The total building-related losses totaled $6.29 million; 19% of the estimated losses were related to the business interruption of the region. By far, the largest loss was sustained by the residential occupancies, which made up more than 35% of the total loss.

Table 4-27: 500-Year Probabilistic Scenario-Damage Counts by Building Occupancy

	None		Slight		Moderate		Extensive		Complete	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Agriculture	3,548	18.23	152	25.01	61	29.81	9	32.04	0	25.12
Commercial	970	4.99	37	6.05	13	6.27	2	6.55	0	6.01
Education	54	0.28	2	0.39	1	0.43	0	0.45	0	0.61
Government	90	0.46	3	0.54	1	0.57	0	0.54	0	0.68
Industrial	270	1.39	11	1.73	4	2.00	1	2.08	0	1.45
Other Residential	2,682	13.78	128	21.12	51	24.75	6	19.80	0	15.41
Religion	394	2.02	16	2.63	6	2.98	1	3.29	0	3.78
Single Family	11,453	58.85	258	42.51	68	33.18	10	35.24	1	46.94
Total	**19,462**		**607**		**205**		**28**		**2**	

Table 4-28: 500-Year Probabilistic Scenario-Building Economic Losses in Millions of Dollars

Category	Area	Single Family	Other Residential	Commercial	Industrial	Others	Total
Income Loses							
	Wage	0.00	0.02	0.20	0.06	0.14	0.41
	Capital-Related	0.00	0.01	0.20	0.04	0.06	0.30
	Rental	0.11	0.02	0.20	0.05	0.07	0.46
	Relocation	0.01	0.00	0.01	0.00	0.02	0.05
	Subtotal	**0.12**	**0.05**	**0.61**	**0.15**	**0.29**	**1.22**
Capital Stock Loses							
	Structural	0.56	0.07	0.22	0.15	1.19	2.19
	Non_Structural	1.08	0.14	0.23	0.17	0.60	2.22
	Content	0.17	0.02	0.08	0.07	0.27	0.59
	Inventory	0.00	0.00	0.01	0.04	0.02	0.07
	Subtotal	**1.80**	**0.23**	**0.54**	**0.43**	**2.07**	**5.07**
	Total	**1.93**	**0.27**	**1.14**	**0.58**	**2.36**	**6.29**

500-Year Probabilistic Scenario—Essential Facility Losses

Before the earthquake, the region had 946 care beds available for use. On the day of the earthquake, the model estimates that only 492 care beds (52%) are available for use by patients already in medical care facilities and those injured by the earthquake. After one week, 97% of the beds will be back in service. By day 30, 100% will be operational.

Results Annualized Risk Scenario

HAZUS-MH estimates that approximately 105 buildings will be at least moderately damaged. This is approximately 1% of the total number of buildings in the region. It is estimated that no buildings will be damaged beyond repair.

Relationship to other Hazards

Ground Failure- According to the National Academies of Sciences Engineering Medicine, the major cause of earthquake damage is ground failure. Some ground failures induced by earthquake are the result of liquefaction of saturated sands and silts, the weakening of sensitive clays or by the crumbling and breaking away of soil and rock on steep slopes. Ground failure has been known to cause buildings to collapse and to severely hinder communication and transportation systems.

Utility Failure- Earthquakes frequently damage utilities particularly underground facilities and older storage tanks, but nearly every utility can be vulnerable to the shaking that earthquakes induce. Seismic damage to buried utilities are often influenced by ground conditions and subsurface strain distribution. Since utilities are typically part of a larger network system, damages to key locations in a network can potentially set off a chain reaction that affects significant portions of the utility system as a whole. Earthquake damage to utilities can also potentially create secondary hazards such as fires or hazmat situations since some utilities may handle volatile or flammable substances.

Plans and Programs in Place

No existing plans or programs were identified.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.3 Ground Failure

Hazard Description

According to the USGS, the term ground failure is a general reference to landslides, liquefaction, lateral spreads, and any other consequence of land shaking that affects ground stability. For ground failure this plan will only address land subsidence and landslides. Landslides are a serious geologic hazard common to almost every state in the US. It is estimated that nationally they cause

up to $2 billion in damages and from 25 to 50 deaths annually. Globally, landslides cause billions of dollars in damage and thousands of deaths and injuries each year.

The term landslide is a general designation for a variety of downslope movements of earth materials. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is the force driving landslide movement. Factors that allow the force of gravity to overcome the resistance of earth material to landslide movement include: saturation by water, steepening of slopes by erosion or construction, alternate freezing or thawing, earthquake shaking, and volcanic eruptions. There are three main types of landslides that occur in Indiana: rotational slump, earthflow, and rock fall.

Landslides

A landslide is a rapid movement of surface land material down a slope. The main causes of landslides include:

- Earthquake or other significant ground vibration
- Slope failure due to excessive downward movement, gravity
- Groundwater table changes (often due to heavy rains)

Preventive and remedial measures include modifying the landscape of a slope, controlling the groundwater, constructing tie backs, spreading rock nets, etc.

The USGS claims that landslides are a significant geologic hazard in the US causing $1-2 billion in damage and over 25 fatalities per year. The expansion of urban and recreational development into hillside areas has resulted in an increasing number of properties subject to damage as a result of landslides. Landslides commonly occur in connection with other major natural disasters such as earthquakes, wildfires, and floods.

Although landslides may not be preventable, their effect on people and property can be mitigated. Mitigation includes any activities that prevent an emergency, reduce the chance of an emergency happening, or lessen the damaging effects of unavoidable emergencies. Investing in preventive mitigation steps now such as planting ground cover (low growing plants) on slopes, or installing flexible pipe fittings to avoid gas or water leaks, will help reduce the impact of landslides and mudflows in the future.

Karst

Southern Indiana has a network of underground caves formed by what is known as karst landscape. According to the Indiana Geological Survey, karst topography is a distinctive type of landscape largely shaped by the dissolving action of groundwater on carbonate bedrock, usually limestone. This geological process, which will take thousands of years, is characterized by unique features such as sinkholes, fissures, caves, disappearing streams, springs, rolling topography, and underground drainage systems.

These karst formations have the potential to collapse under the weight of the ground above them creating a sinkhole. Ground failure of this nature is known as land subsidence. Any structures built above a karst formation could potentially be subject to land subsidence and collapse into a resulting sinkhole. There are no known karst areas in Marshall County.

Fluvial Erosion

The Fluvial Erosion Hazard (FEH) also represents a significant concern in areas where human development and infrastructure, are established in close proximity to natural waterways. In mild cases, this may be seen as the gradual loss of a farm field or the undermining of a fence row when gradual channel migration consumes private land. In more severe cases, the FEH risk may threaten properties and/or structures to the degree that they become uninhabitable or even lost to natural channel processes. Where interaction between human activities and natural waterways within communities exist, those communities must be mindful of the tendency of waterways to shift their position across the landscape. This knowledge can help a community anticipate FEH damages thereby making the community more resilient to flood and erosion impacts.

The Indiana Silver Jackets Hazard Mitigation Task Force has initiated a multi-agency program to identify, study and provide mitigation planning resources for individuals and communities who would like to adopt FEH avoidance strategies. The resources provided by this project will enable individuals and communities to better recognize areas prone to natural stream-erosion processes and adopt strategies to avoid FEH-related risks.

Ground Failure History in Marshall County

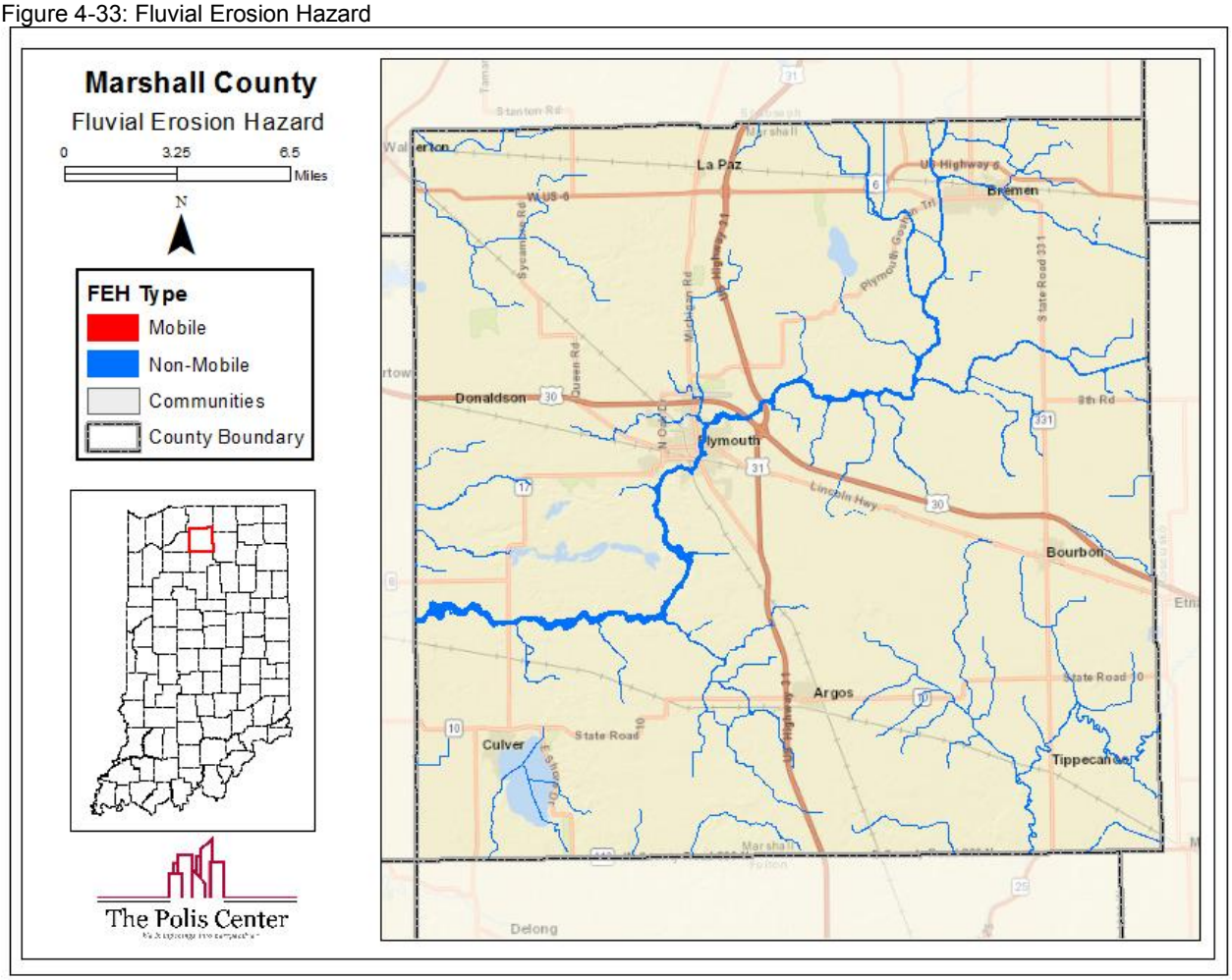
The planning team did not identify any major slope failures. Unrecorded landslide events occur throughout Marshall County with varying degrees of severity. Flash floods, which Marshall County experiences relatively frequently, can trigger mudflows, landslides, and crumbled roads. Ground

failure is less likely to cause spectacular structural collapses, but may the cause of major disruptions, particularly to lifelines, which can lead to prolonged loss of function and income, even for undamaged areas.

Vulnerability and Future Development

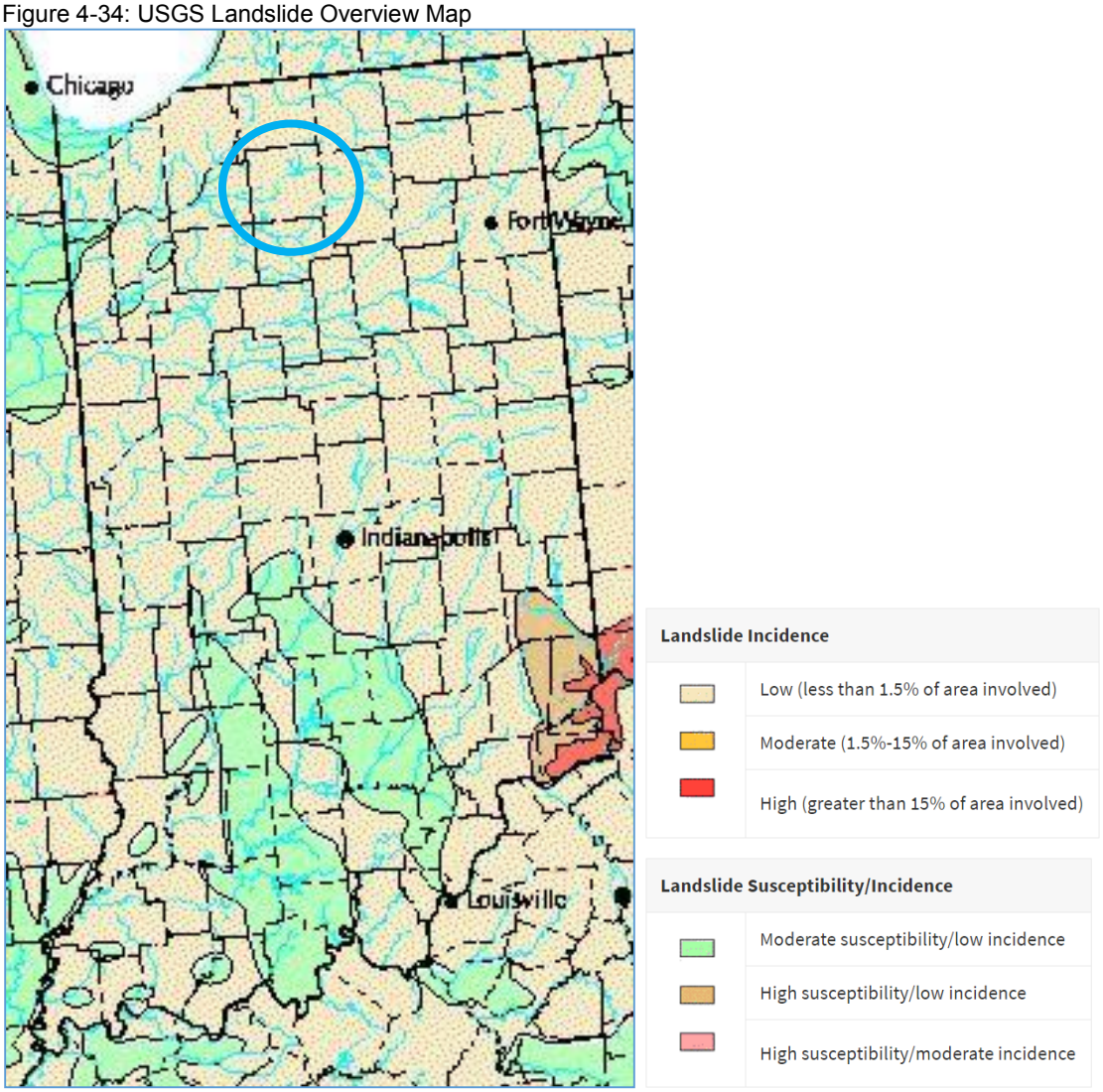
The extent of the ground failure hazard is closely related to development near the regions that are at risk. There are no reported karst areas in Marshall County and the area does not contain any highly mobile steams and thus is not prone to Fluvial Erosion Hazard (FEH) areas.

Figure 4-33: Fluvial Erosion Hazard



The US Geological Survey's Landslide Overview Map of the Conterminous United States shows two large zones in south-central Indiana as having moderate susceptibility for landslides, but with low incidence of landslides. In contrast, the majority of northern Indiana has a very low (less than 1.5% of the area involved) incidence of landslides and only the northwest is shown as having a moderate level of susceptibility. As seen in USGS Landslide Overview Map figure, Marshall County predominantly lies in the low incidence zone.

Figure 4-34: USGS Landslide Overview Map



Risk Analysis

Exposure Analysis

As seen in Figure 4-35, the terrain of Marshall County is primarily flat expanses typical of the northern portion of the state. Any variance in slope is typically found near the many streams and rivers that run primarily through the western half of the county. The existing critical facilities and infrastructures of Madison County are not subjected to any major slope failure but have been mapped for reference.

Figure 4-35: Slope Map – Marshall County

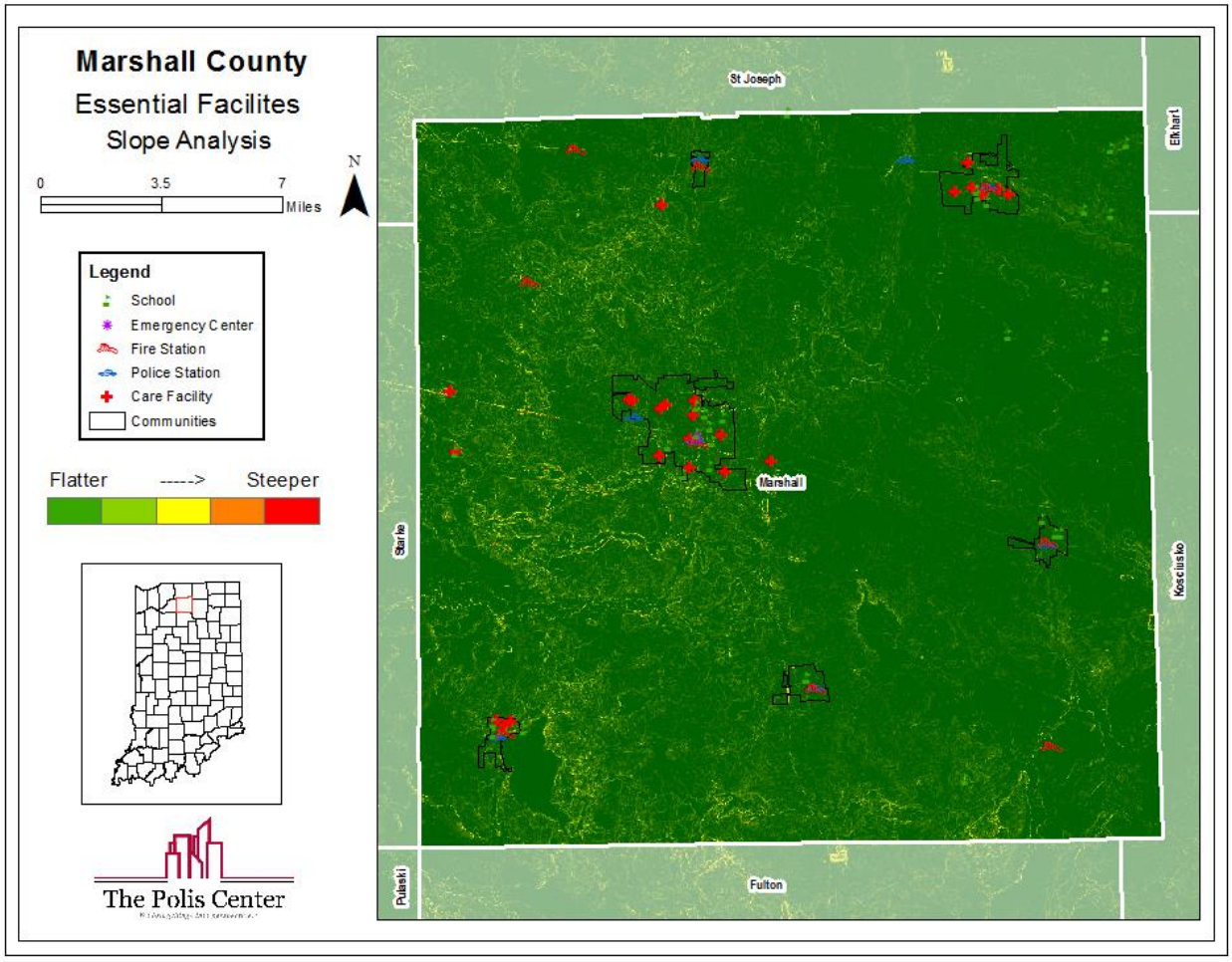
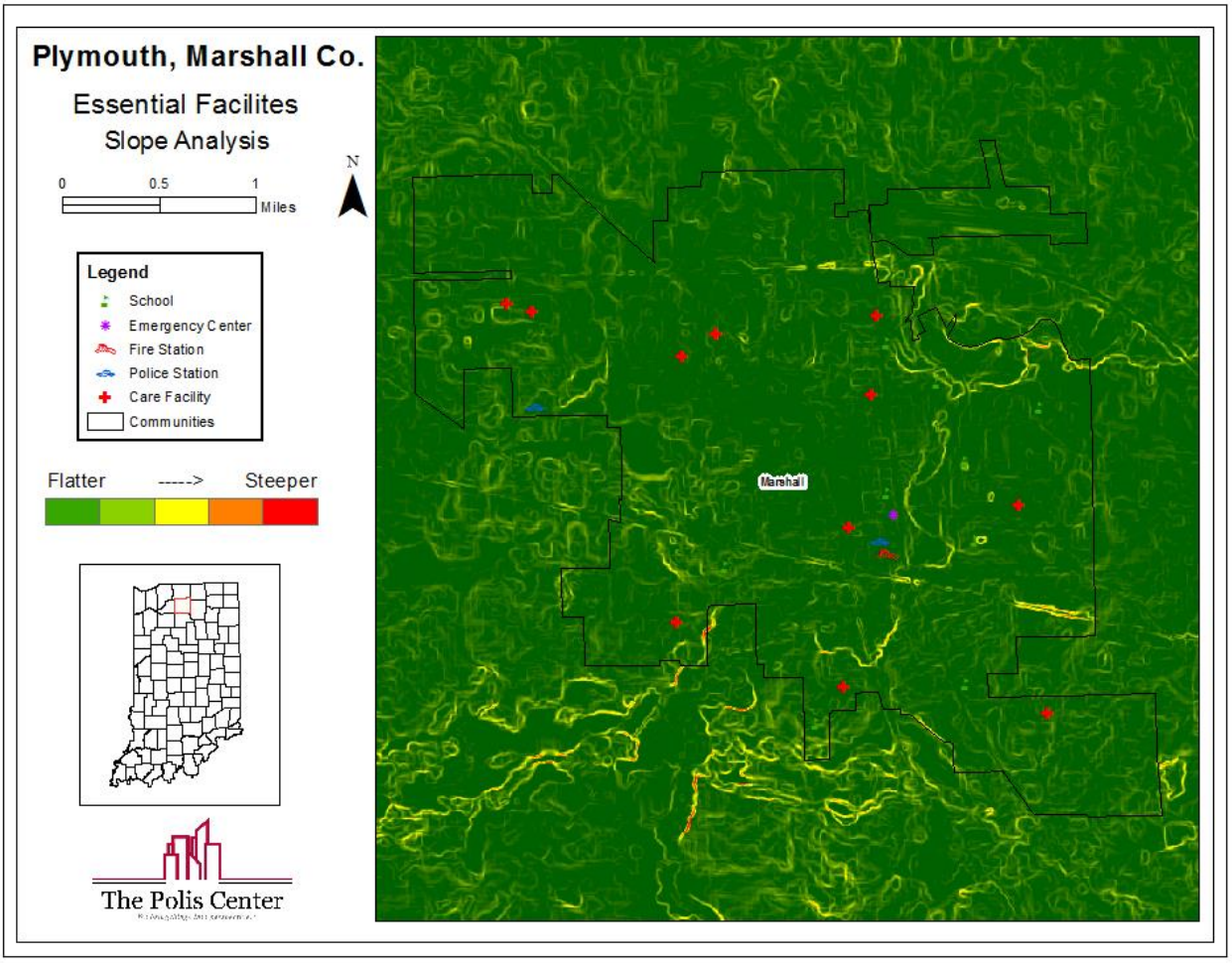


Figure 4-36 shows Plymouth and the surrounding area which displays some of the more diverse slopes in the county.

Figure 4-36: Slope Map – Plymouth, Marshall County



Relationship to other Hazards

Flooding – Flooding is typically the leading cause to ground failure, particularly along streams. Ground failure and flooding combine to impact property and infrastructure such as roads and bridges.

Plans and Programs in Place

Marshall County Erosion and Sediment Control Ordinance: - Ordinance intended to control soil erosion and sedimentation caused by land disturbing activities within Marshall County. The ordinance applies to all land disturbing activities within the boundaries and jurisdiction of Marshall County except for when superseded by a local city or town ordinance.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.4 Summer Storms: Thunderstorms, Hailstorms, Lightning, Tornadoes, Windstorms

Hazard Description

Thunderstorms

Severe thunderstorms are defined as thunderstorms with one or more of the following characteristics: strong winds, large damaging hail, or frequent lightning. Severe thunderstorms most frequently occur in Indiana during the spring and summer but can occur any month of the year at any time of day. A severe thunderstorm's impacts can be localized or can be widespread in nature. A thunderstorm is classified as severe when it meets one or more of the following criteria.

- Hail of diameter 0.75 inches or higher
- Frequent and dangerous lightning
- Wind speeds equal to or greater than 58 miles an hour

Lightning

Lightning is caused by the discharge of electricity between clouds or between clouds and the surface of the earth. In a thunderstorm there is a rapid gathering of particles of moisture into clouds and forming of large drops of rain. This gathers electric potential until the surface of the cloud (or the enlarged water particles) is insufficient to carry the charge, and a discharge takes place, producing a brilliant flash of light. The power of the electrical charge and intense heat associated with lightning can electrocute on contact, split trees, ignite fires, and cause electrical failures. Most lightning casualties occur in the summer months, during the afternoon and early evening.

Hail

Hail is a product of a severe thunderstorm. Hail consists of layered ice particles which are developed when strong updrafts within the storm carry water droplets above the freezing level. They remain suspended and continue to grow larger, until their weight can no longer be supported by the winds. The NWS uses the following descriptions when estimating hail sizes: pea size is ¼ inch, marble size is ½ inch, dime size is ¾ inch, quarter size is 1 inch, golf ball size is 1 ¾ inches, and baseball size is 2 ¾ inches. Individuals who serve as volunteer "storm spotters" for the NWS are

located throughout the state, and are instructed to report hail dime size (¾ inch) or greater. Hailstorms can occur throughout the year; however, the months of maximum hailstorm frequency are typically between May and August. Although hailstorms rarely cause injury or loss of life, they can cause significant damage to property, particularly roofs and vehicles.

Windstorms and Tornadoes

Windstorms can and do occur in all months of the year; however, the most severe windstorms usually occur during severe thunderstorms in the warm months. Marshall County frequently experiences winds blowing at over 50 knots. According to NCDC records, in Marshall County there were 132 thunderstorm wind and high wind events reported between 1976 and August 2016, with wind speeds of up to 61 knots. These winds can inflict damage to buildings and in some cases overturn high-profile vehicles. On September 14, 2008, NCDC reported that a person died as a result of high winds in Marshall County.

Associated with strong thunderstorms, downbursts are severe localized downdrafts from a thunderstorm or rain shower. This outflow of cool or colder air can create damaging winds at or near the surface. Downburst winds can potentially cause as much damage as a small tornado and are often confused with tornadoes due to the extensive damage that they inflict. As these downburst winds spread out, they are frequently referred to as straight-line winds. Straight-line winds can cause major structural and tree damage over a relatively large area. The most recent severe wind and hail storms in Marshall County are shown in map and in tables in the Appendix.

Summer storms, including thunderstorms, hailstorms, and windstorms affect Marshall County on an annual basis. Thunderstorms are the most common summer hazardous event in the county, occurring primarily during the months of May through August, with the severest storms most likely to occur from mid-May through mid-July. Typically, thunderstorms are locally produced by cumulonimbus clouds, are always attended by lightning, and are often accompanied by strong wind gusts, heavy rain, and sometimes hail and tornadoes.

Tornadoes are violently-rotating columns of air extending from thunderstorms to the ground, with wind speeds between 40-300 mph. The *Glossary of Meteorology* defines a tornado as a "violently rotating column of air, in contact with the ground, either pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud." They develop under three scenarios: (1) along a squall line; (2) in connection with thunderstorm squall lines during hot, humid weather; and (3) in the outer portion of a tropical cyclone. Funnel clouds

are rotating columns of air not in contact with the ground; however, the column of air can reach the ground very quickly and become a tornado.

The Cooperative Institute of for Mesoscale Meteorological Studies is currently conducting a Multi-Radar Multi-Sensor system project that harnesses weather data from multiple sources, integrates the information, and allows users to access live displays of data. For more information on the Cooperative Institute of for Mesoscale Meteorological Studies' Live Data projects visit http://cimms.ou.edu/index.php/research/live-data/.

Summer Storm History in Marshall County

All facilities are vulnerable to severe thunderstorms. These facilities will encounter many of the same impacts as any other building within the jurisdiction including structural failure, damaging debris (trees or limbs), roofs blown off or windows broken by hail or high winds, fires caused by lightning, and loss of building functionality, such as a damaged police station would no longer be able to serve the community.

During a severe thunderstorm, the types of infrastructure that could be impacted include roadways, utility lines and pipes, railroads, and bridges. Since the county's entire infrastructure is equally vulnerable, it is important to emphasize that any number of these structures could become damaged during a severe thunderstorm. The impacts to these structures include impassable roadways, broken or failed utility lines, causing loss of power or gas to the community, or railway failure from broken or impassable tracks. Additionally, bridges could fail or become impassable, causing risks to traffic.

Historically, tornadoes predominantly moved from west to east across the county. The extent of the hazard varies in terms of the extent of the path and the wind speed. Tornadoes can occur at any location within the county. Based on historical information, the probability of a tornado in Marshall County is high and the potential impact of a tornado is significant; therefore, the overall risk of a tornado in Marshall County is high.

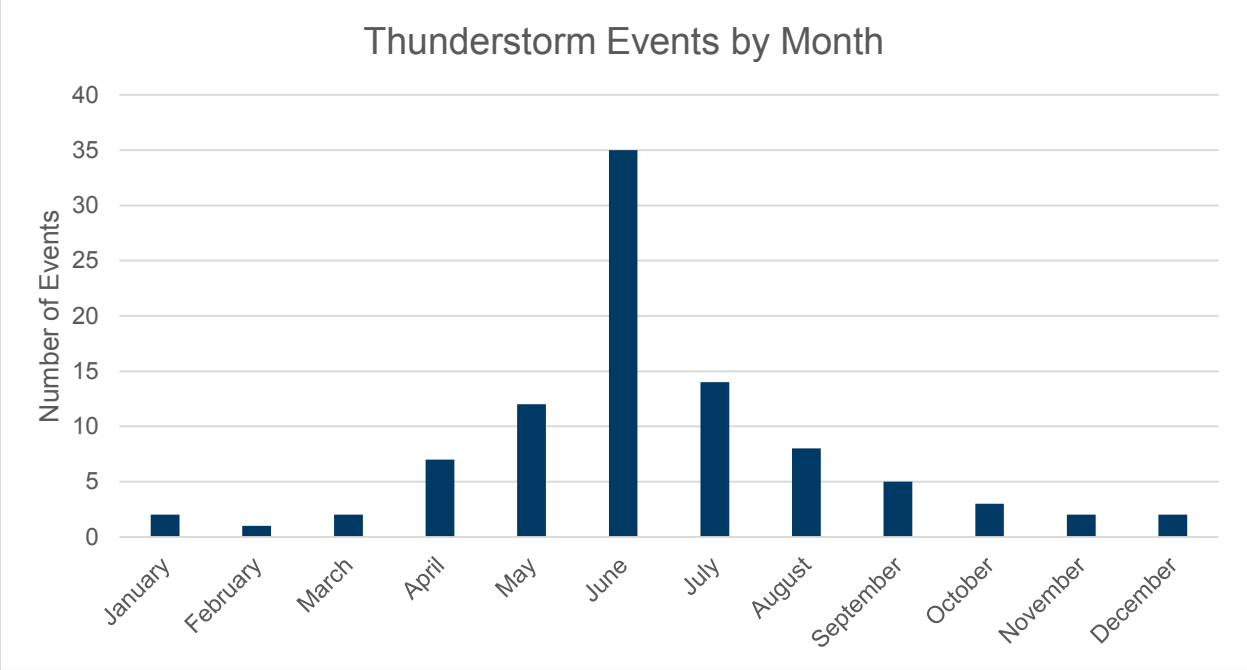
In January 2008, lightning struck a garage attached to a house in the 11000 block of south Michigan Road. When firefighters arrived, the garage was engulfed in flames. The garage and three vehicles in it sustained severe damage, and parts of the house incurred smoke and water damage. Damage was estimated at $90,000. It has been determined that, since 1998, Marshall County has incurred $1.04 million in damages relating to thunderstorms, including hail, lightning, and high winds.

There have been 183 thunderstorm events reported to the NOAA in Marshall County since 1950 as shown in the figure Marshall County Historical Thunderstorm Events by Month (1950-2016).

There have been 36 NCDC reported hail events in Marshall County since January 1965. During this time frame no deaths, injuries, or property damage were reported as a direct result of hail in Marshall County.

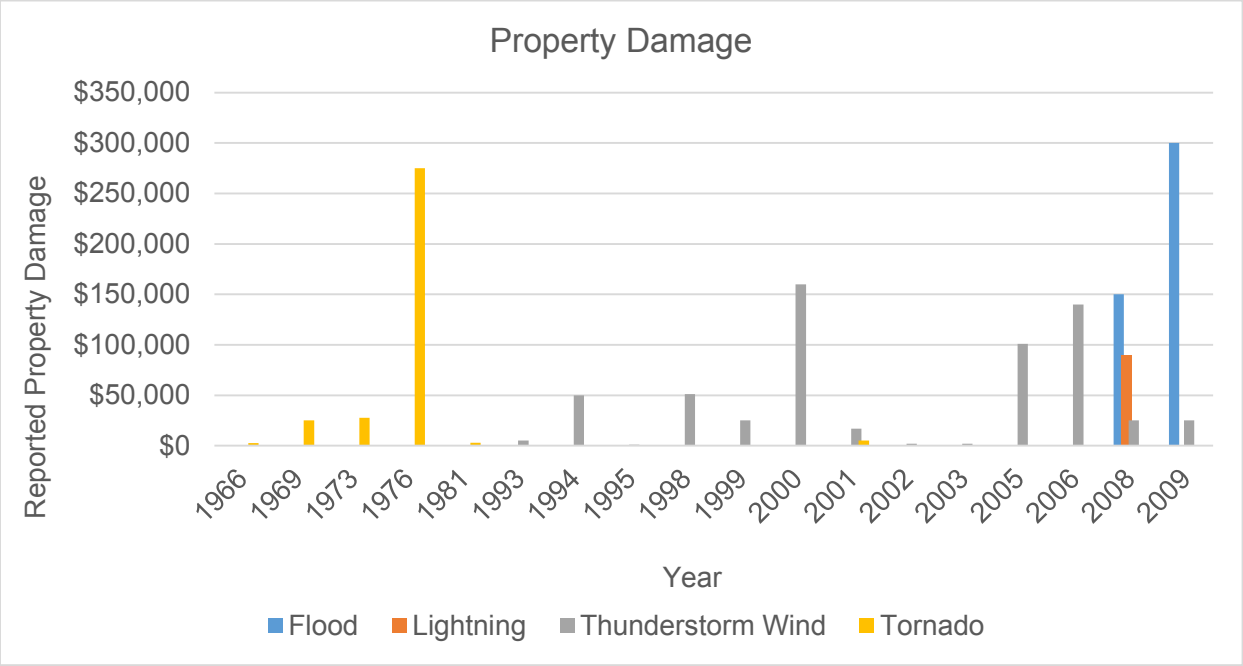
Although these storms are most typical in summer months, they can occur during every season. The Marshall County Historical Thunderstorm Events by Month (1965-2016) figure displays the number of events in all months.

Figure 4-37: Marshall County Historical Thunderstorm Events by Month (1965-2016)



Historically, several severe tornadoes have impacted Marshall County. In April 1965, a particularly severe tornado swept through Marshall County killing three people, injuring twenty-eight, and inflicting over 25 million in property damages. In 1976 another tornado injured ten people and less several displaced from their homes. There have been three tornadoes reported to NCDC in Marshall County since January 2008 and 26 since 1950.

Figure 4-38: Marshall County Tornado Property Losses (1965- 2016)



The Marshall County Historical Tornado Tracks figure shows tornado touchdown points and tracks in Marshall County since 1950. The county has experienced tornadoes in 14 of the 61 complete years on record. According to these statistics, there is a 23% chance of a tornado affecting Marshall County each year.

Vulnerability and Future Development

The Storm Water Drainage Ordinance for Marshall County, Indiana, addresses policies for the controlled release of storm water runoff and declares that the release rate of storm water from developed lands shall not exceed the release rate from the land area in it pre-construction state.

Since topography and the availability and adequacy of outlets for storm runoff vary with almost every site, the requirements for storm drainage tend to be an individual matter for any project. The Storm Water Drainage Ordinance recommends that each proposed project be discussed with the Marshall County Surveyor and Plan Director at the earliest practical time in the planning stage.

Risk Analysis

Risk analysis involves evaluating vulnerable assets, describing potential impacts, and estimating losses for each hazard. The purpose of this analysis is to help the community understand the

greatest risks facing the planning area. This step occurs after hazards and assets have been identified.

Exposure Analysis

Since all buildings are subject to exposure from summer storm events, it is important to recognize the numerous potential benefits of investing in mitigation. An ounce of prevention can be more effective than a pound of cure. Taking steps to guard against and prepare for hazardous events can be one of the most effective means of safeguarding property, community assets, and lives.

The identification of safe rooms and clear communication on the execution of the use of them during a hazardous event can be vital in providing safety to populations, particularly for those who do not inhabit buildings with basements or have easy access to designated shelters. Schools and public buildings where large groups of people will all require shelter demand special attention and planning.

During a tornado, the types of infrastructure that could be impacted include roadways, utility lines and pipes, railroads, and bridges. Since the county's entire infrastructure is equally vulnerable, it is important to emphasize that many of these structures could become damaged during a tornado. The potential impacts to these structures include broken, failed, or impassable roadways, broken or failed utility lines, such as loss of power or gas to community, and railway failure from broken or impassable tracks. Bridges could fail or become impassable, causing risk to traffic.

Combining Available Data and Methods

During a tornado the types of infrastructure that could be impacted include roadways, utility lines/pipes, railroads, and bridges. Since the county's entire infrastructure is equally vulnerable, it is important to emphasize that any number of these items could become damaged during a tornado. The impacts to these items include broken, failed, or impassable roadways, broken or failed utility lines (e.g. loss of power or gas to community), and railway failure from broken or impassable railways. Bridges could fail or become impassable causing risk to traffic.

An example scenario is described as follows to gauge the anticipated impacts of tornadoes, in terms of numbers and types of buildings and infrastructure, in the county.

GIS overlay modeling was used to determine the potential impacts of an F3 tornado. The analysis used a hypothetical path based upon an F3 tornado event that would run for 24.5 miles through the

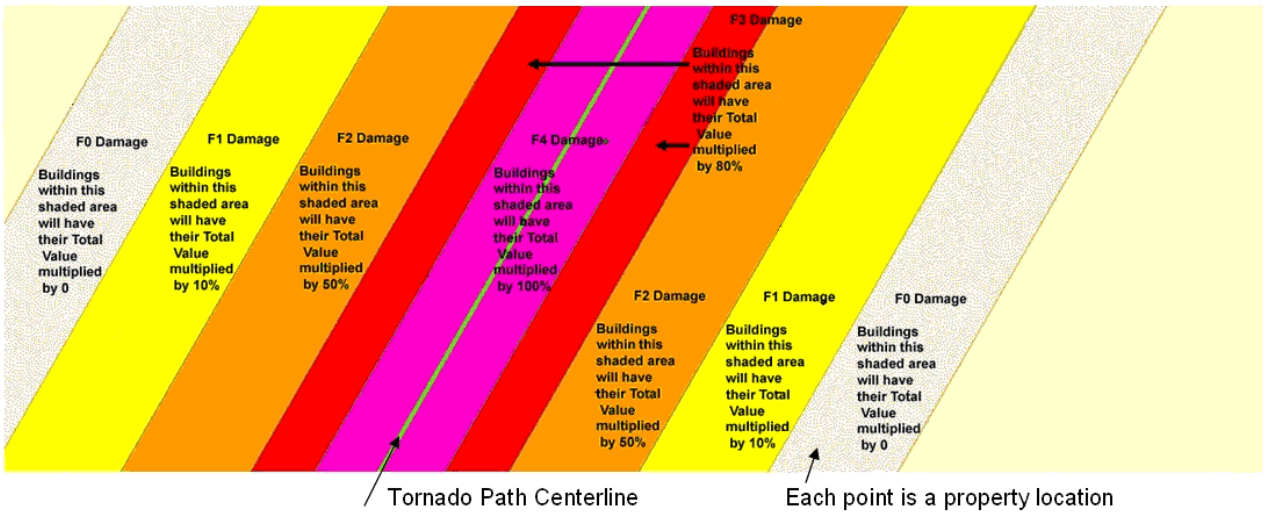
towns of Culver, Plymouth, and Bremen. The selected widths were modeled after a recreation of the Fujita-Scale guidelines based on conceptual wind speeds, path widths, and path lengths. There is no guarantee that every tornado will fit exactly into one of these six categories. Table 4-29 depicts tornado damage curves as well as path widths.

Table 4-29: Tornado Path Widths and Damage

Enhanced Fujita Scale	Path Width (feet)	Maximum Expected Damage
EF5	3,000	100%
EF4	2,400	100%
EF3	1,800	80%
EF2	1,200	50%
EF1	600	10%
EF0	300	0%

Within any given tornado path there are degrees of damage. The most intense damage occurs within the center of the damage path with a decreasing amount of damage away from the center of the path. This natural process was modeled in GIS by adding damage zones around the tornado path. Figure 4-39 and Table 4-30 describe the zone analysis.

Figure 4-39: EF4 Tornado Analysis, Using GIS Buffers



Once the hypothetical route is digitized on the map, several buffers are created to model the damage functions within each zone.

Since 2007, tornado strength in the United States is ranked based on the Enhanced Fujita scale (EF scale), replacing the Fujita scale introduced in 1971. The EF scale uses similar principles to the Fujita scale, with six categories from 0-5, based on wind estimates and damage caused by the tornado. The EF Scale is used extensively by the NWS in investigating tornadoes (all tornadoes are

now assigned an EF Scale number), and by engineers in correlating damage to buildings and techniques with different wind speeds caused by tornadoes. To see a comparative table of F and EF scales, see http://www.spc.noaa.gov/faq/tornado/ef-scale.html.

An EF3 tornado has three damage zones, as shown in Table 4-32. Maximum devastation of 80% is estimated within 150 feet of the tornado path (the darker-colored Zone 1). Within the outer buffer, between 300 and 600 feet of the tornado path (the lightest-colored Zone 3), 10% of the buildings will be damaged.

Table 4-30: F4 Tornado Zones and Damage Curves

Fujita Scale	Zone	Buffer (feet)	Damage Curve
EF-3	3	300-600	10%
EF-3	2	150-300	50%
EF-3	21	0-150	80%

Scenario

The planning team determined to recreate a historical EF3 tornado that occurred in 2002. A hypothetical EF3 tornado path that stretches from the northeastern and southcentral part of the county through Plymouth. The damage curve buffers for this hypothetical tornado path are shown in Figure 4-40.

Figure 4-40: Modeled F4 Tornado Damage Buffers in Marshall County

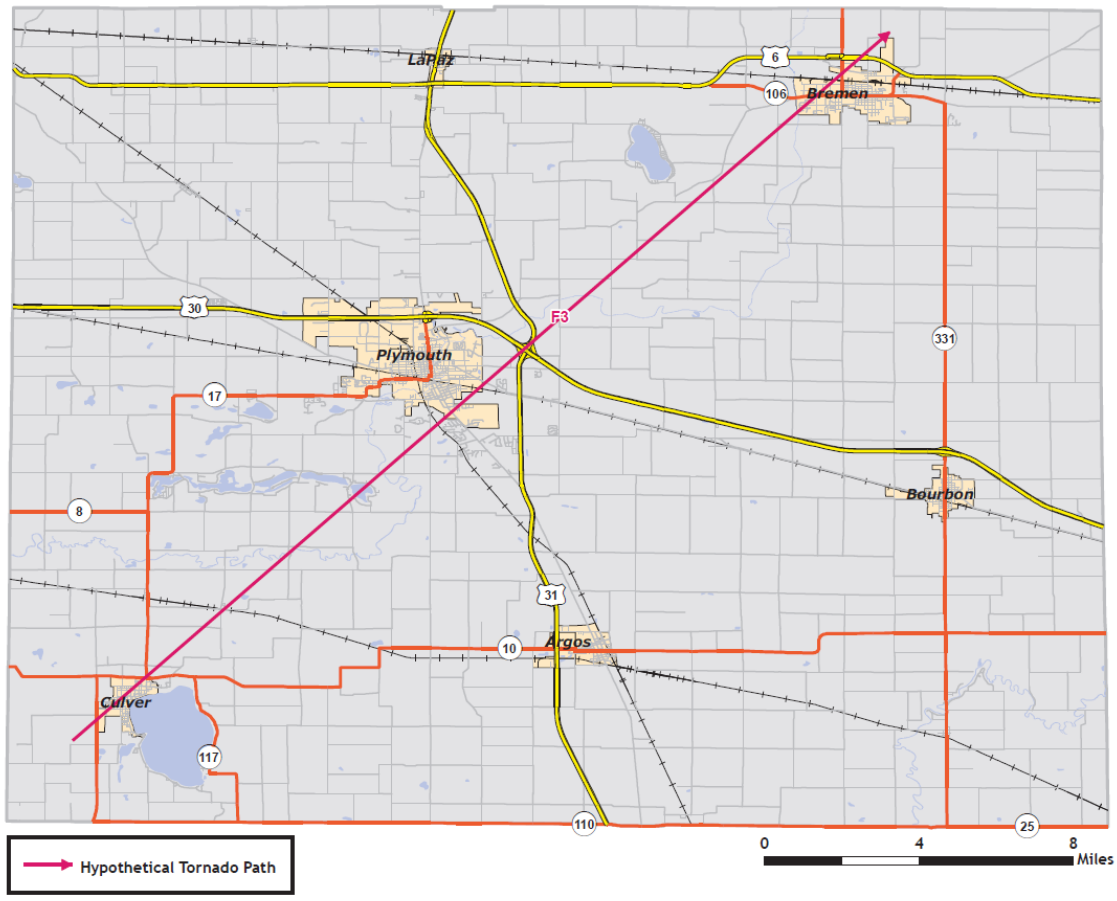
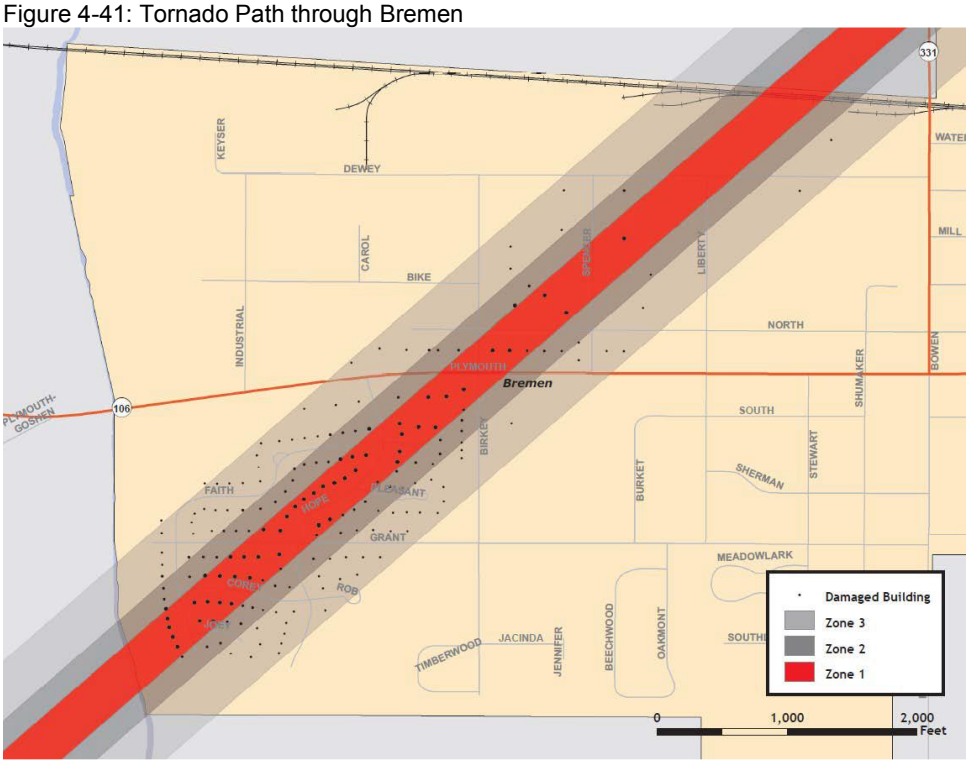


Figure 4-41: Tornado Path through Bremen



Results

The results of the analysis are depicted in Tables 4-31 and 4-32. The GIS analysis estimates that 794 buildings will be damaged. The estimated building losses are $48.6 million. The building losses are an estimate of building replacement costs multiplied by the percentages of damage. The overlay was performed against parcels provided by Marshall County that were joined with Assessor records showing property improvement.

The Assessor records often do not distinguish parcels by occupancy class when the parcels are not taxable; therefore, the total number of buildings and the building replacement costs for government, religious/non-profit, and education may be underestimated.

Table 4-31: Estimated Building Losses by Occupancy Type

Occupancy	Zone 1	Zone 2	Zone 3
Residential	167	171	292
Commercial	19	17	40
Industrial	4	4	10
Agriculture	11	11	22
Religious	1	4	11
Government	1	2	4
Education	1	0	2

Table 4-32: Estimated Losses by Zone

Occupancy	Zone 1	Zone 2	Zone 3
Residential	$16,487	$10,970	$3,408
Commercial	$3,891	$2,236	$1,250
Industrial	$1,632	$2,790	$1,779
Agriculture	$1,790	$1,031	$430
Religious	$107	$503	$220
Government	$0	$0	$0
Education	$0	$0	$34
Total	$23,907	$17,530	$7,122

There are two essential facilities located within 600 feet of the hypothetical tornado path. The model predicts that one police station and one school would experience damage. The affected facilities are identified in Table 4-3, and their geographic locations are shown in Figure 4-43.

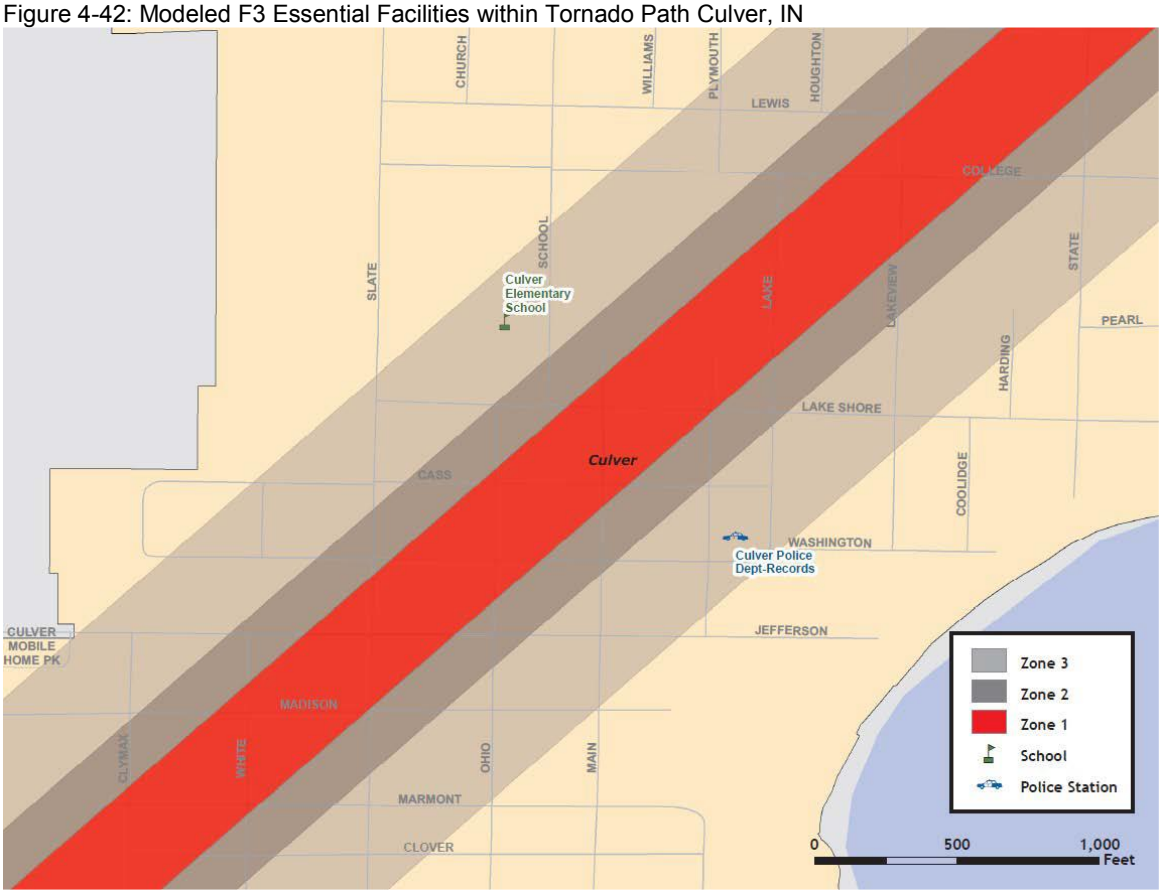
Essential Facility Damage

There were no essential facilities located within 600 feet of the hypothetical tornado path. Although other structures would be impacted, the affected essential facilities are identified in in Table 4-33. One Essential Facility – Footsteps Montessori Pre School – is situated just over 600 feet from the path, within Zone 4. Figure 4-42 depicts the locations of this essential facilities in relation to the path of the tornado.

Table 4-33: Estimated Essential Facilities Affected

Facility Type	Name
School	Culver Elementary School
Police	Culver Police Department

Figure 4-42: Modeled F3 Essential Facilities within Tornado Path Culver, IN



Relationship to other Hazards

Flooding - Thunderstorms with heavy amounts of rainfall can cause localized flooding, which can impact property and infrastructure such as roads.

Public Health - Public health can be impacted as a result of wastewater spills due to flooding.

Wildland Fire - Lighting strikes may ignite a wildland fire. Windstorms that result in downed timber increase the fuel load in a forest that may increase the risk of wildfire.

Structural Fire - Lighting strikes may ignite a wildland or structural fire.

Plans and Programs in Place

SKYWARN Program - The National Weather Services (NWS) has a Northland SKYWARN Program, offering annual training sessions to volunteers in Marshall County. Marshall County held the 2017 Skywarn Spotter Training on February 23, 2017 in Plymouth. There is a network of trained SKYWARN spotters in Marshall County. These volunteers help keep their local communities safe

by providing timely and accurate reports of severe weather to their local National Weather Service office.

Storm Shelters – There is are no Indiana Department of Health requirements for storm shelters based on number of manufactured homes and date of licensing.

In 2016, the Marshall County Emergency Management Agency announced on their faced book page that the 6/8/2016 Storm Shelter Program Re-Opened for Application after the Indiana Department of Homeland Security (IDHS) re-opened a program that will provide financial support to Indiana residents who wish to construct and install a severe weather safe room in their home.

The voluntary program reimbursed homeowners for 75 percent of the eligible costs (up to $4,500) to construct and install Federal Emergency Management Agency (FEMA) compliant safe rooms in their homes. Funding for the program was provided through FEMA.

Those who participated were required to obtain a building permit from a certified building department and had the safe room inspected during installation and/or after installation completion. Participants were also required to build their safe rooms to meet or exceed the standards dictated in FEMA 320 or 361 guidelines. These guidelines can be accessed at the following links:

http://www.fema.gov/fema-p-320-taking-shelter-storm-buildin...
https://www.fema.gov/media-library/assets/documents/3140

Outdoor Warning Sirens– Marshall County, Indiana does possess warning sirens and participated in tornado warning tests issued by the National Weather Service offices in Indiana, triggering programmed electronic devices. Sirens are activated in the event of a tornado warning or severe thunderstorms with winds of 70 mph or greater. Warning sirens are not used for the dual purpose of summoning emergency management workers in the event of an emergency rather they are used to issue a warning to the public concerning inclement weather conditions, enabling them to seek shelter.

Backup Power - For the courthouse complex there is an emergency generator for the jail. There is a small emergency generator that will power EMS, fire and police radio systems. In the city of Plymouth, the fire department has portable generators, one of which is dedicated to water supply and another that can be located as needed.

Burying Power Lines - Burying power lines help eliminate loss of power due to severe summer storms. The power company works to accommodate requests for installation of underground power lines to residents or businesses receiving connection of new power in areas where it is feasible. Some energy providers bury lines in areas where it makes sense to do so, but does not offer this as a regular customer option.

Vegetation Management - The Marshall County Transportation Department strives to clear the right of way of its improved, high-volume roads to reduce tree blowdown in the event of severe summer storms.

School Closings - All school districts within Marshall County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems which allow them to notify all families who are registered in the school system with up-to-date information.

NOAA Weather Radio Transmitter Towers - The National Weather Service delivers storm warnings and key information during severe winter weather events over its radio towers. According to the National Weather Service Coverage Listing for Indiana, all of Marshall County is covered by the National Weather Service transmitters in South Bend and North Webster. The transmitter located Michigan City can be accessed by all of Marshall County except for the southeastern regions of the county.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Marshall County utilizes the CodeRED Mass Notification System and the Marshall County Sheriff's Office Facebook page, as well as local news media. Marshall County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Public Education and Awareness - Marshall County promotes the National Weather Service's "Severe Weather Awareness Week" held in April each year. The event seeks to educate residents on the dangers of severe summer storm events and highlights the importance of preparing for severe weather before it strikes.

Program Gaps or Deficiencies

Outdoor Warning Sirens – Some of the areas within the communities of LaPaz, Culver, Bourbon, Bremen, and Plymouth do not have warning sirens. Marshall County is in the process of equipping these communities with warning sirens as part of their mitigation action strategies.

Storm Shelters - Not all Marshall County public schools have designated safe rooms.

Backup Power - Not all county facilities have backup power in the event of a disaster.

4.5 Drought

Hazard Description

The meteorological condition that creates a drought is below normal rainfall. However, excessive heat can lead to increased evaporation, which will enhance drought conditions. Droughts can occur in any month. Drought differs from normal arid conditions found in low rainfall areas. Drought is the consequence of a reduction in the amount of precipitation over an undetermined length of time (usually a growing season or more).

There are several common types of droughts including meteorological, hydrological, agricultural, and socioeconomic. Figure 4-43 describes the sequence of drought occurrence and impacts of drought types.

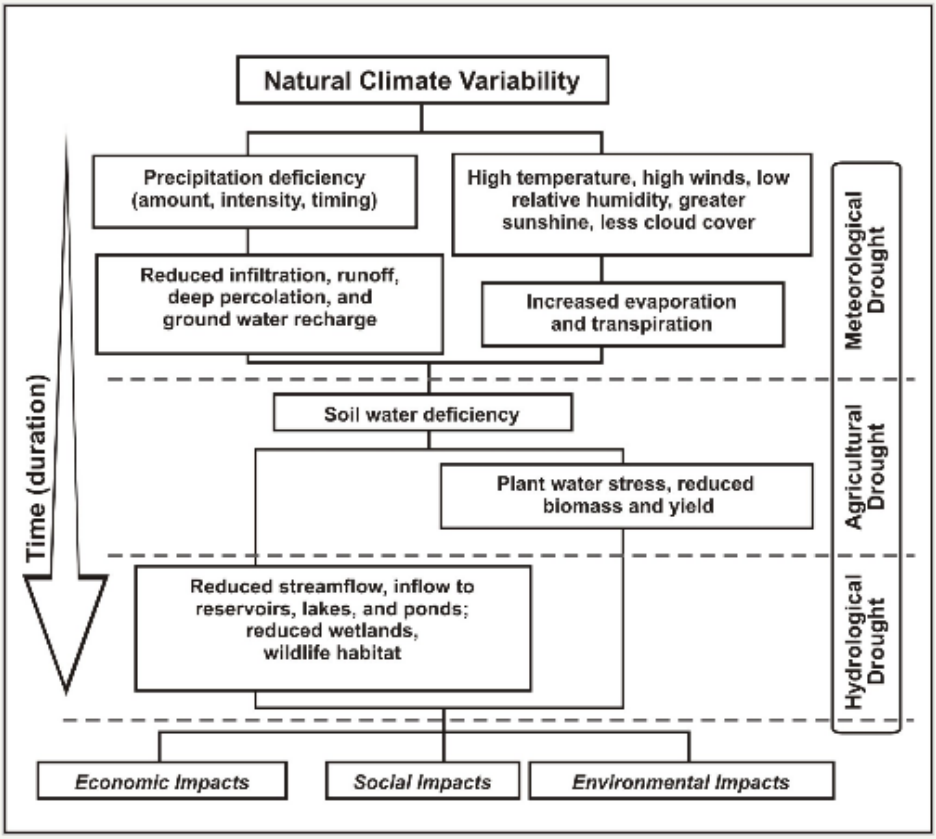
Meteorological: Defined by the degree of dryness (as compared to an average) and the duration of the dry period. These are region-specific and only appropriate for regions characterized by year-round precipitation.

Hydrological: Associated with the effects of periods of precipitation shortfalls (including snow) on surface or subsurface water supply, including stream flow, reservoir and lake levels, and groundwater. Impacts of hydrological droughts do not emerge as quickly as meteorological and agricultural droughts. For example, deficiency on reservoir levels may not affect hydroelectric power production or recreational uses for many months.

Agricultural: Links characteristics of meteorological or hydrological drought to agricultural impacts. An agricultural drought accounts for the variable susceptibility of crops during different stages of crop development from emergence to maturity.

Socioeconomic: Links the supply and demand of some economic good, e.g. water, forage, food grains, and fish, with elements of meteorological, hydrological, or agricultural droughts. This type of drought occurs when demand for an economic good exceeds supply as a result of weather-related shortfall in water supply.

Figure 4-43: Sequence of Drought Occurrence and Impacts



Sequence of drought occurrence and impacts for commonly accepted drought types. All droughts originate from a deficiency of precipitation or meteorological drought but other types of drought and impacts cascade from this deficiency. (Source: National Drought Mitigation Center, University of Nebraska-Lincoln, U.S.A.)

A drought refers to an extended period of deficient rainfall relative to the statistical mean for a region. Drought can be defined according to meteorological, hydrological, socioeconomic, and agricultural criteria. Meteorological drought is qualified by any significant deficit of precipitation. Hydrological drought is manifest in noticeably reduced river and stream flow and critically low groundwater tables. The term agricultural drought indicates an extended dry period that results in crop stress and harvest reduction. Socioeconomic drought refers to the situation that occurs when water shortages begin to affect people and their lives. It associates economic goods with the elements of meteorological, agricultural, and hydrological drought. Many supplies of economic goods (e.g., water, food grains, and hydroelectric power) are greatly dependent on the weather. Due

to natural variations in climate, water supplies are high in some years but low in others. Fluctuating long-term climate variations make drought difficult to predict.

Drought is a climatic phenomenon that occurs in Marshall County. The meteorological condition that creates a drought is below-normal rainfall. Excessive heat, however, can lead to increased evaporation, which will enhance drought conditions. Droughts can occur in any month. Drought differs from normal arid conditions found in low-rainfall areas. Drought is the consequence of a reduction in the amount of precipitation over an undetermined length of time (usually a growing season or more). Drought conditions are often accompanied by extreme heat, which is defined as temperatures that hover 10º F or more above the average high for the area and last for several weeks. Extreme heat can occur in humid conditions when high atmospheric pressure traps the damp air near the ground or in dry conditions, which often provoke dust storms.

The severity of a drought depends on location, duration, and geographical extent. Additionally, drought severity depends on the water supply, usage demands made by human activities, vegetation, and agricultural operations. Drought brings several different problems that must be addressed. The quality and quantity of crops, livestock, and other agricultural assets will be affected during a drought. Drought adversely can impact forested areas, leading to an increased potential for extremely destructive forest and woodland fires that could threaten residential, commercial, and recreational structures.

The Palmer Drought Severity Index (PDSI), developed by W.C. Palmer in 1965, is a soil moisture algorithm utilized by most federal and state government agencies to trigger drought relief programs and responses. The objective of the PDSI is to provide standardized measurements of moisture, so that comparisons can be made between locations and periods of time—usually months. The PDSI is designed so that a -4.0 in Indiana has the same meaning in terms of the moisture departure from a climatological normal as a -4.0 does in South Carolina.

The U.S. Drought Monitor (USDM) provides a national assessment on drought conditions in the United States. The following table is a reference from the classification scheme provided by the USDM, and the correlation between PDSI and the category, descriptions, and possible impacts associated with those level events. This classification is often used to refer to the severity of droughts for statistical purposes. The USDM provides weekly data for each county, noting the percent of land cover in the condition of the drought category identified below.

Table 4-34: USDMX

Category	Description	Possible Impacts	Palmer Drought Severity Index
D0	Abnormally Dry	Going into drought: -short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits	-1.0 to -1.9
D1	Moderate Drought	-Some damage to crops, pastures -Streams, reservoirs, or wells low, some water shortages developing or imminent -Voluntary water-use restrictions requested	-2.0 to -2.9
D2	Severe Drought	-Crop or pasture losses likely -Water shortages common -Water restrictions imposed	-3.0 to -3.9
D3	Extreme Drought	-Major crop/pasture losses -Widespread water shortages or restrictions	-4.0 to -4.9
D4	Exceptional Drought	-Exceptional and widespread crop/pasture losses -Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less

In the past decade, the US has continued to consistently experience drought events with economic impacts greater than $1 billion; FEMA estimates that the nation's average annual drought loss is $6 billion to $8 billion. For Indiana alone, the National Drought Mitigation Center reported hundreds of drought impacts in the past decade ranging from water shortage warnings to reduced crop yields and wild fires.

Droughts are natural events that can potentially lead to fires. This plan will identify four major categories of fires within the county: tire fires, structural fires, wildfires, and arson.

Fires

Fires pose a significant threat throughout the United States. According to the National Fire Protection Agency, in 2014, the United States fire department responded to an estimated 1,298,000 fires. As a direct result of these fires, 3,275 civilians died, 15,775 civilians suffered fire injuries and an estimated $11.6 billion was consumed in property damages caused by fires. During 2014, every 2 hours and 41 minutes a civilian died in a fire related incident, and every 33 minutes a civilian was injured in a fire. Despite the multitude of fire related casualties suffered in 2014, the number of fire hazards per year has actually declined compared to 1977 when over 3,264,500 fires occurred. The U.S. Fire Administration offers fire prevention and public education outreach materials and educational programs in order further diminish the number of yearly fire casualties.

Tire Fires

The state of Indiana generates thousands of scrap tires annually. Many of those scrap tires end up in approved storage sites that are carefully regulated and controlled by federal and state officials. However, scrap tires are sometimes intentionally dumped in unapproved locations throughout the state. Marshall County is part of the Southeastern Indiana Recycling District. Used tires can be brought to the Marshall County Recycling Center in Osgood for disposal. The number of unapproved locations where tires have been dumped cannot be readily determined. Illegal dumping sites are owned by private residents who have been continually dumping waste and refuse, including scrap tires, at those locations for many years. Some lonely areas may be utilized as sites for dumping without the property owners' knowledge or consent. Targeting abandoned properties in particular, offenders will haul debris to secluded areas for illegal waste disposal. Over time an extensive amount of garbage, including tires, accumulates at these sites.

Tire disposal sites can be fire hazards, in large part, because of the enormous number of scrap tires typically present at one site. This large amount of fuel renders standard firefighting practices nearly useless. Flowing and burning oil released by the scrap tires can spread the fire to adjacent areas. Tire fires differ from conventional fires in the following ways:

- Using water and/or foam to extinguish a tire fire is often futile although water may still be used to keep unburned tires form igniting.
- Relatively small tire fires can require significant fire resources to control and extinguish.
- Those resources often cost much more than Marshall County government can absorb compared to standard fire responses.
- There may be significant environmental consequences of a major tire fire. Extreme heat can convert a standard vehicle tire into approximately two gallons of oily residue that may leak into the soil or migrate to streams and waterways.

Structural Fires

Lightning strikes, poor building construction, and building condition are the main causes for most structural fires in Indiana. In 2014, approximately 74% of all structural fires took place in the home. According to the National Fire Protection Association, home fires account for 84% of civilian fire deaths in 2014. Neighborhoods and cities where buildings are constructed close together or attaching face particular risks from spreading fires. Structural fires and wildfires have both been

known to unexpectedly jump across streets and even extend across freeways igniting buildings in the surrounding vicinity and rapidly spreading.

Fires at businesses and public buildings can also cause significant damage particularly if they contain explosive or highly flammable materials. The fire at the Advanced Magnesium Alloys Corp. in Anderson, Indiana in 2005 demonstrates the dangers posed by industrial fires. The fire erupted on a skid holding 6,000 pounds of magnesium, which is a highly flammable metal that releases toxic fumes when ignited. Winds drove the smoke and toxic fumes south into a neighborhood forcing authorities to evacuate about 5,000 people. Since water can cause a flare-up or explosion, firefighters use dry sand to combat magnesium fires. Explosions forced fighters out of the company plant. Running low on sand, firefighters were forced to let the fire burn itself out. Late on Saturday the next day, the U.S. Environmental Protection Agency finally deemed the air quality safe for evacuees to return to their homes. The fire that erupted at the Advanced Magnesium Alloys Corp. in Anderson, Indiana serves as a cautionary example of the need to prepare for the possibility of company fires and identify their potential risks.

Several structural fires break out in Marshall County each year.

Wildfires

Approximately 35% to 55% of Indiana's land base is heavily wooded or forested. When hot and dry conditions develop, forests may become vulnerable to devastating wildfires. In the past few decades an increased commercial and residential development near forested areas has dramatically changed the nature and scope of the wildfire hazard. In addition, the increase in structures resulting from new development strains the effectiveness of the fire service personnel in the county. The National Weather Service in Louisville, Ky issues fire weather planning forecasts for central Kentucky and southern Indiana. During the fire weather seasons from February 15 - April 30th and October 1st - December 15, narrative forecasts are issuded at 4:00 AM and 4:00 PM Eastern time.

Arson

It is important to note that arson is a contributing factor to fire-related incidents within the county. According to the United States Fire Administration, approximately 22% of the total fires reported in the nation from 2001 to 2002 were of incendiary or suspicious nature. In a study of serial arsonists, the National Criminal Justice Reference Service identified the most common motives for settings as revenge, followed by excitement, vandalism, profit, and other crime concealment.

Drought History in Marshall County

The NCDC database did not report any recent drought events in Marshall County since the last Hazard Mitigation Plan in 2009; however, the National Drought Mitigation Center and the Indiana Drought Monitor recorded multiple drought events in the area. The Marshall County Board of Commissioners declared a state of emergency due to drought conditions on October 30, 2010. Due to the drought conditions, the Marshall County Board of Commissioners invoked the provisions of IC 10-14-3-29 and issued an open burning ban since the drought conditions created an elevated risk for potential widespread fire hazards.

The United States Department of Agriculture issued a drought declaration for Marshall County during the drought of 2012. At the peak of the drought, the county experienced a category D3 drought for seven weeks. Along with more than half of Indiana, Marshall County had open burn bans and was declared eligible for small-business administration(SBA) loans.

After the 2012 drought, Marshall County experienced category D0 events that impacted the county from September 3 through December 23, 2013, August 5 through September 1, 2014, and April 7 through June 8, 2015. The National Drought Mitigation Center did not record any impacts in Marshall County for these events, but crops and pastures are commonly affected during D0 drought.

From October 2015 through December 2015, Marshall County underwent eleven weeks of level D1 drought that negatively impacted soybeans, winter wheat, and pastures. In the summer of 2016, Marshall County endured periods of D0 drought during June 7th through July 25th and again from August 9th through 15th. The low rainfall stressed lawns and caused pastures to brown across Marshall County. The dry weather also stressed crops in both June and August 2016.

Vulnerability and Future Development

Drought impacts, as described in the drought history section, are a threat across the entire jurisdiction; therefore, the county is vulnerable to this hazard and can expect the same impacts within the affected area. Future development will remain vulnerable to drought events since all areas of the county are vulnerable to drought. Typically, some urban and rural areas are more susceptible than others. For example, urban areas are subject to water shortages during periods of drought. Excessive demands of the populated area place a limit on water resources. In rural areas,

crops and livestock may suffer from extended periods of heat and drought. Dry conditions can lead to the ignition of wildfires that could threaten residential, commercial, and recreational areas.

The hazard ranking of drought in Marshall County is moderate. Droughts in Marshall County are of particular concern because of the potential for forest fires as well as the impacts to lake levels and agricultural harvests.

Relationship to other Hazards

Wildfires - A drought situation can significantly increase the risk of wildfire.

Extreme Temperatures - A drought situation can significantly increase with long periods of high temperatures.

Plans and Programs in Place

Well Monitoring - The Marshall County SWCD routinely monitors wells throughout the county for water levels for groundwater levels.

EMS Training – The Marshall County Emergency Medical Service (EMS) provides full emergency service over 420 square miles and is dedicated to the preservation of life and quality of life and the education of the public in areas of life preservation.

Livestock Disaster Assistance Programs – The 2014 Farm Bill, alternatively known as the Agriculture Act of 2014, allows the Livestock Forage Program to provide compensation to eligible producers who suffered grazing losses due to drought and fire.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

Winter Storms: Blizzards, Ice Storms, Snowstorms

Hazard Description

Severe winter weather consists of various forms of precipitation and strong weather conditions. This may include one or more of the following: freezing rain, sleet, heavy snow, blizzards, icy roadways, extreme low temperatures, and strong winds. These conditions can cause human-health risks such as frostbite, hypothermia, and death.

Ice Storms

Ice or sleet, even in the smallest quantities, can result in hazardous driving conditions and can be a significant cause of property damage. Sleet can be easily identified as frozen raindrops. Sleet does not stick to trees and wires. The most damaging winter storms in Indiana have been ice storms. Ice storms are the result of cold rain that freezes on contact with objects having a temperature below freezing. Ice storms occur when moisture-laden gulf air converges with the northern jet stream, causing strong winds and heavy precipitation. This precipitation takes the form of freezing rain, coating power lines, communication lines, and trees with heavy ice. The winds then will cause the overburdened limbs and cables to snap, leaving large sectors of the population without power, heat, or communication. Falling trees and limbs also can cause building damage during an ice storm. In the past few decades, numerous ice-storm events have occurred in Indiana.

Snowstorms

Significant snowstorms are characterized by the rapid accumulation of snow, often accompanied by high winds, cold temperatures, and low visibility. A blizzard is categorized as a snowstorm with winds of 35 miles an hour or greater and/or visibility of less than one-quarter mile for three or more hours. The strong winds during a blizzard blow about falling and already existing snow, creating poor visibility and impassable roadways. Blizzards have the potential to result in property damage.

Indiana has been struck repeatedly by blizzards. Blizzard conditions not only cause power outages and loss of communication, potentially for days, but can also make transportation difficult. The blowing of snow can reduce visibility to less than one-quarter mile, and the resulting disorientation makes even travel by foot dangerous, if not deadly.

Damages from blizzards can range from significant snow removal costs to human and livestock deaths. Because of the blinding potential of heavy snowstorms, drivers are also at risk of collisions

with snowplows or other road traffic. Stranded drivers can make uninformed decisions, such as leaving the car to walk in conditions that put them at risk. Drivers and homeowners without emergency plans and kits are vulnerable to the life-threatening effects of heavy snow storms such as power outages, cold weather, and inability to travel, communicate, obtain goods or reach their destinations. Heavy snow loads can cause structural damage, particularly in areas where there are no building codes or for residents living in manufactured home parks.

Winter Storm History in Marshall County

Winter weather hazards are prevalent natural events that can be expected to occur every winter in Indiana. The winter of 2013-2014 ranked among the coldest on record throughout the Midwest. The National Weather Service reported this season as "one of the coldest and snowiest winter seasons on record and certainly one of the most extreme winter seasons in several decades." NOAA's National Climatic Data Center stated that the period from December 2013 through February 2014 was the 34th coldest for the contiguous 48 states since 1895.

NCDC began recording winter storm events in 1996; therefore, historical NCDC Winter Storm data from prior years is not available. The While there have been relatively few winter storms over this timeframe, it should be noted that precipitation types vary significantly throughout the course of each storm. Each type of precipitation carries its own dangers which are combined when multiple types occur in an individual storm. There have been 20 winter events recorded in the hazard-recorded data provided by the NWS and NOAA.

Table 4-35: NOAA Winter Storms

Date	Date
12/14/2013	1/5/2015
12/16/2013	2/4/2015
1/31/2013	2/14/2015
3/24/2013	2/18/2015
1/5/2014	3/1/2015
1/17/2014	3/4/2015
1/18/2014	1/10/2016
11/16/2014	2/8/2016
11/22/2014	2/14/2016
3/2/2014	

Source: National Climatic Data Center

Relationship to other Hazards

Flooding - Melting from heavy snows can cause localized flooding which can impact property and infrastructure such as roads.

Wildland or Structural Fire - Heavy storms that result in large amounts of downed timber can result in an increase of dead or dying trees left standing, thus providing an increased fuel load for a wildfire. There is an additional risk of increased frequency of structural fires during heavy snow events, primarily due to utility disruptions and the use of alternative heating methods by residents.

Public Safety - Drivers stranded in snowstorms may make uninformed decisions that can put them at risk; residents who are unprepared or vulnerable may not be able to obtain goods or reach their destinations. EMS providers may be slowed by road conditions to respond to emergencies. Ice storms may result in power outages due to downed power lines, putting people at risk for cold temperature exposure and reducing the ability to spread emergency messages to the public via television, radio or computer.

The collision of cold and warm temperatures can create dense fog causing hazardous conditions for drivers and public service providers. Widespread dense fog developed across much of Northern Indiana during the morning hours of January 12, 2005. Visibility was reported to be at or near zero in many locations and numerous accidents were reported as a result of the fog.

Plans and Programs in Place

Snow Removal - The Marshall County Transportation Department has capabilities for snow removal and highway treatment in order to maintain safe winter driving conditions. The department carries out snow removal and ice control operations. Paved routes within Marshall County receive priority for snow plowing. INDOT handles snow removal on trunk highways within Marshall County. The county has agreements with several townships to do snow plowing. All other city and township jurisdictions either have their own equipment for snow removal or contract for services to do so.

Backup Power - In the courthouse complex there is an emergency generator for the jail, and from that power can be provided to serve the courthouse, boiler room and I.T. office. Across the street there is a small emergency generator that will serve to power EMS, fire and police radio systems. In

the city of Marshall, the fire department has portable generators, one of which is dedicated to water supply and another that can be located as needed.

Burying Power Lines - Burying power lines helps eliminate loss of power due to snow and ice storms. Mille Lacs Energy Cooperative and Lake County Power work to accommodate requests for installation of underground power lines to residents or businesses receiving connection of new power in areas where it is feasible. East Central Energy buries lines in areas where it makes sense to do so, but does not offer this as a regular customer option. *NOAA Weather Radio Transmitter Towers*- The National Weather Service delivers storm warnings and key information during severe winter weather events over its radio towers. The extreme southeastern part of Marshall County is covered by Pine County. Most of the rest of the county is covered by the Marshall transmitter which is located southeast of the city of Marshall. The Coleraine transmitter covers the extreme northeastern part of the county.

School Closings - All school districts within Marshall County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems which allow them to notify all families who are registered in the school system with up-to-date information.

Public Warning and Notification- In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Marshall County utilizes the CodeRED Mass Notification System and the Marshall County Sheriff's Office Facebook page as well as local news media. Marshall County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Public Education and Awareness - Marshall County promotes the National Weather Service's "Winter Hazard Awareness Week" held in November each year. The event seeks to educate residents on the dangers of winter weather and how to properly deal with it.

Program Gaps or Deficiencies

Backup Power - Not all county facilities have backup power in the event of a disaster.

4.6 Wildfire

Hazard Description

The hazard extent of wildfires is greatest in the heavily forested areas of southern Indiana. The IDNR Division of Forestry assumes responsibility for approximately 7.3 million acres of forest and associated wild lands, including state and privately-owned lands. Indiana's wildfire seasons occur primarily in the spring—when the leaf litter on the ground dries out and before young herbaceous plants start to grow and cover the ground (green up)—and in the fall—after the leaves come down and before they are wetted down by the first heavy snow. During these times, especially when weather conditions are warm, windy, and with low humidity, cured vegetation is particularly susceptible to burning. When combined, fuel, weather, and topography, present an unpredictable danger to unwary civilians and firefighters in the path of a wildfire. Human action can not only intervene to stop the spread of wildfires, but can also mitigate their onset and effects. Forest and grassland areas can be cleared of dry fuel to prevent fires from starting and can be burned proactively to prevent uncontrolled burning.

Wildfire History in Marshall County

There have been no recently recorded wildfires or damage from wildfires reported to the county.

Vulnerability and Future Development

Heavily wooded areas are most vulnerable to wildfire where agricultural fields can be susceptible to brushfires. At the same time, they provides benefits to the ecosystem and society. Future development along heavily wooded areas may remain more vulnerable to wildfire events.

Relationship to other Hazards

Drought and Extreme Heat - Dry, hot conditions can reduce the protective moisture of woodlands and increase the risk of wildfire. Heat stress is a common side effect of fires that can be acerbated by already extreme temperatures.

Hazardous Material Release – Most hazardous material is flammable, volatile, highly incendiary, and some are potentially explosive. Wildfire that spreads to a facility or vehicle handling Hazmat poses increased safety and health hazards. Conversely, hazmat release can in turn trigger wildfires setting off a chain reaction of hazards.

Public Safety - Anyone exposed to extreme heat can develop heat exhaustion and heat stroke. The elderly, children and those who engage in outdoor work or recreation may be most susceptible to the danger of extreme heat.

Plans and Programs in Place

There are no existing plans or programs in place for wildfires.

4.7 Extreme Temperatures

Extreme temperatures are a dynamic hazard in that in the incident of multiple hazards the impact become compounded. In the event of a winter blizzard, followed by a utility failure, an extreme cold event would be a very concerning situation for officials and many populations.

Hazard Description

Severe Cold

What constitutes an extreme cold event, and its effects, varies by region across the US. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Extreme cold temperatures are typically characterized by the ambient air temperature dropping to approximately zero degrees Fahrenheit or below.

Exposure to cold temperatures—indoors or outdoors—can lead to serious or life-threatening health problems, including hypothermia, cold stress, frostbite or freezing of the exposed extremities, such as fingers, toes, nose, and earlobes. Certain populations—such as seniors age 65 or older, infants and young children under five years of age, individuals who are homeless or stranded, or those who live in a home that is poorly insulated or without heat (such as mobile homes) — are at greater risk to the effects of extreme cold.

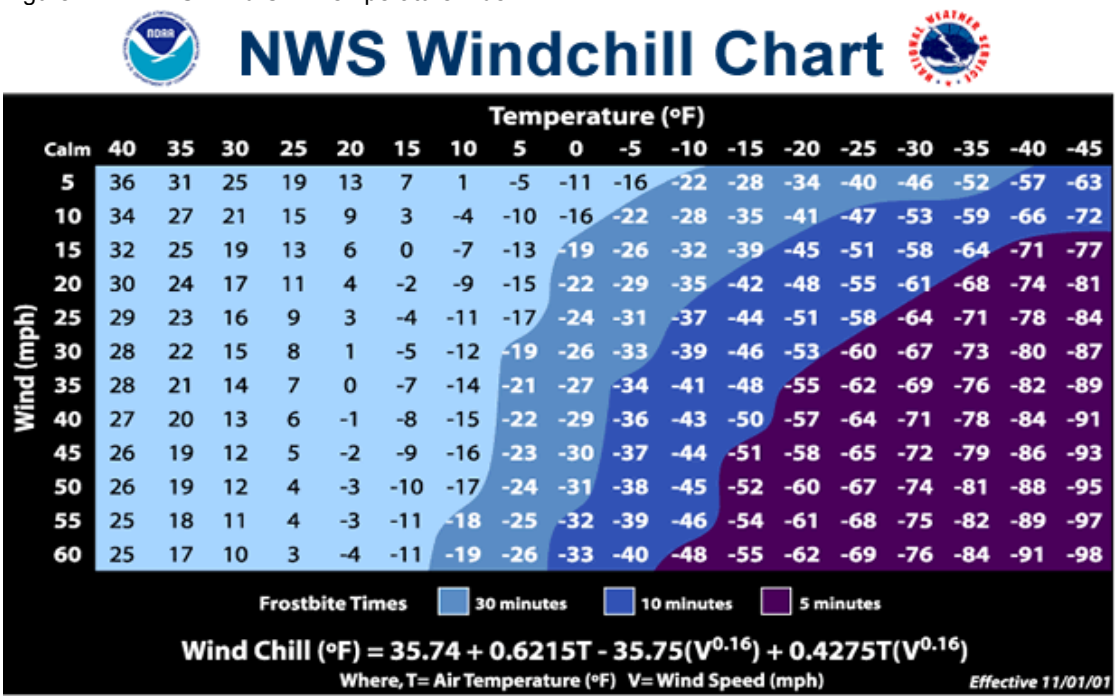
Extremely cold temperatures often accompany a winter storm, so individuals may also have to cope with power failures and icy roads. Although staying indoors can help reduce the risk of vehicle accidents and falls on the ice, individuals are susceptible to indoor hazards. Homes may become too cold due to power failures or inadequate heating systems. The use of space heaters and fireplaces to keep warm increases the risk of household fires, as well as carbon monoxide poisoning.

The magnitude of extreme cold temperatures is generally measured through the Wind Chill Temperature (WCT) Index. WCT are the temperatures felt outside and is based on the rate of heat

loss from exposed skin by the effects of wind and cold. As the wind increases, the body is cooled at a faster rate causing the skin's temperature to drop.

In 2001, the NWS implemented a new WCT Index, designed to more accurately calculate how cold air feels on human skin. The index, shown in Figure 4-44, includes a frostbite indicator, showing points where temperature, wind speed, and exposure time will produce frostbite in humans.

Figure 4-44: NWS Wind Chill Temperature Index



Each National Weather Service Forecast Office may issue the following wind chill-related products as conditions warrant:

- Wind Chill Watch: Issued when there is a chance that wind chill temperatures will decrease to at least 24° F below zero in the next 24-48 hours.
- Wind Chill Advisory: Issued when the wind chill could be life threatening if action is not taken. The criteria for this advisory are expected wind chill readings of 15° F to 24° F below zero.
- Wind Chill Warning: Issued when wind chill readings are life threatening. Wind chill readings of 25° F below zero or lower are expected.

Extreme Heat

Human beings need to maintain a constant body temperature if they are to stay healthy. Working in high temperatures induces heat stress when more heat is absorbed into the body than can be

dissipated out. Heat illness such as prickly heat, fainting from heat exhaustion, or heat cramps are visible signs that people are working in unbearable heat. In the most severe cases, the body temperature control system breaks down altogether and body temperature rises rapidly. This is a heat stroke, which can be fatal. The NWS issues a heat advisory when, during a 24-hour period, the temperature ranges from 105°F to 114°F during the day, and remains at or above 80°F at night.

Heat is the leading weather-related killer in the United States, even though most heat-related deaths are preventable through outreach and intervention (see EPA's Excessive Heat Events Guidebook at: www.epa.gov/heatisland/about/pdf/EHEguide_final.pdf). According to the National Oceanic and Atmospheric Administration, the summer of 2016 was one of the five hottest on record dating to the late 19th century.

Unusually hot summer temperatures have become more frequent across the contiguous 48 states in recent decades1 (see the High and Low Temperatures indicator), and extreme heat events (heat waves) are expected to become longer, more frequent, and more intense in the future. As a result, the risk of heat-related deaths and illness is also expected to increase.

Older adults have the highest risk of heat-related death, although young children are also sensitive to the effects of heat. Across North America, the population over the age of 65 is growing dramatically. People with certain diseases, such as cardiovascular and respiratory illnesses, are especially vulnerable to excessive heat exposure, as are the economically disadvantaged.

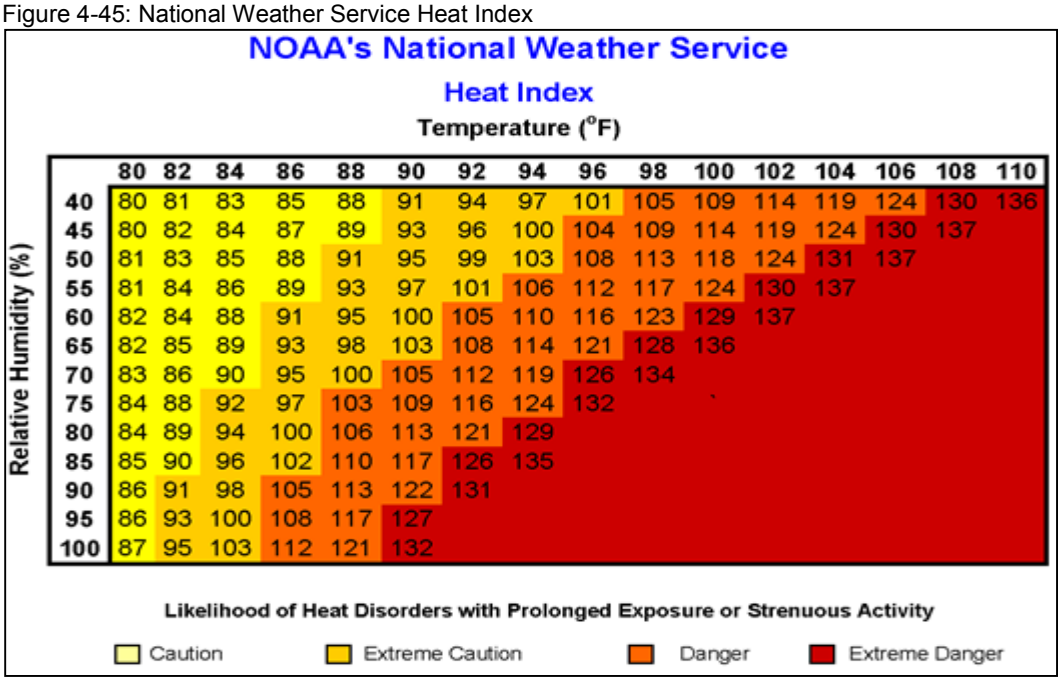
Temperatures that hover 10 degrees Fahrenheit or more above the average high temperature for a region, and last for several weeks, constitute an extreme heat event (EHE). An extended period of extreme heat of three or more consecutive days is typically referred to as a heat wave. Most summers see EHEs in one or more parts east of the Rocky Mountains. They tend to combine both high temperatures and high humidity; although some of the worst heat waves have been catastrophically dry.

Prolonged exposure to extreme heat may lead to serious health problems, including heat stroke, heat exhaustion, or sunburn. Certain populations — such as seniors age 65 and over, infants and young children under five years of age, pregnant women, the homeless or poor, the obese, and people with mental illnesses, disabilities, and chronic diseases — are at greater risk to the effects of extreme heat. Depending on severity, duration, and location, EHEs can also trigger secondary hazards, including dust storms, droughts, wildfires, water shortages, and power outages.

Criteria for EHE typically shift by location and time of year, and are dependent on the interaction of multiple meteorological variables (i.e., temperature, humidity, cloud cover). While this makes it difficult to define EHEs using absolute, specific measures, there are ways to identify conditions. Some locations evaluate current and forecast weather to identify conditions with specific, weather-based mortality algorithms. Others identify and forecast conditions based on statistical comparison to historical meteorological baselines that are the criteria for EHE conditions could be an actual or forecast temperature that is equal to or exceeds the 95th percentile value from a historical distribution for a defined time period.

Heat alert procedures are based primarily on Heat Index Values. The Heat Index—given in degrees Fahrenheit—is often referred to as the apparent temperature and is a measure of how hot it really feels when the relative humidity is factored with the actual air temperature. The National Weather Service Heat Index Chart can be seen in Figure 4-45.

Figure 4-45: National Weather Service Heat Index



Source: Office of Atmospheric Programs. (2006). Excessive Heat Events Guidebook. Unites States Environmental Protection Agency. Washington, D.C.

Each National Weather Service Forecast Office may issue the following heat-related products as conditions warrant:

- Excessive Heat Outlooks- issued when the potential exists for an EHE in the next 3-7 days. An Outlook provides information to those who need considerable lead time to prepare for the event, such as public utility staff, emergency managers, and public health officials.

- Excessive Heat Watches- issued when conditions are favorable for an EHE in the next 24 to 72 hours. A Watch is used when the risk of a heat wave has increased but its occurrence and timing is still uncertain. A Watch provides enough lead time so that those who need to prepare can do so, such as city officials who have excessive heat mitigation plans.
- Excessive Heat Warnings/Advisories- issued when an EHE is expected in the next 36 hours. These products are issued when an excessive heat event is occurring, is imminent, or has a very high probability of occurring. The warning is used for conditions posing a threat to life or property. An advisory is for less serious conditions that cause significant discomfort or inconvenience and, if caution is not taken, could lead to a threat to life and/or property.

Extreme Temperature History in Marshall County

Summer temperatures in Marshall have reached 100ºF (August 1976). July is the warmest month, with an average high of 80ºF (The Weather Channel, 2014).

Although the NCDC database does not include any reported past occurrences of excessive heat, residents of Marshall County should be prepared for such an event in any given year.

The NWS and NOAA identified extreme cold/wind chill events on January 6, 2014 and January 8, 2015.

Relationship to other Hazards

Drought and Wildfire - Dry, hot conditions can reduce the protective moisture of woodlands and increase the risk of wildfire.

Public Safety - Anyone exposed to extreme heat can develop heat exhaustion and heat stroke. The elderly, children and those who engage in outdoor work or recreation may be most susceptible to the danger of extreme heat.

Plans and Programs in Place

School Closings - All school districts in Marshall County have a school closing policy and communications plan in place if inclement weather or temperatures create a hazardous situation for students or staff. Schools have notification systems, which allow them to notify all families who are registered in the school system with up-to-date information.

Public Warning and Notification - In the event of emergencies or hazardous conditions that require timely and targeted communication to the public, Marshall County utilizes the CodeRED Mass

Notification System and the Marshall County Sheriff's Office Facebook page, as well as local news media. Marshall County promotes the use of NOAA weather radios by critical facilities and the public to receive information broadcast from the National Weather Service.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.8 Harmful Organisms and Infectious Agents

Hazard Description

The spread of harmful organisms and infectious diseases are occasionally overlooked, potential natural hazards that can be exacerbated following other natural disasters.

Emerald Ash Borer

The Emerald ash borer (EAB), *Agrilus planipennis*, is an exotic beetle thought to have arrived in the United States by 2002 and was discovered near Detroit, Michigan. Indiana was one of the second states recognized to have the beetle, having been discovered in northern Indiana in 2004. The adult beetles do not pose harm to the ash trees, as they nibble on ash foliage. The immature, or larvae stage, feed on the inner bark of the ash trees, disrupting its ability to transport nutrients and water. The EAB is responsible for killing millions of ash trees in North America. It has cost municipalities, property owners, nursey owners, and forest industries millions of dollars.

Vector-Borne Illness

Vector-borne diseases are caused by infectious microorganisms and transmitted to people via living organisms including blood-sucking arthropods such as mosquitos, ticks, fleas, and spiders. Natural disasters, particularly meteorological events such as cyclones, hurricanes, and flooding, can influence transmission of vector-borne disease. The crowding of infected and vulnerable hosts, a debilitated public health infrastructure, and disruptions of ongoing control processes are risk factors for transmission of vector-borne disease. The Indiana State Department of Health (ISDH) identifies sleeping sickness (Eastern equine encephalitis virus), La Crosse encephalitis (La Crosse virus), St. Louis encephalitis (St. Louis encephalitis virus), West Nile fever (West Nile virus), and dengue fever (dengue virus), as mosquito-borne diseases that Hoosiers should take steps to protect themselves against.

The health department has also reported more than 200 cases of tick-borne illness in Indiana in 2016 alone. The ISDH highlighted Lyme disease, Rocky Mountain spotted fever, and Erlichiosis as tick-borne diseases particularly prevalent in Indiana. Over the past few years, Indiana has experienced a rise in tick-borne Lyme disease. There were approximately 100 confirmed cases of Lyme disease in 2014, but only 26 cases in 2006. Increased summer tick populations frequently follow mild winters, and back-to-back mild winters can cause a notable surge in tick numbers, along with the diseases they carry. In June of 2017, a young Indiana girl died after contracting Rocky Mountain spotted fever from a tick bite. Recently, a new tick-transmitted virus has made headlines through the state. The Centers for Disease Control confirmed two cases of Heartland virus in Indiana. Both infected patients survived.

Infections Connected to Intravenous Drug Use

In January 2015, Indiana Disease Intervention Specialists (DIS) identified 11 new HIV cases linked to a rural county in southeastern Indiana that previously had <5 new HIV cases per year. This prompted a complex outbreak investigation in order to identify additional cases and contacts potentially exposed. In addition, as of June 1, 2015, a total of 166 (163 confirmed and three preliminary positive) individuals linked to this outbreak have tested positive for HIV, and >80% are also infected with hepatitis C virus (HCV). The vast majority of these individuals reported injecting oxymorphone and sharing needles.

Harmful Organisms and Infectious Agents Outbreak History in Marshall County

Emerald Ash Borer

On December 7, 2009, Marshall County was added to the list of counties that contain the EAB and the county was placed under quarantine.

Vulnerability and Future Development

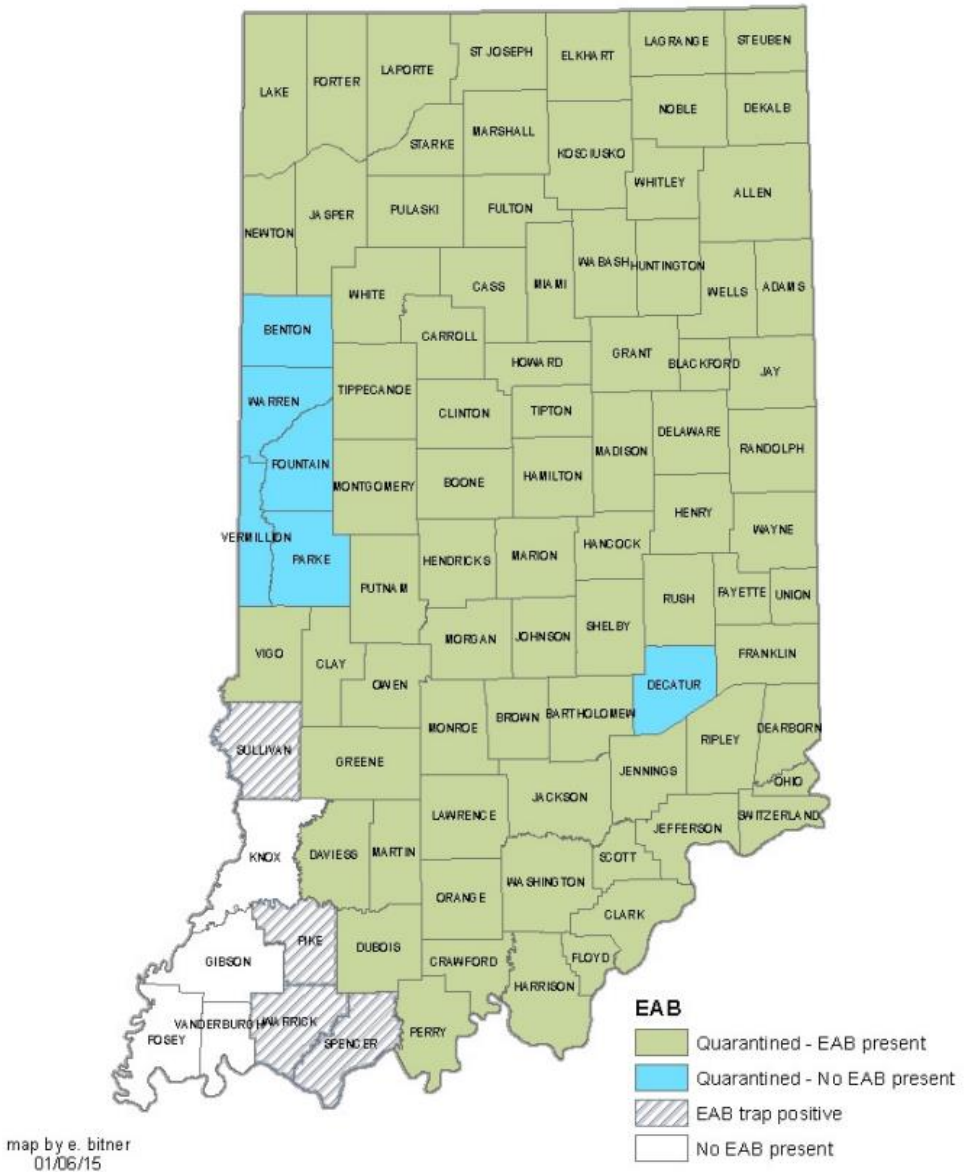
Future development will remain vulnerable to these events. EABs have killed millions of ash trees in Indiana, Michigan, Illinois, Ohio, and Ontario and will continue to do so until the insects are effectively contained or eliminated or a strain of more resistant trees is developed.

According to the National Institute of Allergy and Infectious Diseases, tick-borne illnesses will continue to remain a problem as people build homes in wilderness areas where ticks and their

animal hosts live; however, urban environments can also host ticks and the pathogens they can transmit.

All communities can be potentially at risk for an epidemic and experience increased risk during hazards the cause displacement, contamination of the water supply, and/or deprivation of essential utilities, or when residents are not exposed to educational resources outlining preventive steps.

Figure 4-46: Emerald Ash Borer Quarantine in Indiana

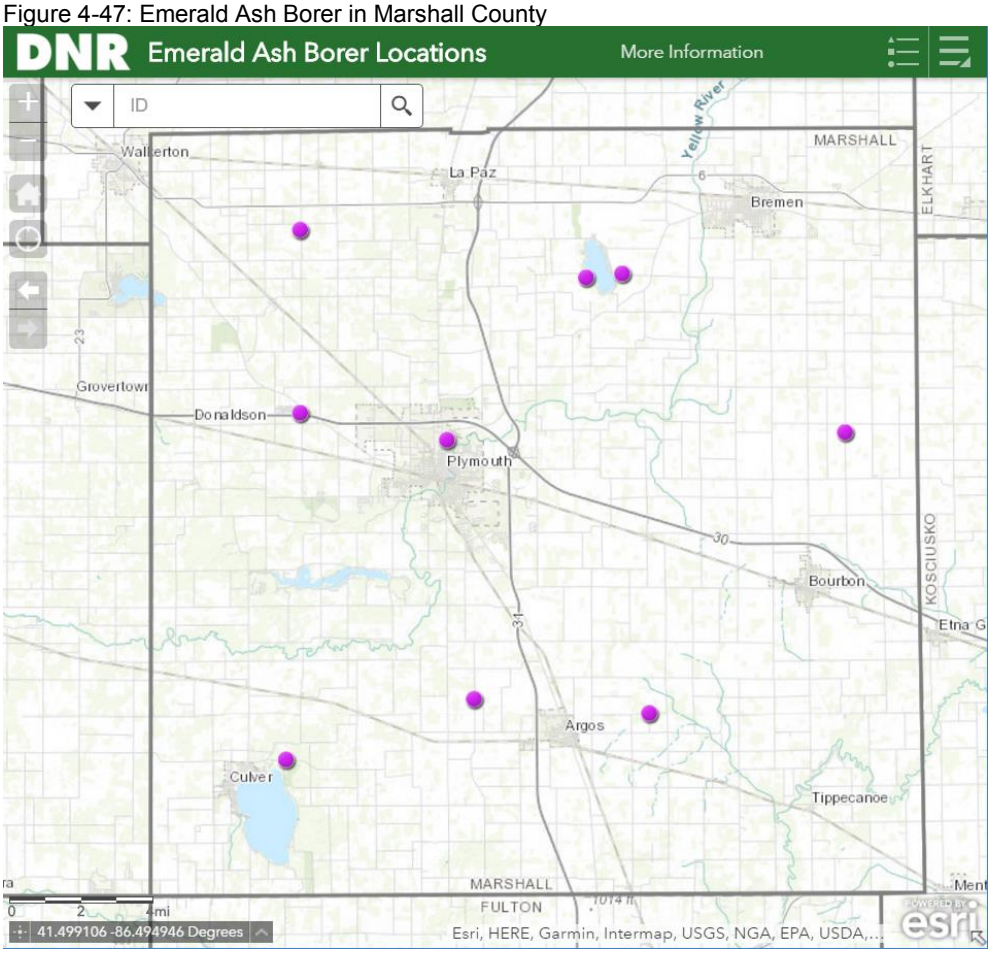


Risk Analysis

Exposure Analysis

The reported identification of the Emerald Ash Borer in Marshall County is identified in Figure 4-47 and reveals that Emerald Ash Borers have been spotted throughout the county.

Figure 4-47: Emerald Ash Borer in Marshall County



An exposure analysis identifies the existing and future assets located in identified hazard areas.

Relationship to other Hazards

The risk for infectious disease transmission is primarily associated with displacement and the characteristics of the displaced population, the proximity of sterile water and function restrooms, the nutritional status of the displaced, the level of immunity to vaccine-preventable infections, and the availability of access to healthcare services.

Flooding – Increased risk of vector-borne diseases. EAB-damaged trees may pose a risk for increased logjam events. In the aftermath of flooding, a plethora of standing water combined with a possibly weakened health infrastructure and an interruption of ongoing control programs increases the risk factors for vector-borne disease transmission. While initial flooding may wash away existing mosquito-breeding sites, standing water caused by heavy rainfall or overflow of rivers can create new breeding sites.

Earthquake – In the aftermath of earthquakes, some populations have experienced infection outbreaks associated with increased exposure to airborne dust from landslides.

Tornadoes – Natural disasters, like tornadoes, that affect communities on a large-scale and cause displacement have been associated with an increased risk in disease.

Utility Failure – Power outages and the disruption of water treatment and supply plants can affect the proper functioning of health facilities and has also been linked with an increase in diarrheal illness.

Plans and Programs in Place

Emerald Ash Borer

Once the EAB is identified, the quarantine is put in place which restricts the movement of regulated ash materials, including any ash tree, limb, branch or debris of an ash tree at least 1 inch in diameter, ash log or untreated ash lumber with bark attached, or cut firewood of any hardwood species outside of the affected county. Along with the state-level quarantine, all of Indiana is under a federal quarantine that prohibits moving regulated ash material out of Indiana without a compliance agreement or permit from the USDA Animal and Plant Health Inspection Service.

The Purdue Extension and IDNR Division of Forestry provides a plethora of excellent resources for homeowners and managers.

There are other invasive species in Indiana that can also pose a concern, such as the Gypsy Moth and Asian long horned beetle. The IDNR requests that any sighting of the beetle or trees with signs of damage are reported to the State Epidemiologist.

Note the date and location where you found the beetle or damaged tree.
Capture the beetle in a plastic jar and place it in the freezer to kill it.
Carefully wrap the beetle and send it to:

Indiana Department of Natural Resources
Division of Entomology and Plant Pathology
402 West Washington Street, Room W290
Indianapolis, IN 46204-2739

Vector-Borne Diseases

In order to help control mosquito populations, the Centers for Disease Control and Prevention recommends draining all standing water left outdoors. Typically, responding effectively to a disaster-affected population requires, among other steps, a disease risk assessment that evaluates the diseases that are common in the area, living conditions of the affected population such as the degree of exposure and density of settlements, availability of safe water and adequate sanitation facilities, access to healthcare, and effective management.

Eliminating areas of standing water may help diminish the disease-carrying mosquito population by removing areas that they like to breed. People can help protect themselves from mosquitoes that potentially carry pathogens by taking the following actions:

- avoiding places and times when mosquitoes bite, whenever possible
- using an insect repellant containing DEET (*N,N*-diethyl-*m*-toluamide)
- wearing shoes, socks, long pants, and a long-sleeved shirt when outdoors for long periods of time, or from dusk to dawn, when mosquitoes are most active
- choosing clothes that are light-colored and made of tightly woven materials to keep mosquitoes away from the skin
- making sure that all windows and doors have screens, and that all screens are in good repair
- using mosquito netting when sleeping outdoors or in an unscreened structure

In a statement, the State Health Commissioner said, "Tick bites can cause serious illness and even death, and the discovery of Heartland virus gives Hoosiers another important reason to take precautions. If you become ill after spending time outdoors, visit your health care provider immediately — especially if you found an attached tick. Prompt diagnosis of tick-borne illness helps prevent complications."

For preventive care, the ISDH recommends removing ticks immediately since ticks usually must be attached for several hours before they can transmit a pathogen. Extract attached ticks in a manner that does not leave the head embedded in the skin. Seek medical attention if a febrile illness or rash develops over the next three to four weeks.

Infections Connected to Intravenous Drug Use

As the local "eyes and ears on the ground," public health staff are critical to the identification of outbreaks. To do this, the following are important:

- Promptly report new HIV cases to the ISDH Division of HIV/STD/Viral Hepatitis.
- Promptly report new HCV cases to the ISDH Epidemiology Resources Center.
- Look for possible clusters of HIV and/or HCV: case numbers clearly above baseline, same demographics, common risk factors and contacts.
- Become familiar with local data so any increases are easily identified.
- Know who to contact for assistance and appropriate health services.

In May 2015, a law was developed to allow local health departments and law enforcement to work together to start a needle exchange program in their counties if certain local health officers declare that situational and notification parameters are met. Syringe exchange programs provide people who inject drugs with an opportunity to reduce the spread of blood-borne diseases such as HIV and Hepatitis C by encouraging them to use sterile syringes, share syringes less often, and safely dispose of used syringes. The programs serve to connect hard-to-reach people who inject drugs with important public health services, including HIV and HCV testing, substance abuse treatment, sexually transmitted disease screening and treatment, and risk-reduction counseling.

Indiana Health Codes

The Marshall County Health Department is committed to promoting public health and enhancing the quality of life and safety for all Marshall County residents and visitors by preventing, planning, and protecting against disease and injury. The Department is a highly utilized and trusted leader offering multiple public health services to better support and prepare our community. As part of its strategic approach to achieving its mission and vision, the Health Department has balanced itself to provide services to residents' health issues ranging from the following:

- Bats
- Bedbugs
- Birth/Death Records
- Ebola Virus
- Enterovirus D68
- Water Testing
- Food Service Permits
- Immunizations
- Meth
- Public Health Nuisance Complaints
- Septic Permit
- Zika Virus

The Marshall County Board of Health, including Department of Health, Environmental Sanitation, Fee Schedule, Food Establishments, Immunization Clinics, Septic Systems, Vital Records, and other resources, can be contacted at the following address:

Marshall County Health Department
510 W. Adams GL-30
Plymouth, Indiana 46563

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.9 Hazardous Material Release

Hazard Description

The State of Indiana has numerous active transportation lines that run through many of its counties. Active railways transport harmful and volatile substances between our borders every day. The transportation of chemicals and substances along interstate routes is commonplace in Indiana. The rural areas of Indiana have considerable agricultural commerce, creating a demand for fertilizers, herbicides, and pesticides to be transported along rural roads. Finally, Indiana is bordered by two major rivers and Lake Michigan. Barges transport chemicals and substances along these waterways daily. These factors increase the chance of hazardous material releases and spills throughout the State of Indiana.

The release or spill of certain substances can cause an explosion. Explosions result from the ignition of volatile products such as petroleum products, natural and other flammable gases, hazardous materials and chemicals, dust, and bombs. An explosion potentially can cause death, injury, and property damage. In addition, a fire routinely follows an explosion, which may cause further damage and inhibit emergency response. Emergency response may require fire, safety and law enforcement, search and rescue, and hazardous materials units.

Transportation

Roads, rails, aircrafts and pipelines, convey hazardous materials while presenting differing levels of risk of unwanted release of the hazardous materials. Transported products include hazardous materials moving from producers to users, moving between storage and use facilities, and hazardous waste moving from generators to treatment and disposal facilities.

The road and train systems in Marshall County act as transportation networks for both hazardous and nonhazardous material. Hazardous materials are transported throughout the region and between local communities as both commodities and waste. Risks of hazardous material events vary based on the classification the hazmat material being transported and the location of the road and its proximity to people and property. Along state highways and in more populated portions of the county, the risk of a major hazmat event is most severe and the damages most potent.

Meth

Methamphetamine laboratories and precursors found in a residence, apartment or motel/hotels will be ordered **unfit for human habitation** by the health department per Rule 318 IAC 1 requirements and Indiana State Department of Health guidance. These dwellings and are to be kept vacant until they are cleaned up and tested, or demolished. The Indiana Department of Environmental Management (IDEM) Rule 318 IAC 1 requires a cleanup and will not accept homeowners clean up or air out of a house as adequate. Clean up contractors and information can be found at the IDEM Website: Inspection & Cleanup of Illegal Drug Labs. The Indiana State Police maintains the listing of contaminated residences, outbuilding, vehicles & properties. A map of the properties is located in Appendix A.

Hazardous Incident History in Marshall County

Marshall County has not experienced a significantly large-scale hazardous material incident at a fixed site or during transport resulting in multiple deaths or serious injuries. However, there have been minor releases that have put local firefighters, hazardous materials teams, emergency management, and local law enforcement into action to try to stabilize these incidents and prevent or lessen harm to Marshall County residents.

Vulnerability and Future Development

The hazardous material release hazards are countywide and primarily are associated with the transport of materials by highway and/or railroad.

During a hazardous material release, the types of infrastructure that could be impacted include roadways, utility lines/pipes, railroads and bridges. The release or spill of certain substances can cause an explosion. Explosions result from the ignition of volatile products such as petroleum products, natural and other flammable gases, hazardous materials/chemicals, dust, and bombs.

An explosion potentially can cause death, injury, and property damage. In addition, a fire routinely follows an explosion, which may cause

Risk Analysis

Exposure Analysis

The extent of the hazardous material (referred to as hazmat) hazard varies in terms of the quantity of material being transported as well as the specific content of the container. Hazardous material impacts are an equally distributed threat across the entire jurisdiction; therefore the entire county is vulnerable to a hazardous material release and can expect the same impacts within the affected area. The main concern during a release or spill is the population affected. This plan will therefore consider all buildings located within the county as vulnerable.

Meth contaminated buildings per year, are tracked by the State Police, the table below identifies the total number of identified buildings in the county for the past ten years.

Table 4-36: Buildings Contaminated by Meth per Year

Year	Total	Year	Total
2007	27	**2012**	37
2008	38	**2013**	21
2009	75	**2014**	20
2010	50	**2015**	20
2011	31	**2016**	10

Combining Available Data and Methods

The Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) jointly developed a suite of software applications known as CAMEO which aid in the response to chemical emergencies. The CAMEO system integrates four separate programs that can be used together or separately. One of the programs, Areal Locations of Hazardous Atmospheres (ALOHA), is designed especially for use by people responding to chemical releases, as well as for emergency planning and training.

ALOHA generates a threat zone area where a hazard (such as toxicity or thermal radiation) has exceeded a user-specified Level of Concern (LOC). ALOHA will display up to three threat zones overlaid on a single picture. Through the development of Acute Exposure Guideline Levels (AEGLs)

are exposure guidelines designed to help responders deal with emergencies involving chemical spills or other catastrophic events where members of the general public are exposed to a hazardous airborne chemical.

AEGLs are intended to describe the health effects on humans due to once-in-a-lifetime or rare exposure to airborne chemicals. The National Advisory Committee for AEGLs is developing these guidelines to help both national and local authorities, as well as private companies, deal with emergencies involving spills or other catastrophic exposures.

- Zone 1 (AEGL 1): Above this airborne concentration of a substance, it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure
- Zone 2 (AEGL 2): Above this airborne concentration of a substance, it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape
- Zone 3 (AEGL 3): Above this airborne concentration of a substance, it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

Scenario

The ALOHA model was utilized to assess the area of impact for a chlorine release on the Norfolk and Southern Railway at the intersection with US 30 in Plymouth. The same location was used as the 2009 Marshall County mitigation plan in order to generate an output that could be compared to the previous analysis.

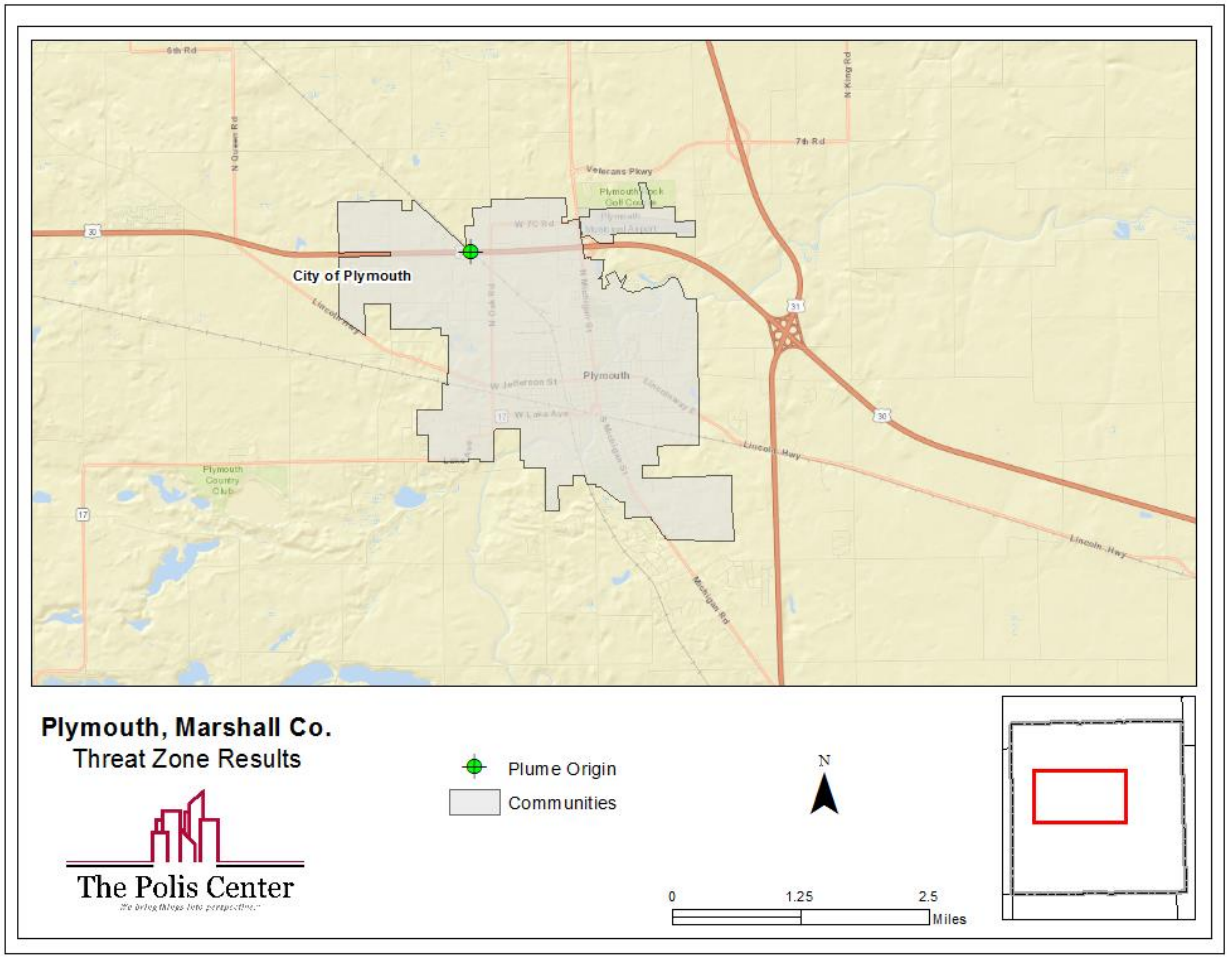
Chlorine is a greenish yellow gas with a pungent suffocating odor. The gas liquefies at -35ºC and room pressure or will liquefy from pressure applied at room temperature. Contact with unconfined liquid chlorine can cause frostbite from evaporative cooling. Chlorine does not burn, but, like oxygen, supports combustion. The toxic gas can have adverse health effects from either long-term inhalation of low concentrations of vapors or short-term inhalation of high concentrations. Chlorine vapors are much heavier than air and tend to settle in low areas. Chlorine is commonly used to purify water, bleach wood pulp, and make other chemicals.

ALOHA is a computer program designed especially for use by people responding to chemical accidents, as well as for emergency planning and training. Chlorine is a common chemical used in

industrial operations and can be found in either liquid or gas form. Rail and truck tankers commonly haul Chlorine to and from facilities.

For this scenario, moderate atmospheric and climatic conditions with a breeze from the Northwest were assumed. The wind direction was chosen based on the previous analysis, so that the hypothetical plume would reach the same significantly populated areas at risk in the previous plan.

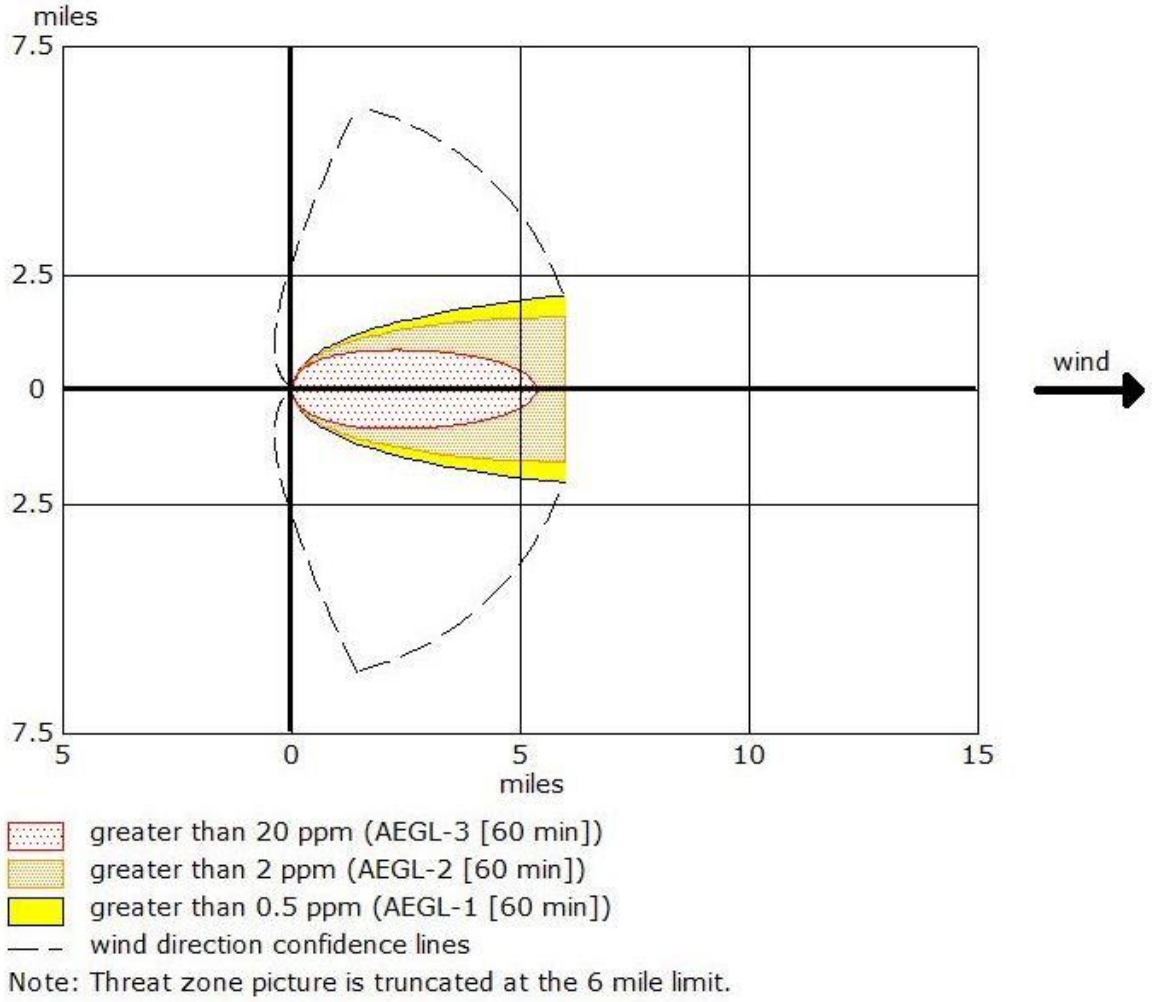
Figure 4-48: Location of Chemical Release



Results

According to the ALOHA parameters, approximately 2,100 pounds of material would be released per minute. The image in Figure 4-49 depicts an example of a plume footprint generated by ALOHA.

Figure 4-49: Toxic Threat Plume Footprint Generated by ALOHA



As the substance moves away from the source, the level of substance concentration decreases. Each color-coded area depicts a level of concentration measured in parts per million (ppm). For the purpose of clarification, this report will designate each level of concentration as a specific zone. The zones are as follows:

- Zone 3 (AEGL-3): The red buffer (>=20 ppm) extends approximately 5 miles from the point of release after one hour.
- Zone 2 (AEGL-2): The orange buffer (>=2 ppm) extends approximately 6 miles from the point of release after one hour.
- Zone 1 (AEGL-1): The yellow buffer (>=0.5 ppm) extends approximately 6 miles from the point of release after one hour.
- Confidence Lines: The dashed lines depict the level of confidence in which the exposure zones will be contained. The ALOHA model is 95% confident that the release will stay within this boundary.

The ALOHA atmospheric modeling parameters, depicted in Figure 4-50, were based upon the actual conditions at the location when the model was run. The air temperature was 68ºF with 75% humidity and clear skies. The wind speed was set for 5 mph blowing to the south east. The modeled source of the chemical spill was a tanker with a diameter of 8 feet and a length of 33 feet (12,408 gallons). The model incorporated a tank that was 100% full with the chlorine in its liquid state at the time of its release.

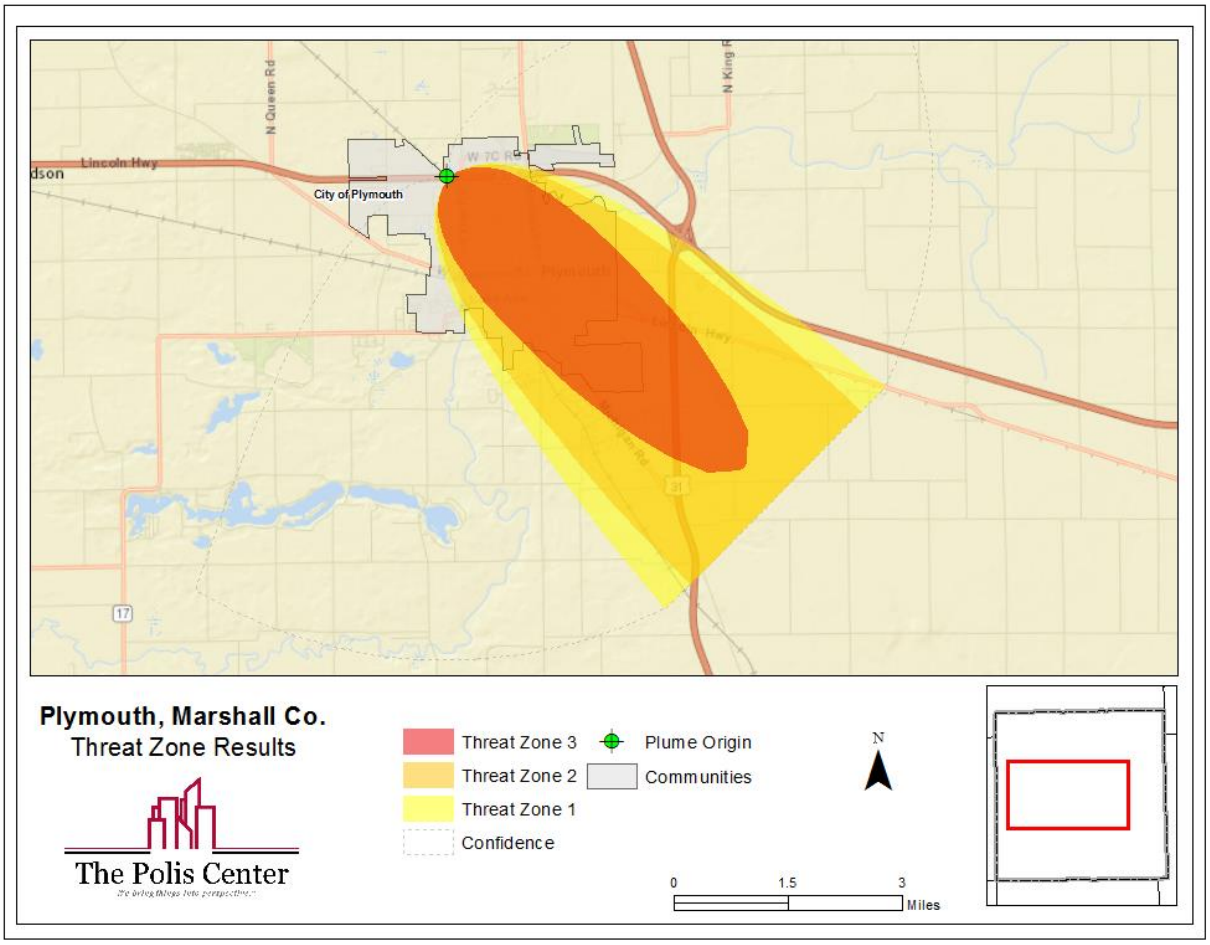
This modeled release was based on a leak from 2.5 feet-diameter hole. According to parameters, approximately 2,100 pounds of material would be released per minute.

Figure 4-50: ALOHA Modeling Parameters

```
SITE DATA:
   Location: PLYMOUTH, INDIANA
   Building Air Exchanges Per Hour: 0.40 (unsheltered single storied)
   Time: June 13, 2017  1431 hours EST (using computer's clock)

 CHEMICAL DATA:
   Chemical Name: CHLORINE
   CAS Number: 7782-50-5                  Molecular Weight: 70.91 g/mol
   AEGL-1 (60 min): 0.5 ppm   AEGL-2 (60 min): 2 ppm   AEGL-3 (60 min): 20 ppm
   IDLH: 10 ppm
   Ambient Boiling Point: -30.4° F
   Vapor Pressure at Ambient Temperature: greater than 1 atm
   Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

 ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
   Wind: 5 miles/hour from NW at 10 meters
   Ground Roughness: open country         Cloud Cover: 5 tenths
   Air Temperature: 68° F                 Stability Class: B
   No Inversion Height                    Relative Humidity: 75%

 SOURCE STRENGTH:
   Leak from hole in horizontal cylindrical tank
   Non-flammable chemical is escaping from tank
   Tank Diameter: 12.5 feet               Tank Length: 33 feet
   Tank Volume: 30,294 gallons
   Tank contains liquid                   Internal Temperature: 68° F
   Chemical Mass in Tank: 178 tons        Tank is 100% full
   Circular Opening Diameter: 2.5 inches
   Opening is 1 feet from tank bottom
   Release Duration: 40 minutes
   Max Average Sustained Release Rate: 10,500 pounds/min
      (averaged over a minute or more)
   Total Amount Released: 346,507 pounds
   Note: The chemical escaped as a mixture of gas and aerosol (two phase flow).

 THREAT ZONE:
   Model Run: Heavy Gas
   Red    : 5.4 miles --- (20 ppm = AEGL-3 [60 min])
   Orange: greater than 6 miles --- (2 ppm = AEGL-2 [60 min])
   Yellow: greater than 6 miles --- (0.5 ppm = AEGL-1 [60 min])
```

The image in Figure 4-51 depicts the threat zone generated by ALOHA. Due to the relatively flat landscape, the chlorine vapor cloud was estimated to travel around 6 miles from the spill

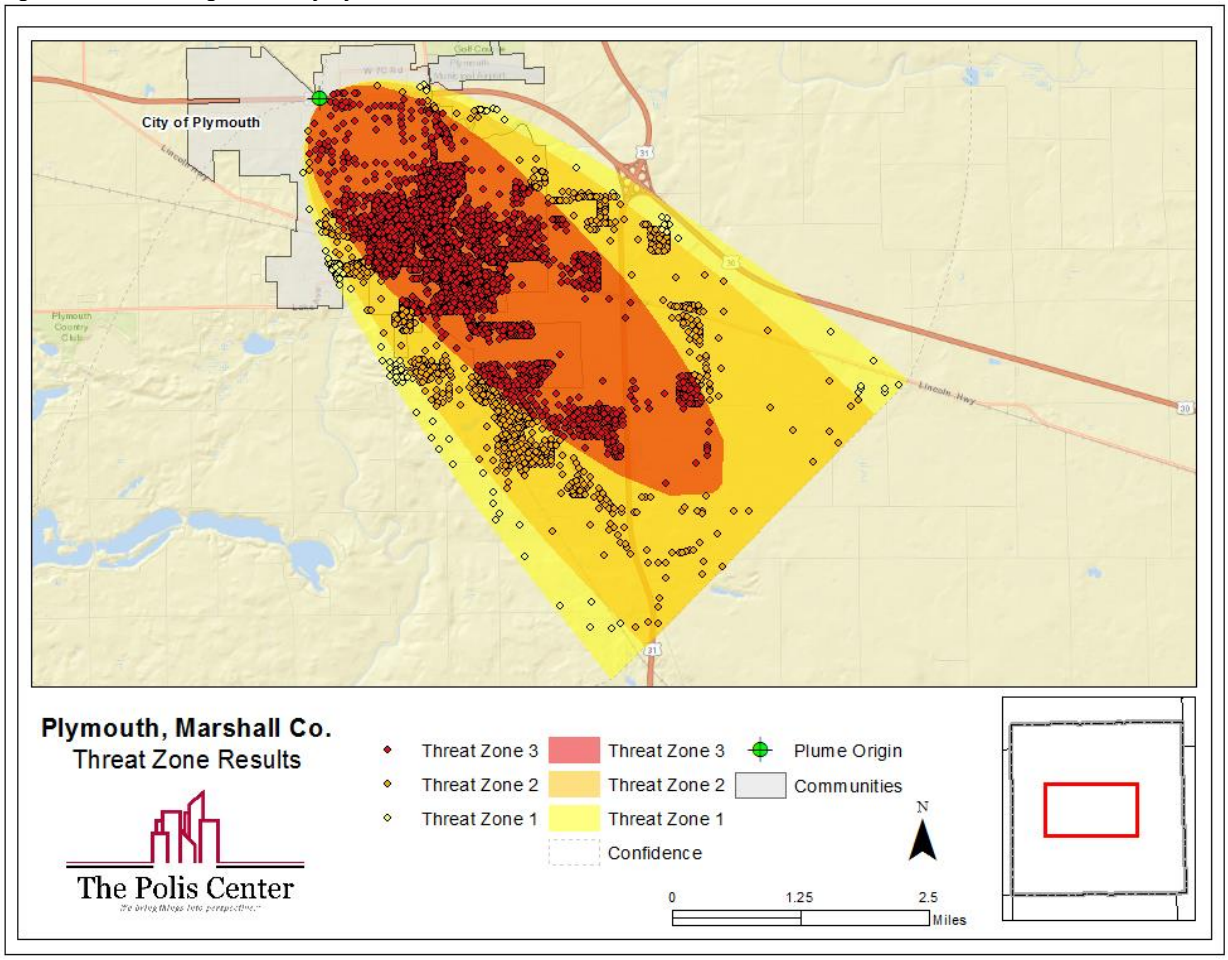
Figure 4-51: Threat Zone Results



Building Inventory Exposure

The Marshall County Building Inventory was added to ArcMap and overlaid with the threat zone footprint. The Building Inventory was then intersected with each of the three footprint areas to classify each point based upon the plume footprint in which it is located. Figure 4-52 depicts the Marshall County Building Inventory after the intersect process.

Figure 4-52: Building Inventory by Threat Zone



By summing the building inventory within the three threat zones; the GIS overlay analysis predicts that as many as 4,388 buildings and 8,923 people could be exposed. The population is estimated based on 2.5 people per residence within Marshall County. The threat zone begins on the northern portion of Plymouth and extends south east past the city limits.

The results of the analysis against the Building Inventory counts are depicted in Table 4-37 summarizes the results of the chemical spill by combining all AEGL zones.

Table 4-37: Estimated Exposure for all Threat Zones

Occupancy	Building Counts	Building Exposure
Agriculture	68	$ 25,956,052
Commercial	448	$ 818,753,166
Education	15	$ 30,250,799
Government	96	$ 110,486,376
Industrial	98	$ 668,048,267
Religious	94	$ 294,981,084
Residential	3,569	$ 733,741,774
Total	**4,388**	**$ 2,954,474,720**

Tables 4-38 summarizes the results of the chemical spill for each zone individually. Values represent only those portions of each zone that are not occupied by other zones.

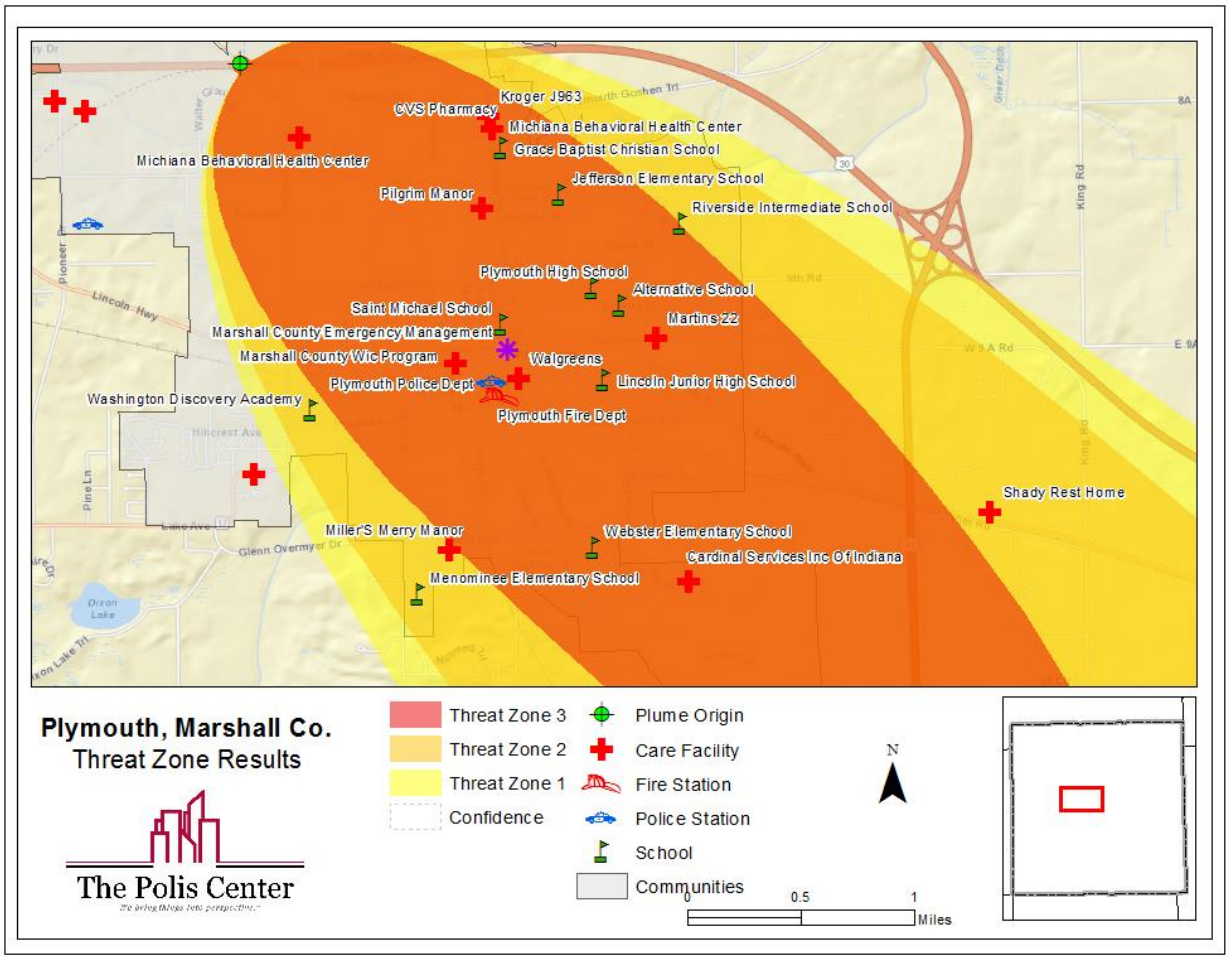
Table 4-38: Estimated Exposure for Threat Zones 1, 2, & 3

Occupancy	Threat Zone 3			Threat Zone 2			Threat Zone 1		
	People Affected	Building Counts	Building Exposure	People Affected	Building Counts	Building Exposure	People Affected	Building Counts	Building Exposure
Agriculture	0	13	$ 2,131,019	0	37	$11,821,669	0	18	$12,003,363
Commercial	0	408	$ 680,278,696	0	30	$90,415,327	0	10	$48,059,142
Education	0	11	$ 226,970,375	0	4	$75,537,624	0	0	$0
Government	0	92	$ 92,573,230	0	4	$17,913,145	0	0	$0
Industrial	0	94	$ 631,136,382	0	4	$36,911,884	0	0	$0
Religious	0	81	$ 212,378,162	0	12	$68,768,227	0	1	$13,834,695
Residential	6,934	2,773	$ 557,950,135	1,825	730	$160,178,888	195	78	$15,612,751
Total	**6,934**	**3,472**	**$ 2,403,418,000**	**1,825**	**809**	**$461,546,767**	**195**	**107**	**$38,012,795**

Essential Facilities

There were 25 essential facilities within the limits of the three threat zones. This includes 13 care facilities, including any emergency operation centers, 1 fire station, 1 police stations, and 10 schools. The affected facilities are labeled in Figure 4-53.

Figure 4-53: Plymouth, Marshall Co Essential Facilities Located in Threat Zone



Critical Facilities Exposure

There were 37 critical facilities within the limits of the three threat zones. 8 communication facilities, 2 airports, 25 Hazmat facilities, 1 potable water facility, and 1 waste water facility. These facilities are labeled in Figure 4-54.

Figure 4-54: Part 1, Plymouth, Marshall Co Critical Facilities in Threat Zones

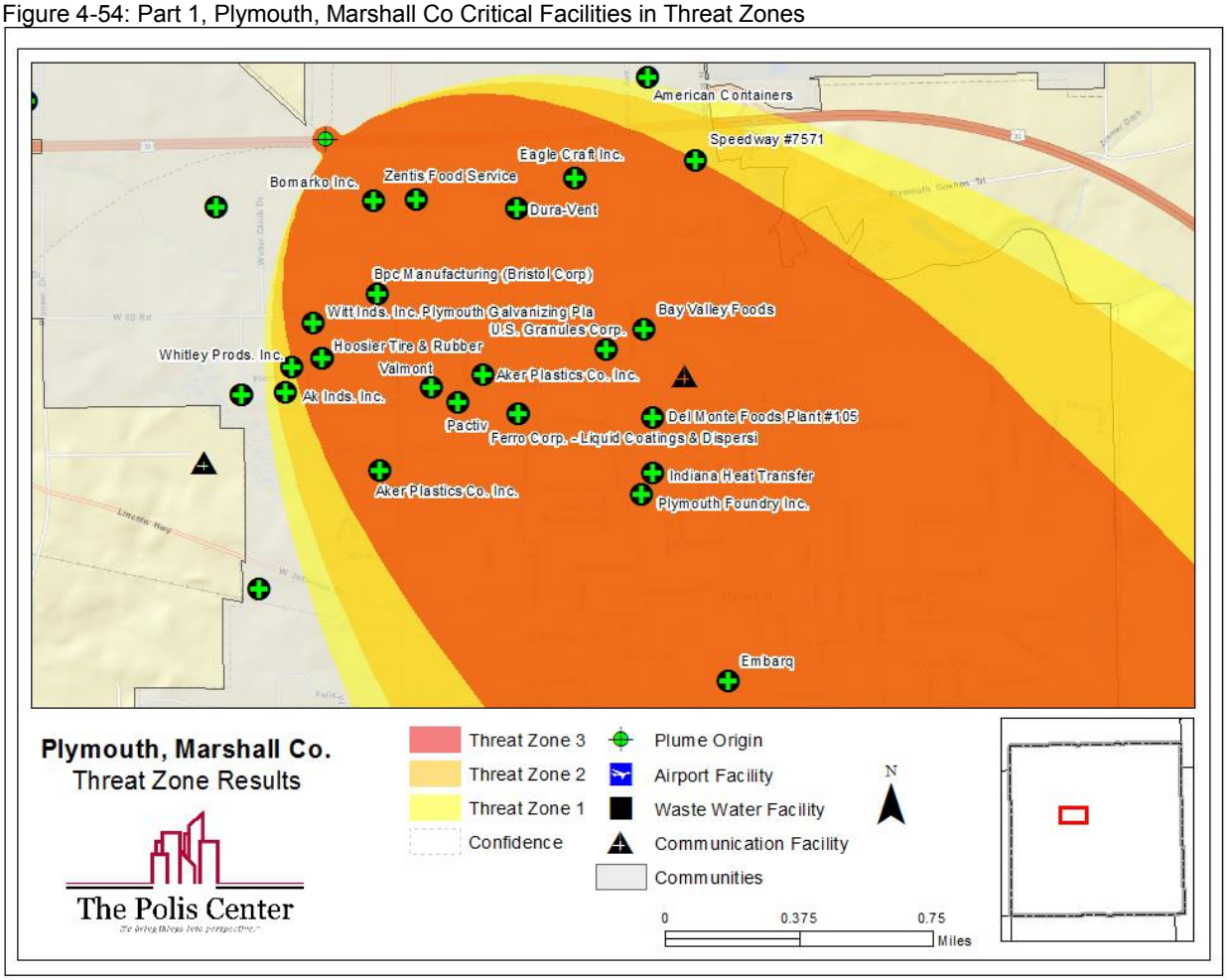
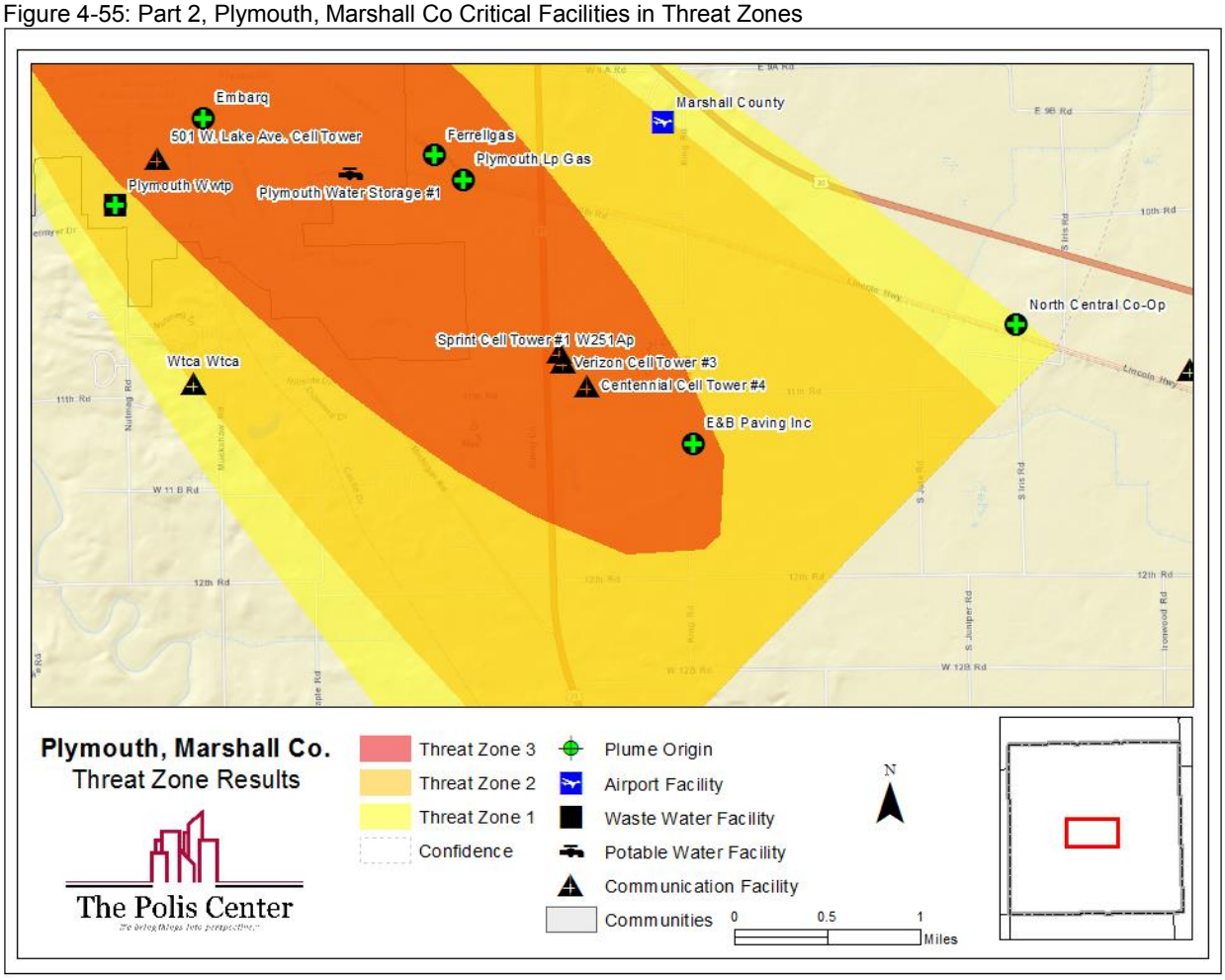
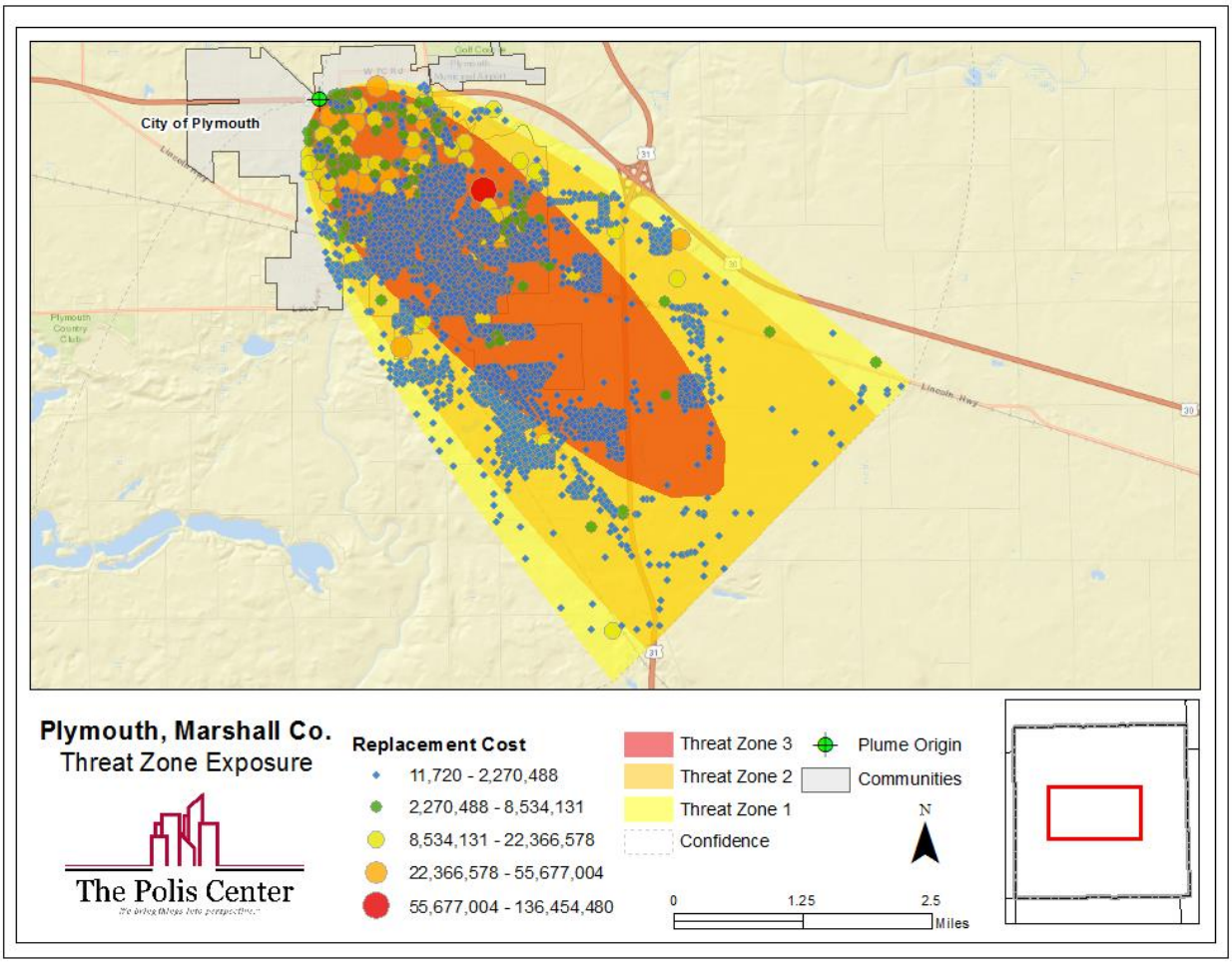


Figure 4-55: Part 2, Plymouth, Marshall Co Critical Facilities in Threat Zones



Exposure Based on Replacement Cost

Figure 4-57: Plymouth, Marshall County Building Exposure Displayed by Replacement Cost



Relationship to other Hazards

Flood- Hazmat incidents are likely when another

Plans and Programs in Place

CEMP- the IDHS State of Indiana Comprehensive Emergency Management Plan (CEMP) incorporates lists of Hazmat preparedness tasks for Emergency Support Function (ESF) personnel that include, but are not limited to, the following:

- Coordination between mass-care, housing, human services, and Hazmat teams to set-up a portable decontamination system at the evacuee/victim shelters, if necessary.
- Search and Rescue working with fire, health, and Hazmat as needed to provide support for effective search and rescue operations.

- Identify training gaps and needs relating to hazardous materials response during emergencies of disasters.
- Assist in the development of legislation, policies and administrative rules that relate directly to hazardous materials response, this ESF and its ability to provide emergency assistance.
- Train Emergency Support Function personnel on technical standards and specifications for essential pieces of equipment related to short and long-term emergency Hazmat response needs.

The Indiana Department of Homeland Security's Plans Development Branch is the entity responsible for the development and maintenance of the state CEMP and offering guidance and assistance for the development of local CEMPs.

LEPC- the Local Emergency Planning Committee is required, under the Emergency Planning and Community Right-to-Know Act, to develop an emergency response plan and to inform citizens about chemicals in their community. The United States Environmental Protection Agency outlines the following elements as requirements for an emergency response plan:

- Identification of facilities and transportation routes of extremely hazardous substances
- Description of emergency response procedures, on and off site
- Designation of a community coordinator and facility emergency coordinator(s) to implement the plan
- Outline of emergency notification procedures
- Description of how to determine the probable affected area and population by releases
- Description of local emergency equipment and facilities and the persons responsible for them
- Outline of evacuation plans
- A training program for emergency responders (including schedules)
- Methods and schedules for exercising emergency response plans

For questions or concerns, Marshall County's Local Emergency Planning Committee can be contacted at marshalllepc@gmail.com.

Commodity Flow Study- In the 2009 Multi-Hazard Mitigation Plan mitigation strategies, Marshall County began the process of conducting a commodity flow study along major roadways.

Program Gaps or Deficiencies

No gaps or deficiencies were identified at this time.

4.10 Dams

Hazard Description

Dams are structures that retain or detain water behind a large barrier. When full, or partially full, the difference in elevation between the water above the dam and below creates large amounts of potential energy, creating the potential for failure. The same potential exists for levees when they serve their purpose, which is to confine flood waters within the channel area of a river and exclude that water from land or communities land-ward of the levee. Dams and levees can fail due to either 1) water heights or flows above the capacity for which the structure was designed; or 2) deficiencies in the structure such that it cannot hold back the potential energy of the water. If a dam or levee fails, issues of primary concern include loss of human life/injury, downstream property damage, lifeline disruption (of concern would be transportation routes and utility lines required to maintain or protect life), and environmental damage.

Many communities view both dams and levees as permanent and infinitely safe structures. This sense of security may well be false, leading to significantly increased risks. Both downstream of dams and on floodplains protected by levees, this false sense of security leads to new construction, added infrastructure, and increased population over time. Levees in particular are built to hold back flood waters only up to some maximum level, often the 100-year (1% annual probability) flood event. When that maximum is exceeded by more than the design safety margin, the levee will be overtopped or otherwise fail, inundating communities occupying the land previously protected by that levee. It has been suggested that climate change, land-use shifts, and some forms of river engineering may be increasing the magnitude of large floods and the frequency of levee failure situations.

In addition to failure that results from extreme floods above the design capacity, levees and dams can fail due to structural deficiencies. Both dams and levees require constant monitoring and regular maintenance to assure their integrity. Many structures across the U.S. have been under-funded or otherwise neglected, leading to an eventual day of reckoning in the form either of realization that the structure is unsafe or, sometimes, an actual failure. The threat of dam or levee failure may require substantial commitment of time, personnel, and resources. Since dams and levees deteriorate with age, minor issues become larger compounding problems, and the risk of failure increases.

The Indiana General Assembly has established dam safety laws to protect the citizens of Indiana. Generally, the laws are intended to insure that the dam owner maintains his/her dam in a safe manner. The laws also define inspection requirements, violation conditions, and actions that the Indiana Department of Natural Resources (IDNR) will take if the dam owner violates the law.

IDNR currently regulates all dams that meet any one of the following criteria:

(1) the drainage area above the dam is greater than 1 square mile
(2) the dam embankment is greater than 20 feet high
(3) the dam impounds more than 100 acre-feet

Dam failure is a term used to describe the major breach of a dam and subsequent loss of contained water. Dam failure can result in loss of life and damage to structures, roads, utilities, crops, and livestock. Economic losses can also result from a lowered tax base, lack of utility profits, disruption of commerce and governmental services, and extraordinary public expenditures for food relief and protection. National statistics show that overtopping due to inadequate spillway design, debris blockage of spillways, or settlement of the dam crest account for one third of all US dam failures. Foundation defects, including settlement and slope instability, account for another third of all failures. Piping and seepage, and other problems cause the remaining third of national dam failures. This includes internal erosion caused by seepage, seepage and erosion along hydraulic structures, leakage through animal burrows, and cracks in the dam.

Since the responsibility for maintaining a safe dam rests with the owner, dam ownership imposes significant legal responsibilities and potential liabilities on the dam owner. A dam failure resulting in an uncontrolled release of the reservoir can have a devastating effect on persons and property downstream.

Low-Head Dams

Low-head, or in-channel, dams can present a safety hazard to the public because of their ability to trap victims in a submerged hydraulic jump formed just downstream from the dam. 38 Recent deaths and injuries around these structures in the state, has brought the attention of this issue to the surface for local, state and federal officials. Current initiatives led by the Indiana Silver Jackets—a multi-agency coalition that leverages efforts to address natural hazards—have focused on the identification of these dams statewide, as well as various efforts to notify the public on their dangers.

Dam Failure History in Marshall County

There are eight IDNR regulated dams in the county. There are no records or local knowledge of any dam failures in the county.

Vulnerability and Future Development

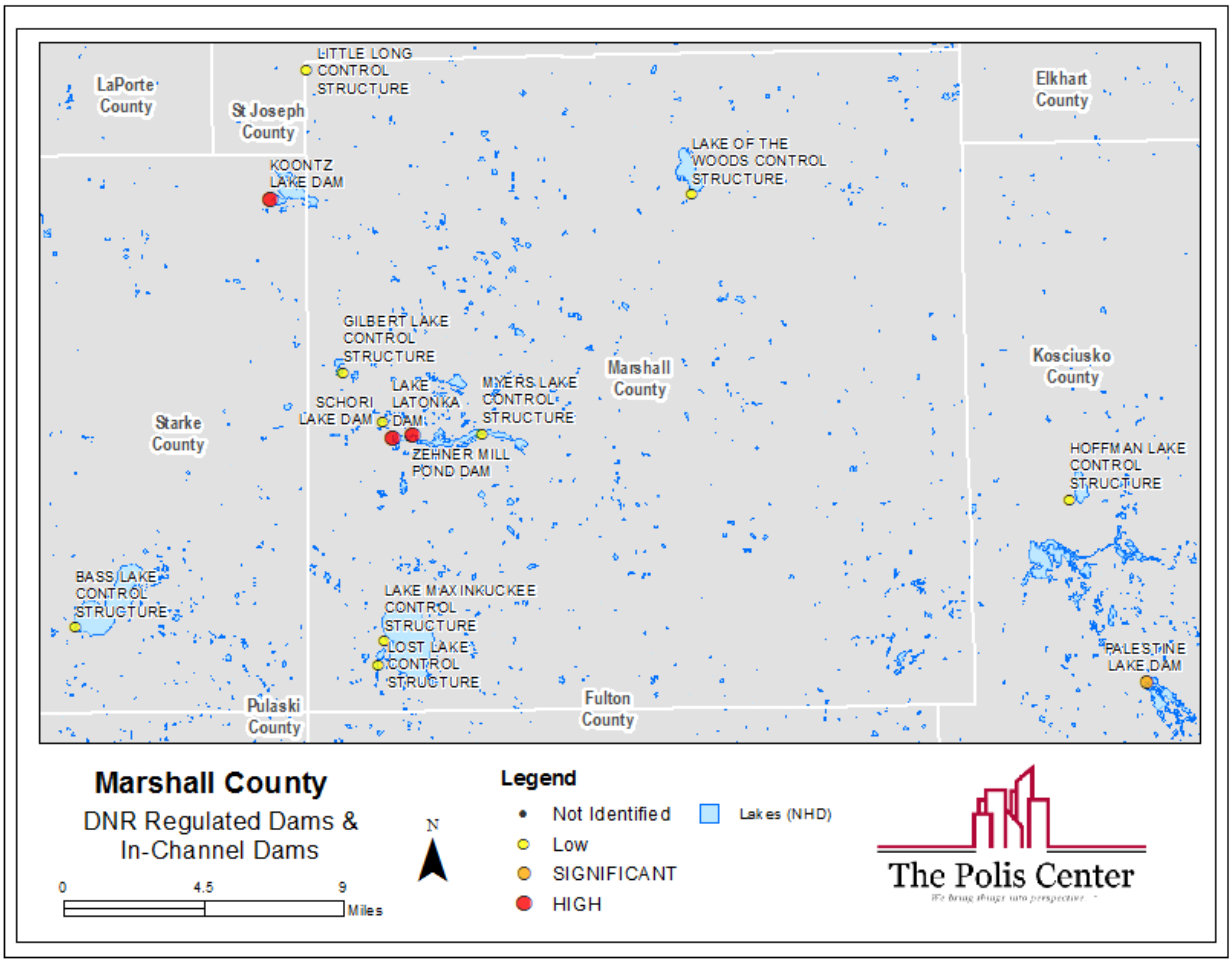
When dams are assigned the low (L) hazard potential classification, it means that failure or incorrect operation of the dam will result in no human life losses and no economic or environmental losses. Losses are principally limited to the owner's property. Dams assigned the significant (S) hazard classification are those dams in which failure or incorrect operation results in no probable loss of human life; however, it can cause economic loss, environment damage, and disruption of lifeline facilities. Dams classified as significant hazard potential dams are often located in predominantly rural or agricultural areas, but could be located in populated areas with a significant amount of infrastructure. Dams assigned the high (H) hazard potential classification are those dams in which failure or incorrect operation has the highest risk to cause loss of human life and significant damage to buildings and infrastructure.

According to IDNR and the National Inventory of Dams, two dams are classified as high hazard, and neither dam has an Emergency Action Plan (EAP). An EAP is not required by the State of Indiana but is strongly recommended in the 2003 Indiana Dam Safety & Inspection Manual.

Table 4-39: Marshall County Dams

Name	Hazard Level	EAP
Zehner Mill Pond Dam	High	No
Lake Latonka Dam	High	No
Lake Of The Woods Control Structure	Low	No
Lake Maxinkuckee Control Structure	Low	No
Gilbert Lake Control Structure	Low	No
Lost Lake Control Structure	Low	No
Myers Lake Control Structure	Low	No
Schori Lake Dam	Low	No

Figure 4-58: Marshall County Dams



Risk Analysis

Exposure Analysis

Marshall County has two high hazard level dams and no dams with Emergency Action Plans (EAP). Marshall County dams are shown in the images below. In the images depicting Lake Latonka Dam and Zehner Mill Pond Dam, the detailed dam failure inundation areas were not available. Therefore, for the purpose of this planning effort, the dams are plotted with approximate locations of downstream structures including critical facilities. The magnitude and extent of damage depend on the type of dam break, volume of water that is released, and width of the floodplain valley to accommodate the dam break flood wave. Based on preliminary analysis of vulnerable facilities in approximate dam failure inundation zone, no critical facilities would be affected by a

dam failure. These do not include bridges and roadways that are in the floodway and floodplains throughout the County that could be damaged or destroyed by a dam breach event.

Figure 4-59: High Hazard Lake Latonka Dam

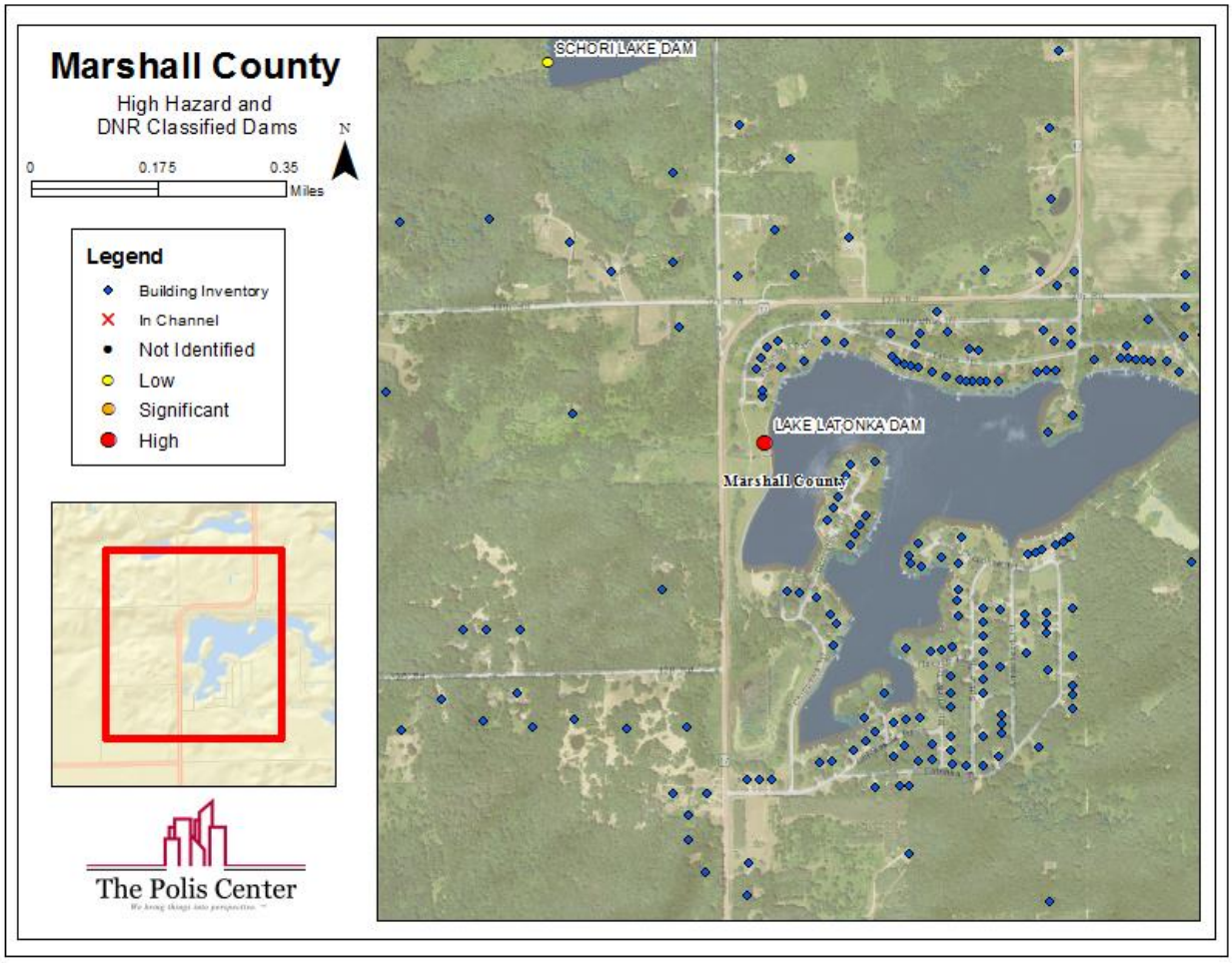


Figure 4-60: High Hazard Zehner Mill Pond Dam

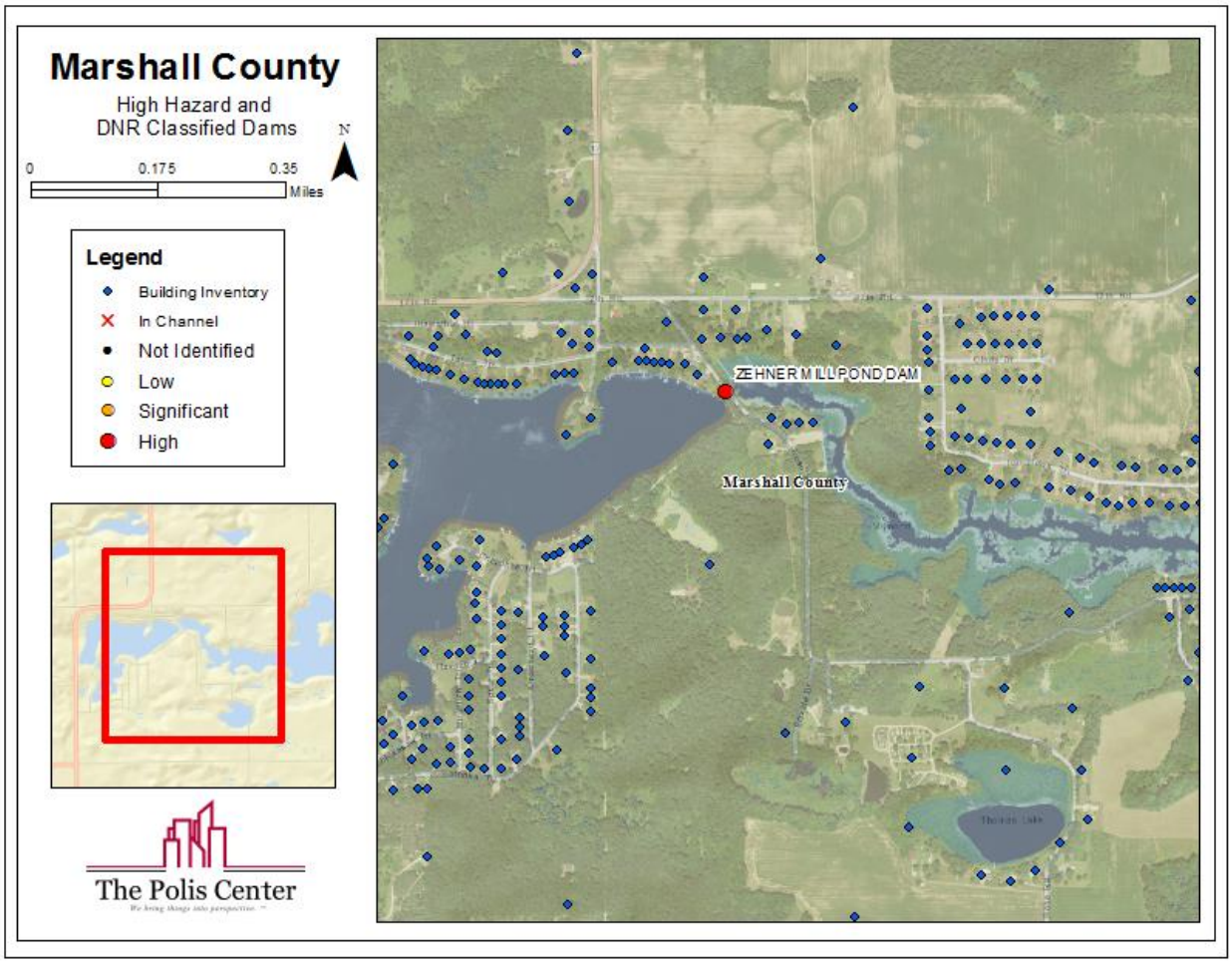


Figure 4-61: Dams in Southwest Marshall County

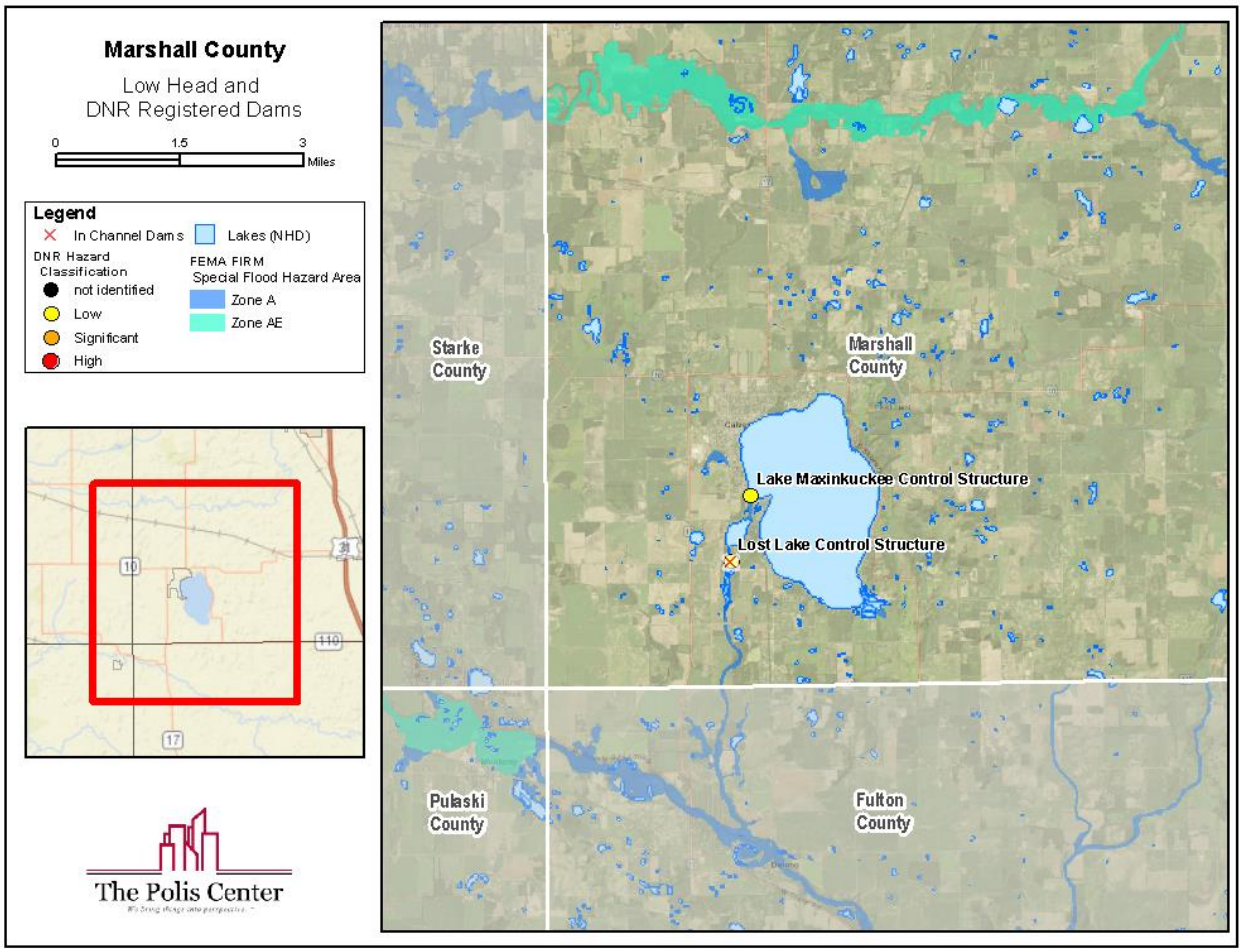


Figure 4-62: Chain O Lakes in Marshall County

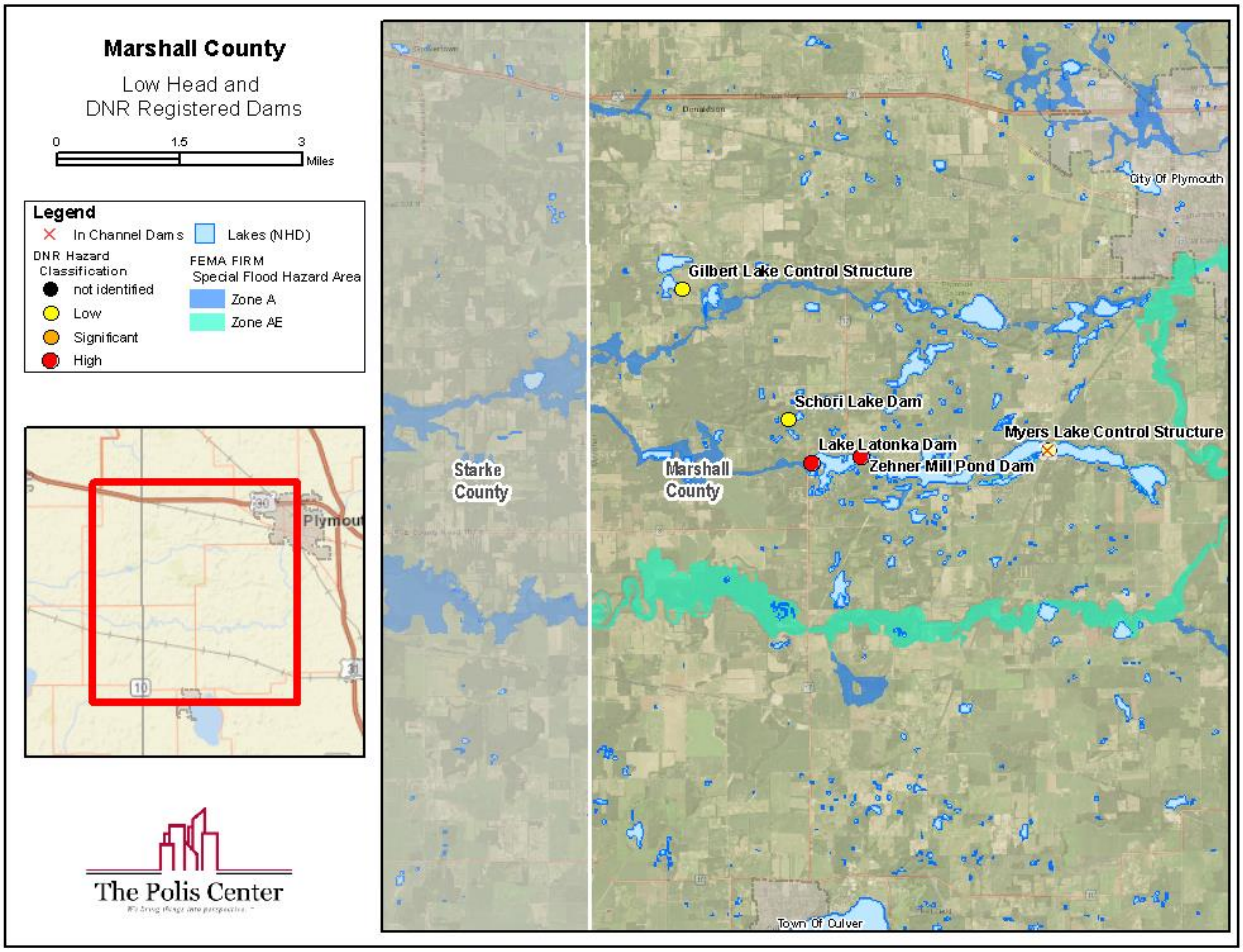


Figure 4-63: Dam in Northwest Marshall County

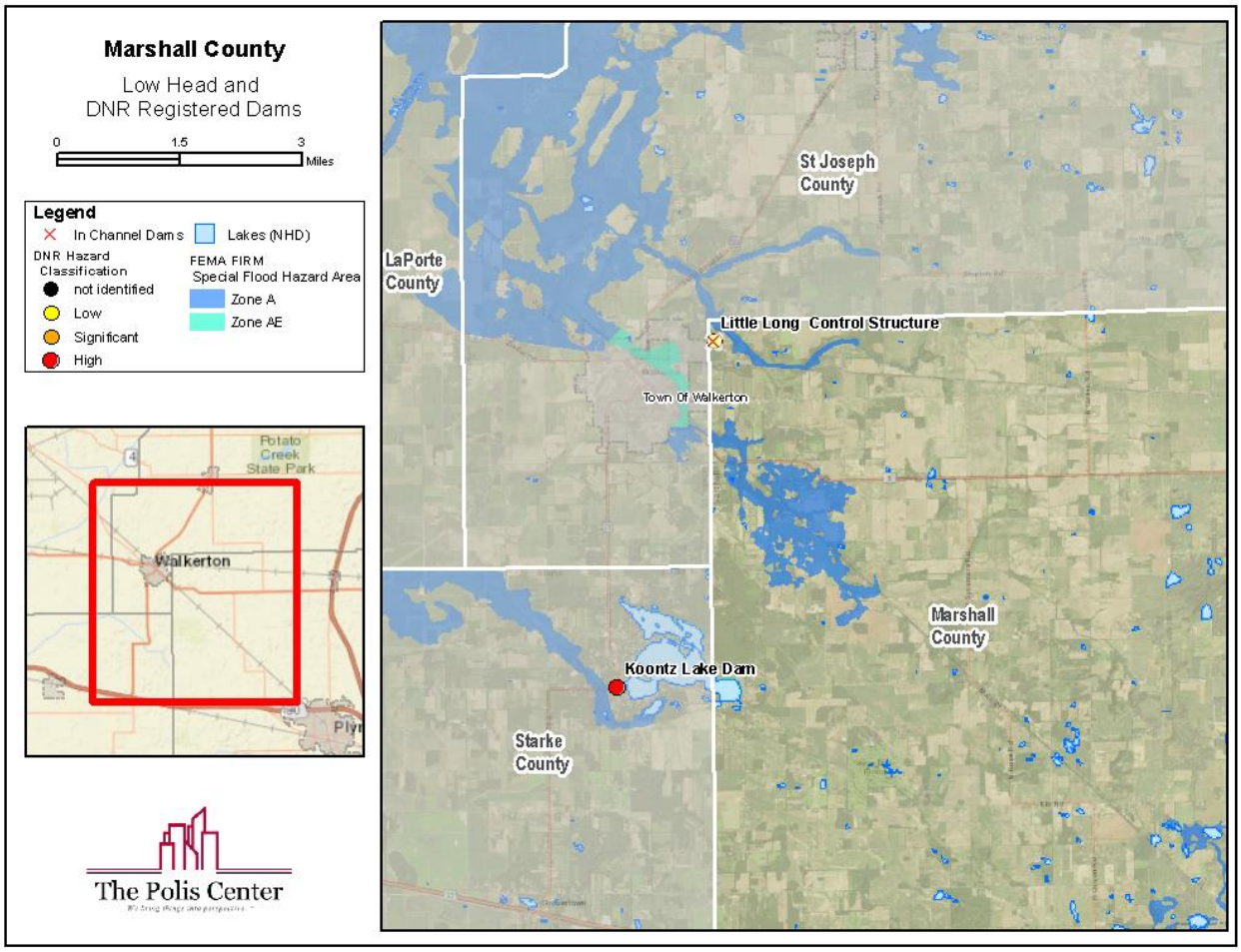
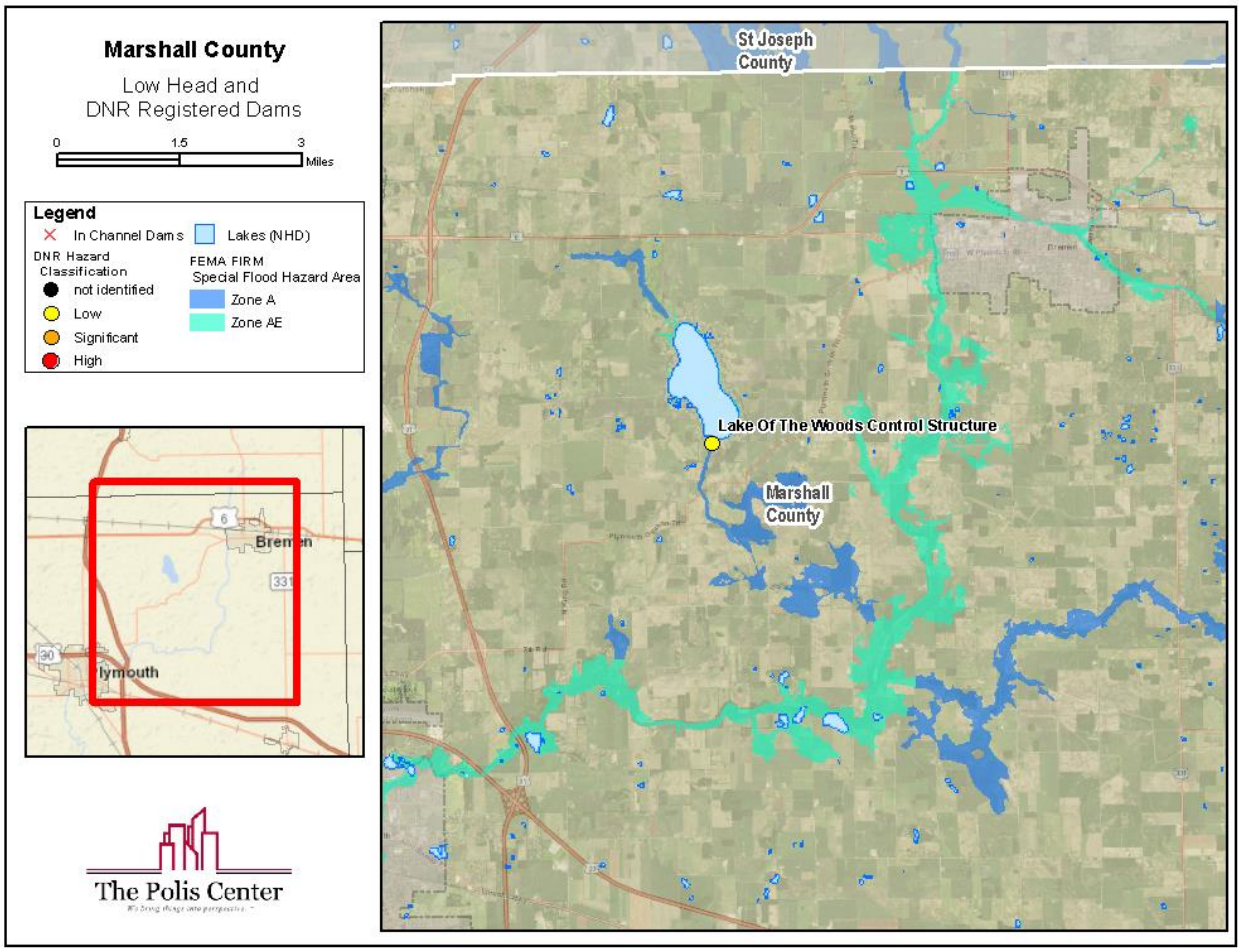


Figure 4-64: Lake of the Woods Marshall County



Relationship to other Hazards

Flooding – Flooding is typically the leading cause of dam failure incidents.

Drought – Property owners living around dams may have problems accessing boating equipment during times of drought.

Plans and Programs in Place

The county surveyor works to maintain the established Lake Levels at particular lakes.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

4.11 Levees

Hazard Description

Levees are small, long earth dams that protect low areas of cities and towns, industrial plants, and expensive farmland from flooding during periods of high water. FEMA defines a levee as a "man-made structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide a level of protection from temporary flooding." Levees reduce the risk of flooding but do not eliminate all flood risk. As levees age, their ability to reduce this risk can change and regular maintenance is required to retain this critical ability. In serious flood events, levees can fail or be overtopped and, when this happens, the flooding that follows can be catastrophic.

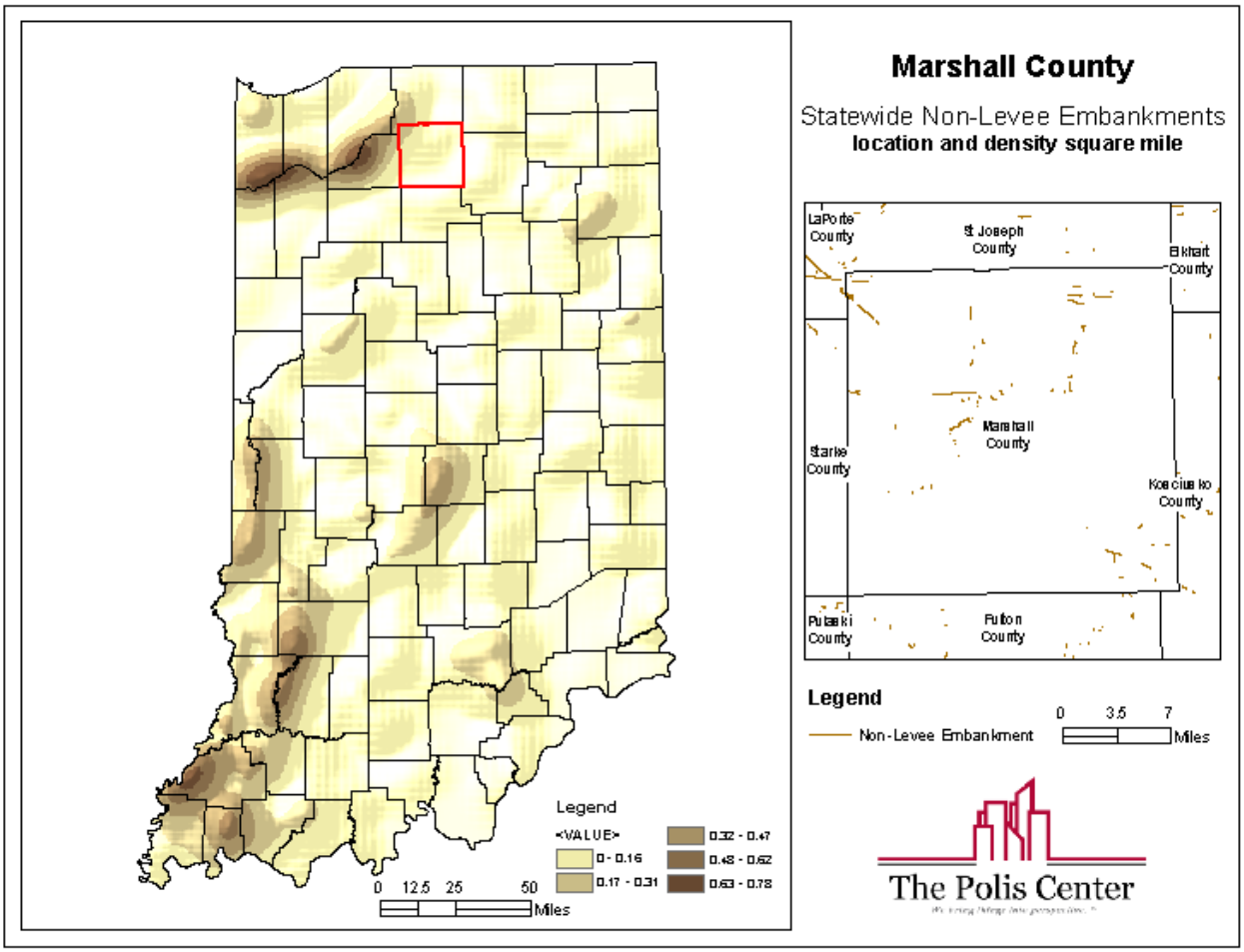
The US Army Corps of Engineers (USACE) and FEMA have different roles and responsibilities related to levees. FEMA addresses mapping and floodplain management issues related to levees, and accredits levees as meeting requirements set forth by the National Flood Insurance Program. USACE addresses a range of operation and maintenance, risk communication, risk management, and risk reduction issues as part of its responsibilities under the Levee Safety Program. FEMA may also provide accreditation for levees which means that the levee meets all the requirements of the Code of Federal Regulations Section 65.10. This ensures that the levee has adequate freeboard above the 1% annual chance flood, meets design specifications, maintenance plan in place, and that the owners take responsibility.

Along with accredited levees regulated by federal agencies, there are also what are referred to as Non-Levee Embankments (NLE), which typically parallel to the direction of natural flow. An embankment is an artificial mound of soil or broken rock that supports railroads, highways, airfields, and large industrial sites in low areas, or impounds water. NLEs are often highways or railroads built on fill in low lying areas and thus tend to impose lateral constraints on flood flows, and typically contain the following characteristics:

- NLEs are elevated linear features adjacent to waterways and within the floodplain.
- They are typically man-made and include agricultural embankments built by landowners and road and railroad embankments banks.
- They are levee-like structures, but are not certified or engineered to provide flood protection.

Figure 4-65 identifies the geographic location density (using a hill shade) of levees in the state of Indiana and an overview of the levees in Marshall County. Just East of Marshall County, there is a heavy concentration of NLE along the Kankakee River.

Figure 4-65: Non-Levee Embankment Density Indiana



The National Committee on Levee Safety estimates that the location and reliability status of 85% of the nation's NLEs are unknown. In Indiana, majority of NLEs are unidentified and are typically not maintained. NLEs impose lateral constraints on flood flows, reducing the floodplain storage capacity and increasing the flood velocity. As a result, downstream flooding and the potential for stream erosion can increase. As such, NLE's can give a false sense of security and protection to the people residing near NLEs. For these reasons, it is extremely important to map where these features are located.

Living with levees is a shared responsibility. While operating, maintaining levee systems are the levee sponsor responsibility, local officials are adopting protocols and procedures for ensuring public safety and participation in the NFIP.

Levee Failure History in Marshall County

There are no records or local knowledge of any significant levee or non-levee embankment failures in the county.

Vulnerability and Future Development

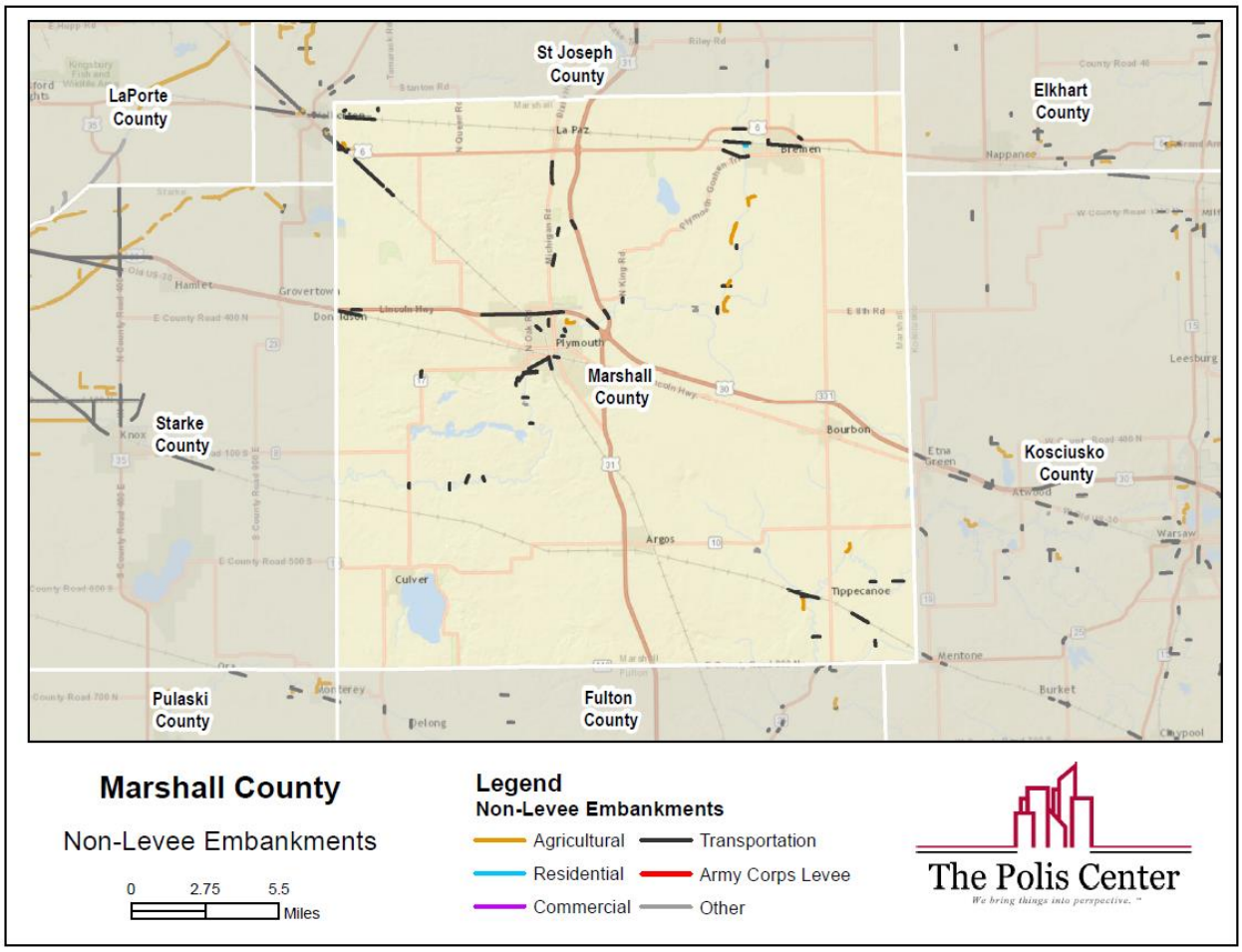
The extent of potential levee failure varies across the county. In order to be considered creditable flood protection structures on FEMA's flood maps, levee owners must provide documentation to prove the levee meets design, operation, and maintenance standards for protection against the "one-percent-annual chance" flood. If this accreditation is maintained, portions that would be mapped as Special Flood Hazard Area appear on a FIRM map as Zone X, protected by levee. A review of the USACE and FEMA data identified no certified levee segments in Marshall County.

Using LiDAR elevation data, in conjunction with multiple GIS data layers including digital elevation models (DEM) and slope maps, the Indiana Silver Jackets identified and mapped NLEs for 82 of the state's 92 counties. The team performed a literature review on existing approaches and developed new approaches before narrowing the methods to manual digitization, a semi-automated slope-derived method, and a semi-automated maximum curvature method. The team developed a set of characteristics that helped define NLE and distinguish them from natural berms or spoil banks.

- The following minimum characteristics were analyzed before capturing the extent of the NLE:
- Within or partially within the buffered 100-year floodplain (DFIRM)
- At least 100 yards (300 ft.) in length
- At least 1 meter (3 feet) in height
- At least 20 degrees of slope on either face

The identification of these embankments can aid in the further improvement of hydraulic modeling for streams. The classification of these structures is not completely objective, as the interpretation of agricultural, residential, and commercial will vary depending on the analyst interpretation. Figure 4-66 shows the extents of the NLE in the county.

Figure 4-66: Non-Levee Embankments: Marshall County



Risk Analysis

Exposure Analysis

Marshall County is predominately made of transportation-related NLEs near the Northwest of the county, Bremen, Tippecanoe, and Plymouth. The following maps provide a closer look at the areas around these NLE structures. IF there are any resources located around these structures, this has been provided to assess the potential exposure to the county and communities.

Non-Levee Embankment Types

Although considered a rough estimation the classification, at the development of the NLE dataset an analyst performed a rough assessment to estimate the function of the NLE based on any suggestions from orthophotography.

Non-Levee Embankment Assets

Figure 4-67: Non-Levee Embankments, Northeast

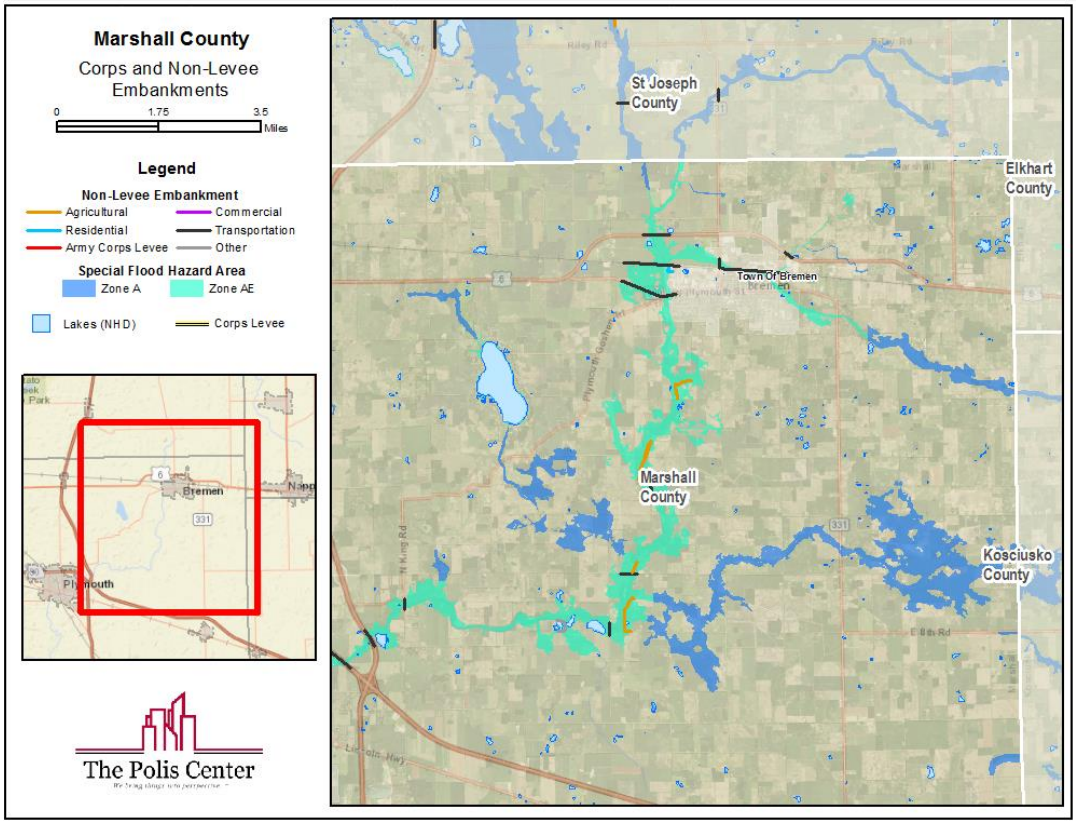


Figure 4-68: Bourbon, IN – Non-Levee Embankments, Northwest

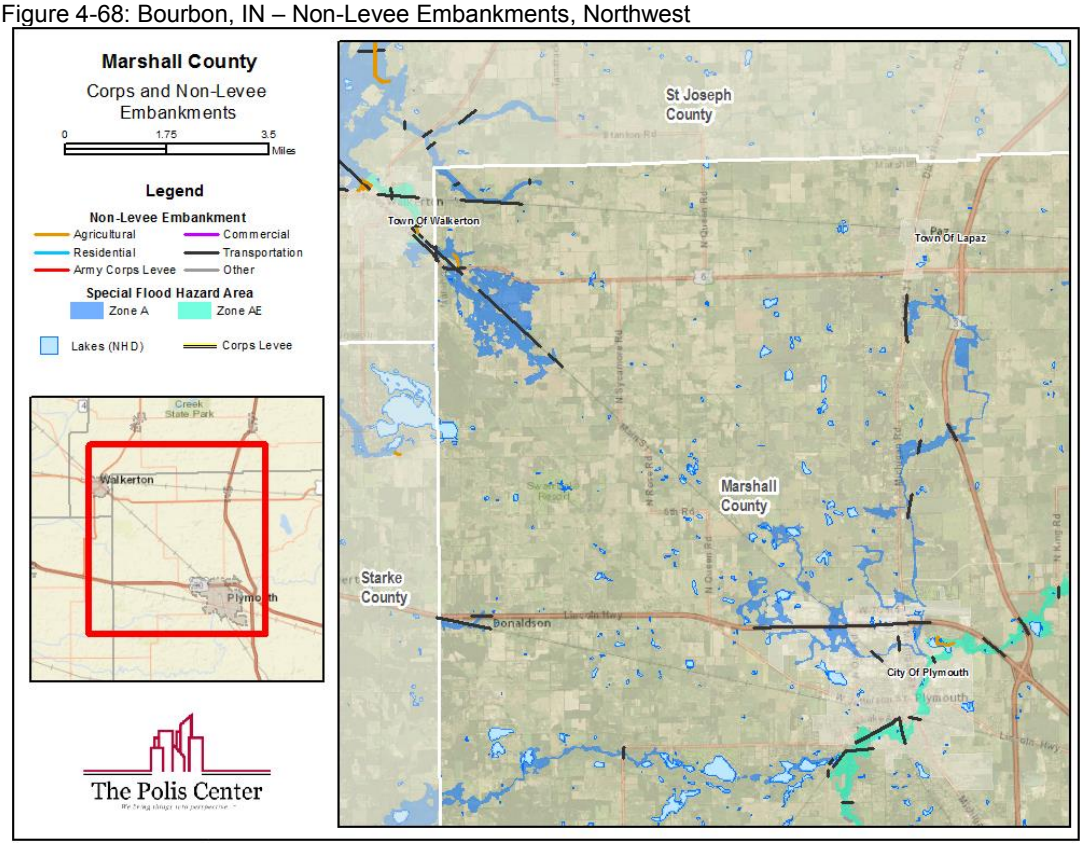


Figure 4-69: Bremen, IN – Non-Levee Embankments, Southeast

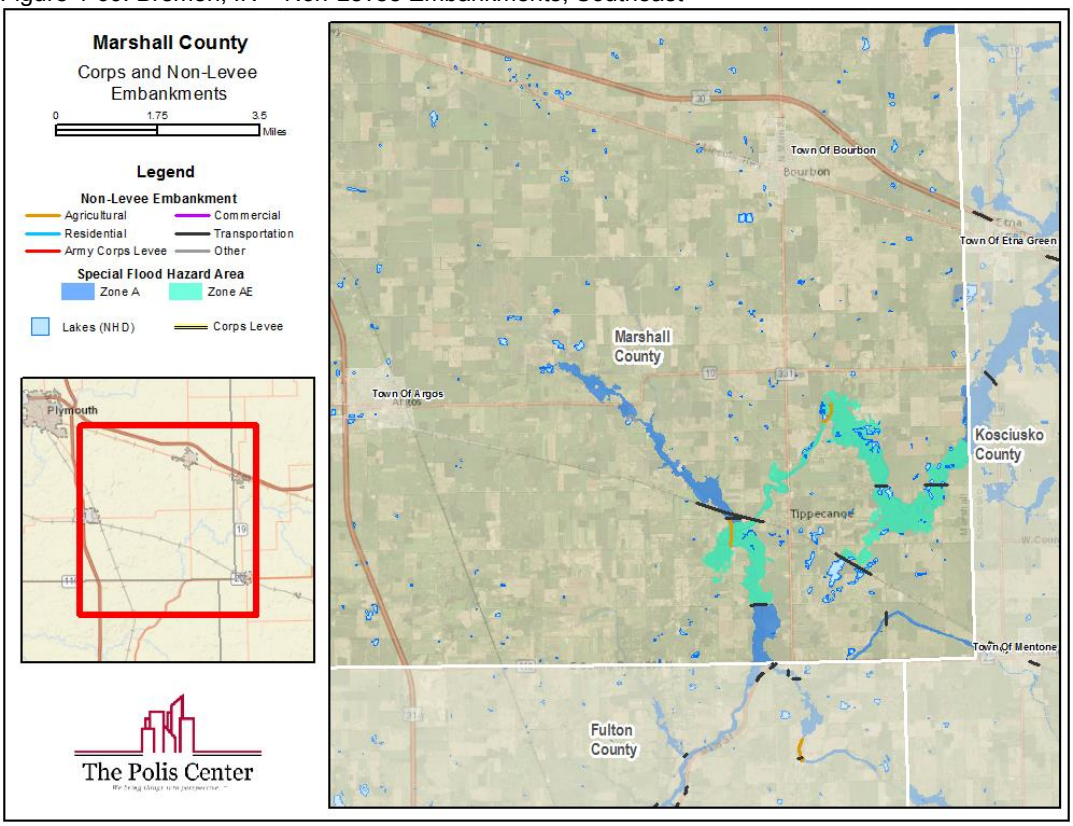
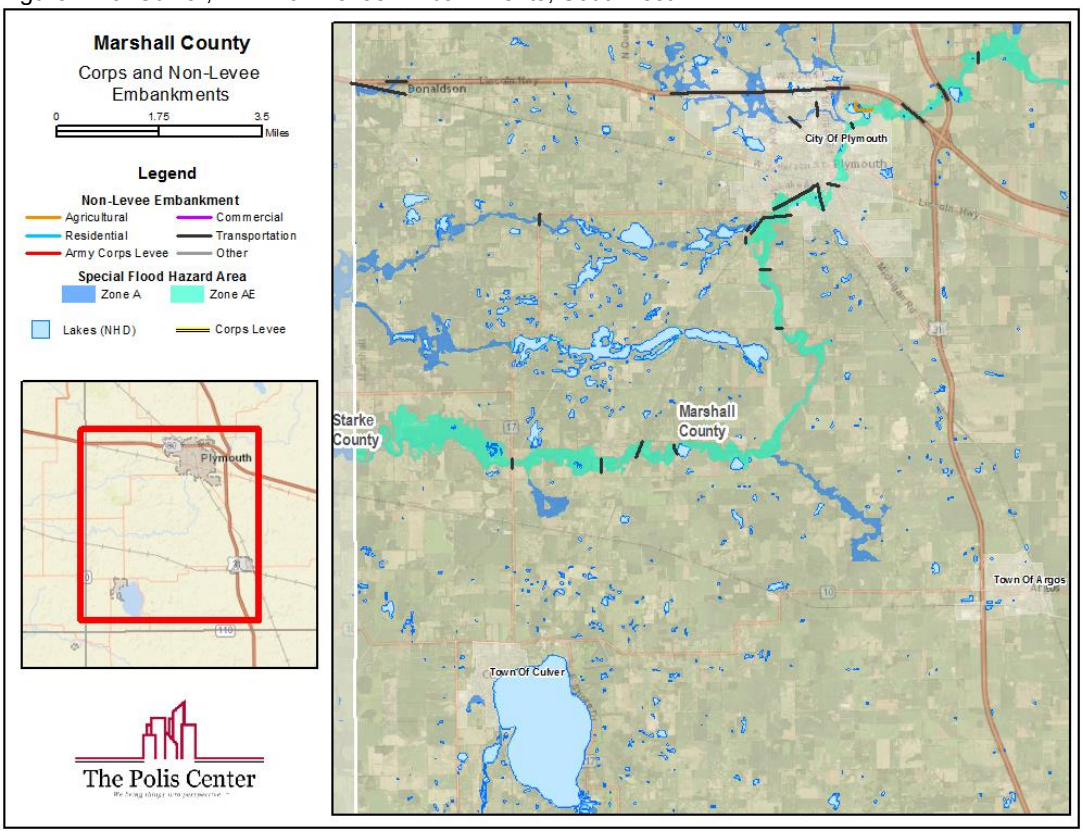


Figure 4-70: Culver, IN – Non-Levee Embankments, Southwest



Relationship to other Hazards

Flooding – Flooding is typically the leading cause to levee failure incidents. In turn, levee failure can cause further flooding and flash flooding downstream of the incident. Depending on the location of the levee, levee failure can unleash flood water onto residential homes, roads, industrial areas, and health facilities, causing millions of dollars of damages and injuries.

Plans and Programs in Place

USACE and FEMA Levee Certification- There are no currently maintained levees certified by the US Army Corps of Engineers or by FEMA under the National Levee Mapping Program. .

Floodplain Ordinance- Proposed construction in the floodway requires the prior approval of the State DNR Division of Water.

Program Gaps or Deficiencies

No program gaps or deficiencies were identified.

Chapter 5 – Goals, Objectives, Mitigation Strategies and Implementation

The goal of mitigation is to protect lives and reduce the future impacts of hazards including property damage, disruption to local and regional economies, the amount of public and private funds spent to assist with recovery, and to build disaster-resistant communities. Mitigation actions and projects should be based on a well-constructed risk assessment, provided in Section 4 of this plan. Mitigation should be an ongoing process adapting over time to accommodate a community's needs.

Community Capability Assessment

The capability assessment identifies current activities used to mitigate hazards. The capability assessment identifies the policies, regulations, procedures, programs, and projects that contribute to the lessening of disaster damages. The assessment also provides an evaluation of these capabilities to determine whether the activities man be improved in order to more effectively reduce the impact of future hazards. The planning team completed a survey and then discussed any of the discrepancies in meeting 3. The following sections highlight the existing plans and

mitigation capabilities within all of the communities and a copy of the results of the capability survey are included in Appendix G.

Planning and Regulatory

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. Below the team details the NFIP program and local plans, codes, and ordinances in place, to make the community more resilient to disasters.

National Flood Insurance Program (NFIP)

The NFIP is a federal program created by Congress to mitigate future flood losses nationwide through sound, community-enforced building and zoning ordinances and to provide access to affordable, federally-backed flood insurance protection for property owners. The NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods. Participation in the NFIP is based on an agreement between local communities and the federal government that states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in Special Flood Hazard Areas (SFHAs), the federal government will make flood insurance available within the community as a financial protection against flood losses.

Marshall County and the Towns of Argos, Bremen, Culver, and the City of Plymouth participate in the National Flood Insurance Program. The Towns of Bourbon and LaPaz do not participate in the NFIP, but they do not have a special flood hazard identified by the FEMA High Risk Zone.

The Indiana Department of Natural Resources (DNR) oversee the continued compliance of state floodway permitting and was empowered by the Indiana General Assembly to regulate certain development activities in the floodway, including the construction of structures, obstructions, deposits, and/or excavations. These activities any State waterway (streams less than 1 square mile in drainage area) by requiring DNR approval prior to the beginning of the project. DNR authority under the Flood Control Act is further described in 312 IAC 10: Floodplain Management.

In 1945, the Indiana Flood Control Act was passed by the state legislature, enabling the IDNR to have regulatory control over floodway areas produced by regulatory floods. The

Indiana "Flood Control Act" (IC 14-28-1) and Flood Hazard Areas Rule (310 IAC 6-1): In the Flood Control Act's preamble, the General Assembly declared that "... the loss of lives and property caused by floods and the damage resulting from floods is a matter of deep concern to Indiana

affecting the life, health, and convenience of the people and the protection of property." Furthermore, "... the channels and that part of the flood plains of rivers and streams that are the floodways should not be inhabited and should be kept free and clear of interference or obstructions that will cause any undue restriction of the capacity of the floodways."

Within the Flood Control Act, the General Assembly created a permitting program. Two of the fundamental provisions of the Act's regulatory programs consist of the following:

(1) An abode or place of residence may not be constructed or placed within a floodway.

(2) Any structure, obstruction, deposit, or excavation within a floodway must receive written approval from the Director of the Department of Natural Resources for the work before beginning construction.

The DNR is Cooperating Technical Partner (CTP) for the FEMA Floodplain Mapping program. The DNR provides floodway site determinations as requested. The DNR performs the Community Assistance Call (CAC) and Community Assistance Visit (CAV) for the NFIP program.

The CAV and CAC services as each NFIP communities assurance that the community is adequately enforcing its floodplain management regulations and prices a chance for technical assistance by the DNR on behalf of FEMA. The City of Plymouth and Town of Culver had their most recent CAV and Marshall County and the Town of Bremen had Community Assistance Call CAC completed in 2016. Neither of which required further compliance follow-up.

The NFIP's Community Rating System (CRS) recognizes and encourages community floodplain management activities that exceed the minimum NFIP standards. Depending upon the level of participation, flood insurance premium rates for policyholders can be reduced. Besides the benefit of reduced insurance rates, CRS floodplain management activities enhance public safety, reduce damages to property and public infrastructure, avoid economic disruption and losses, reduce human suffering, and protect the environment. Technical assistance on designing and implementing some activities is available at no charge. Participating in the CRS provides an incentive to maintaining and improving a community's floodplain management program over the years. Marshall County or any of its communities do not participate in the CRS program.

Plans and Ordinances

Marshall County and its incorporated communities have a number of plans and ordinances in place to ensure the safety of residents and the effective operation of communities. These include

the Marshall County, Indiana Comprehensive Plan, the Marshall County, Indiana Zoning Ordinance, the Lake of the Woods, Marshall County, Indiana Watershed Management Plan, the Soil Survey of Marshall County, Indiana, and the Storm Water Drainage and Sediment Control Ordinance. In Section 4.4 of this plan (*Hazard Profiles)* a review of the plans and programs in place as well as any identified program gaps or deficiencies was included as related to each of the natural hazards addressed in the plan. Information was collected through surveys with planning team representatives from the county, cities, towns and school districts. The review of this information was used to inform the development of mitigation strategies for the 2017 plan update.

General Mitigation Vision

In Section 4.0 of this plan, the risk assessment identified Marshall County is prone to a number of natural hazards. The planning team understands that although hazards cannot be eliminated altogether, Marshall County can work toward building disaster-resistant communities. The goals, strategies and objectives listed in the 2014 Indiana State Hazard Mitigation Plan were adopted for use in the Marshall County Plan. This framework will allow for integration of the mitigation actions that are listed by Marshall County and its jurisdictions into the state plan. The state will then be able to develop a statewide strategy that will benefit all of Indiana.

Table 4-40: Marshall County Strategies

Flooding Goal: Reduce deaths, injuries, property loss and economic disruption due to all types of flooding (riverine, flash flooding, dam/levee failure)	
Mitigation Strategy	Objectives
Prevention:	Planning, technical studies, training, adoption of ordinances and legislation, acquisition and use of equipment, establishing shelters, and encouraging participation in NFIP and CRS will be used to prevent or reduce risks to lives and property from flooding.
Property Protection:	Acquisition, repair, or retrofitting of property and acquisition and use of equipment will be used to prevent or reduce risks to property from flooding.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from flooding in order to prevent or reduce those risks.
Natural Resource Protection:	Stream corridor protection projects and restoration and soil erosion control projects will be used to prevent or reduce risks and increase the protection of natural resources from flooding.
Emergency Services:	Technological improvements, warning systems, responder training, emergency response services, acquisition and use of equipment, and planning will provide emergency services to prevent or reduce the risks to lives and property from flooding.
Structural Improvements:	Construction and maintenance of drains, sewer drainage and separation projects, floodwalls, dams, culverts, levees, roads, bridges, and general flood protection projects will be used to prevent or reduce damages from flooding, loss of services to critical equipment, and the risks they pose to lives, property, and the natural environment.
Summer Storms Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to summer storms.	
Mitigation Strategy	Objectives

Prevention:	Planning, training, technical studies, acquisition and use of equipment, adoption of ordinances and legislation, and construction of new or retrofitting safe rooms will be used to prevent or reduce risks from summer storms to lives, property, and economic activity.
Property Protection:	Constructing safe rooms and storm shelters, retrofitting, and vegetation management will be used to prevent or reduce risks to the protection of property from summer storms.
Public Education and Awareness:	Public education, warning systems, and access to information will be used to raise public awareness of risks from summer storms in order to prevent or reduce those risks.
Emergency Services:	Warning systems, responder training, emergency response services, technological improvements, and response and recovery planning will provide emergency services to prevent or reduce risks from summer storms.
Structural Improvements:	The construction of safe rooms, shelters, and underground utility lines as well as maintenance of structural projects will be used to prevent or reduce risks from summer storms
Tornado Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to tornado.	
Mitigation Strategy	Objectives
Prevention:	Adoption of ordinances and legislation, acquisition and use of equipment, planning, conducting technical training, studies, and retrofit or construction of safe rooms will be used to prevent or reduce risks to lives, property, and economic activity from tornadoes.
Property Protection:	Constructing safe rooms and storm shelters, and retrofits will be used to prevent or reduce risks to property from tornadoes.
Public Education and Awareness:	Warning systems, IPAWS, public education, and access to information will be used to raise public awareness of risks from tornadoes in order to prevent or reduce those risks.
Emergency Services:	Warning systems, technological improvements, responder training, planning, emergency response services, and acquisition and use of equipment will provide emergency services to prevent or reduce risks from tornadoes.
Structural Improvements:	Construction of storm shelter and safe rooms and maintenance of other structural projects will be used to prevent or reduce risks from tornadoes.
Hazardous Incident: Reduce deaths, injuries, property loss, natural resource and economic disruption due to hazardous incidents.	
Mitigation Strategy	Objectives
Prevention:	Planning, training, technical studies, acquisition and use of equipment, adoption of ordinances and legislation, and construction of
Property Protection:	
Public Education and Awareness:	Public education, warning systems, and access to information will be used to raise public awareness of risks from hazardous incidents in order to prevent or reduce those risks.
Emergency Services:	Warning systems, responder training, emergency response services, technological improvements, and response and recovery planning will provide emergency services to prevent or reduce risks from summer storms.
Structural Improvements:	
Severe Winter Storms Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to severe winter weather	
Mitigation Strategy	Objectives
Prevention:	Acquisition and use of equipment, adoption and enforcement of ordinances and legislation, planning, training, and technical studies will be used to prevent or reduce risk to the protection of lives, property, and economic activity from the risks from severe winter storms.
Property Protection:	Acquisition and use of equipment and vegetation management will be used to prevent or reduce risks to property from severe winter storms.
Public Education and Awareness:	Public education, warning systems, access to information, and outreach projects will be used to raise public awareness of the risks from severe winter storms in order to reduce those risks.

Natural Resource Protection:	Management of Logjams
Emergency Services:	Acquisition and use of equipment, emergency response services, warning systems, technological improvements, planning, and responder training will provide emergency services to prevent or reduce risks from severe winter storms.
Structural Improvements:	Structural projects for critical infrastructure will be implemented and maintained to prevent or reduce risks from severe winter storms.
Extreme Temperatures Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to extreme temperatures.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from extreme heat and extreme cold.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from extreme heat and extreme cold.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from extreme cold and extreme heat in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from drought. Structural Improvements:
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from extreme temperatures.
Ground Failure Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to ground failure.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from ground failure.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from ground failure.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from ground failure in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from ground failures.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from ground failure.
Dams and Levee Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to dam and levee.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from dam or levee failure.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from dam or levee failure.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from dam or levee failure in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from dam or levee failure.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from dam or levee.
Drought Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to drought.	
Mitigation Strategy	Objectives
Prevention:	Planning, acquisition and use of equipment, and technical studies will be used to prevent or reduce risks from drought.

Property Protection:	Water treatment measures will be used to prevent or reduce risks to property from drought.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from drought in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from drought.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from drought.
Infectious Disease Outbreak Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to outbreak.	
Mitigation Strategy	Objectives
Prevention:	Planning, acquisition and use of equipment, and technical studies will be used to prevent or reduce risks from outbreak.
Property Protection:	Water treatment measures will be used to prevent or reduce risks to property from outbreak.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of risks from outbreak in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from outbreak.
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from outbreak.
Earthquake Goal: Reduce deaths, injuries, property loss, natural resource and economic disruption due to earthquake.	
Mitigation Strategy	Objectives
Prevention:	Planning and the acquisition and use of equipment will be used to prevent or reduce risks from extreme heat and extreme cold.
Property Protection:	Acquisition and use of equipment will be used to prevent or reduce risks to property and economic disruption from extreme heat and extreme cold.
Public Education and Awareness:	Public education and access to information will be used to raise public awareness of the risks from extreme cold in order to prevent or reduce those risks.
Emergency Services:	Planning and implementing watershed plans will be used to prevent or reduce risks from drought. Structural Improvements:
Structural Improvements:	Technological improvements and acquisition of equipment for structural projects will be used to prevent or reduce risks from drought.

Mitigation Actions and Projects

Upon completion of the risk assessment and development of the goals and objectives, the planning committee was provided a list of the six mitigation measure categories from the *FEMA State and Local Mitigation Planning How to Guides*. The types of mitigation actions are listed as follows:

- **Prevention:** Government, administrative, or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.

- **Property Protection:** Actions that involve the modification of existing buildings or structures to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, structural retrofits, storm shutters, and shatter-resistant glass.
- **Public Education and Awareness:** Actions to inform and educate citizens, elected officials, and property owners about the hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- **Natural Resource Protection:** Actions that, in addition to minimizing hazard losses, preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Emergency Services:** Actions that protect people and property during and immediately after a disaster or hazard event. Services include warning systems, emergency response services, and protection of critical facilities.
- **Structural Projects:** Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include dams, levees, floodwalls, seawalls, retaining walls, and safe rooms.

Implementation of the mitigation plan is critical to the overall success of the mitigation planning process. The first step is to decide, based upon many factors, which action will be undertaken first. In order to pursue the top priority first, an analysis and prioritization of the actions is important. The plan team assessed the status and priority of the existing strategies using the FEMA mitigation evaluation criteria, using the STAPLE + E criteria. Table X lists the factors to consider in the analysis and prioritization of actions. Some actions may occur before the top priority due to financial, engineering, environmental, permitting, and site control issues. Public awareness and input of these mitigation actions can increase knowledge to capitalize on funding opportunities and monitoring the progress of an action.

Figure 5-1: STAPLE+E criteria

Criteria	Description
S – Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
T – Technical	Mitigation actions are technically most effective if they provide a long-term reduction of losses and have minimal secondary adverse impacts.
A – Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
P – Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is public support for the action.
L – Legal	It is critical that the jurisdiction or implementing agency have the legal authority to implement and enforce a mitigation action.
E – Economic	Budget constraints can significantly deter the implementation of mitigation actions. It is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
E – Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, comply with federal, state, and local environmental regulations, and are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.

Understanding the dynamics of STAPLE + E lead to the projects success. Developing questions evolving around the evaluation criteria, similar to those outlined below, help the team prioritize the projects.

Social:

- Will the proposed action adversely affect one segment of the population?
- Will the action disrupt established neighborhoods, break up voting districts, or cause the relocation of lower income people?

Technical:

- How effective is the action in avoiding or reducing future losses?
- Will it create more problems than it solves?
- Does it solve the problem or only a symptom?
- Does the mitigation strategy address continued compliance with the NFIP?

Administrative:

- Does the jurisdiction have the capability (staff, technical experts, and/or funding) to implement the action, or can it be readily obtained?
- Can the community provide the necessary maintenance?
- Can it be accomplished in a timely manner?

Political:

- Is there political support to implement and maintain this action?
- Is there a local champion willing to help see the action to completion?
- Is there enough public support to ensure the success of the action?
- How can the mitigation objectives be accomplished at the lowest cost to the public?

Legal:

- Does the community have the authority to implement the proposed action?
- Are the proper laws, ordinances, and resolution in place to implement the action?
- Are there any potential legal consequences?
- Is there any potential community liability?
- Is the action likely to be challenged by those who may be negatively affected?
- Does the mitigation strategy address continued compliance with the NFIP?

Economic:

- Are there currently sources of funds that can be used to implement the action?
- What benefits will the action provide?
- Does the cost seem reasonable for the size of the problem and likely benefits?
- What burden will be placed on the tax base or local economy to implement this action?
- Does the action contribute to other community economic goals such as capital improvements or economic development?
- What proposed actions should be considered but be "tabled" for implementation until outside sources of funding are available?

Environmental:

- How will this action affect the environment (land, water, endangered species)?
- Will this action comply with local, state, and federal environmental laws and regulations?
- Is the action consistent with community environmental goals?

Hazard Mitigation Actions

Marshall County and its included municipalities share a common Multi-Hazard Mitigation plan and worked closely to develop it. These people work together with their city councils and the Marshall County Emergency Management Director to insure that the hazards and mitigation actions included in this plan are accurate and addressed in their jurisdictions. The jurisdictions responsible for each action are the following:

- Marshall County
- Argos
- Bremen
- Bourbon
- Culver
- La Paz
- Plymouth

Table 5-1 lists all mitigation actions for Marshall County and its jurisdictions. Appendix G contains separate mitigation action tables for each jurisdiction. Each of these mitigation action charts

detail the hazard, the mitigation action to address it, the priority ranking for implementation (1=High Priority; 2= Moderate Priority; 3= Low Priority), its current stage of implementation, the timeframe for implementation going forward, the jurisdictions who have identified they will work to implement the action, the responsible parties to carry through with implementation, and comments on how the plan will be implemented through existing planning mechanisms and funding to make implementation happen.

All of the mitigation actions identified in the 2009 Marshall County Hazard Mitigation Plan have been carried over into the 2017 plan, based on the advisement of the Marshall County Emergency Management Director and the consensus of the steering committee. None of the 2009 mitigation actions have been fully completed and are identified in the 2017 plan to reflect their ongoing implementation. *Appendix K Documentation of Marshall County MHMP Update* documents the carryover of these actions and the language revisions that they underwent for the 2017 plan to clarify or improve the wording of the mitigation action.

The status designations are:

- New – actions have not yet started
- Complete – the action is complete
- Ongoing – actions require continuing application
- In Progress – actions are currently being acted upon
- Deferred – no progress has been made
- Deleted – the action is no longer relevant

The mitigation action types are defined as follows:

- Prevention
- Property Protection
- Public Education
- Natural Resource Protection
- Emergency Services
- Structural Improvement

Mitigation Actions by Community

This is a multi-jurisdictional plan that covers Marshall County, its school districts, City of Plymouth and Towns of Argos, Bremen, Bourbon, Culver and La Paz. The Marshall County risks and mitigation activities identified in this plan also incorporate the concerns and needs of townships and other entities participating in this plan.

Table 5-1: Mitigation Actions

#	Hazards	Mitigation Action Type	Action	Priority	Status	Community	Coordinating Agency	Potential Funder	Action Source
1	Winter Storm	Emergency Services	Determine a plan for use of 4WD vehicles in the event of emergency rescue		Complete	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
2	Flood	Property Prevention	Develop a countywide ordinance prohibiting development in floodplains		Complete	All Communities	EMA Local communities	Local Funds	Hazard Mitigation Plan
3	Flood	Property Prevention	Establish an ordinance requiring all mobile homes to have weather radios		Complete	All Communities	Local Communities	Local Funds	Hazard Mitigation Plan
4	Winter Storm	Public Education	Implement an annual winter weather emergency news release		Complete	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
5	Flood	Natural Resource Protection	Separate sewage and storm drainage in sewer system		Complete	Bremen	Local Communities	*DNR Local funds*	Hazard Mitigation Plan
6	Hazmat	Prevention	Establish a county plan that is specific to Hazmat Emergencies		Complete	Marshall County	EMA	IDHS FEMA	Hazard Mitigation Plan
7	Multiple Hazards	Emergency Services	Establish an active LEPC to mitigate and respond to hazards		Complete	Marshall County	EMA	IDHS FEMA	Hazard Mitigation Plan
8	Multiple Hazards	Property Prevention	Establish an ordinance requiring large subdivisions to install warning systems		Complete	Marshall County	Local Communities	Local Funds	Hazard Mitigation Plan
9	Multiple Hazards	Emergency Services	Implement emergency response training and annual “event or situational” training for LEPC		Complete	Marshall County	EMA	IDHS FEMA	Hazard Mitigation Plan
10	Flood	Prevention	Implement Silt Pits program (dig out 1,000 ft by 6 ft)		Complete	Marshall County		*DNR FEMA*	Hazard Mitigation Plan
11	Winter Storm	Prevention	Implement tree trimming throughout the county		Complete	Marshall County	EMA Local utilities	Local funds	Hazard Mitigation Plan
12	Hazmat	Prevention	Conduct a commodity flow study along major roadways	Medium	In Progress	All Communities	EMA Local communities	*Department of Transportation*	Hazard Mitigation Plan
13	Multiple Hazards	Emergency Services	Create a plan to address special needs populations	High	In Progress	All Communities	EMA Local non-profits	IDHS FEMA	Hazard Mitigation Plan

14	Earthquake	Public Education	Distribute literature advising that residents, schools, healthcare facilities, and other critical facilities bolt bookshelves to walls and secure water heaters	Low	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
15	Multiple Hazards	Emergency Services	Establish new shelters throughout the county	Medium	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
16	Multiple Hazards	Public Education	Implement school-wide programs to educate students on the hazards affecting the county and preparation/mitigation plans	High	Identified	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
17	Flood	Emergency Services	Procure permanent signage to warn of flood hazards	Medium	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
18	Multiple Hazards	Emergency Services	Purchase generators to provide back-up power to schools and shelters	High	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
19	Multiple Hazards	Emergency Services	Schedule NIMS training for first responders	Medium	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
20	Multiple Hazards	Emergency Services	Purchase and install new warning sirens within the county	Low	In Progress	La Paz	EMA	IDHS FEMA	Hazard Mitigation Plan
21	Flood	Structural Improvement	Assess and upgrade drainage system along US 31	Medium	In Progress	La Paz	EMA Local utilities	*Local funds*	Hazard Mitigation Plan
22	Multiple Hazards	Emergency Services	Rehearse communication strategies at monthly Communication Committee meetings	Medium	Complete	Marshall County	EMA Local communities	IDHS FEMA	Hazard Mitigation Plan
23	Flood	Property Prevention	Conduct a study to determine potential buy-out properties along the Yellow River	Low	In Progress	Plymouth	EMA	IDHS FEMA	Hazard Mitigation Plan
24	Flood	Property Prevention	Flood-proof the wastewater treatment facility near Plymouth	Medium	In Progress	Plymouth	EMA Local utilities	*Local funds FEMA*	Hazard Mitigation Plan
25	Multiple Hazards	Emergency Services	Continue regular training for fire and tornado response	High	In Progress	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
26	Multiple Hazards	Emergency Services	Install new warning sirens within the county	Low	In Progress	Culver, Bourbon, Plymouth, Bremen	EMA	IDHS FEMA	Hazard Mitigation Plan

27	Multiple Hazards	Emergency Services	Continue regular testing of sirens	High	Ongoing	All Communities	EMA	IDHS FEMA	Hazard Mitigation Plan
28	Flood	Prevention	Gage at State Road 10 and Deep Ditch	Medium	Identified	County	EMA	IDHS FEMA	Hazard Mitigation Plan
29	Multiple Hazards	Structural Improvement	Structural Improvement on South Walnut	Low	Identified	Plymouth	Local Communities	Local Funds	Hazard Mitigation Plan
30	Multiple Hazards	Structural Improvement	Structural Improvement on county bridge on Center Street over Army Ditch	Low	Identified	Bremen	Local Communities	Local Funds	Hazard Mitigation Plan
31	Flood	Property Prevention	Buyout of two mobile homes in flood hazard area	Medium	Identified	La Paz	EMA	IDHS FEMA	Hazard Mitigation Plan
32	Multiple Hazards	Structural Improvement	Structural Improvement on South Walnut	Medium	Identified	Plymouth	Local Communities	Local Funds	Hazard Mitigation Plan
33	Dam, Levee, Flood	Prevention	Continued compliance of the NFIP, for all NFIP communities	High	Identified	All NFIP Communities	EMA	IDHS FEMA	Hazard Mitigation Plan

Chapter 6 – Plan Maintenance and Implementation

Implementation and Maintenance

The Marshall County All-Hazard Mitigation Plan (AHMP) is intended to serve as a guide for dealing with the impact of both current and future hazards for all county people and institutions. As such it is not a static document but must be modified to reflect changing conditions if it is to be an effective plan. The goals, objectives and mitigation strategies will serve as the action plan. Even though individual strategies have a responsible party assigned to it to ensure implementation, overall responsibility, oversight, and general monitoring of the action plan has been assigned to the Marshall County Emergency Manager.

The corresponding community means that that community will be in charge of implementing that strategy. Goals identified by the county will be implemented by the commission and the Town and City Councils will be responsible for implementing their corresponding strategies.

It will be their responsibility to gather a Local Task Force to update the All-Hazard Mitigation Plan on a routine basis. Every year, the County Emergency Manager will call a meeting to review the plan, mitigation strategies and the estimated costs attached to each strategy. All participating parties of the original Local Task Force and cities will be invited to this meeting. Responsible parties will report on the status of their projects. It will be the responsibility of the committee to evaluate the plan to determine whether:

- Goals and objectives are relevant.
- Risks have changed.
- Resources are adequate or appropriate.
- The plan as written has implementation problems or issues.
- Strategies have happened as expected.
- Partners participating in the plan need to change (new and old).
- Strategies are effective.
- Any changes have taken place that may affect priorities.
- Any strategies should be changed.

In addition to the information generated at the Local Task Force (LEPC and CEMP) meetings, the County Emergency Manager will also annually evaluate the All-Hazard Mitigation Plan and update the plan in the event of a hazardous occurrence. Two-year updates are due on the anniversary of the plan approval date. After the second two-year update meeting, the Marshall County

Emergency Manager will finalize a new Local Task Force to begin the required five-year update process. This will be accomplished in coordination with Marshall County jurisdictions and the entire All-Hazard Mitigation Plan shall be updated and submitted to FEMA for approval (within 5 years of plan adoption). These revisions will include public participation by requiring a public hearing and published notice in addition to multiple Local Task Force meetings to make detailed updates to the plan.

Public participation for updates is as critical as in the initial plan. Public participation methods that were used in the initial writing will be duplicated for any future update processes – direct mailing list of interested parties, public meetings, press releases, surveys, questionnaires, and resolutions of participation and involvement. Additional methods of getting public input and involvement are encouraged such as placing copies of the plan in the Marshall County Emergency Manager's Office and city offices, in addition to placing the plan on the Marshall County and social media websites. Furthermore, jurisdictions will be encouraged to place a notice on their websites stating the plan is available for review at the city offices. Notifications of these methods could be placed in chamber newsletters and local newspapers. Committee responsibilities will be the same as with updates.

Chapters 5 focuses on mitigation strategies for natural hazards, jurisdiction-specific mitigation strategies for both natural and man-made/technological hazards. The All-Hazard Mitigation Plan proposes a number of strategies, some of which will require outside funding in order to implement. If outside funding is not available, the strategy will be set aside until sources of funding can be identified. In these situations, Marshall County and cities will also consider other funding options such as the county's/cities'/towns' general funds, bonding and other sources. Based on the availability of funds and the risk assessment of that hazard, the county will determine which strategies should be continued and which should be set aside. Consequently, the action plan and the risk assessment serves as a guide to spending priorities but will be adjusted annually to reflect current needs and financial resources.

The last step requires an evaluation of the strategies identified in the goals and policies framework, selecting preferred strategies based on the risk assessment, prioritizing the strategy list, identifying who is responsible for carrying out the strategy, and the timeframe and costs of strategy completion. Marshall County and its jurisdictions have incorporated the preferred

strategies including identification of the responsible party to implement, the timeframe and the cost of the activity with the goals and policies framework.

This plan will be integrated into other county plans such as County Comprehensive Plans, the County Water Plan, the County Transportation Plan and all Emergency Operations Plans. Chapter one will serve as an executive summary to be attached to those plans as necessary. The County Board and Emergency Manager will encourage jurisdictions to implement their jurisdiction-specific mitigation strategies in their comprehensive plans, land use regulations, zoning ordinances, capital improvement plans and/or building codes by including mitigation strategies in their plans as listed in Table 6-1. Further, as each land use mechanism is updated, mitigation strategies will be evaluated to determine whether they can implement or include them at that time. The Emergency Management Advisory Council (EMAC) will continue to serve as the advisory body that provides general supervision and control over the emergency management and the disaster programs for the county and its multiple jurisdictions. The quarterly meetings will continue to be available to the public and other mitigation team members through the EMAC and other mitigation projects avenues such as RiskMAP. Table 6-1 provides the year of the currently effective community capability and implementation documents or signifies if the county uses the state ordinances or codes.

Table 6-1: Marshall County and Jurisdictions Planning Mechanisims

		Implementation Documents								
		Zoning Ordinance	Comprehensive Plan	Emergency Operations Plan	Floodplain Ordinance	Storm Water Drainage	Watershed Plan	Erosion Ordinance	Burning Ordinance	Building Codes
Jurisdiction Name	Marshall County	2007	2003	Marshall County Comprehensive Emergency Management Plan 2014	11/16/11	2011	Lake of the Woods, Marshall County, IN Watershed 2005	2011	State	State
	Plymouth	2008	2013		11/16/11	-		State Erosion Control Rule 5 (327 IAC 15-5)	State	State
	Argos	2015	2018		-	-			State	State
	Bourbon	2015	2017		-	-			State	State
	Bremen	1992	-		11/16/11	-			State	State
	Culver	2017	2013		11/16/11	-			State	State
	La Paz	-	-		-	-			State	State

Many of these plans or policies can help implement the goals, objectives and strategies in Marshall County's All Hazard Mitigation Plan. The Marshall County Emergency Manager is responsible for meeting within each jurisdiction within two times throughout the next five years. During these meetings, the local Emergency Manager will review all Local Planning Mechanisms and

collaborate with the Cities and Towns to ensure the All-Hazard Mitigation Plan is becoming as integrated into local plans as possible. These Local Planning Mechanisms are meant to work cooperatively together in order to ensure the health, safety, and welfare of Marshall County and its corresponding jurisdictions. Although only one of the planning mechanisms has been updated since the initial hazard mitigation plan was adopted city, town, and county officials will integrate related plans with hazard mitigation goals, objectives, and strategies when feasible and appropriate.

Adoption, Implementation and Maintenance

County Adoption

One of the first steps in implementing the plan is to make sure that it is officially adopted in a public hearing. The task force and public provided comment on the draft plan. The task force reviewed comments, modifications were made and a final draft was sent to FEMA for review, comment and approval. After FEMA approved the plan, the county board adopted the plan. A public hearing was held to obtain any additional comments that the public or others wished to make. A copy of the county and the community jurisdictions resolutions to adopt are located in Appendix I.

City and Town Adoption

The All-Hazard Mitigation Plan for Marshall County is a multijurisdictional plan. All communities in the county – towns and cities – were involved in the various stages of the planning process and a mitigation strategies have been identified for each jurisdiction. Each of Marshall County's cities and towns passed resolutions to participate in the county plan. Following official adoption of the plan by the county each city and township was notified. Each chose whether or not to adopt the plan as well. Each were encouraged to adopt enabling them to apply for HMGP funds independently not under the umbrella of the county. Copies of the city and towns resolutions choosing to adopt the plan are in Appendix I.

Implementation and Maintenance Guidelines.

The Marshall County All-Hazard Mitigation Plan is intended to serve as a guide/reference to mitigate the impact of both current and future hazards for all county residents and institutions. As such, it is not a static document but must be modified to reflect changing conditions if it is to be an effective plan. The goals, objectives and mitigation strategies will serve as a work or action plan.

Individual strategies have a party assigned to it to help ensure implementation, oversight and general monitoring of the action plan; however, oversight has been assigned to the County Emergency Manager. The following guidelines will help implement the goals, objectives and strategies of the plan. An implementation committee will be used to assist in this process. The existing task force, the planning commission, other appropriate county committee, or any other group of stakeholders could serve as the implementation committee to review implementation opportunities identified in the plan. Implementation of strategies should be a collaborative effort of the participating jurisdictions. This committee should operate by group consensus and create recommendations for implementation to bring forward to the proper governing entity for consideration. Guidelines for the committee include:

1. Commitment to the plan and overall mitigation vision.
2. Protect sensitive information.
3. Take inventory of strategies in progress.
4. Determine strategies that no longer are needed or new strategies that have emerged.
5. Set priorities. Assign responsibilities to complete.
6. Seek funding.
7. Meet minimum bi-annually – one meeting to set the course of action and a second to monitor progress.
8. Report to all respective boards for action.
9. Advisory capacity.

Assigning strategies and implementation activities in this plan to certain entities does not guarantee completion. The strategies and activities addressed in this plan will be addressed as funding and other resources become available and approval by the responsible jurisdiction takes place.

The County Emergency Manager has the overall responsibility of tracking the progress of mitigation strategies. The County Emergency Manager will request updates from responsible agencies and cities on their mitigation actions after each disaster and at least annual to coincide with plan evaluation. Post disaster monitoring will evaluate the effectiveness of mitigation actions that have been completed and determine implementation of planned strategies. Monitoring may lead to developing a project that may be funded by FEMA's Hazard Mitigation Assistance Programs.

Annual reviews to change the plan will be led by the County Emergency Manager using the implementation committee. It will be their responsibility to review the plan and mitigation. Yearly

reviews are due on the anniversary of the plan approval. Responsible parties and the implementation committee will report on the status of their projects. Committee responsibility will be to evaluate the plan to determine whether:

- Goals, objectives and strategies are relevant.
- Risks that have changed including the nature, magnitude, and/or type of risks.
- Resources are adequate or appropriate.
- The plan as written has any implementation problems or issues.
- Deadlines are being met as expected.
- Partners participating in the plan are appropriate.
- Strategies are effective.
- New developments affecting priorities.
- Strategies that should be changed.

Updates every five years are led by the County Emergency Manager in coordination with cities and townships to complete a rewrite for submitting to FEMA. A task force, similar to the one created to complete the plan, will be formed and used in the planning process to rewrite the plan. These revisions will include public participation by requiring a public hearing and published notice. Future updates should address potential dollar losses to vulnerable structures identified. Any major changes in the plan may include additional public meetings besides just a public hearing.

Public participation for updates is as critical as in the initial plan. Public participation methods that were used in the initial writing should be duplicated for any updates – direct mailing list of interested parties, public meetings, press releases, surveys, questionnaires, and resolutions of participation and involvement. Additional methods of getting the public input and involvement are encouraged such as placing copies of the plan in public libraries for public comment or placing the plan on county and city websites. Notifications of these methods could be placed in newsletters and the local newspapers. Committee responsibilities will be the same with updates as the original plan.

The action plan proposes a number of strategies, some of which will require outside funding to implement. If outside funding is not available, the strategy may be set aside until sources of funding can be identified or modified to work within the funding restrictions. In these situations, the county and entities will also consider other funding options such as the county's general fund, bonding and other sources. Based on the availability of funds and the risk assessment of the hazard, the county will determine which strategies should they continue to work on and which should be set aside. Consequently, the action plan and the risk assessment serves as a guide to

spending priorities but will be adjusted annually to reflect current needs and financial resources. It is not a legal binding document.

Updates require an evaluation of the strategies identified in the goals and policies framework, selecting preferred strategies based on the risk assessment, prioritizing the strategy list, identifying who is responsible for carrying out the strategy, and the timeframe and costs of strategy completion. Marshall County has incorporated the preferred strategies including identification of the responsible party to implement, the timeframe and the cost of the activity in the plan framework.

This plan will be integrated into other county plans such as the County Comprehensive Plan, the County Water Plan, the County Transportation Plan and all Emergency Operations Plans. Chapter One can serve as an executive summary to be attached to those plans as necessary. The County Board encourages jurisdictions to address hazards in their comprehensive plans, land use regulations, zoning ordinances, capital improvement and/or building codes by including some of the mitigation strategies in their plans. Many of the plans or policies can include strategies from the Hazard Mitigation Plan. They are meant to blend and complement each other so that strategies are duplicated and occur in different plans as appropriate.