.00	$ 235.65
Ross	0.00608%	142	$ 265,584,512.00	$ 16,136.38
Scioto	0.00608%	55	$ 171,351,723.00	$ 10,410.99
Trumbull	0.01865%	60	$ 55,012,652.00	$ 10,258.55
Tuscarawas	0.00608%	53	$ 56,132,900.00	$ 3,410.52
Vinton	0.00608%	20	$ 5,854,782.00	$ 355.72
Washington	0.00608%	55	$ 29,149,164.00	$ 1,771.04
TOTAL		1,181	$ 1,105,568,576.00	$ 97,306.73

Region 3 the lowest estimated annual damage compared to the other two regions. Ashtabula, the county with the highest estimated damage per capita due to winter storms in the state had the highest estimated annual damage to critical facilities in the region at $18,414. Ross County had the second highest estimated damage at $16,136.38

2.5 LANDSLIDE

Per the Ohio Department of Natural Resources – Division of Geological Survey GeoFacts publication, a landslide is the downward and outward movement of soil and rock material on slopes. There are three main types of landslides that occur in Ohio (http://geosurvey.ohiodnr.gov/portals/geosurvey/PDFs/GeoFacts/geof08.pdf):

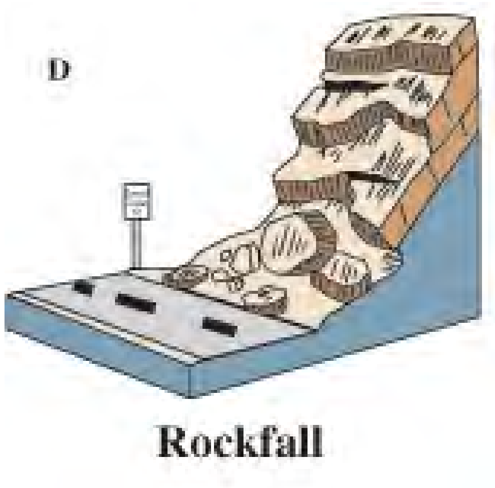


Rotational landslide

Rotational Slump: the movement of a mass of weak rock or sediment as a block unit along a curved slip plane. In Ohio, these types of slides commonly involve hundreds of thousands of cubic yards of material and extend for hundreds of feet. The crown or head, located in the upper section of the ground surface, consists of one or more rupture zones (scarps) that form a stair-step pattern of displaced blocks. The surfaces of these blocks are commonly rotated backward (reverse slope) and form depressions where water may accumulate, creating small ponds or swampy areas. Trees on these blocks may be inclined upslope, toward the top of the hill. The lower, downslope end (toe) of a rotational slump is a fan-shaped, bulging mass of material characterized by radial ridges and cracks. Trees on this portion of the landslide may be inclined at strange angles, giving rise to the descriptive terms "drunken" or "staggering" forest. Rotational slumps may develop comparatively slowly and commonly require several months or even years to reach stability; however, on occasion, they may move rapidly, achieving stability in only a few hours.

Earthflow: involves rock, sediment, or weathered surface materials moving downslope in a mass. The most common form of earth movement in Ohio, earthflow involves a smaller area than a rotational slump and forms a hummocky topography of ridges and swales. Trees may be inclined at odd angles throughout the length of an earthflow. Earthflows are most common in weathered surface materials, do not necessarily indicate weak rock, and are also common in unconsolidated glacial sediments. The rate of movement of an earthflow is generally quite slow.

Earthflow



Rockfall: an extremely rapid, potentially dangerous downslope movement of earth materials. Large blocks of massive bedrock suddenly become detached from a cliff or steep hillside and free fall in a rolling, bounding, or sliding manner downslope. Most rockfalls in Ohio involve massive beds of sandstone or limestone. Surface water seeps into joints or cracks in the rock, increasing its weight and causing expansion of joints in freezing temperatures, thus prying blocks of rock away from the main cliff. Weak and easily eroded clay or shale beneath the massive bed is an important contributing factor to rockfall. All illustrations were provided by the USGS.

One or more of the following conditions contribute to the occurrence of landslide events:

- ***Steep slope:*** All landslides move downslope under the influence of gravity. Therefore, steep slopes, cliffs, or bluffs are a required element leading to a landslide, especially in conjunction with one or more of the conditions listed below.
- ***Jointed rocks:*** Fractures in rocks allow surface moisture to penetrate and weaken it. When the moisture freezes, it pries the rock masses apart at the joint.
- ***Fine-grained, permeable rock or sediment:*** Fine rock particles are particularly conducive to landslide development because large amounts of moisture can enter them easily, increasing the material's weight, reducing the bonding strength of individual grains, and dissolving grain-cementing materials.
- ***Clay or shale units subject to lubrication***: Groundwater penetration of clay or shale can lead to a loss of binding strength between individual mineral grains and subsequent failure.
- ***Large amounts of water:*** Periods of heavy rainfall, excess snowmelt, or other events where water is accumulated saturate the zone above the normal water table and cause a landslide.

In addition to the conditions noted above, a landslide requires a triggering mechanism to initiate downslope movement. Several events or circumstances, many of them human-caused, can trigger landslides, including:

- ***Vibrations*** such as those from human-causes like blasting, the passing of a heavy truck, or from natural events like earthquakes, although no such occurrence has been documented in Ohio.
- ***Over steepened slopes*** caused by undercutting by stream or wave erosion, by human construction activities, or by the addition of fill material to the upper portion of a slope, disturb the equilibrium of a stable slope and cause the angle of stability to be exceeded.
- ***Increased weight on a slope*** caused by the addition of large amounts of fill, the construction of a building or other structure, or an unusual increase in precipitation, either from heavy rains or from artificial alteration of drainage patterns.
- ***Removal of vegetation and trees*** because of the loss of roots, which tend to hold the rock or sediment in place and soak up excess moisture.

RISK ASSESSMENT

LOCATION

Areas in southern and eastern Ohio have several conditions that can lead to the occurrence of landslide events. Thick deposits of broken and weathered bedrock fragments called colluvium, and lake silts, create slopes that are vulnerable to failure (among other geological factors). In addition, redbeds, soft shales that weather rapidly and slip, slide, and flow to form gentle contours that are quickly grassed over, have long presented landslide conditions in the Appalachian Plateau.

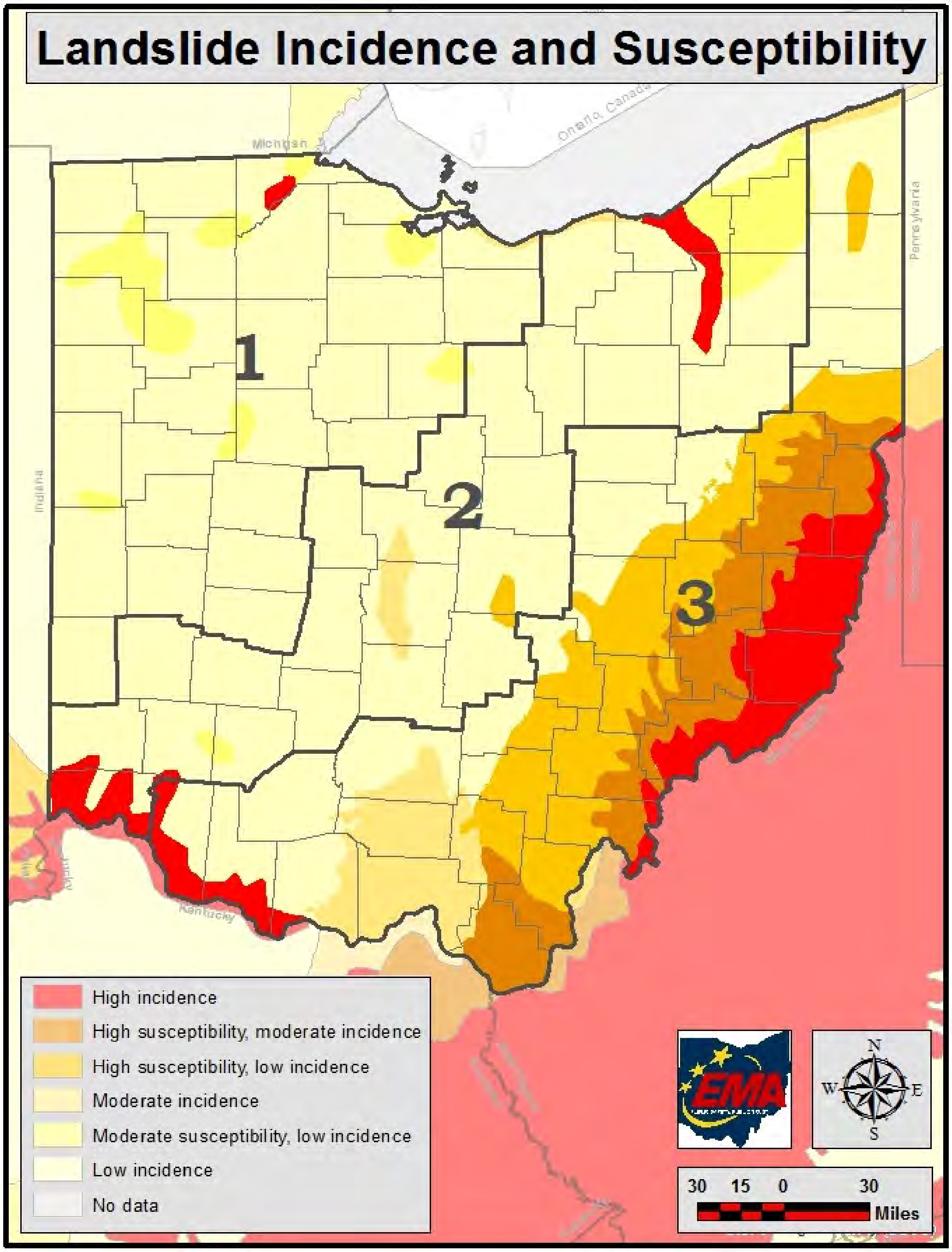
Per the USGS, (https://geochange.er.usgs.gov/sw/impacts/geology/landslides/) the Landslide incidence and susceptibility map (2.5.a) was digitized from the original stable-base manuscripts from USGS Professional Paper 1183. The map displays both the incidence of landslides and susceptibility of the land surface to landslides. Briefly, the map was constructed by evaluating geologic units shown on the geologic map of the United States (King and Beikman, 1974) and classifying them as having high, medium, or low landslide incidence based on number of known landslides, and as having the high, medium, or low susceptibility to landslide. High incidence was assigned to map units (indicated in red on the map) having more than 15 percent of their area involved in landslide; moderate incidence (in tan) to those having between 15 and 1.5 percent; and low incidence (in yellow) to those having less than 1.5 percent.

The largely subjective susceptibility indicators were defined as the probable degree of response of the rocks and soils at the surface to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. The same percentages used to delimit landslide incidence were applied to the three categories of susceptibility. For example, a high susceptibility area would exhibit some movement over 15 percent or more of its surface area in response to widespread artificial cutting or high precipitation. The three susceptibility categories classified were: (1) high susceptibility with moderate incidence of landslide (dark brown); (2) high susceptibility combined with low landslide incidence (in gold); and (3) moderate susceptibility combined with low landslide incidence (in yellow/green).

Full weight could not be given to the important factors of slope angle and precipitation because no adequate slope or precipitation maps at the appropriate scale existed at the time the map was produced in 1982. A more detailed description about the construction of the map is given in the original U.S Geological Survey Professional Paper 1183

Region 1 primarily has a low landslide incidence. The most notable exception to this is Lucas and Wood Counties, which are reported to have a high landslide incidence. (Map 2.5.a). Along with Region 1, Region 2 also has a primarily low landslide incidence. Within Region 2, Butler, Hamilton, Warren, Cuyahoga, and Summit are all identified as having a high landslide incidence, which does not reflect the regional trend. Region 3 is identified as having the most area susceptible to landslide (i.e., the Appalachian Plateau). The largest part of the region has a high susceptibility with a low or moderate incidence. However, most of Belmont and Monroe counties have a high landslide incidence with parts of Columbiana, Jefferson, Harrison, Washington, Athens, Meigs, Adams, Brown, and Clermont Counties having a high incidence as well.

Map 2.5.a



LHMP DATA

Hamilton County – While Region 3 and parts of Region 2 have potentially high susceptibility and incidence to landslides. Hamilton County and the City of Cincinnati has some of the highest cost per capita in the United States for historical landslide damages. The 2013 Hamilton County Multi-Hazard Mitigation plan included a landslide assessment performed by the University of Cincinnati, which is summarized in Table 2.5.a.

Building Type	Number of Buildings	Estimated Losses/Exposure
Residential	1,346	$279,851,500
Non-Residential	610	$19,740,730
Critical Facilities	10	$2,150,000
Totals	1,966	$301,742,230

Table 2.5.a

According to the 2013 Hamilton County plan, landslides are considered to be their fourth area of concern for natural hazards, following flooding (number one), tornadoes, and severe storms. The county officials based their decision on the lack of building regulations in areas deemed high hazard for landslides. Also, the removal of vegetation in riparian corridors can increase the landslide potential, and this is not regulated systematically. Finally, the lack of public education and awareness limits communities' understanding of such geophysical and regulatory relationships. Hamilton County's goal to mitigate landslide events involves identification of methodologies used by other, similar communities, and they want to increase public awareness through outreach initiatives.

Stark County – The 2017 Stark County Multi-Jurisdictional All-Hazard Mitigation Plan states that landslides have occurred primarily in the western and southern portions of the county, near the villages of Brewster, East Canton, Navarre, Waynesburg, and Wilmot and the cities of Canal Fulton, Magnolia, Massillon, and North Canton. Safety problems for travelers caused by landslides are a growing concern. There are several highways that could become damaged as a result of landslides in Stark County. U.S. Routes 30 and 62, and State Routes 21, 43, 93, 172, 289, and 800 all are at risk.

PAST OCCURRENCES

Ohio has had a long history of damage from landslides; for example, 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. Accounts of landslide concerns can date back to the 1970s. A 1980 U.S Geological survey report estimated Hamilton County likely had the highest annual per capita landslide damage costs in the country. Within Hamilton County, Cincinnati alone was spending about $500,000 annually on emergency landslide repairs. Despite the chronic problem, no long-term plan currently exists to permanently provide a solution. 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.

The University of Cincinnati report found that landslide damages in Hamilton County, primarily due to public road construction, averaged 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. Mt. Adams (Cincinnati, Ohio) is the most prominent topographic feature in Cincinnati. It is also home to one of the most expensive landslide remediation projects in the history of the U.S. The cost of remediation was $44.5 million in 2005 dollars. A normal retaining wall for this slide could not be used because the failure surface was too deep.

Rockfalls have also caused dangerous conditions. Ohio DNR reports that on Christmas Eve in 1986, an individual traveling in an automobile was killed by falling rock along U.S. Route 52 in Lawrence County in southern Ohio. In 2017, ODOT reported several large boulders fell in Lawrence County blocking all four lanes of State Route 7 for several days. The westbound lanes of State Route 7 did not reopen for nearly a month. The photograph was provided by ODOT District 9.

Landslides can be triggered by heavy rainfall and flooding, leading to multiple disasters in the same location. The most recent example is from April of 2018 when the State received a disaster declaration (DR- 4360) due to the severe storms, flooding, mudslides, and landslides that struck the southern and southeastern counties of Ohio. Federal funding also was available to State and eligible local governments on a cost-sharing basis for the repair or replacement of public facilities damaged by the severe storms, flooding, mudslides, and landslides in the counties of Adams, Athens, Belmont, Brown, Columbiana, Gallia, Hamilton, Harrison, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Pike, Scioto, Vinton, and Washington Counties. The photograph was provided by ODOT.

The impact of most if not all landslide and rockfall events in Ohio are directly tied to rainfall events, therefore more damage data related to such events in captured under flood related damages for the purposes of FEMA's public assistance program.

OHIO DEPARTMENT OF TRANSPORTATION LANDSLIDE AND ROCKFALL INVENTORIES

The Landslide (10/2013) and Rockfall (12/2016) manuals prepared the ODOT Office of Geotechnical Engineering (OGE), provide rational approach to manage the unsafe or failed slopes/embankments and rockfalls. The manuals include a systematic process for collecting the information needed for decision-making.

LANDSLIDE MANUAL

(http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical/Geotechnical_Documents/Manual%20of%20Landslide%20Inventory.pdf)
This manual was developed by ODOT OGE to inventory soil slopes, to identify potential hazardous slopes, to assess relative risk for those slopes, to determine degree of monitoring required, and to allow for actions to be taken to reduce, minimize, or eliminate the risk to the public's safety and to protect the highway system. The intent of this manual is to facilitate the creation of a statewide landslide inventory process through the development of a statewide inventory procedure and the establishment of office and field methods. These methods should be used during the initial population of the inventory, inventory of new sites following the initial population, and for maintenance and monitoring of the sites. The data collected from the SdAD inventory process will be stored within the Geologic Hazard Management System (GHMS) and other related components of the ODOT GeoMS.

Essentially, this manual provides the information about the following:

- procedure for landslide data collection;
- landside hazard assessment using ODOT rating matrix; and
- guidance on the use of a global positioning system (GPS) and an internet website for the ODOT landslide database

The Preliminary Rating will segregate the lower priority sites from the groups that will receive detailed data collection efforts. This Manual will outline a tiered data collection methodology which will allow landslides within Ohio to be rated for relative risk of slope instability to the public and Ohio's highway system. The map (2.5.b) was created by the Office of Geotechnical Engineering (OGE) and represents the number of landslide by county that are currently impacting the State's highway system. The map indicates the number of moderately and highly rated landslides, along with the total number of landslides for each county. The counties with the most impacted roadways are Monroe (1196), Morgan (1048) and Athens (831).

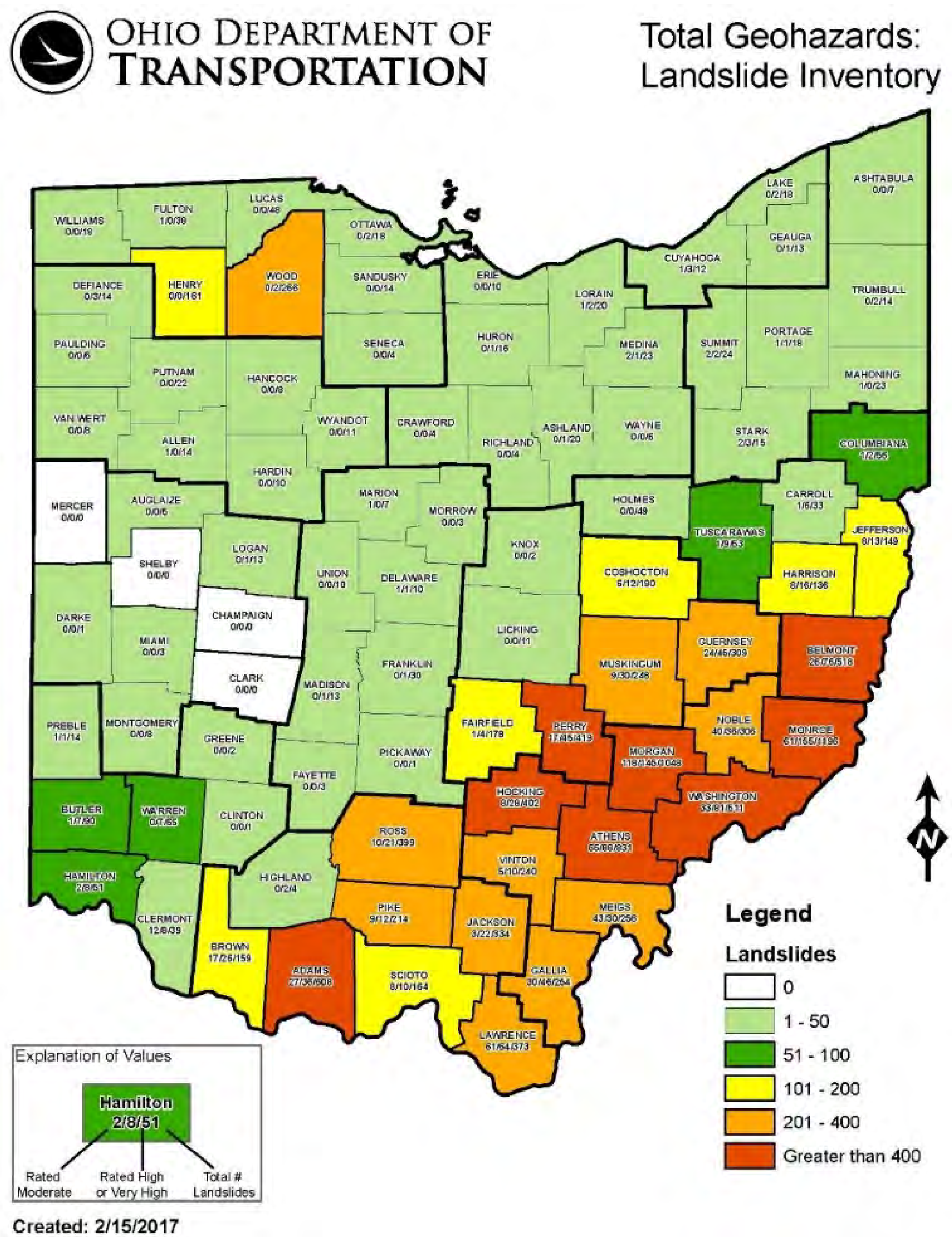

OHIO DEPARTMENT OF TRANSPORTATION
Total Geohazards: Landslide Inventory
WILLIAMS 0/0/19
FULTON 1/0/39
LUCAS 0/0/48
OTTAWA 0/2/18
DEFIANCE 0/3/14
HENRY 0/0/161
WOOD 0/2/266
SANDUSKY 0/0/14
ERIE 0/0/10
LAKE 0/2/18
ASHTABULA 0/0/7
GEAUGA 0/1/13
CUYAHOGA 1/3/12
LORAIN 1/2/20
TRUMBULL 0/2/14
PAULDING 0/0/6
PUTNAM 0/0/22
HANCOCK 0/0/8
SENECA 0/0/4
HURON 0/1/16
MEDINA 2/1/23
SUMMIT 2/2/24
PORTAGE 1/1/18
MAHONING 1/0/23
VAN WERT 0/0/8
ALLEN 1/0/14
WYANDOT 0/0/11
CRAWFORD 0/0/4
RICHLAND 0/0/4
ASHLAND 0/1/20
WAYNE 0/0/6
STARK 2/3/15
COLUMBIANA 1/2/56
MERCER 0/0/0
AUGLAIZE 0/0/5
HARDIN 0/0/10
MARION 1/0/7
MORROW 0/0/3
HOLMES 0/0/49
TUSCARAWAS 1/9/63
CARROLL 1/6/33
JEFFERSON 8/13/149
SHELBY 0/0/0
LOGAN 0/1/13
UNION 0/0/10
DELAWARE 1/1/10
KNOX 0/0/2
COSHOCTON 5/12/190
HARRISON 8/16/136
DARKE 0/0/1
MIAMI 0/0/3
CHAMPAIGN 0/0/0
CLARK 0/0/0
MADISON 0/1/13
FRANKLIN 0/1/30
LICKING 0/0/11
MUSKINGUM 9/30/248
GUERNSEY 24/45/309
BELMONT 26/76/516
PREBLE 1/1/14
MONTGOMERY 0/0/8
GREENE 0/0/2
FAYETTE 0/0/3
PICKAWAY 0/0/1
FAIRFIELD 1/4/178
PERRY 17/45/419
MORGAN 118/145/1048
NOBLE 40/36/306
MONROE 61/155/1196
BUTLER 1/7/90
WARREN 0/7/65
CLINTON 0/0/1
ROSS 10/21/399
HOCKING 8/28/402
WASHINGTON 33/81/611
ATHENS 65/66/831
VINTON 5/10/240
HAMILTON 2/8/51
HIGHLAND 0/2/4
CLERMONT 12/6/39
PIKE 9/12/214
JACKSON 3/22/934
MEIGS 43/30/256
BROWN 17/26/159
ADAMS 27/36/608
SCIOTO 8/10/164
GALLIA 30/46/254
LAWRENCE 61/64/373
Legend
Landslides
0
1 - 50
51 - 100
101 - 200
201 - 400
Greater than 400
N
Explanation of Values
Hamilton 2/8/51
Rated Moderate
Rated High or Very High
Total # Landslides
Created: 2/15/2017

Table 2.5.b

ROCKFALL MANUAL

http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical/Geotechnical_Documents/Manual%20for%20Rockfall%20Inventory.pdf

Rockfalls can constitute a major hazard along Ohio roadways, posing a risk to life, property, and traffic safety. As a result of rockfalls, maintenance problems are constantly occurring, resulting in a strain on the Ohio Department of Transportation (ODOT) funds and manpower. A rockfall inventory will be performed for the state highway system as noted in ODOT's policy on geohazards. This inventory will include all natural and manmade slopes with exposed bedrock.

The data collection procedures are grouped into four (4) primary sections with subsections:

- Site Inventory and Preliminary Rating
- Tier 1 Site Rating
- Tier 2 Site Rating
- Tier 3 and Tier 4 Site Rating

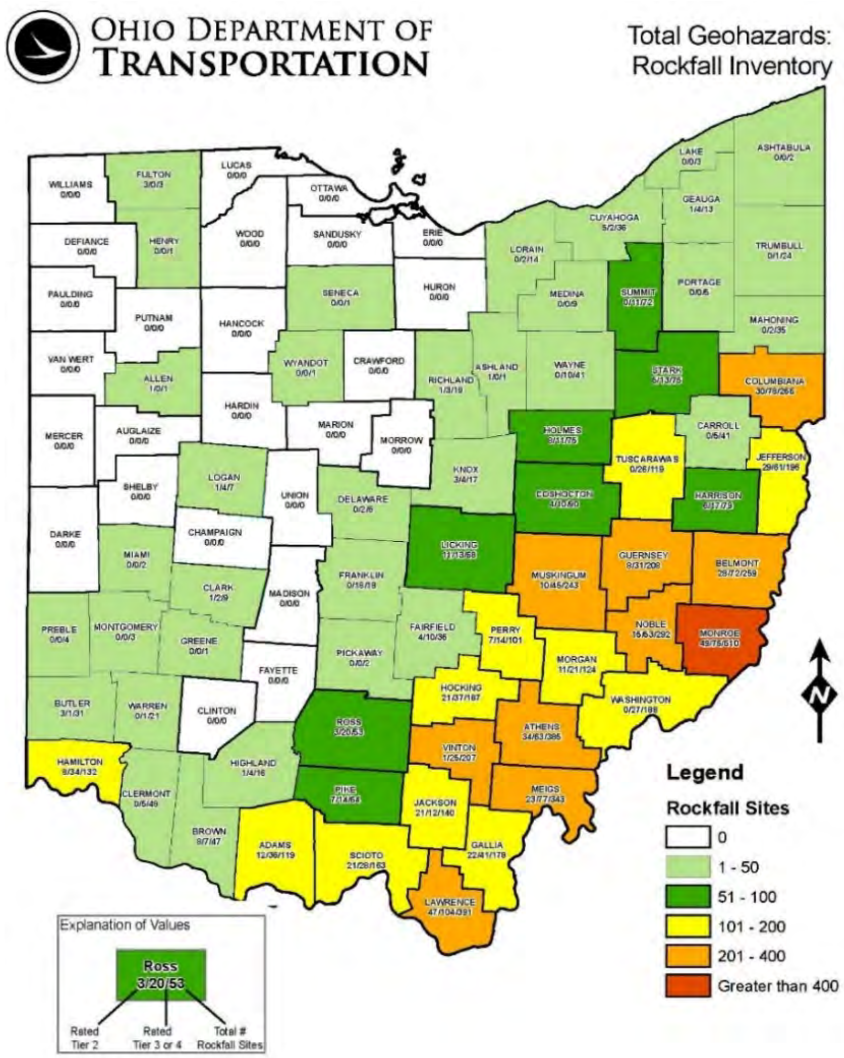


Table 2.5.c

This Manual outlines a tiered data collection methodology which allows rock slopes within Ohio to be rated for relative rockfall risk to the public and Ohio's highway system. The data collected from each site is incorporated into an Enterprise Database and integrated into a GIS system. The inventory consists of identifying and locating Inventory Sites within the rock slopes situated along Ohio's highway system. Generally, this inventory will be concerned with rock slopes located above the roadway, unless a rockfall event below the road could result in adverse impacts to the highway system.

PROBABILITY OF FUTURE EVENTS

Landslide probability is highly site-specific, and cannot be accurately characterized on a statewide basis, except in the most general sense. Statewide analyses for potential landslides have been performed by the US Geological Survey (USGS). The possible landslide incidence and susceptibility was discussed earlier in this chapter and illustrated on Map 2.5.a. When factoring for the previous USGS analyses (map 2.5.a) and the impacts documented in ODOT landslide (2.5.b) and Rockfall (2.5.c) manuals, Region 3 is identified as having the most area susceptible to landslide.

VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

The only predictable impact that can be quantified for analysis is damage to Ohio's roadways. The Ohio Department of Transportation, Office of Geotechnical Engineering has a comprehensive inventory of the federal and state routes, which intersect with known and existing landslide and rock fall events. The location, length of each segment, potential for failure, along with a host of other data is maintained in a database (https://gis.dot.state.oh.us/tims/Map/Geotech). The counties with the greatest number of impacts are located within Region 3, particularly Athens, Lawrence, Morgan and Monroe Counties.

STATE OWNED AND STATE LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

Using the geocoded state owned and state leased critical facilities listing provided by the Ohio Department of Administrative Services (DAS), and the Landslide Incidence and Susceptibility map created and maintained by USGS, Ohio EMA GIS staff performed a buffer, which joined the two data sets and produced a new data set. This new data set allowed us to quantify the risk to the state owned and state leased critical facilities based upon their physical location within each county. For the purpose of this analysis, those critical facilities located within areas with a low incidence (less than 1.5 % chance) of landslide were not included.

RESULTS

The results were weighted based upon the number of critical facilities in each county that were located within areas of high incidence (having more than 15 % chance of landslide). There are counties who had a larger overall number of critical facilities located within areas that fell within the a category noted on the landslide incidence and susceptibility map, but were not considered to be at the same risk level as those counties with critical facilities located within high incidence areas.

Region 1 has a very low potential of loss, with only one county (Lucas) having any critical facilities within an area of high incidence and only eight counties total with possible losses. The vast majority of the region's possible losses and impacted critical facilities are located within Lucas County.

Region 1

County	Total Exposed Critical Facilities	Total Replacement Value	# of Critical Facilities in HIA	% of Critical Facilities in HIA
Lucas	46	$ 273,893,286.00	22	47.8%
Defiance	8	$ 7,200,331.00	0	0.0%
Putnam	1	$ 1,227,541.00	0	0.0%
Mercer	6	$ 885,687.00	0	0.0%
Erie	7	$ 685,079.00	0	0.0%
Darke	1	$ 626,117.00	0	0.0%
Hardin	3	$ 302,153.00	0	0.0%
Henry	5	$ 113,250.00	0	0.0%
TOTAL	77	$ 284,933,444.00	22	

Table 2.5.b

Compared to Region 1, Region 2 has a significantly greater potential for loss. Region 2 has a total of eight counties with possible losses. Of those eight counties, four of them Summit, Hamilton, Butler and Cuyahoga have critical facilities within an area of high incidence. Cuyahoga County the greatest number of critical facilities (38) within an area of high incidence in the state. Franklin County has the highest total critical facilities (111), which are in an area that is susceptible to landslide, but none of those areas exceed moderate incidence. Region 2 also has the greatest potential losses in dollars, although much of this is driven by Franklin County.

Region 2

County	Total Exposed Critical	Total Replacement Value	# of Critical Facilities in HIA	% of Critical Facilities in HIA
Cuyahoga	71	$ 223,491,915.00	38	53.5%
Summit	37	$ 178,272,585.00	37	100.0%
Hamilton	29	$ 172,251,987.00	29	100.0%
Butler	2	$ 367,875.00	2	100.0%
Franklin	111	$ 796,354,215.00	0	0.0%
Geauga	23	$ 8,576,693.00	0	0.0%
Portage	1	$ 684,224.00	0	0.0%
Fayette	1	$ 5,000.00	0	0.0%
TOTAL	352	$ 1,664,937,938.00	128	

Table 2.5.c

Region 3 has by far the highest number of counties with critical facilities, which could sustain potential losses from landslides (715). Region 3 had twenty-eight counties with the potential of loss and nine counties with critical facilities within an area of high incidence.

Region 3

County	Total Exposed Critical	Total Replacement Value	# of Critical Facilities in HIA	% of Critical Facilities in HIA
Washington	56	$ 29,149,164.00	37	66.1%
Belmont	62	$ 54,856,808.00	34	54.8%
Jefferson	37	$ 7,592,901.00	23	62.2%
Clermont	23	$ 3,710,528.00	23	100.0%
Monroe	19	$ 6,522,681.00	19	100.0%
Harrison	30	$ 9,054,441.00	16	53.3%
Brown	7	$ 29,882,234.00	7	100.0%
Meigs	19	$ 8,547,106.00	2	10.5%
Columbiana	37	$ 13,835,662.00	1	2.7%
Scioto	55	$ 171,351,723.00	0	0.0%
Noble	31	$ 50,299,353.00	0	0.0%
Athens	31	$ 45,496,640.00	0	0.0%
Guernsey	54	$ 39,704,477.00	0	0.0%
Gallia	71	$ 35,860,837.00	0	0.0%
Ross	19	$ 19,248,265.00	0	0.0%
Jackson	18	$ 15,130,501.00	0	0.0%
Lawrence	27	$ 11,760,373.00	0	0.0%
Muskingum	17	$ 9,232,685.00	0	0.0%
Vinton	20	$ 5,854,782.00	0	0.0%
Morgan	10	$ 3,950,084.00	0	0.0%
Pike	10	$ 3,878,547.00	0	0.0%
Carroll	17	$ 3,661,999.00	0	0.0%
Tuscarawas	17	$ 2,921,475.00	0	0.0%
Ashtabula	12	$ 1,889,649.00	0	0.0%
Hocking	2	$ 1,373,320.00	0	0.0%
Trumbull	8	$ 1,052,544.00	0	0.0%
Perry	5	$ 979,866.00	0	0.0%
Adams	1	$ 545,334.00	0	0.0%
TOTAL	715	$ 587,343,979.00	162	

Table 2.5.d

2.6 DAM/LEVEE FAILURE

DAM FAILURE

A dam is defined as an artificial barrier that is usually constructed across a stream channel to impound water. A dam failure is defined as an uncontrolled release of that impounded water. The causes of dam failures can be divided into three groups: dam overtopping, excessive seepage, and structural failure of a component. Despite efforts to provide sufficient structural integrity and to perform inspection and maintenance, problems can develop that can lead to failure. While most dams have storage volumes small enough that failures would have little or no consequences, dams with large storage amounts could cause significant flooding downstream.

Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall and flooding;
- Inadequate spillway capacity, resulting in excess overtopping flows;
- Internal erosion caused by embankment or foundation leakage or piping;
- Improper maintenance, including failure to remove trees, repair internal seepage problems, replace lost material from the cross section of the dam and abutments, or maintain gates, valves, and other operational components;
- Improper design, including the use of improper construction materials and construction practices;
- Improper operation, including the failure to remove or open gates or valves during high flow periods;
- Failure of upstream dams on the same waterway that release water to a downstream dam;
- Earthquakes, which typically cause longitudinal cracks at the tops of the embankments that can weaken entire structures.

In terms of emergency management, dam failures are categorized as either sunny day failures or rainy day failures. Sunny day failures occur during a non- flooding situation with the reservoir near normal pool level. Rainy day failures usually involve periods of rainfall and flooding, and can exacerbate inadequate spillway capacity. Improper design of a spillway or operation of gates during high flows can lead to excessive water pressure and subsequent failure as well. Even though both types of failures can be disastrous, it can be assumed that a sunny day failure would be more catastrophic due to its unanticipated occurrence and the lack of time to warn residents downstream.

Dams are complicated structures, and it can be difficult to predict how a structure will respond to distress "… the modes and causes of failure are varied, multiple, and often complex and interrelated, i.e., often the triggering cause may not truly have resulted in failure had the dam not had a secondary weakness. These causes illustrate the need for careful, critical review of all facets of a dam" (Safety of Existing Dams, 1983).

LEVEE FAILURE

A levee is any artificial barrier together with appurtenant works that will divert or restrain the flow of a stream or other body of water for the purpose of protecting an area from inundation by flood waters. Generally, a levee is subjected to water loading during a few days or weeks in a given year; unlike a dam that is retaining water most days in the same year.

A levee breach results when a portion of the levee breaks away, providing an opening for water to flood the landward side of the structure. Such breaches can be caused by surface erosion due to water velocities, or they can be the result of subsurface actions. Subsurface actions usually involve sand boils whereby the upward pressure of water flowing through porous soil under the levee exceeds the static pressure of the soil weight above it (i.e., under-seepage). These boils can indicate instability of the levee foundation given the liquefied substrate below it, leading way to breaching. Levee overtopping is similar to dam overtopping in that the flood waters simply exceed the design capacity of the structure, thus flowing over the lowest crest of the system. Such overtopping can lead to erosion on the landward side which, subsequently, can lead to breaching. In order to prevent this type landward erosion, many levees are reinforced or armored with rocks or concrete.

AUTHORITY AND RESPONSIBILITY

The Ohio Department of Natural Resources, Division of Water Resources - Dam Safety Program (DSP) has the responsibility to ensure that human life, health and property are protected from dam and levee failures. The program achieves its core purpose by performing the following main functions:

- Emergency response – Assessing the conditions of dams during severe floods and emergency's, taking action to correct dams that pose an immediate threat to public safety, providing timely and best-available information to other agencies and the public during disasters, and supporting mandate Ohio Revised Code (ORC) Section 1521.062;
- Construction permits – Ensuring that dams and levees are designed and constructed in accordance with proper engineering standards and OAC rules, reviewing construction plans and specifications, performing calculations and investigations, issuing permits, and monitoring/approving construction;
- Repairs and modifications -- Ensuring that dams and levees are repaired in accordance with proper engineering standards and OAC rules, reviewing construction plans and specifications, performing calculations and investigations, issuing permits, and monitoring/approving construction, and supporting mandate ORC Section 1521.062;
- Periodic safety inspections –Inspecting Class I-III dams once every five years, monitoring the overall condition of Ohio's dams, providing data for the National Performance of Dams Program (NPDP), and supporting mandate ORC Section 1521.062;
- Enforcement – Requiring dam and levee owners to improve safety when efforts for voluntary compliance have been unsuccessful and focusing on Class I dams with dense populations downstream; and
- Public information – Providing data security for Ohio EMA, US Army Corps of Engineers (USACE), the National Guard, Ohio EPA, as well as the state and federal legislatures, providing dam and levee owners and engineers with technical information and access to division files, educating the public about dam safety and providing quality data, and giving presentations for EPA, Water Management Association of Ohio (WMAO), and the Ohio Lake Communities Association (OLCA).

The ORC provides the authority for the program to regulate dam and levee safety, and dictates the responsibilities of the program as well as the responsibilities of the dam and levee owners. The program has jurisdiction over approximately 2,749 dams in Ohio, of which 362 are Class I (highest hazard); DSP does not have jurisdiction over Federal dams. USACE presides over most of those Federal dams, and ensures they are operated and maintained properly.

Many levees in Ohio are owned and maintained by local communities, with a few levees being owned and maintained by the USACE. While a federal inventory of levees is complete, the methodology for evaluating the effects of levees on flood hazards is in flux. This will be discussed later in this section.

RISK ASSESSMENT

DAMS—LOCATION

In Ohio, there are 5,874 known existing structures that retain or detain water, and these are included in ODNR's inventory of dams (DSP data, June 2018). The volume of water impounded, and the density, type, and value of development downstream determine the potential severity and potential classification of dam. The USACE's National Inventory of Dams (NID) represented only a portion of the dams regulated by the State of Ohio. Therefore, a more complete list was obtained from ODNR's inventory for this 2019 Update.

The ODNR DSP classifies dams as Class I, Class II, Class III, and Class IV dams, with Class I being the highest risk and Class IV the lowest risk (Table 2.6.a). The classification of a dam is based on three factors: the dam's height, storage capacity, and potential downstream hazard. The height of the dam is the vertical distance from the crest to the downstream toe. The storage capacity is the volume of water that the dam can impound at the top of dam (crest) elevation. The downstream hazard consists of roads, buildings, homes, and other structures that would be damaged in the event of a dam failure. Potential for loss of life is also evaluated. Various dam failure scenarios must be considered, and they include failures when the dam is at normal pool level (sunny day) and failures during significant flood events (rainy day). Each of the three factors is evaluated, and the final classification of the dam is based on the highest individual factor. The classification of a dam can change based on future development along the downstream channel. It is important to note all classes are required to have Emergency Action Plans (EAPs) and Class I dams are required to include dam failure inundation mapping.

Table 2.6.a

Ohio and Federal Dam Classification Systems		
Ohio Dam Classification	**Description**	**Corresponding Federal Classification**
Class I	Probable loss of life, serious hazard to health, structural damage to high value property (i.e., homes, industries, major public utilities)	High
Class II	Flood water damage to homes, businesses, industrial structures (no loss of life envisioned), damage to state and interstate highways, railroads, only access to residential areas	Significant
Class III	Damage to low value non- residential structures, local roads, agricultural crops and livestock	Significant
Class IV	Losses restricted mainly to the dam	Low

Source: http://water.ohiodnr.gov/safety/dam-safety

This update will focus on Class I dams as they are deemed as having the most potential for loss of life, greatest hazards to health, and causing the most structural damage should any of them fail. Classes II and III also will be evaluated to a slight degree since their failure would most likely result in damages to homes, businesses, infrastructure, but no loss of life is likely.

As mentioned, there are 402 Class I dams, 1089 Class II and III, and 1049 Class IV dams in Ohio. Additionally, there are approximately 3,374 "other" structures throughout the state that are proposed, unclassified, exempt, and/or abandoned. (Table 2.6.b).

Table 2.6.b

Dam Inventory by County and Dam Classification											
Region 1											
County	**I**	**II+III**	**IV**	**Other**	**Total**	**County**	**I**	**II+III**	**IV**	**Other**	**Total**
Allen	5	7	10	24	46	**Marion**	0	2	4	4	10
Auglaize	1	2	2	8	13	**Mercer**	2	5	1	2	10
Champaign	0	9	7	11	27	**Miami**	3	4	6	26	39
Clark	2	6	6	9	23	**Ottawa**	0	2	3	6	11
Crawford	5	5	12	19	41	**Paulding**	1	1	6	9	17
Darke	0	5	7	25	37	**Preble**	5	12	16	38	71
Defiance	2	8	6	11	27	**Putnam**	1	2	3	12	18
Erie	0	2	4	13	19	**Sandusky**	3	0	2	4	9
Fulton	5	5	0	4	14	**Seneca**	2	5	4	10	21
Hancock	9	3	0	11	23	**Shelby**	2	4	10	23	39
Hardin	0	3	6	10	19	**Van Wert**	3	0	1	5	9
Henry	0	1	1	12	14	**Williams**	1	8	14	24	47
Huron	10	12	10	24	56	**Wood**	4	4	0	8	16
Logan	3	8	12	22	45	**Wyandot**	0	6	7	22	35
Lucas	1	4	0	18	23						
TOTAL: 779 (I: 70, II+III: 135, IV: 160, Other: 414)											

Region 2											
County	**I**	**II+III**	**IV**	**Other**	**Total**	**County**	**I**	**II+III**	**IV**	**Other**	**Total**
Ashland	5	19	20	42	86	**Lorain**	5	21	20	101	147
Butler	7	15	22	74	118	**Madison**	1	3	1	3	8
Clinton	8	12	13	18	51	**Medina**	14	51	64	133	262
Cuyahoga	7	12	4	40	63	**Montgomery**	6	6	6	38	56
Delaware	16	13	24	36	89	**Morrow**	3	13	18	28	62
Fairfield	13	34	15	39	101	**Pickaway**	2	10	10	21	43
Fayette	1	3	1	6	11	**Portage**	8	16	27	151	202
Franklin	3	15	11	40	69	**Richland**	3	11	11	31	56
Geauga	9	22	24	68	123	**Stark**	5	30	29	93	157
Greene	4	9	16	26	55	**Summit**	18	30	23	115	186
Hamilton	9	23	15	84	131	**Union**	1	2	5	21	29
Knox	5	12	10	36	63	**Warren**	10	33	48	74	165
Lake	2	9	4	23	38	**Wayne**	3	14	10	50	77
Licking	1	16	40	63	120						
TOTAL: 2568 (I: 169, II+III: 454, IV: 491, Other: 1454)											

Region 3											
County	**I**	**II+III**	**IV**	**Other**	**Total**	**County**	**I**	**II+III**	**IV**	**Other**	**Total**
Adams	3	12	10	38	63	**Jefferson**	7	21	18	47	93
Ashtabula	6	26	24	78	134	**Lawrence**	5	6	3	41	55
Athens	8	4	10	40	62	**Mahoning**	6	14	14	58	92
Belmont	9	12	28	68	117	**Meigs**	2	7	7	24	40
Brown	2	17	16	42	77	**Monroe**	2	9	8	33	52
Carroll	3	17	28	50	98	**Morgan**	2	18	10	38	68
Clermont	8	30	23	63	124	**Muskingum**	5	36	22	71	134
Columbiana	7	36	21	67	131	**Noble**	3	9	4	22	38
Coshocton	3	15	13	23	54	**Perry**	9	23	8	41	81
Gallia	4	9	4	35	52	**Pike**	5	4	3	41	53
Guernsey	4	26	12	30	72	**Ross**	8	16	6	27	57
Harrison	11	23	14	68	116	**Scioto**	8	9	4	59	80
Highland	3	8	9	28	48	**Trumbull**	4	18	12	93	127
Hocking	4	23	10	80	117	**Tuscarawas**	7	19	13	63	102
Holmes	2	3	11	13	29	**Vinton**	3	6	9	19	37
Jackson	5	12	13	94	124	**Washington**	5	12	11	12	40
TOTAL: 2567 (I: 163, II+III: 500, IV: 398, Other: 1506)											

Source: DSP Dam Inventory, June 2018

Region 1 has many fewer dams than regions 2 and 3. This may be largely due to the topography as Region 1 is relatively flatter than Regions 2 and 3. Region 1 has a total of 779 dams consisting of 70 Class I, 135 Class II and III, 160 Class IV, and 414 “Other” dams. Region 2 has a total of 2568 dams consisting of 169 Class I, 454 Class II and III, 491 Class IV, and 1454 “Other” dams. Region 3 has a total of 2567 dams consisting of 163 Class I, 500 Class II and III, 398 Class IV, and 1506 “Other” dams.

LEVEES—LOCATION

There are two primary sources of levee data for the State of Ohio- The US Army Corp of Engineers National Levee Database (NLD) and the Ohio Department of Natural Resources Dam Safety Program. The National Levee Database is dynamic in nature, it does provide static information regarding levee location and attributes, which can aid in decision making and better flood risk management. This database was recently released to the public so individuals would have the ability to conduct custom queries and get information pertinent to their situation and their community. However, gaps remain in some qualitative and quantitative data for levees, which will affect a community’s ability to gauge risk and implement successful risk communication. Such data gaps exacerbate existing state and community-specific levee safety issues, such as estimating levee maintenance costs, which affect future funding priorities; and completing accurate risk assessments among the various counties containing such structures in their jurisdictions. The National Levee Database identifies that there are 257 levees in Ohio (Table 2.6.d).

Table 2.6.c

USACE NLD Levee Inventory by County											
Region 1				Region 2				Region 2			
County	Region	Levee Count	Leveed Area (Sq. Miles)	County	Region	Levee Count	Leveed Area (Sq. Miles)	County	Region	Levee Count	Leveed Area (Sq. Miles)
Erie	1	2	0.16	Butler	2	10	4.12	Clermont	3	1	0.08
Erie/Sandusky	1	1	0.53	Cuyahoga	2	1	0.01	Columbiana	3	1	0.45
Lucas	1	5	4.12	Fairfield	2	2	0.89	Guernsey	3	2	0.12
Lucas/Monroe	1, 3	1	0.50	Franklin	2	3	4.82	Hocking	3	1	0.03
Lucas/Ottawa	1	6	3.68	Hamilton	2	10	5.39	Lawrence	3	2	2.35
Marion	1	2	0.80	Knox	2	5	0.79	Muskingum/Perry	3	1	0.11
Miami	1	6	0.28	Lake	2	1	0.03	Pike	3	4	1.81
Ottawa	1	146	16.62	Licking	2	1	0.16	Ross	3	1	2.15
Ottawa/Sandusky	1	4	0.97	Lorain	2	1	0.25	Scioto	3	1	2.99
Sandusky	1	3	1.30	Montgomery	2	20	10.28	Tuscarawas	3	1	0.11
				Richland	2	1	0.00				
				Stark	2	5	0.78				
				Stark/Carroll	2, 3	1	0.11				
				Warren	2	5	0.45				
Region 1 Total:		176	28.96	Region 2 Total:		66	26.75	Region 3 Total:		15	10.21

Source: USACE National Levee Database

The ODNR DSP levee database classifies the hazard potential for levees as Class I, Class II, and Class III levees (Table 2.6.c), depending on what is identified as the landward risk. Under these classifications, ODNR DSP identifies 36 levees including four unclassified levees (Table 2.6.d).

Table 2.6.c

Ohio Levee Classification Systems	
Hazard Classifcation	**Description**
Class I	Probably loss of human life, structural collapse of at least one residence or one commerical or industrial business
Class II	Disruption of a public water supply or wasterwater treatment facility, or other health hazards; flooding of residential, commerical, industrial, or publically 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 as determined by the chief; damage or disruption to railroads or public utilities
Class III	Property losses including but not limitied to rural buildigs not otherwise described in this rule; damage or disruption to local roads including but not limited to roads not otherwise listed as major roads in this rule

Source: http://water.ohiodnr.gov/safety/dam-safety

Table 2.6.d

ODNR DSP Levee Inventory				
NAME	OWNER TYPE	COUNTY	STREAM	CLASS
SHADYSIDE WWTP LEVEE	PUBLIC, LOCAL	BELMONT	OHIO RIVER	II
HAMILTON SOUTH WATER TREATMENT LEVEE	PUBLIC, LOCAL	BUTLER	PLEASANT RUN	II
BANKER DRIVE LEVEE	PUBLIC, LOCAL	BUTLER	PLEASANT RUN	III
WINDISCH ROAD LEVEE	PRIVATE	BUTLER	EAST FORK OF MILL CREEK	III
HAMILTON LEVEE	PUBLIC, C.D.	BUTLER	GREAT MIAMI RIVER	UNCLASS
WELLSVILLE LEVEE	PUBLIC, LOCAL	COLUMBIANA	OHIO RIVER	I
CERRI LEVEE	PRIVATE	CUYAHOGA	CHAGRIN RIVER	III
AGG ROK REACH LEVEE	PRIVATE	FRANKLIN	SCIOTO BIG RUN	I
KING AVENUE LEVEE	PUBLIC, LOCAL	FRANKLIN	OLENTANGY RIVER	II
NATIONAL LIME & STONE SHADEVILLE LEVEE	PRIVATE	FRANKLIN	SCIOTO RIVER	UNCLASS
SUN VALLEY LEVEE	PRIVATE	GALLIA	UNNAMED TRIBUTARY TO CHICKAMAUGA	EXEMPT
KYGER CREEK LEVEE	PUBLIC, STATE	GALLIA	KYGER CREEK	II
SOUTHGATE DIKE	PUBLIC, LOCAL	GUERNSEY	WILLIS CREEK	I
MUDDY CREEK WWTP LEVEE	PUBLIC, LOCAL	HAMILTON	ALONG OHIO RIVER	I
LITTLE MIAMI WWTP LEVEE	PUBLIC, LOCAL	HAMILTON	OHIO RIVER	II
SYCAMORE CREEK WWTP LEVEE	PUBLIC, LOCAL	HAMILTON	SYCAMORE CREEK	II
HILLSBORO WWTP LEVEE	PUBLIC, LOCAL	HIGHLAND	CLEAR CREEK	UNCLASS
LOGAN WATER TREATMENT PLANT LEVEE	PUBLIC, LOCAL	HOCKING	HOCKING RIVER	II
WARNER LEVEE	PRIVATE	LAKE	CHAGRIN RIVER	III
HEATH WWTP FLOOD PROTECTION LEVEE	PUBLIC, LOCAL	LICKING	SOUTH FORK LICKING RIVER	II
SWANEY LEVEE	PRIVATE	MARION	SCIOTO RIVER TRIBUTARY	III
GRUSENMEYER LEVEE	PRIVATE	MIAIMI	GREAT MIAMI RIVER	III
FULTON LEVEE	PRIVATE	MIAMI	LOST CREEK	III
MORAINE LEVEE AND FLOODWALL	PUBLIC, LOCAL	MONTGOMERY	GREAT MIAMI RIVER	I
ARNOLD LEVEE	PRIVATE	NOBLE	SALT RUN	UNCLASS
WESTFALL LEVEE	PRIVATE	PICKAWAY	BIG DARBY CREEK	III
GREEN ACRES LEVEE	PUBLIC, LOCAL	PIKE	CROOKED CREEK	I
WAVERLY WWTP LEVEE	PUBLIC, LOCAL	PIKE	SCIOTO RIVER	I
MILLS PRIDE LEVEE	PRIVATE	PIKE	SCIOTO RIVER - OFFSTREAM	I
YELLOWBUD CREEK LEVEE	PRIVATE	ROSS	YELLOWBUD	III
SIDNEY LEVEE	PUBLIC, LOCAL	SHELBY	GREAT MIAMI RIVER	II
SWARTZ DITCH LEVEE	PUBLIC, LOCAL	SUMMIT	SWARTZ DITCH	III
SWARTZ DITCH DETENTION DAM	PUBLIC, LOCAL	SUMMIT	SWARTZ DITCH	III
FRAL1 LEVEE	PUBLIC, C.D.	WARREN	GREAT MIAMI RIVER	I
WOOSTER LEVEE RELOCATION	PUBLIC, LOCAL	WAYNE	KILLBUCK CREEK	II
PERRYSBURG WWTP LEVEE	PUBLIC, LOCAL	WOOD	MAUMEE RIVER	I

LHMP DATA

Stark County: According to flood studies on file with the Stark County EMA, many communities in the county could be affected by a dam failure event. In an event that the Dover and Bolivar dams are at the emergency spillway, back up flooding along the Tuscarawas River through Stark County would significantly impact the Village of Navarre, as well as affect the cities of Massillon and Canal Fulton. Flooding in Navarre would far surpass 500-year flood levels, placing much of the village's downtown under water. Similar studies for Atwood Lake and the Beach City Dam, on file with the county EMA, indicate similar concerns. After an extensive examination of spreadsheet calculations, vulnerability assessments show that 28,288 structures could be damaged with an estimated loss of $1,019,132,000.

Delaware County: Dam failure is a significant concern for Delaware County. As of June 2018, there are 88 dams and reservoirs located within the county that could result in significant losses if they were to fail or become overtopped. These include 16 Class I dams, 13 Class II and III dams, and 24 Class IV dams. The Hoover Dam structure is located within Blendon Township in Franklin County, but a significant portion of its reservoir exists within Delaware County and should be considered a potential hazard to Delaware County residents (see Section 2.2). The Dams located within Delaware County are regulated by the U.S. Army Corp of Engineers (USACE), Ohio Department of Natural Resources (Division of Water) (ODNR) and Federal Energy Regulatory Commission (FERC).

For the 2013 Delaware County Hazard Mitigation Plan, local GIS inundation maps for all of the dams, except for the Sunbury and Ashley reservoirs, were overlaid onto the Auditor's parcel data and this determined the number of structures at-risk within each jurisdiction. Delaware, Powell, and Shawnee Hills are the only cities or villages that contain at-risk populations or structures due to their proximity to crucial rivers and reservoirs. Delaware City contains a staggering 1,458 vulnerable structures valued at over $300 million because the densely populated city lies directly south of the dam, in the direct pathway of the water's direction. In addition, there are over 2,000 vulnerable structures that lie outside of the county's municipalities, particularly since the majority of the dams and reservoirs are a sizeable distance from them. The 2013 Delaware County Multi-Hazard Mitigation Plan estimates that a total of 3,734 structures could be damaged with an estimated loss of $909,122,500.

PAST OCCURRENCES

The 2008 State Hazard Mitigation Plan Update referenced "The National Performance of Dams Partnership," a cooperative effort of engineers and dam safety professionals in the U.S. who retrieve, archive, and disseminate information on dam performance in order to list dam incidents and failures throughout the state. According to this database, Ohio experienced 273 dam incidents from 1882 to 2001. Because dam classification can be dynamic, a more complete database was developed by DSP for a span of years ranging from 1852 to 2014. (Please note the DSP data list incidents/failures dating back to 1852, However, the DSP was not created until 1963. Therefore, not all data provided to Ohio EMA were collected by DSP). Table 2.6.e lists the dam failures and incidents for Class I and II dams throughout the state. Due to limitations in data, incidents since 2014 could not be obtained when updating the 2019 State Hazard Mitigation Plan.

There has been little property damage that has resulted from a dam failure alone, as dam failures are few in Ohio. However, there has been property damage due to a combination of downstream flooding from excessive precipitation and dam failure. Unfortunately, it is difficult to assess which property damage was a direct result of the dam failure and which damage was a result of downstream flooding due to excessive precipitation. There has been some infrastructure loss in terms of roads washing away, but there has been no loss of critical facilities due to dam failure to date. It should be noted that DSP does not have much data showing property damages and losses; such data are generally unavailable as there has not been a large dam failure in Ohio for many years. The comments associated with each incident or failure in Table 2.6.e rarely contains such loss information.

There are no documented instances of levee breaches whereby structures or properties were damaged in Ohio as such data are generally unavailable and undocumented. This does not mean there is minimal risk behind these levees; it means more effort needs to be exerted in the collection of such data. However, according to DSP records, in 1997 the Green Acres Levee (Pike County) was overtopped by a flood estimated to be a 100-year event. Several homes were flooded as a result, but no specific damage data could be found for this update.

Table 2.6.e

Ohio High Hazard Dam Incidents/Failures From 1852 to 2014				
County	DSP Class	Dam Name	Incident Year	Incident Description*
Region 1				
Huron	I	NORWALK LOWER RESERVOIR	1969	Dam failed; no damage downstream noted. Dam was rebuilt with berm and drainage.
Huron	I	GREENWICH RESERVOIR DAM	1969	Dam partially failed; no damage downstream noted.
Huron	I	HOLIDAY LAKE DAM	1982, 2007	Left sidewall failed in 1982. A shallow slide was noted in 2007.
Morrow	I	CANDLEWOOD LAKE DAM	1998	Approximately 3-4' noted in the emergency spillway.
Sandusky	I	BALLVILLE DAM	1913	Dam failed with 1913 flood; no damage downstream reported.
Williams	I	LAKE SENECA DAM	1973, 1996	Overflow spillway failed in 1973 and 1996; no damage downstream reported.
Wyandot	I	KILLDEER UPGROUND RESERVOIR	1979, 2004	Leak and slide indicated in 1979, and multiple slides indicated in 2004.
Defiance	II	INDEPENDENCE DAM	1982	Left abutment was overtopped and damaged.
Lucas	II	SWANTON UPGROUND RESERVOIR	1970	Dam failure in 1970, but was repaired.
Seneca	II	MOHAWK LAKE DAM	1910, 1963	Dam failure in 1910 resulted in replacement; dam failure in 1963 resulted in repairs. No damage downstream reported.
Region 2				
Ashtabula	II	GERLAT LAKE DAM	2011	Spillway failed. ODNR issued an order for the dam to be repaired or breached. The dam was breached.
Cuyahoga	I	BRIAR HILL LAKE DAM	2006	Dam possibly overtopped; no damage downstream noted.
Delaware	I	LEXINGTON GLEN DAM	1987	Dam failed due to erosion on the emergency spillway and four erosion rills on the downstream slope.
Delaware	I	SUNBURY UPGROUND RESERVOIR NO. 1	1960s	Dam overtopped; no downstream damage noted.
Fairfield	I	RUSHCREEK STRUCTURE NO. VI-A	1982	An abutment leakage was noted and repaired.
Fairfield	I	PINE LAKE ESTATES DAM	2013	Spillway failure

Geauga	II	KENSTON LAKE DAM	2010	Spillway clogged and the dam overtopped. ODNR issued an order for the dam to be repaired or breached. The dam was breached. Pipe jacked and bored through the dam, eliminating the reservoir and making the dam a roadway embankment.
Geauga	I	MONT-MERE LAKE DAM	2006	Water was 1-1.5' below top of dam; dam never overtopped.
Geauga	I	TANGLEWOOD LAKE DAM	1981	Spillway partially failed, but was repaired; no damage downstream noted.
Knox	I	KNOX LAKE DAM	1950	Seepage was noted and spillway failed.
Lake	I	HOOSE ROAD RETENTION DAM	2006	Water was 1-2' above emergency spillway elevation.
Lake	I	BRIGHTWOOD LAKE DAM	1985	A resident near the emergency spillway stated the dam overtopped; no damage downstream reported.
Lorain	II	BRENTWOOD LAKE DAM	2009	Spillway failed. ODNR issued an order for the dam to be repaired or breached. The dam was breached.
Medina	I	PISCHIERI POND DAM	1999	Dam was breached in controlled manner due to detection of void in dam; no damage downstream.
Medina	I	RAVENS WOOD LAKE DAM	1973	Original dam failed and was rebuilt in 1973.
Medina	I	RUSTIC HILLS LAKE DAM	1980, 2003	Dam failed in 1980, and emergency spillway failed in 2003 which caused overtopping; no damage downstream reported.
Portage	I	BRIMFIELD LAKE DAM	1979	Dam nearly failed due to overtopping; no damage downstream reported.
Richland	I	SHELBY UPGROUND RESERVOIR NO. 2	2001	Seepage was noted through reservoir due to field tile; repairs were made accordingly.
Summit	II	THE MEADOWS DAM	2012	Spillway failed. ODNR issued an order for the dam to be repaired or breached. The dam was breached.
Summit	I	LAKE LITCHFIELD DAM	1973	Embankment failed during construction.
Warren	I	PINE HILL LAKE DAM	2001	Emergency spillway flowed; no damage downstream reported.
Wayne	I	CHIPPEWA CREEK STRUCTURE VII-C	1973	Foundation failure during construction; no damage indicated downstream.
Ashtabula	II	ELKEM FLUID WASTE POND 3A	1980	Slide was noted in the downstream slope, and was fixed.
Cuyahoga	II	MARSHFIELD LAKE DAM	1973	Dam breached under order; no damages reported; rebuilt in 1977.
Franklin	II	TIMBERLAKE NO. 1 DAM	1984	Drain pipe failed, but was repaired.
Geauga	II	BURTON LAKE DAM	1970s, 1997	Dam breached in the 1970s, and seepage boils were noted in 1997.
Geauga	II	PAW PAW LAKE DAM	1941	Dam failed and was rebuilt in 1941; no damage downstream was reported.
Geauga	II	KENSTON LAKE DAM	1970s	Downstream face slipped.
Hamilton	II	HERMITAGE CLUB LAKE DAM	1982	Intense storm resulted in dam overtopping; no damage downstream reported.
Licking	II	GOSS LAKE DAM	1990	Floodwaters caused partial failure of principal spillway; no damage downstream noted.
Licking	II	NEWARK LOW HEAD DAM	1959	Dam washed out in 1959, but was rebuilt.
Medina	II	RPM LAKE DAM	1998	Principal spillway failure; repairs made in 1998.
Portage	II	AURORA POND DAM	1985	Dam failed and was rebuilt around 1985.
Stark	II	MORELLI POND DAM	2003	Causeway breached due to a compromise in left end of dam; no damage downstream reported.
Stark	II	WILLOWDALE LAKE DAM	1923	Original dam failed and was rebuilt in 1924, with multiple repairs through the present.
Summit	II	VIRGINIA KENDALL PARK DAM	2003	Dam failure in late 1970s, and was overtopped in 2003; no damage downstream noted.

Summit	II	CAMP JULIA CROWELL LAKE DAM	2006	Severe erosion was noted on the left side of the emergency spillway.
Summit	II	LAKE FOREST DAM	2003	Dam experienced a flood of record in 2003; no damage downstream reported.
Summit	II	CITY OF HUDSON UPPER LAKE DAM	2003	Dam overtopped; no downstream damage noted.
Summit	II	CITY OF HUDSON LOWER LAKE DAM	2003	Dam overtopped; no downstream damage noted.
Trumbull	II	NEWTON FALLS LOW HEAD DAM	1988	Hole was noted in spillway.
Warren	II	WATER'S EDGE DAM	1993	Dam was rebuilt in 1993 after failure.

Region 3				
Athens	I	ATHENS FISH AND GAME CLUB LAKE DAM	1975	Dam was deemed unsafe due to seepage and a slide and was breeched; no downstream damage reported. It was reconstructed in 1978.
Belmont	I	ST. CLAIRSVILLE RESERVOIR NO. 2 DAM	1980	A sinkhole was noted in the upstream slope.
Belmont	I	BARNESVILLE LAKE DAM	2005	A shallow slide was noted on the downstream slope.
Belmont	I	MEIGS-PHILLIPS I NO. 1 DAM	2004	Severe erosion was noted in the emergency spillway.
Brown	I	RUSSELLVILLE RESERVOIR DAM	1997	Dam was overtopped; no damage noted downstream.
Columbiana	I	GUILFORD LAKE DAM	1852	Dam breached; no downstream damage noted.
Guernsey	I	LUBURGH LAKE DAM	1979	A downstream slope slide was noted and repaired.
Guernsey	I	SALT FORK LAKE DAM	1998	Dam overtopped; no downstream damage noted.
Hocking	I	LAKE LOGAN DAM	1950	Dam was breached upon initial filling; no damage downstream noted. Dam was redesigned in 1952 and rebuilt in 1954.
Hocking	I	LAKE OF THE FOUR SEASONS DAM	2013	Upstream slope earth slide.
Jackson	I	WELLSTON RESERVOIR DAM	1937	A slide was noted.
Jackson	I	OAK HILL UPGROUND RESERVOIR	1986	Multiple slides were noted.
Jefferson	I	JEFFERSON LAKE DAM	2004	Dam was within 0.5' of overtopping two times in one year.
Jefferson	I	WILLIAMS LAKE DAM	2004	Dam overtopped twice in same year; no damage downstream reported.
Morgan	I	CROOKSVILLE RESERVOIR NO. 1 DAM	1950	Dam noted as probably overtopping; no damage downstream indicated.
Morgan	I	CROOKSVILLE RESERVOIR NO. 2 DAM	1984	Slide was noted in the downstream slope, and was fixed.
Perry	I	SHELTON LAKE DAM	1990	Dam overtopped; no downstream damage noted.
Perry	I	ALTIERS LAKE DAM	2004	Flood event resulted in pool being 3-4' above normal; dam did not overtop.
Pike	I	LAKE WHITE DAM	1964, 1994	Dam overtopped in 1964 and 1994; no damage downstream reported.
Ross	I	CALDWELL LAKE DAM	1994	Sink hole was noted and repaired.
Ross	I	KNOLES POND DAM	1979	Lake was drained for repairs.
Scioto	I	ROOSEVELT LAKE DAM	1997	Dam overtopped; no downstream damage noted.
Athens	II	RAINBOW LAKE DAM	1979	Slide was noted in the downstream slope near right abutment, and was fixed.
Carroll	II	ROHR DAM	1975	Failure indicated at right end of dam; no damage downstream reported.
Carroll	II	BOY SCOUT DAM	1984	Upstream slope failed during construction.
Clermont	II	BECKJORD ASH POND C DAM	1999	Elbow of pipe and riser collapsed.

Columbiana	II	WESTVILLE LAKE DAM	1980, 1982, 1994	Breach in the south dike indicated in 1980; another breach indicated in 1982; portion of replacement spillway washed out during construction in 1994. No damage downstream was reported.
Columbiana	II	SEVAKEEN COUNTRY CLUB LAKE DAM	1930s	Dam breached and rebuilt; no downstream damage noted.
Columbiana	II	SLATES LAKE DAM	1965	Dam failed during initial filling of lake due to seepage around spillway pipe; no damage downstream indicated.
Columbiana	II	WOODLAND LAKE DAM	2003	Dam overtopped; no downstream damage noted.
Columbiana	I	Buckeye Water District Reservoir	2008	
Harrison	II	SELESKI LAKE NO. 2 DAM	1989	Dam overtopped at left end; no damage downstream reported.
Jefferson	II	LAKE HENRY DAM	1993	Original principal spillway was blocked.
Lawrence	II	SMITH HOLLOW DAM	1989	Spillway failed; no damage downstream reported.
Morgan	II	MUSKINGUM RIVER LOCK AND DAM NO. 7	1959	Dam failed in 1959; no damage downstream reported.
Muskingum	II	MUSKINGUM RIVER LOCK AND DAM NO. 10	1951	Dam failed in 1951; no damage downstream reported.
Perry	II	MERKLE DAM	1972	Dam washed out but was rebuilt in 1972.
Perry	II	TECUMSEH LAKE DAM	1990	Dam was overtopped by 1-2'; no damage downstream was reported.
Scioto	II	ELKS COUNTRY CLUB LAKE DAM	1980	33' long slide on the downstream slope; repaired, but slipped again.
Scioto	II	LAKE MARGARET DAM	1997	Dam overtopped in 1997, but repaired in 2002. No damage downstream noted.
Tuscarawas	I	SUGARCREEK SPORTSMAN CLUB Dam	2010	Seepage.
Washington	II	CHOPPER'S LAKE DAM	1994	Dam breached due to heavy rainfall with erosion of earth adjacent to spillway; no downstream damage noted.

Source: ODNR—Division of Soil and Water Resources, Dam Safety Program, Dam Inventory Data.

PROBABILITY OF OCCURRENCE

From 1852 to 2014, there were 103 documented Class I and II dam incidents/failures that were generally minor and resulted in little property damage (Table 2.6.e). Based on these figures, there is a 64% (103 incidents/162 years observed) annual chance of Class I/II dam incident/failure in any given year.

There are no documented instances of levee breaches whereby structures or properties were damaged in Ohio as such data are generally unavailable and undocumented. This does not mean that there is a zero percent chance of levee failure within the state, but more effort needs to be exerted in the collection of such data in order to produce a more accurate probability statement. For reasons previously mentioned, and some of which are uncontrollable by humans, it is possible a dam or levee can fail at any time, given the right circumstances. However, the probability of future occurrence is reduced due to proactive preventative action on the part of ODNR, DSP and individual dam and levee owners. As previously discussed in this section, the DSP provides oversight to dam/levee repairs, oversees and issues construction permits, enforces safety standards and mandates, conducts periodic safety inspections, and provides public information to levee owners, engineers, and the general public. This proactive approach to managing dam and levee safety in Ohio reduces the number of losses to property and life as a result of dam or levee failures or near failures.

VULNERABILITY ANALYSIS & LOSS ESTIMATION

DAMS – METHODOLOGY

It should be noted that many dams throughout the state do not possess inundation mapping, including some Class I dams. However, a portion of these high hazard dams have draft or final inundation mapping available through the ODNR- DSP and the local Emergency Management Agencies in which the dams reside. Much of this data is subjected to agreements where it cannot be published. In respect to these agreements, much of the inundation data could not be obtained while updating the 2019 State of Ohio Hazard Mitigation Plan.

Assessing the hazard that a dam poses to downstream areas can be divided into three analyses: (1) analysis of an uncontrolled release of the reservoir, (2) analysis of the inundation from the uncontrolled release, and (3) analysis of the consequence of the release. In other words, a dam fails, the failure causes flooding downstream, and the flooding has negative impacts on people or property. Each of these analyses includes substantial uncertainty. Legitimate estimates of discharge from a breach can differ by over 200%. Discharge from a dam breach is usually several times the one-percent-annual-chance flood, and, therefore, typical flood studies are of limited use in estimating the extent of flooding. Dam failure inundation studies require specialized hydraulic modeling software and experience. Determining the impact of flooding is also difficult to accomplish, especially for estimating loss of life. Loss of life is a function of the time of day, warning time, awareness of those affected, and failure scenario. Many dam safety agencies have used “population at risk” (PAR), a more quantifiable measurement of the impact to human life, rather than “loss of life.” PAR is the number of people in structures within the inundation area that would be subject to significant, personal danger, if they took no action to evacuate.

Another factor in assessing the hazard that a dam poses is the dam’s condition. Assessing the condition of a dam can be an extensive and expensive process. ODNR’s Dam Safety Program inspects all regulated dams once every 5 years. As part of that inspection, the dam’s history is reviewed including original construction plans, previous inspection reports, investigations and studies, “Operation, Maintenance, and Inspection Manuals”, “Emergency Action Plans”, calculations, and any other available information. During the inspection, an assessment of the downstream area is made to verify the classification of the dam. If the inspection, combined with the dam's history and potential downstream impacts, reveal concerns with the dam's condition, the DSP takes enforcement action through the Ohio Attorney General's office as needed.

As mentioned at the beginning of this section, emergency managers usually categorize dam failures as either sunny-day failures or rainy-day failures. Sunny day failures occur during a non-flooding situation with the reservoir near normal pool level. Rainy day failures usually involve periods of rainfall and flooding. Improper design of a spillway or careless operation of gates during high flows can lead to excessive water pressure and subsequent failure as well. Even though both types of failures can be disastrous, it can be assumed that a sunny day failure would be more catastrophic due to its unanticipated occurrence and the lack of time to warn residents downstream.

The impacts of a dam failure are contingent on many factors and, therefore, cannot be concisely described. Table 2.6.f contains rough estimates of the downstream impacts of dam failures for the Class I dams that have an estimated Sunny Day PAR greater than 50. The condition of the dams in table 2.6.f is not a factor of the estimated damage or PAR levels. Because of the uncertainty of determining precisely who and what will be impacted by a dam failure, a scale was developed by the DSP to categorize dams based on their estimated impact to lives and structures downstream. The "Very high, high, medium, and low" scale is based on the PAR and was developed using experience with flood modeling, aerial photographs, field observations, and engineering judgment. The Damage and PAR levels are periodically updated by DSP staff as new data is obtained.

DAMS – RESULTS **Table 2.6.f**

Class I Dams, Estimated Downstream Damage Level and Estimated Population At-Risk (PAR) by County					
Region 1					
County	**Dam**	**Sunny Day Damage Level**	**Sunny Day PAR Level**	**Rainy Day Damage Level**	**Rainy Day PAR Level**
Allen	Ferguson Upground Reservoir	High	Medium	Very High	Medium
Allen	Metzger Upground Reservoir	Medium	Medium	Very High	Medium
Allen	Lost Creek Upground Reservoir	Medium	Low	Medium	Low
Crawford	Bucyrus Reservoir No. 1 Dam	Medium	Low	Medium	Low
Hancock	Veterans Memorial Reservoir	Medium	Low	Medium	Low
Huron	Willard City Upground Reservoir	Medium	Low	Medium	Low
Huron	Norwalk Memorial Reservoir	High	Low	High	Low
Huron	Norwalk Upper Reservoir – Erosion and drainage repairs completed in 2012.	High	Low	High	Low
Huron	Norwalk Lower Reservoir	High	Low	High	Low
Shelby	Lockington Dam – Extensive dam foundation repairs completed in 2012.	--	Low	Very High	Medium
Shelby	Lake Loramie Dam – Extensive spillway improvements completed in 2018.	Medium	Low	Medium	Low

Region 2					
County	**Dam**	**Sunny Day Damage Level**	**Sunny Day PAR Level**	**Rainy Day Damage Level**	**Rainy Day PAR Level**
Butler	Fairfield Detention "A" Dam	--	Low	Medium	Low
Butler	Fairfield Detention "C" Dam	--	Low	Medium	Low
Butler	Acton Lake Dam - Extensive dam repairs completed in approximately 2016.	High	Low	High	Low
Clinton	Wilmington Upground Reservoir No. 2	Medium	Low	Medium	Low
Cuyahoga	Lakeview Cemetery Flood Control Dam	--	Low	High	Medium
Delaware	Alum Creek Upground Reservoir	High	Low	High	Low
Delaware	O'Shaughnessy Reservoir Dam	Very High	Low	Very High	Low
Franklin	Hoover Dam	Very High	High	Very High	High
Franklin	Julian Griggs Dam	High	Low	High	Low
Geauga	Bridge Creek Dam	Very High	Medium	Very High	Medium
Greene	Huffman Dam	--	Low	Very High	Medium
Knox	Apple Valley Lake Dam	High	Low	High	Low
Licking	Buckeye Lake Dam – Extensive dam repairs were completed in 2019.	Very High	High	Very High	Medium
Montgomery	Germantown Dam	--	Low	Very High	Medium
Montgomery	Taylorsville Dam	--	Low	Very High	Medium
Montgomery	Englewood Dam	--	Low	Very High	High
Portage	Mogadore Reservoir Dam	High	Medium	High	Medium
Portage	Lake Rockwell Dam	High	Medium	Very High	Medium
Richland	Clear Fork Reservoir Dam	Medium	Low	High	Medium
Summit	West Reservoir Dam – Extensive dam repairs completed in 2013.	High	Low	High	Low
Summit	Wolf Creek Dam	Very High	High	Very High	High
Summit	Tuscarawas River Diversion Dam – Extensive dam repairs completed in 2016.	Medium	Low	High	Low
Summit	North Reservoir Dam	Medium	Low	Medium	Low
Summit	East Reservoir Dam – extensive dam repairs are currently in construction expected to be completed in 2019.	Medium	Low	Medium	Low
Summit	Lake Dorothy Dam	Medium	Low	High	Low

Region 3					
County	**Dam**	**Sunny Day Damage Level**	**Sunny Day PAR Level**	**Rainy Day Damage Level**	**Rainy Day PAR Level**
Ashtabula	Roaming Rock Shores Lake Dam	High	Medium	High	Medium
Belmont	Belmont Lake Dam	Medium	Low	High	Medium
Clermont	Stonelick Lake Dam	High	Medium	Medium	Low

Columbiana	Guilford Lake Dam	High	Medium	Medium	Low
Gallia	Gavin Bottom Ash Pond	Medium	Low	Medium	Low
Gallia	Stingy Run Fly Ash Dam	Very High	Medium	Very High	High
Guernsey	Salt Fork Lake Dam – dam repairs completed in 2012.	Very High	Medium	Very High	Medium
Highland	Rocky Fork Lake Dam	Very High	High	Very High	High
Holmes	Lake Buckhorn Dam	Medium	Low	Medium	Low
Jefferson	Cardinal Fly Ash No. 2 Dam	Very High	Low	Very High	Low
Jefferson	Lake Austin Dam – Extensive dam and spillway repairs completed in 2018.	High	Low	High	Low
Mahoning	Evans Lake Dam	High	Medium	Very High	Medium
Mahoning	McKelvey Lake Dam	High	Medium	High	Medium
Mahoning	Lake Hamilton Dam	Medium	Low	High	Low
Mahoning	Lake Milton Dam	Very High	High	Very High	High
Noble	Wolf Run Lake Dam	Very High	Medium	Very High	Medium
Noble	Caldwell Lake Dam	High	Medium	High	Medium
Scioto	Turkey Creek Lake Dam	High	Medium	Medium	Low
Trumbull	Mineral Ridge Dam	Very High	High	Very High	High
Washington	Eramet Waste Retention Dam	High	Medium	High	Medium

Source: Ohio Department of Natural Resources Dam Safety Program, "Population at Risk" Evaluation

LEVEES – METHODOLOGY

Levee vulnerability was included as "Risk Characteristics" for each Levee system in the US Army Corp of Engineers National Levee Database (NLD). A risk classification was not assessed for each levee, however the Risk Characteristic assessed FEMA FIRM maps to estimate the number of people and structures at risk, as well as the property value exposed. The risk characteristics are as summarized in table 2.6.e below.

Table 2.6.e

National Levee Database: Vulnerability by County						
County	Region	Levee Count	Leveed Area (Sq. Miles)	People at Risk	Structures at Risk	Property Value at Risk
Erie	1	2	0.16	340	198	$ 67,000,000.00
Erie/Sandusky	1	1	0.53	240	99	$ 21,600,000.00
Lucas	1	5	4.12	2015	875	$ 334,600,000.00
Lucas/Ottawa	1	6	3.68	7	6	$ 9,114,000.00
Marion	1	2	0.80	60	43	$ 375,200,000.00
Miami	1	6	0.28	8501	3011	$ 1,838,530,000.00
Ottawa	1	146	16.62	465	547	$ 163,790,000.00
Ottawa/Sandusky	1	4	0.97	23	10	$ 2,538,000.00
Sandusky	1	3	1.30	2742	1340	$ 481,900,000.00
Butler	2	10	4.12	7582	267.6	$ 1,252,140,000.00
Cuyahoga	2	1	0.01	148	32	$ 10,300,000.00
Fairfield	2	2	0.89	1067	453	$ 232,980,000.00
Franklin	2	3	4.82	14485	4695	$ 2,197,130,000.00
Hamilton	2	10	5.39	16289	1709	$ 2,709,870,000.00
Knox	2	5	0.79	1927	767	$ 302,460,000.00
Lake	2	1	0.03	183	75	$ 24,900,000.00
Licking	2	1	0.16	671	283	$ 61,400,000.00
Lorain	2	1	0.25	13	6	$ 2,000,000.00
Montgomery	2	20	10.28	20717	8114	$ 9,869,017,000.00
Stark	2	5	0.78	1821	671	$ 332,320,000.00
Warren	2	5	0.45	1717	595	$ 238,570,000.00
Clermont	3	1	0.08	6	4	$ 2,690,000.00
Columbiana	3	1	0.45	1868	113	$ 250,000,000.00
Guernsey	3	2	0.12	282	167	$ 147,400,000.00
Hocking	3	1	0.03	60	32	$ 10,200,000.00
Lawrence	3	2	2.35	9377	5043	$ 1,303,000,000.00
Muskingum/Perry	3	1	0.11	384	324	$ 85,700,000.00
Pike	3	4	1.81	37	14	$ 69,592,000.00

Levee Inventory by County						
County	**Region**	**Levee Count**	**Leveed Area (Sq. Miles)**	**People at Risk**	**Structures at Risk**	**Property Value at Risk**
Ross	**3**	1	2.15	9407	3999	$ 1,920,000,000.00
Scioto	**3**	1	2.99	11062	4717	$ 2,650,000,000.00
Tuscarawas	**3**	1	0.11	53	35	$ 23,400,000.00
Lucas/Monroe	**1, 3**	1	0.50	2364	1225	$ 275,000,000.00
Stark/Carroll	**2, 3**	1	0.11	303	141	$ 47,700,000.00

Source: US Army Corp of Engineers National Levee Database

Statewide, there are 257 levee systems in the National Levee Database that protect an area of about 56.50 square miles. Within this protected area resides an estimated 116,216 people, 42,019 structures, and an estimated property value of $27,312,041,000.

In Region 1, there are 146 levee systems that protect an area of about 28.96 square miles. Within this protected area resides an estimated 16,757 people, 7,354 structures, and an estimated property value of $3,569,272,000. One of these levee systems extend into Monroe County which is in Region 3.

In Region 2, there are 65 levee systems that protect an area of about 28 square miles. Within this protected area resides an estimated 66,923 people, 20,217 structures, and an estimated property value of $17,280,787,000. One of these levee systems extend into Carroll County which is in Region 3.

In Region 3, there are 15 levee systems that protect an area of about 9.42 square miles. Within this protected area resides an estimated 32,536 people, 14,448 structures, and an estimated property value of $6,461,982,000.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

DAM VULNERABILITY METHODOLOGY

As discussed in Section 2.1, the Department of Administrative Services maintains a database of all state-owned and state-leased facilities. These data were obtained for this enhanced plan update, and facilities were categorized based on their critical and non-critical nature (per the definition provided in Section 2.1). For dam failures, inundation mapping is available for many Class I dams throughout the state. This mapping can be coupled with the georeferenced state-owned and state-leased facilities to determine which state holdings are at risk given a dam failure that matches the assumptions made during the inundation analyses.

This methodology was used for assessing state-owned and state-leased facilities vulnerable to Class I dams owned and operated by the USACE. Specifically, 16 dams were analyzed. The inundation area that was analyzed for each dam was specific to the spillway design flood with dam failure. While such an event is extremely remote in nature, it is within the realm of possibility given the right conditions. The USACE dams and the critical facilities that fall within their inundation zones are summarized in table 2.6.f below.

Table 2.6.f

USACE Dam Name	Structures	Value of Structures
MOSQUITO CREEK	3	$ 242,823
MOSQUITO CREEK UPSTREAM	20	$ 1,441,000
ALUM CREEK DAM	1	$ 60,600,000
ATWOOD DAM	4	$ 616,148
BEACH CITY DAM	5	$ 39,174,348
BLUESTONE DAM	8	$ 20,602,352
BOLIVAR DAM	52	$ 46,270,783
CAESAR CREEK LAKE DAM	2	$ 101,705
CLENDENING DAM	1	$ 226,644
DELAWARE DAM	56	$ 73,152,052
DILLON DAM	24	$ 2,357,385
DOVER DAM	30	$ 42,908,528
MICHAEL J KIRWAN DAM	3	$ 242,823
MOHAWK DAM	33	$ 4,904,058
TOM JENKINS DAM	1	$ 19,503,602
WEST FORK OF MILL CREEK LAKE DAM	1	$ 1,667,976

It should be noted the majority of dams throughout the state do not possess inundation mapping, many of which are Class I. However, a portion of these high hazard dams have draft or final inundation mapping available through the ODNR- DSP. Future updates to this plan will include analysis of these maps in coordination with the ODNR using the same methodology described previously.

RESULTS

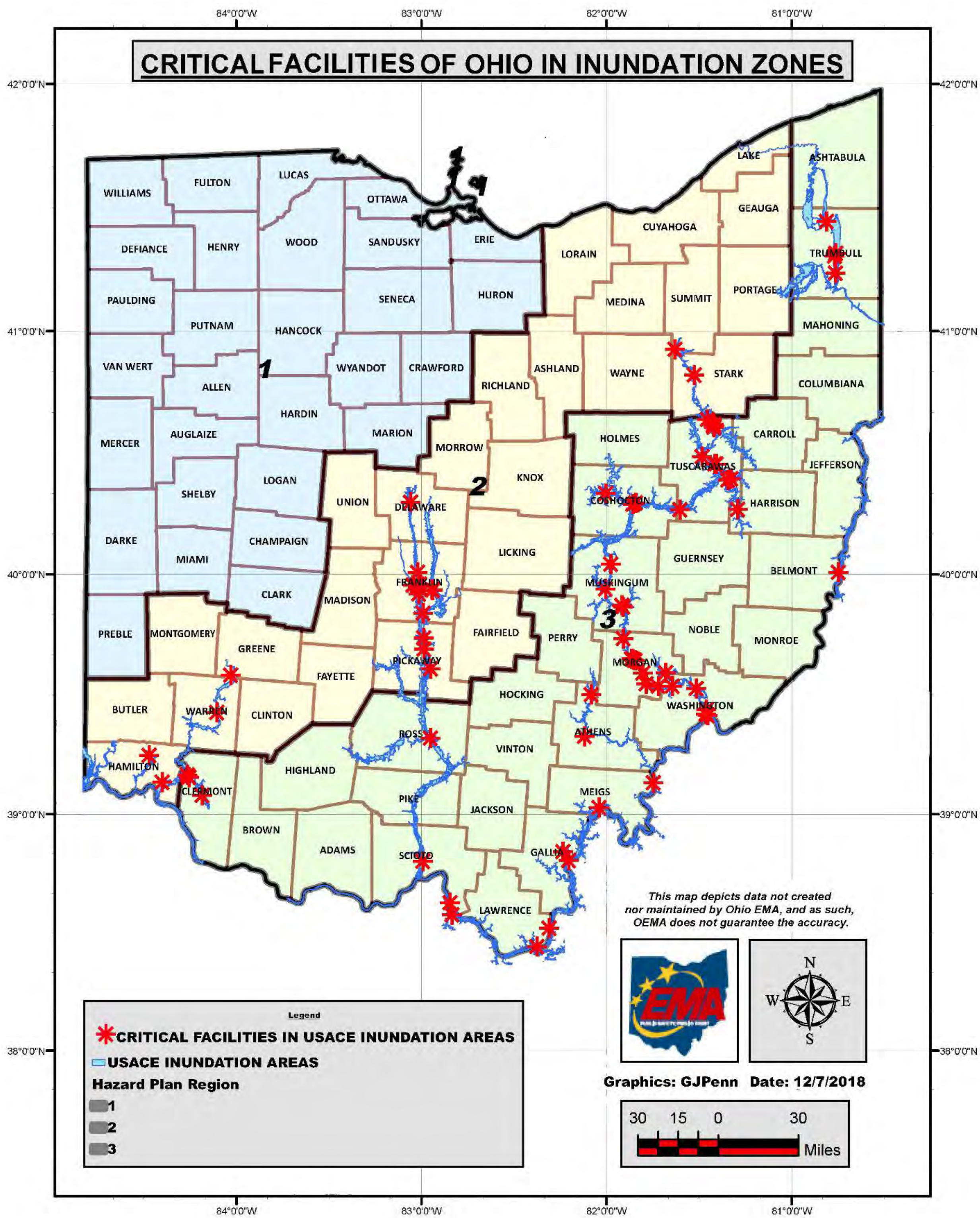
Table 2.6.g shows the numbers of state-owned and state-leased facilities potentially affected by an event equivalent to the spillway design flood with dam failure. Of the dams analyzed, Region 1 did not have any facilities within the spillway. In Region 2, there were an estimated 82 structures within the spillway with a total property value at risk at $460,473,098.00. Franklin County had the most with 58 structures at $435,759,205.00.

Region 3 contains the most state-owned and state-leased facilities within the inundation zones of the assessed dams. There were 240 structures throughout 15 counties in the region with a total property value of $151,752,451.00. Tuscarawas County had most of these counties, with 68 structures worth a total value of $54,290,414.00.

Table 2.6.g

Estimated Losses from Dam Failure for State-Owned and State-Leased Facilities					
Region 2			Region 3		
County	Structures with Levee Protection	Property Value at Risk	County	Structures with Levee Protection	Property Value at Risk
Clinton	1	$ 422,778.00	Athens	12	$ 24,853,315.00
Delaware	3	$ 736,213.00	Belmont	1	$ 22,108.00
Franklin	58	$ 435,759,205.00	Clermont	8	$ 1,675,283.00
Greene	4	$ 995,000.00	Coshocton	14	$ 4,588,245.00
Hamilton	3	$ 19,954,621.00	Gallia	5	$ 927,908.00
Pickaway	6	$ 2,140,011.00	Harrison	1	$ 873,000.00
Stark	2	$ 194,389.00	Lawrence	5	$ 1,862,205.00
Warren	5	$ 270,881.00	Meigs	22	$ 4,163,299.00
			Morgan	19	$ 1,275,120.00
			Muskingum	9	$ 1,263,707.00
			Ross	1	$ 937,500.00
			Scioto	11	$ 33,423,194.00
			Trumbull	42	$ 2,837,882.00
			Tuscarawas	68	$ 54,290,414.00
			Washington	22	$ 18,759,271.00
Region 2 Total:	82	$ 460,473,098.00	Region 3 Total:	240	$ 151,752,451.00

Map 2.6.c


CRITICAL FACILITIES OF OHIO IN INUNDATION ZONES
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41°0'0"N
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39°0'0"N
38°0'0"N
WILLIAMS
FULTON
LUCAS
OTTAWA
DEFIANCE
HENRY
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
LAKE
GEAUGA
ASHTABULA
TRUMBULL
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
MEDINA
SUMMIT
PORTAGE
MAHONING
VAN WERT
ALLEN
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
COLUMBIANA
MERCER
AUGLAIZE
HARDIN
MARION
MORROW
HOLMES
CARROLL
JEFFERSON
TUSCARAWAS
SHELBY
LOGAN
UNION
DELAWARE
KNOX
COSHOCTON
HARRISON
DARKE
MIAMI
CHAMPAIGN
LICKING
GUERNSEY
BELMONT
CLARK
MADISON
FRANKLIN
MUSKINGUM
PREBLE
MONTGOMERY
GREENE
FAIRFIELD
PERRY
NOBLE
MONROE
PICKAWAY
MORGAN
FAYETTE
BUTLER
WARREN
CLINTON
HOCKING
WASHINGTON
ROSS
ATHENS
VINTON
HAMILTON
CLERMONT
HIGHLAND
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This map depicts data not created nor maintained by Ohio EMA, and as such, OEMA does not guarantee the accuracy.
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CRITICAL FACILITIES IN USACE INUNDATION AREAS
USACE INUNDATION AREAS
Hazard Plan Region
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Graphics: GJPenn Date: 12/7/2018
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Miles

LEVEE VULNERABILITY METHODOLOGY

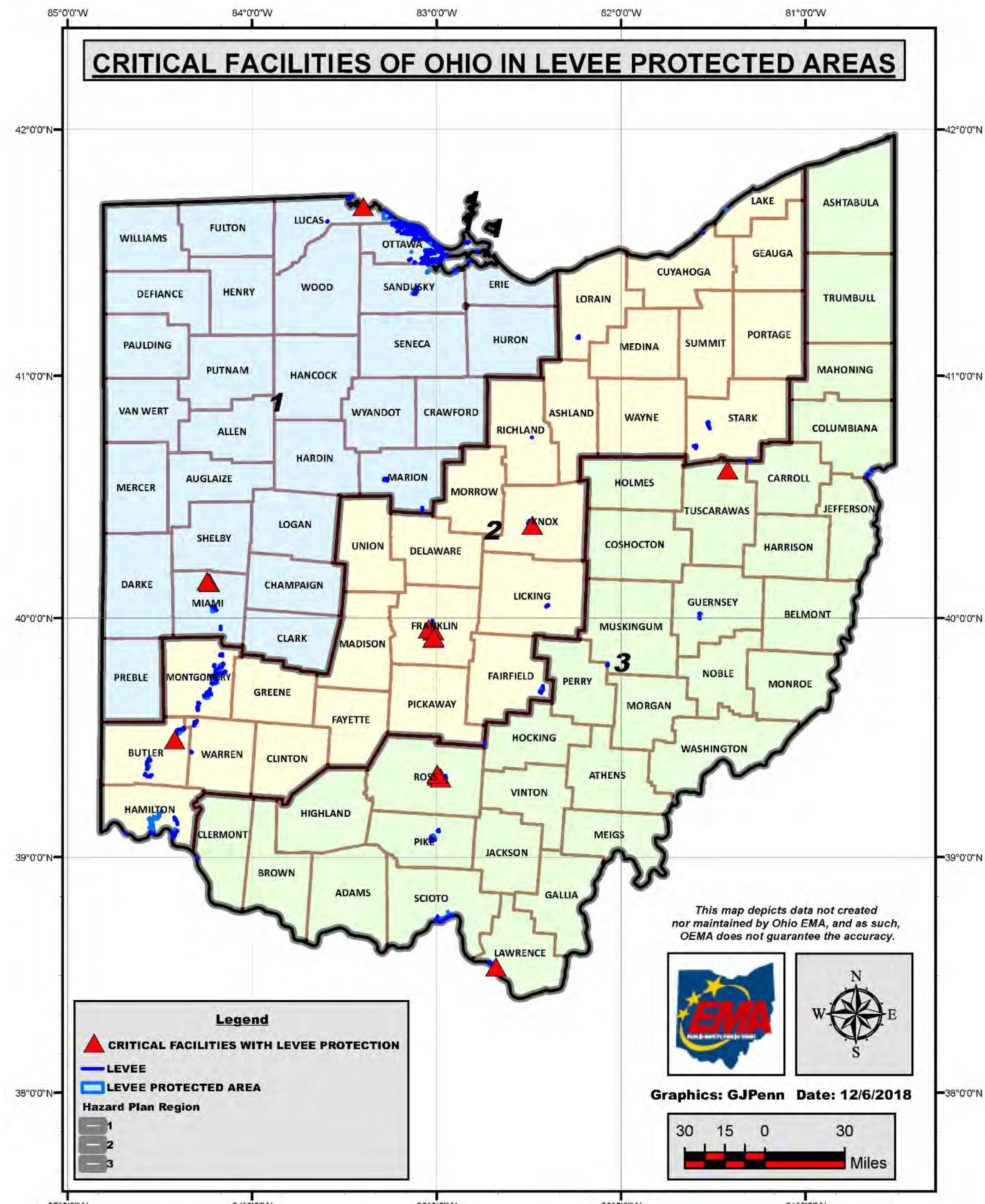
As referenced in Table 2.6.d, the National Levee Database lists 257 levee systems in Ohio. Each one of these levees protects a defined area as determined from FEMA FIRM maps. Each of these leveed areas were used to intersect with the list of State-owned and State-leased critical facilities in Ohio.

RESULTS

Table 2.6.h shows that there are 102 State-owned and State-leased critical facilities in Ohio that are protected by levees listed in the National Levee Database. The total value of these structures amount to approximately $87.82 million. Region 1 had the least number of structures with four—one in Lucas County and three in Miami County. The total value of these four structures in Region 1 is approximately $1.55 million. Region 2 has the second most number of structures at 57 but had the highest property value at risk by far at approximately $68.39 million. 54 of the 57 structures are in Franklin County. Region 3 had the highest number of structures at 68—51 of which are in Ross County. The total value of these 68 structures in Region 3 is approximately $17.88 million.

Table 2.6.h

State-Owned and State-Leased Facilities within Leveed Areas (NLD)								
Region 1			Region 2			Region 3		
County	Structures with Levee Protection	Property Value at Risk	County	Structures with Levee Protection	Property Value at Risk	County	Structures with Levee Protection	Property Value at Risk
Lucas	1	$ 22,000.00	Butler	1	$ 1,447,035.51	Lawrence	1	$ 705,010.77
Miami	3	$1,523,856.86	Franklin	54	$66,332,254.38	Ross	51	$13,770,711.88
			Knox	2	$ 608,285.67	Tuscarawas	16	$ 3,408,608.69
Region 1 Total:	4	$ 1,545,856.86	Region 2 Total:	57	$ 68,387,575.56	Region 3 Total:	68	$ 17,884,331.34


CRITICAL FACILITIES OF OHIO IN LEVEE PROTECTED AREAS
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82°0'0"W
81°0'0"W
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40°0'0"N
39°0'0"N
38°0'0"N
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FULTON
LUCAS
OTTAWA
DEFIANCE
HENRY
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
LAKE
GEAUGA
ASHTABULA
TRUMBULL
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
MEDINA
SUMMIT
PORTAGE
MAHONING
VAN WERT
ALLEN
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
COLUMBIANA
HARDIN
MERCER
AUGLAIZE
MARION
MORROW
HOLMES
TUSCARAWAS
CARROLL
JEFFERSON
LOGAN
SHELBY
UNION
DELAWARE
KNOX
COSHOCTON
HARRISON
DARKE
MIAMI
CHAMPAIGN
LICKING
GUERNSEY
BELMONT
CLARK
MADISON
FRANKLIN
MUSKINGUM
PREBLE
MONTGOMERY
GREENE
FAIRFIELD
PERRY
NOBLE
MONROE
FAYETTE
PICKAWAY
MORGAN
BUTLER
WARREN
CLINTON
HOCKING
WASHINGTON
ROSS
ATHENS
VINTON
HAMILTON
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MEIGS
BROWN
ADAMS
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GALLIA
LAWRENCE
This map depicts data not created nor maintained by Ohio EMA, and as such, OEMA does not guarantee the accuracy.
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CRITICAL FACILITIES WITH LEVEE PROTECTION
LEVEE
LEVEE PROTECTED AREA
Hazard Plan Region
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Graphics: GJPenn Date: 12/6/2018
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2.7 WILDFIRE

A wildfire is an uncontrolled fire that burns an area of combustible vegetation and typically occurs in rural areas. Each year in Ohio, an average of 1000 wildfires burn 4,000 to 6,000 acres of forest and grassland within ODNR Division of Forestry's Wildfire Protection Area (Map 2.7.a). The protection area includes all 200,000+ acres of Ohio's 21 State Forests, as well as all privately owned lands within the district boundaries. The forest fire protection district corresponds mostly to the state's unglaciated hill country (southern and eastern Ohio), and also encompasses a section of northwest Ohio (Maumee State Forest area). According to the Ohio Department of Natural Resources, Ohio's wildfire seasons occur 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) when combined present an unpredictable danger to unwary civilians and firefighters in the path of a wildfire. Open burning is regulated by state laws and local burning ordinances, which may vary from one jurisdiction to another. Outside municipal limits, burning is prohibited from 6 am to 6 pm during the months of March, April, May, October and November. It is during these times of the year and day that wildfires are most likely to occur and are the most difficult to control.

While Ohio government agencies and local fire departments are accustomed to handling seasonal wildfires, occasional extreme events can make conditions dangerous and disruptive. Heavy fuel accumulations oftentimes make wildfire suppression extremely difficult due to more intense blazes. Occasionally, heavy fuel loadings and topography create problems in limiting access to fires, and lead to heavy equipment use for suppression. Prolonged drought may cause an exceptionally long or active wildfire season, as well as contribute to extreme wildfire behavior or burning conditions. Multiple concurrent fires can tax resources and quickly create a lack of manpower and other resources and retard the ability to suppress fires rapidly and safely.

The Wildland Urban Interface (WUI) conditions may create a serious issue of concern in Ohio. The WUI is defined as the situation where homes, residences, and structures are in close proximity to forested lands and grasslands prone to wildfire. This creates a situation where, in the event of a wildfire, personal and property safety are put in jeopardy. Additionally, WUI situations force fire departments to shift focus from fire suppression to structure protection, consequently increasing exposure time and risk. WUI situations are most effectively addressed prior to wildfire occurrence by individual homeowners. Mitigation strategies include reducing flammable vegetation and debris within 30 feet of the structure, choosing less flammable landscape species, using fire resistant building materials, and practicing safe open burning techniques. Currently in Ohio, there a numerous codes in place that regulate buildings and fire safety. The Ohio Fire Code 1301: 7-7 establishes regulations affecting or relating to structures, processes, premises and safeguards regarding:

1. The hazard of fire and explosion arising from the storage, handling or use of structures, materials or devices.
2. Conditions hazardous to life, property or public welfare in the occupancy of structures or premises.
3. Fire hazards in the structure or on the premises from occupancy or operation.

4. Matters related to the construction, extension, repair, alteration or removal of fire protection systems.
5. Conditions affecting the safety of fire fighters and emergency responders during emergency operations.

Because nearly all wildfire occurrences in Ohio are human caused, wildfire prevention through community outreach, education, and local fire department cooperation are critical to decreasing wildfire occurrence and minimizing damage. When local fire departments take the lead on community safety, chances for success are greater because of the leadership and trust that local responders have with community members. The ODNR Division of Forestry supports local fire departments by providing educational materials, brochures, and wildfire prevention handouts for events. The Division of Forestry also supports local Fire Departments by providing wildfire suppression training, grant opportunities, and other capacity-building programs.

Open burning (burning of yard waste or debris) is regulated by state laws and local burning ordinances, which may vary from one jurisdiction to another. ORC addresses kindled fires regulations, and states that outside municipal limits, open burning is prohibited from 6 am to 6 pm during the months of March, April, May, October and November. It is during these times of the year and days that wildfires are most likely to occur and are the most difficult to control. Additionally, the Ohio EPA enforces OAC 3745.19, which regulates materials that may or may not be incinerated through open burning. Prohibited substances include petroleum based materials, food waste, and animal carcasses. To ensure compliance with all regulations, residents should contact their local fire official with jurisdiction for the applicable laws.

RISK ASSESSMENT

LOCATION

Wildfires in Ohio occur most frequently in the southern, southeastern, and eastern parts of the state. This area is predominantly unglaciated, hilly country, and varies in land cover type, including abundant forests and grasslands. The ODNR Division of Forestry is responsible for wildland fire protection on all state and private lands within this area. Additionally, ODNR Division of Forestry has wildfire protection responsibility in a disjoined area in northwest Ohio surrounding Maumee State Forest. Local and volunteer fire departments across these parts of Ohio typically provide initial response wildfire suppression service within their respective jurisdictions. Following response to a wildfire event, local fire departments within the ODNR Division of Forestry wildfire protection area are encouraged to file a wildfire report to ODNR Division of Forestry. Wildfire reports contain information such as date, time, location, size, etc. Filing wildfire reports to ODNR Division of Forestry is not mandatory, but is highly encouraged.

The ODNR Division of Forestry does not collect wildfire occurrence data from outside the ODNR Forestry protection area. Parts of Ohio that are outside of the protection area typically do not experience many wildfire events due to land use and land cover type (agricultural, developed urban/suburban); however certain parts of western Ohio have scattered Conservation Reserve Program (CRP) grasslands, which are a very volatile wildland fire fuel type. Since fire departments outside of the ODNR Forestry wildfire protection area do not file wildfire reports within the ODNR database, ODNR Division of Forestry does not have a dataset for wildfire occurrence in these areas. For the remaining parts of the state outside of the ODNR wildfire protection area, data obtained from the National Fire Incident Reporting System (NFIRS), established by the US Fire Administration, will be used for the purpose of research in this part of the plan. Per their website, NFIRS is a reporting standard that fire departments use to uniformly report on the full range of their activities. It is the largest national database of fire incident information and claims to comprise of about 75% of all reported fires that occur annually. For Ohio, the data is maintained and compiled by the Ohio Department of Commerce Division of State Fire Marshal and reports the compiled data to the US Fire Administration. For the historical and vulnerability analyses in this plan, counties that are entirely within the ODNR wildfire protection area will use ODNR data. Additionally, any historical data in this plan from 1/1/1997 to 11/20/2007 are fires reported from within the wildfire protection area. Counties that are partially covered or entirely outside of the area will be assessed using data from NFIRS (Map 2.7.a).

Region 1: ODNR Division of Forestry collects wildfire data from fire departments in parts of Lucas, Henry, and Fulton counties in Region 1, as these counties contain parts of Maumee State Forest. ODNR Division of Forestry does not collect wildfire report data in the remainder of Region 1 counties. Land cover type in Region 1 is predominantly agricultural land, and generally unforested; therefore, wildfire occurrence and risk are not as great as Region 3 where the topography provides abundant sources of natural combustible fuel.

Region 2: The majority of Region 2 lies outside of the ODNR Division of Forestry wildfire protection area – six counties straddle the wildfire protection area boundary. Ashland County contains Mohican State Forest, which is located completely within Region 2. Additional portions of Region 2 counties that report wildfires to ODNR Division of Forestry include southeastern Fairfield, western Licking, western Knox, and southern Stark. Region 2 contains Ohio’s most developed metropolitan hubs, as well as areas of highest population density. Wildland fuel types (woodland, grasslands) are not as abundant. One notable location for potential large scale and damaging wildfire in Region 2 is the Mentor Marsh in Lake County, east of Cleveland. Mentor Marsh is a 691 acre nature preserve that has converted to nearly a monoculture of 8-12 foot high non-native Phragmites grass. This area is highly flammable, especially in spring with high winds coming off Lake Erie. Mentor Marsh has experienced 10 wildfire events since 1979, four of these being extremely noteworthy: May 1982 – 200 acres, May 1987 – 120 acres, May 1992 – 400 acres, April 2003 – 375 acres. All of these large-scale events were determined to be arson caused. Many homes, businesses, and high valued property are at risk from wildfire events in Mentor Marsh.

Region 3: Counties within Region 3 represent areas of highest wildfire risk and hazard in the State of Ohio. The vast majority of wildfires in Ohio occur in Region 3 due in part to abundant forested lands and grasslands. Population distribution and regional socio-cultural aspects contribute to higher wildfire occurrence, as well. Topography in Region 3 has more variety with numerous ridges and hollows, as opposed to flatter areas in western and central Ohio, which contributes to more complex wildfire behavior. ODNR Division of Forestry has identified 101 communities at risk (CAR) to wildfire in Ohio through GIS analysis, and all 101 CAR lie within Region 3 (Map 2.7.b). ODNR Division of Forestry collects wildfire data from fire departments in all counties of Region 3, with the exception of Brown and Clermont Counties which are completely outside their protection area.

Map 2.7a
State of Ohio Wildfire Hazard Assessment
ODNR Division of Forestry Wildfire Protection Area Boundary

On February 6, 2019, The Ohio Department of Natural Resources Division of Forestry expanded the Wildfire Protection Area. According to Greg Guess, wildfire program coordinator and deputy chief for the ODNR Division of Forestry:

> "The expanded wildfire protection area contains approximately 580 fire departments, a significant increase from approximately 325 fire departments contained in the protection area prior to the expansion…The ODNR Division of Forestry is looking forward to partnering with more rural fire departments to increase wildfire protection efforts in their communities."

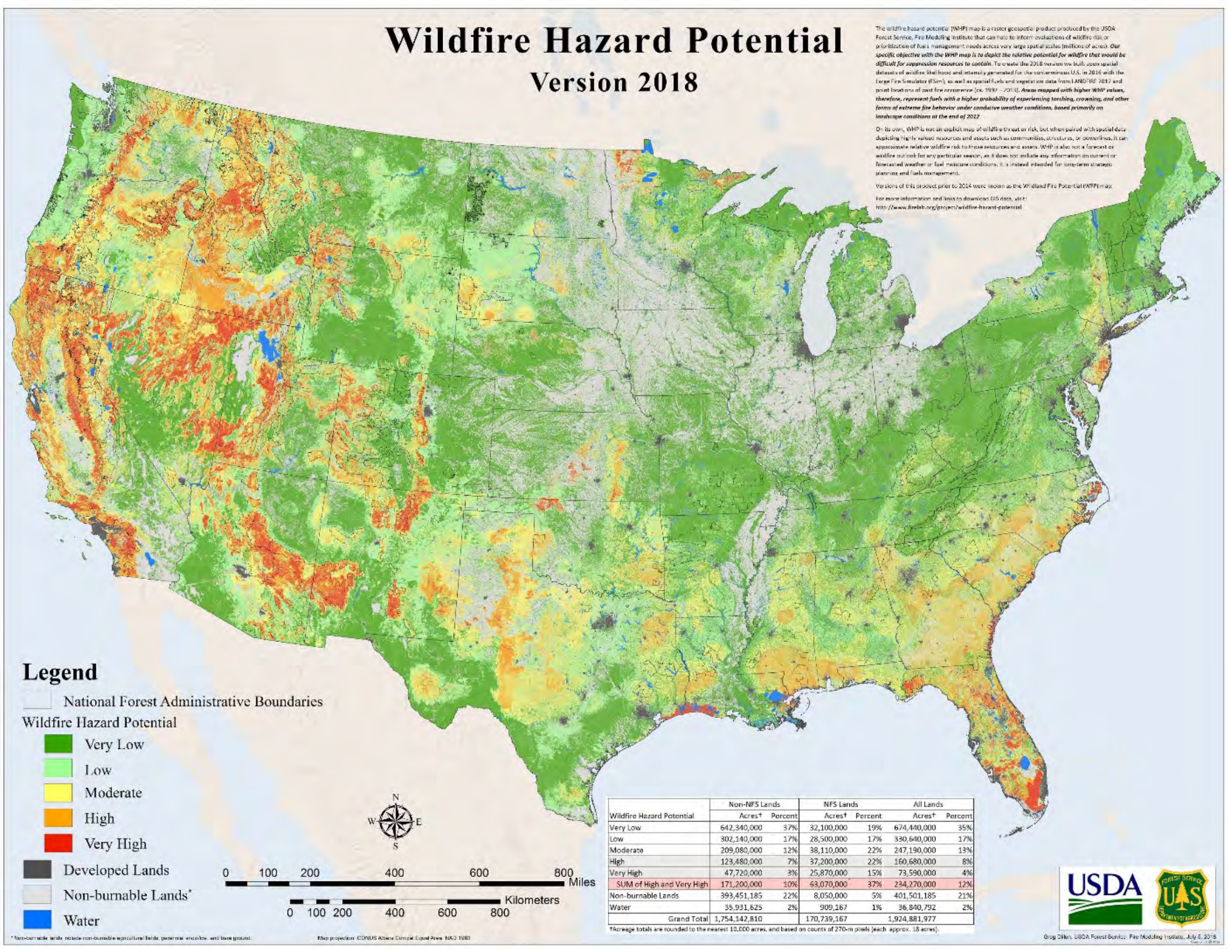
ODNR Division of Forestry's Expanded Forest Fire Protection Area

Due to the timing of the 2019 State of Ohio Hazard Mitigation Plan update and the expansion of the ODNR Wildfire Protection area, the newly expanded areas was not assessed based on incidents reported in the ODNR database. The expanded areas will continue to use the NFIRS database for historical assessment until the availability and timeframe of the expanded area's data becomes uniform with the rest of the state for future assessments.

WILDFIRE HAZARD POTENTIAL

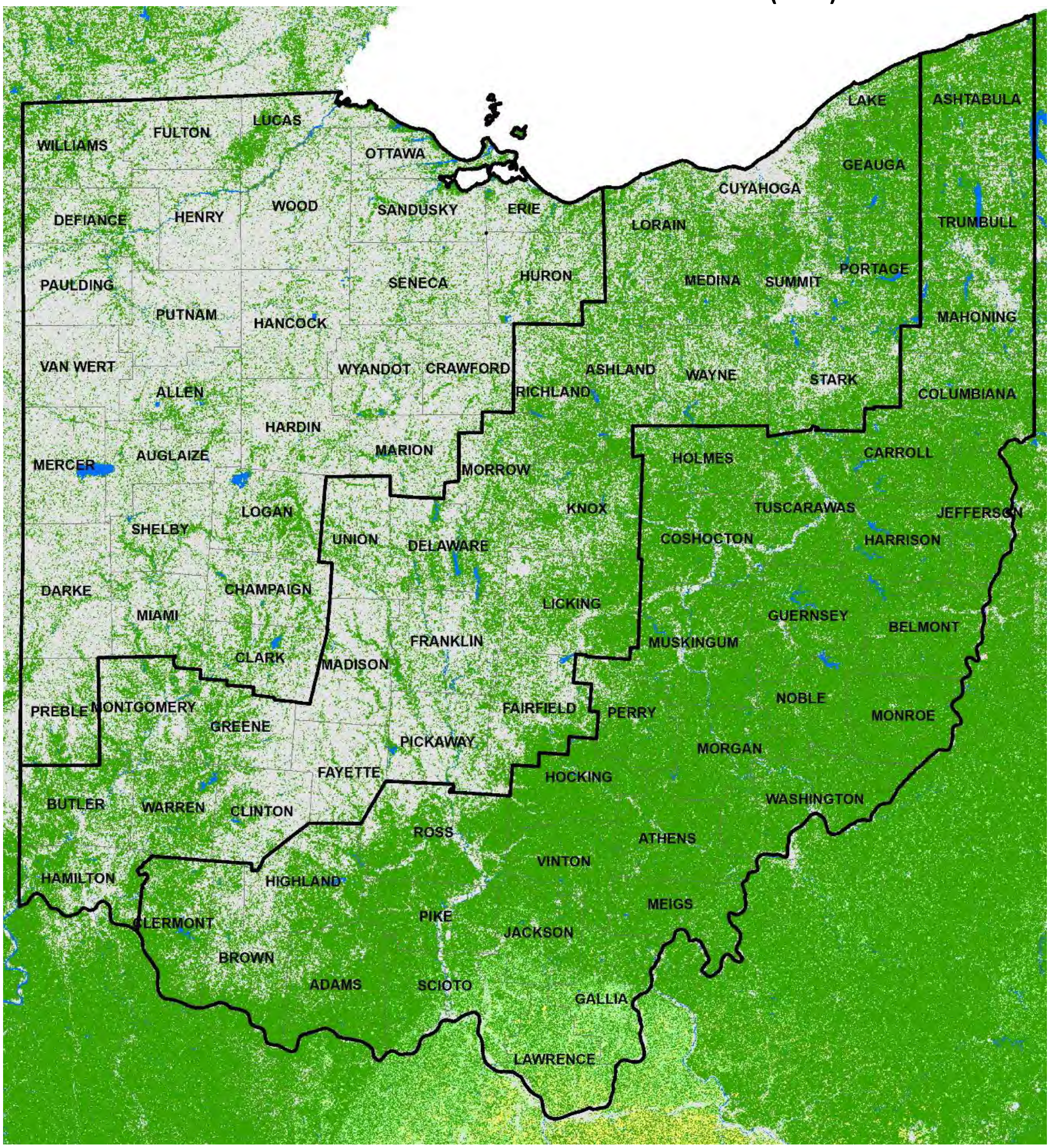
Per the US Forest Service, the wildfire hazard potential (WHP) map is a raster geospatial product produced by the USDA Forest Service, Fire Modeling Institute that can help to inform evaluations of wildfire risk or prioritization of fuels management needs across very large landscapes (millions of acres). It was produced for all of the conterminous United States at a 270-meter resolution. Areas mapped with higher WHP values represent fuels with a higher probability of experiencing torching, crowning, and other forms of extreme fire behavior under conducive weather conditions, based primarily on landscape conditions at the end of 2012. On its own, WHP is not an explicit map of wildfire threat or risk, but when paired with spatial data depicting highly valued resources and assets such as communities, structures, or powerlines, it can approximate relative wildfire risk to those resources and assets. WHP is also not a forecast or wildfire outlook for any particular season, as it does not include any information on current or forecasted weather or fuel moisture conditions. It is instead intended for long-term strategic planning and fuels management.

Map 2.7.b
USDA Forest Service Wildfire Hazard Potential



Source: https://www.firelab.org/project/wildfire-hazard-potential

Map 2.7.c
USDA Forest Service Wildfire Hazard Potential (Ohio)



Based on the WHP 2018 map, Ohio consists of areas of non-burnable to moderate wildfire potential. Most of the wildfire potential and risk exists in the south eastern portion of the state which is also where the ODNR Division of Forestry primarily designates as wildfire protection area. While the vast majority of the state does not have a high potential of wildfire, the potential exists statewide.

LHMP DATA

Scioto County

The Scioto County 2013 Hazard Mitigation Plan states that according to ODNR Division of Forestry Wildfires records, from January 1, 1993 to August 20, 2002, Scioto County experienced wildfires that destroyed 5,482 acres. The most frequent causes of these fires include: debris burning (63%), unknown (13%), and equipment fires (9%). No damages or injuries were reported. April 2010 saw the Largest State Wildfire in Ohio History at Shawnee Forest. Estimated response costs and damage exceeded $175,000.

Jackson County

According to the Jackson County 2017 Hazard Mitigation Plan, Fifty-one percent of Jackson County is forested and another 10% is scrub and brush land. Jackson and Liberty Townships are 74% to 79% forested. These fires generally burn less than five acres but may threaten individual homes and outbuildings. However, they do not pose a significant threat to densely populated areas. Jackson County experiences several wildfires per year, but most are relatively small.

Harrison County

The Harrison County 2015 Hazard Mitigation Plan states that the demographic effect can be high depending on the location of the fire. Many villages within Harrison County border large forested areas and are susceptible to wildland-urban interfaces fires. In addition, the large number of tourist attractions to include parks, national forests, and campgrounds, depending on the time of the year, can increase the demographic effect as temporary population densities increase well within the forest boundaries. The fiscal effects can be large due to the disruption of infrastructure (i.e., roads, rails, and bridges) or loss of commercial and industrial facilities. As the oil and gas industry grows within Harrison County (see section 2.2.11 for more detail), a loss to large processing facilities or transmission lines can result in the loss of billions of barrels of oil and/or millions of cubic feet of natural gas. Wildfire can also effect the timber and forest product industries.

PAST OCCURRENCES

Weather is the primary factor that determines the severity of fall and spring wildfire seasons in Ohio. Drought condition, combined with windy days create red flag, or extreme high fire danger. Consequently, the past fire occurrence record can be closely linked to historical weather data. Weather conditions leading up to and in 1930 resulted in the worst year to date for wildfires in Ohio, as 15,400 acres were recorded as burning over the course of the year.

Extreme drought in 1950 that continued for the next several years provided for very active wildfire seasons as well. March 27, 1950 is considered the worst day in Ohio fire control history – 65 fires burned a total of 5,900 acres. In 1952, continued summer drought spurred a record fall fire season in Ohio and neighboring states. ODNR Division of Parks and Division of Wildlife employees assisted in suppression efforts, and the Ohio National Guard also provided assistance. A total of 680 wildfires burned 22,445 acres in the fall of 1952.

Drought conditions in 1963 required placing on alert the ODNR Division of Forestry's pilots, 2000 fire wardens, 150 ODNR Division of Forestry employees, as well as several thousand volunteer firefighters and the Ohio National Guard. One or more fires were reported every day from September 17 through November 29, and October showed a record number of fires for that month.

1988 was another severe wildfire year, as drought conditions required that Civilian Conservation Corps crews be mobilized, as well as all other trained Division employees. More recently, 1999 proved to be a busy year for wildfire in Ohio, as an above average 7,836 acres were burned by nearly 1,500 wildfires.

Between 1/1/1997 and 11/20/2007, Ohio has experienced 8,235 wildfires that have burned 42,622 acres within the ODNR Division of Forestry Wildfire Protection Area. Wildfires that have occurred on federal lands in Ohio are not included in these data. It can be safely assumed that less than 100% of all wildfires on state and public land are reported; consequently, actual total occurrence and acres burned are suspected to be higher than data indicate. Data for areas outside of the protection area was not obtained in the 2014 State of Ohio Hazard Mitigation Plan.

For the 2019 State of Ohio Hazard Mitigation Plan, the assessed area was expanded from just the ODNR Division of Forestry Wildfire Protection Area to the entire state. In order to obtain historical data for each county, two different datasets were looked at: the ODNR Division of Forestry database, and NFIRS. Counties that are entirely within the ODNR wildfire protection area will use ODNR data. Counties that are partially covered or entirely outside of the area will be assessed using data from NFIRS. Between 1/1/1997 and 11/20/2007, there were 7,963 wildfire events statewide that burned approximately 60,620 acres. 6,609, or 83%, of the 7,963 reported events were classified as 9.99 acres and under. 493 events were from 10 to 99.99 acres, and 19 events were reported as 100 acres or more. Events that reported less than one acre burned were not assessed.

Region 1 had the second highest number of reported events and acres burned. 2,369 events were reported in this timeframe that burned 19,205 acres. Region 2 had the lowest numbers of the three regions at 1,814 events and 9,946 acres burned. Region 3 had the highest number of reported events at 3,780 as well as the highest number of acres burned at 31,469.

Table 2.7.a

Past Occurences of Wildfire Events (1/1/07 to 12/31/2017)										
Region 1										
County	Total Fire Events	Total Acres Burned	Average Acres/Event	Est. Events per Year	1 to 9.99 Acres		10 to 99.99 Acres		100+ Acres	
					# of Events	% of Total	# of Events	% of Total	# of Events	% of Total
Allen	84	477	5.68	8	74	88.10%	9	10.71%	1	1.19%
Auglaize	52	588	11.31	5	38	73.08%	13	25.00%	1	1.92%
Champaign	57	405	7.11	5	43	75.44%	14	24.56%	0	0.00%
Clark	72	524	7.28	7	57	79.17%	14	19.44%	1	1.39%
Crawford	34	219	6.44	3	25	73.53%	9	26.47%	0	0.00%
Darke	148	868	5.86	13	121	81.76%	26	17.57%	1	0.68%
Defiance	92	800	8.70	8	69	75.00%	22	23.91%	1	1.09%
Erie	49	375	7.65	4	37	75.51%	12	24.49%	0	0.00%
Fulton	111	763	6.87	10	90	81.08%	21	18.92%	0	0.00%
Hancock	74	439	5.93	7	59	79.73%	15	20.27%	0	0.00%
Hardin	115	789	6.86	10	93	80.87%	22	19.13%	0	0.00%
Henry	124	1136	9.16	11	88	70.97%	35	28.23%	1	0.81%
Huron	78	707	9.06	7	59	75.64%	18	23.08%	1	1.28%
Logan	117	683	5.84	11	103	88.03%	13	11.11%	1	0.85%
Lucas	73	426	5.84	7	62	84.93%	10	13.70%	1	1.37%
Marion	59	473	8.02	5	46	77.97%	13	22.03%	0	0.00%
Mercer	110	665	6.05	10	86	78.18%	24	21.82%	0	0.00%
Miami	69	407	5.90	6	56	81.16%	13	18.84%	0	0.00%
Ottawa	53	402	7.58	5	40	75.47%	13	24.53%	0	0.00%
Paulding	49	569	11.61	4	32	65.31%	16	32.65%	1	2.04%
Preble	69	839	12.16	6	54	78.26%	12	17.39%	3	4.35%
Putnam	120	1793	14.94	11	97	80.83%	22	18.33%	1	0.83%
Sandusky	63	624	9.90	6	41	65.08%	22	34.92%	0	0.00%
Seneca	68	629	9.25	6	52	76.47%	15	22.06%	1	1.47%
Shelby	94	770	8.19	9	75	79.79%	18	19.15%	1	1.06%
Van Wert	84	800	9.52	8	66	78.57%	16	19.05%	2	2.38%
Williams	100	620	6.20	9	81	81.00%	19	19.00%	0	0.00%
Wood	117	1152	9.85	11	87	74.36%	29	24.79%	1	0.85%
Wyandot	34	263	7.74	3	26	76.47%	8	23.53%	0	0.00%
TOTAL	2,369	19205	8.11	215	1857	78.39%	493	20.81%	19	0.80%

Table 2.7.a (Continued)

Past Occurences of Wildfire Events (1/1/07 to 12/31/2017)										
Region 2										
County	Total Fire Events	Total Acres Burned	Average Acres/Event	Est. Events per Year	1 to 9.99 Acres		10 to 99.99 Acres		100+ Acres	
					# of Events	% of Total	# of Events	% of Total	# of Events	% of Total
Ashland	50	346	6.92	5	44	88.00%	5	10.00%	1	2.00%
Butler	70	295	4.21	6	64	91.43%	6	8.57%	0	0.00%
Clinton	134	897	6.69	12	113	84.33%	20	14.93%	1	0.75%
Cuyahoga	27	102	3.78	2	25	92.59%	2	7.41%	0	0.00%
Delaware	55	227	4.13	5	50	90.91%	5	9.09%	0	0.00%
Fairfield	103	423	4.11	9	93	90.29%	10	9.71%	0	0.00%
Fayette	44	343	7.80	4	36	81.82%	8	18.18%	0	0.00%
Franklin	46	183	3.98	4	41	89.13%	5	10.87%	0	0.00%
Geauga	32	102	3.19	3	30	93.75%	2	6.25%	0	0.00%
Greene	60	221	3.68	5	55	91.67%	5	8.33%	0	0.00%
Hamilton	87	118	1.36	8	87	100.00%	0	0.00%	0	0.00%
Knox	78	370	4.74	7	68	87.18%	10	12.82%	0	0.00%
Lake	17	43	2.53	2	16	94.12%	1	5.88%	0	0.00%
Licking	139	961	6.91	13	117	84.17%	20	14.39%	2	1.44%
Lorain	37	217	5.86	3	36	97.30%	0	0.00%	1	2.70%
Madison	54	554	10.26	5	40	74.07%	13	24.07%	1	1.85%
Medina	39	381	9.77	4	35	89.74%	3	7.69%	1	2.56%
Montgomery	51	199	3.90	5	48	94.12%	3	5.88%	0	0.00%
Morrow	55	258	4.69	5	50	90.91%	5	9.09%	0	0.00%
Pickaway	57	881	15.46	5	38	66.67%	17	29.82%	2	3.51%
Portage	113	389	3.44	10	105	92.92%	8	7.08%	0	0.00%
Richland	97	211	2.18	9	79	81.44%	18	18.56%	0	0.00%
Stark	116	618	5.33	11	99	85.34%	17	14.66%	0	0.00%
Summit	30	218	7.27	3	24	80.00%	6	20.00%	0	0.00%
Union	81	565	6.98	7	62	76.54%	19	23.46%	0	0.00%
Warren	53	590	11.13	5	48	90.57%	3	5.66%	2	3.77%
Wayne	89	234	2.63	8	85	95.51%	4	4.49%	0	0.00%
TOTAL	1,814	9946	5.48	165	1588	87.54%	215	11.85%	11	0.61%

Because Region 3 primarily lies within the ODNR Division of Forestry Wildfire Protection area, the ODNR data was used to for historical and vulnerability analysis for most counties listed in Table 2.7.b. Counties noted with an asterisk (*) will use NFIRS data as they are either partly or completely outside of the protection area.

Table 2.7.b

Past Occurences of Wildfire Events (1/1/07 to 12/31/2017)										
Region 3										
County	Total Fire Events	Total Acres Burned	Average Acres/Event	Est. Events per Year	1 to 9.99 Acres		10 to 99.99 Acres		100+ Acres	
					# of Events	% of Total	# of Events	% of Total	# of Events	% of Total
Adams	125	890	7.12	11	100	80.00%	25	20.00%	0	0.00%
Ashtabula*	137	843	6.15	12	123	89.78%	12	8.76%	2	1.46%
Athens	84	426	5.07	8	78	92.86%	5	5.95%	1	1.19%
Belmont	66	514	7.79	6	55	83.33%	11	16.67%	0	0.00%
Brown*	82	572	6.98	7	62	75.61%	19	23.17%	1	1.22%
Carroll	111	1456	13.12	10	85	76.58%	23	20.72%	3	2.70%
Clermont*	81	373	4.60	7	71	87.65%	10	12.35%	0	0.00%
Columbiana*	80	258	3.23	7	76	95.00%	4	5.00%	0	0.00%
Coshocton	91	1004	11.03	8	70	76.92%	19	20.88%	2	2.20%
Gallia	190	1911	10.06	17	146	76.84%	40	21.05%	4	2.11%
Guernsey	102	638	6.25	9	92	90.20%	7	6.86%	3	2.94%
Harrison	50	459	9.18	5	38	76.00%	10	20.00%	2	4.00%
Highland*	182	1137	6.25	17	155	85.16%	26	14.29%	1	0.55%
Hocking	99	980	9.90	9	85	85.86%	12	12.12%	2	2.02%
Holmes*	53	178	3.36	5	48	90.57%	5	9.43%	0	0.00%
Jackson	161	949	5.89	15	147	91.30%	11	6.83%	3	1.86%
Jefferson	70	556	7.94	6	56	80.00%	13	18.57%	1	1.43%
Lawrence	456	4430	9.71	41	339	74.34%	112	24.56%	5	1.10%
Mahoning*	56	162	2.89	5	53	94.64%	3	5.36%	0	0.00%
Meigs	132	427	3.23	12	121	91.67%	11	8.33%	0	0.00%
Monroe	62	468	7.55	6	57	91.94%	4	6.45%	1	1.61%
Morgan	51	298	5.84	5	46	90.20%	5	9.80%	0	0.00%
Muskingum	145	787	5.43	13	127	87.59%	17	11.72%	1	0.69%
Noble	57	481	8.44	5	45	78.95%	11	19.30%	1	1.75%
Perry	113	710	6.28	10	103	91.15%	9	7.96%	1	0.88%
Pike	227	1309	5.77	21	193	85.02%	33	14.54%	1	0.44%
Ross*	108	855	7.92	10	86	79.63%	21	19.44%	1	0.93%
Scioto	225	6300	28.00	20	173	76.89%	44	19.56%	8	3.56%
Trumbull*	146	616	4.22	13	133	91.10%	13	8.90%	0	0.00%
Tuscarawas	87	392	4.51	8	72	82.76%	15	17.24%	0	0.00%
Vinton	94	674	7.17	9	80	85.11%	13	13.83%	1	1.06%
Washington	57	416	7.30	5	49	85.96%	7	12.28%	1	1.75%
TOTAL	3,780	31469	8.33	2861	3164	83.70%	570	15.08%	46	1.22%

PROABILITY OF FUTURE EVENTS

Based on historical events, there is a 100% probability that a wildfire will occur within any county in any given year. To further see this estimation by county, see the "Est. Events per Year" column in Table 2.7.a/b. For the historical probability of these events, see the "% of Total" columns. However, the severity of these events will depend on many factors. According to research and the historical record, wildfires have occurred every spring and fall in the hardwood forests and grasslands of southern, southeastern, and eastern Ohio for hundreds of years, and will continue to do so. The number of occurrences, size of wildfires, and severity of burn fluctuate annually in response to a variety of factors including:

- Weather – daily, monthly, seasonal, annual, and long-term trends in:
  - Precipitation
  - Relative Humidity
  - Temperature
  - Wind
- Fuels – condition of 1, 10, 100, 1000 hour fuels in terms of:
  - Moisture content
  - Arrangement
  - Accumulation level
  - Availability
  - See Map 2.7.b for The Wildfire Hazard Potential in Ohio, developed by the USDA Forest Service. It is a represention of fuels with a higher probability of experiencing extreme fire behavior under conducive weather conditions, based primarily on landscape.
- Ignitions – presence or absence of wildfire starts:
  - Human caused
    - Debris burning – compliance with ORC 1503.18, and safe debris burning techniques
    - Incendiary – arsonists at large
    - Wildfire prevention and awareness efforts
- Suppression Response – Capability and timeliness of initial attack:
  - Quickness of response to the incident
  - Local / Volunteer fire department capability
  - Availability of state and local resources
    - Number of concurrent wildfires

VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHDOLOGY

In order to accurately and quantitatively determine statewide wildfire risk, ODNR Division of Forestry combined several available datasets, using GIS tools and extensions, to complete a wildfire hazard assessment. Datasets integrated in the wildfire assessment include historic wildfire occurrence and acres burned data (compiled from wildfire reports submitted to ODNR Division of Forestry from Ohio fire departments), USGS Landfire 13 Anderson Fire Behavior Fuel Models land cover dataset, and Wildland Urban Interface / Intermix (WUI) data derived from the University of Wisconsin SILVIS lab. These three datasets were chosen to represent a risk (wildfire occurrence and acres burned), hazard (land cover/fuel type), and value (population/homes through WUI). The township level was chosen to assign wildfire risk because rural fire departments in Ohio are typically organized at the township level. Evaluating wildfire hazard at the township level paints a better picture of the existing wildfire hazard at a level of organization that can affect change through operational function. It is also useful in scoring grant applications and assistance requests from the local fire departments that are responsible for particular high-risk jurisdictions.

Each of these respective datasets was converted to a raster format, and categorical values were reclassified accordingly. A weighted calculation was then performed using the ArcGIS raster calculator function, whereby a total wildfire hazard value was computed from the reclassified values as such:

(("acres_burned" + "fire_occurrence") / 2) + ("fuel_type" * 0.5) + ("wui_value" * 0.5)

The calculation resulted in a new raster. The calculated wildfire hazard value was broken into four categories and labeled low (0 to 1.185), moderate (1.186 to 2.37), high (2.38 to 3.16), and very high (3.17 and above). Areas that are blank are urban and incorporated areas that were not evaluated. Factors pertinent to overall wildfire hazard level not incorporated into the calculation include fire department capability, water availability, defensible space and accessibility of structures, and error associated with FDs who do not submit wildfire reports. The ODNR Division of Forestry wildfire hazard assessment was most recently updated in October 2012.

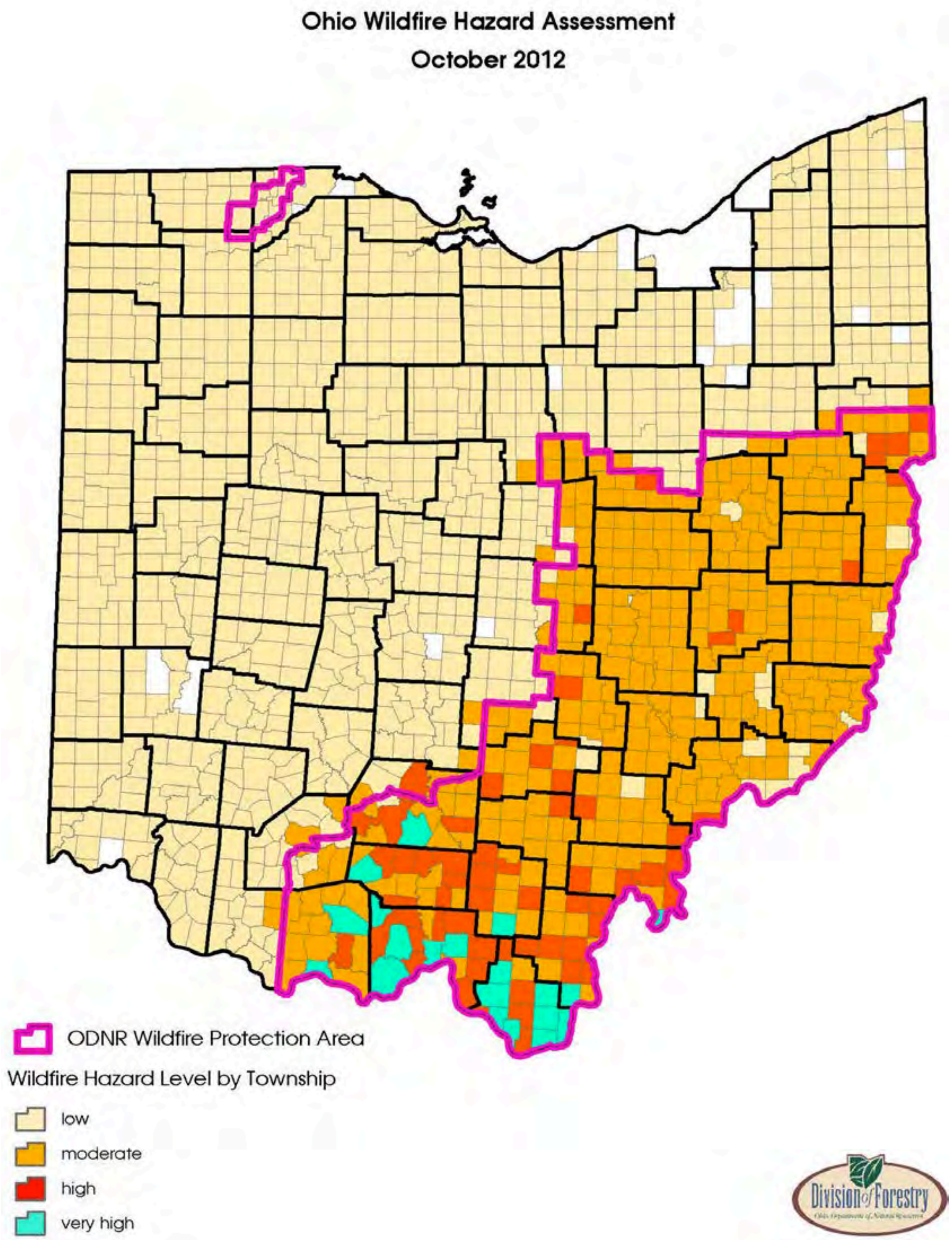
RESULTS

The product of this project, the Ohio wildfire hazard assessment map, accurately indicates wildfire hazard level for all townships in Ohio (see map 2.7.d). Communities at risk to wildfire in Ohio are those townships that were attributed with a calculated wildfire hazard value equal to High or Very High.

Region 1 and Region 2 are assessed as having generally low wildfire hazard, with several pockets of moderate risk of wildfire. Region 3 is assessed as having generally moderate risk of wildfire, with a sizeable section of southern Ohio having high or very high wildfire risk (Gallia, Lawrence, Scioto, Adams, Pike, and southern Ross Counties). Southeastern and eastern Ohio were assessed as having an additional 29 communities rated as having high wildfire hazard. Particular high-risk groups in southeastern and eastern Ohio occur in southern Athens and Meigs Counties, as well as in Belmont and southern Jefferson Counties.

High valued personal property, including homes, machinery, agricultural crops, and tree plantations in areas of high or very high wildfire hazard are more vulnerable to damage by wildfire. Fire engines belonging to local fire departments are occasionally damaged while suppressing wildfires. A great amount of personal property has been saved by fire departments through effective and safe wildfire suppression

Map 2.7.d



HISTORICAL ANALYSIS

Estimating monetary losses to wildfire is difficult as the vast majority of wildfires in Ohio occur on open land or fields and monetary losses are not often recorded. This lack of data may result in inconsistencies if an analysis was done based on reported monetary loss. However, from an exposure assumption, the greater the number of people and property in an area— and the greater variables for wildfire severity (weather, fuel, ignition, suppression response) of that area, the greater the potential of loss. Nevertheless, for the purpose of this plan, a broader (but more consistent) unit needs to be used to determine potential losses. The data that is more consistently available are the number of acres burned per event. For this estimate, the total number of acres burned from January 1st, 2007 to December 31st, 2017 for each county was divided by the respective number of events recorded. This results in the average number of acres burned per event. The results of this method can be seen in the "Acres/Event" column in Tables 2.7.a/b.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Using the wildfire hazard level classifications shown in Map 2.7.d, state-owned and state-leased facilities were analyzed in a GIS environment. Because of the limited attributes associated with the facility data, the assumptions used in this assessment had to be broad. Therefore, the figures projected are based on an exposure assessment. The entire property value is considered exposed based on the wildfire hazard level of the township it resides.

With the exception of Union Township in Ross County, the high and very high risk areas only fall within Region 3, which is the most undeveloped and heavily forested Region in the state. In terms of facilities in areas classified as "Very high" in ODNR's Wildfire Hazard Assessment, Scioto County had the most assets with 70 facilities valued at $20,764,332 followed by Lawrence County with 31 facilities valued at $10,611,231. In terms of facilities in areas classified as "High", Ross County had the most assets with 106 facilities valued at $236,423,088 followed by Scioto County with 40 facilities valued at $164,486,741. Overall statewide, there were 6,788 critical facilities assessed amongst the 4 classification levels. The results for the statewide overview are listed in Table 2.7.c. The county-specific results are listed in Table 2.7.d.

Table 2.7.c

State-owned and State-leased Critical Facility Wildfire Hazard Level Exposure								
State-wide								
Total # of Critical Facilities	ODNR Forestry Wildfire Hazard Level							
	Low		Moderate		High		Very High	
	# of CF	Value of CF	# of CF	Value of CF	# of CF	Value of CF	# of CF	Value of CF
6,788	4,360	$4,804,067,874	1,794	$743,306,445	465	$466,487,445	169	$37,391,207

Table 2.7.d

State-owned and State-leased Critical Facility Wildfire Hazard Level Exposure										
Region 1										
County	Total # of Critical Facilities	ODNR Forestry Wildfire Hazard Level								
		Low		Moderate		High		Very High		
		# of CF	Value of CF	# of CF	Value of CF	# of CF	Value of CF	# of CF	Value of CF	
Allen	138	138	$123,081,953	0	$0	0	$0	0	$0	
Auglaize	91	91	$20,888,999	0	$0	0	$0	0	$0	
Champaign	58	58	$7,504,757	0	$0	0	$0	0	$0	
Clark	81	81	$26,284,967	0	$0	0	$0	0	$0	
Crawford	14	14	$10,388,299	0	$0	0	$0	0	$0	
Darke	32	32	$8,687,352	0	$0	0	$0	0	$0	
Defiance	20	20	$7,784,383	0	$0	0	$0	0	$0	
Erie	93	93	$175,392,052	0	$0	0	$0	0	$0	
Fulton	50	50	$4,930,612	0	$0	0	$0	0	$0	
Hancock	53	53	$20,704,014	0	$0	0	$0	0	$0	
Hardin	19	19	$4,343,406	0	$0	0	$0	0	$0	
Henry	40	40	$5,810,222	0	$0	0	$0	0	$0	
Huron	27	27	$10,829,844	0	$0	0	$0	0	$0	
Logan	84	84	$12,154,380	0	$0	0	$0	0	$0	
Lucas	116	116	$333,521,206	0	$0	0	$0	0	$0	
Marion	116	116	$142,272,619	0	$0	0	$0	0	$0	
Mercer	29	29	$8,037,491	0	$0	0	$0	0	$0	
Miami	44	44	$13,864,357	0	$0	0	$0	0	$0	
Ottawa	190	190	$99,375,613	0	$0	0	$0	0	$0	
Paulding	4	4	$1,426,138	0	$0	0	$0	0	$0	
Preble	113	113	$26,454,883	0	$0	0	$0	0	$0	
Putnam	19	19	$5,634,425	0	$0	0	$0	0	$0	
Sandusky	23	23	$6,999,502	0	$0	0	$0	0	$0	
Seneca	59	59	$35,886,799	0	$0	0	$0	0	$0	
Shelby	60	60	$29,660,305	0	$0	0	$0	0	$0	
Van Wert	23	23	$8,258,684	0	$0	0	$0	0	$0	
Williams	21	21	$8,502,979	0	$0	0	$0	0	$0	
Wood	59	59	$70,021,518	0	$0	0	$0	0	$0	
Wyandot	45	45	$13,019,332	0	$0	0	$0	0	$0	
TOTAL	1,721	1,721	$1,241,721,091	0	$0	0	$0	0	$0	

Table 2.7.d (Continued)

State-owned and State-leased Critical Facility Wildfire Hazard Level Exposure										
Region 2										
County	Total # of Critical Facilities	ODNR Forestry Wildfire Hazard Level								
		Low		Moderate		High		Very High		
		# of CF	Value of CF	# of CF	Value of CF	# of CF	Value of CF	# of CF	Value of CF	
Ashland	146	32	$19,300,471	114	$45,368,964	0	$0	0	$0	
Butler	37	37	$19,264,969	0	$0	0	$0	0	$0	
Clinton	71	71	$16,633,214	0	$0	0	$0	0	$0	
Cuyahoga	1	1	$10,279	0	$0	0	$0	0	$0	
Delaware	109	109	$68,818,336	0	$0	0	$0	0	$0	
Fairfield	92	27	$9,692,388	65	$77,983,487	0	$0	0	$0	
Fayette	45	45	$7,508,833	0	$0	0	$0	0	$0	
Franklin	317	317	$1,511,425,668	0	$0	0	$0	0	$0	
Geauga	75	75	$19,778,026	0	$0	0	$0	0	$0	
Greene	46	46	$24,773,257	0	$0	0	$0	0	$0	
Hamilton	25	25	$23,774,728	0	$0	0	$0	0	$0	
Knox	37	36	$39,860,400	1	$742,572	0	$0	0	$0	
Lake	23	23	$7,129,471	0	$0	0	$0	0	$0	
Licking	98	57	$138,739,051	40	$40,509,655	1	$27,500	0	$0	
Lorain	116	116	$111,907,809	0	$0	0	$0	0	$0	
Madison	137	137	$325,701,163	0	$0	0	$0	0	$0	
Medina	36	36	$19,934,012	0	$0	0	$0	0	$0	
Montgomery	40	40	$49,596,601	0	$0	0	$0	0	$0	
Morrow	37	37	$7,438,291	0	$0	0	$0	0	$0	
Pickaway	211	211	$233,138,844	0	$0	0	$0	0	$0	
Portage	102	102	$22,963,033	0	$0	0	$0	0	$0	
Richland	124	80	$110,097,403	44	$12,671,717	0	$0	0	$0	
Stark	51	50	$106,330,251	1	$685,702	0	$0	0	$0	
Summit	77	77	$128,011,211	0	$0	0	$0	0	$0	
Union	60	60	$89,278,962	0	$0	0	$0	0	$0	
Warren	182	182	$159,065,607	0	$0	0	$0	0	$0	
Wayne	17	17	$8,689,815	0	$0	0	$0	0	$0	
TOTAL	2,312	2,046	$3,278,862,093	265	$177,962,097	1	$27,500	0	$0	

Table 2.7.d (Continued)

State-owned and State-leased Critical Facility Wildfire Hazard Level Exposure										
Region 3										
County	Total # of Critical Facilities	ODNR Forestry Wildfire Hazard Level								
		Low		Moderate		High		Very High		
		# of CF	Value of CF	# of CF	Value of CF	# of CF	Value of CF	# of CF	Value of CF	
Adams	86	0	$0	50	$6,010,266	0	$0	36	$1,702,071	
Ashtabula	198	198	$36,092,722	0	$0	0	$0	0	$0	
Athens	76	5	$12,116,110	68	$38,460,045	3	$171,250	0	$0	
Belmont	91	1	$22,108	90	$57,247,319	0	$0	0	$0	
Brown	33	33	$39,124,798	0	$0	0	$0	0	$0	
Carroll	20	0	$0	20	$4,821,847	0	$0	0	$0	
Clermont	93	93	$27,079,516	0	$0	0	$0	0	$0	
Columbiana	63	3	$1,150,998	45	$17,050,308	15	$1,497,943	0	$0	
Coshocton	30	0	$0	30	$13,976,528	0	$0	0	$0	
Gallia	85	0	$0	58	$28,282,329	27	$9,234,127	0	$0	
Guernsey	181	0	$0	174	$86,597,167	7	$1,842,423	0	$0	
Harrison	46	0	$0	46	$11,102,993	0	$0	0	$0	
Highland	62	17	$3,271,961	43	$12,051,563	1	$6,600	1	$12,500	
Hocking	168	1	$950,041	132	$14,854,928	35	$5,120,754	0	$0	
Holmes	29	2	$837,134	14	$1,421,316	13	$8,221,793	0	$0	
Jackson	46	0	$0	22	$13,801,180	10	$3,971,460	14	$1,664,476	
Jefferson	59	10	$4,729,060	43	$5,675,815	6	$924,352	0	$0	
Lawrence	32	0	$0	0	$0	1	$1,458,701	31	$10,611,231	
Mahoning	77	77	$73,513,718	0	$0	0	$0	0	$0	
Meigs	47	0	$0	10	$2,793,291	37	$7,297,553	0	$0	
Monroe	31	5	$5,197,450	26	$6,290,191	0	$0	0	$0	
Morgan	100	0	$0	96	$20,866,300	4	$22,875	0	$0	
Muskingum	111	0	$0	111	$19,251,307	0	$0	0	$0	
Noble	41	0	$0	41	$50,894,080	0	$0	0	$0	
Perry	20	0	$0	20	$4,019,441	0	$0	0	$0	
Pike	82	1	$61,687	13	$4,818,853	51	$5,844,928	17	$2,636,597	
Ross	270	1	$78,375	163	$41,454,569	106	$236,423,088	0	$0	
Scioto	127	0	$0	17	$8,147,074	40	$164,486,741	70	$20,764,332	
Trumbull	116	116	$59,339,913	0	$0	0	$0	0	$0	
Tuscarawas	106	0	$0	106	$65,210,242	0	$0	0	$0	
Vinton	145	0	$0	46	$8,337,672	99	$19,255,113	0	$0	
Washington	84	30	$19,919,099	45	$21,907,724	9	$680,244	0	$0	
TOTAL	2,755	593	$283,484,690	1,529	$565,344,348	464	$466,459,945	169	$37,391,207	

2.8 STORM SURGE / SEICHE / COASTAL FLOODING

When a storm system moves across a lake, typically the temperature drops and the wind changes direction. This disturbs the water in the lake and causes it to move in the same direction the storm is moving. The magnitude of storm surge events is dependent on a number of factors. Wind velocity and barometric pressure are the most obvious contributors to the size of an event. The orientation of the lake with respect to the direction the storm is moving is critical to the wind fetch distance over the lake, which in turn increases wave heights and storm surges. Lake Erie is oriented southwest to northeast, and the lake is shallowest near Toledo. Therefore, storms moving northeast to southwest have the potential to produce higher storm surges.

Seiche can be defined as a standing wave in an enclosed or partially enclosed body of water, which can result in coastal flooding. The most common cause of seiches in Ohio is a strong, constant wind blowing over the surface of the water forcing it to accumulate at the down-wind shore. When the wind diminishes, the water level will begin to return to its original equilibrium though a series of broad oscillations across the entire body. Often referred to as the bathtub effect, seiches cause the water levels to rise and fall along the shorelines repeatedly until equilibrium is restored. Other causes of seiches include earthquakes, changes in barometric pressure or any of a variety of atmospheric changes.

The United States Army Corps of Engineers office in Detroit, Michigan developed a profile of seiche as part of a larger work analyzing water levels for the Great Lakes. Figure 2.8.a displays the static impact storm surge has on a body of water with water levels rising on the downwind shore and falling along the upwind shore.

Figure 2.8.a

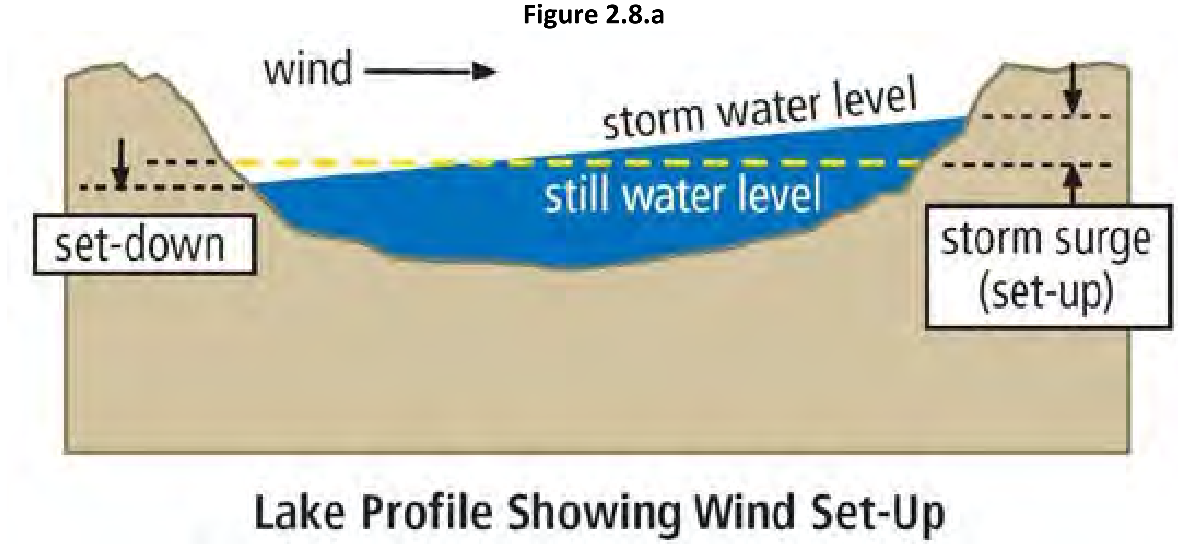


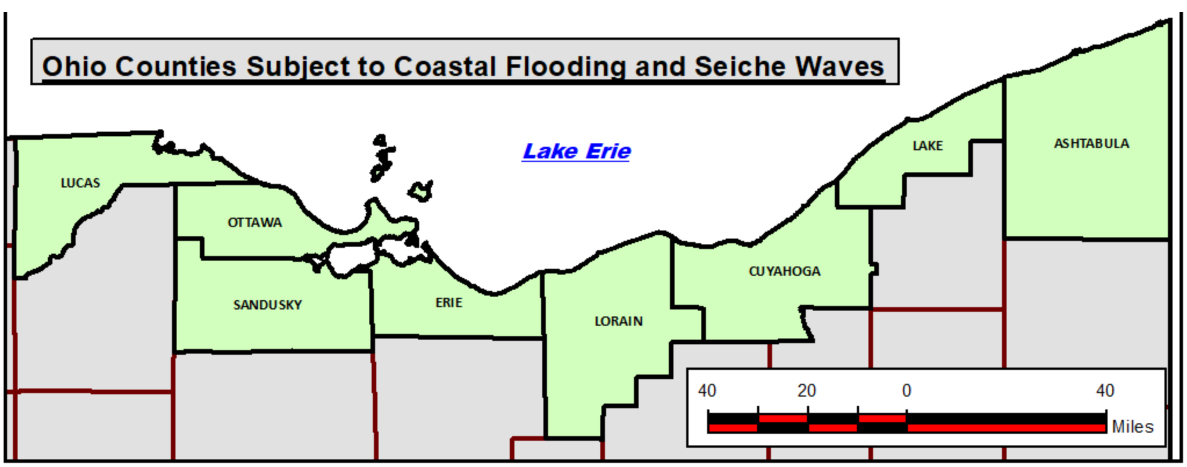
Figure 2.8.b provides a depiction of the combined effect of wind and wave actions. The base water level for the lake is marked as the SWL, or still water level. The position marked R is for run-up, the elevation a wave rises to as it spills on the shore or a structure. When winds are generated by severe storms the potential for wave action increases greatly.

Figure 2.8.b

RISK ASSESSMENT

LOCATION

Lake Erie is the most notable water body impacted by storm surge and seiches in Ohio. Although Lake Erie has 9,940 square miles of surface area implying a large body of water, it is relatively shallow with an average depth of 62 feet. Broken into what is generally referred to as the eastern, central and western basins, Lake Erie's susceptibility to storm surge and seiches varies greatly. The central basin, encompassing the area from Ohio's eastern border to Lorain, ranges from 45 to 65 feet deep with a shoreline that is mostly developed and armored. The western basin is much shallower with a depth averaging about 24 feet. The shorelines in the western basin are former coastal wetlands, many of which have been armored. One of the un-protected areas are the islands off of Ottawa County.



The seiche / coastal flooding hazard exposure is limited to counties adjacent to the south shore of Lake Erie. Region 1 counties impacted by seiche include: Lucas, Ottawa, Sandusky and Erie. Region 2 counties impacted by seiche include: Lorain, Cuyahoga, and Lake. Ashtabula is the only county impacted in Region 3.

PAST OCCURRENCES

The NCDC history of hazardous weather events currently lists only one seiche event, which occurred on November 10, 1998, impacting Erie, Lorain, Lucas and Ottawa counties. The event consisted of southwest storm force winds gusting to 69 miles per hour that pushed water away from the western end of Lake Erie towards the state of New York and Ontario Canada. As the water level fell to four feet below normal, boats and ferries were left stranded in the mud in marinas from the Maumee River east to the lagoons in Vermilion, while freighters were forced to drop anchor outside Sandusky Bay near Port Clinton. There were no estimates provided for property or other economic losses. Prolonged SW storm events create navigational hazards in the western basin due to the low water level. Put-In-Bay harbor has been near-emptied in this type of event, exposing rock and making the harbor non-navigable.

The earliest recorded seiche wave in Ohio history occurred on the morning of June 23, 1882 when an eight-foot wall of water suddenly crashed into the 9th Street Pier in Cleveland. This wave damaged or destroyed several boats and created a novel fishing experience as it propelled hundreds of fish farther inland from the docks. One fatality resulted from this event as a homeless person was sleeping near the shore and drowned. Other events occurred in May 1942, 1944 and 1948 with waves being recorded anywhere from six to 20 feet high. Seiche waves continued to oscillate from several hours to days.

The NCDC database also contains six days with events described as storm surge. The six descriptions cover a period of nearly record high water level. Lake water level is the most important factor in producing storm surges that cause wave damage and coastal flooding. The NE storms happen every year, but flooding and damage occur when there is high water.

March 13, 1997 Storm Surge - Gale force east winds to 35 knots caused the water level at the west end of Lake Erie to rise to 79 inches above low water datum, around 35 inches above the recent average lake level. Flooding and considerable beach erosion occurred along the lakeshores of Lucas, Ottawa, Sandusky and Erie Counties. In Toledo (Lucas County), roads and a parking lot were inundated, including Monroe and Second Streets, and at Point Place on Maumee Bay. Water also overtopped a road in Jerusalem Township. In Ottawa County, roads were flooded in Port Clinton and sandbagging was performed at some local businesses. Also, on Catawba Island, waves were recorded as overtopping at least one road. At Bayview (Sandusky County), County Road 259 was flooded. Losses approached $50,000 from this coastal event.

June 1, 1997 Storm Surge - Businesses and homes were flooded when strong northeasterly winds and near record high lake levels produced waves of six to eight feet, aggravating shoreline erosion and slowing discharge of stream outflow into Lake Erie. In Erie County, 75 – 100 families evacuated near the Vermilion and Huron Rivers, while those on Mudbrook Road moved to their second floors to escape the floodwaters. Also in Erie County, Riverside Avenue residents were evacuated as well as those in Franklin Flats, Rye Beach and White's Landing. Roads along the shoreline were flooded and covered with so much sand and debris that they had to be cleared with snowplows in Port Clinton and Marblehead. On Catawba Island, rising water flooded buildings and cars were submerged. Charter services cancelled trips and hundreds of travelers were stranded on South Bass Island when most ferry trips were also cancelled. In Erie County, the north end of Jackson Pier collapsed. As the water receded, a large number of fish were left behind in people’s yards. Losses were estimated at $525,000 from the event, which encompassed Erie, Lorain, Lucas, Ottawa and Sandusky Counties.

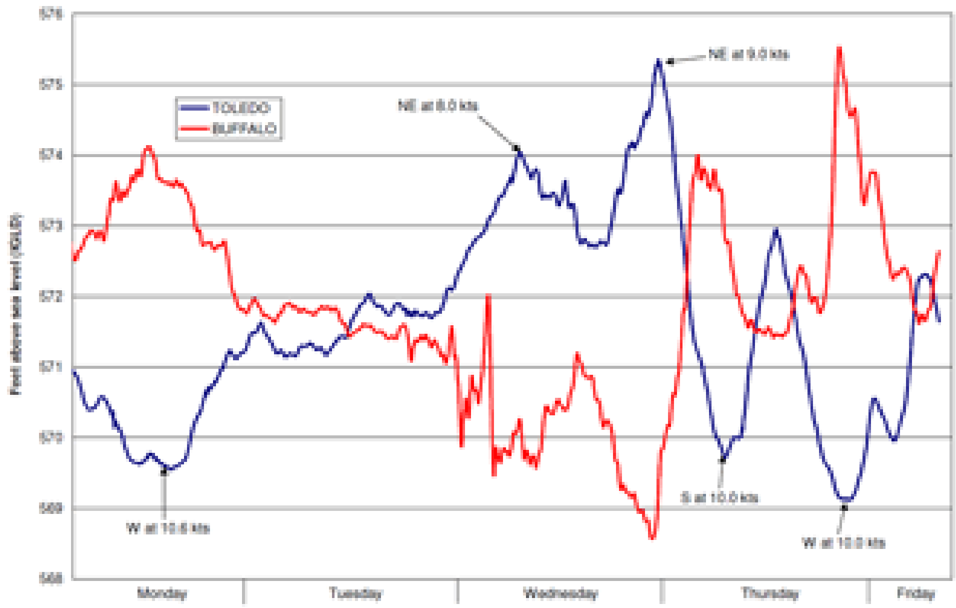
February 4, 1998 Storm Surge - Northeast winds up to 35 miles per hour caused flooding of the immediate lakeshore and beach erosion in Lucas, Erie, and Ottawa Counties. Losses were estimated at $75,000 from the event.

February 17, 1998 Storm Surge - Northeast winds up to 40 miles per hour increased the water level at the Toledo Coast Guard Station (Lucas County) to around seven feet above low water datum. Waves of seven to ten feet caused major flooding and beach erosion along the western shoreline of Lake Erie, particularly at Crystal Rock and Whites Landing (Erie County), where homes and yards were flooded. Losses were estimated at $700,000 from the event, which impacted Erie, Lucas and Ottawa Counties.

March 20, 1998 Storm Surge - North to northeast gales of 35 knots, with higher gusts, produced 11 to 14 foot waves on Lake Erie. Also, the water level at Toledo (Lucas County) was seven feet above low water datum. This combination resulted in major flooding and beach erosion. Many streets were flooded around Sandusky Bay (Ottawa, Sandusky, and Erie Counties) and Maumee Bay (Lucas County) and flooding had progressed further inland in some areas. In Sandusky and Huron (Erie County), several streets were flooded. At Beachwood Cove in Huron, the 30-foot high breakwall was destroyed and just a few feet of land separated the homes from the lake. Losses were estimated at $400,000 from the event, which impacted Sandusky, Lorain, Ottawa, Erie and Lucas counties.

April 9, 1998 Storm Surge - Northeast gales of 35 knots and water levels that peaked just below 100 inches above low water datum produced 10 to 14 foot waves, which caused major damage along the lakeshore. Many lakeshore roads were not only flooded, but also covered with rocks and other debris that, in some places, had to be removed by bulldozers. In Ottawa County, ten houses were destroyed and over 200 others were damaged, streets in downtown Port Clinton were flooded and the dike system and gravel roads in the Ottawa National Wildlife Refuge were badly damaged. Some evacuations took place at Whites Landing in Erie and Sandusky Counties and also at Wightmans Grove and Memory Marina in Sandusky County. A State of Emergency was declared and standing floodwater persisted for several days in some areas. Losses were estimated at $3,700,000 from the event, which impacted Erie, Ottawa, Lucas and Sandusky Counties.

October 17 to 21, 2011 Seiche Event - The graph below traces a recent Lake Erie seiche. From October 17 to 21, 2011, the wind shifted widely, from out of the west to out of the northeast, and to eventually out of the west again. The lines on the graph show the response of the water levels at Buffalo (red) and Toledo (blue) to these shifts. The greatest difference in water level was about 7 feet, and as the up-and-down swings of the lines show, the lake never settled to an equilibrium state over these several days.



Source: Ohio Dept. of Natural Resources, Division of Geological Survey

April 15, 2018 Storm Surge – High water, strong NE winds and rain combine to cause storm surge and flooding in Lucas, Ottawa, Erie and Sandusky Counties. Water levels within 6 inches of 1985's all-time record high, hours of 40-plus knot gale force winds from the east and 1 ½ inches of rain combined resulting in 13-15 foot waves. The municipalities of Marblehead, Port Clinton, Oak Harbor, Bayshore, Woodville, Toledo, Curtice, Point Place and Luna Pier (MI) were issued flood warnings. Damage was reported to structures in Port Clinton. Flooding inundated many farms, roads, businesses and homes on the west end of Lake Erie. State Route 2 was closed between S.R. 590 and Camp Perry, along with many other state routes along the north shore. The high water and waves caused $10-11 Million in damages to outer dikes protecting several of Lake Erie's marshes at Ottawa National Wildlife Refuge, Magee Wildlife Area, and Metzger's Marsh. There was also damage to docks and fishing piers in the area.

PROBABILITY OF FUTURE EVENTS

It is clear storm surge, coastal flooding, and seiche waves have a significant impact in Ohio. Based on the event profiles, it is possible for these events to occur between two and five times in a given year. Based on twelve events over 136 years, there is an 8.82% chance of a storm surge event significant enough to cause coastal flooding happening on any given year. The only seasonal limitation to events on Lake Erie would be during the height of winter when portions of the water surface can be covered by ice. It should be noted that ice coverage on Lake Erie varies from year to year, making it impossible to indicate any definitive time period when events cannot occur.

LHMP DATA

Cuyahoga County – Seiche. The Countywide All Natural Hazards Mitigation Plan states their northern coastline has a high frequency of seiche with a moderate vulnerability. The roads and highways along the coast can become flooded due to seiche waves. Most damage caused by seiche involves boat docks, low-lying areas along the lake shore, and river inlets to Lake Erie. The most severe seiche that hit the Cleveland area was an eight-foot seiche in the early 1990s.

Lucas County – Coastal Flooding. The Plan states that lake surges (also referred to as storm surges) are associated with extreme weather events and are responsible for coastal flooding and erosion (along

Lake Erie within Lucas County). The storms that generate large waves and lake surges can develop year-round, however within Lucas County, these events have typically occurred in the early spring and late fall months. Storm surges inundate coastal floodplains by dune over wash, the rise in water levels in inland bays and harbors, and backwater flooding through river mouths. Storm systems also generate large waves that run up and flood coastal beaches. The problem of lake surges and associated inland flooding is compounded by adjacent low-lying floodplains. The plan's history provides information that lake surges cause coastal flooding in the cities of Toledo, Oregon, the Village of Harbor View and the unincorporated Jerusalem Township. The total damages attributed to lake surges are $665,981.92, which equates to approximately $110,996.99 per event. There are limited data to calculate the probability of occurrence; however, records indicate multiple occurrences during the early spring and late fall months. It is fair to assume that future events would likely result in localized property damage to only specific areas within Lucas County, and that there is only a small potential for future events to result in injuries or deaths.

SHARPP. See section 4.3 for an analysis of SHARPP data in Ohio's coastal counties.

VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

Loss estimates for Ohio's coastal flooding hazard were developed using FEMA's hazard analysis and loss estimation software HAZUS-MH MR3 coastal flooding application within the flood module. This application was updated in HAZUS-MH MR3 to reflect the unique issues associated with the Great Lakes. Still water lake elevations for each county were taken from the US Army Corps of Engineers report *Revised Report on Great Lakes Open-Coast Flood Levels* published April 1988.

HAZUS-MH MR3 analysis was run for each county bordering Lake Erie based on a 100-year return event. Each run was specifically adjusted to take into consideration the type of shoreline associated with each county. Sandusky County could not be analyzed due to the software failing to recognize any coastal exposure. Upon closer review, the exposure, which does exist within the county, was assessed as part of the two neighboring county evaluations.

RESULTS

Region 1 exposure to coastal flooding is limited to the coastal counties of Erie, Lucas, Ottawa and Sandusky. The total building exposure is estimated at $8,743,489,700. The numbers of impacted structures by percent of the structure damaged are estimated to be: 1 to 10 percent damaged at 455, 11 to 20 percent damaged at 2,184, 21 to 30 percent damaged at 1,476, 31 to 40 percent damaged at 1,059, 41 to 50 percent damaged at 309 and substantially damaged at 914. There are an estimated four essential facilities, which will experience at least moderate damage. According to Table 2.8.a, estimates for business interruption and building losses are $8,560,000 and $974,880,000, respectively.

Table 2.8.a

Estimate of Potential Losses to Coastal Flooding Region 1

County	Population	Building Exposure Value	1-10% Damage Count	11-20 % Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	Substantial Damage Count	Essential Facilities Count	Estimate Business Interrupt	Estimated Property Loss
Erie	79,321	$4,150,287,000	159	372	175	28	5	40	1	$2,070,000	$132,210,000
Lucas	454,029	$2,545,448,000	113	395	840	932	227	189	3	$3,260,000	$548,900,000
Ottawa	41,036	$2,047,754,700	183	1,417	461	99	77	685	0	$3,230,000	$293,770,000
TOTAL	**574,386**	**$8,743,489,700**	**455**	**2,184**	**1,476**	**1,059**	**309**	**914**	**4**	**$8,560,000**	**$974,880,000**

The majority of building loss is associated with Lucas County as a result of inland backup flooding of the Maumee River. HAZUS-MH MR3 profiles for the remaining counties do not indicate riverine backup flooding to a significant extent.

Region 2 exposure to coastal flooding is limited to the coastal counties of Cuyahoga, Lake and Lorain. The total building exposure is estimated at $2,396,004,000. The numbers of impacted structures by percent of the structure damaged are estimated to be: 1 to 10 percent damaged at 82, 11 to 20 percent damaged at 260, 21 to 30 percent damaged at 278, 31 to 40 percent damaged at 91, and 41 to 50 percent damaged at 20 and substantially damaged at 12. There are no essential facilities estimated as impacted. Estimates for business interruption and building loss are $500,000 and $82,690,000 respectively (see Table 2.8.b).

Table 2.8.b

Estimate of Potential Losses to Coastal Flooding Region 2

County	Population	Building Exposure Value	1-10% Damage Count	11-20 % Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	Substantial Damage Count	Essential Facilities Count	Estimated Business Interrupt	Estimated Property Loss
Cuyahoga	1,384,252	$1,033,868,000	2	19	16	0	2	0	0	$110,000	$10,410,000
Lake	227,324	$671,888,000	55	159	206	89	12	12	0	$240,000	$43,840,000
Lorain	285,798	$450,219,000	25	82	56	2	6	0	0	$150,000	$28,710,000
TOTAL	**1,897,374**	**$2,396,004,000**	**82**	**260**	**278**	**91**	**20**	**12**	**0**	**$500,000**	**$82,960,000**

Region 3 exposure to coastal flooding is limited to the coastal county of Ashtabula. The total building exposure is estimated at $240,290. The numbers of impacted structures by percent of the structure damaged are estimated to be: 1 to 10 percent damaged at 3, 11 to 20 percent damaged at 12, 21 to 30 percent damaged at 8, 31 to 40 percent damaged at 1, and 41 to 50 percent damaged at 0 and substantially damaged at 1. There are no essential facilities estimated as impacted. Estimates for business interruption and building loss are $80,000 and $5,280,000 respectively (see Table 2.8.c).

Table 2.8.c

Estimate of Potential Losses to Coastal Flooding Region 3

County	Population	Building Exposure Value	1-10% Damage Count	11-20 % Damage Count	21-30% Damage Count	31-40% Damage Count	41-50% Damage Count	Substantial Damage Count	Essential Facilities Count	Estimated Business Interrupt	Estimated Property Loss
Ashtabula	102,729	$240,029,000	3	12	8	1	0	1	0	$80,000	$5,280,000

GREAT LAKES COASTAL FLOOD STUDY

The FEMA has initiated a coastal analysis and mapping study to produce updated Digital Flood Insurance Rate Maps (DFIRMs) for coastal counties around the Great Lakes. This storm surge study is one of the most extensive coastal storm surge analyses to date, encompassing coastal floodplains in eight states. Ultimately, the study will update the coastal storm surge elevations for all of the U.S. shoreline of the Great Lakes. This new coastal flood hazard analyses will utilize updated 1-percent-annual chance stillwater elevations obtained from a comprehensive storm surge study conducted by the U.S. Army Corps of Engineers.

The effort to produce these maps for all the Great Lakes states began in 2012 and is expected to be completed in Ohio in 2020. The resulting DFIRMs will introduce VE Zones to Ohio and the Great Lakes Region. A VE Zone is used on a DFIRM to differentiate coastal high hazard areas from the rest of the 1%-annual-chance flood hazard area (100-year floodplain). The Zone VE designation indicates that during the 1%-chance-annual flood, wave hazards are expected to be particularly strong and have the potential to cause structural damage.

Zone VE is mapped for areas that meet one of more of the following criteria:

1. Wave runup depth exceeds 3 feet relative to the ground,
2. Wave overtopping rate exceeds 1cfs/ft.,
3. Wave heights exceed 3 feet in areas of overland wave propagation, or
4. The primary frontal dune.

Figure 2.8c illustrates wave runup and overtopping as well as overland wave propagation.

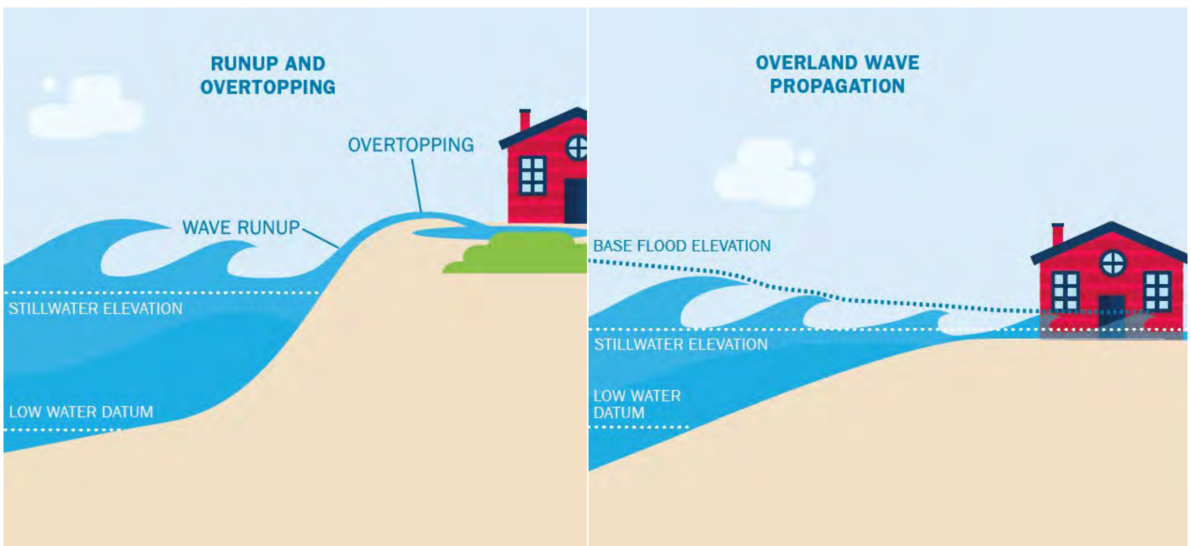


Figure 2.8d illustrates how the VE Zone designations on the FIRM relate to the wave risk.

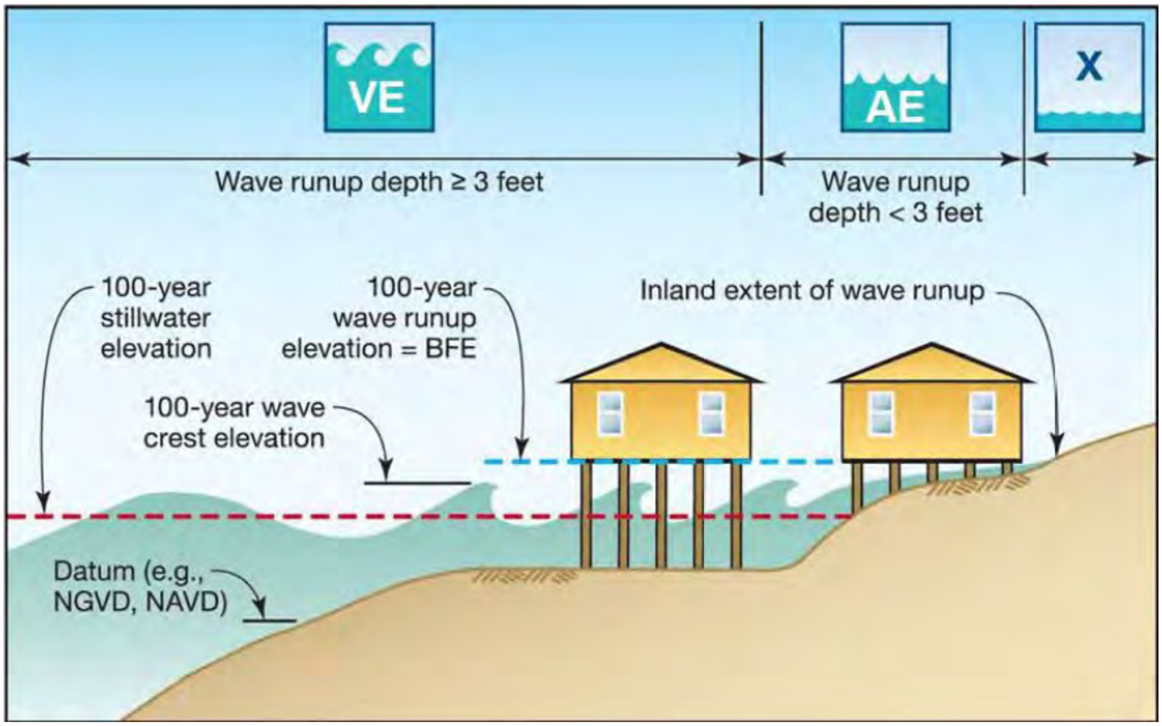


Table 2.8c summarizes building exposure based on analysis performed by the ODNR Office of Coastal Management using Preliminary DFIRM data and county auditor data. The results of this analysis will change as the Preliminary DFIRMs are reviewed and undergo the appeals period.

Table 2.8.c

County	Total Coastal Parcels	Parcels in V-Zone	Parcels with Buildings in V-Zone
Lucas	590	333	1
Ottawa	2,511	1,675	111
Erie	1,982	1,212	20
Lorain	962	1,019	28
Cuyahoga	899	875	24
Lake	1,111	1,070	20
Ashtabula	792	818	29
Total	**8847**	**7002**	**233**

* Sandusky County does not have identified V Zones

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Using HAZUS-MH MR3 results and the FIRMs for the coastal counties, state- owned and state-leased facilities were evaluated for their involvement with seiche/coastal hazards. While all eight coastal counties were evaluated, only three of those contained facilities that could be at risk of flooding via seiche or coastal flooding, and all three are in Region 1. Table 2.8.d lists the results of this analysis.

One state-owned critical facility was located in the hazard area in Lucas County, which represents $153,000 at risk. While this facility is operated by the ODNR, it is a watercraft office that would be crucial to immediate response and rescue necessities. In terms of non-critical facilities, over 90 percent of those identified are located in Lucas County, and the majority of those involve state park facilities. Only one state-leased non-critical facility was noted to be at risk, and it is located in the City of Sandusky, Erie County, representing over $80,000 in annual rent at risk. It should be noted that no state-leased critical facilities were determined to be at risk to this hazard.

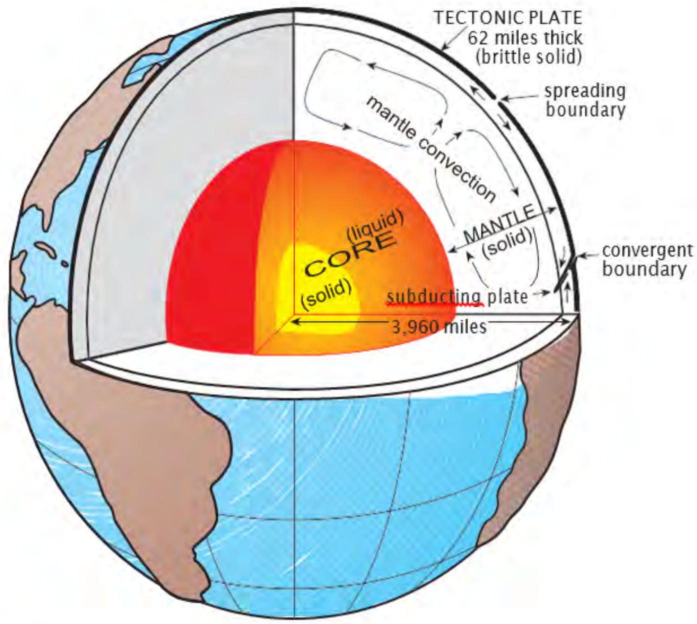
Table 2.8.d

Estimated Losses from Coastal Flooding for State-Owned and State-Leased Facilities						
County	**State-Owned Critical Facility Count**	**State-Owned Critical Facility Value**	**State-Owned Non-Critical Facility Count**	**State-Owned Non-Critical Facility Value**	**State-Leased Non-Critical Facility Count**	**State-Leased Non-Critical Facility Rent**
Erie	0	$0	5	$674,495	1	$82,131
Lucas	1	$153,000	33	$24,256,560	0	$0
Ottawa	0	$0	0	$0	0	$0
Sandusky	0	$0	6	$799,680	0	$0
TOTAL	**1**	**$153,000**	**44**	**$25,730,735**	**1**	**$82,131**

2.9 EARTHQUAKE

Earthquakes occur as a result of the constant motion of the earth. Current science describes the earth in three major regions: the core, mantle and crust. Figure 2.9a provides a three dimensional representation of the earth's regions. The core is hot and consists of two subsections. The very center of the planet's core is hottest and solid. Surrounding the solid center is a liquid (i.e. molten material/magma) layer. The mantle is cooler than the core and although solid, circulates with the consistency of malleable plastic. Through convection, the portion of the mantle closest to the core heats and subsequently rises in the same manner as the air in the earth's atmosphere. Conversely, the upper portion of the mantle transfers its heat to the crust, cools and descends back toward the core.

Figure 2.9a



Interior zones of Earth. Earth's crust consists of great plates that slowly move across the surface of Earth in response to convection cells in the mantle. Most earthquakes occur where plates meet, such as at spreading or convergent boundaries. Modified from Washington Division of Geology and Earth Resources, Information Circular No. 85, 1988.

Source: Educational Leaflet No. 9 Revised Edition 2015 Division of Geological Survey

The crust is also solid; however, unlike the mantle it is rigid and brittle. The crust consists of a number of individual plates, each in constant motion, resting on the mantle. The boundaries where plates meet are the locations where new crust develops (spreading boundary) and alternately existing crust material returns to the mantle (convergent boundary).

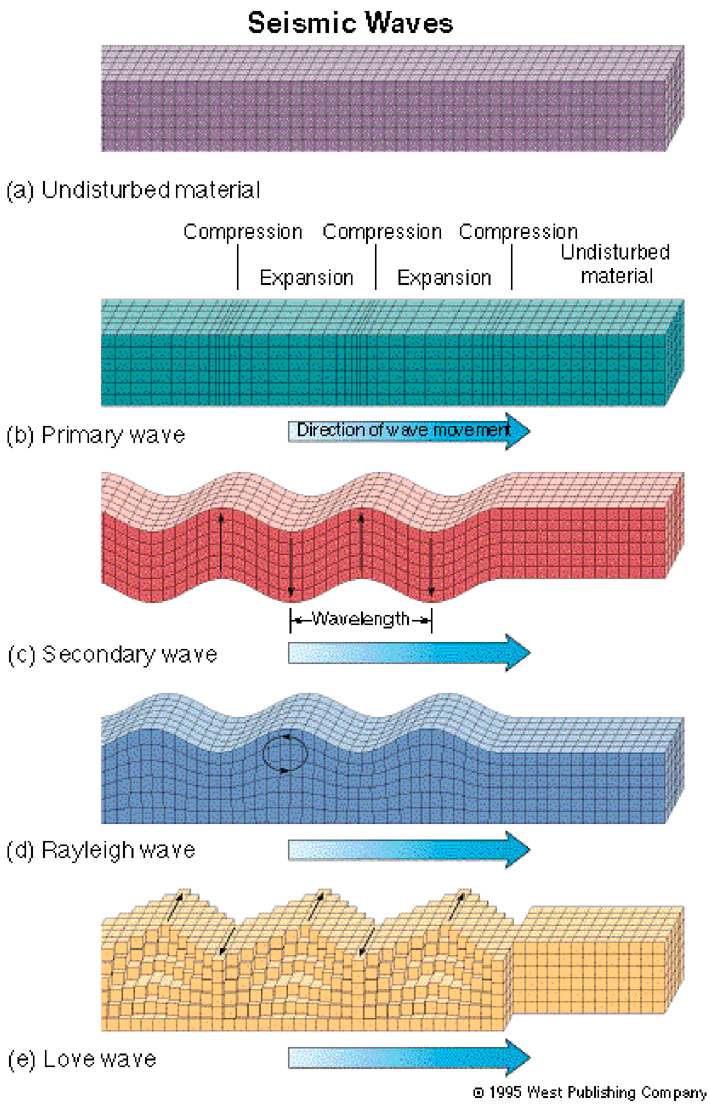
Understanding the composition of the earth is crucial because earthquakes are often associated with boundaries where the plates slide against, rise over or sink under each other. The movement at many of the plate boundaries is not smooth and consistent, but rather grinds and jerks. As entire plates move the boundaries become locked together and enormous amounts of tension build until a sudden release occurs, realigning the plate edges and creating the observed earthquake.

The locations where the crust is fractured and sliding are called faults. California has several famous faults (e.g. the San Andreas Fault), which can be clearly observed though aerial photography. In cases where the crust is pulling apart, the location is called a rift. The Reelfoot Rift and associated rift valley located in Missouri is one of the largest in North America. Ohio geologically contains both fault and rift zones.

Another significant source of earthquakes is associated with large bodies of magma, which are located near the earth's crust. The Hawaiian archipelago and Yellowstone National Park are examples where magma deposits are altering the crust and generating both volcanic activity and earthquakes.

Earthquake locations are recorded based on the latitude and longitude of the occurrence, called the epicenter, and the associated depth underneath the earth's surface. The energy released in earthquakes travels from the epicenter in seismic waves through the earth. The four major types of waves are often referred to as primary, secondary (body waves), Rayleigh and Love (surface waves) (Figure 2.9.b). Primary waves compress the earth's surface in front of it as they travel. Secondary waves cause the earth's surface to rise and fall perpendicular to its line of travel. Rayleigh waves travel in a circulating pattern similar to those in an ocean wave. Finally, Love waves cause the earth's surface to oscillate from side to side perpendicular to its line of travel. The primary and secondary waves travel faster than the Rayleigh and Love waves providing the initial evidence of an event.

Figure 2.9b



Source: West Publishing Company

Figure 2.9c

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

Magni-tude: 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8

Scale showing general relationship between epicentral Modified Mercalli Intensities and magnitude. Intensities can be highly variable, depending on local geologic conditions. Modified from D. W. Steeples, 1978, Earthquakes: *Kansas Geological Survey pamphlet.*

Source: [Educational Leaflet No. 9 Revised Edition 2015 Division of Geological Survey]

Each wave affects structures differently. For example, secondary waves have much greater impact in tall structures. Additionally, each wave has unique characteristics. The secondary wave, for example, cannot travel through fluids, including the molten outer core.

Location of earthquake events has the added dimension of land / crust composition. Within the United States, areas like southern California are primarily young, hot rock that is broken by mountain ranges. Under these conditions seismic waves are somewhat limited in their ability to travel (attenuation) reducing the overall area of impact. Conversely, seismic zones in the central and eastern United States have flat-lying, cold, brittle rocks with much thicker deposits of soil and sediments. Loosely consolidated materials such as sand and soil cause seismic waves to amplify ground motion.

When seismic waves travel through unconsolidated materials it can have the effect of turning solid land into quicksand. When this phenomenon, called liquefaction, occurs, any object located in the affected area may slide over or sink into the soil. Entire buildings, roadways and bridges may be significantly damaged. One factor which greatly determines the extent of damage from an event is duration. Events can last anywhere from a few seconds to minutes. The longer the event is promulgating seismic waves the greater the opportunity for damage.

According to the US Geological Survey, The Modified Mercalli Intensity Scale (MMI) (Figure 2.9.c) was developed in 1931 and is currently used to evaluate the effects of earthquakes. It is composed of increasing levels of intensity that does not have a mathematical basis—only an arbitrary ranking based on observed effects.

RISK ASSESSMENT

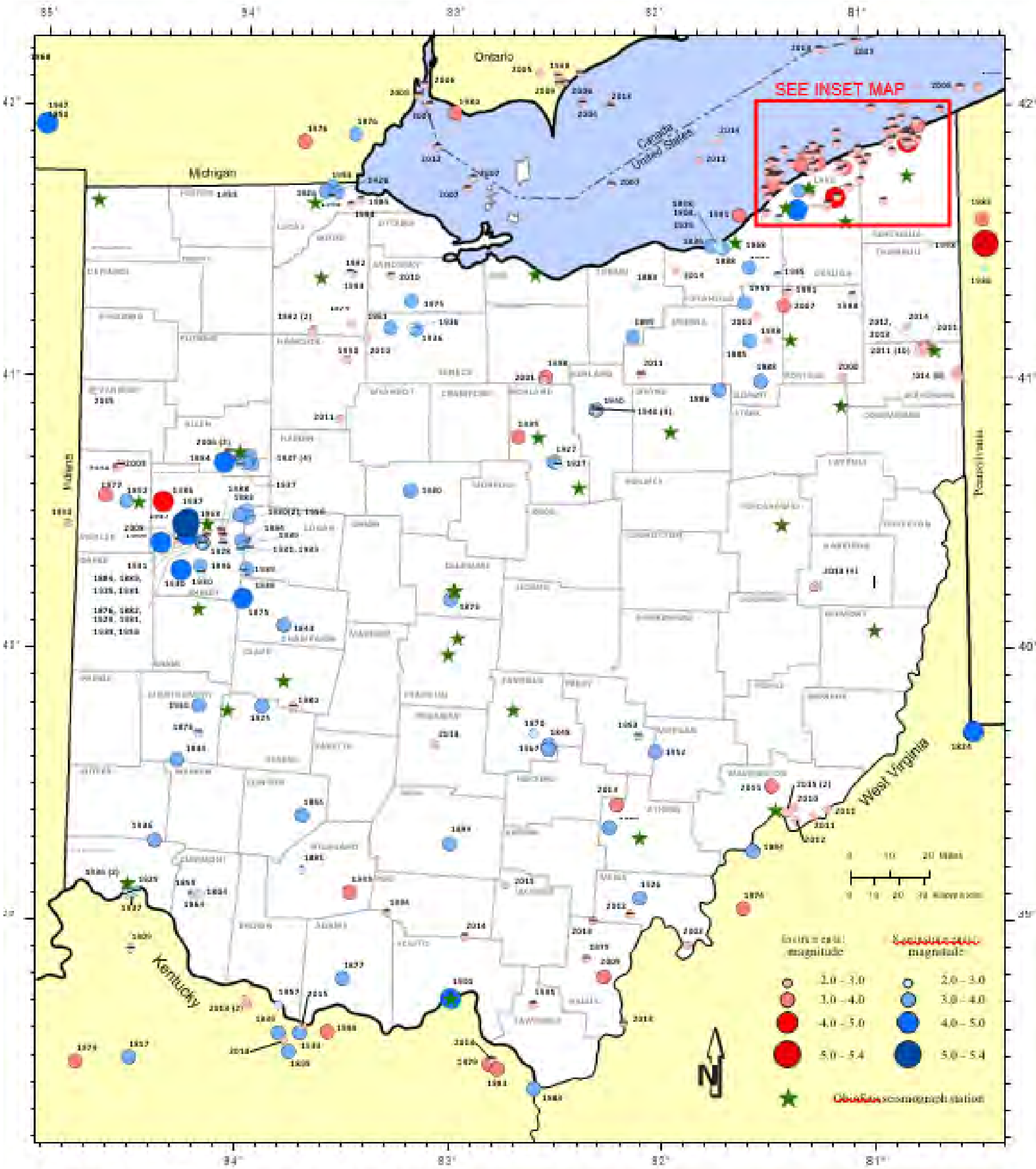
LOCATION

Earthquakes in Ohio are primarily located in the northeast and far west- central portions of the state and historically have not exceeded 5.4 magnitude (Map 2.9a). The map of historical epicenters lists all the events with magnitudes greater than 2.0. The size of the location marker increases with the magnitude of the event. Red circles represent instrumentally recorded events. Blue circles represent non-instrument recorded.

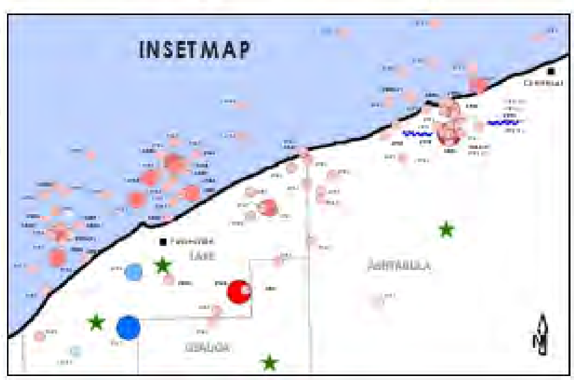
The epicenter map clearly identifies the northeast Ohio counties of Ashtabula, Geauga and Lake as one of the most earthquake-prone areas. Similarly, another earthquake-prone area is located in the west-central Counties of Auglaize, Champaign, Logan, Mercer, and Shelby. Although there are clear clusters of activity, a limited number of events have occurred and are spread over a large portion of the state.

According to information published by the ODNR Division of Geological Survey, the origins of Ohio earthquakes, as with earthquakes throughout the eastern United States, are poorly understood at this time. Those in Ohio appear to be associated with ancient zones of weakness in the Earth's crust that formed during continental collision and mountain-building events about one billion years ago. These zones are characterized by deeply buried and poorly known faults, some of which serve as the sites for periodic release of strain that is constantly building up in the North American continental plate due to continuous movement of the tectonic plates that make up the Earth's crust.

Map 2.9a

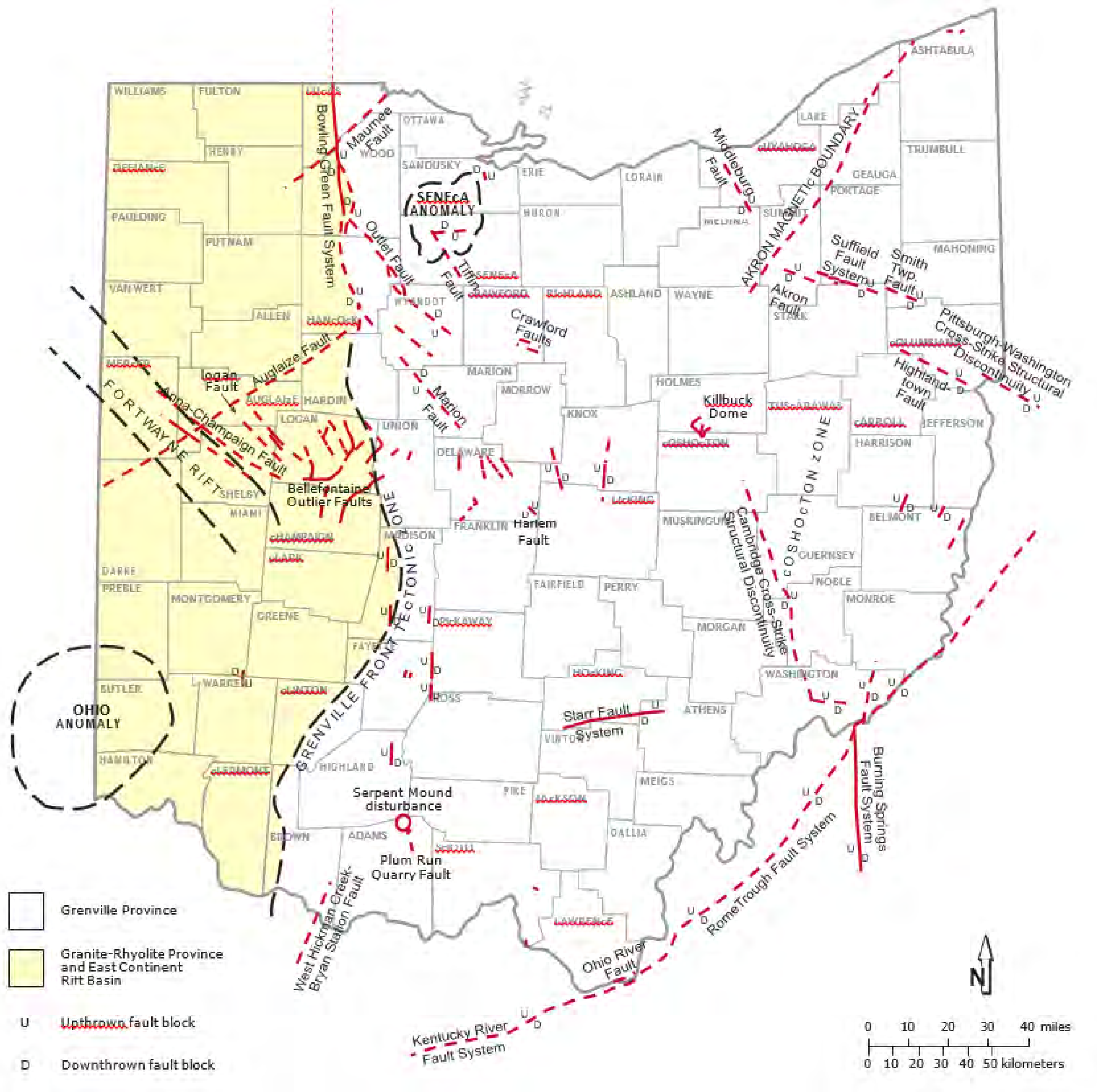


Locations of felt earthquakes or those with magnitudes of 2.0 or greater in Ohio and its border areas. Locations and magnitudes of historic earthquakes are represented by symbols corresponding to felt area or maximum epicentral MMI. Noninstrumental locations may be in error by a considerable distance, especially for early events.



Source: [Educational Leaflet No. 9 Revised Edition 2015 Division of Geological Survey]

Map 2.9b



Source: *Educational Leaflet No. 9 Revised Edition 2015. ODNR - Division of Geological Survey*

The Division of Geological Survey has developed a map of geologic features, referred to as basement structures, which lie far below the earth's surface (see Map 2.9.b). Several geologists have speculated the Akron Magnetic boundary is a fracture zone in crystalline rocks lying more than 6,000 feet below the surface. The Fort Wayne Rift along with the Anna-Champaign, Logan and Auglaize faults, though still poorly understood, can be evaluated using the existing understanding of how these structures behave.

LHMP DATA

Of the top 10 earthquakes in terms of magnitude that happened in Ohio, five occurred in Shelby County, two occurred in Ashtabula County, and Auglaize, Coshocton, Allen, and Lake each had one occurrence. Of the 384 earthquakes documented by the Ohio Department of Natural Resources, Lake, Ashtabula, and Shelby had the most occurrences of all counties in the state.

Shelby County, considered to be one of the most active seismic zones within the state, experienced more than 39 earthquakes averaging 2.80 magnitude, which includes the most damaging earthquake to strike the state at a 5.4 magnitude. The Shelby County Hazards Mitigation Plan of 2016 states that Shelby County has a moderate risk of incurring damage from earthquakes across all five vulnerability assessment categories of infrastructure, population, property, injuries/loss of life, and economic losses.

Ashtabula County experienced 53 events averaging 2.6 magnitude with their largest event having a magnitude at 4.5. The Ashtabula Hazard Mitigation Plan of 2012 states that many of the smaller magnitude earthquakes that have occurred since 1987 can be associated with a deep, now abandoned, Class I injection well located in the City of Ashtabula. The northeastern portion of Ohio is the second most seismically active area in the state.

Lake County experienced 64 events with an average of 2.53 magnitude and the second highest magnitude earthquake in the state at 5.0. The Lake County Multi-Jurisdictional Hazards Mitigation Plan updated in 2017 used HAZUS-MH to analyze a scenario of 5.0 magnitude located 10km underground and centered just off of Mentor Road, between Mentor High School and the Lakeland Freeway. It estimated that 18,273 residential, 8,679 non-residential, and 203 critical facilities are vulnerable to a loss of up to $7,275,468,199.

NATIONAL LEVEL EXERCISE, 2011 (NLE-11)

In September 2010, Ohio EMA's Mitigation Section was consulted to provide HAZUS runs for an earthquake tabletop exercise scenario. The scenario was designed for selected counties in southwest Ohio in preparation for NLE-11 (National Level Exercise 2011). The purpose is to test critical resource logistics and catastrophic planning in conjunction with FEMA Region V and participating States. HAZUS runs were produced for Hamilton, Butler, Clermont, Darke, Scioto and Warren Counties with a 5.7 moment magnitude scale epicenter in downtown Cincinnati to a depth of 10 kilometers.

The aggregate HAZUS runs resulted in 79,070 buildings with moderate damage and 4,418 buildings beyond repair. Four hundred eighty-seven (487) essential facilities would be less than 50% functional. One thousand four hundred sixty-eight (1,468) transportation systems and 201 utility systems would be damaged. Destruction is projected to produce 3.513 million tons of debris and 93 fire ignitions resulting 13,490 people displaced from their residences with $1,248,000,000 in damage. The social impact estimates 179 fatalities, 123 people with life-threatening injuries, 901 people would have to be hospitalized and 3,871 would have to be treated with first aid or at an aid station. Eight thousand eight hundred six (8,806) people would seek temporary shelter. The economic impact is projected to result in $10,828,490,000 in lost income and, $2,050,500,000 in capital stock loss. It is estimated to take 15 years for economic recovery from this event.

PAST OCCURENCES

Earthquakes are a continuously occurring hazard in Ohio. Data are available for events dating back almost 250 years. Most of Ohio's earthquake events are small, registering between 2 and 4 magnitudes. Significant events are discussed in Geological Survey document Educational Leaflet No. 9, which follows. The Ohio Department of Natural Resources have documented 384 earthquakes that have occurred since 1776.

September 19, 1884: An earthquake in the vicinity of Lima (Allen County) had an epicentral Modified Mercalli Intensity Scale (MMI) of VI. There were reports of fallen ceiling plaster as far away as Zanesville

(Muskingum County) and Parkersburg, West Virginia. On the basis of area feeling the earthquake (140,000 square miles), it is estimated to have had a magnitude of 4.8. Workmen on top of the Washington Monument in Washington, D.C., reported feeling this earthquake.

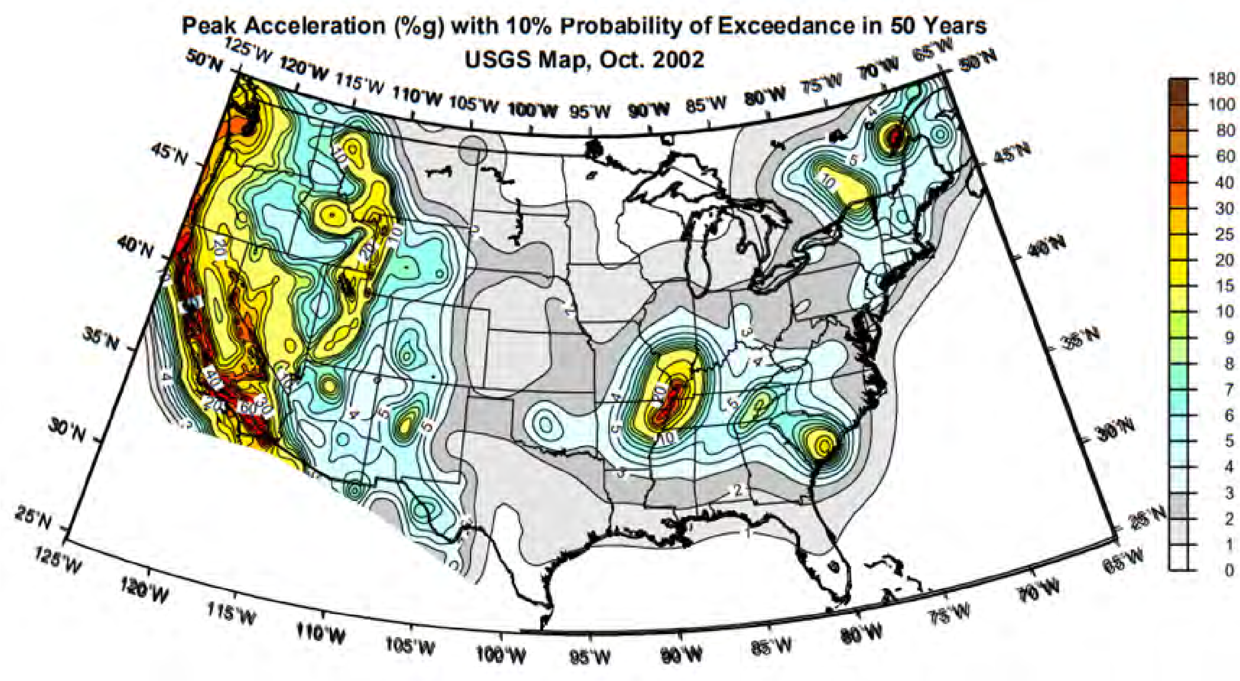
September 20, 1931: In this event, Anna and Sidney in Shelby County experienced toppled chimneys and cracked plaster. Store merchandise and crockery were knocked off shelves, and stones were jarred loose from the foundation of the Lutheran church in Anna. A ceiling collapsed in a school at Botkins, north of Anna. An MMI of VII and a magnitude of 4.7 have been assigned to this earthquake.

March 2 and 9, 1937: These two earthquakes are the most damaging to have struck Ohio. Maximum intensities were experienced at Anna (Shelby County), where an MMI of VII was associated with the March 2 event and an MMI of VIII with the March 9 event. In Anna, chimneys were toppled, organ pipes were twisted in the Lutheran church, the masonry school building was so badly cracked that it was razed, water wells were disturbed, and cemetery monuments were rotated. Both earthquakes were felt throughout a multi-state area—plaster was cracked as far away as Fort Wayne, Indiana. The March 9th event was felt throughout an area of about 150,000 square miles. Analysis of seismograms from these earthquakes by the U.S. Geological Survey (Stover and Coffman, 1993) assigned magnitudes of 4.7 and 4.9, respectively, to these events. On the basis of felt area, these earthquakes have been assigned magnitudes of 4.9 and 5.4, respectively.

January 31, 1986: This earthquake, which had a magnitude of 5.0 and an MMI in the high VI range, occurred in Lake County, east of Cleveland, in the general vicinity of a 1943 event with 4.5 magnitude. The 1986 earthquake cracked plaster and masonry, broke windows, and caused changes in water wells. The epicenter was only a few miles from the Perry nuclear power plant. It is the most intensively studied earthquake in Ohio and was the subject of several scientific reports (i.e., Nicholson and others, 1988).

PROBABILITY OF FUTURE EVENTS

Map 2.9c



Source: https://pubs.usgs.gov/of/2002/ofr-02-420/USpga500v3-508.pdf

Earthquakes have affected Ohio as early in history as written and oral records exist. There is clear precedence to expect Ohio will continue to experience seismic events for the foreseeable future. Probabilities of future events have been developed and mapped by the USGS (Map 2.9.c). The measurement used in this estimation is based on the chance of ground shaking (e.g. peak ground acceleration) as a percentage of the natural force of gravity over time. In this analysis the extreme southwestern portion of Ohio has one in ten chance of experiencing an earthquake equal in force to three percent of the earth's gravity in the next 50 years due to its proximity to the New Madrid seismic zone.

Since 1950, Ohio experienced 233 earthquakes across the three regions. Region 1 had the least number of earthquakes at 34 events, Region 2 had 77 events, and Region 3 had 121 events. Dividing the number of events by the 68 years since 1950, we get a 50 percent (.50) probability of an earthquake happening in Region 1, 100 percent (.113) in Region 2, and a 100 percent (1.78) probability of an earthquake happening in the region in any given year. The average magnitude for Region 1 is 2.76, Region 2 is 2.56, and Region 3 is 2.49. Although future earthquake events are highly likely to occur in Ohio, fortunately the state has not experienced any recorded loss of life due to earthquakes. Damages are commonly limited to poorly built structures.

VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

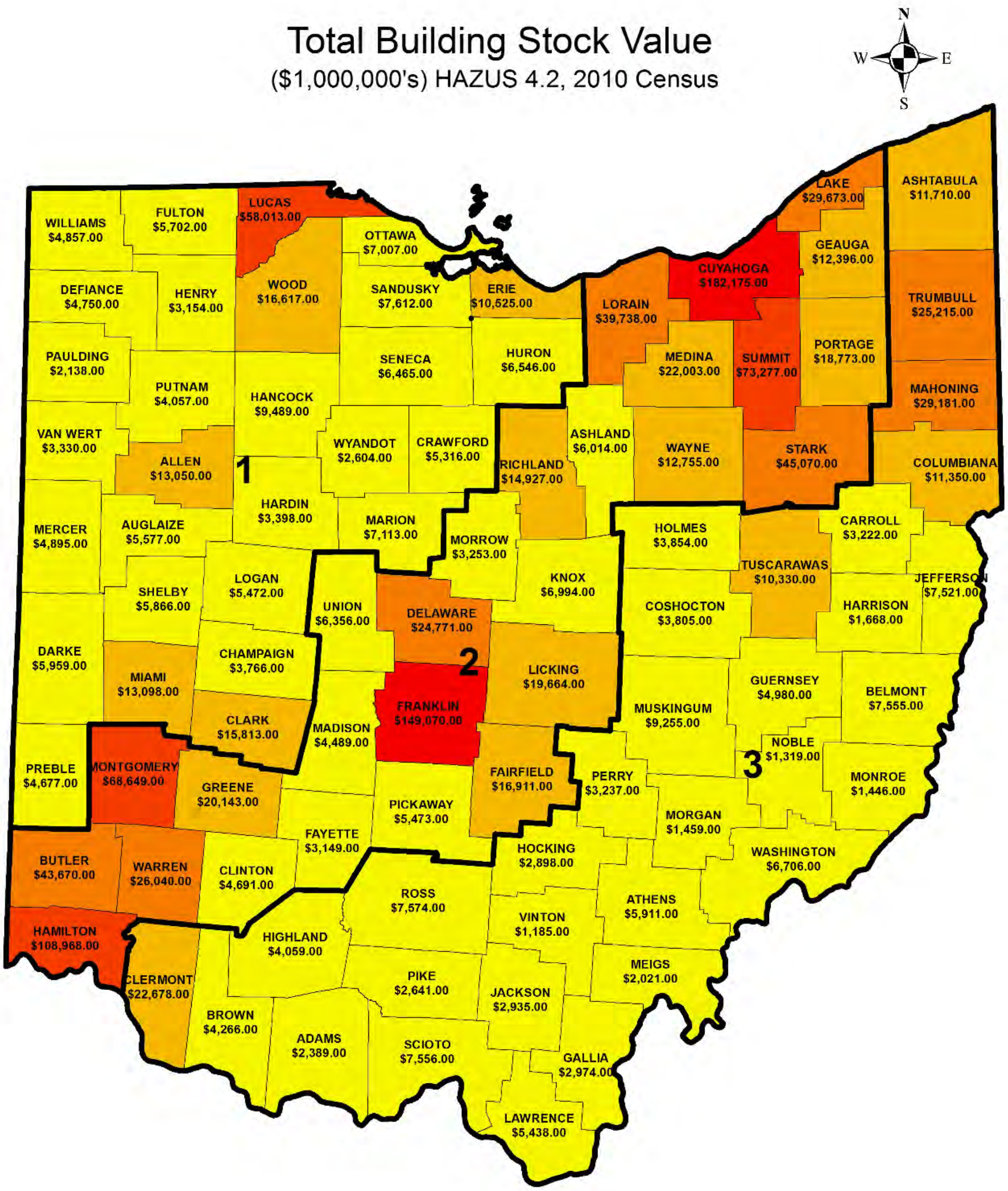
Loss estimates for Ohio's earthquake hazard were developed using FEMA's hazard analysis and loss estimation software HAZUS-MH 4.2 and its ability to simulate arbitrary events. HAZUS has been used successfully for over a decade in California's earthquake preparation and response efforts. For the purpose of this initial effort, level one analyses were completed using the program; un-manipulated, census-tract-level data were used. Results should be interpreted as estimates and cannot be considered precise losses.

There were two methods used in analyzing the vulnerabilities and loss estimates of all counties across Ohio. Because the largest earthquake that happened in Ohio was measured at a 5.4 magnitude and the average magnitude of all 384 earthquakes since 1776 is 2.58, both methods involved simulating an arbitrary event at the program's minimum magnitude of 5.0, and the depth at 5 kilometers.

The first method assessed Map 2.9a for historical hotspots of seismic activity. Based on this information, HAZUS was used to simulate events within a Lake County in Northeast Ohio, and Shelby County in Western Ohio. Shelby County had experienced Ohio's strongest earthquake to date at 5.4 magnitude while Lake County had experienced the state's second strongest at 5.0 magnitude. The epicenters of the simulated events will be set at the projected locations of their respective historical events. It is expected that losses will expand outward contiguously to other counties across the state. The cost of the damage is to the surrounding area will vary greatly on which county the earthquake is located. According to HAZUS and the 2010 census, the total building stock for Shelby County is $5,866,000,000 and is surrounded by six counties whose total building stock adds up to an estimated $38,767,000,000. Lake County has a total estimated building stock at $29,673,000,000 and is surrounded by 3 counties whose total building stock adds up to $206,281,000,000. This method estimates the damages to all Ohio counties from the earthquake event.

Unlike the first method, the second method runs an individual earthquake analysis for each county. Each analysis set the epicenter at the county seat of their respective county. These individual runs assessed only the damages specific to that county. For the total building stock value for each county, see Map 2.9d or "Total Building Value" column on the tables in the results.

Map 2.9d



Source: HAZUS 4.2 County Data based on 2010 Census

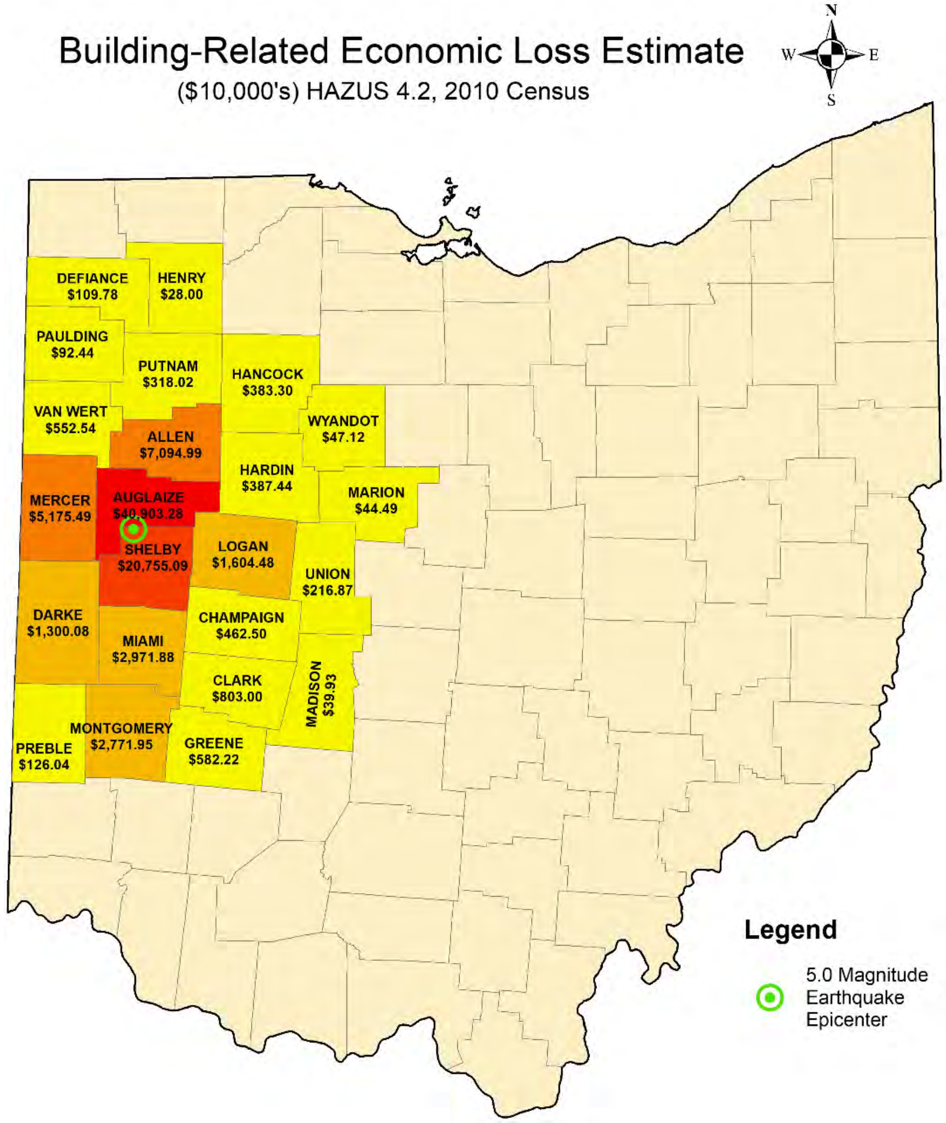
According to HAZUS and the 2010 census, the total building stock for the entire state is an estimated $1,434,296,000,000. The distribution of building stock values are generally clustered in three areas: Southwest, Central, and Northeast Ohio. These three areas are also the largest populated areas within the state including the cities of Cincinnati, Columbus, and Cleveland. The areas also all fall within Region 2 designated this plan. Region 2 has a total building stock value of $969,092,000,000 while Regions 1 and 3 are at $246,866,000,000 and $218,338,000,000 respectively.

There are four damage classifications used for each HAZUS run: Slight, Moderate, Extensive, and Complete. The descriptions for each would vary depending on the type of building damaged. For the complete definitions for different types of building category, refer to section 5.3.1 of the HAZUS Earthquake Model Technical Manual.

RESULTS

Method 1, Scenario A: Shelby County 5.0 Magnitude Earthquake Event (40.47°, -84.28°)

Map 2.9e



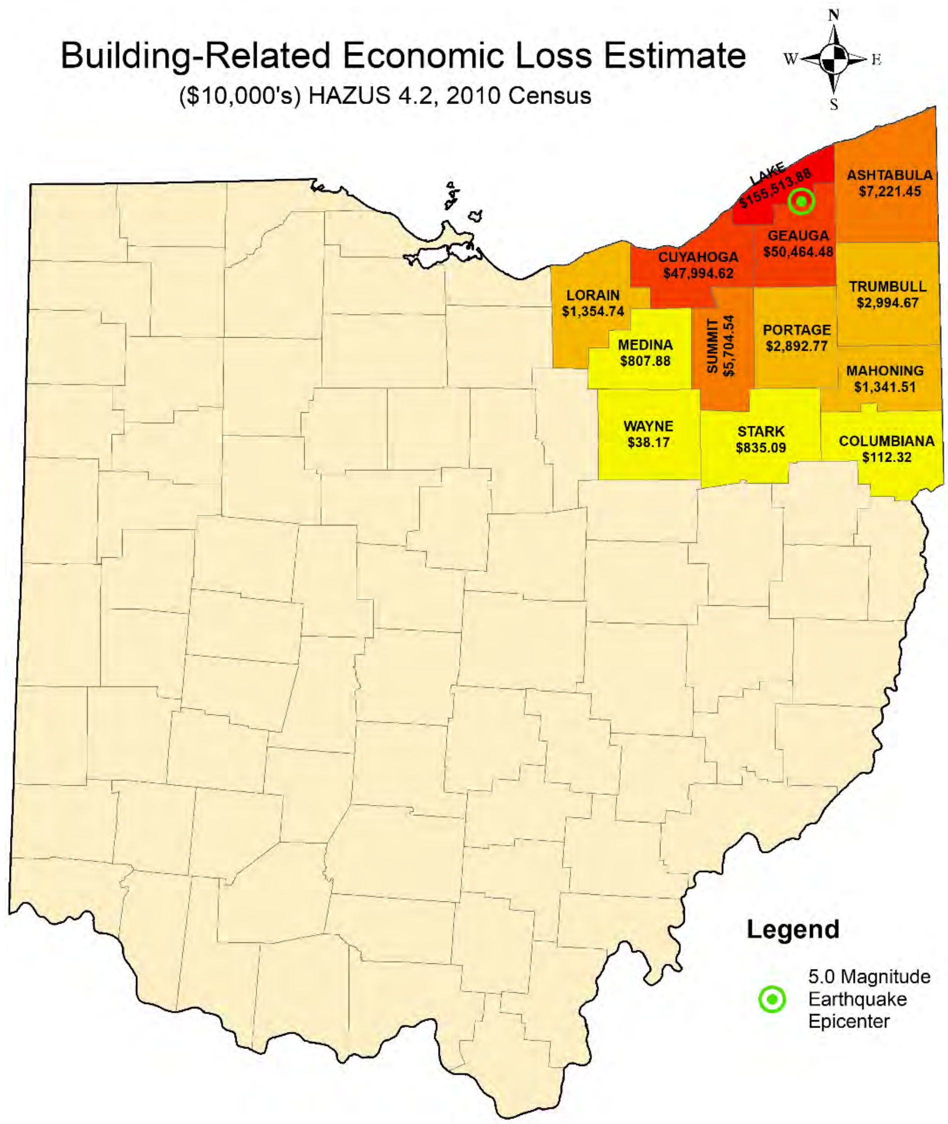
Estimate of Potential Losses to Earthquake									
Shelby County 5.0 Magnitude Earthquake Event (40.47°, -84.28°)									
County	**2010 Population**	**Total Building Value**	**Slight Damage Count**	**Moderate Damage Count**	**Extensive Damage Count**	**Complete Damage Count**	**Income Loss**	**Property Loss**	**Total Building-Related Loss**
Auglaize	45,949	$5,577,000,000	4,057	2,165	639	143	$72,156,000	$336,877,000	$409,033,000
Shelby	49,423	$5,866,000,000	2,849	1,342	339	72	$34,139,000	$173,412,000	$207,551,000
Allen	106,331	$13,050,000,000	2,106	690	106	11	$17,878,000	$53,072,000	$70,950,000
Mercer	40,814	$4,895,000,000	1,423	530	87	10	$10,812,000	$40,943,000	$51,755,000
Miami	102,506	$13,098,000,000	1,093	331	47	4	$7,837,000	$21,882,000	$29,719,000
Montgomery	535,153	$68,649,000,000	1,456	402	42	3	$10,467,000	$17,252,000	$27,719,000
Logan	45,858	$5,472,000,000	867	293	34	3	$4,025,000	$12,020,000	$16,045,000
Darke	52,959	$5,959,000,000	597	185	23	2	$3,312,000	$9,689,000	$13,001,000
Clark	138,333	$15,813,000,000	529	146	13	1	$2,752,000	$5,278,000	$8,030,000
Greene	161,573	$20,143,000,000	320	88	9	1	$1,955,000	$3,867,000	$5,822,000
ALL OTHER COUNTIES	[redacted]		1,741	495	53	5	$8,562,900	$19,519,200	$28,082,100
TOTAL	[redacted]		17,038	6,667	1,392	255	$173,895,900	$693,811,200	$867,707,100

HAZUS results for building counts indicate 17,038 slight, 6,667 moderate, 1,392 extensive and 255 completely impacted structures. The total loss of income is estimated at $173,895,900 and total property losses are estimated at $693,811,200. Auglaize, Shelby, Allen, Mercer, Miami, Montgomery, Logan, Darke, Clark, and Greene are the top ten of 23 counties estimated to see damages from this event. These ten counties have a total population of 1,278,899 people. Auglaize and Shelby had the highest losses and together accounted for 71 percent of the estimated $867,707,100 in total building-related losses. Damage is likely to extend out to counties located in eastern Indiana.

Results indicated minimal losses of utility, transportation and critical facilities. HAZUS estimates that there will be one hospital, two schools, one police station, and two fire stations that will see at least moderate damage (>50 percent). Additionally, there will be three bridges, one railway facility, and one airport facility that will see at least moderate damage. On the first day, 103 households will be without potable water service and 7,353 households without electric power. Within one week, the numbers will drop to 0 and 1,295 households respectively.

Method 1, Scenario B: Lake County 5.0 Magnitude Earthquake Event (41.65°, -81.16°)

Map 2.9f



HAZUS results for building counts indicate 43,983 slight, 17,127 moderate, 3,783 extensive and 751 completely impacted structures. The total loss of income is estimated at $542,298,760 and total property losses are estimated at $2,230,462,376. Lake, Geauga, Cuyahoga, Ashtabula, Summit, Trumbull, Portage, Lorain, Mahoning, and Stark are the top ten of 13 counties estimated to see damages from this event. These ten counties have a total population of 3,534,326 people. Lake, Geauga, and Cuyahoga had the highest losses and together accounted for 92 percent of the estimated $2,772,761,136 in total building-related losses. The building-related losses in the Lake County Scenario are much greater than in the Shelby County Scenario due to having much greater building stock values in the general area. The total number of impacted counties are less than that of the Shelby County event as Lake County is situated along the southern shores of Lake Erie. Damages are likely to extend out to counties located in western Pennsylvania.

Estimate of Potential Losses to Earthquake									
Lake County 5.0 Magnitude Earthquake Event (41.65°, -81.16°)									
County	**2010 Population**	**Total Building Value**	**Slight Damage Count**	**Moderate Damage Count**	**Extensive Damage Count**	**Complete Damage Count**	**Income Loss**	**Property Loss**	**Total Building-Related Loss**
Lake	230,041	$29,673,000,000	15,769	7,517	2,008	459	$268,296,148	$1,286,842,603	$1,555,138,751
Geauga	93,389	$12,396,000,000	5,344	2,704	827	201	$82,706,223	$421,938,582	$504,644,805
Cuyahoga	1,280,122	$182,175,000,000	12,755	3,864	577	57	$125,551,130	$354,395,097	$479,946,228
Ashtabula	101,497	$11,710,000,000	2,328	812	122	14	$15,852,078	$56,362,452	$72,214,530
Summit	541,781	$73,277,000,000	2,398	679	80	6	$17,529,907	$39,515,443	$57,045,350
Trumbull	210,312	$25,215,000,000	1,562	459	53	5	$9,155,358	$20,791,374	$29,946,732
Portage	161,419	$18,773,000,000	1,322	402	45	4	$7,549,739	$21,377,938	$28,927,676
Lorain	301,356	$39,738,000,000	682	187	19	1	$4,685,319	$8,862,076	$13,547,395
Mahoning	238,823	$29,181,000,000	789	218	23	2	$4,964,738	$8,450,316	$13,415,054
Stark	375,586	$45,070,000,000	482	132	14	1	$2,973,399	$5,377,504	$8,350,903
ALL OTHER COUNTIES			552	152	16	1	$3,034,719	$6,548,993	$9,583,712
TOTAL			43,983	17,127	3,783	751	$542,298,760	$2,230,462,376	$2,772,761,136

Results indicated minimal losses of utility, transportation and critical facilities. HAZUS estimates that there will be one hospital, two schools, and three fire stations that will see at least moderate damage (>50 percent). Additionally, there will be one bridge and one airport facility that will see at least moderate damage. On the first day, 468 households that will be without potable water service and 27,451 households without electric power. Within one week, the numbers will drop to 0 and 5,204 households respectively.

Method 2: Epicenter in County Seat

Estimate of Potential Losses to Earthquake											
Region 1											
County	2010 Population	Total Building Value	5.0 Magnitude Earthquake Epicenter	Slight Damage Count	Moderate Damage Count	Extensive Damage Count	Complete Damage Count	Income Loss	Property Loss	Total Building-Related Loss	Percentage of Total Building Value
Allen	106,331	$13,050,000,000	Lima	10,731	6,727	2,420	718	$340,039,700	$1,439,687,900	$1,779,727,600	11.03%
Auglaize	45,949	$5,577,000,000	Wapakoneta	3,943	2,263	769	212	$71,750,000	$361,590,000	$433,340,000	7.77%
Champaign	40,097	$3,766,000,000	Urbana	3,786	2,316	808	226	$74,620,000	$378,820,000	$453,440,000	12.04%
Clark	138,333	$15,813,000,000	Springfield	14,231	8,695	2,988	880	$358,740,000	$1,623,060,000	$1,981,800,000	12.53%
Crawford	43,784	$5,316,000,000	Bucyrus	3,916	2,172	700	189	$67,860,100	$353,616,300	$421,476,400	7.93%
Darke	52,959	$5,959,000,000	Greenville	5,214	3,052	1,023	272	$100,500,600	$454,991,900	$555,492,500	9.32%
Defiance	39,037	$4,750,000,000	Defiance	3,639	2,334	864	254	$105,843,400	$488,064,700	$593,908,100	12.50%
Erie	77,079	$10,525,000,000	Sandusky	7,852	4,694	1,609	468	$243,047,800	$977,979,100	$1,221,026,900	11.60%
Fulton	42,698	$5,702,000,000	Wauseon	3,914	2,412	836	216	$93,335,300	$478,339,000	$571,674,300	10.03%
Hancock	74,782	$9,489,000,000	Findlay	7,578	4,854	1,787	515	$230,190,100	$1,041,613,300	$1,271,803,400	13.40%
Hardin	32,058	$3,398,000,000	Kenton	2,917	1,775	601	166	$60,016,800	$280,151,800	$340,168,600	10.01%
Henry	28,215	$3,154,000,000	Napolean	2,742	1,722	621	165	$56,832,500	$270,484,900	$327,317,400	10.38%
Huron	59,626	$6,546,000,000	Norwalk	4,834	2,897	983	260	$101,017,000	$448,546,000	$549,563,000	8.40%
Logan	45,858	$5,472,000,000	Bellefontaine	5,076	3,064	981	262	$102,276,900	$459,393,100	$561,670,000	10.26%
Lucas	441,815	$58,013,000,000	Toledo	42,442	24,769	8,211	2,341	$1,201,811,700	$5,298,319,500	$6,500,131,200	11.20%
Marion	66,501	$7,113,000,000	Marion	6,955	4,377	1,545	453	$173,421,200	$771,246,000	$944,667,200	13.28%
Mercer	40,814	$4,895,000,000	Celina	4,281	2,698	987	277	$92,836,100	$434,887,200	$527,723,300	10.78%
Miami	102,506	$13,098,000,000	Troy	10,366	5,874	1,892	520	$250,053,200	$1,242,551,000	$1,492,604,200	11.40%
Ottawa	41,428	$7,007,000,000	Port Clinton	4,914	3,343	1,259	302	$94,156,800	$405,834,600	$499,991,400	7.14%
Paulding	19,614	$2,138,000,000	Paulding	2,208	1,456	519	125	$36,283,600	$196,514,800	$232,798,400	10.89%
Preble	42,270	$4,677,000,000	Eaton	4,236	2,423	780	210	$69,693,900	$375,902,700	$445,596,600	9.53%
Putnam	34,499	$4,057,000,000	Ottawa	3,200	1,900	636	173	$60,648,600	$312,804,000	$373,452,600	9.21%
Sandusky	60,944	$7,612,000,000	Fremont	5,846	3,569	1,255	353	$152,490,600	$715,835,900	$868,326,500	11.41%
Seneca	56,745	$6,465,000,000	Tiffin	5,126	2,964	971	261	$108,406,800	$491,019,500	$599,426,300	9.27%
Shelby	49,423	$5,866,000,000	Sidney	4,302	2,599	908	255	$95,385,600	$516,262,900	$611,648,500	10.43%
Van Wert	28,744	$3,330,000,000	Van Wert	3,289	2,053	720	205	$72,727,900	$342,020,600	$414,748,500	12.45%
Williams	37,642	$4,857,000,000	Bryan	3,821	2,423	864	236	$88,186,000	$468,580,200	$556,766,200	11.46%
Wood	125,488	$16,617,000,000	Bowling Green	6,443	3,479	1,059	247	$128,857,300	$594,686,000	$723,543,300	4.35%
Wyandot	22,615	$2,604,000,000	Upper Sandusky	2,456	1,545	555	156	$55,477,600	$256,189,100	$311,666,700	11.97%

Estimate of Potential Losses to Earthquake

Region 2

County	2010 Population	Total Building Value	5.0 Magnitude Earthquake Epicenter	Slight Damage Count	Moderate Damage Count	Extensive Damage Count	Complete Damage Count	Income Loss	Property Loss	Total Building-Related Loss	Percentage of Total Building Value
Ashland	53,139	$6,014,000,000	Ashland	5,154	3,221	1,068	288	$111,583,600	$540,923,000	$652,506,600	8.99%
Butler	368,130	$43,670,000,000	Hamilton	28,806	15,846	4,955	1,355	$624,184,500	$30,870,858,000	$3,087,085,800	7.07%
Clinton	42,040	$4,691,000,000	Wilmington	3,815	2,352	812	218	$85,237,400	$386,703,200	$471,940,600	10.06%
Cuyahoga	1,280,122	$182,175,000,000	Cleveland	101,005	51,979	15,495	4,064	$2,961,934,500	$12,808,180,500	$15,770,115,000	8.66%
Delaware	174,214	$24,771,000,000	Delaware	12,994	6,787	2,090	550	$248,588,700	$1,389,884,900	$1,638,473,600	6.61%
Fairfield	146,156	$16,911,000,000	Lancaster	10,940	6,152	2,032	573	$236,586,300	$1,053,697,200	$1,290,283,500	7.63%
Fayette	29,030	$3,149,000,000	Washington CH	3,230	2,028	717	206	$71,509,100	$354,333,600	$425,842,700	13.52%
Franklin	1,163,414	$149,070,000,000	Columbus	93,203	50,401	15,713	4,262	$2,707,203,600	$11,494,786,200	$14,201,989,800	9.53%
Geauga	93,389	$12,396,000,000	Chardin	7,319	3,888	1,209	308	$133,999,300	$681,662,200	$815,661,500	6.58%
Greene	161,573	$20,143,000,000	Xenia	13,904	7,318	2,174	563	$252,201,800	$1,311,451,700	$1,563,653,500	7.76%
Hamilton	802,374	$108,968,000,000	Cincinnati	60,895	31,815	9,580	2,545	$1,818,884,300	$7,769,951,900	$9,588,836,200	8.80%
Knox	60,921	$6,994,000,000	Mt. Vernon	5,782	3,380	1,106	296	$128,390,000	$588,422,600	$716,812,600	10.25%
Lake	230,041	$29,673,000,000	Painesville	19,503	40,488	3,195	873	$405,108,700	$2,080,489,600	$2,485,598,300	8.38%
Licking	166,492	$19,664,000,000	Newark	13,236	7,701	2,530	700	$329,645,000	$1,398,438,400	$1,728,083,400	8.79%
Lorain	301,356	$39,738,000,000	Elyria	28,256	15,921	5,165	1,421	$667,101,000	$3,173,150,400	$3,840,251,400	9.66%
Madison	43,435	$4,489,000,000	London	3,278	1,910	615	164	$64,493,900	$327,032,600	$391,526,500	8.72%
Medina	172,332	$22,003,000,000	Medina	15,555	8,326	2,529	687	$306,796,500	$1,688,169,300	$1,994,965,800	9.07%
Montgomery	535,153	$68,649,000,000	Dayton	52,232	29,290	9,392	2,657	$1,405,237,800	$5,902,113,100	$7,307,350,900	10.64%
Morrow	34,827	$3,253,000,000	Mt. Gilead	3,326	2,098	714	169	$48,484,000	$237,263,900	$285,747,900	8.78%
Pickaway	55,698	$5,473,000,000	Circleville	4,635	2,856	973	263	$87,323,700	$411,002,400	$498,326,100	9.11%
Portage	161,419	$18,773,000,000	Ravenna	13,162	7,875	2,705	702	$282,285,500	$1,417,867,300	$1,700,152,800	9.06%
Richland	124,475	$14,927,000,000	Mansfield	12,608	7,699	2,680	780	$333,128,700	$1,469,984,200	$1,803,112,900	12.08%
Stark	375,586	$45,070,000,000	Canton	35,574	20,105	6,427	1,813	$935,438,900	$3,845,042,300	$4,780,481,200	10.61%
Summit	541,781	$73,277,000,000	Akron	51,673	29,334	9,502	2,738	$1,424,697,000	$6,346,478,100	$7,771,175,100	10.61%
Union	52,300	$6,356,000,000	Marysville	4,509	2,788	1,000	286	$106,640,000	$596,520,000	$703,160,000	11.06%
Warren	212,693	$26,040,000,000	Lebanon	16,959	8,628	2,513	643	$276,483,500	$1,623,221,600	$1,899,705,100	7.30%
Wayne	114,520	$12,755,000,000	Wooster	9,324	5,606	1,892	496	$207,515,400	$952,870,100	$1,160,385,500	9.10%

Estimate of Potential Losses to Earthquake											
Region 3											
County	2010 Population	Total Building Value	5.0 Magnitude Earthquake Epicenter	Slight Damage Count	Moderate Damage Count	Extensive Damage Count	Complete Damage Count	Income Loss	Property Loss	Total Building-Related Loss	Percentage of Total Building Value
Adams	28,550	$2,389,000,000	West Union	2,694	2,037	832	215	$45,890,000	$183,830,000	$229,720,000	9.62%
Ashtabula	101,497	$11,710,000,000	Jefferson	7,891	4,096	1,105	232	$113,116,000	$509,387,600	$622,503,600	5.32%
Athens	64,757	$5,911,000,000	Athens	5,249	3,798	1,451	364	$137,544,200	$593,587,700	$731,131,900	12.37%
Belmont	70,400	$7,555,000,000	St. Clairsville	661	3,770	1,179	291	$119,834,500	$507,205,900	$627,040,400	8.30%
Brown	44,846	$4,266,000,000	Georgetown	3,776	2,453	855	208	$59,778,100	$256,354,900	$316,133,000	7.41%
Carroll	28,836	$3,222,000,000	Carrollton	3,432	2,263	801	188	$55,473,600	$257,928,800	$313,402,400	9.73%
Clermont	197,363	$22,678,000,000	Batavia	16,230	9,401	3,013	762	$332,814,500	$1,678,040,300	$2,010,854,800	8.87%
Columbiana	107,841	$11,350,000,000	Lisbon	8,493	4,697	1,437	325	$118,951,900	$538,422,700	$657,374,600	5.79%
Coshocton	36,901	$3,805,000,000	Coshocton	3,958	2,716	1,028	273	$86,426,400	$374,156,000	$460,582,400	12.10%
Gallia	30,934	$2,974,000,000	Gallipolis	3,011	2,057	691	173	$70,628,000	$260,583,900	$331,211,900	11.14%
Guernsey	40,087	$4,980,000,000	Cambridge	4,655	3,261	1,261	339	$145,872,400	$542,275,200	$688,147,600	13.82%
Harrison	15,864	$1,668,000,000	Cadiz	1,869	1,214	440	115	$30,972,200	$129,899,800	$160,872,000	9.64%
Highland	43,589	$4,059,000,000	Hillsboro	4,283	2,933	1,064	246	$70,324,200	$307,422,100	$377,746,300	9.31%
Hocking	29,380	$2,898,000,000	Logan	3,186	2,355	947	244	$64,461,700	$280,080,000	$344,541,700	11.89%
Holmes	42,366	$3,854,000,000	Millersburg	3,232	2,027	712	181	$67,446,700	$308,950,100	$376,396,800	9.77%
Jackson	33,225	$2,935,000,000	Jackson	3,487	2,557	969	236	$66,671,600	$277,082,700	$343,754,300	11.71%
Jefferson	69,709	$7,521,000,000	Steubenville	7,239	4,406	1,489	414	$164,410,100	$690,997,200	$855,407,300	11.37%
Lawrence	62,450	$5,438,000,000	Ironton	5,001	3,122	1,066	281	$77,797,300	$341,092,100	$418,889,400	7.70%
Mahoning	238,823	$29,181,000,000	Youngstown	25,087	14,306	4,575	1,346	$636,105,700	$2,736,222,600	$3,372,328,300	11.56%
Meigs	23,770	$2,021,000,000	Pomeroy	2,372	1,599	568	143	$34,764,100	$144,791,900	$179,556,000	8.88%
Monroe	14,642	$1,446,000,000	Woodsfield	1,810	1,204	433	112	$24,918,700	$118,006,600	$142,925,300	9.88%
Morgan	15,054	$1,459,000,000	McConnelsville	2,033	1,550	640	162	$30,786,100	$144,818,100	$175,604,200	12.04%
Muskingum	86,074	$9,255,000,000	Zanesville	8,400	5,466	1,979	550	$230,867,000	$880,869,000	$1,111,736,000	12.01%
Noble	14,645	$1,319,000,000	Caldwell	1,468	1,014	387	105	$26,468,800	$122,858,300	$149,327,100	11.32%
Perry	36,058	$3,237,000,000	New Lexington	3,439	2,440	985	254	$54,876,500	$272,520,700	$327,397,200	10.11%
Pike	28,709	$2,641,000,000	Waverly	2,729	1,878	642	163	$64,492,500	$248,255,700	$312,748,200	11.84%
Ross	78,064	$7,574,000,000	Chillicothe	7,017	4,515	1,518	390	$170,530,000	$663,536,100	$834,066,100	11.01%
Scioto	79,499	$7,556,000,000	Portsmouth	6,809	4,231	1,371	351	$144,352,600	$592,121,000	$736,473,600	9.75%
Trumbull	210,312	$25,215,000,000	Warren	20,475	11,930	3,940	1,086	$497,402,800	$2,177,593,500	$2,674,996,300	10.61%
Tuscarawas	92,582	$10,330,000,000	New Philadelphia	9,007	5,723	2,011	527	$210,656,700	$875,000,800	$1,085,657,500	10.51%
Vinton	13,435	$1,185,000,000	McArthur	1,619	1,279	547	140	$25,479,700	$123,603,400	$149,083,100	12.58%
Washington	61,778	$6,706,000,000	Marietta	5,198	3,067	976	259	$109,787,200	$460,990,900	$570,778,100	8.51%

In Region 2, the counties with the most building-related losses are Cuyahoga County at $15,770,115,000, Franklin County at $14,201,989,800, and Hamilton County at $9,588,836,200. Relative to the total building value, the counties with the highest percentage of total building-related loss are Fayette at 13.52 percent, Richland County at 12.08 percent, and Union County at 11.06 percent.

In region 1, the counties with the most building-related losses are Lucas County at $6,500,131,200, Clark County at $1,981,800,000, and Allen County at $1,779,727,600. Relative to the total building value, the counties with the highest percentage of total building-related loss are Hancock County at 13.40 percent, Marion County at 13.28 percent, and Clark County at 12.53 percent.

In region 3, the counties with the most building-related losses are Mahoning County at $3,372,328,300, Trumbull County at $2,674,996,300, and Clermont County at Clermont. Relative to the total building value, the counties with the highest percentage of total building-related loss are Guernsey at 13.82 percent, Vinton County at 12.58 percent, and Athens County at 12.37 percent.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Method 2 of the Vulnerability Analysis and Loss Estimation above estimated the damage to each county with a scenario where a 5.0 magnitude earthquake occurred with the epicenter in each of their respective county seats. A "Percentage of Total Building Value" was determined by taking the Total Building-Related Losses and dividing it by the Total Building Value in that county. To estimate the losses for State-owned and State-leased critical facilities, the total value of State-owned and State-leased Critical Facilities of each county was multiplied by the county's respective percentage of Total Building Value.

RESULTS

In Region 1, Lucas County is estimated to have the most damage to State-owned and State-leased Critical Facilities at $30,991,663. In Region 2, Franklin County is estimated to have the most damage by far at $204,615,249. In Region 3, Ross County is estimated to have the most damage at $29,246,770.

With the method, the most prevalent variable in the estimated loss in the event of 5.0 magnitude earthquake is the existing value of these critical facilities.

Results

Estimate of Potential Losses of State-owned and State-leased Critical Facilities to a 5.0 Magnitude Earthquake Event				
Region 1				
County	Percentage of Total Building Value	Number of State-owned and State-leased Critical Facilities	Value of State-owned and State-leased Critical Facilities	Estimated Damage to State-owned and State-leased Critical Facilities
Allen	11.03%	120	$ 90,950,176.00	$ 10,033,706.35
Auglaize	7.77%	21	$ 11,545,804.00	$ 897,123.67
Champaign	12.04%	24	$ 5,161,316.00	$ 621,441.09
Clark	12.53%	17	$ 8,868,061.00	$ 1,111,409.81
Crawford	7.93%	13	$ 10,357,812.00	$ 821,213.94
Darke	9.32%	27	$ 8,619,026.00	$ 803,457.68
Defiance	12.50%	11	$ 7,562,674.00	$ 945,585.97
Erie	11.60%	54	$ 162,265,731.00	$ 18,824,781.24
Fulton	10.03%	16	$ 4,397,188.00	$ 440,855.73
Hancock	13.40%	23	$ 16,195,898.00	$ 2,170,723.80
Hardin	10.01%	12	$ 4,141,282.00	$ 414,577.43
Henry	10.38%	14	$ 3,113,844.00	$ 323,150.07
Huron	8.40%	22	$ 10,543,997.00	$ 885,210.91
Logan	10.26%	1	$ 735,568.00	$ 75,501.91
Lucas	11.20%	47	$ 276,597,391.00	$ 30,991,662.75
Marion	13.28%	100	$ 128,613,896.00	$ 17,081,024.75
Mercer	10.78%	26	$ 7,655,738.00	$ 825,354.71
Miami	11.40%	23	$ 10,005,576.00	$ 1,140,201.92
Ottawa	7.14%	75	$ 65,291,745.00	$ 4,658,956.90
Paulding	10.89%	3	$ 1,387,796.00	$ 151,111.64
Preble	9.53%	24	$ 4,859,547.00	$ 462,988.59
Putnam	9.21%	18	$ 5,590,738.00	$ 514,635.36
Sandusky	11.41%	15	$ 5,519,069.00	$ 629,578.81
Seneca	9.27%	49	$ 33,546,722.00	$ 3,110,407.96
Shelby	10.43%	35	$ 26,824,309.00	$ 2,796,973.81
Van Wert	12.45%	13	$ 7,459,562.00	$ 929,081.73
Williams	11.46%	13	$ 5,459,757.00	$ 625,861.26
Wood	4.35%	36	$ 67,981,624.00	$ 2,960,079.95
Wyandot	11.97%	19	$ 10,280,904.00	$ 1,230,497.47

Estimate of Potential Losses of State-owned and State-leased Critical Facilities to a 5.0 Magnitude Earthquake Event				
Region 2				
County	Percentage of Total Building Value	Number of State-owned and State-leased Critical Facilities	Value of State-owned and State-leased Critical Facilities	Estimated Damage to State-owned and State-leased Critical Facilities
Ashland	8.99%	143	$ 64,539,880.00	$ 5,804,972.65
Butler	7.07%	21	$ 17,563,033.00	$ 1,241,552.32
Clinton	10.06%	22	$ 11,528,821.00	$ 1,159,863.29
Cuyahoga	8.66%	84	$ 248,840,544.00	$ 21,541,067.63
Delaware	6.61%	37	$ 46,217,477.00	$ 3,057,047.19
Fairfield	7.63%	78	$ 86,519,830.00	$ 6,601,331.03
Fayette	13.52%	26	$ 5,118,182.00	$ 692,137.33
Franklin	9.53%	249	$ 2,147,726,878.00	$ 204,615,249.31
Geauga	6.58%	24	$ 8,594,197.00	$ 565,501.42
Greene	7.76%	25	$ 10,629,296.00	$ 825,127.14
Hamilton	8.80%	35	$ 173,140,806.00	$ 15,235,838.30
Knox	10.25%	34	$ 40,507,246.00	$ 4,151,573.39
Lake	8.38%	21	$ 5,525,021.00	$ 462,810.73
Licking	8.79%	64	$ 168,043,312.00	$ 14,767,740.95
Lorain	9.66%	90	$ 110,138,241.00	$ 10,643,679.46
Madison	8.72%	109	$ 321,691,881.00	$ 28,057,673.48
Medina	9.07%	22	$ 18,601,644.00	$ 1,686,571.99
Montgomery	10.64%	71	$ 77,351,496.00	$ 8,233,689.11
Morrow	8.78%	21	$ 6,874,959.00	$ 603,905.66
Pickaway	9.11%	133	$ 195,643,558.00	$ 17,813,683.77
Portage	9.06%	25	$ 7,594,529.00	$ 687,788.83
Richland	12.08%	73	$ 109,750,465.00	$ 13,257,351.06
Stark	10.61%	41	$ 102,066,812.00	$ 10,826,014.55
Summit	10.61%	67	$ 201,182,298.00	$ 21,335,792.47
Union	11.06%	53	$ 88,869,557.00	$ 9,831,579.25
Warren	7.30%	109	$ 150,201,626.00	$ 10,957,711.02
Wayne	9.10%	6	$ 7,056,104.00	$ 641,928.72

Estimate of Potential Losses of State-owned and State-leased Critical Facilities to a 5.0 Magnitude Earthquake Event				
Region 3				
County	Percentage of Total Building Value	Number of State-owned and State-leased Critical Facilities	Value of State-owned and State-leased Critical Facilities	Estimated Damage to State-owned and State-leased Critical Facilities
Adams	9.62%	24	$ 6,622,981.00	$ 636,848.55
Ashtabula	5.32%	62	$ 20,008,110.00	$ 1,063,631.13
Athens	12.37%	31	$ 45,496,640.00	$ 5,627,481.79
Belmont	8.30%	62	$ 54,856,808.00	$ 4,552,936.44
Brown	7.41%	18	$ 36,403,605.00	$ 2,697,698.28
Carroll	9.73%	17	$ 3,661,999.00	$ 356,200.89
Clermont	8.87%	38	$ 17,885,810.00	$ 1,585,932.04
Columbiana	5.79%	38	$ 13,835,662.00	$ 801,340.33
Coshocton	12.10%	19	$ 12,943,450.00	$ 1,566,760.91
Gallia	11.14%	71	$ 35,860,837.00	$ 3,993,791.51
Guernsey	13.82%	54	$ 39,704,477.00	$ 5,486,453.93
Harrison	9.64%	30	$ 9,054,441.00	$ 873,265.01
Highland	9.31%	8	$ 9,690,902.00	$ 901,872.97
Hocking	11.89%	19	$ 7,123,096.00	$ 846,861.15
Holmes	9.77%	25	$ 10,336,112.00	$ 1,009,465.36
Jackson	11.71%	18	$ 15,130,501.00	$ 1,772,120.88
Jefferson	11.37%	37	$ 7,592,901.00	$ 863,585.02
Lawrence	7.70%	27	$ 11,760,373.00	$ 905,902.09
Mahoning	11.56%	66	$ 72,389,280.00	$ 8,365,731.73
Meigs	8.88%	18	$ 8,512,106.00	$ 756,259.13
Monroe	9.88%	22	$ 11,202,381.00	$ 1,107,263.95
Morgan	12.04%	10	$ 3,700,608.00	$ 445,402.54
Muskingum	12.01%	25	$ 10,647,135.00	$ 1,278,963.08
Noble	11.32%	31	$ 50,299,353.00	$ 5,694,508.35
Perry	10.11%	16	$ 3,884,728.00	$ 392,909.81
Pike	11.84%	10	$ 3,878,547.00	$ 459,298.97
Ross	11.01%	142	$ 265,584,512.00	$ 29,246,770.29
Scioto	9.75%	55	$ 171,351,723.00	$ 16,701,432.01
Trumbull	10.61%	60	$ 55,012,652.00	$ 5,836,154.69
Tuscarawas	10.51%	53	$ 56,132,900.00	$ 5,899,429.22
Vinton	12.58%	20	$ 5,854,782.00	$ 736,581.48
Washington	8.51%	55	$ 29,149,164.00	$ 2,481,017.66

2.10 COASTAL EROSION

The 1998 Coastal Erosions Area maps defined Coastal erosion is defined as the gradual wearing away of the earth's surface by the natural forces of wind and water. The constant action of wind, waves, and ice flow has affected the coastline of Lake Erie. Primarily, the waves and gravity cause erosion. Waves undercut the land along the shore and gravity causes the land to slip into the water. As material from the bluff or bank slides into the lake, it too is eroded by waves. As this process continues, the shore moves farther landward. Many natural factors affect erosion of the lakeshore, including shore and nearshore geology, shore relief, nearshore bathymetry, beaches, shoreline orientation, lake level fluctuations (long-term, annual, and storm surges), and climate changes (storm frequency, temperature, and precipitation).

The History of Lake Erie by Michael C. Hansen notes Lake Erie owes its fundamental existence to the presence of a basin or lowland that originated long before the Pleistocene Ice Age began 2 million years ago. This lowland was known as the valley of an east-flowing river, known as the Erigan River. This geology in the basin included Silurian and Devonian carbonates (limestone and dolomite) on the west and by Devonian shales on the east. Glacial ice was able to erode the less resistant shales (than the more resistant carbonate rocks) to a greater extent in the central basin and eastern basins. The first of the four major glacial advances during the Pleistocene obliterated this drainage system, and deepened and enlarged the basin. Succeeding glaciations further deepened and enlarged it. Lake Erie, the southernmost of the Great Lakes, is also the shallowest because the ice was relatively thin (therefore lacking significant erosive power) when it reached so far south. During the advancement of the glaciers, they eroded rock and soil and carried them with the flowing ice to the glacier edge where they were deposited as till released from melting ice. Laminated silt and clay were also deposited in proglacial lakes that formed along the margin of the glacier. These geologic materials are exposed in Lake Erie's bluffs and banks. Upon final retreat of the glacier moving out of Ohio, the water started to discharge via the Niagara River. Glacial rebound raised the Niagara outlet and increased the water level in the Lake Erie basin. Due to a rapid glacial rebound in the upper Great Lakes, these lakes began to drain through the Lake Erie Basin 6. There has been a continued slow rise following the rapid rise that has brought Lake Erie to its current mean level of 571 feet above sea level.

Per the Geologic Setting and Processes Along Lake Erie From Fairport Harbor to Marblehead, the geologic settings vary throughout the length of Ohio's coast. From the Ohio- Pennsylvania border to Huron, Ohio, moderate to high relief shore consists of bluffs and slopes composed of glaciolacustrine sands, silts, clay, till, and/or shale. From Huron around Sandusky Bay to Marblehead peninsula, the shore is a low relief plain composed of glaciolacustrine sediments and till, with shale exposed west of Huron and limestone exposed around Marblehead peninsula. At Sandusky Bay, two barrier beach complexes extend across the bay mouth. Around Marblehead Peninsula and Catawba Island, low to moderate banks/bluffs are composed of rock and till. West of Catawba Island, the landscape consists of low-relief lake plain and coastal wetlands (remnants of the Black Swamp). Nearshore slopes are generally gentle and are composed of the same materials in bluff or bank. Beaches are typically narrow (<50 feet per 15 meters wide) to non-existent along much of the shore. Manmade features have affected the longshore transport of sand trapping sand on the updrift side at harbor jetties, power plant intakes, and long groins. Shore parallel structures have altered sand transport as well.

Climate affects overall physical setting in the nearshore, beach, and shore zones. Long-term and annual fluctuations in lake level are due to changes in the volume of the lake resulting from changes in precipitation in the Great Lakes Basin. Short-term fluctuations are due to wind-driven storm surges, changes in barometric pressure, or inertial surges of water (seiches) that occur after lake level has been set up by either of the two previous agents. The greatest storm surges occur when the wind blows parallel to the long axis of the lake. Under extreme conditions, lake level at the confined ends of the lake may rise or fall more than six feet from pre-storm levels. Passage of storm systems through the Great Lakes can cause lake levels at the ends of the lake to fluctuate 10 to 11 feet over a period of several days. The most important storm surges along the western part of the Central Basin and all of the Western Basin are those generated by northeast winds because these storm surges are accompanied by large storm waves.

The size of wind-generated waves depends upon wind speed and duration, open-water fetch distance, and water depth. The largest waves affecting the Ohio lakeshore are those generated by storm winds from the west through the northeast. Wave energy is highest from late fall through spring; however, lake level is at its lowest and shorefast ice typically forms a barrier between the waves and erodible shore material. Most wave erosion occurs during storms in early spring when the greatest amount of wave energy is expended on the shore. The largest waves to strike the shore are generated by onshore storms winds from the west to the northeast. Wave erosion causes undercutting of the bluff or bank, mass wasting including block falls, rotational slumps, and debris flows, and lakebed down cutting of cohesive materials. Bedrock is not as easily eroded as the cohesive glacial sediments. Although erosion of the bluff is necessary to sustain beaches, excessive erosion of the Lake Erie shoreline can be considered a hazard exposure.

Coastal Erosion Area

A Coastal Erosion Area (CEA) is a designated area of land adjacent to Lake Erie that is anticipated to be lost to erosion in 30 years unless preventive measures are taken. Coastal erosion is measured by determining how far landward the bluff, bank, or dune has receded over time. The landward shift of the bluff, bank, or dune is called recession.

Coastal erosion area designations are a component of the Ohio Coastal Management Law passed by the Ohio Legislature in 1988 in response to the serious hazards and substantial economic losses caused by coastal erosion. The laws and rules that define the Coastal Erosion Area program are found in Ohio Revised Code Section 1506 and Ohio Administrative Code Section 1501-6. The objective of the CEA program is to identify the hazards and mitigate the economic losses of erosion-related damage.

The Ohio Department of Natural Resources (ODNR) developed standards for designating coastal erosion areas with input from geologists, engineers, local officials and landowners. CEAs are depicted on maps that are produced by ODNR. To develop coastal erosion maps, rates of recession are calculated using analytical tools, including aerial imagery and LiDAR, mathematical calculations and field visits to verify observations. The amount of recession that is calculated is used to project recession rates for a 30-year period; areas that are projected to erode greater than a given threshold amount are designated as CEAs and shown on coastal erosion maps. The maps include data tables that show the amount of recession calculated at regular 100-foot intervals along all of Ohio's Lake Erie coast, including the bays and islands.

ODNR has mapped Ohio's Lake Erie coast to identify coastal erosion areas since 1988. Maps showing the first CEA designations were finalized in 1998 and were based on the amount of recession that occurred between 1973 and 1990. Since then, ODNR has updated CEA designations in accordance with the laws and rules that define the CEA program. In 2010, ODNR released maps based on the amount of recession that occurred between 1990 and 2004. The 1998 and 2010 CEA maps now serve only as historical records.

In January 2019, ODNR released the 2018 CEA maps, which depict the most current CEA designations based on the amount of recession that occurred between 2004 and 2015. ODNR uses these maps to determine if a property is currently located within a CEA. All sets of CEA maps are available to view online at https://gis.ohiodnr.gov/MapViewer/?config=cea.

Property along Ohio's Lake Erie coast that is located within a designated CEA is subject to CEA program requirements, which address property sales and transfers and construction. Landowners selling or transferring property within a designated CEA must disclose that status on the Residential Property Disclosure Form, which is required with all residential real property transactions in Ohio. Construction within a CEA may require a CEA Permit, depending on the type and location of a structure. A permit is required to construct a new building or add 500 square feet or more (as measured at ground level) to an existing structure. This applies to residential, commercial, industrial, institutional and agricultural buildings, and septic systems. CEA Permits are issued by ODNR through the Office of Coastal Management.

RISK ASSESSMENT

LOCATION AND SELECT HISTORICAL OCCURRENCE

Lake Erie comprises 312 miles of the northern coast of Ohio bordering Lucas, Ottawa, Sandusky (Sandusky Bay), Erie, Lorain, Cuyahoga, Lake, and Ashtabula Counties. Lake Erie, the 12th largest (area) lake in the world, is about 210 miles long, 57 miles wide, and has a shoreline length of 871 miles (including the islands). With the exclusion of government-owned park and reserve areas, the coast is highly prized for commercial and residential development. In many cases, human activity has disrupted the natural function of beach formation and aquatic habitats. According to the Ohio Geological Survey, 95 percent of Ohio's Lake Erie shoreline is eroding.

Unlike many of the other hazards affecting Ohio, Lake Erie is consistently undergoing coastal erosion. Although particular storms or development creates periods of increased occurrence, the shore is eroding slowly every day. To monitor erosion, the net landward movement of the shore over a specific time is calculated. The position of characteristic shore features such as bluff lines can be determined from maps and aerial photographs. By analyzing the position of these features (recession lines) through time, the amount of recession can be determined and rates of recession can be calculated. Long-term and short-term recession data have been developed for each county (see table 2.10.a).

Table 2.10.a – Ohio Lake Erie Erosion Statistics by County from 2004 to 2015

County	Distance	Feet/year
Ashtabula	2.8	0.26
Lake	5.4	0.49
Cuyahoga	0.8	0.07
Lorain	0.3	0.02
Erie (lake)	0.3	0.03
Ottawa (lake)	0.5	0.04
Lucas	0.2	0.01
Erie (bay)	0.6	0.05
Ottawa (bay)	9.1	0.54

During 1929-30, the mid-1940s, 1952, the fall of 1972, the spring of 1973, and 1985, 1998 and 2012 storms and high lake levels caused property damage along the low-lying areas, such as low glacial till bluffs, low glaciolacustrine banks, and barrier beaches and eroded high glacial till or glaciolacustrine bluffs inducing mass wasting in Erie, Lake, Cuyahoga, and Ashtabula counties. The short-term and long-term rates indicate that the low-lying areas have been extremely affected.

LHMP DATA

All of the LHMPs for the counties that border Lake Erie (Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, and Sandusky), indicate that coastal erosion is a recognized hazard and ranked them either fourth or fifth for their county. Almost all of the plans reference the same data (Figure 2.10.a) provided by the Ohio Geological Survey. Erie County's LHMP indicated that they had completed a structural inventory in the late 1990's; but those data were not available to them at the time of writing their plan.

Ashtabula County. The HIRA of the Ashtabula County Countywide All Natural Hazards Mitigation Plan of August 2012 describes that 28 miles of Lake Erie coastline form the northern border of the County. The HIRA also explains that factors such as high lake levels, long shore currents, high winds, water runoff over cliffs, bluff recession and seasonal fluctuations are driving forces that lead to coastal erosion. The risk is classified as a Moderate Probability and Moderate Impact. The plan's vulnerability analysis determined 2,619 structures would be affected with a loss estimate of $78,295,582.

Lake County. As part of the Lake County Planning Commission's coastal management plan, breakwalls have been constructed in Mentor and North Perry. Further, individual jurisdictions have been compiling agreements with appropriate contractors, state agencies, and local partners to ensure that response measures (such as shoring up structures and filling in eroded areas) can be implemented quickly. These jurisdictions include Fairport Harbor, Painesville Township, and North Perry. While coastal erosion is likely to remain a hazard for the foreseeable future (due to the county's proximity to Lake Erie), potential losses have been lessened since previous adoptions of this plan.

Erie County. Factors that cause shoreline erosion include bluff recession, high lake levels, high winds and human activities. These cause many problems to the coastal communities of Bay View, Sandusky, Huron, Vermilion and Kelley's Island. Manmade shoreline structures that lie within a designated CEA along Lake Erie's coastline are susceptible to property damage over a 30-year period. Because of the large number of residential properties located within a CEA along the shoreline, property damages are expected to be high.

Based on the property damage expected from stream bank and lake erosion, the impact on the local economy and local government expenditures is considered to be high. Manmade shoreline structures built along the Lake Erie shoreline, trap sand supply, causing beachless shores. Lack of beaches may have an adverse effect upon tourism in Erie County. County roadways may be affected and in need of repair, but this repair does not typically have an adverse effect on the economy, as motorists will find an alternate route.

Lucas County. According to the Lucas County Countywide All Natural Hazards Mitigation Plan of March 2013, lake surges (also referred to as storm surges) are associated with extreme weather events and are responsible for coastal flooding and erosion along Lake Erie within Lucas County. The storms that generate the large waves of lake surges can develop year-round, however within Lucas County, these events have typically occurred in the early spring and late fall months. Storm surges inundate coastal floodplains, the rise in water levels in inland bays and harbors, and backwater flooding through river mouths. Coastal erosion is generally associated with storm surges, windstorms, and flooding hazards, and may be exacerbated by human activities such as boat wakes, shoreline hardening, and dredging. Conversely, actions to supplement natural coastal processes, such as beach nourishment, dune stabilization, and construction of shore protection structures can greatly modify and reduce erosion trends within an area.

Ottawa County. Within Ottawa County, the risk for coastal erosion varies by jurisdiction. The lakeshore jurisdictions in the western portion of the county have a higher coastal erosion risk than those to the east. The coastal areas in Carroll, Erie, and Bay Township are primarily beach and marsh areas with low elevations. Structures in these coastal areas are primarily residential, and include a large percentage of summer homes and seasonal cottages. Some of these areas are protected by break walls that reduce the impact of waves as they wash onshore.

The eastern municipalities of Marblehead, Port Clinton and Put-In-Bay and Catawba Island, Danbury, Portage, and Put-In-Bay Townships are susceptible to coastal erosion but, given their high elevation and rocky surface and sub-surface, erosion is less likely to impact structures than in other areas of the county. The high cliffs and rock ledges protect the homes, businesses, and infrastructure along the lakeshore from wind and water damage. In the city of Port Clinton, the highway and homes are several hundred feet from the coastline and not significantly susceptible to coastal erosion damage. While the county is significantly lakefront, there is not a large amount of beach across the shoreline. A large percentage of the coastal area is either marsh and wetland, or rocky ledge.

SHARPP. See Section 4.3 for an analysis of coastal erosion data in local hazard mitigation plans.

Coastal Barrier Resourse System

The Coastal Barrier Resources Act (CBRA) of 1982 and subsequent amendments established the John H. Chafee Coastal Barrier Resources System (CBRS). The CBRS consists of relatively undeveloped coastal barriers and other areas located the Atlantic, Gulf of Mexico, Great Lakes, U.S. Virgin Islands, and Puerto Rico coasts. The CBRS currently includes 585 System Units, which comprise nearly 1.4 million acres of land and associated aquatic habitat. There are also 277 "Otherwise Protected Areas," a category of coastal barriers that are mostly already held for conservation and/or recreation purposes that include an additional 2.1 million acres of land and associated aquatic habitat. The CBRS units are identified and depicted on a series of maps entitled “John H. Chafee Coastal Barrier Resources System.” These maps are controlling and indicate which lands are affected by the CBRA. The maps are maintained by the Department of the Interior through the U.S. Fish and Wildlife Service and can be viewed at: https://www.fws.gov/cbra/Maps/Mapper.html.The Coastal Barrier Resources Act and its amendments prohibit most new federal expenditures that tend to encourage development or modification of coastal barriers. The laws do not restrict activities carried out with private or other non-federal funds and only apply to the areas that are within the defined CBRS. The main prohibition affecting property owners is the prohibition on federal flood insurance.

Examples of prohibited federal assistance within System units include subsidies for road construction, channel dredging, and other coastal engineering projects. Federal flood insurance through the National Flood Insurance Program is available in a CBRS unit if the subject building was constructed (or permitted and under construction) before the CBRS unit's effective date. If an existing insured structure is substantially improved or damaged, the federal flood insurance policy will not be renewed.

PROBABILITY OF FUTURE EVENTS

With shore structures increasing along the coastline, the shoreline becomes increasingly modified. Reports and studies suggest that wave erosion and mass wasting caused by Lake Erie will continue to erode the Ohio shore for the foreseeable future. Damage to the built environment is inevitable without intervention and will warrant the full understanding of coastal processes within each stretch to rehabilitate the shoreline.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Previous versions of this plan indicated that coastal erosion had limited potential to affect any state-owned structures or critical facilities. All state facilities near the Lake Erie Coast were evaluated for their proximity to coastal erosion areas using the DAS data within a GIS. No state-owned or state-leased facilities were located in the coastal erosion areas, which represents no change since the last plan update.

2.11 DROUGHT

Drought is a normal, recurrent feature of climate that originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector. Within the State of Ohio, drought is equally as possible to occur in one section of the state as it is in another. The effects of drought within the state vary though, based on land use (agricultural production as opposed to urban areas), economy (dependence on drought-impacted business such as farming), geology (presence of an aquifer or ground structure that limits well production), and water source (public water supply, private well, or cistern).

There are four primary types of drought: agricultural, hydrological, meteorological, and socioeconomic. The State of Ohio is most often affected by agricultural and hydrological types of drought, and is often affected by both simultaneously. Below, these two types of drought are described in more detail.

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

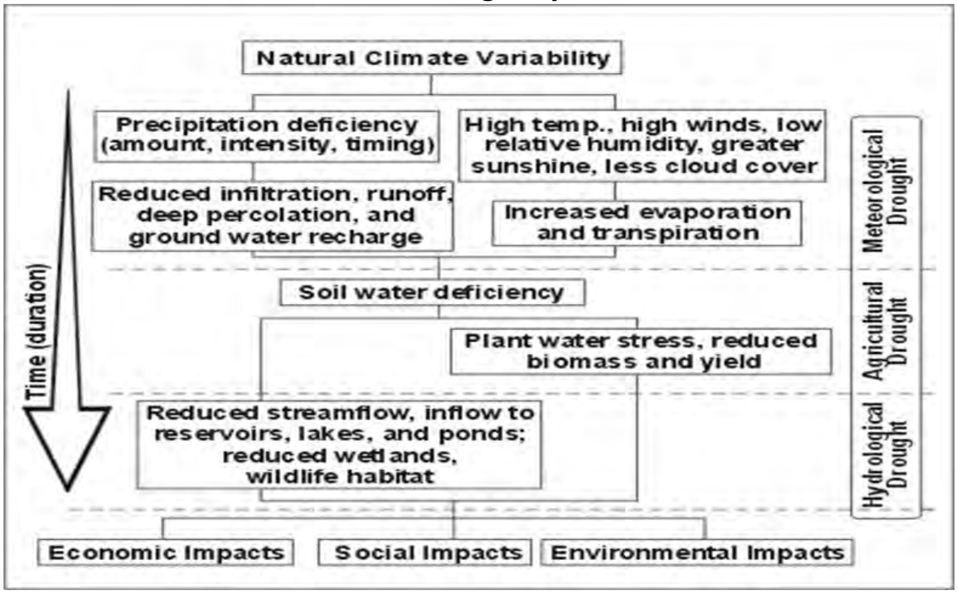
Hydrological Drought— Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on the surface or subsurface water supply – stream flow, reservoir, and lake levels and groundwater. The frequency and severity of hydrological drought are often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system.

Water in hydrologic storage systems (e.g., reservoirs, rivers) is often used for multiple and competing purposes (e.g., flood control, irrigation, recreation, navigation, hydropower, or wildlife habitat), further complicating the sequence and quantification of impacts. Competition for water in these storage systems escalates during drought and conflicts between water users increase significantly.

Although the climate is a primary contributor to hydrological drought, there are other factors such as changes in land use, deforestation, land degradation, and the construction of dams, which can all affect the hydrological characteristics of a basin. Because regions are interconnected by hydrologic systems, the impact of meteorological drought may extend well beyond the borders of the precipitation- deficient area.

The flow chart below illustrates the progression of drought and the relationship between meteorological, agricultural, and hydrological drought. Economic, social, and environmental impacts are shown at the bottom of the chart, independent of the time scale, indicating that such impacts can occur at any stage during a drought.

Figure 2.11.a
The Drought Cycle



Source: Source: National Drought Mitigation Center, University of Nebraska-Lincoln, U.S.A.
http://www.drought.unl.edu/droughtbasics/typesofdrought.aspx

MEASURING DROUGHT

The Palmer Drought Severity Index (PDSI) is a soil moisture algorithm. The PDSI was developed by W.C. Palmer in 1965. Many U.S. government agencies and states rely on the PDSI to trigger drought relief programs and responses. Most of the agency-based actions within the Ohio Emergency Operation Plan's Drought Incident Annex are triggered by the PDSI.

Figure 2.11.b

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

The PDSI is based on the supply-and-demand concept of the water balance equation, taking into account more than just the precipitation deficit at specific locations. The objective of the PDSI is to provide standardized measurements of moisture conditions, so that comparisons using the index can be made between locations and between time periods (usually months). The PDSI is calculated based on precipitation and temperature data, as well as the local Available Water Content of the soil. The Palmer Index is designed so that a -4.0 in South Carolina has the same meaning in terms of the moisture departure from a climatological normal as a -4.0 does in Ohio.

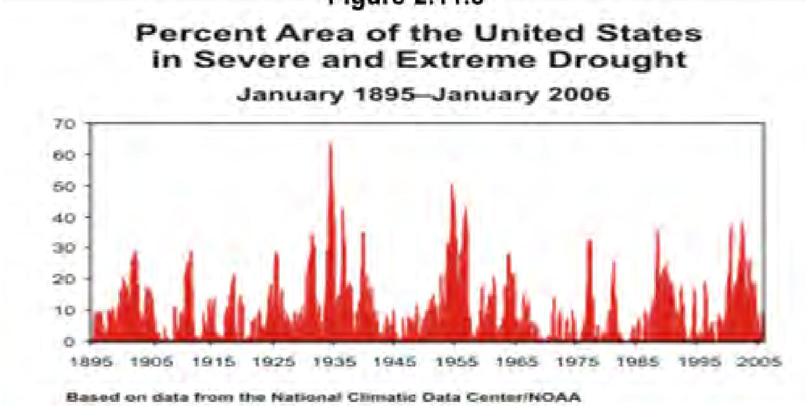
The Palmer Index is typically calculated on a monthly basis, and a long-term archive of the monthly PDSI values for every climate division in the United States exists with the National Climatic Data Center from 1895 through the present. Weekly Palmer Index values are calculated for climate divisions (the State of Ohio has ten climate divisions) during every growing season.

RISK ASSESSMENT

LOCATION

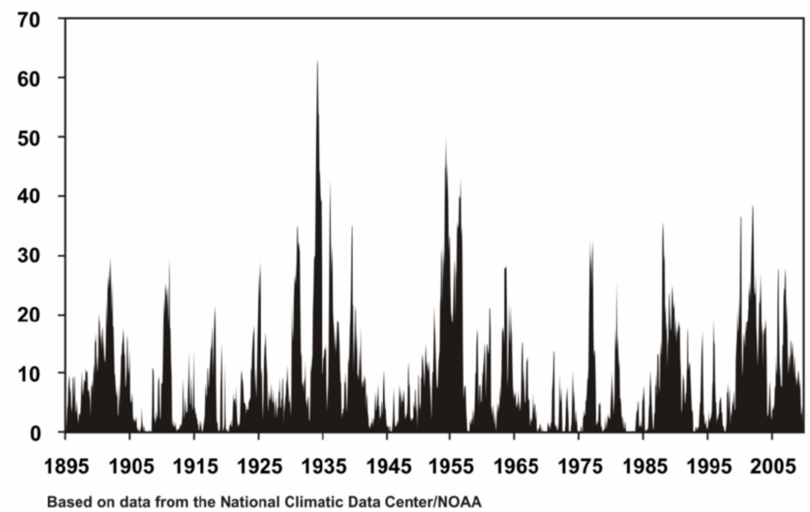
The National Drought Mitigation Center (NDMC) has calculated values showing the spatial extent of drought based on historical Palmer Drought Severity Index (PDSI) data. The annual average of 18.1% was calculated by selecting the month of each year from 1895 to 1995 with the greatest spatial extent of severe or extreme drought and averaging the values. Using PDSI data, the NDMC created data indicating the percent of time each climate division in the United States was in severe or extreme drought, from 1896–1994. The data show the spatial extent of drought for various time periods.

Figure 2.11.c



The worst recent drought event occurred in July 1988, with 36% of the country in severe or extreme drought. The worst drought event ever recorded occurred in July 1934, with 65% of the United States experiencing severe to extreme drought.

Percent Area of the United States in Severe and Extreme Drought
January 1895 – May 2010



Source: Quantification of Agricultural Drought for Effective Drought Mitigation and Preparedness: Key Issues and Challenges
https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1081&context=droughtfacpub

LHMP DATA

Hamilton County

The Hamilton County 2018 Hazard Mitigation Plan states that while the hazard is considered "Not Probable/Not Frequent", there are some areas in the county that may have special vulnerabilities for the hazard. In Crosby Township, there are four major farms that are vulnerable to drought. Similarly, a drought would greatly impact the township with its large agricultural economy in Whitewater Township.

Richland County

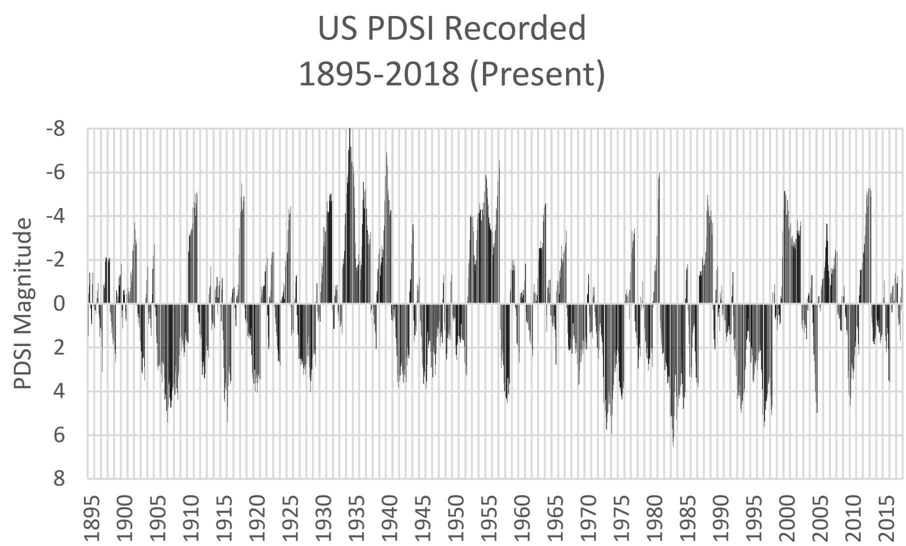
According to the Richland County 2017 Hazard Mitigation Plan, Agriculture is a major contributor to Richland County's economy. The county's 160,000 acres of farmland account for 40% of all land use in the county. Corn, soybeans, and wheat are the most prevalent crops. While Richland County rarely experiences drought conditions, the County's greatest vulnerability to drought is a reduction in crop yields.

Shelby County

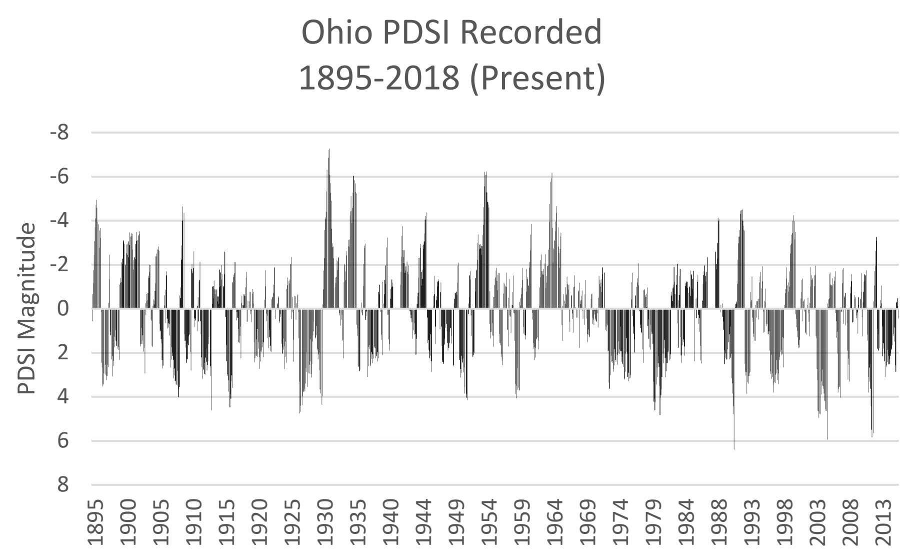
The Shelby County 2017 Hazard Mitigation Plan states Shelby County has a low risk of incurring damage from droughts and extreme heat. By itself, a drought does not damage developed property. However, over a long period of time, certain soils can expand and contract resulting in some structural damage to buildings. A small percentage of buildings in areas with such soils suffer minor damage during their "useful lives." Therefore, the overall impact on the County's infrastructure will be very low. When droughts do occur, the economic losses will be countywide affecting the farming community the most.

PAST OCCURRENCES

The NOAA National Climatic Data Center has calculated values showing the spatial extent of drought based on historical Palmer Drought Severity Index (PDSI) data. The period of record is from 1895 through the latest month (February 2018). Data was derived from area-weighted averages from interpolated estimates across the United States. Table 2.11.a tabulates the PDSI in Ohio since from January 1985 to February 2018 by month.



Source: Monthly Palmer Drought Severity Index for States and Climate Divisions; NOAA National Climatic Data Center
https://www.drought.gov/drought/data/noaa-national-climatic-data-center/monthly-palmer-drought-severity-index-states-and-climate



Source: Monthly Palmer Drought Severity Index for States and Climate Divisions; NOAA National Climatic Data Center
https://www.drought.gov/drought/data/noaa-national-climatic-data-center/monthly-palmer-drought-severity-index-states-and-climate

Table 2.11.a: Ohio PDSI Recorded by Month, January 1985 to February 2018

Year	January	February	March	April	May	June	July	August	September	October	November	December
1895	0.57	-0.65	-1.16	-1.76	-2.45	-3.07	-3.7	-4.1	-4.72	-4.95	-4.58	-3.94
1896	-3.83	-3.55	-2.76	-3.22	-3.65	0.16	2.45	2.68	3.54	3.41	3.45	2.94
1897	2.55	3	3.26	3.04	3.06	2.54	2.65	-0.26	-1.34	-2.44	1.06	1.21
1898	2.29	2.16	3.08	2.6	2.37	1.74	1.28	1.46	0.97	1.47	1.69	1.81
1899	1.87	1.73	2.32	-1.1	-1.18	-1.4	-1.21	-2.11	-2.03	-2.27	-3.03	-3.1
1900	-2.96	-2.01	-1.98	-2.52	-2.91	-2.96	-2.45	-2.35	-3.05	-3.47	-2.9	-3.28
1901	-3.29	-3.44	-3.4	-2.69	-2.21	-1.77	-2.33	-2.34	-2.26	-2.92	-3.48	-3.09
1902	-3.11	-3.35	-3.3	-3.41	-3.53	1.62	1.71	0.87	1.61	1.45	1.21	1.95
1903	1.78	2.94	-0.25	0.29	-0.67	-0.34	-0.38	-0.71	-1.5	-1.4	-1.68	-2
1904	0.5	0.55	1.68	1.75	-0.14	-0.43	-0.19	-0.36	-0.81	-1.16	-2.37	-2.5
1905	-2.69	-2.68	-2.83	-2.64	0.7	1.02	0.97	1.38	1.57	2.33	2.72	2.59
1906	-0.15	-0.62	0.65	-0.86	-1.52	-1.71	0.45	0.9	0.66	0.85	0.7	1.22
1907	2.67	1.75	2.31	2.15	2	2.32	3.16	2.72	3.03	3.27	3.3	3.45
1908	2.82	3.49	4.01	3.66	3.55	-0.6	-0.48	-0.96	-2.23	-2.87	-4	-4.64
1909	-4.35	1.46	1.16	1.46	1.78	2.45	2.3	2.29	1.59	1.66	1.26	1.18
1910	1.96	2.8	-1.8	-2.03	-1.61	-1.71	-1.84	-2.6	0.45	0.83	0.53	0.43
1911	1.02	-0.13	-0.52	0.58	-1.24	-1.29	-2.13	0.57	1.16	2.21	2.64	3.19
1912	2.76	2.46	2.96	3	2.22	1.81	2.42	2.8	2.56	2.38	1.61	1.28
1913	3.07	2.61	4.61	-0.02	-0.2	-1.01	-0.48	-1.02	-1.27	-0.89	-0.66	-0.88
1914	-0.87	-0.34	-0.56	-0.21	-0.56	-0.97	-1.77	-1.04	-1.64	-1.33	-2	-1.58
1915	-0.99	-1.02	-1.57	-2.59	-0.02	0.38	1.64	2.39	2.98	3.06	3.25	3.76
1916	4.48	3.87	4.09	3.28	3.03	3.59	-1.2	-1.44	-1.54	-1.62	-2.12	-2.11
1917	0.54	0.15	0.4	0.42	0.91	1.52	1.55	1.24	0.81	2.25	-0.27	-0.58
1918	-0.18	-0.13	-0.65	-0.6	-0.59	-0.97	-1.41	-1.67	0.6	0.6	-0.35	-0.04
1919	-0.34	-0.76	0.25	0.08	0.61	-0.68	-0.91	-0.23	-0.77	1.53	2.43	2.25
1920	2.14	1.39	0.92	2.19	1.51	1.82	2.19	2.73	2.4	1.93	1.98	1.89
1921	1.75	1.52	2.2	-0.02	-0.41	-1.02	-1.75	0.23	0.57	0.32	1.34	1.8
1922	1.3	0.96	1.68	1.94	1.96	-0.42	-0.51	-0.54	-0.72	-1.1	-1.9	-1.85

Table 2.11.a: Ohio PDSI Recorded by Month, January 1985 to February 2018 (Continued)

Year	January	February	March	April	May	June	July	August	September	October	November	December
1923	0.46	-0.05	-0.02	-0.25	-0.19	-0.49	-0.56	0.56	0.64	0.37	0.24	1.6
1924	2.03	1.74	1.86	1.35	1.7	2.73	2.2	1.49	2.46	-0.91	-1.41	-1.07
1925	-1.25	-1.14	-1.33	-2.01	-2.02	-2.34	0.46	-0.53	0.17	1.43	2.42	-0.58
1926	-0.56	0.51	-0.25	-0.03	-0.62	-0.65	0.16	1.33	3.31	4.76	4.69	4.41
1927	4.38	3.98	3.73	3.8	3.79	3.63	3.74	3.4	2.71	1.99	2.9	3.55
1928	2.92	2.95	2.54	2.38	1.38	2.97	3.13	2.53	1.5	1.22	1.03	0.6
1929	1.35	1.31	0.78	1.2	1.89	1.81	2.29	2.08	1.99	2.79	3.67	3.86
1930	4.36	3.99	-0.19	-0.88	-1.74	-2.3	-3.56	-4.07	-4.15	-4.4	-5.33	-6.31
1931	-6.86	-7.21	-7.28	-6.09	-5.7	-5.27	-4.91	-3.64	-2.97	-2.79	-2.83	-2.3
1932	-0.97	-1.41	-1.17	-1.46	-2.23	-2.15	-1.76	-2.34	-2.32	0.2	0.3	0.77
1933	0.49	0.28	1.45	1.43	2.25	-1.21	-2.02	-1.98	-1.28	-1.69	-2.42	-2.62
1934	-2.84	-3.11	-2.81	-3.15	-4.24	-4.42	-5.11	-4.46	-3.89	-4.59	-5.27	-6.04
1935	-5.84	-5.69	-5.3	-5.24	0.73	0.9	1.24	2.64	2.63	2.6	2.84	2.78
1936	-0.28	0.17	0.28	0.31	-1.04	-2.04	-2.77	-2.87	-2.95	0.51	0.35	0.13
1937	3.1	2.62	1.75	1.83	1.66	2.55	2.62	2.28	1.98	2.47	2.06	2.27
1938	1.71	1.78	2.26	1.8	2.13	2.17	2.4	1.97	2.26	-0.76	-0.66	-1.09
1939	0.14	1.18	1.43	2.11	-1.22	-0.24	-0.03	-0.66	-1.3	-1.13	-1.97	-2.78
1940	-3.23	0.28	0.28	1.39	1.61	1.9	-0.9	-0.46	-0.97	-1.32	-1.18	-1.01
1941	-1.08	-1.68	-2.36	-3.3	-3.76	-2.67	-2.35	-2.07	-2.66	-1.63	-1.73	-1.92
1942	-2.14	-1.68	-1.57	-1.96	-0.02	0.08	0.12	0.28	0.44	0.27	0.61	1.36
1943	0.98	0.65	1.17	1.15	2.09	1.37	2.08	-0.2	-0.56	-0.73	-1.41	-2.32
1944	-2.94	-2.76	-1.67	-1.05	-1.35	-1.78	-2.91	-2.72	-3.06	-3.42	-4.05	-4.21
1945	-4.36	0.41	1.56	1.42	1.86	2.26	1.93	1.16	2.14	2.39	2.88	-0.01
1946	-0.58	-0.1	-0.65	-1.49	0.81	1.61	-0.38	-0.55	-1.23	-1	-1.25	-1.34
1947	0.93	-0.75	-1.2	0.82	1.68	2.42	2.34	2.5	2.42	1.63	1.36	0.87
1948	0.7	1.03	1.55	1.9	1.78	1.79	1.55	1.04	0.89	0.89	1.25	1.58
1949	2.62	2.56	-0.23	-0.45	-0.73	-0.72	-0.65	-0.78	-0.62	-1.18	-1.96	-2.08
1950	2.32	3.12	2.74	2.92	2.15	2.29	2.44	2.26	2.9	2.66	3.86	3.56
1951	3.87	4.04	4.16	0.01	-0.24	0.25	-0.52	-1.52	-1.32	-1.72	0.3	1.24
1952	2.18	1.97	2.11	2.01	-0.05	-0.78	-1.39	-1.77	-1.73	-2.22	-2.98	-3.38
1953	-2.71	-2.91	-2.93	-2.73	-2.45	-2.86	-2.84	-3.35	-3.82	-4.62	-5.56	-6.22
1954	-6.08	-6.23	-5.29	-4.86	-4.85	-4.73	-4.6	0.71	-0.8	1.35	1.04	1.05
1955	0.65	1.22	1.73	-0.54	-1.08	-1.37	-1.43	-1.74	-1.86	-1.27	-0.85	-1.55
1956	-1.62	1.15	1.56	1.65	2.19	2.07	2.37	2.56	-0.04	-0.68	-1.18	-1.11
1957	-1.04	-0.99	-1.63	0.94	0.97	1.72	-0.5	-1.36	0.31	0.34	0.36	1.1
1958	-0.18	-0.76	-1.5	0.19	0.21	1.47	3.41	3.88	4.07	3.51	3.68	2.7
1959	3.59	3.71	-0.31	-0.15	-0.48	-0.95	-0.66	-1.3	-1.85	0.83	1.13	1.18
1960	1.21	1.39	-0.77	-1.81	-1.43	-1.34	-1.04	-1.06	-1.87	-2.12	-2.65	-3.37
1961	-3.85	0.18	0.5	1.81	1.57	1.75	2.34	2.23	1.78	1.4	1.35	1.31
1962	1.46	1.85	-0.14	-0.96	-1.43	-2.2	-1.71	-2.46	-1.71	-1.56	-1.55	-1.8
1963	-2.06	-2.47	-0.93	-1.18	-1.49	-1.94	-1.93	-1.96	-2.68	-3.94	-4.74	-5.76
1964	-5.94	-6.17	-3.67	-2.09	-2.73	-2.7	-3.1	-3.08	-3.52	-3.96	-4.66	-4.35
1965	-3.7	-2.83	-2.53	-1.85	-2.72	-3.28	-3.45	0	0.74	1.47	-0.14	-0.66
1966	-0.36	-0.22	-0.98	-0.63	-0.67	-1.45	-1.14	-1.06	-0.88	-1.1	0.6	1.04
1967	-0.61	-0.6	0.47	0.22	1.09	-0.97	-1.01	-1.51	0.01	-0.08	0.04	0.41
1968	0.41	-0.79	-0.83	-1.18	1.79	-0.22	-0.37	-0.4	-0.59	-0.83	0.1	0.46
1969	0.72	-0.66	-1.29	0.02	0	0.45	1.51	1.16	1.17	0.95	1.26	1.3
1970	-0.45	-0.66	-0.68	0.69	0.41	0.49	0.74	0.11	0.26	0.53	0.45	0.58
1971	0.2	0.86	-0.5	-1.49	-1.11	-1.31	-1	-1.18	-0.75	-1.36	-1.88	-1.57
1972	-1.64	-1.63	0.03	0.96	0.82	1.01	0.69	0.76	1.93	1.9	3.36	3.63

Table 2.11.a: Ohio PDSI Recorded by Month, January 1985 to February 2018 (Continued)

Year	January	February	March	April	May	June	July	August	September	October	November	December
1973	3.03	2.41	2.15	2.37	2.45	2.75	2.87	2.57	1.83	1.98	2.33	2.42
1974	2.54	2.1	2	1.48	1.85	2.05	0.81	1.93	2.41	1.94	2.18	2.5
1975	2.65	3.17	3.22	2.86	2.03	1.96	1.34	2.05	3.09	3.29	2.91	3.17
1976	3.14	3.01	-0.43	-1.21	-1.63	0.35	0.82	1.14	1.39	1.99	-0.14	-0.6
1977	-0.99	-1.39	-1.19	-1.07	-2.07	0	0.12	0.73	0.89	1.12	1.07	1.84
1978	2.46	-0.85	-0.89	-0.85	-0.63	-0.54	-0.68	-0.08	-0.96	0.79	0.48	1.36
1979	1.76	1.86	0.73	1.05	1.15	1.1	1.61	3.31	4.22	4.08	4.61	4.25
1980	3.45	2.67	3.09	2.47	2.16	2.65	3.5	4.83	4.04	3.93	3.67	3.1
1981	2.04	2.47	1.43	1.8	2.24	3.11	2.84	2.22	2.47	2.45	1.97	1.91
1982	2.36	2.06	2.28	-0.6	-0.76	-0.35	-0.91	-0.96	-1.09	-1.89	-1.22	-0.67
1983	-1.1	-1.53	-2.04	0.67	1.77	-0.36	-0.63	-1.49	-1.81	1.3	2.12	2.46
1984	1.65	1.4	1.53	1.72	2.13	-1.04	-1.17	-1.19	-1.25	-1.23	-0.94	-0.73
1985	-1.01	-0.94	-0.58	-1.73	-1.51	-1.59	-1.34	-0.9	-1.72	0.03	2.38	-0.02
1986	-0.46	0.44	-0.51	-1.23	-1.53	0.28	0.69	0.43	1.04	1.69	2.36	2.49
1987	-0.36	-1.13	-1.53	-1.72	-1.97	-1.65	-1.49	-1.24	-1.67	-1.68	-2.3	-2.36
1988	-2.59	-1.79	-2.03	-2.27	-2.98	-4.14	-3.99	-4.06	-0.05	-0.04	0.17	-0.18
1989	-0.24	0.36	0.58	0.96	1.89	2.51	2.22	2.02	2.32	2.28	2.29	1.85
1990	1.52	2.3	1.16	0.81	2.23	2.05	3.15	3.39	3.86	4.79	4.42	6.4
1991	-0.09	-0.21	-0.23	-0.32	-1.14	-2.23	-2.97	-3.27	-3.28	-3.56	-4.31	-4.45
1992	-4.48	-4.51	-4.01	-3.77	-3.58	-3.52	2.52	2.86	3.04	2.88	3.87	3.34
1993	3.4	3.05	2.93	2.87	-0.74	-0.32	-0.4	-1.45	0.41	0.59	1.28	1.14
1994	1.45	-0.17	-0.33	0.4	-0.35	-0.34	-0.45	0.5	-0.46	-1.2	-1.46	-1.67
1995	-0.92	-1.25	-1.94	0.13	1.09	1.06	-0.36	-0.29	-0.91	0.7	0.78	0.69
1996	1.16	1.03	1.02	1.9	2.85	2.97	3.19	2.1	3.09	2.94	3.44	3.81
1997	3.35	3	3.37	2.34	2.94	3.25	2.76	3.43	2.93	2.34	2.19	1.96
1998	2.11	1.88	1.3	2.06	1.34	2.66	-0.18	-0.04	-0.9	-0.72	-1.37	-1.88
1999	-1.06	-0.77	-1.2	-1	-1.69	-2.5	-2.89	-2.95	-3.37	-3.43	-4.01	-4.25
2000	-3.98	-3.14	-3.48	0.25	0.47	0.84	1	1.29	1.8	1.64	1.43	1.76
2001	-0.47	-0.75	-1.29	-1.37	0.57	-0.31	-0.37	-0.43	0.13	1.08	1.12	1.18
2002	-0.18	-0.49	0.2	0.6	1.27	-0.26	-1	-1.9	-1.53	-1.29	-1.39	-1.32
2003	-1.52	-1.02	-1.53	-1.95	1.25	1.34	2.74	3.26	4.64	4.67	4.96	4.77
2004	4.78	3.89	3.3	2.76	3.49	3.52	3.63	3.85	4.18	4.21	4.57	4.64
2005	5.95	-0.23	-0.42	-0.09	-0.47	-1.57	-1.65	-1.1	-1.06	-1.06	-1.05	-1.39
2006	-1.12	-1.27	-1.45	-1.71	0.19	0.57	1.32	1.05	2.03	3.81	3.63	3.55
2007	4.04	-0.06	0.13	0.15	-1.17	-1.77	-1.83	0.68	-0.51	-0.59	-0.71	0.75
2008	0.65	1.91	3.23	2.27	2.54	3.32	-0.06	-0.7	-1.01	-1.25	-1.58	0.62
2009	0.59	-0.07	-0.61	-0.45	-0.53	0.07	0.43	0.31	0.17	1.13	-0.53	-0.18
2010	-0.43	-0.45	-0.76	-1.62	0.39	1.27	-0.3	-0.77	-1.22	-1.56	-1.27	-1.51
2011	-1.75	1.17	1.45	3.09	3.81	3.31	2.68	2.52	3.64	4.44	5.5	5.84
2012	5.64	-0.34	-1.05	-1.7	-1.95	-2.63	-3.08	-3.26	0.92	1.81	1.16	1.91
2013	1.8	-0.14	-0.4	-0.25	-1.05	0.82	2.17	1.81	1.57	2.04	2.39	3.09
2014	2.64	2.58	1.88	2.42	2.14	2.53	2.3	2.52	2.02	2.13	1.89	1.81
2015	1.65	1.14	1.23	1.5	0.86	2.57	2.87	-0.26	-0.31	-0.14	-0.48	0.45
2016	-0.44	0.49	-0.02	-0.1	-0.25	-0.61	-1.04	-0.97	-0.83	-0.86	-1.84	-1.84
2017	0.58	0.21	0.67	0.47	1.02	1.22	2.34	1.79	1.11	1.44	2.47	1.99
2018	1.74	2.95										

Source: Monthly Palmer Drought Severity Index for States and Climate Divisions; NOAA National Climatic Data Center
https://www.drought.gov/drought/data/noaa-national-climatic-data-center/monthly-palmer-drought-severity-index-states-and-climate

The table 2.11.b lists the number of years that the United States has had a severe or extreme drought in the 100 years from 1896 to 1995, based on the Palmer Drought Severity Index (PDSI). The data is divided and analyzed based on NOAA river basins. The chart shows that some part of the United States has experienced a severe or extreme drought in each year from 1896 to 1995, and that in 72 years, droughts covered more than 10% of the country.

Table 2.11.b

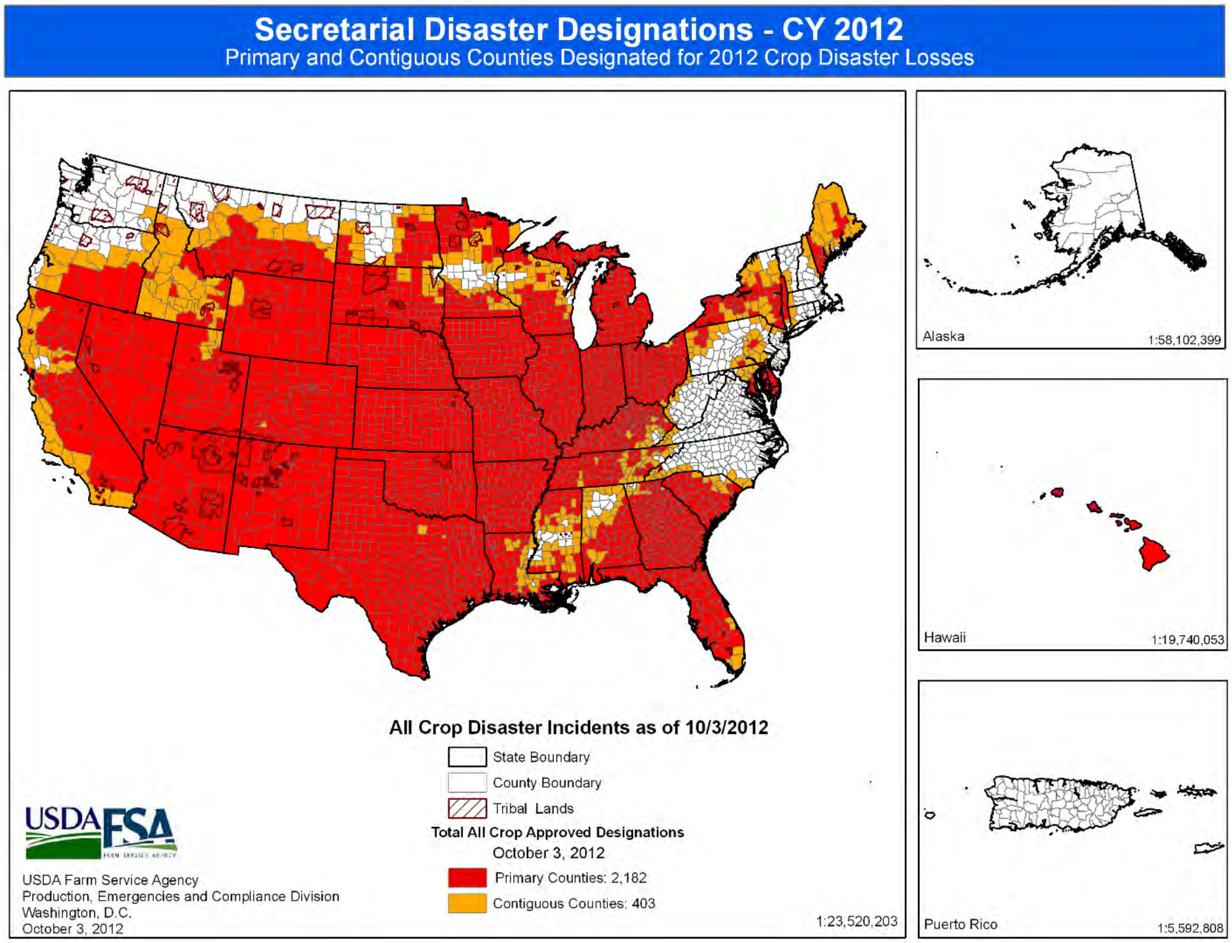
Number of Years with Severe or Extreme Drought between 1896 and 1995									
% area of basin/region	**>0%**	**>10%**	**>25%**	**>33%**	**>50%**	**>66%**	**>75%**	**>90%**	**100%**
United States	100	72	27	13	1	0	0	0	0
Upper Mississippi	77	55	43	30	19	12	9	3	1
Mid-Atlantic	69	49	32	24	12	5	4	0	0
South Atlantic/Gulf	79	47	25	15	9	3	3	0	0
Ohio	67	51	34	28	16	12	9	4	3
Missouri	90	70	43	33	17	10	4	3	0
Pacific Northwest	86	61	42	33	23	14	9	1	0
California	53	45	40	30	14	9	5	3	3
Great Basin	71	65	43	37	19	6	3	1	1
Lower Colorado	56	54	35	28	16	11	10	4	3
Upper Colorado	50	50	42	34	27	25	16	9	8
Rio Grande	58	47	32	24	15	8	5	2	2
Texas Gulf Coast	49	48	38	26	22	13	10	9	7
Arkansas–White–Red	65	48	27	23	14	7	4	0	0
Lower Mississippi	56	38	19	15	4	1	0	0	0
Souris–Red–Rainy	66	57	38	29	19	10	8	5	2
Great Lakes	73	58	32	23	9	3	2	2	0
Tennessee	31	31	27	24	21	16	13	5	5
New England	56	44	27	13	8	5	4	0	0

Source: National Climatic Data Center, Understanding Your Risk and Impacts – A Comparison of Droughts, Floods, and Hurricanes in the United States. [*http://www.drought.unl.edu/risk/us/compare.html.*](http://www.drought.unl.edu/risk/us/compare.html)

2012 NORTH AMERICAN DROUGHT

The 2012-2013 North American Drought was an expansion of the 2010-2012 United States Drought which began in the spring of 2012 when the lack of snow caused very little meltwater to absorb into the soil. The drought included most of the United States and all of Ohio. Several counties in the state were designated with moderate drought conditions by mid-June of 2012. Its effects were equal to similar droughts which occurred in the 1930s and 1950s, but the 2012 event did not last as long. Nonetheless, the 2012 North American Drought inflicted catastrophic economic ramifications on the state. In most measures, the 2012 drought exceeded the 1988-1989 North American Drought, which was the most recent comparable drought.

On July 30th, 2012, the Governor of Ohio sent a memorandum to the U.S. Department of Agriculture State Executive Director requesting primary county natural disaster designations for eligible counties due to agricultural losses caused by drought during the 2012 crop year. The USDA reviewed the Loss Assessment Reports and determined that there were sufficient production losses in 85 counties to warrant a Secretarial disaster designation on September 5th, 2012. By December 2012, all 88 counties received such a designation.


Secretarial Disaster Designations - CY 2012
Primary and Contiguous Counties Designated for 2012 Crop Disaster Losses
Alaska
1:58,102,399
Hawaii
1:19,740,053
Puerto Rico
1:5,592,808
All Crop Disaster Incidents as of 10/3/2012
State Boundary
County Boundary
Tribal Lands
Total All Crop Approved Designations
October 3, 2012
Primary Counties: 2,182
Contiguous Counties: 403
USDA Farm Service Agency
Production, Emergencies and Compliance Division
Washington, D.C.
October 3, 2012
1:23,520,203

The USDA – National Agricultural Statistics Service (NASS) was used to compare a regular crop production period (Crop Year 2011) and the affected crop production period during drought conditions. Commodities were selected through the NASS Program Survey, Crops sector and then by Group: Field Crops, Vegetables, and Fruit & Tree Nuts. Table 2.11.c shows the difference in crop production in Ohio.

Table 2.11.c

Field Crop Losses						
Commodity	Measurement	2011 Quantity	2012 Quantity	Difference	% Change	Trend
Grain Corn - Planted	Acres	3,400,000	3,900,000	500,000	15%	More
Grain Corn - Harvested	Acres	3,220,000	3,650,000	430,000	13%	More
Grain Corn- Production	Bushels	508,760,000	448,950,000	-59,810,000	-12%	Less
Grain Corn - Yield	BU/Acre	158	123	-35	-22%	Less
Hay - Harvested	Acres	1,120,000	1,100,000	-20,000	-2%	Less
Hay - Production	Tons	2,772,000	2,330,000	-442,000	-16%	Less
Hay - Yield	Tons/Acre	2.48	2	0	-19%	Less
Maple Syrup	Number of Taps	405,000	410,000	5,000	1%	More
Maple Syrup - Production	Gallons	125,000	100,000	-25,000	-20%	Less
Maple Syrup - Yield	Gallons/Tap	0.309	0	0	-100%	Less
Soybeans - Planted	Acres	4,550,000	4,600,000	50,000	1%	More
Soybeans - Harvested	Acres	4,540,000	4,590,000	50,000	1%	More
Soybeans - Production	Bushels	217,920,000	206,550,000	-11,370,000	-5%	Less
Soybeans - Yield	BU/Acre	48	45	-3	-6%	Less
Tobacco, air-cured light burley - Harvested	Acres	1,600	1,800	200	13%	More
Tobacco, air-cured light burley - Production	Bushels	3,360,000	3,600,000	240,000	7%	More
Tobacco, air-cured light burley - Yield	BU/Acre	2,100	2,000	-100	-5%	Less
Fruit Losses						
Commodity	Measurement	2011 Quantity	2012 Quantity	Difference	% Change	Trend
Apples	Acres Bearing	4,300	4,000	-300	-7%	Less
Apples - Production	Pounds	66,600,000	33,000,000	-33,600,000	-50%	Less
Apples - Yield	Pounds/Acre	15,500	8,250	-7,250	-47%	Less
Grapes	Acres Bearing	1,900	1,900	0	0%	(No Change)
Grapes - Production	Tons	7,480	5,335	-2,145	-29%	Less
Grapes - Yield	Tons/Acre	3.94	2.81	-1	-29%	Less
Peaches	Acres Bearing	1,200	1,400	200	17%	More
Peaches - Yield	Tons	6,030	4,960	-1,070	-18%	Less
Peaches - Production	Tons/Acre	5.03	3.54	-1	-30%	Less
Vegetable Losses						
Vegetable	Measurement	2011 Quantity	2012 Quantity	Difference	% Change	Trend
Cucumbers - Planted	Acres	2,600	7,100	4,500	173%	More
Cucumbers - Harvested	Acres	2,600	7,000	4,400	169%	More
Cucumbers - Production	Cwt (Hundredweight)	17,910	31,290	13,380	75%	More
Cucumbers - Yield	Cwt/Acre	6.89	4.47	-2	-35%	Less
Bell Peppers - Planted	Acres	3,200	3,200	0	0%	(No Change)
Bell Peppers - Harvested	Acres	3,100	3,100	0	0%	(No Change)
Bell Peppers -Production	Cwt (Hundredweight)	1,004,000	567,000	-437,000	-44%	Less
Potatoes - Planted	Acres	2,000	1,500	-500	-25%	Less
Potatoes - Harvested	Acres	1,700	1,400	-300	-18%	Less
Potatoes - Production	Cwt (Hundredweight)	459,000	308,000	-151,000	-33%	Less
Potatoes - Yield	Cwt/Acre	270	220	-50	-19%	Less
Squash - Planted	Acres	1,900	1,800	-100	-5%	Less
Squash - Harvested	Acres	1,800	1,700	-100	-6%	Less
Squash - Production	Cwt (Hundredweight)	360,000	304,000	-56,000	-16%	Less
Squash - Yield	Cwt/Acre	200	180	-20	-10%	Less
Sweet Corn - Planted	Acres	15,900	16,400	500	3%	More
Sweet Corn- Harvested	Acres	15,100	15,100	0	0%	(No Change)
Sweet Corn - Production	Cwt (Hundredweight)	1,737,000	1,586,000	-151,000	-9%	Less
Sweet Corn - Yield	Cwt/Acre	115	105	-10	-9%	Less
Fresh Market Tomatoes - Planted	Acres	4,500	4,300	-200	-4%	Less
Fresh Market Tomatoes - Harvested	Acres	3,200	4,100	900	28%	More
Fresh Market Tomatoes - Production	Cwt (Hundredweight)	752,000	697,000	-55,000	-7%	Less
Fresh Market Tomatoes - Yield	Cwt/Acre	235	170	-65	-28%	Less

Source: U. S. Department of Agriculture - National Agricultural Statistics Service

PROBABILITY OF FUTURE EVENTS

The probability of future occurrences of drought in Ohio is difficult to predict; however, there are two factors that may influence future drought conditions: The El Niño–Southern Oscillation (ENSO), and climate change.

EL NINO AND LA NINA SOUTHERN OSCILLATION

A great deal of research has been conducted in recent years on the role of interacting systems, or teleconnections, in explaining regional and even global patterns of climatic variability. These patterns tend to recur periodically with enough frequency and with similar characteristics over a sufficient length of time that they offer opportunities to improve our ability for long-range climate prediction, particularly in the tropics.

Every 2 to 7 years, off the western coast of South America, ocean currents and winds shift, bringing warm water westward, displacing the nutrient-rich cold water that normally wells up from deep in the ocean. The invasion of warm water disrupts both the marine food chain and the economies of coastal communities that are based on fishing and related industries. Because the phenomenon peaks around the Christmas season, the fishermen who first observed it named it El Niño ("the Christ Child"). In recent decades, scientists have recognized that El Niño is linked with other shifts in global weather patterns. The intensity and duration of an ENSO event is varied and hard to predict. Typically, it lasts anywhere from 14-to-22 months, but it can be much longer or shorter. El Niño often begins early in the year and peaks between the following November.

During an El Niño–Southern Oscillation (ENSO) event, the Southern Oscillation is reversed. Generally, when pressure is high over the Pacific Ocean, it tends to be low in the eastern Indian Ocean, and vice versa. It is measured by gauging sea-level pressure in the east (at Tahiti) and west (at Darwin, Australia) and calculating the difference. El Niño and Southern Oscillation often occur together, but also happen separately. High positive values of the SOI indicate a La Niña, or "cold event". La Niña is the counterpart of El Niño and represents the other extreme of the ENSO cycle. La Niña years often (but not always) follow El Niño years.

Table 2.11.d, ENSO Phases 1900 to 2005

		Negative PDO: 1900-1924, 1947-1976, 1999-2002	Warm phase PDO: 1925-1946, 1977-1998, 2003- 2005
ENSO PHASE	La Niña (Cool)	1904, 1907, 1909, 1910, 1911, 1917, 1918, 1921, 1923, 1950, 1951, 1955, 1956, 1963, 1965, 1968, 1971, 1972, 1974, 1975, 1976, 1999, 2000, 2001	1925, 1932, 1934, 1938, 1939, 1943, 1944, 1945, 1984, 1985, 1986, 1989, 1996
	ENSO Neutral	1901, 1902, 1908, 1913, 1916, 1922, 1947, 1948, 1949, 1953, 1954, 1957, 1960, 1961, 1962, 1967, 2002	1927, 1928, 1929, 1933, 1935, 1936, 1937, 1946, 1979, 1981, 1982, 1990, 1991, 1993, 1994, 1997, 2004
	El Niño (Warm)	1900, 1903, 1905, 1906, 1912, 1914, 1915, 1919, 1920, 1924, 1952, 1958, 1959, 1964, 1966, 1969, 1970, 1973	1926, 1930, 1931, 1940, 1941, 1942, 1977, 1978, 1980, 1983, 1987, 1988, 1992, 1995, 1998, 2003, 2005

Source: Climate Impacts Group, Joint Institute for the Study of the Atmosphere and the Ocean, University of Washington

Understanding the connections between ENSO (and La Niña) events and weather anomalies around the globe can help in forecasting droughts, floods, tropical storms, and hurricanes. NOAA estimates that the economic impacts of the 1982–83 El Niño, perhaps the strongest event in recorded history, conservatively exceeded $8 billion worldwide, from droughts, fires, flooding, and hurricanes. This event and its associated disasters have been blamed for 1,000 to 2,000 deaths. In addition, the extreme drought in the United States' Midwest during 1988 has been linked to the "cold event", or La Niña, of 1988 that followed the ENSO event of 1986–87.

It is possible that the direct impacts of climate change on water resources might be hidden beneath natural climate variability. With a warmer climate, droughts, and floods could become more frequent, severe, and longer-lasting. The potential increase in these hazards is a great concern given the stresses being placed on water resources and the high costs resulting from recent hazards. The drought of the late 1980s showed what the impacts might be if climate change leads to a change in the frequency and intensity of droughts across the United States. From 1987 to 1989, losses from drought in the United States totaled $39 billion. More frequent extreme events such as droughts and floods could end up being more cause for concern than the long-term change in temperature and precipitation averages.

VULNERABILITY ANALYSIS & LOSS ESTIMATION

Drought risk is based on a combination of the frequency, severity, and spatial extent of drought and the degree to which a population or activity is vulnerable to the effects of drought. The degree of a region's vulnerability depends on the environmental and social characteristics of the region and is measured by the ability to anticipate, cope with, resist, and recover from a drought.

Society's vulnerability to drought is determined by a wide range of factors, both physical and social, such as demographic trends and geographic characteristics. People and activities will be affected in different ways by different hazards.

There is a sequence of impacts associated with meteorological, agricultural, and hydrological droughts in Ohio. When drought begins, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water, which can be rapidly depleted during extended dry periods. If precipitation deficiencies continue, then people dependent on other sources of water will begin to feel the effects of the shortage. Those who rely on surface water (reservoirs and lakes) and subsurface water (groundwater) are usually the last to be affected. A short-term drought that persists for 3 to 6 months may have little impact on these sectors, depending on the characteristics of the hydrologic system and water use requirements.

When precipitation returns to normal and meteorological drought conditions have abated, the sequence is repeated for the recovery of surface and subsurface water supplies. Soil water reserves are replenished first, followed by stream flow, reservoirs and lakes, and groundwater. Drought impacts may diminish rapidly in the agricultural sector because of its reliance on soil water, but linger for months or even years in other sectors, dependent on stored surface or subsurface supplies. Groundwater users, often the last to be affected by drought during its onset, may be last to experience a return to normal water levels. The length of the recovery period is a function of the intensity of the drought, its duration, and the quantity of precipitation received as the episode terminates.

Socioeconomic definitions of drought associate the supply and demand of some economic goods with elements of meteorological, hydrological, and agricultural drought. It differs from the other types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods, such as water, forage, food grains, fish, and hydroelectric power, depends on the weather. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.

FEMA estimated in 1995 that drought costs the United States $6– 8 billion annually. Other studies have indicated that drought losses average $200 million to $1.24 billion annually in the Great Plains. This range is based on crop losses and other direct and indirect losses. According to NOAA's National Climatic Data Center, in 1999, a drought that affected twenty-eight Ohio counties caused $200 million in crop damages.

The Dust Bowl years of the 1930s and the drought of 1988–89 are both contenders for the worst drought on record in the United States. Economic losses are often hard to calculate and compare for a variety of reasons: lack of historical records and economic models, and past and present costs that are often based on different criteria. Today, many different types of losses are often included in an economic analysis, such as energy losses, ecosystem losses, and consumer purchasing losses, but they were not typically included in previous analyses and are difficult to assess in retrospect.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Drought does not pose a specific threat to state-owned or state-leased facilities. The larger threat from drought would be based on the agricultural and drinking water demands with a limited supply. Additionally, drought can play a major role in occurrences of wildfires throughout the state (Section 2.7).

2.12 SEVERE SUMMER STORMS

Severe summer storms traditionally precede an approaching cold air mass. In the northern hemisphere, the spin of the earth naturally produces weather patterns affecting North America, which travel from west to east across the continent. Key components to the formation of storms are a low-pressure zone, high-pressure zone and the jet stream.

The troposphere is the lowest portion of Earth's atmosphere containing approximately 75% of the atmosphere's mass and almost all of its water vapor. Air at this level is acted upon by the earth surface (land and water) and the heating cycle associated with sunlight. Unlike other portions of the atmosphere, which are largely homogenous, at the surface discrete areas or bubbles exist of differing temperature, water vapor content and pressure. Warm areas (low pressure) tend to rise, pressing on the borders of surrounding cool areas (high pressure). It is where the pressure zones interface that temperature changes cause water vapor in the air to condense creating precipitation. The warmer the overall temperature of the atmosphere and the greater the volume of water vapor present, the larger the associated perception event.

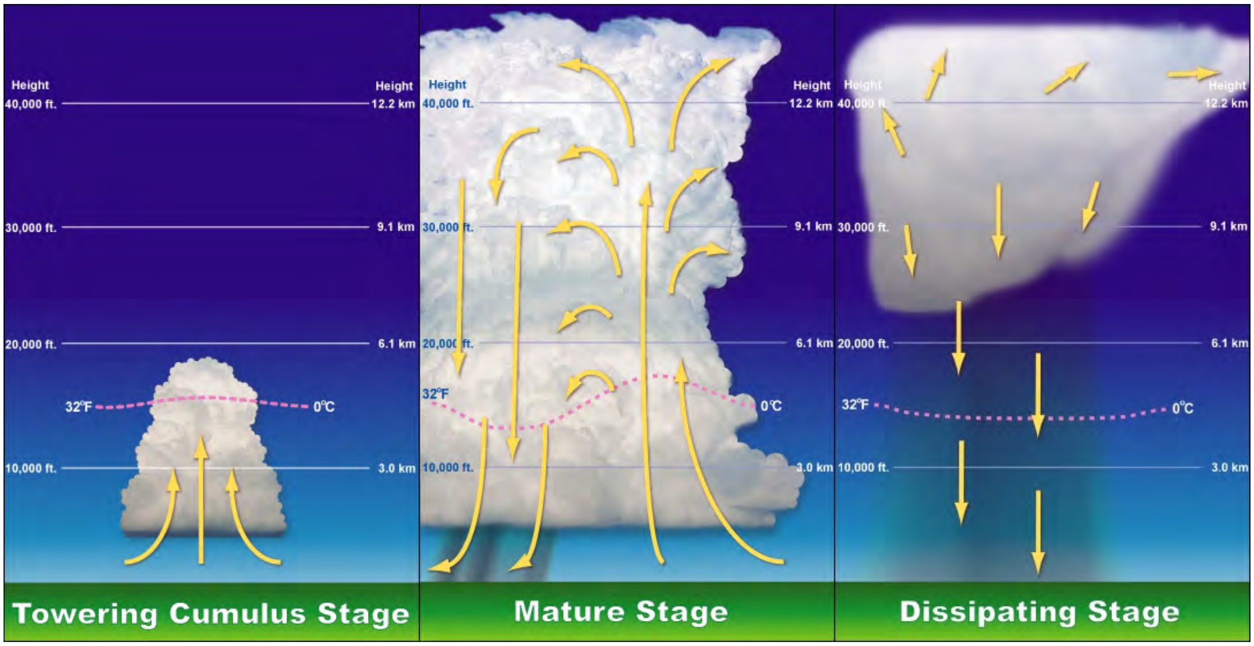
Jet streams are fast flowing, relatively narrow air currents found in the atmosphere around 11 kilometers (36,000 ft.) above the surface of the Earth. They form at the boundaries of adjacent air masses with significant differences in temperature, such as of the polar region and the warmer air toward the equator. These air currents migrate north and south in a snakelike pattern changing their relative location as the planet’s axis tilts with each passing year. These winds act on the high and low-pressure zone moving them across the continent and shifting them north and south.

Thunderstorms develop when large differences exist between adjacent zones combined with significant water vapor. As warm air begins to lift, it eventually starts to cool and condensation takes place. When the moisture condenses, heat is released which further aids in the lifting process. If enough instability is present in the atmosphere, this process will continue long enough for cumulonimbus clouds to form, which supports lightning and thunder (see Diagram 2.12a). As water droplets rise into the colder air, they can freeze. When the velocity of wind becomes great enough, the ice pellets are repeatedly lifted and dropped in the storm adding layers of ice with each cycle. Once the wind cannot support the weight of the ice pellet, it falls the ground in the form of hail.

One key component to a thunderstorm is lightning, an atmospheric discharge of electricity. High-speed videos (examined frame-by frame) show that most lightning strikes are made up of multiple individual strokes. A typical strike is made of 3 to 4 strokes. The sudden increase in pressure and temperature from lightning produces rapid expansion of the air surrounding and within a bolt of lightning. In turn, this expansion of air produces a sonic shock wave, which produces the sound of thunder. Lightning, other storm components, often seeks a path though the tallest object available. Trees, utility line/poles, tall buildings and even humans can be sought as a pathway for the discharging electricity.

Summer storms are considered high wind events by the National Climactic Data Center when surface winds meet or exceed 50 knots or 57.6 miles per hour. It is possible for winds in strong storms to exceed 100 miles per hour, with gusts even stronger.

Figure 2.12a



Source: Wikipedia http://en.wikipedia.org/wiki/Thunderstorm

RISK ASSESSMENT

LOCATION

Severe summer storms and associated thunderstorm/high winds, lightning, and hail events are common throughout Ohio and reported hundreds of times each year. For the purpose of this plan, thunderstorm wind events, hail events, and lightning events will be assessed separately under *Severe Summer Storms* (2.12) section. Each of these are statewide hazards. For thunderstorm wind and hail events, past occurrences will be reported based on days with events unless specified otherwise. For lightning, each reported event will be counted as a single event.

PAST OCCURRENCES

According to the NCDC Storm Database, there has been 453 thunderstorm wind events from January 1, 2008 to December 31, 2017. From these events, about $145,609,158 (2017 dollars) in property and crop damages have been reported and have directly caused 8 deaths and 100 injuries. For hail during the same timeframe, there were 359 days with events that resulted in $187,455,392 (2017 dollars) in property and crop damage and have directly caused zero deaths and two injuries.

From January 1, 1996 to December 31, 2017, there were 229 reported lightning events that resulted in $18,204,489 in property and crop damages and have directly caused 25 deaths and 120 injuries. However, based on the NCDC data from the period of January 1, 1996 to December 31, 2017, it could be assumed that an event was not recorded unless damages were reported or resulted in the death or injury of a person. According to National Geographic, lightning detecting systems in the United States monitor an average of 25 million strokes of lightning and about 100,000 thunderstorms per year.

Within the January 2008 to December 2017 analysis period, the costliest hail event from happened on May 25, affecting Hancock County and had cost $85,000,000 in damages. The event had produced hail as large as baseballs. The western half of the city of Findlay was especially hard hit. As many as 4,000 homes and business in this area may have been damaged by the hail. Thousands of automobiles also sustained damage from the hail. This event could end up being one of costliest hailstorms in Ohio history.

On November 5, 2017, a cold front moved across the Ohio Valley and southern Great Lakes resulting in thunderstorm wind events affecting many. These winds caused $18,032,500 in property and crop damages within Ohio counties. The costliest high wind event happened on September 14, 2008 as a result of Hurricane Ike. High winds affected most parts of the state. The NCDC Storm Database reports that $771,955,000 had been caused in property and crop damage.

Table 2.12.a

Thunderstorm Events by County (January 1, 2008 to December 31, 2017)

Region 1

County	Number of Events	Number of Deathes	Number of Injuries	Total Property and Crop Damage (2017 Dollars)
ALLEN	50	0	0	$ 54,093
AUGLAIZE	79	0	2	$ 1,018,487
CHAMPAIGN	44	0	0	$ 413,232
CLARK	78	0	0	$ 438,238
CRAWFORD	51	0	0	$ 1,412,685
DARKE	72	0	0	$ 680,641
DEFIANCE	37	0	0	$ 303,920
ERIE	49	0	1	$ 3,266,554
FULTON	37	0	0	$ 119,490
HANCOCK	70	0	0	$ 7,617,705
HARDIN	29	0	0	$ 415,186
HENRY	57	0	1	$ 38,970
HURON	70	0	0	$ 1,878,667
LOGAN	55	0	0	$ 355,037
LUCAS	92	1	0	$ 2,373,721
MARION	42	0	1	$ 5,312,356
MERCER	41	0	2	$ 478,753
MIAMI	57	0	1	$ 682,945
OTTAWA	56	0	5	$ 2,075,367
PAULDING	38	0	0	$ 214,200
PREBLE	54	0	0	$ 361,302
PUTNAM	39	0	1	$ 283,652
SANDUSKY	59	0	0	$ 4,794,635
SENECA	69	0	0	$ 3,635,084
SHELBY	53	0	0	$ 215,542
VAN WERT	61	0	0	$ 466,957
WILLIAMS	32	1	1	$ 315,840
WOOD	76	0	0	$ 2,514,480
WYANDOT	25	0	0	$ 2,206,990
TOTAL		2	15	$ 43,944,727

Region 2

County	Number of Events	Number of Deathes	Number of Injuries	Total Property and Crop Damage (2017 Dollars)
ASHLAND	50	0	0	$ 1,359,403
BUTLER	96	0	0	$ 437,804
CLINTON	100	0	0	$ 599,913
CUYAHOGA	122	0	0	$ 11,381,899
DELAWARE	69	0	4	$ 329,520
FAIRFIELD	78	0	0	$ 427,608
FAYETTE	48	0	1	$ 349,108
FRANKLIN	185	0	7	$ 1,857,879
GEAUGA	57	0	0	$ 1,676,326
GREENE	93	0	0	$ 302,650
HAMILTON	132	0	1	$ 1,260,551
KNOX	52	0	1	$ 2,328,393
LAKE	48	0	0	$ 1,154,940
LICKING	99	2	4	$ 722,624
LORAIN	112	0	0	$ 3,097,829
MADISON	37	0	0	$ 306,518
MEDINA	59	1	3	$ 2,084,871
MONTGOMERY	168	0	2	$ 542,686
MORROW	34	0	0	$ 2,380,416
PICKAWAY	49	0	1	$ 439,594
PORTAGE	56	0	0	$ 3,840,670
RICHLAND	69	0	2	$ 2,450,743
STARK	62	0	0	$ 766,638
SUMMIT	77	0	0	$ 8,465,984
UNION	38	0	0	$ 149,309
WARREN	110	0	1	$ 1,019,811
WAYNE	57	0	0	$ 492,966
TOTAL		3	27	$ 50,226,651

Region 3

County	Number of Events	Number of Deathes	Number of Injuries	Total Property and Crop Damage (2017 Dollars)
ADAMS	57	0	0	$ 408,154
ASHTABULA	69	0	0	$ 1,591,711
ATHENS	56	0	6	$ 5,319,926
BELMONT	44	0	0	$ 1,306,337
BROWN	79	0	0	$ 743,335
CARROLL	74	0	0	$ 1,285,670
CLERMONT	100	0	0	$ 638,244
COLUMBIANA	102	0	2	$ 2,090,858
COSHOCTON	56	0	0	$ 1,688,786
GALLIA	38	0	0	$ 2,827,548
GUERNSEY	53	0	0	$ 1,609,770
HARRISON	43	0	0	$ 1,002,081
HIGHLAND	91	0	1	$ 517,609
HOCKING	51	0	0	$ 298,045
HOLMES	40	0	0	$ 1,085,380
JACKSON	36	0	1	$ 2,069,534
JEFFERSON	51	1	2	$ 1,630,829
LAWRENCE	60	0	1	$ 2,354,513
MAHONING	55	0	0	$ 2,537,080
MEIGS	22	0	0	$ 2,653,249
MONROE	19	0	0	$ 412,702
MORGAN	33	0	0	$ 720,113
MUSKINGUM	63	1	1	$ 1,929,222
NOBLE	29	0	0	$ 383,735
PERRY	68	0	0	$ 2,230,567
PIKE	63	0	5	$ 491,191
ROSS	59	0	0	$ 529,848
SCIOTO	107	1	1	$ 719,654
TRUMBULL	112	0	38	$ 2,999,909
TUSCARAWAS	89	0	0	$ 2,464,457
VINTON	33	0	0	$ 641,756
WASHINGTON	54	0	0	$ 4,255,968
TOTAL		3	58	$ 51,437,780

Statewide High Winds – September 2008 (FEMA DR-1805-OH) - *https://www.fema.gov/disaster/1805*

Usually, tropical storms and hurricanes directly affecting other states result in extended rainfall in Ohio. NOAA Operational Significant Event Imagery shows that the windstorms of 2008 were a legacy from Hurricane IKE, which arced clockwise from the Gulf of Mexico to the western basin of Lake Erie and the Saint Lawrence Seaway. Ohio was affected from Hamilton County in southwest Ohio to the northeastern counties of Ashland, Carroll and Summit. Unlike other secondary effects of a diminishing hurricane, high winds in excess of 65 miles per hour were primarily the cause of damage for many counties, causing power outages across these portions of the state. It was reported that winds equal to a Category 1 hurricane (winds up to 74 miles per hour) caused at least $1.255 billion in insured losses.

The Ohio Insurance Institute (OII) Windstorm Loss Survey - FEMA DR-1805-OH

Following the statewide High Winds event of September 2008 (FEMA DR-1805-OH), the Ohio Insurance Institute (OII) conducted a windstorm loss survey in which 24 property and casualty companies participated. This represented:

- 68% of Ohio's personal auto insurance market
- 72% of the homeowners' market
- 33% of the state's commercial lines market based on 2007 Ohio premium volume

The OII survey concluded Ohio's insured losses totaled $1.255 billion and government costs for protection and clean up were $38.6 million. Insurance companies reported a record-high number of claims filed across the state. At least 270,000 were filed in Ohio, including 220,000 homeowners, 30,000 commercial and 20,000 auto insurance claims.

Severe Storms, Flooding and Landslides – April & May 2011 (FEMA DR- 4002-OH) -
https://www.fema.gov/disaster/4002

The impact of this event was widespread and costly due to the prolonged and record-setting spring rainfall during the months of March, April and May. According to the National Weather Service (NWS), a persistent upper valley weather channel over the eastern U.S. led to an active storm track over the Ohio Valley. During the month of April and into mid-May, the local NWS offices serving Ohio issued flood watches, flood warnings, flash flood watches and advisories and/or special weather statements for the Ohio River Watershed and Drainage Basin for 31 of the 44 days. Eighty-one percent of the watches, warnings and advisories were issued directly for the impacted counties; however, all of the counties had high stream levels on their watersheds. Also during this time period, there were road closures almost every day due to flooding and/or high water. A notable incident was a small plane crashed near Ravenna, Ohio with three injuries due to saturated soil absorbing much of the impact. According to the Highway Patrol, had it not been for soft, soaked earth and mud, all three on board would have perished upon impact. Other incidents included 7,630 customers in power outages, trees uprooted, parts of buildings sustaining moderate damage and the loss of a countywide 911 system. As a result, the 21 affected Ohio counties received $44,506,071 in public assistance funds.

Severe Storms and Straight Line Winds – June 2012 (FEMA DR-4077-OH) - *: https://www.fema.gov/disaster/4077*

An anomalously strong storm ridge centered across the Southeast and brought record heat to the Upper Ohio Valley with the area in a flow on the northern edge of the ridge. A weak frontal boundary extended from northern Indiana into western Pennsylvania. Abundant moisture, strong instability, moderate shear, and a short wave just south of the boundary provided the ingredients for a long-tracked mesoscale convective system, classified by the Storm Prediction Center as a derecho, to track all the way from northern Indiana across eastern Ohio, southwestern Pennsylvania, northern WV, and western Maryland. As the system crossed the area, widespread wind damage was reported across areas primarily south and west of Pittsburgh. There were several reports of structural damage and damage led to a fatality when a barn collapsed in Muskingum County. Power outages were widespread with up to 130,000 outages reported immediately after the storms passage, most of which, were in Ohio. Muskingum and Guernsey counties sustained $712,000 and $500,000 in damages respectively. This also became one of the costliest disasters to hit Ohio, right behind Hurricane Ike in 2008. Two fatalities and eight injuries occurred during this event with $40,440,000 in property damage and $105,000 in damage to crops. As a result, of this event, 37 affected Ohio counties received $22,538,519 in public assistance funds.

Hurricane SANDY – October 2012 (FEMA DR-4098-OH) - *https://www.fema.gov/disaster/4098*

On October 29, 2012, Hurricane Sandy made landfall near Atlantic City, New Jersey, however, the storm continued to produce significant wind, storm surge, rainfall and inland-flooding hazards across the Northeastern United States. High wind warnings as well as flood and flash flood watches and warnings for portions of Ohio and Indiana. The National Weather Service reported winds up to 80 miles per hour during the height of the storm system. First Energy Nuclear Operating Company reported sirens without AC power near Perry Nuclear Power Plant (Lake County-15 sirens, Geauga County-1 siren, Ashtabula-1siren) and Beaver Valley Power Station (Beaver County, PA-1siren). In Cuyahoga County, 80 people with functional needs were evacuated to a high school in Cleveland Heights, while another 11 shelters were being opened. The storm delivered a blow to Ashtabula County, but it was not the big uppercut some people had feared. As expected, strong wind toppled trees and dropped power lines, causing power outages across the county. Incessant rain toppled trees and flooded some thoroughfares in the area. Some of the hardest-hit areas were along the lakeshore, including Conneaut, North Kingsville, and Saybrook Township. Outages were reported in every city, village and township in the county, according to Illuminating Company information. Trees and limbs that collapsed on power lines were a big culprit, officials said. Lake County had residents from 142 homes near the mouth of the Chagrin River evacuated to the Mentor Community Center with another 70 evacuated to a shelter in Painesville. First Energy reported 55,516 customers without power in northeast Ohio. No fatalities were reported; however, one occurred. Property damage was estimated at $55,234,000 with no damage to crops. As a result, of this event, 37 affected Ohio counties received $17,810,815 in public assistance funds.

Severe Storms, Landslides, and Mudslides – February 2018 (FEMA DR-4360-OH) -
https://www.fema.gov/disaster/4360

Beginning on February 14, 2018, and continuing through February 25, 2018, a persistent band of moderate to severe storms moved across Region V impacting Illinois, Indiana, Michigan, Ohio, and Wisconsin. While precipitation levels and storm-related damages varied, Ohio experienced a significant amount of flooding and subsequent damage along the southern portion of the state. The snowmelt and continued rain throughout the incident period, combined with the frozen soils, led to flooding along area streams, rivers, and low-lying areas. Numerous flood gauges in this area rose to moderate flood stage, and rainfall totals in the impacted areas during the incident period ranged from a total of five to nine inches. Following these storms, there were several road closures as well as reports of inaccessible areas throughout southern Ohio due to standing water.

On March 26, the Governor requested a Presidential Disaster Declaration. On April 17, 2018, a disaster was declared for the State of Ohio, due to severe storms, flooding, and landslides that occurred during the incident period of February 14, 2018, through February 25, 2018. As a result of that declaration, Public Assistance has been made available for Adams, Athens, Belmont, Brown, Columbiana, Gallia, Hamilton, Jackson, Lawrence, Meigs, Monroe, Muskingum, Noble, Perry, Pike, Scioto, Vinton, and Washington Counties. The Disaster impact data is fluid as only half of the Public Assistance projects have been awarded as of January 2019.

HURRICANES AND TROPICAL STORMS

In more recent years, a number of disaster declarations for Ohio was declared in result of remnants from hurricanes and tropical storms. Notably, wind events caused by remnants of Hurricane IKE in September 2008 had resulted in large damages across Ohio. High winds, rain, and flooding events from Hurricane SANDY followed through to portions of Ohio.

PROBABILITY OF FUTURE EVENTS

The historical period used for thunderstorm winds and hail analysis began with January 1, 2008 and closed December 31, 2017 based on statistics tabulated by the NCDC. During this period, there were 453 days with thunderstorm wind events and 359 days with hail events. For the period from January 1, 1996 to December 31, 2017, there were 229 lightning events. Based on available documented occurrences, severe summer storms are the most prevalent natural hazard events in Ohio with a 100% chance of occurring any given year. According to National Geographic, the odds of being a lightning victim in the U.S. in any given year is about one in 700,000.

LHMP DATA

Henry County: The County's Hazard Mitigation Plan of 2018 states that from January of 1950 to June of 2017 in Henry County. These events have caused two injuries, over $800,000 in property damage, $600,000 in crop damage, and no deaths. Based on historical information, Henry County can expect to endure at least three severe storms in any given year.

Darke County: The 2011 Updated Hazard Mitigation Plan cites that there have been a total of 2 lightning events, 64 hail events, and 148 thunderstorm/wind events in Darke County from June 9, 1958 through December 31, 2010. Based on NCDC data, Darke County can expect at least four severe summer storm events each year along with smaller events. Some of the significant events are described in the following paragraphs.

Fairfield County: The 2016 Fairfield County Natural Hazards Mitigation Plan references 219 severe thunderstorm events from 1968 to 2016. From the period of 1961 to 2016, the County experienced 58 Hail events creating $52,000.00 in property damages. No deaths or injuries as a result of Hailstorms.

VULNERABILITY ANALYSIS AND LOSS ESTIMATION

METHDOLOGY

THUNDERSTORM WINDS AND HAIL

During data development for the thunderstorm/high wind and hail hazard, it quickly became apparent the two must be addressed separately. Hail events have a much greater financial impact in urbanized areas. Events of the same magnitude can create substantially more damage in an urban setting, or as it would in forested or agricultural area. The extreme range of the data for hail would skew any useful thunderstorm/high wind analysis. As a result, there will be one analysis for lightning, thunderstorm/high winds, and heavy rainfall and another separate analysis for hail events.

To determine the estimated annual damage down to the county level, a hybrid approach was taken using historical data and the taxable value of real property for each county within the state. First, a historical analysis was done first for each county. The total reported property damage of each event was adjusted to 2017 dollars and summed up to for each county. This was then divided by 10 for the number of years assessed. The result of this is the estimated annual damage for each county. This number was then divided by the total taxable value of real property within the county to determine the percentage of estimated damage for each of the 88 county in any given year.

To offset the possibility of under-reporting damages, the sum of the ten-year damages across the state $145,609,158 for thunderstorm winds, and $187,455,392 for hail was divided by 10 to determine the annual loss. This figure as well as the statewide real value of property was respectively divided by the 88 (counties in the state) to determine the average damage per county and the average taxable value per county in the state. The first was then divided by the latter resulting in the percentage of estimated damage the average county, 0.006116% for thunderstorm and 0.007874% for hail, in Ohio in any given year. These percentages were then used for any county that reported less than average damages relative to their value of taxable real property.

LIGHTNING

Determining the dollar loss estimate for lightning events is extremely difficult because it is an extremely common hazard that is also greatly under-reported. It could be assumed based on the NCDC data from the period of January 1, 1996 to December 31, 2017 that an event was not recorded unless damages were reported or resulted in the death or injury of a person. Based on what was reported, however, the average damage to property is approximately $827,477 per year statewide. On average, one person is killed and six injured from lightning events in any given year.

RESULTS - THUNDERSTORM WINDS (TABLE 2.12.A)

The total estimated annual severe thunderstorm winds loss for Region 1 is $5,129,520. Within the Region, Marion County is estimated to have the highest annual loss each at approximate $531,236. Hancock, however, had the highest estimate per capita loss at $10.06 per person.

Region 2 has the highest estimated annual summer storm loss in the state at a total of $10,711,819. While it is the most populated region in the state with the highest total taxable value of real property, the region also exhibits the lowest estimated annual per-capita loss of $1.39. Within the Region, Morrow County has the highest estimated annual summer storm per-capita loss at $1.88. Cuyahoga County has the highest estimated total damage at $1,623,120 but an estimated per-capita loss of only $1.30.

Region 3 is estimated to have $5,308,796 in annual damages with an annual per-capita of loss of $2.66. Athens County is estimated to have the highest loss at a total of $531,993. Meigs County is estimated have the highest annual per-capita loss of $11.50.

Table 2.12.a

Estimate of Potential Losses to Thunderstorm Winds by Region

Region 1			
County	Population	Countywide Annual Damage	Annual Damage per Capita
Allen	103,198	$ 111,695.39	$ 1.08
Auglaize	45,778	$ 101,848.65	$ 2.22
Champaign	38,840	$ 51,234.14	$ 1.32
Clark	134,557	$ 136,929.05	$ 1.02
Crawford	41,746	$ 141,268.50	$ 3.38
Darke	51,536	$ 73,648.32	$ 1.43
Defiance	38,156	$ 49,556.80	$ 1.30
Erie	74,817	$ 326,655.40	$ 4.37
Fulton	42,289	$ 58,868.11	$ 1.39
Hancock	75,754	$ 761,770.50	$ 10.06
Hardin	31,364	$ 41,518.60	$ 1.32
Henry	27,185	$ 44,883.20	$ 1.65
Huron	58,494	$ 187,866.70	$ 3.21
Logan	45,325	$ 72,444.99	$ 1.60
Lucas	430,887	$ 421,014.28	$ 0.98
Marion	64,967	$ 531,235.60	$ 8.18
Mercer	40,873	$ 66,418.01	$ 1.62
Miami	105,122	$ 134,669.74	$ 1.28
Ottawa	40,657	$ 207,536.70	$ 5.10
Paulding	18,845	$ 27,399.66	$ 1.45
Preble	41,120	$ 53,890.19	$ 1.31
Putnam	33,878	$ 54,746.03	$ 1.62
Sandusky	59,195	$ 479,463.50	$ 8.10
Seneca	55,243	$ 363,508.40	$ 6.58
Shelby	48,759	$ 68,870.65	$ 1.41
Van Wert	28,217	$ 42,329.97	$ 1.50
Williams	36,784	$ 46,102.25	$ 1.25
Wood	130,492	$ 251,448.00	$ 1.93
Wyandot	22,029	$ 220,699.00	$ 10.02
Total	1,966,107	$ 5,129,520.32	$ 2.61

Region 2			
County	Population	Countywide Annual Damage	Annual Damage per Capita
Ashland	53,628	$ 135,940.30	$ 2.53
Butler	380,604	$ 431,409.39	$ 1.13
Clinton	42,009	$ 55,247.40	$ 1.32
Cuyahoga	1,248,514	$ 1,623,120.46	$ 1.30
Delaware	200,464	$ 412,757.80	$ 2.06
Fairfield	154,733	$ 206,701.02	$ 1.34
Fayette	28,752	$ 42,904.11	$ 1.49
Franklin	1,291,981	$ 1,596,431.89	$ 1.24
Geauga	93,918	$ 182,631.81	$ 1.94
Greene	166,752	$ 233,873.68	$ 1.40
Hamilton	813,822	$ 1,069,320.31	$ 1.31
Knox	61,261	$ 232,839.30	$ 3.80
Lake	230,117	$ 335,138.54	$ 1.46
Licking	173,448	$ 228,566.27	$ 1.32
Lorain	307,924	$ 384,814.03	$ 1.25
Madison	44,036	$ 65,604.48	$ 1.49
Medina	178,371	$ 295,275.69	$ 1.66
Montgomery	531,542	$ 532,156.37	$ 1.00
Morrow	34,994	$ 238,041.60	$ 6.80
Pickaway	57,830	$ 73,815.24	$ 1.28
Portage	162,277	$ 384,067.00	$ 2.37
Richland	120,589	$ 245,074.30	$ 2.03
Stark	372,542	$ 418,899.80	$ 1.12
Summit	541,228	$ 683,319.46	$ 1.26
Union	56,741	$ 96,589.41	$ 1.70
Warren	228,882	$ 367,661.32	$ 1.61
Wayne	116,038	$ 139,618.01	$ 1.20
Total	7,692,997	$ 10,711,818.99	$ 1.39

Region 3			
County	Population	Countywide Annual Damage	Annual Damage per Capita
Adams	27,726	$ 40,815.40	$ 1.47
Ashtabula	97,807	$ 159,171.10	$ 1.63
Athens	66,597	$ 531,992.60	$ 7.99
Belmont	68,029	$ 130,633.65	$ 1.92
Brown	43,576	$ 74,333.45	$ 1.71
Carroll	27,385	$ 128,567.00	$ 4.69
Clermont	204,214	$ 241,864.01	$ 1.18
Columbiana	103,077	$ 209,085.80	$ 2.03
Coshocton	36,544	$ 168,878.60	$ 4.62
Gallia	29,973	$ 282,754.80	$ 9.43
Guernsey	39,093	$ 160,977.00	$ 4.12
Harrison	15,216	$ 100,208.10	$ 6.59
Highland	42,971	$ 45,969.85	$ 1.07
Hocking	28,474	$ 33,547.05	$ 1.18
Holmes	43,957	$ 108,538.00	$ 2.47
Jackson	32,449	$ 206,953.40	$ 6.38
Jefferson	66,359	$ 163,082.90	$ 2.46
Lawrence	60,249	$ 235,451.30	$ 3.91
Mahoning	229,796	$ 235,408.12	$ 1.02
Meigs	23,080	$ 265,324.90	$ 11.50
Monroe	13,946	$ 41,270.20	$ 2.96
Morgan	14,709	$ 72,011.30	$ 4.90
Muskingum	86,149	$ 192,922.20	$ 2.24
Noble	14,406	$ 38,373.52	$ 2.66
Perry	36,024	$ 223,056.70	$ 6.19
Pike	28,270	$ 49,119.10	$ 1.74
Ross	77,313	$ 74,131.44	$ 0.96
Scioto	75,929	$ 58,145.24	$ 0.77
Trumbull	200,380	$ 299,990.90	$ 1.50
Tuscarawas	92,297	$ 246,445.70	$ 2.67
Vinton	13,092	$ 64,175.60	$ 4.90
Washington	60,418	$ 425,596.80	$ 7.04
Total	1,999,505	$ 5,308,795.73	$ 2.66

RESULTS - HAIL (TABLE 2.12.B)

The total estimated annual loss for Region 1 is $12,430,433. Within the Region, Hancock County is estimated to have the highest annual loss each at approximate $9,317,669. This figure however, may be skewed by an event on May 25, 2011 that reported $85,000,000 in damages. Consequently, Hancock County also had the highest estimate per capita loss at $123 per person.

Region 2 has the highest estimated annual hail loss in the state at a total of $19,338,917. While it is the most populated region in the state with the highest total taxable value of real property, the region only has an estimated annual per-capita loss of $2.51. Within the Region, Stark County has the highest estimated total damage at $6,926,028 and also the highest estimated per-capita loss of $18.59.

Region 3 is estimated to have $2,741,032 in annual damages to hail with an annual per-capita of loss of $1.37. Clermont County is estimated to have the highest loss at a total of $311,373. Harrison County is estimated have the highest annual per-capita loss at $2.58.

Table 2.12.b

Estimate of Potential Losses to Hail by Region											
Region 1				Region 2				Region 3			
County	Population	Countywide Annual Damage	Annual Damage per Capita	County	Population	Countywide Annual Damage	Annual Damage per Capita	County	Population	Countywide Annual Damage	Annual Damage per Capita
Paulding	18,845	$ 35,273.97	$ 1.87	Fayette	28,752	$ 55,234.22	$ 1.92	Scioto	75,929	$ 74,855.44	$ 0.99
Hardin	31,364	$ 39,221.24	$ 1.25	Morrow	34,994	$ 59,756.36	$ 1.71	Pike	28,270	$ 28,110.62	$ 0.99
Crawford	41,746	$ 53,725.09	$ 1.29	Clinton	42,009	$ 71,124.81	$ 1.69	Vinton	13,092	$ 13,412.35	$ 1.02
Van Wert	28,217	$ 54,495.07	$ 1.93	Ashland	53,628	$ 75,754.79	$ 1.41	Meigs	23,080	$ 24,877.85	$ 1.08
Henry	27,185	$ 57,782.06	$ 2.13	Madison	44,036	$ 84,458.38	$ 1.92	Athens	66,597	$ 71,910.62	$ 1.08
Williams	36,784	$ 59,351.46	$ 1.61	Pickaway	57,830	$ 95,028.81	$ 1.64	Jefferson	66,359	$ 75,971.88	$ 1.14
Defiance	38,156	$ 63,798.80	$ 1.67	Knox	61,261	$ 99,030.66	$ 1.62	Jackson	32,449	$ 37,176.01	$ 1.15
Champaign	38,840	$ 65,958.18	$ 1.70	Union	56,741	$ 124,347.98	$ 2.19	Perry	36,024	$ 42,752.16	$ 1.19
Preble	41,120	$ 69,377.56	$ 1.69	Richland	120,589	$ 149,006.85	$ 1.24	Lawrence	60,249	$ 71,888.79	$ 1.19
Putnam	33,878	$ 70,479.34	$ 2.08	Wayne	116,038	$ 179,742.46	$ 1.55	Trumbull	200,380	$ 242,200.77	$ 1.21
Fulton	42,289	$ 75,786.06	$ 1.79	Geauga	93,918	$ 235,117.89	$ 2.50	Ross	77,313	$ 95,435.88	$ 1.23
Auglaize	45,778	$ 82,354.85	$ 1.80	Portage	162,277	$ 258,589.01	$ 1.59	Columbiana	103,077	$ 128,895.17	$ 1.25
Marion	64,967	$ 85,200.87	$ 1.31	Fairfield	154,733	$ 266,104.29	$ 1.72	Mahoning	229,796	$ 303,061.45	$ 1.32
Huron	58,494	$ 85,263.96	$ 1.46	Licking	173,448	$ 294,253.33	$ 1.70	Morgan	14,709	$ 19,686.86	$ 1.34
Mercer	40,873	$ 85,505.70	$ 2.09	Greene	166,752	$ 301,086.03	$ 1.81	Muskingum	86,149	$ 117,339.66	$ 1.36
Seneca	55,243	$ 86,316.04	$ 1.56	Medina	178,371	$ 380,134.19	$ 2.13	Gallia	29,973	$ 40,965.44	$ 1.37
Shelby	48,759	$ 88,663.21	$ 1.82	Lake	230,117	$ 431,453.12	$ 1.87	Ashtabula	97,807	$ 134,528.33	$ 1.38
Wyandot	22,029	$ 89,586.80	$ 4.07	Warren	228,882	$ 473,322.54	$ 2.07	Brown	43,576	$ 59,944.98	$ 1.38
Logan	45,325	$ 93,264.76	$ 2.06	Lorain	307,924	$ 495,404.72	$ 1.61	Highland	42,971	$ 59,181.00	$ 1.38
Darke	51,536	$ 94,813.91	$ 1.84	Delaware	200,464	$ 531,379.18	$ 2.65	Coshocton	36,544	$ 51,360.06	$ 1.41
Sandusky	59,195	$ 121,999.60	$ 2.06	Butler	380,604	$ 555,391.00	$ 1.46	Tuscarawas	92,297	$ 136,838.93	$ 1.48
Ottawa	40,657	$ 134,219.14	$ 3.30	Montgomery	531,542	$ 685,091.39	$ 1.29	Hocking	28,474	$ 43,188.05	$ 1.52
Allen	103,198	$ 143,795.23	$ 1.39	Summit	541,228	$ 990,636.40	$ 1.83	Washington	60,418	$ 91,737.16	$ 1.52
Erie	74,817	$ 153,383.81	$ 2.05	Hamilton	813,822	$ 1,376,629.47	$ 1.69	Clermont	204,214	$ 311,372.67	$ 1.52
Miami	105,122	$ 173,372.12	$ 1.65	Franklin	1,291,981	$ 2,055,226.26	$ 1.59	Guernsey	39,093	$ 60,681.33	$ 1.55
Clark	134,557	$ 176,280.72	$ 1.31	Cuyahoga	1,248,514	$ 2,089,584.79	$ 1.67	Belmont	68,029	$ 108,302.45	$ 1.59
Wood	130,492	$ 231,485.92	$ 1.77	Stark	372,542	$ 6,926,027.80	$ 18.59	Holmes	43,957	$ 75,493.60	$ 1.72
Lucas	430,887	$ 542,008.47	$ 1.26	Total	7,692,997	$ 19,338,916.74	$ 2.51	Noble	14,406	$ 26,699.43	$ 1.85
Hancock	75,754	$ 9,317,669.20	$ 123.00					Adams	27,726	$ 60,124.20	$ 2.17
Total	1,966,107	$ 12,430,433.16	$ 6.32					Monroe	13,946	$ 31,222.42	$ 2.24
								Carroll	27,385	$ 62,595.68	$ 2.29
								Harrison	15,216	$ 39,221.24	$ 2.58
								Total	1,999,505	$ 2,741,032.48	$ 1.37

Property damage is not the only loss associated with summer storms and hail. Over the analysis period, 13 deaths and 98 injuries were attributed to these events. Of the injuries reported, 20 are attributed to a single event in Franklin County, which involved a campground.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

The Vulnerability Analysis and Loss Estimation above estimated the damage to each county by using the historical available for that county and the average statewide loss to determine an annual "total building value loss" percentage. This percentage was multiplied by the countywide taxable value of real property to determine an estimated annual damage. To estimate the losses for State-owned and State-leased critical facilities, the total value of State-owned and State-leased Critical Facilities of each county was multiplied by the county's respective percentage of Total Building Value loss. The results are tabulated in Tables 2.12.c and 2.12.d below.

Results- Thunderstorm Winds (Table 2.12.c)

Estimated Annual Damage to State-owned and State-leased Critical Facilities- Thunderstorm Winds											
Region 1				Region 2				Region 3			
County	Number of Critical Facilities	Value of State Critical Facilities	Estimated Annual Damage	County	Number of Critical Facilities	Value of State Critical Facilities	Estimated Annual Damage	County	Number of Critical Facilities	Value of State Critical Facilities	Estimated Annual Damage
Allen	120	$ 90,950,176.00	$ 5,562.47	Ashland	143	$ 64,539,880.00	$ 9,118.85	Adams	24	$ 6,622,981.00	$ 653.42
Auglaize	21	$ 11,545,804.00	$ 1,124.25	Butler	21	$ 17,563,033.00	$ 1,074.15	Ashtabula	62	$ 20,008,110.00	$ 1,863.93
Champaign	24	$ 5,161,316.00	$ 315.66	Clinton	22	$ 11,528,821.00	$ 705.10	Athens	31	$ 45,496,640.00	$ 26,501.19
Clark	17	$ 8,868,061.00	$ 542.37	Cuyahoga	84	$ 248,840,544.00	$ 15,218.98	Belmont	62	$ 54,856,808.00	$ 5,209.80
Crawford	13	$ 10,357,812.00	$ 2,144.42	Delaware	37	$ 46,217,477.00	$ 2,826.64	Brown	18	$ 36,403,605.00	$ 3,554.26
Darke	27	$ 8,619,026.00	$ 527.14	Fairfield	78	$ 86,519,830.00	$ 5,291.51	Carroll	17	$ 3,661,999.00	$ 592.21
Defiance	11	$ 7,562,674.00	$ 462.53	Fayette	26	$ 5,118,182.00	$ 313.03	Clermont	38	$ 17,885,810.00	$ 1,093.89
Erie	54	$ 162,265,731.00	$ 27,208.88	Franklin	249	$ 2,147,726,878.00	$ 131,354.03	Columbiana	38	$ 13,835,662.00	$ 1,767.10
Fulton	16	$ 4,397,188.00	$ 268.93	Geauga	24	$ 8,594,197.00	$ 525.62	Coshocton	19	$ 12,943,450.00	$ 3,350.99
Hancock	23	$ 16,195,898.00	$ 6,872.05	Greene	25	$ 10,629,296.00	$ 650.08	Gallia	71	$ 35,860,837.00	$ 19,488.86
Hardin	12	$ 4,141,282.00	$ 345.17	Hamilton	35	$ 173,140,806.00	$ 10,589.22	Guernsey	54	$ 39,704,477.00	$ 8,293.19
Henry	14	$ 3,113,844.00	$ 190.44	Knox	34	$ 40,507,246.00	$ 7,498.82	Harrison	30	$ 9,054,441.00	$ 1,821.45
Huron	22	$ 10,543,997.00	$ 1,829.21	Lake	21	$ 5,525,021.00	$ 337.91	Highland	8	$ 9,690,902.00	$ 592.69
Logan	1	$ 735,568.00	$ 44.99	Licking	64	$ 168,043,312.00	$ 10,277.45	Hocking	19	$ 7,123,096.00	$ 435.65
Lucas	47	$ 276,597,391.00	$ 16,916.57	Lorain	90	$ 110,138,241.00	$ 6,736.01	Holmes	25	$ 10,336,112.00	$ 1,170.04
Marion	100	$ 128,613,896.00	$ 63,140.00	Madison	109	$ 321,691,881.00	$ 19,674.53	Jackson	18	$ 15,130,501.00	$ 6,631.88
Mercer	26	$ 7,655,738.00	$ 468.22	Medina	22	$ 18,601,644.00	$ 1,137.67	Jefferson	37	$ 7,592,901.00	$ 1,283.33
Miami	23	$ 10,005,576.00	$ 611.94	Montgomery	71	$ 77,351,496.00	$ 4,730.78	Lawrence	27	$ 11,760,373.00	$ 3,032.74
Ottawa	75	$ 65,291,745.00	$ 7,949.00	Morrow	21	$ 6,874,959.00	$ 2,156.32	Mahoning	66	$ 72,389,280.00	$ 4,427.30
Paulding	3	$ 1,387,796.00	$ 84.88	Pickaway	133	$ 195,643,558.00	$ 11,965.47	Meigs	18	$ 8,512,106.00	$ 7,147.86
Preble	24	$ 4,859,547.00	$ 297.21	Portage	25	$ 7,594,529.00	$ 888.12	Monroe	22	$ 11,202,381.00	$ 1,165.88
Putnam	18	$ 5,590,738.00	$ 341.93	Richland	73	$ 109,750,465.00	$ 14,212.53	Morgan	10	$ 3,700,608.00	$ 1,065.79
Sandusky	15	$ 5,519,069.00	$ 2,222.72	Stark	41	$ 102,066,812.00	$ 6,242.36	Muskingum	25	$ 10,647,135.00	$ 1,378.30
Seneca	49	$ 33,546,722.00	$ 11,123.63	Summit	67	$ 201,182,298.00	$ 12,304.22	Noble	31	$ 50,299,353.00	$ 5,692.01
Shelby	35	$ 26,824,309.00	$ 1,640.56	Union	53	$ 88,869,557.00	$ 5,435.22	Perry	16	$ 3,884,728.00	$ 1,595.85
Van Wert	13	$ 7,459,562.00	$ 456.22	Warren	109	$ 150,201,626.00	$ 9,186.27	Pike	10	$ 3,878,547.00	$ 533.61
Williams	13	$ 5,459,757.00	$ 333.92	Wayne	6	$ 7,056,104.00	$ 431.55	Ross	142	$ 265,584,512.00	$ 16,243.03
Wood	36	$ 67,981,624.00	$ 5,814.18	Total	1,683	$ 4,431,517,693.00	$ 290,882.42	Scioto	55	$ 171,351,723.00	$ 10,479.80
Wyandot	19	$ 10,280,904.00	$ 4,293.17					Trumbull	60	$ 55,012,652.00	$ 5,364.99
Total	871	$ 1,001,532,751.00	$ 163,132.66					Tuscarawas	53	$ 56,132,900.00	$ 7,959.81
								Vinton	20	$ 5,854,782.00	$ 2,205.71
								Washington	55	$ 29,149,164.00	$ 10,647.63
								Total	1,181	$ 1,105,568,576.00	$ 163,244.16

Results- Hail (Table 2.12.d)

Estimated Annual Damage to State-owned and State-leased Critical Facilities- Hail											
Region 1				Region 2				Region 3			
County	Number of Critical Facilities	Value of State Critical Facilities	Estimated Annual Damage	County	Number of Critical Facilities	Value of State Critical Facilities	Estimated Annual Damage	County	Number of Critical Facilities	Value of State Critical Facilities	Estimated Annual Damage
Allen	120	$ 90,950,176.00	$ 7,161.06	Ashland	143	$ 64,539,880.00	$ 5,081.61	Adams	24	$ 6,622,981.00	$ 962.53
Auglaize	21	$ 11,545,804.00	$ 909.07	Butler	21	$ 17,563,033.00	$ 1,382.84	Ashtabula	62	$ 20,008,110.00	$ 1,575.36
Champaign	24	$ 5,161,316.00	$ 406.38	Clinton	22	$ 11,528,821.00	$ 907.73	Athens	31	$ 45,496,640.00	$ 3,582.23
Clark	17	$ 8,868,061.00	$ 698.24	Cuyahoga	84	$ 248,840,544.00	$ 19,592.72	Belmont	62	$ 54,856,808.00	$ 4,319.21
Crawford	13	$ 10,357,812.00	$ 815.53	Delaware	37	$ 46,217,477.00	$ 3,638.98	Brown	18	$ 36,403,605.00	$ 2,866.28
Darke	27	$ 8,619,026.00	$ 678.63	Fairfield	78	$ 86,519,830.00	$ 6,812.23	Carroll	17	$ 3,661,999.00	$ 288.33
Defiance	11	$ 7,562,674.00	$ 595.46	Fayette	26	$ 5,118,182.00	$ 402.99	Clermont	38	$ 17,885,810.00	$ 1,408.26
Erie	54	$ 162,265,731.00	$ 12,776.16	Franklin	249	$ 2,147,726,878.00	$ 169,103.51	Columbiana	38	$ 13,835,662.00	$ 1,089.37
Fulton	16	$ 4,397,188.00	$ 346.22	Geauga	24	$ 8,594,197.00	$ 676.67	Coshocton	19	$ 12,943,450.00	$ 1,019.12
Hancock	23	$ 16,195,898.00	$ 84,056.18	Greene	25	$ 10,629,296.00	$ 836.91	Gallia	71	$ 35,860,837.00	$ 2,823.54
Hardin	12	$ 4,141,282.00	$ 326.07	Hamilton	35	$ 173,140,806.00	$ 13,632.42	Guernsey	54	$ 39,704,477.00	$ 3,126.17
Henry	14	$ 3,113,844.00	$ 245.17	Knox	34	$ 40,507,246.00	$ 3,189.38	Harrison	30	$ 9,054,441.00	$ 712.91
Huron	22	$ 10,543,997.00	$ 830.19	Lake	21	$ 5,525,021.00	$ 435.02	Highland	8	$ 9,690,902.00	$ 763.02
Logan	1	$ 735,568.00	$ 57.92	Licking	64	$ 168,043,312.00	$ 13,231.07	Hocking	19	$ 7,123,096.00	$ 560.84
Lucas	47	$ 276,597,391.00	$ 21,778.18	Lorain	90	$ 110,138,241.00	$ 8,671.85	Holmes	25	$ 10,336,112.00	$ 813.82
Marion	100	$ 128,613,896.00	$ 10,126.55	Madison	109	$ 321,691,881.00	$ 25,328.75	Jackson	18	$ 15,130,501.00	$ 1,191.32
Mercer	26	$ 7,655,738.00	$ 602.78	Medina	22	$ 18,601,644.00	$ 1,464.62	Jefferson	37	$ 7,592,901.00	$ 597.83
Miami	23	$ 10,005,576.00	$ 787.80	Montgomery	71	$ 77,351,496.00	$ 6,090.35	Lawrence	27	$ 11,760,373.00	$ 925.97
Ottawa	75	$ 65,291,745.00	$ 5,140.81	Morrow	21	$ 6,874,959.00	$ 541.31	Mahoning	66	$ 72,389,280.00	$ 5,699.65
Paulding	3	$ 1,387,796.00	$ 109.27	Pickaway	133	$ 195,643,558.00	$ 15,404.20	Meigs	18	$ 8,512,106.00	$ 670.21
Preble	24	$ 4,859,547.00	$ 382.62	Portage	25	$ 7,594,529.00	$ 597.96	Monroe	22	$ 11,202,381.00	$ 882.03
Putnam	18	$ 5,590,738.00	$ 440.19	Richland	73	$ 109,750,465.00	$ 8,641.32	Morgan	10	$ 3,700,608.00	$ 291.37
Sandusky	15	$ 5,519,069.00	$ 565.57	Stark	41	$ 102,066,812.00	$ 103,210.28	Muskingum	25	$ 10,647,135.00	$ 838.31
Seneca	49	$ 33,546,722.00	$ 2,641.34	Summit	67	$ 201,182,298.00	$ 17,837.94	Noble	31	$ 50,299,353.00	$ 3,960.37
Shelby	35	$ 26,824,309.00	$ 2,112.04	Union	53	$ 88,869,557.00	$ 6,997.24	Perry	16	$ 3,884,728.00	$ 305.87
Van Wert	13	$ 7,459,562.00	$ 587.34	Warren	109	$ 150,201,626.00	$ 11,826.28	Pike	10	$ 3,878,547.00	$ 305.38
Williams	13	$ 5,459,757.00	$ 429.88	Wayne	6	$ 7,056,104.00	$ 555.57	Ross	142	$ 265,584,512.00	$ 20,911.07
Wood	36	$ 67,981,624.00	$ 5,352.60	Total	1,683	$ 4,431,517,693.00	$ 446,091.75	Scioto	55	$ 171,351,723.00	$ 13,491.56
Wyandot	19	$ 10,280,904.00	$ 1,742.70					Trumbull	60	$ 55,012,652.00	$ 4,331.48
Total	871	$ 1,001,532,751.00	$ 162,701.95					Tuscarawas	53	$ 56,132,900.00	$ 4,419.68
								Vinton	20	$ 5,854,782.00	$ 460.98
								Washington	55	$ 29,149,164.00	$ 2,295.09
								Total	1,181	$ 1,105,568,576.00	$ 87,489.16

2.13 INVASIVE SPECIES

The National Wildlife Federation defines invasive species as any living organism, whether amphibian, plant, insect, fish, fungus, bacteria, or even an organism's seeds or eggs, that is not native to an ecosystem and causes harm. These species can harm the environment, the economy, and even human health. In addition, species that can grow and reproduce quickly, spread aggressively, and have potential to cause harm are identified as "invasive".

According to the ODNR, Division of Natural Areas & Preserves, of the approximately 2,300 species of plants known to occur in Ohio, about 78% are native or have occurred in Ohio before the time of substantial European settlement (1750). The other 22% of species are not native to the state. Non-native plants have been introduced for erosion control, horticulture, forage crops, medicinal use, wildlife foods, or by accident. Most of these species never stray far from where they are introduced, but some become very invasive and displace native plants throughout the state.

Without natural predators or controls, invasive, non-native plants are able to spread quickly and force out native plants. Other non-native plants are impacting our wetlands by creating monocultures. Native plant diversity is important for wildlife habitat, as many animals depend on a variety of native plants for food and cover.

More information about invasive species in Ohio can be found on ODNR's website: http://ohiodnr.gov/invasivespecies, USFWS' website: https://www.fws.gov/invasives/, Early Detection & Distribution Mapping System (EDDMapS) website: https://www.eddmaps.org/, and the USDA National Invasive Species Information Center: https://www.invasivespeciesinfo.gov/index.shtml.

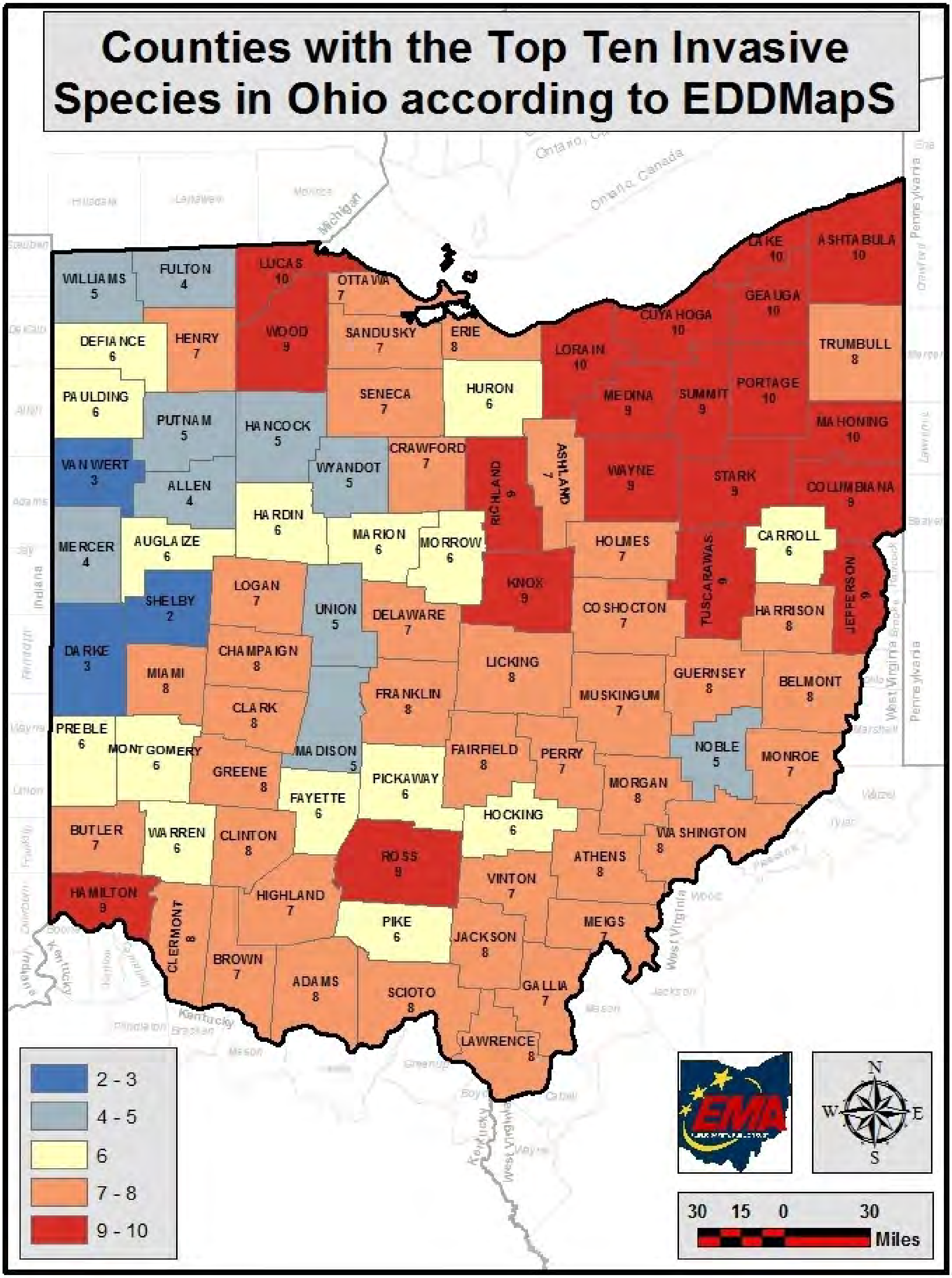
The top ten invasive plant species in Ohio are:

- Bush Honeysuckles
- Autumn – Olive
- Buckthorns
- Common Reed Grass
- Garlic Mustard
- Japanese Honeysuckle
- Japanese Knotweed
- Multiflora Rose
- Purple Loosestrife
- Reed Canary Grass

Per ODNR, aquatic invasive species (AIS) include both plants and animals that have been introduced to our waterways and have become harmful to native species and their habitats. AIS may live entirely within or partially in an aquatic habitat. Below is a list of some Ohio's top AIS threats. The list is not fully inclusive and the USGS maintains an additional list of AIS in the U.S.

Some of Ohio's top AIS are:

- Asian Carp (Bighead Carp, Silver Carp, Black Carp, Diploid Grass Carp)
- Curlyleaf Pondweed
- Hydrilla
- Round Goby
- Ruffe
- Red Swamp Crayfish
- Sea Lamprey
- White Perch
- Zebra Mussel



Counties with the Top Ten Invasive Species in Ohio according to EDDMapS
WILLIAMS 5
FULTON 4
LUCAS 10
OTTAWA 7
DEFIANCE 6
HENRY 7
WOOD 9
SANDUSKY 7
ERIE 8
LAKE 10
ASHTABULA 10
GEAUGA 10
CUYAHOGA 10
LORAIN 10
TRUMBULL 8
PAULDING 6
PUTNAM 5
HANCOCK 5
SENECA 7
HURON 6
MEDINA 9
SUMMIT 9
PORTAGE 10
MAHONING 10
VAN WERT 3
ALLEN 4
WYANDOT 5
CRAWFORD 7
RICHLAND 9
ASHLAND 7
WAYNE 9
STARK 9
COLUMBIANA 9
MERCER 4
AUGLAIZE 6
HARDIN 6
MARION 6
MORROW 6
HOLMES 7
TUSCARAWAS 9
CARROLL 6
JEFFERSON 9
SHELBY 2
LOGAN 7
UNION 5
DELAWARE 7
KNOX 9
COSHOCTON 7
HARRISON 8
DARKE 3
MIAMI 8
CHAMPAIGN 8
LICKING 8
GUERNSEY 8
BELMONT 8
CLARK 8
FRANKLIN 8
MUSKINGUM 7
PREBLE 6
MONTGOMERY 6
GREENE 8
MADISON 5
FAIRFIELD 8
PERRY 7
NOBLE 5
MONROE 7
PICKAWAY 6
FAYETTE 6
MORGAN 8
HOCKING 6
BUTLER 7
WARREN 6
CLINTON 8
ROSS 9
WASHINGTON 8
ATHENS 8
VINTON 7
HAMILTON 9
HIGHLAND 7
CLERMONT 8
PIKE 6
JACKSON 8
MEIGS 7
BROWN 7
ADAMS 8
SCIOTO 8
GALLIA 7
LAWRENCE 8
Ontario, Canada
Michigan
Indiana
Kentucky
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Lastly, according to the ODNR, Division of Forestry, one of the most invasive insect species in Ohio is the Emerald Ash Borer. This Asian pest is part of a group of insects known as metallic wood-boring beetles. Emerald Ash Borer affects all species of native ash found in Ohio. Because North American ash trees did not coexist in association with this pest, they have little or no resistance to its attack. This ash tree-killing insect from Asia was unintentionally introduced to southeastern Michigan several years ago. Emerald Ash Borer larvae feed on the living portion of the tree, directly beneath the bark. This eating habit restricts the tree's ability to move essential water and nutrients throughout the plant. In three to five years, even the healthiest tree is unable to survive an attack.

RISK ASSESSMENT

The area invaded by each plant species varies based on its preferred environment. Those with the fewest limitations have spread to nearly every county in Ohio. The Emerald Ash Borer is currently found in all 88 counties in Ohio, six neighboring states and the province of Ontario.

The State Management Plan for AIS, produced by the Ohio Department of Natural Resources, prioritizes AIS into two categories based on the degree of negative impact. High-risk species are those that currently cause or could potentially cause significant harm, while medium risk species are those that have a lesser impact, but are still a cause for concern. Below are the high-risk and medium-risk AIS that are the most concerning in the United States. While not all of these AIS are currently present in the State of Ohio, there is still a potential risk for the future.

The high-risk AIS are:

- Asian Carp
- Northern Snakehead
- Sea Lamprey
- Round & Tubenose Goby
- Zebra & Quagga Mussels

The medium-risk AIS are:

- Alewife
- River Ruffe
- Spiny & Fishhook water flea

LHMP DATA

Mercer County

The most recent invasive species to impact Mercer County is the Emerald Ash Borer (EAB). EAB is an ash-tree killing insect native to Asia; it kills trees within three to five years of infestation. It was first discovered in Ohio in 2003. Since that time, the Ohio Department of Agriculture and partner agencies have worked to protect the state's 3.8 billion ash trees. Mercer County is not the most impacted area of Ohio but it has experienced effects of the EAB infestation. As diseased trees along waterways have died, they have fallen into the waterways, impacting drainage and the flow of water. Diseased trees along the public right-of-way have also impacted infrastructure, as they are more likely to fall during a storm or high wind event. The Mercer County Engineer and jurisdiction street and road departments have aggressively removed diseased trees along the public right-of-way, which has been effective at reducing the impact on utility lines and other infrastructure

In recent years, Grand Lake St. Marys has been affected by multiple blue-green algae blooms. The algae, which is thought to be caused by increased quantities of phosphorous and nitrogen in runoff water, can produce toxic bacteria that is harmful to plants, animals, and humans. In 2010, the lake was declared unsafe for contact, including boating and swimming, due to an algal bloom. Because of the lake's importance to the economy of the region, this had a serious impact on businesses in the region. In October 2010, the U.S. Small Business Administration issued a declaration of economic injury for Mercer County and the region surrounding the lake. This declaration made loans available to small businesses and non-profit organizations negatively impacted by the algal bloom on the lake. While algal blooms have occurred on the lake since 2010, none have reached the magnitude and economic impact of this incident.

Putnam County

According to searches and reviews of online information provided by the Ohio Division of Forestry and the Ohio Department of Agriculture, Putnam County is susceptible to several infestations: European Gypsy Moth; Asian long horned beetles; mosquitoes infected with the West Nile Virus; spider mites; cicadas; the pine shoot beetle; and the Emerald Ash Borer.

Currently affecting the county is a European strain of gypsy moth which is one of the most destructive defoliating insects to attack the trees and forests of the northeastern United States. Impacts of a gypsy moth infestation include economic losses through timber mortality, loss of recreational opportunities in severely defoliated areas, and nuisances from gypsy moth caterpillars. A State Gypsy Moth quarantine was established in 1987. The Division of Forestry mitigation efforts have been successful in containing the gypsy moth infestation. Putnam County has yet to experience significant damages as a result of an infestation.

According to the Division of Forestry, the spring of 2004 saw an infestation of Brood X Cicadas in the southern portion of Putnam County. These cicadas were last seen in 1987. Adult cicadas damage deciduous trees especially when the female cicada lays her eggs. Cicada infestation can be mitigated against by careful pruning, covering smaller trees with cheesecloth, or spraying insecticide. The pine shoot beetle infests many species of pine, but Scotch pine is the preferred host. Cosmetic damage to pines growing on Christmas tree farms and nurseries may result in reduced product quality and substantial economic loss.

Emerald Ash Borer, an ash tree-killing insect from Asia, was identified in Ohio in 2003. Despite the fact that the Ohio quarantine has been lifted, to prevent the spread of EAB and other pests, it is still recommended that Ohioans continue to exercise caution when moving firewood. EAB kills ash trees within three to five years of infestation. Adults are dark metallic green, 1/2 inch in length and 1/8 inch wide, and fly only from mid-May to September. Larvae spend the rest of the year developing beneath the bark

HAZARD PROFILE

The probability of a large-scale infestation actually occurring in Putnam County is relatively low, with only moderate associated risk to human life. The recurrence frequency interval for this type of event is difficult to calculate, as infestations are not a rapid onset and subsidence type of event. Infestation is a long term invasion on an area and therefor assigning a statistical frequency of infestation would inaccurately assess the impact of such an event.

INVENTORY ASSETS EXPOSED TO INFESTATION

Infestation does not directly pose a threat to county facilities or human life at this time. This does not preclude the potential for a life threatening infestation or structurally damaging one in the future.

POTENTIAL LOSSES

Infestation is most likely to occur in the acres of forested or farmland and will likely cause no damage to structural assets; however, it may cause significant economic loss. Infestation is considered as a hazard in Putnam County due to the high percentage of agricultural and forestland in the county.

HIRA SUMMARY

Putnam County is susceptible to several infestations that may impact agricultural and forested portions of the county. Economic losses pose the greatest threat to the county and as such mitigation efforts

Clark County

Clark County is subject to both insect and plant evasive species. Although there are over 3,000 species of plants known to occur in Ohio, about 75% are native or have occurred in Ohio before the time of Europeans (1750). Some of those that have invaded Ohio displace native plants and disrupt woodlands, prairies, wetlands, and natural areas.

Those plants that typically have been the most invasive for Clark County residents include:

- Bush Honeysuckle
- Garlic Mustard
- Multiflora Rose
- Autumn Olive
- Callery Pear (Bradford Pear)

According to the ODNR Division of Forestry, one of the most prevalent invasive insect species is the Emerald Ash Borer. It is an Asian wood-boring beetle and affects all species of native ash trees found in Ohio. In 2003, other invasive species to affect Clark County include the Gypsy Moth Caterpillars and Spider Mites. Most recently found in southwest Ohio is the Asian Longhorned Beetle (AJB) which attacks broadleaf trees, particularly maples. An infestation is to spread or swarm in or over in a troublesome manner. Also, to live in or on as a parasite.

The probability of an infestation hazard event actually occurring in Clark County is relatively low, with only moderate risk associated with it. Infestation is most likely to occur in the 30,720 acres of forested or the 257,920 acres of farmland and will likely cause no damage to structural assets. Infestation is considered as a hazard in Clark County due to the high percentage of agricultural and forestland in the county. The Asian Long-Horned Beetle (ALB) has been discovered in Southwest Ohio east of Cincinnati by the U.S. Department of Agriculture. Ohio is the 5th state to detect ALB. These beetles attack a wide variety of broadleaf trees particularly Maples.

There are about 60 species of invasive plants identified in Ohio. Invasive species can cause economic and environmental damages in communities. Clark County is currently participating in a 22 county Woodland Invasive Species Program launched to promote healthier forests. Invasive Bush Honeysuckle is one of the most prevalent invasive species in Clark County. Invasive species plants are usually characterized by fast growing, rapid vegetation spread, and efficient speed dispersal and germination. Since these plants are not native to Ohio, they lack the natural predators and disease which would naturally control them in their native habitats.

Past Occurrences

Invasive species have been around since the settlers of the 1750's. Movement of people and transportation has made the spread of invasive species more prevalent. The Emerald Ash Borer was introduced in the U.S. in the 1990's from wood packing material from China, first being discovered in Lower Michigan, spreading to Ohio, Maryland, Pennsylvania, northern Indiana, and Chicago.

Probability of Future Events

Invasive species will continue to affect Ohio. With the increase in worldwide trade and the fast modes of transportation, the invasive species will continue to occur. Just as the Asian Longhorned Beetle has recently been discovered in southwest Ohio, new species of unwanted pests will come. The importance of controlling the natural environment native to Clark County will require local, state, nationwide, and international cooperation to avoid unwanted infestations of invasive species.

PAST OCCURRENCES

Invasive species of plants, fish, and insects have been arriving in Ohio since the establishment of European settlers in the 1750s. With each improvement in the scale and speed of human transportation, the potential for unintended introduction of invasive species has increased. Organisms which could not survive the month-long journey from Europe or Africa to America can make the journey in a matter of hours today. Several examples of species introduction pathways follow.

The Round Goby species was introduced from Eurasia into the St. Clair River and vicinity on the Michigan-Ontario border where several collections were made in 1990 on both the U.S. and the Canadian side. Speculation exists the Goby was transported from its native Caspian Sea by way of ballast tanks on ocean-going vessels. Today, the Goby is found in all the Great Lakes and is making inroads in all contiguous state watersheds.

The Multiflora Rose was introduced to the U.S. from Japan in 1886 as an under-stock for ornamental roses. Birds are responsible for spreading the seeds, which remain viable for a number of years. In the 1930s, the Soil Conservation Services advocated the use of Multiflora Rose for erosion projects and as a way to confine livestock. Hedges of Multiflora Rose have also been used as a crash barrier and to reduce headlight glare in highway medians.

The Emerald Ash Borer was introduced into North America sometime in the 1990's. The insect is believed to have been introduced into the U.S. in wood packing material from China. It was first reported killing ash trees in the Detroit and Windsor areas in 2002. Only species of ash are hosts for the beetle, which usually kill infested trees within a couple of years. Since then, infestations have been found throughout Lower Michigan, Ohio, Indiana, the Chicago area, Maryland and recently in Pennsylvania.

Considering the thousands of plant, dozens of aquatic and unknown number of insect species introduced into Ohio over the past 250 years, samples of the most often cited transfer media are provided here. Exotic species can arrive by a nearly endless number of vectors making a complete listing impossible.

PROBABILITY OF FUTURE EVENTS

Since the beginning of European colonization, non-native species have been arriving in Ohio. With the increase in global trade and travel, the probability of new and unexpected species arriving in Ohio will continue to grow. Legislation is in place around the world in an attempt to control the migration of unwanted species between ecosystems.

ODNR is currently battling the entrance of wild boars from Kentucky and West Virginia. The greatest concentration of verified populations can be found in the unglaciated region of southeastern Ohio. In addition, there are several species of carp currently migrating up the Mississippi watershed from the Gulf

Coast. Per the ODNR, Division of Fish Management and Research, silver and bighead carp are already present in the upper reaches of the Ohio River system in Ohio. The state hopes to seal off all areas where the Ohio River basin and the Lake Erie basin meet. None of the species considered Asian Carp have yet to establish themselves in the Lake Erie basin.

It is certain that new wanted and unwanted species will arrive in Ohio. The importance of controlling the integrity of existing ecosystems will require ongoing state, national and international efforts to avoid unwanted infestations. To this end, the State enacted new rules in January 2018 to make the sale and distribution of 38 invasive species illegal. In addition to the newly illegal plants, the Department of Agriculture assembled an invasive plant committee to review potential future additions to the no-sale list. The 2018 list is available at http://www.agri.ohio.gov/divs/Plant/Forms/InvasivePlantsNewsletter.pdf

VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

Impacts of invasive species tend to have commercial operational impacts, as opposed to many built environment impacts of the other hazards covered. Due to this unique situation, rather than a matrix listing county losses, the loss estimates will be presented using historical response costs to predict future losses in unadjusted dollars.

RESULTS

From the perspective of invasive plant species, the Multiflora Rose is one of most expensive to combat in Ohio. Each individual plant's ability to produce 500,000 seeds a year allows this invasive species to spread over large areas with incredible speed. Agricultural groups are facing the highest exposure and expense in the form of infiltration of croplands and eradication programs. According to agricultural experts associated with the Ohio State University, Ohioans are estimated to spend millions of dollars combating the Multiflora Rose. Precise dollar figures are not available due to the majority of response activities being performed by non-governmental entities.

Turning to invasive aquatic species, the Zebra Mussel is one of the most expensive to control. The mussels naturally collect on any solid surface and create significant problems for drinking water processing facilities and utilities. All in-water structures are impacted including, but not limited to, piers, breakwalls, vessel hulls and vessel engines cooled with external water. Estimates for controlling infestations run between $2 and $10 million per year depending on how many sources are aggregated. Should the Zebra Mussel effectively invade the river systems of Ohio, it is suggested the annual control costs could rise 10-fold.

Invasive insect species are both the direct source of damage to trees and a vector for other parasites. In the last century, the North American population of Elm trees was decimated by a fungus which arrived on infected trees shipped to an Ohio furniture company. One of the primary transport methods is though beetles which the fungus uses as a host to move from tree to tree. The beetle's ability to fly exponentially increased the number of trees impacted. Trees located in non-urban areas posed financial impact only to loggers; however, the Elm was a popular urban tree and the cost to remove them ran into the millions over the years.

The Emerald Ash Borer, which is currently impacting the North American Ash tree, has already cost millions of dollars in attempts to identify and isolate infected trees. In Ohio alone, there are an estimated 5 billion Ash trees at risk. Although many research centers are searching for an effective means of combating the insect, the only method currently available is the use of insecticides which have to be applied annually. The uncaptured cost to treat Ash trees in Ohio will likely reach into the millions, as urban areas combat the insect.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Similar to drought in Section 2.11, invasive species have a very limited impact on state-owned or state-leased facilities. The most prominent impact to state facilities relates to the maintenance of marinas in Zebra Mussel impacted areas. These mussels can clog inlets that could affect facilities, but not in the same manner as many of the other hazards. Also, Emerald Ash Borer could result in significant increases in fuel for wildfires in Region 3, which could adversely affect state facilities.

2.14 LAND SUBSIDENCE

Subsidence is the 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 1900s, underground salt, limestone, and gypsum mining began. All mining activities 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, and development on the ground surface. Abandoned underground coal mines in Ohio have the added environmental impact of discharging acidic water. If acidic mine water is discharged into creeks or streams, it can alter the chemical composition of the water habitat and cause considerable harm to sensitive aquatic life.

Per the ODNR, Division of Geological Survey, karst is a little-known, but unique and important landform that can be found throughout the state of Ohio. Regions that contain sinkholes and other solutional features, such as caves, springs, disappearing streams, and enlarged fractures, are known as karst terrains. Sinkholes form as bedrock dissolves and surface materials erode or collapse into the resulting voids. Sinkholes are the main hazard associated with karst landforms in Ohio, and there are thousands of them in the state.

The last form of land subsidence in Ohio is associated with soils, which dramatically expand when wet and contract when dry. Structures built on these soils can experience significant shifting as the ground saturates and dries.

HAZARD PROFILE

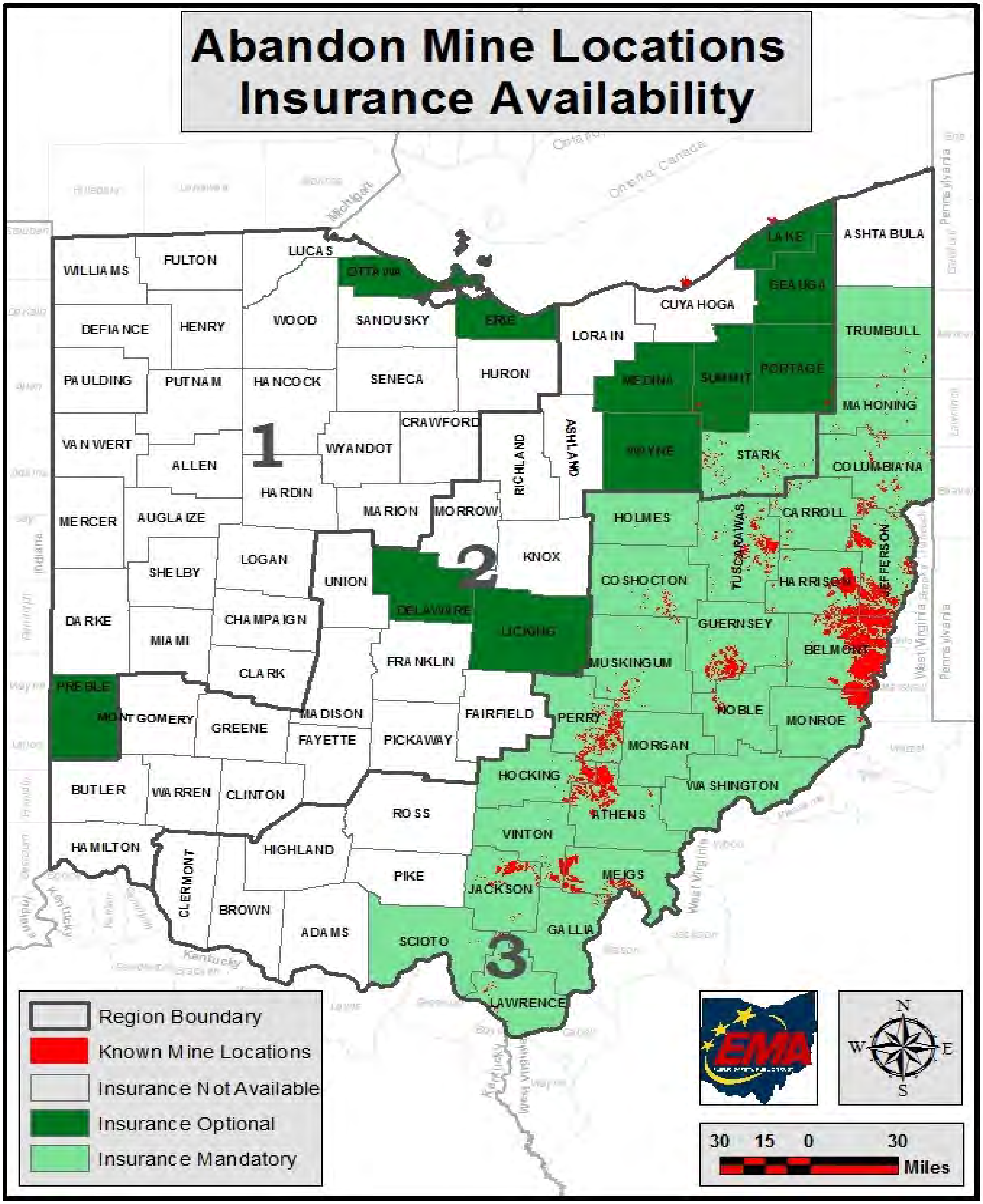
LOCATION

Beginning in the 1700s and continuing to today, there has been considerable coal mining in the Appalachian region of Ohio. In addition to coal, several salt, clay, and gypsum mines opened in counties close to Lake Erie. Finally, in central and southwestern Ohio, there are several isolated mines (Map 2.14a).

ODNR and the Ohio Department of Transportation (ODOT) actively inventories these geologic hazards and conducts risk assessments to determine the potential impact on the state's transportation infrastructure. Both mapped and unmapped underground mines pose a continued threat of subsidence to Ohio's transportation system. The statewide inventory and risk assessment of these mine sites is an ongoing process. Per the ODNR, Division of Mineral Resources Management, there are:

- 283 Surface Coal Mine Operation (203 active, 1118 released, 2502 abandoned, 2444 inactive & awaiting release)
- 26 Active Underground Coal Mines (permitted)
- 1,908 Surface IM Operations (828 active, 1080 released)
- 7 Active Underground IM Mines
- 3,606 Abandoned Underground Mines (Known)
- 6,450 Abandoned Surface Mines (based on topo maps and aerial reconnaissance)

Map 2.14a


Abandon Mine Locations
Insurance Availability
Region Boundary
Known Mine Locations
Insurance Not Available
Insurance Optional
Insurance Mandatory
1
2
3
WILLIAMS
FULTON
LUCAS
OTTAWA
DEFIANCE
HENRY
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
LAKE
ASHTABULA
GEAUGA
TRUMBULL
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
MEDINA
SUMMIT
PORTAGE
MAHONING
VAN WERT
ALLEN
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
COLUMBIANA
HARDIN
MERCER
AUGLAIZE
MARION
MORROW
HOLMES
CARROLL
TUSCARAWAS
JEFFERSON
LOGAN
SHELBY
UNION
KNOX
COSHOCTON
HARRISON
DELAWARE
LICKING
DARKE
CHAMPAIGN
MIAMI
GUERNSEY
BELMONT
CLARK
FRANKLIN
MUSKINGUM
PREBLE
MONTGOMERY
MADISON
FAIRFIELD
PERRY
NOBLE
MONROE
GREENE
FAYETTE
PICKAWAY
MORGAN
BUTLER
WARREN
CLINTON
HOCKING
WASHINGTON
ROSS
ATHENS
HAMILTON
CLERMONT
HIGHLAND
VINTON
PIKE
MEIGS
JACKSON
BROWN
ADAMS
SCIOTO
GALLIA
LAWRENCE
Michigan
Ontario, Canada
Indiana
Kentucky
West Virginia
Pennsylvania
N
W
E
S
EMA
30 15 0 30
Miles

The majority of abandoned mines are located in, or directly adjacent to, Region 3, and most of these were coal mines. Coal mine depths can range from less than 100 feet below the surface to 1,000 feet or more. Deeper mines, with solid layers of rock (i.e., strata) above the void and limited soil at the surface, are less likely to fail than those closer to the surface. The ODNR, Division of Geological Survey and ODOT have developed profiles of voids, support strata composition and surface soils for a limited number mines, in order to assist in understanding the potential for subsidence events. Analysis requires experts trained in geology and significant time, which limits the number of sites assessed.

Other minerals mined include gypsum, clay and limestone, primarily in Ottawa, Preble, and Butler counties. Finally, very limited exposure to abandoned mines exists in Hamilton, Lucas, Erie, Delaware, and Licking counties, where the mineral being extracted was not available.

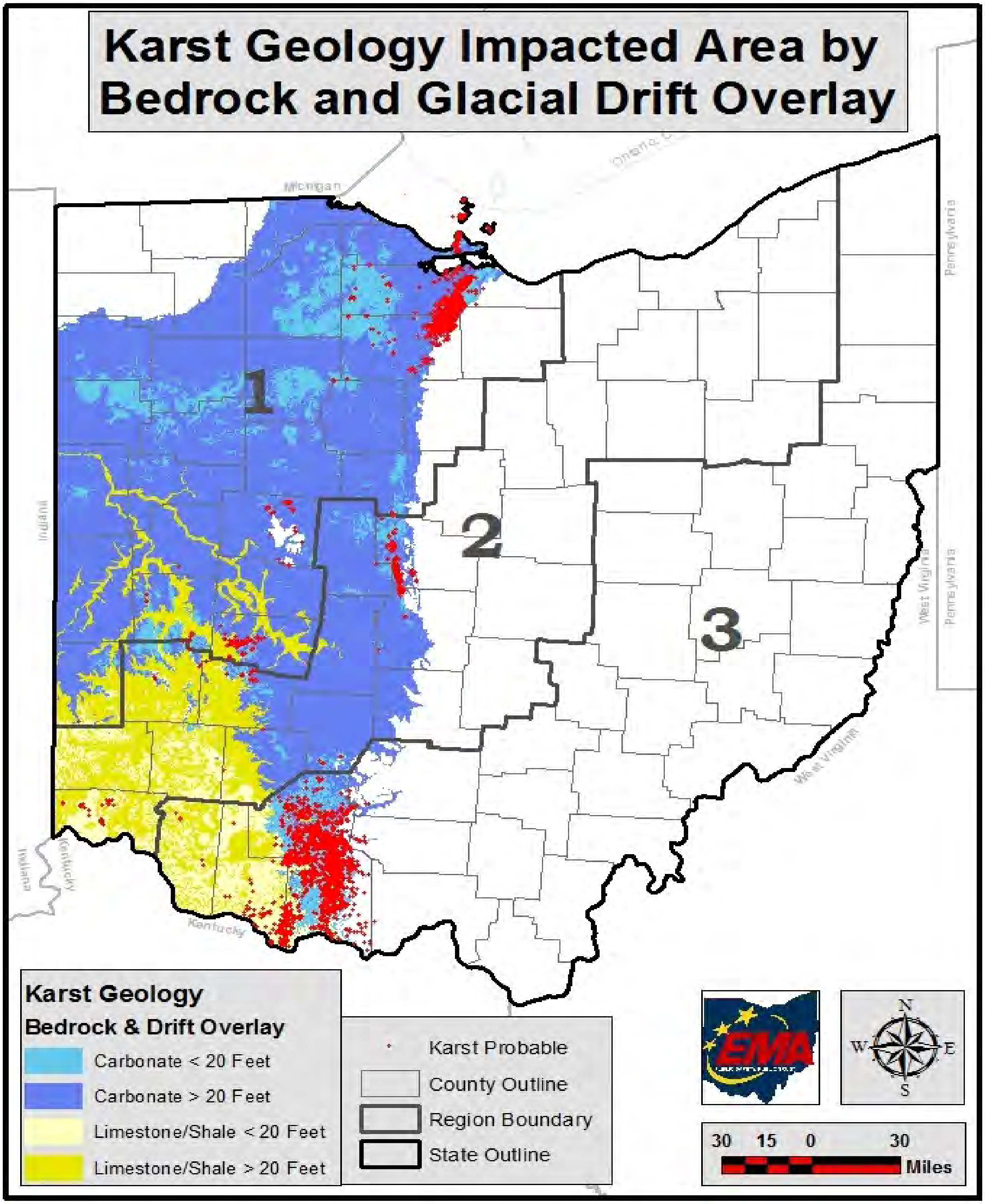
The Ohio Mine Subsidence Insurance Underwriting Association provides eligible Ohio counties with mine subsidence insurance (Map 2.14a). Under the program, 26 primarily Appalachian counties (Region 3) are required to carry mine subsidence insurance at a cost of one dollar annually. Additionally, eight counties in Region 2 and three counties in Region 1 are eligible to obtain insurance at the owner's discretion at a cost of five dollars annually. The remaining 51 counties are not eligible for mine subsidence insurance.

Karst features are associated with the western third of Ohio, excluding the far northwestern counties of Williams, Fulton, and Defiance (Map 2.14b). Nearly all of Region 1 and the far western sections of Regions 2 and 3 are impacted by karst geology. The limestone, shale, and dolomite layers were deposited between 408 and 505 million years ago as the floor of an ancient sea. Later, the continental plate would rise above the existing sea level creating dry land and vast salt deposits. These sedimentary rock layers are naturally porous and dissolve into the water which passes through them.

The current landscape in the karst region of Ohio was created by glaciers as they advanced from the north reaching to the Ohio River roughly 14,000 years ago. When the last glacier receded, it left behind a layer of unconsolidated material in a wide range of depths. The shallower the loose material layer, the greater the chance of water penetrating to the underlying bedrock, resulting in a void or ground deformation occurring. This is represented by the probable karst areas on the map which group into two significant clusters. In the south, the greatest impacted counties include Brown, Adams, and Highland. In the north, the greatest impacted counties include Seneca, Huron, Erie, Sandusky, and Ottawa.

Areas which are reclaimed strip mines and other type of soils poorly suited for development are often mapped by local communities and the Ohio Department of Natural Resources. Ohio's built environment exposure to this type of hazard is very limited.

Map 2.14b


Karst Geology Impacted Area by Bedrock and Glacial Drift Overlay
Michigan
Ontario
Indiana
Pennsylvania
West Virginia
Kentucky
1
2
3
Karst Geology
Bedrock & Drift Overlay
Carbonate < 20 Feet
Carbonate > 20 Feet
Limestone/Shale < 20 Feet
Limestone/Shale > 20 Feet
Karst Probable
County Outline
Region Boundary
State Outline
EMA
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W
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S
30 15 0 30
Miles

LHMP DATA

The City of Bellevue is located within the Bellevue-Castalia Karst Plain and resides within four counties; Erie, Huron, Sandusky, and Seneca. Three of the four counties (Huron did not) indicated that land subsidence was a hazard risk. They recognized that land subsidence, in the form of sinkholes, has a potential to occur, but also notes that there have been no incidents of land subsidence that have resulted in the damage of structures, personal injury, or loss of life. An area of concern for Sandusky County, in regards to land subsidence, is a Class I dam that is located in the southeastern portion of the county.

Sandusky, Erie, and Seneca Counties all have specific mitigation action items related to karst and land subsidence, such as to identify high-risk areas and evaluate land-use planning techniques to mitigate future events.

PAST OCCURRENCES

Abandoned underground mines in Ohio are monitored by the ODNR, Division of Mineral Resources Management, which is primarily federally funded. Within the division, two programs exist to address mine subsidence, one for emergencies and a second for non-emergencies. The emergency program gives priority to events which are directly affecting a structure (within 300 feet) or transportation route. Each year between 50 and 60 investigations are completed generating 25 to 30 projects. The time between the event and response is often within a week. Projects are undertaken to protect lives and property, and can range from simple precautions to filling the void with cement to stabilize the area affected.

Repeated emergency incidents can lead to larger non-emergency response. The City of North Canton (Region 2), Village of Cadiz (Region 3) and Village of New Lexington (Region 3) each experienced repeated emergency events culminating in area-wide engineering studies to address the problems. In each case, comprehensive mitigation activities, including the installation of in-mine support columns and the filling of voids, stabilized large areas which were subsidence-prone.

The most notable transportation-related event occurred in 1986 when an abandoned mine located in Guernsey County collapsed underneath Interstate 70 resulting in the closure of the entire interstate. Remediation included stabilizing the void and repairing the damaged roadway costing over $10 million dollars.

Underground salt mining under Lake Erie has not generated any known subsidence to date; however, solution mining in Lake, Summit and Medina Counties has. The most dramatic case in Ohio is in the Lake County community of Painesville, where an abandoned mine is responsible for a six-foot surface depression. Due to the proximity of the impacted area to Lake Erie, it is now filled with water.

Until recently, Karst events in Ohio had very little direct impact from a subsidence perspective on the built environment; however, they have been very costly in terms of pollution and flooding. Two well-documented karst-related events deal with contamination of aquifers. The oldest researched event in Ohio is associated with the Village of Bellevue, straddling the Huron / Sandusky County border. The 1961 study documents how from 1919 to 1946 the community permitted untreated wastewater injection wells and unimpeded groundwater runoff into sinkholes as an acceptable water management program. In 1946, after the groundwater was determined unfit for human consumption, the Village abandoned its last well and has since spent millions of dollars to develop a potable system based on piping water from safe sources. In February 2008, more than 200 homes experienced flooding in Bellevue when runoff from heavy snows and spring rains flooded underground karst chambers. Experts believed building pressure caused the pent-up water to surge up existing sinkholes and cracks, flooding homes and yards. A section of State Route 269 was swamped from February through June 2008.

The Village of Put-In-Bay, located on South Bass Island in Lake Erie, was the site of an extensive gastrointestinal illness outbreak in 2004. The island is a popular, warm-weather tourist destination and, at the height of the season, over 1,000 cases of digestive related maladies were documented in people who had recently vacationed there. The investigation began with the municipal systems and quickly shifted to a number of transient, non-community, public water systems used for geothermal cooling, flushing toilets, and outdoor cleaning. These systems were found interconnected to the main water system. The karst topography allowed groundwater to travel quickly between locations and is easily affected by seasonal precipitation.

The only known karst-related subsidence impact to the built environment is roadway damage. In 2007 State Route 19 was closed in Crawford County when an adjacent karst feature expanded destabilizing the robed.

Some examples of the impact of karst during construction include U.S. Route 33 near East Liberty, where construction crews had to perform considerable back-filling and reinforcing, creating a land-bridge to make sure the highway was secure. Another example would be the construction of tunnels for sewage pipelines by the City of Dublin (Franklin County). Sinkholes, filled with clayey overburden caused the expensive rock-boring machinery to clog and break, resulting in tremendous cost overruns.

Finally, one housing development in the City of Westerville (Franklin County) contains homes, which have been dislodged and damaged by the effects of soils which dramatically expand when wet and contract when dry. Since 2000, the Ohio EMA has purchased 6 damaged homes; however, this is the only known impact from this form of land subsidence.

PROBABILITY OF FUTURE EVENTS

Mine-related land subsidence is an annual event impacting an average of five homes or roadways. Approximately 20 additional events occur each year that do not impact the built environment, yet may require remediation. Unlike mine-related events, karst events historically have manifested their impact in the form of groundwater contamination. Based on past exposure, a significant event occurs approximately each decade.

VULNERABILITY ANALYSIS & LOSS ESTIMATION

METHODOLOGY

The only predictable impact, which can be quantified for analysis, is damage to Ohio's roadways. The Ohio Department of Transportation, Office of Geotechnical Engineering has a comprehensive inventory of the federal and state routes which intersect with known and estimated abandoned mines. The location, length of each segment, potential for failure, along with a host of other data is maintained in a database (https://gis.dot.state.oh.us/tims/Map/Geotech).

ODOT updated their AUM Inventory and Risk Assessment Manual in January of 2018. This new manual has an updated methodology for assessing the risk and impact of AUMs on federal and state routes. The new methodology makes use of an initial and detailed site evaluation process. This process then ranks the

AUM on a 4 tier scale. More detailed information about the manual is available at http://www.dot.state.oh.us/Divisions/Engineering/Geotechnical/Pages/GeoHazards.aspx

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

Land subsidence is a spatial hazard, but is spatial-specific in that it would only affect very small areas given an occurrence. Therefore, this hazard has a very limited potential of affecting any state-owned or state-leased facilities. However, it should be noted that such events could impact lifelines, which could have significant effects on the functionality of various state facilities.

2.15 FUTURE POTENTIAL AREAS OF RISK

There are several potential areas of risk which will impact the natural hazards of the state, but are not easily categorized within any of the existing natural hazards located within the HIRA. The following potential areas of risk will be addressed in this section:

- Future growth
- Harmful algal bloom
- Hydraulic fracturing
- Climate change

FUTURE GROWTH

The Ohio Development Services Agency, Office of Research publishes individual county statistics evaluating the 2010 Census and the current American Community Survey (ACS) data. The county profiles cover an array of characteristics ranging from demographics to taxable land value. These county profiles and the underlying Census projections for population change were used to determine the possible future population changes for all of the counties in the state. Overall between 2010 and 2016, the State of Ohio has seen very little change in population, showing an estimated 0.67 percent increase. This increase can be attributed to the significant increases in southwest and central Ohio, which include counties from Regions 1 and 2.

The projection shows significant population changes in central (Columbus Metropolitan Area) and southwest Ohio (Cincinnati Metropolitan Area). Specifically, the greatest changes in central Ohio took place in Delaware County (12.8 percent) and Franklin County (8.7 percent) (Table 2.15.a), and the greatest in southwest Ohio was Warren (6.7 percent) County.

COUNTY	Region	Census Pop (2010)	Current Population (2016 ACS)	% Change 2010-16
Delaware	**2**	**174,189**	**196,463**	**12.8%**
Franklin	**2**	**1,163,529**	**1,264,518**	**8.7%**
Warren	**2**	**212,868**	**227,063**	**6.7%**
Union	**2**	**52,267**	**55,457**	**6.1%**
Fairfield	**2**	**146,177**	**152,597**	**4.4%**

The dataset projections for 2020, 2030, and 2040 show the significant growth will continue to be focused in and around central Ohio. Four counties (Delaware, Union, Fairfield, and Licking) are projected to lead in the percentage of growth for each 10 year period between 2010 and 2040. Delaware County is projected to see the greatest increase every decade.

COUNTY	Region	Census Pop (2010)	Projection (2020)	2010-2020 Projection %
Delaware	**2**	174,189	210,630	**20.92%**
Union	**2**	52,267	59,760	**14.34%**

Fairfield	**2**	146,177	165,850	**13.46%**
Licking	**2**	166,492	180,860	**8.63%**
Morrow	**2**	34,827	37,380	**7.33%**

Morrow County is projected to see the fifth greatest increase from 2010 to 2020, but then Knox County will overtake it in the following years.

COUNTY	Region	Projection (2020)	Projection (2030)	2020-2030 Projection %
Delaware	**2**	210,630	246,000	**16.79%**
Union	**2**	59,760	68,230	**14.17%**
Fairfield	**2**	165,850	187,820	**13.25%**
Licking	**2**	180,860	196,570	**8.69%**
Knox	**2**	64,960	69,810	**7.47%**

By 2040, Delaware County is project to have a population of 282,160, an increase of 43% over the 2016 population.

COUNTY	Region	Projection (2030)	Projection (2040)	2030-2040 Projection %
Delaware	**2**	246,000	282,160	**14.70%**
Union	**2**	68,230	77,360	**13.38%**
Fairfield	**2**	187,820	210,910	**12.29%**
Licking	**2**	196,570	212,370	**8.04%**
Knox	**2**	69,810	74,850	**7.22%**

Knowing this increase in population will be an impact on the hazards in the Delaware County, the county's 2014 multi-jurisdictional mitigation plan clearly describes the difficulties associated with double digit increases in population and the associated growth of the built environment. Per the 2014 Delaware County LHMP, the great recession influenced development trends in the county and the changes of development patterns have done little to affect the vulnerability of any jurisdiction from previous to current plans. Delaware County is still the fastest growing county in Ohio.

Still large sections of farmland have been and are being developed into residential housing, retail commercial facilities and office parks with the necessary infrastructure to support them. Increased runoff and shorter time available for natural attenuation has resulted in greater water levels and flows near existing neighborhoods.

Delaware County has a clear understanding of the problems, their implications and is working to address them through mitigation planning and educational outreach. Part of the difficulty in addressing the situation is that the growth areas are creating high-value real estate for Ohio, while the impacted areas range from manufactured home parks to older, residential structures built in or near the floodplain. Over time the size of the regulatory floodplain can be expected to increase due to development. Two other central Ohio counties, Franklin and Union, experienced moderate growth; however, no adverse impacts were observed for different reasons. Union County did not sustain enough growth to cause any sizable impacts, and Franklin County's growth was driven heavily by the increase of multi-family structures acting as in-fill or redevelopment of existing developed areas.

Considering the rapid growth in southwest Ohio and the impacts on Warren County, the Warren County Regional Planning Commission has planned for structured growth, which has resulted in minimal adverse impact. The Warren County multi-jurisdictional mitigation plan outlines the program objectives to:

- Discourage small, isolated subdivisions where soil conditions and lot size are not conducive to on-site wastewater disposal systems, where applicable;
- Encourage a logical pattern of residential development where future growth would occur in proximity to existing residential areas, within the designated Urban Service Areas of the township;
- Build multi-family housing at a scale that can accommodate the need, combined with prudent use of the Planned Unit Development process, to accomplish quality development, mitigating the impact of county utilities and other public services;
- Develop adequate, well designed and affordable housing for the elderly population, the handicapped and families with children;
- Give a stronger emphasis to establishing open space/green belt areas, separating developing residential areas from incompatible uses;
- Establish a system to encourage housing maintenance through a coordinated, ongoing inspection program by county and local officials;
- Encourage the repair or removal of dilapidated/substandard structures;
- Identify, document and protect older homes or residential areas of historical and/or architectural significance from unwanted, incompatible land uses; and
- Explore the establishment of an historical zoning district to protect individual structures or neighborhoods of historical and/or architectural significance.

Mitigation planning and associated strategies have been adequately developed at the local level to minimize adverse effects from the significant growth experienced in central and southwest Ohio and aid in community resilience.

OHIO BALANCED GROWTH STRATEGY

One of the primary strategies that the State of Ohio adopted to address future growth throughout state is the Ohio Balanced Growth Strategy (http://balancedgrowth.ohio.gov). This strategy is a voluntary, incentive based program that provides local governments with a regional planning framework based upon watersheds and water resource protection. The fundamental principle to guide the action of state agencies is that if local governments within a watershed can agree upon areas where development is to be encouraged and which are to be conserved, Ohio will align state programs to support these locally based decisions and conversely will not utilize state programs to violate them.

The Ohio Water Resources Committee (OWRC) has implemented this initiative statewide based upon a previous program developed by the Ohio Lake Erie Commission (OLEC). The program has many elements that encourage balanced growth throughout the state, specifically:

- Focusing on land use and development planning in Ohio's watersheds. The goal is to link land use planning to the health of watersheds and major bodies of water.
- Creation of Watershed Planning Partnerships to encourage regional cooperation on the issues of land use planning and development.
- Production of Watershed Balanced Growth Plans, which will guide how growth and conservation would be promoted by both local and state policies.
- The development of model regulations to promote local land use practices that minimize development impacts on water quality.
- Align state policies, incentives and other resources to support Watershed Balanced Growth planning and implementation.

WATERSHED BALANCED GROWTH PLANS

One of the primary aspects of the Ohio Balanced Growth Strategy is the creation and adoption of a Watershed Balanced Growth Plan. These plans are intended to provide a framework for regional decision-making on growth, conservation, stormwater issues and water quality. Each of these plans is based upon the 10 guiding principles for sustainable Ohio watersheds, the guiding principles are:

- Maximize investment in existing core urban areas, transportation, and infrastructure networks to enhance the economic vitality of existing communities.
- Minimize the conversion of green space and the loss of critical habitat areas, farmland, forest, and open spaces.
- Limit any net increase in the loading of pollutants or transfer of pollution loading from one medium to another.
- To the extent feasible, protect and restore the natural hydrology of the watershed and flow characteristics of its streams, tributaries, and wetlands.
- Restore the physical habitat and chemical water quality of the watershed to protect and restore diverse and thriving plant communities and preserve rare and endangered species.
- Encourage the inclusion of all economic and environmental factors into cost / benefit accounting in land use and development decisions.
- Avoid development decisions that shift economic benefits or environmental burdens from one location within a region to another.
- Establish and maintain a safe, efficient, and accessible transportation system that integrates highway, rail, air, transit, water, and pedestrian networks to foster economic

growth and personal travel.

- Encourage all new development and redevelopment initiatives to address the need to protect and preserve access to historic, cultural, and scenic resources.
- Promote public access to and enjoyment of our natural resources for all Ohioans.

These Watershed Balanced Growth plans are not intended to supersede either local comprehensive plans or local hazard mitigation plans, but to harmonize with them. Each Watershed Balanced Growth Plan must identify or include the following:

- Priority Conservation Areas (PCA), which are critical areas to protect within the watershed. This includes areas which provide flood control, are susceptible to significant natural hazards and offer areas for ecological / open space restoration in urban areas.
- Priority Development Areas (PDA), which are areas where development should be encouraged. This includes areas which will maximize development potential and efficient use of infrastructure.
- The related documentation for justifying the designation of any PCAs or PDAs.
- Plans for the implementation of any developed strategies and a description of the governance structure.
- A specific statement noting how the plan will meet the 10 guiding principles for sustainable Ohio watersheds.

STATE INCENTIVES

One of the challenges of the Balance Growth Program is that the State of Ohio is a home rule State. Therefore all land use, zoning, and planning decisions are made solely at the local level. State agencies do, however, influence the location of development in many ways through infrastructure investments, economic development incentives, tax policies and other policies and programs. In order to encourage local watershed groups to undertake the Balanced Growth Program process, the state created an incentive package that is available to Watershed Planning Partners and their participating local jurisdictions with an endorsed plan. These are the 26 state programs that include special consideration for Balanced Growth participating communities these programs are offered by various state agencies including the OEPA, ODNR, ODSA, ODOT and several other State agencies. More information about the specific state sponsored incentives is available at http://balancedgrowth.ohio.gov/BalancedGrowthStrategy.aspx

BEST LOCAL LAND USE PRACTICES

In addition to providing incentives for the adoption of Balance Growth Plans, the State has created several best local land use practices that address the following subject matters:

- Stream, Floodplain, and Wetland Protection
- Storm Water Management/Erosion and Sediment Control
- Comprehensive Planning
- Compact Development
- Conservation Development

- Natural Areas Establishment and Management
- Source Water Protection

These best local land use practices are available for download at: http://balancedgrowth.ohio.gov/BestLocalLandUsePractices/BestLocalLandUseP ractices2012.aspx

LOCAL ADOPTION OF WATERSHED BALANCED GROWTH PLANS

Since 2008, 12 local State endorsed Watershed Balanced Growth Plans have been adopted throughout the State of Ohio and over half of those plans were adopted in the past three years. The plans must be adopted at the local level with support from local governments that represent at least 75% of the geographic land area of a watershed, and 75% of the local governments in the watershed and 75% of the population in the watershed. Once local support requirements are met, the state conducts a final review prior to endorsing the plan to ensure compliance with the criteria of the program.

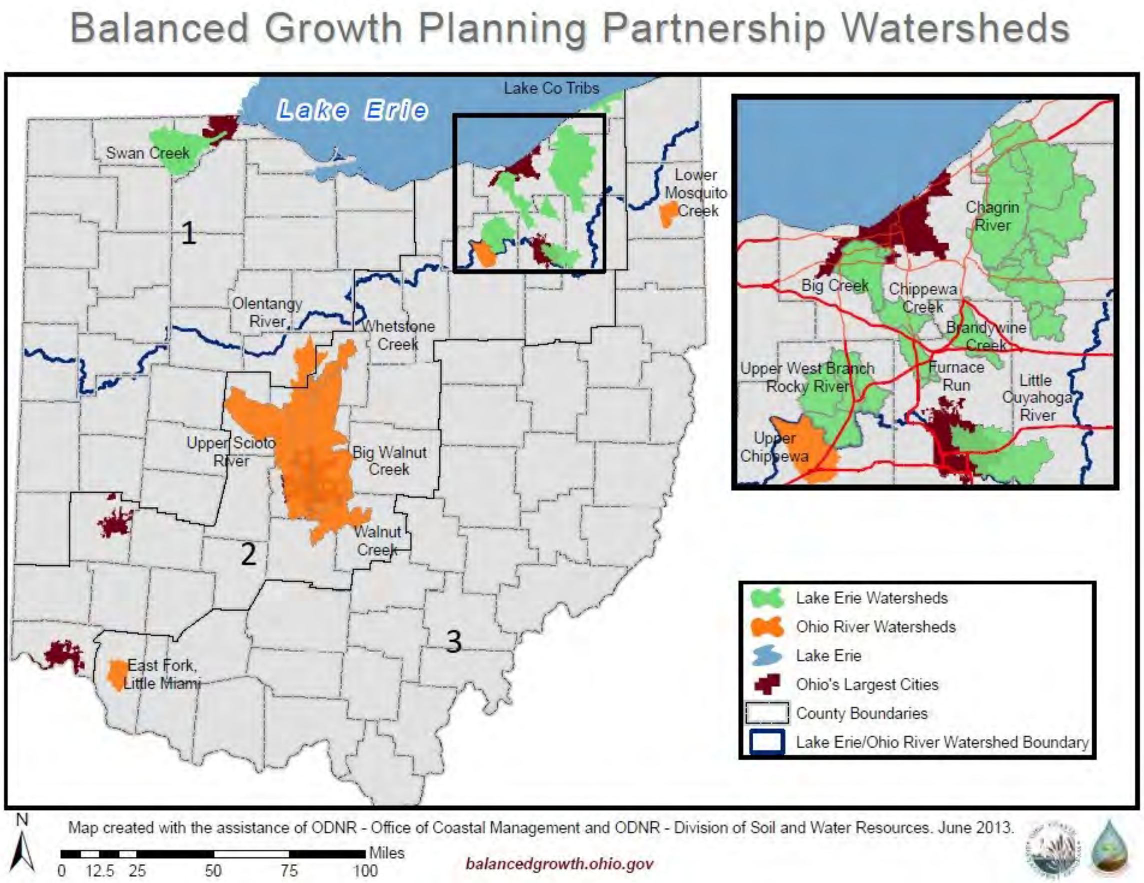
The following Watershed Balanced Growth Plans have been adopted at the local level and endorsed by the State of Ohio:

- Chippewa Creek Watershed (December 2008)
- Upper West Branch Rocky River Watershed (June 2009)
- Chagrin River Watershed (September 2009)
- Swan Creek Watershed (September 2009)
- Big Creek Watershed (June 2011)
- Furnace Run (December 2011)
- Eastern Lake County Coastal Tributaries (December 2011)
- Middle East Fork (February 2012)
- Lower Mosquito Creek (February 2012)
- Upper Chippewa Creek (April 2012)
- Olentangy River (April 2012)
- Walnut Creek (February 2013)
- Brandywine Creek (March 2014)

These 13 endorsed Watershed Balanced Growth Plans are spread across 18 different counties throughout the State. The following counties have at least one State Endorsed Watershed Balanced Growth Plan within their borders:

- Clermont
- Cuyahoga
- Delaware
- Fairfield
- Franklin
- Fulton
- Geauga
- Lake
- Licking
- Lucas
- Marion
- Medina
- Morrow
- Pickaway
- Portage
- Summit
- Trumbull
- Union

The majority of the endorsed plans in the State are primarily located within central and north eastern parts of the State. Of these 18 counties, two counties (Franklin, Medina), have specifically incorporated the State Endorsed Watershed Balanced Growth Plan into their Local Hazard Mitigation Plan and nine of counties have references to local watershed and storm water management plans throughout their Local Hazard Mitigation Plans. The continued adoption of the Watershed Balanced Growth Plans throughout the State will encourage sound planning and land use development Statewide. These activities will promote linkages between Balanced Growth Plans and local hazard mitigation plans which will minimize adverse effects of future growth and contribute to more resilient communities.



HARMFUL ALGAL BLOOMS

The Ohio Sea Grant Program states Harmful Algal Blooms (HAB) are caused by a combination of warm water temperatures (above 60 degrees Fahrenheit) and high concentrations of phosphorus in the water. Typically, a high concentration of phosphorus and nitrogen in cold weather will produce a bloom of diatoms, in cool weather we would expect a bloom of green algae, and in warm weather we often see blue-green algae.

One of the main focuses on reducing the number of HABs is to reduce the amount of phosphorus, which is one of the three major components in most fertilizers, followed by nitrogen and potassium. Phosphorus entering natural water ways is a major issues in the state. In Lake Erie, more than 65% of the phosphorus that causes HABs comes from agricultural fertilizer and manure runoff. Some phosphorus also comes from sewage treatment plants, combined sewer overflows, water treatment plants, cleaning products, faulty septic tanks and residential lawn fertilizers. The largest phosphorus load, about 80-90%, happens during heavy rain storms when fertilizer and other phosphorus sources are quickly washed into rivers and streams that flow into Lake Erie.

HABs can produce toxins that are capable of causing illness and sometimes even death. Microcystin is the most concerning toxin as it causes skin rashes, GI problems and varying degrees of nervous system, liver and kidney damage. While most healthy adults recover from contact with the toxin, it can be more problematic to children, the elderly and people with pre-existing conditions that weaken their systems. Exposure has also killed people in other parts of the world. The toxin can also be fatal to pets that drink or come in contact with contaminated water.

LAKE ERIE

Lake Erie is the southernmost, shallowest and warmest of the Great Lakes. Its watershed has the least forest, the most agricultural land and the second-most urban/suburban land. Therefore, Lake Erie gets more sediment and nutrients (fertilizer runoff, sewage, etc.) than the other lakes, while also having environmental conditions that favor algal blooms. HABs typically occur first in Maumee Bay at the mouth of the Maumee River and in Sandusky Bay at the mouth of the Sandusky River because blue-green algae prefer warm water and high concentrations of phosphorus. Both bays are very warm and shallow, and the watersheds of both rivers have very high percentages of farm land (the Maumee is the largest tributary to the Great Lakes and drains 4.2 million acres of agricultural land). As a result, both streams contain very high concentrations of phosphorus that eventually feeds into Lake Erie.

CLIMATE CHANGE

Climate change will bring more rain and snow, higher average temperatures and flooding to the Great Lakes region. More rain and snowfall increases runoff of the nutrients that fuel harmful algal blooms into the lake. The cyanobacteria that cause HABs also prefer the warmer water that comes with the higher air temperature caused by climate change. When combined, these changing conditions can increase the severity of harmful algal blooms.

OHIO'S DOMESTIC ACTION PLAN (DAP)

https://lakeerie.ohio.gov/LakeEriePlanning/OhioDomesticActionPlan2018.aspx

Ohio's Domestic Action Plan (DAP) will advance efforts toward the proposed 40 percent nutrient reduction target put forth in the Great Lakes Water Quality Agreement of 2012 (GLWQA). Ohio's DAP will expand on the collaborative implementation initiatives and will also include the Central Basin as well as the Western Basin of Lake Erie. The DAP was developed with input through meetings and conversations with various stakeholder groups and state agencies.

While the focus of the DAP is to achieve nutrient reductions from the base year of 2008, we also need to consider the potential impact of new sources of phosphorus coming into in the watershed, the increased frequency and severity of rainfall events, and how these changes pose challenges to the over-all net reduction of nutrients as we work towards the established goals.

The Goals of the Ohio Domestic Action Plan

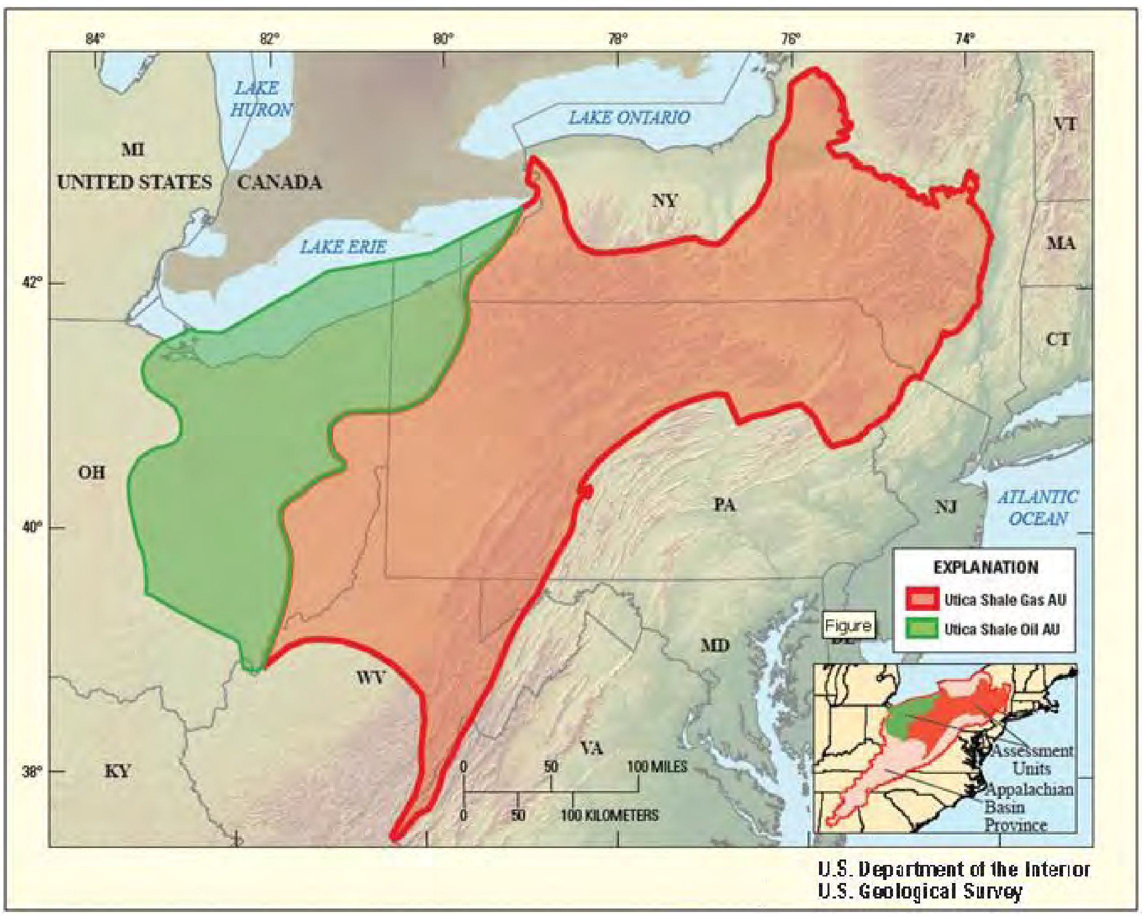
- Achieve a 40 percent total spring load reduction in the amount of total and dissolved reactive phosphorus entering Lake Erie's western basin by the year 2025 with an aspirational goal of a 20 percent reduction by 2020.
- Achieve a 40 percent total annual load reduction in the amount of total phosphorus entering Lake Erie's central basin by the year 2025 with an aspirational goal of a 20 percent reduction by 2020.

The Domestic Action Plan is based on the following guiding principles:

- Implementation of point and nonpoint nutrient reduction practices.
- Verification of targeted practice implementation and effectiveness.
- Documentation of water quality changes resulting through the implementation of nutrient reduction practices.
- Adaptability to allow for the modification of programs, practices and policy as new information is obtained and changes occur.
- Accountability to ensure compliance with rules and laws, establish clear areas of responsibilities, and that the commitment is made and kept toward achieving the goals.

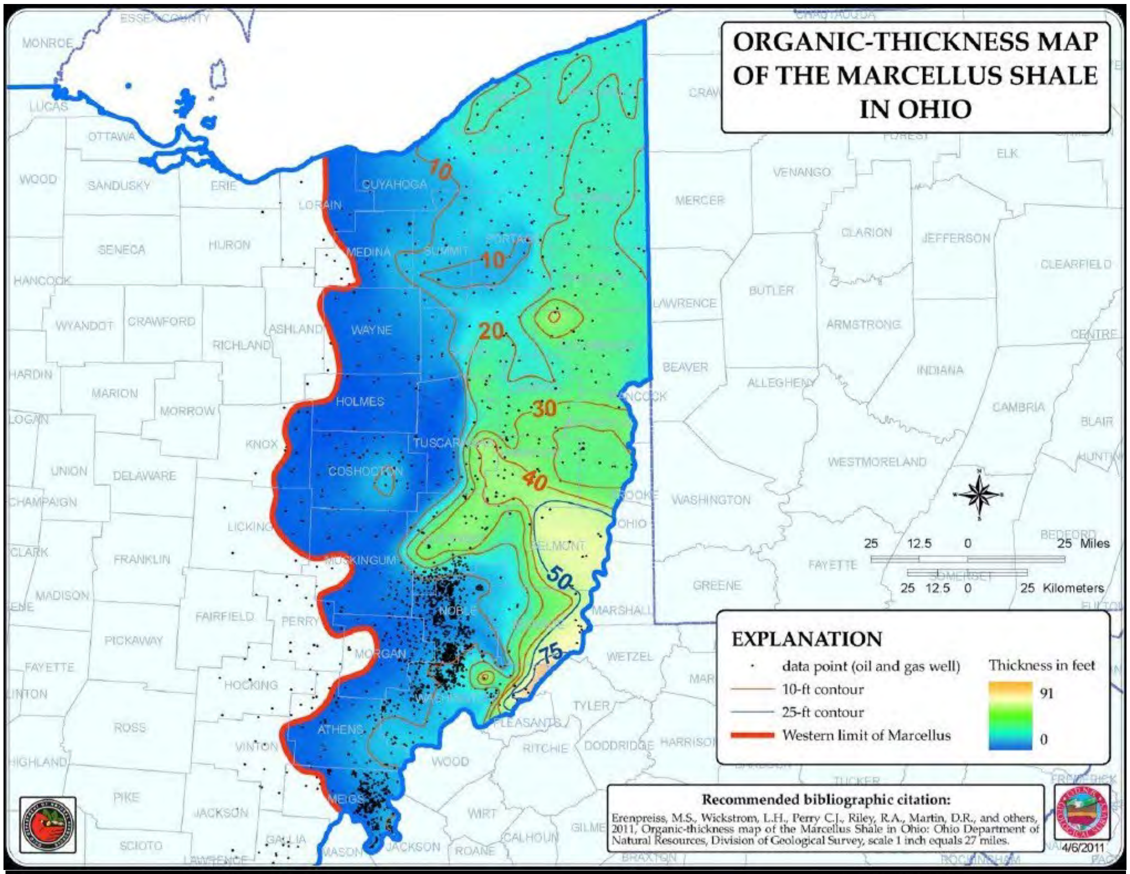
HYDRAULIC FRACTURING

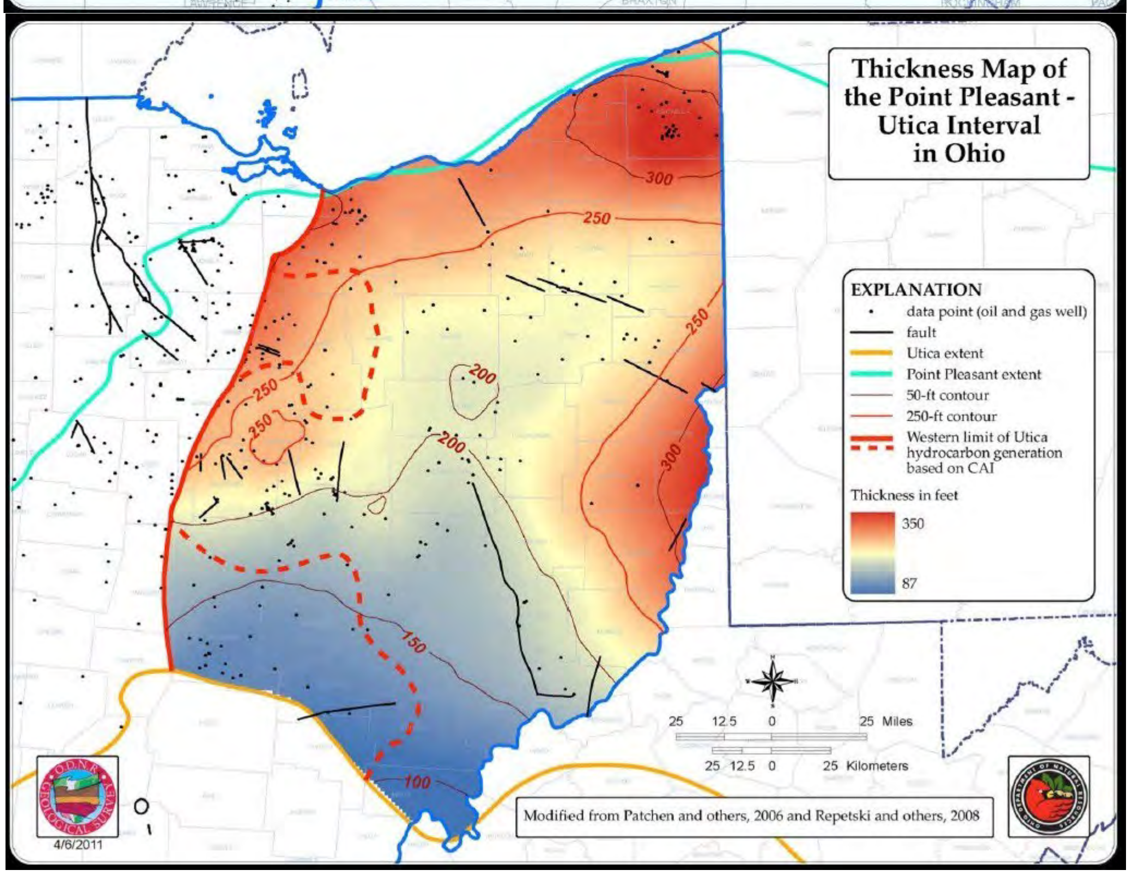
Together, the Marcellus and Utica Shale regions extend across New York, Pennsylvania, Maryland, West Virginia, Ohio and portions of Kentucky and these deposits sit between 7,000 and 12,000 feet below ground. Both the Marcellus and the Utica shale regions are important geologic formations because they hold large reserves of natural gas. Researchers estimate the Marcellus Shale alone could contain as much as 363 trillion cubic feet of natural gas. Ohio is experiencing far less Marcellus Shale drilling than several of the neighboring states because the Marcellus Shale is much thinner on its western edge.



However, Ohio has and will continue to see a significant increase in drilling as much of the state sits over the Utica Shale Formation. The extraction of natural gas from the shale is a two-step process of horizontal drilling and hydraulic fracturing. The process starts with a production well, which is drilled thousands of feet downward and then gradually angled out horizontally through the shale deposit. After the well is drilled, a mixture of water, sand and chemical additives is injected at very high pressure to fracture the shale. This part of the process called hydraulic fracturing or fracing, is a technique used in the oil and gas industry since the 1950's.

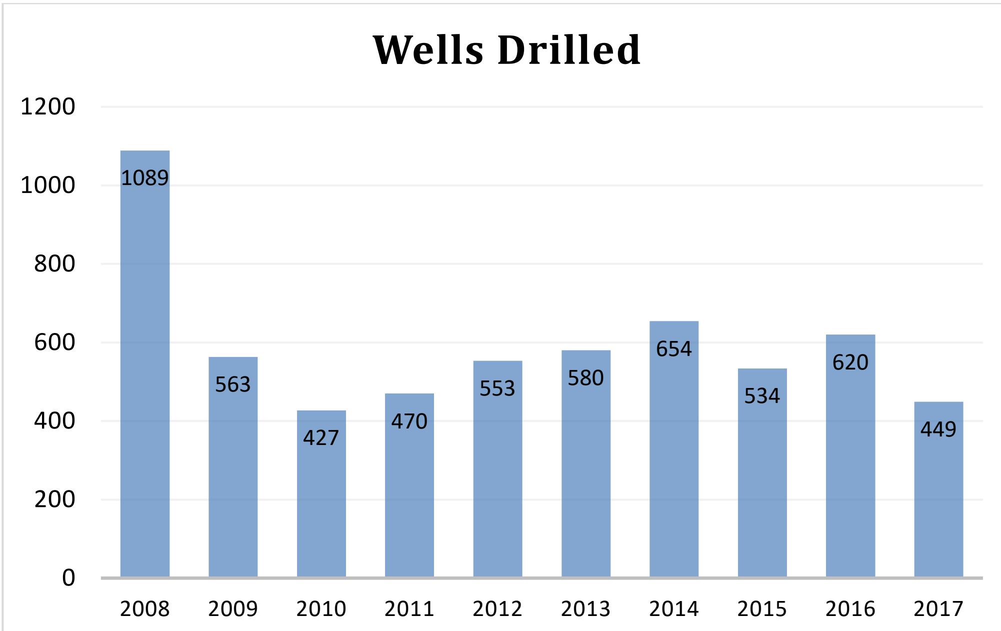
Per the ONDR Division of Geological Survey, resource estimates indicate the Devonian-age Marcellus Shale is the largest exploration play in the eastern United States. Recently, the application of horizontal drilling combined with multi-staged hydraulic fracturing to create permeable flow paths from wellbores into shale units has resulted in a drilling boom for the Marcellus in the Appalachian Basin states of Pennsylvania, West Virginia, southern New York, and eastern Ohio. Fracturing technology also may have application in other shale units, such as the Ordovician-age Utica Shale, which extends across much of the Appalachian Basin region. While limited production has occurred in the Utica up to this point, thickness and widespread geographical extent indicate it may also have great oil-and-gas potential.


ORGANIC-THICKNESS MAP OF THE MARCELLUS SHALE IN OHIO
EXPLANATION
data point (oil and gas well)
10-ft contour
25-ft contour
Western limit of Marcellus
Thickness in feet
91
0
25 12.5 0 25 Miles
25 12.5 0 25 Kilometers
Recommended bibliographic citation:
Erenpreiss, M.S., Wickstrom, L.H., Perry C.J., Riley, R.A., Martin, D.R., and others, 2011, Organic-thickness map of the Marcellus Shale in Ohio: Ohio Department of Natural Resources, Division of Geological Survey, scale 1 inch equals 27 miles.
4/6/2011


Thickness Map of the Point Pleasant - Utica Interval in Ohio
EXPLANATION
data point (oil and gas well)
fault
Utica extent
Point Pleasant extent
50-ft contour
250-ft contour
Western limit of Utica hydrocarbon generation based on CAI
Thickness in feet
350
87
25 12.5 0 25 Miles
25 12.5 0 25 Kilometers
Modified from Patchen and others, 2006 and Repetski and others, 2008
4/6/2011

CURRENT STATE OF NATURAL GAS AND OIL DRILLING IN OHIO

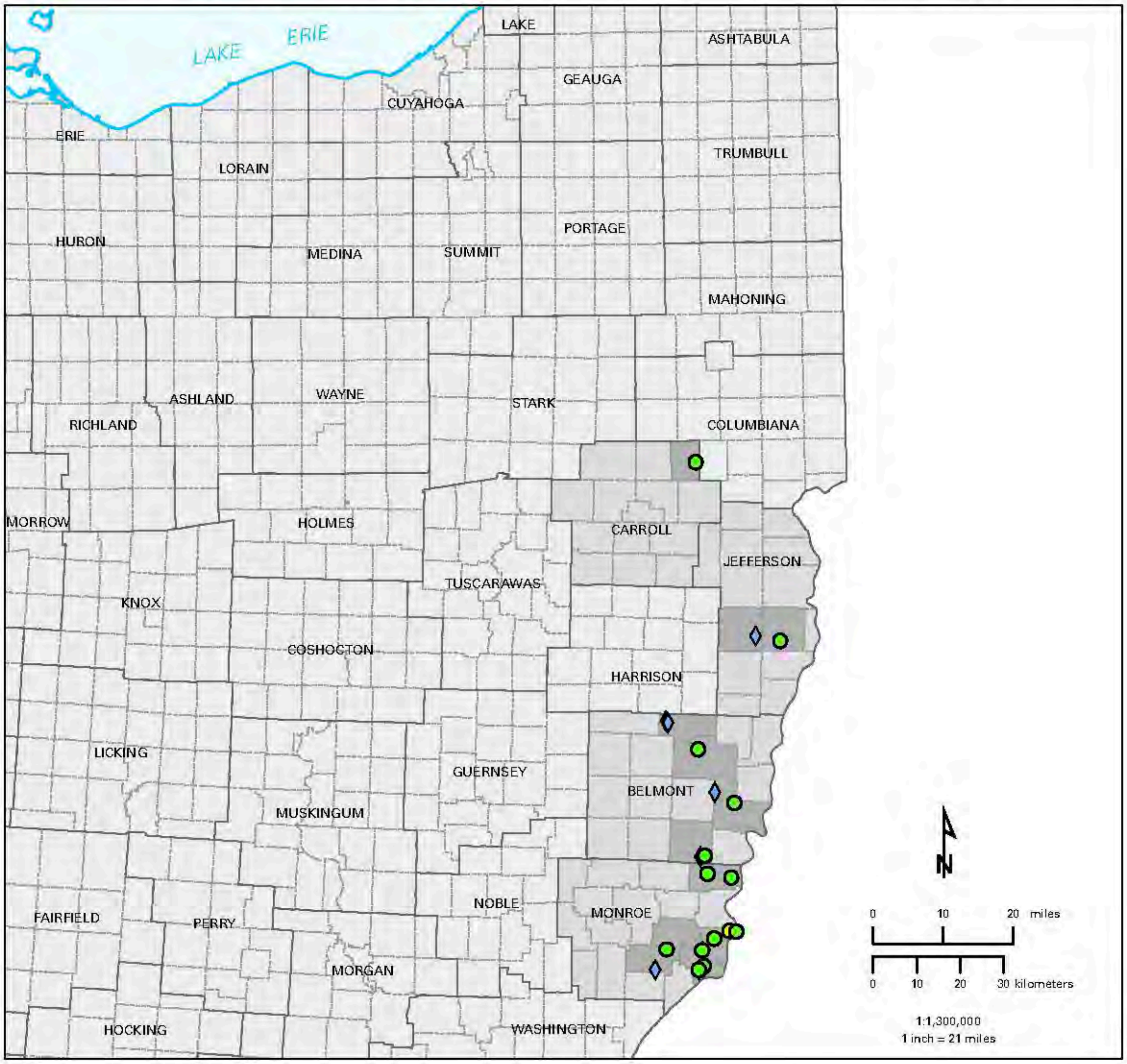
The Ohio Oil & Gas Summary issued each year reflects the most up to date information and trends effecting Ohio's oil and gas industries. The 48th edition of this Summary noted that 449 oil and gas wells were drilled in the state is 2017 and this is down from a peak of 1089 new wells drilled in 2008. The spike of wells drilled from 2005-2008 was related to the exploration of the Devonian Shale.



The ONDR Division of Oil and Gas Resources Management indicates the activity of horizontal well drilling in the Marcellus and Utica-Point Pleasant Shale in the State. As this map indicates the current and future activity will occur in the eastern and southeastern portions of the State.

OHIO DEPARTMENT OF NATURAL RESOURCES

HORIZONTAL MARCELLUS WELL ACTIVITY IN OHIO



EXPLANATION

Horizontal well status as of 12/1/2018

- PERMITTED-(Permitted; Not Drilled; Canceled) (24)
- DRILLED-(Drilling; Well Drilled) (12)
- PRODUCING-(Producing; Plugged Back) (23)
- INACTIVE-(Drilled Inactive; Shut in) (1)

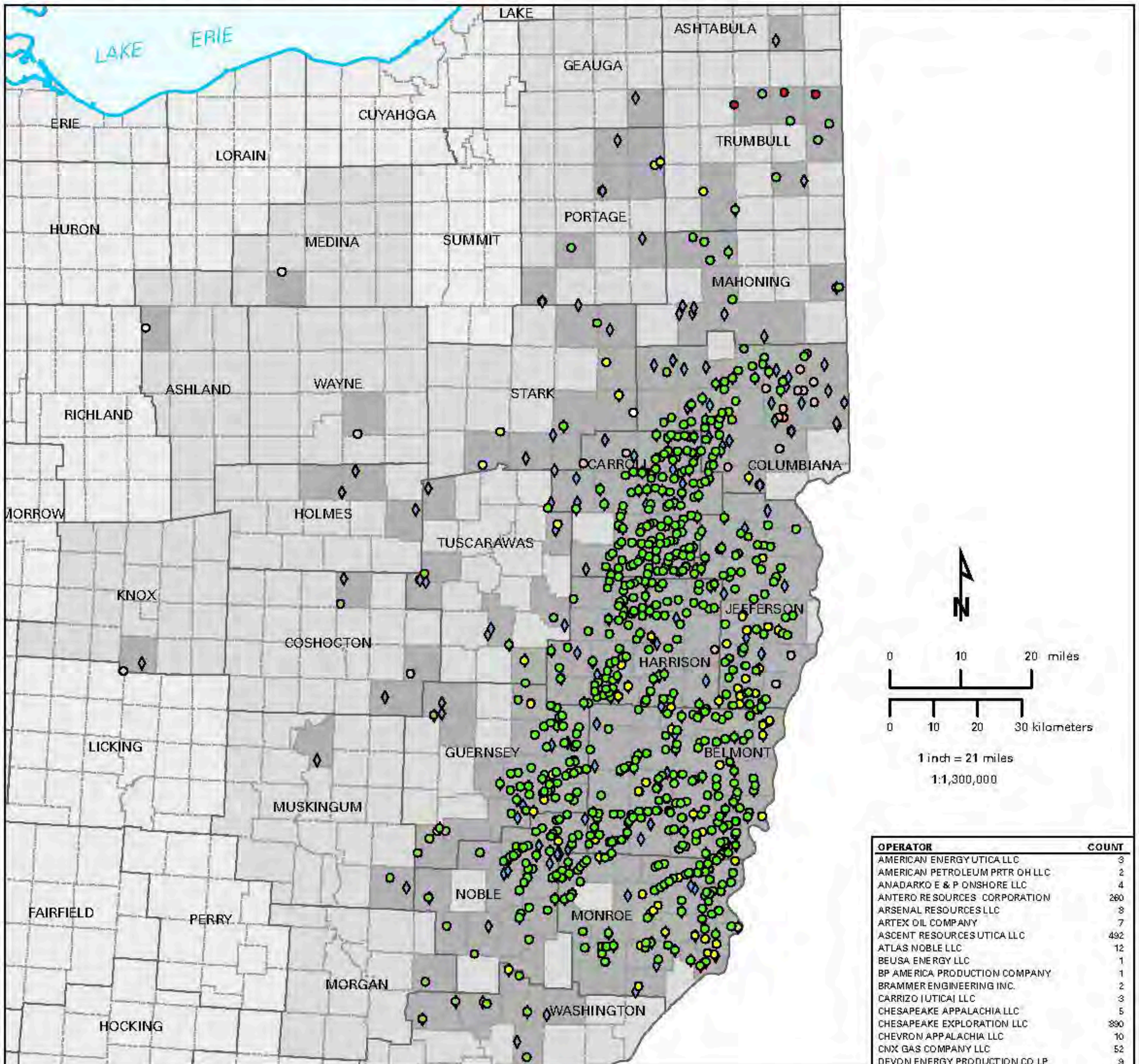
OPERATOR	COUNT
ALLIANCE PETROLEUM CORPORATION	1
ASCENT RESOURCES UTICA LLC	3
CHESAPEAKE EXPLORATION LLC	1
CNX GAS COMPANY LLC	1
ECLIPSE RESOURCES I LP	13
EM ENERGY OHIO LLC	1
EQUINOR USA ONSHORE PROPERTIES INC.	15
HESS OHIO RESOURCES LLC	3
PHILLIPS EXPLORATION INC	1
PROTEGE ENERGY II LLC	1
TRIAD HUNTER LLC	17
XTO ENERGY INC.	3
TOTAL	**60**

Well permit information from the ODNR Division of Oil and Gas Resources Management

Recommended citation:
Ohio Department of Natural Resources, 2018, Horizontal Marcellus Well Activity in Ohio: Columbus, scale 1:1,300,000, revised 12/3/2018.

OHIO DEPARTMENT OF NATURAL RESOURCES

HORIZONTAL UTICA - PT PLEASANT WELL ACTIVITY IN OHIO



EXPLANATION

Horizontal well status as of 12/1/2018

- PERMITTED-(Permitted; Not Drilled; Canceled) (473)
- DRILLED-(Drilling; Well Drilled) (295)
- PRODUCING-(Producing; Plugged Back) (2,090)
- INACTIVE-(Drilled Inactive; Shut in) (27)
- Lost Hole or Final Restoration (28)
- Dry and Abandoned (3)
- Plugged and Abandoned (19)

Well permit information from the ODNR Division of Oil and Gas Resources Management

Recommended citation:
Ohio Department of Natural Resources, 2018, Horizontal Utica-Point Pleasant Well Activity in Ohio: Columbus, scale 1:1,300,000, revised 12/3/2018.

OPERATOR	COUNT
AMERICAN ENERGY UTICA LLC	3
AMERICAN PETROLEUM PRTR OH LLC	2
ANADARKO E & P ONSHORE LLC	4
ANTERO RESOURCES CORPORATION	260
ARSENAL RESOURCES LLC	8
ARTEX OIL COMPANY	7
ASCENT RESOURCES UTICA LLC	492
ATLAS NOBLE LLC	12
BEUSA ENERGY LLC	1
BP AMERICA PRODUCTION COMPANY	1
BRAMMER ENGINEERING INC.	2
CARRIZO (UTICA) LLC	3
CHESAPEAKE APPALACHIA LLC	5
CHESAPEAKE EXPLORATION LLC	890
CHEVRON APPALACHIA LLC	10
CNX GAS COMPANY LLC	52
DEVON ENERGY PRODUCTION CO LP	9
ECLIPSE RESOURCES I LP	197
EM ENERGY OHIO LLC	23
ENERVEST OPERATING LLC	26
EQT PRODUCTION COMPANY	4
EQUINOR USA ONSHORE PROPERTIES INC.	32
GEOPETRO LLC	5
GULFPORT APPALACHIA LLC	21
GULFPORT ENERGY CORPORATION	406
HALCON OPERATING COMPANY INC.	4
HESS OHIO DEVELOPMENTS LLC	24
HESS OHIO RESOURCES LLC	1
HG ENERGY LLC	7
HILCORP ENERGY COMPANY	59
M & R INVESTMENTS OHIO LLC	1
NORTHWOOD ENERGY CORP	6
PDC ENERGY INC.	9
PENNENERGY RESOURCES LLC	40
PIN OAK ENERGY PARTNERS LLC	13
PROTEGE ENERGY III LLC	2
R E GAS DEVELOPMENT LLC	10
RICE DRILLING D LLC	128
SIERRA RESOURCES LLC	3
STATOIL USA ONSHORE PROPERTIES INC.	10
SWEPI LP	1
TRIAD HUNTER LLC	32
UTICA RESOURCE OPERATING LLC	35
XTO ENERGY INC.	75
TOTAL	**2,935**

ENVIRONMENTAL CONCERNS

Some citizens and local governments are becoming aware and concerned about the potential environmental and societal impacts of drilling activity in their communities. The primary concerns noted in “Drilling for Natural Gas in the Marcellus and Utica Shales: Environmental Regulatory Basics” by ODNR & OEPA dated January 2014 are:

- The possible impacts of brine or flowback water on ground water resources
- The hydraulic fracturing fluid compositions and there possible health effects
- Increased road traffic and higher road maintenance costs
- Method of disposal for the brine, hydraulic fracturing fluid and other substances related to the drilling
- Possible increase in seismic activity from injection wells
- Possible increase in air pollution from the drilling related activities

REGULATION OF NATURAL GAS DRILLING IN THE MARCELLUS AND UTICA SHALE

The regulation of Natural Gas Drilling in the Marcellus and Utica Shale lies with primarily two bodies in the State of Ohio: the Ohio Department of Natural Resources (ODNR) and the Ohio Environmental Protection Agency (OEPA). The table below is a summary of ODNR and OEPA regulatory authorities over oil/gas drilling and production activities.

Summary of ODNR and Ohio EPA regulatory authority over oil/gas drilling and production activities

	Ohio Department of Natural Resources	Ohio Environmental Protection Agency
Drilling in the shale deposits	✓ Issues permits for drilling oil/gas wells in Ohio. ✓ Sets requirements for proper location, design and construction requirements for wells. ✓ Inspects and oversees drilling activity. ✓ Requires controls and procedures to prevent discharges and releases. ✓ Requires that wells no longer used for production are properly plugged. ✓ Requires registration for facility owners with the capacity to withdraw water at a quantity greater than 100,000 gallons per day.	✓ Requires drillers obtain authorization for construction activity where there is an impact to a wetland, stream, river or other water of the state. ✓ Requires drillers obtain an air permit to install and operate (PTIO) for units or activities that have emissions of air pollutants.
Wastewater and drill cutting management at drill sites	✓ Sets design requirements for on-site pits/lagoons used to store drill cuttings and brine/flowback water. ✓ Requires proper closure of on-site pits/lagoons after drilling is completed. ✓ Sets standards for managing drill cuttings and sediments left on-site.	✓ Requires proper management of solid wastes shipped off-site for disposal.
Brine/flowback water disposal	✓ Regulates the disposal of brine and oversees operation of Class II wells used to inject oil/gas-related waste fluids. ✓ Reviews specifications and issues permits for Class II wells. ✓ Sets design/construction requirements for Class II underground injection wells. ✓ Responds to questions/concerns from citizens regard safety of drinking water from private wells from oil/natural gas drilling.	
Brine/flowback water hauling	✓ Registers transporters hauling brine and oil/gas drilling-related wastewater in Ohio.	
Pumping water to the drill site from a public water supply system		✓ Requires proper containment devices at the point of connection to protect the public water system.

The ODNR Division of Oil and Gas summarizes below the impacts and effects of the two primary legislative acts that created the current framework for have regulating the oil and gas industry in the State of Ohio.

SENATE BILL 165

On March 31, 2010 Governor Ted Strickland signed Substitute SB 165, the first major revision to Ohio oil and gas law in twenty-five years. Many significant changes were implemented as a result of passage of this new legislation which became effective on June 30, 2010. The bill provided for enhanced permitting authority in urban areas, strengthened funding for operations and orphan well plugging, added additional notification requirements by the industry and expanded enforcement provisions.

SENATE BILL 315

On June 11, 2012, Governor John Kasich signed landmark oil and gas regulatory legislation, which established one of the nation's toughest regulatory frameworks for overseeing the new technologies that allow for the exploration of natural gas in deep shale rock formations. Among other things, SB 315 creates the nation's first combined well construction and hydraulic fracturing chemical disclosure requirement, requires the sharing of all chemical information with doctors, allows appeals to the Ohio Oil & Gas Commission for certain permitting concerns prior to pursuing court action, and requires operators to take pre-drilling water samples and to disclose the proposed source of water used in wet drilling and hydraulic fracturing.

LOCAL LAND USE, ZONING REGULATION, AND HOME RULE

In the state, municipal corporations (cities and villages) have certain powers granted to them in Article XVIII of the state Constitution that exist outside their authority found in the Revised Code. Because these powers originate in the Constitution, laws passed by the General Assembly that interfere with them are invalid as applied to municipal corporations unless those laws otherwise are sanctioned by the Constitution. These constitutionally granted powers, known as "home rule" power include the power of local self-government, the exercise of certain police powers, and the ownership and operation of public utilities. "Police power" has been defined as the authority to make regulations for the public health, safety, and morals and the general welfare of society. Keep in mind any Municipal laws for the exercise of municipal police powers cannot be in conflict with general laws. Included in these "Police power" regulations are local land use and zoning regulation. http://www.lsc.state.oh.us/membersonly/128municipalhomerule.pdf

Per the American Bar Association, on February 17, 2015, the Ohio Supreme Court ruled that a city ordinance aimed at limiting fracing operations cannot be used to circumvent the state's authority over oil and gas drilling. Specifically, the court held in State ex rel. Morrison v. Beck Energy Corp., No. 2015-Ohio-485, that because the state had granted a permit to a drilling company under a state regulatory scheme governing oil and gas operations, the municipality could not pass ordinances setting forth additional restrictions.

The case arises out of a dispute over a permit that Beck Energy Corp. obtained from the state of Ohio to drill an oil and gas well within the Munroe Falls city limits. Beck Energy obtained its permit pursuant to an Ohio statute that (1) provided uniform statewide regulation of oil and gas production; (2) gave a state agency the sole and exclusive authority to regulate the permitting, location, and spacing of oil and gas wells; and (3) required parties seeking to drill a new well to obtain a state permit.

Soon after Beck Energy began drilling, however, Munroe Falls filed a lawsuit seeking an injunction to prohibit the drilling. The city argued that Beck Energy violated city ordinances requiring the company to meet certain conditions before it began drilling. The trial court granted the city's request for injunctive relief and prohibited Beck Energy from drilling until it complied with the city's ordinances. The court of appeals reversed, holding that the state statute governing drilling operations prohibited the city from enforcing its ordinances. Munroe Falls sought relief from the Ohio Supreme Court.

The main issue before the Ohio Supreme Court was whether the state's Home Rule Amendment allowed Munroe Falls to enforce its own permitting scheme on top of the state's permitting system. The Ohio constitution's Home Rule Amendment gives local municipalities the broadest possible powers of self-government in connection with all matters that are strictly local and do not infringe on matters that are of a statewide nature. But the amendment provides that a municipal ordinance must yield to a state law if (1) the municipality's ordinance represents an exercise of police power, rather than of local self-government; (2) the statute is a general law; and (3) the ordinance conflicts with the state statute.

After analyzing these three factors, the Ohio Supreme Court concluded that Munroe Falls' ordinances had to yield to the state statute. The city did not dispute—and the court agreed—that its ordinances amounted to an exercise of police power. Likewise, the court determined that the Ohio statute constituted a general law, as the law operated uniformly throughout the state.

THE NORTHSTAR 1 CLASS II INJECTION WELL AND SEISMIC EVENTS IN YOUNGSTOWN

A preliminary report was released by ODNR in March 2012 on the Northstar 1 Class II Injection Well and the Seismic Events in the Youngstown, Ohio Area. The reports show that since March 2011, the Youngstown area has experienced 12 low-magnitude seismic events along a previously unknown fault line. These events ranged from 2.1- to 4.0-magnitude and were recorded by the ODNR Ohio Seismic Network (OhioSeis). The OhioSeis network works closely with the U.S. Geological Survey to monitor and study all seismic activity within the state. Prior to the network's establishment in 1999, monitoring earthquakes in Ohio was sporadic at best. In fact, before the network was operational, the Ohio Geological Survey was unable to accurately determine any seismic events below an approximate magnitude of 3.1. A station at Youngstown State University joined the network in 2003.

Before 2011, OhioSeis had not recorded earthquake activity with epicenters located in the Youngstown area. Also, no fault line had been previously mapped within the boundaries of Youngstown or Mahoning County. However, the broad geographical area does have a history of seismic activity, and Mahoning Valley residents have felt earthquakes from nearby faults. In fact, the area has experienced at least three prior earthquakes in the past 25 years.

The 2011 earthquakes are distinct from previous seismic activity in the region because of their proximity to a Class II deep injection well, known as the Northstar 1 well. In fact, all of the events were clustered less than a mile around the well. Northstar 1 is one of 177 operational Class II deep injection wells primarily used for oil and gas fluid waste disposal (Ohio Disposal Wells). The well is drilled 200' into the rock formation known as the Precambrian layer at a depth of 9,184' and began injection in December 2010.

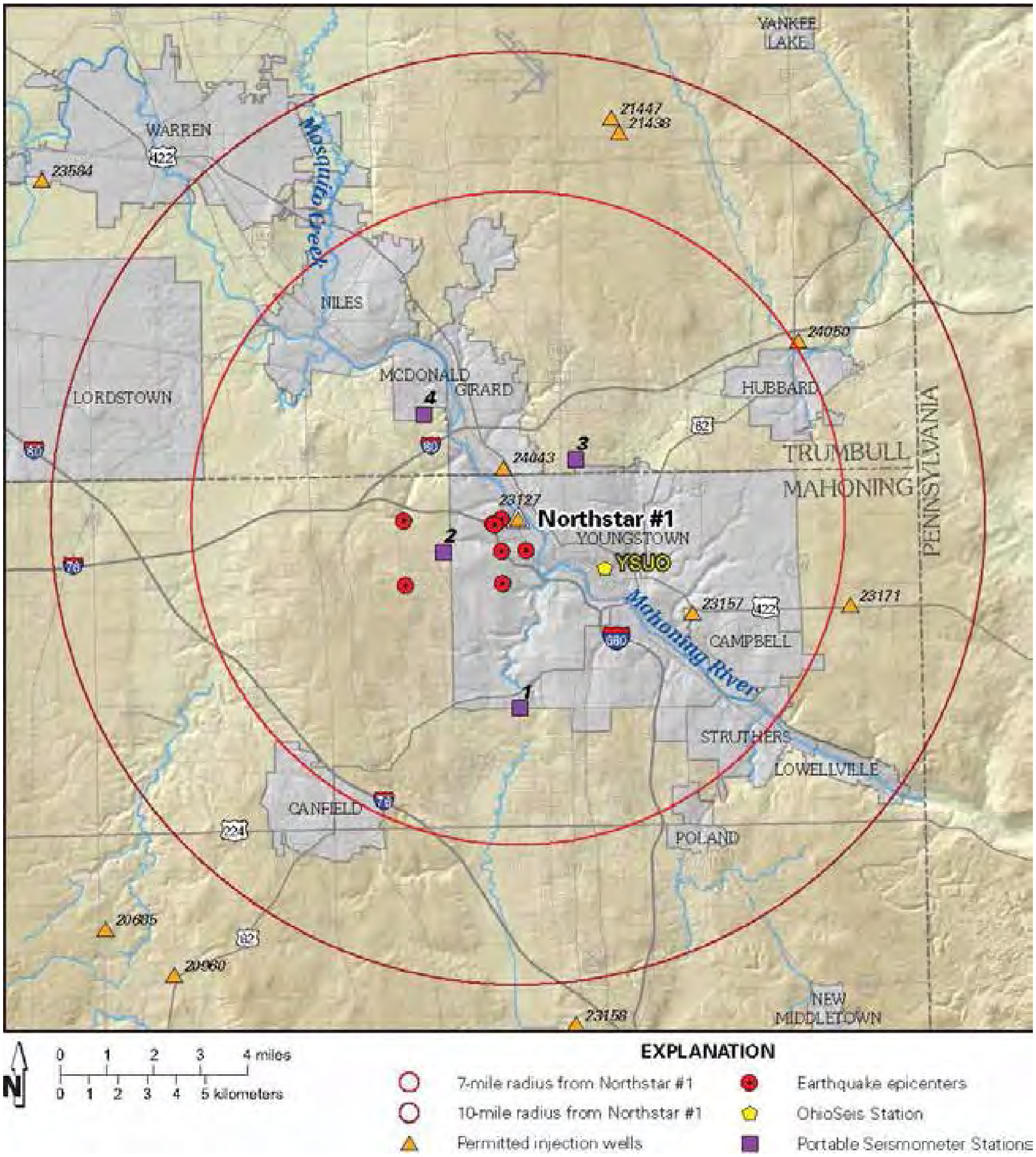
The below table, provide by the US EPA, describes the six categories or "classes" of injection wells, along with the estimated national inventory for each class. The six classes are based on similarity in the fluids injected, activities, construction, injection depth, design, and operating techniques.

This categorization ensures that wells with common design and operating techniques are required to meet appropriate performance criteria for protecting underground sources of drinking water.

Classes	Use	Inventory
Class I	Inject hazardous wastes, industrial non-hazardous liquids, or municipal wastewater beneath the lowermost Underground Sources of Drinking Water (USDW).	680 wells
Class II	Inject brines and other fluids associated with oil and gas production, and hydrocarbons for storage.	172, 068 wells
Class III	Inject fluids associated with solution mining of minerals beneath the lowermost USDW.	22,131 wells
Class IV	Inject hazardous or radioactive wastes into or above USDWs. These wells are banned unless authorized under a federal or state ground water remediation project.	33 sites
Class V	All injection wells not included in Classes I-IV. In general, Class V wells inject non-hazardous fluids into or above USDWs and are typically shallow, on-site disposal systems. However, there are some deep Class V wells that inject below USDWs.	400,000 to 650,000 wells Note: an inventory range is presented because a complete inventory is not available.
Class VI	Inject Carbon Dioxide (CO2) for long term storage, also known as Geologic Sequestration of CO2.	6-10 commercial wells expected to come online by 2016. (Interagency Task Force on Carbon Capture and Storage)

Ohio runs its Class II deep injection program on behalf of the U.S. EPA. As a result, the state meets and in many instances far exceeds U.S. EPA standards and regulations for the program. Since the program's inception in 1983, more than 202 million barrels of oilfield fluids have been disposed of, with no reports of subsurface ground water contamination incidents. In addition, no seismic event had been previously linked to operations at any of the state's Class II wells.

The earthquakes and their potential link to the Northstar 1 deep injection well were closely scrutinized by state geologists and regulators, who performed 35 separate inspections of the well from April 26 to Dec. 15, 2011. Each inspection indicated the well was operating within its permitted injection pressure and volume. In addition, ODNR regulators conducted additional testing of the well to determine if injection fluids were entering permitted injection zones. Tracer tests showed injections were reaching appropriate zones and were within permitted injection intervals. However, the tests proved inconclusive with regard to the volume of fluid entering the Precambrian layer. As a result, state regulators requested the well owner plug the Precambrian section of the Northstar 1 borehole, and the well operator voluntarily agreed to the procedure, albeit on a delayed timetable. With only one seismometer deployed in the Youngstown area, state geologists lacked the necessary data on the earthquakes' depth and exact location to draw a direct correlation between the seismic events and the deep injection well.



LAMONT-DOHERTY EARTH OBSERVATORY AT COLUMBIA UNIVERSITY

In November 2011, the ODNR Director ordered the Ohio Geological Survey to seek an outside research partner and deploy the needed portable seismometers around the Youngstown area. The Lamont-Doherty Earth Observatory at Columbia University had the available equipment and was willing to assist the state. The seismometers were deployed on Dec. 1, 2011. On Dec. 24, the newly deployed equipment recorded a 2.7-magnitude earthquake in the area. Data from the portable seismometers was downloaded and analyzed by experts at Lamont- Doherty. On Dec. 29, Lamont-Doherty presented ODNR with their preliminary findings, which indicated the seismic event depth was 2,454' below the injection well.

Based on the Lamont-Doherty data, ODNR regulators ordered the immediate halt of injections at

Northstar 1, either voluntarily by the operator or by agency order. The next day, the Youngstown area experienced a 4.0-magnitude seismic event. Gov. John Kasich immediately placed an indefinite moratorium on three drilled deep injection wells and one well with a permit pending in the vicinity of the Northstar 1 well.

INDUCED SEISMICITY

Geologists believe it is very difficult for all conditions to be met to induce seismic events. In fact, all the evidence indicates that properly located Class II injection wells will not cause earthquakes. To induce an earthquake a number of circumstances must be met:

- A fault must already exist within the crystalline basement rock and that fault must already be in a near-failure state of stress.
- An injection well must be drilled deep enough and near enough to the fault and have a path of communication to the fault.
- The injection well must inject a sufficient quantity of fluids at a high enough pressure and for an adequate period of time to cause failure, or movement, along that fault (or system of faults).

A number of coincidental circumstances appear to make a compelling argument for the recent Youngstown-area seismic events to have been induced:

- The Northstar 1 well began injection operations in December 2010. Roughly three months later, the first seismic events were noted and were fairly close to the well.
- Subsequent seismic events were clustered around the vicinity of the wellbore.
- Evidence of permeability zones within the Precambrian basement rock is interpreted in some of the geophysical logs obtained from within the Northstar 1 well; and (Logs A, B, C, and D).
- Once sufficient monitoring equipment was in place, the focal depths of events were found to be about 4,000' laterally and 2,500' vertically from the wellbore terminus.

It appears there are observed permeability zones within the Precambrian basement rock in the drill coring logs recorded by the Battelle Memorial Institute during the drilling of Northstar 1. These logs were not available to inform regulators of possible issues in geological formations prior to well operation. Instead, Battelle produced and made the logs available to provide geologists with additional information on the region's geological formations. In the future, ODNR will require the Class II well owner to provide a suite of geophysical logs germane to the respective injection well.

To establish a better understanding of what may have happened, further analysis and detailed modeling of all factors must be completed on the Northstar 1 well and the surrounding geology. This work is already underway through ODNR and cooperating agencies and institutions.

FUTURE EVENTS

As the number of oil, gas, and injection wells in the state increases, so does the potential for environmental impacts. The state is mitigating this risk by enhancing regulatory and monitoring programs for well drilling and waste disposal operations. Additional information on these efforts can be found at the ODNR Division of Oil and Gas website: http://oilandgas.ohiodnr.gov/. The state's direction will be to continue to take steps to ensure that oil and natural gas development benefits the citizens of the state and does not adversely impact human health and the environment.

CLIMATE CHANGE

The Intergovernmental Panel on Climate Change defines climate change as "a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use." The National Oceanic Atmospheric Administration defines climate change as "a non-random change in climate that is measured over several decades or longer. The change may be due to natural or human-induced causes."

The Ohio State University's climate outreach notes that, "Climate change, two words that are already synonymous with changes in weather patterns across the world, from global warming to increased rainfall and severe storms. But climate change affects different areas in different ways – while some regions will see increased precipitation in the form of snow or rain, others will dry out because of reduced rainfall. And while overall temperatures across the globe are likely to increase, climate change can also be related to an increase in freezing temperatures and severe winter storms. Ohio is likely to be affected by a number of these phenomena, and adapting to different weather conditions will be important to maintain quality of life in the area."

Climate change acts as an amplifier of existing natural hazards. The fact that climate change is occurring is not disputed and over the past several decades there has been a marked increase in the frequency and severity of weather-related disasters, both nationally and in the state. This trend is being driven in part by changing global and regional climate conditions. The preponderance of available scientific evidence for anthropogenic forcing of climate change is overwhelming, or simply stated climate change is, in part, being caused by human actions, rather than natural factors alone. It is important that all levels of government and all sectors of society have at least a basic understanding of the potential impacts of climate change. The best available scientific data and modeling suggest that climate change has and will continue to impact natural hazards in the state. While the impacts of climate change may vary by regions and jurisdictions throughout the state, it is clear that the potential consequences of climate change will have significant impacts on all the citizens of the state.

OHIO EMERGENCY MANAGEMENT AGENCY SUMMARY ANALYSIS

The scientific studies and data referenced within this section come to one cohesive conclusion, climate change will have an impact on the natural hazards in the state through 2100. The greatest impact to the natural hazards in the state from climate change will be from the changes in precipitation rate and variability. To put it simply, these changes will lead to increased flooding in the spring and fall and increased periods of drought in the summer. Another impact on the state from the effects of climate change is a warming trend that will enhance the possibility of extended and increased extreme heat wave events. This climate change related warming trend will likely lead to an increased evaporation /transpiration feedback cycle, which will lead to reduced availability of water resources.

Since many of the anticipated effects of climate change exacerbate or accelerate existing natural hazards, many of the possible mitigation and adaptation strategies already exist. Based upon the best available scientific data and studies, Ohio EMA would make the following general mitigation and adaption strategy recommendations:

1. Develop greater built environment resilience
2. Improve stormwater infrastructure

3. Increase water quality and resource protection
4. Enhance essential utility resilience

These recommendations will be useful and positive actions regardless of the long term impacts of the climate change on the state. Each of these recommendations will be addressed in greater detail later in this section.

LITERATURE AND STUDIES REVIEW

While there is a considerable amount of climate change data and related studies available, there are still challenges in synthesizing the data from the available scientific sources into both the state and local hazard mitigation plans, due to the spatial context of the data in the Midwest. The majority of these studies use a spatial resolution of the entire United States or a regional approach such as focusing on the Great Lakes or Midwest Regions. There is a limited amount of data available that specifically address the impacts and effects of climate change at the state, watershed or local level for Ohio.

The fact that climate change is occurring is not disputed. The current scientific data and modeling suggest that climate change has and will impact the state. The challenges in determining the probability and severity of future impacts can make it difficult to determine with an absolute degree of certainty the full degree of impact climate change may have on the state. This is also further complicated by the fact that information gathered is continually evolving. Therefore, this section will not attempt to estimate potential losses. This section will only provide information on the potential impacts climate change may have on some of our already existing hazards profiled within the SOHMP.

This section incorporates basic scientific findings and the most current projections for global climate change as they have the potential to impact the state and the Great Lakes Region. This section will not address any one specific jurisdiction or region in an attempt to determine risk as has been completed for natural hazards within this plan update. In some instances, examples of potential impacts to specific areas are incorporated. It is important to note that in such instances, the analysis has been conducted by scientists and subject matter experts as referenced, and not by Ohio EMA Staff. As climate science evolves and improves, future updates to this plan will incorporate any new or improved relevant climate change data.

Several new or updated climate resiliency or related studies have been completed since the 2014 SOHMP, but the underlying issues with the availability of downscaled climate change data continues to be a challenge. The new or updated studies include:

- Ohio River Basin - Formulating Climate Change Mitigation/Adaptation Strategies through Regional Collaboration with the ORB Alliance
- NOAA National Centers for Environmental Information State Summary for Ohio
- Climate Resilience in Ohio, A Public Health Approach to Preparedness and Planning – Ohio Public Health Association
- Fourth National Climate Assessment
- Smart Growth Fixes for Climate Adaptation and Resilience – EPA
- ODOT Infrastructure Resiliency Plan
- Climate Change, Extreme Precipitation and Flooding: The Latest Science - Union of Concerned Scientist

- Local Jurisdiction Climate, Sustainability or Resiliency Plans

OHIO RIVER BASIN– Formulating Climate Change Mitigation/Adaptation Strategies through Regional Collaboration with the ORB Alliance

https://usace.contentdm.oclc.org/digital/collection/p266001coll1/id/5108/

The Huntington District of the USACE, in collaboration with the Ohio River Basin Alliance, the Institute for Water Resources, the Great Lakes and Ohio River Division, and numerous other Federal agencies, non-governmental organizations, research & academic institutions, prepared the Ohio River Basin Climate Change Pilot Report.

The report provides downscaled climate modeling information for the entire basin with forecasts of future precipitation and temperature changes as well as forecasts of future streamflow at numerous gaging points throughout the basin. These forecasts are presented at the Hydrologic Unit Code-4 sub-basin level through three 30-year time periods between 2011 and 2099 developed as part of the response to climate change pilot study of the Ohio River basin.

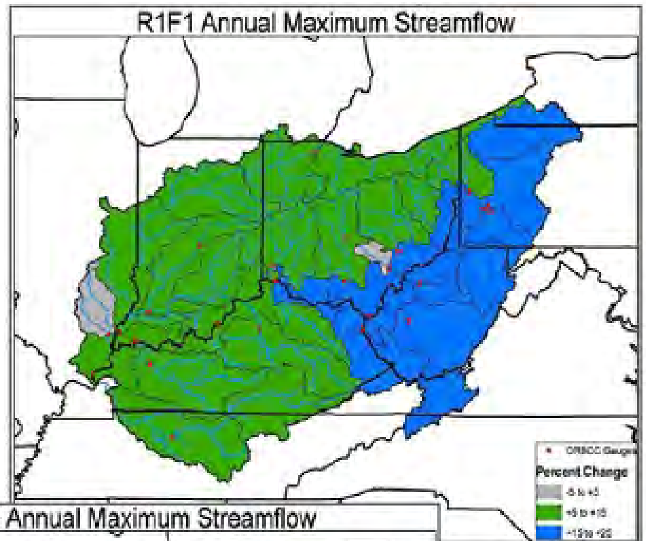
This pilot study was one of the first studies that has developed a downscaled model using current climate change data. This model was developed using archived CMIP3 and CMIP5 Climate and Hydrology Projections, which were in turn downscaled to the river basin level. The downscaled modeling results included both observed data for the 1951-2001(R1) and three 30 year forecast periods; 2011-2040(F1), 2041- 2070(F2) and 2071-2099(F3). The pilot study produced stream flow outputs for the following nine measures:

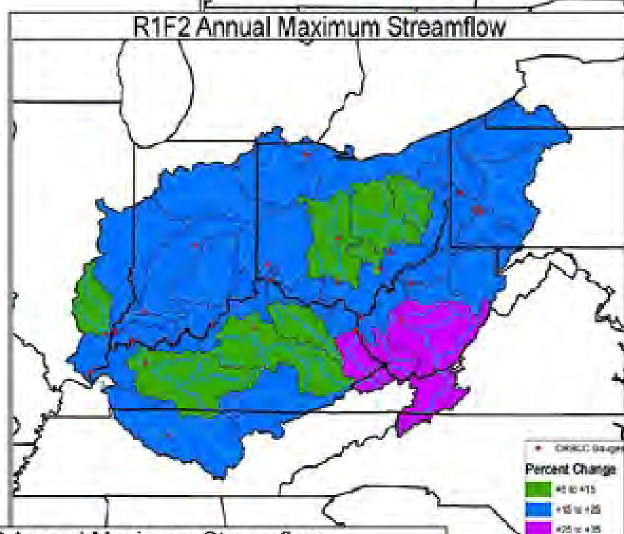
1. Annual % change mean flow
2. Annual % change maximum flow
3. Annual % change minimum flow
4. March % change mean flow
5. March % change maximum flow
6. March % change minimum flow
7. October % change mean flow
8. October % change maximum flow
9. October % change minimum flow

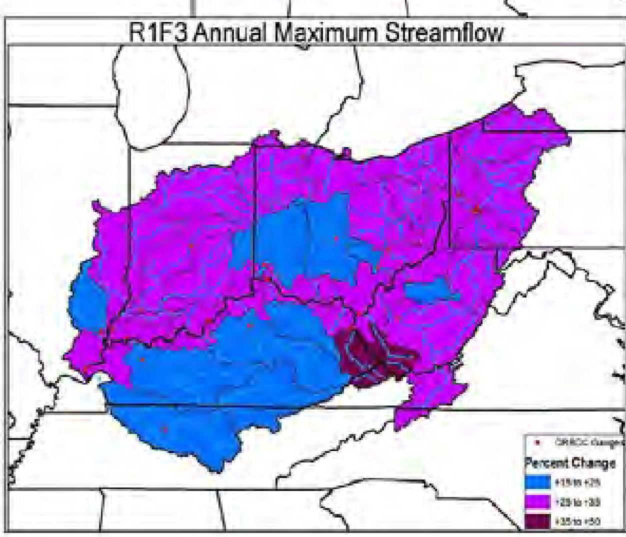
Thematic basin maps have been created to represent the above noted data, these maps highlight the percent changes for the three 30-year periods which are referenced in the maps below as F1 (2011-2040), F2 (2041-2070) and F3 (2071- 2099). The thematic basin maps for the percent change in annual maximum stream flow and percent change in October maximum stream flow have been included for reference. The remainder of the thematic basin maps are available in the draft study.

The downscaling of these ensemble climate models suggest the overall mean, maximum and minimum flows will generally be within range of recent history through the year 2040. After the year 2040, the increases occur in the mean and maximum flows in the 10% to 40% range. There are some watersheds in northern and eastern Ohio that appear to experience greater than 40% increases in mean and maximum flows. This appears to occur primarily from later summer until early winter. The autumn increases in maximum flows may enhance early cool season flood events in late autumn and early winter. These increases could lead to worsening spring flooding beyond 2040. The models suggest that droughts could lengthen or shift more between spring, summer and autumn beyond 2040. The models also suggest that the overall variability is also likely to increase with time as well.

<u>Percent Change in Annual Maximum Stream Flow:</u> In terms of the annual % change in the annual max flows; F1 shows an increase in the max flows across portions of PA and WV within the basin. In F2, this higher max discharge trend continues, but spreads into OH and IN and the Cumberland River watershed.

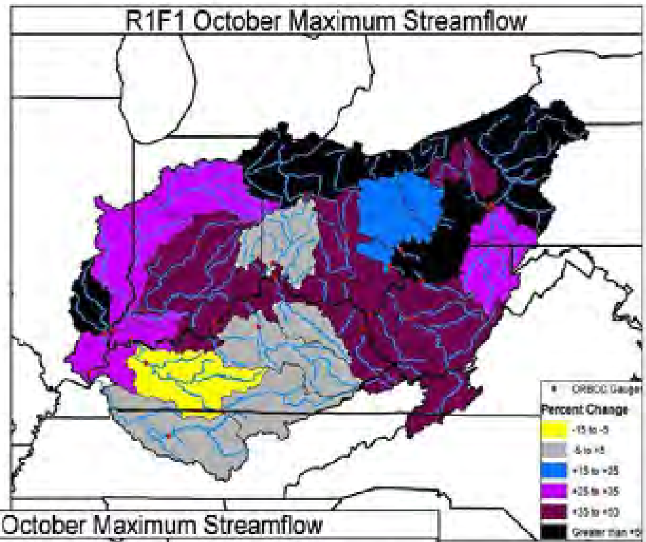


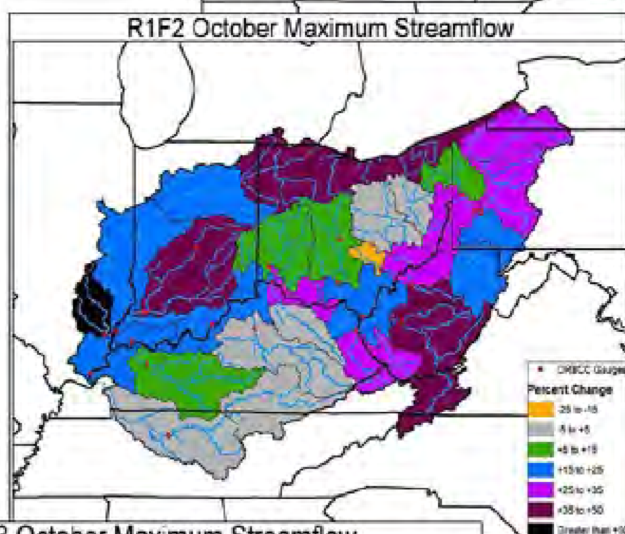


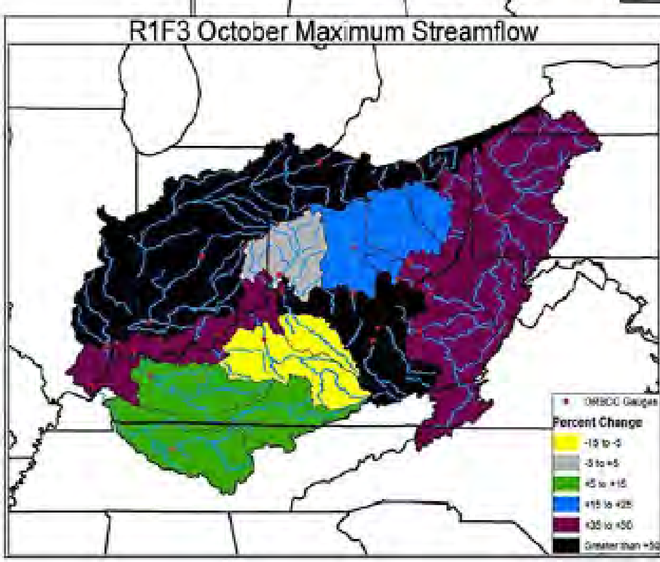


The % change in max flow increases markedly in the Kanawha and Big Sandy River sub-basins. In F3, the annual % change in max flows increases substantially across PA, WV, OH, IN and IL. The increase in annual % change in max flows appears significant in the Big Sandy River watershed during this third period. The progression of these flow changes is shown below in the three figures.

Percent Change in October Maximum Stream Flow: Period F1 shows increases in % change of max flow over much of the basin and substantially higher October flows in the Allegheny River and Little Wabash River watersheds and significant increases in the Kanawha, Scioto, Big Sandy and White River watersheds over the base condition.







Period F2 shows some relaxing of the wetter October conditions but the Kanawha, White River and Little Wabash remain higher than the base condition flows. Period F3 shows a return to higher October flows across the basin with the exception of central OH and KY. Substantial increases during this period are seen in the Big Sandy River, White River and Wabash River watersheds.

The report also included the results of preliminary investigations into the various impacts that forecasted climate change may have on ecosystems and infrastructure, and recommends mitigation and adaptation strategies. The mitigation and adaptation strategies in the pilot study can be deployed at all levels of government, private or corporate ownership to address the anticipated climate change impacts identified in the report and other effects cited in the research literature. Strategies for addressing unavoidable, residual impacts of climate change were also developed, along with objective assessments of the likelihood of success. These strategies include:

- Restoring Wetlands
- Reconnecting Floodplains
- Reducing Consumptive Uses of Water
- Harvesting Precipitation and Flood Flows
- Drought Contingency Planning
- Increasing Nutrient and Abandoned Mine Drainage Management
- Modifying Thermoelectric Power Plant Cooling Systems
- Reducing Flood Damages Through Nonstructural Measures
- Increasing Water Quality and Flow Discharge Monitoring
- Promoting Wise Land Use Management
- Modifying Reservoir Operations, Policies and Structures
- Managing Ecosystem Stress
- Temporal Staging

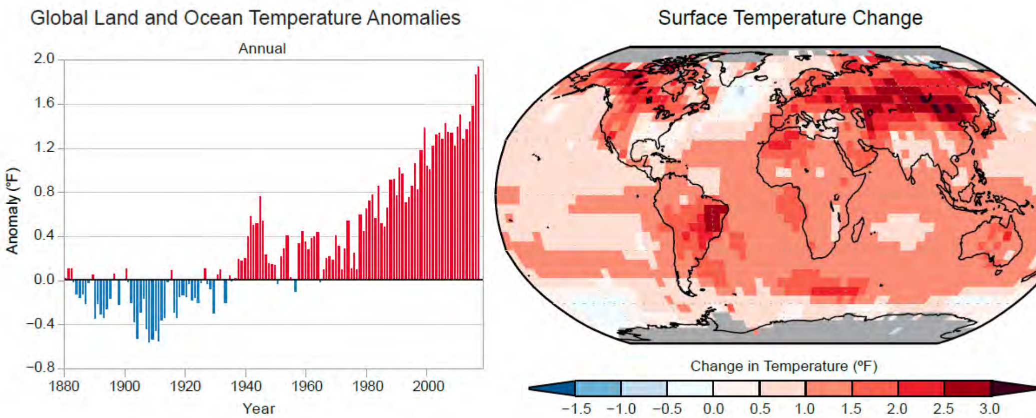
The report then recommends “next-steps”, which include filling in numerous data gaps identified during the study process. Many gaps in knowledge, understanding, and modeling need to be filled and much more investment will be required to assure ourselves that (1) the downscaled modeling results displayed in this pilot study are updated on a regular basis (at least decadal), (2) the mitigation and adaptation measures identified remain current based on new strategies and the documented successes or failures of applied strategies by others, and (3) the USACE accept an Army Strong role in leading basin water managers toward a comprehensive plan for basin water planning that can offset the potential effects of climate change on infrastructure and the ecosystems that are dependent upon operation of those facilities.

FOURTH NATIONAL CLIMATE ASSESSMENT VOLUME 1 & 2

Fourth National Climate Assessment | Volume 1

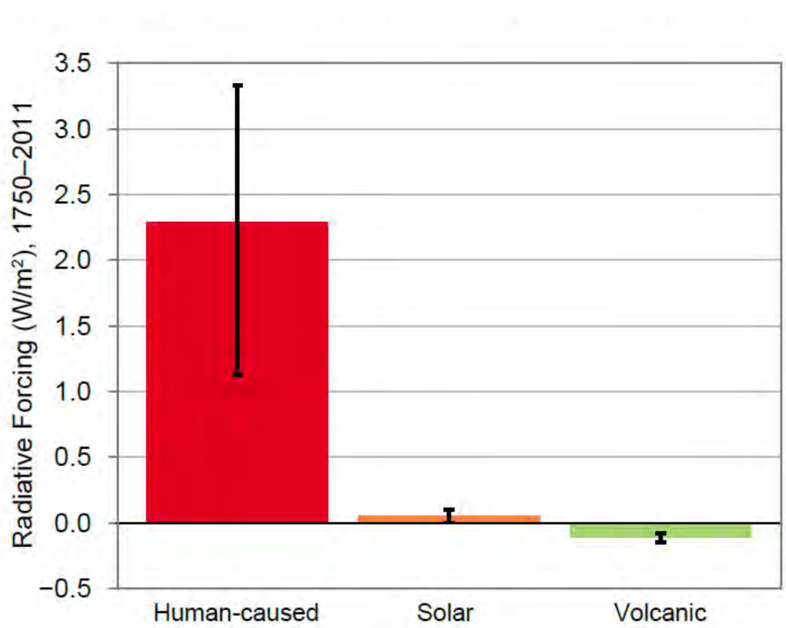
The National Climate Assessment is the authoritative assessment of the science of climate change, with a focus on the United States, and serves as the foundation for efforts to assess climate-related risks and inform decision-making. The climate of the United States is strongly connected to the changing global climate and this assessment highlights past, current, and projected climate changes for the United States and the globe.

Global annually averaged surface air temperature has increased by about 1.8°F (1.0°C) over the last 115 years (1901–2016). This period is now the warmest in the history of modern civilization, with the last three years being the warmest years on record for the globe. These trends are expected to continue over climate timescales.



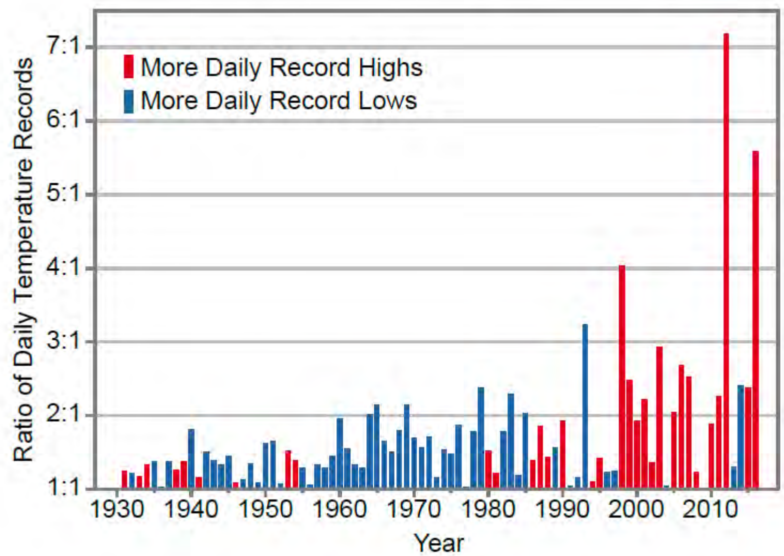
This assessment concludes, based on extensive evidence, that it is extremely likely that human activities, especially emissions of greenhouse gases, are the dominant cause of the observed warming since the mid-20th century. For the warming over the last century, there is no convincing alternative explanation supported by the extent of the observational evidence.

In addition to warming, many other aspects of global climate are changing, primarily in response to human activities. Thousands of studies conducted by researchers around the world have documented changes in surface, atmospheric, and oceanic temperatures; melting glaciers; diminishing snow cover; shrinking sea ice; rising sea levels; ocean acidification; and increasing atmospheric water vapor.



Changes in the characteristics of extreme events are particularly important for human safety, infrastructure, agriculture, water quality and quantity, and natural ecosystems. Heavy rainfall is increasing in intensity and frequency across the United States and globally, and is expected to continue to increase.

Additionally, heatwaves have become more frequent in the United States since the 1960s, while extreme cold temperatures and cold waves are less frequent. Recent record-setting hot years are projected to become common in the near future for the United States, as annual average temperatures continue to rise. Annual average temperature over the contiguous United States has increased by 1.8°F (1.0°C) for the period 1901–2016; over the next few decades (2021–2050), annual average temperatures are expected to rise by about 2.5°F for the United States, relative to the recent past (average from 1976–2005), under all plausible future climate scenarios.



The magnitude of climate change beyond the next few decades will depend primarily on the amount of greenhouse gases (especially carbon dioxide) emitted globally. Without major reductions in emissions, the increase in annual average global temperature relative to preindustrial times could reach 9°F (5°C) or more by the end of this century. With significant reductions in emissions, the increase in annual average global temperature could be limited to 3.6°F (2°C) or less.

The global atmospheric carbon dioxide (CO2) concentration has now passed 400 parts per million (ppm), a level that last occurred about 3 million years ago, when both global average temperature and sea level were significantly higher than today. Continued growth in CO2 emissions over this century and beyond would lead to an atmospheric concentration not experienced in tens to hundreds of millions of years. There is broad consensus that the further and the faster the Earth system is pushed towards warming, the greater the risk of unanticipated changes and impacts, some of which are potentially large and irreversible.

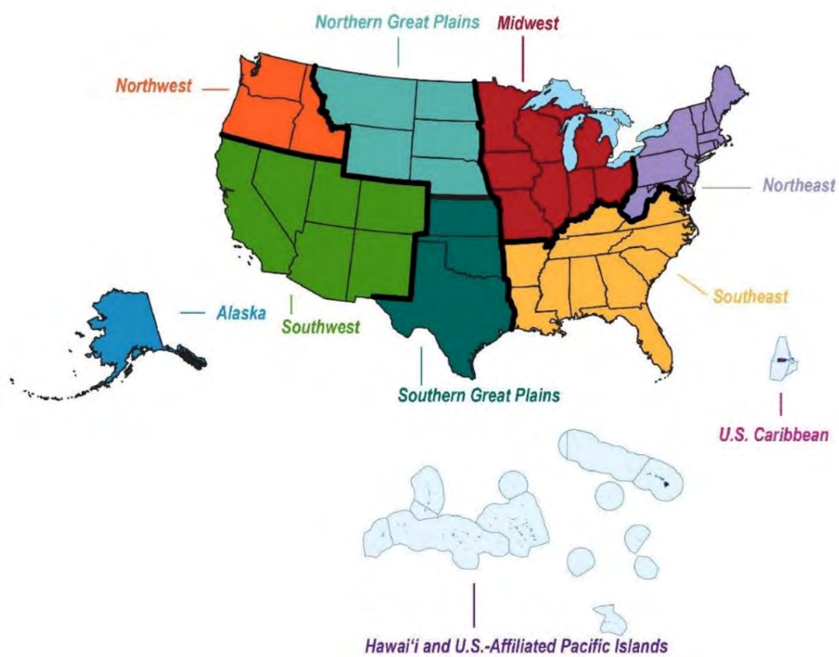
Fourth National Climate Assessment | Volume 2- Summary Findings

Volume 2 of the Fourth National Climate Assessment (NCA4) focused on consolidating the findings into twelve broad Key Messages:

1. Communities
2. Economy
3. Interconnected Impacts
4. Actions to Reduce Risks
5. Water
6. Health
7. Indigenous Peoples
8. Ecosystems and Ecosystem Services
9. Agriculture and Food
10. Infrastructure
11. Oceans and Coasts
12. Tourism and Recreation

These Key Messages broadly apply across the nation and generally echo other climate change studies in stating that climate change will like have broad impacts in many sectors of American life. For communities across the country, climate change creates new risks and exacerbates existing vulnerabilities, presenting growing challenges to human health and safety, quality of life, and the rate of economic growth.

Volume 2 of the Fourth National Climate Assessment further delineates the impacts of climate change by breaking down the nations into 10 Regions. The State of Ohio is located within the Midwest region, so that is the region we will focus on.



Midwest Chapter

NCA4 identifies 6 key messages in the Midwest Chapter: Agriculture, Forestry, Biodiversity & Ecosystems, Human Health, Transportation & Infrastructure, and Vulnerability & Adaptation. Biodiversity & Ecosystems and Vulnerability & Adaptation are newly introduced key messages for this report. A summary of the overall findings in each key message area of the NCA4 report follows:

Agriculture

The Midwest is a major producer of a wide range of food and animal feed for national consumption and international trade. Increases in warm-season absolute humidity and precipitation have eroded soils, created favorable conditions for pests and pathogens, and degraded the quality of stored grain. Projected changes in precipitation, coupled with rising extreme temperatures before mid-century, will reduce Midwest agricultural productivity to levels of the 1980s without major technological advances.

Forestry

Midwest forests provide numerous economic and ecological benefits, yet threats from a changing climate are interacting with existing stressors such as invasive species and pests to increase tree mortality and reduce forest productivity. Without adaptive actions, these interactions will result in the loss of economically and culturally important tree species, such as paper birch and black ash, and are expected to lead to the conversion of some forests to other forest types or even to non-forested ecosystems by the end of the century. Land managers are beginning to manage risk in forests by increasing diversity and selecting for tree species adapted to a range of projected conditions.

Biodiversity and Ecosystems

The ecosystems of the Midwest support a diverse array of native species and provide people with essential services such as water purification, flood control, resource provision, crop pollination, and recreational opportunities. Species and ecosystems, including the important freshwater resources of the Great Lakes, are typically most at risk when climate stressors, like temperature increases, interact with land-use change, habitat loss, pollution, nutrient inputs, and nonnative invasive species. Restoration of natural systems, increases in the use of green infrastructure, and targeted conservation efforts, especially of wetland systems, can help protect people and nature from climate change impacts.

Human Health

Climate change is expected to worsen existing health conditions and introduce new health threats by increasing the frequency and intensity of poor air quality days, extreme high temperature events, and heavy rainfalls, extending pollen seasons, and modifying the distribution of disease-carrying pests and insects. By mid-century, the region is projected to experience substantial, yet avoidable, loss of life, worsened health conditions, and economic impacts estimated in the billions of dollars as a result of these changes. Improved basic health services and increased public health measures—including surveillance and monitoring—can prevent or reduce these impacts.

Transportation and Infrastructure

Storm water management systems, transportation networks, and other critical infrastructure are already experiencing impacts from changing precipitation patterns and elevated flood risks. Green infrastructure is reducing some of the negative impacts by using plants and open space to absorb storm water. The annual cost of adapting urban storm water systems to more frequent and severe storms is projected to exceed $500 million for the Midwest by the end of the century.

Community Vulnerability and Adaptation

At-risk communities in the Midwest are becoming more vulnerable to climate change impacts such as flooding, drought, and increases in urban heat islands. Integrating climate adaptation into planning processes offers an opportunity to better manage climate risks now. Developing knowledge for decision-making in cooperation with vulnerable communities will help to build adaptive capacity and increase resilience.

Adaption actions could have a positive impact on the effects of climate change in the Midwest. The Community Vulnerability and Adaptation Key Messages of NCA4 follow:

- Expanding the use of green infrastructure and locating it properly may mitigate the negative impact of heat islands in urban settings.

- Documented implementation of climate change planning and action in Midwest cities and rural communities remains low.
- In-depth interviews with local decision-makers on water management across scales have suggested that a lack of political and financial support at the state and federal levels is a barrier to adaptation action in cities and counties.
- While initiatives are underway in the Midwest to mainstream adaptation action (such as the Great Lakes Climate Adaptation Network), there are few examples in published literature that document failure or success.

Factors that shape or contribute to the successful adoption and implementation of adaptation by public-sector organizations include:

- Plans written by a professional staff and approved by elected officials;
- Community engagement, including the participatory development of plans; the formation of action teams or regional collaborations across jurisdictions, sectors, and scales; and public- and private-sector leaders who champion and support the process;
- Adaptation actions that address multiple community goals, not just climate change;
- Well-structured implementation, including the identification of parties responsible for each step, explicit timelines, explicit and measurable goals, and explicit provisions and timelines for monitoring and updating the plan; and
- Adequate funding for the adaptation actions and for sustained community outreach and deliberation.

ODOT INFRASTRUCTURE RESILIENCY PLAN

The plan's executive summary states that the key objective of the study was to identify the vulnerability of the Ohio Department of Transportation's (ODOT's) infrastructure to climate change effects and extreme weather events. The analysis includes a discussion and analysis of the type of transportation assets vulnerable, the degree of exposure, sensitivity, adaptive capacity, and the potential approaches to adapt to these changes. The study includes:

- Understanding the vulnerability of ODOT's overall transportation system to climate change;
- Determining potential consequences from a broad range of potential climate impacts;
- Identifying facilities at risk to climate change impacts within Ohio by type;
- Identify range of adaptation and/or sustainability options (activities) that ODOT should consider in detail in future adaptation studies
- Providing the foundation for ODOT to integrate the results of this vulnerability assessment into future decision making processes and future adaptation/resiliency studies.

Utilizing ODOT's existing GIS systems, the project team developed additional GIS mapping and analytics to evaluate the vulnerability of ODOT's infrastructure to climate change effects. This effort determined that the primary climate change effect of concern is the increased incidence of heavy precipitation events, which will impair the functioning of core assets -- highways, bridges, and culverts.

A summary of this study's recommendations are below:

- Identify a lead office within ODOT- Office of Planning.
- Completion of Annual Tasks by the Resiliency Lead
- Ongoing refinement of VAST model for the 3 asset types (highways, bridges, culverts):

- Interagency Coordination

THE IMPACT OF CLIMATE CHANGE AND POPULATION GROWTH ON THE NFIP THROUGH 2100

http://www.aecom.com/deployedfiles/Internet/News/Sustainability/FEMA%20Climate%20Change%20Report/Climate_Change_Report_AECOM_2013-06-11.pdf

This study was funded by FEMA at the request of the Government Accountability Office. The goal of the study is to gain a better understanding of the potential impacts of climate change on the National Flood Insurance Program. This study focused on both riverine and coastal flooding throughout the U.S. with estimates at 20-year intervals through the year 2100. The study relied on existing data, studies, reports, and research. Although no new climate modeling was performed for this study, the methods used to evaluate the data were innovative. The study found that in riverine environments the typical 1% annual change of floodplain nationwide is projected to grow by about 45%, with areas in the northwest and the Great Lakes region experiencing growth that may exceed 100%. Nationally, 30% of that 45% increase in floodplain is due solely to population growth and would occur without the effects of climate change. The study suggests that 70% of that 45% increase in floodplain riverine areas is due solely to climate change and would occur even if there was no population growth. For reference, the below maps indicate the projected increases in both the percent change in 1% annual flood discharge through 2100 and the median projected percent change in special flood hazard areas through 2100. These results reflect national averages only and are not intended to be interpreted locally.

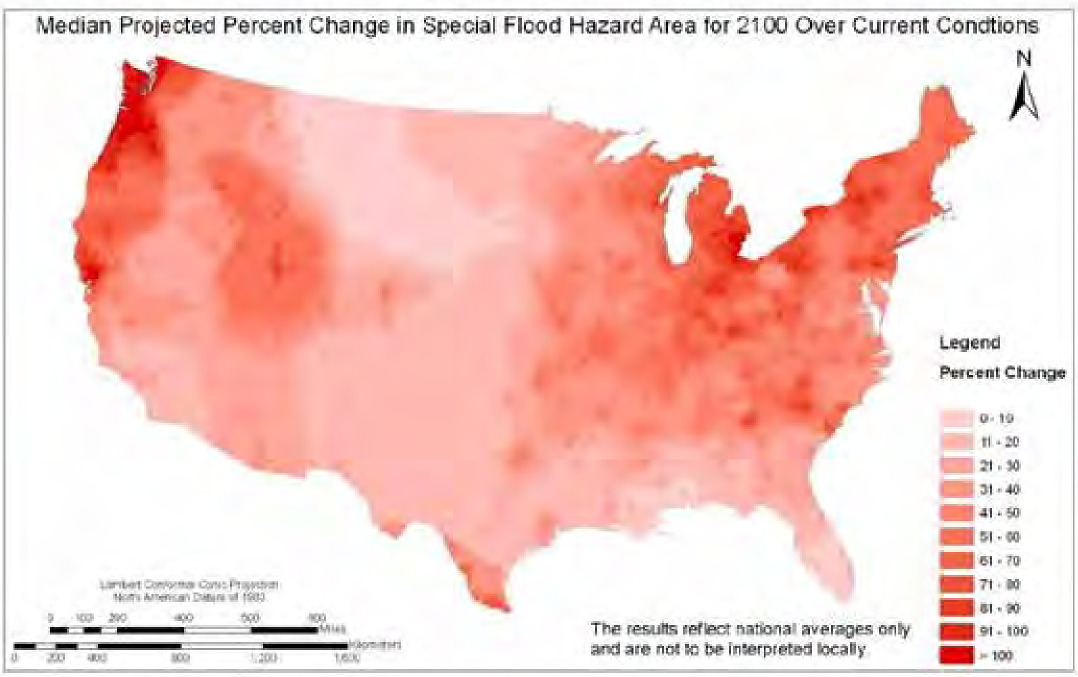


Figure 4-10. The median (50th percentile) relative change of the SFHA at epoch 5 (2100). Changes are with respect to current conditions.

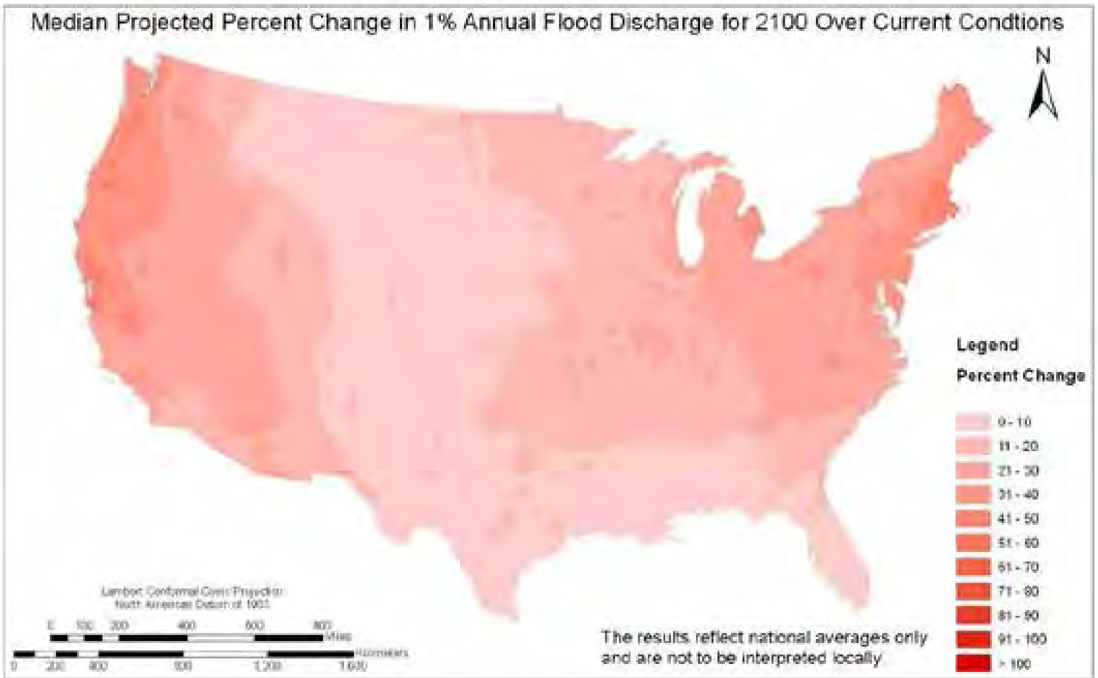


Figure 4-5. The median (50th percentile) relative change of the 1%-annual flood discharge at epoch 5 (2100). Changes are with respect to current conditions.

CLIMATE CHANGE, EXTREME PRECIPITATION AND FLOODING: THE LATEST SCIENCE – UNION OF CONCERNED SCIENTISTS

https://www.ucsusa.org/sites/default/files/attach/2018/07/gw-fact-sheet-epif.pdf

This report is a synopsis by Union of Concerned Scientist of the latest scientific findings on how and why precipitation and flooding patterns have changed in the United States, a summary of the possible future scenarios, and recommendations. While coastal flooding and sea level rise are important parts of the complete picture of flood risk, this synopsis focuses on flooding of inland areas.

According to the 2017 Climate Science Special Report, flooding across the United States is changing, though not uniformly across the country. The data shows that flood frequency has increased in the Mississippi Valley and the Midwest over the last century, including an increase in moderate and major flood frequency in the Midwest. Across the country, increasingly frequent heavy rain is one of the most obvious weather changes. The regions experiencing increases in extreme precipitation generally align well with those experiencing increases in flood frequency. Increases in extreme precipitation frequency and intensity are projected to continue across much of the United States over the 21st century, particularly in the northern and Midwestern regions.

The reports cites several current Federal flood risk reductions programs that may help to mitigate future flood risk such as the Hazard Mitigation Assistance suite of grant programs, HUD CDBG Disaster Recovery grants, and several others. The report also recommends several possible reforms to the NFIP that would establish risk-based insurance rates, fund mapping that factors for future conditions and provide incentives for investment in flood risk reduction measures. Additionally the report suggests several policies that could be implemented at all levels of government, not just at the federal level. The possible policies include:

- Plan, design, build, retrofit and maintain infrastructure to withstand the reality of climate change.

- Incentivize regional flood risk planning to help consolidate funding and resources and implement flood resilience measures on a larger scale.
- Design and implement policies that incentivize good behavior.
- Ensure targeted funding and resources for disadvantaged populations.

The report concludes by stating our current climate no longer replicates many past patterns. Our future climate will only stray farther from what we have come to expect and have developed our societies to withstand. To adapt, we must understand these unfolding precipitation and flooding trends, prepare for changes, and learn to be more resilient amidst them. But, vitally, we are only adaptable to a point, beyond which the damages, costs, and strain will create deep harm. We must recognize the climate risks to the U.S. landscape that we simply cannot cope with, and we must strive to reduce changes to our climate and thus slow, and where we can, outright avoid these dangerous risks.

CLIMATE CHANGE IN THE MIDWEST: IMPACTS, RISKS, VULNERABILITY, AND ADAPTATION

S.C. Pryor, Provost's Professor of Atmospheric Science at Indiana University Bloomington and editor of the Journal of Geophysical Research Atmospheres edited and released Climate Change in the Midwest: Impacts, Risks, Vulnerability, and Adaptation in 2013. This book presents research that focuses on identifying and quantifying the major vulnerabilities to climate change in the Midwest. The book addresses the key sectors that may have vulnerabilities amplified by the effects of climate change, including agriculture, human health, water, energy and infrastructure.

The climate vulnerability assessment performed in the book came to the following conclusions for the Midwest:

1. The average temperature may increase 1 to 3 degrees Celsius over the next several decades. Projected change in the climate models indicate a clear tendency towards increased frequency of heat waves. Further cold- air outbreaks and other extreme cold spells will still occur but with reduced likelihood.
2. That rainfall will increase variably across the Midwest over the next several decades. The rainfall potential will increase 20-30% in the spring and winter months and there will be a significant increase in variability of precipitation events in the summer and fall months. There is evidence to suggest a split in future rainfall events, leading to a greater likelihood of droughts in the summer months and floods in the fall months.
3. Some other affects include the likelihood of warmer nights and possibly warmer days leading to an increased susceptibly to pests. The warming will likely cause a reduction in crop yields and the evaporation / transpiration feedback will lead to less available water resources.
4. The projected soil loss through erosion is expected to be significant and greater than anything that has occurred in the previous century.
5. The most direct impact of climate on human health is heat-related morbidity and mortality. The climate models indicate an increase in heat stress across all models over the course of the 21st century.
6. Using the concepts of stream flow elasticity, projected increases in precipitation over much of the Midwest are estimated to increase by 16- 20%

DROUGHT, EXTREME SUMMER WEATHER AND INVASIVE SPECIES

The studies and reports referenced above indicate that a warming trend will increase over the next several decades up to the extent of the studies/reports which is 2100. This warming trend will increase the possibility of extended and increased extreme heat wave events. The average temperature may increase 1 to 3 degrees Celsius over the next several decades throughout the Midwest. The projected change in the climate models indicate a clear tendency towards increased frequency of heat waves. Further cold-air outbreaks and other extreme cold spells will still occur, but with reduced likelihood. The studies suggest that a warming trend combined with increased variability of rainfall events in the summer months will lead to increasing periods of drought in the state and the Great Lakes region. The models suggest that droughts could lengthen or shift more between spring, summer and autumn beyond 2040. The warming trend will likely cause a reduction in crop yields and the evaporation / transpiration feedback will lead to less available water resources for human consumption, recreation and agricultural purposes. The changes in precipitation, drought and heat patterns will also create more heat related stress on crops and livestock. The changing weather patterns may also lead to a greater amount of crop pests and pathogens ranging farther northward.

FLOODING, SEVERE THUNDERSTORMS, SEVERE WINTER/ICE STORMS

The studies and reports referenced above indicate that one of the primary impacts on the state from climate change will be the changes in precipitation rates and variability. The studies also indicated that rainfall will increase variably across the Midwest over the next several decades. The increased variability of precipitation events will mostly occur in the summer and fall months. There is evidence to suggest a split in future rainfall events, leading to a greater likelihood of droughts in the summer months and floods in the fall months.

The studies also indicated that after the year 2040, the increases occurring in the mean and maximum stream flows will be in the 10% to 40% range with the north and northeast parts of that state experiencing greater than 40% increases. These increases appear to occur primarily from later summer until early winter, with the autumn increases in maximum stream flows enhancing early cool season flood events in late autumn/early winter. These increases also indicated the possibility of worsening spring flooding beyond 2040.

MITIGATION AND ADAPTION STRATEGIES

As the climate change data specific to the state becomes more readily available, mitigation and adaptation will be one of the focuses of dealing with the impacts of climate change. Ohio EMA has recommended four mitigation and adaption strategies that will help alleviate the future impacts of climate change on the natural hazards within the state. These strategies are recommended because they will have positive impacts regardless of climate change and its predicted long term impacts.

DEVELOP GREATER BUILT ENVIRONMENT RESILIENCE

The built environment refers to the any buildings or structures which are manmade as opposed to the natural environment. Developing resilience in the built environment is an important mitigation action, especially when you factor for the probability of increasing precipitation rates and variability. Examples of actions that increase resilience of the built environment include:

- Reduce the number of pre-FIRM flood prone, repetitive loss and severe repetitive loss structures through FEMA mitigation grant programs.

- Adopting building, zoning and floodplain regulations that include higher standards than the minimum regulatory requirements.
- Encourage resilient local land use regulation through the Ohio Balanced Growth Initiative.

IMPROVE STORMWATER INFRASTRUCTURE

Stormwater infrastructure is normally designed to convey or capture flows associated with a designed storm event; the scale of which is based on a probability distribution of observed rainfall events. One of the underlying assumptions of the atypical design approach is that the rainfall probability distribution is static. The best available climate change models indicate that future larger precipitation events will occur with an increasing frequency. The existing stormwater infrastructure, which was designed with current storm approach, cannot be expected to provide the intended level of protection throughout its lifetime service. Examples of actions that improve stormwater infrastructure are:

- Encourage increased green infrastructure and the use of low impact development strategies to reduce stormwater.
- Seek to minimize impervious surfaces such as parking lots, roads, and rooftops in sensitive areas.
- Encourage riparian buffers along streams, rivers, and waterways to maintain natural floodplains.
- Protect and reestablish wetlands to hold runoff and recharge groundwater.
- Implement the separation of combined storm and sanitary sewer overflows to reduce pollution from sewage, bacteria, and E. Coli entering waters during storm event

INCREASE WATER QUALITY AND RESOURCE PROTECTION

The current climate change models indicate that its effects will have a variety of impacts on ground water resources and water quality. The higher water and air temperatures and changes in the timing, intensity, and duration of precipitation will impact water quality and ground water resources. Examples of actions that can be pursued to increase water quality and provide ground and surface water resources protection include:

- Encourage effective water-conservation strategies during summer months, and consider year-round water-conservation strategies for water-intensive users.
- Implement the separation of combined storm and sanitary sewer overflows to reduce pollution from sewage, bacteria, and E. Coli entering waters during storm events.
- Recommend sewer and septic systems be upgraded to reduce non-point source pollution from urban areas, farmland, and other sources.
- Ensure that water extractions and diversions are appropriately planned and factor the future impacts of climate change.

ENHANCE UTILITY AND ENERGY RESILIENCE

Water, electricity, and wastewater treatment are three utility services that are essential for modern daily life. These three utilities support business, industry, recreation, housing, hospitals and schools in communities across the state. These essential utility services have been traditionally planned, designed and operated with an assumption that the future environment is mostly static and predictable. The scientific climate change models show that increasingly variable and extreme precipitation patterns and temperature increases crises will intensify the risks faced by these essential utility services. With these risks in mind, essential utilities need to be working to strengthen their resilience to extreme climate events, also seeking ways to mitigate the impacts of climate change. Examples of actions that can be pursued to assist utilities services in increasing their resiliency include:

- Engage and educate stakeholders, having their active engagement will help to build shared a understanding and support for utility initiatives
- Strengthen existing utility transmission generation networks so they are able to cope with the future demand resulting from climate change.
- Encourage the development and construction of green infrastructure to help lessen the impact of the increasing extreme climate events.
- Support the upgrade of neglected infrastructure networks to provide an efficient supply of utilities.

LOCAL CLIMATE CHANGE ADAPTATION AND MITIGATON PLANS

Ohio's largest 6 cities (Columbus, Cleveland, Cincinnati, Toledo, Akron and Dayton) and the City of Athens have all, in varying levels, identified potential climate change impacts for the city and either acknowledge the need for future adaptation planning (Toledo, Dayton) or have already created adaptation/action plans (Athens, Columbus, Cleveland, Cincinnati, Akron).

Commonly identified impacts by the cities include:

- Health implications from deteriorated air quality and increased temperatures, and;
- Increased heavy precipitation and storm events.

Among cities with adaptation plans:

- Energy efficiency, transportation, and water and food supply are commonly reoccurring themes.
- The cities of Akron, Cincinnati and Cleveland have all identified quantitative, city-wide greenhouse gas reduction goals.
- The cities of Columbus, Cincinnati and Cleveland cite lack of federal and/or state level action on climate change as a driver for its city level adaptation and mitigation planning.

Actions/Recommendations:

- Athens has 10 key recommendations (pertaining to sustainability more generally).
- Columbus has 43 recommendations grouped into 8 thematic areas.
- Cincinnati has 80 recommendations (several recommendation per each objective).
- Cleveland has several actions per each of the 28 objectives.
- Akron has "strategies" for consideration but no finalized recommendations or actions.

The subsequent pages summarize the following documents:

- The Greenprint for Akron (2012)
- The Athens Sustainability Action Plan (2017)
- The Green Cincinnati Plan (2018)
- The Cleveland Climate Action Plan (2018)
- Columbus Climate Action Plan (2018)
- The Potential Impacts of Climate Change on Dayton, Ohio (2013)

- The University of Michigan Climate Center's City Fact Sheet: Toledo Ohio (2016)

Akron

The City of Akron has recognized likely impacts of climate change on the city and has laid out 7 guiding principles as part of its sustainability plan for the city. The city has completed a study to identify baseline levels and sources of emissions in order to achieve tangible Green House Gas (GHG) reductions. The City of Akron's Climate Action Plan was completed using the International Council for Local Environmental Initiatives (ICLEI)'s Climate and Air Pollution Planning Assistance software and is intended to identify where policymakers will need to target emissions reduction activities if they are to make significant progress toward adopted targets.

Athens

The Athens Sustainability Action Plan explores 8 topic areas (energy, economy, solid waste, food, housing and development, transportation, water, air and greenhouse gas emissions) and the current status in Athens for each topic as well as an action plan for each. Based on community concerns and additional research, the City of Athens Environment and Sustainability Commission has identified 10 key recommendations as the most important to put the city on a sustainable path and to reduce greenhouse gas emissions.

Columbus

The Columbus Climate Adaptation Plan (CCAP) recommends 43 actions to be taken by the City that fall under 8 thematic chapters (Extreme Heat, Air quality and Energy, Flooding, Water Quality, Water Use, Ecosystems, Emergency Preparedness and Vulnerable Populations). The list of recommended actions are prioritized into necessary and aspirational actions. Necessary actions are considered the most impactful and easiest to implement based on expertise, cost and will. The Plan recommends that various city departments should assume leadership roles in project planning, assigning duties and executing actions. The City could allocate funds related to climate adaption to departments to utilize and the annual sustainability report should include documentation of progress toward completion of each action item.

Cincinnati

Following Cincinnati's 2017 commitment to reach 100% renewable energy in the city by 2035, the 2018 Green Cincinnati Plan outlines 80 high-impact recommendations to reduce carbon emissions by 80% by 2050. The recommendations have been grouped into eight themes: built environment, education & outreach, energy, food, natural systems, resilience, transportation, and waste. It also identifies 26 measureable goals that will be used to measure progress toward a sustainable, equitable and resilient Cincinnati. The report identifies that adoption of autonomous vehicles, encouraging electric vehicle use and infrastructure, and industrial energy efficiency as the top three recommendations in terms of potential impact towards the 2050 GHG goal.

Cleveland

The 2013 Cleveland Climate Action Plan (updated in 2018) established an overarching GHG reduction goal of 80% below 2010 emissions by 2050, with interim goals of 16% reduction by 2020 and 40% reduction by 2030. The plan identified 28 objectives across five focus areas (energy efficiency and green building, clean energy, sustainable transportation, clean water and vibrant green space, more local food, less waste) and cross-cutting priorities as well as goals through numeric targets and time frames for achieving targets. Additionally, it identifies actions, which are specific strategies that will be implemented to meet the goals and objectives.

Dayton

The City of Dayton does not have a designated climate or sustainability plan. The city has, however, identified and analyzed the potential impacts of climate change on the city. It has acknowledged that the next step is deciding which strategies make the most sense for the city's climate efforts. Strategies focus on increasing the amount of green infrastructure, encouraging the use of pervious surfaces, on-site stormwater management through rain gardens and bio-swales, urban forestry, green and white roofs, energy efficiency, renewable energy, land-use planning, updated zoning policies, the use of reflective pavement, strategies to increase adaptive capacity of residents and businesses, and enhancing community engagement and empowerment.

Toledo

The City of Toledo (with the University of Michigan) has created a Climate Fact Sheet on the city. The city recognizes deteriorating water infrastructure as a major issue as the city is built over a wetland area and ground saturation and stormwater overflow pose major threats to health. The city of Toledo is partnering with General Motors and Teledyne to increase green infrastructure in flood-prone neighborhoods.

CLIMATE CHANGE ADAPTATION LITERATURE AND STUDIES REVIEW

There are several current studies that suggest various climate change adaption strategies for the Great Lakes or Midwestern region. Many of these studies do not provide enough downscaled data or go into sufficient detail to warrant full inclusion within this current iteration of the plan update. As climate science evolves and improves, future updates to this plan will incorporate any new or improved relevant climate change adaption strategies.

CLIMATE CHANGE RESEARCH AT THE OHIO STATE UNIVERSITY

http://esn.osu.edu/climate-change

The Ohio State University has long been a leader in global climate change research, from physical drivers to impacts to adaptation and mitigation. Research teams across the university are investigating many aspects of global change, including:

- Glaciers, climate change and sea level, atmospheric sciences, contemporary and paleo climate.
- Ecosystem and biodiversity impacts, greenhouse gas monitoring and mitigation, freshwater quantity and quality, economic modeling, coastal community adaptation and mitigation.
- Changes in ecosystem services, risk and decision science, education and community engagement, agricultural impacts and strategies.

THE OHIO STATE CLIMATE CHANGE OUTREACH TEAM

http://changingclimate.osu.edu/

The Ohio State University Climate Change Outreach Team is a partnership among multiple departments within Ohio State University; the team's goal is to help localize the climate change issue by bringing related research and resources to residents of Ohio and the Great Lakes region. The team is comprised of leading academics from Ohio State Extension, the Department of Agricultural, Environmental, & Development Economics, Byrd Polar Research Center, School of Environment and Natural Resources (SENR), Department of Geography, Department of Evolution, Ecology & Organismal Biology, Ohio Agricultural Research and Development Center (OARDC) and the Ohio Sea Grant College Program & Stone Laboratory.

CLIMATE CHANGE ADAPTATION IN GREAT LAKE CITIES STUDY

http://deepblue.lib.umich.edu/handle/2027.42/97435

This study looks at the anticipated impacts of climate change and how those impacts affected different communities throughout the state. Researchers have identified a variety of resources, assets, and governance structures that increase the ability and likelihood of successful adaptation, even in the face of significant uncertainty. In order to anticipate and successfully respond to these impacts, cities in the state need to better understand the opportunities and constraints within their own organizations.

To evaluate this capacity, an Integrated Assessment was conducted for four cities in the state (Toledo, Dayton, Elyria, and Avon Lake). The study takes a broad view of the political, social, and ecological causes, consequences, and potential solutions to climate vulnerability and impact reduction. The results of the study describe the capacities and constraints each city possesses, as well as identifies best practices cities can implement to take advantage of these capacities and overcome constraints. Each city had specific capacities and constraints based on the analysis, several overarching themes emerged. Decision-makers in each city expressed interest in adapting to climate change. Leaders within city governments are working to connect issues of sustainability and adaptation to the core mission of their departments, as well as forming policy networks across the city. Overall, leadership and the quality of current city employees emerged as key capacities throughout the study, but there are significant constraints to adaptation as well. Two broad trends identified are scarce financial resources and limited access to scientific knowledge. The lessons learned in this study could be applied to future plan updates as additional appropriate climate change data become available statewide.

ADAPTING TO CLIMATE CHANGE: A PLANNING GUIDE FOR STATE COASTAL MANAGER'S – A GREAT LAKES SUPPLEMENT

https://coast.noaa.gov/czm/media/adaptationgreatlakes.pdf

This report for the Great Lakes region is intended to provide additional detail and supplement the Adapting to Climate Change: A Planning Guide for State Coastal Managers, which the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean and Coastal Resources released in 2010. The report included information on climate change and steps to help set up a planning process, assess vulnerability, devise a strategy, and implement a plan to minimize climate change impacts on the Great Lake's coasts. The planning guide also provides an extensive list of resources to help throughout the planning and implementation process.

The report provides updated data and information on the potential climate change impacts and effects for Great Lakes coastal areas. It highlights case examples of adaptive actions taking place in the Great Lakes region today, many of which are still in the planning and policy development stages.

NOAA – NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION STATE SUMMARY OF OHIO

https://statesummaries.ncics.org/oh

The State Climate Summaries were produced to meet a demand for state-level information in the wake of the Third U.S. National Climate Assessment, released in 2014. The summaries cover assessment topics directly related to NOAA's mission, specifically historical climate variations and trends, future climate model projections of climate conditions during the 21st century, and past and future conditions of sea level and coastal flooding.

The three key takeaways from the Ohio Summary are:

- Historically unprecedented warming is projected by the end of the 21st century and increases in extreme heat are of particular concern for Cincinnati, Columbus and other urban areas where urban heat island effect raises summer temperatures.
- Winter and spring precipitation are projected in increase. Extreme precipitation is projected to increase, potentially causing more frequent and intense floods.
- The intensity of future droughts is projected in increase. Future summer droughts are likely to be more intense.

SMART GROWTH FIXES FOR CLIMATE ADAPTATION AND RESILIENCE- EPA
https://www.epa.gov/smartgrowth/smart-growth-fixes-climate-adaptation-and-resilience

The Environmental Protection Agency's (EPA) Smart Growth Fixes for Climate Adaptation and Resilience: Changing Land Use and Building Codes and Policies to Prepare for Climate Change (2017) is intended to help local jurisdictions develop strategies to prepare for climate change impacts through land use, zoning and building code policies. The policy options described in this publication bring multiple short- and long-term environmental, economic, health, and societal benefits that can not only prepare a community and its residents and businesses for the impacts of climate change, but also improve everyday life.

The strategies can be worked into a local community's regular processes, for example, through scheduled updates to zoning and building codes. This approach allows incremental change, which might be easier for some communities because it costs little or nothing extra compared to "business as usual", and gives communities the opportunity to adjust codes based on the most up-to-date climate observations and projections. To help communities determine which policy and code changes might be best for them, the options in each chapter are categorized as modest adjustments, major modifications, and wholesale changes.

The options can address one, some or all of the following hazards: flooding and precipitation, sea level rise, extreme heat, drought, and wildfire. Examples of the options include, but are not limited to:

- Use regional climate change, population demographics, transportation demand, and related projections to understand where community assets could be vulnerable.
- Evaluate development incentives to see if they encourage development in particularly vulnerable areas.
- Design open space in flood plains for multiple amenities.
- Adopt a site plan requirement that requires all new development to retain all stormwater on-site.
- Establish a task force to review building codes, development patterns, and other relevant issues.

CLIMATE RESILIENCE IN OHIO, A PUBLIC HEALTH APPROACH TO PREPAREDNESS AND PLANNING
https://ohiopha.org/download/climate-resiliency-in-ohio/

In 2016, the Ohio Public Health Association (OPHA) formed the Ohio Public Health Resiliency Coalition (OPHCRC) to develop a document for use by local public health professionals in their efforts to address the public health impacts of climate change and climate-related weather events in their jurisdictions.

The result of the OPHCRC's work is the paper titled Climate Resilience in Ohio, a public health approach to preparedness and planning that focuses on the risks and adverse outcomes that the communities served by Ohio's local health departments (LHDs) are likely to face due to climate change effects. It was the Coalition's decision to focus first on adaptation and resilience from a public health perspective and then to build upon this work and address mitigation efforts. In the context of climate change, the term "adaptation" refers to activities, programs and efforts that seek to allow societies to continue functioning in the face of continued temperature increases and fluctuations in local weather patterns.

STATE-OWNED AND STATE-LEASED CRITICAL FACILITIES VULNERABILITY ANALYSIS & LOSS ESTIMATION

As downscaled climate change data becomes more readily available the state will assess its vulnerability in terms of population, structures and critical facilities at risk. The state will also encourage the inclusion of such data in local hazard mitigation plans once the data is granular enough to support the analysis.

SECTION 3:
STATE MITIGATION STRATEGY

3.1 STATE HAZARD MITIGATION GOALS, OBJECTIVES, & ACTIONS

OVERVIEW

According to 44 CFR 201.4(c)(3) a state hazard mitigation plan must contain a mitigation strategy that is the state's blueprint for reducing losses identified in the risk assessment. The state's mitigation strategy is described below, and has been updated as part of the 2019 revision. During the update of hazard mitigation goals, objectives, and actions, the Mitigation Branch:

- Identified applicable mitigation goals, objectives, and actions of the stakeholders that participated in the updating of the plan. This includes direct feedback from the SHMT, Emergency Support Function (ESF) Leads, ESF-14 Partners, and state agency staff.
- Identified and reviewed the goals, objectives and actions of the all hazard county mitigation plans that have been developed and approved by FEMA, the handful of community specific mitigation plans that have been developed and approved and any FMA plans that have not been incorporated into local DMA2K plans. These local goals, objectives and action items were compared to those found in the state plan and gave the Ohio EMA Mitigation Branch a clearer vision of what the locals felt was important.
- Identified and reviewed the goals, objectives, and actions of the 2014 State of Ohio Hazard Mitigation Plan.
- Reviewed the state's priority hazards, which include: flooding, tornado/wind, severe summer storms and severe winter storms.

  The State of Ohio mitigation strategy in this section of the plan utilizes the following terminology, based on FEMA's *State and Local Mitigation Planning How-To Guide*:

- G*oals* – General guidelines that explain what is desired to be achieved. They are usually broad policy-type statements, long term, and represent global visions.
- *Objectives* – Strategies or implementation steps to attain identified goals. Unlike goals, objectives are specific and measurable.
- *Mitigation Actions* – Specific actions to achieve goals and objectives. The mitigation actions are described below and listed in the Mitigation Action Plan Table found in Section 3.2. This table prioritizes mitigation actions, identifies a lead agency for implementation, and is used to track implementation status.

PROGRESS ON 2014 GOALS/OBJECTIVES/ACTIONS; CHANGES IN 2019 UPDATE

The format used to report the goals, objectives, and mitigation actions in the 2019 plan update is consistent with previous state mitigation plan updates. For example, the plan generally identifies goals that are all hazard in nature, with specific objectives related to one or more hazards (with the exception of the goal of mitigating repetitive flood loss structures). A 2014 Mitigation Action Plan Update Summary Table is in the appendices (Appendix E); which provides commentary on the status of the action items identified in the 2014 Enhanced plan update.

Finally, the goals/objectives/actions items in this update incorporate priority goals and actions identified in local plans that have been submitted and approved by Ohio EMA and FEMA; incorporate any changes/updates in the strategic plans of agencies that have a role in hazard mitigation; and reflect current trends, issues and priorities. The 2019 mitigation strategy update outlined below was developed with input from the Ohio EMA Executive Staff, the State Hazard Mitigation Team, the Silver Jackets team, and various federal, state, and local entities.

GOAL #1: REDUCE LOSS OF LIFE AND INJURY FROM HAZARD EVENTS

Goal Discussion. Ohio is a populous state with over 11 million people. The population centers in Ohio are often concentrated in hazard areas, especially floodplains. This is due to their natural progression from communities whose economies were largely water dependent (steel mills needed water for cooling, water was needed for transportation). Events that historically caused loss of life were epidemiological – specifically outbreaks of cholera and influenza killed thousands of Ohioans in the 19th and early 20th centuries. More recently, hazards that have resulted in significant losses of life include: flooding (467 in Great 1913 flood, 26 in 1990 Shadyside flash flood); fires (322 in 1950 Columbus Penitentiary, 95 in 1963 Marietta nursing home); blizzards/winter storms (51 in 1978 blizzard); and tornadoes (35 in 1974 Xenia tornado).

Less known, but more widespread are injuries from hazard events. In addition to minor or major physical injuries, mental injury (trauma, etc.) is an issue after any type of major hazard event. In addition, both injuries and loss of life are possible not only for direct victims of a hazard event, but also for those responding to / assisting those victims.

If the flood of 1913 occurred today, it is doubtful that there would be as many casualties. This would be due to current building and other safety codes. For example, over 700 communities in Ohio have adopted flood loss reduction regulations to participate in the National Flood Insurance Program. The regulations make buildings more resilient in flood events, which results in improved safety for building occupants. Similarly, building codes today contain standards for wind and fire resistance, and dam/levee construction and rehabilitation standards help prevent catastrophic failures of these structures.

Monitoring and warning systems today are far more sophisticated and effective than their predecessors. The Ohio STORMS (State of Ohio Rain/Snow Monitoring System) effectively monitors precipitation during hazardous weather events. Integrated warning systems (not just a siren on a pole) are effective in flash flood and tornado prone areas; which can also be very effective in reducing potential loss of life and injury.

New or continuation? This goal is a continuation from the 2008 update.

Objective 1: Continue to map hazard areas, refine existing hazard mapping data, and develop/refine loss estimation and vulnerability analysis data

- <u>Action:</u> Conduct HAZUS Level 2 flood analyses for all counties in the state using the best available data.
- <u>Action:</u> Continue to update and improve the vulnerability analysis for state - owned buildings and critical facilities.
- <u>Action:</u> Gather and incorporate structure specific risk data into the Risk Management Information System (RMIS).
- <u>Action</u>: Perform on-site appraisals of all state buildings valued at $500,000 or more.
- <u>Action:</u> Perform desktop valuations for all state buildings valued at less than $500,000 to determine current replacement value.

Objective 2: Promote the use of effective early alert / warning systems

- Action: Install pre-planned detour signage for recurring closures.
- Action: Install sensors in road shoulders or video detection to monitor flooding.
- Action: Ohio EMA will work with the National Weather Service and local emergency management agencies to adjust trigger points for flood warnings based on completed mitigation projects, changing flood levels and other factors.
- Action: Work with USGS, NOAA, and other partners to promote flood warning systems and the importance of stream and rain gauges.

Objective 3: Prioritize acquisition of properties, including those in high risk areas (floodways) or those in imminent danger (e.g., landslide) for available funds from FEMA mitigation programs

- Action: Ensure that grant application review tools and processes prioritize acquisition of repetitively damaged and highest risk properties.

Objective 4: Ensure the continuation of an effective dam/levee safety program

- Action: Inspect all class I-III dams once every 5 years.
- Action: Take enforcement actions on violations of state dam/levee safety laws for severely deficient and/or structurally unsound high hazard dams.
- Action: Increase the number of Emergency Action Plans through compliance and education efforts.

Objective 5: Promote wind mitigation techniques and programs

- Action: Continue to implement and improve the Ohio Safe Room Rebate Program.

Goal #2: Minimize Damage to Property and Societal Disruptions from Hazard Events

Goal Discussion. Property damage from hazard events is significant in Ohio. Between 1978 and September, 2018, there has been $323,553,037.21 in paid claims from the NFIP in Ohio. Although this data is a good indicator – it does not account for all of the property losses due to flood. Only about 10% of flood prone structures have flood insurance, the data doesn't include flood claims available through private insurers (for large facilities like factories – private insurance through a secondary insurer is significant), and the data doesn't include crop losses due to flooding.

Similarly, tornadoes and straight-line winds have high loss potential. The 1974 Xenia tornado event resulted in over $1 billion in damages in a multi-state region (including Ohio). The September 2008 straight-line wind event in Ohio resulted in over $553.1 million in insured losses, which set a record for the highest amount of insured losses as a result of a single event in Ohio. This event also resulted in over $52,643,099 in public assistance to communities for infrastructure repair and debris removal. In addition to property losses, societal disruptions occur after a hazard event. Consider the following impacts:

- Infrastructure disruption can result in the cutoff of evacuation routes, pollution due to sanitary facilities not working, lack of clean drinking water, and isolation of populated areas (such as in a road or bridge collapse). Loss of medical facilities, and or public safety facilities, can result in vulnerable populations should a subsequent disaster event occur.

- Direct loss of facilities used by employers, or indirect loss due to infrastructure disruption, can lead to lost wages and lost tax revenues for all levels of government.
- Research has shown that mental health problems, divorce rates, and physical/emotional abuse increase after a significant hazard event.
- Local "gathering places" that are destroyed in a hazard event result in disruption of the social fabric of a community.

Strengthening of laws, regulations, and ordinances for new and existing facilities is not only critical to the protection of property and life but, also, the reduction of massive physical, social, and economic disruption that accompanies disasters. Regulations and ordinances help communities design and construct new facilities or alter existing facilities in a manner that resists the forces of nature and ensures safety. Local land use laws can support this effort by keeping buildings and development out of the most hazardous areas through local land use planning. It is essential that mitigation planning be incorporated into all land use planning activities at the local and state levels.

New or continuation? This goal is a continuation from the 2005 plan.

Objective 1: Evaluate and improve safety & loss reduction codes/standards for hazards that affect Ohio

- <u>Action</u>: Support communities who choose to adopt standards beyond NFIP minimums for flood loss reduction.
- <u>Action</u>: Review and consider the most recent version of the ICC Commercial Codes for incorporation into the Ohio Building Code.
- <u>Action</u>: Review and consider the most recent version of the ICC Residential Codes for incorporation into the Ohio Building Code.

Objective 2: Develop mitigation resource information for the business community

- <u>Action</u>: Continue to participate in the public/private partnership effort between Ohio EMA and the business community.

Objective 3: Identify funding sources and obtain funds from a variety of Federal, state, regional and local entities to implement mitigation activities

- <u>Action</u>: Formalize a state level hazard mitigation grant program for Ohio communities.
- <u>Action</u>: Work with Ohio EMA to document a process to be followed if CDBG-DR funds are ever available in the state.
- <u>Action</u>: Explore the possibility of using Alternative Stormwater Infrastructure Loan Program to target properties purchased with HMA grants as future green infrastructure project sites.
- <u>Action</u>: Seek funding to expand local vector control programs.

Objective 4: Promote sustainable communities and hazard resilient development

- <u>Action</u>: Develop a priority list of generator needs for Center for Medicaid/Medicare funded facilities.
- <u>Action</u>: Ensure that federally-funded housing, community development, and economic development programs administered by the ODSA are conducted in accordance with state

and local floodplain management regulations.

- Action: The Department of Commerce will partner with ODNR Floodplain Management Program to develop educational information for floodplain managers and the manufactured home community on the Manufactured Homes Program.
- Action: Limit construction or assist with relocation of electrical substations, distribution, and transmission lines in flood-prone areas that serve critical infrastructure customers.
- Action: Implement ODA commitments delineated in the Ohio Domestic Action Plan for Lake Erie.
- Action: OPWC will continue to incorporate hazard mitigation principles into emergency projects whenever possible.
- Action: Support dialogue between stakeholders about utilization of quality building components to mitigate damage.

Objective 5: Promote sustainable communities and hazard resilient development

- Action: Work with industry to ensure a streamlined and consumer-focused claim filing and premium payment process during and after a disaster event.
- Action: Monitor the uptake of flood insurance on the private insurance market.
- Action: Support insurers offering hazard mitigation discounts to customers.
- Action: Support dialogue between the National Flood Insurance Program, insurance companies and the lending community.
- Action: Empower Ohioans with educational toolkits that will help them better understand hazard risks, insurance needs, and disaster preparedness.

Goal #3: Integrate Hazard Mitigation Policies and Programs

Goal Discussion. Hazard mitigation, which includes loss reduction, has historically occurred in piecemeal fashion – where a need existed or an opportunity made available, mitigation happened. However, with the requirements to do mitigation planning at the state and local level, mitigation programs have the potential to be more robust and have a need to be integrated. Policies and programs at all levels of government tend to be stove-piped, and it is often up to communities to understand how the programs fit together – many times with little help.

As indicated in the previous goal, incorporating actions identified in local mitigation plans such as suggested code and/or land use changes by actually updating local codes and land use plans is one significant way hazard mitigation policies and programs can be integrated. Another is to promote interagency coordination at the state and national level.

New or continuation? This goal is a continuation from the 2008 plan update.

Objective 1: Expand the SHMT to include other federal, state and local entities

- Action: Invite at least two additional entities each year to participate on the SHMT.
- Action: OPWC will continue participation on the State Hazard Mitigation Team

Objective 2: Work with non-traditional partners to better align programs and policies to facilitate hazard mitigation

- Action: Continue inter-agency participation on the USACE Silver Jackets Initiative.

- Action: Review the OFMA substantial damage mutual aid process and incorporate recent Stafford Act changes.
- Action: Develop statewide procedures providing guidance to state agency fiscal officers on disaster cost tracking policy.

Objective 3: Ensure better coordination of state and local mitigation planning activities

- Action: Develop and implement strong state incentives for maintaining local mitigation plans.
- Action: Continue participation in the FEMA pilot program that enables Ohio to review and approve local hazard mitigation plans.

Objective 4: Work with partners to improve customer experience with mitigation grant/planning programs

- Action: Ohio EMA will work with FEMA legal staff to develop modified deed language for properties acquired with HMA funds in Ohio that clarifies the property re-use review and approval process.

Goal #4: Eliminate Vulnerable Repetitive Loss Flood-Prone Structures in the State of Ohio

Goal Discussion. Ohio ranks in the top twenty states in the nation in the number of FEMA identified repetitive loss flood prone structures. Furthermore, flooding is Ohio's most costly natural hazard. Although there are various definitions of repetitive loss, these structures represent the most vulnerable and flood prone building stock in Ohio. For such structures, the best and preferred mitigation option is acquisition/demolition. However, it may be possible to use other mitigation techniques (i.e., flood proofing) especially when the structure use is non-residential.

The Ohio EMA Mitigation Branch and ODNR, Floodplain Management Program continue to be active in this area. The Mitigation Branch utilizes repetitive loss lists published by FEMA to identify repetitive loss structures and target them for outreach regarding FEMA mitigation grant programs that may be available. The ODNR Floodplain Management Program addresses repetitive loss properties through education and training of local floodplain administrators. The Floodplain Management Program's efforts ensure that the local floodplain administrators are aware of the requirements to conduct "substantial damage" determinations, which require compliance with local flood damage reduction regulations to ensure that vulnerable structures are mitigated during the repair/renovation process. Structures that are substantially damaged/improved, and have flood insurance, may also have access to additional funds available through the property owner's flood insurance policy to make such changes. During the year, substantial damage training is provided in workshops statewide. After significant flood events, the Floodplain Management Program conducts NFIP briefings that focus on a community's responsibility to conduct substantial damage determinations. Finally, the Floodplain Management Program works with the Ohio Building Official's Association to train a volunteer cadre of building officials to conduct substantial damage determination field inspections.

New or continuation? This goal is a continuation from the 2008 plan update.

Objective 1: Continue to educate Ohio Floodplain Administrators and volunteer cadres such as the Ohio Building Officials Association on the post-event "substantial damage" process

- Action: Conduct training and/or post-disaster briefings for appropriate audiences on substantial damage assessments.

Objective 2: Educate owners of repetitive loss properties on mitigation techniques and programs that are available

- Action: Develop and implement an outreach strategy targeting repetitive loss property owners on mitigation techniques and funding programs.

Objective 3: Prioritize repetitive loss properties for available funds from FEMA mitigation programs

- Action: Reduce the number of severe repetitive loss properties each year by assisting such owners with successful funding of mitigation projects through FEMA mitigation programs.

Goal #5: Promote Research, Education, and Outreach Activities to Create a Culture of Mitigation in Ohio.

Goal Discussion. To take effective mitigation actions, individuals, communities, and the state must have data upon which to make decisions. This data must be based on the best and latest scientific research (ranging from data on the hazard itself to the mitigation actions taken) and must be disseminated effectively.

New or continuation? This goal is a continuation from the 2008 plan update.

Objective 1: Develop publications and information on all hazards that could potentially impact Ohio

- Action: Develop success stories in wind resistant construction codes and mitigation techniques.
- Action: Update the Debris Management Course, deliver pilot offerings, and train Ohio EMA Regional staff to deliver the course.
- Action: Create Ohio version of mitigation planning and project courses.
- Action: Vector control recommendations communicated to the public to eliminate/avoid sources of standing water and overgrown brush that allow for the breeding of disease-carrying vectors.
- Action: Ohio EMA will continue to actively participate on the Ohio Committee for Severe Weather Awareness.

Objective 2: Utilize the State Hazard Analysis, Resource, and Planning Portal to promote hazard mitigation

- Action: Continue to maintain, populate, and enhance the State Hazard Analysis Resource and Planning Portal.
- Action: Develop an interactive digital summary of the State of Ohio Hazard Mitigation Plan.
- Action: Conduct open space monitoring of properties purchased with HMA funds and report to FEMA every three years using SHARPP to collect data.

Objective 3: Seek opportunities to partner with academic institutions to promote mitigation and resilience principles

- Action: Sustain the Mitigation Branch internship program.
- Action: Continue the local mitigation planning studio course with The Ohio State University.

Objective 4: Identify hazard risk data gaps and promote research projects that expand knowledge

- Action: Incorporate a "weather resilience" data category into the Traffic Operation Assessment Systems Tool (TOAST)

Objective 5: Educate the public on government, private sector and non-profit programs that reduce hazard risk.

- Action: Educate potential applicants on how OPWC programs can be used to assist with mitigation.

Goal #6: Provide leadership in hazard mitigation

Goal Discussion. Mitigation and Recovery Branch staff strive to integrate hazard mitigation principles in a variety of ways to make Ohio communities more sustainable and citizens more resilient in the face of future disaster events. The Branch is the leading voice for mitigation in the State of Ohio.

The Branch Chief leads and coordinates activities for the State Hazard Mitigation Team (SHMT). The role of the SHMT is twofold: to facilitate a collaborative discussion of mitigation policies, programs, and procedures in Ohio, and to have a mechanism for efficiently and objectively reviewing project applications for many of FEMA's hazard mitigation programs. Additionally, the Branch is the state entity responsible for implementing FEMA's Hazard Mitigation Assistance programs, and assists Ohio communities in their mitigation planning efforts. State and local governments rely on Mitigation and Recovery Branch staff technical assistance to develop mitigation plans and projects both before and after a disaster.

The Branch is very active in state and federal associations and workgroups in order to provide hazard mitigation guidance that is aligned with the Branch vision and mission. Such groups include (but are not limited to) the External Stakeholder Workgroup, FEMA's Cooperating Technical Partnership, the Association of State Floodplain Managers, and the Ohio Floodplain Management Association.

New or Continuation? This goal is a continuation from the 2011 update.

Objective: Continue to be a leading voice in mitigation nationwide through increased involvement in national and state initiatives, dialogues and workgroups

- <u>Action</u>: Continue to support efforts to comply with the Emergency Management Accreditation Program (EMAP).
- <u>Action</u>: Continue participation on emergency management and floodplain association workgroups.
- <u>Action</u>: Participate in earthquake table top exercise with mitigation component.

3.2 STATE MITIGATION ACTION PLAN

OVERVIEW

According to the planning requirements of DMA 2000, a SHMP will contain mitigation actions that are cost-effective, environmentally sound, and technologically feasible. Additionally, such actions are to be prioritized. The mitigation action plan below attempts to provide a concise table of the mitigation actions identified in the previous section, with an assigned priority. Additionally, a lead agency is identified for each action.

Borrowing a prioritization technique from the State of Kentucky, the mitigation actions have been prioritized in the following way:

Table 3.2.a

Priority	Description
A	Projects or activities that permanently eliminate damages or deaths and injuries across the state from any hazard
B	Projects or activities that reduce the probability of damages, deaths, and injuries across the state from any hazard
C	Projects or activities that educate the public on the subjects of hazard mitigation, hazard research, and disaster preparedness
D	Projects or activities that warn the public to approaching natural hazard threats

Action Number	Action	Goal / Objective Reference	Hazard	Lead Agency	Priority	Potential Funding Source	Status	% Complete
Goal 1, Objective 1								
1	Conduct HAZUS Level 2 flood analyses for all counties in the state using the best available data.	Goal 1, Obj 1	Multi	Ohio EMA Mitigation Branch	C	Silver Jackets Funding	Silver Jackets funding was used to complete HAZUS Level 2 analysis for Planning Region 2.	33%
2	Continue to update and improve the vulnerability analysis for state-owned buildings and critical facilities.	Goal 1, Obj 1	Multi	Ohio EMA Mitigation Branch	C	GRF	Work with DAS to enhance the building inventory and incorporate data from ongoing appraisal process.	Ongoing
3	Perform on site appraisals of all state buildings valued at $500,000 or more.	Goal 1, Obj. 1	Multi-hazard	DAS - ORM	B	GRF	Contract has been awarded. System implementation is underway. Region 1 planning/kickoff will be occurring soon.	10%
4	Perform desktop valuations for all state buildings valued at less than $500,000 to determine current replacement value.	Goal 1, Obj. 1	Multi-hazard	DAS - ORM	B	GRF	Contract has been awarded. System implementation is underway.	10%
5	Gather and incorporate structure specific risk data in the Risk Management Information System (RMIS).	Goal 1, Obj. 1	Multi-hazard	DAS - ORM	B	GRF	Contract has been awarded. System implementation is underway. Region 1 planning/kickoff will be occurring soon.	10%
Goal 1, Objective 2								
6	Install pre-planned detour signage for recurring closures	Goal 1, Obj 2	Flood	ODOT	D	ODOT	Ongoing	Ongoing

7	Install sensors in shoulders or video detection to monitor flooding	Goal 1, Obj 2	Flood	ODOT	D	ODOT	Ongoing	Ongoing
8	Ohio EMA will work with the National Weather Service and local emergency management agencies to review trigger points for flood warnings and adjust based on completed mitigation projects, changing flood levels and other factors.	Goal 1, Obj 2	Flood	Ohio EMA, NWS, Local EMA	D	GRF	New Action Item	0%
9	Work with USGS, NOAA, and other partners to promote flood warning systems and the importance of stream and rain gauges.	Goal 1, Obj 2	Flood	Ohio EMA Mitigation Branch	C	USGS, HMA	There may be an opportunity to utilize DR-4360 HMGP 5% funds to purchase stream gauge equipment.	Ongoing
Goal 1, Objective 3								
10	Ensure that grant application review tools and processes prioritize acquisition of repetitively flooded and highest risk properties.	Goal 1, Obj 3	Flood	Ohio EMA Mitigation Branch	A	HMA	New action item.	Ongoing
Goal 1, Objective 4								
11	Inspect all Class I-III dams once every 5 years.	Goal 1, Obj 4	Dam Failure	ODNR-DDS	B	Dam permit fees and GRF	The Dam Safety Program met this goal in the last 5-year planning period.	Ongoing

12	Take enforcement actions on violations of state dam/levee safety laws for severely deficient and/or structurally unsound high hazard dams.	Goal 1, Obj 4	Dam Failure	ODNR-DDS	B	Dam permit fees and GRF	Notices of Violation are issued for deficiencies identified during inspections. The Dam Safety Program provides technical assistance to remedy deficiencies.	Ongoing
13	Increase the number of Emergency Action Plans through compliance and education efforts.	Goal 1, Obj 4	Dam Failure	ODNR-DDS	B	Dam permit fees and GRF	DNR is working with Class I dam owners statewide to increase the numbers of approved EAP's.	Ongoing
Goal 1, Objective 5								
14	Continue to implement and improve the Ohio Safe Room Rebate Program.	Goal 1, Obj 5	Wind	Ohio EMA Mitigation Branch	B	HMA	Ohio EMA recently applied for a PDM grant to fund construction of 39 residential safe rooms.	Ongoing
Goal 2, Objective 1								
15	Support communities who choose to adopt standards beyond NFIP minimums for flood loss reduction.	Goal 2, Obj 1	Flood	ODNR-DOW, FPM	B	FEMA CAP Program and State GRF	The majority of these initiatives include flood plain regulation, map modification & higher standards workshops.	Ongoing
16	Review and consider the most recent version of the ICC Commercial Codes for incorporation into the Ohio Building Code.	Goal 2, Obj 1	Multi	DOC – Industrial Compliance	B	GRF	New action item.	Ongoing

17	Review and consider the most recent version of the ICC Residential Codes for incorporation into the Ohio Building Code.	Goal 2, Obj 1	Multi	DOC – Industrial Compliance	B	GRF	New action item.	Ongoing
Goal 2, Objective 2								
18	Continue to participate in the public/private partnership effort between Ohio EMA and the business community.	Goal 2, Obj 2	Multi	Ohio EMA Mitigation Branch	C	GRF	The Ohio Public Private Partnership has focused on response and recovery efforts to date. The Ohio EMA Mitigation Branch will continue to explore the possibility of OP3's engagement in mitigation activities.	Ongoing
Goal 2, Objective 3								
19	Formalize a state level hazard mitigation grant program for Ohio communities.	Goal 2, Obj 3	Multi	Ohio EMA, DPS, and Governor's Office	B	GRF	New action item.	0%
20	Work with Ohio EMA to document a process to be followed if CDBG-DR funds are ever available in the state.	Goal 2, Obj 3	Multi-hazard	DSA	C	CDBG-DR	New action item.	0%

21	Explore the possibility of using the Alternative Stormwater Infrastructure Loan Program to target properties purchased with HMA grants as future green infrastructure project sites.	Goal 2, Obj 3	Flood	DSA	B	Alternative Stormwater Infrastructure Loan Program	New action item.	0%
22	Seek funding to expand local vector control programs.	Goal 2, Obj 3	Biological (Disease)	ODH	B	GRF	New action item.	0%
Goal 2, Objective 4								
23	Develop a priority list of generator needs for Center for Medicaid/Medicare funded facilities.	Goal 2, Obj 4	Multi	ODH	B	GRF	New action item.	Ongoing
24	Ensure that federally-funded housing, community development, and economic development programs administered by the Ohio Development Services Agency are conducted in accordance with state and local floodplain management regulations.	Goal 2, Obj 4	Flood	DSA	C	GRF	New action item.	Ongoing

25	Partner with ODNR Floodplain Management Program to develop educational information for floodplain managers and the manufactured home community on the Manufactured Homes Program.	Goal 2, Obj 4	Flood	DOC – Industrial Compliance	C	GRF	New action item.	0%
26	Limit construction or assist with relocation of electrical substations, distribution, and transmission lines in flood prone areas that serve critical infrastructure customers	Goal 2, Obj 4	Multi	PUCO	B	PUCO approval for electric infrastructure improvement rider(s)	New action item	Ongoing
27	Implement ODA commitments delineated in the Ohio Domestic Action Plan for Lake Erie.	Goal 2, Obj 4	Natural Hazards	ODA-DSWC	B	GRF, USEPA & USDA	New action item.	Ongoing
28	OPWC will continue to incorporate hazard mitigation principles into emergency projects whenever possible.	Goal 2, Obj 4	Multi	OPWC	B	GRF	New action item.	Ongoing
Goal 2, Objective 5								
29	Support dialogue between stakeholders about utilization of quality building components to mitigate damage.	Goal 2, Obj 5	Multi	OPWC	B	GRF	New action item.	Ongoing

30	Work with industry to ensure a streamlined and consumer-focused claim filing and premium payment process during and after a disaster event.	Goal 2, Obj 5	Multi	ODI	C	GRF	New action item	Ongoing
31	Monitor the uptake of flood insurance on the private insurance market.	Goal 2, Obj 5	Flood	ODI	C	GRF	New action item	Ongoing
32	Support insurers offering hazard mitigation discounts to customers	Goal 2, Obj 5	Multi	ODI	C	GRF	New action item	Ongoing
33	Support dialogue between the National Flood Insurance Program, insurance companies and the lending community	Goal 2, Obj 5	Flood	ODI	C	GRF	New action item	Ongoing
34	Empower Ohioans with educational toolkits that will help them better understand hazard risks, insurance needs, and disaster preparedness.	Goal 2, Obj 5	Multi	ODI	C	GRF	New action item.	Ongoing
Goal 3, Objective 1								
35	Invite at least two additional entities each year to participate on the SHMT.	Goal 3, Obj 1	Multi	SHMT	C	GRF		Ongoing

36	OPWC will continue participation on the State Hazard Mitigation Team.	Goal 3, Obj 1	Multi	OPWC	B	GRF	New action item.	Ongoing
Goal 3, Objective 2								
37	Continue inter-agency participation on the USACE Silver Jackets Initiative.	Goal 3, Obj 2	Flood	SHMT	C	GRF	The Ohio Silver Jackets team meets quarterly and continues to implement a range of mitigation projects statewide.	Ongoing
38	Review the OBOA Substantial Damage mutual aid process and incorporate recent Stafford Act changes.	Goal 3, Obj 2	Flood	Ohio EMA, ODNR, and OBOA	B	GRF	New action item.	0%
39	Develop statewide procedures providing guidance to state agency fiscal officers on disaster cost tracking policy.	Goal 3, Obj 2	Multi	OBM	C	GRF	New action item.	Ongoing
Goal 3, Objective 3								
40	Develop and implement strong state incentives for maintaining local mitigation plans.	Goal 3, Obj 3	Multi	Ohio EMA	C	GRF		0%
41	Continue participation in the FEMA pilot program that enables Ohio to review and approve local hazard mitigation plans.	Goal 3, Obj 3	Multi	Ohio EMA	C	HMA and GRF	New action item.	Ongoing

Goal 3, Objective 4								
42	Ohio EMA will work with FEMA Region V legal staff to develop modified deed language for properties acquired with HMA funds in Ohio that clarifies the property re-use review and approval process.	Goal 3, Obj 4	Multi	Ohio EMA	C	HMA	New action item.	0%
Goal 4, Objective 1								
43	Conduct training and/or post-disaster briefings for appropriate audiences on substantial damage assessments	Goal 4, Obj 1	Flood	ODNR-DOW, FPM	A		Workshops are conducted as needed or requested. Post-event briefings are ready for deployment.	Ongoing
Goal 4, Objective 2								
44	Develop and implement an outreach strategy targeting repetitive loss property owners on mitigation techniques and funding programs	Goal 4, Obj 2	Flood	Ohio EMA Mitigation Branch	C		Ohio EMA will continue to utilize FMA technical assistance grants to implement repetitive loss outreach to property owners.	Ongoing
Goal 4, Objective 3								
45	Reduce the number of severe repetitive loss properties each year by assisting such owners with successful funding of mitigation projects through FEMA mitigation programs	Goal 4, Obj 3	Flood	Ohio EMA Mitigation Branch	A	HMA, State GRF, and local funds from various sources including property owners	Ongoing effort through the administration and implementation of FEMA HMA programs and other mitigation funding sources. According to SHARPP, 1532 properties have been mitigated in Ohio using HMA programs.	Ongoing

Goal 5, Objective 1								
46	Develop success stories in wind resistant construction codes and mitigation techniques.	Goal 5, Obj 1	Wind	Ohio EMA Mitigation Branch	C	GRF		Ongoing
47	Update the Debris Management Course, deliver pilot offerings, and train Ohio EMA Regional staff to deliver the course.	Goal 5, Obj. 1	Multi	Ohio EPA and Ohio EMA	C	GRF	New action item.	0%
48	Create Ohio version of mitigation planning and project courses	Goal 5, Obj 1	Multi	Ohio EMA	C	GRF	New action item	0%
49	Vector Control recommendations communicated to the public to eliminate/avoid sources of standing water and overgrown brush that allow for the breeding of disease-carrying vectors.	Goal 5, Obj 1	Biological (Disease)	ODH	C	GRF	Enduring mitigation program not identified in previous plans.	Ongoing
50	Ohio EMA will continue to actively participate on the Ohio Committee for Severe Weather Awareness.	Goal 5, Obj 1	Multi-hazard	Ohio EMA Mitigation Branch	C	GRF	Ongoing	Ongoing
51	Continue to maintain, populate, and enhance the State Hazard Analysis Resource and Planning Portal.	Goal 5, Obj 2	Multi	Ohio EMA Mitigation Branch	C	GRF	Ohio EMA will work with DAS and DPS IT to upgrade outdated portions of site.	Ongoing

Goal 5, Objective 2								
52	Develop an interactive digital summary of the State of Ohio Hazard Mitigation Plan.	Goal 5, Obj 2	Multi	Ohio EMA	C	PDM and State GRF	New action item. PDM grant to help pay the cost was awarded in summer 2018. Project kick-off with IT staff will occur winter of 2019.	5%
53	Conduct open space monitoring of properties purchased with HMA funds and report to FEMA every 3 years using SHARPP.	Goal 5, Obj 2	Multi	Ohio EMA	A	GRF	New action item. Ohio EMA Mitigation Branch will utilize SHARPP to conduct open space monitoring and report to FEMA every three years.	Ongoing
Goal 5, Objective 3								
54	Sustain the Mitigation Branch internship program.	Goal 5, Obj 3	Multi	Ohio EMA	B	HMA and GRF	Revised action item.	Ongoing
55	Continue the local mitigation planning studio course with The Ohio State University.	Goal 5, Obj 3	Multi	Ohio EMA and OSU	B	HMA and GRF	New action item.	Ongoing
Goal 5, Objective 4								
56	Incorporate a "weather resilience" data category into the Traffic Operation Assessment Systems Tool (TOAST)	Goal 5, Obj 4	Multi	ODOT	B	ODOT	New action item.	0%
57	Educate potential applicants on how OPWC programs can be used to assist with mitigation.	Goal 5, Obj 5	Multi	OPWC	C	GRF	New action item.	Ongoing

Goal 6, Objective 1								
58	Continue to support efforts to comply with the Emergency Management Accreditation Program (EMAP).	Goal 6, Obj 1	Multi	Ohio EMA Mitigation Branch	C	GRF	Ohio EMA EMAP re-accreditation is scheduled for February 2019.	Ongoing
59	Continue participation on emergency management and floodplain association workgroups.	Goal 6, Obj 1	Multi	Ohio EMA Mitigation Branch	C		Mitigation Branch staff participate in multiple associations and work groups.	Ongoing
60	Participate in earthquake table top exercise with mitigation component.	Goal 6, Obj 1	Earthquake	Ohio EMA Mitigation Branch	C	NEHRP	Kick-off meeting for exercise design will occur in winter 2019.	5%

3.3 STATE CAPABILITY ASSESSMENT

The 44 CFR 201.4(c)(3)(ii) states the mitigation strategy shall include a description of the State's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including an evaluation of the State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas.

This section outlines these items. This section includes a discussion of the state's primary laws, regulations, programs, and policies related to hazard mitigation strategy. State agency programs were evaluated via a self- assessment. A brief evaluation of the state's overall approach to development in hazard-prone areas and mitigation funding capability is also included.

Overall, the state's capability to manage hazards and implement hazard mitigation has remained steady.

LAWS AND REGULATIONS

OHIO CONSTITUION

Section 3 of Article XVIII of the Ohio Constitution designates Ohio as a "home rule" state. Home Rule gives municipal jurisdictions the power to govern themselves in local municipal matters independent of state laws. Section 7 of Article XVIII requires that municipalities need to adopt or amend a charter for its government to enact laws. Municipal corporations that do not adopt a charter must follow the procedures provided in state law.

OHIO REVISED CODE (ORC) and OHIO ADMINISTRATIVE CODE (OAC)

All statutes of a permanent and general nature of the State of Ohio are organized and published in the Ohio Revised Code (ORC). These are the laws passed by the Ohio General Assembly. The Ohio Administrative Code (OAC) is a codification of the rules of the administrative agencies of the state. These rules must be reviewed by the Joint Committee on Agency Rule Review (JCARR). The committee consists of five State Representatives and five State Senators.

The primary function of JCARR is to review proposed new, amended, and rescinded rules. JCARR ensures that:

1. the rules do not exceed the scope of the rule-making agency's statutory authority;
2. the rules do not conflict with a rule of that agency or another rule-making agency;
3. the rules do not conflict with the intent of the legislature in enacting the statute under which the rule is proposed;
4. the rule-making agency has prepared a complete and accurate rule summary and fiscal analysis of the proposed rule, amendment, or rescission, and;
5. if the rule has an adverse impact on businesses, that the rule-making agency has demonstrated through the business impact analysis, the Common Sense Initiative Office (CSI) recommendations and the agency's memorandum of response to the CSI recommendations, that the rule's regulatory intent justifies its adverse impact on business.

A discussion of the primary laws, regulations, and policies that have an impact on mitigation programs within the State of Ohio follows.

PLANNING, ZONING, AND SUBDIVISION AUTHORITIES

Under the Ohio Constitution, the power to plan, zone, subdivide or regulate land use belongs to the General Assembly. Most state authority to plan and regulate land use has been delegated to local government. In recent years some of the delegated power has been taken back to address state wide concerns, especially in the environmental arena (for example the authority to regulate drilling for oil and gas wells used to rest with home rule municipalities but now rests with the ODNR–Division of Mineral Resource Management).

Planning, zoning, and subdivision regulations are not the same. Each is described below.

A comprehensive plan serves as a guide and a tool for decision makers regarding land use, development, capital investments, and place making; the plan sets the general direction for future growth and redevelopment across a jurisdiction for the next 10-15 years. Typically, a comprehensive plan consists of elements such as: land use, transportation, housing, recreation and open space, economic development, community character, and others as needed. Each element included in the plan is unique to that community's situation and desires.

In Ohio, separate document known as a "comprehensive plan" not required to be adopted by local governments in order to promulgate and enforce planning and zoning regulations. The state statutes enabling planning are permissive and not mandatory. Failure to plan does not necessarily invalidate zoning regulations.

The relationship between wise land use planning and the reduction of a community's exposure, risk, and vulnerability to hazards is clear. Experience has shown that those communities that carefully plan future land development to avoid (to the extent possible) hazard areas and vulnerable structures suffer much less disaster-related damage and impacts than do communities that don't carefully plan for development. The benefits of wise land use and development planning, from a hazard mitigation standpoint, include:

- Less disruption to a community's economic, social, and physical structure;
- Less impact on the community's tax base;
- Less impact on the provision of essential services; and
- Less financial impact in terms of local participation in disaster program cost sharing.

In addition, communities that are more prone to disaster damage may be looked upon less favorably by potential business enterprises as a safe, secure place in which to conduct business. Two ways to incorporate hazard mitigation planning into comprehensive planning is to have a hazard mitigation element in the comprehensive plan, and incorporate hazard mitigation concepts, strategies, and policies into existing elements of the comprehensive plan.

The purpose of zoning is to regulate land use, prevent land-use conflict, and allow growth to occur in a rational manner. More specifically, zoning aims to:

- Promote public health, safety, and general welfare
- Encouraging appropriate land uses
- Protect or maintain property values
- Protect the environment
- Manage traffic flow and density

- Encourage housing for a variety of lifestyles and economic levels
- Manage aesthetics
- Provide for orderly development and manage density
- Help attract business and industry

Zoning is a regulatory way to implement a community's comprehensive plan. From a hazard mitigation perspective, zoning can be used to regulate land use and development in hazardous areas. For example, many Ohio communities have adopted zoning regulations for floodplains and steep slope/landslide prone areas.

The authority to subdivide land is found in ORC Chapter 711. Subdivision regulations are generally adopted to provide for:

- The proper arrangement of streets or highways in relation to existing or planned streets or highways, or to the Official Land Use Plan and Official Thoroughfare Plan;
- The orderly and efficient layout and the appropriate use of the land;
- A common ground of understanding and a sound working relationship between the county and the developer and to safeguard the interests of the homeowner, the subdivider and the jurisdiction and its citizens,
- The accurate surveying of land, preparing and recording of plats and the equitable handling of all subdivision plats by approving authority and subdividers;
- Technically feasible and economically reasonable standards, which achieve a level of subdivision design & construction to minimize damage to property, degradation of natural resources, and to promote and maintain the health, safety and general well-being.

Subdivision regulation can incorporate hazard mitigation principles. For example, subdivision regulations could require flood studies be completed for drainage ways, streams, etc. where no data exists and stormwater management measures for a subdivision could be required to be designed to a 100-year flood event vs. a higher frequency event (such as a 10-year event). Similarly, standards for infrastructure could specify protection against any potential significant hazard.

CHAPTER 5502.22 et seq., ORC – STATE / LOCAL EMERGENCY MANAGEMENT AGENCIES

The Chapter provides for a State EMA (which includes the Mitigation Branch), and authorizes countywide (5502.26), regional (5502.27), or local emergency management authorities (5502.271), requiring an emergency management director or coordinator and an Emergency Operations Plan for each county. The law also establishes the legal protection and authority of the EMA to work in times of a disaster. The Ohio EMA is the central point of coordination within the state for response and recovery to disasters.

The Mitigation Branch of the Ohio EMA is responsible for management of FEMA mitigation program activities for the state (except for the ODNR–DOWR, which is the state coordinating entity for the NFIP – see below). The Ohio EMA Mitigation Branch administers pre- and post-disaster HMGP, FMA, and PDM grant programs, including project ranking, implementation, technical assistance, and monitoring. The Mitigation Branch staff coordinates with State agencies to incorporate mitigation techniques into their everyday functions and to provide assistance with project development. The Mitigation Branch also maintains the SOHMP.

TITLE XXXVII HEALTH-SAFETY-MORALS, ORC –OHIO BUILDING CODE (OBC)

The Board of Building Standards is comprised of 10 members appointed by the Governor, with the advice and consent of the Senate. The board provides uniform standards and requirements for construction and materials to make buildings safe and sanitary for their intended use and occupancy. This refers to any building that may be used as a place of resort, assembly, education, entertainment, lodging, dwelling, trade, manufacture, repair, storage, traffic or occupancy by the public, and all other buildings or parts and appurtenances thereof erected within the state. The Ohio Department of Commerce, Division of Industrial Compliance ensures compliance with and enforcement of OBC for industrial facilities.

The Board emphasizes the importance of mitigation techniques. In 1995, the International Basic Building Code was implemented and that date is used as a marker for NFIP determinations. Homes built pre-1995 were not required to meet the same standards as those after the code's inception, and are more hazard-prone. The code includes provisions for several mitigation initiatives, such as flood damage reduction, compliance with established building standards and protection of existing buildings from future hazard events.

Changes to the Ohio Building Code in 2017 include the adoption of design and construction standards for residential and community tornado safe rooms. Community safe rooms are required for 911 call stations, emergency operations centers, and fire, rescue, ambulance and police stations. Community and residential safe rooms must comply with ICC 500 Standard for the Design and Construction of Storm Shelters.

CHAPTER 1301, ORC – OHIO FIRE CODE

The Ohio Fire Code was enacted with the purpose of prescribing rules to safeguard life and property from the hazards of fire and explosion. ORC 3781.03 requires the fire marshal or fire chief of municipal corporations having fire departments or the fire chief of townships having fire departments to enforce all provisions of Chapter 3781, and 3791, of the ORC relating to fire prevention. ORC 1301:7-7-07 consists of issues relating to emergency planning and preparedness. The Fire Code effectively reduces the wildfire hazard through the comprehensive scope of the code, which ranges from training and conducting exit drills, to the development of emergency plans.

CHAPTER 1506, ORC – OHIO COASTAL MANAGEMENT ACT, OHIO COASTAL EROSION MANAGEMENT PROGRAM

The ODNR is the designated lead agency for the development and implementation of the Federal Coastal Zone Management Program. The Coastal Erosion Management Program identifies the coastal erosion areas, enforces rules and regulations for new structures and issues permits for coastal erosion control structures. Coastal erosion is a major concern for cities that border Lake Erie. The permitting and enforcement of the rules and regulation by the ODNR has been effective in reducing coastal erosion in hazard-prone areas.

CHAPTER 1521, ORC – OHIO DAM SAFETY PROGRAM

The ODNR-DOWR is the agency that does inspections and the permitting programs for dams and levees. Legislation outlines the standards for dam and levee construction and ODNR-DOWR enforces the dam safety laws. The consequence, if the Dams are not regulated, is flood inundation and potential loss of life.

The ODNR-DOWR's active enforcement of the laws prevents damage, which is the primary goal of mitigation. The program has been effective; there have not been any significant dam failures since the creation of the program.

CHAPTER 1521.13-14; 18 ORC – OHIO FLOODPLAIN MANAGEMENT PROGRAM

The ODNR–DOWR, Floodplain Management Program coordinates all floodplain management activities for the State of Ohio. The Floodplain Management Program is the state coordinating office for the NFIP established in the National Flood Insurance Act of 1968, "82 Stat. 572, 42 U.S.C.A. 4001, as amended and ensures a participating community's compliance with all requirements.

The Floodplain Management Program in Ohio has been the most effective method of flood reduction and prevention. Regulation of development within the floodplains and compliance after natural disasters lessens the extent of flood damages. The Floodplain Management Program and the Mitigation Branch work closely together to ensure mitigation techniques are being considered.

4781.26 RULES OF UNIFORM APPLICATION FOR MANUFACTURED HOME PARKS; CONTRACTS FOR INSPECTIONS

The division of industrial compliance, subject to Chapter 119 of the Revised Code, shall adopt, and has the exclusive power to adopt, rules of uniform application throughout the state governing the review of plans, issuance of flood plain management permits, and issuance of licenses for manufactured home parks; the location, layout, density, construction, drainage, sanitation, safety, and operation of those parks; and notices of flood events concerning, and flood protection at, those parks. The rules pertaining to flood plain management shall be consistent with and not less stringent than the flood plain management criteria of the national flood insurance program adopted under the "National Flood Insurance Act of 1968," 82 Stat. 572, 42 U.S.C.A. 4001, as amended. The rules shall not apply to the construction, erection, or manufacture of any building to which section 3781.06 of the Revised Code is applicable.

CHAPTER 6101, ORC – OHIO CONSERVANCY DISTRICT

The Chapter outlines the responsibilities for the organization of conservancy districts. There are multiple active conservancy districts in the state that work to prevent floods, modify stream channels, regulate stream flow and prevent erosion along the Lake Erie Ohio shoreline. Conservancy districts can assess property owners based on the direct benefits they realize from flood reduction and erosion control projects.

CHAPTER 6131, ORC – OHIO PETITION DITCH ENABLING AUTHORITY

The provisions in this chapter allow counties to dispose or remove surplus water for controlled drainage, irrigation, the storing of water to regulate stream flow or to prevent the overflow of any land in the county and for water conservation. The ODNR-DOWR assists counties to enact actions associated with the Ditch Enabling Authority, which effectively reduces flood damage. Funding occurs through assessment of property owners benefiting from the mitigation project.

STATE AGENCY PROGRAMS & POLICIES

The State of Ohio emphasizes reduction of adverse effects from hazard events and promotes programs to achieve this objective. This section provides a better understanding of the resources available through State Agencies Pre- and Post-Disaster as related to hazard mitigation.

The format for assessing state agency programs and policies was adapted from FEMA publication 386-3. The planning process described in Section 1.2 was utilized to update the state capability assessment. ESF Lead Partners and ESF-14 Partners either provided updates to the plan text directly, or in some cases coordinated a response with the appropriate subject matter expert in their respective agencies.

The following section identifies and analyzes agencies with programs, policies, regulations, funding, and practices that either: support, facilitate, or hinder hazard mitigation in Ohio. The definitions used to evaluate whether a specific state capability supports, facilitates, or hinders hazard mitigation are:

- Support loss reduction – Programs, plans, policies, regulations, funding or practices that help implement mitigation measures.
- Facilitate loss reduction – Programs, plans, policies, etc. that make implementing mitigation measures easier.
- Hinder loss reduction – Programs, plans, policies, etc., that pose obstacles to implementing mitigation measures.

Several state agencies promote programs that encompass pre- and post-disaster mitigation activities. Hazards are unpredictable, but there are programs that present an opportunity to mitigate the hazard's destruction before an event occurs. Utilization of mitigation programs prior to a disaster could prevent the damage from occurring or work to lessen the recovery time and expenditures caused by the natural hazard. Post-disaster the State relies on its agencies to assist with the recovery process. A State requests a Presidential Declaration when the scope of recovery from an event is beyond the State's capability. A Presidential Declaration provides numerous resources, which are incorporated into the State agency functions, for assistance in the response and recovery from a disaster.

OFFICE OF BUDGET AND MANAGEMENT (OBM)

The Ohio OBM is a cabinet-level agency within the executive branch of the Ohio State government. The director of OBM sits on the Governor's cabinet as the Governor's chief financial officer.

The mission of OBM is to provide policy analysis, fiscal research and financial management services to the Governor and agencies of state government, helping to ensure the proper and responsible use of state resources. As a cabinet-level agency within the executive branch of state government, OBM develops, coordinates and monitors the individual budgets of state agencies and reviews all financial transactions made with public funds.

Table 3.3.a

Office of Budget and Management Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Allocation of Project Funds (Pre- and Post-Disaster)	X			The Controlling Board of the OBM supports mitigation activities by allocating the funds to complete the State's cost share match for the HMA grant programs. Ohio EMA worked diligently during the 1997 flood event, with the Controlling Board to identify a 100% match to the HMGP. The State matched HMGP dollar for dollar through the disaster declarations of March 2003. In recent disaster declarations, the state has provided 12.5% of the required 25% non-Federal match.
State-wide policies and procedures for tracking disaster costs	X			OBM worked with the Ohio EMA on a policy which would allow for a defined process in tracking disaster costs upon activation of the Emergency Operations Center (EOC). The policy, which became effective on July 1, 2018, requires state agencies to track costs upon notification of an activation of the EOC and to report back costs to the Ohio EMA. OBM plans to continue to strengthen education efforts of state agency Chief Fiscal Officers by incorporating procedures for tracking and when to track within its statewide financial procedures manual, the "FIN Source."

OHIO DEPARTMENT OF ADMINISTRATIVE SERVICES

OFFICE OF RISK MANAGEMENT (ORM)

The Office of Risk Management (ORM) provides comprehensive risk management programs and services to all state agencies, boards and commissions, as well as the Judicial and Legislative branches of state government. Pursuant to ORC Sections 9.82 – 9.83, the Office of Risk Management is responsible for the administration of self-insurance and private insurance programs protecting the assets and liabilities of the State of Ohio, its agencies, officials and employees.

ASSET MANAGEMENT

Asset Management Services assist state agencies in fulfilling statutory requirements for maintaining, reporting, and certifying state-owned assets; provides technical direction and assistance to agencies regarding asset management, transfers, and consolidation of agencies, retirements, and reconciliation.

Table 3.3.b

Ohio Department of Administrative Services –Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Statewide Property Insurance Program (Pre-Disaster)		X		All state-owned buildings as well as the contents and equipment located therein, or within 1000 feet of premises, are insured under one commercial policy. The policy is underwritten on an all risk, replacement cost basis. The policy includes coverage for excess flood, earth movement, and terrorism. Sub-limits include expenses for green building improvements following a covered loss. Debris removal expenses and limited pollution cleanup (no off-premises pollution liability) are also included coverages.
Loss Control Inspections (Pre-Disaster)		X		Loss control inspections are conducted for state owned properties by the property insurance carrier to identify specific hazards and allow the state agency the opportunity to correct and mitigate hazards prior to loss. Carrier inspections focus mostly on fire peril. Recommendations are made in the report based on criticality to reduce risk.
Ohio Administrative Knowledge System (OAKS), Enterprise Resource Planning (Pre- Disaster)		X		DAS OIT administers the OAKS enterprise computer system. Asset Management, a module contained within OAKS, lists all state-owned buildings, assets and land that are required to be included in an annually certified physical inventory. Asset data provides important planning information to the State and local jurisdictions.

Insured Building and Asset Inventory (Pre-Disaster)	**X**			DAS ORM maintains a statement of values (insurance inventory of buildings, contents and equipment of all property insured, which assists other state agencies in locating specific assets and identifying potential hazards and prevention. ORM is implementing an additional computer program to house site specific details for enhanced modeling capabilities for total cost of risk and probable maximum loss projections including specific hazard exposure.

OHIO DEPARTMENT OF AGRICULTURE

The mission of the Ohio Department of Agriculture is to protect Ohio citizens by ensuring the safety of the state's food supply and the health of Ohio's food animals and plant life, and to create economic opportunities for Ohio's farmers, food processors and agribusinesses.

The Ohio Department of Agriculture provides leadership for Ohio's No. 1 industry – food and agriculture – to create greater economic opportunity for Ohio's farmers and processors; to preserve and enhance Ohio's bountiful resources; and to partner with Ohio's research institutions to further the development of new agricultural products and services.

The department administers numerous regulatory, food safety and consumer protection programs for the benefit of all Ohioans and helps build marketing opportunities for Ohio farmers and food processors. The department's workload is divided among the following divisions and programs: Administration, Amusement Ride Safety, Animal Health, Consumer Protection Laboratory, Dairy, Enforcement, Farmland Preservation, Food Safety, Livestock Environmental Permitting, Markets, Meat Inspection, Ohio Grape Industries, Plant Health, Soil and Water Conservation and Weights and Measures

Table 3.3.c

Ohio Department of Agriculture – Division of Soil and Water Conservation (DSWC)

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Division of Soil and Water Conservation	X			The DSWC provides leadership and services that enable Ohioans to conserve, protect, and enhance soil, water, and land resources. The DSWC was established beginning January 2016 through a transfer of programs from the Department of Natural Resources. The DSWC provides leadership and services that enable Ohioans to conserve, protect, and enhance soil, water, and land resources. The DSWC was established beginning January 2016 through a transfer of programs from the Department of Natural Resources. The DSWC: • Provides administrative guidance, training, program development support and financial assistance to Ohio's 88 SWCDs, their 440 elected board members and over 430 staff; • Provides administrative and organizational support to the Ohio Soil and Water Conservation Commission; • Implements agricultural and non-point source water pollution control programs - a regulatory component enforces agricultural sediment and

				livestock manure application and runoff. • Supports and helps fund local development of watershed-based planning and implementation; • Implements a comprehensive statewide soils information program, and assists private and public sectors in using soils and natural resource information.
Urban Stormwater Program, Watershed Programs (Pre- and Post Disaster)		X		ODNR, Division of Soil and Water Conservation develops model regulations for urban stormwater management; provides assistance with stream morphology assessments; funds/administers Ohio Watershed Coordinator Program.
Protection from Bio-terrorism, Zoonotic, Plant and Animal Diseases and Other Disasters (Pre-Disaster)				ODA utilizes technology, and expert resources to meet the ever growing, ever changing needs of local communities and the agriculture industry in Ohio. ODA teams with ODH, OEPA, FDA, USDA, CDC, and Local Health Departments to help ensure Ohio is prepared and protected from bio-terrorism, plant diseases, animal diseases and foodborne outbreaks as well as other disasters. ODA also participates in preparedness drills and mock disaster mitigation and recovery exercises.

OHIO DEPARTMENT OF COMMERCE (ODC)

The Ohio Department of Commerce is the State's chief regulatory agency. The mission of ODC is to assist businesses to operate lawfully so they can succeed as jobs-creators and we can safeguard Ohioans. The Department of Commerce is self-supporting, through fees. They issue nearly 600,000 licenses, permits, registrations and certifications each year in various professions, industries and commercial enterprises. The Department is made of up 7 Divisions: Financial Institutions, Industrial Compliance, Liquor Control, Real Estate and Professional Licensing, Securities, State Fire Marshal and Unclaimed Funds.

Table 3.3d

Ohio Department of Commerce Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Ohio Building Code Flood Regulations (Pre- and Post-Disaster)	X			The Industrial Compliance, Board of Building Standards administers the OBC, which is based on the International Code Council (ICC) International Building Code (IBC). IBC is a model code governing building regulations for the protection of public health, safety and welfare. The Code includes mitigation methods for hazard reduction. Flood hazard mitigation is accounted for in OBC Section 1612.1 "Flood Resistant Construction" of the OBC. If local authorities determine a building or structure requires flood resistant construction, they must comply with the OBC.
Site, Building and Community Profiles (Pre- and Post-Disaster)		X		Provides a catalog of businesses and industrial sites in Ohio, and assists the State and local jurisdictions with identification of hazardous material locations as part of the planning process.
Education and Outreach (Pre- and Post-Disaster)		X		The office of the State Fire Marshal provides information on Fire Prevention as well as Severe Weather Awareness.
Firefighter Training Grant (Pre- and Post-Disaster)	X			This grant provides funding to pay for the costs of providing Firefighter I or Firefighter I Transition certification courses free of charge to select students by SFM approved class providers. By partnering with eligible class providers, it is the goal of the SFM to ease the costs to local governments, promote shared services and broaden the availability of these courses throughout the state.

Fire Department Training Reimbursement Grant (Pre- and Post-Disaster)	**X**			Fire Departments that provide primary fire protection to an area with a permanent population of 25,000 or less qualify for the grant. Reimbursement is available for specific fire training classes, including the cost of training manuals and student workbooks up to the maximum amount that is authorized.
Revolving Loan (Pre- and Post-Disaster)	**X**			The Small Government Fire Department Services Revolving Loan Program was created by the General Assembly to assist local governments in funding certain fire department major related expenses. A revolving loan can be used to expedite the purchase of major firefighting, rescue or EMS equipment. It can also be used for the construction or renovation of fire department buildings.
Fire Department Equipment Grant (Pre- and Post-Disaster)	**X**			The Division of State Fire Marshal makes the Fire Department Equipment Grant available to qualifying fire departments. Allowable equipment within the grant includes protective clothing, SCBA, communications equipment and other miscellaneous equipment. Eligible fire departments must serve a population of less than 25,000, be in compliance with the Volunteer Firefighter Dependents Fund outlined in Ohio Revised Code 146, and have submitted incident fire reports for the designated year.
Fire Prevention Bureau	**X**			The Fire Prevention Bureau is responsible for the promotion of rural and urban fire prevention and protection through public information and education programs (R.C. 3737.22(E)), maintaining a record of all fires occurring in the state (R.C. 3737.23), and issuing Public Safety Vehicle Decals to volunteer firefighters (R.C. 4511.01(E)(3)).
BUSTR	**X**			The Bureau of Underground Storage Tank Regulations (BUSTR) regulates the installation, operation, maintenance and removal of underground storage tank systems. It also regulates the cleanup of releases of petroleum from underground storage tanks into the environment and enforces regulations through field inspections and litigation.
Code Enforcement Bureau	**X**			The Code Enforcement Bureau is responsible for the development of the Ohio Fire Code and the statewide enforcement program of the Ohio Fire Code and related statutes. The Assistant Fire Marshals assigned to this bureau are responsible for conducting fire safety inspections and enforcing the state fire code. Fire safety inspections are mandated by statute or administrative rule for various occupancies in accordance with associated licensure programs.

Ohio Fire Academy	X			The Ohio Fire Academy provides basic and advance level training for Ohio's Firefighters and Emergency Responders. In addition to structural fire training and EMS programs, the OFA trains first responders on water rescue, structural, trench and machinery extrication, wildland firefighting and hazardous materials incident response. This training is offered both on campus and off campus through the Direct Delivery program.
State Fire Marshal/ ODNR Forestry Wildland Fire Program	X			A joint program between ODNR Forestry and the Ohio Fire Academy, addresses wildland fire risk and mitigation across Ohio. The wildland fire program trains hundreds of wildland firefighters for deployment across Ohio as well as across the nation via the Interagency Fire Crew program. Wildland gear and apparatus are stored on site at the Ohio Fire Academy for training and deployment.
Ohio Fire Code	X			The State Fire Marshal promulgates the Ohio Fire Code which is based on a recent version of the International Fire Code. The 2017 Ohio Fire Code was adopted in December 2017. The OFC addresses a variety of mitigation strategies for various fire hazards across Ohio, including most structures and premises. The goal of the Fire Code is to reduce the incidence of structure, wildland and other fires, enhance safety of Ohioans, and to improve safety for first responders.
Local Building Department Certification	X			The Board of Building Standards certifies local residential and commercial building departments to accept construction documents and to exercise enforcement authority.
Manufactured Homes Program	X			The Divisions of Real Estate & Professional Licensing and Industrial Compliance share responsibility for ensuring the proper licensing of those who sell, install and inspect manufactured housing, and the communities in which they operate, as well as the safety of the residents who live there.

OHIO DEVELOPMENT SERVICES AGENCY (ODSA)

The Ohio Development Services Agency (ODSA) was established in 2012 to administer state and federal funds for infrastructure development, provide energy assistance to companies and municipalities and assist with housing support and home energy assistance to low-income families.

The Agency is also committed to assisting small and disadvantaged businesses to grow and create jobs, oversee public incentives for job creation and increase Ohio's economic impact through tourism. ODSA also supports JobsOhio, a private, nonprofit entity in its efforts to attract and retain major employers for Ohio.

Table 3.3.e

Ohio Development Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Community Development Block Grant (CDBG) (Pre- and Post-Disaster)		X		Provides a flexible community development resource to address locally identified needs that are eligible CDBG activities and qualify under the national objective of Low- and Moderate-Income (LMI) Benefit or Elimination of Slum and Blight. Ohio's non-entitlement counties and cities are eligible to apply and can use the CDBG funds for housing rehabilitation, economic development and public works improvements. CDBG funds can assist with the rebuilding process that occurs after disasters. Local communities may also utilize CDBG funds as part of the match for HMGP projects. The HMGP program is an effective mitigation initiative since it reduces or eliminates flood damage by elevating, acquiring or retrofitting repetitively flooded structures.
Community Housing Improvement Program (CHIP) (Pre- and Post- Disaster)		X		Offers funding to improve and provide affordable housing for low- and moderate-income people. Eligible activities include private owner rehabilitation; rental rehabilitation; homeownership assistance; home repair; new housing construction through Habitat for Humanity; and tenant-based rental assistance. The program may be used as match for HMGP projects.

Alternative Stormwater Infrastructure Loan Program	**X**			The Alternative Stormwater Infrastructure Loan Program offers below-market rate loans for the design and construction of green infrastructure as part of economic development projects. Up to $5,000,000 in loan funds per project are available to governmental entities through the program. Development partners are encouraged to partner with the governmental entity for their projects. The funds can pay for design, demolition, construction, materials and administrative costs associated with the green infrastructure project. This program targets a specific challenge of redevelopment projects by reducing the cost to businesses and communities that need to minimize both the financial and environmental impact of their stormwater runoff.
Governor's Office of Appalachia		**X**		Works to coordinate economic and community development and partnership endeavors to improve lives in Ohio's 32 county Appalachian Region. Through its partnership with the Ohio Developments Services Agency, funds a wide variety of activities including planning, community and economic development, and infrastructure projects.

OHIO DEPARTMENT OF HEALTH (ODH)

The Ohio Department of Health (ODH) is a cabinet-level agency, meaning the director reports to the governor and serves as a member of the Executive Branch of Ohio's government. The ODH executive team helps the Director of Health formulate the agency's strategic policy goals and objectives. The team is composed of the Chief of Staff, the Medical Director and the General Counsel. These leaders, along with agency senior-level managers and supervisors, work in tandem to ensure the state health department is responsive to the needs of Ohio's 11.6 million residents.

ODH's mission is to protect and improve the health of all Ohioans by preventing disease, promoting good health and assuring access to quality care.

Table 3.3.f

Ohio Department of Health Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Private Water Supply System Standards	X			ODH does not allow private water supply systems to be located in FEMA identified 100-year floodplain areas.
Protection from Bio-terrorism and Other Disasters (Pre-Disaster)	X			ODH utilizes new technology and scientific and medical discoveries to meet the ever growing, ever changing needs of the communities. In addition to research, ODH teams with public safety and the public health and medical partners to ensure that Ohio is prepared and is protected from bio-terrorism, as well as other disasters. ODH also offers grants relating to a variety of public health programs to organizations in Ohio, including county and local health departments.
Bathing Beach and Recreational Water Monitoring		X		The Bathing Beach Monitoring Program is a cooperative effort of the Ohio Department of Health, the Ohio Department of Natural Resources, local health departments with public beaches within their jurisdictions and private and public organizations along the Lake Erie border and throughout Ohio. The goal of the program is to assure a safe and healthy aquatic recreational environment by protecting the bathing public from risks of contracting waterborne diseases from exposure to contaminated waters or public health exposure to toxins found in Harmful Algal Blooms (HAB).

OHIO HOMELAND SECURITY (OHS)

Ohio Homeland Security's mission is to analyze and share information, increase awareness, reduce vulnerabilities, and develop strategies in order to prevent, prepare for and protect against acts of terrorism and other threats to public safety

Table 3.3.g

Ohio Homeland Security Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Critical Infrastructure/Key Resource Protection and Security		X		Gather information on critical infrastructure in Ohio and share the information with partners. Identify vulnerabilities and develop protective programs. This data has been used in the past to supplement the state owned/leased critical facility in this plan.

OHIO DEPARTMENT OF INSURANCE (ODI)

The mission of the Ohio Department of Insurance is to provide consumer protection through education and fair but vigilant regulation while promoting a stable and competitive environment for insurers. As an agency with multiple functions, ODI carries out its mission through a number of divisions. These are organized by function and are as follows: agent licensing, captive insurance, customer service, fraud and enforcement, liquidation, market conduct, Medicare (OSHIIP) Services, Ombudsman, Product Regulation and Actuarial Services, and Risk Assessment.

Table 3.3.h

Ohio Department of Insurance Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Education and Outreach (Pre- and Post-Disaster)	X			ODI supports loss reduction through educational outreach provided pre- and post-disaster. The information includes tips about how to prevent and reduce damage from hazard events. Taking appropriate pre- and post-disaster mitigation actions can reduce damage and the number of policy claims filed.
Severe Weather and Disaster Preparation and Recovery Toolkit		X		Toolkit created by ODI to help Ohioans prepare for severe weather and recover from damage following an event. The toolkit kit contains information on flood insurance and other mitigation related messaging.

OHIO DEPARTMENT OF NATURAL RESOURCES (ODNR)

A department of incredible diversity, ODNR owns and manages more than 590,000 acres of land, including 74 state parks, 21 state forests, 136 state nature preserves, and 117 wildlife areas. The department also has jurisdiction over more than 120,000 acres of inland waters; 7,000 miles of streams; 481 miles of the Ohio River; and 2-1/4 million acres of Lake Erie.

ODNR licenses all hunting, fishing, and watercraft in the state and is responsible for overseeing and permitting all mineral extraction, monitoring dam safety, managing water resources, mapping the state's major geologic structures and mineral resources, and promoting recycling and litter prevention through grant programs in local communities. As an umbrella organization for such diverse interests, the department pulls all these activities into four fundamental mission components:

- Resource management by sustained productivity of Ohio's renewable natural resources, promoting the wise use of non-renewable natural resources, and protecting Ohio's invaluable threatened and endangered natural resources.
- Economic development through job creation/expansion/retention, stimulating local economies, developing industry and tourism opportunities, and supporting the present and future economic health of the state.
- Recreation by providing leisure services and recreation opportunities for the public at all levels.
- Health and safety through fair and consistent law enforcement participating in regulatory matters and identifying and responding to environmental hazards

Table 3.3.i

Ohio Department of Natural Resources Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Ohio Floodplain Management Program ORC 1521.13-14;.18 (Pre- and Post- Disaster)	X			ODNR-Division of Water Resources (DOWR) Floodplain Management Program coordinates the NFIP in Ohio and monitors compliance with state and local floodplain management standards; serves as the state repository for flood hazard data; coordinates efforts of federal, state, and local agencies involved in flood loss reduction programs. Assists Ohio communities with adopting flood loss reduction standards that meet NFIP minimums and assists communities interested in adopting standards beyond NFIP minimums. Coordinates the FEMA RISK Map Program. Risk MAP provides high quality flood maps and information, tools to better assess the risk from flooding and planning and outreach support to communities to help them take action to reduce (or mitigate) flood risk. Each Risk MAP flood risk project is tailored to the needs of each community and may involve different products and services.
Ohio Coastal Management Act, Ohio Coastal Erosion Management Program ORC 1506. (Pre- and Post- Disaster)	X			ODNR, Office of Coastal Management identifies coastal erosion areas, enforces rules regulating new structures in coastal erosion areas, and issues permits for coastal erosion control structures. Provides Coastal Management Assistance Grants and Erosion Control Loans.
Ohio Dam Safety Program ORC 1521 (Pre- and Post- Disaster)	X			ODNR-DOWR DS has inspection and permitting programs for dams and levees, classifies hazards, and develops standards for dams and levees. They have authority for emergency drawdown of water and other remedial measures.
Ohio Conservancy District ORC 6101 (Pre-Disaster)		X		ODNR-DOWR enables organization of conservancy districts for the purposes of preventing floods, modifying stream channels, and regulating flow of streams and erosion along the shoreline of Lake Erie. Mitigation funding occurs when a conservancy district assesses property owners.

Ohio Petition Ditch enabling authority ORC 6131 (Pre- and Post-Disaster)		X		ODNR-DOWR allows counties to dispose or remove surplus water, for controlled drainage of any land, for irrigation, and storage of water to regulate stream flow or to prevent the overflow of any land in the county.
Abandoned Mine Lands Program (Pre-Disaster)	X			ODNR, Division of Mineral Resources Management administers mine lands programs to reclaim those areas disturbed by coal mining operations. Types of problems addressed include: mine openings, landslides, highwalls, erosion and subsidence.
Ohio Mine Subsidence Insurance (Pre-Disaster)	X			Ohio FAIR Plan, Mine Subsidence Insurance Underwriting Association pays insurance claims as a result of mine subsidence. The insurance is mandatory as part of homeowners insurance in 26 Ohio counties and optional for 11 counties.
Ohio Seismic Network (Pre-Disaster)		X		ODNR, Division of Geological Survey is a cooperative effort consisting of29 seismic stations coordinated by the Division and managed from the Ohio Earthquake Information Center. The stations provide historical and current information to Ohio.
Firewise Program (Pre- Disaster)		X		ODNR, Division of Forestry heads a multi-organizational initiative designed to include fire safety professionals, homeowners, and community leaders in localizing efforts to lessen the risk of wildfires. The goal is to reduce susceptibility to wildfires through a cooperative effort.

OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

Ohio's transportation system is essential to keeping and creating jobs. With a mission to facilitate the movement of people and goods from place to place, the Ohio Department of Transportation is responsible for maintaining one of the largest transportation networks in the nation. Guided by ethical principles and accountability, ODOT works to improve safety, enhance travel and advance economic development. As a $3.2 billion enterprise, the department wisely invests in its core services of snow and ice removal, annual construction program and highway maintenance operation.

Table 3.3.j

Department of Transportation Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Engineering and Design Practices (Pre- and Post-Disaster)		X		Ensures that land use and re-use laws and regulations are adhered to, which reduces loss from future events.
Disaster Recovery and Repair (Post-Disaster)			X	Clear and repair roadways interrupted by flooding, tornados and landslides. Promotes and utilizes mitigation measures throughout engineering and design process to prevent future damage. Performs small-scale bank stabilization.
Transportation Review Advisory Council (TRAC) (Pre- and Post-Disaster)		X		Established by ORC in 1997 at ODOT's request, the TRAC is a permanent body of predominantly non-ODOT personnel that develops and modifies the Major New Project Selection process and approves major new capacity by adding projects for funding. Mitigation objectives are taken into consideration as part of the process.
Education and Outreach (Pre- and Post-Disaster)		X		The DOT provides information to citizens on safety and prevention techniques and promotes severe weather awareness.
Transportation Asset Management Plan (TAMP)		X		ODOT has a process for developing a risk management plan (23 CFR 515.7(c)). This process must identify risks that can affect the NHS condition and performance, including risks associated with current and future environmental conditions, such as extreme weather events, climate change, seismic activity, and a summary of the evaluations of facilities repeatedly damaged by emergency events, as defined in 23 CFR Part 667.

OHIO EMERGENCY MANAGEMENT AGENCY (OHIO EMA)

Established under Chapter 5502 of the ORC, the Ohio EMA is the central point of coordination within the state for all hazard preparedness, response, recovery and mitigation. Ohio EMA coordinates all situation and damage assessment operations in a disaster area. The agency routinely cooperates with federal, state, and local governments to maintain and develop disaster preparedness, response, recovery, and mitigation plans. Ohio EMA establishes and maintains a state Emergency Operations Center (EOC) to provide coordination and public information during emergencies and disasters. It is the State Coordinating Agency responsible for the administration of federal disaster assistance programs under The Robert T. Stafford Act, Public Law 93-288, which requires mitigation plans as a condition of federal financial assistance.

The primary focus of the agency, when not in a response or recovery mode, is to ensure that the state, and the 11 million citizens residing in it, is prepared to respond to an emergency or disaster and to lead mitigation efforts against the effects of future disasters. It is critical that Ohio EMA's staff interfaces regularly with their local and federal counterparts to ensure preparedness and the capability to respond at all levels.

Table 3.3.k

Ohio Emergency Management Agency Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Manages the State Hazard Mitigation Program (Pre- and Post-Disaster)	X			The mission of the Mitigation Branch is to integrate hazard mitigation principles in a variety of ways to make Ohio communities more sustainable and citizens more resilient in the face of future disaster events.
Hazard Mitigation Grant Program (HMGP) (Post-Disaster)	X			Ohio EMA Mitigation Branch administers this program, which is available after a Presidential Disaster Declaration. HMGP funds hazard mitigation plans and cost-effective projects that reduce or eliminate the effects of hazards and/or vulnerability to future disaster damage. Typically, the state provides a portion of the required non-federal match.
Pre-Disaster Mitigation Grant Program (PDM - Pre-Disaster)	X			Ohio EMA Mitigation Branch administers funds from this annual, nationally competitive program. PDM funds hazard mitigation plans and cost-effective projects that reduce or eliminate the effects of hazards and/or vulnerability to future disaster damage.

Flood Mitigation Assistance Program (FMA – Pre - Disaster)	X			Ohio EMA Mitigation Branch administers this program, which funds flood mitigation plans, provides technical assistance, and funds construction projects that reduce flood risk to insured, repetitive loss properties.
Mitigation Post-Disaster PDA (Post-Disaster)	X			Mitigation Staff accompanies PDA teams to evaluate the disaster in its early stages and determine which communities could benefit from mitigation actions. It also presents an opportunity to highlight potential success stories.
Education and Outreach (Pre- and Post-Disaster)	X			Mitigation Staff conducts education and outreach activities focused on promoting pre- and post-disaster mitigation techniques, developing effective mitigation projects, benefit- cost analysis, mitigation planning, and other mitigation related topics.
Ongoing Technical Assistance (TA)		X		If a community requests technical assistance at any time, the Mitigation Branch will facilitate the request, if possible.
Mitigation Planning Coordination (Pre- and Post-Disaster)		X		Mitigation Planner assists with the update of the SHMP, as well as facilitates and reviews local plans that are developed. Assists communities with integrating local mitigation plans into other plans/functions; assists with plan implementation.
Public Assistance	X			Ohio EMA Disaster Recovery Branch (DRB) administers Stafford Act recovery programs including Public Assistance (PA). The PA program provides mitigation funding for certain public facilities that are damaged in a declared disaster event and PA funds are also available to mitigate these facilities (Section 406 mitigation). The Recovery Branch is responsible for this program and Mitigation Branch assists when needed.
Ohio Safe Room Rebate Program	X			The Ohio Safe Room Rebate Program provides a rebate for the purchase and installation of tornado safe rooms for homeowners. Homeowners apply online and are selected to participate through a random lottery. Funding for the program is made available through the FEMA HMA programs (75%) and is matched with homeowner contributions (25%). Ohio EMA plans to offer this program on an annual basis, contingent upon funding.

OHIO ENVIRONMENTAL PROTECTION AGENCY (OEPA)

The Ohio Environmental Protection Agency is a trusted leader and environmental steward using innovation, quality service and public involvement to ensure a safe and healthy environment for all Ohioans. Ohio EPA's goal is to protect the environment and public health by ensuring compliance with environmental laws and demonstrating leadership in environmental stewardship. Those laws and related rules outline Ohio EPA's authority and what things can be considered when making decisions about regulated activities.

Ohio EPA establishes and enforces standards for air, water, waste management and cleanup of sites contaminated with hazardous substances. They also provide financial assistance to businesses and communities; environmental education programs for businesses and the public; and pollution prevention assistance to help businesses minimize their waste at the source.

Table 3.3.l

Ohio Environmental Protection Agency Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Regulation of Waste Streams (Pre- and Post- Disaster)	X			Defines regulated waste streams; outlines requirements for proper management and disposal. Includes flood reduction criteria.
Public Outreach Materials (Pre- and Post-Disaster)	X			Provide clarification of regulatory requirements, including flood reduction criteria.
Debris Management Course (Pre- and Post- Disaster)		X		Co-presented with Ohio EMA; provides guidance/training for anyone involved in disaster preparedness and response/recovery activities. Provides an opportunity to outline mitigation goals and objectives for flood reduction.
Technical Assistance (Pre- and Post-Disaster)		X		Provide guidance to local officials regarding regulatory requirements for managing and disposing of various waste streams without making them hazard-prone.
Project Development (Pre-Disaster)	X			Provide clearance for any mitigation project actions that would alter the natural environment as part of the development process.
Water Pollution Control Loan Fund (WPCLF)		X		Provides funding for wastewater treatment facilities, storm water projects, and non-point source project improvements. Funded WWTPs must ensure that upgrades and facility are protected to 500-year flood or 2 feet above 100- year flood.

Project WET (Water Education for Teachers)		X		Award winning national curriculum for educating teachers about water. Contains several chapters on flood mitigation and awareness.
Emergency Loan Fund	X			Provides loans to public water supply systems for emergency remediation of a “threat of contamination”.
Water Supply Revolving Loan Account (WSRLA)	X			Provides funding for drinking water facilities. Other than surface water intakes, all funded water system components shall be protected to at least 3 feet above the 100 year flood elevation or maximum flood of record, whichever is higher.
Environmental Response Unit	X			Ohio EPA’s Environmental Response (ER) Unit is a specialized group of staff stationed throughout Ohio who coordinate with first responders and other Federal, State and local responders and support entities on environmental emergencies such as train wrecks, facility malfunctions, highway crashes, fish kills, oil and gas releases, natural disasters, etc., to minimize and abate the impact these releases cause to the environment. ER is capable of responding 24 hours a day, seven days a week and responders are fully trained in the Incident Command System.
Urban Stormwater Program, Watershed Programs (Pre- and Post Disaster)		X		ODNR, Division of Soil and Water Conservation develops model regulations for urban stormwater management; provides assistance with stream morphology assessments; funds/administers Ohio Watershed Coordinator Program.

OHIO HISTORY CONNECTION (OHC)

The Ohio History Connection, formerly the Ohio Historical Society, is a statewide history organization with the mission to spark discovery of Ohio's stories. As a 501(c) (3) nonprofit organization chartered in 1885, the Ohio History Connection carries out history services for Ohio and its citizens focused on preserving and sharing the state's history. This includes housing the State Historic Preservation Office (SHPO), the official state archives, local history office and managing more than 50 sites and museums across Ohio. For more information on programs and events, visit ohiohistory.org.

The State Historic Preservation Office is the official historic preservation agency of the State of Ohio. It has developed since 1967 when the Ohio Historical Society (now the Ohio History Connection) was designated to manage responsibilities delegated to the state by Congress in National Historic Preservation Act of 1966. Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects of federally assisted undertakings on historic properties. Review of these undertakings is conducted by the SHPO.

Table 3.3.m

State Historic Preservation Office Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
National Historic Preservation Act (Pre- and Post-	X			OHC, ensures all historic and archeological laws and statutes are addressed and adhered to.
Project Application Review Process (Pre-Disaster)	X			OHC, ensures the archeological integrity of lands and structures are addressed and reviewed for environmental applicability during project ranking process.
Provide Technical Assistance and Training (Pre-Disaster)		X		If the structure is protected under the National Historic Preservation Act, the OHC works with the property owner and State to provide a mitigation solution that considers the historic integrity of the structure.
Programmatic Agreements (Pre-Disaster and Post-Disaster)		X		OHC coordinates, reviews, and negotiates programmatic agreements that help expedite the historic review requirements for mitigation projects funded before and after disasters.

OHIO PUBLIC WORKS COMMISSION (OPWC)

The OPWC was created initially in 1987 to administer the State Capital Improvement Program which was soon joined by the Local Transportation Improvement Program. These programs, which run concurrently, are solicited, scored and selected by the 19 District Integrating Committees according to each district's schedule. In 2000, the OPWC became responsible for the administration of the Clean Ohio Conservation Green Space Program in which applications are solicited, scored, and selected by the 19 Natural Resource Assistance Councils (NRACs).

The OPWC staff is accountable to the legislatively appointed twelve-member Commission who provides oversight to the Director and adopts the bylaws governing the conduct of OPWC's business. The Commission's staff works with the district committees to ensure that the programs are administered in a fair and objective manner. On a daily basis staff maintain ongoing contact with local communities, providing technical assistance through each project's completion.

Table 3.3.n

Ohio Public Works Commission Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
State Capital Improvement Program (SCIP) (Pre- and Post-Disaster)	X			Provides funding to assist Ohio jurisdictions in repairing/replacing public infrastructure, including emergency projects. Mitigation objectives are incorporated into project development.
Clean Ohio Fund (Pre- Disaster)	X			This program is dedicated to environmental conservation including acquisition of green space and the protection and enhancement of river and stream corridors. Grant recipients agree to maintain the properties in perpetuity so that they can be enjoyed and cherished for generations to come.

PUBLIC UTILITIES COMMISSION OF OHIO (PUCO)

The PUCO was created to assure Ohioans adequate, safe and reliable public utility services at a fair price. Monitoring and enforcing PUCO rules and state laws against unfair, inadequate and unsafe public utility and transportation services achieve this. More recently, the PUCO gained responsibility for facilitating competitive utility choices for Ohio consumers. The PUCO regulates providers of multiple utility services including electric and natural gas companies, local and long distance telephone companies, water and wastewater companies, and rail and trucking companies.

Table 3.3.p

Public Utilities Commission Mitigation Summary

Programs, Plans, Policies, Regulations, Funding or Practices	Effect on Loss Reduction (X)			Comments
	Support	Facilitate	Hinder	
Technical Assistance for Program Development (Pre-Disaster)	X			The PUCO supports mitigation measures and provides imperative information to Ohio EMA, during project development, regarding the safety of property before demolition of homes, including the locations of buried power lines.
Identify Projects Post- Disaster (Post-Disaster)	X			Work with utility companies post- disaster to identify projects and utilize 406 mitigation funds through the PA program, if possible.

STATE DEVELOPMENT POLICIES FOR HAZARD-PRONE AREAS

State development policies for hazard areas are generally manifested through the programs identified in the previous section. As a home rule state, Ohio does not have comprehensive or overarching standards for development in hazard- prone areas. At the same time, Ohio communities have significant freedom to adopt and enforce policies for these areas. For example, any Ohio community could adopt zoning standards that apply to hazard-prone areas because such standards have a direct tie to public health and safety. As was stated earlier, Ohio does not have a requirement for comprehensive planning nor hazards planning other than the requirements found in the Disaster Mitigation Act of 2000.

Most Ohio policies are targeted and limited to the hazard of flooding or coastal erosion. A few examples follow:

- Under Section 1521 of the Ohio Revised Code (ORC), development in 100-year floodplains that is funded by state and state-administered federal monies must comply with the minimum National Flood Insurance Program (NFIP) criteria.
- Infectious waste treatment facilities permitted under Section 3734 of the ORC are prohibited in all special flood hazard areas.
- The Ohio Basic Building Code and the Ohio Fire Code are now based on the International Code Council codes. The OBC contains minimum standards for flood resistant construction and the construction or community and residential safe rooms.

The Ohio EMA has prioritized hazard mitigation planning and the acquisition/demolition of hazard-prone structures as a mitigation action for many years. Acquiring and demolishing high risk structures and deed restricting the land as open space in perpetuity is the only way to mitigate all risk to people and the built environment. This priority is supported by the State Hazard Mitigation Team, and the grant application review process.

STATE FUNDING CAPABILITY FOR HAZARD MITIGATION

Ohio has been aggressive in pursuing hazard mitigation projects available through FEMA programs. Appendix F: FEMA Mitigation Programs Funding Summary shows that since 1990, the date of the first Federal disaster declaration, which resulted in mitigation funding, over $26.2 million of state funds have been spent on FEMA's hazard mitigation programs (this does not include state match assistance for 406 mitigation accomplished through the Public Assistance program). Typically, the State of Ohio provides a cost share for the HMGP that varies from disaster to disaster. The State of Ohio will provide 12.5% of the mitigation project cost for the most recent disaster declared in April 2018 (DR- 4360). Ohio has provided anywhere from matching Federal mitigation funds dollar-for-dollar, to providing a portion of the non-Federal matching funds required to only providing funds to match the state management costs of the program. It has generally been a policy of the state, even when Federal mitigation funds were matched dollar-for-dollar, that there be some amount of local match contributed so a community would have some vested interest in the project.

In addition to providing matching funds for FEMA HMA programs, the state has also committed to building / maintaining state staffing to provide technical assistance to Ohio communities and citizens in the state Floodplain Management Program, Dam Safety Program, Industrial Compliance and Mitigation Branch.

These programs, along with the multitude of other state programs, policies, plans, regulations and funding practices clearly demonstrate Ohio's commitment to hazard mitigation.

An example of a mitigation project funded recently by the State of Ohio is the re-construction of Buckeye Lake Dam in Licking and Fairfield Counties. The earthen dam was constructed from 1825 to 1832 and measures approximately 4.1 miles long. The lake surface area at normal summer pool is 2,800 acres and is designated as a Class I high-hazard potential dam. In March 2015, a report produced by the U.S. Army Corps of Engineers concluded that the likelihood of embankment failure was high and posed significant risk to the public. As the dam owner, ODNR oversaw the three year project to reconstruct the dam at a cost of $107 million. The identified safety issues with the dam have been addressed and the surrounding communities are looking forward to future boating, fishing and other recreational opportunities provided by the lake. Additional information on this project can be found on ODNRs website: http://engineering.ohiodnr.gov/buckeyelake#overview.

The State of Ohio has also recently provided mitigation funds to communities in the Blanchard River Watershed to help reduce damage caused by repeated flooding. Since 2007, the state has appropriated close to $30 million in for various flood mitigation projects in the watershed including: bridge modifications, acquisition/demolition of repetitively flooded structures, flood control diversion channel, engineering reports and studies, and dry dams. These projects are in various stages of completion but are expected to significantly reduce flood impacts to communities in Hancock and Putnam Counties.

In an effort to address unmet local funding needs and ensure an effectively coordinated state level program, the Ohio Emergency Management Agency has developed a proposal for a state funded mitigation grant program. The mitigation grant program proposal is part of the agency's strategic plan and creation of the program is being pursued with the Department of Public Safety and Governor's Office

3.5 COMMITMENT TO A COMPREHENSIVE STATE MITIGATION PROGRAM

The State of Ohio has had a long-standing commitment to a comprehensive mitigation program. Certainly, the action items in Section 3.2 reflect this commitment. This commitment has been exhibited through past, existing and future initiatives. This section provides a thorough discussion of different dimensions of the state's commitment, how each aspect has been implemented in the past and the state's plan to continue said implementation.

LOCAL MITIGATION PLANNING SUPPORT

Local mitigation planning has been and will continue to be supported significantly. All 88 counties in Ohio have had a FEMA approved local hazard mitigation plan at some point. Ongoing training on developing/updating a local mitigation plan is provided by the Mitigation Branch through the training program at Ohio EMA. In addition, Ohio EMA has developed and maintains the State Hazard Analysis Resource Planning Portal (SHARPP). The SHARPP houses every county mitigation plan, as well as a summary of the HIRA and mitigation action items.

SHMT IMPROVEMENT

The collaborative power of the SHMT is understood. Invitations were sent to additional organizations with the intent to expand the SHMT to allow for better program integration/utility.

OHIO SILVER JACKETS TEAM

The Ohio EMA is the state coordinator of the U.S. Army Corps of Engineers Silver Jackets program. The Ohio Silver Jackets Team is an interagency team dedicated to creating a collaborative environment to bring together Federal, State, local, and other stakeholders to develop and implement solutions to natural hazards and mitigation by combining available agency resources, which include funding, programs, and technical expertise. The Ohio Silver Jackets Team was the first state team in the Silver Jackets program. A team charter was signed in May 2005 and the team continues to meet on a quarterly basis. Some recent projects involving Silver Jackets funding and state match resources include:

- Marion County Floodplain Mapping
- HAZUS Level 2 Analysis
- The Great Ohio Flood of 1913 Awareness Campaign

PROVIDING NON-FEDERAL MATCH

Ohio has consistently provided state match for local HMGP projects, HMA funded state mitigation projects, and match to HMA management cost grants that support Ohio EMA Mitigation Branch staff salaries (see Appendix F). The current estimate of state funds spent to support HMA related mitigation efforts is $26 million over a 28 year period.

USE AND PROMOTION OF NATIONAL BUILDING CODES

The current commercial building code for Ohio known as the Ohio Building Code (OBC) was adopted 9/30/2016, effective 1/1/2017 and then Amended 7/13/2018, effective 8/1/2018. This code is mandatory statewide for the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal and demolition of buildings under its purview. The OBC is generally applicable to construction that is not detached one-, two-, or three-family dwellings. This current code is based upon the 2015 International Building Code.

The current residential building code for Ohio is known as the 2013 Residential Code of Ohio, passed 5/28/2012, effective 1/1/2013. This code is mandatory statewide for the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal, and demolition of every one-, two-, or three-family dwelling. This current code is based upon the 2009 International Residential Code. These building codes include provisions to meet flood and wind requirements, and simultaneously allow communities to adopt and enforce higher standards for floodplain management should they choose to do so.

SAFE ROOM REBATE PROGRAM

The Ohio EMA Mitigation Branch created the Safe Room Rebate Program to help property owners off-set the cost of constructing/installing residential tornado safe rooms. As of December 2018, the program has leveraged $349,235 in property owner funds with $1,008,474 in federal HMA funds to complete 184 residential safe rooms across the state.

INTEGRATION OF MITIGATION IN RECENT POST DIASTER RECOVERY OPERATIONS

Ohio EMA works cooperatively with FEMA after a disaster event in the state to ensure that post-disaster mitigation opportunities are incorporated into the recovery. There is comprehensive hazard mitigation strategy that is prepared by FEMA and the state after every event.

During FEMA DR-1805-OH, the Mitigation Branch was co-located in the JFO Mitigation Section with federal counterparts. As a result, this joint team crafted the hazard mitigation strategy for 1805 that included the following objectives and priorities: promotion of local mitigation planning, mitigation project application outreach, promotion of best practices and NFIP coordination with FEMA and ODNR.

FEMA DR-4077-OH included severe storms and straight-line winds which impacted many parts of Ohio. The Joint Field Office helped develop the hazard mitigation strategy for this event. The strategy identified the different activities that are to be conducted as a result of the disaster declaration. The Joint Hazard Mitigation Strategy for this event included deployment of a 406 specialist to the Joint Field Office that worked with state and local staff to maximize mitigation opportunities for public assistance projects.

FEMA DR-4098-OH was declared because of the impacts of super storm Sandy and the impacts were felt primarily in Northeast Ohio. The Joint Field Office again helped develop the hazard mitigation strategy.

FEMA DR-4360-OH was a flood event in southern and eastern Ohio. The greatest impact from this event was to infrastructure, specifically roads and bridges. The Ohio EMA Recovery Branch worked with FEMA Public Assistance staff to fund 406 mitigation through the new Public Assistance delivery model.

3.4 FEMA MITIGATION PROGRAM IMPLEMENTATION CAPABILITY ASSESSMENT

Effective hazard mitigation programs require strong partnerships between Federal-state-local government, the private sector, and non-profit organizations. States have a responsibility for maintaining competency in the ability to manage and implement a robust state hazard mitigation program. Effective state mitigation programs not only administer FEMA mitigation programs, but assist in the administration or promotion of other entities mitigation programs. For example, many local mitigation plans identify structural flood control as a possible mitigation measure. A competent state mitigation program is aware of possible USACE programs that could be utilized, and could facilitate project initiation.

Overall, Ohio has been a leader in implementing FEMA mitigation programs for many years. FEMA has recognized Ohio as an "Enhanced Plan" state, which is an acknowledgement of the states mitigation planning and grant management capability. Recently, Ohio signed a Program Administration by State agreement with FEMA that allows the state to review and approve local hazard mitigation plans. Section 3.3 describes the myriad of state programs that contribute to hazard vulnerability and loss reduction.

State mitigation planning criteria under the Stafford Act focuses on state competency delivering FEMA mitigation programs. The following sections describe the Ohio EMA Mitigation Branch's capability in this regard.

PROJECT IMPLEMENTATION CAPABILITY

Title 44 Part 201 Section 5(b) (2) (i) and (ii) of the CFR states that an enhanced SHMP must document the state's project implementation capability, identifying and demonstrating the ability to implement the plan, including:

- Established eligibility criteria for multi-hazard mitigation measures;
- A system to determine the cost effectiveness of mitigation measures, consistent with OMB Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs; and
- a system to rank the measures according to the state's eligibility criteria (Evaluation criteria).

For the purposes of this section, eligibility criteria are those that either allow or disallow a mitigation project to be considered further. Evaluation criteria are those that allow for a comparison of different mitigation projects.

ELIGIBILITY CRITERIA FOR HAZARD MITIGATION MEASURES

The CFR and Hazard Mitigation Assistance Guidance identifies eligibility requirements for projects under the HMA programs. Generally, the State of Ohio does not establish eligibility criteria for hazard mitigation measures that exceed those found in the CFR or specific program guidance. The main exception to this is under HMGP, where the state requires that the sub-applicant is participating and in good standing in the National Flood Insurance Program. The HMGP criteria for Ohio are listed below.

1. Applicants can only be state and local governments or certain non-profit entities (Ohio does not have any federally recognized Indian tribes). Conservancy districts and sewer districts are also eligible applicants if they meet local mitigation plan requirements.
2. Projects must be in conformance with the state and local mitigation plans approved under 44 CFR 201.

3. Projects that have a beneficial impact on the disaster area are prioritized over other project statewide. (HMGP only).
4. Projects must be in conformance with Federal environmental regulations, including 44 CFR Part 9, Floodplain Management and Protection of Wetlands and DHS Directive Number: 023-01, Implementation of the National Environmental Policy Act.
5. Projects must solve a problem independently or constitute a functional portion of a solution, where there is assurance that the project as a whole will be completed.
6. Projects must be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster (see Cost-Effectiveness of Mitigation Measures section below).
7. Projects must be an eligible activity for the specific HMA grant program.
8. Sub-applicants must commit to required non-Federal cost share.

In Ohio, competition for HMGP funds is tremendous. On average, project applications will exceed available funding by 3-10 times. As a result, both eligibility criteria and evaluation criteria have been developed to fairly distribute these post-disaster funds. These criteria, and modifications needed if necessary, are found in the Administrative Plan (see Appendix H) and Mitigation Strategy for the event.

PDM AND FMA

The statute, CFR, and specific program guidance identifies eligibility criteria for these programs that are slightly different from the ones described for HMGP. Ohio follows the federal eligibility criteria for PDM and FMA.

DETERMINING COST-EFFECTIVENESS OF MITIGATION MEASURES

A key criterion for mitigation projects to be eligible for funding is that they must be cost-effective according to OMB Circular A-94, Guidelines and Discount Rates for Benefit-Cost analysis of Federal Programs. If the project benefits are higher than the project costs, then the project is cost-effective.

In order to ensure a consistent approach in determining the cost-effectiveness of all mitigation projects, the state uses the FEMA benefit-cost analysis (BCA) software. Since this is also the method used by FEMA to determine the cost- effectiveness of a project, it is only reasonable that the state use the same method. The BCA is an assessment of the mitigation project to determine whether the cost of investing federal/state/local funds in a hazard mitigation project is justified by the prevented or reduced damages from future disasters.

It is understood that a positive benefit cost ratio (BCR > 1) does not necessarily guarantee that a hazard mitigation project will be approved – but it does ensure that it meets the cost-effectiveness eligibility requirement. By applying project specific information to the benefit cost analysis module, we can get a good initial look at the mitigation potentials associated with that project. The results of this analysis can also help communities evaluate current and future mitigation projects and adjust their overall mitigation strategy accordingly.

The Mitigation Branch coordinates with FEMA Region V to provide BCA training every year. This training coincides with the release of the HMA Guidance and start of the non-disaster application cycle. Mitigation Branch staff also periodically conduct BCA training workshops. Information on BCA training and instructions for downloading the most current version of the BCA tool can be found on the Mitigation Branch website.

SYSTEM TO RANK MITIGATION MEASURES ACCORDING TO THE STATE'S ELIGIBILITY CRITERIA (EVALUATION CRITERIA)

For HMGP projects, evaluation and ranking is a two-step process. First, pre- applications are submitted to Ohio EMA, usually within 10 weeks of the disaster declaration. The SHMT will meet and evaluate the project pre-applications based on the state and federal mitigation priorities and discussion of the limited data available in the pre-applications using the scoring forms (see example in Appendix G) provided by Ohio EMA Mitigation Branch. After the pre-applications are reviewed, enough sub-applicants are invited to develop full applications to ensure that the projected amount of HMGP funds will be expended.

The SHMT will meet again after the Ohio EMA Mitigation Branch has fully processed the full project applications (conducted environmental review and benefit-cost analysis), to review and discuss all eligible projects. The SHMT will score the projects using the project application scoring sheet (see Appendix G). These forms combine basic criteria found in the CFR, criteria for the nationally competitive mitigation programs, and criteria based on Ohio's priorities. The scores are then used to make a recommendation to the Executive Director of Ohio EMA as to which projects to forward to FEMA for funding. In cases where a good, eligible project does not receive funding, Mitigation Branch staff work with the applicant to submit the application for funding under other FEMA mitigation programs, if applicable.

The SHMT also reviews project applications for PDM and FMA. The evaluation criteria are similar to those used in the national competition (see Appendix G). The SHMT evaluates these projects based on the full project applications rather the pre- applications and only reviews them once.

PROGRAM MANAGEMENT CAPABILITY

A comprehensive state mitigation program should have effective program management capability. In 1998, Ohio was selected as one of the three "pilot" states to test the Managing State concept, which was to provide the state with more responsibility and autonomy in managing the FEMA mitigation programs. Selection was based on program management ability, well-documented fiscal controls and a strong, well-developed SHMT. In 2006, FEMA terminated the managing state program, not only for Ohio but for all states in the nation. The stated reason was that the DMA 2000 law established a mechanism for a "delegated state" program, and it was FEMA's opinion that such legislation superseded the managing state concept.

The benefits associated with Managing State status included: quicker project approval, ability to review, rank and select projects, pre-approval of environmental reviews and pre-certification of local hazard mitigation plans. An approved project had to include a completion of a benefit cost analysis and environmental clearances from ODNR Division of Real Estate and Land Management, US Department of Interior Fish and Wildlife Services, and Ohio Historical Preservation Office. Managing States performed the benefit cost analysis and approved the environmental review for each project prior to submitting the selected applications for FEMA's approval. The certified applications enabled FEMA to process the applications quickly.

Environmental Reviews are conducted at the State level in conjunction with all applicable state and federal agencies. The State ensures that the local applicants are aware of the environmental review process and encourages them to provide as much information as possible before the review and contact of applicable agencies begins. The state then reviews each applicant's project for environmental information, prepares letters of review request to each applicable agency, prepares the REC (HMGP Only), and forwards it to FEMA for concurrence and signature. A more detailed explanation of the process is located in the current HMGP Administrative Plan.

A detailed breakdown of the benefit cost capabilities of the State Mitigation staff is located earlier in this section. Benefit cost runs and copies of each type of analysis is kept with each approved project.

The State of Ohio has a good record of providing timely, complete and accurate quarterly progress reports and financial reports. In each grant agreement, regardless of the program, applicants are required to submit quarterly progress reports within 15 days of the end of the quarter. The Mitigation Branch compiles a comprehensive narrative and financial quarterly report to the Region V Office within 30 days of the end of the quarter. A more detailed explanation of the quarterly report is located in the HMGP Administrative Plan. All HMA grant program projects are required to adhere to the same quarterly reporting process.

HMA project closeout and financial reconciliation are also described in detail in Administrative Plan and closeouts have been a Mitigation Branch strategic priority for several years. Mitigation staff conduct explicit reviews of the project or program close-out. The terms of the grant agreements and quarterly reports provided by the project applicant give a detailed summary of the project or program. On-site visits are conducted prior to the projects closeout and fiscal reconciliation.

Ohio EMA actively supports ongoing mitigation planning throughout the state. The Mitigation Branch has one staff position dedicated to mitigation planning. The Mitigation Branch staff and Ohio EMA Regional Staff provide educational visits, technical assistance visits and planning presentations to facilitate the planning process in Ohio. The Mitigation Branches SHARPP website is very heavily focused on promoting mitigation planning activities.

The final aspect of a comprehensive state mitigation program is to develop and present mitigation educational materials and conduct outreach relative to mitigation. Ohio EMA mitigation branch staff conducts mitigation planning courses, natural hazard planning workshops, technical assistance visits, program and project development meetings, and participates in public meetings. As changes occur in FEMA and Ohio EMA mitigation programs, the Mitigation Branch develops new presentations and courses to provide educational opportunities to the emergency management community in Ohio.

EFFECTIVE USE OF AVAILABLE MITIGATION FUNDING

Appendix F shows that the State of Ohio has been very effective, and aggressive in pursuing available mitigation funding. Ohio has successfully obtained funding in all of FEMA's mitigation programs. The Mitigation Branch has also developed mechanisms to ensure that funds are effectively used:

- Under HMGP, full project applications are developed based on 200% of the available funding. This ensures that there will be enough complete, eligible project applications to submit for funding before the application deadline has passed. If an application is developed and eligible, but not funded, Mitigation Branch staff will work to find another program under which it can be funded.
- The Mitigation Branch will keep HMA projects that are eligible but not funded as "shelf" projects to be submitted under another program or subsequent HMA funding cycles.

- The Mitigation Branch and SHMT leverage other (non-FEMA) sources to fund mitigation projects. USACE's Planning Assistance to States, Floodplain Management Services, and HUD Disaster Supplemental funds have been used for mitigation planning and projects.
- "Zero-Funded Projects" are those actions that are currently prepared for implementation once funding becomes available. These projects have complete information and are prioritized.

SECTION 4:
LOCAL MITIGATION PROGRAM COORDINATION

4.1 LOCAL CAPABILITY ASSESSMENT

OVERVIEW

The preparation of Local Hazard Mitigation Plans (LHMPs) is a precondition for receipt of Hazard Mitigation Assistance grant project funds under the Disaster Mitigation Act of 2000 (DMA 2000), which also requires that states examine LHMPs as part of their State Hazard Mitigation Plan (SHMP) process. FEMA has established mitigation planning requirements for local jurisdictions to meet, among other things, to demonstrate that proposed mitigation actions are based on a sound planning process that accounts for the inherent risk and capabilities of the individual communities.

The Ohio EMA Mitigation Branch administers the LHMP Program for the state. The Mitigation Branch supports and assists local governments in the development and update of LHMPs. In early 2000's, a significant amount of federal and state funds were provided to develop LHMPs. For the time period spanning from the 2005 plan to the 2008 update, the main planning emphasis of the Mitigation Branch has been to get LHMPs reviewed, adopted, and FEMA approved. From 2008 to 2011, the emphasis shifted to tracking LHMPs progress and effectiveness in a quantitative way, and integrating plan information more significantly into the state plan. The focus during 2011-2018 was populating the State Hazard Analysis, Resource and Planning Portal (https://sharpp.dps.ohio.gov/ohiosharpp) with local plan information that enhances mitigation planning efforts statewide. In June of 2018, the Ohio EMA signed a Program Administration by State (PAS) Pilot Operational Agreement. This agreement allows the state to review and approve LHMPs and decrease the amount of time that LHMPs are in review.

Currently, Ohio has a very high LHMP participation rate. A county-by-county plan status report is included in Appendix D. As of December 2010, every county in the state of Ohio had developed a baseline mitigation plan that had been approved by FEMA. Based on an October 2018 report from FEMA, Region V 87.4% of the population of Ohio was situated in a community with a locally adopted, FEMA approved plan. As of October 2018, there are sixty-five county plans that are current and have final Federal approval. An additional two county plans (Franklin and Meigs) are federally approved pending adoption. Fifty-three counties are updating their plans under a federal grant, while six counties are developing their plans without a grant.

The Mitigation Branch has engaged in multiple outreach efforts to counties with expiring LHMPs to emphasize the importance of updating the plan, offer technical assistance, and identify possible funding sources for local mitigation plan updates. Fourteen LHMP updates were funded with PDM 16 funds, eighteen LHMP updates were funded with PDM 17 fund and nineteen plans will be funded under DR-4360. The Mitigation Branch will continue local mitigation plan outreach and technical assistance efforts during the next SOHMP update cycle.

SHARPP highlights local mitigation planning and project efforts. Providing greater public access to local mitigation plans will help publicize local strategies for reducing risk, and support requests for investment in mitigation projects. In addition to the benefits provided by SHARPP, the local mitigation planning capability has been enhanced by the Mitigation Branch's efforts to conduct statewide HAZUS version 4.2 runs for the 25- and 100-year recurrence intervals (see Section 2.2) and earthquakes. These HAZUS version 4.2 runs were made available to local officials for inclusion in LHMP updates. The Ohio EMA Mitigation Branch will continue to utilize HAZUS and promote the use of the tool throughout the state.

Local authority to implement a comprehensive hazard mitigation program is ample. Ultimately, it is up to each local jurisdiction to determine which mix of authorities, programs, policies, and capabilities it wants to develop. All Ohio communities (cities, villages, and counties) have the power to develop and adopt many different kinds of plans including comprehensive plans, capital improvement plans, economic development plans, emergency operations/response plans, continuity of operations plans, and hazard mitigation plans. Communities have regulatory powers to adopt zoning, subdivision, development, floodplain management and health codes. Ohio communities have the power to levy taxes / assessments for special purposes (including petition ditch projects, storm water utilities) and have the authority to borrow funds (bonding). Finally, communities have the authority to create planning, emergency management, health, public works, economic development and other needed agencies. All of these authorities have, or potentially could have, a bearing on local hazard mitigation.

QUALITATIVE ANALYSIS OF LHMPs

Because the Mitigation Branch has reviewed each LHMP, some trends were evident. Again, these trends are based on a qualitative, not quantitative review of the LHMPs.

OVERALL PLAN QUALITY

Overall, LHMPs involved many local agencies/entities and are of a good quality. It was noted that the quality of the plan is not dependent on its size; rather, it is the format and quality of information in the plan that is more important. Some of the best LHMPs are small to moderate sized. Ohio EMA recommends that jurisdictions use FEMA's planning how-to publications including the Local Mitigation Plan Review Guide, Local Mitigation Plan Review Tool, Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards and the Local Mitigation Planning Handbook to guide the development of their plan.

One of the consistent issues across most, if not all, LHMPs is that the definitions used are not consistent. The areas where inconsistencies were most evident was in defining critical facilities, which seems to vary dependent on each jurisdiction's individual interpretation, building off of the definition within 44 CFR Part 201.6.

Another area of inconsistency was the way LHMPs conducted risk assessments and ranked the related hazard. There was a high level of variability in these processes, but variability in the risk assessment process and data sources used is not surprising given that communities have significantly different amounts and quality of data. In terms of ranking hazards, some LHMPs ranked the hazards based on a numerical ranking (using a matrix or scoring system), some developed a relative ranking system (one hazard ranked higher than another, but no number identified), and some developed a qualitative ranking system (ranking hazards as high, medium or low threat). However, flooding, severe summer storms, high winds/tornadoes, and severe winter storms were consistently ranked high or severe.

The final areas of inconsistency across the LHMPs is the manner in which hazards are grouped in the individual plans. Jurisdictions may choose to address each hazard separately or group similar hazards together, such as putting summer storms, hail and tornados together. The manner in which each hazard is addressed varies greatly depending upon the impacts to the local jurisdictions.

MITIGATION POLICIES, PROGRAMS & CAPABILITIES

Local mitigation policies and programs can be best understood by reviewing the local mitigation strategies. Those strategies should indicate whether policies or programs exist and need to be modified, or whether they exist at all. A few trends were noted.

It was evident that the majority of larger communities and counties have more extensive policies and programs in place versus smaller communities. Many of the local strategies pertaining to larger local governments tended to be geared towards refining or enhancing existing policies and programs versus creating them. The reverse was seen with smaller units of government. A similar trend was seen with local mitigation capability. Participants in the planning process for larger communities tended to be professional staff positions and/or multiple persons, while participants for smaller communities ranged from the mayor to council members to an appointed citizen.

Mitigation policies/programs/capabilities varied significantly from community to community and county to county. Some communities and counties had very sophisticated mitigation programs either demonstrated by the sophistication of their mitigation plans/goals/actions or the integration of mitigation programs. In addition, some communities developed their own, stand-alone plans. On the other end of the spectrum were communities that have virtually no involvement in hazard mitigation.

MITIGATION ACTIONS

While the mitigation actions in each LHMP can vary depending on the hazards and needs of each jurisdiction, there are several actions which occur in most if not all LHMPS. Education and outreach actions were the most frequently identified in LHMPs. Other actions that were frequently mentioned included flood mitigation projects (acquisitions/elevation, storm water), community and residential safe rooms, and warning systems (sirens/gages).

4.2 LOCAL MITIGATION PLANNING ASSISTANCE

44 CFR 201.4(c) (4) (i) requires the state to include a description of the process to support, through funding and technical assistance, the development of Local Hazard Mitigation Plans (LHMPs).

Hazard mitigation planning is a way, in a non-disaster environment, to understand hazards and prepare strategies and actions to reduce the impact of these hazards. The ever-rising recovery costs of disasters plaguing Ohio made it apparent that a pre-disaster planning and project focus with ongoing risk analysis could reduce these costs. The State of Ohio utilizes any available federal program funds for mitigation projects, and has documented success stories proving the necessity and effectiveness of the programs. The DMA 2000 stipulates that state and local jurisdictions need to have an approved LHMP to remain eligible for federal funding for mitigation projects. Ohio continues to take a very proactive role in the involvement with local jurisdictions to secure the availability of the funding programs and assist local communities in developing LHMPs. This effort has resulted in all 88 counties at one point in time have a FEMA approved local hazard mitigation plan.

CURRENT STATE EFFORTS

FEMA approved LHMPs are now prerequisites to obtaining funds from the FEMA Hazard Mitigation Assistance (HMA) programs. In addition, requirements published by FEMA on October 31, 2007 require all updated plans to meet FMA planning requirements (additional flood hazard mitigation strategy and strategy for repetitive loss programs). To keep abreast of and implement these changes, the Mitigation Branch will continue to prioritize the planning element of the state mitigation program.

TECHNICAL ASSISTANCE

Technical assistance that the state provides to Ohio communities includes:

- Mitigation planning process assistance including facilitating planning meetings, providing guidance documents for plan creation/update, etc.
- HIRA data development. The Ohio EMA Mitigation Branch and the ODNR, Floodplain Management Program both have competencies in running FEMA's HAZUS-MH program. Staff can provide assistance and training in HAZUS-MH and conduct HAZUS analyses that are available for communities to incorporate into LHMPs. In addition, state staff can provide other data that communities may not have (other flood studies, underground mine maps, etc.). State staff, with the assistance of Federal agency partners, often develop data after disasters.
- Information on mitigation actions including manuals, reference documents and other resources on different mitigation actions for all hazards.
- Mitigation action budget information. Since state staff is often involved in implementing mitigation projects statewide, they have a good understanding of the current costs of mitigation actions.
- Reviewing draft LHMPs for compliance with FEMA criteria.

FINANCIAL ASSISTANCE

44 CFR201.4(c)(3)(iv) requires the state to include identification of current and potential sources of federal, state, local or private funding to implement LHMP mitigation actions and to undertake mitigation planning.

It is important not only to provide financial assistance whenever possible, but also to identify sources of funding that can fund hazard mitigation planning and action item implementation (projects). LHMPs, if properly created, should not only identify mitigation actions that can be funded by FEMA, but other agencies as well. Table 4.2.a identifies several potential funding sources for hazard mitigation projects. For a more complete list, see the (Insert name and hyperlink to FEMA V funding summary very recently completed by Steve Greene).

The primary source for state and local hazard mitigation projects have been the federally funded cost-share programs. The state has historically matched a portion of FEMA hazard mitigation grant programs (primarily HMGP) through the state's disaster relief fund and has contributed over $26.2 million for hazard mitigation activities since 1990. As a general policy, the state requires local jurisdictions to contribute a portion of the non-federal matching funds. A summary of federal, state, and local contributions to all HMA programs can be found in Appendix F.

The limited funding from local community budgets requires the use of alternate funding sources for the cost-share match. Different state agencies distribute funds that can be used for mitigation activities. A summary of state funded mitigation planning and project programs can be found in Section 3.3 of this plan. Table 4.2.a examines some of the federal, state, local, and private sources available to provide financial assistance to local communities to implement hazard mitigation plans and projects.

Table 4.2.a
Potential Hazard Mitigation Funding Sources

Program	Administered By	Federal / State / Local	Purpose / Contact	Used Before?
Hazard Mitigation Grant Program (HMGP)	Ohio EMA Mitigation Branch	Federal - FEMA	Provides funds after Federally declared disaster to implement certain hazard mitigation projects and plans. Can be used for any hazard, subject to state Administrative Plan and Mitigation Strategy. Commonly used to acquire/demolish, elevate, retrofit, buildings; construction of tornado/high wind safe rooms, stormwater management system improvements, etc. https://sharpp.dps.ohio.gov/ohiosharpp/	Yes, extensively. Largest mitigation program used in Ohio – over $100 million Fed/state/local funds since 1990.
State Match to HMGP	Ohio EMA Mitigation Branch	State – Disaster Relief Fund	Dollars from the State Disaster Relief Fund are used to match federal HMGP project funds and state management cost awards for Hazard Mitigation Assistance grants in Ohio. The State Controlling Board must approve the use of Disaster Relief Funds.	The State of Ohio can contribute up to a 12.5% match to planning projects applied for under HMGP following a Federally declared disaster. Since DR-4077, the state have committed to $92,232 dollars towards local hazard mitigation plans
Pre-Disaster Mitigation Grant Program (PDM)	Ohio EMA Mitigation Branch	Federal – FEMA	Provides funds annually based on Congressional appropriations to implement certain hazard mitigation projects (includes mitigation planning grants). Can be used for any hazard. Nationally competitive. Commonly used for activities similar to HMGP. https://sharpp.dps.ohio.gov/ohiosharpp/	Yes, increasingly used. Since PDM-11,
Flood Mitigation Assistance Program (FMA)	Ohio EMA Mitigation Branch	Federal – FEMA	Provides funds annually based on Congressional appropriations to implement certain flood hazard mitigation projects (includes flood mitigation planning grants). Each state receives an allocation of funds. Commonly used for flood mitigation activities similar to HMGP. These funds now include the RFC and SRL programs. https://sharpp.dps.ohio.gov/ohiosharpp/	Yes – FMA funds available since 1988. Ohio receives allocation of between $200,000 and $300,000 per year. Usually funds 1-2 projects from communities.

Table 4.2.a (Continued)

Program	Administered By	Federal / State / Local	Purpose / Contact	Used Before?
HUD Disaster Supplemental Funds	Ohio Department of Development	State or Federal depending on Congress	Can be used for mitigation projects and planning.	Yes, used for five previous disasters. When funds are available, can be used to supplement FEMA funds to increase the number and size of mitigation projects.
Planning Assistance to States (PAS)	USACE	Federal	Section 22 of the Water Resources Development Act (WRDA) of 1974, as amended, provides authority for the Corps of Engineers to assist the states, local governments, and other non-Federal entities in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land. The Planning Assistance to States (PAS) Program is funded annually by Congress. Federal allotments for each State or Tribe from the nation-wide appropriation are limited to $500,000 annually, but typically are much less. These studies are cost shared on a 50 percent Federal-50 percent non-Federal basis.	The PAS was used to conduct a Level 1 HAZUS-MH analysis for the HIRA section of the 2008 SHMP update. The study covered the 25-year and 100-year flood analysis for 49 of the 88 counties in Ohio.
Flood Control (Structural & Non-Structural)	USACE	Federal	USACE, without specific authorization, may study, adopt, and construct small flood control projects, stream clearing and snagging projects, and participate in planning and preparedness. The cost share for Flood Control projects are 65 percent Federal-35 percent non-Federal	
Silver Jackets Partnership Program	USACE	Federal	Authorized by Section 206 of the Flood Control Act of 1960, the Flood Plain Management Services provides funding for interagency work between the U.S. Army Corps of Engineers (USACE), federal, state, and local agencies to better manage and reduce flood risks. These are dubbed "Silver Jackets" teams and are uniquely implemented by state.	The Silver Jackets team in Ohio cooperated to conduct Level 2 HAZUS-MH 100-year and 25-year flood runs for 25 counties in the state to enhance local vulnerability assessments.
"Partners in Watershed Management" Project Assistance Program	Muskingum Watershed Conservancy District	Local	In an effort to support the work of agencies and groups involved in conservation programs, water quality issues, and flood reduction and mitigation projects, the Muskingum Watershed Conservancy District (MWCD), has developed the "Partners in Watershed Management" Project Assistance Program (PWM). This competitive grant program provides assistance to local communities, agencies and groups involved in projects and programs that support the conservation and flood control aspects of the MWCD. Political subdivisions of the state, IRS Section 501 groups, and other organizations in the Muskingum River watershed are eligible for potential assistance through this program. Applications are accepted on a year-round basis for assistance with non-federal match to FEMA Hazard Mitigation Assistance programs.	This program was created in 2009 and has been used as non-federal match for two HMA projects in the Muskingum Watershed.

HMA GRANTS

FEMA's Hazard Mitigation Assistance (HMA) programs provide the two largest funding sources for local hazard mitigation plans (LHMP) in Ohio. Per FEMA, the Hazard Mitigation Grant Program (HMGP) is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. States, Federal-recognized tribes and territories may apply on behalf of state agencies, federally-recognized tribes and tribal agencies, private non-profits, and local governments/communities for assistance in implementing long-term hazard mitigation planning and projects following a Presidential major disaster declaration. In Ohio, the state may contribute up to 12.5% of a planning projects' cost if applied under for HMGP.

The other primary funding source for LHMP's in Ohio is the Pre-Disaster Mitigation Grant Program (PDM) that provides funds for hazard mitigation planning and projects on an annual basis. Authorized by Section 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the PDM grant is opened yearly and is nationally competitive. States, Federal-recognized tribes and territories may prioritize and apply on behalf of state agencies, federally-recognized tribes and tribal agencies, private non-profits, and local governments/communities to obtain mitigation planning funding that meets the requirements outlined in 44 CFR Part 201. Table 4.2.b details the HMA funding history specifically for local hazard mitigation plans. More information and guidelines regarding FEMA's Hazard Mitigation Assistance programs can be found at: https://www.fema.gov/media-library/assets/documents/103279.

Table 4.2.b

LHMP HMA Grants						
Grant No.	Award Date *	No. of Plans	Federal Share	State Share	Local Share	Total
PDM-02	2002	38	$ 416,713.00	$ 300,955.00	$ 238,909.00	$ 956,577.00
PDM-03	Aug-03	18	$ 218,571.00	$ 226,815.00	$ 148,462.00	$ 593,848.00
LPDM-08	Aug-08	2	$ 92,422.77	$ -	$ 30,808.36	$ 123,231.13
LPDM-09	Sep-12	2	$ 134,500.00	$ -	$ 44,850.00	$ 179,350.00
PDM-11	Jun-11	1	$ 18,985.23	$ -	$ 6,328.41	$ 25,313.64
PDM-13	Jul-13	1	$ 34,999.30	$ -	$ 11,666.44	$ 46,665.74
PDM-14	May-15	5	$ 110,437.19	$ -	$ 36,812.81	$ 147,250.00
PDM-15	Jan-16	6	$ 116,397.75	$ -	$ 38,800.57	$ 155,198.32
PDM-16	Dec-16	14	$ 383,495.99	$ -	$ 127,619.85	$ 511,115.84
PDM-17	Jul-18	18	$ 395,129.79	$ -	$ 131,710.00	$ 526,839.79
DR-1519	Jul-07	3	$ 38,538.00	$ 22,432.00	$ 21,469.25	$ 82,439.25
DR-1651	Dec-06	1	$ 18,750.00	$ -	$ 6,250.00	$ 25,000.00
DR-1805	Dec-09	26	$ 353,530.00	$ -	$ 119,316.00	$ 472,846.00
DR-4002	Jan-12	12	$ 217,260.00	$ -	$ 73,515.00	$ 290,775.00
DR-4077	Jun-13	6	$ 102,084.00	$ 16,537.00	$ 17,777.00	$ 136,398.00
DR-4098	Jan-14	3	$ 41,700.00	$ 7,065.00	$ 7,065.00	$ 55,830.00
DR-4360	Applied	19	$ 411,777.00	$ 68,630.00	$ 68,630.00	$ 549,037.00
Total **		**175**	**$ 3,105,291.02**	**$ 642,434.00**	**$ 1,129,989.69**	**$ 4,877,714.71**

Award dates are of the earliest planning project award date within that specific grant.
*****Total amounts do not account for State hazard mitigation plans, management costs, costs over/under-runs, and withdrawn projects.***

NEW STATE-WIDE HMA PLANNING GRANT APPLICATION

Since 2017, the Ohio Emergency Management Agency began applying for PDM and HMGP grants on behalf of local counties and communities looking to update their hazard mitigation plans. All applications were compiled and rolled into a single state-wide application and submitted to FEMA. This is done in an effort to stream-line the application process for local governments and lessen the work necessary for them to obtain funding for a hazard mitigation plan that meets federal and state requirements. Counties are not selected based on geographic location, but chose to apply based on the expiration date of their current plan which have already expired, or will be expiring within two and a half years.

Subsequently, this state-wide application method has allowed the state to reach out and encourage local communities to undergo meaningful hazard mitigation planning processes. PDMC FY-17 was a relative success in that all 18 counties that applied were awarded the full grant amounts. The total grant amount for the state-wide application came out to $526,810 dollars (not including management costs or over/under-runs). The State of Ohio is looking to replicate this success in its HMGP application following DR-4360 that will provide 19 counties the funding to complete their hazard mitigation planning projects for a total of $549,037.

PROGRAM ADMINISTERED BY STATES (PAS) PILOT OPERATIONAL AGREEMENT

Following the Presidential Disaster Declaration FEMA-4360-DR, a Program Administered by States (PAS) pilot agreement between the Federal Emergency Management Agency (FEMA) and the Ohio Emergency Management Agency (OEMA) was signed. This delegated to the Ohio Emergency Management Agency the ability to review and approve all local hazard mitigation plans. To ensure that the program is being administered correctly, Ohio EMA and FEMA have agreed to the following:

- Ohio EMA will submit quarterly programmatic and financial reports within 30 days following the end of the quarter.
- Ohio EMA submits mitigation plan monthly reports that describe plan review activity for the month.
- FEMA will do full reviews of one in every five plans submitted. One-fifth of the plans reviewed will be found approvable pending adoption.

As federal reviews are no longer required in four-fifths of the plans submitted, this agreement has allowed the state and local governments to cut down the required time to have a federally-approved hazard mitigation plan. This time saved helps ensure that opportunities to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. The state will continue to conduct reviews to ensure that all local hazard mitigation plans have met the federal requirements established in 44 CFR 201.6.

4.3 LOCAL MITIGATION PLAN INTEGRATION INTO STATE PLAN

44 CFR 201.4(c)(4)(ii) requires a description of the state's process and timeframe by which the LHMPs will be reviewed, coordinated, and linked to the State Mitigation Plan.

LOCAL HAZARD MITIGATION PLAN REVIEW AND COORDINATION PROCESS

The Ohio EMA Mitigation Branch reviews all Local Hazard Mitigation Plans (LHMP); however, FEMA is the final approval authority. Following Presidential Disaster Declaration DR-4360, a PAS Pilot agreement between FEMA and Ohio EMA delegated to the State the ability to review and approve four out of five local hazard mitigation plans. The State reviews the draft to ensure compliance with 44 CFR 201.6 local mitigation plan criteria within 45 days of arrival. If the plan is found to have met all requirements, the jurisdiction will be sent a letter saying that the plan is now "Approved Pending Adoption" (APA). The state will also notify FEMA when it has determined any approved plans along with the APA letters and completed local mitigation plan review tools. For quality assurance of the PAS Pilot Agreement, every fifth plan that the state receives will have to undergo both state and Federal reviews. If found to have met all requirements, FEMA will issue the APA letter for the plan as it did before the agreement. LHMPs are to be logged into the State Hazard Analysis Resource and Planning Portal (SHARPP) whether or not it has to go through FEMA review.

LHMP TRACKING

Local Hazard Mitigation Plan status is tracked through the SHARPP. When a local official uploads a draft plan into SHARPP for state review the status of the plan is tracked from the time of submittal to FEMA final approval. Once the plan receives final federal approval, it is posted to SHARPP for view by the public. A report can be generated in SHARPP that summarizes the status of all LHMPs in the state.

SHARPP is a repository for past, present, and future versions of all local natural hazard mitigation plans in Ohio. These documents are stored as PDF files and can be searched and retrieved by local jurisdictions or the general public. Providing easier public access to these documents will help inform citizens about local natural hazard risk and the actions that communities have planned to undertake that will reduce risk. As local mitigation plans are updated they will be uploaded into SHARPP.

LINKING LHMPS TO THE SHMP

Because LHMPs are developed based on Federal guidance and must meet specific Federal criteria, there are some similarities in their content. Nonetheless, LHMPs tend to be very different from one another in terms of: the quantity and quality of data presented in the HIRA; the techniques used to complete risk assessments and vulnerability analyses; and the "structure" of goals, objectives and action items. For that reason, the Mitigation Branch has determined that the two most logical areas where the LHMP should link back to the state plan are in the Risk Assessment and the State Mitigation Strategy.

LINK TO STATE MITIGATION STRATEGY

Because the state mitigation strategy is a global view, its objectives and actions may be of a different nature than those found in LHMPs. However, the goals in the state mitigation strategy reflect and are complimentary to LHMP goals. LHMP goals/objectives/actions are useful to identify trends, needs, and do have a bearing in the development of state mitigation strategy goals and action items. To determine whether or not a particular local objective / action is reflected in the state plan, it is evaluated to determine whether it has statewide applicability and whether it is a need expressed in a large number of LHMPs.

SHARPP has simplified the task of reviewing mitigation action items in LHMPs. Local officials enter information into SHARPP that summarizes the local mitigation action items identified in their jurisdictions mitigation plan. SHARPP captures basic information about the proposed mitigation action including: project lead, cost, potential funding sources, estimated start and end dates. SHARPP can generate a report that summarizes the locally proposed mitigation action items in each community. Analyzing these datasets will help the state to identify trends, needs, and assist in project identification and development. Local officials can update the status of proposed mitigation action items as they are implemented to help track progress.

LOCAL RISK ASSESSMENT INTEGRATION

The LHMPs were reviewed and used to "ground truth" the data the state used to determine the most serious hazards facing the state. In Section 2, flooding, tornadoes, severe summer storms and winter storms were identified among the most significant risk facing the state. These four were also the highest ranked hazards based on the number of LHMPs reviewed indicating them as serious hazards. Coastal flooding, landslides, and invasive species are ranked high in the state plan; however only some LHMPs identified these hazards as significant. This is likely due to the more limited geographical extent of these hazards. Narrative descriptions and summaries of LHMP data are included throughout the state HIRA.

Analyses in the state plan HIRA are utilized by local officials and may be incorporated into LHMP updates. The Mitigation Branch has completed and provided HAZUS runs for every county in the state for the 25 and 100 year recurrence intervals. The Mitigation Branch regularly informs county emergency management agency directors of the availability of these HAZUS runs and encourages them to incorporate this information into their LHMP updates.

When local officials upload a mitigation plan into SHARRP, they are asked to input data that summarizes their local hazard analysis and vulnerability assessment. In order to standardize the local data collected, SHARPP utilizes the factors considered in the HIRA methodology used by the State of Ohio. Local officials use information collected in their mitigation plans to complete the hazard analysis summary screen in SHARPP. Collecting the information in a standardized format allows the state to analyze risk statewide based on local risk assessments. Many local plans also contain estimates of the potential dollar losses to vulnerable structures. Vulnerability analysis information can be entered into SHARPP as part of the local mitigation plan upload process. Each approved hazard mitigation plan is highly encouraged and, often times, required to be uploaded onto SHARPP. The Mitigation Branch provides training to local officials and contractors on how to use SHARPP.

Standardizing the local HIRA information in the form of SHARPP was an effort to allow the state to analyze vulnerability and potential loss to structures based on local risk assessments. However, it remains difficult to compare each of the counties' potential losses because there is no requirement for a standardized plan template in local hazard mitigation plans. Therefore, each county had the liberty to use its own methodology and approaches for determining potential loss. Although this assessment considers the hazard analysis documented by the 2018 State of Ohio Hazard Identification and Risk Assessment (HIRA), the source behind the methodology in this section are specifically from local hazard mitigation plans entered onto SHARPP. The results of the local HIRA analysis through SHARPP tend to agree with the State HIRA, the risk analyses done throughout section 2 of the SOHMP, and the state priorities for local mitigation project funding.

METHODOLOGY

The Ohio EMA has incorporated and analyzed data from local mitigation plans with the assistance of SHARPP. Hazard Analysis Data from local counties were assessed and a total of 57 local hazard mitigation plans was reviewed as part of this analysis. These 57 plans were the plans that were approved and not expired as of April 2018.

When entering a plan onto SHARPP, there are 13 default hazards that the LHMP can assess. 12 are which the hazards assessed in the State Hazard Mitigation Plan, with the addition of Windstorm. If a hazard/event does not apply, the County can enter it as "N/A". If there are additional hazards assessed in the Local Hazard Mitigation Plan, the County can enter them into empty boxes below the default hazards. Figure 4.3.a shows the overlay when entering in Hazard Analysis data onto SHARPP.

Figure 4.3.a

Hazards	Frequency	Response	Onset	Impact	Business	Human	Property
Coastal Erosion	NA	1	1	1	1	1	1
Dam/Levee Failure	1	1	1	1	1	1	1
Drought	2	2	2	2	2	2	2
Earthquake	3	3	3	3	3	3	3
Flooding	4	4	4	4	4	4	4
Invasive Species	5	5	1	1	1	1	1
Land Subsidence	1	1	1	1	1	1	1
Mud/Landslide	1	1	1	1	1	1	1
Severe Summer Storms	1	1	1	1	1	1	1
Tornado	1	1	1	1	1	1	1
Wildfire	1	1	1	1	1	1	1
Windstorms	1	1	1	1	1	1	1
Winter Storms	1	1	1	1	1	1	1
Power Outages/	1	1	1	1	1	1	1
Hazmat Inciden	1	1	1	1	1	1	1
Extreme Temps	1	1	1	1	1	1	1
Disease impact	1	1	1	1	1	1	1
	NA	1	1	1	1	1	1
	NA	1	1	1	1	1	1

There are seven factors for each hazard: Frequency, Response, Onset, Impact (magnitude), Impact on business, Impact on people, and Impact on Property. Each have four or five level of inputs that the county can enter. For frequency, all hazard scores were derived from inputs of every one of the 57 plans assessed—even if a majority of the plans did not assess or entered a “N/A” input for some hazards. For example, only seven of 57 county plans saw coastal erosion as a hazard, but the “Frequency” scores entered was weighed amongst all 57 plans. This resulted in the hazard scoring lower in frequency on a state-wide assessment even though it may have a high frequency in the counties that did consider it a hazard. For the other six factors, hazards were assessed based on the scores of only the plans that have considered it a hazard. For example, “Invasive Species” was only considered a hazard in 16 of 57 plans but the State-wide “Response” score was obtained by averaging only the 16 scores inputted for that hazard. The goal of this methodology was to assess “Frequency” on a broad state-wide scale while assessing the other six factors solely by the attributes of the hazard.

FREQUENCY

If a hazard/event does not apply it is given a value of NA. If a hazard/event resulted in no local disaster declarations, it scored a one. If the hazard/event resulted in one – two local disaster declarations, it has a Low Probability of occurrence and scored a two. If it resulted in three – five declarations, it has a Medium Probability and numerical score of three. If the hazard/event resulted in six – eight local disaster declarations, it has a High Probability and scored a four. If the hazard/event resulted in nine or more declarations, it should receive an Excessive Probability rating and a score of five. It is important to note that frequency was considered a key factor in determining the hazard profile. To that end, an Adjusted Frequency score was added for this factor and multiplied by 1.5 to weight the score more importantly than other factors.

1	2	3	4	5
None	Low	Medium	High	Excessive

AVERAGE RESPONSE DURATION

Average Response Duration may be defined as "time on the ground" or the time-period of response to a hazard, or event. Transportation accidents may last a few hours whereas a tire fire may last a week or a flood several weeks. Duration, therefore, may not always be indicative of the degree of damage but it remains an important planning factor.

1	2	3	4	5
Less than ½ day	Less than 1 day	Less than 1 week	Less than 1 month	Less than 1 Year

AVERAGE SPEED OF ONSET

Average Speed of Onset may affect all other factors due to lack of warning or time to prepare for impact. The lead-time required protecting lives and property varies greatly with each event. For instance, a winter storm may develop so slowly that there is time to alert crews and emplace plows, but flash floods can occur with no warning.

1	2	3	4
Over 24 hours	12 – 24 hours	6 to 12 hours	Minimal to no warning

AVERAGE MAGNITUDE (IMPACT)

Average Magnitude is the geographic dispersion of the hazard. For instance, how much of your community would be impacted by a flood or hazardous material incident? Similar to the Frequency, this factor is deemed more important and therefore received a weighted value of 1.25 above the raw score. The score is based on the percent of land area impacted by an event.

1	2	3	4
Negligible	Limited	Critical	Catastrophic
(Less than 10)	(10 to 25)	(25 to 50)	(More than 50)

IMPACT ON BUSINESS

The Impact on Business refers to enduring economic impact of the hazard on the community by an event. A score of one compares to a shutdown of critical facilities for less than 24 hours. Two equals a complete shutdown of critical facilities for one week. A score of three means a complete shutdown of critical facilities for at least two weeks. A score of four equals a complete shutdown of critical facilities for 30 days or more.

1	2	3	4

1- (Shutdown of critical facilities for less than 24 hours)
2- (Complete shutdown of critical facilities for one week)
3- (Complete shutdown of critical facilities for at least two weeks)
4- (Complete shutdown of critical facilities for 30 days or more)

IMPACT ON PEOPLE

This factor relates to the number of lives potentially lost to a particular hazard agent. This factor can vary between jurisdictions based on economic, geographic, and demographics of the particular populations. Therefore, some generalization should be inflected on this factor.

1	2	3	4
Minimum	Low	Medium	High
(Minor injuries)	(Some injuries)	(Multiple severe injuries)	(Multiple deaths)

IMPACT ON PROPERTY

This factor relates to the amount of property potentially lost to a particular hazard agent. This factor can vary between jurisdictions based on economics, geographic amount owned, and demographics of the particular populations. Therefore, some generalization need be inflected on this factor.

1 2 3 4

1- (Less than 10% of property severely damaged)
2- (More than 10% of property severely damaged)
3- (More than 25% of property damaged)
4- (More than 50% of property severely damaged)

Results

Frequency		
Hazard	Score	Rank
Flooding:	5.55	1
Severe Summer Storms:	5.26	2
Winter Storms:	5.11	3
Tornado:	3.45	4
Drought:	3.24	5
Earthquake:	2.18	6
Dam/Levee Failure:	1.71	7
Landslide:	1.42	8
Land subsidence:	1.34	9
Wildfire:	0.92	10
Invasive Species:	0.82	11
Coastal Erosion:	0.39	12

Response Time		
Hazard	Score	Rank
Flooding	2.95	1
Tornado	2.53	2
Winter Storms	2.51	3
Severe Summer Storms	2.23	4
Wildfire	2.20	5
Landslide	2.17	6
Drought	2.07	7
Dam/Levee Failure	2.06	8
Earthquake	2.06	9
Land subsidence	1.96	10
Invasive Species	1.38	11
Coastal Erosion	1.29	12

Onset Time		
Hazard	Score	Rank
Invasive Species	3.81	1
Drought	3.79	2
Coastal Erosion	3.43	3
Winter Storms	3.14	4
Land subsidence	2.93	5
Flooding	2.54	6
Dam/Levee Failure	2.38	7
Landslide	2.29	8
Severe Summer Storms	2.15	9
Wildfire	1.60	10
Earthquake	1.49	11
Tornado	1.49	12

Impact (Magnitude)		
Hazard	Score	Rank
Winter Storms	4.63	1
Severe Summer Storms	3.80	2
Flooding	3.78	3
Drought	3.66	4
Tornado	3.60	5
Earthquake	3.45	6
Dam/Levee Failure	2.89	7
Invasive Species	2.64	8
Land subsidence	2.23	9
Landslide	2.21	10
Wildfire	2.19	11
Coastal Erosion	1.56	12

Impact on Business		
Hazard	Score	Rank
Earthquake	2.30	1
Tornado	2.19	2
Flooding	2.11	3
Dam/Levee Failure	1.89	4
Winter Storms	1.68	5
Severe Summer Storms	1.53	6
Wildfire	1.45	7
Drought	1.38	8
Coastal Erosion	1.29	9
Landslide	1.25	10
Land subsidence	1.18	11
Invasive Species	1.00	12

Impact on People		
Hazard	Score	Rank
Tornado	2.57	1
Earthquake	2.19	2
Dam/Levee Failure	2.04	3
Flooding	1.96	4
Severe Summer Storms	1.72	5
Winter Storms	1.70	6
Wildfire	1.40	7
Landslide	1.33	8
Drought	1.23	9
Land subsidence	1.18	10
Invasive Species	1.13	11
Coastal Erosion	1.00	12

Impact on Property		
Hazard	Score	Rank
Tornado	2.23	1
Flooding	2.19	2
Earthquake	2.00	3
Winter Storms	1.77	4
Severe Summer Storms	1.75	5
Dam/Levee Failure	1.72	6
Drought	1.55	7
Wildfire	1.45	8
Coastal Erosion	1.43	9
Landslide	1.29	10
Invasive Species	1.25	11
Land subsidence	1.14	12

Overall Hazard Ranking		
Hazard	Score	Rank
Flooding	21.09	1
Winter Storms	20.54	2
Severe Summer Storms	18.44	3
Tornado	18.04	4
Drought	16.91	5
Earthquake	15.67	6
Dam/Levee Failure	14.71	7
Invasive Species	12.02	8
Landslide	11.97	9
Land subsidence	11.97	10
Wildfire	11.21	11
Coastal Erosion	10.39	12

STATE OF OHIO HAZARD IDENTIFICATION AND RISK ASSESSMENT (HIRA)

Separate from the assessment of local HIRA's above, the 2018 State of Ohio HIRA also provides research and updates on hazards that the state is vulnerable to. While the SHARPP assessments primarily focuses on natural hazards from local hazard mitigation plans, the state HIRA assesses a wider range of hazards that are natural, technological, and human-caused. There are 49 hazards assessed in the State of Ohio HIRA. There are 12 hazards that relate to the 12 hazards assessed in the SOHMP. Because of how certain hazards are categorized, it may be difficult to directly compare the ranking of hazards between the two documents. However, it is worth noting that three of the top four natural hazards in either documents are also the top four of the other.

State of Ohio HIRA	SHARPP Local Hazard Mitigation Plan Assessment
1. Terrorism, Radioactive	1. Flooding
2. Nuclear Accident	2. Winter Storms
3. Terrorism, Chemical	3. Severe Summer Storms
4. Terrorism, Biological	4. Tornado
5. Public Health Emergency	5. Drought
6. Mass Casualty Incident (Medical)	6. Earthquake
7. Tornado	7. Dam/Levee Failure
8. Mass Casualty Incident (Trauma)	8. Invasive Species
9. Accidental Hazmat Release	9. Landslide
10. Blizzard or Ice Storm	10. Land subsidence
11. Flood, Riverine	11. Wildfire
12. Electrical Grid Failure	12. Coastal Erosion
13. Earthquake	
14. Dam Failure	
15. High Winds	
16. Animal/Crop Eco-terrorism	
17. Urban/Flash flood	
18. Urban Fire	
19. Wild Fire	
20. Mass Communications failure	
21. Water Supply Failure	
22. IT System Security Breach	
23. Aircraft Incident	
24. Shortage of Critical Materials	
25. Drought	
26. IT Infrastructure Disruption	
27. Natural Gas Failure	
28. Temperature Extremes	
29. Fuel Shortage	
30. Transportation Failure	
31. Public Event Disturbance	
32. Landslide / Erosion	
33. Hurricane	
34. Sewer Failure	
35. Severe Thunderstorm	
36. Suspicious Powder	
37. Bomb Threat	
38. Emergency Generator Failure	
39. Hostage Situation	
40. Civil Disturbance	
41. Flood, Internal	
42. Space Weather	
43. Abduction	
44. Mail/Package Bomb	
45. Workplace Violence	
46. Labor Action	
47. Stalking	
48. VIP Situation	
49. Space Debris	

BARRIERS TO LOCAL PLANNING AND APPROACHES TO ADDRESS THEM

The majority of local hazard mitigation plan updates in Ohio are done on a countywide, multi-jurisdictional basis. While there are clear benefits in undergoing the planning process and having a federally approved hazard mitigation plan, there are also barriers in the local planning process. This section will attempt to summarize the most common barriers. However, the problems encountered when undergoing planning processes and doing mitigation actions often results from a combination of multiple barriers.

Local Motivation

The underlying reason behind this lack of local motivation may stem from various factors including the perceived return from having a hazard mitigation plan to local officials. This positive return may not outweigh the perceived effort of undergoing a planning process. Hazard mitigation planning can be a time-consuming and expensive process. County emergency management directors are responsible for many roles in emergency management including hazard mitigation and this can lead to having many competing priorities that limit the amount of time that can be reasonability spend on mitigation.

An approach that the Ohio Emergency Management Agency have taken to address this barrier is by embracing a dual approach to grant funding. Counties are encouraged to apply for federal grant programs such as the Pre-disaster Mitigation (PDM) grant, and the Hazard Mitigation Grant Program (HMGP). Counties are highly encouraged to apply along the midway point of 5-year approval period of their current plan. Any county with an expired plan is encouraged to apply for either PDM or HMGP grants whenever an opportunity opens. Obtaining a federal grant often reduces the major financial limitations a county or jurisdiction may face by paying for up to 87.5% of a Hazard Mitigation Plan update. In these grant programs, the county or jurisdiction may meet their match commitment with an in-kind contribution. Having this source of funding allows counties and jurisdictions to pay a contractor to assist them with the update, or to fund the update done in-house.

The second part of this approach is by streamlining the grant application process for counties and jurisdictions. Since the PDM FY-17 grant, the State of Ohio began rolling all local planning applications into a statewide application for each grant opportunity. By doing this, the State assumes the applicant role and the county or jurisdiction become sub-applicants. This saves the local entity the time and effort required to each individually develop their applications and enter them into FEMA eGrants or NEMIS systems. Overall, this approach has allowed local entities to reduce the overall amount of steps and effort in order to obtain funding.

Local Participation

Participation from local jurisdictions is a mandatory requirement for their coverage under a multi-jurisdictional hazard mitigation plan. While most plan updates in the state are countywide planning processes, participation by local jurisdictions greatly vary by the resources available to the jurisdiction. For example, a village with a population of 36 (the lowest amongst all jurisdictions in the 2010 census) will likely have less overall capability in participating and contributing to the planning process than larger communities with greater social, technical, and financial resources.

Factors that make it more convenient for larger jurisdictions with dedicated roles and resources (timing, etc.) makes it easier for these jurisdictions to participate and contribute than smaller communities. In many cases, representatives from these smaller communities work other jobs making it harder to attend daytime countywide meetings. These limitations due resources are not limited to just cities and villages. Counties with more resources may have greater ability in outreach and accommodation.

In addition to the plan update process, the implementation of mitigation actions and objectives are directly limited by the capability of the community. The prioritization of local mitigation actions is largely determined by the capabilities of that jurisdiction. For example, a mitigation action may have more benefit to a jurisdiction but can be ranked lower due that jurisdiction's capabilities- such as their ability to meet the local match of a grant, or to implement that action in general.

While participation is still a mandatory requirement per jurisdiction basis, technologies have allowed for different levels of participation to happen. Where physical presence is not possible, it is encouraged that local jurisdictions participate by various other means that contribute toward a meaningful and collaborative Whole Community Approach. The planning team is always encouraged to pursue the next best option if a jurisdiction is unable to attend a countywide meeting. Such methods include telephone and web conferencing of countywide meetings, bi-lateral communications over email, telephone, survey, and follow-up meetings at different locations. In addition to community representatives, stakeholders such as businesses and institutions are invited. As required by federal regulation, the general public are also invited to participate in the planning process.

Technical Data.

The availability of technical data for local planning may vary from county to county. For example, one of the more common local methods of finding flood-prone properties is by utilizing GIS to intersect local parcel and building footprint layers with FEMA's National Flood Hazard Layer (NFHL). The availability of GIS data can certainly be a limitation depending on what is available in a county. There are currently ten counties out of 88 in Ohio that do not have modernized maps of the NFHL. In addition, there are a handful of counties in the state that do not have local parcel or building footprint data. This lack of local GIS data is a limitation to more hazards than flooding alone. It creates technical barriers in developing modern risk assessments and vulnerability analyses.

There are various approaches taken to address this barrier. The first is by obtaining grant funding to hire a contractor to do the Hazard Mitigation Plan update. Subject-matter experts bring expertise and understanding of the field, as well as tools to make use of the best available data. State and federal agencies are also a great source to obtain data. Grant funding can be used to obtain data that is vital to developing effective risk assessments and vulnerability analyses.

Another way to plan around this limitation is to make the best use of the available data. For example, there are various methods for analyzing risk but two common methods are exposure analyses and historical analyses. Each of these two methods have their strengths and weaknesses, and require a different set of data. While exposure analyses provide a detailed look at risks for site-specific scenarios, they also generally require a great deal of quantitative data and GIS data. Historical analyses, on the other hand, estimate losses based on past events. This is then limited to the availability of documented events and how accurately they were documented. If the data for the ideal analysis method is not available, developers will consider other methods to make the best use of the available data.

Policies and Capabilities in Addressing Repetitive Loss and Severe Repetitive Loss Properties

The State of Ohio strives to promote sustainable communities and development (Goal #2, Objective 4). The ODNR Floodplain Management Program's effort to promote sound floodplain management statewide is one example of the state's commitment. Ohio EMA's promotion of mitigation planning through SHARPP also demonstrates the state's commitment to promoting community sustainability principles. The mitigation priorities identified in the State of Ohio Hazard Mitigation Plan align well with the identified risk in the state. In partnership with the Federal government and local communities, the State of Ohio will continue to develop, implement and administer mitigation grant programs that reduce risk to repetitive loss properties. These mitigation planning and project activities will continue to decrease the burden of repetitively flood damaged structures on the Disaster Relief Fund and the National Flood Insurance Fund.

Recent legislation is focused on reducing the number of repetitive loss structures by offering mitigation options to the owners. FEMA mitigation grant programs have also prioritized the mitigation of repetitive loss structures including: HMGP, FMA, and the PDM-C. The repetitive loss data should be used to identify areas that are repetitively flooded in a community. Given the current prioritization of repetitive loss structures, these structures should be considered when developing mitigation projects that utilize FEMA funding.

As part of the State mitigation strategy, Goal #4 includes the elimination of repetitive loss flood-prone structures. One of the three objectives under this Goal is to prioritize repetitive loss properties for available funds from FEMA mitigation programs. As opportunities for mitigation funding have developed, Ohio has worked with local jurisdictions, counties and FEMA to address repetitive loss and other issues to reduce loss or disaster impact. The table below shows the top 12 counties in the state by the number of mitigated properties funded by FEMA grants.

County	RL/SRL Properties	Flood Mitigation Projects	Mitigation Type				Mitigated Properties	Project Funding Total*
			Acquisition	Elevation	Floodproofing	Relocation		
HANCOCK	266	5	49	-	-	-	49	$ 4,161,905.11
WASHINGTO	202	2	10	-	-	-	10	$ 312,291.00
CUYAHOGA	148	7	7	19	4		30	$ 4,329,054.74
HAMILTON	141	15	232	-	16	-	248	$ 12,517,282.16
OTTAWA	130	3	-	12	-	-	12	$ 702,213.77
ERIE	99	-	-	-	-	-	-	
SUMMIT	89	6	14	-	-	-	14	$ 1,646,427.00
LUCAS	80	3	24	-	-	-	24	$ 745,694.85
LAKE	78	3	79	-	-	-	79	$ 6,372,783.00
FRANKLIN	70	4	28	-	-	-	28	$ 3,802,125.53
BELMONT	61	2	37	-	-	-	37	$ 1,275,083.00
ATHENS	60	5	56	1	4	-	61	$ 3,060,510.01
Grand Total	1,424	55	536	32	24	-	592	$ 38,925,370.17

Assumptions:

- Chart reflects structures that have been mitigated as of April 16, 2019.
- Project Funding Total column for completed projects = Final Project Cost.

Records from closed mitigation projects in Ohio indicate that there have been 1,546 structures mitigated in the state, with a project-funding total of about $99,022,173 and an average of $64,051 invested in mitigation actions per structure. The grant-funded mitigated properties in the top 12 counties with RL/SRL properties account for about 38 percent of the total mitigated properties in the state. This aligns with the state mitigation strategy of prioritizing acquisitions and concentrating efforts on mitigating repetitive loss structures. Ohio's record of successfully mitigating these structures helps the state reach the goal of minimizing societal disruption and damage to property from hazard events (Goal 2, Objective 3).

Ohio continues to be very active in accomplishing the objectives set forth in the mitigation strategy regarding repetitive loss structures. Still, there are counties where there have been few or no mitigated repetitive loss structures. Ultimately, mitigation occurs at the local level. There are many valid reasons why a particular community has not yet addressed identified repetitive loss structures including: lack of property owner interest, the targeted structure cannot meet benefit-cost analysis requirements, lack of grant match dollars, etc. As demonstrated by the number of successful mitigation projects, the Ohio EMA Mitigation Branch is committed to working with Ohio communities to overcome these obstacles and support local mitigation efforts.

4.4 PRIORITIZING LOCAL MITIGATION FUNDING ASSISTANCE

44 CFR 201.4 (c) (4) (iii) requires states to include criteria in their mitigation plans for prioritizing communities and local jurisdictions that would receive planning and project grants under available funding programs. The criteria should include consideration for communities with the highest risks, repetitive loss properties, and most intense development pressures. The plan also needs to include a principal criterion for non-planning grants based on the extent to which benefits are maximized according to a benefit-cost review.

Demand for hazard mitigation funds usually exceeds fund availability. In the last four flood-related Presidential Declarations, available Federal mitigation funds have only met 20% of the demand on average. (DR-1805 was not listed due to the hazard was a windstorm event and also, pre-applications were not required.)

Table 4.4.a

EVENT	HMGP FUNDS REQUESTED	HMGP FUNDS AVAILABLE (FED)	DIFFERENCE	
DR-1651	$15,191,356	$1,798,019	($13,393,337)	(-88%)
DR-1656	$18,166,108	$3,411,736	($14,754,372)	(-81%)
DR-1720	$44,888,432	$6,630,799	($38,251,633)	(-85%)
DR-4002	$15,287,118	$5,046,137	($10,240,981)	(-67%)
DR-4077	$16,723,428	$3,353,199	($13,370,229)	(-79%)
DR-4098	$14,077,947	$3,704,581	($10,373,366)	(-73%)
DR-4360	$48,072,625	$6,939,178 (30-day estimate)	($41,133,447)	(-85%)

Therefore, it is important that the State of Ohio prioritize local mitigation funding assistance. Section 3.4 explains how Ohio has established both eligibility and prioritization criteria. Appendix G includes the worksheets the SHMT uses to rank project applications for funding. The final project ranking by the SHMT is also the prioritization of eligible projects for funding. The exceptions to this are under HMGP where 5% and 7% projects are funded outside of the SHMT ranking process. Projects submitted under these categories are funded in accordance with the specific priority outlined in the Administrative Plan and Mitigation Strategy for that particular event.

In the event that there is not enough funding for an eligible, high-ranking mitigation project, Mitigation Branch staff will work with the sub-applicant to refine and submit the project for consideration under another grant funding cycle or program. The Ohio EMA Mitigation Branch website contains a list of potential funding sources for hazard mitigation projects.

Although Federal planning guidance indicates criteria for local mitigation funding assistance should include consideration for communities with the highest risks, repetitive loss properties, communities with the most intense development pressures, and maximizing benefits based on a benefit-cost analysis; Ohio only considers repetitive loss and benefit-cost. For the nationally competitive grant programs, state criteria match the national ranking and evaluation criteria exactly. Doing otherwise would put Ohio projects at a competitive disadvantage as compared to other projects that used the national criteria. For HMGP and FMA, repetitive loss is considered as is benefit-cost; however, communities with the highest risks and high development pressures are not. The reason for this is that it is assumed that almost all Ohio communities have high risk from the most serious hazards and mitigation projects are used to remedy the "already built" environment, not the developing environment, which is much better handled through appropriate codes and land use measures.

Grant applications to update LHMPs are evaluated based on the local plan expiration date and the amount of funding available. Counties with expired or soon to expire plans are prioritized higher. Ohio has always set aside up 7% of available HMGP funds to offset the cost to develop/update local mitigation plans. For the PDM program, Ohio has always provided technical assistance to local officials developing planning grant applications and submitted all eligible and complete applications for funding. Recently, due to FEMA caps on the number of PDM applications that can be submitted, Ohio compiled all of the planning grant applications into a single state application to submit to FEMA for funding.

4.5 ASSESSMENT OF MITIGATION ACTIONS

Mitigation actions identified in both the SHMP and LHMPs are tracked and assessed. For the state plan, tracking and assessment of state goals, objectives, and actions will be done in accordance with the Section 1.4 after each Federal disaster declaration, on an annual basis, and at the next five-year update point.

For mitigation actions in LHMPs, tracking and assessment is done in SHARPP. Local officials enter information into SHARPP that summarizes the local mitigation action items identified in their jurisdictions mitigation plan. SHARPP captures basic information about the proposed mitigation action including: project lead, cost, potential funding sources, estimated start and end dates. SHARPP can generate a report that summarizes the locally proposed mitigation action items in each community. Local officials can update the status of these action items as they are implemented to help track progress. The status of mitigation action items are recorded in SHARPP as: new, unchanged, deferred, deleted, or completed. These data are analyzed to help establish trends, identify needs, and develop success stories.

SHARPP helps the state demonstrate that mitigation projects are investments that improve community sustainability. The SHARPP home page displays the aggregate losses avoided (benefits) by implementing flood mitigation projects in the state since 2004. SHARPP automatically calculates this figure based on the expected annual benefits (i.e. losses avoided) for each mitigated structure as computed by FEMA benefit-cost analysis software at the time of project application. The expected annual benefits are multiplied by the number of years that the project has been closed (up to the “useful life” of the project) and then totaled for all structures to produce a dollar estimate of the losses avoided to date.

SHARPP also helps quantify the “actual” costs avoided by implementing flood mitigation projects in the state. In order to calculate the actual costs avoided, a flood must occur in an area where a mitigation project has been implemented. One methodology for quantifying the actual costs avoided is outlined in the FEMA December 2009 publication titled, Loss Avoidance Study, Riverine Methodology Report. Using this methodology, actual losses avoided are estimated by comparing damage that would likely have been caused by the same flood events without the mitigation project, with damage that actually occurred with the project completed. In order to estimate the actual losses avoided as the result of implementing a particular mitigation project, data are needed on the pre- and post-conditions of the subject property, in addition to other data collected throughout the project. All of the project-specific data required as input for a loss avoidance study are collected through SHARPP.

Loss avoidance studies will be conducted for past mitigation project implemented in Ohio dependent on:

- A large event occurring in a past mitigation project area that justifies the resources required to conduct a loss avoidance study,
- The availability of the data required to conduct a loss avoidance study in the project area, and
- The availability of 5% HMGP funds, HMA State Management Cost funds, or another funding source to pay for the study.

The Ohio EMA Mitigation Branch website contains a page that highlights success stories and best practices. This webpage highlights successful mitigation projects in many different communities around the state. The success stories cover a range of mitigation project types that have been implemented across the state to reduce hazard risk. In 2018, Ohio EMA created five new success stories using interactive story map software. The success stories created in this format help capture the reader's attention by supplementing text with maps, photos and data graphics.

Mitigation Branch staff document losses avoided as the result of previous mitigation measures by implementing the following process:

- Utilize information in SHARPP to determine if a mitigation project has occurred in an area impacted by a hazard event.
- If yes, contact local officials to request information on the effectiveness of the mitigation project and the impact of the event in the project area.
- Meet with local officials to conduct an interview and gather information (photos, high water marks, and historic damage data).
- Develop and publish a success story based on the information collected. Promote the success story statewide to encourage mitigation measures that will reduce future disaster losses.

STATE OF OHIO DISASTER HISTORY (1964 - 2018) (Presidential and Emergency Disaster Declarations)
(Updated as of 06/03/19)

DISASTER DECLARATION NUMBER	DATE DECLARED	FEDERAL DISASTER PROGRAMS	INCIDENT TYPE	COUNTIES DECLARED	FUNDS PROVIDED
DR- 167	March 24, 1964	PA	Heavy rains and flooding	Adams, Athens, Auglaize Belmont, Brown, Butler, Carroll, Clermont, Clinton, Columbiana, Coshocton, Cuyahoga, Delaware, Fairfield, Franklin, Gallia, Geauga, Guernsey, Greene, Hamilton, Harrison, Hocking, Jackson, Jefferson, Lake, Lawrence, Licking, Medina, Meigs, Miami, Monroe, Morgan, Muskingum, Noble, Perry , Pickaway, Pike, Preble, Richland, Ross, Scioto, Summit, Trumbull, Tuscarawas, Vinton, Warren, Washington,	$571,482 (P)
DR- 191	April 14, 1965	PA	Tornadoes and high winds	Allen, Cuyahoga, Delaware, Hancock, Harrison, Highland, Lorain, Lucas, Medina, Mercer, Morrow, Pickaway, Seneca, Shelby, Van Wert	$275,248 (P)
DR- 238	May 4, 1968	PA	Tornadoes	Brown, Clermont, Gallia, Licking, Scioto	$270,000 (P)
DR- 243	June 5, 1968	PA	Heavy rains and flooding	Adams, Athens, Brown, Butler, Clermont, Clinton, Fairfield, Franklin, Fayette, Gallia, Greene, Guernsey, Hamilton, Hocking, Jackson, Lawrence, Licking, Meigs, Monroe, Montgomery, Morgan, Noble, Perry, Pickaway, Pike, Ross, Scioto, Vinton, Warren, Washington	$600,000 (P)
DR- 266	July 15, 1969	PA	Heavy storms and floods	Ashland, Ashtabula, Coshocton, Cuyahoga, Erie, Harrison, Holmes, Huron, Lake, Lorain, Lucas, Medina, Morgan, Muskingum, Ottawa, Richland, Sandusky, Seneca, Stark, Trumbull, Tuscarawas, Wayne, Wood	$1,000,000 (P)
DR- 345	July 19, 1972	PA	Storms and flooding	Ashtabula, Belmont, Cuyahoga, Jefferson, Lake, Lorain, Monroe	$1,328,098 (P)
DR- 362	November 24, 1972	PA	Storms and flooding	Erie, Lake, Lorain, Lucas, Ottawa	$615,863 (P)
DR- 377	April 27, 1973	PA	Storms and flooding	Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky	$1,417,975 (P)
DR- 390	June 4, 1973	PA	Mudslides	Hamilton, Washington	$1,434,684 (P)

STATE OF OHIO DISASTER HISTORY (1964 - 2018) (Presidential and Emergency Disaster Declarations)
(Updated as of 06/03/19)

DISASTER DECLARATION NUMBER	DATE DECLARED	FEDERAL DISASTER PROGRAMS	INCIDENT TYPE	COUNTIES DECLARED	FUNDS PROVIDED
DR- 421	April 4, 1974	PA/IFG	Tornadoes and high winds	Adams, Butler, Clark, Delaware, Fayette, Franklin, Greene, Hamilton, Madison, Paulding, Pickaway, Putnam, Summit, Warren,	$10,250,454 (P) $1,945,833 (I)
DR- 436	May 31, 1974	PA	Heavy rains and flooding	Lucas, Ottawa, Sandusky	$858,824 (P)
DR- 445	July 11, 1974	PA	Heavy rains and flooding	Warren	$507,364 (P)
DR- 480	September 11, 1975	PA	Floods	Belmont, Cuyahoga, Jefferson, Lake,	$3,320,493 (P)
DR- 3055-EM	January 26, 1978	PA	Severe blizzard conditions	All 88 counties	$3,546,669 (P)
DR- 630	August 23, 1980	PA/IFG	Heavy rains and flooding	Belmont, Columbiana, Guernsey, Jefferson, Monroe, Muskingum, Noble	$1,653,327 (P) $669,820 (I)
DR- 642	June 16, 1981	PA/IFG	Tornado, high winds and flooding	Hancock, Morrow, Putnam, Wyandot (IA) Morrow (PA)	$346,950 (P) $47,382 (SCB)** $515,593 (I)
DR- 653	March 26, 1982	PA/IFG	Flood	Defiance, Fulton, Henry, City of Toledo (Lucas), Paulding, Wood County (IA) Defiance, Paulding, Village of Grand Rapids (Wood only) (PA)	$157,390 (P) $268,187 (I)
DR- 738	June 3, 1985	PA/IFG	Tornadoes	Ashtabula, Columbiana, Coshocton, Licking, Portage, Trumbull (IA) Trumbull (PA)	$1,556,950 (P) $419,751 (SCB)** $424,893 (I)
DR-796	1987	IFG	Floods	Crawford, Marion, Morrow, Richland	$1,066,258 (I) $266,564 (SCB)**
DR- 831	June 10, 1989	IFG	Severe storms and flooding	Butler, Coshocton, Cuyahoga, Franklin, Geauga, Greene, Lake, Licking, Lorain, Mercer, Montgomery, Preble, Warren	$2,363,868 (I) $590,967 (SCB)**

STATE OF OHIO DISASTER HISTORY (1964 - 2018) (Presidential and Emergency Disaster Declarations)
(Updated as of 06/03/19)

DISASTER DECLARATION NUMBER	DATE DECLARED	FEDERAL DISASTER PROGRAMS	INCIDENT TYPE	COUNTIES DECLARED	FUNDS PROVIDED
DR- 870	June 6, 1990	PA/IFG/HMGP *	Severe storm, tornadoes, and flooding	Athens, Belmont, Butler, Columbiana, Fairfield, Hamilton, Harrison, Hocking, Jackson, Jefferson, Lawrence, Licking, Monroe, Muskingum, Perry, Pike, Richland, Vinton (PA/IA) Clermont, Franklin, Mahoning, Morrow, Madison, Ross, Trumbull (IA only)	$10,847,075 (P) $4,331,497 (I) $3,849,783 (SCB)** $630,000 (M) $630,000 (S)
DR- 951	August 4, 1992 (IA) August 14, 1992 (PA/HMGP)	PA/IFG/HMGP *	Severe storms, tornadoes, flooding	Cuyahoga, Franklin, Logan, Mahoning, Medina, Mercer, Ross, Shelby, Summit, Trumbull, Van Wert (PA/IA) Auglaize, Belmont, Columbiana, Erie, Fairfield, Fulton, Geauga, Jefferson, Lorain, Lucas, Ottawa, Portage, Wood (PA only)	$8,308,334 (P) $2,081,117 (I) $2,474,083 (SCB)** $250,000 (M) $350,000 (CDBG)+
DR-1065	August 25, 1995	IFG/HMGP	Severe storms and flooding	Champaign, Erie, Logan, Lorain, Licking, Marion, Mercer, Miami, Scioto, Shelby, Washington	$3,493,319 (I) $81,731 (SCB)** $721,500 (M)
DR-1097	January 27, 1996	PA/IFG/ HMGP	Ohio River flooding	Adams, Belmont, Columbiana, Gallia, Jefferson, Lawrence, Meigs, Monroe, Scioto, Washington (PA/IA) Brown, Clermont, Hamilton (IA)	$4,335,000 (P) $1,822,056 (I) $1,617,991 (SCB)** $1,721,655 (M)
DR-1122	June 24, 1996	PA/HMGP	Severe storms and flooding	Adams, Belmont, Brown, Butler, Clermont, Gallia, Hamilton, Hocking, Jefferson, Lawrence, Meigs, Monroe, Paulding, Scioto, Vinton, Williams	$10,811,838 (P) $2,702,960 (S) $1,137,951 (M)
DR-1164	March 4, 1997	IA/PA/HMGP	Flash flooding on inland rivers/streams and Ohio River flooding	Adams, Athens, Brown, Clermont, Gallia, Hamilton, Highland, Hocking, Jackson, Lawrence, Meigs, Monroe, Pike, Ross, Scioto, Vinton, Washington (IA/PA/HMGP) and Morgan (PA/HMGP)	$29,666,825 (P) $22,196,350 (I) $9,821,524 (M) $9,821,524 (S) $9,740,294 (NRCS)*+
DR-1227	June 30, 1998	IA/PA/MIT	Flash flooding, flooding, high winds and tornadoes.	Athens, Belmont, Coshocton, Guernsey, Harrison, Jackson, Jefferson, Knox, Meigs, Monroe, Morgan, Morrow, Muskingum, Noble, Ottawa, Perry, Pickaway, Richland, Tuscarawas, Washington; (IA only) Franklin, Sandusky (PA only) Holmes	$21,803,771 (P) $14,312,348 (I) $9,000,000 (M) $9,000,000 (S) $10,410,817 (NRCS)*+

DR-1321	March 7, 2000	IA/MIT	Flash flooding, flooding	Adams, Gallia, Jackson, Lawrence, Meigs, Pike and Scioto	$1,914,189 (I) $297,310 (M) $297,310 (S)
DR-1339	August 25, 2000	IA/MIT	Flooding	Lucas	$7,898,840 (I) $1,132,279 (M) $1,132,279 (S)
DR-1343	September 26, 2000	IA/PA/MIT	High winds and tornadoes	Greene	$189,051 (I) $3,430,810 (P) $558,025 (M) $558,025 (S)
DR-1390	August 8, 2001	PA/MIT	Flooding	Brown, Butler, Clermont and Hamilton	$ 7,712,456 (P) $ 876,439 (M) $ 876,439 (S)
DR-1444	November 18, 2002	IA/MIT	Tornados, Severe Storms	Ashland, Auglaize, Coshocton, Cuyahoga, Franklin, Hancock, Henry, Huron, Lorain, Medina, Ottawa, Paulding, Putnam, Sandusky, Seneca, Summit, Union, Van Wert, Wayne and Wood	$ 11,668,849 (I) $ 139,068 (M) – $ 48,409 (S) $ 2,297,222 (SDRP)
DR-1453*	March 24, 2003	IA/PA/MIT	Ice/Snow Storm	Adams, Gallia, Jackson, Lawrence, Meigs, Pike and Scioto (IA/PA); Athens, Belmont, Darke, Delaware, Fayette, Franklin, Greene, Guernsey, Harrison, Hocking, Licking, Madison, Miami, Monroe, Morgan, Montgomery, Muskingum, Noble, Perry, Preble, Ross , Union, Vinton and Washington (PA)	$ 16,689,841 (I) $ 39,621,605 (P) * $ 2,415,899 (M) $ 2,415,899 (S) -
DR-1478*	July 15, 2003	IA/MIT	Severe Storms, flooding	Auglaize, Columbiana, Crawford, Darke, Logan, Mahoning, Mercer, Pike, Shelby and Van Wert (IA/MIT); Adams, Auglaize, Darke, Logan, Mercer, Pike, Shelby and Van Wert (SDRP)	$ 6,451,793 (I) $ 145,762 (M)* $ 13,721 (S) $ 2,976,949 (SDRP)
DR-1484*	August 1, 2003	IA/PA/MIT	Severe storms, tornadoes and flooding	Carroll, Columbiana, Cuyahoga, Franklin, Jefferson, Mahoning, Medina, Portage, Richland, Stark, Summit and Trumbull (IA/MIT); Adams, Columbiana, Carroll, Jefferson, Mahoning, Medina, Monroe, Portage, Stark, Summit, Trumbull and Vinton (PA)	$ 135,723,395 (I) $ 13,160,834 (P)* $ 6,016,488 (M) $ 162,790 (S) -
EM-3187*	August 23, 2003	PA Only	Power Outage	Ashland, Ashtabula, Cuyahoga, Erie, Geauga, Huron, Knox, Lake, Lorain, Lucas, Portage, Summit and Trumbull	$ 2,067,222 (P)*

DR-1507*	January 26, 2004	IA/PA/MIT	Landslide, severe storms and landslides	Belmont, Jefferson, Morgan, Ross, Tuscarawas and Washington (IA/PA/MIT); Franklin, Licking (IA/MIT); Athens, Guernsey, Harrison, Monroe, Noble and Perry (PA/MIT)	$ 3,408,934 (I) $ 14,811,923(P*) $ 875,265 (M)* $ 164,804 (S) -
DR-1519*	June 3, 2004	IA/PA/MIT	Severe storms and flooding	Athens, Carroll, Columbiana, Cuyahoga, Delaware, Guernsey, Harrison, Hocking, Holmes, Medina, Noble, Perry, Portage, Summit and Tuscarawas (IA/PA/MIT); Crawford, Geauga, Licking, Logan, Lorain, Mahoning, Richland and Stark (IA/MIT) and Knox and Jefferson (PA/MIT)	$ 30,238,921 (I)* $ 14,060,750 (P) * $ 2,305,560 (M) $ 748,426 (S) -
DR-1556*	September 19, 2004	IA/PA/Mit	Severe storms and flooding	Athens, Belmont, Carroll, Columbiana, Gallia, Guernsey, Harrison, Jefferson, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Tuscarawas, Vinton and Washington (IA/PA/MIT); Lawrence, Mahoning, Stark and Trumbull (IA/MIT)	$ 47,455,690 (I) $ 35,597,480 (P)* $ 3,948,349 (M)* $ 2,300,000 (S)
EM-3198*	January 11, 2005	PA Only	Snow Removal and Response	Butler, Champaign, Clark, Crawford, Darke, Delaware, Erie, Franklin, Greene, Hamilton, Hardin, Huron, Logan, Madison, Marion, Miami, Montgomery, Morrow, Preble, Richland, Sandusky, Seneca, Shelby, Union, Warren and Wyandot	$ 11,116,398 (P)*
DR-1580*	February 15, 2005	IA/PA/MIT	Severe winter storms, ice and mudslides	Clark, Sandusky, Warren and Miami (IA/MIT); Ashland, Auglaize, Athens, Belmont, Coshocton, Crawford, Delaware, Fairfield, Franklin, Guernsey, Henry, Hocking, Holmes, Huron, Jefferson, Licking, Logan, Morgan, Muskingum, Pickaway, Pike, Richland, Ross, Scioto, Stark, Tuscarawas, Washington and Wyandot (IA/PA/MIT); Adams, Allen, Brown, Carroll, Champaign, Clermont, Columbiana, Darke, Fayette, Hancock, Hardin, Harrison, Highland, Knox, Lorain, Marion, Medina, Meigs, Mercer, Monroe, Montgomery, Morrow, Noble, Paulding, Perry, Putnam, Seneca, Shelby, Union, Van Wert and Wayne (PA/MIT)	$ 13,823,757 (I)* $123,935,836 (P)* $7,534,746 (M)* $1,500,000 (S) -
EM-3250	September 13, 2005	PA	Hurricane Katrina Emergency Shelter Operations	All 88 Counties were included in the federal declaration	$2,499,103 (P)*

DR-1651*	July 2, 2006	IA/MIT	Severe storms and flooding	Cuyahoga, Erie, Huron, Lucas, Sandusky and Stark	$25,001,761 (I)* $1,798,019 (M) $593,090 (S)
DR-1656*	August 1, 2006	IA/PA/MIT	Severe storms and flooding	Ashtabula, Geauga and Lake	$25,895,531 (I)* $9,282,843 (P)* $3,411,736 (M) $1,137,245 (S)
DR-1720	August 28, 2007	IA/PA/MIT	Severe storms and flooding	Allen, Crawford, Hancock, Hardin, Putnam, Richland, Wyandot (IA/PA/MIT); Seneca (IA/MIT)	$45,452,363 (I) $12,688,139 (P) $6,630,799 (M) $1,984,493 (S)
EM-3286	April 24, 2008	PA	Snow	Ashtabula, Brown, Clermont, Clinton, Crawford, Delaware, Fairfield, Franklin, Geauga, Greene, Hardin, Huron, Lake, Morrow, Richland, Union and Wyandot	$9,481,809 (P) est.
DR-1805	October 24, 2008	PA/MIT	Wind Event	Ashland, Brown, Butler, Carroll, Champaign, Clark, Clermont, Clinton, Coshocton, Delaware, Fairfield, Franklin, Greene, Guernsey, Hamilton, Harrison, Highland, Hocking, Holmes, Knox, Licking, Madison, Miami, Montgomery, Morrow, Perry, Pickaway, Preble, Shelby, Summit, Tuscarawas, Union, and Warren	$47,968,724 (P) $6,507,249 (M)
DR-4002	July 13, 2011	PA/MIT	Severe storms, landslides	Adams, Athens, Belmont, Brown, Clermont, Gallia, Guernsey, Hamilton, Hocking, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Noble, Pike, Ross, Scioto, Vinton, Washington	$45.8 Million (PA) $5,046,137 (M)
EM-3346	June 30, 2012	PA (for Direct Assistance only)	Severe storms, straight-line winds (derecho)	All 88 counties	PA was for Direct Assistance only, no financial assistance
DR-4077	August 20, 2012	PA/MIT		Adams, Allen, Athens, Auglaize, Belmont, Champaign, Clark, Coshocton, Fairfield, Franklin, Gallia, Guernsey, Hancock, Hardin, Harrison, Highland, Hocking, Jackson, Knox, Lawrence, Licking, Logan, Meigs, Miami, Monroe, Morgan, Morrow, Muskingum, Noble, Paulding, Perry, Pickaway, Pike, Putnam, Shelby, Van Wert, Vinton, Washington, Wyandot	Initial Estimates of: $22.0 Million (PA) est. $3.4 Million (M) est.

DR-4098	January 3, 2013	PA/MIT	Severe storms, flooding	Ashtabula, Cuyahoga	Initial Estimates of: $17.8 Million (PA) est. $2.7 Million (M) est.
DR-4360	April 17, 2018	PA/MIT	Severe storms, flooding, landslides	Adams, Athens, Belmont, Brown, Columbiana, Coshocton, Gallia, Hamilton, Harrison, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Pike, Scioto, Vinton, Washington	Initial Estimates of: $65 Million (PA) est. $9.75 Million (M) est.

- HMGP first available with disaster declared after 1987.
- (P) – Public Assistance (S) – State Match to Federal Hazard Mitigation funds (M) – Hazard Mitigation Grant
- (SCB)** - State Controlling Board funds; (SDRP)**State Disaster Relief Program
- (CDBG)+ - Community Development Block Grant funds provided by the OH Department of Development
- (I) Individual Assistance includes FEMA Disaster Housing, SBA loans for homes, personal property and businesses and FEMA/State Other Needs Assistance grants for families and individuals
- (NRCS)*+ - Natural Resources Conservation Service
- EM 3187 is an Emergency Declaration for Public Assistance
- * Indicates the disaster is not officially closed.

Appendix B

Federal Emergency Management Agency
National Flood Insurance Program
Repetitive Loss Summary
For the State of Ohio

Revised December 2018

County Name	Community Name	Community Number	Total Losses	Total Building Payment	Total Contents Payment	Total Payment	Total RL/SRL Structures	Total RL Structures	Total SRL Structures
Region 1									
ALLEN COUNTY	ALLEN COUNTY (Unincorp.)	390758	25	$368,439.21	$499,881.50	$868,320.71	9	9	0
	BLUFFTON, VILLAGE OF	390004	24	$343,807.30	$50,504.18	$394,311.48	7	6	1
	DELPHOS, CITY OF	390005	6	$32,531.68	$0.00	$32,531.68	3	3	0
	ELIDA, VILLAGE OF	390656	4	$70,673.47	$24,731.26	$108,346.24	2	2	0
AUGLAIZE COUNTY	AUGLAIZE COUNTY (Unincorp.)	390761	2	$48,087.22	$692.64	$48,779.86	1	1	0
	ST. MARYS, CITY OF	390022	2	$16,043.21	$0.00	$16,043.21	1	1	0
	WAPAKONETA, CITY OF	390023	14	$211,210.93	$8,893.34	$220,104.27	4	3	1
CHAMPAIGN COUNTY	URBANA, CITY OF	390060	3	$56,204.61	$0.00	$56,204.61	1	1	0
CLARK COUNTY	CLARK COUNTY (Unincorp.)	390732	20	$353,974.56	$31,354.47	$385,329.03	7	7	0
	NEW CARLISLE, CITY OF	390062	2	$3,473.58	$471.56	$3,945.14	1	1	0
	SPRINGFIELD, CITY OF	390063	8	$28,773.15	$5,529.62	$34,302.77	3	3	0
CRAWFORD COUNTY	CRAWFORD COUNTY (Unincorp.)	390811	4	$126,568.47	$40,110.17	$166,678.64	2	2	0
	BUCYRUS, CITY OF	390090	20	$360,146.42	$22,058.67	$382,205.09	7	7	0
	CRESTLINE, VILLAGE OF	390091	5	$96,173.41	$5,433.55	$101,606.96	2	2	0
	GALION, CITY OF	390092	20	$388,708.38	$78,290.06	$466,998.44	7	6	1
DARKE COUNTY	DARKE COUNTY (Unicorp.)	390137	2	$12,193.65	$0.00	$12,193.65	1	1	0
	GREENVILLE, CITY OF	390139	5	$47,754.42	$16,285.76	$64,040.18	1	0	1
DEFIANCE COUNTY	DEFIANCE COUNTY (Unicorp.)	390143	2	$3,656.73	$0.00	$3,656.73	1	1	0
	DEFIANCE, CITY OF	390144	139	$1,359,911.50	$428,636.20	$1,788,547.70	41	34	7
ERIE COUNTY	BELLEVUE, CITY OF	390487	9	$253,297.87	$4,426.19	$257,724.06	4	4	0
	ERIE COUNTY (Unincorp.)	390153	61	$584,917.15	$128,739.45	$713,656.60	24	22	2
	HURON, CITY OF	390154	48	$432,864.16	$98,793.31	$531,657.47	12	9	3
	SANDUSKY, CITY OF	390156	68	$312,076.06	$86,531.08	$398,607.14	25	24	1
	VERMILION, CITY OF	395374	145	$1,178,536.15	$453,163.90	$1,631,700.05	34	25	9
FULTON COUNTY	FULTON COUNTY (Unincorp.)	390182	3	$15,878.25	$8,520.10	$24,398.35	1	1	0
HANCOCK COUNTY	FINDLAY, CITY OF	390244	801	$17,581,469.00	$1,735,775.17	$19,317,244.17	253	210	43
	HANCOCK COUNTY (Unincorp.)	390767	34	$415,520.26	$53,785.59	$469,305.85	13	11	2
HARDIN COUNTY	KENTON, CITY OF	390253	4	$133,974.27	$2,000.00	$135,974.27	2	1	1
HENRY COUNTY	HENRY COUNTY (Unincorp.)	390776	62	$513,413.69	$128,811.88	$642,225.57	18	15	3
	HOLGATE, VILLAGE OF	390265	16	$207,317.44	$42,329.62	$249,647.06	5	5	0
	LIBERTY CENTER, VILLAGE OF	390619	4	$19,462.46	$17,148.84	$36,611.30	1	1	0
	NAPOLEON, CITY OF	390266	13	$54,197.46	$29,921.84	$84,119.30	5	5	0
HURON COUNTY	MONROEVILLE, VILLAGE OF	390283	2	$8,255.38	$0.00	$8,255.38	1	1	0
	NORWALK, CITY OF	390286	15	$312,194.07	$32,238.58	$344,432.65	6	6	0
LOGAN COUNTY	BELLEFONTAINE, CITY OF	390340	2	$6,998.71	$0.00	$6,998.71	1	1	0
	LAKEVIEW, VILLAGE OF	390341	15	$173,233.10	$6,901.29	$186,804.83	6	5	1
	LOGAN COUNTY (Unincorp.)	390772	5	$71,668.03	$16,192.01	$87,860.04	2	2	0
	RUSSELLS POINT, VILLAGE OF	390342	15	$217,989.12	$9,572.79	$227,561.91	4	3	1

LUCAS COUNTY	LUCAS COUNTY (Unincorp.)	390359	33	$468,594.05	$12,720.44	$481,314.49	13	12	1
	MAUMEE, CITY OF	390360	2	$7,669.86	$6,659.34	$14,329.20	1	1	0
	OREGON, CITY OF	390361	26	$284,959.79	$22,752.94	$307,712.73	10	10	0
	TOLEDO, CITY OF	395373	151	$1,624,142.17	$191,083.70	$1,815,225.87	52	46	6
	WATERVILLE, VILLAGE OF	390637	15	$100,350.04	$34,449.89	$134,799.93	4	3	1
MADISON COUNTY	LONDON,CITY OF	390366	2	$10,109.21	$5,554.64	$15,663.85	1	1	0
MARION COUNTY	GREEN CAMP, VILLAGE OF	390374	8	$63,025.32	$1,904.54	$64,929.86	3	2	1
	LA RUE, VILLAGE OF	390375	20	$1,700,167.33	$42,834.85	$1,743,002.18	20	20	0
	MARION COUNTY (Unincorp.)	390774	22	$377,822.19	$43,037.42	$420,859.61	10	9	1
	PROSPECT, VILLAGE OF	390377	14	$90,453.53	$50.00	$90,503.53	4	4	0
MERCER COUNTY	FORT RECOVERY, VILLAGE OF	390395	18	$182,731.07	$65,042.75	$247,773.82	9	9	0
	MERCER COUNTY (Unincorp.)	390392	24	$259,129.93	$26,082.28	$285,212.21	8	8	0
MIAMI COUNTY	MIAMI COUNTY (Unincorp.)	390398	26	$566,807.60	$80,495.58	$647,303.18	11	10	1
	TROY, CITY OF	390402	9	$150,426.64	$25,500.05	$175,926.69	4	4	0
OTTAWA COUNTY	OAK HARBOR, VILLAGE OF	390433	14	$75,367.45	$9,446.92	$84,814.37	4	4	0
	OTTAWA COUNTY (Unincorp.)	390432	329	$2,344,341.72	$602,695.22	$2,947,036.94	116	113	3
	PORT CLINTON, CITY OF	390434	32	$186,225.44	$73,441.74	$259,667.18	10	8	2
PAULDING COUNTY	PAULDING COUNTY (Unincorp.)	390777	9	$126,636.82	$21,759.28	$148,396.10	4	4	0
	PAULDING, VILLAGE OF	390438	2	$28,694.27	$0.00	$28,694.27	1	1	0
PREBLE COUNTY	PREBLE COUNTY (Unincorp.)	390460	2	$35,934.92	$0.00	$35,934.92	1	1	0
PUTNAM COUNTY	OTTAWA, VILLAGE OF	390472	141	$2,579,378.08	$309,064.11	$2,888,442.19	41	33	8
	PUTNAM COUNTY (Unincorp.)	390465	8	$80,017.67	$2,722.32	$82,739.99	3	3	0
SANDUSKY COUNTY	CLYDE, CITY OF	390489	3	$8,605.00	$0.00	$8,605.00	1	1	0
	FREMONT, CITY OF	390490	3	$7,096.07	$3,424.53	$10,520.60	1	1	0
	SANDUSKY COUNTY (Unincorp.)	390486	24	$192,050.43	$32,248.51	$224,298.94	10	10	0
	WOODVILLE, VILLAGE OF	390495	15	$81,527.59	$2,073.00	$83,600.59	3	2	1
SENECA COUNTY	SENECA COUNTY (Unincorp.)	390779	15	$156,939.62	$9,731.96	$166,671.58	6	5	1
	TIFFIN, CITY OF	390502	22	$761,319.46	$51,240.98	$812,560.44	9	9	0
SHELBY COUNTY	SHELBY COUNTY (Unincorp.)	390503	15	$79,049.99	$1,923.37	$80,973.36	6	6	0
	SIDNEY, CITY OF	390507	7	$17,088.45	$0.00	$17,088.45	3	3	0
UNION COUNTY	MARYSVILLE, CITY OF	390548	6	$11,773.95	$7,827.62	$19,601.57	1	1	0
	RICHWOOD, VILLAGE OF	390549	5	$8,228.11	$13,993.95	$22,222.06	1	1	0
	UNION COUNTY (Unincorp.)	390808	6	$65,842.84	$0.00	$65,842.84	3	3	0
VAN WERT COUNTY	VAN WERT, CITY OF	390552	2	$2,764.50	$106.54	$2,871.04	1	1	0
WILLIAMS COUNTY	BRYAN, CITY OF	390580	4	$266,459.83	$311,196.71	$577,656.54	2	2	0
	WILLIAMS COUNTY (Unincorp.)	390785	3	$29,099.19	$0.00	$29,099.19	1	1	0
WOOD COUNTY	BOWLING GREEN, CITY OF	390583	2	$12,599.00	$5,626.51	$18,225.51	1	1	0
	GRAND RAPIDS, VILLAGE OF	390585	21	$239,676.05	$37,727.60	$277,403.65	9	9	0
	MILLBURY, VILLAGE OF	390586	2	$13,369.47	$3,904.17	$17,273.64	1	1	0
	PEMBERVILLE, VILLAGE OF	390624	17	$201,075.61	$56,892.50	$257,968.11	7	6	1
	WOOD COUNTY (Unincorp.)	390809	17	$99,499.15	$8,912.44	$108,411.59	7	7	0
WYANDOT COUNTY	CAREY, VILLAGE OF	390590	39	$1,271,738.51	$69,307.84	$1,341,046.35	14	11	3
	WYANDOT COUNTY (Unincorp.)	390787	4	$55,070.93	$28,937.71	$84,008.64	2	2	0
		REGION 1 SUBTOTAL	**2,768**	**$41,345,453.38**	**$6,290,098.57**	**$47,655,163.90**	**937**	**830**	**107**

Region 2

County Name	Community Name	Community Number	Total Losses	Total Building Payment	Total Contents Payment	Total Payment	Total RL/SRL Structures	Total RL Structures	Total SRL Structures
ASHLAND COUNTY	ASHLAND COUNTY (Unincorp.)	390759	5	$59,129.23	$39,192.48	$98,321.71	2	2	0
	ASHLAND, CITY OF	390007	4	$0.00	$11,775.94	$11,775.94	2	2	0
	LOUDONVILLE, VILLAGE OF	390009	2	$150,056.63	$13,954.42	$164,011.05	1	1	0

ASHTABULA COUNTY	ASHTABULA COUNTY (Unincorp.)	390010	41	$518,255.76	$139,470.97	$657,726.73	12	10	2
	CONNEAUT, CITY OF	390012	2	$23,967.12	$0.00	$23,967.12	1	1	0
	GENEVA, CITY OF	390013	2	$9,990.64	$0.00	$9,990.64	1	1	0
	JEFFERSON, VILLAGE OF	390014	4	$122,005.80	$8,313.11	$130,318.91	1	1	0
BUTLER COUNTY	BUTLER COUNTY (Unincorp.)	390037	20	$276,070.24	$92,469.12	$368,539.36	8	8	0
	FAIRFIELD, CITY OF	390038	92	$887,210.20	$215,146.55	$826,286.51	31	30	1
	HAMILTON, CITY OF	390039	7	$111,037.77	$14.39	$111,052.16	3	3	0
	MIDDLETOWN, CITY OF	390040	3	$25,998.87	$0.00	$25,998.87	1	1	0
	MILLVILLE, VILLAGE OF	390041	3	$23,432.21	$0.00	$23,432.21	1	1	0
	MONROE, CITY OF	390042	4	$127,734.81	$50,622.73	$178,357.54	1	0	1
	SHARONVILLE,CITY OF	390236	22	$827,052.78	$512,576.24	$1,343,500.11	9	9	0
	SOMERVILLE, VILLAGE OF	390046	4	$23,825.87	$0.00	$23,825.87	2	2	0
CUYAHOGA COUNTY	BAY VILLAGE, CITY OF	390093	3	$31,394.66	$641.36	$32,036.02	1	1	0
	BEACHWOOD, CITY OF	390094	4	$25,066.72	$0.00	$25,066.72	1	1	0
	BEDFORD HEIGHTS, CITY OF	390096	26	$246,650.55	$459,157.73	$705,808.28	3	2	1
	BEDFORD , CITY OF	390095	3	$8,949.48	$0.00	$8,949.48	1	1	0
	BENTLEYVILLE, VILLAGE OF	390682	3	$11,217.19	$0.00	$11,217.19	1	1	0
	BEREA, CITY OF	390097	2	$4,337.04	$533.79	$4,870.83	1	1	0
	BRECKSVILLE, CITY OF	390098	13	$426,390.70	$55,737.66	$482,128.36	5	5	0
	BROADVIEW HEIGHTS, CITY OF	390099	4	$58,409.66	$19,970.62	$78,380.28	4	4	0
	CLEVELAND, CITY OF	390104	22	$317,492.93	$405,726.17	$723,219.10	9	8	1
	CUYAHOGA COUNTY (Unincorp.)	390766	11	$70,645.02	$24,899.54	$95,544.56	4	4	0
	EUCLID, CITY OF	390107	2	$10,289.08	$0.00	$10,289.08	1	1	0
	GARFIELD HEIGHTS, CITY OF	390109	12	$186,537.59	$38,153.86	$224,691.45	4	4	0
	GATES MILLS, VILLAGE OF	390593	4	$38,691.07	$0.00	$38,691.07	2	2	0
	INDEPENDENCE, CITY OF	390111	114	$5,953,080.91	$6,150,118.68	$12,103,199.59	20	7	13
	LAKEWOOD, CITY OF	390112	12	$160,635.40	$48,565.27	$209,200.67	3	1	2
	MAYFIELD, VILLAGE OF	390116	9	$957,339.62	$5,367.55	$962,707.17	2	1	1
	MIDDLEBURG HEIGHTS, CITY OF	390117	15	$192,947.70	$18,811.02	$211,758.72	6	6	0
	NORTH OLMSTED, CITY OF	390120	11	$78,519.40	$9,869.45	$88,388.85	5	5	0
	NORTH ROYALTON, CITY OF	390121	20	$211,877.32	$30,156.47	$242,033.79	6	5	1
	OAKWOOD, VILLAGE OF	390122	2	$13,852.19	$667.19	$14,519.38	1	1	0
	PARMA, CITY OF	390123	6	$31,927.39	$0.00	$31,927.39	3	3	0
	PEPPER PIKE, CITY OF	390125	9	$104,903.32	$1,362.94	$106,266.26	4	4	0
	RICHMOND HEIGHTS, CITY OF	390126	3	$16,559.96	$2,551.86	$19,111.82	1	1	0
	ROCKY RIVER, CITY OF	395372	5	$25,161.51	$7,435.38	$32,596.89	1	1	0
	SEVEN HILLS, CITY OF	390128	2	$24,673.63	$0.00	$24,673.63	1	1	0
	SOLON, CITY OF	390130	2	$95,325.31	$100,000.00	$195,325.31	1	1	0
	STRONGSVILLE, CITY OF	390132	11	$156,702.94	$27,419.49	$184,122.43	5	5	0
	VALLEY VIEW, VILLAGE OF	390134	216	$11,002,194.19	$1,418,286.13	$4,396,973.72	49	37	12
	WALTON HILLS, VILLAGE OF	390636	2	$11,908.14	$15,032.41	$26,940.55	1	1	0
	WESTLAKE, CITY OF	390136	5	$310,687.43	$37,174.25	$347,861.68	2	2	0
DELAWARE COUNTY	DELAWARE COUNTY (Unincorp.)	390146	24	$337,081.67	$47,664.38	$384,746.05	8	6	2
	POWELL, VILLAGE OF	390626	2	$23,220.49	$1,881.00	$25,101.49	1	1	0
	WESTERVILLE, CITY OF	390179	2	$4,128.96	$0.00	$4,128.96	1	1	0
FAIRFIELD COUNTY	BUCKEYE LAKE, VILLAGE OF	390882	4	$35,184.22	$0.00	$35,184.22	2	2	0
	FAIRFIELD COUNTY (Unincorp.)	390158	12	$87,662.67	$92,390.43	$180,053.10	6	5	1
	LANCASTER, CITY OF	390161	23	$160,575.85	$6,962.82	$439,609.30	10	9	1
	PICKERINGTON, CITY OF	390162	4	$31,392.87	$4,936.30	$36,329.17	2	2	0
	REYNOLDSBURG, CITY OF	390177	30	$234,449.06	$77,037.70	$311,486.76	9	7	2

FRANKLIN COUNTY	BEXLEY, CITY OF	390168	4	$2,319.75	$5,859.67	$8,179.42	3	3	0
	COLUMBUS, CITY OF	390170	76	$803,808.17	$259,144.15	$1,062,952.32	70	68	2
	FRANKLIN COUNTY (Unincorp.)	390167	54	$549,167.19	$123,242.37	$672,409.56	22	22	0
	GAHANNA, CITY OF	390171	3	$24,779.34	$0.00	$24,779.34	1	1	0
	GROVE CITY, CITY OF	390173	8	$50,334.17	$16,369.59	$66,703.76	4	4	0
	UPPER ARLINGTON, CITY OF	390178	6	$19,003.46	$31,348.76	$50,352.22	3	3	0
	WHITEHALL, CITY OF	390180	2	$4,322.43	$0.00	$4,322.43	1	1	0
	WORTHINGTON, CITY OF	390181	12	$164,545.81	$64,891.14	$229,436.95	4	3	1
GEAUGA COUNTY	GEAUGA COUNTY (Unincorp.)	390190	11	$178,829.29	$15,581.46	$194,410.75	4	3	1
	SOUTH RUSSELL, VILLAGE OF	390740	2	$23,784.02	$13,193.95	$36,977.97	1	1	0
GREENE COUNTY	BEAVERCREEK, CITY OF	390876	4	$32,672.72	$1,338.57	$34,011.29	2	2	0
	FAIRBORN, CITY OF	390195	6	$69,332.02	$0.00	$69,332.02	1	1	0
	GREENE COUNTY (Unincorp.)	390193	8	$27,024.57	$12,025.17	$39,049.74	3	2	1
	HUBER HEIGHTS, CITY OF	390884	2	$7,361.34	$4,797.41	$12,158.75	1	1	0
	XENIA, CITY OF	390197	6	$77,239.05	$88,852.52	$166,091.57	2	2	0
HAMILTON COUNTY	AMBERLEY, VILLAGE OF	390206	13	$80,530.42	$30,012.16	$110,542.58	4	4	0
	CINCINNATI, CITY OF	390210	220	$5,707,181.76	$3,029,774.44	$8,736,956.20	65	55	10
	CLEVES, VILLAGE OF	390211	11	$162,048.35	$49,885.98	$211,934.33	2	1	1
	EVENDALE, VILLAGE OF	390214	14	$404,521.75	$373,147.90	$777,669.65	3	1	2
	FAIRFAX, VILLAGE OF	390215	13	$233,034.22	$176,657.67	$409,691.89	5	4	1
	GREENHILLS, VILLAGE OF	390219	11	$40,597.24	$15,704.03	$56,301.27	3	3	0
	HAMILTON COUNTY (Unincorp.)	390204	116	$1,669,091.24	$381,788.44	$2,050,879.68	41	37	4
	INDIAN HILL, CITY OF	390221	2	$42,128.90	$3,664.59	$45,793.49	1	1	0
	MONTOGERMY, CITY OF	390228	2	$10,845.61	$0.00	$10,845.61	1	1	0
	MOUNT HEALTHY, CITY OF	390229	2	$1,028.23	$1,831.75	$2,859.98	1	1	0
	NEWTOWN, VILLAGE OF	390230	5	$33,941.12	$38,809.04	$72,750.16	2	2	0
	NORTH COLLEGE HILL, CITY OF	390232	8	$67,066.40	$5,146.93	$72,213.33	4	4	0
	READING, CITY OF	390234	5	$50,611.64	$0.00	$50,611.64	2	2	0
	SPRINGDALE, CITY OF	390877	6	$113,962.69	$0.00	$113,962.69	3	3	0
	TERRACE PARK, VILLAGE OF	390633	2	$5,879.78	$0.00	$5,879.78	1	1	0
	WOODLAWN, VILLAGE OF	390239	3	$37,836.25	$27,737.57	$65,573.82	1	1	0
	WYOMING, CITY OF	390240	2	$14,245.45	$8,935.90	$23,181.35	1	1	0
KNOX COUNTY	FREDERICKTOWN, VILLAGE OF	390309	2	$7,421.99	$1,218.47	$8,640.46	1	1	0
	KNOX COUNTY (Unicorp.)	390306	2	$31,814.00	$0.00	$31,814.00	1	1	0
	MOUNT VERNON, CITY OF	390311	2	$9,194.61	$0.00	$9,194.61	1	1	0
LAKE COUNTY	EASTLAKE, CITY OF	390313	110	$884,023.39	$174,905.65	$1,058,929.04	41	40	1
	FAIRPORT HARBOR, VILLAGE OF	390314	19	$187,885.25	$15,284.01	$203,169.26	1	0	1
	GRAND RIVER, VILLAGE OF	390315	9	$195,081.94	$25,517.02	$220,598.96	2	2	0
	LAKE COUNTY (Unincorp.)	390771	23	$632,056.21	$28,783.81	$660,840.02	9	8	1
	MADISON, VILLAGE OF	390316	5	$111,679.65	$9,941.50	$121,621.15	2	2	0
	MENTOR, CITY OF	390317	4	$55,603.57	$18,095.63	$73,699.20	2	2	0
	PAINESVILLE, CITY OF	390319	6	$55,361.65	$12,658.62	$68,020.27	3	3	0
	PERRY, VILLAGE OF	390320	2	$3,939.63	$2,794.65	$6,734.28	1	1	0
	WILLOUGHBY HILLS, CITY OF	390323	30	$373,164.84	$254,572.01	$627,736.85	10	7	3
	WILLOUGHBY, CITY OF	390322	12	$141,458.76	$47,807.34	$189,266.10	5	4	1
	WILLOWICK, CITY OF	390324	5	$138,430.33	$221.47	$138,651.80	2	2	0
LICKING COUNTY	ALEXANDRIA, VILLAGE OF	390329	2	$3,879.92	$0.00	$3,879.92	1	1	0
	HEATH, CITY OF	390332	5	$29,395.36	$13,076.62	$42,471.98	2	2	0
	HEBRON, VILLAGE OF	390333	24	$287,225.70	$86,848.78	$374,074.48	7	5	2
	LICKING COUNTY (Unincorp.)	390328	26	$225,476.28	$26,601.98	$252,078.26	9	7	2
	NEWARK,CITY OF	390335	2	$2,492.20	$0.00	$2,492.20	1	1	0
	PATASKALA, CITY OF	390336	2	$59,525.48	$8,519.90	$68,045.38	1	1	0

LORAIN COUNTY	AVON LAKE, CITY OF	390602	4	$29,908.98	$0.00	$29,908.98	2	2	0
	AVON, CITY OF	390348	13	$167,085.05	$4,634.87	$171,719.92	6	6	0
	BROWNHELM, TOWNSHIP OF	395371	6	$18,756.96	$5,532.43	$24,289.39	3	3	0
	LORAIN COUNTY (Unincorp.)	395371	58	$617,605.82	$124,532.14	$742,137.96	16	15	1
	LORAIN, CITY OF	390351	9	$520,573.43	$26,783.71	$547,357.14	4	4	0
	NORTH RIDGEVILLE, CITY OF	390352	29	$514,319.17	$21,109.52	$535,428.69	13	13	0
	SHEFFIELD, VILLAGE OF	390354	2	$0.00	$10,972.80	$10,972.80	1	1	0
	SOUTH AMHERST, VILLAGE OF	390356	6	$155,450.88	$23,041.03	$178,491.91	2	1	1
MAHONING COUNTY	CANFIELD, CITY OF	390369	2	$14,023.09	$5,797.65	$19,820.74	1	1	0
	MAHONING COUNTY (Unincorp.)	390367	56	$372,550.62	$105,589.80	$478,140.42	22	22	0
	YOUNGSTOWN, CITY OF	390373	13	$49,395.81	$499,460.77	$548,856.58	4	3	1
MEDINA COUNTY	BRIARWOOD BEACH, VILLAGE OF	390379	2	$8,865.61	$0.00	$8,865.61	1	1	0
	BRUNSWICK, CITY OF	390380	4	$27,220.42	$2,878.17	$30,098.59	2	2	0
	CHIPPEWA-ON-THE-LAKE, VILLAGE OF	390644	2	$13,620.03	$0.00	$13,620.03	1	1	0
	GLORIA GLENS PARK, VILLAGE OF	390381	63	$506,361.94	$68,568.82	$574,930.76	10	7	3
	MEDINA COUNTY (Unincorp.)	390378	33	$1,193,395.06	$258,607.17	$1,452,002.23	10	7	3
	MEDINA, CITY OF	390383	4	$13,250.89	$0.00	$13,250.89	2	2	0
	RITTMAN, CITY OF	390578	2	$3,982.51	$4,370.04	$8,352.55	1	1	0
MONTGOMERY COUNTY	BROOKVILLE, CITY OF	390407	2	$4,350.78	$0.00	$4,350.78	1	1	0
	CLAYTON, CITY OF	390821	3	$19,472.70	$0.00	$19,472.70	1	1	0
	DAYTON, CITY OF	390409	14	$173,158.96	$39,680.04	$212,839.00	5	3	2
	MONTGOMERY COUNTY (Unincorp.)	390775	13	$99,638.28	$23,307.91	$122,946.19	6	6	0
	VANDALIA, CITY OF	390418	7	$109,622.57	$12,828.17	$122,450.74	2	1	1
PICKAWAY COUNTY	CIRCLEVILLE, CITY OF	390447	2	$0.00	$17,092.62	$17,092.62	1	1	0
	PICKAWAY COUNTY (Unincorp.)	390445	14	$254,341.57	$40,000.00	$294,341.57	6	5	1
PORTAGE COUNTY	AURORA, CITY OF	390454	4	$3,516.43	$4,528.71	$8,045.14	2	2	0
	PORTAGE COUNTY (Unincorp.)	390453	10	$183,932.01	$12,211.11	$196,143.12	5	5	0
RICHLAND COUNTY	BELLVILLE, VILLAGE OF	390604	26	$392,666.43	$177,222.53	$569,888.96	9	7	2
	BUTLER, VILLAGE OF	390605	2	$5,527.56	$0.00	$5,527.56	1	1	0
	MANSFIELD, CITY OF	390477	26	$902,398.61	$501,068.58	$1,403,467.19	12	12	0
	ONTARIO, VILLAGE OF	390478	3	$6,670.97	$1,494.84	$8,165.81	1	1	0
	RICHLAND COUNTY (Unincorp.)	390476	9	$80,356.91	$320.80	$80,677.71	4	4	0
	SHELBY, CITY OF	390479	56	$974,718.82	$245,439.26	$1,220,158.08	20	17	3
STARK COUNTY	CANAL FULTON, CITY OF	390511	11	$27,133.02	$31,679.75	$58,812.77	3	3	0
	CANTON, CITY OF	390512	2	$13,752.21	$1,426.75	$15,178.96	1	1	0
	EAST CANTON, VILLAGE OF	390513	2	$9,996.06	$5,102.15	$15,098.21	1	1	0
	LOUISVILLE, CITY OF	390516	21	$1,297,304.80	$882,221.19	$2,179,525.99	7	5	2
	MASSILLON, CITY OF	390517	6	$19,559.63	$6,039.94	$25,599.57	1	1	0
	NORTH CANTON, CITY OF	390521	20	$160,705.81	$23,047.47	$183,753.28	8	7	1
	STARK COUNTY (Unincorp.)	390780	73	$1,691,035.37	$401,272.74	$2,092,308.11	20	19	1
SUMMIT COUNTY	AKRON, CITY OF	390523	43	$498,960.62	$43,054.94	$542,015.56	19	19	0
	BARBERTON, CITY OF	390524	80	$809,811.99	$209,823.56	$1,019,635.55	33	33	0
	CLINTON, VILLAGE OF	390525	9	$31,033.45	$7,267.09	$38,300.54	3	3	0
	FAIRLAWN, CITY OF	390657	2	$2,887.79	$1,454.37	$4,342.16	1	1	0
	HUDSON, CITY OF	390660	2	$24,382.92	$26,931.06	$51,313.98	1	1	0
	MUNROE FALLS, CITY OF	390843	9	$192,756.60	$17,911.74	$210,668.34	2	0	2
	NORTON, CITY OF	390529	9	$1,425,143.88	$610,200.00	$2,035,343.88	4	4	0
	PENINSULA, VILLAGE OF	390530	2	$49,921.27	$7,114.82	$57,036.09	1	1	0
	REMINDERVILLE, VILLAGE OF	390855	2	$4,599.19	$0.00	$4,599.19	1	1	0
	STOW, CITY OF	390532	11	$44,896.02	$39,180.01	$84,076.03	4	4	0
	SUMMIT COUNTY (Unincorp.)	390781	51	$888,388.69	$226,403.79	$1,114,792.48	19	16	3
	TALLMADGE, CITY OF	390533	2	$101,704.83	$0.00	$101,704.83	1	1	0

County Name	Community Name	Community Number	Total Losses	Total Building Payment	Total Contents Payment	Total Payment	Total RL/SRL Structures	Total RL Structures	Total SRL Structures
TRUMBULL COUNTY	GIRARD, CITY OF	390536	4	$25,489.72	$979.04	$26,468.76	1	1	0
	HUBBARD, CITY OF	390537	3	$24,684.51	$0.00	$24,684.51	1	1	0
	TRUMBULL COUNTY (Unincorp.)	390535	74	$1,126,862.54	$340,121.56	$1,466,984.10	29	27	2
	WARREN, CITY OF	390541	26	$283,125.96	$35,514.16	$318,640.12	9	8	1
WARREN COUNTY	LEBANON, CITY OF	390557	2	$4,123.32	$0.00	$4,123.32	1	1	0
	MASON, CITY OF	390559	3	$33,638.38	$933.80	$34,572.18	1	1	0
	MORROW, VILLAGE OF	390561	2	$2,720.00	$530.00	$3,250.00	1	1	0
	SOUTH LEBANON, VILLAGE OF	390563	18	$302,810.43	$49,835.58	$352,646.01	5	3	2
	SPRINGBORO, CITY OF	390564	2	$1,459.79	$11,119.26	$12,579.05	1	1	0
	WARREN COUNTY (Unincorp.)	390757	11	$135,726.31	$46,232.75	$181,959.06	5	5	0
WAYNE COUNTY	APPLE CREEK, VILLAGE OF	390642	4	$99,248.97	$6,735.72	$105,984.69	2	2	0
	WAYNE COUNTY (Unincorp.)	390574	6	$11,216.85	$16,498.24	$27,715.09	2	2	0
		REGION 2 SUBTOTAL	**2,806**	**$55,750,707.48**	**$20,945,148.51**	**$68,672,220.87**	**992**	**885**	**107**

Region 3

County Name	Community Name	Community Number	Total Losses	Total Building Payment	Total Contents Payment	Total Payment	Total RL/SRL Structures	Total RL Structures	Total SRL Structures
ADAMS COUNTY	ADAMS COUNTY (Unincorp.)	390001	17	$204,373.92	$27,260.37	$231,634.29	6	5	1
ATHENS COUNTY	AMESVILLE, VILLAGE OF	390015	11	$340,662.79	$72,221.84	$412,884.63	5	4	1
	ATHENS COUNTY (Unincorp.)	390760	59	$879,418.39	$165,605.81	$1,045,024.20	17	13	4
	BUCHTEL, VILLAGE OF	390728	2	$8,813.10	$0.00	$8,813.10	1	1	0
	CHAUNCEY, VILLAGE OF	390017	72	$269,730.38	$56,912.18	$335,455.66	11	10	1
	GLOUSTER, VILLAGE OF	390018	15	$138,571.05	$27,303.21	$165,874.26	7	6	1
	JACKSONVILLE, VILLAGE OF	390019	4	$42,349.30	$19,561.08	$61,910.38	2	2	0
	NELSONVILLE, CITY OF	390020	7	$21,115.37	$0.00	$21,115.37	3	3	0
	TRIMBLE,VILLAGE OF	390021	29	$307,962.43	$185,454.82	$493,417.25	14	14	0
BELMONT COUNTY	BELLAIRE, CITY OF	390025	6	$105,895.12	$0.00	$105,895.12	3	3	0
	BELMONT COUNTY (Unincorp.)	390762	72	$663,421.23	$86,091.76	$749,512.99	30	28	2
	BRIDGEPORT, VILLAGE OF	390026	3	$27,879.08	$3,589.35	$31,468.43	1	1	0
	BROOKSIDE, VILLAGE OF	390027	18	$208,103.20	$30,853.62	$238,956.82	6	6	0
	MARTINS FERRY, CITY OF	390029	11	$668,187.83	$25,312.85	$693,500.68	4	4	0
	POWHATAN POINT, VILLAGE OF	390030	35	$679,094.85	$80,202.86	$759,297.71	16	16	0
	YORKVILLE, VILLAGE OF	390033	2	$25,714.92	$0.00	$25,714.92	1	1	0
BROWN COUNTY	ABERDEEN, VILLAGE OF	390675	2	$16,468.56	$2,164.00	$18,632.56	1	1	0
	BROWN COUNTY (Unincorp.)	390034	6	$61,511.16	$0.00	$61,511.16	2	2	0
	GEORGETOWN, VILLAGE OF	390035	2	$8,484.94	$712.40	$9,197.34	1	1	0
CARROLL COUNTY	CARROLL COUNTY (Unincorp.)	390763	5	$14,872.60	$0.00	$14,872.60	2	2	0
	MINERVA, VILLAGE OF	390518	2	$33,513.62	$6,198.62	$39,712.24	1	1	0
CLERMONT COUNTY	BATAVIA, VILLAGE OF	390066	6	$10,585.00	$110.00	$10,695.00	2	2	0
	CLERMONT COUNTY (Unincorp.)	390065	30	$375,453.95	$265,439.20	$640,893.15	12	11	1
	LOVELAND, CITY OF	390068	10	$54,674.28	$10,351.13	$65,025.41	4	4	0
	NEW RICHMOND, VILLAGE OF	390071	41	$591,312.36	$89,449.45	$680,761.81	14	13	1
	WILLIAMSBURG, VILLAGE OF	390072	3	$91,781.97	$591,896.79	$683,678.76	1	1	0
COLUMBIANA COUNTY	COLUMBIANA COUNTY (Unincorp.)	390076	9	$116,780.91	$25,855.81	$142,636.72	4	4	0
	EAST PALESTINE, CITY OF	390079	2	$12,355.41	$0.00	$12,355.41	1	1	0
	HANOVERTON, VILLAGE OF	390082	5	$33,887.00	$9,807.01	$43,694.01	2	2	0
	LISBON, VILLAGE OF	390085	2	$5,262.33	$1,686.17	$6,948.50	1	1	0
	WELLSVILLE, CITY OF	390088	6	$16,101.16	$1,408.75	$17,509.91	2	2	0
COSHOCTON COUNTY	COSHOCTON COUNTY (Unincorp.)	390765	8	$45,885.95	$2,068.31	$47,954.26	4	4	0
GALLIA COUNTY	CHESHIRE, VILLAGE OF	390186	6	$41,889.23	$569.08	$42,458.31	1	0	1
	GALLIA COUNTY (Unincorp.)	390185	41	$381,030.69	$167,008.07	$548,038.76	13	10	3
	VINTON, VILLAGE OF	390189	4	$57,859.26	$34,565.23	$92,424.49	1	0	1

GUERNSEY COUNTY	BYESVILLE, VILLAGE OF	390199	32	$852,495.22	$90,462.24	$942,957.46	15	14	1
	CAMBRIDGE, CITY OF	390200	59	$1,719,479.29	$799,737.24	$2,519,216.53	22	22	0
	GUERNSEY COUNTY (Unincorp.)	390198	30	$421,630.01	$824,176.07	$1,245,806.08	13	13	0
	LORE CITY, VILLAGE OF	390202	5	$26,705.92	$7,805.51	$34,511.43	2	2	0
	PLEASANT CITY, VILLAGE OF	390203	2	$9,098.43	$0.00	$9,098.43	1	1	0
	QUAKER CITY, VILLAGE OF	390853	11	$110,583.82	$12,800.00	$123,383.82	4	3	1
HARRISON COUNTY	ADENA, VILLAGE OF	390295	2	$10,370.63	$0.00	$10,370.63	1	1	0
	BOWERSTON,VILLAGE OF	390257	14	$66,269.78	$87,542.24	$153,812.02	3	0	3
	JEWETT, VILLAGE OF	390259	3	$43,485.31	$0.00	$43,485.31	1	1	0
HIGHLAND COUNTY	HILLSBORO, CITY OF	390269	2	$0.00	$11,992.37	$11,992.37	1	1	0
HOCKING COUNTY	HOCKING COUNTY (Unincorp.)	390272	22	$93,753.28	$23,990.64	$117,743.92	7	7	0
	MURRAY CITY, VILLAGE OF	390275	16	$96,506.65	$31,658.19	$128,164.84	6	5	1
HOLMES COUNTY	GLENMONT, VILLAGE OF	390277	2	$10,138.41	$0.00	$10,138.41	1	1	0
	HOLMES COUNTY (Unincorp.)	390276	2	$36,021.98	$1,437.49	$37,459.47	1	1	0
	KILLBUCK, CITY OF	390279	13	$47,382.46	$10,560.67	$57,943.13	6	6	0
	MILLERSBURG, VILLAGE OF	390280	3	$4,890.31	$24,607.24	$29,497.55	1	1	0
JACKSON COUNTY	COALTON, VILLAGE OF	390291	10	$117,731.46	$7,646.79	$125,378.25	3	2	1
	JACKSON COUNTY (Unincorp.)	390290	22	$376,422.60	$173,371.10	$549,793.70	6	4	2
	JACKSON, CITY OF	390292	23	$663,120.58	$55,570.51	$718,691.09	14	14	0
JEFFERSON COUNTY	DILLONVALE, VILLAGE OF	390298	16	$147,024.58	$14,078.22	$161,102.80	7	7	0
	IRONDALE, VILLAGE OF	390741	2	$23,073.04	$3,734.29	$26,807.33	1	1	0
	JEFFERSON COUNTY (Unincorp.)	390294	27	$432,334.95	$32,233.71	$487,641.70	11	11	0
	RAYLAND, VILLAGE OF	390301	4	$15,202.32	$0.00	$15,202.32	2	2	0
	TORONTO, CITY OF	390304	4	$196,266.33	$128,144.05	$324,410.38	2	2	0
LAWRENCE COUNTY	CHESAPEAKE, VILLAGE OF	390608	2	$8,194.20	$0.00	$8,194.20	1	1	0
	HANGING ROCK, VILLAGE OF	390699	3	$28,569.89	$9,055.00	$37,624.89	1	1	0
	LAWRENCE COUNTY (Unincorp.)	390325	117	$1,309,901.70	$219,815.64	$1,529,717.34	41	36	5
	PROCTORVILLE, VILLAGE OF	390700	8	$34,490.93	$29,024.16	$63,515.09	2	1	1
	SOUTH POINT, VILLAGE OF	390630	7	$297,021.98	$69,510.97	$366,532.95	6	6	0
MEIGS COUNTY	MEIGS COUNTY (Unincorp.)	390387	47	$540,900.29	$359,494.19	$900,394.48	18	14	4
	POMEROY, VILLAGE OF	390389	37	$248,604.47	$38,308.16	$286,912.63	13	11	2
	RUTLAND, VILLAGE OF	390670	21	$203,075.57	$135,964.32	$339,039.89	8	6	2
	SYRACUSE, VILLAGE OF	390391	2	$12,112.00	$4,823.28	$16,935.28	1	1	0
MONROE COUNTY	CLARINGTON, VILLAGE OF	390405	4	$44,542.86	$0.00	$44,542.86	2	2	0
	MONROE COUNTY (Unincorp.)	390404	19	$239,547.86	$37,059.96	$276,607.82	9	8	1
MORGAN COUNTY	MALTA, VILLAGE OF	390421	2	$3,400.00	$14.00	$3,414.00	1	1	0
	MCCONNELSVILLE, VILLAGE OF	390422	2	$17,520.55	$0.00	$17,520.55	1	1	0
	MORGAN COUNTY (Unincorp.)	390420	59	$686,361.73	$124,344.20	$810,705.93	24	21	3
MUSKINGUM COUNTY	MUSKINGUM COUNTY (Unincorp.)	390425	46	$523,431.73	$115,951.05	$639,382.78	2	2	0
	ZANESVILLE, CITY OF	390427	5	$151,582.78	$48,432.82	$200,015.60	2	2	0
NOBLE COUNTY	BELLE VALLEY, VILLAGE OF	390429	16	$361,944.37	$50,605.96	$412,550.33	8	8	0
	CALDWELL, VILLAGE OF	390430	6	$91,808.88	$24,152.32	$115,961.20	3	3	0
	DEXTER CITY, VILLAGE OF	390431	2	$95,942.49	$30,171.40	$126,113.89	1	1	0
	NOBLE COUNTY (Unincorp.)	390428	6	$81,128.91	$53,494.64	$134,623.55	3	3	0
PERRY COUNTY	CORNING, VILLAGE OF	390440	11	$255,005.64	$36,053.06	$291,058.70	4	3	1
	GLENFORD, VILLAGE OF	390442	2	$24,983.64	$0.00	$24,983.64	1	1	0
	NEW LEXINGTON, VILLAGE OF	390443	2	$44,435.76	$0.00	$44,435.76	1	1	0
	PERRY COUNTY (Unincorp.)	390778	2	$14,590.37	$309.10	$14,899.47	1	1	0
PIKE COUNTY	PIKE COUNTY (Unincorp.)	390450	22	$349,881.76	$99,118.32	$449,000.08	10	9	1
	PIKETON, VILLAGE OF	390451	2	$33,670.48	$0.00	$33,670.48	1	1	0
	WAVERLY, CITY OF	390452	4	$369,915.68	$38,577.43	$408,493.11	2	2	0
ROSS COUNTY	CHILLICOTHE, CITY OF	390482	6	$28,453.47	$10,551.84	$39,005.31	3	3	0
	FRANKFORT, VILLAGE OF	390484	2	$16,610.43	$4,997.79	$21,608.22	1	1	0
	ROSS COUNTY (Unincorp.)	390480	24	$286,235.92	$34,918.71	$321,154.63	9	8	1

SCIOTO COUNTY	PORTSMOUTH, CITY OF	390498	6	$47,019.03	$4,096.00	$51,115.03	3	3	0
	SCIOTO COUNTY (Unincorp.)	390496	52	$472,149.13	$105,599.85	$577,748.98	23	22	1
TUSCARAWAS COUNTY	DENNISON, VILLAGE OF	390542	3	$14,647.64	$733.90	$15,381.54	1	1	0
	DOVER, CITY OF	390543	2	$40,504.43	$4,438.96	$44,943.39	1	1	0
	NEW PHILADELPHIA, CITY OF	390545	15	$104,502.39	$30,207.18	$134,709.57	5	5	0
	TUSCARAWAS COUNTY (Unincorp.)	390782	16	$109,771.65	$6,072.41	$115,844.06	6	6	0
	UHRICHSVILLE, CITY OF	390547	7	$30,866.99	$4,059.84	$34,926.83	3	3	0
WASHINGTON COUNTY	BELPRE, CITY OF	390567	46	$764,289.74	$34,932.24	$799,221.98	17	15	2
	BEVERLY, VILLAGE OF	390568	7	$113,580.75	$0.00	$113,580.75	3	3	0
	LOWELL, VILLAGE OF	390569	6	$46,879.23	$2,597.09	$49,476.32	3	3	0
	LOWER SALEM, VILLAGE OF	390570	9	$219,435.58	$15,323.08	$234,758.66	3	2	1
	MACKSBURG, VILLAGE OF	390571	5	$56,932.80	$3,784.27	$60,717.07	2	2	0
	MARIETTA, CITY OF	390572	298	$7,266,053.04	$826,186.00	$8,092,239.04	120	111	9
	WASHINGTON COUNTY (Unincorp.)	390566	139	$2,292,911.48	$332,635.19	$2,625,546.67	54	47	7
		REGION 3 SUBTOTAL	**1978**	**$30,064,400.92**	**$7,276,622.67**	**$37,372,909.73**	**751**	**684**	**67**

	Total Losses	Total Building Payment	Total Contents Payment	Total Payment	Total RL/SRL Structures	Total RL Structures	Total SRL Structures
STATE OF OHIO GRAND TOTAL	**7,552**	**$127,160,561.78**	**$34,511,869.75**	**$153,700,294.50**	**2,680**	**2,399**	**281**

Data Sources: WebDataExchange 4/14 and FEMA SRL List 4/14

NOTE: The Data contained on this report are Repetitive Loss Properties, as identified by the Federal Emergency Management Agency.

Web Data Exchange Report Description and Use

Report displays repetitive loss summary data by state and community. User selects current repetitive loss properties, mitigated properties, or combined. Report includes number of the selected type of properties in each community in the user's state, as well as community summary statistics. A drill-down to specific property data for each community is available.

Report Drivers

This report provides FEMA Mitigation Staff, regions, and states the opportunity to see whether particular communities/regions need to increase their mitigation outreach efforts to avoid future repetitive losses to their structures.

Field Descriptions

County Name: Name of the county. Report is divided into State regions, counties, and communities.
Community Name: Name of the community
Community Number: Six-digit number uniquely identifying the NFIP community
Total Losses: Total number of losses or claims identified by the NFIF
Total Building Payment: The total amount of payments on losses, excluding contents, for current RL properties in the community
Total Contents Payment: The total amount of payments on contents losses for current RL properties in the community
Total SRL Structures: The total number of properties that meet the statutory definition of SRL and included on FEMA's tracking list

Appendix C - State-Owned Critical and Non-Critical Facilities

Adams County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	8	$1,033,100
Transportation	19	$3,210,607	0	$0
Ohio Historical Society	0	$0	1	$850

Allen County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	1	$4,960,889	0	$0
Job & Family Services	0	$0	1	$1,710,396
Natural Resources	0	$0	6	$2,293,755
Public Safety	1	$1,997,321	0	$0
Rehabilitation and Corrections	65	$53,134,111	0	$0
Transportation	50	$29,577,065	6	$498,372

Ashland County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	106	$43,493,645	1	$28,000
Public Safety	2	$2,263,524	0	$0
Transportation	31	$16,926,350	0	$0

Ashtabula County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	139	$15,830,316
Public Safety	1	$2,679,552	1	$321,886
Transportation	57	$15,381,846	12	$2,026,259

Athens County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Mental Health and Addiction Services	9	$24,291,911	1	
Natural Resources	0	$0	34	$4,539,018
Public Safety	1	$3,343,585	0	$0
Rehabilitation and Corrections	5	$12,116,110	0	$0
Transportation	10	$2,811,856	7	$529,060

Auglaize County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	2	$4,385,386	0	$0
Natural Resources	0	$0	47	$4,753,825
Ohio Historical Society	0	$0	6	$3,270,435
Public Safety	1	$2,915,075	0	$0
Transportation	17	$3,735,701	0	$0

Belmont County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	17	$1,710,750
Public Safety	1	$2,215,407	0	$0
Rehabilitation and Corrections	22	$43,966,224	4	$4,649,993
Transportation	36	$5,672,840	10	$636,380

Brown County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	5	$858,019
Ohio Historical Society	0	$0	5	$1,236,455
Public Safety	1	$3,270,567	0	$0
Transportation	8	$832,584	4	$567,666
Veterans Services	3	$27,451,291	0	$0

Butler County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	2	$10,059,695	0	$0
Natural Resources	0	$0	7	$845,625
Public Safety	1	$2,402,146	2	$1,400,000
Transportation	18	$5,101,192	3	$393,875

Carroll County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Ohio Historical Society	0	$0	1	$1,112,000
Transportation	15	$2,290,075	0	$0

Champaign County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	28	$1,164,875
Ohio Historical Society	0	$0	4	$1,140,578
Transportation	23	$4,627,441	0	$0

Clark County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	52	$17,344,481
Public Safety	1	$3,641,152	0	$0
Transportation	25	$4,446,615	0	$0

Clermont County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Developmental Disabilities	14	$11,132,093	0	$0
Natural Resources	0	$0	47	$8,608,034
Ohio Historical Society	0	$0	4	$417,194
Public Safety	1	$3,043,189	0	$0
Transportation	22	$3,364,879	1	$32,797

Clinton County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	46	$4,255,450
Public Safety	2	$8,159,814	1	$422,778
Transportation	19	$2,809,098	0	$0

Columbiana County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	22	$3,807,233
Ohio Historical Society	0	$0	2	$1,977,433
Public Safety	1	$2,871,451	0	$0
Transportation	33	$8,140,004	0	$0

Coshocton County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	1	$4,858,562	0	$0
Natural Resources	0	$0	9	$1,002,473
Transportation	14	$3,810,905	0	$0

Crawford County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	2	$7,150,179	0	$0
Transportation	10	$2,527,741	0	$0

Cuyahoga County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	4	$18,799,910	0	$0
Administrative Services	1	$108,393,110	0	$0
Developmental Disabilities	15	$20,105,617	0	$0
Natural Resources	0	$0	2	$1,848,125
Public Safety	1	$11,925,645	0	$0
Rehabilitation and Correction	14	$9,680,325	0	$0
Transportation	36	$30,001,508	0	$0
Department of Youth Services	4	$42,160,484	0	$0
Ohio History Connection	0	0	2	$944,576

Darke County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	1	$2,943,354	0	$0
Ohio Historical Society	0	$0	4	$41,246
Transportation	23	$3,706,724	0	$0

Defiance County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	6	$197,450
Public Safety	1	$2,998,990	0	$0
Transportation	12	$4,563,684	0	$0

Delaware County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	1	$12,671,682	0	$0
Natural Resources	0	$204,000	62	$21,496,560
Public Safety	1	$2,430,610	1	$20,400
Transportation	34	$30,220,913	8	$975,205

Erie County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	1	$3,255,025	0	$0
Natural Resources	0	$0	37	$13,080,766
Public Safety	1	$2,722,425	0	$0
Transportation	16	$5,834,047	0	$0
Veterans Services	33	$149,412,438	0	$0

Fairfield County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	1	$2,791,770	1	$513,290
Natural Resources	0	$0	11	$1,014,200
Public Safety	1	$2,943,416	0	$0
Rehabilitation and Corrections	61	$74,353,881	27	$13,924,132
Transportation	14	$5,769,433	0	$0

Fayette County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	3	$1,290,250
Transportation	20	$4,117,291	15	$1,056,251

Franklin County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	3	$38,286,990	0	$0
Bureau of Workers Compensation	0	$0	2	$194,536,403
Capitol Square Review Board	4	$237,088,814	1	$46,925,828
Administrative Services	11	$960,175,638	1	$126,000
Developmental Disabilities	20	$29,302,474	0	$0
Job and Family Services	0	$0	1	$22,958,639
Mental Health and Addiction Services	9	$45,904,375	0	$0
Natural Resources	0	$0	26	$75,798,216
Public Safety	7	$405,181,027	0	$0
Rehabilitation and Correction	13	$37,404,034	0	$0
Transportation	76	$124,687,159	1	$26,625
Judicial Supreme Court	0	$0	1	$242,457,166
Ohio Expositions Commission	31	$156,539,811	0	$0
Ohio History Connection	0	$0	27	$98,073,038
Ohio School for the Blind	20	$35,677,807	0	$0
Ohio School for the Deaf	34	$37,184,750	0	$0

Fulton County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	32	$1,716,846
Transportation	14	$3,170,048	0	$0

Gallia County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Developmental Disabilities	56	$25,735,417	0	$21,776,188
Public Safety	2	$3,212,308	0	$0
Transportation	9	$3,243,150	11	$797,958
Ohio History Connection	0	$0	2	$819,618

Geauga County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	50	$11,133,092
Public Safety	1	$2,122,753	0	$0
Transportation	20	$4,568,140	0	$0

Greene County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	1	$1,902,409	0	$0
Natural Resources	0	$0	21	$5,753,018
Ohio History Connection	0	$0	2	$9,000,000
Public Safety	1	$2,072,705	0	$0
Transportation	18	$4,498,394	0	$0

Guernsey County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Developmental Disabilities	22	$26,185,067	0	$0
Natural Resources	0	$0	113	$46,914,036
Public Safety	3	$6,801,569	1	$412,661
Transportation	25	$4,776,656	9	$904,422

Hamilton County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	2	$19,881,993	0	$0
Administrative Services	1	$89,000,000	0	$0
Mental Health and Addiction Services	3	$55,002,995	0	$0
Public Safety	0	$0	1	$212,277
Transportation	26	$5,884,049	0	$0
Ohio History Connection	0	$0	1	$1,132,400

Hancock County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	17	$3,299,548
Public Safety	3	$10,302,327	1	$462,997
Transportation	19	$5,275,066	11	$708,400

Hardin County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	1	$5,500
Transportation	12	$3,013,095	0	$0

Harrison County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Ohio Historical Society	0	$0	2	$22,695
Natural Resources	0	$0	4	$1,570,572
Transportation	26	$6,944,911	7	$275,048

Henry County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	25	$2,642,000
Transportation	13	$2,547,412	0	$0

Highland County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	51	$5,544,494
Ohio Historical Society	0	$0	2	$67,993
Transportation	6	$8,833,500	0	$0

Hocking County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	141	$13,246,699
Transportation	13	$2,902,923	6	$501,542

Holmes County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Transportation	23	$8,964,361	3	$107,789

Huron County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	2	$3,143,865	0	$0
Natural Resources	0	$0	1	$55,000
Public Safety	1	$3,003,021	0	$0
Transportation	18	$3,616,370	3	$184,989

Jackson County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	21	$2,077,834
Public Safety	3	$9,247,106	0	$0
Transportation	11	$2,945,648	5	$2,160,137

Jefferson County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	13	$1,354,136
Ohio History Connection	0	$0	2	$1,748,450
Public Safety	1	$1,743,824	0	$0
Transportation	34	$5,418,577	5	$551,652

Knox County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Developmental Disabilities	20	$32,856,186	0	$0
Natural resources	0	$0	2	$58,750
Transportation	11	$5,477,191	0	$0

Lake County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	24	$5,721,625
Transportation	20	$5,337,835	6	$580,148

Lawrence County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	4	$275,125
Public Safety	2	$3,073,385	0	$0
Transportation	22	$5,651,315	0	$0

Licking County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	2	$3,966,103	0	$0
Agriculture	14	$82,002,539	0	$0
Commerce	6	$25,155,011	0	$0
Natural Resources	0	$0	17	$9,992,234
Ohio History Connection	0	$0	7	$752,576
Public Safety	1	$2,096,456	0	$0
Transportation	35	$39,159,284	6	$2,750,109

Logan County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	53	$5,140,530
Transportation	22	$5,554,474	7	$691,436

Lorain County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	1	$2,632,549	0	$0
Natural Resources	0	$0	24	$1,685,283
Public Safety	1	$2,989,909	0	$0
Rehabilitation and Corrections	70	$99,200,945	39	$4,857,598
Transportation	16	$4,006,212	7	$749,674

Lucas County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Administrative Services	1	$134,961,558	0	$0
Developmental Disabilities	15	$13,825,035	0	$0
Mental Health and Addiction Services	6	$39,106,204	0	$0
Natural Resources	0	$0	59	$52,802,770
Public Safety	1	$2,704,105	0	$0
Rehabilitation and Correction	13	$83,023,469	0	$0
Transportation	9	$2,153,922	0	$0

Madison County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Attorney General	7	$50,386,620	3	$457,232
Natural Resources	0	$0	13	$2,444,594
Public Safety	1	$2,899,940	0	$0
Rehabilitation and Corrections	73	$263,867,040	0	$0
Transportation	27	$3,751,630	11	$1,052,812

Mahoning County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	1	$6,591,063	0	$0
Developmental Disabilities	11	$11,441,954	0	$0
Job and Family Services	0	$0	1	$2,500,996
Natural Resources	0	$0	14	$1,220,250
Public Safety	1	$2,659,739	0	$0
Rehabilitation and Correction	11	$41,532,983	0	$0
Transportation	39	$9,344,436	0	$0
Ohio History Connection	0	$0	1	$7,255,333

Marion County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	4	$894,811
Public Safety	2	$3,474,101	0	$0
Rehabilitation and Correction	81	$118,203,547	0	$0
Transportation	16	$6,183,294	4	$274,869
Ohio History Connection	0	$0	5	$12,453,379

Medina County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	1	$9,788,642	0	$0
Natural Resources	0	$0	3	$131,288
Public Safety	1	$2,855,536	1	$216,749
Transportation	17	$3,676,936	7	$857,739

Meigs County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	20	$1,340,630
Transportation	13	$3,986,061	8	$198,600

Mercer County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	2	$349,500
Transportation	24	$5,649,522	0	$0

Miami County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	2	$4,733,083	0	$0
Transportation	20	$4,560,303	8	$593,804
Ohio History Connection	0	$0	12	$3,215,865

Monroe County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	2	$4,671,825	0	$0
Transportation	16	$3,042,720	7	$201,319

Montgomery County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	1	$15,375,211	0	$0
Developmental Disabilities	13	$7,954,521	0	$0
Natural Resources	0	$0	5	$908,125
Public Safety	2	$6,143,782	0	$0
Rehabilitation and Correction	17	$40,505,608	0	$0
Transportation	34	$6,390,774	0	$0
Ohio History Connection	0	$0	7	$4,334,508

Morgan County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	86	$19,983,433
Transportation	8	$3,101,447	2	$42,797

Morrow County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	15	$537,625
Public Safety	1	$2,414,474	0	$0
Transportation	19	$3,891,747	0	$0

Muskingum County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	79	$5,932,694
Ohio History Connection	0	$0	1	$2,171,200
Public Safety	1	$2,525,827	0	$0
Transportation	20	$5,200,863	0	$0

Noble County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	9	$554,025
Rehabilitation and Corrections	14	$43,878,793	4	$3,162,988
Transportation	14	$2,170,667	0	$0
State Library of Ohio	2	$3,391,692	0	$0

Ottawa County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	52	$57,636,943	0	$0
Natural Resources	0	$0	110	$33,741,630
Transportation	22	$2,316,252	4	$5,273,481

Paulding County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Transportation	2	$577,267	0	$0

Perry County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	2	$82,500
Transportation	14	$3,266,059	0	$0

Pickaway County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	72	$37,142,046
Public Safety	1	$1,851,990	0	$0
Rehabilitation and Corrections	108	$176,288,498	0	$0
Transportation	14	$2,951,664	4	$193,470
Youth Services	8	$13,329,357	0	$0

Pike County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	66	$7,720,584
Transportation	8	$2,620,816	4	$1,725,682

Portage County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	71	$14,388,841
Public Safety	1	$3,847,973	0	$0
Transportation	19	$2,682,914	8	$1,659,139

Preble County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	77	$19,702,675
Public Safety	0	$0	1	$212,756
Transportation	23	$4,624,095	10	$1,627,198

Putnam County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
	15	$2,763,489	0	$0

Richland County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	42	$11,118,000
Public Safety	2	$2,891,337	0	$0
Rehabilitation and Corrections	49	$100,697,084	0	$0
Transportation	20	$4,927,589	5	$963,234

Ross County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	115	$6,488,949
Ohio History Connection	0	$0	10	$5,720,083
Public Safety	1	$2,779,894	0	$0
Rehabilitation and Corrections	112	$239,522,498	0	$0
Transportation	21	$17,683,028	0	$0

Sandusky County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	7	$1,426,250
Public Safety	1	$2,570,826	0	$0
Transportation	13	$2,194,243	0	$0

Scioto County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	66	$20,497,157
Public Safety	1	$2,497,787	0	$0
Rehabilitation and Corrections	27	$159,073,472	0	$0
Transportation	19	$5,053,231	3	$988,716

Seneca County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	1	$2,616,121	0	$0
Developmental Disabilities	38	$26,155,953	0	$0
Natural Resources	0	$0	8	$1,165,000
Transportation	8	$4,021,906	0	$0

Shelby County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	24	$2,826,900
Transportation	34	$26,176,043	0	$0
Ohio History Connection	0	$0	0	$9,096

Stark County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	2	$18,515,162	0	$0
Mental Health and Addiction Services	10	$28,421,035	0	$0
Natural Resources	0	$0	4	$3,781,250
Public Safety	4	$14,170,888	0	$0
Transportation	19	$3,729,741	0	$0
Youth Services	2	$34,573,514	0	$0

Summit County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	3	$23,037,060	0	$0
Administrative Services	1	$52,502,992	1	$2,252,552
Attorney General	1	$13,939,187		
Mental Health and Addiction Services	6	$73,063,158	0	$0
Natural Resources	0	$0	33	$6,560,210
Ohio History Connection	0	$0	1	$755,000
Transportation	53	$35,498,827	12	$1,591,928

Trumbull County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Natural Resources	0	$0	53	$4,200,833
Public Safety	5	$8,592,937	1	$213,230
Rehabilitation and Corrections	20	$36,797,342	0	$0
Transportation	32	$7,755,534	3	$332,800

Tuscarawas County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	1	$3,379,607	0	$0
Ohio History Connection	0	$0	50	$8,970,141
Public Safety	1	$3,344,347	0	$0
Transportation	47	$47,159,496	0	$0

Union County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Adjutant General	1	$8,794,356	0	$0
Public Safety	2	$2,752,386	0	$0
Rehabilitation and Corrections	29	$72,150,270	0	$0
Transportation	19	$3,761,949	6	$341,758

Van Wert County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	1	$3,340,536	1	$217,198
Transportation	11	$3,181,009	8	$553,400

Vinton County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	124	$21,690,842
Transportation	16	$3,074,322	0	$0

Warren County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	1	$3,109,675	0	$0
Natural Resources	0	$0	46	$3,294,512
Ohio History Connection	0	$0	14	$3,836,260
Public Safety	1	$2,817,310	0	$0
Rehabilitation and Corrections	77	$118,452,479	0	$0
Transportation	28	$23,216,005	10	$1,625,198

Washington County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	7	$190,224
Ohio History Connection	0	$0	11	$12,332,145
Public Safety	1	$2,147,441	0	$0
Transportation	45	$19,664,219	12	$685,936

Wayne County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	1	$2,452,183	0	$0
Natural Resources	0	$0	3	$504,977
Public Safety	2	$3,193,830	0	$0
Transportation	0	$0	6	$1,044,108

Williams County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	6	$1,533,750
Transportation	10	$4,071,906	0	$0

Wood County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Adjutant General	2	$25,649,483	0	$0
Attorney General	1	$14,900,000	0	$0
Natural Resources	0	$0	1	$40,250
Ohio History Connection	0	$0	13	$442,296
Public Safety	1	$3,268,409	1	$412,997
Transportation	29	$15,647,385	10	$6,200,651

Wyandot County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Natural Resources	0	$0	5	$889,550
Ohio History Connection	0	$0	1	$155,550
Transportation	18	$9,513,296	18	$1,631,750

Please note these data were obtained from Administrative Services for use in this plan development. Ohio EMA did not produce or maintain these data, and therefore do not guarantee their accuracy.

Site specific information was omitted from this summary for security purposes. For additional information, please contact the Ohio EMA Mitigation Branch.

Appendix C - State-Leased Critical and Non-Critical Facilities

Adams County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$55,406

Allen County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Bureau of Workers' Compensation	0	$0	1	$785,217
Public Safety	0	$0	1	$71,149
Industrial Commission	1	$106,416	0	$0

Ashland County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$51,787

Ashtabula County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$51,787

Athens County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Broadcast Educational Media Commission	1	$203,366	0	$0
Public Safety	0	$0	1	$43,211
Public Defender Commission	0	$0	1	$97,500

Auglaize County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$46,913

Belmont County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	2	$65,489

Brown County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$59,053
Transportation	1	$625,000	0	$0

Butler County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	4	$198,726

Carroll County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$198,726

Champaign County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$37,988

Clark County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	2	$72,425

Clermont County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	3	$135,681

Clinton County

Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$419,685

Columbiana County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$48,841

Coshocton County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$30,605
Transportation	1	$1,250,000	0	$0

Crawford County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$30,487

Cuyahoga County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Broadcast Educational Media Commission	1	$203,366	1	$15,434
Bureau of Workers Compensation	0	$0	1	$1,583,205
Civil Rights Commission	0	$0	1	$41,020
Department of Commerce	0	$0	1	$890
Department of Job and Family Services	0	$0	1	$27,839
Department of Public Safety	0	$0	5	$990,395
Department of Youth Services	0	$0	1	$49,851
Industrial Commission	0	$0	1	$403,457
Office of the Attorney General	0	$0	1	$854,382

Darke County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$27,080

Defiance County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$24,259

Delaware County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	2	$129,094

Erie County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$34,154

Fairfield County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	2	$127,985

Fayette County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	0	1	$44,150
Transportation	5	$608,500	0	0

Franklin County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Accountancy Board of Ohio	0	$0	1	$7,916
Air Quality Development Authority	0	$0	1	$74,000
Board of Chiropractic Examiners	0	$0	1	$15,930
Board of Embalmers and Funeral Directors	0	$0	1	$99,238
Board of Examiners of Architects	0	$0	1	$16,663
Board of Optometry	0	$0	1	$0
Board of Pharmacy	0	$0	1	$240,914
Board of Psychology	0	$0	1	$33,770
Board of Tax Appeals	0	$0	1	$126,065
Broadcast Educational Media Commission	4	$5,245,000	5	$1,410,276
Bureau of Workers Compensation	0	$0	2	$2,376,179
Commission on Minority Health	0	$0	1	$78,097
Commission on Service & Volunteerism	0	$0	1	$6,795
Counselors & Social Workers Board	0	$0	1	$23,298
Dental Board	0	$0	1	$26,337
Department of Administrative Services	1	$4,508,976	2	$4,405,515
Department of Aging	0	$0	1	$272,973
Department of Commerce	0	$0	1	$5,210,917
Department of Developmental Disabilities	0	$0	1	$58,170
Department of Education	0	$0	2	$3,222,519
Department of Health	0	$0	3	$18,498,121
Department of Higher Education	0	$0	2	$409,648
Department of Insurance	1	$6,494,001	0	$0
Department of Job and Family Services	0	$0	3	$7,411,404
Department of Mental Health and Addiction Services	0	$0	1	$7,000
Department of Public Safety	0	$0	5	$106,406
Department of Rehabilitation and Correction	0		1	$2,808,780
Department of Taxation	1	$11,000,000	2	$7,330,963
Department of Veterans Services	0	$0	1	$135,224
Department of Youth Services	0	$0	2	$966,862
Development Services Agency	0	$0	1	$5,264,289
Employment Relations Board	1	$475,046	0	$0
Engineers & Surveyors Board	0	$0	1	$7,586

Environmental Protection Agency	0	$0	1	$200,229
Industrial Commission	1	$206,383	25	$4,086,774
Inspector General	0	$0	1	$342,645
Judicial Supreme Court	0	$0	1	$350,446
Legislative Service Commission	0	$0	3	$4,908,343
Liquor Control Commission	0	$0	1	$24,532
Medical Board	0	$0	1	$209,745
Motor Vehicle Collision Repair Board	0	$0	1	$12,680
Occupational and Physical Therapy Board	0	$0	1	$116,724
Office of Budget and Management	0	$0	2	$937,065
Office of the Attorney General	0	$0	1	$4,541,003
Office of the Consumers' Counsel	1	$985,000	2	$32,338
Office of the Governor	0	$0	1	$128,028
Ohio Facilities Construction Commission	0	$0	1	$4,469
Ohio Housing Finance Agency	1	$3,153,170	0	$0
Ohio Secretary of State	1	$1,371,351	0	$0
Ohio Treasurer of State	0	$0	2	$4,818,229
Opportunities for Ohioans With Disabilities Agency	0	$0	1	$100,000
Public Defender Commission	0	$0	1	$1,600,000
Racing Commission	0	$0	1	$82,100
Spanish Speaking Affairs Commission	0	$0	1	$9,917
State Cosmetology and Barber Board	0	$0	1	$929,203
State Library of Ohio	0	$0	1	$25,023
The Ohio Senate	1	$1,053,455	0	$0
Veterinary Medical Board	0	$0	1	$33,738

Fulton County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$67,554

Gallia County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$38,043

Geauga County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$50,737

Greene County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Broadcast Educational Media Commission	2	$30,868	1	$48,912
Public Safety	0	$0	1	$75,729

Transportation	1	$1,125,000	0	$0
Industrial Commission	1	$210,467	0	$0

Guernsey County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Bureau of Workers Compensation	0	$0	1	$432,556
Department of Public Safety	0	$0	1	$59,969
Industrial Commission	1	$165,562	0	$0

Hamilton County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Broadcast Educational Media Commission	1	$209,366	1	$15,434
Bureau of Workers Compensation	0	$0	1	$1,304,591
Department of Administrative Services	1	$2,669,002	0	$0
Department of Public Safety	0	$0	3	$270,117
Industrial Commission	1	$288,968	0	$0

Hancock County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$37,171

Hardin County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$49,005
Transportation	1	$20,000	0	0

Harrison County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$46,382

Henry County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$54,378

Highland County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$39,235

Southern Ohio Agricultural & Community Development	1	$145,600	0	$0

Hocking County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$106,956
Industrial Commission	1	$172,150	0	$0

Holmes County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$36,342

Huron County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$45,858

Jackson County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$46,916

Jefferson County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	2	$82,088

Knox County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Pubic Safety	0	$0	1	$36,976

Lake County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	2	$117,015

Lawrence County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$34,434

Licking County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Commerce	1	$10,000,000	0	$0
Public Safety	0	$0	2	$128,831
Environmental Protection Agency	1	$3,363,695	0	$0

Logan County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$32,372

Lorain County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	4	$160,728

Lucas County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Broadcast Educational Media Commission	1	$203,366	0	$0
Civil Rights Commission	0	$0	1	$75,806
Department of Health	0	$0	1	$297,772
Department of Job and Family Services	0	$0	1	$26,213
Department of Public Safety	0	$0	4	$165,495
Department of Youth Services	0	$0	1	$47,586
Industrial Commission	0	$0	1	$228,901
Office of the Attorney General	0	$0	1	$279,497

Madison County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$54,644

Mahoning County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Broadcast Educational Media Commission	1	$15,434	0	$0
Public Safety	0	$0	0	$15,434

Marion County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$87,996

Medina County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	3	$35,664
Transportation	1	$200,000	0	$0

Meigs County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$39,508

Mercer County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$32,253

Miami County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$49,112

Monroe County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$48,917

Montgomery County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Broadcast Educational Media Commission	2	$248,600	1	$15,434
Bureau of Workers Compensation	0	$0	1	$683,414
Public Safety	0	$0	5	$213,764

Morgan County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$41,739

Morrow County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$25,707

Muskingum County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$65,613

Noble County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$40,702

Ottawa County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$67,529

Paulding County

Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$38,342

Perry County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$41,314

Pickaway County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$65,219

Pike County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$24,534

Portage County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Broadcast Educational Media Commission	2	$214,600	0	$0
Public Safety	0	$0	1	$61,748
Transportation	1	$20,000	0	$0

Preble County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$52,707

Putnam County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$12,384

Richland County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Bureau of Workers Compensation	0	$0	1	$740,949
Public Safety	0	$0	1	$55,533
Industrial Commission	0	$0	1	$117,349

Ross County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$39,988
Transporation	1	$937,500	0	$0
Public Defender Commission	0	$0	1	$122,500

Sandusky County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$54,183

Scioto County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Broadcast Educational Media Commission	0	$0	1	$15,434
Bureau of Workers Compensation	0	$0	1	$501,173
Department of Public Safety	0	$0	1	$43,944
Industrial Commission	1	$122,770	0	$0

Seneca County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$50,077

Shelby County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
No state-leased facilities in this county				

Stark County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Bureau of Workers Compensation	0	$0	1	$994,955
Public Safety	0	$0	4	$162,657

Summit County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Broadcast Educational Media Commission	0	$0	1	$15,434
Civil Rights Commission	0	$0	1	$55,520
Department of Health	0	$0	1	$54,587
Job and Family Services	0	$0	1	$35,079
Public Safety	0	$0	3	$151,869
Rehabilitation and Correction	0	$0	1	$2,545
Youth Services	0	$0	1	$36,534
Industrial Commission	0	$0	1	$295,109

Trumbull County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Bureau of Workers Compensation	0	$0	2	$946,278
Public Safety	0	$0	1	$12,732
Industrial Commission	1	$300,300	1	$30,060
Public Defender Commission	0	$0	1	$62,500

Tuscarawas County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	2	$71,722

Union County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$67,647

Van Wert County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$28,524

Vinton County				
Agency/Department	**Number of Critical Facilities**	**Value of Building/Contents**	**Number of Non-Critical Facilities**	**Value of Building/Contents**
Public Safety	0	$0	1	$47,161

Warren County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	3	$108,011

Washington County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$70,233
Public Defender Commission	0	$0	1	$64,000

Wayne County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Broadcast Educational Media Commission	1	$31,907	0	$0
Public Safety	0	$0	2	$84,626

Williams County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$30,022

Wood County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Broadcast Educational Media Commission	1	$199,166	0	$0
Public Safety	0	$0	1	$47,231

Wyandot County				
Agency/Department	Number of Critical Facilities	Value of Building/Contents	Number of Non-Critical Facilities	Value of Building/Contents
Public Safety	0	$0	1	$50,678

Please note these data were obtained from Administrative Services for use in this plan development. Ohio EMA did not produce or maintain these data, and therefore do not guarantee their accuracy.

Site specific information was omitted from this summary for security purposes. For additional information, please contact the Ohio EMA Mitigation Branch.

County	Approval Pending Adoption	Final Approval Date	Plan Expiration Date	Plan Exp. Status	Days Until Expiration (As of 2/6/2019)	Grant Status	APA STATUS
ADAMS	3/12/2010	4/23/2010	4/16/2015	Expired	-1509	PDMC-2017	
ALLEN	5/26/2016	6/3/2016	6/3/2021	Active	731		
ASHLAND	5/7/2015	8/31/2015	8/31/2020	Active	455		
ASHTABULA	8/30/2012	12/30/2013	12/30/2018	Expired	-155	PDMC-2017	
ATHENS	1/12/2015	6/9/2015	3/4/2020	Active	275	HMGP 4360	
AUGLAIZE	12/4/2018	1/4/2019	1/4/2024	Active	1676		
BELMONT	10/17/2013	2/3/2014	2/3/2019	Expired	-120	PDMC-2017	
BROWN	10/11/2017	10/26/2017	10/26/2022	Active	1241		
BUTLER	12/21/2017	3/26/2018	3/25/2023	Active	1391		
CARROLL	4/27/2005	1/12/2007	1/12/2012	Expired	-2699	Without Grant- Contractor	
CHAMPAIGN	4/12/2005	6/12/2006	6/12/2011	Expired	-2913	PDMC-2017	
CLARK	10/9/2013	11/5/2013	11/5/2018	Expired	-210	PDMC-2017	
CLERMONT	12/30/2013	3/12/2014	3/12/2019	Expired	-83	PDMC-2017	
CLINTON	2/12/2016	3/1/2016	3/1/2021	Active	637		
COLUMBIANA	7/7/2014	3/22/2016	12/18/2019	Active	198	PDMC-2017	
COSHOCTON	9/7/2010	11/24/2010	11/24/2015	Expired	-1287	PDMC-2017	
CRAWFORD	10/21/2014	11/5/2014	11/5/2019	Active	155	HMGP 4360	
CUYAHOGA	8/18/2017	9/19/2017	9/19/2022	Active	1204		
DARKE	9/21/2011	11/7/2011	11/6/2016	Expired	-939	PDMC-2016	
DEFIANCE	10/10/2017	10/10/2017	10/10/2022	Active	1225		
DELAWARE	3/12/2014	7/16/2014	5/22/2019	Expired	-12	PDMC-2017	
ERIE	12/12/2014	1/30/2015	1/29/2020	Active	240	HMGP 4360	
FAIRFIELD	9/19/2017	3/5/2018	1/15/2023	Active	1322		
FAYETTE	2/11/2015	3/6/2015	3/6/2020	Active	277	HMGP 4360	
FRANKLIN	9/19/2018	12/28/2018	12/28/2023	Active	1669	PDMC-2016	
FULTON	8/3/2015	9/30/2015	9/30/2020	Active	485		
GALLIA	12/2/2013	1/13/2014	1/13/2019	Expired	-141	PDMC-2017	
GEAUGA	5/7/2015	9/15/2015	9/15/2020	Active	470		
GREENE	8/7/2015	10/9/2015	9/30/2020	Active	485	HMGP 4360	
GUERNSEY	1/3/2018	1/11/2013	1/11/2018	Expired	-508	Without Grant	Yes
HAMILTON	9/4/2018	9/28/2018	9/27/2023	Active	1577	PDMC-2016	
HANCOCK	1/13/2014	2/3/2014	2/3/2019	Expired	-120	PDMC-2017	
HARDIN	3/8/2018	3/26/2018	3/26/2023	Active	1392		
HARRISON	2/23/2016	5/10/2016	5/10/2021	Active	707		
HENRY	12/4/2018	11/8/2012	10/17/2017	Expired	-594	PDMC-2016	Yes
HIGHLAND	2/14/2006	4/25/2007	4/24/2012	Expired	-2596	PDMC-2017	
HOCKING	6/6/2005	8/30/2005	8/30/2010	Expired	-3199	Without Grant- In house	
HOLMES	7/24/2014	9/15/2014	9/15/2019	Active	104	HMGP 4360	
HURON	11/30/2011	3/8/2012	3/8/2017	Expired	-817	PDMC-2016	
JACKSON	10/26/2017	12/8/2017	12/8/2022	Active	1284		
JEFFERSON	7/7/2014	1/8/2015	10/29/2019	Active	148		
KNOX	4/28/2015	5/21/2015	5/21/2020	Active	353	HMGP 4360	
LAKE	3/6/2017	8/18/2017	8/18/2022	Active	1172		
LAWRENCE	5/13/2015	7/24/2015	7/14/2020	Active	407	HMGP 4360	
LICKING	11/20/2013	3/4/2014	3/4/2019	Expired	-91	HMGP 4360	
LOGAN	3/13/2018	4/30/2018	4/30/2023	Active	1427	PDMC-2015	
LORAIN	3/10/2015	5/21/2015	5/21/2020	Active	353	HMGP 4360	
LUCAS	3/22/2013	9/6/2013	4/22/2018	Expired	-407	PDMC-2016	
MADISON	12/23/2013	2/3/2014	2/3/2019	Expired	-120	PDMC-2017	
MAHONING	10/24/2012	4/24/2013	4/24/2018	Expired	-405	PDMC-2016	
MARION	6/25/2014	7/16/2014	7/16/2019	Active	43	PDMC-2017	
MEDINA	12/30/2011	2/16/2012	2/16/2017	Expired	-837	PDMC-2016	

MEIGS	9/17/2018	11/29/2018	11/29/2023	Active	1640		
MERCER	9/5/2017	10/6/2017	10/6/2022	Active	1221		
MIAMI	3/13/2018	5/31/2018	5/31/2023	Active	1458	PDMC-2015	
MONROE	9/22/2014	3/4/2015	3/4/2020	Active	275	HMGP 4360	
MONTGOMERY	12/17/2013	4/15/2014	4/15/2019	Expired	-49		
MORGAN	3/25/2013	4/9/2013	4/9/2018	Expired	-420	HMGP 4360	
MORROW	8/24/2018	11/29/2018	11/29/2023	Active	1640	PDMC-2016	
MUSKINGUM	3/5/2018	4/30/2018	4/30/2023	Active	1427	PDMC-2015	
NOBLE	10/29/2014	11/5/2014	11/5/2019	Active	155	HMGP 4360	
OTTAWA	6/16/2017	6/23/2017	6/23/2022	Active	1116		
PAULDING	6/11/2018	6/26/2018	6/26/2023	Active	1484	PDMC-2015	
PERRY	6/12/2017	11/20/2017	11/20/2022	Active	1266		
PICKAWAY	4/26/2013	7/16/2014	7/16/2019	Active	43	HMGP 4360	
PIKE	3/14/2007	3/16/2007	3/15/2012	Expired	-2636	PDMC-2017	
PORTAGE	2/23/2016	4/1/2016	4/1/2021	Active	668	HMGP 4360	
PREBLE	10/12/2018	10/16/2018	10/16/2023	Active	1596	PDMC-2016	
PUTNAM	8/7/2015	9/30/2015	9/30/2020	Active	485	HMGP 4360	
RICHLAND	6/16/2017	6/23/2017	6/23/2022	Active	1116		
ROSS	6/27/2011	8/11/2011	8/10/2016	Expired	-1027	PDMC-2017	
SANDUSKY	5/18/2015	6/8/2015	6/8/2020	Active	371	HMGP 4360	
SCIOTO	8/14/2014	9/21/2014	9/21/2019	Active	110	HMGP 4360	
SENECA	12/29/2014	1/8/2015	1/8/2020	Active	219	HMGP 4360	
SHELBY	10/23/2017	11/8/2017	11/8/2022	Active	1254		
STARK	10/23/2017	10/23/2017	10/23/2022	Active	1238		
SUMMIT	12/31/2013	4/15/2014	4/15/2019	Expired	-49	Without Grant- In house	
TRUMBULL	10/19/2011	3/8/2012	3/8/2017	Expired	-817	PDMC-2017	
TUSCARAWAS	6/16/2017	8/3/2017	8/3/2022	Active	1157		
UNION	6/11/2018	8/22/2018	8/22/2023	Active	1541		
VAN WERT	7/30/2014	8/21/2014	8/21/2019	Active	79	HMGP 4360	
VINTON	6/16/2016	7/11/2016	7/11/2021	Active	769		
WARREN	10/9/2015	1/11/2016	1/11/2021	Active	588		
WASHINGTON	8/24/2016	8/25/2016	8/25/2021	Active	814		
WAYNE	5/29/2018	7/2/2018	7/2/2023	Active	1490	PDMC-2016	
WILLIAMS	6/14/2013	6/28/2013	6/28/2018	Expired	-340	PDMC-2017	
WOOD	8/24/2018	9/13/2018	9/12/2023	Active	1562		
WYANDOT	10/17/2017	1/5/2018	1/5/2023	Active	1312		

APPENDIX E: 2014 MITIGATION ACTION PLAN TABLE

Action	Goal / Objective Reference	Hazard	Lead Agency	Priority	Status	% Complete
1. Build on the success of the Risk MAP Areas of Mitigation Interest (AOMI) pilot project by continuing to utilize SHARPP to map areas of mitigation interest.	Goal 1, Obj 1	Flood	Ohio EMA Mitigation Branch	C	FEMA created a national database to capture AOMI data so this action is considered completed.	100%
2. Conduct HAZUS Level 2 flood analyses for all Counties in Region 2 using Ohio Statewide Imagery Program data and corresponding Digital Flood Insurance Rate Map data.	Goal 1, Obj 1	Multi	Ohio EMA Mitigation Branch	C	Ohio EMA worked with the USACE to complete HAZUS Level 2 flood analyses for counties in planning Region 2. The project was funded through the USACE Silver Jackets program and the results were incorporated into the 2019 SOHMP update.	100%
3. Continue to update and improve the vulnerability analysis for state-owned buildings and critical facilities.	Goal 1, Obj 1	Multi	Ohio EMA Mitigation Branch	C	Obtained updated state-owned and state-leased facility information from DAS; obtained supplemental data (HSIP Gold) from FEMA; developed vulnerability analysis methodologies for	Ongoing

Action	Goal / Objective Reference	Hazard	Lead Agency	Priority	Status	% Complete
					each hazard; analyzed all spatial hazards; generated maps/tables depicting results of analyses.	
4. Work with USGS, NOAA, and other partners to promote flood warning systems and stream/rain gauges.	Goal 1, Obj 2	Flood	Ohio EMA Mitigation Branch	C	Mitigation staff developed an HMGP application that is specific to 5% projects that includes guidance on warning systems.	100%
5. Reduce the number of pre-FIRM, flood prone properties each year by assisting such owners with successful funding of mitigation projects through FEMA mitigation programs.	Goal 1, Obj 3	Flood	Ohio EMA Mitigation Branch	A	Ongoing effort through the administration and implementation of FEMA HMA programs and other mitigation funding sources. According to SHARPP, 1,525 properties have been mitigated in Ohio using HMA programs.	Ongoing
6. Inspect all Class I-III dams once every 5 years.	Goal 1, Obj 4	Dam Failure	ODNR-DDS	B	The Dam Safety Program has recently expanded the number of dams that will be inspected every 5 years to include Class II-III dams.	Ongoing
7. Take enforcement actions on violations of state dam/levee safety	Goal 1, Obj 4	Dam Failure	ODNR-DDS	B	Notices of Violation are issued for deficiencies identified	Ongoing

Action	Goal / Objective Reference	Hazard	Lead Agency	Priority	Status	% Complete
laws for severely deficient and/or structurally unsound high hazard dams.					during inspections. The Dam Safety Program provides technical assistance to remedy deficiencies.	
8. Increase the number of Emergency Action Plans through compliance and education efforts.	Goal 1, Obj 4	Dam Failure	ODNR-DDS	B	All ODNR-owned Class I dams have EAPs. Efforts to increase EAPs statewide continues.	Ongoing
9. Continue to implement and improve the Ohio Safe Room Rebate Program.	Goal 1, Obj 5	Wind	Ohio EMA Mitigation Branch	B	The Safe Room Rebate Program is in its 6th year. As of Dec. 2018, the program has funded 352 safe rooms across the state; 184 have been completed to date and 168 are pending. The application website was also recently modernized.	Ongoing
10. Develop wind mitigation educational materials and outreach programs for vulnerable populations.	Goal 1, Obj 6	Wind	Ohio EMA Mitigation Branch	C	The state utilized an HMGP grant to purchase a mobile safe room display and accompanying signage. The display is available for counties to borrow and use public events.	100%

Action	Goal / Objective Reference	Hazard	Lead Agency	Priority	Status	% Complete
11. Promote the adoption of standards beyond NFIP minimums for flood loss reduction.	Goal 2, Obj 1	Flood	ODNR-DOW, FPM	B	As of 2018, there are 415 communities with higher standards.	Ongoing
12. Continue to participate in the public/private partnership effort between Ohio EMA and the business community.	Goal 2, Obj 2	Multi	Ohio EMA Mitigation Branch	C	New action item.	0%
13. Invite at least two additional entities each year to participate on the SHMT.	Goal 3, Obj 1	Multi	SHMT	C	In the last year, two new members joined and actively participate on the SHMT.	Ongoing
14. Continue inter-agency participation on the USACE Silver Jackets Initiative.	Goal 3, Obj 2	Flood	SHMT	C	The Ohio Silver Jackets Team continues to meet quarterly. The team has tackled multiple projects including: 1) HAZUS Level 2 project, 2) multi-media flood awareness campaigns, 3) loss avoidance studies, and others.	Ongoing
15. Develop and implement strong state incentives for maintaining local mitigation plans.	Goal 3, Obj 2	Multi	Ohio EMA	C	Despite several attempts, the Mitigation Branch has not successfully completed this task. Efforts will continue.	10%

Action	Goal / Objective Reference	Hazard	Lead Agency	Priority	Status	% Complete
16. Participate in FEMA's Risk MAP Outreach initiatives by facilitating local discussions on hazard mitigation	Goal 3, Obj 2	Multi	Ohio EMA Mitigation Branch	C	During the last planning cycle, Ohio EMA partnered with ODNR and FEMA on multiple Risk MAP initiatives.	Ongoing
17. Provide training to local county EMA Directors and mitigation plan keepers on entering local plan data into the State Hazard Analysis, Resource, and Planning Portal (SHARPP).	Goal 3, Obj 3	Multi	Ohio EMA Mitigation Branch	C	The State Hazard Mitigation Planner provides technical assistance to counties and contractors as needed.	Ongoing
18. Conduct training and/or post-disaster briefings for appropriate audiences on substantial damage assessments	Goal 4, Obj 1	Flood	ODNR-DOW, FPM	A	Multiple SD trainings were offered at the OFMA conferences and 5 Regional workshops are planned for 2019.	Ongoing
19. Develop and implement an outreach strategy targeting repetitive loss property owners on mitigation techniques and funding programs.	Goal 4, Obj 2	Flood	Ohio EMA Mitigation Branch	C	Ohio EMA received FMA technical assistance grants in 2016 and 2017 to conduct outreach to property owners and communities on mitigation techniques and funding programs. This outreach has resulted in multiple project applications.	Ongoing

Action	Goal / Objective Reference	Hazard	Lead Agency	Priority	Status	% Complete
20. Reduce the number of severe repetitive loss properties by 5% each year by assisting such owners with successful funding of mitigation projects through FEMA mitigation programs	Goal 4, Obj 3	Flood	Ohio EMA Mitigation Branch	A		Ongoing
21. Develop success stories in wind resistant construction codes and mitigation techniques.	Goal 5, Obj 1	Tornado	Ohio EMA Mitigation Branch	C	Mitigation Branch staff has developed multiple presentations highlighting successful community and residential safe room projects. The presentations also highlight recent state building code changes requiring tornado safe rooms in schools, EOCs, and other critical facilities.	50%
22. Work with stakeholders interested in expanding knowledge of earthquake risk.	Goal 5, Obj 1	Earthquake	Ohio EMA Mitigation Branch	C	In 2019, the Mitigation Branch will participate in an earthquake table top exercise.	100%
23. Ohio EMA will continue to actively participate on the Ohio Committee for Severe Weather Awareness.	Goal 5, Obj 1	Multi-hazard	Ohio EMA Mitigation Branch	C	The State Hazard Mitigation Officer is an active participant on this committee.	Ongoing

Action	Goal / Objective Reference	Hazard	Lead Agency	Priority	Status	% Complete
24. Continue to maintain, populate, and enhance the State Hazard Analysis Resource and Planning Portal.	Goal 5, Obj 2	Multi	Ohio EMA Mitigation Branch	C	The Mitigation Branch will initiate a project in early 2019 to modernize the website and enhance the hazard and risk data available.	Ongoing
25. Add a range of mitigation focused web-based training courses to the State Hazard Analysis Resource and Planning Portal (SHARPP).	Goal 5, Obj 2	Multi	Ohio EMA Mitigation Branch	C	The Mitigation Branch has not prioritized this action but hopes to make progress during the next planning cycle.	0%
26. Develop a Mitigation and Recovery Branch internship program.	Goal 5, Obj 3	Multi	Ohio EMA	C	The Mitigation Branch has worked with OSU CRP to develop a very successful internship program.	100%
27. Continue to support efforts to comply with the Emergency Management Accreditation Program (EMAP).	Goal 6, Obj 1	Multi	Ohio EMA Mitigation Branch	C	Ohio EMA was re-accredited in 2014 and is preparing for re-accreditation again in February 2019. SHARPP was highlighted as a best practice in 2014.	Ongoing
28. Continue participation on emergency management and floodplain association workgroups.	Goal 6, Obj 1	Multi	Ohio EMA Mitigation Branch	C	The ASFPM conference will be in Cleveland in 2019. Mitigation Branch staff are actively involved in OFMA and the APA.	Ongoing

Summary of FEMA Mitigation Program Funding - State of Ohio

Program	Federal Share	State Share	Local Share	Program Total
HMGP-870	$630,000	$630,000	$0	$1,260,000
HMGP-951	$250,000	$0	$383,300	$633,300
HMGP-1065	$721,500	$0	$217,867	$939,367
HMGP-1097	$1,721,655	$208,624	$1,020,833	$2,951,112
HMGP-1122	$1,137,951	$2,702,960	Data Not Available	$3,840,911
HMGP-1164	$9,083,056	$3,490,605	$3,190,065	$15,763,726
HMGP-1227	$5,426,834	$3,283,373	$3,271,089	$11,981,296
HMGP-1321	$297,310	$289,745	$50,000	$637,055
HMGP-1339	$847,417	$231,223	$316,739	$1,395,379
HMGP-1343	$329,512	$52,247	$173,301	$555,060
HMGP-1390	$863,898	$718,518	$327,494	$1,909,910
HMGP-1444	$139,068	$37,209	$9,145	$185,422
HMGP-1453	$2,048,689	$2,071,335	$1,133,366	$5,253,390
HMGP-1478	$32,021	$9,568	$8,000	$49,589
HMGP-1484	$4,230,606	$163,932	$1,404,717	$5,799,255
HMGP-1507	$752,424	$164,804	$162,252	$1,079,480
HMGP-1519	$2,109,464	$787,072	$442,869	$3,339,405
HMGP-1556	$2,484,734	$2,050,442	$1,529,262	$6,064,438
HMGP-1580	$7,193,257	$1,315,933	$1,130,177	$9,639,367
HMGP-1651	$1,679,616	$379,251	$293,121	$2,351,988
HMGP-1656	$2,777,449	$969,617	$411,471	$4,158,537
HMGP-1720	$4,480,109	$1,570,055	$565,676	$6,615,840
HMGP-1805	$4,713,715	$0	$1,466,944	$6,180,659
HMGP-4002	$4,510,493	$727,785	$778,210	$6,016,488
HMGP-4077	$3,135,380	$772,586	$2,341,730	$6,249,696
HMGP-4098*	$3,704,581	$617,431	$617,431	$4,939,443
HMGP-4360*	$6,939,178	$1,156,530	$1,156,530	$9,252,238
subtotal:	*$72,239,917*	*$24,400,845*	*$22,401,589*	*$119,042,351*
FMA 1996	$96,240	$25,313	$19,500	$141,053
FMA 1997	$109,260	$0	$36,420	$145,680
FMA 1998	$103,042	$0	$34,347	$137,389
FMA 1999	$229,000	$7,000	$74,000	$310,000
FMA 2000	$39,880	$6,960	$6,333	$53,173
FMA 2001	$220,800	$25,328	$66,853	$312,981
FMA 2002	$23,938	$11,458	$3,017	$38,413
FMA 2003	$348,914	$315,256	$160,335	$824,505
FMA 2004	$37,870	$12,623	$0	$50,493
FMA 2005	$97,529	$32,067	$0	$129,596
FMA 2006	$48,968	$8,457	$8,507	$65,932
FMA 2007	$1,654,286	$9,957	$541,977	$2,206,220
FMA 2008	$135,531	$4,504	$42,542	$182,577
FMA 2012	$52,083	$1,578	$15,783	$69,444
FMA 2013	$162,875	$0	$0	$162,875
FMA 2014	$1,127,604	$1,545	$62,834	$1,191,983
FMA 2015*	$1,651,251	$2,557	$25,568	$1,679,377
FMA 2016*	$2,103,872	$36,372	$197,058	$2,337,302
FMA 2017*	$3,381,706	$16,666	$986,073	$4,384,444
subtotal:	*$11,624,649*	*$517,641*	*$2,281,147*	*$14,423,437*

Summary of FEMA Mitigation Program Funding - State of Ohio				
Program	**Federal Share**	**State Share**	**Local Share**	**Program Total**
PDM 2002	$502,797	$304,238	$258,621	$1,065,656
PDM 2003	$238,966	$220,209	$147,419	$606,594
subtotal:	$741,763	$524,447	$406,040	$1,672,250
PDM-C 2003	$2,630,064	$77,422	$799,264	$3,506,750
PDM-C 2006	$1,603,955	$42,933	$492,084	$2,138,972
PDM-C 2007	$831,146	$139,584	$138,500	$1,109,230
PDM-C 2008	$49,174	$13,962	$4,312	$67,448
PDM-C 2009	$1,094,041	$33,164	$332,000	$1,459,205
PDM-C 2010	$4,614,169	$90,079	$1,346,570	$6,050,818
PDM-C 2011	$475,157	$7,927	$155,749	$638,833
PDM-C 2012	$1,025,240	$29,848	$321,913	$1,377,001
PDM-C 2013	$165,185	$11,745	$49,790	$226,720
PDM-C 2014	$655,874	$32,204	$193,712	$881,790
PDM-C 2015*	$637,931	$29,082	$183,563	$850,576
PDM-C 2016*	$2,669,838	$92,895	$808,748	$3,571,481
PDM-C 2017*	$1,792,525	$106,569	$490,940	$2,390,034
subtotal:	*$18,244,299*	*$707,414*	*$5,317,145*	*$24,268,858*
LPDM 2008	*$293,828*	*$8,858*	*$90,060*	*$392,746*
LPDM 2009	*$376,295*	*$9,960*	*$126,038*	*$512,293*
LPDM 2010	*$1,087,906*	*$37,013*	*$1,218,030*	*$2,342,949*
subtotal:	*$1,758,029*	*$55,831*	*$1,434,128*	*$3,247,988*
RFC 2007	$189,841	$0	$0	$189,841
RFC 2008	$318,062	$0	$0	$318,062
RFC 2010	$138,021	$0	$0	$138,021
RFC 2011	$412,473	$0	$0	$412,473
RFC 2012	$1,499,318	$0	$0	$1,499,318
subtotal:	*$2,557,715*	*$0*	*$0*	*$2,557,715*
SRL 2008	$112,705	$1,216	$12,181	$126,102
SRL 2009	$108,900	$1,100	$11,000	$121,000
subtotal:	*$221,605*	*$2,316*	*$23,181*	*$247,102*
DRU 2003	$100,000	$0	$33,333	$133,333
subtotal:	*$100,000*	*$0*	*$33,333*	*$133,333*
PI 1998	$500,000	$0	$166,667	$666,667
PI 1999	$300,000	$0	$100,000	$400,000
PI 2000	$300,000	$0	$100,000	$400,000
PI 2001	$500,000	$0	$166,667	$666,667
subtotal:	*$1,600,000*	*$0*	*$533,334*	*$2,133,334*
TOTAL:	**$109,087,978**	**$26,208,494**	**$32,429,896**	**$167,726,368**

Updated December 13, 2018
Data Not Available: Local share records either incomplete or unavailable.
* Projects are still ongoing within the funding source.

OHIO EMERGENCY MANAGEMENT AGENCY
MITIGATION AND RECOVERY BRANCH

ADMINISTRATIVE PLAN

for the

HAZARD MITIGATION GRANT PROGRAM (HMGP)

Updated for DR-4360-OH
DECLARED:
April 17, 2018

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I. STATEMENT OF PURPOSE

Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended, and the Disaster Mitigation Act of 2000, Public Law 106-390, establishes a cost-sharing Hazard Mitigation Grant Program (HMGP) used to fund state and local hazard mitigation projects. This section is closely tied to the post-disaster hazard mitigation plans defined and required in Section 322 of the Stafford Act, and is implemented following a Presidential declaration of a major disaster. Sections 322 and 404 of the Stafford Act, in combination with several other state and federal programs and activities, help to form an overall pre- and post-disaster hazard mitigation strategy for the State of Ohio and affected local governments in the State.

The purpose of this document is to delineate the general organization, staffing, policies, and procedures which the State of Ohio will use when administering Section 404 HMGP and Section 322 Hazard Mitigation planning requirements of the Stafford Act.

II. REFERENCES AND AUTHORITIES

A. The Robert T. Stafford Act of 1988, Public Law 93-288, as amended, 42 U.S.C. 5121 et seq., and related authorities

B. Hazard Mitigation Relocation and Assistance Act of 1993, Public Law 103-181

C. Disaster Mitigation Act of 2000, Public Law 106-390

D. 44 Code of Federal Regulations

1. Part 7, Nondiscrimination in Federally assisted Programs
2. Part 9, Floodplain Management and Protection of Wetlands
3. Part 80, Property Acquisition and Relocation for Open Space
4. Part 201, Mitigation Planning
4. Part 206, Federal Disaster Assistance
5. Part 207, Management Costs

E. 2 CFR Part 200

F. National Flood Insurance Act, as amended

G. 42 U.S.C. 4001 et seq.

H. Executive Orders 11988 (Floodplain Management), 11990 (Protection of Wetlands), 12612 (Federalism), and 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Families)

I. Ohio Revised Code, Section 5502, and implementing rules

J. Ohio Emergency Operations Plan

K. State of Ohio Hazard Mitigation Plan, 2014

L. Hazard Mitigation Assistance Guidance and Addendum, February 27, 2015

M. National Historic Preservation Act and the National Environmental Policy Act (NEPA)

III. DEFINITIONS

APPLICANT - A state agency, local government, or eligible non-profit organization submitting an application to the grantee for assistance under HMGP.

GOVERNOR'S AUTHORIZED REPRESENTATIVE (GAR) - The person empowered by the Governor to execute, on behalf of the state, all necessary documents for disaster assistance. In Ohio, the functions of the GAR and the State Coordinating Officer (SCO) may be assigned to the same individual.

GRANT - An award of financial assistance. The total Hazard Mitigation Grant Program (HMGP) award shall not exceed twenty percent (20%) of the estimated total eligible Federal assistance under the Stafford Act us to $35.333 billion of such assistance, excluding administrative costs authorized for the disaster.

GRANTEE - The government entity to which a grant is awarded and, which is accountable for the use of the funds provided. The grantee is the entire legal entity even if only a particular component of the entity is designated in the grant award document.

MEASURE - Any mitigation measure, project, or action proposed to reduce risk of future damage, hardship, loss or suffering from disasters. The term "measure" is used interchangeably with the terms "project" and "action" in FEMA regulations.

MITIGATION BRANCH PROJECT MANAGER – The staff person from the Ohio EMA Mitigation Branch that has been assigned by the SHMO to be the Branch point of contact for that particular project.

NON-FEDERAL ENTITY – A state or local government, institution of higher education (IHE), or non-profit organization that carries out a Federal award as a recipient or sub-recipient.

PROJECT - Any mitigation measure, project, or action proposed to reduce risk of future damage, hardship, loss or suffering from disasters. The term "project" is used interchangeably with the terms "measure" and "action" in FEMA regulations.

44 CFR Part 201 Mitigation Planning and Part 206 Hazard Mitigation Grant Program – These rules contain the requirements to have a FEMA approved state and local natural hazard mitigation plans in order to be eligible for HMGP funds.

RECIPIENT – means a non-Federal entity that receives a Federal award directly from a Federal awarding agency to carry out an activity under a Federal program.

STATE ADMINISTRATIVE PLAN FOR THE HMGP - The plan developed by the State to describe the procedures for the administration of the Hazard Mitigation Grant Program (HMGP).

STATE COORDINATING OFFICER (SCO) - The person appointed by the Governor to act in cooperation with the Federal Coordinating Officer to administer disaster recovery efforts. In Ohio, the functions of the SCO and GAR may be assigned to the same person.

STATE HAZARD MITIGATION OFFICER (SHMO) - The person designated by the GAR as the responsible individual on all matters related to the HMGP.

STATE HAZARD MITIGATION PLANNER (SHMP) - The individual with the designated responsibility for developing and maintaining the State of Ohio Hazard Mitigation Plan in accordance with Section 322 (42 USC 5165).

STATE HAZARD MITIGATION TEAM - The team chaired by the SHMO that has a role in developing, updating, and implementing the state hazard mitigation plan; and assisting in recommendations and selection of projects for the HMGP and other Hazard Mitigation Assistance programs.

SUB-AWARD - An award provided by a pass-through entity to a subrecipient for the subrecipient to carry out part of a Federal award received by the pass through entity.

SUB-RECIPIENT – a non-Federal entity that receives a subaward from a pass-through entity to carry out part of a Federal program; but does not include an individual that is a beneficiary of such program.

IV. CONCEPT OF ORGANIZATION AND ASSIGNMENT OF RESPONSIBILITIES

A. ORGANIZATION

1. Staffing Plan

   Refer to Attachment 1.

2. Mitigation Staffing Assignments

   a. The Ohio Emergency Management Agency (Ohio EMA) and various State agencies will provide personnel who will perform the following functions:

      1. Governor's Authorized Representative (GAR) – Executive Director, Ohio EMA.
      2. Alternate GAR – Assistant Director, Ohio EMA.
      3. State Coordinating Officer (SCO) – Executive Director, Ohio EMA.
      4. State Hazard Mitigation Officer (SHMO) – Mitigation and Recovery Branch Administrator, Ohio EMA.
      5. State Hazard Mitigation Planner – Mitigation Branch Planner.
      5. Business Manager - Fiscal Branch Chief, Ohio EMA.
      6. Disaster Services Consultant (DSC) employees – will generally serve as Mitigation Branch Project Managers overseeing multiple sub-awards. One DSC is also assigned to be the Branch fiscal point-of-contact.
      7. Disaster Relief Grant Employees (DRG) staff will be hired as dictated by the staffing plan for the disaster – will generally serve as mitigation project managers overseeing multiple sub-awards.
      8. Administrative Assistants – Ohio EMA Mitigation, Recovery, Grants and Fiscal Division Administrative Assistants provide support to staff that manage and projects.
      9. Fiscal Specialist – Specialist assigned by Ohio EMA Fiscal Branch.
      10. Members of the State Hazard Mitigation Team.

   b. Cost of State personnel assigned to administer the HMGP in the Joint Field Office (JFO) are eligible HMGP management costs.

   c. After the close of the JFO, costs of State personnel (regular time salaries only) for continuing management of the HMGP are eligible HMGP management costs.

3. Securing Other Specialized Technical Assistance

   a. Contractual Assistance – Traditional areas where assistance is needed and it is either not possible or cost effective to have such skill sets on staff. These can include but are not limited to: data development for benefit-cost analysis, expert appraisal review, and specialized research assistance to complete NEPA requirements (i.e., records review by the Ohio Department of Natural Resources).

B. ASSIGNMENT OF RESPONSIBILITIES

1. Governor's Authorized Representative (GAR)

   a. Ohio Revised Code Section 5502.22 provides authority for the Emergency Management Agency to administer the HMGP. The GAR is the state official ultimately responsible for ensuring that the state properly implements its responsibilities under Sections 322 (42 USC 5165) and 404 (42 USC 5170c) in a Presidential disaster declaration. The GAR shall supervise/monitor the activities of the SHMO. The GAR is responsible for the submission of a Section 404 (42 USC 5170c) grant application to Federal Emergency Management Agency (FEMA), on behalf of the State of Ohio, including state agencies, local governments, and private non-profit organizations.

2. State Hazard Mitigation Officer (SHMO)

   a. The SHMO is responsible for the State's Mitigation Program and the Section 404 (42 USC 5170c) program, as well as other mitigation programs, including development and maintenance of this Administrative Plan and procedures.

   b. Major responsibilities include:

      1. Prepare Section 404 (42 USC 5170c) program materials for distribution to communities announcing the availability of plan update funds.
      2. Train mitigation staff to assume their responsibilities.
      3. Provide direction for mitigation staff, as necessary.
      4. Disseminate Section 404 (42 USC 5170c) program information, initial application forms, and other program material.
      5. Brief local officials on mitigation, work with local Points-of-Contact, as related to HMGP.
      6. Ensure all required reports and correspondence are prepared and distributed.
      7. Chair meetings of the State Hazard Mitigation Team, and follow-up on team recommendations, in support of HMGP.
      8. Ensure project development and technical assistance is provided to interested communities.
      9. Ensure project selection is in compliance with administrative plan guidelines and State Hazard Mitigation Plan.
      10. Submit projects selected to FEMA for review and approval.

11. Ensure proper grant management of HMGP projects approved by FEMA.
12. Monitor the status of projects.
13. Ensure projects are completed in a timely manner and within federal rules and regulations governing the HMGP.
14. Ensure projects are closed properly and in a timely manner.

3. Business Manager

   a. Managing SMARTLINK, including:

      1. Performing disbursements and financial revisions;
      2. Preparing appropriate forms for closeout of projects/disasters; and,
      3. Providing monthly status reports on expenditures to program managers.

   b. Processing, or supervising the processing, of HMGP checks or the transfer of funds to Sub-recipients, recording disbursements, determining correct mailing addresses for checks, and entering disbursements into the state financial management system.

   c. Maintaining records of administrative expenses and state management costs eligible for reimbursement for each open disaster.

   d. Other duties as identified in **Attachment 1**.

4. State Hazard Mitigation Planner (SHMP)

   a. Develop and deliver training to local officials on updating local natural hazard mitigation plans to ensure compliance with 44 CFR 201.6.

   b. Perform project manager duties associated with planning grant projects.

   c. Review draft local hazard mitigation plans for compliance with 44 CFR 201.6 before forwarding to FEMA Region V for final approval.

   d. Update state mitigation plan with relevant data following a disaster declaration.

5. Other Mitigation Staff

   a. Work on project development and implementation. Duties are outlined in the state management cost and staffing plan **(Attachment 1).**

V. FUNDING

A. FEMA will make HMGP monies available to the State of Ohio as follows:

1. The total funds available for the HMGP shall be up to 20% of the total Stafford Act assistance provided.

   a. FEMA will provide an initial estimate of the total available HMGP funds to the State Hazard Mitigation Officer not earlier than 30 days and not later than 35 days from the date of the disaster declaration.

   b. Within 120 days of the disaster declaration, documentation must be submitted to FEMA to support costs and activities for which projected management costs will be used in accordance with 44 CFR 207.7. Alternatively, a letter requesting an extension up to one (1) year from the declaration date must be submitted to FEMA.

   c. The state may request an estimate of the amount of HMGP funds available at any time. Prior to 12 months after the declaration, total HMGP obligations are limited to not more than 75% of the current estimate without the concurrence of the Regional Administrator, or Federal Coordinating Officer, and the Office of Chief Financial Officer (OCFO).

   d. The final lock-in of funds will be provided by the OCFO twelve months (12) months from the date of declaration. This amount, known as the “lock-in”, is the maximum that FEMA can obligate for HMGP activities.

   e. FEMA may, at the Recipient’s written request, conduct a subsequent review of the lock-in amount 18 months after the declaration. The resulting review may result in an increase or reduction of the lock-in.

   f. Large sub-awards may be subject to the FEMA Strategic Funds Management (SFM) process. FEMA may elect to provide funding for certain projects in incremental amounts. SFM allows FEMA to schedule obligations to be available when the State is ready to execute an HMGP subgrant or components of the subgrant. SFM also allows for incremental obligations as needed within the 3-year period of performance requirement to support project activities as described in the project work schedule.

2. The federal funds provided to sub-recipients will be based on the cost-sharing provisions outlined in the FEMA-State Agreement or state legislation or as determined for each disaster. The federal share of projects may not exceed 75% of the cost of approved projects.

3. The non-federal share of projects may exceed the federal share, and it may be provided from a combination of state, local, or private funding sources. However, Section 404 (42 USC 5170c) funds cannot be used as a substitute or replacement to fund projects or programs that are available under other federal authorities, or used as a match for other federal funds.

4. Applicants must invest in the project cost through cash or in-kind contributions accounting for 25% of the total project cost, unless state funds are provided and the GAR approves a lesser share. For DR-4360, the state will be providing a 12.5% (one-half of the 25%) match to mitigation project applications (including planning grants).

B. The availability of state funding for Section 404 (42 USC 5170c) projects will be determined at the time of a Presidential disaster declaration. If such funds are made available, the amount of state funds for hazard mitigation projects available to communities will be equal to or less than the amount of HMGP funds awarded.

1. If State funding is provided, the funding shall be allocated in accordance with any requirements set by the Governor and/or the Ohio General Assembly. If there are no requirements set by the Governor and/or the General Assembly or the requirements apply to only a portion of state funds, combined HMGP and State funds will provide no more than 87.5% of the project cost. However, if additional funds are needed, the GAR may increase the percentage of funds to a level above 87.5% but not greater than 90%. It is the approach of Ohio EMA that applicants must invest in at least a portion of the cost of a HMGP project.

2. State agencies may receive a state share toward a project under the same percentages as local governments.

C. All potential funding sources from other agencies and programs will be explored, and utilized, wherever possible.

D. The State can set-aside 5% of the total HMGP available to use at its discretion. Any 5% project submitted to FEMA for approval must still meet basic eligibility, environmental, and benefit-cost analysis (BCA) requirements (although it is only a narrative BCA). Examples of projects eligible for 5% funding are experimental actions and measures not identified in the State's priorities (as noted in Section VI of this document). The 5% can be increased to 10% at the discretion of the Recipient for a disaster declaration involving tornadoes or high winds.

E. The State can utilize up to 7% of the total HMGP funds available to award plan development/update grants to sub-recipient. The final plan deliverable of any sub-recipient awarded HMGP funds to develop/update a local mitigation plan will meet 44 CFR Part 201. These funds may also be used to update the State of Ohio Hazard Mitigation Plan.

F. Management costs will be requested from FEMA in accordance with 44 CFR 207.7. The State may use funds made available by FEMA under its management cost allowance for any indirect costs, any administrative expenses, and any other expenses not directly chargeable to a specific project that are reasonably incurred in administering and managing HMGP. Regular time salaries, materials/equipment costs, travel and other cost items are allowable.

   For DR-4360, $1,000 will be passed through to sub-recipients that are awarded project grants (planning projects will not receive in-direct management cost pass through funds). The sub-recipient may use in-direct management costs funds for any indirect costs, administrative expenses, and other expenses not directly chargeable to a specific project that are reasonably incurred in administering and managing the HMGP sub-award.

   Any sub-recipient funds that are not used will be reallocated for State use. Reallocations that are less than 10% of the management cost budget do not require prior approval from FEMA. Reallocations that are greater than 10% must be submitted to FEMA in writing and include:

   1. An explanation of why the change in budget is necessary,
   2. An updated budget, and
   3. An updated budget support narrative.

   The recipient is responsible for oversight of in-direct management cost funds given to sub-recipients. Sub-recipient in-direct management cost funds will be reviewed by Mitigation Branch staff on a quarterly basis and during monitoring visits in accordance with this plan. Sub-recipient in-direct management cost closeout procedures will comply with Section XV.

G. Fiscal Procedures

   1. Sub-recipient fiscal procedures

      a. Sub-recipients will make requests for an advance of funds using the Mitigation Grant Program Request for Payment form **(Attachment 15)** at least 4 – 6 weeks prior to the actual need for the funds. This will allow enough time for the State to issue the state warrant or transfer funds. A community may elect to use electronic transfer of funds (EFT).

      b. The Sub-recipient Project Coordinator should request funds to pay salary on a quarterly basis. These funds should be identified appropriately on the request for payment form.

      c. The advance of funds request should specify how the funds would be utilized. For example, the request should indicate the need for in-direct management costs and/or project costs, and what supplies, equipment and/or number of structures to be acquired or demolished.

d. The final payment of HMGP and/or state share for planning grants will be held until the final, FEMA approved locally adopted plan has been provided to the Ohio EMA. The amount held will not exceed 10% of the total project cost.

e. The Sub-recipient will follow established fiscal procedures and comply with the 2 CFR Part 200. Expenditures will be tracked by funding source and show the balance of federal, state, and local funding. **Attachment 9** is an example of the appropriate spreadsheet for tracking funds that will be used in all HMGP projects.

2. State fiscal procedures

a. State fiscal procedures include built in redundancy – the Mitigation Branch fiscal point-of-contact works closely with the Ohio EMA Business Manager and ODPS fiscal office. Procedures to ensure proper fiscal management include the program fiscal point-of-contact reviewing, on a monthly basis, grant expenditures to ensure proper coding.
b. A monitoring program as described in this document will be used to monitor both programmatic and fiscal issues.
c. Procedures have been developed to manage fund drawdowns including ensuring that quarterly reports from the sub-recipient are up-to-date before processing the drawdown.
d. Quarterly reports are required to be submitted by sub-recipients to the recipient. These reports are reviewed for programmatic and fiscal issues.

VI. ELIGIBILITY

A. Applicants

1. Applicant eligibility criteria will be in accordance with federal regulations. Eligible applicants are: state agencies, local governments, and certain eligible private non-profit organizations. Ohio does not have any Federally recognized Indian tribes. Any questions regarding the eligibility of an applicant will be resolved by the SHMO or, if necessary, by the GAR.

2. The entire State is declared for Hazard Mitigation with a presidential declaration. The process for selecting applicants is explained in Section VIII.

B. Projects

1. **Eligible Project Types.** Projects may be of any nature that will result in protection to public or private property. Specific types of eligible projects include but are not limited to:

   a. Acquisition/relocation of real property in a hazard area;

   b. Elevation of structures above the base flood elevation (BFE);

   c. Retrofit of structures by wet or dry flood proofing (according to local code/building standards, compliant with NFIP standards); high wind strengthening; seismic strengthening of structures or their nonstructural components; application of wildfire resistant materials;

   d. Minor structural flood control and storm water management measures, to include but not be limited to: debris basins, storm water detention basins or infiltration wells, culvert upgrades; diversions, flap gates or floodgates, and localized flood control systems to protect critical facilities;

   e. Vegetation management, such as: natural windbreaks; living snow-fences; shoreline stabilization; natural dune restoration using native vegetation and sand-fencing; urban-forest practices; and landslide stabilization.

   f. Tornado safe room design and construction

   g. Phase I or II design, engineering, or feasibility studies for complex mitigation projects that are reasonably expected to be funded and implemented;

   h. The state may utilize up to 5% of total HMGP funds for non-technically proven projects that would not normally be funded under the program. Potential projects include, but are not limited to: research and development; generators for non-critical facilities; development of codes and standards; and education/public awareness programs with mitigation as central feature. Hazard warning systems, sirens, and NOAA weather radios may be eligible if the declaration includes a tornado event. Projects funded through this initiative are determined on a case by case basis and do not require review by the State Hazard Mitigation Team.

i. The state may utilize up to 7% of total HMGP funds for mitigation planning purposes. Potential projects include, but are not limited to: updating/revision of state and/or local mitigation plans (or portions thereof), or the creation of new local mitigation plans. Local planning grant applications may be bundled and submitted as one state application, or submitted separately.

2. Minimum Project Eligibility Criteria

   a. **Federal Criteria**. To be eligible for the HMGP, a project must meet the minimum project criteria established by FEMA:

      1. Be in conformance with the Hazard Mitigation Plan developed as a requirement of section 322 of the Robert T. Stafford Act, 42 U.S.C.5165.

      2. Local government applicants for project subgrants must have an approved local plan in accordance with 44 CFR part 201 before receipt of HMGP subgrant funding for projects.

      3. Have a beneficial impact upon the designated disaster area, whether or not located in the designated area.

      4. Be in conformance with 44 CFR Part 9, Floodplain Management and Protection of Wetlands, and other applicable environmental and historic preservation laws, regulations, Executive Orders and agency policy.

      5. Be cost-effective and substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster. The grantee must demonstrate this by documenting that the project:

         a. Addresses a problem that has been repetitive, or a problem that poses a significant risk to public health and safety if left unsolved.

         b. Will not cost more than the anticipated value of the reduction in both direct damages and subsequent negative impacts to the area if future disasters were to occur.

6. Has been determined to be the most practical, effective, and environmentally sound alternative after consideration of a range of options.

7. Contributes, to the extent practicable, to a long-term solution to the problem it is intended to address.

8. Considers long-term changes to the areas and entities it protects and has manageable future maintenance and modification requirements.

9. Solves a problem independently or constitutes a functional portion of a solution where there is assurance that the project as a whole will be completed. Projects that merely identify or analyze hazards or problems are not eligible.

b. **State Criteria.** In addition to the above criteria, the State of Ohio has considered other basic criteria for evaluating potential Section 404 (42 USC 5170c) projects:

   1. The community is participating and in good standing with the National Flood Insurance Program (NFIP). As a general rule, only mitigation activities involving pre-FIRM or post-FIRM compliant structures are eligible.

VII. PRE-DECLARATION AND JOINT FIELD OFFICE ACTIVITIES

A. Concept of Operations. As an event unfolds that may result in a Presidential disaster declaration, State Mitigation Branch staff initiate activities that, in the eventuality of a declaration, will lay the groundwork for appropriate and successful project applications, will maximize the technical assistance given limited resources, and will result in effective mitigation. These activities are divided into the following phases: Incident assessment, declaration, and Joint Field Office (JFO) activities.

B. Incident Assessment. Incident assessment may include but is not limited to the following activities:

1. Reviewing local and state mitigation plans including: hazard identification / risk assessments; potential mitigation activities; identifying any problems or vulnerable critical infrastructure.

2. Generate HAZUS models to project possible impacts in case of flood or earthquake.

3. Participating in Emergency Operation Center (EOC) Emergency Support Function briefings,

4. Coordinating with ODNR during flood incidents to identify NFIP sanctioned communities in impacted areas, and

5. Participate on joint federal/state hazard mitigation teams formed during the preliminary damage assessment (PDA). Information acquired during this assessment process may be used to identify potential projects, and develop the mitigation strategy for that disaster.

C. Disaster Declaration

1. Develop staffing a plan and logistics information for JFO, and

2. Begin to work on the Hazard Mitigation Strategy in consultation with FEMA, and ODNR (for flood events).

D. JFO Activities

1. Develop the Hazard Mitigation Strategy. The Hazard Mitigation Strategy will identify the different activities that are to be conducted as a result of the disaster declaration. It will be prepared in consultation with FEMA and ODNR (for flood events).

2. Provide mitigation planning and project technical assistance to impacted communities.

3. Attend meetings / briefings, including Federal Coordinating Officer meetings.

4. Complete the mitigation section of the ESF-14 Recovery Report.

5. Implement the Hazard Mitigation Strategy.

6. Conduct Mitigation Briefings. Normally, Mitigation Branch staff will offer to conduct countywide mitigation briefings in all counties included in the declaration to discuss mitigation with local officials. These briefings are coordinated with the PA briefings conducted by the Ohio EMA Recovery Branch. Counties may opt to not have a mitigation briefing (they may have had one recently), in which case packets will be offered to them for distribution to local officials. Briefings are part of the State's education and public awareness process necessary to the effective implementation of mitigation. Local officials will, during this process, be given the opportunity to identify mitigation issues and concerns. Although primarily focused on HMGP eligibility issues, application process/development, and types of mitigation actions; the National Flood Insurance Program and FEMA's other mitigation programs are also discussed briefly. The briefing is given as a Powerpoint presentation **(Attachment 10)**.

   Briefings can be a joint NFIP/mitigation briefings if the flood event was in an area with high flood insurance policy coverage and Increased Cost of Compliance will be triggered due to the large number of substantially damaged structures.

   For this declaration, mitigation briefings will be conducted in conjunction with PA briefings conducted by the Recovery Branch, whenever possible. If Mitigation Branch staff are not available to conduct HMGP briefings in coordination with PA briefings, a series of four webinar briefings will be offered. A webpage was also created on the Ohio EMA Mitigation Branch website to notify potential sub-recipients of the availability of HMGP funds.

VIII. APPLICATION PROCESS / PROJECT DEVELOPMENT

A. Concept of Operations

There will be two application cycles for HMGP funds available as the result of DR-4360. The first application cycle will be expedited and include: 1) unfunded Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) applications, 2) “shelf applications” that are ready to be submitted, 3) applications developed to mitigate damage caused by the disaster event and 4) applications for “substantially damaged structures.” Applications in category 1 will not be required to submit an HMGP application. The e-Grants application will be used to enter the required project application data into NEMIS. All other applicants in the first round must complete an HMGP full application by the established deadline in order to be considered for funding. The SHMT will review these applications and make award recommendations to the GAR.

The second HMGP application cycle will be a two-part process. Pre-applications are submitted first **(Attachment 2)**. Pre-applications are reviewed and ranked by the SHMT and enough pre-applications to expend 150 - 200% of the estimated remaining project funds will be selected for full project application development (this is to allow for projects that could be withdrawn and for the submission of zero funded projects to ensure that all Federal and state funds can be appropriated). Full project applications **(Attachment 3)** will be evaluated by the SHMT after the deadline for submission has passed. Projects will then undergo a cost-effectiveness, environmental, and completeness and eligibility review conducted by Mitigation Branch staff. Eligible and complete full project applications will then be submitted to FEMA for approval. The goal is to submit projects for the second cycle on or near the one-year anniversary date of the disaster declaration.

The timeline for this process is as follows:

ESTIMATED HMGP APPLICATION TIMELINE	
Time Period	Event
Week 0	Disaster Declared
Week 1-2	Pre-application period opens
Week 4-8	Applications for cycle one submitted to FEMA Region and Pre-applications submitted to state for cycle 2
Week 13	SHMT meets to review pre-applications and select those for full application development
Week 24	Full normal applications due at Ohio EMA
Week 36	OEMA completes completeness and eligibility review; begin to submit projects to FEMA for approval
Week 52	Completion of submission of projects to FEMA; FEMA begins to approve projects

IX. PROJECT REVIEW, RANKING, AND SELECTION

A. Priority

The following priorities are established by the State of Ohio under HMGP for DR-4360 based on the unique characteristics of the event, the DR-4360 *Hazard Mitigation Strategy,* and the *State of Ohio Hazard Mitigation Plan*:

- Priority will be given to projects in the declared counties over projects in other counties (except for planning grant applications).
- 7% planning funds will be utilized to fund local natural hazard mitigation plans that are approaching the five-year deadline for plan expiration. Priority will be given to planning grant applications with the earliest plan expiration date. Planning grant applications are not reviewed by the SHMT.
- Among flood loss reduction projects, priority will be given for the acquisition of repetitively flood-prone properties as it is the only permanent mitigation solution.
- Priority will also be given to the construction/installation of safe rooms that mitigate the loss of life from severe wind and storm events.

B. Review Process

1. The SHMO and/or Mitigation Branch staff will perform the initial review of project pre-applications to ensure all information and documentation is provided. The Mitigation Branch staff member assigned to each pre-application will present the project to the SHMT.

2. The SHMO will chair the SHMT. Representatives from the following agencies/organizations are permanent members of this team:

   a. Ohio EMA
   b. Development Services Agency, Community Services Division
   c. Department of Natural Resources, Division of Water Resources, Floodplain Management Program
   d. Watershed Conservancy District Representative
   e. Emergency Management Association of Ohio (EMAO)
   f. U.S. Army Corp. of Engineers (USACE)
   g. U.S. Geological Survey
   h. Ohio Voluntary Organizations Active in Disaster
   i. Ohio Public Works Commission
   j. Federal Emergency Management Agency (FEMA)

3. Additional State Agency representatives will be determined by the nature of the projects for which HMGP funds have been requested. Appropriate Federal agencies may also be asked to help review the merits of certain types of projects.

4. In keeping with the MOU between FEMA and the USACE, the appropriate Corps district will be advised of all proposed mitigation projects in Ohio prior to the recommendation to forward to FEMA for approval.

C. Evaluation and Ranking of Projects

1. The SHMT will review all applications (with the exception of applications for projects under 5% and 7% funding set-asides) according to established criteria. The membership of the State Hazard Mitigation Team will evaluate each project according to the HMGP Application Scoring Sheet (see **Attachment 6**). Criteria used to evaluate the projects include, but are not limited to the following:

    1. Whether the community was in the declared or impacted area,

    2. Consistency with state and local mitigation plans,

    3. The community's ability to manage a grant,

    4. Repetitive nature of the hazard the mitigation option is designed to protect against,

    5. Implementation of day-to-day mitigation programs outside of HMGP,

    6. Other criteria as necessary

    Projects are ranked according to their total evaluation score, highest to the lowest.

c. The SHMT will review all projects submitted as zero funded projects using the above evaluation and ranking criteria.

D. Environmental and Floodplain Management Reviews

1. National Environmental Policy Act (NEPA) coordination and review are FEMA responsibilities. In order to assist FEMA, the Mitigation Branch gathers documentation from applicants and various government agencies and prepares a Record of Environmental Consideration (REC) for FEMA concurrence. Documentation includes:

    a. Site photographs

    b. Subapplicant responses to the Environmental Review section of the HMGP application (see **Attachment 3**),

c. A series of maps depicting the project location on:

   i. A street and/or plat map
   ii. Topographic map
   iii. Flood Insurance Rate Map
   iv. Wetlands map (if applicable)
   v. State Historic Preservation Office Map (if applicable)

d. Consultation with:

   i. The U.S. Army Corps of Engineers
   ii. State Historic Preservation Office
   iii. Ohio Department of Natural Resources
   iv. The Ohio Environmental Protection Agency
   v. The U.S. Fish and Wildlife Service

e. Public notice of project provided by community

2. Communities that participate in the National Flood Insurance Program and/or that adopt local regulations governing development in identified flood hazard areas are responsible for ensuring that proposed mitigation projects in these areas meet applicable floodplain management criteria. Copies of this documentation should be maintained with the local project files and be available for review during monitoring visits.

E. Selection

1. For project applications, following the evaluation and ranking of projects, the SHMT will make the following recommendations to the GAR:

   a. Projects recommended for approval, and,

   b. The order in which projects should be funded (i.e., a listing of the projects by priority).

3. In the event two or more projects are tied in rank, they will be listed according to their benefit-cost ratios (BCR).

3. The GAR will make the final decision regarding the selection, level of funding for, and ranking of projects by priority. Those projects not selected for funding will be forwarded to FEMA for approval as zero funded projects. This means that if additional funds become available, or if cost-underruns occur in

other projects, the zero funded projects can receive funding if approved by FEMA.

4. The GAR will notify all applicants of the decision made by the state relative to their proposed project.

5. Following notification by the applicant, the projects will have a final environmental, cost-effectiveness, and completeness review. The GAR will then submit the applications to FEMA for approval. Submittal will be done in NEMIS as well as hard copy. Hard copy application documents include the Project Summary, B/C Analysis narrative, and Record of Environmental Consideration (REC) with supporting letters and documentation. A hard copy will be forwarded to the FEMA Regional Administrator for approval. The application materials, which the GAR will forward to FEMA, will include the following:

    a. A SF 424 (Application for Federal Assistance).
    b. A SF 424D (Assurances for Construction Programs), if appropriate.
    c. A Project Summary that includes:

        1. Community point of contact, address, phone and fax numbers
        2. Major disaster number
        3. Project number
        4. Applicant name
        5. Location of the project
        6. Description of the project
        7. List of alternatives considered
        8. Congressional district
        9. Record of Environmental Consideration
        10. Benefit Cost Analysis
        11. Project Review and Results statement
        12. Projects involving the acquisition of property for open space (acquisitions and relocations) must include:

            - A photograph that represents the property at the time of application,
            - Statement of assurances acknowledging the conditions for mitigation of the property,
            - A notice of voluntary interest form signed by each property owner, which must include that the sub-applicant has informed them in writing that it will not use its eminent domain authority for the open space purpose,
            - Sample of the actual deed restriction that the local government will record with each property deed and,
            - Documentation of coordination with the U.S. Army Corps of Engineers and the Ohio Department of Transportation.

13. Projects that mitigate property by elevating, retrofitting, and/or relocation must include a signed form acknowledging the conditions for mitigation of property in a Special Flood Hazard Area with FEMA grant funds, and a statement that the elevation will be designed in accordance with ASCE 24-14, or latest edition as minimum design criteria.

6. All approved mitigation projects must be submitted to FEMA for environmental concurrence and obligation of funds twelve (12) months from the date of the disaster declaration. If necessary, the state can request up to two additional (2) ninety (90) day extensions to the one year application deadline (for a total of 18 months).

F. Award

1. FEMA will sign the REC and approve projects when all submittal requirements are met. At the discretion of the SHMO, a press release describing the program may be developed and issued.

2. Prior to project approval and if notice has been received by the SHMO, the local official of the community (project point-of-contact), the County EMA Director, the Ohio EMA Regional Field Office, the EMA PIO (if not already notified), and Ohio EMA Executive Director will be notified by the SHMO. This will be done by e-mail to ensure that local and state staff are aware in the case that there is media follow-up due to an early FEMA and/or Congressional press release.

3. After FEMA approval of a project has been received by the Mitigation Branch, the Executive Director will send a congratulatory letter followed by the State/Local Agreement and other administrative forms from the SHMO.

X. PROJECT INITIATION

A. General

1. Ohio EMA will serve as the Recipients for project management and accountability of funds in accordance with 2 CFR Part 200. (Sub-recipients are accountable to the Recipient for funds that have been awarded to them and will utilize the same resources).

2. The SHMO will provide the sub-recipient with the State/Local Grant Agreement, two W-9 forms, and a sample Designation of Applicants Agent (**see Attachments 7 and 8**). The Chief Elected Official (CEO) must sign the agreement and return to the Ohio EMA within thirty (30) days of receipt. If a problem should arise with the agreement, the SHMO should be notified as soon as possible to avoid any delays in beginning the project.

3. The GAR must sign the agreement, and the Mitigation Branch Project Manager will provide the Sub-recipient with a copy of the executed document, along with program requirements and information during the Implementation Meeting.

4. The designated local Project Manager will meet with the Mitigation Branch Project Manager within thirty (30) days of submission of the signed State/Local agreement (see Section XIV(A)(3) for more specific information on the *Implementation Meeting*).

5. Based upon the approved project application and work schedule for a project, both the Ohio EMA and sub-recipient will implement a record keeping and financial system relative to the project.

6. Sub-recipients will submit quarterly progress reports **(Attachment 11)** to the SHMO. Program regulations and this Administrative Plan identify specific due dates for these reports (see Section XIII – Reports.). The SHMO will submit quarterly progress reports to FEMA. The final report will be a complete assessment of project accomplishments and will meet 44 CFR Part 206 requirements.

7. The Mitigation Branch Project Managers will monitor and evaluate project accomplishments and adherence to the work schedule. Problems will be reported to the SHMO, GAR, and FEMA HMO as soon as identified (see Section XIV).

8. The Mitigation Branch Project Manager, SHMO, and Fiscal Officer will review advance of funds requests, time extension requests, and cost overruns.

9. The Mitigation Branch Project Manager will coordinate individual project close out and the SHMO will coordinate the overall grant closeout.

B. Request for Funds

1. The state may advance a portion of the federal share of the cost of an approved hazard mitigation project.

2. An initial advance will be made to an applicant based on expenditures necessary to start the project; ensuring that the remaining work to be completed is well within the dollar amount of the approved project. Additional advances will be made as long as expenditures can be documented, good record keeping is maintained, and sound fiscal procedures are used.

3. A request for an advance of funds must be submitted in writing to the SHMO. The request must be made using the form in **Attachment 15**. Request for funds should be made at least 4 – 6 weeks prior to the identified need, and should be expended within thirty (30) days of receipt.

4. Requests for funds are reviewed and signed in the following order prior to forwarding to the Fiscal Specialist for processing:

   a. The Mitigation Branch Project Manager responsible for project oversight,
   b. The Mitigation Branch Fiscal Staff person responsible for fiscal tracking and grant reconciliations, and
   c. The SHMO for final review and concurrence.

5. If the request is denied, the sub-recipient will be advised and given the reason for the denial. Requests will be denied if the sub-recipient is not up-to-date in submitting quarterly reports.

C. Time Limits and Extensions

1. Time Limits

   a. As a general rule, projects must be initiated within ninety (90) days of the approval date. When FEMA approves a project, the initial approval period is no later than (3) three years from the close of the application period.

2. Time Extensions

   a. If a sub-recipient determines that the project cannot be completed by the time specified in the state-local grant agreement, the sub-recipient must immediately notify the Mitigation Branch Project Manager, and request a time extension. Formal requests for a time extension must be submitted by letter and the sub-recipient must:

1. Explain why the project cannot be completed by the deadline;
2. Explain the outstanding project work;
3. Explain when it anticipates the project will be completed; and
4. Provide a signed request for extension by the appropriate local authority.

b. Upon receipt of the time extension request, the Mitigation Branch Project Manager will review the request for appropriateness and determine whether the extension request is necessary for the state-local agreement, for the FEMA approval, or both. The Mitigation Branch Project Manager will send the extension request form (for a state-local agreement extension request) to the sub-recipient for signature. If a FEMA extension request is needed, the Mitigation Branch Project Manager will complete the extension request form and prepare the request letter for the GAR signature. **Extension requests to the FEMA period of performance must be submitted to the FEMA Regional Office no later than 60 days prior to the expiration of the period of performance.**

c. The Mitigation Branch Project Manager will then forward the request, signed form(s) and prepared letters (if necessary) with a recommendation to the SHMO who will then forward the request to the GAR and/or FEMA (if necessary), along with a recommendation for approval or disapproval.

c. The Mitigation Branch Project Manager is responsible for ensuring that projects are operational within approved timeframes.

D. Cost Overruns/Under-runs

1. Sub-recipients will be required to notify their assigned Mitigation Branch Program Manager by letter as soon as they determine that they will have a project cost overrun. The letter should include the dollar amount of the overrun, the reason for the overrun, and an appropriate justification and documentation (invoices, copies of contracts, pictures, and so on) to support the additional costs.

2. The SHMO in consultation with the Mitigation Branch Project Manager will evaluate each cost overrun. If the evaluation indicates that the cost overrun is justified, *and if funds are available*, the SHMO may recommend to the GAR approval of cost overruns. Cost overruns will be approved only if funds are available in the grant program to support the additional amount requested.

3. The GAR will forward all such cost overruns, along with a recommendation for approval, to the FEMA Region V, Regional Administrator. The Regional

Administrator will notify the GAR of the final determination made on the overrun.

4. The sub-recipient must notify the SHMO as soon as possible if a cost under run *will* occur.

5. Any request for deviation from an approved project must be consistent with and approved in accordance with current FEMA policy guidance as it relates to a change of project scope. This may trigger the need to review environmental compliance and/or conduct a new benefit-cost analysis. Project amendments must be sent to the FEMA Regional Office for approval prior to commencement of work related to the change in scope of the project. The Mitigation Branch Project Manager will be responsible for ensuring project amendments comply with all rules and any NEMIS changes that may be needed as a result.

XI. APPEALS

A. An eligible applicant or sub-recipient may appeal a decision made by the Mitigation Branch staff regarding projects submitted for funding under the HMGP. The appeal must be in writing, and contain sufficient additional information beyond that submitted with the original application, to warrant consideration. There are two types of appeals: those appealing state policies and those appealing Federal (FEMA) policies. The appeal will be made to the SHMO who will then determine whether the appeal is to a state policy or Federal policy. Upon this determination, the processes identified below will be followed accordingly.

   Appeals relating to state decisions based on state policies such as determinations made by the State Hazard Mitigation Team (SHMT), NFIP compliance, state mitigation priorities, state/local agreement issues, reasonable and necessary costs associated with project management, etc. are usually state appeals. For issues regarding program eligibility, time extensions beyond the FEMA approved time for the grant overall, determination of allowable project management and indirect management costs, allowable project costs, and other project implementation requirements, or the state's interpretation of any Federal policy related to these issues is usually a Federal appeal. Any appeal disputing the benefit-cost ratio (BCR) for a specific property or project must be accompanied by a benefit-cost analysis conducted by the appellant in accordance with FEMA guidelines.

B. State Appeals**.** There are two levels of state appeal. The Assistant Officer (AO) with responsibility for oversight of the Mitigation Branch is the decision-maker for the first appeal. If a second appeal is necessary the Governor's Authorized Representative (GAR) makes the decision on the second appeal.

   1. All applicant appeals must be submitted in writing to the AO within thirty (30) days of the date of the letter notifying the applicant of the State Hazard Mitigation Officers decision. The AO will respond within thirty (30) days of the applicant's letter.

   2. If the applicant does not agree with this decision they can appeal to the GAR. The applicant must provide additional information supporting their position to the GAR within thirty (30) days of the first decision letter. The GAR will respond within thirty (30) days of receipt of the request for appeal. The GAR's decision is final and no other state appeals will be considered.

   3. The GAR may, on behalf of an applicant or the state, request guidance and/or a decision from FEMA related to an applicant's appeal to the state. If guidance is requested from FEMA, the GAR will notify the applicant and

an additional thirty (30) days will be added to the time frame for response from the GAR.

C. Federal Appeals. The applicant or sub-recipient has the option of appealing to FEMA for a decision relating to Federal policy.

   1. Federal appeals must be submitted in writing to the SHMO. All Federal appeals on behalf of the applicant or state are made by the Executive Director of the Ohio Emergency Management Agency to the FEMA Regional Administrator.

   2. The Mitigation Branch may prepare materials and information including a summary and staff recommendation related to the issue being appealed to be forwarded to FEMA.

   3. The appeal will then be forwarded to the FEMA Regional Administrator within sixty (60) days of the date the applicant requests the appeal.

   4. Per the 44 CFR Part 206.440 FEMA will respond within ninety (90) days.

   5. An appeal of the FEMA decision may be made within the following ninety (90) days to the FEMA Associate Director in Washington. FEMA will respond within ninety (90) days and the decision is final. No other appeals exist.

   FEMA's decision will be in writing to the state. The state will copy the applicant with FEMA's decision.

XII. TECHNICAL ASSISTANCE

As a general rule, applicants for HMGP funds will be responsible for obtaining any technical assistance they may need in order to develop a hazard mitigation project proposal or to carry out a hazard mitigation project. Technical assistance will be available from the Ohio Emergency Management Agency Mitigation staff and FEMA Region V, Mitigation Division. Applicants may also request assistance from Regional Planning Councils and State agencies. Applicants who want such assistance are advised to notify the SHMO.

XIII. REPORTS

A. Sub-recipients will submit a Quarterly Progress Report (QPR) **(Attachment 11)** to the SHMO within fifteen (15) days of the end of the quarter, on the following schedule:

Quarter	Months	Report Due
1st	Oct. - Dec.	Jan. 15
2nd	Jan. - Mar.	Apr. 15
3rd	Apr. – June	July 15
4th	July - Sept.	Oct. 15

B. QPRs will be used to monitor and follow-up on projects. Failure to submit reports may result in suspension of HMGP funds. Copies of QPRs will be maintained by the State. The SHMO will submit a quarterly report to FEMA on the status of all mitigation projects by the end of the month following the end of the quarter.

XIV PROGRAM MONITORING

A. Purpose of Project Monitoring

1. As the Recipient for federal mitigation funds, the Ohio EMA is responsible for managing the day-to-day operations of Recipient and Sub-recipient activities. Ohio EMA must monitor Recipient and Sub-recipient activities to assure compliance with applicable Federal requirements and that performance goals are being achieved. Monitoring must cover each program, function or activity.

2. Role of Mitigation Staff

   a. The Mitigation Branch staff person assigned the project (herein referred to as the Mitigation Branch Project Manager) will be responsible for reviewing and documenting the community's ability to implement the project according to their project application, grant agreement, program requirements, and federal regulations. This is accomplished through the review of quarterly progress reports, on-site review of the project and fiscal records and the project area to ensure the scope of work as outlined in the project application is being fulfilled and all funds are expended and accounted for properly.

   b. The SHMO will be notified as soon as possible of any significant issues related to the above. Reporting requirements are discussed under section XIII Reports.

3. Implementation Meeting & Monitoring Visits

   a. **Implementation Meeting.** An on-site meeting will be conducted no later than two (2) months after the grant agreement has been signed by the community. The purpose of this meeting is to ensure the local Project Manager understands the program requirements. Often, the local Project Manager will not be the person who was involved in the development of the project and may not be as familiar with requirements of the program. The local Project Manager, local officials, and fiscal officer for the community are encouraged to attend the implementation meeting. Meeting topics include:

      - Presentation and review of the Implementation Binder. The Implementation Binder includes guidance materials, forms, timelines, and reporting requirements.
      - Review of file management procedures and fiscal management procedures.
      - Review of procedures that are specific to the mitigation action taking place.

The implementation meeting should also consist of a tour of the project site, especially if it has not been visited by Mitigation Branch Project Manager to date.

b. Following the implementation meeting, monitoring visits will be conducted. The frequency of monitoring visits will be based on the project type:

- For 5% Projects, such as single warning siren, that does not constitute significant construction, an annual monitoring visit shall be conducted at a minimum.
- Planning projects shall not necessitate any additional monitoring visits beyond the implementation meeting. Provided drawdown requests are tied to plan progress milestones that have been verified by the Mitigation Branch Project Manager, and the final drawdown is contingent on the final plan being submitted.
- For all other mitigation projects, monitoring visits shall be conducted *no less than one time each year*. The monitoring visits will include a review of programmatic files and fiscal records. The visit should also include an on-site visit to the project area. These visits will occur throughout project completion.

c. Additional monitoring visits may be scheduled by assigned Mitigation Branch Project Manager(s) in communities displaying an inability to manage the mitigation grant properly. Determination of an inability to manage the grant would include, but not be limited to the following inconsistencies in project implementation:

1. The project is not on schedule for completion within the 24-month grant agreement.
2. Project/program activities are not being documented properly.
3. Quarterly progress reports are not being provided each quarter or are not complete.
4. The community does not appear to be meeting their local cost share responsibility.
5. More than one instance of a failure to follow guidance on issues related to the project.

d. The SHMO or immediate supervisor will determine if additional monitoring visits are needed after discussion with the assigned Mitigation Branch Project Manager. The local Project Manager will be notified in writing, within ten (10) days of the most recent monitoring visit, of any corrective actions and the date of the next monitoring visit.

e. A sub-recipients failure to comply with requested corrective actions may result in enforcement actions as outlined in 2 CFR Part 200.338.

4. Scheduling the Implementation Meeting and Monitoring Visit(s)

    a. The scheduling of the implementation meeting should be done through the local Project Manager. Minimally, local officials, the local Project Manager, and whoever is responsible for fiscal management in the community should attend.

    b. The first monitoring visit will be scheduled during the implementation meeting. Other monitoring visits should be scheduled during each subsequent visit.

    c. A letter or email to the local Project Manager will be used to confirm the implementation meeting and monitoring visits. The County EMA Director, Ohio EMA Regional Field Operations staff, and any other appropriate local officials should be copied. The letter should outline the purpose of the visit, what the Mitigation Branch Project Manager wants to review, who should be at the meeting, and if other officials are needed in addition to the local Project Manager.

5. Conducting the Monitoring Visit

    a. The Mitigation Branch Project Manager shall review the project application prior to the monitoring visit and take the project files/binder to the monitoring visit. At a minimum the Mitigation Branch Project Manager should be *as familiar* with the project as the local Project Manager.

    b. The project must be implemented according to program guidance and the scope of work outlined in the project. Discrepancies should be discussed with the local Project Manager. If needed, clarification will be requested from the community officials responsible for project success.

    c. Quarterly Progress Reports (QPRs) are required to document the progress of the project. The QPR should reflect the amount of funds expended, and the steps taken with each structure in the project (e.g. property closing, demolition, etc).

    d. The QPR should be used in the review of project files. For example, if the QPR indicates a property has been acquired, the file should include the appropriate documentation.

e. The Mitigation Branch Project Manager shall review the fiscal information and spreadsheets to assess the funding levels and the amount advanced. All funds advanced prior to the last thirty (30) days should be expended. The only exception to this would be management costs.

   1. The fiscal documentation should be compared to the last QPR and/or the spreadsheet.

   2. Use the Final Closeout Report form (**Attachment 12**) to determine the amount of the local share of the project. Calculating the local share is especially important after the project is a year old and/or actions are documented for over half of the properties in the project. All communities are aware of their local share commitment and should be prepared to document availability.

   3. Verify the exact percentage of local share budgeted in the project. The federal funds contributed will never be greater than 75%. In some instances, State funds may be contributed toward the project cost or the local match requirement.

f. Each property file must be reviewed to ensure compliance with the Duplication of Benefit (DOB) requirement. Documentation related to how disaster assistance was expended should be provided in each file.

g. The Record of Environmental Consideration (REC) should also be reviewed during the monitoring visit, especially if further coordination has been requested or required by an agency. For example, the Indiana bat is commonplace in Ohio and will impact the cutting of trees. The local Project Manager should document whether trees have been removed during implementation of the project. Or, if an elevation project requires obtaining a local floodplain development permit, this should be in the file. The REC should be reviewed during the first monitoring visit and in subsequent visits if conditions have been identified requiring compliance by the community.

h. The Project Monitoring Forms will be used to document the review of individual property files **(Attachment 13)**. The appropriate form will be completed for each property file. The Mitigation Branch Project Manager will identify whether the file was complete or incomplete in the box in the upper right corner.

i. The Mitigation Branch Project Manager shall discuss corrective actions with the local Project Manager at the time of the monitoring visit. The local Project Manager can begin working on the corrections before the follow up letter is sent.

6. Reporting Requirements

   a. After the implementation meeting, the Mitigation Branch Project Manager will follow-up on specific issues with the local Project Manager, but a follow-up letter is not required.

   b. Following monitoring visits (not implementation meetings), a follow up letter will be sent by the Mitigation Branch Project Manager to the local Project Manager within 10 days of the monitoring visit. The letter will outline the results of the visit and any corrective actions required. The local Project Manager will be given 30 days to complete the corrective actions.

7. Follow-up

   a. The completed Project Monitoring forms should be given to the designated staff person upon return from the visit.

   b. This individual will prepare property listings with property owner, address, and parcel numbers for the completed files, and property owner, address, and the information missing from the file.

   c. The monitoring forms and property listings will be filed when completed. A copy of the property listings will be provided to the appropriate staff person.

   d. The property listings will be used during future monitoring visits to identify the files already reviewed and prevent duplication of effort.

B. Post-Project Closeout Open Space Monitoring for Properties Acquired with HMGP Funds

   1. Ohio EMA will comply with the requirements in 44 CFR Part 80 to monitor properties acquired with Hazard Mitigation Assistance funds and report the status to FEMA every three years
   2. Ohio EMA will comply with 44 CFR Part 80 to review re-use requests and coordinate with FEMA Region V as required.

XV. PROJECT COMPLETION AND CLOSE OUT

A. The period of performance begins on the date of declaration or authorization for HMGP and ends no later than 3 years from the close of the application period. The Mitigation Branch Project Manager is responsible for ensuring that all approved activities are completed by the end of the period of performance. The deadline can be extended if necessary, but only in unusual circumstances (see Section X(C)(2)). The total period of performance should not exceed five (6) years.

B. Project Completion by Sub-recipient

1. The local Project Manager **<u>must</u>** notify the Ohio EMA Mitigation Branch Project Manager within ten (10) days of the completion of **<u>all</u>** work on the project. This contact may be by phone with a follow up written notification by email or by letter.

2. The notification should be accompanied by a Final Progress Report (which is a quarterly report modified to indicate that it is a final report) and fiscal documentation including a completed Record of Grant Activity **(Attachment 9)**.

3. Upon receiving this notification the Mitigation Branch Project Manager will schedule a final monitoring visit to review all program and fiscal records related to the project. All project funds are suspended at the time of completion of the project unless approval to spend is given in writing by the SHMO.

C. Final Monitoring Meeting -- Programmatic Closeout

1. At the time of closeout all files not previously reviewed or complete will be reviewed to ensure all appropriate documents are included. The Project Monitoring Form **(Attachment 13)** will be utilized for the review. At closeout, the Mitigation Branch Project Manager should be able to fully complete a monitoring form for each property in the project.

2. If a file does not contain all required documentation, the local Project Manager will be required to provide the information within thirty (30) days of closeout, if not readily available at the monitoring meeting. If this time frame is not appropriate, a greater amount of time may be granted by the Mitigation Branch Project Manager. However, failure to provide the documentation may result in the requirement to repay some or all of the grant amount for a particular property or activity.

3. A photograph(s) of the project area or each individual acquired property must be taken by the Mitigation Branch Project Manager at the closeout meeting. The photograph(s) are required to close out the project with FEMA.

4. An Environmental Closeout Declaration must be presented to the local project manager and signed by them at the closeout meeting. This form is to verify compliance with the provisions of the REC.

5. For projects involving the acquisition of property for open space, the Mitigation Branch Project Manager must obtain a copy of the recorded deed for each property mitigated with deed restrictions consistent with FEMA model language. The Mitigation Branch Project Manager must also obtain a signed copy of the Statement of Voluntary Interest form.

6. The Mitigation Branch Project Manager will obtain a completed NFIP Repetitive Loss Update Worksheet (AW-501 form) for each property mitigated that is on the NFIP repetitive loss or severe repetitive loss list.

7. For projects where a structure will remain in the Special Flood Hazard Area, the Mitigation Branch Project Manager will obtain a copy of the notice recorded with the deed specifying flood insurance, disaster assistance and floodplain regulation compliance requirements for the property.

D. Final Monitoring Meeting - Fiscal Closeout

1. If possible, the local Project Manager should provide copies of spreadsheets to the Mitigation Branch Project Manager before conducting the closeout meeting.

2. The total project cost will be determined and appropriate cost shares calculated. Any discrepancies will be noted and brought to the attention of the local Project Manager. The Mitigation Branch Project Manager will work with the local Project Manager to reconcile any discrepancies. If the closeout identifies unspent funds being held by the community they must return the funds upon notification by the Mitigation Branch Project Manager. If funds are due the community, the Mitigation Branch Project Manager will request those funds as soon as possible and will forward the state warrant within sixty (60) days of identifying the short fall.

3. In the event final closeout cannot be completed, funds due the community will be held until all required information has been provided to the Mitigation Branch Project Manager.

E. Completing Project Closeout with Sub-recipient

After the fiscal issues have been reconciled, monitoring forms are completed, and the necessary documentation has been obtained from the local Project Manager, the Mitigation Branch Project Manager shall provide a final closeout package to the community. The package will include:

- □ A letter of congratulations (under the signature of the SHMO) indicating that the documents and fiscal records were reviewed and accepted by the Mitigation Branch, and
- □ A completed Final Closeout Report with the reconciled / adjusted project costs **(Attachment 12)**.

F. Completing Project Closeout with FEMA

1. De-Obligation of Funds. If funds are to be de-obligated because of cost under-runs, it is necessary to request that FEMA de-obligate funds. The Mitigation Branch must have confirmation of FEMA's de-obligation of the funds (a letter) before a Closeout Package can be sent to them. The de-obligation request letter will be under the signature of the Alternate GAR or GAR to the FEMA V Regional Administrator.

2. Transmittal of Closeout Package to FEMA. Upon completion of the project closeout with the sub-recipient and de-obligation of remaining funds (when necessary), a closeout package shall be submitted to FEMA. The closeout package will include:

- □ A letter of transmittal to the FEMA V Regional Administrator, cc: HMO, (under the signature of Alternate GAR or GAR) requesting that FEMA closeout the project,
- □ A completed Final Closeout Report with the reconciled / adjusted project costs **(Attachment 12)**,
- □ Property Information Sheet for each property mitigated,
- □ Pictures of properties in their final, mitigated state,
- □ Completed and signed Environmental Closeout Declaration
- □ Completed NEMIS Project Closeout Verification Form, and
- □ For projects involving the acquisition of property for open space, the following shall be provided for each mitigated property
  - A copy of the recorded deed,
  - A photo of each property site after project completion,
  - A signed Voluntary Participation Form for each property acquired,
  - The latitude and longitude coordinates, and
  - Identification of property repetitive loss status.
- □ For mitigation projects in the Special Flood Hazard Area where structures remain after project implementation (elevation or retrofit of a structure), a copy of the notice recorded with the deed specifying flood insurance, disaster assistance and floodplain regulation compliance requirements for the property.

- Verification of flood insurance for each structure

- ◻ For elevation projects:
  - A final Elevation Certificate for each structure to verify compliance with NFIP requirements
  - Verification of flood insurance for each structure

G. The Ohio EMA and sub-recipient will comply with the Single Audit Act, as amended, and maintain all project documentation for a period of three years following project or disaster closeout.

H. Specific audit requirement information will be included with the State/Local Agreement.

I. The Mitigation Branch Project Manager is responsible for ensuring that the appropriate mitigation project information is entered into the State Hazard Analysis, Resource and Planning Portal. Some of this data may be entered by the local Project Manager.

XVI. PLAN REVIEW AND UPDATING

A. This document will be reviewed annually by the SHMO noting any changes in policy or guidance so that the plan can be easily updated when a Major disaster declaration occurs. It will be updated as needed to reflect regulatory or policy changes, or to improve program administration.

B. Following a Presidential disaster declaration, the SHMO will prepare any updates, amendments, or revisions to the plan that are required in order to meet current policy guidance or changes in the administration of the HMGP, and submit the plan to FEMA for approval.

C. FEMA will reply in writing that the plan is approved and/or if any further revisions required. FEMA will provide a timeframe for submission of any corrections in their letter.

XVII. ATTACHMENTS

Attachment 1	–	State Management Cost & Staffing Plan / Budget Worksheet
Attachment 2	–	HMGP Project Pre-application
Attachment 3	–	HMGP Project Full Application
Attachment 4	–	HMGP Planning Grant Application
Attachment 5	–	HMGP Application Workbook
Attachment 6	–	HMGP Application Scoring Sheet and Instructions
Attachment 7	–	State/Local Agreement for Projects and Planning Grants (includes audit standards)
Attachment 8	–	Sample Designation of Applicants Agent
Attachment 9	–	Record of Grant Activity form
Attachment 10	–	Mitigation Briefing PowerPoint Slides
Attachment 11	--	Quarterly Progress Report (QPR)
Attachment 12	--	Final Closeout Report
Attachment 13	--	Individual File Review form
Attachment 14	--	Property Information Sheet
Attachment 15	--	Mitigation Grant Program Request for Payment form

FEMA-4360-DR-OH

Hazard Mitigation Strategy

Declared: April 17, 2018

Figure 1: Ohio EMA Photo Credit (Website)

Counties Declared for Public Assistance:
Adams, Athens, Belmont, Brown, Columbiana, Gallia, Hamilton, Jackson, Lawrence, Meigs, Monroe, Muskingum, Noble, Perry, Pike, Scioto, Vinton, and Washington Counties
Amended to add: Coshocton, Harrison, Jefferson and Morgan

FEMA

I. HAZARD MITIGATION STRATEGY

Following a disaster, the Federal Emergency Management Agency's (FEMA's) mitigation programs play a critical role developing and integrating disaster operations policies, procedures, and training under the National Response Plan. The Insurance and Mitigation Readiness Division within the Federal Insurance and Mitigation Administration (FIMA) acts as the coordination point for mitigation disaster operations and activities.

PURPOSE OF THE HAZARD MITIGATION STRATEGY

This document outlines a strategy to identify and implement hazard mitigation opportunities following the disaster declaration for FEMA-4360-DR-OH, severe storms, flooding, and landslides. It also provides the framework for implementing long-term, cost-effective solutions to minimize future disaster damages statewide. The strategy has been designed to be consistent with the State Mitigation Plan and will serve to:

- Describe actions for Hazard Mitigation (HM);
- Identify opportunities to achieve hazard mitigation efforts within the state; and
- Document these efforts so they may be shared and enhanced in future disasters.

This document is a multi-agency effort. For this disaster, the Ohio Emergency Management Agency (Ohio EMA), the Ohio Department of Natural Resources (ODNR), and FEMA coordinated to develop strategies and priorities for HM within this disaster.

DESCRIPTION OF THE EVENT

Beginning on February 14, 2018, and continuing through February 25, 2018, a persistent band of moderate to severe storms moved across Region V impacting Illinois, Indiana, Michigan, Ohio, and Wisconsin. While precipitation levels and storm-related damages varied, Ohio experienced a significant amount of flooding and subsequent damage along the southern portion of the state. The snowmelt and continued rain throughout the incident period, combined with the frozen soils, led to flooding along area streams, rivers, and low-lying areas. Numerous flood gauges in this area rose to moderate flood stage, and rainfall totals in the impacted areas during the incident period ranged from a total of five to nine inches. Following these storms, there were several road closures as well as reports of inaccessible areas throughout southern Ohio due to standing water.

Immediately following the onset of this event, the Ohio State Emergency Operations Center (SEOC) began actively assessing and monitoring the situation across the state. The Governor of Ohio declared a State of Emergency on February 24, 2018 for Adams, Athens, Belmont, Brown, Clermont, Columbiana, Gallia, Hamilton, Hocking, Jackson, Jefferson, Lawrence, Meigs, Monroe, Muskingum, Scioto, and Washington Counties.

Widespread flooding culminated February 26, 2018, when the Ohio River at Cincinnati rain gauge showed a crest of 60.53 feet, 8 feet above flood stage and the highest crest since 1997. Communities near the river and its tributaries incurred damages to roads, bridges, and public buildings, as well as basement flooding and sewage backup. According to the Governor, preventative steps on the part of state and local agencies, such as Ohio EMA, shielded the area from the worst possible damage. The SEOC was partially activated with Emergency Support Functions (ESFs). A FEMA Region V Liaison Officer was deployed to the SEOC from February 25, 2018, through February 27, 2018, and the SEOC returned to normal operations on February 27, 2018.

There were several local evacuations due to flooding and the American Red Cross opened three shelters in the impacted areas. There was one confirmed fatality (Shelby County) as a result of this event, and at its peak, there were 10,449 customers without power statewide. On March 6, the Governor requested a joint preliminary damage assessment (PDA) conducted by local, state, and federal emergency management officials. The joint PDA resulted in documentation of approximately $44 million worth of damages to county, village and township roads, bridges, and public buildings. On March 26, the Governor requested a Presidential Disaster Declaration.

On April 17, 2018, a disaster was declared for the State of Ohio, due to severe storms, flooding, and landslides that occurred during the incident period of February 14, 2018, through February 25, 2018. As a result of that declaration, Public Assistance has been made available for Adams, Athens, Belmont, Brown, Columbiana, Gallia, Hamilton, Jackson, Lawrence, Meigs, Monroe, Muskingum, Noble, Perry, Pike, Scioto, Vinton, and Washington Counties. Hazard Mitigation is available statewide.

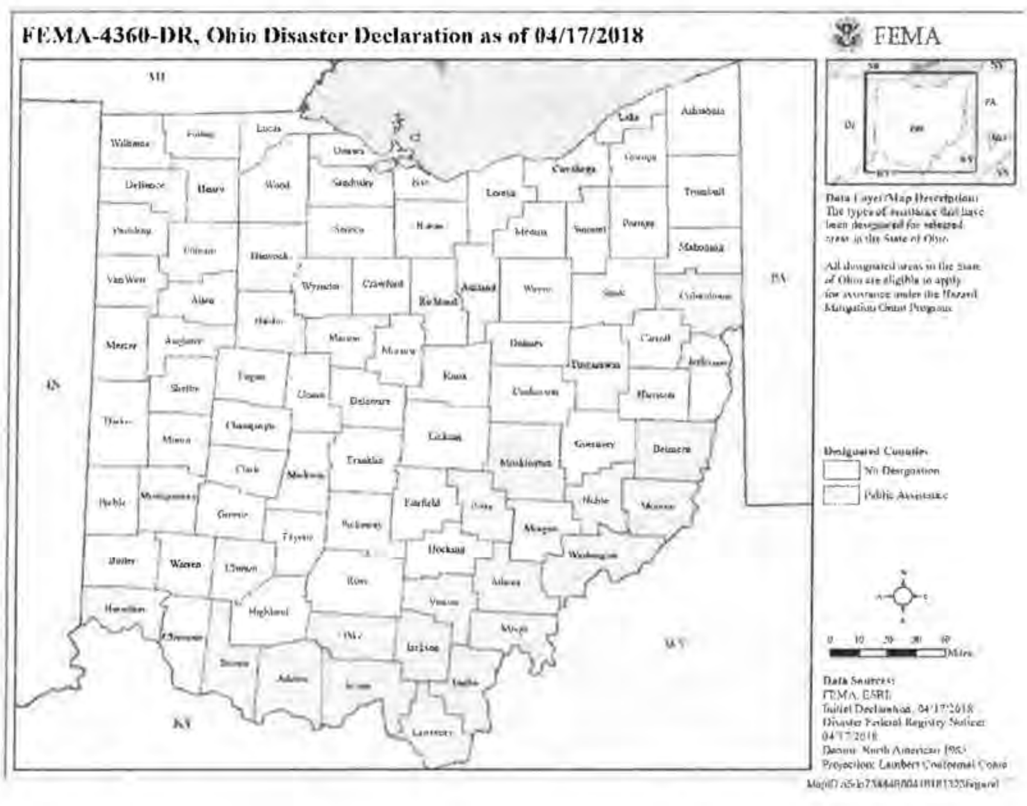

Figure 2: Map of FEMA-4360-DR-OH

II. MISSION, VISION, AND PRIORITIES

The FEMA Mission and Strategic Plan, FIMA Moonshots, and State and Regional priorities were taken into account in the development of this HM Strategy. The following is a summary:

FEMA MISSION
Helping people before, during, and after disasters.

FEMA STRATEGIC PLAN
This FEMA 2018-2022 Strategic Plan was developed with input from our external partners—state, local, tribal, and territorial governments, non-governmental organizations, and the private sector—as well as FEMA employees from offices and directorates across the agency. The vision for the next five (5) years includes objectives that Mitigation directly supports.

The Strategic Plan sets out three overarching Strategic Goals:

- **Build a Culture of Preparedness**
  Every segment of our society, from individual to government, industry to philanthropy, must be encouraged and empowered with the information it needs to prepare for the inevitable impacts of future disasters.
- **Ready the Nation for Catastrophic Disasters**
  FEMA will work with its partners across all levels of government to strengthen partnerships and access new sources of scalable capabilities to quickly meet the needs of overwhelming incidents.
- **Reduce the Complexity of FEMA**
  FEMA must continue to be responsible stewards of the resources we are entrusted to administer. We must also do everything that we can to leverage data to drive decision-making, and reduce the administrative and bureaucratic burdens that impede impacted individuals and communities from quickly receiving the assistance they need.

FIMA - RISK MANAGEMENT DIRECTORATE: Moonshots
The Federal Insurance and Mitigation Administration's (FIMA's) mitigation efforts are significant, are conducted across FIMA's directorates and include visible and less tangible activities, including mitigation planning and grants, investments in better data and maps for decision-making, and capacity building of FIMA stakeholders at the local, state, tribal, and national levels.

The purpose of "*moonshots*" is to engage, challenge, and motivate FIMA members around certain core objectives. FIMA Leadership believes that moonshot targets should engage staff across various directorates and offices around a common goal. Ideally moonshots address both the *Performance* and *Organizational Health* aspects of FIMA's 2017 Leadership Intent. Two aspirational ideas that cut across FIMA:

1. *Double policies-in-force by 2023*
2. *Increase mitigation Investments by 4x by 2023*

While both Moonshots are applicable to all FIMA employees, the Mitigation Investment moonshot is jointly sponsored by the Mitigation and Risk Management Directorates. Selective Executive Service Leads are Mike Grimm and Nick Shufro. Team Leads are Jennie Orenstein and Kathleen Smith. The Double Policies Moonshot is led by the Insurance Directorate under David Maurstad and Paul Huang.

STATE PRIORITIES
The State's HMGP priorities for FEMA-4360-DR-OH, as defined in the State of Ohio Administration Plan, are as follows:

- Priority will be given to projects in the declared counties over projects in other counties (except for planning grant applications).
- 7% planning funds will be utilized to fund local natural hazard mitigation plans that are approaching the five-year deadline for plan expiration. Priority will be given to planning grant applications with the earliest plan expiration date.
- Among flood loss reduction projects, priority will be given for the acquisition of repetitively flood-prone properties as it is the only permanent mitigation solution.
- Priority will also be given to the construction/installation of safe rooms that mitigate the loss of life from severe wind and storm events.

FEMA REGION V PRIORITIES
In support of the FIMA Moonshot, to "double coverage by 2023," one of FEMA Recreational Vehicle's (RV) priority is to deliver outreach on flood insurance through a coordinated Flood Insurance Outreach Strategy. This priority is also in line with the FEMA Strategic Plan goal to "Build a Culture of Preparedness" and objective of "Closing the Insurance Gap."

Floods are the most common and most costly natural disaster in the U.S. and it is important for individuals and communities to know their flood risk and take steps to minimize that risk and protect their financial investments. The Flood Insurance Outreach Strategy will be designed to provide outreach materials to increase an individual's knowledge of flood risk and understanding of flood insurance. Region V would like to focus on the Cincinnati Metropolitan Area as the target for this outreach. Outreach activities should include outreach at special events and state/county fairs, coordination with the State Insurance Commissioner's Office, and distribution of flood insurance publications to a wide range of stakeholders. Additionally, research on the availability of private flood insurance coverage in Ohio would be valuable to help inform risk management knowledge

III. HAZARD MITIGATION GOALS, OBJECTIVES, AND ACTIONS

The mission of hazard mitigation is to protect lives and prevent or reduce the loss of property from hazard events. Post-disaster, this is accomplished through comprehensive efforts authorized by the Stafford Act, as amended by the Disaster Mitigation Act of 2000, the National Flood Insurance Act, the Flood Insurance Reform Act, and Executive Orders.

In this event, the specific HM strategy goals, listed below, lay the foundation for building the capacity to mitigate future disaster damage throughout the state.

HM GRANTS AND PLANNING

Grants and Planning supports state, local, tribal, and territorial governments in the development and update of multi-hazard mitigation plans; provides technical assistance to support the use of Hazard Mitigation Assistance (HMA) grants, specifically Hazard Mitigation Grant Program (HMGP) funding for projects that are consistent with hazard mitigation plan strategies; and collaborates with HM Hazards and Performance Analysis (HPA), Public Assistance (PA), and Environmental Planning and Historic Preservation (EHP) partners to synchronize hazard mitigation opportunities authorized under Sections 404 and 406 of the Stafford Act.

<u>Grants</u>

For this declaration, mitigation briefings will be conducted in conjunction with PA briefings, whenever possible. If Mitigation Branch staff are not available to conduct HMGP briefings in coordination with PA briefings, a series of four webinar briefings will be offered. A webpage was also created on the Ohio EMA Website to notify potential subrecipients of the availability of HMGP funds.

As identified in the Administrative Plan for the HMGP, there will be two application cycles for HMGP funds. The first application cycle will be expedited and will include: 1) unfunded Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) applications, 2) "shelf applications" that are ready to be submitted, 3) applications developed to mitigate damage caused by the disaster event and 4) applications for "substantially damaged structures." Applications in category 1 will not be required to submit an HMGP application. The existing eGrants application for these projects will be used to enter the required project application data into NEMIS. All other applicants in the cycle complete a full HMGP application by the established deadline in order to be considered for funding. The State Hazard Mitigation Team (SHMT) will review these applications and make award recommendations to the Governor's Appointed Representative (GAR).

Also as noted in the Administrative Plan for the HMGP, the second HMGP application cycle will be a two-part process. Pre-applications are submitted first. Pre-applications are reviewed and ranked by the SHMT and enough pre-applications to expend 150 – 200% of the estimated remaining project funds will be selected for full project application development (this is to allow for projects that could be withdrawn and for the submission of zero funded projects to ensure that all Federal and State funds can be appropriated). Full project applications will be evaluated by the SHMT after the deadline for submission has passed. Projects will then undergo a cost effectiveness, environmental, and completeness and eligibility review conducted by the Mitigation Branch staff. Eligible and complete full project applications will then be submitted to FEMA for approval.

Program Administration by States (PAS) is a program created to provide a more streamlined grant approval process allowing communities to get the hazard mitigation funds they need faster. FEMA can delegate activities and subtasks to States, including mitigation planning review. States must submit a request letter to FEMA to indicate interest. States must have a current FEMA-approved mitigation plan, experience in the activities/subtasks requested, and a demonstrated commitment to hazard mitigation. Under this declaration Ohio EMA would like to explore this option and potentially participate in the program.

Planning
Hazard mitigation is most effective when implemented under a comprehensive, long-term mitigation plan. State, tribal, and local governments engage in hazard mitigation planning to identify risks and vulnerabilities associated with natural disasters and develop long-term strategies for protecting people and property from future hazard events. Mitigation plans are key to breaking the cycle of disaster damage, reconstruction, and repeated damage.

According to the Disaster Mitigation Act of 2000 (DMA2K), states must have an all hazards mitigation plan approved by the Federal Emergency Management Agency (FEMA) in order to remain eligible for federal mitigation and public assistance funds associated with a presidential disaster declaration.

The State of Ohio Standard Hazard Mitigation Plan was first approved by FEMA in 2005. The 2014 Enhanced Hazard Mitigation Plan revision details Ohio's highest priority hazards: river/stream flooding; tornadoes; winter storms; landslides; dam/levee failure; wildfire; coastal flooding; earthquakes; coastal erosion, drought; severe summer storms; invasive species; and land subsidence hazards. The 2014 Ohio mitigation plan also integrates the State Hazard Analysis, Resource and Planning Portal (SHARPP)—a web-based system that captures and disseminates state and local hazard mitigation planning and project information.

Applicants with a FEMA-approved State or Tribal Enhanced Mitigation Plan are eligible for HMGP funding not to exceed 20 percent of the estimated total Federal assistance under the Stafford Act, up to $35.333 billion of such assistance, excluding administrative costs authorized for the disaster. Therefore, because Ohio has an Enhanced Mitigation Plan, the State is eligible for HMGP funding in accordance with this provision.

The Ohio Comprehensive Hazard Mitigation Plan Report, as of March 27, 2018, provides the status of local mitigation plans statewide (See Appendix 2). All subapplicants for HMGP must have a FEMA-approved local Mitigation Plan at the time of obligation of grant funds for mitigation projects.

Goal 1: Partner with the State of Ohio to identify mitigation opportunities and assist communities in the development of cost-effective and technically feasible mitigation projects.

Objective 1.1 *Build and support the capacity of the State to implement Hazard Mitigation Assistance*

1.1.1 Support the State in the development of a Program Administration by State (PAS) agreement related to approval of Hazard Mitigation Plans

- Coordinate with Ohio EMA to explore and potentially execute a PAS agreement between the State and FEMA for review of Hazard Mitigation Plans

1.1.2 Support submission and implementation of State Management Costs

- Ohio EMA will submit the initial request for State Management Costs (SMC) in mid-May 2018 after receipt of the initial 30-day lock-in of the estimate of the amount of funding eligible to be used for HMGP, and FEMA will approve and obligate up to 25% of SMC funds.
- Ohio EMA will submit to FEMA by mid-August 2018 (no later than 120 days after the date of declaration) the SMC narrative on how the State will utilize the SMC funds
- Ohio EMA will submit a request for the remaining SMC funds after 12 months from the declaration or in April 2019, and FEMA will approve and obligate the remaining funds for SMC.

1.1.3 Administer HMA grants to reduce future damages from hazards as identified in the State Hazard Mitigation Plan.

- Ohio EMA will contact those counties whose plans have expired or are at risk of expiring to encourage them to apply for a planning grant in May 2018
- Ohio EMA will solicit pre-applications from affected communities including contacting local officials, mailing application packages, and attending local meetings by December 2018
- Ohio EMA will submit to FEMA the Application for Federal Assistance (SF424) and Assurances for the Disaster

1.1.4 Develop two application cycles with the first cycle of submittals including applications for projects which were not selected for the 2017 non-disaster HMA programs. (HMA and Ohio EMA)

Cycle 1, Steps:

- The SHMT will review subapplications and make award recommendations to the Governor's Authorized Representatives (GAR)
- The Ohio EMA will submit HMGP subapplications to FEMA in May 2018
- FEMA will review and approve sub-applications and obligate HMGP funds

Cycle 2, Steps:

- The SHMT will review and rank pre-applications to expend 150–200% of the estimated remaining project funds selected for full project application development by May 2018
- Subapplicants will submit full subapplications to Ohio EMA by December 2018
- Ohio EMA will submit full subapplications to FEMA beginning in December 2018
- FEMA will review and approve subapplications and obligate HMGP funds in a timely manner

Goal 2: Ensure compliance with the Disaster Mitigation Act of 2000, Part 322 (Mitigation Planning Requirements)

Objective 2.1 Encourage communities in the declared area with HM plans that have not been adopted to complete the adoption and resolution process

2.1.1 FEMA will coordinate with the Ohio EMA to develop a letter to send to communities that have not adopted their local mitigation plan

- First, FEMA will provide a list of communities that have not adopted local mitigation plans
- Ohio EMA will send emails to the County Emergency Management Agencies advising that there are communities within their county that have not adopted to local plan
- Then, FEMA will send letters to the community to encourage communities to submit mitigation plan adoptions to the state

HM FLOODPLAIN MANAGEMENT AND INSURANCE

Floodplain Management and Insurance promotes community participation in the National Flood Insurance Program (NFIP); monitors compliance with NFIP regulations during rebuilding/ relocating; and provides floodplain management expertise to state, local, tribal, and territorial governments, and Joint Field Office (JFO) partners.

Insurance

For this declaration, FEMA will initiate the development of targeted Flood Insurance Outreach Strategy to encourage individuals to consider purchasing flood insurance. The strategy will be developed in coordination with FEMA Region V Floodplain Management and Insurance Branch and External Affairs.

Floodplain Management

Communities that participate in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed the minimum requirements of the Program. The requirements are intended to prevent loss of life and property and reduce taxpayer costs for disaster relief, as well as minimize economic and social hardships that result from flooding. In exchange for community adoption and enforcement, FEMA makes flood insurance available to all property owners throughout the community. There are 98 communities statewide that do not participate in the NFIP.

Communities that are identified as flood-prone, but do not participate in the NFIP are subject to sanctions. Federal grants and loans for development in SFHAs and Federal disaster assistance for flood damages are not available in these communities

Of the 98 non-participating communities, 14 have been identified as flood-prone and are subject to sanctions. (See Appendix 1)

For participating communities in the affected areas, one of the most demanding requirements of the NFIP in a post-disaster environment is to evaluate damaged structures to determine if they have been substantially damaged. Additionally, any substantially damaged structures are required to repair or reconstruct in compliance with the local ordinance. This often means elevating, flood proofing, or relocating structures to reduce their future risk to flooding.

For this disaster, FEMA and the State will coordinate to provide any technical assistance or training on substantial damage and other requirements of the NFIP as requested by communities in the affected areas. Rebuilding after an event also provides an opportunity to build back safer and stronger. Therefore, FEMA and the State will work with communities interested in adoption of higher standards.

Goal 3: Assist the State of Ohio in increasing awareness and knowledge of the NFIP and supporting floodplain management compliance and flood insurance.

Objective 3.1 *Encourage individuals and communities to evaluate their risk and protect their investments through a targeted Flood Insurance Outreach Strategy.*

3.1.1 FEMA will develop a strategy to deliver insurance outreach to communities and individuals in the affected areas

- Coordinate with RV to develop and implement an Insurance Outreach Strategy in the target area, Cincinnati, to include:
    - Agent training—Coordinate with H2O Partners for targeted agent training in Ohio (COMPLETE)
    - Outreach at special events—State and county fairs, first time homebuyers events
    - Coordination with State Insurance Commissioner's office and the Big I (Ohio Insurance Association)
    - Providing Publications to communities, libraries, and home repair stores
    - Analysis of private flood insurance coverage throughout the state
    - Coordination with External Affairs to provide proactive and accurate flood insurance messaging to penetrate the digital media market

Objective 3.2 *Encourage participation in the NFIP through outreach to non-participating communities throughout the state.*

3.2.1 Reach out to all non-participating communities throughout the State and invite them to join the NFIP

- Gather current contact information for non-participating/sanctioned communities
- Prepare letter, with attachments, to be signed by FEMA RV Mitigation Director and sent to communities
- Provide any technical assistance necessary to guide interested communities through the process, COMPLETE—technical assistance will be provided, as needed

Objective 3.3 *Provide appropriate technical assistance to communities on the requirements of the NFIP and opportunities to promote resilience and sustainability.*

3.3.1 Reach out to all participating communities in the affected area to remind them of their NFIP responsibilities and offer technical assistance

- ODNR emailed impacted communities (COMPLETE)
- Additional follow-up with Pomeroy may be required

3.3.2 Provide publications and technical assistance on compliance with NFIP minimum standards and encourage higher standards

- Cincinnati request (review of ordinance and suggestion for higher standards)
- New Richmond request (support of higher standards in campgrounds)
- Hamilton County (concerns over new National Flood Hazard Layer—no hyperlink to Letter of Map Amendment—coordinate with Risk Analysis)
- Columbus (support of higher standards for storage of materials)
- Publications requested for Hamilton County, Cincinnati, and New Richmond

COMMUNITY EDUCATION AND OUTREACH

During the preliminary damage assessment phase of the disaster, potential best practices and success stories were identified. A Best Practice Writer will support the development of potential best practices and successes. Additionally, FEMA and the State of Ohio will coordinate to provide training opportunities to communities.

Goal 4: Advance education, outreach and community resilience in support of the Hazard Mitigation Strategy

Objective 4.1 *Identify hazard mitigation measures that effectively reduce damages and develop them into Best Practices and Success Stories, media releases, stories for social media, and local newsletters.*

4.1.1 Capture and develop Best Practice story opportunities including those based on past Hazard Mitigation projects implemented in designated areas.

- The following leads have been identified for potential best practices or success stories:
  - Delhi—Successful HMGP projects
  - Cincinnati—East End avoided losses due to acquisition projects
  - Cincinnati—Highlight success of building codes/floodplain management standards as illustrated by an elevated school that avoided losses
  - New Richmond—Successful HMGP projects

Objective 4.2 *Identify hazard mitigation training needs and outreach opportunities and provide training and resources to support the needs*

4.2.1 Provide training to support project application development and submittal.

- Ohio EMA and FEMA have identified the following trainings for state and local officials responsible for preparing HMA applications:
  - HM Grant Application Development Workshop: 4-hour hazard mitigation workshop based on received pre-applications (this course will not result in a FEMA certificate)
  - BCA Training: A one-day training focusing on storm water and safe room projects (After May 2017 in Columbus)
  - Environmental and Historic Preservation (EHP) Training: A one-day training on EHP for HMA
  - Quality Application Development Webinar: A one-day training (Early to mid-June)

4.2.2 Provide training to support community compliance with NFIP requirements

- Ohio DNR and FEMA have identified the following trainings for NFIP stakeholders
  - Substantial Damage training for Cincinnati area communities
  - Elevation Certificate and Letter of Map Change Training for Ohio River Valley Professional Licensed Surveyor Organization (May 18)

4.2.3 Leverage and build on existing partnerships between the FEMA Region, and local and state organizations to maintain public awareness of hazard mitigation.

- Provide communities with publications for display and dissemination

HAZARDS AND PERFORMANCE ANALYSIS
Hazards and Performance Analysis (HPA) informs Response and Recovery operations with risk analysis and provides technical assistance to state, local, tribal, territorial, and federal partners.

With significant investment being made in mitigation, demonstrating cost-effectiveness is crucial for continued support, Loss Avoidance Studies (LAS) quantify the losses avoided (also known as damage prevented or benefits) due to the implementation of the projects. FEMA and Ohio EMA explored the possibility of conducting a LAS for this event, however, the detailed data on acquisition projects in the declared area required to complete a LAS were not available. In lieu of this data, FEMA and Ohio EMA decided to prepare Best Practice and Success Stories to document the projects for the state. Additionally, FEMA RV and Ohio EMA will work with the US Army Corps of Engineers to determine what is required to finalize draft LAS's completed for the communities of Findlay and Ottawa.

HM HPA analyzes past performance and projects for structural and infrastructure mitigation funded under Sections 404 or 406 of the Stafford Act and supports the development and adoption of more rigorous, risk informed building codes and standards. In this disaster, in support of Public Assistance (PA) projects, Mitigation will deploy 406 Specialists to work directly with the PA organization. The 406 specialists will be embedded on the PA teams. PA has requested 8 406 Mitigation Specialists, however, there are not 8 available. Therefore, PA will be assessing the PA Specialists that are deployed to the disaster to determine if they have knowledge and experience doing 406 Mitigation. Those that do have 406 capability will be redirected to provide that support and any remaining needed staff will be coordinated through the Mitigation Cadre.

HPA will prepare the Best Available Flood Hazard Information Memo in support of the disaster. The memo provides guidance on the following: for FEMA in complying with 44CFR Section 9.7(c) and Executive Order (E.O.) 11988 Sec. 2(a) (1) on the use of best available flood hazard information; and, on the use of work maps, Preliminary Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies (FIS) or when Advisory BFEs are available to communities for new and substantially improved/substantially damaged structures. The memo also acknowledges the coordination responsibilities for federal agencies to communicate and allow for an informed and collaborative approach to unifying environmental and historic preservation compliance reviews for disaster recovery work under the Unified Federal Review Process.

Goal 5: Provide risk analysis products to support sound decision making in the recovery and rebuilding process in order to reduce vulnerability and increase resiliency to future flood events.

Objective 5.1 *Coordinate with Public Assistance to assist in the identification of potential mitigation opportunities.*

5.1.1 Deploy 406 Mitigation staff to support the needs of PA and embed the staff within the PA organization

Objective 5.2 *Provide guidance to FEMA, the State, and communities on the best available flood hazard data for use in rebuilding and recovery.*

5.2.1 Prepare Memo on available flood hazard information in compliance with FEMA Policy #104-008-2

Objective 5.3 *Evaluate the possibility of conducting a losses avoided study and finalize previously prepared losses avoided studies that are still in draft format.*

5.3.1 Coordinate with Ohio EMA and ODNR to determine if data exists to conduct a losses avoided study for this disaster (Complete)

5.3.2 Coordinate with USACE and Ohio Silver Jackets to determine what is required to finalize draft losses avoided studies

HM STRATEGY WORK GROUP

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Laurie Smith-Kuypers	FEMA RV	Outreach Specialist
FEMA IOF		
Patricia Beck	FEMA	Group Supervisor

SIGNATURES

5/22/18

Steven Johnson **Date**
Federal Coordinating Officer
FEMA-4360-DR-OH

5/22/18

Sima Merick **Date**
State Coordinating Officer / Governor's Authorized Representative
FEMA-4360-DR-OH

MARY B CARUSO

Digitally signed by MARY B CARUSO
Date: 2018.05.15 10:04:01 -05'00'

Mary Beth Caruso **Date**
Mitigation Division Director
FEMA Region V

APPENDIX 1

Community Declared Disaster - Non Participating

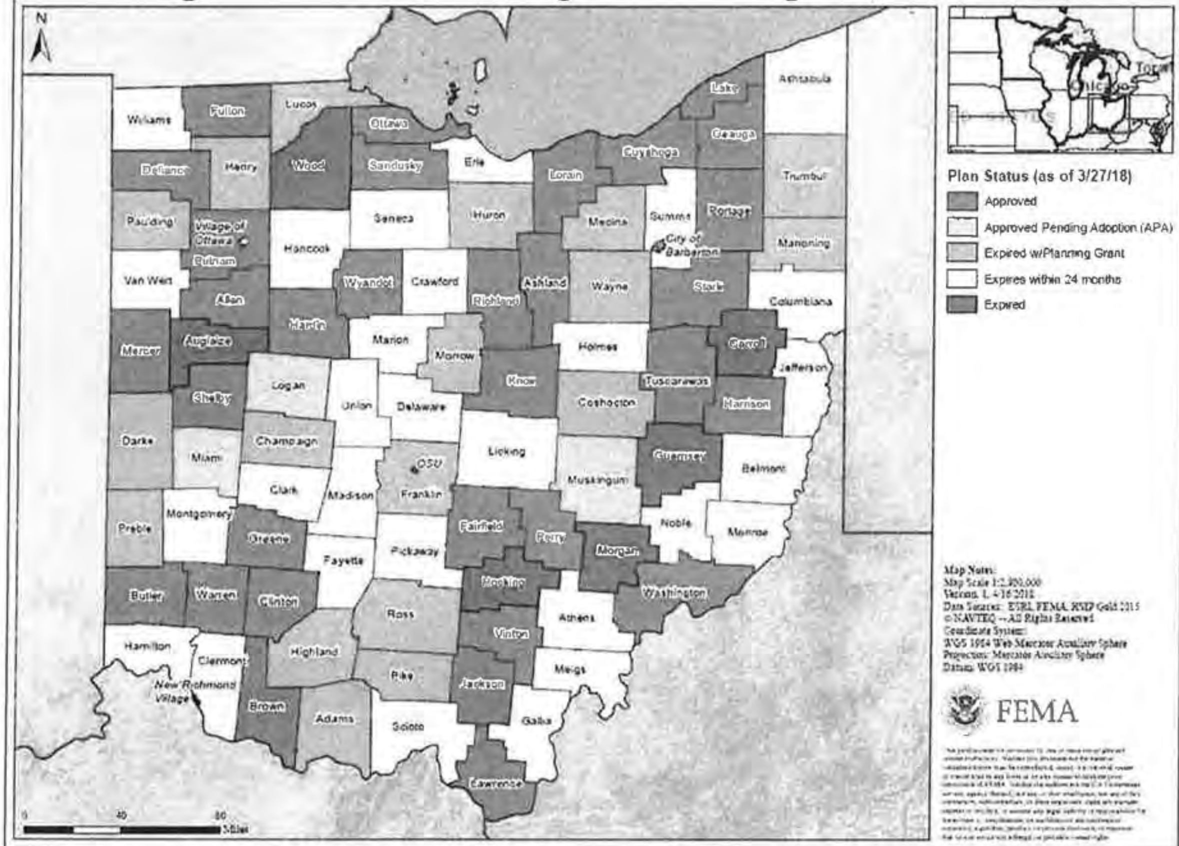
OHIO

Including Future Sanction Dates

CID	County	Community	Hazard Area Identified	Date Sanction
390819#	ADAMS COUNTY	CHERRY FORK, VILLAGE OF	09/22/78	09/22/79
390908#	ADAMS COUNTY	WEST UNION, VILLAGE OF	11/21/01(F)	11/21/02(F)
390017#	ATHENS COUNTY	CHAUNCEY, VILLAGE OF	06/21/74	06/21/75
390822#	ATHENS COUNTY	COOLVILLE, VILLAGE OF	11/03/78	11/03/79
390788#	BROWN COUNTY	FAYETTEVILLE, VILLAGE OF	08/05/77	08/05/78
390911#	BROWN COUNTY	SAINT MARTIN, VILLAGE OF	11/21/01(F)	11/21/02(F)
390789#	BROWN COUNTY	SARDINIA, VILLAGE OF	01/13/78	01/13/79
390851#	MUSKINGUM COUNTY	PHILO, VILLAGE OF	03/30/79	03/30/80
390815#	NOBLE COUNTY	BATESVILLE, VILLAGE OF	01/06/11(F)	01/06/12(F)
390431#	NOBLE COUNTY	DEXTER CITY, VILLAGE OF	08/23/74	08/23/75
390802#	PERRY COUNTY	RENDVILLE, VILLAGE OF	12/02/77	12/02/78
390710#	PERRY COUNTY	SHAWNEE, VILLAGE OF	02/07/75	02/07/76
390913#	SCIOTO COUNTY	OTWAY, VILLAGE OF	09/04/02(F)	09/04/03(F)
3907188	VINTON COUNTY	MCARTHUR, VILLAGE OF	11/26/76	11/26/77
	Total : 14			

APPENDIX 2

Ohio Comprehensive Hazard Mitigation Plan Report (as of 3/27/18)



State of Ohio
Hazard Identification and Risk Assessment
(HIRA)

Ohio Emergency Management Agency
2855 West Dublin-Granville Road
Columbus, Ohio 43235

December 2018 Edition

Foreword

December 19, 2018

This 2018 edition of the State of Ohio Hazard Identification and Risk Assessment (HIRA) provides current research and updates on those natural, technological and human-caused hazards to which the state of Ohio is most vulnerable. Knowledge of these hazards, their frequency, and the state's overall vulnerability to them allows state and local government officials to better assess their risks and to plan and prepare for the consequences.

This revision is an update to the Spring / Summer 2013 HIRA. This HIRA has been reviewed in its entirety, with all information evaluated and updated as necessary. This document was prepared by Planning, Training and Exercise Branch at the Ohio Emergency Management Agency (Ohio EMA) with the assistance of all branches within the agency and other state/federal partners. The information contained in this HIRA is a compilation of research from federal, state, and local government sources, as well as from public sources.

SIMA S. MERICK
Executive Director

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Introduction

The intent of this document is to be a useful tool for state and local emergency management partners to rate the risk, determine vulnerability, and predict the adverse impact of disasters and emergencies. The HIRA does not provide policy or action-based recommendations to manage hazards. This document is one element of a comprehensive emergency management program that incorporates mitigation, preparedness, response and recovery. Mitigation plans, the State of Ohio Emergency Operations Plan, as well as standard operating procedures, round-out a comprehensive program to manage hazards.

Emergency management in Ohio is governed by Ohio Revised Code (ORC) 5502. Section 5502.21 mandates that the EMA, a division of the Department of Public Safety, is the primary coordinating agency for statewide emergency readiness activities to meet the threats posed by various hazards.[1] In cooperation with other state offices and agencies, the agency has developed this analysis of the primary hazards that may threaten both lives and property.

For the purpose of this HIRA, we will use the ORC definition of hazard. 'Hazards' in Chapter 5502.21 of the ORC are defined as: "… any actual or imminent threat to the survival or overall health, safety, or welfare of the civilian population that is caused by any natural, human-made, or technological event."[2]

A catastrophic incident, as defined in the FEMA National Response Framework, is "any natural or manmade incident, including terrorism that results in extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions."

As defined by the ORC, "Hazard identification means an identification, historical analysis, inventory, or spatial distribution of risks that could affect a specific geographical area and that would cause a threat to the survival, health, safety, or welfare of the civilian population, the property of that population, or the environment."[3] The National Fire Protection Association (NFPA) Standard 1600 requires entities to "identify hazards, monitor those hazards, the likelihood of their occurrence, and the vulnerability of people, property and the environment, and the entity itself to those hazards"[4] as part of the risk assessment process.

Upon reviewing the literature in hazard analysis, over seventy hazards were identified. These hazards include those listed in NFPA 1600, the Homeland Security Council and DHS-developed National Planning Scenarios, Ohio EMA's State of Ohio Enhanced Hazard Mitigation Plan, and Ohio Homeland Security documents.

To help categorize the hazards, this HIRA analysis utilizes three major groups based primarily on the categories recommended in the Federal Emergency Management Agency's Comprehensive Preparedness Guide 101. The categories are Natural, Human Caused and Technological as shown in Figure 1. Each of the hazards identified are not mutually exclusive. Some hazards are not germane to Ohio and/or not likely enough a scenario to warrant consideration in this hazard identification and risk analysis.

A General Overview of Hazards in Ohio

The most damaging hazards/events in Ohio are floods and tornadoes. Other severe weather events, such as winter storms, have also led to floods or costly recovery actions. Drought has also led to agricultural losses and forced water users to seek assistance during these sustained periods of insufficient precipitation. Ice storms can take a greater toll, especially in regards to travel, infrastructure, and power and communication lines. When an ice storm strikes, roads can turn deadly, leaving schools and businesses closed.

For over 200 years, earthquakes, often centered in the Anna (Shelby County) Seismic Zone, have also occurred in Ohio, with most classified as “minor” in nature. Northeastern Ohio, east of Cleveland, has been particularly active in recent years. A large-scale (regional) event involving the New Madrid, Missouri fault, could significantly affect portions of southwestern Ohio.

Activities associated with humankind also have their effects such as woodland and field fires which represent high economic impact to costly resources. Mine closings have led to issues related to subsidence and landslides. From the 1940s until the present, closings were made without actions to prevent shaft collapses. Urban expansion, or new highway construction, has led to damages related to these collapses. Class I and other earthen dams also pose a potential threat to adjacent or downstream communities. Many of these dams serve as up-ground reservoirs or recreational sites. If not properly built or maintained, they may fail, leading to downstream flooding and strained response capabilities.

In addition to fossil fuels, electric power generation uses nuclear technology. Three nuclear generating facilities are sited in, or within five miles of, Ohio. The 50-mile ingestion pathway from the Enrico Fermi plant in Michigan also extends into Ohio. Three separate U.S. Department of Energy (DOE) facilities also pose a potential risk. The issue of on-site waste treatment and the removal from these sites poses a unique hazard for adjacent communities. In the event of a problem, local subdivisions (and the state) would be engaged in extensive recovery actions. Two of the three DOE facilities are in the process of being decommissioned.

Passenger and cargo airlines continue to cover the state’s airspace daily and railway accidents remain a matter of concern in areas of high traffic density. Like other hazards, transportation events may not occur regularly, but authorities in areas with a high density of air or rail traffic should weigh the potential of a transportation emergency.

Since 1964, nearly 60 major emergency events in Ohio have received a Presidential Declaration of Disaster. As a result, Ohioans have received hundreds of millions in federal assistance monies. The Ohio EMA has aided both the public and private sectors in obtaining this assistance. Although hazards may either decrease, or increase, from a strictly numerical standpoint, inflationary labor and material trends have caused overall recovery costs to rise. Each new event is more costly to the state and nation than its predecessors.

As national mutual aid between states grows, our state may have to respond to hazards not necessarily associated with Ohio. Most recently, Ohio sent personnel and equipment to Texas, Florida, Massachusetts, the Carolinas, the Virgin Islands, Puerto Rico, Hawaii, and North Dakota in response to EMAC requests.

An Ohio Profile

All geographical and political subdivisions of the state are vulnerable to some form of natural, technological, or other hazard. The effects of these hazards (regardless of type or size) will vary due to geography, climate or land use. Examination of the State's characteristics provides a better understanding of these hazards and their associated risks.

Geography and Climate

With a total land area of 40,952.6 square miles, and a 2017 population in excess of 11,658,609 (a gain of approximately 100,000 persons since the last risk assessment), nationally, Ohio ranks 34th in total area, and 7th in population.

Topographically, the state presents a varied combination of landforms, which are diagonally divided across the state between the flat, glaciated, areas of the north-northwest, to the unglaciated highlands in the south and southeast. The steeply incised landforms in the south and east often contribute to flooding, mudslides, and other effects via rapid runoff from heavy rains and melt water. In the north and west, the level topography is subject to flooding when heavy snowstorms are followed by rapid melt water discharges.

The state possesses a continental climate ranging through the year from cold, damp winters, to warm, humid summers with prevailing westerly wind patterns throughout the year. The average temperature in Ohio is 52.5°F with an average monthly high of 86°F (July) and average monthly low of 19°F (January). The average annual rainfall is 40.16 inches.

Ohio's Economy

Ohio has a diversified economy, with goods-producing activities including agriculture, natural resources and mining, construction, and manufacturing, which contribute $53.1 billion to the state's economy; an 18% increase from 2011. The majority of this increase is due to recent increases in the extraction of the shale oil resources of the southeastern highlands.

Ohio's $10 billion agricultural industry is dependent on the State having some of the most fertile and ideal farming conditions in the country. The west and northwest sections of the state are characterized by glaciated plains, with large deposits (up to 400 feet-deep) of fertile soil and wide expanses of lands that were flattened by glacial retreat, which make these rich lands ideal for agricultural production with modern, heavy farm machinery.

Major service industries/trade, such as utilities, healthcare, finance/insurance, and business services contribute another $163 billion to the state's growing economy.

An extensive transportation network of roads, rail lines, waterways, and air travel supports the state's economy. State, federal and interstate highways form connecting links to, or around, major metropolitan areas. The state's large and medium-sized cities host commercial air traffic carriers. Ohio's railway infrastructure ranks fourth nationally in rail route mileage, and eighth overall in carloads carried. Waterborne commerce (via barge or ship) contributes to local economies along the Ohio River and along the Lake Erie shore.

Historical Review of Disasters

For almost 200 years, the State of Ohio has recorded casualties (injuries and fatalities) associated with disasters varying in origins and effects. The more noteworthy of these, which resulted in loss of life or economic damages, are listed in Figure 1. Historical Events and Impacts below.

Figure 1. Historical Events and Impacts

Name of Disaster	Year	Hazard/Event Type	Location	Casualties
Cholera Epidemic	1849/50	Bio/Epidemiological	Statewide	5,000 +
Rail Bridge Collapse	1876	Transportation	Ashtabula	92
Collinwood School Fire	1908	Fire	Cleveland	17
Easter Flood	1913	Flood	S/SW Ohio	467
Influenza Epidemic	1918	Bio/Epidemiological	Statewide	Multiple Thousands
Sandusky/Lorain Tornado	1924	Tornadoes	Lorain and Sandusky	85
Cleveland Clinic Fire	1929	Fire	Cuyahoga	123
Millwood Mine Disaster	1930	Mine Fire – Collapse	Athens Co.	82
Penitentiary Fire - Columbus	1930	Prison Fire	Franklin Co.	322
Extreme Heat	1934	Heat Wave	Statewide	160
Winter Flood	1937	Flood	Statewide	250
Gas Explosion & Fire	1944	Technological + Fire	Cleveland	130
Blizzard	1950	Winter Storm	Statewide	Unknown
Penitentiary Fire - Columbus	1952	Prison Fire	Franklin Co.	0
Winter/Spring Floods	1959	Flood	Statewide	Unknown
Nursing Home Fire	1963	Fire	Marietta	95
Tornado	1965	Tornadoes	Toledo, Lima, Strongsville. Delaware, Mercer, Seneca, and Shelby counties	55
Lake Central/TWA Crashes	1967	Transportation	N&W Ohio	70 + (Combined)
Prison Riot - Columbus	1968	Other (Prison Riot)	Franklin Co.	5
Xenia Tornadoes	1974	Tornadoes	Greene Co.	30; 1150 injured
Blizzard	1978	Winter Storm	Statewide	51
Explosion/Fire - Miamisburg	1986	Technological + Fire	Butler Co.	0
Train wreck-HAZMAT Spill	1986	Transportation	Miamisburg	0
Flash Flood – Shadyside	1990	Flash Flood	Belmont Co.	26
Prison Riot – Lucasville	1993	Other (Prison Riot)	Scioto Co.	11
Floods (from snow runoff)	1996	Flood	Statewide	0

Name of Disaster	Year	Hazard/Event Type	Location	Casualties
Severe Storms/Floods	1997	Flood	Southern Ohio	5
Severe Storms/Floods	1998	Flash Flood	Central/east central & SE	12
Xenia Tornadoes	2000	Tornadoes	Greene Co.	1; 100 injured
Van Wert Tornado	2002	Tornadoes	Van Wert (1 of 83 tornadoes in 17 states)	5
Winter Storms	2004-05	Severe Winter Weather	Statewide	0
Severe Winter Weather	2005	Ice Storm	Statewide	0
Severe Storms	2007	Flooding	Statewide	0
Wind Storm	2008	High Wind Storm	Statewide	7
H1N1	2009/10	Pandemic	Statewide	119 (total influenza deaths, including H1N1)
Severe Weather & Tornadoes	2010	Tornado	Wood, Fulton, Ottawa & Lucas counties	6
Severe Weather; Flooding	2011	Flooding	Ohio River	0
Winter Storm	2012	Blizzard	NW Ohio	0
Severe Weather (Derecho)	2012	High Wind	From NW Ohio to SE Ohio	1 (subsequent heatwave may have caused other deaths)
Hurricane Sandy	2012	Hurricane; High Wind	Northern Ohio	0
Train Derailment/Explosion	2012	Technological - HazMat	Franklin	
Severe Weather and Tornadoes	2012	Tornado; Severe Thunderstorms	Clermont, Hamilton, Highland, Pike, Adams, Lawrence, Athens	4
Cridersville Tornado	2013	High Wind, Flooding	Auglaize, Perry, Morrow	0
Traffic Accidents (90 car pileup)	2013	Winter Storm	SW Ohio	1; 28 injured
Flooding	2014	Flooding	Summit, Clark, Highland	0
Toledo Water	2014	Harmful Algal Bloom	Lucas	0
Severe Weather	2014	Power Outage, Propane Shortage	Summit	0
Ebola Response	2014	Public Health Emergency	Summit	0

Name of Disaster	Year	Hazard/Event Type	Location	Casualties
Severe Weather	2014	Tornado, High Wind	Mahoning, Highland	0
Winter Storm	2014	Winter Storm, Power Outage	Gallia, Darke, Warren, Highland	0
Akron Plane Crash	2015	Aircraft	Summit	9
Argo Shipwreck	2015	HazMat	Lake Erie	0
Kettering Tornado	2015	Tornado	Montgomery	0
Stark County Radium Response	2016	Radiological	Stark	0
Tornadoes	2016	Tornado	Statewide (24)	0
Tornadoes	2017	Tornado	Statewide (39)	0
Cincinnati Fifth Third Bank Shooting	2018	Active Aggressor	Hamilton	4 (incl. shooter)/2 injured
Flooding	2018	Flood	SE Ohio and Ohio River	1
Ross Correctional Facility Unknown Substance	2018	Public Health Emergency	Ross	0

Source: *Ohio Almanac/Contributing agencies/Ohio EMA*

The previous figure shows some of the historically serious events (with hazards) occurring since 1849 by events and mortality statistics, but not property damages or other costs.

Since 1964, many events have received a Declaration of Disaster by the President of the United States as shown in Figure 2. Presidential Major and Emergency Disaster Declarations in Ohio with Costs, by County (1964-18) which provides a breakout of the types of federal assistance, funds provided, incident type, as well as date declared with federal disaster number.

These incidents have affected both people and property. Gubernatorial Declarations have often been used for a number of other events, not qualifying for federal assistance via Presidential Declarations, as “Emergencies” or “Disasters.” This process serves to initiate coordinated state response efforts for areas requiring assistance beyond local capabilities.

Figure 2. Presidential Major and Emergency Disaster Declarations in Ohio with Costs, by County[5] (1964-18)

Disaster Declaration Number	Date Declared	Federal Disaster Programs	Incident Type	Counties Declared	Funds Provided
DR- 167	March 24, 1964	PA	Heavy rains and flooding	Adams, Athens, Auglaize Belmont, Brown, Butler, Carroll, Clermont, Clinton, Columbiana, Coshocton, Cuyahoga, Delaware, Fairfield, Franklin, Gallia, Geauga, Guernsey, Greene, Hamilton, Harrison, Hocking, Jackson, Jefferson, Lake, Lawrence, Licking, Medina, Meigs, Miami, Monroe, Morgan, Muskingum, Noble, Perry , Pickaway, Pike, Preble, Richland, Ross, Scioto, Summit, Trumbull, Tuscarawas, Vinton, Warren, Washington,	$571,482 (P)
DR- 191	April 14, 1965	PA	Tornadoes and high winds	Allen, Cuyahoga, Delaware, Hancock, Harrison, Highland, Lorain, Lucas, Medina, Mercer, Morrow, Pickaway, Seneca, Shelby, Van Wert	$275,248 (P)
DR- 238	May 4, 1968	PA	Tornadoes	Brown, Clermont, Gallia, Licking, Scioto	$270,000 (P)
DR- 243	June 5, 1968	PA	Heavy rains and flooding	Adams, Athens, Brown, Butler, Clermont, Clinton, Fairfield, Franklin, Fayette, Gallia, Greene, Guernsey, Hamilton, Hocking, Jackson, Lawrence, Licking, Meigs, Monroe, Montgomery, Morgan, Noble, Perry, Pickaway, Pike, Ross, Scioto, Vinton, Warren, Washington	$600,000 (P)
DR- 266	July 15, 1969	PA	Heavy storms and floods	Ashland, Ashtabula, Coshocton, Cuyahoga, Erie, Harrison, Holmes, Huron, Lake, Lorain, Lucas, Medina, Morgan, Muskingum, Ottawa, Richland, Sandusky, Seneca, Stark, Trumbull, Tuscarawas, Wayne, Wood	$1,000,000 (P)
DR- 345	July 19, 1972	PA	Storms and flooding	Ashtabula, Belmont, Cuyahoga, Jefferson, Lake, Lorain, Monroe	$1,328,098 (P)
DR- 362	November 24, 1972	PA	Storms and flooding	Erie, Lake, Lorain, Lucas, Ottawa	$615,863 (P)
DR- 377	April 27, 1973	PA	Storms and flooding	Ashtabula, Cuyahoga, Erie, Lake, Lorain, Lucas, Ottawa, Sandusky	$1,417,975 (P)
DR- 390	June 4, 1973	PA	Mudslides	Hamilton, Washington	$1,434,684 (P)

Disaster Declaration Number	Date Declared	Federal Disaster Programs	Incident Type	Counties Declared	Funds Provided
DR- 421	April 4, 1974	PA/IFG	Tornadoes and high winds	Adams, Butler, Clark, Delaware, Fayette, Franklin, Greene, Hamilton, Madison, Paulding, Pickaway, Putnam, Summit, Warren,	$10,250,454 (P) $1,945,833 (I)
DR- 436	May 31, 1974	PA	Heavy rains and flooding	Lucas, Ottawa, Sandusky	$858,824 (P)
DR- 445	July 11, 1974	PA	Heavy rains and flooding	Warren	$507,364 (P)
DR- 480	September 11, 1975	PA	Floods	Belmont, Cuyahoga, Jefferson, Lake,	$3,320,493 (P)
DR- 3055-EM	January 26, 1978	PA	Severe blizzard conditions	All 88 counties	$3,546,669 (P)
DR- 630	August 23, 1980	PA/IFG	Heavy rains and flooding	Belmont, Columbiana, Guernsey, Jefferson, Monroe, Muskingum, Noble	$1,653,327 (P) $669,820 (I)
DR- 642	June 16, 1981	PA/IFG	Tornado, high winds and flooding	Hancock, Morrow, Putnam, Wyandot (IA) Morrow (PA)	$346,950 (P) $47,382 (SCB)** $515,593 (I)
DR- 653	March 26, 1982	PA/IFG	Flood	Defiance, Fulton, Henry, City of Toledo (Lucas), Paulding, Wood County (IA)	$157,390 (P)
				Defiance, Paulding, Village of Grand Rapids (Wood only) (PA)	$268,187 (I)
DR- 738	June 3, 1985	PA/IFG	Tornadoes	Ashtabula, Columbiana, Coshocton, Licking, Portage, Trumbull (IA)	$1,556,950 (P)
				Trumbull (PA)	$419,751 (SCB)** $424,893 (I)
DR-796	June 9, 1905	IFG	Floods	Crawford, Marion, Morrow, Richland	$1,066,258 (I) $266,564 (SCB)**

Disaster Declaration Number	Date Declared	Federal Disaster Programs	Incident Type	Counties Declared	Funds Provided
DR- 831	June 10, 1989	IFG	Severe storms and flooding	Butler, Coshocton, Cuyahoga, Franklin, Geauga, Greene, Lake, Licking, Lorain, Mercer, Montgomery, Preble, Warren	$2,363,868 (I) $590,967 (SCB)**
DR- 870	June 6, 1990	PA/IFG/HMGP *	Severe storm, tornadoes, and flooding	Athens, Belmont, Butler, Columbiana, Fairfield, Hamilton, Harrison, Hocking, Jackson, Jefferson, Lawrence, Licking, Monroe, Muskingum, Perry, Pike, Richland, Vinton (PA/IA) Clermont, Franklin, Mahoning, Morrow, Madison, Ross, Trumbull (IA only)	$10,847,075 (P) $4,331,497 (I) $3,849,783 (SCB)** $630,000 (M) $630,000 (S)
DR- 951	August 4, 1992 (IA)	PA/IFG/HMGP *	Severe storms, tornadoes, flooding	Cuyahoga, Franklin, Logan, Mahoning, Medina, Mercer, Ross, Shelby, Summit, Trumbull, Van Wert (PA/IA)	$8,308,334 (P)
	August 14, 1992 (PA/HMGP)			Auglaize, Belmont, Columbiana, Erie, Fairfield, Fulton, Geauga, Jefferson, Lorain, Lucas, Ottawa, Portage, Wood (PA only)	$2,081,117 (I) $2,474,083 (SCB)** $250,000 (M) $350,000 (CDBG)+
DR-1065	August 25, 1995	IFG/HMGP	Severe storms and flooding	Champaign, Erie, Logan, Lorain, Licking, Marion, Mercer, Miami, Scioto, Shelby, Washington	$3,493,319 (I) $81,731 (SCB)** $721,500 (M)
DR-1097	January 27, 1996	PA/IFG/ HMGP	Ohio River flooding	Adams, Belmont, Columbiana, Gallia, Jefferson, Lawrence, Meigs, Monroe, Scioto, Washington (PA/IA) Brown, Clermont, Hamilton (IA)	$4,335,000 (P) $1,822,056 (I) $1,617,991 (SCB)** $1,721,655 (M)
DR-1122	June 24, 1996	PA/HMGP	Severe storms and flooding	Adams, Belmont, Brown, Butler, Clermont, Gallia, Hamilton, Hocking, Jefferson, Lawrence, Meigs, Monroe, Paulding, Scioto, Vinton, Williams	$10,811,838 (P) $2,702,960 (S) $1,137,951 (M)

Disaster Declaration Number	Date Declared	Federal Disaster Programs	Incident Type	Counties Declared	Funds Provided
DR-1164	March 4, 1997	IA/PA/HMGP	Flash flooding on inland rivers/streams and Ohio River flooding	Adams, Athens, Brown, Clermont, Gallia, Hamilton, Highland, Hocking, Jackson, Lawrence, Meigs, Monroe, Pike, Ross, Scioto, Vinton, Washington (IA/PA/HMGP) and Morgan (PA/HMGP)	$29,666,825 (P) $22,196,350 (I) $9,821,524 (M) $9,821,524 (S) $9,740,294 (NRCS)*+
DR-1227	June 30, 1998	IA/PA/MIT	Flash flooding, flooding, high winds and tornadoes.	Athens, Belmont, Coshocton, Guernsey, Harrison, Jackson, Jefferson, Knox, Meigs, Monroe, Morgan, Morrow, Muskingum, Noble, Ottawa, Perry, Pickaway, Richland, Tuscarawas, Washington; (IA only) Franklin, Sandusky (PA only) Holmes	$21,803,771 (P) $14,312,348 (I) $9,000,000 (M) $9,000,000 (S) $10,410,817 (NRCS)*+
DR-1321	March 7, 2000	IA/MIT	Flash flooding, flooding	Adams, Gallia, Jackson, Lawrence, Meigs, Pike and Scioto	$1,914,189 (I) $297,310 (M) $297,310 (S)
DR-1339	August 25, 2000	IA/MIT	Flooding	Lucas	$7,898,840 (I) $1,132,279 (M) $1,132,279 (S)
DR-1343	September 26, 2000	IA/PA/MIT	High winds and tornadoes	Greene	$189,051 (I) $3,430,810 (P) $558,025 (M) $558,025 (S)
DR-1390	August 8, 2001	PA/MIT	Flooding	Brown, Butler, Clermont and Hamilton	$ 7,712,456 (P) $ 876,439 (M) $ 876,439 (S)
DR-1444	November 18, 2002	IA/MIT	Tornados, Severe Storms	Ashland, Auglaize, Coshocton, Cuyahoga, Franklin, Hancock, Henry, Huron, Lorain, Medina, Ottawa, Paulding, Putnam, Sandusky, Seneca, Summit, Union, Van Wert, Wayne and Wood	$ 11,668,849 (I) $ 139,068 (M) – $ 48,409 (S) $ 2,297,222 (SDRP)
DR-1453*	March 24, 2003	IA/PA/MIT	Ice/Snow Storm	Adams, Gallia, Jackson, Lawrence, Meigs, Pike and Scioto (IA/PA); Athens, Belmont, Darke, Delaware, Fayette, Franklin, Greene, Guernsey, Harrison, Hocking, Licking, Madison, Miami, Monroe, Morgan, Montgomery, Muskingum, Noble, Perry, Preble, Ross , Union, Vinton and Washington (PA)	$ 16,689,841 (I) $ 39,621,605 (P) * $ 2,415,899 (M) $ 2,415,899 (S) -

Disaster Declaration Number	Date Declared	Federal Disaster Programs	Incident Type	Counties Declared	Funds Provided
DR-1478*	July 15, 2003	IA/MIT	Severe Storms, flooding	Auglaize, Columbiana, Crawford, Darke, Logan, Mahoning, Mercer, Pike, Shelby and Van Wert (IA/MIT); Adams, Auglaize, Darke, Logan, Mercer, Pike, Shelby and Van Wert (SDRP)	$ 6,451,793 (I) $ 145,762 (M)* $ 13,721 (S) $ 2,976,949 (SDRP)
DR-1484*	August 1, 2003	IA/PA/MIT	Severe storms, tornadoes and flooding	Carroll, Columbiana, Cuyahoga, Franklin, Jefferson, Mahoning, Medina, Portage, Richland, Stark, Summit and Trumbull (IA/MIT); Adams, Columbiana, Carroll, Jefferson, Mahoning, Medina, Monroe, Portage, Stark, Summit, Trumbull and Vinton (PA)	$ 135,723,395 (I) $ 13,160,834 (P)* $ 6,016,488 (M) $ 162,790 (S) -
EM-3187*	August 23, 2003	PA Only	Power Outage	Ashland, Ashtabula, Cuyahoga, Erie, Geauga, Huron, Knox, Lake, Lorain, Lucas, Portage, Summit and Trumbull	$ 2,067,222 (P)*
DR-1507*	January 26, 2004	IA/PA/MIT	Landslide, severe storms and landslides	Belmont, Jefferson, Morgan, Ross, Tuscarawas and Washington (IA/PA/MIT); Franklin, Licking (IA/MIT); Athens, Guernsey, Harrison, Monroe, Noble and Perry (PA/MIT)	$ 3,408,934 (I) $ 14,811,923(P*) $ 875,265 (M)* $ 164,804 (S) -
DR-1519*	June 3, 2004	IA/PA/MIT	Severe storms and flooding	Athens, Carroll, Columbiana, Cuyahoga, Delaware, Guernsey, Harrison, Hocking, Holmes, Medina, Noble, Perry, Portage, Summit and Tuscarawas (IA/PA/MIT); Crawford, Geauga, Licking, Logan, Lorain, Mahoning, Richland and Stark (IA/MIT) and Knox and Jefferson (PA/MIT)	$ 30,238,921 (I)* $ 14,060,750 (P) * $ 2,305,560 (M) $ 748,426 (S) -
DR-1556*	September 19, 2004	IA/PA/Mit	Severe storms and flooding	Athens, Belmont, Carroll, Columbiana, Gallia, Guernsey, Harrison, Jefferson, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Tuscarawas, Vinton and Washington (IA/PA/MIT); Lawrence, Mahoning, Stark and Trumbull (IA/MIT)	$ 47,455,690 (I) $ 35,597,480 (P)* $ 3,948,349 (M)* $ 2,300,000 (S)
EM-3198*	January 11, 2005	PA Only	Snow Removal and Response	Butler, Champaign, Clark, Crawford, Darke, Delaware, Erie, Franklin, Greene, Hamilton, Hardin, Huron, Logan, Madison, Marion, Miami, Montgomery, Morrow, Preble, Richland, Sandusky, Seneca, Shelby, Union, Warren and Wyandot	$ 11,116,398 (P)*

Disaster Declaration Number	Date Declared	Federal Disaster Programs	Incident Type	Counties Declared	Funds Provided
DR-1580*	February 15, 2005	IA/PA/MIT	Severe winter storms, ice and mudslides	Clark, Sandusky, Warren and Miami (IA/MIT); Ashland, Auglaize, Athens, Belmont, Coshocton, Crawford, Delaware, Fairfield, Franklin, Guernsey, Henry, Hocking, Holmes, Huron, Jefferson, Licking, Logan, Morgan, Muskingum, Pickaway, Pike, Richland, Ross, Scioto, Stark, Tuscarawas, Washington and Wyandot (IA/PA/MIT); Adams, Allen, Brown, Carroll, Champaign, Clermont, Columbiana, Darke, Fayette, Hancock, Hardin, Harrison, Highland, Knox, Lorain, Marion, Medina, Meigs, Mercer, Monroe, Montgomery, Morrow, Noble, Paulding, Perry, Putnam, Seneca, Shelby, Union, Van Wert and Wayne (PA/MIT)	$ 13,823,757 (I)* $123,935,836 (P)* $7,534,746 (M)* $1,500,000 (S) -
EM-3250	September 13, 2005	PA	Hurricane Katrina Emergency Shelter Operations	All 88 Counties were included in the federal declaration	$2,499,103 (P)*
DR-1651*	July 2, 2006	IA/MIT	Severe storms and flooding	Cuyahoga, Erie, Huron, Lucas, Sandusky and Stark	$25,001,761 (I)* $1,798,019 (M) $593,090 (S)
DR-1656*	August 1, 2006	IA/PA/MIT	Severe storms and flooding	Ashtabula, Geauga and Lake	$25,895,531 (I)* $9,282,843 (P)* $3,411,736 (M) $1,137,245 (S)
DR-1720	August 28, 2007	IA/PA/MIT	Severe storms and flooding	Allen, Crawford, Hancock, Hardin, Putnam, Richland, Wyandot (IA/PA/MIT); Seneca (IA/MIT)	$45,452,363 (I) $12,688,139 (P) $6,630,799 (M) $1,984,493 (S)
EM-3286	April 24, 2008	PA	Snow	Ashtabula, Brown, Clermont, Clinton, Crawford, Delaware, Fairfield, Franklin, Geauga, Greene, Hardin, Huron, Lake, Morrow, Richland, Union and Wyandot	$9,481,809 (P) est.

Disaster Declaration Number	Date Declared	Federal Disaster Programs	Incident Type	Counties Declared	Funds Provided
DR-1805	October 24, 2008	PA/MIT	Wind Event	Ashland, Brown, Butler, Carroll, Champaign, Clark, Clermont, Clinton, Coshocton, Delaware, Fairfield, Franklin, Greene, Guernsey, Hamilton, Harrison, Highland, Hocking, Holmes, Knox, Licking, Madison, Miami, Montgomery, Morrow, Perry, Pickaway, Preble, Shelby, Summit, Tuscarawas, Union, and Warren	\$47,968,724 (P) \$6,507,249 (M)
DR-4002	July 13, 2011	PA/MIT	Severe storms, landslides	Adams, Athens, Belmont, Brown, Clermont, Gallia, Guernsey, Hamilton, Hocking, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Noble, Pike, Ross, Scioto, Vinton, Washington	\$45.8 Million (PA) \$5,046,137 (M)
EM-3346	June 30, 2012	PA (for Direct Assistance only)	Severe storms,	All 88 counties	PA was for Direct Assistance only, no financial assistance
DR-4077	August 20, 2012	PA/MIT	straight-line winds (derecho)	Adams, Allen, Athens, Auglaize, Belmont, Champaign, Clark, Coshocton, Fairfield, Franklin, Gallia, Guernsey, Hancock, Hardin, Harrison, Highland, Hocking, Jackson, Knox, Lawrence, Licking, Logan, Meigs, Miami, Monroe, Morgan, Morrow, Muskingum, Noble, Paulding, Perry, Pickaway, Pike, Putnam, Shelby, Van Wert, Vinton, Washington, Wyandot	Initial Estimates of: \$22.0 Million (PA) est. \$3.4 Million (M) est.
DR-4098	January 3, 2013	PA/MIT	Severe storms, flooding	Ashtabula, Cuyahoga	Initial Estimates of: \$17.8 Million (PA) est. \$2.7 Million (M) est.
DR-4360	April 17, 2018	PA/MIT	Severe storms, flooding, landslides	Adams, Athens, Belmont, Brown, Columbiana, Coshocton, Gallia, Hamilton, Harrison, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Pike, Scioto, Vinton, Washington	Initial Estimates of: \$65 Million (PA) est. \$9.75 Million (M) est.

(M) – Hazard Mitigation Grant
(S) – State Match to Federal Hazard Mitigation funds
(P) – Public Assistance
(I) Individual Assistance includes FEMA Disaster Housing, SBA loans for homes, personal property and businesses and FEMA/State Other Needs Assistance grants for families and individuals
(NRCS)*+ - Natural Resources Conservation Service
* Indicates the disaster is not officially closed.

HMGP first available with disaster declared after 1987.
(SCB)** - State Controlling Board funds
(SDRP)**State Disaster Relief Program
(CDBG)+ - Community Block Grant funds provided by the Ohio Department of Development
EM 3187 is an Emergency Declaration for Public Assistance

Detailed Hazard Overview

Natural Hazards - Meteorological

Flood, Flash Flood, Seiche

Ohio can experience four types of floods. *Riverine* (The overflow of rivers and streams from rains or melt water); *Flash* (A fast rising of streams or "dry-gulch" waters after heavy rain/snowmelt); *Urban and Small Stream* (An overflow of storm sewers and streams after a heavy rainfall); and *Coastal (Seiche)* (Floods along the Lake Erie shoreline, often associated with severe storms and/or seiche waves).

Flood/Riverine (Total Risk = 633) constitutes a significant threat to life and property in the state of Ohio. Riverine floods result from prolonged heavy rain over a large area. Riverine floods are more common in winter and spring when the soil is saturated or frozen. Large-scale weather systems producing heavy rain are most common during these seasons. The National Weather Service issues flood warnings several hours or days before riverine floods develop. Also, there may be two or more days of preparation before the flood crests on the major rivers in Ohio. Heavy rains in Ohio may cause floods on the rivers flowing into the Ohio River, such as the Muskingum, Scioto, and Miami Rivers, without causing a large flood on the Ohio River. On the other hand, heavy rains in Pennsylvania and West Virginia may cause a flood on the Ohio River even if heavy rain has not fallen over Ohio.[6]

Flash Floods and Seiche (Total Risk = 564) are the result of intense local rainfall and usually last a few hours. Normally, little warning precedes flash flooding. One of the deadliest flash floods occurred in Shadyside, a community on the Ohio River in Belmont County, late on June 14, 1990. Twenty-six people lost their lives in a brief flash flood on Wegee Creek and Pipe Creek near Shadyside. Flash flooding began at 9:30 p.m. and was over in 30 minutes.

Lake Erie is particularly prone to short-term, wind-caused fluctuations because of its shallowness and elongation. These can lead to extreme seiche waves of up to 16 feet between the ends of the lake. The seiche effect can cause oscillation back and forth across the lake for some time until it settles down again. In May 1942, two seiche-related waves unexpectedly battered the Ohio shore between Bay Village and Conneaut. Madison-on-the-Lake received the brunt of the waves. The first wave ranged between 4 and 20 feet, and the second, following 15 minutes later, was 6 to 8 feet high. The seiche wave killed seven people.

Although often confined to specific drainage systems or geographic regions, floods can pose a threat to over 700 communities and potentially hundreds of thousands of residents in all 88 counties. Protective actions (evacuation/sheltering) may deplete both material and fiscal resources. Floodwaters have also damaged key infrastructure elements (roads, bridges and sanitary facilities). Infrastructure damages may also lead to an increase in infectious diseases in some affected areas. Other collateral problems include power outages and transportation delays. Mudslides, a component of the 1990 Shadyside event, are often a flood-related concern in the south-southeast areas of the state. The costs in labor, time and monies for flood-related mitigation and preparation actions may also be exceedingly high.

In the late 1990s, two major floods affected the state within a space of 16 months. The first, in February 1997, caused flash and riverine flooding in 18 southern counties. In June 1998, a varied weather pattern with tornadoes, severe storms, and flash flooding struck 23 counties on a northwest to southeast track. Variable weather patterns in late winter frequently cause flooding throughout Ohio and especially in southern counties where rivers converge. In February 2018 severe storms were followed by disastrous flooding resulting in federal declarations for 22 counties. These events affected thousands of residents and caused millions of dollars in business and residential losses The following chart provides a comparison of the 1998 and 2018 events.

Figure 3. Flood Damage Comparison Chart for Ohio[7]

Critical Element	1998	2018
Overall Financial Impact	$184.3 million	$74.75 million (est.)
Federally Declared Counties	23	22
Casualties (Deaths)	12	1

Flooding increases environmental vulnerability in several ways. Pipelines can be exposed if cover is washed away, leaving them vulnerable to breakage and spills which can contaminate the environment. Similarly floods can carry contaminants to unspoiled places, causing exposure to chemicals and other toxins. Flooding also poses problems for sewage and water treatment infrastructure, increasing risk of contaminating surface and groundwater sources and downstream ecosystems.

Windstorm, Tornadoes

Windstorms and Tornadoes (Total Risk = 690) are the primary natural hazard to the state. These violent, rotary windstorms can attain wind-speeds up to 300+ mph and often accompany or follow severe thunderstorms. They may occur anywhere, at any time of the year with unpredictable, severe effects. In Ohio, tornadoes are more frequent in the spring and summer months of April, May, June, and July. Other severe storm associated winds, not classified as tornadoes, may be almost as violent and damaging. Tornadoes and windstorms have a high potential to cause loss of life, damage or destroy property, and overwhelm local response capabilities.

Tornado effects vary according to wind-speed, duration on the ground, and topography. From 1950 to 2010, the National Weather Service reported 1053 tornado touchdowns in Ohio. Ohio averages 16 tornados per year resulting in an average of 3 fatalities per year with Northwest counties at highest risk. Estimated losses over a 30-year period are in excess of $110+ million. The Lorain and Xenia storms cost more than 100 lives and caused millions of dollars in property damages. As in the case of floods, the costs and duration of recovery may extend over years.

On April 9, 1999, a tornado in Clinton, Hamilton, and Warren counties killed four and injured 42 while destroying or damaging over 400 dwellings. Estimated financial losses were in the millions for the storm, which the National Weather Service termed as the most devastating in terms of casualties since the 1985 event, which killed 18 Ohioans.

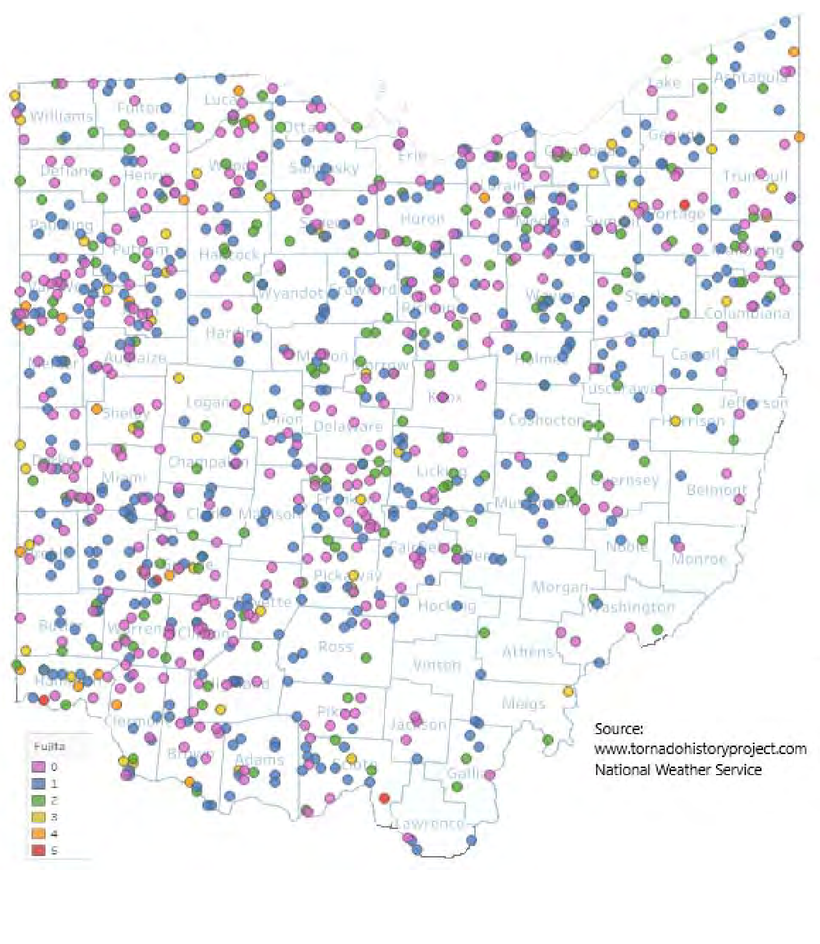
One of the most destructive windstorms in the state's history hit Ohioans on September 14, 2008. Remnants from Hurricane Ike moved through Ohio with tropical storm force winds, leaving nearly two million homes and businesses without electricity during the height of the emergency. Eighty-four of Ohio's 88 counties reported some type of windstorm damage, fallen debris or power outages. Seven Ohioans died from injuries sustained from the windstorm. This event also resulted in a Presidential Declaration for 33 counties.

In 2010, three significant events severely impacted Ohio's communities. The first event occurred June 5-6, 2010, when a major tornado outbreak affected the Midwestern United States and Great Lakes Region. The event resulted in seven people dead in Wood County. The second event occurred when severe weather and tornadoes swept across the state in the afternoon of September 16, 2010. The National Weather Service confirmed 11 tornadoes in Athens, Delaware, Fairfield, Holmes, Meigs, Perry, Tuscarawas, and Wayne counties and in the Tarlton, Ohio area. No deaths were associated with the event.

The third event occurred October 27, 2010, when a very intense area of low pressure pushed east through the Great Lakes Region, with a strong cold front moving through the Ohio Valley. Wind gusts of 50-60 mph were recorded in some areas of the state. The National Weather Service confirmed eight tornadoes in Auglaize, Fayette, Franklin, Licking, Paulding, Pickaway and Van Wert counties. No deaths occurred with this event. Late season tornado outbreaks are rare but not unlikely. On November 5, 2017, Ohio experienced a statewide outbreak of 17 tornadoes in a single day.

Windstorms and tornadoes are not typically associated with causing environmental problems, though they have the ability to create massive amounts of woody debris and construction debris, which requires coordination with environmental regulators, haulers and landfills. This was noted and experienced during the response and recovery operations in the Village of Moscow (Clermont County) in March 2012.

Figure 4. Ohio's Tornado History (1950-2016)



Snow, Ice, Hail and Sleet

Blizzard or Ice Storm (Total Risk = 665) are the fourth leading weather-related threat to the state. These include heavy snowfall with extreme cold and ice, or a combination of the three.

Over 500 Winter Storms from 1950 to present are reported by the National Weather Service. The storms of 1913, 1940, 1950, 1977, 1978, 1994, 1996, and 2004/2005 were especially damaging. Some winter storms have occurred in specific sectors of the state; south/southeast (1984); east/northeast (1993); and south/central (1994). However, the storms of 1950 and 1978 were statewide in nature and of a severity that required massive state/federal response and recovery efforts.

In addition to structural and power line damages, these storms have a potential for collateral effects; isolation and economic disruption (from roadway and business closings) along with ice dams and floods caused by the melting process.

Winter weather is not associated with increased environmental vulnerability.

Natural Hazards - Biological

Public Health Emergency

Public Health Emergency (Total Risk = 808) which includes emerging diseases, such as plague, smallpox, anthrax, West Nile Virus, foot and mouth disease, Severe Acute Respiratory Syndrome (SARS), Pandemic Influenza, Bovine Spongiform Encephalopathy (BSE), commonly known as mad cow disease, are becoming increasingly prevalent on the world stage. This type of event would likely affect multiple states and would likely have global impact. The impacts of Pandemic Influenza, Ebola and other viruses have become a planning priority for the state of Ohio as well as at the federal level. Likewise, certain health conditions such as the Methicillin-resistant Staphylococcus aureus (MRSA) staph infection are coming to prevalence in the media.

A pandemic outbreak has the potential to infect large numbers of Ohio citizens, which could easily overwhelm the health care system in the state, and impact the personnel needed to respond and recover from such an event. A pandemic outbreak could also jeopardize essential functions by causing high levels of absenteeism in critical services areas. Large numbers of people would likely become ill or expire. Examples such as the 1918/19 Influenza Pandemic demonstrate the potential for loss of human life and significant impacts on society.

A continuous significant concern has been the emergence of a Pandemic Influenza or other human infectious disease, such as the recent Novel Influenza A (H1N1). The outbreak initially emerged in April 2009 for two months and then increased activity again in October 2009 for another four months. The H1N1 was not considered to have a high severity; however, it was considered extremely virulent in younger populations and pregnant women. From August 30 through January 30, 2010, the cumulative total for Ohio influenza confirmed hospitalizations is 3,194 individuals per Ohio Disease Reporting System (ODRS). At least 51 people hospitalized with H1N1 infection died in Ohio during that period. Fortunately there was not a significant impact to infrastructure or on personnel needed to respond and recover.

Diseases which cause widespread human deaths would have an impact on the environment in terms of the disposal of human remains and the handling of bio-hazardous waste.

Environmental and regulatory factors would have to be evaluated in the disposal of both human remains and bio-hazardous waste.

Diseases which cause widespread deaths of animals, both captive and wild, would have an effect on public health and the environment in terms of disposal of the carcasses. Whether the infected animals are buried, burned or left in place, a large quantity and concentration of carcasses may impact air, soil and groundwater.

Natural Hazards - Geological

Earthquakes

Earthquakes (Total Risk = 574) are defined as a rapid motion of the ground accompanied by shaking, faulting (surface and subsurface) and ground failure. Earthquakes from two points affect Ohio: events having epicenters within the state, and those occurring along the New Madrid, Missouri Fault Zone. Figure 6 shows a map of earthquake epicenters for Ohio and adjacent areas.

More than 200 earthquakes with magnitude of 2.0 or greater with epicenters in Ohio have occurred since 1776, and 15 of these events are known to have caused minor to moderate damage. Fortunately, these events have not resulted in fatalities, only minor injuries.

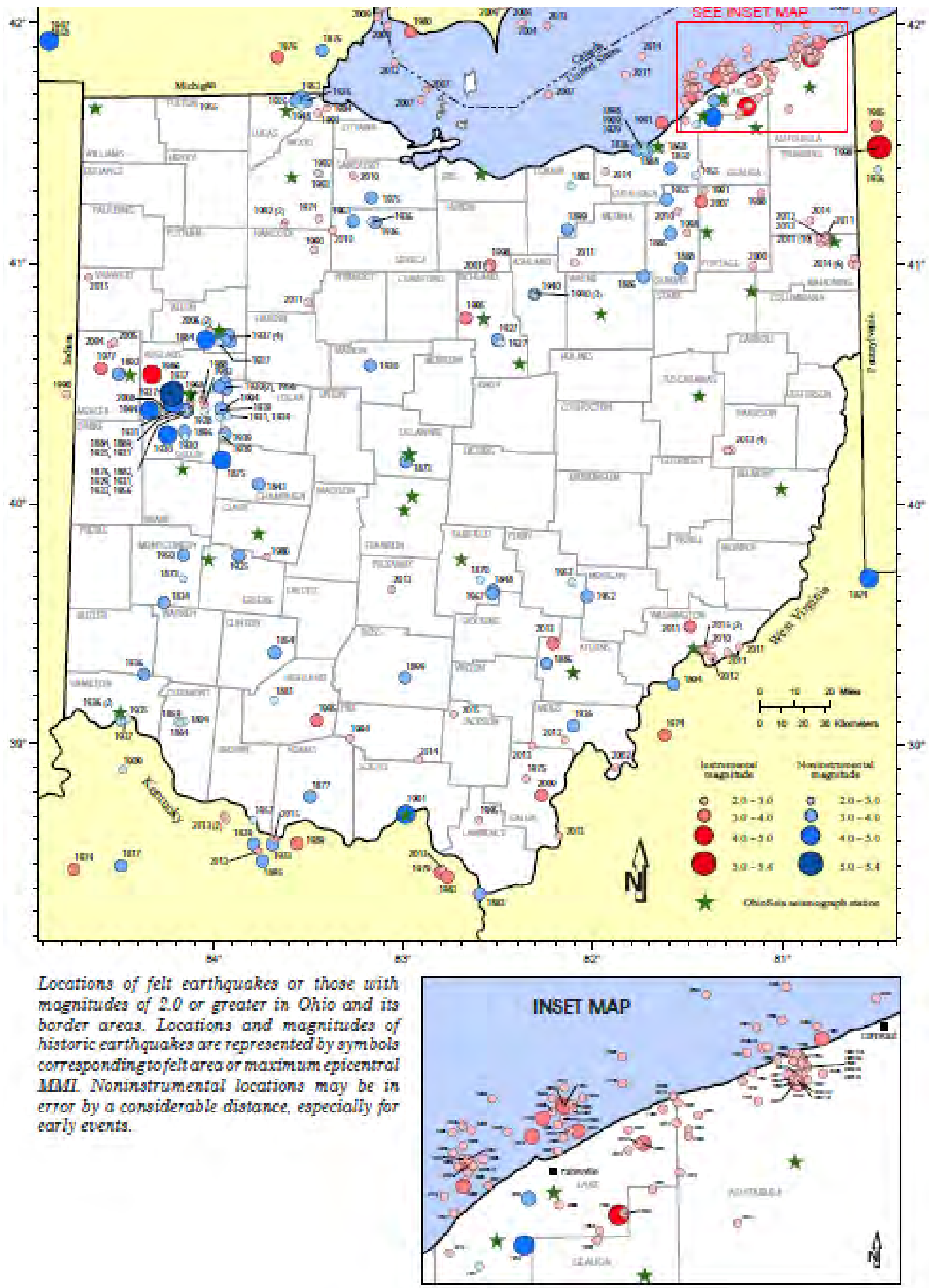
Most earthquakes that occurred in Ohio before the 1960s have been located and assigned intensities and approximate magnitudes based on newspaper accounts. Epicentral locations for many of these events probably have a considerable margin of error. Non-instrumental data should be used cautiously. (Hansen, 2015, p.4)[8]

Seismic activity is concentrated in, but not confined to, three areas of the state. Historically, the most active area, with at least 40 earthquake events since 1875, is the Anna Seismogenic Zone centered in Shelby County, (western Ohio). Many other events have occurred in the Lake County area, or in the southeast, and have caused minor to moderate damage.

Other counties with documented earthquake epicenters include Adams, Allen, Ashland, Ashtabula, Athens, Auglaize, Brown, Butler, Champaign, Clermont, Cuyahoga, Gallia, Geauga, Greene, Hamilton, Hancock, Hardin, Highland, Hocking, Jackson, Lake, Lucas, Marion, Meigs, Mercer, Montgomery, Muskingum, Perry, Pike, Portage, Preble, Putnam, Richland, Ross, Sandusky, Scioto, Seneca, Shelby, Summit, Washington, Williams, Wood, and Wyandot.

The state would also be affected by events generated by the New Madrid Fault Zone, extending from Arkansas to Indiana along the Mississippi and Ohio River Valleys. This fault generated the most powerful earthquakes ever documented in the Continental U.S. in a four-month period during 1811 and 1812. If earthquakes of this intensity occur again, devastating damages in our southwestern counties could be expected. Figure 5 lists the counties potentially impacted, and effects from a major New Madrid earthquake in Ohio.

Figure 5. Earthquake Epicenters in Ohio and Adjacent Areas



Locations of felt earthquakes or those with magnitudes of 2.0 or greater in Ohio and its border areas. Locations and magnitudes of historic earthquakes are represented by symbols corresponding to felt area or maximum epicentral MMI. Noninstrumental locations may be in error by a considerable distance, especially for early events.

Source: *Ohio Department of Natural Resources, Ohio Division of Geological Survey, 2012, Earthquake epicenters in Ohio and adjacent areas*

Figure 6. Effects of a Major New Madrid Earthquake in Ohio

Mercalli Intensity	Effects	Counties Potentially Affected
VI	Felt by all, indoors & outdoors. Many people frightened and excited. Liquids set in strong motion. With slight damage in poorly built structures. Fallen & cracked plaster with a considerable quantity of broken dishes & glassware.	Allen, Ashland, Auglaize, Crawford, Cuyahoga, Defiance, Erie, Geauga, Hancock, Hardin, Henry, Huron, Lake, Logan, Lorain, Mahoning, Marion, Medina, Mercer, Morrow, Ottawa, Paulding, Portage, Putnam, Richland, Sandusky, Seneca, Shelby, Stark, Summit, Trumbull, Van Wert, Wayne, Wood, & Wyandot. (Approx. 4 million people in 36 counties)
VII	Many people find it difficult to stand. Slight damage in ordinary buildings., Considerable amounts of fallen plaster & numerous broken windows & fallen cornices	Athens, Belmont, Carroll, Champaign, Clark, Columbiana, Coshocton, Darke, Delaware, Franklin, Fulton, Gallia, Guernsey, Harrison, Holmes, Jackson, Jefferson, Knox, Lawrence, Licking, Lucas, Madison, Meigs, Miami, Monroe, Morgan, Noble, Tuscarawas, Union, Washington, and Williams (Approx. 3 million people in 31 counties)
VIII	Alarm approaches panic. Branches of trees broken. Changes in the flow of well & spring water. Considerable damage in ordinary substantial buildings. Fallen walls, factory stacks, towers, & monuments. Heavy furniture overturned.	Adams, Brown, Butler, Clermont, Clinton, Fairfield, Fayette, Greene, Hamilton, Highland, Hocking, Montgomery, Muskingum, Pickaway, Perry, Pike, Preble, Ross, Scioto, Vinton, & Warren (Approx. 3 million people in 21 counties)

Source: *U. S. Geological Survey, Maximum Seismic Interactions Map for New Madrid Seismic Zone; Algermission & Hopper*

Collateral effects from an earthquake could be extensive and may include hazardous material spills, landslides, subsidence, dam failures, fires, groundwater contamination, pipeline breaks, infrastructure disruptions, epidemics, floods, along with theft/looting.

Earthquakes can cause a tremendous increase in environmental vulnerability. Beyond the tremendous amounts of debris that will need to be managed, the possibility of broken pipelines increases the likelihood of cascading impacts that include contamination. The possibility of water and sewage treatment facilities being damaged and taken offline similarly increases the risk to ground and surface waters and the ecosystems they feed. Sustained fires, also a possibility following earthquake associated structural collapses, would also lead to a possibility of toxic fumes and a certainty of degraded air quality.

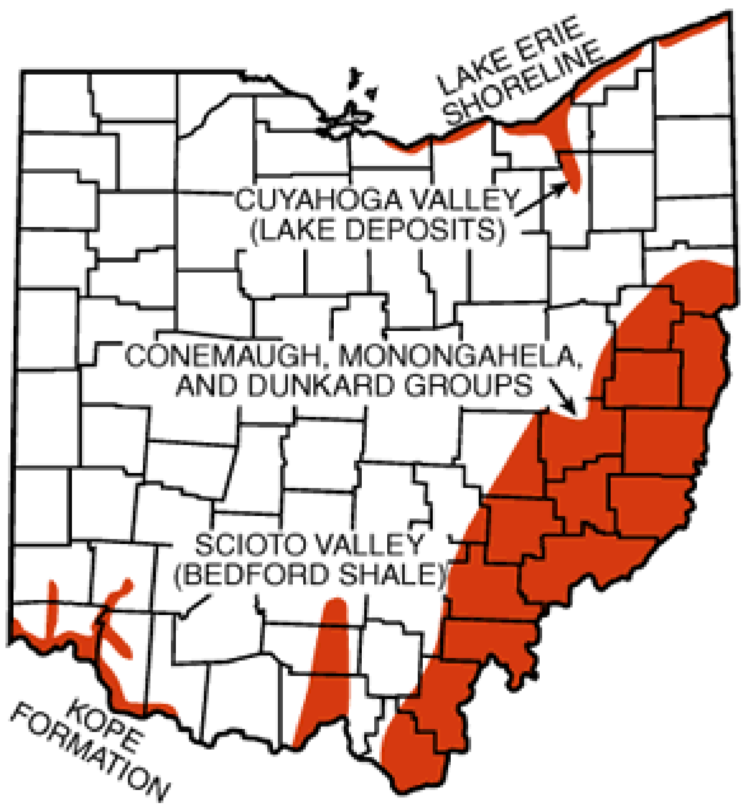
Landslide, Mudslide, Subsidence (and Mines)

Landslide, Mudslide and Subsidence (Total Risk = 375) are the second major geological threat. *Subsidence* is defined as a drop in the earth's surface due to a collapse in bedrock or other underlying material (coal pillars, rock, etc.) into underground mines or other open space.

Land or Mudslides are defined as downward and outward movements of slopes due to rains or melting snow with accompanying damage and debris deposition. They may also include sudden collapses of mines, tunnel walls, or supports with resulting damage to surface structures or features (buildings and highways).

Landslides include three types. A *Rotational Slump* occurs when weak rock or sediment moves as a mass in a slow or imperceptible movement. A more common event, *Earthflow*, involves rock, sediment, or weathered surface materials moving down slope in a mass. *Rock fall* is seen as the most common and dangerous form of movement. Rock from a cliff or cut will fall onto roadways or structures. This action is common during periods of late winter or early spring thawing. Traffic vibration, undercut slopes, increased weight on slopes, or the removal of vegetation and ensuing erosion may also contribute to these events. Events have been traced back to 1923 at various sites. They occur mainly through the Ohio or Scioto River Valleys, or elsewhere in the eastern portion of the state with some occurring along the eastern Lake Erie Shoreline shown in red on Figure 3 below.

Figure 7. Ohio Subsidence and Landslides



During and after WWII, when the demand for mineral resources was high, the state had over 700 active coal mines. As the supply of coal in many mines was exhausted, the mines were abandoned with little or no preparation. Supporting pillars of coal in shaft mines were mined away prior to closings. In the mid-1990s, over 6,000 closed or abandoned underground mines were estimated to exist in 37 counties with over 61,000 acres of land affected by closings or site abandonment.

Abandoned mines have also occasionally collapsed with damage to surface structures or costly infrastructure damage. On March 5, 1995, a twelve foot section of Interstate 70 in Guernsey County collapsed due to an abandoned underground mine subsidence. In addition, landslides and mudslides affecting roadways have led to costly repair actions by state and local governments. It is estimated that repair or replacement costs could reach $9 million or more if a major highway is involved. The ODNR Division of Geological Survey has detailed maps for approximately 4,200 abandoned mines in Ohio and estimate there are approximately an additional 2,000 abandoned mines not detailed on maps.

Subsidence and landslides, particularly during floods, have also led to the temporary relocation of farmsteads, housing units, or businesses. Landslide, Mudslide, Subsidence and Mine Collapses have the potential, albeit on a lesser scale, to cause similar environmental impacts as earthquakes (see above).

Human-caused - Accidental

Radiological Incidents (Nuclear Power Generating Sites)

Radiological Incidents (Nuclear Power Generating Sites) (Total Risk =1186) are the greatest human-caused, accidental hazard and ranked as the 2nd hazard in the state overall. The release (or potential for release) of radioactive materials could initiate protective actions (evacuation or sheltering) for populations residing within a 10-mile Emergency Planning Zone (EPZ), and affect the ingestion pathway within a 50-mile EPZ of a site. Ohio residents could potentially be affected by three nuclear power generating facilities operating in or near the state:

- Davis-Besse Nuclear Power Station located in Port Clinton (Ottawa County)
- Perry Nuclear Power Plant located in North Perry (Lake County)
- Beaver Valley Power Station located in Shippingport, Pa. (Beaver County)

In an emergency involving a single power plant, over 95,000 residents could be affected by accidental emissions. Response and recovery actions could cost millions of public and private sector dollars.

Environmental impacts of a nuclear disaster can cause the permanent contamination of some areas downwind from plants that receive fallout. These areas would not be suitable for agriculture for generations nor could they be occupied.

Water Control Structure (Dam/Levee Failure)

Water Control Structure (Dam/Levee Failure) (Total Risk = 570) is the second greatest human-caused hazard and ranked thirteenth in the state, a change from 6th overall in the 2013 HIRA. The change is perhaps a reflection of the state's successful response to the failing Buckeye Lake Dam and its timely remediation which nears completion in 2018. Dam/Levee Failure is defined as a gradual or immediate collapse or failure of water impounding systems or structures, resulting in downstream damages.

Dams in Ohio have been divided into four classes; I, II, III, IV, based upon a downstream threat potential. Figure 9 shows the number of Class I dams by county. There are 365 Class I dams in the state. The failure of a Class I dam would result in the probable loss of life or pose a serious hazard to health, property and high-value industrial or commercial properties or public utilities in the below-dam inundation plain. A Class I dam is one with a volume capacity of over 5,000 acre-feet or a height greater than 60 feet. Although damages to Class I dams pose the greatest threat to human life, Class II and III units could also pose a similar threat if affected.

Figure 8. Class I Dams in Ohio

Source: ODNR - Division of Water Resources, 2018

The Ohio Department of Natural Resources has identified most dams in the state and categorized each by their impact to citizens in the event of failure. A review of similar events in other states illustrates the possible consequences: Buffalo Creek, W.Va. suffered 125 casualties and $400 million in property damages; Lawn Lake, Colorado incurred three casualties and $21 million in property damages; and the town of Toccoa, Georgia, suffered 39 casualties and $30 million in property damages.

Water control structure failures have the potential to cause similar environmental impacts as flooding, landslides and subsidence and earthquakes.

Transportation Failure (including Bridge/Structure Collapse)

Transportation Failure (Total Risk = 402) is primarily related to bridge/structure collapse. Bridges are the most common type of collapse in the state. There are over 42,000 bridges in the state of

Ohio. The Ohio Department of Transportation (ODOT) is responsible for nearly 15,000 bridges on the state highway system. Our state has the second largest number of bridges in the country. Ohio law requires all bridges to be inspected on an annual basis. This applies to all bridges maintained by ODOT as well as county and city bridges.

The 2007 Interstate 35W bridge collapse in Minneapolis, Minnesota, brought to light challenges states face with structurally deficient bridges. Like Minnesota, Ohio has over a dozen highway deck truss bridges that share the same design structure as the I-35W Bridge. In 2009, Lake County replaced a similarly-designed bridge with twin bridges on Interstate 90 over the Grand River. The bridge partially collapsed in 1996 due to deteriorating corroded steel plates. No injuries were reported, but the bridge was closed for months for repairs. In another comparable case, the city of Cleveland's Inner belt Bridge is undergoing more than $150 million in repairs.

In 1983 a bridge collapsed in Antwerp (Paulding County) killing five people. The 30-foot stone and asphalt structure caved-in and four cars plunged into a dry creek bed. Another notable bridge collapse occurred in Ohio on December 15, 1967. The Silver Bridge over the Ohio River collapsed killing 46 people. The bridge connected the towns of Point Pleasant, West Virginia, and Managua, Ohio.

More recently, Ohio resources have been used to respond to building structural collapse rescues. On July 7, 2010, the Ohio Regional Urban Search and Rescue and the northwest area's Regional Structural Collapse Response Unit responded to a significant structural collapse in Fremont. Support columns inside a food processing plant partially collapsed the roof structure. Area-wide assistance was requested for two workers trapped under the debris. One person was killed and the other was trapped for hours beneath the rubble.

Structural/building collapse will remain a primary human-caused hazard in Ohio, primarily due to the threats faced in this state. Significant threat concerns include the impact from tornadoes, earthquakes, snow loads, landslides, gas explosions, acts of terrorism, and environment.

The collapse of a building or other structure may lead to environmental damages through hazardous materials releases, the atmospheric release of asbestos or other harmful substances, and the contamination of the water table through sewage release or other chemicals. Contaminated debris may pose special challenges for waste disposition or recycling.

Impact on plants, animals and humans and associated eco-systems is a concern when in immediate proximity to the collapse. Multiple deaths are expected as well as long-term consequences to the eco-system in the immediate area. Depending on the purpose of the structure and its date of construction lead and asbestos may be present and their contamination could readily be spread through water and wind movement.

Urban Fire

Urban Fire (Total Risk = 540) ranks fairly high as a human-caused hazard, primarily due to its impact on people. Cleveland is noted by fire historians for the Collinwood School Fire in 1908 that killed 172, as well as the Cleveland Clinic Fire in 1929 that killed 123.

Structural fires pose many of the same environmental challenges of building collapse with an added immediate impact to the atmosphere. Depending on what materials are in the structure, it is possible that air quality could deteriorate for an unknown length of time and pose an immediate threat to life and long term threat to well-being.

Hazardous Materials

Hazardous Materials (Total Risk = 674) incidents remain the most common form of accidental threat to Ohio, occurring almost daily. A hazardous materials spill can be the result of human negligence, an intentional act, or a natural hazard. Human negligence occurs predominantly during the manufacture, transport, or storage of the hazardous material. An intentional act would be considered either a terrorist act, criminal act, or act of vandalism. A hazardous materials spill can be a secondary effect of a natural hazard (e.g., flooding, earthquake, or severe weather).

Environmental impacts - Although major chemical accidents and spills seem most threatening, it is the smaller, more routine accidents and spills that have a greater impact on humans, wildlife, economy, and environment. Some of the most common spills involve tanker trucks and railroad tankers containing gasoline, chlorine, or other industrial chemicals. The National Environmental Law Center reported that 34,500 accidents involving toxic chemicals were reported to the EPA's Emergency Response and Notification System between 1988 and 1992, meaning that on average, a toxic chemical accident was reported nineteen times a day in the United States, or nearly once every hour. [9]

Human Caused Hazards - Intentional

Terrorism (CBRNE)

Terrorism incidents, involving CBRNE - Chemical (Total Risk = 1055), Biological (Total Risk = 947), Radiological (Total Risk = 1193), Nuclear & Explosives (Total Risk = 330), are ranked as the highest human-caused intentional hazard. The Federal Bureau of Investigation (FBI) defines terrorism incidents as the "…unlawful use of force or violence against persons or property to intimidate, or coerce a government, civilian population, or any segment thereof in the furtherance of political and social objectives." The victims of terrorism may not always, however, be the intended, or most concerned, elements of society.

Although events such as the World Trade Center Bombing/Destruction (1993 & 2001) and Oklahoma City bombing (1995) did not occur in Ohio, the threat, real or implied, to employ terrorism in this state, remains. Threats often involved the employment of Weapons of Mass Destruction (WMD), to include bombs and pathogens, and can be directed at targets in both rural and urban-industrial settings.

In 1995, an Ohio resident with ties to unorganized militias was able to order, via mail, samples of Plague bacilli. Although that attempt was thwarted, the events of 2001 show that the bio-terrorist threat remains viable.

One of the most dangerous emerging threats to our country is the criminal and terrorist use of Improvised Explosive Devices (IEDs). IEDs have the potential to make a lethal impact, with relatively low-tech skills needed to produce them. IEDs have been the weapon of choice for foreign terrorists since the first World Trade Center attack in 1993 and for domestic terrorists since the Oklahoma City bombing in 1995. This threat has expanded to include both Vehicle-born Improvised Explosive Devices (VBIEDs) and small arms attacks.

IEDs have an enormous potential for influencing public perception and for creating an atmosphere of fear and uncertainty. A car bomb exploding in the middle of a busy urban setting can quickly undermine emergency response efforts to protect the public.

An act of terrorism's impact on the environment can be very large and can be felt by the environment in several different ways.

Chemical incidents are unlikely to have a significant effect on electric utilities, natural gas utilities, pipelines nor water courses. Such incidents would create some debris, though not an unmanageable amount. Chemical terrorism would however have a large impact on both the short-term quality of the air, and long-term quality of waste water systems, aquatic ecosystems and soils that sustain wildlife.

A biological incident probably would not compromise utilities, displace waterways, create large amounts of debris, nor have a large-scale effect on air quality, but could certainly effect sewage systems, septic systems, waterway ecosystems, soil usability - and subsequently the plant life and wild life that depend on them.

A radiological incident has the potential to make a large impact on air quality due to fallout from the device; contamination of water utilities, storm sewers, sewage and septic systems; contamination of water eco-systems; and soil contamination from both the device itself and from radioactive water leeching into the soil. Such an incident has less likelihood of effecting electric, natural gas, pipelines, utilities; watercourses; or of creating an immediate debris problem.

A nuclear incident would have a huge impact on the environment. All utilities and wastewater systems would be compromised. Air quality would be hampered by smoke, lead, and asbestos from damaged older structures. Water courses could be displaced thereby altering their ecosystems. Soil would be contaminated not only from fallout/debris, but also by released hazardous material and raw sewage. The harm to wildlife habitat would be catastrophic and long-lasting.

Explosive incidents have the potential to impact electric, water, natural gas, pipelines, and utilities. These types of incidents would pollute the air with smoke, lead fumes and asbestos. Explosive incidents would alter water ecosystems by rerouting, damming or displacing waterways. Explosive incidents would potentially contaminate soil with not only hazardous materials, but also debris. All of which in turn effect wildlife habitat and the environment. Such an incident has less likelihood of affecting storm sewers, sewage and septic systems, or of creating overwhelming amounts of debris.

Primary sources of data for determining the likelihood or probability of occurrence for human-caused, intentional acts of terrorism are risk assessments by the Ohio Department of Natural Resources and Ohio Homeland Security's Ohio Strategic Analysis Information Center (SAIC). Other sources of data include weekly Ohio SAIC intelligence summaries, U.S. Coast Guard risk assessments on intentional pollution in both ports and in rivers, U.S. Forest Service intelligence summaries, and classified federal intelligence reports containing vulnerability information.

From that, risk to the environment can be assessed not in terms of percentage, but in terms of magnitude and of impact on plant, animal, and human life as well as the eco-systems in which they interact. In accordance with the Magnitude factor used throughout the Hazard Identification and Risk Analysis Update 2011, magnitude of risk to the environment due to terrorism of all types is overall rated as "Localized." This term does not mean that resulting damage would be unimportant, but rather when all the possible types are considered collectively, the average is projected to be small in geographical scope with less than 10 of 88 counties expected to be impacted.

Vulnerability of the environment can be assessed similarly using the Impact on Humans factor used in the 2018 HIRA. Impact on plants, animals and associated eco-systems is rated at “High” because they will be either the focus of such an attack, or will be in immediate proximity to an attack without means of evacuation. The movement of wind and water could easily spread the damage. Multiple deaths are expected as well as long-term consequences.

Hazard Grouping

Figure 9. Threats and Hazards Identified

Natural Hazards	
Biological	Disease, Human
	Public Health Emergency
Geological	Earthquake
	Landslide / Erosion
Meteorological	Blizzard or Ice Storm
	Drought
	Flood, Riverine, Areal, Coastal (Forecasted)
	Flood, Seiche / Standing Wave (Unpredicted)
	Hurricane
	Space Weather
	Temperature Extremes
	Tornado/High Wind/Thunderstorm
	Urban/Flash flood
	Wild Fire
Human-Caused	
Intentional	Active Aggressor (stalking, abduction, workplace violence, threat)
	Aircraft Incident
	Animal/Crop Eco-terrorism
	Civil Disturbance
	Cyber Attack/IT System Security Breach
	Electromagnetic Pulse (EMP)
	Electrical Grid Failure
	Hostage Situation
	IT Infrastructure Disruption
	Labor Action
	Mass Communications Interruption
	Planned Public Event
	Terrorism, CBRNE (bomb, suspicious powder, etc.)
Accidental/ Technological	Accidental Hazmat Release
	Dam Failure
	Emergency Generator Failure
	Fuel Shortage Nuclear Accident
	Pipeline Failure
	Sewer Failure
	Shortage of Critical Materials
	Space Debris
	Transportation Incident
	Urban Fire
	Water Supply Incident

Example Hazard Scenarios

Each type of hazard that could affect the State will have varying consequences based on the severity of the event. For instance, the consequences of an earthquake to the impact factors in this analysis would differ greatly based on the magnitude of the earthquake scenario being considered. For hazards that have historically occurred in the State, the scenarios considered as part of this consequence analysis were developed based on the magnitude of events that have actually occurred. Following is a brief description of the hazard scenarios used by the authors to evaluate the consequences of each hazard.

Flood (Riverine)
Storms that produced heavy rains in March result in severe flooding in southern, Ohio. Widespread damages to private and public property occur throughout the area. Eighteen counties are declared Federal and State Disaster areas. Nearly 20,000 people are evacuated. Over 6,500 residences and 833 businesses are affected. Five deaths are attributed to the flood and preliminary damages are estimated at over $200 million (Ohio River flooding March 1-2, 1997, USGS Water-Resources Investigation Report 97-4149).

Windstorm, Tornado
Severe weather and tornadoes swept across the state. The National Weather Service confirmed 11 tornadoes in Wayne, Holmes, Fairfield, Athens, Perry, Pickaway, Meigs, Delaware and Tuscarawas counties and in the Tarlton, Ohio area that borders 3 counties. The tornadoes ranged from EF-0 to EF-3. Athens, Meigs, Pickaway, Perry and Wayne Counties declared a local state of emergency. Thirteen people were injured in Athens County, and six were injured in Meigs County. The following structure damage estimates were compiled by the State and county teams: 62 destroyed, 77 with major damage, 113 with minor damage and 373 structures as affected. Residential loss equated to 2,227 insurance claims totaling $11,400,000, while business losses included 287 claims totaling $4,700,000. There were 421 auto insurance claims resulting in a loss of $1,200,000 (State Hazard Mitigation Plan, Section 2.3).

Flash Flood, Seiche
Three to four inches of rain fall in a little over one hour causing a flash flood in southeastern Ohio. The total rainfall over a three hour period is estimated at 5.5 inches. Soils saturated from previous rains and narrow, steep-sided valleys cause the water to rise quickly. A wall of water rushing down the valley claims 26 lives, destroys 80 homes and damages 250 residences. There are also significant impact to roads and bridges in the valley (Shadyside, Ohio event June 1990).

Snow, Ice, Hail, Sleet
A February storm produces heavy snowfall across the majority of the State and freezing rain and ice along the Ohio River. The storm causes widespread power outages, road closures, business and school closures. Households are isolated and sensitive populations are at risk as many are without heat and communication systems have been damaged. Storm debris on roads delays early attempts to restore critical facilities and services. Fifteen counties are declared Federal and State disaster areas. Insured losses exceed $25 million and government expenses and uninsured losses exceed $10 million (FEMA DR-1453 Hazard Mitigation Post-Event Strategy).

Radiological Incidents (Nuclear Power Generating Site)
During the July 4th weekend, a massive heat wave created a breaking point to the electric grid resulting in a loss of power at the Beaver Valley Power Station. The primary containment vessel

is compromised, creating a major release of radiation across portions of Ohio and Pennsylvania. Residents living within a 10-mile radius of the plant are evacuated. Thousands of other residents living outside the radius self-evacuate due to fear creating transportation issues.

Disease – Human

An elevated number of E. coli O157:H7 cases have been reported in various jurisdictions across Ohio. A total of 5 cases have been reported and one child is hospitalized with hemolytic uremic syndrome (HUS). Other cases of coli O157:H7 and HUS have occurred in seven other states.

Water Control Structure (dam/levee failure)

Near record spring precipitation, compounded by a series of spring storms led to a Class I dam failure upstream of a highly populated area in central Ohio. The inundation area downstream of the dam contains business, residential, commercial and other uses. There were 550 casualties and thousands of injuries. Property and infrastructure damage totals over $600 million. Bridges, culverts and other stream crossings were destroyed 20 miles downstream of the dam. The event caused significant environmental contamination downstream of the dam and habitat degradation in the reservoir and surrounding park.

Disease – Animal

Emerging diseases and others, such as anthrax, foot and mouth disease, Avian and Swine Influenza, Bovine Spongiform Encephalopathy (BSE), commonly known as mad cow disease, are becoming increasingly prevalent on the world stage. Outbreaks are often regional, if not global, in nature. Disease outbreaks are a planning priority for the State of Ohio and also at the federal level. Diseases which cause widespread deaths of animals, both captive and wild, would have an effect on the environment in terms of disposal of the carcasses. Whether the infected animals are buried, burned or left in place, a large quantity and concentration of carcasses may impact air, soil and groundwater.

Building/Structure Collapse

Bridges are the most common type of collapse in the state. There are over 42,000 bridges in Ohio, the second largest number of bridges in the country. The Ohio Department of Transportation (ODOT) is responsible for nearly 15,000 bridges on the state highway system. Ohio law requires all bridges to be inspected on an annual basis. This applies to all bridges maintained by ODOT as well as county and city bridges.

The 2007 Interstate 35W bridge collapse in Minneapolis, Minnesota, brought to light challenges states face with structurally deficient bridges. Like Minnesota, Ohio has over a dozen highway deck truss bridges that share the same design structure as the I-35W Bridge. In 2009, Lake County replaced a similarly-designed bridge with twin bridges on Interstate 90 over the Grand River. The bridge partially collapsed in 1996 due to deteriorating corroded steel plates. No injuries were reported, but the bridge was closed for months for repairs. In another comparable case, the city of Cleveland's Inner belt Bridge is undergoing more than $150 million in repairs. The I-71 bridge in Morrow County (Jeremiah Morrow Bridge), similar in structure to the I-35 bridge, was replaced. In 1983 a bridge collapsed in Antwerp (Paulding County) killing five people. The 30-foot stone and asphalt structure caved-in and four cars plunged into a dry creek bed.

More recently, Ohio resources have been used to respond to building structural collapse rescues. On July 7, 2010, the Ohio Regional Urban Search and Rescue and the northwest area's Regional Structural Collapse Response Unit responded to a significant structural collapse in Fremont. Support columns inside a food processing plant partially collapsed the roof structure. Area-wide assistance was requested for two workers trapped under the debris. One person was killed and the other was trapped for hours beneath the rubble.

Terrorism (CBRNE)
Approximately 40,000 are gathered at a 32-acre park that is surrounded by a residential neighborhood and downtown Columbus for a popular annual community event. It is a clear Saturday in late June, with a temperature of 88 degrees and a mild wind blowing in a northeasterly direction. A radiological dispersion device (RDD) detonates at the northern end of the park. Debris recovers the streets and a cloud of dust quickly envelops the park and nearby homes. On-scene security and first responders are reporting countless injuries from the blast. As additional responders arrive, including initial Columbus bomb squad, a monitor detects radiation. As fire & EMS deal with the wounded, the bomb squad conducts an assessment and discovers radiation within the park's perimeter. There is mass chaos along with fears of radiation exposure from the crowd as well as near-by residents.

Explosion/Fire
A vehicle borne improvised explosive device is detonated in the parking garage of a government facility resulting in 150 confirmed fatalities with 500 injured. The building suffered vast damage and the effective blast radius affected approximately sixteen city blocks. (This was evidenced by the Oklahoma City blast of 1995.)

Fuel/Resource Shortage
A gulf-coast hurricane disrupts production, refinement and transportation of fuels. Refineries and pipelines are damaged and will be offline for months. Heading into the winter months and the requirements for heating fuels, this could have a tremendous impact on the availability and price of fuels. Hurricane Katrina caused these kinds of damages and caused some supply disruptions, especially for southwestern Ohio.

Earthquake (5.4 magnitude)
A 5.4 magnitude earthquake occurs at 5:00 PM on a weekday near the border of Lake and Geauga Counties in northern Ohio. Most people in these two counties run outdoors and the shaking is felt all along the Akron Magnetic Boundary. The communities of Mentor, Painesville and Chardon are the most heavily impacted. Damage to buildings varies depending on the quality of building construction. Some older buildings near the epicenter are destroyed and many other older buildings sustained damage. There are hundreds of collapsed chimneys and many automobile accidents 20 miles from the epicenter (Based on the March 9, 1937 earthquake in Anna, Ohio).

Landslide, Mudslide, Subsidence
Above normal rainfall amounts were recorded at the three climate stations in Ohio during the months of March, April, and May, with April being the wettest month overall. Rainfall was above normal across the entire State, but the Cincinnati area experienced rainfall in April that surpassed the previous record by 4 inches. As a result of this significant rainfall, groundwater levels, soil moisture, lake and reservoir levels, and stream flow were well above normal for an extended period of time. During this time many roads are washed out due to flash flooding. Bridges and culverts suffered flood damage and over 500 slope failures occurred. The prolonged event results in over $45 million dollars in damages to roads, bridges and other infrastructure (Hazard Mitigation Strategy for FEMA-DR-4002).

Extreme Temperatures (heat, cold)
Severe summer storms damage trees causing downed power lines and outages statewide. Due to the widespread nature of the storms, many areas are without power for 4 - 6 days.

Immediately after the storms, an extended heat wave affects the State. Since many areas are without power, cooling stations and shelters are opened in most counties. Hospitals emergency rooms are filled with sensitive populations overwhelmed by heat exhaustion and related symptoms. Despite efforts to remind citizens to check on their neighbors, 10 elderly people die from heat related complications.

Hazardous Material

In Miamisburg, Ohio on July 8, 1986 fifteen cars derailed rupturing a tank car carrying 12,000 gallons of white phosphorous. The white phosphorous ignited in the atmosphere and created a plume of phosphoric acid. In the hours and days following the derailment, the situation degraded, forcing the evacuation of an estimated 30,000 people; 569 persons were treated for various complaints during the incident. This evacuation represents the largest ever U.S. evacuation due to a train derailment involving hazardous materials, and the largest emergency evacuation in Ohio history.

Product Defect/Contamination

In 2010, an Ohio food producer issued a recall of romaine lettuce products that were linked to an outbreak of a foodborne illness from *E. coli* 0145 bacteria. Although no deaths were reported, 19 people were sickened, with 12 hospitalized, including three who developed a potentially life-threatening complication called hemolytic uremic syndrome, or HUS. The lettuce was shipped to 23 states, and the most cases of illness were reported in New York, Michigan and Ohio.

Civil Disturbance, Public Unrest, Riot

In 2001, the Cincinnati race riots is considered one of the largest urban disturbances in the United States since the Los Angeles riots of 1992. The four days of rioting were a reaction to the fatal shooting of a 19-year-old black male, by a white police officer. Full-scale rioting lasted nearly a week, with millions of dollars in property damage reported.

Drought

In July 1995, higher than normal temperatures and dry vegetation for two straight weeks create extreme drought conditions in 13 southern Ohio counties. Crops are adversely affected, as well as lawns, gardens, and other urban landscapes. Many municipalities mandated water-use restrictions by the end of June as water supplies approached critically low levels.

Mine Collapse

Thousands of abandoned coal mines in 35 Ohio counties pose a risk to residents, buildings and roads as they collapse, creating open holes or sinking patches of earth. In 2009, a house in village of Sugarcreek bowed and cracked its building façade and walls due to mine subsidence. Records from the Ohio Department of Natural Resources Division of the Geological Survey showed that an old abandoned coal mine ran under large portions of Sugarcreek. According to date from the geological survey office, Ohio is now home to about 5,000 documented abandoned underground mines (AUMs). As many as 2,000 additional AUMs might exist for which there are no records. Known AUMs are in Ohio's coal-rich Appalachian counties. More than 550 lane miles of Ohio's roads run over AUMs.

Fire (forest, range, urban, wildland)

A lighted cigarette tossed from a car window sparks a 200 acre wildfire in Lawrence County. Fire crews from neighboring townships, counties, cities and villages are dispatched to the scene. Despite conditions being relatively dry, and a moderate wind, fire crews are able to control the fire in two days. The area is sparsely populated and all residents were able to be evacuated ahead of the fire. Three fire fighters were injured, and two residential structures were destroyed in blaze (Based on historical wildfire data in Section 2.7 of the State of Ohio Hazard Mitigation Plan).

Geomagnetic Storm
A Geomagnetic Storm associated with a gigantic solar Coronal Mass Ejection (CME) produced widespread commercial power grid failures in Ohio and across the Midwest. As a result, the entire State and many surrounding states were without power for 36 hours. Damage to communication satellites affected banking, fuel distribution systems, cellular telephone networks and Global Positioning System signals. Several cities in the State experienced minor rioting and looting.

Energy/Power/Utility Failure
Twelve counties in northeast Ohio experience complete “blackout” for 5 days during a blizzard in mid-February after an unknown source corruptions electrical grid control systems.

Cyber Attack
An unknown cyber threat group breaches a variety of financial systems throughout Ohio and the United States siphoning funds from thousands of accounts from various banks and financial institutions.

Animal or Insect Infestation or damage
Since the discovery of Ohio’s first Emerald Ash Borer (EAB) infestation in 2003, this exotic, invasive species has caused millions of dollars in damage to the State’s wooded ecosystems, residential properties, urban forests, as well as to landscape and nursery businesses. The U.S. Department of Agriculture Forest Service estimated that there were 3.8 billion white ash trees in Ohio in 2003. The current estimate of all ash trees in the State is 254 million. Northwestern Ohio, with its high percentage of ash trees and proximity to the Michigan EAB introduction site, was especially hard hit. Assistance requests from EAB-impacted landowners and communities are high. An ODNR Division of Forestry survey of communities returned a request of $11 million from more than 60 communities to provide for ash tree removal and replacement assistance. In the City of Toledo alone, more than 7,500 ash trees needed to be removed, dramatically impacting the urban right-of-way landscape (ODNR Division of Forestry website).

Air/Water Pollution/Contamination
In the late 1960s, about 2,500 pounds of sulfur dioxide escaped into the air from a burst pipe at a chemical plant located in the northern industrial part of Cincinnati. The release of sulfuric dioxide started at midnight and lasted for about 8 hours. People who are staying at about 200 meters to the east of the plant were affected. People were awakened by a rotten-egg smell and difficulty in breathing. Fortunately nobody was killed.

Communication Systems Interruptions
In June 2012, portions of Ohio’s communications systems were severely disrupted due to a destructive windstorm “Derecho” that resulted in millions without electrical power during a record summer heat wave across the nation. The 2012 derecho severely disrupted 9-1-1-related communications called Public Safety Answering Points (PSAPs). In Ohio, 74 MARCS towers were on generator power during the height of the derecho.

Transportation Accident
In 1994, a commercial airline, Atlantic Coast Airlines, crashed on approach after a flight from Washington Dulles International Airport to Port Columbus International Airport. Five passengers and crew were killed and three people survived the accident. The aircraft slowed to a stall

resulting in the aircraft impacting the ground less than 2 miles from the runway. After the impact, a fire started in or near the left engine, which spread to the rest of the aircraft.

Criminal Activity
A subject in a major urban area purchased an unusually high quantity of a chemical which could be used in the creation of an explosive device. A concerned citizen reported this information to the local fusion center which, in turn, processed and developed additional information, and shared information with the Federal Bureau of Investigation – Joint Terrorism Task Force and the Department of Homeland Security, and subsequently preventing an attack through successful interdiction. From this information/investigation, it is learned the subject has ties to a designated terrorist organization. In addition, it is learned the subject is in the process of building a significant explosive device to launch against American citizens.

Lightning Strikes
A three day outdoor music festival was held in western Ohio in July. The event drew 50,000 people to an open field area in a rural part of the State. A quickly developing severe summer storm directly hits the festival area causing two casualties from lightning strikes.

Space Debris
About 40,000 to 60,000 tons of space material falls onto the Earth each year, but most of it is mere dust. Larger materials fall during regular cycles called meteor showers, but again most of it is small enough to harmlessly burn up as it hits the Earth's atmosphere at high speeds. Material that does manage to strike the Earth's surface lands in random locations, and since 70% of the Earth's surface is water, these meteorites mostly go unnoticed by ordinary people. There is a 1-in-3,200 chance of satellite debris hitting a person on the ground. Throughout the entire 54 years of the Space Age there has been no report of anyone being injured or impacted by any re-entering debris.

Risk Assessment: The Analysis Process

Methodology

A hazard identification and risk assessment consists of three elements –establishing threat and hazard profiles, assessment of vulnerability related to each threat or hazard, and consequences expected should an incident occur. Research for this assessment involved the collection of both historical and statistical data, including review of available literature and interviews with professionals in various disciplines at the local-level and at the state-level. Information was then systematically analyzed for potential risk value. Composite risk values are calculated based on scores for several factors under each of the three elements. Because the analysis incorporates data applicable to the entire state, the data for any specific (county) jurisdiction may differ.

Figure 9. Threats and Hazards Identified lists the threats and hazards identified and as they were consolidated by subject matter experts for planning purposes.

Figure 11. Total Risk Values (Probability x Consequence) provides the numerical score, the hazard profile, vulnerability, and overall risk total for each hazard. The hazards are categorized primarily by FEMA's Comprehensive Preparedness Guide 101.

Threat and Hazard Profiles were determined based on: ***Frequency, Duration, Speed of Onset, and Magnitude.*** Vulnerability is determined based on impacts to: ***Business, Humans, Property, and the Environment.*** The consequence analysis further estimates the impacts to people, property and the environment by evaluating impacts to: ***the Public, First Responders, Business Continuity, Public Confidence, Economy, Facilities/Infrastructure, and the Environment (estimated remediation required).***

Generally, these factors were considered for an average occurrence of the hazard, not an incidence of catastrophic occurrence. The resulting risk total values allow hazards to be compared against each other to obtain a prioritization of hazards. Although this assessment considers the hazard analysis documented by the Ohio EMA's Mitigation Branch in the Ohio Enhanced Hazard Mitigation Plan, the threats and hazards identified and risk values determined in this report are used for planning purposes only. The outcome of this risk assessment is referenced in the State of Ohio Emergency Operations Plan and as Step 1 of the annual statewide Threat and Hazard Identification and Risk Assessment (THIRA) process.

Factors for Threat and Hazard Profiles

Frequency. *A key factor in the risk of a particular hazard is the frequency with which it occurs. Some hazards have been relatively frequent in this state while others were only sporadic. For this hazard analysis, the frequency with which an event occurs is based on historical reports and query of subject matter experts from various state and local authorities as well as the number of Gubernatorial Declarations associated with the hazard agent. Using these criteria provides a wider variety of hazards than utilizing presidential declarations alone. State declaration records from Ohio's Secretary of State date back to 1991.*

4	Highly Likely	Near 100% probability in next year. Many state declarations have occurred.
3	Likely	Between 10 and 100% probability in next year, or at least one chance in 10 years. Some state declarations have occurred.
2	Possible	Between 1 to 10% probability in the next year, or at least 1 in the next 100 years. Very few state declarations have occurred.
1	Unlikely	<1% probability in next 100 years. No state declarations are likely.

Duration *may be defined as "time on the ground" or the time-period of response to a hazard or event. Transportation accidents may last a few hours whereas a tire fire may last a week and a flood several weeks. Duration, therefore, may not always be indicative of the degree of damage, but it remains an important planning factor.*

5	Excessive	More than 30 days
4	Long	7 to 30 days
3	Medium	1 to 7 days
2	Short	12 to 24 hours
1	Minimal	Less than half a day

***Speed of Onset** may affect all other factors due to lack of warning or time to prepare for impact. The lead-time required protecting lives and property varies greatly with each event. For instance, a slow-rising Ohio River flood may allow time to evacuate residents and begin flood fight measures, but flash floods can occur with little warning.*

4	Short-None	Minimal to no warning
3	Short	6 to 12 hours
2	Medium	12 to 24 hours
1	Extended	More than 24 hours

***Magnitude** is the geographic dispersion of the hazard. For instance, comparing the number of counties impacted by a flood on the Ohio River versus a transportation accident involving hazardous materials.*

4	Catastrophic	More than 50 counties impacted
3	Critical	25 to 50 counties impacted
2	Limited	10-25 counties impacted
1	Localized	Less than 10 counties impacted

Factors for Vulnerability

***Impact on Business** refers to enduring economic impact of the hazard on the community by an event.*

4	Complete shutdown of critical facilities for 30 days or more
3	Complete shutdown of critical facilities for at least two weeks
2	Complete shutdown of critical facilities for one week
1	Shutdown of critical facilities for less than 24 hours

***Impact on Humans.** This factor relates to the number of lives potentially lost to a particular hazard.*

4	High	Multiple deaths
3	Medium	Multiple severe injuries
2	Low	Some injuries
1	Minimum	Minor injuries

***Impact on Property**. This factor relates to the amount of property potentially lost to a particular hazard agent. This factor can vary between jurisdictions based on economics, geographic amount owned, and demographics of the particular populations.*

4	High	More than 50% of property severely damaged
3	Medium	More than 25% of property severely damaged
2	Low	More than 10% of property severely damaged
1	Minimum	Less than 10% of property severely damaged

***Impact on Environment.** This factor considers the impacts from the hazard event to the air, water, land, and biota.*

4	High	Catastrophic Impacts to the environment as a result of the event and/or cascading effects. Environmental impacts would have immediate and long term health effects to people. Significant resources required for remediation.
3	Medium	Localized and temporary Impacts to the environment as a result of the event and/or cascading effects. No immediate health threat to people and environmental remediation would restore the environment to acceptable limits.
2	Low	Impact to the environment would be minimal and only require a local response.
1	Minimum	Impact to the environment would not require remediation.

The impact categories considered for each hazard reflect broad impact categories in a nationally recognized consequence analysis standard. Each hazard was evaluated by subject matter experts using the high, medium, and low criteria (a rating of 4 represents "catastrophic impact" for each category, reserved for the most severe incidents) and the results are summarized in the Consequence Analysis Summary. Following is a brief description of some of the factors considered when determining how to rate the impact for each of the hazards.

Factors for Consequence Analysis

Public. *This category considers the overall impact to the citizens of the State caused by the hazard. The short and long term impacts caused by the hazard were considered in addition to efforts at the State and local level to mitigate, prepare for, respond to and recover from the event. The ranking is a general reflection of the State's resilience to the hazard being evaluated.*

3	High	Impacts to the public would likely exceed State resources and necessitate Federal assistance. Impacts would include multiple casualties.
2	Medium	Impacts to the public would likely not exceed State resources. Some casualties and injuries would occur.
1	Low	Impacts to the public would be managed at the local level.

First Responders. *This category considers the impact of the hazard event to police, fire, EMT, emergency management and other State and local officials that respond to the event. The threats to the health and safety of first responders posed by the hazard were considered in addition to staffing, training, and overall preparedness of first responders.*

3	High	Extreme threat posed to first responders, which would likely exceed local and State resources.
2	Medium	Significant threat posed to first responders, but would likely not exceed State and local resources.
1	Low	Threat posed by hazard would be managed at the local level.

Continuity of Operations. *This category considers the impact of the hazard event to State government's ability to continue or reestablish essential services.*

3	High	Impacts to essential functions as a result of the hazard event and/or cascading effects would be catastrophic. This failure would have an immediate cascading effect to public health and safety.
2	Medium	Impacts to essential functions as the result of the hazard event and/or cascading effects would be significant, but localized and temporary. This impact would create delayed response to public health and safety, but no immediate concerns.
1	Low	Impact to essential functions would be minimal and only require a local response.

Facilities/Infrastructure (i.e. Property). *This category considers the impacts of the hazard event to the built environment.*

3	High	The hazard event would result in catastrophic damages to the built environment. Damage to the built environment would have cascading and long term effects. Impacts would strain Federal resources and require extensive long term recovery efforts.
2	Medium	The hazard event would result in significant damages to the built environment and likely require the need for Federal resources to effectively recover.
1	Low	Effects to the built environment would be limited and likely not exceed the response and recovery efforts at the State and local level.

Economy. *This category considers the impact to the State economy from the hazard event.*

3	High	Cost to respond and recover from the event would quickly exceed the amount budgeted in the State Disaster Relief Fund requiring federal resources.
2	Medium	Cost to respond and recover from the event would likely not exceed the amount budgeted in the State Disaster Relief Fund.
1	Low	Cost to respond and recover from the event would likely not exceed local resources.

Environment (est. remediation). *This category considers the overall impact to the citizens of the State caused by the hazard. The short and long term impacts caused by the hazard were considered in addition to efforts at the State and local level to mitigate, prepare for, respond to and recover from the event. The ranking is a general reflection of the State's resilience to the hazard being evaluated.*

3	High	Impacts to the environment as the result of the hazard event and/or cascading effects would be catastrophic. Environmental impacts would have immediate and long term health effects to people. Significant resources would be required for environmental remediation.
2	Medium	Impacts to the environment as the result of the hazard event and/or cascading effects would be localized and temporary. There would be no immediate health threat to people and environmental remediation would restore the environment to acceptable limits.
1	Low	Impact to the environment would be minimal and only require a local response.

Public Confidence. *This category considers the impact a hazard event of each type could have on the public's confidence in the government and emergency management community.*

3	High	Significant negative impact. Downturn in public trust for the government's ability to respond to or recover from disaster.
2	Medium	Some negative impact. Public trust is eroded but recoverable as the recovery ensues.
1	Low	Little or no impact on the public trust.

Calculating Total Risk

Threat/Hazard Value (T) = (Duration + Speed of Onset + Frequency + Magnitude)/1.7
where 1.7 is a normalizing factor to adjust the scores to the model used in the FEMA Critical Asset Risk Management MGT-315, October 2016

Vulnerability Rating (V) – Compare the calculated vulnerability (below) to the table provided by FEMA to determine the vulnerability rating, which is used for final calculation and plotting on the risk graph.

Vulnerability Score = (Business + Human + Property + Environment)/2.2
where 2.2 is a normalizing factor to adjust scores to the 35 point scale for vulnerability ratings in FEMA Critical Asset Risk Management MGT-315, October 2016.

Figure 10. Vulnerability Ratings Table

Vulnerability Score	*Rating*
0-2	*1*
3-5	*2*
6-8	*3*
9-11	*4*
12-14	*5*
15-17	*6*
18-20	*7*
21-23	*8*
24-26	*9*
27-29	*10*
30-32	*11*
33-35	*12*

Consequence Value (C) = sum of scores for each of the seven factors described in the Consequence Analysis section above divided by 2 to adjust scoring of six Ohio factors vs three factors used in *FEMA Critical Asset Risk Management MGT-315, October 2016*.

Hazard and vulnerability are used to calculate an overall Probability (P), which is then multiplied by Consequence to assign a Total Risk Value.

Probability (P) = T x V

Total Risk = P x C

The table below provides the calculated results for each of the risk measures above. Throughout the series of calculations, the spreadsheet functions round the values to integers for ease of display. This compounds the rounding error and presents data totals which appear to be "miscalculated." For this reason, the table should be viewed as representative values rather than attempting to re-create the totals through the calculations.

Data Summary and Hazard Ranking

Figure 11. Total Risk Values (Probability x Consequence) Ranked within Hazard Grouping

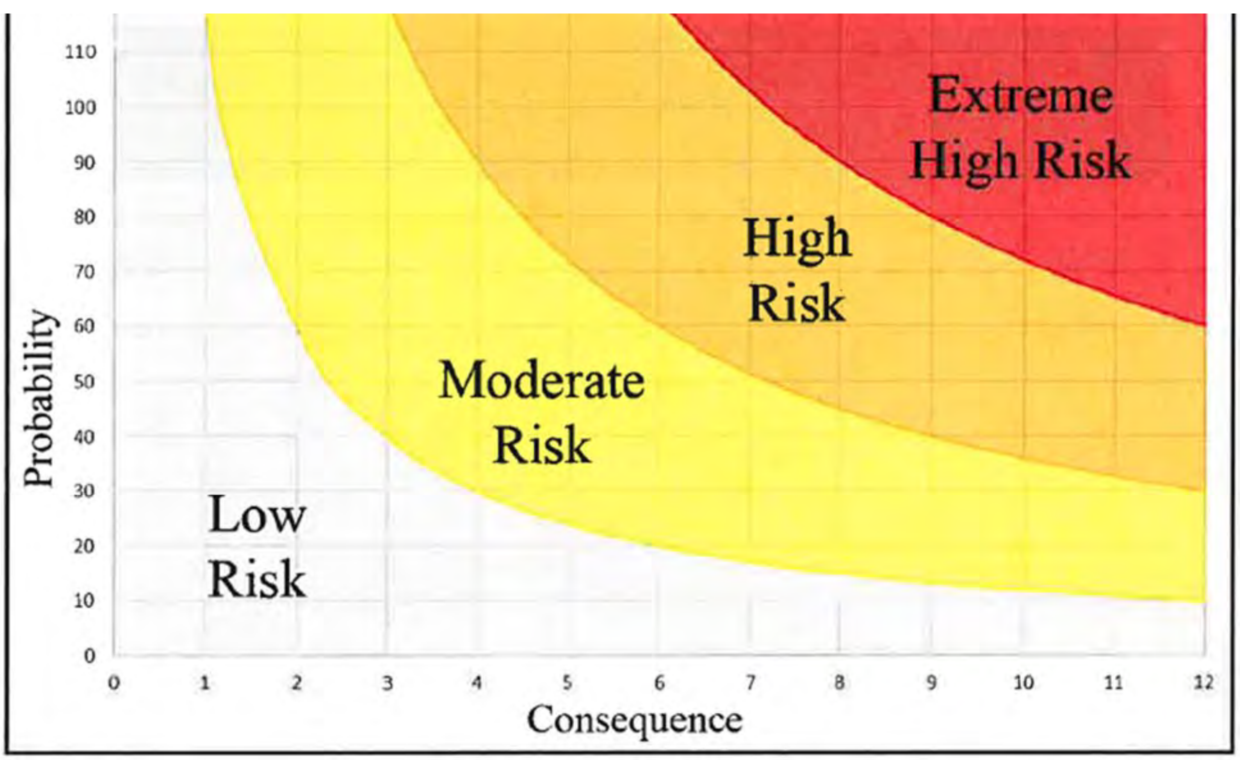
Hazard	Total Risk Value	Probability Value (P)	Consequence Value (C)	Threat/Hazard Value (T)	Vulnerability Rating (V)
Natural Hazards - Meteorological					
Tornado	690	64	11	7	9
Blizzard or Ice Storm	665	69	10	8	9
Flood, Riverine	633	64	10	7	9
High Winds	565	64	9	7	9
Urban/Flash flood	564	58	10	6	9
Wild Fire	536	53	10	6	9
Drought	470	52	9	6	8
Temperature Extremes	445	54	8	8	7
Hurricane	375	37	10	4	9
Severe Thunderstorm	356	42	8	7	6
Space Weather	287	35	8	6	6
Natural Hazards - Geological					
Earthquake	574	53	11	6	9
Landslide / Erosion	375	42	9	5	8
Natural Hazards - Biological					
Public Health Emergency	808	74	11	8	9
Mass Casualty Incident (Medical)	744	69	11	8	9
Human-Caused – Accidental/Intentional					
Electrical Grid Failure	597	58	10	8	7
Mass Communications failure	533	54	10	8	7
Water Supply Failure	517	52	10	6	8
Aircraft Incident	500	53	9	6	9

Hazard	Total Risk Value	Probability Value (P)	Consequence Value (C)	Threat/Hazard Value (T)	Vulnerability Rating (V)
IT Infrastructure Disruption	457	49	9	8	6
Transportation Failure	402	45	9	6	7
Sewer Failure	359	42	8	7	6
Human-Caused – Intentional					
Terrorism, Radioactive	1193	91	13	8	11
Terrorism, Chemical	1055	84	13	8	11
Terrorism, Biological	947	76	12	8	10
Animal/Crop Eco-terrorism	565	52	11	6	8
IT System Security Breach	515	58	9	8	7
Public Event Disturbance	399	45	9	6	7
Suspicious Powder	344	39	9	6	6
Bomb Threat	330	39	9	6	6
Hostage Situation	303	39	8	6	6
Civil Disturbance	300	35	8	6	6
Abduction	284	39	7	6	6
Mail/Package Bomb	283	32	9	5	6
Workplace Violence	275	35	8	6	6
Labor Action	274	35	8	6	6
Stalking	272	39	7	6	6
VIP Situation	247	32	8	5	6
Human-Caused - Accidental					
Nuclear Accident	1186	91	13	8	11
Mass Casualty Incident (Trauma)	675	64	11	7	9
Accidental Hazmat Release	674	64	11	7	9
Dam Failure	570	53	11	6	9
Urban Fire	540	58	9	6	9

Hazard	Total Risk Value	Probability Value (P)	Consequence Value (C)	Threat/Hazard Value (T)	Vulnerability Rating (V)
Shortage of Critical Materials	486	49	10	7	7
Natural Gas Failure	452	49	9	7	7
Fuel Shortage	420	45	9	6	7
Emergency Generator Failure	313	39	8	6	6
Flood, Internal	295	35	8	6	6
Space Debris	235	28	8	5	6

The relative severity of risk is graphically represented by plotting the Probability and Consequence Values as in Figure 5 below.

Figure 12. Total Risk Graph



Source: FEMA Critical Asset Risk Management MGT-315, October 2016

Hazards Ranked by Total Risk Value

1 Terrorism, Radioactive
2 Nuclear Accident
3 Terrorism, Chemical
4 Terrorism, Biological
5 Public Health Emergency
6 Mass Casualty Incident (Medical)
7 Tornado
8 Mass Casualty Incident (Trauma)
9 Accidental Hazmat Release
10 Blizzard or Ice Storm
11 Flood, Riverine
12 Electrical Grid Failure
13 Earthquake
14 Dam Failure
15 High Winds
16 Animal/Crop Eco-terrorism
17 Urban/Flash flood
18 Urban Fire
19 Wild Fire
20 Mass Communications failure
21 Water Supply Failure
22 IT System Security Breach
23 Aircraft Incident
24 Shortage of Critical Materials
25 Drought
26 IT Infrastructure Disruption
27 Natural Gas Failure
28 Temperature Extremes
29 Fuel Shortage
30 Transportation Failure
31 Public Event Disturbance
32 Landslide / Erosion
33 Hurricane
34 Sewer Failure
35 Severe Thunderstorm
36 Suspicious Powder
37 Bomb Threat
38 Emergency Generator Failure
39 Hostage Situation
40 Civil Disturbance
41 Flood, Internal
42 Space Weather
43 Abduction
44 Mail/Package Bomb
45 Workplace Violence
46 Labor Action
47 Stalking
48 VIP Situation
49 Space Debris

Impact on State Emergency Operations

Emergency managers have the task of coordinating mitigation, preparedness and planning, response and recovery efforts for the threats and hazards that Ohioans face. The State Emergency Operations Center and the emergency management staff coordinating its operations require all available information, tools, and expertise in their efforts to lessen the impact of disasters and to ensure as rapid a return to normal operations as possible.

Although Ohio EMA analyzed the consequences of all hazards (natural and human-caused) for their effect on the state's emergency operations, the most likely hazards determined to affect state emergency operations are those which impact the critical lifeline sectors of energy, water/sewer, and information technology.

In addition to critical lifelines, the State Emergency Operations Center's has vulnerabilities attributed to its proximity to an active airport (OSU Airport) to the south of the property and an active rail line to the east, which contributes substantial risk to egress to/from the facility as well as the potential for hazardous materials accidents which would require evacuation and relocation.

Although less likely, a public health emergency, such as the pandemic flu experienced during the H1N1 outbreak in 2009/2010, is of higher consequence to the state's emergency operations due to the resulting reduction in workforce for a prolonged period.

Method and Schedule for Review, Maintenance and Revision

The HIRA is reviewed informally by the general public via its availability on the Ohio EMA's website and is distributed, upon request, to any interested party. Formally, the HIRA is reviewed by planning partners representing the whole community (the State THIRA Workgroup members) who are identified for their subject matter expertise and support of core capabilities for emergency management. Effective with this revision, the HIRA is now included as Step 1 (Identification of Threats and Hazards) of the THIRA process, which is conducted annually.

As part of routine maintenance, this document, any reviews, and changes must be verified to conform to the current, approved Emergency Management Accreditation Program (EMAP) standard, and primarily to sections 4.1.1 to 4.1.3.

The HIRA will be revised as needed to remain current or correct typographical errors. Formal publication and re-approval will be completed at least once every five years. Significant revisions will be recorded in the Record of Changes on the following page.

Record of Changes

Change Number	Description of Change (with page number)	Date	Authorized by
001	Section added on Assessing Risk and Vulnerability to the Environment for Building Collapse and Terrorism...	July 2008	Ted Filer
002	Added Record of Changes	July 2008	Patrick Sheehan
003	HIRA Update Change from Human-Caused Hazard to Manmade / Adversarial	December 2011	Portia Pulsifer
004	HIRA Update • Formatting changes and updates • Update Data in Tables • Update Environmental Impacts Analysis Statements and Scoring • Update footnotes and references that have changed • Added consequence analysis	Spring / Summer 2013	Pulsifer Sheehan Dragani Ferryman Little Merick
005	Reviewed and added analysis of risk and vulnerability State of Ohio Emergency Management Operations	Summer 2013	Sheehan
006	HIRA Update • Formatting changes and updates • Update data tables, analysis statements and scoring for consistency with FEMA Critical Asset Risk Management formulae • Update footnotes and references that have changed • Incorporated consequence analysis as part of total risk valuation • Updated analysis of risk and vulnerability to State of Ohio Emergency Management Operations	December 2018	Susan Wyatt

Endnotes

[1] See Ohio Revised Code 5502.22 accessed at http://codes.ohio.gov/orc/5502.22
[2] See Ohio Revised Code 5502.21 (I) accessed at http://codes.ohio.gov/orc/5502.21
[3] See Ohio Revised Code 5502.21 (J) accessed at http://codes.ohio.gov/orc/5502.21
[4] See National Fire Protection Association. NFPA 1600: Standard on Disaster/Emergency Management and Business Continuity Programs, 2010 Edition, Pp. 1600-18
[5] As reported by the Ohio EMA Disaster Recovery Branch, information accurate as of October 2018
[6] *Thunder in the Heartland, A Chronicle of Outstanding Weather Events in Ohio*, 1996
[7] Ohio EMA Disaster Recovery Branch materials
[8] Hansen, Michael C. *Earthquakes in Ohio*, Ohio Department of Natural Resources, 2015.
[9] Pollution Issues, http://www.pollutionissues.com/