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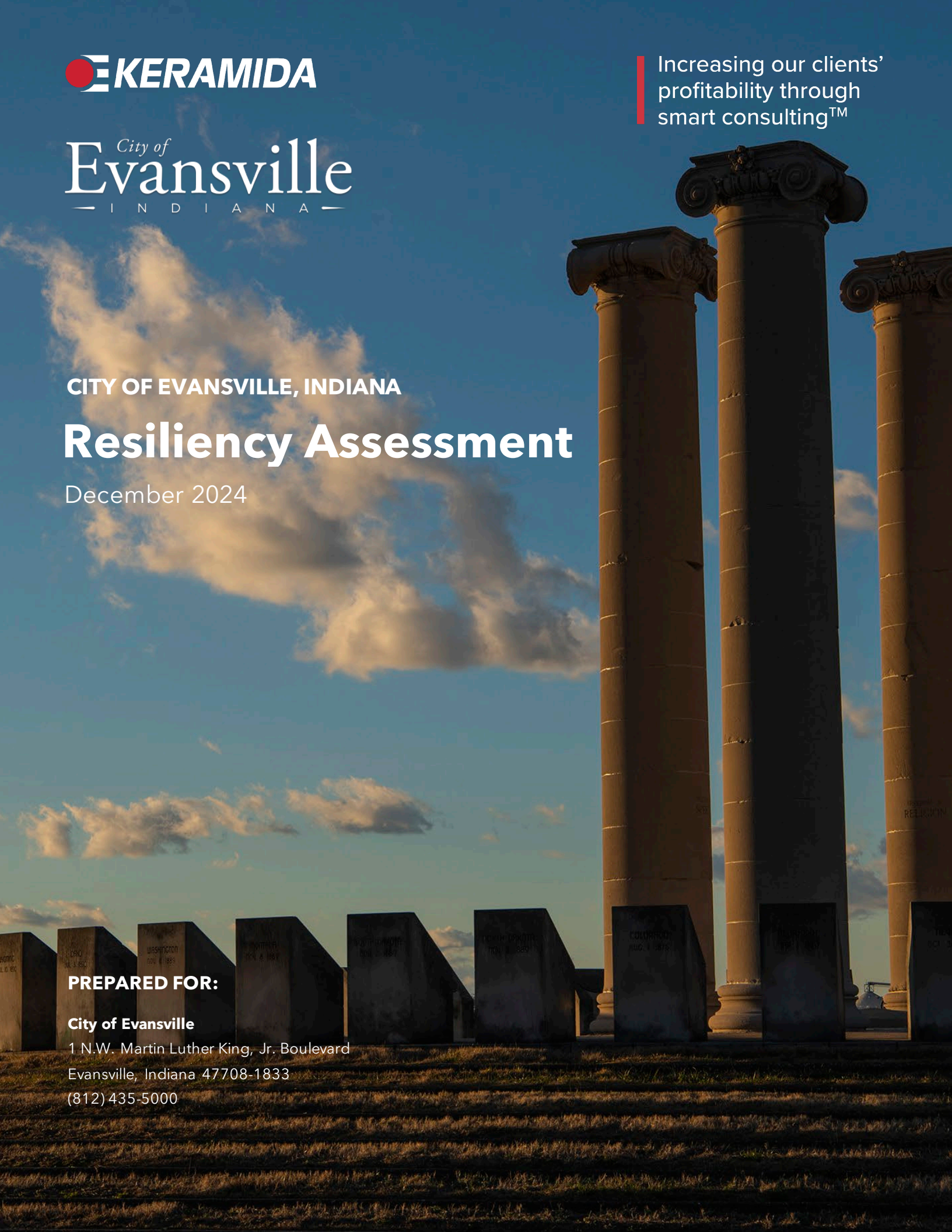

CITY OF EVANSVILLE, INDIANA

Resiliency Assessment

December 2024

PREPARED FOR:

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Glossary of Terms

Adaptive Capacity – The ability of systems or institutions to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Climate Hazards – Events or conditions that may cause injury, illness, or death to people or damage to assets.

Climate Risk – The result from the interaction of hazard, exposure, and vulnerability caused by climatic events.

Extreme Event – A time and place in which weather, climate, or environmental conditions rank above threshold values near the upper or lower ends of the range of historical measurements.

Resilience – The capacity of social, economic, and environmental systems to remain functioning following hazardous events while also maintaining the capacity to learn and transform.

Vulnerability – The propensity or predisposition to be adversely affected. Vulnerability includes many elements, including sensitivity or susceptibility to harm, or lack of capacity to cope and adapt.

CONTEXT AND TRENDS

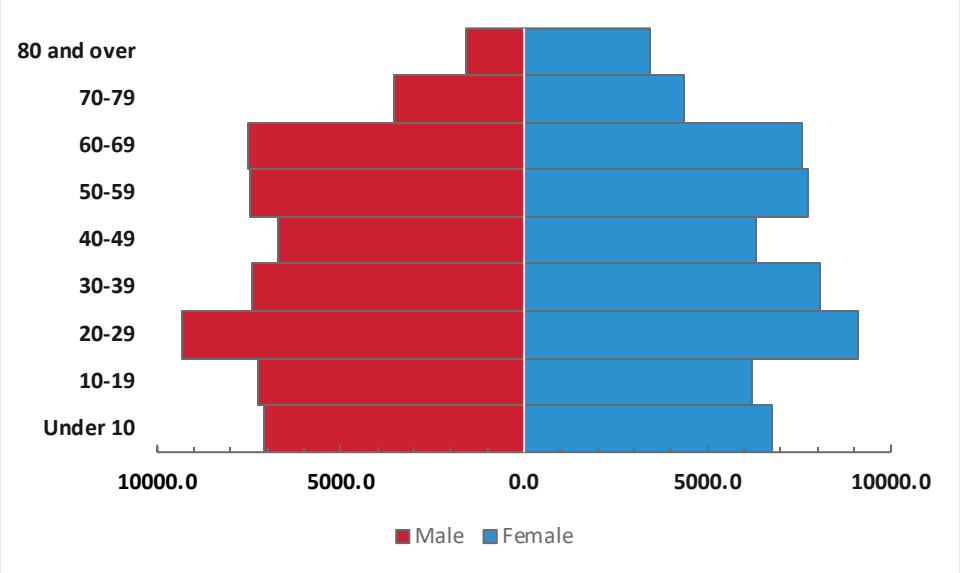
Demographic & Socio-Economic Context

DEMOGRAPHIC

The City of Evansville is the main city hub in the Evansville Metropolitan Area and the county seat of Vanderburgh County. Evansville was recorded in the 2020 Decennial Census to have a total population of 117,298, making it the third-most populous city in Indiana. With a land area of 47.36 square miles (mi^2), Evansville has a population density of 2,477 people/mi^2. Between the 2020 Decennial Census and July 2023, Evansville's population is estimated to have decreased by 1.7% and by 18.5% since Evansville's peak population of 141,543 in 1960. Evansville's population is expected to continue to decline, following global trends of urban population dynamics.

The age of the Evansville population is well distributed with an average age of 37.5 years, indicating an even spread between younger and older residents. The largest age group in Evansville is represented by young adults aged 20 to 29 years, likely related to the undergraduate and graduate educational institutions and early career opportunities present in the area.

Figure 1 – Evansville Population Pyramid



The majority of Evansville residents identify as white (72%), followed by Black or African American and Hispanic or Latino residents at 13.1% and 4.1%, respectively.

Table 1 – Race and Ethnicity

Race and Ethnicity	Percent of Population
American Indian or Alaskan Native	0.3%
Asian	1.2%
Black or African American	13.1%
Hispanic or Latino	4.1%
Native Hawaiian or Pacific Islander	0.5%
Other Race	1.9%
Two or More Races	6.7%
White	72.2%

SOCIO-ECONOMIC

While Evansville is home to many professional and business services and acts as the regional economic hub, Evansville has a median household income of $52,318, 28% less than the Indiana average of $69,477. Along with a lower median household income, Evansville has a lower employment rate (59.9%) than the Indiana average at 61.9%. With lower median household income and a lower employment rate, Evansville additionally experiences poverty rates higher than the Indiana average at 16.9% and 12.3%, respectively.

Evansville is home to five higher education institutions, including the University of Evansville, University of Southern Indiana, Indiana University School of Medicine (branch), Ivy Tech Community College – Evansville, and Oakland City University School of Adult and Extended Learning. Despite many higher education institutions being present, only 24% of Evansville's population hold a bachelor's degree or higher, which is lower than the Indiana average of 30.2%.

Table 2 – Education Attainment

Education Attainment (25 years and older)	Percent of population
High school or equivalent degree	35.9%
Some college, no degree	19.8%
Associate's degree	9.3%
Bachelor's degree	15.8%
Graduate or professional degree	8.3%

Economically, Evansville and the Evansville Metro Area are highly dependent on manufacturing, which accounts for 18% of total annual wages. Like most of the United States, Evansville's manufacturing workforce dropped following the 2007 Great Recession, however, at a rate much higher than the rest of Indiana. Evansville has made significant progress in recovery by increasing the workforce year-over-year. Since 2007, both the number of jobs and the nominal personal income have increased and are expected to continue.

ENVIRONMENTAL CONTEXT & PROJECTED TRENDS

The City of Evansville is near the Indiana-Kentucky border and is situated on an oxbow in the Ohio River. Surrounding Evansville are low-rolling hills, while Evansville sits in a valley ranging from 20-80 feet lower than areas to the north, east, and west. The City of Evansville is classified as an urban environment.

Evansville is at the northern edge of the humid, subtropical climate region in the US, characterized by hot, humid summers and cool to mild winters. Average temperatures range from 32˚F in January to 78˚F in July. Average yearly precipitation is 45.31 inches, with 11 inches coming from snowfall.

Days of high heat, characterized as days above 90˚F, occur regularly, dating back to 1950. On average, Evansville experiences 57 high heat days per year with the lowest on record of 23 days in 1950 and the highest on record of 85 days in 2018.

PAST CLIMATIC HAZARDS

Hazard Description and Scale

Below are descriptions of hazardous events that typically occur in Evansville and significant historical events. Events are considered significant if lives are lost, injuries occur, or if there is recorded property damage.

DROUGHT

Droughts are classified as a period of drier-than-normal conditions with varying degrees of dryness, described below with typical impacts:

D0 – Abnormally Dry

- Dryland crops and Rangeland are stressed
- Lawns are brown; gardens are watered more frequently

D1 – Moderate Drought

- Crop growth is stunted; supplemental feed for livestock begins
- Blue-green algae blooms appear
- Creek and pond levels are low

D2 – Severe Drought

- Corn and soybeans are in poor condition; irrigation increases; hay and crop yields are low
- Wildlife encroaches on urban areas for water
- Lawns go dormant

- County-level burn bans are implemented; brush fires occur more frequently
- Creeks, ponds, and wetlands are dry; lake levels drop; well levels are low; water restrictions begin

D3 – Extreme Drought

- Corn is a total loss with no ears; corn is cur for feed; soybeans are severely dry; supplemental hay for livestock is increased; other row crops are impacted
- Fireworks are banned; fire departments are strained
- Gardening businesses struggle
- Trees and shrubs show drought stress or are dying; deer disease increases; fish kills occur; vegetation is dying
- Lake and reservoir levels are very low

D4 – Exceptional Drought

- Farmers sell cattle; feed costs are high; producers haul hay from outside of the state
- Communities and businesses tied to water activities and agriculture experience economic loss
- Water restrictions are implemented statewide; water shortage warnings are issued statewide

Since 1950 Vanderburgh County has experienced 21 significant droughts, resulting in estimated crop loss equal to $3.03M.

EXTREME TEMPERATURES

Extreme temperatures are characterized as temperatures that are significantly above or below the historical average for any given day.

High heat, characterized by temperatures above 90˚F occurs regularly in Evansville. On average, Evansville experiences 57 high-heat days per year. In addition to high heat, excessive humidity can result in extreme heat conditions. The combination of high heat and high humidity, known as the heat index, can result in temperatures that feel hotter than the actual temperature. Extreme heat is characterized by a heat index that is at or above 115˚F for more than 3 hours. The National Weather Service will issue a Heat Advisory for Evansville when heat indices are expected to reach 105˚F during the day or 80˚F at night. Since 1950, there have been a total of 16 excessive heat days in Vanderburgh County.

On the other hand, extreme cold is characterized by temperature and wind that result in a wind chill of less than -10˚F. The National Weather Service will issue a Wind Chill Advisory for Evansville when wind chill temperatures are expected to reach -4˚F to -20˚F. Since 1950, there have been 196 days with temperatures below -10˚F in Vanderburgh County.

Since 2010, there have been 3 recorded deaths and 16 injuries due to extreme heat. There have been 2 deaths due to extreme cold since 1996.

FLOODING

Flooding occurs in Evansville with regularity due to the proximity to the Ohio River and Pigeon Creek. The topographic valley that Evansville lies within adds a layer of susceptibility to flooding. Extreme precipitation events, characterized as an excess of 0.86 inches over a 24-hour period, have the potential to create high crests in the Ohio River, Pigeon Creek, and surrounding tributaries.

The Ohio River reaches action levels when it crests above 26 feet (ft) and is considered at flood stage once it reaches 42 ft. The following are flood impacts associated with river levels:

26 ft – The levee authority closes the floodgates downtown.

36 ft – Agricultural bottomland begins to flood, and the levee authority is operating several pumping stations.

38 ft – Most of the bottomland is covered, and farmers should move livestock and equipment to higher ground.

40 ft – Basements along the riverfront begin to fill. Flooding begins along Pigeon Creek.

42 ft – The river is 3,300 ft wide.

45 ft – Many county roads are flooded, and some are impassable.

52 ft – Major flooding occurs. Several highways are closed and at this level, parts of the airport begin to flood.

Since 1996, 128 significant flood and flash flood events have been reported in Vanderburgh County, which has resulted in 1 direct fatality, 2 direct injuries, and an estimated $6.36M in property damage.

SEVERE STORMS AND TORNADOES

Evansville, like much of Indiana, resides in an area of the US that frequently experiences severe storms. Between 1980 – 2006, Evansville experienced an average of 62 days of severe storm events per year, including hail, lightning, high wind, and tornadoes.

A thunderstorm is considered severe when either hail is three-quarters of an inch or larger or when winds equal or exceed 58 miles per hour (mph). High winds have the potential to cause as much damage as a weak tornado and can reach speeds of 150 mph.

Severe storms (hail, high wind, lightning) have accounted for a combined total of 1 death, 2 injuries, and $12.33M in property damage since 1962.

Since 1955, Vanderburgh County has experienced 32 tornadoes ranging from Enhanced Fujita (EF) 0 to 3 (Note: prior to 2007, tornadoes were measured on the Fujita scale). The tornadoes that have impacted Vanderburgh County have resulted in 20 fatalities, 210 injuries, and an estimated total property damage of $19.95M.

Current Risk Level

Hazard risk levels are determined by the likelihood and impact of the hazard event (Risk = likelihood x impact). Likelihood and impact are defined in Tables 4 and 5, respectively.

Table 4 – Likelihood Definitions

4	Highly Likely	Near 100 percent chance of occurring every year
3	Likely	10 – 100 percent chance of occurring on an interval of 10 years or less
2	Occasional	1 – 10 percent chance of occurring in the next year or has a recurrence interval of 11 – 100 years
1	Unlikely	Less than 1 percent chance of occurring in the next 100 years or has a recurrence interval of greater than every 100 years.

Table 5 – Impact Definitions

4	Catastrophic	Multiple deaths; property destroyed and severely damaged; and/or interruption of essential facilities and services for more than 72 hours
3	Critical	Isolated deaths and/or multiple injuries; major or long-term property damage that threatens structural stability; and/or interruption of essential facilities and services for 24 – 72 hours
2	Limited	Minor injuries; minimal property damage that does not threaten structural stability; and/or interruption of essential facilities and services for less than 24 hours
1	Negligible	No or few injuries; minor quality of life loss; little or no property damage; and/or brief interruption of essential facilities and services

Table 6 – Current Risks

Hazard	Likelihood	Impact	Risk	Fatalities	Injuries	Economic Loss (Million USD)
Drought	2	1	2	0	0	$3.03
Extreme Temperatures	4	3	12	5	16	$0
Flooding	3	4	12	1	2	$6.36
Severe Storms	3	3	9	1	2	$12.33
Tornadoes	3	3	9	20	210	$19.95

Intensity and Frequency

Below are each identified hazard and how intense and frequent these hazard events occur historically. Table 7 summarizes each hazard intensity and frequency.

DROUGHT

Vanderburgh County experienced 21 droughts, 20 of which caused no deaths, injuries, or financial damage. However, one drought in September of 2007 caused significant damage to soybean crops at an estimated $3.03M. Because 95% of the droughts caused no impact to Vanderburgh County, droughts are considered to be of minor intensity.

With 21 droughts recorded between 1999 and 2024, this averages 0.8 droughts per year, or 1-2 every two years.

EXTREME TEMPERATURES

Evansville totaled heat indices for 3,940 days above 90˚F, 1,043 days above 100˚F, and 78 days above 110˚F between 1950 and 2023. This averages 57 days above 90˚F, 15 days above 100˚F, and 1 day above 110˚F per year. With 57 days a year above 90˚F occurring mostly between the beginning of June and the end of August, more than half of the summer months are under extreme heat conditions deemed severe.

Evansville totaled 196 days with wind chill below -10˚F in the winters between 1950 and 2022. This equates to 2.7 days per year below -10˚F. Due to the potential health risks of temperatures below freezing (32˚F) and additional stress added to the infrastructure, such as freezing pipes and increased heating demand, locations that regularly reach temperatures less than -10˚F are considered severe.

FLOODING

Since 1996, 128 floods and flash floods have occurred. The impacts of individual floods vary from no damage to inconveniences such as flooded country roads to extensive damage to nearly 250 structures, including homes, schools, and businesses. In total, the 128 floods in Vanderburgh County have resulted in an estimated $6.36M in property damage, which averages to nearly $50,000 per flood. While $50,000 is substantial, put into the context of the cost per citizen of Vanderburgh County, this would be considered a minor flood. With the most recent US Census estimate of approximately 180,000 people, a $50,000 flood would cost $0.28 per citizen.

With 128 floods between 1996 and 2024, this results in approximately 4.6 floods per year, or just over 9 floods every two years.

SEVERE STORMS

Data for all storms is not tracked by the National Weather Service (NWS) or the National Oceanic and Atmospheric Association (NOAA). Therefore, the data for storms are only those classified as severe in intensity.

Vanderburgh County experienced 93 hail events between 1962 and 2024, resulting in 1.5 hail events per year, or 3 hail events every 2 years.

Vanderburgh County experienced 9 high wind events between 1997 and 2024 which results in 0.33 events per year, or 1 high wind event every 3 years.

Reported lightning strikes are only those that have struck humans and human-built structures since 1994. Therefore, the total of 6 lightning strikes between 1994 and 2024 is presumed to be significantly low and will not be factored into frequency calculations for severe storms.

Because high winds and hail are not always present simultaneously during severe storms and have the potential to occur on different days, the frequency of both hail and high winds is added for a total frequency of 1.83 severe storms a year or nearly 2 severe storms per year.

TORNADOES

Of the 32 tornadoes that have impacted Vanderburgh County between 1955 and 2024, 26% were classified as F0/EF0, 48% were classified as F1/EF1, 16% were classified as F2/EF2, and 10% were classified as F3/EF3. Therefore, most tornadoes that have impacted Vanderburgh County have been F1/EF1 or lower.

With 32 tornadoes across 69 years, Vanderburgh County averages almost 0.5 tornadoes per year, or roughly 1 tornado every 2 years.

Table 7 –Current intensity and frequency

Hazard	Intensity	Frequency (Annual)
Drought	Minor	0.8
Extreme Temperatures	Severe	57 heat / 2.7 cold
Flooding	Minor	4.5
Severe Storms	Severe	2
Tornadoes	EF1	0.5

Vulnerable Sectors and Populations

Below are descriptions of each hazard and the sectors/populations that are most impacted by a hazard event. Table 8 summarizes each hazard in relation to sectors and populations.

DROUGHT

During periods of reduced water, the sectors most affected would be those that rely on water. Droughts will likely have a significant impact on the following sectors:

- Agriculture and farming, which requires water for crops and livestock
- Water-intensive industries such as breweries and beverage companies or textile manufacturing
- Energy production that depends on water for hydropower, steam, or cooling
- Tourism that is based on water bodies such as lakes and rivers
- Water utilities like municipalities that rely on natural bodies of water for drinking water

Many groups could be disproportionately affected by droughts. These groups include:

- Rural communities who depend on farming for financial well-being
- Rural communities who utilize well water instead of municipal-supplied water
- Low-income households who may struggle to afford an increased cost of water
- Indigenous communities who may rely on water for spiritual or cultural practices.
- Elderly and children who are at increased risk of heat-related illnesses and dehydration

EXTREME TEMPERATURES

Extreme heat and extreme cold have the potential to affect people directly and indirectly through infrastructure or supply chain impacts. Vulnerable sectors may be affected by extreme temperatures in the following ways:

- Agriculture sectors can face stress if crops become heat-stressed, and livestock can become heat-stressed or cold-stressed.
- Energy production and delivery can be strained with increased energy demand for heating and cooling.
- Construction and other outdoor labor will often face slower project completion times due to worker breaks to avoid heat or cold-related illnesses.
- Tourism and outdoor recreation may see a decrease in visitors due to dangerous temperatures.
- Transportation services can be impacted by hot air affecting aircraft or railroads, causing delays, or by accumulation of ice and snow on roads and aircraft.
- Water management can be affected by increased water demand for cooling, irrigation, and consumption – potentially depleting water sources. Water management can also be negatively affected by extreme cold temperatures, freezing pipes, or reducing the efficiency of water treatment.
- Infrastructure can be damaged by frozen or burst pipes due to extreme cold.
- Manufacturing can be impacted by materials like plastics or metals that are negatively affected by extreme heat or cold.

Populations that are vulnerable to extreme temperatures may be affected in the following ways:

- Elderly populations are more likely to have cardiovascular or respiratory complications that can be exacerbated by extreme heat or cold.
- Children are likely to be vulnerable because their bodies do not regulate temperature as effectively as adults, making them more susceptible to heat- or cold-related illnesses.
- People with chronic health conditions like heart disease, diabetes, or respiratory illness are more at risk due to the increased stress from extreme temperatures.
- Homeless populations may not have access to warming or cooling centers or clean water, which makes them highly vulnerable to heatstroke, dehydration, and hypothermia.

- Outdoor workers who spend long hours outdoors face an increased risk of heat- and cold-related illnesses.
- Low-income populations may lack access to adequate cooling or heating or face difficulty affording higher utility bills for increased HVAC energy usage.
- People with disabilities are likely to be impacted by extreme cold due to the increased complications of navigating in icy conditions and the potential inability to respond to hypothermia or frostbite.
- Rural populations can be vulnerable due to a lack of immediate access to heating or cooling centers and emergency services. Additionally, rural populations may face more transportation disruptions in extreme cold due to snow or ice accumulation on roads, limiting access to food and medical care.
- Pregnant women may have an increased risk of health complications due to elevated blood pressure often caused by high heat.

FLOODING

Flooding has the potential to cause major impacts on many sectors. Sectors that are most vulnerable to flooding may be affected in the following ways:

- Agriculture can face crop, livestock, and/or soil quality devastation. Flood waters have the potential to destroy crops, drown livestock, and erode or waterlog soils, making land less fertile.
- Transportation can become limited if roadways, railroads, and/or runways become impassable or damaged by flood waters.
- Real estate and housing can be impacted directly by flooding from damage or destruction of residential and commercial properties.
- Tourism and outdoor recreation can be impacted if popular destinations become inaccessible or unsafe for visitors due to flood waters.
- Retail and manufacturing can face losses if flood waters damage factories, warehouses, or stores, leading to inventory loss or supply chain disruptions.
- Finance and insurance companies may become overwhelmed due to significant financial losses of businesses and property owners that file claims.
- Healthcare institutions may face additional strain due to increased standing water, which can lead to increases in waterborne diseases and mosquito-borne illnesses.
- Energy production and distribution can be disrupted if energy plants are damaged by flood waters or if power lines and transformers become submerged and damaged.

Populations that are vulnerable to flooding may be affected in the following ways:

- Low-income households are often located in high-risk areas such as floodplains and may not be well protected by infrastructure or flood control measures. This group may also be less likely to have the financial resources to evacuate or pay for repairs or damages.

- Elderly people may have limited mobility and may face challenges evacuating flood areas or seeking medical attention.
- Children may become endangered by their limited ability to comprehend the dangers of floods and could suffer early trauma from floods.
- Homeless populations may face displacement and personal loss if they live in temporary housing or in locations that are vulnerable to flooding, like floodplains or under bridges.
- People with disabilities may face challenges evacuating flood areas or accessing emergency services.
- Rural communities may face additional challenges of limited access to emergency services and limited options for evacuation as roadways become flooded.
- Pregnant women face additional challenges with increased stress and increased susceptibility to waterborne diseases that may be caused by flooding.

SEVERE STORMS

Severe storms, including hail, high winds, and lightning, have the potential to cause significant damage to vulnerable sectors in the following ways:

- Agriculture can be affected by severe storms, which have the potential to cause significant damage to crops and livestock.
- Construction and outdoor labor may face challenges from work delays and damage caused by severe storms.
- Energy distribution can be impacted by high winds knocking down power lines, transformers, and utility poles or by knocking down trees, limbs, or other structures into energy infrastructure.
- Real estate and housing can be damaged or destroyed by severe storms.
- Tourism and outdoor recreation may be affected by facilities being damaged by severe storms and the limiting of safe operating hours of popular outdoor destinations.
- Transportation can be impacted by severe storms damaging roadways, creating blockages from limbs, trees, or other blown debris, and delays in air traffic or supply chain shipments.

Populations that are vulnerable to severe storms include:

- Low-income households who may have inadequate housing that is more susceptible to damage and may have limited resources to recover from damages and losses
- Elderly people who may have reduced mobility and face challenges when evacuating or seeking medical attention
- Homeless populations who may lack adequate protection from severe storm conditions
- Rural populations who live in more isolated areas and may have limited access to emergency services or evacuation routes
- People with disabilities may have difficulty evacuating during severe weather or have difficulty accessing emergency services

TORNADOES

Tornadoes have the potential to cause severe damage to entire communities. However, the most vulnerable sectors may be affected in the following ways:

- The agriculture sector may have catastrophic damage to crops, livestock, and vital equipment.
- Construction and outdoor labor may face work delays and additional work to repair damages.
- Retail and commercial businesses may face inventory loss or infrastructure damage that can result in a loss in revenue.
- Healthcare facilities that sustain damage can cause service delays which have the potential for severe consequences for individuals seeking medical attention.
- Transportation can be adversely affected by damaged roadways, fallen debris, and delays.
- Energy distribution and communications can be impacted by damaged utility poles, power lines, and cellular towers.

Populations that are vulnerable to tornadoes include:

- Low-income households who may live in structures that were not built to withstand tornado winds or that may lack the financial resources to recover from damages and losses
- Elderly people who have limited mobility may be unable to evacuate or seek medical attention
- Children who may not be able to take the necessary safety precautions during a tornado and are more likely to suffer from psychological trauma following a tornado
- Homeless populations who may lack adequate shelter from a tornado are extremely vulnerable to personal loss and injury from flying debris
- Rural communities who are more isolated and may lack immediate emergency services causing additional challenges in evacuating
- People with disabilities who may face barriers when evacuating or may require specific accommodations for seeking shelter, such as ramps or lifts

Table 8 – Affected Sectors and Populations

Hazard	Sectors Affected	Populations Affected
Drought	• Agriculture • Water-intensive industries • Energy production • Tourism • Water utilities	• Rural communities • Low-income households • Indigenous communities • Elderly • Children
Extreme Temperatures	• Agriculture • Energy production • Construction and outdoor labor • Tourism and outdoor recreation • Transportation	• Rural communities • Low-income households • Elderly • Children • People with chronic illness • People with disabilities • Outdoor workers

	• Water management • Infrastructure • Manufacturing	• Homeless populations
Flooding	• Agriculture • Transportation • Real estate and housing • Tourism and outdoor recreation • Retail and manufacturing • Finance and Insurance • Health Care • Energy Production	• Low-income households • Elderly • Children • Homeless populations • People with disabilities • Rural communities • Pregnant women
Severe Storms	• Agriculture • Construction and outdoor labor • Energy distribution • Real estate and housing • Tourism and outdoor recreation • Transportation	• Low-income households • Elderly • Homeless populations • Rural populations • People with disabilities
Tornadoes	• Agriculture • Construction and outdoor labor • Energy distribution • Communications • Healthcare • Transportation	• Low-income households • Elderly • Children • Homeless populations • Rural communities • People with disabilities

PROJECTED CLIMATE HAZARDS AND IMPACT

Description of Expected Future Hazards

Projected climate hazards are based on historical climate data in Vanderburgh County and projections of a high emissions future and a medium emissions future, which were averaged from 10 global climate models. The data projects high-emission and medium-emission scenarios for the 2050s and 2080s.

There are no additional climate hazards expected in Indiana; however, the frequency and intensity of current hazards are predicted to change in the future. Climate hazards are described below.

DROUGHT

During the cold season, it is projected that there will be increased precipitation, while the warmer seasons are expected to be drier. Long-term droughts that last months to years are expected to decline in Indiana. However, short-term droughts lasting weeks to months are expected to increase.

Table 9 – Projected changes in Indiana's Precipitation

Scenario	Period	Winter	Spring	Summer	Fall	Annual
Medium Emissions	2050s	16%	13%	-2%	-2%	6%
	2080s	17%	10%	-3%	-3%	5%
High Emissions	2050s	20%	16%	-3%	-2%	8%
	2080s	32%	17%	-8%	-2%	10%

Source: Purdue University, INCCIA – The Future of Indiana's Water Resources: A Report from the Indiana Climate Change Impacts Assessment

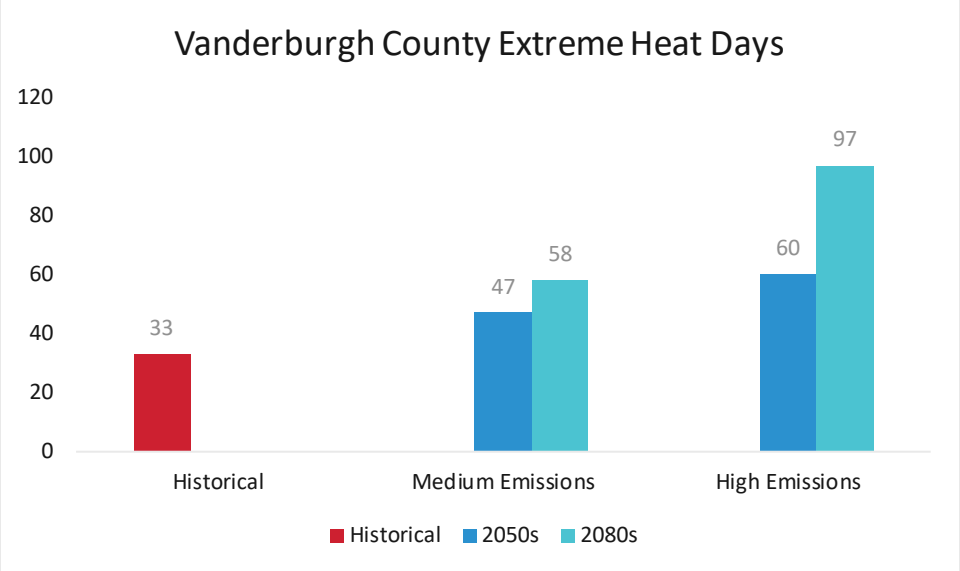
With decreased warm-season precipitation and increased short-term droughts, vegetation and wildlife will be strained. This, in turn, could have negative impacts on agriculture and outdoor recreation as crops may reduce in yield and local biodiversity may diminish, respectively.

EXTREME TEMPERATURES

Future temperatures in Indiana are expected to rise. This will mean an increase in extreme heat and a decrease in extreme cold. The graphs below depict historical averages and projected future temperature trends.

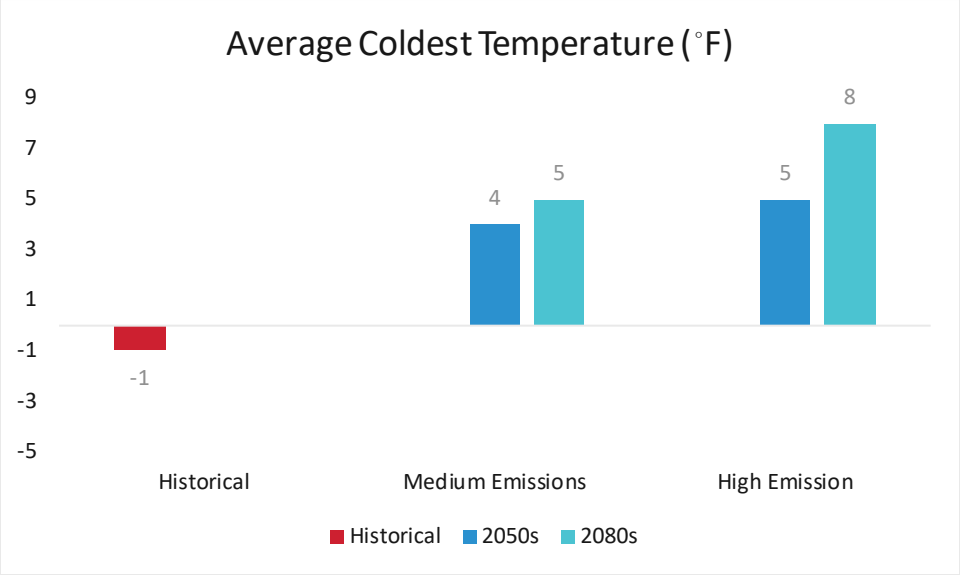
In Vanderburgh County, extreme heat is expected to increase from an average of 33 days above 95˚F per year to between 47 and 58 days in the 2050s and between 60 and 97 days in the 2080s. This has the potential to negatively impact crops and livestock, outdoor labor, and exacerbate heat-related illnesses.

Figure 2 – Average days of extreme heat



In Vanderburgh County, extreme cold is expected to decrease from a historical average of -1˚F being the coldest temperature of the year to 4˚- 5˚F in the 2050s to 5˚- 8˚F in the 2080s. While this may lessen impacts on infrastructure and human health, this will likely have a negative impact on cold weather outdoor activities and puts Vanderburgh County at a higher risk for some invasive species and insects.

Figure 3 – Average coldest temperature of the year



FLOODING

Precipitation is predicted to increase in intensity in the winter and spring while decreasing in the summer and fall. Total annual precipitation is expected to increase 5-6% in medium emission scenarios and 8-10% in high emission scenarios. The increase in rainfall in the winter and spring, rather than snowfall, will lead to wetter winters and springs.

An increase in rainfall in the winter and spring will lead to a higher average streamflow in rivers and streams and increased flooding. Increased flooding has the potential to negatively impact agricultural yields by flooding fields and waterlogging soil. In urban areas where there are more impervious surfaces, excessive water may overflow stormwater systems, resulting in more street and home flooding.

SEVERE STORMS AND TORNADOES

Severe storms, including extreme precipitation, hail, and high winds, are difficult to model. Components of severe storms include instability and vertical wind shear that can lead to thunderstorms and tornadoes. These components are expected to increase in frequency, but due to the unpredictability of storms, climatologists are unable to model the future magnitude of severe storms and tornadoes.

While future magnitude is unknown, an increase in the frequency of severe storms and tornadoes can still have potentially catastrophic consequences. An increase in the frequency of severe storms and tornadoes will add additional stress to infrastructure, economies, and communities.

Projected Intensity and Frequency

Table 10 – Projected Risks

Hazard	Project Intensity	Projected Frequency
Drought	Increase	Increase
Extreme Temperatures	H Increase / C Decrease	H Increase / C Decrease
Flooding	Increase	Increase
Severe Storms	Unknown	Increase
Tornadoes	Unknown	Increase

Projected Vulnerable Sectors and Populations

There are no new climatic hazards expected in the future. As a result, the sectors and populations previously identified remain the most vulnerable. However, because hazardous event intensity and/or frequency are expected to increase (with the exception of extreme cold), impacts from hazardous events are also expected to increase in magnitude and/or frequency for the identified groups.

CLIMATE ADAPTATION

Description and Degree of Factors

The table below describes Evansville's factors that will most greatly affect its adaptive capacity and enhance climate resilience.

The description of the factor is as it relates to support or challenging adaptive capacity. The degree is the level to which the factor opposes adaptive capacity and will be described as high, moderate, low, no concern, and do not know. A high degree means the factor presents the largest challenge to adaptation, while no concern means the factor is supportive of adaptation.

Table 11 – Factors for adaptive capacity

Factor	Description	Degree
Services		
Access to basic services	Includes services such as public safety, fire protection, emergency medical, transportation, recreation opportunities, social services, waste and sanitation, and education. Evansville has adequate service coverage for all areas.	No concern
Access to healthcare	In 2023, Evansville had 11.1% of people under the age of 65 without health insurance. This is higher than the US average of 9.5%, meaning residents are	Moderate

	less likely to be able to afford healthcare in Evansville compared to the national average.	
Access to education	For persons 25+, 89.2% of the population are a high school (or equivalent) graduate or higher in Evansville. Compared to the national average of 89.1%, Evansville is on track with the US.	Low
Public health	The national average life expectancy is 77 years. In Evansville, the average life expectancy is slightly lower than the national average of 75 years.	Moderate
Socio-economic		
Cost of living	In Evansville, the cost of living is 6% lower than the national average.	No concern
Housing	Between 2018 and 2022, the median value of owner-occupied housing was $121,100 in Evansville. This is significantly lower than the national average of $281,900. Evansville also has a lower homeownership rate compared to the national average of 54.2% and 64.8%, respectively. Additionally, the median monthly rent in Evansville was $917, lower than the national average of $1,268	Low
Poverty	In Evansville, people in poverty account for 18.6% of the population. This is significantly higher than the US average of 11.1%.	Moderate
Inequality	In Evansville, the areas surrounding the downtown area tend to be in the 80th percentile or higher for many environmental justice indices such as particulate matter 2.5, diesel particulate matter, lead paint, proximity to superfund sites, and proximity to hazardous waste. These areas also have a higher percentage of low-income and people of color, indicating an unequal distribution in environmental living conditions.	High
Unemployment	The 2023 unemployment rate was 3.2% in Evansville while the national average was 3.6%.	No concern
Migration	In general, Evansville's population has been in decline since the 1960s, indicating migration as a driver of population decrease. However, the rate of migration out of Evansville is not projected to cause significant impacts to adaptive capacity.	No concern

Economic health	From 2022 to 2023, Evansville's GDP has grown 3.68%. The national GDP grew 2.5% over the same time frame.	No concern
Economic diversity	Evansville has well-spread economic diversity with manufacturing as the lead industry sector, trailed by retail, and entertainment.	Low
Governmental		
Political stability	Evansville has a stable political environment. Evansville operates as a mayor-council government system, with the mayor serving as the executive and the council serving as the legislative body.	Low
Political engagement/ transparency	Evansville often holds public engagement events including community surveys where residents can provide feedback. Additionally, Evansville keeps the city website up to date with news and alerts for residents.	Low
Budgetary capacity	Evansville has the budgetary capacity to maintain essential city services, but like most cities, struggles to mobilize funds to conduct expansive improvements without utilizing outside funds, such as federal grants. While current funding can maintain current infrastructure and programs with steady improvements over time, adaptation to climate change is anticipated to require greater funding than is readily available.	High
Safety and security	Crime rates are reported as the number of crimes per 100,000 people. At the beginning of 2024, the US crime rate was 119.4 while the Evansville crime rate was significantly higher at 266.2.	High
Land use planning	Evansville has a municipal zoning code indicating land use planning within the city. Additionally, Evansville has a wide variety of parks and green spaces and plans to provide walking and biking connections throughout the city.	Low
Access to quality / relevant data	While there is ample data for Vanderburgh County and the Evansville MSA, the City of Evansville is often lacking in city-specific data. However, due to the large area of unincorporated land that often relies on Evansville, the lack of city-specific data is not considered a major issue.	Medium

Community engagement	Evansville often publishes community surveys to gather feedback from residents. Additionally, many institutions such as the Evansville public school system, often have ongoing initiatives for community engagement. In general, while Evansville is an urban setting, many residents describe Evansville as having a suburban feel.	Low
Physical & Environmental		
Resource availability	Evansville has a variety of physical and environmental resources including the Ohio River, fertile agricultural lands, coal and limestone deposits, and diverse wildlife and biodiversity.	No concern
Environmental conditions	Evansville's environmental conditions offer abundant water resources and natural landscapes but face challenges like urban sprawl and poor air quality.	Medium
Infrastructure conditions / maintenance	Evansville has a well-developed infrastructure with a wide network of roads, highways, and public transportation. Evansville has reliable utilities including water, sewage, and electricity. Like many other cities, Evansville often faces the ongoing challenge of aging infrastructure and the need for modernization.	Low
Infrastructure capacity	Evansville's current infrastructure capacity is generally capable of meeting current demand. However, ongoing work is needed to improve the resiliency of aging infrastructure.	Low

Adaptation Strategies

Below are recommended adaptation strategies to proactively prepare for more hazardous climatic events in Evansville. When applicable, adaptation strategies were linked to mitigation strategies identified in the 2018 Multi-Hazard Mitigation Plan for Vanderburgh County.

Strategy types can be reactive, preventative, and transformative. Reactive strategies are implemented in response to an event after it has already occurred. Preventative strategies are those that aim to avoid problems, risks, or negative outcomes before events happen. Transformative strategies have the goal of fundamentally changing existing structures or processes to achieve long-term success.

For the purposes of this report, the timescale will be defined as short-term, medium-term, and long-term. Short-term strategies are those that can be implemented within 5 years. Medium-term strategies can be implemented between 5 and 15 years. Long-term strategies are implemented for 15 years or longer.

Table 12 – Adaptation Strategies

Adaptation Strategy	Strategy Type	Timescale	Benefits	Infrastructure Needed	City Stakeholder Involvement	Multi-Hazard Mitigation Plan Action #
Drought						
Water conservation and efficiency	Preventative	Short	By promoting water-efficient appliances and water-saving habits in the dryer months, residents can reduce water usage which will help maintain water resources and reduce water utility bills for residents.	None	Minimal stakeholder involvement to create awareness campaigns	Not included
Encourage water collection and reuse	Preventative	Short	Promoting on-site harvesting of rainwater and reuse of greywater on-site will reduce city water usage while also reducing the risk of flooding due to on-site storage of rainwater.	None	Minimal stakeholder involvement to create awareness campaigns and workshops	Not included
Smart water management	Preventative	Medium	Adapting water infrastructure to monitor water consumption, demand, and leaks will help the city better plan and utilize water resources and stop leaks faster.	Smart water metering equipment	Stakeholders will have moderate involvement to determine products to be purchased, where meters are to be installed, proposal development, and	Not included

					project management.	
Green stormwater Infrastructure	Transformative	Long	Redesign city structures to capture and conserve water while reducing runoff. Infrastructure could include rain gardens, bioswales, and retention ponds to capture and store stormwater for later use.	Improvements to stormwater management systems	Stakeholders will have major involvement in city planning and infrastructure upgrades throughout the entire city	15, 16
Drought-Tolerant Landscaping (Xeriscaping)	Preventative	Short	Xeriscaping utilizes native species and landscaping elements that do not require irrigation for maintenance. By reducing water usage for non-essential purposes, more water will be available during droughts.	None	Stakeholders will be moderately involved in creating an information campaign or voluntary incentives for businesses and residents that implement xeriscaping on their property.	Not included
Water-efficient building codes	Preventative	Medium	By requiring buildings to utilize water-efficient fixtures, buildings can reduce water usage allowing for more water availability during droughts.	None	Stakeholders will have major involvement in updating building codes for the city or county.	Not included

Policy measures	Reactive	Short to Medium	During droughts, set water usage limits on non-vital activities and enforce water conservation.	None	Major stakeholder involvement to determine limits, restricted activities, and method(s) of enforcement.	Not included
Restoration of natural water systems	Transformative	Medium to Long	Restoring and preserving natural water systems, such as wetlands and forests, can help manage water flow and maintain groundwater recharge. This can help ensure a constant water supply.	None	Major stakeholder involvement to identify and manage multiple restoration and preservation projects.	38, 41
Extreme Temperatures						
Develop a heat action plan.	Reactive / Preventative	Short	By creating an action plan that focuses on both immediate actions to take during heat events and longer-term actions for reducing the negative effects of high heat, Evansville can be prepared and continue to be prepared for future extreme heat days. Immediate actions can be working with community hubs and opening municipal buildings to be cooling centers for residents or deploying water	Cooling centers and water stations	Major stakeholder involvement to create and implement a heat plan and working with community spaces during heat events.	Not included

			stations for residents who may not have access to clean drinking water. Long-term plans can include expanding cooling centers, installing water stations, or creating action plans for the adaptation strategies below.			
Reflective Surfaces	Preventative	Medium	Traditional flat surfaces, such as pavement and rooftops can trap heat and radiate into the surrounding environment resulting in a heat island. By switching from darker-colored materials to lighter-colored materials, surfaces can reflect sunlight and reduce ambient temperatures in urban environments.	None	High stakeholder involvement to create and implement new building codes or voluntary programs and incentives for pavement and building owners.	Not included
Expand Urban Canopy and Green spaces	Preventative	Short to medium	Shade from trees can provide protection from sunlight for residents and pavement and short roofs that absorb and radiate sunlight as heat. Green roofs, green walls, and community gardens are additional measures that can block sunlight from reaching pavement and roofs with potential to radiate heat. Added advantages to the	None	Moderate to major stakeholder involvement to determine canopy expansion areas and/or where to develop new city parks.	Not included

			expansion of tree canopies and green spaces are improved air quality and city-scape beautification.			
Update building codes	Transformative	Medium	Updating building codes to require new buildings to reach a set level of energy efficiency will help to ensure buildings are better able to withstand heat while providing comfortable temperatures for occupants without overutilizing air conditioning systems. Because air conditioning systems cool the air by transferring heat from indoor environments to outdoor environments, this can raise ambient outdoor temperatures up to 5˚F in urban environments. More efficient buildings that are better at maintaining indoor temperatures can reduce energy usage, peak demand, and ambient temperatures.	None	Major stakeholder involvement to develop new efficient building codes at the city and/or county level.	Not included
Building retrofits	Preventative	Short to medium	Similar to updating building codes, creating incentives to increase building efficiency can enable buildings to cool indoor spaces without	None	Major stakeholder involvement to create incentives and acquire funding to help	3, 31

			straining energy systems or increasing ambient outdoor temperatures. Efficiency upgrades can include upgrades to insulation, doors, and windows, and efficient equipment like heat pumps.		business owners, property managers, landlords, and homeowners carry out efficiency upgrades in buildings and homes.	
Climate-responsive urban planning	Transformative	Long	By integrating urban planning to include mixed-use zoning, wind corridors, and heat-resistant infrastructure, Evansville can be designed to allow greater comfort and fewer disruptions during heat events. Mixed-use zoning combines residential, commercial, and recreational spaces allowing residents to have shorter commutes and keeping people close to essential services during heat events. Designing neighborhoods with wind corridors allows for natural airflow, reducing the heat island effect and improving the ventilation of urban spaces. Designing infrastructure to better withstand high heat and with reflective surfaces allows for	Climate-ready infrastructure (as needed)	Major stakeholder involvement to plan and rezone (if applicable) areas of the city to be better adapted for high-heat days.	Not included

			a reduction in closures from maintenance and a reduction in the heat island effect.			
Flooding						
Green stormwater infrastructure	Transformative	Medium to Long	Redesign city structures to capture and conserve water while reducing runoff. Infrastructure could include rain gardens, bioswales, retention ponds, and permeable pavements to capture stormwater and allow for greater infiltration.	Improvements to stormwater management systems	Stakeholders will have major involvement in city planning and infrastructure upgrades throughout the entire city	15, 16
Floodplain zoning	Preventative	Medium	By limiting development in flood-prone areas, people and properties will not be at direct risk of flood events. Zoning requirements could limit the types of structures built in a floodplain or set minimum setback requirements along rivers and streams.	None	Stakeholders will have major involvement in mapping and identifying flood areas and passing updates to zoning and setback requirements.	Not included
Flood forecasting and early warning	Reactive / Preventative	Short to Medium	By implementing systems such as stream gauges and flood warning systems to alert residents of potential flooding, emergency response and evacuations can occur before flood	River/stream monitoring and alert systems	Stakeholders will have moderate involvement to determine the best locations for monitoring and alert systems as	2, 19, 20

			events can cause harm to residents.		well as determining who will be in charge of flood systems.	
Update building codes and retrofits.	Preventative / Transformative	Short to Medium	Updating building codes to be more resilient to flooding events can ensure less costly damage if floods occur. Utilizing materials that are resistant to water damage and ensuring buildings are constructed above flood levels can make buildings less susceptible to critical damage.	None	Major involvement to stakeholders to identify flood levels and create building codes that protect against most flooding events. Moderate involvement to create programs and/or incentives to help residents learn and finance upgrades.	31
Flood Insurance	Reactive	Short	By encouraging or mandating flood insurance, buildings, and homeowners can have financial means to recover quickly following damaging flood events.	None	Minor involvement from stakeholders to create education campaigns and work with insurance companies in the area.	33
Restoration of natural water systems	Transformative	Medium to Long	Restoring and preserving natural water systems, such as wetlands, forests, and floodplains can help	None	Major stakeholder involvement to identify and manage multiple	38, 41

			manage water flow and maintain groundwater recharge. This can help ensure water infiltrates into the soil rather than flood.		restoration and preservation projects.	
Severe Storms and Tornadoes						
Update building codes and retrofits.	Preventative	Medium	Updating building codes or providing means for retrofits that ensure buildings can resist severe storms can reduce the impacts of severe storms. Buildings with stronger windows, doors, and roofs will be better prepared for hail and high winds during storms.	None	Major stakeholder involvement to determine necessary minimum requirements for building codes and to create campaigns and/or funding for retrofits.	3, 31
Early warning and emergency response plans	Reaction / Preventative	Short to Medium	By updating monitoring systems and emergency response plans, Evansville can better alert citizens and emergency response services to incoming severe weather. This in turn will allow better preparation for incoming severe weather.	Early warning systems	Major stakeholder involvement to determine where and how to implement warning systems and to develop emergency response plans.	1, 6, 8, 19, 20, 34
Emergency shelters	Reaction	Medium	By working with community facilities or constructing emergency shelters, people who don't have access to adequate shelter can access	Potential to build emergency shelters	Moderate to major stakeholder involvement to work with community	10, 14

			safe locations during severe weather events.		facilities or plan and construct emergency shelters.	
Tree management	Preventative	Short	Creating tree management best practices and campaigning community information will help ensure trees and limbs that would otherwise be a high risk for damaging roadways, structures, and energy infrastructure are pruned and less likely to cause damage during severe weather events.	None	Moderate stakeholder involvement to create best practices for tree management in Evansville and create programming for residents.	9, 30
Power grid resiliency	Preventative / Transformative	Medium to Long	By working with the local energy provider to ensure energy infrastructure is up to date, well maintained, and underground (when possible), the power grid will be less susceptible to damage caused by high winds, hail, and electrical storms.	None	Minor stakeholder engagement to work with residents and the local utility to ensure energy infrastructure is well equipped to withstand severe weather.	37

CONCLUSION

Evansville and Vanderburgh County already face many severe climate hazards. However, Evansville faces increasing climate hazards, including more frequent and intense droughts, extreme heat, flooding, severe weather, and tornadoes. While the region is expected to experience fewer extreme cold events, the overall rise in climate-related challenges will place additional strain on the environment, infrastructure, economy, and residents. Despite these growing threats, Evansville demonstrates a strong adaptive capacity through its existing infrastructure, community engagement, and commitment to improving resilience. However, areas such as community inequities, crime, and budgetary constraints should be prioritized while planning for climate adaptation. Evansville is well suited to begin embracing proactive adaptation strategies, that can strengthen its resilience, safeguarding both its residents and its economy in the face of climate change.

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