2.0 RISK ASSESSMENT

2.2.5 Flooding

Flooding is an overflow of water onto normally dry land. Flash floods are floods caused by heavy or excessive rainfall in less than six hours.				
Vulnerability  HIGHEST HIGH MEDIUM LOW LOWEST	Period of Occurrence:	Floods can occur at any time	Hazard Index Ranking:	19-Medium
	Warning Time:	12-24 hours	State Risk Ranking:	1
	Probability:	Highly Likely	Severity:	Critical
	Type of Hazard:	Natural	Disaster Declarations:	DR-1580 DR-1556 DR-1519 DR-1484

Hazard Overview

Historically, floods are the most common hazard in the United States, and 99% of US counties experienced flooding from 1996 to 2019. According to the National Oceanic and Atmospheric Association (NOAA), causes of flooding include:

- **Excessive Rainfall:** This is the most common cause of flooding. Water accumulates faster than it is absorbed by the soil.
- **Snowmelt:** This occurs when the source of water involved is melting snow. Snow can store water for extended periods until temperatures rise above freezing and snow melts.
- **Ice or Debris Jams:** These are common along rivers, creeks, and streams. As ice or debris moves downstream, it can become lodged on obstructions, causing flooding upstream. When the jam clears, it can cause flash flooding downstream.
- **Dam or Levee Failure:** Dams can overtop, have excessive seepage, or experience structural failure.

There are two types of flooding that affect Carroll County: flooding and flash flooding. Floods can be described as the overflow of water onto normally dry land. Flash floods are floods caused by heavy or excessive rainfall in a short period, typically less than six hours. Flash floods can also occur when no rain has fallen, such as during a dam failure or release of water during a debris or ice jam.

Location and Extent

Floods are described by the depth of floodwaters and probability of occurrence. The probability of occurrence has historically been expressed in terms such as a "100-year" flood. Such terms are better described as a probability of occurrence, so a 100-year flood is one that has a 1% chance of occurring in a given year.

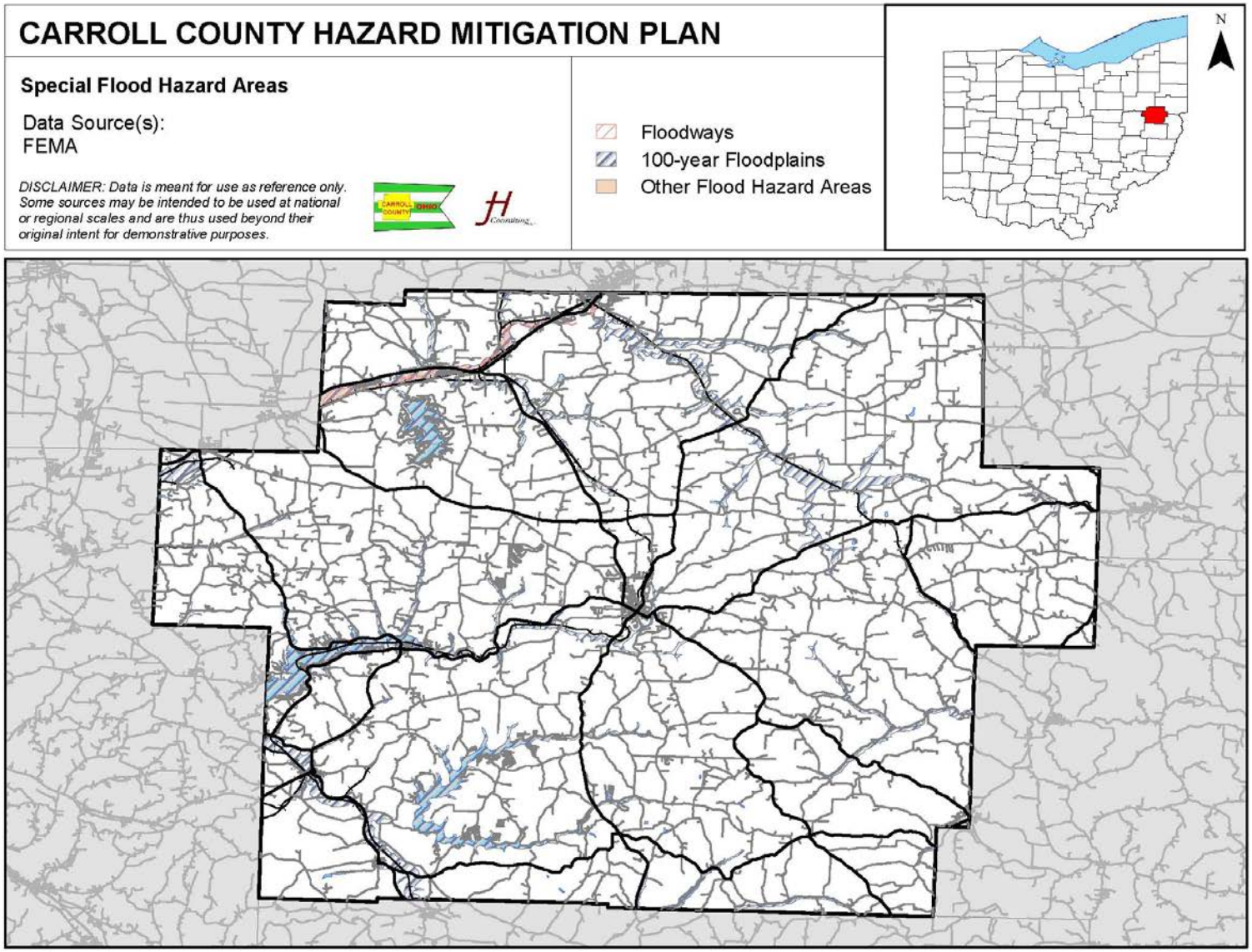
When buildings experience more than one loss due to flooding, they can become repetitive or severe repetitive loss properties. There are two accepted definitions of repetitive loss and severe repetitive loss; one from the Flood Mitigation Assistance (FMA) grant and the other from the National Flood Insurance Program (NFIP). The following table attempts to reconcile the differences between these two programs' definitions.

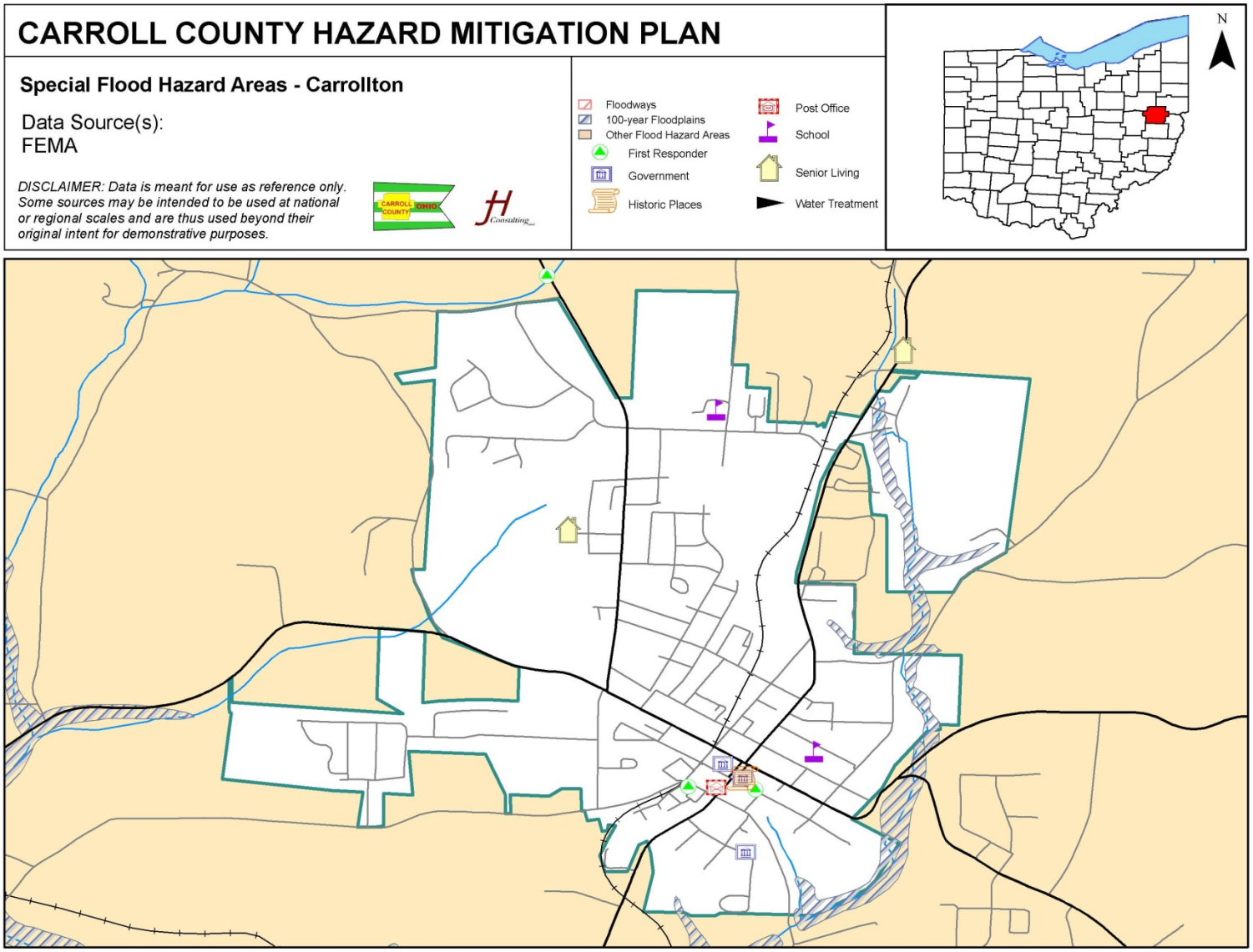
REPETITIVE LOSS AND SEVERE REPETITIVE LOSS DEFINITIONS		
Program	*Repetitive Loss*	*Severe Repetitive Loss*
Flood Mitigation Assistance (FMA) Grant	*A Repetitive Loss (RL) property is a structure covered by a contract for flood insurance made available under the NFIP that:* Has incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25% of the market value of the time of each such flood event; At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.	(a) Is covered under a contract for flood insurance made available under the NFIP; and (b) Has incurred flood-related damage i. For which 4 or more separate claims payments (includes building and contents) have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claim's payments exceeding $20,000, or ii. For which at least 2 separate claims payments (includes only building) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.
National Flood Insurance Program (NFIP)	A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978.	A single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.

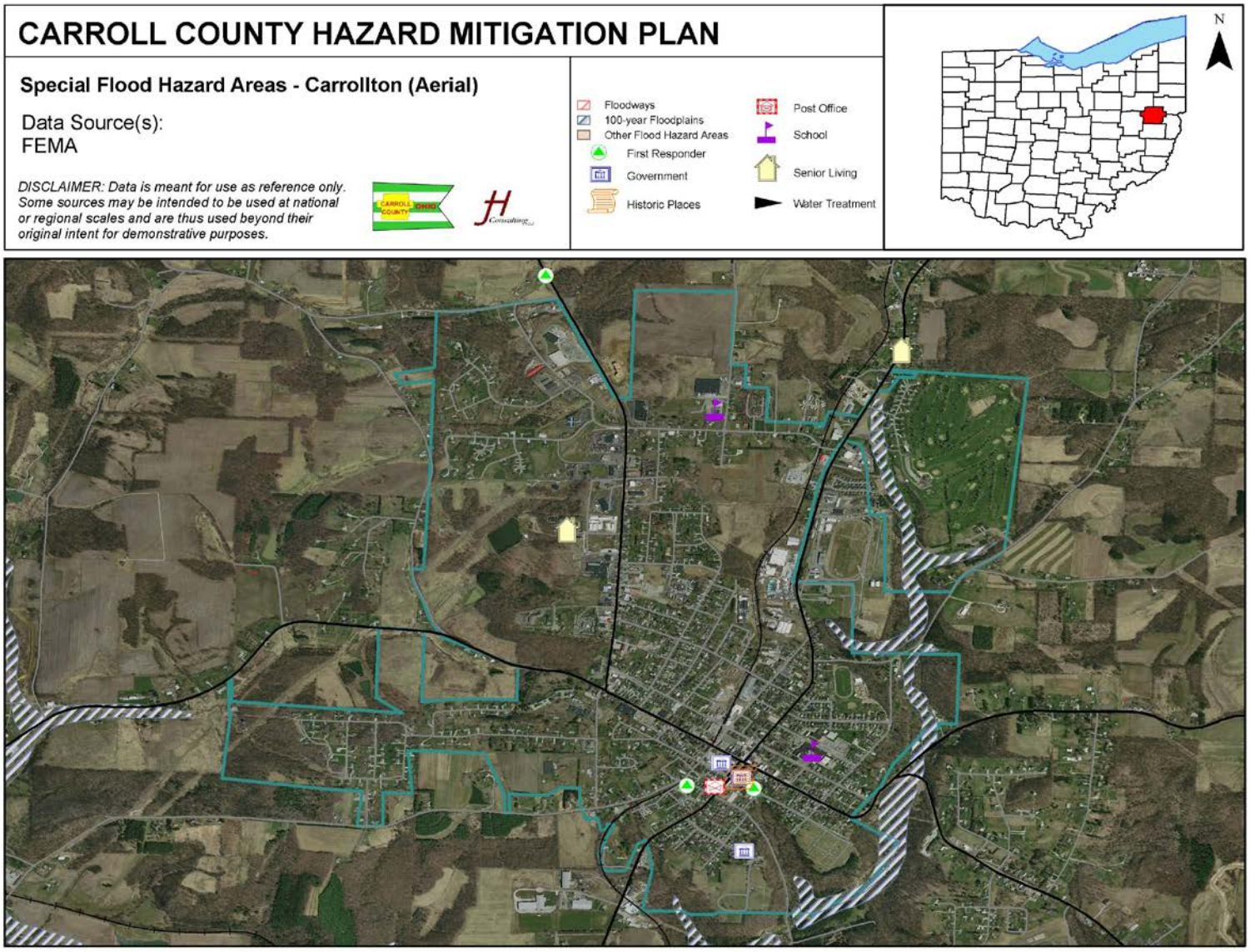
According to Ohio Emergency Management Agency, there are three repetitive loss properties and no severe repetitive loss properties in Carroll County. The following table presents the city, losses, and payments for these properties (current as of August 2018).

CARROLL COUNTY REPETITIVE LOSS PROPERTIES							
Community Name (Jurisdiction)	*Occupancy*	*Zone*	*Losses*	*Building Payments*	*Contents Payments*	*Total Paid*	*Average Payment*
Carroll County	Single Family	AE	3	$10,743.36	$0	$10,743.36	$3581.12
Carroll County	Single Family	N/A	2	$4,129.24	$0	$4,129.24	$2,064.62
Village of Minerva	2-4 Family	X	2	$33,513.62	$6,198.62	$39,712.24	$19,856.12

Several areas in Carroll County are located in flood-prone areas. The following maps depict these areas in Carroll County and each of the municipalities therein.


CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas
Data Source(s):
FEMA
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
Floodways
100-year Floodplains
Other Flood Hazard Areas
N


CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas - Carrollton
Data Source(s):
FEMA
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment
N


CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas - Carrollton (Aerial)
Data Source(s):
FEMA
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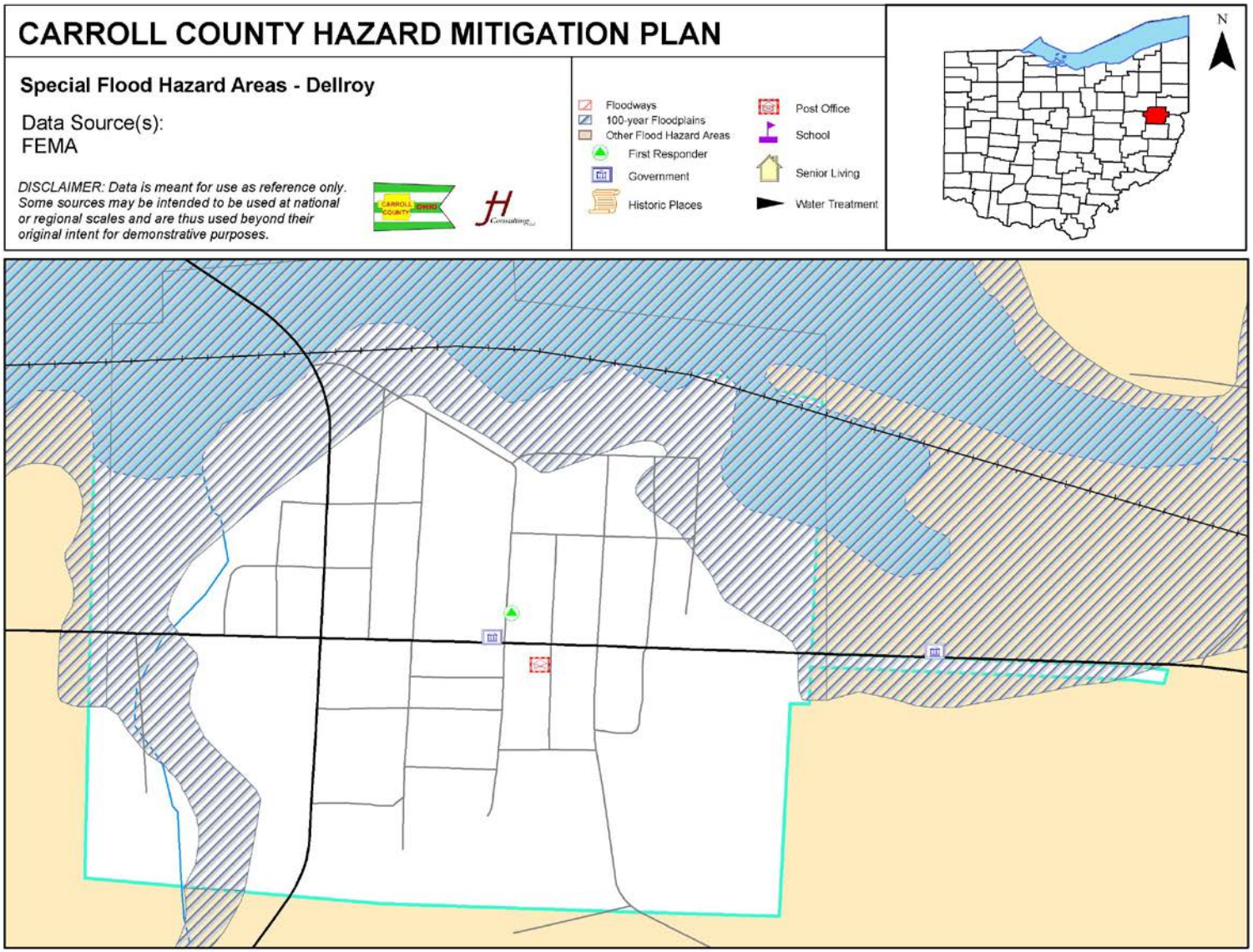
Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment
N


CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas - Dellroy
Data Source(s):
FEMA
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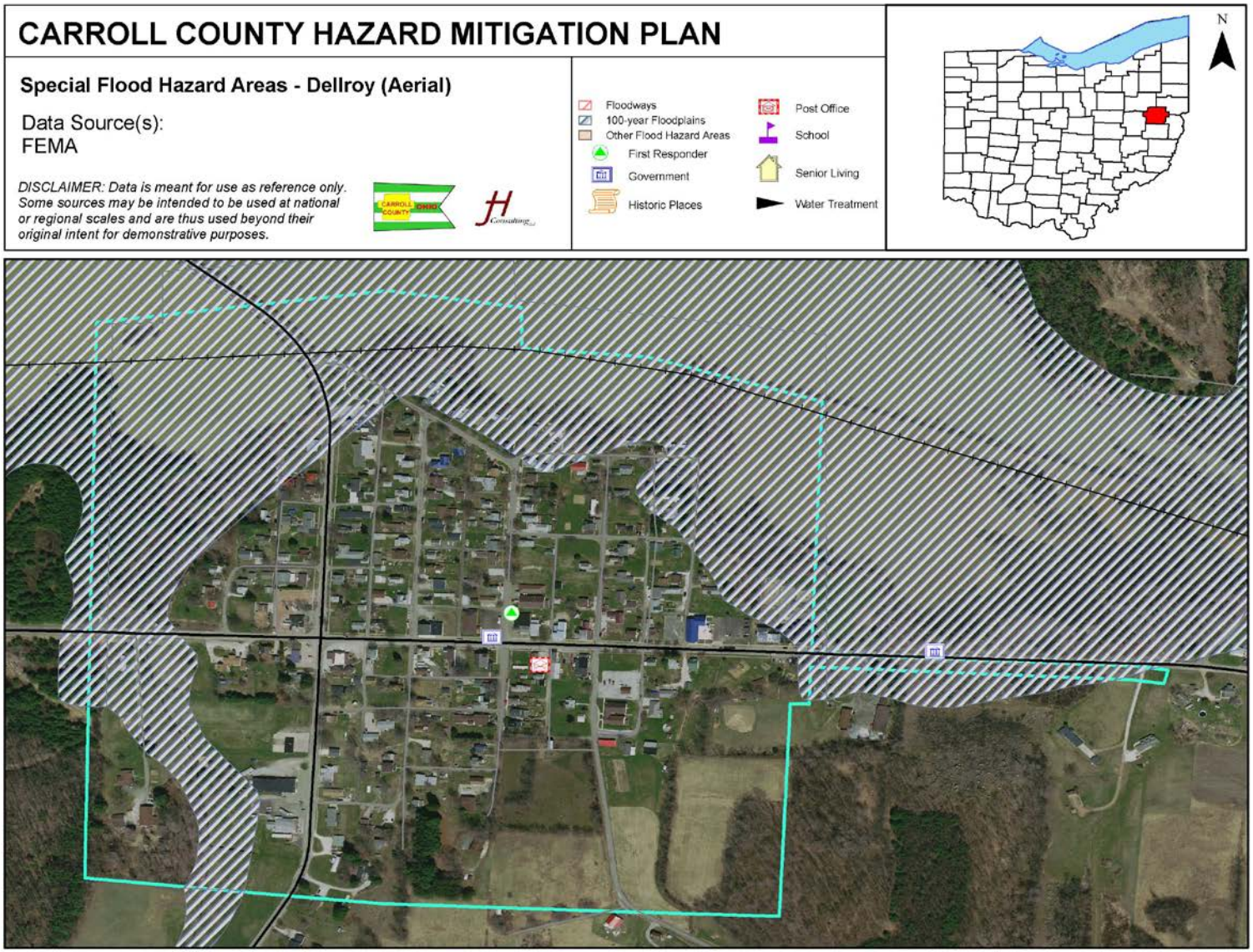
Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment
N


CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas - Dellroy (Aerial)
Data Source(s):
FEMA
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Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment
N

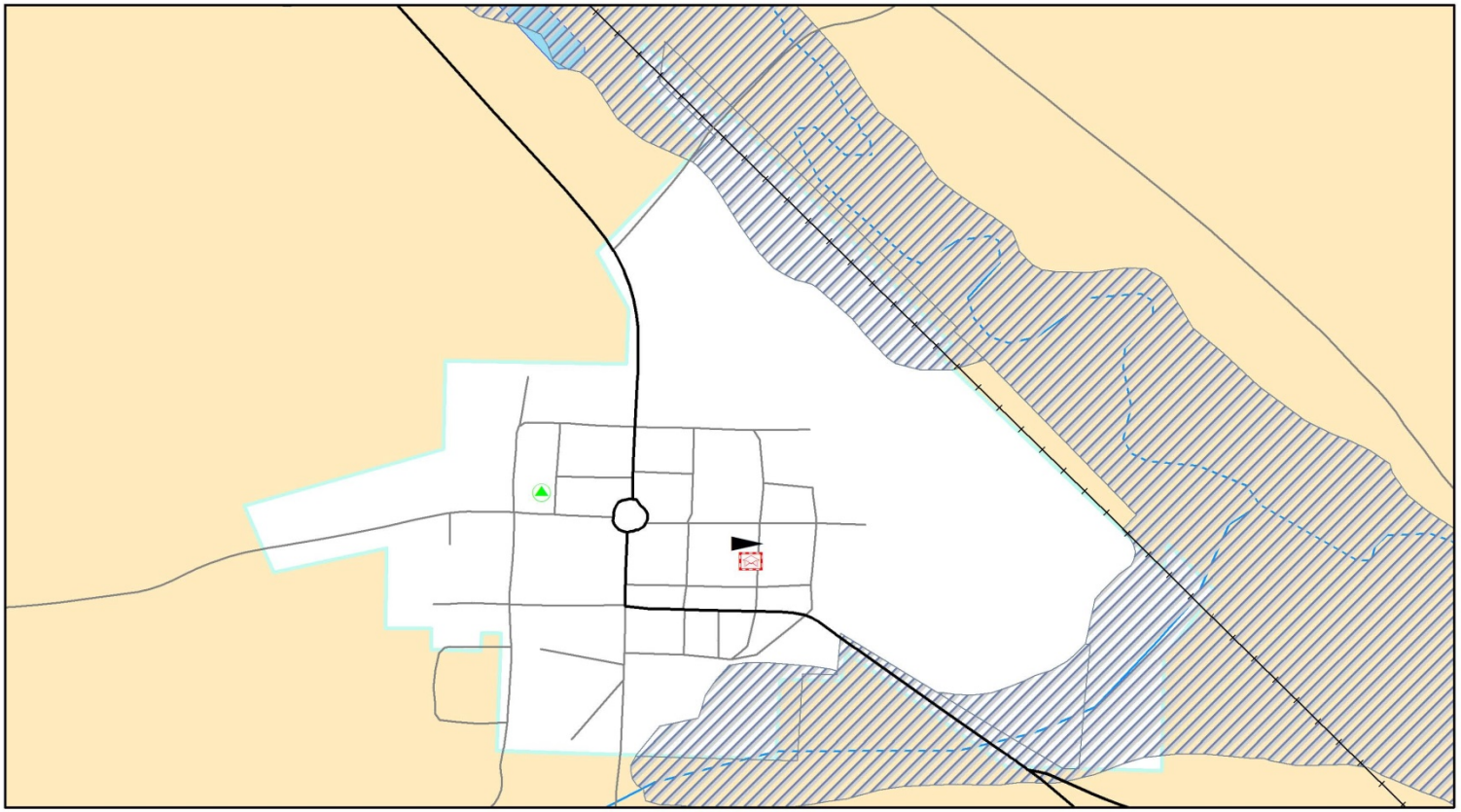
CARROLL COUNTY HAZARD MITIGATION PLAN

Special Flood Hazard Areas - Leesville

Data Source(s):
FEMA

DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.

- Floodways
- 100-year Floodplains
- Other Flood Hazard Areas
- First Responder
- Government
- Historic Places
- Post Office
- School
- Senior Living
- Water Treatment



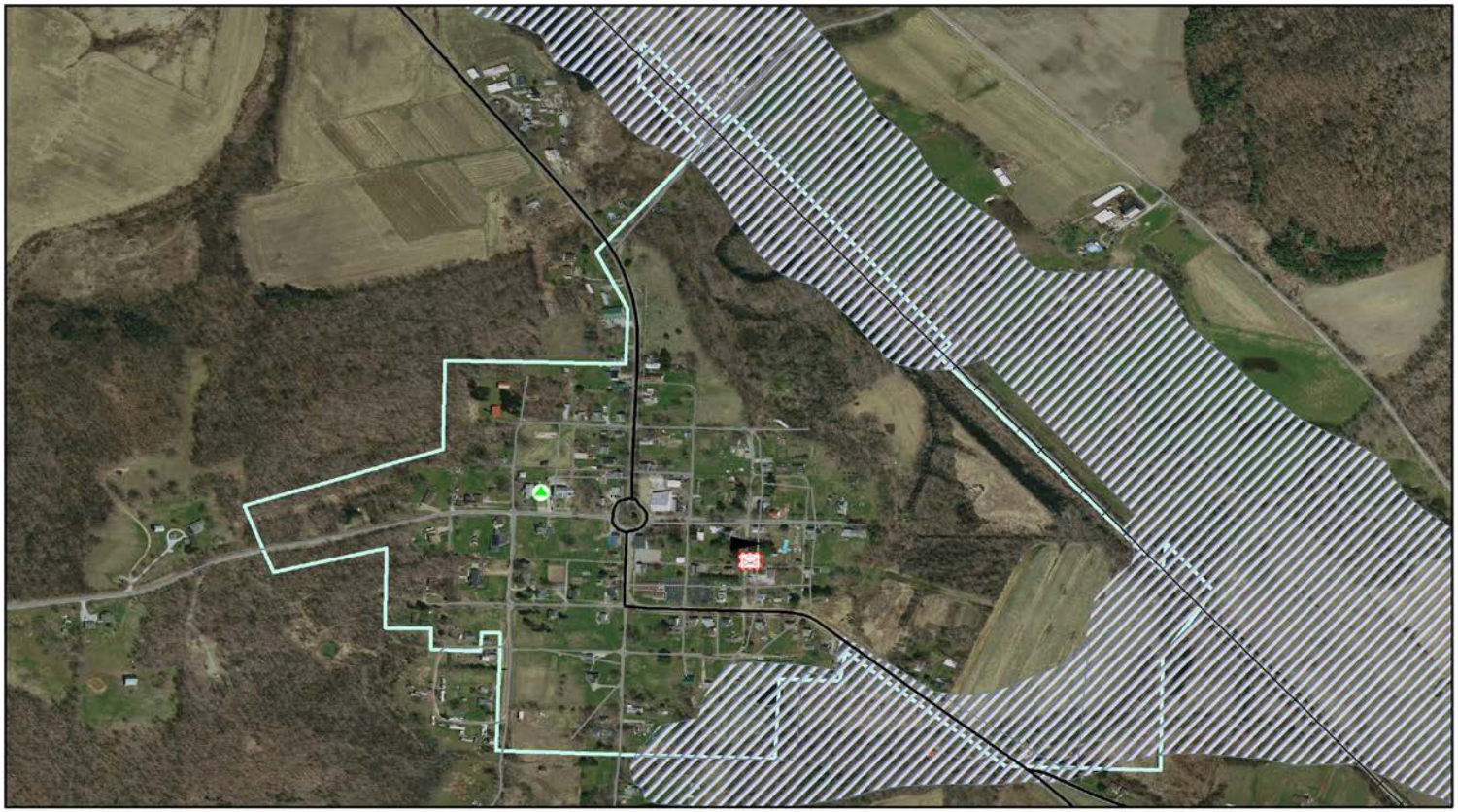
CARROLL COUNTY HAZARD MITIGATION PLAN

Special Flood Hazard Areas - Leesville (Aerial)

Data Source(s):
FEMA

DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.

- Floodways
- 100-year Floodplains
- Other Flood Hazard Areas
- First Responder
- Government
- Historic Places
- Post Office
- School
- Senior Living
- Water Treatment



CARROLL COUNTY HAZARD MITIGATION PLAN

Special Flood Hazard Areas - Magnolia

Data Source(s):
FEMA

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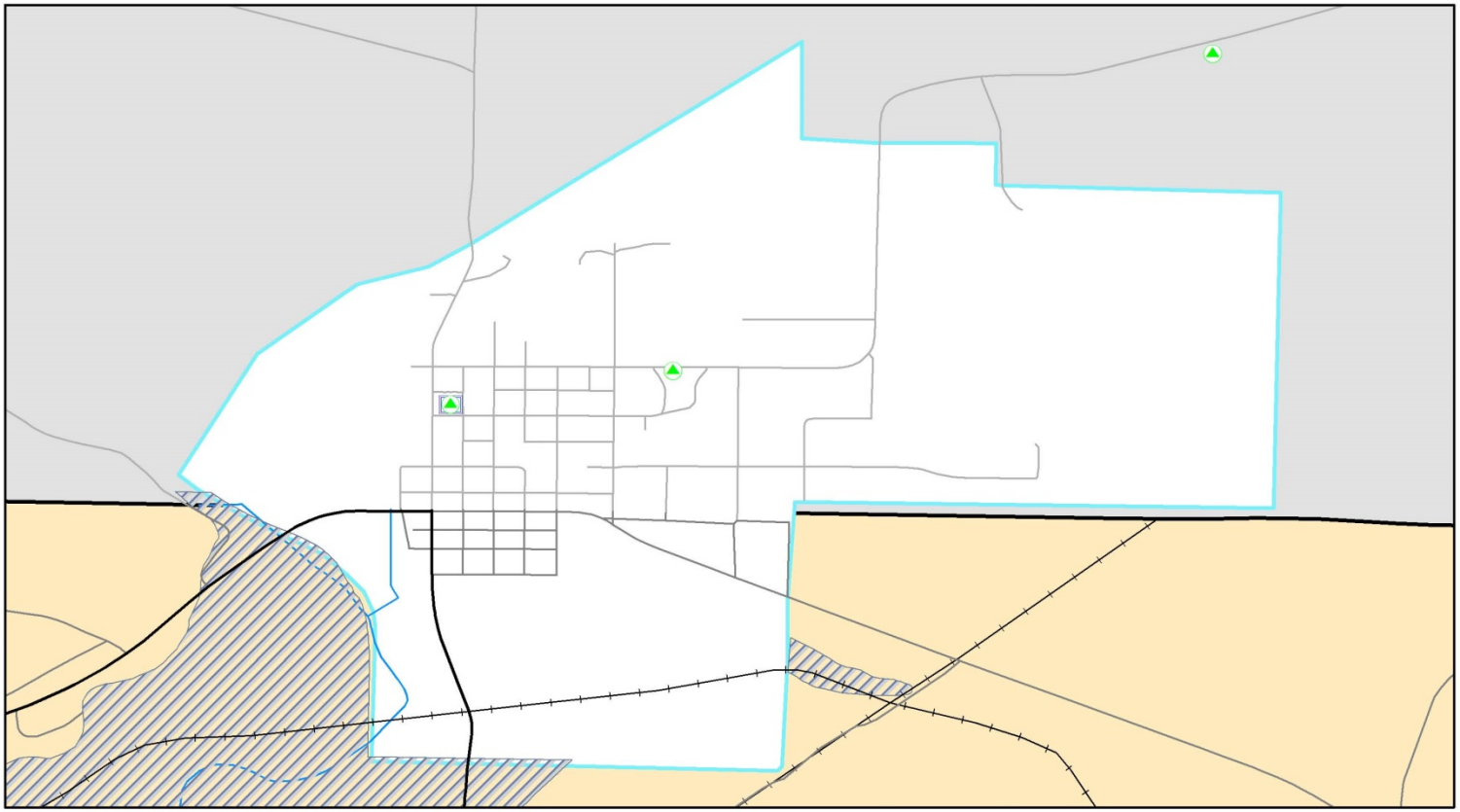
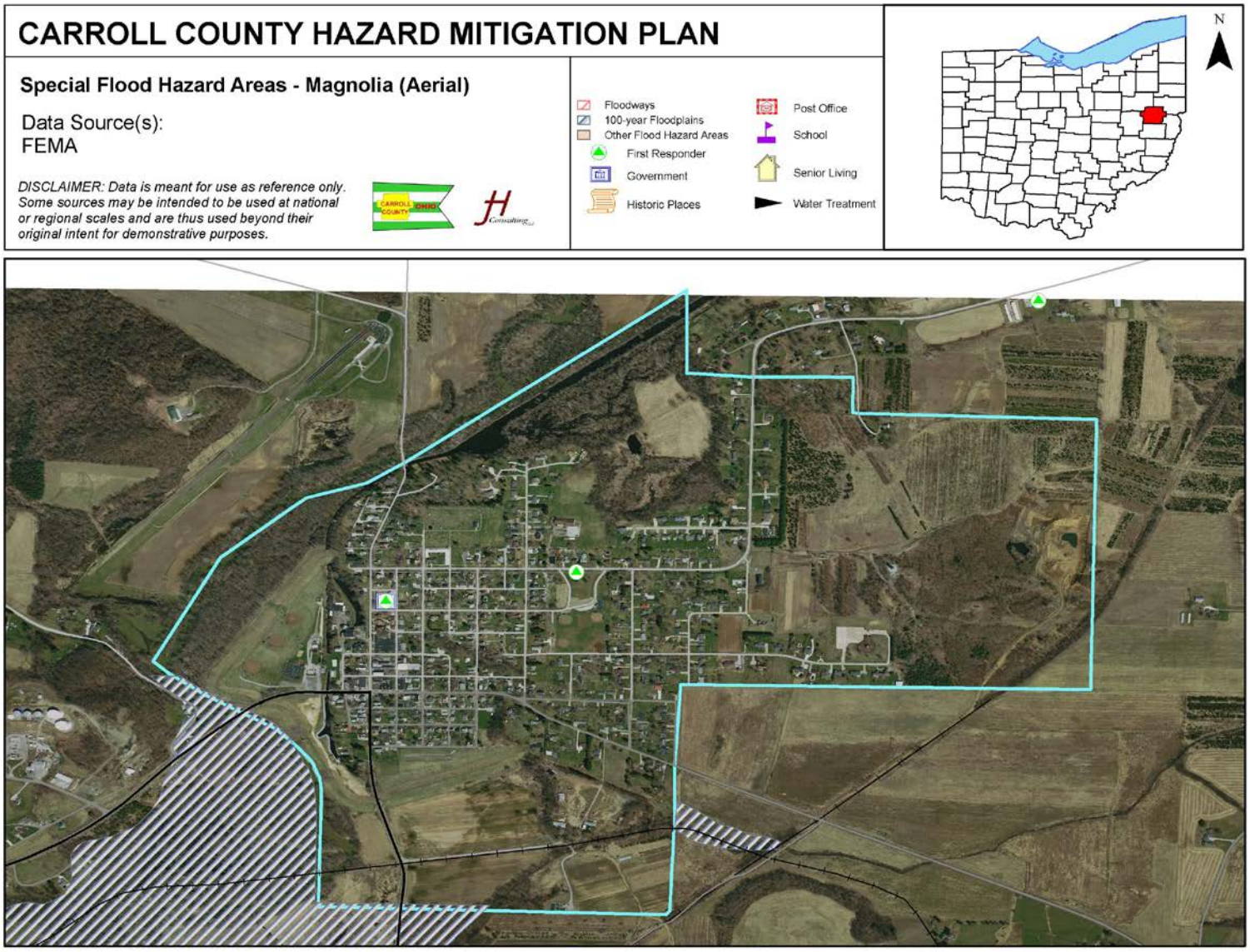
- Floodways
- 100-year Floodplains
- Other Flood Hazard Areas
- First Responder
- Government
- Historic Places
- Post Office
- School
- Senior Living
- Water Treatment




CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas - Magnolia (Aerial)
Data Source(s):
FEMA
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment
N

CARROLL COUNTY HAZARD MITIGATION PLAN

Special Flood Hazard Areas - Malvern

Data Source(s):
FEMA

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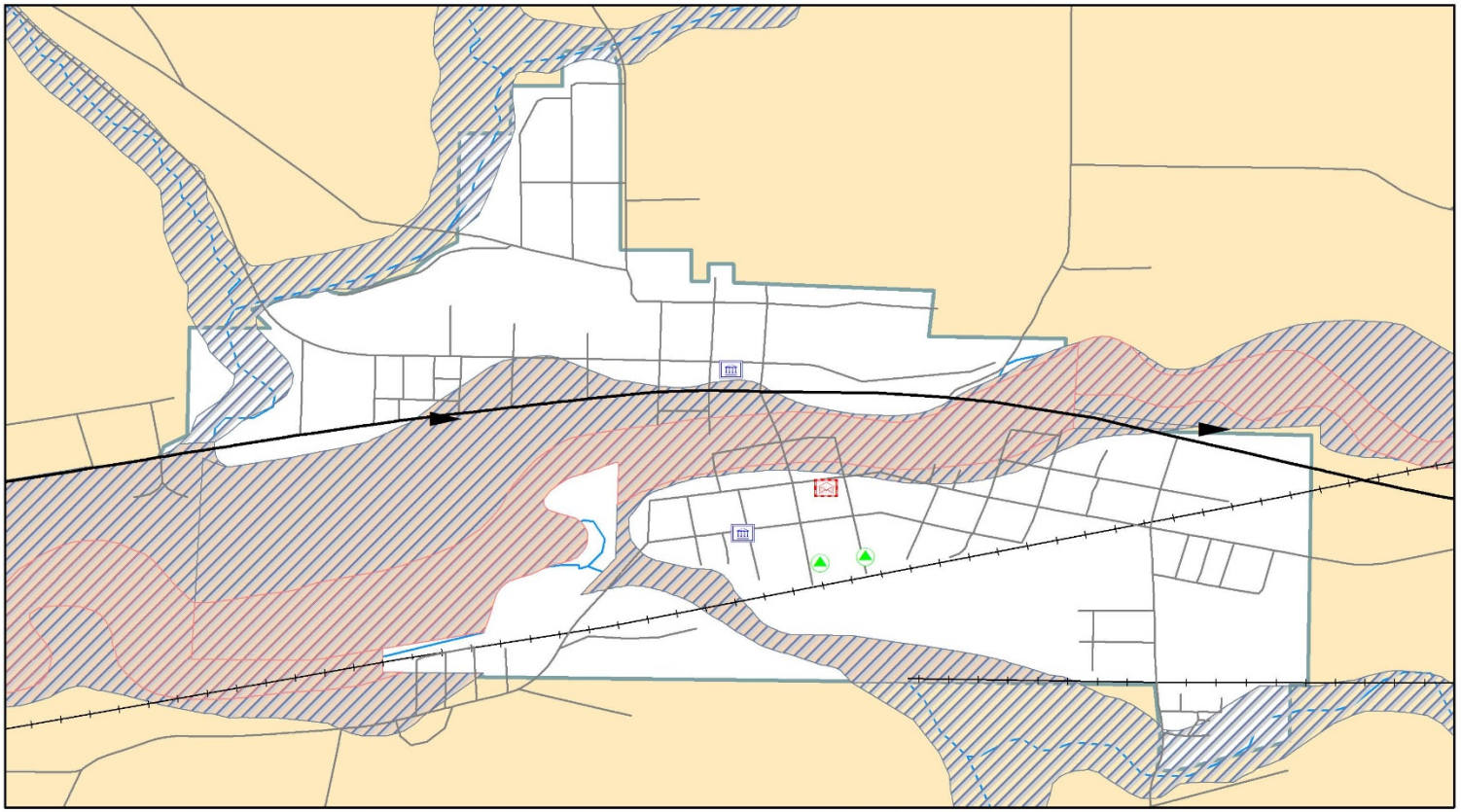
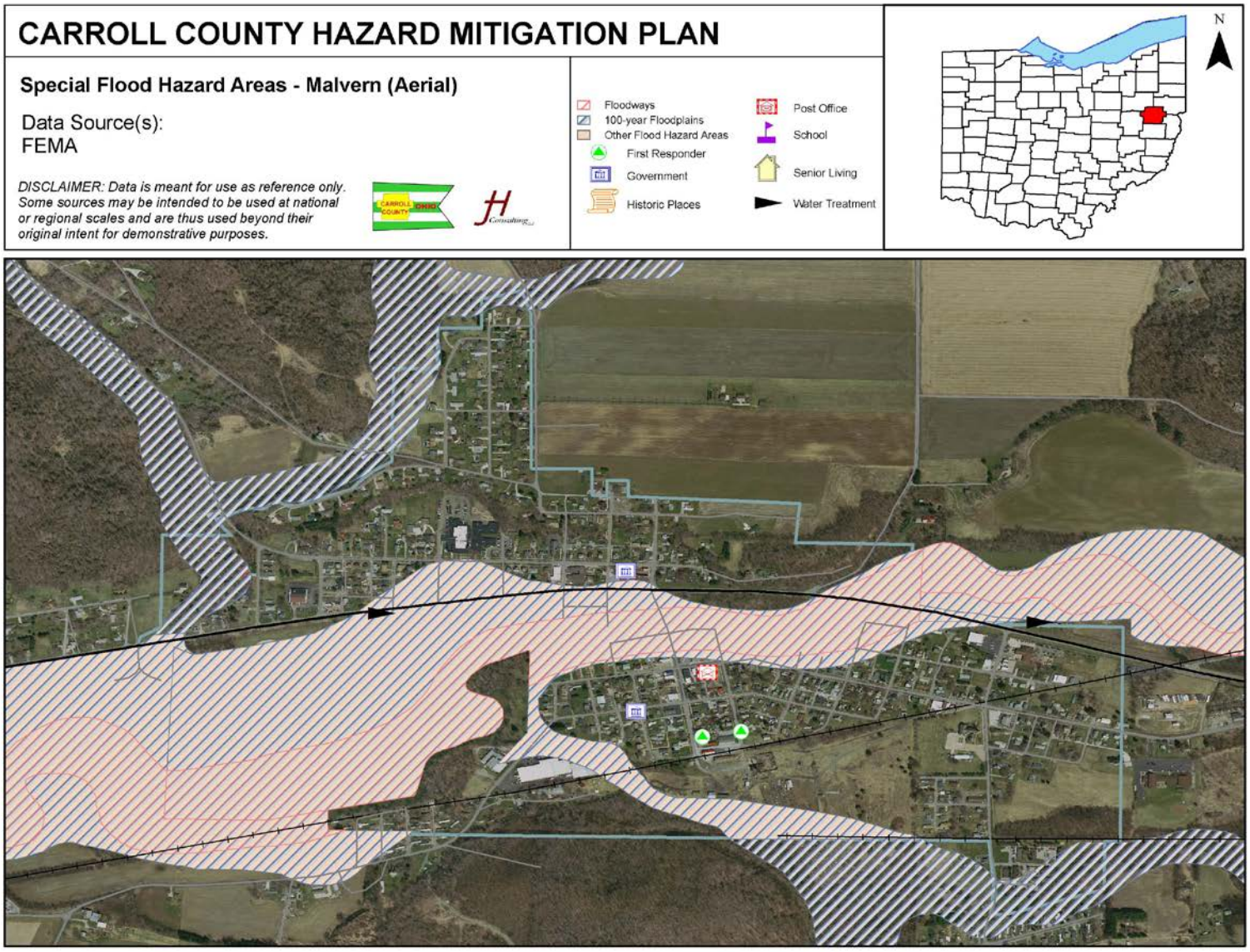
Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment




CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas - Malvern (Aerial)
Data Source(s):
FEMA
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Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment
N

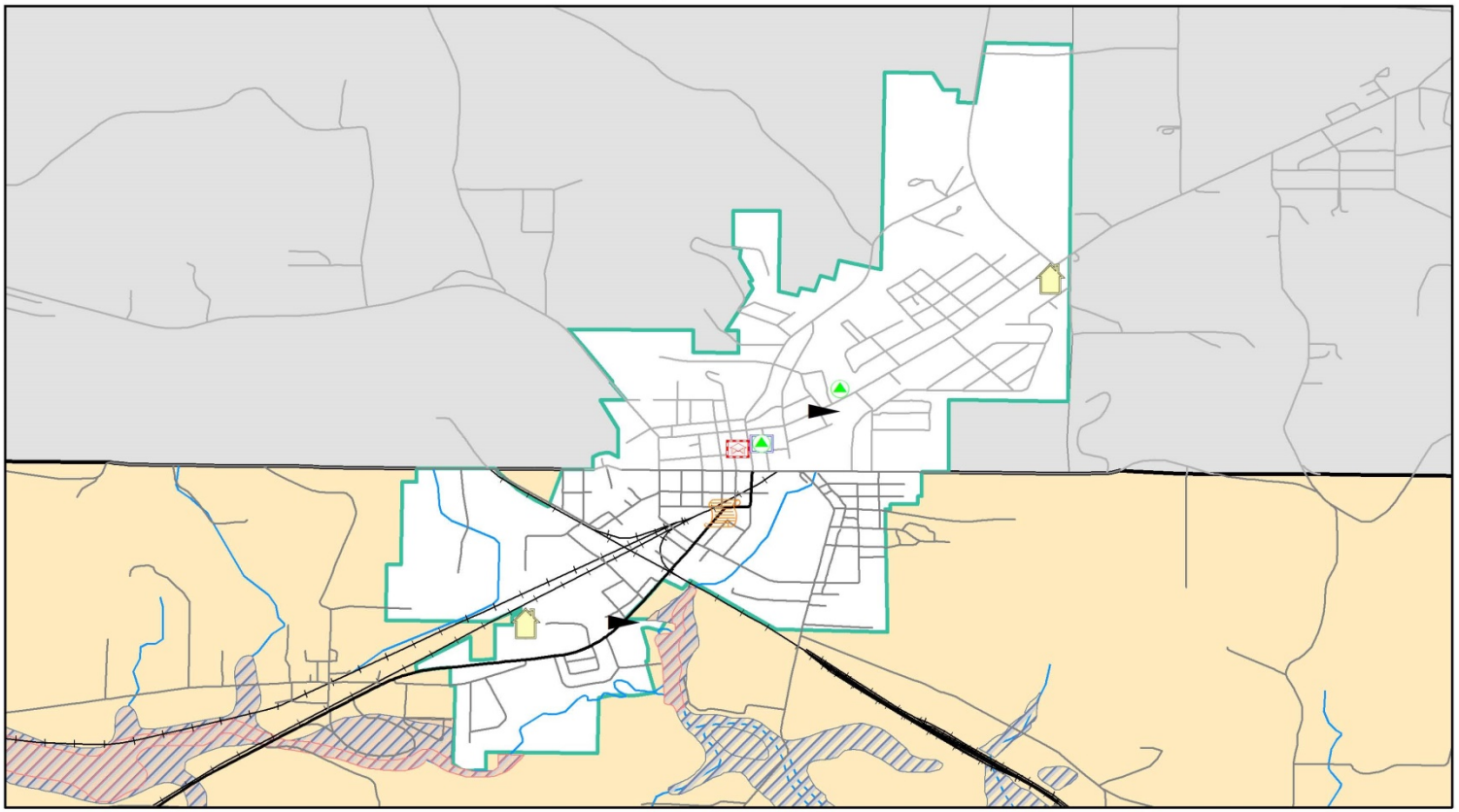
CARROLL COUNTY HAZARD MITIGATION PLAN

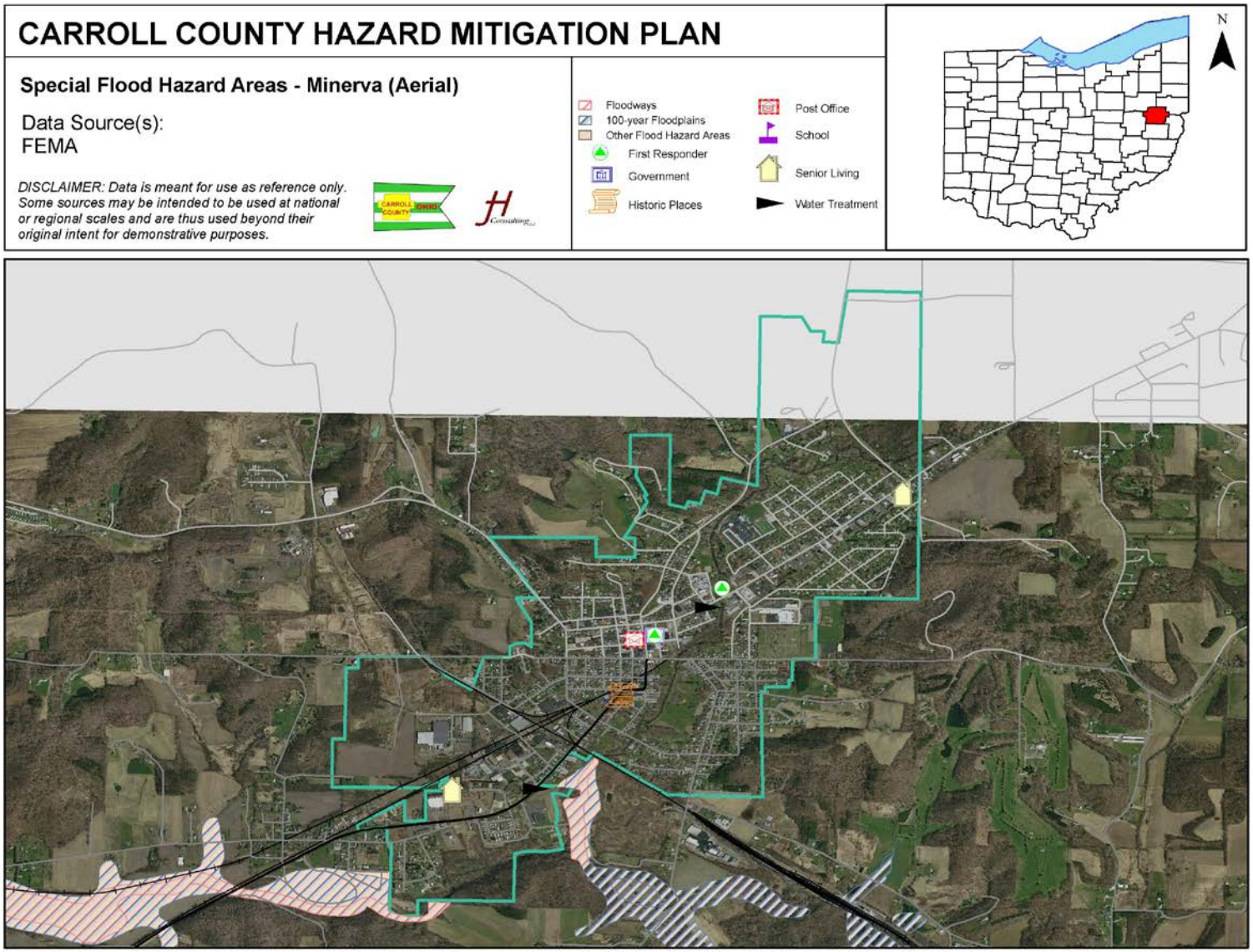
Special Flood Hazard Areas - Minerva

Data Source(s):
FEMA

DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.

- Floodways
- 100-year Floodplains
- Other Flood Hazard Areas
- First Responder
- Government
- Historic Places
- Post Office
- School
- Senior Living
- Water Treatment




CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas - Minerva (Aerial)
Data Source(s):
FEMA
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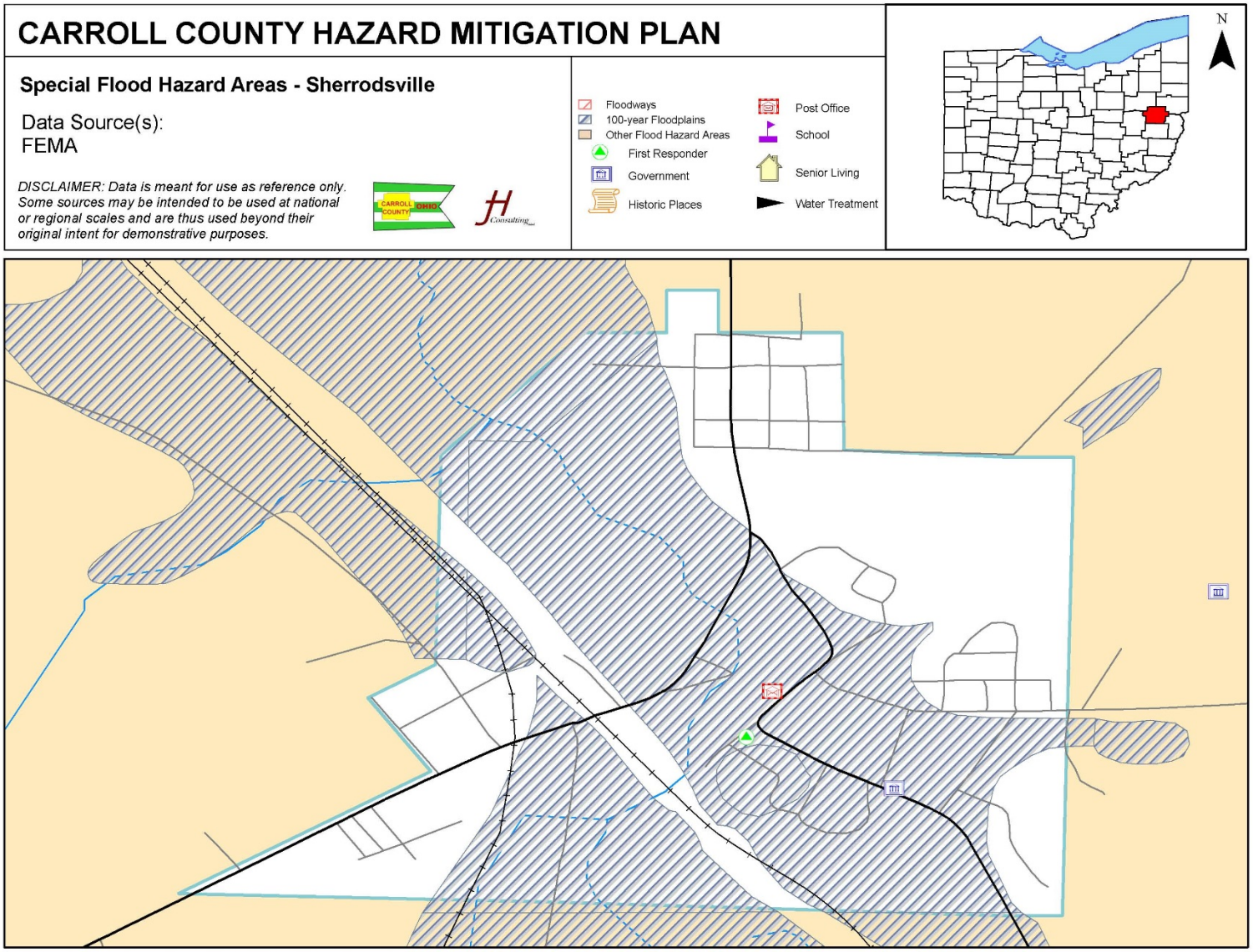
Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment
N


CARROLL COUNTY HAZARD MITIGATION PLAN
Special Flood Hazard Areas - Sherrodsville
Data Source(s):
FEMA
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
Floodways
100-year Floodplains
Other Flood Hazard Areas
First Responder
Government
Historic Places
Post Office
School
Senior Living
Water Treatment
N

CARROLL COUNTY HAZARD MITIGATION PLAN

Special Flood Hazard Areas - Sherrodsville (Aerial)

Data Source(s):
FEMA

DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.

- Floodways
- 100-year Floodplains
- Other Flood Hazard Areas
- First Responder
- Government
- Historic Places
- Post Office
- School
- Senior Living
- Water Treatment

Impacts and Vulnerability

Hazards associated with flooding are categorized as primary, or those that result from contact with water, secondary effects, which include disruption of services, and long-term or tertiary effects, such as a change in position of river channels. The following table describes the types of effects of flooding.

EFFECTS OF FLOODING	
Type	*Description*
Primary Effects	• With higher velocities, streams are able to transport larger particles as suspended load. Such large particles include not only rocks and sediment, but, during a flood, such large objects as automobiles, houses, and bridges. • Massive amounts of erosion can be accomplished by floodwaters. Such erosion can undermine bridge structures, levees, and buildings, causing their collapse. • Water entering human-built structures causes damage. Even with minor flooding of homes, furniture is ruined, floors and walls are damaged, and anything that comes in contact with the water is likely to be damaged or lost. Flooding of automobiles usually results in damage that cannot easily be repaired. • The higher velocity of floodwaters allows the water to carry more sediment as suspended load. When the floodwaters retreat, velocity is generally much lower and sediment is deposited. After retreat of the floodwaters, everything is usually covered with a thick layer of stream-deposited mud, including the interior of buildings. • Flooding of farmland usually results in crop loss. Livestock, pets, and other animals are often carried away and drowned. • Humans that get caught in high velocity floodwaters are often drowned. • Floodwaters can concentrate garbage, debris, and toxic pollutants into small areas that can cause the secondary effects of health hazards.
Cascading or Secondary Effects	• Disruption of Services o Drinking water supplies may become polluted, especially if sewerage treatment plants are flooded. o Gas and electrical service may be disrupted. o Transportation systems may be disrupted, resulting in shortages of food and cleanup supplies.
Long-Term or Tertiary Effects	• Location of river channels may change as the result of flooding; new channels develop, leaving the old channels dry. • Sediment deposited by flooding may destroy farmland (although silt deposited by floodwaters could also help to increase agricultural productivity). • Jobs may be lost due to the disruption of services, destruction of business, etc. (although jobs may be gained in the construction industry to help rebuild or repair flood damage). • Destruction of wildlife habitat.

In addition to property and structure damage caused by flooding, floodwaters can pose a risk to human health and safety (CDC, 2018). Floodwaters can contain:

- downed power lines
- human and livestock waste
- household, medical, and industrial hazardous waste, physical objects such as lumber, vehicles, or debris

- wild or stray animals
- other contaminants that can lead to illness

Flash floods can roll boulders, tear out trees, destroy buildings and bridges, and scour out new channels. Rapidly rising water can reach 30 feet or more in some places. Occasionally, flash floods can trigger mudslides, or floating debris can accumulate at a natural or mon-made obstruction and restrict the flow of water. Water held back by this debris can cause upstream flooding, and subsequent downstream flooding if the obstruction suddenly releases.

Historical Occurrences

The National Oceanic and Atmospheric Association's National Centers for Environmental Information (NCEI) Storm Events Database shows 19 flood events since 2004, and 33 flash flood events since 1996, for a combined 52 events. The following table lists those events, along with associated damages and casualties.

FLOOD, FLASH FLOOD EVENTS						
Location	*Date*	*Event Type*	*Deaths*	*Injuries*	*Property Damage*	*Crop Damage*
Carrollton	1/19/1996	Flash Flood	0	0	$ 10,000.00	$ -
Malvern	5/11/1996	Flash Flood	0	0	$ -	$ -
Lindentree	6/14/1996	Flash Flood	0	0	$ -	$ -
Mechanicstown	6/18/1997	Flash Flood	0	0	$ 1,000.00	$ -
Wattsville	6/18/1997	Flash Flood	0	0	$ -	$ -
Countywide	1/7/1998	Flash Flood	0	0	$ -	$ -
Countywide	6/29/1998	Flash Flood	0	0	$ 50,000.00	$ -
Mechanicstown	12/22/1998	Flash Flood	0	0	$ 20,000.00	$ -
Perryville	4/3/2000	Flash Flood	0	0	$ -	$ -
Countywide	5/28/2000	Flash Flood	0	0	$ -	$ -
Augusta	6/12/2000	Flash Flood	0	0	$ 2,000.00	$ -
Countywide	7/14/2000	Flash Flood	0	0	$ 5,000.00	$ -
Perryville	7/28/2000	Flash Flood	0	0	$ -	$ -
Perryville	8/6/2000	Flash Flood	0	0	$ -	$ -
Carrollton	4/19/2002	Flash Flood	0	0	$ -	$ -
Lindentree	5/15/2003	Flash Flood	0	0	$ -	$ -
Perryville	7/8/2003	Flash Flood	0	0	$ -	$ -
Dellroy	8/5/2003	Flash Flood	0	0	$ -	$ -
Mechanicstown	8/30/2003	Flash Flood	0	0	$ 20,000.00	$ -

FLOOD, FLASH FLOOD EVENTS						
Location	*Date*	*Event Type*	*Deaths*	*Injuries*	*Property Damage*	*Crop Damage*
Wattsville	9/1/2003	Flash Flood	0	0	$ -	$ -
Dellroy	5/18/2004	Flash Flood	0	0	$ -	$ -
Carrollton	6/14/2004	Flash Flood	0	0	$ -	$ -
Malvern	6/15/2004	Flash Flood	0	0	$ -	$ -
Dellroy	6/17/2004	Flash Flood	0	0	$ -	$ -
Malvern	6/22/2006	Flash Flood	0	0	$ -	$ -
Carrollton	8/9/2007	Flash Flood	0	0	$ 25,000.00	$ -
Augusta	3/22/2010	Flash Flood	0	0	$ 25,000.00	$ -
Augusta	3/22/2010	Flash Flood	0	0	$ 25,000.00	$ -
Pekin	3/22/2010	Flash Flood	0	0	$ 75,000.00	$ -
Palermo	4/9/2015	Flash Flood	0	0	$ 150,000.00	$ -
Sherrodsville	6/16/2015	Flash Flood	0	0	$ 10,000.00	$ -
Sherrodsville	6/8/2018	Flash Flood	0	0	$ -	$ -
		Flash Flood Total:	*0*	*0*	*$418,000*	*$0*
Carroll County	1/4/2004	Flood	0	0	$ -	$ -
Carroll County	2/6/2004	Flood	0	0	$ -	$ -
Carroll County	5/21/2004	Flood	0	0	$ -	$ -
Carroll County	9/8/2004	Flood	0	0	$1,000,000.00	$ -
Carroll County	1/5/2005	Flood	0	0	$ -	$ -
Carroll County	1/13/2005	Flood	0	0	$ 15,000.00	$ -
Carroll County	1/19/2005	Flood	0	0	$ -	$ -
Dellroy	3/4/2008	Flood	0	0	$ 10,000.00	$ -
Leesville Res.	3/19/2008	Flood	0	0	$ 10,000.00	$ -
Malvern	3/19/2008	Flood	0	0	$ 5,000.00	$ -
Minerva	3/19/2008	Flood	0	0	$ 10,000.00	$ -
Carrollton	6/2/2010	Flood	0	0	$ 50,000.00	$ -
Sherrodsville	6/5/2010	Flood	0	0	$ 75,000.00	$ -
Malvern	2/28/2011	Flood	0	0	$ 75,000.00	$ -
Carrollton	3/1/2011	Flood	0	0	$ 25,000.00	$ -
Sherrodsville	3/10/2011	Flood	0	0	$ 8,000.00	$ -
Mechanicstown	6/19/2011	Flood	0	0	$ 75,000.00	$ -
Morges	8/20/2014	Flood	0	0	$ 5,000.00	$ -
New Harrisburg	7/6/2015	Flood	0	0	$ -	$ -
		Flood Total:	*0*	*0*	*$1,363,000.00*	*$0*
		Totals	*0*	*0*	*$1,781,000.00*	*$0*

Loss and Damages

Over the past 23 years, floods and flash floods have caused a combined $1.78 million in property damage in Carroll County, or $64.28 per capita based on 2018 population estimates. Flash floods caused an average of $12,666 per event, and flood events caused an average of $71,736 per event.

FEMA estimates losses from flooding through the HAZUS-MH program. The program calculates the expected losses to buildings during a 100-year flood event. The following tables outline damages during the event to buildings by occupancy, buildings by construction type, and building economic losses.

EXPECTED BUILDING DAMAGE BY OCCUPANCY												
Occupancy	*1-10*		*11-20*		*21-30*		*31-40*		*41-50*		*>50*	
	Ct.	*%*	*Ct.*	*%*	*Ct.*	*%*	*Ct.*	*%*	*Ct.*	*%*	*Ct.*	*%*
Agriculture	0	0	0	0	0	0	0	0	0	0	0	0
Commercial	0	0	0	0	0	0	0	0	0	0	0	0
Education	0	0	0	0	0	0	0	0	0	0	0	0
Government	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	0	0	0	0	0	0
Religion	0	0	0	0	0	0	0	0	0	0	0	0
Residential	42	22	96	49	36	18	11	6	5	3	5	3
TOTAL	42		96		36		11		5		5	

EXPECTED BUILDING DAMAGE BY BUILDING TYPE												
Building Type	*1-10*		*11-20*		*21-30*		*31-40*		*41-50*		*Substantially*	
	Ct.	*%*	*Ct.*	*%*	*Ct.*	*%*	*Ct.*	*%*	*Ct.*	*%*	*Ct.*	*%*
Concrete	0	0	0	0	0	0	0	0	0	0	0	0
Manufactured Housing	0	0	0	0	0	0	0	0	0	0	2	100
Masonry	8	32	13	52	2	13	1	4	0	0	0	0
Steel	0	0	0	0	0	0	0	0	0	0	0	0
Wood	34	20	83	49	33	20	10	6	5	3	3	2

BUILDING-RELATED ECONOMIC LOSS ESTIMATES (MILLIONS OF DOLLARS)						
Category	*Area*	*Residential*	*Commercial*	*Industrial*	*Others*	*Total*
Building Loss	Building	20.05	2.28	1.52	1.27	25.11
	Content	8.98	7.97	4.10	6.91	27.95
	Inventory	0.00	0.20	0.81	0.03	1.04
	Subtotal	29.03	10.44	6.43	8.21	54.11
Business Interruption	Income	0.26	6.34	0.14	1.76	8.50
	Relocation	7.66	1.49	0.13	1.42	10.70
	Rental Income	2.47	1.05	0.03	0.17	3.72
	Wage	0.63	6.41	0.19	52.49	59.71
	Subtotal	11.02	15.28	0.49	55.84	82.63
TOTAL		40.04	25.72	6.93	64.04	136.74

Risk Assessment

The following table assigns point totals based on the research presented in this profile for each category that appears in Ohio EMA's SHARPP tool.

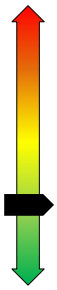
FLOODING VULNERABILITY SUMMARY			
Category	*Points*	*Description*	*Notes*
Frequency	5	Excessive	There have been 52 flood and flash flood events in the past 23 years, for an average of 2.26 events per year.
Response	4	1 month	Recovery from a large-scale flood would require a significant amount of time and resources.
Onset	2	12-24 hours	The National Weather Service typically issues flood watches and warnings 12-24 hours in advance.
Magnitude	3	Critical (25-50% of land area)	Although flooding is typically a localized event, damages within the affected area are significant.
Business	1	Less than 24 hours	A flooding incident in Carroll County is unlikely to interrupt the county's economy for prolonged periods.
Human	2	Low	Human health is generally unaffected by flooding, in that these events do not typically cause illness or injuries. However, there is potential for harm during flood events.
Property	2	10-25% of property	Historical data indicates that flash floods caused an average of $12,666 per event, and flood events caused an average of $71,736 per event.
Total	19	Medium	

The following table depicts assets in Carroll County that are located in 100-year floodplains.

ASSETS VULNERABLE TO FLOOD, CARROLL COUNTY
Monroe Township Office
Sherrodsville Village Office
Carroll County Environmental Services (Forner BTM Sewer)
Regional EMS
Sherrodsville Post Office
Patrick Hull House

2.0 RISK ASSESSMENT

2.2.6 Invasive Species

Species that are "both non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health are considered invasive.				
Vulnerability  HIGHEST HIGH MEDIUM LOW LOWEST	Period of Occurrence:	Invasive Species can occur at any time	Hazard Index Ranking:	13-Low
	Warning Time:	None	State Risk Ranking:	8
	Probability:	Likely	Severity:	Critical
	Type of Hazard:	Natural	Disaster Declarations:	N/A

Hazard Overview

The National Invasive Species Council defines invasive species as those that are "both non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." The National Wildlife Foundation considers species that grow and reproduce quickly and spread aggressively, with the potential to cause harm, to be "invasive." In the United States, an estimated 5,000 species of plants, animals, and microbes are considered invasive.

Not all non-native species become invasive; in fact, many non-native species occur in environments where they were introduced without causing harm (Ohio Invasive Plants Council, n.d.). Others fare poorly in the places of introduction and do not spread or survive. A relatively small number of non-native plants (e.g., corn, wheat, rice, oats) form the basis of our agricultural industry, but they do not escape to natural areas or behave aggressively.

Location and Extent

All areas of Carroll County are vulnerable to invasive species. Ohio DNR uses the following classifications for invasive species:

- **Invasive Terrestrial Plants:** The majority of plant species in Ohio's natural areas are non-native. Of the more than 700 non-native plant species in Ohio, fewer than 100 are known to be problems in natural areas.

- **Invasive Terrestrial Wildlife:** Invasive terrestrial species can damage habitats that other wildlife depends on. Feral swine are the only current invasive terrestrial wildlife species in Ohio.
- **Invasive Insects and Diseases:** Insects, fungus, and other organisms can cause a great deal of damage to plant, forest, and wildlife health.
- **Aquatic Invasive Species:** Aquatic invasive species include plants and animals living in and degrading the quality of waterways. No waterway, from Lake Erie to the Ohio River, is immune to the negative impacts of invasive aquatic species.

Impacts and Vulnerability

Invasive species cause harm to wildlife in a variety of ways. Generally, when a new and aggressive species is introduced into an ecosystem, it may not have natural predators or controls, causing it to breed and spread quickly. Native wildlife may not have defenses against the invader, or may not be able to compete with a species that has no predators. Invasive species can impact native plants, animals, and natural ecosystems by:

- Reducing native biological diversity
- Interfering with natural succession
- Displacing rare plant species
- Replacing complex communities with monocultures
- Altering hydrologic conditions
- Altering soil characteristics
- Altering fire intensity and frequency
- Displacing wildlife that rely on native plants for food, shelter, and breeding sites

The emerald ash borer (EAB), a type of beetle, and oak wilt, a fungal disease, are of particular concern for Carroll County. The Ohio Department of Agriculture identified EABs in every county in Ohio. EABs breed and mature inside the bark of all species of ash trees, and as the density of EAB larvae inside a tree increases, the stress on the tree increases as well. EABs are a source of food for woodpeckers, which can cause further damage to the tree. After a length of time subjected to a cycle of being eaten from both the inside and outside, the tree eventually dies. The most common species of ash tree grows along rivers and streams and helps prevent soil erosion in case of flooding. Increased flooding is a cascading effect of an EAB infestation.

Historical Occurrences

ODNR has identified the ten top invasive plant species for the state, which are listed below.

- Bush Honeysuckles
- Autumn – Olive
- Buckthorns
- Common Reed Grass
- Garlic Mustard
- Japanese Honeysuckle
- Japanese Knotweed
- Multiflora Rose
- Purple Loosestrife
- Reed Canary Grass

Of the top ten invasive plant species in Ohio, seven (purple loosestrife, multiflora rose, garlic mustard, buckthorn, autumn olive, reed canary grass, and bush honeysuckle) have made their way into Carroll County. In addition to the top ten invasive species, the Early Detection and Distribution Mapping System (EDDMapS) lists all reported invasive species by county. Carroll County is now home to more than 400 invasive organisms. The following table lists the known invasive species in Carroll County.

INVASIVE SPECIES IN CARROLL COUNTY			
Common Name	*Scientific Name*	*Common Name*	*Scientific Name*
Oak Wilt	*Ceratocystis fagacearum*	Large Crabgrass	*Digitaria sanguinalis*
Greater Celandine	*Chelidonium majus*	Virginia Pepperweed	*Lepidium virginicum*
Hairy Bittercress	*Cardamine hirsuta*	Cheatgrass	*Bromus tectorum*
Red Fox	*Vulpes vulpes fulvus*	Shepherd's-Purse	*Capsella bursa-pastoris*
Broadleaf Dock	*Rumex obtusifolius*	Smooth Brome	*Bromus inermis*
Rose Rosette Disease (RRD)	*Emaravirus RRD*	Common Viper's Bugloss	*Echium vulgare*
White Campion	*Silene latifolia*	Tall Oatgrass	*Arrhenatherum elatius*
Deptford Pink	*Dianthus armeria*	Sweet Vernalgrass	*Anthoxanthum odoratum*
Red Clover	*Trifolium pratense*	Japanese Barberry	*Berberis thunbergii*
Dames Rocket	*Hesperis matronalis*	Western Salsify	*Tragopogon dubius*
Purple Crown-Vetch	*Securigera varia*	Eastern White Pine	*Pinus strobus*
Bull Thistle	*Cirsium vulgare*	Common Pokeweed	*Phytolacca americana*
Red Sorrel	*Rumex acetosella*	Perennial Sowthistle	*Sonchus arvensis*
Common Yarrow	*Achillea millefolium*	Waterpurslane	*Ludwigia palustris*
Large Aspen Tortrix	*Choristoneura conflictana*	Prickly Lettuce	*Lactuca serriola*
White Pine Blister Rust	*Cronartium ribicola*	White Mulberry	*Morus alba*
Gypsy Moth	*Lymantria dispar*	Kingdevil Hawkweed	*Hieracium piloselloides*
Large Aspen Tortrix	*Choristoneura conflictana*	Bristly Oxtongue	*Helminthotheca echioides*

INVASIVE SPECIES IN CARROLL COUNTY			
Common Name	*Scientific Name*	*Common Name*	*Scientific Name*
White Pine Blister Rust	*Cronartium ribicola*	American Burnweed	*Erechtites hieraciifolius*
Large Aspen Tortrix	*Choristoneura conflictana*	Star-Of-Bethlehem	*Ornithogalum umbellatum*
Large Aspen Tortrix	*Choristoneura conflictana*	Wild Garlic	*Allium vineale*
White Pine Blister Rust	*Cronartium ribicola*	Chicory	*Cichorium intybus*
Emerald Ash Borer	*Agrilus planipennis*	Bittersweet Nightshade	*Solanum dulcamara*
Japanese Stiltgrass	*Microstegium vimineum*	Tree-Of-Heaven	*Ailanthus altissima*
Butternut Canker	*Sirococcus clavigignenti-juglandacearum*	Thymeleaf Speedwell	*Veronica serpyllifolia*
Periwinkle	*Vinca spp.*	Corn Speedwell	*Veronica arvensis*
Common Speedwell	*Veronica officinalis*	Water Speedwell	*Veronica anagallis-aquatica*
Germander Speedwell	*Veronica chamaedrys*	Common Periwinkle	*Vinca minor*
Common Dandelion	*Taraxacum officinale ssp. officinale*	Moth Mullein	*Verbascum blattaria*
Common Chickweed	*Stellaria media*	Wild Parsnip	*Pastinaca sativa*
Little Starwort	*Stellaria graminea*	Bird Vetch	*Vicia cracca*
White Campion	*Silene latifolia*	Smooth Bedstraw	*Galium mollugo*
Broadleaf Dock	*Rumex obtusifolius*	Yellow Rocket	*Barbarea vulgaris*
Curly Dock	*Rumex crispus ssp. crispus*	Yellow Nutsedge	*Cyperus esculentus*
Peach	*Prunus persica*	Eurasian Water-Milfoil	*Myriophyllum spicatum*
Marsh-Pepper Smartweed	*Persicaria hydropiper*	Field Horsetail	*Equisetum arvense*
Prostrate Knotweed	*Polygonum aviculare*	Bigroot Morning-Glory	*Ipomoea pandurata*
Alfalfa	*Medicago sativa ssp. sativa*	Bulbous Buttercup	*Ranunculus bulbosus*
Alfalfa	*Medicago sativa*	Hedge Bindweed	*Calystegia sepium*
*Bush Honeysuckles (Exotic)	*Lonicera spp.*	Annual Sowthistle	*Sonchus oleraceus*
Privet	*Ligustrum spp.*	Burcucumber	*Sicyos angulatus*
Field Pepperweed	*Lepidium campestre*	Elecampane	*Inula helenium*
Kummerowia	*Kummerowia spp.*	Greater Celandine	*Chelidonium majus*
Low Cudweed	*Gnaphalium uliginosum*	Spotted Spurge	*Euphorbia maculata*
*Autumn Olive	*Elaeagnus umbellata var. parvifolia*	Venice Mallow	*Hibiscus trionum*
Elaeagnus	*Elaeagnus spp.*	Horsenettle	*Solanum carolinense*
Teasel	*Dipsacus spp.*	Fall Panicum	*Panicum dichotomiflorum*
Dwarf Snapdragon	*Chaenorhinum minus*	Hedge Mustard	*Sisymbrium officinale*
Bittersweets	*Celastrus spp.*	Wild Onion	*Allium canadense*
Largeseed Falseflax	*Camelina sativa*	Queen Anne's Lace, Wild Carrot	*Daucus carota*
Halberdleaf Orach	*Atriplex patula*	Buckhorn Plantain	*Plantago lanceolata*
Broadleaf Dock	*Rumex obtusifolius*	Ladysthumb	*Persicaria maculosa*
White Willow	*Salix alba*	Willowleaf Lettuce	*Lactuca saligna*
Water Mint	*Mentha aquatica*	*Glossy Buckthorn	*Frangula alnus*
Spearmint	*Mentha spicata*	Orange Hawkweed	*Hieracium aurantiacum*

INVASIVE SPECIES IN CARROLL COUNTY			
Common Name	*Scientific Name*	*Common Name*	*Scientific Name*
Chinese Mysterysnail	*Cipangopaludina chinensis*	Sweetbriar	*Rosa rubiginosa*
*Purple Loosestrife	*Lythrum salicaria*	Lambsquarters	*Chenopodium album*
Paradise Apple	*Malus pumila*	Sulfur Cinquefoil	*Potentilla recta*
Woodland Strawberry	*Fragaria vesca ssp. vesca*	Japanese Clover	*Kummerowia striata*
Woodland Strawberry	*Fragaria vesca*	Meadow Hawkweed	*Hieracium caespitosum*
Creeping Buttercup	*Ranunculus repens*	Pale Smartweed	*Polygonum lapathifolium*
Oriental Lady's Thumb	*Persicaria longiseta*	Water Knotweed	*Polygonum amphibium*
*Autumn Olive	*Elaeagnus umbellata*	Northern Catalpa	*Catalpa speciosa*
Wild Buckwheat	*Fallopia convolvulus*	Thymeleaf Sandwort	*Arenaria serpyllifolia*
Redcedar	*Juniperus virginiana*	Creeping Yellow Loosestrife, Creeping Jenny	*Lysimachia nummularia*
Green Bristlegrass	*Setaria viridis var. viridis*	Spotted Waterhemlock	*Cicuta maculata*
Green Foxtail	*Setaria viridis*	Yellow Toadflax	*Linaria vulgaris*
Yellow Foxtail	*Setaria pumila*	Sweet Cherry	*Prunus avium*
Common St. Johnswort	*Hypericum perforatum*	Henbit	*Lamium amplexicaule*
Giant Foxtail	*Setaria faberi*	Common Purslane	*Portulaca oleracea*
Roughstalk Bluegrass	*Poa trivialis*	West Indian Nightshade	*Solanum ptychanthum*
Kentucky Bluegrass	*Poa pratensis*	English Ivy	*Hedera helix*
Canada Bluegrass	*Poa compressa*	Moist Sowthistle	*Sonchus arvensis ssp. uliginosus*
Annual Bluegrass	*Poa annua*	Common Duckweed	*Lemna minor*
Bladder Campion	*Silene vulgaris*	Brown Knapweed	*Centaurea jacea*
Timothy	*Phleum pratense*	Pineapple-Weed	*Matricaria discoidea*
White Campion	*Silene latifolia*	Common Selfheal	*Prunella vulgaris*
*Reed Canarygrass	*Phalaris arundinacea*	Canadian Horseweed	*Erigeron canadensis*
Big Chickweed	*Cerastium fontanum ssp. vulgare*	Purple Cudweed	*Gamochaeta purpurea*
Common Mouse-Ear Chickweed	*Cerastium fontanum*	Mexicantea	*Dysphania ambrosioides*
Perennial Ryegrass	*Lolium perenne*	Broadleaf Plantain	*Plantago major*
Common Velvetgrass	*Holcus lanatus*	Purple Deadnettle	*Lamium purpureum*
Meadow Fescue	*Festuca pratensis*	Oxeye Daisy	*Leucanthemum vulgare*
Quackgrass	*Elymus repens*	Dog Rose	*Rosa canina*
Goosegrass	*Eleusine indica*	Jimsonweed	*Datura stramonium*
Wild Mustard	*Sinapis arvensis*	Yellow Sweet-Clover	*Melilotus officinalis*
Barnyardgrass	*Echinochloa crus-galli*	Wirestem Muhly	*Muhlenbergia frondosa*
Watercress	*Nasturtium officinale*	Hemp Dogbane	*Apocynum cannabinum*
Orchardgrass	*Dactylis glomerata*	Common Viper's Bugloss	*Echium vulgare*
Birdsrape Mustard	*Brassica rapa*	Toothed Spurge	*Euphorbia dentata*
Bald Brome	*Bromus racemosus*	Longleaf Groundcherry	*Physalis longifolia*

INVASIVE SPECIES IN CARROLL COUNTY			
Common Name	*Scientific Name*	*Common Name*	*Scientific Name*
Black Mustard	*Brassica nigra*	Hairy Galinsoga	*Galinsoga quadriradiata*
*Garlic Mustard	*Alliaria petiolata*	Corn Cockle	*Agrostemma githago*
True Forget-Me-Not	*Myosotis scorpioides*	Eastern Poison-Ivy	*Toxicodendron radicans*
Broomsedge Bluestem	*Andropogon virginicus*	Nimblewill	*Muhlenbergia schreberi*
Common Cocklebur	*Xanthium strumarium*	Black Locust	*Robinia pseudoacacia*
Coltsfoot	*Tussilago farfara*	Tall Thistle	*Cirsium altissimum*
Redtop	*Agrostis gigantea*	Dotted Smartweed	*Persicaria punctata*
Dandelion	*Taraxacum officinale*	Common Teasel	*Dipsacus fullonum*
European Privet	*Ligustrum vulgare*	Giant Ragweed	*Ambrosia trifida*
Tall Lettuce	*Lactuca canadensis*	Alsike Clover	*Trifolium hybridum*
Brittleleaf Naiad	*Najas minor*	Hop Clover	*Trifolium aureum*
Osage-Orange	*Maclura pomifera*	Large Hop Clover	*Trifolium campestre*
Common Mallow	*Malva neglecta*	Ground Ivy	*Glechoma hederacea*
Stinging Nettle	*Urtica dioica*	*Multiflora Rose	*Rosa multiflora*
Canada Thistle	*Cirsium arvense*	Pale Dock	*Rumex altissimus*
Catnip	*Nepeta cataria*	Balsam Poplar	*Populus balsamifera*
Peppermint	*Mentha x piperita*	Common Pear	*Pyrus communis*
Lemon Balm	*Melissa officinalis*	Spiny Sowthistle	*Sonchus asper*
Common Burdock	*Arctium minus*	Black Medic	*Medicago lupulina*
Common Mullein	*Verbascum thapsus*	Stinking Chamomile	*Anthemis cotula*
White Poplar	*Populus alba*	Yellow Woodsorrel	*Oxalis stricta*
White Clover	*Trifolium repens*	Yellow Fieldcress	*Rorippa sylvestris*
European Red Raspberry	*Rubus idaeus*	Motherwort	*Leonurus cardiaca*
*Appears on Ohio's Top 10 Invasive Species list			

Loss and Damages

If left unchecked, invasive species can devastate entire ecosystems, and their economic impact can be extensive. According to the Ohio Invasive Plant Council, invasive plants cause $34 billion a year in damage to the environment, forestry, agriculture, industry, recreation, and human health. Sydnor, Bumgardner, and Todd estimate the potential cost to Ohio is estimated to be between $157,000 and $665,000 per 1,000 residents from the EAB alone (Sydnor et al., 2007). Using the average of $420,000 per 1,000 residents, EAB costs to Carroll County are estimated at $70,468,020.

Risk Assessment

The following table assigns point totals based on the research presented in this profile for each category that appears in Ohio EMA's SHARPP tool.

INFESTATION VULNERABILITY SUMMARY			
Category	*Points*	*Description*	*Notes*
Frequency	5	N/A	There are nearly 400 species of invasive organisms in Carroll County. Once introduced, invasive species are difficult to remove.
Response	1	Less than half a day	Invasive species do not generally warrant a traditional emergency response.
Onset	1	Over 24 hours	Once introduced to a new area, invasive species need time to establish an infestation.
Magnitude	2	Limited (10-25% of land area affected)	The most notable invasive species in Carroll County, the EAB, has affected ash trees. Loss of these trees has caused destabilization of streambanks.
Business	1	Less than 24 hours	Typically, the economy would not be interrupted by an infestation.
Human	1	Minimum (minor injuries)	Infestation does not pose a direct threat to human health at this time.
Property	2	10-25% of property affected	An infestation in Carroll County would not affect significant amounts of property. Losses and damages are primarily limited to land area and the environment.
Total	13	Low	

2.0 RISK ASSESSMENT

2.2.7 Landslide and Erosion

Landslides are the movement of a mass of rock down a slope. Erosion is the wearing away of earthen materials.				
Vulnerability HIGHEST HIGH MEDIUM LOW LOWEST	Period of Occurrence:	Landslides can occur at any time. Erosion is a continuous process.	Hazard Index Ranking:	15-Medium
	Warning Time:	Some slides are rapid and occur in seconds, while others take hours to weeks to develop.	State Risk Ranking:	9
	Probability:	Highly Likely	Severity:	Localized
	Type of Hazard:	Natural	Disaster Declarations:	N/A

Hazard Overview

Landslides are a serious geologic hazard common to nearly every state in the U.S. It is estimated that landslides cause between 25 and 50 deaths and damages in excess of $1billion each year. The U.S. Geological Survey defines a landslide as the movement of a mass of rock, debris, or earth down a slope. The three types of landslides that occur in Ohio are rotational slump, earthflow, and rockfall.

- **Rotational Slump-** A rotational slump is characterized by the movement of a mass of weak rock or sediment as a block unit along a curved slip plane.
- **Earthflow-** Earthflows are the most common forms of downslope movement in Ohio, though many are comparatively small in size. An earthflow involves a weathered mass of rock or sediment that flows downslope as a jumbled mass.
- **Rockfall-** A rockfall is an extremely rapid and potentially dangerous downslope movement of earth materials.

Erosion, according to National Geographic, is the process in which earthen materials are worn away and transported by natural forces such as wind or water. Erosion can include physical erosion or water erosion.

- **Physical Erosion-** Physical erosion describes the process of rocks changing their

physical properties without changing their basic chemical composition. Plant growth can contribute to physical erosion through a process called bioerosion, in which plants break up earthen materials as they take root, creating cracks and crevices in the rocks they encounter.

- **Erosion by Water-** Water is the major agent of erosion. Rain, rivers, floods, lakes, and the ocean carry away bits of soil and slowly wash away sediment.

Location and Extent

Landslides occur in every U.S. state and territory. The Appalachian Mountains, Rocky Mountains, the Pacific Coastal Ranges, and spome parts of Alaska and Hawaii have severe landslide problems. However, any area composed of weak or fracturing materials resting on a stepe slope will likely experience landslides.

Most of Ohio does not experience landslides; however, areas in southern and eastern Ohio have several conditions that lead to the occurrence of landslide events. Steep slopes, clay and shale units, and weather patterns with large amounts of rainfall make Appalachian Ohio (including Carroll County) susceptible to landslides.

The presence of one or more of the following conditions can serve as an alert to potential landslide problems.

- **Steep slopes-** all landslides move downslope under the influence of gravity. Therefore, steep slopes or cliffs are required for landslide, especially in conjunction with one or more of the conditions listed below
- **Jointed rocks-** Vertical joints (fractures) in rocks allow surface moisture to penetrate the rock and weaken it. During periods of cold weather, the moisture freezes and causes the rock masses to be pried apart at the joint.
- **Fine-grained, permeable rock or sediment-** These materials are particularly susceptible to landslides because large amounts of moisture can enter them, causing an increase in weight, reduction of the bonding strength of individual grains, and dissolution of grain-cementing materials.
- **Clay or shale units subject to lubrication-** Groundwater penetrating these materials can lead to loss of binding strength between individual mineral grains and subsequent failure. Excess groundwater in the area of contact between susceptible units and underlying materials can lubricate this contact and promote failure.
- **Large amounts of water-** periods of heavy rainfall or excess snowmelt can saturate the zone above the normal water table and cause a landslide

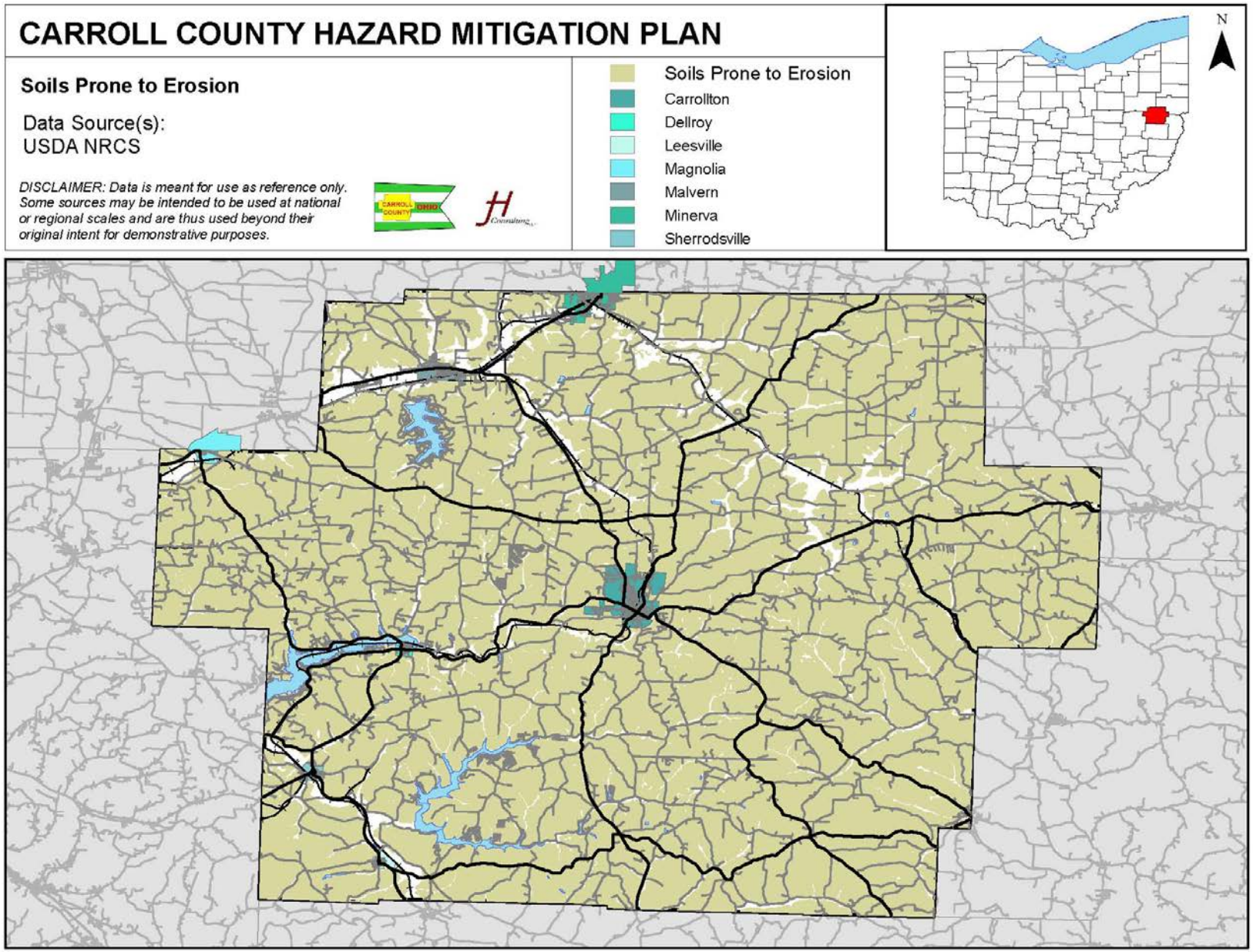
Several factors affect the rate of erosion, including climate, topography, soil type, and vegetation cover.

- **Climate-** In any given location, rainfall is the primary climate factor influencing soil erosion. Heavy, torrential rains generally result in more intense erosion than slow, gentle rains.
- **Topography-** The ability of water to erode soil depends upon its velocity and volume.
- **Soil Type-** Some soils erode more easily than others under the same conditions. Coarse-textured soils absorb water rapidly, leading to little erosion. Ohio subsoils are usually fine-textured and erode more easily.
- **Vegetation Cover-** The kind and quality of vegetation cover affect the erosion rate. Forests limit runoff, while grassy areas are less efficient at controlling runoff. Croplands present conditions that are most favorable for erosion.

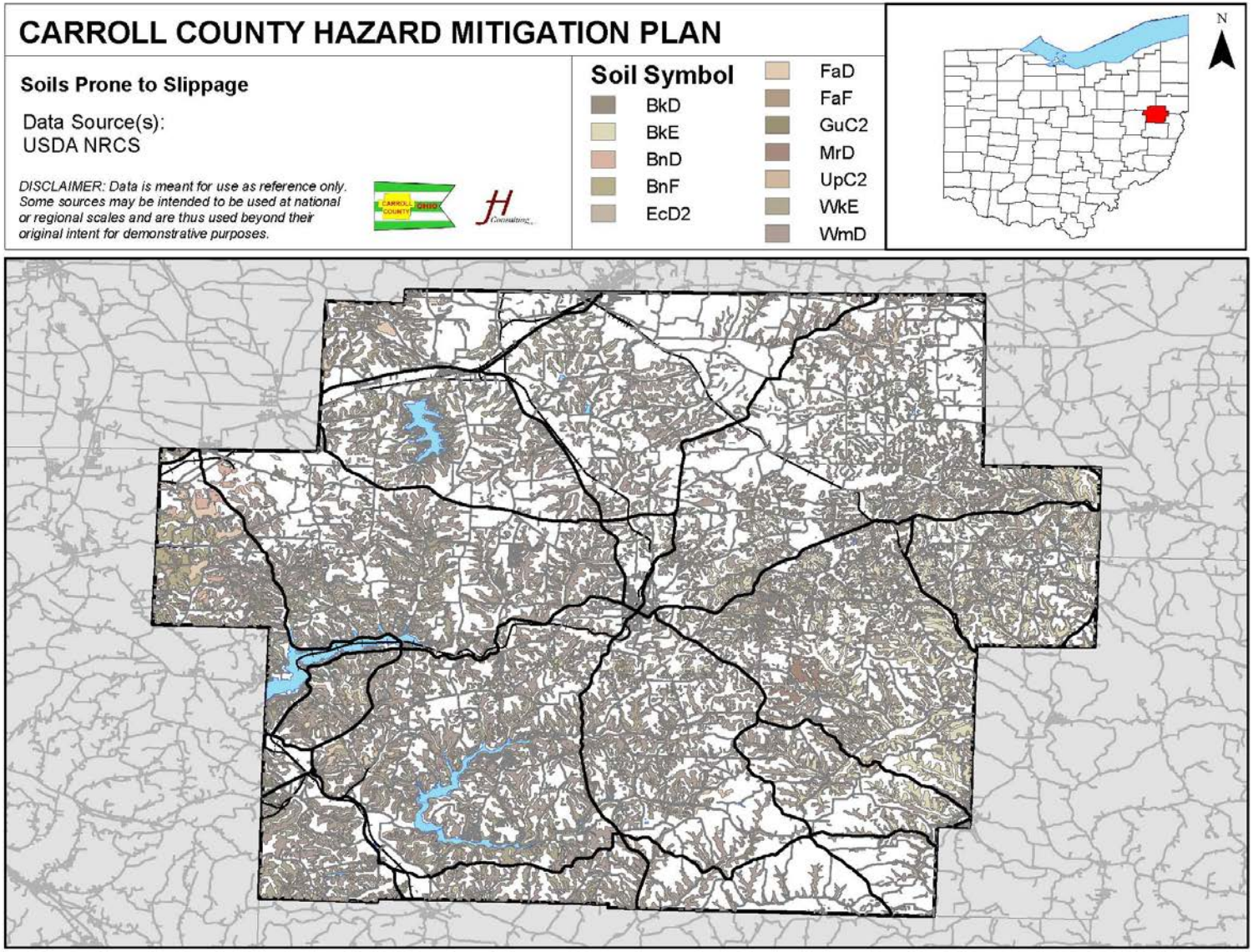
Soil type plays a significant role in erosion activity. The US Department of Agriculture's Soil Survey classifies each type of soil according to their erosion potential. The following table displays the erosion hazards of soil in Carroll County by the percentage of soil in the county. As shown in the table, most soil in Carroll County has a severe or moderate erosion potential.

EROSION HAZARD BY RATING VALUE		
Rating	*Acres in Carroll County*	*Percent of Soil in Carroll County*
Severe	168,925.9	66.2%
Moderate	60,338.8	23.6%
Slight	22,811.4	8.9%
Null or Not Rated	3,281.4	1.3%
TOTAL	255,356.9	100%

The UDA's NCRS records soil types prone to erosion. The following image depicts these areas in Carroll County. As noted in the table above, most soils in the county have the potential for erosion.


CARROLL COUNTY HAZARD MITIGATION PLAN
Soils Prone to Erosion
Data Source(s):
USDA NRCS
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
Soils Prone to Erosion
Carrollton
Dellroy
Leesville
Magnolia
Malvern
Minerva
Sherrodsville
N

Soil type also determines whether an area is prone to land slippage. Land slips occur where deep soil on sloping land becomes unstable and slips downhill, and can potentially turn into landslides. The USDA's NRCS also maintains geograohic information regarding soil types prone to slippage. The following map depicts these soils in Carroll County.


CARROLL COUNTY HAZARD MITIGATION PLAN
Soils Prone to Slippage
Data Source(s):
USDA NRCS
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
Soil Symbol
BkD
BkE
BnD
BnF
EcD2
FaD
FaF
GuC2
MrD
UpC2
WkE
WmD
N

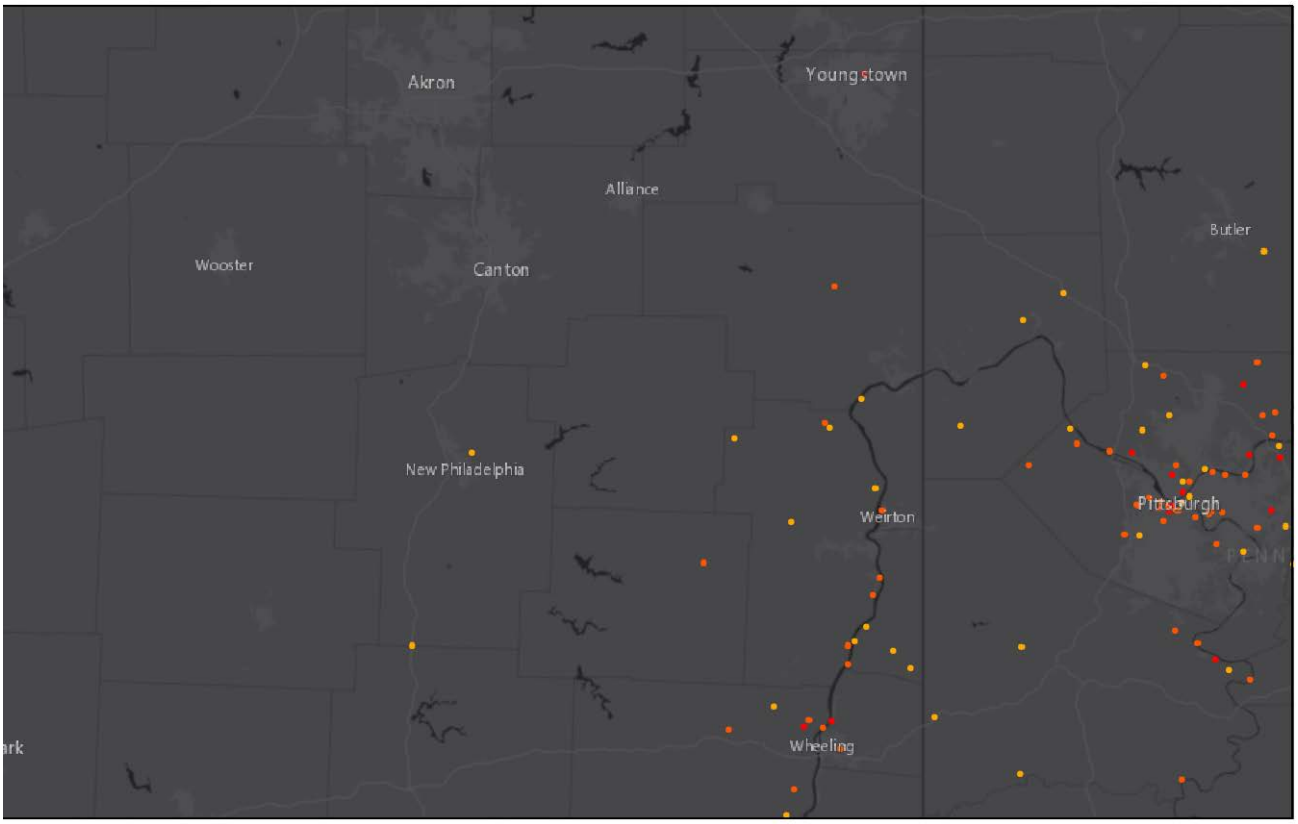
Impacts and Vulnerability

The impact of landslides can be extensive, including loss of life, destruction of infrastructure damage to land, and loss of natural resources (Food and Agriculture Organization of the United Nations, n.d.). Landslide materials can also block rivers and increase the risk of floods. Many landslides in Ohio damage or destroy homes, businesses, and highways, resulting in annual costs of millions of dollars.

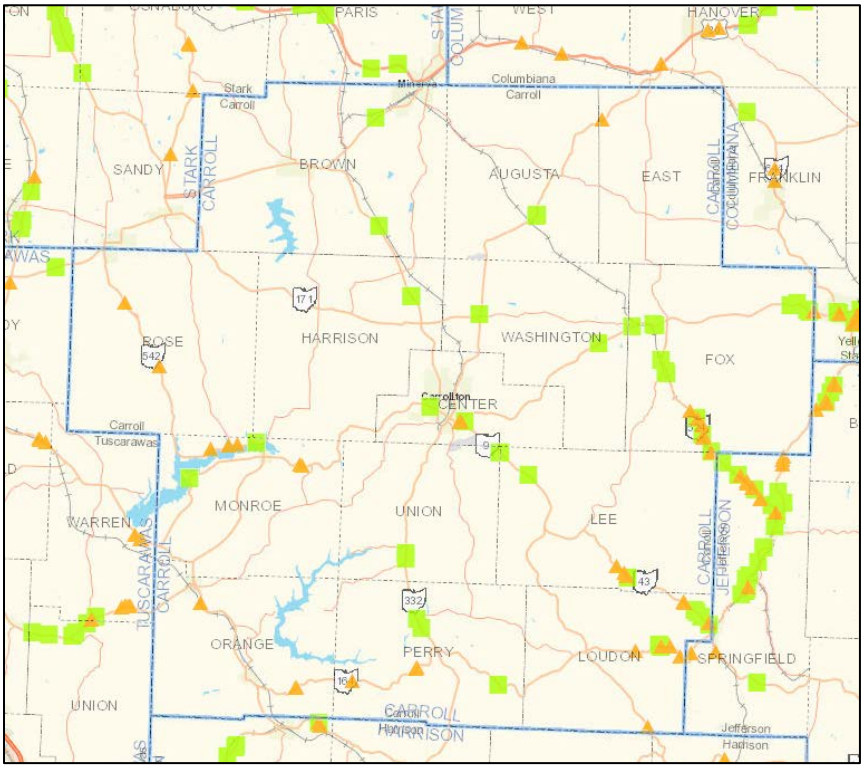
Landslides also have the potential to have a large impact on the environment. They impact all utilities (gas, electric, petroleum pipelines, storm sewers, sewage and septic systems, and water supplies), which in turn affect the environment. Ruptured gas lines can cause fires, which contributes to polluting the air quality. Water systems can become contaminated from hazardous materials and debris, and damaged wastewater systems can permit sewage to enter the environment.

Historical Occurrences

The USGS U.S. Landslide Inventory maps landslides and potential landslides in the United States. While there are no landslides reported by the USGS in Carroll County, there are potential landslides in Columbiana, Harrison, Jefferson, and Tuscarawas counties. The following figure depicts those events.


Akron
Youngstown
Alliance
Butler
Wooster
Canton
New Philadelphia
Weirton
Pittsburgh
Wheeling

The Ohio Department of Transportation maintains county records of landslide and rockfall events that impact transportation throughout the state. Currently, geologic hazards have affected all State Routes in Carroll County, as shown in the following image. Landslides are depicted by orange triangles, while green squares depict rockfalls.



Local news sources have reported some landslide and erosion incidents in Carroll County. These incidents are described in further detail below.

June 2017

The Ohio Department of Transportation's 2017 construction program designated $7 million for projects in Carroll County. Of those funds, $415,650 were used to repair slips on State Routes 164 and 332. This repair work began in June and concluded by August.

June 18, 2019

According to local news sources, heavy rains caused a mudslide in Carroll County in June of 2019. At the intersection of State Route 212 and Route 39, a wall of mud approximately 20 feet high and 12 feet wide blocked the roadway.

Loss and Damages

Economic losses from landslides come in the form of the destruction of infrastructure, homes, business, loss of life, disruption and contamination of water supplies, and the difficulty of removing and stabilizing landslide material. Even a small landslide can cause damages that can cost millions of dollars. The U.S. Geological Survey estimates annual losses to be between $2 billion and $4 billion per year.

The State of Ohio Hazard Mitigation Plan estimates that 17 critical facilities in Carroll County are vulnerable to landslides. The replacement value of those facilities is $3,661,999. The average loss from landslides in Carroll County is $88,152.

Risk Assessment

The following table assigns point totals based on the research presented in this profile for each category that appears in Ohio EMA's SHARPP tool.

LANDSLIDE AND EROSION VULNERABILITY SUMMARY			
Category	*Points*	*Description*	*Notes*
Frequency	5	N/A	Between ODOT and local news sources, there have been a significant number of landslide and erosion events in Carroll County.
Response	1	Less than half a day	Most landslides in Carroll County do not require a traditional emergency response. Affected roadways are generally re-opened within hours.
Onset	5	N/A	Landslide events can occur suddenly, without warning.
Magnitude	1	Localized (less than 10% of land area affected)	Landslide events are typically highly localized and would affect only a small portion of land area in Carroll County,
Business	1	Less than 24 hours	The local economy would likely remain active during a landslide event.
Human	1	Minimum (minor injuries)	There are no recorded illnesses or injuries due to landslides or erosion in Carroll County,
Property	1	Less than 10% of property	Landslides are localized events. Typically only a small portion of land area would be lost during a landslide.
Total	15	Medium	

The following table presents the assets in Carroll County that are located in areas prone to erosion.

ASSETS VULNERABLE TO EROSION, CARROLL COUNTY
Augusta Township
Carroll County Courthouse
Carrollton Village Office
Center Township Office
Dellroy Village Office
East Township Office
Fox Township Office
Harrison Township Office
Lee Township Office
Loudon Township Office
Monroe Township Office
Orange Township Office
Perry Township Office
Rose Township Office
Washington Township Office
Carrollton Sewer Treatment Plant
Carrollton Water Treatment Plant
Leesville Sewer Treatment Plant
EMT Ambulance- Carrollton
Amsterdam Volunteer Fire Department
Augusta Township Volunteer Fire Department
Carroll County Sheriff
Carrollton Police
Carrollton Village Fire Department
Dellroy Community Volunteer Fire Department
Fox Township Volunteer Fire Department
Leesville Fire Department
Loudon Township Fire Department
Perry Township Volunteer Fire Department
Sherrodsville Fire Department
Carroll Golden Age Retreat
Carroll Healthcare Center
Centerville Village
Bowerston Pointe
Country View Manor
Carrollton Elementary School
Carrollton High/Middle School
Carroll County Christian Academy
Conotton Valley High School
Conotton Valley Elementary School
Deer Run School
Country Corner
Saw Mill Run
Plane Ridge
Augusta Post Office
Carrollton Post Office
Dellroy Post Office
Leesville Post Office
Mechanicstown Post Office
Kilgore Union Presbyterian Church
John Herrington House

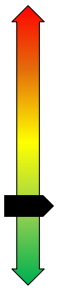
ASSETS VULNERABLE TO EROSION, CARROLL COUNTY
Herrington Bethel Church
Henry and Mary Pottorf House and Farmstead
St. Mary's of Morges

The following table presents the assets in Carroll County that are vulnerable to land slippage.

ASSETS VULNERABLE TO SLIPPAGE, CARROLL COUNTY
Monroe Township Office
Orange Township Office
Sherrodsville Volunteer Fire Department
Plane Ridge
Dellroy Post Office
Herrington Bethel Church
St. Mary's of Morges

2.0 RISK ASSESSMENT

2.2.8 Mine Failure

Mine subsidence is the lowering of the earth's surface due to the collapse of bedrock and unconsolidated materials into underground mine areas.				
Vulnerability  HIGHEST HIGH MEDIUM LOW LOWEST	Period of Occurrence:	Mine failure can occur at any time	Hazard Index Ranking:	11- Low
	Warning Time:	None	State Risk Ranking:	N/A
	Probability:	Unlikely	Severity:	Limited
	Type of Hazard:	Human-Caused	Disaster Declarations:	N/A

Hazard Overview

There has been considerable mining activity in Ohio, dating back to the 1800s. Abandoned underground mines are found in 41 Ohio counties. Overall, there are an estimated 8,000 abandoned mines in Ohio, most of which were coal mines. Unfortunately, the cessation of mining activity left several hazards, including highwalls, mine spoil, mine subsidence, mine-related landslide, dangerous impoundments, mine gas, and vertical mine openings. The following describes each of these events.

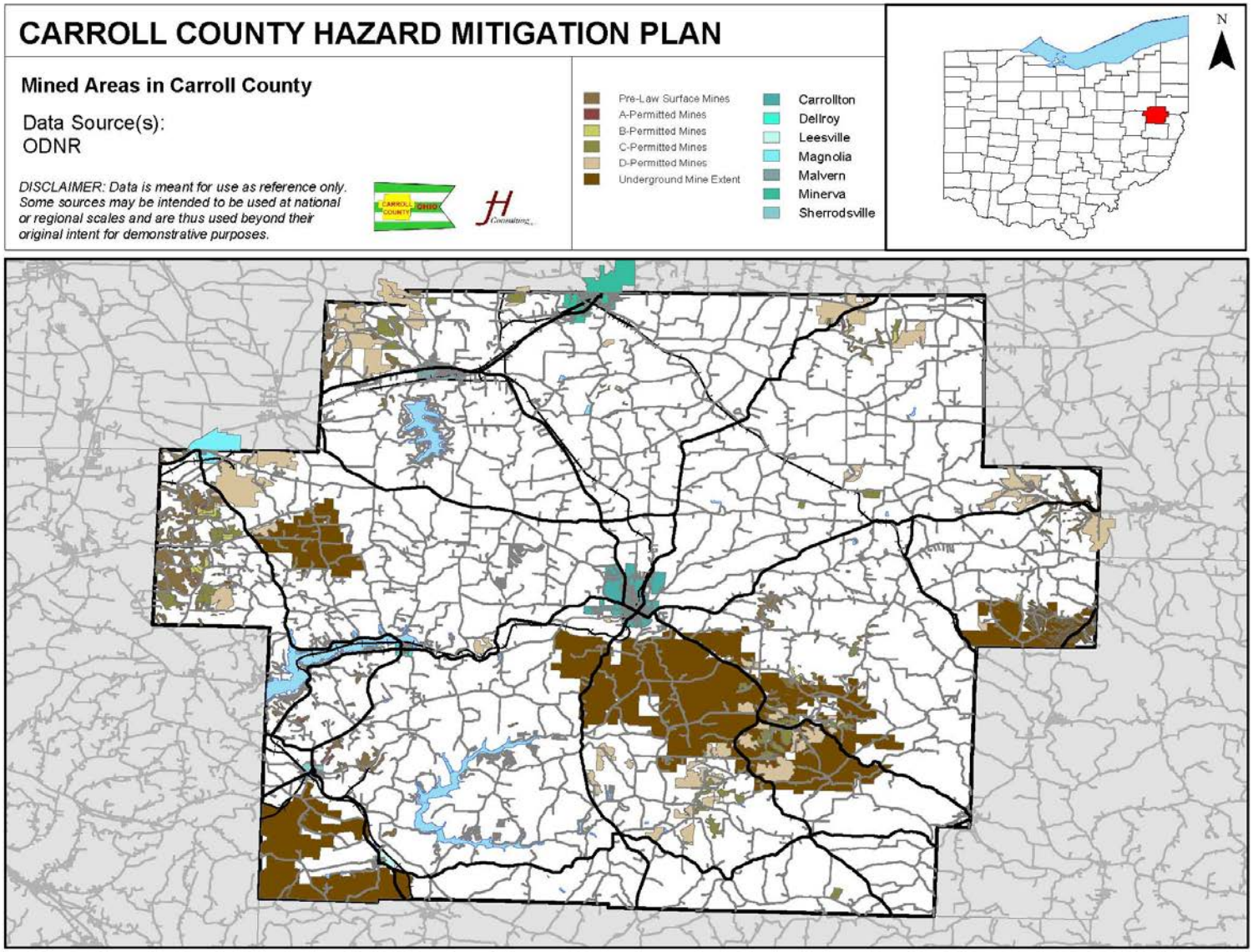
- **Highwalls** are vertical rock faces that left as the last cut of strip mining operations. Highwalls are inherently unstable due to the deterioration of the geologic formation by weathering and erosion.
- **Mine Spoil** is the earthen material located above the coal seam that must be excavated to extract or mine the coal. Mine spoil is prone to settlement and is subject to movement by freeze-thaw cycles.
- **Mine Subsidence** occurs when the pillars of coal and the roof supports left in the mine can no longer support the bedrock above the mine.
- **Mine-related Landslides** can occur when mine spoil causes significant instability in steeply sloped areas.
- **Impoundments** occur when the pit between a highwall and a soil pile fills with water.

These impoundments can retain large quantities of water, sediment, and slurry.

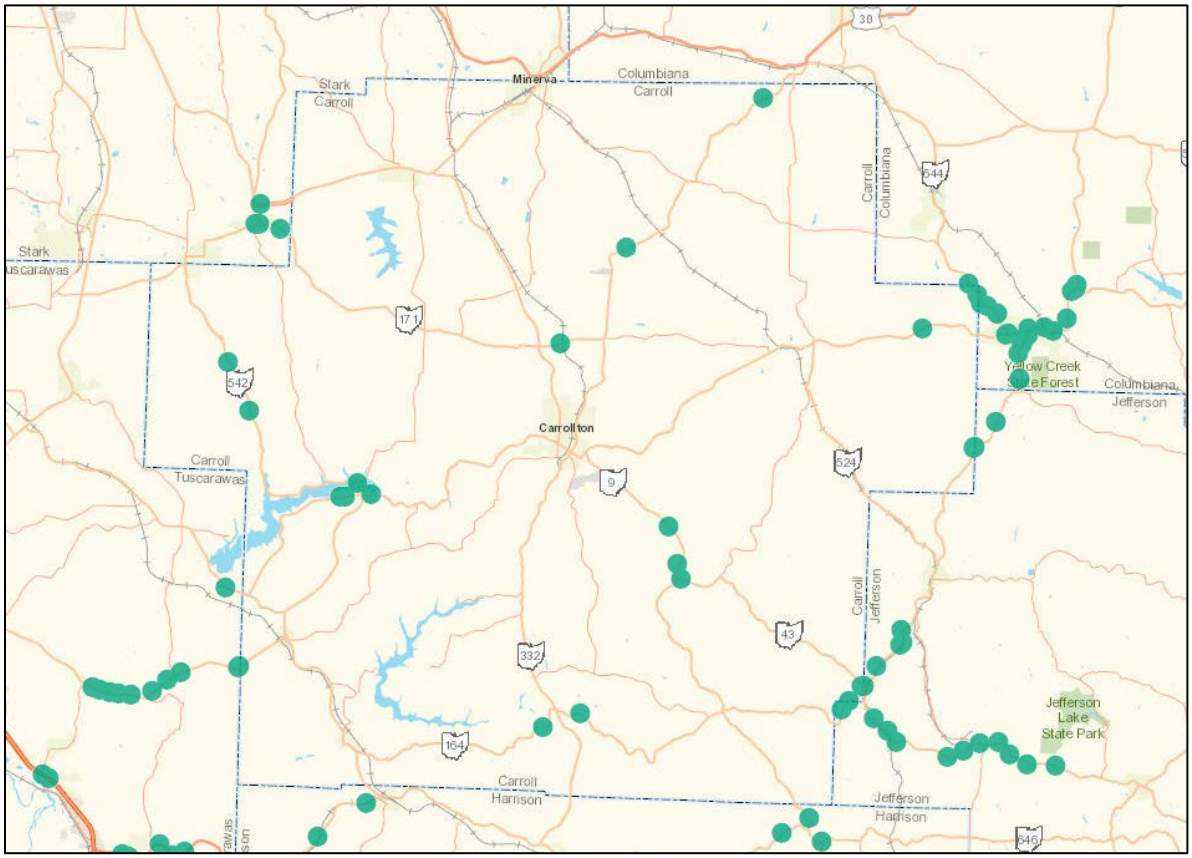
- **Mine Gas:** Abandoned deep and strip mines can be sources of gases, especially methane and carbon dioxide.
- **Portals and vertical openings:** Deep mines are entered by sloped entrances (portals) or vertical openings (shafts). Though these openings were sealed in the 1940s, many portals or shafts have fallen into disrepair.

Location and Extent

Ohio DNR's Division of Geological Survey maintains the Ohio Mine Locator, which maps active and abandoned mines throughout Ohio. According to the Mine Locator, there are mines or affected areas throughout Carroll County. ODNR estimates that mine subsidence will increase as underground mines age. The following figure shows all active and inactive mines in Carroll County. It is important to note that pre-1874 mines may not appear on this map, and that mine maps are only a general planning tool.


CARROLL COUNTY HAZARD MITIGATION PLAN
Mined Areas in Carroll County
Data Source(s):
ODNR
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
Pre-Law Surface Mines
A-Permitted Mines
B-Permitted Mines
C-Permitted Mines
D-Permitted Mines
Underground Mine Extent
Carrollton
Dellroy
Leesville
Magnolia
Malvern
Minerva
Sherrodsville
N

The Ohio Department of Transportation, Office of Geotechnical Engineering has a comprehensive list of federal and state routes that intersect with known and estimated abandoned mines. The following image depicts these intersections in Carroll County.



Impacts and Vulnerability

Each hazard associated with mine failure presents a risk to infrastructure, structures, and/or human health. The following table describes the possible effects of abandoned mines.

IMPACTS OF ABANDONED MINES	
Abandoned Mine Failure Type	*Impacts*
Highwall	• Structures built below highwalls may be damaged by falling rock. • Injuries can result from pedestrians walking above or below highwalls and rock faces giving way causing physical harm
Mine Spoil	• Buildings, septic systems, and other such features located on mine spoil may settle, move, or have leachate problems • Buildings can be damaged as a result of mine spoil settling under the foundation • A building's footer drains can stop functioning as a result of mineral leachate clogging the drainage system. • Septic systems can be damaged as mine spoil settles. The leach field of the septic

IMPACTS OF ABANDONED MINES	
Abandoned Mine Failure Type	*Impacts*
	system settles and no longer functions as designed
Mine Subsidence	• Building homes, garages, roads, septic systems, and other such features above abandoned mines can sustain structural problems if subsidence occurs.
Mine-Related Landslide	• Buildings and roadways constructed on abandoned mine lands are at risk for damage from mine-related landslides • Excavating spoil material and improperly placing it can cause overload. Excess weight from mine spoil can destabilize hillsides
Dangerous Impoundment	• Potential flooding problems due to heavy seasonal rains • Impoundments can saturate the surrounding areas and create seeps, which can cause hillside instability • Impoundments can be dangerous for swimmers due to unstable vertical rock faces, and steep drop-offs or large rocks beneath the water surface • Impoundments can become attractive nuisances to the public, which brings unwelcome visitors to the area
Mine Gas	• Mine gases can cause low oxygen levels in confined areas such as basements or crawl spaces
Portals and Vertical Mine Openings	• Improperly sealed mine openings are inherently unsafe. • Foundation problems can occur in the event of a collapse • Mine drainage can seep into foundations or basement areas • Hillside near mine openings can occur due to mine drainage seepage • Toxic mine gas can infiltrate structures built near mine openings • Like impoundments, mine openings can become attractive nuisances.

With any type of mine failure, particularly with subsidence, there is a risk of damage to structures built on mine lands. There are two primary modes of subsidence: sinkhole subsidence and trough subsidence. Sinkhole subsidence occurs in areas where mines are close to the ground's surface, and is characterized by an abrupt depression. Sinkhole subsidence is the more common form of mine subsidence. Trough subsidence occurs over abandoned mines when the overburden sags downward due to failing pillars or pillars settling into the soft mine roof or floor. Ground movement within a subsidence area can cause damage to buildings, roadways, underground pipelines and utilities, and any other feature present either below or above the Earth's surface.

Historical Occurrences

Although there is no county-level data available for mine failures, data is available for the State of Ohio. The Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH) maintains records of mining disasters (or mining incidents with five or more fatalities) since 1839. The following table presents these incidents for Ohio.

MINING DISASTERS IN OHIO, 1839-PRESENT (SOURCE: NIOSH)						
Date	*Mine Name*	*City*	*State*	*Deaths*	*Product*	*Incident Type*
07/03/1872	Atwater Slope	Atwater Township	OH	10	Coal	Fire
07/11/1877	Brookfield	Brookfield	OH	7	Coal	Suffocation
02/10/1881	Robbins	Robbins	OH	6	Coal	Explosion
11/03/1906	San Toy No. 1	San Toy	OH	5	Coal	Haulage
04/21/1910	Amsterdam	Amsterdam	OH	15	Coal	Explosion
05/17/1913	Noble	Belle Valley	OH	15	Coal	Explosion
10/29/1919	No. 2	Amsterdam	OH	20	Coal	Fire
12/22/1925	Webb	Bellaire	OH	9	Coal	Fire
11/05/1930	No. 6	Millfield	OH	82	Coal	Explosion
01/03/1931	Midvale No. 4	Midvale	OH	5	Coal	Explosion
06/21/1937	Rupert Mine	Keystone	OH	6	Coal	Explosives
03/16/1940	Willow Grove No. 10	St. Clairsville	OH	72	Coal	Explosion
11/29/1940	Nelms	Cadiz	OH	31	Coal	Explosion
07/05/1944	Powhatan	Powhatan Point	OH	66	Coal	

Thomas Acid Mine Drainage Reclamation Project

The Thomas Acid Mine Reclamation Project, located in the Carroll County portion of the Huff Run Watershed, received a national award in 2011. Water quality in the watershed was severely impacted by the discharge of acid mine drainage from the un-reclaimed mine areas and the deep mined areas.

The project involved removing and treating mine impoundments, treating and applying soil cover on acidic mine waste, installing erosion controls, and removing toxic metal discharges during drainage. Upon project completion, water quality improved, native fish species returned to Huff Run, and the wildlife habitat was more hospitable.

Loss and Damages

The Ohio Mine Subsidence Insurance Law mandates mine subsidence coverage for all basic homeowner insurance policies in 26 Ohio counties, including Carroll County. Of the 1,750 mine subsidence claims filed between 1988 and October 2010, only 117 (6.6%) were a result of mine subsidence (ODNR, 2010). Those 117 claims resulted in damage payments estimated at nearly $3.5 million, for an average of $299,145 per claim. In addition to insurance claims, the ODNR Division of Mineral Resource Management and the U.S. Office of Surface Mining, Reclamation, and Enforcement have treated 359 acres of mine subsidence at an estimated cost of $23 million.

Risk Assessment

The following table assigns point totals based on the research presented in this profile for each category that appears in Ohio EMA's SHARPP tool.

MINE FAILURE VULNERABILITY SUMMARY			
Category	*Points*	*Description*	*Notes*
Frequency	2	Low	The most significant mine incident in Carroll County was related to acid mine drainage in the Huff Run watershed.
Response	2	1 day	Mine failure in Carroll County would not typically require an extended emergency response.
Onset	1	Over 24 hours	Mine incidents tend to develop over time. However, sudden failure is possible.
Magnitude	2	Limited	A mine failure in Carroll County would not affect large amounts of land area. Failures are generally localized.
Business	1	Less than 24 hours	A mine failure would not typically interrupt the county's economy for an extended period.
Human	2	Low (some injuries)	There have been 14 mine disasters (in which five or more people were killed) between 1839 and 2010, for an average of 0.08 mine deaths per year in Ohio.
Property	1	Less than 10% of property affected	Mine failures are generally localized events, and would not affect a large portion of property in the area.
Total	11	Low	

2.0 RISK ASSESSMENT

2.2.9 Oil and Gas Emergencies

Oil and gas emergencies include accidents or incidents related to the extraction, storage, or transportation of oil and gas.				
Vulnerability HIGHEST HIGH MEDIUM LOW LOWEST 	Period of Occurrence:	Oil and gas emergencies can occur at any time	Hazard Index Ranking:	18-Medium
	Warning Time:	None	State Risk Ranking:	N/A
	Probability:	Highly likely	Severity:	Limited
	Type of Hazard:	Human-caused	Disaster Declarations:	N/A

Hazard Overview

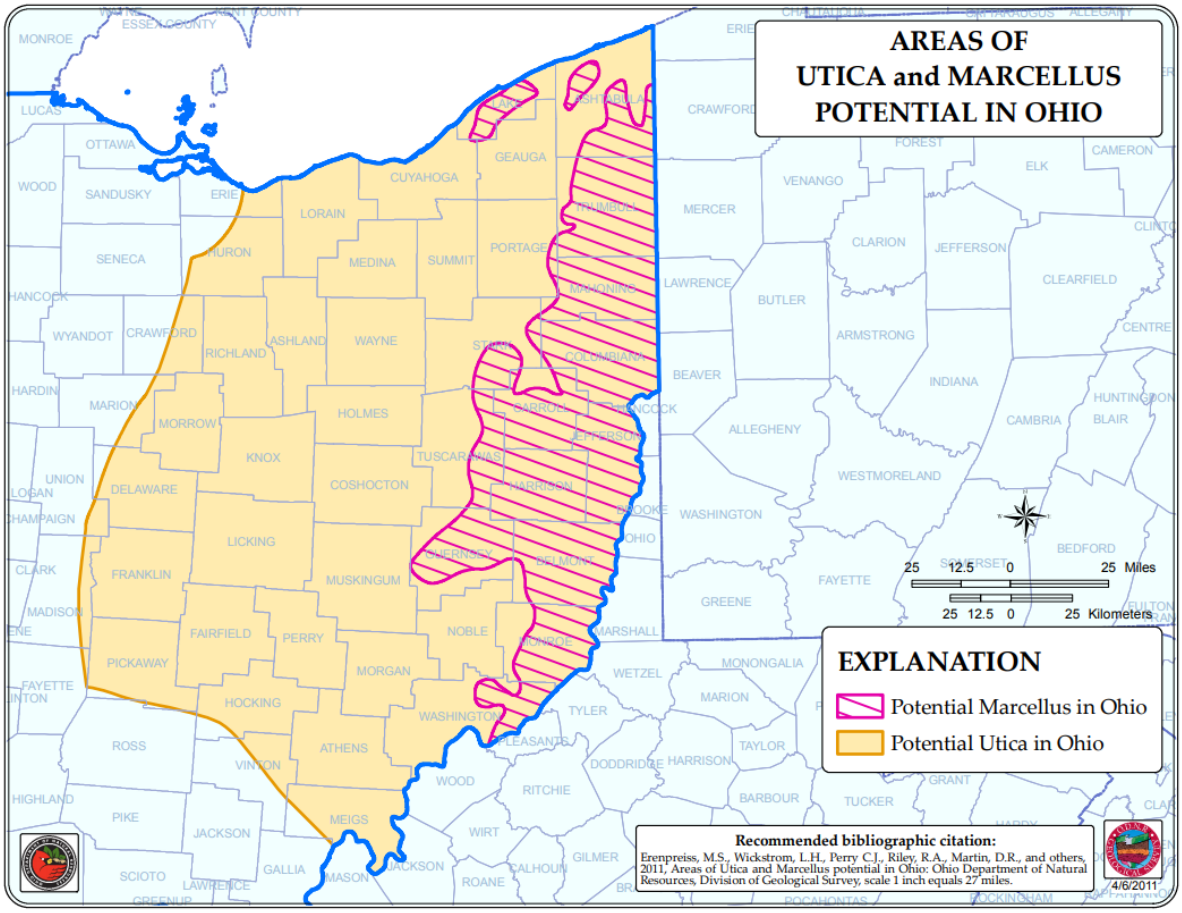
Oil and natural gas are fossil energy sources that are formed deep beneath the Earth's surface. Millions to hundreds of millions of years ago, over long periods, the remains of plants and animals built up in layers on the Earth's surface and ocean floors. Over time, these layers were buried under sand, silt, and rock, where the pressure and heat changed some of this material into coal, oil, and natural gas (U.S. Energy Information Administration, 2019).

Geologic formations that contain oil and gas include clastic or detrital rocks (formed from pieces of pre-existing rocks or minerals), chemical rocks (formed by the chemical precipitation of minerals), and organic rocks (formed by decayed shells, plant material, and skeletons). The three most common sedimentary rock types encountered in oil and gas fields are shales, sandstones, and carbonates.

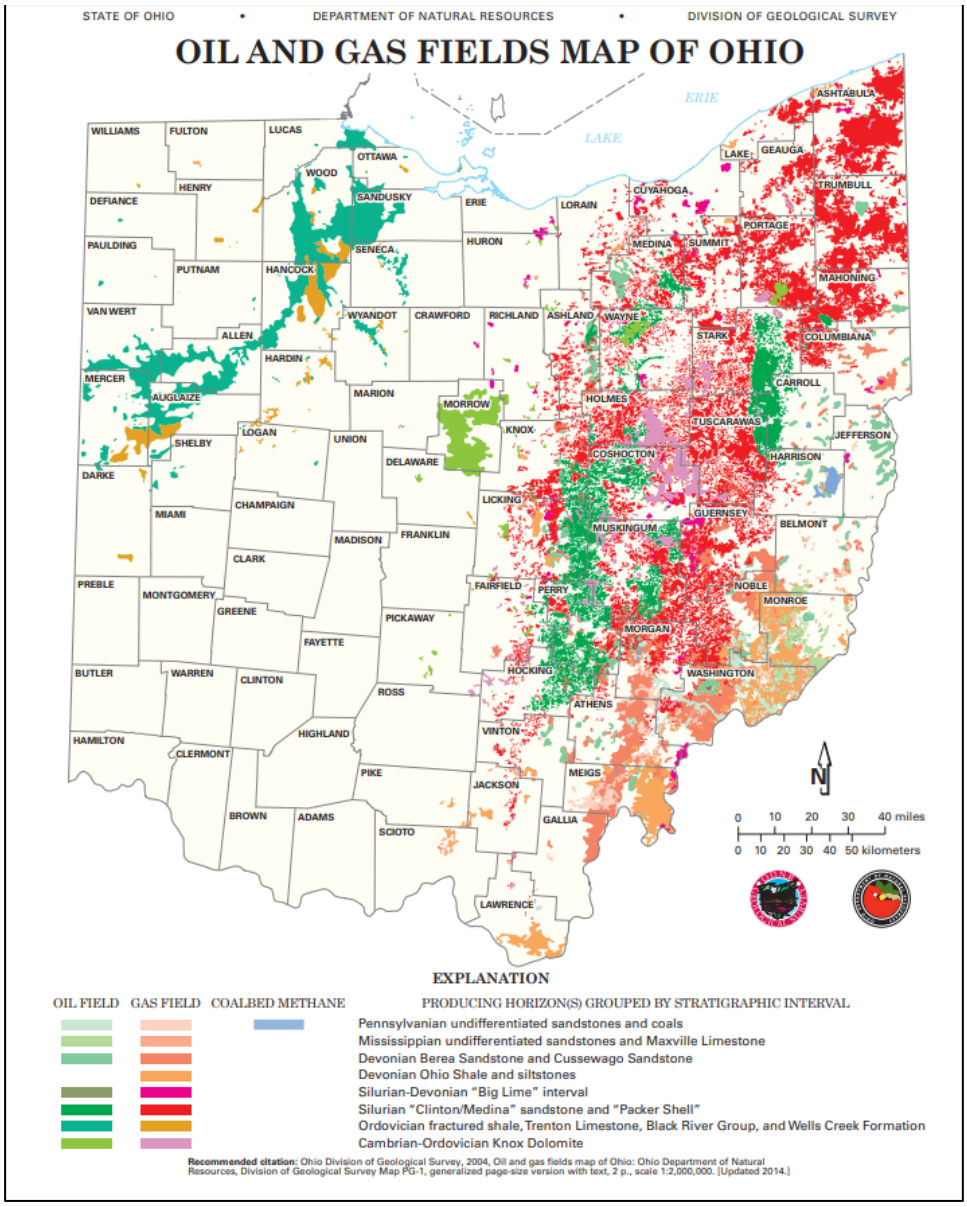
- **Shale** is formed by the accumulation of small sediments deposited in deep water at the bottoms of rivers, lakes, and oceans. Shale is the most abundant sedimentary rock and is considered to be the primary source rocks for oil and gas formation.
- **Sandstone** is created by larger sediment, deposited in deserts, river channels, deltas, and shallow sea environments.
- **Carbonate** is created by the accumulation of shells and skeletal remains of water-dwelling organisms in marine environments. Carbonate is a good reservoir and is commonly encountered during oil and gas production (U.S. Energy Administration, 2019).

Location and Extent

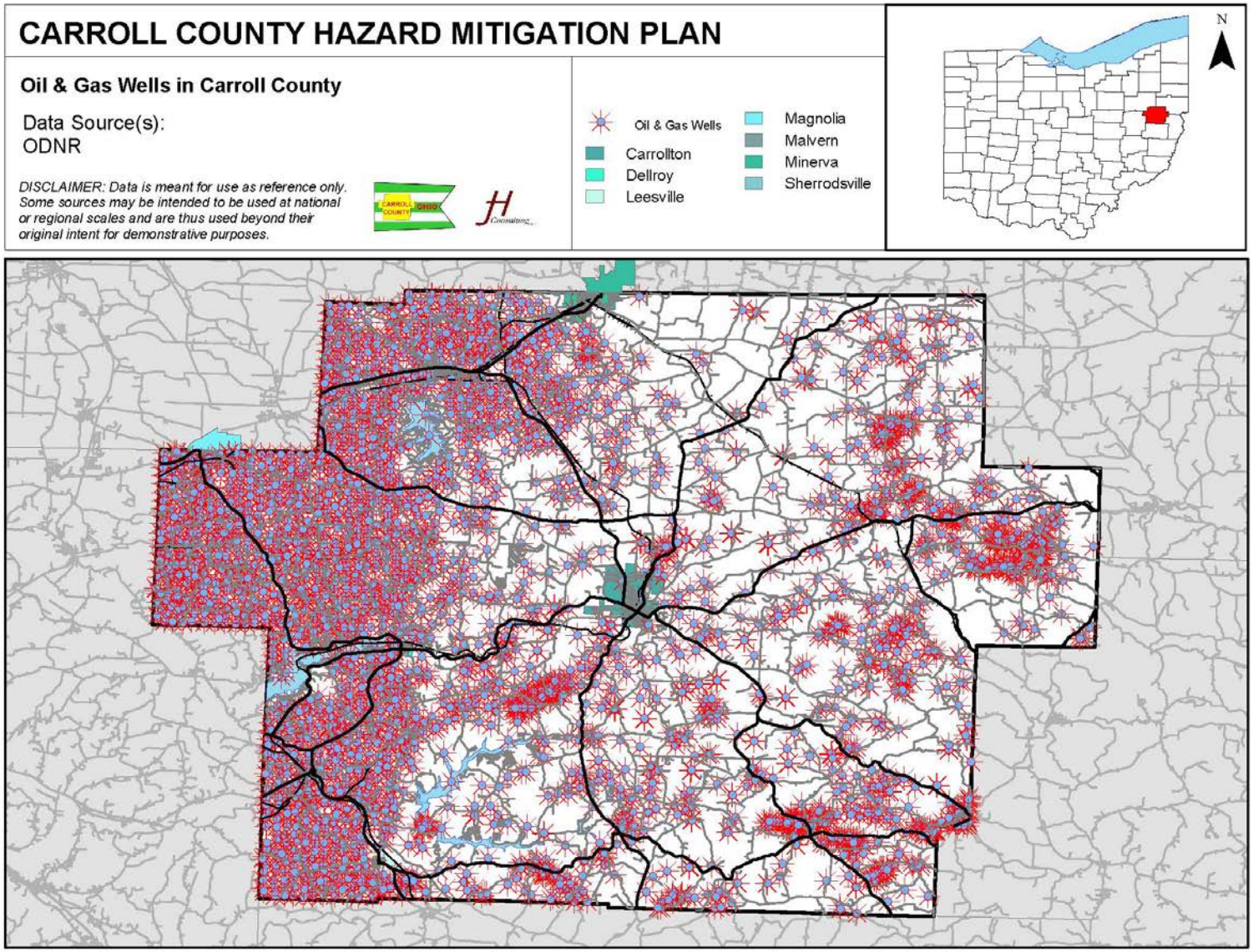
Utica and Marcellus are deep underground oil and gas reserves in the United States, both of which occur in Eastern Ohio. The following image depicts these formations.



There are oil and gas wells throughout much of Ohio, primarily in the Northeastern portion of the state. Western Carroll County has a higher oil and gas well presence than other areas of the county, though there are wells throughout the county. Ohio DNR's Oil and Gas Field Map depicts the location of these wells throughout the state, as well as in Carroll County.



The following map more clearly depicts the location of oil and gas wells in Carroll County. As shown below, most wells are located in the western portion of the county, but there are wells throughout most of Carroll County.


CARROLL COUNTY HAZARD MITIGATION PLAN
Oil & Gas Wells in Carroll County
Data Source(s):
ODNR
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
Oil & Gas Wells
Carrollton
Dellroy
Leesville
Magnolia
Malvern
Minerva
Sherrodsville
N

Carroll County has 509 Utica Shale wells in various stages of activity. From 2013 to 2015, oil production in the county increased by 221% and gas production increased by 323%. Oil and gas are measured using different units. Oil production is measured in barrels. One barrel of oil is equivalent to 42 U.S. liquid gallons. Due to its physical properties, natural gas is measured using MCF's. One MCF is equivalent to 1,000 cubic feet. The following table shows the increase in industry presence in Carroll County from 2010 to 2015.

CARROLL COUNTY SHALE PRODUCTION			
Year	*Oil (barrels)*	*Gas Production (MCF)*	*Property Tax*
2010	0	0	$177,732
2011	46,326	2,651,524	$166,687
2012	352,958	7,751,602	$255,821
2013	1,768,635	50,224,722	$1,048,405
2014	3,962,654	161,137,566	$3,381,772
2015	5,673,333	212,610,576	$9,244,863
Total	11,803,906	434,285,990	$14,275,280

Impacts and Vulnerability

Oil and gas well drilling and servicing activities involve many different types of equipment and materials, some of which may pose a risk to industry professionals or the general public, including vehicle collisions, explosions, and fires. Additionally, oil and gas development poses inherent risks to air quality, water quality and quantity, and land and wildlife (U.S. Government Accountability Office, 2012).

- **Air Quality:** According to studies reviewed by the U.S. Government Accountability Office (GAO), oil and gas development affects air quality due to increased truck traffic, emissions from diesel-powered pumps that power equipment, intentional venting of gas for operational reasons, and unintentional pollutants from faulty equipment or impoundments.
- **Water Quality and Quantity:** The extraction of oil and gas requires a significant amount of water. Operators use water for drilling, and water is a primary component of fracturing fluid. Water for these activities likely comes from surface water, groundwater aquifers, municipal supplies, or reused wastewater. Fresh water sources are at risk of pollution

from oil and gas production due to spills and releases of produced water, chemicals, and drill cuttings, erosion from ground disturbances, and underground migration of gases and chemicals.

- **Land and Wildlife:** Oil and gas development poses a risk to land resources and wildlife habitats as a result of constructing, operating, and maintaining the infrastructure necessary to develop oil and gas, as well as injecting waste products underground.

The oil and gas industry has contributed significantly to the local economy. Since 2010, the production of oil and gas in Carroll County has contributed significantly to the local economy. The Ohio Department of Taxation's Tax Commissioner calculated a uniform formula for the valuation of oil and gas. For the 2017 tax year, the following schedule determines the value of petroleum products in Ohio.

2017 OIL AND GAS VALUATION	
Production	*Taxable Value*
All Grades of Oil	
One barrel or more	$4,510 per barrel per day
Less than one barrel	$2,710 per barrel per day
Natural Gas	
Eight MCF or more	$190 per MCF per day
Less than 8 MCF	$95 per MCF per day

Transportation infrastructure in Carroll County has been affected by the oil and gas industry. Wells are primarily located in rural areas, so heavy trucks and equipment have contributed to traffic congestion and road wear and tear. In an attempt to offset the cost of road repair, the industry has contributed $302 million to road repair throughout the state. More than $44 million was spent by the oil and gas industry to improve 99.33 miles of roadways in Carroll County.

Historical Occurrences

The Ohio Environmental Protection Agency maintains a county-specific database of oil and gas spills since 2017. The following table lists the 27 incidents that occurred in Carroll County.

SPILLS IN CARROLL COUNTY, 2017-PRESENT				
Product	*Spill Size*	*Location*	*Year*	*Month*
Air Fire Facility	Small: 500 Gal/4000 Lbs	Carrollton	2018	May
Oil Motor / Lube Oil / Vehicle	Unknown Amount	Carrollton	2018	June
Propane (C3h8)	Large: 2500 Gal/ 20000 Lbs	Union Township	2019	March
Drilling Waste / Cuttings	Unknown Amount	Orange Township	2017	July
Oil Crude	Unknown Amount	Loudon Township	2019	November
Oil Motor / Lube Oil / Vehicle	Unknown Amount	Carrollton	2018	August
Fuel Oil/ Home Heating / Heating Oil	Small: 500 Gal/4000 Lbs	East Township	2018	November
Oil Crude	Unknown Amount	Orange Township	2018	April
Oil Crude	No Spill	Orange Township	2017	August
Natural Gas Condensate / Condensate / Gas Condensate	Med: 500-2499 Gal/ 4000-19999 Lbs	Brown Township	2019	November
Oil Crude	Small: 500 Gal/4000 Lbs	Rose Township	2019	May
Oil Hydraulic Fluid(S)	Small: 500 Gal/4000 Lbs	Brown Township	2019	October
Oil Crude	Unknown Amount	Carrollton	2019	May
Manure Nos (Not Specified)	Unknown Amount	Augusta Township	2019	July
Bentonite / Drilling Mud	Small: 500 Gal/4000 Lbs	Orange Township	2017	June
Manure NOS (Not Specified)	Large: 2500 Gal/ 20000 Lbs	Lee Township	2018	December
Oil Crude	Small: 500 Gal/4000 Lbs	Rose Township	2019	November
Sediment / Sedimentation	Large: 2500 Gal/ 20000 Lbs	Perry Township	2018	April
Brine Oil And Gas Related	Small: 500 Gal/4000 LBS	N/A	2018	April
Oil Crude	Unknown Amount	N/A	2018	April
Runoff Nos (Not Specified)	Unknown Amount	Perry Township	2017	July
Orphan Drum(S)	Unknown Amount	Brown Township	2017	June
Fuel Diesel / Diesel Fuel (Vehicle On Or Off-Road)	Small: 500 Gal/4000 Lbs	Perry Township	2018	July

SPILLS IN CARROLL COUNTY, 2017-PRESENT				
Product	*Spill Size*	*Location*	*Year*	*Month*
Oil Crude	Small: 500 Gal/4000 Lbs	Orange Township	2018	July
Material Undetermined / Other	Unknown Amount	Rose Township	2019	August
Fuel Diesel / Diesel Fuel (Vehicle On Or Off-Road)	Small: 500 Gal/4000 Lbs	Fox Township	2018	July
Oil Crude	Small: 500 Gal/4000 Lbs	N/A	2018	October

Local news sources have reported two oil and gas tanker truck accidents in Carroll County. The following section depicts these incidents.

November 10, 2019

On November 10, 2019, a tanker truck operated by Pilot overturned on State Route 403. The truck was carrying more than 8,000 gallons of oil and gas byproducts, 2,000 gallons of which leaked due to a tear in the tank. A team of 30 first responders from Jefferson and Carroll Counties responded to the scene.

March 7, 2019

On March 7, 2019, a tanker truck caught rolled over and caught fire near State Route 332/Scio Road. Portions of State Route 332 were closed in the area, and officials asked drivers to avoid the area. Multiple fire departments and the Carroll County Emergency Management Agency responded to the incidents.

Loss and Damages

The largest known oil and gas spills in Carroll County occurred during transportation. The average cleanup cost for an oil spill in the United States is estimated at approximately $16 per gallon (Cohen, 2010). The average volume of a tanker truck ranges from 5,500 to 11,600 gallons. Thus, the average cost to clean up a transportation-based oil or gas incident ranges from $88,000 to $185,600. This figure includes both the cost of cleanup and the cost of environmental damages related to the spill.

Risk Assessment

The following table assigns point totals based on the research presented in this profile for each category that appears in Ohio EMA's SHARPP tool.

OIL AND GAS EMERGENCY VULNERABILITY SUMMARY			
Category	*Points*	*Description*	*Notes*
Frequency	5	N/A	Since 2017, there have been 27 spills and two transportation incidents associated with the oil and gas industry.
Response	2	One day	A typical oil and gas emergency would require an immediate but not necessarily prolonged response.
Onset	5	N/A	Oil and gas emergencies are unpredictable and occur with no warning.
Magnitude	1	Localized (less than 10% of land area affected)	Oil and gas emergencies are localized events, and only a small portion of the county would be affected.
Business	2	1 week	The oil and gas industry is an important part of Carroll County's economy. An emergency might have a more significant impact than some other hazards.
Human	2	Low (some injuries)	The highest risk of injury during an oil and gas emergency are industry professionals and first responders.
Property	1	Less than 10% of property	Oil and gas emergencies are, again, highly localized incidents. The most significant
Total	18	Medium	

2.0 RISK ASSESSMENT

2.2.10 Public Health Emergency

A public health emergency occurs when there is a sudden increase in the number of cases of a disease above what is expected in a given area				
Vulnerability  HIGHEST HIGH MEDIUM LOW LOWEST	Period of Occurrence:	Public health emergencies can occur at any time	Hazard Index Ranking:	17-Medium
	Warning Time:	None	State Risk Ranking:	Not ranked
	Probability:	Likely	Severity:	Critical
	Type of Hazard:	Natural	Disaster Declarations:	EM-3457

Hazard Overview

A public health emergency (the condition that requires the governor to declare a state of public health emergency) is defined as "an occurrence or imminent threat of an illness or health condition, caused by bioterrorism, epidemic or pandemic disease, or (a) novel and highly fatal infectious agent or biological toxin, that poses a substantial risk of a significant number of human facilities or incidents or permanent or long-term disability (WHO/DCD, 2001). The declaration of a state of public health emergency permits the governor to suspend state regulations, change the functions of state agencies.

Location and Extent

Unlike geographically and temporally bounded disasters, a public health emergency will spread across the globe over months or a year, possibly in waves, and will affect communities of all sizes and compositions. The most traditional public health emergency is an infectious disease. According to the Center for Disease Control and Surveillance (CDC), there are three widely accepted “levels” of disease presence.

- ***Endemic*** refers to the baseline level of a particular disease in a population or area. This level is not necessarily the desired level, but the observed level.
- ***Epidemic*** refers to an increase in the number of cases of a disease above the usual level in that population or area. Epidemics may result from an increase of the disease’s

virulence, presence of a disease in a new outbreak, enhanced disease transmission, increased susceptibility among exposed persons, or increased exposure to the disease-causing agent. Note that, while the term "epidemic" originally only included infectious diseases, some non-infectious health conditions (such as obesity and opioid misuse) have reached epidemic status in the United States.

- ***Pandemic*** refers to an epidemic that has spread over several countries or continents, typically affecting a large number of people.

"**Outbreak"** is another term used to describe public health emergencies. An outbreak carries the same definition as "epidemic," but often for a more limited geographic area.

While the presence of a particular disease does not always constitute a public health emergency, certain diseases are more likely than others to meet this threshold. The Ohio Department of Health (ODH) classifies diseases due to their severity or potential for epidemic spread. Local officials must report Class A notifiable diseases immediately upon the recognition that a case, suspected case, or positive laboratory result exists. Class A diseases include the following.

- Anthrax
- Botulism, foodborne
- Cholera
- Diphtheria
- Influenza A, novel virus
- Measles
- Meningococcal disease
- Middle East respiratory syndrome (MERS)
- Plague
- Rabies, human
- Rubella, not congenital
- Severe acute respiratory syndrome (SARS)
- Smallpox
- Tularemia
- Viral hemorrhagic fevers (Ebola, Lassa fever, etc.)
- Yellow Fever

Class B notifiable diseases must be reported the next business day following the existence of a case, suspected case, or a positive laboratory result is known. Class B diseases include the following.

- Amebiasis
- Abnormal neuroinvasive and non-neuroinvasive diseases, including
  - Chikungunya virus
  - Eastern equine encephalitis virus disease

  - La Cross virus disease
  - Powassan virus disease
  - St. Louis encephalitis
  - West Nile virus infection
  - Western equine encephalitis disease
  - Zika virus infection
  - Other arthropod-borne diseases
- Babesiosis
- Botulism
- Brucellosis
- Campylobacteriosis
- Chancroid
- *Chlamydia trachomatis* infection
- Coccidioidomycosis
- Creutzfeldt-Jakob disease
- Cryptosporidiosis
- Cyclosporiasis
- Dengue
- Escherichia coli, Shiga toxin-producing
- Ehrlichiosis/Anaplasmosis
- Giardiasis
- Gonorrhea
- Haemophilus influenza, invasive disease
- Hantavirus
- Hemolytic Uremic Syndrome
- Hepatitis A
- Hepatitis B, non-perineal
- Hepatitis B, perineal
- Hepatitis C
- Hepatitis D
- Hepatitis E
- Influenza-associated hospitalization
- Influenza-associated pediatric mortality
- Legionellosis
- Leprosy (Hansen disease)
- Leptospirosis
- Listeriosis
- Lyme disease
- Malaria
- Meningitis, aseptic
- Meningitis, other bacterial
- Mumps
- Pertussis
- Poliomyelitis
- Psittacosis
- Q fever
- Rubella, congenital
- Salmonellosis
- Shigellosis
- Spotted fever rickettsiosis
- *Staphylococcus aureus*, vancomycin-resistant or intermediate resistant
- Streptococcal disease, group A, invasive
- Streptococcal disease, Group B, newborn
- Streptococcal toxic shock syndrome (STSS)
- *Streptococcus pneumoniae*, invasive disease
- Syphilis

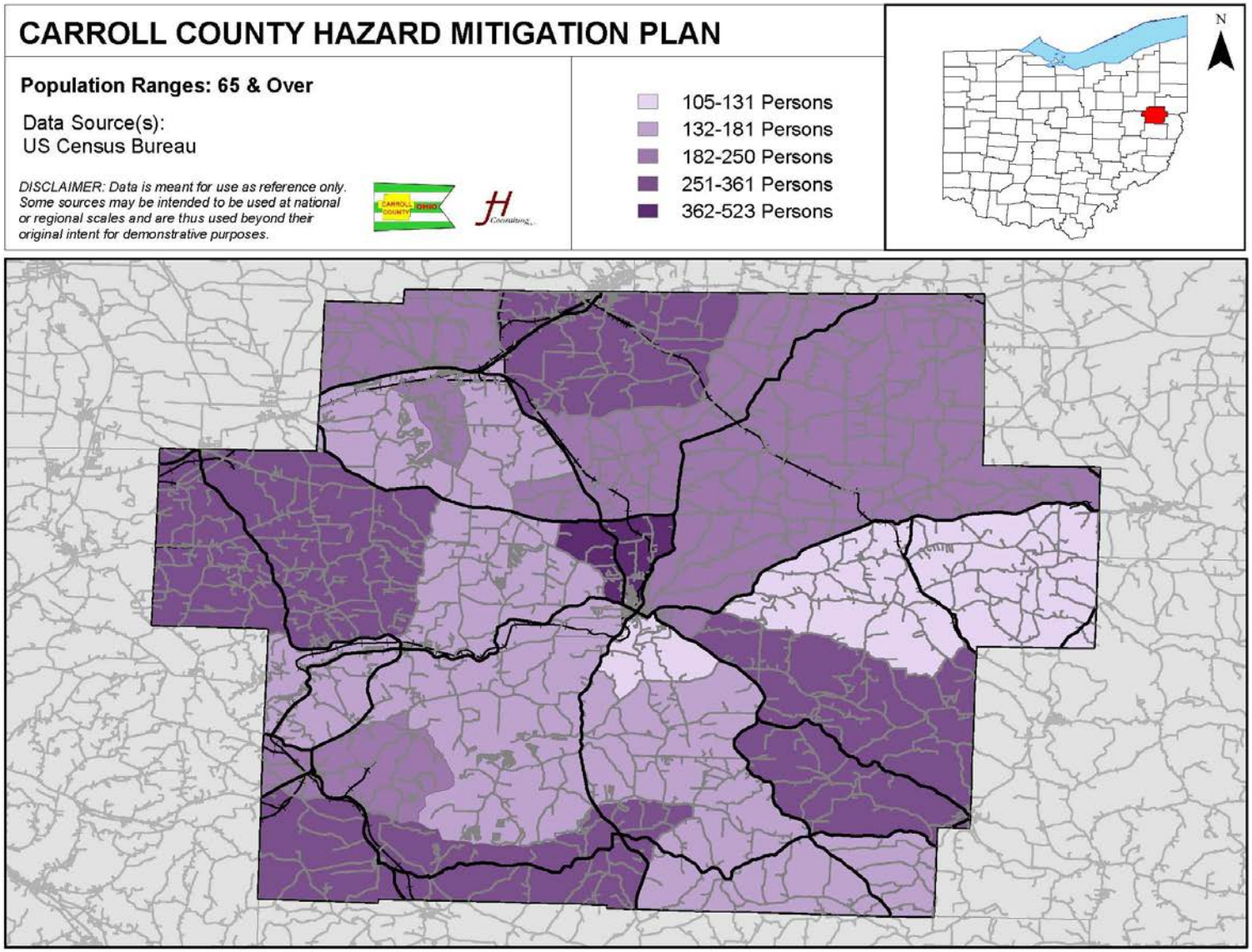
- Tetanus
- Toxic shock syndrome (TSS)
- Trichinellosis
- Tuberculosis (TB)
- Typhoid fever
- Varicella (chickenpox)
- Yersiniosis

These diseases can be spread either by direct contact, indirect contact, insect bites, or food contamination.

- **Direct Contact:** Includes person-to-person, animal-to-person, and mother-to-child transmission of disease.
  - **Person-to-person** transmission occurs when an ill individual touches, kisses, or coughs or sneezes on someone who is not infected.
  - **Animal-to-person** transmission occurs when an infected animal bites or scratches a person, or a person handles infected animal waste.
  - **Mother-to-child** transmission occurs when a woman passes infectious agents to her child through the placenta or breast milk.
- **Indirect Contact:** Occurs when the infectious agent lingers on an inanimate object such as a table or doorknob. For example, someone ill with influenza could touch a doorknob and leave some of the viruses behind. Another person who touches that doorknob is then at risk of becoming ill with influenza.
- **Insect Bites:** Also known as vector-borne contact, insects can carry diseases from the environment. When the insect bites a person, the disease-causing agent transfers to the person who can become ill. An example of this type of transmission is malaria caused by a disease-carrying mosquito bite.
- **Food Contamination:** This occurs when food is contaminated with disease-causing agents. Examples would be an undercooked hamburger or unpasteurized milk or juice.

Impacts and Vulnerability

Certain populations are more likely to be adversely affected by public health emergencies. Typically, children younger than five years old, adults older than 65 years old, and individuals with weakened immune systems or pre-existing health conditions are most likely to suffer the most severe side effects of infectious diseases. Additionally, the elderly are more likely to live with one or more chronic illnesses than younger adults and children. The following map depicts residents aged 65 and older in Carroll County by census block.


CARROLL COUNTY HAZARD MITIGATION PLAN
Population Ranges: 65 & Over
Data Source(s):
US Census Bureau
DISCLAIMER: Data is meant for use as reference only. Some sources may be intended to be used at national or regional scales and are thus used beyond their original intent for demonstrative purposes.
105-131 Persons
132-181 Persons
182-250 Persons
251-361 Persons
362-523 Persons
N

Major concerns during a public health emergency include the ability of local healthcare providers to give medical attention to everyone who becomes ill, and the ability to identify the source of illness in the population. Cascading effects of public health emergencies can include:

- illness or death
- civil disturbance
- distrust of government
- poor water quality, and
- temporary loss of income

Historical Occurrences

The following table summarizes recent disease outbreaks declared by the CDC and the Ohio Department of Health from 2010-2019. The outbreaks listed below had a widespread, substantial impact on public health in the U.S. and globally.

FEDERAL AND STATE OUTBREAKS, 2010-2019		
Year(s)	*Agent*	*Reporting Agency*
2010	*Salmonella*	CDC
2011	*Listeria monocytogenes*	CDC
2012	Meningitis, Fungal	CDC
2012	West Nile Virus	CDC
2012	*E. coli* O145	CDC
2013	Cyclosporiasis	CDC
2013	MERS (Middle East Respiratory Syndrome)	CDC
2014	Ebola virus	CDC
2014-2015	Enterovirus	CDC
2014-Present	Chikungunya virus	CDC
2016-2017	Zika virus	CDC
2017-Present	Hepatitis A	CDC, ODH
2019	Measles	CDC, ODH
2020	COVID-19	CDC, ODH, WHO

Each year, the Ohio Department of Health publishes the Annual Summary of Infectious Diseases, which lists incidences of reportable infectious diseases in each county. The following table lists incidences of reportable diseases in Carroll County from 2008 to 2017.

REPORTED CASES OF SELECTED NOTIFIABLE DISEASES, CARROLL COUNTY											
Disease	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*Average*
General Infectious Diseases											
Botulism	0	0	0	1	0	0	0	0	0	0	0.1
Botulism, infant	0	0	0	0	0	0	0	0	0	0	0
Campylobacteriosis	4	3	7	2	3	6	2	3	47	11	8.8
Coccidiomycosis	0	0	0	0	0	0	1	0	1	0	0.2
Creutzfeld-Jakob Disease	1	0	1	0	0	0	0	0	0	0	0.2
Cryptosporidiosis	1	8	2	2	0	1	3	0	4	3	2.4
Cyclosporiasis	0	0	0	0	0	0	0	0	0	0	0
Cytomegalovirus (CMV), congenital	0	1	0	0	0	0	0	0	0	0	0.1
Escherichia coli, Shiga Toxin-Producing (STEC)	0	0	0	1	0	0	0	0	2	2	0.5
STEC, O157:H70	0	0	0	0	0	0	0	0	0	1	0.1
STEC, Not O157:H7	0	0	0	1	0	0	0	0	1	1	0.3
Unknown serotype	0	0	0	0	0	0	0	0	1	0	0.1
Giardiasis	4	5	4	6	2	4	0	0	0	2	2.7
Haemophilus influenzae, invasive disease	0	1	0	1	1	0	0	1	0	0	0.4
Hepatitis A	0	0	0	0	0	0	1	0	0	0	0.1
Legionellosis	1	0	2	1	0	1	0	2	0	0	0.7
Listeriosis	0	0	1	0	0	2	0	2	1	0	0.6
Meningitis, aseptic	2	0	1	2	2	3	3	1	0	5	1.9
Meningitis, other bacterial	0	0	0	0	0	0	1	0	0	0	0.1
Salmonellosis	4	5	5	2	9	6	4	3	3	7	4.8
Shigellosis	0	1	0	0	0	0	4	0	0	1	0.6
Streptococcal Disease, Group A, invasive	1	1	1	3	1	1	1	1	0	6	1.6
Streptococcal Disease, Group B, newborn	0	0	0	1	1	0	0	0	0	0	0.2
Streptococcal Toxic Shock Syndrome (STSS)	0	0	0	0	0	0	0	1	0	0	0.1
Yersiniosis	1	0	0	0	0	0	1	0	1	2	0.5
Vaccine-Preventable Diseases											
Influenza associated hospitalization	0	11	1	11	13	20	25	16	10	41	14.8
Influenza associated pediatric mortality	0	0	0	0	0	0	0	0	0	0	0
Measles	0	0	0	0	0	0	0	0	N/A	0	0
Pertussis	1	0	1	0	4	0	0	0	2	1	0.9
Streptococcus pneumoniae (Sp) invasive disease	10	4	7	1	6	2	0	2	6	3	4.1
Sp, Age <5 years	0	0	0	0	0	0	0	0	0	0	0
Sp, Drug resistant, 5+	6	3	3	0	1	0	0	0	1	1	1.5
Sp, Drug Susceptible, 5+	4	1	4	1	5	2	0	2	5	2	2.6
Varicella	5	5	7	2	1	1	0	0	0	0	2.1

REPORTED CASES OF SELECTED NOTIFIABLE DISEASES, CARROLL COUNTY											
Disease	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*Average*
Zoonotic Diseases											
Leptospirosis	0	0	0	0	0	0	0	0	1	0	0.1
Lyme disease	1	1	1	0	1	0	1	2	0	6	1.3
Malaria	0	0	0	0	0	0	0	0	1	0	0.1
Rabies, animal	0	0	0	1	1	0	0	2	0	0	0.4
West Nile Virus infection	0	0	0	0	0	0	1	0	0	0	0.1
Zika Virus infection	0	0	0	0	0	0	0	0	0	0	0
Source: Ohio Department of Health	A number of cases reported above average				A steady increase above average for at least three consecutive years				A steady decrease above average for at least three consecutive years		

When comparing the outbreak table with diseases reported in Carroll County, Salmonella, Listeria, Meningitis, West Nile Virus, and Hepatitis A appear on both. During the 2010 outbreak, there were five cases of Salmonellosis in Carroll County. Listeria was present in Carroll County during 2010, 2013, 2015, and 2016, which are inconsistent with the 2012 outbreak. Meningitis and West Nile Virus were reported in Carroll County in 2014, two years after the declared 2012 outbreaks. The one reported case of Hepatitis A in Carroll County occurred in 2014, three years before the declared 2017 outbreak.

2020 COVID-19

In November of 2019, a novel coronavirus, later named COVID-19, began in Wuhan, China. Symptoms of COVID-19 were similar to those of seasonal influenza infection. However, due to its novel nature, it spread rapidly throughout China in late 2019 and early 2020. In January of 2020, the Ohio Department of Health issued a directive making COVID-19 a Class A reportable disease in the state. By March 2020, the virus was spread to the United States, and the World Health Organization classified the virus as a pandemic on March 11. Businesses, including restaurants and retail stores, operated with limited capacity, nursing homes postponed or limited visitation hours, and events of more than 10 people were postponed or canceled.

Additionally, public and private schools, colleges, and universities suspended in-person education during the pandemic. On March 12, the Governor imposed a mandate closing all school buildings and mandating remote learning throughout the state through the end of the 2019-2020 school year. School districts in Carroll County are planning to start the 2020-2021 school year in-person, with discticts choosing either an in-person or hybrid in-person/online model.

Loss and Damages

Losses associated with public health emergencies are typically limited to human health impacts and reduced productivity. Such losses are difficult to estimate. According to a study by Molinari et al. (2007), seasonal influenza results in a substantial economic impact, estimated, in part, at $16.3 billion in lost earnings. By population, Carroll County is 0.0083% of the U.S. population. Since seasonal influenza primarily impacts the human population, using Carroll County's composition of the U.S. as a multiplier (i.e., 0.000083) and applying it to the potential economic impact, lost earnings in the county could reach $1,352,900 each year.

Although that number appears high, it equates to approximately $86.14 per year for each person listed by the U.S. Census Bureau as "in the civilian labor force" for Carroll County. Public health emergencies rarely affect structures. They affect people, and at times, the operations of critical facilities, businesses, and other community assets.

Risk Assessment

The following table assigns point totals based on the research presented in this profile for each category that appears in Ohio EMA's SHARPP tool.

PUBLIC HEALTH EMERGENCY VULNERABILITY SUMMARY			
Category	*Points*	*Description*	*Notes*
Frequency	5	High	Based on historical data, 1.3 incidences of a reportable disease will occur annually in Carroll County.
Response	5	More than one month	Outbreaks develop slowly over weeks or months. For large outbreaks, public health officials may remain in response for a substantial period of time.
Onset	1	Over 24 hours	Public health emergencies develop slowly over weeks or months.
Magnitude	1	Localized (Less than 10% of land area)	Public health emergencies do not impact land areas; they impact the human population, the patterns of which may spread over the area.
Business	2	1 week	Large outbreaks may diminish economic activity; the loss estimate in this profile consists of impacts to earnings.
Human	2	Low (some injuries)	Public health emergencies impact the human population, and by nature, results in injuries. This figure is low because most health-related emergencies result in illnesses (rather than deaths).
Property	1	Less than 10% of property affected	Public health emergencies do not impact structures or property.
Total	17	Medium	